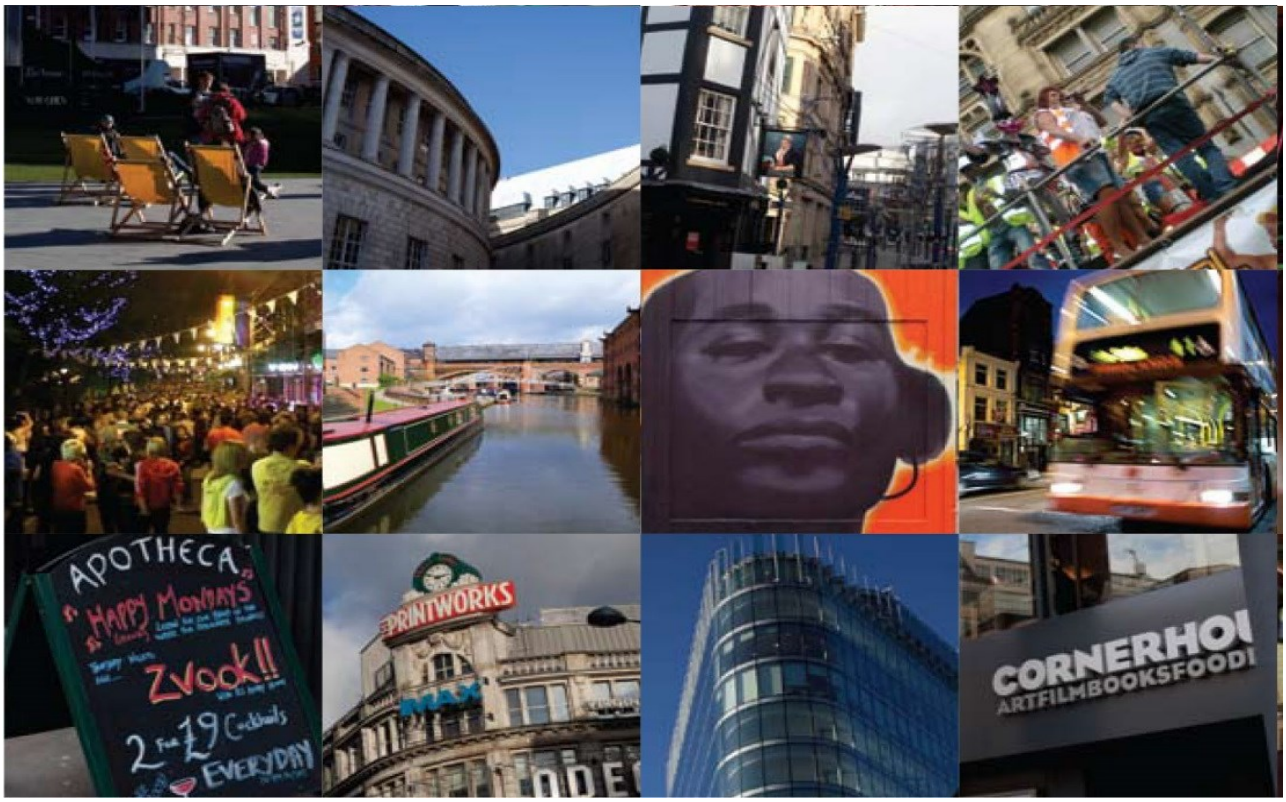
Abstract Book

35th International Conference on Geochemistry and Health

1-5th July 2019



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Society for Environmental Geochemistry and Health

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Contents

Welcome to Manchester

Getting around

Manchester is notoriously busy with busses arriving on the "Oxford Road corridor" (Piccadilly, central to Didsbury, south Manchester) nearly every 2mins. There are two competing bus companies so it may prove most convenient and cheap to choose one of these such as "magic bus" which is dark. The "Oxford road corridor" is serviced by buses marked either 42 or 142 and is the most effective way of travelling North-South in the city.

To explore the city in an east – west direction there is a metro system with the nearest major stop at St. Peters square (Library, Town hall and Tram station). From here, you can visit the two football clubs, many museums and the media hub of Manchester in Salford. You can also use the metro to travel to the airport though the train from Piccadilly is probably quicker and cheaper.

Eating around the venue

The location directly around the conference centre is dominated by student accommodation and as a result, the food here is quick, easy and usually also serves a beer. The wider Manchester food scene is good though you may need to travel a little to get the best of what the city has to offer. In general, tripadvisor has done a decent job of scoring the dining in the city but most the high scoring locations are a little inconvenient to get to. Here is Peter's (ECR secretary) summary

More adventurous

Northern Quarter – V-REV vegan diner. https://vrevmcr.co.uk/

"I have visited V-REV a few times with vegan friends and despite being a meat eater the diner is simple, easy and full of flavour"

Local to conference

Peter Street - Rudy's. https://www.rudyspizza.co.uk/peter-st/

"Rudy's is an excellent pizzeria. It is an independent diner dedicated to maintaining traditional methods, no bookings and let their dough rest for 24hrs. The result of this is a light pizza. But be warned as they only the place is always busy, so I recommend if you want to try this place go straight from the conference around 18:00, don't expect a table after 20:00"

Breakfast and brunch

Brunch and breakfast is very popular in Manchester and as a result, there is a great selection of locations near Piccadilly for this type of food with a variety of prices and styles. They will be busy on almost any day so my advice is to choose a day and get there for near opening time.

"My personal favourites are: Evelyn's café bar, moose coffee, the pen and pencil, koffee pot or if you can get a table Alabama's all American"

Program - Monday 1st and Tuesday 2nd July

Day	Time	Business school lecture theater G35	Business school cafe / atrium
Monday, July 1st	4:00pm-8:00pm	Welcome mixer and registration Manchester Met Business School	
Tuesday July 2nd	8:00am	Registration Opens	Poster set-up Sponsor exhibition
	8:45-9:15am	Welcome and Introduction	
	Session 1: Urban wastelands: potential for enhancing urban resilience (Chair: Dr. Gina Cavan & Dr. Rachel Dunk)		
	9:15-10:00am	**Keynote Talk: (Professor David Manning, Newcastle, UK)**	
	10:00-10:20am		Break Poster viewing Sponsor exhibition
	10:20am-12:20pm	Platform presentations	Sponsor exhibition
	12:25 – 12:45pm	Poster flash presentations	Sponsor exhibition
	12:45-1:45pm		Lunch Poster viewing Sponsor exhibition
	Session 2: Environmental change: impact on the environment & human health (Chair: Dr. Sanja Potgieter-Vermaak)		
	1:45-2:30pm	**Keynote Talk: (Prof Ricardo Godoi, UFPR, Brazil)**	
	2:30-3:30pm	Platform presentations	Sponsor exhibition
	3:30-3:50pm		Break Poster viewing Sponsor exhibition
	3:50-4:50pm	Platform presentations	Sponsor exhibition
	4:55 – 5:15pm	Poster flash presentations	Sponsor exhibition
	5:15-5:45pm		Poster & sponsors social
	6:30-9:30pm	Behind the scenes evening social at Manchester City Football Stadium	

Program – Wednesday 3rd July

Day	Time	Business school lecture theater G35	Business school cafe / atrium
Wednesday July 3rd	9:00-9:15am	Welcome and Introduction	
	Session 3: New Technologies (Chair: Dr. David Megson)		
	9:15-10:00am	**Keynote Talk: (Dr. Kirsty Shaw, Manchester Met University)**	
	10:00-10:20am		Break Poster viewing Sponsor exhibition
	10:20am-12:20pm	Platform presentations	Sponsor exhibition
	12:25 – 12:45pm	Poster flash presentations	Sponsor exhibition
	12:45-1:45pm	ECR lunch workshop BS 3.12 (N Atrium)	Lunch Poster viewing Sponsor exhibition
	Session 4: Monitoring the environment (Chair: Prof. Paula Marinho Reis, Portugal)		
	1:45-2:30pm	**Keynote Talk: (Prof. Stuart Harrad, University of Birmingham)**	
	2:30-3:30pm	Platform presentations	Sponsor exhibition
	3:30-3:50pm		Break Poster viewing Sponsor exhibition
	3:50-4:50pm	Platform presentations	Sponsor exhibition
	4:55 – 5:15pm	Poster flash presentations	Sponsor exhibition
	5:15-6:00pm		Poster & sponsors social
	7:00-10:00pm	Formal Dinner at the Midland Hotel	

Program – Thursday 4th and Friday 5th

Thursday July 4th	9:00-9:15am	Welcome and Introduction	
	Session 5: Environmental Health (Chair: David Megson / Sarah Dack)		
	9:15-10:00am	**Keynote Talk: (Sarah Dack, Public Health England)**	
	10:00-10:20am		Break Poster viewing Sponsor exhibition
	10:20am-12:05pm	Platform presentations	Sponsor exhibition
	12:10 – 12:30pm	Poster flash presentations	Sponsor exhibition
	12:30-1:15pm		Lunch Poster viewing Sponsor exhibition
	Session 6: Sustainable Nutrition & Agriculture (Chair: Dr Judi Barrett)		
	1:15-2:00pm	**Keynote Talk: (Dr. Haleh Moravej, MetMUnch)**	
	2:00-3:30pm	Platform presentations / flash poster presentations	Sponsor exhibition
	3:30 – 5:00pm	DON'T MISS MetMUnch interactive workshop on sustainable nutrition	
	5:00 – 5:30pm	CLOSING CEREMONY, PRIZE GIVING & SEGH AGM (ALL DELEGATES)	
	6:00-9:00pm	Manchester pub crawl	
Friday, July 5th	09:30 – 15:30	Field trip (Jodrell Bank Telescope)	

Conference session themes

Session 1 themes:

Vacant, abandoned, previously developed, derelict, brownfield, wasteland: Multiple terms describe these diverse, interesting, and important urban spaces. Often relics of industry, these urban spaces require intervention to bring them back to beneficial use, for example, due to issues with water and soil contamination. But these 'wasted' spaces have great potential for enhancing urban resilience if restored. This session focuses upon understanding urban derelict land from multiple disciplinary perspectives (e.g. contaminated land, ecology, economic, social, policy). Case studies demonstrating innovation in restoration and use are particularly welcomed.

Session 2 themes:

This session explores the impact of environmental change and pollution on the (bio)geochemical character of the environment. We also welcome contributions of a multi-disciplinary nature, for example where the data is linked to in-vitro/in-vivo studies, medical data or well-being. All aspects of pollution and/or environmental change will be covered and is not limited to air and water pollution only.

Session 3 themes:

This session will showcase the latest developments and technologies in the field of environmental science. We are welcoming talks that showcase novel chemical, physical and biological methods to solve complex environmental challenges.

Session 4 themes:

Environmental monitoring is a systematic approach to observing and studying the conditions of the environment. This session welcomes monitoring studies conducted to establish environmental baselines, trends, and cumulative effects, to test environmental modelling processes, to inform policy design and decision-making, to ensure compliance with environmental regulations, to assess the effects of anthropogenic influences, or to conduct an inventory of natural resources.

Session 5 themes:

Environmental Health is part of public health, focussing on the inter-relationship between people and their environment. Environmental exposures in air, water, soil and food from chemicals and other environmental hazards can impact individuals and communities. Abstracts concerning programs or assessments of chemicals and environmental hazards to health are welcome, as are case studies in carrying out assessments to prevent impact on communities, or the protection of healthy and safe communities from such hazards.

Session 6 themes:

Food is fundamental to the human condition. However, land suitable for food production is both finite and non-renewable in the human timescale. As the demands on this precious and limited resource grow in tandem with the human population, this session seeks to look at both the legacy from historic management regimes and explore practices that aim to meet the challenges of agriculture and nutritional needs in the future.

Plenaries and keynote speakers

Prof. David Manning, Newcastle University, UK - Session 1: Carbon Capture Gardens: a new function for urban wastelands

Professor of Soil Science, Newcastle University

David Manning is Professor of Soil Science at Newcastle University. He is a geologist by training, with a BSc from Durham University and a PhD from Manchester University. He was President of the Geological Society of London from 2014-6. He has worked at Newcastle and Manchester Universities, with fellowships in Manchester, Nancy and Calgary. His career has focused on the science behind geological raw materials, working with tin and tungsten, then petroleum, landfill and clays. His current research focuses on mineral reactions in soils that remove CO2 from the atmosphere, and that deliver nutrients to plants. He works on geothermal energy as a zero carbon source of heat, and is Senior Science User for the Natural Environment Research Council's Geoenergy Observatories.

Keynote presentation - Carbon Capture Gardens: a new function for urban wastelands

Over many years, we have investigated the soils in urban wastelands for their carbon capture potential. We have focused on the carbonate minerals found in these soils, as they represent the final destination for organic carbon that is metabolised naturally in soils. High levels of CO2 in the soil solution, derived from root and microbial metabolism, combine with calcium released by the weathering of soil minerals to produce calcite, a common and stable carbonate mineral. We have measured removal of 25-85 t CO2 per hectare annually by this process, although this varies greatly from one site to another. Importantly, the calcium required for carbonation is derived from Ca-rich minerals present in crushed concrete from demolition, or from silicate minerals. Carbon and oxygen isotope analyses of the carbonate minerals show unambiguously that the carbon is derived from the atmosphere.

As a way of demonstrating carbon capture in soils to a wide range of audiences, we developed the concept of Carbon Capture Gardens. These can be developed on existing wastelands with little additional preparation. Where circumstances allow, a Carbon Capture Garden can be produced by mixing compost with a suitable mineral substrate, using existing sources (such as municipal green waste composts and existing rock dust products). Provided these materials are accredited, introduction of potentially harmful contaminants is avoided. Once constructed, Carbon Capture Gardens can be used for a range of community engagement activities – raising awareness of the importance of soils for carbon capture. Student projects provide a means of regularly measuring the carbon content of the soils, extending the reach of the gardens within higher education.

This presentation summarises work done by a large number of researchers and students over the last 15 years, and by Groundwork North East and Cumbria.

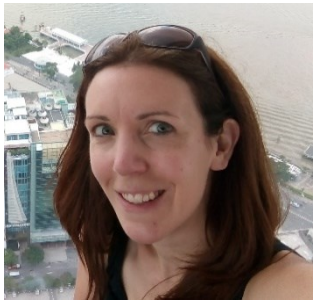
Prof. Ricardo Godoi, Federal University of Parana State, Curitiba, Brazil: Keynote speaker – Session 2: Environmental Change

Prof. Ricardo H. M. Godoi has a multidisciplinary background, with a Ph.D. in Physical Chemistry from São Paulo State University-UNESP. A postdoctoral period at the University of Antwerp-Belgium refocused his research to environmental chemistry and secured his current post as Associate Professor of the Environmental Engineering Programme at UFPR. He is the Coordinator of Innovation Projects at the Innovation Agency of UFPR and *Director* of the Laboratory of Analysis and Quality of Air-Lab-Air. Ricardo was a guest researcher at the Lawrence Berkeley National Laboratory -CA, United States (2015-2016). International projects: National Institute of Science and Technology - PROANTAR / CNPq; The Amazon Tall Tower Observatory – ATTO - a scientific research facility in the Amazon rainforest of Brazil; and Observations and Modelling of The Green Ocean Amazon (Goamazon).

Keynote presentation - Long-term accumulation of perchlorate aerosol combined with geothermal heat flux may contribute to basal ice lubrication at West Antarctica.

The future of the West Antarctic Ice Sheet is presently under considerable uncertainty. The scale of its collapse from numerical modeling may vary by a factor of 10 depending on the climate warming scenario projected. A key-factor into the elucidation of this physical process relies on understanding the cause of ice flow speed up of recent decades as evidenced by satellite monitoring. Here, we propose a thermo- geochemical model based on the long-term ice basal layer accumulation of perchlorate (a molecule produced by the photolysis and/or oxidation of naturally occurring chlorine species in the atmosphere) brines and active geothermal heat flux. Once combined they may provide conditions for a lubricating basal ice condition and consequently increase ice flow velocity. Considering that perchlorate salts have supercooling properties and high stability a long time in environmental conditions, under existing geothermal conditions basal perchlorate concentrations may reach levels (from our model) to preserve water in its liquid-state and consequently act as lubricating agent for increasing ice flow float. We present evidence of atmospheric processing, via microscopic and chemical speciation of individual aerosol particles by scanning transmission X-ray microscopy with near edge X-ray absorption fine structure spectroscopy (STXM/NEXAFS) combined with computer-controlled scanning microscopy (CCSEM) with energy dispersive X-ray (EDX) microanalysis. This study suggests a tropospheric formation of perchlorate from microscopic and molecular speciation of individual aerosols. The x-ray chemical imaging reveals a unique signal of ClxOy-type-molecules that could be associated with OH radical oxidation products of NaCl particles float. Besides the ClxOy-type-molecules, an essential fraction of internally mixed particles with NaCl cores and nitrate coatings in were also observed in samples collected in the west-central part of Antarctica. One striking observation was the lack of carbon coating that may reflect the oxidation process of aerosols that contain a certain amount of organic matter from the border of Antarctica.

Dr Kirsty Shaw, MMU, UK: Keynote speaker – Session 3, New Technologies



Dr Shaw graduated from Imperial College, London with a BSc in Biochemistry, before completing an MSc in Forensic Science at King's College, London. Following this, she was awarded PhD from the University of Hull in 2009 for work entitled *"Integrated DNA extraction and amplification in microfluidic devices",* as part of the development of a portable system for analysing DNA at a crime scene. She then spent three years as a Post-Doctoral Research Associate at the University of Hull developing microfluidic devices for the detection of sexually transmitted infections. Dr Shaw then joined the Division of Chemistry and Environmental Sciences as a Lecturer in Forensic Biology in 2012, before being promoted to Senior Lecturer in 2016. She has over twelve years' experience in microfluidics and the development of Lab-on-a-Chip (LOC) devices for molecular biology applications. The versatility of such devices has allowed her to work on a range of interdisciplinary projects with applications in forensic science, clinical and veterinary diagnostics and conservation biology.

Keynote presentation - Lab-on-a-Chip in the Environment

Lab-on-a-Chip (LOC) devices use microfluidics to enable conventional laboratory processes to be miniaturised offering numerous advantages including: reduced sample/reagent consumption, reduced waste and increased speed of analysis. The ability to integrate multiple analytical and/or biological techniques on LOC devices allows creation of 'sample in-answer out' systems which have a small footprint. Such devices can then be used by non-specialists at the point-of-need opening up new avenues for testing which may not have been feasible previously, for example, due to prohibitive cost, lack of specialist facilities/personal, or inaccessible environments.

The versatility of such devices has seen their application in a wide range of scientific disciplines, particularly those of an interdisciplinary nature. Therefore, an overview of the current state of LOC technology will be provided, focussing on environmental geochemistry and health. This will include considerations of device design and manufacturing techniques for a range of substrates, namely glass, polymers and paper. Selected case studies will then be presented covering areas of forensic science, clinical diagnostics and conservation biology. This includes a paper LOC device for detection of new psychoactive substances, both found in powdered forms by police or as metabolites found in urine samples taken from suspects/inmates, which can produce results in <5 minutes. Field-testing of a polymer LOC device which can be used for genetic identification by producing a colour change result indicating 'presence/absence' of certain species, as applied to illegal trading and conservation efforts. Also, an example of a glass LOC device for atmospheric-plasma treatment of water to remove chemical and biological contaminants.

Prof. Stuart Harrad, University of Birmingham, UK: Keynote speaker – Session 4, New Technologies

Prof Stuart Harrad is Professor of Environmental Chemistry at the University of Birmingham. Since 1994, he has supervised 42 PhD students and 19 postdoctoral fellows and currently supervises 10 PhD students and 3 postdoctoral fellows. He has 35 years' experience of research into the environmental sources, fate, and behaviour of organic contaminants, spanning air, soil, water, sediment, and biotic contamination with halogenated persistent organic pollutants (POPs), VOCs, and emerging contaminants such as pharmaceuticals and personal care products. Particular interests are the implications for the circular economy of POPs in the waste stream, as well as the relationships between external and internal human exposure and how this is impacted by the efficiency of contaminant uptake and metabolism. Since 2010, Harrad has led research grants worth ~£11M. Career publications total 175 (123 since 2008) with an ISI H-index of 51.

Keynote presentation - The Organic Flame Retardant Story: Knowns and Unknowns

To meet flame retardancy regulations, a wide range of consumer goods are treated with chemical flame retardants. The discovery in the late 1990s that concentrations of one such class of chemicals (polybrominated diphenyl ethers – PBDEs) were increasing exponentially in human milk, triggered concerns about the environmental presence and effects of PBDEs and related brominated and organophosphate flame retardants (BFRs and PFRs). Because of their extensive indoor applications, the pathways of human exposure to these chemicals differ from those of organochlorine POPs like dioxins. Moreover, while manufacture and new use of PBDEs has ceased, there is a vast quantity of consumer goods containing them that have already or are yet to enter the waste stream, with concomitant potential for environmental releases. This presentation will summarise what is known about the sources, pathways, and extent of human exposure to BFRs and PFRs, covering emissions and exposure during both the in-use and end-of-life phases.

Sarah Dack, PHE, UK: Keynote speaker – Session 5: Environmental Health

Sarah is a Specialist Environmental Public Health Scientist at Public Health England's (PHE) Centre for Chemicals, Radiation & Environmental Hazards (CRCE). She is a Chartered Geologist, SiLC and a member of CIWEM, where she is a former Chairman of the contaminated land network (CLN) group. At CRCE she leads on contaminated land and water for her department, dealing with incident response and enquiries from internal and external partners on a range of topics. She is currently the CRCE rep for the new C4SL Steering Group and for the EU COST ACTION – IS1408 - Industrially Contaminated Sites and Health Network (ICSHNet). Prior to PHE, Sarah was a technical director with 25year's experience in risk assessment relating to soil, water, gas and waste, advising a large number of Local Authorities on Part 2A issues. Sarah has been a named expert for the World Bank with regard to regional mercury risk assessment (Nura-Ishim Basin, Kazakhstan). Sarah additionally authored a technical manual for a UNIDO publication (United Nations Industrial Development Organisation) on persistent organic pollutants in West Africa.

Keynote presentation - The problem with "Background" in contaminated land assessment.

Contaminated land investigations are generally proposed on land to examine known or suspected contaminant sources (often industry), so the risk assessor is considering the contaminant loading above 'background' to a receptor such as nearby residents. However, although this may be background soil concentrations, background air concentrations or background levels in water and food may be elevated although considered 'background'.

In the UK, the idea of background as acceptable levels of contamination is written into Government Contaminated Land Statutory Guidance for the Environment Protection Act 1990, as the "Normal" presence of contaminants. This guidance, concerning land contamination that poses unacceptable levels of risk, assumes that 'land with levels of contaminants in soil that are commonplace and widespread throughout England or parts of it' would not pose an unacceptable risk.

Therefore it is assumed that "Normal" is non-harmful; however in many parts of the UK, concentrations of metallic and inorganic compounds such as Arsenic, Lead, Fluoride and Hardness may be highly elevated in private water supplies and/or soils. However, even if levels of a chemical in food, air, water and soil are within 'background' levels, together they may have a cumulative effect that is harmful.

In the UK, the soil concentrations found on a site are compared to guideline values and background. Water can be compared against Standards. However, although Health Based Guideline Values are generally protective of children, they only consider soil and soil based (inhalation) exposure and not the socio-economic effects. For example, children absorb more Pb if Ca and Fe intake are low, which is often the case with malnutrition. They may also be exposed to a number of other stressors such as air pollution from roads, a potentially chaotic lifestyle and maybe noise. All will reduce their resilience.

Dr. Haleh Moravej, MetMUnch, UK: Keynote speaker – Session 6, Sustainable nutrition

Haleh Moravej (@halehmoravej) is a National Teaching Fellow of 2018 awarded by Advanced HE for outstanding impact on student outcomes and teaching profession. She is a multi-award winning senior lecturer in Nutritional Sciences at Manchester Metropolitan University, a nutrition entrepreneur and senior fellow at Manchester Food Research Centre as well a highly experienced media nutritionist. Haleh has been recognised and has been nominated and won several awards since starting teaching in 2007, including MMU Union Best Teacher of the Year 2012; National and International EAUC Green Gown Award Winners in Student Engagement 2014 for MetMUnch; UnLtd/ HEFCE SEE Changemakers: Social Enterprise Outstanding Achievement Award 2017; MMU Union Outstanding Teaching for Employability Winner 2016, and has been nominated for the 2018 MMU Union Teaching Awards in the category of Outstanding Teaching for Sustainability and by IOEE as the Intrapreneur of the year 2018. Haleh has worked extensively with BBC Breakfast, BBC Radio Manchester, BBC Radio 1, BBC Radio 5, Granada Television and Calendar News in Sheffield. She has written numerous nutrition and health articles for local and national magazines and newspapers. Haleh is the founder of MetMUnch, an international award winning student social enterprise bringing community, creativity, employability and sustainability together while enhancing the student experience and belonging at MMU. MetMunch (www.metmunch.com) is an award winning globally-recognised, student-led social enterprise based at MMU, which promotes sustainable, healthy and nutritious food.

Keynote presentation - Raising Health Awareness and Wellbeing in Student Population

An increasingly populous and affluent world is leading to greater pressures on our food system. Food is a key contributor to global warming, whilst malnourishment and over consumption create major health challenges that not only impact on individual wellbeing but on communities, inequalities and public services. This problem can be addressed by building interconnected solutions and strengthen ties for a more sustainable and better future. With this goal in mind Haleh Moravej will share her story of how she set up MetMUnch. MetMUnch provides the skills and training to promote health and wellbeing and enables graduates to apply it in sessions at university and community events. As an extra-curricular organic enterprise, students that take part get to enrich their university experience with entrepreneurial and creativity skills, all with sustainability at the core. MetMUnch creates an environment that encourages enterprising entrepreneurial mindsets and behaviours, both in staff and students, and ensure that sustainable ideas and innovation are given the support they need to flourish.

The aim of the session is to share front line research and experience, with a focus on the core challenges of engaging students in fun activities to enhance their sustainability awareness and explore possible new collaborations and new ways of thinking in order to help meet these challenges.

Session 1 - Oral Presentation Abstracts – Tuesday 2nd (am)

OR1 – Christine M Davidson: Copper, Lead And Zinc In Soils From Scottish Schools.

Christine M DAVIDSON*, Craig DUNCAN, Cameron MacNAB, Bethany PRINGLE, Stuart J STABLES and Debbie WILLISON

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The determination of potentially toxic elements in soils with which children have regular contact can provide valuable information to support health risk assessment. It is also important to engage schoolchildren with environmental geochemistry so that they become well-informed adult citizens. The *Soils in Scottish Schools* project (2017-18) created teaching resources to assist secondary school pupils gain a deeper appreciation of the importance of soil and involved them in scientific research through sampling of soils from school grounds for trace element analysis.

Soil samples collected by second year pupils from 43 secondary schools across Scotland were subjected to microwave-assisted aqua-regia digestion and the simplified bioaccessibility extraction test [1], followed by the determination of copper, lead and zinc by inductively coupled plasma mass spectrometry. Results varied widely, as would be expected given the diverse locations sampled, with pseudototal concentrations: Cu 15.6-220 mg kg^{-1}; Pb 24.6-479 mg kg^{-1} and Zn 52.5-860 mg kg^{-1} and bioaccessible concentrations: Cu 3.94-126 mg kg^{-1}; Pb 6.29-216 mg kg^{-1} and Zn 4.38-549 mg kg^{-1}. Levels of all three analytes were generally higher in proximity to Glasgow, which was historically the industrial hub of the country and home to heavy manufacturing industries including steelmaking and shipbuilding.

Although concentrations of copper and zinc exceeded the Dutch intervention values [2] in a few samples, and average lead bioaccessibility was >40% of pseudototal concentrations at some locations, there was no indication of health risk to children who accidentally ingest soil whilst at play during breaks in the school day.

OR2 – Miguel Izquierdo-Díaz: Environmental Impact Of Historical Mining Near An Urban Settlement.

Miguel IZQUIERDO-DÍAZ[1*], Fernando BARRIO-PARRA[1], Almudena ORDOÑEZ[1], Rodrigo ÁLVAREZ[2], Eduardo DE MIGUEL[1], Bárbara BIOSCA[1], Ana ARTALEJO[1], Jesús DÍAZ-CURIEL[1], and Rafael MEDINA-FERRO[1]

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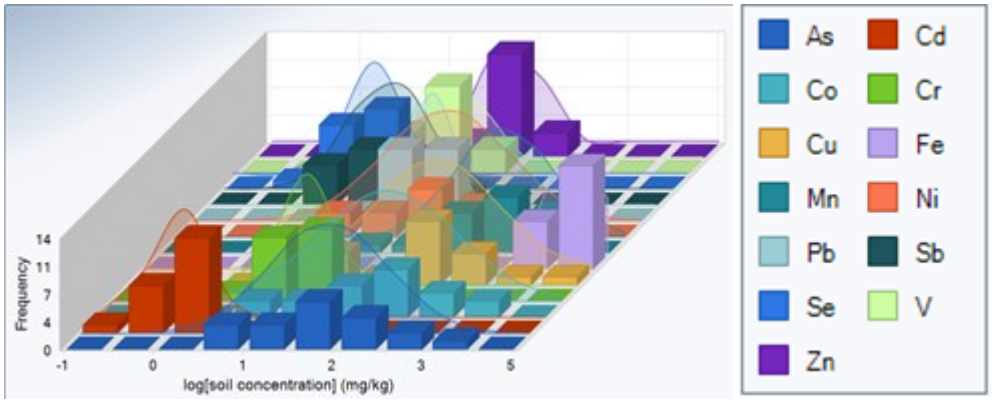
The objective of the study was to determine the concentration of trace elements in the surroundings of Carreña de Cabrales (Spain), a town located on the foothills of three mine entrances and two tailings dams. For this purpose, 19 soil samples were collected, as well as 8 surface water and 6 sediment samples from a river running through the locality. Soil and sediment samples were dried and sieved to 100 µm, followed by digestion with a solution of HCl and HNO_3 using a graphite block system. Extracts and water samples were analysed by ICP-OES and ICP-MS, determining a total of 13 heavy metals and metalloids.

From the results obtained, soil samples showed a strong correlation between the characteristic elements of the mineral paragenesis (mainly chalcopyrite, pyrite, bravoite and cobaltite). On the other hand, for most of the elements the local soil screening levels for agricultural or forestry uses were exceeded. This shows that, although mining activities stopped decades ago, soils would still be affected and could pose a potential risk to the population. On the contrary, water samples had contents approximately one order of magnitude below the legal limits for drinking water. A prliminary human health risk assessment shows that the population could be at risk from exposure to trace elements, especially children.



OR3 - Paul Preston: A New Approach For The City-Scale Assessment Of Brownfield Land And Impact Upon Climate Resilience.

Authors: Paul Preston, Gina Cavan, Rachel Dunk, Graham Smith

Urbanisation and urban densification alter urban structure, land use and land cover, for example through replacement of vegetated areas with impervious construction materials. This in turn can alter the energy balance in urban areas and lead to increased heat storage, exacerbating the Urban Heat Island (UHI) effect. These changes to land cover can also cause modifications to hydrological processes and increase surface runoff of rainwater through reducing evapotranspiration, reducing infiltration of water to the soil, and reducing the capture of rainfall. As climate risks such as heat waves, and pluvial flooding are pressing issues in cities, the understanding of factors that can influence urban resilience is of particular importance.

The presence of brownfield land (previously developed land that lies vacant or derelict and requires intervention to return the land into productive use) can provide islands of spontaneous vegetation succession, which are extensively distributed across many urban landscapes. While these sites likely provide climate regulating ecosystem services and positively impact upon urban climate resilience, they are now under developmental pressure in many cities. This research presents a new approach for the city-scale assessment of brownfield land, and its contribution to climate resilience.

Here we present a novel brownfield typology, based on land cover characterisation, and transferable to other post-industrial cities, that has been developed and locally adapted to the study area of Greater Manchester (GM), UK. An assessment of current brownfield land was undertaken using the evaluation of several criteria based on land cover classification using aerial imagery, spatial metrics, and various geospatial and topographical datasets, in order to produce a comprehensive characterisation of GM brownfield sites. This assessment found that a significant proportion of GM brownfield was vegetated and contained pervious surfaces or water bodies, indicating that such land is currently playing an important role in delivering climate regulating ecosystem services. Implications of the findings for climate resilience are further discussed.

OR4 - Jennifer McKinley: Multivariate Investigation Of Rural And Urban Soil Geochemistry And Incidences Of Renal Disease.

Jennifer MCKINLEY[1], Siobhan COX[1*], Ute MUELLER[2], Peter M. ATKINSON[1,3], Ulrich OFTERDINGER[1], Chloe JACKSON[1], Tatiana COCERVA[1], Rory DOHERTY[1] and Damian FOGARTY[4]

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The World Health Organisation (WHO) divides elements into three groups based on their nutritional significance in humans: 1) essential elements; 2) elements which are probably essential; and 3) potentially toxic elements (PTEs). Often we consider potential negative health effects from PTEs based only on the presence of elevated levels of a single PTE or in some cases a combination of PTEs. However, it is recognised that multi-element interactions can increase the bioavailability or modify the utilization or metabolism of both essential and potentially toxic trace elements. Therefore, a multivariate approach is more suitable to investigate the relationship between elements in the environment and human health.

This study uses rural and urban soil geochemistry databases of total element concentration combined with measurements of oral bioaccessibility of PTEs in the same soils using the Unified BARGE Method (UBM) to examine the potential relationship between Standardised Incidence Rates (SIRs) of Chronic Kidney Disease (CKD) and cumulative low level geogenic and diffuse anthropogenic contamination. A multivariate compositional data analysis approach is undertaken through the use of isometric log-ratio (ilr) and log-contrasts. Preliminary results using Poisson regression show potential dependency between total concentrations of stream geochemical data and SIRs of renal disease data. However due to the zero-inflated nature of the SIR data, further models including loglinear and a Tweedie model, are explored.

OR5 - Daniel Niepsh: Lichen Biomonitoring Assessment Of The Spatial Variability Of Air Quality In The City Of Manchester, UK.

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Airborne pollutants are increasingly impacting urban populations, contributing to acute and chronic human health issues, e.g. cardiovascular and respiratory diseases and cancer, leading to approximately 40,000 premature deaths within the UK[1]. Automated air quality monitoring stations, i.e. on Oxford Road and at Piccadilly Gardens in the City of Manchester, do not adequately record spatial distribution of airborne pollutants. Hence, additional methods need to be applied to increase spatial resolution, such as the use of natural biomonitors. Lichens are proven biomonitors for several inorganic and organic pollutants, i.e. metals and PAHs[2].

This study has sought to elucidate a high spatial resolution assessment of air quality in the City of Manchester (UK), using lichen carbon, nitrogen and sulphur contents (CN analyser), combined with their stable-isotope-ratio signatures ($\delta^{13}C$, $\delta^{15}N$ and $\delta^{34}S$; IRMS), nitrate and ammonium (IC) contents and metal (ICP-OES/ICP-MS) and polycyclic aromatic hydrocarbon (PAH; GC-APCI-MS/MS) concentrations. Epiphytic lichens, *Xanthoria parietina* and *Physcia* spp., were collected from 94 sites distributed across the study area and were analysed for aforementioned pollutants. Lichen derived data, specifically nitrogen compounds, were ground-truthed using NO_x diffusion tubes (for a 12-month period).

Results show that lichen nitrogen and sulphur contents and their isotopic compositions were spatially variable across Manchester, with systematic variation between the two lichen species. Moreover, spatial variability of metal and PAH concentrations in lichens showed site-specific sources, i.e. traffic. Positive correlation between certain metals (i.e. Cu, Fe and Cr) suggest similar sources, such as traffic and railroads (i.e. Cu, Fe, Cr, Mn and Zn from tyre, brake wear and railway abrasion)[3,4] with comparable findings for PAHs, i.e. predominance of 4-ring PAHs that originate from vehicular traffic[5]. Finally, lichen-derived pollutant loadings illustrate spatial variability of airborne pollutants for the City of Manchester with regard to specific influencing factors, i.e. distances from major roads and green spaces. In conclusion, this study highlights the beneficial and low cost use of lichens to monitor airborne pollutants and air quality in an urban environment at a high spatial resolution.

OR6 – Paraskevi Maria Kourgia: Factors Affecting Trace Metal Concentrations In Depositional Sediments After A Flash Flood Event In Attica, Greece

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On November 15 2017, a high intensity storm, caused a flash flood event in the town of Mandra, situated in the western part of Attica region in Greece. The aim of this study is to determine the concentrations of trace metals in residual sediments and associated soils in Mandra and the surrounding area after the floodwater had been receded.

A total of 30 sediments and soil samples were collected and analyzed for 33 elements following an aqua regia dissolution. Soil organic carbon and soil pH determination, grain size distribution, magnetic susceptibility measurements and mineralogical analysis by powder X-ray diffraction were also performed in order to identify possible factors explaining the variability of chemical elements concentrations. The BCR sequential extraction protocol was subsequently applied to a set of seven selected samples with the highest concentrations of trace metals (Cd, Co, Cr, Cu, Ni, Pb, Zn). Seasonal sampling of the selected sampling sites over one year was also performed followed by analysis after a 0.43 M HNO_3 extraction.

Aqua regia concentrations in flood-deposited sediments reached values of 1mg/kg for Cd, 24mg/kg Co, 183mg/kg Cr, 599mg/kg Cu, 195mg/kg Ni, 122mg/kg Pb and 945mg/kg Zn. Factor analysis on the results identified three groups of elements accounting for 78% of the total variance. The first factor contains elements of geogenic origin As, Co, Cr, Fe, Mn and Ni as well as the %clay. The second factor contains Cd, Pb, organic matter and magnetic susceptibility and is interpreted to be influenced by anthropogenic activities. The third factor contains Cu and Zn and is also interpreted as anthropogenic. Sequential extraction results correspond to this grouping as the anthropogenic elements tend to be released in the first two extraction steps. Cadmium is the only metal showing significant association with the exchangeable fraction, reaching 40%, suggesting that it is the most susceptible metal to mobilization during runoff. A positive correlation between trace metal concentrations and organic matter content has been observed during the months following the flash flood within an one year monitoring period.

Mandra's flash flood event, and the seasonal monitoring of depositional sediments, allows a better understanding of metal transport during catastrophic events in urban areas and provides useful information on the long-term exposure of the residents.

OR7 – Tatiana Cocerva: Spatial Distribution And Sources Of Orally Bioaccessible Potentially Toxic Elements In Topsoils In Belfast.

Tatiana COCERVA [1], Siobhan COX [1*], Rory DOHERTY [1], Rebekka MCILWAINE [1, 2], Ulrich OFTERDINGER [1], Manus CAREY [3] and Mark CAVE [4]

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Elevated concentrations of Potentially Toxic Elements (PTEs) (Ni, Cr, V, As, Pb, Cu, and Zn) in topsoils in Belfast, Northern Ireland were found to be related to historical development zones and underlying geology (McIlwaine et al. 2017). Concentrations in soils in some areas of the city exceed published generic assessment criteria and therefore may potentially pose a risk to human health. However, most generic assessment criteria for soils assume that 100% of the contaminants present in the soils are bioavailable to humans, which is often not the case. Oral bioaccessibility testing can be used to measure the soil contaminant fraction that will become dissolved in the digestive tract and therefore will be available for absorption by the body. This study investigates how PTE bioaccessibility varies spatially across the city and identifies the contribution of geogenic and anthropogenic sources of contamination.

In total, 103 surface soil samples overlying different bedrock types and land uses were collected from across Belfast and oral bioaccessibility testing was undertaken using the Unified BARGE Method. Results showed low bioaccessible fraction (BAF) for Cr (0.5 to 5.7%), V (3.3 to 23.4%), and Ni (1 to 45.7%) which are associated with soil parent materials in the underlying Antrim Basalt. In contrast, higher BAF values were registered for Cu (0.4 to 68.1%), Zn (5 to 78.2%), As (6.8 to 82.9%) and Pb (8.8 to 100%) that were associated with anthropogenic sources within Belfast.

OR8 – Martin Gaberešk: SEM/EDS Characterisation Of Metal-Bearing Particulate Matter Deposited In Snow In An Urban Area.

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Detailed morphological, chemical and mineralogical characterisation of airborne particulate matter (PM) in urban areas is highly important due to their possible detrimental effects on human health. Determination of physical and chemical properties of PM also enables identification of their main sources and thus reduction of their emissions. PM can be collected directly from air by various sampling and measuring equipment, which can be quite expensive, or by sampling those urban media which are recognised as sinks of airborne PM. One of the medium, which can be used for such purposes is snow, which is highly effective collector of airborne PM, both by dry and wet deposition.

Five samples of snow were collected in January 2017 in the urban area of Maribor, which is the second largest town in Slovenia (EU), with 95,000 inhabitants. It was one of the biggest industrial centres of Slovenia and also former Yugoslavia, known especially for textile and metal industry. Sampling was performed 11 days after the last snowfall, on locations close to the industrial zones and in the old town centre. Samples were collected from an area of 0.5 m2 and depth of 3 cm. Snow samples were melted and filtrated (< 0.6 µm) to obtain particulate matter, which was analysed by scanning electron microscopy coupled with energy dispersive spectroscopy (SEM/EDS). Metal-bearing particles were the main interest of presented study.

Qualitative and semi-quantitative chemical analysis of more than 4,400 metal-bearing particles was performed. The main metal-bearing phase at all sampling sites was iron oxide (pure FeO and FeO with addition of small concentrations of other elements, mostly metals), which represented from 70% to 92% of all analysed particles. Iron oxide phase was divided into several sub-groups, based on particle shape and type of included elements. Particles, mostly shavings, consisting of Fe-Cr-O (Ni, Cu, Mn) represented a significant part of particulate matter at two sites. Silicon-rich spherical particles and naturally occurring metal-bearing minerals (e.g. ilmenite, barite) were also detected throughout the whole town. Interesting Cu-Zn particles were detected only at sampling site close to foundry.

SF1 - Poster and flash presentations

Peng Wang: Photocatalytic Degradation Of DOM In Urban Stormwater Runoff With TiO_2 Nanoparticles Under UV Light Irradiation: EEM-PARAFAC Analysis And Influence Of Co-Existing Inorganic Ions.

Richard Lord: Can Dredged Canal Sediments Be Used For Flood Defences As Part Of The Scottish Circular Economy?

Ofelia Morton-Bermea: Historical Trends Of The Metals Concertation In PM10 In The Urban Area Of Mexico City.

Sunil Kumar: Heavy Metals Contamination Level At Industrial Areas Of Rohtak City, Haryana, India.

Adewole Michael Gbadebo: Health Risk Assessment Of Peri-Urban Groundwater Supply From Catchment To Consumers In Selected Areas Of Abeokuta, Southern Western Nigeria.

Jiancheng Kang: Interannual Variation Of Land-Source Marine Pollutants At Sea Around Shanghai.

Tatyana Krupnova: Concentrations And Health Risk Assessment Of Metal(Loid)S In Dust From Russian City.

Doreen Meso and Kaumba Womba: Challenges To Develop Laboratory Capacity In Institutions Of Africa For Geochemistry And Health Studies.

Famuyiwa Abimbola Oladimeji: An Investigation Of The Distribution And Associated Human Health Risks Of Potentially Toxic Elements In Urban Street Dust Of Abeokuta Metropolis, Southwestern Nigeria.

Akinade Olatunji: Assessment Of Suitability Of Selected Wetlands For Cultivation In Metropolitan Lagos, Nigeria.

Session 2 - Oral Presentation Abstracts – Tuesday 2nd (pm)

OR9 – Rob Sparkes: Carbon Export From Thawing Siberian Permafrost.

Robert SPARKES[1*], Juliane BISCHOFF[2], Ayca DOGRUL SELVER[3], Helen TALBOT[4], ÖRJAN GUSTAFSSON[5] , Igor SEMILETOV[6], and Bart VAN DONGEN[7]

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Northern hemisphere permafrost contains globally significant amounts of organic carbon, currently frozen in soils, peat and ice complexes ("yedoma"). Release of this carbon as greenhouse gases will have a profound effect on global climate. Ongoing rapid climate warming in eastern Siberia causes thawing of permafrost, in-situ degradation of permafrost carbon, and the erosion of sediment and permafrost to the Arctic Ocean. Here the organic carbon can be deposited and reburied in shelf and deep ocean sediments, or degraded in the water column and released as greenhouse gases.

We have used a variety of organic geochemical proxies to understand the source, mobilisation, transport, distribution and fate of organic carbon in the East Siberian region. These include glycerol dialkyl glycerol tetraethers (GDGTs), bacteriohopanepolyols (BHPs), pyrolysis of large organic molecules, stable and radiogenic carbon isotopes and Raman spectroscopy. Together, these proxies show that both fluvial and coastal erosion deliver carbon to the East Siberian Arctic Shelf, but that the major source of organic carbon is coastal erosion. A combination of deposition and degradation in nearshore sediment means that there is a transition from terrestrial to marine sourced carbon across the marine shelf.

Ongoing warming will further destabilise the Arctic shoreline, leading to further coastal erosion of organic matter and subsequent degradation to greenhouse gas, causing a positive feedback to climate change.

OR10 - Alex Tait: Novel Approaches To The Investigation And Remediation Of Mercury In The Environment.

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The overall aim of this project is to develop and apply novel approaches to the investigation and remediation of mercury in the environment. Here we present finding from a two-part initial study investigating: (1) Hg concentration and its chemical speciation in contaminated sediment; and (2) the impact of three iron-based nanoparticle treatments on Hg, and additional geochemical and geomicrobiological parameters, in long-term microcosm experiments. The chemical speciation of mercury in contaminated canal bed sediment (MLR) from the Weaver Navigation (Runcorn, UK) was investigated using a sequential extraction procedure (SEP) in combination with inductively coupled plasma -mass spectrometry (ICP-MS), and x-ray absorption spectroscopy (XAS). A total Hg extraction procedure established that the Hg concentration in MLR sediment is ~86± 1 mg/kg (dry wt.). Additional analytical techniques were employed to assist in other aspects of sediment characterisation. Mineralogical analysis identified that the bulk of the sediment contained calcite, halite and brucite, which are key components of solid waste from the mercury-cell chlor-alkali plants. SEPs revealed that the mercury appears to be recalcitrant in the sediment as ~97% requires strong acids to be extracted, suggesting that it is predominantly strongly complexed or mineral bound, and therefore relatively immobile and less bioavailable. XAS data was able to reveal more detailed Hg compound specific information, XANES linear combination fitting suggested that ~99% is metacinnabar (β-HgS). Figure1 and Figure 2 show Hg L-IIIedge XANES and EXAFS spectra for an MLR sediment sample and a metacinnabar standard. Figure 1(Left): Hg L-III edge XANES spectra for MLR sediment and metacinnabar; linear combination fit; fitting range -20 eV to +30 eV from Hg L-III edge; metacinnabar 98.6% (±0.4%); R-factor 0.0004; reduced chi-square 0.000067Figure 2(Right): Hg L-III edge EXAFS spectra for MLR sediment and metacinnabar (k = 0 –13). Additional experimental work investigating the impact of three iron-based nanoparticle treatments (biomagnetite, NanoFER and Carbo-Iron®) on residual Hg in MLR sediment and added soluble HgCl2 are currently in progress (commenced June 2018). Long term anaerobic microcosms were setup in 120 mL serum bottles containing MLR sediment and artificial groundwater to simulate environmental conditions at the sediment-water interface. Microcosms were monitored over a one-year period to determine changes in:(1) sediment and pore-water chemistry (and mineralogy); (2) the chemical speciation of mercury; and (3) the microbial community. Monitoring samples are taken by degassed needle and syringe, aliquots of each sample are allocated for various analytical techniques, detailed here: ion chromatography (IC)(aqueous phase anions), ICP-MS (aqueous phase Hg), ferrozine assay (bioavailable solid phase Fe), XAS (solid phase Hg speciation), transmission electron microscopy (TEM) (solid phase high resolution imaging) and 16S rDNA (sequencing of microbial communities in solid phase). This research work is part of an EPSRCCASE funded studentship and will provide scientific information that could assist in the development of new in situ remediation treatments.

OR11 – Jatinder Kaur: Physico-chemical characterization and mutagenicity/genotoxicity of soil samples of Amritsar, Punjab (India).

Jatinder Kaur Katnoria and Avinash Kaur Nagpal
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Soil pollution is of concern because soil represents one of the most important natural factors that support life and environment. Presently in India, the ongoing intensive agricultural practices are driving out the essential nutrients during the crop cultivations. The district Amritsar of Punjab (India) is known for its agricultural production mainly rice and wheat. In order to have high productivity vast variety of chemical fertilizers and pesticides, both organic and inorganic are being used by farmers. Considering this, the present study was initiated to analyze the physicochemical parameters as well as the mutagenicity/genotoxicity of soils of agricultural fields of Amritsar. The soil samples were analyzed for their soil texture, pH, alkalinity, calcium, magnesium, nitrates, phosphates, sodium, potassium and heavy metal contents. For mutagenic and genotoxic potential, Ames assay, Allium cepa root chromosomal aberration assay and potato disc tumor assay were employed. During Ames assay, most of the samples have shown the mutagenic response in both TA98 and TA100 strains of Salmonella typhimurium. The squash preparations during Allium cepa root chromosomal aberration were screened under the microscope for different types of chromosomal aberrations. All soil samples resulted in appearance of different types of chromosomal aberrations in root tip cells of A.cepa. The spectrum of chromosomal aberrations included c-mitosis, stickiness, delayed anaphase/s, laggard/s, vagrant/s, chromatin bridge/s, ring chromosome/s and chromosomal break/s in both the modes of treatment. The induction of tumors in potato discs on exposure to the soil extracts further confirmed the tumorigenic potential of the soil samples. The samples have also shown high contents of heavy metals like lead, copper and chromium.

OR12 - Simon Gabriel Mafulul: Heavy Metalcontamination In Soils And Food Crops And Health Risk Assessment Of Inhabitants In Bokkos, Plateau State, Nigeria.

Mafulul S.G.*[1], Longdet I.Y.[1], Okoye Z. S.C.[1], Potgieter-Vermaak S.[2]and Potgieter J. H.[2]
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The past mining activities in Bokkos Local Government Area (LGA) were performed in an uncontrolled way and gave rise to serious environmental contamination which left behind many abandoned ponds now serving as domestic and irrigation water sources. This study was designed to determine the level of heavy metal contamination in pond water, soil and food crops and assess the health risk of inhabitants in the abandoned tin mining community in Bokkos LGA having a population of about 148,345 people. The health risk of inhabitants was assessed using the data recommended by the United States Environmental Protection Agency. Samples of the mining pond water, soil and selected food crops from farms irrigated with the pond water: okra (*Albelmoschus esculentus*), pepper (*Piper nigrum*), bitter leaf *(Vernonia amygdalina*), maize (*Zea mays)*, sweet potato (*Ipomoea batatas)*, Irish potato (*Solanum tuberosum*) and cassava (*Manihot esculenta*), guava (*Psidium guajava*), avocado pear (*Persea Americana*) and banana (*Musa spp*) were analyzed for each of the eight heavy metals (viz; Pb, Cd, Ni, Cr, Cu, Fe, Mn& Zn) using inductively coupled plasma optical emission spectrometry (ICP-OES).The results showed that the levels for all the 8 metals detected except Fe were above WHO maximum permissible limits in soil and pond water which indicated a potential hazard. The studied food crops vary in their ability to take up and accumulate heavy metals in their tissue parts. The concentrations of Cu, Mn, Ni and Zn in pepper, guava, banana, avocado pear, maize, sweet potato, Irish potato and cassava were 2 to 3-fold higher than their corresponding concentration in mine pond water. Bitter leaf accumulated Cd (6.9-fold), Mn (4.5-fold) and Zn (1.5-fold) several fold their concentrations in the soil while okro accumulated Mn (1.34-fold) and Cd (1.30-fold) manifold their levels in the soil. There were significant correlations between the metal profile in each of the food crop and mining pond water or soil indicating that the mining site was a potential hazard. The hazard quotient (HQ) upon ingestion of soil was calculated as per USEPA, 2012 and the values used for specific variables were adapted for Nigerian population statistics. HQ values for Cu (3.8), Cr (1.2), Mn (4.2), Ni (5.3), Zn (1.4), and Pb (4.3) were greater than 1 and thus indicated a potential health risk for both adults and children. The total hazard quotient for the eight heavy metals was 15.6 for children and 43 for adults. It can be concluded based on the results and risk assessment provided by this study that human exposure to mining pond water and soil in farms around the mining pond through the food chain suggests a high vulnerability of the local community to heavy metal toxicity. This finding can be beneficially used for risk communication so that preventive measures to safeguard the health of the local residents can be put in place.

OR13 – Tran Thi Thu Dung: Trace Element Contamination Status In Core Sediments In A Coastal District In Ho Chi Minh City, South Of Vietnam.

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Can Gio- a coastal district in Ho Chi Minh city is considered as "the lung" of Ho Chi Minh City due to the mangrove biosphere reserve which can protect the environment of the surrounding area. The objective of this study is to investigate the levels of selected trace elements (TEs: As, Cr, Cu, Mn, Ni, Pb and Zn) in the core sediments in Can Gio and preliminary assess the ecological risks relating to these TEs. Cored sediments were collected in dry season in 2018 at three sampling sites representing for different land use patterns such as household settlement (HS), extensive shrimp farming area (ES) and core zone (CZ) of the biosphere reserve. Total elemental (K, Na, Mg, Al, Ca, Fe, S, As, Cr, Cu, Mn, Ni, Pb and Zn) and other geochemical parameters including pH, organic matter, and grain size content were determined. Results indicated that average values of Ni exceeded the probable effect level, whereas As, Cr, and Cu were in the range of threshold effect level and probable effect level. High mean values (in mg/kg) compared to upper continental crust values were recorded for As: 17, Cr: 124 and Ni: 60, and their Geo-accumulation index (I_{Geo}) (Figure 1) ranged from moderate to strongly contaminated. The overall potential ecological risk (RI) calculated as the sum of all five risk factors for As, Cr, Cu, Ni, Pb and Zn indicated a moderate ecological risk at extensive shrimp farming area.

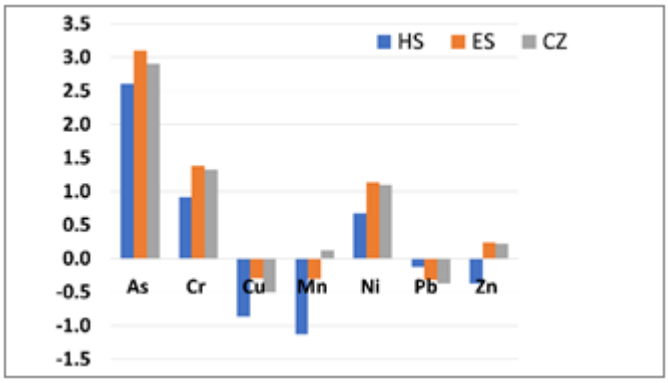

Figure 1: Mean I_{Geo} of selected TEs in different land uses

Acknowledgements

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OR14 – Carly Woods: Metal Ratio Analysis Of Ambient Particulate Matter.

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Air pollution is currently considered the greatest environmental threat to the global population. In the UK alone ambient air pollution has been associated with an estimated 40,000 deaths and a cost to the economy of £20bn. It is well documented in epidemiological studies that this hazard is particularly problematic for vulnerable groups, such as those in early developmental stages, the elderly and those with pre-existing respiratory conditions such as chronic obstructive pulmonary disease (COPD). Control of airborne xenobiotics within Britain is addressed by the Air Quality Strategy (AQS) which utilises Automatic Urban and Rural Network (AURN) monitoring stations to identify excessive levels of these pollutants. However, this system does not provide a comprehensive overview of the pollution profile within an area and additionally there are still many designated Air Quality Management Areas (AQMAs) in place throughout the country. Furthermore, some of the levels of pollutants which are deemed 'safe' by the AQS have been identified as hazardous to human health within a review by the World Health Organisation (WHO).

For these reasons, there is a requirement for further analysis of pollution levels through utilisation of cost effective monitoring networks and identification of the components within particulate matter (PM) to give an accurate outline of air quality within different areas. This study has a major focus on the metal composition within particulates, as this would allow for both source apportionment of the most abundant contaminants, and (when studied within the context of *in vitro* models) scope for recognition of the elements most influential to perceived health impact. Through examination of the components which comprise PM alone, and in conjunction with other gaseous pollutants, we can further understand biological influence and thereby set stringent limitations for the most detrimental toxins.

OR15 – Alicja Kicińska: Environmental Risk Related To The Presence And Mobility Of Zn And Pb In The Soils Around The Zinc-Works - Observations Over A Period Of 20 Years.

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The zinc-works discussed has a multifaceted impact on the soil environment. It is related to emission of industrial fly-ashes onto the top level of the soil profile, but also to the introduction of various forms of metals (metal fractions), which are not naturally found in soils. Subsequent changes related to e.g. weathering, deflation or suffusion of soil particles, aided by natural and anthropogenic factors affect the behaviour of metals which are originally embedded in crystal lattices of minerals. These changes mainly cause an increase in mobility and chemical activity of metals, which results in the creation of simple bonds with other ions present in soils. This in turn leads to their permeation into or uptake by living organisms.

Over the last 20 years, studies have been conducted in the vicinity of one of the largest zinc-works in Poland (in Miasteczko Śląskie) to establish: (*i*) the total content of Zn and Pb in soils, (*ii*) mineral forms in which these metals are found, (*iii*) quantity of their bioavailable forms, (*iv*) changes in mobility of Zn and Pb in the soil environment resulting from its increasing acidity. An additional purpose of the studies was (*v*) to calculate and analyse the *Risk Assessment Code* (RAC) related to the presence of Zn and Pb in soil samples collected from the close vicinity of the zinc-works in 2018 and 20 years earlier.

The total content of Zn and Pb in the soil samples collected in the vicinity of the zinc-works in 2018 ranged from 3358 to 21 866 mg/kg for Zn and from 3975 to 26 199 mg/kg for Pb. These values were considerably higher than those measured 20 years earlier (i.e. 1009–13 924 mg/kg and 601–11 939 mg/kg, respectively). The mineral composition was dominated by quartz, feldspars and carbonates (e.g. calcium carbonate). Additionally, iron hydroxides (lepidocrocite), lead sulphates (anglesite) and zinc silicates (hemimorphite) were found. The bioavailable amount ranged between 3 and 54% of the total content in the case of Zn, while in the case of Pb the values were considerably higher, ranging from 48 to 84% of the total content. The acidity of soils in the vicinity of the zinc-works confirmed their very good buffering capacity as well as an increase in the metals released, reaching 36% of the total content in the case of Zn and 63% in the case of Pb, while pH decreased by only 2.7 units. The RAC calculated based on the percentage share of Zn and Pb related to easily reducible fractions (i.e. exchangeable and carbonate fractions) was 31–57% and 44–69% of the total content, respectively. It was found that over the period of the preceding 20 years, there existed a high and very high environmental risk related to the presence of the studied metals in soils.

The presence of large quantities of Zn and Pb in soils over the last 20 years has created justifiable anxiety among local communities. It is therefore required to take more decisive action to improve the quality of the soil environment.

OR16 - Martyn Ward: GC-ToF-MS for remote monitoring-Cape Verde Atmospheric Observatory (CVAO)

Abstract:

This presentation will focus on the considerations and challenges faced when making atmospherically relevant measurements of air and aerosol composition using GC-MS based techniques. It will highlight the long term GC-MS measurement of short chained halocarbons and other species at our observatory in Cape Verde (National Centre for Atmospheric Science (NCAS)) and GCxGC-MS investigative work into VOC and S/IVOC release from burning. Both of these measurements have been made utilizing recently installed/purchased LECO ToF MS systems with the appropriate GC front end. For the long term halocarbon measurements a discussion of current instrument performance, and previous installations' performance will be included.

S2F – Flash and poster presentations

Stanislav Rapant: Life – water and health.

Ariadne Argyraki: Groundwater Quality And Risk Perception Of Water Users In Cr(Vi) Affected Areas Of Greece.

Andrew Marriot: Aquaculture Around Lake Victoria, Kenya: Considerations For Food Security And Environmental Geochemistry.

Rajesh Dhankhar: Waste Water Assesment By Membrane Bioreactor.

Laurence Maurice: Childhood Lead Exposure Of Amerindian Communities In French Guiana: A Lead Isotopic Approach To Identify The Sources

Rachna Bhateria: Statistical Modelling Of Lead Biosorption Process In Aqueous Medium By Aspergillus Niger Using Response Surface Methodology

Shofiqul Islam: Exposure Of Arsenic From Non-Irrigated Rice In Bangladesh And Human Health Risks

Akinade Olatunji: Cadmium Contamination Of Wetland Sediments In Part Of Lagos Metropolis, Nigeria.

Soni Rajbala: Particulates, Microbes In Homes And Their Impact Of Human Health.

Jonathan Lageard: Tracing aluminium production using tree chemistry.

Isabel Margarida Horta Ribeiro Antunes: Stream Sediment Contamination Indexes In A U-Enriched Area.

Session 3 - Oral Presentation Abstracts – Wednesday 3rd (am)

OR17 – Prof. Dr. Taicheng An: Simultaneous Quantitative Analysis Of The Several Groups Emerging Contaminants In Human Samples For Their Exposure Assessment.

Meiqing Lin, Shengtao Ma, Jian Tang, Yingxin Yu, Guiying Li, Taicheng An*
School of Environmental Science and Engineering, Institute of Environmental Health and Pollution Control, Guangdong University of Technology, Guangzhou 510006, China
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Human biomonitoring is an efficient way to assess the population's exposure to environmental contaminants by directly measuring substances or their metabolites. However, the challenge of sampling, such as ethical issues, limited sample amount and the will of participants, limited the extensive application of this way. In this situation, developing multiclass methods to simultaneously analyze different chemical classes in human samples has been increasing demand.

The main objective of this study was to develop new methods to simultaneous analysis of polybrominated diphenyl ethers (PBDEs) and their metabolites (OH-PBDEs), bromphenol (BPs), polycyclic aromatic hydrocarbons (PAHs) and their metabolites (OH-PAHs), tetrabromobisphenol A (TBBPA) as well as triclosan (TCS) in human hair and urine with non-invasive methodology. For hair sample, liquid-liquid extraction and the gel permeation chromatography cleaned up procedure were applied, and then the parent compounds (PBDEs and PAHs) were separated from their hydroxylated metabolites and BPs, TBBPA, and TCS with silica gel solid phase extraction (SPE) column. For urine samples, all target analytes (except PBDEs and PAHs) were extracted by Oasis HLB column. The gas chromatography-mass spectrometry (GC-MS) and the gas chromatography-triple quadrupole mass spectrometry (GC-MS/MS) were applied for analyzing PBDEs and PAHs, respectively. While their hydroxylated metabolites, BPs, TBBPA, and TCS could be simultaneously analyzed by high-performance liquid chromatography-triple quadrupole mass spectrometry (HPLC-MS/MS) within 13 min. The recoveries of PBDEs, PAHs, OH-PBDEs and OH-PAHs were obtained in the range of 62%–125%, 76%–135%, 78%–88% and 77%–146% in hair sample, respectively. The recoveries of OH-PBDEs, OH-PAHs, BPs, TBBPA and TCS were obtained in the range of 56%–76%, 70%–106%, 69%–116%, 62%-76% and 69%–78% in urine sample, respectively. The developed methods were applied to measure the levels of target analytes in hair and urine samples obtained from e-waste dismantling site's residents as well as the students in Guangzhou, respectively. PBDEs, PAHs and OH-PAHs had 100% detection frequency in hair sample, while OH-PAHs, some BPs, TCS and TBBPA were detected in urine samples with the relatively low detection frequency.

OR18 – Alan Griffiths: Using Comprehensive Gas Chromatography To Double Confidence And Quadruple Analyte Identification In Complex Environmental Samples.

Alan Griffiths
LECO UK Separations Science Product Specialist

Comprehensive gas chromatography utilises two different stationary phases on two separate GC columns. When hyphenated with Mass Spectrometry the approach consistently shows a vast improvement in confidence of identified analytes, and an increase of four times the number of identifications. We will discuss the technique in its most advanced form, the latest in cost effective technology and demonstrate the effectiveness with samples collected by the Arctic Floating University.

OR19 – Kiri Rodgers: Co-Selection Of Antimicrobial Resistance From PTE Legacy Pollution In Gram-Negative Bacteria.

Kiri Rodgers[1*], Rebecca Tonner[3], Iain McLellan[2], Tatyana Peshkur[3], Roderick Williams[1], Charles W. Knapp[3], Fiona L. Henriquez[1*] and Andrew S. Hursthouse[2],

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[2]School of Computing, Engineering and Physical Sciences, University of the West of Scotland, Paisley, UK

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Antimicrobial resistant bacteria are increasingly found within the environment, including estuarine sediments. Evidence strongly suggests contaminated sediments pose hazards that not only affects the health care sector, but also tourism and aquaculture industries. Potentially toxic elements (PTEs) found in post-industrialised estuaries are found alongside antimicrobial resistant bacteria harboured within sediments. The River Clyde, Scotland is a prime example due to its extensive industrial history, with this study focusing on three sites that represent different levels and types of industrial activities: highly polluted (Dumbarton West and Clydeview) and relatively “pristine” site (Cardross). Geochemical characteristics and PTE profiles were compared to gram-negative, enteric bacteria isolates from sediment cores. Their susceptibilities to antibiotics and metals were assayed—determining minimum inhibitory concentrations (MIC) and minimum bactericidal concentrations (MBC). Results prove co-selection of PTEs and antibiotic resistance, which impacts bacteria that are potential human pathogens. Higher concentrations of metals correlate to antibiotic resistance and higher MICs and MBCs to metals compared to bacteria found in less polluted sites. For example; high MICs values against Penicillin G Sulfate which correlate with bacteria isolated from sediment with high levels of total Zinc. As well as significant correlations between tetracycline and arsenic which may highlight dual-resistance being shown to these compounds This study provides critical information behind the specific causes of antibiotic resistance due to a legacy of pollution and to continue to protect human health, theses interactions aid our understanding.

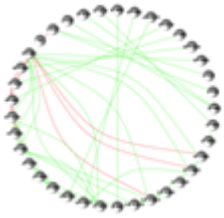
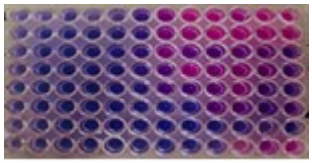


Figure 2: Network analysis of MIC, MBC, IC50 and geochemical conditions

Figure 1: Minimum Inhibitory 96-well assay depicting the resistance of isolated bacteria to selected antibiotic. Values are in two-fold dilution and units are mg/L.



OR20 – Chaosheng Zhang: Towards Spatial Machine Learning For Data Analytics In Environmental Geochemistry In The Big Data Era.

Chaosheng ZHANG
International Network for Environment and Health (INEH), School of Geography and Archaeology & Ryan Institute, National University of Ireland, Galway, Ireland. Chaosheng.Zhang@nuigalway.ie

Environmental geochemistry is playing an increasingly important role in mineral exploration, environmental management and agricultural practices. With rapidly growing databases available at regional, national, and global scales, environmental geochemistry is facing the challenges in the “big data” era. One of the main challenges is to find out useful information hidden in a large volume of data, with the existence of spatial variation found at all the sizes of global, regional (in square kilometers), field (in square meters) and micro scales (in square centimeters). Meanwhile, the rapidly developing techniques in machine learning become useful tools for classification, identification of clusters/patterns, identification of relationships and prediction. Based on spatial variation, this presentation demonstrates the potential uses of a few practical machine learning techniques (spatial analyses) in environmental geochemistry: neighbourhood statistics, hot spot analysis and geographically weighted regression.

Neighbourhood (local) statistics are calculated using data within a neighbourhood such as a moving window. In this way, spatial variation at the local level can be quantified and more details are revealed. Hot spot analysis techniques are capable of revealing hidden spatial patterns. The techniques of hot spot analysis including local index of spatial association (LISA) and Getis Ord Gi* and their applications are explained and investigated using examples of geochemical databases in Ireland, China, the UK and the USA. The geographically weighted regression (GWR) explores the relationships between geochemical parameters and their influencing factors at the local level, which is effective in identifying the complex spatially varying relationships. Machine learning techniques are expected to play more important roles in environmental geochemistry. Challenges for more effective “data analytics” are currently emerging in the era of “big data”.

OR21 – Ed Randviir: Towards Electrochemical Determination Of Pops: Targeting The C-Cl Bond.

Edward RANDVIIR[1*]
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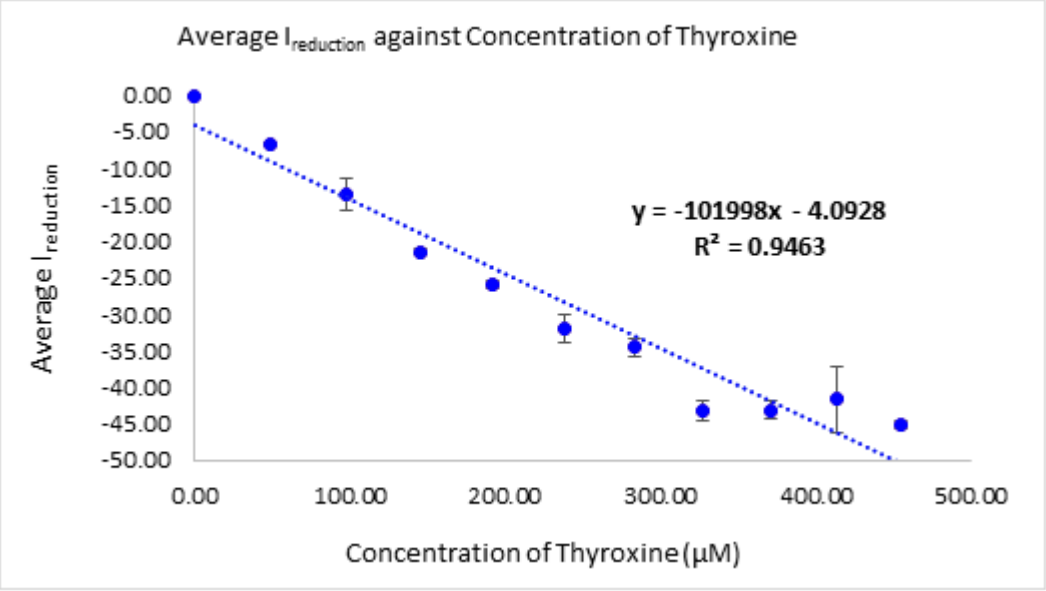
Persistent Organic Pollutants (POPs) are compounds of environmental concern. They are resistant to chemical, biological, and physical degradation and remain within biological systems for several years. POPs are toxic and are regulated from a production and an environmental release point of view. Methods to detect POPs are focused on laboratory-based techniques such as GC-MS, requiring specialized methods and personnel to acquire reliable datasets. Many organizations who produce or manage POPs do not have the expertise to monitor POPs internally and hence there is a need to develop new technology to determine POP concentrations at the point of release. Electrochemical methods are intensively researched for the purpose of supporting data acquisition for environmental purposes, since they are quick, cheap, and portable compared to laboratory-based methods. However, the benign nature of the C-Cl bonds normally prohibits the use of electrochemical methods for POPs. Hence, this work investigates an indirect electrochemical detection route for chlorinated POPs based upon the known toxicity pathways of POPs within the human body. The sensor takes advantage of the favourable interaction of POPs with thyroxine-binding globulin (TBG) in a competitive electrochemical assay in the presence of the electrochemically active thyroxine. The electrochemical reduction current of thyroxine is shown the be linear with respect to thyroxine concentration as shown in the figure below. The competitive assay is expected to positively affect currents, such that increases in electrochemical reduction current can be correlated to the POP concentration in the assay.



OR22 – Peter Lawrence: Cameras, Lasers And GPS: The Future Of Landscape Ecology?

Peter LAWRENCE [1*], Hannah MOSSMAN [2]
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Manchester Metropolitan University, Faculty of Science and Engineering
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Across many ecosystems, the importance of topography is often linked to the presence or absence of large-scale features such as shelter or drainage. In recent years, researchers have been developing techniques to observe and understand the roles of features that are far smaller in scale (from 1m to 1cm). These features also constitute niches for plants, fungi, and lichen to colonise or can be barriers to colonisation. Small-scale topographic features such as cracks in soil, hillocks or even smaller such as scratches on concrete can contain significant chemical gradients despite their small spatial distances. Despite the growing appreciation for large and small scales of topographic drivers, how we measure and review the topography of our surroundings has often lacked resolution (observations per unit area), or researchers have lacked computing power for analysis on the smallest scales. As a result, researchers are often left wondering how to monitor and map moderate and micro environments, how do we describe and analyse these features and importantly do this scale up and ultimately represent a bottom-up process acting on diversity and functioning of a far larger location.

Here we will discuss the findings of our research into the importance of topography in an ecosystems with very strong environmental gradients that we may expect to out weigh the role of topography, but we find does not. This re-enforces the need for further topographic studies and a better understanding of its role in multiple systems from macro to micro environments.

We will make the case that an underused technique of landscape survey is the re-emergence of a technology called photogrammetry. With this technique we can emulate and improve upon results generated from expensive or specialist equipment such as LiDAR, SONAR and RADAR equipment with a far lower cost and more accessible processing method. We will discuss the evolution of landscape survey techniques, its pros and cons, and the possible future options for researchers. Finally, the talk will conclude with a discussion of the future of topographic analysis, and make a call for engagement from the conference attendees to suggest research questions on centimetre to sub millimetre scales micro scales.

OR23 – Khadija Jabeen: Unravelling The Exposome: New Insights From The Dustsafe Citizen Science Study.

Khadija Jabeen[1], Jane A. Entwistle[1], Michael E. Deary[1], David A. Pearce[2], Mark P. Taylor[3] and Gabriel M. Filippelli[4]

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[2]*Department of Applied Sciences, Northumbria University, Newcastle upon Tyne, UK*
[3]*Department of Environmental Sciences, Macquarie University, Sydney, NSW, Australia*
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***Presenting author:** Khadija Jabeen **Email:** khadija.jabeen@northumbria.ac.uk

Particulate matter (PM) pollution has been historically linked with multiple adverse health endpoints in humans, with mounting evidence suggesting associations with cardiovascular disease (CVD), chronic obstructive pulmonary disease (COPD) and asthma among others. Efforts to monitor and characterise PM emissions in ambient atmospheres have been numerous in the past few decades, however, little is known about the nature or spatio-temporal variability of such emissions in indoor settings. With global time-activity patterns now suggesting that humans tend to spend up to 90% of their time indoors, the characterisation of PM pollution in indoor environments has recently been propelled to the forefront of exposure science research.

PM is composed of a variety of potentially hazardous environmental agents, both biotic and abiotic. Dynamic and ubiquitous in nature, it is not only a constituent of indoor atmospheres but also covers virtually every indoor surface of a house in the form of a fine layer of dust. Research has shown typical indoor dust compositions include an array of pollutants such as metals, flame-retardants, pesticides, phthalates and perfluoroalkyl substances among others - all of which are associated with the development of negative health effects in humans. Indoor dust also serves as a reservoir for diverse microbial communities, some of which exhibit pathogenicity. Human contact with dust may be facilitated by ingestion and inhalation-potent exposure pathways that receptors routinely engage in whilst indoors. As a result, there is now a burgeoning need for the comprehensive characterisation of human exposures in indoor environments, with increased interdisciplinary research efforts and cross-faculty collaboration required to bridge gaps in existing knowledge. 360 Dust Analysis ('*DustSafe*') is a global research initiative that aims to establish a baseline of potentially hazardous environmental agents routinely found in residential settings worldwide. A first of its kind, the program uses citizen science approaches to improve the average citizen's environmental health literacy by equipping them with high resolution, microscopic-level insights into their own homes. DustSafe UK is set for launch in early 2019 during which vacuum cleaner waste sample will undergo geochemical and metagenomic analysis of the samples via high-throughput DNA sequencing, enabling characterisation of residential bacterial microbiota, thus helping to elucidate biogeographical trends in microbial diversity across UK homes. The project aims to answer more pressing questions of epidemiological and clinical concern by exploring possible links between metal contamination of household dust and the prevalence of antibiotic resistance (AR) in bacterial communities native to the home environment.

OR24 - Moataz Tarek: Planetary Medical Geology: An Overview.

Moataz T. Mostafa [1,*], Diego H. Fridman[2]
[1]Faculty of Science, Geology Department, Arish University, Giza, Egypt
[2] Fundacion del Centro de Estudios Infectológicos, Buenos Aires, Argentina
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According to our desire to do more achievements in space exploration, there are many barriers which hider our efforts. One of these barriers is the lack of cooperation and coordination between different involved fields.

Astronauts face severe health problems related to geology, for example, celestial dust that causes lunar hay fever and blindness in addition to the mechanical and structural integrity issues.

Based on medical geology, it is very important to understand the geochemical characters, physicochemical origin, toxicity, hazard assessment and mineralogical and crystallographic composition of the dust by performing geochemical, in vivo and in vitro studies.

This session will be the starting point for a fruitful discussion between differently related specializations to unify our efforts for more successful space missions and to determine the framework of this new subfield.

S3F – Flash and poster presentations

Na Song: Resource From Waste, Potential Of Sepiolite Mining By Products In The Mitigation Of Environmental Impacts From Resource Exploitation In Hunan, PRC.

Chong-Chen Wang: Applications Of MOFs/Composites In Wastewater Treatment.

Huifen Fu: Light-Responsive Uio-66-NH_2/Ag_3PO_4 MOF-Nanoparticle Composites For The Capture And Release Of Sulfamethoxazole.

Paula Marinho-Reis: Reducing The Gap Between Field And Laboratory X-Ray Fluorescence Analysis.

A H Gaddah: Dye Degradation With The Aid Of Coated Fly Ash.

Maria-Anna Gatou: Mercury Removal From Crude Oil Using Natural Minerals.

Alexandra Gordon: Photocatalytic Advanced Oxidation Processes Under Solar and UV Irradiation for Degradation of Organic Matter in Raw Water.

Paula Marinho-Reis: Comparative Study Of Experimental Peloids Formulations With Different Clayey Dermocosmetic Products.

Idowu E Obolo: The Effect Of Freeze And Air Drying On Operational Speciation Of Potentially Toxic Elements In Freshwater Sediment And Ecological Risk Assessment.

Kabenuka Munthali : The Potential Of Biochar Soil Amendment In Cycling Nitrogen And Phosphorus In Zambian Soils

Session 4 - Oral Presentation Abstracts – Wednesday 3rd (pm)

OR25 - Margarida Antunes: Environmental Risk Assessment In Mining Areas Before And After Remediation.

Isabel Margarida Horta Ribeiro Antunes[1*]

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* Presenting Author: imantunes@dct.uminho.pt

The mining complex of Murçós is located in the Trás-os-Montes region (Bragança, NE Portugal) and belongs to the Terras de Cavaleiros Geopark. The hydrothermal W>Sn quartz veins intruded Silurian metamorphic rocks and a Variscan biotite granite. These veins contain mainly quartz, cassiterite, wolframite, scheelite, arsenopyrite, pyrite, sphalerite, chalcopyrite, galena, rare pyrrhotite, stannite and native bismuth. The exploitation produced 335 ton of a concentrate with 70 % of W and 150 ton of another concentrate with 70 % of Sn, between 1948 and 1976. Remediation processes of confination and control of tailings and rejected materials and associated phytoremediation with macrophytes from three lakes were carried out between 2005 and 2007. After the remediation processes, between 2008 and 2009, stream sediments, soils and surface water samples were collected. Most stream sediments showed deficiency or minimum enrichment for metals. Stream sediments are extremely enriched with W, while stream sediments and soils are contaminated with As. Two soil samples collected around mine dumps and an open pit lake are also contaminated with U. After the remediation, the surface waters are acidic to neutral and contaminated with F^-, Al, As, Mn and Ni and must not be used for human consumption. Open pit lake waters must also not be used for agriculture because are contaminated with NO_2^-, F^-, Al e Mn. Although the remediation processes promoted a decrease in potential toxic elements of soils and waters, the applied processes must be complemented to rehabilitate this abandoned mining area.

OR26 - Timothy Harris: "Systems Thinking Approach in Catchment Management and the role of Natural Capital in the Water Industry"

United Utilities is the major Water and Wastewater provider in the North West of England. After years of environmental investment, the pressures driven by regulatory requirements such as the Water Framework and Bathing and Shellfish Directives, are increasingly hard to meet at sustainable costs. Therefore, there is an emphasis on finding more cost beneficial approaches, balancing the impact on customers' bills, with the need to meet our regulatory requirements, and to enhance the natural environment as laid out in DEFRA's 25-year Environment Plan.

The way forward is to look for more holistic solutions, looking at catchments as a whole, and to deliver improvements in line with enhancing and protecting the natural capital value of the North West. United Utilities is doing this by developing and delivering natural sustainable solutions to remove pollutants and address flooding risk, working with external stakeholders and partners to achieve our regulatory requirements whilst also benefiting a broad range of ecosystems services, such as mental and physical health, recreation, amenity, flood protection, water quality and biodiversity, which impacts on our customers' lives beyond managing the impact on their bills. A leading example of this new way of working is the river Petteril in Cumbria a tributary of the larger Eden catchment.

OR27 - Xia Huo: Pollutant Trend And Environmental Health Impacts In An E-Waste Recycling Area.

XU[1], Zhang[1], Wang[2], and HUO[2*]

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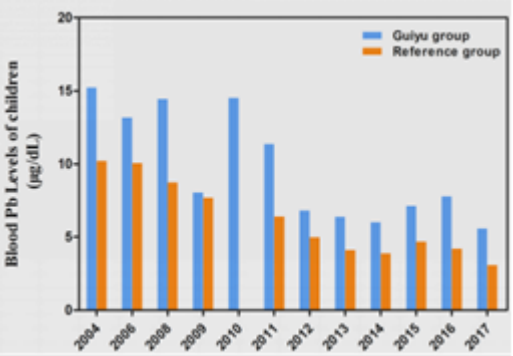

Electronic waste or e-waste describes discarded electrical or electronic devices. E-waste recycling has become a global environmental health issue. Our research focuses on e-waste exposure and children's health, and early life exposure and disease risk. We here report the temporal trends of heavy metals and persistent organic pollutants (POPs) in biospecimen of neonates and children from Guiyu (e-waste exposed group) and Haojiang (reference group) areas of China between 2004 to 2017. Our results showed that Guiyu children and neonates had significantly elevated heavy metals and POPs, including lead (Pb), cadmium (Cd), chromium (Cr), manganese (Mn), mercury (Hg), Polybrominated diphenyl ethers (PBDEs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) Perfluorooctanoic acid (PFOA), phthalate esters (PAEs) and Bisphenol A (BPA) level in their blood, urine and other biospecimen than the reference group. Children in the exposed group have alterations in blood composition, neuro-endocrine-immune response, molecular biochemical levels, and impairment in cardiovascular and respiratory systems. Our studies suggest that exposure to improper e-waste recycling in the e-waste exposed area has adversely affected child and infant health and development. This kind of exposure may cause long-term adverse outcomes for health. These alterations and impairments may increase the risk of some chronic diseases such as metabolic diseases, cardiovascular disease, and respiratory disease.

OR27 – Matthieu Delannoy: Reduction Of Chlordecone Environmental Availability By Soil Amendment Of Biochars And Activated Carbons.

Ronald Ranguin[1], Corine. Jean-Marius[1], Christelle Yacou[1], Valerie Jeanne-Rose[1], Sarra Gaspard[1]*, Cyril Feidt[2], Guido Rychen[2]*, Matthieu Delannoy[2]

[1] Laboratoire COVACHIMM, EA 3592, Université des Antilles et de la Guyane, BP 250, 97157 Pointe à Pitre Cedex, Guadeloupe, France.

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Chlordecone (Kepone or CLD) was formerly used in French West Indies as an insecticide. Despite its formal ban in 1993, high levels of this pesticide are still found in soils. Sequestering matrices like biochars or activated carbons (ACs) may decrease the bioavailability of halogenated compounds like CLD when added to contaminated soils. The present study intends (i) to produce contrasted sequestering matrices in order to (ii) assess their respective efficiency to reduce CLD environmental availability. This study involved two experimental steps. The first one consisted in the production of contrasted sequestering media (Biochars and ACs) using pyrolysis and distinct activation processes on two lignocellulosic precursors: oak wood (*Quercus ilex*) and coconut shell (*Cocos nucifera*). The chemical activation was made with phosphoric acid and physical activation with carbon dioxide and steam. Their physico-chemical properties were then characterized. In the second step, the CLD environmental availability was assessed either in an OECD artificial soil or in an Antillean contaminated nitisol (2.1 µg CLD per g of soil Dry Matter) amended with 5% of biochar or 5% of AC (mass basis). Main characteristics for coconut and oak biochars and ACs determined by nitrogen adsorption at 77K shows that mixed microporous and mesoporous structures (ranging from 30 % to 70%), high pore volume (ranging from 0.38 $cm^3.g^1$ to 2.00 $cm^3.g^1$) and a specific (BET) surface areas from 299.9 $m^2.g^1$ to 1285.1 $m^2.g^{-1}$ resp. The amendment by lignocellulosic biochars did not limit CLD environmental availability in contrast to ACs which resulted in a significant reduction of the environmental availability in both artificial and natural soils. Thus, ACs amendment reduced CLD-transfer by at least 65% ($P<0.001$) for both lignocellulosic matrices (at the exception of coco activated with steam displaying a 47%-reduction). These results confirm quality and extent of porosity are of particular importance in the retention process of CLD in aged soil. This study leads to conclude that AC introduced in CLD contaminated soils could significantly reduce CLD transfer to fauna and biota.

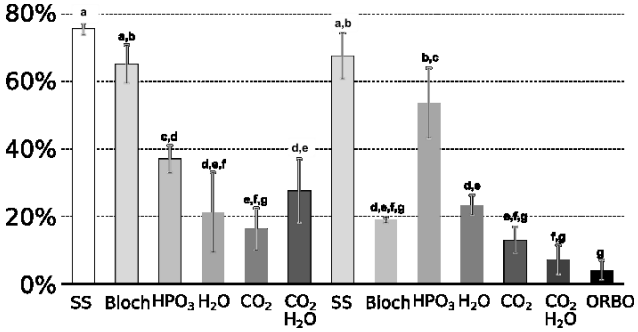

Fig. CLD availability in OECD soils. CLD availability is expressed in %. Values correspond to the mean ± SD (n=3 or 6 (OECD, DARCO, ORBO). ***Mean values*** with different superscript ***letters (a, b, c, d, e, f, g)*** are statistically different ($P<0.05$). Statistical analysis was performed using the one-way ANOVA procedure of R software and Tukey post-hoc test.

OR28 - Elena Korobova: An Approach To Mapping The Risk Of Endemic Diseases Based On The Concept Of The Spatial Organization Of Biogeochemical Provinces.

Elena Korobova[1*], Sergey Romanov[2]
[1] Vernadsky Institute of Geochemistry and Analytical Chemistry, Moscow, Kosygin Street, 19
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* Presenting Author: Email Address: korobova@geokhi.ru

Geochemical structure of modern biogeochemical provinces is proposed to be considered as a result of the two-layer organization of the noosphere, which, unlike the virgin biosphere, is an object formed by processes of both natural and man-made genesis. In structural terms, it consists of a powerful natural foundation formed during the historical interaction of biota with a geological substrate, and a relatively thin layer of anthropogenic deposits universally positioned over the natural substrate. The geochemical heterogeneity of the natural background of the noosphere is climatically differentiated at the level of natural zones, within which geologically distinct subregions are distinguished, which within the landscape geochemical systems are further differentiated by soil formation processes. The main feature of technogenic pollution is that it forms anomalies of a monocentric or polycentric structure, which may be easily identified and have a mathematical interpretation. Using the soil cover structure as a marker of the natural geochemical heterogeneity and being able to reproduce the structure of the pollution field with the minimum sufficient amount of measurements, it is possible to evaluate the health risk due to the cumulative impact of natural and man-made factors. A cartographic assessment of the health risk can be performed by overlaying two layers with subsequent analysis of the resulting interference pattern, which allows high-precision reproduction of the configuration of areas at risk for specific diseases of a combined geochemical nature. The proposed approach can also be treated as a methodological basis for improving the system of biogeochemical regionalizing from the point of view of identifying biogeochemical provinces differing in the degree of their preference for life and the production of agricultural products. The approach was tested on the example of constructing a risk map for thyroid diseases caused by a combination of iodine deficiency and contamination with radioactive isotopes of iodine of the adjacent territories of Russia and Belarus as a result of the accident at the Chernobyl nuclear power plant.

OR29 - Andrew Hursthouse: Resource Exploitation And Environmental Impact: Addressing Rebound Effects From China's Rapid Industrial Expansion.

Andrew Hursthouse [1,2]*, Zhenghua Wang [1,2], Bozhi Ren [1], Iain Mclellan [2] Simon Cuthbert [2] & Na Song [1,2]

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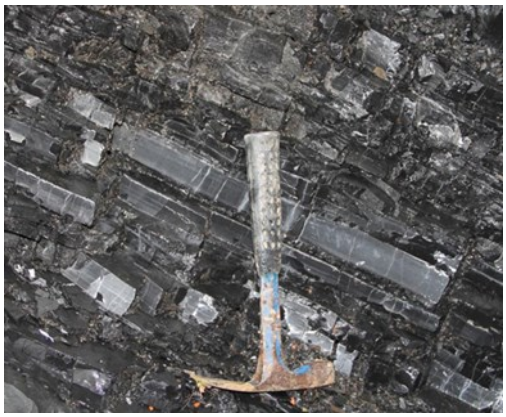

In January 2012, China's Sinopec announced the discovery of Shale Gas at Lianyuan city in Hunan province, Southern China. Subsequently the Hunan Provincial Key Laboratory of Shale Gas Resource Utilization was approved by Hunan Provincial Government. Based at the Hunan University of Science & Technology campus in Xiangtan City, it houses 34 permanent researchers in the laboratory, including 9 professors, 8 associate professors http://hnoilgas.hnust.edu.cn/ and whilst independent is affiliated with a number of Schools in the University http://english.hnust.cn/. The laboratory aims to apply an in-depth systematic study to new concepts, methods and scientific principles for shale gas exploration, development and environmental management through three institutes and to develop internationally leading research programmes in: **Geological Evaluation**; **Exploration Technology** and **Contamination Process Control and Evaluation**. The region locally also hosts a number of base metal and other mineral resources that have been actively exploited during China's rapid industrial development. As re-bound effects from this process, environmental contamination issues and food chain security are now of regional and national concern.

In 2014 the Centre for Environmental Research, UWS, developed collaborative relations with the Key lab, bringing from UWS wide experience of pollutant migration, environmental impact and human health risk assessment as well as over 20 years of programme development in Environment, Waste and Resource Management focused on geosystem, industry, regulatory and governance solutions. This has developed in intensity over the last 5 years, providing two way exchanges of staff and students, as part of both UWS and HNUST international strategies.

The presentation will identify key outcomes from the thematic focus and research achievements from the collaboration. Highlights of strategic plans/opportunities, particularly focused following President Xi's 2018 strategy on "ecological civilisation" and pollution control.

OR30 – Stanislav Rapant: Impact Of Potential Toxic Elements On The Health Status Of The Inhabitants In The Slovak Republic.

Stanislav Rapant* and Veronika Cveckova
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The impact of potentially toxic elements (PTE) on the health status of the population of the Slovak Republic has been studied both at national and regional levels (three historical mining areas – HMA). PTE contents (As, Sb, Cu, Cd, Hg, Pb, Zn, Cr) were analyzed in groundwater (20,339 analyzes) and in soil (10,738 analyzes) together with other elements/compounds/parameters. The health status of the resident population was assessed on the basis of 43 health indicators (HI) classified according to the International Classification of Diseases (ICD), including those indicating mortality rates for cardiovascular and oncological diseases. Several mathematical and statistical methods have been used to connect the PTE and the HI. Based on the linear and Spearman correlations, no significant dependence was found between the PTE and HI contents, both in the national level and in the HMA. Using Artificial Intelligence – Artificial Neural Network (ANN), it has also been confirmed that PTE contents have negligible effects on HI, both at the national level and in three HMAs. Sensitivity coefficients for PTE were generally below 1, i.e. not affecting the human health. The health status of inhabitants in three investigated HMAs was comparable to the surrounding areas. We can conclude that PTE content has much less impact on the health status of the population than previously assumed. The most important elements on human health are the Ca and Mg contents with the influence of two orders higher than PTE.

OR31 - Olivier Humphrey: Investigating Short Term Soluble Iodine Dynamics In Soils.

Olivier Humphrey[1,2*], Scott Young[2], Elizabeth Bailey[2], Neil Crout[2], Elizabeth Ander[1] and Michael Watts[1]

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Iodine is an essential micronutrient for human health required for the production of thyroid hormones. Soil properties, such as pH and the concentration of organic matter and Fe/Al/Mn hydrous oxides, influence the speciation of iodine and its availability to plants, which can then impact human consumption. Our current understanding of iodine geodynamics would be significantly improved with a greater understanding of soluble iodine interactions with soil. In this study we report the first use of microdialysis to isotopically labelled (^{129}I) iodine from soils in order to observe short-term sorption and fixation processes without disturbing the system dynamics.

We validated the use of microdialysis to extract inorganic soluble iodine species in solution before applying the technique to soils. To investigate short-term soil iodine dynamics we spiked three soils with $^{129}I^-$ or $^{129}IO_3^-$ prior to a 40-hour extraction in which we passively sampled the soluble soil phase using microdialysis. We then coupled size exclusion chromatography (SEC), which separates chemical species in aqueous samples according to molecular size, and ICP-MS equipped with a triple quadrupole (QQQ) facility to separate interfering isobaric and polyatomic species from the target analyte in order to determine iodine concentrations.

We successfully demonstrated the use to microdialysis to passively monitor short-term sorption and fixation processes without disturbing the soil microcosms under test conditions. The isotopically spiked soils showed a rapid decline of iodine present in the soil solution due to sorption by soil components. We also witnessed the conversion of inorganic iodine species to organically-bound iodine within the experimental period. The newly formed soluble organically-bound iodine was primarily associated with dissolved organic matter with low molecular weights (<5 kDa), identified using SEC-ICP(QQQ)-MS. In conclusion, microdialysis was proven to be an effective extraction method for soluble soil iodine species and the use of online SEC and MS detection enabled greater understanding of short-term iodine dynamics in soils. The results from this study have the potential to influence future agricultural practices for iodine phytofortification and understanding the fate and transport of anthropogenic ^{129}I.

S4F – Flash and poster presentations

Jon A Connelly: The Effects Of Artificial Weathering On Virgin Microplastic Pellets.

Zacharenia Kypritidou: Interaction Of Clays With Lead In Aqueous Solutions Soil Leachates And Soil Porewater.

Hatim Badri: DNA Strand Breaks Induced By Crushed Rock Powders From The Panasqueira Mine Area, Portugal – Association With Bulk Chemical Composition.

Amanda Burson: Palaeolimnological analysis in Lake Victoria reveals potential threat to aquaculture security

Belinda Kaninga: Soil-Crop Relations And Uptake Of Heavy Metals At A Mine Tailings Dump In The Zambian Copperbelt.

Jaskaran Kaur: Evaluation Of Genotoxicity Of Buddha Nullah Water Using Plasmid Nicking Assay.

Mgbeahuruike Leonard Udochi: Evaluation Of Clay Minerals As Underlying Influence To Soil Washing Efficiency: Contaminated Soils.

Shofiqul Islam: Exposure Of Arsenic From Non-Irrigated Rice In Bangladesh And Human Health Risks.

Amy Sansby: Investigating pollutants and potential food safety concerns within aquaculture

Natalie Pickwell: Is aquatic environmental element content driving the development of resistance in bacteria?

Hernández-Álvarez Elizabeth: Determination Of Exposure To Mercury In Hair From Inhabitants Of Two Regions In Mexico.

Session 5 - Oral Presentation Abstracts – Thursday 4th (am)

OR33 – Alex Stewart: Decisions, Decisions, Decisions: The Health Effects Of Measuring Geochemical Concentrations.

Alex Stewart[1*], Jane Entwistle[2], Paula Marinho[3], Andrew Hursthouse[4], Anthea Brown[5]

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As, Cd, Cu, Cr, Fe Hg, Ni, Pb, U, Zn are all found in metalliferous dust and all can have adverse health effects. Much is known about the health effect of metals in particles (and other toxins), with good scientific summaries available, e.g. from Public Health England (www.gov.uk/government/collections/chemical-hazards-compendium) and the US based Agency for Toxic Substances and Disease Registry (www.atsdr.cdc.gov/substances/indexAZ.asp#A). For example, there is an known epidemiological association between exposure to particles and mortality and morbidity in lung cancer and cardiovascular diseases. The generation of reactive oxygen species (ROS) in biological tissues via Fenton-type reactions is one likely mechanism. However, the actual mechanisms often remain unclear.

There is an urgent need to go beyond characterisation and description of environmental toxins (of all kinds, not just elements) and try to determine the causal relationships between the various environmental, personal/social and economic influences and health. Such influences operate on scales ranging from the individual (e.g. sex, age, genetics) to the international (war, trade, global corporations, weather, pollution) in complex mixes. Successfully addressing these challenges will require an understanding and development of:

- the influence that society, history, culture, religion, and the environment might have on risk behaviours and care seeking behaviour,
- culturally sensitive, community-centred approaches to data collection and data sharing to enable better prediction, prevention and management of related diseases,
- international and multi-professional collaborations, in which SEGH is a leader through its mentoring and fellowship programmes, and annual conferences,
- and suitable and available funding, e.g. though the UK Global Challenges Research Fund.

Furthermore, we need to consider the future: people live longer in mining areas, with new dusts being generated from new developments; what other dust sources may compound this? Geochemists should incorporate wide thinking about outcomes from assessments, including, but not limited to, health effects, into their routine approach to dusts or other environmental issues. Integrated, multi-professional collaborative groups are key to this, reducing the stress of working beyond one's professional knowledge, thus improving geochemists' own health!

OR34 - Raeesa Moolla: Health Risk Assessment At An International Airport.

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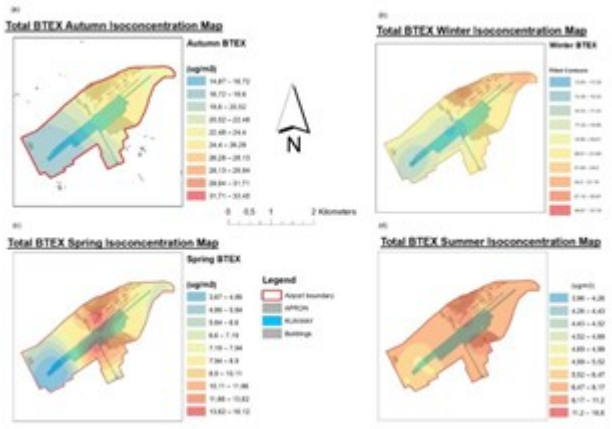
The probable human health risk associated with airport related emissions has been a highlight of many studies in the last two to three decades. Studies have focused on exposure to volatile organic compounds (VOCs), and specifically a group of VOCs; viz. benzene, toluene ethyl-benzene and xylenes (BTEX), a group of compounds associated with airport activity. This is due to their associated adverse health effects. However, little work has been done in Southern Africa to quantify the potential health risk for populations living near airports.

The methodological design entailed a three step process to address the inhalation risk assessment. This included an air sampling campaign (using diffusive passive samplers to monitor ambient BTEX concentrations seasonally); kriging interpolation surfaces (in order to predict emissions across the entire airport); and finally, quantifying the hazard quotient (HQ) of non-cancer risk; incremental lifelong cancer risk (ILCR) and lifetime average daily dose (LADD) (to represent exposure of the hypothetical subpopulation groups that reside near the airport).

The results of the passive sampling campaign indicated that $BTEX_{total}$ concentrations ranged from 0.7 to 30.59 µg/m^{-3}. The 0-6 month (i.e. infants) subpopulation group had the highest LADD, HQ and cancer risk overall. Furthermore, ILCR levels were above the 1 x10^{-6} US EPA guideline for all subpopulation groups. The kriging results further indicated areas of high $BTEX_{total}$ concentrations during autumn and winter (Figure 1).



With the prolific increase in air traffic transportation, the probability of deteriorating air quality and the resultant associated health risk for populations in and/or around airports may intensify, which is a cause for concern and further investigation.

OR35 - David A. Polya: Arsenic In Public Water Supplies In The United Kingdom: Implications For Exposure, Health And Regulation.

David A. Polya[1*], Lingqian Xu[1], Yifei Zhang[1], Qian LI[1], Jake Launder[1], Daren C. Gooddy[2] and Matthew Ascott[2]

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UK public water supplies have an outstanding compliance with regulatory standards, including with respect to the UK PCV (prescribed concentration value) for arsenic of 10 μg/L. Nevertheless, many UK public water supplies contain arsenic at concentrations within a factor of 10 of the PCV. In 2015, on the order of 100,000 consumers in the UK were supplied with drinking water with arsenic concentrations at or above 5 μg/L; 1,000,000 at or above 2 μg/L and 10,000,000 at or above 1 μg/L. Epidemiological evidence seems currently insufficiently powerful to reliably quantify the detrimental health outcomes arising from such sub-regulatory exposures, but arsenic-attributable premature avoidable deaths in the UK on the order of 100 to 1000 per annum from combined cancer and cardiovascular disease are plausibly estimated here. These values are considerably lower than those ascribed to air pollution but are broadly equivalent to the number of annual fatalities of car occupants in road traffic accidents in the UK and therefore warrant concern and consideration of appropriate actions. Uncertainties and limitations of the approach are discussed together with implications for stakeholders.

We acknowledge with thanks the data provided by the 24 largest water supply companies in the UK as well as their approvals to use their data for this research. Any views expressed here do not necessarily reflect those of any of these companies. This abstract is largely based on those presented previously elsewhere by DAP at the Arsenic 2018 (Beijing, July 2018) and IAH/Geological Society Ineson (London, November 2018) meetings.

OR36 - Paula Marinho-Reis: Lead Isotope Analysis And Oral Bioaccessibility Testing For Source Apportionment In Kindergarten Microenvironments.

Paula Marinho-Reis[1,2*], Vojtěch Etler[3], Martin Mihaljevič[3], Tatiana Cocerva[4], Manus Carey[5], Siobhan Cox[4], Marina Cabral-Pinto[1], Mark Cave[6], and Yves Noack[7]

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Due to the hand-to-mouth activities, frequently observed among the youngest children, these are likely to ingest higher amounts of indoor dust than adults. Hence, preschoolers are further prone to exposure through the ingestion route. Characterising environmental pollution within kindergarten microenvironments is, therefore, paramount for children who spend considerable time in school.

The present study was carried out in Estarreja, an industrial city in the north of Portugal, where elevated concentrations of potentially toxic elements (PTEs) in the environment have been reported. Indoor dust (ID), playgrounds dust (OD), and garden soil (S) samples were collected from the kindergartens. Near total concentrations were determined by ICP-MS and the oral bioaccessibility of chromium (Cr), cobalt (Co), nickel (Ni), cadmium (Cd), arsenic (As) and lead (Pb) was estimated using the Unified BARGE Method (UBM). Isotopic measurements of lead were performed by ICP-MS in bulk samples and solid residues resulting from the UBM extractions.

Differences in Cd, Ni, and Pb contents between garden soil and indoor dust are significant ($P< 0.05$).The bioaccessible fraction of the Pb and Ni is significantly higher ($P< 0.05$) in indoor dust samples than in garden soil. The isotope ratios $^{206}Pb/^{207}Pb$ and $^{208}Pb/^{206}Pb$ of garden soil are significantly different ($P< 0.05$) of those measured in the dust. Differences between the isotopic composition of bulk samples and UBM residues are not statistically significant. We propose a methodology for source apportionment and provenance analysis, using the bulk sample and the residues of the UBM extractions. The results suggest that lead associated with industrial emissions is more bioaccessible than that associated with construction works or natural soils.

OR37 - Veronika Cveckova: Hard Water – More Elastic Arteries, A Case Study From Krupina District, Slovakia.

Veronika Cveckova[1], Katrína Fajčíková[2] and Stanislav Rapant[*1]
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The article is dealing with the impact of low Ca and Mg contents in drinking water on the arterial stiffness of resident population living in the Krupina district, Slovak Republic. The study was based on the two-phase measurement of the arterial stiffness in a sample of 144 randomly selected respondents, being divided into two groups according to Ca and Mg contents in the drinking water. One group of respondents was supplied by soft water (Ca < 25 $mg.l^{-1}$, Mg < 10 $mg.l^{-1}$) and the second group was supplied by harder water (Ca > 80 $mg.l^{-1}$, Mg > 20 $mg.l^{-1}$). Arterial stiffness was determined by measuring the aortic pulse wave velocity (PWVao). Based on the measured levels of PWVao the arterial age of respondents was calculated. Achieved results have documented higher arterial stiffness (i.e. lower elasticity of arteries) of the respondents drinking soft water deficient in Ca and Mg contents. This was reflected in higher PWVao levels, higher number of pathological cases (PWVao > 10 $m.s^{-1}$) and in higher arterial age of respondents supplied by the soft drinking water in comparison with their real age. "The absolute difference" between the real and arterial age in the case of two evaluated groups of respondents (soft vs. harder water) was in average nearly 5 years (5.5 in the 1st phase and 4.3 year in 2nd phase of measurements).

Acknowledgments

This research has been performed within the projects LIFE – Water and HEALTH (LIFE 17 ENV/SK000036) and LIFE FOR KRUPINA (LIFE12 ENV/SK/000094) which is financially supported by the EU's funding instrument for the environment: Life + programme and Ministry of the Environment of the Slovak Republic.

OR38 - Avinash Kaur Nagpal: Bioconcentration Of Chromium In Rice Grains And Associated Health Risks For Human Population Of Ropar Wetland, India And Its Environs.

Sakshi Sharma[1], Avinash Kaur Nagpal[1*], and Inderpreet Kaur[2]
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Chromium is a non-essential and carcinogenic element, detrimental to various metabolic processes and enzymatic activities in living beings. In the present study, chromium (Cr) contents were estimated in soil and rice grain samples (*n = 13* each) collected from agricultural fields in Ropar wetland and its environs followed by appraisal of bioconcentration of Cr in rice grains. Possible non-cancer and cancer health risks posed to human population of the study area via daily consumption of Cr contaminated rice grains was also assessed. Soil samples were collected from agricultural fields under rice cultivation in the study area followed by rice grain sampling from the same fields during September and October, 2013, respectively. Contents of chromium in soils and rice grains (estimated using flame atomic absorption spectrophotometer), ranged from 0.29 to 10.03 mg/kg and 5.82 to 30.76 mg/kg, respectively. Cr content in all soil samples was found to be below the typical soil concentration of 100 mg/kg. Cr content in 54% of rice grain samples was higher than the safe limit of 20.00 mg/kg. Bioconcentration factor (BCF) values of Cr in rice grain samples varied from 1.83 to 73.24. It revealed that rice grains acted as efficient accumulator of Cr as BCF values estimated for all samples were > 1. Daily dietary intake of Cr via rice grain consumption ranged from 1.91×10^{-3} to 1.01×10^{-2} mg/kg/day. Hazard quotients (HQs) for Cr intake through daily dietary intake in rice grain samples ranged from 0.64 to 3.37 and was higher than safe limit of 1.00 given by United States Environmental Protection Agency (USEPA) in 92% samples. Possible cancer risk (CR) posed to residents varied from 9.56×10^{-4} to 5.06×10^{-3}, which was quite higher than the safe limit of 1.00×10^{-6}, prescribed by USEPA for all samples. The study shows that Cr intake via daily consumption of rice rains posed elevated risk of both non-cancer and cancerous health problems to the residents of the study area.

OR39 - Moataz Tarek: Environmental Geochemistry And Psychological Disorders.

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The relation of environmental geochemistry to psychological diseases and disorders still neglected. So in order to achieving more integration between geology and medicine, we planned for this session as a plat form for further studies focusing on the role of the heavy metals, trace elements and urban geochemistry in some psychological disorders and neuropsychological diseases.

We will shine the light on some of these topics including:

- Minerals and mood
- Copper and schizophrenia
- Lithium in water and suicide mortality.
- Relaxation and healing in salt caves.
- Alzheimer and heavy metals
- Post-traumatic stress disorder after earthquakes and tsunamis.
- Toxic heavy metals associated with neurological symptoms and autism.
- Tourette syndrome and magnesium deficiency.
- Minerals for premenstrual syndrome treatment.
- Restless legs syndrome and Iron Deficiency.
- Trace mineral imbalances associated with Wilson & hemochromatosis diseases.
- Psychology of geophagy and pica.

S5F – Flash and poster presentations

Mateja Gosar: Slovenian Soil: Determination Of Geochemical Background And Threshold Values And Comparison With European Soil.

Benjamin Nunn: Chemical And Biological Tests To Assess The Viability Of Amendments And Phalaris Arundinacea For The Remediation And Restoration Of Historic Mine Tailings.

Xiaofan Huang: The Effects Of Placental Exposure To PAHs On AMH Levels And Birth Outcomes Of Newborns.

Aliyar Mousavi: Mineral Calomel: A Natural Source Of A Violent Poison In The Environment.

Lin Peng: Chronic BDE-47 Exposure Aggravates Malignant Phenotypes Of Endometrial Cancer Cells By Activating ERK Through GPR30 And Erα.

Mary Odukoya: Environmental And Health Risks Assessment Of Artisanal Small Scale Gold Mining Activities In Western Part Of Nigeria.

Odipo Osano: Emerging Fluoride Challenges To Health Of Animals And Humans In Kenya.

Diana Menya: Dental Fluorosis And Oral Health In The African Esophageal Cancer Corridor: Findings From The Kenyan Case–Control Study And A Pan-African Perspective.

Haitao Ma: The Impact Of Phenanthrene On Immune Cytokines Related To T-Regulatory Cell Function In Liver And Lung Of Female Rats.

Ibrahim Ali: Selenium And Iodine Interaction With Calcareous Soil Minerals.

Session 6 - Oral Presentation Abstracts – Thursday 4th (pm)

OR40 - Michael Watts: Source Apportionment Of Micronutrients In The Diets Of Kilimanjaro-Tanzania And Western Kenya.

Michael J Watts[1], Daniel Middleton[2], Diana Menya[3], Andrew Marriott[1], Olivier Humphrey[1], Elliott Hamilton[1], Amanda Gardner[1], David Samoie[4], Valerie McCormack[2] and Odipo Osano[4]
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Soil and crop chemistry data can reveal regional differences influenced by changes in soil type, pH, geology and geographical features, to which bespoke interventions can be devised to ensure micronutrient intake remains within the narrow margin between sufficiency and excess for both human or animals and for crop productivity. For example, in previous work Joy et al. (2015) and Hurst et al. (2013) reported on the influence of soil pH on mineral concentrations in food crops, with Ca, Cu, Fe, Mg, Se and Zn higher in maize grain and Ca, Cu, Fe and Se higher in leafy vegetables from calcareous rather than non-calcareous soils. Specific soil and food composition data for estimates of dietary mineral supplies can be particularly powerful where subsistence farming is dominant (e.g. food grown in limited diversity of soil type/pH) and will better inform estimates of dietary diversity, especially in sub-Saharan Africa.

Here we present data from a survey of soil, drinking water and crops across Kilimanjaro District in Tanzania and several districts in Western Kenya with the following objectives: (1) generate crop composition data to provide new estimates of dietary micronutrient supplies and estimates of deficiency for specific micronutrients by incorporating FBS supply data; (2) investigate influence of soil types on crop micronutrient composition and subsequent influence on micronutrient deficiency rates; (3) consider drinking water as a contributory factor to dietary intake of micronutrients.

Both Tanzanian and Kenyan districts presented dietary intakes that provided largely sufficient Cu and Mo intake according to male and female Estimated Average Requirements (EAR). Calcium and I both presented ~100% deficiency in either country and across soil types, whereas for Se and Zn whilst also deficient, exhibited differing rates of deficiency between calcareous (pH>6.5) and non-calcareous soils. Data will be presented showing the potential contribution of drinking water to meeting the EAR for micronutrients, particularly when considering the source e.g. well, surface, rainwater, piped.

OR41 - Debapriya Mondal: Arsenic Exposure From Wheat-Based Diet In Bihar, India.

Debapriya Mondal[1*], Sidharth Suman[1,2,5], Pushpa Kumari Sharma[2], Abu Bakkar Siddique[3], Md. Aminur Rahman[3], Ranjit Kumar[2], Nupur Bose[4], Shatrunjay Kumar Singh[5], Mohammad Mahmudur Rahman[3] and Ashok Ghosh[2]

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Arsenic contamination in groundwater of Bihar, India was first reported in 2003, where more than 10 million people are currently facing health risks due to arsenic exposure. Like all other arsenic effected areas in south-east Asia, exposure is no longer restricted to drinking water and food is becoming a significant route. While exposure from rice is well explored, little is known about exposure from wheat-based food products. In this study, we have determined arsenic in whole wheat and flour collected from households of 19 villages in 0 out of 38 districts of Bihar and estimated total arsenic using the Inductively coupled plasma mass spectrometry. We also measured total arsenic in drinking water and participant's blood using Atomic absorption spectrophotometer.

While mean arsenic in whole wheat was 67.3 µg/kg (SD: 60.6, n=44), maximum concentration recorded was 234.3 µg/kg, which is close to concentrations reported in literature (mean 50 µg/kg, and maximum 220 µg/kg, n=19)[1]. The wheat flour (*Atta*) made from grinding the grain, often using hand mills at home or using community grinder had mean arsenic of 88 µg/kg (SD: 98.9, n=27) and maximum concentration of 448.3 µg/kg. Arsenic in wheat flour was significantly correlated with whole wheat (n=42, spearman's rho=0.70, p<0.000) but the correlation is weaker when water arsenic is less than 50 µg/l (n=12, spearman's rho=0.65, p=0.02). It is the flour which is used for making the bread (*rotti)* which is consumed as a staple along with the rice in Bihar. In fact, based on the food frequency questionnaire (n=206), we found 78% of the studied population consumed rice everyday while bread (*rotti*) was consumed everyday by almost all the participants (99.5%). We found significant correlation between blood arsenic and arsenic in wheat flour (n=50, spearman's rho=0.40, p=0.003) but the correlation holds only when arsenic in drinking water was greater than 50 µg/l (n=36). This study results warrant further investigation on arsenic concentration in wheat and the effect of the processing (milling) the whole wheat to generate the flour and finally the estimation of health risks from consumption of wheat-based food products.

OR42 - Sesugh Ande: The Accumulation And Uptake Of Potentially Toxic Metals By Vegetable Plants Grown In Fertiliser Amended Soil.

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In this study, an urban soil was amended with some commonly used fertilisers and effects on the concentrations and bioavailabilities of potentially toxic metals (PTM) studied through plant uptake experiment. A suite of PTM (As, Cd, Cr, Cu, Fe, Mn, Ni, Pb, U, and Zn) was quantified in sample digests and extracts using inductively coupled plasma mass spectrometry. Uptake of PTM by bean plants grown in 2% chicken manure amended soil, and by radish grown in 2% chicken manure, 0.2% growmore fertiliser or 2% chicken manure + 0.2% growmore fertiliser amended soil were studied. The PTM concentrations in control bean plant exceeded those in bean plants grown in chicken manure amended soil, and a similar trend was observed for radish, suggesting that chicken manure addition can decrease PTM bioavailability to plants. Addition of growmore fertiliser resulted in plants with similar PTE burden to control plants. It was found that EDTA-extraction of soil generally overestimated actual plant uptake of PTM.

OR43 - Zulin Zhang: Occurrence, Fate And Effect Of Emerging Contaminants In The Organic Fertilisers Amended Soils.

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Globally there is an increasing requirement to recycle nutrient rich organic wastes to land, as fertilisers. However, organic materials can also contain potentially toxic constituents, and so application of organic materials to land has the potential to increase levels of contaminants in soils and cause harm to the environment. Emerging contaminants (ECs) such as endocrine disrupting chemicals (EDCs), antibiotic resistance genes (ARGs) and microplastics attracted worldwide concern during the last decades due to their potential adverse effects on humans and ecosystems. Little data is available for the environmental effect of the application of different organic fertilisers (e.g. farm manure, biosolid and municipal food-derived compost) to the soils, particularly of emerging contaminants. Therefore, this study is to investigate (1) the occurrence of ECs in the agricultural soils; (2) changes and fate of ECs in the soils treated by different organic wastes including manure, biosolid and compost; (3) effect and the potential risk of ECs in the treated soils. Three different ECs (EDCs, microplastics and ARGs) were determined and all these ECs were present in both the control and treated agricultural soils. The predicted environmental concentration (PEC, calculated by the chemical content in organic wastes and the treating rate to soils) of EDCs in treated soils showed as following order: Biosolid>Compost>Manure, which is in agreement with the measured EDCs concentration in the differently amended soils and suggested that the organic fertilisers introduced the chemicals to the treated soils.

It is found that the microplastics concentration in biosolid amended soils were obviously higher than those of other treatments particularly of repeated ones. In all treatments, the relative abundances of most ARGs detected in soils decreased over time, especially IntI1 and tet ARGs. However, the multiple applications of organic fertilisers resulted in higher ARGs in comparison to inorganic fertiliser (NPK), either by a lesser decrease of IntI1 and tet ARG or an increase of sul ARG. Further studies are necessary for the consequences of long-term fertilizers application and their impact of ECs contamination on the soil quality.

OR44 - Rebekah Moore: Understanding Cd Uptake By Cacao Plants Using Isotope Analysis.

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As of January 2019, the European Commission has reduced the upper allowed limit for the cadmium (Cd) content of cocoa products, to lower the risk of bioaccumulation of this toxic metal in humans. Research is therefore being undertaken to ensure that cacao crop farmers, who are predominantly small-holders in developing countries, can adhere to the new Cd threshold. Such research aims to (i) assess the sources high concentrations of plant-available Cd in soils, (ii) evaluate farming practices that are adopted to reduce Cd uptake by cacao trees, and (iii) identify cacao genotypes that produce beans with low Cd levels

We investigated the uptake of Cd by multiple genotypes of cacao plants from mature plants from farms in Ecuador and hydroponically-grown plants. Soil, soil additives, roots, leaves and beans were mineralised, and Cd was isolated from each sample by anion exchange chromatography. Cadmium concentrations and stable isotope compositions were then determined at high precision by MC-ICP-MS (multiple collector inductively coupled plasma mass spectrometry). The results were employed to investigate differences in Cd uptake, storage and translocation between genotypes, environmental conditions and farming practices.

For the hydroponically grown plants, most genotypes reveal higher Cd concentrations in roots than leaves, with some showing a particularly favourable divergence. Importantly, the latter genotypes are easy to identify, as the leaves are characterised by both low Cd concentrations and particularly heavy Cd isotope compositions (higher $^{114}Cd/^{110}Cd$), due to sequestration of isotopically light Cd in the roots. The Cd isotope data for the farmed cacao plants reveal that plant leaves are enriched in heavier Cd isotopes relative to soil. Notably, these results are in accord with data from previous investigations of soil-wheat systems. Cacao beans, however, do not have heavier Cd isotope compositions than leaves; this contrasts with wheat, where the grains are particularly enriched in heavy Cd isotopes. This suggests that cacao beans may act as a reservoir for active sequestration of Cd. The data, furthermore, indicate that enrichments of Cd in topsoil may be linked to the use of cacao leaf litter as natural fertilizer.

These results demonstrate that coupled Cd concentration and isotope analyses are well suited for the study of Cd uptake and translocation by cacao trees and to identify genotypes that take up little Cd and/or store this preferentially in roots. In particular, such work can support molecular and genetic studies that aim to resolve the mechanisms for Cd accumulation in cacao plants and enable development of farming practises for sustainable production of cocoa with low Cd contents.

OR45 - Hannah Bowley: Agricultural Research: Making The Conversation Work

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Problem: There is a growing awareness of the importance of soil and environmental health, and that not all agronomic answers can be found 'in a can'. Farmers and land managers have a lot of ideas, information and opinions either thrust in their direction, or available to seek out. These may include family history, economics, legislation, peer pressure and environmental concerns. Meanwhile, geochemists, soil scientists and others undertake research into fundamental questions of interest to, and importance for, those farmers.

Issues: A key challenge to researchers who intend to inform practical policy, is to ensure that the work they do can be practically applied. Laboratory studies and investigations into underlying mechanisms are necessary to develop theories. However, care must be taken to ensure that field-scale research makes use of practices realistically available within, and applicable to, agriculture.

Following relevant, practical research, results must be communicated appropriately to the people who can make best use of them. While peer-review is an important process to ensure the scientific integrity of investigations, other modes of communication are more likely to be relevant to farmers. For example, using social media to raise awareness; or producing short, clear publications showing the relevant findings (with minimal study methods), which can be accessed easily online.

The agricultural market is open to less than ideal products, particularly at a time when growers are searching for alternative solutions: some products may be unsupported by evidence; some may contain so many ingredients that they will have some effect sometimes, but defining the most appropriate scenarios for their use is very difficult. Farmers can be overwhelmed by pressure to use such products, which may cost relatively little individually, but add up to significant value. It is important that growers feel able to ask for relevant information, and are well enough informed to be able to decide the best course of action for their situation, rather than simply being threatened by reduced yields or higher disease in a very competitive world.

Conclusion: Optimisation of agricultural practices needs to be based on well-researched evidence, incorporating ideas from people who need to know and use the answers, and disseminated using appropriate methods. This is true for all products and systems whether chemical, physical or biologically based. Furthermore, farmers and other decision-makers in agriculture should feel supported to ask questions of academics and others in order to make decisions for themselves based on the best available advice.

S6F – Flash and poster presentations

Nswana Kafwamfwa: Improving Grain Storage Structures For Smallholder Farmers In Mozambique And Zambia.

John S.K. Banda: The Impact Of Conservation Agriculture On Soil Quality.

Godfrey M. Sakala: The Unsustainability Of Intensive Plough Systems Compared To Minimum Tillage Systems.

Ivy Legowe: Agronomic bio-fortification of leafy vegetables with iodine in vertisols, oxisols and alfisols.

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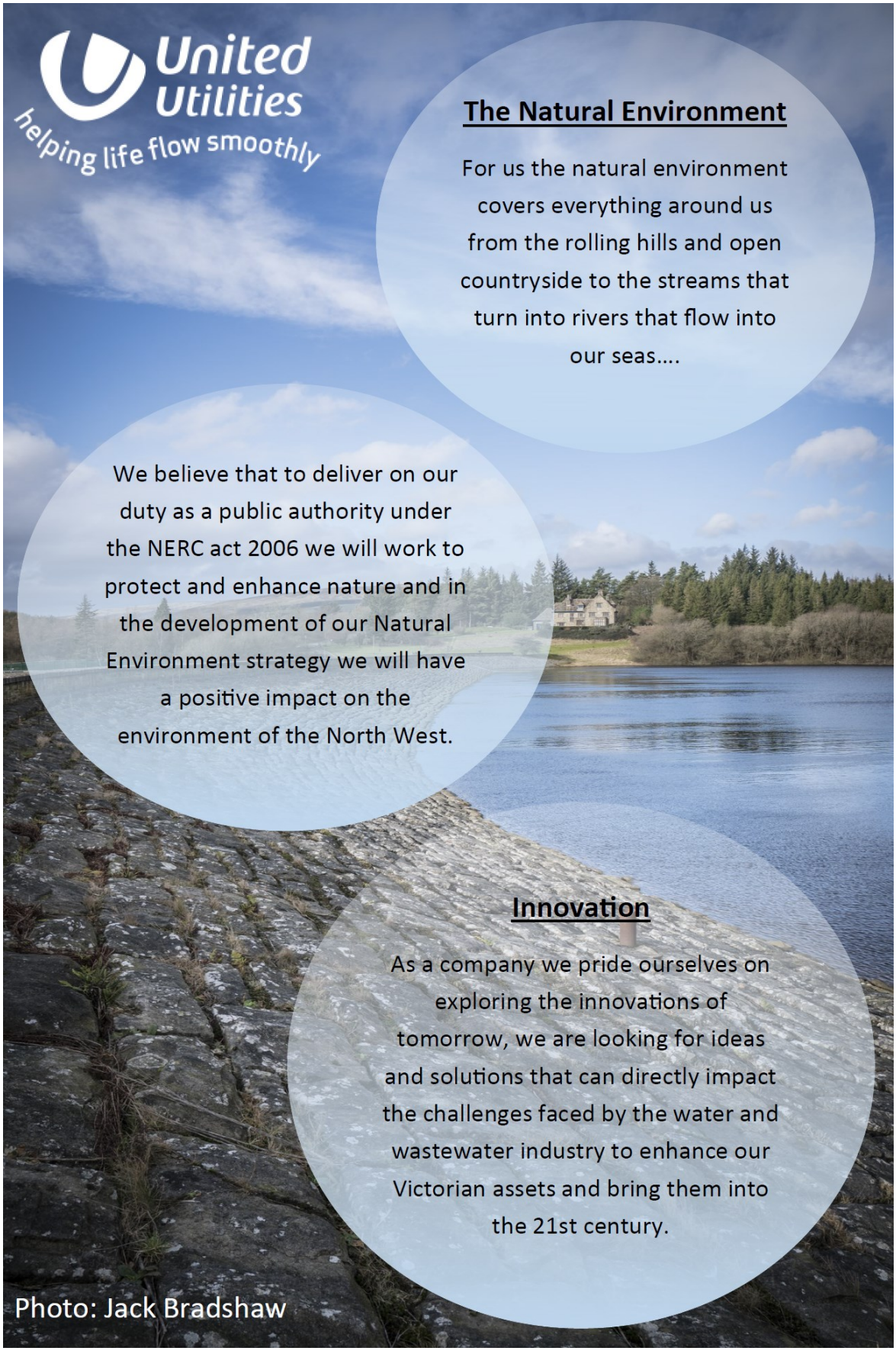
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Flash and poster presentation abstracts

Session 1: Urban wastelands: potential for enhancing urban resilience

Photocatalytic degradation of DOM in urban stormwater runoff with TiO2 nanoparticles under UV light irradiation: EEM-PARAFAC analysis and influence of co-existing inorganic ions

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In situ photocatalytic degradation of dissolved organic matter (DOM) of stormwater runoff can efficiently improve the aquatic environment quality and relieve the wastewater treatment pressure. In this work, photocatalytic degradation of DOM in TiO2 (AEROXIDE® P-25) photocatalyst under illumination of ultraviolet (UV) light was carried out, considering the influence of various factors like TiO2 dosage, solution pH along with the existence of co-existing ions (Cu2+ and H2PO4-). Generally, the variations of dissolved organic carbon (DOC), UV-based parameters and peak intensities of fluorescent constituents with UV exposure time fitted perfectly with the pseudo-first-order kinetics model. The total DOM removal efficiency was affected by diversiform factors like adsorption capacity of TiO2, UV light utilization efficiency, reactive free radicals produced and the influence of co-existing ions. The results of fluorescence excitation-emission matrix (EEM) coupled with parallel factor analysis (PARAFAC) modeling demonstrated that all the photodegradation rates for three identified fluorescent constituents (protein-like constituent 1 and 3, humic-like constituent 2) were faster than UV-absorbing chromophores, suggesting the DOM molecules in urban stormwater runoff contained much more π*-π transition structures. In addition, H2PO4- ions affected the photodegradation of DOM by capturing positive holes (h+) and hydroxyl radical (·OH), whereas Cu2+ ions were inclined to generate Cu-protein complexes that were more difficult to degrade than the other Cu-DOM complexes. This study supplied novel insights into the photocatalytic degradation mechanism of individual organic constituent in urban stormwater runoff and explored the influences of co-existing contaminants on their adsorption-photocatalysis processes.

Peng Wang: Photocatalytic Degradation Of DOM In Urban Stormwater Runoff With TiO2 Nanoparticles Under UV Light Irradiation: EEM-PARAFAC Analysis And Influence Of Co-Existing Inorganic Ions.

Can dredged canal sediments be used for flood defences as part of the Scottish Circular Economy?

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Scottish Canals and the University of Strathclyde have joined a consortium of 7 key European academic and industrial partners as part of the EU-funded Interreg NWE SURICATES Project - Sediment Uses as Resources in Circular And Territorial Economies (http://www.nweurope.eu/projects/project-search/suricates-sediment-uses-as-resources-in-circular-and-territorial-economies/). Within Europe some 200 x 106 m3 of dredged sediment (equivalent to c. 80 x 106 t dry weight) remain annually after operational and capital works at ports, harbours and waterways. Over 99% of EU marine sediment is dumped at sea, representing a lost opportunity to reuse or recycle materials for use in engineering works to prevent flood risk or erosion under climate change scenarios. Using a series of pilots and trials the SURICATES consortium will demonstrate the potential for safe and effective reuse options of this potential resource, including sediment nourishment, use in concrete, pozzolanic mixtures, or phyto-conditioning and bio-engineering of soil for restoration and reclamation.

Scotland's network of four operational canals divides roughly into two groups with different challenges for reuse or recycling: In the Highlands the Caledonian and Crinan Canals, immediate reuse of typically clean material is largely presented by remoteness and the associated challenges of dewatering for transport, materials separation and the infrequency of any receiving engineering works; In contrast, in the Lowland Forth and Clyde or Union Canals, the legacy of industrial activity requires detailed testing, dewatering and recycling methods to be developed and treatment technologies to extract secondary feedstocks suitable for use from a linearly dispersed source.

Historical trends of the metals concertation in PM10 in the urban area of Mexico City

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The aim of this study is to investigate the metals concentration trends contained in PM10 samples collected in the Mexico City Metropolitan Area between 2004-2014.

About 88 PM10 samples collected in four locations, along the autumn/winter season each year (October to January) were selected. This choice is due to different factors. From one side, during this period the emission sources of atmospheric pollutants are more markable. On the other, in the same period atmospheric phenomena such as thermal inversions occur, which can lead to greater exposure levels for the population.

Metal mean annual levels are evaluated and compared with mean recorded levels during the studied period, as well as analyzed for statistically significant trends (Mann–Whitney U test).

Increase in % metal concentration was observed for Pt,V, Cr, Cd Ni and Ag, as well as for PM10 mass concentration. Athough V and Ni show a very high % increase in PM10 (205.6 for V and 130 for Ni), only Cr, Cd, Ag and Pt show a statistically positive increase.

The high positive trend of V and Ni, as well as the statistically significant increase in Pt, is

interpreted as derived from the increased road traffic in the studied area. On the other hand, the increase of the other elements can be the result of the impact of several anthropogenic effects attributable to different sources not evaluated in this study.

The % increase observed for Mn, Co and As is less than the % increase in PM10.

In the same time period Ti Cu and Hg registered an important % reduction. Furthermore, Pb and Zn show the largest decrease over the time period with a statistically significant trend.

The evaluation of these data provided information to be considered in the evaluation of the impact of anthropogenic sources and the application of regulatory measures to control emissions.

Heavy metals contamination level at industrial areas of Rohtak city, Haryana, India

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Abstract: Soil pollution may still harm humans indirectly. One way such soil pollution can harm humans is by bioaccumulation. Plants that are grown in lightly polluted soil continuously absorb toxic heavy metals. This study examined the heavy metals contamination level in soil and vegetation at HSIIDC and IMT industrial areas of Rohtak city. Total 20 soil samples and vegetation from 15 sites were collected from various locations. Soil and fine powder of the plant stem, leaves and roots were digested with di-acid mixture and analysed by Atomic Absorption Spectrophotometer. The minimum pH soil value 1.66 at site five (near M/S MR. Fasteners) and maximum Electrical Conductivity 8.83 mmho/cm at site 17 (HSIIDC Site office) indicate that soil quality was totally altered by industrial activity. The average values of Cd (8.8) and Zn (132 mg/kg) were found to be above the WHO permissible limits of soil at both industrial areas. The average value of Ni at HSIIDC industrial area was to be above the permissible limit of soil. The values of lead concentration in plant samples were extremely high and exceeded the recommended limits. The maximum concentration of lead was 1349.37mg/kg in the leaves of Croton bonplandianum plant at site 2 (Rama industry, plot-250). The average value of other heavy metal viz., Cd, Zn, Pb and Cr were found to be above the permissible limits in vegetation. The concentration of all the heavy metals in HSIIDC industrial area is more as compared to the IMT area are could be due to the industries in that area are set up from longer period of time. The present study reveals that elevated concentrations of heavy metals in the soils and vegetation in two industrial areas are mainly due to their gradual accumulation and persistence, which can be attributed to rapid industralization with inefficient solid waste management.

Health Risk Assessment of Peri-urban Groundwater Supply from Catchment to Consumers in Selected Areas of Ogun State, Southwestern Nigeria

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Globally, approximately 2.2 billion people rely groundwater for daily consumption. This study investigates the quality of groundwater, being the only source of water for domestic purpose in the area and possible health problems to which consumers are exposed. Sixty samples comprising of twenty well-ditch cuttings and

forty well-water samples were analyzed. Parameters analyzed include pH, EC, nitrate and metals using standard methods. Trace elements analysis of samples was by ICP-MS at the Activation Laboratory in Canada and health risk indices were calculated using established formulae. The results indicated a pH range of 7.6 to 8.5, while the electrical conductivity ranged from 180.0 to 698.0 µS/cm and total dissolved solid ranged from 90.0 to 348.2 mg/L. The well water metal mean concentrations for toxic elements include Pb (1.58-14.5 µg/L); Cd (0.07-0.40 µg/L); As (0.32-1.49 µg/L); Cr (2.0-33.3µg/L); Mn (11.1-36.0µg/L). Similarly, mean metal contents for selected toxic elements in the aquifer sediments (i.e well cuttings) range as follows viz: Pb (8.9-27.6 µg/L); As (0.8-8.6 µg/L); Cr(14.0-98.0 µg/L) and Mn (138.0-1080 µg/L). Calculated water metal dose is greater than unity (1.0) with the exception of Cd, As and Cr. Similarly, the calculated Consumption Rate Posing Health Risk (CRPHR) of water by the residents of the study area is proportional to their body weights. The risk index(RI) for cancer in the well water of the study area varied from Cr (2.0x10-3) to As (5.0x10-2) with a risk sum of 0.09, while the non-cancer hazard index(HI) range from Cr (64.00) to Ba (142.71) with (HI) sum of 462.00. The studied groundwater parameters fell within the WHO standard for drinking purpose with some localized cases of high nitrate, manganese, arsenic and lead thereby signifying possible health problem from catchment to consumer.

Interannual Variation of Land-Source Marine Pollutants at Sea around Shanghai

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In order to understand the changes of land-source pollutants into the sea around Shanghai in recent years, collecting the Shanghai Marine environment quality bulletin issued by Shanghai Oceanic Administration from 2009 to 2017, and extracting the data of land-source pollutants into the sea. The data include the annual sea inflow from the Yangtze and Huangpu Rivers and treated tail water discharged, the annual chemical oxygen demand (CODCr), total nitrogen and phosphorus. The results showed, on yearly average, the content of chemical oxygen demand (CODCr) in the estuary of the Yangtze River is 0.0737 ten thousand tons of per 100 million cubic meters of water. Since 2013, the content is below the average value, and the content shows a downward trend. The content of CODCr in the Estuary of Huangpu River is 1.95 times that of the Yangtze River on average, and the content has decreased obviously since 2014. The average content of CODCr in the tail water discharged from land sources is 3.96 times that of the Yangtze river, but the content of CODCr in the tail water is decreasing rapidly year by year, and has been close to that in the Yangtze River in 2017. The annual average content of total nitrogen and total phosphorus in the Estuary of the Yangtze River is 0.02586 ten thousand tons per 100 million cubic meters of water. The annual average content of total nitrogen and total phosphorus in the Estuary of the Huangpu River is 1.54 times that of the Yangtze River. The annual average of the total nitrogen and total phosphorus content in the tail water was 5.07

times as much as that of the Yangtze River, showing a decreasing trend year by year, with little change in the content in the past three years.

Concentrations and health risk assessment of metal(loid)s in dust from Russian city

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The metal(loid)s content in the environment is one of the important issues in the environmental management. The metal(loid)s may be present in the both from naturals like natural components of the Earth's crust and anthropogenic sources as human activity effects. Some metal(loid)s are toxic and dangerous for the environment. Chelyabinsk was chosen for researching as a typical industrial Russian city. Road dust and household dust were collected to investigate the contamination of metal(loid)s (Cr, Ni, Cu, Zn, As and Pb). A total of 32 road dust and 17 household dust samples were collected from the urban area during August 2017. The concentrations of metal(loid)s in the dust samples were determined by mass spectrometry with inductively-coupled plasma ICP-MS using a Perkin Elmer ELAN 9000. The study shows that Zn has the highest content in road dust whilst in household dust, both As and Ni have the highest content. Cu, Pb, Zn and Cr contamination were significantly elevated in the outdoor and indoor dust. Risk assessment models described by United States Environmental Protection Agency (USEPA) was applied. The study showed that both children and adults having individual health quotient (HQ)<1 for all metal(loid)s are at negligible non-carcinogenic risk. The combined total exposure hazard index (HI) value for children was 1.07. It is indicating that the metal(loid)s detected would harm the children. The cancer risk for adults from exposure to As and Cr was found to be the acceptable or tolerable, their carcinogenic risk assessment (CRA) was in the range of 1E-6…1E-4. The cancer risk for children from exposure to As and Cr was found to be harmful to human beings (CRA > 1E-4).

Challenges to develop laboratory capacity in institutions of Africa for geochemistry and health studies

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Capacity building is the key to sustainable development of laboratories in Africa. It is for this reason that research and teaching laboratories from different institutions from Kenya, Malawi, Tanzania, Zambia and Zimbabwe partnered with the British Geological Survey and

University of Nottingham to form a consortium in which laboratories are helped to develop its capacity by being equipped with modern equipment and training of laboratory staff using modern analytical methods and lab systems.

In this poster we present the challenges faced by laboratories in Africa to produce scientific data to inform studies on agriculture, environmental and health sciences, particularly to a comparative level with international studies. Here we report on initiatives for a collaborative approach to ultimately develop a self-supporting network within Africa for sustainable capacity development in laboratory capability across environmental and health sciences. Overall, eight laboratories in five countries across east and southern Africa since 2016 will report on laboratory and staff development with a roadmap that will be relevant to other African (and developing country) institutions. Ultimately the aim is to develop data outputs that provide confidence in their reliability through building necessary quality assurance controls applicable to international publications and for data comparison between studies, within and between countries – this is a major challenge for African science capability.

An investigation of the distribution and associated human health risks of potentially toxic elements in urban street dust of Abeokuta metropolis, southwestern Nigeria

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Street dust is one of the major source contributors to PTE contamination in urban environments. Long term exposure to polluted PTE laden road dust can cause severe health consequences to man through ingestion, inhalation and dermal contact. The concentration of PTE in street dust can provide valuable information of the extent of pollution in urban areas, since in most cases; such concentrations reflect the degree of anthropogenic contributions to the dusts. Data related to potentially toxic element levels in street dust of Abeokuta metropolis, in Ogun state Nigeria and their associated human health risk is scarce or arguably not available. To this end, 31 street dust samples were collected along major roads in Abeokuta metropolis in Ogun state, Southwestern Nigeria. At each point of sampling area, about 50 g of bulked dust samples were collected, sieved, acid digested and analysed by Microwave Plasma Atomic Emission Spectomtery (MP-AES). The average concentration of Cr, Cu, Ni, Pb and Zn in the dust samples were 29.7, 25.1, 38.4, 31.3 and 138 mg/kg respectively. These concentration results showed that dusts studied were characteristically unpolluted as the average PTE concentration at each site did not exceed the soil guideline values. Considering the pollution assessment tools employed, some soil samples showed some form of anthropogenic input from PTE. Health risks associated with PTE measured in the dust samples was assessed by estimating man's exposure from ingestion, inhalation, and dermal contact. Result indicated that the highest risk is associated with ingestion followed by dermal contact and inhalation in that order. For non-carcinogenic effects, the summation of hazard quotient value for the PTE studied was less than the safe level of 1; suggesting minimal or no risks. Only Cr and Ni were considered for carcinogenic risks evaluation and results obtained were below the 1 × 10-6 but this value was exceeded at some locations. This study has

revealed that the exposure of Abeokuta city populace to PTE from the investigated street dusts may not pose any serious health implications but continuous monitoring is necessary to keep the metal contents low in the dusts.

Assessment of suitability of Selected Wetlands for Cultivation in Metropolitan Lagos, Nigeria

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Urban Agriculture in open spaces has become a source of vegetables and fruits to city dwellers. The non-availability of such open spaces in a densely populated and built up mega city like Lagos has necessitated the cultivation of available wetland that are also repository of land derived liquid wastes and wastes run-off of drainage catchments. The need to ascertain the suitability of the wetlands for agricultural activities is thus inevitable.

Sediment/soil Core samples (≤100cm) along define profiles within selected wetlands were obtained. The cores were subdivided at 5cm intervals, dried, disaggregated and sieved. The sieved samples were then digested and analysed for elemental constituents at the Activation Laboratory Ontario, Canada using ICP-MS. Elemental results obtained were evaluated by comparing with global agricultural quality guidelines to ascertain the suitability of the wetland sediments/soil.

The elemental analysis for the top 25cm layers of the core samples revealed that the concentrations (%) of Na, K, Ca, Mg, Fe and S ranged from 0.019-0.238, 0.02-0.28, 0.03-0.54, 0.02-0.35, 0.2-5.61, 0.9-6, while that of Cr, Ni, Cu, Zn, As, Cd and Pb (mg/Kg) ranged from 11.00-97.00, 3.40-47.00, 1.30-58.00, 5.70-338.00, 0.10-3.10, 0.01-7.43 and 5.80-33.80. The Fe, Mg and K contents falls within acceptable limits for global agricultural soil standard; Na was observed to be below the guidelines in some of the wetlands sediment/soils while Ca was below global average in all the wetlands sediments/soils investigated. Some of the heavy metals contents of the wetlands were observed to be within accepted limits when compared to most agricultural soil standards as applied in the USA, UK, Canada and Tanzania. Agricultural suitability soil assessment using ESP revealed that the sediment/soil ranged from sodic through moderately sodic to strongly sodic types. However, the sodic types predominated. An evaluation of the nutrient nature of the sediments/soils using Ca/Mg, Ca/K, and Mg/K revealed fair to ideal nutritional standards.

Most of the wetlands soils/sediments currently being cultivated are suitable for agricultural practices however, the elevated levels of some deleterious heavy metals are of significant environmental concern owing to possibility of crossing into the cross into the food chain, where they could cause serious public health challenge. A need for continuous monitoring is thus recommended.

Session 2: Environmental change: impact on the environment & human health

Life – water and health

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The negative impact of drinking water with low Ca and Mg contents on cardiovascular diseases has been known approximately since the middle of the last century. Recently, several research papers have been published that present the relation between increased incidence/mortality on oncological diseases, the gastrointestinal system, the respiratory system and the endocrine system (diabetes) with the low Ca and Mg contents in drinking water. According to the results of two previous LIFE GEOHEALTH and LIFE FOR KRUPINA projects, a new LIFE – WATER and HEALTH project has been prepared and is realized since September 2018 at the Faculty of Natural Sciences of Comenius University in Bratislava.

Project title: Improvement of health status of population of the Slovak Republic through drinking water re-carbonization. Duration: September 2018 – December 2022. Project goal: The main objective of the project is to improve the health status of the population in two towns/villages of the Slovak Republic based on improved drinking water quality by re-carbonization. Main investigation: Risk analysis, Selection of two drinking water sources for water re-carbonization, Laboratory tests, Biomonitoring, Construction of prototypes, Installation of two prototypes into testing operation, Installation of two prototypes for water re-carbonization into continuous operation.

Acknowledgments

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Groundwater quality and risk perception of water users in cr(vi) affected areas of Greece

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Hexavalent chromium impacted aquifers are a global environmental concern as consumption of Cr(VI) contaminated water potentially has widespread health implications. This study presents data collected during CrITERIA, an EU-ERANETMED project on water management of Cr(VI) impacted water bodies in the Mediterranean. One of the project's objectives is to enable participation of stakeholders in finding the most appropriate option for tackling the problem, by involving them in dialogue and support, during data collection and development of a water use demand driven management process.

Within this frame the Greek project team has performed 4 periodic groundwater sampling surveys and collected 157 groundwater samples during the wet and dry seasons of 2017 and

2018 from selected areas where the problem had previously been identified. Concentrations of Cr(VI) ranged from < 2 µg/L to 62 µg/L in drinking water samples and reached 131 µg/L in irrigation water. The origin of elevated Cr(VI) in water in most instances has been attributed to natural processes linked with the presence of Cr-bearing rocks in the aquifers. Feedback on water analysis results has been provided to stakeholders including water managers and users, aiming to build trust but also raise awareness on the Cr(VI) problem. Furthermore, a public survey based on questionnaires was utilised in order to understand and detect how the water users perceive the risk and value improvements in the quality of water, as well as how far they are ready to pay for environmental improvements. The involvement of water administrators from local authorities during the 2-year monitoring period of the project enabled to detect the challenges of translating policy implementation into outcomes on the ground.

Overall, the project provided integration and guidance on active involvement of stakeholders as well as capacity building on best practices for collection and analysis of water samples for Cr speciation. It also set the ground for informed decision-making and operational water management in the study areas.

Aquaculture around Lake Victoria, Kenya: considerations for food security and environmental geochemistry?

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Lake Victoria plays a vital role in Kenya's inland fish production, providing a major food source for communities around the lake. However, demand exceeds supply and Kenya's huge aquaculture potential is increasingly being explored as a way of alleviating problems associated with overfishing of 'wild' fish. With 10 million people in Kenya suffering chronic food insecurity and poor nutrition, the contribution of aquaculture to future food security cannot be overstated.

However, aquaculture has associated environmental consequences, including the discharge of particulates such as uneaten feed, faecal and excretory products (including antibiotics) which could negatively affect the ecosystem of the lake. Furthermore, increased anthropogenic activity has had adverse effects through run-off into the lake-basin, including discharge of raw sewage, domestic and industrial waste and fertiliser/chemicals from farms and contamination from both commercial and artisanal mining. Anthropogenic pollutants, such as metals, can bioaccumulate in fish with implications for human health.

This project collected fish from around the Kenyan portion of the lake, both wild caught and cage raised, along with lake sediment and water samples from the same locations. Fish tissue and ecosystem toxic metal (e.g. Hg, Pb) concentrations were measured, along with micronutrient content (e.g. Se, Zn, Mg) for fish nutritional value. We present a preliminary evaluation of data, including relative contributions to recommended daily intakes (RDIs) and provisional maximum tolerable intakes (PMTIs), based on material collected across three fieldtrips in 2018 and 2019. This has enabled an initial assessment of potential risks and benefits for human health, facilitating informed decision-making and environmental management.

Waste water assesment by membrane bioreactor

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Present study involves, a lab based model using aerobic treatment followed with immersed Membrane was developed for the treatment of dairy waste water. Dairy wastewater treatment plants are intended to be the main part of water reuse and recirculation into water network. A hydrodynamic model was developed for Dairy wastewater treatment plant in micro scale which is exposed to indicate all the steps of wastewater treatment from entry to the package through exit. In this model from left to right include equalization basin, aerobic reactors, iMBR (immersed Membrane Bioreactor) system, settling basin, chlorination basin, sludge and effluent storage tanks.

Performance evaluation was studied for Chemical Oxygen Demand, Total Suspended Solid, Biological Oxygen Demand, Alkalinity, pH and Volatile Fatty acids through Membrane Technology named as iMBR (Immersed Membrane BioReactor). The Rheological characterization and Retention time study of the dairy wastewater in bioreactor with different loading rate was also conducted. Removal efficiency of Chemical Oxygen Demand gradually increases from 55.7% to 95.5% in respect to sludge retention time in the organic reactor. Removal efficiency of Biological Oxygen Demand also increased from 75.7% to 98.6%. Continuous aeration using fine bubble diffusers and timely backwashing results indicated high filtrate fluxes during treatment with less membrane fouling to avoid excessive chemical for de-fouling. Retention time of six and eight hours was found efficient for evaluating removal efficiency of dairy waste water. Frequency of Membrane fouling rate can be controlled with regular recirculation of wastewater and same was noticed and proved highly efficient throughout the rheological characterization study. Membrane fouling starts gradually during continuous operation of organic wastewater. Continuous aeration using fine bubble diffusers and timely backwashing results indicated high filtrate fluxes during treatment with less membrane fouling to avoid excessive chemical for de-fouling. Retention time of six and eight hours was found efficient for evaluating removal efficiency of dairy waste water.

Chilhood lead exposure of Amerindian communities in French Guiana: a lead isotopic approach to identify the sources

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Recently, in French Guiana, were detected high lead (Pb) levels in blood of Amerindian people living far upstream along the Oyapock River. Lead exposure is a serious hazard mainly for children that can affect their cognitive and behavioral development. To reduce their exposure, the French Health Agency decided to find a way to identify the predominant Pb exposure pathways. Fingerprinting based on stable isotopes of Pb in environmental media is often used to trace natural and anthropogenic sources but is rarely paired with blood data. In this study, 14 families were selected in small villages around Trois Sauts, in French Guiana. Soil, manioc tubers, food bowls, beverages, small and large games, lead shots for hunting and children blood were sampled in 2018. Blood Pb levels of 15 children ranged between 5.7 and 35 µg.dL-1, all exceeding the WHO threshold (2018) of 5 µg.dL-1. Among the different dietary sources, manioc tubers (1.63 ± 1.25 mg.kg-1 dry weight) and large game (doe close to the shot impact, 46 mg.kg-1 dw) contained elevated Pb concentrations while manioc-based food (0.78 ± 0.75 mg.kg-1 dw) and beverages (0.23 ± 0.24 mg.kg-1 dw) were diluted. The isotopes ratios (207Pb/206Pb and 208Pb/206Pb) of children blood (0.871-0.892 and 2.083-2.223) overlapped the same isotopes ratios of lead shots (0.872 and 2.124-2.132) and of manioc-based liquid (0.834-0.939 and 2.030-2.382) and solid (0.860-0.953 and 2.163-2.419) food. These first results confirm the dietary pathways (diary consumption of manioc-based food and more unusually of wild games) as an important contributor to children's blood lead levels but don't exclude the exposure to Pb bullets by hunting activities.

Statistical modelling of lead biosorption process in aqueous medium by *Aspergillus niger* using Response Surface Methodology

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In present study, cadmium resistant fungal strain Aspergillus niger was isolated from the effluent of electroplating industry. The effect of five independent variables i.e. pH (3-7), initial Pb(II) ion concentration (90 – 210 mg/L), biomass dosage (0.5 – 1.5 g/mL), temperature (10 - 50° C) and contact time (30 – 90 min) were studied on Pb(II) biosorption by employing Aspergillus niger using batch mode. Optimum conditions were selected for maximum biosorption. The experimental design i.e. Box-Behnken design (BBD) was aimed at distinguishing the optimum levels of the above selected process variables. Maximum biosorption was achieved at pH 5.0, initial Pb(II) concentration (150 mg/L), biomass dosage (1.0

g/mL), temperature (30° C) and contact time (60 min). At optimum conditions, 97% removal of lead ions was achieved.

Exposure of arsenic from non-irrigated rice in Bangladesh and human health risks

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Arsenic (As) contaminated soil, water and food especially rice has aroused considerable attention worldwide. Arsenic exposure from rice poses a significant risk to humans, especially people who are heavily dependent on rice-based diet. Inorganic forms of arsenic are associated with various cancers and cause major health problems. Like irrigated rice, rainfed rice also pose a potential health risk when grown in As contaminated soil. In this study, a field experiment was conducted to investigate the effect of residual As and rice variety on As accumulation in rice grains. Twelve rice varieties were planted on three levels of As-contaminated paddy soils in three different locations of Bangladesh. These rice varieties include short duration, drought tolerant, salt tolerant modern high yielding (HYV), and local aromatic rice varieties. Accumulation of arsenic in straw, husk and rice grain significantly ($p<0.0001$) differ with location and variety. Total arsenic content in rice grain ranges from between 89 - 279 µg kg-1 (dry weight). The mean and median arsenic levels in grain are 130 and 115 µg kg-1, respectively. Rice grain samples from Faridpur district had total arsenic content 150 µg kg-1 followed by Rajshahi and Mymensingh districts (120 µg kg-1). Most importantly, total arsenic levels of local aromatic rice had significantly ($p<0.0001$) lower (mean101 µg kg-1) than that of non-aromatic rice (mean 143 µg kg-1). The newly developed drought tolerant modern rice variety was found to contain higher grain As contents than other rice varieties irrespective to location. On the other hand, short duration and salt tolerant rice varieties have lower grain As levels compared to other HYV. Thus, rice grain arsenic content greatly varies from location to location as well as varieties and varietal characters. This study suggests that not only irrigated boro rice but also non-irrigated aman rice poses a potential route of As exposure to the local populations. The supply of safe drinking water that has no As in it for local communities is not enough to eliminate risks arising from exposure to inorganic arsenic in locally grown rice in Bangladesh.

Cadmium contamination of wetland sediments in part of Lagos metropolis, Nigeria

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Cadmium (Cd) is a known human carcinogen and its occurrence in environmental media had elicited several research interests globally, especially among the industrialised nations. However, despite the toxic, non-degradable properties and the health effects of cadmium contamination that have been reported, very little is known about the presence and potential effects of cadmium in developing countries such as Nigeria. This study was therefore undertaken

to assess the level of cadmium contamination in Lagos metropolis wetland sediments and the potential health effects.

Wetland core (30cm length) sediment samples were collected from identified wetlands in Lagos metropolis. The samples were dried, prepared and analysed for Cd contents using ICP-MS. Result was compared with statutory guideline values and evaluated using geochemical and, ecological and health risk assessment methods.

Cadmium concentration ranged from 1-73mg/kg. The cadmium concentration in all the wetland sediments was observed to be greater than statutory guideline levels as specified by the WHO/FAO (0.05-0.5mg/kg in food), UNEP (0.03-0.3mg/kg) and EU (0.05mg/kg). The calculated mean value for Cd (23 mg/kg) in the wetland sediments was greater than the Effect Range Median as proposed by USEPA (ERM, 9.6mg/kg) indicating a very high likelihood to cause adverse biological effects. Calculated Geo-accumulation and Contamination Factor revealed considerable to very high contamination for Cd while the calculated Pollution Load Index was >1 indicative of general deterioration of the sediment quality. Ecological assessment revealed high risk with mERM-Q (Effects Range-Median Quotient) values for Cd greater than 1.5mg/kg in the wetlands' sediments indicating highly toxic sediments. The calculated Daily Intake values and Total Chronic Hazard Quotient Index (THI) was > 1 and showed that elevated ecological health risk.

The current Cd status of the wetlands' sediments is of concern as portions of the wetlands are currently cultivated for vegetables. This could provide appropriate pathway for bio-transfer of Cd into the population that may result in debilitating health conditions.

Particulates, microbes in homes and their impact of human health

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In modern era, air pollution is one of the typical problems to human health. People spend their maximum time in indoors (houses or at work place) and affected more in indoor as compare to outdoor. In indoors people affect directly or indirectly by physical, chemical and biological factors. They affected by number of disease like respiratory, pulmonary and allergic reactions at indoor. Biological agents especially fungi are the causal agents for different diseases in animals, plants, and human beings. Otomycosis, chronic bronchitis, emphysema, asthma, allergy as well as systemic mycosis diseases caused only by fungal strains. The present study was conducted to analyze particulate matter and biological agent lie in indoors of middle class houses at Rohtak City, Haryana.

Stream sediment contamination indexes in a U-enriched area

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The occurrence of Potential Toxic elements (PTE) in a river system is influenced by different factors such are geology, mineralogy, hydrology, chemical reactivity, land use and biological activity. Around mine sites, the mineralogical content of the material exploited consists of inert materials from the gangue constituent's mineralization or mineral constituents of rocks. Stream sediments are usually used as a tool for contamination evaluation and definition of PTEs enrichment clusters. The abandoned Picoto uranium mine area is located close to Viseu (central Portugal). The mine is in a soft slope area, with altitudes ranging from 360 to 380 m, and is cut by a stream that runs from Vilar Seco in the NW direction to the Cagavaio stream, in the NE-SW direction. Stream sediments were collected inside and outside the mine influence and Al, Fe, As, Cr, Cu, Mn, Pb, Sr, Th, U, W and Zn contents were determined.

Geoaccumulation index (Igeo), contamination factor (CF) and enrichment factor (EF) have been used in the assessment of the PTE contamination degree in stream sediments. The stream sediments are heavily to extremely contaminated in U and Th (Igeo=4-5) and moderately to heavily contaminated in As and W (Igeo=3-2). Contamination factor is moderate for Al, Cu and Pb (1≤Cf<3), considerable for As and W (3≤Cf<6), and very high for U and Th (Cf≥6). The degree of contamination is very high (Cd = 50.6). The EF was also calculated using Al content as a reference value because it does not change significantly in stream sediments. Most stream sediments have a significant enrichment in As, W and U (EF=5-20) and are very highly enriched in Th (EF=20-40).

The contamination of stream sediments from the Picoto area is due to erosion and leaching of the four mine dumps from the mine area. Furthermore, the contaminant concentrations tend to decrease downstream of the source, due to hydrodynamic and chemical processes in fluvial systems affected by the mine drainage.

Tracing aluminium production using tree chemistry

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An opportunity emerged in 2011 to retrieve samples from trees growing on Fenn's, Whixall and Bettisfield Mosses National Nature Reserve, a large former raised mire straddling the English-Welsh border. This is a largely rural location, but is unusual in being adjacent to an aluminium smelting site, which has operated since 1941. Trees growing in such localities are potentially receptors of atmospheric emissions, and as such Scots pine trees were sampled at varying distances upwind of the smelter. Sampling involved the collection of tree-ring increment cores, trunk discs, needles (top, middle and base of canopies) and soil from the base of trees. Tree-ring samples were synchronised using dendrochronological techniques, and wood and soil samples subsequently underwent acid digestion and ICP elemental assays.

Additionally, secondary data were obtained on emissions from the industrial site (Natural Resources Wales / Environment Agency), on the chronology of technological change and on aluminium outputs from the former smelter operator. Interim results for tree and soil chemistry suggest that Scots pine trees can, not only produce accurate temporal records linked to changes in aluminium output, but these data also have significant implications for surrounding sensitive vegetation communities.

Session 3: New Technologies

Resource from waste, potential of sepiolite mining by products in the mitigation of environmental impacts from resource exploitation in hunan, PRC

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Hunan region of central South China produces >6% of China's rice from only 3% of its arable land. It is reported that an estimated 8.2% of arable land (7.59 million ha) in China is contaminated with heavy metals. The extensive exploitation of base metals, discharges of gas, liquid and solid wastes as well as over use of agricultural amendments has resulted in estimated 37% of Hunan region arable land (2.73 million ha) contaminated with heavy metals, which might have influences on environmental health and be a hinder for sustainable agriculture. Bio-availability of some heavy metals further threatens food security and human health. Whilst there have been extensive projects of waste management control and remediation initiated, the long term need for improved mitigation strategies is more urgent because of more opportunities for further resource exploitation in the region. This includes potential for shale gas, in a region where hydrologically, surface and ground water connection are intense and there is risk for land contamination because of wastewater leakage.

This project is focused on the opportunity to evaluate the capability of waste materials from the exploitation of sepiolite deposits in the region, which not only benefits for industril sustainable development but also promotes new technical products' research for environment health. China hosts 1/5 of the world's known sepiolite reserves and in Hunan region, >85% of the Chinese total (>12 million t). Sepiolite has been used widely in industry for rheological and catalytic purposes. Marine-sedimentary deposit, consisting of sepiolite-palygorskite beds in the upper layer of the Permian Qixia (Chihsia) formation and have provided raw materials for purification of high quality sepiolite products for industrial application (http://elvenpath.en.made-in-china.com/). Waste generated from this process and mining has many of the mineralogical characteristics potentially useful for the retention of mobile metal ions in aqueous systems, sediment or land. The performance and capacity of wastes and potential for modification to improve characteristics form the core to studies being developed during PhD (Ms

Na Song) projects jointly between UWS, HNUST and industrial partners in China.

Applications of MOFs/composites in wastewater treatment

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Recent research indeed not only demonstrated porous MOFs materials to be a new class of photocatalysts usable in catalytic degradation of organic pollutants under UV/visible/UV-visible irradiation, but also triggered an intense interest in exploring MOFs application as photocatalysts in other aspects. Based on the richness of metal-containing nodes and organic bridging linkers, as well as the controllability of synthesis, it is easy to construct MOFs with tailorable capacity to absorb light, and thereby initiating desirable photocatalytic properties for specific application in organic pollutants degradation and Cr(VI) reduction[1-4]. The possible mechanism and proposed pathway of photocatalytic degradation of methylene blue (MB) were illustrated in Figure 1[5, 6].

As well, some ionic hybrid crystalline materials were also used for selectively adsorbing and further separating cationic or anionic dye molecules from mixed dyes solution by host-guest electronic interactions and/or guest-guest exchange interactions, but still facing the challenges of either time consume or operating in none - aqueous solutions. Some efficient MOF adsorbents like ZIF-67, BUC-14, BUC-17 are developed to carry out adsorption toward organic pollutants and heavy metals [7-10]. Considering that conventional adsorption is generally a spontaneous process, chemical treatment (using organic solvents, acid or alkali) or energy are needed to achieve desorption, which might result into secondary pollution and massive energy consumption. We developed some visible light-triggered desorption MOF-based materials like Ag3PO4/UiO-66 to conduct light controlled desorption toward some typical PPCPs.[11].

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Light-Responsive UiO-66-NH2/Ag3PO4 MOF-Nanoparticle Composites for the Capture and Release of Sulfamethoxazole

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Light-responsive materials are attracting increasing amount of attention and have great potential in many research fields in environmental chemistry, materials science, biology, and nanotechnology. In this work, UiO-66-NH2/Ag3PO4 (UAP-X) Metal-organic framework (MOF)-nanoparticle composites with remarkable adsorption performance toward sulfamethoxazole (SMX) were reported. In addition, visible light-triggered release of SMX in the UAP-X composites was reported for the first time. It is believed that the light-triggered desorption of SMX is due to the transformation from Ag+ to Ag0 in the light-sensitive Ag3PO4 nanoparticles (NPs) of the composites. The SMX release performance of UAP-X can be tuned by the size of Ag3PO4 NPs distributed on the UiO-66-NH2. Specifically, the smaller crystal size of Ag3PO4 NPs, which can facilitate the reduction of Ag+ to Ag0, can be achieved with an increase in relative UiO-66-NH2 content in the composites. In addition, the higher UiO-66-NH2 content of the composite could provide more deposition area to minimize the aggregation of Ag3PO4, which could further enhance the reduction of Ag+. The light triggered desorption provides new possibility to achieve pollution-free and low-cost recyclability of adsorbents.

Frankly, in this paper, the transformation from Ag+ to Ag0 under light irradiation was not reversible, which hindered the reutilization and potential application to remove environmental PPCPs pollutants. But, it leaves a window open for these composites to be used in drug delivery. Further researches are designed to facilely prepare similar MOFs-based composites to achieve their adsorption-desorption activities triggered by light toward targeted organic matters, which will knock a door open to achieve light induced desorption with zero-pollution and low-cost regeneration.

Reducing the gap between field and laboratory x-ray fluorescence analysis

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Soil samples preparation methods for X-ray fluoresence analysis diverge between different studies. An official method is described in US-EPA 3200, but many authors do not follow this recommendation and propose adaptation according to the specificity of the analyzed matrix. Furthermore, XRF analysis is supposed to be rapid and precise for in situ mapping or lab bench measurements. The succession of preparation procedures can delay the acquisition of results: if the duration of samples preparation is equivalent or superior to a standard total acid-extraction procedure, the use of the XRF method can be questionable.

Portable XRF devices (pXRF) are typically designed for in situ mapping. However, researchers frequently collected and analyzed soil samples back home in their laboratory, for different reasons: (1) need to investigate deeper soil horizons, (2) reduction of time-consuming

field analysis (soil sampling can actually be faster than XRF analysis), (3) comfort and safety reasons (i.e. weather conditions), (4) requirement of extra analyses, etc.... As the soil samples are supposed to represent the field conditions, the correlation between field results and laboratory results is decisive.

The first experiments in this study aimed at optimizing the analyzing time and ensure measurement quality: (1) calibrations using different organic and mineral reference materials, (2) effect of time measurement on calibration. Then, we focused on the effects of sample preparation of XRF measurements, by comparing different procedures: (a) Directly from field, (b) after drying, (c) after sieving 2 mm, (d) after grinding at 6m/s, until 180 microns (80mesh), (e) after burning at 550oC (elimination of organic matter). We confirmed that a 2 min time measurement is sufficient for accurate and precise pXRF results. As expected, a strong effect of the organic matter appears during the analysis. We could distinctly model two calibration curves using two groups of certified references material: 8 mineral samples (soils and sediments) and 19 organic samples. Within the second group, we included aquatic plants, lichen, peat, leaves and coal samples. The slope of the calibration curve is three to four times attenuated in these organic samples, so specific calibration according to soil matrix is mandatory. Concerning the preparation procedure, most of the elements (40 of 50 elements) presented a low variability (<8%) within analytical replicates, even after shaking the powder within the cup. Among the main elements, only Fe, Ca and Zr had >8% variability. Burning of the sample at 550^{o}C does not change the chemical composition (which must be corrected due to the loss of organic matter). Surprisingly, even the 2mm sieving does not significantly modify the XRF measurements. Finally, we observe that fine grindind (<180 µm) provides results far from the real field values, probably because the procedure generates metal-rich fine particles that can accumulate at the bottom of the capsule where the XRF measurement is made. We conclude that the preparation of the samples should be minimal to avoid laboratory bias. This makes the XRF scans faster, which is the main purpose of this type of analysis and allows to get closer to the real conditions of the field.

Dye degradation with the aid of coated fly ash

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Fly ash is a residue of coal combustion in thermal energy generation. The fly ash particles are hollow, spherical in shape and vary in size ranging between 0.5 to 300□m, consisting of a number of elements including: silicon, aluminium and iron. It is becoming more of interest, as the research community aims to reduce the environmental impact of discarded fly ash. Even so, fly ash has still has not been explored to its full potential for useful applications. This research aims to explore the use of reactive magnetron sputtering to produce functional films, such as photocatalytic coatings, on the fly ash with environmental applications in, for example, water treatment.

The fly ash is placed in an oscillating substrate holder adapted from a bowl feeder system, allowing the particles to tumble around the bowl underneath a pair of magnetrons. The targets used were titanium, bismuth and tungsten. The power to each target is controlled independently by a dual channel Advanced

Energy Pinnacle Plus pulsed DC power supply. The coated product is analysed using X-ray diffraction (XRD) and Scanning electron microscope with energy dispersive X-ray analysis (SEM EDX). Photocatalytic activity of the coated fly ash was investigated by methylene blue (MB) dye degradation tests. The results confirm the successful deposition of functional films onto the fly ash, with an average of 68.4% decrease in absorbance over a period of 150 minutes. This means the method applied is a viable method for coating powders and the final product, 'coated fly ash', may be incorporated into water treatment system.

Mercury removal from crude oil using natural minerals

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Mercury has been reported to be naturally occurring trace contaminant in the oil reservoirs. The chemical nature of mercury in oil reservoirs is of interest for a variety of reasons, but especially because it is important to understand the fate of the various species, as they partition to fuels and waste streams in processing. Practical considerations also exist as mercury affects equipment integrity, catalyst performance, product quality, as well as the health and safety of workers. This study, evaluates the suitability of natural minerals (zeolite and attapulgite) as sorbents of mercury in artificial aqueous solution and crude oil. The tested materials were natural zeolite (clinoptilolite), thermally treated zeolite, silver-loaded zeolite and attapulgite. Mercury sorption experiments were carried out under stable conditions using an artificial aqueous solution, characterized by an Hg concentration of the order of 50 mg dm-3, simulating the concentration of mercury in crude oil. In the case of attapulgite and silver-activated zeolite, the sorption efficiency was achieved at a level of above 90%. Under the same experimental conditions testing of commercially available resins took place, in order to be used for further enhancing the absorption capacity of the natural materials, and therefore to present overall higher selectivity in mercury. Additionally, the removal of mercury from real crude oil was investigated. The results for the tested samples indicate a significant increase of the sorption efficiency. Based on these results, a novel, effective and low-cost mercury-selective adsorbent is proposed and therefore, it can be used as a filter during oil production processes.

Photocatalytic Advanced Oxidation Processes Under Solar and UV Irradiation for Degradation of Organic Matter in Raw Water

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There has been an increasing need to determine effective treatment methods for the rising levels of organic matter in raw water, particularly methods that are environmentally conscious. In this study, photocatalytic advanced oxidation methods were investigated for degradation, using black and rooibos tea as model solutions. The photocatalysts ZnO and TiO2 were tested in the presence of natural sunlight, artificial solar irradiation and artificial UV irradiation with and without H2O2 dosing. A focus was placed on comparison in the presence of the artificial light sources as natural sunlight was found to be ineffective. The optimal catalyst concentration was 10 g/l in all cases. Rooibos tea was degraded by >60% in all optimised solar methods. It was only possible to degrade black tea by >50% when the photocatalysis was carried out under UV light with dosing of 10 mM H2O2, this is considered to be due to the higher polyphenolic content. A significant finding in this research was the performance of TiO2 under solar irradiation. In treatment of rooibos tea, TiO2 was effective without H2O2 dosing (62% degradation) but, in treatment of black tea, degradation was significantly increased from 15% to 47%. ZnO was determined to be the better performing photocatalyst.

Comparative study of experimental peloids formulations with different clayey dermocosmetic products

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Clays have been empirically used for therapeutic purposes since the ancient times, through ingestion (geophagy) or topical application in the form of cataplasms or mud baths, known as pelotherapy. There are several studies about thermal mud maturation under specific conditions where in some cases resulted a new formulation peloid, with unique aesthetic and/or therapeutic properties. Such studies highlight the importance of features such as the characteristics of the raw materials used and its toxicity associated with the transdermal delivery of some elements. Mixing clays with different ionic composition waters produces muds with different properties. Unlike what happens with cosmetics chemical safety assurance, that is well documented, there are no regulation or quality criteria in what concerns the technological features that a therapeutic or aesthetic mud/peloid developed for topical application should possess.

The identification of the most suitable raw materials, as well as the most effective maturation protocol for the peloid design are present in the literature as the sustentation base for a rationale comparison with the peloid properties commonly used in spa-centres and its therapeutic and/or aesthetic purposes. The aim of this study was to develop an experimental protocol using two different Portuguese sulphurous mineral-medicinal waters for one single clay (bentonite) maturation, for 90 days and under specific controlled conditions of illumination and stirring, looking for the best peloid attributes, its potential therapeutic acquirement and human safety usage. The physical, chemical and mineralogical characteristics of these lab maturated clays were further compared with some clayey commercial products available on the market and some international spa-centres.

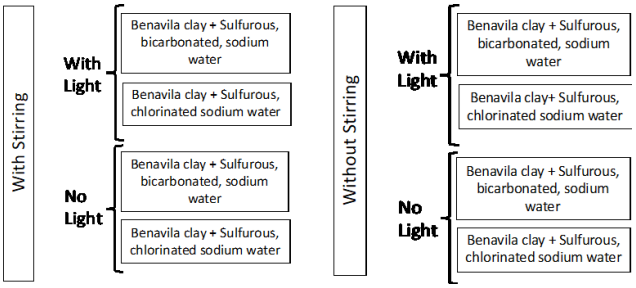

Fig.1 – Scheme showing the experimental conditions for peloids formulation.

The effect of freeze and air drying on operational speciation of potentially toxic elements in freshwater sediment and ecological risk assessment

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The BCR sequential extraction procedure1 is widely used to determine the operational speciation of potentially toxic elements (PTE) in environmental solid samples (e.g. soils and sediments) in order to obtain information on their mobility, bioavailability and toxicity to organism. When applying the BCR sequential extraction procedure, a dichotomy exists between maintaining a sample's natural speciation, and pre-treating the sample to make it stable and more suitable for standard laboratory operations such as sieving, cone-and-quartering etc. Sample drying in particular has been reported to cause redistribution of analytes to more readily extractable forms2, 3.

Pseudototal aqua regia digestion and BCR sequential extraction procedure were applied to sediments collected from the River Derwent and the River Wear, UK, both of which are impacted by historical mining and smelting. Sediments were analysed as received, freeze-dried and air-dried. Digests and extracts were analysed for As, Cd, Cu, Fe, Pb and Zn using an Agilent 7700x ICP-MS instrument.

It was found that freeze drying significantly transferred Cd, Fe, and Zn to forms inaccessible to aqua regia digestion. Different changes in operational speciation occurred for different PTE (at 95 % confidence level) but no sample pre-treatment procedure preserved the speciation of the PTE intact. Ecological risk values of Cd, Cu, Fe, Pb and Zn calculated using the risk assessment code also differed between treated samples and sediments as received. To obtain the most accurate information on operational speciation of PTE in freshwater sediment – and hence the most appropriate information to use in risk assessment – it is recommended that samples should be analysed immediately as received.

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The Potential of biochar soil amendment in cycling Nitrogen and Phosphorus in Zambian soils

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Most agricultural soils in Zambia are said to be highly weathered, with very low plant nutrient reserves due to unsustainable farming practices and extreme climatic conditions. Thus, the need for remedial technologies, especially using locally available low-cost inputs, has been a pre-occupation of the scientific community for a long time now. Research evidence has shown that biochar, a carbon-rich organic material, has potential to retain plant nutrient elements, and these retained nutrients will generally be in states that will be available to plants for uptake. Biochar can also influence the microbial environment through the various nitrogen (N) and phosphorus (P) reactions such as mineralization, N fixation and mitigating losses through volatization and denitrification.

This study focused on chemical as well as the biological effect of biochar on the changes in concentration of N and P in the soil profile (30cm) of fields under conservation farming. Biochar was applied at 0, 10, 20 and 40 Kg/ha on sandy clay loam soils with soybean as the test crop. The results in the short-term reveal reduction in N losses and an increase in Phosphorus use efficiency (PUE) of 4 and 7.8% respectively at an application of 40kg/ha. Crop yields were also significantly higher at the highest application. An increase in crop yield indicate the potential of biochar in agroecosystems in Zambia at low cost. This can offset the cost of fertilizer inputs on rural communities whose agriculture is are already adversely affected by climatic changes and other socio-economic factors.

Session 4: Monitoring the environment

The effects of artificial weathering on virgin microplastic pellets

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Plastic pollution in the marine environment has become a major topic of research in recent years because of the harmful effects of plastics on marine biota1. One area of particular concern arises from the ability of microplastic particles to adsorb potentially toxic elements (PTE)2. These PTE's can then be transferred to marine biota upon ingestion of the plastics. It has been noted that even virgin (newly produced) pellets can adsorb PTE, although the mechanism by which this occurs is not well understood3.

The aim of the current study was to investigate the effects of artificial weathering on the surface chemical characteristics of plastic micropellets in order to improve understanding of PTE-pellet interactions. Virgin pellets of different types (polycarbonate, polyethylene, polyethylene terephthalate, polypropylene and polystyrene) were subjected to three simulated weathering processes under controlled conditions: solar irradiation, physical abrasion, and exposure to seawater. An Atlas SUNTEST XLS+ Weatherometer was used to simulate the sunlit conditions that pellets experience when floating at the ocean's surface. Sandpaper was used to simulate the mechanical effects of sand and particles polishing the surfaces of the pellets whilst in suspension in the oceans or following beaching. Finally, pellets were treated with a solution of Lake Products Co SEA SALT (ASTM D-1141-98) to study the effects of contact with artificial seawater on surface chemistry.

Attenuated total reflectance Fourier-transform infrared spectroscopy (ATR-FTIR) was used to analyse the plastic pellets before weathering and to monitor changes occurring in their surface composition during weathering over a period of several weeks.

The results will provide insight into the mechanisms by which both virgin and weathered pellets can adsorb PTE in the marine environment.

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Interaction of clays with lead in aqueous solutions soil leachates and soil porewater

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The treatment of Pb contaminated water and soils by mineral amendments, such as clays, is a common remediation method. The effectiveness of clays as sorbents of this toxic element is generally attributed to their special structural, morphological and physicochemical properties during interaction in simple elemental solutions. However, the soil-clay-Pb system is characterized by higher complexity. The aim of the preset study is to assess the factors controlling Pb retention by clays under conditions prevailing in aqueous solutions, contaminated soil leachates and soil porewater.

Three Fe-Mg-rich clays from Greece were selected for the study. The clays are the alteration product of ultramafic rocks, and include a palygorskite-rich (>70% pal) (PCM), a Fe-smectite-rich (>70% sm) (SCM) and a mixed palygorskite (20%)/Fe-smectite (40%) (MCM) sample. Auxiliary phases include quartz, serpentine and plagioclase. The samples are characterized by high surface area (SSA~140-210 m2 g-1), high point of zero charge (PZC~9) and significant cation exchange capacity (CEC=27-63 meq/100g). The sorption of Pb from monometallic artificial solutions by the clays under static and dynamic conditions was found to be controlled by surface complexation, cation exchange and precipitation, and the maximum sorbed Pb content follows the order: MCM (~52-84 mg/g)>SCM (49-78 mg/g)> PCM (~30 mg/g). Further assessment of the retention efficiency of the Fe-rich clays involved testing with soil from 3 Pb contaminated areas. All three clays exhibited the same retention efficiency towards Pb in soil leachates. Lead in leachates was bound to the Fe-Al colloidal fraction and the high surface area of the clay particles acted as a substrate for the deposition of Fe-Al oxides with a concomitant removal of Pb. Additionally, the MCM sample significantly decreased the labile Pb fraction in the porewater of the highly contaminated soil sample.

Overall, the sorption behavior of clays with respect to Pb in aqueous solutions depends upon the physicochemical properties of the clay and the element addressed. In contaminated soil systems, however, the retention behavior of clays is primarily controlled by the specific physicochemical characteristics of the soils.

DNA strand breaks induced by crushed rock powders from the Panasqueira mine area, Portugal – association with bulk chemical composition

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Our natural environment and particularly mining areas may contain a large number of heavy metals and metalloids. Previous studies investigating the effects of the mining industry on populations near the Panasquiera mine area have found an elevated risk of human environmental contamination. Exposure to particles composed of different mixtures of heavy metals can contribute to many patho-physiological complications including genetic damage by causing DNA strand breaks. Heavy metals have the ability to produce reactive oxygen species (ROS) such as superoxide ion, hydrogen peroxide, and hydroxyl radical by utilizing the Fenton chemistry/Haber-Weiss reaction. Their release can result in oxidative damage of proteins and DNA. Other than causing direct DNA strand breaks, ROS's resulting from redox reactions can cause the activation of transcription factors and have a role in mutagenic signals leading to carcinogenic effects in humans.

The aim of this study was to assess the level of DNA strand breaks caused by powdered (< 50 µm) samples of known chemical composition (with elevated heavy metal(loid)s) in order to determine the compositional dependence of induced genetic damage. Samples were obtained from the Panasquiera mine area in Portugal. Using an in-vitro cell-free plasmid DNA scission assay, samples were incubated with and without H2O2 to see if damage occurs directly or indirectly through the catalysis of the Fenton reaction. All samples resulted in a dose-dependent increase in DNA strand breaks in the presence of H2O2 (see Figure 1). Samples incubated without H2O2 did not cause any significant strand breaks. MnO, W, and P2O5 were found to be significant predictors of DNA strand breaks using hierarchical cluster analysis (HCA) and multiple linear regression. The findings of this study confirms that the oxidative capacity of different particles depend on their chemical and mineralogical composition.

Palaeolimnological analysis in Lake Victoria reveals potential threat to aquaculture security

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As wild fish stocks decline in Lake Victoria, aquaculture has seen a dramatic rise. Concerns over the sustainability and future security of fish farms as a food source for local communities prompted research into the environmental impacts both on and from aquaculture within Lake Victoria. By using a palaeolimnological approach, we can assess the changes in multiple environmental parameters over approximately the last 140 years. This provides insights to the historical environmental and biological landscape within Lake Victoria, and allows for predictions on how these might change with further anthropogenic influences. By using chlorophyll and carotenoid pigments as indicators of algal communities, we tracked shifts in major algal dominance from diatoms toward cyanobacterial communities from approximately 1950 onwards. This shift may pose a considerable risk to the stability of aquaculture as many cyanobacteria species produce potent toxins which can be both

ichthyotoxic and harmful to humans. The global increase in cyanobacteria blooms is highly linked with anthropogenic nutrient loading and may be even further exacerbated by nutrients associated with caged fish farms. This study shows the dominance of cyanobacteria within Lake Victoria is a long-standing and substantial characteristic of the current environment, and one that must be fully appreciated and managed to maintain the security of aquaculture as a food source.

Soil-crop relations and uptake of heavy metals at a mine tailings dump in the Zambian copperbelt

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Mine tailings are a significant source of heavy metal contamination for soils in their proximity. When such soils are used for agriculture, heavy metals may be absorbed by crops and thereby enter the food chain. However, only the labile fraction of soil-borne metals have the potential to be absorbed by plants. Metal lability is affected by (i) the original form of the contaminant source, (ii) the soil-contaminant contact time and (iii) soil factors, such as pH and organic matter content, which have an influence on heavy metal sorption strength.

A paired soil-crop study was conducted in the fields of Mugala Village, an agricultural settlement adjacent to a tailings dam in Kitwe in Copperbelt Province, Zambia, to investigate possible correlations between metal lability and crop metal content. Labile concentrations of the heavy metals were determined by isotopic dilution with enriched stable isotopes of Ni, Cu, Zn, Cd and Pb using ICP-MS (Agilent 8900). Total elemental concentrations in crops were determined by ICP-MS following microwave-assisted acid digestion. Lime and manure were applied to the soil to assess whether their ameliorative effect on soil acidity and low organic matter had a corresponding effect on crop uptake (maize and pumpkin leaves) of Ni, Cu, Zn, Cd and Pb.

Results showed no direct correlation between the labile heavy metal concentrations in soil and crop metal content. Lime significantly reduced the lability of Ni, Cu and Pb by 1–4%, 2–16% and 9–22% respectively. Neither lime nor manure had a significant effect on metal concentration in either maize or pumpkin leaves. The concentrations of the heavy metals in maize were all below the maximum recommended for cereals according to FAO/WHO, while in pumpkin leaves, Cu and Pb were above the recommended limits for leafy vegetables. The information generated in this study will be useful in the management and risk assessment of soils that are in close proximity to potential heavy metal pollution sources such as mine tailings.

Evaluation of genotoxicity of Buddha Nullah water using plasmid nicking assay

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Water pollution on account of growing input of genotoxic agents into aquatic environment is a serious matter of concern. Water pollutants like heavy metals are known to produce reactive oxygen species like superoxide and hydroxyl radicals which in turn can account for their genotoxicity. Heavy metal exposure contributes to genetic damage by inducing double strand breaks as well as inhibiting the synthesis of critical proteins from different DNA repair pathways. Considering this, the present study was carried out to evaluate the genotoxic effects of surface water samples collected from different sites of Buddha Nullah employing DNA nicking assay using pBR322 plasmid. Various heavy metals like arsenic, copper, chromium, cobalt, lead and zinc were estimated using ICP-MS. Buddha Nullah, a tributary of Satluj, Punjab, India is one of the natural water bodies flowing through Ludhiana (popularly known as 'Manchester of India') that was once a brook of sparkling water and now has turned into a dirty drain due to continuous disposal of industry effluents, sewage, dairy and domestic waste. Moreover, Budha Nullah flows like an open sewer which causes diseases like respiratory disorders, skin infection, tuberculosis and hepatitis. During the present study, double and single stranded breaks in pBR322 plasmid treated with the water samples of Buddha Nullah confirmed their genotoxicity. The presence of high contents of heavy metals in the Buddha Nullah water samples were observed to be the prime factors for induction of genotoxicity because the metals like arsenic, chromium and cobalt has the potency to interact with DNA and promote the DNA damage.

Evaluation Of Clay Minerals As Underlying Influence To Soil Washing Efficiency: Contaminated Soils

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Increased remediation of heavy metal contaminated soil is becoming attractive due to unprecedented degradation of soil systems. Therefore, sustainable remedial approach and the study of contaminant geochemistry are topical areas of intense research. In this study, clay minerals, a constituent part of the soil system has been evaluated as an underlying influence to soil cleaning. Multi-metal spiked simulated soil (SS), prepared according to standard guidelines, and varied for montmorillonite clay (MC) and kaolinite clay (KC) which, are commonly found in soils were utilized as a proxy to investigate the leaching behaviour of contaminated soils (SA and SB) of natural origin for cleaning protocols using different chelating agents (ethylene diamine

tetraacetic acid [EDTA], ethylene diamine disuccinic acid [EDDS], acetylacetone [Hacac], and citric acid [CA]) on a dynamic system. Geochemical characteristics and metal quantification were conducted on the samples using X-ray powder diffraction (XRD), Raman and inductive coupled plasma-optical emission spectroscopy (ICP-OES) respectively. Results showed that similar leaching trends were observed for both the simulated and natural soil systems regardless of the leaching treatment applied. As expected, higher (2-fold) leaching regime was observed for the simulated soil compared to the natural soils due to metal ageing. Geochemical analysis revealed a stronger influence of montmorillonite clay minerals on the sorption of targeted metals compared to the kaolinite clay.

A more advanced soil washing protocol specifically engineered for a recalcitrant-clay soil system is essential to promote agricultural production, enhance food security and scale down land tenure problems in the 21st century.

Exposure of arsenic from non-irrigated rice in bangladesh and human health risks

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Arsenic (As) contaminated soil, water and food especially rice has aroused considerable attention worldwide. Arsenic exposure from rice poses a significant risk to humans, especially people who are heavily dependent on rice-based diet. Inorganic forms of arsenic are associated with various cancers and cause major health problems. Like irrigated rice, rainfed rice also pose a potential health risk when grown in As contaminated soil. In this study, a field experiment was conducted to investigate the effect of residual As and rice variety on As accumulation in rice grains. Twelve rice varieties were planted on three levels of As-contaminated paddy soils in three different locations of Bangladesh. These rice varieties include short duration, drought tolerant, salt tolerant modern high yielding (HYV), and local aromatic rice varieties. Accumulation of arsenic in straw, husk and rice grain significantly ($p<0.0001$) differ with location and variety. Total arsenic content in rice grain ranges from between 89 - 279 µg kg-1 (dry weight). The mean and median arsenic levels in grain are 130 and 115 µg kg-1, respectively. Rice grain samples from Faridpur district had total arsenic content 150 µg kg-1 followed by Rajshahi and Mymensingh districts (120 µg kg-1). Most importantly, total arsenic levels of local aromatic rice had significantly ($p<0.0001$) lower (mean101 µg kg-1) than that of non-aromatic rice (mean 143 µg kg-1). The newly developed drought tolerant modern rice variety was found to contain higher grain As contents than other rice varieties irrespective to location. On the other hand, short duration and salt tolerant rice varieties have lower grain As levels compared to other HYV. Thus, rice grain arsenic content greatly varies from location to location as well as varieties and varietal characters. This study suggests that not only irrigated boro rice but also non-irrigated aman rice poses a potential route of As exposure to the local populations. The supply of safe drinking water that has no As in it for local communities is not enough to eliminate risks arising from exposure to inorganic arsenic in locally grown rice in Bangladesh.

Investigating pollutants and potential food safety concerns within aquaculture

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Aquaculture is currently the fastest growing livestock sub-sector worldwide. Many countries are using aquaculture to provide a sustainable and relatively cheap source of protein to their growing populations, as well as providing a contribution to foreign currency earnings through the exportation of aquaculture products. It is crucial that the industry grows in a sustainable way that limits environmental impact but also considers the suitability of that environment for aquaculture activity, and ensures the food is safe and nutritious for consumers.

This study aimed to assess the quality of aquaculture products from upcoming (Kenya) and leading (Vietnam) aquaculture producing countries. The presence of pollutants, including antibiotics and heavy metals, in the fish was investigated using a PremiTest and Inductively coupled plasma mass spectrometry respectively. Bacterial DNA isolated from the fish products was also analysed for the presence of antibiotic resistance genetic elements.

The study found significant differences in heavy metal content and highlighted the presence of antibiotic residues in both fish from Kenya and from Vietnam. Bacterial DNA isolated from the aquaculture samples was found to contain genes for both antibiotic and heavy metal resistance. This study highlights the importance of monitoring the development of aquaculture and the quality of their products, and a potential hidden driver for the development of antibiotic resistance.

Is aquatic environmental element content driving the development of resistance in bacteria?

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Aquaculture is a burgeoning industry providing both a sustainable and relatively cheap source of protein and a contribution to foreign currency earnings through the exportation of aquaculture products. It is essential that consideration is given to the suitability of the aquatic environment for aquaculture activity, and that any impact that it may have on the aquaculture products is monitored.

This study compared the elemental content of aquaculture products, using Inductively coupled plasma mass spectrometry, from Lake Victoria in Kenya to those present in both the water and sediment from the same location. Bacterial DNA isolated from the fish products was also analysed for the presence of metal resistance genetic elements.

The study found significant differences in elemental content in the fish products between different locations, which correlated with the levels of the element detected in the sediments from where the fish were farmed. Interestingly, bacterial DNA isolated from these fish found a high correlation between the presence of copper resistance genetic elements, copper load of the fish and also in the sediment from their environment. This study highlights the importance of monitoring the environment for the suitability of aquaculture activity and

potential impacts on the quality of the products, and a potential hidden driver for the development of antibiotic resistance.

Determination of exposure to mercury in hair from inhabitants of two regions in Mexico

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Objective of this study was to determine mercury hair concentration in the population from two contrasting areas in Mexico, exposed to different possible sources of mercury (Hg) contamination. It is well accepted that two of the most important sources of human exposure of Hg in the world are fish consumption as well as the exposition to Hg-enriched residues of mining and metallurgical processes. In this work, 2 populations exposed to possible different Hg sources were considered: 1) Inhabitants of the small town of Cedral S.L.P. (n= 21, mean age 31.1) located in the Mexican Altiplano, exposed to previously reported high Hg concentrations in the environment derived from historical metallurgical activities, specifically by using Hg in extraction procedures of gold and silver. The population reported very low fish consumption (1.4 tpm*), 2) Inhabitants of México City (n=37, mean age=33.9), exposed to low levels of environmental Hg related to urban activities. Oppositely, the considered population reported a regular fish consumption (average 3.4 tpm). Data assessment shows interesting differences between the two populations analyzed: The inhabitants of Mexico City show higher mean hair Hg levels than the inhabitants of Cedral (473.3 µg kg-1 vs 145 µg kg-1 respectively). In both populations, the effects of potential factors such as age and gender, as well as fish diet, that may have influenced the concentration of mercury, were evaluated. No significant differences were reported between hair Hg concentration in females (424 µg kg-1) and males (404 µg kg-1) in Mexico City. However there is a significant effect of age in relation to Hg concentration in the hair. The population analyzed in age range between 16 and 30 years presented the highest concentrations (mean 1020 µg kg-1). In Cedral males were found to have a higher mean Hg value than females (185 µg kg-1 vs 138 µg kg-1 respectively). The monitored group in a age range between 0 and 15 years old present the highest Hg hair concentration. The entire population considered in this study showed a significant correlation coefficients (P≤0.05) between the content of Hg in hair with the frequency of fish consumption. The differences in concentration of the two populations may be related to the nature of the Hg in both locations: Hg in the Cedral environment is present mainly in the form of Hg °, while the source of mercury to which the inhabitants in Mexico City are exposed is related to the fish content that is usually methyl mercury. By this way, results confirm the usefulness of hair as a exposure marker for methylmercury. Population from Cedral is exposed to metallic mercury. This kind of exposure is detected through urine analysis.

*tpm=times per month .

Session 5: Environmental Health

Slovenian soil: determination of geochemical background and threshold values and comparison with european soil

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Geochemical background and threshold values of chemical elements in soil need to be established to define background levels and to identify areas with unusually high concentrations of potentially toxic elements. High concentrations can be caused by natural or anthropogenic influence.

Geological survey of Slovenia collected 817 topsoil (0-10 cm) samples using grid of 5 x 5 km. The <2 mm fraction of these samples was analysed for 47 elements by ICP-MS and ICP-AES, following modified aqua regia (HNO3/HCl/H2O) digestion of 15 g samples.

Results were used to establish the geochemical background variation and threshold values, derived statistically from the data set, in order to define background concentrations and to identify unusually high element concentrations in the soil samples. Geochemical threshold values were determined following different methods of determination for (1) the whole Slovenia and (2) for 8 spatial units determined based on geological structure, lithology, relief, climate and vegetation. Medians and geochemical thresholds for whole Slovenia were compared with GEMAS agricultural soil data for whole Europe and for southern Europe separately as large differences in the spatial distribution of many elements are observed between northern and southern Europe. Potentially toxic elements (PTEs), namely As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, and Zn, are of particular interest. Medians of these PHE elements are all higher in Slovenia compared to southern Europe. Medians of Pb and Mo are 1.5 times higher and medians of Hg and Cd are more than 2 times higher in Slovenian soil. Geochemical thresholds for As, Cr, Cu, Ni, Sb and Zn are of similar values in both Slovenia and southern Europe, up to 1.5 times higher in Slovenia for Co, Mo and Pb and more than 2.5 times higher in Slovenia for Cd and Hg.

Chemical and biological tests to assess the viability of amendments and Phalaris arundinacea for the remediation and restoration of historic mine tailings

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Recent research in the Upper River Derwent, NE England highlighted the contribution of historic mining and mineral processing areas as sources of particulate and dissolved potentially toxic elements (PTE) entering river sediments. Subsequent analysis of mining and mineral processing sites has confirmed the presence of significant Cd, Pb and Zn concentrations in loose

spoil, tailings and unvegetated soils. The aim of this study is to evaluate the potential of several organic amendments and a perennial native grass species, reed canary grass (Phalaris arundinacea), to immobilize PTEs and stabilise contaminated soils. The plant specie was selected for its ability to rapidly colonize and establish on contaminated soils whilst not (usually) accumulating high levels of PTEs or thereby adding to dispersion. Preliminary pot trials using bulk samples of mine spoil and amendments are currently ongoing following an adapted British Standards (BS/EN 11269-2:2013) method for the effects of PTEs on above ground plant growth. A combination of biological and chemical approaches will be used to analyse the efficacy of the different amendments throughout this study. These include the use of the modified BCR sequential extraction procedure and single extractants to assess PTE bioavailability, the monitoring of changes in soil properties such as OM, pH and CEC and the measurement of above ground biomass after a 12-week growth period. Although several recent studies have conducted similar pot trials, very few have applied their results to actual field trials. The results of these experiments will used to implement a two-year phytoremediation trial at a former mine site beginning in Spring 2019.

The Effects of Placental Exposure to PAHs on AMH Levels and Birth Outcomes of Newborns

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PAHs are a subset of a set of compounds known as polycyclic organic matters (POM). They are, originally, organic compounds that are formed primarily from the incomplete combustion of organic materials or pyrolysis of organic material. Humans are exposed to PAHs through three main pathways: ingestion, inhalation, and dermal contact. Exposure to PAHs is linked with various adverse health effects including poor fetal development. Long-term exposure to PAHs is suspected of raising the risks of cell damage via gene mutation and cardiopulmonary mortality. Maternal exposure to PAHs can result in long-term adverse effects in children, including developmental delays and behavioral problems.

Previous studies proved that Estradiol (E2) and Anti-Mullerian hormones (AMH) levels were negatively affected by exposure to PAHs while FSH levels in the umbilical cord serum was positively affected. So far, there have been few studies about the correlation between environmental exposures of PAH and alterations to reproductive hormone levels, so that there is not enough data on the potential effects of prenatal exposure to PAHs on umbilical cord serum levels of sex hormones. Also, there are no studies about PAHs in umbilical cord serum and the levels of reproductive hormones in neonates. Our group has monitored the exposure levels of neonatal cord blood and various peripheral blood pollutants in the e-waste dismantling area since 2003. We found that the exposure levels of PAH in cord blood of local newborns was high and the anal colony of the children was also higher than the newborns in the control group. Based on this, we suggest that the exposure of PAH in the e-waste dismantling zone would affect the expression of AMH in neonates, thereby affecting the anogenital distance (AGD) of the newborns. By acting on the hypothalamic-pituitary-gonadal axis to alter male testosterone levels and female estrogen (E2) levels, ePAHs would affect the

expression level of AMH in neonates, leading to changes in neonatal colonization and endocrine disorders. We also found that the newborns in the exposed group were found to have significantly longer AGD, which is an important clinical measure to assess the adverse impact of in utero exposure to environmental EDCs.

Mineral Calomel: A Natural Source of a Violent Poison in the Environment

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Obtained by sublimation from mercury(II) sulfate (HgSO4) and sodium chloride (NaCl) in the past, mercury(II) chloride (HgCl2), also known as corrosive sublimate, has been known since the Middle Ages and was widely used as a violent poison in that era. Farrar and Williams, both from University of Manchester Institute of Science and Technology, note that HgCl2 was prepared by Chinese alchemists in the first millennium A.D., and also mention an account of its preparation given by the Persian Rhazes (Abu-Bakr Muhammad ibn-Zakariya al-Razi, 865-925) in the thirteenth-century Latin translation of his work Razis de aluminibus et salibus. Then they state that "this is perhaps the first synthesis of a definite chemical compound that does not occur in nature."

Found along lines of previous volcanic activity, cinnabar (HgS) is the only important ore of mercury, and mineralogists have not found any mineral HgCl2. Still, an inorganic compound not found as a mineral is not sufficient to conclude that it does not occur in nature. Considering the extreme toxicity of HgCl2, the correct answer to the question if HgCl2 is a naturally occurring compound is of great importance in environmental health. Mercury(I) chloride (Hg2Cl2) is found as the secondary mineral calomel in mercury-bearing deposits, and its slight solubility in water results in a low concentration of aqueous Hg22+ in a saturated solution of Hg2Cl2 in water. The conclusion is concerning.

Electrochemical principles were applied to show that the secondary mineral calomel in mercury mines is partly converted to HgCl2 in a natural process. This proved that HgCl2 nonoccurrence in nature is a fallacy and opened the way for the detection and quantification of solid HgCl2 as a mineral in mercury mines and aqueous HgCl2 in mine waters. Noting that HgCl2 is a violent poison, such analysis should be taken into serious consideration.

Chronic BDE-47 exposure aggravates malignant phenotypes of endometrial cancer cells by activating ERK through GPR30 and ERα

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2,2',4,4-Tetrabromodiphenyl ether (BDE-47) is one of the most frequently detected polybrominated diphenyl ethers (PBDEs) in environmental and biological samples. Recently, the effect of BDE-47 on hormone-dependent cancers becomes compelling. Endometrial cancer (EC) is known as one of the estrogen-dependent cancer. However, the influence and underlying molecular events of BDE-47 involved

in EC progression remain to be elucidated. Methods Two EC cells (Ishikawa and HEC-1B) were continuously exposed to10 μM BDE-47 for 45 days, designating as Ishikawa-BDE-47 and HEC-1B-BDE-47. Then the BDE-47 effect on EC development were investigated through MTT assays, transwell assays and xenografts in mice. Hematoxylin-eosin staining and immunohistochemistry were used to assess the cellular morphology and metastatics. Western blotting (WB) was used to detect the protein expression. Furthermore, siERα or siGPR30 was transfected into Ishikawa-BDE-47 and HEC-1B-BDE-47 an pERK inhibitor or pEGFR inhibitor was also used to silent the expression of pERK or pEGFR in these two cells. Results Shikawa-BDE-47 and HEC-1B-BDE-47 cells exhibited an obvious increase in cell growth and metastatic ability in vitro and in vivo in contrast with the parental cells ($P < 0.05$). Upregulation of ERα and/or GPR30 accompanied with pEGFR and pERK expression were found in Ishikawa-BDE-47 and HEC-1B-BDE-47 cells. Downregulation of ERα and/or GPR30 through siRNA could reverse the positive effect of BDE-47 on the EC malignant progression. Besides, the relative cell proliferative values following pEGFR inhibitor or pERK inhibitor treatment was significantly reduced in Ishikawa-BDE-47 and HEC-1B-BDE-47. Simultaneously, the addition of pEGFR inhibitor or pERK inhibitor impaired the metastatic ability of Ishikawa-BDE-47 and HEC-1B. Conclusions BDE-47 could promote the proliferation, migration and invasion of EC cells in vitro and in vivo via the cross-talk between ERα/GPR30 and EGFR/ERK signal pathway.

Environmental and health risks assessment of artisanal small scale gold mining activities in western part of Nigeria

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This research critically reviewed the state of artisanal gold mining activities in Nigeria, its adverse effects on the environment and associated health hazards especially with regards to the use of mercury for gold processing. Geochemical assessment of stream sediments, soil and water samples within the vicinity of artisanal gold mine sites in both Southwestern and Central parts of Nigeria was carried out using ICPMS to determine concentration of toxic elements and the health impacts on the populace. Results of different contamination indices such as enrichment and contamination factors revealed that soil and sediments in the study areas showed extremely high enrichment with Zn, Mn, Fe, Th, La, Cr, Ti, Sc, Ce, Pr, Nd, Sm, Gd, Ta, Nb and In, significant enrichment with Pb, Co, W, Eu and Dy and low enrichment with Mo, Cu, Ag, Co, V, P, La, Ba, Al, Sn, Y. Potential ecological risk factor (RI) showed that soil and sediments in the study areas fall between low to considerable risk with toxic elements. Ninety percent of both soil and sediment samples showed that Total Health Risk Index (THI) values were above 1 which depicted great potential non carcinogenic health hazard for both young and adults in the study area. Twenty-five percent of the water samples showed pollution index (PI) above 1 with highest contribution (37.8%) from Pb. Mn, Al, Ni, Fe and As contributed 29.3%, 19.13%, 8.66%, 4.25% and 0.82% respectively. The health risk index

calculated for toxic elements through both ingestion and dermal exposure showed that 16% of the water samples were within unacceptable risk for non-carcinogenic adverse health effect based only on dermal exposure route and Cr, V, Mn, Sb, Fe and arsenic contributed highest to the risk. Cancer risk showed that only Arsenic exceeded acceptable risk for carcinogenic adverse health risk for children and adults and this make Arsenic to be carcinogenic in the water of the study area. It can be concluded that some toxic elements which include Pb, As, Ni, Cd, Al and Zn in the study area potentially have low to moderate non -carcinogenic risks to the mine workers especially the children and level of arsenic in water of the study area is already carcinogenic.

Emerging fluoride challenges to health of animals and humans in Kenya

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Fluoride which is essential at low concentrations exists in supra high concentrations in the some parts of the country where it elicits adverse health effects to humans and animals. Fluorosis occurs concurrently with the distribution of Esophageal Squamous cell carcinoma in the North to South Easterly lying corridor from Ethiopia to South Africa along or proximal to the Great Rift Valley. Odds ratio for ESCC is more than 14 times for persons with ESCC than not. Frequency of occurrence of oesophageal disorders – dysplacia, dysphagia and inflammation is compared between animals with fluorosis and those without. Apparent higher frequency of occurrence of dysphagia among animals in fluorosis afflicted areas than in non- affected areas suggesting that the condition may precede carcinogenesis. In view of the large numbers of thyroid disorders in Kenya the effects of fluoride on metabolism of iodine is examined in the Xenopus laevis bioassay system. The frog is highly dependent on thyroxine for completion of its metamorphosis and a standard Amphibian Metamorphosis Assay is carried out to assess the effects of fluoride on metamorphoses of the frogs. The results of our studies would help understand the emerging roles of fluoride in health conditions in Kenya.

Dental fluorosis and oral health in the African Esophageal Cancer Corridor: Findings from the Kenyan case–control study and a pan-African perspective

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There are no studies of oral health in relation to esophageal cancer in Africa, or of Eastern Africa's endemic dental fluorosis, an irreversible enamel hypo-mineralization due to early-life excessive fluoride intake.

During 2014–18, we conducted a case–control study of squamous cell esophageal cancer in Eldoret, western Kenya. Odds ratios (AORs (95% confidence intervals)) were adjusted for design factors, tobacco, alcohol, ethnicity, education, oral hygiene and missing/decayed teeth.

Esophageal cancer cases (N = 430) had poorer oral health and hygiene than controls (N = 440). Compared to no dental fluorosis, moderate/severe fluorosis, which affected 44% of cases, had a crude OR of 20.8 (11.6, 37.4) and on full adjustment was associated with 9.4-fold (4.6, 19.1) increased risk, whilst mild fluorosis (43% of cases) had an AOR of 2.3 (1.3, 4.0). The prevalence of oral leukoplakia and tooth loss/decay increased with fluorosis severity, and increased cancer risks associated with moderate/severe fluorosis were particularly strong in individuals with more tooth loss/decay. Using a mswaki stick (AOR = 1.7 (1.0, 2.9)) rather than a commercial tooth brush and infrequent tooth brushing also independently increased risk. Geographic variations showed that areas of high esophageal cancer incidence and those of high groundwater fluoride levels have remarkably similar locations across Eastern Africa.

In conclusion, poor oral health in combination with, or as a result of, high-altitude susceptibility to hydro-geologically influenced dental fluorosis may underlie the striking co-location of Africa's esophageal cancer corridor with the Rift Valley. The findings call for heightened research into primary prevention opportunities of this highly fatal but common cancer.

The impact of phenanthrene on immune cytokines related to T-regulatory cell function in liver and lung of female rats

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Our previous study found associations between impairments of immune functions and exposure to polycyclic aromatic hydrocarbons (PAHs) in rural women. Meanwhile, Phenanthrene (Phe) was found that ranked in the first place of the 16 PAHs in the local atmosphere. So, the aim of this study was to further explore the impact of Phe (one of biomarkers of PAHs) on immune changes in liver and lung of female rats.

Wistar female rats were randomly divided into control (C), low (L) and high (H) groups and administered Phe orally with the doses equivalent to 10% and 50% of the LD50 (180 mg/kg and 900mg/kg) at first day, and by intraperitoneal injection with the dose (90mg/mg and 450 mg/kg) at the last two days. The control rats received the same volume of corn oil. The 8-hydroxy-2-deoxyguanosine (8-OHdG), malonaldehyde (MDA) and superoxide dismutase (SOD) were measured to evaluate oxidative damage and the interleukin 6 (IL-6) and tumor necrosis factor-α (TNF-α) were detected to evaluate inflammation and immune regulation. Immunoglobulin E (IgE), and protein and gene expressions of forkhead box

transcription factor 3 (Foxp3), transforming growth factor-β (TGF-β), interleukin 10 (IL-10) and interleukin 35 (IL-35), composed of interleukin-12alpha (IL-12a) and Epstein-Barr-virus-induced gene 3 (EBi3), were examined to

evaluate Treg cells related immune functions. The results showed that IgE and the protein and mRNA expressions of TGF-β, IL-10, Foxp3, IL-12a and EBi3 were all decreased significantly in the H groups both in lung and liver ($p < 0.05$, Fig. 1 A-H). Meanwhile, 8-OHdG, SOD and MDA were significantly increased

in H groups in lung and liver ($p < 0.05$, Fig. 1 I-K). In addition, there were significant increases in the protein and mRNA expressions of TNF-α and IL-6 in the H groups of lung and liver ($p < 0.05$). Therefore, the results suggested that an obvious change of Phe exposure might be associated with oxidative damage and the repression on Treg cells function and Phe exposure possibly could induce immune impairments.

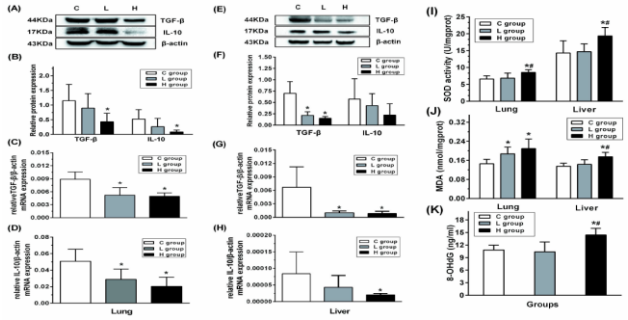

Fig. 1 The protein and mRNA expressions of TGF-β and IL-10 in lung and liver, and the levels of SOD, MDA and 8-OHdG

(n =5). Significant differences from the C group and L group at *p< 0.05 and #p< 0.05, respectively.

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Selenium and iodine interaction with calcareous soil minerals

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Background. Selenium and iodine are essential trace elements; they are required in low amounts by humans and animals but are toxic when ingested at high concentrations. The two elements have some common geochemical properties and sources so knowledge of how Se and I interact with soils is important in understanding factors affecting transfer into the food supply. Both Se and I are thought to interact mainly with Fe oxides and humus in soils. However, in calcareous and gypsiferous soils CaCO3 and CaSO4.2H2O may also provide important sinks and control bioavailability to crop plants.

Aims. The aim of this study was to increase understanding of how selenium and iodine are adsorbed in calcareous and gypsiferous soils.

Methods. The overall study combined a field survey of soils and ground water from Somalia alongside laboratory experiments examining I and Se interactions with calcite and gypsum. Sequential extraction (0.01 M KNO3, 0.016 M KH2PO4, 10% TMAH) and batch isotopic dilution studies using enriched 77Se and 129I were undertaken to determine adsorption and reactivity of inorganic I and Se species.

Results. Average total selenium and iodine in the Somali soils were c. 0.4 mg kg-1 and 5 mg kg-1 respectively but only c. 4% of the total soil Se and I was 'available' (extraction with KNO3 and KH2PO4). Ground waters in the region have relatively high iodine concentrations (c. 1700 □g L-1) which are used for irrigation. Batch experiments revealed that CaCO3 has the potential to act as a sink for selenite (Kd c. 100)

and, to a lesser extent, for selenate. Isotopic dilution using enriched 77Se suggest that isotopically exchangeable selenite was approximately 70% of recently adsorbed (5 days) selenite. Iodine adsorption on calcite revealed that more iodate (Kd c. 30) is adsorbed compared to iodide, and virtually all the adsorbed iodate remained isotopically exchangeable. Adsorption of I and Se on gypsum was much weaker.

Conclusions. Calcite is an important sink for selenium and iodine in soils, with a higher affinity for selenite and iodate compared to selenate and iodide species. Adsorption of freshly added Se and I (e.g. in irrigation water) occurs rapidly (< 24 hr) and a large proportion remains labile at least for several days following adsorption. However, the low lability of the native Se and I therefore suggests that there are longer-term fixation processes in the calcareous soils which may involve other constituents, such as humus.

Session 6: Sustainable Nutrition & Agriculture

Improving grain storage structures for smallholder farmers in Mozambique and Zambia

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Food and nutrition security in Sub-Saharan Africa (SSA) remains at risk due to the volatility and rapid increases in food prices, natural disasters and climate change effects. Post-harvest losses (PHL) at smallholder farm level are some of main challenges in most of SSA. For instance, the PHL of cereal and pulses are reported to be over 35%, thereby contributing significantly to food insecurity in rural and urban households in Mozambique and Zambia. PHL in SSA can be attributed to poor storage infrastructure. One of the most sustainable ways to ensure crop productivity, food and nutrition security is to reduce PHL and simultaneously lower the burden on the environment. This can be achieved by use of storage infrastructures such as Polyethylene and metal silo tanks, (PST and MS) apart from the Local grain bag (LGB), which have not been largely promoted in SSA.

On-station and on-farm trials in parts of Mozambique and Zambia, differentiated by climatic conditions, showed that SGB, MS and PST were 88%, 76% and 55% better than LGB, respectively. At 95% confidence level, there were significant differences among the treatments. However, under farmer conditions, there were no significant differences between the PST, SGB and MS in terms of insect pest infestation. There were more insects observed in the LGB compared to the other structures. This means that the PST and SGB, as well as the MS were the most effective structures in maize and cowpea storage due to less infestation of insects which are the major storage problems among smallholder farmers in Mozambique and Zambia.

The Impact of Conservation Agriculture on Soil Quality

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Conservation Agriculture (CA) has been of great promotion in Zambia as a way to mitigate some of the negative effects that exists because of the unsustainable methods of farming. However, Conservation Agriculture provides a good number of possible benefits on the soil properties. The benefits are dependent on the different management practices as well as the agro ecological regions.

The study was conducted so as to assess the effects of CA on selected soil properties and

their relationship to crop productivity in different systems. Soil samples were collected at 0-20 cm from all the 5 representative fields for each treatment (conventional tillage (maize), CA-maize and cowpea intercropped, CA-rotation-maize and cowpea phases, and CA-sole maize which were replicated 6 times. The results reveal that pH, organic carbon, calcium and available phosphorus were significantly higher in CA sole maize, CA rotation maize phase, CA rotation maize phase and conventional tillage, respectively, than in the other practices and total nitrogen was highest in CA intercrop and rotation maize phase. The levels of soil pH, total nitrogen, organic carbon and available P were dependant on the management practices, amount and type of residue, and the presence of the nitrogen fixing legume in the system. CA sole maize and CA rotation maize phase were consistent in giving higher levels of all the measured properties. The results indicate that CA improves different aspects of soil fertility and it would be recommended to study the different CA practices in segregation in order to have an improved understanding of their individual contributions towards improvement of soil fertility.

The unsustainability of intensive plough systems compared to minimum tillage systems

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Like the rest of the developing world, agriculture in Zambia is beset with multiple problems including low use of fertilizers, little access to appropriate soil fertility practices and use of poor land husbandry practices resulting in low crop yield An on-station experiment was conducted for two cropping seasons in two sites, Monze and Choma, with contrasting soil environments located in the low to medium rainfall agro ecological zone of southern Zambia. The overall aim of the study was to evaluate organic/inorganic fertilizer combinations under minimum tillage systems compared to conventional plough on maize grain yield and selected soil chemical properties. Animal manure was applied at 0, 1, 2, 4 and 8 t ha-1. All treatments received a blanket application of lime in the first year and basal dressing fertilizer (Compound D: 10N, 20P, 10K and 6S) was applied at half of the 200 kg ha-1 recommended rate in both seasons. Maize (Zea mays) was the test crop. Initial soil characterization was carried out. Changes in soil properties were monitored at the end of each cropping season from samples taken from the various treatments. There was a significant increase in exchangeable calcium at subsurface level. The increase was both directly below point where treatments had been applied and away from point of application suggesting influence of manure on vertical and lateral movement of the cation. There was a concomitant increase in soil pH suggesting influence of the lime on sub-soil acidity in the presence of manure The first season grain yields were better (up to 5t ha-1) than in the second season (3.7 t ha-1) but were less reflective of the incremental manure treatments probably due to the compounding fertilizer effects of the previous land use on the trial site. Accordingly in the second season the yield increased with increase in manure treatment rates at both sites under CA tillage practices. On the other hand, greater benefits of fertilizer were seen with 2 t ha-1 manure under conventional tillage while

rates above 2 t ha-1 gave lower crop yield probably due immobilization enhanced by larger surface area resulting from ploughing. These results signifies the efficiency of CA tillage systems and their potential sustainability for crop production over conventional tillage systems.

Agronomic bio-fortification of leafy vegetables with iodine in vertisols, oxisols and alfisols

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Prevalence of iodine deficiency disorders (IDD) in Sub-Saharan countries is related to low soil iodine content. To combat IDD salt iodisation has been adopted by many countries. However, this approach is affected by losses during cooking and storage of salt. Furthermore, availability of iodised salt depends on the socio-economic status of communities. Agronomic bio-fortification of food crops may be an alternative way to increase iodine status in populations. This study aimed to assess the effectiveness of iodine bio-fortification in tropical soils with contrasting chemistry and fertility; soils included an oxisol (pH = 4.2), an alfisol (pH = 5.8) and a vertisol (pH = 8.4). Three levels of sodium iodide (NaI) were assessed (0, 5 and 10 kg ha-1), using both foliar and soil application methods. The leafy vegetables tested were Brassica napus L and Amaranthus retroflexus L grown in an RCBD factorial experiment replicated four times. Leaf samples were collected fortnightly, starting from 14 days after iodine application, on five occasions. Iodine concentration and uptake showed a sharp drop > 60 % and > 80 % in A. retroflexus and B. napus by 28 days after iodine application in all soil types and both iodine levels and application methods.

The drop in iodine concentration and uptake might be because of iodine fixation in the soil, depletion and immobility within the folia applied plant. Soil application method was more efficient in vertisols while foliar application was observed to be more effective in all soil types. Iodine bio-fortification was therefore observed to increase iodine concentration, uptake by green vegetables and intake by humans and could be a way to reduce IDD in tropical regions. Biofortification of green vegetables which are subject to multiple harvests requires repeated application and this may raise logistical difficulties for smallholder farmers.

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