Book of Abstracts

ISEH 2016, ISEG 2016 & Geoinformatics 2016

ISEH 2016: The 3rd International Symposium on Environment and Health
ISEG 2016: The 10th International Symposium on Environmental Geochemistry
Geoinformatics 2016: The 24th International Conference on Geoinformatics

National University of Ireland, Galway.
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http://www.nuigalway.ie/iseh2016/

Conference Programme

http://programme.exordo.com/iseh2016/

Conference Venue

Arts/Science Building,
National University of Ireland, Galway, Ireland.

Conference Secretariat

Go West Conference & Event Management Ltd
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Welcome Message

On behalf of the Steering and Organizing Committee of the joint international Conference of ISEH 2016, ISEG 2016 & Geoinformatics 2016 on Environment, Health, GIS and Agriculture, I would like to extend my warmest welcome to all delegates from all over the world.

The joint international conference provides a historical opportunity for international experts working in several closely related areas of environment, health, geographical information system (GIS) and agriculture, to meet and share the latest understanding of the ever growing challenges between human and our changing environment. As a joint conference, delegates are allowed and encouraged to attend any sessions of the conferences and to extend their academic networks. This approach of conference organisation maintains the traditional identities of ISEH, ISEG and Geoinformatics conference series while provides a new opportunity of networking for all delegates.

The themes of the conference include the most challenging issues that human beings are currently facing. With the economic development and improvement of our quality of life, the environment around us is under pressure, and often deteriorated. The themes cover a wide range of topics within the environment, health, GIS and Agriculture spheres, with all the details in the Book of Programme.

To complement the academic programme of the conference, we have also organized two conference field trips to the Burren and Cliffs of Moher, Connemara and the Aran Islands as well as a number of unforgettable social events.

Galway is a popular tourist destination, attracting more than 1 million international visitors annually. Conference delegates and their accompanying persons will undoubtedly make significant contribution to the local economy.

I hope Galway will provide you a good experience with its well preserved Irish tradition, hospitality and natural beauty. Thank you and have a nice time in Galway!

Dr. Chaosheng Zhang 张朝生
Chair
ISEH 2016, ISEG 2016 & Geoinformatics 2016
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Abstracts for Oral Presentations
KEYNOTE APPLICATION OF GLOBAL HIGH-RESOLUTION EMISSION INVENTORIES OF AIR POLLUTANTS FROM COMBUSTION SOURCES AND THEIR APPLICATION

Monday, 15th August - 10:00 - KN-1.01 - Keynote Speech (Joint Conference) - Keynote

Prof. Shu Tao

1College of Urban and Environmental Sciences, Peking University, Beijing 100871, China.

A set of global emission inventories were compiled for major air pollutants including primary particulate matter (TSP, PM10, PM2.5), BC, OC, SO2, NOx, polycyclic aromatic hydrocarbons (PAHs), and Hg. Spatial resolution of 0.1 by 0.1 degree was achieved by using sub-national fuel data instead of national data to reduce spatial bias caused by population density based disaggregation. A spatial-for-time substitution method was developed to test a hypothesis that spatial and temporal variations of energy consumption are affected by the same factors. The method was use to simulate monthly and daily variation of the energy consumption and emissions. Most importantly, the inventories include 81 individual sources, which is useful for providing policy makers with critical information for abatement strategy development.

The inventories were used to model atmospheric transport of various pollutants. For example, exposure of global population to ambient air benzo(a)pyrene was simulated and lung-cancer morbidity induced by the exposure were evaluated. Similarly, health risk of inhalation exposure to ambient PM2.5 was assessed on global scale. A simulation was conducted to distinguish influences of emissions and meteorological conditions on ambient air PM2.5 contamination.
DUST INGESTION RATES FOR GUIDELINE DEVELOPMENT AND HUMAN HEALTH RISK ASSESSMENT

Monday, 15th August - 11:45 - OS-1A.01 - Indoor Particles - Oral

Mr. Ross Wilson
1

1Wilson Scientific

Importance of the Work and Objectives: Dust ingestion rate is a key input parameter in the development of indoor dust guidelines and human health risk assessment of substances in indoor dust; however, dust ingestion rates have received relatively little attention in the scientific literature. Consequently, there was a need to develop estimates of dust ingestion rates.

Methodologies: A mechanistic method was developed that incorporates the concept of hand-to-mouth transfer to estimate indoor dust ingestion rates. The approach provides indoor dust ingestion rates as “mg/day” and “m²/day” such that these results can be applied to measurements provided as either bulk dust (where contaminant concentrations are presented in units of “µg/g”) or surface loadings (where contaminant concentrations are presented in units of “µg/m²”). The methods incorporated both deterministic and probabilistic techniques.

Main Results and Conclusions: For residences that are comprised of similar proportions of hard and soft surfaces, mean indoor dust ingestion rates were estimated to range from 2.2 mg/day for teenagers to 41 mg/day for toddlers. For consideration of surface loadings, the analysis resulted in estimated mean dust intakes that range from 0.0032 m²/day (for teenagers) to 0.061 m²/day (for toddlers). Ingestion rates assuming 100% hard surfaces and 100% soft surfaces were also estimated. The values provided are intended to assist the interpretation of indoor dust investigations where substance content is presented as either surface loadings or bulk dust concentrations.
RARE EARTH ELEMENTS IN HOUSE DUST: LOADING RATES VERSUS CONCENTRATIONS

Monday, 15th August - 11:45 - OS-1A.02 - Indoor Particles - Oral

Dr. Pat Rasmussen¹, Mr. H. David Gardner², Ms. Christine Levesque³, Mr. Marc Chenier³

¹Health Canada and University of Ottawa, ²University of Ottawa, ³Health Canada

Importance and objectives: The Canadian House Dust Study (CHDS) provides nationally representative baseline information about the geochemistry of urban house dust. House dust contains a wide variety of compounds from both indoor and outdoor sources, and is a useful medium for assessing residential exposures. In this study, element loading (ng/sq m/day) is examined as a function of the dust loading (mg/sq m/day) and the element concentration (µg/g) in the settled dust, with focus on the rare earth elements (REE).

Methodologies: “Active” or fresh dust was collected from 1025 urban homes according to sampling protocols developed to obtain different measures of elements in house dust – concentration and loading rate - which provided complementary types of information for risk assessments. REE were determined in the <80 micron fraction, using INAA for Sc-21 and ICP-MS for Y-39, La-57, Ce-58, Pr-59, Nd-60, Sm-62, Eu-63, Gd-64, Tb-65, Dy-66, Ho-67, Er-68, Tm-69, Yb-70 and Lu-71.

Main results: Loading rates for all REE are significantly higher (p <0.01) in homes occupied by smokers than in homes occupied by non-smokers, which is partly attributable to the significantly higher dust loading rate in homes of smokers (geomean = 12.6 mg/sq m/day) compared to homes of non-smokers (geomean = 9.2 mg/sq m/day).

Conclusions: Concentration data are useful for identifying sources of REE in the home, including building materials and consumer products. However it is dust levels within the home and the dustiness of the external environment that are the important drivers of exposure.
LUNG BIOACCESSIBILITY OF METALS IN PARTICULATE MATTER FROM CONTAMINATED SOILS AND MINE TAILINGS

Monday, 15th August - 11:45 - OS-1A.03 - Indoor Particles - Oral

Prof. Gerald J. Zagury, Dr. Mert Guney, Mrs. Clothilde M. J. Bourges, Prof. Robert P. Chapuis

1Polytechnique Montreal

Human exposure to particulate matter (PM) has been associated with adverse health effects. While inhalation exposure to airborne PM is a prominent research subject, exposure to PM of geological origin has received less attention. Inhalation of PM from contaminated soils or mine tailings into residential environments may impact both indoor and outdoor exposures. Thus, exposure assessment warrants the use of in vitro bioaccessibility testing to predict lung bioavailability of metals. The present study aims to (1) characterize contaminated soils (n=6) and mine tailings samples (n=3) for As, Cu, Fe, Mn, Ni, Pb, and Zn content; and, (2) determine elemental lung bioaccessibility in PM20 by using Gamble’s solution (GS) and artificial lysosomal fluid (ALF). Metal concentrations were elevated in bulk samples, particularly for As (up to 2,040 mg.kg⁻¹), Fe (up to 59.8%), Mn (up to 6,510 mg.kg⁻¹), and Zn (up to 4,060 mg.kg⁻¹) and metal concentrations in PM20 were almost always higher. In vitro tests using ALF predicted higher bioaccessibility than the ones using GS. Bioaccessibility in ALF solution was high for all elements after 2 weeks of testing (e.g. concentrations up to 1,730 mg.kg⁻¹ for As; percentages up to 67.6% for Fe). The solubilisation rate of elements was very high after 2 h, and then declined rapidly and continuously with time. As a result, percent bioaccessibility increased rapidly and tended to reach a plateau with time. Additional research on the bioaccessibility of toxic elements in PM of geological origin as well as on human health risk characterization is recommended.
A pilot survey focusing on potentially toxic elements (PTE) in house dust and toenails of residents from the industrial city of Estarreja was carried out for purposes of environmental exposure assessment studies. A total of 21 households and 30 individuals were recruited for the pilot study. Whereas the exposure–biomarker association is subject to variation due to receptor-related and environmental factors, investigation on such factors was carried out via questionnaire data. Ethics approval was obtained from the National Committee for Data Protection (Proc. nº 1241/2013). This study aims at investigating relevant ambient factors influencing exposure to environmental Pb, as determined by its levels in human toenails. Total Pb concentrations in the indoor dust (mean: 174 mg kg⁻¹) are higher than in outdoor dust (mean: 121 mg kg⁻¹) although the differences are not statistically significant. Furthermore, average indoor dust Pb concentration for Estarreja is above the one of the control sites. Whilst levels of Pb are higher in toenail clippings from the exposed group, the differences are not statistically significant (p > 0.01). A random forest machine learning algorithm was used as a screening tool to check which of the possible 53 elements determined in the house dust and 19 household related environmental factors from the questionnaire could account for the elemental compositions of the toenail samples. Preliminary evaluations suggest that in addition to Pb, other PTEs such as Ag and Cu in toenails may relate to the household environment.
BIOACCESSIBILITY AND BIOAVAILABILITY OF AS AND PB IN HOUSEDUST

Monday, 15th August - 11:45 - OS-1A.05 - Indoor Particles - Oral

Prof. Lena Ma\textsuperscript{1}, Dr. Hong-bo Li\textsuperscript{1}, Ms. Jie Li\textsuperscript{1}, Dr. Albert Juhasz\textsuperscript{2}

\textsuperscript{1}Nanjing University, \textsuperscript{2}University of South Australia

Reliable assessment of human health risks from exposure to As and Pb in housedust depends on their bioavailability. In vivo animal assays to estimate As and Pb relative bioavailability are costly so in vitro assays have been developed. However, they need be correlated to in vivo animal data before they can be used to estimate As/Pb bioavailability. The <150 µm fractions of 24 housedust samples containing 4.48–38.2 mg kg\textsuperscript{-1} As and 25.0–738 mg kg\textsuperscript{-1} Pb were analyzed using gastric and intestinal phases of four in vitro assays including SBRC, IVG, DIN, and PBET. Twelve housedust samples were assessed for As and Pb relative bioavailability (RBA) using a mouse blood AUC model. Both As and Pb bioaccessibility varied significantly with in vitro assays. In the gastric phase, the SBRC produced the highest As and Pb bioaccessibility (73 and 78%) compared to IVG (68 and 70%), DIN (53 and 46%), and PBET (49 and 41%) assays. Lead bioaccessibility in the intestinal phase of the 4 assays were considerably lower. Based on the mouse blood model, As-RBA was 22-86% with samples containing low Fe and high OC having higher As-RBA, while Pb-RBA was 29-60%. Strong in vivo–in vitro correlations were found between As-RBA and As bioaccessibility for SBRC and DIN (r\textsuperscript{2}=0.63–0.85). Similarly, Pb bioaccessibility based on the gastric phase of SBRC and DIN assays was correlated with Pb-RBA (r\textsuperscript{2} = 0.68 and 0.85). Our data suggested that both SBRC and DIN had potential to assess As and Pb bioavailability in housedust samples.
GEOCHEMICAL BACKGROUND OF SOME POTENTIALLY TOXIC AND ESSENTIAL TRACE ELEMENTS IN SOILS AT THE NADOWLI DISTRICT OF THE UPPER WEST REGION OF GHANA

Monday, 15th August - 11:45 - OS-1B.01 - Geochemical Mapping with EuroGeoSurvey - Oral

Dr. Emmanuel Arhin¹, Mr. Saeed Zango¹
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Use of universal baseline values such as continental crustal averages to assess related health issues from trace elements in environmental soils may be fraught with challenges because the method only considers unmineralized rocks and soils in the determination of average crustal abundances or background values. Likewise legislated guideline values are also for specific geographic locations in the environments. None of these takes into accounts the human activities at a particular local community as the environmental conditions have dire influence on trace element mobility, concentrations and storage in the surface soils. The 29 trace element samples collected from soils up to the depth of 20 cm were analysed using ICP-MS analytical technique. The results of the trace element concentrations were analysed statistically and graphically to isolate sets of background values that are better suited locally to identify and assess trace elements contaminated and depleted areas. Local background values of 15.00 ppm was estimated for As, 0.02 ppm for Cd, 0.01 ppm for Hg, 35.0 ppm for Zn, and 20.0 ppm for Cu and 0.40 ppm for Se. For clean-up goals in environmental legislation and for the assessment of trace elements impacts on health in Nadowli District these background values should be used.
A MACHINE LEARNING APPROACH TO GEOCHEMICAL MAPPING

Monday, 15th August - 11:45 - OS-1B.02 - Geochemical Mapping with EuroGeoSurvey - Oral

Mr. Charlie Kirkwood¹, Dr. Mark Cave¹, Dr. David Beamish¹, Dr. Stephen Grebby¹, Dr. Antonio Ferreira¹

¹British Geological Survey

Geochemical maps provide invaluable evidence to guide decisions on issues of mineral exploration, agriculture, and environmental health. However, the high cost of chemical analysis means that geochemical survey sampling density will always be limited. Traditional geochemical maps, produced by spatial interpolation alone, are therefore limited in resolution and lack useful fine-scale accuracy. A possible solution to this problem comes from implementing models that form predictions on the basis of high resolution auxiliary information instead. This study uses quantile regression forests (an elaboration of random forest) to investigate the potential of high resolution remote sensing and geophysical survey data to support the generation of accurate and interpretable geochemical maps in south west England. A summary of their performance is presented.

Through stratified 10-fold cross validation we find the accuracy of quantile regression forests in predicting soil geochemistry in south west England to be a general (but not quite unanimous) improvement over that offered by ordinary kriging. The concentrations of immobile elements whose distributions are most tightly controlled by bedrock lithology are predicted with the greatest accuracy (e.g. Al with a cross validated R² of 0.79), while the concentrations of more mobile elements prove harder to predict. In addition to providing a high level of prediction accuracy, models built on high resolution auxiliary variables allow for informative, process based, interpretations to be made. In conclusion, this study has highlighted the ability to map and understand the surface environment with greater accuracy and detail than previously possible by extracting information from multiple datasets.
GEMAS - GEOCHEMICAL MAPPING OF AGRICULTURAL SOIL OF EUROPE: NEW DEVELOPMENTS

Monday, 15th August - 11:45 - OS-1B.03 - Geochemical Mapping with EuroGeoSurvey - Oral

Dr. Clemens Reimann¹, Prof. Joerg Matschullat², Dr. Karl Fabian¹, Dr. Martin Klug¹, Prof. Danis Nurgaliev³, Dr. GEMAS Project Team⁴

¹Geological Survey of Norway, ²TU Bergakademie Freiberg, ³Kazan (Volga region) Federal University, ⁴EuroGeoSurveys

Geochemical Mapping of Agricultural Soils (GEMAS) is a cooperative project between the Geochemistry Expert Group of EuroGeoSurveys (EGS), Eurometaux and a number of external project partners. 2108 samples of agricultural (0–20 cm, Ap horizon) and 2024 samples of grazing land (0–10 cm, Gr) soil were collected in 2008 at a density of 1 site/2500 km² in Europe. Results were presented in a Geochemical Atlas in 2014, the GEMAS atlas. Since then ongoing investigations are primarily focused on the Ap samples. Total C, N, S were measured with an Elementar Vario EL Cube with very low detection limits. New maps for total N and for the C/N-ratio in European agricultural soil can thus be presented.

High-resolution HDR color images of dry and moist Ap samples were acquired using a GeoTek Linescan camera. Soil color variations can be directly presented in new maps.

Low (460 Hz), and high frequency (4600 Hz) magnetic susceptibility k were measured using a Bartington MS2B sensor. Hysteresis properties were determined by a J-coercivity spectrometer, built at the paleomagnetic laboratory of Kazan University, providing for each sample a modified hysteresis loop, backfield curve, acquisition curve of isothermal remanent magnetization, and a viscous IRM decay spectrum from zero field up to 1.5 Tesla and back to -1.5 Tesla. The resulting data are used to create the first continental-scale maps of magnetic soil parameters.
ASSESSING EQUIVALENCE BETWEEN GEOCHEMICAL DATASETS AND LEVELING DATA WHEN MAPPING AN AREA COVERED BY MULTIPLE GEOCHEMICAL DATASETS

Monday, 15th August - 11:45 - OS-1B.04 - Geochemical Mapping with EuroGeoSurvey - Oral

Mr. Benoît Pereira¹, Mr. Aubry Vandeuren¹, Prof. Bernadette Govaerts¹, Prof. Philippe Sonnet¹

¹Université catholique de Louvain

In many parts of the world, multiple geochemical datasets are available for cartographers when mapping a region. Using multiple datasets for regional geochemical mapping can be highly beneficial for establishing geochemical maps with increased resolution and/or coverage area. This practice involves assessing the equivalence between datasets and, if needed, applying data leveling to correct possible biases between datasets. Here we present two original methods for assessing equivalence and for leveling data when datasets contain records that are located within the same perimeter. The first method is designed for datasets similarly spatially distributed and is based on the Kolmogorov-Smirnov test and quantile regression. The second method does not require datasets to be similarly spatially distributed and is based on the prior knowledge about the factors explaining the geochemical concentrations and on Bivariate Least Squares regression. The scope of application, pros, cons and detailed practical recommendations are presented for each method. Both methods were then applied to a case study involving Fe, V and Y datasets originating from two European geochemical mapping projects: the Geochemical Mapping of Agricultural Soils of Europe (GEMAS) and the Baltic Soil Survey (BSS). The two methods yielded similar results thereby suggesting that they are both reliable and effective enough to take advantage of the steadily increasing number of geochemical datasets available for mapping a region.
WATERSHED ANALYSIS AND INVERSE DISTANCE WEIGHTED INTERPOLATION OF STREAM SEDIMENTS COMPOSITION FOR THE GEOCHEMICAL MAPPING AND ENVIRONMENTAL RISK ASSESSMENT OF THE VOLTURNO RIVER BASIN (SOUTHERN ITALY)

Monday, 15th August - 11:45 - OS-1B.05 - Geochemical Mapping with EuroGeoSurvey - Oral

Dr. Maria Clara Zuluaga¹, Ms. Daniela Zuzolo², Prof. Domenico Cicchella², Prof. Stefano Albanese¹, Prof. Annamaria Lima³, Dr. Gianluca Norini⁴, Prof. Benedetto De Vivo¹

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Geochemical analysis of stream sediments is used for mining exploration and environmental studies. For this purpose, two main different types of spatial analysis of the analytical results are commonly used to produce geochemical maps. The first method uses geostatistics interpolators based on samples proximity, like the Inverse Distance Weighted interpolator (IDW). The second method is based on the catchments delineation upstream from the sampling points.

In this study the two mapping methods are compared, analyzing the geochemistry of stream sediments in the Volturno river basin (5,455 km²). 998 stream sediment samples were collected, prepared and analyzed with ICP-MS for 53 elements. These geochemical data were processed with a statistical analysis. Then, the spatial distribution of the elements concentration was analyzed in a Geographic Information System (GIS), using the two mapping methods mentioned above. The samples have been split into two sets: 900 samples for the geochemical mapping, and 98 samples as tests for accuracy analysis.

The geochemical maps based on the watersheds delineation show better accuracy in the mountainous areas, where the topography has a high impact on the spatial distribution and dispersion in the environment of the elements. Instead, IDW, based only on the proximity of the sampling points on a map, which not necessarily imply that they share correlated variables, is less accurate in mountain areas, but shows better performance in the gentle alluvial plains, where elements transport is less influenced by gravity and slope.
A VULNERABILITY ANALYSIS FOR URBAN POPULATION TO AIR-BORNE PARTICULATE MATTER AND PAHS: EVIDENCE BASED EXPOSURE ASSESSMENT FOR HEALTH PROMOTION

Monday, 15th August - 11:45 - OS-1C.01 - Health Risk A - Oral

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This study was conducted in urban area of Rawalpindi city with an aim to analyze population exposure to particulate matter (PM) and PAH in relation to their vulnerability for disease susceptibility. Biomonitoring study using serum naphthalene, pyrene and urinary 1-hydroxyprene was also conducted to quantify PAH exposure. The health risks based on self-reported health status was also noted using a questionnaire. Results of HPLC based serum analysis showed that mean concentration of blood naphthalene was 106 g L⁻¹ which had significant correlation with cigarette smoking by (r=0.49; p<0.01). However, pyrene body burden (mean 19.18 g L⁻¹) appeared to be a significant predictor of urinary 1-hydroxyprene pyrene (69.9 mol mol⁻¹ creatinine). There was fairly high significant effect of daily work-hours and job duration on serum pyrene levels. Workers exposed to 6 hour per day or more had significantly high prevalence of physical disorders (OR=2.79, 95% CI=1.28–6.09). Neurasthenic symptoms were found in 65% of the subjects and were associated with years of involvement in job. Ten years or more occupational work at petrol pumps attributed substantial development of neurasthenic effects (OR=2.80, 95% CI=1.23–6.34). We conclude that subjects associating disturbances in physical and neurological behavior with petrol related occupation rated their overall health and functional capacity significantly poorer than that of urban area general population. A direct relationship between exposure to PM with population illness was observed especially during winter. To promote health of occupational groups, reduction in work hours and provision of masks and gloves could be introduced as health interventions.
DEVELOPING EXPOSURE BIOMARKERS FOR ENVIRONMENT HEALTH IMPACTS ASSESSMENT TO APPLY ECOHEALTH AND MEDICAL GEOLOGY APPROACH IN URUGUAY

Monday, 15th August - 11:45 - OS-1C.02 - Health Risk A - Oral

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¹University of the Republic of Uruguay (UDELAR)

Environmental and public health studies with Ecohealth and/or Medical Geology approach require the contributions of environmental and public health research areas with integration of stakeholders, in order to address regional transdisciplinary actions with a global perspective. However, local capabilities and resources not always are sufficiently developed for global strategies’ national implementation.

Human biomonitoring data in public health risk assessment play an important role establishing relationships between specific human health adverse effects and environmental chemicals exposure. This study highlights the importance of developing locally available analytical tools for appropriate biomarkers to assess human chemicals exposure risks. The focus is on the integration of multidisciplinary knowledge and transdisciplinary thinking towards the benefit of community health, ecosystems and Uruguayan society.

Lead is an example of a well known environmental toxic chemical pollutant that can be absorbed and cause adverse health effects on susceptible living organisms. Blood lead level (B-Pb) is the main biomarker of exposure. However, in Uruguay this environmental problem became of public concern recently. Uruguayan human populations (infants, children, adults, workers) lead studies were conducted to show the incidence of different variables on B-Pb. Then, health benefits of medical intervention, nutrition, regulations and environmental education were demonstrated by a statistically significant decrease of their B-Pb.

Ongoing multidisciplinary projects in Uruguay, with locally developed biomarkers for other metals (arsenic, zinc, mercury, chromium, cadmium) used in health impacts assessment studies, are also described to show the relevance of this practice for the consolidation of Medical Geology and Ecohealth approach at a local level.
POTENTIAL OF SPINACH FOR PHYTOREMEDIATION OF SOILS COLLECTED FROM KETTE BATOURI GOLDSMINES, CAMEROON

Monday, 15th August - 11:45 - OS-1C.03 - Health Risk A - Oral

Dr. Georgina Arthur¹, Dr. Adeyemi Aremu², Dr. Manoj Kulkarni², Dr. Wendy Stirk², Prof. Theophilus Davies¹, Prof. Johannes van Staden²

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The mining sector in sub-Saharan Africa is one of the main sources of potentially harmful elements (PHEs) that enter the water, air and soil environment. PHEs from existing and abandoned mines impact negatively on ecosystems, and may enter the food chain, posing nutritional health challenges to humans and animals, and possibly death. Crops have different nutrient absorptive capacities; and depending on available elements in the soil, they accumulate different amounts in their various tissues. Our study assessed the concentrations, toxicity potential and phytoavailability of PHEs in two different soil samples collected from Kette Goldmines at Batouri in the Eastern Region of Cameroon using inductively coupled plasma mass spectrometry (ICP-MS). Thereafter, the soil samples were mixed with different proportions (0, 25, 50, 75 and 100%) of potting soil to reduce the levels of the PHEs, and spinach (Spinacia oleracea) grown to determine its tolerance to, and bioaccumulation potential for, the PHEs identified. More than 60 elements were quantified in both soil samples with iron (31499-33964 mg/kg) and aluminium (6701- 6815 mg/kg) being the most abundant. Analysis of spinach samples is on-going using ICP-MS to ascertain bioaccumulation factors, pollution indices and other growth parameters. Overall, our findings will provide an essential science-based information on phytotechnology that can be crafted into tools to educate farmers and indigenous people within the vicinity of mine sites. Such knowledge will guide their choice of appropriate methods that will ensure reclamation and restoration of soil health for sustainable agriculture.

Keywords: Ecosystem, PHEs, Pollution, Phytoremediation, Spinacia oleracea
ENVIRONMENTAL EXPOSURE TO CADMIUM: HEALTH RISK ASSESSMENT AND ITS ASSOCIATIONS WITH HYPERTENSION AND RENAL DYSFUNCTION

Monday, 15th August - 11:45 - OS-1C.04 - Health Risk A - Oral

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We estimated the risk level caused by Cd exposure through various pathways and examined the relationship between urinary cadmium (UCd) and hypertension and renal dysfunction at low levels (1.3±1.5 mg/kg creatinine) in a Chinese Cd-polluted town.

Blood pressure measurements, questionnaires, and urinary samples of 217 residents were collected. Environmental samples (56), food (29), and cigarette samples (6) were collected. Samples were measured by ICP-MS. Logistic regression model was used when examining associations.

For non-smokers, incremental lifetime cancer risk (ILCR) and hazard quotient (HQ) were 1.74E-04 and 2.96, while for smokers, 1.07E-03 and 52.5. Rice and smoking contributed most to HQ and ILCR. UCd was significantly associated with hypertension (OR=1.352; 95% CI: 1.063-1.725) and renal dysfunction (OR=1.904, 95% CI: 1.054-3.432).

Rice and smoking are the main sources of elevated risks from Cd exposure. UCd is significantly associated with hypertension and renal dysfunction at low levels.
QUANTIFYING HUMAN EXPOSURE TO SELECTED SOIL-BOUND METALS USING HUMAN BIOMONITORING AND PHYSIOLOGICALLY-BASED PHARMACOKINETIC MODELLING

Monday, 15th August - 11:45 - OS-1C.05 - Health Risk A - Oral

Mr. Eric Dede¹, Prof. Christopher Collins², Dr. Marcus Tindall², Prof. John Cherrie³

¹University of Reading & Institute of Occupational Medicine, ²University of Reading, ³Institute of Occupational Medicine & Heriot Watt University

Research Problem and Objective

Current exposure models used in contaminated land risk assessment are highly conservative. Use of these models may lead to over-estimation of actual exposures, possibly resulting in negative financial implications from unnecessary remediation. A study is being carried out to improve our understanding of human exposure to selected soil-bound elements (As, Cd, Cr, Pb, Ni) resulting from allotment land-use.

Methods

The research employs physiologically-based pharmacokinetic (PBPK) modelling and biomonitoring to quantify human exposure to these elements. Biomonitoring is being carried out with thirty-six participants across Scotland. Ethical approval was granted by the University of Reading Research Ethics Committee.

Results and Conclusion

Preliminary PBPK models have been developed. The models were used to estimate the distribution and accumulation of the elements in key body organs/compartments, thus indicating the internal body burden. In addition, the PBPK models have been used to predict the concentrations of the elements in blood and urine. Simulating low metal intake (based on soil and allotment produce test results from a pilot study), the predictive models suggest that detection of these elements in participants’ blood and urine would be possible within a given period of time following exposure. This information is being used to plan the biological monitoring and in the subsequent interpretation of test results from biological samples.

Importance of the work

The findings from this study will help improve the existing models used to predict human exposure to soil-bound contaminants, subsequently promoting a more sustainable approach to contaminated land management.
MEASURING NATURE’S IMPACT ON HEALTH: DEVELOPING A CITIZEN SCIENCE FRAMEWORK

Monday, 15th August - 11:45 - OS-1D.01 - Environmental Management - Oral

Ms. Valentine Seymour¹

¹University College London

With the increase in chronic diseases, costs of health provision and the growing importance of health and wellbeing becoming of increasing concern for UK policy makers and public health officials. The rapid rise in the numbers of eco-health programmes - including environmental volunteering activities - emerging in the past decade can be seen to address these concerns. Calls for a green agenda within the UK health care systems follows the growing evidence that suggests nature’s benefits on people’s health and wellbeing. However, further detailed research is needed to explore the types of health benefits generated from eco-health programmes as well as mediating mechanisms. The study aimed to develop a measurement framework in order to provide to strengthen and progress existing research on the impact that engaging in environmental volunteering activities has on a person’s health and wellbeing. This is done by using The Conservation Volunteers national volunteering programme as a case study. The study combines both participatory design research methodologies with exploratory and spatial data analysis in order to develop develops a novel data collection framework and sampling methodology which recruits volunteers as ‘citizen scientists’ to capture nature’s impact on their health and wellbeing. In this way, findings shows that through using such approaches provides a more detailed understanding of user requirements that is enriched through the knowledge gained through a real life context.
PERCEPTIONS VERSUS EVIDENCE OF HEALTH AND WELLBEING BENEFIT/RISK TRADE-OFFS FROM THE NATURAL ENVIRONMENT: IMPLICATIONS FOR DECISION-MAKERS AND PRACTITIONERS

Monday, 15th August - 11:45 - OS-1D.02 - Environmental Management - Oral

Dr. Caitriona Carlin¹, Mr. David Quinn¹, Prof. Martin Cormican², Prof. Mike Gormally¹
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Importance of study: For the first time, Irish decision-makers’ perceptions are assessed in relation to the evidence of health and wellbeing benefit/risk trade-offs from the natural environment. Here, as elsewhere, trends of aging populations and socio-economic inequality compounded by excess consumption, sedentary lifestyles and social isolation increase the burden of illness, as restricted public funding limits capacity to deliver health care services. A new approach is needed to reframe attitudes in terms of health-sustaining environments.

Objective: To examine evidence of health-related benefit/risk trade-offs from engaging with biodiversity in relation to green space decision-makers’ values, and make recommendations for policymakers and practitioners.

Methodologies: We appraise emerging themes and challenges presented by the current literature. We assess perceptions of key stakeholders involved in the planning, design, management and use of Ireland’s green spaces. Using Q methodology, we ascertain stakeholder values in relation to the evidence base.

Results: We categorise evidence of health-related benefit/risk trade-offs from the natural environment according to life stage. We show that stakeholder values are complex, differing within and across stakeholder groups.

Conclusion: Biodiversity is essential to a health-sustaining environment but quantifying the evidence is a major challenge. Perceptions of health benefit/risk trade-offs cannot be categorised solely on the basis of stakeholder role. In seeking to influence policy in this area, we must demonstrate the need to employ multifaceted arguments to engage planners, landscape architects, engineers, health practitioners, conservationists and communities to determine how biodiverse spaces can be created to suit individual preferences and life stages.
INTEGRATED ENVIRONMENTAL ASSESSMENT OF ARTISANAL ALLUVIAL GOLD MINING IN NIGERIA

Monday, 15th August - 11:45 - OS-1D.03 - Environmental Management - Oral

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This paper critically reviewed the state of Artisanal gold mining in Nigeria, its adverse effects on environment and associated health hazards.

Geochemical assessment of stream sediments, soil and water samples within the vicinity of both abandoned and active artisanal mine sites in Southwestern Nigeria were carried out using Inductively Coupled Plasma Mass Spectrophotometer (ICP-MS) at ACME laboratories, Canada to determine 56 major and trace elements.

Result of different contamination indices such as enrichment and contamination factors revealed that soil and sediments show 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.

The ecological risk index show that soil and sediments fall within low risk index with Zn, Ni and Cr, moderate risk index with Cu, considerable risk index with Pb and very high risk index with Cd. Potential ecological risk factor (RI) ranged between low to considerable risk of toxic metals to the environment.

The total chronic hazard quotient index of oral exposure to soil contamination in the study area (THI) ranged between 1.58 and 22.69 for children and 0.28 and 4.05 for adult which indicate moderate to high hazard exposure.

Twenty five percent of the water samples show 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.
SOIL ENVIRONMENTAL QUALITY, RISKS AND CONTROLLING STRATEGIES UNDER GREENHOUSE VEGETABLE PRODUCTION OF CHINA

Monday, 15th August - 11:45 - OS-1D.04 - Environmental Management - Oral

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Lately, the greenhouse vegetable production (GVP) is being developed rapidly. However, high crop indexes, a large amount of agricultural inputs, and very closed environment easily result in the accumulation of some pollutants and increase of their availability in soil, which bring about the risk of the ecological environment. It is necessary to illuminate the problems of soil environmental quality, analyze the reasons of the problems, and put forward the management strategies. Results showed that the pollutants such as pesticides, remaining nutrients, heavy metals, phthalic ester, and antibiotics were more accumulated in GVP soil than open field vegetable production soil and their environmental risk were greater in the former soil than the latter soil. The changes of soil properties and accumulation of the pollutants decreased soil ecological function, and increased the levels of pollutants in crops, and deteriorate surrounding water quality, bringing about the risks for ecological environmental safety and human health. The reasons were related with heavy application of agricultural inputs, outmoded production capacity, unmeet regulations and standards for enviromental management needs, and deficiency of monitoring and management. In the future, in order to assure sustainable development of GVP, monitoring, management, and supervision to agricultural input uses would be reinforced, system of environmental quality assessing standards being suitable for GVP would be improved, the monitoring and supervising mechanism for GVP would be set up, and research and development investment in environmental protection would be increased.
COMPLIERS AND PROTESTERS ATTITUDES TO PEATLANDS REGULATION: IMPLEMENTATION OF THE EU HABITATS DIRECTIVE ON IRISH RAISED BOGS

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Irish raised bogs are unique in the global context and 2% of these were designated under the EU Habitats Directive. In addition to biodiversity, peatlands conservation has strong potential to contribute to climate change mitigation. Cultural attachment to peatlands as productive natural resources has contributed to ongoing difficulties with peatlands regulation in Ireland, but does not fully explain ongoing regulatory challenges. In this paper Q Methodology is adopted to analyse local attitudes on governance and knowledge underlying regulation of raised bogs. The methodology adopted a naturalistic approach to statement generation for the concourse, by conducting twenty-one semi-structured interviews with stakeholders. Thirty-six statements were then selected to form the Q set. The Q sort was conducted by sixteen turf cutters, followed by a post-sort interview or focus group interview. The results were analysed using principal components analysis and subjected to factor analysis and varimax rotation.

The results reveal that legitimacy of regulation is undermined by post-colonial subjectivities on property rights and governance in addition to perceived government failure to regulate ongoing harvesting on non-SAC (Special Areas of Conservation) peatlands. Inattention to local knowledge, combined with the non-communicative approach of conservation authorities has also served to undermine peatlands regulation. Recent moves integrating bottom-up practices and local knowledge into relocation to non-designated peatlands, reveals a more positive attitude to conservation management, but also reveals ambivalence towards the conservation potential of non-SAC peatlands. Overall, the research reveals how inconsistencies and flaws in peatlands policy lead to complex and contradictory attitudes at local level.
KEYNOTE ENVIRONMENTAL GEOCHEMISTRY OF PERSISTENT TOXIC SUBSTANCES, FISH CONTAMINATION AND HEALTH EFFECTS, WITH EMPHASIS ON SOUTH CHINA: A MULTI-DISCIPLINARY APPROACH

Monday, 15th August - 14:30 - KN-2.01 - Keynote Speech - Keynote

Prof. Ming H. Wong

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Most of the fish consumed in Hong Kong are farmed fish, including freshwater and marine fish, which are highly susceptible to various chemicals discharged from industrial sites nearby. It is recognized that emissions from coal-power plants are major sources of Hg in the environment worldwide. The situation is serious in the Pearl River Delta, South China, with a high demand of electricity, to support rapid development of various industries. In addition, the area has become the world’s manufacturer for electrical/electric equipment, textiles, footwear, furniture, etc., emitting a wide range of toxic chemicals into the environment. In addition, the use of trash fish (small fish, without commercial value), and to certain extent, commercial feed pellets containing a high proportion of fish meal (very often made from trash fish), for feeding carnivorous fish (such as grouper), resulted in higher concentrations of environmental contaminants, notably mercury in the cultured fish. In fact, “chemical food contaminants” is one of the 3 key global food safety concerns. Food safety is any action and policy which ensure food is safe, in the entire food chain, i.e. from production to consumption (WHO, 2013). This article attempts to review environmental health issues related to persistent toxic substances (PTS), with a focus on Hg; from biogeochemistry, ecology, epidemiology, to policy and management, citing examples related to South China. Reduction of anthropogenic Hg emissions pays an important role for minimizing biotic exposure to MeHg and associated human health risks. The use of food wastes for producing safe and quality fish would be an attractive alternative, for replacing trash fish and fish meal used in commercial feed pellets. Furthermore, there seems to be an urgent need of establishing a regional list of toxic chemicals for more efficient control, focusing on PTS commonly found in local food items.
KEYNOTE A SYSTEMATIC STUDY OF SEDIMENT CONTAMINATION IN A LARGE EUTROPHIC LAKE BASED ON PASSIVE SAMPLING TECHNIQUES

Monday, 15th August - 15:30 - OS-2A.01 - Environmental Technology - Keynote

Prof. Shiming Ding\textsuperscript{1}, Prof. Chaosheng Zhang\textsuperscript{2}

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Sediment is one of the main pools for a wide range of contaminants which can be released to water under certain conditions, posing a high risk on deteriorating aquatic ecosystems. A Zr-oxide based diffusion gradients in thin films (Zr-oxide DGT) technique has been developed for measurements of a range of labile chemicals in sediments, including phosphorus (P), sulfide, oxyanions and metals. This technique has significant advantages over traditional methods: in situ and simultaneous measurement, time averaged concentrations and high spatial resolution.

Based on the use of the Zr-oxide DGT and other associated techniques (e.g., planar optode), the contamination of sediments was studied in a large freshwater Lake Taihu. The results showed high concentrations of labile phosphorus, arsenic and heavy metals in sediments of contaminated regions and induced high fluxes of these chemicals to the overlying waters. The remobilization and release of these elements in sediments were mainly related to Fe and Mn redox. The effects of dominant biological activities (macroinvertebrate bioturbation, algal bloom, macrophyte growth) on the remobilization and release of pollutants from sediments were studied. The effects of capping agent coverage and dredging on inhibiting the lability and release of pollutants in sediments were further assessed. These studies have laid a basis for development of management strategy for sediment contamination.
LESSONS FROM A NATIONAL SCALE STUDY IN FRANCE: TRACE METALS MEASURED IN FRESHWATER BY DIFFUSIVE GRADIENT IN THIN FILM

Monday, 15th August - 15:30 - OS-2A.02 - Environmental Technology - Oral

Dr. Emmanuelle Uher¹, Dr. Jean-Philippe Besse², Mrs. Adeline François¹, Dr. Jérémie Lebrun¹, Dr. Olivier Geffard¹, Dr. Marina Coquery¹

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The last past decades of research have shown that the passive sampling technique DGT (Diffusive gradient in thin film) (Zhang and Davison, 1995) is a robust tool to monitor trace metals in freshwater. The progress made in understanding the use of DGT allow us to produce reliable measurement of metals and to extend the use of DGT at a scale larger than a few close sampling sites. We propose to present how a field study including more than 100 sites all over France has been implemented and what are the first results and lessons from this study regarding the spatial and environmental distribution of metals.

DGT were deployed during one week at each site. Grab sampling of total and filtered metals were taken at the beginning and the end of the deployment. Physicochemical parameters (temperature, pH, conductivity, anions and cations, DOC) were also measured. In parallel, gammarids were transplanted to measure bioaccumulated metals. The whole set of measurements constitute a rich dataset including large and small rivers, and reference as well as impacted sites. The results first allowed us to draw a map the metallic contamination at the national scale. Then multivariate analyses were conducted to assess the explanatory variables of the distribution: geochemical patterns, anthropogenic stresses, and abiotic factors like organic matter or temperature. The advantages to use passive samplers like DGT to assess trace metal contamination and the ability of the DGT to meet regulatory monitoring expectations will be discussed, as well as implication for environmental management.
A NEW TECHNOLOGICAL APPROACH TO THE ANALYSIS AND FORENSIC INTERPRETATION OF TPHCWG IN SOILS AND WATERS USING 2D GAS CHROMATOGRAPHY METHOD (GCXGC)

Monday, 15th August - 15:30 - OS-2A.03 - Environmental Technology - Oral

Ms. Maria Nevin¹, Ms. Cacilia Terloh¹, Dr. Rory Doherty²

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The objective was to develop an analytical methodology for TPHCWG. Raw data from this method is then to be evaluated for forensic interpretation and risk assessment modelling. The development of methods for forensic tracing contaminant sources, transport modelling, human health risk modelling and detailed quantitative risk assessment.

Validation was through a designated systematic experimental protocol and challenged with spikes of known concentration of parameters such as recoveries, precision, bias and linearity. The method was verified by testing a CRM which was used as a proficiency testing for numerous laboratories.

Quantification of compounds were key to developing this method. It was required to individually map out where each compound falls chromatographically in the 2D. This was done through comparing carbon equivalent numbers to the n-alkane carbons. This proved e.g. 2-methylnaphthalene has 11 carbons in its structure; its carbon equivalent is 12.84, the result of which falls within the band of Aromatic eC12-eC16 as opposed to expected eC10-eC12. This was carried out for all 16 PAH (polyaromatic hydrocarbons) and BTEX.

This method will be used in conjunction with the panel of expert analysis through Bonn Agreement with their OSINet group to which includes CLS. With the use of various statistics differences within numerous fuels and can be used as comparison and identifying tool.

This method has proven itself to be a robust method and benefit the industry for contaminated land and water. It will help identify contaminants and assist consultants, regulators, clients and scientists valuable information not seen in 1D.
BREAKTHROUGH DEVELOPMENT FOR QUANTITATIVE ANALYSIS OF TOTAL METALS IN SOIL BY PORTABLE HDXRF

Monday, 15th August - 15:30 - OS-2A.04 - Environmental Technology - Oral

Dr. Zewu Chen¹, Mr. Wei Song¹, Mr. Jay Burdett¹, Mr. Kyle Kuwitzky¹, Mr. Shenghua Song¹

¹XOS

Heavy metal contamination from industrialization in developing countries is an important environmental issue today. Hand Held X-ray Fluorescence (HHXRF) analysis recently become a powerful tool to screen metal contamination in brown field sites. However, HHXRF on site analysis does not meet the needs in many contamination site survey and risk assessments due to two major reasons: 1) Not accurate enough to provide good assessment of contamination site, and 2) poor detection limits at low level contamination survey, especially for As, Cd, Ni and Hg contamination sites. Currently, comprehensive site assessment is heavily dependent on field sample collection and lab analysis. The large scale sample collection and lab analysis is a severe bottle neck for environmental cleanup in both cost and resource aspects.

Recently, a portable soil metal analyzer has successfully developed base on an innovative multiple monochromatic focused beams XRF technology, called high-definition XRF (HDXRF). This new analyzer is designed with miniature doubly curved crystal optical system coupled with a miniature x-ray tube. It provides superior detection limits for low level metal analysis due to the use of monochromatic excitation. In this paper, in-depth data set of various soil standards and soil samples from actual survey sites will be presented. Comparison between HDXRF data and lab ICP results will also summarized. It is demonstrated that on site non-destructive quantitative analysis for low level metals (1-10 ppm range) in soil has been achieved for the first time.
BEHAVIOUR OF POTENTIALLY TOXIC ELEMENTS (PTES) AND PB ISOTOPES IN NORTH-TRØNDELAG FOREST SOIL

Monday, 15th August - 15:30 - OS-2B.01 - Geochemical Database - Oral

Dr. Clemens Reimann¹, Dr. Karl Fabian¹, Dr. Belinda Flem¹, Dr. Julian Schilling¹

¹Geological Survey of Norway

Analysis of soil C and O horizon samples in a recent regional geochemical survey in central Norway (752 sample sites, 25,000 km²), identified a strong enrichment of several PTEs in the O horizon. Of 53 elements analysed in both materials, Cd concentrations are, on average, 17 times higher in the O horizon than in the C horizon and other such as PTEs Ag (11-fold), Hg (10-fold), Sb (8-fold), Pb (4-fold) and Sn (2-fold) are all enriched relative to the C horizon. In addition to element concentrations the Pb isotopes 206Pb, 207Pb and 208Pb were also determined.

Geochemical maps do not reflect an impact from local or distant anthropogenic contamination sources in the O horizon soil samples – neither for the PTEs nor for the Pb isotopes. The higher concentrations of PTEs in the O horizon and the isotopic composition of the O horizon soil are the result of the interaction of the underlying geology, vegetation, and climatic effects (weathering). Based on the general accordance with existing data from earlier surveys in other parts of northern Europe, the presence of a location-independent, superordinate natural trend towards enrichment of these elements in the O horizon relative to the C horizon soil is indicated. The Pb isotopes show a general shift towards lower 206Pb/207Pb ratios at surface when compared to values determined in the underlying soil C horizon. At the regional scale surface soil chemistry and isotopic composition is still dominated by natural sources and processes.
IDENTIFYING MINERAL DUST SIGNATURES IN THE GEOCHEMISTRY OF EUROPEAN AGRICULTURAL SOILS

Monday, 15th August - 15:30 - OS-2B.02 - Geochemical Database - Oral

Dr. Mark Cave

1 British Geological Survey

Roughly half of the mineral dust load to the atmosphere originates from the Sahara and is transported across the Atlantic towards South America and Eastern US or across the Mediterranean to Europe. Approximately 10% of these dusts is calcite and gypsum, they are therefore rich in Ca (1).

The GEMAS project (2) provides geochemical data on metals on agricultural and grazing land soil at the European scale.

This study has applied a self-modelling mixture resolution algorithm to the combined GEMAS geochemistry data set consisting of 4115 samples with 53 elements identifying 29 distinct geochemical signatures. Of these, one Ca rich component which showed high concentrations in southern Europe decreasing towards the north was tentatively identified as being derived from Saharan dust. Another signature, rich in iron and relatively high lead content, which is deposited mainly on the western coasts of European countries is a possible candidate for windblown dust from the Atlantic.


Geochemical data collected for regional mapping have considerable, and largely untapped, potential to benefit the agricultural sector. However, variables measured in geochemical surveys do not necessarily correspond directly to those which are used for agronomic guidance. It is also necessary to manage the considerable variability exhibited at a range of scales, which introduces uncertainty into the interpretation of regional-scale data at the scale of the field or farm. This uncertainty must be quantified and communicated effectively to the data-user.

Here we present examples from Irish and British surveys, relevant to the grazing livestock sector. Data on pH of soils under pasture are compared with recommended soil pH thresholds (6.0 and 6.5 for grass and grass–clover systems respectively) across the north of Ireland. These demonstrate that over much of the area liming is required to achieve the chosen target pH values (Lark et al., in press). The variation in soil cobalt and manganese is assessed against Teagasc guidance, demonstrating the importance of the joint variation in the variable of primary interest to livestock health (cobalt) and of a key soil complexing element (manganese) (Lark et al., 2014, Geoderma 226:64). Both studies quantify the uncertainty in predictions at un-sampled locations arising from spatial variability, particularly at short scales. The uncertainty is expressed in probabilistic terms on a verbal scale and visualized, accounting for recent psychological research on the efficacy and limitations of such scales. Other elements, such as iodine and magnesium, require more work to understand transfer from soil to herbage.
OPTICAL SENSING FOR THE RAPID PREDICTION OF SOIL GEOCHEMISTRY

Monday, 15th August - 15:30 - OS-2B.04 - Geochemical Database - Oral

Dr. Sharon O’Rourke¹, Prof. Nick Holden¹, Prof. Budiman Minasny², Prof. Alex McBratney²

¹University College Dublin, ²The University of Sydney

Proposed legislation to secure and maintain soil quality in Europe has generated interest surrounding how best to characterize soil geochemistry, and how to assess and monitor soil contamination. Many soil laboratories are now equipped with technology platforms in portable visible near-infrared (vis-NIR), mid-infrared (MIR) and X-ray fluorescence (XRF) spectrometers. These technologies have complementary capabilities, where XRF is known to accurately measure the soil’s inorganic element concentration, and vis-NIR and MIR have the ability to estimate the soil’s organic component and mineralogy suites. The objective of this study was to investigate if there was a benefit to using these techniques in a synergistic way for the estimation of soil properties. This hypothesis was tested using agricultural topsoils (n = 322) sampled from the National Soil Database. Data mining was used to estimate soil geochemistry from the vis-NIR and MIR, and in a novel way from the XRF spectral data. The predictions were combined into a single prediction outcome, using formal methods called model-averaging procedures. Prediction accuracy for a suite of soil geochemistry (40 total elements) was much improved using this approach, and the total number of well predicted elements increased from 15 to 25. Most notable is the large number of trace elements (As, Cd, Co, Cu, Hg, Mn, Ni and Zn) predicted to good or reasonable accuracy in non-polluted soils. It is concluded that the synergistic use of vis-NIR/MIR and XRF spectral methods are well placed as a tool to permit large scale routine soil geochemical monitoring (i.e. soil contamination).
PREDICTING THE ABILITY OF SOILS TO ACCEPT THE APPLICATION OF ORGANIC AMENDMENTS IN ACCORDANCE WITH THE METAL SOIL POLICY THRESHOLD (WALLONIA - BELGIUM)

Monday, 15th August - 15:30 - OS-2B.05 - Geochemical Database - Oral

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As in many parts of the world, land application of organic amendments such as sewage sludge known to contain trace metal elements motivated the Walloon administration (Belgium) to establish a regulation to limit the spreading on soils with high contents of trace metal elements. This regulation requires to perform a soil analysis prior to application to check if the parcel meets the policy thresholds for trace metal elements. As most of the soil metal content analyses were below the policy thresholds, the Walloon administration conducted a study leading to the establishment of a map recommending the necessity to impose a soil analysis before application. This paper presents an algorithm to determine for each agricultural parcel in Wallonia if it is able to receive spreading sludge according to soil metal content policy thresholds basing on the soil analyses performed in the frame of the implementation of the regulation. The principles of this algorithm combine both geostatistical methods, expert judgement and constraints imposed by the Administration. As a result more than 50\% of agricultural parcels are located in zones where a soil analysis is not recommended, reducing thus costs for both the administration and owners of agricultural parcels.
ACCUMULATION, SOURCES AND HEALTH RISKS OF HEAVY METALS IN INTENSIVE GREENHOUSE VEGETABLE PRODUCTION SYSTEM, CHINA

Monday, 15th August - 15:30 - OS-2C.01 - Health Risk B - Oral

Dr. Wenyou Hu¹, Prof. Biao Huang¹

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In recent years, greenhouse vegetable production is growing rapidly and makes up a sizeable proportion of vegetable production in China. Heavy metal accumulation in greenhouse soils and vegetables is a growing concern for public health. In this study, 120 surface greenhouse soils and corresponding vegetable samples were collected from three typical intensive greenhouse vegetable production systems in China to systematically evaluate the transfer characteristics, sources and potential health risk of selected heavy metals. Mean concentrations of Cd, As, Hg, Pb, Cu and Zn in greenhouse soils were 0.21, 7.12, 0.05, 19.81, 24.95 and 94.11 mg/kg, dw, respectively. Concentrations of heavy metals in all vegetable samples were decreased in the order of Zn>Cu>Pb>As>Cd>Hg. The sources of heavy metals were mainly from fertilizer application, especially for livestock manure. Compared with rootstalk and fruit vegetables, leafy vegetables had relatively high concentrations and transfer factors of heavy metals, especially for Cd. Accumulation of heavy metals in soils were also affected by soil pH and organic matter. The target hazard quotient (THQ) of heavy metals by consumption of different kinds of vegetables decreased in the order of leafy vegetables>rootstalk vegetables>fruit vegetables, and their risk values were 0.61, 0.33 and 0.26, respectively. The findings of this study suggested that excessive consumption of leafy vegetables grown in the greenhouse posed a relatively greater potential health risks for consumers. The rootstalk and fruit vegetables showed a relatively lower transfer factor and health risks for heavy metals, and therefore they were more suitable for cultivation in greenhouse soils.
THE GEOGRAPHIC DISTRIBUTION OF OUT-OF-HOSPITAL CARDIAC ARREST AND THE CHAIN OF SURVIVAL IN IRELAND

Monday, 15th August - 15:30 - OS-2C.02 - Health Risk B - Oral

Ms. Siobhan Masterson¹, Dr. John Cullinan¹, Dr. Conor Teljeur², Dr. Akke Vellinga¹

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Importance of the work and objectives

Cardiac arrest occurs when the heart suddenly stops pumping blood around the body. Out-of-hospital cardiac arrest (OHCA) is the term used to describe cardiac arrest that occurs somewhere other than in an acute hospital. Without intervention, death occurs within minutes of collapse. In order to optimise survival from OHCA, knowledge of the spatial distribution of OHCA and the availability of resuscitation, or 'Chain of Survival', is required. The aim of this study was to describe OHCA incidence and Chain of Survival availability in a manner that could support pre-hospital planning in the Republic of Ireland.

Methodologies

In view of Ireland’s heterogeneous settlement pattern, we analysed the association between varying degrees of rurality, OHCA incidence and the availability of the Chain of Survival. A multi-class urban-rural classification that accounts for population density, settlement size and land-use was used.

Main results and conclusion

When adjusted for age and sex, the incidence of adult OHCA decreases with increasing rurality. We found also, that the lowest levels of bystander cardiopulmonary resuscitation occurred in the most urban class and that the average distance to the nearest ambulance station and average call-response interval increased with greater rurality. To the best of our knowledge, this is one of the very first whole-country geographic descriptions of OHCA to be performed internationally. It is also the first OHCA study to use a multi-class urban-rural classification that considers rurality as more than a function of population density.
Local variations in abundance of Anopheles mosquitoes and exposure to their bites are keys to explain the spatial and temporal malaria transmission heterogeneity. Vector distribution is itself driven by environmental factors. Based on variables derived from satellite imagery and meteorological observations, this study aims to dynamically model and map the densities of Anopheles darlingi in the municipality of Saint-Georges de l’Oyapock (French Guiana).

Longitudinal sampling sessions of An. darlingi densities were implemented between September 2012 and October 2014. In parallel, appropriate satellite imagery and meteorological data were selected and processed in order to extract a panel of variables potentially related to An. darlingi bio-ecology. Based on these data, a robust methodology was implemented to elaborate a statistical predictive model of the space – time variations of the An. darlingi densities in Saint-Georges de l’Oyapock. The final cross-validated model integrated two remotely sensed landscape variables, the dense forest surface and the built surface together with four meteorological variables related to the absence of rainfall, the maximal evapotranspiration, the minimal and maximal temperature. The extrapolation of the model allowed generating predictive weekly maps of the An. darlingi densities at a 10-meters resolution.

Results from the present research support the use of satellite imagery and meteorological data to predict the malaria vector densities. Such fine scale modeling approach provides tools for health authorities to plan control strategies and social communication in a cost-effective, targeted and timely manner.
IDENTIFYING SURFACE IMPOUNDMENTS ON LIDAR GENERATED DEMS TO IDENTIFY DENGUE PRONE AREAS

Monday, 15th August - 15:30 - OS-2C.04 - Health Risk B - Oral

Ms. Isabella Pauline Quijano¹, Mr. Jao Hallen Bañados¹, Mr. Jared Kislev Vicentillo¹, Mr. Chito Patiño¹, Dr. Jennifer Sinogaya²

¹University of the Philippines Cebu Phil-LiDAR 1, ²University of the Philippines Cebu Program for Environmental Studies

It has long been known that stagnant water is the one of the main reasons for the dissemination of the dengue virus, since it serves as the breeding area for the suspect mosquitoes. Armed with the knowledge of possible impoundments for stagnant water to remain after a flood or a rainy season, communities can be warned to siphon water to prevent another outbreak of the disease. This study uses a LiDAR generated DEM, Land Use, and Land Cover data and GIS Tools to create a flood map. Surface impoundments that are affected by the flood are identified through the generated flood extent and are set apart from the river due to its remote locations. Dengue case validation is made by using a clustering tool to identify dengue outbreak hotspots in the area. According to the statistical analysis from the correlation between the generated surface inundations and dengue outbreak hostpots, the hypothesis that there is in fact dengue cases near these areas are correct with a certain degree of magnitude. It is believed that with the surface impoundments near the residential areas dengue outbreak will occur after a flood event or during the rainy season and it is recommended that communities with such surface impoundments prepare for such circumstances from happening.
A SUSTAINABLE APPROACH TOWARDS MANAGEMENT OF MINING WASTE FOR LAND MANAGEMENT

Monday, 15th August - 15:30 - OS-2C.05 - Health Risk B - Oral

Ms. Neha Mehta¹, Dr. Giovanna Dino¹, Prof. Franco Ajmone-marsan¹, Prof. Domenico De Luca¹

¹University of Torino

Mining waste occupy vast areas on land and can cause contaminant transfer through air, soil and water. As for air pollution the main contamination is because of dust transfer. As for water contamination there are problems connected to leaching of pollutants into groundwater, acid mine drainage which cause rivers contamination, ocean pollution etc. As for soil contamination, mining waste may enhance pollutants in the nearby areas and cause alteration of chemical, physical and biological behaviors of soil.

The successful mitigation process of environmental and economic impacts connected to mining waste production can be done through integrated approach which includes:

A) Characterization of area: Definition and geological characteristics, hydrogeological characteristics, type of land use and transfer of potential pollutants.

B) Characterization of waste: Determining the volume of waste and the type of pollutants in the mining waste. Application of soil characterization techniques to determine heavy metal contents in soil.

C) Determination of current and potential impacts of mining waste: on surrounding soil and water streams and underground water by sampling and analysis of pollutants and applying risk assessment methods.

D) Assessment of the possibility of reuse: Mining waste with high utilizable metal contents can be used for recovery of minerals while the inert waste can be used as fillers and aggregates.

E) Assessment of the need of action: The possibility of stabilizing or cleaning of mining waste from the dump.

To determine the success of mitigation methods used, post operation monitoring of site must be done.
This paper explores the use of mapping tools in the field of human rights and specifically the exercise of the right to a healthy environment (RHE).

It does so employing a constructivist and hybrid research methodology that brings together several approaches to RHE and reconciling environmental protection and sustainable development in a pragmatic manner.

Maps are being used for the purpose of environmental rights advocacy to recognize critical overlapping that exacerbate socio-environmental conflicts and human rights violations.

Contemporary debates on environmental rights include access to information, public participation and access to justice in decision making. The right to participation, or ‘meaningful participation’ identified as being core to the RHE, can promote rights interdependence, transparency and accountability as well as just distribution of benefits and burdens. Georeferenced maps can be used to layer social, economic, environmental and legal data to visualize conflicts, facilitate the identification of an extended ‘concerned public’ and identify opportunities for deepening participation. Offering insights of rights based approaches to environmental issues, maps can provide a visual platform to design innovative policies that address human rights, environment and sustainability concerns.

Recently completed doctoral research on the RHE recognized the role of two environmental law principles – the precautionary principle and the common but differentiated responsibility principle - to inform human rights practices related to the environment. Mapping tools might support the precautionary character of RHE, bridging human rights issues with environmental protection and sustainable development concerns.
There have been enormous advances in constituting environmental rights, a trend that has been
dubbed an ‘environmental rights revolution’ (Boyd, 2012). A large body of environmental law, in-
struments and frameworks has emerged in all developed countries, most developing countries, and
on an international level. However conceptual vagueness, weakness and timidity have characterized
the formulation and implementation of global goals for sustainable development. The objective of
sustainable human –nature coexistence with human-human equity appears to be receding, rather
than being progressively realized, spurring some scientists to call for an alternative implementation
of ‘Earth Jurisprudence’ (Rühs & Jones, 2016; Voight, 2013). The legal and goal-setting approaches
miss the failures of intelligibility underpinning many shortcomings of environmental regulation, pol-
icymaking and public mobilization for sustainable development. Although sustainability norms and
principles are well-known, they fail to gain traction at the level of policy negotiation and goal-setting.

The paper addresses the intelligibility gap between environmental law and the politics of really
existing unsustainability (Barry, 2012). It begins by making the argument for an inter-disciplinary
approach to the themes of this major conference – environment, health and agriculture. It then
moves toward an argument for strong transdisciplinarity normatively centred on health. Strong
transdisciplinarity requires an epistemological shift to accept multiple levels of reality, the principle
of the ‘included middle’ and complexity. Rational and relational modes of reasoning are simultaneously
included (Max-Neef, 2005) in transdisciplinary science, policy and citizen participation.
ENVIRONMENTAL PROTECTION THROUGH E-REGULATION: EMPIRICAL PERSPECTIVES USING AN ACTOR-NETWORK THEORY ANALYSIS

Monday, 15th August - 15:30 - OS-2D.03 - Environmental Governance - Oral

Dr. Rónán Kennedy

National University of Ireland, Galway

Sometimes the most commonplace and uninteresting tools demand close attention because their mundane nature means that their role is misunderstood. The use of computer technology by government – specifically, by environmental regulators – is one such instance. Information and communications technology (ICT) is increasingly deployed in bureaucratic and regulatory processes; as in business, software code and databases are becoming the invisible ‘glue’ that interconnects the various actors in the regulatory system and weaves an invisible web of control between decision-makers, regulated entities and ordinary citizens. Nonetheless, this topic has received only disconnected academic attention, perhaps because there is little that seems intrinsically interesting about a database.

The paper critically reviews the operation of digitised government. It combines theoretical perspectives from sociology, chiefly actor-network theory, with insights from semi-structured interviews with staff in regulatory agencies, non-governmental agencies and regulated entities, to build a thematic network model of how the use of ICT for information-gathering, as a means of control and as a conduit for communications is perceived by practitioners of environmental regulation. It uses this understanding to sketch the contours of a new field of study, ‘e-regulation’, centred around the core values of the rule of law. It queries whether these new tools could help to make the regulatory system more ‘objective’ or will codify biases, assumptions, and power imbalances.
This paper investigates two major drivers that endanger human and ecosystem sustainability and health: growing population/demographics and global warming. Today’s population of 7.3 billion people is projected to grow to 9.8 billion by 2050 and 11 billion by 2100. In 2016, with 780 million malnourished, 800 million without safe water, and >2.5 billion without access to adequate sanitation, the capabilities to sustain basic life needs for growing populations are questionable. Add to this, needs for societal stability such as safe shelter, healthcare, education, employment, and personal security, and questions persist. These problems are exacerbated by demographic changes. In 2016, 3.7 billion people lived in cities and 3.6 billion in rural areas whereas the 2050 projection has 6.9 billion in cities (increased population density) and 2.9 billion in rural locations. There is increasing encroachment on ecosystems for space and further ravaging of their natural resources. Global warming will affect food production and water availability as climatic zones change. Vector-borne infectious diseases will spread to regions free of them in the past, diseases that transmit rapidly in densely populated cities. Crops will suffer from invasive species. Also the effects of extreme weather on land and sea level rise on coastal populations plus natural and anthropogenic hazards, and the need to mitigate problems that will intensify in the future should greatly concern government worldwide. Mitigation of these problems has possibilities if there is targeted investment in event prediction and warning systems, prevention methods, and preparedness to respond to societal needs.
RESEARCH ON INFLUENCING FACTORS OF COASTWISE RURAL HOUSEHOLDS’ WILLINGNESS TO PAY FOR CONTROLLING RURAL NON-POINT SOURCE POLLUTION

Monday, 15th August - 15:30 - OS-2D.05 - Environmental Goverance - Oral

Ms. Lili Liu\textsuperscript{1}, Mr. Xuewu Gao\textsuperscript{2}, Mr. Liangliang Gao\textsuperscript{3}

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Rural non-point source pollution problem nearshore and offshore was increasingly serious in China. Public participation of rural households was an important factor in the process of controlling non-point source pollution. Therefore, detailed investigation and empirical research on coastwise rural household environmental behavior is needed.

343 households around 4 village in Dalian were surveyed in this paper. Variables of knowledge about the environmental pollution, influences from the government and characteristics were selected and then Probit model was established to analyze the major factors that motivates rural households to pay for water pollution. In order to further investigate the Stability of the model, a Logit method was carried out Simultaneously.

The results show that understanding about the causes of water pollution awareness can significantly affect their abatement investment, And two coefficients are significant at the 1% significance level; Government’s pollution control measures can significantly affect farmers’ abatement investment behavior, and significant at the 1% significance level. Meanwhile, farmers’ education level would pay a significant abatement incentives to farmers’ willingness to pay. However, Gender had no significant positive effect on willingness to pay in reducing water pollution; Farmers’ annual income has a significant positive impact for their willingness to pay; Model estimation results were stable.

Therefore, the suggestions given were as follows: the dark green environmental policy propaganda should be popularized; Government Information of pollution control should be disclosed; education level of the farmers should be increased continuously; Of course, increasing farmers’ income is the fundamental measure for their investing in environmental protection.
Besides arsenic, fluoride is considered to be one of the most widespread geogenic contaminants worldwide. While being essential for the human bones and teeth, elevated fluoride concentrations can lead to severe inverse health effects like dental and skeletal fluorosis. Several cases of dental fluorosis were detected in the Münsterland Cretaceous Basin (northwestern Germany), probably associated to elevated concentrations in groundwater from the Cretaceous Emscher Fm. Despite low hydraulic conductivities, this marly stratum is used for drinking water supply by numerous individual wells on farms etc.

The hydrochemistry and geochemistry of the Emscher Fm. were investigated. Groundwater data (760 analyses of individual house wells, mainly from several dentistry PhD studies from the early 2000s) were collected and evaluated. Contents of Corg, Cinorg, Stot and Spytite were analyzed in 160 rock samples.

Beneath a weathered oxidized zone, unweathered pyrite containing rocks were found. Groundwater partly contains high fluoride and boron concentrations of up to 10 mg/L. Regionally, up to 30 % of house and farm wells show fluoride concentrations above 1.5 mg/L, and up to 50 % above 1 mg/L boron. The spatial distribution depends on the presence or absence of Quaternary cover sediments. Groundwater with high fluoride concentration displays low Ca2+, and vice versa, indicating control by the mineral fluorite (CaF2). Concentrations above drinking water guidelines almost exclusively occur in ion exchange waters of the Na-HCO3-(Cl) type with pH>7.5. The main mobilization mechanism of the two well correlating contaminants appears to be pH-triggered desorption from mineral surfaces.
ASSESSMENT OF POLLUTION DEGREE OF RECENT ANTHROPOGENIC SEDIMENTS WITH POTENTIALLY HARMFUL ELEMENTS (PHES) AT THE URBAN TERRITORY

Monday, 15th August - 17:15 - OS-3A.02 - Environmental Geochemistry - Oral

Dr. Andrian Seleznev\textsuperscript{1}, Dr. Ilia Yarmoshenko\textsuperscript{2}, Ms. Anastasia Savastianova\textsuperscript{3}, Ms. Anastasia Noskova\textsuperscript{3}

\textsuperscript{1}Institute of Industrial Ecology UB RAS, \textsuperscript{2}Ins, \textsuperscript{3}Ural Federal University

The assessment of the pollution degree with PHEs was conducted in terms of pollution indexes for the residential territories of the city. The study was conducted on the example of Ekaterinburg (Russia). Puddle sediment (PS), a specific type of geochemical traps of the recent anthropogenic sediments, was used for assessment of pollution degree. The PS starts forming simultaneously with the construction and landscape planning. The PS cocktail concentrates pollution over the landscape area and over time from landscape forming. The PS reflects the natural (surface runoff, ground weathering and erosion) and anthropogenic (urban management and landscape planning) processes controlling migration of pollutants. 210 upper 5 cm samples of PS were taken (sample mass approx. 1.5 kg of dry weight). The concentrations of PHEs (Co, Ni, Cu, Zn and Pb) and conservative elements (Al, Mn and Fe) in PS samples were determined with ICP-MS method. The enrichment factor (EF) was assessed for the PS samples. The background values for PHEs in PS were assessed by statistical analysis of the sample, analysis of regression with the conservative elements, analysis of cumulative distribution frequency curves and 137Cs timescale tracer approach. The study of the recent anthropogenic sediments allowed ranking the territories on the pollution degree, identifying main pollutants, determining the relationship and genesis of pollution of soil and PS in the city.
LONG-TERM APPLICATION OF THE ORGANIC AND INORGANIC PESTICIDES IN VINEYARDS: ENVIRONMENTAL RECORD OF PAST USE

Monday, 15th August - 17:15 - OS-3A.03 - Environmental Geochemistry - Oral

Dr. Carla Patinha¹, Dr. Anabela Cachada², Dr. Ana Dias¹, Dr. Nuno Durães³, Dr. Paula Marinho Reis¹, Prof. Armando Duarte², Prof. Eduardo Ferreira Da Silva³

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Viticulture represents an important agricultural practice in many countries and the long-term use of pesticides resulted in the increase of the levels of these pollutants in soils and other environmental compartments. Many pesticides have been progressively banned, but in numerous cases, these molecules are stable and may persist in soils and sediments. Areas such as the Douro region (Portugal), with vineyards frequently located on steep slopes of narrow valleys, can be particularly sensitive to pollutants migration. A research project (DVINE) has been carried out in order to evaluate the impact of viticulture activity on the quality of soils and adjacent aquatic systems, and to reconstruct the recent history of viticulture practices. The strategy included the collection and analysis of composite soil samples from different terraces in three areas according to vineyards age: < 15 years, between 15 and 50 years, and > 50 years. A retro-observation approach based on dam sediment records was also conducted to reconstruct the long-term pesticide use, compared with the historical introduction, and banning of these organic and inorganic pesticides in local vineyards.

The results showed that vineyard age influences the concentration of Cu and organic pesticides in soils. The old and new vineyard reveals the presence of DDT that was banned for decades, showing that abandoned practices could still have impacts in new vineyard plantations. Sediment record showed that the decrease of contamination in more recent sediments could be related to Portuguese and European policies changes.
Gallium (Ga) has special physiochemical characteristics and important economic value, thus is of great interest in many research aspects. Over the past decades, significant advancements about Ga geochemistry have been achieved based mainly on the analysis of Ga concentration and species. These studies have demonstrated that the species, the coordination and lattice of Ga could change under different physical-chemical conditions, or be modified in many physiochemical processes. In addition, Ga would also behave differently in variable biological processes. Thus, Ga isotopes are beneficial for studies of its geochemical behavior, and may have numerous potential applications. However, without an effective and reliable method for separation of Ga from matrix, Ga isotopes have been rarely reported.

We developed a chromatographic method for purifying Ga from geological (biological) samples for precise analysis of Ga isotopic composition on MC-ICP-MS. The isotopic measurements were performed on the Nu Plasma II MC-ICP-MS (Nu Instruments Ltd., UK) or Neptune Plus MC-ICP-MS (Thermo Finnigan®, Germany). Our Ga purification method has Ga recovery of 99.8±0.8% (2SD, n=23) and no fractionation is introduced. Long-term measurement gave reliable 71/69Ga analysis with precision 0.05‰ (2SD). The 71/69Ga of two basalt and one Ga standard solution are 0.11±0.02‰ (2SD, n=9), 0.08±0.02‰(SD, n=10) and 1.74±0.05‰ (2SD, n=100), respectively, demonstrating the potential exploration and applications of Ga isotopes in geochemistry, cosmochemistry, oceanography and environmental research.
GEOCHEMICAL TRANSFER OF THALLIUM AND ACCOMPANY METALS IN THE PEARL RIVER: IMPLICATIONS FROM SEDIMENT PROFILES, SOUTH CHINA

Monday, 15th August - 17:15 - OS-3A.05 - Environmental Geochemistry - Oral

Dr. Juan Liu\textsuperscript{1}, Mr. Tianzheng Huang\textsuperscript{1}, Dr. Jin Wang\textsuperscript{1}, Prof. Yongheng Chen\textsuperscript{1}, Mr. Xueheng Liang\textsuperscript{1}, Mr. Haoxi Wen\textsuperscript{1}, Mr. Yiben Li\textsuperscript{1}, Ms. Ziyang Zhou\textsuperscript{1}, Mr. Yuxing Chen\textsuperscript{2}

\textsuperscript{1}Guangzhou University, \textsuperscript{2}Guangzhou Uni

Since the pollution of thallium (Tl) broke out successively in the Pearl River branches (such as North River, the He River), the issue of Tl contamination has gained public concerns. In an attempt to explore the characteristic of Tl contamination and its geochemical transfer in the Pearl river, sediment profiles were taken both from an outlet of a Pb-Zn smeltery (representing a major Tl pollution point-source) and its near basin. The inductively coupled plasma mass spectrometry (ICP-MS) was used to analyze the concentration and the spatial distribution of Tl and accompany heavy metals (Pb, Zn, Cd, Cu, etc.). The Geoaccumulation Index (I\textsubscript{geo}) and the Hakanson Potential Ecological Index were applied to evaluate the pollution degree of Tl and other metals in the sediment. The results indicate that serious Tl contamination and high potential ecological risks present in both the sediment profiles from the smeltery outlet and the North river entrance, and nonlinearly concentrates as the depth increases. The correlation analysis and principal component analysis (PCA) indicates that the main source of Tl pollution may be the waste discharge of the near smeltery.
THE EFFECTS OF BIOTURBATION ON THE RELEASE OF LABILITY PHOSPHORUS

Monday, 15th August - 17:15 - OS-3B.01 - Water Quality - Oral

Dr. Musong Chen¹, Prof. Shiming Ding¹, Prof. Chaosheng Zhang²

¹State Key Laboratory of Lake Science and Environment, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing 210008, China, ²GIS Centre, Ryan Institute and School of Geography and Archaeology, National University of Ireland, Galway, Ireland

Phosphorus (P) is a major factor in the influence on the water eutrophication and algal bloom. Bioturbation have played an important role in P flux from sediments into the water column. Bioturbation could be caused by a variety of benthic macroinvertebrates, including chironomids, oligochaetes and bivalves, which are very common in eutrophic lakes. Therefore, benthic macroinvertebrates bioturbation may affect the health of aquatic ecosystems.

The effects of different macroinvertebrates bioturbation on the lability of P in sediments were studied. The results showed that chironomid larvae bioturbation significantly decreased concentrations of soluble P, soluble Fe(II) in pore water and DGT-labile P, labile Fe in sediments and inhibited the release of soluble P from pore water to overlying water. In contrast, bivalve (Corbicula fluminea) bioturbation significantly increased concentrations of pore water soluble P/Fe(II) and sediments DGT-labile P/Fe and promoted the release of soluble P from pore water to overlying water. The results proved the theory that the adsorption and desorption by Fe redox were the major mechanisms responsible for the decreases and increases of soluble and labile P.

Recently, the experiments about the effects of those two macroinvertebrates bioturbation on the heavy metals such as Mn, Co, Ni, Cu, Zn, Cd, Pb, Cr, As in sediments were investigated. The preliminary results showed that the bioturbation also had significant effects on heavy metals. The further data analysis is still needed.
THE NITRATE TIME BOMB (NTB) MODEL - A SIMPLE BUT EFFECTIVE METHOD TO INVESTIGATE THE IMPACTS OF HISTORICAL NITRATE LOADING ON LONG-TERM GROUNDWATER NITRATE CONCENTRATIONS

Monday, 15th August - 17:15 - OS-3B.02 - Water Quality - Oral

Dr. Lei Wang¹, Ms. Marianne Stuart¹, Mr. Sean Burke¹, Mr. Rob Ward¹

¹British Geological Survey, Keyworth, Nottingham, UK, NG12 5GG

Nitrate water pollution, which remains an international problem, can cause long-term environmental damage and threaten both the economy and human health. Agricultural land is the major source of nitrate water pollution. It can take decades for nitrate leached from the soil to discharge into freshwaters. However, this nitrate time lag in the groundwater system has generally been ignored within the water resource management in many countries including the UK.

We present a nitrate time bomb (NTB) model to modelling nitrate processes in the groundwater system. Whilst NTB contains simplified conceptual models, it can represent the major nitrate and hydrogeological processes in the groundwater system at both national and catchment scales, such as spatio-temporal nitrate loading, low-permeability superficial deposits, dual-porosity unsaturated zones and nitrate dilution in aquifers. The NTB model has been successfully used to simulate annual nitrate concentrations from 1925 to 2150 in the major aquifers in Great Britain and four local aquifer zones in the Eden Catchment, England. Monte Carlo simulations were undertaken to analyse parameter sensitivity and calibrate the model using observed datasets. These results help decision makers to understand how the historical nitrate loading from agricultural land affects the evolution of groundwater quality due to the nitrate time lag in the groundwater system. This NTB approach will be particularly valuable to evaluate the long-term impact and timescale of land management scenarios and programmes of measures introduced to help deliver water quality compliance. This model requires relatively modest parameterisation and is readily transferable to other areas.
INORGANIC CHEMICAL QUALITY OF EUROPEAN TAP WATER: GEOGRAPHICAL DISTRIBUTION AND REGULATORY COMPLIANCE

Monday, 15th August - 17:15 - OS-3B.03 - Water Quality - Oral

Dr. Belinda Flem¹, Dr. Clemens Reimann¹, Dr. Manfred Birke², Mr. David Banks³, Prof. Peter Filzmoser⁴, Dr. Bjorn Frengstad¹, Dr. GEMAS Project Team⁵

¹Geological Survey of Norway, ²Federal Institute for Geosciences and Natural Resources, ³Holymoor consultancy, ⁴TU Wien, ⁵EuroGeoSurveys

579 tap water samples were collected at the European scale and analysed in a single laboratory for more than 70 parameters. This dataset is analysed in terms of the spatial distribution of the analysed parameters to detect some key processes that control tap water geochemistry at a continental scale. These parameters are also compared to European drinking water regulations.

The use of surface waters and poorly-buffered silicic aquifers for drinking water supply in Norway, Sweden and Finland is reflected in low concentrations of Ca, Mg, Sr and Li. At the same time, these tap waters show the highest concentrations of the rare earth elements, probably reflecting their geological availability and the generally low pH of raw water sources.

Geology is an important factor determining the regional distribution patterns for some elements; e.g., high values of Cr and V appear to be influenced by the distribution of mafic and ultramafic rocks in Europe.

Water treatment is, for example, reflected in especially high P values observed in the United Kingdom, where phosphate is used to fight plumbosolvency from the water distribution network.

For most parameters a level of 99% or better compliance with international drinking water norms is achieved. A dataset based on a greater number of tap water samples (N = 1000 – 2000), evenly distributed over Europe would deliver highly relevant information for scientists, water managers and politicians, highlighting the different raw water sources, the differences in geology but also water treatment practices at the European scale.
NEW THREATS TO THE SAFETY OF DRINKING WATER BY NATURAL ORGANIC MATTER

Monday, 15th August - 17:15 - OS-3B.04 - Water Quality - Oral

Prof. Bing Tang¹

¹Institute of Environmental Health and Pollution Control and School of Environmental Science and Engineering, Guangdong University of Technology, Guangzhou 510006, China

Most of the organics contained in dead plants and animals are very easily degraded by microorganisms in natural world. However, some of the organics are non-degradable, and they eventually dissolve in water to form a kind of biorefractory organic compounds, which is called natural organic matter (NOM) and is found in all surface, ground and soil waters. The concentration and characteristics of NOM not only differ with climate and region, but also vary with other factors (such as the emission from the adjacent residential area). For numerous reasons from both natural world and human society, the types and characteristics of NOM have changed profoundly and exhibited an increasingly complex trend in the past decades. The reasons leading to the changes of NOM in its chemical composition and amount are quite complex, and cause considerable difficulties in recognizing its characteristic and designing a suitable process to achieve effective purification to the contained NOM. These issues have brought about great challenges to the traditional methods to characterize and purify these complex compounds, including: (1) accurate and convenient methods to measure and characterize the type and concentration of NOM; (2) high efficient process to remove the contained NOM. Obviously, these challenges are also potential threats to the safety of drinking water and human health. The aim of the present article is to give a systematic review to the literature about NOM published in recent years, including the difficulties of characterizing and removing NOM.
USING COMPOUND-SPECIFIC ISOTOPE ANALYSIS FOR ASSESSING BIODEGRADATION OF GASOLINE PRODUCTS IN GROUNDWATER BELOW A GAS STATION ABOVE ISRAEL’S COSTAL AQUIFER

Monday, 15th August - 17:15 - OS-3B.05 - Water Quality - Oral

Dr. Faina Gelman¹, Mrs. Almog Gafni², Prof. Zeev Ronen²

¹Geological Survey of Israel, ²Zuckerberg Institute for Water Research, Ben-Gurion University

Fuel leakage from underground storage tanks (UST) is a worldwide problem. Gasoline spills containing benzene, toluene, ethyl benzene and xylene (BTEX) as well as methyl-tert-butyl-ether (MTBE). In the groundwater, these pollutants undergo processes of natural attenuation (NA) including volatilization, dilution, sorption, and microbial degradation. The latter is the most important process since it is the only one that breaks down or transforms the pollutants. Monitored Natural Attenuation (MNA) was selected as alternative for a spill below gas station situated in the southern part of Israel coastal aquifer. The aim of the study was to answer the question: Does biodegradation of BTEX and MTBE occur and if so can we determine the rate of degradation? To address the question, groundwater samples were analysed for biogeochemical and isotopic indicators for in-situ microbial activity. These parameters included changes in water geochemistry, isotopic fractionation of carbon in the target pollutants. The results indicated that manganese, iron, nitrate and sulphate reduction took place in the two most contaminated wells with concurrent reduction in BTEX. In addition significant changes in carbon isotope composition of MTBE has been detected in the groundwater sampled from the contaminated site. The results proved natural biodegradation occurrence at the contaminated site; the rate of the biodegradation was estimated as 0.5 /year.
EFFECT OF SILICATE ON ARSENIC FRACTIONATION IN SOILS AND IRON PLAQUE FORMATION IN RICE PLANTS

Monday, 15th August - 17:15 - OS-3C.01 - Health Risk of Metals - Oral

Dr. Chuan Wu

1 Central South University

Pot experiments under greenhouse condition were conducted to investigate the effects of silicon application with different levels on iron plaque formation, As fractionations in soils, As uptake and grain As speciation in indica and hybrid rice genotypes with different radial oxygen loss (ROL). The results showed that Si significantly increased root (P<0.05) and grain (P<0.001) biomass. Silicate addition reduced the proportion of As associated with well-crystallized hydrous oxides of Fe and Al and residual phases, whilst increasing the proportions of As specifically-sorbed and associated with amorphous and poorly-crystalline Fe and Al hydrous oxides. Indica genotypes induced more iron plaque than hybrid genotypes (P<0.005) and tended to sequestrate higher contents of As. Si application significantly increased Fe concentrations in iron plaque of rice (P<0.05). Si application significantly decreased As concentrations in roots (P<0.005), straws (P<0.05) and husks (P<0.001). Si addition both decreased iAs and DMA concentrations in rice grains.
ENVIRONMENTAL EXPOSURE OF THALLIUM AND HEALTH RISK IN AREAS WITH NATURALLY OCCURRING THALLIUM

Monday, 15th August - 17:15 - OS-3C.02 - Health Risk of Metals - Oral

Prof. Tangfu Xiao

1State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences

Little is known about thallium (Tl) exposure from naturally occurring Tl contamination. This paper draws attention to the potential health risk posed by high concentrations of naturally occurring Tl in the environment. The inhabitants from a rural area impacted by Tl-rich sulfide mineralization face a severe Tl exposure in their daily lives. High Tl concentrations were detected in urines of the local residents. Measured urinary Tl levels are as high as 2.51-2,668 µg/L, surpassing the accepted world urine Tl level <1 µg/L for “non-exposed” humans. The urinary Tl levels show significant difference among 3 communities, but no significant difference in either sex or age groups. However, there is a positive relationship between the extent of Tl exposure from Tl in soil and crops in the immediate environment and the levels of Tl detected in urine. The urinary Tl concentrations correlate with the extent of exposure, in terms of geographical, dietary and behavioral differences. The elevated urinary Tl levels are mainly attributable to Tl accumulation in locally grown vegetables acquiring Tl from natural sources in local soils, and represent a steady-state condition with long-term exposure. Natural enrichment of Tl can pose a potential health risk to the population, and monitoring for urinary Tl level is a reliable and accurate way of bio-marking Tl exposure before the health risk attains epidemic proportions.
THE GEOGENIC CADMIUM AND POTENTIAL HEALTH RISK IN THE THREE GORGES REGION, SOUTHWEST CHINA

Monday, 15th August - 17:15 - OS-3C.03 - Health Risk of Metals - Oral

Dr. Yan Xiong¹, Dr. Yizhang Liu¹, Prof. Tangfu Xiao¹

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The geogenic Cd related to black shale weathering has produced Cd enrichment in local surface environment of the three Gorges region, China. In order to investigate the Cd distribution and health risk, the local rock, soil, food crop and population urine samples were monitored. Elevated Cd concentrations were observed in local arable soils (0.42-42 mg/kg) and natural soils (0.12-8.5 mg/kg), corresponding to high amounts of Cd (0.22–42 mg/kg) in local black shale. The enrichment factor plots illustrated that the majority of soil samples had EF values of <5, pointing to geogenic origin of Cd, whereas some arable soils had EF values >5, pointing to an additional anthropogenic input of Cd. The average Cd contents were 0.68 mg/kg (fresh weight) in local vegetables. The elevated bio-accumulation factors for Cd were due to its high potential bioavailability in soils, and leaf vegetables tend to accumulate more Cd than the other crops. The calculated health risk index has higher values (4.62) for Cd than for other metals (< 1), suggesting that Cd represents a significant potential risk for the local population. The urinary Cd levels (mean at 3.92 g/L for male and 4.85 g/L for female) of local inhabitants were significantly higher than those from control area (mean at 0.8 g/L for male and 0.42 g/L for female). The findings show that naturally-occurring Cd in local soils is taken up appreciably by food crops, and can pose potential health risk to public, through dietary vegetable ingestion exposure of Cd.
GEOCHEMICAL INVESTIGATIONS OF POTENTIALLY HARMFUL ELEMENTS (PHEs) IN HOUSEHOLD DUST OF IDRIJA TOWN

Monday, 15th August - 17:15 - OS-3C.04 - Health Risk of Metals - Oral

Dr. Spela Bavec1, Dr. Mateja Gosar1, Dr. Miloš Miler1, Dr. Harald Biester2

1Geological Survey of Slovenia, 2Technische Universität Braunschweig

This study tackles geochemical investigation of potentially harmful elements (PHEs) in household dust from the town of Idrija (Slovenia), once the world famous Hg mining town that is now seriously polluted. After aqua regia digestion, the contents of mercury (Hg), arsenic (As), cadmium (Cd), cobalt (Co), chromium (Cr), copper (Cu), molybdenum (Mo), nickel (Ni), lead (Pb) and zinc (Zn) were measured. PHE-bearing particles were recognised and observed by scanning electron microscopy and energy dispersive spectrometry before and after the exposure to simulated stomach acid (SSA). Mercury binding forms were identified by Hg thermo-desorption technique. With regard to rural and urban background values for Slovenia, only Hg (6–120 mg/kg) is severely enriched. Mercury pollution is a result of past mining and ore-processing activities. With regard to local topsoils, enrichments are observed for Cd, Cr, Cu, Mo, Ni and Zn, while As, Co and Hg show lower values and Pb shows similar values. SEM/EDS revealed the presence of Hg-, Cu-, Cd-, Pb-, Ni- and Zn-containing particles of geogenic and anthropogenic origin in dust samples. Hg sulphides in form of chemically stable cinnabar and potentially metacinnabar show no signs of dissolution in SSA, while for other recognised metal-bearing particles significant morphological and/or chemical alterations were observed. Four Hg binding forms were identified: Hg bound to the dust matrix, cinnabar (HgS), metallic Hg (Hg0) and minor amounts of mercury oxide (HgO). In average about 36 % of Hg is bound to potentially transformable secondary matrix bound Hg, of which specific compounds are not recognised.
Environmental pollution is a major dilemma of industrialization caused by untreated disposal of industrial waste. These effluents include various toxic chemicals including heavy metals. One of the top pollutants that are released through industrial effluents is chromium with known mutagenic and carcinogenic effects on all life forms. The present study is aimed at the isolation and characterization of chromium resistant bacteria that may have the potential to remediate Cr-polluted environment. Industrial effluent was collected from Sialkot, an industrial city of Pakistan, and bacteria were isolated and selected on the basis of resistance against chromium(VI). Highest Resistance of 375mM of Chromium(VI) was exhibited by isolate AM-81. 16S rRNA gene sequencing revealed the identity of the bacterial isolate AM-81 as Cellulosimicrobium cellulans. Besides chromium resistance, this isolate was found to be resistant to multiple heavy metals and antibiotics. Chromium(VI) reduction by this isolate was determined both aerobically and anaerobically under variable nutritional requirements and non-growth conditions. Cell free extract was purified using French press, ultracentrifugation and various chromatographic columns. The size of chromate reductase of Cellulosimicrobium cellulans isolate AM-81 was detected through SDS-PAGE. The bacterial isolate with known reductase activity can be exploited for the removal of chromium(VI) from industrial effluents thus can act as one of the prospective applicants for bioremediation purposes.
ENHANCEMENT OF METAL PHYTOSTABILIZATION BY INOCULATION OF ENDOPHYTIC BACTERIUM ACHROMOBACTER PIECHAUDII E6S

Monday, 15th August - 17:15 - OS-3D.01 - Soil Pollution - Oral

Dr. Ying Ma¹, Prof. Helena Freitas¹
¹Centre for Functional Ecology, Department of Life Sciences, University of Coimbra, Coimbra, Portugal

Application of hyperaccumulator–endophyte symbiotic system is becoming a potential technique to improve phytostabilization. The objective was to isolate metal resistant and immobilizing endobacterium and to evaluate its role in enhancing plant growth and metal phytostabilization. A metal resistant endophytic bacterial strain E6S was isolated from stems of Sedum plumbizincicola using DF salts minimal agar medium with 1-aminocyclopropane-1-carboxylate (ACC) as sole nitrogen source and identified based on morphological, biochemical characteristics, partial 16S rDNA sequence and phylogenetic analysis. Metal resistance and sensitivity to antibiotics of E6S were determined by plate dilution and disc diffusion method, respectively. Plant beneficial traits of E6S, e.g. phosphate (P) solubilization and indole-3-acetic acid (IAA) production were measured in Pikovskayas and Luria–Bartani medium, respectively. The ability of E6S to immobilize metals in soil and to absorb metal ions by its cells in liquid media were also analysed. The effects of E6S on the growth and metal accumulation in S. plumbizincicola were assessed in pot experiment. Strain E6S exhibited high level resistance to various metals (Cd, Zn, Pb) and antibiotics (ampicillin, chloramphenicol, kanamycin, tetracycline and streptomycin). Besides utilizing ACC, E6S was able to solubilize P and produce IAA. Inoculation of E6S significantly decreased concentrations of bioavailable Cd, Zn and Pb. In addition, E6S bound considerable amounts of metal ions in their resting cells in the sequence: Zn > Cd > Pb. Inoculation of E6S stimulated plant biomass, uptake and bioconcentration factor of Cd, Zn and Pb. However, E6S significantly declined translocation factor of Cd and Zn less than 1.
The health risks posed by heavy metals (HMs) contamination have received increasing attention. Phytoextraction using hyperaccumulator has been given specific focus. Intercropping of hyperaccumulator and economical crops is now being widely utilized in slightly or moderately HMs contaminated farmlands.

This study conducts both laboratory experiments and field trials, to evaluate the efficiency of intercropping system, from both the aspect of cleanup ability and the aspect of economic merits. Based on the assumption that hyperaccumulator can mobilize HMs in rhizosphere and that hyperaccumulator and economical crop have different tendencies to approach and mobilize or immobilize HMs, Synchrotron Radiation X-ray Absorption Spectrum and X-ray Phase Contrast Imaging are utilized to disclosed the HMs species and root architecture in the rhizosphere. The impacts of intercropping system on the transfer and transportation process of HMs from soil to plant in the rhizosphere of the intercropping system are to be elucidated. In the field, the intercropping system was utilized in a farmland contaminated by a nearby Pb-Zn mine. The remediation efficiency and the produced economical benefits in a two-year remediation period are to be calculated. Results will be instructive for the optimization of phytoremediation technology using intercropping system.
Organotin compounds including tributyltin chloride (TBT) have been extensively employed in a variety of industrial products, such as antifouling paints for ships, wood preservatives, biocides, and plastic stabilizers. A comprehensive literature review has indicated that TBT is the most toxic compound known to aquatic ecosystems. The widespread use of TBT, has resulted in severe environmental problems around the world, including endocrine disruptions of aquatic life. TBT can bond to suspended material and is deposited in benthic sediments, where it can last unaltered for decades. In recent years, biological degradation has been suggested to be the major pathway for the removal of TBT from the estuarine and marine sedimentary environment compared to physicochemical methods such as thermal treatment, steam striping and chemical oxidation. In this study, TBT resistance bacteria were isolated from a variety of sediments and soil samples using TBT containing media. A number of assays took place to assess the suitability of the microorganism strains such as their resistance to TBT and the strains ability to utilise TBT as a sole carbon source via GC-MS over a period of 21 days. Successful candidate microorganisms were phylogenetically identified using 16rRNA sequence analysis. Results show 54% of the bacterial isolates were resistant to TBT. In addition six isolates have the ability break down TBT to its less toxic species monobutyltin (MBT) and dibutyltin (DBT). Consequently the six isolates have the potential to be used in a remediation assay of sediment or soil with minimal disruption to the local environment.
CONTAMINATION, FRACTIONATION AND MOBILITY OF TRAFFIC RELATED ELEMENTS IN ROAD ENVIRONMENTS

Monday, 15th August - 17:15 - OS-3D.04 - Soil Pollution - Oral

Dr. Ewa Adamiec

AGH University of Science and Technology, Faculty of Geology, Geophysics and Environmental Protection

The purpose of this research is to extend the current knowledge of traffic-related metals bounded in roadside topsoil. Traffic generated particles (e.g. brake dust and tyre dust) are key tracers of non-exhaust emissions. In order to assess and recognize road-specific contamination in the urban environment, sites characterized by heavy traffic and congestions were selected in Krakow, Warsaw as well as in Wroclaw and Opole. In each of the eight research sites, samples of road dust and roadside topsoil were collected during summer, autumn, winter and spring. Results (ICP-MS, ICP-OES and AAS) revealed that roadside topsoil is especially contaminated with Zn, Cr, Cu, Pb, Fe, Ba and Ti. These metals are key tracers of non-exhaust brake wear emissions. The concentrations of the majority of these elements were significantly elevated when compared with the concentrations found in roadside topsoil sampled from relatively traffic-unpolluted areas. Moreover, SEM-EDS analysis of road dust have confirmed the presence of brake-lining components and significantly amount of particles of geogenic origin. Studies on metal forms in road dust and roadside topsoil revealed that e.g. Zn is significantly mobile and constitutes a potential source of contamination derived from wear and tear of tyres.

Acknowledgments:

The research leading to these results has received funding from the Polish-Norwegian Research Programme operated by the National Centre for Research and Development under the Norwegian Financial Mechanism 2009-2014 in the frame of Project Contract No Pol-Nor/208849/106/2015
THE GEOCHEMICAL BASELINE CONCENTRATIONS FOR POTENTIALLY TOXIC ELEMENTS (PHEs) IN AN URBAN ENVIRONMENT

Monday, 15th August - 17:15 - OS-3D.05 - Soil Pollution - Oral

Dr. Andrian Seleznev\textsuperscript{1}, Dr. Ilia Yarmoshenko\textsuperscript{1}, Dr. Alexander Sergeev\textsuperscript{1}

\textsuperscript{1}Institute of Industrial Ecology UB RAS

The assessment of geochemical baseline concentrations for PHEs were conducted for puddle sediment (PS) in Ekaterinburg and topsoil in the small arctic cities: Noyabrsk, Novy Urengoy and Tarko Sale in Yamalo-Nenets Autonomous Okrug (Russia). The PS is the specific type of geochemical traps of the recent anthropogenic sediments at the urban territory. The PS and topsoil concentrate surface geochemical fluxes over the landscape area and over time from the forming of artificial landscape. The PS and topsoil reflect local geochemical conditions of the territory. The PS sampling was conducted in residential areas in Ekaterinburg. The PS samples were taken from the puddles from the upper 5 cm layer (sample mass approx. 1.5 kg of dry weight). The 370 topsoil samples were collected in Noyabrsk, 103 in Tarko Sale and 308 in Novy Urengoy at the period of 2006-2008. Concentrations of Cd, Cu, Zn, As, Cr, Ni, Co, Hg, Pb, Mn, Fe, Al, petrochemicals and phenol were determined in topsoil and PS samples. The geochemical baseline values for elements were calculated on the basis of statistical analysis of the sample population, normalization procedure and analysis of cumulative distribution frequency curves. Baseline values were also assessed for soil data obtained from the regular soil survey in Ekaterinburg. The obtained geochemical baseline values for PHEs can be used as reference in the assessment of pollution degree of the territories of the cities.
KEYNOTE HOW FOSSIL FUEL AND ELECTRICITY CAN SAVE MILLIONS OF LIVES BY REDUCING AIR POLLUTION EXPOSURE

Tuesday, 16th August - 09:00 - KN-3.01 - Keynote Speech (Joint Conference) - Keynote

Prof. Kirk Smith

University of California Berkeley

The various credible estimates of the global burden of disease from use of biomass and coal as household cookfuels range from ~3-4 million premature lives lost per year due to the exposures to air pollution in and around the household, primarily as products of incomplete combustion. Globally being the largest single environmental health hazard, the highest per capita impact is in Sub-Saharan Africa, followed by South Asia, and then SE and West Asia, including China. Although closely linked to poverty, waiting for poverty alleviation to reduce the burden has stalled in spite of economic development in many countries. Unfortunately, there are now more people using such fuels than anytime in human history. The second approach has been to try to burn solid fuels more cleanly such that high household air pollution exposures are eliminated, but this too has not worked to reduce health impacts substantially. In just the last year, however, major new efforts have been undertaken in several countries to address this problem through innovative policies to extend access to Liquefied Petroleum Gas (LPG), clean cookfuel, to hundreds of millions of the poor. In addition, the advent of innovative, efficient, and inexpensive electrical cooking appliances combined with growing electrification is leading a handful of countries to consider a leapfrog approach to the cookfuel problem, i.e., to skip the gas phase entirely and go directly to full electric cooking. These two approaches also can help reduce ambient air pollution in those countries, such as India and China, where household fuel use is responsible for 25-33% of health-damaging ambient pollution in recent estimates. A brief history of the problem, summary of the health impacts, and discussion of current approaches to solutions will be discussed.
CHEMICAL COMPOSITION OF GROUNDWATER/DRINKING WATER AND ONCOLOGICAL DISEASE MORTALITY, SLOVAK REPUBLIC

Tuesday, 16th August - 10:00 - OS-4A.01 - Environmental Health - Oral

Mrs. Veronika Čvecková¹, Dr. Katarina Fajciková¹, Prof. Beata Stehlíková², Dr. Stanislav Rapant¹

¹State Geological Institute of Dionyz Stur, ²Faculty of Economy and Business, Panaeuropean University

This study deals with relationship between chemical composition of the groundwater / drinking water and mortality from oncological diseases (MOD) in Slovakia. Primary data consist of the Slovak national database of groundwater analyses (20,339 chemical analyses, 34 chemical elements/compounds) and data on MOD (17 health indicators collected within 1994-2003). The chemical and health data were unified in the same form and expressed as the mean values for each of 2,883 Slovak municipalities. Pearson and Spearman correlation as well as artificial neural network were used for statistical data analysis to identify the most significant chemical elements having influence on MOD and their limit and optimal contents. Based on calculations through neural network, eight chemical elements/parameters in the groundwater were defined as the most significant for MOD: Ca+Mg (mmol l-1), Ca, Mg, TDS, Cl, HCO₃, SO₄ and NO₃.

The highest relationship between MOD and groundwater contents was documented for Ca+Mg (mmol l-1), Ca and Mg. We observe increased MOD with their low (deficit) contents in groundwater/drinking water. The limit values were set for Ca+Mg 1.73-5.85 mmol l-1, Ca 60.5-196.8 mg l-1 and Mg 25.6-35.8 mg l-1. At these concentration ranges MOD in the Slovak Republic is at the lowest levels. These limits are about twice higher in comparison with the current Slovak guideline values for the drinking water.

This research has been performed within the project Geohealth (LIFE10 ENV/SK/086) which is financially supported by the EU’s funding instrument for the environment: Life+ programme and Ministry of the Environment of the Slovak Republic.
CHEMICAL COMPOSITION OF GROUNDWATER/DRINKING WATER AND HEALTH STATUS OF POPULATION OF THE SLOVAK REPUBLIC

Tuesday, 16th August - 10:00 - OS-4A.02 - Environmental Health - Oral

Dr. Stanislav Rapant¹, Mrs. Veronika Cveckova¹, Dr. Katarina Fajcikova¹, Ms. Jana Michalcova², Prof. Beata Stehlikova³

¹State Geological Institute of Dionyz Stur, ²Regional authority of public health, Zvolen, ³Faculty of Economy and Business, Panaeuropean University

Presented study deals with relationship between chemical composition of groundwater/drinking water and health status of inhabitants of the Slovak Republic. Primary datasets consist of national database of chemical analysis of groundwater (20,339 analyses, 34 chemical elements/compounds) and data on health status of population. Health status is evaluated through 14 health indicators, including the most common causes of deaths in Slovakia, cardiovascular and oncological diseases, diseases of gastrointestinal tract and respiratory system as well as life expectancy and potential years of lost life. Pearson and Spearman correlation and method of neural networks were used for analysis of relationship between chemical composition of groundwater and health indicators. Following chemical elements were identified as most influential in relation to human health: water hardness, Ca, Mg, T.D.S., HCO3-, NO3-and SO4²-. The most significant relationship between health indicators and chemical elements in groundwater was documented for water hardness, calcium and magnesium. At deficit levels of these elements we observe significantly worse levels of health indicators as well as lower life expectancy. We have defined following limit values: Ca > 60 mg l⁻¹, Mg > 25 mg l⁻¹ and water hardness >2 mmol l⁻¹, at which mortality for evaluated diseases is the lowest and life expectancy is the highest. Defined limit contents are two times higher compared to Slovak guideline for drinking water.

The project is supported by the EU Life+ programme (LIFE10 ENV/SK/086) and Ministry of the Environment of the Slovak Republic.
Exposure to Bisphenol A (BPA) has been linked to the increased incidence of nonalcoholic fatty liver disease (NAFLD): the hepatic manifestation of metabolic syndrome. In this study, male post-weaning C57BL/6 mice were exposed to 50 g/kg/day BPA or corn oil for 90 days by. We found that insulin resistance, impaired hepatic lipid accumulation and increased serum triglycerides (TG) existed concomitantly in the BPA exposed mice. In addition, BPA exposure caused significant reduction in miR-192 expression in both mice liver tissues and human HepG2 cells, which were accompanied by significant up-regulation of SREBF1 (a key transcription factors that is capable of activate lipid synthesis) and subsequent expression of lipogenic genes. Bioinformatic and in vitro studies suggested that miR-192 acted to the 3'UTR of SREBF1 directly, resulting in profound dysregulations in hepatic lipid homeostasis. Inhibition of miR-192 led to higher TG levels and increased hepatic lipid accumulation by enhancing SREBF1 processing. In contrast, the opposite results were observed with overexpression of miR-192, which downregulated SREBF1 expression. Most importantly, we also showed that in vivo and in vitro overexpression of miR-192 effectively prevented BPA induced hepatic lipid accumulation, which was independently of insulin resistance. In conclusion, this study showed a novel mechanism that exposure to BPA may up-regulate SREBF1 through inhibition of miR-192 in the liver, thereby contributing to NAFLD.
HEARING LOSS IN CHILDREN WITH E-WASTE LEAD AND CADMIUM EXPOSURE

Tuesday, 16th August - 10:00 - OS-4A.04 - Environmental Health - Oral

Ms. Yu Liu¹, Prof. Xia Huo², Prof. Xijin Xu³

¹Laboratory of Environmental Medicine and Developmental Toxicology, Shantou University Medical College, ²School of Environment, Guangdong Key Laboratory of Environmental Pollution and Health, Jinan University, ³Department of Cell Biology and Genetics, Shantou University Medical College

Hearing loss is caused by exposure to a wide range of biological and environmental factors. Exposure to heavy metals has been proposed as an important risk factor for hearing loss. We evaluated the cross-sectional associations between blood lead (Pb) levels, urinary cadmium (Cd) levels and audiometrically determined hearing thresholds in preschool children from Guiyu, an e-waste recycling area. A total of 234 children, 3-7 years of age, were recruited to participate in audiometric testing in 2014. Air conduction hearing thresholds were examined from 0.5 to 8 kHz, and hearing loss was defined as a pure-tone average (PTA) > 25 decibel (dB) in one or both ears. Higher Pb levels and urinary Cd levels were measured in the exposed group than the reference group (p < 0.01). Hearing thresholds in both ears increased with advancing age and declined with increasing frequency in both groups. After adjusting for age, the PTA in one or both ears was significantly higher in the exposed group (p < 0.01). Compared with the reference group, the exposed group had a significantly higher prevalence of hearing loss (21.2% vs 4.5%; p < 0.01). After adjustment, the multivariable adjusted odds ratios (ORs) for hearing loss were 4.855 (95% CI: 1.248, 18.882) and 0.667 (95% CI: 0.134, 3.319) in the highest versus the lowest blood Pb and urinary Cd quintiles, respectively. Results suggest that exposure to Pb in preschool children from an e-waste recycling area may be an important risk factor for hearing loss.
GEOLOGICAL FACTORS INFLUENCE ON INDOOR RADON IN SETTLEMENTS ON TECHA RIVER

Tuesday, 16th August - 10:00 - OS-4A.05 - Environmental Health - Oral

Dr. Ilia Yarmoshenko¹, Dr. Georgy Malinovsky¹, Dr. Aleksey Vasilyev¹, Dr. Andrian Seleznev¹

¹Institute of Industrial Ecology UB RAS

Radon-222, radioactive gas is a product of decay of natural radium-226 in rocks and soils. Radon emanates from solid grains and exhalates to the atmosphere. Accumulation of radon in homes is a significant health problem. Geological and building factors are generally known to control indoor radon entry. More detailed data are necessary for identifying radon-prone areas and indoor radon prediction in new buildings. Techa River is the region of radioactive contamination due to discharges of liquid radioactive wastes by Mayak nuclear plant in 1949-1956. Data on the strength of different radon sources is required for reconstruction of Techa population exposure to radon in the past. The aim of the study was to conduct an indoor radon survey and analyze the influence of geological factors on indoor radon in Techa river settlements. The studied area is located at the East Urals uplift and West Side of the West Siberian lithosphere plate. Geological setting is represented by the rocks and lithological complexes of Early and Middle Triassic, Middle Riphean, Late Proterozoic, Early Carboniferous, Middle Devonian and Middle Ordovician ages. Quaternary sediments of Holocene and Late Pleistocene age cover almost continuous overlap bedrock and principally consist of alluvium, talus and eluvium. Contemporary indoor radon concentration was measured in about 500 one-storey rural houses in 14 settlements along 160 km of the river. Average indoor radon concentration CRn=150 Bq/m³, GSD 2.1. Analysis of variations revealed dependence of CRn on lithological complexes and quaternary sediments. Relationship between CRn and ventilation rate in houses appears to depend on age of quaternary sediments.
NITRATE IN DRINKING WATER AND COLORECTAL CANCER - A NATIONWIDE POPULATION-BASED FOLLOW-UP STUDY

Tuesday, 16th August - 10:00 - OS-4B.01 - Drinking Water - Oral

Mr. Jörg Schullehner1, Dr. Birgitte Hansen1, Prof. Carsten Bøcker Pedersen2, Prof. Torben Sigsgaard3

1Geological Survey of Denmark and Greenland (GEUS), 2Centre for Integrated Register-based Research, Aarhus University, 3Department of Public Health, Aarhus University

Importance of work and objectives

Studies have suggested that nitrate in drinking water increased the risk of colorectal cancer. However, often exposure estimations and study size were insufficient to yield unequivocal results. We addressed these challenges by conducting a detailed exposure assessment of the entire Danish population.

Methodologies

GIS methods were used to assign nitrate concentrations at the waterworks to the 2,779 water supply areas and 55,752 private wells. Annual nitrate concentrations were assigned to each resident of Denmark from 1978-2012, based on their exact address in the Civil Registration System. For each person the individual adult exposure (age 20-35) was calculated. Information on colon and rectal cancer diagnoses was obtained from the national Cancer Registry. Cox proportional hazard models using age as time scale were fit to assess the risk within exposure deciles. Possible confounding co-variates, such as sex, education, region and previous cancer diagnoses were included and sensitivity analyses conducted taking the uncertainty of the exposure estimate into account.

Main results

2,833,825 individuals were enrolled, totaling a follow-up time of approx. 32 million person-years. Preliminary results will be presented, indicating an increased risk for colon cancer at concentrations far below the drinking water standard (50 mg/l). Results for rectal cancer did not show the same consistent pattern.

Conclusions

This nationwide population-based study addresses previous studies’ challenges of poor exposure assessment and insufficient study population sizes. It adds to the increasing body of evidence of negative chronic health effects associated with increased levels of nitrate in drinking water.
Numerous research works reveal that quality of drinking water is defined by its chemical composition. One of the important public health value of water is its hardness that causes process of limescaling. In our opinion such deposits contain information concerning water quality and could be useful in environmental studies.

We processed a database (> 700 samples) on chemical elements content in drinking water salt deposits in Siberia, Urals and Kazakhstan differing by natural and anthropogenic conditions. Methods used include NAA, ICP-MS, XRD, SEM, fission radiography for element and mineral composition analysis.

Results show that limescale inherits chemical composition of water. Chemical elements in the limescale common for all regions are Zn, Fe, Ag, which concentration coefficients (respectively to limescale of Lake Baikal water) range within wide limits. Moreover, Zn takes the leading role in all geochemical series. Thus each territory has its geochemical specialization depending on geological structure and metallogeny (e.g. ore deposits, rifting processes). It is clearly seen in mountain-folded territories such as Altai or Baikal region.

Anthropogenic development also finds its reflection in chemical composition of the limescale, especially in the vicinity of industrial plants (e.g. nuclear reactors) or tailings (e.g. Dzhida W-Mo district, Novo-Ursk Ag-Au deposit, Komsomolsk Au deposit).

High rates of chemical elements content in the limescale are in correlation with general and specific incidence. It means that we could use such correlations for water quality assessment and forecast of diseases.

The research was supported by grant from Russian Science Foundation (project № 15-17-10011)
BIG DATA EPIDEMIOLOGY: DRINKING WATER QUALITY IN RELATION TO HEALTH STATISTICS IN THE NETHERLANDS

Tuesday, 16th August - 10:00 - OS-4B.03 - Drinking Water - Oral

Mrs. Monique van der Aa¹, Mr. Merijn Schriks², Mr. Danny Houthuijs³, Mrs. Lieke Coppens³, Prof. Annemarie Van Wezel⁴

¹RIVM National Institute for Public Health and the Environment, ²KWR Watercycle Research Institute, ³Nelen-Schuurmans, ⁴Utrecht University / KWR Watercycle Research Institute

Importance of the work and objectives

The increasing availability of databases with health data in the Netherlands, offers opportunities to investigate associations between drinking water and health characteristics for all Dutch residents. The aim of our study is to use existing national databases to evaluate associations between health characteristics and drinking water quality.

Methodologies

We will couple national databases on health and mortality on municipal and possibly individual level, to information on drinking water quality. Using this approach, we will work with maximum sample sizes and most contrasting exposure levels available in the Netherlands. We will evaluate associations of drinking water quality and health characteristics and correct for confounding factors such as sex, age and socio-economic status.

We start with associations between stressors and diseases that are described by classic epidemiological research i.e. associations between hardness of drinking water and occurrence of cardiovascular diseases, associations between lung (and skin) cancer and arsenic concentration in delivered drinking water, and associations between Legionnaires’ disease incidence and type of drinking water production. In a further stage we might use the ‘big data epidemiology’ for more debated associations.

Main results and conclusions

Our null-hypothesis is that we will find no associations between drinking water quality and health characteristics in the Netherlands, and so that we can confirm earlier toxicologically based risk assessments. Moreover, the research will provide insight in additional value of big data epidemiological approach compared to the more classical risk assessment approach. At the conference, preliminary results will be presented.
LOW RISK OF SUICIDE AND LITHIUM IN DRINKING WATER: A DANISH INDIVIDUAL-LEVEL COHORT STUDY USING SPATIAL ANALYSIS

Tuesday, 16th August - 10:00 - OS-4B.04 - Drinking Water - Oral

Ms. Nikoline Nygård Knudsen¹, Mr. Jörg Schullehner², Mrs. Lisbeth Flindt Jørgensen³, Dr. Birgitte Hansen², Dr. Lars Vedel Kessing⁴, Prof. Annette Kjær Ersbøll¹

¹National Danish Institute of Public Health, University of Southern Denmark, ²Geological Survey of Denmark and Greenland (GEUS), Department of Groundwater and Quaternary Geology Mapping, ³Geological Survey of Denmark and Greenland (GEUS), Hydrological Department, ⁴Rigshospitalet, University Hospital of Copenhagen, Department of Psychiatry

Importance of the work and objectives: Lithium occurs naturally in drinking water and may have a positive effect on mental health and suicide. In clinical practice, lithium in high therapeutic doses is used as a mood-stabilizer in the treatment of affective disorders. Previous studies performed at an ecological level have found an association between lithium in drinking water and risk of suicide. The present study is the first to investigate this association at an individual level considering long-term exposure.

Methodologies: The study population consisted of all 3,724,588 Danish adults (≥20 years) of which 15,370 committed suicide from 1990-2012. Information on suicides was obtained from the nationwide Danish Register of Causes of Death. Data on lithium concentrations were obtained through a nationwide drinking water campaign from 2013 including 151 measurements from waterworks supplying approximately 42% of all residents in Denmark. Spatial statistics were applied to investigate geographical patterns in lithium levels and to compute an accumulated lithium exposure for each individual. Poisson regression analyses were used to investigate the association between accumulated lithium exposure and suicide rate.

Main results and conclusions: Significant regional clustering in drinking water lithium levels were found with high levels in Eastern and low levels in Western Denmark. A significant dose-response trend of decreasing suicide rates with increasing lithium exposure was found even after adjustment for socioeconomic factors. This study supports the growing evidence of naturally occurring lithium being protective against suicide, which, if further supported, may have implications for future public health strategies on suicide prevention.
A QUANTITATIVE EXPOSURE ASSESSMENT FOR METALS AND FAECAL COLIFORMS IN SURFACE RUNOFF FOLLOWING LAND SPREADING OF BIOSOLIDS TO AGRICULTURAL GRASSLANDS

Tuesday, 16th August - 10:00 - OS-4B.05 - Drinking Water - Oral

Ms. Rachel Clarke, Mr. Dara Peyton, Dr. Mark G. Healy, Dr. Owen Fenton, Dr. Enda Cummins

1University College Dublin, 2National University of Ireland, Galway, 3NUI Galway, 4Teagasc

Long-term application of biosolids to agricultural land has led to concerns regarding the potential accumulation of metals and faecal coliforms in soil, the subsequent runoff into surface waters, and the potential risk to human health through drinking water. This study used surface runoff water quality data generated from a field-scale study in which three types of biosolids (anaerobically digested (AD), lime stabilised (LS), and thermally dried (TD)) were spread on micro-plots of land. The aim of this research was to conduct a human health risk assessment of metals and faecal coliforms, which may persist in drinking water after treatment in a WTP. A quantitative drinking water treatment model was developed that was capable of predicting likely human exposure and resulting risk from six metals (Cu, Cd, Cr, Pb, Ni and Zn) and faecal coliforms present in the final drinking water. Different dose-response relationships were characterised for the different pollutants with reference Lifetime Average Daily Dose (LADD) and Hazard quotient (HQ) used for metals, whereas a worst-case negative exponential dose-response model was used for faecal coliforms. Mean metal results showed that mean Cu exposure concentrations for children were highest in all three time frames corresponding to the LS biosolids, but all were below regulatory limits. With regard to coliforms, the risk of illness was negligible for healthy individuals; however, care is required with immunocompromised individuals where the annual risk was greater than the threshold risk of illness (10^-4) as set by the USEPA.
KEYNOTE MODELING OF HERBICIDE ADSORPTION BY GOETHITE: 4-CHLORO-2-METHYLPHENOXYACETIC ACID (MCPA)

Tuesday, 16th August - 10:00 - OS-4C.01 - Organic Chemicals A - Keynote

Prof. Michael Kersten¹, Dr. Daniel Tunega², Dr. Ivelina Georgieva³

¹Geosciences Institute, Johannes Gutenberg-University, Mainz 55099, Germany, ²BOKU Institute of Soil Sciences, Vienna 1190, Austria, ³Bulgarian Academy of Sciences (IGIC), Sofia, Bulgaria

Interactions between goethite (FeOOH) and the ionic herbicide agent MCPA were studied using molecular dynamics (MD) calculations at temperature 300 K in the canonical (NVT) ensemble applying a Nosé-Hoover thermostat. Newton’s equations of motion were integrated using the Verlet velocity algorithm with a time step of 1 fs for up to 25 ps (slow-motion movies will be shown). Modeling both a solvated and protonated mineral surface provided a major breakthrough showing that there were energetically optimized hydrogen bonded MCPA surface complexes. However, such strong inner-sphere complexation is predominating only at acidic pH < pKa = 3.1, whereby the innersphere complex shares one of the oxygens between the MCPA carboxylate group and a singly coordinated surface hydroxyl group of the goethite surface, releasing an H₂O molecule. At ambient soil pH values, MCPA is only weakly sorbed by outer-sphere complexation. The molecular modeling results were used in turn to constrain charge distribution parameters of an advanced CD-MUSIC surface complexation model. The adsorption constants were fitted to experimental batch equilibrium data 1. The model was then extended by adding Cu which was found to trigger strong MCPA sorption even at circumneutral pH values forming a ternary innersphere surface complex. These informations enabled to parameterize in turn a reactive transport model to predict MCPA mobility in Cu-contaminated soil at any pH conditions. Positron emission tomography using Cu-64 tracer was used to verify the model.

Reference:

QUANTIFYING THE BIOAVAILABILITY OF PYRENE SORBED ON SUSPENDED SEDIMENTS OF VARIOUS COMPOSITIONS AND GRAIN SIZES TO DAPHNIA MAGNA

Tuesday, 16th August - 10:00 - OS-4C.02 - Organic Chemicals A - Oral

Dr. Xinghui Xia\textsuperscript{1}, Dr. Xiaotian Zhang\textsuperscript{2}

\textsuperscript{1}beijing, \textsuperscript{2}State Key Joint Laboratory of Environmental Simulation and Pollution Control, School of Environment, Beijing Normal University

Suspended sediment (SPS) composition and grain size will affect the bioavailability of hydrophobic organic compounds (HOCs) associated with SPS in aquatic environments. However, no research has been carried out to quantify the bioavailable fraction of HOCs sorbed on SPS with different compositions and grain sizes. In this work, the passive dosing devices were made to control the freely dissolved concentration of pyrene, a typical HOC, in the exposure systems. The effect of pyrene associated with amorphous organic carbon (AOC), black carbon (BC), and minerals of SPS with grain sizes of 0-50 m and 50-100 m on the immobilization and enzymatic activities of D. magna was investigated to quantify the bioavailability of pyrene sorbed on SPS with different grain sizes and compositions. The results showed that the contribution of AOC-, BC-, and mineral-associated pyrene to the total bioavailability of SPS-associated pyrene was approximately 50%-60%, 10%-29%, and 20%-30%, respectively. The bioavailable fraction of pyrene sorbed on the three components of SPS was ordered as AOC (22.4%-67.3%) > minerals (20.1%-46.0%) > BC (9.11%-16.8%), and the bioavailable fraction sorbed on SPS of 50-100 m grain size was higher than those of 0-50 m grain size. This is because the SPS grain size will affect the ingestion of SPS and the SPS composition will affect the desorption of SPS-associated pyrene in D. magna. Based on this, a model has been developed to calculate the bioavailability of HOCs to aquatic organisms in natural waters considering both SPS grain size and composition.
SEDIMENT TOXICITY IDENTIFICATION EVALUATION: THE APPLICATION OF PASSIVE SAMPLING AND PASSIVE DOSING TECHNIQUES

Tuesday, 16th August - 10:00 - OS-4C.03 - Organic Chemicals A - Oral

Dr. Jing You¹, Mr. Xiaoyi Yi², Dr. Huizhen Li²

¹State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, ²Guangzhou Institute of Geochemistry, CAS

In aquatic environment, hydrophobic organic contaminants preferentially deposit into sediment. Over time, sediment becomes an important sink for these contaminants, posing a hazard to aquatic organisms. Therefore, the assessment of sediment quality is one of the vital tasks for understanding the risk of these contaminants. It is well accepted that bioavailability of sediment-bound contaminants is affected by many factors, such as sediment characteristics, chemical properties, and chemical-sediment contact time, which makes the bulk sediment concentration a poor indicator for sediment toxicity. Thus, a variety of methods have been developed for estimating contaminant bioavailability in recent decades. As a more relevant dose metric compared to bulk sediment concentration, the freely dissolved concentration in sediment pore water (Cfree) reflects the exposure and the bioaccumulation potential of contaminants to organisms. By incorporating Cfree into the dose-response relationship, exposure indicated by Cfree is directly linked to adverse effects. Additionally, passive dosing has been recently introduced as a replacement of solvent dosing during aquatic toxicity testing in order to maintain constant water concentrations. Through the equilibrium partitioning of chemicals within dosing systems, chemical concentrations in water could be stabilized and monitored by quantifying chemical concentration in the polymers. To conduct toxicity testing with passive dosing systems is another approach to incorporate the bioavailability into sediment toxicity assessment. In this presentation, two case studies will be used to demonstrate the applications of bioavailability-base sediment toxicity testing.
REAL-TIME VISUALIZATION OF PERYLENE NANOCLUSTERS IN WATER AND THEIR PARTITIONING TO GRAPHENE SURFACE AND MACROPHAGE CELLS

Tuesday, 16th August - 10:00 - OS-4C.04 - Organic Chemicals A - Oral

Prof. Xuejun Guo¹, Ms. Xin Jin¹

¹School of Environment, Beijing Normal University

Importance of the work and objectives

Hydrophobic organic chemicals (HOCs) are of special ecotoxicological concern because they can be directly incorporated and bio-concentrated in living organisms. However, the effects of self-clustering of HOCs on their environmental behavior and toxicology have not yet received enough attention. The behavior of HOCs in cluster form is quite different from those in single molecular form. HOCs distributing in the environmental systems in the form of nano-clusters may have significant implications for understanding their environmental fate and potential toxicological effects.

Methodologies

With the use of a recently developed technique, single-molecule fluorescence microscopy (Zeiss, Axio Observer), the adsorption of perylene nano-clusters (PNCs) onto carbonaceous surface and the transport of PNCs across the cell membrane were visualized with high temporal and spatial resolution. Perylene clusters were excited by a 405 nm laser (Coherent OBIS 405), and monitored with the filter set (dichroic mirror 405 nm, emission 570-640 nm). The fluorescent emission was collected by an 100× oil-immersion objective with numerical aperture of 1.46 and imaged onto an electron multiplying charge coupled device (EMCCD) camera (Photometrics, Evolve 512).

Main results and conclusion

We showed the characteristic of irreversible adsorption of perylene in the form of nano-clusters onto carbonaceous surfaces, exhibiting random sequential ‘car-parking’ events.

PNCs can enter macrophage cells by endocytosis. The uptake of HOCs in the form of nano-clusters by endocytosis was proposed to be an additional but important mechanism for their bio-concentrating into living cells.
RELATIONSHIP BETWEEN URBANIZATION AND HEAVY METAL POLLUTION IN SUBURBAN SOILS OF SHANGHAI

Tuesday, 16th August - 10:00 - OS-4D.01 - Urbanization Impacts - Oral

Prof. Jiancheng Kang

1Shanghai Normal University

Based on the data collected from various sources, the connection of urbanization and the distribution of heavy metal in suburban soils in Shanghai was analyzed using Correlation Analysis and Regression Analysis Methods after having measured Comprehensive level index of urbanization and heavy metal pollution index of Agricultural soil in Suburban district of Shanghai; besides, the differences of distribution of heavy metal elements in different regions and driving factors were explored so as to provide theoretical support of the coordination of urban development and rational utilization of soil and soil environmental protection. The results showed: (1) The diversity of urbanization level of suburban districts is obvious, the overall shows that suburban is higher than exurban in Shanghai; the cumulation of heavy metal shows varying degrees in different districts, accumulative degrees shows as follows: Zn > Cu > Cr > Pb. (2) The results of Correlation Analysis shows that the relativity of the One-pollution indexes of Zn and Cu, and Comprehensive pollution index of heavy metal with Comprehensive level index of urbanization is obvious, the relativities of Pb and Cr in One-pollution index with Comprehensive level index of urbanization is not obvious; (3) The results of Regression Analysis shows that the fit curves of three indexes (Zn One-pollution Index, Cu One-pollution Index, Comprehensive pollution index) with Comprehensive level index of urbanization have the features of Environmental Kuznets Curve (EKC). But, all suburban districts had not crossed the inflection point excepting Min-hang District, they are still in the left side of the EKC curve.
TEMPORAL DYNAMICS OF URBANIZATION-DRIVEN ENVIRONMENTAL CHANGES EXPLORED BY METAL CONTAMINATION IN SURFACE SEDIMENTS IN A RESTORING URBAN WETLAND PARK

Dr. Shen Yu, Mr. Ma Jun

Key Laboratory of Urban Environment and Health, Institute of Urban Environment, Chinese Academy of Sciences

Spatial patterns of metal distribution along urban-rural or multi-city gradients indicate that the urbanization process directly lead to metal enrichment and contamination in the environments. However, it has not yet looked at homogenization dynamics of an urban-rural gradient pattern over time with urbanization process in an area. This study monitored anthropogenic metals (Cr, Cu, Pb, and Zn) in surface sediments from channels of a newly-opened national wetland park to elucidate the urbanization-driven dissolution of urban-rural gradient pattern between 2008 and 2011. Sixty-eight surface sediment samples were taken from these channels in July of both 2008 and 2011. Results showed that a spatial distribution pattern of total metal contents along the gradient of urbanization influence, evident in 2008, was homogenized in 2011 with the area development. The lead stable isotope ratio analysis identified anthropogenic Pb origins from vehicular exhausts, cements, and coal flying ashes, which elevated metal contents in the inner channels via atmospheric deposition. Specific hazard quotients of the metal contamination in surface sediment were also assessed and enhanced over time in the study wetland park. These findings suggest that emissions from traffic, construction, and energy generation contribute metal loadings in the urbanizing environment.
In less than 4 decades, China got a rapid urbanization from 17.9% urban population by 1978 up to 54.8% by 2014. Urban sediments recorded environmental changes in metals and other contaminants over time. Sediment quality changes along a urban-rural gradient were different from along a multiple urban gradient, which was similar to temporal changes indicated by sediment cores. Calculated by Pb stable isotopic compositions, over 50% of sediment Pb in Shanghai was derived from coal combustion emission and nearly 20% from traffic emission in the past century. However, in a long-term monitored urbanizing watershed, urbanization process reduced metal contents in surface sediments, suggesting that urbanization can ameliorate environmental pollution due to wastewater treatments. A series of studies in China reveal that sediments recorded environmental changes driven by urbanization.
Sealing of urban areas leads to increasing flooding and contamination which can be addressed by replacing impermeable surfaces with Pervious Paving Systems (PPS) which have the potential to remediate some pollution in situ.

This paper presents results of the testing of laboratory-based models with a variety of surface courses and sub-surface structures in order to monitor their pollutant-retention capabilities. These models included porous asphalt (PA), pervious concrete (PC), block pavers (BP) and one PA which had been a quarry car park for 12 years. The total monitoring period was 3 years. Coventry Road Sediment (CRS) and unused oil was applied to the surfaces and artificially rained on in order to investigate their efficiency in dealing with contamination. Water quality of the effluent subsequently draining from the rig was found to be better than WHO potable water guidelines.

A core was taken down through the surface of one PA rig into the subsurface structure, and revealed that the majority of the sediment remained in the surface course, identified by its high heavy metal concentrations. However, these levels were lower than the original CRS, suggesting some of the metals had migrated down through the rig. Relatively high levels of metals were found in the tap water feed to the rainfall simulator which was removed from the effluent, suggesting that the large amounts of sediment found throughout the aggregate layer were acting as sinks for the metals. This has implications for management at end-of-life for the device, whether it is classified hazardous material.
ASSESSMENT OF ECOLOGICAL AND HUMAN HEALTH RISKS OF METALS POLLUTION IN THE URBAN SOILS UNDER THE INFLUENCE OF RAPID URBANIZATION

Tuesday, 16th August - 10:00 - OS-4D.05 - Urbanization Impacts - Oral

Mr. Ma Jun\textsuperscript{1}, Dr. Shen Yu\textsuperscript{1}

\textsuperscript{1}Key Laboratory of Urban Environment and Health, Institute of Urban Environment, Chinese Academy of Sciences

Urbanization has been resulted in a series of environmental problems, particularly in those countries going through rapid development, such as in China. To assess the risks of anthropogenic metals in the top soils that resulted from urbanization, a case study was carried out in a coastal city of the southeastern China. The distribution characteristics and risks assessment of 88 top soils from different urbanization levels of urban villages, tourism region, commercial and residential region, traffic region, industrial region and 393 human hair samples from different profession, gender and age were analysed. Results indicated that urban sectorization had a significant impact on the total contents and effective components of metals in the top soils. Urbanization had more significant impact on Cr and Pb than Cd, Cu and Zn. In addition to the potential ecological risk of Cd in urban villages surface soils was medium, the rest were minor. Analogously, human health risks of metals were slight. Rapid urbanization is gradually narrowing the impact difference of metals among regions. It is worth noting that the widely attention and effective measures for environmental management of urban village soils are urgent need in the urban.
KEYNOTE IS INDOOR ENVIRONMENT A SAFE HAVEN TO AVOID AIR POLLUTION?

Tuesday, 16th August - 11:45 - OS-5A.02 - Indoor Exposure - Keynote

Ms. Yuan-Jie Hu¹, Prof. Zeng Eddy Y.², Dr. Lian-jun Bao², Prof. Shao-meng Li³

¹State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, ²School of Environment, Jinan University, ³Air Quality Research Division, Environment Canada

Air pollution by particulate matter has aroused worldwide concerns. Ultrafine particles (UFP) are particularly in focus because of their potential health risk and capability of exchanging between indoor and outdoor environments. Urban residents spend the majority of time in indoor environments, which, however, may not be a safe haven for staying away from outdoor air pollution.

Three representative types of functional area, i.e., school, office and home, in Guangzhou, China were selected as study sites. Indoor and outdoor UFP (14–660 nm) at each site were simultaneously and consecutively monitored using a Scanning Mobility Particle Sizer with an automatic indoor/outdoor switch system in October 2014 and July 2015, which represent dry and wet weather seasons, respectively.

Among three functional areas, the highest UFP level occurred at home, and the indoor UFP concentrations were greater than those in outdoors. There was insignificant differences of UFP concentrations between dry and wet weather seasons, suggesting low efficacy for scavenging of UFP through wet deposition. The UFP concentrations peaked during rush hours, implicating motored vehicles as the major contributors to outdoor UFP, whereas human activities, such as cooking and smoking, were the major source of indoor UFP. It is interesting to note that the number concentrations of indoor UFP were positively correlated with outdoor UFP at schools and offices, suggesting that the exchange of UFP between indoor and outdoor environments was efficient. In addition, particles with the sizes of 50–100 nm predominated UFP deposited in both the tracheobronchial and alveolar regions.
POLYCYCLIC AROMATIC HYDROCARBON (PAH) METABOLITES IN MATERNAL URINE AND RISK ASSESSMENT FOR NEONATAL BIRTH OUTCOMES IN AN INTENSIVE E-WASTE RECYCLING AREA

Tuesday, 16th August - 11:45 - OS-5A.02 - Indoor Exposure - Oral

Mr. Long Xu¹, Prof. Xijin Xu², Prof. Xia Huo³

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Polycyclic aromatic hydrocarbons (PAHs) are well-known carcinogenic and endocrine disrupting chemicals whose hydroxylated metabolites have become of increasing concern. We aimed to determine the hydroxylated PAH (OHPAH) metabolite concentrations in maternal urine and evaluate their risk effects on birth outcomes. Maternal urine samples were collected from the e-waste-contaminated area of Guiyu and the reference area of Haojiang, China. The median OHPAH concentration was 6.87 g/g creatinine from Guiyu, and 3.90 g/g creatinine from Haojiang. Principal component analysis showed that 2-OHNap and 1-OHPyr were the predominant compounds, followed by 1+9-OHPhe, 2+3-OHPhe and OHPhe. Residence in Guiyu and recycling in houses were associated with predominated PAHs. Risk assessment revealed that high exposure (fourth quartile) to PAH metabolites adversely affected birth outcomes (overall standardized mean difference (SMD): -0.09; 95%CI: -0.15, -0.03), including head circumference, BMI and Apgar 1 scores, and positively affected height. Quantile linear regression models further demonstrated an inverse association of birth weight (β: -234.56; 95%CI: -452.00, -17.13), head circumference (β: -1.72; 95%CI: -2.96, -0.48) and BMI (β: -1.06; 95%CI: -1.82, -0.31) with the fourth quartile of OHPAHs, and Apgar 1 scores (β: -0.42; 95%CI: -0.66, -0.18) with the third quartile of OHPAHs, after adjusting for confounders. These findings suggest that comparatively high exposure to PAH metabolites during pregnancy in e-waste areas poses a potential detriment to neonatal development, which likely can be attributed to direct e-waste recycling activities. Ongoing studies should be continued to monitor human exposure and health, in particular for vulnerable individuals in e-waste-polluted areas.
Household air pollution caused by solid fuel combustion is of wide public concern in China. To investigate the correlations of personal inhalation exposure to PMs and PAHs with indoor and outdoor air, PMs with different fractions, gaseous and size-segregated particulate phases PAHs were collected in summer by personal carried samplers for adult residents, combined with simultaneously stationary monitoring at different locations in rural households from Northern China using solid fuels and liquefied petroleum gas (LPG).

Averaged concentrations of total PMs were 180.8±175.9, 104.3±67.1 and 77.4±28.7 μg/m³ in kitchen, bedroom and outdoor air, respectively. The values for 29 PAHs were 1541.1±938.2, 955.6±464.7 and 573.8±302.5 ng/m³. Fine particles (PM1.0) were dominant fraction indoors and outdoors, with greater than 58% of total PMs. The highest PM0.25 content occurred in kitchens using firewood and crop residues. Gaseous PAHs were prevailing compared with particulate PAHs. The majority of particulate PAHs were associated with PM1.0. Larger fraction of heavier PAHs was found indoors, especially in kitchen.

Averaged personal exposure concentrations of PM2.5 and 29 PAHs were 72.1±43.5 μg/m³ and 953.1±801.7 ng/m³. Exposed concentrations of housewives responsible for cooking were higher than male residents without cooking. Exposed concentrations using firewood and crop residues evidently exceeded those using LPG. Greater exposure contribution originated from bedroom and outdoor air. The local population attributable fraction for lung cancer was 0.44% and health risks for inhaled PAHs was 2.33E-5. Solid fuel combustion in rural households produced higher inhalation exposure and LPG substitution may alleviate indoor air pollution.
SO2 REMOVAL WITH A SIMULTANEOUSLY IMPROVED SOLAR-TO-H2 ENERGY CONVERSION

Tuesday, 16th August - 11:45 - OS-5A.04 - Indoor Exposure - Oral

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Sulfur dioxide (SO2) emitted from fossil fuels burning and chemical industries can cause lots of harmful issues in the environment. In a conventional method for SO2 removal, aqueous sodium hydroxide (NaOH) solution is typically utilized to absorb SO2 from flue gas. The resulted Na2SO3 solution is then purged with air for an oxidation of Na2SO3 before disposal. The energy of Na2SO3 is wasted in this process. Herein, we propose that the solar-to-H2 energy conversion efficiency can be greatly improved with a simultaneous removal of venenous SO2 via a photoelectrochemical water splitting process, since Na2SO3 possesses lower activation energy and faster kinetics as compared with the direct oxidation of water on the photoanode. A H2 production rate of 41 mol h-1cm-2, with a Faradaic efficiency of 98% is obtained in 0.075 M Na2SO3. This work provides a new method for the SO2 removal with a simultaneous H2 production.

References:
MINERALOGICAL CHARACTERISATION TO IMPROVE UNDERSTANDING OF ORAL BIOACCESSIBILITY OF CR AND NI IN BASALTIC SOILS IN NORTHERN IRELAND

Tuesday, 16th August - 11:45 - OS-5B.01 - Contaminated Land with IBN - Oral

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Geological soil parent material is often the source of elevated levels of potentially toxic elements (PTEs) in soils, and in some cases these are at concentrations which exceed regulatory guidelines for protection of human health. However, geogenic contaminants are often bound tightly within the soil matrix and are not bioavailable to humans in significant concentrations. Therefore oral bioaccessibility testing is used to quantify the PTEs in soils that are accessible to humans.

A previous study investigated the distribution of Ni and Cr amongst soil components in 3 soils overlying Palaeogene basalt lavas in Northern Ireland using non specific sequential extraction coupled with chemometric analysis (CISED) and related this to oral bioaccessibility measured by the Unified Bioaccessibility Method (UBM). However, without data relating to soil mineralogy, interpretation of the role of mineralogy on the oral bioaccessibility of Ni and Cr was inconclusive. This paper presents the findings of elemental mapping using Electron Probe Microanalysis (EPMA) and mineralogical mapping undertaken using QEMSCAN®, an automated mineral/phase analysis system based on a scanning electron microscope. Results are related to oral bioaccessibility and CISED analyses to determine the effect of soil mineralogy on oral bioaccessibility of Ni and Cr.

Results indicate that Cr concentrations are principally related to recalcitrant chrome spinel, which explains the relatively low bioaccessibility of Cr. In contrast, Ni is more widely dispersed within the soils, with a proportion of total Ni found in weathered olivine, clay and carbonates, leading to the higher oral bioaccessibility measurements recorded for Ni than Cr.
INTEGRATED HYDROGEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL INVESTIGATION OF A FORMER GASWORKS SITE

Tuesday, 16th August - 11:45 - OS-5B.02 - Contaminated Land with IBN - Oral

Ms. Sandra Puig\textsuperscript{1}, Dr. Rory Doherty\textsuperscript{1}, Prof. Mike Larkin\textsuperscript{1}, Dr. Ulrich Ofterdinger\textsuperscript{1}

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For more than 150 years a gasworks in Northern Ireland manufactured town gas from the cracking of coal. This process led to contamination of soil and groundwater by spillage, leaks or waste disposal of coal gasification by-products, which can pose a significant risk to human health and the environment. After the plant was closed in 1988; the polluted land was remediated and redeveloped into a modern urban setting. However, at that time only the top layer (~3m) of the subsurface was identified as requiring remediation. There is a possibility that by-products from the gas manufacture, such as BTEX compounds, polycyclic aromatic hydrocarbons (PAHs), and ammonium, are still present deeper in the subsurface, these need to be identified and the risk they pose assessed.

The subsurface consists of two groundwater regimes, a shallow aquifer formed by glaci-fluvial tills and a deep aquifer formed by sandstone, providing a mechanism for the pollution to spread through the area and to the adjacent river. This study takes an interdisciplinary field approach using hydrogeology, geochemistry and near-surface geophysics techniques to (1) assess the characterization of the contaminant plume in the groundwater environment, (2) determine a possible connection between the aquifers, and between groundwater and adjacent river, and (3) construct a conceptual biogeochemical model of the on-going subsurface processes. This conceptual model will be the key tool to further plan and construct a large-scale bioelectrochemical system (BES) in the site, to act as a biosensor to monitor natural attenuation processes in near real time.
DIAGNOSTIC STRATEGY AND RISK ASSESSMENT FRAMEWORK FOR COMPLEX CHEMICAL MIXTURES

Tuesday, 16th August - 11:45 - OS-5B.03 - Contaminated Land with IBN - Oral

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Environmental contamination comprises a complex mixture of both organic and inorganic contaminants. Understanding their distribution, behaviour and chemical interactions provides the evidence necessary to make informed decision and implement robust remediation strategies. The current regulatory regimes use risk assessment to guide management strategies; however partitioning and bioavailability of chemical mixtures are rarely included. This inability contributes to an overestimation for risk estimation and risk characterisation. In order to address the issues of partitioning and bioavailability and therefore have a more rationale understanding of the factors that drive uncertainty in determining bioavailability, a series of soil mesocosms was setup. The three soils tested contained heavy metals and hydrocarbons and one of them was treated using physicochemical stabilisation. A sequential cyclodextrin and solvent extraction was used to determine the bioaccessible and total extractable fractions of hydrocarbons and chemometric identification of substrates and elements distribution (CISED) was used to measure the metal trace elements in soils. We are currently completing the analysis to describe the interaction of poorly biodegradable contaminants with particulate matter through its exchangeable and bound residues under the range of environmental conditions tested. The challenge is to develop standardised methods to assess dissolved-sorbed phases interactions of poorly water-soluble substances at the same time as assessing degradation of the bioavailable fraction.
Previous research work has shown elevated concentrations of potentially toxic elements (PTEs) in Belfast soils and in some cases, these exceed the Suitable 4 Use Levels. However, these measurements are total concentrations and not all the PTEs present in soil are bioaccessible to humans. Applying the Unified Barge Method (UBM) to mimic the human gastrointestinal digestion, the current research aims to assess the risks posed to human health in the situation of soil ingestion. Geochemical datasets used for this study are provided by the Geological Survey of Northern Ireland (GSNI) which were sampled during the Tellus project. Firstly, this research proposes to set up the UBM using an oven for sample incubation. The efficiency of this low-cost device has been previously demonstrated in comparison with a heated water bath, both giving similar results. After installation, the validation of UBM will be assessed by replicating samples already extracted via a heated water bath, in a study conducted for the rural soils in Northern Ireland. Once, the configuration of the UBM is confirmed, oral bioaccessibility will be assessed for 100 soil samples retrieved from the GSNI. Selected samples will cover the urban area of Belfast with a representative range of rocks, different soil types and regions with sensitive receptors.

The outcomes of this study are expected to provide valuable information for local authorities concerning human health risk assessment and could be extrapolated to other regions which present similar geochemical properties.
LIFE CYCLE THINKING TO SELECT CONTAMINATED LAND REMEDIATION TECHNOLOGIES

Tuesday, 16th August - 11:45 - OS-5B.05 - Contaminated Land with IBN - Oral

Mr. Diogo Santos¹, Dr. Stephen Tlatlik¹, Prof. Axel Gottschalk¹
¹SUPREN GmbH

Environmental sustainability of contaminated land remediation is a major challenge besides financial and legal aspects. The choice of remediation technologies should consider a potential shift of problems from today to the future as well as from one place to another one.

Life cycle assessment (LCA) models provide a quantitative understanding of remediation technologies and systems over their entire life cycle. LCA modelling is performed according to the rules of the International Reference Life Cycle Data System and in line with international standards (ISO14040 and 14044, 2006). These models are useful to look beyond the contaminated sites and to detect unexpected effects caused by remediation activities.

This paper presents the efforts towards a generic approach to investigate the environmental sustainability of alternative contaminated land remediation technologies and systems. The ultimate goal is to develop a tool to support the decision making process, considering and benefiting from life cycle thinking.

This research work is being carried out as part of an Innovative Training Network (ITN), the REMEDIATE project, that has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie-Sklodowska-Curie grant agreement No. 643087.
Importance of the work and objectives. With increasing production and use of carbon nanomaterials (CNMs), they will inevitably be released to the environment. Once released into the environment, CNMs would interact with organic pollutants (OPs) upon contact. Due to large surface area and highly hydrophobic nature of CNMs, they have been proposed as a promising sorbent for removing environmental pollutants. To help better understand the interaction difference between OPs and carbonaceous materials on site energy respect, the site energy distribution analysis was conducted to probe sorption behaviors of naphthalene, lindane, and atrazine on ten sorbents with different physical structure and chemical composition.

Materials and methods. Naphthalene, lindane, and atrazine were selected as sorbates. Ten kinds of carbonaceous materials with considerably different physical structure and chemical composition were used as sorbents.

Main results and conclusion. Introduction of O-containing functional groups to the sorbents decreased their average sorption energy for the studied compounds. However, relative to the decrease in average site energy, the reduction in number of sorption sites as indicated by surface area more strongly reduced sorption capacity of the tested compounds to the carbonaceous materials used based on the result of the linear regression analysis. Sorption site heterogeneity of the sorbents decreased as their oxygen contents increased. The better dispersion of the sorbents with higher oxygen-containing moieties as shown by TEM images could be the reason for their more homogeneous sorption site energy distribution. These findings are critical for better understanding of the sorption mechanisms of OPs to carbonaceous materials.
THE POTENTIAL IMPACT ON THE BIOAVAILABILITY OF ORGANIC POLLUTANTS FROM COMPOSTING FOR SOIL REMEDIATION

Tuesday, 16th August - 11:45 - OS-5C.02 - Organic Chemicals B - Oral

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Soil pollution by organic chemicals resulting from industrial and agricultural activities has caused high concerns in recent years. Large numbers of contaminants, such as polycyclic aromatic hydrocarbons (PAHs), pesticides and chlorophenols, are discharged into soil, posing a huge threat to human health and natural ecosystem. Traditional chemical and physical remediation technologies are either incompetent or expensive, and may cause secondary pollution. The technology of soil composting or use of compost as soil amendment can utilize quantities of active microbes to degrade organic pollutants with the help of available nutrients in the compost matrix, in order to remedy organic contaminated soil. It is highly cost-effective for soil remediation. On one hand, compost incorporated into contaminated soil is capable of significantly increasing the organic matter content which improves the soil environment and stimulates the metabolically activity of microbial community. On the other hand, the increased organic matter content will enhance the adsorption of organic pollutants and affect their bioavailability, leading to decreased fraction available for microorganism-mediated degradation. Meanwhile, the aging of bioavailability also brings a great challenge to the soil remediation control. Therefore, the study on bioavailability of organic pollutants in soil is extremely important for the application of composting technology. This work will discuss the changes of physical and chemical properties of contaminated soils and the bioavailability of organic pollutants by the adsorption of composting matrix. Also, the influence of different organic matter contents, types and compositions of compost amendments on removal and bioavailability of organic pollutants will be evaluated.
A PEDO-INFORMATIC APPROACH FOR UNIVERSAL PREDICTIONS OF COMPLEX SOIL ENVIRONMENTAL PROCESSES

Tuesday, 16th August - 11:45 - OS-5C.03 - Organic Chemicals B - Oral

Dr. Mark Chappell¹, Dr. Jennifer Seiter-Moser¹, Ms. Haley West², Ms. Maria Negrete², Ms. Beth Porter², Ms. Cynthia Price¹, Ms. Lesley Miller¹

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Soils represent one of the most difficult and recalcitrant barriers to the ecologically sustainable acquisition of new materials within the DoD. Biogeochemical processes driving environmental risk are difficult enough to decipher on their own; however, the problem is further complicated when accounting for the geospatial and compositional heterogeneity of soil matrices. Here, we present a new approach, called Pedo-Informatics, for developing robust datasets to predict (universally) any complex soil biogeochemical interaction and process. In Pedo-Informatics, soil types are quantified based on extensive physical and chemical characterizations, which is then explored using multivariate statistical dimension-reduction techniques. Linear functions can be developed to predict complex biogeochemical soil behavior by regressing kinetic rate constants against the latent structure obtained from the multivariate analysis. The implications of the approach expand far beyond contaminant descriptions but are expected to be useful for a large variety of difficult environmental challenges.
A methodology was developed in this study to estimate the volume of sediments in polluted river systems and their organic carbon storage quantities, through a case study of 6 river sections in Wenzhou, Southeastern China. These river sections have been receiving organic pollutants from local residents and industries for decades. The bathymetry data of the river sections were measured using an echo sounder equipped with a differential GPS. Sediment cores were collected for the analysis of organic carbon contents and sediment properties. The underwater digital elevation models of the river sections were developed using ArcGIS, and the carbon storages in sediments were then calculated using the bathymetric data and sediment analysis data. The results from a river network of 1.2 km$^2$ revealed a total organic carbon storage of 42.8 million kg in its polluted sediments, which had a volume of 1.4 million m$^3$. This indicates that the sediments in polluted rivers can be important carbon sinks in carbon cycle, which should be taken into consideration for proper river restoration planning.
BIOCONCENTRATION AND TISSUE DISTRIBUTION OF LONG- AND SHORT-CHAIN PERFLUOROALKYL SUBSTANCES IN ZEBRAFISH (DANIORERIO)

Tuesday, 16th August - 11:45 - OS-5C.05 - Organic Chemicals B - Oral

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Perfluoroalkyl substances (PFASs) composed of a hydrophobic perfluoroalkyl chain and a hydrophilic functional group are a class of persistent global contaminants. Many studies reported that PFASs were detected and could be accumulated in many aquatic organisms. Although the bioconcentration kinetics and factors of PFASs have been investigated by some researchers, limited information is available about PFAS bioconcentration kinetics in various tissues of fish, and especially the difference in PFAS bioconcentration between single and multiple PFAS exposures. In this work, adult female zebrafish (Daniorerio) were exposed to systems containing single (perfluorooctane sulfonate, PFOS) and 11 PFASs (C4-C12 carboxylate, C4 and C8 sulfonate) for 28 days, respectively, to study the bioconcentration of PFASs in various tissues of zebrafish. The results showed that the bioconcentration kinetics of long chain PFASs (C7-C12) was fitted for the first-order accumulation rate model in blood, gill, intestines and stomach (IS), and muscle, while the zero-order accumulation rate model in liver, gonad and brain. After 28-day exposure, the bioconcentration factor (BCF) values of PFASs in each tissue increased with carbon chain length, except for perfluorobutyl sulfonic acid and PFOS. The BCF values of all tested PFASs were greatest in the blood (1.4-19248 L/kg wet weight), followed by liver, gill, gonad, brain, IS and muscle. Compared with the multiple exposure system, the BCF values of PFOS in blood, gill, IS and muscle in single PFOS exposure system were higher while in liver, gonad and brain were lower. This may be due to the different bioconcentration mechanisms in various tissues.
To study the distribution patterns, possible sources and potential transport of organic matters in the marginal sea, surface sediments were collected from a subtropical estuary (Jiulong River Estuary, JRE) and the inner shelf of adjacent Western Taiwan Strait (WTS), n-alkanes, polycyclic aromatic hydrocarbons (PAHs) have been investigated. Odd C25-C31 n-alkanes were predominant in the JRE, while C14-C17 n-alkanes had high abundance reserves in the coastal area. The terrigenous/marine ratios of n-alkane reflected biogenic terrestrial inputs reduced, while marine inputs increased from the JRE to WTS, reflects the transport changes of relative contributions from allochthonous and autochthonous hydrocarbons to the sediments. The concentrations of anthropogenic PAHs and perylene, retene from the natural diagenetic formation of terrestrial organic matters (soil-derived materials) decreased with the descending distance from the JRE to WTS, the correlations between anthropogenic PAHs and perylene or retene were significant, reflected they were likely to share the same fluvial input and transport pathways, the compositions and isomer ratios of PAHs indicated that the estuarine materials tended to transport to the southern coast. The proportion of perylene relative to the total 5-ring PAHs increased from the JRE to WTS, implied the early diagenesis of terrestrial organic matters enhanced gradually. The presence of the unresolved complex mixture (UCM), hopanes and steranes indicated petrogenic contribution, PAH isomeric ratios reflected a pattern of mainly pyrogenic input in the estuary while petrogenic sources in the coast. Therefore, organic matters accumulated in the WTS adjacent to the JER were derived from both terrestrial and marine sources.
ENHANCED BIODEGRADATION OF PAHS IN HISTORICALLY CONTAMINATED SOIL BY BIOCHAR IMMOLIZED WITH M. GILVUM CELLS

Tuesday, 16th August - 11:45 - OS-5D.02 - POPs - Oral

Mr. Chao Cai, Ms. Xiong Bijing, Mr. Yo-chi Zhang, Mr. Yan-Wei Hou

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Rice straw biochar inoculated with PAH-degrading actinobacteria (Mycobacterium gilvum) (1.27x10¹¹±1.24x10¹⁰cell g⁻¹) was tested (18d) for its ability to biodegrade soil associated PAHs, using a coke plant soil. Biochar alone had limited potential for PAH degradation; with no significant (P>0.05) reductions in phenanthrene and fluoranthene and a small reduction in pyrene (13.46±2.82%) being observed. Free M. gilvum cells inoculated directly into the soil showed no significant reduction in fluoranthene, little reduction in pyrene (19.73±6.52%), and some reduction in phenanthrene (47.30±4.09%). In contrast, inoculated biochar treatments indicated significant (P<0.05) reductions of 62.6±3.2, 52.1±2.3 and 62.1±0.9%, in phenanthrene, fluoranthene, and pyrene concentrations, respectively. It is hypothesized that this enhanced remediation performance was underpinned by i) biochar enhanced mass transfer of PAHs from soil to the carbonaceous biochar “sink”, and ii) the subsequent degradation of the fluxed PAHs by the immobilized M. gilvum. To test this mechanisms a surfactant (Brij 30; 2 mg g⁻¹ soil), was added to impede PAH mass transfer to the biochar. The surfactant increased solution phase PAH concentrations and significantly (P<0.05) reduce PAH degradation in the biochar immobilized M. gilvum treatments. These results support the potential application of inoculated biochars for the low cost remediation of PAH contaminated soils.
ENANTIOMER-SPECIFIC ACCUMULATION, BIOTRANSFORMATION OF HBCDS IN MAIZE AND THE SELECTIVE MOLECULAR MECHANISMS

Tuesday, 16th August - 11:45 - OS-5D.03 - POPs - Oral

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Accumulation, bioisomerization and metabolization of individual hexabromocyclododecane (HBCD) enantiomers in maize (Zea mays L.) were investigated. Molecular interactions of HBCD enantiomers with plant isozymes were further characterized by homology modeling combined with molecular docking. The (−)-, (−)- and (+)-HBCDs accumulated significantly higher in maize than their corresponding antipodes. Bioisomerization from (±)- / (±)-HBCD to (−)-HBCD was frequently observed, and (−)-HBCD was most easily converted with bioisomerization efficiency of 90.47 ± 8.24%. Mono- and dihydroxyl HBCDs, debrominated metabolites of pentabromocyclododecenes (PBCDs) and tetrabromocyclododecenes (TBCDs), and HBCD-GSH adducts were detected in maize roots. Patterns of hydroxylated and debrominated metabolites were significant different among HBCD enantiomers. Three pairs of HBCD enantiomers selectively bound into the active sites and interacted with specific residues of maize isozymes of CYP71C3v2 and GST31. (+)-, (−)- and (−)-HBCDs preferentially bound to CYP71C3v2, while (−)-, (−)- and (+)-HBCD had strong affinities to GST31, which were consistent with the experimental observations that (+)-, (−)- and (−)-HBCDs were more easily hydroxylated , and (−)-, (−)- and (+)-HBCDs were more easily isomerized and debrominated by maize compared to their enantiomeric pairs. This study for the first time provided both experimental and theoretical evidences for enantiomer-specific biotic processes of HBCD in maize.
Perfluorooctane sulfonate (PFOS) has been added to the persistent organic pollutants list of the Stockholm Convention. With the effective reduction in release from direct sources in recent years, exploring the indirect sources of PFOS has become increasingly important. N-ethyl perfluorooctane sulfonamido acetic acid (N-EtFOSAA) has been found extensively in sewage sludge and biosolids-amended soils. The degradation of N-EtFOSAA serves as a significant source of PFOS in the environment. In this study, the uptake, translocation of N-EtFOSAA in seven species of plants, namely maize, soy bean, mung bean, radish, ryegrass, alfalfa and lettuce, and the degradation of N-EtFOSAA in soil-plant microcosms were evaluated over 60 days. N-EtFOSAA was found in roots of all plant species studied, while was not found in the above part of plants. The root concentration factors ranged 0.65-2.54 (pmol/groot)/(pmol/gsoil). Four degradation products, including N-Ethyl perfluorooctane sulfonamide (N-EtFOSA), perfluorooctane sulfonamide (FOSA), perfluorooctane sulfonamide acetate (FOSAA) and PFOS were found in the soils and plant roots, straws and leaves, indicating the degradation of N-EtFOSAA in soil-plant system. Evidence of a relatively higher proportion of degradation products in plant tissues than in the soil indicates that there is further degradation of N-EtFOSAA within plants or degradation products are more readily taken up by plants. Degradation kinetics fitted first-order kinetic model well. In the presence of plants, degradation rates of N-EtFOSAA were 2.03-3.59 times higher than those in the absence of plants. Degradation rate of N-EtFOSAA in plant-soil system of maize was relatively higher than those of other plant species.
The biotransformation of fluorotelomer alcohols (FTOHs) are widely considered as sources of environmentally persistent perfluorocarboxylic acids (PFCAs). However, degradation of 8:2 FTOH $\text{F(CF}_2\text{)}_8\text{CH}_2\text{CH}_2\text{OH}$ by plants has not been studied. In the present study, a hydroponic experiment was conducted to investigate the uptake, translocation and metabolism of 8:2 FTOH in soybean (Glycine max L. Merrill). The kinetic and concentration profiles of metabolites in different soybean tissues were monitored over 144 hours. Results showed that 8:2 FTOH could be fast taken up by soybean roots, translocated to soybean shoots and leaves, and metabolized into liable intermediates, including 8:2 FTCA $\text{F(CF}_2\text{)}_8\text{CH}_2\text{COOH}$, 8:2 FTUCA $\text{F(CF}_2\text{)}_7\text{CF}=$CHCOOH and 7:2 sFTOH $\text{F(CF}_2\text{)}_7\text{CHOHCH}_3$, which were subsequently biotransformed to 7:3 FTCA $\text{F(CF}_2\text{)}_7\text{CH}_2\text{CH}_2\text{COOH}$ and PFOA $\text{F(CF}_2\text{)}_7\text{COOH}$ in all tissues of the plant. At the end of the experiment, 7:3 FTCA and PFOA were the main metabolites, and accounted, respectively, for 47.5 % and 21.3 % of the total amount of degradation products detected in soybean tissues. More PFOA was detected in soybean leaves than 7:3 FTCA, which was the predominant compound in soybean roots and stems. The activities of some enzymes, such as alcohol dehydrogenase (ADH), aldehyde dehydrogenase (ALDH) and glutathione S-transferase (GST) in soybean roots over different exposure times were also investigated. This study provides important information for better understanding of plant uptake, transformation and metabolism of FTOHs and fluorotelomer-based compounds.
KEYNOTE ENVIRONMENTAL ANTIBIOTIC RESISTOME: SOURCES AND SINK

Tuesday, 16th August - 14:30 - KN-4.01 - Keynote Speech - Keynote

Prof. Yongguan Zhu\(^1\)

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Antibiotics have been widely used not only in humans but also in animals for growth promotion and infectious disease control. Antibiotic resistance is defined as the microbial ability to sustain and multiply in the presence of antibiotics. Antibiotic resistance is ancient and ubiquitous in environmental microbes, particularly soils where many antibiotics have been discovered so far, and this original resistance is viewed as intrinsic resistance. Nevertheless, the intensive use of antibiotics in humans and animals have undoubtedly increased the emergence and abundance of antibiotic resistance in the environment, and therefore threatening global human health. Numerous studies now have demonstrated that the amounts of antibiotics use and residual discharge into the environment is well correlated with the abundance of antibiotic resistance, and antibiotic resistance can spread via not only vertical gene transfer but also horizontal gene transfer (HGT), and eventually to human pathogens, and even the emergence of superbugs. In 2006 Pruden et al. explicitly proposed antibiotic resistance as emerging contaminants, and suggested that conventional environmental treatment systems were not designed to remove these emerging contaminants. This talk will first discuss the major sources of environmental antibiotic resistome-urban waste water system vs. intensive animal farming. Subsequently the talk will discuss the major pathways of the emission of antibiotic resistance genes to the environment (soil and water). Thirdly the talk will take China as an example to investigate the pollution status of antibiotic resistance genes in soils, rivers and estuaries. Finally, potential mitigation measures will be discussed. Throughout the talk, divers molecular tools and “omics” approaches characterizing the environmental antibiotic resistome will be highlighted.
Wetlands, especially floodplains, offer a variety of ecosystem functions. One of the most important is their ability to act as a water regulator. Floodplains also fulfil important retention functions in relation to the cycling and treatment of nutrients and contaminants. Therefore, contamination of wetland soils by potentially toxic elements (PTEs) is of serious environmental concern. Many floodplain soils world-wide are polluted what can increase the solubility and leaching of PTEs resulting in adverse impacts on the agricultural environment. The PTEs can be released from soil to soil solution, particularly under different flood-dry-cycles, and can be transferred through the food chain, thus posing a hazard to environmental and human health. Therefore, the release kinetics of PTEs including their controlling factors are highly relevant because they affect both scientific and practical issues regarding protection of groundwater and plants, sustainable management of soils, and our understanding of environmental pathways taken by harmful substances. At the same time, it is scientifically challenging to elucidate the underlying biogeochemical processes and drivers that control the dynamics of PTEs due to the high natural complexity of these ecosystems which have a unique oxic and anoxic soil environment. The redox potential (EH), and pH are master variables in controlling the release of dissolved PTEs, however, the mobilization of PTEs is a complex process and govern by many factors such as the chemistry of iron, manganese, sulfur, chloride, aliphatic and aromatic dissolved organic carbon, and microorganisms. This presentation provides an overview about the recent knowledge to the topic.
Attic and household dusts burdened with toxic metals are hazardous to human health dependent on metal bioaccessibility. Since metals primarily occur as solid phases, bioaccessibility depends on their properties. The objective of this study was to determine morphological and chemical properties of metal-bearing phases, characterize their changes after exposure to reagents simulating digestion and determine which metal-bearing phases contribute to bioaccessible fraction of metals.

Dust samples were collected from four-storey building in small industrial town Žerjav in NNE Slovenia, characterized by more than 300 years of Pb-Zn mining, smelting and recycling. Heavy fraction was prepared from fraction <0.125 mm using bromoform. Metal-bearing phases were characterized by morphology, size and chemical composition using SEM/EDS. Samples were exposed to simulated gastric fluid (pH~1.3) at 30-40°C and were reanalysed after 5, 15 and 75 minutes to characterize the changes to the same particles.

The analysis showed different degree of transformation on metal-bearing phases, particularly Pb-bearing phases. The majority of Pb-oxide/carbonate grains completely dissolved, while corrosion pits appeared on remaining grains. Pb-K sulphate crystals reduced in size by 30% after 15 minutes and K was completely leached out. After 75 minutes they dissolved completely or transformed into Pb-sulphates. Pb-sulphate grains and aggregates experienced minor corrosion on crystal surfaces. No changes were observed on Pb- and Zn-sulphides, Pb- and Fe-sulphates, and Pb-Sb-Sn-oxides.

The study showed that Pb-oxides/carbonates, Pb-K sulphates and Pb-sulphates are unstable phases that contribute most to bioaccessibility of Pb during their digestion.
EFFECT OF SOIL PROPERTIES ON ZN AVAILABILITY FOR PLANT PLANT UPTAKE IN SOILS AMENDED WITH ZNO NANOPARTICLES

Tuesday, 16th August - 15:30 - OS-6A.03 - Biogeochemistry - Oral

Dr. Sónia Rodrigues¹, Mr. Nuno Cruz¹, Ms. Daniela Tavares², Prof. Tito Trindade¹, Prof. Armando Duarte¹, Dr. Eduarda Pereira¹, Dr. Paula Alvarenga³, Dr. Paul Romkens⁴

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There is a need to understand processes regulating fate of NPs in natural media like soil. Recent studies, however, show that the solubility and plant uptake of NPs in soil cannot be fully explained on the basis of common soil-solution partition processes as for ionic metals.

To identify the degree to which Zn from ZnONPs added to well-aerated soils was available for plant uptake, a pot experiment with 3 natural soils of variable properties (pH=4.8-7.0; OC=1.1-2.2 %; clay=3-17 %) was performed. Each pot was equipped with solution samplers to extract in-situ pore water samples. Pots were amended with a suspension of ZnONPs (at 10 or 100 mg Zn kg⁻¹ soil) and kept for 30 days at constant moisture (70 % of WHC). After this, seeds of Lactuca sativa were planted. Plants were observed for 21 days after 50 % emergence of the seedlings in control pots (OECD 208 guideline). Finally, emerged plants were harvested, dried and shoots were analysed for Zn total concentration.

The soil-pore water distribution of dispersed ZnONPs as well as dissolved Zn released from NPs was monitored throughout the experiment. At the end of the experiment, soils from pots were separated in 2 sub-samples (0-5 and 5-10 cm depth) and dried. Subsequently extraction tests were applied to quantify the geochemically reactive and bioavailable pool of Zn that remained in soil.

In this presentation the effect of soil properties on the solubility of ZnO NPs and availability of Zn for plant uptake will be discussed in detail.
IN VITRO BIOACCESSIBILITY METHOD FOR PREDICTION OF RELATIVE BIOAVAILABILITY OF ARSENIC IN CONTAMINATED SOILS

Tuesday, 16th August - 15:30 - OS-6A.04 - Biogeochemistry - Oral

Dr. Karen Bradham¹, Mr. Clay Nelson¹, Dr. Albert Juhasz², Dr. Euan Smith², Dr. Kirk Scheckel¹, Dr. Daniel Obenour³, Dr. David Thomas¹

¹US Environmental Protection Agency, ²University of South Australia, ³North Carolina State University

Accurate assessment of human health risks from exposure to arsenic (As) contaminated soils depends on estimating its bioavailability. Bioavailability methods are needed to provide inexpensive, accurate, and reliable data that can be applied to cleanups of arsenic-contaminated sites. We evaluated 5 commonly used in vitro bioaccessibility (IVBA) methods to determine the bioaccessibility of As in 40 contaminated soils from the United States and Australia. A wide variety of soils were used in this study, including reference materials, railway corridors, cattle tick dip, gossan sites, and residential soils affected by mining or smelting. Arsenic bioaccessibility was highly correlated with the in vivo mouse assay results (R²=0.92). Research was also conducted to evaluate the predictive capabilities of an IVBA assay for As RBA in mice and to develop a more robust model across multiple soil types, arsenic contaminant sources, and arsenic concentrations. We validated the predictive capability of this model using an independent set of arsenic contaminated soils. Validation of model performance using data independent to those used to construct the model is imperative for IVBA data to be used routinely for incorporation into human health risk assessments. Arsenic speciation in soils was examined using the Materials Research Collaborative Access Team’s (MRCAT) beamline, Argonne National Laboratory (ANL). AsV species were the dominant arsenic forms in most test soils while other soils had appreciable levels of AsIII sulfide or ore species. The in vivo-in vitro correlation and independent data validation presented provide critical verification necessary for regulatory acceptance in human health risk assessment.
BIOAUGMENTATION DEGRADATION OF 2,4,6-TRIBROMOPHENOL WITH THE BACTERIAL MICROCOSMS FROM E-WASTE POLLUTED RIVER SEDIMENTS BY BACILLUS SP. GZT

Tuesday, 16th August - 15:30 - OS-6B.01 - Honouring Jiomo Fu - A - Oral

Dr. Jukun Xiong1, Prof. Guiying Li2, Prof. Xun-an Ning3, Prof. Taicheng An4, Prof. Pingan Peng5

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2,4,6-Tribromophenol (TBP) is a pesticide with fungicide activity, presently used as a replacement of pentachlorophenol as a wood preservative and as a flame retardant in electronic and electric devices, and has been frequently detected in various matrices including water, soil, sediment, and groundwater. In this study, microcosms with different conditions were constructed to investigate the biodegradation of TBP and the evolution of microbial community. The results showed that, as compared with the unamended controls, the bioaugmentation with Bacillus sp. GZT can effectively enhance TBP degradation, with approximately 40.7% of TBP removal after seven weeks incubation without lag phase (p<0.01). While in unamended controls, the biodegradation of TBP was not obvious. Amendment with 2-bromophenol (2-BP), 2,6-dibromophenol (2,6-DBP) and 2,4-dibromophenol (2,4-DBP) did not promoted rapid biodegradation of TBP in the river sediment (p>0.05). However, the TBP biodegradation was enhanced by adding sodium chloride, humic acid, sodium lactate and sodium propionate alone, especially glucose and yeast extract. Metagenomic analysis of the total 16S rRNA genes from the treatment system with bioaugmentation showed that four phylums including Proteobacteria (52.08-66.22%), Actinobacteria (20.03-5.47%), Bacteroidetes (6.68-13.68%) and Firmicutes (4.53-20.83%) were found to be the dominant microbial species. This study may provide the possibility to use bioaugmentation with Bacillus sp. GZT to develop cost-effective approaches to eliminate TBP in the water and sediment environments.
ENHANCED BIODEGRADATION OF 2,4,6-TRIBROMOPHENOL BY A NOVEL DEHALOGENASE PURIFIED FROM BACILLUS SP. GZT

Tuesday, 16th August - 15:30 - OS-6B.02 - Honouring Jiamo Fu - A - Oral

Ms. liang Zhishu¹, Prof. Taicheng An², Prof. Guiying Li³

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As a typical flame retardant, 2,4,6-tribromophenol TBP has a wide range of application and can be easily transmitted into the biota and environment, resulting various health hazards. Although many researches were mainly focused on the debromination and mineralization of TBP by isolated bacteria, barely research has been attempted to specifically investigate the enhanced biodegradation of TBP by a newly enzyme. In this study, the purification process as well as their application properties of the dehalogenase isolated from Bacillus sp. were investigated. The results showed a novel TBP dehalogenase, capable of rapidly biodegrading TBP, was purified and characterized for the first time. Overall 46.7-fold purification of enzyme with recovery of 28.6% and final specific activity of 18.9 U/mg was obtained using progressively purification protocol. The molecular mass of this enzyme with an isoelectric point (pI) of 8.45 was estimated to 63.4 kDa by SDS-PAGE. Characterization of N-terminal amino acid sequence revealed this enzyme has high similarity with oligopeptide ABC transporter oligopeptide-binding protein and peptide ABC transporter substrate-binding protein. Up to 80% degradation efficiencies was achieved by TBP dehalogenase within 120 min under optimal conditions. Addition of H₂O₂, NADPH, Mn²⁺ and Mg²⁺ can greatly promote enzyme reaction, whereas the activities were strongly inhibited by EDTA, methyl viologen, Ni²⁺, Cu²⁺, Ca²⁺ and Fe²⁺. Measured Km value (73 µmol/min/mg) and Vmax (0.63 µmol/L) for TBP degradation indicated this dehalogenase can specifically eliminate TBP with high efficiency and favorable stability. This pioneer report demonstrated this newly-isolated TBP dehalogenase is effectively involved in biodegradation of TBP.
OCCURRENCE AND TEMPORAL TRENDS OF PERFLUOROALKYL ACIDS (PFAAS) IN OCCUPATIONAL WORKERS: ARE THE HALF-LIVES OF PFHXS AND PFOS SHORTER THAN EXPECTED?

Tuesday, 16th August - 15:30 - OS-6B.03 - Honouring Jiamo Fu - A - Oral

Prof. Aiqian Zhang¹, Dr. Jianjie Fu², Dr. Yan Gao², Ms. Ke Gao², Prof. Yawei Wang¹, Prof. Guibin Jiang¹

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Perfluorooctanesulfonate (PFOS) has been restricted by the Stockholm Convention, and the reported half-lives of perfluoralkyl acids (PFAAs) based on human serum concentrations remained some controversial and ranged from several days to decades. Paired serum and urine samples were collected from workers in a fluorochemical plant from 2008 to 2012 (n=302) to investigate the level, temporal trends, and half-lives of PFAAs in workers of a fluorochemical plant. High levels of perfluorohexane sulfonate (PFHxS), perfluorooctanoic acid (PFOA), and PFOS appeared in serum with median concentrations of 764, 427, and 1725 ng mL⁻¹, respectively. There were big difference of PFAAs levels among workers, and PFAA levels were influenced by work assignment and the length of service in the plant, and temporal trends of PFAAs in workers were closely related to the production structure. The elimination of PFAAs was considered to be a first-order model, and the half-lives of PFAAs in workers were estimated by clearance rates of PFAAs and longitudinal data in serum, respectively. The average estimated half-lives for PFHxS, PFOA, and PFOS were, respectively, 17.0 (95% confidence interval (CI), 13.0-20.9), 5.84(4.27-7.42), and 52.0(34.7-69.3) years by the clearance rates, and they were only 3.79(95% CI, 0.541–12.7), 1.68(1.02–1.88), and 1.94(1.70–2.44) years estimated by longitudinal data. The results indicated that there were other important elimination pathways of PFHxS and PFOS other than renal clearance. The half-lives estimated by longitudinal data were the shortest values ever reported, and the intrinsic half-lives might even shorter due to the high levels of ongoing exposure to PFAAs.
TEMPORAL TRENDS AND CONGENER PROFILES OF PCBs, PCDD/FS AND PBDEs IN UMBILICAL CORD BLOOD FROM AN E-WASTE RECYCLING AREA

Tuesday, 16th August - 15:30 - OS-6B.04 - Honouring Jiamo Fu - A - Oral

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The environmental pollution and health impacts from the crude e-waste recycling have attracted global attention. Guiyu is a major crude e-waste recycling area in southeast China. In this study, the levels of PCBs, PCDD/Fs and PBDEs in umbilical cord blood of Guiyu (exposed group) and Haojiang (reference group) from 2007 to 2012 were determined by isotope dilution high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) to investigate the effect of e-waste activities on maternal and newborns. The annual average levels of PCBs, PCDD/Fs and PBDEs in umbilical cord blood from Guiyu were significantly higher than those from reference areas of Haojiang. The main congeners in the e-waste exposed group were PCB-138, 153, 180, 28 and 118; PBDE-153, 47, 183, 28 and 154; and OCDD, 1, 2, 3, 4, 6, 7, 8-HpCDF, 1, 2, 3, 4, 6, 7, 8-HpCDD and 1, 2, 3, 4, 6, 7, 8-HpCDF. The concentrations of PCDD/Fs, DL-PCBs and TEQ PCDD/Fs increased sharply at the year of 2007 to 2009, then remained at a constant level during the year of 2010 to 2012, while marker-PCB, PBDE, ΣTEQPCB, and PCDD/F+DL-PCB levels rose up at first three years, and falling rapidly during the year of 2011 and 2012. Results show that Guiyu newborns have higher POP levels in their cord blood, and POP levels vary with the opening and closing of local workshops. Centralized recycling pattern and strengthen managements for crude e-waste recycling might control the increasing of POPs, but POPs are difficult to degrade and eliminate from human body.
BENTHIC INVERTEBRATE ECOLOGICAL RISK ASSESSMENT OF LUANHE RIVER, CHINA: COMBINED PHYSICAL, CHEMICAL AND BIOLOGICAL APPROACH

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Abstract: With the enhancement of human activities which influence the physical and chemical integrity of ecosystem, it was bound to increase ecological risk to the ecosystem. Benthic invertebrate can stable reflect the state of the ecosystem. We used a comprehensive approach, including the response relationship between environmental flow requirements guarantee ratio (GEF) and river ecological risk index (ERI), the Sediment Quality Guideline Quotient index (SQG-Q) and the Biotic Index (BI), to evaluate the risk of benthic invertebrate in sediment of the Luanhe River, China. Sediment samples were collected at 10 sites during wet season and dry season. According to the response relationship between GEF and ERI that Luanhe River was at moderately risk level in dry season, and low risk level in wet season. It was concluded that all sites appeared to be moderately impacted by the contaminants in dry season, and unimpacted in wet season. The results of BI showed that Luanhe River was at moderately polluted in dry season, and unpolluted in wet season. In conclusion, the benthic invertebrate in sediment of the Luanhe River was at moderate risk level in dry season, and low risk level in wet season.

Keywords: Luanhe River; Ecological risk assessment; benthic invertebrate; contaminant; Sediments
GISGROUNDWATER - A SEAMLESSLY COUPLED GIS AND DISTRIBUTED GROUNDWATER FLOW MODEL

Tuesday, 16th August - 15:30 - OS-6C.01 - GIS & Quantitative Methods A - Oral

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Geographic Information System (GIS) is the major data source for many numerical groundwater models; and it is common practice to couple the models with GIS. There are three methods for coupling numerical groundwater models with a GIS, namely ‘loose’, ‘tight’, and ‘seamless’. In seamless coupling a model code is written into, and run from within, a GIS. A seamless GIS groundwater model facilitates the construction and simulation of the model, and the visualisation of the results all within the GIS environment. Currently, there is no seamlessly coupled GIS numerical groundwater-flow model. We have addressed this by developing a seamless GISGroundwater model, which consists of a finite-difference groundwater flow model and a user-interface, which are packaged up as an add-in for ArcGIS®. It can represent heterogeneous aquifers, variably confined and unconfined conditions, and distributed groundwater recharge and abstraction. GISGroundwater has been validated against analytical solutions to groundwater-head profiles for a range of aquifer configurations. It offers benefits in terms of ease of use and in streamlining the model construction and application process. This has been demonstrated in constructing a regional groundwater flow model for the Chalk aquifer in the Thames Basin, UK. Therefore, it allows non-modellers, such as scientists, students and even policy makers, to carry out numerical groundwater flow modelling in GIS. In addition, GISGroundwater can potentially be coupled with any GIS that handles raster datasets.
The spatial distribution patterns of phosphorus (P) concentration in soils of the London urban area was investigated based on 6467 samples from the London Earth soil geochemical survey of the Greater London area of British Geological Survey. Both the results of analysis of variance (ANOVA) and GIS mapping implied that the P distribution showed a strong geogenic control with elevated concentrations in areas of alluvium and river terrace deposits. The P distribution demonstrated strong association with riverine areas, especially accumulated along the River Thames, the River Lea and the Grand Union Canal. However, the P concentrations decreased dramatically below Woolwich Reach of Thames estuary where the soils were gradually dominated by bed-load transport from the sea. Besides the natural control, P soil content was also strongly impacted by human activities, including three main types of sources: sewage treatment works (STWs), septic tanks and agriculture. The optimized hot spot analysis showed that two STWs, Beddington and Deephams, had high concentrations where water flows often exceeded the capacity of the treatment plants during heavy rain events. The patterns shown by cluster and outlier analysis matched well with London population density. Heathrow airport, Stockley and Bexley heath Golf Course showed high levels of P. The spatial patterns of P controlled by parent material (PM) have are still clearly seen even in the metropolitan urban area where anthropogenic activity is high. The identified P hotspots suggest places where attention needs to be paid to soil quality.

Key words: London; phosphorus; GIS; hotspots; sewage; Thames
Rare earth elements (REEs) in urban soils are receiving more attention because of their potential toxicity and long-term effects on human health. Up to now, there is little information about the spatial patterns of REEs and their influencing factors in urban soils. In this study, based on data from the British Geological Survey “London Earth” geochemical survey containing a total of 6468 soil samples collected from the urban area of London, the spatial distribution of Y, Yb, Sc, La, Ce, Sm and Nd, and the influencing factors were investigated. Spatial clusters and spatial outliers were classified using the index of local Moran’s I, showing elevated concentrations of REEs in the northwest, northeast and south parts of the study areas while all the 7 REEs exhibited generally similar spatial patterns: high values were mainly located in soil over Alluvium, Glacial till and Clay-with-flints deposit, demonstrating close relationships between REEs and the lithology. Meanwhile, hotspot analysis identified high values of REEs in public parks, private golf clubs, school playing fields and domestic gardens especially in Brent, Harrow, Croydon and Bromley. These areas are likely to arise from anthropogenic activities including the application of phosphate fertilisers. The hotspots of REEs revealed in urban soils may imply potential contamination requiring further attention.

Key words: Hotpots, Rare earth elements, Local Moran’s I, Urban soil
In fast growing regions, zoning eco-protected areas has become important for ecological conservation and environmental management. Rapid and continuous urban expansion, however, may exert negative effects on the performance of practical zoning designs. Various methods have been developed for protected area zoning, but most of them failed to consider the conflicts between urban development (for the benefit of land developers) and ecological protection (local government). Our study aims to address these problems based on a combined use of CA and game theory. Guangzhou, a rapidly urbanizing metropolis suffering from severe ecological issues in China, is selected as the study area. Game theory is a theory of decision-making that can mathematically analyze and simulate the conflicts between rational decision-makers. The ecological compensation mechanism was taken into account by simulating the negotiation processes between the government and land developers. A final zoning scheme can be obtained when the two sides reach agreements.
MODELLING THE POTENTIAL DISTRIBUTION OF THE EELGRASS ZOSTERA MARINA AT LOCAL AND REGIONAL SCALE IN IRELAND

Tuesday, 16th August - 15:30 - OS-6C.05 - GIS & Quantitative Methods A - Oral

Mr. Pedro Beca

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Eelgrass, Zostera marina L., the most widely distributed seagrass in the northern hemisphere, plays a key role in the coastal zone in terms of high productivity, stimulation of biodiversity, protection of the coastline, carbon storage and nutrient retention. However, despite these key effects on marine ecosystems, its conservation status and distribution in Ireland is not clear, partly because of inaccessibility of potential eelgrass habitats. It is therefore likely that actual distribution of seagrass along the coast of Ireland is larger than currently reported in the literature. Here, ecological niche models (ENMs) were used to calculate habitat suitability at local and regional scale, and moreover, to identify the relative importance of different factors determining the presence of eelgrass communities at these scales. To develop species distribution models, sediment, bathymetry, slope, current velocity and water temperature at different depths were used as key factors determining distribution. The predicted areas of Zostera marina habitats were compared with an eelgrass distribution map obtained by using satellite derived images. Our models have predicted the potential range of the Irish eelgrass which will be verified by sampling. As eelgrass populations are under threat globally, an accurate distribution map of eelgrass in Ireland will be critical to define adequate future conservation policies. This project therefore constitutes an essential study to contribute to current efforts in seagrass monitoring and management across Europe.
There is a rather limited understanding concerning the antibiotic-resistance of the airborne S. aureus and the transmission of the antibiotic-resistant genes it carries. Therefore, we isolated 149 S. aureus strains from the samples collected from the feces, the indoor air and the outdoor air of 6 chicken farms, and performed the research on them with 15 types of antibiotics and the REP-PCR trace identification. The 100% homologous strains were selected to conduct the research on the carrying and transmission status of the antibiotic-resistant genes. The results revealed that 5.37% strains (8/149) were resistant to methicillins (MRSA), and 94% strains (140/149) were resistant to compound sulfamethoxazole, etc. In addition, these strains displayed a resistance to multiple antibiotics (4, 5 or 6 types) and there were also 3 strains resistant to 9 antibiotics. It should be noted that the antibiotic-resistance of some strains isolated from the feces, the indoor and outdoor air was basically the same, and the strains with the same REP-PCR trace identification result carried the same type of antibiotic-resistant genes. The results showed that airborne transmission not only causes the spread of epidemic diseases but also exerts threats to the public health of a community.
CHEMICAL MODIFICATION AND DEGRADATION OF ATRAZINE IN MEDICAGO SATIVA THROUGH MULTIPLE PATHWAYS

Tuesday, 16th August - 15:30 - OS-6D.02 - Microbiology - Oral

Dr. Jing Jing Zhang¹, Prof. Hong Yang¹

¹Nanjing Agricultural University

The atrazine residue in ecological systems has resulted in a negative effect on environmental quality. Once alfalfa crops were contaminated by atrazine residues, the dairy and livestock production may be further affected. Thus, investigation on the accumulation and degradation of atrazine in alfalfa is of great importance from the environmental and agricultural points of view. The objectives of this study were (1) to assess the ability of alfalfa to accumulate and degrade atrazine and (2) to investigate the possible atrazine catabolic pathway.

Alfalfa seedlings were planted using hydroponics. To study the accumulation and translocation of atrazine in alfalfa, the concentration of atrazine in shoots and roots was analyzed by HPLC. Metabolites and conjugates of atrazine in alfalfa were analyzed using UPLC coupled to LTQ Orbitrap XL. The structures of metabolites were determined by analyzing fragmentation patterns from MS2 and MS3 data. The activities of glutathione S-transferase and glycosyltransferases were assayed spectrophotometrically.

The study demonstrated that alfalfa had a great ability to accumulate and translocate atrazine. Some atrazine absorbed in alfalfa was found as 10 chemically modified derivatives like deisopropylated atrazine, dehydrogenated atrazine, methylated atrazine, etc. Some derivatives were further conjugated with polar donor molecules such as glucose, homoglutathione and amino acids. The activated activities of glutathione S-transferase and glycosyltransferase supported the atrazine degradation models. These results suggest that atrazine in alfalfa can be degraded through different pathways. The biochemical responses and metabolism pathway will serve as useful indicators for assessment of the herbicide contamination in agricultural environments.
DIVERSITY AMONG ANTIMICROBIAL RESISTANT E.
COLI ISOLATED FROM IRISH RETAIL MEATS

Tuesday, 16th August - 15:30 - OS-6D.03 - Microbiology - Oral

Dr. Carina Brehony¹, Ms. Blathnaid Mahon¹, Prof. Martin Cormican¹, Dr. Bob Madden², Dr. Carmel Kelly², Dr. Lynn Moran², Dr. Siobhan Kavanagh¹, Dr. Cyril Carroll¹, Dr. James Bray³, Dr. Keith Jolley³, Prof. Martin Maiden³, Dr. Dearbhaile Morris⁴

¹NUI Galway, ²Agri Food & Biosciences Institute, ³University of Oxford, ⁴National University of Ireland, Galway

Background and Objectives

Antimicrobial resistance is recognised globally as a major public health concern. The role of food in the dissemination of these important antimicrobial resistant bacteria is examined in this study.

Methods

A total of 600 raw meat samples were purchased from retail outlets throughout the island of Ireland from November 2013 to September 2014. All samples were screened for the presence of antimicrobial resistant E. coli (AREC) and 496 AREC isolates were detected. All AREC isolates were characterised by a series of phenotypic and genotypic tests and based on these results 96 isolates were selected for whole genome sequencing. Isolate genomes were hosted in and analysis was performed using a local installation of BIGSdb.

Results

In total 46 sequence types (STs) and 12 clonal complexes and 61 ribosomal sequence types (rSTs) were identified. rST-1544 accounted for 15% of isolates and an association with source was apparent with 92.9% of rST-1544 from chicken samples (13/14). A total of 4981 loci were compared for all genomes and the fewest differences (n=39) were found in two chicken meat isolates within the rST-1544 grouping. None of the rST-1544 group were ESBL producers.

Conclusions

AREC E. coli found in Irish retail meats were relatively diverse with over half being ESBL producers. Interrogation of whole genome databases for emerging antimicrobial resistance determinants provides a rapid low cost approach to evaluate the extent of dissemination prior to recognition and will become more powerful as databases expand.
TRANSFERABLE COLISTIN RESISTANCE ENCODING GENE MCR-1 NOT DETECTED IN E. COLI ISOLATED FROM HUMANS AND RETAIL MEATS IN IRELAND

Tuesday, 16th August - 15:30 - OS-6D.04 - Microbiology - Oral

Dr. Carina Brehony¹, Ms. Blathnaid Mahon¹, Prof. Martin Cormican¹, Dr. Bob Madden², Dr. Carmel Kelly², Dr. Lynn Moran², Dr. Siobhan Kavanagh¹, Dr. Cyril Carroll¹, Dr. James Bray³, Dr. Keith Jolley³, Prof. Martin Maiden³, Dr. Dearbhaile Morris⁴

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Background and Objectives

The plasmid-mediated colistin resistance gene, mcr-1, was first described in November 2015 by Liu et al in E. coli isolated from food, animals and humans. Subsequently, others have isolated E. coli harbouring mcr-1 from human animal and food specimens. This finding is concerning as plasmids can transfer easily between different genera of bacteria, raising concerns for the rapid and widespread dissemination of colistin resistance.

Methods

Whole genome sequences of 96 E. coli isolates collected from retail meats in Ireland and Northern Ireland (November 2013 - September 2014) and 96 E.coli isolates collected (2005 – 2011) primarily from residents of long term care facilities were examined. Genomes were hosted in and analysis was performed using a local installation of BIGSdb. The mcr-1 sequence of Liu et al was used to conduct a BLASTN search against all 192 Irish human and food E. coli genomes.

Results

No significant matches were returned indicating the absence of the gene in this set of genomes.

Conclusions

The absence of mcr-1 in this limited collection of food and human genomes suggests that it has not yet been disseminated widely in food animals or humans in Ireland. Use of colistin and related compounds in human health care on the island of Ireland is very limited. The recent finding of a transferable colistin resistance mechanism in China and more recently in Europe and North America is of major concern and underlines the necessity of continuous surveillance.
SURFACE-ENHANCED RAMAN SPECTROSCOPY (SERS) FOR ENVIRONMENTAL MICROORGANISM ANALYSIS: ANTIBIOTIC RESISTANCE, NANOTOXICITY, AND BIOFILM.

Tuesday, 16th August - 15:30 - OS-6D.05 - Microbiology - Oral

Dr. Li Cui¹, Dr. Yingjiao Zhang¹, Dr. Kaisong Zhang¹, Prof. Yong-Guan Zhu¹

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Surface-enhanced Raman spectroscopy (SERS) is a non-destructive molecular-vibration spectroscopy capable of providing whole-organism fingerprinting information of microorganism and their sensitive phenotypic responses to various external factors. Moreover, the strong electromagnetic enhancement provided by Ag or Au nanoparticles endows SERS extra advantages over normal Raman spectroscopy in ultrahigh sensitivity down to single-molecules level, rapid detection, surface information characterization, and fluorescence-quenching ability. Here, the applicability of SERS in studying heavy metal arsenic (V)-enhanced antibiotic resistance, nanotoxicity of Ag and ZnO NPs to bacteria, as well as variation of bacterial species and chemical compositions of biofilm during the development will be presented.

Bacterial antibiotic resistance poses a threat to global public health. Independent and robust SERS spectral changes representing phenotypic bacterial responses, combined with multivariate analysis, clearly identified that As(V) enhanced antibiotic resistance to tetracycline (Tet).¹ For nanotoxicity studies, SERS in-situ revealed size-, media-, time-, and dose-dependent toxic responses of bacteria to Ag and ZnO nanoparticles.² For biofilm studies, SERS indicated a dynamic change of dominant bacterial species within the biofilm with culture time, based on the distinguishable SERS features of two bacteria.³ SERS also achieved layer-by-layer interrogation of the chemical composition of biofilm on nanofiltration membrane (biofouling) during both development and removal processes and revealed biofilm composition-dependent cleaning efficiency.⁴

KEYNOTE: THE OCEAN AND HUMAN HEALTH: NEW HORIZONS AND OPPORTUNITIES

Tuesday, 16th August - 17:15 - OS-7A.01 - Coastal & Marine Ecosystem - Keynote

Prof. Lora E Fleming¹, Prof. Michael Depledge¹, Dr. Niall McDonough², Dr. Mathew White¹, Prof. Sabine Pahl³, Prof. Melanie Austen⁴, Prof. Anders Goksøyr⁵, Prof. Helena Solo Gabriele⁶, Prof. John Stegeman⁷, Prof. Henrik Enevoldsen⁸

¹European Centre for Environment and Human Health, University of Exeter Medical School, ²European Marine Board, ³University of Plymouth, ⁴Plymouth Marine Laboratory, ⁵University of Bergen, ⁶University of Miami, ⁷Woods Hole Oceanographic Institute, ⁸IOC UNESCO Programme University of Copenhagen

Interdisciplinary research and training in the ocean and human health is an area of increasing global importance. There is growing evidence that the health of both the ocean and humans are inextricably linked, and that how we interact with and impact our ocean and seas will significantly influence our future on Earth. Throughout history, the ocean has provided culture, livelihoods, expansion, trade, food, and other resources. However, rapidly increasing global population (particularly coastal urbanization) and continuing alterations of coastal environments are placing overwhelming pressure on coastal seas and the ocean. Negative anthropogenic impacts including climate change, pollution (chemical, microbial, material), habitat destruction (e.g. bottom trawling, dredging) and overfishing, affect not only ecosystem health and services, but also human health and economic welfare. Conversely, there are opportunities to promote human health and wellbeing through sustainable interactions with the coasts and the ocean, including through the restoration and preservation of coastal and marine ecosystems. In particular, a growing evidence base indicates that interactions with coastal and ocean environments may improve both physical and mental health and quality of life.

The study of the ocean and human health is inherently interdisciplinary, bringing together the natural, medical and social sciences, as well as diverse stakeholder communities (including fishers, recreational users, private enterprise, and policymakers). Reviewing the known and potential risks and benefits of interactions between humans and the oceans provides insights into new avenues of global cooperation with the potential for collaboratively addressing both local and planetary environmental challenges and human health and wellbeing.
GEOGRAPHIC VARIATION IN TRACE ELEMENTS IN SCALES OF PRE-SMOLT FARMED ATLANTIC SALMON

Tuesday, 16th August - 17:15 - OS-7A.02 - Coastal & Marine Ecosystem - Oral

Dr. Belinda Flem\textsuperscript{1}, Dr. Vidar Moen\textsuperscript{2}, Mr. Tor Erik Finne\textsuperscript{1}, Dr. Hildegunn Viljugrein\textsuperscript{2}, Dr. Anja Bråten Kristoffersen\textsuperscript{2}

\textsuperscript{1}Geological Survey of Norway, \textsuperscript{2}Norwegian Veterinary Institute

The Norwegian aquaculture management authorities’ need a method that enables the identification of escaped farmed salmon caught in sea or in the river systems. A method based on the natural variation of incorporated trace elements in the salmon scale is under development.

The growth pattern, of the mineralized layer on the fish scale, has radical increments (sclerites) quite analogue to tree rings. While a tree forms a new ring on a yearly basis, a new sclerite is formed every 7-8 days. The trace element content in these mineralized growth bands of the scale reflects those present in the ambient water at the time of creation.

The chemical variation of 12 elements in sclerites of salmon scales has been analysed by laser-ablation-ICPMS. Eighteen hatcheries distributed along the entire Norwegian coastline are included in the survey, making this the largest study ever published on fish-scale chemistry linked to geographic variation. Based on robust multivariate statistical analysis 97\% of the smolt was correctly identified to its hatchery. Of 1347 scale analyses only 44 were misplaced in relation to its origin. Strontium and barium are the most important elements for group separation. Floodplain sediments at the south-western coastline of Norway show elevated lead-values compared to the remaining coastline. In this area the majority of the scales show values of lead above detection limit. Scale chemistry may provide a tool to determine the origin of escaped Atlantic salmon, however further investigations are needed before this method can be implemented in the salmon management in Norway.
This paper outlines the experiences of using oral histories as a method of promoting knowledge transfer as part of wider strategies to promote wetland conservation and rehabilitation projects. It details their use as part of a recent collaboration with postgraduate students and staff on the work of the Community Wetlands Forum, (CWF), a grouping of over 20 wetlands groups from mainly the Midland counties in Ireland. It was set up in 2013 in response to concerns about ongoing management of wetlands following the EU Peatlands Directive which now prohibits turf cutting in many wetland locations. The Wetlands Community Forum views development of wetlands as best undertaken as a community development venture, with their full involvement. This means that the community must become more engaged with the process, in terms of acquiring greater knowledge of the value of wetlands and how they can be used as a new kind of local resource (instead of turf cutting) which can return benefits to the community and locality. This presentation discusses the process of collecting oral histories from community members living in the catchment area of the CWF, and the ways in which these have contributed to a process of public participation, illustrating that even though changes are taking place they can happen with respect to the traditions of the past.
Comparing and optimizing different survey methods for mapping topography and functional vegetation distribution in coastal dune systems

Tuesday, 16th August - 17:15 - OS-7A.04 - Coastal & Marine Ecosystem - Oral

Ms. Chen Suo¹, Dr. Eugene McGovern¹, Dr. Alan Gilmer¹

¹Dublin Institute of Technology

Coastal dune systems are dynamic landforms that are vulnerable to damage from both natural and anthropogenic sources. There is increasing awareness of the importance of effective management of coastal dune systems and numerical modelling can help in this regard. High-resolution mapping of the topography and the vegetation communities across a dune field, in particular the mixture of different functional plant types such as pioneer versus succession species, is critical for the establishment of rigorous and quantitative numerical simulation landscape models. These models can inform targeted land management actions that maintain biodiversity and ecological functions.

There are a number of sources of spatial data available for coastal dunes mapping. National mapping agencies provide base topographical data from aerial photography with, more recently, digital elevation models from airborne laser scanning while satellite imagery provides remotely-sensed panchromatic, colour and multispectral data. Although valuable, these data may not provide the resolution necessary for accurate numerical modelling of a dune complex. Recent developments in surveying technology have enabled high resolution and high accuracy spatial data to be gathered quickly and relatively easily on-site. These technologies include RTK GPS, robotic Total Stations, terrestrial laser scanners and Unmanned Aerial Vehicles (drones). This paper compares and contrasts these technologies, and their deliverables, for the topographical and vegetation mapping of coastal dune complexes with particular reference to the Brittas-Buckroney dune complex in Co. Wicklow.
Increased anthropogenic activities have contributed to the deteriorating air quality of Beijing in recent years. During the period of November 2014, we collected 90 air samples in the urban and rural sites of Beijing to investigate the variations of PCDD/Fs before, during and after the APEC summit. The effectiveness of emission-control measures on reducing atmospheric pollution of POPs was assessed. The air concentrations of PCDD/Fs at the urban sites were in the range of 0.29-177 pg m$^{-3}$, which is clearly higher than the rural site (0.02-69 pg m$^{-3}$). This urban-rural concentration gradient demonstrated urban areas as emission sources of PCDD/Fs to the ambient air and can be explained by the lower population density, sparse traffic and fewer industrial activities in the rural area. The air concentrations of PCDD/Fs during the APEC was the lowest, showing a $\sim$70% reduction from one week before the summit. Haze days corresponded to high elevation of PCDD/Fs, showing the highest of 17 folds from non-haze days. In non-haze days, the TEQs of PCDD/Fs averaged 0.23 pg WHO-TEQ m$^{-3}$, lower than the air quality guideline of 0.6 pg TEQ m$^{-3}$ proposed by Japan government. However, in haze days, the TEQs of PCDD/Fs averaged 3.4 pg WHO-TEQ m$^{-3}$, obviously higher than non-haze days.
STUDY OF THE INTERACTIONS BETWEEN ZINC ION AND DISSOLVED ORGANIC MATTER BY USING IN SITU METHODS OF ABSORBANCE

Tuesday, 16th August - 17:15 - OS-7B.02 - Honouring Jiamo Fu - B - Oral

Prof. Yujuan Lu¹, Ms. Tao Wang²

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The bioavailability and toxicity of zinc to aquatic life depends on dissolved organic matter (such as Suwannee River Fulvic Acid), which plays an important role in the speciation of zinc. This study examined reactions of SRFA with varying zinc concentration at pHs from 3.0 to 9.0, as well as competitive binding of Calcium/Magnesium and zinc to SRFA at pH 6.0 by using in situ methods of absorbance. Interactions of Zn²⁺ with SRFA chromophores were accompanied by the emergence of features in Zn-differential spectra. Among all of Zn²⁺-SRFA systems, the dominant peaks were located at 230 nm, 270 nm, 320 nm, 375 nm, the highest intensity of them was located at 230 nm, the observed results indicated the occurrence of the replacement of a characteristic number of protons by the bound Zn²⁺. The extent of Zn²⁺ binding with SRFA could be quantified by calculating the changes of the slopes of Zn-differential log-transformed absorbance in the range of wavelength 350 to 400 nm (denoted as DS350-400) and by comparing the data with predictions made using the Non-ideal Competitive Adsorption (NICA-Donnan) model, the result showed DS350-400 were well correlated to the bound Zn²⁺ concentrations predicted by NICA-Donnan model with or without Ca²⁺ or Mg²⁺. Ca²⁺ and Mg²⁺ only effect intensity of the Zn-differential and Zn-differential log-transformed absorbance rather than shape. In situ methods of absorbance can be used to gain more information about Men⁺-DOM interactions in the presence of varying metals.
The occurrence, distribution of 21 antibiotics, including eleven fluoroquinolones (FQs), and seven sulfonamides (SAs), two macrolides (MLs) and chloramphenicol in the urban river in March (dry season) and July (wet season), 2013 were investigated. Samples were analysed using ultra high-performance liquid chromatography coupled to a mass spectrometer (UHPLC-MS/MS) after clean up and pre-concentration by solid phase extraction (SPE). The studies revealed the occurrence of 21 classes of antibiotics including sulfadiazine, sulfamethoxazole, sulfamethazine, sulfamerazine, sulfachinoxalin, sulfanilamide, sulfathiazole, sulfacetamide, sulfapyridine, sulfachlorpyridazine, sulfisoxazole, levofloxacin, enoxacin, enrofloxacin, nadifloxacin, ciprofloxacin, norfloxacin, lomefloxacin, erythromycin, roxithromycin and chloramphenicol. Their concentrations ranged from 3.9 to 2554.7 ng/L. The most frequently detected antibiotics were found to be sulfonamides and fluoroquinolones in surface water. The concentration of antibiotics from samples in March was higher than that in July. The highest total concentration of 21 antibiotics in water samples were 2554.7 and 1948 ng/L in March and July, respectively. In particle matters, low level of sulfonamides was detected during July and the highest total concentration of antibiotics in all samples was 116 ng/L. In terms of the river reach, the contamination levels of antibiotics were much higher in main stream than that in branch. The data collected implies that while insufficiently treated wastewater contributes to surface water contamination, human activities also contribute appreciably to the antibiotics loading of the urban river. The results provided basic data for evaluating the health and ecological risk of antibiotics in these areas.
Contaminants of emerging concern (CEC) represent a host of pharmaceutical agents and personal care products (PPCPs) and other agents released into aquatic ecosystems. Assessing the ecological impacts of these structurally-diverse contaminants is a formidable challenge. Using a biomarker approach, based on understanding modes of action of these chemicals in cell and animal models and incorporating laboratory and field studies, is enabling us to define cause-and-effect relationships from exposures to these compounds and identify species at risk. Multi-analyte HPLC/MS/MS analysis was used to identify elevated concentrations of particular PPCPs in Chinook salmon in estuarine surface waters of the Puget Sound, WA. Several of the PPCPs identified are inhibitors of the mitochondrial electron transport system (ETS) and elicit cellular oxidative stress in hepatic tissues of laboratory models. Based on this knowledge and our field studies, we conducted a dietary feeding study with juvenile Chinook exposed to an environmentally relevant CEC mixture, including 13 pharmaceuticals and personal care products (PPCPs) and 3 perfluorinated compounds. Exposure to the CEC mixture inhibited Chinook liver mitochondrial function as evidenced by an elevation of State 4 respiration and loss of efficiency of oxidative phosphorylation relative to controls. Other endpoints under investigation include analysis of metabolic parameters, high throughput analysis of liver antioxidant and mitochondrial gene expression, and analysis of hepatic oxidative damage. In summary, using an integrated approach involving field and laboratory studies and incorporating molecular and biochemical and cellular endpoints is enabling us to identify the impacts of CEC on ecologically sensitive aquatic species.
TRANSPORT AND CHANGES OF EMERGING CONTAMINANTS IN THE AMENDED SOILS BY ORGANIC WASTES

Tuesday, 16th August - 17:15 - OS-7B.05 - Honouring Jiamo Fu - B - Oral

Dr. Zulin Zhang1, Dr. Hui Lin2, Mr. Mark Osprey3, Dr. Stephen Chapman1, Dr. Thomas Freitag1, Dr. Stewart Rhind1, Ms. Carol Kyle1, Mr. Dave Hamilton1

1The James Hutton Institute, 2The Institute of Environmental Resource and Soil Fertilizers, Zhejiang Academy of Agricultural Sciences, 3The James Hutton Institute

As the costs of fossil fuel and inorganic fertiliser increases and availability declines, 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. Therefore, the objective of this work is to trace the changes of emerging contaminants (e.g. antibiotic resistance genes (ARGs) and endocrine disrupting compounds (EDCs)) in the agricultural soils amended by different organic wastes (sewage sludge, compost and manure). The field experiment was conducted at the James Hutton Institute research station at Glensaugh, Aberdeenshire, UK. The organic fertilizer, control and treated soil samples were collected for EDCs and ARGs analysis over time. The predicted environmental concentration (PEC, calculated by the chemical content in organic wastes and the treating rate) of EDCs in in treated soils showed as following order: Sludge>Compost>Manure. These trends are in agreement with the measured EDC concentration in the differently amended soils, which suggested that the organic wastes introduced the chemical and increased/accumulated the contaminants in the treated soils. In all treatments, the relative abundance of most ARGs detected 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.
A GIS-BASED ASSESSMENT OF ENERGY POTENTIAL FROM BIOMASS AND WASTE FOR THERMOCHEMICAL BIOMETHANE IN IRELAND

Tuesday, 16th August - 17:15 - OS-7C.01 - GIS & Quantitative Methods B - Oral

Mr. Alessandro Singlitico\(^1\), Dr. Jamie Goggins\(^1\), Dr. Rory F. D. Monaghan\(^1\)

\(^1\)National University of Ireland, Galway

Ireland’s most recent Energy White Paper calls for a radical transformation of energy in Ireland and significant reductions of CO2 emissions. Biomethane production via a nationwide system of second-generation biomass gasification and methanation, which is among the most promising biomass-to-energy conversion routes, can pave the way to an efficient and greener energy network, using the existing gas infrastructure. The implementation of this large-scale bioenergy system requires a preliminary assessment of the currently available resources suitable to the proposed technology.

This research presents a GIS-based nationwide assessment of resource capability to meet energy demand using ArcGIS. It will quantify the theoretical energy potentials of possible feedstocks and their distributions throughout the 3440 Electoral Divisions of Ireland. In addition to dedicated energy crops, wastes and by-products of different economic activities are considered. Waste material and by-products, which can offer 275 ktoe (thousand tonnes of oil equivalent) per year, comprise agriculture and forest residues, non-compostable non-recyclable, and digestate from anaerobic digestion facilities. Additionally, 11% of Ireland territory is under rough grazing of low economic value. If this land was devoted to cultivating energy crops, such as Miscanthus, it could supply 1500 ktoe per year, as a first estimate. For comparison, the current use of biomass and waste, through thermochemical conversion to energy is 231 ktoe, indicating the significance of the potential resource.

From this study will follow an uncertainty analysis of model inputs and a multi-criteria analysis for siting bioenergy plants, based on the economic and environmental optimisation of biomass supply chain.
APPLICATION OF ARTIFICIAL NEURAL NETWORK IN MEDICAL GEOCHEMISTRY

Tuesday, 16th August - 17:15 - OS-7C.02 - GIS & Quantitative Methods B - Oral

Dr. Katarina Fajcikova¹, Prof. Beata Stehlikova², Mrs. Veronika Cveckova¹, Dr. Stanislav Rapant¹

¹State Geological Institute of Dionyz Stur, ²Faculty of Economy and Business, Panaeuropean University

Presented study deals with application of artificial neural network (ANN) in geochemical and health data analysis to define influence of chemical elements in drinking water on health status of population in the Slovak Republic (elaborated within the project Geohealth). The first step includes calculation of spatially smoothed values of health indicators through empirical Bayes smoothing. Next step consist of ANN calculations to identify those chemical elements in drinking water that have influence on evaluated health indicators. Influence of particular elements is defined based on values of coefficient of sensitivity (sr). The influence increases with the increase of sr value. Very important task is to identify the optimal number of calculated ANN. ANN with the highest correlation coefficients may not be the most appropriate. They can be wavy with several peaks. That is why in further analysis we use median value from 50 the best ANN with the highest correlation coefficients (from the total number 200 ANN). The results of ANN calculations were verified by methods of non-linear regression, e.g. method of decils. For influential elements is compliance excellent. Limit values of chemical elements for particular health indicators represent intersection of model curve for chemical contents with mean value of health indicator. We define limit (critical) and optimal concentration levels at which level of health indicator is the most favourable.

The project is supported by the EU Life+ programme (LIFE10 ENV/SK/086) and Ministry of the Environment of the Slovak Republic.
ESTIMATING THE ECONOMIC LOSS OF RICE PRODUCTION DUE TO CLIMATE-CHANGE-REINFORCED Floods: AN APPLICATION OF GIS AND HYDROLOGICAL MODELLING

Tuesday, 16th August - 17:15 - OS-7C.03 - GIS & Quantitative Methods B - Oral

Dr. Pham Quy Giang¹, Prof. Kiyo Kurisu², Prof. Keisuke Hanaki²

¹The University of Tokyo, Japan and Vietnam National University of Agriculture, ²The University of Tokyo, Japan

Estimating flood damage to crops is important for post-flood relief and recovery planning as well as for long-term adaptation and mitigation actions in the agricultural sector; however, this is a challenging task due to the complex interaction between flooding processes and crop systems, especially when climate change is considered.

In this study, a GIS/modelling based method was applied to estimate the economic loss of rice production due to climate-change-reinforced floods. The method included: (1) using GEV distribution and GCMs to project climate-change-reinforced extreme precipitation; (2) establishing maps of inundation depth and inundation duration of extreme precipitation-generated floods from the results of flood model simulations; and (3) calculating economic loss of rice production using GIS methods coupled with stage-damage functions.

The highly agricultural Ca River Basin in north-central Vietnam, which is home to more than 4 million people was selected for this case study. The results reveal that under medium-high greenhouse gas concentration scenario RCP6.0, in the future period 2061-2080 the intensity of 10-year extreme precipitation would increase approximately 12% (compared to the baseline period of 1986-2005), leading inundation to rise 0.6 m and last 0.5 days longer. As a result, the inundation of rice cultivation areas is expected to expand by 27% and the economic loss of rice production is expected to increase by 32%.

The method used in this study is a powerful tool for flood damage prediction under climate change impacts. It is expected to help better decision-making regarding the prevention of flood damage to agriculture.
RELATIONSHIPS BETWEEN GRID SAMPLING SPACING AND KRYING VARIANCE IN SOME GRASSLANDS OF IRELAND AND ITS IMPLICATIONS ON SOIL SAMPLING

Tuesday, 16th August - 17:15 - OS-7C.04 - GIS & Quantitative Methods B - Oral

Dr. Xiaolin Sun¹, Prof. Chaosheng Zhang²

¹Sun Yat-sen University, ²National University of Ireland, Galway

Sampling plays an important role in acquiring precise soil information which is pursued for modern agricultural production world-wide, because it determines both the cost and quality of final products. It had been proposed that the relationships between kriging variance and grid spacing from an area with existing information could be applied to estimate the grid spacing for sampling neighboring and similar areas in order to achieve desired soil prediction accuracy. However, this approach had never considered the issues of location-dependent soil variation and the parameter uncertainty. In order to investigate these issues in sampling design, this study established and compared the relationships between kriging variance and grid spacing in four grasslands of Ireland, taking into account of parameter uncertainty using the Monte Carlo Markov Chain (MCMC) approach. Results showed that relationships between kriging variance and grid spacing were not monotonic, but quite complicatedly related to study area and sample repeats. Actually, kriging variance was strongly correlated with sample variances. Moderate parameter uncertainty did not have much influences on the relationship between kriging variance and grid spacing, since the total kriging variance, i.e., mean kriging variance (MKV) plus prediction variance due to parameter uncertainty, varied with grid spacing in the same way to the MKV generated using a parameter set having maximum likelihoods. It was concluded that it is still challenging to apply the relationships between kriging variance and grid spacing built on one area to another area to attain desired kriging variance.
MOLECULAR AND CHEMICAL ECOLOGY OF INTERTIDAL SAND-DWELLING PROTISTS IN THE NORTHWEST OF IRELAND USING A GIS-BASED SAMPLING STRATEGY

Tuesday, 16th August - 17:15 - OS-7C.05 - GIS & Quantitative Methods B - Oral

Mr. Henry Koehler

1Institute of Technology Sligo / CERIS (Center for Environmental Research Innovation and Sustainability)

Eutrophication in coastal waters has increased in the last decades around the globe owing to growing human populations in coastal areas and the development of industrial and agricultural activities. The EU - Water Framework Directive (WFD) introduced in 2000 set out measures to improve the quality of all water bodies by 2015. Phytoplankton diversity is considered a suitable biological indicator to determine the trophic state of coastal waters.

This study focuses on intertidal sand-dwelling protists (protozoa and microalgae) in northwest Irish beaches. A stratified simple semi-random sampling strategy based on GIS analysis of a 2km buffer zone along the northwest/west coast of Ireland was used for the selection of coastal sites to sample. The typology of 50 coastal spatial units was described based on topographical and land cover parameters following GIS analysis in ArcMap Version 10.2.2 (ESRI) of publicly available database sets. Similarity analysis was then applied to build clusters of spatial units to define the sampling effort.

The well-established molecular method PCR-DGGE (Polymerase Chain Reaction – Denaturant Gradient Electrophoresis) and HPLC-based pigment analysis were used to investigate the community structure of microphytobenthos (benthic protists) in intertidal sediments at various sampling sites. The molecular data generated will provide the foundations for the future ecological mapping of particular benthic protists species, population and/or communities. It is anticipated that the results obtained on benthic protist community diversity could permit the development of a new environmental quality index that could be incorporated in the future to extent monitoring programmes.
KEYNOTE AN OVERVIEW OF MERCURY POLLUTION IN CHINA

Prof. Xinbin Feng¹, Dr. Xuewu Fu², Prof. Guangle Qiu², Prof. Hua Zhang², Dr. Ping Li²

¹State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry, Chinese Academy of Sciences, ²Institute of Geochemistry, CAS

China is the largest mercury producing, consumption and emission country over the global due to rapid economy development during the last decades. We have conducted intensive monitoring of mercury distribution and deposition in ambient air in remote areas across mainland China since 2007. Our data showed that total gaseous mercury concentrations in ambient air in China are generally elevated compared to the global background values measured at remote sites in Europe and North America as a result of large manmade Hg emissions. However, our studies showed that fish in China generally contained low levels of mercury. Because almost all fish in Chinese market are aquaculture production and these fish are growing very fast, the effect of bioaccumulation and biomagnification of methylmercury in fish body will not be significant so that mercury concentrations in fish are very low. As a result, mercury exposure levels to Chinese people from fish eating are very low. Our studies showed that at mercury contaminated sites such as mercury mining areas, the surface environment compartments are seriously contaminated with mercury. We found that rice has a strong ability to accumulate MeHg and rice consumption constitutes health risk of MeHg exposure to local inhabitants in mercury mining areas. Therefore, the increasing Hg deposition from air in mainland China may increase MeHg concentrations in rice, which may pose potential health risk for general population in China as rice is the staple food for a large population in China.
ISOTOPIC COMPOSITION FOR SOURCE APPOINTMENT OF MERCURY IN PM2.5

Tuesday, 16th August - 17:15 - OS-7D.02 - Mercury & Other Pollutants - Oral

Prof. Jiubin Chen¹, Dr. Qiang Huang², Prof. Pingqing Fu³, Prof. Xinbin Feng²

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Previous studies have reported mass-dependent fractionation (MDF) and mass-independent fractionation (MIF, for both odd isotopes (odd-MIF) and even isotopes (even-MIF)) of mercury (Hg) isotopes in natural samples, and demonstrated the potential of Hg isotopes for studying the biogeochemical cycle of Hg. However, the usefulness of Hg isotopes for tracing the sources and pathways of Hg (and its vectors) in atmospheric fine particles (PM2.5) has not been tested.

In this study, we measured Hg isotope ratios of 30 potential source materials and 23 PM2.5 samples collected in four seasons from the center of the largest and most populated City Beijing in China, with a goal of tracing the possible sources of Hg (and the relative particles) by coupling Hg isotopic compositions with geochemical parameters and meteorological data. All PM2.5 samples displayed clear seasonal variations of both Hg isotopic compositions and elemental concentrations. This seasonal variation was likely caused by variable contributions of potential sources, with continuous industrial input in four seasons, while dominated impact of coal combustion in winter and significant contribution from biomass burning in autumn. The long-range transport was also a contributor to PM2.5-Hg, which explained the relatively higher odd-MIF particularly found in Spring and early Summer. Our study demonstrates Hg isotope approach is a powerful tool for tracing the sources (and pathways) of Hg and its vectors in the atmosphere, and stresses the importance of studying toxic metals such as Hg (and other heavy metals) in atmospheric particles and their potential threat to human health during hazes episodes.
APPLYING DIFFERENTIAL ION-MOBILITY SPECTROMETRY TO IMPROVE LC-MS/MS ANALYSIS OF EMERGING ORGANIC CONTAMINANTS

Tuesday, 16th August - 17:15 - OS-7D.03 - Mercury & Other Pollutants - Oral

Dr. Chunyan Hao

1Laboratory Services Branch, Ontario Ministry of the Environment and Climate Change

Importance of the work and objectives: Perfluoroalkyl acids and nonylphenol ethoxylates are widely used surfactants in various products that may cause potential adverse effects in the environment. Neonicotinoids have been investigated recently due to their possible link to bee colony collapse disorder. These compounds are organic contaminants of emerging concern and reliable analytical methods are critically needed for different environmental matrices to fully understand their distribution, fate, exposure and impacts.

Methodologies: Samples were analyzed using a liquid chromatograph-tandem mass spectrometer (LC-MS/MS) modified with differential ion-mobility on a SCIEX QTRAP® 5500 or 6500 mass spectrometer system equipped with a SelexION® cell to remove or reduce the isobar interference and noise by permitting only ions with specific mobility through to the MS/MS detector.

Main results: False positive results for perfluorobutane sulfonate (PFBS) in mussels and perfluoropentanoic acid (PFPeA) in fish samples were eliminated by ion-mobility. The interference for imidacloprid from soil and pollen sample matrices was significantly reduced. An interference for nonylphenol monoethoxylate from the analytical instrument itself is currently being investigated.

Conclusion: The results demonstrated that ion-mobility is an effective tool to minimize chemical background and isobaric interference for emerging organic contaminants. It is a great alternative to reduce time-consuming sample cleanup and LC method re-optimisation efforts for complex matrices such as biota, soil and pollen.
CHANGES IN THE METAL MOBILITY AFTER REPEATED PHYTOEXTRACTION BY CD/ZN HYPERACCUMULATOR SEDUM PLUMBIZINCICOLA

Tuesday, 16th August - 17:15 - OS-7D.04 - Mercury & Other Pollutants - Oral

Prof. Longhua Wu¹, Dr. Wuxin Liu¹

¹Key Laboratory of Soil Environment and Pollution Remediation, Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, China

Phytoextraction is one of the most promising technologies for remediation of agricultural soils contaminated by heavy metal. Information of metal mobility changes during the phytoextraction process is helpful for understanding the mechanisms of phytoremediation. Changes in metal mobility in the low and high level metal contaminated soils after phytoextraction by the Cd/Zn hyperaccumulator Sedum plumbizincicola were investigated. Kinetic extraction with EDTA was applied to assess heavy metal (Zn, Cd, Cu and Pb) mobilization and the two first-order reactions model was used to fit the heavy metal extraction data, which distinguished soil heavy metal into three fractions: readily labile (QM1), less labile (QM2) and non-labile (QM3). The results show that non-labile metals were the dominant fraction with the exception of Cd in low level polluted soil, and the readily metal predominated in high level polluted soil. Compared with the metal in contaminated soils without phytoextraction, the labile Zn and Cd (QM1 + QM2) in the soils with repeated phytoextraction by S. plumbizincicola decreased significantly, but the labile Cu and Pb (non-accumulated metals by S. plumbizincicola) were increased. In both contaminated soils, the readily labile fractions of Zn and Cd decreased markedly after repeated phytoextraction, but the readily labile Cu and Pb increased significantly. Besides, the non-labile of Zn, Cd, Cu and Pb decreased greatly in both contaminated soils after repeated phytoextraction. These results indicated repeated phytoextraction could decline the mobility of plant accumulated metal and transform non-labile metal to labile fractions, but increase the plant non-accumulated metal mobility.
KEYNOTE: ASSESSING ANTHROPOGENIC IMPACTS ON URBAN ENVIRONMENTS IN THE UK THROUGH SOIL GEOCHEMISTRY

Wednesday, 17th August - 09:00 - KN-S1.01 - Keynote Speech AM 1 & 2 - Keynote

Dr. Mark Cave¹, Dr. Joanna Wragg¹, Prof. Chaosheng Zhang², Mr. Robert Lister¹

¹British Geological Survey, ²National University of Ireland, Galway

Urban inhabitants account for over half of the world’s population, increasing annually by ca. 2%, it is expected that more than 2 billion people will join the current urban population over the next 30 years. Multiple global organisations recognise the importance of the urban environment to human health, attributing an estimated 20% of all deaths in the European region to urban dwelling.

Urban pollution has a detrimental impact on soil chemistry with many cities suffering from poor soil quality. Urban populations are exposed to soil through re-suspension of dusts into the air column, back tracking of soils into homes, hand to mouth contact in gardens/ allotments/play areas and consumption of home-grown vegetables.

In 1993, the Geochemical Baseline Survey Of The Environment (G-BASE) rural geochemical mapping programme was extended to include sampling in urban areas and to date around 22 urban centers have been sampled including a detailed survey of over 6000 soils from London. Data is available on key inorganic contaminants including Cr, Cu, Cd, Ni, As, Pb, Zn, Sn and Sb.

A source apportionment approach has been applied to a number of cities including London, Nottingham, Leicester and Derby which has resulted in a quantified identification and separation of anthropogenic inputs from the underlying geogenic sources. A comparison of the chemical composition of these sources from the different cities has been linked to current and historical industrial use. The results of a preliminary investigation of the effect of soil geochemistry on the human deprivation will be reported.
KEYNOTE SMART BIOCHAR TECHNOLOGY - A SHIFTING PARADIGM TOWARDS ADVANCED MATERIALS AND HEALTHCARE RESEARCH

Prof. Yong Sik Ok

1Korea Biochar Research Center, Kangwon National University (KNU), Chuncheon 24341, Korea

Biochar, produced through pyrolysis of biomass under low or no oxygen conditions, has found a wide range of applications from soil fertility improvement to removal of contaminants. Initial interest in biochar is to use it as a means to capture carbon dioxide from the atmosphere; however, recent developments are seeing biochar being applied in engineering, and health care and life sciences, some of those applications have large potentials for rapid commercialization. We expect a paradigm shift towards the development of the next generation of biochar with applications in a range of new fields. This work was supported by the National Research Foundation of Korea (NRF) (NRF-2015R1A2A2A11001432).
KEYNOTE: PHOTO-INDUCED TOXICITY AND PHOTOCHEMICAL TRANSFORMATION MECHANISM OF POLYCYCLIC MUSKS: EXPERIMENTAL AND THEORETICAL STUDIES ON TONALIDE

Dr. Yanpeng Gao\textsuperscript{1}, Prof. Guiying Li\textsuperscript{2}, Dr. Yuemeng Ji\textsuperscript{2}, Prof. Taicheng An\textsuperscript{3}

\textsuperscript{1}Guangzhou Institute of Geochemistry, CAS, Guangzhou 510640, China, \textsuperscript{2}Institute of Environmental Health and Pollution Control and School of Environmental Science and Engineering, Guangdong University of Technology, Guangzhou 510006, China, \textsuperscript{3}Guangzhou Institute of Geochemistry, CAS, Guangzhou 510640, China; Institute of Environmental Health and Pollution Control and School of Environmental Science and Engineering, Guangdong University of Technology, Guangzhou 510006, China

Polycyclic musks (PCMs), widely used as fragrance in cosmetics and household commodities, and they would be easily left over on the surface of skin and might be harmful to human beings through photo-induced reaction. Moreover, the unabsorbed PCMs would be washed down the drain, eventually entering into aquatic environment. Once released into aquatic environment, PCMs may photo-chemically transform into other products, resulting in potential adverse impacts on aquatic ecosystems. Thus, photochemical processes of PCMs would impose risks to human beings and aquatic organisms.

This talk will focus on the two important photochemical processes of PCMs: (a): The photo-induced damage of amino acids using PCMs as photosensitizer during normal usage; (b): \textbullet OH-initiated indirect photochemical transformation of PCMs in both non-aqueous and aqueous solutions, due to hydrophobic properties of PCMs. Tonalide is selected as typical PCMs to elucidated transformation mechanisms, and the results show tonalide can initiate the photo-transformation of amino acids indeed, finally resulting in the damages to proteins and cells. The formed reactive species, \textbullet O and 1O2, could result in common and exceptional pathways of photosensitized transformation of amino acids. In aquatic ecosystems, tonalide also can be degraded by \textbullet OH via \textbullet OH-addition and H-abstraction pathways. The reaction rate constant in aqueous environment is 2 times faster than that in non-aqueous environment. Compared with original tonalide, all H-abstraction products was found to be declined bioaccumulation and aquatic toxicity, while \textbullet OH-addition products are more bioaccumulative and harmful to aquatic organisms. Therefore, particular attentions should be paid to PCMs and their transformation intermediates.
KEYNOTE HEALTH EFFECTS OF NATURAL DUST - 
DEFINING THE RISK FROM A CHEMICAL, MEDICAL 
GEOLOGY AND ENVIRONMENTAL PATHOLOGY 
PERSPECTIVE

Wednesday, 17th August - 10:00 - KN-1A.02 - Keynote Session 1 - Keynote

Dr. Jose Centeno¹

¹U.S Food and Drug Administration

The total aerosol load in the atmosphere as well as their chemistry and microbiological composition, have been shown to be strongly influenced by presiding climate systems and presence of dry land areas (deserts) and industrialized areas. Hence, natural dust is a form of geologic emission, arising from arid land areas, or from any human activity disturbing the earth’s surface such as mining, agriculture, construction, etc. Health effects from exposure to particulate matter have been widely described in the medical respiratory diseases literature. Direct contact with potentially harmful inhaled particles and the fine, fragile airways contributes to making the respiratory system a major target for dust and toxic agents. But toxic agents carried by dust can also exert adverse effects in other parts of the body as they are dissolved in the lung and absorbed into the blood stream. It is not only the inhalation pathway that needs to be considered, but also the increased exposure from dust deposition on edible crops and in drinking water sources. Thus, in order to set up preventive measures and regulations for dust levels to ensure public health, it is critical to gain knowledge about the potential health effects of environmental dust exposure. Geological information on dust sources, processes that affect mobilization, and transport of dust, as well as toxicological information on the effects and pathways of dust particles through respiratory organs are needed. This presentation stresses the global scale of the problem, in terms of its environmental, chemical, medical geology, and human health implications.
Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.

Responding to such a broad array of risks, acute and chronic, manmade and natural relies upon robust evidence and research that can inform public policy, decision making and regulation.

This session will highlight the health and well being context of:

- Sustainable communities/organisations
- Human biomonitoring approaches including exposomics
- Case studies on responses to public health or environmental health incidents /emergencies
KEYNOTE DIFFUSE POLLUTION FROM AGRICULTURE: THE PHOSPHORUS STORY AND HOW IT GOT COMPLICATED

Wednesday, 17th August - 10:00 - OS-8B.01 - Agriculture - Keynote

Dr. Karen Daly¹
¹Teagasc

Diffuse pollution from agriculture has focussed on phosphorus (P) transfer from land to aquatic environments. Research on P loss has typically focussed on understanding the sources and pathways of P loss to water and the P transfer continuum provided a conceptual model of P loss to guide research and emphasised the complex, inter-disciplinary nature of the problem. Whilst current policy instruments in water quality (EU Water framework Directive, WFD), seek to derive measures for agriculture, policy makers need to be mindful of the complexities that a variable biochemical and physical landscape brings. Pre-WFD research on P loss from agriculture assumed a direct and linear relationship between P in soil and potential losses to water and these results formulated the basis for our current restrictions on P usage on farms in Ireland and across EU. Post-WFD, we now know that these relationships are not linear, and that confounding factors such as lag times for nutrient transfer, nutrient attenuation in the landscape and hydrological connectivity create a complex biogeophysical setting upon which policy makers are expected to impose mitigation measures and risk assessment. In this paper, we document the significant components of diffuse pollution research during the past 20 years that shaped our understanding of P loss from agriculture, and we identify current research and knowledge gaps that present challenges for policy makers and practitioners, as the EU WFD moves into the second cycle to devise programmes of measures.
PHOSPHORUS FLOW PATTERNS IN THE CHAOHU WATERSHED FROM 1978 TO 2012

Wednesday, 17th August - 10:00 - OS-8B.02 - Agriculture - Oral

Mr. Songyan Jiang¹, Prof. Zengwei Yuan¹

¹State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University

Understanding historical patterns of phosphorus (P) cycling is critical for sustainable P management and eutrophication mitigation in watersheds. This study built a bottom-up model using the substance flow analysis approach to quantify P cycling in the Chaohu watershed during 1978−2012. We found that P flows have been intensified, with a 5-fold increase of annual P inputs to sustain the expanding intensive agriculture. Annually, most P inputs (75%) were stored within the watershed, which caused accelerating buildup of legacy P in cultivated land (from 4.9 Gg to 6.5 × 10² Gg), uncultivated land (from 2.1 Gg to 1.3 × 10² Gg) and surface water (from 3.7 Gg to 2.6 × 10² Gg) during 1978−2012. The main legacy P sources include fertilizer application for cultivated land, phosphogypsum abandonment for uncultivated land, respectively. The animal husbandry contributed about 63−66% of total P inputs to surface water. The contribution of animal food-P increased greatly during 1978−2012, from 7% to 24% and from 1% to 8% for urban and rural residents, respectively. This work demonstrates principle for the buildup of legacy P at the watershed-scale, and advances the knowledge of sustainable P management, such as improving agricultural technologies to reduce fertilizer application.
EVALUATION OF ALLOCATION METHODS FOR CALCULATION OF CARBON FOOTPRINT OF GRASS-BASED DAIRY PRODUCTION

Wednesday, 17th August - 10:00 - OS-8B.03 - Agriculture - Oral

Mr. Paul Rice¹, Dr. Donal O’Brien², Dr. Laurence Shalloo², Prof. Nick Holden³

¹University College Dublin; Teagasc, Moorepark, ²Teagasc, Moorepark, ³University College Dublin

Allocation is a major methodological issue for life cycle assessment (LCA), which is commonly used to quantify greenhouse gas (GHG) emissions from livestock systems. When a process produces multiple outputs, the environmental burden has to be shared between the outputs, such as milk and liveweight from a dairy herd. Standards and Guidelines provide different recommendations but there is no objective function for choosing the best method. This study evaluated 7 allocation methods to calculate the global warming potential (GWP) of the economically average dairy farm in Ireland considering both milk and liveweight. The allocation methods were: economic, energy, protein, emergy, mass (liveweight), mass (carcass) and physical causality. System expansion was also assessed using an ‘avoided burden’ approach. The data quality for each method determined using a pedigree matrix of reliability, completeness, temporal applicability, geographical alignment and technological appropriateness. Scenario analysis was used to compare the normalised impact calculated by the different allocation methods for the best and worst third of farms (economically). For the average farm, GWP / FU ranged from 0.75 to 1.22 kg CO2-eq/kg FPC milk. Pedigree scores ranged from 6.0 to 15.9 with economic allocation and protein content having the best pedigree. The choice of allocation method should be based on the quality of the data available, but a range of allocation methods should be used to understand the uncertainty of the outcome.
Iodine is an essential element for humans and animals and, consequently, there is major interest in its geochemistry. The key component in the geochemical cycle of iodine is its volatility. The oceans represent the most important reservoir in the global iodine cycle, it being volatilised from the marine environment as a series of iodo-organic compounds together with elemental iodine, both of which are derived from biological and inorganic sources. Marine-derived iodine is the most important source of this element in the terrestrial environment. However, determination of iodine in soils has demonstrated that the major marine influence stretches to only 80 km from the coast. Elevated concentrations of atmospheric iodine in inland areas highlights the importance of its volatilisation from the terrestrial environment. Volatilisation of iodine has been shown to occur in soils, most particularly from waterlogged soils and wetlands, with much of the iodine emitted as CH3I, which is derived from microbial action. Higher plants have also been found to emit CH3I, possibly as a detoxification mechanism.

It has been found that emissions from iodine-rich marshy areas in the English Fenlands of the UK enrich iodine in soils up to 40 km from the source, thus demonstrating that terrestrially-derived iodine can be a significant source of that element in soils and, potentially, the biosphere.
KEYNOTE WASTE RECYCLING AND SECONDARY MATERIALS, ARE ENVIRONMENTAL AND HEALTH CRITERIA ENOUGH?

Dr. Job Spijker\textsuperscript{1}

\textsuperscript{1}RIVM National Institute for Public Health and the Environment

The world population is expected to increase to over 9.3 billion by 2050. Together with this increase, an increase of people entering the ‘middle class’ and adopting Western lifestyles occurs. The high material and energy consumption of the middle class is based on the paradigm of abundance of resources. However, this high demand for materials and energy is simply not feasible.

The concept of the Circular Economy, embraced by the European Union, is based on an industrial economic system where materials are circulated without becoming waste. In the Circular Economy closing the loop can be challenging. Technological advancements and innovation can make it possible to close material loops already. However, this closing of loops is hampered due to current waste streams containing substances which are potentially harmful for human health and the environment.

In the Netherlands waste from construction demolition is generally reused. For stony materials recycling rates close to 100\% are achieved. Policy regulations ensure that the application of the recycled materials is safe, based on an environmental impact assessment. At the Dutch National Institute for Public Health and the Environment (RIVM) we used the policy model of construction demolition to study how policy measures can promote the safe reuse of other materials like wastewater, electronic waste, plastics, rubber tires, and diapers (nappies). The results show that environmental assessment of effects is not enough. Public perception, life cycle analysis, subsequent life cycles, are examples of factors which should also be taken into account.
KEYNOTE ENGINEERED NANO-PARTICLES: WHAT DO WE KNOW ABOUT RISKS TO ENVIRONMENT AND HEALTH?

Wednesday, 17th August - 11:45 - KN-2A.03 - Keynote Session 2 - Keynote

Prof. Martin Cormican¹, Dr. Dearbhaile Morris¹

¹National University of Ireland, Galway

Engineered nano-particles (ENP) are have applications in industrial domestic and other sectors. Significant benefits are claimed for their use however there are concerns regarding potential for unwanted impacts on human health and the environment. It is difficult to evaluate the potential risk because there is so little data on which to base a risk assessment. Although there is a online database (http://www.nanotechproject.org/cpi/) documenting more than 1600 nanotechnology based consumer products this may not be comprehensive and the total quantity of each ENP’s is uncertain. Thus it is difficult to predict likely environmental discharges. There is inadequate data on persistence/transformation in the environment and such parameters are likely to vary with the nature of the ENP and its application. There is no consensus regarding optimal methods for detection of ENP’s in the environment therefore we cannot consistently measure the extent to which they are distributed in aquatic and other environments and to what extent they persist or undergo transformation. The potential ecotoxicology and health impacts of ENP’s is largely unknown. An understanding of the ecological and health effects of ENP’s must seek to unravel impact related to the material of which the ENP is made (e.g. silver) and any modification (enhanced or reduced) of the effects of the substance related to the engineered structure. The available data on ENPs in the environment was reviewed and is presented in the context of a the DeTER project which seeks to contribute to these questions in the first instance in relation to silver ENP’s.
KEYNOTE MEDICAL GEOLOGY: A CLASSIC EXAMPLE OF ENVIRONMENTAL INJUSTICE

Wednesday, 17th August - 11:45 - OS-9B.01 - Medical Geology - Keynote

Dr. Robert Finkelman¹
¹University of Texas at Dallas

Environmental Justice is defined as the fair treatment of all people regardless of race, national origin, or income level with respect to environmental laws and regulations and their enforcement. Unfortunately, Environmental Injustice is all too common. This is particularly true when it comes to the health impacts of minerals, trace elements, naturally occurring organic compounds, and radioactivity. Most of the severe medical geology health problems afflict people who live in constant contact with the natural environment. A major reason for this disparity is that those people who are affected most by the mobilization of trace elements, minerals, and organic compounds are generally poor, live in rural communities, and are politically weak. Thus, the situation is a classic example of environmental injustice. Examples include: communities living above and near active burning coal seams in Jharia, India; people drinking water that has leached organic compounds from lignite aquifers; villagers in China suffering from exposure to arsenic, fluorine, selenium, and quartz mobilized from domestic coal combustion; and respiratory problems in South African Townships and Native American reservations burning coal indoors. Scientists have an opportunity, if not an obligation, to help protect the health of these disadvantaged people. This can be accomplished by: generating data bases containing accurate and comprehensive analytical data; conducting collaborative research on the health impacts of geogenic material; disseminating the data to public health agencies, to government decision makers at every level, to citizen’s advocacy organizations; and providing appropriate information to the people most likely affected by geogenic materials.
LONG TERM TRENDS IN NITRATE IN DANISH GROUNDWATER DURING THE LAST 70 YEARS

Wednesday, 17th August - 11:45 - OS-9B.02 - Medical Geology - Oral

Dr. Birgitte Hansen¹, Dr. Lærke Thorling¹, Prof. Tommy Dalgaard²

¹Geological Survey of Denmark and Greenland (GEUS), ²Department of Agroecology, Aarhus University

The Danish water supply is solely based on simple treated groundwater, and protection of groundwater has therefore a high priority. At the same time, Danish farming is among the most intensive in the world threatening the groundwater resources in regard to e.g. nitrate leaching. Numerous waterworks and wells have been closed due to nitrate pollution, and approximately 15% of the area of Denmark has been classified as nitrate vulnerable groundwater abstraction areas.

Since the 1980s, regulations implemented by Danish farmers have succeeded in optimizing the nitrogen (N) management at farm level. The N-surplus (N-output/N-input) has significantly been reduced, the farming N-efficiency has increased, and the N losses to the aquatic and atmospheric environment have been significantly reduced. Accordingly, since the 1980s the overall national upward trend of the nitrate concentrations in oxic groundwater has been reversed. Locally, nitrate trend analyses in monitoring wells have shown a more varied pattern with both upward and downward nitrate trends depending on the age of the groundwater and local agro-hydro-geochemical conditions. Therefore local groundwater protection action plans are being carried out in order to further protect drinking water resources from nitrate pollution.

Strong correlations between nitrate response in oxic groundwater to nitrogen management in Danish agriculture since the 1940’es will be presented.
Trace element contents in clay-balls intentionally ingested by geophagia practitioners in Ghana were studied. Ten samples of 100 g weight were sub sampled from 1400 g. The remaining 400 g samples were kept as library samples. Trace element contents in the clay-balls were determined by X-ray fluorescence technique. Results indicated clay-balls eating to prevent diseases contain toxic trace elements arsenic (As), chromium (Cr), cobalt (Co), Cs, Zr and La that are hazardous to health. It was concluded that geophagy clay originating from Ashanti, Upper East and Volta regions that are widely sold on markets in Ghana could have potentially negative health impact on consumers if consumed at 70g per day or more and on regular basis. Investigations to know the contained elemental concentrations to guide the daily dose rate will make geophagia attractive and risk free from the undesirable non-essential trace elements.
AFRICA: A NATURAL LABORATORY FOR MEDICAL GEOLOGY STUDIES

Prof. Hassina Mouri

1 university of johannesburg

Although there is a growing development of Medical Geology in the world, it is in Africa that application of research results would be most relevant. However, it is in Africa that the field is least developed.

African continent is characterised by a complex and dynamic geological history including frequent earthquakes, volcanic activities in tectonically active regions, pervasive dust, water toxicity due to interaction with the geological environment etc..etc. All these naturally occurring process and material could have short and long term impact on humans and animals health. In addition most of the population in Africa live close to the land, relying on locally produced food and water, and that large tracts of cultivated land are arid, semi-arid, or lack essential trace elements for healthy plant growth.

Therefore, considering the significance of the health problems possibly related to the naturally occurring geological issues on the African continent in general, we strongly believe that it is necessary to develop this discipline. This would lead to broadening our understanding of the diagnostic spectrum as well as therapy for many geological related health issues and thus improve life quality on the African continent.

In this presentation, we will present some examples of naturally occurring geological process and materials, which might be the cause of a number of health issues occurring in Africa such as some types of cancer, thyroid issues, fluorosis, silicosis...etc.
KEYNOTE: GEOCHEMISTRY AND SCALE

Wednesday, 17th August - 14:30 - KN-S2.01 - Keynote Speech PM 1 & 2 - Keynote

Dr. Clemens Reimann¹, Dr. Karl Fabian²
¹EuroGeoSurveys, ²Geological Survey of Norway

Geochemists at the Geological Surveys of Europe are since over 60 years mapping Europe at a large variety of scales – from hundreds of samples per km2 for mineral exploration projects, 1 to 4 sites per km2 in urban geochemistry, 1 site per 2 to 10 km2 in country-wide mapping projects to 1 site per 2500 to 5000 km2 for mapping the continent. Such surveys provide ample empirical evidence that different geochemical processes become visible at different scales. Not all sample materials are suitable for all scales. A variety of scales in combination with a variety of different sample materials are needed to fully understand geochemical processes in the critical zone.

Examples are shown that highlight the importance of a strategy to optimize sampling density and design for the chosen scale already during the planning stages of a project. Anthropogenic element sources are visible at a local scale and the major impact of geology, mineralogy and climate (as a driving force for weathering) dominates geochemical maps at the continental scale. Interestingly, mineralization can generate features which are visible at a variety of scales.

Some further issues that need attention when carrying out geochemical surveys at a variety of scales are (a) the need for an excellent and well documented analytical quality control, (b) the choice of the elements to be analyzed (as many as possible) (c) the required detection limits (the lowest possible) and (d) the choice of extraction (several if feasible).
Rapid economic development and increasing personal income over the last three decades has been leading to perhaps one of the most significant changes in food patterns in Chinese population in human history. Food ingestion is a major route for human exposure and body burden to dioxins. We estimated the potential influence of changes in dietary patterns in Chinese population on human health risk to 2,3,7,8-TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) over the last three decades. We performed multiple modeling scenario investigations to discriminate the contribution of 2,3,7,8-TCDD emissions and changes in dietary patterns to the cancer risks (CR) to dioxins. Results showed that changes in dietary patterns and structure, featured by decreasing consumption of total grain (including all unprocessed grains) and vegetables and increasing intake of animal-derived foodstuffs, caused increasing CR from $7.3 \times 10^{-8}$ in 1980 to $1.1 \times 10^{-7}$ in 2009. Varying dietary patterns contributed 17% to the CR of Chinese population in 2009 under the fixed emission in 1980. The CR to 2,3,7,8-TCDD in urban and eastern China residents was higher considerably than those who lived in rural area and western China, attributable to higher emissions, household income, and greater intake of animal-derived foodstuffs in urban and eastern China inhabitants. On the other hand, more rapid increasing trend of the cancer risk was found in rural residents due to their more rapid increase in the consumption of fat-dominated foods as compared with urban residents.
Analytical and sampling techniques capable of detecting engineered nanomaterials are needed, due to concern about their potential release into the environment, and concern about worker exposures during manufacturing and handling processes. This presentation describes the use of catalysts and other metal impurities in carbon nanotubes (CNT) as tracers for monitoring CNT releases. Selection of an appropriate CNT tracer requires knowledge of the metal impurities in the CNT material being handled, and knowledge of potential interferences from background sources. The most common catalyst elements are transition metals, such as Fe, Ni, Mo, Y, Co, Cu, and Cr, but other elements may occur as trace impurities in CNTs. The impurities that are most likely to be useful tracers are those that exist as trace elements in the environment (low mg/kg range), but are elevated in the CNTs (1000 mg/kg and higher). ICP-MS has the sensitivity required to determine metal impurities in CNTs, and is also suitable for analysis of sample substrates (e.g., air filters, surface wipes) commonly used for workplace monitoring. Useful geochemical approaches include spatial concentration mapping and interpretation of elemental and/or isotopic signatures. These well-established geochemical tools can assist in identifying CNT releases in indoor and outdoor environments, monitoring the effectiveness of control measures, and distinguishing released CNTs from background particles.
KEYNOTE DYNAMIC PHOSPHORUS CYCLING PATTERNS IN CHINA

Wednesday, 17th August - 15:30 - KN-3A.02 - Keynote Session 3 - Keynote

Prof. Zengwei Yuan¹

¹State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University

Phosphorus (P), an essential nutrient for living systems, has altered its biogeochemical cycle globally and is running out with no substitutes. Considering its temporal dynamics are still unclear, we quantify the P pathways across China over the last four centuries with a process-balanced model. We find that P cycles in China have been artificially intensified during this period to sustain the increasing populations, especially their demands for animal protein-based diets, with continuous accumulations in inland waters (from 0.44 to 1.57 Tg-P·yr⁻¹) and arable and non-arable lands (from -0.75 to 7.95 Tg-P·yr⁻¹). Although per capita food-P demand has not changed substantially, the contribution of crop products has reduced from over 98% before the 1950s to 76% in 2012. In the last decade, China’s international trade of P involves net exports of P chemicals and net imports of downstream crops, specifically the soybeans from the United States, Brazil and Argentina. Chinese domestic P reserve depletion can be postponed for over 20 years through the improvement of agronomic efficiency without decreasing the current crop yields, and other opportunities exist in the recycling of abundant P legacy in soils and ocean sediments. Our results advance the knowledge of closing P cycle to achieve the co-benefits of P resource conservation and eutrophication mitigation.
KEYNOTE INTEGRATING GEOSPATIAL REMOTE
AND IN-SITU SENSING: OPPORTUNITIES AND
CHALLENGES

Wednesday, 17th August - 15:30 - KN-3A.03 - Keynote Session 3 - Keynote

Dr. Margaret McCaul¹, Mr. Jack Barland¹, Mr. Eoghan McNamara¹, Mr. Peter McCluskey¹, Dr. Conor Cahalane², Dr. Tim McCarthy², Prof. Dermot Diamond¹

¹Insight Centre for Data Analytics, National Centre for Sensor Research, Dublin City University,
²National Centre for Geocomputation, National University of Ireland, Maynooth

Globally, the move towards services based on so-called ‘big data’ is, and will increasingly, profoundly affect the way in which every aspect of society functions. The environmental sector will be a major contributor to these changes, based on multi-modal information obtained from numerous sources. Critical to the creation of new services and related industries that will emerge from these trends will be access to high quality data that is essential for informed and accurate decision-making across agriculture and land use, optimised food production, management of water bodies, prediction of climatic events (e.g. flooding, droughts) and organisation of their subsequent management.

Two major sources of environmental information will be via remote sensing using satellite and flyovers (including drones), and in-situ distributed monitoring using sensor networks. In this paper, I will discuss the strengths and weaknesses of remote and in-situ sensing, and show how many of the weaknesses of each can be overcome by pooling the information from both sources, as this will enable the creation of a much more complete and robust picture of environmental status over time. Issues related to long-term in-situ chemical and biosensing will be discussed, along with the potential use of surrogate measurements to indicate the status of local chemistry/biology.
COUNTING THE COST OF A WATERBORNE OUTBREAK OF CRYPTOSPORIDIOSIS

Wednesday, 17th August - 15:30 - OS-10B.01 - Crypto Project Workshop - Oral

Dr. Dearbhaile Morris¹, Prof. Martin Cormican², Dr. Diarmuid O’Donavan³, Dr. Srinivas Raghavendra³, Dr. Martina Prendergast³, Mr. Aksana Chyzheuskaya³

¹National University of Ireland Galway, ²NUI, ³National University of Ireland, Galway

Cryptosporidium is a protozoan parasite that lives in the intestinal tract of infected humans and animals. It is shed in faeces, thereby contaminating waters and soils, and may be present in inadequately treated drinking water. Infection can be asymptomatic in some cases, but more frequently results in watery diarrhoea, stomach cramps, bloating, vomiting and fever. Although usually a self-limiting illness in otherwise healthy people, it may be associated with chronic gastrointestinal sequelae in some people and may be fatal for those with impaired immune function.

In March 2007, the largest outbreak of cryptosporidiosis since surveillance began in Ireland was identified, and was associated with contamination of the water supply serving Galway City and surrounding areas. The outbreak lasted for 5 months, by which time there were 242 confirmed cases of cryptosporidiosis, although it is likely that the actual number affected was far higher. A boil water notice was put in place for the duration of the outbreak affecting approximately 120,000 people living in the area, all of whom required an alternative water supply. The outbreak ended in August 2007 following major investments by local authorities in water treatment infrastructure and major disruption to residents and local businesses.

The aim of this research was to place a monetary value on the costs and inconveniences imposed by the 2007 Galway outbreak on the public, local businesses, the healthcare system, local authorities, national agencies, tourism and other water-dependent sectors. The research also examined the relationship between the investment needed to mitigate risk of contamination with Cryptosporidium and the benefits that would arise from such an investment.

This study represents the first of its kind in Ireland.

Key findings include:

1. The overall cost of the waterborne outbreak of cryptosporidiosis that occurred in Galway in 2007 was estimated to amount to €19 million or €120,000 per day of the outbreak.

2. The estimated total cost to households in the affected area was approximately €3.9 million. This translates into an average cost of almost €88 per household (or €0.55 per household per day of the outbreak) in the boil notice zone in 23 weeks (158 days) while the boil water notice was in effect.

3. The estimated cost to lodging and care businesses amounted to almost €8 million or €50,000 per day of the outbreak.

4. Almost €6 million of the total cost of the outbreak was the cost of mitigation actions by the local authorities. This includes €388,000 for the installation of a UV treatment facility that effectively inactivates Cryptosporidium oocysts in water, thus preventing waterborne transmission.

5. When the capital investment necessary to accommodate the installation of UV treatment system was taken into account, the total cost was €1,674,000. If we consider that this investment made prior to the outbreak would have prevented the outbreak, the potential saving per euro invested amounts to €11.
Research team: Professor Martin Cormican, Dr. Diarmuid O’Donovan, Dr. Srinivas Raghavendra, Dr. Martina Prendergast and Dr. Aksana Chyzheusakya

This academic workshop will involve

1. A 15 minute PowerPoint presentation by the PI (Dr Dearbhaile Morris) who led the research team to present the key findings of the research.

2. A Q&A-style session with the research team members for 30 mins about the rational for the study, work leading to the study proposal, and lessons learned from conducting the study.

3. A 20 mins general discussion on the recommendations arising from the research.

4. A 20 min networking session over tea/coffee between research team and delegates to discuss the possibilities of collaboration for future projects.
Abstracts for
Poster Presentations
A PRELIMINARY INVESTIGATION OF ARSENIC CONCENTRATION ON SURFACES OF CCA-TREATED WOOD PLANKS IN A PARK

PS.01 - Poster Session Available from 14th - 17th August - Poster

Prof. Chaosheng Zhang¹, Prof. Ya Tang², Prof. Shiming Ding³, Prof. Taicheng An⁴, Prof. Ming H. Wong⁵

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Wood preservatives can protect wood from dry rot, fungi, mold and insect damage, and chromated copper arsenate (CCA) has been used as an inorganic preservative for many years. A portable XRF analyser was used to investigate As concentration on surfaces of in-service CCA-treated wood planks in a popular park, as well as the influencing field factors of age in-service, immersion and human footfall. With a total of 1207 readings, the observed As concentrations varied from below the detection limit (<10 mg/kg) to 15746 mg/kg with a median of 1160 mg/kg. The oldest planks exhibited high As concentrations, which was related to its original treatment with high retention of CCA preservative. The effect of immersion in the field for about four months was insignificant for As concentration on the surfaces. However, a significant reduction of As was observed for immersion combined with human footfall. Human traffic in general caused slightly reduced and more evenly distributed As concentrations on the wood surfaces. The strong variation, slow aging and relatively weak immersion effects found in this study demonstrate that the in-service CCA-treated wood poses potential health risks to the park users, due to easy dermal contact especially when the wood is wet after rainfall. It is suggested that further comprehensive investigations and risk assessments of CCA-treated wood in residential areas in China are needed, and precautionary measures should be considered to reduce the potential risks to residents and visitors, especially children.
TOWARDS PRACTICAL APPLICATIONS OF MEASUREMENTS OF LABILE CHEMICALS IN THE ENVIRONMENT BASED ON A NOVEL PASSIVE SAMPLING TECHNIQUE

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The recent development of a passive sampling technology of diffusive gradients in thin films (DGT) is moving towards practical applications in measurements of liable/bioavailable chemicals in soils, waters, and sediments. This presentation provides a summary of the theory and development of a novel DGT variant using Zr-oxide based binding gels. The Zr-oxide DGT was developed in 2010. It has relatively high capacity for measurements of oxyanions (P, As, Cr, Se, Sb, Mo and W), with 50 and 5-29 times of those of the commonly used ferrihydrite DGT for measurements of P and As, respectively. It is easy to provide high-resolution (sub-millimetre), two-dimensional spatial information of P using a gel coloration procedure, while this technique has been successfully applied to in situ monitoring labile P in a large eutrophic Lake Taihu in China. Simultaneous measurements of cations and anions, such as P and S, P and Fe, As and Fe, and As, Fe and P, as well as multiple elements of P, As, Cr, Mo, Sb, Se, V, and W, have been successfully achieved through development of several types of mixed binding gels based on the Zr-oxide gel. The application of this technique is also effective to investigate the mechanisms of eutrophication in lakes, by providing high-resolution evidence for iron-coupled mobilization of phosphorus in sediments. Meanwhile, improvements have been made to modify the design of the DGT probes including a dual-mode holder and a new flat-type holder for easier practical applications in water/soils and sediments, respectively.
The spatial distribution patterns of phosphorus (P) concentration in soils of the London urban area was investigated based on 6467 samples from the London Earth soil geochemical survey of the Greater London area of British Geological Survey. Both the results of analysis of variance (ANOVA) and GIS mapping implied that the P distribution showed a strong geogenic control with elevated concentrations in areas of alluvium and river terrace deposits. The P distribution demonstrated strong association with riverine areas, especially accumulated along the River Thames, the River Lea and the Grand Union Canal. However, the P concentrations decreased dramatically below Woolwich Reach of Thames estuary where the soils were gradually dominated by bed-load transport from the sea. Besides the natural control, P soil content was also strongly impacted by human activities, including three main types of sources: sewage treatment works (STWs), septic tanks and agriculture. The optimized hot spot analysis showed that two STWs, Beddington and Deephams, had high concentrations where water flows often exceeded the capacity of the treatment plants during heavy rain events. The patterns shown by cluster and outlier analysis matched well with London population density. Heathrow airport, Stockley and Bexley heath Golf Course showed high levels of P. The spatial patterns of P controlled by parent material (PM) are still clearly seen even in the metropolitan urban area where anthropogenic activity is high. The identified P hotspots suggest places where attention needs to be paid to soil quality.

Key words: London; phosphorus; GIS; hotspots; sewage; Thames
USING GEOSTATISTICS AND LOCAL MORAN’S I TO IDENTIFY POLLUTION HOTSPOTS OF RARE EARTH ELEMENTS IN URBAN SOILS OF LONDON

PS.04 - Poster Session Available from 14th - 17th August - Poster

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Rare earth elements (REEs) in urban soils are receiving more attention because of their potential toxicity and long-term effects on human health. Up to now, there is little information about the spatial patterns of REEs and their influencing factors in urban soils. In this study, based on data from the British Geological Survey “London Earth” geochemical survey containing a total of 6468 soil samples collected from the urban area of London, the spatial distribution of Y, Yb, Sc, La, Ce, Sm and Nd, and the influencing factors were investigated. Spatial clusters and spatial outliers were classified using the index of local Moran’s I, showing elevated concentrations of REEs in the northwest, northeast and south parts of the study areas while all the 7 REEs exhibited generally similar spatial patterns: high values were mainly located in soil over Alluvium, Glacial till and Clay-with-flints deposit, demonstrating close relationships between REEs and the lithology. Meanwhile, hotspot analysis identified high values of REEs in public parks, private golf clubs, school playing fields and domestic gardens especially in Brent, Harrow, Croydon and Bromley. These areas are likely to arise from anthropogenic activities including the application of phosphate fertilisers. The hotspots of REEs revealed in urban soils may imply potential contamination requiring further attention.

Key words: Hotpots, Rare earth elements, Local Moran’s I, Urban soil
Spatial analyses play an important role in environmental studies by providing not only the mapping functions, but also analyses of the spatial patterns and influencing factors of environmental variables. This study investigates the associations between sources and their corresponding spatial patterns of Pb in soils at different spatial scales in Ireland: the national scale, a regional scale of Galway City, site scales of green areas of a roadside ground, a historical rubbish dumping site and a bonfire site. At the national scale, the spatial patterns of elevated concentrations of Pb in soils are in line with the locations of major urban areas and mining sites, affected by the anthropogenic sources of urbanization and mining activities. At the regional scale of Galway City, elevated concentrations of Pb is found in the city centre areas with high density of road network, related to the source of historical traffic emissions. Elevated Pb concentrations along the roadsides of a ground also showed the sources of historical traffic emissions. The rubbish dumping associated elevated Pb concentrations were located at areas where the rubbish was exposed in the air or the top soil cover was thin. The bonfire associated elevated Pb concentrations were found as scattered spatial outliers. Spatial patterns at large spatial scales are helpful for the identification of sources at large scales, and vise versa. Such associations between spatial patterns and sources of pollutants help to improve our knowledge of soil pollution processes and pollution management.
The identification of pollution hotspots is an important approach for a better understanding of spatial distribution patterns and the searching for influencing factors in environmental studies. One of the most often asked questions in an environmental investigation is: Where are the pollution hotspots? This presentation explains one of the popularly used methodologies called local index of spatial association (LISA) and its applications in urban geochemical studies in Galway, Ireland. The LISA is a useful tool for identifying pollution hotspots of Pb pollution in urban soils, and for classifying them into spatial clusters and spatial outliers. The results were affected by the definition of weight function, data transformation and existence of extreme values, and it is suggested that all these influencing factors should be considered until reasonable and reliable results are obtained. The LISA is also found useful in identifying polluted areas in bonfires sites. Soils with elevated metal concentrations, as evident from the spatial distribution maps, coincided with the locations of traditional festival bonfires. The results of hotspots analysis provide useful information for the management of urban soils.
SPATIAL ANALYSES IN ENVIRONMENTAL STUDIES: III. USE OF LOCAL STATISTICS TO REVEAL SPATIAL VARIATION AND SPATIALLY VARYING RELATIONSHIPS

PS.07 - Poster Session Available from 14th - 17th August - Poster

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It is always a challenge to reveal, quantify or visualize spatial variation properly. This presentation demonstrates the use of local statistics to quantify spatial variation and model spatially varying relationships. Based on a total of 6138 topsoil samples in Northern Ireland, neighbourhood statistics of local mean, local standard deviation and local coefficient of variation were calculated. The results showed that high local standard deviation values were found to be associated with high local mean values thereby limiting the usefulness of local standard deviation as an indicator of spatial variation. The strongest spatial variations were observed in areas with strong changes of rock type, e.g., on the western edge of the basalt area along the boundary of the basalt-sandstone areas and the schist area. Within each rock type, spatial variations were relatively weak and this was most clearly demonstrated in the basalt area. Another “local” statistical method of geographically weighted regression (GWR) was applied for the spatial modelling of SOC in Ireland. Based on a total of 1310 samples of SOC data, environmental factors of rainfall, land cover and soil type were investigated and included as the independent variables to establish the GWR model. SOC showed good spatially varying relationships with elevation. The SOC map produced using the GWR model showed clear spatial patterns influenced by environmental factors and the smoothing effect of spatial interpolation was reduced. These results demonstrate the potential uses of local statistics in revealing spatial variation and spatially varying relationships in environmental studies.
A HYBRID MODEL USING ARTIFICIAL NEURAL NETWORK, KRIGING, AND RESIDUAL KRIGING FOR FORECASTING THE ABNORMAL POLLUTANT DISTRIBUTION

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Forecasting of soil pollutants distribution is a significant field of research in view of the current concerns regarding environment all over the world. Increasing of emissions, particularly at urban locations, is an essential threat to habitat quality. In view of the health and environment hazards posed by increasing of soil pollution, it will be helpful to have a model, which is able to predict the distribution of contaminants and to forecast the pollutants over the analyzed domain. This paper presents a hybrid model using artificial neural networks, kriging and residual kriging to predict the abnormal distribution of a soil pollutant (Cr) comparing with the normally distributed element (Cu) at the particular location in subarctic Tarko-Sale, Russian Federation using data of the chemical analysis. The proposed model is developed, implemented and tested using ArcGIS; combining with the MLP developed in MATLAB. The network structure is selected individually for each element ((2-10-1) for Cr and (2-9-1) for Cu) during the computer simulation based on the minimization of the RMSE. The model consists of several steps: 1) comparing of kriging estimates and network ones; 2) building residues; 3) residual kriging and combination with ANN estimates. The work confirms that trained ANN is suitable for modeling both the normal and abnormal spatial distribution of pollutants. The prognostic accuracy of the ANN is higher than in geostatistical (kriging) and deterministic (IDW) methods. The hybrid model (ANN-kriging) allows improving the predictive accuracy of the model for the both simulated elements.
QUANTITATIVE ANALYSIS METHODS USED TO INVESTIGATE THE EFFECTS OF WEATHER AND CLIMATE ON INFECTIOUS DISEASES

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The potential impacts of climate change on infectious diseases are an increasingly important area of research. Climate change is likely to increase these risks associated with extreme temperatures and changing rainfall. We performed a systematic review of statistical and modelling analysis methods available to investigate the effects of weather/climate on water-associated diseases. We considered English language papers in the main databases. Search terms included: water-associated disease, weather/climate indicators, and methods used. 201 papers met our inclusion criteria. The most commonly used quantitative analysis methods can be grouped into three main clusters: process-based models (PBM); empirical statistical models (ESM); and spatial analysis and methods based on geographic information systems (GIS). PBM are applied when the bio-physical mechanism of the pathogen under study is relatively known (e.g. cholera); ESM and GIS tend to be used when the roles of specific environmental drivers are unclear. The most common limitations were: non-inclusion of key factors (e.g. biological mechanism, demographic heterogeneity, human behaviour) in the methods, reporting bias, poor data quality, and correlation among predictor variables. Methodologies often do not distinguish among the multiple sources of time-lags (e.g. patient’s physiology, reporting mechanisms) between environmental exposures and disease onset. The review identified important limitations, missed opportunities and knowledge gaps in the analysis of climate change and infectious disease associations. Key areas of future research include disentangling the complex effects of weather/climate on each exposure-health outcome pathway (e.g. person-to-person vs environment-to-person), linking weather data to individual cases longitudinally and distinguishing multiple sources of exposures at different time-lags.
The accumulation of a trace metal in rice grain is not only affected by the total concentration of the soil trace metal, but also by crop variety and related soil properties, such as soil pH, soil organic matter (SOM) and so on. However, these factors were seldom considered in previous studies on mapping the pollution risk of trace metals in paddy soil at a regional scale. In this study, the spatial nonstationary relationships between rice-Cr and a set of perceived soil properties (soil-Cr, soil pH and SOM) were explored in paddy fields in Jiaxing city, China, using geographically weighted regression; and the relationships were then used for calculating the critical threshold (CT) of soil-Cr concentration that may ensure the concentration of rice-Cr being below the permissible limit. The concept of “loading capacity” (LC) for Cr in paddy soil was then defined as the difference between the CT and the real concentration of Cr in paddy soil, so as to map the pollution risk of soil-Cr to rice grain and assess the risk areas in Jiaxing city, China. Compared with the information of the concentration of the total soil-Cr, such results are more valuable for spatial decision making in reducing the accumulation of rice-Cr at a regional scale.
BIOACCUMULATION AND DEGRADATION OF AMETRYN IN MEDICAGO SATIVA, RYEGRASS, WHEAT AND MAIZE

Ms. Ying Liu¹, Dr. Yi Chen Lu¹, Prof. Hong Yang¹
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Importance of the work and objectives:
Ametryn as a selective and uptake triazines herbicide is widely used for killing annual grasses and weeds in China and other countries. However, overuse of ametryn results in contamination to soil environment. The purpose of the study was to test the accumulation and degradation of ametryn in different plants (wheat, ryegrass, alfalfa and maize).

Methodologies:
Soil enzyme activities and the antioxidant and degradation enzyme activities in ryegrass tissues were determined by spectrophotometer. Ametryn and low molecular weight organic acids (LMWOAs) in plants and soil were quantified using HPLC.

Main results and conclusion:
When tested wheat, ryegrass, alfalfa and maize were exposed to ametryn concentrations at 1.0 mg kg⁻¹, wheat, alfalfa and maize had larger accumulation of ametryn than ryegrass, resulting in pesticide concentration in plants. The lowest ametryn residue was found in soil planted with ryegrass and ryegrass accumulated lowest amount of ametryn. Ryegrass had the highest value of translocation factor (TF) and the strong capacity of phytoextraction from soil contaminated ametryn. The activities of CAT, GST and LAC in ametryn-exposed ryegrass tissues were significantly increased in free-ametryn ryegrass tissues. The activities of soil enzymes in soil contaminated ametryn were affected by planted different plants. The content of malonic acid, citric acid and malic acid in soil planted with wheat were highest. Above the result showed that ryegrass had a potential ability removing ametryn from contaminated soil, which may permit to develop ryegrass-based clearing-up systems for bioremediation of herbicide-contaminated soil environment.
DIRECT AVAILABILITY AND GEOCHEMICAL REACTIVITY OF ZN IN AN AGRICULTURAL SOIL AMENDED WITH ZNO NANOPARTICLES OR ZNCL2

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Zinc is an essential micronutrient for plants and it is often applied to zinc-deficient soils to increase crop yields. Recent studies suggest that nanoparticles (NPs) of ZnO have the potential for delivering Zn via soil in a more efficient manner than conventional fertilisers (containing e.g. ZnCl2 or ZnSO4.7H2O). However, the fate of ZnONPs in soil is not fully understood.

To compare the direct availability and geochemical reactivity of Zn from ZnONPs with that from ZnCl2, pots containing a sandy loam agricultural soil (pH=5.0; OC=1.1%; clay=3.1%) (500g of soil per pot) were amended with a suspension of ZnONPs or ZnCl2 solution (at 10 or 100 mg Zn kg⁻¹) and kept for 120 days at constant moisture (70 % of WHC).

Each pot was equipped with two solution samplers to extract in-situ pore-water. The direct availability (expressed as total Zn concentration in pore-water) were characterised at day 1, 2, 3, 7, 15, 30, 60, 70 and 120 after amendment. After 120 days, soils were removed from pots, air-dried and analysed for pseudo-total Zn concentration (following aqua regia digestion). The geochemically available and reactive pools of Zn that remained in soil was characterised by soil extraction tests (with 0.01 M CaCl2, 0.43 M HNO3 or 0.4 M glycine (at pH 1.5) solutions).

In this presentation, the variation of the direct availability of Zn in amended pots along 120 days as well as the potential for subsequent release of Zn retained in soil will be presented. Implications for future fertilisation practices will be discussed.
METAL-BEARING PARTICLES IN ATTIC AND HOUSEHOLD DUST FROM PB MINING AND SMELTING AREA AS INDICATORS OF CONTRIBUTION OF PAST AND PRESENT SOURCES

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The environment in the study area (Žerjav, NNE Slovenia) is heavily burdened with toxic metals, due to past mining, mechanical ore/mine waste processing, past Pb-smelting and present-day Pb-recycling. Investigation of particles deposited in snow indicated prevalent influence of present-day Pb recycling on recent metal pollution in the area. Objective of present study was to characterize recent and past airborne metal pollution in order to understand present-day situation.

Attic and household dust was collected at two locations in Žerjav. Fraction <0.125 mm was analysed by ICP-MS and ICP-ES. Individual particles were characterized by their composition and morphology using SEM/EDS analysis.

Pb and Sb contents in dust exceed the New Dutchlist intervention values for soils by up to 135 and 55 times, respectively. Metal-bearing particles in attic dust occupy 22% of the sample. 50% of these (Cu-bearing anglesite, Zn-sulphate) probably originate from Pb-smelting, 27% of metal-bearing particles (pure anglesite, sphalerite, (Zn,Cu,Sn)-bearing Fe-oxyhydroxy sulphates) result from mining and mechanical ore/mine waste processing, while 23% (Pb-K sulphate, (Sb,Sn,Cl)-bearing anglesite, Pb-Sb-Sn-oxides and sulphates), emanate from present-day Pb-recycling. In the household dust, C-bearing particles (55%) prevail, while metal-bearing particles represent 4% of the sample. 77% of metal-bearing particles (Fe-(Pb,Zn)-bearing oxyhydroxides, barite) probably originate from mining and mechanical ore/mine waste processing, 20% from Pb-smelting and 3% from present-day Pb-recycling.

It can be concluded that the influence of historical emissions from Pb-smelting, mining and mechanical ore/mine waste processing on dust composition is greater than that from present-day Pb-recycling as reflected in dust particle composition and associations.
ARE SEDIMENTS IN LAKES AND DAMS A SINK OR SOURCE FOR DOC?

PS.14 - Poster Session Available from 14th - 17th August - Poster

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Importance of the work and objectives: Increasing concentrations of dissolved organic carbon (DOC) in surface waters are observed worldwide in the northern hemisphere. This poses an increasing ecological threat as well as an economic problem for drinking water reservoirs by higher water treatment costs to remove the DOC and the potential formation of toxic, carcinogenic disinfection by-products. Sediments could act either as a source or sink for several compounds depending on environmental conditions.

Methodologies: In this study we tested the sediment from two pre-dams of a drinking water reservoir for their exchange behavior of DOC by incubating sediment cores at different temperatures and redox conditions. The cores were taken from different sites of the pre-dams representing more riverine and lacustrine zones, respectively. Incubation was performed at in-situ conditions using climate chambers. Beside DOC, other solutes were analyzed in the overlying water.

Main results and conclusions: Only under oxic conditions and low temperatures the sediments acted as a sink for DOC. At higher temperatures and under anoxic conditions the sediment was a source for DOC. A strong positive correlation of the fluxes of DOC, iron and phosphorus was observed suggesting that adsorption of DOC on iron mineral surfaces was the major regulating mechanism. Temperature had also a significant effect on DOC release from the sediment by stimulating microbial processes. Higher temperatures as proposed for the future might then result in more reducing conditions in the hypolimnion of lakes and dams followed by enhanced benthic DOC release.
DANISH STUDIES ON EXPOSURE OF GEOGENIC ELEMENTS IN DRINKING WATER AND PUBLIC HEALTH

PS.15 - Poster Session Available from 14th - 17th August - Poster

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In Denmark, drinking water is entirely based on groundwater. Water quality can be assessed with a high degree of certainty for the major part of the population. Drinking water quality is monitored routinely, and data on drinking water quality have for decades been archived in the public-available database JUPITER.

Assessing the health impacts of geogenic natural occurring elements in drinking water requires sufficient data on life-long exposures. Thus, high-quality data on both spatial and temporal variation of drinking water quality are of paramount importance when assessing public health related to geogenic exposures. In addition, utilizing Danish nationwide population-based registers, we can identify the exact geographical residential location from 1978 onwards on a personal level and link this information with later health outcomes. The combinations of these unique data sources allow a longitudinal population-based assessment of the potential health impact of drinking water quality. These data are available through the National Centre for Integrated Register-based Research at Aarhus University.

Here, we’ll present an overview of the drinking water quality data on specific geogenic elements during the last almost 100 years and show how the amount of data increased since the 1980s. The aim is to combine drinking water quality data in the Danish geo-database JUPITER with the health data available at the National Centre for Integrated Register-based Research at Aarhus University (CIRRAU). Finally we will present examples where we combine the data and analyze the association between drinking water quality and human health.
A SURVEY OF POTENTIAL CARCINOGENIC COMPOUNDS IN DANISH PRIVATE WELLS – NITRATE AND ARSENIC

PS.16 - Poster Session Available from 14th - 17th August - Poster

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Private wells for drinking water purposes in Denmark are known to contain higher levels of nitrate than drinking water from public waterworks. Only nitrate, phosphate and microbiological parameters are normally included in the mandatory water quality analysis program for private wells. In addition, public waterworks are extensively registered while private wells are neither monitored nor registered sufficiently (Schullehner & Hansen, 2014). Thus, little is known about concentrations of the potential carcinogenic compounds as arsenic and nitrate in the drinking water from private wells. Accordingly, the aim of the present study is to compare concentrations of these potential carcinogenic compounds in private wells with public waterworks in the same area.

In a field campaign in 2015, we collected water samples for analysis of nitrate and arsenic from private wells in two municipalities in the western Denmark (81 nitrate & 81 arsenic analyses). Historical data from private wells were also obtained from a public-accessible database (3,953 nitrate & 11 arsenic analyses), and from the two municipalities (4,328 nitrate & 0 arsenic analyses).

As a preliminary result from the sampling campaign only one analysis had arsenic above the Danish and WHO drinking water threshold of 10 µg/L. A total of 3 samples had arsenic concentrations above 5 µg/L, which is the enforceable limit of the water leaving public Danish water works. During the conference, more results will be presented and discussed.

References:
A PROBABILISTIC FRAMEWORK FOR ASSESSING HEALTH RISK ASSOCIATED WITH ARSENIC INTAKE FROM DRINKING WATER IN SOUTHERN TAIWAN

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¹National Central University, ²Fooyin University

Groundwater is widely used for drinking in the Pingtung Plain, Taiwan. However, monitoring results proved that a considerable portion of groundwater quality at the monitoring wells has As concentration higher than the safe drinking water regulation of 10 g/L. Considering residents of the Pingtung Plain continue to use groundwater for drinking, this study presents a probabilistic risk assessment for inorganic arsenic intake from drinking groundwater for local residents in Southern Taiwan. Besides the As concentration is considered as a probability distribution, the consumption rates and daily water intake rate and body weight are also treated as probability distributions to account for the variability of individuals. Monte Carlo simulation is thus utilized to conduct the exposure assessment of inorganic As daily intake from drinking water as probabilistic outputs. The health risk from drinking groundwater are evaluated based on the hazard quotient (HQ) and target risk (TR) established by the U.S. Environmental Protection Agency. The results shows that the 95th percentile of HQ exceeded 1 and TR is above the safe value of threshold value of 10-5. The results implies that groundwater use for drinking can places people at As exposure risk. The government must adopt appropriate measure to provide safe drinking water for residents of the Pingtung Plain. Moreover, this study provides a general framework for probabilistically assessing the health risk of inorganic As intake and characterize the uncertainty of risk assessment.
**SPATIAL HEALTH RISK ASSESSMENT OF ARSENIC EXPOSURE FROM DRINKING GROUNDWATER IN TAIWAN’S PINGTUNG PLAIN**

Prof. Ching-Ping Liang¹, Prof. Jui-Sheng Chen²

¹Fooyin University, ²National Central University

In Taiwan, the residents of the Pingtung Plain are unusual, in that only approximately 45.8% use tap water. In that area, a substantial amount of groundwater, which is relatively abundant and inexpensive, is used as a source of water to meet drinking. A long-term groundwater quality survey of the Pingtung Plain indicated that arsenic concentration at several wells exceeded the water quality standards of 10 g/L for drinking. In this study, we attempt to spatially assessing health risk associated with arsenic exposure through drinking groundwater in Pingtung Plain. Geostatistical Kriging is used to estimate spatial variability of arsenic concentrations in groundwater. The hazard quotient (HQ) and target risk (TR) established by the U.S. Environmental Protection Agency are adopted to evaluate the potential health risk based on the estimated arsenic concentration distributions. The estimated arsenic concentrations in groundwater reveal that arsenic concentrations (>50 g/L) in groundwater are high in several townships. The results show that HQ exceeds 1 and TR is above the safe value of threshold value of 10-6 at these arsenic-affected townships. Residents of the townships with high arsenic-affected groundwater should use tap water as drinking water and use groundwater only for other purpose. The well water in other townships in the Pingtung Plain has no adverse effects on human health.
THE ROLES OF OSNIPS GENE’S TRANSCRIPTION REGULATION IN ARSENIC ABSORPTION AND ACCUMULATION IN RICE (ORYZA SATIVA L.)

PS.19 - Poster Session Available from 14th - 17th August - Poster

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In order to study the transcription regulation of arsenic uptake and accumulation of rice (Oryza sativa L.), in different phosphate concentrations, the rice seedlings are treated with arsenate (As (V)) and arsenite (As (III)) (0 µM, 10µ M, 100 µM). We determine the change of rice biomass, arsenic accumulation, AsA-GSH redox system activity and gene expression of OsNIPs family, also determine the short-term absorption kinetics of As (V) andAs (III) of rice. The results showed that phosphorus deficiency (-P) can promote root biomass under As (III) stress but inhibited root biomass under As (V) stress. The high concentration of As (III) (100 µM) stress can promote the expression of the OsNips family, except for OsNip2;2. OsNip1;2, OsNip1;3, OsNip1;4, and OsNip3;3 may participate in the absorption of As (III) in root, phosphorus deficiency can improve the absorption rate of arsenic in rice. OsNip1;2, OsNip2;1, OsNip2;2, OsNip3;1, and OsNip3;2 may participate in root-to-shoot arsenic translocation. -P could improve root-to-shoot arsenic transport and increase the accumulation of As (III) in plants. -P also was observed enhance the activity of AsA-GSH redox system to reduce the lipid peroxidation degree.

Key Words: Arsenate, Arsenite, rice, OsNips, transcription
THE FUNCTIONS OF OSPHT7 GENE INVOLVED IN ARSENIC ABSORPTION AND ACCUMULATION IN ORYZA SATIVA L.

PS.20 - Poster Session Available from 14th - 17th August - Poster

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In order to fully understand the function of OsPHT7 (high affinity phosphate transporter gene in Oryza sativa L.) in phosphorus and arsenic absorption and accumulation, the effect of OsPHT7 gene expression on arsenic and phosphorus absorption was investigated in this study.

OsPHT7 was cloned from Indica rice. Then, genes were connected with a shuttle vector pPIC9K and express successfully in Pichia pastoris GS115. The rice seedlings and yeast were treated with different arsenate As(V) and arsenite As(III) treatments with or without phosphate. The result showed OsPHT7 play an important role in the As(V) absorption and accumulation of both in rice and yeast. The absorption of As (V) and P were the cooperative relationship. According to OsPHT7 sequence, one of predicted arsenic binding sites of the transporter was site-directed mutagenesis from glutamine into proline. The experiment also proved that glutamine could be a key amino to bind As(V).

Key Words:arsenic, phosphate transporter gene, Oryza sativa, Pichia pastoris
ASSESSMENT OF ORAL AND LUNG
BIOACCESSIBILITIES OF METALS FROM
SMELTER-IMPACTED DUST

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Soil and dust contamination by metals engenders important environmental and health problems in northern France where a lead smelter was in activity for more than a century. This study aims to look at the long-term effects of the smelter after its closedown on metals accumulation in sidewalk dust for a better assessment of the local population’s exposure to Cd and Pb. The investigation included: (i) the metal distribution in different dust particle sizes, and (ii) the assessment of metal bioaccessibility via ingestion and inhalation of dust.

Fourty sidewalk dusts were collected using a dust-sampling vacuum. The samples were sieved to collect different particle sizes from 0.3 µm to 1 mm. The Unified Bioaccessibility Method was employed to evaluate the oral bioaccessibility of metals in the different particle sizes. Respiratory bioaccessible fraction of Cd and Pb via the finest particles was extracted with lung simulating solution.

Ten years after the smelter closedown, (i) a strong relationship was observed between the concentrations of metals in dust and the distance to the former smelter; (ii) the metal concentrations are high in the finest fraction (0.3-5 µm) and decrease when the particle size increases; (iii) a higher oral bioaccessibility of Cd and Pb was measured in the gastric phase compared to the gastro-intestinal phase; (iv) metal bioaccessibility via inhalation of dust was high (on average 74% and 69%, respectively for Cd and Pb).

The high contamination level of the sidewalk dust studied continues to be a risk for the environment and the population’s health.
BIOSORPTION AND BIOACCUMULATION OF THALLIUM BY THALLIUM-TOLERANT FUNGAL ISOLATES

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Thallium (Tl) contamination in soil exerts a significant threat to the ecosystem health due to its high toxicity. However, little is known about the effect of Tl on the microbial community in soil. The present study aimed at characterizing the culturable microbial groups in long-term Tl-polluted soils. The soils at the study site were highly contaminated with Tl derived from Tl-rich sulfide mineralization and mining activity in Guizhou Province, Southwest China. Our investigation clearly showed the existence of culturable bacteria, filamentous fungi and actinomycyes in long-term Tl-contaminated soils. Indeed, some fungal groups can grow in the presence of high Tl level up to 1,000 mg kg⁻¹. We have isolated and identified nine Tl-tolerant fungal strains based on the morphological traits and ITS analysis. The dominant genera identified were Trichoderma, Penicillium and Paecilomyces. Preliminary data showed a positive correlation between the biomass and the biosorbed Tl content. The Tl-tolerant strains were capable of bioaccumulating Tl, up to 7,189 mg kg⁻¹ dry weight. The subcellular distribution of Tl showed obvious compartmentalization: cytoplasm >> cell wall > organelle. The majority of Tl (up to 79%) was found in the cytoplasm, suggesting that intracellular compartmentalization appeared to be responsible for detoxification. These findings further suggest the applicability of the fungal isolates for cleanup of Tl in Tl-polluted water and soil.
LINKING HUMAN HEALTH AND WELLBEING WITH WEATHER, CLIMATE AND THE ENVIRONMENT

PS.23 - Poster Session Available from 14th - 17th August - Poster

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A large part of the global disease burden can be linked to environmental factors, underpinned by unhealthy behaviours. However, research into these linkages suffers from the lack of common tools and databases for carrying out investigations across many different scientific disciplines to explore these complex associations. The MEDMI Partnership brings together leading organisations and researchers in climate, weather, environment, and human health and wellbeing.

We have created a proof-of-concept central data and analysis system with data from the Met Office and Public Health England (PHE) as the internet-based MEDMI Platform to serve as a common resource for medical and public health researchers to link and analyse complex meteorological, environmental and epidemiological data in the UK. The Platform is hosted on its own dedicated server, with secure internet and in-person access with appropriate safeguards for ethical, copyright, security, preservation, long-term accessibility and data sharing issues. Via the Platform, there is a demonstration Browser Application which allows for access to user-selected subsets of the data for performing: a) analyses using time series (e.g. mortality and environmental variables), and b) data visualizations (e.g. infectious diseases and environmental variables).

The MEDMI Project provides a demonstration of the potential, as well as a better understanding of the barriers and challenges, of these “data mashups” of environment and health data. Although there remain many challenges to creating and sustaining such a shared resource, these activities and resources are essential to truly explore the interactions between environment and health at the local and global scale.
Importance of the work and objectives: Several studies have shown the influence of climate variables on hospital admissions and deaths from Pulmonary Embolism (PE). However, this effect is not fully understood. The aim of this study was to investigate the influence of temperature on mortality from pulmonary embolism in São Paulo.

Methodologies: Daily mortality data from PE of the city of São Paulo- Brazil was used for a period of ten years (2002-2011). Mean temperatures, atmospheric pressure and relative humidity were tested. Quasi-Poisson regression models with GLM were built to estimate the effects mean temperature on mortality for PE, controlling for pollutants, and day of the week.

Results: The Relative Risk between the mean temperature and the PE was high (1.45), with high temperatures in the early days of exposure, with a time lag of more than 15 days the heat is replaced by protective effect, as for cold temperature the risk was low but present between the first days of exposure and with a lag of 15 to 21 days. Cases in elderly (over 65 years) in contrast had higher risk with cold temperatures (RR = 1.40), with heat there was almost no association.

Conclusion: The identification of risk temperatures for mortality from pulmonary embolism is extremely important for the public health since this disease is victimizing a large number of people in São Paulo.
CHARACTERISTICS OF PARTICLE SIZE AND BIOGEOGRAPHIC RELATIONS WITH ECOLOGICAL RISK OF HEAVY METAL POLLUTION IN BEIJING RIVER SEDIMENTS

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Importance of the work and objectives

The water environment problem of urban river is becoming more and more serious. To evaluate the ecological integrity of urban river, the surface sediments were collected from Liangshui River to study the physical properties of sediments and pollution characteristics of heavy metals.

Materials and Methods

In proceeding with the research, we applied Laser particle size analyzer to analyze the particle grain and BCR methodology to analyze the speciation of heavy metals: Cr, Cd, Cu, As and Zn. The relationships between the river sediments’ grain sizes and form of heavy metals, as well as the influences of the river dams have on sediment grain sizes.

Results and Conclusion

The results showed that the average particle size of sediment decreased along the flow of the Liangshui River or through dam and gate. The content of speciation of heavy metals in Liangshui River sediments followed the order: residual >> oxidizable > acid soluble> reducible. The potential ecological risk index showed that heavy metals pollution risk was relatively high in the river (RI=396.952 on average). EF values revealed that there are anthropogenic Cd sources in the upstream and mid-stream of Liangshui River. River dams have the influences on the heavy metal forms. In addition, when the grain size is less than 0.2mm, the contents of non-steady-state of heavy metals increased with the particle sizes decreasing.
DEGRADATION OF AROMATIC AMINES IN TEXTILE-DYEING SLUDGE BY COMBINING THE ULTRASOUND TECHNIQUE WITH POTASSIUM PERMANGANATE TREATMENT

PS.26 - Poster Session Available from 14th - 17th August - Poster

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Textile-dyeing sludge has raised serious concerns regarding their adverse effect on environment, which has been listed as a pollutant in the legislation of Strict Control Waste in Guangdong Provinces, China. Aromatic amines are one of the characteristic pollutants in textile-dyeing sludge, and our recent study has elucidated that trace levels of aromatic amines in textile-dyeing sludge may pose a high risk to the soil ecosystem after being discarded into soil or in a landfill. To address this risk, for the first time, a combined ultrasound and potassium permanganate (US-KMnO4) system was developed for degradation of aromatic amines in textile-dyeing sludge. The results indicated that there was a synergistic effect between US and KMnO4. US treatment greatly enhanced KMnO4 degradation of aromatic amines in textile-dyeing sludge, resulting in apparent sludge disintegration and separation of pollutants from sludge. In addition to accelerating Mn(VII) reaction with pollutants in the filtrate, US also caused Mn(VII) to enter the porous sludge and sufficiently facilitated the reaction of Mn(VII) with the strongly absorbed aromatic amines. The combined US-KMnO4 treatment was effective in the degradation of aromatic amines in textile-dyeing sludge. On average, 58.7% of monocyclic anilines, 88.3% of other forms of aromatic amines and 24% of TOC were removed under the optimal operating parameters of KMnO4 dosage of 12 mM, an ultrasonic density of 1.80 W/cm³ and pH 5. The present study proposed the US-KMnO4 treatment as a practical method for disposal of aromatic amines in textile-dyeing sludge.
CONCENTRATIONS AND DISTRIBUTIONS OF PCBS, PBDES AND PCDD/FS IN THE ATMOSPHERE OF BEIJING, CHINA

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Atmospheric concentrations of polychlorinated biphenyls (PCBs), polybrominated biphenyl ethers (PBDEs) and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) were measured in different seasons from November 2010 to March 2012 using passive air samplers to investigate levels and spatial distributions of POPs in the atmosphere of Beijing. The 19PCBs concentrations varied from 9.6 to 76.7 pg m⁻³ with an average value of 63.26 pg m⁻³. The congener of PCB-28 was predominant in all samples compared to other congeners, accounting for 86.3% to 19PCBs. The summed concentration of 13 PBDEs ranged from 0.91 to 176 pg m⁻³ with mean concentration of 19.4 pg m⁻³. BDE-28, -47, -99, -153 and BDE-183 were predominant congeners, accounting to 58-85% for 13PBDEs. The PCDD/Fs concentrations were 0.28-3.73 pg m⁻³ with average value of 0.93 pg m⁻³. OCDF (16.7%) and OCDD (27.6%) were predominant congeners. International-toxic equivalents (I-TEFs) of PCDD/Fs ranged from 10.8 to 158 fg I-TEQ m⁻³ with mean value of 66.9 fg I-TEQ m⁻³ and 2,3,4,7,8-PeCDF was the main congener, contributing to 44% of the total TEQ. Higher PCBs and PBDEs concentrations were observed in the summer, which can be related to temperature variations. Although the industrial sites showed higher levels of PCBs, PBDEs and PCDD/Fs levels than rural areas, atmospheric concentration of the pollutants in Beijing was relatively low. The results from this study provides further aid in estimating the emission sources of POPs and evaluating the impact of sources and seasonal variations on POPs distributions in mega-cities of China.
Polycyclic aromatic hydrocarbons (PAHs) and heavy metals are ubiquitous contaminants in the e-waste dismantling areas, and have become a global environmental concern because of their high toxicity and bioaccumulation through food chains. Microbial remediation has been considered as a promising and economical technology for the simultaneous removal of heavy metals and PAHs combined pollutants. In our research, the biodegradation of BaP and biosorption of Cu(II) were carried out in single and combined pollution system simultaneously to discuss metabolic pathways and cellular response to combined pollutants by Stenotrophomonas maltophilia. The results indicated that BaP was broken down following the common phthalic degradation pathway when there was only BaP in the solution, while a new degradation pathway of BaP was found in Cu(II) combined system. There was more than one mechanisms behind Cu(II) removal by S. maltophilia, and the bacteria removed Cu(II) through physical/chemical interaction at first, then a part of Cu(II) changed into Cu(I) and Cu and the other part of Cu(II) adsorbed transported into bacterial cell across membrane by the P-type ATPase. However, most of Cu(II) was removed with the EPS by extracellular precipitation in the BaP-Cu(II) combined pollutant system. Cell apoptosis was observed during bioremediation process, and the intracellular ATPase activity, cell microstructure and cell membrane system were changed and damaged in a varying degree, thus, affecting the transport and removal of BaP and Cu(II). The achievements in our research provide theoretical basis and technical support for the bioremediation of PAHs and heavy metal combined pollutants.
SEPARATION AND ENRICHMENT OF NORFLOXACIN IN WATER BY IONIC LIQUID SOLVENT SUBLATION

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Solvent sublation, originally introduced by Sebba, has shown promising features for removing hydrophobic compounds and ions from aqueous systems. The ionic liquid is an environment-friendly green solvents. The ionic liquid solvent sublation technique combines the advantages of ionic liquid extraction and conventional solvent sublation technique; it is a new method for separation / enrichment of trace substances from water. In this study, the separation of norfloxacin in water by ionic liquid solvent sublation using the mixture of ionic liquid BmimPF6 and ethyl acetate(EA) as solvent. The influence of various factors on the removal rate of norfloxacin were investigated, the optimal conditions of ionic liquid solvent sublation of norfloxacin were obtained. Experimental results showed that the optimal conditions: pH=2.0, the amount of bromocresol green was 5ml, air flow rate was 60 ml/min, solvent sublation time was 75 min., the amount of solvent was 15mL, the mass fraction of NaCl was 12%. Under the optimum conditions, the removal rate of ionic liquid solvent sublation was 89.9%. The experiments showed that ionic liquid BmimPF6 solvent sublation was an effective pre-treatment method. Due to the high density and viscosity of ionic liquid, it can not be directly used as sublation solvent. When the ionic liquid used in the experiment, ethyl acetate and salt should be added which affected the use of ionic liquid in the experiments.
Methyl parathion (MP), a typical organophosphorus pesticide widely used in agriculture, can cause a variety of late onset multiple neuropathy and permanent damage to nerve cells with irreversibility. Therefore, the study on its environmental fate and transport has aroused extensive concern of researchers. The adsorption behavior of MP on synthetic goethite was investigated in our study given the ubiquity of goethite in soils and aquatic sediments. It was found that the adsorption behaviour of MP on goethite could be expressed well using pseudo-second-order kinetic models, including the fast surface diffusion process and the slow formation stage of aggregates or oxidation of by-products. The adsorption behaviour of MP on geothite was strong pH dependent and related to other adsorbents such as humus acid, montmorillonite and modified geothite with humus acid. At the same time, other factors including the initial concentration of MP, the dosage of geothite, solution ionic strength and temperature were also discussed. Not only there exist different adsorption capacity, but the desorption process of MP on modified geothite and humus acid present obvious hysteresis phenomenon than that on montmorillonite attributed to their various adsorption mechanisms of MP. According to the characterization of adsorbed geothite and the identification of by-products in solution, the adsorption mechanism of MP by geothite was also discussed.
SEDIMENTARY ALIPHATIC AND POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN THE NORTHWEST OF QINLING MOUNTAINS: PATTERNS, POTENTIAL RISK AND A CRITICAL APPRAISAL OF PAH RATIOS TO INFER SOURCE

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Surface sediment from the tourism areas of the northwest of the Qinling Mountains was analyzed by GC/MS/MS to determine the concentration, probable source and potential risk of aromatic and aliphatic hydrocarbons. Concentrations of aliphatic and aromatic hydrocarbons ranged from ng g⁻¹ 4.18 to 3243.42 ng g⁻¹ and 0.05 ng g⁻¹ to 101.35 ng g⁻¹ of dry sediment, respectively. The results indicated that the extent of soil contamination by hydrocarbons was generally typified unpolluted to slightly polluted levels. As a result, the incremental lifetime cancer risks (ILCRs) for exposing to the soil borne PAHs showed a completely safety for tourists. For the origin of hydrocarbons, early diagenesis of natural products, bacteria activities and petroleum were the three main ways of aliphatic hydrocarbons, while the long-range transport of air pollutants from pyrolytic process was the main origin of PAHs. Because the photochemical reaction of PAHs in the atmosphere would produce lower ratios for Ant/(Ant+Phe), BaA/(BaA+Chr) and IcdP/(IcdP+BghiP), but higher ratio for Fla/(Fla+Pyr), the source classification highly depended on the diagnostic ratios chosen and the plot of ΣCOM/Σ14PAHs vs. ΣLMW/ΣHMWPAH using more compounds than signal ratio was proposed to distinguish PAHs origins. Additionally, there was a good exponential relationship (r²=0.97) between the Natural n-Alkanes Ratio (NAR) and the carbon preference index for C23–C35 (CPI23–35) for all the samples. It is of great use for the determination of the aliphatic hydrocarbon origins.
POTENTIAL ENVIRONMENTAL GEOCHEMICAL HAZARDS OF THE SLAG FROM DAZHAI GE EXTRACTION PLANT IN LINCANG, WESTERN YUNNAN, CHINA

PS.32 - Poster Session Available from 14th - 17th August - Poster

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The Dazhai Coal Mine in Lincang, western Yunnan, China, one major coal-hosted Ge deposits around the world, is of special environmental interest due to the open storage of slags after Ge extraction. To investigate the environmental geochemical characteristics of the slag, 6 bump slag samples were collected from the pile, and the trace elements were determined by ICP-MS and ICP-CCT-MS (As and Se).

These slags commonly preserved the geochemical features of its raw coals with exception of Ge, i.e., unusually enriched in Be and W; and significantly enriched in As, Sb, Cs, and U. Moreover, the slags samples are significantly more enriched in Cr, Cu, Mo, In, and Th than raw coals. The Upper Continental Crust-normalized REY patterns indicated that all the extraction procedures did not changed the REY distribution pattern of its raw coals.

Compared to the world soils, Be (178 mg/kg, 59×), Ge (33.4 mg/kg, 16×), As (172 mg/kg, 34×), Mo (49.8 mg/kg, 42×), In (2.08 mg/kg, 30×), Sb (123 mg/kg, 245×), Cs (9.3 mg/kg, 33×), W (310 mg/kg, 207×), and U (148 mg/kg, 55×) are significantly concentrated in the slags. Therefore, the open storage of these slags might endanger the supergene media (soil, surface and ground water) around the Ge extraction plants.
THE DISTRIBUTION, FATE AND ENVIRONMENTAL INDICATIONS OF URANIUM, THORIUM IN RESERVOIR WATER AND SEDIMENT PROFILE NEAR A URANIUM MILLING AREA, GUANGDONG PROVINCE

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During a sampling campaign from 2010 to 2012, the concentrations of Uranium (U) and thorium (Th) in surface waters were extensively investigated; the concentrations of U and Th in water decrease with the distance from the uranium milling site, and reach the local background level when getting to the reservoir as a terminal. In order to study the fate of U and Th, water in different depth and 4 sediment profiles in the reservoir were sampled and analyzed with ICP-OES. The results show that: (1) the concentrations of U and Th in surface water of reservoir are extremely low but U rise significantly in the depth of 5~10 m while Th represents homogeneous distribution with very low concentration in the same depth; it is likely that most of U and Th have transferred to sediments; (2) The total U concentrations in sediment profiles ranged from 114.6 to 916.2 mg/kg with the average of 415.6 mg/kg while Th ranged from 41.9 to 114.5 mg/kg, averaged 80.3 mg/kg; and (3) 30~50% of U and around 33% of Th in reservoir sediment could be leached using 0.50 mol/L hydrochloric acid, indicating the great possibility of potential release from sediment to water. XRD test shows that the main mineral in sediment is associated with illite and kaoline, together, accounting for more than 50% of total, which might dominate the process of mass balance and environmental behaviors of U and Th between water and sediments.
RESPONSE OF ROOT FORAGING AND MORPHOLOGY TO DIFFERENT SOIL PHOSPHORUS FORMS IN A TREE DIVERSITY POT EXPERIMENT

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Background: Phosphorus (P) is a limiting element for primary productivity in subtropical and tropical regions. The maintenance of soil P availability through species diverse forests might be an important ecosystem service. Meanwhile, given the large range of biologically available soil P forms, and the variety of mechanisms by which plants can access P, it is assumed that co-existing plant species partition soil P to increase P use efficiency and reduce competition.

Materials and Methods: Four subtropical tree species seedlings, comprising Castanea henryi, Lithocarpus glaber, Quercus fabri and Liquidambar formosana were planted in one pot as monoculture, two-species and four-species-mixtures in different substrates containing equal amount of total P, but different forms of P derived from: a) topsoil with large proportion of organic P; b) subsoil with mostly inorganic P; c) mixed litter with solely organic P; d) mineral inorganic P fertilizer.

Results: The results showed that fine root biomass and productivity were not significantly different among the species diversity level, while the significantly higher fine root biomass were found in the treatment with topsoil, followed by the subsoil and litter, and the treatment with P fertilizer the lowest. While the SRL was the highest in P fertilizer treatment, and lowest in pot with topsoil for all the species, except for L. formosana.

Conclusion: The diversity effects on P partitioning use in this bioassay experiment was not significant, and the seedlings adapted to the different soil P forms by changing either root foraging or morphology, which are essential for P-acquisition.
INSIGHTS INTO THE MECHANISM OF LIGHT-INDUCED DISSOLUTION OF GOETHITE IN THE PRESENCE OF ATMOSPHERIC DICARBOXYLIC ACIDS

PS.35 - Poster Session Available from 14th - 17th August - Poster

Prof. Hongbo Fu

Biogeochemistry cycle of iron is of great important to the oceanic primary productivity. Increased evidences suggested that organic ligands play an important role in the mobilization of iron from mineral dust aerosol. The purpose of this study is to better understand the iron dissolution processes in the presence of low-molecular organic acid. The dissolution of goethite was investigated in the presence of three low-molecular dicarboxylates. The ligand-promoted dissolution rates of iron in the dark were in the following order: oxalate > malonate > succinate > MSA. Irradiation and deaerated conditions were beneficial to the improvement of iron solubility. The dissolution rate under the irradiation were higher by 5~10 orders of magnitude than that in the dark. The Fe(II)/Fe(t) ratio approached 83%-93%, indicated that the iron mobilization was mostly contributed to the photoreductive dissolution. The dissolution rates of the three dicarboxylate ligands correlated with carbon chain length: n = 2 > 3 > 4, because the space barrier action of carbon chains affected structure and stability of the complexes, thereby inhibit inner-sphere ligand-to-metal electron transfer. The production of active species (H2O2, •OH and O2•−) determined by Acridinium Ester Chemiluminescence detection and Electron spin resonance measurement suggested that the photoreductive dissolution of Fe is very sensitive to dissolved oxygen. Transmission electron microscopy (TEM) gave the direct evidence that dissolution was preferential detached at the reactive sites such as surface defects and/or sharp edges. This study deepens our understanding on the ligand promoted-dissolution mechanisms, and contributes to atmosphere models in the atmosphere.
A GIS APPLICATION FOR DISEASE MONITORING BASED ON ICD REPORT-SYSTEM

PS.36 - Poster Session Available from 14th - 17th August - Poster

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The International Classification of Diseases (ICD) is an international standard diagnostic tool published by WHO in the field of epidemiology, healthcare management, and clinical purposes. It is required by WHO that all inpatients’ diagnosis should be reported to local WHO organisations in ICD codes for mortality and morbidity statistics. This paper suggests a web-based intelligent system which can translate the clinical diagnosis into ICD codes via Natural Language Processing module and matching algorithm, then collect these ICD codes for related organisations, and finally display the information on GIS. This system is a flexible schema matching software that would allow for the ICD database to be linked to the GIS database, so that it realises the dynamic monitoring of diseases in the specified area, or supports the data analytics of ethnicity, environmental factors, life behaviours and etc. This application could be helpful for local healthcare departments to monitor and control the eruption of large-scale pandemic, especially by combining with Big-data analysis techniques.
MICROCYSTINS-LR IMPAIRS ZEBRAFISH REPRODUCTION BY AFFECTING OOGENESIS AND ENDOCRINE SYSTEM

PS.37 - Poster Session Available from 14th - 17th August - Poster

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Studies showed that microcystins (MCs) are able to exert negative effects on the reproductive system of animals. However, the major focus of research has been directed toward male reproductive system and few data are available on females. In this study, female zebrafish were exposed to 2, 10, and 50 g/L of MC-LR for 21 d, and the effects on reproduction, sex steroid hormones, transcription of genes on the hypothalamic-pituitary-gonad (HPG) axis and critical factors in oogenesis were investigated for the first time. Egg production was significantly decreased at 10 g/L MC-LR. MC-LR was identified to increase the concentrations of 17β-estradiol and vitellogenin significantly after 10 g/L exposure, while decreased the levels of 17β-estradiol, vitellogenin and testosterone in fish after 50 g/L exposure. The transcriptions of steroidogenic pathway gene (cyp19a, cyp19b, 17 hsd, cyp17 and hmgrα) changed as well after the exposure and corresponded well with the alterations of hormones level. A number of intra- and extra-ovarian factors, such as gnrh3, gnrhr1, fsh, fshr, lhr, bmp15, m1r , ptgs2 and vtg1 which regulating oogenesis were significantly changed with a different dose-related effect. Moreover, the maternal exposure resulted in decreased fertilization and hatching rates were also observed and may suggest the possibility of trans-generational effects of MC-LR exposure. The results demonstrate that MC-LR could modulate endocrine function and oogenesis, eventually leading to disruption of reproductive performance in female zebrafish. And these data represent a concrete risk for the aquatic population living in MC polluted areas.
MODELING THE DYNAMICS OF HARMFUL ALGAL BLOOMS HABS, HUMAN COMMUNITIES, AND POLICY CHOICES ALONG THE FLORIDA GULF COAST: THE CHANS PROJECT

Prof. Lora E Fleming¹, Prof. Porter Hoagland², Dr. Barbara Kirkpatrick³, Dr. Gary Kirkpatrick³, Dr. Di Jin², Prof. Steve Ullmann⁴, Mr. Andy Reich⁵, Dr. Andy Beet², Prof. Gary Hitchcock⁴, Dr. Cathy Li⁶, Dr. Vince Lovko³, Dr. Kate Kohler⁴, Dr. Bruce Garrison⁴, Ms. Katrin Rudge⁷

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Coupled human-nature systems (CHANS) involve dynamic interactions between humans and nature, often influenced by and affecting the distinct dynamic characteristics of each component. We present an overview of an ongoing interdisciplinary research program focused on a specific type of system that couples expanding and fluctuating human coastal populations to episodic blooms of toxic marine algae, drawing examples primarily from human interactions with blooms of the toxic harmful algal bloom (HAB) dinoflagellate, Karenia brevis, from the eastern Gulf of Mexico (“Florida red tides”). Using extant, but extraordinary, data to specify empirical models, this program of research has focused on characterizing the influence of anthropogenic sources on K. brevis blooms, assessing the public health and economic impacts of these blooms in an exposure-response framework, and defining the choice of appropriate human policy responses to the hazard. We present examples of the generic aspects of CHANS systems in the context of Florida red tides, and we discuss also some of the challenges involved in compiling and analyzing the relevant data to support our positive and normative analytical efforts.
ARISTOLOCHIC ACIDS: POSSIBLE CONTAMINANTS OF SOIL IN BALKAN ENDEMIC NEPHROPATHY (BEN) AREAS

PS.39 - Poster Session Available from 14th - 17th August - Poster

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Aristolochic acids (AAs) are carcinogenic and nephrotoxic plant alkaloids present in Aristolochia species and are considered a cofactor for Balkan Endemic Nephropathy (BEN), a severe kidney disease geographically restricted to the Balkan Peninsula. Although AAs have been directly involved in the etiology of BEN, it is not yet very clear how the susceptible population is exposed to these toxins. Aristolochia clematitis plants have been widely used as traditional medicine by the villagers from endemic (and nonendemic) areas but this sole use would not account for the exposure levels necessary to induce the disease.

Additional exposure pathways are likely to occur and we have shown in previous research that AAs can contaminate crop plants through adsorption from soil, under controlled laboratory environment. Here we bring additional support to this potential exposure pathway, by revealing the presence of AAs in soil samples collected from BEN areas. The samples were solvent extracted in order to be analyzed and quantified by high pressure liquid-chromatography (HPLC) and the mass of aristolochic acid was confirmed by ion trap liquid chromatography-mass spectrometry (LC-MS). Our results show that the aristolochic acid is present in small concentrations, around or below 7 ng/g of soil, in the soil where Aristolochia plants grow and in the soil where Aristolochia seeds are present.

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THE EFFECTS OF NITROGEN ADDITION ON THE
SOIL MICROBIAL BIOMASS AND FINE ROOT
BIOMASS IN CINNAMOMUM CAMPHORA
PLANTATION

PS.40 - Poster Session Available from 14th - 17th August - Poster

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It is estimated that the nitrogen deposition to forests has been doubled in the past century, which has the potential to cause a series of changes therein, including increasing productivity, carbon allocation and soil respiration, etc. As the nitrogen input accumulates, some would become “nitrogen saturated”. Here we simulated nitrogen input by spray nitrogen fertilizer (NH4NO3) at low level (LN, 50 kg N · hm-2 · yr-1), medium level (MN, 150 kg N · hm-2 · yr-1), high level (HN, 300 kg N · hm-2 · yr-1) and control level (CK, no nitrogen fertilization) in subtropical Cinnamomum camphora plantation. Soil microbial carbon (Cmic) and microbial nitrogen (Nmic) was determined using the chloroform fumigation extraction method to assess the effects of Nitrogen deposition on soil microbial biomass and fine root biomass. The results showed that Cmic and Nmic exhibited different patterns as the concentrations of Cmic were somehow lower in treatments with nitrogen fertilizer, whereas Nmic showed higher value instead, suggesting the nitrogen input would have altered the nitrogen content in microbial organisms. The fine root biomass decreased as the elevated nitrogen input and the control treatment showed highest fine root biomass. The nitrogen concentration, however, were significantly higher in fine roots in treatments with nitrogen fertilizer, and the carbon concentration in fine root showed the opposite. Our results suggested the elevated nitrogen input to forests has impacts not only on the amounts of microbial organisms and fine root biomass, but also the activities of them.
THYROID HORMONE STATUS IN UMBILICAL CORD SERUM IS ASSOCIATED WITH MALE ANOGENITAL DISTANCE

PS.41 - Poster Session Available from 14th - 17th August - Poster

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Context: Animal experiments have shown that thyroid hormones played a crucial role in embryonic gonad development. In human adults and adolescents, thyroid function affects sex hormones and male reproductive functions.

Objective: The aim was to study the association of thyroid hormones (THs) with sexually dimorphic genital development and fetal growth in human infants.

Participants: Six hundred twenty pregnant women were recruited from two local hospitals. THs and AGDs were available for 616 singleton newborns.

Main Outcome Measures: Thyrotropin (TSH), free 3,5,3\textsuperscript{-}triiodothyronine (FT3) and free thyroxine (FT4) levels in cord blood serum, anogenital distance (AGD), birth weight, birth length, birth body mass index (BMI) and head circumference in male and female neonates.

Results: Longer AGD in male newborns was observed with higher cord serum FT3 \(1.36\, \text{mm} \quad (95\% \, \text{CI} \, 0.58–2.13)\) for 1 pmol/L FT3, FT4 \(0.12\, \text{mm} \quad (95\% \, \text{CI} \, 0.00–0.25)\) for 1 pmol/L FT4, TSH \(3.14\, \text{mm} \quad (95\% \, \text{CI} \, 0.65–5.63)\) for a 10-fold TSH increase, and lower FT4/FT3 ratio \(-0.11\, \text{mm} \quad (95\% \, \text{CI} \, -0.20–-0.02)\) for doubling FT4/FT3 ratio. The relation between TSH and birth weight or birth length were different by second hand smoke exposure. Second hand smoke exposure had an effect modification, with interaction P value 0.039 and 0.010, respectively.

Conclusions: In the absence of overt thyroid dysfunction, THs are associated with AGD in male newborns. THs may affect fetal genital development in a sexually dimorphic pattern, whereas the effects on body size and head circumference may be modified by maternal second hand smoke exposure.
THE AUTOMOTIVE INDUSTRY AND OCCUPATIONAL DISEASES IN CZECHIA

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The automotive industry represents the most important industrial sector in terms of gross value added and the number of employees in Czechia. The objective of this study was to analyse the occurrence of occupational diseases (OD) in the automotive industry in Czechia during the 2001-2014 period. Data on OD cases were retrieved from the National Registry of OD. Further, we conducted a survey in automotive companies with focus on occupational health services and positions of the companies in global production networks (GPNs). An analysis of OD distribution in the automotive industry was performed (age, gender, company size and its role in GPNs, regional distribution of studied companies, and regional unemployment rate), and was accompanied by assessment of the quality and range of occupational health services. Employees older than 40 years have nearly 2.5 times higher probability of OD occurrence compared with employees younger than 40 years (OR 2.41; 95\% CI: 2.05-2.85). OD occurrence probability was 3 times higher for women than for men (OR 3.01; 95\% CI: 2.55-3.55). OD incidence rates increased with the size of the company. An association between OD incidents and the unemployment rate was not found. A statistically significant increase in OD incidents dependent on company size can be arguably attributed to a higher quality of occupational medical services in bigger companies, which ensures better detection and diagnosis of OD.

Key words:

occupational diseases, automotive industry, health geography, unemployment
GROUNDWATER VULNERABILITY ASSESSMENT TO NITRATE POLLUTION IN PINGTUNG PLAIN OF SOUTHERN TAIWAN

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A long-term groundwater quality survey revealed that NO₃⁻-N concentration in some monitoring wells of the Pingtung Plain of southern Taiwan exceeded the Taiwanese standards for drinking water quality of 10 mg/L. Therefore, efforts for assessing groundwater vulnerability are required to prevent and control groundwater pollution. This study attempts to perform a groundwater vulnerability assessment in the Pingtung Plain using a modified overlay index-based DRASTIC model. The modification of the DRASTIC model is achieved by reassigning the weighting coefficients of the factors in DRASTIC with the help of a discriminant analysis statistical method. The analytical results of the modified DRASTIC model can effectively promote the prediction performance for groundwater vulnerability assessment to nitrate pollution and correctly identify the groundwater protection zones in Pingtung Plain. Moreover, the results of the sensitivity analysis of the seven factors in the modified DRSSTIC model demonstrate that the aquifer media (A) is the most sensitive factor when the nitrate-N concentration is below 3 mg/L. For the nitrate-N concentration is above 7.5 mg/L, the aquifer media (A) remains the most important factor, followed by net charge (R).
Aquifer storage and recovery (ASR) is one of the promising strategies for managing surplus water and overcome the water shortages. The performance of an ASR scheme is generally evaluated in terms of recovery efficiency, which is defined as percentage of water injected into a system in an ASR site that fulfills the targeted water quality criterion. Site selection of an ASR scheme typically faces great challenges due to the spatial variability of the groundwater quality and hydrogeological condition. This study presents a general framework for site selection of an ASR scheme. Due to the limited costs and times to obtain the whole data of groundwater quality and hydrogeological condition, the geostatistical approach is used to spatially delineate the safe zones based on the drinking water quality standards and the suitable zones based on transmissivity. According to the geostatistical analyzed results, the sites with safe groundwater quality, suitable hydrogeological condition and adjacent to water sources are selected as the candidate site at the first stage. Finally, simplified groundwater flow and contaminant transport models are used to explore the recovery efficiency and ASR operation. The general framework presented in this study may help government administrator establishing reliable site selection of ASR scheme.
METHOD TO ESTIMATE COARSE ROOT BIOMASS
AND LOST MASS DURING EXCAVATION IN
SUBTROPICAL SECONDARY FORESTS

PS.45 - Poster Session Available from 14th - 17th August - Poster

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Coarse root biomass (CRB) is an important pool of biomass and carbon in forest ecosystems. Accurate estimation of CRB is fundamental to understanding carbon cycling in forest ecosystems. However, very few allometric equations developed for the CRB and CRB lost during excavation seldom examined in subtropical forest. In this study, we used excavation method to determine coarse root of seven subtropical dominant tree species, including coniferous (Pinus massoniana), deciduous (Alniphyllum fortunei, Choerospondias axillaris, Liquidambar formosana), and evergreen broadleaved (Cyclobalanopsis glauca, Litsea rotundifolia, Schima superba). The lost mass during excavation were estimated by developing a regression equation to relate the mean proportion of the lateral root loss beyond 1.5 m from the ground stump and diameter at breast (DBH) interval at 5 cm. The results showed that the average increase for CRB after correction is 11.65 kg, indicating that significant amounts of lateral of roots (15.49%) was lost during the excavation. The linear-transformed regression (LR) and nonlinear regression (NLR) were used to estimate CRB as a function of diameter at breast height (DBH) or crown width (CW). All allometric equations for seven tree species and three functional groups were significant (P<0.001), and LR performed better than NLR approach. The results indicated the method for correcting lost mass and the DBH-based allometric equations can be useful for evaluating coarse root carbon storage in subtropical secondary forest.
RELATION BETWEEN GD ANOMALIES AND PERFLUORINATED COMPOUNDS IN SURFACE AND GROUND WATERS: CASE STUDY OF THE ROMAGNA AREA (ITALY)

PS.46 - Poster Session Available from 14th - 17th August - Poster

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Perfluorinated compounds (PFAS) are bioaccumulative and biologically harmful substances. They enter the environment as a consequence of the incorrect disposal of effluents coming from wastewater treatment plants, not always efficient in removing such microcontaminants. Gadolinium, one of the rare earth elements group used as contrast agent in magnetic resonance imaging, is a good conservative tracer of wastewater effluents, being stable in aquatic systems once released in the environment. This study aims to assess the degree of contamination by PFAS on the main river bodies and confined aquifers of the Romagna area (Italy), using Gd as tracer. Samples taken at the entrance and exit of two drinking water treatment plants were also analysed. PFAS detection was carried out with LC-MS/MS technique. Among the analysed PFAS, only PFOA reports concentrations above the detection limit in approximately 50% of total samples. Rivers on the northern part of the study area show an anthropogenic enrichment of Gd relative to its geogenic concentration, with values up to 10 times higher than the geogenic expected value. The southern portion of the area, as well as samples coming from confined aquifers, do not show any Gd anomaly. PFOA displays a similar distribution pattern, with higher values concentrated in the final stretch of the northern rivers, in proximity of hospital and wastewater treatment plants. The statistically significant correlation (\(\rho = 0.05\)) between the two compounds demonstrates a similar input in the aquatic environment. The two drinking water treatment plants are not completely efficient in removing PFOA from contaminated waters.
The contamination of antifouling paints, tributyltin (TBT) and triphenyltin (TPhT) was still concerned in many countries due to their high toxic and relative permanence in marine aquatic ecosystem. This study was conducted to determine the concentration of butyltins (BTs) and phenyltins (PhTs) in intertidal neogastropods Thais clevigera and investigate the imposex degree of them in the coast of China. The concentrations of BTs and PhTs in total tissues were ranged 29.6~109.3 ng(Sn)/g dw, 3.5~33.2 ng(Sn)/g dw) respectively. TBT and TPhT were dominant while their degraded compounds were lower. The accumulation patterns of organotin compounds in different gender and tissues showed significant difference: liver (38.5~52.7 ng(Sn)/g dry wt)>digestive gland (13.0~16.1 ng(Sn)/g dry wt)>muscle (8.0~9.8 ng(Sn)/g dry wt). The spatial distribution of OTs showed that OTs level in the north was generally higher than in the south and generally decreased from inner harbor to outlet harbor. The 100% imposex degree were found in most areas in the coast environment of China except Dalian (62%) and Ping-tan (71%). Therefore, the contamination of OTs and their impact on the coast environment were still serious even TBTs was banned.
Strategies for Monitoring Groundwater Discharge Into Kinvara Bay, Galway, Ireland

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Submarine and intertidal groundwater discharge (SIGD) is of increasing global significance due to its role in transporting freshwater to the ocean as well as contaminants or nutrients. The increasing anthropogenic impacts on the environment pose significant risks to the quality of aquatic systems, specifically in highly vulnerable karst systems. Past groundwater monitoring programs have classified the Western River Basin District and specifically the Kinvara-Gort groundwater body to be of high risk for contamination. This groundwater body is primarily underlain by limestone that includes large fissures, cracks, and tunnels that act as preferential flow paths for groundwater. This project located the various SIGD occurrences in Kinvara Bay using a fusion of data collected via the Earth Observation satellite, small aircraft and in-situ sensors. Over the course of a four day field campaign in late August 2015, ~65,000 in-situ temperature and salinity measurements were collected in accordance with aircraft flyovers. The in-situ data was spatially interpolated with ArcGIS software and will be used to ground truth thermal infrared imagery. Processed in-situ data illustrate clear gradients in temperature and salinity at the southern end of Kinvara Bay where freshwater springs are identified at low tide. Salinity values near the southern end of the bay were found to be as low as 1-2 ppt opposed to 29-31 ppt on average closer to the mouth of the bay. This variance in salinity indicates the presence of a freshwater wedge that extends some distance outwards from the Kinvara Springs where it mixes with seawater.
MAPPING THE SPATIAL AND TEMPORAL VARIATIONS OF WATER QUALITY IN DUBLIN BAY

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Dublin Bay is a shallow bay on Ireland’s east coast measuring 296 km\(^2\) and containing the country’s busiest port with 31 million tonnes of cargo and 1.6 million ferry passengers passing through each year. Several unique habitats are also situated within the bay which are home to internationally important bird populations. Due to the ecological significance of the area it has recently been designated as a UNESCO Biosphere. In-depth knowledge of the environmental conditions of such a complex ecosystem is essential to ensure proper management of this national resource. We propose to build on existing physical, chemical and biological data in Dublin Bay by developing in-situ water-column sensors that will be validated with traditional analysis of water properties. Here we present data obtained through a comprehensive study of the bay using a combination of in-situ and remote sensing approaches. Conductivity, temperature, turbidity, and colour dissolved organic matter (CDOM) data were collected using mobile sensing systems and boat based transects. Real-time information was obtained on water column variables that can be used to glean information from remote (including satellite) sensing that provides the information required to develop empirical models that inform and predict coastal response to environmental stimuli. The goal is to integrate this information with seabed mapping, geochemical and microbiological information to get a true picture of water quality in Dublin Bay.
The aims of the study were to assess an environmental condition and observe changes of road specific elements in the Odra and Vistula River in Krakow, Warsaw as well as in Wroclaw and Opole – heavily congested Polish cities. The investigation were carried out in 2015 and 2016. Rivers were sampled in various seasons: summer, autumn, winter and spring. Results of ICP-MS revealed that rivers were contaminated especially with Zn, As, Cd, Cr, Cu, Pb, Fe, Ba and Ce. The concentrations of the majority of these elements varied in the wide ranges and were significantly elevated when compared with the concentrations found in relatively traffic-unpolluted areas in the same cities. Additionally, considering the median values of the metal contents, the regional as well as seasonal differences are visible. According to LAWA classification, rivers water in selected research area of the Vistula and the Odra River are moderately to highly contaminated with heavy metals. Significantly elevated concentration of metals were found in Vistula River (Krakow) as well as in Wroclaw (Odra River). In order to ensure quality of the analytical results, reagent blanks and certified reference materials SRM 1643f were used.

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Heavy metals in soils may pose risks to both ecosystem and human health, especially in an urban environment. The objective of this study is to evaluate the chemical forms and environmental risk of heavy metals in the urban soils using sequential extraction and short-term extraction procedures. A total of 40 contaminated urban topsoils were collected from industrial areas and roadsides of two Chinese cities (Luoyang and Hangzhou). The sequential chemical extraction, toxicity characteristic leaching procedure (TCLP) and 0.05 M EDTA (pH 7) extraction were performed. In order to obtain a measure of metal leachability and bioaccessibility, the ratios between the individual metal fraction and total concentration are calculated. Results show that there are great differences in leachability and bioaccessibility of metals in soils. In the Hangzhou urban soils, the order of TCLP-extractability is Cd>Zn>Pb>Cu>Cr, and EDTA-extractability is Cd>Cu>Pb>Zn>Cr. In the Luoyang urban soils, the order of TCLP-extractability is Pb>Cd>Zn>Cu>Cr, and EDTA-extractability is Pb>Cd>Zn>Cu>Cr. The Cr exhibits the lowest leachability and bioaccessibility among the investigated metals. The Cd has the highest TCLP leachability value in Hangzhou urban soils while Pb has the highest leachability in Luoyang urban soils. The high leachability and bioaccessibility of heavy metals indicates higher potential hazard for the human health and environment. Based chemical forms analysis, the metals Cd, Cu, Pb, and Zn are classified as potentially mobile elements and Cr is classified as immobile.
POTENTIOSTATIC ENRICHMENT OF ELECTROCHEMICALLY ACTIVE BACTERIA FROM SEDIMENTS AND SOILS

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The majority of studies on electrochemically active mixed microbial consortia investigate domestic wastewater. While this is relevant for industrial applications such as microbial fuel cells (MFCs), it is likely that only a small fraction of electrochemically active microorganisms is found in domestic wastewater. Because of the abundance of microbial consortia in soils and sediments, combined with higher insoluble metal and mineral concentrations which can be used as external electron acceptors, soils and sediments are likely to host a much larger diversity of electrochemically active bacteria. There is also potential to discover novel microorganisms capable of Extracellular Electron Transfer (EET) mechanisms with relevant application to biogeochemistry, biosensors and bioremediation. In this study, we will investigate the potentiostatic enrichment and preliminary characterization of electrochemically active microorganisms from contaminated soils and sediments.

Soils and sediments from polluted and pristine sites will be used as inoculum for enrichment of electrochemically active bacteria, enriched by growth on carbon felt working electrodes poised at 0.2 V vs Ag/AgCl in 120 mL stirred anaerobic reactors at 30°C. Carbon felt was selected because of its large accessible surface area for biofilm formation. The microbial composition of the sediment inoculum and the enriched biofilm will be determined by metagenomic analysis. The biofilm’s electrochemical properties will be measured by voltamperometric methods and electrochemical impedance spectroscopy.
TRACKING THE FATE OF POLYCYCLIC AROMATIC HYDROCARBONS IN CONTAMINATED SOILS DURING WINDROW BIOREMEDIATION PILOT PROJECT

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\textsuperscript{1}Dublin City University

Petrochemical contamination of soils leads to adverse effects for human health and local ecology. Of particular concern are sixteen polycyclic aromatic hydrocarbons (PAHs) listed as priority pollutants by the EPA for their known toxic and carcinogenic properties. Bioremediation strategies including aerobic composting have shown promise for degrading PAHs; however studies of the optimal composting conditions for this purpose are limited. Moreover, few open air studies have been undertaken in conditions comparable to the Irish climate, and few simultaneously track these contaminants in the leachate fraction. In this study, we investigate the attenuation of PAHs in a heavily contaminated soil throughout an open air windrow composting pilot project in Ireland. This study supports improved decision making for sites targeted for remediation projects where groundwater or surface water contamination is of concern.

Five windrows were constructed and subjected to the following treatments: four control treatments – 1. no further treatment, 2. aeration only, 3. addition of 10% wood shavings and aeration, 4. addition of 5% green waste and aeration - and one test treatment – 5. addition of 10% wood shavings, 5% green material, and aeration. Soil and leachate samples were analysed throughout the project for PAHs using GC-MS. We report on contaminant attenuation of this soil and discuss the conditions which may favour remediation of PAHs during the composting process. Methods for improving the quantification of PAHs in solid phase and aqueous phase extracts via GC-MS analysis are also investigated and discussed here.
VULNERABILITY ASSESSMENT OF URBAN WATER AND WASTEWATER SYSTEMS FACING HIGH GROUNDWATER LEVEL USING FUZZY DECISION-MAKING APPROACH

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Arid cities in Iran have neither sufficient nor efficient sewage system. The water returned to surface cesspools and leakages from insufficient sewage system makes internal groundwater recharge within the urban area. Additionally, water supply system leakages further raise the groundwater level which produces several potential danger and risks for the infrastructure / foundations and parts of water and wastewater systems. In this paper, a modelling framework based on fuzzy decision making has been developed for vulnerability assessment of water and wastewater collection systems to manage their performance while facing high ground water level under natural or man-made critical conditions. In this model, certain criteria were defined, fuzzy MADM techniques were exploited, and an inference check list was employed to measure such risk parameters as the probability of threats, the severity of their impacts, and the vulnerability of the network components. Based on the calculated magnitude of the risks, the threats and hazards in urban cities facing high ground water level were classified into groups ranging from low-risk to high-risk threats. This procedure was employed for the water and wastewater collection system in Kerman city as a case study in Iran. Kerman city has encountered with high groundwater level causes flowing of wastewater in underground spaces, corrosion of infrastructures and etc. ‘Introduction of chemical pollutants into the sewers’ and ‘drastic changes in wastewater quality’ were identified as the most threatening crises for the district and the ‘risk reduction strategy’ was proposed for combating the critical conditions in this area.
THE ELIMINATION OF NEGATIVE IMPACT OF GEOLOGICAL COMPOUND OF THE ENVIRONMENT ON HEALTH STATUS OF RESIDENTS IN THE KRUPINA DISTRICT, THE SLOVAK REPUBLIC

PS.55 - Poster Session Available from 14th - 17th August - Poster

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Character of geological environment is generally reflected in diverse geochemical background, emitting chemical elements of different composition into groundwater, soils, food chain. These elements have either a positive or negative impact on human health. The Krupina district is located among Neogene volcanics identified by previous studies as the most unfavourable geological environment for human health due to deficit contents of Ca and Mg in groundwater / soils. This is probably reflected in worse health state of population in the Krupina district identified as one of the most unfavourable in Slovakia (increased mortality for cardiovascular and oncological diseases).

The main objective of the project is to improve the health state of the population of the Krupina district. The basic datasets for further analysis consist of environmental indicators (contents of chemicals in groundwater and soils) and health indicators (data on mortality). Through linking of both datasets (via neural networks) limit values for drinking (ground) water and soils, maximum acceptable and minimum contents necessary for human organism, will be defined. Biomonitoring including hair / nail analysis and arterial stiffness measurements is realized to confirm relationship between geological environment and health state residents. Implementation of set of measures including realization of simple technological actions to increase Ca and Mg content in drinking water, legislative measures and increase of public awareness through dissemination will lead to the improvement of the health state of the residents.

The project is supported by the EU Life+ programme (LIFE12 ENV/SK/094) and Ministry of the Environment of the Slovak Republic.
LEAD DISTRIBUTION AND CYCLING IN
FOREST-RICE AGROFORESTRY SYSTEMS IN
NORTHERN HUNAN

PS.56 - Poster Session Available from 14th - 17th August - Poster

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In hilly regions of southern China, rice plants are often cultivated with forests to make up of a forest-rice agroforestry system, where the forests are often occupied in upper parts and the rice paddy fields in lower parts. In this present study, the distribution and dynamic characteristics of Pb were investigated in two types of forest-rice agroforestry systems and one rice paddy system (without forests, as a control) in Taoling Forest Farm, Human Province of China from late May to early September in 2012. The main objectives of this study were to examine transport patterns of Pb in different components of hydrological process and to calculate input-output budgets of Pb in the forest-rice systems. The results showed that (1) Of the total amount of Pb input into the systems by precipitation, about 30.5%~47.3% of them was retained in forests, -6.9%~7.5% was in ponds, 17.8%~21.2% was in rice paddy-fields, and the rest was exported from the systems through rice paddy field water, rice-straw and rice-grain harvestings; (3) Because of the difference of canopy density of forests between the forest-rice agroforestry systems, the Mixed forests-rice paddy system exhibited the highest capacity to retain the Pb, the next was Pine forests-rice paddy system, and the control site had the minimum value of capacity. It seemed that the retaining capacity of Pb was positively related to the canopy density of forests. The canopy density of forests and different forest types affected distribution, transport and output of Lead in the forest-rice agroforestry systems.
**MICROBIAL CO2 FIXATION IN TWO AGRICULTURAL SOILS OF CONTRASTING SOIL TEXTURE**

PS.57 - Poster Session Available from 14th - 17th August - Poster

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Soil microbial autotrophs play an important role in mitigating atmospheric CO2 uptake and they are sensitive to soil properties. However, little is known about how soil texture impacts microbial CO2 fixation processes. Here, a loam clay paddy soil and a sand clay loam paddy soil collected from the same location were incubated with continuous 14C-CO2 labeling, aiming to evaluate the effect of soil texture on microbial CO2 fixation. The CO2 fixation bacterial communities were investigated by quantitative PCR and clone libraries targeting the cbbL gene, which encodes ribulose-1,5-bisphosphate carboxylase oxygenase (RubisCO). After 110 days incubation, the incorporation of 14C-CO2 to soil organic carbon (14C-SOC) were significantly differed in two soils (P<0.05). Higher amount of 14C-SOC was observed in sand loam soil (1350.57 ± 62.01 mg kg⁻¹) than loam clay (1036.53 ± 37.89 mg kg⁻¹) at 0-1 cm soil depth, whereas trend reversed for 14C-SOC concentration at 1-5 cm and 5-17 cm soil depth. 14C-SOC concentrations decreased with increasing soil depths irrespective of soil texture. The differences in incorporation rates of two soils were also reflected by specific CO2 fixation activity, which is the ratio of 14C-SOC concentrations to cbbL gene copy numbers. The compositions of bacterial autotrophs were distinct in two soils, with clones from different soils forming different clusters in the phylogenetic tree. These results indicate that soil texture has a strong impact on the activity and composition of autotrophic bacteria, and improvement of soil texture is helpful for microbial sequestration of CO2.
LEVELS OF POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS IN AIRBORNE FINE PARTICULATE MATTER AND INHALATION RISK ASSESSMENT FOR LOCAL RESIDENTS OF SHENZHEN, SOUTH OF CHINA

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Objectives To explore the levels and congener profiles of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) in airborne fine particulate matter (PM2.5) in Shenzhen, South of China.

Methods A total of twelve samples were collected using the high volume air samplers in six sampling sites in respective winter and spring phase and summer and autumn phase. Referring to the US EPA TO-9A for dioxins detection methods, the concentrations of the 17 PCDD/Fs in airborne fine particulate matter were determined by HRGC/HRMS.

Results The total concentrations of PCDD/Fs ranged from 0.32 to 9.35 pg/m³, with an average of 2.45 pg/m³. The toxicity equivalent (TEQ) concentrations ranged from 0.006 to 0.388 pg I-TEQ/m³, with an average of 0.095 pg I-TEQ/m³. The four abundant congeners were found to be OCDD (36.49%), 1,2,3,4,6,7,8-HpCDF (14.89%), OCDF (13.34%) and 1,2,3,4,6,7,8-HpCDD (10.92%). 2,3,4,7,8-PeCDF was the dominant contributor to toxicity equivalent, accounting for 34.7%. Positive relationship was found between the levels of fine particle-bound PCDD/Fs and PM2.5 concentration (rs = 0.794, p = 0.006), whereas no correlation was observed for temperature, humidity and atmospheric pressure. Inhalation exposure to PCDD/Fs in airborne fine particulate matter (PM2.5) were 0.023 pg I-TEQ/(kg/d) and 0.035 pg I-TEQ/(kg/d) for adult and children during winter and spring respectively, and the values were relatively higher than those of 0.014 pg I-TEQ/(kg/d) for adult and 0.021 pg I-TEQ/kg/d for children during summer and autumn, respectively.

Conclusion The levels of PCDD/Fs in airborne fine particle-bound samples collected in Shenzhen were largely lower than the limit published data in the world.
PAHS CONTAMINATION IN AGRICULTURAL PRODUCTS AND CORRESPONDING HEALTH RISK ATTRIBUTABLE TO SOIL AND AMBIENT PAHS POLLUTION IN A LARGE COKE PRODUCTION BASE IN SHANXI, CHINA

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As one of the largest coke production area in the world, heavy contamination of polycyclic aromatic hydrocarbons (PAHs)—a group of organics with carcinogenic and mutagenic potentials that are mainly produced from incomplete combustion process, in air and soil has been documented, and arisen grown concerns on environmental quality and food safety. In this study, we investigated the contamination of PAHs in agricultural products like wheat and corn grown in a coking base. Rhizosphere soil, dust and ambient samples (gaseous and particulate phases) were collected to look into the relationship between PAHs in agricultural products and the contamination level in soil and/or air. 28 PAHs, including 16 U.S EPA priority PAHs and 12 additional PAHs with some high molecular weight ones, were analyzed using a GC–MS in EI mode. Further efforts are to address potential human health risk due to inhalation and dietary PAHs exposure. The study provide valuable information on the contamination and potential sources of PAHs in agricultural products, and also important suggestions and publicity for local residents and policy makers on the food safety and effective control countermeasures in the coke production base.
MAPPING THE SOIL METAL NO EFFECT CONCENTRATION FOR TERRESTRIAL ORGANISMS IN EUROPEAN COUNTRIES AND COMPARISON TO NATIONAL SOIL POLICIES THRESHOLDS

PS.60 - Poster Session Available from 14th - 17th August - Poster

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High levels of metal concentrations in soils constitute a threat to terrestrial organisms leading possibly to a loss of biodiversity and/or soil functions. This is why most European countries have adopted soil protection policies each containing soil threshold values representing a limit above which remediation interventions will be possibly required. The toxicity of metals in soils has been assessed with the Predicted No Effect Concentration (PNEC) calculator methodology. This approach relies on chronic toxicity data for terrestrial organisms and Ageing/Leaching factors which take into account soil parameters such as organic matter content, clay content, pH and cation exchange capacity. The aim of this study is to map the PNEC in European countries in order to compare their soil threshold values with the observed PNEC values. The soil parameter dataset used for computing the PNEC is the Lucas Topsoil Dataset, which includes 20 000 soils parameter analyses similarly spatially sampled across Europe. Here we presents maps and comparison results for Cu and Zn. The resulting maps show that the PNEC exhibits strong variations across Europe. This map allow to compare the level of the soil threshold values for each country with the observed distribution of PNEC. This approach highlights differences in soil environmental conservation level among the compared countries. Although it takes into account only the soil ecosystem receptors, this work provides a first approach toward consistent soil threshold values across Europe.
GEMAS: MAPPING SOIL PROPERTIES AND METAL CONCENTRATIONS IN AGRICULTURAL AND GRAZING LAND SOIL AT THE EUROPEAN SCALE

PS.61 - Poster Session Available from 14th - 17th August - Poster

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Geochemical Mapping of Agricultural Soils (GEMAS) is a cooperative project between the Geochemistry Expert Group of EuroGeoSurveys (EGS) and Eurometaux. During 2008 more than 4000 samples of agricultural (0-20 cm, Ap horizon) and grazing land (0-10 cm) soil were collected at a density of 1 site/2500 km² from western Europe. The sample density is based on previous experiences of the Geological Surveys with comparable projects. All samples were analysed for 52 chemical elements in an aqua regia extraction, 41 elements by XRF and soil properties like CEC, TOC, pH (CaCl₂) following tight external quality control procedures. The data allow studying the distribution of metals, many other elements and soil properties at the European scale and to better understand the processes driving the observed patterns. Metal concentrations in northern and southern Europe are different, observed concentrations in north-eastern Europe are by up to a factor of 3 lower than in south-western Europe. The break in concentration occurs along the maximum extent of the last ice age. At the European scale element distribution patterns are still governed by natural processes, most often a combination of geology and climate. All anomalies can be clearly identified and are most often associated with known mining areas. The poster shows maps of analytical results obtained for the Ap horizon (67 elements). They are presented in form of a the periodical table and provide a good first overview of the project results.
Agricultural (Ap, Ap -horizon, 0–20 cm) and grazing land soil samples (Gr, 0–10 cm) were collected from a large part of Europe (33 countries, 5.6 million km²) at an average density of 1 sample site/2500 km². The resulting more than 2 x 2000 soil samples were air dried, sieved to <2 mm and analysed for their Hg concentrations following an aqua regia extraction. Median concentrations for Hg are 0.030 mg/kg (range:<0.003–1.56 mg/kg) for the Ap samples and 0.035 mg/kg (range: <0.003–3.12 mg/kg) for the Gr samples. Only 5 Ap and 10 Gr samples returned Hg concentrations above 1 mg/kg.

In the geochemical maps the continental-scale distribution of the element is clearly dominated by geology and Hg mineralisation. Climate exerts an important influence. Mercury accumulates in those areas of northern Europe where a wet and cold climate favours the build-up of soil organic material. Typical anthropogenic sources like coal-fired power plants, waste incinerators, chlor-alkali plants, metal smelters and urban agglomerations (note that some are visible, e.g., London, Paris, Kiev) are hardly detectable at the continental scale but can have a major impact at the local-scale.
SOURCE AND BEHAVIOUR OF GE IN AGRICULTURAL AND GRAZING LAND SOILS AT EUROPEAN CONTINENTAL SCALE

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Agricultural soil (Ap-horizon, 0–20 cm) and grazing land soil (Gr-horizon, 0–10 cm) were collected from a large part of Europe (33 countries, 5.6 million km²) as part of the GEMAS soil mapping project (GEochemical Mapping of Agricultural and grazing land Soil) at an average density of 1 site/2500 km². The area represents soil parent materials with varying geological history, a wide range of climate zones, and landscapes. Germanium concentrations were determined by ICP-MS after a hot aqua regia extraction which will predominantly highlight the non-silicate bound Ge. The median Ge concentration in European soil is 0.037 mg/kg in the Ap and 0.034 mg/kg for the Gr samples.

The Ge maps show a number of fascinating anomalies. The whole Caledonian mountain chain is marked by high Ge concentrations. On first glance this could be taken as a climatic signature, however, Ge does not show any correlation with TOC or rainfall. Also the expected correlation between clay and Ge was not found. Rather high Ge concentrations mark granitic intrusions and related sulphide mineralisation or vein deposits (Portugal, France, Germany, Czech Rep, Sardinia, Greece), carbonate-hosted sulphide deposits (Ireland and in the Alps), iron ore deposits (e.g., Germany) and alkaline Intrusions (Norway, Italy). An anthropogenic impact (e.g. from coal burning or metal smelters) is rarely detected in the European scale maps.
Biases between geochemical survey datasets and procedures for dataset leveling are issues that have been discussed for a long time. Methods proposed in the literature are generally based on common sense, but their performance are not discussed with statistics and indicators figures. Here we propose a general procedure for randomly generating geochemical datasets and assessing the performance of methods applied in geochemical mapping by computer simulation. This procedure is illustrated by the performance comparison between two methods for testing the equivalence between geochemical datasets and for data leveling. The first compared method is based on the Kolmogorov-Smirnov test and quantile regression. The second method is based on BLS (Bivariate Least Squares) regression. Each simulation run consists in randomly generating a reference dataset and a biased dataset and applying the methods to test the equivalence between these two datasets and to level the bias between datasets. After completing 10 000 simulations, we compute several performance indicators aimed at answering the following questions: are the methods efficient to detect the bias introduced into the biased datasets? Are both methods efficient to remove the bias? What is the best method depending on the bias? The results of this study show that computer simulation is a useful tool to identify the particular benefits and limitations of each method, and provide practical recommendations for prudent use of these methods in geochemical mapping.
Precious metal (Ag, Au, Pd, Pt) concentrations are reported for the <2 mm fraction of soil samples from agricultural (Ap horizon, 0–20 cm; N=2218) and grazing land (Gr, 0–10 cm; N=2127). The survey covers 33 European countries and 5.6 million km² at a sample density of 1 site/2500 km². Element concentrations were analysed in two different extractions, aqua regia and mobile metal ion (MMI®) with inductively coupled plasma emission mass spectrometer-finish.

Geochemical maps of Ag and Au for both land use types (Ap and Gr) in aqua regia extraction show overall similar spatial distribution patterns; the dominant feature is the southern limit of the last glaciation, indicated by a sharp break between northern and southern European Ag and Au concentrations. This break, although more subtle, is still discernible on the MMI® extraction Au and Ag maps. Most of the Ag and Au anomalies are geogenic (e.g., associated with known mineralised districts), but there are some interesting anomalous patterns that indicate an anthropogenic footprint (e.g., London, Paris, Madrid).

Although most of the Pd and Pt aqua regia results are below detection, there are a number of interesting continental-, regional- and local-scale patterns. Some of the Pd and Pt aqua regia anomalies are associated with mafic and ultramafic rocks (e.g., Norway, Hellas), but this is not always the case, some are related to karst and bauxite/laterite mineralisation (e.g., Croatia, Bosnia and Herzegovina, Hellas), and to ashes of historical volcanic eruptions of Vesuvius, Campi Flegrei and Mount Vulture (e.g., Italy).
GEMAS: MAPPING ZINC DEFICIENCY IN AGRICULTURAL AND GRAZING LAND SOIL IN EUROPE

PS.66 - Poster Session Available from 14th - 17th August - Poster

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Zinc is an important nutrient needed for healthy growth of crops and well-being of humans and animals. Worldwide, many regions with active agriculture experience severe zinc deficiency which can be easily remediated by using zinc-enforced fertilisers. Zinc deficiency appears to be the most widespread micronutrient deficiency problem in crop and pasture and it affects one-third of the world’s population.

Within the GEMAS Project (GEochemical Mapping of Agricultural and Grazing land Soil), agricultural (Ap) and grazing land (Gr) soil were collected from 33 countries in Europe. Zn concentrations in soil were determined by ICP-MS after an aqua regia extraction (median=45 mg/kg in Ap) and after weak MMI\textsuperscript{\textregistered} extraction (median=0.76 mg/kg in Ap) and total concentrations - by XRF (median=60 mg/kg in Ap).

Generally, zinc concentrations in soil are higher in southern Europe than in northern and central Europe where significant deficiency is related to the dominance of young sandy soil (e.g. Poland) and loess deposits (Ukraine, Hungary). Northernmost regions in Scandinavia are particularly depleted in zinc mainly, due to low soil pH and high TOC which control the removal of zinc from the soil layer. In Spain, the main cause of the zinc deficiency is the high content of calcium carbonate in soil (limestone in the bedrock). Deficiency in northern France can be explained by a combination of factors such as low soil pH, parent materials composed of Cretaceous to Tertiary sedimentary rocks of the Paris Basin and excessive phosphate fertilisation which usually has antagonistic effect on zinc content in soil.
SPATIAL ANALYSIS OF COMPOSITIONAL DATA USING A SPECTRUM-AREA MULTIFRACTAL MODEL IN CAMPANIA REGION (ITALY)

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In this study, the spatial distributions of Mn, Fe, Se and Hg in Campania region (Southern Italy) were explored. The study area covers 13,595 km\textsuperscript{2} on a 16 km\textsuperscript{2} grid in the suburban and agricultural areas and on a 4 km\textsuperscript{2} grid in urban areas. A total of 3,535 top soil samples were collected and analysed by ICP-MS after an aqua regia digestion. The isometric logratio transformation was applied to deal with the closure effects of geochemical data prior to statistical analyses. A spectrum-area (S-A) multifractal model was used to decompose the interpolated maps and to identify background and anomalous components. The results demonstrate that (1) strong anomalies of Fe mainly occur in the pyroclastic coverings of the Somma-Vesuvius volcanic district and the Apennine margin, and the spatial distribution characteristics of Fe in Phlegrean district is different from the Somma-Vesuvius Volcanic district, probably due to the different eruptive history; (2) sedimentary lithologies host widespread Mn anomalies, and Fe and Mn distribution is mostly controlled by geogenic factors; (3) selenium data show a strong correlation with the annual rainfall, and high Se concentration values (> 2 mg/kg) occur in correspondence of the drainage channels network known as “Regi Lagni” affected by urban and industrial wastewater; (4) Hg spatial distribution highlights anomalies (> 1 mg/kg) where urban areas and highway arterial roads occur. These results suggest that the S-A model is a powerful tool to decompose the mixed geochemical patterns and this approach coherent with composition increases information quality.
A MULTIFRACTAL ANALYSIS OF SPATIAL VARIABILITY IN TOP SOIL COMPOSITIONS IN THE CAMPANIAN REGION

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The spatial distribution of elements in topsoils of the Campanian Region are controlled by a number of factors. Chief among them, geogenic controls based on the geological substrate and the influence of anthropogenic activity. The Campanian region comprises a diverse range of morphologies and land uses. Over 50% of available land is committed to agriculture and cultivation, while urbanization has claimed ~15% of the region. A total of 3535 soil samples were collected over the 13,593 km² study area using a 16 km² grid from suburban and agricultural areas, and a ~4 km² grid in urban zones. These samples were analysed for 53 elements using LA-ICPMS, and spatial analysis was performed on each element using multifractal methods. Distribution maps were obtained using an IDW algorithm, and applying a Concentration-Area (C-A) filter to discriminate common behaviours in the spatial distribution of elemental concentrations. A Spectrum-Area (S-A) filter was also used in order to separate the baseline values from anomalies.

Most elements were clearly correlated with the underlying Na–K volcanism (e.g., La, Th, Ti, Na, K) and were generally enriched in areas surrounding the Campi Flegrei and Somma–Vesuvius volcanic regions, while Ca, Mg, and Sr were also enriched in the N and NE of the region, where limestones and dolostones dominate the substrate. Enrichments in Co, Cr, and Ni were associated with the flysch deposits of the NE, while clear enrichments in Pb, Cd, P and Cr were found in areas affected by urbanization, agricultural fertilization, and industrialization.
INTERACTION BETWEEN SULFUR AND LEAD IN TOXICITY, IRON PLAQUE FORMATION AND LEAD ACCUMULATION IN RICE PLANT

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Human activities have resulted in lead and sulfur accumulation in paddy soils in parts of southern China. A combined soil–sand pot experiment was conducted to investigate the influence of S supply on iron plaque formation and Pb accumulation in rice (Oryza sativa L.) under two Pb levels (0 and 600 mg kg⁻¹), combined with four S concentrations (0, 30, 60, and 120 mg kg⁻¹). Results showed that S supply significantly decreased Pb accumulation in straw and grains of rice. This result may be attributed to the enhancement of Fe plaque formation, decrease of Pb availability in soil, and increase of reduced glutathione (GSH) in rice leaves. Moderate S supply (30 mg kg⁻¹) significantly increased Fe plaque formation on the root surface and in the rhizosphere, whereas excessive S supply (60 and 120 mg kg⁻¹) significantly decreased the amounts of iron plaque on the root surface. Sulfur supply significantly enhanced the GSH contents in leaves of rice plants under Pb treatment. With excessive S application, the rice root acted as a more effective barrier to Pb accumulation compared with iron plaque. Excessive S supply may result in a higher monosulfide toxicity and decreased iron plaque formation on the root surface during flooded conditions. However, excessive S supply could effectively decrease Pb availability in soils and reduce Pb accumulation in rice plants.

Keywords: Glutathione, Iron plaque, Lead, Rice (Oryza sativa L.), Sulfur
EFFECT OF LIGHT ON DEGRADATION OF HERBICIDE PROMETRYN IN SOIL

PS.70 - Poster Session Available from 14th - 17th August - Poster

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Prometryn has been used in crop (e.g. corn and sorghum) field or orchard to prevent growth of annual grasses and broadleaf weeds. As a moderately persistent herbicide in soil, prometryn may exert detrimental effects on environments and crop production. Photolysis is a significantly degradation pathway for removal of contaminants. The objectives of the present study were (1) to monitor the process of photodegradation of prometryn with different factors and (2) to investigate the possible prometryn photodegradation pathway.

The present study evaluated photodegradation of prometryn in soil by exploring a variety of factors such as soil moisture, temperature, initial concentration, light exposure and photocatalyst TiO2 that may potentially affect prometryn photodegradation. The photodegradation rate and degradation products of prometryn in soil were analyzed by HPLC and UPLC coupled to LTQ Orbitrap XL respectively.

The result indicated that the dissipation rate of prometryn during a 14-d period was close to 90 % under UV-light exposure. Soil (clay loam) with 60% moisture level was effective for prometryn photodegradation. The increase of temperature and dosage of prometryn accelerated the dissipation of prometryn on soil. TiO2 is a good photocatalyst to promote the photodegradation of prometryn. Analysis of UPLC-LTQ-Orbitrap-MS/MS showed that prometryn decay in soil was through hydroxylation, dealkylation and dethiomethylation pathways.
MIXTURING OF LOCAL MANGANESE MINE WASTELANDS IMPROVED NATIVE TREE SPECIES POTENTIAL PHYTOREMEDATION PERFORMANCE IN HUNAN, CHINA

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The planting of trees on mine wastelands is an effective, long-term technique for phytoremediation of heavy metals contaminated wastes. The selection of suitable tree species for phytoremediation is of key factor for successful restoration of manganese mine wastelands. At the same time, finding the appropriate proportion of the mixturing local manganese mine wastelands has become the key technical measures of improving plant survival rate. In this study, a pot experiment with seedlings of Koelreuteria paniculata, Schima superba, and Pinus massoniana under six treatments of local mine wastes was designed to determine effects of mixturing local manganese mine wastelands on phytoremediation and possible phytoremediation mechanism of different tree species. Results showed that P. massoniana was not suitable for planting on manganese mine wastelands for its low survival rate. Both K. paniculata and S. superba had almost the same survival rate except that no survival of the former under the mine sludge treatments. The tree species of S. superba has different adaptation strategy from K. paniculata in terms of bioaccumulation coefficient factor and translocation factor. Mixturing of mine sludge and mine tailings can effectively improve the survival rates of seedlings of K. paniculata and S. superba. The improved survival rate is closely related with improving soil pH and soil texture of mixturing of mine sludge and mine tailings. Both S. superba and K. paniculata are is suited to restore manganese mine wastelands by mixing the mine sludge with local mine tailings.
IMPACT OF GRASS COVER ON THE MAGNETIC SUSCEPTIBILITY MEASUREMENTS FOR ASSESSING METAL CONTAMINATION OF SOIL

PS.72 - Poster Session Available from 14th - 17th August - Poster

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The assessment of magnetic properties of soils is becoming widely established as a non-invasive in-situ proxy for metal contamination. However, it is recognised that soil vegetative cover can impede on the measurements obtained while the removal of this layer can increase the costs and fieldwork duration of magnetic monitoring studies. This study provides the first field-based examination of the effects of a grass vegetative cover on magnetic susceptibility measurements of underlying soils. Magnetic measurements were taken under two conditions to determine the effects of grass height on MS (volume magnetic susceptibility): 1.) MS GRASS - When the grass layer was present. 2.) MS NO GRASS - After the grass layer was trimmed to the root. The height of the grass was also recorded. Soil samples (n=194) were taken from the same locations and MS (ln) and MS (SOIL) were assessed in the laboratory. Metal concentrations (Cu, Fe, Pb, Zn (mg kg-1)) of soil samples were analysed for comparative purposes. Laboratory-based mass specific susceptibility is the most efficient method of soil susceptibility determination. However, importantly both MS GRASS (ln) and MS NO GRASS (ln) are also strongly correlated to each of the metals. Spatial distribution maps were created using IDW and LISA to identify common patterns across the determined soil characteristics. Notably, MS GRASS and MS NO GRASS are highly correlated r = 0.967, n=194, p=.000. The results suggest that it is not necessary to remove a vegetative layer prior to obtaining in-situ susceptibility measurements of soil.
GEOCHEMICAL INVESTIGATIONS OF HG IN URBAN SOIL OF IDRIJA TOWN

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The presented research deals with urban area of Idrija (3 km², 6000 inhabitants), where the world’s second largest mercury (Hg) mine is situated. The mine was under exploitation for 500 years, leaving behind highly contaminated surrounding soils. On the basis of systematic soil sampling (9 soil samples per km², 45 sampling sites, two depths 0-10 cm and 10-20 cm) Hg properties were examined. After aqua regia digestion, the contents of Hg (ARS Hg) were measured. Using Hg thermal desorption Hg binding forms were identified. After water leaching test, water-soluble Hg fractions and after simulated stomach acid extraction, bioaccessible Hg fractions were estimated using ICP-MS. Spatial distribution of Hg properties was examined using GIS software. Regarding all samples, Hg ranged from 7 to 1550 mg/kg. Two binding forms were identified: matrix-bound Hg and cinnabar (HgS). The maximum of 1.2 % of ARS Hg was estimated to be water soluble and the maximum of 3.3 % of ARS Hg was estimated to be gastric bioaccessible. According to national guidelines, the investigated soil is critically polluted with mercury. This raises concern, because investigated soil is often used for vegetable gardening by the local population. Extremely high levels were detected near identified mercury sources (rocks containing mercury ore, mercury ore residue dumps and old roasting sites). Water-soluble Hg may lead to elevated Hg concentrations in edible plants or groundwater, gastric bioaccessible Hg may lead to elevated concentrations of Hg in the target vulnerable groups of population (children and gardeners), who often undergo hand-to-mouth exposure.
THE STUDY OF WATER QUALITY RESPONSE CHARACTERISTIC IN THE PROCESS OF SURFACE WATER-GROUNDWATER INTERACTION ON THE AREA OF SONGHUA RIVER

PS.74 - Poster Session Available from 14th - 17th August - Poster

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Study on the interaction between surface water and groundwater (SW-GW) can reveal the information that is vital to regional water resource protection, especially for typical irrigation regions in northeastern China. This study investigated 10-km area on both sides of Songhua River, the northeast of China, and explored the characteristic of water quality response in different types of interaction. Three types of SW-GW interaction were classified with water levels' relationship and water exchange capacity with the data of 18 monitoring sections: “recharge”, “discharge”, and “cross-flow”. According to different types of interaction, methods of Single factor index, principal component analysis, and hierarchical cluster analysis were applied in this study. The results demonstrated that the results demonstrated that the SW-GW interaction along the Songhua River basin was obvious: (1) groundwater usually discharges into surface water at upstream area of the Songhua River, (2) groundwater was recharged by surface water at downstream area, and (3) “discharge” and “cross-flow” were coexistence at midstream area. The results of statistical analysis indicated the degrees of water quality response in different types of hydraulic connection were various, which were obvious in “recharge” and “cross-flow” mode, and not obvious in “discharge” mode. During the interaction process, dilution, absorption, redox reaction, nitrification, denitrification, and biodegradation were contribute to change the concentration of pollutants, and affected the effect of water quality response in hyporheic zone.
LITHIUM IN THE NATURAL WATERS OF THE SOUTH EAST OF IRELAND

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The Blackstairs mountains (Carlow region) are rich with deposits of the rare lithium bearing mineral, spodumene. Lithium a desirable resource, is fundamental to the future production and availability of electric cars, i.e. lithium-ion batteries. Ninety percent of the world’s lithium resources can be found in the salt flats of South America, however, a lack of infrastructure has resulted in delays of this lithium entering the global market, advantageously increasing the economic viability of lithium mining in Ireland. The potential benefits of lithium mining in Ireland versus the environmental impact must also be considered. This study aimed to establish baseline levels for lithium and several other metals in our natural waters, in the event that mining were to ever take place this data could be used as a benchmark to ensure that no extraneous metals were being leached into our waters. In addition, the data could also be used to support an environmentally aware mining process. Ground and surface water samples were taken from five sampling transects over the course of 2015. Atomic absorbance and flame emission spectroscopy was used to measure the levels of lithium and nine other metals in the samples. According to Hem 1992, the average amount of lithium found in natural water is normally between 1 and 10 ppb. The current study has revealed lithium levels three times higher than this. With a wealth of mineral deposits undiscovered throughout Ireland, the geochemistry of lithium needs some attention.
PROJECTION OF ENVIRONMENTAL RISK OF SELECTED ORGANIC CHEMICALS IN CHINA: IMPLICATION TO SUSTAINABLE DEVELOPMENT

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China’s rapid economic growth in the past decade has resulted in market growth for the home and personal care products (HPCPs) industry. This growth needs to be counter balanced with Sustainable Development Goals set by the United Nations to reduce chemical releases to wastewater and to protect the water-related ecosystem. Six daily use chemicals, benzophenone-3, octocrylene, octyl methoxycinnamate, triclosan, triclocarban and climbazole were selected to evaluate their environmental risk both in 2012 and under future growth scenarios. Emissions for 2012 were compiled by estimating the usage and wastewater treatment rates. Environmental concentrations were predicted using the SESAMe v3.3 model. Predictions suggested that some freshwater areas of China may exhibit chronic environmental risks owing to triclosan. The predicted environmental concentrations of the other five chemicals were under current ecotoxicity thresholds. Predictions also suggested that agriculture soil could potentially be an important sink for triclosan, climbazole and benzophenone-3, although the concentrations would be low. However, the expected rising middle class and GDP in China will drive further demand. This may be counter balanced by the development of wastewater treatment capacity to removing these chemicals and be complicated considering long-term changes in riverine flows. A preliminary evaluation of future projections implies that increasing demand and usage of these chemicals by 2030 would not result in higher environmental risks compared to the current scenario due to the expected rapid infrastructure construction for wastewater treatment. The methodology can be applied for other emerging or industrial chemicals as a reference for business and environmental sustainable development.
MAPPING RADON RISK IN IRELAND USING AIRBORNE GEOPHYSICS

PS.77 - Poster Session Available from 14th - 17th August - Poster

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Radon is a radioactive element that occurs naturally in rocks and soils as a daughter product of Uranium 238 and Radium 226. Exposure to high concentrations is known to increase the risk of lung cancer (UNSCEAR 2009; WHO, 2009). Accurate mapping of its occurrence can help identify households that are at risk of exposure to high radon levels and highlight areas where buildings require radon mitigation measures.

The Tellus Project is a geochemical and airborne geophysical survey programme, managed by the Geological Survey of Ireland (GSI). As part of the airborne geophysical survey, gamma-ray spectrometry data is employed to measure concentrations of potassium, thorium and uranium in soils and rocks. Using this data in conjunction with groundwater datasets (aquifer classification and vulnerability) can help model radon risk potential. This is different to geogenic radon modelling carried out in other counties where the source rather than the pathway is the main controlling variable analysed. GSI’s models have been constructed and evaluated using indoor radon measurements made available by the EPA. They use multivariate linear regression based on 1km grid squares. The airborne and geological data is assigned to grid squares and correlated with existing indoor radon measurements. Good agreement has been found and new detailed maps of radon risk produced. New anomalous zones have been found and are subject to further investigation. An improved way of communicating these findings from the model and highlighting the risk of radon exposure are also being discussed with the EPA.
DIVERSITY OF ARSENIC OXIDIZING BACTERIA AND MICROBIALLY-MEDIATED ARSENITE OXIDATION IN HOT SPRINGS

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Arsenic in hot springs can contribute to the contamination of surface water or groundwater. Microorganisms could oxidate arsenite (AsIII) to arsenate (AsV) which is less toxic and easier to be adsorbed. In this study, diversity of arsenite oxidizing bacteria and microbially-mediated arsenic oxidation in hot springs in Tengchong of China were investigated. A total of 230 aioA clone sequences were obtained and these sequences were affiliated with four phyla: Betaproteobacteria, Alphaproteobacteria, Deinococcus-Thermus and Aquificae. Betaproteobacteria was mainly distributed in low temperature (T=27.7~42.7°C) and circumneutral or light alkaline (pH=7~9) springs; Alphaproteobacteria was mainly predominant in low pH (pH=3.3~3.6) springs; Deinococcus-Thermus and Aquificae were mainly inhabited in high temperature springs with a wide range of pH. Deinococcus-Thermus was dominant when springs had a pH within 4~8. While Aquificae dominated springs with pH > 8 or pH < 4. A new facultative chemolithoautotrophic arsenite-oxidizing bacterium TCC9-4 was obtained. This strain could grow with arsenite (AsIII) as an energy source, CO2-HCO3- as a carbon source and oxygen as the electron acceptor in a minimal salts medium. Under chemolithoautotrophic conditions, more than 90 % of AsIII (100 mg/L) could be oxidized by the strain TCC9-4 in 36 hours. The highest AsIII oxidation rates and Aio activity were found at the optimal temperature of 40 oC. Addition of 0.01 % yeast extract enhanced the growth significantly, but delayed the AsIII oxidation. The strain TCC9-4 was identified as Anoxybacillus flavithermus. The results of this study expand our current understanding of microbially-mediated arsenic oxidation in hot springs.
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