MANCHESTER
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HELLO TOMORROW

Faculty of Science and Engineering

POSTGRADUATE RESEARCH

Programme of Events

Department of Earth and Environmental Sciences Postgraduate Research Conference

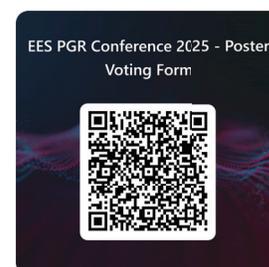*Wednesday 19th November 2025*

Conference Overview

Time	Session	Location
12:30 – 13:00	Poster Preparation	PGR Common Room, 1st Floor Williamson
13:00-14:30	Welcome Address & PGR Presentations *HoPGR Clare Robinson*	Williamson G.03
14:40 – 15:30	Pizzas & Poster Lunch Session	PGR Common Room, 1st Floor Williamson
15:30 – 17:00	PGR Presentations Continued	Williamson G.03
17:00 - 17:30	Drinks & Cheese Prize Reception & Closing Address *HoD Prof. Ann Webb*	Dinosaur Foyer

Please note that the Williamson building will close at 18:00.

Voting Instructions

Poster Voting
- All PGRs and staff can vote for their favourite poster using the online Microsoft form. **This form will close at 15:45.** Winners will be announced in the prize ceremony.

Presentation Voting
- A selected panel of academic colleagues will vote for their favourite presentations using a paper form. Instructions for this will be communicated to selected judges by Dr Clare Robinson and the PGR Experience Team.

Prizes & Certificates

- All PGRs presenting posters and talks can collect a certificate of participation for their records.
- Prize Certificates & Vouchers: 1st Place - £50, 2nd Place: £30, 3rd Place - £20.

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Presentation Schedule

Instructions for Talk Presenters

- Email your slides to FSE Doctoral Academy by 3pm on Tuesday 18 November. This will ensure that changeovers are efficient.
- Arrive to G:03 at 12:50 so that the session can begin at 13:00 prompt.
- You have up to 10 minutes to present, and up to 5 minutes to welcome questions from the audience.

Session 1: 13:00-14:40	Presenter	Title
1	Micol Dellavalle	Mechanisms controlling diversity affect the stability-diversity relationship of competitive communities
2	Amy Kember	Changing degassing dynamics during mild basaltic eruption transitions: insights from XCT analysis of vesicle textures in Fagradalsfjall tephra
3	Huihui Long	Satellite-based global monitoring of urban-scale methane emissions
4	Nathan Millen	Eight-Legged Random Walks: Network Models of Tick-Borne Disease from Host GPS Data"
5	Nazmunnahar Nazmunnahar	Removal of reactive dyes from textile industry wastewater through combined adsorption and electrochemical oxidation
6	Flora Reid	The influence of metal cations on dsRNA adsorption and stability at goethite surfaces
Session 2: 15:30 – 17:00	Presenter	Title
7	Alexander Riddell	SO_2 flux measurements from ground, air and space before, during and after a lava fountain on Mt Etna
8	Denalis Rohaningsih	Predicting the Evolution and Fate of Iron/Organic Carbon colloids (FeOCc)
9	Harry Savage	Quantifying disparity in annelid locomotion using discrete non-morphological characters
10	Ritwick Sen	H_2O and F Contents of Voluminous Younger Deccan Traps Eruptions in Early Palaeogene
11	Sarla Thawre	Missing value imputation for improving Air Pollution data quality- A case study of Nagpur 2018-2024
12	Xiao Yulun	Shock metamorphism of lunar basaltic meteorites

Poster Information

Instructions for Poster Presenters
- Arrive between 12:30-13:00 to display your poster in advance of the session
- The PGR Experience team will have assigned you a poster number and provide Velcro for adhesion
- Ensure you are present to discuss your poster throughout the 14:30-15:30 session
- Collect your prize certificate and/or certificate of participation at the 17:00 drinks reception.

Poster Number	PGR	Research Group/Theme
1	Maram zaki h Al Saif	Basins Studies
2	Max Barclay	Geomicrobiology and RADER
3	Elise Gaulier	Isotope geochemistry
4	Priya Gordon	ICAL
5	Patrick Harvey	Geomicrobiology
6	Becky Hirst	GEOMICRO
7	Rebecca Hughes	Geoscience
8	Ayesha Israr	Microbial
9	Thomas Pierce-Jones	Geoscience
10	Felicity Marlanda Roberts	Interdisciplinary Centre for Ancient Life (ICAL) - The Microbiology of Decay and Fossilisation
11	Mingchong Wang	Molecular Environmental Sciences
12	Lingyun Wu	Basins Group
13	Flavia Rojas Guzman	Geosciences - Volcanology

Presentation Abstracts

Mechanisms controlling diversity affect the stability-diversity relationship of competitive communities

M. Dellavalle [1*], R.T. Gilman [1]

* presenting author, micol.dellavalle-2@manchester.ac.uk

[1] Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

The relationship between biodiversity and ecosystem stability has fascinated community ecologists for decades. Before the 1970s, ecologists thought that more diverse communities are likely to be more stable, but subsequent theory and empirical studies have provided mixed results. This is partly because researchers have used different definitions of stability. However, even when researchers have defined stability in the same ways, empirical results have been conflicting, with some finding that more diverse communities are more stable and others finding that they are less stable. Here, we propose that the diversity-stability relationship is shaped by a mechanism that has been previously neglected – namely, how biodiversity is maintained. We studied stability in computationally simulated communities where we controlled diversity by changing species pool size, species immigration rates, or niche homogenisation. We studied five measures of stability and found that, for four of those measures, the direction of the diversity-stability relationship depends qualitatively on how diversity is controlled. Our results show that, if we want to understand ecosystem stability, it is not enough to know how diverse an ecosystem is. We also need to understand why it is or is not diverse.

Changing degassing dynamics during mild basaltic eruption transitions: insights from XCT analysis of vesicle textures in Fagradalsfjall tephra

B. A. Kember [1*], M. E. Hartley[1], M. Polacci[1] E. Evans[2] L. Mancini[3]

* amy.kember@manchester.ac.uk

[1] Geosciences Group, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] Henry Moseley X-ray Imaging Facility, Photon Science Institute, Alan Turning Building, Manchester, M13 9PY, UK

[3] Slovenian National Building and Civil Engineering Institute, 1000 Ljubljana, Slovenia

Keywords: Magma degassing, X-ray computed tomography, eruption style transitions, vesicle size distributions, basaltic volcanoes, Iceland

The 2021 Geldingadalir eruption (Fagradalsfjall volcano, SW Iceland) demonstrated transitions between mild and explosive activity over many months. Transitional and hybrid behaviour presents evolving risk management challenges for local populations. A key driver of volcanic eruptions is the exsolution of magmatic volatiles to form vapour bubbles which are preserved as vesicles in tephra. We have scanned tephra samples from temporally and spatially well constrained eruption phases using X-ray computed tomography (XCT) (Figure 1). We present quantitative analysis of textural features, such as vesicle volume distributions and tortuosity of the connected pore space, to interpret processes occurring within the ascending magmatic foam. We consider these textural insights in light of existing models of eruption style transitions at basaltic volcanoes [1] [2] [3] with particular focus on the degree of melt-gas segregation and gas transport efficiency.
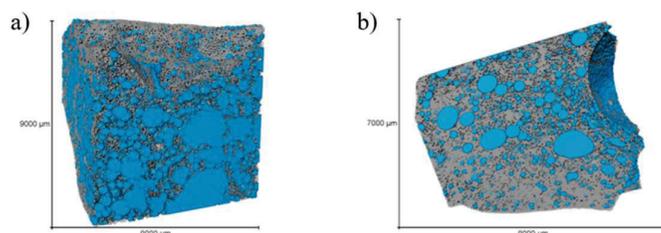

Figure 1. Volume renderings of tephra. Contrasting vesicle textures evident during a) mild activity (lava effusion, spatter, mild Strombolian bubble bursting) and b) sustained lava fountaining.

References

1. Parfitt, E.A., *A discussion of the mechanisms of explosive basaltic eruptions.* Journal of Volcanology and Geothermal Research, 2004. **134**(1-2): p. 77-107.
2. Gaonac'h, H., S. Lovejoy, and D. Schertzer, *Scaling vesicle distributions and volcanic eruptions.* Bulletin of Volcanology, 2005. **67**(4): p. 350-357.
3. Colombier, M., et al., *Degassing and gas percolation in basaltic magmas.* Earth and Planetary Science Letters, 2021. **573**.

Satellite-based global monitoring of urban-scale methane emissions

Huihui Long [1*], Grant Allen [1], Maria Tsivlidou [1]

* Huihui Long, huihui.long@postgrad.manchester.ac.uk

[1] Department of Earth & Environmental Science, Simon Building, University of Manchester, Manchester M13 9PL, UK

Quantifying and understanding methane emission profiles of cities are of great importance since cities are a key focus of current and future mitigation efforts to combat climate change. However, little research has been done to characterize and verify city scale emission inventories. Also, the representativeness of studies that seek to provide a robust methodology to address existing large uncertainties is currently unknown. In this study, we have developed and tested an advanced method that involves mass balance emissions accounting and satellite observations from TROPOMI to estimate daily city-level methane emissions and corresponding emissions uncertainties. We test and validate the method and demonstrate that the novel integration of boundary layer height and hourly wind data enables robust assessment of methane emissions from urban areas. Initial assessments with this approach were tested for three global megacities (London, Los Angeles and New York) from 2021 to 2023. Our results suggest that emission inventories generally underestimate methane emissions but by greatly varying proportions, and with large differences year-to-year. For example, in New York city in 2021, we find emission rates of CH_4 equal to 52.11 ± 22.35 t h^{-1}, compared to reported inventories of 7.18 t h^{-1} estimated by the U.S. Environmental Protection Agency. Our results provide evidence that satellites can serve as a promising technology for ongoing city emissions detection, reconciliation and reporting through long-term monitoring across the globe, which can be used to help build methane emission characteristics and track whether emission targets are being met.

Title: "Eight-Legged Random Walks: Network Models of Tick-Borne Disease from Host GPS Data"

P.G. Researcher: Nathan Millen

Supervisor: Tucker Gilman

Nathan.millen@postgrad.manchester.ac.uk

Keywords: Tick-borne disease, movement ecology, parasites, graph theory, random walk theory, Markov chains, epidemiology

Abstract:

Most models of tick-borne disease omit explicit host movement and population structure, limiting their ability to generate robust predictions and effective control strategies. Using GPS data from free-roaming domestic dogs across multiple populations, we construct networks of host-tick contact that define potential tick transfer pathways. Tick dispersal is then modelled as a random walk across these networks, allowing us to simulate the spread of diverse tick-borne pathogens and evaluate different control strategies. We show that interventions targeting network edges—such as restricting host movement or tick repellents —are substantially more effective than node-level measures such as culling or environmental acaricide use. This framework offers a generalisable, data-driven approach for linking host movement, network structure, and vector-borne disease dynamics in complex ecological systems.

Picture:
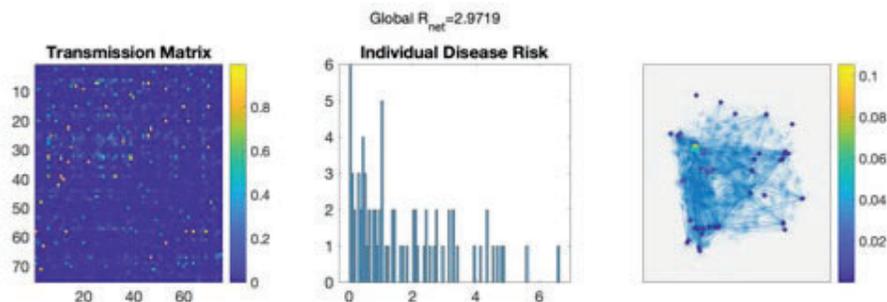
Removal of reactive dyes from textile industry wastewater through combined adsorption and electrochemical oxidation.

Nazmunnahar, N.[1]*, Boult, S.[1] and Brown, N.[2], and van Dongen, B.E.[1]

* Presenting author, nazmunnahar@manchester.ac.uk

Molecular Environmental Sciences Group, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] Arvia Technology Ltd., Heath Business and Technical Park, Cheshire, WA7 4EB, UK

The textile industry is a major contributor to global water pollution, discharging dye-rich effluents that are chemically stable, highly soluble, and resistant to conventional treatment. Reactive dyes are widely used for colouring cellulosic fabrics, but their low fixation efficiency leads to significant dye release into wastewater, threatening aquatic ecosystems and human health. Conventional treatment methods often suffer from high energy demand, sludge generation, and/or incomplete mineralisation.

This study investigates the efficiency of a novel hybrid treatment process combining adsorption with electrochemical oxidation (the Nyex Rosalox process; NR process) for the removal of two widely used industrial reactive dyes, Reactive Blue 19 and Reactive Orange 16, from textile effluent under batch flow conditions, without the generation of (toxic) by-products. To simulate real industrial wastewater conditions, the impact of key operational parameters, including pH, salinity (up to 5 g/L NaCl), temperature (up to 50 °C) and the presence of competing contaminants, including the presence of mixed-dye solutions were examined. Reusability of the effluents after treatment was assessed by applying treated water for fabric dyeing trials.

The results to date indicate that using the NR process, both dyes can be completely removed without the generation of (potentially) toxic by-products. The system maintained its effectiveness across varying pH levels, achieving up to 40% higher dye removal at acidic and alkaline conditions, while increasing the effluent temperature showed no adverse impact on performance. To simulate a more complex scenario, a concentrated solution was treated under these optimised conditions, achieving complete dye removal within five hours. The system performed consistently when treating a complex dye mixture, suggesting its viability for treating actual textile effluents. Reusability tests further indicate that treated water can be reused for fabric dyeing without compromising outcome, highlighting a promising potential for industrial water reuse and reducing groundwater stress.

Combined, these findings highlight the potential of this novel hybrid treatment process for sustainable textile wastewater treatment and water recovery. Ongoing work will extend evaluation to other reactive dyes and real textile effluents in continuous-flow systems to assess industrial feasibility.

The influence of metal cations on dsRNA adsorption and stability at goethite surfaces

Flora Reid [1*], Richard Kimber [1], Victoria Coker[1]

* presenting author, flora.reid@postgrad.manchester.ac.uk

[1] Molecular Environmental Science, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

Keywords: Double-stranded RNA, Adsorption, Mineral-catalysed hydrolysis, Iron oxyhydroxides, Environmental fate

RNA is an essential biomolecule with emerging applications in environmental technologies such as wastewater-based epidemiology, RNA interference pesticides and transcriptomics. Although generally considered to be readily biodegradable in the environment, double-stranded (ds)RNA exhibits enhanced resistance to hydrolysis compared to its single-stranded counterpart, possibly enhancing its retention in environmental systems. However, hydrolysis at iron (oxyhydr)oxide mineral surfaces constitutes a notable abiotic degradation process which could impact dsRNA persistence in the environment[1]. As such, the environmental fate of dsRNA is likely regulated by a variety of geochemical factors but the mechanisms controlling dsRNA fate and their relative contributions are not well understood. In this work, we investigated the effect of pH and the presence of various metal cations (Na, Ca, Mg, Ni, Zn) on adsorption of polyadenylic-polyuridylic acid (poly(A:U)), a synthetic dsRNA analogue, at goethite surfaces through a series of batch equilibrium tests. Stability of poly(A:U) adsorbed to goethite in the presence and absence of Ca and Zn was also assessed over longer timescales (4 days) through analysis of fragment size distribution by automated gel electrophoresis. We found poly(A:U) adsorption to be profoundly influenced by solution pH and enhanced with increasing divalent metal concentration at all pH levels tested. Despite goethite catalysed hydrolysis, a broad size distribution of poly(A:U) was found to persist even after 4 days, suggesting that hydrolysis may induce fragmentation but not complete degradation of dsRNA polymers. Additionally, the size distribution between poly(A:U) adsorbed in goethite-only systems and goethite-metal systems after 4 days was similar, suggesting the presence of metals strongly influence dsRNA adsorption but may play a smaller role in impacting hydrolysis at the mineral surface. Our results indicate that dsRNA may exhibit greater persistence under specific geochemical conditions than previously recognised, offering a foundation for mechanistic understanding of the factors governing its environmental fate.

References

[1] Zhang, K., et al. (2023). 'RNA Hydrolysis at Mineral–Water Interfaces' *Environmental Science & Technology*, 57 (22), pp. 8280-8288

SO$_2$ flux measurements from ground, air and space before, during and after a lava fountain on Mt Etna

Alexander Riddell[1], Mike Burton[1,3], Ben, Esse[1], Brendan McCormick Kibride[1], Giuseppe Di Grazie[2], Alessandro La Spina[3], Giuseppe Salerno[3]

[1]School of earth and environmental Science, University of Manchester, Manchester, UK

[2] Istituto Nazionale di Geofisica e Vulcanologia: Roma, Lazio, Italy

[3]Istituto Nazionale di Geofisica e Vulcanologia: Catania, Sicily, Italy

Quantifying volcanic gas emissions, particularly sulfur dioxide (SO$_2$), is essential for understanding magmatic processes and improving eruption forecasting. We present a four-day multi-platform investigation of SO$_2$ emissions at Mt Etna, Italy, spanning the 15th-18th July 2024 and capturing the build-up, climax, and recovery from a major paroxysmal eruption at the Voragine crater on the 15th July 2024. Measurements were obtained using ultraviolet spectrometers traversed by car and drone. Spectra from these sources as well as those acquired by the FLAME network of scanning spectrometers were analysed using the iFit intensity fitting algorithm, providing consistent retrievals of SO$_2$ slant column densities and allowing application of a light-dilution correction based on dual-waveband diagnostics. For all three methods the source of wind speed measurements used in the flux calculation is derived from the drone when available. These results were supplemented by SO$_2$ emissions rates derived by PlumeTraj analysis of TROPOMI SO$_2$ imagery.

Across the integrated dataset, SO$_2$ emission rates increased from ~6 kg/s in the late morning up to 40 kg/s approximately two hours before lava fountaining commenced, when ground and aerial measurements ceased. PlumeTraj analysis of TROPOMI imagery reveals a peak flux of 720 kg s^{-1} and a total SO$_2$ release of 7.0 ± 1.7 kt during the eruption. Volcanic tremor amplitude rose concurrently with the pre-eruptive SO$_2$ increase, but briefly decoupled during the fountaining phase, likely reflecting a change in the dominant seismic source. Following the event, all methods recorded reduced fluxes below pre-eruptive baselines on 16th-17th July, consistent with the depletion of the shallow reservoir, before emissions began to recover by the 18th July.

Each platform contributed complementary strengths: the drone spectrometer offered the highest signal-to-noise and allowed direct correction for light dilution; car traverses provided complete plume cross-sections but limited temporal resolution; fixed scanners captured short-term degassing fluctuations and correlated closely with tremor but were dependant on plume directions and scanner geometries; and PlumeTraj quantified the eruptive fluxes not observable from the ground. Together, these results demonstrate that no single technique can fully characterise degassing across all eruptive phases, but that coordinated, multi-platform SO$_2$ monitoring provides a powerful framework for resolving rapid emission dynamics and enhancing eruption-forecasting capability at persistently active volcanoes.

Predicting the Evolution and Fate of Iron/Organic Carbon colloids (FeOCc)

Denalis Rohaningsih [*], Stephen Boult, Samuel Shaw, Bart van Dongen
* presenting author, denalis.rohaningsih@postgrad.manchester.ac.uk
[1] Molecular Environmental Science, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

Iron (Fe) oxyhydroxides play a key role in controlling contaminant transport in natural waters as they form a major component of the particle surfaces available as sorption sites. Prediction of water quality, therefore, requires prediction of the amount of Fe oxyhydroxide surface area, and whilst this is known to be a function of redox and pH, it is now recognised to also be a function of the type and concentration of natural organic matter (NOM). Under oxic conditions Fe(II) is rapidly oxidised to Fe(III) which precipitates as insoluble $Fe(OH)_3$. However, NOM can interact with Fe(II) to prevent its oxidation, with Fe(III) to prevent its precipitation as $Fe(OH)_3$, and with $Fe(OH)_3$ to prevent its agglomeration into settleable particles. This production of Fe–Organic Carbon colloids (FeOCc) can thereby control the specific surface area of $Fe(OH)_3$ and, more broadly, the reactivity of Fe. This work aims to determine the dominant controls on the production of a range of FeOCc; for example, how do different types of NOM change the speciation and particle size of Fe.

Methods have been developed to characterise NOM and to simulate in the laboratory the evolution of Fe(II) to $Fe(OH)_3$ that would occur in a natural water. NOM from a river was characterised by size separation, using Tangential Flow Ultrafiltration (TFU), into classes ranging from 0.2 μm to 3 kD. The acid functional group profile of each size class was evaluated by titration and its absorbance spectrum (190 – 700nm) recorded. Fe evolution results in generation of acidity, which in a beaker will eventually limit the oxidation, therefore to simulate open water an automatic titrator was used to maintain a constant pH in a beaker. Monitoring the amount of base added by the titrator also allowed the production of $Fe(OH)_3$ to be monitored, whilst FeII was monitored by ferrozine assay.

The amount of NOM (total organic carbon – TOC) varied between size fractions. Each size fraction produced a unique titration curve, with the smallest fraction (<10 kD) showing a faster pH increase, indicating higher Fe complexation potential. Evolution of Fe has been monitored in a beaker in the absence of NOM and has generated waters with the range of species and particle sizes that were predictable from the work of Davison and Seed (1982).

These findings demonstrated that the methods can now be applied to prepare NOM for further chemical analysis, and to study the evolution of Fe in the presence of this NOM. Further high-resolution characterization (including FTIR, GC-MS, and Direct Light Scattering) will be performed to enhance the understanding of Fe-NOM interactions and the conditions of the simulation will be developed to enhance their environmental significance.

Keywords: Fe speciation, Fe evolution, natural organic matter, Fe-organic colloid

Reference:

Davison, W. S., G. (1982). The Kinetics of the Oxidation of Ferrous Iron in Synthetic Natural Waters. *Geochimica et Cosmochimica Acta*, 47, 67-79.

Title: Quantifying disparity in annelid locomotion using discrete non-morphological characters

Authors: Harry J. Savage[1], Russell J. Garwood[1], Jane C. Reeves[1], Thomas J. Smith[2], Robert S. Sansom[1], William I. Sellers[1], Luke A. Parry[2]

1 - Department of Earth and Environmental Sciences, University of Manchester

2 - Department of Earth Science, University of Oxford

Abstract:

Locomotion is an integral part of survival for most animals, and consequently, locomotory strategy captures various aspects of phenotype. Despite its importance, disparity in locomotion is rarely studied quantitatively. Annelid worms comprise a taxonomically and morphologically diverse phylum and show great variation in their locomotion. This is evident when comparing the two major annelid subclasses, Errantia and Sedentaria, which are generally characterised by differing locomotory strategies. Using a novel technique to characterise phenotypic disparity by describing locomotory strategy with a suite of discrete non-morphological characters, we show that the evolution of annelid locomotion is driven by both anatomical and ecological factors. Annelid locomotion can be broadly divided into two types, appendage-using and non-appendage-using, which align with the Errantia and Sedentaria respectively. Locomotion strategy is weakly associated with feeding guild and lifestyle, but the combined effect of the sampled ecological variables is capable of explaining the majority of locomotory variation observed. In general, Sedentaria display more locomotory disparity than Errantia and microphagous taxa are the most disparate feeding guild. In contrast to motile pelagic annelids, infaunal and epifaunal annelids are highly disparate. Our results demonstrate that locomotory strategy constitutes an important aspect of disparity, shaped by anatomy and ecology, and the strong correlation between ecology and locomotion highlights the adaptability of the annelid body plan.

H$_2$O and F Contents of Voluminous Younger Deccan Traps Eruptions in Early Palaeogene

R. Sen [1,2*], M. Hartley [2], M. Polacci [1], S. Gupta[2]

* presenting author, ritwick.sen@manchester.ac.uk

[1] Petrology and Volcanology, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] Department of Geology and Geophysics, Indian Institute of Technology Kharagpur, Kharagpur, 721302, India

Keywords: Volatile budget, lava flows, melt inclusions, augite, equilibrium melt

Volatile emissions from the extensive lava flows of the Deccan Traps, India, are considered to be one of the primary drivers of the Cretaceous-Palaeogene mass extinction event ~66 million years ago [1]. H$_2$O and F are among the most soluble volatile species in silicate melts and therefore exert strong control over eruptive style. In this study, the pre-eruptive H$_2$O and F contents of the most voluminous phase of Deccan eruptions are quantified using melt inclusions and clinopyroxene-melt equilibrium calculations. The average melt F content of the Ambenali Formation, measured using both approaches, yields consistent values of ~560 ppm (Fig. 1a). In contrast, the average melt H$_2$O content determined from melt inclusions is ~1.69 wt%, compared with ~0.16 wt% obtained from cpx-melt equilibrium calculations (Fig. 1b). The low average H$_2$O content estimated from cpx-melt equilibrium calculations likely reflects diffusive re-equilibration of H$_2$O in cpx grains with the surrounding degassed melt within the lava flow [2]. Quantifying the H$_2$O and F concentrations is critical for understanding the extent to which volatile emissions reached the end-Cretaceous and early Palaeogene stratosphere and influenced global climate during the most voluminous phase of Deccan volcanism.
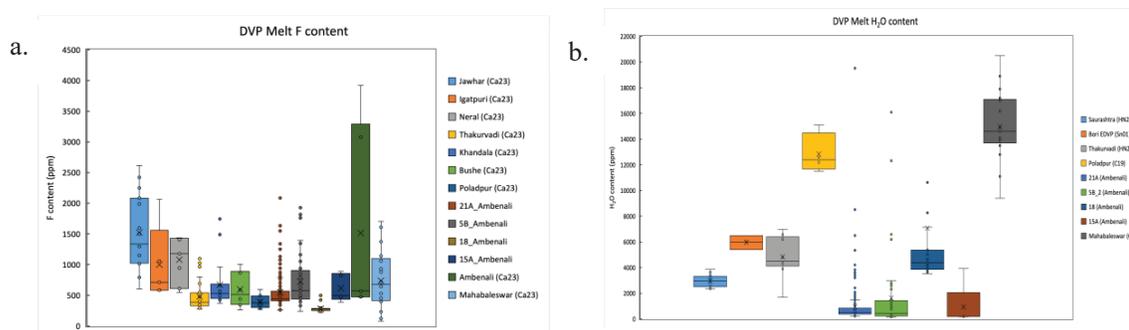

Figure 1. Pre-eruptive magmatic content of: a. F and b. H$_2$O across different chemostratigraphic formations of the Western Ghats region, Main Deccan Traps.

References

[1] G. Keller, et al., *Mercury Linked to Deccan Traps Volcanism, Climate Change and the End-Cretaceous Mass Extinction*. Glob. Planet. Change (2020), 194, 103312.

[2] A. Lloyd, et al., *An Assessment of Clinopyroxene as a Recorder of Magmatic Water and Magma Ascent Rate*. J. Petrol. (2016), 57 (10), 1865–1886.

Missing value imputation for improving Air Pollution data quality- A case study of Nagpur 2018-2024

Sarla Thawre[1*], Dr. Hugh Coe[1], Dr. Amanda Lea-Langtan[1], Dr. Grant Allen[1]

* Presenting author, sarla.thawre@postgrad.manchester.ac.uk

[1] School of Natural Science, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

Keywords: Data Imputation, Air pollution, Random Forest, MissForest

The air pollution observational data contains missing values due to inconsistent reporting, machine failure, maintenance gaps etc. the inability to evaluate and handle missing data will significantly hamper the data analysis process. To resolve this issue, the missforest, a non-parametric imputation method based on random forests, is employed to obtain the missing values in the air pollution data from Nagpur city, India, for the years 2018-2024. The data set included particulate matters, sulphur dioxide, nitrogen dioxide, ozone and meteorological parameters such as temperature, humidity, precipitation, windspeed, wind direction.

The results indicated that imputation is efficient for most pollutants, particularly with larger sample sizes, while sites with fewer observations display slightly reduced accuracy. This approach improves the reliability of air quality assessments and facilitates more precise measurement of the health impacts of air pollution in rapidly developing environments.

Shock metamorphism of lunar basaltic meteorites

Yulun Xiao[1*], Joshua Snape[1], Bre Oliveira[1], David Neave[1], Margaret Hartley[1], Anthony J. Irving[2], Katherine Joy[1]

*presenting author, yulun.xiao@postgrad.manchester.ac.uk

[1] Department of Earth and Environmental Sciences, University of Manchester, Manchester, M13 9PL, UK. [2] Department of Geological Sciences, University of Washington, Seattle, WA 98195, USA

Keywords: Lunar basaltic meteorites; Shock metamorphism; Raman spectrum

Introduction: Lunar meteorites are crucial for understanding past magmatic events on the Moon, but they may have been modified by subsequent impact events. These shock events can cause mineral deformation, reset geochronological systems, and induce localised to complete melting [1-3]. Distinguishing the chemical and petrographic fingerprints of shock impacts in pristine endogenous igneous lunar rocks is essential for exploring the Moon's past igneous and impact history.

This study focuses on several shocked lunar basaltic meteorites: Northeast Africa (NEA) 039, Northwest Africa (NWA) 12839, and NWA 15952. All these samples exhibit abundant vesicles and glassy melt pockets (Figure 1). The goal of this study is to examine the pressure and temperature conditions responsible for the formation of these vesicles and glassy features, and to determine whether they formed through lunar igneous processes (i.e., magma degassing [4, 5]), impact-induced melting (i.e., shock melting [6, 7]), or other mechanisms.

Meteorite Petrography and Raman Spectrums: NEA 039 is a low-Ti, unbrecciated basalt [8]. The vesicles in NEA 039 are mostly round, with glassy mantles on the millimetre scale (Fig. 1a). Silica polymorphs within NEA 039 are mainly coesite and cristobalite; NWA 12839 displays a diabase texture, and glassy pockets mostly exhibit elongated shapes (Fig. 1b). Silica polymorphs are mainly coesite and quartz; NWA 15952 shows an ophitic texture, and the largest vesicles are approximately 1 mm in size, and microfractures radiating out are often observed (Fig. 1c). Silica polymorphs are mainly coesite.

Conclusions: vesicles in the basaltic meteorites are round or elliptical, ranging in size from 0.1 to 1 mm, and are surrounded by a glass-rich mantle (Fig. 1). Additionally, glass pockets and veins are present without vesicles. Impact induced shock may have caused localised melting, indicating that all four samples experienced localised pressures of >45 GPa [6].
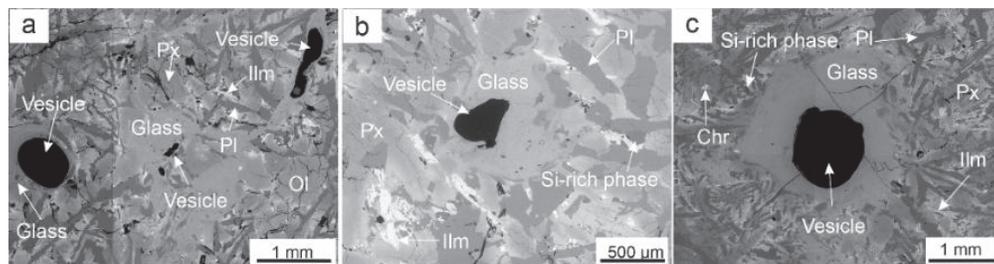

Figure 1: Vesicles within NEA 039 (a), NWA 12839 (b), and NWA 15952 (c). Mineral abbreviations: Chr, chromite; Ilm, ilmenite; Ol, olivine; Pl, plagioclase; Px, pyroxene.

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Impacts of entrainment on secondary ice production in deep convective clouds

Bowen. Zhu [1*], Paul. J. Connolly [1], Alan. M. Blyth [2], Huihui Wu [3]

* Presenting author, bowen.zhu@manchester.ac.uk

[1] Centre for Atmospheric Science, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] National Centre for Atmospheric Science, University of Leeds, Leeds, UK

[3] Univ Paris Est Créteil and Université Paris Cité, CNRS, LISA, 94010 Créteil, France

Keywords: Secondary Ice Production; Deep Convective Clouds; Entrainment

The accurate representation of secondary ice production (SIP) is crucial for understanding the microphysics of deep convective clouds, yet the underlying mechanisms remain uncertain. We used the University of Manchester bin microphysics parcel model to simulate trajectories through convective clouds observed during the Deep Convective Microphysics Experiment (DCMEX). Four SIP parameterisations were examined: rime splintering, ice–ice collisional breakup, spherical freezing fragmentation of drops (mode 1), and fragmentation between supercooled droplets and larger ice particles (mode 2). Our results indicate that mode 2 is the dominant mechanism explaining the observed high ice particle concentrations, whereas rime splintering remained largely inactive. We further investigated the effects of adiabatic, homogeneous, and inhomogeneous entrainment conditions. Homogeneous mixing best reproduced observed cloud properties and, when combined with aerosol entrainment, accelerated droplet growth and ice enhancement. Mechanisms dependent on large droplets, such as mode 2, were particularly sensitive to entrainment, highlighting the need to represent mixing processes accurately in models.

HELLO TOMORROW

Faculty of Science and Engineering

POSTGRADUATE RESEARCH

Poster Abstracts

Please note that not all presenters have submitted an abstract

Chemostratigraphic Analysis of a Cline Shale Core (Wolfcamp-D) in the Midland Basin, Texas, USA

Maram AlSaif [1*], Mauro Becker[2], Art Donovan[2], Franco Marcantonio[2]

* presenting author, maramzakih.alsaif@postgrad.manchester.ac.uk

[1] Basins Group, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] Texas A&M, College Station, 77840, United States

Basinal mudrocks assigned to the Wolfcamp Group in the Midland Basin are prolific producers of oil and gas. Technological advancements in horizontal drilling and hydraulic fracturing have been successful in the exploitation of oil and gas from these tight mudrocks. However, many challenges remain unsolved in capturing their macroscale compositional variations to enhance recovery factors and delineate "sweet spots". To gain improved insights into this fine-grained system, high resolution chemostratigraphic (XRF) data was integrated with mineralogical measurements (XRD), logs, thin sections, and TOC readings, as well as hierarchical cluster analysis to: 1) develop a sequence stratigraphic framework, and 2) reconstruct paleo-redox, as well as ancient water-mass, conditions within the Cline Shale (Wolfcamp-D) from a core in the Midland Basin.

This study revealed the presence of three chemo-stratigraphically distinct depositional sequences in the Cline Shale, herein termed Lower, Middle, and Upper Cline from the base upwards. All three units exhibit distinct mineralogical and petrophysical characteristics, were correlated across the basin, and interpreted as third-order sequences. Superimposed onto the three interpreted third-order sequences within the Cline, are potential higher frequency (fourth-order) sequences. These fourth-order sequences typically consist of a lower interval, interpreted as lowstand deposits and an upper interval, which is interpreted as transgressive and highstand deposits. The lower interval is interpreted to be deposited during highly reducing conditions while the upper interval is interpreted to be deposited under suboxic conditions. The highest organic matter preservation is associated with the interpreted lowstand deposits, especially in the Upper Cline. Optimal landing zones (20 ft) are recognized in the upper zone of the Cline Shale based on their high resistivity, total organic richness, elevated siliceous content, and reduced percentage of clay minerals. These zones have been correlated with several nearby wells.

The current study demonstrates the wealth of information that can be gained from a single core/well when properly investigated at high resolution with measurements on a cm-scale. The observed shifts in the chemistry of the sediments character and composition are distinct, with implications for sequence stratigraphic analysis, the reconstruction of ancient water-mass conditions, and the identification of "sweet spots" for hydrocarbon resources. The provided analysis lays a foundational basis for further studies in the region, serving as critical data input for expansive regional research efforts.

Impact of Biomolecules on Mineral Transformations

Max Barclay Christopher Egan Morriss, Victoria Coker, Richard Kimber

Max Barclay, max.barclay@manchester.ac.uk

Kimber Lab, Geomicrobiology and RADER, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

Interactions at mineral surfaces in the environment they exist play an important role in controlling their phases and processes, however the mechanisms and understanding around the effects of biomolecules, such as DNA, on these processes are poorly understood. With the prevalence of these biopolymers within many systems, this represents a key area to better develop understanding of these interactions, especially on environmentally important mineralogical cycles such as iron oxides. Ferrihydrite is a metastable iron oxyhydroxide that plays a key role in binding pollutants and essential nutrients, therefore a better understanding of these transformation processes into more crystalline intermediatory/secondary minerals will give insight into any (in)direct consequences of changes or alterations to these cycles.

Using quantitative phase analysis techniques, as well as electron microscopy and XRD, any differences in mineral transformations after catalysis with differing concentrations of Fe(II), and a variety of incubation times was measured. This helps towards developing further understanding of these systems and the interactions between iron oxides and biopolymers. So far, this has identified differences in % phase compositions between no DNA and DNA containing conditions, as well as preferential formation of intermediatory/secondary mineral phases that are present. As well as this, differences in DNA polymer length are seen to affect transformation inhibition, as well as smaller biopolymers inhibiting transformation more than phosphate, even when phosphate is at a much higher loading when normalising between the two by mass. This could indicate differences in secondary crystal nucleation processes, as well as downstream differences seen regarding nutrient and pollutant binding, potentially altering understanding and research direction of these systems in the lab, and in-situ.

What drove the maintenance of sexual reproduction in early eukaryotes - and what drives it today - is a key question in evolutionary biology. Modelling and empirical studies that investigate this seemingly disadvantageous reproductive method are widespread. To date, there are no definitive answers regarding the ecological conditions or evolutionary benefits that may have led to the retention of sexual breeding. Unisexuality (mating without sexes or types) is a potential ancestral state of eukaryotic sex. This, and associated traits, are yet to be investigated in conjunction with abiotic forcing such as environmental change. Here, we use the eco-evolutionary model REvoSim to assess how biotic Red Queen, abiotic Court Jester, and pluralistic drivers impact the prevalence of sex in a unisexual digital ecosystem over macroevolutionary timescales. Our results indicate that frequent antagonistic biotic interactions (pathogens/predators) and high rates of abiotic change both elicit a high proclivity towards sex in unisexual evolutionary agents. Pluralistic investigations demonstrate that a synergistic relationship exists between Red Queen and Court Jester drivers: a combination drives increased investment in sex. Abandon-Ship mechanisms allow sexual life cycles to break down maladapted epistatic relationships in stressful conditions, regardless of the ecological origin of that stress. We suggest that both biogenic and non-biogenic stressors could have maintained unisexuality in Proterozoic environments.

Biotechnological synthesis of nanocatalysts from industrial wastewaters

Patrick Harvey[1*], Christopher Egan Morriss[1], Jennifer Cavet[2], Victoria Coker[1], Alejandro Gallego Schmid[2], Sarah Haigh[2], Chris Hardacre[2], Jonathan R Lloyd[1].

*patrick.harvey-3@postgrad.manchester.ac.uk

[1] Lloyd lab, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK
[2] School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

Keywords: Platinum group metals, dissimilatory metal-reducing bacteria, bioreduction, *Shewanella oneidensis*, Nanocatalysis, Selective hydrogenation

The Platinum Group Metals (PGMs), including platinum, palladium, rhodium, ruthenium, and iridium, are critical to a wide range of industrial applications, often due to their excellent catalytic properties. Recycling of PGMs after their product lifespans represents both an engineering challenge and an environmental boon, with PGMs acquired from secondary sources estimated to release up to 98% fewer greenhouse gases per kg. Bacterial based metal bioreduction, such as carried out by the dissimilatory metal-reducing bacteria *Shewanella oneidensis*, has shown great promise in selective native state PGM recovery from synthetic effluents in a batch scenario. Scale up of this technology may facilitate PGM removal from industrial effluents, introducing an alternate secondary source of PGMs bypassing harsh chemical treatments currently utilised. Biorecovered PGMs are further shown to form catalytically active nanoparticles, potentially introducing a direct route from industrial effluent to revalorised product [1]. My PhD investigates process design for optimal PGM biorecovery; assays include media, solution chemistry, electron donor and metal loading variables. A current focus includes implementation of a design of experiment (DOE) framework. Catalytic testing of synthesised materials represents a further objective, with proposed experiments investigating selective hydrogenation of nanocatalysts produced. I propose that through a deeper understanding of the bioreduction systems in *S. oneidensis*, higher rates of PGM recovery, tailorable, catalytically relevant nanoparticles, and an industrial scale PGM reclamation system all represent achievable goals in the sphere of PGM biorecovery. Should this technology be validated, implementation of PGM biorecovery to compatible effluent waste streams will represent a novel, scalable waste revalorisation strategy.

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Understanding microbe-mineral-organic interactions in Icelandic hot springs.

B. Hirst [1*], V. Coker [1], B. Van Dongen [1], S. Nixon [1], R. Kimber [1]

* Becky Hirst, becky.hirst@postgrad.manchester.ac.uk

[1]Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

Keywords: Hot springs, microbial mat, Iceland

Hot springs are unique geothermal environments that serve as natural laboratories for studying interactions between microorganisms, minerals, and organics. Understanding these interactions is essential because they underpin the transformation and long-term stabilisation of organic and inorganic compounds central to global biogeochemical cycles. Within these systems, certain microbial metabolic processes can drive biomineral formation, producing minerals whose surface chemistry, structure, and reactivity influence the preservation, degradation, or transformation of organic matter. These properties also create micro-environments that shape microbial community diversity and functionality. Despite their importance, the mechanisms governing microbe–mineral–organic matter interactions remain poorly understood, particularly across spatial scales within hot spring ecosystems. This study aims to addresses this gap by characterising the physicochemical and microbial processes that control organic matter stabilisation in geothermal settings. Focusing on microbial mats from Icelandic hot springs, initial analyses will characterise bulk organic and inorganic constituents to guide site selection. Subsequent work will explore vertical and horizontal mechanisms within the mats. Preliminary characterisation of the samples with XRD has indicated the presence of pyrite and sulphate minerals, implying that sulphur redox cycling is occurring.
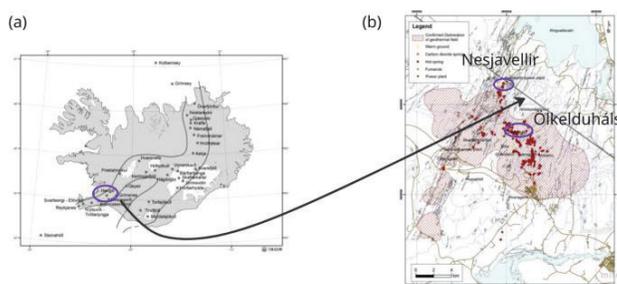
Figure 1. (a) Simplified map showing the location of the Hengill area in Iceland where the hot spring sampling sites are located (purple circle, detailed in (b)) and (b) location of the two sampling sites: Nesjavellir and Ölkelduháls. Image: Ármannsson (2015) [1].

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What can crystallinity and phase proportions tell us about magma assembly along the Reykjanes Ridge?

R.R. Hughes [1*], D.A. Neave [1], M.E. Hartley [1], B.J. Murton[2]

* presenting author, rebecca.hughes-3@manchester.ac.uk

[1] Geoscience Group, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] National Oceanography Centre, University of Southampton, European Way, Southampton SO14 3ZH

Keywords: Mid ocean ridge basalt, Reykjanes Ridge, Icelandic Mantle Plume, magmatic processes

The Reykjanes Ridge is a 1000 km slow-spreading segment of the Mid-Atlantic Ridge that extends southwest from the Reykjanes Peninsula, Iceland. The Icelandic Mantle Plume exerts a thermal and chemical influence on the Reykjanes Ridge: magma supply rates and crustal thickness increase, magma storage depths decrease, and erupted melts become increasingly enriched in incompatible trace elements northwards towards Iceland. Although the systematic changes in ridge properties are well-constrained, we do not know if the assembly, processing and transport of magmas systematically changes along the ridge with increasing proximity to the Icelandic Mantle Plume.

The chemistry and texture of crystals in igneous rocks reflect the physiochemical conditions experienced during crystal nucleation and growth. Crystal cargoes in volcanic rocks can therefore provide insights into the magmatic processes involved in the assembly, storage and eruption of melts. Here, we present one aspect on an ongoing textural and chemical characterisation of crystal cargoes in dredged mid ocean ridge basalt (MORB) from the Reykjanes Ridge: quantifying variation in crystallinity and phase proportions. We find that there is no clear trend in crystallinity of erupted MORB with spatial distribution along the ridge. Samples vary from sparsely phyric (<5 % crystals) to highly phyric (>25 % crystals). The production of highly phyric samples could be controlled by disaggregation and entrainment of crystal mush, magma mixing combining distinct crystal cargoes, or extended crystallisation during ascent through the crust. We find that the proportion of clinopyroxene in erupted MORB varies, with greater proportions of clinopyroxene found in samples erupted further north along the ridge. This observation could be controlled by the crystallisation of variably enriched melts, with enriched melts that favour clinopyroxene fractionation increasing in frequency northwards with increasing proximity to the mantle plume. Further work will assess these ideas regarding what controls the variation in crystallinity and phase proportions along the ridge. This will allow us to comment on the relative importance of mush entrainment, magma mixing, crystallisation upon ascent and initial melt composition in producing the crystal cargo of the Reykjanes Ridge MORB.

Microbial Dumpster Divers: How Bioinformatics Finds Nature's Polysaccharide Cutters

Ayesha Israr [1*], Christopher Stead[2], Neil Dixon[3], James Chong[4], Sophie Nixon [1]

Ayesha Israr, ayesha.israr@postgrad.manchester.ac.uk

[1] Nixon Group, Manchester Institute of Biotechnology, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] Chong Group, Department of Biology, University of York, YO10 5DD

The microbiomes of the aerobic activated sludge systems behave like the dumpsters divers, scavenging the complex polysaccharides. The current study employs the bioinformatical workflow to decode the metagenomics based degradation potential of these microbiomes across multiple wastewater treatment facilities and geographies. For the purpose, dbCAN3 pipeline was utilized to annotate the carbohydrate active enzymes (CAZymes) repertoires which includes glycoside hydrolases (GH), carbohydrate esterases (CE), polysaccharide lyases (PL), auxiliary activities (AA) and carbohydrate binding modules (CBM). This pipeline also facilitated the prediction of preferences for degradation of wide variety of polysaccharide substrates by these microbiomes. This analysis revealed a conserved core of GH13 enzymes, which targets the alpha-1,4 linkages to degrade substrates like starch and maltodextrin, which were consistently abundant, aligning with the global preference for starch like substrates. Other abundant families included the CE1/CE4, PL1/PL12, AA1/AA3, and CBM48/CBM9, though the relative abundance varied across site and time, indicating a local tuning atop a shared degradative backbone. These comparative CAZymes profiles helps generate a rational shortlist of the representative polysaccharides and their modified versions for the experimental identification of the active members of the microbiomes [1], the verification of the CAZymes expression and the pathway end products. Hence, coupling of the genome-resolved mining with the targeted validation outlines the scalable route for the "natural cutters" in engineered ecosystems and to inform the design of the next generation, wastewater treatment plants-compatible green polymers that are degradable prior to the environmental release.

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Crystal-rich lavas at ocean island volcanoes

T. Pierce-Jones [1][*], M. E. Hartley [1], O. Namur [2], J. Vander Auwera [3], D. A. Neave [1]

* presenting author, thomas.pierce-jones@manchester.ac.uk

[1] Geoscience Research Group, Department of Earth and Environmental Sciences, University of Manchester, Manchester, M13 9PL, UK
[2] Department of Earth and Environmental Sciences, KU Leuven, Celestijnenlaan 200E, 3001 Leuven-Heverlee, Belgium
[3] Department of Geology, Université de Liège, allée du Six-Août 12, 4000 Liège, Belgium

Keywords: Iceland; petrology; crystal mush; ocean islands; magma storage

The crystal content of lavas can be used to interpret their magmatic histories and infer the structure and internal processes of magma reservoirs. Magma reservoirs are increasingly being viewed as complex, crystal-rich systems, often expressed in terms of a crystal mush paradigm where melt is distributed within crystal frameworks [1]. Crystal mush models were primarily developed at volcanic arc systems, where magma flux and volatile content are high, allowing trans-crustal mushes to form. It is uncertain whether such trans-crustal mushes are viable at ocean island (OI) volcanic systems, due to lower magma fluxes and volatile contents. In some OI systems, spatially and temporally proximal samples have a wide range of crystal contents. It is possible that the variation in crystal content reflects the level of interaction between the magma and a type of crystal mush structure, as portions of the mush are entrained during magma ascent [2].

This study aims to investigate and contrast magma reservoir processes operating in OI settings characterised by different magma fluxes. Whole-rock analyses, e.g. X-Ray fluorescence (XRF), will be combined with thin section textural observations from optical and electron imaging [backscattered electron (BSE) imaging and scanning electron microscope energy dispersive spectroscopy (SEM-EDS)] and geochemical microanalysis [electron probe microanalysis (EPMA)], to reconstruct the magmatic histories recorded in different lavas.

The work thus far focusses on the Eastern Volcanic Zone of Iceland, which erupts plagioclase-ultraphyric samples alongside crystal-poor samples, potentially representing varying degrees of interaction with mush-rich reservoirs. Optical imaging of thin sections reveals a variety of textures between samples, ranging from microcrystalline ophitic textures to cumulate textures. XRF data shows the major element chemistry of samples, which has been compared with crystal accumulation and fractional crystallisation models to begin determining sample origins. EDS maps have been generated to input into the GPyEDS machine learning model [3], to develop a new, less labour-intensive, method for estimating macrocryst abundances.

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Abstract:

Microorganisms are commonly invoked in models of exceptional fossilisation, from Burgess Shale-type preservation to Ediacaran "death masks", yet the composition and succession of microbial decomposer communities in marine settings remain poorly understood. The microbial "necrobiome", the community of microorganisms associated with decomposing organic matter, has been characterised primarily in forensic studies of terrestrial vertebrates, leaving a major gap in palaeontological contexts. Here we present a 121-day experimental decomposition of the squat lobster, *Munida rugosa*, under two contrasting conditions: natural estuarine mud and artificial seawater. Microbial communities were profiled at multiple timepoints using 16S rRNA gene sequencing to resolve necrobiome succession. Initial assemblages were dominated by host-associated bacteria but rapidly transitioned to opportunistic anaerobes and environmental taxa. In mud, early enrichment of fermentative and facultatively anaerobic populations preceded the rise of sulphur-cycling lineages and archaeal taxa. In contrast, the sediment-free system developed more slowly and was dominated by fermentative guilds with reduced taxonomic complexity. Temporal trajectories revealed stage-specific shifts and convergence during early to mid-decomposition, highlighting deterministic structuring in sediment compared to more stochastic assembly in seawater. These findings provide a time-resolved characterisation of a marine invertebrate necrobiome and contribute to understanding how microbial dynamics may influence decay and preservation.

Removal of Tributyltin from Water Using a Coupled Adsorption and Electrochemical Regeneration Process

M. Wang [1*], S. Boult [1], N. Brown [2], B. van Dongen [1]

* presenting author, mingchong.wang@manchester.ac.uk

[1] Molecular Environmental Sciences, Department of Earth and Environmental Sciences, University of Manchester, Manchester, M13 9PL, UK

[2] Arvia Technology Ltd, The Heath Business & Technical Park, Cheshire, UK

Clean water scarcity is an escalating global issue, affecting more than half of the world's population by 2050 if the problem is not addressed in time. The removal of pollutants from wastewater is of particular importance to meet the clean water growing demand. Organometallic contaminants such as tributyltin (TBT) are of particular concern due to their toxicity, persistence, and bioaccumulation in ecosystems. Despite global bans on, for instance, TBT-based antifouling paints, residues remain widespread, underscoring the need for removing organometallic compounds such as TBT from water.

This study evaluates the potential of the Nyex Rosalox™ (NR) process—a combined adsorption and electrochemical oxidation technology using patented Nyex™ media—for the removal of TBT from water. The aim of this project is to (i) assess to what extent TBT can be adsorbed onto the Nyex™ media and (completely) removed/destroyed through the NR process, and (ii) evaluate what happens to the tin and what the impact of energy, salinity, and initial TBT concentration are on the overall process.

Results show that TBT can be effectively adsorbed onto the Nyex media (maximum 0.67 mg/g dry media) and removed through the NR process without forming toxic organotin by-products. Optimal treatment occurs at 6.5 Wh, beyond which additional energy offers little improvement. Increased salinity enhances removal, likely through hypochlorite formation, while adsorption is identified as the rate-limiting step. After treatment, most tin (≈94%) is retained on the adsorption media, predominantly on the anode side where the oxidation occurs.

These findings demonstrate that the NR process can effectively remove organometallic pollutants such as TBT without producing toxic by-product, offering a promising pathway for advanced water treatment. The accumulation of metal ions could potentially alter the property of Nyex media and subsequent treatments, also providing a potential strategy for recovering of metal ions.

Climate and Slope Instability Signals Recorded in Northern Red Sea Shallow Sediments

Lingyun Wu [1*], Sam J. Purkis [2], Neil C. Mitchell [1]

* presenting author, lingyun.wu@postgrad.manchester.ac.uk

[1] Basins Group, Department of Earth and Environmental Sciences, School of Natural Sciences, Faculty of Science and Engineering, University of Manchester, Manchester, M13 9PL, UK

[2] Department of Marine Geosciences, University of Miami, Miami, FL 33149, USA

There has been interest in the sediments of the Red Sea because the isolated basin records amplified global climatic changes in sedimentary $\delta^{18}O$ [1] and because of their histories of dust exported from surrounding land areas. High-resolution CHIRP seismic (sediment profiler) data are potentially useful for such studies; as reflections in the central Red Sea they have been found to relate to glacial low-stands [2], making them useful for sediment dating and palaeoceanography. Here, we examine data from a Knudsen CHIRP system collected in the Arabian side of the northern Red Sea to see if they have similar utility. In these data, the seabed reflection is used to generate a new bathymetry map, which provides new context to existing sedimentary core sites. Density data available for three of those cores in hemipelagic sediments and the known CHIRP source signature were used for synthetic seismic modelling. For all three sites, the modelling reveals high reflectivity corresponding to sediment of glacial terminations (marine isotope states (MIS) 2 and 6) separated by transparent interglacial units. Prominent reflections near the seabed are observed throughout the CHIRP profiles, though the lower zone of reflectivity (interpreted as MIS-6 in age) is intermittently present. For most of the data, we are not able to trace reflections continuously across the area. However, in the northernmost area, we can identify a common structure of two reflectivity zones as observed at the core sites. In that area, the interval between the lower (MIS-6) reflectivity and the seabed thickens systematically westward. We interpret this as indicating greater dust import to the west or an effect of currents. Data crossing basins show a general thickening of seismic intervals, as observed elsewhere in pelagic sequences. The data also reveals possible evidence of submarine slope failure (landslide scars lying above continuous reflections) and mass transport deposits (lensoid zones absent of reflectivity) on slopes. The data highlight the utility of these sediments to record both past climatic changes and sediment transport events.

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We look forward to seeing many of you again next year.

Best Wishes,
PGR Experience Team