

DEPARTMENT OF EARTH AND ENVIRONMENTAL SCIENCES

2026 PGR CONFERENCE

G.03 WILLIAMSON BUILDING

13:00 – 18:00

18 NOVEMBER



Conference Overview

Time	Section	Location
1:00 – 1:15 pm	Registration and Poster Preparation	PGR Common Room, 1st Floor Williamson
1:15 – 1:20 pm	Welcome by HoPGR	Williamson G.03
1:20 – 2:35 pm	Research presentations	Williamson G.03
2:35 – 2:45 pm	Transition to Poster Session	
2:45 – 4:15 pm	Poster Session and Pizza	PGR Common Room, 1st Floor
4:15 – 4:30 pm	Transition to Prize-giving	
4:30 – 5:00 pm	Prize-giving and closing	Dinosaur Foyer

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

Voting Instructions



Poster Voting

- PGRs 30% + Academics 70%
- Voting link for PGR

Presentation Voting

- Ayesha Israr will chair the presentation session.
- Dr Clare Robinson and the PGR Experience Team will provide the selected judges with further instructions on the voting process.

Prizes & Certificates

- All PGRs presenting posters and talks can collect a certificate of participation for their records.
- Prize Certificates & Vouchers: 3 x Best Presentation prizes; 3 x Best Poster prizes

Presentation Schedule

Instructions for Talk Presenters

- Email your slides to FSE Doctoral Academy by 3pm on Tuesday 17 November. This will ensure that changeovers are efficient.
- You have up to 8 minutes to present, and up to 2 minutes to welcome questions from the audience.
- Chair of the presentation: Ayesha Israr

Session: 1:20 – 2:35	Presenter	Title
1	Harry Savage	Quantifying metazoan locomotion
2	Mohammad Mehrabi	Less Recognised Association of Children's Dental Caries with Drinking Water Hardness (as a Proxy for Calcium) in England: Implications for Community Water Fluoridation
3	Florence Wilkinson	Analysis of Lunar Agglutinates Through X-ray Computed Tomography
4	Thomas Pierce-Jones	Variations in the crystal content of basalts from the Eastern Volcanic Zone of Iceland
5	Huihui Long	TROPOMI-derived methane emission estimates and regional socioeconomic linkages for 206 global cities in 2025
6	Nayab Raza	Can Microalgae outperform Traditional Chemical Fertilisers?
7	Pauline Nyakairu Karega	Data journey modelling as a method of identifying socio-technical barriers to air quality and health data integration in Kenya, Uganda, and UK

Poster Information

Instructions for Poster Presenters

- Arrive between 1:00 – 1:15 pm to display your poster in advance of the session
- The PGR Experience team will have assigned you a poster number and provide Velcro
- Ensure you are present to discuss your poster throughout the 2:45 – 4:15 pm session
- Collect your prize certificate and/or certificate of participation at the 4:30 pm reception

Poster Number	Presenter	Research Group/Theme
1	Nazmunnahar Nazmunnahar	Molecular Environmental Sciences Group
2	Jiang Jiaqi	Geomicrobiology group
3	Joseph Dowling	DUST
4	Juan Gomez Coronado	Basins Research Group
5	Lauren Stella	Earth & Environmental Modelling, Data & AI Systems Group (EMDAI)
6	Maram zaki h Al Saif	Basins Group
7	Nadia Rojas Arevalo	Soil and Ecosystem Ecology Lab
8	Rebecca Hughes	Geoscience Group
9	Leanne Russell	ICAL
10	Zhao Hanyue	Basin
11	Cariad Morgan	Geoscience (Volcanology)
12	Jasmine Murphy	Impact of climatic on evolution and ecological systems
13	Fatimah mohammed o Alshamsan	Vitamin D Status among Children with and without Diabetes
14	Elise Gaulier	Waiting to confirm

Presentation

Abstracts

Title: Quantifying metazoan locomotion

Authors: Harry J. Savage[1], Luke A. Parry[2], Thomas J. Roper-Smith[3], Jane C. Reeves[1], William I. Sellers[1], Russell J. Garwood[1,4]

Affiliations: [1]Department of Earth and Environmental Sciences, University of Manchester. [2]Department of Earth Sciences, University of Oxford. [3]Oxford University Museum of Natural History, Oxford OX1 3PW. [4]The Natural History Museum, London SW7 5BD, UK.

Abstract: Locomotion is fundamental to the survival and evolution of most animals. A wide variety of animal locomotion strategies are known, many of which have evolved convergently. Previous kingdom-wide morphological studies have found most extant metazoan phyla occupy distinct regions of morphospace, and this 'clumpiness' is driven by extinction of intermediate taxa. However, locomotion and morphology are often decoupled; thus, broad patterns in locomotory evolution remain unstudied through a quantitative framework. By characterising locomotion through a suite of discrete, non-morphological characters, we produced a novel dataset containing extant representatives from all animal phyla, creating metazoan 'locomotion space'. Metazoan locomotion space is less structured than morphospace, with regions of high taxon density representing dominant cross-phylum locomotion strategies and minimal phylogenetic clustering. At phylum-level, locomotion spaces are more structured, and phylogenetic clustering is common, indicating fundamental morphological or lifestyle traits may impact locomotion evolution at lower taxonomic ranks. Locomotory disparity varies significantly between phyla and is positively correlated with species richness, with the exception of Arthropoda, a highly speciose phylum which exhibits surprisingly low locomotory disparity. Overall, we show the evolution of locomotion within animals is flexible and frequently results in locomotory convergence, but is fundamentally constrained by an animal's evolutionary history.

Less Recognised Association of Children's Dental Caries with Drinking Water Hardness (as a Proxy for Calcium) in England: Implications for Community Water Fluoridation

Mohammad Mehrabi [1*], Yang Han [2], Deborah Moore [3], Matthew J. Ascott [4], Anne-Marie Glenny [5], David A. Polya [1]

* Presenting author, mohammad.mehrabi@manchester.ac.uk

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

[2] Department of Mathematics, School of Natural Sciences, Faculty of Science and Engineering, The University of Manchester, Manchester M13 9PL, UK

[3] Public Health Directorate, NHS England (North West), Liverpool, UK

[4] British Geological Survey, Nicker Hill, Keyworth, Nottingham NG12 5GG, UK

[5] Division of Dentistry, School of Medical Sciences, Faculty of Biology, Medicine and Health, The University of Manchester, Manchester M13 9PL, UK

Keywords: Dental caries, Fluoridation, Calcium, Water Hardness, England

Community water fluoridation is reportedly among the most beneficial cost-effective interventions in dealing with dental caries (DC)—the most prevalent oral health condition worldwide [1]. Several studies have investigated the benefits of water fluoridation in England, including with respect to socio-economic deprivation status as a confounder. However, hitherto there have been no published studies exploring how important or otherwise calcium is also as a confounder. We addressed this research gap [2] by undertaking a multiple linear regression analysis of the relationship between children's DC and three predictors, namely fluoride concentration (F), deprivation status, and water hardness (WH)—latter being a proxy for calcium concentration. While the findings aligned with earlier studies regarding the protective effect of increased F and decreased deprivation, we also demonstrated that increased WH also provided a new (statistically) significant protective effect. Furthermore, exploring the DC~F relationship showed that (i) accounting for calcium modifies the protective impact of F by as much as 24% and (ii) the DC~F relationship itself is a function of F, with the strongest protective effect being observed for F < 0.10 mg/L which is considerably lower than the widely reported optimal F, i.e., (0.7–1.0) mg/L. Hence, this research should be considered in cost-benefit analyses of prospective community fluoridation schemes. Further impact may be generated through a recent British Dental Journal commentary [3] on our paper.

References

1. Bernabe, E., et al., *Trends in the global, regional, and national burden of oral conditions from 1990 to 2021: a systematic analysis for the Global Burden of Disease Study 2021.* The Lancet, 2025. **405**(10482): p. 897-910. https://doi.org/10.1016/S0140-6736(24)02811-3
2. Mehrabi, M., et al., *Drinking water hardness (as a proxy for calcium) significantly modifies the relationship between dental caries prevalence in 5 year old children and drinking water fluoride and socio-economic inequalities in England.* Exposure and Health, 2026. **18**(3): p. 47. https://doi.org/10.1007/s12403-026-00782-z
3. *Water hardness modifies the relationship between fluoride, deprivation and caries*. 2026: British Dental Journal. https://doi.org/10.1038/s41415-026-0032-x

Analysis of Lunar Agglutinates Through X-ray Computed Tomography

F.A. Wilkinson [1*], E. Evans [2], R. Tartèse [1], J.D. Gilmour [1], M.B. Broadley [1], K.H. Joy[1]

* Florence Wilkinson, florence.wilkinson@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

[2] NXCT at the Henry Moseley X-ray Imaging Facility (HMXIF), University of Manchester, Manchester, UK

Keywords: Agglutinates, Space Weather, XCT, Lunar Regolith

The lunar regolith holds a record of space activity, as it is the boundary layer between the lunar interior and the space environment [1]. Agglutinates are welded glassy constructs that are found in the lunar regolith, and are a product of space weather that can make up to 60% of mature Apollo soil samples by volume [2]. Formed from micrometeoroid bombardment, agglutinates are used as a measure of a soil's exposure to space weather.

While agglutinates are known to be a product of space weathering, they have no formal morphological or geochemical classification [3], and so their identification relies on observer judgement of their exterior texture. Ranging from a few microns to several millimetres in diameter [4], they are comprised of lithic and mineral grains, bound by a glassy matrix resulting in irregular shapes and 'fluffy' exterior textures. Vesicles form within the glassy phase during agglutinate formation. As the regolith undergoes high pressure and temperature conditions, during this process, volatiles implanted within the grains are released. As the agglutinate begins to cool, some volatiles are trapped in the melt as gas bubbles and are preserved as vesicles. The abundance and size of each component varies between agglutinates [5, 6]. By understanding the composition, structure, and texture of agglutinates, this study aims to improve understanding of their formation, and support more reliable identification.

Initial characterisation of the agglutinate morphology was done with non-destructive micro-X-ray computer tomography (XCT) analysis. 21 agglutinates from three different Apollo 16 soils and nine terrestrial mineral and glass standards were successfully scanned in a Zeiss Xradia 520-620 verse at the HMXIF. To prevent contamination from epoxy that would compromise future noble gas and light volatile analysis, samples were wrapped in nitrogen-free weighing paper and staked within hydropropyl methylcellulose capsules. A pixel size of 1.5 µm was achieved, enabling the detection and analysis of components with a 93 μm^3 volume.

Using the Avizo v2024.2 software, agglutinates were segmented into silicate, metal, sulphide and vesicular phases. Vesicular phases in agglutinates range from isolated bubbles to interconnected pore networks. Using this data, it is possible to differentiate between the two, and from that, calculate bubble number densities of each agglutinate. For the samples in this study, the BND values ranged from 1.7×10^{10} m^{-3} to 2.7×10^{13} m^{-3}.

References

[1] Curran et al., 2020, P&SS, 182, 104823; [2] McKay et al., 1972, LPSC, 3, 983; [3] Wilkinson et al. 2026, BPSC; [4] Yasanayake et al., 2025, JGRE, 129 (2) [5] Baker et al., 2020, LPSC, 51, 1321; [6] Li et al., 2025, Research, 8, 0638

Variations in the crystal content of basalts from the Eastern Volcanic Zone of Iceland

T. Pierce-Jones [1*], M.E. Hartley [1], O. Namur[2], J. Vander Auwera[3], D. 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 to infer both the structure of magma reservoirs and the nature of the processes that operate within them. Magma reservoirs are increasingly viewed as complex, crystal-rich systems, often expressed in terms of a crystal mush paradigm, where melt is distributed within vertically extensive crystal frameworks [1]. Crystal mush models were primarily developed at volcanic arc systems, where magma flux and volatile content are high, sustaining trans-crustal mushes. It is uncertain whether such trans-crustal mushes are viable at ocean island volcanic systems, due to their generally lower magma fluxes and volatile contents. In some ocean island systems, such as the Eastern Volcanic Zone (EVZ) of Iceland, spatially and temporally proximal samples have a wide range of crystal contents. In the EVZ, plagioclase-phyric magmas are erupted alongside crystal-poor magmas. It is possible that the variation in crystal content reflects the level of interaction between the magma and a crystal mush structure, as portions of the mush are entrained during magma ascent [2].

In this study, we use the geochemistry and petrology of 28 basalt samples and two gabbroic nodule samples from the EVZ, which were mostly erupted beneath ice, to investigate the nature and cause of variation in crystal abundances and proportions. We combine whole-rock analyses from X-ray fluorescence, thin section textural observations from optical and electron imaging (backscattered electron imaging and scanning electron microscope energy dispersive spectroscopy), and geochemical microanalysis (electron probe microanalysis) to constrain magma storage conditions and examine the processes controlling crystal content. Our goal is to evaluate magma storage models of ocean island systems, using the EVZ as a case study of an ocean island system with relatively high magma flux.

References

[1] Sparks et al. (2019). Phil Trans R Soc A 377: 20180019; [2] Neave et al. (2014). J Pet 55(12): 2311-2346

TROPOMI-derived methane emission estimates and regional socioeconomic linkages for 206 global cities in 2025

Huihui Long[1*], Maria Tsivlidou[1], Hugo Ricketts[1,2], and Grant Allen[1]

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

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

[2] National Centre for Atmospheric Science, University of Manchester, Oxford Road, Manchester M13 9PL, UK

Keywords: Methane emissions, Satellite measurement, TROPOMI, City-level GHGs

Cities are one of the major sources of anthropogenic methane emissions, and reducing their emissions has become an increasing priority in climate policy. However, monitoring and quantifying urban methane emissions at national to global scales remain challenging due to the complexity and diversity of emission sources. Moreover, widely used activity-based emission inventories that are self-reported by cities (or nations) often lack independent verification, raising questions about their accuracy, and therefore the trajectory of future climate change. Here, we use satellite observations of column-averaged methane from the TROPOspheric Monitoring Instrument (TROPOMI) to estimate methane emissions from 206 cities worldwide in 2025. Our satellite-based estimates yield a total of 39.25 (17.97–60.54) Mt yr^{-1}, accounting for approximately 11% of global anthropogenic methane emissions. Comparison with a global gridded bottom-up emission inventory reveals a mean relative difference of 45%, with substantial and systematic regional discrepancies. Bottom-up inventories tend to underestimate per capita methane emissions by a factor of two on average, particularly in North America, whereas estimates for cities in Central and Southern Asia show relatively good agreement. Further analysis of socioeconomic linkages reveals that high-income cities do not necessarily have higher methane emissions, while the diversity in per capita methane estimates can be partially explained by the inverse of population density. Our findings demonstrate the potential of satellite measurements to independently monitor and verify urban methane emissions for global cities and highlight the importance of socioeconomic factors in understanding global patterns of urban methane emissions.

Can Microalgae outperform Traditional Chemical Fertilisers?

Name: Nayab Raza

Affiliation: Department of Earth and Environmental Sciences, Faculty of Science and Engineering, The University of Manchester, Manchester, UK

Email: nayab.raza@manchester.ac.uk

Name: Giles Johnson

Affiliation: Department of Earth and Environmental Sciences, Faculty of Science and Engineering, The University of Manchester, Manchester, UK

Email: giles.johnson@manchester.ac.uk

Name: Constantinos Theodoropoulos

Affiliation: Department of Chemical Engineering, Biochemical and Bioprocess Engineering Group, Faculty of Science and Engineering, The University of Manchester, Manchester, UK

Email: k.theodoropoulos@manchester.ac.uk

Name: Jon Pittman

Affiliation: Department of Earth and Environmental Sciences, Faculty of Science and Engineering, The University of Manchester, Manchester, UK

Email: Jon.pittman@manchester.ac.uk

Expected Presenter: Nayab Raza

APPLICABLE TOPIC AND SUB-TOPIC NUMBER: Please briefly justify the subtopic you have chosen for your abstract submission. Providing this information will assist the evaluators in assigning the most appropriate reviewers, ensuring a thorough and accurate evaluation.

My research is closely aligned with Sustainable resources for decarbonising the economy " under sub-topic "Sustainable integrated agricultural management practices", encompassing a broad range of related subtopics. My research focuses on developing novel biotechnology to replace chemical fertilisers with microalgal biomass, which is enriched with nutrients and works as a bio-fertiliser. This is cross-disciplinary technology which integrates algae biomass cultivation and waste nutrient recovery with sustainable agriculture by transforming waste into a valuable resource. This algal biomass is valorised as a nutrient resource for soil remediation and crop cultivation, while the avoidance of chemical fertilisers allows a reduction in CO_2 emissions.

INTRODUCTION

Healthy soil is a vital determinant of healthy and efficient food production. By 2050, the world's population is projected to reach 9.8 billion. To feed this population, food production needs to increase by 50% compared to 2012, according to the Food and Agriculture Organisation (FAO) (Alexandratos and Bruinsma 2012). To meet this rising demand, the excessive use of chemical fertilisers in agriculture has become prevalent to facilitate more rapid crop growth. However, these chemical fertilisers have significant long-term impacts on biodiversity, water pollution and emission of harmful greenhouse gases into the atmosphere. Furthermore, the persistent application of chemical fertilisers can lead to the accumulation of heavy metals such as lead, arsenic and cadmium in soil (Alengebawy, Abdelkhalek et al. 2021). This contamination poses various threats to the food chain and increases potential health risks for consumers. To overcome the critical challenges of excessive chemical fertilisation, a solution is the use of bio-fertilisers, such as those derived from microalgal biomass. Microalgal biomass contains essential nutrients, including nitrogen, phosphorus and potassium and also produces bioactive compounds, such as pigments, phytohormones and other secondary metabolites, which can be beneficial to promote plant growth. This study investigates the use of two microalgal species compared with a commercially available chemical fertiliser for the cultivation of tomato plants grown in low-nutrient soil. Four treatments were compared: T_0= Negative control (no fertiliser), T_1= Tomorite (chemical fertiliser), T_2= *Spirulina* biomass and T_3= *Chlorella vulgaris* biomass. The experiment consisted of three rounds of harvests conducted during the cultivation of the tomato plant, each with a one-week interval. Physiological characteristics of the plants were measured. This study concludes that microalgae-based bio-fertiliser was able to promote Tomato plant growth as effectively as the chemical fertiliser, demonstrating the use of microalgae biomass as an effective route towards delivering sustainable agriculture."

Keywords : Microalgae, Bio-fertiliser, Sustainable agriculture

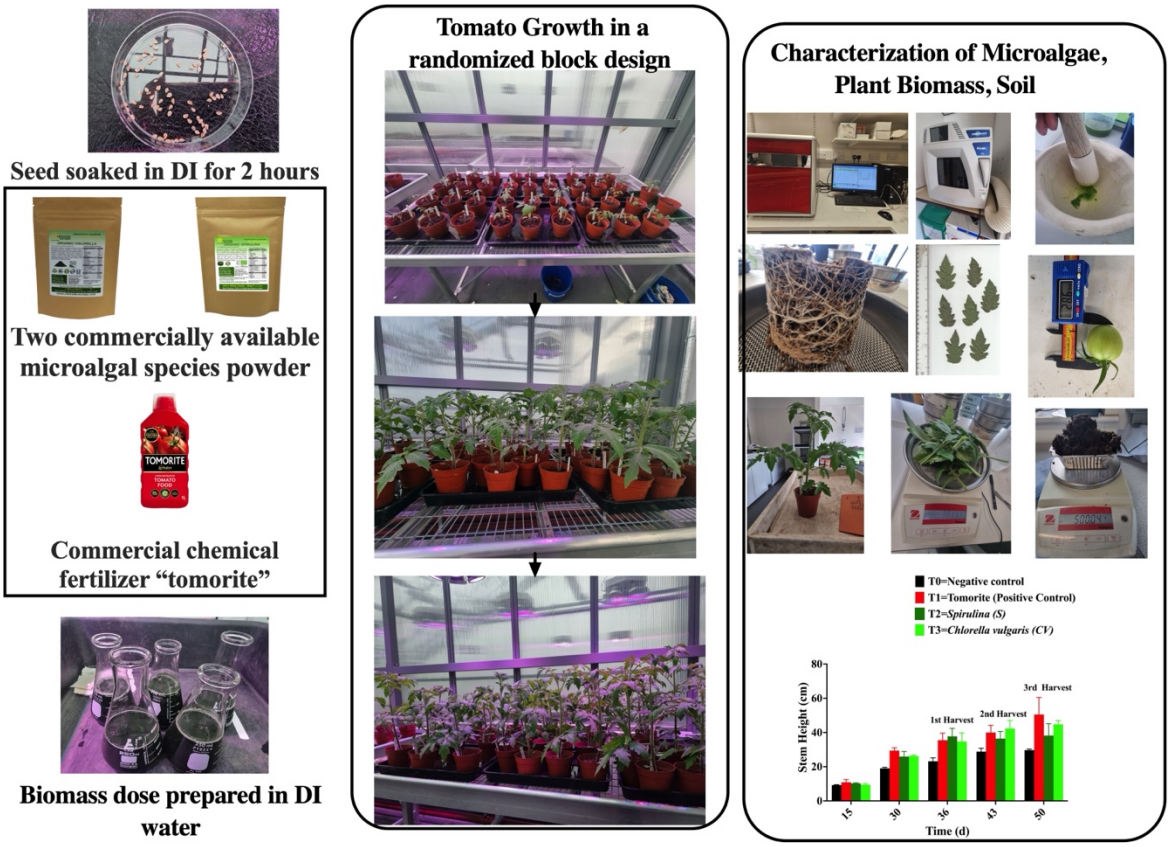


Fig.1. A graphical abstract illustrating the sustainable microalgae biofertilizer approach.

AIM AND APPROACH (Briefly describe the approach you used)

The aim was to evaluate the efficacy of two microalgae-based bio-fertilisers in comparison to the chemical fertiliser "Tomorite" by analysing the improvement to soil health, plant nutrient uptake and enhancing crop growth. A secondary aim was to evaluate the microalgal biomass for its nutritional composition to determine its viability as a bio-fertiliser. Two commercially available dried microalgal biomass sources were used, namely *Chlorella vulgaris* and *Spirulina*. The initial nutrient composition of both microalgal species was quantified by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) and Carbon and Nitrogen analysis (CN) analyser in order to ensure that the microalgal biomass and chemical fertiliser were applied to the plants with an equivalent nutrient load. Morphological growth parameters of the tomato plants, including total plant, stem and branch height and width, were recorded. Additionally, the number of stem branches and leaves was recorded after 15-day intervals to monitor the growth dynamics. Shoot and root biomass were quantified at each harvest, and the root-to-shoot ratio was calculated to assess the biomass allocation. Biomass was also

analysed by ICP-OES and CN analysis to determine plant nutrient uptake. Other measured physiological parameters were leaf chlorophyll a and b concentration and chlorophyll a:b ratio, specific leaf area, and the relative plant growth rate.

SCIENTIFIC INNOVATION AND RELEVANCE

In this section, clearly highlight the innovative aspects of your research and its significance within the scientific community. Address the following points:

Innovation: Describe the novel methods, technologies, or approaches introduced in your research. Explain how your work advances existing knowledge or practices in the field.

This study aims to develop an innovative and sustainable agricultural solution that minimises the use of excessive chemical fertilisers and improves soil health. Microalgae-based bio-fertilisers represent a promising solution for less fertile agricultural land to increase the transfer of micro and macronutrients to plants, stabilise soil pH, and capture the CO_2 from the atmosphere, leading to reduced GHG emissions by excessive use of chemical fertilisers, which leads in benefiting in addressing climate change

Relevance: Discuss the importance of your findings in relation to current scientific challenges or opportunities. Outline how your research addresses gaps in the literature or provides solutions to practical problems

One of the major challenges and research gaps is an in-depth understanding of the influence of microalgae on soil-microbe interaction. The microbial community is important for crop health, and it is relevant to examine how the bio-fertiliser treatment maintains high soil fertility. Soil microbial communities play a key role in initiating microalgal biomass hydrolysis to deliver nutrient transfer efficiently to the crops.

Impact: Explain the potential applications or implications of your work in the broader scientific, industrial, or environmental context. Highlight how your research could influence future studies or developments in the field.

Post-harvest nutrient levels were analysed in terms of soil nutrients such as Al, Fe, K, Mg, Mn, P, S, Si, Ba, B, and Ca. nutrients were typically declined 2-5x (fold reduction) across harvest in all treatments, such as**:** T_3 (*Chlorella*) > T_2 (*Spirulina*) > T_1 (Tomorite) > T_0 (Control). However, microalgal biostimulant showed the least depletion of nutrients and also some was retained in soil, which improves the soil health. The outcomes of this research demonstrate that microalgae-based fertilisers can enhance plant growth and improve soil health, supporting sustainable farming practices. These findings could guide future

development of biofertilizer formulations and influence policies promoting green agricultural technologies.

RESULTS (Summarise the main findings of your research, including any key data or trends observed.

The study investigates the four different fertilisation treatments: T_0 (negative control), T_1 (Tomorite treatment), T_2 (*Spirulina*) and T_3 (*Chlorella vulgaris*) on the tomato plant (*Solanum lycopersicum*) growth and soil nutrient dynamics under greenhouse conditions. Plants were grown in a randomised block design across three destructive harvests (plants were randomly chosen for use in analysis), and morphological and biochemical traits were analysed. Root-to-shoot biomass accumulation was higher in the *Spirulina* (T_2) treatment, determined by relative growth rate, compared to Tomorite increased by 1.23-fold (0.087 vs 0.071 g d^{-}). *Chlorella vulgaris* showed lower biomass accumulation than both Tomorite and *Spirulina,* indicating a decline of approximately 15-20%. Tomorite produced the tallest plants (76.8 ± 1.12 cm), which is about a 2.6-fold increase over the control-followed by *chlorella vulgaris (*65.1 ± 0.98 cm) and *spirulina* (54.2 ± 1.04 cm). While control had the lowest height. For stem elongation, Tomorite and *Chlorella vulgaris* achieved the highest stem elongation at the 3rd harvest (day 50), showing a 71% and 51% increase (1.7-fold) compared to the control (29.6 cm). All treatments statistically outperformed the control. In terms of stem thickness, *Spirulina* (T_2) produced the thickest stems (≈12.1 mm), about a 75% increase (1.7-fold) over the control, followed by Tomorite (T_1) and Chlorella (T3), all significantly higher than the untreated plants. Statistical analysis confirmed Spirulina's strong and consistent effect ($p < 0.0001$). By the 3rd harvest, *spirulin*a treatment produced more branches (18%) and leaves (35%), which were significantly higher ($p = 0.0087$ and $p < 0.0001$) than all other treatments. Spirulina (T2) maintained the highest and most stable RGR (0.08–0.15) across both intervals, outperforming Tomorite (T_1) and Chlorella (T_3) ($p < 0.05$). Chlorophyll content declined across harvests but stayed higher than the control in all treatments. Chlorella (T_3) showed the highest chlorophyll in the 1st and 2nd harvests (≈32.9 and 31.4 nmol/ml), while by the 3rd harvest, *Spirulina* (T_2) led with 22.9 nmol/ml, about a 24–32% increase over Tomorite and Chlorella, showing a significant shift in pigment retention ($p=0.0137$). *Spirulina* (T_2) consistently showed the highest nitrogen accumulation across all harvests, which is 33% higher (1.3-fold) than Tomorite and control, followed closely by *Chlorella* (T_3). Nitrogen remained low across treatments, but still, *Spirulina* (0.023 ± 0.0071 mg/g) gave the highest values in soil, though differences were not significant. However, carbon contents were higher in the negative control and Tomorite-

treated plants in the 2nd harvest, but *Spirulina* showed a higher content of carbon at the 3rd harvest. Carbon remaining in the soil was highest in the *Spirulina* and *Chlorella vulgaris* treatments, indicating a slow release of nutrients into the soil and plants over a longer term.

CONCLUSIONS (Provide a concise conclusion, emphasising the main contributions of your work and potential future directions).

Conclusively, the above-mentioned results clearly indicate that the application of microalgal biofertilizers is an effective, eco-friendly, and cost-effective approach to maintaining soil nutrient profiles, reducing the reliance on chemical fertilisers, and thus promoting sustainable agriculture. Microalgae biomass is enriched with protein, lipids, micro and macronutrients, organic matter, vitamins and hormones, making them ideal for producing green fertilisers. Moreover, a larger amount of nutrients is required for the cultivation of crops on a large scale and for commercial needs. To mitigate the challenge, we required a huge amount of production biomass to overcome the challenge. Microalgae are considered tools for combating climate change due to their excellent photosynthetic capabilities to sequester carbon dioxide and the bioavailability of their metabolites, which enhance soil fertility and crop yield.

References

Alengebawy, A., S. T. Abdelkhalek, S. R. Qureshi and M.-Q. Wang (2021). "Heavy metals and pesticides toxicity in agricultural soil and plants: Ecological risks and human health implications." Toxics **9**(3): 42.

Alexandratos, N. and J. Bruinsma (2012). "World agriculture towards 2030/2050: the 2012 revision."

Data journey modelling as a method of identifying socio-technical barriers to air quality and health data integration in Kenya, Uganda, and UK

Pauline Karega [1*], David Topping [1], Caroline Jay [1]

* Pauline Nyakairu Karega, paulinenyakairu.karega@manchester.ac.uk

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

Keywords: Air Quality, Health, Data, Data journeys, Interoperability

The integration of air quality and health data is increasingly important for scientific research, policymaking, and public-health decision-making. However, effective integration remains challenging because data needs to move across disciplinary, organisational, and technical boundaries. Existing methods investigating interoperability, and reuse focus on specific components of the data ecosystem, which limits their visibility of how socio-technical components of a system impacts data movement. This study evaluates the utility of data journey modelling (DJM) technique as a method for identifying barriers to integrating air quality and health data across three national contexts; Kenya, Uganda, and the United Kingdom. Data journey modelling (DJM) is a lightweight analytical technique that examines data movement across interconnected organisations, infrastructure and actors. Data journeys were constructed from stakeholder interviews and validated using peer-reviewed and grey literature. Across all study settings, DJM revealed socio-technical barriers that were difficult to identify through conventional interoperability assessments; including informal governance structures, missing data flows, hidden actor dependencies and fragmented infrastructures. While these barriers manifested differently across contexts, they consistently affected data discovery, access, transformation and reuse. Specifically, findings show that the availability of data does not necessarily translate into accessibility or usability, and that data governance structures strongly shape how data move through complex systems. We argue that DJM complements existing interoperability and governance focused approaches by treating data movement itself as the unit of analysis. The method provides a practical framework for identifying barriers to data integration and reuse across complex socio-technical data ecosystems.

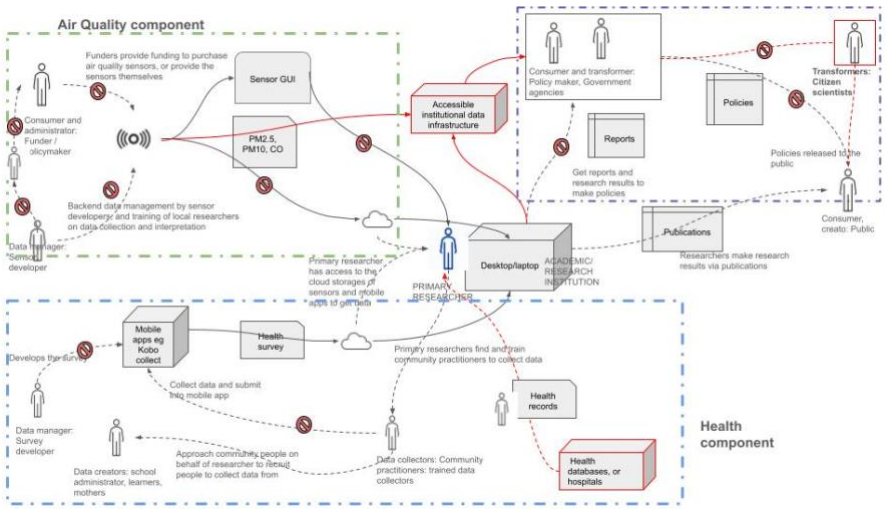


Figure 1. An example of the data journey model representing the Kenyan air quality and health data landscape. Image: Pauline Karega

Poster Abstracts

Please not that not all presenters have submitted an abstract

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

Keywords: Textile wastewater, Nyex Rosalox process, Reactive Blue 19, Reactive Orange 16

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 four widely used industrial reactive dyes, Reactive Orange 16, Reactive Red 120, Reactive Black 5 and Reactive Blue 19 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. This performance was maintained across a range of conditions, with removal efficiency up to 40% higher under acidic and alkaline conditions than at baseline (neutral pH, no added salts, room temperature), while elevated temperature and salinity had no adverse effect. Even when these conditions were combined with multiple dyes to simulate real textile effluent, the process still achieved complete dye removal alongside 95% COD removal. In addition, reusability tests further showed that the treated water could be reused for fabric dyeing without compromising outcome, pointing to a promising route for industrial water reuse and reduced 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.

Biogeochemical Mechanisms of Arsenic Mobilization in Bangladesh Aquifers: Insights from Microbial Community Composition and Functional Potential

Jiaqi Jiang [1*], Laura Richards [1], David Polya [1], Jonathan Lloyd [1]

* presenting author, jiaqi.jiang-3@postgrad.manchester.ac.uk

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

Keywords: Groundwater, Arsenic mobilization, Microbial communities, Coupled C-Fe cycling, Biogeochemical mechanism, Bangladesh

Groundwater arsenic (As) contamination is a long-standing environmental problem in Bangladesh. Although electron donors such as dissolved organic carbon (DOC) and methane (CH_4) are known to fuel redox reactions that govern As release (e.g., the reductive dissolution of As-bearing Fe(III) minerals), the underlying microbial mechanisms remain poorly understood. Particularly across different geochemical settings, redox conditions and electron-donor regimes may shape distinct microbial community structures, leading to multiple As mobilization pathways. Here, we integrated geochemical analyses, 16S rRNA gene sequencing, and PICRUSt2-based functional predictions to investigate microbial associations with As distribution across three historically contaminated aquifers in Bangladesh. Elevated As concentrations occurred in shallow groundwater at two sites, each exhibiting distinct microbial community compositions and functional profiles. One high-As site showed high DOC concentrations and enrichment of *Candidatus_Omnitrophus* and *Candidatus_Methanoperedens* taxa, accompanied by enhanced predicted CH_4 metabolism. The positive correlation between As and *Methanoperedenaceae* (r=0.65) suggests a potential link between anaerobic CH_4 oxidation (AOM) and As release. This is consistent with earlier isotopic studies proposing that AOM-driven As release in Bangladesh aquifers[1]. In contrast, the other high-As site exhibited pronounced Fe cycling, with elevated Fe concentrations (>5 mg/L) and high relative abundances of *Mariprofundus* and *Ferriphaselus* taxa (total up to 51%), indicating a distinct Fe-associated microbial control on As behavior. These contrasting microbial and geochemical signatures of high-As environments suggest that As mobilization may proceed through multiple biogeochemical pathways under specific conditions. Overall, our findings provide new microbiological insight into the spatial heterogeneity of As mobilization in Bangladesh and highlight AOM process, potentially involving AOM coupled Fe(III) reduction (Fe-AOM), as an additional pathway operating alongside more conventional DOC-mediated mechanisms, although this possibility remains to be experimentally verified.

References

[1] Ernst, K., Stirn, C., Maier, M., Schroll, M., Polya, D.A., Keppler, F., 2026. Hydrogenotrophic Methanogenesis and Aerobic Methane Oxidation in Arsenic-Prone Groundwaters in Northern Bangladesh: Stable Isotopic and Geochemical Evidence. ACS EST Water 6(3), 1520-1530.

Constraining the formation conditions of mineral deposits in aircraft engines through high-temperature experiments

Author: Joesph Dowling

Abstract:

The ingestion of mineral dust into aircraft engines results in the accelerated degradation of engine components such as high pressure turbine (HPT) blades. HPT blades are protected from the extreme thermal conditions by ceramic thermal barrier coatings (TBC) comprised of yttria-stabilised zirconia (YSZ). Reactions of ingested mineral dusts produce CaO-MgO-Al_2O_3-SiO_2 (CMAS) deposits that damage the TBC through thermochemical and thermomechanical degradation. Thermochemical degradation occurs when CMAS deposits react with the YSZ TBC to produce new phases. This study has investigated the mineral assemblage of a CMAS deposit on an ex-service HPT blade, observing melilite, spinel and kimzeyite-type garnets. The melilites and garnets observed in this study have few natural counterparts making these engine deposits unique. Therefore, high-temperature experiments were conducted on four synthetic glass powders, produced to replicate the bulk composition of the melilite-spinel-garnet mineral assemblage, to constrain the formation conditions. The glass powders synthesised increase in complexity from CMAS through CMAS+Zr to CMAS+Zr+Fe and CMAS+Zr+Fe+Ti. Isothermal experiments were done in Pt-crucibles at 1 atm and temperatures of 1100-1400 ^{0}C for 3 hours. Samples were then analysed by Scanning Electron Microscopy and X-Ray Diffraction to determine texture, mineralogy and chemistry. Thus far, melilite, spinel and kimzeyite-types garnets have been reproduced at different temperatures and from different chemical compositions.

Lithium in clay-rich deposits: Moroccan Ghassoul Clay, the first case study in northwestern Africa

Gomez-Coronado. J,S [1*], Ouabid. M [2], Taylor. K [1]

* juan.gomezcoronado@postgrad.manchester.ac.uk

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

[2] Geology & Sustainable Mining Institute, Mohammed VI Polytechnic University, Hay Moulay Rachid Ben Guerir, 43150, Morocco

Keywords: Lithium, Ghassoul clay, lacustrine deposits, clay mineralogy, volcano-sedimentary deposits.

The rapid growth in demand for cleaner energy technologies associated with the global energy transition has increased the need for critical minerals. Lithium is a key element in batteries for energy storage, and concerns over energy security, supply-chain availability and access to this critical material have encouraged the exploration of alternative lithium sources. Among these, volcano-sedimentary deposits represent an emerging exploration target in which lithium is hosted within clay minerals, although the origin of this enrichment remains debated.

This study presents a preliminary mineralogical and geochemical characterisation of commercial material from the Ghassoul clay deposit of Jbel Rhassoul, Morocco, a clay-rich lacustrine succession interpreted to have formed in a non-caldera, intermontane basin [1]. The deposit contains economically exploited clay layers known as ghassoul which are currently mined for pharmaceutical and dermatological applications. Two commercial Ghassoul samples were characterised by X-ray diffraction (XRD) of bulk powders and oriented clay aggregates, revealing smectite, chlorite and mica composition, together with carbonates (calcite and dolomite). Major-element analysis by X-ray fluorescence (XRF) shows enrichment in Mg, Ca, Fe and K, consistent with this mineralogy. Aqua-regia-extractable lithium, determined by inductively coupled plasma optical emission spectrometry (ICP-OES) and validated against two certified reference materials, is 1000 and 1300 mg/kg in the two samples, well above typical upper-crustal abundances (~35 mg/kg) [2].

These preliminary data provide an initial mineralogical and geochemical framework for assessing lithium potential in the deposit. Stratigraphically controlled sampling, total digestion, and detailed examination of geological relationships, mineralogical and chemical distributions, textures and sedimentary facies will aid to understand the deposit-scale distribution and mineralogical residence of lithium. If confirmed, the Ghassoul clay could represent a possible analogue of volcano-sedimentary lithium mineralisation in non-caldera settings, contributing to the geological understanding and exploration of lithium-bearing clay deposits.

References

[1] P. Duringer, M. Ais, A. Chahi, Contexte géodynamique et milieu de dépôt du gisement de stevensite (rhassoul) miocène du Maroc; environnement lacustre ou évaporitique?, *Bull. Soc. Géol. Fr.* 166 (1995) 169–179.

[2] F.-Z. Teng, W.F. McDonough, R.L. Rudnick, C. Dalpé, P.B. Tomascak, B.W. Chappell, S. Gao, Lithium isotopic composition and concentration of the upper continental crust, *Geochim. Cosmochim. Acta* 68 (2004) 4167-4178. https://doi.org/10.1016/j.gca.2004.03.031

Adapting CorrDiff to Air Quality: Probabilistic $PM_{2.5}$ Downscaling with Observation-Guided Inference

Author: Lauren Stella

High-resolution information on air quality is essential for assessing population exposure and informing policy. However, running chemical transport models (CTMs) at fine-scale resolution over large geographical regions is computationally expensive. Machine learning based downscaling offers a more efficient alternative by increasing the resolution of CTM outputs. In this study, we adapt CorrDiff, a two-stage framework originally developed by NVIDIA for meteorological downscaling, which combines a deterministic regression network with a diffusion model to correct residual errors. We apply CorrDiff to downscale hourly surface $PM_{2.5}$ concentration over the UK from 45km to 3km, using WRF-EMEP simulations from 2019 as training data. The model uses coarse-resolution $PM_{2.5}$ concentration, with meteorological covariates and terrain as predictors. Preliminary results from the deterministic regression stage demonstrate promising performance in reproducing the 3km WRF-EMEP fields.

The diffusion stage extends the framework to probabilistic downscaling, generating an ensemble of plausible 3km fields of hourly $PM_{2.5}$ concentrations, enabling uncertainty to be quantified in each grid cell. We explore how the ensemble variability captures the small-scale spatial variability in $PM_{2.5}$ concentrations, and whether it provides a useful measure of predictive uncertainty, particularly during periods of high pollution.

As CorrDiff learns the relationship between two sets of CTM simulations, it may inherit the systematic biases present in the underlying model. To address this, we propose extending the CorrDiff framework to include score-based data assimilation which guides diffusion sampling towards observations from the UK Automatic Urban and Rural Network during inference. Integrating ground monitoring measurements with model simulations would yield a 3km $PM_{2.5}$ field that retains the detail from high-resolution simulations while improving agreement with observed concentrations.

Did preservation of carbohydrates through sulfurisation cause high accumulation of organic carbon in the Blackstone Band depositional sequence in the Weald Basin?

Maram AlSaif, Kevin G. Taylor, and Bart E. van Dongen
Department of Earth and Environmental Sciences, University of Manchester, Oxford Road, Manchester M13 9PL, UK

The Upper Jurassic Kimmeridge Clay Formation (KCF) represents one of the most prolonged and globally significant periods of organic carbon (OC) accumulation in Earth's history (Pearce et al., 2010). It is a major petroleum source rock, characterised by anomalously high total organic carbon (TOC) contents, extensive lateral continuity and a well-preserved stratigraphic record. Within the KCF, the depositional sequence potentially containing the Blackstone Band (the Blackstone Band Depositional Sequence; BBDS), is a remarkably organic-rich interval that reaches TOC contents of up to 52 wt% (Huc et al., 1992), mainly caused by the preservation through sulfurisation of organic matter (OM) driven by prolonged periods of photic zone euxinia (van Dongen et al., 2006; van Kaam-Peters et al., 1997; Abubakar et al., 2022, 2025) . The BBDS has been correlated from the Wessex Basin into the Weald Basin (e.g. Ahmadi, 1997; Bohacs et al., 2022; Taylor et al., 2001), however it remains unresolved whether the exceptionally high TOC contents, and the associated preservation through sulfurisation documented in the Wessex Basin persist laterally into the Weald Basin. The main objectives of this study are therefore to (1) assess whether the BBDS extends laterally into the Weald Basin; and (2) evaluate whether the same preservation mechanism, e.g. sulfurisation of OM (mainly carbohydrates) is the major mechanism through which the additional OC is preserved.

Initial results from a basin-wide correlation of the BBDS, conducted using wireline logs from 40 wells, complemented by new measurements on drill cuttings and sidewall cores, confirm its lateral continuity into the Weald Basin, with TOC and total sulfur (TS) values ranging from 1.4 to 23.7 and 0.15 to 3.18 wt% within the BBDS, respectively. Pyrolysis-gas chromatography mass spectrometry (Py-GCMS) on a subset of samples confirmed, besides the presence of a series of *n*-alkanes/alkenes doublets, alkylbenzenes and an unresolved complex mixture (UCM) characteristic of an organic rich mudstone, the presence of a series of sulfur containing short chain alkylated thiophenes and benzothiophenes. Although the same compound classes were present in all pyrolysates, their relative abundances differed substantially between samples with high and low TOC. Ratios such as 2-methylthiophene and benzothiophenes to toluene correlated strongly with TOC. These ratios were highest within the peak TOC interval, consistent with previously measured depth profiles across the Blackstone Band in the Wessex Basin (van Dongen et al., 2006; van Kaam-Peters et al., 1997). These results not only confirmed the continuation of high TOC contents into the Weald Basin but also provided direct evidence for the presence of substantial amounts of sulfurized OM. The results are comparable to those previously reported from outcrop and borehole samples in the Wessex Basin and suggest that similar OM preservation processes occurred in both basins during the deposition of the Blackstone Band. This has direct implications for paleoenvironmental reconstructions and petroleum system modelling through refining quantification of carbon burial fluxes and long-term carbon sequestration in the basin and fundamentally altering kerogen kinetics by lowering thermal activation energies and driving early petroleum generation at lower maturities.

References: Abubakar, Taylor, Coker, V., Wogelius, and van Dongen, 2022. Mar. Pet. Geol. 141, 105684; Abubakar, Wogelius, Coker, Taylor, Edwards, and van Dongen, 2025. Chem. Geol. 692, 122971; Ahmadi, 1997. Unpubl. PhD thesis, University of Durham; Bohacs, Macquaker, and Lazar, 2022. The American Association of Petroleum Geologists and Brazil petrostudies; Huc, Lallier-Verges, Bertrand, Carpentier, and Hollander, 1992. Columbia Univ. Press, New York, pp. 469-486; Pearce, Coe, and Cohen, 2010. Paleoceanography, 25, PA4213; Taylor, Sellwood, Gallois, and Chambers, 2001. J. Geol. Soc. 158, 179–192; van Dongen, Schouten, and Sinninghe Damsté, 2006. Org. Geochem. 37, 1052–1073; van Dongen, Schouten, and Sinninghe Damsté, 2002. Mar. Ecol. Prog. Ser. 232, 83–92; van Kaam-Peters, Schouten, de Leeuw and Sinninghe Damsté, 1997. Org. Geochem. 27, 399–422.

Effects of inoculum origin and nitrogen availability on early growth and ectomycorrhizal colonization in *Pinus sylvestris* seedlings

Nadia Rojas-Arévalo, David Johnson, Bart van Dongen, Richard Bradgett, Filipa Cox.

The seedling stage is a critical phase in tree development, where establishment is strongly influenced by soil properties and microbial communities. Understanding how inoculum origin and nitrogen (N) availability affect seedlings is key for identifying conditions that promote successful reforestation. This study evaluated their combined effects on growth and performance of *Pinus sylvestris* seedlings in a controlled seven-month experiment using custom-design pots allowing indirect exposure to soil microbial communities. Treatments included four inoculum origins (grassland, young plantation, mature plantation and sterile control), and two N regimes (addition, and no addition). Seedling performance was primarily shaped by inoculum origin, which strongly influenced ectomycorrhizal (ECM) colonization, root morphology (length, diameter, area and volume), and biomass allocation patterns. N availability affected ECM colonization both directly and through its interaction with inoculum origin. Additionally, the interaction of factors altered seedlings height, root and shoot biomass allocation, and needles length, revealing context-dependent shifts in carbon partitioning strategies. These findings demonstrate that microbial context and N availability jointly regulate early seedling development, emphasizing that their interaction should be consider in reforestation strategies to improve establishment success and better predict long-term forest trajectories.

Do crystal cargoes record the rapid reorganisation of the magmatic plumbing system during the 2021 Fagradalsfjall eruption?

R.R. Hughes[1*], M.E. Hartley[1], S. Matthews[2], S.A. Halldórsson[2], E. Bali[2] & D.A. Neave[1]

* 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] Nordic Volcanological Center, Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland

Keywords: basaltic volcanism, Fagradalsfjall 2021, crystal cargoes, plagioclase, olivine

The 2021 Fagradalsfjall eruption was a six-month long, low-explosivity basaltic fissure eruption of the Reykjanes Peninsula, Iceland. This eruption represents the earliest stage of the reactivation of volcanism on the Reykjanes Peninsula after 780 years of inactivity, commencing the ongoing eruptive crisis. Exceptionally rapid transitions in melt chemistry characterised the first 50 days of activity, followed by relative compositional stability until the end of the eruption [1, 2]. However, how the crystal cargoes may reflect the rapid reorganisation of the magmatic plumbing system, or the period of compositional stability, remains to be explored.

We present petrographic characterisation of crystal cargoes in nine samples collected throughout the eruption, achieved using Scanning Electron Microscopy methods including Backscattered Electron (BSE) imaging and Energy-Dispersive X-ray Spectroscopy (EDS) mapping. During the first 50 days of eruption, as melt compositions rapidly change, the mineral assemblage changes from plagioclase- to olivine-rich. Olivine is initially absent, increasing in abundance with time. The proportion of olivine with reverse zonation also increases with time. Plagioclase initially appear as sub-euhedral crystals with multiple coarse compositional zones and either distinctly primitive or evolved cores (textural Type 1). A textural transition occurs to smaller, rounded crystals with finer-scale compositional zonation (textural Type 2). The petrographic changes may reflect variation in the nature of crystal mush erosion and entrainment over time, and in magma mixing. During the remainder of the eruption, as melt compositions stabilise, the mineral assemblage transitions back to plagioclase-rich. The proportion of olivine with reverse zonation decreases and in some samples is entirely absent, and plagioclase transitions back to textural Type 1.

We demonstrate that the crystal cargo does reflect the rapid reorganisation of the plumbing system, and that the crystals may record evolution of the plumbing system that is not obvious from melt chemistry alone. We will integrate our petrographic observations with quantitative geochemistry of minerals to better understand how crystal cargoes may record the inception, progression and cessation of prolonged basaltic eruptions that occur globally.

References

[1] Halldórsson, S. A., et al., 2022. Nature, 609 (7927), 529–534.
[2] Marshall, E.W., et al., 2024. AGU Advances, 5 (6), e2024AV001310.

Visualising Niche Theory and the Impacts of Environmental Change

Author: Leanne Russell

Environmental fluctuation is a key driver for species extinctions. The past five mass extinctions were as a result of natural disaster-induced climate changes rendering the Earth inhospitable for much of its biodiversity. We are currently within the sixth mass extinction. Unlike its precursors, the sixth mass extinction is primarily driven by anthropogenic activity causing extensive habitat loss and atmospheric changes resulting in substantial global warming. Understanding species distributions and their relationships with the environment is crucial to inform conservation measures and reduce the speed and intensity of the sixth mass extinction. Species have an N-dimensional hypervolume defined by an N number of environmental gradients that describe the conditions under which the species can persist and reproduce, which is called the niche. The niche determines a species' distribution and abundance across space and is considered fundamental for understanding biogeographical patterns. The ACH is a foundational concept within ecological niche theory. The ACH defines the centre of a species range to be the location of most abundance in accordance with the niche or geographic centre with a steady decline towards range edges. Defining a species niche is inherently difficult due to the abstract nature, computer modelling is regularly used to spatially expand empirical data and predict temporal change. My PhD research investigates the use of REvoSim, an individual based evolutionary computer model, to explore the ACH in response to environmental change. The first chapter of my PhD confirms the ability of REvoSim to produce species distributions that support the ACH whilst confirming the presence of spatial autocorrelation within the environment.

Evaluating the Wittenoom Formation carbonate archive for the Archaean pre-Great Oxidation Event (GOE) ocean redox reconstruction

Hanyue Zhao [1]*, Kevin G. Taylor [1], Cathy Hollis [1], Kurt O. Konhauser [2]

* presenting author, hanyue.zhao@postgrad.manchester.ac.uk

[1] Basins Research 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 Earth and Atmospheric Sciences, University of Alberta, Edmonton, Alberta T6G 2E3, Canada

Keywords: Precambrian carbonate; Wittenoom Formation; pre-GOE; redox; X-ray diffraction

Reconstructing seawater chemistry and redox evolution before the Great Oxidation Event (approx. 2.2 billion Years ago) is central to understanding Earth's transition toward oxygenation. Marine carbonates can preserve rare-earth element and yttrium (REY) systematics, but these signals may be modified by dolomitisation, recrystallisation, silicification and later fluid–rock interaction. This project aims to establish a carbonate-based chemostratigraphic record across the Hamersley Basin, initially using 23 samples spanning the upper Marra Mamba Iron Formation to the Wittenoom Formation. This interval captures the shift from iron-formation- to carbonate-dominated sedimentation, providing a framework for testing carbonate geochemical changes against seawater redox evolution.

Integrated petrography, cathodoluminescence, Raman spectroscopy and XRD show a pervasively recrystallised, strongly dolomite-dominated succession in which much of the original stratigraphic fabric remains recognisable. Bedding-parallel stylolites, increasing fabric distortion and carbonate redistribution are consistent mainly with burial compaction and internal reorganisation rather than pervasive external-fluid replacement, although local silicification occurs. Cathodoluminescence distinguishes relatively homogeneous matrix dolomite from optically clear veins and microdomains with stronger internal zoning, indicating multiple recrystallisation or growth stages. Raman identifies no unambiguous relict calcite in the analysed domains, supporting extensive dolomitisation, and shows that carbonaceous material contributes substantially to the darker lower intervals, where more abundant pyrite is consistent with locally more reducing depositional or early-diagenetic conditions. XRD further indicates highly ordered dolomite and subtle lattice-scale compositional variability now being tested by full Rietveld refinement.

These results provide a framework for testing preservation at two scales: whether texturally or mineralogically distinct domains differ from adjacent dolomite matrix, and whether comparable matrix domains show coherent stratigraphic trends. The next stage will combine these constraints with bulk and in-situ REY analyses and redox-sensitive proxies, particularly Ce anomalies, to separate diagenetic effects from systematic stratigraphic variation and build a defensible carbonate-based reconstruction of pre-GOE ocean redox history.

Joint Analysis of Volcanic SO_2 and Deformation Time Series to Understand Transitions in Unrest at Sangay Volcano

Morgan, C.[1], Burton, M. [1], Ebmeier, S.K. [2], Espín Bedón, P.A.[2], Esse, B. [1], McCormick Kilbride, B.T[1]

[1]COMET, Department of Earth and Environmental Sciences, University of Manchester

[2]COMET, School of Earth and Environment, University of Leeds

Historically, a lack of continuous observations has hampered our ability to relate changes in volcano monitoring data to imminent shifts in unrest or eruptive style, particularly at persistently active open vent volcanoes. Satellite remote sensing offers observations at ever-improving spatial, spectral, and temporal resolutions to establish multi-year records of volcanic unrest, often with daily resolution, providing opportunities to improve our understanding of volcanic behaviour. The TROPOMI sensor onboard ESA's Sentinel-5P satellite provides daily global coverage and a significant improvement in sensitivity to atmosphere SO_2 column concentrations over its predecessor instruments [1,2]. Using TROPOMI data, we can quantify SO_2 emissions from potentially any actively degassing volcano on Earth. Volcano deformation monitoring through Sentinel-1 InSAR observations has also expanded in recent years, allowing for high spatial and temporal coverage of ground displacement throughout Earth's volcanic regions [3].

In this study, we focus on Sangay, a remote and highly active open-vent stratovolcano in Ecuador. Since 2019, Sangay has entered a new eruptive period, characterised by continuous ash emissions, explosions, and lava flows. We investigate how SO_2 emissions from Sangay evolve across a multi-year timeseries of changing activity and how gas emissions co-vary with trends in ground deformation [5]. We aim to understand the sustained inflation observed at Sangay since 2019 and characterise changes in degassing behaviour as the volcano transitions from low-level unrest to higher intensity eruptions. We hope this will provide insight into the processes driving volcanic behaviour, aid the development of new models of volcanic unrest states [6] and ultimately contribute to eruption forecasting and risk mitigation.

[1] McCormick Kilbride, B. T. et al. (2023) G-cubed 10.1029/2022GC010786
[2] Esse, B. et al. (2024) Geol. Soc. Spec. Publ 10.1144/SP539-2022-77
[3] Lazecký, M. et al. (2020) Remote Sensing 10.3390/rs12152430
[4] Vasconez, F. J. et al. (2022) Bull. Volcanol 10.1007/s00445-022-01560-w
[5] Espín Bedón, P. A. et al.(2024).Volcanol.Geotherm.Res 10.1016/j.jvolgeores.2024.108147
[6] Reath, K. et al. (2020) G-cubed 10.1029/2019GC008494

Title: Knowledge, Awareness, Attitudes and Sources of Vitamin D Deficiency and Sufficiency in Saudi Children

Author: Fatimah mohammed

Background: Vitamin D deficiency is a common health concern among Saudi children. Limited awareness of its sources and health benefits may contribute to inadequate vitamin D status.

Objective: To assess knowledge, awareness, and attitudes regarding vitamin D and its sources among Saudi children with vitamin D deficiency compared with healthy children.

Methods: A cross-sectional study was conducted at Security Forces Hospital in Riyadh, Saudi Arabia, between January and December 2011. The study included 200 children and adolescents, comprising 100 vitamin D-deficient patients and 100 healthy children. Participants were interviewed using multiple-choice and short-answer questions assessing vitamin D knowledge, awareness, attitudes, and related behaviours.

Results: Awareness of vitamin D sources was lower among vitamin D-deficient children than healthy children (28% vs. 64%). Similarly, knowledge of the health benefits of vitamin D was reported in 50% of patients and their parents compared with 70% of healthy participants. Differences in reported sun exposure behaviours were also observed between the groups.

Conclusion: Saudi children with vitamin D deficiency demonstrated lower awareness of vitamin D sources and health benefits than healthy children. These findings highlight the need for targeted educational initiatives to improve vitamin D-related knowledge and awareness among children and their families.

Keywords: Vitamin D deficiency; Saudi children; Knowledge; Awareness; Sun exposure; Nutrition.

Resolving the origin of gas in Sicilian Mud Volcanoes

Elise Gaulier

Mud volcanoes release CO_2 and CH_4, two of the most important greenhouse gases, to the atmosphere. However, gas can be transformed between its source and the surface, and the processes controlling what is ultimately emitted remain less well constrained. Tracing this source-to-sink pathway is important for estimating natural contributions to global carbon budgets. We sampled six mud volcanoes and gas seeps across Sicily, spanning sedimentary and volcanic settings, and combined noble gases, which are chemically inert and preserve a fingerprint of the deep source unaffected by chemical or biological reactions, with stable carbon and hydrogen isotopes, which record how gas is generated and modified along its path. Noble gas isotopes show contributions from both mantle and crustal sources, with increasing groundwater interaction at some sites. Methane reflects a mix of thermogenic and microbial gas (Bernard et al., 1978; Whiticar, 1999). Carbon isotopes reveal that the carbon inventory is substantially modified during migration and storage through microbial activity, CO_2 dissolution and carbonate precipitation, so the gas emitted at the surface differs from that at depth. By following gas from source to sink, this multi-tracer approach helps distinguish source signatures from near-surface modification, and will next be applied to mud volcanoes in the Northern Apennines.

Conference Feedback Form

Dear All,

Thank you for your participation in the inaugural EES PGR Conference. We would especially like to thank the HoPGR Dr Clare Robinson for leading the planning and delivery of this event.

We would like to encourage feedback from you to help us expand on the delivery of the next EES PGR Conference.

Example Areas:

- Involving PGR Reps and volunteers in the planning process
- Assessing how to improve on delivering a commitment to sustainability
- Improving accessibility and support for participating PGRs

You can submit your anonymous feedback using this **online form** until Friday, 20th November.

If you have any further comments after this date, please contact fse.doctoralacademy@manchester.ac.uk.

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

Best Wishes,

PGR Experience Team