









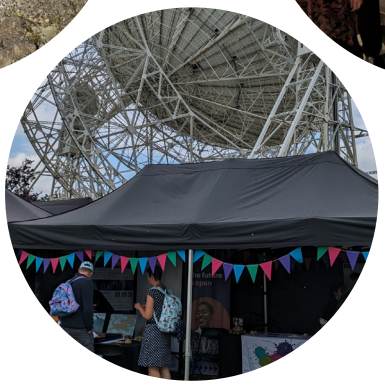

AstrobiologyOU

2022-2023
ANNUAL REPORT

AstrobiologyOU

The Open University

AstrobiologyOU
Schools of Environment, Earth and Ecosystem Sciences;
Physical Sciences; Law, and Social Sciences & Global Studies
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A message from our Directorate

Welcome to our fourth annual report, showcasing the wonderful work that the group has undertaken over the period 1 Aug 2022 to 31 July 2023. This is a merely snapshot of the group's activities and we had to make very difficult decisions about what to not include! We also recognise the huge effort that continues 'behind the scenes' from our technical team and Support Hub, and from many others that continue to support and facilitate the group's work. Nothing that you read here could be done without them.

We've sadly goodbye to some colleagues: Simon Lee, Sevi Filippidou, Stuart Turner, David Slade and Mario Toubes-Rodrigo all left for new opportunities. Connor Dazley successfully completed his microbiology apprenticeship and also left for pastures new. We've also seen some changes to those still with us: Ben Stephens has transitioned to a new role as Commercialisation Project Officer, Abi Outred was promoted to Project Officer, Nisha Ramkissoon moved to an open-ended contract, and we welcomed Natalie Trevino as PDRA in Space Ethics, Lewis Sym and Daniel Loy as new PhD students, and Weronica Rojek as a Level 3 Laboratory Technician apprentice.

We have celebrated with those PhD students who have successfully defended their theses: Scott Steele, Devyani Gajjar, Zoe Emerland and Anushree Srivastava. Zoe remains at the OU as Project Officer in the hypervelocity impact laboratory, while the others are now employed using their PhD skills and experiences to good effect. Scott Steele left us having being named runner up as the OU's Outstanding PhD student in their Research Excellence awards.

Recognising its important and valuable role in nurturing the next generation of talent, we've continued to support several short internships (Aliss Rodrick, Poppy Marsh, Yifan Zhu and Amy Perrio) and work experience students, and thanks go to everyone who supported them.

One of the biggest changes in this academic year has been our ability to undertake engagement and community events in person, including the mammoth effort - led by Hannah Cooper - to deliver an AstrobiologyOU presence at the Bluedot festival at Jodrell Bank. Not only was this a superb event, but it was also wonderful to see the group's enthusiasm and commitment to bringing astrobiology to a wider audience. It was a lot of fun, and very inspirational (and muddy).

There have, of course, been innumerable research highlights, many outlined in this report. There continues to be direct involvement in NASA's Curiosity rover mission, and looking to the future, Susanne Schwenzer is involved in two Mars Sample Return panels. Our early career researchers have also achieved funding successes, such as, Mark Fox-Powell was successful in the SPS STFC Consolidated Grant, for a project on to which Rachael Hamp has transitioned as a postdoc; Claire Batty has been awarded a CASE studentship - in partnership with Airbus and after a successful STFC-IAA project, investigating volatile release in cleanroom environments, and Michael Macey has developed a collaboration with the University of Strathclyde and been awarded OU Open Societal Challenges funding, exploring 'Extremophiles Against Antibiotic Resistance'.

In addition, this year, we have welcomed Geraint (Taff) Morgan and Louise Thomas as Associate Directors.

There are many more individual achievements to celebrate, but we were collectively successful in the OU's Research Excellence awards: our Support Hub were runners up for Best Support Team, and the group itself won the Best Research Project award.

Well done everyone!

4 Book Chapters Published

25,313 Views on YouTube

New Members of Staff **5**

Engagement Comms & Events **47**

£4.8M Grants Awarded

26 Journal Articles Published

46 Conference Presentations

2 New PhD Students

7 Videos Published

2 White Papers Published

31 Bids Sudmitted

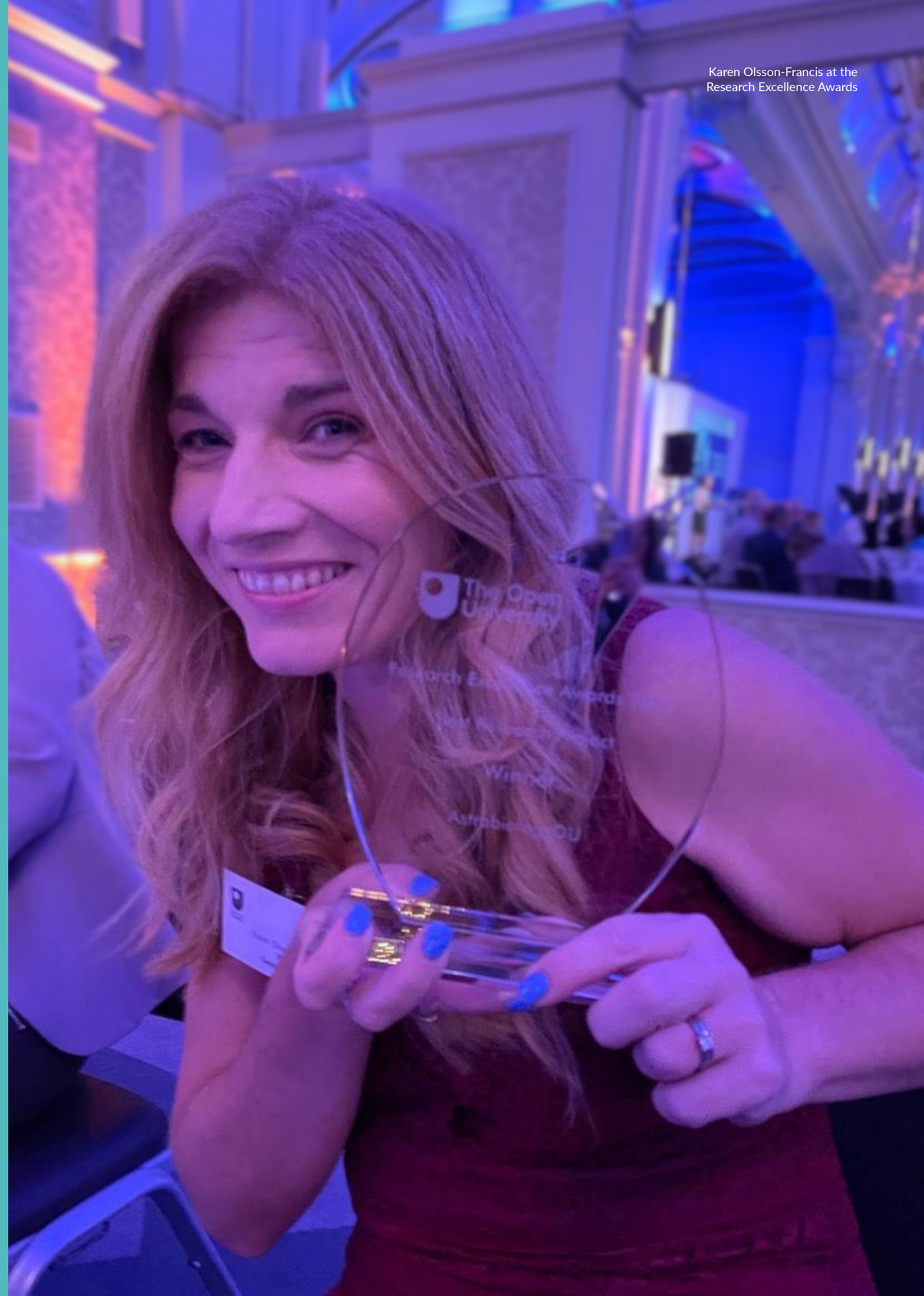
2007 Followers on Twitter

14 Award Nominations

5 Workstreams

4 Key Themes

1 Aim



Karen Olsson-Francis at the Research Excellence Awards

AstrobiologyOU fieldwork from Iceland to Botswana

Geitafell volcano

In September I was able to travel to Geitafell central volcano near Hoffell in the south-eastern part of Iceland to carry out fieldwork. This region is an ideal analogue for Mars because the volcanic units of a former central volcano were significantly altered by hydrothermal fluids. Hydrothermal systems provide conditions and nutrients for microbial life and thus have the potential to create subsurface habitats on Mars. Characteristic minerals associated with these hydrothermal systems have been detected on the surface of Mars by spectral observations from orbit, but their formation conditions and spatial distribution remain unknown.

The aim of this study was a detailed characterisation of the spatial distribution and mineral chemistry of the low-grade metamorphic/hydrothermal alteration mineralogy in the extinct hydrothermal system and to sample characteristic low-grade metamorphic minerals, which have also been detected on Mars.

19 samples were collected from different alteration zones within the hydrothermal system including veins and vesicular basalt showing a range of alteration minerals such as carbonates, quartz, zeolites, chlorite, prehnite, epidote, andradite, and actinolite.

We are now in the process of conducting a detailed study of the samples including petrography, mineral chemistry, and spectroscopy, which can then be used to further constrain our models of hydrothermal alteration on Mars. We expect this research to be highly relevant to the study of hydrothermal systems on Mars and particularly for sample return once the Perseverance Rover reaches the rim of Jezero Crater, which likely exposed hydrothermally altered rocks.

Julia Semprich
Research Fellow

This fieldwork was funded by Europlanet 2024RI grant agreement number 871149.

Makgadikgadi salt pans

After a long flight from Heathrow via Johannesburg, Karen, Susanne and myself arrived in Gaborone, Botswana. Although our airport check-in at Heathrow was one of the most challenging any of us had ever had, the flights ran smoothly.

We travelled to Palapye, home of our host Fulvio Franchi, Professor of Sedimentology at the Botswana International University of Science and Technology (BIUST). As an expert in the Makgadikgadi Salt Pans (an analogue for Mars) we were in safe hands for collecting our samples.

We travelled with Fulvio and his colleague Dr Lesedi Lebogang, Lecturer in Microbiology as well as a driver – Ace (who proved to be excellent in removing vehicles from mud!).

Armed with what seemed like most of the AstrobiologyOU labs, we had everything we needed to test for pretty much anything we found: gas samples, aerosol, sediment, rocks, biofilm, or water. Unpredictable patches of water were apparent, with no indication of depth or what could be below the shallow sediments. We spent our first night camped on the Pan in an unexpected place as our 4x4 got stuck in the hidden tracks of a large truck.

For me this was one of the best nights. With no light pollution the stars were amazing and I couldn't help but gasp when a shooting star blazed above us and a lightening storm crossed the horizon. Fulvio and Ace's valiant efforts the next day freed us of the mud and we continued our journey. Other highlights included dust devils, bubbling gas pockets, salt crystals and floating biofilms, all showing the diversity and changes that can occur in the salt pan environment.

The rest of our short but productive trip was highly dependent on where on where we could get the 4x4's.

This highlighted to me the skill of Fulvio and Ace in predicting where to drive and where to avoid. Overall we found some interesting and useful samples, all of which we will be excited to report on once everything is analysed.

Claire Batty
PDRA

Hoffelsjökulll, Iceland taken
by Julia Semprich

The future of Mars research: sample return

The Perseverance rover – now on Mars for over 750 sols – is in the process of collecting samples for Mars sample return. Most recently, the rover team has put ten of these samples down onto the Martian surface in an area called Three Forks. This is the backup set of samples, with a duplicate of each one of those still in the rover.

While Perseverance adds to its collection, Earth is busy with all the processes actually required for sample return. Much of this is building things: spacecraft, receiving facilities..., but who looks at all the details of those processes? Experts, of course. There are many teams of experts involved, and one such team is the Mars Sample Return Science Campaign Group. It comprises 16 experts from Europe, the US, Canada and Japan, who cover a very wide range of subjects from petrology to microbiology, from organics to atmospheres and much more. I am one of these experts, bringing my knowledge in noble gases, alteration mineralogy and water-rock reactions to the table.

But what does such a group actually do? We look at many aspects of sample return, one day we might be looking into the best analogue materials to test some processes, and the next day be concerned about how organics might react to a certain phase of the return journey.

It is a very varied set of tasks, all aimed at one goal: to get the best possible science from those precious samples as soon as possible after they arrived on Earth and for many, many decades to come thereafter. Just think of the Apollo samples, those lunar rocks have been on Earth for over 50 years now, and they continue to bring new and exciting insights into the formation of the Moon as our analytical technologies evolve. This will be no different for Mars samples, and this is what to me is the most exciting part of sample return: scientists will continue to investigate will these samples for decades to come!

Susanne Schwenzer
Senior Lecturer

Joining ESA's L4 expert team

I had the privilege of being selected as a member of ESA's L4 expert team, developing the science rationale for a future L-class mission to moons of the Outer Planets. This team is made up of 12 scientists from across Europe, bringing together the experts in icy moon and mission science to work together to help define the next ESA mission to an icy moon. The team is comprised of physicists, geologists and astrobiologists with each bring their different skills sets. I, personally, contribute a geochemistry perspective.

The Senior Committee has provided recommendations regarding the main aims for the mission, including assessing habitability, identifying prebiotic chemistry, and furthering our geophysics knowledge. It is our job to use these aims to identify the best targets and then design basic mission profiles that allow us to meet these objectives. The mission should substantially further our current understanding of one or more moons of the outer Solar System and engage a large proportion of the planetary science community. Our work will take approximately 2 years to complete and at the end we will lay out mission or multiple mission profiles for either one target or a range of targets that would meet the aims of the Senior Committee.

Throughout the first year, I have learnt so much from being part of this team. It has been a wonderful experience to learn from expert scientists who are leading the way in their fields. It was initially quite overwhelming being part of a team made up of such accomplished scientists, however over time I have built my confidence in putting my ideas forward. I look forward to the final year of this project and cannot wait to see what the final outcomes will be!

Rachael Hamp
PDRA

Centring environmentalism in space governance

Our Space Policy article is a good representation of the work that we have been doing in AstrobiologyOU. It is the result of conversations between Dr Marino and myself over the past three years. In short, the article brings aspects of social studies scholarship to questions of space law, particularly focusing on the questions of the 'uses of outer space' and the shortcomings of the existing legal instruments. This includes considering the 'paths not taken' specifically a more environmentally minded approach to the space law regime starting with the Outer Space Treaty.

A common refrain regarding the 'lack' of environmental concern in the Outer Space Treaty is that the Outer Space Treaty predated the environmental movement. Not only does this narrative ignore Rachel Carson's Silent Spring and place too much focus on the 'Earthrise' photo taken by Apollo 8 but, as we argue, ignores the efforts by some delegations (most notably Japan) to argue for a more robust environmental mandate in the Outer Space Treaty.

By reading the history of the Outer Space Treaty, within the broader context, we challenge the seemingly egalitarian clauses which mask the persisting hegemony of older space powers in access to and benefits from outer space.

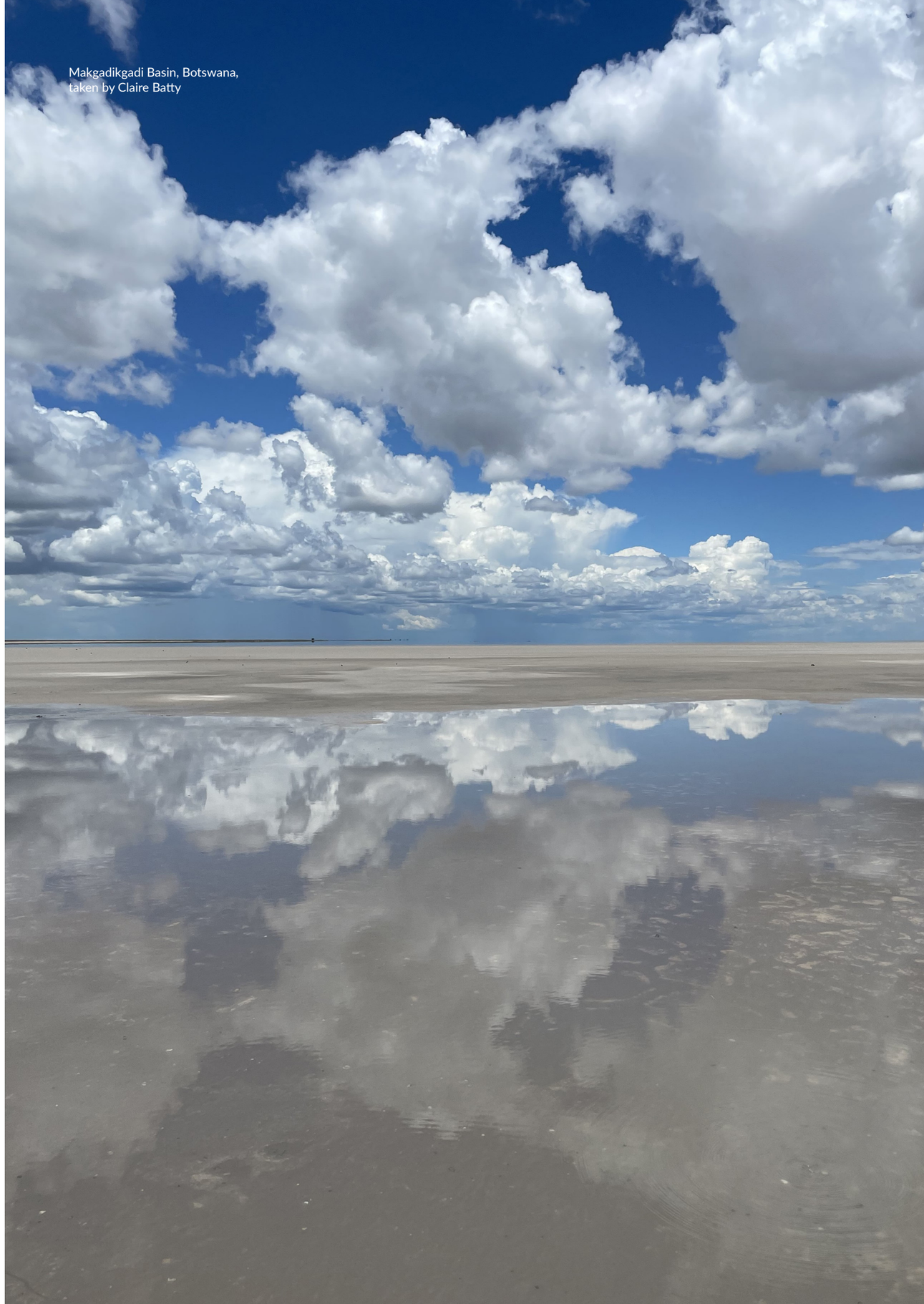
Even when we look beyond the Outer Space Treaty and look at multiple legal and governance frameworks of outer space, from Planetary Protection to the International Telecommunications Union, these different approaches reiterate a utilitarian view of space environments that ties them to their usefulness to exploration and exploitation. These mechanisms do not go far enough in proposing that environmental protection underpins all principles of space governance.

One of the effects of this failure is that more technically-able nations keep crowding the orbits with megaconstellations. We propose an interdisciplinary approach to understanding the complex interrelation between space governance, geopolitics, and concerns about the future of outer space environments.

This includes a call for a critical legal geography of outer space which will provide a possibility to examine the role of the law in relation to both geographical imaginaries and historical contexts and advance discussions on the role and responsibilities of humans beyond the planet we inhabit.

Thomas Cheney
Lecturer in Space Governance

Marino, A. and Cheney, T. (2023) Centring Environmentalism in Space Governance: Interrogating Dominance and Authority Through a Critical Legal Geography of Outer Space, Space Policy (63) 101521. https://doi.org/10.1016/j.spacepol.2022.101521.



Makgadikgadi Basin, Botswana, taken by Claire Batty

From Astrobiology to Parliament

Last summer I did a fellowship with the parliamentary office of science and technology (POST). One of POST's functions is to produce impartial, accessible briefings that bring together research on topics of current interest, for use by parliamentarians – both MPs and peers. The topic I was assigned was to undertake research for a POST report on Assisted Dying.

For the research, I interviewed experts and representatives from across academia, the third sector, government and parliamentarians. I used the evidence from the interviews to help me pinpoint the key literature I needed to include in the report, which I reviewed and analysed. Then I drafted the briefing paper with my POST supervisor, building on feedback from external reviewers (including some of my interviewees).

It was one of the best times of my life! Highlights include having lunch in the Palace of Westminster, sitting on the terrace of the House of Commons, going to Prime Minister's Questions, and MP spotting. And of course, I knew that I was working on something that would have an impact and be used by parliamentarians; that I was producing something that could help decision-makers make informed decisions on laws that directly affect people.

Devyani Gajjar
PhD Student

A summer internship at Rawwater

I was very fortunate to undertake a 6-week internship with Rawwater Engineering in August 2022. Rawwater offers contract R&D and consultancy for sour fluid management. Souring is a huge issue in the oil industry operations, because when sulfate-rich seawater is injected into wells for secondary oil recovery, it usually creates favourable conditions for sulfate-reducing bacteria that produce hydrogen sulfide as a by-product of their metabolism. Hydrogen sulfide is a highly toxic and corrosive gas that leads to damage of expensive equipment. Rawwater offers two major services to the energy sector to deal with this issue: desktop-based souring forecasting and pressurised bioreactor facilities.

I was involved in the maintenance of the pressurised bioreactor facilities, which are used in simulation studies to generate quantitative data about hydrogen sulfide production for operators and chemical service providers globally. The work highlights of my time at Rawwater were the opportunity to build and decommission bioreactors and to perform accurate hydrogen sulfide quantification. Also, it was enjoyable to change my usual academic lab environment to an industrial microbiology one, where I got to use a vice, spanners, and other cool tools, while still being involved in microbiology work.

My personal highlight during the placement was working alongside the science team at Rawwater! I had a great time getting to know all scientists and managed to learn a lot from them in these six weeks. I believe I made very valuable connections that may open opportunities for future collaboration!

Veli Ilieva
PhD Student

Habitability and biosignature formation in simulated martian aqueous environments

Water present on early Mars is often assumed to have been habitable. It is possible to simulate the possible chemistry of this water by combining chemically accurate simulants to act as proxies for the martian regolith in combination with fluids that have been derived from modelling water interacting with the regolith over geological time. In our study we simulated the chemistry of Gale Crater, the landing site of the Mars Curiosity rover and former martian lake, to investigate the habitability of these waters.

The simulated environment was inoculated with sediment from the Pyefleet mudflats (United Kingdom), as this sediment has been shown to contain microbes with multiple anaerobic metabolisms with which to test the habitability of the waters. These enrichments were grown for 28 days and subcultured seven times to ensure that the microbes were solely grown on our defined, simulated martian chemistry as opposed to any residual material from the inoculum.

The fluids were confirmed as habitable, with the microbes able to grow in the fluid showing a steady reduction in abundance and diversity over the subcultures relating to the selection of specific metabolic groups. The community of microbes at the end of the experiment was comprised of sulfate-reducing ($SO_4^{2-} + 9H^+ \rightarrow HS^- + 4H_2O$), acetogenic ($4H_2 + 2CO_2 \rightarrow CH_3COOH + 2H_2O$), and other fermentative bacteria.

The fluid and regolith of the simulation were analysed with an array of analytical techniques (ICP-OES, IC, FTIR, and NIR) to identify if there were any shifts in chemistry that could potentially be used to inform the search for the former presence of life. Modelling was also used to test whether these changes could happen without the microbes over geological timescales. These analyses of the simulant and fluids identified clear differences between the biotic and abiotic experiments, including the elimination of sulfur owing to the presence of sulfate-reducing bacteria and more general changes in pH associated with actively respiring cells – these changes can impact the formation of specific minerals and can therefore be used to inform future life-detection missions.

Michael Macey
PDRA

Macey, M., Ramkissoon, N. K., Cogliati, S., Toubes-Rodrigo, M., Stephens, B. P., Kucukkilic-Stephens, E., Schwenzer, S. P., Pearson, V. K., Preston, L. J. and Karen Olsson-Francis.(2023) Habitability and Biosignature Formation in Simulated Martian Aqueous Environments. Astrobiology.Feb 2023.144-154.http://doi.org/10.1089/ast.2021.0197

Questioning the imperative of reaching for the stars

From space technologies enabling navigation and communication to space missions enhancing knowledge about the universe, human activities in space are more varied and even more mundane than we often tend to think. With commercial actors entering the space economy, giving rise to what is often referred to as the New Space Age, these activities are developing as fast as our technological capabilities.

Scholarship has been slow(er) to catch up with the current discourses, plans and fantasies about space access and use. At The Open University, where space research is of international standing, a group is being formed to spearhead the study of space-related activities from an ethical perspective. In plain terms, the Space Ethics Group – co-led by Professor Derek Matravers (Philosophy) and Dr Alessandra Marino (Geography/AstrobiologyOU) – asks the question: Even if we can access/ exploit/ technologically occupy/ colonise/ terraform space, should we?

The space age is awash in fantasies of space colonisation, including plans for settlements on Mars, which often take the headlines. However, our group will take a broad view of space-related activities, ranging from exploration to exploitation, and will investigate their fundamental assumptions as well as their interconnected social, political and environmental aspects. Redefining space ethics as an interdisciplinary conversation means that the 'should we?' question is not merely a theoretical one, but one with ramifications in policy and practice.

Let's provide an example. International, national and commercial actors, from the United Nations to private corporations, brand their space efforts as crucial tools to harness for the benefit of our planet. The launch of mega-constellations in orbit, with their hundreds or thousands of satellites, provides a case in point. SpaceX's Starlink is predicated upon the objective of extending the benefits of internet coverage to underserved communities on our planet. However, this seemingly benevolent objective and the consequence of satellite launches need close investigation. How can we reframe the public conversation about mega-constellations, if we place the problem of space debris (or space junk) at the centre of planetary environmental ethics? How can we talk about space benefits in new ways?

The aim of this group is to bring together scholars from Arts and Humanities and the Social Sciences that have an interest in space research and innovation, and bridge conversations with space scientists.

Ale Marino
Senior Research Fellow

AstrobiologyOU stall at the Bluedot Science and Music Festival held at Jodrell Bank, taken by Hannah Cooper

AstrobiologyOU at Bluedot festival

AstrobiologyOU were showcased this summer at the Bluedot festival, held at the UNESCO World Heritage Site of Jodrell Bank Observatory.

The annual festival combines live music, comedy and culture with science and space delivered through expert talks, live demonstrations and interactive activities. More than 15,000 music fans, families, and space and sci-fi enthusiasts attended each day.

The theme of this year's festival was 'Our Fragile Earth', which included the human impact on the space environment, a key research theme within AstrobiologyOU.

Karen Olsson-Francis was invited to deliver a public talk on the main stage. The talk, entitled 'Life at the Limits' described Open University research in astrobiology and explained how studying extreme environments on Earth plays an important role in planning life detection missions. The marquee was packed out, and Karen said it was the first time she had delivered a talk in wellies!

More than 1,000 visitors also joined AstrobiologyOU researchers in a marquee to take part in a range of activities such as creating aliens out of Lego, and a "Mars or icy moons" challenge. The group showcased their research into terrestrial analogue sites, giving festival go-ers the opportunity to interact with our research directly. Interactive screens also allowed them to explore AstrobiologyOU's and other content on OpenLearn.

Karen was also recorded at the event for BBC's Inside Science as a panellist alongside the UK Space Agency's Libby Jackson and Jodrell Bank's Tim O'Brien, which is available on BBC Sounds.

The AstrobiologyOU team that delivered the event included: PhD students Amy Dugdale, Anushree Srivastava, Ben Tatton, Grace Richards and Veli Ilieva, postdoctoral researchers Julia Semprich, Mark Fox-Powell, Jess Crumpton-Banks, Rachael Hamp and Peter Fawdon, and academics Karen Olsson-Francis and Vic Pearson. Massive thank you to Hannah Cooper who coordinated and led this, and made everything run smoothly. She was unable to control the rain, however, but she is working on this.

Vic Pearson
Associate DIrector

AstrobiologyOU and UN SDGs 2030

With the year 2030 deadline to meet the United Nations' Sustainable Development Goals (UN SDGs), the discussion about these global goals and targets will reach a crescendo over the remaining part of this decade. The goals have an ambitious strapline: "to provide shared blueprint for peace and prosperity for people and the planet, now and into the future." And these goals are an urgent call for action by all countries - developed and developing - in a global partnership.

All this is well and good, will say a sceptic, but are these just hollow words that we often see in international diplomacy? They might ask: There doesn't seem to be anything about science in them, so why should we really pay attention to them? More so, what could these goals possibly have anything to do with Astrobiology?

To reflect on these questions, we hosted a workshop to explore how our work might relate to UN SDGs. Thinking collectively and 'outside the box', group members came up with some refreshing ideas about the relevance of their work to these goals.

Ceri Gwyther and Abi Outred, part of the lab team, had some brilliant ideas about making labwork greener through, for example, making labs more energy efficient or switching to greener chemicals. These ideas speak directly to UN SDG 12, Responsible Consumption and Production and there are some easy wins for energy efficiency:

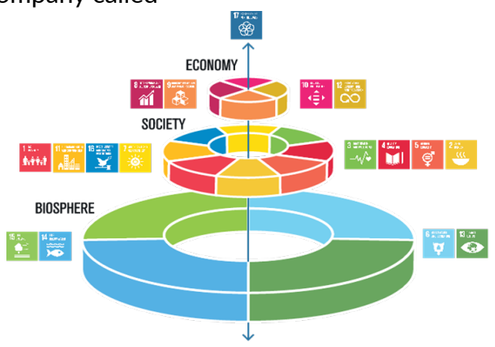
• Lab equipment consumes enormous amount of electricity and it does not come with energy ratings like domestic white goods. Ceri has been liaising with suppliers to get energy efficiency ratings for lab equipment.

• Energy efficiency can also be achieved by some very simply 'hacks'. Abi has been taking part, and is encouraging others to take part, in the International Freezer Challenge aimed at increasing freezer sustainability. As part of this challenge, emptying and reorganising fridges and freezers can go a long way in achieving energy efficiency.

• Ceri has been working with a company called Paper Round who recycle non-contaminated nitrile gloves and face masks.

We also do a lot of work in the field, often in remote parts of the world, which requires strong local partnerships. UN SDG 17 is all about partnership for the goals and Ann Grand, Ale Marino, Rick Holliman and Sarah Davies are promoting an engaged way of working, which is important and valuable for building effective and equitable local partnerships. So, whether in the lab or in the field, we have a lot to do with UN SDGs. If done well, our research can contribute to meeting some of these global goals and we are already contributing to this global mission.

Shonil Bhagwat
Professor of Environment and Development



The SDGs wedding cake helps to visualise the 17 UN SDGs. The biosphere supports our society, and the society supports economy. The 16 goals in these categories can only be achieved through the 17th goal which runs throughout.
Credit: Azote for Stockholm Resilience Centre, Stockholm University CC BY-ND 3.0.

Supporting students doing an Extended Project Qualification

The Extended Project Qualification (EPQ) offers school students in Years 12 & 13 the opportunity to undertake a standalone research project on a topic they are interested in. The EPQ is designed to help students become independent learners and build the research and communication skills that will be useful in higher education or working life.

As part of the Engaging Opportunities project, colleagues in the Open University have previously worked with EPQ students in Milton Keynes, facilitating workshops in research skills and mentoring individual students. The changes wrought by the COVID-19 pandemic offered an opportunity to build on the workshop content to create a series of online interactive resources for self-directed learning. The four resources focus on basic research skills: designing a good research question, finding and analysing evidence and communicating through writing and presentation.

To give a sense of research as a real-life process done by real people, I asked fellow researchers in AstrobiologyOU to contribute advice and ideas from their experience. They were generous in their responses, providing audio and video recordings, photographs, drawings, GIFs and text that I incorporated into the resources. As well as practical advice, their contributions reflect the diversity of voices, interests and people in AstrobiologyOU.

Coincidentally, the Foundations Programme team at the OU was looking for ways to enhance the content for schools offered by the OpenLearn platform. They planned to include support for the EPQ in this project (working title Life Launchpad), so they were delighted to learn our resources already existed and were excited by the quality of the material.

The resources are now live on the Life Launchpad on OpenLearn, taking AstrobiologyOU's aspirations and name around the world.

Ann Grand
Senior Lecturer Astrobiology Education

SOPHIA: the first simulant for Oxia Planum

The past few months have seen the submission and publication of the first paper from my PhD entitled 'SOPHIA: A mineralogical simulant for phyllosilicate terrains at the Rosalind Franklin landing site, Oxia Planum, Mars'. As the title suggests, the paper presents a simulant for Oxia Planum, the proposed landing site for the Rosalind Franklin rover mission, which will launch in 2028 and will search for signs of past or present life on Mars. SOPHIA is the first simulant for Oxia Planum and represents the local mineralogy there. SOPHIA has been developed for use in biosignature and mineralogy experiments, which will assist in interpreting data returned by the rover.

The design for SOPHIA is based on orbital observations of Oxia Planum and its catchment area. Since no in situ data is available for Oxia Planum, comparable sites on Mars were used to design the simulant, including orbital data from Arabia Terra and Mawrth Vallis and in situ data collected from Gale crater. The mineralogy, chemistry and physical properties of the simulant were characterised using standard laboratory techniques (SEM-EDS, XRF, XRD), as well as techniques analogous to rover instruments (Raman spectroscopy, Near-IR spectroscopy analogous to the Raman laser spectrometer and ISEM and MicrOmega instruments). The simulant is rich in Fe/Mg phyllosilicates with additional primary igneous and alteration minerals and can be used as a spectral and mineralogical analogue for Oxia Planum.

Amy Dugdale
PhD Student

Dugdale, A., Ramkissoon, N. K., Fawdon, P., Patel, M. R., Hills, L., Degli-Alessandrini, G., Bonsall, E.; Schröder, C., Turner, S. M. R., Achilles, C.N. and Pearson, V. K. (2023). SOPHIA: A mineralogical simulant for phyllosilicate terrains at the Rosalind Franklin landing site, Oxia Planum, Mars. Icarus, article no. 115568. https://doi.org/10.1016/j.icarus.2023.115568

PhD student spotlight

I have recently started my PhD project at the Open University as part of AstrobiologyOU. So far, I have received a warm welcome from fellow members of the group, and I am looking forward to working with everyone as I embark on my long (and hopefully not too arduous) PhD journey.

The project revolves around one of Jupiter's largest (and best) moons – Europa. Beneath Europa's planetary-wide icy shell, it is believed that there is an extensive global ocean that is in contact with the moon's rocky interior. As observed here on Earth, water-rock reactions at the seafloor can produce a range of chemicals – including molecular hydrogen. Hydrogen has important astrobiological implications because it has been shown that terrestrial microbes can utilise chemical reactions involving hydrogen to provide energy for cell activity (e.g. metabolism).

As such, my project is aiming to investigate the production of hydrogen in simulated Europan ocean-rock conditions and the effect that the ocean's carbon content would have on this. From this, we can understand the potential amount of energy available for Europan life – and even estimate the possible number of microbial cells that could be supported. It is my hope that this research will serve to inform future work interpreting data collected by the upcoming flagship missions to Europa – ESA's JUICE and NASA's Europa Clipper.

I am eagerly anticipating getting properly started on the PhD, working alongside my supervisors and the broader AstrobiologyOU team, and developing as a researcher.

Lewis Sym
PhD Student

Our PhD students

Bea Baharier
"From the Colorado Plateau to beyond Earth: using magmatic intrusions into sulfate-rich sediments as analogue for planetary habitable environments."

Aedan Baker
"Venus: petrological-geophysical modelling of the crust to understand tesserae composition"

Alvaro del Moral
"Limits of habitability of the icy moons"

Amy Dugdale
"Biosignature modification in the Oxia Planum region"

Devyani Gajjar
"The use of space technologies in International Development: Opportunities and Challenges"

Christopher Houghton
"Defining a capitals approach to evaluating the socio-economic benefits of space exploration."

Velislava Ilieva
"The Influence of sulfur cycling on community diversity in hypersaline Mars-analogue environment"

Daniel Loy
"Microbial Survival in the Makgadikgadi Basin, Botswana"

Zoe Morland
"Impact and heat processing of Mars' moon Phobos"

Grace Richards
"The feasibility of in situ VOC analysis on icy moons"

Silvio Sinibaldi
"Rapid detection techniques for Planetary Protection"

Anushree Srivastava
"Habitability of Mars brine chemistries"

Scott Steele
"The future of the COSPAR planetary protection guidelines: space governance and astrobiology"

Lewis Sym
"Hydrogen Availability in the Europan Subsurface"

Ben Tatton
"The limits of microbial life"

Our Directorate

Prof. Karen Olsson-Francis
Director and Professor of Geomicrobiology.

Karen is a microbiologist by training, and her research focuses on life at the limits. She is particularly interested in microorganisms that live in extreme environments, including the International Space Station, and terrestrial environments that are analogues for extraterrestrial locations. She developed the simulation facilities at the OU to subject model organisms to simulated extraterrestrial environments.

Dr Vic Pearson
Associate Director and Senior Lecturer.

Vic is a planetary scientist and she completed her PhD and postdoc roles in organic characterisation of carbonaceous chondrite meteorites at the OU. She is particularly interested in the origins of organic molecules in space, and their role in the origins of life on Earth and other planetary bodies. She also leads on a range of equality and diversity activities.

Dr Susanne Schwenzer
Associate Director and Senior Lecturer.

Susanne is a mineralogist, who studies volatile-rock interactions including noble gases, methane, and water-rock reactions. Her main research target is Mars, where she also is a member of the NASA Mars Science Laboratory Science team. She is responsible for Early Careers Researchers within AstrobiologyOU, including their training and development.

Dr Geraint (Taff) Morgan
Associate Director and Research Fellow.

Taff is an analytical chemist, specialising in the development and optimisation of analytical techniques for the quantification of volatile organic compounds in complex samples. He developed instruments for the Rosetta and Beagle2 missions and has spent the last 20 years translating the know-how to solve challenges back here on Earth. His research is commercially focussed from characterising distilled spirits globally, to proof-of-principle cancer studies with clinical partners.

Dr Louise Thomas
Associate Director and Senior Manager.

Louise is a geochemist by training, having attained her PhD at the OU, she worked as a research fellow in igneous isotope geochemistry. She was the NERC Uranium Series Facility Lab Manager at the OU, followed by 10 years as research manager and project manager for large EU and UKRI projects.

AstrobiologyOU members

Academic Staff:
Prof Shonil Bagwhat - Professor of Environment and Development
Prof Matt Balme - Senior Lecturer
Dr Thomas Cheney - Lecturer in Space Governance
Dr Sarah Davies - Senior Lecturer
Dr Ann Grand - Senior Lecturer in Astrobiology Education
Prof Richard Holliman - Professor of Engaged Research
Prof Christopher Newman - Professor of Space Law and Policy, Northumbria University
Dr Manish Patel - Senior Lecturer

Affiliated Members:
Dr Eddie Abbott-Halpin - Professor of Social and Human Rights Informatics; University of the Highlands and Islands
Dr Andrea Berardi - Senior Lecturer
Prof Leslie Budd - Professor of Regional Economy
Dr Simon Sheridan - Senior Research Fellow

Research Fellows:
Dr Mark Fox-Powell - Research Fellow
Dr Ale Marino - Senior Research Fellow
Dr Julia Semprich - Research Fellow

Post Doctoral Research Associates:
Dr Claire Batty
Dr Simone Cogliati
Dr Sevasti Filippidou
Dr Rachael Hamp
Dr Michael Macey
Dr Nisha Ramkissoon
Dr David Slade
Dr Mario Toubes-Rodrigo
Dr Natalie Treviño
Dr Stuart Turner

PhD Students:
Bea Baharier
Aedan Baker
Alvaro Del-Moral
Amy Dugdale
Devyani Gajjar
Christopher Houghton
Velislava Ilieva
Daniel Loy
Zoe Morland
Grace Richards
Silvio Sinibaldi
Anushree Srivastava
Scott Steele
Lewis Sym
Ben Tatton

Placements:
Poppy Marsh - Nuffield Research Student
Amy Perrio - Intern
Aliss Rodric - Engagement and Outreach Intern
Yifan Zhu - Intern

Support Hub:
Mr Brandon Cook - IT Support Officer
Miss Hannah Cooper - Public Engagement Officer
Mrs Rosalind Miller - Office Manager

Lab Staff:
Mrs Jitka Dojivova - Laboratory Assistant
Dr Ceri Gwyther - Lab Manager
Dr Ezgi Kucukkilic-Stephens - Project Officer
Miss Abigail Outred - Project Officer
Miss Weronika Rojek - Microbiology Technician Apprentice
Mr Anthony Scales - Research Technician
Mr Dominic Siggs - Project Officer
Mr Ben Stephens - Microbiology Project Officer

Publication highlights

Cogliati, S., Wolsey, E., Ramkissoon, N. K., Schwenzer, S. P., Pearson, V. K. and Olsson-Francis, K. (2022) Geochemical bio-signatures in Martian analogue basaltic environments using laboratory experiments and thermochemical modelling. Frontiers in Astronomy and Space Sciences, 9:1062007, https://doi.org/10.3389/fspas.2022.1062007

Dugdale, A., Ramkissoon, N. K., Fawdon, P., Patel, M. R., Hills, L., Degli-Alessandrini, G., Bonsall, E., Schröder, C., Turner, S. M. R., Achilles, C. N. and Pearson, V. K. (2023) SOPHIA: A mineralogical simulant for phyllosilicate terrains at the Rosalind Franklin landing site, Oxia Planum, Mars. Icarus, 400. https://doi.org/10.1016/j.icarus.2023.115568

Marino, A. and Cheney, T. (2023) Centring Environmentalism in Space Governance: Interrogating Dominance and Authority Through a Critical Legal Geography of Outer Space. Space Policy, 63, 101521, https://doi.org/10.1016/j.spacepol.2022.101521

Macey, M.C., Ramkissoon, N.K., Cogliati, S., Toubes-Rodrigo, M., Stephens, B. P., Kucukkilic-Stephens, E., Schwenzer, S. P., Pearson, V. K., Preston, L. and Olsson-Francis, K. (2023) Habitability and biosignature formation in simulated martian aqueous environments, Astrobiology, 23, 1-11. https://doi.org/10.1089/ast.2021.0197

Roche, M. J., Fox-Powell, M. G., Hamp, R. E & Byrne, J. M. (2023) Iron reduction as a viable metabolic pathway in Enceladus' ocean. International Journal of Astrobiology, 2(5), 53 9-558. https://doi.org/10.1017/S1473550423000125

Marino, A. (2023). Astroenvironmentalism as SF. Environmental Humanities, 15 (1) 25–43. https://doi.org/10.1215/22011919-10216140

Moreras-Marti, A., Fox-Powell, M. G., Cousins, C.R., Macey, M.C. and Zerkle, A. L. (2022) Sulfur isotope biosignatures for Mars and Europa exploration. Journal of the Geological Society, 179, 6. https://doi.org/10.1144/jgs2021-134

Newman, C. and Cheney, T. (2023). Barriers and Gateways to Cleaning Up Earth Orbit: The Legal, Economic, and Political Dimensions of Debris Remediation. Air and Space Law, 48, 113–136.

Olsson-Francis, K., Doran, P. T., Vyacheslav, I., Raulin, F., Rettberg, P., Kminek, G., Zorzano, M. P., Coustenis, A., Hedman, N., Shehhi, O. A., Ammannito, E., Bernardini, J., Fujimoto, M., Grasset, O., Groen, F., Hayes, A., Gallagher, S., Kumar, P., Mustin, C., Nakamura, A., Seasly, E., Suzuki, Y., Peng, J., Prieto-Ballesteros, O., Sinibaldi, S., Xu, K. and Zaitsev, M. (2023) The COSPAR Planetary Protection Policy for robotic missions to Mars: A review of current scientific knowledge and future perspectives. Life Sciences in Space Research, 36, 27-35, https://doi.org/10.1016/j.lssr.2022.12.001

Treiman, A.H. and Semprich, J. (2023) A Dunite Fragment in meteorite Northwest Africa (NWA) 11421: a Piece of Moon's Mantle. American Mineralogist, https://doi.org/10.2138/am-2022-8911

Sutter, B.... Schwenzer, S. P., Turner, S. M. R., *et al.* (2022). Constraining alteration processes along the Siccar Point group unconformity, Gale crater, Mars: Results from the sample analysis at Mars instrument. Journal of Geophysical Research: Planets, 127. e2022JE007387. https://doi.org/10.1029/2022JE007387

Makgadikgadi Basin, Botswana, taken by Claire Batty

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