GeoCam

EARTH SCIENCES ALUMNI MAGAZINE

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NEWS
Mysterious missing ingredient in the clouds of Venus identified

FEATURE
Chloe Harford's Life After Earth Sciences

RESEARCH
Paleo-environmental controls on the rise and fall of the Ediacaran Biota

UNIVERSITY OF CAMBRIDGE


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Welcome

Greetings,

Welcome to the 2024 edition of *GeoCam*, my last edition as Head of Department. Sitting down to write this introduction, I took the opportunity to review the one I wrote a few months after the start of my five-year term in Summer 2019. Blissfully unaware of how the world was about to turn upside down, I welcomed new staff members, celebrated the opening of the Sedgwick Museum's new Collections Research Centre and looked forward to the planned Alumni day that was due to take place on the 9th May 2020 …

As it turned out, perhaps not most optimal time to find oneself at the helm. However, despite the challenges, I look back over the COVID years with a real sense of pride – that period brought out the very best of us, with everyone pulling together to maintain outstanding research and teaching throughout (and the quickest return to in-person teaching in the whole university). The commitment and dedication of all our staff did not go unnoticed by the students, who have remained with us throughout, giving us this year our largest cohort of Part II students since the mid-90s.

What has made my term as Head of Department so rewarding is seeing how we have created new opportunities to engage and inspire future generations of Earth Scientists. Being ranked number one for Earth and Environmental Sciences in REF2021 was a ringing endorsement of the very special place that I am privileged to work in. As we look to maintain that position, our vision has evolved to embrace the full remit of Earth, Environmental and Planetary sciences. Just as my term comes to a close in October 2024, we will launch our two new MPhil courses in *Quantitative Climate and Environmental Sciences* and *Planetary Science and Life in the Universe*, both multi-disciplinary courses taught in close collaboration with the Department of Applied Maths and Theoretical Physics and the Institute of Astronomy. These courses illustrate our commitment to being an outward looking Department, one that places fundamental science at the heart of addressing present and future societal challenges, and works to understand the past, present and future of our planet and beyond. With that I would like to wish my successor the very best of luck, and I look forward to seeing many of you at the next Alumni day on the 11th May (pandemics permitting)!

Richard Harrison,
Head of Department

IN THIS ISSUE

EDITING TEAM
Cara Hanman
Dr Nigel Woodcock
Dr Erin Martin-Jones

Cover Image: Proglacial icing formed in front of a glacier during winter on Svalbard, Norway.
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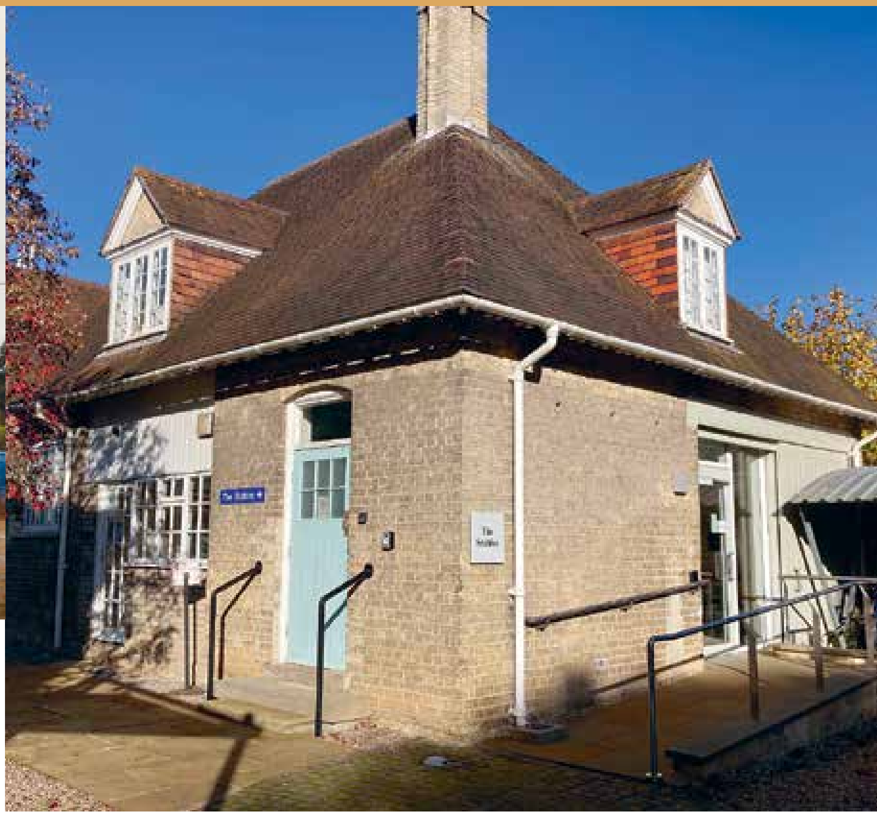

CAROL WILLIAMS,
AUTHOR OF 'MADINGLEY RISE AND EARLY GEOPHYSICS AT CAMBRIDGE'

Above left: The stables c1995.
Above right: The Stables today.

The Stables at Madingley Rise

When Hugh Frank {later professor} Newall, the Astronomer, had Madingley Rise built in 1891 he naturally had the stables built too. They face onto a small courtyard behind the main house and today are connected into the BP Institute of Energy and Environmental Flows.

From the outside you would have seen the coach house. Beyond were the actual stables for the four horses, Union Jack and Winsome and Mignonette and Deuce. There was also a workshop. In the days when I worked in the office above, these actual stables still existed.

A coachman, Mr Arthurs, was hired in 1901; he lived in the small flat above the stables and coach house with a bedroom looking out today over the cycle racks, and a living room with a dormer window overlooking the courtyard. Mr Arthurs in his livery would cut quite a figure driving his master around Cambridge and Newall's outfit was one of the last coach and horses to be seen locally.

The post-Newall period

After the death of Professor Newall in 1944, he bequeathed Madingley Rise to Trinity College. Then, on the decision to upgrade the School of Geodesy into the Department of Geodesy and Geophysics in 1955, the University took over the house for the new Department. It was at this time that certain alterations were made to the house and stables. In the mid-1960s Drum Matthews' office occupied the Arthurs' former bedroom, whilst the living room had the addition of chart cabinets and storage racks for rolls of maps; Drum used the next-door hay loft to keep his collection of 1:1 million charts with vertical profiles of magnetic anomalies made out of polystyrene. He would crawl around these trying to see whether any lineations could be seen through the profiles. Downstairs a small workshop was used by Marcia Miller to prepare samples for her husband Jack for geochronology.

In 1980, with the creation of the new Department of Earth Sciences, the workshop, hay loft and chart office were modified to accommodate the equipment for Jim Long and his team operating the ion probe.

When the BP Institute was under construction around 1995, the former Arthurs' bedroom, living room and hayloft were converted into three bedsits for visiting scientists and the coach house (by then a garage) and the actual stables were converted into a seminar room for the BP Institute.

RESEARCH NEWS

DR ERIN MARTIN-JONES

FOR ALL THE LATEST EARTH SCIENCES RESEARCH NEWS, VISIT WWW.ESC.CAM.AC.UK/NEWS

CLIMATE CHANGE INDUCED HEAVY RAINFALL COULD HARM SEA URCHINS

As our climate warms, Britain's weather is becoming ever more extreme: with heatwaves and heavy rainfall events increasingly frequent and severe. In Scotland, winter precipitation has increased by 20% since the 1960s, and this upward trend looks set to intensify.

A group of scientists from the University of Cambridge and the British Antarctic Survey investigated how extra rainfall pouring into Scottish lochs could impact sea urchins by diluting the salty seawater they live in. Urchins are slow moving bottom feeders, making them vulnerable to changing seawater conditions because they cannot evade rapid influxes of floodwater.

In experiments at the Scottish Association for Marine Science, PhD student Nick Barrett detected clear signs of stress in those urchins plunged into highly diluted seawater – replicating an extreme and protracted flood event, "they were sluggish, eating less and moving slowly, and at the same time they respired more quickly," said Barrett. The picture was more rosy for those urchins only exposed to partial dilution, who tolerated conditions and made adjustments.

Read more: https://bit.ly/41VMlyx

© NICK BARRETT

SHRINKING ARCTIC GLACIERS ARE UNEARTHING A NEW SOURCE OF METHANE

As the Arctic warms, shrinking glaciers are unearthing a new source of the potent greenhouse gas methane, say researchers from Cambridge and Norway. Cambridge Earth Science's Dr Gabby Kleber studied 78 glaciers across Svalbard, in the high Arctic, using a snowmobile to get around and sample bubbling groundwater springs unveiled by melting glaciers.

The research suggests that this previously unrecognised source of methane will likely increase as Arctic glaciers retreat and more springs are exposed. This, and other methane emissions from melting ice and frozen ground in the Arctic, could exacerbate global warming.

In Svalbard, air temperatures are rising two times faster than the average for the Arctic. Kleber likens Svalbard to the canary in the coal mine of global warming, "since it is warming faster than the rest of the Arctic, we can get a preview of the potential methane release that could happen at a larger scale across this region."

Kleber said there are likely to be additional complex outcomes from climate change, including positive feedbacks like this, which scientists are yet to uncover.

Read more: https://bit.ly/3tDFI7q

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Proglacial icing formed in front of a glacier during winter on Svalbard, Norway.

© KEVIN GILL

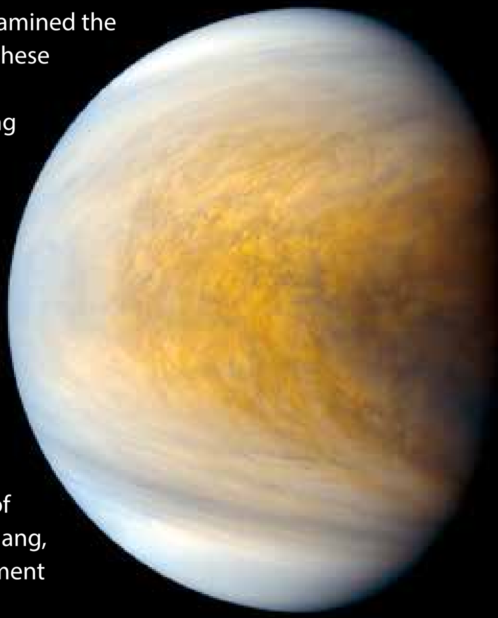
MYSTERIOUS MISSING INGREDIENT IN THE CLOUDS OF VENUS IDENTIFIED

Minerals present in Venus' atmosphere could explain why the planet's clouds look mottled when viewed in the ultraviolet range, say Cambridge researchers – solving a long-standing mystery.

Scientists know that the Venusian clouds are mainly composed of sulfuric acid droplets with some water, chlorine and iron – a mix that varies with height in the thick and hostile Venusian atmosphere. But, until now, the reason for the strange patches and streaks on the clouds has eluded scientists.

Research published in Science Advances, and led by Cambridge's Department of Earth Sciences and Cavendish Laboratory, has revealed that a combination of two minerals, rhomboclase and acid ferric sulfate, could cause the mysterious UV absorption features.

The team synthesised the minerals in Professor Nick Tosca's aqueous geochemistry laboratory at the Department of Earth Sciences, under conditions mimicking the Venusian atmosphere. They then examined the spectroscopic features of these minerals in the Cavendish Laboratory's FlareLab, using light sources specifically designed to simulate the spectrum of solar flares.



"These targeted experiments revealed the intricate chemical network within the atmosphere, and shed light on the elemental cycling on the Venusian surface," said lead author of the study, Clancy Zhijian Jiang, from Cambridge's Department of Earth Sciences.

Read more: https://bit.ly/3vuL5GF

SCOTTISH ROCKS TO PLAY A KEY ROLE IN MARS SPACE MISSION

What links the beautiful Isle of Rum in Scotland with the distant Red Planet? Remarkably, some of Rum's igneous rocks have a very similar mineral and chemical content to those collected by NASA's Perseverance Rover during its exploration of an ancient lakebed on Mars.

A group of scientists, including Cambridge Earth Science's Professor Helen Williams, collected rock samples from the NatureScot National Nature Reserve (NNR) on Rum as part of the NASA and European Space Agency (ESA) Mars Sample Return Program.

Rum was selected as the only UK sample site due to its unique geology. According to Williams, "we've still got several years left to wait before we can study the real Mars rocks but, in the meantime, our Scottish samples will provide scientists with the perfect material to test and refine the analytical techniques they will be using to investigate material returned from the Red Planet."

The Rum sampling campaign was led by Dr Lydia Hallis from the University of Glasgow, and includes scientists from Cambridge, Leicester and Brock University in Canada.

Read more: https://bit.ly/47noUza

© LUKE DALY

GLOBAL MAPPING OF MYSTERIOUS DEEP-EARTH STRUCTURES

© SARA-ANN

You might think Earth's deep and rocky interior is relatively featureless but, three thousand kilometres beneath our feet, enigmatic structures akin to colossal mountain ranges rise from the edge of the planet's core.

"It's anything but boring down there," said Carl Martin, who has just completed his PhD in the Department of Earth Sciences.

Martin used seismic waves generated by earthquakes to create the first global map of the structures, which are located at the boundary between Earth's liquid iron outer core and the surrounding rocky mantle.

To build his map, Martin compiled thirty years of data picked up by seismic stations across the world. He simulated each quake – tracing the path of the seismic waves as they diffracted around the core-mantle boundary and were refracted by structures called ultra-low velocity zones, or ULVZs.

Read more: https://bit.ly/48IF3Af

PETER WEBB, ALUMNUS, AUTHOR, ADVENTURER

IT ALL STARTED **WITH ROCKS**

I was attracted to geology as a scientific discipline which gives the option to make up a story. Like many first years, I'd get lost in the colours and lines of crystals under a microscope; or in centuries of desert wind or river flow laying down the rock record; or in mass burials laying clues back through the evolution of life. But field work was best, because you could take science-based earth history and go out and see the world with a purpose.

After the IA trip to Arran, CASP[1] took me on as a field assistant in Spitsbergen. I spent the summer pitching tents, taking notes, and looking out for polar bears. Field work was different then: just a compass no GPS, HF radios no sat phones, and pre-packed food well past its sell-by-date. Naturally, I returned to do my undergraduate mapping project.

That second summer, while logging sections and measuring strikes and dips, I planned a third trip. One more year later I returned with a friend and packed a wooden boat with tent, rifle, food and climbing gear (in case we had to walk home). We rowed and sailed past ice cliffs and polar bears, around the whole of Spitsbergen, 1200 kilometres in 30 days. We were the first, and I believe the only ones, to do that in an unpowered open boat[2].

As my undergraduate years ended, Dr Peter Friend told me about a job for 'geology graduates happy to fix a broken truck axle in the desert'. That sounded like fun and I applied. Schlumberger gave me the job and a one-way ticket to Patagonia. After nine months, I'd learned enough engineering and Spanish to lead local teams on wireline rig operations.

Our job was to connect long steel tubes with sensing technology to armoured cable and to lower them into new wells, kilometres deep. Often it seemed that instead of measuring resistivity, porosity and radioactivity to locate hydrocarbons and water, the tools failed in the downhole heat and got stuck on the way out. Diameters, tensions, and breaking points were all top of mind.

Nevertheless, I was soon an experienced hand, age 26, and became a field test engineer. The advantage of some new imaging tools seemed to be their short length, not fancy images. So, in deepest Argentina, we connected them to drill pipe and succeeded in pushing them around tight bends into horizontal wells. I presented that project to Chief Executive Euan Baird in Paris HQ, another department alum: that was a big day for a young engineer.

Top left: Peter planning his Spitsbergen expedition, 1990.
Top right: Peter on his 1991 circumnavigation of Spitsbergen.
Far left: Peter (far right) and his Schlumberger field test crew, Argentina, 1995.
Left: Peter rigging up for testing on a well site, Argentina, 1995.
Opposite: Mapping project base camp, Nordenskioldkysten, 1990.

After seven years on rigs, I followed the well-worn path through an MBA in France to more commercial and financial work. I joined Shell and worked ten years in their downstream business with teams supplying fuels and lubricants to those who need them; at the time that seemed to be to most of humanity. Then a two-year spell with UK government as an industry fuels advisor led to government relations work back with Shell in Den Haag HQ.

AFTER NINE MONTHS, I'D LEARNED ENOUGH ENGINEERING AND SPANISH TO LEAD LOCAL TEAMS ON WIRELINE RIG OPERATIONS.

By 2014, the need to decarbonise economies was plain. But it is difficult for fuels sellers to do that, when it's the fuels demand that needs to change. Customers make their own decisions, electorates vote for policies that make life better not more difficult, and pension funds holding energy shares want their dividend. Go figure.

I had to 'go figure' because my last assignment after 20 years with Shell was to answer the question 'what should the Chief Financial Officer and finance teams be doing differently as a result of climate?' Well, there are some things from the financial perspective but re-wiring the global energy system will be one extraordinary challenge. And whilst many engineers and technicians will come from today's big energy companies, the companies themselves can't take the role of referee. That's the job of governments and the people they represent.

I've now left Shell to become an independent energy advisor. My current projects include helping to develop CO_2 shipping in the UK for carbon emitters that cannot otherwise access geological storage. And assessing future road tax options for the UK vehicle fleet as petrol and diesel vehicles are replaced by electric. In December, I published a paper[3] on capturing carbon directly from the air. Direct Air Capture is one to watch.

Nobody has all the answers to climate. We'll need all the talents: scientists, engineers, financiers, industrialists, broadcasters and more for that. But – a personal view – those who understand Earth History and the forces behind it will be central to the effort.

1. Cambridge Arctic Shelf Programme; https://www.casp.org.uk/about-us/
2. 'Ice Bears and Kotick' tells the story; https://www.amazon.co.uk/Peter-Webb-Ice-Bears-Kotick/dp/B00RWNNTYW
3. OIES 2023, "Scaling Direct Air Capture (DAC): A moonshot or the sky's the limit?"; https://www.oxfordenergy.org/wpcms/wp-content/uploads/2023/12/CM07-Scaling-Direct-Air-Capture-DAC-technology.pdf

DR BRENNAN O'CONNELL, POSTDOCTORAL RESEARCH ASSOCIATE

Paleo-environmental controls on the rise and fall of the **EDIACARAN BIOTA**

The Ediacaran biota pose a riddle that scientists have grappled with for decades. Found in three distinct biotic assemblages – the Avalon (575–560 million years ago; Ma), White Sea (560–550 Ma), and Nama (550–539 Ma) – these peculiar Ediacaran organisms may hold the key to unlocking the secrets of early animal evolution.

Conventional studies tie diversity and ecological changes across these assemblages to biological radiation and extinction events. Can a closer look at the preserved paleo-environments that contain the fossils, using our sedimentology and stratigraphy toolkit, offer a fresh perspective?

On the slippery coastline of Newfoundland, Canada, the Avalon Assemblage provides a window into the dawn of macroscopic animal life. Picture an ancient seaway. Shallow-water deltaic environments were seemingly barren, whereas the depths of the sea hosted macro-organisms on top of turbidite event beds. Organisms established communities on the ancient seafloor only to be episodically smothered by volcanic eruptions. In Australia and Russia, the White Sea Assemblage reveals a spectacular rise in biological diversity. Here we see a shift of organisms to shallower water environments, with some unfortunate individuals meeting their end as they are smothered by storm-mobilised sand. In Namibia, the youngest Nama Assemblage marks a curious decline in biological diversity. Some researchers believe this decline archives Earth's first major 'mass extinction' event, potentially triggered by anoxia in the ancient Ediacaran oceans.

Traditionally, we've viewed the Avalon, White Sea, and Nama assemblages through the lens of biological change. But what if some answers lie in the paleo-environments? At Cambridge, researchers Alex Liu, William McMahon, and I have embarked on a global adventure, using a sedimentologic-stratigraphic approach to reconstruct the paleo-environmental context of key Ediacaran sites. Our quest aims to uncover potential paleo-environmental controls on Ediacaran macrobiota, and challenges the assumption that shifts in Ediacaran diversity and community structure are solely biological.

Preliminary findings from our global expedition suggest a broad overlap in paleo-environments between key sites. Deltaic, shoreface, and offshore shelf environments are represented in all studied locations, providing a common thread across the Avalon, White Sea, and Nama assemblages. Yet, subtle differences between sites may hold the key to understanding Ediacaran ecological communities. For instance, the Avalon Assemblage boasts an extensive delta system, hundreds of metres thick, overlying fossiliferous turbidites. Evidence points to a delta system with an enormous sediment supply. Avalonian shallow water environments, consistently battered by sediment with only short-lived breaks, appear inhospitable. The tops of deeper turbidite units potentially served as the only environments exposed long enough for organisms to establish and flourish.

Ernietta in the Nama Group, Namibia.

Rough day for an unlucky Pteridinium. Farm Aar, Nama Group, Namibia.

Investigating shoreface sandstone. Brachina Gorge, Flinders Ranges, South Australia.

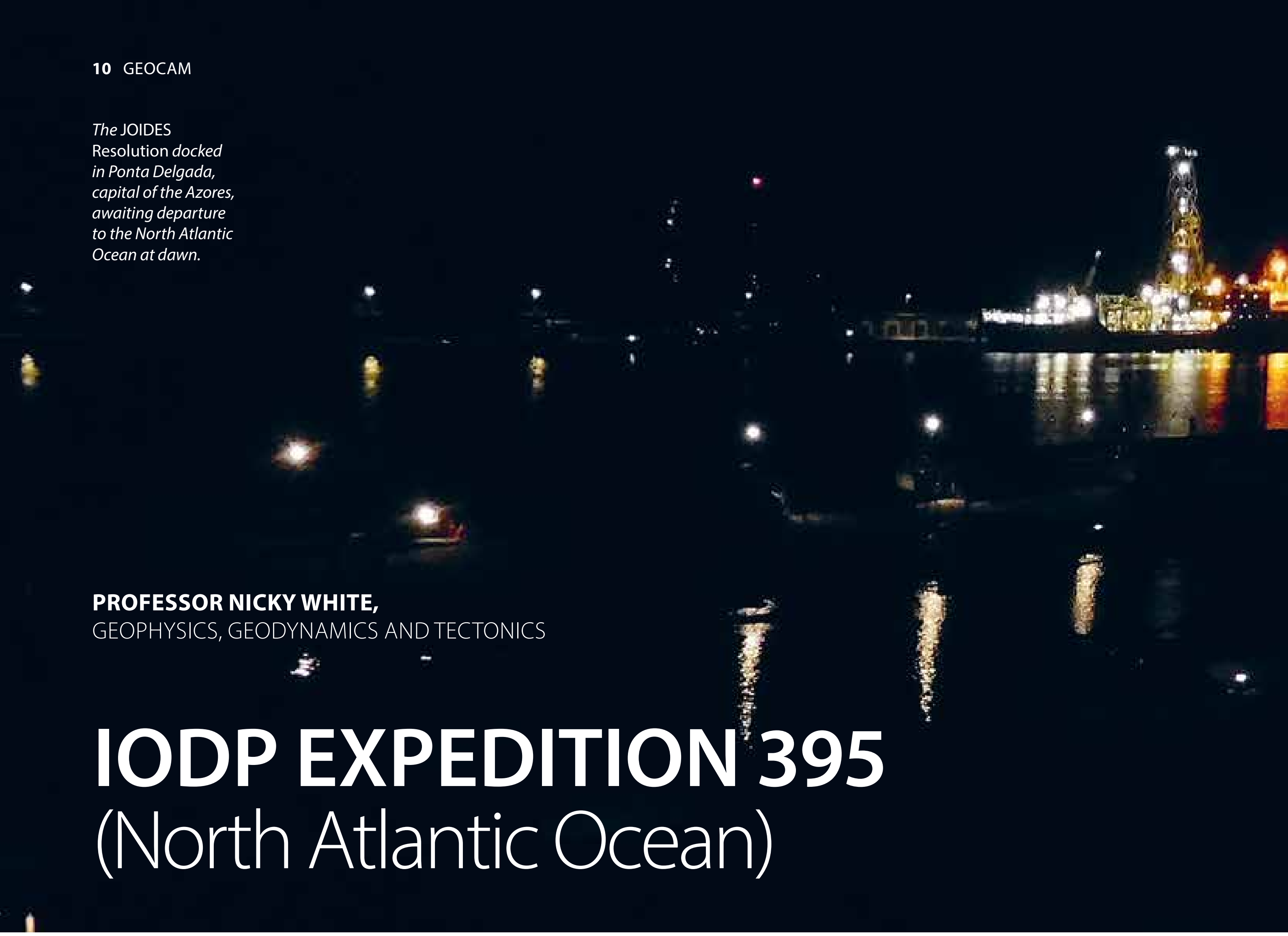
Sunset overlooking Farm Swartpunt, Nama Group, Namibia.

The Avalon's extensive delta system contrasts with smaller-scale deltas in the White Sea and Nama. These small deltas had a lower sediment supply, with potential for long breaks in sedimentation for creatures to establish communities on the seafloor. Could subtle paleo-environmental variables shift our perception of early animal evolution? For example, maybe the broad trend of organisms moving from deep to shallow water between the Avalon and White Sea Assemblage does not represent true biological change – maybe the organisms simply inhabit sediment starved environments at each location.

What happens between the White Sea and the Nama assemblage? Is there a genuine shift in ecology and does this transition truly record Earth's first 'mass extinction'? Our investigation reveals that paleo-environments in each site are directly comparable. At first glance, it could then be argued that all changes between the two assemblages represent entirely biological change. A closer look at the Nama Assemblage, however, reveals an exciting new finding. Nearly all organisms are transported in sediment gravity flows (debris flows, transitional and turbidity flows), sometimes far away from home. Are transported beds true representations of Nama assemblage ecological communities and diversity? Who knows… we are currently searching for non-transported examples to answer this question.

Variation in community composition, ecosystem maturity, taxonomic diversity, and organism size could well be partly controlled by paleo-environmental variables rather than traditional notions of biological change. Our exploration and analyses hint that paleo-environmental controls are an underappreciated and potentially critical variable in the mystery of the Ediacaran Biota. The answers to questions are still emerging and promise to shed light on the dynamic changes in animal evolution during the Ediacaran Period. Stay tuned!

Will McMahon, Brennan O'Connell, and Alex Liu frolicking on sand dunes in Sossusvlei, Namibia.



The JOIDES Resolution *docked in Ponta Delgada, capital of the Azores, awaiting departure to the North Atlantic Ocean at dawn.*

PROFESSOR NICKY WHITE,
GEOPHYSICS, GEODYNAMICS AND TECTONICS

IODP EXPEDITION 395
(North Atlantic Ocean)

The Scientific Mission

During July and August 2023, I participated in an ambitious seagoing expedition on the *JOIDES Resolution* to drill holes through the oceanic plates south of Iceland. This expedition was funded and organised by the International Ocean Discovery Program (IODP). Each expedition lasts 2 months and costs up to $20 million. What was the motivation behind this breathtakingly expensive piece of science?

Plumes or hotspots are the most dramatic manifestation of mantle convection, which drives plate tectonics, and the Icelandic plume on our doorstep is easily the biggest plume on Earth. One effect of this plume is that the oceanic floor across much of the North Atlantic Ocean is between 1 and 2 km shallower than it should be, according to the rules of plate cooling. Since the Icelandic plume is about 60 million years old, it has significantly sculpted the sedimentary architecture of fringing continental margins. It has also moderated overflow of North Atlantic Deep Water, which is generated by downwelling in the Norwegian-Greenland Sea and flows south through two major oceanographic gateways along the Greenland-Scotland Ridge, coalescing with other deep water masses to form the Deep Western Boundary Current.

The big scientific issue underpinning IODP Expedition 395 is how this gigantic plume fluctuates through time, modulating paleoceanographic gateways. Luckily, the upwelling plume is transected right down the middle by a mid-ocean spreading ridge, which acts as a linear sampler of activity. Internal plume fluctuations appear to be expressed as a chevron pattern of ridges and troughs that are imprinted upon newly formed oceanic crust. Contourite drift deposits nestle within this undulating seabed. Expedition 395 had two interlocking drilling targets: to sample basaltic rocks that build the V-shaped ridges and troughs; and to core the major contourite deposits that record the history of North Atlantic Deep Water overflow. This expedition continued a previous cruise in July – August 2021, at the height of the pandemic and without an onboard scientific party.

How this Proposal Came About

In 2004, a drilling expedition was proposed by a group of Cambridge alumni to target the V-shaped ridges and troughs that flank the Reykjanes Ridge southwest of Iceland. This proposal was partly motivated by problematic attempts to dredge basalts from the crests of V-shaped ridges on board the *Celtic Explorer* during April 2006. This cruise, led by Stephen Jones (former PhD student of mine now at University of Birmingham), successfully dredged a suite of basaltic glasses from the ridge axis itself with a view to extending and complementing earlier heroic dredging programs. Off-axis dredging was largely unsuccessful but did act to stimulate development of a revamped proposal. The next step was a comprehensive seismic reflection survey led by myself and Tim Henstock (former PhD student now at University of Southampton).

Two long regional flow lines, together with more than twenty short cross lines were acquired during July 2010 together with swath bathymetry and other underway geophysical observations. This survey formed the basis of Ross Parnell-Turner's PhD dissertation at Cambridge. Parnell-Turner (now at Scripps Institute of Oceanography) spearheaded the formulation of a revised IODP proposal in September 2015. The approved proposal was sent to the *JOIDES Resolution* Facilities Board in 2018 and the expedition was scheduled.

Cambridge Alumni on Board

Two other Cambridge Earth Sciences alumni participated in this expedition: Professor Paul Pearson (former PhD student now at University College London) and Professor Tom Dunkley Jones (former undergraduate student now at the University of Birmingham). Paul and Tom are internationally renowned micropaleontologists and biostratigraphers who specialise in planktonic foraminifera and nannofossils. Both have a deep interest in Cenozoic climate change. They like the challenge of working on mid-to-high latitudinal taxa with a view to understanding the Plio-Pleistocene development of northern hemisphere glaciation.

Paul and Tom have both sailed on previous IODP expeditions to lower latitudinal regions. I have not previously sailed with IODP, although I do have extensive seagoing experience and was Principal Investigator for the seismic reflection survey used to design this particular expedition. My main interest is in understanding how mantle convective processes affect the Earth's surface.

We were very excited and motivated to participate in this highly successful drilling expedition. The multi-disciplinary, yet highly focussed, nature of this scientific proposal targeting the biggest plume on Earth has proved to be a uniquely bonding and embracing experience. We strongly believe that our combined results will significantly increase understanding of how mantle processes impact the Earth's hydrosphere and climate. This topic is at the cutting edge of scientific enquiry and IODP is the apotheosis of collaborative, complex, and international scientific investigation at its very best. The three of us felt privileged to be part of the fantastically efficient machine that is *JOIDES Resolution*, underpinned by amazingly clever, flexible, dedicated and experienced technical support.

The UK scientific team. Back row: Cambridge alumni Nicky White, Paul Pearson and Tom Dunkley Jones. Front row: Sevi Modestou (University of Northumbria) and David McNamara (University of Liverpool).

Example of a peperite which consists of glassy fragments of vesicular basalt within baked carbonate-rich sediment. These volcaniclastic rocks form when hot magma comes into contact with cold wet sediment with explosive results. Horizontal width is 4 cm.

IN CONVERSATION WITH
Emilie Ringe

Emilie Ringe, Professor of Natural and Synthetic Nanomaterials, has held a dual appointment between the Departments of Earth Sciences and Materials Science & Metallurgy since 2017. Emilie reflects on her research at the intersection of two disciplines with Erin Martin-Jones.

What is so special about nanoscale?

I'm fascinated by the nanometre-scale beauty and order of the natural world, and how that extreme detail can inspire the products we design and manufacture. In my lab we use light and electron microscopy to see deep into the microstructure of natural and human made materials – right down to how individual atoms are ordered.

On the nanoscale, materials can have a whole range of weird and wonderful properties. For example, if you change the size of a particle it can appear a different colour because the number of atoms alters the available energy levels which absorb light.

What work are you most known for?

I'm probably most proud of, and recognised for, my work on plasmonic nanoparticles. These miniscule metallic nanoparticles interact with light strongly. That quality means they act almost like beacons for light, absorbing and scattering energy which can be harnessed to power chemical reactions, or heat which can kill cancerous cells.

Usually nanoparticles are made of rare metals like gold or silver, but in 2017 we started to explore how readily-available magnesium could be used instead. This advance opened up a new field of study with new applications, previously limited by the cost of rare metals. Taking inspiration from natural materials, and looking for interesting properties and behaviours in earth-abundant phases, is at the heart of what I do.

Did you always want to be a scientist?

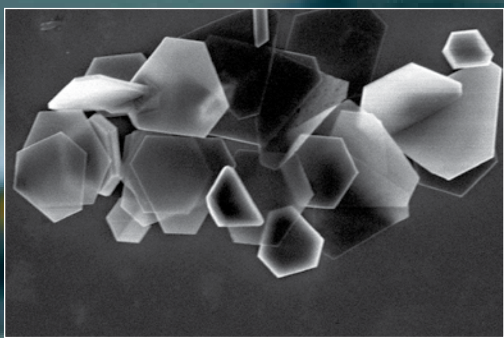
I'm French Canadian, brought up in Montréal. I've always loved science, but when I was young I didn't have being a scientist mapped out as a career. I was the first in my family to go to University and initially I think I thought I'd be a science teacher – I really didn't have any idea of career options.

I'm not sure I ever envisioned ending up in Cambridge either! I first moved to Cambridge for a research fellowship at Trinity Hall over ten years ago. That experience developed not just my scientific skills but also my social network. I met my husband, like many people in Cambridge, through college dinners!

After my fellowship I moved to the US, to Rice University, where I set up an electron microscopy and spectroscopy lab. But the attraction of Cambridge remained with me, and five years later I moved back to join Earth Sciences, Materials Sciences, and Gonville and Caius.

Earth science was new to you when you started your lectureship?

The earth science aspect of my position is a real plus for me. There is so much synergy between earth and materials science. We ask similar questions and use similar tools, and yet expertise doesn't tend to be shared. After interviewing for the joint position here I was buzzing, having had so many interesting conversations with earth scientists. I knew there was huge potential for new collaborations and experiments.



Another major attraction was that I'd have access to an inexhaustible source of geological samples! I've worked with Marian Holness on olivine microstructures and crystal aggregates. We also work with Rich Harrison, making 3D reconstructions of magnetite and other nanoparticles, which have interesting magnetic properties as well as being tracers of particulate air pollution.

What else has been new to you?

Having trained as a physical chemist I'd never been on a fieldtrip before coming to Cambridge. Joining the Arran trip has been a wonderful way to apply my knowledge, and now when I help out on the trip I try to incorporate aspects of spectroscopy and microanalysis into discussions with students about mineralogy. My teaching and supervising is evenly split between the two Departments: in Earth Sciences, I teach Part II Mineralogy and a Part III option. I even have labs in both Departments.

Can you give us a glimpse into your labs?

Over in Materials Science we make materials, whereas in Earth Sciences we characterise them. We've got multiple lasers for Raman Spectroscopy and powerful transmission electron microscopes to image at atomic scale. Our workhorse optical microscope is a kind of Frankenstein instrument: we've adapted it to do about ten different things, such as measure polarisation, fluorescence and scattering, day in day out.

You've also designed teaching resources for people with visual impairments

Science isn't just visual, even though it is often taught in that format. When I was a grad student I started guide running to support blind and partially sighted people. Once I had a research group, I saw an opportunity to develop teaching kits to make science more accessible. We've a series of multi-sensory activities, often involving tactile elements that cover a range of topics – from basic concepts like semi-conductors to, more recently, sonar, earthquakes and magnetism. Some of these activities have been showcased at the Sedgwick Museum and we're hoping to expand to other museums in Cambridge.

CHLOE HARFORD

Life After Cambridge Earth Sciences

Chloe with Tim Druitt (middle), Steve Sparks (right) and pyroclastic flows of the Soufriere Hills Volcano, Montserrat, 1997.

"Our new kitchen countertops crystallised in a magma chamber under Norway 65 million years before the first dinosaurs," I mentioned to my kids the other day. While not now a practising scientist, my Cambridge studies have deeply influenced and enriched my perspective, lifestyle and career.

I was introduced to Earth Sciences in Iceland aged 16, and was inspired by the vast Vatnajökull icecap flowing into the geothermal valley we were studying. To explore combining my passions for the outdoors and science, I applied and was accepted for Cambridge Natural Sciences.

I graduated in Earth Sciences just as Montserrat's Soufrière Hills Volcano started erupting, providing the exciting focus for my PhD with Professor Sir Steve Sparks and the Montserrat Volcano Observatory. The project was a four-year whirlwind of pyroclastic flows, explosive eruptions, night duties, evacuations, and interdisciplinary collaborations. I loved using scientific principles to uncover volcanic mysteries, to forecast what might happen next and, above all, to mitigate hazards affecting local people.

My career journey to use science and technology to help people took me across continents from the Boston Consulting Group to GlaxoSmithKline and Expedia. Then, at a job interview with real-estate startup Zillow in Seattle – epicenter of the dot.com revolution – the founder said, "Look, Mount Rainier volcano is out and we ski at weekends. Come join us!" I did, and loved the exhilarating roller-coaster ride that took Zillow through launch, mobile transformation, IPO, $1B revenue and 200 million monthly users. My training in developing and testing scientific hypotheses with often incomplete data was a perfect background for a career in high-growth startups.

Meanwhile, Washington's volcanoes beckoned. Glacier Peak was the toughest, with ferocious mosquitos guarding the 16-mile approach. But the spectacular bread-crust bombs littering the summit cone were worth it. Now my outdoor pursuits are more family friendly. Recently we discovered orienteering, a sport where you find controls using a map and compass. Visualising the 3D terrain reminds me of mapping projects. Our family sailing adventures also feature charts and rock collecting. And I host an annual school volcano lab with dramatic explosions to inspire future scientists.

The Sedgwick Club Committee 1995-6: L to R, Brian Cox, Ian Lunt, Chloe Harford, Claire Byers, Norman Valentine.

My passion for the intersection of the outdoors, technology and impact led to my first my first corporate board position with REI, the US's largest outdoor retailer. Big-picture thinking and digging deep into critical details is a skillset I've taken from science labs to boardrooms across the world.

Now I'm focused on tackling the climate crisis, my generation's biggest challenge, and believe we're on the cusp of a technological revolution in decarbonisation. A great example is Overstory – a startup using AI and satellite data to monitor vegetation and reduce wildfires – where I'm board chair. I'm also excited about decarbonising homes, including our own.

Our iridescent larvikite countertops remind me of the deep influence Earth Sciences have had on me, and of the importance of protecting our precious planet for future generations.

Chloe and Millie, with Finlay and Henry in front.

NIGEL WOODCOCK

The southern Spain field course

Dr Peter Friend.

Nigel Woodcock – with a little help from his friends – pieces together the origins of the Part III trip to southern Spain.

On a recent visit to see Peter Friend, conversation turned to the fourth year field trip to the Betics of southern Spain. We calculated that, in 2024, it would be 25 years since Peter helped run the trip for the first Part III Earth Sciences cohort in 1999. We also remembered that the trip had an earlier history, but Peter's memory of that was less good.

He can be forgiven lapses of memory. Peter did Geology in Cambridge in 1960–63 and has been in the Department ever since, teaching sedimentology until his 'retirement' in 2001, then leading the Spain trip for four more years.

Peter suggested that I contact David Pyle, his co-leader in the early years, now in the Oxford department. David remembered a reconnaissance Betics field trip in 1994 with colleagues from Plymouth, Liverpool and Imperial, then the first Cambridge trip – for the Part II geologists – in 1995. He remembered too the self-catering Playa de Mojacar holiday apartments used as a base, and how 'Pedro Amigo' was in his element on the Spain trip after some years of research in the Ebro basin of northern Spain.

However, David couldn't remember why the Part II trip had been moved from Scotland, where it had been running for some years. Fortunately, a chance conversation with Nick McCave – Head of Department 1988–98 – unlocked a rich seam of information. Nick didn't have to rely on memory; he had diaries recording every Cambridge field trip he has taught on.

The Scottish Part II trip had been run by Graham Chinner and Peter Friend since at least the early 70s. It seems that Nick McCave replaced Peter in 1986 and then from 1990–93. By then the long journey north had been cut by flying from Stansted to Edinburgh. David Pyle replaced Graham Chinner in 1991 and he and Nick had the thought that, rather than getting on a plane to the cool, wet north, they could equally well fly south to warmer climes. That was Nick's logic in asking Peter and David to join the 1994 Betics reconnaissance.

So 1995–8 were the golden years for Part II, with two foreign trips: Greece and Spain. When the department initiated Part III Earth Sciences, the course repurposed the Spain trip, with all the Part II students now going to Greece in the Christmas break.

The leadership of the Spain trip has evolved further through the years. When David Pyle moved to Oxford in 2006, his place was taken by John Maclennan with help from Tim Holland. When John in turn took over the Skye mapping course in 2017, David Hodell and Marie Edmonds took charge in Spain. They are continuing a varied, instructive and sociable course, fondly remembered by students for nearly thirty years.

2006. David Pyle (blue bucket hat) leads his final Spain trip.

PROFESSOR EDWARD TIPPER AND GIO BERNARDI, PART II STUDENT

The new Environmental Geochemistry projects

Left: Gio using a depth sampler to get access to water in the river.
Right: Lin sampling the salinity in the lagoon, in the Balaruc Le Vieux.

Last year the Department launched its new Environmental Geochemistry Part II projects. The project retains similarities to the mapping project; it is independent, and the field area is chosen by the students. However, instead of mapping rocks in three dimensions, students map geochemical gradients in both time and space. The time in the field is also shorter.

The new projects coincide with the launch of two new courses in Natural Sciences; Quantitative Environmental Science at IB and Quantitative Climate Environmental Science at Part III and as an MPhil. In 2023, 11 students took the environmental geochemistry pathway, which included a new field course to Aix-en-Provence in Southern France. This taught them how to frame an environmental question, and answer it using spectrophotometers, pH, and salinity meters. Students then conducted their independent projects in small groups in Northern Ireland, Norfolk, Thailand, and France. As an example, Gio Bernardi reports below on his project to the Thau lagoon in southeast France with partners Reefe Conley and Xianzhen Lin.

The Thau is a hypersaline lagoon, connected to the Mediterranean, 140km west of Aix-en-Provence. Over sixteen field days, we studied the mixing dynamics between the lake's freshwater supply from rivers and groundwater and the saline water supply from the Mediterranean. Environmental pressures on the lake include evaporation and oyster farming. We quantified several key chemical parameters of the water using spectrophotometry – silica, phosphate, and ammonia, in addition to alkalinity and salinity.

Our project came at a key time in the life of the Jurassic karstic aquifer that supplies groundwater to the lake, and is a major domestic water source for nearby towns. During arid periods, the aquifer is affected by salinization events in which saline water from the lagoon intrudes the freshwater aquifer.

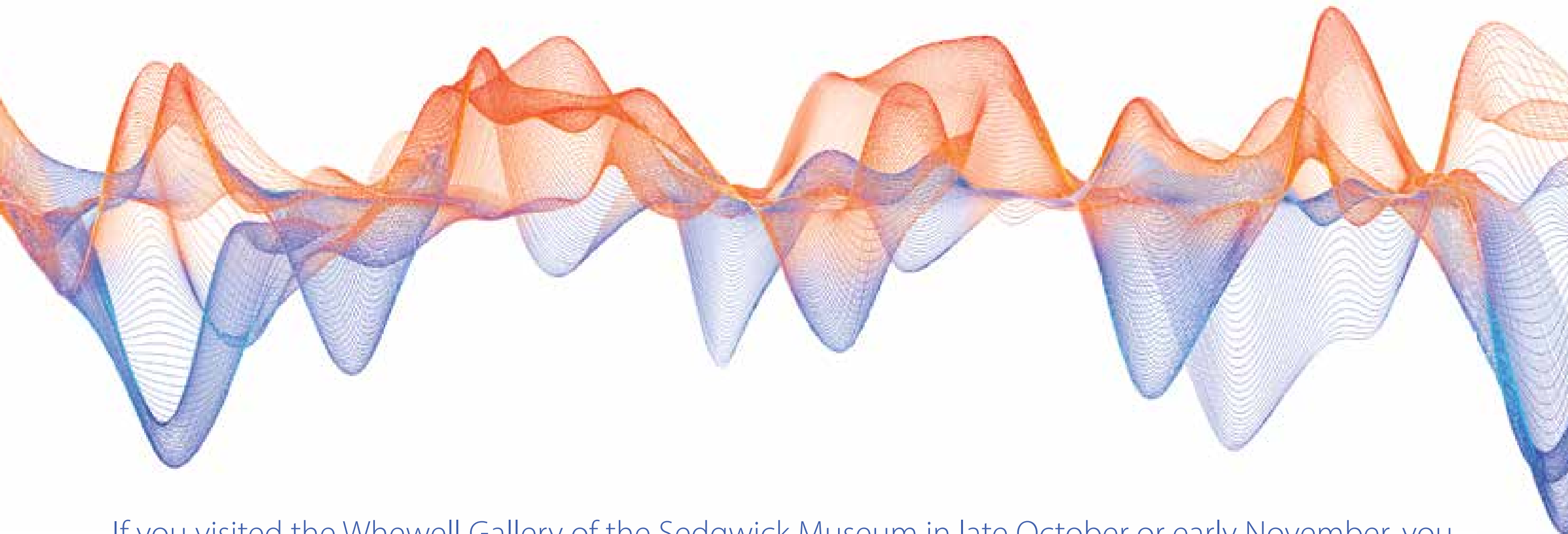
Our findings demonstrated an exceptionally high salinity in the lagoon – up to 45 salinity units, compared with 37 in Mediterranean seawater. However, with our "tool kit" we were able to identify a freshwater supply to the lake, with groundwater likely supplying a small stream. We had to travel one kilometre upstream to find the freshwater signature, demonstrating the strong influence of the salt water and wind-forcing at this location. Our work explored whether silica and alkalinity were only influenced by mixing of fresh and saline water, or whether biological processes were significant.

Upon returning to Cambridge, I spoke with the lead engineer at the Thau Basin Mixed Union. He emphasised the global importance of salinization and revealed that a new event had occurred in October 2023. Lagoonal systems such as the Thau lagoon are widespread around central Europe, and karstic springs provide freshwater to large populations. It is therefore gratifying to think that the new Cambridge environmental geochemistry projects not only develop students' scientific skills, but can also directly impact the livelihood of populations affected by water quality issues.

The lagoon looking towards Balaruc Le Vieux.

DR SALLY COLLINS, SEDGWICK MUSEUM LEARNING AND ENGAGEMENT MANAGER

THE SEDGWICK MUSEUM'S EARTH TRACES SOUND INSTALLATION; a fusion of art and seismology



If you visited the Whewell Gallery of the Sedgwick Museum in late October or early November, you would have found yourself immersed in our sound installation, 'Earth Traces'.

This was a collaboration between artist, composer and sound engineer David Stalling, and the department's Sergei Lebedev, Professor of Geophysics. The gallery was filled with conversations between whales in the oceans, the low throb of ship engines and seismic vibrations, all of which the human ear is not usually able to detect.

The collaboration arose when David was posted as an artist-in-residence on a research cruise led by Sergei in 2019. The expedition on the RV Celtic Explorer aimed to deploy 18 seismometers on the Atlantic seafloor off Ireland and the UK. Getting into a storm right from the beginning of the trip was a good time for David and Sergei to get to know each other. Their conversations centred around commonalities between music, sound and seismic waves. They wondered: what does an earthquake sound like? They had the idea of trying make the data that the seismometers collected audible, using David's expertise as a sound engineer. They devised a new method of converting the waveform information contained within seismic data traces into spatial surround sound.

Jumping on a board to make "seismic" waves.

Visitor feedback for the museum's installation was positive: "Like nothing I've EVER heard before!!...very cool installation;" "I like how it packaged nature in a different and unique way;" "Great to see such a positive outcome from the interaction of scientists and art."

We had great fun devising half-term family activities that explored the science of sound, to complement the installation. Soundwaves were enthusiastically generated by hitting various objects to make sugar granules – located half a metre away – jump on a home-made drum. Song requests were played on a mobile phone in a vase, causing salt to 'dance' to the beat on clingfilm stretched above it. It turns out 'Build Me Up Buttercup' was the winning track for creating the best salt-disco.

Two other department seismologists helped with the installation. Professor Nick Rawlinson lent us a seismometer, so that visitors could jump to make their own earthquake and learn how it was represented on a screen. Professor Sanne Cottaar provided us with 3D models of the Earth, each with different materials hidden inside them. Visitors tried to work out what these were by shaking the models and feeling and hearing the vibrations. Many young children and their adults became completely absorbed in this challenge and enjoyed the comparison with seismologists' work.

Whilst the Whewell Gallery is sadly no longer home to whale song or rumbling seismic vibrations, the results of David and Sergei's fascinating art-science collaboration can still be heard by visiting **https://www.soundsoftheearth.ie/**

RECENT NEWS & AWARDS

Awards

Dr Carrie Soderman received the Geochemistry Group Postdoctoral Medal for her paper in on the use of novel stable isotopes as tracers of mantle heterogeneity in February 2023.

Marie Edmonds has been awarded the Exploring the Frontiers (new pilot scheme in 2022) NERC funded grant for research that started in February 2023.

Rachael Rhodes has been awarded the Exploring the Frontiers (new pilot scheme in 2022) NERC funded grant for research that started in April 2023.

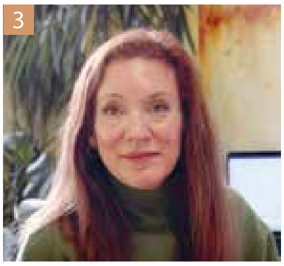
Oscar Branson has been awarded the Leverhulme Trust Research Leadership Award for work that commenced in July 2023.

Helen Williams and **Jerome Neufeld** have both been promoted to Professor Grade 12.

Daniel Field, Sanne Cottaar and **Oli Shorttle** have all been promoted to Professor Grade 11 in the 2023 Academic Career Pathways (ACP) round.

Richard Harrison was awarded the AGU 2023 Edward Bullard Lecture in October 2023, which recognises significant contributions to geomagnetism, paleomagnetism and electromagnetism.







Top to bottom: 1. Dr Carrie Soderman, 2. Marie Edmonds, 3. Helen Williams, 4. Daniel Field, 5. Sanne Cottaar, 6. Oli Shorttle and 7. Richard Harrison..

The Geological Record

Student Prizes

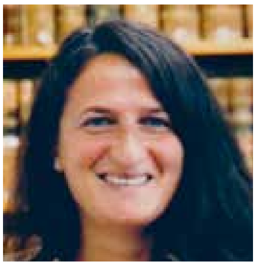
Debby Wehner (St John's) received an Outstanding Student Presentation Award at the 2022 Fall Meeting of AGU for her poster presentation "Full-waveform tomography of the eastern Indonesian region that includes surface topography and the fluid ocean".

Olivia Plateau (supervised by Daniel Field) was awarded the Swiss National Science Post-doctoral Mobility Fellowship which started in March 2023

Carla du Toit (JFR at St John's, supervised by Daniel Field) was awarded the Royal Society Newton International Fellowships (NIFs) which started in March 2023.

Philippa Slay (Clare/Darwin) and **Xiaoqing Chen** (Murray-Edwards), who are supervised by Prof. Nicky White, have won the EGU Outstanding Student and PhD Candidate Presentation (OSPP) Award.

New Staff


Left to right: Neil Marjoram, Rosa Danisi and Dr Maximilian Van Wyk de Vries.

Neil Marjoram has joined the Department's IT team as Assistant IT Manager.

Rosa Danisi joined the department as the new technician for X-ray diffraction/SEM lab in October 2023.

Dr Maximilian Van Wyk de Vries was appointed Assistant Professor in Natural Hazards (a joint position between the Departments of Geography and Earth Sciences) in January 2024. His research uses remotely sensed, ground-based and modelled datasets to investigate a range of geohazards in glaciated landscapes.

Ayse Nal Akcay has formally accepted the offer to stay on in the teaching office, providing secondment cover until July 2024.

Rayssa Martins Pimentel, joined as Research Assistant/Associate, working with Helen Williams in November 2023.

Joshua Shea, joined in November 2023 as a Research Associate, working with Oli Shorttle.

Lindsay Nockolds and **Kay Warren** joined as cleaners based at the Downing site in January 2024.

Sean Chen, who joined us in January 2024 a Senior Research Lab Technician in the Godwin Laboratory.

Mandy Cockrill, also joined in January 2024 as Facilities and Safety Supervisor, based at the Bullard Laboratory.

Duygu Sevilgen, Research Associate in Oscar Branson's group, was welcomed in January 2024.

Leavers

Luke Rochford, X-ray Diffractometer (XRD) Technician, left the department in May 2023.

John Nicolson, Godwin Lab Senior Technician, left the department at the end of June 2023 to take up the role of Technician Commitment Coordinator for the University.

Mitha Madhu Teaching Coordinator, left the department in July 2023 to undertake maternity cover as Teaching Coordinator at the Genetics department.

Samin Monem Dorabad, IT Support, left the department in September 2023.

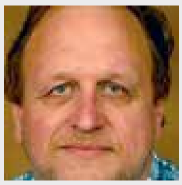
Ian Frame left the department in November 2023. He has been associated with the department since 2005 and worked at the Bullard since 2009.

Obituaries

It is with great sadness that we share the news of the death of **Simon Kelly** on the 19th May 2023. Simon was formerly a member of the Department before working at BAS and then CASP. He was an amazing field geologist and will be fondly remembered by many in the Department and in the Earth Science community beyond.

Retirements

David Lyness retired as Computer Officer at the Bullard in September 2023.



Dudley Simons retired as Bullard Safety Officer and Facilities Supervisor in September 2023.

Student MAPPING PROJECTS

From the Okanagan Valley to Northwest Scotland

Ben Sutton, Zhenya Tumarkin, Ewan Barrett, Anchal Garg

The Okanagan Valley, British Columbia, is known for its vineyards and a dry, sunny climate, ideal for mapping. It has interesting geology too; volcanics and folded sedimentary rocks separated from a metamorphic complex by the Okanagan Valley Fault. We travelled by plane, train and bus to Okanagan, a small town with a single row of shops, full of friendly locals in vests and sandals; a sunny Canadian suburbia.

Day 1 of mapping combined amphibolite-grade gneisses with rattlesnake encounters. Day 2 brought another scare when a large bulbous Black Widow spider crawled from a crevice in an augen gneiss. Alerted as we were to the next potentially life-threatening predator encounter, little did we think that another sort of natural disaster would wreck our plans.

Day 4 was when the smoke first descended. On our way back down Mt Keegan, it became difficult to breathe so we retreated to the car and abandoned the afternoon's mapping. Over the next few days it became routine to check the air quality on the BC Wildfire app, to assess whether it was safe to go outside. Matters came to a head when fire broke out within our mapping area, an inferno reducing our project to cinders. Immediately, the government ordered all visitors to leave. Our first flight out was cancelled due to poor visibility caused by smoke, and further flights were cancelled to give air space to the water bomber planes. Fortunately, one flight went ahead the following day.

Arriving home disappointed and disbelieving, we nevertheless had to formulate a new plan. We chose Northwest Scotland due to its world-renowned geology and complex structures. Specifically, we chose Stoer, Clachtoll and Achmelvich bays where the Stoer Group rests unconformably on the Lewisian basement. The Stac Fada member proved of particular interest as a possible ejecta blanket from a meteorite impact. The Canisp Shear Zone was also rewarding, with its combinations of brittle and ductile deformation. A third focus was the local 90° misorientation of a gneiss lineation relative to the basement near Clachtoll, interpreted as a megaclast emplaced during a rockfall 1.2Ga ago.

With a successful project behind us, we could at last reflect on our sobering encounter with a harsh reality of climate change, and on our incredible adventure in Scotland, where complex geology had sculpted landscapes of serene beauty… even in torrential rain.

Right: Near Clachtoll Bay, 'split rock' in background.

The Okanagan Valley, BC, Canada.

Mapping in the Barberton Greenstone Belt

Nadia Chadirchi, Shivani Dawson, Annabel Hall, Erica Morgan

We chose to do our mapping project in the Barberton Greenstone Belt, South Africa, as it includes some of the rarest rocks on Earth. The belt is around 3.5Ga old and includes komatiites, ultramafic lavas made possible because of the early Earth's hotter mantle. The area also had great exposure for geological mapping.

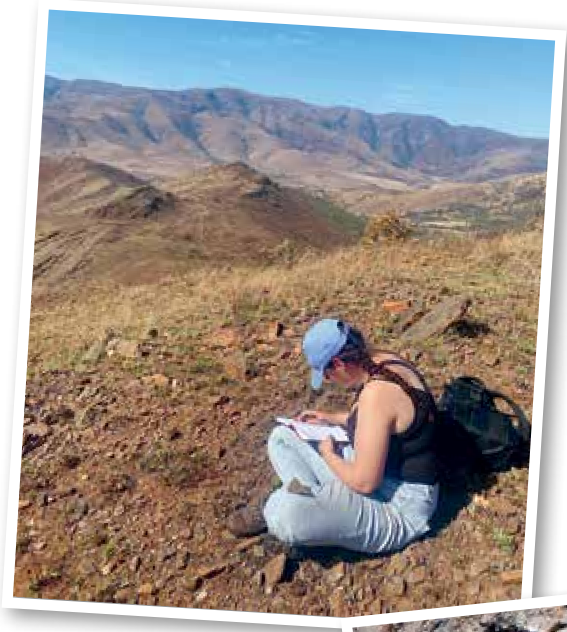
We mapped the Threespruit and Komati formations around the Steynsdorp anticline. At the beginning of the project we had help from local contacts from the University of Johannesburg. They helped us to identify the different units and to understand how these rocks formed, including the characteristic spinifex texture defined by elongate olivine and pyroxene. In total, we mapped around 15km^2, filled 5 notebooks and took over 1000 measurements, which have been used to plot stereonets and to define the geometry of the anticline.

The project taught us many important field-work skills relating to mapping, note taking and making diagrams. It was exciting to see our maps come together, see how the lithologies changed across the area and how the anticline affected the sequence. We gained so much more skill and confidence than we expected from this project, even including how to change a tyre!

During mapping we also saw so much wildlife, including greater kudu, monkeys, baboons and impala, not to mention colourful birds and huge insects. During a visit to the Kruger National Park we were able to see all the "big five" species – lion, leopard, elephant, buffalo and rhino – to learn more about the habitat they live in and why they are so endangered.

We also became more confident travellers, as this entire project was planned independently and, for some of us, was the first time we had left the country in over six years. We met many local people, in the field and at our field camp. We learnt a lot about the culture of the area, including some traditional dance in the evening after a day of mapping. We also tried lots of local food, particularly unfamiliar meats.

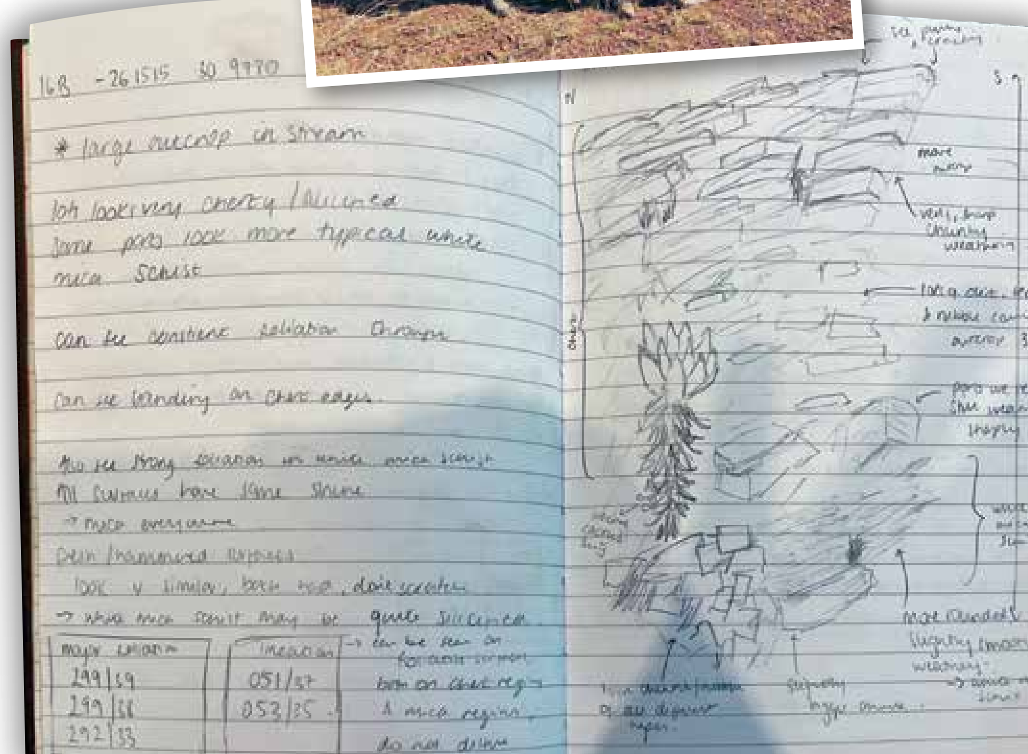
Overall then, the mapping project was a valuable and unforgettable experience for all of us.



Above: Nadia making notes, with the view of the mountains.

Right: A good outcrop of internally veined pillow lavas seen on our last day on mapping.

Below: The four of us on a rest day.



Right: An example page from a notebook.

Make a world of difference in Earth Sciences

Donations from our alumni are increasingly important in adding value to our students' experience of Earth Sciences, whether through teaching or through research as a Part II or III undergraduate or post grad.

There are four ways that you can allocate your gift:

- The **Earth Sciences Fieldwork Fund** helps maintain the department's strong commitment to field teaching as a vital way of bringing lecture and practical material to life. Boosting fieldwork provision for all students who have missed field courses due to COVID restrictions will involve extra costs, which the fund can help with.

- The **Earth Sciences Student Support Fund** helps individual students struggling with the extra costs of doing an Earth Sciences degree. Our aim is for nobody to be disadvantaged because they can't afford a field course fee, or the cost of a laptop for remote learning for instance.

- The **Sedgwick Museum of Earth Sciences** fund helps the Museum to care for and share its internationally important collections. The Museum has continued to provide access to its collections for researchers and students throughout the pandemic, while its targeted school and public programmes encourage the next generation of Earth Scientists.

- The **Earth Sciences General Fund** is unrestricted in its use. It can help to support all urgent or unexpected needs within Department, which including topping up partially-funded postgraduate studentships, helping with travel to research labs, with new initiatives for lab equipment, and – most recently – adding cameras to microscopes to allow socially-distanced teaching.

You can donate online at **philanthropy.cam.ac.uk/give-to-cambridge/earth-sciences** or fill out the Donation Form inserted with this GeoCam.

For further information about donating to Earth Sciences or guidance on how to leave a gift, please do contact us:

Cara Hanman
Alumni Coordinator
alumni@esc.cam.ac.uk

Meaghan Annear
Head of Development, Physical Sciences
meaghan.annear@admin.cam.ac.uk

Ed Tipper points out an interesting formation to students during a fieldtrip.

Thank you to all our donors

To all our donors, whose contributions to the Department's funds help with the provision of a full and enriching experience for our students, we offer our most grateful thanks.

Your donations have supported, in particular:

- The undergraduate field trips providing enriching and crucial experiences that are unique to Earth Sciences
- Mapping project costs
- The shortfall in the graduate tuition fee for UKRI students
- Support with our provision of alumni events and activities over the years.

Some year groups contribute regularly to a Class Award Fund which provides grants or awards to students. The pandemic put paid to mapping projects for a number of years but we are pleased to bring you an update on recent winners:

- The Class of 2005 Fund: Rose Bainbridge was awarded a contribution from the Fund toward mapping project fieldwork in New Zealand.

- The Reekie Memorial Prize Fund: Hannah Ria-Alles (St John's) won the 2023 prize for her project 'Geology of the Eastern Pistolet Bay Area, Newfoundland, Canada'.

- The Dave Thompson Award:
  - 2022 winners: Shumona Nath, Geri Peykova, Will Kay, Naomi Driver, Harrison Silver for their Mapping Project in Zanskar River Valley, Ladakh, India.
  - 2023 Winners: William Pizii, Pippa Lewis, Rosa Woods, James Boyce for their Mapping Project in Pilbara, Western Australia.

With costs rising for everyone, your donations – one off or regular contributions alike – make a huge difference to Cambridge Earth Sciences offering a fully rounded experience to our students and keeping the quality of learning provision as high as possible.

We are so grateful to everyone who offers us this support and welcome new donors. Please feel free to get in touch or utilise the donation form enclosed with this edition of GeoCam if you would like to contribute.

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Cara Hanman, Alumni Co-ordinator
Department of Earth Sciences
E: alumni@esc.cam.ac.uk

Meaghan Annear, Head of Development, Physical Sciences
Cambridge University Development and Alumni Relations
E: meaghan.annear@admin.cam.ac.uk

Students exploring a coastal landscape under typically British conditions.