GeoCam

EARTH SCIENCES ALUMNI MAGAZINE

ISSUE 22 | SPRING 2025

NEWS

Ancient Antarctic Ice Insights

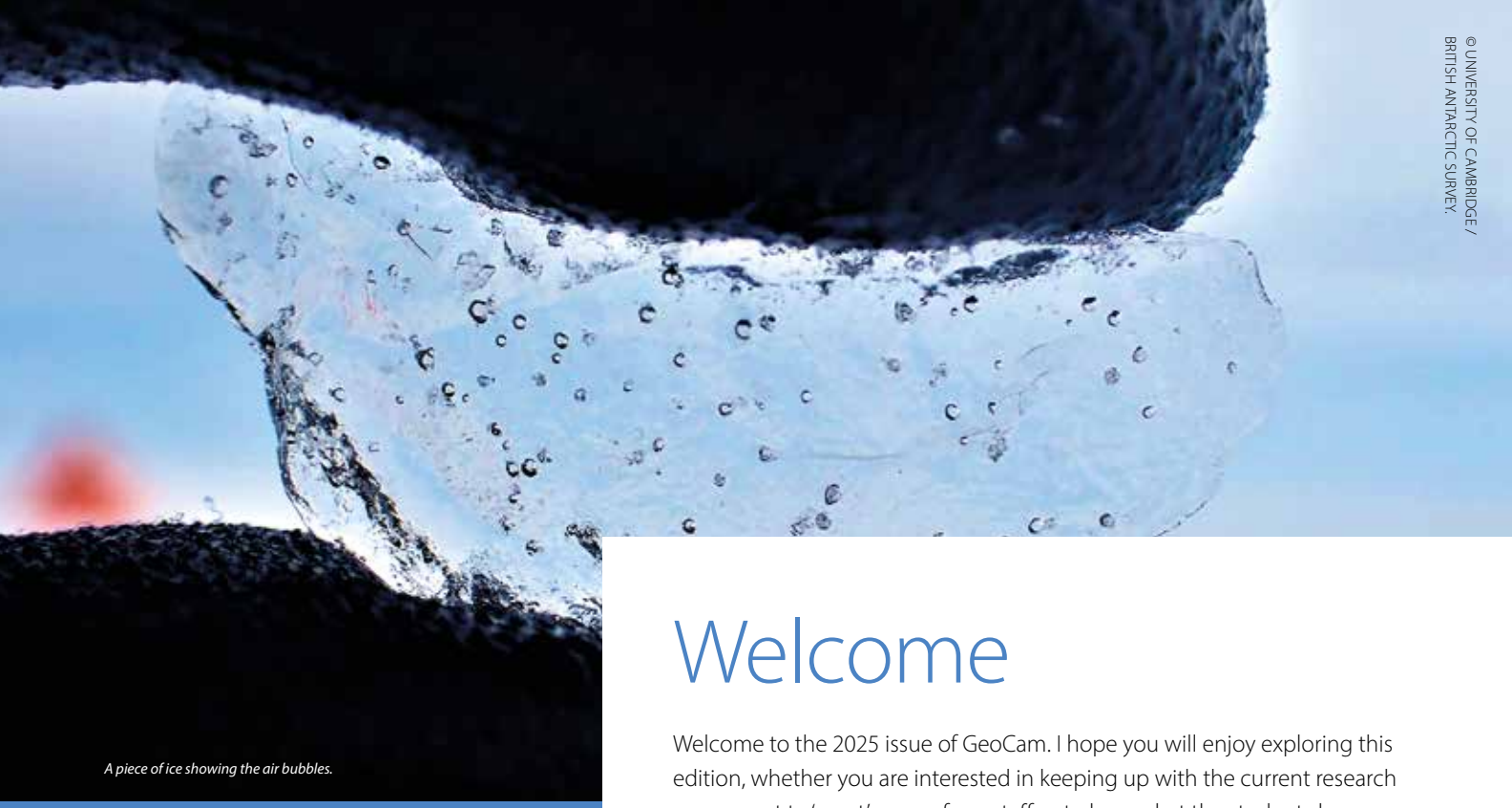
RESEARCH

The origins of our Orbicular Granite

STUDENT FOCUS

Geochemistry of La Plagne

UNIVERSITY OF CAMBRIDGE



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A piece of ice showing the air bubbles.

IN THIS ISSUE

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

Cover Image: One of the stunning views from the Spain mapping project (page 21).

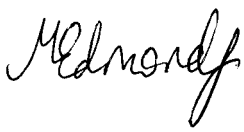
Welcome

Welcome to the 2025 issue of GeoCam. I hope you will enjoy exploring this edition, whether you are interested in keeping up with the current research news, want to 'meet' more of our staff or to hear what the students have been up to in their mapping projects and research projects.

The department has been a hive of activity this year, with many exciting research highlights to report. Of particular note, our researchers have made significant discoveries in the fields of extreme weather, avian intelligence, understanding the building blocks of our planet, and carbon drawdown by kelp forests, among many other topics. The Sedgwick Museum goes from strength to strength and has hosted a number of successful exhibitions based on our research and is very active in schools' outreach, laying the foundation for future Earth Scientists.

This year we were successful in winning a 5-year PhD studentship programme funded by NERC, which will help us sustain our vibrant postgraduate community in the department. We also saw the launch of two new MPhil courses on Planetary Science and Life in the Universe, and on Climate and Environmental Sciences. In 2025, we will focus on strengthening existing and building new links with a range of stakeholders across industry, charities and government, to pursue our aims of producing globally competitive research to tackle society's most pressing challenges in our field.

You, the Alumni, are very important to us. We want to make it easy for you to maintain the relationship with the department that started during your time here. As well as GeoCam, we have a termly e-newsletter, an alumni LinkedIn group and department Instagram and Bluesky accounts for you to follow. If you have not yet perused the many articles on our Blog, I recommend enjoying the diverse content shared there. If you find yourself able to join us, the Alumni Day is a chance to reconnect – with staff and student volunteers as well as your peers. I wish you a happy and healthy 2025. We hope to see you soon.



Marie Edmonds,
Head of Department

PROFESSOR MARIAN HOLNESS FRS, PROFESSOR OF PETROLOGY

The Microscope Store

The South Wing staircase is notable for the furtive location of store-rooms at the end of each flight, hidden in the corner of the building. While some double as passageways to even better-hidden emergency flights of stairs, that on the second floor is an enclosed space housing a vast amount of optical microscopy equipment.

I became interested in apparently obsolete microscopy equipment when I realised that my research required a universal stage, a wonderful invention allowing the rotation of a thin section in 3D. Universal stages are no longer made as their primary use is for measuring mineral composition and crystal lattice orientation, which can be achieved far more quickly and accurately using modern equipment. However, they remain the only way to measure the 3D geometry of three-grain junctions, necessary to constrain thermal histories of igneous rocks. It dawned on me that it was likely that other, even more arcane, optical microscopic equipment might turn out to be similarly useful, so I asked everyone to look through cupboards and drawers in their offices and labs, and stored all the unearthed treasures in the newly established Microscope Store. This exhaustive search threw up an astonishing seven Leitz 4-axis U-stages, accompanied by a generous collection of spare parts, and a couple of older, museum-quality, stages that are too valuable to be used.

John Maclennan and I recently created a new petrology 4th year course. These courses are an excellent way of introducing research techniques and I decided to show the students how to use a U-stage. This required all seven stages to be carefully looked over by our wonderful workshop team, together with the 1960's microscopes required to mount them (modern microscopes do not have sufficient space). The practical in Lent Term 2024 is the first time since the 1970's that Cambridge undergraduates have been introduced to the universal stage!

The Store contains equipment ranging from the late 19th Century to the latter part of the 20th, tracking the progress of research in Cambridge from before the construction of the current buildings, through the lifetime of the co-existing Department of Mineralogy and Petrology, to the Great Amalgamation in 1980 to form the Department of Earth Sciences. A wonderful story can be told of the development of optical techniques that underpin our evolving understanding of igneous and metamorphic petrology: I see great potential for yet another hands-on 4th year course.

Perhaps the only practical class in the world in which undergraduates are taught how to use a universal stage for petrographic work: the 4th year class studying Crustal Magmatic Processes.

RESEARCH NEWS

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

UNLOCKING THE CARBON CAPTURE POTENTIAL OF KELP FORESTS

Marine carbon dioxide removal (mCDR) strategies, such as the use of kelp forests, are gaining traction as promising technologies to reduce atmospheric carbon dioxide concentrations. Researchers from Cambridge have united with Stanford University, along with other universities in California, for an international collaboration investigating mCDR.

Cambridge Earth Sciences PhD student, Zhenna Azimrayat Andrews, visited the Ocean Rainforest Inc.'s (ORI) pilot kelp farm, off the California coast, last summer. The site, in the Santa Barbara Channel, is being used to collect data on the fluid dynamics, biogeochemistry, and carbon dioxide removal potential of kelp farms. Zhenna, alongside Cambridge researchers, will use the new field data to construct model simulations that explore the viability of this potential mCDR technology.

Read more: https://bit.ly/3WKFuH5

© JENNY ADLER

Kelp in the tide.

MAGMA RISING EXHIBITION AT THE HEONG GALLERY, DOWNING

A new art-science exhibition at Downing College's Heong Gallery brings Iceland's incandescent volcanic eruptions and earth-shattering seismic tremors to Cambridge.

The exhibit, 'Magma Rising', interweaves research and scientific data from geoscientists at Cambridge's Departments of Earth Sciences and Geography with wide-ranging artworks including illustrations, sculptures, sound installations, films, video games, microscope imagery, shoe design and more.

The exhibit runs from 26th February until Earth Day, the 22nd April and is free to visit.

Read more: https://bit.ly/4hIMYYR

An image from the exhibition titled Un-Balanced (shoes).

© SRUU RECHT

BIRD BRAINS FROM AGE OF DINOSAURS REVEALS ROOTS OF AVIAN INTELLIGENCE

© STEPHANIE ABRAMOWICZ

Navaornis skeleton

Researchers from our Department have made a one-of-a-kind fossil bird discovery that could transform our understanding of how modern birds evolved their unique brains and intelligence.

The fossil, which is roughly the size of a starling and dates from the Mesozoic Era, is so well preserved that the complete skull is almost intact: a rarity for any fossil bird, but particularly for one so ancient, making this one of the most significant finds of its kind.

The extraordinary 3D preservation of the skull allowed the team, led by Cambridge and the Natural History Museum of Los Angeles County, to digitally reconstruct the brain of the bird, which they have named Navaornis hestiae. Navaornis lived approximately 80 million years ago in what is now Brazil, before the mass extinction event that killed all non-avian dinosaurs.

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

© ZARA CRAPPER

EXPLORING WATER FLOW PATHS IN NEPAL

The Himalayas is an ideal place to study water-rock reactions due to its high erosion rates and contribution to the global carbon cycle by drawing carbon dioxide from the atmosphere via mineral reactions.

Ed Tipper's research group journeyed to the Melamchi Valley in Nepal to explore how spring flow paths impact silicate weathering and carbon drawdown in the Himalayas. The trip was part of an international project funded by the Frontier Research in Earth Sciences (FRES) programme in association with the NSF. The team's research in Nepal aims to advance understanding of the role mountains play in the Earth system, investigating areas such as topography and landsliding, chemical weathering variations and water flow paths.

Read more: https://bit.ly/3Epx5SW

IMPULSE RESEARCH UPDATE

In August 2024 we announced that the IMPULSE research expedition had sailed from Hafnarfjörður, Iceland. The team collected detailed measurements of the seafloor near Iceland to better understand processes operating deep within the 'Icelandic Mantle Plume' – a giant fountain of slowly-creeping hot rock that rises from Earth's core-mantle boundary.

The collaboration is led by the University of Birmingham and involves scientists from Cambridge and Southampton Universities, plus collaborators in the US and Iceland. PhD students Aisling Dunn, Callum Pearman and Philippa Slay from Cambridge were aboard the research vessel. Professor Nicky White is the Cambridge-lead on the project.

© CALLUM PEARMAN

The R/V Marcus G Langseth at port in Hafnarfjörður, Iceland.

Read more: https://bit.ly/4hl1Bvd

ANCIENT ANTARCTIC ICE OFFERS INSIGHTS INTO FUTURE CLIMATE SCENARIOS

Increasing greenhouse gas emissions are warming our planet at an unprecedented rate and scale. While anthropogenic warming has no direct historical parallel, warm episodes in Earth's history can offer clues as to the future.

A team of ice core scientists led by Cambridge University wanted to find out what happened to the West Antarctic Ice Sheet during the Last Interglacial, over 100,000 years ago; a period when the polar regions were about 3°C warmer than present and sea levels were significantly higher.

In 2019 a team from Cambridge and BAS drilled a 651-metre-long core from Skytrain Ice Rise and, after years of detailed analysis, they now have the first direct evidence of the ice sheet's extent at this time. "Studying the vulnerability of the West Antarctic Ice Sheet during the Last Interglacial could help us better forecast how the continent's ice will respond in future," said Cambridge Earth Science's Eric Wolff.

Read more: https://bit.ly/4ghSXwZ

© ERIC WOLFF

The drilling and living tents at Skytrain Ice Rise.

NIGEL WOODCOCK, EMERITUS READER IN STRUCTURAL GEOLOGY

History and future of stone use in Cambridge

The time sequence of building stone use in Cambridge shows the competing influences of function, fashion and finance in the city's historic fabric. Now natural stone is poised for a resurgence because of its strength, durability and low embodied carbon.

For the unabridged article visit: **https://blog.esc.cam.ac.uk/history-and-future-of-stone-use-in-cambridge/**

Cambridge buildings display one of the UK's best records of historic stone use. Never systematically researched, it has remained an underused resource for educators, historians and architects. So, in 2019, Euan Furness and I surveyed all Cambridge buildings with significant exterior stone[1]. We identified the types of stone in each building and assigned a date and a rough volume to each of the thousand or so construction or repair projects involving stone.

Clare College Old Court, south range, 1640-42, built of Ketton Limestone, the most commonly used stone in Cambridge.

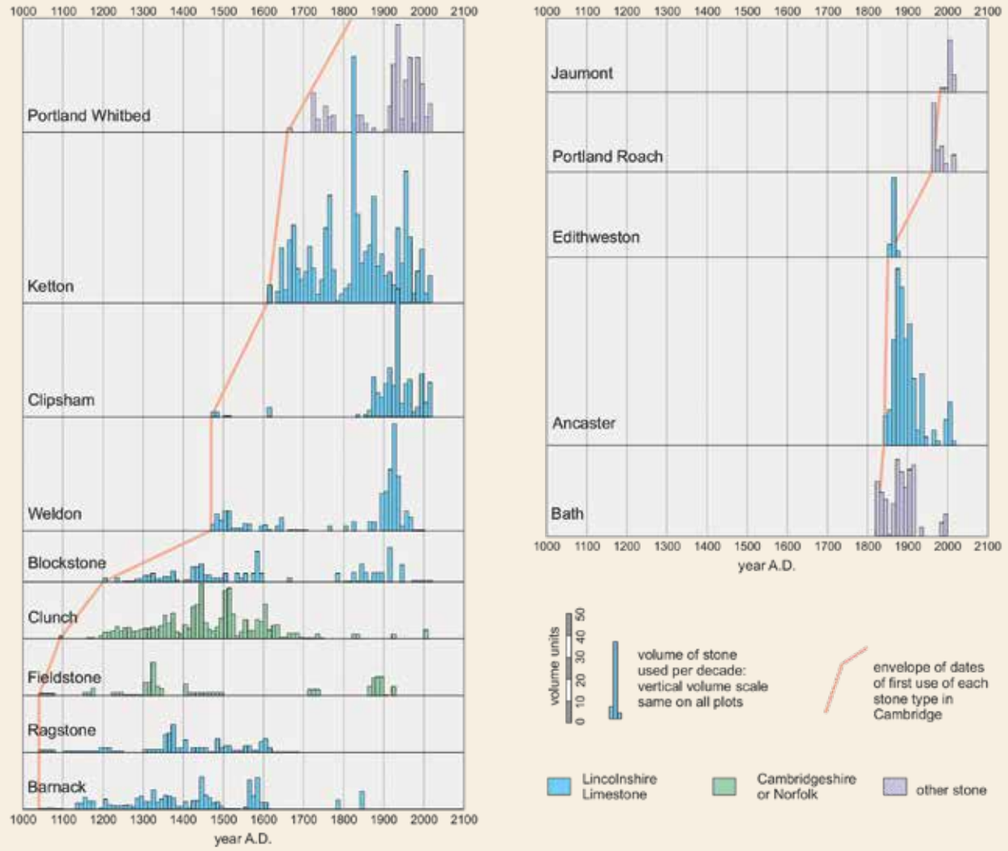
We identified 23 main stone types, almost all (94%) limestone. Two-thirds of that limestone comes from the Middle Jurassic Lincolnshire Limestone Formation that extends from Lincoln southward to Corby. Nine main quarry areas have supplied stone to Cambridge, particularly Ketton (35%). Ancaster (18%), Clipsham (10%) and Weldon (9%).

Bar charts show the pattern of use of each stone, with each bar showing the volume used in one decade. The charts – ordered by the first use date of each stone – reflect key historical influences, for instance:

- Before the 15th century, low quality stone came either from local Cretaceous Clunch (hard Chalk) or from locally harvested fieldstone. High quality stone was imported from Barnack, 60 kilometres away in the Jurassic limestone belt.
- After the Black Death (1349), the supply of fieldstone declined due to the decreased area of arable farming.
- Barnack stone supply declined after 1460 as the quarries were worked out. Recycled sources arose from demolished monasteries after their dissolution in 1536-41.
- White Portland limestone became fashionable in the 18th century, despite the long coastal transport route from the south coast of England.
- In 1847, the extension of the railway network to Cambridge increased the variety of distant UK stone that was used in Cambridge, notably from Bath in southwest England and from Ancaster, the most northerly of the good Lincolnshire limestones.

The choice of building stone was influenced by three factors: a) its intended function; for instance, medieval Clunch was best for carving but Barnack was more weather resistant; b) the prevailing fashion; c) the finance available for the project. The cost of medieval stone doubled when transported only ten miles overland from the quarry. Even if stone such as Barnack was moved by inland waterways at about a fifth of the overland cost, the economics still favoured more local stone. The artificially low cost of fossil fuels through the 20th century has decreased the global pressure to use local construction materials; but this is set to change.

But what modern relevance is a study of historic building stone? It certainly helps architects to identify stone in restoration projects and to source alternatives. More importantly, a historical study shows the range of stone available for new-build projects, and the Cambridge buildings where their durability can be assessed after centuries of natural weathering.

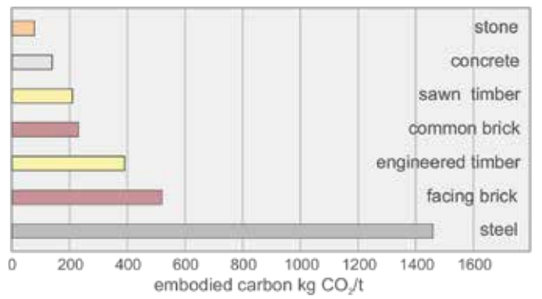


Bar charts of the volume of each main type of preserved Cambridge stone used per decade; charts are stacked in order of the date of first use.

WANT TO KNOW WHAT STONE YOUR COLLEGE IS MADE OF? CONSULT NIGEL WOODCOCK'S BRIEF GUIDE[2].

Surprisingly perhaps, natural stone is regaining favour as a construction material, not just because of its strength, durability and beauty but because of its low embodied carbon[3]. Stone does not have to be fired like brick or kilned like cement or dried timber. Stone for walling or dressings is simply cut to shape. Long stone beams can be created by joining blocks with glue and a tensioned steel cable.

So, building stone – available as it is in large volumes – should play an increasing role in future construction. This trend will need geologists to find and monitor resources. Increasing fuel costs will likely mean more pressure to use local stone. Maybe the inner skins of Cambridge buildings will once again be made of blocks of local Clunch, just as in medieval Cambridge.



Bar charts of the embodied carbon in common building materials.

1. N. H. Woodcock and E. N. Furness, 'Quantifying the history of building stone use in a heritage city; Cambridge, UK, 1040-2020', *Geoheritage*, vol. 13, p. 12, 2021, doi: https://bit.ly/4kptTHu
2. N. Woodcock, 'Building stones of Cambridge colleges', *Cambridge*, 2023. https://bit.ly/4fZv4tN
3. A. Klemm and D. Wiggins, 'Sustainability of natural stone as a construction material', in *Sustainability of construction materials*, Elsevier, 2016, pp. 283–308. Accessed: Oct. 12, 2024. [Online]. Available: https://bit.ly/4jqWPOW

CHARLOTTE GORDON, PHD RESEARCH STUDENT

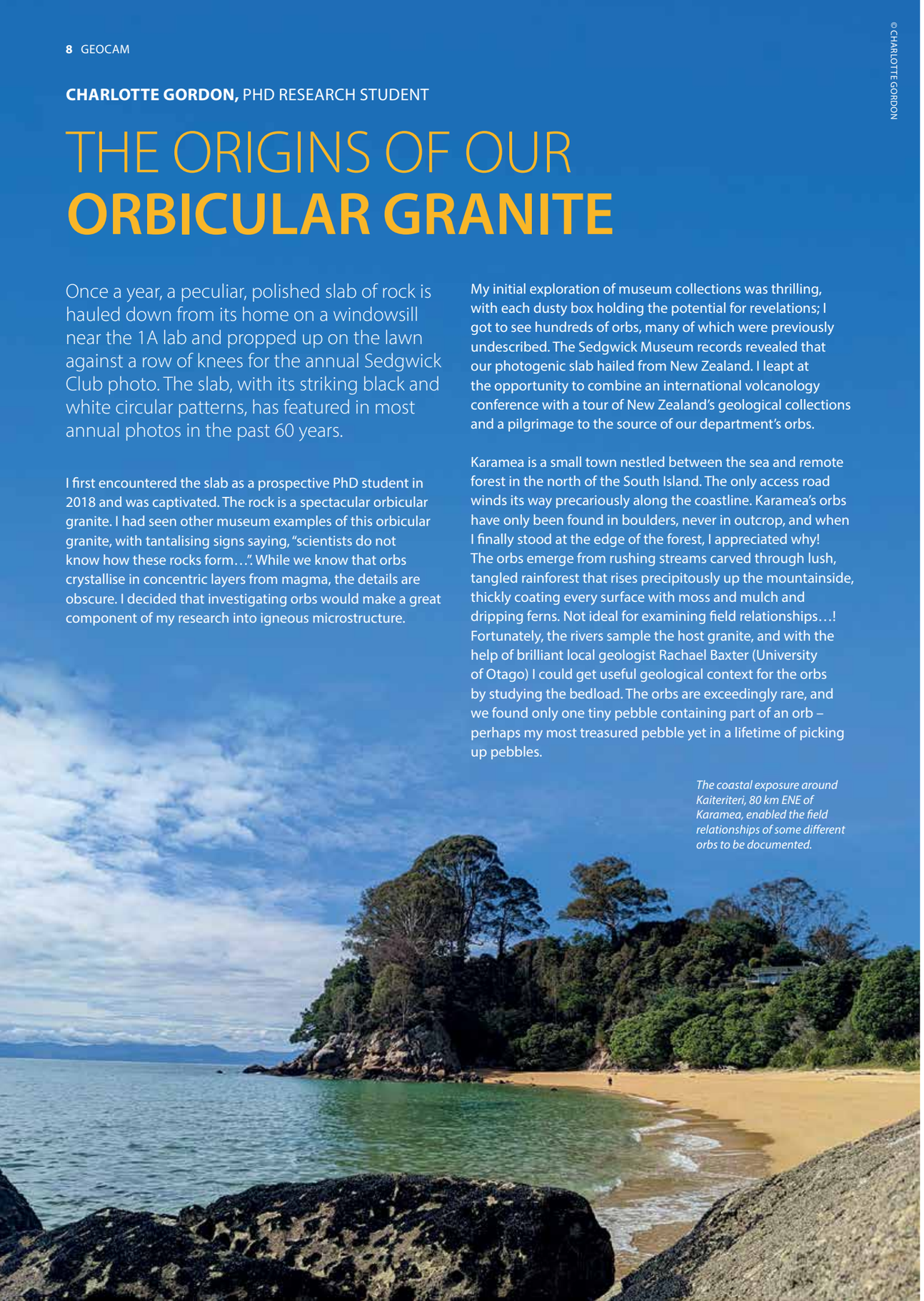
THE ORIGINS OF OUR **ORBICULAR GRANITE**

Once a year, a peculiar, polished slab of rock is hauled down from its home on a windowsill near the 1A lab and propped up on the lawn against a row of knees for the annual Sedgwick Club photo. The slab, with its striking black and white circular patterns, has featured in most annual photos in the past 60 years.

I first encountered the slab as a prospective PhD student in 2018 and was captivated. The rock is a spectacular orbicular granite. I had seen other museum examples of this orbicular granite, with tantalising signs saying, "scientists do not know how these rocks form…". While we know that orbs crystallise in concentric layers from magma, the details are obscure. I decided that investigating orbs would make a great component of my research into igneous microstructure.

My initial exploration of museum collections was thrilling, with each dusty box holding the potential for revelations; I got to see hundreds of orbs, many of which were previously undescribed. The Sedgwick Museum records revealed that our photogenic slab hailed from New Zealand. I leapt at the opportunity to combine an international volcanology conference with a tour of New Zealand's geological collections and a pilgrimage to the source of our department's orbs.

Karamea is a small town nestled between the sea and remote forest in the north of the South Island. The only access road winds its way precariously along the coastline. Karamea's orbs have only been found in boulders, never in outcrop, and when I finally stood at the edge of the forest, I appreciated why! The orbs emerge from rushing streams carved through lush, tangled rainforest that rises precipitously up the mountainside, thickly coating every surface with moss and mulch and dripping ferns. Not ideal for examining field relationships…! Fortunately, the rivers sample the host granite, and with the help of brilliant local geologist Rachael Baxter (University of Otago) I could get useful geological context for the orbs by studying the bedload. The orbs are exceedingly rare, and we found only one tiny pebble containing part of an orb – perhaps my most treasured pebble yet in a lifetime of picking up pebbles.



The coastal exposure around Kaiteriteri, 80 km ENE of Karamea, enabled the field relationships of some different orbs to be documented.

The people of Karamea are justifiably proud of the local "ringstones". While asking around for permission to access land, we found plenty of folk keen to share their local history and show us their family rock collections. The Karamea Centennial Museum archives newspaper cuttings, photos (including an old Sedgwick Club photo!) and other documents relating to orb discoveries over the past hundred years, all invaluable for my research.

Our department slab comes from a boulder found by a local man, Levis Johnson, while deerstalking in 1943. Too large to be moved by one man, the boulder lay undisturbed until the construction of a logging road meant that a bulldozer, wire ropes and manpower could be borrowed to relocate the rock to Johnson's lawn. The boulder was so remarkable that it made the local news. Upon hearing of the discovery, a government geologist named Pat Marshall visited Karamea to acquire it. Initially, he offered Johnson £5, which Johnson declined saying "if it's worth that much it must be worth more!" After a telephone call to Wellington, Marshall got permission to pay £50 – Johnson reportedly felt like a millionaire! When a government truck arrived to collect the prized rock, the driver is said to have asked, "Where's the boulder for Dr. Marshall that's to be wrapped in cotton wool?"

I could certainly relate to Marshall's concern as I meticulously padded my own samples for transport. This came back to bite me, when a customs official found my dozens of tiny baggies of tissue suspicious and made me unwrap every single chip of rock for inspection. After a clean swab test and a lot of granite, he shifted from suspicion to bafflement, then to amusement. By the end we were chatting about volcanoes!

Exploring the tributaries of the Karamea River to document the textures of the granite that hosts small patches of orbs.

Marshall thought the boulder so fine that it deserved to be displayed in as many museums as possible, so the government sliced up the rock and distributed specimens worldwide. I tracked down a number of the slabs during my research. Our slab's closest cousin is on display in the Auckland War Memorial Museum. Visiting it was a surreal experience after studying our department's slab so closely: like looking at your reflection through two mirrors.

Years on from my first encounter with orbs, I feel as though my analyses have resolved some mysteries but unearthed many more. We hope to have papers out soon. I like to think that everyone involved in our slab's colourful history would be happy to know that it is still yielding exciting new scientific insights.

References:

Grapes, R., 1996. Saga of a unique boulder – Orbicular granite from Karamea, *Geological Society of New Zealand Newsletter*, 110, pp.19–22

Marshall, P., 1946. Spheroidal granites, *The Australian Museum Magazine*, Vol. IX no.3, pp. 74–78

Gordon, C., 2024. *Insights into magmatic processes from the crystal orientation mapping of igneous microstructures*. PhD thesis, University of Cambridge.

Comparison of five slabs from the collections of: GNS Science (A and F/G), the Sedgwick Museum (B/C), the Auckland War Memorial Museum (D/E), and the Australian Museum in Sydney (H – Credit: Ross Pogson).

ANDY WOODS, DIRECTOR, IEEF

Institute for Energy and Environmental Flows:
A RESEARCH UPDATE

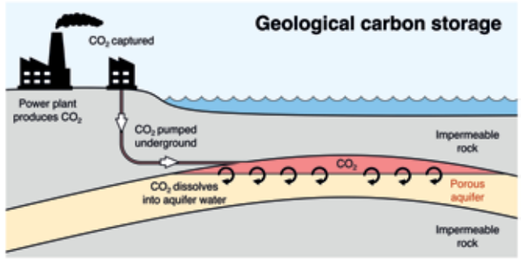
Exciting new projects in the Institute are focussing on the long term geo-storage of hydrogen, carbon dioxide and thermal energy, all vital to the energy transition. Renewable energy generation from wind and solar power is intrinsically intermittent. Solar radiation has both a daily and an annual cycle, complicated by the more random cloud cover associated with weather patterns. Wind power is highly coupled to weather systems on time scales of days to weeks, and systematically increases in winter. These fluctuations lead to week- to month-long periods of over- or under-supply of renewable energy. Such intermittency needs to be actively managed. Solutions include the use of gas fired power, linked to carbon capture and storage, during periods of low renewable generation and large-scale energy storage during periods of over-supply of renewables; stored energy is reused in periods of low-supply.

Carbon capture and storage

Scientific research and technology can be deployed to improve the efficiency of carbon capture and storage in subsurface aquifers. One aim is to enable liquefied CO_2 to access a greater fraction of the injected subsurface permeable reservoir. A second aim is to understand the long-term fate of CO_2 whether trapped by geological structures such as anticlines, by capillary trapping in the water-filled pore spaces between sedimentary grains, or by dissolution into the pore water. Our research focusses on the dynamics of CO_2 transport through porous layers, and on controls on the rate and mechanisms of trapping of the CO_2 (Figure 1).

We have evolved a fascinating suite of analogue experiments to model the dissolution of trapped CO_2. They use bead packs containing salt powder and unsaturated water, which provide an analogue system for trapped CO_2 and CO_2-unsaturated brine.

Figure 1



Hydrogen storage

Hydrogen storage represents one response to the challenge of large-scale energy storage. Hydrogen is produced through electrolysis in periods of excess renewable generation. This hydrogen is stored at pressure in a salt cavern or on a larger scale in a saline aquifer. The hydrogen is then recovered in periods of low generation, typically over seasonal time scales (Figure 2). Our research into hydrogen storage focusses on the potential use of aquifer storage in anticlines (Figure 3).

Figure 2

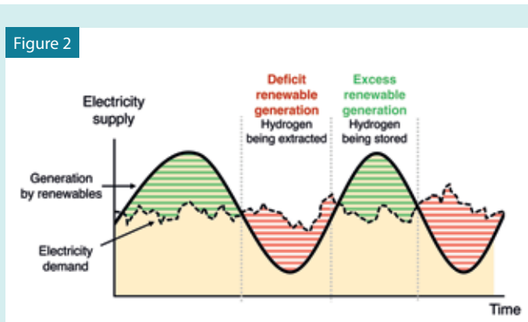
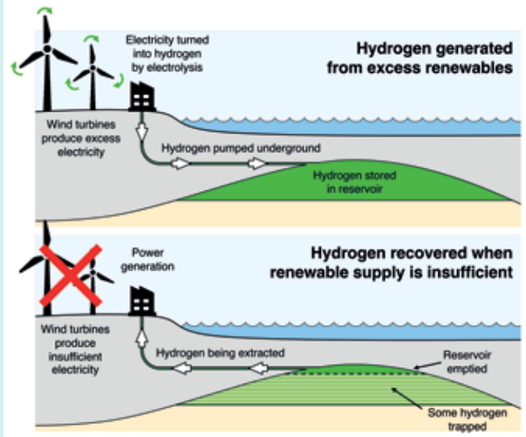


Figure 3



A suitable aquifer for CO_2 or hydrogen storage: Bridport Sand Formation, West Bay, Dorset.

© NICOLA MINGOTTI

Key questions concern the efficiency of aquifer storage in that some hydrogen may not be recovered from the system owing to capillary trapping or buoyancy trapping. Our new models and experiments have identified that capillary trapping may lead to 5-20 % of the injected pore space continuing to host hydrogen. A plume of hydrogen may remain trapped in the aquifer unless the production rate is low or the reservoir permeability is high (Figure 3).

Thermal energy storage

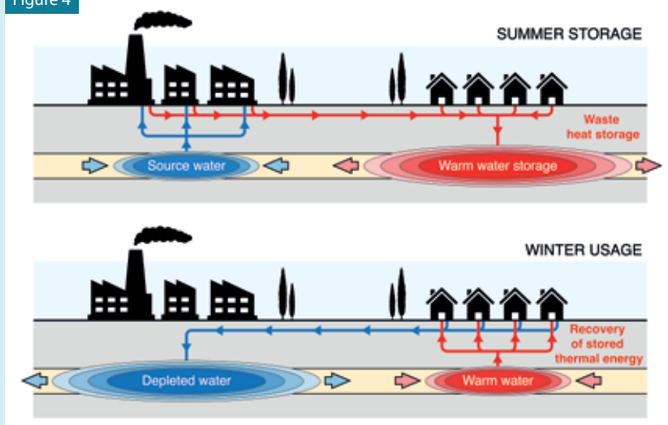
A third programme of our research explores the potential for thermal energy storage in aquifers or arrays of boreholes. Excess thermal energy in the summer or waste industrial thermal energy can then be used for heating applications in the winter (Figure 4). Waste heat represents over 10% of global primary energy use, so recycling this heat has enormous potential for reducing the energy load required for heating. The value of the thermal energy depends on the temperature at which is it collected. However, combining stored low temperature waste heat with heat-pump technology can reduce by a factor of four the energy cost and carbon emissions of heating in winter or cooling in summer. Our research models the distribution of thermal energy stored in the subsurface through circulation of warm or cold water, and how this can be used in complex heating and cooling systems.

Such modelling also helps to ensure that thermal losses in the subsurface are minimised and that the use of the ground as a store of thermal energy is optimised. As the depth of the thermal store is increased, its potential to generate power and heat increases. So too does the elasticity of the thermal storage, in the sense that it can better accommodate inter-annual fluctuations in the heating or cooling demand. Moreover, at these higher temperatures, the thermal energy can be converted to electricity using thermo-mechanical conversion techniques, creating a hybrid geothermal power – energy storage system.

Other IEEF research

Our projects on long-term energy and carbon storage are vitally important for future schemes to buffer fluctuations in the supply of renewable power. However, the Institute is involved in a host of other research projects relating to energy transition and the environment. These include ice dynamics, deep ocean mixing, pollutant transport in rivers and research into processes of enhanced weathering. The IEEF is proud to be successfully applying fundamental scientific research to some of the most important practical issues on Earth.

Figure 4



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Acknowledgements: The research described in this article includes research carried out by Andy Woods, Nicola Mingotti, Emma Lepinay, Thierry Menand.

Find out more about the IEEF at:
www.ieef.cam.ac.uk

IN CONVERSATION WITH

Marie Edmonds

For the unabridged version of this interview see:
https://blog.esc.cam.ac.uk/in-conversation-with-marie-edmonds/

One volcanic eruption kick-started your career as a volcanologist?

Volcanoes weren't a stand-out interest as a child. But, as a Natural Sciences undergraduate, volcanology really clicked for me. The subject suited my broad interests. David Pyle was my lecturer, and I stayed on at Cambridge for a PhD with him. I didn't spend much of my time in Cambridge though – I was lured away by a volcano in the Caribbean!

Soufrière Hills, in Montserrat, had been erupting for two years when I started my PhD in 1997. The eruption was making world news, and, because Montserrat is a British Overseas Territory, British volcanologists were flocking there to assist with the monitoring effort.

Montserrat wasn't in my original PhD design; I insisted on going there! My interest was in the volcanic gases and the melt inclusions trapped inside crystals as the magma rose. Some extremely useful insights came from my work, showing that sulphurous volcanic gases originate deep in the crust rather than being formed nearer the surface as had been thought.

More broadly, the eruption was decisive in developing UK volcanology. Over the two decades that the volcano was active, countless papers came out led by British volcanologists. We learnt a huge amount about long-lived, start-stop eruptions, and managing their complex hazards.

You've worked at several volcano observatories?

Following my PhD, I continued to work at the Montserrat Observatory as a junior volcanologist for the BGS. We installed UV spectrometers that scanned the volcanic plume and sent gas measurements back to the observatory every few minutes. That was a world-first; the instruments were fully telemetered and ran autonomously on solar power. I remember when we initially got the system installed – we could sit in our offices and watch all this data streaming in, it was a powerful moment! (Today the same remote gas monitoring methods are in operation at perhaps 35 volcanoes around the world).

After that spell with the BGS, I secured a USGS Mendenhall Fellowship working alongside Terry Gerlach – a giant in the field of gas geochemistry – at the Hawaiian Volcano Observatory. I was in a privileged position: Hawaii is known as the laboratory volcano because you can test new instruments there. I could collect data day in day out, learning and developing ideas all the while. During that time, I was seconded to the Cascades Observatory when Mount St Helens erupted in 2004 and, in 2006, I visited the Alaskan Observatory to monitor the Augustine eruption.

These case study eruptions shaped my career. When I started out, I was a volcanologist focussed on volcanic degassing; how volcanic gases drive eruptions and in turn influence climate. But my experiences at different volcano observatories widened my horizons, and that's when I started to think about the bigger picture questions of how volcanoes impact people and the environment.

What brought you back to Cambridge?

I came back to Cambridge as a lecturer and fellow at Queens' in 2006. James Jackson invited me to Queens, something that changed my life at Cambridge. Having the college affiliation has meant so much to me, I think of it as a supportive extra family. The Department is also full of supportive people, many of whom I have known for a long time, including several who have been there for me since my undergraduate years.

I'm now in a place, as Head of Department, where I can give something back. I think of myself as one in a string of stewards; I am looking after the Department for the next five years and guiding it to the next place. It's an exciting time where we can move forward together.

You have two children. How do you manage work and life?

Home-life is important, family is important. That balance is significant for every member of staff. There have been times where it's been difficult for me, and I want to make it a priority to support those facing similar challenges.

From my own perspective, I've seen positive changes within academia. A couple of decades ago it was very much the women who were looking after the children. It was commonplace for academics not to discuss their family life at work, and the idea of leaving a meeting early to pick the kids up was frowned upon. But thankfully that's different now – caring responsibilities are more balanced and flexible working is welcomed.

I really want our department to be a place where we can be content and, above all, accepting of each other. My philosophy is that everyone has their own circumstances and different needs, and we must be tolerant of how people want to work.

Marie Edmonds, Professor of Volcanology and Petrology, was both an undergraduate and postgraduate in Cambridge from 1994–2001 and has been a lecturer in the Department of Earth Sciences since 2006. Marie reflects on her career and new role as Head of Department with Erin Martin-Jones.

SARAH JOHNSON (NÉE LYLE)

Life After Cambridge Earth Sciences

Quite honestly, I fell into geology during my Natural Sciences course in no small part due to the lure of fieldwork. Then, before I could make meaningful decisions about how to use my degree, I was presented with a once in a lifetime opportunity to join an expedition called EverestMax.

The ambition was to be the first team to travel from the lowest point on earth to the highest. Five cyclists, supported by two in a van, travelled 8000 km from the Dead Sea (-421m) to Everest base camp (5,150 m), then continued on foot. Three of the five summitted. I made it to the final camp (8,050 m). Arguably I had no right to be part of the team given my lack of high-altitude experience, but I was experienced enough to know my limits and respect the environment I found myself in.

While on the mountain I secured a place on the Birmingham University Hydrogeology MSc. The course was extensive, with clear practical application and my project took me to Brazil. Opportunities ranged from bottled water to contaminated land. Intending to locate close to family in Gloucestershire, I found myself accepting a job in Chile instead and life took another unexpected turn.

Although based in Chile, I worked primarily on a large open-pit copper mine in Peru. The variety was striking: my days included field mapping, data analysis, numerical modelling, environmental impact assessment, and engineering solutions for mitigation. I'd never considered mining as a career, but it was fun, and Chile was fantastic.

I returned to the UK in 2008 amid the financial crisis. I'd hoped to explore work in another sector, but no-one was hiring. It was a difficult time with much rejection. I picked up ad-hoc hydro work, but free-lancing didn't suit me. I eventually secured a job back in mining with SRK Consulting. I could work remotely so didn't need to relocate. Within 5 days of starting, I was in the Republic of Congo for five weeks!

I am now a mother of three. I work three days a week for SRK and my travel has reduced dramatically. The work is still diverse but has had to adapt to my commitments; it can be hard to juggle it all. However, mining has proved to be a dynamic, stimulating and flexible industry to work in, and I'm excited to see where it will take me next.

Family out for a bike ride.

Approaching Camp Two on Everest (~7,500 m).

A rather muddy ride in Pakistan with EverestMax!

SARAH HUMBERT

ASBESTOS VS LIBRARY – the first move

© SARAH HUMBERT

On top of the cabinets were 1000s of reprints in 100s of boxes. Here Jess and Izzy sort them into piles where everything will end up either being kept or jettisoned.

The Earth Sciences Library Collection – books, maps, journals, tracts, monographs, etc - has been more than three hundred years in the making. In that time, I imagine it has 'lived' in some unusual places.

Older alumni might remember when it was two or three separately-housed collections; Geology, Mineralogy & Petrology, and Geodesy and Geophysics. There are currently two libraries, at the Bullard Labs and on the Downing Site. The bulk of the downtown collection is housed in 168 metal cabinets, containing approximately a kilometre of shelf space. However, a complete refurbishment of the site of the cabinets, on the third floor in the north wing of our Downing site building forces their relocation. A move that prompts many questions to be asked.

Existential questions like what is the point of a library collection in these digital times? Should we keep everything? Isn't this the perfect opportunity to get rid of lots of these musty books? You can access everything on-line now, can't you? Should we pass on the 'valuable' stuff to the University Library? How do we manage the logistics, of the move itself and afterwards? Not all these questions can or should be answered at the present time, but the logistics questions had to be. Where and how shall we go? Can we access the material with ease and at short notice?

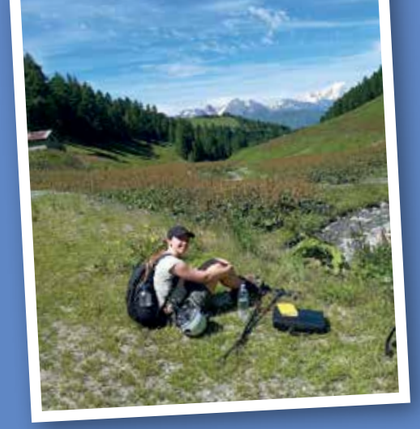
At first, we thought we would be able to move to available library space on the New Museums Site, across Pembroke Street. Alas, that space had its own asbestos issues. We were then granted a large space at the old Cambridge Assessment building on Hills Road. It took the movers, Trevor Newling and team, several weeks of hard work to shift all the library material: first out of the cabinets into over 1700 crates, then down a temporary scaffold lift, into the van, up Hills Road, out of the van and into the new building. Next, they moved the cabinets, down the lift, into the van, up Hills Road, out of the van and into the new building. Then they emptied the crates into the cabinets. All of this had to be done without losing track of what material went into which cabinet.

That we can retrieve material within hours adds to our gratitude to the movers. Next we will consider the questions of how much of the collection returns to the Downing Site, and what happens to the remainder.

MIA WHITE, UNDERGRADUATE STUDENT

Geochemistry of La Plagne

La Plagne, 'the flat', is a region situated over 1500–2100m altitude, in the shadow of Mont Blanc. The region is geologically complex and includes metamorphic schists, an Alps-unique 'Cargneule' lithology consisting of gypsum-dolomite breccia, and a Pb-Ag-Zn vein mined up until the 1970s.



A quick break before continuing titrations downstream.

To what extent can we track the geology and the mining history in the mountainous streams of La Plagne? We attempted to answer this question over 20 days in the field, and with a makeshift lab on our balcony. We used spectrophotometric measures for sulfate, calcium, magnesium and zinc, and measured alkalinity by in-field titration, often in the company of playfighting marmots.

We quickly discovered many calcium rich springs, with waters also containing up to 1g/l of sulfate. Sometimes, the spring water flowed directly out of the bank into the main streams. The springs had low pH and high total dissolved solids so, with our pH probe, we could track how they mixed progressively with the main stream.

Chemical analysis suggested the springs were strongly affected by dissolution of the Triassic gypsum. This is a highly permeable rock, which may evolve into karst-style topography under continued interaction with the spring's aquifers, a common effect elsewhere in the French Alps. We observed massive calcium carbonate precipitation below one spring. The step-like calcified moss (tufa) was utilised by many hikers, much to our distress. By analysing its carbonate system, we interpreted precipitation to be still active. This maybe aided by its slippery surface, a potential microbial mat which occasionally caught hikers, and us, out.

We also tested for and mapped zinc levels in waters near the disused and boarded up entrance of La Plagne mine. Values were up to two orders of magnitude above base level, suggesting pollution was present. To investigate its temporal variability, we took a 10 hour shift measuring zinc every hour after a classically dramatic alpine lightning storm. The results suggested that zinc-rich water is pushed out of the aquifers by the inflowing rain deluge. Importantly, zinc is likely co-occurring with lead. In these concentrations, lead is a significant concern for the local environment here.

Overall, we learnt how to collect high quality data, evolve our hypotheses in the field, and appreciate the complexity of geochemical processes. We also learnt the logistics of living 1000m above the local supermarket, and learnt never again to live 400m uphill of our fieldwork area.

LIZ HIDE, DIRECTOR, SEDGWICK MUSEUM OF EARTH SCIENCES

SEDGWICK UPDATE:

The Butterfly Effect

Step into the Sedgwick Museum at the moment and you'll see that it has been invaded by hundreds of origami butterflies. They're overflowing the tops of the display cases and flying up the walls.

While the effect is joyful and fun, they're there to communicate important messages about climate change and biodiversity loss. They are there to start conversations amongst visitors, and to enable young people to have their voices heard about protecting the planet.

The Butterfly Effect is the culmination of a six-month collaboration between young people from Parkside Community College, university climate researchers and the museum. In the words of Nicola Skipper, the Museum's Education Coordinator 'this programme was created to connect the upcoming generation with our world-leading climate scientists and to give the students a space and voice within the Museum'.

Over six months, the students volunteered their free time after school, meeting researchers, including Professor Eric Wolff. They heard first-hand about how their research is expanding our understanding of climate change and its impacts, and they explored how the Museum's fossil collections evidence changes through geological time. They were particularly taken by zoologist Matthew Hayes' research on how insects' sensitivity to environmental change can act as a warning system for humans. Then they worked with artist Hilary Cox Condron to create the butterfly installation from recycled paper. It became a large-scale community effort with museum visitors, school classes and students all contributing; Department workshop staff contributed considerable ingenuity to solving how to display the butterflies on and in the historic display cases.

The colourful display runs throughout the museum gallery. At key points, monochrome butterflies highlight the five mass extinction events during earth history, with the young people posing the key question of whether we might now be in the sixth mass extinction event. In response to this question, they created protest banners that are also displayed in the Museum alongside the butterflies, reflecting the students' views and concerns and urging people to take positive action on climate change.

The project clearly struck a chord; it received national and international press coverage, and Nicola has been shortlisted for a University of Cambridge 'Improving our Environmental Performance' award.

The Butterfly Effect is in the Sedgwick Museum until June 2025. For more information about the project please contact Nicola Skipper **ns578@cam.ac.uk**

RECENT NEWS & AWARDS

Awards

Many congratulations to **Helen Williams** on being elected a Fellow of the European Association of Geochemistry. A well-deserved honour.

Sasha Turchyn has been awarded a Pilkington Prize for teaching in March 2024. This is a richly deserved award for one the Department's most dedicated teachers. Well done Sasha!

Congratulations to **David Hodell** on his election as a Fellow of the Royal Society. A very well-deserved recognition of his contributions to the field of climate science.

Nicola Skipper, Education Co-ordinator at the Sedgwick Museum, has been shortlisted for the 2024 Professional Services Recognition Scheme, in the category, 'Improving our Environmental Performance'.

© GREG PALMR

© NICK SAFFELL

Top to bottom: 1. Helen Williams, 2. Sasha Turchyn, 3. David Hodell, 4. Nicola Skipper.

The Geological Record

Obituaries

We were saddened to hear of the passing of **Professor Fred Vine** FRS of UEA (St John's 1959), one of the founding fathers of the plate tectonics revolution, in June 2024.

The Department is deeply saddened to learn that **Dr Bryan Lovell**, Emeritus Senior Researcher in the Department, based at Bullard, died in September 2024. He was a past President of the Geological Society and an ardent advocate for the sequestration of CO_2 in subsurface reservoirs. He was the author of the influential book "Challenged by Carbon: the Oil Industry and Climate Change".

We are sad to share the news of the passing of **Jim Webb**, who was the Department Accountant for many years. Jim passed away after a battle with cancer, in December 2024. Even after his retirement he remained in touch with the Department, making regular contributions to support the students and staff in their endeavours.

It is with immense sadness that we share the news that **Professor Ekhard Salje** passed away peacefully in late February. He had been ill for some time. We will all miss Ekhard dreadfully. He was not only an eminent and great scientist and a former Head of Department, but also our dear friend and colleague.

Retirements

Douglas Palmer retired at the end of December 2024. Throughout his career as a writer, he has made an immense contribution the Sedgwick Museum's public engagement and the department's teaching.

Charlie Aldous, Senior Building Technician and long-standing member of the Department, retired at the end of January 2025. Charlie was a central figure in much of the maintenance, building work and creation of a wide range of purpose built facilities that have helped to keep going the endeavours of everyone housed at the downtown site.

Student Prizes

The Reekie Memorial Prize Fund:
Ben Sutton for mapping in Oliver/Okanagan, British Columbia, Canada.

The Dave Thompson Award:
C. Gil, J. Goodband, M. Hidary, S. Wilkinson, T. Holland, P. Jackson, O. Tang for their fieldwork in Tamames, Salamanca, Spain (Sierra de Francia).

New Staff

Left to right: Nicole Shibley, Nishant Chauhan, Emilie Bowman and Amir Atoufi.

Tom Merry joined in February 2024 as a Research Associate working with Sergei Lebedev, based at the Bullard.

Alex Zhang, our new Research Grants Administrator, joined in April 2024. He is working with Oya, and Sue Pearce in Geography, to support the research grant administration in both Departments (50% in each).

Samin Monem Dorabad returned to the Department as IT Technician in April 2024.

Emilie Bowman, joined as Research Associate in Sally Gibson's group in June 2024.

Siyuan Sui, Research Associate in Sergei Lebedev's group, joined in June 2024.

Nishant Chauhan started in June as a new Researcher in Oscar Branson's group.

Oksana Gerasimova joined the Department in July 2024 as our interim Assistant Departmental Administrator covering Emma Chapman's maternity leave.

Niko Ovenden joined as our Interim Business and Operations Manager in August 2024. Niko covered the same role after Andy Buckley's retirement.

Nicole Shibley, started in September 2024 as Assistant Professor, in a joint post with DAMTP.

Amir Atoufi, Research Associate with Ali Mashayek started in October 2024.

Harriet Brown, joined the Sedgwick Museum in October 2024 as Visitor Services Assistant.

John Parry joined the IT team in October 2024 as IT Specialist.

Alexandra Irish started in November 2024 temporarily covering the Teaching Administrator role.

Lorenzo Nava started in November 2024 as a new Researcher in Max Van Wyk De Vries' group.

Sukalpa Chatterjee joined in December 2024 as a visiting researcher in Helen Williams' research team.

Evie Forey joined the Sedgwick Museum as Collections Assistant in January 2025.

Claudine Israel, Research Facility Manager in the Clean Labs, joined in January 2025.

Alice Turner, Research Associate in Alex Copley's group, joined in January 2025.

Gilly Walker, joined in January 2025 as CDT Administrator for AI4ER.

Leavers

Charlie Beard, a member of Research staff working with Owen Weller, moved to a permanent position at Utrecht in April 2024.

Heye Freymuth, Geochemistry lab manager, moved to Hamburg in April 2024.

Alison Cook, Business and Operations Manager, left in August 2024.

Otis Meredith, part of our IT team, left the department at the end of July 2024.

Adriana Dote, AI4ER Administrator, left the department in September 2024.

Annabelle Scott, AI4ER CDT Programme Manager, left the department at the end of September 2024.

Mitha Madhu, Undergraduate Teaching Administrator, moved to the Physics Department in November 2024.

Zydan Alaaeldin, part of our cleaning team, left the department in November 2024.

Student
MAPPING PROJECTS

The spiky grass trees that grew on ultramafics.

ALL IMAGES © CATRIONA MCCLEERY

Mapping the Peel-Manning Fault

Catriona McCleery

Last summer, half of the Cambridge Part II mapping groups travelled all the way to Australia. My group mapped in New South Wales, enjoying rustic accommodation in an old shearer's shed on a rural farm. However, and despite the cold nights of early August, it soon felt like home. The people of the local town, Barraba, were incredibly welcoming although no one quite understood why we cared so much about their rocks. We gave a short talk on the geology to the town's Rotary Club, explaining why we thought it was worth the long trip!

We mapped part of the New England Orogen that contains the major Peel-Manning fault system, extending for hundreds of kilometres across eastern Australia. The system is an important part of the Palaeozoic history of the Gondwana margin yet still poorly understood. In our region, the fault hosts a dismembered ophiolite sequence within a foliated serpentinite melange. The ultramafic cumulates have made for some very beautiful thin sections but were pervasively altered, so were challenging to identify in the field. There were also some very unusual alteration products such as listwaenite, a carbonatised serpentinite that occurs along faults in ophiolites. To the west of the fault zone were siliciclastic forearc basin sediments, in which we hunted for folds. To the east were accretionary wedge cherts, where we hunted for any outcrops at all! The lack of exposure was a challenge, along with a few menacing bulls and a very unhappy horse. We were often mapping with only the many, many, many kangaroos for company.

The family who runs the farm were very keen that we got involved, from which we learnt that Esme has a promising future as a sheep shearer, and none of us want to be farm vets! On rest days, we went on some exciting excursions to a Campdraft (involving many cowboys and a large barbecue) and to AgQuip (an agricultural convention, involving huge tractors, cows, and of course barbecues).

Finally, we must mention our ancient green Land Rover and the off-road driving skills we developed. Impressively, we did not break down and had far fewer car problems than many other groups in their modern cars! Overall, the project was a great experience, and we were very lucky to stay in such a lovely community.

View of our house and car in the sunshine.

(From left to right) Stella Wilkinson, Oliver Tang, Mahdeia Hidary, Candela Gil, Peter Jackson, Jago Goodband, Thomas Holland on the Isle of Skye practising mapping techniques ahead of the project to come.

Our Spanish trip of a lifetime

Mahdeia Hidary

We all agreed that we'll never again have an experience quite like our Part II mapping project. Seven friends in our 20s living for six weeks in a rural Spanish village situated in the most breathtaking natural landscape, and doing what we love for hours every day; looking at interesting rocks and, of course, producing a geological map! Our three mapping areas were situated in the Central Iberian Zone in Spain and were magnificently complex. Each day uncovered more puzzles that needed solving and our job was to find those jigsaw pieces out in the field. The project saw us maturing as geologists. With none of our helpful demonstrators around to ask, we gained confidence in the reliability of our observational skills and in our ability to make decisions based on inference. We were no longer field-trip students, but researchers.

It was very rewarding that the landscape became more familiar each day and that a geological picture began to form. The valleys provided evidence for an early Caledonian compression and a later, more prominent NW-SE Variscan folding with a Barrovian metamorphism up to phyllite grade. Sigmoidal porphyroblasts and tension gashes demonstrated an extensional event between the two compressions. A granite aureole had contact metamorphosed the country rock with a clear cordierite zone. The southern limb of the fold was subject to the contact metamorphism, and the northern limb allowed a direct comparison between the hornfels and its protolith.

(From left to right) Thomas Holland, Stella Wilkinson, Peter Jackson, Jago Goodband, Mahdeia Hidary, Candela Gil, Oliver Tang enjoying their first sunset in Spain as they explore the village.

Majestic caves at Peña de Bolanca.

ALL IMAGES © MAHDEIA HIDARY

I will leave a little piece of me in Spain. I'm still watching the sunsets every evening casting the scenery in a golden and purple hue. I'm still enthralled by the sheep and goats we encountered in the field; who knew goats were curious about geology! Above all, I will cherish the kindness of the La Bastida folk who gifted us bags of home-grown grapes and figs, and giant tomatoes as a half-way milestone present. They welcomed us with their traditions at the village fiesta, calling us the energetic students and truly made our stay special.

We faced a list of challenges, from restricted vulture sanctuaries overlapping with mapping areas, missing vehicle permits and broken cars, to bouts of illness and the sweltering heat. However, I would live each day exactly the same, for fear of losing all the laughter and memories seared into our minds. Each day reaffirmed the integral role of geology in our lives and I can't wait to see where a career in Earth Sciences leads us all.

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. Donating to the fund helps us maintain the provision of field courses for all students.
- 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 continues to provide access to its collections for researchers and students, 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 other urgent requirements.

You can donate online at **www.esc.cam.ac.uk/alumni/support-the-department** 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:

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Associate Director, Physical Sciences
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Thank you to all our donors

To all whose contributions to the Department's funds makes possible providing a fuller and enriching experience for our students, we offer our most grateful thanks.

Your donations make a difference to the department on a daily basis.

Some year groups contribute regularly to a Class Award Fund which provides grants or awards to students. Details of the prize winners can be found on the Geological Record pages herein.

With costs rising for everyone, your donations – one-off and 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.

Students make their way through the field on Arran.

A Unique Alumni Day

When presented with an unusual opportunity, we often worry about change. Work on the third floor of the Sedgwick building has provided us with just such an opportunity and I can confidently say that many weeks consideration went into deciding to grab this chance with both hands.

The building work would limit how much of the Downtown building could be open. It seemed an obvious choice to invite our alumni to discover a part of the Department that many alumni have never visited - in spite of it being the home to some amazing events in Earth Sciences history. An Alumni Day at the Bullard. A one-off change of location where the familiar will meet the new.

Whether you come for the people (your peers/current staff and students), are curious to explore the grounds (or revisit your old haunts), are keen to hear the talks, are most tempted by the tours, or perhaps all of the above – this Alumni Day will be unique. An opportunity that we are excited to provide.

We will welcome you with refreshments in the Tea Room then take you to Astronomy for our opening talks. We have invited Dan McKenzie and Andy Woods as Emeritus and staff speakers. Their talks will take you from the exciting past of the site right through to the work of the IEEF today. They will be followed by a student project talk (a very popular part of our regular programmes).

After the opening talks, alumni have the chance to explore the site either self-guided or via our set tours. Groups will see interesting geological features, find out firsthand about the kinds of experiments that can be run in our labs, see the Collections Research Centre, and have the chance to see the geophysical Crombie collection. Or relax with refreshments in the Old House if a catch up with friends suits you better.

Our closing talks begin with Marie Edmonds and a State of the Department update, then enjoy our second Student Project talk and hear Nick Rawlinson summarise current research.

Weather allowing, this year's drinks reception will be on the lawn of the Old House.

No Alumni Day would be complete without a college dinner – this year being hosted at Downing. With pre-dinner drinks in a private corner of the college grounds and dinner in the Hall, the evening is going to be a relaxed and enjoyable one. Join us in May for an afternoon (and evening) to remember!

Cara Hanman, Alumni Coordinator

See the website for programme information:
https://www.esc.cam.ac.uk/alumni/alumni-events
Buy Tickets: **https://bit.ly/4gjH1LS**
Or use the booking form attached.

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To keep in touch, make sure you update your contact details with us at:
alumni.cam.ac.uk/contact/update-your-details

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Amonite fossils in situ on the Dorset fieldtrip.