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School of Earth & Environmental Sciences

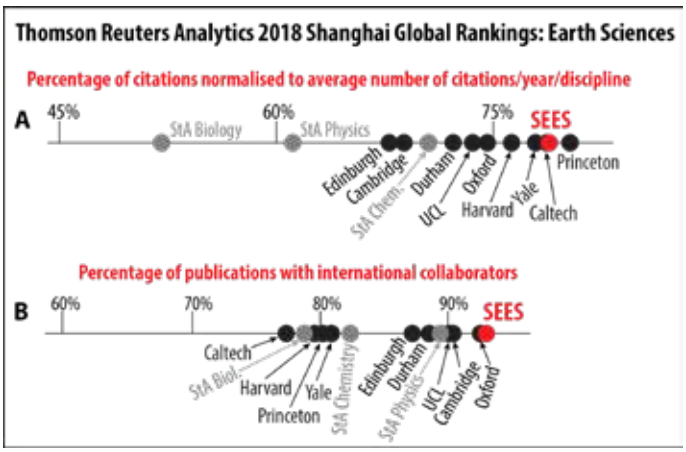
Newsletter Number 15

March 2019

Welcome from the Head of School

Dear All

Happy 2019! The New Year is only into its second month and we already have good news to relay. Having always prided ourselves in our teaching, we were delighted when the School was ranked as the No. 1 Earth Science programme in the UK in the 2018 National Student Survey and 4th in the 2019 Complete University Guide League Tables, just behind Cambridge, Oxford and Imperial. Further, the most recent metrics by Thomson Reuters Analytics show that citations of our research



(Fig. A) place us as one of the top programmes in the world and at the forefront for international collaborations (Fig.B). For comparison, our companion science Schools at St Andrews are shown in their positions for their respective disciplines. I am enormously proud of these achievements, which are testament to the commitment and dedication of my colleagues.

We have also had some personnel changes since the last Newsletter. Declining funding has resulted in GeoBus evolving into a largely web-based resource and Dr Jen Brooke, the educational coordinator of GeoBus, has taken on the additional role of Outreach, Impact and Recruitment Officer. Feel free to contact Jen directly for further information about these aspects. (See article below).

Jonathan Cloutier and his family have moved to Hobart where he has been employed in the Centre for Ore Deposits and Earth Sciences at the University of Tasmania, and we give them our best wishes for a successful and happy life Down Under. We have been given the green light to fill the position Jonathan left and, as I type, we are in the process of recruiting and I hope to be writing to you about our newest colleague in the next Newsletter.

This is a nice segue to inform you that our newest colleague, Dr Michael Byrne, along with his wife, Gemma, and their 5-month-old twins, Mattie and Aibhín, will be joining us full-time come September. We are excited about Michael bringing his climate modelling expertise to the School and look forward to enhancing our Global Change and Earth Surface Processes research areas, as well as our curriculum in the crucial area of climate change.

All-in-all, I think you will agree that we have started the New Year well. Until next time,

Cheers,

STAFF NEWS

Last July, ***Claire Cousins*** was elected into the Royal Society of Edinburgh's Young Academy of Scotland.

James Rae was awarded a €2m grant to reconstruct CO_2 and climate change over the last 100 million years of Earth's history. James will use the ERC Starting Grant to examine the fundamental mechanisms governing Earth's environmental evolution and improve current predictions of how the environment will response to future changes in carbon dioxide levels. Carbon dioxide exerts a major control on Earth's environment, including ocean acidity and global climate. Human carbon emissions have elevated carbon dioxide levels to levels substantially higher than at any time in the last the 800,000 years.
James said: "If we want to understand how Earth's environment and climate will respond to a high carbon dioxide world, we need to look deeper into the geological past."

Hearty congratulations are due to ***Sarah Rugheimer*** who, last July, won the Caroline Herschel Lectureship Prize of the William Herschel Society and the Royal Astronomical Society. It is awarded to early-career researchers for achievements in astronomy-related research and/or instrumentation and/or communication and/or teaching. As part of the Prize, Sarah gave a Lecture at the University of Bath in November as a part of the prestigious William Herschel Society Astronomy Lectures Series and at an RAS Public Lecture in London.

Nicky Allison and ***Adrian Finch*** got their **NERC** grant funded: *Trace element and isotope partitioning in carbonates in simulated biological environments.*

Three cheers to ***Rob Wilson*** as part of a successful consortium (Cambridge, Edinburgh, Leeds, StAndrews) funded by **NERC** to address: *Reconciling volcanic forcing and climate records throughout the last millennium (Vol-Clim).*

Fernando Gasquez published a paper last August in *Science* confirming the Maya civilisation collapse was drought-related. In even more exciting news for him, he recently got an offer he could not refuse - his dream job! Starting November 1, Fernando took up a 3-year fellowship leading to a permanent position at the University of Almería in his home town in Spain.

Tim Raub successfully obtained and retained support from the Global Challenges Research Fund for his work in leading the project focussing on Understanding Drought Cycles Across South-Central Africa: Impact on Integrated Renewable Energy Strategies.

Will McCarthy and his wife Kate had a baby girl! Skye was born on Monday 27 August. All are doing well.

In September 2018, ***Rob Wilson*** had a prime slot on the BBC. As many of you know, Rob's work was the focus of a BBC film crew a month or so ago and he's made it onto the Breakfast Show. This is great publicity for the School.

https://drive.google.com/file/d/1Ah-Nrsk1oAiwUF91IFOh 33RAmWV4nXw/view?usp=sharing

Sarah Rugheimer left SEES in September 2018 to join the Physics Department, University of Cambridge, to take up the prestigious Glasstone Fellowship.

James Rae

A team of scientists, led by the University of St Andrews, has shown that rapid CO_2 release from the ocean around Antarctica helped end the last ice age.

The findings published in *Nature* (25 October 2018), found that CO_2 was stored in the deep Southern Ocean during the last ice age and then released into the atmosphere as the ice age ended, linked to pulses of rapid climate change and melting sea ice.

The new study, led by ***Dr James Rae*** from SEES, provides crucial evidence of the processes that controlled CO_2 and climate during ice ages. Although scientists have long-known that CO_2 rise helped end the last ice age, its cause has remained a mystery.

Lead researcher Dr Rae said: "Many scientists suspected that the ocean round Antarctica was responsible for changing CO_2 levels during ice ages, but there's not previously been data that directly proved this."

Using samples of fossil deep sea corals, brought up from 1000 metres below the sea surface, Dr Rae and his team made chemical measurements that allowed them to reconstruct the CO_2 content of the deep ocean. The researchers found that the deep ocean CO_2 record was the "mirror image" of CO_2 in the atmosphere, with the ocean storing CO_2 during an ice age and releasing it back to the atmosphere during deglaciation.

"CO_2 rise during the last ice age occurs in a series of steps and jumps associated with intervals of rapid climate change," explained Professor Laura Robinson from the University of Bristol, who collected the samples from the Southern Ocean. "Deep sea corals capture information about these climate changes in the chemistry of their skeletons but are hard to find."

DOI (dx.doi.org/10.1038/s41586-018-0614-0

Will Gray left SEES in November to take up an academic position at **LSCE** in Paris.

Images Of Research

In November, **StAnd Engaged** organised a display at the Byre Theatre entitled Research Image Gallery featuring St Andrews researchers in action. Four entries featured staff from SEES: Adrian Finch in Greenland, Richard Batchelor pointing out tuff beds at Dunkeld, GeoBus running a climate change activity and Nicky Horsburgh in the Mojave Desert in California visiting a Rare Earth Element mine.

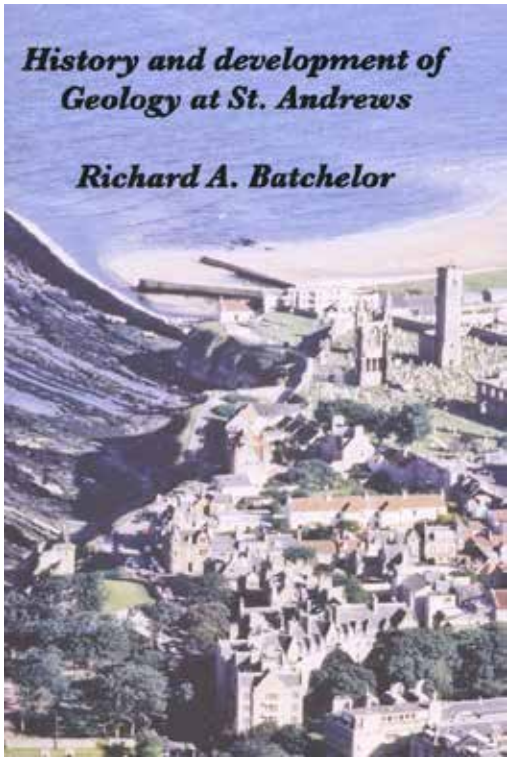
School of Earth and Environmental Science researcher ***Adrian Finch*** is seen here in Greenland, as part of an exploration geology project looking for critical metal resources (rare earths are used in a range of modern technologies, niobium is used in superalloys for building jet engines and tantalum is used used in electronic equipment, including mobile phones).

GeoBus shared activities developed with climate scientists at the University of St Andrews to show the effects of Climate Change at an event at Glasgow Science centre. The project created teaching resources as well as science-centre and school activities, and focussed on the importance of introducing young people to the science behind Climate Change – but also on helping them discover potential solutions and encouraging them to play an active role in shaping the future of our planet.

School of Earth and Environmental Science researcher ***Nicky Horsburgh*** is seen here on a Society of Economic Geologists trip to the Mojave Desert, visiting Mountain Pass rare earth mine in California. Rare Earth Elements are ubiquitous in modern technologies, including computers, low energy lighting, energy storage devices and large wind turbines, making their supply vital to our ever growing technological society and the development of a low carbon economy.

Honorary Research Fellow, ***Richard Batchelor***, is here seen pointing to 600 million year old volcanic ash layers which he discovered in the Southern Highlands of Scotland near Dunkeld.

Richard Batchelor published a book entitled ***"History and Development of Geology at St Andrews*** in December 2018. Printing of the book was grant-funded by The Russell Trust. Copies are available free to alumni, but postage and package costs of £3 (€4) should be sent to Richard at the SEES address.



Jonathan Cloutier accepted a research position at the Centre for Ore Deposit and Earth Sciences (CODES), University of Tasmania. He will be starting his new position on February 2019. The position will focus on conducting research on sediment-hosted ore deposits of NE Australia.

Richard Bates featured on a Channel 4 documentary *Operation Iceberg*, in December as a member of a team studying the dynamics of a large iceberg in the Arctic.

We welcome ***Celeste Kellock*** who has started as a research assistant to work on the Leverhulme-funded project *Biomineralisation in coral* with ***Nicky Allison.***

Celeste in Svalbard

In mid-January 2019, two members of SEES celebrated their birthdays, 120 years combined. ***Colin Mettam*** (PhD 2018) turned 50 and ***Richard Batchelor*** (Honorary Research Fellow and Editor of this Newsletter) reached 70. The Miller Club held a special event to celebrate the double (120) whammy.

Richard Batchelor (third from left) and Colin Mettam on the right (seated)

POSTGRADUATE NEWS

Congratulations to ***Ben Taylor*** for defending his PhD thesis in November entitled *The North Pacific from glacial to modern: assemblages, isotopes, and CO_2*

Robert Campbell Postgraduate Prize 2018

Congratulations to ***Simon Jones*** who has been awarded this year's Robert Campbell Postgraduate Prize. The citation states that the prize was awarded in recognition of Simon's "outstanding progress in academic research and active engagement with the mineral resource industry". Also recognised were his contributions to undergraduate and taught postgraduates though lectures, laboratory demonstrating, field courses and career networking.

Rob Campbell was a final year research student in DEES when he died in August 2013. This award for research postgraduates in the Department was established in his memory. Previous winners are Sebastian Fischer (2014), Cristina Evans (2015), Colin Mettam (2016) and Jess Crumpton-Banks (2017). Rob was awarded a PhD posthumously in 2014 and is commemorated by an oak tree and bench in front of Andrew Melville Hall placed there as a mark of gratitude and respect by the Andrew Melville students he cared for while serving as an assistant warden.

On receiving the award Simon provided us with a summary of his recent research activities:

> My research investigates the fluid flow regime which formed the 1.1 Ga White Pine sediment-hosted copper deposit in the Midcontinent Rift System, Michigan, USA. This style of deposit is formed by large volumes of formation water leaching metals from permeable oxidised sandstones and precipitating them upon contact with reduced rocks or fluids. I have employed a variety of techniques including field mapping, petrography, stable isotopes, geochronology and geochemistry to elucidate the timing of fluid movement and ore formation, the origin and chemistry of the fluids, the scale of these fluid systems and the drivers of fluid flow. The findings suggest the fluid was derived from seawater and its migration was driven primarily by burial compaction during diagenesis. Ore deposits formed on the flanks of the basin in petroleum trap-like structures.
>
> My project is funded by my previous employer, First Quantum Minerals, who, through active involvement in research such as mine, hope to improve the success rate of their mineral exploration programs. Logistical support in Michigan was provided by Highland Copper and isotope and geochronology studies have been funded by NERC.

In the photograph Simon is being presented with the award by Professor Tony Prave, Head of School.

Many congratulations Simon.

Colin Mettam (PhD 2018) was offered a post-doc position at UCL which he took up in January. We wish him well in his new career. He will be researching carbon and nitrogen isotopic systems in northern China that archive the evolution of some of the oldest known metazoans.

UNDERGRADUATE NEWS

Two of the top students from the MSc Geochemistry graduating class last year have taken up jobs as research assistants: ***Emma Robertson*** for the water chemistry aspects of the Geobiology Lab, and ***Helen Innes*** for the STAIG labs.

Stella Linnekogel has been awarded the **Tupper Prize of the Geologists' Association** for the best undergraduate student of geology at a UK university.
Good news indeed and well done to Stella!

The student Geological Society held a social event on 12 September 2018.

ALUMNUS NEWS

Jim Westland (BSc 1980) visited St Andrews in August 2018 and met up with ***Richard Batchelor*** and ***Rosalind Garton*** (BSc 1978). Jim lives on the Isle of Mull and works as an IT consultant but still keeps his hand in with the local geology. He and Richard discussed aspects of the geology of Mull and Iona. Some years ago he assisted Rosalind on one of her summer courses on Mull.
Jim sent us his mini biography.

Richard and Jim in a local hostelry in St Andrews.

"After graduating from St Andrews in 1980 I worked offshore in mud logging and MWD for 6 years until getting made redundant in the oil price crash of 1986. I went to the Gaelic College in Skye to study Gaelic, Business Studies and IT (having got sucked into IT when I was offshore). I worked in IT in Skye until 1991. I actually met my wife at the Gaelic College but we didn't get married until 1998 when we came to Mull. My wife is Mull born and bred so it was a home-coming for her, the good life for me... Since then I have taken an active role in promoting the geology of the island in addition to being a self-employed IT geek. I run geology walks both for myself and on behalf of others and am always available to assist researchers and students who may be visiting the island. I have a website *www.mullgeology.net* and am fairly active on social media and involved with the local Geodiversity group for Argyll and the Islands. Also do regular interviews and short pieces for Gaelic TV (BBC Alba). In 2014 I graduated with an MSc by research from Glasgow University having spent the previous few years looking at ultramafic rocks in south east Mull. Currently working on a couple of papers I am hoping to have published next year (2019) and hoping to present my MSc research at the VMSG Conference which is at St Andrews in 2019."

GEOBUS NEWS

As many of you are already aware, unfortunately our funding situation has become unsustainable over recent years. As a result, we're sorry to say that **GeoBus** will no longer be able to operate across our wide network of schools.

Dr Jen Brooke

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Over the last six and half years, **GeoBus** is proud to have worked with more than 70,000 pupils across Scotland, delivering workshops on everything from volcanoes to climate change to Mars. Thanks to financial support from a number of different avenues, we have been able to operate as a team of three full-time staff, providing free of charge school visits across the country. Unfortunately, over the last couple of years it has become increasingly difficult to source sufficient funding and provide job security for the whole team. We have explored many different funding possibilities – including introducing a charge for schools – but have been unable to find a viable long term solution. We are extremely saddened to announce that **GeoBus** will no longer be able to operate in schools to the extent it has done previously. As such, as has been the case since August, it will not currently be possible to make any new GeoBus bookings.

We'd like to sincerely thank all of those who have been involved with the project over the years; the researchers who have helped us to develop new resources, the volunteers who have got involved with delivery and created videos for us, the organisations who have provided sponsorship, the wonderful teachers who we've had the pleasure of working with, and the pupils who have inspired us to overcome the challenges and work hard to bring activities and resources to classrooms across Scotland.

We will make all of our teaching resources freely available on our website (*geobus.st-andrews.ac.uk*) and in time, **GeoBus** will be able to provide technical kit for schools to borrow. The **GeoBus** email address will still be active so that support can be provided for anyone choosing to use these.

The School of Earth and Environmental Science, University of St Andrews, has been extremely supportive of **GeoBus** over the years, and will continue to support the delivery of earth science topics in schools by hosting **GeoBus** activities and resources into the future. As always, we are interested in hearing from any organisations who would like to get involved to facilitate these efforts.

SPECIAL FEATURE

Extra-terrestrial research at St Andrews

The recent announcement by the James Hutton Institute in Aberdeen that soils on Mars show a strong resemblance to those from the islands of Skye and Mull[1], reminded me (the Editor) that geologists from the University of St Andrews had already worked on rocks from Skye that were similar to rocks brought back from the Moon by the Apollo 12 mission.

In the early 1970's, Professor Harald Drever and Mr Bob Johnston of the Department of Geology were invited by NASA to study lunar rocks. Precious samples arrived in St Andrews and I and other colleagues personally viewed them. Since the Moon has no atmosphere, the lunar rocks were pristine, free from the weathering effects on rocks by the Earth's atmosphere. It was an exciting time. The key feature of the Skye and Moon rocks was the way that the mineral olivine (an iron and magnesium silicate) sometimes grew in a "skeletal" form, rather than as a regular solid crystal. Technician Norman Spittal used to complain about the challenges of making large thin sections which Drever liked. By comparing the lunar samples with olivines from Skye, Drever and Johnston[2,3] were able to interpret the conditions in which the lunar rocks formed. Drever's postgraduate student, alumnus

Colin Donaldson (BSc 1972, PhD 1975), carried out experimental work which showed that skeletal olivines formed by rapid cooling[4].

Thus, the Isle of Skye has again provided examples of rocks and soils found elsewhere in the Solar System. However, when one considers that lunar and Martian rocks are mostly basalts, it is no surprise that Skye and

Mull should provide analogues for extra-terrestrial bodies. Substantial areas of the two islands are covered with basalt and related rocks erupted as the Atlantic Ocean began to crack open around 60 million years ago.

Research of extra-terrestrial bodies continues in the School of Earth & Environmental Sciences today. At the time of writing, current members of staff ***Claire Cousins*** and post-doc ***Elyse Allender,*** are involved in developing instrumentation to analyse Martian soils for the forthcoming Exo-Mars 2020 mission, and four other colleagues, ***Mark Claire, Paul Savage, Aubrey Zerkle*** and Sami Mikhail are researching various aspects of exoplanets' evolution and atmospheres.

Skye olivine

Harald Drever (standing, left), with students in the Cuillins, Skye, 1960's

References

1. https://www.hutton.ac.uk/news/mars-and-mull-share-similar-soil-hutton-analysis-finds

2. Drever, H.I. & Johnston, R. 1957. Crystal growth of forsteritic olivine in magmas and melts. Transactions of the Royal Society of Edinburgh, 63, pt.2, 289-314.

3. Drever, H.I., Johnston, R., Butler, P. & Gibb, F.G.F. 1977. Some textures in Apollo 12 lunar igneous rocks and in some terrestrial analogs. Proceedings of the Lunar Science Conference, 3, 171-184.

4. Donaldson, C.H., Drever, H.I. & Johnston, R. 1977. Supercooling on the lunar surface: a review of analogue information. Philosophical Transactions of the Royal Society of London A285, 207-217.

Lunar olivine

Bob Johnston at his retirement

Well, what do you know?

JAMES HUTTON,
CABINETMAKER, UPHOLSTERER, & HOUSE AGENT,
125 SOUTH STREET,
St Andrews.

How little did we know - spotted in the Fife News Almanac 1881. A family connection or a case of reincarnation?
Courtesy of the University of St Andrews Library (rper DA.880.F4A7 Vol. 9 1881).

125 South Street today.

USEFUL LINKS

http://earthsci.st-andrews.ac.uk

https://www.facebook.com/standrewsgeologyalumni

http://soi.st-andrews.ac.uk

http://www.geobus.org.uk

https://www.st-andrews.ac.uk/development/alumni

http://www.st-andrews.ac.uk/development/alumni/reconnecting

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We are always interested to receive news from our alumni which we are pleased to publish in the Newsletter and the SEES website.

Front cover picture: A river channel preserved in Lower Carboniferous sediments, Roome Bay, Crail, Fife. (R.E Garton)

Eden Estuary seen from the air (R.E. Garton & J.A.F. Allan)

This roller banner was produced by geoHeritage Fife and funded by the Scottish Geodiversity Forum. It shows and explains the variety of geological features in Fife. The roller banner is available on loan to schools and colleges.