



**NEWSLETTER**  
**Number 9**  
**January 2016**



## STAFF NEWS

The Department welcomes **Dan Nita** as a Research Officer working in new clean isotope geochemistry laboratories (with **Andrea Burke** and **James Rae**). He got his PhD from “Babeş-Bolyai” University, Cluj-Napoca, Romania, working on uranium ores and radon remediation. After his PhD, he was hired by the University of Bristol to work on ultra-high-precision U-series dating of young carbonates, in particular on cave deposits and stalagmites. He joined DEES in September 2015.

**Kathryn Moore**, BA (Chemistry), Colby College, USA, researched the role of halogenated species in the sea surface microlayer on ozone deposition rates to the surface ocean. Then followed a year and a half at UCSD/Scripps in San Diego, CA, studying the chemical and physical factors controlling sea spray aerosol production, as well as the transformations they undergo in the marine boundary layer following entrainment. Here at St. Andrews she will be working with **Andrea Burke** and **James Rae** on isotopic measurements of B and S to constrain which volcanic eruptions released particulates into the stratosphere.

**Tim Hill** got married last June and took up a post in Exeter University starting in November.

**Harry Oduru** has left the department to pursue more applied aspects of stable isotope geochemistry and is now working for Saudi-Aramco, based in Saudi Arabia. His legacy at St Andrews is a world-class laboratory facility capable of analysing 4 sulphur isotopes.

**James Rae** is co-Investigator on a successful NERC grant with Bristol entitled “*Bridging the timing gap: connecting Southern Ocean and Antarctic Climate records*”. PI Laura Robinson (Bristol); Co-I James Rae (St Andrews);

Co-I Tina Van der Fliert (Imperial College, London). This will fund analyses in our new isotope geochemistry clean labs and includes technician time and a shared PDRA with Bristol.

**Claire Cousins** was awarded a 36 month Leverhulme Trust Research Project Grant. The project is entitled “*Looking for life in the UV: fluorescence as a tool for planetary exploration*” and will investigate how UV luminescence imaging and spectroscopy can be used to detect organic material preserved within minerals relevant to Mars exploration (salts, sulphates, clays, etc). **Adrian Finch** is co-Investigator.

**Ruth Hindshaw** has moved to Cambridge. She will be finishing the last few months of her Marie Curie fellowship there and then starting as a NERC PDRA with Ed Tipper and Nick Tosca (both former St Andrews staff).

**Adrian Finch** is part of a Horizon 2020 bid with Camborne that has been successful for a grant entitled: HiTech AlkCarb “*New models to explore deeper for high-technology critical raw materials in alkaline rocks and carbonatites*”. The project overall is worth €5.4M (£3.6M) of which Adrian’s component is €0.37M (£0.26M).

**Nicky Allison** has been awarded a £170k research project grant from The Leverhulme Trust to employ a postdoc for 3 years to investigate the control of coral biomineralisation. How corals form mineral skeletons, which serve as the building blocks of coral reefs, is poorly understood. Three key factors are implicated in the control of biomineralisation, namely the dissolved inorganic carbon and magnesium chemistry of the fluid used for coral calcification and the presence of skeletal organic materials which act as templates for crystallisation. This project will resolve how each of these factors

influences aragonite crystallisation and will determine how they interact to control biomineralisation.



*Labelling, cataloguing and photographing*

### **Museum Internships**

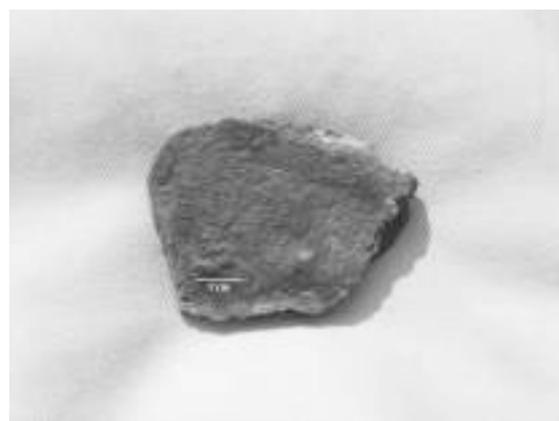
In the summer of 2015 a collaboration with the Museum of the University of St Andrews (MUSA) gained University Summer Internship funding for 2 undergraduates to carry out urgently needed cataloguing work on the Geological Collection under the guidance of **Stuart Allison**. Gemma Broomhead and Charlotte Gordon spent 6 weeks working on the mineral collection along with gallery and front of house duties at MUSA. They also worked with the learning and access team to produce workshops for children to explain geological processes and fossilisation and led a family geology walk to the Kinkell Braes and Rock and Spindle. The data from the cataloguing process feeds into a central university museum database which will be going online sometime in the future. Many thanks to Helen Rawson of the Museum Collections Unit for initiating the project and securing the funding.



*Guided walk to the Rock and Spindle*

### **RESEARCH NEWS**

**Richard Batchelor** has had a paper accepted by the *Scottish Journal of Geology* which describes the first recorded occurrence of microbial wrinkle texture in Lower Devonian sediments in Scotland. A shale horizon at Wormit, NE Fife, has yielded a distinctive puckered surface that is interpreted as the product of microbial mats on a soft sediment substrate. This assemblage reflects a shallow water lacustrine or sub-tidal environment.



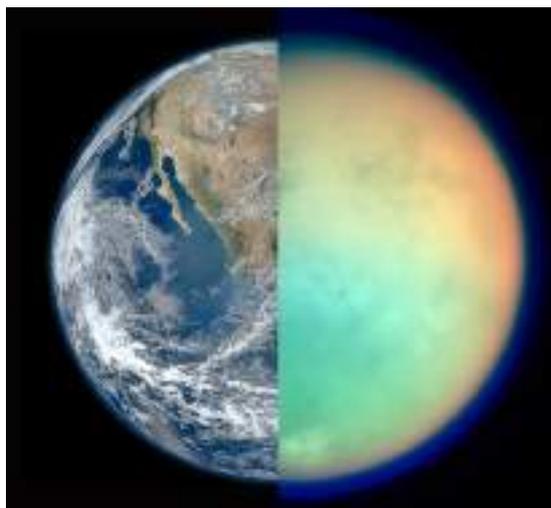
*Microbial wrinkle texture, Wormit, Fife*

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### **Geobiology Group Publications**

**Izon G, Zerkle AL, Zhelezhinskaya Y, Farquhar J, Newton RJ, Poulton SW, Eigenbrode JL, and Claire MW (2015)** Multiple oscillations in Neoproterozoic

atmospheric chemistry: *Earth & Planetary Science Letters* **431**, 264-273.



*New research from the Geobiology group hindcasts a hazy atmosphere for the Late Archean Earth, similar to Saturn's moon Titan. Photo credit: National Geographic*

The Great Oxidation Event (GOE) represents a crucial juncture in Earth history, signifying the rise in atmospheric oxygen from parts per million to percent levels at ~2.45–2.32 billion-years-ago (Ga). Although planetary oxygenation undoubtedly led to the inception of the contemporary Earth system, the trigger(s) and mechanism(s) controlling this chemical reorganisation remain elusive. Quantitative estimates of the atmosphere's composition in the prelude to the GOE are central to understanding this oxygenation event. Previous analyses of 2.65–2.5 Ga sediments from the Griqualand Basin (South Africa) invoke a tantalising picture of an unusual Earth environment, alluding to an atmosphere periodically dominated by a layer of organic particles (“haze”) formed from methane photolysis. However, as yet this hypothesis has remained untested. Here we present four new coupled carbon and quadruple sulphur isotope records from distal, time equivalent (2.7–2.5 Ga), sedimentary successions from South Africa and Western Australia. These extended records reveal similar chemostratigraphic trends, supporting a dynamic terminal-Neoproterozoic atmosphere, oscillating between a hazy state at elevated methane concentrations, and a haze-free anoxic background state. We suggest these atmospheric aberrations were related to heightened biogenic methane fluxes fuelled by enhanced nutrient delivery from climatically or weathering induced feedbacks. These data question the canonical view of a simple, unidirectional planetary oxygenation and signify that the overture to the GOE was

governed by complex feedbacks within the Earth–biosphere system

Lyons TW, Fike DA, **Zerkle A** (2015) Emerging biogeochemical views of Earth's ancient microbial worlds: *Elements Special Issue: Geomicrobiology and Microbial Geochemistry* **11** (6).

Microbial processes dominate geochemical cycles at and near the Earth's surface today. Their role was even greater in the past, with microbes being the dominant life form for the first 90% of Earth's history. Most of their metabolic pathways originated billions of years ago as both causes and effects of environmental changes of the highest order, such as the first accumulation of oxygen in the oceans and atmosphere. Microbial processes leave behind diverse geochemical fingerprints that can remain intact for billions of years. These rock-bound signatures are now steering our understanding of how life coevolved with the environments on early Earth and are guiding our search for life elsewhere in the universe.

**Zerkle AL**, Jones DS, Farquhar J, and Macalady JL (2015) Sulfur isotope values in the sulfidic Frasassi cave system, central Italy: A case study of a chemotrophic S-based ecosystem: *Geochimica et Cosmochimica Acta*, [doi:10.1016/j.gca.2015.10.028](https://doi.org/10.1016/j.gca.2015.10.028).



*Aubrey Zerkle sampling subterranean microbial communities in sulfidic cave waters in Italy.*

Sulfide oxidation forms a critical step in the global sulfur cycle, although this process is notoriously difficult to constrain due to the multiple pathways and highly reactive intermediates involved. Multiple sulfur isotopes ( $\delta^{34}\text{S}$  and  $\Delta^{33}\text{S}$ ) can provide a powerful tool for unravelling sulfur

cycling processes in modern (and ancient) environments, although they have had limited application to systems with well-resolved oxidative S cycling. In this study, we report the major ( $\delta^{34}\text{S}$ ) and minor ( $\Delta^{33}\text{S}$ ) isotope values of sulfur compounds in streams and sediments from the sulfidic Frasassi cave system, Marche Region, Italy. These microaerophilic cave streams host prominent white biofilms dominated by chemolithotrophic organisms that oxidize sulfide to  $\text{S}^0$ , allowing us to estimate S isotope fractionations associated with *in situ* sulfide oxidation and to evaluate any resulting isotope biosignatures. Our results demonstrate that chemolithotrophic sulfide oxidation produces  $^{34}\text{S}$  enrichments in the  $\text{S}^0$  products that are larger than those previously measured in laboratory experiments, with  $^{34}\epsilon_{\text{S}^0\text{-H}_2\text{S}}$  of up to 8‰ calculated. These small reverse isotope effects are similar to those produced during phototrophic sulfide oxidation ( $\leq 7\%$ ), but distinct from the small normal isotope effects previously calculated for abiotic oxidation of sulfide with  $\text{O}_2$  ( $\sim 5\%$ ). An inverse correlation between the magnitude of  $^{34}\epsilon_{\text{S}^0\text{-H}_2\text{S}}$  effects and sulfide availability, along with substantial differences in  $\Delta^{33}\text{S}$ , both support complex sulfide oxidation pathways and intracellular recycling of S intermediates by organisms inhabiting the biofilms. At the ecosystem level, we calculate fractionations of less than 40‰ between sulfide and sulfate in the water column and in the sediments. These fractionations are smaller than those typically calculated for systems dominated by sulfate reduction ( $> 50\%$ ), and contrast with the commonly held assumption that oxidative recycling of sulfide generally increases overall fractionations. The relatively small fractionations appear to be related to the sequestration of  $\text{S}^0$  in the biofilms (either intra- or extra-cellularly), which removes this intermediate substrate from fractionation by further disproportionation or oxidation reactions. In addition, the net  $^{33}\lambda_{\text{H}_2\text{S}\text{-SO}_4}$  values calculated in this system are larger than data published for systems dominated by reductive sulfur cycling, partially due to the isotopic imprint of chemolithotrophic sulfide oxidation on the aqueous sulfide pool. These distinct isotopic relationships are retained in the sedimentary sulfur pool, suggesting that trends in  $^{34}\text{S}$  and  $^{33}\text{S}$  isotope values could provide an isotopic fingerprint of such chemolithotrophic ecosystems in modern and ancient environments.

### **Presentations from the Goldschmidt Geochemistry Conference, Prague, Czech Republic (August 2015)**

**Claire M** (2015) Minor Sulfur Isotope Constraints on the Composition of Earth's Archean Atmosphere: *Goldschmidt Abstracts* **562**

**Izon G, Zerkle A**, Farquhar J, Williford K, Poulton S & **Claire M** (2015) Clarifying the Haze: Biological Control as an Atmospheric Primer to the GOE?: *Goldschmidt Abstracts* **1401**

**Üpraus K**, Lepland A, **Zerkle A**, Oduro H, Patel N, McLean F, Kreitsmann T, Kirsimäe K, Wing B, Bui TH, Martma T, Romashkin A & Rychanchik D (2015) Origin of 2.0 Ga Phosphorites and Associated Carbon and Sulphur Isotope Anomalies, Zaonega Formation, NW Russia: *Goldschmidt Abstracts* **3211**

**Yang J**, Barling J & Halliday A (2015) Molybdenum Isotopic Fractionation in Clastic Sediments: *Goldschmidt Abstracts* **3502**

**Zerkle A** (2015) **Keynote:** Stable Isotope Geomicrobiology – Modern Microbes and their Ancient Implications: *Goldschmidt Abstracts* **3574**

### **Geobiology Group activities**

**Colin Mettam** visited Svalbard last summer to obtain Permian-Triassic samples for his thesis work exploring nitrogen isotopes during key transitions in Earth's history. He has also been appointed as a visiting researcher at National History Museum in London, where he is working with Professor Richard Twitchett (see later article).

**Colin Mettam** and **Jie Yang** went to East Kilbride in January to build a nano-Elemental Analyzer prep. line, enabling nitrogen isotope measurements on samples with very small amounts of organic matter.

**Mark Claire** received a £1.3M grant from the European Research Council to quantify the evolution of Earth's atmosphere. This 5 year project will involve experiments, field work, and numerical modelling to better interpret clues in the sedimentary oxygen and sulfur isotope records. In addition to 4 new postdocs and PhD students, the grant will enable the department to better quantify (even more!) isotopes via the purchase of a Cavity Ringdown spectrometer.

**Richard Bates** travelled to Iran this year to carry out geophysical studies on the drowned “Red Snake” – The Sasanian Persian Empire’s Great Walls.

A couple of years ago Prof. Eberhard Sauer (Edinburgh University) got in touch as he has had a 10yr project investigating the “Red Snake” of Persia. This is better known as the Gorgan Wall that once ran near the border of Iran and Turkmenistan from the Caspian Sea in the west and the Elburz Mountains in the west.

At a known length of over 195km it was pretty significant as an ancient line of defence. However, today it is almost invisible in the present landscape to the non-archaeologist. The problem with the wall is that it was constructed of mud bricks and so the ravages of time and the deconstruction (robbing) of bricks means that it is often difficult to see today. However there is a silver lining, or at least a geophysical signature silver lining, that results from the use of bricks, because the firing process can give the bricks a strong magnetic signature.



*6th – 5th C kiln*

195km of wall requires many bricks – an estimated over 200 million were used! Making these bricks was achieved using temporary field kilns set up all along the path of the wall at approximately 50m intervals. The wall was garrisoned by an army of over 20,000 soldiers barracked in at least 30 forts. Eberhard’s team have spent the last few years excavating some of these kilns together with some of the forts and sections of the wall itself. They have also investigated a sister wall, the

Tammisheh Wall that ran from the southeast corner of the Caspian south to the Elburz Mountains. Through <sup>14</sup>C and OSL (Optically Simulated Luminescence) dating, their work puts a construction date on both walls to the Sasanian Persian Empire between the 5<sup>th</sup> and 6<sup>th</sup> Century AD.

So what am I doing here? The western extent of both walls is unknown. Historical writing describes how the walls enter the Caspian Sea and certainly the Tammisheh Wall can be traced almost to the modern shoreline but where it goes after that is unknown. Some descriptions even suggest that both walls were joined up. So we are back again to our old problem of changing sea levels and with it the usual battering that this can give to the landscape and our human endeavours.



So I am here to help the search for the walls, both on the sea floor and beneath it if they have been covered by more recent sediments. We were looking for upstanding bricks or a scattering of bricks on the seafloor with the hope they would not have disintegrated. Beneath the seafloor the hope was again to find lines of bricks or mounds. Perhaps we would also see the cross –section of the trench that ran along the wall. With the magnetic signature associated with the kilns on land this might stand out too but for this first preliminary survey I chose to use the Tritech Seaking Parametric Sub-bottom Sonar that we have found so effective in the shallow waters of Orkney together with an ultrahigh resolution Tritech Starfish 990kHz Sidescan Sonar. A great

advantage of both these systems is that they can be taken as hand luggage on flights!

We started with the Tammisheh Wall as the projection into the Caspian is better known. The parametric sonar proved worthwhile once again despite the occasional gas blanking by picking out a strong reflection from the brick scatter on the sea floor. The signature of this continued as it became buried further offshore with up to 2m of sediment. After approximately 3km it abruptly disappeared or terminated. The scatter on the sea floor was also mapped with the sidescan sonars from which the surface brick scatter was readily identified together with a number of linear features. Given the time available for this trip and the relatively sparse knowledge on where the Gorgan Wall might be crossing the shore line we had a much larger potential target area to cover. With a few days of poor weather (yes, the Caspian Sea can get rough with over a 1m wave and swell heights) we covered a large area but without finding any definitive wall signatures. So more and better targeted data acquisition is needed for the marine side here. I now propose to return and try with a magnetometer and an electromagnetic ground conductivity meter to survey from the last known western point of the wall across the land and shallow lagoons to the shore. If we can trace this then we stand a much better chance of mapping it offshore, if that is where it goes.

I had a fantastic crew with me on the water (I cannot thank Hamid, Bardia and Hassan enough) and also back in the base as Eberhard and his co-project leader in Iran, Dr Jebrael Nokandeh of the National Museum of Iran have assembled a talented team of archaeologists for the project.

It was a privilege to work with some great people, with such friendly banter, engaging conversation, fantastic archaeological potential, some great food and wonderful scenery – the bird life on

the Caspian is stunning! I can't wait to return next summer to continue the hunt.



*Bird life on the Caspian Sea*

### **New Laboratory opens**

The St Andrews isotope Geochemistry Laboratory (STAiG lab) is having a “clean lab” opening party on March 4, 2016 from 13.30 – 17.00 in the Purdie Building. The three PIs of the clean laboratory suite (**Andrea Burke, James Rae, and Paul Savage**) will be hosting an afternoon of talks and posters about isotopes and their application to Earth Science, as well as other fields such as medicine and biology. Prof. Alex Halliday, FRS (Oxford) is our keynote speaker and will be giving a talk on isotope geochemistry that will be suitable for a general audience.

## **POSTGRADUATE NEWS**

In October, Rob Wilson's PhD student **Milos Rydval** successfully defended his thesis entitled “Dendroclimatic Reconstruction of Late Holocene Summer Temperatures in the Scottish Highlands”.

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### **Locating new titanium-vanadium deposits in Greenland**

Greenland is one of the last remaining resource-rich frontier regions. Recently **Joshua Hughes** was invited to participate in the Expert Panel for a three day Mineral Resource Assessment Workshop on the titanium-vanadium potential in Greenland which was held in Copenhagen in November 2015. The Expert Panel also included Dr Mike Zientek (USGS), Dr Tuomo Karinen (GTK) and Robert Campbell (Largo Resources), along with other academics and mining professionals,

each with specific knowledge on relevant aspects of Greenland geology or expertise in titanium-vanadium deposits.

In 2014, Joshua also participated as a member of the Expert Panel for an assessment of the orogenic gold potential in Greenland and presented on orogenic gold mineralisation hosted with Palaeoproterozoic granitoids belonging to the Julianehåb Batholith of South Greenland. Expert Panel members for this workshop included Professor Jochen Kolb (GEUS), Professor Pasi Eilu (GTK) and Professor Richard Golfarb (USGS).

Jointly hosted by the Government of Greenland's Ministry of Mineral Resources and the Geological Survey of Denmark and Greenland (GEUS), the Greenland "Mineral Resource Assessment Workshop" has become an annual event and feeds into the USGS Global Mineral Resource Assessment Program. Since 2009 the annual workshop has covered several commodities in Greenland, including copper, rare earth elements, zinc, nickel, tungsten, gold, and now titanium-vanadium. Mineral deposit models, along with compiled information on known deposits and examination of different geological provinces (including petrological, geochemical and geophysical data) were used by the Expert Panel to assess the potential for undiscovered mineral deposits, define prospective tracts for future mineral exploration and rank the most prospective tracts.

Joshua provided presentations on South East Greenland, an area in which he has previously led exploration programs as Chief Geologist of Greenland's national exploration company, NunaMinerals A/S. This focussed upon the potential of the Palaeoproterozoic Stendalen and Paatusoq layered mafic intrusions to host titanium-vanadium mineralisation. In 2013, Joshua and **Adrian Finch** were the first group ever to visit the Paatusoq gabbro (and neighbouring Mesoproterozoic syenite complex – the eastern-most intrusive centre of the Gardar Alkaline Igneous Province). Subsequent research by Adrian

Finch and his group on the critical metal potential of the Paatusoq syenite complex was fundamental to the development of a \$2 million USD Joint Venture Agreement between NunaMinerals A/S and Greenland Rare Earth Projects Ltd in August 2014. It has also led to two research dissertations within the department and a PhD currently being advertised through the NERC IAPETUS program.



*Joshua undertaking fieldwork at Paatusoq (S.E. Greenland)*

As part of his presentation on Paatusoq, Joshua presented litho-geochemical and petrological data from the thesis of Mark Stacey who graduated from the department in 2014 with a First Class MGeol degree.



*Spectacular rhythmic layering at the Paatusoq layered mafic intrusion (S.E. Greenland); layering is evident within the intrusion on the scale of 10's of centimetres to 10's of metres*

The results of the workshop will appear in a special edition of the GEUS publication "Geology and Ore" in early 2016, and in a formal report expected later in the year.

The resulting information will impact directly upon industry, academia and policy makers in Greenland, as well as highlighting gaps in our geological understanding which can be addressed through future field campaigns.

Joshua gratefully acknowledges DEES for covering the cost of flights and accommodation through a postgraduate conference grant.



*View of west face of Stendalen showing Ketilidian metasediments overlain by the Stendalen layered mafic intrusion with wide rust zone at the basal contact. The intrusion is divided into the relatively pale, lower layered mafic suite (LMS) and dark, upper homogeneous gabbro to diorite (HGD). A continuous Fe-Ti-V mineralised zone up to 20 metres thick occurs at the contact between the LMS and HGD.*

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### Colin Mettam visits Svalbard



*Base camp on Svalbard*

In July 2015 a party including me, Prof Richard Twitchett and Dr Will Foster (both Natural History Museum), flew to Longyearbyen on Svalbard in order to explore the outstanding late-Permian and early-Triassic sediments. We were

transferred from Longyearbyen by boat to the world-famous Festningen locality on the shores of Isfjorden where we would set up base camp for seven nights. This site is only some 10 kilometres west from the Russian mining town of Barentsburg, but contact with civilization would involve a 24-hour walk due to fjords and glaciers separating the two sites. We were fully prepared for encounters with polar bears having trip-wire alarms, a guard dog, flare guns, and rifles.



*Colin on the late-Permian extinction horizon*

I collected more than 60 samples at 10cm intervals spanning the late-Permian extinction horizon in the Kapp Starostin Formation and up into the Vardebukta Formation, which represents the earliest Triassic. This is the highest resolution sample set ever collected from this site and the geochemical analyses to be undertaken will provide new insights into the late-Permian extinction in Boreal seas. The section sampled was logged in detail in order to provide a lithological and environmental context, with particular note taken of trace fossils in order to provide comparisons with samples currently being analysed from East Greenland. The remainder of the expedition involved assisting Prof Twitchett and Dr Foster produce a detailed log of the lowermost Triassic in the Vardebukta Formation.

This work was funded by The Russell Trust and a DEES Small Grant Fund.

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## New students

Shortly after the start of the new academic year, three new PhD students joined DEES.

Jessica Crumpton-Banks: I did an MSci at the University of Bristol in Environmental Geoscience before starting my PhD at St Andrews with **Andrea Burke** and **James Rae**. My PhD project uses boron isotopes to investigate possible mechanisms in the Southern Ocean which could control atmospheric CO<sub>2</sub>.



*Jessica Crumpton-Banks*

Because Antarctic temperature and CO<sub>2</sub> are coupled over glacial-interglacial cycles, the Southern Ocean is thought to be a control on atmospheric CO<sub>2</sub>. The Southern Ocean acts as a "leak" of CO<sub>2</sub> to the atmosphere today, and it has been suggested that this leak was stemmed during ice ages, resulting in lower CO<sub>2</sub>. The mechanisms I am investigating are increased sea ice cover and enhanced surface stratification. I will be using boron isotopes, which are a proxy for pH - the two mechanisms are expected to show very different pH signatures.

Nicola Horsburgh: I completed my undergraduate study at St. Andrews University in 2009. Since graduating I have been working as an Engineering Geologist, specialising in landslide and rock fall mitigation. For my PhD I will be investigating Laser and X-Ray Luminescence of REE ore minerals,

supervised by **Adrian Finch**, Professor Animesh Jha and Professor Frances Wall. This will involve investigating whether luminescence can fingerprint REE minerals and be adapted to develop 'smart' sorting methods.



*Nicola Horsburgh*

Vinicius Louro: I am a Brazilian, Star Wars and Game of Thrones lover, and not-so-good football player.



*Vinicius Louro*

I am a geophysicist starting the fourth and last year of my Co-tutelle PhD (Universidade de São Paulo/University of St. Andrews). I had worked with several geophysical methods (seismics, GPR, electro-resistivity and IP) in civil engineering during my undergraduate career. Since then I have specialized in

Potential Field Methods and gamma-ray spectrometry focused on mining, with a special focus on strategies to overcome remanent magnetization effects. For my PhD I chose to extrapolate the bounds of geophysics, adventuring in unknown waters (at least for me) of tectonics, geochemistry and isotopes. I seek to understand the tectonic evolution of the Mesoproterozoic Figueira Branca Mafic Suite in the Jauru Terrane (SW Amazon Craton), integrating geological, geophysical (magnetic, gravity and gamma rays), geochemical and isotope data.

### Conference attendance

**Jess Crumpton-Banks** and **Ben Taylor** attended the Postgraduate Research in Marine and Earth Science (PRIMES) conference in Cambridge (Nov. 2015) to present the work of their PhD projects. Although only 2 months into her PhD, Jess won the Best Poster prize for her contribution “*Using Boron isotopes to investigate Southern Ocean controls on glacial atmospheric CO<sub>2</sub>.*”

In July, **Batzi Fischer** presented his work at the Granulites & Granulites conference in Namibia and also attended an exciting post-conference field trip to the Damara belt in the Namib desert, looking at melt generation and the structural controls on melt migration through the crust. In August he also presented at the Goldschmidt conference in Prague. His attendance at Goldschmidt was partly funded by the DEES postgraduate conference fund.



Sebastian (Batzi) Fischer in Namibia

### School Postgraduates Football Club

This season our team managed to win the first two games. After that, we had a streak of bad luck, ending up with two of our players injured. It didn't look good and we were at the bottom of the league. The last game was against the league leader, who had won every game. But, thanks to brilliant tactics devised by captain Ben Taylor, our team managed a 4:3 win against a (admittedly short-handed) not-so-mighty-after-all opponent. This allowed us to come second last place, which surely qualifies as the improvement promised in the last newsletter.



*The assembly that managed the 3:3, missing those injured or unavailable. Clockwise, from back left: Batzi Fischer\*, William Hiles, Steve Owen, David McCollum, Ben Taylor\*, Vinicius Louro\*, Fabro Guamán-Guevara. Missing are Noor Saeed, William McCarthy\* and Sami Mikhail\* (\*DEES members)*



## UNDERGRADUATE NEWS

### Prizewinners

Prizes for various activities in DEES were awarded at a Friday Miller Club evening.



Back row: Prof. Peter Cawood, Amy Chambers, Kerr Barrack, Craig Martin, Jordy de Vries, Peter Stewart, Craig Walton, Blair Thomson

Front row: Lanita Gutieva, Kirsty Mackenzie, Roxana Shafiee, Jessica Chandler, Emily Madoff, Charlotte Gordon



*Nicollette Meyer at Eschaness, Shetland Islands*

**Nicolette Meyer**, 4<sup>th</sup> year BSc Geology student, has raised a total of £2700 to support her dissertation work, via personal research grants from the Geological Society of London Alan & Charlotte Welch Fund, the Palaeontological Association Undergraduate Research Grant, and the University of St Andrews Zannah Stephen Memorial Travel Scholarship. Nicolette's dissertation work, supervised by **Aubrey Zerkle** in the DEES Geobiology group, involves using multiple sulphur isotopes to examine S cycling in ~2.5 billion year old pyritized microbial mats preserved in South African drillcores. With this additional funding,

Nicolette was able to visit the lab of Dr David Fike at Washington University, US, to use the state of the art CAMECA IMS 7f-GEO SIMS facility to measure spatially resolved  $\delta^{34}\text{S}$  and  $\Delta^{33}\text{S}$  in these microbialite samples at the micron-scale. Her work will have important implications for understanding Archaean sulphur cycling and the role of microbial processes in shaping the Earth's surface chemistry leading up to the Great Oxidation Event.

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**Elena Field** was a Highly Commended Entrant in The Undergraduate Awards. Her paper performed in the top 10% of the 2015 programme, and she made the shortlist to be announced as one of the 50 Winners.

As a Highly Commended Entrant in The Undergraduate Awards, she was identified as an outstanding academic at the international level. This year, there were 5,117 submissions from students in 255 universities across 39 countries. Elena's paper, entitled "*A comparison of object-based vs pixel-based classification methods for geological mapping*" made it to the top 10% of all submissions in the Earth & Environmental Sciences category, representing the University of St Andrews, as assessed by a panel of academics from universities around the world. **Timothy Hill** was her supervisor.



*Elena Field*

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Two out of the 5 projects highlighted from last years "undergraduate research awards" from the Dean's office are from DEES:

## **Michael Van Mourik (Earth and Environmental Sciences)**

Mikey worked with ancient sediments collected from Greenland, which represent an exceptionally high-resolution record of ocean conditions during the world's greatest mass-extinction event. He prepared the samples for their chemical composition to be determined by XRF housed in DEES. He quantified the total amount of iron and aluminium in 30 samples. Mikey's iron data (the "FeT" of FeHR/FeT) provide key evidence of water-column oxygenation prior to the extinction event, with a transition to low-oxygen concentrations during the extinction event itself. His aluminium data suggest that the source of detrital sediment changed intermittently during the period studied, perhaps as a result of massive erosion and landslides after all the trees and plants abruptly died.

*Permian-Triassic mass extinction; geochemical record of Earth's greatest kill event (Mettam et al., in prep)*

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## **Louise Cameron (4<sup>th</sup> year Marine Biology student) and Emma Butler (2nd year Geology student)**

Louise and Emma worked on a project to investigate the impact of changes in atmospheric CO<sub>2</sub> on tropical reef building corals. This is a long term project, funded by NERC, in which they have cultured corals for over a year over a wide range of CO<sub>2</sub> atmospheres reflecting past conditions, e.g. the low atmospheric CO<sub>2</sub> concentrations found at the Last Glacial Maximum, and future high atmospheric CO<sub>2</sub> scenarios. They are examining how the change in CO<sub>2</sub> affects key metabolic processes in the coral, particularly photosynthesis and calcification. Both Louise and Emma worked in the coral culturing laboratory in DEES on aspects of aquarium husbandry.

The 2015 BSRG Award for Undergraduate Sedimentology, awarded annually to the best final-year undergraduate sedimentological project at a UK or Irish University, went to **Alex Rolland** for his project on "*Hummocky cross stratification and ancient storms.*"

## **ALUMNI NEWS**

### **Gordon Osinski (BSc 1999)**

Western University (London, Ontario) served as mission control for a Mars rover simulation exercise giving 35 undergraduate, graduate and post-doctoral students from across the country the chance to identify and collect rocks that could be found on the red planet, using state-of-the-art technology. "This is the most realistic such mission that anyone in Canada has ever done," said **Gordon Osinski**, Western Earth Sciences professor and director of the university's Centre for Planetary Science and Exploration.

"This is the next generation of space explorers getting a unique opportunity." The students - the majority from Western with a handful from the University of British Columbia, York University in Toronto and St. Mary's University in Halifax - are simulating a Mars sample-return mission, the new holy grail of space missions.

"The students are commanding a Mars rover in an environment that simulates the planet's environment - somewhere in Utah. They have to figure out which rock samples they want to collect and how to collect them", Osinski said.

"We have never returned samples from Mars. We have driven around Mars, but we've never come back. These students are thinking, 'What kind of instruments do you take? Why collect this sample, and not the next one?'"

Western is working with the Canadian

Space Agency and using its technology to take part in the simulated mission. Its findings will contribute to future missions to Mars. “The ultimate goal is for one of those students to be doing an actual mission on Mars one day,” Osinski said.

<http://www.lfpress.com/2015/11/17/western-university-serving-as-mission-control-for-mars-rover-exercise>

**Ann Murray (née McDonald)** (BSc 1998) visited DEES in mid-November to talk about her career in the oil service industry to a group of undergraduates. She was accompanied by her husband **Neil Murray** (BSc 1998), who also works in the oil industry. Ann said “Having been the Geol. Soc. secretary when I was a student, I know from experience that organising guest lecturers is like herding cats! On being informed that the Earth Science department was keen to hear from Alumni about what they have done with their lives since graduating, I thought that I had better help out.”

“After graduation I embarked on an MSc at Aberdeen University. On completion, I began work in the oil industry, specialising in the interpretation of borehole images and have remained there ever since. About 5 years ago I started up my own company consulting in the field of borehole images, core and petrography. I now have a couple of colleagues and thoroughly enjoy the flexibility of my work. I work globally and have interpreted data from most of the world’s reservoirs. There is never a dull moment and I have fortunately been kept busy since setting out on the venture and have never looked back.”

“It was lovely to visit the department again, albeit in a different building, and seeing some of the old faces (*that included me – Editor*). Many thanks for the invite. I hope that the talk was useful for the students”.

Murray, A. and Montgomery, D.W. 2014. Characterization of highly fractured basement, Say'un Masila Basin, Yemen. *Geological Society, London, Special Publications* **374**, 289-310.  
doi: 10.1144/SP374.1

Murray, A. 2015. A method for characterizing basement rocks from borehole images. In: Richards, F. L., Richardson, N. J., Rippington, S. J., Wilson, R. W. & Bond, C. E. (eds). *Industrial Structural Geology: Principles, Techniques and Integration. Geological Society, London, Special Publications*, **421**.  
<http://dx.doi.org/10.1144/SP421.6>

**Lesley Andrews (née McDowell)** (BSc 1974). Lesley is teaching mineralogy and geochemistry part-time at Pretoria University, South Africa, having retired from a career in metalliferous mining.

**Anthony Ware** (BSc 1988) is still teaching at Wrekin College, Telford, where he is in charge of the Science faculty. In his spare time he enjoys driving his ancient MG Midget car.

**John (Ben) Bennett** (PhD 1981) is working as a consultant with ExxonMobil in Angola.



## OUTREACH



Earth &  
Environmental  
Sciences



University of  
St Andrews

Since the last newsletter GeoBus has been very busy driving around Scotland. During the past four years the GeoBus team and its volunteers have involved more than **40,000** pupils in experiential Earth science learning activities in 190 different schools (over 400 separate visits). We are delighted to announce that this year we embark on a new adventure and a developing a sister project at University College London (UCL), working with Charlotte Pike. Watch this space!

**New Staff:** Ben Moorhouse is the most recent addition to the *GeoBus* team. He graduated from University of Leicester in 2011 with an M.Geol. He then moved to New Zealand to complete his PhD at the University of Otago where he worked on subaqueous and monogenetic volcanoes. His research interests lie within physical volcanology, sedimentology and stratigraphy. Ben has a real passion for communicating science to the public which, when mixed with a rather theatrical flair (yes he sings a lot in the van) has meant an involvement with numerous Earth science related outreach projects throughout his geological career. He's thoroughly enjoying his new adventure with the *GeoBus* project, being able to collaborate with and learning from the brilliant staff here at St Andrews.



**Social Media:** *GeoBus* has been working on stepping up the social media side of the project with an increased presence on Twitter, Instagram and Facebook and has just started a YouTube channel that aims to promote short geological sketches, career interviews and a video blog of the antics on the road. To get involved and enjoy a slice of what *GeoBus* has to offer follow us on Twitter and Instagram and subscribe to our channel on YouTube. You'll find all the information on our website or for ease head straight to Twitter or Instagram for more information – **handle is @geobus\_sta**

**New workshops:** Over the last two month *GeoBus* was busy developing a new hydrology workshop, which uses experiments to bring the hydrograph to life and lets pupils



explore for themselves the factors that affect a river basin. We would like to thank both staff and pupils at Tarbert Academy and St Machar Academy for their help during the development stage.

In 2015 we also had the pleasure of working with Crown Estate developing a series of Carbon Capture and Storage (CCS) activities. The resources are now ready to go thanks to our fantastic interns Megan O'Donnell and Katy Relph. Look out for the launch at the beginning of March.

**Teaching Highlights:** During 2015, despite the weather, we have had some fabulous field trips including our first field camp for senior pupils, a trip to Orkney and some memorable school visits. We have celebrated Halloween and Children in Need in Geological style. As the saying goes a picture paints 1000 words...



We would like to say a huge thank you to our principal sponsors for their continued support. For more information on *GeoBus*, contact Dr Ruth Robinson (rajr@st-andrews.ac.uk).

YouTube link:

<https://www.youtube.com/channel/UC0Sry1dA-hGuThgTKu4iGNg>



And last, but not least, the School of Geography & Geosciences staff and postgraduates football team.



*STAFF. L to R, back row: Jed Long, Sami Mikhail, Vincent Rinternecht, Colin Cameron, Alan Marshall, Darren Lightfoot, Will McCarthy, Tim Raub, Stuart Allison, David McCollum. (Missing: Donald Herd)*

*POST-GRADS. L to R, front row: Steve Owen, Colin Mettam, Ben Taylor, William Hiles, Fabricio Guaman, Vinicius Louro, Sebastian Fischer, Noor Saeed*



*Aerial view of the Maiden Rock fold, St Andrews*



## USEFUL LINKS

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

<https://www.facebook.com/standrewsgeologyalumni>

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

<http://www.cersa.org.uk>

<http://www.geobus.org.uk>

<http://www.st-andrews.ac.uk/alumni/relations>

<http://www.st-andrews.ac.uk/alumni/relations/stayconnected/email>

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*The Scores cliffs*

We are always interested to receive news from our alumni which, with your permission, we would like to publish in the Newsletter and the DEES website. Contact the editor: Richard Batchelor ([rab@st-andrews.ac.uk](mailto:rab@st-andrews.ac.uk))

