The University of Oxford
Department of Earth Sciences

earth sciences news

issue no 04 2013

A New Model of Martian Evolution

Rocks in Gusev Crater.
Photo © NASA/JPL-Caltech/Cornell

in this issue:

UNIVERSITY OF OXFORD

Welcome

by Professor Gideon Henderson Head of Department

My first year as Head of Department: a daunting but exciting job. It's proving to be an eventful year.

The Department received its largest ever grant, establishing a new portfolio of research with generous funding from Shell International. The return to a close relationship with the company that helped fund our last building (remember the Pecten above the door?) seems fitting as we are now settled in our new home. The partnership seeks to understand the structure, stratigraphy, and carbon cycling of sedimentary basins. There is plenty of fascinating science to get our teeth into and a wealth of data and samples from Shell. The work also has implications for the discovery and extraction of oil and gas (as you'd expect given Shell sponsorship!). Although it is not the focus, the work is relevant to fracking – a controversial subject as you will have seen from recent media coverage (including some comment pieces directly associated with the launch of our Shell partnership in May).

For a Department that also has an active research portfolio in understanding long-term climate and environmental change, to be involved in the discovery of unconventional hydrocarbons provokes careful consideration of what we stand for. Do we seek to discover earth resources? Or to assess the often-damaging implications to the planet of the use of such resources? My answer is that we should do both. Our goal continues to be, as it always has been, to use the latest tools and smartest thinking we can muster to better understand the fundamental processes that shape our planet. The questions that society asks of us as earth scientists are diverse, but we have the skills to answer them objectively. It is in leading Universities, like Oxford, that work to assess the benefits and pitfalls of technologies such as fracking is best done – where many views and skills can come to bear, without a driving industrial imperative. So, although the oil industry will not come to dominate our research agenda (or our funding), we welcome collaboration with this and other industries, and the chance to share their scientifically fascinating problems and data.

The arrival of Professor Joe Cartwright as part of this Shell partnership coincides with the appointment of two Visiting Professors with senior positions in the oil industry – Bruce Levell (Shell), and Mike Daly (BP). Both expect to spend a significant amount of time in the Department in coming years, and we look forward to collaborating with them on future research and teaching projects. The arrival of three such well-respected experts in petroleum geoscience is a coup for the Department. With existing work, such as Tony Watts' work on the evolution of sedimentary basins, the Department now boasts real critical mass in the field. I'm sure we will be reporting on new developments in coming issues.

These new appointments are very far from the only ones in the last year. As reported in the last issue by my predecessor, John Woodhouse, the Department has been enjoying a period of significant recruitment. Six new lecturers have joined us (see more opposite) and we are delighted to welcome Christopher Ballentine from Manchester as the new Chair of Geochemistry. The Department has a long history of exchanging faculty members with Manchester, so this is an almost traditional appointment. But Chris's work is far from traditional – applying noble-gas geochemistry in highly innovative ways to address questions as diverse as mantle structure and carbon sequestration.

These new appointments take the Department's faculty above 30 for the first time in its 200-year history, but our wonderful new building has enabled us to accommodate everyone and to keep the same collegial atmosphere and close interaction between all levels of the staff and students. It's not quite all been immigration, however. We wish Steve Hesselbo a fond farewell – he is off to take up a Chair at Exeter, and his words of wisdom will be much missed in the Department and St. Peter's College. Others have had a change of role, but remain in the Department. Hugh Jenkyns has stepped down as Tutorial Fellow at St. Edmund Hall after 35 years. I know I'm not alone in remembering the huge reading lists and insightful discussion of a Jenkyns tute! Hugh's research continues, and explores ever further into the nature of environmental change during ocean anoxic events.

I hope you will enjoy the pages that follow, which give something of an insight to the 2013 version of the Department that you were once a member of. We detail some of the highlights of the last year, along with fond memories of David Vincent, whose life and long leadership of the Department was celebrated at a memorial in May. We also hope to provoke memories of your time in the field (p14-15). Field-work continues to be such a vital part of an earth-sciences education, and we are continually battling to keep our programme vibrant and relevant. The considerable support we have had from alumni in this endeavour is always hugely appreciated.

Of course, you will get more insight still about the Department from a visit to Oxford or to one of our events elsewhere. Do come along – you are always welcome, and I look forward to meeting old friends as well as new.

New Faculty


1.

1. Professor Chris Ballentine
Chair of Geochemistry, St. Hugh's College
Chris joins us from Manchester. He uses noble gases and halogens to probe many aspects of earth structure and process. He is a new Fellow of the American Geophysical Union, and is President of the European Association of Geochemistry.


2.

2. Dr Roger Benson
University Lecturer in Paleobiology, Tutor, St Edmund Hall
Studying dinosaurs, evolution, and the patterns and biases of the fossil record. Roger takes on a tutorial fellowship at Teddy Hall, and arrived from Cambridge in 2012.


3.

3. Professor Joe Cartwright
Shell Professor of Earth Sciences, St. Peter's College
Joe arrived from Cardiff in 2012 with strong links to industry and a number of active field projects. His new seismic interpretation lab will provide fresh insight into faulting, deformation, and the movement of fluids in sediments.


4.

4. Dr Lars Hansen
University Lecturer in Mineralogy, Tutor, University College
Lars squeezes and heats rocks to see how minerals behave deep in the crust. He is the new Sollas Fellow at University College, arriving from post-doctoral work at Stanford, USA.


5.

5. Professor Samar Khatiwala
University Lecturer in Climate Science, Linacre College
Quantifying the role of the oceans in climate change with new models of ocean chemistry, physics and biology. Samar arrives from Columbia University, USA.


6.

6. Dr Tarje Nissen-Meyer
University Lecturer in Geophysics, Wolfson College
Probing the interior of the Earth with innovative analysis of seismic data and high-performance computers. Tarje joins us from ETH, Switzerland.


7.

7. Dr Stuart Robinson
University Lecturer in Sedimentology and Stratigraphy, St. Cross College
Stuart arrives from University College London. His research, in field and lab, uses the sedimentary archive to reconstruct the past environment and understand key earth processes.


8.

8. Dr Karin Sigloch
University Lecturer in Geophysics, Tutor, Exeter College
Karin will be at sea when you read this – recovering seismometers from the sea-floor of the Indian Ocean. She joins us from Munich, Germany, and her work uses geophysical observations to understand upper mantle and crustal structure.

A New Model of Martian Evolution

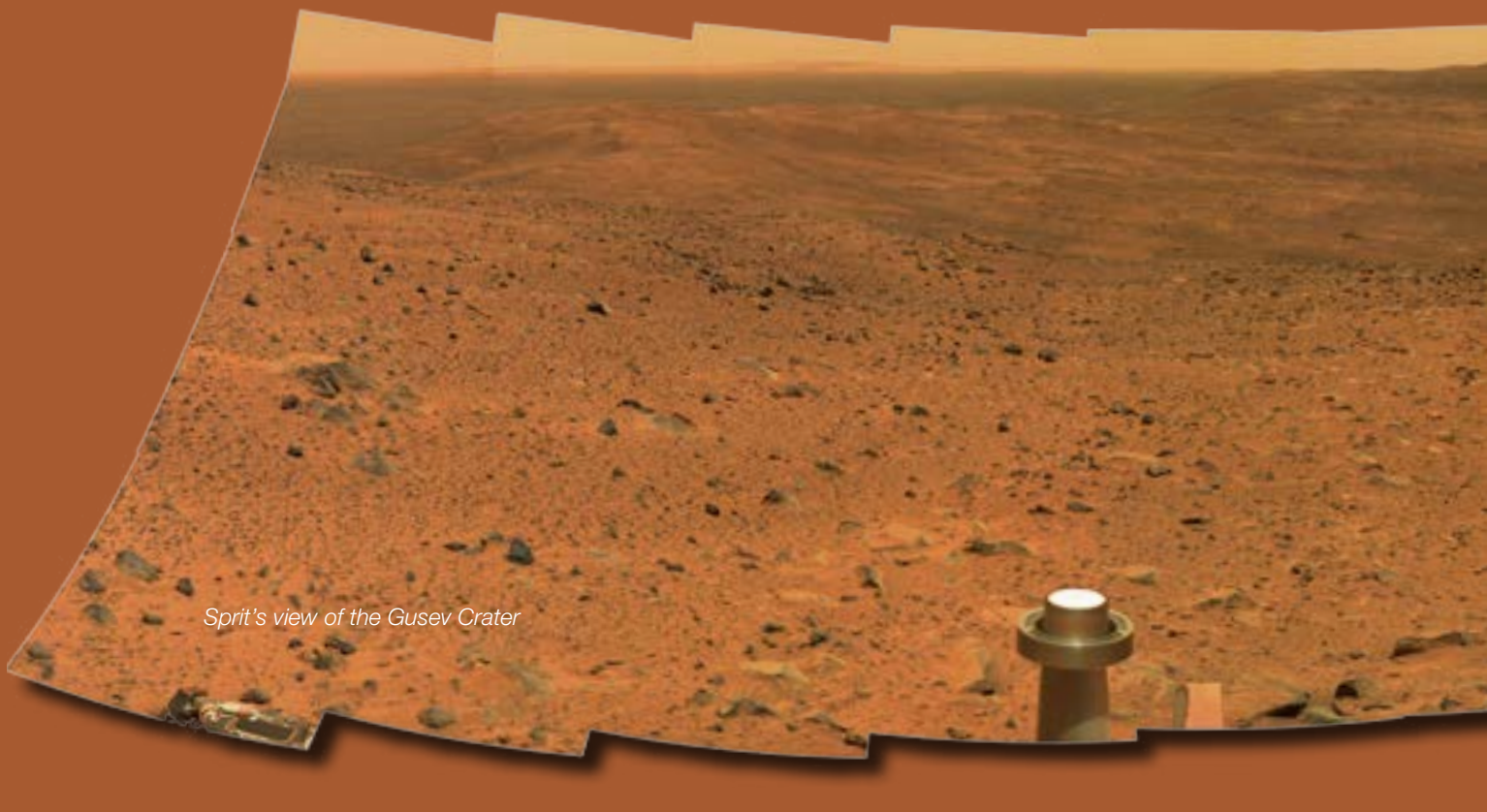
by Professor Bernie Wood

Until the recent Mars rover landings, almost all of our ideas about the chemical composition and evolution of Mars had been derived from the Martian meteorites which arrive on Earth.

These SNC (shergottite–nakhlite–chassignite) meteorites are genetically-related igneous rocks which contain trapped Martian atmosphere, the composition of which had been measured by the Viking spacecraft in 1976. Chemically and texturally similar to terrestrial basalts and cumulates, the SNC meteorites have higher concentrations of iron and volatile elements such as phosphorus and chlorine and lower concentrations of nickel and other chalcophile (sulphur-loving) elements.

In 2004 NASA landed two rovers, Spirit and Opportunity which contained APXS (alpha-proton X-ray spectrometry) instruments capable of chemically analyzing the rocks and soils at the surface. The former was landed in a volcanic crater (Gusev Crater) and continued to send back chemical information until 2010. The analyses performed by Spirit indicate that the volcanic rocks on the surface are chemically similar to the SNC meteorites but have one or two unexpected differences. The most important of these is that the surface rocks contain about 5 times as much nickel as the meteorites. This observation led to doubts that the SNC meteorites are representative of the red planet's igneous crust.

The question of nickel in Martian rocks and its implications for Martian evolution is one of the topics which has been discussed for the last three years by undergraduates taking the 'Planetary Chemistry' option in the fourth year. This option is run by Professor Bernard Wood and members of the department's experimental petrology group. Generally the conclusion has been that Mars' mantle must be quite heterogeneous in nickel content possibly due to inefficient mixing. This year, however, Professor



Sprit's view of the Gusev Crater

Wood and post-docs James Tuff and Jon Wade were sitting at lunch discussing the effects of sulphides on island arc volcanism (on Earth) when they realised that sulphides could be the key to the high nickel content of Mars' crust. The basic idea is that nickel is a sulphur-loving element which partitions strongly into sulphides in all environments. In order to explain the low nickel contents of the SNC meteorites you need to have a lot of sulphide in the interior region of Mars' mantle where melting occurs. This sulphide holds back the nickel in Mars' mantle so that the igneous SNC meteorites are low in nickel. In contrast, for the surface rocks, all of the sulphide has to dissolve in the silicate melt taking all of the nickel with it. This produces volcanic rocks rich in nickel and sulphur. As it happens, we know that the surface rocks are very rich in sulphur as well as nickel, so the idea is sensible. The question now is: Why would all the sulphide dissolve in the silicate in one region and not in the other? The answer is oxygen.

Sulphur is reduced in sulphides (S^{2-}) but oxidised in sulphates (S^{6+}). Under the reducing conditions recorded by minerals in the Martian meteorites iron sulphide is stable and the solubility of sulphur and nickel in silicate melt are very low. The step the experimental petrology group made is to model what would happen if the surface (Gusev Crater) rocks came from a more oxidised region of the interior. The result is that, under oxidising conditions, sulphide would be unstable and sulphur and nickel would dissolve to concentrations at least five times those observed under reducing conditions. This would explain the high sulphur and nickel concentrations of the surface rocks. The implication is that the surface rocks from Gusev crater were generated in an oxidised part of Mars' interior. This is particularly interesting when we consider the ages of the different rocks.

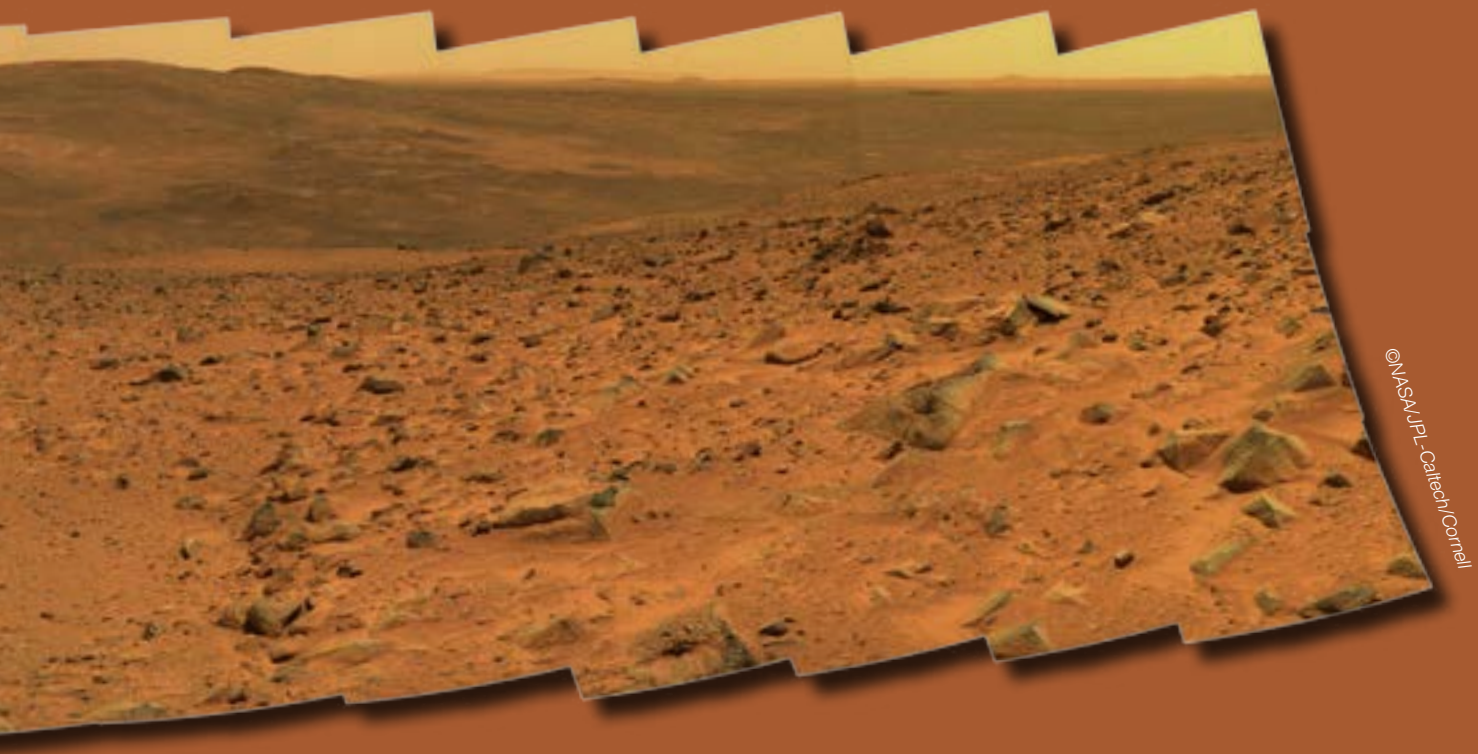
'What we have shown is that both meteorites and surface volcanic rocks are consistent with similar origins in the deep interior of Mars but that the surface rocks come from a more oxidised environment, plausibly caused by recycling of oxidised materials into the interior through subduction,' explains Professor Wood. 'This result is surprising because while the meteorites are geologically 'young', around 180 million to 1400 million years old, the Spirit rover was analysing a very old part of Mars, more than 3700 million years old.'

The result indicates that the Martian surface was oxidised very early in the history of the planet and that, this oxygen-rich material was drawn into the shallow interior and recycled back to the surface during eruptions ~4000 million years ago. The meteorites, by contrast, are much younger volcanic rocks that emerged from deeper within the planet and so were less influenced by the oxidation process.

Professor Wood said: 'The implication is that Mars had an oxygen-rich atmosphere at a time, about 4000 million years ago, well before the rise of atmospheric oxygen on earth around 2500 million years ago. As oxidation is what gives Mars its distinctive colour it is likely that the 'red planet' was wet, warm and rusty billions of years before Earth's atmosphere became oxygen rich.'

The new model of Martian evolution was first presented to the 4th year undergraduate seminar 'Planetary Chemistry' and later at a departmental 'brown bag' lunch before being published in *Nature*.

A report of the research, entitled 'Volcanism on Mars controlled by early oxidation of the upper mantle', was published in Nature in June 2013. The research was carried out by Dr James Tuff, Dr Jon Wade, and Professor Bernard Wood at Oxford University's Department of Earth Sciences and was supported by the Science and Technology Facilities Council (STFC) and the European Research Council. You can read more about the research online: http://www.nature.com/nature/journal/v498/n7454/full/nature12225.html#auth-1



Secrets from the Siberian Permafrost

by Dr Anton Vaks

Dr Anton Vaks works within the Isotopes and Climate Research group within the Department. The group uses isotope geochemistry to study the surface environment of the Earth, both now and in the past. This research has a broad application providing information about the drivers of natural climate change, the history of ocean circulation and our understanding of geochemical cycles.

Dr Vaks' research aims to understand how changing global temperatures affect the permafrost and desert regions of the world, by examining carbonate cave deposits (speleothems) to access paleoenvironmental conditions. His paper reporting on evidence from stalactites and stalagmites in caves located along the permafrost frontier in Siberia was widely reported in the press this year due to the implications for global climate change.

The team used radiometric dating techniques to date the growth of stalactites and stalagmites from six caves in Siberia and the Mongolian Gobi Desert. Stalactites and stalagmites grow only when liquid water seeps into the cave, therefore they cannot grow in frozen or arid conditions. The northernmost Ledyanaya Lenskaya Cave is located in the continuous permafrost (permanently frozen ground) at a latitude of 60 degrees North. The ages of stalactites there showed that the latest period when stalactite growth took place in this presently frozen cave occurred about 400,000 years ago (Marine Isotopic Stage 11). During this period the global temperature was 1.5 degrees Celsius higher than the preindustrial period (before 1800 A.D). 125,000 years ago, when the world was 0.5-1 degrees Celsius warmer than preindustrial period there was no stalactite growth in this cave, suggesting that 1.5 degrees Celsius warming is the 'tipping point' at which the coldest permafrost regions begin to thaw.

A global temperature rise of 1.5 degrees Celsius could see permanently frozen ground thaw over a large area of Siberia, threatening release of carbon from soils, and damage to natural and human environments.

'As permafrost covers 24% of the land surface of the Northern hemisphere significant thawing could affect vast areas and release billions of tonnes of carbon, potentially enhancing global warming,' Dr Vaks explains. 'This has huge implications for ecosystems in the region, and for aspects of the human environment. For instance, natural gas facilities in the region, as well as power lines, roads, railways and buildings are all built on permafrost and are vulnerable to thawing. Such a thaw could damage this infrastructure with obvious economic implications.

'Although it wasn't the main focus of our research our work also suggests that in a world 1.5 degrees Celsius warmer than today, warm enough to melt the coldest permafrost, adjoining regions would see significant changes with Mongolia's Gobi Desert becoming much wetter than it is today and, potentially, this extremely arid area coming to resemble the present-day Asian steppes.'

A report of the research, entitled 'Speleothems reveal 500 kyr history of Siberian permafrost', was published in *Science*. The work was carried out by scientists from Oxford University, Institute of Earth's Crust in Irkutsk (Russian Academy of Sciences), Swiss Federal Institute of Technology Zurich, Institute of Geography in Ulan-Bator (Mongolian Academy of Sciences), and Arabica Speleological Club, Irkutsk, Russia. The research was supported by the UK's Natural Environment Research Council (NERC), The Royal Society and the Russian Foundation for Basic Research.

Anton Vaks in the Okhotnichya Cave, Siberia

Thoughts from Cumbria: Energy

Wind Turbine at the Wind Farm in Cumbria. Do massed collections of these enhance the countryside? Are they the answer to burgeoning power needs?

Energy supply is one of the foremost issues for the UK at present, with power outages likely unless action is taken. The Cumbrian coast is dubbed the “Energy Coast” with much debate locally around three possible sources: nuclear, wind and shale gas. The solutions adopted will have a considerable impact on this part of the country.

Sellafield in West Cumbria includes all the waste generated by the nuclear programme since its inception after World War 2. Reportedly it includes 25 tons of plutonium. Proposals to bury this material under West Cumberland were rejected by Cumbria County Council after vociferous opposition. It was however accepted by the two district councils, Copeland and Allerdale, who are most affected by (and have also had most employment from) the nuclear industry.

It is disappointing that no other councils in the UK have offered a storage site, given that this is a national problem. The present site would avoid hazardous transport and, in spite of reservations by “experts”, I find it difficult to imagine that no safe underground site can be found in the area. Sweden and Finland propose to bury nuclear waste in caverns in granites, so what’s wrong with the Ennerdale and Eskdale granites? An organization called Radiation-Free Lakeland argues that radioactive deposits will damage tourism in the Lake District, an argument helped by the ficticious horror stories put out by this group. Years of negative, biased reporting in the press has led to the average citizen having deep-seated, irrational fear of anything with the words “nuclear” or “radiation” in them. Why have people such a horror of the nuclear industry which has killed far fewer workers than the oil, gas or coal industries?

and other problems

By Dr Kent Brooks
(Linacre, 1962)

The plutonium alone contains enough energy to cover the UK's needs for many years, but is now regarded as a highly troublesome waste. Perhaps methods of using this plutonium could be developed using some of the money currently wasted on subsidizing relatively inefficient forms of energy, such as wind.

We have a large number of wind turbines in Cumbria and offshore and, although some people think they enhance the countryside, this is not the majority view and certainly not that of people who have to live with the noise or the sight of gigantic industrial installations in what previously was quiet, unspoiled countryside. On a country-wide basis, a majority have expressed a preference for this form of energy production, but this may be because most people live in cities and will not be affected. They have been persuaded by "unlimited supplies of clean, free energy" in the words of those promoting wind energy. The fact is that these structures are expensive, inefficient and require back-up by alternative sources of power. They consume large amounts of energy to produce and emit large volumes of CO^2 in the process (each turbine requires thousands of tons of concrete in its foundations, which has an adverse effect on the local environment and hydrology). They would never be built without substantial subsidies, which push up the cost of electricity for everyone, while a few firms pocket fortunes. I consider them an eyesore in some of Britain's loveliest countryside, invariably sited on high places and visible for tens of miles. Some of the rural landscapes I loved as a child are now dominated by huge wind turbines and new transmission lines, with pylons double or treble the height of the existing ones. The Lune, Kent and Eden valleys are constantly under threat as is the hill country around Beatock Summit in Scotland. This destruction of our rural heritage is not the answer to carbon reduction.

The third issue concerns the recovery of shale gas. One local newspaper reported that "seismic tremors" connected with tests near Blackpool could lead to devastating earthquakes and even volcanic activity in the Lake District! This may have been an extreme example, but fear of earthquakes has been widely expressed, along with contamination of groundwater. Admittedly, there are environmental risks and care must be taken, just as with any new technique, but it is clear that the general public has no idea of the dimensions involved. The seismic tremors are not more than might be caused by a bus passing and the depth where the fracking takes place (<3 km) is well below any exploited water reservoirs. Surface disturbance by this process would be minimal and easily remediated. In the United States shale gas is regarded as adequate for hundreds of years and gas prices have fallen to one third of their previous levels. This is a possibility we cannot afford to ignore. If all our power production went over to gas we would be reducing our carbon footprint, whereas the wind farms may encourage new coal-fired plants when their devotees at last acknowledge they are not up to the job.

Here we have some serious questions which must be addressed now. The answers we choose will have significant effects on some of Britain's finest scenery, which is already under threat from increasing urbanization. Whatever happens, the green and pleasant country I grew up in seems to have its days numbered. Nuclear power, wind farms and traffic links will determine the future of this idyllic region and our children will never know how it used to be.

The M6 slices through the Lune gorge, bringing noise, pollution, disfigurement, industry and settlers to rural Cumbria. Note the spreading industrial buildings at the Tebay junction (top, middle).

Shell launch

By Professor Joe Cartwright

LEFT: Harold Reading, centre, with his former students Bruce Levell and Jack Russell (L) and Harold Johnson (R).

May 2013 saw the official launch of the Shell-Oxford Research Partnership, designed to support more effective development of natural resources to meet fast-growing global demand for energy. The Research Partnership was made possible by a generous award of £5.9m from Shell International Exploration and Production B.V. (Shell) and creates a new research group and state-of-the-art laboratory within the Department. The award comes in three components:

1. The Shell Geoscience Laboratory, aimed at providing research training in the use of 3D seismic and other subsurface data, and conducting fundamental research into depositional, deformational, hydrodynamic and diagenetic processes operative in sedimentary basins.
2. The Mudrock Observatory, equipped with an all singing and dancing new SEM and RockEval facility, and aimed at understanding how organic matter is deposited in fine-grained sediments, how it is affected by diagenesis and burial, and how diagenesis can lead to fracturing of mudrocks.
3. Metal Isotopes and Source Rocks, exploiting the Department's world leading isotope geochemistry capability to probe novel metal isotopic proxies for the reconstruction of ocean chemistry at times when shale gas reservoirs or conventional source rocks were being deposited.

The research group will address fundamental challenges relating to the physical and chemical characterisation and origins of mudrocks. Mudrocks have been generally neglected as a subject for petroleum-related research over the years, with most sedimentological research effort being directed onto clastic and carbonate reservoirs. The spotlight has now shifted onto mudrocks, because of their importance as source rocks for conventional hydrocarbons, as reservoirs for unconventional hydrocarbons, and as seals, both for conventional hydrocarbon accumulations and for the geological storage of carbon dioxide. Research will also be carried out into such carbon dioxide sequestration, which will be critical to the successful development of carbon capture and storage technology both in the UK and globally. In particular, research on seal capacity of mudrocks should feed into current debates on regulatory frameworks governing geological storage of carbon dioxide.

The establishment of the Shell Geoscience Laboratory enables researchers to develop novel techniques for the interpretation of huge geophysical and geochemical databases that are now available to analyse the geological processes that shape sedimentary basins around the world. This new initiative offers opportunities for graduates interested in working in this expanding area through the development of a structured programme of postgraduate training.

Representatives from Shell and the University at the official opening

FROM LEFT:
(L-R) Gideon Henderson, Alison Goligher, Ed Davey and Andrew Hamilton
Members of the Oxford Shell lab during a tour of the new computing suite
Gideon chats to Joe Brennan

Leading the new Shell Geoscience Laboratory is Professor Joe Cartwright (Jesus, 1977): “This new Oxford collaboration with Shell is a huge boost for fundamental geoscience research in the UK. We see this as an opportunity to shape the direction of the subject and create a centre of expertise that will attract interest from all over the world.

Understanding the complex processes at work in sedimentary basins is vital to meeting our future energy needs and could also help in mitigating the impact of climate change.”

The research partnership was officially launched by Ed Davey, Minister for Energy and Climate Change, who attended with Andrew Hamilton , Vice-Chancellor of the University of Oxford, and Alison Goligher, Executive Vice President Unconventionals at Shell. In her speech, Goligher said, “As the world’s demand for energy grows, energy systems need to continue to meet this demand and also become cleaner and more efficient. Shell invests significant resources into research and development, both through our own work and through partnerships like this. It’s important that companies like Shell make meaningful contributions to understand how our natural resources can continue to be safely and responsibly developed. We are delighted to be working with a world leading university, supporting students at the cutting edge of research.”

The group consists of Joe Cartwright, Steve Hesselbo, Hugh Jenkyns, Don Porcelli, Stuart Robinson and Gideon Henderson with postdoctoral support from Micha Ruhl, John Hooker, Claudia Bertoni and Alex Dickson, as well as DPhil students Qingfeng Meng, Linhao Fang, Marisa Storm, Matteo Paganoni, Weimu Xu. Bruce Levell (St Catz, 1972) joined the group as Visiting Professor in September 2013, after an illustrious career in Shell International, which culminated in the position of Chief Scientist (Geology) for the global Shell network.

The launch event on the 9th May demonstrated the vitality of this partnership. We were reminded that the old department building had a pecten above the door in recognition of Shell funding to expand into new premises after the war. Harold Reading, who maintained close links with the company throughout his academic career, was able to meet with some of the many students whose careers were also influenced by Shell, such as his DPhil tutee Howard Johnson (St Peter’s, 1971), now Shell Professor of Petroleum Geology at Imperial, Jack Russell (Univ, 1985) and Bruce Levell (St Cat’s 1972), VP Emerging Technologies and Chief Scientist Geology at Shell.

For more information on the Shell-Oxford Research Partnership, please visit their web page: shell.earth.ox.ac.uk

Memorial to a lasting legacy

Over 50 current and former faculty, administrative staff, technicians and students attended the Memorial Celebration of the life of Professor David Vincent, who died on Christmas Eve 2012 at the age of 93. We were joined by David's daughters and their families as well as Fellows from University College.

On display for the afternoon was a selection of photos in meticulously-labelled albums that David had taken during his trips abroad to Italy and Nigeria, and also much-loved photos from Scotland in the 1940s, and Oxford in the 1970s. A new plaque was unveiled, naming the Vincent Mineralogy Laboratory, which stands in testament to the legacy David left in that field.

Short talks gave an inspirational view of different aspects of David's life and work. Brian Upton spoke about David's career in the Department in the early years after Wager, Jack Zussman highlighted David's brief but fruitful spell as Head of Department in Manchester, and David Vaughan – now at Manchester himself – spoke about his student days under David's tutelage. David Bell gave a brief account of his life from a University College perspective, and finally Gideon Henderson brought the gathering up to the present day with an overview of the Department and the legacy that David's work and vision left for us.

The afternoon was rounded off with refreshments in the Researchers' Common Room, giving everyone a chance to mingle and share their own memories. At the funeral in January, David Bell gave a very moving and personal account of David Vincent's life and work, which is reproduced in part on the next page.

The full text can be seen on our website: www.alumniweb.ox.ac.uk/earth/vincent

Scan your mobile device here to read the full text of the eulogy David Bell delivered at David Vincent's funeral in January, as well as the talk given by David Vaughan at the Memorial.

Former Professor's Secretary Diana Relton with Professor Mike Worthington.

"I think one may safely say that during David's Professorship the foundations of the present splendid Department of Earth Sciences were laid."

Eulogy by David Bell

David Vincent went to the University of Reading, graduating in 1940. During that time he first came into contact with Lawrence Wager, a geologist who was to have a significant influence on him and whose colleague he became both at Durham and Oxford, eventually succeeding Wager as Professor of Geology at Oxford and Professorial Fellow of University College.

The young graduate Vincent deployed his skills during the War in research on the analysis and testing of explosives. I always found it difficult to associate such a kind and gentle man with such a lethal trade. He did once, while teaching me, then an undergraduate, the arcane skill of gravimetric silicate analysis, prevent me from making nitrocellulose by accident for which I am grateful and so no doubt was he.

He first met his wife Myrtle in the explosives laboratory in Scotland. Their honeymoon was spent on Arran: no better place for a geologist. They remained together for sixty years, reaching their Diamond Wedding Anniversary barely a month before Myrtle died in May 2004.

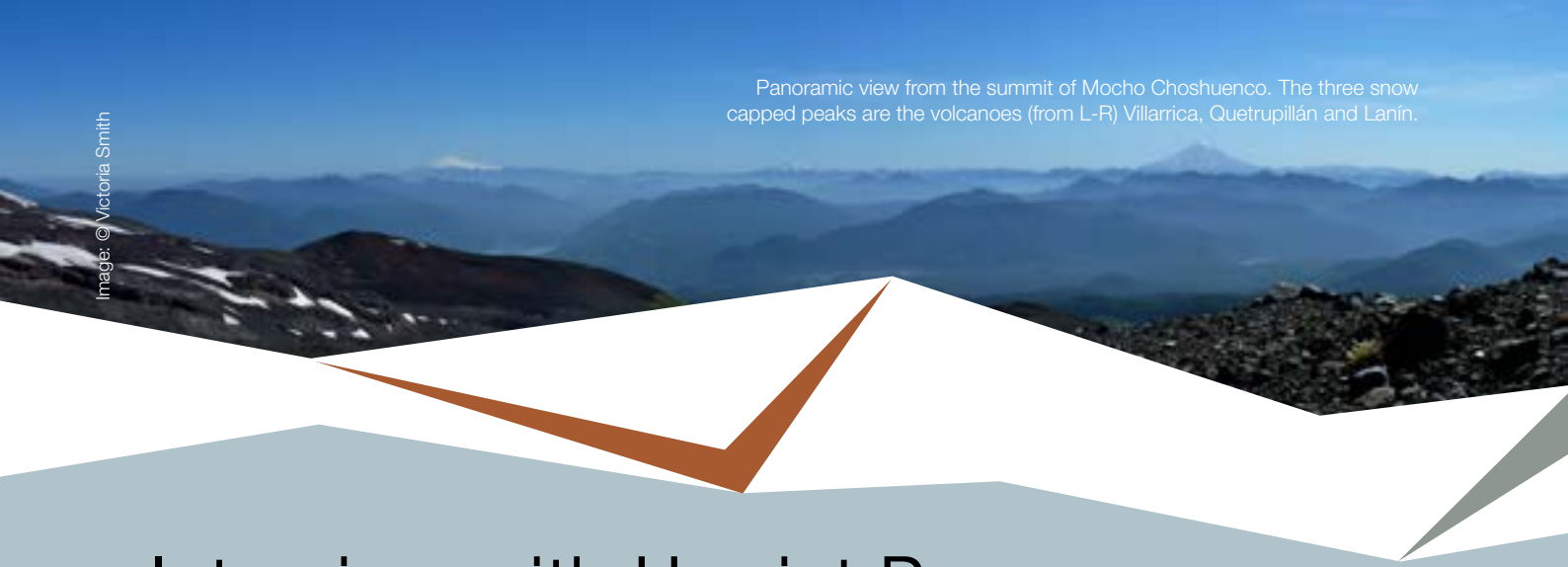
I see David's academic career as having two parts. At Durham and at Oxford up to 1962 he was lecturer, tutor and ultimately Reader in Mineralogy and also fully committed to research. He established and refined techniques such as neutron activation of rock and mineral analysis, and became expert in reflected light ore microscopy. He became without doubt one of the finest, if not the finest, analyst in the field of geological and mineralogical research.

The second part of his career began with his move to the Chair of Geology at Manchester where he spent some five happy years and was deeply involved in the planning and construction of a large new extension to his department. Administrative duties began to assume priority and grew yet more demanding when he returned to the more labyrinthine world of Oxford in 1967. He had very able assistance particularly from Jack Zussman and Nina Phipps and later Eric Whittaker but I think he took a conscious decision to concentrate on running his Department well and helping everyone else to get on with their work. And he did this, balancing the books and quietly but effectively arguing Geology's case in the tough new forums of the Faculty of Physical Sciences into which he had had it transferred. He was a great enabler. Many of us owe our achievements and our careers to him.

I think one may safely say that during David's Professorship the foundations of the present splendid Department of Earth Sciences were laid. Fittingly there is a room in the new building bearing his name.

Guests gather in the atrium.

Our speakers: Jack Zussman, Brian Upton, David Vaughan, Gideon Henderson.



Panoramic view from the summit of Mocho Choshuenco. The three snow capped peaks are the volcanoes (from L-R) Villarrica, Quetrupillán and Lanín.

Image: © Victoria Smith

Interview with Harriet Rawson

I interviewed Harriet Rawson, a third year DPhil student, sitting in her office surrounded by 200 kilos of volcanic rock, to find out more about her DPhil project researching the volcanoes of Southern Chile.

What made you apply to Oxford?

As an undergraduate at Cambridge, I enjoyed the wide range of the Natural Sciences Tripos, most particularly my 4th year project looking at volcanic gas emissions from Soufrière Hills Volcano, Montserrat. I had previously worked in Chile, for my 2nd year mapping project, in a copper mine in the Atacama Desert. This wonderful experience sparked an interest in the geology of Chile. The research interests, good reputation and large size of the volcano group at Oxford were also factors that led me to apply.

What does your DPhil involve?

I primarily research the Holocene activity of Mocho-Choshuenco Volcano, which is a snow-capped twin volcano in the Chilean Lake District. The volcano has been dormant since 1864 though there is evidence of multiple large eruptions in the Holocene. My project involves collecting samples, mainly of pumice and ash, from the surrounding area. Back in the lab, I analyse the chemistry of the samples on the Electron Microprobe to fingerprint the different eruptions. This, along with field observations, enables me to correlate multiple outcrops and hence reconstruct the eruptive history, style and size of past explosive eruptions. I find it very rewarding to be able to be involved in all the various stages before drawing my own conclusions.

What is the impact of your project on scientific and local communities?

Mocho-Choshuenco is a poorly studied volcano in southern Chile that is thought to be one of the most hazardous and dangerous volcanoes in the Southern Volcanic Zone (SVZ). Although the area around the volcano is relatively sparsely populated ongoing growth in the local population, due to recent investment in tourism, means it is increasing important to know more about this volcano. Furthermore the surrounding lakes pose a major hazard. Not only can water levels rise due to lahars, as was documented for the 1864 eruption, the volcanic deposits can cause damming of the rivers and consequent flooding downstream. This could be catastrophic as downstream of Mocho-Choshuenco is the city of Valdivia with a population of 150,000. We are therefore working with SERNAGEOMIN, the Chilean Geological Survey, Mocho-Choshuenco National Reserve and the Huilo-Huilo Biological Reserve, in which the volcano is located. Hopefully through these organisations, and the local museum, more locals and visitors to the area will learn about this volcano.

What has been the highlight of your DPhil so far?

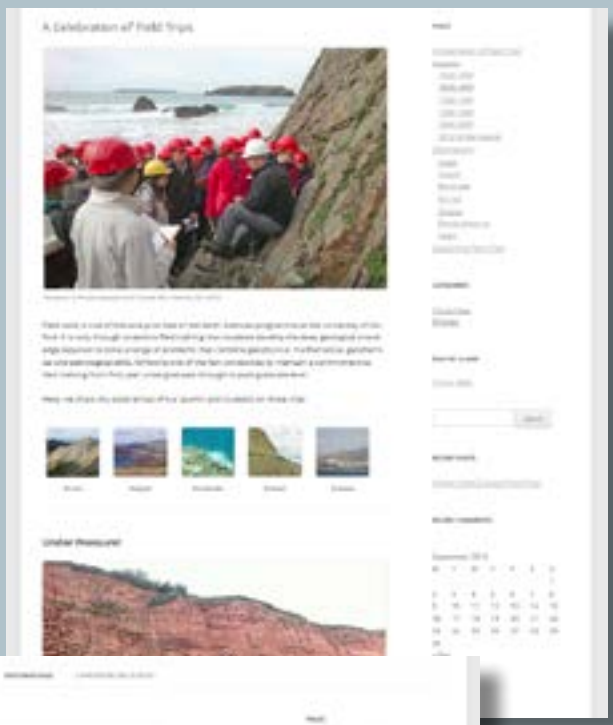
I feel lucky to have been able to go out to South America to study this particular volcano for 3 months in my first year and 2 months this year. It's in a beautiful region - we camp on the edge of the park, beside a glacial river, cook our own meals and live a hardworking but rewarding life! I have also been able to get to know the local people. It's wonderful to have such freedom to explore your own questions and follow through to your own conclusions. Very liberating!

Mocho-Choshuenco taken looking across Lake Panguipulli

Image ©Harriet Rawson

A Celebration of Fieldwork

A new website is being launched to celebrate our memories of field trips throughout the ages:
http://blogs.earth.ox.ac.uk/alumni



Field work is a hugely important aspect of the undergraduate course, but of course does not stop there. Researchers are rarely found in the Department in the summer months – with teaching commitments over, faculty and postdocs alike are more often found in the field than sat at their desks. From the warmth of Malaysia, Nepal, Bermuda and Mauritius to the oceans of the Arctic and the Antarctic, Oxford researchers prefer to complete the 'full cycle' of investigation, from sample collection to analysis back at the lab.

For students, their experience in the field is a vital learning tool – as Jack Matthews, now DPhil student, recalled in his article in our 2010 issue: "I found I never did fully understand refraction seismic profiles until I had laid out a geophone array, set off an explosive charge, and watched the refraction data roll in." It's also a wonderful bonding experience, for students as well as the faculty and demonstrators who accompany them. Our current first years experience the wonders of field trip camaraderie before they even have to attend lectures, having four days in Pembrokeshire just before Week 1 of Michaelmas Term.

If you have any photos, anecdotes (or even song lyrics) from your time on an undergraduate field trip, we would be most grateful to share these via the website.

As always, please do get in touch with Claire Grainger, Alumni Relations Officer, for more info: **alumni@earth.ox.ac.uk**

Thank you!

Over the last two years, alumni support for the Department has manifested itself in many ways.

Over the last two years, alumni support for the Department has manifested itself in many ways. The Department has received just over £4.8M in philanthropic support from 58 different donors, including alumni and corporate donations both large and small, providing direct support for professorial chairs, university lectureships, postdoctoral research, graduate student support, undergraduate field teaching and student prizes. Individual alumni donations to the Field Teaching Fund amounted to £54,000 – more than enough to cover the annual cost of the 1st Year field trip to Pembrokeshire. Recent changes in student fees and government funding make the cost of field trips increasingly difficult to cover, so these donations are critical to the future of undergraduate field trips; we are very grateful.

On the more personal level, many of our students have experienced internships and work placements thanks to alumni in a range of industries. Others were able to benefit from one-to-one advice from alumni with a wealth of experience at one of the various networking and careers events throughout the year, and we are particularly grateful to those alumni who take the time to speak to students in this way. We also appreciate those of you who are able to take on our young graduates as they make their way in the world beyond the Department!

You will notice that we have not included a giving form this year. That doesn't mean new and continuing support isn't vital to us - quite the contrary! There are various ways to give. We encourage you to choose the most convenient and tax-efficient method from the following possibilities:

Give online if you prefer to set up a regular or single gift via credit card or direct debit: www.giving.ox.ac.uk/earthsciences

Give by post if you wish to donate by cash, cheque, card, standing order or direct debit, please print off the most appropriate giving form from our website: www.giving.ox.ac.uk/earthsciences. The relevant mailing address can be found on the form, and the website also provides a brief overview of the tax-efficient giving options depending on where you live.

Give in your will. If you are thinking of leaving a legacy to the department, please do speak to the Alumni Relations Officer. We can advise on the different legacy types and provide suggested wording. We can also ensure that legacy pledges are thanked during your lifetime.

Don't forget, many employers offer 'Matched Funding' schemes which could hugely increase the value of your gift to the department.

If you are interested in finding out more about how you or your company could support the Department, financially or by other means, please contact the Alumni Relations Officer by email alumni@earth.ox.ac.uk, by phone +44 (0)1865 272031 or write to

Claire Grainger
Alumni Relations Officer
Department of Earth Sciences
South Parks Road
Oxford, OX1 3AN

Students on the 2012 2nd year Arran field trip

Photo: © Anna Bidgood

Department news and awards

1. Professor Gideon Henderson was made a Fellow of the Royal Society for his work developing new techniques to determine the timescales, magnitude and effects of past global climate change.

2. Professor Chris Ballentine has been made a fellow of the American Geophysical Union for his leading geochemistry work in the application of noble gas isotopes to the origin and evolution of Earth's volatile elements.

3. Professor Joe Cartwright has been awarded the 2014 Distinguished Educator Award of the AAPG in much deserved recognition of his distinguished and outstanding contributions to geological education.

4/5. Dr Matt Friedman and **Dr Richard Katz** won Philip Leverhulme Prizes, awarded to outstanding scholars who have made a substantial and recognised contribution to their particular field of study.

6. Professor Bernie Woods was awarded the Harry H. Hess Medal of the American Geophysical Union.

7. Dr Conall MacNiocaill was voted "Most Acclaimed Lecturer" in the Division (MPLS) at the recent OUSU Teaching Awards.

8. DPhil student **Richard Palin** received the MPLS Teaching Award, voted by students and staff.

9/10. DPhil students **Teresa Kyrke-Smith** and **Cedric Twardzik** were awarded the Guralp prize for outstanding progress in graduate research.


1.


2.


3.


4.


5.


6.


7.


8.


9.


10.

11. Earth Sciences Building Highly Commended for Performance in Use Award at the Constructing Excellence in London and the South East Awards 2013.


11.

Alumni News and Updates

Dr David Cruden (St Edmund Hall 1961) was awarded the Varnes Medal by the International Consortium for Landslides in 2008

Mr Steve Drinkwater (Merton 1968) retired from the Pembrokeshire Coast National Park in May 2010. He is now leading walking holidays in the UK for HF Holidays Ltd: www.hfholidays.co.uk

Dr Charles (Henry) Emeleus (Wadham 1953) continues to research on Rum and the Small Isles in Scotland.

Dr Robert (Bob) Findlay (St Edmund Hall 1968): After localising my position of Assistant Director Geological Survey of Papua New Guinea in 2005, I set up Montagu Minerals Mapping Pty Ltd in Tasmania to consult in Australia, Asia and the Pacific Rim.

Dr Geoffrey Glasby (Magdalen 1965): After being awarded a first in Chemistry from Oxford I did my part II thesis on the trace element analysis of rock samples using X-ray fluorescence techniques in the Department of Earth Sciences. I then emigrated to New Zealand where I worked at the New Zealand Oceanographic Institute for 22 years during which time I published 220 articles on diverse topics but mainly on deep sea minerals. I also edited a major book on the Antarctic sector of the Pacific for Elsevier and contributed a chapter on Manganese: Predominant Role of Nodules and Crust (Eds Schulz & Zable.) I have now published 351 scientific papers at a rate of nine papers a year for 40 years. I have spent more than half my working life abroad. In 1979 – 1981 I was an Alexander Von Humboldt fellow at the Technische Hochschule in Aachen, Germany under Professor G.H. Friedrich.

Robert (Bob) Pankhurst (Jesus 1964) retired from British Antarctic Survey 10 years ago and continues collaborating with research geologists in Chile and Argentina. In November 2012 he was honoured by the Argentine government. In a ceremony in Buenos Aires he received a “Dr Luis Federico Leloir” award from Dr Lino Barañao, Minster for Science, Technology and Productive Innovation, in recognition of his contribution to the promotion of science and technology in that country.

In memoriam
Dr Geoffrey Francis Hattersley (New 1942)
died on 21st July 2012.
Mr Peter Baber Saxby (Keble 1956)
died on 21 June 2013

Forthcoming Events

Aberdeen Dinner
Thursday 17th October 2013
Alumni living and working in Scotland are warmly invited for dinner at the rather aptly-named Granite Park Restaurant in Aberdeen on Thursday 17th October 2013.

Lobanov Lecture In Planetary Geology
Friday 25th October 2013
Our inaugural lecture in an exciting new series, this year to be presented by Lindy Elkins-Tanton, visiting Astor Lecturer in Physics and Earth Sciences.

GeolSoc Recruitment Fair
Wednesday 30th October 2013
Bringing together the smaller employers in earth sciences with current students, this is a great opportunity to showcase your company, or your area of industrial expertise to the bright minds of the future.

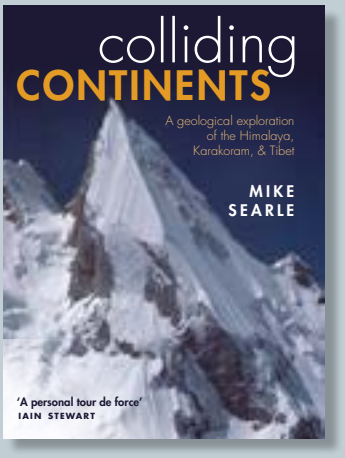
London Panel Discussion
Thursday 13th February 2014
A panel discussion on current energy proposals, with academic experts, government policy makers and opponents, hosted in the beautiful Royal Society building.

Alumni Dinner
Friday 9th May 2014
This year our alumni dinner will be hosted at St Hugh’s, home of Dr Matt Friedman. In the afternoon we invite you to join our research seminar and spend time offering careers advice to current students.

Follow us online:

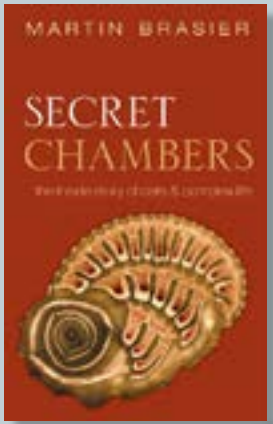
Twitter: @OxUniEarthSci
Linkedin: http://www.linkedin.com/groups?gid=3379392
Facebook: www.facebook.com/OxUniEarthSci

Recent Academic Publications

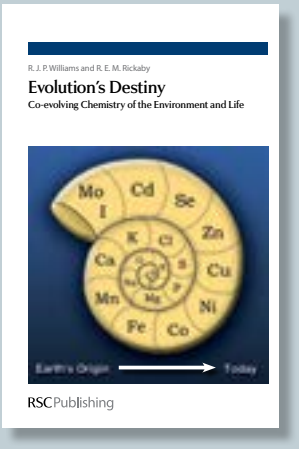


The crash of the Indian plate into Asia is the biggest known collision in geological history, and it continues today. The result is the Himalaya and Karakoram - the largest mountain range on Earth. The Karakoram has half of the world's highest mountains and a reputation as being one of the most remote and savage ranges of all. In this beautifully illustrated book, Professor Mike Searle, one of the most experienced field geologists of our time, presents a rich account of the geological forces that were involved in creating these mountain ranges. Using his personal accounts of extreme mountaineering and research in the region, he pieces together the geological processes that formed such impressive peaks. You can purchase the book and view a short video of Mike talking about his work on the OUP website: **http://ukcatalogue.oup.com/product/9780199653003.do#.**

Martin Brasier's new book *Secret Chambers* (Oxford University Press, now in paperback) explores the mysterious origins of the eukaryote cell and especially of the symbiotic origins of the chloroplast. Pleasingly, the book has just been shortlisted for the Society of Biology book awards for 2013. As with *Darwin's Lost World*, he draws the reader in with lively descriptions of his early field work around the reefs of the Caribbean, and tells the stories of great cell biology explorers such as Robert Hooke and Lynn Margulis. The book ends with chases in search of 2 billion year old cells along the shores of the great lakes in Canada, around the Gulf of Carpentaria in Australia, and then the rugged coast of northwest Scotland. He is currently writing a book concerning the search for the earliest signs of life on earth. **http://ukcatalogue.oup.com/product/9780199644001.do#**



Ros Rickaby, Professor of Biogeochemistry, has co-authored a book which aims to expand the biological understanding inherited from Darwin by incorporating a modern understanding of the chemical processes which influenced evolution. By concentrating on a wide range of chemical elements, it can be shown that there is a close relationship between the geological or environmental chemical changes from the formation of Earth and those of organisms from the time of their origin. These are considerations which Darwin or other scientists could not have explored until very recent times because sufficient analytical data were not available. The book explores the combined geo- and bio-chemical evolution of increasingly complicated organisms in relation to environmental changes. **http://pubs.rsc.org/en/content/ebook/978-1-84973-558-2#!divbookcontent**



Claire Grainger
Alumni Relations Officer
Department of Earth Sciences
South Parks Road, Oxford OX1 3AN

UNIVERSITY OF OXFORD