ROYAL HOLLOWAY UNIVERSITY OF LONDON

Department of Earth Sciences
Graduates Newsletter
2013

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2012–2013: A Year of Great Activity and Achievement

Prof Jason Morgan, Head of Department, writes: "Our department is ending a year in which we have the second highest student satisfaction scores in the country, and we are also ranked 5th in the country in research. Student recruitment is rising, with an increase in the numbers at both undergraduate and postgraduate levels.

The following pages of this newsletter enthusiastically outline the global reach of our research, which now spans from geological and geodynamic study of global tectonics in compressional and extensional regimes, to volcanic processes, the implications of Precambrian lifeforms for hydrocarbon preservation, study of the impact of wildfire on our planet, greenhouse gases, snow, sea ice and the Earth's albedo, and beyond. (Literally beyond, even to Earth's essential 'rareness' within the Cosmos.)

Our staff have been very active in building creative projects and ideas to obtain funding from both research councils and industry. We have established a new and innovative partnership in China that shows promise that it will lead to a strong research association with leading Chinese colleagues, and are working, in the near term to do something similar in Brazil.

Our staff are also experiencing a significant turnover this past year. Several of our more experienced academic staff, Gary Nichols, Graeme Eagles, and Chris Elders have departed for attractive senior positions elsewhere, but we have been successful in recruiting younger staff to replace them, with new hires soon to arrive with research interests in sedimentology (Javier Hernandez-Molina) and geophysics (Saswata Hier-Majumder), that will reshape the department's research in these areas. Several staff are retiring at the end of this year (Andrew Scott and Steve Smith), and we anticipate they will remain active members of our teaching and research cohort. Next year we have been given the green light to hire a replacement for Chris as Director of Petroleum Geosciences, and, while Chris, like Graeme and Gary, is fundamentally irreplaceable, we look forward to welcoming a new department member to help us to deliver these important courses of instruction.

Our department's research infrastructure is also in the process of rejuvenation, starting with Matthew Thirlwall's successful effort to raise £350K for the purchase of a new TIMS mass spectrometer that replaced the workhorse instrument that was older than any of our current students. New research consortia have been built to look at sedimentological and margin-evolution aspects of the Southern Atlantic margins. Martin Menzies has led our department through the process of submitting a strong REF proposal, and I am looking forward to the next few 'REF-free' years of departmental research and teaching.

Now, as I head out to sea to pick up Ocean Bottom Seismometers that will hopefully(!) image the mantle roots of the Reunion Hotspot, I look back at a whirlwind year where our department has taught enthusiastically and well, done good research and worked hard to raise research support, borne as cheerfully as possible a large administrative burden, and worked to become an even stronger place for the future. Our staff and support staff have put in extra-hard hours this year to cover gaps during our transition in personnel, and host, for one example, a superb Petroleum Geoscience symposium. I hope everyone takes pride in the achievements and successful transitions this past year. Thank you all, and may you have a great 2014!"

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Andrew Scott's Retirement Conference, 14 September 2012

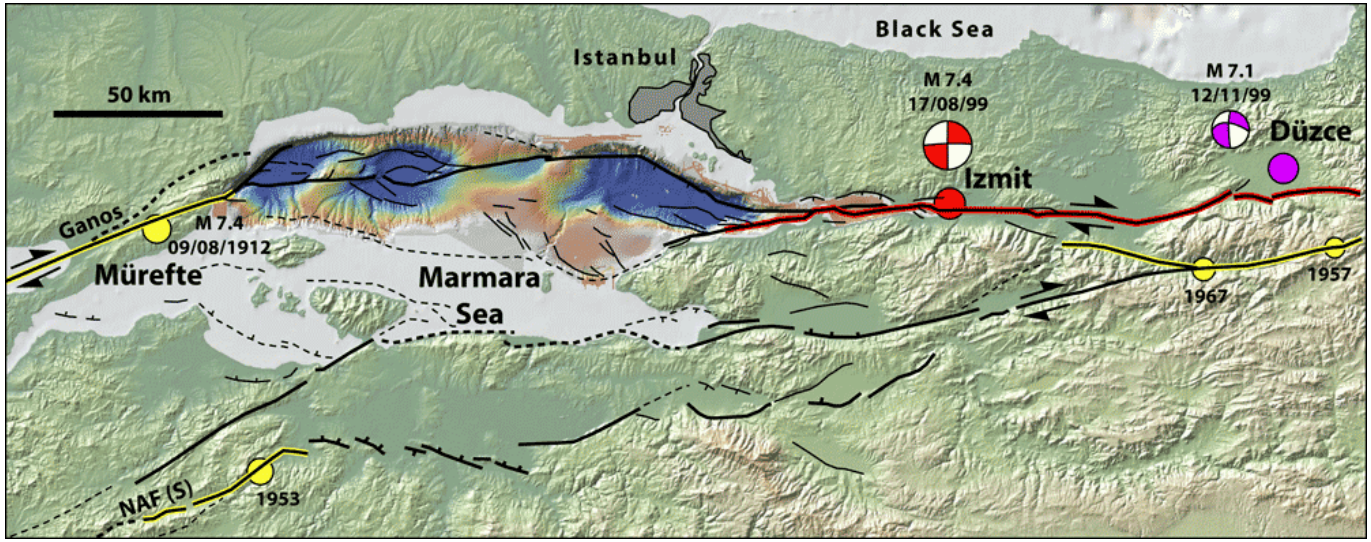
Speakers and Chairpersons. L to R: Ted Rose, Paulo Pereira, Claire Belcher, William Bond, Barry Lomax, Derek Siveter, Deborah Martin, Laura McParland, Chris Roos, Margaret Collinson, Jean Galtier, Andrew Scott, Nick Rowe, Brigitte Meyer-Berthaud, Richard Bateman, Bill Chaloner, Mark Hardiman, Bob Spicer

Andrew with some of his current and former research students

Andrew was introduced to geology when a schoolboy by Ted Rose and supervised as a student at Bedford College by Bill Chaloner, both of whom remain life-long friends and colleagues. Appointed to a lecture-ship in the Geology Department at Chelsea College in 1978, Andrew rapidly established his academic career, teaching and researching in palaeobotany. Early on he established a research collaboration with Jean Galtier and Brigitte Meyer-Berthaud at the University of Montpellier, which has endured. Margaret Collinson joined forces with him whilst at Chelsea. All met up again when the Department moved to The new Department at Royal Holloway, since when Andrew's career has broadened and burgeoned. He has taken an early "retirement" to concentrate on his research and this conference in his honour provided the opportunity to mark his many achievements.

Palaeoseismology along the North Anatolian Fault

Ian Watkinson



Western sections of the North Anatolian Fault, modified after Armijo et al. (2002), showing ruptured segments and major earthquakes of the last century, with Marmara Sea bathymetry from the IFREMER Le Suroit Survey (2000).

One hundred years ago, on 9th August 1912, a Mw 7.4 earthquake ruptured the western end of the North Anatolian Fault at Mürefte, Turkey, signalling the start of a remarkable series of large earthquakes along the 1500 km-long strike-slip structure. Between 1939 and 1999 almost the entire eastern and central section of the fault was ruptured during a further eight Mw ≥7.0 events, each involving up to 5 m of right-lateral slip. The sequence culminated in a Mw 7.4 earthquake at Izmit, at the eastern end of the Marmara Sea on 17th August 1999. This event caused widespread devastation very close to Istanbul and led to a period of intense study of the North Anatolian Fault. Even before the Izmit earthquake, it was clear that the rupture sequence was propagating westward towards Istanbul, with each new rupture initiating within the zone of elevated Coulomb stress at the tip of the previous event. Istanbul now straddles a 160 km-long seismic gap across the Marmara Sea, between the ends of the 1912 and 1999 ruptures, so there is significant interest in continuing to learn about how the fault behaves. To this end, the "Palaeoseismology Along the North Anatolian Fault (PANAF)" meeting was organised to bring together people studying the fault and other active strike-slip structures around the world. The meeting was held at the Istanbul Teknik Üniversitesi from 8th to 10th October 2012, to commemorate the 100 year anniversary of the 1912 Mürefte earthquake. Amongst about 50 delegates there were many well-known North Anatolian Fault experts, such as A.M. Sengör, Rolando Armijo, Aurelia Hubert-Ferrari and Cenk Yaltirak. The event was an opportunity to see the state of ongoing and future palaeoseismology projects, and to meet people using innovative ways to study active strike-slip faults. As it happens 1912 was also the year, 7000 km away, of the largest recorded earthquake in Myanmar (M 8.0, on the strike-slip Kyaukkyan Fault), providing a convenient opportunity for me to contribute a SE Asian example. Overall it was an interesting meeting, but perhaps in the light of the recent treatment of Barberi et al. in Italy, something that will become increasingly rare. I would like to thank the STAR consortium for funding my participation at the meeting.

View to the ESE from Süleymaniye Camii, across the eastern Marmara Sea and Istanbul.

1st NEMOH Network School

Ludwig Maximilian University, Munich

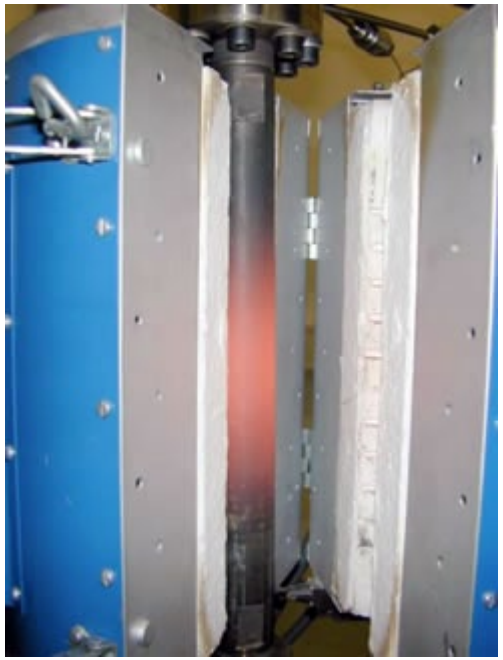
John Browning

In February I attended the 1st network school of NEMOH (Numerical, Experimental and Stochastic Modelling of vOlcanic processes and Hazards) at LMU in Munich. NEMOH is a Marie Curie initial training network designed to train the next group of European volcanologists. This school focused on experimental volcanology and data processing techniques: more information about the network can be found here **http://www.nemoh-itn.eu/.**

Volcanology is a multi-disciplinary branch of geological science which is still in its relative infancy; this fact is made particularly apparent when considering the range of volcanic processes for which we still have little understanding. Consider for example the first attempt by Einstein and Roscoe in 1952 to quantify the viscosity of magmatic fluids; only in the past 10 years has there been a real experimental dataset which has been able to build on a simple notion of a linear stress–strain relationship. At LMU in Munich, analogue materials such as silicon oil are used to test theories of how crystals and bubbles in magma affect relative viscosity. State of the art fragmentation equipment (right) is used to understand how the effect of viscosity controls volcanic eruptions. It is the viscosity of erupted products which is believed to be a primary control on the structure of volcanic edifices. This is important for the project I am conducting at Royal Holloway which is concerned with the collapse of volcanic edifices.

My visit to LMU would not have been possible without a grant from the departmental research committee. It is hoped that Royal Holloway will be represented at future NEMOH meetings and therefore continue to be a part of this exciting European network.

fragmentation equipment in Munich



Uniaxial press with heating

Volcano–ice interactions and Icelandic volcanism

John Browning

Zöe Barnett and I recently attended a conference at the Lancaster Environment Centre on Volcano–ice interactions and Icelandic volcanism. Both of us presented our latest research in the form of posters. The conference provided an informal setting for PhD students to showcase and discuss their research with each other and experienced academics. The subjects of talks ranged from developing our understanding of fracture patterns in entablature (cooled lavas) to quantifying the eruptive characteristics of historic Icelandic volcanoes in order to better prepare for future eruptions. Volcanic ash from the 2010 eruption of Eyjafjallajokull caused widespread disruption across Europe; however several volcanoes in Iceland may pose an even greater risk. In 1918, Katla produced an eruption which was over 10 times more explosive than Eyjafjallajokull. Research presented at the Lancaster conference showed how these huge eruptions were not necessarily a consequence of water/ice interaction but may be due to the unusually high concentrations of gases stored within the feeding magmas.

Dr Hugh Tuffen took time to show attendees around the thermal laboratory at LEC. This lab is used to cook and melt volcanic rocks to understand more about the processes of bubble growth, crystallisation and determine chemical contents of magmas. The lab features TGA (thermo gravimetric analysis), a mass spectrometer and a hot-stage microscope.

Zöe and I are part of the volcano tectonics group and our research focuses on how magma chambers form and volcanoes collapse, with much of their field data coming from Iceland.

Research School on Stromboli – *John Browning*

Last week I attended the first NEMOH field school on the Island of Stromboli. NEMOH (Numerical, Experimental and stochastic Modelling of vOlcanic processes and Hazards) is a European Union network designed to train the next group of European Volcanologists and the field school was provided to understand the challenges of monitoring an active volcano. Stromboli is the perfect island for this as it is one of the most active volcanoes in the world, erupting on average once every ten minutes (see figures below). Furthermore the island has a dense array of monitoring and surveillance equipment, as well as a permanent operational command centre. INGV (Instituto Nazionale di Geofisica e Vulcanologia) and The Civil Protection Department are tasked with monitoring the volcano and several representatives from both organisations were in attendance. Following two large eruptive episodes in 2002–2003 and 2007 the monitoring network of Stromboli was substantially increased, with several new instruments installed, which makes the volcano one of the best monitored in the world.

The main challenge at Stromboli in terms of monitoring is forecasting the occurrence of major explosive activity and paroxysms, which threaten tourists who visit the volcano and in the case of larger events, nearby settlements. An additional hazard is connected to the instability of the Sciara del Fuoco (photo right), which in 2002 collapsed into the sea producing a ten metre high tsunami which inundated the main town of Stromboli within a matter of seconds and reached the other Aeolian Islands and the mainland of Italy.

During the school I was given a unique insight into the multi-parametric nature of volcano surveillance by those who monitor and make decisions on levels of alert every day. A visit to the operational command centre (below left) provided me with an appreciation of the uncertainties and problems associated with many volcano monitoring techniques. Several practical lessons were given at the summit of the volcano, where we took measurements of ongoing activity using a variety of techniques, namely thermal cameras, high-speed imagery, gas plume FTIR, infrasonic microphones and broad-band seismometers (below right). Later we analysed data from dilatometers which measure strain in the edifice and tiltmetres as well as Ground Based InSAR and GPS.

All of the latter methods are useful for determining the deformation of the volcano, which is particularly important for understanding volcanic stability, of which I am concerned within my PhD project.

It is my view that whilst Stromboli is an exceptionally well monitored volcano, much of the monitoring is concentrated on shallow level conduit processes and the upper edifice. This is partly because most of the volcano is located below sea-level, providing a great challenge for monitoring larger-scale changes in the edifice, presenting significant problems

for understanding the volcano's chamber system, of which little is known. It is possible that a more effective forecasting tool for major explosions and paroxysms will be achieved by learning more about the deeper sub-surface processes at Stromboli and other ocean island volcanoes.

Heavy Mineral School in Milan

Inga Sevastjanova and Anna Bird

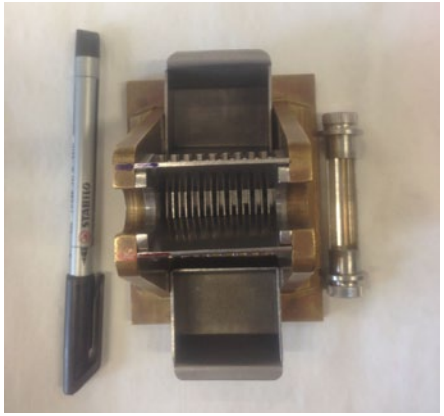
In early May most of the provenance community gathered in Milan for a meeting organised by Dr. Sergio Andò, Prof. Eduardo Garzanti and Dr. Luca Caracciolo from University of Milano-Bicocca and University of Calabria. The meeting started on what was a bank holiday Monday evening in UK with an ice-breaker party, in the Achille Castiglioni Museum, the studio of a famous Italian designer, who also happens to be Sergio's late father-in-law. Unaware about the Sergio's family connections in advance, many guests could not help wondering about the choice of the ice-breaker venue. The element of surprise, a brilliant collection of most unexpected design objects, delicious Italian food and the friendliness of the guests played positive tricks on our scientific curiosity and immediately reminded all of us about the best aspects of our jobs. To add to this, an entertainment programme included an Italian playing the Scottish pipes, not something that you would expect across the road from the Sforza Castle!

Weathered hornblende grain, used as a logo of the Heavy Mineral School in Milan and also as a scary face mask. Image courtesy of Sergio Andò.

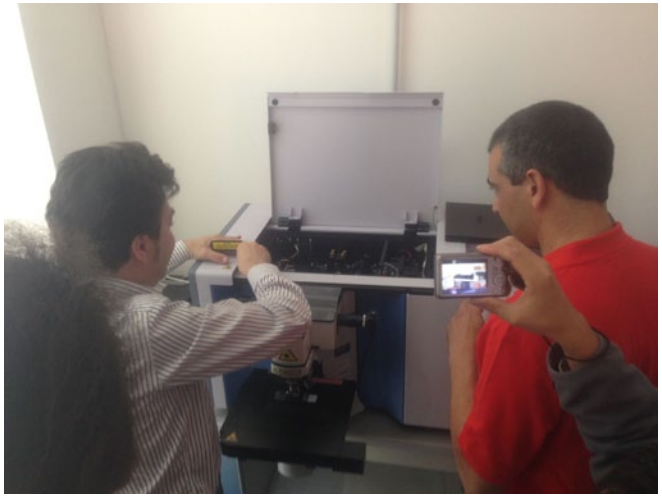
The Sforza Castle, Milan.

An Italian player of Scottish pipes, at the ice-breaker in the Achille Castiglioni Design Museum

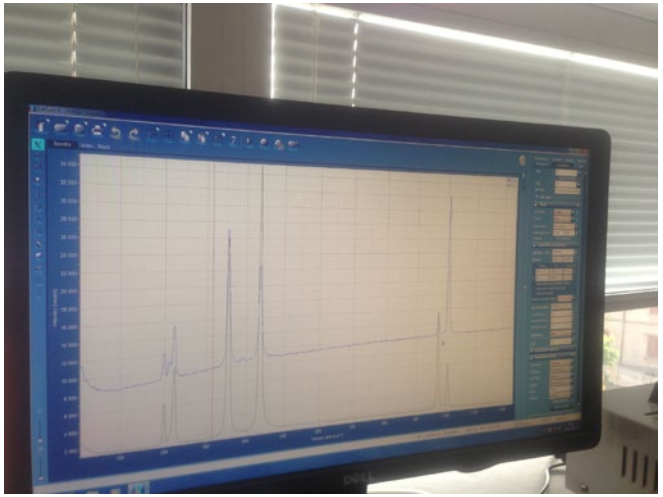
This atmosphere continued on into the meeting, when we could learn from Sergio, Eduardo, Captain John Dewey, Dr Andy Morton, Prof Hilmar von Eynatten, Dr Pieter Vermeesch, Dr Udo Zimmerman, Dr Danilo Besani, Dr Jenny Omma, Prof. Skip Pallenic and many other scientists experienced in all possible aspects of heavy mineral analysis, from optical microscopy, to geochemistry, Raman spec-



Sample micro-splitter used to reduce the size of the heavy mineral fraction before mounting on slides.



In the Raman laboratory.



Raman spectra of a zircon crystal.

troscopy, QEMSCAN, and even forensic science. It was also great to visit state-of-the-art heavy mineral separation laboratories, to have hands-on experience with mineral identification, using advanced conoscopic techniques and Raman Spectrometry, and to attend a poster session. The meeting was dedicated to the memory of Dr Maria Mange. Therefore, the evenings were full of shared memories about her remarkable life and work, which touched every person who was lucky enough to meet her. There was also plenty of time for Skip Palenik's gripping crime stories, such as the Green River Murders or the Case of the Maryland Serial Rapist, in which optical microscopy has played a critical role in solving them.
An inspiring experience!.

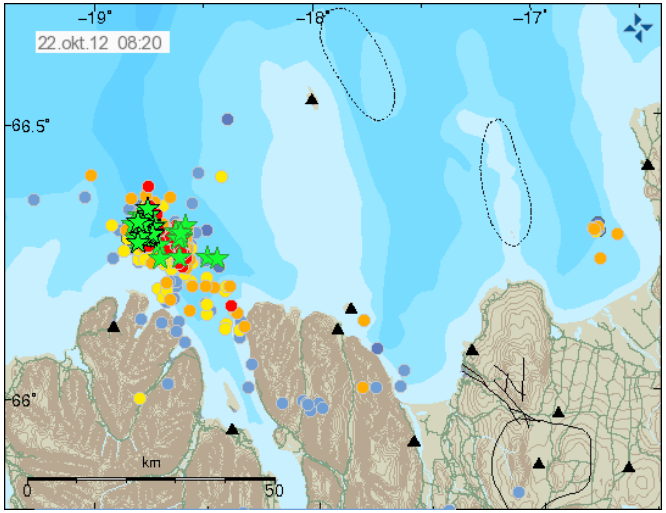
L to R: Sergio Andò, Maria Mange and Giovanna Castiglioni

Earthquake Risk along the Husavik–Flatey Fault, Iceland

Agust Gudmundsson

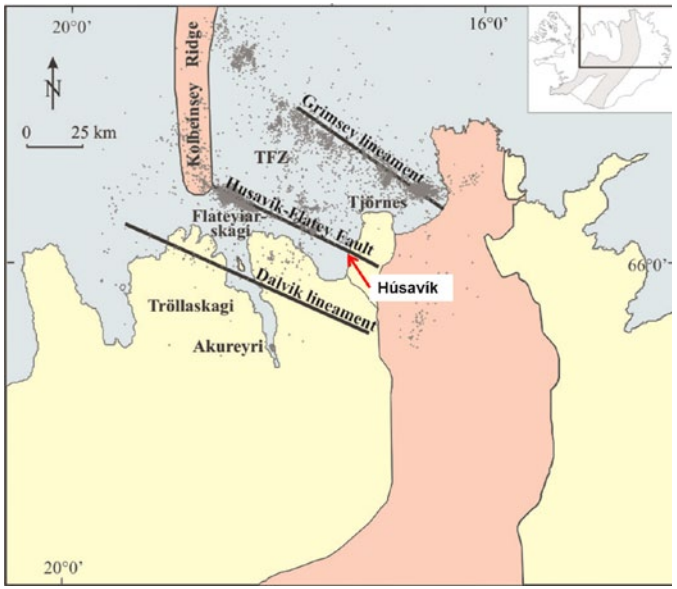
Very few oceanic transform faults can be studied on land; the best-exposed one is presumably the Husavik–Flatey Fault (HFF) which comes on land in North Iceland (see map). The HFF is a part of the Tjornes Fracture Zone, a complex transform zone, partly offshore and partly onshore North Iceland, and connects the Kolbeinsey Ridge north of Iceland with the onland rift zone in North Iceland. The total length of the HFF is about 120 km, its damage zone is about 2 km thick (with several fault cores), and the total offset (displacement) across the fault is many tens of kilometres. The fault is capable of generating earthquakes that reach at least M7 and may be considerably larger (possibly M7.3). It so happens that the main town in the area, Husavik, is located exactly on the fault, which has been subject to increasing earthquake activity in the past few years – including several earthquake swarms not far from the town of Husavik.

In early June there was an international meeting in the town of Husavik to discuss the likely near-future earthquake scenarios on the HFF and the associated hazards and risks. About 60 scientists from all over the world attended the meeting. In addition, there were representatives from the civil protection authorities and related departments in Iceland. The HFF is certainly



Seismic events recorded between 20 and 22 October 2012. Those with m>3 are shown as stars. This sequence lasted about a month. Data from Iceland Met Office

one of the best monitored seismogenic faults in the world. At and around the fault there are numerous GPS measurement points (to monitor the displacement across the fault), as well as seismometers, strainmeters, water-chemistry monitoring sites, and other data-gathering facilities. Because there is so little traffic in this part of Iceland, seismometers can easily be adjusted so as to detect earthquakes far below M1, in fact down to negative magnitudes. This is very important because experience from South Iceland indicates that the “foreshocks” for larger earthquakes, such as the two June 2000 (M6.6) earthquakes, may be mostly very small. In fact, for the 2000 earthquakes, most of the foreshocks were less than M1. By con-



trast, in the Parkfield earthquake-forecasting experiment (in California), where no precurors were detected before the 2004 earthquake (despite numerous monitoring instruments at and around the fault), the detected magnitude was apparently cut off at M1 – that is, earthquakes smaller than M1 were not considered.

The HFF has been the main research focus of several international projects, including EU projects. Because of glacial erosion parts of the fault can be studied in the field to a crustal depth of about 1500m, offering unique opportunities for comparing detailed field studies of the active with its currently monitored activity. Although much progress has been made, particularly in terms of long-term forecasting, the sober conclusion is that accurate short-term earthquake forecasting is still somewhere in the future.

Microbial carbonates in space and time: implications for global exploration and production

Geological Society of London, 19–20 June.

Arnaud Gallois, Estani Kozlowski and Erwan Le Ber

Microbialites are the oldest record of life on Earth, with the first evidence dated at ca. 3.5 Ga in Australia, they are still present today in well-known spots like Shark Bay and Lee Stocking Island. The economic interest around microbial carbonates has increased significantly after the discovery of highly productive fields in Pre-salt strata (Mesozoic), offshore Brazil in 2006. Such a discovery motivates industry to finance research, new projects and conferences such as the one held in June.

The Department was massively involved in this conference. Dan Bosence, Bernie Vining, Dan Le Heron and Erwan Le Ber were part of the organizing committee, preparing the event since June 2011. But organizing the event was not the only involvement of our Department: Gerd Winterleitner, Moises Muniz (now Petrobras), and Erwan Le Ber presented their research. Even the Department of Geography was there, with Sila Pla-Pueyo presenting a poster. It is noteworthy that among the students who attended the conference, only a few were based in the UK, yet most of them were from Royal Holloway. Our Department is therefore a pioneer in the new generation of geologists studying microbial carbonates, who were eager to enjoy the show at the Geological Society.

Bernie Vining (Baker Hughes) introducing the conference.

Microbial reefs exposed in South Namibia

And what a show! 33 presentations (22 oral + 11 poster) went through space and time to present their work on microbial sediments, covering observations from the nanoscale to the basin scale. Key geological themes were represented: biogeochemistry, sedimentology, diagenesis, well data and seismic interpretation, petrophysics and reservoir modelling. A lot of questions and discussions around these sediments were raised; are they marine or non-marine? Are they microbial or not? What parameters control microbial facies and textures? Are analogues relevant with producing fields? We do not know all the answers yet, but their understanding is moving fast forward and microbial carbonates promise to be an exciting line of research for the next decades. And the best evidence at the moment is the interest in such a conference with researchers and engineers from all over the world gathered in Burlington House. The place that hosted the first public reading (1st July 1858) of Charles Darwin's theory of evolution.

Perhaps we shall have a new beginning, 155 years later on, in Darwin's footsteps.

Greenhouse Gas Measurement Techniques (GGMT–17)

Beijing, 10–14June 2013

Dave Lowry

The greenhouse gas meeting is organized every two years on behalf of the World Meteorological Organization and this was the first time that it has been hosted in China. The meeting was attended by 120 delegates from 40 countries, coming together to discuss new measurement techniques, changes in calibration scales, improvements in precision, the development of new networks and lots of other exciting topics. My taxi ride to the hotel was a nerve-wracking 80 minutes in bumper-to-bumper traffic, which combined with the jetlag meant that I slept through the rain of the first day until the ice-breaker. Three and a half days of talks, posters and breakout sessions were punctuated by a lab visit and chances to discuss new collaborations. Top of the wish list are a Southern Ocean ship network involving Australia, New Zealand, South Africa and the UK, and a SE Trades network involving Cape Point South Africa, Namibia, Ascension Island and Brazil.

Conference group photo outside the Chinese Meteorological Administration building

Two evenings were kicked off by banquets, with as much as you can eat in 2 hours, and a lot of debate into what we were eating.

The final afternoon is traditionally reserved for a discussion of the recommendations for the next two years, which tends to start at the meeting and then continue by e-mail for another year before publication. I chose to give this a miss as I had little tourist time in Beijing, so I took the excellent subway system and visited the Forbidden City and Tian'an Men Square. Fortunately the smog of the previous week had cleared and visibility allowed some good

Forbidden City, Beijing

View of Forbidden City looking South

Shiangdianzi GAW regional station

Jinshanling Great Wall – plenty of steps to think about

Jinshanling Great Wall – goes on and on and on

views. The following day was the conference field trip, consisting of a 2.5-hour drive starting in Beijing rush hour to the Regional Global Atmosphere Watch (GAW) station at Shangdianzi. This is one of a number of developing Chinese regional stations that has had huge amounts of money thrown at it in recent years; the new building has marble floors, a chandelier, a new 80 m high sampling tower, and an accommodation block for staff is being built. These stations in most parts of the world consist of a shipping container and a mast on a rocky headland. The cash-strapped UK and Spanish delegates, battling to maintain measurement stations, were soon crying into their tea. Lunch consisted of about 20 dishes in 45 minutes before we took a 20-minute drive to the Jinshanling section of the Great Wall. This is one of the best preserved sections of 500 year-old wall, although a lot of the walkway seems to have been replaced in the last 30 years according to the lady who followed me all afternoon trying to sell me souvenirs.

My final morning was an early start to fit in the Summer Palace, built around a very large man-made lake and a hill constructed from the dredged material. This place has something for everyone from dragon boat rides on the lake, hilltop temples, entertainments and local crafts.

Food for thought: nothing for the gluten-free – Fieldtrip lunch

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Dragon boat and 17-arch bridge, Beijing Summer Palace

Traditional music and dance at the Summer Palace

Hong Kong and Kowloon across bay from the Lugard walk

Euan Nisbet had persuaded me to take a detour to Hong Kong on the return to visit a potential monitoring site at Cape d'Aguilar on the SE corner of Hong Kong Island, looking out over the South China Sea and next stop Philippines. First I had the whole of Sunday to take the Star Ferry to Kowloon before crossing back to take the old cable car up to the ridge and do the circular walk of Victoria Peak with views around the west end of the island. The director of the Swire Marine Science Institute collected me the following morning and gave me the grand island tour before reaching the site, which, despite being only 6–7 miles as the crow flies from the centre of the city has a bigger population of cobras than people. I checked out the roof for a possible airline inlet and some of the rooms for a place to put an instrument. Bag sampling is due to start at the site as soon as we can get sampling kit over there and hopefully we will start continuous measurement of CO_2 and CH_4 at the site later this year or next. After another afternoon in the steaming hustle and bustle I was ready for my overnight flight back to Heathrow.

Swire Marine Science Institute, Cape d'Aguilar Hong Kong Island

Granodiorite, basalt dykes and volcanics, Cape d'Aguilar

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Gary Nichols' Final Seminar

Gary completed 23 years in the Department with a final seminar on 27th November, 2012 presented to a packed audience in QB240 – standing room only! He gave a fascinating talk and here is the Abstract:

"Most of the time not much happens – rates of deposition in fluvial systems

Faced with a few metres of beds of sedimentary rock, a perfectly reasonable question is "How long did it take to deposit that?" It is also not an easy question to answer. In fluvial sediments a study of modern processes provides some information: analysis of time-lapse satellite imagery shows how packages of metres of sediment can be deposited on a basin plain over tens of years. However, extrapolating into the record of sedimentation over the last few 10s to 100s ky can be misleading: the Quaternary is not very 'typical' of most of the Phanerozoic because of the high magnitude and high frequency of climate and sea level fluctuations. So what can be done?

The Miocene of the Ebro Basin, northern Spain, provides a natural laboratory for the study of fluvial processes in the past. First, the strata are well exposed and whole depositional systems can be traced over thousands of square kilometres. Secondly, it was a basin of internal drainage, so all the sediments that went in stayed there: this makes it possible to make mass balance determinations and work out system-wide rates of erosion and deposition. Thirdly, a palaeomagnetic reversal chronostratigraphy has been established in lacustrine facies that are coeval with the fluvial deposits. Because of all this, the rates of sedimentation can be worked out to be an average of about 90 mm/ky in the Early Miocene (and, incidentally, by reconstructing the drainage area, the erosion rates in the adjacent mountains can be estimated to have been about 60 mm/ky).

But, what does this average rate actually mean? It certainly does not mean that in every thousand years another 90 mm of sediment was added at any point. The behaviour of modern rivers suggests that packages of metre-thicknesses of sediment are deposited in a matter of tens of years. However, the data from the Ebro Basin indicate that a 10 metre succession represents over 100 ky. This means that the beds of sedimentary rock are fluvial deposits that represent only one tenth of a percent of the time at any point: 99.9% of the time, nothing was happening.

Perhaps the biggest puzzle is why it has taken me 30 years to figure this out….."

Following the seminar, Dave Waltham presented various gifts for Gary, on behalf of the Department. In addition to certain libations, these included an inscribed ammonite and two beautiful photographs, one of Gary on fieldwork in the Pyrenees, the other of Founders Building. Then came a drinks reception, provided by Gary, to complete the occasion in style!

Underground at Hay Tor

Dave Alderton

Hay Tor, on the southeast margin of the Dartmoor Granite in Devon, is a well-known granite tor and a favourite for geological field trips. Indeed, our 1st years sometimes pay it a visit on the Torquay field trip. However, not many people (even locals) know of its mining history. Some households in the village of Haytor Vale learned the hard way when their gardens started collapsing into the disused workings! (It always amazes me when people build on old mine workings and then are surprised when something untoward happens).

Because of issues regarding house insurance, the old workings must be inspected regularly by engineering geologists to monitor their stability. I accompanied them on their recent visit underground and the photo shows one of the zones where the mineralization has been extracted ('stopes') plus a roof support ('pillar') conveniently left behind and showing the ore zone. The Hay Tor mine worked magnetic iron ore, probably from the 16th Century up until the late 19th Century, at first from the surface and then at progressively deeper levels (down to about 80m below ground level). The deposit takes the form of beds containing magnetite, garnet and amphibole and the stratiform nature is clearly seen in the image. There has been some debate about the origin of this deposit, but its form and mineralogy suggest to me that it is a 'skarn' deposit, formed by granite-related fluids replacing more calcareous lithological horizons in the Carboniferous sediments. Fortunately for the house-owners above, the workings seem stable at the moment. Their gardens are subsiding slightly but this seems to be settling of loose fill material rather than collapse of the older workings.

Bringing Climate Science into Government Policy

Research seminar by Dr Chris Sear

Derek Blundell

Dr Sear gave us a fascinating insight into his work in the Department of Energy and Climate Change (DECC) as Head of Climate Science. His prime task, and that of his team, is to inform and advise Government policy makers to enable them to devise policies that are based on the best and most reliable data available: then, to provide effective policy development as science advances. DECC's main priorities lie in two areas: how best to reduce dangerous levels of global warming by means of a low carbon economy at least cost; and how best to deal with shortfalls in supplies of safe, affordable energy. Means to achieve these involve the Green Deal, smart meters, renewables, low carbon heat, new nuclear energy, CCS and a range of other possible measures. He reminded us that the scientific evidence indicates that time has almost run out on limiting global warming to no more than 2°C by 2100, despite the UK's own efforts to drive international action. DECC policy is formed and evolves in the real world. DECC has to operate within the global context as well as the national one. One of his tasks, therefore, is to get policy makers to understand the implications of climate change. He is particularly concerned to emphasise the changing risks of extreme events. He pointed out that climate science is highly complex and highly technical, requiring integrated systems analysis and a multidisciplinary approach. He gave us a number of examples where improvements in data analysis led to higher resolution models that could more realistically match actual observations and lead to better understanding of the processes involved. His team are proactive in commissioning new research focused on areas of specific interest to DECC, for example, in the Arctic, on ice sheets and ice dynamics, also on permafrost. Equally, DECC needs to be interactive, both in dealing with innumerable questions from politicians, business and the general public, and in seeking expert advice from academics and other sources, both nationally and internationally. A major challenge for his team is to find sufficient funding to provide the high performance computing needed to underpin the commissioned research conducted by the Met Office Hadley Centre to model climate processes more precisely and accurately. Much has been done already but there remains much more to do.

Lyell Day – a Review

1st March 2013

Cíaran Gilbride and Huw Richards

The Lyell Symposium, entitled "The Impact of Geology on Life and Evolution", started bright and early at 9 am. It had been eagerly anticipated by many after the display of some fantastic posters created by Sam Fortune. The day kicked off with our very own Dr. Dave Waltham and Dr. Nathalie Grassineau giving talks on Earth's suitability for life and 3 billion years of bacterial life, respectively, setting the scene for future evolution.

Following the morning coffee break, we resumed the timetable of lectures with Prof. Laurence Robb (from Oxford) and his talk looking at metallogony with reference to life in the deep-freeze during Snowball Earth. Then, Head of Department, Prof. Jason Morgan spoke about his theory on Verneshots and their association with flood basalts and mass extinctions, which suitably introduced the final talk before lunch, given by Dr. Paul Barrett of the Natural History Museum, on new insights into the recovery of life, particularly dinosaurs, after the end Triassic boundary.

A buffet lunch of sandwiches, cakes and drinks from Deli Rumbles was held in Room 205 for the attending guest lecturers, staff and double discount members as a chance to relax between lectures and network with one another. The final trio of presentations of the symposium began with Dr. Phillip Pogge von Strandmann speaking about the continents' effect on climate, ocean chemistry and mass extinctions, which was followed by Dr. Frances Westall who, after working with the ESA, discussed habitability and potential life not on Earth, but on Mars! The symposium was concluded with Prof. Randy Parrish's insights into uranium and its effects on both the environment and personnel who took part in recent conflicts.

The Committee would like to formally thank the generous donations for Lyell Day 2013 from the following: the Alumni Fund, BG Group, BP, Neftex and Statoil; without such contributions, this symposium would not have been financially possible.

The evening's festivities began at 7 pm in Founders Building's Victorian Corridor with a Sparkling Wine reception, and slowly, Dinner Guests began to take their seats at around 7:30 pm in the prestigious Picture Gallery. The 3-course banquet began with a selection of roasted Mediterranean vegetables, followed by either the tender roast breast of Gressingham duck or the smooth wild mushroom cannelloni, both served with seasonal vegetables and roasted potatoes.. The main course preceded the long-awaited chocolate dessert, the beautifully rich duo of chocolate mousse!

The dinner was a roaring success with, once again, well over 100 in attendance. Over tea and coffee, there were a number of speeches: a vote of thanks by the President, Huw Richards, the announcement of the photo competition, a look towards the future by Jason Morgan and finally by our esteemed guest of honour, Lord Lyell, who was humbled to have been invited to "one of his most memorable events".

dinner in the Picture Gallery

dancing afterwards in the Dining Hall

To conclude the evening, guests walked over to the Dining Hall where excellent live music was provided once again by GoldHeart Assembly performing a stunning set. Students, postgraduates, guests and staff all mixed together on the dance floor, which epitomises the closeness and tightly-knit community of the entire Department.

All in all the day was a massive success, and the current feedback has been overwhelmingly positive.

Royal Holloway University of London

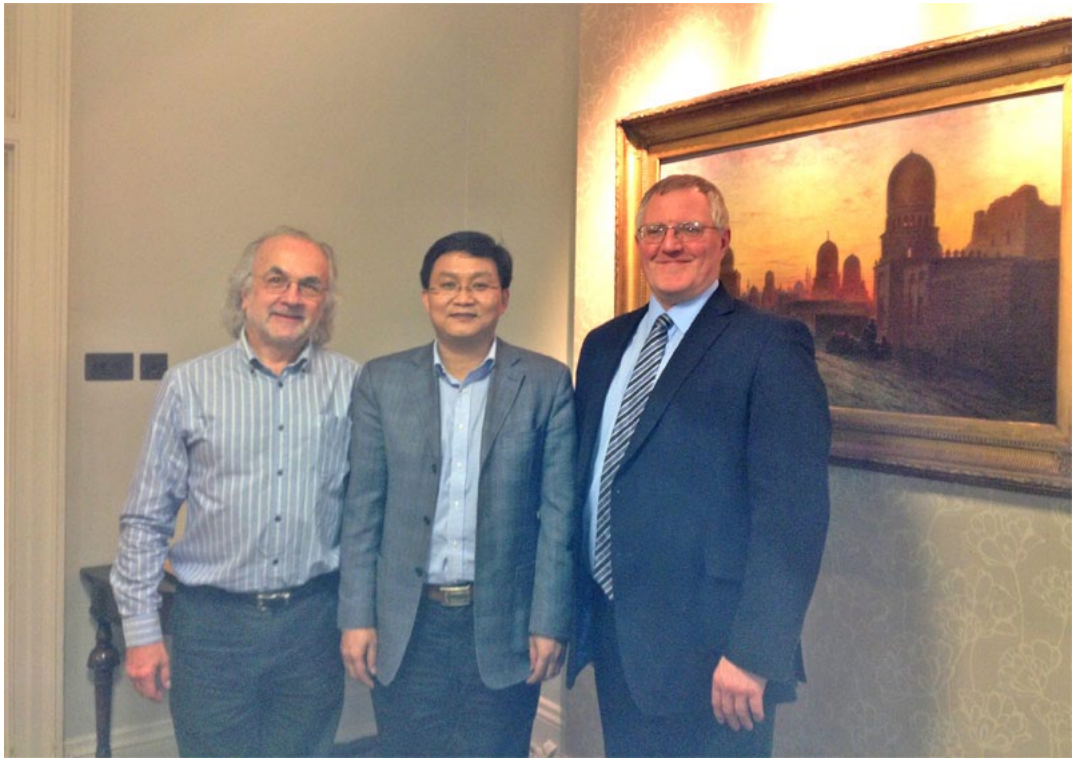
Guangzhou Institute of Geochemistry Chinese Academy of Sciences

Guangzhou Institute of Technology–Royal Holloway Joint Research Centre Established

Martin Menzies

In late March 2013 a memorandum of understanding was signed between Prof. Paul Layzell, Principal of Royal Holloway, and Professor Xu Yi Gang, Director of Guangzhou Institute of Technology (GIG)–Chinese Academy of Sciences (CAS). The plan for a joint research centre is underpinned with PhD funding from GIG–CAS and Chinese Scholarships from RHUL for co-supervised Chinese research students (MPhil/PhD). Two projects will begin in 2013–14: Computational dynamics of the North China Craton (Morgan & Xu), and Chinese lakes as environmental archives (Menzies & Xu).
Reciprocal visits to Guangzhou are planned for RHUL co-supervisors and the intention is to expand the programme over the next 5 years to 15 students. Co-operation will be carried out through the following activities:

- Research collaboration between members of academic staff at a departmental and institutional level
- Joint PhD programmes and projects with co-supervision of candidates by academics from both institutions
- Sharing of research facilities and exchange of methodologies
- Staff exchange for purposes of research planning, data acquisition and publication.
- Staff visits to allow for provision of lecture programmes, seminars, workshops, colloquia and academic meetings
- Joint research publications
- Development of special academic progression pathways for postgraduate students
- Student exchange at postgraduate levels



In March 2013 Prof Xu was appointed as a Visiting Professor in Earth Sciences. He completed his PhD in 1994 at IPG Paris with Jean Claude Mercier and was a Royal Society fellow with Martin Menzies from 1994–1996 during which time he undertook research on deep lithosphere evolution beneath eastern China. Research collaboration has continued for the last 20 years with several exchange visits between GIG–CAS and RHUL, resulting in many joint publications and a CAS funded craton meeting in Beijing 2011 marked with two special volumes of *Gondwana Research* and *Lithos* in 2012.

”I live on the Sagaing Fault”

Ian Watkinson

On 11th November 2012 a Mw 6.8 earthquake ruptured the Sagaing Fault at Thabeikkyin, 100 km north of Mandalay, Myanmar (still referred to by colonialist western media as Burma).

Most of Myanmar’s population lives close to the Sagaing Fault, which passes east of Yangon (previously Rangoon) and directly through the cities of Bago, Nay Pyi Taw, Sagaing and Mandalay. Fortunately the November earthquake occurred in a remote and largely rural part of the country. Nonetheless it killed 26 people, injured 231 and left the area in ruins.

During the course of recent fieldwork I had the pleasure of meeting – and drinking copious amounts of tea with – hundreds of people who live along the ruptured segment of the Sagaing Fault. I’d like to give a flavour of their life after the earthquake and relay some of their stories:

“We live on the Sagaing Fault in Thabeikkyin. Half of our house is attached to SE Asia and the other half is attached to India. During the earthquake the western half shifted over half a metre to the north.”

Left: “We live on the fault in Ponna village. These fractures appeared throughout the village during the November earthquake. Our water well dried up and has not produced anything since then.”

“These fractures opened up during the earthquake and my house was badly damaged. The fractures were over one metre deep so I filled them with soil so the children wouldn’t fall into them.”

“The step behind us was a fracture that formed during the earthquake. It snakes through the houses here in Yemyet. Liquid mud poured from the fracture during the earthquake.”

“Our field lies on the fault. The centre of the field subsided by over 1 metre during the earthquake. Our water well dried up so now we get water from the Ayeyarwaddy river, an hour’s walk away. The river is full of human waste so even now our health is at risk as a result of the earthquake.”

“My house is directly on the fault. The floor of my house was cut by deep fissures. I levelled the ground with bricks from a fallen wall. These wooden posts support my house and used to line up, but have been displaced by dextral slip. The water tank behind me used to be the same height as I am, but subsided during the earthquake.”

“We live in Male town which was badly damaged because it is built on a steep slope dipping into the Ayeyarwaddy River.”

“I’m utilising my new side door, on my way to have an evening bath. My house is of the typical bamboo construction for this area. Although it is still habitable, like many similar buildings it was distorted and now requires more repair work than I can afford.”

“I live in Male too. This house was on wooden stilts on a concrete base, but it was flung to the ground during the earthquake.”

“My shop in Thabeikkyin city was built in the brick nogging style. Bricks filled the spaces between timbers but were not well tied to the frame so they were ejected during the shaking. Insurance is unheard of here so I continue to work from the ruins.”

“I live on the Sagaing Fault, in Yeeshin village. A traditional and still widespread belief here is that earthquakes are a form of divine punishment. We are afraid that there will be another earthquake.”

“We are building a new bridge over the Ayeyarwaddy river, which flows parallel to the fault. Eleven of our colleagues died in November when an earlier attempt collapsed during the earthquake.”

“Large fractures formed in my field at Ywe Tharyar during the earthquake. Two weeks ago I ploughed and planted it, but recent heavy rain and aftershocks have caused renewed subsidence and the reappearance of fractures.”

“I am picking peanuts from the edge of this sweetcorn field close to my house. Large fractures appeared in the field during the earthquake, and the bounding fence is now bent.”

“We live in a monastery on the side of a steep hill. The monastery was badly damaged in November and there were lots of landslides on this slope. Every time there is an aftershock there are more landslides. The senior monks say this is a sacred place, so we are safe living here, aren’t we?”

“I own a noodle shop at Taung Ka Byet village. My house and shop slipped partly into the river as the banks collapsed during the earthquake. I am concerned that there will be further slippage when the rainy season starts later this month.”

“I am Thein Taung pagoda. Perched on a precarious hill, my associated monastery and I sustained major damage during November. The monastery is being rebuilt and monks continue to live on these unstable slopes.”

“My name is Lin Thu Aung and I work for the Myanmar Earthquake Committee – the only such organisation in Myanmar and manned entirely by volunteers. I am providing education about earthquakes to people such as these farmers who live along the fault.”

NERC RESET Consortium: Finale Meeting

Martin Menzies

In 2008 the NERC supported a major consortium involving scientists from Royal Holloway University of London (Earth Sciences & Geography), the School of Archaeology in Oxford University, the National Oceanography Centre and the Department of Archaeology in Southampton University, and the Natural History Museum. The RESET multi-disciplinary consortium brought together specialists in human palaeontology, archaeology, tephrochonology, oceanography, volcanology, geochemistry and paleoclimate in order to investigate how our ancestors coped with rapid changes in climate/environment and volcanic eruptions during the last 80,000 years.

On 6–8th June 2013 all RESET scientists and collaborators from across Europe gathered at the British Museum for a three-day "Finale" science meeting. This three-day meeting was held to explore the links between abrupt environmental change and human dispersal and development during the Middle and Upper Palaeolithic periods. The principal outcomes of the RESET project were presented and project members and associates took stock of what we understand about the links between humans and abrupt environmental change. The Open Science Meeting (Thursday 6th and Friday 7th June) was attended by ca.110 scientists and the Public-Engagement–with-Science Day (Saturday 8th June) drew an audience of ca. 225 interested members of the public. Alice Roberts gave a guest lecture on "Ice Age Giants".

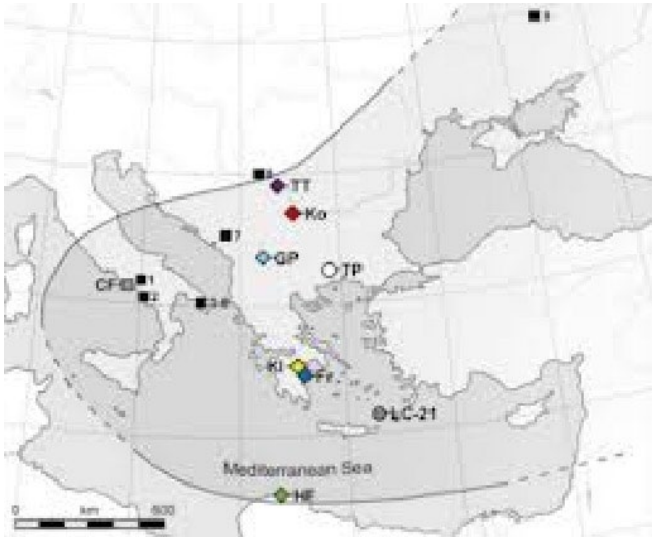
Within RESET, Earth Science staff (Menzies, Müller, Thirlwall, Tomlinson, now at Trinity College Dublin, Albert, Todman, Cross) worked on the geochemistry of tephra "glasses", fundamental to the project. They used in-house LA-ICPMS (Wolfgang Müller) with links to the electron probe at Oxford (Vicki Smith) for major/minor elements and the ion probe in Pavia (Luisa Ottonello) for trace elements in particles too thin and/or small for analysis by the LA-ICPMS. Emma Tomlinson (Trinity College Dublin) worked closely with all the RESET scientists, establishing protocols for geochemical analysis. Paul Albert (now a PDRA at Oxford Archaeology) tackled Central Mediterranean marine–continental correlations and targeted many of the key tephra markers for re-investigation. Anna Todman (now at the Natural History Museum) worked on the temporal and spatial variability of the explosive and effusive deposits on Vulcano. Jo Cross (final year PhD at RHUL) unravalled the magmatic history of the highly explosive Colli Albani volcano, Rome. Two joint PhDs with Prof John Lowe (co-ordinator) in Geography used tephras in lake and marine cores. Chris Satow (now at the NHM) investigated tephra-bearing Mediterranean cores and links to environmental/climate records. Mark Hardiman (PDRA at RHUL) worked on lacustrine cores in eastern Europe, investigating the causative links between environmental and climate change using tephras to "fix" time.

RESET scientists on Vesuvius

Some headlines with a slight volcanological bias:

Did the Neanderthals die out because of environmental change or the Campanian Ignimbrite (CI) super-eruption which deposited ash as far as the Urals?

We demonstrated using tephrochronology that Neanderthal "industries" existed post the CI eruption indicating that, in places, they survived both major eruptions and a significant change in climate (colder and drier) at that time (39 ka). Their eventual



Neanderthal image and the extent of visible ash from the CI eruption

demise must have had more to do with the superior skills of anatomically modern humans.

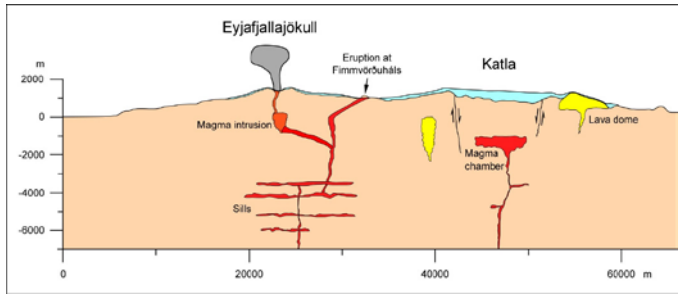
How can ash "chemistry" be used to "date" distant ash layers?

Deposits on the slopes of volcanoes are studied and the chemistry of the volcanic glass is characterized for a range of major, minor and trace elements producing a "fingerprint". This is then compared with the chemistry of distal glasses found several 1000s km from source occurring as either visible tephra or invisible crypto-tephra. A statistically valid chemical match allows for ages to be exchanged. Proximal and distal deposits can be dated by (a) $^{40}Ar/^{39}Ar$ using sanidine phenocrysts; (b) bracketed with ^{14}C ages on charcoal produced by burning of vegeta-

Volcanic ash or tephra <4 mm

tion during deposition of hot pyroclastic flows, and (c) annual records in varve deposits in lakes and ice cores. An exchange of ages and cross-validation of ages using several chronometers allows us to resolve time, in some instances, to a centennial scale

Given Eyja's eruption in 2010 what about its "scary" neighbour Katla?



Eyja erupting in 2012 and a cross-section of Eyja and Katla

Eyja's neighbour, Katla is a major sub-glacial volcano with a violent past. RESET demonstrated that the last time Katla's caldera failed (10–12,000 years ago) significant ash was deposited across Europe from Norway, eastward to Poland and southward across Europe to Italy. Bearing in mind that Eyja's eruption left no visible ash in most of Europe the societal impact of future eruptions would be major.

What about Mt Etna's impact, since it is continually erupting?

Etna overlooking Catania

Mount Etna is one of the world's most active volcanoes and is dominated by lava fountaining associated with lava flows that destroy property in and around the volcano. Although much of the impact is local it can lead to closure of the airport at Catania. However 16,000 years ago two major explosive eruptions (perhaps similar to Vesuvius) sent significant ash clouds across the Mediterranean to Africa and beyond, and across the southern part of Italy to the Adriatic. Undoubtedly should this happen again, and there are no signs that it will, given the regularity of eruptions, it would significantly impact on the economy of the Mediterranean region.

The 16–18 ka old Biancaville ignimbrite

Thanks to our European-wide tephra network involved in our work package, without whom this work would have been impossible:

Erkan Aydar & Evren Çubukçu, Hacettepe University, Ankara (*Turkey*); **Richard Brown**, University of Durham (*Ischia*); **Mauro Coltelli & M. Deborah Lo Castro**, INGV, Catania (*Etna*); **Raffaello Cioni,** Universita' di Cagliari, Italy (*Vesuvius*); **Rosanna DeRosa & Paola Donato** Univ Cozensa (*Tyrrhenian Coast*); **Alessandro Di Roberto**, INGV, Pisa (*Tyrrhenian Sea*); **Ralf Gertisser**, University of Keele (*Azores*); **Guido Giordano**, Roma Tre, Rome (*Colli Albani Rome*); **Mike Branney & Nina Jordan**, University of Leicester (*Pantelleria*); **Jörg Keller** Univ Freiburg Germany (*Ionian Sea*); **Helen Kinvig, Jo Gottsman & Jon Blundy**, University Bristol (*Nisyros*); **Michael Marani**, ISMAR, CNR Bologna (*Tyrrhenian Sea*); **Giovanni Orsi, Lucia Civetta, Ilenia Arienzo, Antonio Carandente**, INGV Naples (*Vesuvius, Campi Flegrei, Ischia, Pantelleria*); **Mauro Rosi & Giovanni Zanchetta**, University of Pisa (*Campi Flegrei, Vesuvius*); **Ioan Seghedi**, Institute of Geodynamics, Bucharest, & **Alex Szakacs**, Sapientia University, Romania (*Ciomadul*); **Roberto Sulpizio** University of Bari (*Campi Flegrei*); **Thor Thordarson**, University of Edinburgh & Reykjavik (*Iceland*); **Sabine Wulf**, Potsdam (*Campanian*)

South Atlantic seafloor depth through time

Lucia Perez-Diaz

The German SAMPLE Programme (South Atlantic Mantle Processes and Links with onshore Evolution) held a colloquium in Heidelburg from 11th to 14th June to bring together professionals from the field of geology with a common research interest in the tectonic evolution of the South Atlantic Ocean. Some of the topics discussed were the influence of mantle plumes on the dynamics of rifting, advances in lithosphere modelling and the influence of passive margin evolution on hydrocarbon generation and leakage. I presented a poster at the colloquium entitled "Seafloor depth through time in the South Atlantic"

Abstract: Accurate and reliable tectonic models describing plate motions from Early Cretaceous to present are key for this project's main aim: to develop palaeo-bathymetric models of the ocean's conjugate margins, depicting the topography of the ocean floor. Knowledge of past plate motions provides the key for modelling palaeobathymetry by allowing us to construct a high-resolution age grid that will in turn be the base for modelling thermal subsidence. However, many other factors affect bathymetry at smaller temporal and spatial scales, both within the ocean and at its margins. Assessing and quantifying these processes is key to increase the resolution and accuracy of palaeobathymetric maps. Understanding ocean topography is essential if its role in palaeoclimate change is to be properly understood. Also, it will shed light on the tectonic and stratigraphic processes that shape basin evolution on its rifted margins.

MSc Course Symposia

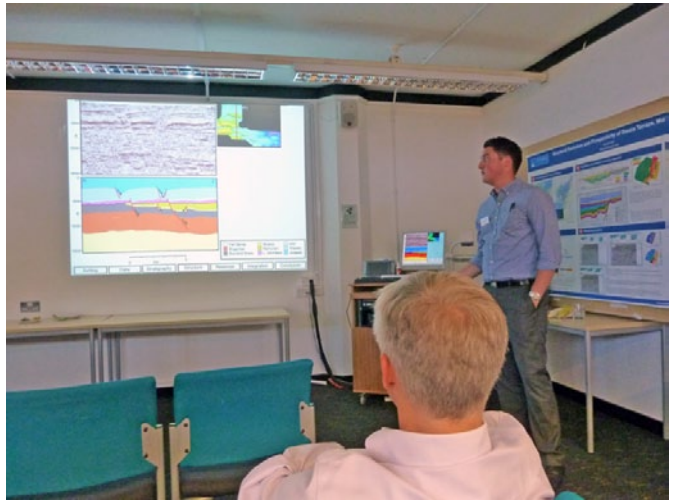
Symposia were held on successive days, 4th and 5th September, for the MSc Course in Environmental Diagnosis and Management and the MSc Course in Petroleum Geoscience. Both included oral presentations by the students, followed by questions from audiences that included visitors from industry, many from companies that had sponsored the research projects and provided data and facilities. Both symposia were of a very high standard, forming the culmination of their studies for the year.

Environmental Diagnosis and Management

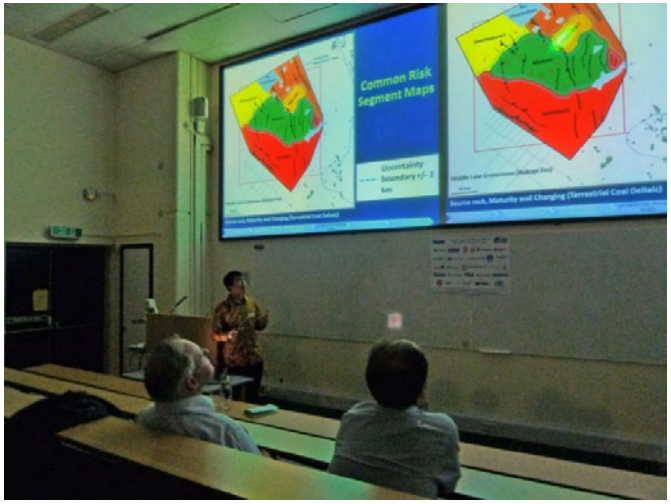
Ten students presented their project work, covering a diverse range of subjects. These included the control and management of Mountain Pine beetles in a National Park in Canada that could decimate tree growth, monitoring and analysis of methane leaking from landfill sites, understanding and encouraging earthworm populations to promote plant growth, assessment of groundwater conditions at a disused gas works site. monitoring changes in water quality along stretches of the Thames, and the impact of frossil fuel CO_2 emissions on natural ^{14}C concentrations.

Petroleum Geoscience

Thirty two presentations were crammed into a very full day of talks, including some parallel sessions, supported by poster displays, to a large and receptive audience in the Queen's Lecture Theatre. Reflecting the wide range of student's nationalities, the subject matter of the presentations covered the globe, as illustrated by the session headings: Southern Atlantic Basins, South America, Northern North Sea and North Atlantic Margins, Southern North Sea and onshore UK, Mediterranean and Africa, Southeast Asia and Australasia. Presentations involved a considerable amount of sesimic and well-log interpretation, attribute analysis and numerical modelling in studies ranging from structural analysis and fault networks to stratigraphic interpretations of basin evolution, together with evaluations of hydrocarbon prospects and risks.



James Wiltshire explains the structural evolution of the Cordillera Oriental foothils, Colombia

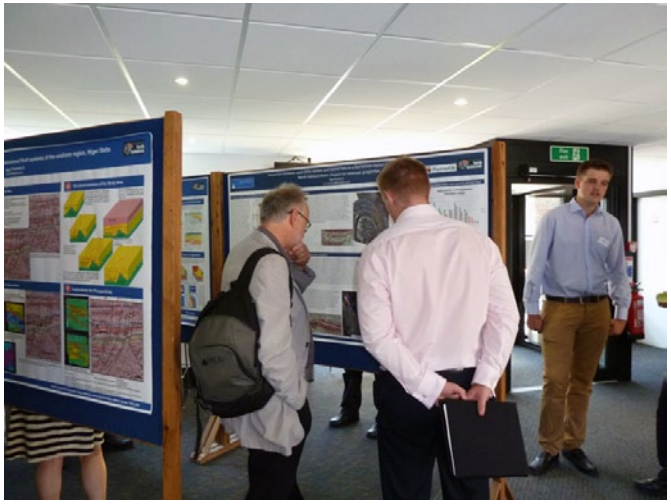


Mulki Winata discusses the hydrocarbon potential of the deepwater Taranaki Basin, New Zealand

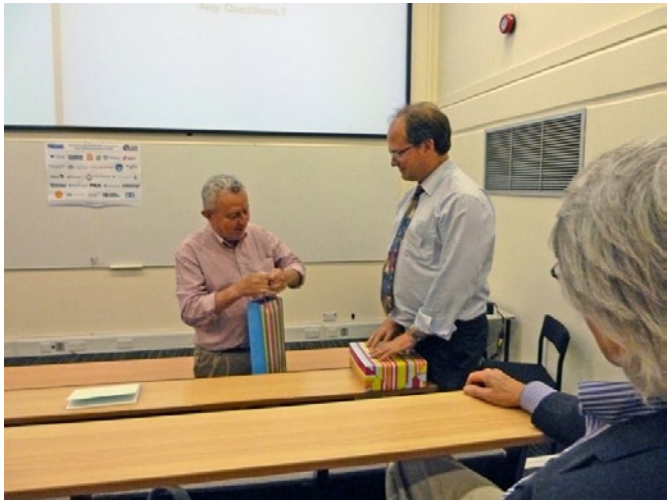
The symposium followed the format of previous years and demonstated to all the mastery of this huge range of accomplishment required to work successfully in the world of hydrocarbon exploration, discovery and mangement. It was a tribute not only to the students themselves but to the teaching and format of the MSc course, that have evolved to an international level second to none under the direction of Professor Chris Elders and his team of teaching and support staff

But this was no ordinary occasion in the sequence of symposia that conclude the annual MSc courses, 27 years on from the first in 1986. It marked the final symposium for Chris Elders (and his 20th) before he sets off for Curtin University in Perth where he will continue his exploits as Chevron Professor of Petroleum Geoscience. As it was a special occasion, Chris was presented at the end with gifts by Ken McClay, who has been strongly associated with the course and allied research programmes over the same period. The photos below give a flavour of the day.

the lunch break was a great time to chat but somehow all the sandwiches were eaten very quickly!



The posters were a great focus for intensive discussion



Ken McClay presenting Chris Elders with a bottle of whisky

Chris admires his gift of a plaque featuring an ironstone from Australia

The MSc Class of 2012–2013, full of smiles following the successful conclusion of their course

Group photo at the reception ahead of the dinner

Celebration Dinner in honour of Chris Elders

Picture Gallery, 6th September

Derek Blundell

Ken McClay, Julie Brown and Kevin D'Souza organised a dinner to mark the completion of Chris Elders' final MSc course and celebrate his appointment as the Chevron Professor of Petroleum Geoscience at Curtin University when he moves to Perth, Australia, next month. Sixty three members of the Department, former students and friends from industry attended the dinner, including every Head of Department during Chris' 21 years here as a member of staff. It was a truly memorable occasion.

Chris joined the Department in 1993 as Lecturer in Structural Geology and Tectonics, having previously spent four years with Shell as an Exploration Geologist and Seismic Interpreter. Chris took over as Director of our MSc course in Basin Evolution and Dynamics in 1994 and developed it over the following years into arguably the finest of its kind in Britain and amongst the top courses worldwide. Making use of his industry links, Chris obtained funding to provide the course with state-of-the-art workstations and software, including a 3D visualization system, often at enormous discounts. And he secured high quality data from industry for the students to work on for their projects, which they presented to an industry audience at the annual Symposium that formed their oral examination. His innovation and energy enthused and inspired successive cohorts of students, from all over the world, in ever increasing numbers. The course spawned the MSc course in Tectonics and then in 2007 he was responsible for revising the structure and content of the two courses to become the Petroleum Geoscience MSc programmes. By then, the MSc course had attracted wide international interest in industry, which led to the highly innovative Joint Award MSc programme in Petroleum Geoscience in partnership with Tyumen State Oil and Gas University, Siberia, sponsored by BP and the Russian gas giant TNK. The course began in October 2008 and was taught in English, much of it by staff from our Department, with most of the classes held in Tyumen, although it included a visit to Royal Holloway and a field excursion to southern England. The students from Tyumen have a great affinity with Royal Holloway and return for their degree ceremony here as Royal Holloway MSc students.

We enjoyed an excellent dinner

Professor Vining

For his efforts, Chris was awarded the Chair of Petroleum Geoscience in 2010. That same year he was elected Vice President of the European Region of the AAPG. He has twice won the "Apple for the Teacher" award from the Students' Union, a true accolade from his students.

His contributions to the MSc course and to the teaching and research of the Department have been outstanding. He has a very bright future in Perth, where he will be joining many friends from Royal Holloway, including Moyra Wilson (SEARG 1991–1998) with husband Nigel Deeks (MSc 1991–92) and NERC Research Fellow Ian (Ming) Fitzsimons (1991–94).

After dinner, the main speaker was Professor Bernie Vining (Vice President and Chief Geoscientist, Baker Hughes; Visiting Professor in Petroleum Geoscience at Royal Hollway, an alumnus of King's College, London). The following are some extracts from his speech:

I have had the pleasure of knowing Chris over many years, starting back in the 1990s when I was with Exxon recruiting some of his high quality postgraduates. I believe that there are now in excess of 500 of Chris' postgraduates in the petroleum sector worldwide and some are here this evening.

Chris, you have done an outstanding job over the years to build the MSc programme into a global leader. The high reputation of the programme in Petroleum Geoscience speaks for itself; an immense achievement. I understand that for 2013–14 there have been over 400 applicants; testament in itself to the high profile of the programme.

Your experience, expertise, patience, commitment and dedication to many generations of students is well known. You are held in high regard, throughout the Department from the support staff to your peers. I want to select some of Chris' many qualities and illustrate each with an example:

1. *dedication and commitment*; long hours, long weeks, long months, long years! The Tyumen MSc programme in Russia provides an excellent illustration. Chris is the only person I know to possess an Aeroflot Gold Card. Apparently, Chris made 14 trips in one year; incredible dedication. The 0530hrs videoconferences linking Tyumen in west Siberia with Royal Holloway show Chris' commitment to keep engaged with his students.

2. *cultural sensitivity*. The MSc programme has long been truly international, with students from all over the world. Chris is forever inclusive: as example, Chris' many October "MSc Party Practicals" held at his home. Chris cooks a diversity of dishes to cover the range of cultural sensitivities.

3. *attention to detail*. Many of his former students will fondly recall all the hours he spent reviewing their work. For example their Powerpoint presentations; ensuring the appropriate font size, spelling, scales,

Chris responds

colour schemes, etc. Car aficionados of a certain age will remember the "Allegro" – a classic! On the BBC Top Gear "Cool Wall" this car is at the "Very Cool" end. It had a gear lever on which were marked 5 forward gears. However, in reality, it actually had only 4 forward gears. Attention to detail is important.

4. *creativity and innovation*. The longevity and high reputation of the MSc programme is built on creativity and innovation underpinning high quality science. One particular example, as an illustration, is source rock geochemistry. The scene is Kimmeridge Bay in Dorset; an immature, world class super source rock outcrop. Chris has the Department mobile geochemistry laboratory, namely a blow torch and a test tube. He matures the source rock and expels hydrocarbons before the eyes of the surrounding students – creativity and innovation in action.

5. *leadership and management*. Building a world class MSc programme does not just happen. Leadership and management are forever required. For my example I return to a story about the Pyrenees field trip. The discipline is structural geology. Chris instructs the class to construct a regional transect in 2 hours; from noon to 2pm.

Chris: well known for his friendliness, sense of humour and a raucous laugh.

The class goes off. However, one individual soon returns to ask Chris what he will be doing during this time. Chris replies that he will be down the hill on the river bank, under a shady tree, taking a siesta – leadership and management in practice!

I attended the MSc Symposium yesterday. The success of the Symposium is a credit to Chris once again. I was particularly taken by a quote of one of Chris' students, Daniel Skomorowski and his presentation on the Valencia Trough. In his Acknowledgements slide, Daniel listed the names of those he wished to be acknowledged. At the end of the list was Chris. Daniel thanked him for his patience, guidance and expertise and, I quote "…..if this man can turn me into a petroleum geoscientist, then he must be a true miracle-maker". Daniel he is! There are over 500 former students to tell you about it.

Chris, on behalf of the Department and the petroleum industry, thank you for all your many contributions; a tremendous achievement. We wish you good health, good luck and every success and happiness in your big adventure Down Under. Enjoy it.

All attention as the lecture begins

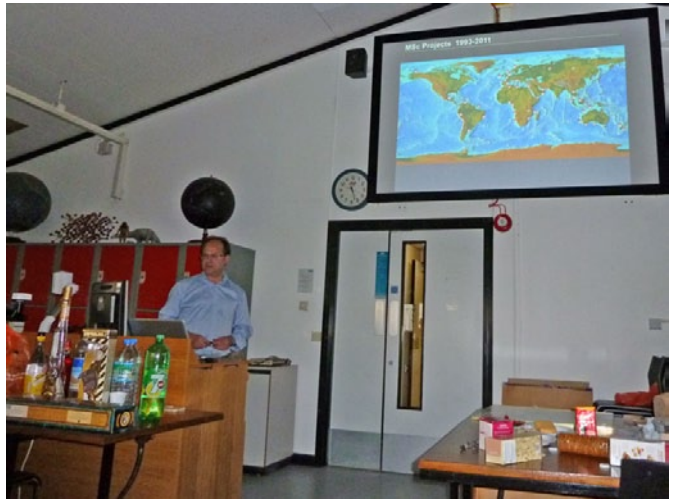
Chris Elders' Disaugural Lecture, 27th September 2013

What has changed in the last 20 years:
in seismic interpretation... and the Department of Earth Sciences

Chris presented his Lecture to a substantial audience, filling Room 240, that included present students and staff plus a number of former students and staff, including Philip Beesley (who, as Dean of Science, helped Chris set up the MSc course at Tyumen), Dan Bosence, Bill Chaloner, Robin Gill, Ted Rose, and Keith Stephens (who we congratulate for having recently gained, in retirement, his pilot's licence)

He began by introducing his array of whisky and other spirits that had accumulated over the years and now needed to be consumed, inviting audience participation. He also reminded us of the old days in the Department when there were regular tastings of beer, wine and spirits, in the hope that there might be a revival – we had the impression that such events may occur in Perth in years to come!

He then moved to the subject of seismic interpretation, with an illustration of a seismic section from



map of MSc student project locations

the 1960s, pointing out that very little has changed in the intervening years. The essence of the science has remained the same, thus shortening the basis of his lecture. However, the major change had come in computing, which has transformed the subject. He reminded us of the state of the art 20 years ago when we had Applemac computers set up in the lab next door, with small, black & white screens *(that at least were "student-proof" – DJB)*. With so little computing power, seismic surveys consisted of a grid of quite widely spaced lines – 2D surveys – that were interpreted individually. But, as he pointed out, in those days the targets in the North Sea were large and could be discovered on very little evidence, such as a "flat spot", the horizontal surface marking the interface between oil below and gas above it in a reservoir. None in the audience recognised the flat spot on the seismic section he had displayed, despite it being the largest in Europe, from the Troll field offshore Bergen. But later, with increased computing power, seismic data acquisition became more sophisticated, with multiple reflections generated from the same spot on the reflecting surface (cdp) to greatly enhance

Apple for the Teacher

signal-to-noise. Survey lines were placed closer together until the spacing between them equalled the spacing between shotpoints along the lines, thus creating 3D surveys. In more recent years, computing power has raced away, with workstations able to display 3D data in colour and visualization picking out fine detail such as small radiating fractures around the tops of salt diapirs and the polygonal cracks covering mud layers. He likened the advances to those of the mobile phone, which a few years ago was used to make phone calls whilst cameras were used to take photos, whereas nowadays mobile phones have taken over and are rarely used by the young to actually speak to each other!

Chris commented on his time with the MSc course in Petroleum Geoscience that he had run for 20 years and the teaching experience he had enjoyed over those years. He had been thrilled with his “Apple for the Teacher” awards from the Students Union, making the point that good teaching and research are indivisible and equally vital to the life of a university.

He was delighted that Margaret Collinson and Rebecca Fisher had been awarded “Apples” this year. He had also been gratified to see the global scope of the MSc course, as illustrated by the map of student project locations that covers the world. The extension of the course five years ago to include the parallel course at Tyumen, Siberia, had not only been highly successful in bringing Russian students to the same levels of expertise as our own at Egham but had opened up new areas of opportunity, such as the West Siberia Basin, that he hoped to develop in future. The problem was not so much in the geology but in gaining access to the seismic and well-log data. Somehow, knowing Chris, we felt he would achieve that.

As expected, Chris was thoroughly entertaining throughout his lecture, holding our attention with his wit and humour. We shall miss him greatly when he flies off to Perth next Saturday to take up his new post of Chevron Professor of Petroleum Geoscience at Curtin University. He has all our very best wishes.

DJB

Chris explaining about his computer discs to Jason Morgan and Tim Dooley

Dan Bosence, Ted Rose and Margaret Collinson at the party

Food and, especially, drink were plentiful ...

but most people were too busy talking to imbibe

CONTENTS

First Year Field Trip to South Devon, October 2012

Pete Burgess

How to draw an outcrop, as indicated by laser

Students and the Variscan unconformity

The South Devon field trip ran again this year October 5th to 8th, taking the 64 new 1st year undergraduate students for their first taste of university-level geological field work, and equally importantly, their first chance to get to spend time together as a group outside the classroom. Staff on the trip were Christina Manning, Howard Falcon-Lang and me, all very ably assisted by postgraduate demonstrators Dave Evans and Beth Wilks. The trip started on Friday 5th with a day spent looking at Devonian fluvial rocks and folded Lower Carboniferous Limestone on the coast at Portishead, then continued down to a lovely old house called Colehayes on the edge of Dartmoor where we stayed for three nights. On Saturday we were looking at Devonian and Permian strata, mostly on the coast just south of Paignton. After some parking trauma (Christina, it turns out, is a precision minibus reverser) the students did a basic mapping exercise along a coastal traverse. So it's in at the deep-end for many of them, with their first experience of trying to map contacts in the field and of course some hard-core colouring-in. Sunday was spent looking at igneous and metamorphic rocks on and around Dartmoor, including in a quarry which at first sight could be described as a "big pile of grey-brown crud", but that on closer examination reveals a spectacular and complex contact between thermally metamorphosed cordierite-rich Devonian rocks and the Dartmoor granite. The final day involved a shorter stop back on the coast, this time near Torquay, to look at a very well exposed oblique-slip fault complete with slickensides, and a fabulous life-assemblage of fossils in the Devonian Torquay limestone. Despite a few sick students, the trip ran smoothly, and we all had a good time. And of course the pressure is now on Howard and Dan to deliver the same level of stick waving, laser pointing, bad jokes and Star Wars references (question – is it legitimate to ask students to draw R2D2 as a scale in outcrop photos? I anticipate a majority of readers will say not, but I can never resist) for the first year students' next big field trip in Pembrokeshire.

Cyprus 2012

Christina Manning and David Evans

Escaping the freezing temperatures of the UK along with Dave Alderton, we accompanied 24 enthusiastic-looking third year students to Cyprus. Checking into a 4-star hotel was an unusually luxurious field trip experience, although we did this to the slight surprise of the large number of elderly couples on their yearly Saga holiday. After a bit of time in the sauna the first four days were spent on the Troodos massif, looking at an impressive array of mantle lithologies, intrusive and extrusive igneous rocks, including layered gabbros, pillow lavas, and some spectacular dykes, made all the more enjoyable by the sunshine. Cyprus is well known for its extensive mineral deposits generated through alteration and extensive serpentinisation of the ocean floor, including white asbestos veins and copper-bearing hydrothermal sulfides.

Dave A standing atop an outcrop of serpentinised and deformed harzburgite (pale layers) and dunite (brown layers).

Logging (or watching others log) a large submarine debrite in the evening sun.

The afternoon of the fourth day was spent mapping an area that provided insight into the nature of the contact between pillow lavas, umber (Mn-Fe oxides precipitated at hydrothermal vents), an impressive picrite intrusion and the overlying Chalk. This allowed the students who did not undertake an independent mapping project to refresh their skills as well as providing an important lesson in lithological identification through the medium of taste. Day five saw a change in the focus of the trip from igneous-based lithologies to some younger sedimentary units. It also marked a change in the weather from sun to rain. The students were quick to notice the empirical relationship between the arrival of Pete Burgess and bad weather, although one of them very astutely pointed out that it may in fact be the study of sedimentary rocks that was making the sky sad. Luckily, even frequent downpours could not dampen Pete's enthusiasm for looking at all things carbonate. The students braved the rain admirably along with Dave A whilst us less hardy beings huddled under the bus driver's umbrella. However, even those of us with more of an affinity for hard rocks couldn't help but be impressed with the sedimentary outcrops, including a turbidite sequence with spectacular load and flame structures and an impressive submarine canyon fill.

Pete Burgess paying homage to the sediments.

Snow, Flow and DO: the River Thames Basin Case Study

Kevin Clemitshaw

Although much delayed by a disrupted train service due to snow, on Monday 21st January the EDM MSc class, led by Clem and Nathalie and very ably supported by our own TOM and Jerry, set off on a voyage of scientific discovery.

The River Thames Basin Case Study follows the non-tidal flow of water from the source of the Thames at Thames Head in Gloucestershire to the first lock on the tidal Thames at Richmond, and includes several tributaries with distinct industrial and agricultural inputs. It comprises much fieldwork and laboratory analyses to diagnose water quality in chemical, physical and ecological terms, and to determine environmental, ecological and health impacts. Monitoring data provided by the NERC Centre for Ecology and Hydrology (CEH) in Wallingford and the Environment Agency (EA), enable the observations to be put into a wider context. The Case Study also benefits from affiliation with the NERC Better Thames Network, which supports the EA and local stakeholders implement the EU Water Framework Directive targets for water quality within the River Thames River Basin, and offers MSc research projects.

After settling in at the Streatley Youth Hostel (Image 1), our next stop was the CEH at Wallingford where we heard several presentations of recent research concerned with water quality and climate change, hydrology and ecology within the River Thames Basin. Two of our hosts, Mike Hutchins and Andy Johnson, had previously supervised 6 EDM MSc research projects, and it was very pleasing to see much of the students' work presented, together with offers to discuss new projects with potential links to the EA. Upon arrival back at Streatley, staff quickly established in a large room, a fully-equipped laboratory to collect, prepare and analyse samples, an office to collate data, and an auditorium to present and discuss observations and results each evening. Estates take note.

The next day we set off early and despite much recent snow, the roads across country were remarkably clear and Map Man began to gently spar with Sat Nav. The first site at Thames Head is a short walk from the Thames Head Inn, just north of Kemble in Gloucestershire. A scouting mission in late November had established that water does indeed bubble up at the source and an infant river was seen to flow slowly through an otherwise insignificant meadow. Honest. (Images 2 and 3).

However, as they arrived armed to the teeth with equipment, the Green and Red Teams were greeted by a small snow covered depression containing a few large pebbles with an inscribed monument nearby. (Image 4). There was no flow rate to meas-

ure, no water to sample and analyse for heavy metals, ammonia, nitrate or macro-invertebrates, no turbidity to quantify, no sediment to sample, size and analyse, no river width to measure, nowhere to dip the HANNA probe in to determine pH, redox potential, temperature, conductivity, dissolved solids, salinity, or dissolved oxygen (DO). But position was measured with HANNA by the Green Team, as was elevation with a GPS, although the same value would likely be recorded atop the nearby trees!

Ashton Keynes is a very attractive village within the Cotswold Water Park, and the infant Thames runs slowly between the High Street and several very desirable properties, rather reminiscent of Bourton on the Water. This was the next site and the Red Team eagerly measured and sampled everything they could, almost within touching distance of the mini-bus. (Image 5). Alternating teams and team leaders at each site, we travelled downstream and eventually reached Rushey Lock as snow fell briefly. Locks, weirs, bridges and pontoons, upstream, downstream, and profiles across rivers and tributaries were all fair game. In the evening, water samples were prepared for subsequent heavy metal analyses by ICP–AES, and nitrate was measured with a portable colorimeter. Macro-invertebrates were identified and assigned a habitat-independent Average Score Per Taxa (ASPT) based on their sensitivity to organic pollutants and DO according to the Biological Monitoring Working Party (BMWP). While all this was being carried out, data were collated by members of each team, and then presented with lively discussion. A very successful and productive first day. (Images 6–12).

And so it went on for the rest of the week at a total of 15 Locks (St John's, Rushey, Eynsham, Osney, Sandford, Culham, Day's, Goring, Caversham, Sonning, Hurley, Boulter's, Sunbury, Teddington and Richmond), 7 tributaries (Leach, Windrush, Evenlode, Kennet, Loddon, Wey and Crane), 4 bridges (Hannington, Sonning, Wey, and Teddington), and 4 other sites (Ashton Keynes, Newbridge, Wallingford, and Runneymede). Early mornings, long days in the field with a picnic lunch, and busy evenings in the laboratory with discussion of the data. (Image 13). Great fun. At Newbridge we even had the company of 2 military helicopters that flew overhead, we passed at least 4 Trout Inns on our travels, and this time we did not get locked in at Day's Lock...

On Friday 15th February, Mike Hutchins of CEH attended the verbal presentations made separately by the Green and Red teams. He was very impressed by the volume of data recorded and the insights into the winter-time water quality of the Thames afforded by its interpretation. Apparently very few detailed studies are carried out in winter; apart from one site, water temperatures of 3–5°C were recorded during the case study...

Elevated levels of boron in the River Crane and at Sandford Lock provided evidence for discharge from nearby Sewage Treatment Works (STW) into the Thames. (Analyses of a STW discharge into the River Wey in an on-going 3rd year research project confirm this). High levels of Na+ and K+ in tributaries may be consistent with snow-melt run-off from gritted roads. However, in chemical terms according to the EA, the case study data for DO (73–93%), NH_3 (0–0.25 mg/l) and NO_3- (1–6 mg/l) clearly suggest very good/good water quality in the Thames. In ecological terms, limited macro-invertebrate BMWP (20-30) and ASPT data (3.3–5.5) imply poor to good quality water in 3 shallow, slow flowing tributaries, with better water quality implied in the Thames itself. Decreases in ASPT with increasing Pb levels, and with reduced DO (perhaps a consequence of low flow and decay of organic matter from recent flooding events), were also apparent. Bank side sediment was predominantly sand and silt, with grain size and flow rates consistent with transportation and deposition.

Mike also described several potential research projects for the spring–summer under very likely conditions of warmer weather, slower flow, elevated levels of inorganic and organic pollutants, episodes of algal blooms and eutrophication, and higher biodiversity. But in the winter, especially with much snow, flow and DO, the solution to water pollution is definitely dilution. Old Father Thames would be pleased. (Image 14). Perhaps even more so if next year we had a boat and sampler to collect sediment across the upper Thames, and were also able to analyse for organics. A comparison of water quality at high tide in central London seems to be a sensible development too.

Many thanks to the EDM MSc students and ES staff for persevering under challenging but rewarding conditions. Also to Sue Hall and Adrian Palmer for help with producing the data on heavy metals, and on sediment composition and size.

New Lyell Society Sardinia Field Trip

Huw Richards

There hasn't been a field trip hosted by the New Lyell Society since at least 2009; the committee this year was keen not only to change that but go one step further and organize such an excursion … but overseas! After toying with a number of ideas, sometimes constrained by cost, weather and logistics, eventually we were able to settle upon a 6-day field trip to Alghero, Sardinia in March and, luckily, Eldert Advokaat offered to be our guide having mapped the region prior to coming to Royal Holloway.

An ambitious 5:30 am wake up on Tuesday 26th was required to catch the coaches from Holloway, through Heathrow and onto Stansted airport where we boarded a Ryanair flight to Alghero, leaving the chilly (in fact, snowy!) British weather for a much more pleasant, Mediterranean climate. A final, short bus journey saw us establishing ourselves into our apartments which were perfectly located with a 5 minute walk from a large supermarket and 10 minutes from the nearest beach and restaurants. The first and second days were spent settling into the hostel, buying supplies for the upcoming days and 'sampling' some of the Italian beer and wine.

Thursday 28th:

We picked up our hire cars and drove up to the Stintino peninsula on the Northern coast where we saw some of the metamorphic basement including foliated mica-schists with isoclinal quartz veins. Driving back down the west coast, our next stop at Argentiera saw another formation of regionally metamorphosed rocks but this time, of a lower grade. The beach-side outcrop displayed quartz veined phyllites with perfectly developed cleavage and internal fold structures.

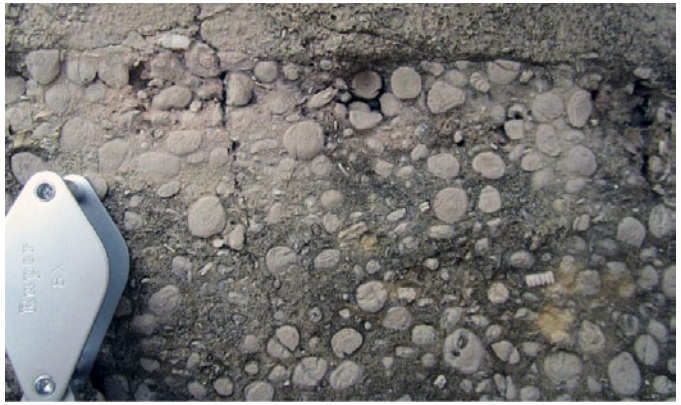
Argentiera basement:
internal folds within quartz veined phyllites.

Friday 29th:

Having enjoyed a substantial dose of metamorphic rocks, Eldert's plan was to now show us the varied sedimentary sequences along Algerho's coast. Our first location was a fossil hunt at Punta Del Lavatoio, a thick succession of platform carbonates with high fossiliferous content containing various bivalves, mussels and the type locality for Muschelkalk.

Muschelkalk

.Following our carbonate theme, our next stop, Maristella, definitely did not fail to impress. This cat-filled car park was a nice spot to have our lunch but also, a short walk to the sea, displayed some beautifully formed oolitic limestone that even the Spanish Pyrenees mapping group would be jealous of …!



Oolitic limestone: some perfectly concentric concretions of carbonate within this limestone

Fossil hunt: Amy Phillips, Huw Richards, Josh Sines, Ciarán Gilbride, Gosia Wronski, Will Hodgson, Rosie Hughes and Eldert Advokaat lead the charge to find the fossil-rich beds at Punta Del Lavatoio!

Neptune's Grotto: a sea cut cave at the bottom of resistant limestone cliffs.

The final site, Neptune's Grotto, was the pinnacle for many of the trip; a staircase descent through stunning limestone cliffs towards the vibrant blue sea below eventually led to a cave simply teeming with stalactites and stalagmites. Lit with an eerie glow from orange lamps, the local owner led a tour into the depths of the grotto showing us stalactites growing with defiance to gravity and a marker showing the sea level of the last glacial maximum; a fantastic way to end the day.

Saturday, 30th:

The final day in the field took us south of Alghero, slightly along the coast and then into the interior of the island. With the avid volcanology enthusiasts among us feeling left out having been smothered with carbonates, fossils and metamorphics, we stopped twice to look at some basaltic lava flows, one of which had pristinely preserved elongated and aligned vesicles giving an indication of the palaeoflow direction.

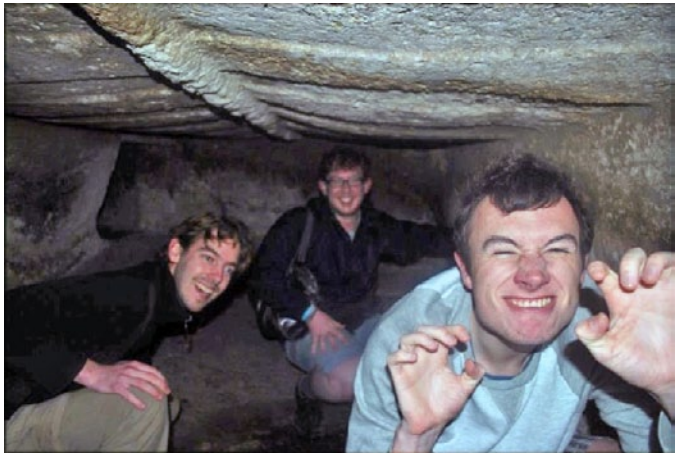
At one of our final localities we ventured into a limestone necropolis which had a number of interconnected tunnels and caves. After exploring some of these, we headed home, returned the hire cars and prepared ourselves for a well-deserved evening meal and final celebratory drink!

Weathered basalt:
showing alignment of elongated vesicles.

In the morning, we had to leave bright and early to catch our return flight home. However, due to the clocks rolling forward an hour, we had been deprived of much needed student-sleep meaning we were feeling perhaps a little bit worse for wear. So when I say "we had to leave bright and early", I really only meant "we had to leave early".

Luckily, we all managed to get to the airport in time and after a day of travelling back to Royal Holloway by plane, coach and bus, we arrived safe and sound (and a bit chilly …) at 4:30 pm local time.

As a final word, I'd like to thank Eldert Advokaat for guiding our trip from start to finish and to Joe Millward, Heleyna Wade and Ciarán Gilbride for assisting in the organization of the field trip. We hope all those who came along thoroughly enjoyed themselves and are looking forward to whatever next year has in store … I know I certainly am!



Necropolis: Eldert Advokaat and Ciarán Gilbride exploring with Will Hodgson doing his own thing …!

Sardinia 2013 *(anticlockwise from right):*
Amy Phillips (1st), Huw Richards (3rd), Ciarán Gilbride (3rd), Gosia Wronksi (3rd), Will Hodgson (3rd), Kat Jones (2nd), James Powell (3rd), Matt Green (3rd), Henry Ridgway (3rd), Elder Advokaat (PhD), Rosie Hughes (2nd), Josh Sines (1st)
and Joe Millward (3rd).
Will Reese not present due to illness.

MSc Pyrenees Field Trip, May 2013

Chris Elders

The students on the MSc course in Petroleum Geoscience enjoyed another very successful field trip to the Pyrenees in early May. Spain has not escaped the unseasonable weather affecting most of Europe, but for the most part the sun shone and the rain stayed away, for the middle of the trip at least. Thus we were able to enjoy the spectacular scenery (and geology) of the axial zone at Puerto de Aragüés, north of Jaca, and in the Pineta Valley, north of Ainsa, out into the External Sierras and the Ebro Basin. Only one day had to be revised as the heavier than normal snow meant that we could not get to the inner parts of the Cotiella Thrust sheet.

The trip was admirably led by Ken McClay, in his own inimitable style – equally at home marshalling minibuses into the tightest possible parking spaces as using a single outcrop to elucidate the entire geological history of the Pyrenees. We were very fortunate to be joined by Tomas Villamil, President of Platino Energy, a Colombian-based exploration company, who provided some very valuable insights into the way that a Petroleum Geologist would evaluate plays in such a geological setting. The trip would not have been the success it was were it not for invaluable support provided by Kevin D'Souza, and the superb food and wine, particularly that provided with characteristic generosity and care by Fonda Carrera at Labuerda, where we stayed for the second half of the trip.

For me it was a final chance to enjoy and be inspired by the amazing geology on show in the Spanish Pyrenees – in the company of Royal Holloway students at least. Who knows, maybe in a few years time there might be a group from Curtin University making a very similar trip…

The spectacular view of the External Sierras and the Ebro Basin from Pico de Aguila. On the very first Pyrenees field trip that I went on, I remember Ken saying "Here y' have it – the whole ball of wax" – clearly a bit of Australian that I will have to learn.

Ken impersonating Celine Dion in Titanic singing "My Heart Will Go On", at Puerto de Aragüés

Group Photo at Puerto de Aragüés with a fault propagation fold for scale.

In the Pineta Valley, looking along the strike of the hangingwall of the Gavarnie Thrust

Having the difference between light grey Cretaceous limestones and not quite such light grey Devonian limestones pointed out to us at the tectonic window beneath the Gavarnie Thrust, Llanos de Larri.

This year we have the largest Petroleum Geoscience MSc class on record – not quite in terms of student numbers, but definitely in terms of student height. As the picture shows, the top end of the class has the makings of an ideal basketball team, but in the fining upwards sequence illustrated we have a very regular distribution of sizes.

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Fieldwork in Namibia and Australia, 2012 – how to successfully avoid the London Olympics

Marie Busfield

Field area in Omutirapo Palaeovalley, northwestern Namibia

Dropstone puncturing laminae in stratified diamictite deposit

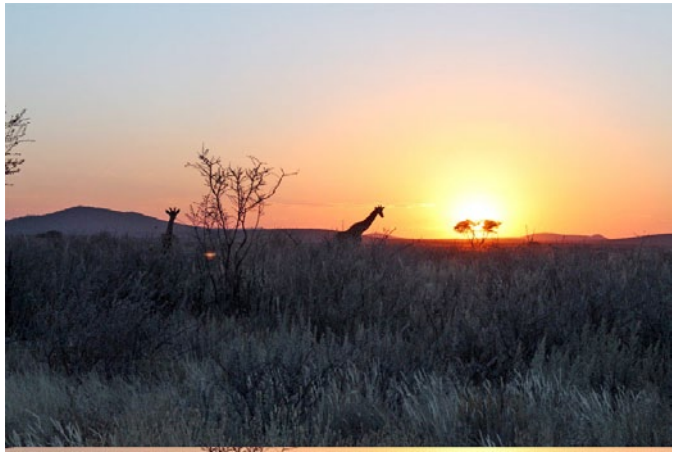
Sheared clasts deformed due to overriding ice, alongside associated sedimentary dyke injection into deformed clast

Roughly four weeks were spent in Namibia with Erwan Le Ber, working along the southern margin of the Owambo Basin from Tsumeb in the east, to Opuwo towards the north-west. Some pretty convincing evidence of glaciation was found in the form of dropstones and glacitectonic deformation structures, attesting to dynamic ice behaviour at this time.

Naturally, one of the perks of doing fieldwork in a country like Namibia is the chance to see some amazing wildlife, and given that Etosha National Park ran alongside our field area it would be rude not to pay a visit!

After a brief trip back to sunny Egham, I was on the road again, this time to the Flinders Ranges of South Australia. On good days, the climate was pretty similar to Namibia reaching a pleasant average of 20–25°C. However, on other days we were made to feel a little more at home.

Zebras in Etosha National Park



Conveniently posed giraffes on the drive back from the field one day

Typical view of field area in the southern Flinders Ranges

Sheltering from the somewhat more British style weather!

Thick diamictite sequence at Tillite Gorge, on the Arkaroola Wilderness Sanctuary, the old stomping ground of eminent geologists Reg Sprigg and Douglas Mawson

Geology-wise we again saw some great exposure of diamictites, with and without glacial dropstones. In this area, the vertical and lateral variability within sediment packages seemed to be much higher than what we saw in Namibia, alongside a greater abundance of thick, stacked turbidite sequences, the reason for which remains unknown at present.

In terms of wildlife, I admit I was little nervous of the numerous poisonous beasts said to lurk in Australia's wilderness, taking careful steps not to tread on a Taipan or wake up with a Red-back spider sleeping on my face. Alas, the real danger turned out to be kamikaze kangaroos, emus and sheep with a penchant desire to jump in front of the car as often as possible. We also came across a fair few slow lizards, which are very aptly named and toothless… not so scary after all!

And of course no trip to South Australia would be complete without supporting the local economy in the Clare Valley wine region…

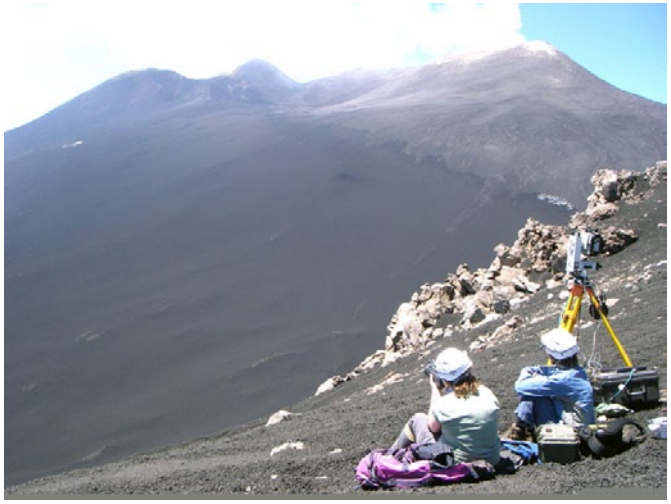
One of the many Kangaroos hopping around the Australian outback

Arguably the most tame reptile in Australia: the toothless 'slow lizard'

Sevenhill: the oldest vineyard in the Clare Valley, set up my Jesuit monks

New activity in the Bocca Nuova crater at Mount Etna in 2012

John Browning



Imaging recent lava flows with a laser scanner

4 x 4 vehicles took us to the summit area

fumeroles smoking from the crater walls

This summer I joined some colleagues from Lancaster University and INGV to assist in taking measurements of lava flows using a long range laser scanner. The group originally comprised of Dr Mike James, Neil Slatcher (a PhD student at Lancaster) and myself. The aim of the fieldtrip was to optimize some software that Neil had been developing to automate the process of long range laser scanning. To do this we would hike to a number of pre-selected locations around the summit area and the Valle del Bove in order to image recent (< 1 year old) lava flows.

Long range laser scanning is a very boring process consisting of setting up the very heavy scanner (~30 kg), pressing start and waiting several hours (I'm sure it's much more complicated than that in reality, but that's how it appeared to me) The fun part is hiking the equipment to the top of the volcano and taking in the scenery. We were assisted in our endeavours by some colleagues from INGV who are responsible for monitoring the volcano, although this position is in jeopardy. They assisted us in getting to the summit areas using 4 x 4 vehicles. They informed us on the first day that there was some new activity in an old crater (Bocca Nuova) at the summit. Without hesitation we embarked on a hike to the Bocca Nuova crater, which was not accessible by vehicle.

We were met at the edge of the crater rim by what sounded almost like continuous rounds being fired from a shotgun. This sound bounced all around the crater, reverberating off each wall. Several large fumaroles smoked volcanic gases from the crater walls. When the wind finally cleared the gases from the crater, a small dark black scoria cone was observed on the crater floor. The vent was producing mild strombolian activity characterized by regular explosions every 1 to 10 seconds. In the period of observation we also saw a short lava flow (approximately 20 m wide and 120 m long). Over the course of four days we used the laser scanner to determine the elevation gain of the cone (~15 m) and the increase in volume (~ 84,000 m^3).

continued next page

eruption of short lava flow

The findings from this research will be presented at the Fall AGU conference in December under the title “Observing scoria cone growth and lava flow development in the Bocca Nuova crater, Mount Etna, Sicily (2012), using repeat terrestrial laser scanner measurements” by N.Slatcher, M.R. James, J.Browning, S.Calvari and G, Canci.

Etna was for many years associated with strombolian activity, but between 2011 and 2012 intense periods of fire fountaining activity gave rise to a new south east crater. In March 2012 i was also fortunate enough to see from a great distance some of the more violent volcanic activity (Paroxysm) that Etna displays.

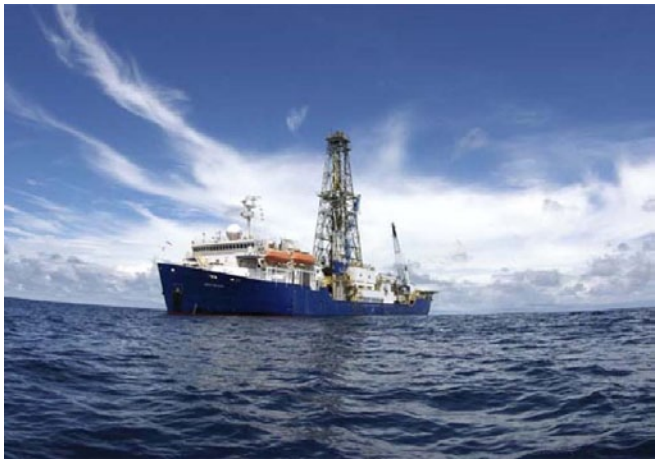
Scoria cone on the crater floor

violent activity on Etna

The Costa Rica Seismogenesis Project, CRISP: IODP Exp. 334 and 344 – *Paola Vannucchi*

The second IODP cruise dedicated to the Costa Rica Seismogenesis Project, CRISP, ended in December 2012. IODP Exp. 344 involved an international team of scientists to drill on board the JOIDES Resolution, near the Pacific coast of Costa Rica. The project is designed to study the subduction zone where the Cocos tectonic plate dips beneath the Caribbean plate. This fault boundary was responsible for causing two earthquakes in 2012, on September 5 and October 23. While the epicentre of those earthquakes was north of the study site, under the Nicoya Peninsula, the IODP expeditions are focusing on a portion of the subduction system where the seismogenic plate boundary is within drilling capability of the Japanese riser drillship Chikyu.

Integrated Ocean Drilling Program (IODP) Expedition 344 (Costa Rica Seismogenesis Project A Stage 2), also known as CRISP 2, picked up where Expedition 334 (CRISP 1) left off last year. The study site, near the Osa Peninsula, is of particular interest for two major reasons. First, it is a relatively shallow subduction zone, and such boundaries are responsible for some of the world’s deadliest and most damaging earthquakes and tsunamis. Second, the boundary is an erosive convergent margin, a type that is relatively poorly understood by scientists. The goal of the project is to ultimately sample and collect data from the plate boundary to help scientists better understand how earthquakes happen – here in Costa Rica and elsewhere.



JOIDES Resolution. (photo: Arito Sakaguchi and IODP/TAMU)

Yuzuru Yamamoto (Structural Geologist, JAMSTEC, Japan) and Paola Vannucchi (Structural Geologist, JAMSTEC, Japan/RHUL, UK) describe deformation features in a core section. (photo: John Beck, IODP/TAMU)

In contrast to accretionary convergent margins, where the subducting plate transfers sediments to the overlying plate, erosive margins like the Cocos–Caribbean boundary drag rocks from the overlying plate deeper into the subduction system. Because this process removes mass from the upper plate, it can cause the overlying ground to subside, potentially generating seismic activity. While accretionary margins have been studied more extensively, scientists still have much to learn about erosive margins. Drilling into these zones is the only way to directly observe the processes responsible for seismic activity.

IODP Expedition 344 left from Panama on October 23 and concluded in Puntarenas on December 11. Ten boreholes were drilled, each of which penetrated from 25 to 800 metres into the ocean floor, recovering in total more than one and a half kilometres of core. Core samples, as well as data recorded from the borehole walls using sensitive instruments lowered into the holes, will help to characterize the geophysical and chemical properties of the seismogenic zone.

The science team comprises 34 scientists from 12 IODP member countries (USA, Japan, UK, France, Germany, Brazil, Spain, Austria, China, Korea, Australia, Switzerland).

Personally I have been involved with CRISP for over 10 years, being the PI of the riserless part of the project. I have been co-chief scientist of CRISP 1 Exp. 334 and I was a structural geology specialist on board Exp. 344. The feasibility of the second part of the project, the deep riser hole to be drilled with Chikyu, will be discussed in April at the Chikyu+10 meeting. Fingers crossed!

Fieldwork in the Chin Hills, Myanmar – *Inga Sevastjanova*

The field party: L to R – Saw Mu, Tin Tin, Inga and our driver U Chon Sen, who had previously worked for a mining party and knew the locations of almost every outcrop around Kalay.

Crossing the road (i.e. the river).

In early 2012 Robert Hall suggested that I should undertake a provenance study of Triassic turbiditic sandstones in the Chin Hills of Western Myanmar. The aim of this study was to collect data that will help resolve existing arguments about the origin of continental crust beneath Western Myanmar (West Burma Block). About a year later (in late January 2013), after several late cancellations and last minute changes, I finally made it to the land of unreadable road signs, bicycles, temples and monks.

We travelled to the field with two Burmese colleagues, Tin Tin Naing (MSc, ETH, Zürich) and Dr Saw Mu Tha Lay Paw (PhD, Yangon University). They are both excellent counterparts. Chin Hills are only accessible (foreigners need a permit from the government) during the dry season, when river valleys are used as roads and plantations (peanuts, onion, etc.).

Most of the work in the villages is done by hand. It is common to see women and children carrying heavy loads of water, rice or rocks (for local construction purposes). Some of the heavier loads and people are often transported in carts pulled by cows. Trucks are rare and cars are practically unseen. During the rainy season, local people travel on bamboo rafts.

A weaver from Kalay

Ceremonial procession before initiating a monk

The local people are friendly, helpful and curious. In the village of A Nya Ka Din, while Saw Mu was negotiating motorbikes to go to the next stream, Tin Tin got questioned by a village chap, who was convinced that he had found gold locally (pyrite, of course).

Chin Trip super team: Saw Mu (left) and Tin Tin (right) in the elephant camp in the Saw Stream.

View over the Chin Hills in the afternoon.

Saw Mu, a super-human who needs no sleep, no food, has every published and unpublished geological and topographic map and needs only rocks to be happy. In this photo he is wearing a dust mask, as we all were most of the time.

Sunrise in the northern Chin Hills

As far north in the Chin State as we were allowed to go

Fieldwork focused on two main areas in the Chin Hills, (i) around Mt Victoria (Saw–Mindat–Kanpetlet) and (ii) around Kalay. In the area around Mt Victoria our vehicle was a jeep with open windows. In Kalay we had a proper 4X4 drive. When we changed cars, I could not help wondering why all of a sudden we were driving on the opposite side of the road. It

Little ones in charge.

turns out that drivers stick (mostly) to the right side of the road only in Yangon and Mandalay. Away from larger cities they drive on whichever side they prefer. This is mostly because cars with the steering wheel on the right are just as common as those with the steering wheel on the left.

It was a fantastic field trip with beautiful geology and great outcrops, particularly in the streams.

Stickers from UK for the kids

Happily relaxed – sightseeing in Mandalay after packing our samples for shipping home. From left to right: Saw Mu, Tin Tin and Inga.

The Equianos Network:

how George, James and Stan maintain Continuous Greenhouse Gas Measurements in the South Atlantic Region

Dave Lowry and Euan Nisbet

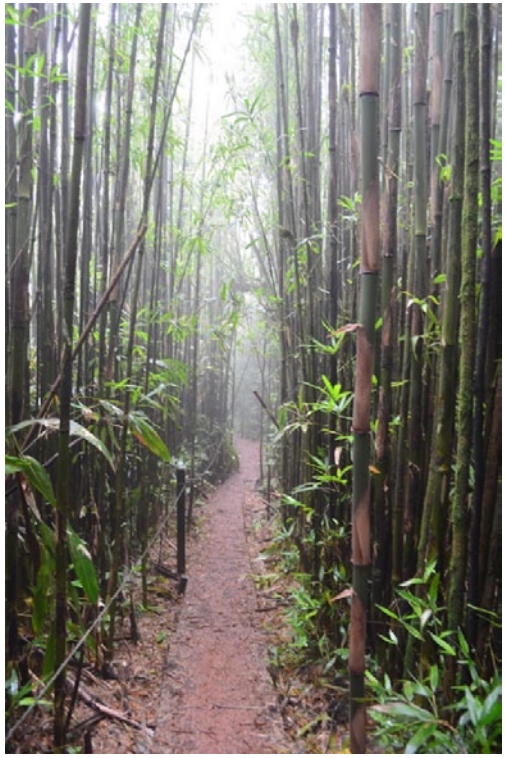
The Equianos Network (EQuator-Inter-Atlantic-North-Ocean-South) is a group of independently operated sites for flask sampling and continuous measurement of greenhouse gases and their isotopes. It is a RHUL initiative bringing into the fold groups from University of East Anglia, British Antarctic Survey (BAS), Norway, Finland and the South African Weather Service. It runs the length of the Atlantic, from Antarctica to the Arctic Ocean. To find out more about Equiano and the network locations go to **equianos.com**

Most of the measurement stations are in fairly remote locations. Data is very often transmitted back to the parent laboratory by ftp connection on a daily basis, and much of the fine tuning and even software and instrument corrections can be made remotely, even by the instrument manufacturer. Filters clog, pumps get jammed with salt, and the instruments have an 18-month to 2-year hardware service interval. So on 10th February we headed to the South Atlantic to perform maintenance and repairs on three of our continuously measuring instruments, and to talk to the many kind folk watching over our precious toys, George, Stanley, and James.

Ascension Island

First stop, following an overnight flight from RAF Brize Norton and lots of bangers and mash, was the UK's own tropical desert island – Ascension Island at 8°S 14°W. After checking in at our hotel in the capital city, Georgetown (pop 200) we went to see George, our Picarro Cavity Ringdown Spectroscopy (CRDS) instrument, which has been in operation since June 2010. The tropical climate and heavy water vapour content of the air has recently been taking its toll on poor George. It is situated in the Met Office building at the airport and is looked after by their staff. Although southern Ascension is a desert, the air is very moist, hot and muggy. The drying system was in a really bad state, so much of it was replaced and new filters were added. The instrument was showing signs of recovery before we left. Yet despite all the weather and moisture thrown at it, the amount of calibration standard drift over 32 months was remarkably small. With this type of work it is often a case of changing parts then going away to leave the instrument to settle for a few hours before checking on the level of improvement. This gave us the opportunity to visit some other sites around the island and fill bags with air for analysis back at RHUL.

Then came a panic. We faced life imprisonment on a desert island! This was the unexpected requirement to pay 3 days of income tax for working on the island, before they would let us leave. Many thanks to Diane, Julie and the RHUL personnel and finance



Bamboo Plantation on the Summit of Green Mountain

Fish trapped in a tidal pool on Hannay's Beach

departments for a tremendous amount of rapid help to get our details to the Ascension tax office so quickly and so properly. We paid up and were allowed out.

Our time off allowed for a trip up Green Mountain with its summit bamboo plantation, walks to some spectacular volcanic and coastal scenery, abundant with wildlife, and a swim with blackfish (a distant relative of the Piranha) at English Bay. This is the time of year when the green turtles come ashore overnight to lay their eggs in circular pits that they dig on the wide sandy beaches. They are very sensitive to light, so the only photography is from behind during egg laying or as they move out. We could see vague outlines of large shapes, hear the occasional grunting and see sand flying backwards as the pit was dug, so some guesswork was needed for a photo. One morning we were due to meet the Conservation Officer, but she was delayed having to re-float a turtle too tired to get back to the sea.

On the hunch that some turtles might come ashore early and hoping to catch a Long Beach sunset, another photo opportunity presented itself in the fading light of the final evening.

We also had time to meet with the administrator and finance director of the island to discuss our new project and possible new measurement initiatives on the island. They were very receptive and we hope that Ascension can become the only British overseas atmospheric monitoring super-site.

Blow hole where waves break beneath a lava flow

Blackfish in the only 'safe' swimming on Ascension Island at English Bay

Green turtle leaves nest after laying eggs

Green turtle tries to climb the beach just after sunset

Calibration gas cylinders on the deck of the James Clark Ross

Falkland Islands

On the morning of 14th February we boarded the HiFly Air Luxor-operated RAF flight bound for the Mount Pleasant International (MPI) military airport in the Falkland Islands, but were soon informed that there was a minor technical issue. Some engineer-time later and after a second attempt to fire up the left engine we were herded off the plane and back into the departure pen. The plane had a hydraulic fluid leak, so the engineer got out his toolbox, lifted the bonnet, and set to work inside the A330 engine housing. After another short delay for 'Russian Uplift', later translated as 'ration uplift' (many more toasted cheese sandwiches, bangers and mash) we headed south four and a half hours late, and reached our hotel in Port Stanley late into the evening.

The next morning we drove to the harbour just outside town where the BAS ship *RRS James Clark Ross* was moored. Our greenhouse gas instrument on the ship (James, of course) had failed 2 months ago due to sea salt crystallizing in the pump diaphragms, and despite having replacement pumps and filters with us we were very nervous that the instrument itself was damaged (i.e. £10k repair bill).

We shouldn't have worried. After making our changes the instrument kicked into life and slowly the water dropped as our air-drying system kicked in.

The British Antarctic Survey ship, James Clark Ross, moored in Port Stanley

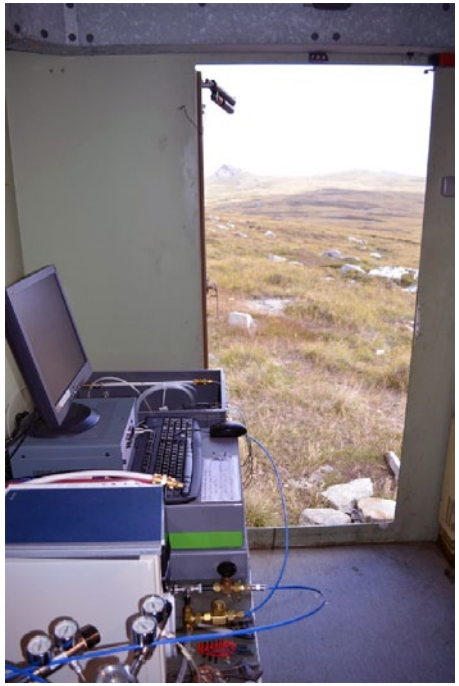
San Carlos Bay, west coast of East Falkland Island

***Right**: Darwin settlement (nice tea rooms) with Mount Usborne (705 m) behind*

Saturday 16th February was spent driving around the gravel roads of East Falkland collecting air samples for analysis back at RHUL for comparison with our measurements at Sapper Hill, just outside Port Stanley. The road is over wide-open country, not a tree in sight, but lots of great stone rivers running down from quartzite ridges, where a glacier has melted out. The road signs saying "Slow Mines" were a bit puzzling – are they mining slowly, or do they blow up less if you drive slowly? We visited some historic sites from the 1982 conflict such as San Carlos, Goose Green and Darwin.

After another visit to the ship on Sunday morning to construct a new inlet and drain configuration we headed up to Sapper Hill to see Stan and replace his pump and internal filter. This instrument has been sending back continuous data since October 2010. There were some serious problems with internal pressure stability of the instrument and the drying system was failing. This was traced to a fine bore tube on an inlet valve blocking with salt, so this had to be stripped down and cleaned out. This solved all of the problems in one go.

Euan collecting an air sample from the Sapper Hill site near Stanley



Our greenhouse gas monitoring instrument and gases, Sapper Hill hut

The hut space, power, WiFi link and able assistance in all things technical at Sapper Hill are provided by Mario Zuvic, who runs the cable TV network on the islands as well as being involved with Falkland Islands TV. So on our final day we were interviewed as part of their weekly 25-minute programme, with a picture of Sapper Hill superimposed behind us to replace the green studio wall.

Finally all 3 instruments were up and running properly again. This was a big relief and an opportunity with our remaining few hours to see the Stanley Museum (where Euan spotted the great battle flag of HMS Erin, his great-uncle's dreadnought at Jutland, commanded by Capt. Stanley, of course). This was followed by a trip to Gypsy Cove, where there is a colony of Magellanic penguins nesting under the clumps of 'tussac' grass. Most of this area is out of bounds due to mines remaining from the 1982 conflict, so the penguins, geese and cormorants on the rocks and beach are relatively untroubled by humans. We also met a couple of chilly Zimbabweans from Euan's home town, who were busy flailing the mines with great chains: it'll be many years before they're done.

A 5:15 am start for our shuttle back to MPI was bad enough, but 20 minutes into our trip the driver (also the preacher in the local kirk) got a call from a panicking passenger in Port Stanley who she had forgotten to pick up. The luggage van was duly dispatched back to the "town" (2000 people), and we shivered at the airport for 30 minutes waiting for our bags to arrive. As the HiFly A340 reached the end of the MPI runway for take-off we were greeted with two giant hands waving from the control tower and the sight of about 20 people standing at the side of the tar, including several in penguin suits, and a giant Bon Voyage sign. If ever we needed confirmation that we were leaving somewhere just a little bit different from the normal tourist destination this was it! Then followed our 18-hour flight back to the UK with a nice warm reminder of the equator during the 2-hour refuelling stop on Ascension. And of course, more portions of bangers and mash.

Magellanic penguins on beach, Gypsy Cove

Scenery around Kuna Ba cave

A flying visit to assess caves in Iraqi Kurdistan – *Dave Mattey*

I admit being a little unsure of this trip, not least as the college travel insurers wanted to know whether I would be asking for ransom insurance. The caves in question are in the foothills of the Zagros Mountains, quite close to the Iranian border, and the same area that American hikers were detained in 2009. Now back home I can say that I have never had a nicer, trouble free visit among such friendly people and spectacular geology, and I hope we can develop research in this climatically significant area.

We visited two caves near Sulamaniyah, the administritative centre of Autonomous Kurdistan with archaeologists from UCL. The objective was to find sites that might yield a late Holocene climate record, to link in with work on migration and development of agriculture in Mesopotamia. It serves our research interests as well since the region receives precipitation from both the Mediterranean and the Gulf, and could be a vital monitor of interactions between Monsoonal and Atlantic weather systems.

Formations in Kuna Ba

Kuna Ba was a long breakdown passage, and Gejkar a very large phreatic chamber. Both sites are known to locals and visited (and rather damaged), so leaving monitoring equipment is out of the question. Even so I hid some temperature loggers in Kuna Ba (and got my finger bitten by an unseen inhabitant of the rock cleft as I put the logger in!) in the hope we can get some information on stability

Entrance to Gejkar Cave (on left)

The main passage in Kuna Ba, rough going over roof breakdown

of the site. There are many limestone areas and undiscovered caves in the region and it shouldn't be hard to locate more suitable and out of the way sites to work on. We have an ERC grant in review at the moment, so you never know, maybe there will be funding to continue work here next year.

Ghostly formations in Gejkar

Measuring surface albedo at Ny-Ålesund, Svalbard

Chris Ball and Amelia Marks

Surface albedo is an essential climate variable and is important for climate and biogeochemical modeling. To accurately derive surface albedo from measurements of radiance made from radiometers aboard Earth observing satellites requires an understanding of the surface's bidirectional reflectance (BRDF). Knowledge of the BRDF at the top of the atmosphere allows a conversion from measured radiance to total upwelling flux. Surface measurements of BRDF are required to help validate top of atmosphere BRDF models.

The snow and sea ice research group at Royal Holloway's Earth Sciences Department have recently obtained ground based measurements of BRDF for Arctic snow covered tundra during a 3-week field campaign at Ny-Ålesund in March/April this year. Ny-Ålesund is currently the world's most northern settlement at 79° latitude, and provides researchers with the infrastructure and services required to carry out experiments in such a remote region.

The GonioRAdiometric Spectrometer System (GRASS) measuring the hemispherical directional reflectance (HDRF) of Arctic snow covered tundra.

The BRDF dataset was obtained using the NERC GonioRAdiometric Spectrometer System (GRASS), which measures the reflectance of the snow surface using 16 cameras positioned at regular intervals along 3 arms. The arms can be rotated around a 3 m diameter base ring to view the snow surface at multiple azimuth angles.

Ny-Ålesund is an international collection of research stations on the NW coast of Spitsbergen, the largest island of the Svalbard archipelago.The British research station, Harland House, is arrowed

Physicochemical analysis of snow samples was also carried out at each site. The measurements include snow density, grain size, grain type, temperature and concentration of light absorbing impurities. The data will allow us to assess a link between these properties and the BRDF of the surface.

Digging snow pits and collecting samples.

Transporting equipment with snowmobiles

Dropstones and Olistostromes in Death Valley

Dan Le Heron

Marie Busfield (second year PhD) and I recently spent a month in the field looking at Neoproterozoic glacial deposits of the Kingston Peak Formation in Death Valley, California with funds provided to us by the Geological Society of London. March through April is a good time for fieldwork in this part of the Basin and Range province, and whilst temperatures get murderously hot in the basins, temperatures on the somewhat more elevated peaks such as in the Kingston Range are more manageable. Stunning basin outcrops such as those of the Sperry Wash section (see below, elevation 200 m) contain numerous dropstones and reveal the development of beautiful subaqueous fan complexes dominated by turbidite and debrites. Many of the dropstones are striated, attesting to a clear glacial origin.

In the Kingston Range (elevation 1500 m), the succession is punctured by a huge granite intrusion, tipping the strata steeply (photo below), though this certainly does not mean that no climbing is required! A typical day's fieldwork in this range would consist of a 5–6 km hike over uneven ground (e.g. alluvial fans) dappled with Joshua trees, cacti and bighorn sheep (well, their droppings anyway). We had the great assistance of Dr Tony Prave (who has worked Death Valley stratigraphy for 32 years now) to guide us to the best sections. The succession of interest to us there is at least 2 km thick, and we thought we had reached the base of it when we encountered a 100 m-thick limestone with oncolites. Yet there was a problem: the limestone was stratigraphically inverted, and turned out to be one of several ~500–2000 m-wide clasts!! This was an olistostrome succession (the deposit of a huge underwater instability). Rather than sliding downhill, it transpires that

Dan taken aback, and looking remarkably Victorian, at the sight of a boulder-sized dropstone in the Kingston Peak Formation.

olistoliths "tombstone" down slope. The olistoliths are encased in non-glacial rocks, with glacial rocks above and below. We are currently speculating why, and one thought is that the olistoliths record gravitational instability during an interglacial isostatic rebound event. I suppose we'll just have to write a grant proposal to find out!

I would recommend doing fieldwork in Death Valley. Aside from the complex interactions of both Neoproterozoic and recent tectonics and sedimentation, and good quality outcrop, there is every chance that you will run into many other geologists and benefit from an enriching experience. One of the great legends of Death Valley geology, Lauren Wright, sadly passed away earlier this year. Together with his PhD student, Bennie Troxel, and in turn through their research "progeny", huge tracts of this part of the Mojave Desert were mapped. Lauren's memorial service so happened to coincide with our fieldwork, and it was a great privilege to meet a large contingent of Death Valley geologists. Hawaii University's Geology Department run a mapping class in the area, and it was a delight to take Professor Scott Rowland and

Kingston Peak granite to the left of the picture (first ridge) punching through the Beck Spring Formation (light grey, second ridge), overlain by non-glaciogenic light brown strata (base of third ridge from left), unconformably capped by glacials (top of third ridge from left) to the right of the picture with km-scale carbonate olistoliths (fourth ridge). Field of view ca. 1 km.

his students into the field on their last day for a short intro to Neoproterozoic glacial sedimentology (see below). They also did an absolutely wonderful job of cooking for us EVERY night that we overlapped with them: the legend of Hawaiian hospitality!

Dan (centre), Marie Busfield (right) and Scott Rowland (middle "row", to the left of Dan) together with the Hawaiian mapping group at Sperry Wash.

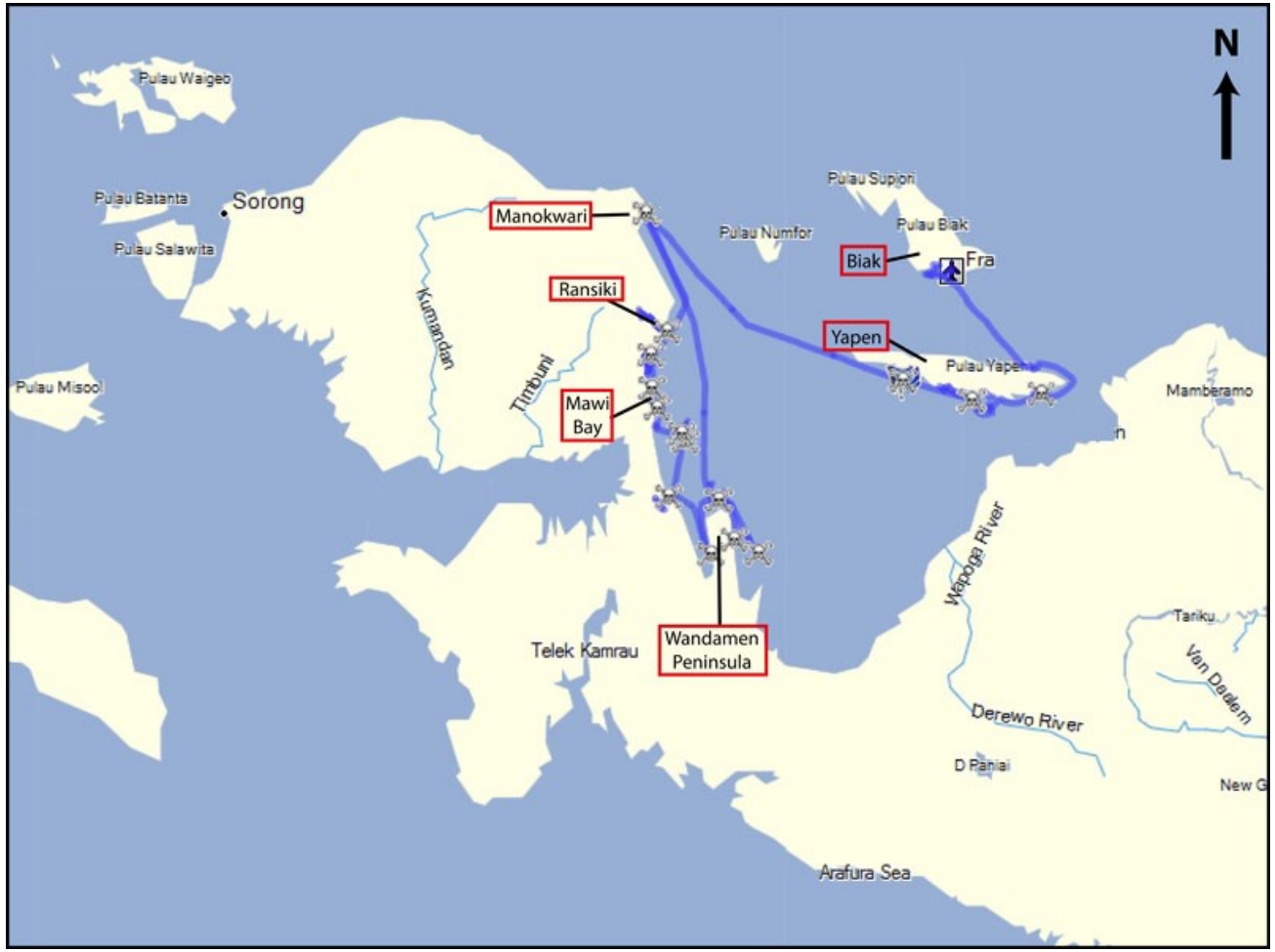
Cenderawasih Bay, West Papua

Lloyd White

David Gold and I spent the past month on an expedition around Cenderawasih Bay, West Papua on a large live-aboard dive boat called the *"Shakti".* The trip was organized and funded by two of SEARG's company sponsors. This meant that Dave and I were looked after quite well; we had the luxury of a daily shower each night, a cook who served three hot meals a day and most importantly there was a fridge filled with beer. It also meant that no expense was spared in bringing along a whole lot of field and safety equipment as excess baggage.

We flew from Jakarta to the town of Manokwari (found on the northeastern tip of the Bird's Head, and the capital of West Papua province) to board the *Shakti*. After filling the boat with provisions and obtaining the relevant harbour permits, we made our way south to Ransiki and later to Mawi Bay. Here, we hired 4WD's to take us inland to look at the basement exposures and to discover where the roads led. We were fortunate that Dave had visited these parts several weeks earlier and could therefore tell us about which roads existed (as they aren't shown on any maps) and their condition.

We brought a load of stuff with us. The blue coolers were eventually filled with rocks for easy air freighting back to Jakarta.

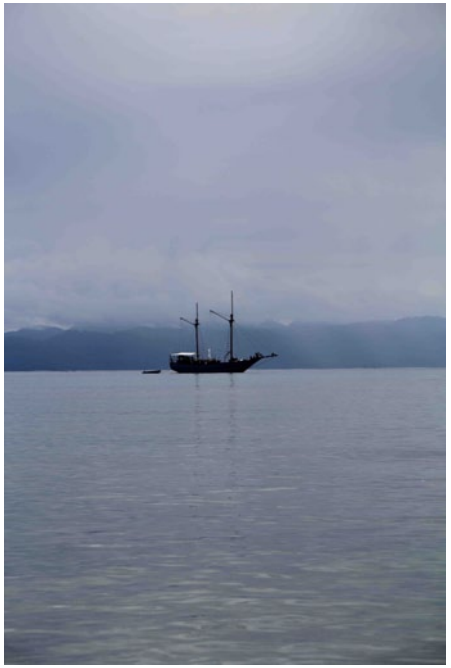


Map of Cenderawasih Bay. The blue lines are the GPS tracks to show where we visited. The Skull and Cross-bones symbols indicate the various anchoring locations of the Shakti during the trip.

We usually did not know what to expect about the extent of the condition of the roads in Papua. In this case the bridge was being repaired and it would take several hours wait before we would be allowed to cross – we turned around instead and spent the time looking at outcrops on the way back to the boat.

Left: Dave and Angus watching the storm approach. The weather was good and bad. Rain would usually come about in the afternoon, but on the Wandamen Peninsula came every morning up until lunchtime.

Right: The *Shakti*



We weren't always able to hire 4WD's, or indeed 2WD vehicles. So there was some creativity involved in our solution for transportation. One village offered to rent us their ambulance to use for the day, but thinking this might get us into trouble if there was a medical emergency in the village, we reconsidered our options…and hired a dump truck instead.

The fieldwork saw us continue to travel south, working our way down the eastern side of the Bird's Neck and mapping and sampling the various limestone units and folded metasedimentary sequences. Dave was quite happy to get several straight days looking at carbonates of various shades of grey, though the rest of us were growing tired of the monotonous grey limestones. So we ventured further south to the Wandamen Peninsula where we were rewarded with the multiply deformed, medium–high grade schists and gneisses.

Most of the fieldwork was completed on coastal outcrops accessed with a speed boat that was launched from the *Shakti*.

Local boys entertained us with their tyres. They were so skilled at this that they were able to turn the tyres around corners and jump over gutters and drains.

The same village that the boys were from offered to rent us their ambulance so we could access outcrops in the interior. Also note the village Christmas tree in the background.

Life on the *Shakti* was quite comfortable – we were able to relax on deck with a beer each night.

Is this where the term “piggy back” came from?

Though it wasn’t always smooth sailing. The capstan (brown octagonal block of wood) which helped take the slack when hauling the anchor up snapped off its support. Dave was made to sing for his supper one morning by helping the crew manually hoist the anchor (though not shown here).

Fortunately we managed to hire a dump truck which gave us some more room – though it wasn’t a comfortable or quiet ride.

It was here on Wandamen that I was given control of the scientific programme (and ultimately the boat) for several days. While I wasn’t driving the boat, it was still quite daunting as the scientific goals were often outweighed by the Captain’s desire to anchor in certain places (often so that he might go snorkeling to look for Whale Sharks or Dugongs). Adding to my frustrations was a change in weather – it poured with rain each morning up until lunchtime. Knowing that we only had a few days to look at the rocks here, we had no choice but to stick it out, get drenched and to see what we might find. We were lucky that our final day around Wandamen saw the rain clear early, and made way for a lovely, hot day to look at a few outcrops before returning to Manokwari for a crew change – guided by dolphins swimming alongside the boat.

While Dave thoroughly enjoyed his time in West Papua, he had now been in Indonesia for about four months and it was beginning to show that he was ready to see his family, have a break and

escape the clutches of our small shared room and the stench associated with several weeks of damp clothes infused with sweat.

After saying farewell to Dave and the other geologists of the first crew, those of us who remained ventured on to the island of Yapen (the elongate island found at the northern part of Cenderawasih Bay), though we first had to sneak past Greenpeace's *Rainbow Warrior* which had followed us into port at Manokwari.

We spent the next six days cruising along the southern edge of Yapen, stopping off at various outcrops along the coast. Our efforts to drive across the island were hampered by some recent local conflicts, so we returned to the boat and made our way around the eastern tip of the island to push northward to the island/town of Biak to fly back to Jakarta.

The rain begins to clear on Wandamen Peninsula.

Greenpeace's *Rainbow Warrior* in port at Manokwari. Frustratingly I don't think they were there to help clean the harbour that was so riddled with plastic bags that they twice got caught in the *Shakti's* propeller.

The region is still seismically quite active. We often saw evidence of parts of the coast that had subsided where locals would inform us that these events were linked with earthquakes on specific dates.

The expedition was very successful: we observed rocks that were last mapped by Indonesian and Australian geologists in the 1970's, gathered enough material for modern geochronological analyses and we also have a much better idea of the infrastructure and the way things work in Papua which will benefit future field campaigns.

Sunset over Yapen island.

Fieldwork on the Whin Sill – *Zöe Barnett*

Standing alongside Cauldron Snout

Dramatic crags at Holwick Scars

River Tees flows over the Whin sill at High Force with underlying baked sediments

John Browning and I carried out fieldwork along the Whin sill for 2 weeks this June. The weather held up and we were able to enjoy the fantastic geology of the Whin sill and associated sedimentary host rocks, along with the fabulous views both offshore and inland Northumberland and County Durham. The Whin sill forms the dramatic landscape of the northern Pennines and Northumberland National Park, forming natural cliffs and crags excellent for quarrying and for climbing.

The Whin sill was formed about 295 Ma with a temperature of ~1000°C where the magma intruded laterally between Carboniferous strata of limestones, shales and sandstones. The dolerite sill today has a thickness of up to 80 m covering an area greater than 4500 square kilometres over NE England and into the North Sea. Due to millions of years of erosion we are able to see the sill outcropping at the surface today with the most spectacular outcrops at Holy Island, Bamburgh Castle, High Force, Falcon Clints, Holwick Scars and Hadrian's Wall.

The Whin sill is thought to have taken approximately 50 years to cool to form the columnar joints that we see today in the cliffs and in the quarries. When the sill was molten it induced contact metamorphism on the adjacent rocks. The most notable metamorphosed/baked host rock is the limestone in Upper Teesdale colloquially termed 'sugar limestone'.

This trip has provided us with some excellent data and now it's time to start analysing!

MAMM Lapland air sampling road trip

From the North Cape to the Baltic

Dave Lowry and Nathalie Grassineau

As part of our Methane in the Arctic Measurement and Modelling (MAMM) project funded by the NERC Arctic Programme, we undertook ground-based sampling to cover the area being overflown by the NERC FAAM BAE146 aircraft, to verify measurements of excess methane that they record over the vast areas of wetland in Lapland.

We reached Kiruna, Sweden, on the afternoon of Monday 12th August, having taken the early flight from Heathrow, and then spent nearly 4 hours driving up to Bodø on the Norwegian coast. We soon realised that our itinerary was an underestimate of time due to a lot of summer road resurfacing activity and a lorry in the roadside ditch. We collected 3 samples up to the Norwegian border and had some nice views of the lake near Abisko.

The following day we set out from Bodø just after 9 and didn't get to the hotel at Skaidi until 20.00 in the evening. Couldn't keep up with the itinerary again. Probably too many photo stops. After the Tromsø turn off there were some stunning coastal views as the mountains started to appear out of the cloud. Collected 10 more samples on the route and saw a porpoise just off shore at one stop. We refuelled on an excellent reindeer stew and some of the local cloudberries for dessert.

Wednesday 14th August started in glorious sunshine and a 260 km return detour to visit and sample at Nordkapp, 71°10'N. Definitely worth the effort for the gorgeous coastal scenery, interesting geology and lots of tunnels through the mountains, including the 7 km long Nordkapp tunnel under the ocean, with 9% road gradients inside. Passed 100 or more ancient cars and camper vans from Poland in some sort of race to Nordkapp, one of them slowly struggling up the long tunnel incline. We would have sampled right at the cape, except for some devious behavior by the Norwegians. Without any advance warning the cape itself is closed off by fence and a row of entry-by-ticket booths. The equivalent of £56 for a car and 2 people to park and enter the visitor centre is ridiculous. We only wanted to collect a sample and have a quick look around, so we found the first good alternative spot to sample the south-easterly airflow, only 1 minute south of the cape. The clouds appeared suddenly on the drive back south from the cape, along a very sharp weather front and that was almost it for the sun for the day. There seemed to be reindeer everywhere, even on the beach in a few places, and hundreds in large enclosures, but none were seen in the areas of white quartzite rock, which formed a barren upland moonscape with very little growing. We pitched up at the Austertana quarry truck stop and motel at 19.30.

View across Tornetrask, near Abisko – 12/08/2013

View over Kvaenangen 13/08/2013

Collecting a sample near Nordkapp 14/08/2013 (71°10'N)

Barren quartzite ridge on the Berlevag road 15/08/2013

Carpet of red berries at Kongsfjord, south of Berlevag 15/08/2013

Tana estuary, north of Tana Bru 15/08/2013

The border crossing between Norway and Finland 15/08/2013

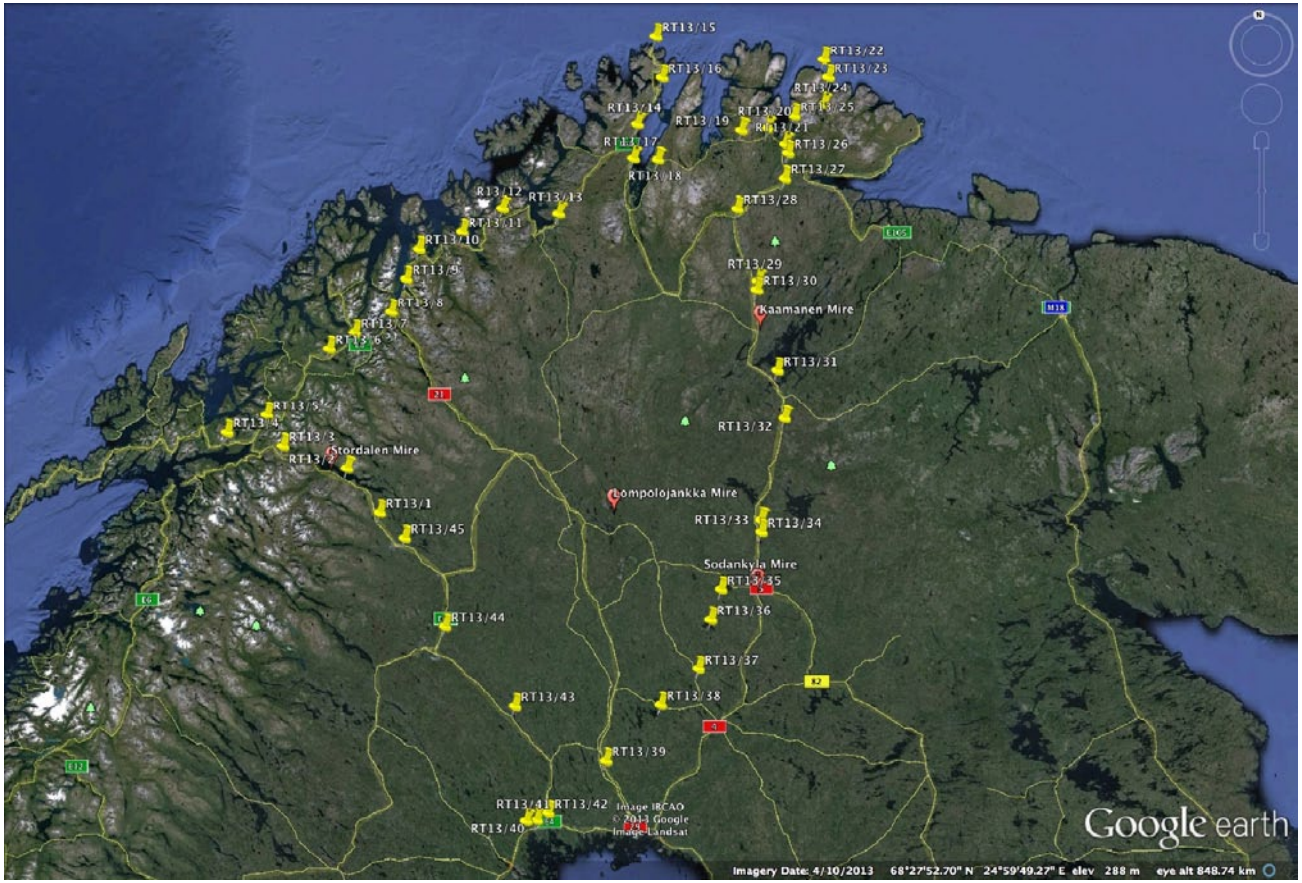
Conditions for overnight sampling at Kaamanen were not very good. The temperature dropped only from 14°C to 10°C and a gentle breeze was maintained even at 4 am. And when you are trying to catch some sleep between sampling the last thing you need are red squirrels chasing each other across the roof above your room. The Neljan Tuulan Tupa hotel is built entirely out of logs and is a feeding place for multiple species of woodland birds, some quite rare, as well as the squirrels. The wetlands also resounded to the sound of a pair of cranes who decided to circle the site, just before the plane flew over, at the same height.

Friday 17th August involved a long drive down from Kaamanen close to 70°N to the Baltic at Luleå, having finished the diurnal with the 8 am local time sampling. It seemed like an endless cycle of forest, bog, forest, lake, with a few villages thrown in, again under a leaden grey sky. We sampled every hour or so when either bogs or lakes formed the upwind direction with winds predominantly from the NE–SE sector. After escaping from the supposedly moose-protected E4 road and some searching the back roads the last sample of the day was collected beside the Baltic Sea, before finding our way to Luleå. Later there was time for a coffee with Euan Nisbet and Mary Fowler. They had spent the day doing an east–west transect into Finland before heading over to the Sodankylä wetland for the weekend (see the next section on “Seeing Ghosts”).

A Kaamanen sunset 15/08/2013

Neljan Tuulan Tupa hotel and café. Choose from ensuite or cabin in the woods 16/08/2013

Saturday 18th morning was the final leg of the circuit, starting with Baltic coast sampling and continuing with the inland leg to join the flight team in Kiruna, the last 2 hours through torrential rain. The final sample was collected at the edge of the airport tarmac during a quiet period. Total distance covered in 5 days was close to 2,900 km, with 45 road trip and 10 wetland diurnal samples collected (see map below).



Road trip sampling locations in Northern Scandinavia, August 2013.

Now the samples are back at RHUL the CO_2 and CH_4 concentrations have to be analysed by Picarro CRDS and then analysed on the stable isotope mass spectromter to determine the carbon isotope signature. The data will be used to determine if all of the enhancements at ground level are from wetlands and how the extent and magnitude of the enhancement compares with measurements and sampling from the flights.

Seeing Ghosts? – are all methanes the same?

Euan Nisbet and Mary Fowler

If you stay up too long sampling, you tend to go a bit stir-crazy. At Sodankylä mire, Finland we went out every two hours, day and night, to collect air samples. It's quite a balancing act, especially after hours and hours of no-sleep.

Off to sample again – the end of the line in Sodankylä

A great part of the North is covered in "Boreal" forest wetlands (Boreal is from Greek for North). When we try to work out the world's methane emissions, we can measure how much is in the air. We can even make a good guess about how much is injected into the northern air, as compared with the tropics and the southern hemisphere. But that only gives us the total amount of northern methane production. What makes northern methane? – there are giant gasfields in the North that leak; there are big fires making methane that's carried in their smoke; there is methane leaking from permafrost lakes. And there

Sammy the ghost reindeer

Sodankylä bubbles – yes we did see them popping…

Sodankylä dawn…

are the vast soggy forests, the endless Canadian muskeg, the lakes of Finland, the swamps of western Siberia. How much do they make?

Here, Carbon isotopes come to help. Carbon-12 is a little lighter and easier to fit into biological molecules. Carbon-13 is more abundant in methane from thermal sources, like fires or coalfields. But to use these isotopes we have to work out the isotopic signatures of the main sources; especially forest. How do we do that? Lots of ways, but one of the most direct is to sit up all night.

Swamps make methane, and it is emitted into the air. In the daytime as the wind blows, methane mixes into the background. At night, and especially in the small still hours around dawn, the methane that is emitted from the wetlands sits close to ground, in the cold still air.

We sample that, every two hours through the night and the day, over 24 hour periods. Plot up the results on a plot of methane isotope ratio versus 1/methane concentration (the reciprocal of the methane concentration) and the intercept on the 0 of the 1/conc axis (i.e. infinite concentration) is the isotopic signature of the wetland emission. Once you've got that you can use it to work out a global isotopic budget for methane.

All methanes are NOT the same – some are 'light', rich in carbon-12 and come from wetlands (and probably differ according to where the wetland is, tropics or north); some are 'heavy', rich in carbon-13 and come from fires or coalmine leaks, and some are in the middle and are from landfills or maybe Russian gas (Dutch gas is much 'heavier'). That means we can sniff a methane-rich wind, wind it back by reversing the weather forecast computer, and find where it came from, and identify the source of the methane. Well, it's not as easy as that, but that's the intention. It's a methane telescope. For example, Rebecca Fisher and our team showed that the input of methane to Arctic air in summer seems mainly to come from wetlands.

That means staying up all night. Just days after coming back from two weeks in Canada, doing exactly that in northern Ontario and Saskatchewan, we moved on to the mire at Sodankylä, Finland to do exactly the same thing.

There was a difference though – Sammy was around to look after us, and few mosquitoes. And the wonderfully welcoming saints of the Finnish Met Office (FMI) most generously gave us a fine cabin to sleep in and make strong coffee – a wonderful place by a riverside. Could science be more fun? Marvellous!

Abisco to Zeppelin to Abisco – the Z to A of wetness

Euan Nisbett

"Two Hundred Feet….One Ninety….One Eighty……One Seventy…..One Sixty…..One Fifty"….The pilot's calm voice calls the heights and we're now in level flight over the Arctic waves. Below you can see the white caps and bubbles in the heavy swell – that's the oxygen mixing into the water, and you can almost imagine the fish leaping and darting in the rich cold water.

We're off the west coast of Spitsbergen (Svalbard is the territory, Spitsbergen is the biggest island), looking for methane plumes coming from the methane hydrates on the seabed below. They're here, a couple of hundred metres down – but do they break surface? Rebecca Fisher, today sitting by the window, and Mathias Lanoisellé, who was on last year's flight, were both on the ship that found the plumes. So now we're running along the track of the plumes, 150 feet above the waves. But today, as last year, we don't find any methane that has escaped. It has all dissolved in the seawater, or been 'eaten' by methanotropic bacteria in the sea.

That's comforting – this is a big gas release going on beneath us, and we know it's there, but at least it isn't hitting the atmosphere. The hydrates are being warmed by the West Spitsbergen Current, the top end of the Gulf Stream, which is pouring Gulf of Mexico heat into the Arctic Ocean.

Take off

We took off from Kiruna, sopping wet under low skies. The pilots' mikes were offline on our headphones, but you could hear the quiet comment when the BAe 146 rotated and lifted off, climbing up towards the hills towards the Norwegian border. As we unbuckled the top two straps of the 4-way

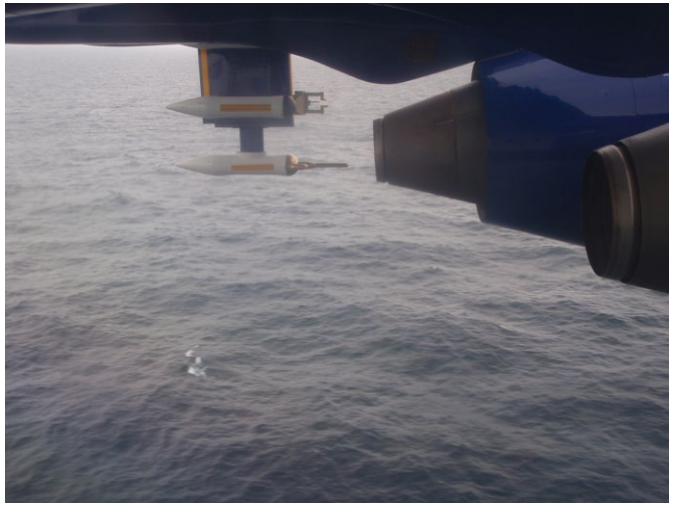


Photo Mathias Lanoisellé, 2012

harness we would have had the wetlands of Abisko park, where we'd been the previous day, off on our side, far below in the murk. James France and Dave Lowry, having volunteered to do the hard stuff while we fly, would be setting off for another wet day there. More on Abisko later. Meanwhile ten thousand feet up, we're given good hot coffee and – surprise – superb chocolates (mystery gift: was it the pilots?).

We're climbing from 10,000 towards 25,000 feet now, over the border hills between Sweden and Norway. There's high methane air here. We don't know where it comes from, but Michelle will find out after we land, by running the winds backwards in the Met Office computer, using the 'NAME' model that was originally set up after the Chernobyl accident (NA in NAME stands for Nuclear Accident!) to work out how pollutants travelled. NAME is very powerful and in addition to nuclear accidents has been used for tracking emissions from volcanoes like Eyjafjallajökull and for the Elgin gas leak in the North Sea.

There are three snakes writhing across the screen – one's methane. Below it is CO_2. If they both rise together, it's likely to be industrial air. But if just methane rises, then the source will be natural wetland or maybe hydrate. Below is the H_2O vapour trace, and in an inset is CO and Ozone. If there's lots of CO, then the air mass may come from a distant giant forest fire – at 25000 ft this maybe was days or even weeks ago and perhaps as far away as eastern Russia, or even North America, heading for Zeppelin – or at least a few dozen miles west of Zeppelin.

There's a brief excitement – ozone is climbing. Is this a filament of stratospheric air, a downhanging tendril from above? – they saw one on the transit across from the UK a couple of days ago. The Polar Vortex brings the stratosphere down here: some of this polar stratospheric air rose long ago over the giant thunderstorms of the Inter Tropical Convergence Zone, in what's called the Brewer-Dobson circulation. But the ozone soons falls again – maybe it was just a little breath now mixing in with the ambient troposphere, left over from something that took place earlier.

We reach the point of descent, far north of Tromso, and then dive fast to begin a sharp sawtooth pattern – down low to 150 ft, then up to a few thousand, then down again, up, down, up, down, up down. We're hunting – like a hound going to ground, then lifting to sniff upwards, seeking out the easterly winds from Siberia. There's some wind at a few thousand feet that's rich in methane, and we sample it. Down low, the air is very uniform – some wiggles in the snake, but this is well-mixed polar air.

This is very good news for the planet, as it means there are no huge point sources feeding blasts of methane into the winds: at least, not this day! If some large point source existed in the Barents Sea (which is rich in hydrates), or even further east perhaps, we'd see a spike in our results. No such spike. Disseminated sources – such as wetlands – are lots of little inputs, and there may be many of these adding to the air we are measuring. But even if they aren't well mixed, they may just be the noise

on our wiggles, where CH_4 goes up but not CO_2. The giant Russian gasfields of the Ob River estuary are upwind of us also, but this is still September and they're probably just coming to the end of the summer quiet, before cranking out the vast volumes of gas that keep the light and heat on in Germany in winter. Besides, they have invested enormous amounts of money into leak-reductions and may now be better at it than many UK North Sea fields.

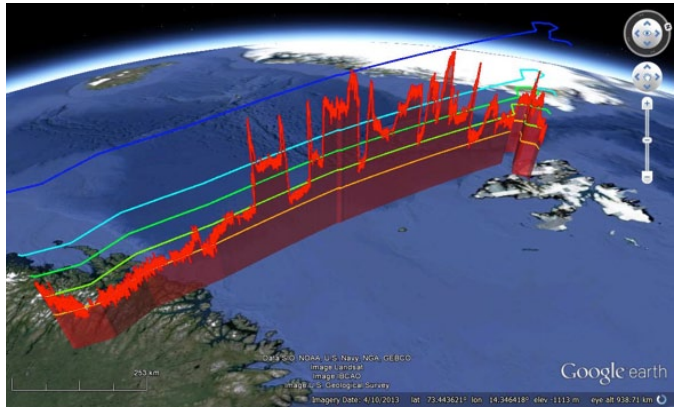
Then the sawtooth pattern ends. We have just enough fuel for a long run at 150 ft over the west coast of Spitsbergen. This is where the methane plumes are, hundreds of them, in a line along the gas hydrate stability boundary 250 to 400 m underwater. The pilot calls '150 ft' then we run smoothly along, just above the waves, and watch the wiggles. The pilots are watching keenly also "Two birds to the left…..and to the right….less than we saw last time…(an engine ate birds once, which can be indigestible at 150 ft)…shower ahead…

All's quiet – the wiggles stay calm. Back up to 25,000 ft and turn for home. We poor souls who have been on the west side of the aircraft listening to the comments about fantastic visibility finally get a glimpse of the astonishing landscape of Spitsbergen. Dave, Rebecca, James and I have all worked there, at Zeppelin Mountain: it's marvelous to see the sharp teeth – the Spits-bergen – of the jewel of the North again.

Last year we did a similar flight. The plane flew through wide tracts of air that had come from the Russian Arctic, where much of the Arctic methane hydrate is located.

We certainly saw lots of air masses from Siberia with high methane, as the plots above show.

When Rebecca Fisher did the isotopic analysis, the extra methane in the air masses last year had the typical signature of high-latitude northern wetland. In summer at least the Arctic methane in Russia is



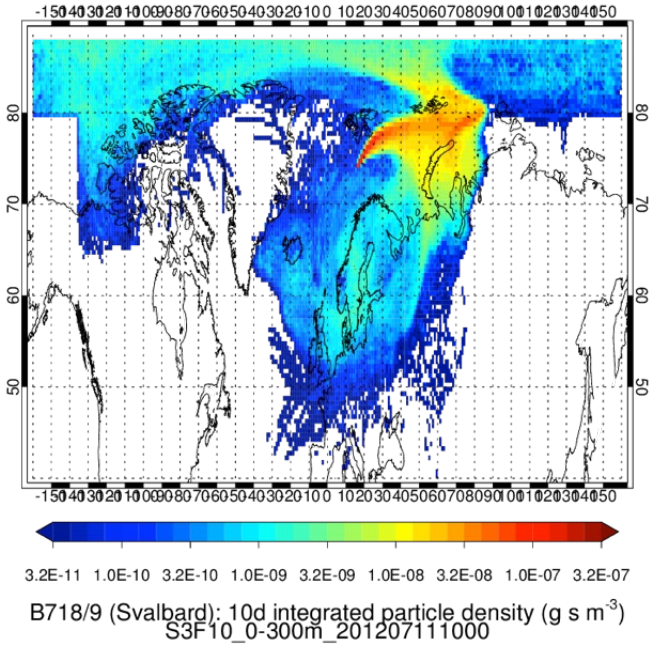
Methane measurements during last year's Flight to Spitsbergen (plot from James France).

Blue 1925ppb, cyan 1900ppb, dark green 1890ppb, light green 1880ppb, orange 1870ppb

probably mostly coming from the vast swamps and bogs of Siberia.

That's more or less the same conclusion that we reached in 2008–9 from samples collected at Zeppelin station, which is on the mountain crest 400m above the Ny Alesund on the west coast of Spitsbergen, only a few tens of miles from where we've been flying. Thus far we're seeing wetlnd emissions of methane in summer, but not really much or indeed any that we could tentatively identify as hydrate-sourced methane.

This year the methane profile is somewhat different. We've been in easterly winds, coming from the Siberian coast, so conditions are perfect to assess emissions from Siberia. We fly though a huge tract of air slightly enriched in methane, but it's very uniform, without any obvious spikes that would suggest plumes from high-emission areas. Some air masses might have come from large forest fires, as these air masses have more CO and CO_2 and well as more CH_4 than the regional norm. Other methane-rich air is not enriched in CO_2 also, suggesting wetland sources (or hydrates): we'll find out when we meas-



Sources of air near to Spitsbergen during last year's flight – NAME plot by Michelle Cain. Note the well-defined plume of air from the northern Siberian shelf area.

ure the C isotopes in the lab).

Wetland Methane

How are we able to recognise the signature of wetlands methane? This is where you get eaten by mosquitoes in summer (see August blogs) and soaking wet and frozen in autumn (as now). Either you sample air in the open to work out a 'Keeling plot' (see earlier blogs) or you set up chambers in the swamp to collect methane.

This time we've been chambering at Abisko National Park, using chambers set up by Ute Skiba's team from the NERC Centre for Ecology and Hydrology in Edinburgh.

There's simply no way to stay dry. That's where Dave Lowry and James France are while the rest of us keep warm by flying to Spitsbergen. On Saturday Euan Nisbet got so wet his passport photo dis-

solved. Unlike the tough ancient blue UK passports that could go to hell and back, the new biometric wimps dissolve on the slightest provocation. It's an interesting task getting through flights and Heathrow immigration with a photo-less passport that looks as if it has been through a washing machine. One option, seriously considered was to stow away in the Arctic survival gear in the cabin of the FAAM plane and throw the still-soggy passport onto the mercy of the Aberdeen immigration people (Scots tend to understand a Gaelic name!) …..

Touch down

We're still in the high methane air over the hills as the plane descends. We've taken 41 flask samples (they're in the hold – you press a command and the flask fills) and half a dozen bag samples (that's done from the airline hissing all the time between our seats). Quick – stow the air bags, turn off the pumping system for the flask samples, stow the air bags, put away the laptops, do up the four straps.

Down we go – through the cockpit door I can see the bright glowing lights of the runway. We're perfectly lined. Touch down with these super-skilled pilots is so gentle it's a second or so before it's obvious the plane is now on the ground.

At least it's still raining, not freezing at Abisko. And we can ease off afterwards in Kiruna (on hot chocolate - as beer is £7 a small glass!)

But the results are worth it. Across the wetlands of Finland and NE Norway we have had very consistent results for the isotopic signature of wetland methane, and that's exactly the same as the signature we've measured in the air above central northern Scandinavia and also in the Arctic Ocean. This suggests extremely strongly that the summer methane increment in the Arctic is mainly from wetlands.

Methane scientists suffer from seismology-syn-

Zeppelin Station, Spitsbergen, a few tens of miles east of our flight track. This mountain-crest station run by NILU (the Norwegian Air research Institute) continuously monitors methane.

drome. That's when seismologists are excited when a magnitude 9 quake happens. Of course they are – they're trying to understand what makes big quakes, and they're not in any way the cause. But then later they calm down and realise the horrendous truth, that enormous suffering is taking place. Maybe their excitement is forgivable – their work is important as it helps warn of dangers and it plays a big part in reducing the impact of future events. Methane work is like that too – we're excited when we see big plumes of gas – wow! – where are they and what's making them? – can we figure out how to reduce them in future, or at least predict them. So we get disappointed when we find huge air masses like the polar air we've been flying through that are well mixed and don't show giant new methane sources. But actually we should be celebrating – the planet needs all the good news it can get!

Now how does one get back to Britain with a passport in which the photo has dissolved? Fortunately SAS check-in folk at Kiruna are kindly and

Spitsbergen (photo by Mathias Lanoisellé, 2012)

Abisko sampling (Photo by Rebecca Fisher in August 2013). Chambers are marked by little flags. Cotton grass growing in water (darker areas). Mire is underlain by permafrost.

understand wet climates. The kindly Kirunans even phoned ahead to explain to sophisticated Stockholm airport that odd things happen in the Arctic because a chief security man is there at the gate with authorisation to go through - with a smile and an amused understanding. Thanks SAS (that's an airline, not heavy gents in soft shoes!).

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PhD SUCCESS FOR . . .

Martin Rittner, who successfully completed his PhD on Friday, 9th November 2012 with his viva on "U-Pb dating of brittle deformation". Martin is now workoing as a PostDoctoral Research Assistant at Birkbeck/UCL.

John Pernet-Fisher, who successfully defended his PhD thesis on "Petrochemistry of the Northern Rift Zone, NE Iceland: Plumbing dynamics and source variations" at his viva on 5th December 2012. He has a PostDoc position, starting soon at the University of Tennessee at their Planetary Geoscience Institute, to work on meteorite and lunar samples.

Diego Costantino, who successfully defended his PhD thesis on "4D evolution of deepwater fold belt- Offshore Niger Delta" at his viva on 22nd January 2013.

Anna Kulikova who, on 18th April, successfully defended her PhD thesis on "Architecture of distributive fluvial deposits: quantative characterisation and implications to reservoir modelling". She is now working in Norway.

Ali Kahal who on 18th July passed his PhD viva on the project "Tectono-Stratigraphic Evolution of the Eastern Otway Basin, SE Australia".

Sohail Waheed, who successfully defended his PhD thesis "4D Tectonic Evolution of Kohat Plateau, NW Pakistan." at his viva on 1st August

Lorin Davies who, having survived months in the jungles of Borneo, successfully survived his viva on 4th August on his thesis "Basement rocks of Eastern Sundaland". He is due to join Robertson Research in North Wales in the near future.

JON WRIGHT MEMORIAL PRIZE 2012

On Monday, 12th November 2012, Head of Department Prof Jason Morgan presented the Jon Wright Memorial Prize jointly to Kimberley Graabeck and Huw Williams for their outstanding achievements in fieldwork during their second year. Jon Wright died in 1995 at the start of his final year, and the Prize was set up by his parents to commemorate his life. His fellow students and the staff all contributed to the Prize Fund. The tangible expression of the Jon Wright Memorial Prize is the Borrowdale Trophy, which is exhibited in the showcase in the Geology Foyer. Jon was a brilliant student, who had mapped across the Borrowdale Volcanics in the Lake District to complete his undergraduate field mapping project. His work had been so good that he was posthumously awarded a first class honours degree in geochemistry by the University of London. The Trophy is a specimen of green tuff from the Borrowdale Volcanic Series, collected from a quarry within the area that Jon mapped. His parents wanted the Trophy to go to the students judged to have shown the most progress and achievement in geology through fieldwork in their second year. They also wanted the prize winners to use the funds in whatever way they chose, to enjoy their third year as undergraduates.

CONGRATULATIONS TO . . .

Andrew Scott, who has been appointed by the College from 1st November 2012 as a Distinguished Research Fellow in the Department of Earth Sciences. This is a 20% position lasting until the end of 2013. Andrew has also been awarded a Leverhulme Research Fellowship for 2013 and 2014.

Ken McClay, on receiving a major award from a consortium of eight companies to fund the continuation of the STAR Project on "Structural Analogues for Reservoirs".and funding from ConocoPhillips to support Jorge Belenguer for his PhD project on Central North Sea Salt Tectonics.

Ken McClay, who has been presented with the AAPG Robert Dott H. Snr Memorial Award to honour and reward the author/editors of the best Special Publication dealing with Geology published by the Association: "Thrust Fault-related Folding", Memoir 94 (2013), editors Ken McClay, John Shaw and J. Suppe. This is a most prestigious award and expression of international esteem.

Dan Bosence, who has been presented with the 'Perce Allen Award' for 2012 by the British Sedimentological Research Group, BSRG. The award, which recognises a substantial body of research in any field of sedimentology, was the result of an online vote open to all 700 members of BSRG. The citation for Dan's research names colleagues in the Department he has worked with as well as former RHUL PhD students: "After pioneering work on Cainozoic calcareous algal facies of W Ireland, Malta and later Brazil, Dan produced the first quantitative sediment budgets for Florida Bay. With Waltham, Pomar

and Aurell he developed the most successful forward models for understanding carbonate platform dynamics. He developed with Cross and Wilson carbonate tectono-strat models for rift basins. In addition, his taphonomy work is very highly cited. Recently he has produced major studies on the nature of cyclic peritidal carbonates. No researcher in the UK, if not Europe, has produced such a diverse, innovative and substantial body of work on carbonates, modern or ancient. Although Dan retired from full-time work in the Department nearly ten years ago to develop his own consultancy company he continues to teach on the MSc Petroleum Geoscience course, supervise PhD students and attract research grants to the Department. His latest grant (joint with Peter Burgess) is a £1/4 million award (Baker-Hughes/BP/RHUL) to try and understand the enigmatic Purbeck Limestones of Dorset's Jurassic Coast. These have intrigued and tested the minds of geologists since the late 19th Century, including Dan with student projects and a publication in the 1980s. Understanding the origin of these limestones, that are probably seen by most geology undergraduate students in the UK at the Fossil Forest in Lulworth Cove (see photo), is one of the frontier areas of carbonate sedimentology. They form from unusual algal/bacterial communities in very restricted or extreme environmental conditions and are termed microbialites. Today microbialites are receiving renewed interest as the Dorset examples are, in part, analogous to some highly porous, hydrocarbon bearing limestones of Early Cretaceous age buried beneath a salt seal 3000–4000 metres down in the South Atlantic. The new grant includes support for two PhD students, Arnaud Gallois and Estanislau Kozlowski.

John Browning, who with Hugh Tuffen and Mike James (Lancaster) has been awarded the 'Geoff Brown Memorial Prize' for the best student poster at the recent Volcanic and Magmatic Studies Group (VMSG) Annual Meeting. The research presented was from his Masters degree at Lancaster on the Vesiculation of a rhyolitic melt. Abstract: Although pumice is an end-member product of gas-rich explosive volcanism, the process of bubble growth which leads to the formation of pumiceous textures is not well constrained. Vesiculation in rhyolitic melts is a primary control on some of the largest explosive eruptions. This study presents the results of a series of experiments which have utilised hot-stage microscopy techniques to track vesicle growth in an initially vesicle-poor rhyolitic melt. Using rhyolitic obsidian erupted from Chaiten, Chile in 2008 (containing ~1.38 wt. % H_2O), thin wafers were held at atmospheric pressure for periods of between 5 minutes and 2 days in the hot-stage, at temperatures between 575°C and 875°C. In-situ vesiculation was directly observed and the growth of individual bubbles measured using image tracking code in MATLAB.

John has also been awarded the Kirsty Brown Memorial Fund to support his fieldwork at the intriguing volcanic islands of Tenerife and La Palma. It is hoped that the intended fieldwork and later numerical and analytical modelling will produce results which aid the understanding of collapse processes and contribute to the interpretation of geological features on the islands.

Tetsuzo Fukunari, who was awarded the prize for the best poster by a postgraduate student at the Tectonic Studies Group Annual Meeting in January 2013.

Colonel Ted Rose, who made the cover article for the February 2013 issue of Geoscientist (v. 23 no. 1) on "Wartime Geotechnical Maps: Hong Kong". Having retired in 2003, he was appointed Honorary Research Fellow in the Earth Sciences Department and he is still publishing after all these years!

Colonel Ted Rose, who has been elected Honorary President of the newly inaugurated International Association for Military Geosciences

Pete Burgess, on being awarded the Aberconway Medal for 2013 by the Geological Society of London. The Aberconway medal was established by the Institution of Geologists in 1980, and continued following reunification in 1991. It is awarded normally to persons with no more than 25 years full time equivalent experience and to recognise distinction in the practice of geology with special reference to work in industry.

Chris Elders on his appointment to the Chevron Chair of Petroleum Geoscience at Curtin University in Perth, Western Australia. As well as being a high honour and achievement, it is also a great opportunity for Chris, that comes with initial funding for a post-doc and two PhD students. He will be joining old friends from Royal Holloway when he gets there in September. Already on the staff at Curtin are Moyra Wilson, who was a PhD student and then research fellow with the Southeast Asia Research Group between 1991 and 1998 and Ian (Ming) Fitzsimons, who was a NERC Research Fellow from 1991 to 1994. In addition, Moyra is married to Nigel Deeks (MSc in Basin Evolution and Dynamics 1991–92, and later a PGRA from 1993 to 1996).

Martin Menzies for bringing about a major coup to establish a Joint Research Centre with Guangzhou Institute of Technology (GIG)–Chinese Academy of Sciences (CAS).

Euan Nisbet, who has been awarded a substantial grant from NERC for a project entitled "Investigation of the Southern Methane Anomaly: causes, implications, and relevance to past global events."

Dave Lowry, who has been awarded a grant from the National Physical Laboratory for the project entitled "Methane oxidation by landfill cover soils."

Ian Watkinson, who has been awarded a research grant from NERC for a project entitled "Coseismic deformation associated with the 11th November 2012 Shwebo earthquake, Myanmar."

Dave Waltham, who has been awarded a grant from Midland Valley Exploration Ltd for a project on "Numerical Modelling of the Two-Way Feedbacks Between Turbidity Current Deposition and Ductile Deformation."

Martin King, who has been awarded two research studentships: One is a CASE award from NERC, jointly with National Physical Laboratory in Teddington on "Characterisation of bi-direflectance (BRDF) of sea-ice in response to deposited aerosol for the CAL/VAL of remote sensing products." The idea is to make sea ice at the RHUL sea-ice simulator and dose it with humic materials and dust to calibrate the remote sensing signal from Earth observing satellites, and to see if the deposition of aerosol onto sea ice can be monitored from space. The deposition of aerosol on sea ice will lower the planet's albedo and act as a warming driver for modern climate change. The student will also calibrate a reflectance standard at NPL at space temperatures for a proposed satellite. The other is an award from STFC, jointly with the Rutherford-Appleton Laboratory in Oxfordshire, on "Oxidation of real atmospheric organic matter on interfaces of atmospheric aerosol; does it activate cloud droplet." The plan is to extract real organic matter from precipitation, snow, atmospheric aerosol and seawater, and to study the oxidation on laser levitated droplets at RAL using a new Mie Scattering technique. The oxidation will also be studied with x-ray and neutron reflection at the large facilities Diamond, ILL and ISIS. Oxidation of organic matter in the atmosphere may change the hydrodynamic properties of aerosol and thus affect the cloud forming potential. Clouds reflect radiation back to space and act as a cooling mechanism in the modern climate system.

Dan Le Heron and **Wolfgang Müller** on their promotion to Readerships.

Margaret Collison and **Rebecca Fisher**, who both won "Apple For the Teacher" Awards at the Student Union's Laurel ceremony for their dedication and commitment to lecturing, the students, the New Lyell Society and the Department this year!

Lucia Perez-Diaz, who has been awarded the Helen Shackleton Fund, a College scholarship contributing towards the cost of foreign travel connected to academic work. This will enable her to work for periods with Graeme Eagles at the Alfred Wegener Institute in Bremerhaven.

David Evans, who won the Doctoral Publication Award, and **James France**, who won the Postdoctoral Publication Award. These awards are made in recognition of excellence in writing and publication in Earth Sciences during 2012.

The New Lyell Society, on an award from The Students' Union for its outstanding contribution to charity fundraising, 2012–2013.

Marta Perez-Gussinye and husband **Javier** on the birth of their daughter **Maria** on 20th August. Both mother and daughter are doing fine!

Athena SWAN Bronze Award

The Department, which has won a Bronze Award from the Athena SWAN organisation (charter for women in science – recognising commitment to advancing Women's careers in STEMM academia).
1) It shows the Department embraces the advancement of Women's careers in science and we can place the Athens Swan logo on our web site to demonstrate our good practise.
2) Research Councils (so far only medical) are requiring departments to have a Bronze award to be elgible for funding, and our present award can be used in environment type statements about the department in which the work would take place.
3) For the college to move from Bronze to Silver institutional award a number of departments need to have a bronze award and we, as a department, contributed to this.
The documentation was prepared by the departmental Athena committee, (Peter Burgess, Barbara Davis, Graeme Eagles, Dan Le Heron, Martin King, Christina Manning, Gary Nichols, and Marta Perez-Gussinye). The award is valid until April 2016 at which point we should have submitted for a silver or gold award or renewed our Bronze award, The process is not static and the departmental Athena SWAN committee will now have to go through our action plan. The committee is now led by Marta Perez-Gussinye.

WELCOME TO . . .

Dr Nora Lecoeur
who joined Agust Gudmundsson's research group as a Postdoc in April. She is working mainly on numerical modelling of intrusions – on the mechanical conditions for intrusions (mainly sills and dykes in sedimentary basins), the thermal effects of the intrusions on the surrounding rocks, and fluid flow in rock fractures (including dykes and sills). She works with Agust's PhD students who are studying sill and dyke emplacement and magma-chamber development and their thermal and mechanical effects on the host rock.
Nora has just completed a PhD at Imperial College on multiphase flow (both modelling and experimental), funded by the Oil and Gas Petroleum Consortium. She has a strong mathematical background, with her first degree in mathematics, mechanics and numerical simulation from the University of Caen, followed by a Masters degree in applied mathematics involving numerical and statistical analysis techniques, together with a Masters degree in coastal engineering.

Dr Javier Hernández-Molina
We are delighted that Dr Javier Hernández-Molina is joining the Department in December 2013 as Reader in Sedimentology. Javier is currently at the University of Vigo and has a long interest in different aspects of basin analysis, including sedimentary processes and seismic & sequence stratigraphic analysis, continental margin evolution and environmental reconstruction in terms of climate, sea level and palaeoceanographic changes. These different research strands have evolved into integrated studies of continental margins, with special interest in deep-water sedimentary processes and the effects of interaction of bottom circulation along margins, through the study of Contourite Depositional Systems (CDSs). Much of Javier's work has focused on the Alboran Sea, Gulf of Cadiz, NW margin of Iberia, the Cantabrian Sea, the Argentine and Uruguayan margins and Antarctica. He has recently became interested in bottom-current reworked sands (BCRSs) and sandy mass transport deposits (SMTDs).

Dr Oriol Ferrer
who joined the STAR Team of the Fault Dynamics Research Group: from the Universitat de Barcelona where he completed his BSc and PhD in Geology. His doctoral thesis focused on the study of the eastern Bay of Biscay structure (including the Parentis Basin) and understanding the origin and kinematics of salt structures of this basin. Oriol has been a research assistant at the Geomodels Research Institute, combining this work with teaching for BSc and MSc courses at the university. During the last 3 years he has been responsible for developing the Geomodels analogue modelling laboratory (University of Barcelona). Much of Oriol's work has focused on the structure of the eastern Bay of Biscay, the North-Iberian Margin, the Basque–Cantabrian Basin, the Ebro and Duero Basins, the Prebetic Zone in Spain and on the Salta Basin (Argentina). His current research interest includes analogue modelling of extensional, inversion, compressional and salt tectonics, 2D/3D seismic interpretation and 3D reconstruction of geological bodies.

Nicholas Sellier joined the STAR Team of the Fault Dynamics Research Group: from the University of Lille where he completed his PhD on the interactions between deformation and sedimentation along salt-bearing passive margins. The aim of his PhD research was to design a totally new kind of experimental underwater apparatus that combined the physical modelling of turbiditic transport/deposition with the salt-related deformation. By means of this new experimental procedure he investigated the effect of depositing consecutive sub-circular and gentle-dipping lobes onto a mobile salt analogue layer. This method was used to demonstrate the initial geometry impact onto the structural evolution of allochthonous salt tongue remobilized by sediment loading.

Dr Hodei Uzkeda joined the STAR Team of the Fault Dynamics Research Group: from the University of Oviedo (Spain), where he has recently completed his PhD thesis. His research has been focused on the study of fault-related structures, which includes the development of geometric and kinematic models and methods to estimate related parameters. Furthermore, he has also performed digital cartography, combining GPS and laser rangefinder measurements with GIS software, which can be used as the foundation for the elaboration of 3-D geological models. His research also includes the employment of photogrammetry to create accurate geological cross-sections from outcrops.

Dominique on fieldwork in South Africa for her PhD

Dominique Tanner, who arrived in August to take over from Simon Suggate as the new Research and Administration Officer for SEARG. Dom joins us from the Australian National University where she is in the final stages of completing a PhD which focused on the high temperature modification of ore deposits. This work involved bringing together aspects of economic geology, mineralogy and igneous petrology/geochemistry. Dom was fortunate to be one of the first users of SHRIMP-SI (Stable Isotopes) and has experience with SHRIMP-II, LA-ICPMS and analytical SEM's. We hope that some of these analytical skills can be applied to a number of SEARG's future projects.

Lynne White, who joined us in September as Postgraduate Programmes Coordinator. Lynne had previously worked in the Information Security Group at Royal Holloway. We wish her well in her new role.

FAREWELL TO . . .

Gary Nichols

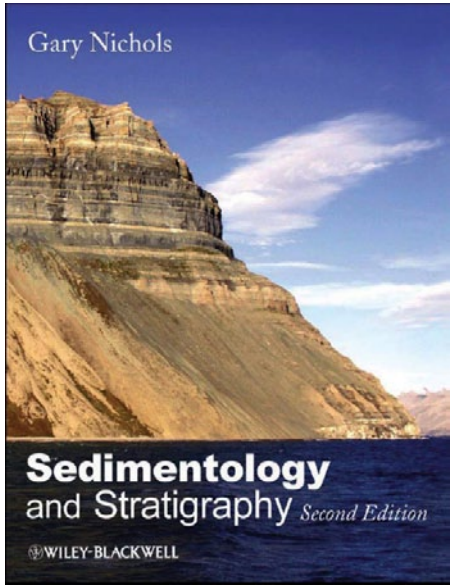
Derek Blundell

Gary has been such an integral part of the Department since he joined us 23 years ago in October 1989, that when he left in January 2013 to take up an appointment with Nautilus Ltd, Reading, we knew we were bound to miss him. His new job is to oversee their portfolio of about 250 geoscience training courses for the petroleum industry that they provide to around 5,500 company professionals worldwide each year, to develop new courses and generally manage the academic aspects of the petroleum geoscience training. He expects to have a certain amount of time to continue with research, which he plans to do associated with the Department at Royal Holloway, particularly with his research students. In recent months he has been working on collaborative programmes between Nautilus and Royal Holloway for the validation of training courses for masters and doctoral degrees – hopefully these will continue, but with his role somewhat changed.

Gary has been central to both undergraduate and postgraduate teaching in the Department during a period when the pace of advances in clastic sedimentology and stratigraphy has been quite extraordinary. Indeed, through his research he has done much to advance that pace, particularly regarding fluvial processes. For many years he and Dan Bosence combined to cover the fields of clastic and carbonate sedimentology. They formed an essential part of the team that brought our MSc course in Petroleum Geosciences, led by Chris Elders, to world-class acclaim. Gary teamed up with either Ken McClay or Chris Elders to present the very exciting Southern Pyrenees field trip. Gary knew this area particularly well as he spent many holidays there walking across the mountains.

Gary and Chris Elders with the MSc students on their fieldtrip to the southern Pyrenees, May 1998

As part of his research, Gary has worked on every continent in the world. In 1993 he was seconded to the British Antarctic Survey for 6 months to work on Alexander Island in the neighbourhood of Fossil Bluff in the far south of the Antarctic Peninsula. From 2004 to 2006 he worked at UNIS (the University Centre on Svalbard) in Longyearbean, Spitsbergen, sending us regular dispatches to the Departmental Newsletter of his activities there. He recalled that "during that time the only things he had to really worry about were remembering how to use a rifle to protect himself against marauding polar bears when on fieldwork and taking care to cover up every millimetre of bare skin when he walked to work in temperatures of minus 35". His polar experience led him to be appointed to the Board of Trustees of the geological research organization CASP, of which he is now chairman. Over the years he has worked extensively in Europe (including as Visiting Professor at Charles University, Prague where he gained his expertise in Pilsner Urquell beer), in Namibia, the Gulf of Suez, Southeast Asia, at the University of Melbourne, Australia, and in America. Recently he gave a Distinguished Lecturer tour of six universities across Australia for the Petroleum Exploration Society of Australia. He has developed many links with industry, including a spell on secondment with BP, leading to funding for research students.



His highly acclaimed textbook, published in 2009 in its second edition, is a major work

He has taken on a number of jobs to enhance Earth Sciences in general, including Secretary of the British Sedimentological Research Group and now a Council member of the Geological Society of London, Special Publications co-editor and subsequently member of Council for the Society of Sedimentary Geology (SEPM). This requires him to go to meetings in the US a couple of times a year. The first meeting was in Long Beach, California – sounds like a tough job to me . . . And, of course, he has taken a major part in the management of the Department, especially the organization of courses and field trips. He was Head of Department for six months in 2006 to give Mary Fowler a mid-term break. He has done this with great good humour and a great deal of patience. No wonder we miss him!

Graeme Eagles, who moved in April to work at the Alfred Wegener Institute in Bremerhaven, Germany, where he has a research role centred around the collection, processing and publishing of airborne remote-sensing data from the world's polar and marine regions. However, he has been returning intermittently to the Department as an occasional visitor until November.

Chris Elders, who presented his Disaugural Lecture at 5 pm on Friday, 27th September, with a party to follow! *see page 30*

Simon Suggate, who resigned his post as Administration Officer for the Southeast Asia Research Group (SEARG) in July to join Gary Nichols at RPS/Nautilus. Our congratulations go to Simon on his new position. He has been associated with the Department for over ten years, first as an undergraduate student, then as a part time PhD student at the same time as being SEARG's Administration Officer, before taking on this role with additional research responsibilities after graduating. Simon ensured that SEARG's day-to-day activities ran smoothly; a job that entailed managing SEARG's activities both here and abroad, as well as maintaining an interaction between the academic, technical and administrative staff as well as students. He leaves big shoes to fill and will be greatly missed, but will no doubt go on to make as good an impression on his new employers as he did here.

Kathryn Hardy, who resigned at the end of July as Postgraduate Programmes Coordinator to take up a position at the London College of Fashion in their International Recruitment Office. Ex-HoD, Dave Waltham, described her as "friendly, professional, and always willing to help in any way she could. She'll be extremely hard to replace.

Inga Sevastjanova, who has been an active member of SEARG for the past seven years, first as an MSc student before completing a PhD, and continuing as a Postdoctoral Research Fellow carrying out fieldwork and working on material from numerous parts of SE Asia including Malaysia, Indonesia, the Philippines and Myanmar (Burma). For the past two years, Inga has organised the Department's research seminars, very effectively encouraging and persuading research students and visiting staff to tell us about their latest work. Inga's skills in sedimentology, geochronology, mineral separation and heavy mineral analysis attracted the attention of Origin Analytical (Chemostrat), who Inga will join at the end of September. We wish her all the best in the future.

SAD NEWS

Chris Elders writes:

It is with great sadness that we have learnt of the death of **David Roberts**, Visiting Professor to the Department and an Honorary Fellow of the College, at the age of 70. David had become ill at Christmas time, but his illness was only more recently diagnosed as lung cancer, and he was being treated at the Royal Marsden Hospital.

David was a very active Visiting Professor, teaching his Petroleum Systems course for us both at Royal Holloway and in Tyumen. Many of you would have run into him during those visits, which always inspired the students taking his course, leaving them working late into the night to complete their competitive bids for Alaskan acreage. But his visits were always much more than just for the delivery of his course – he enjoyed spending time talking with many of us, encouraging us in our research, and offering invaluable advice for all aspects of departmental life, something that I know was appreciated by a number of Heads of Department. He was a staunch supporter of our MSc programme, and also contributed regularly to our project reviews before his move abroad meant that his visits became less frequent. He was a real friend of the Department, and will be much missed.

Prior to his retirement David was Global Exploration Advisor for BP and until his death was a non-executive director of Premier Oil. His recently published book on Regional Geology and Tectonics, to which many members of this Department contributed, is a fitting tribute to his work

CONTENTS

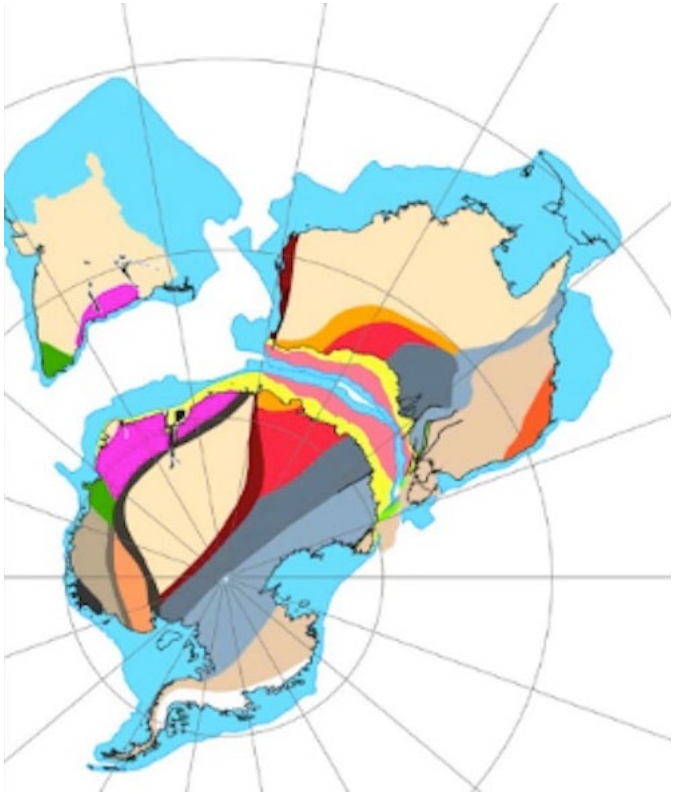
Reconstructing Eastern Gondwana

Lloyd White

I recently published a feature article in *Gondwana Research* presenting results from my postdoctoral fellowship at The Australian National University (ANU). Surprisingly, the media releases that we wrote to accompany our publication were picked up by *Discovery News* and national media organizations in Australia, USA, Canada, China, India, the Netherlands, Italy, Vietnam, Ghana, Peru and Venezuela (e.g. http://www.livescience.com/37991-gondwana-breakup-detailed.html).

The study was sponsored by a joint grant from the Australian and Indian governments, shared between ANU, Sydney University and the Indian National Institute of Oceanography (NIO). The purpose of the grant was to build a unified tectonic reconstruction of eastern Gondwana. So, I set out to understand how much variation there was in the positioning of plates in different published reconstructions of Eastern Gondwana.

I was soon able to show that there were significant differences between different published models. In order to test which of these was the best representation of reality, I draped geological maps on top of each continent and assessed which models produced the best fit between conjugate geological terranes and structures. This showed that many of the most recent plate reconstructions mispositioned the Australian plate by several hundred kilometres. This offset was mainly due to the geophysicists misinterpreting magnetic features (e.g. linear peridotite ridges generated during rifting) on the seafloor as those produced due to symmetrical seafloor spreading.



Continent reconstruction from White, L.T., Gibson, G.M. and. Lister, G.S., 2013. A reassessment of paleogeographic reconstructions of eastern Gondwana: Bringing geology back into the equation. Gondwana Research: doi.org/10.1016/j.gr.2013.06.009

The problem with this mispositioning is that plate reconstructions are typically built by moving one plate relative to another one. So, the mispositioning of the Australian plate has major impacts in global plate reconstructions. I showed how this problem impacted on the positioning of India and Antarctica, and how this influenced determining the size of India before its collision with Asia. These errors would also affect the positioning of other major plates, microplates and the location of ancient subduction zones in plate models.

Considering all of these issues, my co-authors and I developed a new plate reconstruction that remained faithful to the available geological and geophysical data and we made the animation freely available online: https://vimeo.com/68311221 . The media attention we received led to our reconstruction animation being played more than 22,000 times (clearly more than what I could achieve by clicking “play/refresh” all day).

Our work demonstrates the importance of using geological data in plate reconstructions to assess their legitimacy: something, many would think would be commonplace in modern plate reconstructions, but sadly are not.

New PhD Research Projects

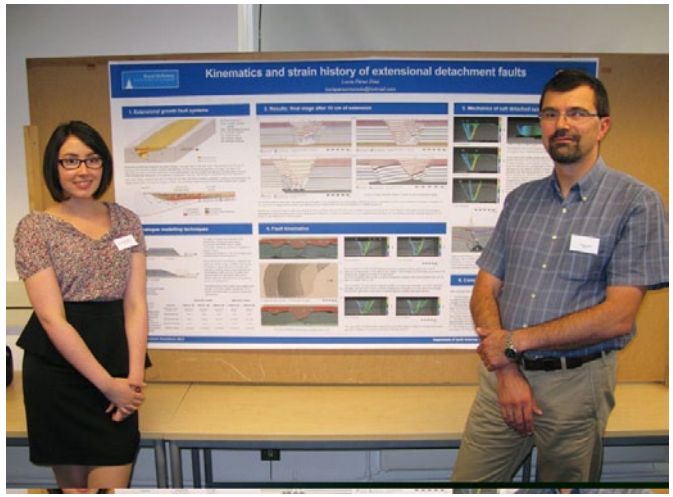
In October 2012 we again asked our new research students and postdoc researchers to introduce themselves and their new research projects, to keep the rest of us up to date. Here are the results:

The mechanics of caldera collapse and landslides in stratovolcanoes and basaltic edifices – *John Browning*

I am studying for a PhD under the supervision of Prof Agust Gudmundsson. My project is partly on the differences in failure frequencies between stratovolcanoes, where vertical and lateral collapses appear to be comparatively rare, and basaltic edifices, where such collapses are much more common. In the project I use numerical and analytical modelling to assess the strain energy and stress conditions needed for the collapse of a volcanic edifice. The results are expected to be useful for predicting the likelihood of collapse-caldera formation and large landslides during periods of unrest in volcanic edifices of different types.

Paleobathymetric Development of the South Atlantic Ocean – *Lucia Perez Diaz*

Having completed the MSc course here in the Department at Royal Holloway, I was offered the opportunity to join the COMPASS Consortium, a multi-disciplinary research team aiming to improve understanding of extended continental margin processes at different scales (both temporal and spatial). As a part of COMPASS, my research will be focused on the South Atlantic opening during Cretaceous times, developing plate kinematic and paleobathymetric models of the South Atlantic conjugate margins. I am excited at the prospect of increasing my knowledge of geophysics and plate dynamics, whilst broadening my horizons for a future career in the petroleum industry.



Lucia presenting her MSc project on the kinematics and strain distribution of extensional detached fault systems

The Celebes Molasse Deposits in Sulawesi, Indonesia – *Abang Surya Nugraha (Ega)*

I come from Kalimantan in Indonesia and I graduated from Institut Teknologi Bandung, Indonesia. I did my MSc at Royal Holloway, funded by the SE Asia Research Group (SEARG), with a project on the Tectono-stratigraphic Evolution of the East Java Forearc, Indonesia. I worked with subsurface data to provide important insights into the Cenozoic history of the East Java Forearc.

My PhD project will examine the evolution of Sulawesi landscape and relationships to the timing and sedimentation history of the Sulawesi molasse. I have just completed reconnaissance fieldwork with Robert Hall and Lloyd White of the SEARG, and another SEARG student, Karen Oud. Various rocks have been sampled from South and Southeast Sulawesi which are related to the sedimentation of the Sulawesi Molasse and the tectonics of the region.

Moving toward a 4D (3D+time) reconstruction of SE Asia using a combination of field observations, geochronology and geophysical data – *Lloyd White*

I joined the Southeast Asia Research Group as a Postdoctoral Research Fellow in October 2012, having completed my PhD and a postdoctoral fellowship at the Research School of Earth Sciences at the Australian National University where I worked on dating rocks from the Himalaya and tectonic reconstructions of the Indian and Australian plates. Before arriving in the UK, I joined Robert Hall and PhD students Karen Oud and Ega Surya Nugraha for fieldwork in SE and South Sulawesi, where Karen and I were officially welcomed to SEARG over several pieces of Durian.

Lloyd, Robert Hall and Karen Oud with quarry workers, Latimojong mountains, Sulawesi

Exhumation history of the Latimojong mountains, Sulawesi, Indonesia – *Karen Oud*

I come from Utrecht, the Netherlands. In September I started my PhD at SEARG on the Latimojong Mountains and surroundings on Sulawesi, Indonesia. I already had my first two weeks in the field, a really nice experience to start of my project. Lots of samples to work on now… The aim of my project is to determine the exhumation history of the Latimojong metamorphic complex in the SW arm of Sulawesi, and its relation to the surrounding units. I will do a lot of sampling: to determine the emplacement age of the rocks surrounding the complex, and chemical analysis to determine the origin (continental/oceanic) of the rocks. I will also do mapping and structural analysis to improve existing geological maps of the area.

Lloyd being aided by several local kids in collecting river sands for later detrital zircon analysis

Karen and Lloyd with curious villagers, Latimojong Mountains, Sulawesi

Karen in the field

Karen and Lloyd with a local villager who offered them a coconut each after a long day in the field

Central North Sea Salt Tectonics – *Jorge Belenguer*

I have been a PhD student in the Fault Dynamics Research Group since October 2012. I am from Spain and I graduated in 2010 from the University of Barcelona (UB) with a Degree in Geology. As a postgraduate, supervised by Prof. Josep Antoni Muñoz, I developed a structural 3D model using field data and seismic interpretation in the NE of the Vallès–Penedès Basin (Northeast Spain). The aim was to provide a realistic structural 3D model to the IGC for the evaluation of the geothermal resources in this part of Catalonia. I extended this to work on the development of a 3D structural model of Catalonia. The results were communicated in the VII Congreso Geológico de España in 2012 (Oviedo).

Now, at Royal Holloway, I am working on North Sea Salt Tectonics under the supervision of Profs. Ken McClay and Chris Elders, co-supervised by Prof. Josep Antoni Muñoz and sponsored by ConocoPhillips. The aim of my PhD project is to study the formation and evolution of different types of salt structures in the Central North Sea (UK and Norwegian sectors) formed by multi-stage extension and compression. To do it I will use 2D and 3D seismic interpretation, analogue modelling and comparative analysis of field analogues in the Basque–Cantabrian Basin (North of Spain, probably in the Salinas de Añana Diapir) as well as remotely sensed analogues in the Zagros fold-belt (Iran).

Outcrop analogue study of Mesozoic lacustrine carbonates; facies modelling and pore system analysis – *Arnaud Gallois*

I am from Marseille in South Eastern France, having graduated with an MSc in Carbonate Sedimentology and Diagenesis in 2010. For my Master's thesis, I carried out a petrophysical study of microporous carbonates of Cretaceous age (Urgonian facies) outcropping in Provence (SE France). I had to characterise crystal shapes and contacts to identify the impact of microporosity on petrophysical properties. In the following two years I made a structural, sedimentological and diagenesis study of Cretaceous formations outcropping in the Nerthe anticline (near Marseille) which allowed me to identify the impact of the early diagenesis on petrophysical properties.

My new research project at Royal Holloway in September, supervised by Prof. Dan Bosence and Prof. Peter Burgess, will focus on non-marine carbonates of the Purbeck Formation (Late Jurassic to early Cretaceous) outcropping in Dorset (Southern England). I will study lacustrine and palustrine carbonates developed within the syn-rift succession of the Wessex basin, as a possible analogue for South Atlantic lacustrine carbonate reservoirs. I have already completed two field visits and I have focused on the strata of the lower Purbeck Formation where in-situ microbial mounds (thrombolitic and stromatolitic textures) and bedded inter-mound limestones (Packstone textures) can be studied. The main aim of the project will be to identify and to predict the development of those microbial mounds in this extensional tectonic setting. Traditional field studies will be combined with Ground Penetrating Radar (GPR) and/or LIDAR scans of cliffs and quarries. 3D CT scanning methods will be used to identify porosity types to map, quantify and develop predictive models for spatial distribution of mound and inter-mound facies and their associated porosities. Facies models and environmental setting will be established from this field and lab-based data together with an understnding of likely controls on the accumulation of the mounds as opposed to inter-mound sediments. At least one analogous modern lacustrine system will also be investigated. The project will also run in close collaboration with a project developing numerical stratigraphic forward models of the same strata.

Arnaud enjoying fieldwork conditions in the mist

Peat forming environments in the Eocene greenhouse – *Brittany Robson*

I'm no stranger to Royal Holloway, having completed my MSci here last summer. Under Margaret Collinson's tutelage I investigated the applications of SRXTM (Synchrotron Radiation X-Ray Tomographic Microscopy) to 50 million year-old fruits and seeds from Messel, Germany. Some of the data from the project were used in one of Margaret's papers and thus I was named co-author, which was rather exciting! Margaret and Andrew Scott were advertising a NERC funded PhD project entitled "Peat forming environments in the Eocene greenhouse" and I couldn't resist applying! I was successful in gaining the studentship and I am again studying the Eocene – the samples just happen to be lignite this time. The purpose of the PhD is to investigate the current hypothesis that the Eocene is a low fire world. By comparing the type and abundance of charcoal found in multiple global samples, some of which I will collect from Schöningen in Germany in April, I will be able to establish if increased methane release at the Palaeocene–Eocene Thermal Maximum caused global warming, which in turn affected the global fire regime. Most of my time at the moment is spent in front of the reflectance microscope counting and identifying charcoal in order to have some preliminary results to present to the project partners in Bristol, and the other post-grads, later this month. As the new year starts and the academic year continues I plan to start studying key samples under fluorescence, to master the charcoal maceration technique and to continue my investigation into charcoal quantification techniques.

Tectonostratigraphic evolution and salt tectonic processes in Southeastern Gulf of Mexico: Implications for petroleum systems and exploration – *Alejandro Ruiz-Osorio*

I have a Bachelor degree in Geology from National Polytechnic Institute (IPN) and a Masters in Engineering in Exploration of Underground Energy Resources from La Universidad Nacional Autónoma de México (UNAM). For my Master`s thesis, I carried out a basin analysis with a transect across a petroleum sub-basin in the South of Mexico. In this study, Geochemical and paleontological data, well logs and sequence analysis were combined with seismic interpretation using the methodology of basin analysis. The aim of the thesis was to apply the methodology of sequence stratigraphy and perform an integrated interpretation (biostratigraphy, geophysical well logs, geochemistry and seismic) of the depositional history of the area. During my professional development in PEMEX Exploration and Production, I participated in various stages of the exploration process: Basin analysis, Play analysis and Prospect generation. I started my new research project at Royal Holloway in September, supervised by Jürgen Adam and Chris Elders. The main objective of the research is the analysis of the tectono-stratigraphic evolution and salt tectonic processes of the Isthmian Saline basin

Outcrops of Eocene Turbidites in Chiapas Range, Southern Mexico

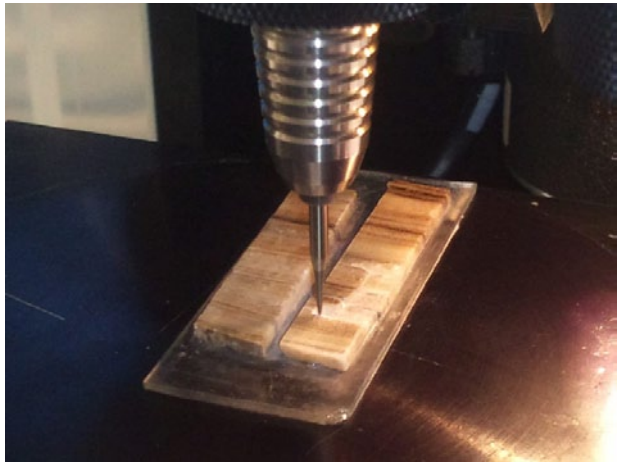
of Late Jurassic age in the Southern Gulf of Mexico. A particular focus will be the structural and kinematic analysis of deformed and fractured sediments linked to extensional–contractional systems of a passive margin sedimentary basin and deepwater fold belts, which are of great interest for the exploration activities of PEMEX Exploration and Production. The second objective will be the simulation and analysis of salt–related fold structures in linked extensional–contractional passive margins, and sedimentary wedges detached on salt using scaled analogue experiments and high resolution optical strain monitoring techniques (Digital Image Correlation – DIC)

Climate cycle signal preservation in speleothems of the Pacific – *Ciara Thrush*

I started my current PhD project under the supervision of Dave Mattey in September 2012, having graduated from Royal Holloway in July 2012 with an MSci degree in Environmental Geoscience. My 4th year Masters project was titled "A new record of ENSO (El Niño Southern Oscillation), Fiji: Interpretation and regional significance". This project revolved around the study and analysis of a speleothem from the Voli-Voli cave in Fiji, focusing on the possible climate signals the specimen may hold and assigning those waveforms to a linear timescale. It was found that there is strong evidence for the preservation of ENSO cycles within the oxygen variations in the speleothem calcite, and that these cycles are of the appropriate duration when an annual resolution is used. This established resolution of the data was based on past dating work and the carbon oscillations of the calcite indicating winter and summer seasonality.

I thoroughly enjoyed the undergraduate work I undertook on the speleothem project and relished the chance to resume the work at PhD level with considerably more freedom and time to investigate the many possible pieces of climate information the speleothem may hold beyond ENSO. Furthermore, I have presented my undergraduate findings at the EGU conference in Vienna and gained invaluable knowledge relating to where to go next with the work. The main aims of the current PhD project are to continue with the previous work and further establish what other climate cycles may be present within the specimen, as well as further correlate the date record and resolution with significant events in the region aided by trace element analysis. In addition to this, investigation into the differing fabrics of the speleothem will be undertaken in order to see if a particular fabric relates directly to a specific climate event.

Presenting the poster at EGU, Vienna



micromilling of a Fijian speleothem

It was noted during the undergraduate work that many resources on various types of isotopic proxy data (i.e. rainfall amount, $\delta^{18}O$, etc.) for the Pacific region are lacking, and for Fiji were entirely absent. Current monitoring work being performed in the region will allow for analysis of rainfall isotopic ratios and in time will permit the construction of a local meteoric water line with which to more accurately compare the oxygen oscillations in the specimen. A field trip has been scheduled to visit the cave site itself, along with neighbouring outlying caves, in order to promote a more in-depth investigation into the cave systems of the area and to oversee the monitoring work in person. I am very much looking forward to the new experiences the next three years will grant and also to the exciting new challenges that the PhD work will bring.