

# 29th GradSchool Conference

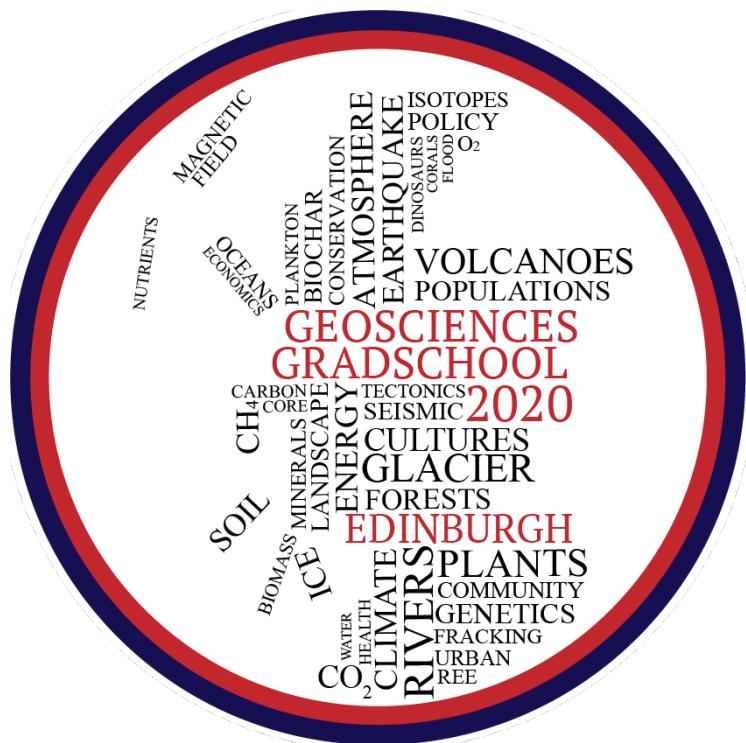
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7-9th February 2020

DOUBLETREE BY HILTON  
WESTERWOOD GLASGOW

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**The GradSchool committee 2019/2020 would like to thank the following organisations for their support:**



THE UNIVERSITY of EDINBURGH  
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**BOLIDEN**

**Schlumberger**



# Ntombi wants to expand her business. She couldn't without metals.

Women all over the world are empowered by starting companies of their own. Thanks to mobile communication, they can place orders, pay the bills and watch their business grow. But mobile phones cannot function without copper, gold and silver – metals that can be recycled and reused over and over again. Ntombi is in it for the long run, and so are our metals.



**BOLIDEN**  
Metals for modern life

**Dear Delegate,**

The GradSchool committee is delighted to welcome you to the 29<sup>th</sup> Annual GeoSciences GradSchool Conference. This year the event will take place at the DoubleTree by Hilton, Westerwood Glasgow. We would like to extend a special welcome to those attending the conference for the first time. We are also very pleased to see familiar faces supporting the event.

The main aim of the event is to provide an encouraging environment for young researchers, MSc and PhD students to present their work. It is a perfect way for people to practise their presentation skills, but also a great platform for discussion, networking and collaborations among the students. It is also the first conference experience for some students and their first opportunity to present their research to a wider audience and get useful feedback.

We would like to express our gratitude to our sponsors who enabled this conference to run this year. Their support and contributions are widely appreciated.

The conference has become part of the GeoSciences GradSchool tradition since it has been a highlight of the postgraduate calendar for the last 29 years. We hope that you will find the conference a great way to meet new researchers, exchange ideas, and above all have a great time!

### ***Your GradSchool Committee 2019-2020***

Rebecca Chambers (*Chair*)  
Elizabeth Balmer (*Secretary*)  
Dylan Price (*Treasurer*)  
Zoi Kynigopoulou (*Social Secretary*)  
Alice Drinkwater (*Vice-Chair Crew*)  
Anna Gebruk (*Vice-Chair Grant*)



# Conference General Information

## **Check in/ Check out / Registration**

Room check in will be open from 15:00 on Friday 7<sup>th</sup> February following your registration for the conference. Check out will take place on Sunday, 9<sup>th</sup> February at 11:00. A room will be available to leave luggage both at arrival on Friday and before departure for Edinburgh at 12:00 on Sunday.

## **Oral Presentations**

In order to keep to our busy schedule, speakers must keep to their allotted time slot that is 10 to 12 minutes for their presentations followed by a couple of minutes for questions. Session chairs will be strict to allow the smooth running of sessions. **Speakers are asked to upload their presentations at the end of the previous session.** The session chairs will be around in the presentation hall to help you with this.

## **Poster Presentations**

Posters need be put up on the Friday evening and taken down on Sunday morning. Posters should be A0 in size and can be either landscape or portrait.

## **Feedback & Prizes**

During each season, there will be feedback sheets for each speaker. We encourage you to give constructive and helpful feedback since this will be forwarded on to the student and used to award prizes. Likewise, there will be feedback for the poster session. Prizes are available for the best talk given by first year PhD student, best talk for other years, and best poster.

## **Keynote Speaker**

Professor Sanjeev Gupta from the Imperial College London will give a talk on the Saturday afternoon. Professor Sanjeev is working in understanding modern and ancient environmental change on Earth's surface and on Mars.

## **Skills Workshop**

### **'Communicating your Science in the Digital Age'**

Dr. Stuart Gilfillan will run this year's conference skills workshop. This workshop will focus on science outreach; and effective methods for communicating your science to a wider audience outside of the academic community.

## **Hotel Facilities**

Delegates are welcome to use the hotel's leisure facilities over the weekend including pool, gym and fitness centre. If you are interested in making a spa booking speak to a member of staff at reception or book on the hotel's website. The hotel also boasts an 18-hole golf course which can be booked through the hotel.

## **Meals**

A full Scottish buffet breakfast will be served from 07:00 to 09:00 on Saturday and Sunday, with arrival refreshments in the Carrick Foyer from 08:45. A hot buffet lunch will be provided at 12:00 on Saturday, with a packed lunch being provided from the hotel on Sunday before departure.

On Friday evening, there will be an informal dinner following by a Quiz Night; a great way to socialize and kick off the conference weekend!

## **Gala Dinner**

On Saturday, the Gala Dinner will take place at 19:00.

Afterwards, a ceilidh lead by the **Kilter Ceilidh Music** band will follow.



## Conference Timetable

| FRIDAY |  | SATURDAY                        |  | SUNDAY           |  |
|--------|--|---------------------------------|--|------------------|--|
| 12:00  | <b>Lunch</b>                             | <b>Breakfast</b>                |  | <b>Breakfast</b> |  |
| 12:30  |  | 09:15                           | <b>Session 3<br/>(09:15-11:00)</b>               | 09:15            | <b>Session 5<br/>(09:15-10:45)</b>       |
| 13:00  | <b>Session 1<br/>(13:00-15:00)</b>       | 10:00                           |  | 09:30            |  |
|        |  | 10:30                           |  | 10:00            |  |
|        |  | 10:45                           |  | 10:15            |  |
| 13:30  |  | 11:00                           |  | 10:30            |  |
| 14:00  |  | Posters<br>Tea/ Coffee<br>break | <b>Sponsor Talk<br/>(11:30-12:00)</b>            | 10:45            | <b>Posters<br/>Tea/ Coffee<br/>break</b> |
| 14:30  |  | 11:30                           |  | 11:15            |  |
| 15:00  |  | Tea/ coffee<br>break            |  | 11:30            |  |
| 15:15  | <b>Session 2<br/>(15:15-17:15)</b>       | 12:00                           | <b>Lunch</b>                                     | 12:00            | <b>Depart hotel</b>                      |
| 16:00  |  | 12:30                           |  |                  |  |
| 16:30  |  | 13:00                           | <b>Keynote<br/>Speaker</b>                       |                  |  |
| 17:00  |  | 13:30                           |  |                  |  |
| 17:15  | Conference<br>ends 17:15                 | 14:00                           |  |                  |  |
| 18:00  | Late Bus<br>delegates arrive<br>at hotel | 14:30                           | <b>Session 4<br/>(14:30-15:30)</b>               |                  |  |
| 18:30  |  | 15:00                           |  |                  |  |
| 19:00  | <b>Dinner</b>                            | 15:30                           | Skills Workshop<br>(15:30-16:15)                 |                  |  |
| 19:30  |  | 16:00                           |  |                  |  |
| 20:00  |  | 16:30                           | Conference ends<br>16:20<br><br><b>Free Time</b> |                  |  |
| 21:00  |  | 17:00                           |  |                  |  |
|        |  | 17:30                           |  |                  |  |
|        |  | 18:00                           |  |                  |  |
|        |  | 18:30                           | <b>Gala Dinner</b>                               |                  |  |
|        |  | 19:00                           |  |                  |  |
|        |  | 19:30                           |  |                  |  |
|        |  | 20:00                           |  |                  |  |
|        |  | 20:30                           |  |                  |  |
|        |  | 21:00                           | Ceilidh  |                  |  |

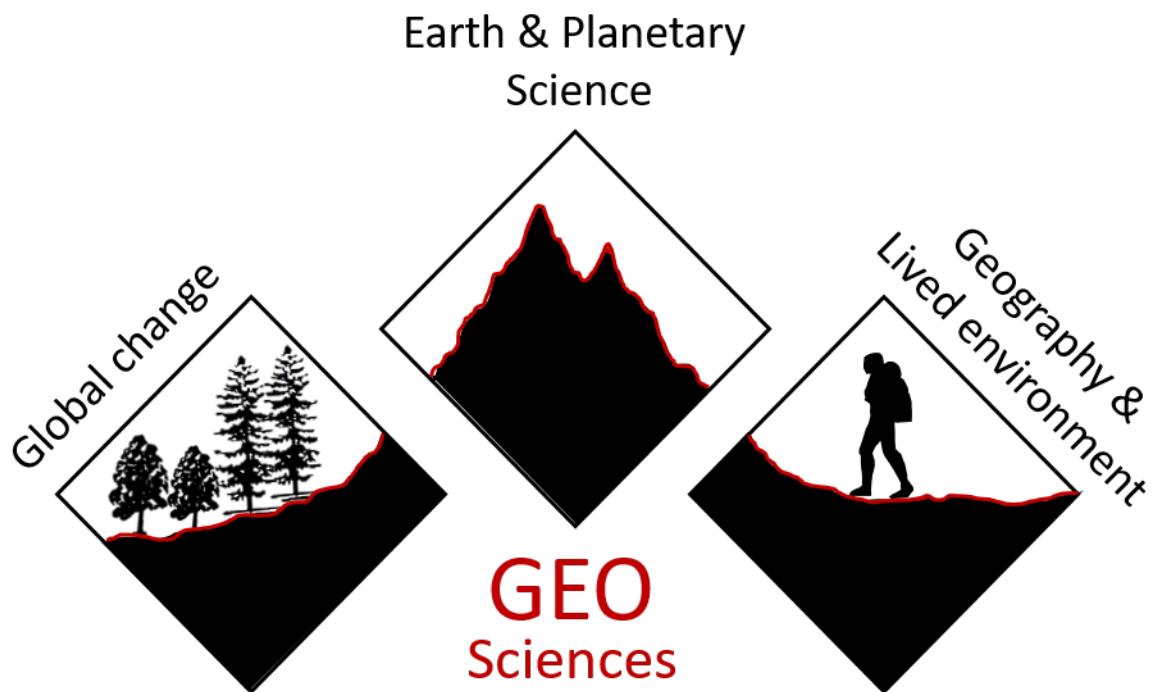
## Talks Schedule

| Friday   | Saturday   | Sunday   |
|--|--|--|
| <b>Session 1</b><br>Amber Carter<br>Isla Simmons<br>Ben Harris<br>Mylene Receveur<br>Jennifer Scott<br>Helen Waters<br>Selena Georgiou<br>Edwin Rodriguez Dzul | <b>Session 3</b><br>Derek Leung<br>Nicholas Allen<br>Francesco Serafini<br>Helena Slater<br>Rory Leslie<br>Louis Kinnear<br>Charlotte Bowman | <b>Session 5</b><br>Michael Saunders<br>Sophia Anderson<br>Yi Xiong<br>Junhao Cheng<br>Helen Ockenden<br>Rebecca Grant |
| <b>Session 2</b><br>Amy Shore<br>Blair Mackie<br>Guillem Rubio Ramon<br>Chris Holdsworth<br>Hugo Bloem<br>Matthew Purslow<br>Elizabeth Telford<br>Ben Murphy   | <b>Session 4</b><br>Marina Ruiz Sánchez-Oro<br>Kelsey Archer Barnhill<br>Mohammed Alkharji<br>Mariana Yilales                                | <b>Session 6</b><br>Xuebin Zhao<br>Marina Jimenez Lao  |

## Key to Symbols

The School of GeoSciences is split between three research groups. Each abstract, as well as each nametag, is accompanied by a symbol to indicate the research group the participant is part of.

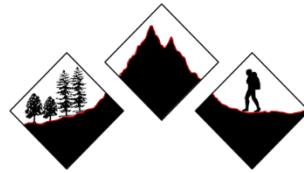
This year we are celebrating the diversity of the School but also highlighting our unity!



# Oral Presentation Abstracts

**FRIDAY**

**SESSION 1**



**AMBER CARTER**

## Integrating climate variability and change into Marine Protected Area (MPA) strategy and design

**Authors:** Amber Carter, Sandy Tudhope, Meriwether Wilson, Andrew Schurer, Mark Inall, Al Harris

Marine Protected Areas (MPAs) are spatially defined marine or coastal units in which anthropogenic activities are partially or fully restricted, designed to conserve marine ecosystems and support the sustainable use of marine resources. Despite global efforts to increase the spatial coverage of MPAs, effects associated with increasing anthropogenic carbon emissions will continue to threaten the likelihood of MPAs achieving their conservation and social-ecological objectives. Thus, there is an urgent need to operationalise the integration of climate change in MPA strategy and design. For my PhD, I will investigate the role of localised climate variability and change on the integration of climate change adaptation in MPA strategy. To address this complex problem, I will investigate both biophysical and human social issues, recognising marine ecosystems and human societies are inter-related parts of a marine social-ecological system.



**ISLA SIMMONS**

## Holocene volcanism at the Quetrupillán Volcanic Complex – What can field evidence tell us about past eruptions

**Authors:** Isla Simmons, Dave McGarvie, Joaquín Cortés, Eliza Calder, Andrés Pavez

Many of the world's volcanoes are poorly studied, resulting in potential hazards for populations living nearby, should they erupt. One such volcano is Quetrupillán, in Chile. Located next to one of the most active volcanoes in South America, Quetrupillán is often overlooked as a source of hazard due to its apparent lack of activity. However, my fieldwork suggests that Holocene activity at Quetrupillán is actually likely to have been much greater than the initial appearance of the volcano suggests, as intense ice-scouring of the volcano has removed evidence of past eruptions. At least 10 eruptions have also occurred from vents on the flanks of the volcano, with the varied products indicating a range in eruptive styles. However, geochemical analysis of tephra layers in surrounding valleys provides evidence of only three large explosive eruptions from Quetrupillán. This diverse volcanism poses issues for hazard mitigation at Quetrupillán.



## BEN HARRIS

### Constraints on metasomatic fluid evolution during continental subduction in the Western Alps

**Authors:** Benedict Harris, Cees-Jan de Hoog, Simon Harley, Ralf Halama

Phengite is a major host of boron, nitrogen and other fluid-mobile elements (FME) in subducted crust. Phengite-bearing whiteschists from the Dora Maira Massif, Western Alps record metasomatism of granites during continental subduction to > 4 GPa. Previous studies debate the timing, source, and composition of the metasomatic fluid. Boron isotopes can distinguish between proposed crustal and serpentinite-derived fluid sources and can be combined with information on boron as a FME. We will conduct in situ analyses of B, B isotopes and other FME on phengite from whiteschists and unaltered granite and metapelitic protoliths. Isotope and FME data will constrain sources and fluxes of fluids during metasomatism using combined thermodynamic and geochemical modelling. Our dataset will provide constraints on the devolatilization behaviour of phengite during subduction metamorphism and on the presence of external oceanic-derived fluids at sub-arc depths, from which there is no exhumed oceanic material to study.



## MYLENE RECEVEUR

### Investigating geothermal heat resources of legacy mine workings, why are some mine waters hotter than others

**Authors:** Mylene Receveur, Christopher McDermott, Andrew Fraser-Harris, Stuart Gilfillan

Mine-water in abandoned mine workings in the UK constitutes a low-temperature geothermal resource that can be used for heating/cooling purpose. Using open-loop ground source heat pumps, heat can be extracted from the large volume of warm water stored in mining voids, generally located in densely populated areas. However, little is known about the heat sources and the recharge mechanisms in mine workings, hence the overall heat resource which can be accessed. Temperature measurements in several mine shafts in the UK have shown the lack of correlation between the measurement depth and the mine-water temperature, suggesting that it does not only depend on the geothermal gradient. We are developing conceptual hydrogeological and heat transport models of mine workings in order to identify the potential factors influencing the mine-water temperature. The OpenGeoSys software is used to solve numerically for heat transfer in the mines, to understand the temperature distribution and the extent of the heat available over the long-term within mine workings.



JENNIFER SCOTT

## Mg/Ca based sea surface temperature reconstruction of the western Arabian Sea from Heinrich Event 2-6

**Authors:** Jennifer Scott, Simon Jung, Douglas Coenen

The modern climate and surface circulation of the Arabian Sea is dominated by the Indian monsoon, the western part of the overarching Asian monsoon system. Presently, the summer SW monsoon induces upwelling of cold water along the coast, leading to reduced sea surface temperatures (SSTs) in the summer months. However, this may not have always been the case, with previous work covering the last 20 ka BP indicating that during glacial periods weakened summer upwelling and increased cooling by the winter NE monsoon could have caused lowest SST during the winter. Presented here is a record of SST from 20-70 ka BP covering Heinrich Events 2-6 from core NIOP929 located north of the island of Socotra. The record is produced from Mg/Ca-derived palaeothermometry of the shallow dwelling foraminiferal species *Globigerinoides ruber*, which calcifies throughout the year, and *Globigerina bulloides*, which calcifies mainly during the summer SW monsoon.



HELEN WATERS

## Creating an index of crop-farming traits to assess the biodiversity impact of foods: what is the biodiversity impact of your breakfast

**Authors:** Helen Waters, Alfred Gathorne-Hardy, John Holland, Barbara Smith

The global food system is the single largest driver of biodiversity loss worldwide. Agriculture currently occupies just under 40% of the total ice- and desert-free land and is directly responsible for approximately 80% of tropical forest clearance. But not all food options are equivalent. Within the global food system, there is huge variation in biodiversity impact between different crops and crop production methods. However, unlike for carbon emissions or water-use, there is not currently an accepted framework for measuring or comparing the biodiversity impact of different foods. My PhD project is about developing new methods for quantifying the local, regional and global biodiversity footprints of different crops and crop production systems. In this talk I will briefly introduce the project: I will present a review of existing approaches to quantifying biodiversity impact, discuss interesting conceptual issues, and outline the theoretical basis for my proposed approach.



## SELENA GEORGIOU

### Quantifying the greenhouse gas balance of tropical peatlands: integrating field data, satellite observations, land-surface and atmospheric modelling

**Authors:** Selena Georgiou, Ed Mitchard, Sofi Sjorgersten, Paul Palmer

It is well understood that large tropical peatlands exist in South East Asia, and research has been done to quantify their extent, depth and biomass attributes. However, peatlands in other regions, including the Peruvian Amazon and Congo basin, remain largely unexplored, even though they are major stores of carbon and vulnerable to rapid loss of their carbon stocks through land-use change or climate change impacts. My research will assess the greenhouse gas fluxes over tropical peatlands, with an initial focus on the Peruvian Amazon and Congo basin peatlands, and a wider aim to apply the developed methods across all tropical peatlands. These aims will be achieved through a mixture of fieldwork, analysis of remotely sensed data, and land-surface and atmospheric modelling. In this presentation, I will give an introduction to tropical peatlands, their role in the carbon cycle, and the aims of, and methods used within, the proposed research.



## EDWIN RODRIGUEZ DZUL

### Fossil microorganisms from the Rhynie Chert: importance and implications for early ecosystems

**Authors:** Edwin Rodriguez Dzul, Sean McMahon, Bryne Ngwenya

The Rhynie Chert is a unique fossiliferous silica deposit from the Early Devonian, located in Scotland and dated to ~407 million years old. Formed in a terrestrial hydrothermal setting, it contains exquisitely preserved organic and silicified remains of early land plants and their associated animals, fungi, algae and bacteria. Although several studies have been accomplished focusing on plants and fungi, the fossil bacteria have received little attention despite the clear potential for exciting studies of terrestrial microbial ecology. Petrographic analysis, mapping and optical imaging of thin sections from the Rhynie Chert, using optical microscopy along with limited scanning electron microscope (SEM) and Raman spectroscopy, as an additional source of mineralogical and compositional information. Photomicrographs of cyanobacteria (possible *Anabaena*-like bacteria, palisade fabric texture cyanobacterium and *Rhyniosarcina devonica*), fungi and amoebae *Palaeoleptochlamys hassii*. Analysis of more thin sections and optical methods would be utilised to obtain further results.

## **SESSION 2**



**AMY SHORE**

### **Regional nutrient decrease drove redox stabilisation and metazoan diversification in the late Ediacaran Nama Group, Namibia**

**Authors:** Amy Shore, Bowyer F.T., Wood R.A., Alcott L.J., Thomas A.L., Butler I.B., Curtis A., Hainanan S., Curtis-Walcott S., Penny A.M., Poulton S.W.

The late Ediacaran witnessed an increase in metazoan diversity and ecological complexity. To constrain the drivers for diversification, we combine local redox and nutrient data for shelf transects, with an inventory of biotic diversity from the Nama Group, Namibia (~550 to ~538 Million years ago; Ma). Unstable marine redox conditions characterise the inner to outer ramp from ~550 to 547 Ma, but a deepening of the redoxcline is recorded from ~547 Ma, with full ventilation of the outer ramp by ~542 Ma. Phosphorus speciation data show initial anoxic conditions promoted the drawdown of bioavailable phosphorus, with productivity constrained by limited phosphorous recycling into the water column. A long-term decrease in nutrient delivery from continental weathering led to the ventilation of the Nama basins. This, in turn, decreased anoxic recycling of bioavailable phosphorus to the water column, promoting the development of stable oxic conditions and the radiation of new mobile taxa.



**BLAIR MACKIE**

### **Wastewater Remediation Using Chitosan – Coagulation and Flocculation**

**Authors:** Blair Mackie, Andrea Semiao, Jonathan Hughes

Coagulation and flocculation are essential processes in my PhD project and my aim for the presentation is for delegates to come away having learned something about coagulation and flocculation. Coagulation and flocculation will be presented to the audience by explaining how potable water can be obtained using coagulation and flocculation. Then coagulation and flocculation will be described in a research context by explaining the outcomes of a recent visit to a salmon processing plant where my supervisor and I carried out trials at their onsite wastewater treatment plant in the Scottish Borders. Discussed also will be various side projects I am involved with alongside my main research and the importance of interdisciplinary research encouraging others to do so as well.



## GUILLEM RUBIO RAMON

### The bear and the shepherd: Nationalism, Rural Development and Nature Politics in the Pyrenees

**Authors:** Guillem Rubio Ramon, Karen Syse

This contribution analyses the connections between nationalist agendas, nature politics, and contemporary rural transformations in the Catalan Pyrenees in Spain. The study is qualitative, with an emphasis on ethnography and interviews. We explore how biophysical landscapes are used to reinforce discourses on nationhood and rural development policies. Conflict around the reintroduction of the brown bear to the Pyrenees is used as a starting point to examine biopolitical relations between various actors both at the local and national level. We argue that the connection between different nationalist discourses on nonhuman nature and a change in landscape values are reflected in the reintroduction of the brown bear. We also describe how the Catalan Government uses the shepherd as a tool to create consensus within an area of growing local conflicts. Finally, we discuss the social, cultural and biopolitical dimensions of various ecological restoration policies adopted by the government.



## CHRIS HOLDSWORTH

### Atmosphere Tracking CO<sub>2</sub> mineralisation at the CarbFix2 site using stable isotope and noble gas tracers

**Authors:** Chris Holdsworth, Stuart Haszeldine, Stuart Gilfillan, Fin Stuart, Sandra Snæbjörnsdóttir

Carbon Capture and Storage (CCS) is an integral component of pathways and legislation proposed for limiting global warming to 1.5°C. Mineralisation of CO<sub>2</sub> in mafic rocks offers a safe and secure method of CCS over geological timescales. Tracking and quantifying the fate of injected CO<sub>2</sub> is an essential requirement of this CCS method for industrial scale deployment. Combined noble gas and stable carbon isotope measurements have been shown to track and measure CO<sub>2</sub> mineralsation and dissolution in natural CO<sub>2</sub> reservoirs and natural gas fields. This project will apply the same methodology to the CarbFix2 field pilot site in Iceland.



**HUGO BLOEM**

## Design for monitoring seismicity

**Authors:** Hugo Bloem, Andrew Curtis, Hansruedi Maurer

Statistical Experimental Design (SED) is the field of statistics concerned with designing experiments to obtain as much information as possible about a target of interest. We compare the most used linear method, Bayesian D-optimisation, to two nonlinear methods, Maximum Entropy Design and D<sub>N</sub>-optimisation, in a source location problem where we define a region of the subsurface in which earthquake sources are likely to occur. The goal of SED is to define a surface monitoring network that optimally constrains this set of source locations given the data that would be observed. Receiver networks so designed are evaluated on performance—a proxy for an inversion algorithm, the number of prior samples (earthquakes) required for stability, and the compute time. We find that D<sub>N</sub> -optimisation provides the best results in terms of performance and compute time. Linear design is more compute intensive and may not work well with complex velocity structures. Maximum Entropy Design is shown to be effectively impractical due to long co



**MATTHEW PURSLOW**

## Using spaceborne remote sensing of forest structure to improve simulation of snow in weather and climate models

**Authors:** Matt Purslow, Steven Hancock, Richard Essery, Noel Gourmelen

Accurate simulation of forest-snow interactions is vital for forecasts of snowmelt and hence predictions of snow-albedo feedbacks in a changing climate. Current weather and climate models feature inaccurate or incomplete representations of forest, resulting in poor model simulations of snow cover and melt rates. A global map of forest structure created using data from a new generation of lidar and radar satellites will be used to drive a land surface model. The impact of the new forest representation on the accuracy of simulated snow will be assessed. Accurate, global maps of forest structure may prove the key to more accurate predictions of snow melt and snow-albedo feedbacks in forested regions.



## ELIZABETH TELFORD

### Understanding the role of Nitrogen fixation explain the dominance of woody legumes in the African savanna

**Authors:** Elizabeth Telford, Caroline Lehmann, Lorna Street, Nicola Stevens

Legumes are an ancient, diverse and ecologically successful plant family. However, most research examining their dynamics and distributions has focussed on forests despite legumes being a plant family common across tropical savannas. Little is understood of the dynamics of this important plant group and how their unique functional characteristic of nitrogen (N) fixation relates to savanna ecosystem dynamics. Some legume groups have the unique ability to fix atmospheric N via root symbioses. Root nodules harbour N-fixing bacteria (rhizobia) capable of converting atmospheric N into a form available for plant growth. N-fixation provides a competitive advantage in areas where high environmental stress (e.g. low rainfall) and/or frequent disturbances (e.g. fire and herbivory) make an ability to exploit limited resources and grow quickly advantageous. Therefore, understanding the limits and dynamics of plant species and their functional responses to key savanna aspects (such as fire, herbivory, drought) can allow us to estimate the vulnerability of this ecosystem to global change.



## BEN MURPHY

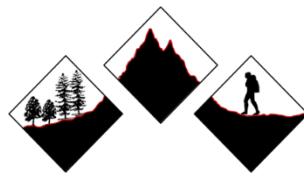
### Taken to extremes: ultra-running's role in shaping models of aspiration, achievement and resilience in contemporary society

**Authors:** Ben Murphy, Rachel Hunt, Hayden Lorimer, Nina Morris

This project investigates the ways in which ultra-marathons (any running race or adventure-based challenge covering a distance greater than 26.2 miles) create and reflect changing contemporary attitudes about the value of experiencing extremes, variously environmental, emotional and physiological. Despite diverse research on contemporary cultures of mobility, and the natural or built environments in which they operate, critical geographical research has yet to consider the configuration of mobile bodies and mobile subjects in endurance challenges staged in extreme environments. These are an increasingly popular, celebrated and intensely mediated form of cultural tourism. A 'durational methodology', utilising various data gathering techniques, will explore participants' experiences in terms of their motivations and experiences, the environments involved, and the host communities in order to understand contemporary ultra-running culture. As such the research project seeks to critically engage with ultra-marathon practices and to situate these experiences and events within global narratives of consumption, neoliberalism and commodification.

## SATURDAY

### SESSION 3



DEREK LEUNG

#### Where curling collides with rock physics: Characterising the damage evolution of curling stones

**Authors:** Derek D. Leung, Florian Fusseis, Ian B. Butler

Only rocks from Ailsa Craig (Scotland) and Trefor (Wales) are used to produce curling stones for international competition. During a game, curling stones collide into and displace each other, inevitably causing damage to their striking bands. Here we interpret the cause and consequence of curling stone impacts from an experimental geoscience perspective, by combining (1) a characterisation of damaged curling stones, (2) *in-situ* 4D synchrotron microtomography of loading on pristine samples, and (3) on-ice experiments to determine the mechanics of curling stone impacts. Curling stone collisions are not point impacts; margins of contact areas resemble curved fractures, suggesting that imprinting of colliding stones controls the morphology of curved fractures. Within the contact area, impact forces locally exceed the yield stress of the rocks, thus enabling comparison with our 4D microtomography experiments. Our findings illustrate the characteristics of cumulative damage in granitoids and provide insight into the maintenance of curling stones.



NICHOLAS ALLEN

#### Modelling the potential for soil carbon storage using biochar – a case study

**Authors:** Nicholas Allen, Bernardo Borges, Saran Sohi

Biochar additions to agricultural fields could greatly increase the carbon sink potential of sugarcane plantations, turning abundant crop residues into highly recalcitrant forms. Biochar not only stores carbon but the production process is energy positive. Gradual improvement to soil cation exchange capacity and bulk density may benefit nutrient and water retention, potentially mitigating some effects of climate change. Relatively little is known about the kinetics of biochar carbon decay since accumulation over decades to centuries is not directly observed. Modelling decay based on known biotic and abiotic factors in soil and climate requires knowledge of biochar sub-pools, specifically their size and rate constants. Here we have used accelerated chemical ageing as a proxy for oxidative ageing in soils. The resulting partitioning of biochar recalcitrance with mean residence time of up to 10,000 years allows extraction of decay parameters without resorting to extrapolation from short-term study. We compared carbon accumulation using 1, 2 and 3 biochar pools based on differently adapted versions of the RothC soil carbon model. Results from sensitivity analyses will be presented in terms of biochar type, model structure and climate. These will be illustrated in the

context of the sugarcane system of São Paulo, Brazil, under current and potential future climate.



## FRANCESCO SERAFINI

### Southern California Long-term seismicity with Inlabru

**Authors:** Francesco Serafini, Mark Naylor, Finn Lindgren

Considerable research has been dedicated to predicting earthquakes occurrence, although, we are still unable to provide reliable forecasts of large earthquakes for specific regions over time spans smaller than decades. The necessity of trying new models and to compare them with the established one has led to the development of the Collaboratory for the Study of Earthquake Predictability (CSEP), a global infrastructure devoted to evaluate and compare earthquake forecast models. Our temporary goal is to model the long-term seismicity using Log-Gaussian Cox Processes (LGCP) in a Bayesian setting with the help of the R-package inlabru. This package offers an extensible framework to perform Bayesian analyses and a natural way of studying the effect of spatial covariates (strain rate, fault maps,...) on the seismicity. This approach also allows us to revise the statistical tests adopted by CSEP, to provide built-in methods to compute them in inlabru and to design new ones.



## HELENA SLATER

### Education and the future of conservation

**Author:** Helena Slater

The future of conservation is uncertain and there are ongoing debates about what, why and how best to conserve nature. So far, little attention has been paid to the role of higher education in shaping the direction of conservation. Several conservation-related courses exist, but what is taught in the courses and how teaching influences conservation perspectives remains unknown. This PhD aims to investigate the role of higher education in shaping the views and skills of future conservation leaders. Focusing on universities in the UK and Australia, this project uses a mixed-method approach to map the conservation curriculum and explore students' views on key conservation topics. A before-after survey design will measure students' views over the course of their studies and investigate whether views change in relation to course content. This research will provide a snapshot of conservation higher education and new insights into how future conservation leaders are being trained.



## RORY LESLIE

### Quantifying rates of CO<sub>2</sub> dissolution in natural CO<sub>2</sub> reservoirs using noble gas geochemistry and reservoir modelling

**Authors:** Rory Leslie, Stuart Gilfillan, Stuart Haszeldine, Philip Ringrose

For Carbon and Capture and Storage (CCS) to be an effective means of reducing CO<sub>2</sub> emissions to the atmosphere, secure trapping of CO<sub>2</sub> over >10,000 year timescales is required. Dissolution of CO<sub>2</sub> into groundwater is an important process for secure trapping, as it forms a denser fluid which removes the buoyancy of free phase CO<sub>2</sub>. However, the long-term rates of dissolution are uncertain. Natural CO<sub>2</sub> reservoirs, which have held CO<sub>2</sub> for >10,000 years, provide a means of investigating this over the timescales required for engineered storage. My research will use noble gas geochemistry and reservoir modelling to quantify rates of CO<sub>2</sub> dissolution in natural CO<sub>2</sub> reservoirs in western and southern USA. Through the study of multiple reservoirs with diverse geology, the factors that control dissolution rate may also be identified. The results will improve constraints on dissolution trapping rates in CCS projects and enhance the accuracy of storage security predictions.



## LOUIS KINNEAR

### Influence of erosion on clay production and CO<sub>2</sub> drawdown

**Authors:** Louis Kinnear

More carbon is stored in the soil than in the earth's atmosphere and vegetation combined. However, much of our focus has been on arable land that make up only a small percentage of worldwide soils. The clay particle size fraction plays a key role in stabilising soil carbon before and during its transport to long-term sinks yet its formation is poorly understood. My research attempts to quantify the relationships between soil production, weathering and clay formation via erosion from upland areas through coupling field data with numerical modelling. Providing us with an initial estimate of the erosional clay flux from these upland landscapes as well constraining a potentially important but overlooked part of the carbon cycle.



**CHARLOTTE BOWMAN**

## How the snout changes in the land-to-sea transition: a case study using fossil crocodylomorphs

**Authors:** Charlotte Bowman

Computerised Tomography (CT) has revolutionised the study of crocodylomorph endocranial anatomy. While it has largely been used to investigate the brain and inner ears, the cranial rostrum houses numerous sinuses and neurovascular canals. Here I focus on the changes in rostrum internal morphology during a major evolutionary transition: the land-to-sea seen in Thalattosuchia. Thalattosuchians were a group of marine crocodylomorphs that lived during the Mesozoic. One sub-group, Metriorhynchidae, adapted to a pelagic lifestyle, evolving a tail fin and flippers. My sample consists of a large juvenile and an adult of two extant longirostrine species (*Tomistoma schlegelii* and *Gavialis gangeticus*), as well as two basal thalattosuchians (*Pelagosaurus typus* and *Eoneustes gaudryi*) and four metriorhynchids (*Cricosaurus araucanensis*, *C. schroederi*, *Metriorhynchus superciliosus* and *Torvoneustes coryphaeus*). Interestingly, the rostral sinuses and neurovascular canals of thalattosuchians are more similar to those of extant juveniles than adults, suggesting a paedomorphic shift early in thalattosuchian evolution.

## **SPONSOR TALK**

### **DAVID DREJING-CARROLL from BOLIDEN**

#### **New insight into the links between major IOA, IOCG, and porphyry copper deposits from the Gällivare area, northern Sweden**

The Palaeoproterozoic rocks of the Fennoscandian shield, Norrbotten, Sweden, host many major mineral deposits. In the Gällivare area the deposits include magnetite-apatite (iron oxide-apatite; IOA) mineralization at Malmberget, porphyry copper style mineralization at Aitik and IOCG mineralization at Nautanen. Boliden's work in the area, in collaboration with LTU, has led to a new understanding of the relationships between these different deposits.

Geologically the district is hosted by mafic to intermediate intrusions, volcanic rocks and their related volcanoclastic facies that were intruded by layered gabbroic intrusions. At least two major deformation events are recognised, the first resulted in the formation of a strong, penetrative fabric that overprints the IOA and porphyry mineralization. A second event led to the development of a major northwest-southeast striking corridor of intense deformation (the Nautanen Deformation Zone (NDZ)). It is characterized by intense alteration, deformation and sulphide mineralization. The deformation zone appears to contain a thrust stacked sequence with originally deeper portions (Malmberget) of the system thrust on to higher-level sections (Nautanen). This juxtaposition of deep and shallow portions of an IOA-IOCG system has been observed in other districts (e.g. Sequerinho-Sossego, Carajas District, Brazil). The Aitik porphyry copper deposit is also located along the NDZ, in the south of the district. Both Aitik and Nautanen share a number of alteration characteristics suggesting the porphyry system was overprinted by a later IOCG event. Better understanding of the possible links between these different mineralization systems is the focus of ongoing research.

## **KEYNOTE SPEAKER**

### **PROFESSOR SANJEEV GUPTA from Imperial College London**

#### **'The Geological adventures of Curiosity on Mars'**

Professor Sanjeev is working in understanding modern and ancient environmental change on Earth's surface and on Mars. He is an excellent researcher and a great speaker having participated in TEDx Talks before.

## **SESSION 4**



**MARINA RUIZ SÁNCHEZ-ORO**

### **Learning to recognize landslides and catastrophic landscape change with deep neural networks**

**Authors:** Marina Ruiz Sánchez-Oro, Simon Mudd, Hakan Bilen, Iain Woodhouse

Efficiently identifying landscape change caused by natural disasters such as landslides, floods and fires can be challenging, especially in a time constrained scenario. However, the increasing availability of high resolution satellite imagery and open source AI and deep learning frameworks have brought new opportunities to improve research in this field. The aim of this project is to combine satellite data with topographic and geospatial information to train deep neural networks in classification and segmentation tasks focused on natural disaster imagery. An analysis of images in multiple spectral bands will be performed with different satellite types and resolutions, using multiple neural network architectures and techniques to explore the optimal set up. As a result we will be able to efficiently identify natural disaster satellite images to allow for real-time response and to improve on current mapping techniques.



**KELSEY ARCHER BARNHILL**

### **Cold-Water Coral Reef Growth and Loss in a Changing Ocean**

**Authors:** Kelsey Archer Barnhill, Sebastian Hennige, Uwe Wolfram, Murray Roberts

Cold-water corals (CWC) and their structurally complex skeletal remains create biodiversity hotspots by providing crucial deep-sea habitats. However, these ecosystem engineers and their provided ecological services are vulnerable to ocean acidification (OA) and a shoaling Aragonite Saturation Horizon (ASH). While resilient living CWC can acclimate to acidifying waters, the structural integrity of dead CWC skeletons deteriorate. As exposed CWC skeletons make up ~75% of deep-sea reef frameworks, understanding how OA and the shoaling ASH affect skeleton load-bearing capacity is crucial. Long-term experimental mesocosms under future environmental projections and pollution/sedimentation conditions will assess live CWC growth rates, respiration, and tissue growth/retraction and dead CWC dissolution and structural integrity. ROV video analysis will be used to assess live:dead ratios of CWC across regional biogeochemical conditions. Results will be synthesized to produce end-of-the-century predictions of whether Atlantic CWC reefs will experience net growth or loss, with implications to influence conservation management and practices.



## MOHAMMED ALKHARJI

### Quantitative Gas Saturation Estimation by Dispersive AVO Inversion Algorithm

**Authors:** Mohammed Alkhariji, Mark Chapman, S. Treitel, G. Papageorgiou, J. Queen

One of the key problems in quantitative reservoir characterization is determining the reservoir fluid saturation. This is especially the case when the fluid is gas, due to the fizz gas phenomena (Domenico, 1975). Attenuation and dispersion of seismic data could be used to characterize fluid saturation within the reservoir. Attenuation caused by local fluid flows showed that attenuation decreases with increasing gas saturation (Mavko and Mukerji, 1998; Murphy III et al., 1984). Dispersion in seismic amplitudes caused by fluid saturation were also used as fluid indicator. Wilson et al., 2009 showed that dispersive P and S-wave impedances are observed at seismic gathers with different saturation. Our goal is to utilise the relationship between fluid saturation and seismic dispersion and attenuation to characterise fluid saturation, fracture properties, porosity and reservoir thickness of the reservoir. The method is to generate synthetic seismic data using different combinations of reservoir properties and train an artificial neural network to predict back those properties.



## MARIANA YILALES

### What triggered calcification in coccolithophores?

**Authors:** Mariana Yilales, Rachel Wood, Rosalind Rickaby, Alex Thomas, Fabio Nudelman

Coccolithophores are single-celled calcifying nannoplankton from the upper ocean that have greatly influenced the environment and marine ecosystems since their appearance in the Late Triassic, ~215 million years ago. By means of their photosynthesis and calcification processes, they became crucial in establishing modern ocean biochemical conditions and carbon cycling dynamics, however, the causes that triggered biomimetic mineralization in these organisms remains unknown. Oxygen availability has been proposed as a driver for macroevolutionary novelty and innovation, nonetheless, the relationship between coccolithophore evolution and ocean oxygenation has not been addressed. This project intends to reconstruct a high-resolution record of upper-ocean redox conditions during the Triassic using iodine-to-calcium ratios (I/Ca) analysis to assess how changes in oxygen concentration relates to the evolution of biomimetic mineralization in coccolithophores. Marine carbonate I/Ca analysis is a reliable proxy to trace oxygen variation in the upper ocean and can track redox dynamics during the period coccolithophores first evolved.

## SUNDAY

### SESSION 5



MICHAEL SAUNDERS

#### The Chemistry of Hydrothermal Vent Fluids

**Author:** Michael Saunders

Of 297 known active hydrothermal systems, only twenty-six have sulphide chemistry data for both hydrothermal fluids, and the deposits which they form. Given the difficulty in the resource estimation of naturally-inhomogeneous submarine hydrothermal deposits (seafloor massive sulphides), which chimney and/or grab samples: could analysis of the active hydrothermal vent fluid chemistry be an alternative method to predict metal abundances? Second to that, could the abundances of metals in hydrothermal fluids be worth exploiting in their own right?

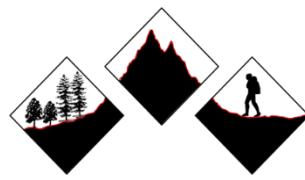


SOPHIA ANDERSON

#### Goniacodon and its Place in the History of Mammals

**Authors:** Sophia Anderson, Steve Brusatte, Sarah Shelley, Thomas Williamson

*Goniacodon* was first described over 130 years ago from a partial jaw bone and teeth. Since then, further jaw and tooth material has been discovered and described while attempts are made to place the genus within the enigmatic phylogeny of the archaic ungulates of the Paleocene (66-56 million years ago). No postcranial material has been described for the genus, leaving much of its functional morphology in question and up for speculation. This ongoing work provides a complete description of three specimens of *Goniacodon*, including a thorough description of postcranial material from *Goniacodon levisanus*, and studies what this can say about the animal's functional morphology. The work will add significantly to the diagnostic characteristics of *Goniacodon*, and ultimately help us understand one of the early mammals to emerge and thrive after the K-Pg extinction, providing insight into the type of ecology which was most advantageous to a mammal at the time.





**YI XIONG**

## The evolution of seawater chemistry during the Cambrian Explosion

**Authors:** Yi Xiong, Rachel Wood

Many diverse animal species firstly appeared during the Cambrian Explosion, which is closely related to variations of seawater chemistry. The changes of  $\text{mMg/Ca}$  influence the different skeletal mineralogy, and the evolution of seawater redox conditions controls the development of metazoan communities. Here, we collected the early marine cements from Mongolia, Siberia, Namibia and Labrador to track the evolution of seawater chemistry. Based on the optical and cathodoluminescence (CL) characteristics, We use Electron Probe Microanalysis to conclude the changes of seawater  $\text{mMg/Ca}$  and carbonate mineralogy during the Cambrian Explosion, and we also utilize the rare earth elements and CL to investigate the variations of seawater redox conditions.



**JUNHAO CHENG**

## Operational earthquake forecasts using physics-based method

**Authors:** Junhao Cheng, Margarita Segou, John McCloskey, Maximilian Werner

For the last several decades, seismologists have implemented multiple methods to make earthquake forecasts. Still, so far, only statistical methods have shown considerable performance describing the spatial and temporal clustering features of triggered earthquakes, and there is always a need to specify the earthquake nucleation process and mechanics in detail. Here, the overall objective of our project is to establish an operational physics-based earthquake model and demonstrate how a high-resolution catalogue changes the forecast result. This research project aims to employ the recent advances in Coulomb stress rate-and-state theory and use the high-resolution catalogue from the RISE project to generate several state-wide and sequence-based forecasts in Italy and potentially in other areas within Europe. All the forecast models will be submitted to the Collaboratory for the Study of Earthquake Predictability (CSEP) project in the next testing phase.



## HELEN OCKENDEN

### The importance of basal topography in the future flow and retreat of Thwaites Glacier, West Antarctica

**Authors:** Helen Ockenden, Rob Bingham, Dan Goldberg, Andrew Curtis, Antonios Giannopoulos

There is a lot of uncertainty in predictions of sea level rise before 2100 and one of the biggest uncertainties is the contribution from melting of the West Antarctic Ice Sheet, of which Thwaites Glacier is one of the most unstable glaciers. In order to predict the future melt rate and retreat of Thwaites Glacier we need a much better constraint on the basal topography, as this controls the pattern of retreat predicted by models. I will collect and process ground penetrating radar data to produce a more detailed map of the basal topography along the central flow line of Thwaites Glacier. This data will be used in ice sheet modelling to explore the role of the basal topography in glacier flow, and to predict the future evolution of Thwaites Glacier. This research will then feed into other work to produce more accurate predictions of sea level rise.



## REBECCA GRANT

### The geographies of energy justice: assessing the implications of solar uptake in Kenya

**Authors:** Rebeca Grant

Electricity access in rural Kenya remains low, despite a national vision for universal access by 2022. In response, solar photovoltaics (PV) have been promoted to meet aims for rural electrification. Drawing on the Energy Justice framework, my PhD examines *to what extent recognition, procedural and distributional energy injustices arise from the use of decentralised solar PV systems in rural Kenya?* This will be a mixed methods research study utilising both GIS and interviews. It seeks to understand where solar PV has been identified as the least cost electrification option within Kenya (RQ1), the risks and benefits emerging from energy system planning and use of solar PV systems (RQ2), and how solar PV users are included/ excluded in energy system planning and policy (RQ3). It will also examine how rural energy needs are quantified by different stakeholders, and how this shapes experiences of solar PV energy users in Kenya (RQ4).

## SESSION 6



XUEBIN ZHAO

### A Stable Approach for Q-compensated Reverse Time Migration using Excitation Amplitude Imaging Condition

**Authors:** Xuebin Zhao and Hui Zhou

The earth Q filtering causes poor illumination of the subsurface. Compensating for this effect is crucial to improve the imaging quality. Conventional Q-compensated Reverse Time Migration methods tend to boost the attenuated energy to inverse the Q effects. These methods usually suffer from severe numerical instability problem because of the unlimited amplification of the high-frequency noise. Low-pass filtering is generally used to stabilize the process, however, at the expense of precision. In this abstract, we have developed a stable compensation approach. Based on the decoupled fractional Laplacians viscoelastic wave equation, two stable compensation operators are derived and further embedded into Excitation Amplitude Imaging Condition, finally providing a new stable Q-RTM algorithm. Attenuation effect could be compensated accurately without any stability issue using this method.



MARINA JIMENEZ LAO

### Virtual endocasts of *Trogosus* and brain evolution in Tillodontia

**Authors:** Marina Jiménez, Ornella Bertrand, Steve Brusatte

The aim of this project is to describe the first virtual endocast of *Trogosus*. This genus of Eocene mammals belongs to the higher group Tillodontia. We studied two species within this genus: *Trogosus hillsi* (V17157) and *Trogosus castoridens* (52524) both from North America. We created a virtual endocast of these two species which allowed us to identify anatomical structures of the brain and to measure the size of the mayor encephalic subdivisions. Both virtual endocasts were compared with species related to *Trogosus* phylogenetically and with taxa exhibiting a similar ecology. These data were also compared to contemporaneous mammals. The measurements obtained give us information about its sense of smell, vision, motor and auditory functions as well as an approximation of intelligence. The results obtained in this study will allow us to have a better understanding of *Trogosus* biology and whether its extinction was linked to its neurological organization.

## Poster Descriptions



ANTONIA DONCILA



### Primary productivity and nutrient cycling in the Central Arctic halocline

**Authors:** Antonia Doncila, Raja Ganeshram, Robyn Tuerena, Sian Henley

In the context of current climate warming, we investigate if a fresher, ice-free Arctic Ocean will support enhanced primary productivity. Nutrient stoichiometry and  $\text{NO}_3^-$  stable isotope ( $\delta^{15}\text{N}$ ,  $\delta^{18}\text{O}$ ) data above 84°N in Nansen, Amundsen and Makarov basins are utilised to document nitrogen supply, uptake and recycling in the Central Arctic halocline. Despite the fact that all three basins are covered by permanent sea-ice, we show that the ultimate limiting factor for primary productivity in the Central Arctic is nutrient availability. There is evidence for under-ice biological activity across the study area, however the isotopic signature of Nansen halocline is very different from that of Amundsen and Makarov haloclines. Biological activity peaks in the weakly stratified Nansen basin, extending throughout the entire halocline (100m), eventually limited by Si and Fe-availability. Contrastingly, in Amundsen and Makarov basins, the strong salinity stratification impedes nutrient recharge from the halocline, restricting biological uptake to the  $\text{NO}_3^-$  depleted meltwater layer (20-30m). The extent of nutrient uptake, its control mechanisms and subsequent impact on water column biogeochemistry show spatial differences consistent with proximity to Atlantic/Pacific inflows, distinct shelf sources and the location of the Transpolar Drift. The systematics behind nutrient limitation are very different between Nansen and Amundsen/Makarov, meaning these regions may respond differently in a warming climate.



ALICE DRINKWATER

### Atmospheric Composition Through an Isotopic Lens

**Authors:** Alice Drinkwater, Tim Arnold, Paul Palmer

The relative importance of methane sources and sinks are continuously evolving as a result of changing human behaviour (such as changing agricultural practices and increasing fossil fuel emissions). Important sources of methane include natural sources such as wetlands, as well as anthropogenic sources such as oil and gas emissions and agriculture; but how these sources have evolved over time is poorly understood. The isotopic composition of methane has been shown to provide constraints on source apportionment, with different sources having characteristic isotope ratios, or 'source signatures'. However, source signatures may themselves vary over time, and have inherent uncertainties. As such, I am using the GEOS-Chem 3D chemical transport model along with in-situ datasets and emissions inventories in order to understand the spatial and temporal isotopic behaviour of atmospheric methane on a global scale.



## AYTHYA YOUNG

### Insects, Postglacial Colonisation and Refugia in northern Norway

**Authors:** Aythya Young, Anthony Newton, Andrew Ross, Inger Alsos

Although northern Norway is a geographically important region to investigate, palaeoecological studies of Quaternary insect data are limited. A variety of different questions, including immigration of the biota at the end of the last glaciation, evidence for refugia, environmental change and human impact can be answered using the fossil record. This research will provide some of the first fossil insect climatic and environmental reconstructions from northern Norway. A number of sites will be examined to test the possibility of insect survival in refugia within the arctic during the Last Glacial Maximum, whether human presence and impact can be inferred through fossil insect assemblages, and whether the environmental DNA (eDNA) technique can be successfully applied to insects.



## REBECCA CHAMBERS

### Investigations into geochemical fingerprints of UK Carboniferous Coal Measures at the Glasgow UKGEOS site

**Authors:** Rebecca Chambers, Stuart Gilfillan, Gareth Johnson, Adrian Boyce

Interest in the presence and origin of dissolved methane within groundwaters in the UK has recently increased in conjunction with the exploration for unconventional hydrocarbon resources. Recent experiences from North America have highlighted the importance of pre-hydrocarbon extraction baselines to provide a record of dissolved methane concentrations in groundwaters. Opportunistic sampling at the Glasgow UKGEOS site has provided the unique opportunity to investigate the geochemical fingerprints of gases obtained from UK Carboniferous coal measures. Typically, samples of gas are either taken in the shallow subsurface or at a specific depth corresponding to borehole depth. As such, there is little data on if or how this geochemical signature changes with depth as you approach the shallow subsurface. Therefore, the UKGEOS site provides a unique opportunity to investigate the shallow subsurface methane signature; and establish the effectiveness of using geochemical fingerprinting tools to monitor for the unintentional migration of deep hydrocarbon gases.



DYLAN PRICE

## Crystallisation of REE carbonates from aqueous solutions

**Authors:** Dylan Price, Ian Butler, Bryne Ngwenya, Linda Kirstein

We present a low temperature aqueous geochemical investigation of REE carbonate crystallisation pathways, which takes into consideration the influence of multiple REEs in solution. This serves to mimic more realistic conditions that are found in natural geological settings propitious to REE mineralisation. Results suggest that the crystallisation process of REE carbonates begins with the formation of an amorphous phase that transitions into a crystalline phase after a lag time that depends on the element and the proportions in the mixture. This lag time is REE specific and is shorter for lighter REE compared to their heavier counterparts. In particular, the presence of another REE in the system affects the crystallisation timings and the morphology of the resulting crystals. Furthermore, we find that the resulting growth rates and crystal habits are unique to the ratio of the REE mixture, with the underlying ionic potential of the mixture linked to the growth rates.



ELIZABETH BALMER

## Sedimentation of the remnant Tethys in the easternmost Mediterranean region: new evidence from western Cyprus

**Authors:** Elizabeth Balmer, Alastair Robertson, Dick Kroon

Late Cretaceous-Neogene marine sedimentary rocks have been extensively studied around the southern, eastern and northern periphery of the Troodos ophiolite in Cyprus. However, equivalent facies in western Cyprus have received little attention. Here a recently uplifted, Late Cretaceous-Neogene sedimentary succession covers an amalgamated Mesozoic basement providing a unique opportunity to investigate sedimentation of the remnant Tethys. Fieldwork combined with facies analysis and nannofossil biostratigraphy has revealed that the southeast is characterised by Paleogene pelagic carbonates, with incoming of redeposited shallow-water carbonate detritus during the Miocene. In contrast, the northern area is dominated by two phases of Miocene reef development, with deeper-water conditions in the central area during the mid-Miocene. The evidence implies sedimentation was strongly controlled by seafloor topography, inherited from Late Cretaceous emplacement tectonics and the recently observed northward deformation in the south is coupled with the development of the c. N-S Neogene-Recent Polis graben (in the North).



## HANNAH ROGERS

### Investigating regional variation in core flow models using virtual observatories and spherical Slepian functions

**Authors:** Hannah Rogers

We assume secular variation (magnetic field change) of the Earth is linked to the motion of outer core surface flow. These models are known to be under-determined and thus require other assumptions to produce feasible flows. There are regions where poor knowledge of the core flow dynamics gives rise to further uncertainty, such as the influence of regions of anomalously low seismic velocity at the base of the mantle. We use spherical Slepian functions to separate core flow models, confining the flow to either inside or outside a region of interest. We find that the Slepian decomposition generates unwanted spatial leakage which obscures flow in the region of interest, particularly along the boundaries. This work builds on previous work by using virtual observatory inversions rather than existing flow models



## JONATHAN MORLEY

### High spatial overlap between potentially harmful World Bank projects and areas of high global biodiversity importance

**Authors:** Jonathan Morley, Graeme Buchanan, Edward Mitchard, Aidan Keane

Economic development activities are the biggest threat to biodiversity. A subset of projects World Bank involves can potentially harmful activities. There is extensive overlap between these types of projects and of globally threatened invertebrate species richness, protected areas, key biodiversity areas and biodiversity hotspots. This overlap is significant, excluding protected areas, when controlling for socio-economic drivers. There is little evidence of within country avoidance, highlighting the importance of project level policies and actions in mitigating impacts. Additionally, they highlight the need for continued engagement of conservation with the actions and policies of the World Bank.



**JOHN LOW**

## Zero Carbon road vehicle fuelling – options for Scotland

**Authors:** John M. Low

The Scottish Government has set net emissions reduction targets of 75% from 1990 levels by 2030, and 100% by 2045. We have carried out predictive modelling assessment examining the likely emission impact, cost, and implementability of pathways to reach these targets in respect of road transport using Battery Electric Vehicles (BEV) and/or Hydrogen Fuel Cell Electric Vehicles (FCEV). Costs and emissions through the transition are estimated mathematically from the model, while implementability requires a degree of subjective assessment. Early outcomes of the modelling suggest that there is an optimum cost point between FCEV and BEV, arising because hydrogen production is likely to be more expensive than electricity, but the fixed infrastructure costs are likely to be higher for electricity. This poster presents the results of the modelling and related investigations.



**JULIEN A. BODART**

## Recovery of Englacial Stratigraphy across Pine Island Glacier: Proof of Concept for Analysing the Internal Architecture of West Antarctica

**Authors:** Julien Bodart, Bingham R.G., Ashmore D. W., Karlsson N.B., Corr, H.F.J., Vaughan D. G.

Concerns over the potential collapse and future contribution of the West Antarctic Ice Sheet (WAIS) to sea level rise have resulted in significant scientific interest over the last three decades. Central to this issue are dynamic changes such as the thinning and mass loss observed over Pine Island Glacier (PIG) in recent years. Few studies have utilised the geometry of radar-sounded internal layers to reconstruct past changes to the catchment. Here, we use a novel approach to radar processing that utilises two data-acquisition modes from the 2004-2005 PASIN airborne survey to assess the internal stratigraphy of the PIG catchment. We tie in these horizons with further internal layers traced across PIG's main trunk and tributaries from GPR data acquired as part of the 2013-2014 iSTAR science programme. Our results act as a proof of concept that wider layer tracing is possible across a significant proportion of the WAIS.



## JUSTINE DOMINGO

### Suspended Sediment Dynamics and Heavy Metal Contamination in Catchments Affected by Nickel Mining: A Case Study in the Philippines

**Authors:** Justine Perry Domingo, Mikaël Attal, Bryne Ngwenya, Simon Mudd

In this study, we monitored the discharge and suspended sediment concentration (SSC) at several stations in the nickel mining-affected Santa Cruz Catchment in The Philippines. Metal concentrations in sediments were also examined to assess the degree of contamination and potential ecological risk. Results show that the SSC peak in upstream areas coincides with the first rainfall event, suggesting the flushing of fine sediment during the initial flooding. However, a more erratic SSC behaviour observed at the downstream stations indicate the significance of other sediment sources. Geochemical data reveal that sediments deposited downstream have minimal degree of pollution if hillslope and floodplain samples are used as reference; yet, background metal concentrations already exceed the threshold levels set by sediment quality guidelines. These findings highlight the need to understand sediment sources and pathways during transport events in order to develop effective measures to limit the dispersal of sediment-borne pollutants in these areas.



## KERR ADAMS

### Understanding knowledge needs for Scotland to become a resilient Hydro Nation

**Authors:** Kerr Adams, Marc Metzger, Rachel Helliwell, Kit Macleod, Ina Pohle

Driving forces such as climate, land-use, and population change can lead to pressures on freshwater environments such as pollution, water scarcity and flooding. These pressures are forecast to increase in severity and intensity in the future, creating the need for resilient management and policy options. Scotland is a nation that recognised this need, by introducing the legislative agenda 'Scotland: The Hydro Nation', the Scottish Government aims to maximise the value of freshwater resources for the benefit of both the Scottish economy and natural environment. Telephone and face-to-face interviews with Scottish stakeholders are conducted to understand knowledge needs for Scotland to become a resilient Hydro Nation. Results indicate that stakeholders require greater knowledge of how the interactions between multiple drivers for change and their associated pressures could impact freshwaters in the future. To achieve this, a systems-thinking approach to facilitate the identification of adaptive water management and policy solutions is recommended.



## MARGOT DEBYSER

### Overview of nutrient cycling in the Labrador Sea: insights from nitrate isotopes

**Authors:** Margot Debysen, Robyn Tuerena, Raja Ganeshram, Laetitia Pichevin

The Labrador Sea is central to controlling nutrient budgets in the North Atlantic as it receives water masses directly exported from the Arctic Ocean through the Davis Strait, as well as recirculated waters from the East Greenland Current and the North Atlantic. Through deep wintertime convection, Labrador Sea Water (LSW) ventilates the intermediate and deep North Atlantic waters. With climate warming, freshwater melt from the Greenland ice sheet and Arctic-sourced water export through the Davis Strait have increased, thereby impacting nutrient dynamics. To gain insights into the role of LSW on controlling nutrient export to the North Atlantic, measurements of nutrient stoichiometry and stable isotopes are presented across the Labrador Sea along the AR7W transect. In the context of current climate warming in the Arctic Ocean, the contribution of Arctic-sourced freshwater to the isotopic signature of nutrients in the Labrador Sea will be considered and the potential impact to the North Atlantic nutrient budget evaluated.



## NADIA JOGEE

### Characterising the corallith community and testing the free-living stabilisation hypothesis in Utila, Honduras

**Authors:** Nadia Joge

Coralliths are a much overlooked spheroidal morphology of coral. Unlike coral fragments they have the ability to remain free-living. This study is the first extensive characterisation of coralliths in the Mesoamerican Barrier Reef. Using transect surveys across four sites at varying depths all unattached corals were assessed for species, size and whether they were coralliths or fragments. The data were used to test whether the free-living stabilisation hypothesis observed in The Maldives holds true in a different reef system. There were signs of coralliths stabilising sediments as they get larger, but unlike in The Maldives distance from shore is not a predictor of size. This initial survey will be a springboard for investigation into the limiting factors of corallith formation.



**PAIGE DEPOLO**

## Piecing Together the Pantodont Puzzle

**Authors:** Paige dePolo

The Cretaceous-Paleogene (K-Pg) extinction radically restructured Earth's ecosystems 66 million years ago, allowing mammals to diversify and become some of the modern world's most recognizable animals. However, the timing and tempo of the placental mammal radiation with relationship to the extinction remain topics of debate. To tackle these questions, we investigate the strange mammal groups that appear to arise in the wake of the extinction. Pantodonts were some of the first mammals to grow to large body sizes after the K-Pg extinction and occupy large herbivory niches. They achieved a broad geographical distribution and are found in North and South America, Europe, and Asia. Several pantodont groups show evidence of gregarious (herd) behavior. Although their teeth show unique and distinctive shapes and fairly complete skeletons are preserved of many different species, pantodonts remain difficult to place within the mammal family tree.



**POLLY THOMPSON**

## Identifying environmental records held within tephra layer morphology

**Authors:** Polly Thompson, Andrew Dugmore, Anthony Newton, Caroline Lehmann, Nick Cutler, Richard Streeter

This project aims to expand upon the use of tephra layers as a proxy for past environments and for environmental reconstruction. Tephrochronology is an important and highly useful tool that has made significant contributions to understanding chronology, volcanic eruptions, and past environments. However, an overlooked aspect is how the morphology, thickness and grain size distribution of tephra layers incorporated into soil can be used to identify past land surface conditions, environmental changes and land management activities. Through field-based study in Iceland, environmental data held within tephra layer morphology will be further explored. This will not only provide insight into past landscapes, but will also improve the interpretation of tephra layers to better reconstruct volcanic parameters, both in Iceland and volcanic regions globally.



**SAM HARRISON**

## Using remote sensing and ordination to map tree composition gradients in tropical agroforestry landscapes

**Authors:** Sam Harrison, Casey Ryan, Rhett Harrison, Gary Watmough

Trees on farms will play an increasingly important role in meeting global targets ensuring sustainably managed agriculture for biodiversity. Meeting these targets relies on appropriate wide-scale biodiversity monitoring to measure progress and inform decision making. Prevailing methods to map vegetation tend to generalise composition and classify them into groups of assemblages. This study uses an ordination approach to find gradients in tree species compositions. This method has had few applications, most of which have been in homogenous landscapes in continuous fields in temperate regions. This study applied a nonmetric multidimensional scaling (NMDS) ordination to a dataset of trees on farms in Uganda. The ordination axes were then regressed against remote sensing imagery using a random forest approach. The resulting map had model fits of  $R^2=0.85$  and  $R^2=0.55$  for NMDS axes 1 and 2 respectively. The map produced provides a detailed map of the gradient of composition in the landscape.



**SOFIA HOLPIN**

## New material of *Tetraclaenodon* (Mammalia, 'Condylarthra'), from the San Juan Basin, New Mexico, USA, reveal insights into its evolution and palaeo-environment

**Authors:** Sofia Holpin, Thomas Williamson, Sarah Shelley, Stephen Brusatte

Among the initial groups that ushered in the Age of Mammals, early Paleogene 'condylarths' are thought to include the ancestors of extant odd-toed ungulates. Within the 'condylarth' group Phenacodontidae, *Tetraclaenodon* is the oldest genus and was a medium sized, lightly built, terrestrial mammal. We assessed 124 teeth of *Tetraclaenodon* using statistical and multivariate analyses in order to explore dental and body mass variations throughout its evolutionary history. Measurements were subject to principal component analysis to test for trends over time. Body mass estimates were obtained via a regression equation of the area of m1. The specimens were ordered by their biostratigraphical reference into six time bins, from Tj1 (~63.8 Ma) through Tj6 (~62.4 Ma). Our results suggest that Torrejonian populations of *Tetraclaenodon* were relatively constant in body size throughout Tj1-3, but between Tj3 and Tj4 underwent an increase in body mass and a shift in dental proportions that subsequently stabilized.



## SPENCER READ

### Can ERA5 reanalysis data be used to drive a snow model?

**Authors:** Spencer Read, Richard Essery, Chawn Harlow, Hugh Pumphrey

Snow models are used to better understand seasonal snow processes but require extensive meteorological forcing data. Automatic Weather Stations (AWS) in remote regions such as Polar and Alpine regions, are often sparse or unreliable, so reanalysis datasets are often used. ERA5 has recently been made available by the European Centre for Medium-Range Weather Forecasts (ECMWF) and has higher temporal and spatial resolutions compared to ERA-Interim, the former ECMWF reanalysis dataset. Here, ERA5 is compared to a meteorological dataset from an AWS at an Arctic tundra site in Canada. ERA5 is also used to drive the Flexible Snow Model (FSM2), a recently developed physically based snow model. Results show that ERA5 agrees with most meteorological variables, but is unable to accurately represent wind speed in the region. As a result, modelled snow depth is significantly different from snow depth measured by the AWS, although other factors are explored.



## ZOI KYNIGOPOULOU

### The postcranial morphology and phylogeny of Taeniodonta (Mammalia); determining locomotor adaptations

**Authors:** Kynigopoulou Zoi, Shelley Sarah, Williamson, Brusatte Stephen

After the Cretaceous-Paleogene (K-Pg) mass extinction mammals managed to survive and thrive. An ideal group to investigate the post K-Pg evolution of mammals is taeniodonts, as they are among the few taxa to purportedly cross the boundary. Ten genera of taeniodonts are currently recognized and are commonly arranged into two families. The Conoryctidae is usually considered to have a more generalized body plan while Stylinodontidae possess relatively extreme digging adaptations and more highly derived dentitions with enlarged canines. We conducted a phylogenetic analysis by applying parsimony and found that the taxa *Conoryctes* and *Onychodectes* are placed as key basal taxa outside the clade of the more robust derived taxa. We then conducted quantitative multivariate analyses, using 9 forelimb linear measurements and 29 tarsal ones, comparing taeniodonts to a suite of extant mammals with known locomotor mode. Our study indicates that digging behaviors are ancestral for taeniodonts.

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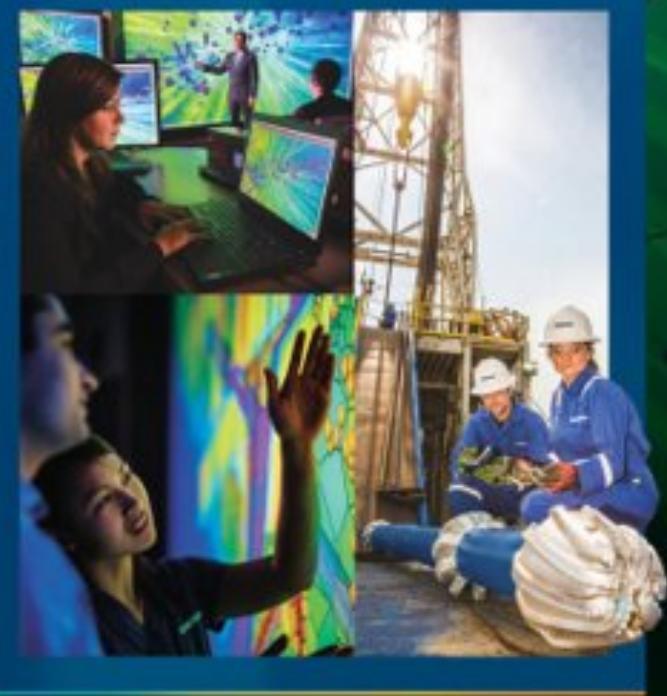
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