UK-IODP Student Conference

9th-11th September 2012

NATURAL ENVIRONMENT RESEARCH COUNCIL

Conference Organisers:

Dayton Dove, UK-IODP Science Coordinator, British Geological Survey

Sasha Leigh, former UK-IODP Programme Manager, NERC

Jessica Batchelor, current UK-IODP Programme Manager, NERC

Lucy Hopewell, UK-IODP Programme Administrator, NERC

Welcome to the UK-IODP Student Conference,

Chicheley Hall,

Newport Pagnell, MK16 9JJ

9th-11th September 2012

Contents

To access wireless internet during the meeting use the code 'chicheley' and password 'kavli123'.

For those attending the main conference on Wednesday 12th September, transport has been arranged to the venue. Please keep your badge for use at the main conference.

Programme

Day 1: Sunday 9th September

18:00	Arrival and Registration
19:00	Dinner
20:30	After-dinner talks: Platform experiences and student research: • Understanding the dike-gabbro transition: Fluid flow and thermal perspectives from Hole 1256D and Hess Deep **-** ***Michelle Harris*** • A day in the life of a record-breaking scientific drilling team- ***Becky Cook***

Day 2: Monday 10th September

09:00-09:05	Welcome, outline and aims of meeting - ***Dayton Dove***
09:05-09:35	History and overview of scientific Drilling - ***Joe Cann***
09:35-09:45	An introduction to the UK-IODP – ***Dayton Dove***
09:45-10:00	IODP—the next 10 years, including New Science Plan – ***Mike Bickle***
	Student research presentations:
10:00-10:20	Glacial-Interglacial boron isotope changes in the deep North Atlantic - ***Tom Chalk***
10:20-10:40	Carbon-isotope stratigraphy: a case study from New Jersey coast, IODP Expedition 313- ***Linhao Fang***
10:40-11:00	Symbiont 'bleaching' in planktic foraminifera during the Middle Eocene Climatic Optimum - ***Kirsty Edgar***
11:00-11:20	Break and Posters
	Student research presentations:
11:20-11:40	Direct Evidence for East Antarctic Ice Sheet Sensitivity During Pliocene Super-Warmth - ***Carys Cook***
11:40-12:00	Building the case for CAS: testing Carbonate-Associated Sulfate as a proxy for marine sulfur isotopes - ***Victoria Rennie***
12:00-12:20	A long Blake Excursion? A case study of palaeomagnetic measurements in sedimentary cores - ***Mark Bourne***

12:20-12:40 **12:40-13:00**	Insights into explosive volcanic eruption dynamics using deposits in deep sea sediments. ***Samantha Engwell*** A 40 million year record of dynamic topography in the North Atlantic Ocean – ***Ross Parnell-Turner***
13:00-14:00	Lunch and Posters
14:00-15:30	Break-out discussions: framed around NSP science themes and drawing on student presentations and posters – ***Sasha Turchyn, John Maclennan, and Peter*** **Clift** lead discussions
15:30-16:00	Break and Posters
16:00-16:30	How to propose a drilling project (including Site Surveys); Presentation and Discussion- ***Heiko Pälike***
16:30:16:45	Introduction to workshop exercise - Formulating proposal ideas – ***Damon Teagle***
16:45-17:45	First meeting with break-out groups: proposal formulation
19:00	Dinner

Day 3: Tuesday 11th September

09:00-09:15	Welcome Back-– Outline of the day and anticipated outcomes
09:15-11:00	Break-out groups: proposal formulation
11:00-11:20	Break
11:20-13:00	Break-out groups: proposal formulation cont.
13:00-14:00	Lunch
14:00-15:45	Presentation of Proposals ideas (20min each)
15:45-16:00	Break
16:00-17:30	Feedback from peers and workshop speakers/senior scientists
19:00	Dinner

Day 4: Wednesday 12th September

08:00	Departure for UK-IODP General Conference, University of Oxford (arrival ~09:30)

Student UK-IODP Conference Workshop Exercise

Objective:

Groups of 6-8 will work with senior scientists to formulate a mock IODP drilling proposal, which will then be presented to the group.

Specifics:

- Groups of 6-8 will be pre-selected to ensure a spread of expertise and institutions between groups. You will be informed of your groups when you arrive at the meeting.
- **Everyone should come to the meeting with a drilling target in mind**
- The first step of the exercise will be for the group to adopt one member's general plan. This decision should be made before the start of the second day. Remember that IODP expeditions are multi-disciplinary in nature, so there is a good chance that several members' scientific objectives could be incorporated.
- The presentation will be a Power Point presentation in the style that has previously been given to the Operations Task Force (OTF). This means summarizing your scientific question(s), specifying you're scientific goals (potential and anticipated results), and describing the means (site-surveys, platform, instruments, sampling, staff (scientific expertise) requirements) you require to accomplish your goals. While it may not be possible for each group member to present, try to arrange different people to present different aspects of your proposal.

Recommendations:

- First and foremost, choose a compelling science question that can only be addressed through scientific drilling.
- Bring a laptop. You'll have the internet to help you on your way.
- What are the site-survey requirements at your site(s)? Does data already exist?
- Are there major drilling hazards or environmental risks at your site? In this case you should generally focus on the science rather than hazards.
- Which platform is required for your proposal?
- Will you require any specific or novel coring/engineering solutions?
- Don't present a one-dimensional case; prepare a multidisciplinary proposal. What secondary and tertiary scientific goals can be accomplished without interfering with you accomplishing your primary goal?
- How does your proposed science fit with the challenges in the new science plan for scientific ocean drilling "Illuminating Earth's Past, Present and Future"

Recommended Reading.

- In last year's UKIODP Newsletter, Heiko Pälike (NOCS) wrote an excellent primer describing the IODP proposal process: http://www.bgs.ac.uk/iodp/docs/UKIODP_36.pdf
- New Science plan for 2013 to 2023 - http://www.iodp.org/Science-Plan-for-2013-2023

Students' Talks: Abstracts

A long Blake Excursion? A case study of palaeomagnetic measurements in sedimentary cores.

Mr Mark Bourne, University of Oxford

Science Question My research attempts to investigate the behaviour of the Earth's magnetic field during 'geomagnetic excursions'. These are brief periods in time when the Earth's magnetic field deviates from 'typical' behaviour and can include intervals of reversed polarity.

Methods I take a broad range of palaeomagnetic measurements principally using a 2G SQUID magnetometer. I have also taken measurements of oxygen isotopes and radiogenic U-Th isotopes (MC-ICPMS). I use measurements of 230Th-excess to determine variations in sedimentation rate.

Results I have measured a very high-resolution record of the Blake excursion from ODP cores on the Blake Outer Ridge. This record indicates a duration of a reversed polarity interval of 6.5 kyr (longer than theoretical considerations might predict) coupled with rapid transitions between polarity states.

Glacial-Interglacial boron isotope changes in the deep North Atlantic.

Mr Thomas Chalk, National Oceanography Centre, Southampton

Science Question My research is primarily concerned with the role of deep ocean carbon storage in controlling and responding to major glaciation in the northern hemisphere. It also looks at the development of benthic foraminiferal boron proxies as recorders of the ocean carbonate system.

Methods Measurement of boron isotopes and trace element data on benthic foraminifera by (MC)-ICPMS.

Results Deep water ventilation and carbon storage are shown in records from boron based proxies as well as variations in glacial interglacial water mass. B/Ca records at high resolution show carbonate characteristics of Heinrich events in the North Atlantic.

Comparing and contrasting structural and decollement variations along the Sumatran Subduction Zone.

Miss Becky Cook, University of Southampton

Science Question Recent earthquake-triggered tsunamis offshore Sumatra, Japan and Chile involved shallower than expected rupture. Wedge theory relates large-scale structures to frictional properties of the plate boundary fault and will be used to investigate varying rupture behaviour along the Sumatran margin.

Methods Coulomb wedge theory states that wedge taper can be used to infer frictional properties of a basal detachment. Values of wedge taper from bathymetric and seismic data will be compared to decollement reflective properties and seismicity of the region.

Results Near-trench seismicity of the 2004 earthquake is associated with a strongly negative reflection in the incoming section. Elsewhere strong negative reflectors arise due to high pore pressures which weaken a fault. Wedge tapers from Sumatra will provide insight on how wedge properties vary with depth.

Direct Evidence for East Antarctic Ice Sheet Sensitivity During Pliocene Super-Warmth
Miss Carys Cook, Imperial College London
Science Question Was the East Antarctic Ice Sheet sensitive to climatic warmth during the Pliocene? More specifically, where low-lying subglacial basins susceptible to destabilisation during such warmth?
Methods I study the geochemical provenance of marine sediments, utilising the radiogenic isotopes of neodymium and strontium in detrital clays and silts, and argon isotopes of mineral grains in ice rafted debris.
Results Results from recent IODP expedition 318 to Antarctica suggest that the massive Wilkes Subglacial Basin was the site of substantial ice sheet collapse, during super-warm Pliocene intervals.

Oligocene carbon compensation dynamics in the equatorial Pacific Ocean.
Dr Kirsty Edgar, Cardiff University
Science Question What is the `natural' magnitude of ocean acidification changes approximated by [CO32-]? On what timescales does the carbonate compensation depth (CCD) vary despite carbonate buffering? How does CCD variability relate to climate change? What is the origin of these CCD fluctuations?
Methods The proposed presentation utilises the following methodologies; Sediment properties, e.g., wt% CaCO3 and physical property datasets. Stable carbon and oxygen isotope analysis in bulk and foraminiferal calcite. Time series analysis
Results My postdoctoral research provides the first record documenting the magnitude of `background' CCD variability on orbital timescales during the Oligocene. These records provide new insights into the controls on the CCD over geological timescales.

Insights into explosive volcanic eruption dynamics using deposits in deep sea sediments.
Miss Samantha Engwell, University of Bristol
Science Question Little in known about the number of volcanic eruptions through time, with information predominantly from historical records and land deposits. I have used ash in deepsea sediments to determine the size of eruptions to better our understanding of rates of explosive activity over time.
Methods Measurements of ash thickness in deep sea deposits and sampling from deep-sea cores for grain size analysis.
Results Tephra thickness information is better preserved in the deep sea than on land at equivalent distances. Grain size trends are identical regardless of whether deposition is on land or in the deep sea.

The Miocene atmospheric carbon-isotope fluctuations: evidence from terrestrial organic matter, New Jersey, USA.

Mr Linhaou Fang, University of Oxford

Science Question I am exploring the evidence for atmospheric carbon-isotope fluctuations in the Early-Middle Miocene from terrestrial organic matter and the potential cause-reason relationship of sea-level change.

Methods Measuring the carbon isotope documented in the organic fragments of plants, so called phytoclasts.

Results Carbon isotope reconstructed from the organic phytoclasts is well consistent with the sea-level changes in Middle Miocene, New Jersey, US.

Understanding the dike-gabbro transition: Fluid flow and thermal perspectives from Hole 1256D and Hess Deep.

Dr Michelle Harris, National Oceanography Centre, Southampton

Science Question How does the lower oceanic crust form at fast spreading rates? To what extent do hydrothermal fluids contribute to the cooling of the lower oceanic crust?

Methods Petrology, isotope geochemistry, geochemistry, electron probe.

Results Isotope studies identify regions of focussed fluid flow within the dike-gabbro transition. Cooling rate studies cannot confidentially distinguish between end member thermal models for the accretion of the lower oceanic crust.

40 million years of the Iceland Plume.

Mr Ross Parnell-Turner, University of Cambridge

Science Question Can we relate processes at the Earth's surface such as deep-water oceanic circulation, transient uplift events and sediment deposition, to the deeper mantle convection system? If so, how is this manifested, and on what spatial and temporal scales do these processes interact?

Methods At the heart of my research are observations of the oceanic crust and overlying sediments from multichannel seismic reflection and scientific borehole data. These are complimented by the use of simple mathematical models.

Results The mid-Atlantic ridge acts as a linear recorder for activity of the Iceland mantle plume. There is a striking correlation between this plume chronology and surface processes in the North Atlantic, such as deep-water oceanic circulation and sedimentary drift deposition.

Building the case for CAS: testing Carbonate-Associated Sulfate as a proxy for marine sulfur isotopes.

Miss Victoria Rennie, University of Cambridge

Science Question Carbonate-Associated Sulfate (CAS) is an important proxy for the isotopic composition of aqueous sulfate over geological time, however the extent to which it is robust under carbonate diagenesis is not yet well constrained.

Methods Sulfate extracted from carbonate-rich ODP sediments from a variety of diagenetic settings are compared with the coeval barite record of sulfur isotopes, and pore fluid sulfur isotopes, to examine the reliability of the proxy.
Results Marine d34S is well preserved in carbonate-rich and organic poor settings, despite large variations in porefluid d34S. However Carbonate-Associated Sulfate is ~1permil more variable than coeval barite d34S.

Posters: Abstracts

Coupled sulfur and oxygen isotope insight into bacterial sulphate reduction in the natural environment.

Mr Gilad Antler, University of Cambridge

Science Question What controls the relative evolution of d18O(SO4) vs. d34S(SO4) in marine sediments during and how it relates to the mechanism of BSR?
Methods I used the analysis of d18O(SO4) and d34S(SO4) from ODP-acquired deep sea sediments, the shallow Mediterranean, and the Yarqon estuary (Israel). I combined this data with a model of the biochemical steps involved in BSR to explore how the slope on a d18OSO4 vs. d34SSO4 plot relates to the SRR.
Results My data demonstrates a correlation between the BSR rate and the slope of d18O(SO4) vs. d34S(SO4). The subsequent model suggests that the critical parameter for this relative evolution during BSR in natural environments is the rate of intracellular sulphite oxidation.

A record of the Paleocene/Eocene Thermal Maximum from exceptionally preserved planktonic foraminifera from Tanzania.

Dr Tracy Aze, Cardiff University

Science Question What was the effect of abrupt temperature change and ocean acidification on planktonic foraminiferal communities during the Paleogene hyperthermals?
Methods Species level assemblage data combined with multi-species single specimen carbon and oxygen isotope analysis using some of the best preserved planktonic foraminifera available for this time period.
Results Planktonic foraminifera isotope analysis has demonstrated, what we believe to be, the most negative oxygen isotope values for the Cenozoic. This would be presented with species level assemblage data that may represent evacuation of the tropical oceans during the peak warmth of the PETM.

Orbital scale alkenone based CO2 records across the Pliocene intensification of Northern hemisphere glaciation.

Dr Marcus Badger, University of Bristol

Science Question The most informative analogues for future anthropgenic climate change are likely to be those with boundary conditions similar to today. The late Pliocene is the most recent time in earth history with elevated global temperatures and CO2 estimated to be similar to that anticipated by the end of this century. Furthermore, Pliocene continental positions and vegetation distributions are thought to be broadly similar to today. Consequently the IPCC fourth assessment report highlighted the Pliocene as an important time period for further study. Recently our understanding of Pliocene CO2 and temperature has improved, with publication of multiple records from alkenone and boron isotope reconstructions for CO2, and Mg/Ca, UK'37 and TEX86 reconstructions for sea surface temperature. However, none of the published CO2 records have sufficient temporal resolution to resolve orbital scale variations in CO2, or to determine the relationship between the apparent reduction in atmospheric CO2 and the intensification of northern hemisphere glaciation.

Methods Organic Geochemisty, Alkenone δ13C, TEX86 and UK'37 based palaeothermometry, planktonic foraminiferal Mg/Ca, δ13C and δ18O

Results Our new, high temporal resolution alkenone carbon isotope based record of pCO2 spans 2.6 to 3.3 million years ago from ODP Site 999. Our record is of high enough resolution (~19 Kyrs) to resolve glacial-interglacial changes beyond the intrinsic uncertainty of the proxy method. The record confirms Pliocene CO2 levels were stable and similar to or slightly higher than the pre-industrial, estimated at ~270 ppm based on most likely assumptions

North Atlantic Ocean Circulation and the onset of Northern Hemisphere Glaciation.

Mr Peter Bloxsom, Cardiff University

Science Question The timing and nature of changes in ocean circulation in the North Atlantic, and how they relate to the global cooling and glaciation between 5 and 2 Ma.

Methods Multiproxy benthic foraminiferal records from intermediate depth IODP Site 982 in the North Atlantic. These records include multispecies trace metal reconstructions, Mg/Ca B/Ca, along with stable isotope and the Sortable Silt bottom water flow speed proxy.

Results So far, preliminary data suggests a link between bottom water flow speed at this site and regional climate (colder climate=slower flow speed, or vice-versa). Furthermore, significant offsets in trace metal content are detected within Cibiciboides subspecies.

Ocean circulation changes during the early Eocene 'greenhouse'. How can Neodymium isotopes help?

Miss Adele Cameron, The Open University

Science Question How did oceanic circulation patterns differ during a `greenhouseÂ¿ climate and can we predict how oceans might behave in a future warm climate? Where might deep-waters have formed during a time with low equatorial-pole temperature gradients? How can Neodymium isotopes in fish teeth help?

Methods Geochemical analysis of fish teeth sourced from IODP drill sites. Nd concentrations via ICPMS and Nd isotope suites via MC-ICPMS Sortable Silt analysis of material sourced from IODP sites.

Results Fish tooth material has been picked for Leg 207, Site 1258 Demerara Rise from between 53Ma and 47Ma (Early Eocene peak temperatures and subsequent initiation of cooling) which will be analysed presently and I hope will provide a mid-member locality for assessing Atlantic circulation patterns.

Late Miocene climate cyclicity inferred from Eastern Equatorial Pacific benthic foraminiferal stable isotope records.

Miss Anna Joy Drury, Imperial College London

Science Question Orbital tuning of benthic stable isotopes to help construct an age model for the late Miocene (Site U1338). We will combine the d18O with benthic foraminiferal Mg/Ca and Li/Ca to constrain ice volume and sealevel variations during the Messinian Salinity Crisis, as the role of sealevel is ambiguous.

Methods Planktic biostratigraphy & orbital tuning of benthic stable isotopes to establish agemodel Benthic foraminiferal d18O, Mg/Ca & Li/Ca to constrain d18Oseawater, ice volume & sealevel. Planktic foraminiferal Mg/Ca, d18O & clumped isotopes to constrain SSTs and seawater composition (in collaboration).

Results Benthic foraminiferal d18O and d13C stratigraphy, including preliminary spectral analysis. Preliminary planktic foraminiferal Mg/Ca and d18O with corresponding clumped isotope analysis on bulk carbonate

The uncertainty of the ash layers in cores.

Miss Wenjiao Du, University of Bristol

Science Question What kinds of factors will affect the thickness of ash layers?

Methods Creating database by summarying the literatures and the description of cores.

Results Creating a precise database and analysing the data seriously.

History of Southern Ocean Ventilation Through the Last Deglaciation Evidenced by a Benthic Forminiferal d13C Transect.

Dr Aurora Elmore, Durham University

Science Question How quickly does the ocean respond to the warming trend of the last deglaciation? Is the ocean's response to deglaciation uniform or variable?

Methods Chemical analysis of planktonic and benthic foraminifera from deep-sea sediment cores to reconstruct paleo-environments.

Results The Southern Ocean's response to the last deglaciation began with the surface water and progressed into deeper, intermediate waters as the deglaciation progressed. This finding allows us to better understand the storage of carbon (CO2) in the Southern Ocean.

Thermohaline structure imaged using muti-channel Seismic Data.

Mr Matthew Falder, University of Cambridge

Science Question Most conventional oceanographic methods are effectively many 1D profiles stitched together. Using multichannel seismic imaging allows us to use true 2D, full water-column, imaging in order to answer the question 'What happens in the horizontal dimension at fine scales?'

Methods My major work is done using multi-channel Seismic imaging (MCS). This technique uses reflected acoustic energy to provide images of the water column with metre scale resolution in both the vertical and horizontal directions. With MCS, temperature discontinuities as little as 0.03ºC may be imaged.

Results Full ocean-basin transects across the North Atlantic Ocean, being the two longest seismic oceanographic lines processed to date. These lines show the details of many thermohaline features which could not be imaged by conventional methods.

Some Like it Hot: A Planktonic foraminiferal perspective of the mid-Miocene climate optimum.

Miss Lyndsey Fox, University of Leeds

Science Question What was the rate and magnitude of equatorial sea surface temperature changes during the Miocene? What is the relationship between foraminiferal diversity, evolution, and extinction during times of climatic stress?

Methods Stable isotope analysis, Scanning electron microscopy.

Results A high resolution stable isotope curve for early to Middle Miocene.

Initial Findings of a Northwest Pacific Neogene Investigation.

Marise Gorton, University of Bradford

Overall a multiproxy approach that will eventually allow extraction of separate temperature,productivity etc signals, but at this stage, bulk sediment oxygen/carbon isotope analysis coupled with downhole logging data (reflectance, bulk density, magnetic susceptibility) to determine any cyclical signals in the core and then the use of these results as a basis for continuing study/comparisons/analysis.

Deglacial surface and interior water column structure of the subarctic Pacific.
Mr Will Gray, University College London
Science Question This research aims to assess the mechanisms by which the high-latitude North Pacific ocean controls atmospheric CO2 on glacial-interglacial timescales. Specifically how the surface and interior watercolumn structure, and deep ocean chemistry changed in the over the last deglaciation.
Methods Planktonic and Benthic foraminiferal stable isotopes (d18O and d13C) Planktonic and Benthic foraminiferal trace metal/Ca (Mg/Ca, Li/Ca, B/Ca) Ostracod Mg/Ca Benthic-Planktonic foraminiferal radiocarbon.
Results New d18O and d13C measurements on benthic, thermocline and mixed layer foraminifera from ODP Site 882 show an expansion of an intermediate watermass to >2000m depth and an increase in surface ocean salinity during glacial times.

Deep-sea macrofaunal ecology and biodiversity of the Whittard submarine canyon (NE Atlantic).
Miss Laetitia Gunton, University of Southampton
Science Question Is a greater species diversity found in submarine canyons or on the adjacent slope? How does physical disturbance affect deep-sea species diversity? How does habitat heterogeneity affect deep-sea species diversity?
Methods Megacore samples were taken from different locations in the Whittard canyon and on the adjacent slope. The macrofauna (>300ÂµmÂ) were picked out and identified to class level. Polychaetes will be identified to species level. Statistical analysis will be performed on the data.
Results There appears to be little difference in macrofaunal diversity between the canyon and adjacent slope. The physically disturbed and physically quiescent environments appear to have the same species diversity.

Cycles of dome construction and collapse on Montserrat: insights from major/minor elements, isotopes and gravity flows.
Mr Edward Inglis, University of Southampton
Science Question My research seeks to characterise gravity flows within the flow deposit succession. Geochemical signatures will allow for a chemostratigraphic classification of these flows, and ages and provenance to be assigned.
Methods Grain size will be analysed to highlight the difference between volcanic deposits and entrained sediment. Isotopic analysis will be used to characterise flows from different collapse events; thus ‘what sediment relates to which collapse event’ is posed as my central hypothesis.
Results This project is awaiting the arrival of samples for analysis (due July 2012). Onboard corelogging illustrates distinct tephra layers and volcanic material deposited as part of a flow regime.

Warm Ocean Processes and Carbon Cycling During the Eocene

Miss Eleanor John, Cardiff University

Science Question As part of my postdoctoral project I am investigating changes in the vertical structure/chemistry of the ocean during the Eocene - specifically, how temperature, pH and rates of remineralisation of organic matter change through the water column. This epoch saw a gradual cooling from a 'greenhouse' world to an 'icehouse' world and the overall aim of the NERC-funded project I am involved with ('Descent Into the Icehouse') is to investigate the details of and the controls on this cooling trend.

Methods Different planktonic foraminifera live and calcify at different depths in the oceans. I am exploiting this fact to reconstruct vertical changes in the water column via chemical analysis of the tests (mainly d13C, d18O, d11B and trace element/Ca ratios) of different species in entire foraminifera assemblages for different ocean basins. The samples mainly come from IODP material.

Results Preliminary results suggest that throughout the Eocene, the decrease in the d13C of dissolved organic carbon through the water column (which reflects photosynthetic carbon fixation at the surface and its remineralisation as it sinks) was sharper, larger and higher in the water column than today, at least in one locality. This is consistent with the idea that in a warmer ocean higher metabolic rates in microbe communities could have resulted in more rapid remineralisation of sinking organic carbon thus affecting a) the amount of carbon reaching the seafloor, b) the distribution of oxygen minima in the world's oceans and c), the nutrient structure of the ocean.

Middle Eocene greenhouse climate stability from IODP Expedition 320, Site U1333 in the equatorial Pacific.

Wendy Kordesch, National Oceanography Centre, Southampton

Science Question Fundamental questions remain regarding the basic functioning of climate dynamics in the Eocene. This study will generate new high-resolution records to help constrain factors controlling the evolution of middle Eocene greenhouse climate in the equatorial Pacific using sediments from IODP Site U1333.

Methods This study uses the geochemical properties of deep-sea sediments and stable isotopes of benthic foraminiferal calcite from the equatorial Pacific to produce detailed records of changes in ocean temperature, continental ice volume, and the global carbon cycle during the middle Eocene.

Results Preliminary results suggest we are able to obtain high-resolution stable isotope records that will allow us to test the timing and magnitude of transient climate events in the middle Eocene.

Use of ash-layer data from IODP cores to develop our understanding of global rates of volcanic activity through time.

Dr Sue Mahony, University of Bristol

Science Question Are global rates of volcanic activity increasing over the last few Myrs? Decreasing? Cyclic? How do global rates of volcanism relate to tectonic or glacial patterns? How does this information inform climate models?

Methods Data collection from literature as well as use of physical properties data to identify ash layers in IODP cores. Translation of data into a time series of eruptions of varying magnitude for analysis to answer questions posed.

Results Use of VCDs to create a comprehensive dataset of ash layers is not possible.

Physical constraints for the geological CO2 storage into the ocean crust.

Miss Chiara Marieni, National Oceanography Centre, Southampton

Science Question Are the CO2-injections into the ocean crust a stable method to storage the CO2? What is the behaviour of CO2 into the basement, from a thermodynamical point of view? How does the sediment thickness influence the CO2 physical parameters like P, T and density?

Methods Geochemical available data from the ODP/IODP cruise. PHREEQC for the low-T aqueous geochemical calculations. MATLAB and the application TEOS-10 for the plots and the equation of state of seawater. NIST database for the equation of state of CO2.

Results The pure CO2 fluid isn't denser than seawater at the sediment-basement interface (verified into the ODP Leg 168 and into the Holes: 1256D, 504B and 896A). The sediment thickness on the ridge flank influences the physical behaviour of CO2.

Correlating geochemical, sedimentological and petrophysical changes through the Mid-Miocene Global Cooling event in New Jersey Shallow Shelf cores (IODP Expedition 313).

Dr Annette McGrath, J. Inwood, S. Morgan & S.J. Davies University of Leicester

*Science Question*The New Jersey margin is an ideal location to study the impact of late Cenozoic sea level change on the evolution of shelf depositional systems due to a combination of rapid depositional rates, tectonic stability and a well-preserved fossil record. This project focuses on the geochemistry of an unusual 7m interval of Unit II colour-banded clays from the most landward (M0027A) of the three holes cored during IODP Expedition 313. The clays lie immediately above a key surface (the m4.1 reflector) and were deposited during a time of global cooling and major sea level change. The behaviour of major and trace elements from this interval will help to elucidate the paleoenvironmental conditions and nature of shelf sedimentation during this time.

Methods Conventional XRF, XRF core scanning, existing downhole and core petrophysical datasets from Expedition 313

Results Conventional XRF analysis of the colour-banded clays reveals enrichments in the redox-sensitive trace elements As, Co, Sc, V, Cr, the LREEs La, Ce and Nd, and also Ba and Cs throughout this interval. The enriched zone consists of a sequence of cm- to metre-scale

packages of banded clays, alternating with thinner, paler homogeneous clays. The cm-scale colour-bands are interpreted to represent diagenetic features due to the mobilisation and relocation of redox-sensitive elements in the sediments during, or shortly after, deposition. The observations are consistent with deposition of the clays in a restricted marine environment, with limited water circulation, decreased bottom water ventilation and sulphidic conditions. Increased precipitation and runoff during the mid-Miocene global cooling event may have contributed more oxygen-rich river-derived organic material to the shelf, driving redox fronts through the sediment and thus forming this distinctive interval.

Calcareous phytoplankton response at Blake Nose during the latest middle Eocene zooplankton extinctions.

Miss Cherry Newsam, University College London

Science Question My research is a qualitative study of nannofossil species across the latest middle Eocene where foraminifera and radiolarian extinctions have been recorded. The research will address the response in calcareous phytoplankton across the event and give insight into potential causes for the extinctions.

Methods My Masters project is based on micropalaeontological techniques. The focus is smear slide production and light microscope analysis of ODP samples. The techniques used will be species recognition and abundance counts. Scanning electron microscope imaging will indicate the preservational state.

Results I have currently prepared smear slides which I will be performing abundance counts on. The data will be collected and statistically analysed by August.

Use of core scanning XRF to obtain records of detrital material in the North Atlantic.

Mr Joseph Nicholl, University of Cambridge

Science Question How does the input of detrital material to the North Atlantic change over time? Are major ice rafting events (e.g. Heinrich events) similar over the mid-Pleistocene transition?

Methods Core scanning XRF. Oxygen and carbon stable isotope analysis (bulk carbonate and forams). Point counting of coarse IRD.

Results Fine scale features can be seen within major detrital events. Some features of the last termination are duplicated further back in time.

Agulhas Current input into the SE Atlantic for the last 3.5 million years.

Mr Benjamin Petrick, Newcastle University

Science Question How do changes in the Agulhas leakage affect climate during transitions between interglacial/glacial conditions? How does the transfer of heat and salinity to the Atlantic ocean change during major climate transitions in the last 3.5 million years?

Methods Organic geochemistry proxies, foraminifera and dinoflagellate assemblages analyses. The UK37' and TEX86 indices used to reconstruct sea surface temperatures. The relative inputs of algal sterols and pigments record productivity changes.

Results Changes in SSTs and productivity are identified that reflect shifts in the position of the Benguela upwelling cells and Agulhas Leakage through time. Diminished Agulhas leakage occurs during the mid-Pliocene warm period; stronger Agulhas leakage develops at ~1 Ma (the MPT).

Examining palaeo productivity in coccolithophores from the Eocene/Oligocene Transition.
Miss Katy Prentice, Imperial College London
Science Question Can we use the Sr/Ca preserved in coccolithophores as a reliable proxy for plaeo productivity? How suitable the coccolith fossils are for Sr/Ca analysis. The suitability of using SIMS analysis for Sr/Ca measuring. What factors can be identified as affecting Sr/Ca from the fossil record?
Methods SIMS (secondary ion mass spectrometry) ICP-AES (Inductively coupled plasma unit atomic emission spectrum) Coccolith species counts (diversity and proportions).
Results There appears to be significant changes in productivity across the E/OT; an increase in the late Eocene, a sharp fall at the E/O boundary, followed by a steady recovery into the Oligocene. Different species show different reactions to Sr/Ca, which is thought to reflect their ecological preferences.

Constraint of ridge-flank hydrothermal systems; a case study of the Juan de Fuca Ridge Flank, eastern Pacific Ocean.
Ms Jennifer Rutter, University of Southampton
Science Question The circulation of seawater through oceanic crust persists for tens of millions of years, and occurs on magnitudes similar to that of the global riverine fluid flux to the ocean. This global hydrothermal fluid flux provides a cooling mechanism for the lithosphere, and resultant water-rock reactions influence the chemical composition of both oceanic crust and seawater. The ocean crust therefore preserves a time-integrated record of hydrothermal processes. However, as yet, many of the fundamental parameters contributing to fluid flow processes remain poorly quantified, limiting the application of observational and modelling experiments in describing the hydrologic properties of the oceanic crust.The aim of my research is to provide a thorough and systematic characterisation of the alteration and oxidation states of the Juan de Fuca basalts, to generate a much-needed backdrop to hydrogeological and geochemical studies of the upper oceanic crust in this region.
Methods Wet chemistry titrations are performed to generate oxidation state (Fe3+/FeT) profiles for all samples. ICP-MS analyses give minor/trace element values, XRF analyses give major element values, loss on ignition analyses are used to measure the volatiles content of powders, and Sr isotopes are measured using a multi-collector ICP-MS. Microscopy work allows identification and quantification of secondary alteration minerals.
Results An in-progress development of a database of the oxidataion and alteration states of the upper oceanic crust at the Juan de Fuca ridge flanks.

Lengthscales of isotopic diversity recorded in Icelandic basalts: Implications for mantle compositional structure.

Mr Oliver Shorttle, University of Cambridge

Science Question The nature of the decoupling between Pb isotopes and Sr and Nd isotopes in the mantle. The lengthscales over which mantle variability exists. How a lithologically heterogeneous mantle influences long wavelength geochemical patterns, and is responsible for melting anomalies along mid-ocean ridges.

Methods Numerical modelling, solution chemistry for ICP-MS trace element analyses and MC-ICP-MS isotope analyses, XRF for major elements, electron probe for microanalytical work on separate crystal phases, field work.

Results The mantle is lithologically heterogeneous: enriched mantle melts in Iceland are derived from a peridotite source that has had basalt added to it. Melting anomalies are primarily a result of mantle potential temperature variations in excess of 100K.

The nature and timing of carbonate precipitation within oceanic basement. Insights from IODP Exp 329.

Dr Christopher Smith-Duque, University of Southampton

Science Question 1) How and why does carbon uptake in oceanic crust vary over time? 2) What can calcium carbonate precipitation in oceanic crust tell us about the timing and evolution of alteration in the upper oceanic crust?

Methods Methods include: Pb-isotope ratios by MC-TIMS, Sr-isotope ratios by TIMS, C and O-isotope ratios (CAPS prep, Geo 20-20), Major, Trace and REE analyses by ICP-MS, Petrographic analyses from polished thin sections.

Results The most important results include an attempt at absolute age dating of carbonate veins, and insights into carbon uptake in oceanic crust.

Climate Evolution during the Middle Miocene.

Dr Sindia Sosdian, Cardiff University

Science Question Is there a role for pCO2 in the Middle Miocene Antarctic cryosphere expansion? Did sea surface temperature cool globally across the middle Miocene climate transition? Can B/Ca in planktonic foraminifer be used as an surface ocean ph proxy?

Methods I utilize elemental ratios in surface dwelling planktonic foraminifera, specifically Mg/Ca and B/Ca, to reconstruct sea surface temperature and surface ocean ph. Also, I use stable isotopes in planktonic foraminifera to reconstruct the oxygen isotopic composition of seawater.

Results Across the Middle Miocene, our Mg/Ca record shows that the surface ocean in the eastern Indian Ocean cooled along with the major step in Antarctic cryosphere expansion. The B/Ca record covaries with ice volume records suggesting that ice sheets were tightly coupled to pCO2 variations.

Tracing past ocean circulation in the deep Indian Ocean: insights from combined carbon and neodymium isotopes.

Dr David Wilson, University of Cambridge

Science Question This study aims to (i) assess glacial-interglacial changes in water mass sourcing to the deep Indian Ocean and their climatic links; and (ii) improve our understanding of how neodymium and carbon isotopes are controlled in the deep ocean and how they may be used together as water mass tracers.

Methods Our approach is based on the analysis of neodymium isotopes and carbon isotopes in authigenic and biogenic phases from ocean sediment cores in the Indian Ocean. We have studied both Holocene coretops and downcore records spanning 0-250 ka before present.

Results We have determined that boundary exchange can influence neodymium isotopes, while productivity affects carbon isotopes. Despite such non-conservative behaviour of both proxies, we demonstrate coupled and climatically-tuned temporal changes, from which the ocean circulation signal may be recovered.

Changes in ocean circulation associated with transient cooling in the European shelf sea during OAE2.

Mr Xinyuan Zheng, University of Oxford

Science Question How ocean circulation changed during a major ocean anoxic event - OAE 2 during the late Cretaceous.

Methods Using Nd isotopes retrieved from fossil fish debris (teeth and bones) collected from a Chalk section at Eastbourne as traces for bottom waters.

Results (1)a change in ocean circulation occurred after the onset of OAE 2 in European shelf sea, and was closely associated with a transient climatic cooling within OAE 2; (2) a possible volcanic signal in Nd isotope record.

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