ABSTRACTS OF ORAL PRESENTATIONS

Abstracts are listed in order of the respective AFI round and project reference number.

Speakers are identified by **bold** typeface in the following Table.

Project	Title	Authors	
AFI7/02	Geophysical reconnaissance of a West Antarctic Subglacial Lake The Lake Ellsworth Project	**Dr Andy Smith[1]**, Dr John Woodward[2], Dr Neil Ross[3], Professor Martin Siegert[3], Mr Hugh Corr[1], Dr Richard Hindmarsh[1], Dr Ed King[1], Professor David Vaughan[1] Dr Matt King[4]	[1] British Antarctic Survey [2] Northumbria University [3] University of Edinburgh, [4] Newcastle University
AFI7/03	The age, structure, origins and evolution of the Antarctic continent: new insights from zircons	Dr Horst Marschall[1] **Professor Chris Hawkesworth[1]** Dr Craig Storey[1] Dr Phil Leat[2]	[1] University of Bristol, [2] British Antarctic Survey
AFI7/05	Microbial diversity in Antarctic soils	**Professor David Hopkins[1]** Dr Paul Dennis[1] Dr Kevin Newsham[2] Ms Victoria Ord[3] Professor Steve Rushton[3] Dr Tony O'Donnell[4]	[1] University of Stirling and Scottish Crop Research Institute [2] British Antarctic Survey [3] University of Newcastle [4] University of Western Australia and University of Newcastle
AFI7/06	Gene function in Antarctic krill: determining the role of clock-genes in synchronized behavioural patterns	**Dr Ted Gaten[1],** Dr Ezio Rosato[1] Dr Geraint Tarling[2] Dr Rachael Shreeve[2] Professor Charalambos Kyriacou[1]	[1] University of Leicester [2] British Antarctic Survey
AFI7/22	Improved tide modelling for the Filchner-Ronne and Larsen C ice shelves through GPS data assimilation	**Dr Matt King[1]** Dr Laurie Padman[2] Dr Keith Nicholls[3] Dr Keith Makinson[3] Professor Peter Clarke[1]	[1] University of Newcastle [2] Earth & Space Research, USA [3] British Antarctic Survey
AFI6/14	Sediment transfer from Antarctica to the deep ocean – New insights into sedimentary processes on the continental slope and rise, from the *Isis* remotely operated vehicle	**Dr Rob Larter[1]** Professor Julian Dowdeswell[2] Professor Gwyn Griffiths[3] Dr Riko Noormets[2] Dr Jeff Evans[2] Dr Colm Ó Cofaigh[4] Dr Kelly Hogan[2]	[1] British Antarctic Survey [2] Scott Polar Research Institute [3] National Oceanography Centre [4] Durham University

Project	Title	Authors	
AFI6/16	Gene flow in Antarctic fishes: the role of oceanography and life history	Professor Gary Carvalho[1] Dr Emma Young[2] Dr Jenny Rock[1] **Dr Mike Meredith[2]** Professor Eugene Murphy[2] Dr Sally Thorpe[2] Dr Bill Hutchinson[3] Dr Mark Belchier[2] Dr Martin Collins[2] Dr Tony North[2] Dr Inigo Everson[2] Professor Paul Rodhouse[2] Dr Lorenz Hauser[4]	[1] University of Wales at Bangor [2] British Antarctic Survey [3] University of Hull [4] University of Washington
AFI6/25	ADELIE Antarctic drifter experiment: links to isobaths and ecosystems	Professor Karen Heywood[1] **Dr Abigail Nye[1]** Dr Sally Thorpe[2] Dr Andrew Thompson[3]	[1] University of East Anglia [2] British Antarctic Survey [3] University of Cambridge
AFI6/28	Ice in a greenhouse world: terminal cretaceous climate change and biotic response in Antarctic	**Professor Jane Francis[1]** Dr Vanessa Thorn[1] Dr Jim Riding[2] Dr Alan Haywood[1] Stephen Hunter [1,3] Professor Rob Raiswell[1] Dr Duncan Pirrie[4] Professor Jim Marshall[5] Dr Alistair Crame[3] Abigail Clifton[1], Rob Lednor[1] Holly Bridgewater[1] Tom Weber[1] Peter Frost[4]	[1] University of Leeds [2] British Geological Survey [3] British Antarctic Survey [4] University of Exeter, [5] University of Liverpool
AFI5/25	Geochronology of the mid-cretaceous palmer land event and accretion of Alexander Island terranes	Dr Craig Storey[1], **Professor Simon Kelley[1]**, Dr Alan Vaughan[2] Dr Ian Millar[3]	[1] Open University [2] British Antarctic Survey 3 NERC Isotope Geoscience Laboratory
AFI5/09	Winter feeding behaviour of Antarctic krill, *Euphausia superba*	**Dr Katrin Schmidt** Dr Angus Atkinson Dr David Pond	British Antarctic Survey
AFI1/05	Ice flow, basal conditions and climate history of the Rutford Ice Stream: the RABID Project	**Dr Andy Smith[1]** Professor Tavi Murray[2] Dr Keith Nicholls[1] Dr Keith Makinson[1] Dr Guðfinna Aðalgeirsdóttir[2] Dr Alessandro Forieri[2] Mr Hugh Corr[1] Dr Brian Barrett[2] Dr Matt King[3] Dr Alberto Behar[4]	[1] British Antarctic Survey [2] Swansea University [3] Newcastle University [4] Jet Propulsion Laboratory, California

Project	Title	Authors	
CGS8/30	Improving habitat preference models with information on the mechanisms of individual flight	**Ewan Wakefield**[1] Dr Richard Phillips[1] Dr Jason Matthiopoulos[2] Dr Philip Trathan[1]	[1] British Antarctic Survey [2] Sea Mammal Research Unit
CGS8/31	Biogeochemistry of the Mars Oasis ecosystem	**Dr Andy Hodson**	University of Sheffield
CGS9/32	Neodymium isotopes in Southern Ocean water masses and deep-water sediments	Dr Derek Vance[1] **Paul Carter**[1] Dr Claus-Dieter Hillenbrand[2] Dr James Smith[2]	[1] University of Bristol [2] British Antarctic Survey
CGS9/33	Biodiversity and evolutionary origin of Antarctic polychaetes	**Dr Adrian Glover**[1] Lenka Nealova[1] Dr Ondine Cornubert[1] Dr Katrin Linse[2]	[1] The Natural History Museum [2] British Antarctic Survey
CGS9/34	Iron availability and effects on phytoplankton communities in contrasting production regimes of the Scotia Sea	**Maria Nielsdottir**[1] Dr Tom Bibby[1] Daria Hinz[1] Dr Mark Moore[1] Mick Whitehouse[2] Dr Rebecca Korb[2] Professor Eric Achterberg[1]	[1] National Oceanography Centre [2] British Antarctic Survey
CGS9/39	Seasonal variations in oceanic carbon dioxide in the Atlantic Southern Ocean	**Elizabeth Jones**[1] Dr Dorothee Bakker[1] Dr Nick Hardman-Mountford[2] Dr Hugh Venables[3] Dr Angus Atkinson[3] Professor Andrew Watson[1]	[1] University of East Anglia. [2] Plymouth Marine Laboratory [3] British Antarctic Survey

GEOPHYSICAL RECONNAISSANCE OF A WEST ANTARCTIC SUBGLACIAL LAKE: THE LAKE ELLSWORTH PROJECT [AFI 7/02]

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Subglacial lakes are of particular interest for any life they contain, for their record of ice sheet history and for their potential impact on ice dynamics. So far, none has been accessed directly, but Subglacial Lake Ellsworth (SLE) has been identified as the most suitable target in West Antarctica where access should proceed. We have completed a geophysical reconnaissance of Subglacial Lake Ellsworth. Here we describe the fieldwork and present the first results.

Seismic, radar and GPS surveys were conducted over SLE between November 2007 and February 2008. The radar surveys mapped the lake outline and the ice thickness in the region, and showed the internal structure within the ice sheet. GPS receivers measured the ice flow over the lake and the surrounding area. The seismic data gave information on the water depth, the ice-water interface and the bed of the lake itself. The aims of the seismic surveys were to determine the lake bathymetry and to give some indication of both the physical conditions within the lake, and the nature and structure of any sediments at the lake floor. Surface accumulation, firn density profile and mean annual temperature were determined from shallow ice cores.

The lake surface covers an area approximately 22.5 km^2. Maximum water depth is more than 150 m, showing that SLE is a substantial body of water, exceeding 2 km^3 in volume. The ice-water interface shows no evidence for freeze-on of basal ice, indicating that the ice is melting at its base over the whole of the lake. Hydrostatic analysis indicates that bridging stresses influence the floatation level over virtually all the lake. In places the ice is supported above its hydrostatic equilibrium level; elsewhere it is depressed below this level.

The lake bed is composed of high-porosity, low-density sediments with acoustic properties very similar to material found on the deep ocean floor. Seismic reflections indicate a substantial thickness of this soft sedimentary material, accumulated at the lake bed in a low-energy environment. These results have implications for subglacial conditions and ice sheet history, as well as significant practical implications for lake access operations, including access location, preparations for break-through and expectations for the bed sedimentary sequence.

THE AGE, STRUCTURE, ORIGINS AND EVOLUTION OF THE ANTARCTIC CONTINENT: NEW INSIGHTS FROM ZIRCONS [AFI7/03]

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The continental crust is unique to the Earth. It was first formed 4400 million years ago, shortly after planetary accretion, and it is still being generated, albeit slowly. Previous isotope and dating studies seem to suggest that continental crust growth in the early Earth was episodic, whereby the `background' of continental growth was punctuated by pulses of accelerated growth, each of which spanned several hundred million years. The striking periodicity lies at the heart of debates on the development of the continental crust. It has been argued that the `background' signal of crustal growth could be due to continuous subduction-zone magmatism, while the episodic peaks in the Earth's early history may be attributed to major thermal pulses associated with the emplacement of mantle `super-plumes'. However, it remains unclear, whether the age distribution observed to date is representative, or whether the peaks are merely artefacts of selective sampling. So far, there are few data on crustal growth ages from Antarctica, which constitutes 9% of the continental crust and contains several areas of very old crust.

This study is to undertake the first major study into the crustal evolution of East Antarctica, as preserved in zircon. Dronning Maud Land (DML) was situated along the axis of a huge Himalaya-type mountain belt in Late Precambrian-Early Palaeozoic times (470 million years ago), known as the Pan-African. This was a major mountain chain, and it formed when East Gondwana (Australia, India and most of East Antarctica) collided with West Gondwana (Africa and South America). The deep roots of this mountain belt are now exposed in East Africa and Antarctica. DML comprises an Archean craton overlain by Mesoproterozoic clastic sediments (1100 Ma old) in the west, and a high-grade metamorphic belt in its central and eastern part. Archean rocks are exposed at one locality (Annandagstoppane), and the overlying sediments are sandstones, greywackes, conglomerates and mudstones intruded by large mafic sills. The metamorphic belt (the Maud Belt) is composed of high-grade gneisses intruded by km-sized magmatic plutons and countless dykes. The Pan-African collision is thought to have reworked rocks that originally formed much earlier (in the Grenvillian). Metamorphism in the Maud belt is therefore related to two mountain building events, the Grenvillian and Pan-African events.

Field work by Dr Horst R. Marschall, accompanied by Sune Tamm-Buckle, was carried out between 01 December 2007 and 05 February 2008. Outcrop conditions were superb, with high walls of vertical outcrop of metamorphic, sedimentary and magmatic sequences. Weathering is restricted to the tops of the nunataks and most outcrops are accessible on foot, after driving to the foot of the nunataks by skidoo. 208 samples were taken and have now been unpacked and catalogued in the UK. This presentation will summarize current views on crustal evolution and the application of accessory phases.

MICROBIAL DIVERSITY IN ANTARCTIC SOILS [AFI 07/05]

David Hopkins[1], Paul Dennis[1], Kevin Newsham[2], Victoria Ord[3], Steve Rushton[3], and Tony O'Donnell[4]

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It is well established that soils harbour a vast range of different microorganisms which contribute to a wide range of ecological and environmental functions, including, for example, the transformations or nutrients, the breakdown of both natural and anthropic organic wastes. However, the vast biological diversity in soils, which can amount, conservatively, to thousands of species per gramme, makes identifying the individual roles of soil microorganisms an intractable problem for most soils. This difficulty makes it difficult to understand or predict how soil organisms respond to changing environmental conditions and therefore to assess whether the ecological functions they perform will be affected by changing conditions. Soils in polar regions may offer an opportunity to more effectively link diversity of the community to ecological functions because of the perceived, or anticipated, lower diversity with increasing latitude. The aim of this project is to improve knowledge of Antarctic microbial diversity and its relationship with ecosystem functioning by:

- Assessing the diversity of the microbial communities using molecular, structural and functional approaches in soils on a latitudinal gradient from 54-74ºS
- Investigating the flow of carbon from isotopically-enriched substrates (plant materials and model compounds) into and through the soil microbial communities at selected sites along the latitudinal gradient and determining whether it differs between soils of differing diversity
- Determining the effect of experimental manipulations of temperature and liquid water content of the soils to simulate expected climate change scenarios on the diversity and functioning of the soil microbial communities at selected sites along the latitudinal gradient
- Developing models for investigating the dynamics of nutrient flow and energy flow in microbial communities in relation to both the environmental and biological conditions.

During the first field season (2007/8), two tasks were completed:

- Field experiments in which soil resource and environmental conditions are being manipulated have been established on Signy Island and at Mars Oasis
- Soil samples were collected from 30 sites along an extended latitudinal gradient of 20º (54 to 74º) from South Georgia through islands and maritime sites along the Antarctic Peninsula and Graham Land to the Ronné Entrance in the Bellingshausen Sea, include several sites which have previously been subject to biological survey.

Results from the field experiment will not be available until after the second field season (2008/9). The presentation in the workshop will provide a summary of the experiments established at Signy and Mars Oasis, but concentrate on the results on the biological and biogeochemical characterization of soils from the latitudinal gradient.

GENE FUNCTION IN ANTARCTIC KRILL: DETERMINING THE ROLE OF CLOCK-GENES IN SYNCHRONIZED BEHAVIOURAL PATTERNS [AFI7/06]

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Behaviour in eukaryotic organisms is profoundly influenced by diurnal and seasonal changes in their environment. The evolution of circadian clocks has allowed these organisms to regulate molecular and physiological rhythms, which in turn affect the animals' rhythmic behaviour. In this project we are investigating two rhythmical behavioural patterns – diel vertical migration (DVM) and the moult cycle – in Antarctic krill (*Euphausia superba*).

Many components of the plankton exhibit DVM, usually rising towards the surface at night and moving to deeper water during the day. In this way the more abundant food resources present nearer to the surface can be exploited at night and visually oriented predators can be avoided by day. The situation in Antarctic krill is more variable, with the amplitude and period of such migrations varying with the developmental stage of the animals and the available food supply.

Fieldwork carried out in the austral summer 2008 included experiments on DVM, carried out in an activity monitor, and the collection of samples for subsequent molecular investigations into the role of clock genes in these rhythmic behaviours.

The results of behavioural experiments show a complex rhythmicity in krill activity, both under an ambient photoperiod and in constant darkness. Analysis of the data using CLEAN and MESA (Fourier-based programs designed to test for periodicity in time series data) reveals the presence of both 24 h and 12 h rhythms in locomotor activity in many of the animals used. It appears from this that the behavioural circadian pacemaker in krill is made up of multiple oscillators with varying periods and differing sensitivities to external cues, such as light, food availability and social interactions.

IMPROVED TIDE MODELLING FOR THE FILCHNER-RONNE AND LARSEN C ICE SHELVES THROUGH GPS DATA ASSIMILATION [AFI 7/22]

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The ocean tides under the Larsen C and Filchner-Ronne Ice Shelves are some of the least well observed on Earth. Data to assimilate into ocean tide models is sparse and the accuracies of the models are likewise difficult to assess. Tide model errors alias into measurements of ice shelf elevation from satellite altimetry and ice mass change estimates from the Gravity Recovery and Climate Experiment (GRACE). To address this shortcoming, three geodetic-quality GPS receivers were deployed on Larsen C Ice Shelf and ten on Filchner-Ronne Ice Shelf during Nov. 2007-Mar. 2008. The units were powered by various combinations of solar, wind and lithium battery technologies. As planned, 7 of these have been left for the austral winter and will be retrieved during 2008/9. As not-quite-planned, but as an additional bonus to our project, two additional receivers were also left for the winter due to logistical constraints. For those sites retrieved, or where data download was possible, three-dimensional coordinate time series have been determined from the raw GPS data. The resulting height time series are dominated by the ocean tides but are contaminated by the effects of atmospheric pressure variations (the "inverse barometer effect"). After correcting for these using local atmospheric pressure data, a harmonic analysis is then be applied to these time series to resolve the individual tidal constituents at each site. The horizontal components of the time series reveal that the flow of both the Larsen C and the FRIS are modulated at semi-diurnal, diurnal and fortnightly signals (and possibly longer). The talk will discuss the field logistics, data analysis and our current attempts to model the vertical and horizontal signals.

SEDIMENT TRANSFER FROM ANTARCTICA TO THE DEEP OCEAN – NEW INSIGHTS INTO SEDIMENTARY PROCESSES ON THE CONTINTNAL SLOPE AND RISE FROM THE *ISIS* REMOTELY OPERATED VEHICLE [AFI6/14]

Rob Larter[1], Julian Dowdeswell[2], Gwyn Griffiths[3], Riko Noormets[2], Jeff Evans[2], Colm Ó Cofaigh[4], and Kelly Hogan[2]

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Marine sediments on the Antarctic continental margin contain a unique record of past ice-sheet extent, sub-glacial processes, erosion of the continent, and environmental changes. However, the understanding of this record is complex in terms of both the process environment in which sediments are deposited and reworked and palaeo-environmental interpretation.

In January and February 2007 the *Isis* remotely operated vehicle (ROV) was used to investigate a range of sedimentary environments on the Antarctic margin at an unprecedented level of detail. Sixteen *Isis* dives were carried out from RRS *James Clark Ross* on Cruise JR157. The dives were targeted to investigate different environments ranging from the head of a fjord to 3500 m water depth on the continental rise. The latter dive was the deepest ever by an ROV around Antarctica. Most of the target sites were selected on the basis of multibeam bathymetry data collected on previous cruises.

Before each dive *Isis* was configured for either high-resolution swath sonar survey or sea-floor sampling. Several video cameras and a digital stills camera were carried in both configurations. For swath sonar surveys a Kongsberg SM2000 echo sounder, which transmits a 200 kHz signal, was mounted on the ROV and was 'flown' 20 m above the sea floor. The resulting swath width was 70 m and the data have enabled us to produce bathymetric images with grid cell sizes smaller the 1 m^2.

In this presentation we will focus on new insights from the *Isis* dives on the continental slope and rise. These include new visual evidence of the presence and effects of bottom currents on sedimentation on the rise, collapse of the flank of a large sediment drift as a result of erosion by a turbidite channel, and confirmation of the presence of abundant coarse sediment on the continental slope. The latter observation is consistent with models that suggest sediment deposition on the slope occurs mainly in the form of glacigenic debris flows at times when ice is grounded to the continental shelf edge during glacial periods.

GENE FLOW IN ANTARCTIC FISHES: THE ROLE OF OCEANOGRAPHY AND LIFE HISTORY [AFI6/16]

Gary Carvalho[1], Emma Young[2], Jenny Rock[1], Mike Meredith[2], Eugene Murphy[2], Sally Thorpe[2], Bill Hutchinson[3], Mark Belchier[2], Martin Collins[2], Tony North[2], Inigo Everson[2], Paul Rodhouse[2], and Lorenz Hauser[4]

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Marine organisms with pelagic larvae are generally assumed to experience high gene flow and low levels of population differentiation. However, variability in life histories and environmental characteristics can significantly influence dispersal, and their relative effects are often unclear. This AFI project has been examining the influence of oceanography and life history variations on gene flow in two species of Antarctic fish, namely *Champsocephalus gunnari* and *Notothenia rossii*. These species are broadly sympatric in their distribution, but differ in aspects of life history with possible strong impacts on dispersal capabilities. We have been employing two oceanographic models for this study: a low-resolution global model for predictions of larval transport on circumpolar and basin scales, and a high-resolution regional model to investigate finer-scale cross-shelf transport and retention around South Georgia. To compare predictions from the oceanographic models with patterns of population differentiation at both circumpolar and regional scales, we have been using mtDNA and microsatellite markers to examine historic and contemporary gene flow. We will present data from the oceanographic models in combination with genetic analyses, including evidence for inter-specific variation in mitochondrial gene flow at the circumpolar level.

ADELIE – ANTARCTIC DRIFTER EXPERIMENT: LINKS TO ISOBATHS AND ECOSYSTEMS [AFI6/25]

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An array of 40 surface drifters, drogued at 15m depth, were deployed in February 2007 to the east of the tip of the Antarctic Peninsula as part of the Antarctic Drifter Experiment: Links to Isobaths and Ecosystems (ADELIE) project. The trajectories of these drifters, the first Lagrangian instruments deployed east of the Peninsula, have provided the most detailed observations to date of the surface circulation in the northwestern Weddell Sea. Observations from the ADELIE drifters provide important information about how the circulation near the tip of the Antarctic Peninsula regulates the export of deep waters to the global ocean and impacts biological dynamics in the Southern Ocean through Antarctic krill transport and natural iron fertilization.

In particular, current work investigating a standing eddy feature located along the South Scotia ridge, north-east of the Antarctic Peninsula and just south of Clarence Is., is described. The anticyclonic eddy, centred about 61.8°S, 54°W with a diameter of ~45km, is a sustained feature in ADELIE surface drifter data available in the area throughout the period March–April 2007, as well as in previous drifter data and iceberg trajectories ranging over more than a decade. The eddy is positioned over a region of raised bathymetry, with depths varying between ~650m at its edge and ~300m at its centre. ADELIE drifter SST measurements indicate an approximately 1°C decrease in potential temperature at the eddy centre relative to values outside the eddy. A signature of the eddy is also detected in SST and ocean colour satellite images for that period and previous years, with the eddy centre consistently associated with lower temperature and Chlorophyll-a values than those in surrounding regions over summer months. The eddy is described in terms of its structure and potential biological impact.

Hydrographic data from the ADELIE project reveal the frontal structure and transport along a section across the continental shelf and slope in the northwestern Weddell Sea. The flow is dominated by three barotropic northward flowing currents: the Antarctic Coastal Current, the Antarctic Slope Front and the Weddell Front. The strongest baroclinic flows are confined to the region between the Slope Front and the Weddell Front over the steepest part of the continental slope. Over 16 years the densest water, found within the ribbon of Weddell Sea Bottom Water hugging the continental slope of the Weddell Sea, has cooled by about 0.1 degrees Celsius and freshened by about 0.04. Nonetheless the water masses remain on the same mixing line indicating that the same formation processes are likely to be at work.

ICE IN A GREENHOUSE WORLD: TERMINAL CRETACEOUS CLIMATE CHANGE AND BIOTIC RESPONSE IN ANTARCTIC [AFI6/28]

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Although the Cretaceous is classically known as a greenhouse period of globally warm climates, data from oxygen isotopes and the sedimentary record have been interpreted as evidence of ice sheets, particularly during the latest Cretaceous (Maastrichtian), ~70-65 million years ago.

The highest latitude (~65°palaeoS) and most extensive sequence of Maastrichtian strata is preserved in the Antarctic Peninsula region, mostly on Seymour Island. This project uses many palaeoclimate proxies to see whether ice sheets were present on Antarctica at that time.

The sedimentary sequence on Seymour Island consists of over 1200m of bioturbated muddy siltstones that filled the James Ross Basin, representing relatively quiet depositional conditions on a shallow marine shelf. There are no obvious tillites or direct sedimentary evidence of glaciers, apart from some possible glacially-etched quartz grains. The pollen record from terrestrial vegetation shows that forests of podocarp and araucarian conifers grew on adjacent land, with ferns and mosses as ground cover. The vegetation indicates temperate climates that were fairly stable over time.

In the marine record there is, however, evidence of dramatic changes in sea level. Glauconite-rich horizons indicate intervals of sea level rise and extensive periods of non-deposition, associated with rich accumulations of marine fossils and palynomorphs. Sea level variations are also reflected in the change from near-shore to offshore dinocyst floras (marine algae). Clay minerals suggest that warming climates were associated with sea level rises. Preliminary oxygen isotope data suggest cool marine waters at times but not extensive glaciation. Climate simulations for the Maastrichtian indicate that ice could have been present on East Antarctica; with atmospheric CO_2 levels 2 x pre-industrial level an East Antarctic ice sheet could have existed that was equivalent in size to the present Greenland ice sheet (~7m sea level change).

In summary, the geological evidence points to changes in sea level that may have been caused by climate change (waxing and waning of ice sheets?) but there is no direct evidence of glaciation in the James Ross Basin. It is possible that small ice sheets were able to survive on East Antarctica.

GEOCHRONOLOGY OF THE MID-CRETACEOUS PALMER LAND EVENT AND ACCRETION OF ALEXANDER ISLAND TERRANES [AFI5/25]

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Alexander Island consists of a series of domains, including a Mesozoic subduction-accretion complex known as the LeMay Group which accreted from East to West, overlain unconformably by an Upper Jurassic to Lower Cretaceous forearc basin, known as the Fossil Bluff Group. In this study we have dated directly the age of shear zones within the accreted terranes, and dated both detrital white micas and zircons.

In-situ IR laser Ar-Ar spot ages from shear zone samples give a best age of deformation of c.125 Ma, which is somewhat older than the c.107-105 Ma deformation and associated plutons documented on the mainland of the Antarctic Peninsula along the East Palmer Land Shear Zone. Further evidence of the complex interplay of deformations and sedimentation comes from detrital Ar-Ar white mica ages, and detrital zircon U-Pb ages. Sediments in the hanging wall (i.e. the prism) have a maximum age of c.220 Ma. However, sediments within the footwall (i.e. sediments overlying the accreted oceanic crust) have a maximum age of c.125 Ma and the micas and zircons yield age spectra much more reminiscent of sediments found further west on Charcot Island and indeed within foreland basin sediments of the Fossil Bluff Group to the east. These younger sediments have undergone at least one period of folding, which must therefore be younger than c.125 Ma deformation and may correlate with events on the mainland.

On the mainland, the Palmer Land Event is the Antarctic Peninsula expression of a major tectonothermal episode that affected the whole Pacific margin in the mid-Cretaceous, contemporaneous with emplacement of large igneous provinces in the Pacific basin. In the Antarctic Peninsula, two phase of deformation, an initial north-south compressional phase, followed by oblique dextral transpression along a southwest trend, coincided with emplacement of the Lassiter Coast Intrusive Suite. The most intense shortening related deformation was focused along the Eastern Palmer Land Shear Zone, although thrusting and uplift are recorded across the width of the arc. New data from a transfer structure to the Eastern Palmer Land Shear Zone, the Beaumont Glacier shear zone, shows that a previously undated pluton of the Lassiter Coast Intrusive Suite was emplaced 113 million years ago and then deformed by sinistral transpressional shearing at 104 million years ago, with kinematics consistent with the earlier phase of the Palmer Land Event. This provides new supporting evidence for a two phase Palmer land event and places even tighter temporal control on the time of transition to dextral transpression.

These new data confirm that the LeMay Group consists of at least two separate sedimentary successions of different age and imply repeated accretionary events along the long-lived Gondwana margin. The detrital age spectra are non-unique and do not require that the sediments were deposited in exotic loci. However, the lack of a 125 Ma deformation even in the main part of the Antarctic Penninsula east of Alexander Island provides support for models of terrane accretion, i.e. arrival of Alexander Island from elsewhere on the Gondwana margin, and docking of it to the main part of the AP at 107 Ma. Further work is planned to address this issue.

WINTER FEEDING BEHAVIOUR OF ANTARCTIC KRILL, *EUPHAUSIA SUPERBA* [AFI5/09]

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The dark season is considered a time of special hardship for Antarctic krill as their major food source, pelagic algae, is in short supply. Most previous studies tend to suggested that adult krill spend this time in a passive mode (no food uptake, reduced metabolic rates, usage of storage lipids, shrinkage in body size) and that the changing day length triggers their behaviour. However, some field-collected krill have shown full stomachs even in winter and authors pointed to the importance of ice biota, copepods or seabed detritus as alternative food sources. Active versus passive over-wintering will necessarily affect the population development via a number of factors, e.g. continuously feeding krill might be able to invest more into reproduction than krill that accumulate body reserves or are recovering from starvation.

We addressed this debate by analysing winter krill from three different regions: Lazarev Sea (60-69°S, 8 Stations, June-Aug. 2006), South Georgia (53-54°S, 5 Stations, July/Aug. 2005 and 5 Stations, July/Aug. 2006) and Bransfield Strait (62-63°S, 8 Stations, June/July 2006). The krill were either caught from ~150m water depth by a commercial fisheries trawl (South Georgia, Bransfield Strait) or directly under the ice with a custom build trawl (Lazarev Sea). About 30 krill from each station were scored for their stomach fullness, 10 pooled krill were analysed for lipid content and fatty acids composition, and the stomach contents of 2-3 krill were examined under the microscope. In addition, a database of krill length-frequencies was used to test for growth or shrinkage during winter.

Krill from the Lazarev Sea were lipid-rich and most individuals had an empty stomach. However, a few krill had recently fed on algae, protozoa and copepods. Overall, low proportions of diatom-indicating fatty acids in their tissues suggest that ice algae had not been ingested in significant quantities. South Georgia krill contained less lipid, but ~50% of the stomachs were at least half-full, with some being completely full. The ingested food was a mixture of lithogenic sediment, various diatom species, protozoa and copepods. High proportions of diatom- and flagellate-indicating fatty acids [16:4(n-1); 20:5(n-3); 18:4(n-3)] in their tissue confirmed on-going feeding activities. Krill from the Bransfield Strait showed a third combination of characteristics: their lipid content was as high as in krill from the Lazarev Sea, while their feeding activity and fatty acid composition resembled that of krill from South Georgia.

In conclusion, adult krill use a range of over-wintering strategies for ice-covered as well as ice-free habitats. Feeding activities can be high even in winter and seem to depend not alone on light levels but also on the availability of suitable food. Our results draw attention to the importance of seafloor material as an alternative food source for krill. In high productive areas, such as South Georgia and the Bransfield Strait, krill seem to frequently feed on the seafloor. The benefit is sustained growth year-round.

ICE FLOW, BASAL CONDITIONS AND CLIMATE HISTORY OF RUTFORD ICE STREAM, THE RABID PROJECT [AFI1/05]

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The RABID Project was designed to determine the glacial history, flow dynamics and basal conditions of a West Antarctic ice stream. Rutford Ice Stream is over 2 km thick and the central component of the project was to access the bed using a large hot-water drill. This would allow core samples to be retrieved from the bed and ice, and arrays of instruments to be deployed within the basal sediment and the boreholes. Activities on the ice surface were to include seismic, radar and GPS surveys.

Drilling operations ran very smoothly, but unfortunately, within metres (literally) of reaching the bed, a hose failure occurred from which we were unable to recover. This was a serious blow to the project. Access to the ice stream bed was the project's main focus, around which the other activities were tailored. However, these other project components continued and were very successful in their own right. Analysis of these is now almost completed and here we summarise the main results.

Ice flow
New ice stream flow mechanisms were identified from the GPS results, at both longer and shorter periods than were known previously. The first successful over-winter measurements of ice stream flow showed seasonal variations in speed, driven by long-period ocean tidal forcing at the ice stream grounding line. GPS data combined with passive seismic detection of microearthquakes at the ice stream bed showed a correlation between surface speed and basal friction, and also a short-period (~3 hourly) flow perturbation resulting from complex ice flexure at the grounding line.

Basal conditions
The seismic reflection and radar data gave new insights into subglacial conditions and temporal variability. These include: the formation of a new drumlin at the ice stream bed (the first time these glacial bedforms have been observed actually forming beneath a modern glacier); exceptionally rapid subglacial erosion (~1 m/a); and the spatial and temporal characteristics of the hydrological system beneath the ice, both at the basal interface and within the bed material, particularly in relation to the different ice flow mechanisms.

Climate history
The temperature profile in the upper part of the ice column indicates a sequence of cooling, then warming climate in this region over the past 200 years.

IMPROVING HABITAT PREFERENCE MODELS WITH INFORMATION ON THE MECHANISMS OF INDIVIDUAL FLIGHT [CGS8/30]

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Over the past twenty years satellite telemetry has provided unprecedented information on the areas visited by albatrosses during foraging trips. Such information can be combined with environmental data, often collected by remote sensing, in order to build models of habitat preference. However, an implicit assumption of these models is that the amount of time spent in a habitat is directly proportional to a bird's preference for that habitat. This assumption may or may not be valid for albatrosses. For example, birds may spend more time at a particular location simply because there is insufficient wind to fly; because they are involved in preening or social behaviour or because of a behavioural response to diurnal changes. We aim to improve habitat preference models by classifying behaviour according to metrics of movement and activity, which in turn will allow us to identify preferred foraging habitats. Such information will be of great utility to conservationists working to reduce fisheries bycatch, which is currently posing a critical threat to almost all species of albatross. Key behaviour types we hope to distinguish between are commuting versus foraging flight. The former is thought to be typified by fast direct and uninterrupted flight, while the latter, sometimes referred to as Area Restricted Search, is thought to be slower, more sinus, with frequent takeoffs and landings. With this aim in mind we report on data collection during the 2008 field season at Bird Island, South Georgia. In order to track the movements of birds at sea we equipped 49 breeding black-browed albatrosses *Thalassarche melanophrys* prior to foraging trips with high and low temporal resolution GPS loggers. Birds were also equipped with miniature wet/dry loggers, allowing us to identify when and where they landed and took off and in some cases accelerometers, which record different modes of flight. In addition, seven birds were equipped with stomach temperature loggers, data from which show unequivocally when and therefore where birds ingested prey. Here we present some initial results from this work and outline how we intend to analyse these data further.

BIOGEOCHEMISTRY OF THE MARS OASIS ECOSYSTEM [CGS8/31]

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Rapid regional warming has led BAS researchers to develop a metagenomic data resource to characterise the various stages of ecosystem response to change. This project aims to enhance the utility of resource by developing a complementary biogeochemical data set that will enable a more comprehensive interpretation of how Antarctic microbial communities respond to changes in their environment. Particular attention is being given to organic and inorganic biogeochemistry along flowpaths that are activated by melt, since changes along them document the impact of biogeochemical processes as soon as water becomes available to living microorganisms. For this reason, a field programme was undertaken in December 2007 with the following objectives:

1) ***Quantify the physico-chemical conditions along the hydrologic flowpaths*** where microorganisms thrive following the onset of melt ***in the Mars Oasis ecosystem***.

2) ***Compare the biogeochemistry*** of the Mars Oasis ecosystem ***to the adjacent Ares Oasis,*** the nearby ***Khufu Corrie at Fossil Bluff*** and ***Signy Island***, the latter data already having been collected.

3) ***Define the biogeochemistry of Antarctic Peninsula runoff*** from a wide range of geological, ecological and geomorphological settings.

This talk will focus upon the first two objectives. Preliminary results will be presented that depict a significant range of chemical conditions along flowpaths at Mars and Ares Oases. The changes are due to a combination of inorganic and microbially-mediated reactions, many of which involve secondary minerals produced by evaporation, and also a major chemical divide caused when flowpaths leave the Oasis and enter moraines produced by the ice shelf system. It will be shown that these factors combine to produce a compelling case for examining the biogeochemistry of sulphur, not least because it might be intricately linked to the presence/absence of the ice shelf itself.

NEODYMIUM ISOTOPES IN SOUTHERN OCEAN WATER MASSES AND DEEP-WATER SEDIMENTS [CGS9/32]

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The Pacific Sector of the Southern Ocean is a key region in the global thermohaline circulation, with significant areas of deep water formation and circumpolar flow. The characteristics of Neodymium (Nd), a radio-isotope water mass tracer, are poorly understood in the Southern Ocean, with relatively little data existing for most of the major southern sourced water masses [1, 2]. The goal of this AFI project is to characterise Circumpolar Deep Water (CDW), as well as any other water masses sampled, and to better understand the contribution of these to the global circulation, in particular to the application of Nd isotopes in the study of the meridional overturning circulation.

The BAS cruise JR179 (James Clark Ross), in 2008, allowed sampling of water masses along the Antarctic Peninsular, the Polar Front and in the Bellinghausen and Admundsen Seas, including Pine Island Bay. A total of 55 4L water samples from 6 depth profiles were collected on JR179, and one 10 sample depth profile on JR141, 2006. Filtered samples were spiked (to determine concentrations), dissolved trace elements were extracted by Fe co-precipitation, REE separated by Cation exchange, and Nd separated by LN Spec Resin. Nd Isotopic Composition (IC) expressed as ε_{Nd} (ε_{Nd}= $[(^{143}Nd/^{144}Nd)_{sample}/(^{143}Nd/^{144}Nd)_{chur} -1]*10000$) and Nd concentrations were measured on a Thermo-Finnigan Neptune MC-ICPMS, at the Department of Earth Sciences, University of Bristol.

Dissolved Nd concentrations and isotopic compositions for all 7 water column profiles will be presented. Based on the locations of the samples, CTD and other preliminary data, the expectation is that we will be able to determine the following: the Nd IC and concentration of the Antarctic Circumpolar Current in the Pacific sector, and therefore the Nd contribution of the Pacific as it enters the Drake passage; the Nd IC of the Westerly flowing counter current, if present, at positions along the Western edge of the peninsular; the characteristics of CDW on, along and off the continental shelf; and the conservative nature of Nd in the Southern Ocean. Initial results, from the JR141 depth profile from Pine Island Bay, show a significant difference in Nd IC between CDW (ε_{Nd}= 7.81 ± 0.18) and surface water masses (ε_{Nd}= 5.34 ± 0.14), with Nd concentrations of 30.51 and 21.97 pmol/kg respectively. This underlines the potential of Nd isotopes as water mass tracer in the Southern Ocean.

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BIODIVERSITY AND EVOLUTIONARY ORIGIN OF ANTARCTIC POLYCHAETES [CGS9/33]

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The BIOPEARL II sampling program in the southern Bellingshausen and Amundsen Seas offered an outstanding opportunity for polychaete collections complementing previous expeditions undertaken to the northern part of the West Antarctic Peninsula. Whilst the fauna collected using trawl nets is historically, the best studied, new species and records were expected, and to date there have been few studies which have combined live photography, morphology and DNA studies. We were the first British research ship to enter Pine Island Bay, and the first vessel to take benthic samples there. Two deep-sea sampling methods were employed – Agassiz Trawls, which recover larger organisms, and epibenthic sledges which recover smaller epi and infauna. From the Aggasiz trawls, a diverse polychaete assemblage was recovered represented by 17 families and at least 39 different species. From the epibenthic sledges, very high abundances of between 1000-5000 individuals per sample were recorded, and species identifications are currently underway. Pine Island Bay, sited approximately half-way between the better-studied Ross Seas and West Antarctic Peninsula region will provide a crucial biogeographic 'missing-link'. Furthermore, our samples will allow us to test hypotheses regarding the potential for local extinctions on the Antarctic shelf during the last glacial maxima.

IRON AVAILABILITY AND EFFECTS ON PHYTOPLANKTON COMMUNITIES IN CONTRASTING PRODUCTION REGIMES OF THE SCOTIA SEA [CGS9/34]

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Large regions of the Southern Ocean are characterised as High Nutrient Low Chlorophyll (HNLC) waters owing to a combination of insufficient deep water iron supply (relative to N and P) and a lack of aeolian supply of Iron (Fe). This condition limits photosynthesis and primary production. Fe limitation in Southern Ocean HNLC waters has been demonstrated by Fe-addition bioassays and, more recently, *in situ* Fe-fertilisation experiments. Within the Southern Ocean there are naturally occurring hot sports of high primary production that are hypothesised to be naturally enriched with Fe. Such phytoplankton blooms are associated with island chain formations such as South Georgia, Crozet and Kerguelen. The bloom around South Georgia is one of the biggest blooms in the open ocean and supports significant higher tropic levels of the food web. This study represents the first seasonal measurements, from the Discovery 2010 programme in austral spring 2006 and summer 2008, of iron concentrations around the South Georgia plateau. The results demonstrate iron limitation of primary production to the south of South Georgia and iron fertilisation to the north of South Georgia. The results imply that the South Georgia plateau is a source of iron which sustains a phytoplankton bloom well into the austral summer.

SEASONAL VARIATIONS IN OCEANIC CARBON DIOXIDE IN THE ATLANTIC SOUTHERN OCEAN [CGS9/39]

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The global oceans act as a buffer for the anthropogenic carbon dioxide (CO_2) released into the atmosphere. The Atlantic sector of the Southern Ocean between the Falkland Islands, the Antarctic Peninsula and South Georgia is thought to be a net CO_2 sink region. However, sparse shipboard measurements have made it difficult to accurately quantify the magnitude and degree of temporal variability of CO_2 uptake in this region. A CASIX (Centre of Observation of Air-Sea Interactions and Fluxes) autonomous underway pCO_2 (partial pressure of CO_2) instrument was installed on the British Antarctic Survey research ship *RRS James Clark Ross* in 2006 and has since collected pCO_2 data from 13 cruises in this region. When combined with satellite observations the data show that distinct seasonal variations in the surface water pCO_2 can be attributed to phytoplankton blooms, frontal dynamics and the presence of sea ice. Vertical profiles of alkalinity and dissolved inorganic carbon from discrete seawater samples provide additional information on the factors that effect the distribution of carbon in the upper ocean. Thus, shipboard and satellite data help to unravel the processes that drive the carbon cycle in this region of the Southern Ocean.