### PP31A-07 0930h

## A Coral Perspective on Holocene Climate Variability in the Western Pacific Warm Pool

Terrence M. Quinn[1] (727-553-1658; quinn@marine.usf.edu); Frederick W. Taylor[2] (512-471-0453; fred@utig.ig.utexas.edu); R. Lawrence Edwards[3] (612-626-0207; edwar001@umn.edu); George Burr[4] (520-621-8411; burr@physics.arizona.edu); Hai Cheng[3] (612-626-0207; cheng021@umn.edu); Yue-Gau Chen[5] (886-2-2369-7648; ygchen@ccms.ntu.edu.tw)

[1]College of Marine Science, University of South Florida, 140 Seventh Avenue South, MSL 119, St. Petersburg, FL 33701, United States

[2]Institute for Geophysics, The John A. and Katherine G. Jackson School of Geosciences, The Univ. of Texas at Austin, 4412 Spicewood Springs Rd., Austin, TX 78759-8500, United States

[3]Department of Geology and Geophysics, University of Minnesota, 310 Pillsbury Drive Southeast, Minneapolis, MN 55455, United States

[4]NSF Accelerator Facility, Department of Physics, University of Arizona, 1118 E. 4th Street, PO Box 210081, Tucson, AZ 85721, United States

[5]Dept. of Geosciences, National Taiwan University, No.1, Sec. 4, Roosevelt Road, Tapei 106, Taiwan

The Western Pacific Warm Pool (WPWP) serves as a heat engine for Earth's climate and as a major moisture source for its hydrological cycle. Studies of the instrumental record document that variations in the thermal and hydrologic properties of the WPWP have global ocean and atmospheric ramifications. Coral-based climate records have been exploited in other regions of the tropical oceans, yet such records are rare from the WPWP despite the fact that proxy climate records from the WPWP are recognized as among the most critical targets for future paleoclimate research. We have begun to address this recognized need by generating monthly resolved proxy records of thermal and hydrologic variability in the WPWP via paired determinations of $\delta^{18}$O and Sr/Ca in fossil corals from Tetepare, Western Solomon Islands (8° 43' S; 157° 33' E). Thirty-three of the 54 fossil coral cores that were drilled and recovered have been dated by AMS $^{14}$C and by TIMS U-series techniques, and these corals range in age from 250 to 12,000 years old. Post-depositional alteration of our Holocene coral samples is judged to be minimal based on mineralogic (XRD), petrographic (SEM) and geochemical criteria (preservation of modern marine initial $\delta^{234}$U values). We have initially chosen to generate short time series (∼4-5 years) of monthly $\delta^{18}$O and Sr/Ca variations from eight of the fossil corals and one nearby modern coral, although some of the cores contain well over 100 annual density bands. Annual cyclicity is observed in both $\delta^{18}$O and Sr/Ca in all of the time series generated to this point. Coral $\delta^{18}$O data show a general decrease in values through the Holocene from more enriched values of ∼-4.65$^{o}/_{oo}$ at ∼10 Ka to a value of ∼-5.25$^{o}/_{oo}$ in the modern coral. Coral Sr/Ca data indicate ∼2°C cooler SST w/r to modern values at 10,254±35 yr BP and ∼1°C warmer SST w/r to modern values at 3336±18 yr BP. The suite of fossil coral samples from Tetepare will ultimately yield multidecadal to centennial length proxy climate time series having subannual resolution that will be used to 1) determine how changes in the mean climate state of the tropics in the WPWP influence the nature of tropical climate variability on interannual to centennial timescales during the Holocene; and 2) define the timing and magnitude of abrupt transitions and extremes in Holocene climate in the WPWP and determine how these abrupt changes in the tropics are related to previously defined intervals of abrupt change in the extra-tropics.

### PP31A-08 0945h

## Arctic/North Atlantic Oscillation impact on sea-surface temperature trends during the Holocene: alkenone thermometry, instrumental data and coupled atmosphere-ocean climate simulations

Jung-Hyun Kim[1] (+49 421 218 8929; jungkim@allgeo.uni-bremen.de)

Stephan J. Lorenz[2] (+49 40 41173 102; lorenz@dkrz.de)

Norel Rimbu[1] (+49 421 218 7185; nrim@geo.palmod.uni-bremen.de)

Gerrit Lohmann[1] (+49-421-218-2835; gerrit@palmod.uni-bremen)

Ralph R. Schneider[3] (r.schneider@epoc.u-bordeaux1.fr)

[1]University Bremen, FB5 Geowissenschaften, Klagenfurterstrasse, Bremen 28359, Germany

[2]Max-Planck-Institute for Meteorology, Model and data group, Bundesstrasse 55, Bremen 20146, Germany

[3]Université de Bordeaux I, Département de Géologie et Océanographie, Talence Cedex 33405, France

To better assess anthropogenic impact on post-industrial climate, it is essential to reconstruct reliable surface temperature distribution patterns in a long-term perspective. Here we show a global spatial pattern of long-term sea-surface temperature (SST) trends over the last 7,000 years solely based on alkenone-derived SST records and coupled atmosphere-ocean transient climate simulations. Our modelling strategy uses a technique for transient simulations with a state-of-the-art general circulation model, where we accelerate the very slow time scale of the Earth's orbital parameters to enable simulations of the whole Holocene. Reconstructed alkenone SST records in the North Atlantic realm show that a continuous SST decrease in the Northeast Atlantic over the last 7,000 years was accompanied by a persistent warming over the western subtropical Atlantic, the eastern Mediterranean Sea, and the northern Red Sea. Our transient ensemble simulations over the last 7,000 years show similar spatial distribution pattern. Based on the analysis of the instrumental data and of model experiments, we show that SSTs during the Holocene can be attributed to a continuous weakening of a Northern Hemisphere atmospheric circulation pattern similar to that of the Arctic/North Atlantic Oscillation (AO/NAO) at present. This implies that the AO/NAO plays not only an important role for short-term climate changes for the present but also for long-term climate trends during the Holocene.

---

# PP31B MCC: Level 1 Wednesday 0830h

## Southern Ocean Climatic Evolution: The Marine Geologic Record I

**Posters** *(joint with OS, C, GC)*

***Presiding:*** **D A Warnke,** California State University**; N Exon,** Geoscience Australia**; G M Filippelli,** Indiana University-Purdue University Indianapolis

### PP31B-0250 0830h POSTER

## Integrated Study of Ice-Rafted Debris, Temperaturess, and Stable Isotopes on a Spliced Record (piston cores and ODP Site 177-1090) From the South Atlantic

Detlef A Warnke[1] (1-510-885-4716; dwarnke@csuhayward.edu); Lora Teitler[1] (lteitler@csuhayward.edu); Sabine Becquey[2] (sbecquey@awi-bremerhaven.de); Rainer Gersonde[2] (rgersonde@awi-bremerhaven.de); Kathryn Venz[3] (venz@ufl.edu); David A Hodell[3] (dhodell@geology.ufl.edu)

[1]California State University, Hayward, 25800 Carlos Bee Blvd., Hayward, CA 94542

[2]A.W.I., Columbusstrasse, Bremerhaven 27515, Germany

[3]University of Florida, 241 Williamson Hall, Gainesville, FL 32611, United States

We have conducted an integrated study of ice-rafted debris (IRD) and stable isotopes on a spliced record (TN057-6-PC4/ODP Site 177-1090, about 43° S, 9° E) raised on the Agulhas Ridge, in the South Atlantic. The site is just north of the northern boundary of the present-day Polar-Front Zone (PFZ), and is in a very sensitive location to record both ice-rafting and stable-isotopic-ratio changes. Our combined record reveals a pattern of ice-rafting episodes that may be characteristic for the subantarctic South Atlantic, at least for locations N of the PFZ. Ice rafting occurs during the waxing stages of each glaciation, and ends at, or before, the peak of each glaciation. IRD peaks are also associated with strong stadials during "cold" interglacials, e.g. MIS 7. A little IRD shows up during the entire interval studied here, from the Holocene to mid-MIS 14. We suggest that the IRD record at this site is essentially a temperature record on glacial-interglacial timescales. If the temperature is low enough, enough icebergs survive to melt at this location. If the temperature is too warm, only an occasional iceberg survives to deliver debris. A peculiar aspect of the combined record is the fact that during Ice-rafting events (IREs), the planktic oxygen-isotopic ratios are higher at the end of an IRE compared to the beginning. Further, by comparing our records with the Summer Sea Surface Temperature record of Becquey and Gersonde (2002) for a nearby (respectedly the same) site (PS2489-2/ODP177-1090), we see that the temperature is generally very similar at the beginning and the end of an IRE. The same age model provided by Venz and Hodell (2002) was used for both sites, allowing such direct comparisons of the data. Assuming as a working hypothesis that the IRD record is a pure temperature record, and ignoring the salinity effect for the present, then this difference in oxygen-isotopic ratios must be the ice volume effect. For MIS 12, the difference in planktic oxygen-isotopic ratios at the beginning and the end of the IRE is about 1.3 permil, which translates to 130 m sea level equivalent. The present-day temperature at the site is about 10° C (Levitus and Boyer, 1998). To attain a temperature of about 4° C (presently located at about 47° S in this area), as indicated by the SSST record of Becquey and Gersonde (2002) for the IRE during MIS 12, the Polar Front Zone (the zone of major iceberg melting) had to move north by about 4° latitude (about 240 nautical miles), a not unreasonable assumption.

### PP31B-0251 0830h POSTER

## Support From the Southern Ocean and Equatorial Pacific for the Glacial Shelf-Nutrient Hypothesis

Gabriel M. Filippelli[1] (317-274-3795; gfilippe@iupui.edu)

Jennifer Latimer[1]

Richard W. Murray[2]

[1]Dept. of Geology, IUPUI, 723 W. Michigan St., Indianapolis, IN 46202-5132, United States

[2]Dept. of Earth Science, Boston University, Boston, MA 02215

The impact of sea level variations on marginal sedimentation and hence biogeochemical sinks has long been recognized, but few quantitative data exists on the oceanic response of the biolimiting nutrient phosphorus (P) to changing depositional sinks. A greater understanding of the sinks and geochemistry of P in marine sediments, together with multi-proxy analyses of a variety of P-related records from the deep sea, indicates that the redistribution of this nutrient from marginal to deep sea sinks during glacial lowstands has had an important impact on the oceanic P cycle. We compared records of P/Ti ratios (an "excess" P proxy) and P accumulation rates from the Southern Ocean (ODP Site 1089) and the eastern equatorial Pacific. The P/Ti records for these widely spaced sites show a remarkable degree of similarity over the last 400 kyr. The P/Ti ratios at both sites exhibit peaks with a 100 kyr periodicity, and a phasing of broad peaks that begins during glacial intervals, reaching maxima just after the glacial-interglacial transition, then decreasing to low values by the beginning of the next glacial interval. These records indicate relatively high "excess" P export occurring about 40-60 kyr after the onset of glacial intervals. P accumulation rates from these sites reveal sharp peaks 40-60 kyr after glacial onset, followed by a slow decline, with some abbreviated peaks, over the ensuing 60-80 kyr. These two semi-independent proxies provide a picture of a potentially globally-coherent signal in the deep ocean marine P mass balance, with increased P export to the deep ocean from shelf weathering and lack of shelf depositional area during glacials. The delay in P accumulation in the deep ocean is due to the slower response time of P (residence time of 10-20 kyr). Given higher recycling of P in the deep sea sink, this redistribution from shelf to deep sea may have resulted in higher oceanic dissolved phosphate concentrations and increased oceanic productivity, especially soon after glacial onset.

### PP31B-0252 0830h POSTER

## The end of the Early Eocene Climatic Optimum: Evidence for Concomitant Cooling of Southern Ocean Surface Waters and Global Deep Waters From Dinoflagellate Endemism.

Henk Brinkhuis[1] (31302537691; H.Brinkhuis@bio.uu.nl)

Jeroen Warnaar[1] (31302532638; J.Warnaar@bio.uu.nl)

Matthew Huber[2] (mhuber@purdue.edu)

James C. Zachos[3] (jzachos@es.ucsc.edu)

[1]Laboratory of Palaeobotany and Palynology, Utrecht University, Budapestlaan 4, Utrecht 3584 CD, Netherlands

[2]Earth Atmospheric Science, Purdue University, 1397 Civil Engineering Bldg., Lafayette, IN 47807-1397, United States

[3]Department of Earth Sciences, University of California at Santa Cruz, 1156 High Street, Santa Cruz, CA 95064, United States

ODP Leg 189 drilling around Tasmania retrieved quasi-continuous Eocene records from the Southern Ocean - Antarctic Margin. The shallow marine, prodeltaic successions of Sites 1170, 1171 and 1172 include the interval representing the onset (~55 Ma) and termination (~50 Ma) of the Early Eocene Climatic Optimum (EECO). The end of the EECO is globally reflected in the oceans by the onset of increasingly cooler deep-water temperatures, and marks the onset of the trend towards the Icehouse world. Here we show that a strong increase of endemic Antarctic dinoflagellates precisely matches the termination of the EECO in the Southern (Pacific) Ocean. The record of these surface-dwelling organisms thus indicates that changes of surface water parameters, notably temperature, occurred near simultaneously with global deep-water temperature changes. Comparison of the field data with predictions from fully coupled climate model simulations, and a new basic understanding of Eocene Southern Ocean circulation, suggests that changes in atmospheric greenhouse gasses may have been driving the apparently coupled surface- and deep-water signals.

## PP31B-0253 0830h POSTER

### *Eucampia antarctica* Abundance Stratigraphy in the Southern Ocean

David de Give[1,2] (degived@rice.edu); Kristin Anderson[1,3] (kristin.anderson@yale.edu); Christina Hew[1,4] (christih@andrew.cmu.edu); Brenton E Anderson[1,5] (Brenton.Anderson@sunysb.edu); Lloyd H Burckle[1] (burckle@ldeo.columbia.edu); Robert F Anderson[1] (845-365-8508; boba@ldeo.columbia.edu)

[1]Lamont-Doherty Earth Observatory, P.O. Box 1000, Palisades, NY 10964, United States

[2]Rice University - Lovett College, 6310 Main Street, Houston, TX 77005, United States

[3]Yale University, P.O. Box 200153, New Haven, CT 06520, United States

[4]Carnegie Mellon University - SMC 3296, 5032 Forbes Avenue, Pittsburgh, PA 15213, United States

[5]State University of New York, North Loop Rd., Stony Brook, NY 11790, United States

*Eucampia Antarctica* (diatom) relative abundance stratigraphy is a useful biostratigraphic tool for identifying and correlating late Quaternary glacial/interglacial sequences in Southern Ocean sediments, especially for those regions where $^{14}C$ dating and $\delta^{18}O$ stratigraphy are not available. Understanding the nature of the variability of *E. Antarctica* abundances greatly improves its reliability as a biostratigraphic tool. Hence, a spatial analysis of *E. Antarctica* abundance and $^{230}Th$-normalized *E. Antarctica* flux is conducted using data from several Atlantic and Pacific sites. An *E. Antarctica* stratigraphy is presented for several cores in the Pacific sector and compared to magnetic susceptibility records. Last Glacial Maximum (LGM) depths are determined from this stratigraphy and shown to be well correlated across the Pacific sector. Variations are noted in percent *E. Antarctica* within each sector of the Southern Ocean at different latitudes and between the Atlantic and Pacific sectors where data available from existing studies are merged. Average values of absolute *E. Antarctica* flux during the Holocene and LGM, computed using $^{230}Th$-normalized opal fluxes and percent *E. Antarctica*, are compared at several sites in the Atlantic and Pacific sectors of the Southern Ocean. This analysis demonstrates a comparatively small variation in absolute numbers of *E. Antarctica* in the Pacific sector between the LGM and Holocene at all sites studied but a noticeable increase in the Atlantic sector just north of the Antarctic Polar Front (APF) during the LGM implying that it is not only the relative abundance of *E. Antarctica* that increases during glacial periods in certain regions but also its absolute abundance.

## PP31B-0254 0830h POSTER

### *Eucampia antarctica* (Diatom) Stratigraphy Allows Correlation of Millennial-Scale Events in the Southern Ocean

Brenton E Anderson[1,2] (Brenton.Anderson@sunysb.edu)

Lloyd H Burckle[1] (burckle@ldeo.columbia.edu)

Robert F Anderson[1] (845-365-8508; boba@ldeo.columbia.edu)

[1]Lamont-Doherty Earth Observatory, P.O. Box 1000, Palisades, NY 10964, United States

[2]State University of New York, North Loop Rd., Stony Brook, NY 11790, United States

Whether or not the Antarctic ice sheet experienced instabilities during the Last Glacial Maximum (LGM), similar to those that characterized periods of abrupt climate change in the North Atlantic, remains unresolved due to the difficulty in establishing reliable high-resolution chronologies for Southern Ocean sediments. We developed a stratigraphy, based on relative abundance of *Eucampia Antarctica* to provide a signal that is correlative throughout many areas of the Southern Ocean. Three high-resolution records (two in the Atlantic and one in the Pacific sector) have been developed in which *E. Antarctica* stratigraphy and the Vostok deuterium record are well correlated at near-millennial resolution over the past 80 ka. Magnetic susceptibility (MS) was measured in three cores as a proxy for ice-rafted debris (IRD). When the *E. Antarctica* stratigraphies in two cores in relatively close proximity (RC13-271 and TN057-14; 52°S, 4.5°E) were aligned, the MS records show nearly identical patterns, indicating that our approach detects correlated IRD events under circumstances where such a correlation would be expected. *E. Antarctica* and MS records in RC11-78, nearly 800 km to the west of these two cores, were then used to test our ability to detect correlated IRD events over broader spatial scales. After aligning the stratigraphies of the cores based on *E. Antarctica* abundance, we found that the MS peaks in RC11-78 are generally well correlated with those in the other cores with the exception of two thick volcanic ash layers in RC13-271 and TN057-14 that may reflect local deposition. *Eucampia Antarctica* stratigraphy offers excellent promise for correlating events in Southern Ocean sediments.

## PP31B-0255 0830h POSTER

### A Benthic Foraminiferal Assessment of Holocene Oceanographic Change: Northern Antarctic Peninsula Margin

Phillip B. Szymcek[1] (618-351-8051; pszymcek@hotmail.com)

Scott E Ishman[1] (618-453-7377; sishman@geo.siu.edu)

Eugene W. Domack[2] (315-859-4711; edomack@hamilton.edu)

Amy Leventer[3] (315-228-7213; aleventer@mail.colgate.edu)

[1]Southern Illinois University, Department of Geology, Carbondale, IL 62901-4324, United States

[2]Hamilton College, Department of Geology, Clinton, NY 13323, United States

[3]Colgate University, Department of Geology, Hamilton, NY 13346, United States

A 20.53 meter sediment sequence of Holocene glaciomarine sediments was recovered in core NBP0003-JPC38 from the Vega Drift, northern Antarctic Peninsula. Samples were collected every 4 cm from JPC38 for foraminiferal analyses to determine Holocene paleoceanographic and paleoclimatic variability of the northern Antarctic Peninsula margin. The foraminiferal data were analyzed using principle component and cluster analyses. Results of these analyses show significant stratigraphic changes in the benthic foraminiferal record of the Vega Drift. Transfer function analysis of the foraminiferal data from JPC38, using modern foraminiferal biofacies of the Antarctic Peninsula margin, indicate significant Holocene oceanographic changes. Two dominant assemblages characterize the core, the *Textularia weisneri* assemblage and the *Stainforthia fusiformis* assemblage. The bottom-most section of the core, 16.0 meters to base, is dominated by the calcareous *S. fusiformis* assemblage that also occurs in several abrupt intervals within the upper 16 meters of the core. This assemblage is characterized by abundant calcareous forms including *Globocassidulina biora, G. subglobosa, Nonionella iridea* and the planktonic species *Neogloboquadrina pachyderma.* The *S. fusiformis* assemblage has greatest affinities to modern assemblages found in the higher productivity areas of the Larsen Ice Shelf and western Antarctic Peninsula. The top 16.00 meters (~7000 yrs. BP to recent) of the core is dominated by agglutinated forms, and defined by the *Textularia weisneri* assemblage. The unaltered *T. weisneri* assemblage is similar to modern assemblages directly to the south of the Vega Drift in the Prince Gustav Channel. Most agglutinated forms tend to decrease downcore, and comparisons to modern analogues imply post-depositional disintegration. The altered assemblage is dominated by *Miliammina arenacea*, which resists taphonomic dissolution. Interpretation of the results from the foraminiferal analyses provides important paleoceanographic information related to the depositional architecture of the Vega Drift as interpreted from its sediment thickness, distribution and internal structures.

## PP31B-0256 0830h POSTER

### Depositional Architecture and Seafloor Mapping of the Vega Drift, Erebus and Terror Gulf, Antarctic Peninsula

Emily Backman[1] (ebackman@hamilton.edu)

Eugene Domack[1] (edomack@hamilton.edu)

[1]Hamilton College, Department of Geology, Clinton, NY 13323, United States

High resolution sediment archives on the Antarctic continental shelf are providing detailed paleoenvironmental records with unprecedented resolution (for example the Palmer Deep). Yet we are only beginning to discover the true extent and nature of these sediment deposits. Geophysical data collected in 2000, on the Nathaniel B. Palmer (NBP) in the northern Prince Gustav Channel, discovered the presence of the Vega Drift. The drift was originally believed to be restricted to the northern Prince Gustav Channel, however additional swath bathymetric data gathered on the NBP 01-07 cruise in the Erebus and Terror Gulf revealed that the Vega Drift extends much farther that once believed, with an estimated area of approximately 6,140 km2, making the Vega Drift is the largest sediment drift on the Antarctic continental shelf. Drifts are areas where thick sequences of sediment have been deposited by deep-water bottom currents, which result from thermohaline and tidal circulation. High resolution acoustic Chirp profiles allowed us to develop a detailed isopach of the deposit that revealed four distinct centers of drift accretion and surfaces of active sediment erosion. This shows that the Vega Drift is a channel-related drift with the depositional centers located just outside the channels on basement highs while a more broad sediment apron tapers off into the Erebus and Terror Gulf. It is the confinement and then deceleration of currents in both the Prince Gustav Channel and the Antarctic Sound (as they enter the Erebus and Terror Gulf) that provides the focus for deposition across a relict glacially sculpted surface. Complementing the subsurface view of the drift are bottom video surveys that reveal distinct contrasts in sediment transport and erosion across the drift surface, consistent with the deposit's complex architecture. Drift accretion began in the early Holocene, perhaps Late Pleistocene as revealed by jumbo piston cores in excess of 23 m in length. Sedimentation was marked by several episodes of laminated diatom ooze and siliciclastic mud deposition. Diatom ooze laminations are unique within the Vega Drift, in regards to their species composition when compared to other drift accumulations. Radiocarbon dating of in situ molluscs provides a temporal framework along with preservation of key laminations of volcanic ash. The dynamic sediment history preserved within the drift deposits along with the preservation of a diverse foraminifera assemblage makes the Vega Drift an attractive target for paleoenvironmental study, as planned for the first SHALLDRILL initiative.

## PP31B-0257 0830h POSTER

### Changes in Deep Ocean Circulation During Times of High Climate Variability from Nd Isotopes in South Atlantic Cores

Alexander M Piotrowski[1] (arcturus@ldeo.columbia.edu)

Steven L Goldstein[1] (steveg@ldeo.columbia.edu)

Sidney R Hemming[1] (sidney@ldeo.columbia.edu)

David R Zylberberg[1,2] (dzop@dartmouth.edu)

[1]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964, United States

[2]Dartmouth College, Dept. of Earth Sciences, Hanover, NH 03755, United States

The transition between marine isotope stages (MIS) 5a and 4 appears in the stacked benthic foraminferal d18O SPECMAP record as a gradual increase in ice volume. In contrast, the transition occurs in the Greenland ice core d18O records with two well-developed interstadial events (I19 and I20), which are the first Dansgaard-Oescheger events of the last ice age. The MIS 5b/5a transition appears as a much more rapid warming in both the Greenland ice and benthic d18O records. Recent work (Lehmann et al. 2002, Chapman et al. 1999) indicates that climate variability in MIS 5 as indicated in the Greenland ice record was closely interconnected with iceberg discharges, surface temperature changes, and deep ocean circulation in the North Atlantic. In order to determine the response of deep ocean circulation to climate changes from late in MIS 5 to full glacial MIS 4, we have measured Nd isotope ratios from the Fe-Mn portion of core TNO57-21 from the Cape Basin in the South Atlantic. Nd isotopes, unlike nutrient water mass proxies, are not affected by biological fractionation, and reflect the strength of the North Atlantic Deep Water (NADW) signal in the seawater above the core site. Results from cores TNO57-21 and RC11-83 (also from the Cape Basin) indicate

that the NADW export to the Southern Ocean has varied on time scales reflecting glacial-interglacial cycles through MIS 4 (Rutberg et al. 2000) and during interstadial events through MIS 3 (Piotrowski et al., Fall AGU), and was stronger and weaker during warmer and colder Northern Hemisphere climate intervals, respectively. The extension of the Nd isotope record to MIS 5a and 5b indicates an increased NADW signal during MIS 5, therefore the long-term pattern of strong and weak NADW export during warm and cold periods persists beyond the last ice age. The Nd isotope pattern during MIS 4 through 5b generally corresponds to the benthic foraminferal d13C record from Cape Basin cores (Ninnemann et al. 1999), indicating that the pattern of the carbon isotope record also generally reflects ocean circulation changes. Over the transition to the last ice age (MIS 5a to 4) the NADW signal rapidly decreases toward LGM levels, and displays a smaller decrease between the MIS 5b and 5a peaks. However, during MIS 4 the NADW signal is stronger than during the LGM, and during the MIS 5a and 5b peaks it is weaker than during the Holocene. There is a larger degree of millennial-scale variability in THC intensity during MIS 5a than MIS 4, a pattern that is also observed in MIS 3 and 2, respectively (Piotrowski et al. Fall AGU). The sharp decrease in NADW intensity over the MIS 5a/4 transition appears to correspond to the end of interstadial 19 at  70 ka, in contrast with the gradual increase in ice volume, which approached its maximum at that time. This may indicate that the system reached a threshold that forced a rapid change to a different ocean circulation mode.

## PP31B-0258 0830h POSTER

### Late Cretaceous to Oligocene Geological History of the East Tasman Plateau, a Key Piece of the Tasmanian Gateway Story

Neville F Exon (+61 6249 9347; Neville.Exon@ga.gov.au)

Geoscience Australia, GPO Box 378, Canberra, ACT 2601, Australia

A fairly complete Maastrichtian to Holocene marine sequence 776 m thick was drilled at ODP Site 1172 on the East Tasman Plateau. The ETP is a continental fragment that rifted from the adjacent parts of Gondwana (Tasmania, South Tasman Rise and Lord Howe Rise) in the Late Cretaceous and became part of the southwest margin of the proto-Pacific. However, rapid subsidence started only in the late Eocene. The ETP lies just east of the Tasmanian Gateway that formed as Australia and Antarctica separated in the Paleogene, so Site 1172 was ideally located to monitor the effects of its opening. Slow detrital sedimentation (averaging 1.3 cm/ka) persisted until the latest Eocene in this area east of the subsiding land bridge' (Tasmania and the South Tasman Rise) connecting Australia and Antarctica. When the South Tasman Rise separated from Antarctica at the Eocene-Oligocene boundary (33.5 Ma), the Tasmanian Gateway opened, currents first connected the Indian and Pacific Oceans, and pelagic carbonate sedimentation commenced. At Site 1172, dinocysts, spores and pollen dominate the Maastrichtian through middle Eocene microfossil assemblages, diatoms become abundant in the middle Eocene, and calcareous nannofossils and planktonic foraminifers dominate the Oligocene. The sequences provide evidence of a complex interplay of tectonics, paleoceanography including the onset of the Antarctic Circumpolar Current, and Antarctic cooling and glaciation. The ETP moved northward with Australia, from 65$^{o}$S in the Late Cretaceous to 60$^{o}$S in the early Oligocene. At Site 1172, during the Maastrichtian and Paleocene (70-55 Ma) shallow marine mudstone was deposited in reducing conditions, while the onshore climate was humid and seasonally cool and supported a conifer forest. Much of the Paleocene is missing. Cool oceanic conditions characterised the Eocene (dinocysts represent the Transantarctic Flora'). The early and middle Eocene (55-37 Ma) was marked by slow subsidence, a thick sequence of shallow marine mudstone deposited in increasingly open shelf conditions, and a uniformly wet and cool onshore climate with angiosperms. There was faster subsidence in the late Eocene (37-33.5 Ma), marine shelf mudstone gave way to glauconitic bathyal siltstone as the land bridge between the Indian and Pacific Oceans subsided and strong currents caused condensed sedimentation, and the climate cooled. When the Tasmanian Gateway finally opened at the Eocene-Oligocene boundary, strong currents led to a brief hiatus. Rapid Oligocene subsidence allowed deposition of bathyal chalk and the onset of Antarctic glaciation led to cooling.

## PP31B-0259 0830h POSTER

### Deep Ocean Circulation Changes During the Transition to the Last Ice Age

David R Zylberberg[1,2] (dzop@dartmouth.edu)

Alexander M Piotrowski[1] (arcturus@ldeo.columbia.edu)

Steven L Goldstein[1] (steveg@ldeo.columbia.edu)

Sidney R Hemming[1] (sidney@ldeo.columbia.edu)

[1]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY 10964, United States

[2]Dartmouth College, Dept. of Earth Sciences, Hanover, NH 03755, United States

The transition between marine isotope stages (MIS) 5a and 4 appears in the stacked benthic foraminferal $\delta^{18}$O SPECMAP record as a gradual increase in ice volume. In contrast, the transition occurs in the Greenland ice core $\delta^{18}$O records with two well-developed interstadial events (I19 and I20), which are the first Dansgaard-Oescheger events of the last ice age. The MIS 5b/5a transition appears as a much more rapid warming in both the Greenland ice and benthic $\delta^{18}$O records. Recent work (Lehmann et al. 2002, Chapman et al. 1999) indicates that climate variability in MIS 5 as indicated in the Greenland ice record was closely interconnected with iceberg discharges, surface temperature changes, and deep ocean circulation in the North Atlantic. In order to determine the response of deep ocean circulation to climate changes from late in MIS 5 to full glacial MIS 4, we have measured Nd isotope ratios from the Fe-Mn portion of core TNO57-21 from the Cape Basin in the South Atlantic. Nd isotopes, unlike nutrient water mass proxies, are not affected by biological fractionation, and reflect the strength of the North Atlantic Deep Water (NADW) signal in the seawater above the core site. Results from cores TNO57-21 and RC11-83 (also from the Cape Basin) indicate that the NADW export to the Southern Ocean has varied on time scales reflecting glacial-interglacial cycles through MIS 4 (Rutberg et al. 2000) and during interstadial events through MIS 3 (Piotrowski et al. Fall AGU), and was stronger and weaker during warmer and colder Northern Hemisphere climate intervals, respectively. The extension of the Nd isotope record to MIS 5a and 5b indicates an increased NADW signal during MIS 5, therefore the long-term pattern of strong and weak NADW export during warm and cold periods persists beyond the last ice age. The Nd isotope pattern during MIS 4 through 5b generally corresponds to the benthic foraminferal $\delta^{13}$C record from Cape Basin cores (Ninnemann et al. 1999), indicating that the pattern of the carbon isotope record also generally reflects ocean circulation changes. Over the transition to the last ice age (MIS 5a to 4) the NADW signal rapidly decreases toward LGM levels, and displays a smaller decrease between the MIS 5b and 5a peaks. However, during MIS 4 the NADW signal is stronger than during the LGM, and during the MIS 5a and 5b peaks it is weaker than during the Holocene. There is a larger degree of millennial-scale variability in THC intensity during MIS 5a than MIS 4, a pattern that is also observed in MIS 3 and 2, respectively (Piotrowski et al. Fall AGU). The sharp decrease in NADW intensity over the MIS 5a/4 transition appears to correspond to the end of interstadial 19 at $\sim$70 ka, in contrast with the gradual increase in ice volume, which approached its maximum at that time. This may indicate that the system reached a threshold that forced a rapid change to a different ocean circulation mode.

## PP31B-0260 0830h POSTER

### Ice rafting and oceanographic changes in the southern Indian Ocean during the Oi-1 transition

Steven M. Bohaty[1] (sbohaty@es.ucsc.edu)

James C. Zachos[1] (jzachos@es.ucsc.edu)

Margaret L. Delaney[2] (delaney@ucsc.edu)

[1]Earth Sciences Department/ Institute of Marine Sciences, University of California, Santa Cruz, Santa Cruz, CA 95064, United States

[2]Ocean Sciences Department/ Institute of Marine Sciences, University of California, Santa Cruz, Santa Cruz, CA 95064, United States

The early Oligocene Oi-1 event marks the development of the first large ice sheets on Antarctica during the Cenozoic. We have investigated this interval through high-resolution study of the stable isotope and minor element chemistry of planktonic foraminifera and the stratigraphic distribution of ice-rafted debris at ODP Sites 738 and 748 (southern Kerguelen Plateau). At both Sites 738 and 748, a major pulse of ice rafting occurs within the positive $\delta^{18}$O shift during the Oi-1 transition interval at $\sim$33.6 Ma. This correlation suggests a maximum production of debris-laden icebergs in the Prydz Bay region during the initial stages of ice-sheet expansion in East Antarctica. These results are consistent with ice-sheet models in which the Gamburtsev Mountains serve as one of the nucleation points for ice-sheet development, with the Gamburtsev ice margin reaching sea level in the Lambert Graben well before smaller ice sheets coalesced and maximum ice volume was attained. The paucity of ice-rafted debris during the peak of the Oi-1 event may indicate a period of ice-sheet stabilization at maximum ice volume and, possibly, a change in the character of glaciation to cold-based conditions, with a decrease in rates of ice calving and/or a decrease in the sediment load of icebergs exiting Prydz Bay. Mg/Ca data from the surface-dweller *Chiloguembelina cubensis* indicate no significant change in surface-water temperatures across the Oi-1 transition. Previous Mg/Ca results from benthic foraminifera have similarly suggested no change in Southern Ocean deep-water temperatures (Lear et al., 2000). If no temperature change in surface or deep waters is assumed at Site 748, a damping of the $\delta^{18}$O signal in *C. cubensis*, relative to the 1.2$^{o}/_{oo}$ increase recorded in *Subbotina angiporoides* and *Cibicidoides* spp., can be interpreted as a negative surface $\delta^{18}O_{SW}$ anomaly. This anomaly is greatest during the interval of intense ice rafting, providing support for a local decrease in surface-water salinity. A freshening of surface waters may have resulted in a more stratified water column during the Oi-1 interval. This physical change in water-column structure may have contributed to the success of siliceous plankton and led to the observed increase in opal accumulation during the Oi-1 event.

## PP31B-0261 0830h POSTER

### High resolution correlations between South Indian Ocean cores and Antarctic EPICA ice record

Alain Mazaud[1] (33 1 69 82 35 27; mazaud@lsce.cnrs-gif.fr)

Catherine Kissel[1] (33 1 69 82 43 28; kissel@lsce.cnrs-gif.fr)

Carlo Laj[1] (33 1 69 82 35 38; laj@lsce.cnrs-gif.fr)

Barbara Delmonte[2,3] (33 476 824244; bdelmonte@nest.it)

Jean Robert Petit[2] (33 476 824244; petit@lgge.obs.ujf-grenoble.fr)

[1]Laboratoire des Sciences du Climat et de l'Environnement, CEA-CNRS, Domaine du CNRS, Avenue de la Terrasse, Gif-sur-Yvette 91198, France

[2]Laboratoire de Glaciologie et Géophysique de l'Environnement, BP96, St Martin d'Hères 38402, France

[3]University Milano Bicocca, Milano, Dipartimento di Scienze dell'Ambiante e del Territorio, Piazza della scienze, Milano 20126, Italy

New high resolution records of bulk magnetic parameters (ARM, IRM, and low field susceptibility) of cores taken in the South Indian Ocean, northeast of the Kerguelen plateau document a coherent signature during the last glacial epoch and the previous interglacial, with marked variations at a millennial scale. We interpret this signal as tracing past changes in the deep-sea currents which erode the Kerguelen plateau and transport material to the studied sites. These profiles can be precisely correlated with the dust record obtained from Vostok and Epica (Petit et al., 1999, Delmonte et al, submitted). This suggests coherence at the millennial scale between eolian activity which transports dust to east Antarctica site and marine current activity in the southwestern sector of the Indian ocean. With this correlation, the Laschamp geomagnetic event recorded in the MD94-103 marine core is recorded below the position of the 10Be peak (Yiou et al., 1985) deduced from correlation with Vostok and EPICA ice core (Schwander et al., 2001). Two different causes may explain this difference. It may indicate that the climatic variations recorded in the ice around 41 kyr B.P. lead those recorded in the sedimentary cores by 500 to 750 years. Alternatively, it may indicate a non-zero lock-in depth, of about 10-15 cm, for the Natural Remanent Magnetization (NRM) signal recorded in core MD94-103. This second hypothesis would imply that the age model of core MD94-103, which was deduced from a geomagnetic correlation to Napis-75 in the 30-50 kyr B.P. interval (Mazaud et al., 2002), has to be shifted towards older ages by approximately 500 to 750 years. Implications of both scenarios on phasing with climatic records from the North hemisphere will be also discussed.

## PP31B-0262 0830h POSTER

### Formation of Bedrock Plateaus Within the Ross Sea Embayment, Antarctica, by Marine Erosion in Late Tertiary Time

Bruce P Luyendyk[1] (luyendyk@geol.ucsb.edu)

Douglas S Wilson[2] (dwilson@geol.ucsb.edu)

Christopher C Sorlien[1] (chris@crustal.ucsb.edu)

[1]Institute for Crustal Studies, University of California, Santa Barbara, Cal 93106, United States

[2]Marine Science Institute, University of California, Santa Barbara, Cal 93106, United States

Ice penetrating radar (mostly airborne) and marine seismic surveys have revealed plateaus and terraces beneath parts of the Ross Embayment including the West

Antarctic ice sheet, the Ross Ice Shelf, and the eastern Ross Sea. These surfaces cover many thousands of square kilometers and are separated by bedrock troughs cut by the West Antarctic ice streams. Elevations of the plateaus vary from about 100-250 m below sea level (bsl) near the Edward VII Peninsula in the eastern Ross Sea to about 350 m bsl along the Siple Coast. Airborne geophysical surveys over a 350 by 450 kilometer area of western Marie Byrd Land (MBL) mapped one of the largest plateaus, a 300 km by 100 km level surface at about 250 meters bsl at the boundary between the Ross Embayment and MBL. We interpret these surfaces as remnants of a continental shelf formed by wave erosion when the coastal regions of Antarctica were relatively free of ice. The generally flat and level nature of the surfaces that are near the same depth over large distances supports an interpretation of an origin by marine rather than glacial erosion. Marine seismic reflection profiles over one of the plateau remnants in the Eastern Ross Sea west of Edward VII Peninsula show thin, flat-lying glacial marine sediments draped with angular unconformity over gently dipping RSS2 sediments of Early Miocene age. Combining this age constraint with ice sheet and global sea level histories suggests that the shallower plateaus were last eroded in the early Middle Miocene, about 15 Ma, prior to formation of the modern West Antarctic ice sheet, and when sea level was at least 30-50 m higher. The plateau surfaces might be correlated to Ross Sea unconformities including RSU5 and RSU4. One possible explanation of the present depths consistent with forming the plateaus near Miocene sea level is that a model for removal of extremely thick early Holocene ice, such as ICE-3G is approximately correct, and current bedrock depths are at least 200 m below isostatic equilibrium. Free Air gravity anomalies of about -30 milligals in the region are consistent with it being depressed below isostatic equilibrium by at least this amount. The plateaus along the Siple Coast, with depths around 350 m bsl, do not rebound to close to either present or Miocene sea level for simple models of removing the current and Holocene ice load. Another part of the explanation may be that the lithosphere was heated and at higher elevation in Oligocene time due to substantial extension or intense mantle plume activity. Subsequent cooling has caused a moderate amount of crustal subsidence since then so that rebound alone does not return the surfaces to sea level or above.

### PP31B-0263 0830h POSTER

## Environmental magnetism of late Cenozoic sediments from the East Antarctic continental rise (Site 1165, Prydz Bay)

Carl Richter[1] (337-482-5353; richter@louisiana.edu)

Detlef Warnke[2] (dwarnke@csuhayward.edu)

Fabio Florindo[3] (florindo@ingv.it)

[1]Department of Geology University of Louisiana at Lafayette, PO Box 44530, Lafayette, LA 70504, United States

[2]California State University, 25800 Carlos Bee Boulevard, Hayward, CA 94542, United States

[3]Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605, Rome 00143, Italy

The objective of this study is to advance our understanding of the late Cenozoic environmental history of East Antarctica as part of a multiparameter interdisciplinary project. We analyzed a set of 500 samples taken at 10 k.y. resolution from the Plio-Pleistocene section at Ocean Drilling Program Site 1165. The site is located on Wild Drift, a thick contourite deposit on the continental rise off Prydz Bay, East Antarctica. The data set provides a 5 m.y.-old record of environmental change and ice-sheet history with the opportunity to link the histories of the Antarctic Ice sheet and the distal ocean-current and climate systems. As part of this project we investigated the sources of magnetic remanence and magnetic susceptibility variations by characterizing rock magnetic properties. Variations in grain size, mineralogy, and concentration of magnetic grains reflect pre- and post depositional environmental changes, yielding clues to fluctuations in climate, source material, and depositional environments. From the beginning of the record at about 5 Ma throughout the early Pliocene the concentration of magnetic material varies very little, while the magnetic mineralogy and the magnetic grain size (S-ratio, and ARM/k and ARM/IRM ratios) shows various large and small scale cycles. A remarkable change occurs at 34 mbsf in the lowermost, normal interval of the Gauss Chron, at about 3.4 Ma(?), where the magnetic grain size increases dramatically. This significant change is expressed in non-magnetic measurements as well, and may coincide with the beginning of ice rafting in the South Atlantic during MIS MG2, just above an interval without any IRD (Murphy et al., 2002). Another significant change in the magnetic properties occurs at 30-28.5 mbsf (around 3.3 Ma) where the magnetic concentrations drop to very low values and the magnetic properties are carried by a high-coercivity component. These changes may reflect climate variations or changes in the location of the source area within the Lambert-Graben drainage area.

### PP31B-0264 0830h POSTER

## Sedimentation Processes Along the Continental Margin of the Western Bellingshausen Sea, West Antarctica

Karsten Gohl[2] (kgohl@awi-bremerhaven.de)

Carsten Scheuer[1] (0049-471-4831-1234; cscheuer@awi-bremerhaven.de)

[1]Carsten Scheuer, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven 27568, Germany

[2]Karsten Gohl, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven 27568, Germany

Since the beginning of glaciation of West Antarctica, changes of glacial and interglacial periods affect the sediment supply across the shelf and onto the deep sea. Along the slope and rise of the continental margin of the Antarctic Peninsula, Cenozoic sediments were deposited which development was influenced by ice sheet fluctuation and mass transport processes. Thus, both the sediment stratigraphy and the physiography of the sea floor reflect the history of the West Antarctic ice sheet as well as processes that transport, erode and deposit sediment along the outer shelf, slope and rise of the continental margin. We present interpretations of multichannel seismic reflection data produced along and across the sparsely investigated continental rise of the western Bellingshausen Sea. This new seismic line links previously data sets of the eastern Bellingshausen Sea and the Amundsen Sea and contributes to a better understanding of the glacial-marine sedimentation processes along the West Antarctic margin. We could identify three sedimentary units, named Unit 1, 2 and 3. The lowermost Unit 3 is characterised as "Low-deposition Stage", representing the pre-glaciation stage. Unit 2 seems to reflects the onset of the glaciation on the continental shelf and can be termed as "Transition Stage". The uppermost Unit 1 is made of terrigenous sediment material transported by shelf ice across the shelf edge. The correlation with a profile orientated perpendicular to the slope shows that the boundary between the units 2 and 1 coincides with the base of a sediment wedge that consists of strong prograding shelf sequences, a strong evidence for shelf ice deposits. Thus, the boundary between units 2 and 1 indicates the advance of shelf ice up to the shelf edge, where transported sediment material was deposited. The onset of this advance along the margin of Antarctic Peninsula occurred approximately in the mid to late Miocene (about 5-8 Ma). However, an exact dating of the onset along this margin is difficult due to the far distance to the closest ODP Drill Sites 1095 and 1096.

### PP31B-0265 0830h POSTER

## Searching for Last Glacial Deep-Sea Polar Carbonates in the Ross Sea Continental slope and Their Relevance to Chronological Constraints

Antonio Brambati[1] (39 040 5582056; brambati@units.it)

Rosalba Bonaccorsi[1] (39 040 5582069; bonaccor@units.it)

Tullio Quaia[1] (39 040 5582048; quaiatu@units.it)

Martina Busetti[2] (+39-040-2140254; mbusetti@ogs.trieste.it)

[1]University of Trieste - Dipartimento di Scienze Geologiche, Ambientali e Marine (DiSGAM), Via Weisss, 2, Trieste 34127, Italy

[2]Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Borgo Grotta Gigante 42/c Sgonico, Trieste 34010, Italy

Abstract Ice-proximal glacial marine sediments from the Antarctic continental margin retain ice rafting events as proxy record for change in the volume and extension of the Antarctic ice sheet throughout glacial-interglacial cycles. However, the sedimentary sequences from the Ross Sea continental margin remain relatively poorly understood and most research has been focused mainly on continental shelf sequences during the last past decades. We present a data set (i.e., X-ray lithology, Multi Sensor Core Logger physical data, and preservation of biogenic carbonates), obtained from six deep-sea cores (1991-1999 Italian Antarctic Research Programme, PNRA - Summer cruises). Specifically, the cores were collected from a) the central Eastern sector (i.e., Core ANTA95-89C, depth: 2056 m, length: 401 cm and Core ANTA99-c22, depth: 2650 m, length: 851 cm); b) the central Western sector (i.e., Core ANTA99-c23; water depth: 2158 m, length: 548 cm; and ANTA99-c24, water depth: 2750 m, length: 811 cm); and c) the North Western sector (i.e., Core ANTA91-08C, and ANTA91-02C) of the Ross Sea Continental slope. Well-preserved calcareous foraminifers (N. pachyderma, sx) in coarse-grained IRD materials sparsely occur and/or are concentrated in discrete layers (i.e., up to 22 cm-thick) of at least three cores (i.e., Cores ANTA91-08, ANTA91-02, and ANTA95-89C, e.g., at 217-238 cm-depth). Some carbonate layers were deposited during a period of time bracketing Stage3/Stage2. In Core 89C foraminifers are associated to multiple ice rafting episodes and likely occurred with oceanographic changes in the properties of slope water masses. The search of well-preserved, in situ-deposited, polar carbonates is demanded for a reliable C-14 AMS dating of late Pleistocene events in the Ross Sea.

### PP31B-0266 0830h POSTER

## Sub-Ice Shelf Stratigraphy as Documented From Beneath the Larsen B Ice Shelf, Antarctica

Diana M. Duran[1] (205-246-3346; duran006@bama.ua.edu)

Eugene Domack[1] (315-859-4711; edomack@hamilton.edu)

Katherine McMullen[1] (kmcmulle@hamilton.edu)

Amy Leventer[2] (aleventer@mail.colgate.edu)

[1]Hamilton College, Department of Geology 198 College Hill Road, Clinton, NY 13323, United States

[2]Colgate University, Department of Geology 13 Oak Drive, Hamilton, NY 13346, United States

The final disintegration of the Larsen B Ice shelf (March 2002) was a significant event in the history of glaciology. During NBP01-07, the Larsen B Ice shelf area was surveyed as a continuation of a multi-year investigation of the sediment processes and paleohistory of the Larsen B. Six kasten cores (KC1-KC6) were recovered from the Larsen B inlet at depths ranging from 438 m to 676 m. These cores were sampled at 2 cm intervals for grain size analysis and water content. Ice rafted debris (IRD) content was obtained by observing x-rays and counting at 2.5 cm intervals. Magnetic susceptibility was measured every 2.5 cm using the Bartington MS2C 44 mm sensor. 14C-calcite dates were obtained from the top 20 cm in KC2 and KC5. Results from the data allowed for the construction of a general litho-stratigraphy of the Larsen B Ice shelf depositional environments prior to its collapse. KC1-KC6 consist of three main units (from top to bottom): (1) sandy silty clay, (2) stratified sandy mud and muddy sand with granules, and (3) structureless muddy-diamicton. Three different depositional environments are suggested based on the sedimentological features of these units: open-marine, transitional, and glacial. The gravel pavement (0-1 cm) on top of KC5 was deposited as a product of the Larsen B Ice Shelf calving event in 1999. This is significant to our interpretation of the Larsen B's sedimentary processes and paleohistory because the stratigraphy of the Larsen A (Pudsey et al. 1998) does not show these angular pebbles and cobbles on top of unit 1, but rather biosiliceous ooze in its silty clay unit . Furthermore, 14C-calcite dates from KC5 (2,300 +/-35 at 2 cm, 2,760+/-35 at 5 cm, and 9,210+/-45 at 20 cm) and KC2 (3,710+/-40 at 2cm, 9,760+/-45 at 15cm, and 10,600+/-55) help confirm that the Larsen B has not experienced a history of recession and reformation since the end of the last Ice Age. Instead the ice shelf seems to have been in place for some time while embayments to the north were experiencing open marine conditions (Domack et al., 2001 & Pudsey et al., 2001). Thus, our investigation illustrates that the disintegration of the Larsen B Ice Shelf was an unprecedented event in which its litho-stratigraphy indicates a sub-ice shelf environment formed during the entire Holocene.

---

# PP31C MCC: Level 1 Wednesday 0830h

## Evolution of the Antarctic Climate System: Modeling and Observation I

**Posters** *(joint with A, OS, C, GC)*

***Presiding:*** **M J Siegert,** Bristol Glaciology Centre**; D Pollard,** Pennsylvania State University

### PP31C-0267 0830h POSTER

## Ocean Response to Possible Southern Meltwater Pulses During Eocene-Oligocene Cooling Climate Trend: A Sensitivity Ocean Modeling Study

Bernd J. Haupt[1] (814-865-8188; bjhaupt@psu.edu)