Cenozoic bi-polar connections over millennia

Session and town meeting at 33rd International Geological Congress Oslo, Norway, August 2008

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Several innovative geological drilling projects (e.g., Arctic Coring Expedition (ACEX), Lake El'gygytgyn, ANDRILL (Antarctic Drilling Project), SHALDRIL (Shallow Drilling on the Antarctic Continental Margin) in the polar regions are in the process of recovering long sedimentary records of climate and environmental change for the past hundreds to millions of years. Syntheses and inter-comparative assessments of these records are required for better understanding of polar climate drivers and linkages, and science plans need to be established in order to evaluate conflicting interpretations of those comparative syntheses. The focus of this session at the 33rd IGC was to assess the initial results of these drilling projects and place them in a global context. The session was advertised and solicited as an International Polar Year contribution to the Bipolar Climate Machinery (BIPOMAC) and Antarctic Climate Evolution (ACE) programs.

Lively presentations and discussions emphasized the global nature of late Cenozoic (ca. 40 Myr ago) change, especially the timing and magnitude of past climatic events on orbital and millennial timescales, and the interplay of events at both poles. Provocative assessments were made on the role the polar regions play in driving and amplifying global variability, and in interpreting the co-evolution of polar paleoenvironments.

Keynote talks introduced and summarized each of the major completed and planned polar drilling projects; there were five presentations each for Antarctic and Arctic science, and one relating South Atlantic records to both poles. The Arctic records included papers led by Moran, Stickley, Sangiorgi and Krupskaya, focusing on results from the ACEX drilling project. These presentations included a general overview of a dynamic Arctic Ocean, biogenic silica productivity in the Middle Eocene (ca. 40 Myr ago), surface water temperature estimates from Tex86 that differ from iceberg rafting inferences made from sedimentology, and Arctic weathering regimes inferred from clay mineralogy. Brigham-Grette explained the conflict in data from land records compared with some of those from ACEX, regarding a cold Arctic in the Paleogene. The last contribution on Arctic data was a poster presented by Gleason on isotopic studies of Eocene fish remains used to infer paleoceanography in the Arctic Ocean.

The Antarctic talks focused on recently recovered ANDRILL core data. Powell and others summarized the Plio-Pleistocene paleoclimatic inferences and framed them with correlative Arctic climatic events. Scherer and others described the youngest warm event recorded in Antarctica as MIS 31 and raised the question of the corresponding Arctic record of this interglacial. Magens and Hinnov both presented the distinctive physical properties of the core and showed Milankovitch-band cyclicity in the Plio-Pleistocene record. Also from this core, Hannah evaluated the use of extant Arctic marine palynomorphs as analogs for interpreting inferred Antarctic paleoclimates. Lastly, Ljung evaluated the Holocene bipolar seesaw effect using cores from the South Atlantic (Fig. 1).

Papers in the session highlighted the need for more interaction between scientists conducting research in the two polar regions, in order to assess the reaction and interaction of these regions during past warming events and better understand what their future may hold. This topic lead to an evening reception and town hall meeting to determine the level of enthusiasm for a Chapman Conference proposal to further develop the science leading to a series of IPY benchmark papers in the coming years. The session was well attended and general agreement on the need for such a conference was reached.

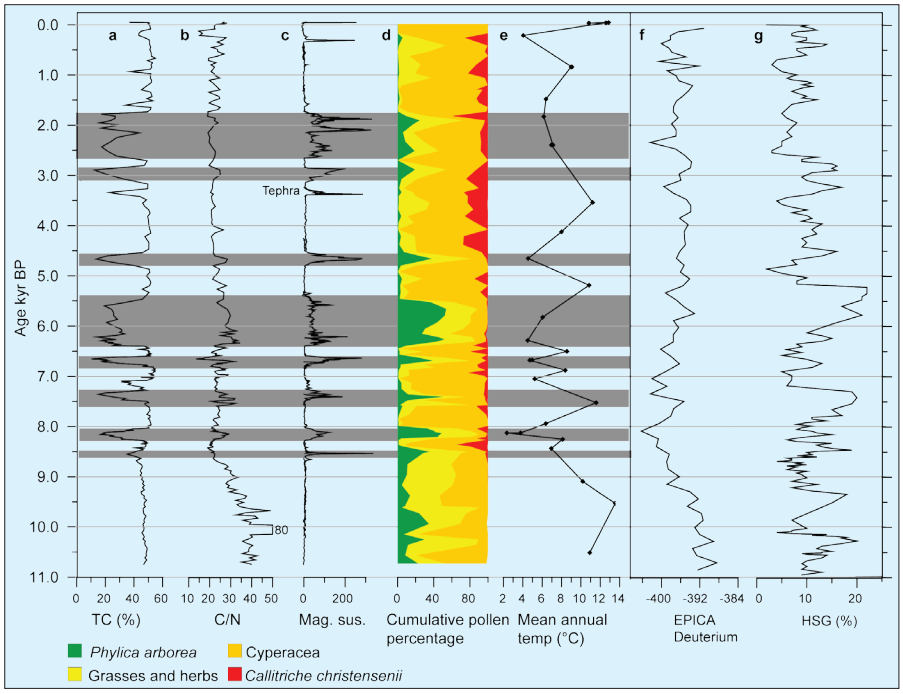

*Figure 1: **a-d**) Total carbon, carbon-nitrogen ratio, magnetic susceptibility, cumulative pollen percentages (Ljung and Björck, 2007) and **e**) mean annual temperatures (unpublished data) from a lake on Nightingale Island (37°S) in the central South Atlantic. The temperature reconstructions are inferred from the methylation index of branched tetraethers (MBT) using the calibration of Weijers et al. (2007). **f**) Deuterium from the EPICA ice core as an indicator of temperature (Epica Community Members, 2004), and **g**) percentage of hematite stained grains (HSG) from marine cores in the North Atlantic, as an indicator of ice rafting (Bond et al., 2001). Gray bars denote periods with increased erosion caused by increased precipitation on Nightingale Island. The Nightingale proxy data reveal a variable Holocene climate, with temperature and precipitation changes probably caused by variations of the southern hemisphere Westerlies and South Atlantic sea surface temperatures.*

References

Bond, G., Kromer, B., Beer, J., Muscheler, R., Evans, M.N., Showers, W., Hoffman, S., Lotti-Bond, R., Hajdas, I. and Bonani, G., 2001: Persistent solar influence on North Atlantic climate during the Holocene, *Science*, **294**: 2130-2136.

Epica Community Members, 2004: Eight glacial cycles from an Antarctic ice core, *Nature*, **429**: 623-628.

Ljung, K. and Björck, S., 2007: Holocene climate and vegetation dynamics on Nightingale Island, South Atlantic –an apparent interglacial bipolar seesaw in action? *Quaternary Science Reviews*, In press.

Weijers, J.W.H., Schouten, S., van den Donker, J.C., Hopmans, E.C. and Sinninghe Damsté, J.S., 2007: Environmental controls on tetraether membrane lipid distribution in soils, *Geochemica et Cosmochimica Acta*, **71**: 703-713.