

Final Report: North Atlantic Drilling for Climate Dynamics—Filling the Oligo-Miocene-Pliocene Gap in the North Atlantic

Steering Committee (in alphabetic order)

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Executive Summary:

This workshop aimed to bring together specialists from various fields in order to develop a drilling proposal to fill the “Oligo-Miocene Gap” that exists in our understanding of the function of Earth’s systems. It is planned to establish the first continuous high-deposition record of the Oligo-Miocene through new International Ocean Discovery Program (IODP) drilling in the North Atlantic to allow the development of a continuous Neogene cyclostratigraphy and to enhance our knowledge of Oligo-Miocene ocean-ice-climate dynamics. In order to achieve these goals, a workshop was held in Heidelberg from 15-17 September 2014 funded by ESF (EARTHTIME EU), NSF, and the ECORD MagellanPlus Workshop Series Program. 24 participants from six different countries (Australia, France, Germany, The Netherlands, United Kingdom, and United States) attended the workshop, including several early-stage researchers. The group discussed certain aspects of Cenozoic paleoceanography and paleoclimate and how the gaps in the Oligo-Miocene could be filled using scientific drilling. The ultimate goal of the workshop (to submit a pre-proposal to IODP) was targeted by presentations on the first day followed by self-selected breakout groups that discussed different topics and produced text and figures for the proposal. The workshop produced IODP 874-pre, a drilling proposal submitted to IODP review panels in October 2014. The development of a full proposal was recommended by the Science Evaluation Panel based on the evaluation of the proposal in January 2015.

Proposed Recommendations

During the workshop, we recognized:

1. The workshop showed that there is a major, persistent gap in recovery of high-deposition records of Oligocene-Miocene age in the North Atlantic. This gap persists despite the importance of this area and time period for understanding the evolution of the cryosphere, Northern Hemisphere ecosystem structure, and the history of ocean productivity and chemical balances. Recent drilling in this time period has focused on the Pacific where new, very highly resolved records with good chronology have been produced (e.g.,

- Holbourn et al., 2013; Tian et al., 2013). A key task is therefore to produce comparable records from the sites of deep ocean overturning in the Atlantic for understanding the relative contributions of regional and global signals preserved in the Pacific records.
2. The participants of the workshop also recognized the value of obtaining both continuous but low temporal resolution records from pelagic sites.
 3. There was also interest in locating one or more sites off West Africa (near Morocco) to obtain a Oligocene-Miocene sediment record with a precession-dominated aridity record, like existing Pliocene records in the Mediterranean. However, no specific West African drilling target was identified during the meeting. Nonetheless, participants left the meeting agreeing on the importance of drilling off West Africa to extend the orbital time scale back into the early Neogene and update the widely used LR04 stack (Lisiecki and Raymo, 2005) of oxygen isotope records used in the Pliocene time scale.

We Proposed:

1. To obtain high-deposition records of the Oligocene-Miocene interval from the same region of deep-sea sediment drifts that was sampled during the highly successful, early Paleogene-focused Expedition 342 (Fig. 1).
2. Drilling and the high quality seismic grid over the Newfoundland Ridges reveals the existence of highly expanded Oligocene, Miocene and Pliocene drift deposits in the region (for an example see Fig. 2). The drifts can provide the depth range and temporal record to reconstruct a latest Paleogene-Neogene companion record to Expedition 342's early Paleogene climate history.
3. New records from the Oligocene and early Miocene can also be linked to Expedition 342's deep-water sites (Norris et al., 2012) to fully reconstruct the North Atlantic CCD.
4. Analysis of existing seismic data for the SE Newfoundland Ridge (available from previous IODP Expedition 342) was used to identify 15 primary and alternate drill sites that could cover the entire Oligocene-Pliocene sequence with high deposition rate sections. These prospective drill sites also span a ~1800 m depth transect, including abyssal sites at up to 5 km water depth. All but three of these sites would be drilled entirely with APC to depths of ~250 m.
5. We wrote IODP Proposal 847-Pre and submitted this for the October 2014 deadline. The development of a full proposal was recommended by the Science Evaluation Panel based on the evaluation of the proposal in January 2015.

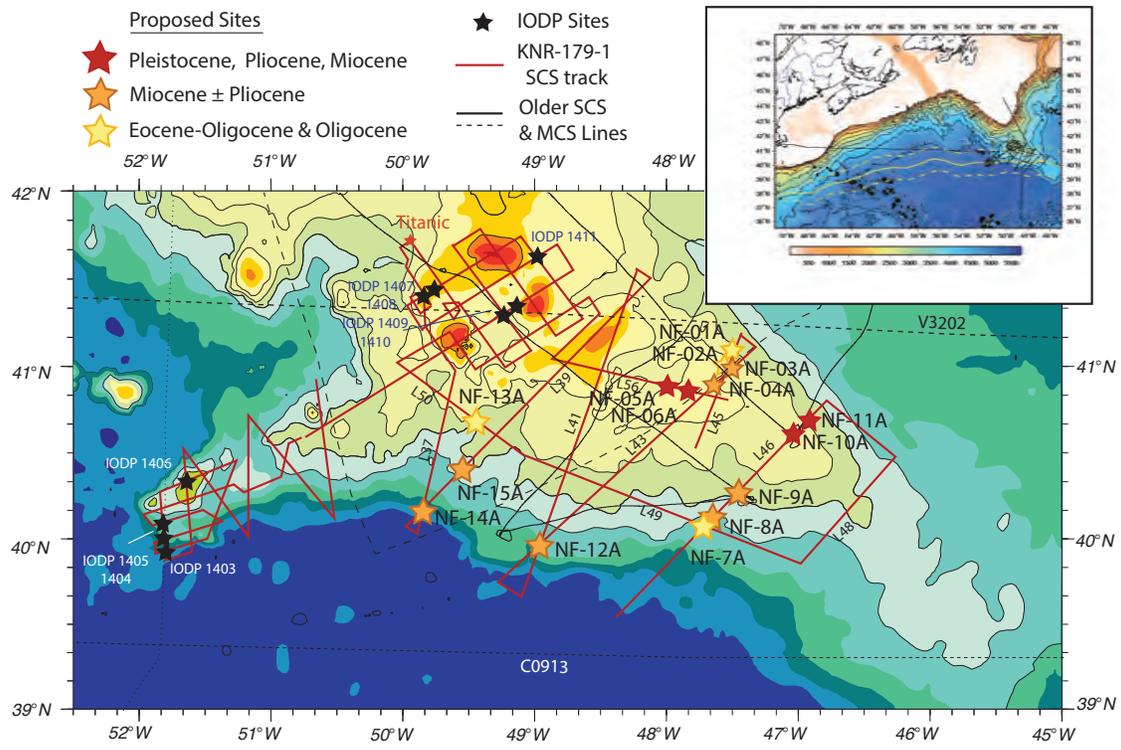


Figure 1. Location map and seismic grid proposed in IODP 874-pre.



Fig 2. Workshop participants in front of the IWH venue. Photo: Lucas Lourens.

The participants of the workshop (Fig. 2) were in alphabetic order:

Markus Badger (University of Bristol), Ian Bailey (University of Exeter,), Helen Beddow-Twigg (University of Utrecht), Steven Bohaty (NOCS), Clara Bolton (CEREGE), André Bornemann (BGR), Anja Crocker (NOCS), Oliver Friedrich (University of Heidelberg), Jens Grützner (AWI), Timothy Herbert (Brown University), Ann Holbourn (University of Kiel), Pincelli Hull (Yale University), Diederick Liebrand (NOCS), Peter Lippert (University of Utah), Lucas Lourens (University of Utrecht), Mitch Lyle (Oregon State University), Richard Norris (Scripps Institution of Oceanography), Bradley Opdyke (ANU), Jörg Pross (University of Heidelberg), Yair Rosenthal (Rudgers State University), Phil Sexton (The Open University), Michael Stärz (AWI), Thomas Westerhold (MARUM), Paul Wilson (NOCS).

Future impact of the workshop

Regarding the initial goals, the workshop was highly successful since the outcome was a submitted pre-proposal to IODP (874-pre) and a re-evaluation and revision of an existing pre-proposal (851-pre). For both pre-proposals, text and figures were produced by the participants that can be used by the proponents to submit a full proposal to IODP.

In case that both expeditions will be scheduled within IODP, the workshop will have a great impact on our knowledge of North Atlantic paleoceanography and paleoclimate and will serve as resource of many scientific proposals from the international scientific community. Scientific ocean drilling in the Atlantic Ocean based on these two proposals will massively increase our understanding of the feedbacks and function of Earth's systems due to the recovery of archives with millennial-scale temporal resolution as well as long-term records. In combination with previous drilling, the planned continuous high-deposition record of the Cenozoic could be used to establish a sophisticated orbital age model for most of the Cenozoic to investigate the spatial and temporal dimension of single events as well as long-term evolution of the Earth's system.