Scientific report for
ECORD/ICDP MagellanPlus Workshop Proposal

Newfoundland Drilling for Climate Dynamics—Filling the Oligo-Miocene Gap in the North Atlantic

Heidelberg (Germany), 15.-17. September 2014

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1. Summary

This workshop aimed to bring together specialists from various fields (magnetostratigraphy, cyclostratigraphy, paleoclimatology, paleoecology, geochemistry) 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 was proposed to establish the first continuous high-deposition record of the Miocene through new International Ocean Discovery Program (IODP) drilling 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 September 15-17, 2014. The group of 24 participants from 6 different countries discussed certain aspects of Cenozoic paleoceanography and paleoclimate and how the gaps in the Oligo-Miocene could be filled with 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 outcome of the different breakout groups was selected and combined by the lead convenors to match the required proposal structure for an IODP pre-proposal.

The direct outcomes of this workshop are:

I) an IODP pre-proposal to drill Neogene Newfoundland drift sediments (874-pre submitted on October 1st, 2014)

II) Discussion and revision of the existing IODP pre-proposal 851-pre

2. Participants (in alphabetic order):

Convenors:

Oliver Friedrich (Heidelberg University, Germany)

Richard Norris (Scripps Institution of Oceanography, USA)

Bradley Opdyke (Australian National University, Australia)

Paul Wilson (NOCS, UK)

Speakers:

André Bornemann (BGR, Germany)

Timothy Herbert (Brown University, USA)

Ann Holbourn (Kiel University, Germany)

Pincelli Hull (Yale University, USA)

Diederick Liebrand (NOCS, UK)

Mitch Lyle (Texas A&M University, USA)

Further participants

Markus Badger (University of Bristol, UK)

Ian Bailey (University of Exeter, UK)

Helen Beddow-Twigg (Utrecht University, The Netherlands)

Steven Bohaty (NOCS, UK)

Clara Bolton (Oviedo University, Spain)

Anja Crocker (NOCS, UK)

Jens Grützner (AWI, Germany)

Peter Lippert (University of Utah, USA)

Lucas Lourens (Utrecht University, The Netherlands)

Jörg Pross (Heidelberg University, Germany)

Yair Rosenthal (Rudgers State University, USA)

Phil Sexton (The Open University, UK)

Michael Stärz (AWI, Germany)

Thomas Westerhold (MARUM, Germany)

3. Program of the workshop

Day 1: Monday 15.09.2014

9:00 am	Welcome to the participants and workshop goals
9:15 am	Presentation "IODP and proposal structure" (André Bornemann)
9:40 am	Presentation "Oligocene climate evolution and isotope stratigraphy" (Diederik Liebrand)
10:05 am	Presentation "Miocene climate evolution and isotope stratigraphy" (Ann Holbourn)
10:30 am	Coffee Break
10:50 am	Presentation "Pliocene climate evolution and isotope stratigraphy" (Tim Herbert)
11:15 am	Presentation "Evolution of Oligo- to Pliocene Ecosystems" (Celli Hull)
11:40 am	Presentation "Western North Atlantic Transekt (851-Pre)" (Mitch Lyle)
12:05 pm	Lunch at venue
1:00 am	Presentation "Newfoundland as drilling target" (Dick Norris)
1:25 pm	Organization of outbreak groups (e.g., cyclostratigraphy, Ice sheet dynamics, climate dynamics, drift sediments, ecosystems, site survey)
3:00-3:30 pm	Coffee Break
5:00 pm	Brief Reports From Breakout Groups (2-3 slides, 10 minutes/each)
6:00 pm	Return to Rooms
7:00 pm	Dinner at venue

Day 2: Tuesday 16.09.2014

8:15 am	Group discussion
8:30 am	Work by Breakout Groups (continued from Day 1)
10:00-10:30am	Coffee Break
11:00 am	Reports From Breakout Groups (2-3 slides, 10 minutes/each)
12:00 pm	Lunch at venue
1:00 pm	Work by Breakout Groups (continued from morning session)
3:00-3:30 pm	Coffee Break
5:00 pm	Reports From Breakout Groups (2-3 slides, 10 minutes/each) Draft reports due to Workshop Conveners
6:00 pm	Return to Rooms
6:30 pm	Conference Dinner at Kulturbrauerei Heidelberg

Day 3: Wednesday 17.09.2014

8:15 am	Proposal Structure (Workshop conveners)
8:30 am	Discussion of Site Selection and Survey Needs
9:00 am	Final Synthesis and Figures by Breakout Groups
10:00-10:30am	Coffee Break
10:30 am	Writing, Figures, and References for Breakout Groups
12:00 pm	Lunch at venue
1:00 pm	Writing, Figures and References for Breakout Groups
3:00-3:30 pm	Coffee Break
5:00 pm	Reports From Breakout Groups (2-3 slides, 10 minutes/each)
6:00 pm	Final remarks

The lead convenors, Richard Norris and Oliver Friedrich, continued to work on the proposal structure, site forms, cover sheet and editing text on Sept 18-19, 2014 after the meeting had concluded in order to submit an IODP pre-proposal.

4. Main results and discussions at the workshop

Major discussions at the event and scientific results that came out of the workshop are the following:

I) While the workshop discussed Oligocene-Pliocene drilling objectives, the resulting pre-proposals both focused on Oligocene-Miocene objectives, particularly the Middle Miocene Climatic Optimum (15-17 Ma). This drilling strategy acknowledges the importance of focusing on extreme climate dynamics (such as the abrupt warming and carbon-cycle dynamics of the middle Miocene). We are also aware of previous recovery of Eocene-Oligocene boundary records during Expedition 342, and previous recovery of expanded Pliocene records from the North Atlantic that reduce the scope of future drilling requirements.

II) 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. A key task is therefore to produce comparable records form the sites of deep ocean overturning in the Atlantic for understanding the relative contributions of regional and global signals preserved in the Pacific records.

III) Participants recognized the value of obtaining both continuous but low temporal resolution records from pelagic sites (covered in 851-pre) and high-resolution drift records (covered in Newfoundland drilling, pre-proposal 874 that was submitted on October 1st). Pelagic records have particular value for recovering signals from biomarkers, organic proxies like alkenones, and long productivity records.

IV) There was also interest in locating one or more sites off West Africa (near Morocco) to obtain a Miocene-Oligocene sediment record with a precession-dominated aridity record, like existing Pliocene records in the Mediterranean. Mediterranean records have proven very useful in adjusting the details of the Pliocene time scale since the aridity record does not require assumptions about orbital tuning of the high latitude glacial cycle. However, participants did not identify a specific West African drilling target 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 of oxygen isotope records used in the Pliocene time scale.

V) Analysis of existing seismic data for the SE Newfoundland Ridge identified 15 primary and alternate sites that could cover the entire Pliocene-Oligocene 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.

VI) Proposal 851-pre continues to require a site survey cruise to collect new seismic records. However, the locations of some of the prospective sites were adjusted to take better advantage of existing sites (such as IODP 1313) and synergistic Newfoundland drilling.

5. Assessment of potential 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). Therefore, the hope is that two full proposals for an IODP expedition into the North Atlantic will be the result of this workshop. Both the main proponents of 874-pre (Oliver Friedrich and Richard Norris) and 851-pre (Mitch Lyle and Bridget Wade) got text and figures at hand from the participants that can be used to submit a full proposal to IODP. If these two expeditions will be funded, 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.

6. Financial statement

Total expenditure for the workshop:		Used grant money:	
Travel:	15942 €	ESF "Earthtime"	16100 €
Accommodation:	5542 €	NSF travel grant	8779 €
Meals:	3315 €	MagellanPlus	2113 €
Administrative costs:	1323 €		
Meeting room rental:	870 €		
Total:	26992 €		

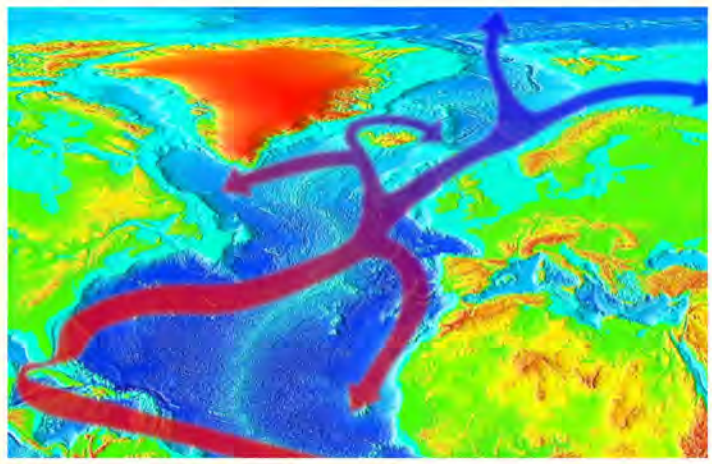
Workshop

North Atlantic drilling for climate dynamics – Filling the Oligo-Mio-Pliocene Gap in the North Atlantic

September 15-17, 2014

Internationales Wissenschaftsforum Heidelberg,
University of Heidelberg, Germany


Credit: Heidelberg Marketing GmbH



Workshop Rationale

The Oligo-Miocene to Pliocene interval of Cenozoic time is thought to record the imprint of dynamic ice sheets on Antarctica, the intensification of the cryosphere in the Northern Hemisphere and the evolution of the modern Nordic seas. Our understanding of the feedbacks and function of the Earth system in this interval of time, however, is severely hampered by a lack of high quality deep-sea sedimentary sections with high rates of deposition and robust age control particularly from the North Atlantic Ocean, the region best suited, perhaps, to evaluating some of these key events.

This workshop seeks to develop new drilling proposals to fill this "Oligo-Miocene to Pliocene Gap". We will target the acquisition of the new sedimentary sections that are needed to establish a sophisticated orbital age model and to enhance our knowledge of Oligo- to Pliocene ocean-ice-climate dynamics. A particular focus of the workshop will be to develop proposals that exploit what we have learned by employing new drilling strategies during the most recent phase of scientific drilling such as IODP Exp. 342, which targeted clay-rich sediment drifts of Eocene age on the Newfoundland Margin or IODP Exp. 320 and 321 which employed a systematic Cenozoic age transect drilling method in the equatorial Pacific.

In this way the workshop aims to tackle the following major themes: (1) filling the Oligo-Miocene to Pliocene gap in the North Atlantic with high quality sections that will provide a continuous record for the last 35 Ma of Earth's history, (2) the evolution of Northern Hemisphere cryosphere, (3) the development of the Oligo-Miocene to Pliocene CCD and how its comparison to the equatorial Pacific record, (4) the overturning history of the North Atlantic including its underlying dynamics and timing, (5) the timing of the initiation of massive drift sedimentation in the Neogene, and (6) the interplay between climate and ecosystem change in the North Atlantic.

We seek to bring together specialists from various fields (e.g., paleoclimatology, paleoecology, geochemistry, bio- cyclo- magnetostratigraphy, geophysics) to lead at least one competitive IODP pre-proposal supported by existing seismic stratigraphy to tackle the above-mentioned themes and (where necessary) a site-survey proposal to collect new seismic datasets.

Convenors

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Sponsors

Main sponsor: ESF Research Networking Programmes (EARTHTIME-EU)
Co-sponsors: ECORD/ICDP MagellanPlus, University of Heidelberg and NSF

Further information

To register an expression of interest please email Oliver Friedrich in the first instance. Oliver.Friedrich@geow.uni-heidelberg.de