IODP Proposal Cover Sheet

Central Arctic Paleoceanography

708 - Full

Title	Arctic Ocean Paleoceanography: Towards a Continuous Cenozoic Record from a Greenhouse to an Icehouse World (ACEX2)
Proponents	R. Stein, W. Jokat, H. Brinkhuis, L. Clarke, B. Coakley, M. Jakobsson, J. Matthiessen, M. O'Regan, C. Stickley, K. St. John, E. Weigelt,
Keywords	Arctic Ocean, Paleoceanography, Cenozoic
Area	Lomonosov Ridge

Contact Information

Contact Person:	Ruediger Stein		
Department:	Geosciences		
Organization:	Alfred Wegener Institute for Polar and Marine Research		
Address:	Am Alten Hafen 26	Bremerhaven	27568
Tel.:	+4947148311576	Fax:	+4947148311923
E-mail:	Ruediger.Stein@awi.de		

Abstract

Prior to 2004, the geological sampling in the Arctic Ocean was mainly restricted to near-surface Quaternary sediments. Thus, the long-term Pre-Quaternary geological history is still poorly known. With the successful completion of the Arctic Coring Expedition - ACEX (IODP Expedition 302) in 2004, a new era in Arctic research has begun. Employing a novel multi-vessel approach, the first Mission Specific Platform (MSP) expedition of IODP has proven that drilling in permanently ice-covered regions is possible. During ACEX, 428 meters of Quaternary, Neogene, Paleogene and Campanian sediment on Lomonosov Ridge were penetrated, providing new unique insights into the Cenozoic Arctic paleoceoceanographic and climatic history. While highly successful, the ACEX record also has three important limitations. Based on the original age model, the ACEX sequence contains a large hiatus spanning the time interval from late Eocene to middle Miocene, i.e., 44.4 to 18.2 Ma. This is a critical time interval, as it spans the time when prominent changes in global climate took place during the transition from the early Cenozoic Greenhouse world to the late Cenozoic Icehouse world. Furthermore, generally poor recovery during ACEX prevented detailed and continuous reconstruction of Cenozoic climate history. Finally, a higher-resolution reconstruction of Arctic rapid climate change during Neogene to Pleistocene times, could not be reached during ACEX in 2004. We believe, this justifies a return to the Lomonosov Ridge for a second MSP - type drilling campaign within IODP to fill these major gaps in our knowledge on Arctic Ocean paleoenvironmental history through Cenozoic times and its relationship to the global climate history.

Overall goal of the proposed drilling campaign is the recovery of a complete stratigraphic sedimentary record on the southern Lomonosov Ridge to meet our highest priority paleoceanographic objective, the continuous long-term Cenozoic climate history of the central Arctic Ocean. Furthermore, sedimentation rates two to four times higher than those of ACEX permit higher-resolution studies of Arctic climate change in the Pleistocene and Neogene. As demonstrated in the proposal, this goal can be achieved by careful site selection, appropriate drilling technology, and applying multi-proxy approaches to paleoceanographic, paleoclimatic, and age-model reconstructions. We propose one primary drill site with three APC/XCB/RCB holes to recover multiple sections of the sediment sequence to ensure complete recovery for construction of a composite section.

ACEX2 objectives are key elements in the IODP New Science Plan, Theme 1 Climate and Ocean Change, especially Challenges 1 and 2.

708 - Full

Scientific Objectives

A complete Cenozoic sedimentary sequence from the central Arctic Ocean will be studied to answer the following key questions:

- Did the Arctic Ocean climate follow the global climate evolution during its course from early Cenozoic Greenhouse to late Cenozoic Icehouse conditions?
- Are the Early Eocene Climate Optimum (poor recovery in the ACEX record) and the Oligocene and Mid-Miocene warmings also reflected in Arctic Ocean records?
- Did extensive glaciations (e.g., the OI-1 and Mi-1 glaciations) develop synchronously in both the Northern and Southern Hemispheres?
- What is the timing of repeated major (Plio-)Pleistocene Arctic glaciations as postulated from sediment echosounding and multi-channel seimic reflection profiling?
- What was the variability of sea-ice in terms of frequency, extent and magnitude?
- When and how did the change from a warm, fresh-water-influenced, biosilica-rich and poorly ventilated Eocene ocean to a cold, fossil-poor, and oxygenated Neogene ocean occur?
- How critical is the exchange of water masses between the Arctic Ocean and the Atlantic and Pacific for the long-term climate evolution as well as rapid climate change?
- What is the history of Siberian river discharge and how critical is it for sea-ice formation, water mass circulation and climate change?
- How did the Arctic Ocean evolve during the Pliocene warm period and succeeding cooling? How do the ACEX2 record correlate with the terrestrial record from the Siberian Lake Elgygytgyn?
- What is the cause of the major hiatus recovered in the ACEX record? Does this hiatus in fact exist?

Non-standard measurements technology needed to achieve the proposed scientific objectives.

The sites are located in the seasonally ice-covered central Arctic Ocean (southern Lomonosov Ridge), and will need mission specific vessels to perform the drilling in the pack ice (marginal ice zone). A well organized ice-management strategy and support by an icebreaker (e.g., RV Polarstern) are needed.

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
LORI-5B	83.80, 146.48	1334	1250	0	1250	Recovery of a complete stratigraphic sedimentary record on the central Lomonosov Ridge to meet our highest priority paleoceanographic objective, the continous long-term Cenozoic climate history of the central Arctic Ocean. (Alternate Site)
LORI-16A	80.78, 142.78	1752	1850	0	1850	Recovery of a complete stratigraphic sedimentary record on the southern Lomonosov Ridge to meet our highest priority paleoceanographic objective, the continous long-term Cenozoic climate history of the central Arctic Ocean. (Alternate Site)
LR-02A	80.97, 142.47	1450	1300	0	1300	Recovery of a complete stratigraphic sedimentary record on the southern Lomonosov Ridge to meet our highest priority paleoceanographic objective, the continous long-term Cenozoic climate history of the central Arctic Ocean (Alternate Site)

LR-01A	80.95, 142.97	1405	1225	0	1225	Recovery of a complete stratigraphic sedimentary record on the southern Lomonosov Ridge to meet our highest priority paleoceanographic objective, the continuous long-term Cenozoic climate history of the central Arctic Ocean (Primary site)