

Title	Shallow drilling in the far southeastern Ross Sea Antarctica for records of the early West Antarctic Ice Sheet
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Abstract:

Shallow drilling (~50-100 m) in the far southeastern Ross Sea can explore hypotheses concerning the role of West Antarctica on global climate evolution, Antarctic glaciation, and lithosphere subsidence in the Ross Sea. This project proposes to obtain geologic evidence of the earliest history (Oligocene- early Miocene) of the West Antarctic Ice Sheet (WAIS) by drilling buried suspected glacial sequences in the far southeastern Ross Sea adjacent to Marie Byrd Land (MBL). Cores will also provide ground truth for the warmer Cretaceous-Eocene greenhouse world.

Project goals are consistent with the IODP science plan 2013-23 within the RESEARCH THEME of Climate and Ocean Change —how will climate, the ocean, and ice sheets respond to ongoing increases in greenhouse gases? The project addresses two IODP CHALLENGES:

- How does Earth's climate system respond to elevated levels of atmospheric CO₂?
- How do ice sheets and sea level respond to a warming climate?

Outcrops in MBL are sparse (< 2% of area) and have had most or all glacial deposits removed by erosion. The only complete stratigraphic records lie on the continental shelf.

The area is proximal to MBL and has logistical advantages. All of the proposed drill sites are well protected by Edward VII Peninsula to the east, by the ice shelf to the south, and by pack ice to the north. The area is generally free of ice for the austral summer. Satellite images for years 2002-2009 show ice-free conditions in the area we propose to drill.

We completed a marine survey in an area of buried features that we propose are evidence for Oligocene glaciers or ice streams. Our targets are mostly beds with gentle westward dips, with the seafloor eroded to nearly horizontal, so deep holes are not required to sample the section. We are planning for drilling 8-12 holes and to recover ~500-1000 m of core. The primary sites have targets in the upper 50 m with two at 100 m. Shallow drilling can be accomplished with either the shipboard Seacore or MeBo seafloor systems from an ice-strengthened ship.

Drilling with MeBo has been proposed by German scientists, including a proponent of this proposal, in the Amundsen Sea Embayment to the east of MBL. The proponents are also participating in the international ANDRILL project that is proposed for drilling Neogene glacial sequences on the Coulman High in the Central Ross Sea.

Scientific Objectives

Confirm glacial nature of probable Oligocene deposits from ice sheets that must have been sourced in West Antarctica; improve dating of sequences; improve understanding of Oligocene glacial variability; recover record of Eocene-Oligocene greenhouse-icehouse transition.

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

Proposed Sites

Site Name	Position (Lon, Lat)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
SERS-08A	-159.47610, -77.92165	566	60	0	60	Age and environment of oldest accessible strata as part of intended continuous age transect. Potentially reaches syn-rift, inferred Cretaceous strata beneath RSU7.
SERS-07A	-159.54844, -77.92798	619	60	0	60	Age and environment below RSU6 reflector; if marine, gives control on paleodepth. Part of intended continuous age transect. Potentially includes E-O boundary & Oi-1
SERS-06A	-159.60682, -77.93404	644	60	0	60	Age and environment below RSU6 reflector; if marine, gives control on paleodepth. Part of intended continuous age transect.
SERS-05A	-159.65009, -77.93965	646	60	0	60	Age and environment above and below RSU6 reflector; if marine, gives control on paleodepth. Uppermost core of intended continuous age transect.
SERS-04A	-159.89476, -77.96318	647	60	0	60	Determine onset of proximal glaciation in southeast Ross Sea. Sample strata just below sub-glacial delta. Determine paleoenvironment and depth.

SERS-03A	-160.25768, -77.93998	694	80	0	80	A direct test of the oldest glaciation. Depositional environment, paleo-water depth. Date prograding sequences in RSS-2-lower. Demonstrate proximity to Oligocene glaciers.
SERS-02A	-160.51352, -77.60899	556	60	0	60	Sample and date near base RSS-2-upper, within stratified, reflective, non-reworked (?) marine strata. Will aid in assigning ages to RSS-2-lower glacial strata below (site 3). Determine depositional environment including paleo-water depth.
SERS-01A	-162.71355, -78.36955	698	80	0	80	Sample and date section spanning composite Miocene unconformity; middle Miocene RSS-5. Sample fill of narrow trough interpreted to be Late Oligocene, perhaps Mi-1. Find evidence of glacial proximity, paleo-water depth of sequences above and below composite Miocene unconformity and trough fill.