

# IODP Proposal Cover Sheet

911 - Full

Argentine Marine Deep-Water Interactions

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Title	Argentine Margin Transects: Deciphering the Interactions among Southern Ocean Circulation, Climate, and Tectonics		
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Keywords	Deepwater circulation, Andean Uplift, Sedimentation	Area	Argentine Margin

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## Abstract

Southern Ocean water masses are a primary component of ocean circulation and climate, influencing global heat transport, primary productivity, nutrient and geochemical cycling, and atmospheric CO<sub>2</sub>. Seismic data indicate that the Argentine margin has thick sequences of Cenozoic sediments. This margin is ideally situated to characterize Southern Ocean water masses and monitor ocean circulation. Despite its importance as a sedimentary archive, almost no scientific ocean drilling has been conducted in this region to-date. We propose to drill a suite of sites along the Argentine margin to reconstruct the histories of Southern Ocean-sourced waters and their influence in the global ocean. These sites will yield broad vertical (750-5000 m) and temporal (0-70 Ma) coverage, enabling better understanding of the evolution of the Southern Ocean's deep to intermediate water structure through time.

The first major focus of the proposal will be reconstruction of the histories of deep-water masses and their interactions. Several issues will be addressed. First, a fundamental change occurred during the Cenozoic as "Cretaceous-like" early Paleogene circulation gave way to the more vigorous currents that characterize the Oligocene to present. This change was initiated near the Eocene/Oligocene boundary. While the deep-water objectives are geared towards understanding the large-scale systems, the recovered sediments are likely to contain the deep-water response during prominent events like the K/Pg boundary and Paleocene Eocene Thermal Maximum among others. A second major focus of the proposal will be to reconstruct the uplift history of the southern Andes. Geochemical typing along with mass accumulation rates will provide critical information. In addition, integration of the lithologic data contained in the cores (ages and facies) with the seismic profiles will allow a complete picture to be reconstructed of how the margin architecture evolved.

The drilling plan employs two strategies. First, sites are located near the edges of depo-centers where seismic reflections are clear and drilling targets are reachable. Second, a "windows to the past" approach is used to recover deeper/older targets, exploiting areas where younger sediments are thin or missing. It is anticipated that both the physical records of currents and the geochemical proxies of climate change will be contained in the same cores allowing direct cause and effect relationships to be determined through superposition.

## Scientific Objectives

1. History of Deep-Water Circulation a Greenhouse world.
2. Constrain the timing of the Antarctic Circumpolar Current initiation relative to the expansion of the AIS and deep-water cooling.
3. Generate record of deep-water geochemistry (e.g.,  $\delta^{18}\text{O}$  and Mg/Ca) concurrent with indicators for current intensity from onset of ACC through the early Miocene..
4. Determine behavior of Southern Ocean derived deep water masses during the transition from Miocene Climate Optimum to the establishment of permanent Antarctic Ice Sheet.
5. Document when North Atlantic-sourced deep water entered the Argentine basin..
6. Determine Southern Ocean's deep-water response to large Pleistocene glacial/interglacial cycles.
7. Reconstruct the deep-water response during "global events" such as the K/PG boundary, Paleocene-Eocene Thermal Maximum, Eocene Hyperthermals., and the onset of large-scale glacial cycles in the latest Pliocene.
8. Constrain depositional history of sediments from the Andean uplift..
9. Constrain ages and geochemistry of sediments from the Andean uplift.
10. Passive margin architecture response to climate and tectonics during the Cenozoic.

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

## Proposed Sites (Total proposed sites: 11; pri: 8; alt: 3; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
AMN-01A (Primary)	-40.0255 -55.4524	1296	550	0	550	• Record of surface to deep water properties and circulation during Cenozoic Oligocene to present) • Record of Southern Ocean response to MMCO and large, permanent ice sheet • Timing of closure of CAI • Variations in uplift of the Andes • Variation of fluxes of carbon and other nutrients
AMC-10A (Primary)	-42.6153 -58.1456	1485	600	0	600	• Record of surface to deep water properties and circulation during latest Cretaceous to Paleocene • Climate response to global events (K/Pg, PETM, hyper thermals) • Constrain timing of initiation of ACC • Variation of fluxes of carbon and other nutrients
AMC-11A (Primary)	-42.9844 -56.2543	4599	500	0	500	• Record of surface to deep water properties and circulation during Miocene to present • Response of Southern Ocean to MCO and establishment of permanent large ice sheet • Variations in uplift of the Andes • Variation of fluxes of carbon and other nutrients
AMC-12A (Alternate)	-43.0393 -55.9568	4884	650	0	650	• Record of surface to deep water properties and circulation during Miocene to present • Response of Southern Ocean to MCO and establishment of permanent large ice sheet • Variation of fluxes of carbon and other nutrients
AMC-13A (Alternate)	-44.2999 -59.2059	1557	600	0	600	• Record of surface to deep water properties and circulation during latest Cretaceous to Paleocene • Climate response to global events (K/Pg, PETM, hyper thermals) • Initiation of ACC • Variation of fluxes of carbon and other nutrients
AMS-21A (Primary)	-47.1655 -59.9000	776	450	0	450	• Record of surface to deep water properties and circulation during Cenozoic • Variation of fluxes of carbon and other nutrients
AMS-22A (Primary)	-47.1659 -59.2986	1308	425	0	425	• Record of surface to deep water properties and circulation during Cenozoic • Variation of fluxes of carbon and other nutrients
AMS-23A (Alternate)	-46.7565 -59.4994	1101	600	0	600	• Record of surface to deep water properties and circulation during Cenozoic • Variation of fluxes of carbon and other nutrients
AMS-24A (Primary)	-46.4100 -58.7721	2261	950	0	950	• Record of surface to deep water properties and circulation during Miocene to present • Response of Southern Ocean to MCO and establishment of permanent large ice sheet • Constrain timing of initiation of ACC and closure of CAI • Variations in uplift of the Andes • Variation of fluxes of carbon and other nutrients
AMS-25A (Primary)	-45.9271 -57.8112	3363	650	0	650	• Record of surface to deep water properties and circulation during Miocene to present • Response of Southern Ocean to MCO and establishment of permanent large ice sheet and large-scale glacial/interglacial cycles • Timing of closure of CAI • Variation of fluxes of carbon and other nutrients
AMS-26A (Primary)	-46.8672 -57.2495	4098	375	0	375	• Record of surface to deep water properties and circulation during latest Miocene to present • Response of Southern Ocean to large-scale glacial/interglacial cycles • Variation of fluxes of carbon and other nutrients