

# IODP Proposal Cover Sheet

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Argentine Margin Paleooceanographic Transects

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Title	Argentine Margin Transects: Deciphering the Interactions among Southern Ocean Circulation, Climate, and Tectonics		
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## Abstract

The Southern Ocean is a primary component of Earth's integrated ocean circulation, climate, and biosphere. Southern Ocean waters fill much of the world's oceans, influencing global heat transport, primary productivity, nutrient and geochemical cycling, and atmospheric CO<sub>2</sub>. Yet, for all of the Southern Ocean's importance, records for key intervals are limited. Seismic data indicate that the Argentine Margin holds thick sequences of Cenozoic sedimentation based on ties to industry wells on the shelf. This margin is ideally situated to record changes in ocean circulation and onset/evolution of the ACC. Despite its importance as a sedimentary archive, almost no scientific ocean drilling has been conducted in the region to-date. We propose to drill a suite of sites along the margin to reconstruct Southern Ocean-sourced waters and their influence in the global ocean.

The proposed Argentine margin sites will yield broad vertical (1000-5000 m) and temporal (0-70 Ma) coverage, enabling better understanding of the evolution of the Southern Ocean's deep to intermediate water structure and production. Three scales of investigation will be addressed: 1) the long-term contrast between Cretaceous-like early Paleogene circulation and the more vigorous circulation of the Oligocene to present; 2) fundamental climate/circulation transitions (Eocene/Oligocene spin up of the Antarctic Circumpolar Current; Miocene Climate Optimum to a polar Antarctica; and development of large glacial-interglacial cycles in late Pliocene); and 3) ocean response to prominent events (e.g., K-Pg boundary; Paleocene Eocene Thermal Maximum; extreme glacials like Mi1, and G2). Sea-surface conditions will be reconstructed using faunal/floral distributions and geochemical/isotopic proxies, which will contribute to a better understanding of Cenozoic climate history.

Existing seismic lines show the direct influence of deep- to intermediate-water currents along the Argentine margin. 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. Recovered sediments will temporally constrain sediment delivery and the evolution of stratigraphic features on the margin. The resulting sediment column will present ideal spatial/temporal records of microbial life and pore-water geochemistry in sediments deposited under vastly different circulation and climate regimes over a range of water depths, and in locations proximal to an important region of primary production in the ocean.

## Scientific Objectives

1. History of Southern Ocean sourced deep to intermediate water during the Cenozoic.
2. Constrain the timing of initiation of the Antarctic Circumpolar Current (ACC) in the Atlantic sector of the Southern Ocean.
3. Generate a detailed record of surface water (climate) and deep-water circulation from onset of the ACC to the middle Miocene.
4. Determine the response of the Southern Ocean during the transition from the Miocene Climate Optimum to the establishment of a permanent Antarctic Ice Sheet.
5. Document when North Atlantic sourced deep water entered the Argentine basin.
6. Determine the Southern Ocean's deep-water response to the large glacial/interglacial cycles of the Pleistocene.
7. Constrain the age for and geochemically type the sediments resulting from the Andean uplift.
8. Generate a record of surface-water properties in the high southern latitudes for the Cenozoic.
9. Reconstruct the deep-water response during global events such as the K/PG boundary, Paleocene-Eocene Thermal Maximum, Eocene Hyperthermals, Oi and Mi climate coolings, and the onset of large-scale glacial cycles in the latest Pliocene.
10. Passive margin architecture response to climate and tectonics during the Cenozoic
11. Document microbial variability through time under different climate, deep-water circulation and sediment flux regimes.

## 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 -Diversity and activity of microbial life and 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 Paleogene -Climate response to global events (K/Pg, PETM, hyperthermals) -Constrain timing of initiation of ACC -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and 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 Paleogene -Climate response to global events (K/Pg, PETM, hyperthermals) -Initiation of ACC -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and 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 -Diversity and activity of microbial life and variation of fluxes of carbon and other nutrients

## Proposed Sites (Continued; 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	
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 -Diversity and activity of microbial life and variation of fluxes of carbon and other nutrients