IODP Proposal Cover Sheet

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Argentine Margin Seaward Dipping Reflectors

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Title	Exploring the transition from continental breakup to a passive margin during the opening of the South Atlantic
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Area	Argentine Margin

Proponent Information

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Abstract

The opening of the South Atlantic Ocean and the subsequent volcanic passive margin formation resulted from lithospheric extension and breakup of the Paleozoic Gondwana supercontinent during the Early Cretaceous. The breakup and formation of the Argentine Continental Volcanic Margin (ACVM) was accompanied by extensive magmatism recorded as magmatic underplating, sill intrusions, and extrusive flood basalt and volcanic wedges identified as Seaward Dipping Reflectors (SDRs) in seismic data. Despite the wide global distribution of volcanic margins, the nature of the processes that lead to continental breakup and progressive oceanic crust formation remains controversial. SDRs have only been sampled through scientific ocean drilling in the NE Atlantic in an area impacted by hotspot volcanism. Furthermore, the environmental impact of the magmatism as recorded in the sedimentary section is not yet well understood. Here we propose a drilling program to core two sites on the ACVM to sample the SDRs and the overlying sedimentary record. Sampling the SDRs to determine their age and composition will allow a better understanding of the temporal opening of the South Atlantic, the source of the magmatism, and the processes involved during breakup, and to test the active vs. passive rifting hypotheses. We will investigate evidence for magma/crust interaction and the impact this volcanism had on climate through delivery of gases to the ocean and atmosphere. Following breakup, the progressive opening of the South Atlantic resulted in a major change in landmass configuration and ocean water mass distribution, with significant implications for climate evolution during the Cretaceous. The Cretaceous Atlantic was marked by deposition of widespread black shales during oceanic anoxic events (OAEs), yet the causes for their formation remain poorly understood. The record of Upper Cretaceous OAEs in the southern South Atlantic is sparse and sampling the Cretaceous on the ACVM will fill this gap and provide significant insight into the formation and expression of these deposits. During the Cenozoic, uplift of the Andes had a major impact on atmospheric circulation and landscape evolution in South America. The Argentine Basin is an ideal location to recover records of this evolution and the impact it had on paleoclimate, including the development of the South American monsoon.

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Scientific Objectives

Objective 1: Examine the nature and environmental impact of volcanic rifted margin formation in the South Atlantic
- Determine the mechanism responsible for excess magmatism during continental breakup
- Assess magma source and evidence for crustal contamination within the SDRs to understand breakup magmatism
- Determine the age of magmatism and chronology of South Atlantic rifting
- Assess the depositional environment, climate impact, and plausible emplacement model for SDRs

Objective 2: Examine the impact of changing landmass configuration and progressive opening of the Atlantic on ocean circulation, climate, and carbon cycling in the Cretaceous
- Assess age of earliest marine sedimentation in the Argentina Basin, rates of South Atlantic deepening, and timing for the first evidence of northern-sourced water
- Understand controlling factors leading to the transition from ramp-type to shelf-to-slope-type basins
- Assess sedimentological and micropaleontological expression and temporal variations of Cretaceous OAEs
- Investigate the importance of ocean circulation versus productivity for OAE formation and determine the characteristics of the deepwater mass during the Late Cretaceous supergreenhouse.
- Examine the marine biotic response and recovery to the Cretaceous/Paleogene mass extinction in the southwestern Atlantic Ocean

Objective 3: Examine changes in ocean circulation, climate, and sedimentation on the ACVM from the Greenhouse world to the Icehouse world
- Investigate evidence for Andean uplift and its possible effects on climate (atmospheric circulation, oceanographic circulation, etc.).
- Examine ocean circulation evolution and its impact on sedimentation, including development of the contourite depositional system
- Assess the effects of major Cenozoic climatic changes on ocean circulation, paleoproductivity, sedimentation, and terrestrial ecosystems on the ACVM

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

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Proposed Sites (Total proposed sites: 6; pri: 2; alt: 4; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
AVCM-01A (Primary)	-42.873746 -57.551379	2163	1555	100	1655	Objective 1: Examine the natural and environmental impact of volcanic rift margin formation in the South Atlantic; Objective 2: Examine the impact of changing landmass configuration and progressive opening of the Atlantic on ocean circulation, climate, and carbon cycling in the Cretaceous
ACVM-02A (Alternate)	-42.919556 -57.551662	2213	1727	100	1827	Alternate for ACVM-01A. Objective 1: Examine the natural and environmental impact of volcanic rift margin formation in the South Atlantic; Objective 2: Examine the impact of changing landmass configuration and progressive opening of the Atlantic on ocean circulation, climate, and carbon cycling in the Cretaceous
AVCM-03A (Alternate)	-42.998175 -57.719045	2139	1685	100	1785	Alternate for ACVM-01A. Objective 1: Examine the natural and environmental impact of volcanic rift margin formation in the South Atlantic; Objective 2: Examine the impact of changing landmass configuration and progressive opening of the Atlantic on ocean circulation, climate, and carbon cycling in the Cretaceous
ACVM-10A (Primary)	-38.989043 -54.032863	3000	1120	100	1220	Objective 1: Examine the natural and environmental impact of volcanic rift margin formation in the South Atlantic; Objective 3: Examine changes in ocean circulation, climate, and sedimentation on the ACVM from the Greenhouse world to the Icehouse world
ACVM-11A (Alternate)	-39.021578 -54.056732	2949	1473	100	1573	Alternate for Site ACVM-10A. Objective 1: Examine the natural and environmental impact of volcanic rift margin formation in the South Atlantic; Objective 3: Examine changes in ocean circulation, climate, and sedimentation on the ACVM from the Greenhouse world to the Icehouse world
ACVM-12A (Alternate)	-39.142110 -54.150201	2854	875	100	975	Alternate for ACVM-10A. Objective 1: Examine the natural and environmental impact of volcanic rift margin formation in the South Atlantic; Objective 3: Examine changes in ocean circulation, climate, and sedimentation on the ACVM from the Greenhouse world to the Icehouse world