IODP Proposal Cover Sheet

Falkland water depth record

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Title	Multi-proxy intermediate water depth records from the Subantarctic SW Atlantic: Falkland Plateau
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Abstract

The global oceans overturning circulation is modulated by the transport of heat and freshwater by Subantarctic Mode Water (SAMW) and Antarctic Intermediate Water (AAIW) formed north of the Polar Front in the Southern Ocean. SAMW/AAIW supply nutrients and ventilate the thermocline through the southern-hemisphere and subtropics as well as facilitating the transfer of considerable quantities of anthropogenic gases into the ocean interior. The Subantarctic SW Atlantic is a key site of SAMW/AAIW formation, however, the lack of paleoceanographic reconstructions from intermediate water depths in this region have limited our understanding of the sensitivity and variability of these water-masses on suborbital to long-term timescales. We propose that Site SFSD_01A, South Falkland Slope Drift (SFSD), provides a unique opportunity to address Challenge 1 of the IODP Science Plan through the generation of high-resolution, multi-proxy records of the complex linkages between polar oceans, atmosphere and high latitude land processes and by reconstructing the physical, chemical and biological response to past changes in atmospheric pCO2 in this climatically sensitive region.

The SFSD, which exceeds 400 m in thickness, was deposited under the influence of the Antarctic Circumpolar Current where it emerges from the confines Drake Passage. Site SFSD_01A is located just north of the Subantarctic Front, ideally positioned to document past changes in AAIW properties close to source and/or migration of the boundaries between AAIW with overlying SAMW and underlying Upper Circumpolar Deep Water as their relative volumes changed. Preliminary paleoceanographic proxy records from gravity core GC528, recovered from 600 m water depth on the SFSD by the British Antarctic Survey in 2011, attest to the sensitivity of these sediments to record changes in hydrography, biological export flux and terrigenous influences over the last glacial cycle with sub-millenial to millennial resolution, given sedimentation rates averaging 6.5 cm/kyr through this interval. We request up to 5 days of JOIDES Resolution ship time to advance piston core (APC) three holes to refusal at SFSD_01A to extend these remarkable records. Recovery of at least 150 m of sediment will capture significant climatic episodes including the most recent ‘warm interglacials”of the Late Pleistocene, the Mid-Pleistocene transition (~1.20.6 Ma), when the global climate shifted from ~41 to ~100 ka periodicity and the Mid Pliocene Warm Period (3.3-3 Ma), a past warm climate which has been identified as the best analogue for possible future climate change.

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Scientific Objectives

The motivation to triple APC to refusal at site SFSD_1A is to recover an intact sedimentary record spanning at least the last 1 Ma, to:
1). Infer the relative production rates/depth of advection of Antarctic Intermediate Water (AAIW) in the SW Atlantic on millennial timescales and for the first time assess the sensitivity of these processes to orbital and longer-term climate cycles.
2). Document changes in the geochemical signature of AAIW to infer the relative influence of aged Southern Ocean deep water upwelled south of the Polar Front and/or AAIW imported from the SE Pacific via the 'old water route' through Drake Passage.
3). Quantify biogenic export fluxes to the core site to assess the sensitivity of this region to dust-borne Fe-fertilisation and/or variable pre-formed nutrient content within the mixed layer.
4). Link changes in primary production, AAIW export volume and chemical signatures to likely changes in the Southern Hemisphere Westerly Wind regime.
5). Provide the first long-term marine perspective of the evolution of the Patagonian Ice Sheet and its interaction with the SW Atlantic.
6). Provide the first long-term Subantarctic sea surface temperature records from the Subantarctic SW Atlantic to extend our understanding of Antarctic atmospheric temperatures beyond 800 kyrs.
7). Constrain the stratigraphy of the South Falkland Slope Drift to determine the timing and nature of observed unconformities and their relationship to episodes of ice-ocean-climate evolution, in turn allowing accurate interpretation of seismic data to form the basis for a full IODP proposal.

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

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
SFSD-1A	-53.2, -58.7	600	300	0	300	The motivation to triple APC to refusal at site FP_1A is to recover an intact sedimentary record to generate the first multi-proxy paleoceanographic record which integrates evidence for millennial to orbital scale variability in the ocean, atmosphere, nutrients, productivity and ice sheet dynamics in the SW Atlantic through at least the last 1 Ma.