

IODP Proposal Cover Sheet

Iberian Margin Paleoclimate

771 - Full 2

Title	Iberian Margin Depth Transect: Linkng Marine, Ice-core and Terrestrial Records of Global Change		
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Keywords	millennial-climate-variability, marine-ice-terrestrial correlation, deepwater circulation	Area	Southwest Iberian Margin

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Abstract

The Iberian Margin is well known as a source of rapidly accumulating sediment that contains a high-fidelity record of millennial-scale climate variability for the late Pleistocene. Nick Shackleton demonstrated that piston cores from this region can be correlated precisely to polar ice cores in both hemispheres (Shackleton, 2000, 2004). Moreover, the narrow continental shelf off Portugal results in the rapid delivery of terrestrial material to the deep-sea environment, thereby permitting correlation of marine and ice core records to European terrestrial sequences. Few places exist in the world where such detailed marine-ice-terrestrial linkages are possible. The continuity, high sedimentation rates, and fidelity of climate signals preserved in sediments make this region a prime target for ocean drilling.

During IODP Expedition 339, we drilled one of the proposed sites to 155.9 mbsf (APL-763). Site U1385 (Shackleton Site) recovered a complete record of hemipelagic sedimentation for the last 1.43 Ma (Marine Isotope Stage 47) with a mean sedimentation rate of 11 cm kyr⁻¹. Preliminary results from Site U1385 demonstrates the great promise of the Iberian margin to yield long records of millennial-scale climate change and land-sea comparisons.

Here we propose to extend this remarkable sediment archive through the Pliocene and recover a complete depth transect of sites. A dedicated site survey cruise in July-Aug 2013 has permitted us to refine the location of the five primary sites proposed in IODP 771-Full. The water depths at the proposed sites range from 1335 to 4657 mbsl, and are designed to complement those sites drilled during Expedition 339 (560 to 1073 mbsl). Together the sites will constitute a complete suite of down-core records with which to study past variability in the major subsurface water masses of the North Atlantic. Because nearly all the mass, thermal inertia, and carbon in the ocean-atmosphere system is contained in the deep ocean, understanding its role in climate change is the key to unlocking the underlying mechanisms of glacial-interglacial cycles and millennial-scale variation (Adkins, 2013).

Building on the success of Site U1385 and given the seminal importance of the Iberian margin for paleoclimatology and marine - ice - terrestrial correlations, additional drilling of this region by the IODP is warranted.

Scientific Objectives

1. Document the nature of millennial-scale climate variability for older glacial cycles of the Quaternary, including changes in surface and deep-water circulation during the ‘100-kyr world’; Mid Pleistocene transition, ‘41-kyr world’; and intensification of Northern Hemisphere Glaciation.
2. Derive a marine sediment proxy record for the Greenland Ice Core to examine the amplitude and pacing of millennial variability during older glacial stages.
3. Determine interhemispheric phase relationships (leads/lags) by comparing the timing of proxy variables that monitor surface (Greenland) and deep-water (Antarctic) components of the climate system, thereby overcoming problems of age determination on millennial and submillennial time scales.
4. Study how changes in orbital forcing and glacial boundary conditions affect the character of suborbital-scale climate variability and, in turn, how millennial-scale variability interact with orbital geometry to produce the observed glacial-to-interglacial patterns of climate change.
5. Reconstruct the climate transitions into (inception) and out (termination) of glacial periods at high temporal resolution.
6. Reconstruct the history of changing local dominance of northern-sourced versus southern-sourced deep water using the depth transect of IODP sites on orbital and suborbital time scales during the Quaternary.
7. Investigate climate during past interglacial periods, including the warm Pliocene period prior to the intensification of Northern Hemisphere glaciation.
8. Link terrestrial, marine and ice core records by analyzing pollen and terrestrial biomarkers that are delivered to the deep-sea environment by rivers.
9. Contribute to the development of a global stratigraphy having sufficient resolution to study abrupt climatic events and their phase relationships

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

none

Proposed Sites

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
SHACK-16A	37.534, -10.151	2720	400	0	400	<ol style="list-style-type: none"> 1. Recover millennial-scale marine reference section for the Quaternary 2. Provide marine sediment analog to the polar ice cores. 3. Surface hydrography and upwelling 4. Reconstruct deepwater circulation changes from the core of NEADW (i.e., mixing ratio of southern and northern component water). 5. Facilitate marine-terrestrial correlations. 6. Astronomically-tuned timescale for the Plio-Pleistocene
SHACK-15A	37.803, -10.180	3198	500	0	500	<ol style="list-style-type: none"> 1. Plio-Pleistocene marine reference section 2. Reconstruct deepwater circulation changes (i.e., mixing ratio of southern and northern component water). 3. History of the intensification of Northern Hemisphere glaciation 4. Plio-Pleistocene record of terrestrial

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SHACK-14A	37.581, -10.359	3467	400	0	400	1. Plio-Pleistocene marine reference section 2. Reconstruct deepwater circulation changes (i.e., mixing ratio of southern and northern component water) from a site near the mixing zone between LDW and NEADW. 3. History of the intensification of Northern Hemisphere glaciation and Middle Pleistocene Transition 4. Plio-Pleistocene record of terrestrial vegetation changes 5. Surface and subsurface biosphere
SHACK-13A	37.725, -10.510	3805	400	0	400	1. Plio-Pleistocene marine reference section 2. Reconstruct deepwater circulation changes (i.e., mixing ratio of southern and northern component water) from a site near the mixing zone between LDW and NEADW. 3. History of the intensification of Northern Hemisphere glaciation and Middle Pleistocene Transition 4. Plio-Pleistocene record of terrestrial vegetation changes 5. Surface and subsurface biosphere
SHACK-12A	37.591, -10.677	4179	400	0	400	1. late Miocene-Pleistocene reference section 2. History of deep overturning circulation. Monitor the influence of northern and southern source deep waters through the late Miocene-Quaternary. 3. Interglacial conditions including Pliocene warm period 4. History of the intensification of Northern Hemisphere glaciation and Middle Pleistocene transitions 5. late Miocene-Pleistocene record of terrestrial vegetation changes 6. History of the Atlantic lysocline and carbonate ion variations 7. Date and identify the nature of acoustic transition at ~6.6 twt
SHACK-11A	37.619, -10.707	4685	400	0	400	1. late Miocene-Pleistocene reference section 2. History of deep overturning circulation. Monitor the influence of northern and southern source deep waters through the late Miocene-Quaternary. 3. Interglacial conditions including Pliocene warm period 4. History of the intensification of Northern Hemisphere glaciation and Middle Pleistocene transitions 5. late Miocene-Pleistocene record of terrestrial vegetation changes 6. History of the Atlantic lysocline and carbonate ion variations 7. Date and identify the nature of acoustic transition at ~6.6 twt
SHACK-10A	37.920, -9.548	1335	500	0	500	1. Late Miocene-Quaternary history of

-	-	-	-	-	-	<p>lower MOW</p> <ol style="list-style-type: none"> 2. Significance of MOW on thermohaline circulation 3. MOW history during the intensification of Northern Hemisphere glaciation 4. Oceanic record of the Messinian Salinity Crisis 5. How does the history of MOW compare at this distal deep site compared to that inferred at more proximal sites to Gibraltar (Hernandez-Molina et al., 2014)?
SHACK-04B	37.566, -10.128	2587	400	0	400	<ol style="list-style-type: none"> 1. Recover millennial-scale marine reference section for the Quaternary 2. Provide marine sediment analog to the polar ice cores. 3. Surface hydrography and upwelling 4. Reconstruct deepwater circulation changes from the core of NEADW (i.e., mixing ratio of southern and northern component water). 5. Facilitate marine-terrestrial correlations. 6. Astronomically-tuned timescale for the Plio-Pleistocene
SHACK-09A	37.852, -10.150	3080	500	0	500	<ol style="list-style-type: none"> 1. Plio-Pleistocene marine reference section 2. Reconstruct deepwater circulation changes (i.e., mixing ratio of southern and northern component water). 3. History of the intensification of Northern Hemisphere glaciation 4. Plio-Pleistocene record of terrestrial vegetation changes 5. Surface and subsurface biosphere
SHACK-08A	37.710, -10.494	3740	400	0	400	<ol style="list-style-type: none"> 1. Plio-Pleistocene marine reference section 2. Reconstruct deepwater circulation changes (i.e., mixing ratio of southern and northern component water) from a site near the mixing zone between LDW and NEADW. 3. History of the intensification of Northern Hemisphere glaciation and Middle Pleistocene Transition 4. Plio-Pleistocene record of terrestrial vegetation changes 5. Surface and subsurface biosphere
SHACK-07A	37.605, -10.692	4657	400	0	400	<ol style="list-style-type: none"> 1. late Miocene-Pleistocene reference section 2. History of deep overturning circulation. Monitor the influence of northern and southern source deep waters through the late Miocene-Quaternary. 3. Interglacial conditions including Pliocene warm period 4. History of the intensification of Northern Hemisphere glaciation and Middle Pleistocene transitions 5. late Miocene-Pleistocene record of terrestrial vegetation changes 6. History of the Atlantic lysocline and carbonate ion variations 7. Date and identify the nature of

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