IODP Proposal Cover Sheet

965 - Pre

Jurassic-Cretaceous Paleoceanography (Leg 1/11)

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Title	Back to the Jurassic and Early Cretaceous: DSDP Legs 1 and 11 Revisited 50 Years Later
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Keywords	Jurassic, Cretaceous, paleoceanography, carbonate chemistry
Area	western North Atlantic; redrill of 8 sites spot cored by DSDP Leg 1 and Leg 11.

Proponent Information

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Abstract

Deep time drilling objectives have not been priority targets during ODP and IODP. Early expeditions of DSDP drilled deep time objectives (Jurassic and Lower Cretaceous) at numerous sites, but many of these sites were spot cored. Drilling technologies have vastly improved over the past 50 years, as has the nature of scientific investigations into our planet's history. We propose to redrill six primary sites originally spot cored by DSDP Leg 1 (1968: Sites 4 and 5) and DSDP Leg 11 (1970: Sites 99, 100, 101, and 105) with the purpose of recovering complete, multiply-cored records of Oxfordian (~163 Ma) through Maastrichtian (66 Ma). The primary targets are shallow (~300 mbsf) or relatively shallow (600-700 mbsf). We know from several of these sites that the preservation of calcareous foraminifera and organic matter provides good evidence for the recovery of Mesozoic proxy records.

The Mesozoic records striking changes in sea level, paleogeography, and ocean circulation; the evolution of terrestrial and marine organisms was facilitated in large part by the warm, equable climates that characterized much of the Jurassic and Early Cretaceous. Uplifted land-based marine sections, particularly in Europe and in the Himalaya region, have provided important insights into the paleoclimate and paleoceanography of the Mesozoic. However, the Deep Sea Drilling Project demonstrated the presence of situ sequences suitable for high resolution paleoceanographic analyses and modeling.

Subsiding continental margins adjacent to the new North Atlantic Ocean basin and its subsequent connection with the Gulf of Mexico, Caribbean, and with the South Atlantic during the Mesozoic provided an evolution of tectonic gateways for ocean circulation and ventilation of the deep-sea. Scientific objectives will focus on the following: (a) Changing ocean chemistry (e.g., declining Mg/Ca, changing depths of the CCD), (b) multiple Oceanic Anoxic Events, (c) impact of the evolution of the major phytoplankton groups and its effect on oceanic productivity and global carbon cycling, (d) changing water mass sources in response to changing sea level, global climate, and ocean gateways, and (e) paleoceanographic factors that caused Middle Jurassic-Early Cretaceous benthic foraminiferal assemblages to exploit the deep sea and become stratified relative to paleowater depth. The drilling expedition proposed here is in some ways analogous to NASA's plan to analyze lunar samples for the first time since they were collected 50 years ago, except in our case, we fully expect to have much better recovery at multiply cored sites and fresh samples to analyze.

Scientific Objectives

1. To determine the relationship between the explosive radiation of dinoflagellates and calcareous nannoplankton and the history of the CCD in the deep Mesozoic North Atlantic, as well as the relationship between oceanic productivity and the accumulation of organic matter.
2. To establish the rate and timing of secular changes in the Mg/Ca ratio of the deep North Atlantic in relation to likely loci of hydrothermal activity, especially the transition from Late Jurassic aragonite seas (with high Mg/Ca) to mid-Cretaceous calcite seas (reduced Mg/Ca) as context for possible selection pressures that influenced the evolution and changing assemblages of micro- and macro-calcifiers.
3. To test the resilience of ecosystems and biotas to major environmental perturbations, including the 11 OAEs of the Mesozoic, with variable global extent, but most are better documented in the Atlantic and surrounding continental seas. These events will be targeted to examine if the general trends among Jurassic, Early Cretaceous, and Late Cretaceous OAE's help discriminate among proposed OAE triggering mechanisms.
4. To understand how the major changes in Late Jurassic-Early Cretaceous deep sea benthic foraminiferal assemblages inform us about primary productivity, seasonality, the biological pump, and bentho-pelagic coupling for organisms of the largest habitat on Earth.
5. To identify changing sources of deep water masses during the Mesozoic and examine their relationship to climate evolution. Deep and intermediate water masses likely had multiple sites of origin, including low latitude shelf environments that produced warm saline water masses, and higher latitude seas that produced cooler deep waters.

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

Proposed Sites (Total proposed sites: 7; pri: 5; alt: 2; N/S: 0)

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
WNAJK-01A (Primary)	34.8953 -69.1733	5251	633	20	653	Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, Tithonian-Barremian Blake-Bahama Formation, and the Oxfordian-Tithonian Cat Gap Formation.
WNAJK-02A (Alternate)	32.3200 -67.6667	5117	791	2	793	Upper Eocene to Pleistocene Blake Ridge Formation, Paleocene-middle Eocene Bermuda Rise Formation, Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, and the Tithonian-Barremian Blake-Bahama Formation.
WNAJK-03A (Primary)	23.6857 -73.8498	4914	278	20	298	Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, Tithonian-Barremian Blake-Bahama Formation, and the Oxfordian-Tithonian Cat Gap Formation.
WNAJK-04A (Primary)	24.4780 -73.7920	5320	259	20	279	Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, Tithonian-Barremian Blake-Bahama Formation, and the Oxfordian-Tithonian Cat Gap Formation.
WNAJK-05A (Primary)	24.6878 -73.7997	5325	331	20	351	Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, Tithonian-Barremian Blake-Bahama Formation, and the Oxfordian-Tithonian Cat Gap Formation.
WNAJK-06A (Alternate)	24.7265 -73.6410	5354	278	20	298	Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, Tithonian-Barremian Blake-Bahama Formation, and the Oxfordian-Tithonian Cat Gap Formation.
WNAJK-07A (Primary)	25.1988 -74.4385	4868	1000	20	1020	Uppermost Maastrichtian Crescent Peak Member, Upper Cretaceous Plantagenet Formation, mid-Cretaceous Hatteras Formation, Tithonian-Barremian Blake-Bahama Formation, and the Oxfordian-Tithonian Cat Gap Formation.