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IODP Proposal Cover Sheet

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☒ **New** ☐ **Revised** ☐ **Addendum**

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Please check if this is Mission proposal	☐

Title:	**High North Atlantic Greenhouse to Icehouse Climates**		
Proponent(s):	H. Coxall, D. Mosher, J. Eldrett, J. Firth, I. Harding, C. Lear, B. Thomas, M. O'Regan and B. Wade		
Keywords: *(5 or less)*	Paleoceanography, Labrador Sea, Cenozoic	Area:	Southern Labrador Sea

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Permission to post abstract on IODP Web site: ■ Yes ☐ No

Abstract: (*400 words or less)*

Evidence for Antarctic glaciation and global cooling in the late Eocene to early Oligocene is widely accepted but there remains a great deal of uncertainty about the parallel history of northern hemisphere climate evolution, including the timing of the transition to bipolar glaciation and bipolar sources of deep-water production. This is surprising because the high northern latitude oceans represent some of the most climatically sensitive regions of the Earth and the deep water masses that form there play a key role in global thermohaline circulation, and hence global climate. Limits to our understanding are largely due to a lack of continuous sediment sections that contain calcareous microfossils suitable for high-resolution climate proxy reconstructions. This IODP pre-proposal calls for an expedition to redrill the exceptional middle Eocene-to early Oligocene sequence at ODP Site 647 in the southern Labrador Sea. Situated on the southern flank of Gloria Drift (53°N), this site remains the northernmost known carbonate-bearing sequence spanning this critical interval. Owing to low-permeability Paleogene clay lithologies it boasts a rare suite of exceptionally well-preserved calcitic, siliceous, and organic-walled microfossils (including terrestrial pollen and 'glassy' forams), which geochemical pilot studies demonstrate can provide coherent proxy signals of fundamental parameters such as sea surface, deep-sea and atmospheric temperature, pCO2 and water mass provenance/mixing. Regrettably, the Site 647 RCB cores have very low recovery and there is a lack of continuous coring (single hole). If adequately cored, the site offers enormous potential for filling a large gap in our understanding of high northern latitude climate history at a scale that resolves orbital influences. The improved cores will provide geochemical and sedimentary histories of (i) the influence of deep water movement over this site during extreme phases of the Cenozoic, (ii) constraints on early Cenozoic climate sensitivity (pCO2), and (iii) a history of Plio-Pleistocne ice-rafting and circulation to help constrain the dynamics of northern hemisphere glaciation. Ground-truthed by previous drilling, this site represents a great opportunity to capture detailed histories of "Extreme Climates" and climate transients in an under sampled but climatically sensitive region during past greenhouse and icehouse climates. Triple APC and XCB-coring, and optimized scheduling in the June-August weather window of a future expedition would ensure improved recovery. The objectives contribute to the IODP's "Extreme Climates" initiative.

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Scientific Objectives: (*250 words or less*)

The principal goal is to improve our understanding of the nature of climatic changes that occurred in the high northern latitudes during the Paleogene greenhouse and subsequent transition to an icehouse climate. An ancillary objective is to obtain a deep-water Pliocene-Quaternary glacial history. The objectives can be achieved by triple-coring to recover a continuous sedimentary sequence with excellent age control through the shallow burial, expanded, carbonate-bearing middle Eocene to early Oligocene sequence at ODP Site 647.
Examples of related questions are:

1. What were the Eocene 'base-line' ocean temperatures in the Labrador Sea during the Eocene greenhouse, and what was the extent of warming during 'hyperthermal' events?
2. What was the magnitude of sea surface and atmospheric cooling in high northern latitudes during the Eocene-Oligocene transition?
3. How did the thermal structure of water masses change in the Labrador Sea through the middle Eocene transient warming, the late Eocene and during the Eocene-Oligocene transition?
4. Was there accompanying change in northern hemisphere ice?
5. To what extent did changes in seawater density and evolving tectonic configuration of Arctic gateways influence early Cenozoic thermohaline circulation?
6. What is the significance of ubiquitous North Atlantic biosilica accumulations in the lower to middle Oligocene? What was the interplay between climate, surface productivity, dissolution, the carbon cycle, and the observed lithological and seismic stratigraphy?
7. What was the relationship between major ice discharges and deep-water currents during Plio-Pleistocene glacial cycles?

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

N/A

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
LABS-01A	53° 19.876'N 45° 15.717'W	3862	600	0	600	Paleogene and Pliocene-Quaternary paleoceanography