# IODP Proposal Cover Sheet

961 - APL

Gulf of Mexico Glacier-Methane Link

Received for: 2019-04-01

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| Title | Linking sediment deposition during glacial cycles and methane hydrate occurrence |
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| Keywords | glacial cycles, methane hydrate |
| Area | northern Gulf of Mexico |

## Proponent Information



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## Abstract


Methane hydrate is an ice-like clathrate composed of CH4 and H2O found within sediments on continental slopes worldwide, however, our ability to locate and quantify the amount of hydrate below the seafloor is poor. Herein, we hypothesize that methane hydrate in laterally extensive marine mud layers is associated with glacial sealevel lowstands. If true, this may provide a new approach to identifying and quantifying low-concentration methane hydrate below the seafloor. The eustatic sealevel decrease during glaciations increases the concentration and preservation of particulate organic carbon which may be caused by higher sediment supply, shelf bypass, and higher marine biological productivity. Over time, the labile fraction of organic carbon in marine mud is consumed by microbes and eventually causes the reactions that generate methane. As more methane is generated, the dissolved methane concentration in the pore water eventually reaches solubility, and methane hydrate forms within marine mud. We hypothesize that increased organic carbon deposited during glacial sealevel lowstands could explain hydrate in laterally extensive, strata-bound marine mud units worldwide.

We propose to test this hypothesis in the Terrebonne minibasin, located on the northern Gulf of Mexico continental slope. At Terrebonne, we are able to leverage high resolution 2D seismic, two logging-while-drilling (LWD) scientific boreholes with data starting at the seafloor, and controlled-source electromagnetic surveys to investigate the Mendenhall Unit. The Mendenhall Unit is a marine mud unit where hydrate is observed at low concentration on LWD data and models suggest this unit could be related to the Wisconsin glacial lowstand.

At Terrebonne, the Mendenhall Unit is the shallowest of three hydrate-bearing marine mud units. Exploring only the Mendenhall Unit to a depth of 152 mbsf (less than 500 ft) at three sites will allow us to avoid stringent US offshore drilling regulations and permit the JR to drill in the northern Gulf of Mexico. At three sites, we will use continuous sediment core to determine the concentration of labile and refractory organic carbon, sediment age, and sedimentation rates as well as characterize the pore water geochemistry, gas geochemistry and the microbial communities. To identify the occurrence of gas hydrate, we will use LWD data, wireline logs, and infrared camera images of core. We will integrate all of these data to test the hypothesis that the increased preservation of particulate organic carbon during glacial sealevel lowstands effects the occurrence of methane hydrate in marine muds.

## Scientific Objectives

Our objective its to test the hypothesis that laterally extensive hydrate bearing marine mud units are related to increased organic carbon concentration and preservation occurring during glacial sealevel lowstands. At three sites in the Terrebonne minibasin, we will investigate the Mendenhall Unit, a laterally extensive marine mud unit containing low concentration gas hydrate in near-vertical fractures. We propose to collect continuous sediment core through the Mendenhall Unit to determine the concentration of labile and refractory organic carbon, sediment age, and sedimentation rates as well as characterize the pore water geochemistry, gas geochemistry and the microbial communities. To identify the occurrence of gas hydrate, we will use LWD data, wireline logs, and infrared camera images of core.

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

We request the to use inferred cameras to image the temperature of the core directly after core recovery, especially at Sites TB-02A and TB-03A.

# Proposed Sites (Total proposed sites: 3; pri: 3; alt: 0; N/S: 0)

| Site Name | Position (Lat, Lon) | Water Depth (m) | Penetration (m) | | | Brief Site-specific Objectives |
|---|---|---|---|---|---|---|
| | | | Sed | Bsm | Total | |
| TB-01A (Primary) | 26.6628 -91.6762 | 1966 | 152 | 0 | 152 | Site TB-01A will serve as a control site to TB-02A and and TB-03A, where little to no gas hydrate is observed and the Mendenhall Unit thins or pinches out. We will core this hole to 152 mbsf, which will allow sampling and dating of the stratigraphy surrounding the Mendenhall Unit; in addition, we will collect heat flow measurements in this hole. We will also collect a second core in the 'B' hole to 50 mbsf for high resolution geochemistry and microbiology. |
| TB-02A (Primary) | 26.6633 -91.6842 | 1999 | 152 | 0 | 152 | At Site TB-02A, we will core to 152 mbsf through the Mendenhall Unit for sampling and age dating and collect heat flow measurements. We will also collect a second core in the 'B' hole to 30 mbsf for high resolution geochemistry and microbiology. The 'B' hole is the shallowest of the 3 sites because we observe hydrate in the LWD hole at this site at 27 mbsf. We will also wireline log this hole, so that the wireline logs can be easily compared with Site TB-03A. |
| TB-03A (Primary) | 26.6615 -91.6862 | 2004 | 152 | 0 | 152 | At Site TB-03A, we will core to 152 mbsf through the Mendenhall Unit for sampling and age dating and collect heat flow measurements and to understand what lateral changes occur in the Mendenhall Unit. We will also collect a second core in the 'B' hole to 40 mbsf for high resolution geochemistry and microbiology. We will also wireline log this hole to compare to the LWD data and the wireline logs at TB-02A. |