IODP Proposal Cover Sheet

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W Atlantic Passive Margin Landslide

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Title	The Role of Pressure and Temperature in Quaternary Retrogressive Landslides in the Western North Atlantic
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Keywords	Landslides, Geomechanics, Pressure, Atlantic, Temperature
Area	Eastern North American Margin, offshore United States

Proponent Information

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Abstract

The focus of this proposal is to quantify and constrain the physical stress state of passive margin sediments at submarine landslide headwalls, where retrogressive slope failure occurs, and from this, determine, how perturbations to the marine environment (including changes in sedimentation, temperature, pressure) will impact future slope stability. We propose to answer these fundamental questions on the Eastern North American Margin where several of the world's largest submarine landslides occur; the Cape Fear, Currituck, and Cape Lookout Slide. Recently acquired high-resolution multi-channel seismic data along with and existing dataset of other geophysical data are available for site survey analysis. These locations offer an opportunity to understand the dynamics of geologically young retrogressive failures, the present state of stress and pore pressure, and the relative role of gas, salt tectonics, and pore pressure controls on slope stability. This pre-proposal is one of 2 pre-proposals (see pre-proposal by Daigle et al.,) that were stimulated by the recent IODP Workshop "Drilling strategies for assessing links between Quaternary Gulf Stream dynamics, pore pressure evolution, and slope stability on the Western North Atlantic Margin" (April 11-13, 2017). Though there are several theoretical and numerical models considering how retrogressive failure may occur, the mechanisms that lead to failure remain a fundamental geological question. To understand retrogressive failure, we need to know 1) the variation in material properties upslope (i.e. in the direction of retrogression), 2) the depth to failure plane and 3) the stratigraphy. These factors can only be assessed by drilling and collecting pressure and physical property measurements and sediment core. A focused analysis of these properties coupled with pore pressure analysis will allow us to make fundamental steps to illuminate the retrogressive landslide process and significantly improve theoretical and numerical models.

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Scientific Objectives

The objectives of this proposal are to quantify and constrain the physical stress state of passive margin sediments at slide headwalls, where retrogressive slope failure occurs, and from this, determine, how perturbations to the marine environment (including changes in sedimentation, temperature, pressure) will impact future slope stability on the Western North Atlantic Margin. We will constrain temperature and pressure with depth, sediment strength, and the frequency of failures and determine (1) the pore-pressure and temperature profiles across the Cape Fear and Currituck Slides and if temperature and pore pressure varies spatially, (2) what the necessary stress conditions are for failure today, and (3) if the timing of past failures at this site correlate with the timing for pore-pressure rebound or the onset of hydrate dissociation. These field data and post-expedition geotechnical work will provide crucial constraints for forward modeling the dynamics of heat and fluid. As we integrate sediment depositional processes, slope failure and its recurrence, and evolution of the gas hydrate stability field, we will provide information on Earth in Motion at time-scales ranging from 100kys to yrs. The findings of this scientific drilling program will increase our understanding of the processes driving submarine landslides and how slope stability evolves in response to ocean temperature changes, and therefore to climate forcing.

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

Non-standard measurements include the T2P (Temperature-Two Pressure) probe for in-situ temperature and pressure, logging-while-drilling tools, and sterile laboratories for microbiological subsampling.

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

Site Name	Position (Lat, Lon)	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
CFEAR-01A (Primary)	33.11967 -76.37655	878	200	0	200	APC coring, LWD, pore pressure, Temperature, geotechnical cores
CFEAR-02A (Primary)	33.10952 -76.34421	870	200	0	200	APC coring, LWD, pressure and temperature, geotechnical
CFEAR-03A (Primary)	33.10865 -76.34145	878	200	0	200	Coring, LWD, pressure and temperature, geotechnical
CFEAR-04A (Primary)	33.00358 -76.00875	2592	400	0	400	APC coring, LWD, in situ temperature and pressure, geotechnical
CFEAR-05A (Primary)	32.99413 -75.97901	2658	700	0	700	Coring, LWD, in situ pressure and temperature, geotechnical
CTUCK-01A (Primary)	36.26489 -74.61772	1250	200	0	200	Coring, LWD, in situ pressure and temperature, geotechnical
CTUCK-02A (Primary)	36.28647 -74.62472	1400	200	0	200	Coring, LWD, in situ pressure and temperature, geotechnical