APPLICATION FOR CONSENT TO CONDUCT MARINE SCIENTIFIC RESEARCH

1. General Information

1.1 Cruise name and/or number:	Exploration of the Greater Antilles (NA032) - F2013-048

1.2 Sponsoring institution(s):		
Name	Address	Name of Director
Ocean Exploration Trust	Dr. Katherine Croff Bell URI Narragansett Bay Campus South Ferry Road Narragansett, RI 02882	Dr. Robert Ballard

1.3 Scientist in charge of the project:	
Name:	Uri ten Brink
Country:	US
Affiliation:	U.S. Geological Survey
Address:	384 Woods Hole Road Woods Hole, Massachusetts 02543 US
Telephone:	508-457-2396
Email:	utenbrink@usgs.gov

1.4 Entity(ies) /Participant(s) from coastal State involved in the planning of the project:	
Name: Country: Affiliation: Address: Telephone: Fax: Email: Website (for CV and photo):	See Section 6.2.

2. Description of Project

2.1 Nature and objectives of the project:
We intend to use the E/V Nautilus to work off the north coast of Puerto Rico, proximal to where a large M7.2 1918 earthquake produced a tsunami that struck northwestern corner of the island. Multibeam bathymetry and additional seismic profiles have identified a large landslide in that area and hydrodynamic models suggest that it could have been the source of the tsunami. This target will be investigated with the Hercules-Argus ROV system. We will also dive along several transects up the vertical walls of the Mona Rift (4000 to 1500 m depth). The Septentrional fault is the major strike-slip fault taking the oblique motion between the Caribbean and North American plate. Its offshore extension at depths of 1000-2000 m is clearly observed on multibeam bathymetry. The fault ends in an unusual circular depression, not seen in any major strike-slip fault system around the world. We intend to investigate this feature and other nearby faults north of the island with the ROV system. Fluid flow is highly likely along these faults and the nature of biological communities in the region will be explored. There also may be mud volcanoes along the faults that will be investigated. A transect along the tilted carbonate platform north of Puerto Rico will provide evidence for slope failure and fissure development within the platform, which are probably induced by fresh water seepage. The platform was horizontal near sea level until 3 m.y. ago, but its northern edge is now at depths of 2500-4000 m. The transect can be extended farther north down the 1-1.5 km thick cliff-like edge of the carbonate platform, which will provide a geological cross-section as well as likely fresh water seepages. Mona Passage to the west of the island, into waters of the Dominican Republic, will be investigated. This passage is one of the entry points for surface Atlantic waters that circulate into the Caribbean. The water become warmer and saltier in the Caribbean and returns back to the Atlantic via the Gulf of Mexico as the Gulf Stream. Multibeam bathymetry clearly shows flow marks on the seafloor across the shallowest parts of the passage that will be investigated with the ROV to explore the nature of the seafloor and the diversity of biological communities. The passage is crossed by many normal faults that are probably active, but because of current erosion, the surface is cleared of recent sediments. Targeted dives to find pockets of sediments offset by the faults will be sampled and dated. The 1867 Virgin Islands earthquake and tsunami devastated both St. Thomas and St. Croix. The source of the earthquake is unknown, but using multibeam bathymetry and tsunami modeling the likely fault has been located along a scarp crossing the northern wall of the Virgin Islands Basin. We intend to verify the location and orientation of this fault with direct seafloor observations, because the wall is almost devoid of sediment. This region will also be investigated with a vertical transect across the northern wall of the Virgin Islands basin from depths between 4000 m and 50 m. Additionally, there are some faults and mounds on the floor of the Virgin Islands Basin that could focus fluid flow and the biology of these regions will be investigated, sampled and imaged. Anegada Passage, which is mostly in British Virgin Islands EEZ, is the only conduit for Atlantic intermediate water into the Caribbean Sea. All other waters entering the Caribbean Sea from the central Atlantic are surface waters because the other sills are only a few hundreds of meters deep. Most of the intermediate waters were thought to run along the northern wall of the passage but bathymetry and seismic stratigraphy suggest another route and a spillway for the waters farther south. This spillway is bounded by Barracuda bank, a narrow bank, which rises from a depth of 2000 m to 40 m over 3 km. The top of the bank is only 1 km wide and is flat. Nothing is known about the formation of the bank and the possible biological activity on its crest. This region will be explored with the ROV system.

2.2 Relevant previous or future research projects:
The USGS has been engaged in Caribbean exploration and research during the past decade. The foundation for this work was established with funding by Ocean Exploration to map the Puerto Rico trench using the multibeam sonar system aboard the NOAA

ship Ronald H. Brown. The work got additional boost from Congress following the 2004 Sumatra earthquake and tsunami. The work has since expanded to include diverse exploration methods such as multichannel seismic reflection, sediment coring, deployment of ocean bottom seismometers to record earthquakes, paleo-tsunami studies, installation of GPS stations, as well as additional multibeam bathymetry mapping. Mapping of more than 200,000 km2 of the ocean floor around Puerto Rico and the Virgin Islands was completed with resolution varying from 150 m to 5 m depending on water depth. Analysis and modeling of various data sets, the assembly of historical earthquake catalog, and geophysical modeling followed. The work led to a detailed view of the Caribbean in scales ranging from several hundred kilometer deep upper mantle to a few centimeter thick storm and tsunami deposits. It led to understand many (but not all!) of the geological processes that shaped this part of the world and their associated natural hazards. The work was accomplished in cooperation with other government and academic institutions both within and outside the U.S., including the University of New Hampshire, the NOAA Office of Ocean Exploration and Research, the NOAA Pacific Marine Environmental Laboratory, and the NOAA Biogeography program.

2.3 Previous publications relating to the project:

Plate interaction in the NE Caribbean subduction zone from continuous GPS observations, Geophysical Research Letters, 2012. Significant Earthquakes on the Enriquillo Fault System, Hispaniola, 1500-2010: Implications for Seismic Hazard, Bulletin of the Seismological Society of America, 2012. Historical perspective on seismic hazard to Hispaniola and the northeast Caribbean region, Journal of Geophysical Research, 2011. Accounts of Damage from Historical Earthquakes in the Northeastern Caribbean, to Aid in the Determination of their Location and Intensity Magnitudes, U.S. Geological Survey Open-File Report 2011-1133, 2012. Inland fields of dispersed cobbles and boulders as evidence for a tsunami on Anegada, British Virgin Islands, Natural Hazards, 2011. Homotrema rubrum (Lamarck) taphonomy as an overwash indicator in Marine Ponds on Anegada, British Virgin Islands, Natural Hazards, 2011. Probable tsunami origin for a Shell and Sand Sheet from marine ponds on Anegada, British Virgin Islands, Natural Hazards, 2011. Gravity modeling of the Muertos Trough and tectonic implications (north-eastern Caribbean), Marine Geophysical Researches, 2010. Geomorphic and stratigraphic evidence for an unusual tsunami or storm a few centuries ago at Anegada, British Virgin Islands, Natural Hazards, 2010. Extension in Mona Passage, Northeast Caribbean, Tectonophysics, 2010. Tsunami simulations of the 1867 Virgin Island earthquake: Constraints on epicenter location and fault parameters, Bulletin of the Seismological Society of America, 2010. NOAA/West Coast and Alaska Tsunami Warning Center Atlantic Ocean Response Criteria, Science of Tsunami Hazards, 2009. Far field tsunami simulations of the 1755 Lisbon earthquake: Implications for tsunami hazard to the U.S. East Coast and the Caribbean, Marine Geology, 2009. Morphotectonics of the central Muertos thrust belt and Muertos Trough (northeastern Caribbean), Marine Geology, 2009. Bivergent thrust wedges surrounding oceanic island arcs: Insight from observations and sandbox models of the northeastern Caribbean plate, Geological Society of America Bulletin, 2009. Coarse-clast ridge complexes of the Caribbean: A preliminary basis for distinguishing tsunami and storm-wave origins, Journal of Sedimentary Research, 2008. Tsunami probability in the Caribbean region, Pure and Applied Geophysics, 2008. Submarine landslide as the source for the October 11, 1918 Mona Passage tsunami: Observations and modeling, Marine Geology, 2008. Size distribution of submarine landslides and its implication to tsunami hazard in Puerto Rico, Geophysical Research Letters, 2006. Submarine slides north of Puerto Rico and their tsunami potential, in Caribbean Tsunami Hazard, edited by A. Mercado and P. Liu, 2006. Vertical motions of the Puerto Rico Trench and Puerto Rico and their cause, Journal of Geophysical Research, 2005. Stress interaction between subduction earthquakes and forearc strikeslip faults: Modeling and application to the northern Caribbean plate boundary, Journal of Geophysical Research, 2004. New seafloor map of the Puerto Rico trench helps assess earthquake and tsunami hazards, EOS, Transactions, American Geophysical Union, 2004. Seismic and tsunami hazards in Puerto Rico and the Virgin Islands: A report on a USGS Workshop, March 23-24, 1999, EOS, Transactions, American Geophysical Union, 1999. Seismic and tsunami hazards in Puerto Rico and the Virgin Islands, U.S. Geological Survey Open-File Report 99-353, 1999. Joint Spanish-American research uncovers fracture pattern in northeastern Caribbean, Eos, Transactions, American Geophysical Union, 1998.

3. Geographical Areas

3.1 Indicate geographical areas in which the project is to be conducted (with reference in latitude and longitude, including coordinates of cruise track/ way points):

Northern boundary: 19.75d N Southern boundary: 17.0d N Western boundary: 68.5d W Eastern Boundary: 64.0d W

3.2 Attach chart(s) at an appropriate scale (1 page, high-resolution) showing the geographical areas of the intended work and, as far as practicable, the location and depth of sampling stations, the tracks of survey lines, and the locations of installations and equipment.

Chart provided - see Section 10.1.

4. Methods and Means to be Used

4.1 Particulars of vessel:	
Name:	NAUTILUS
Type/Class:	Ship
Nationality (Flag state):	Saint Vincent and the Grenadines
Identification Number (IMO/Lloyds No.):	6711883
Owner:	Humboldt Shipping
Operator:	Ocean Exploration Trust
Overall length (meters):	64.23
Maximum draught (meters):	4.90
Displacement/Gross tonnage:	1249.00
Propulsion:	single 1286 controllable pitch
Cruising:	10.00
Maximum speed:	12.00
Call sign:	J8B3605
INMARSAT number and method and capability	Inmarsat 437700078@inmc.eik.com

of communication (including emergency frequencies):	
Name of master:	Pavel Chubar
Number of crew:	17
Number of scientists on board:	31

4.2 Other craft in the project, including its use:
None

4.3 Particulars of methods and scientific instruments:		
Types of samples and measurements	Methods to be used	Instruments to be used
Acoustic seafloor, subseafloor, and water column mapping High-definition video footage; CTD; Dissolved oxygen; eH probe; Geological samples (cores and grab samples); Biological samples; Water samples; Gas samples; High-resolution microbathymetry; Stereo imaging; Structured light mapping; sidescan sonar	Multibeam sonar and sub-bottom profiler Underwater electronic still cameras; Underwater video cameras; CTD; eH probe; dissolved oxygen sensor; ROV-deployed sediment coring; suction sampler; Other ROV-based sampling tools (in development); High-frequency multibeam sonar; Mass spectrometry; Sidescan sonar	Kongsberg EM302 and Knudsen 15 kHz SBP Remotely Operated Vehicle Hercules; Remotely Operated Vehicle Argus

4.4 Indicate nature and quantity of substances to be released into the marine environment:
No

4.5 Indicate whether drilling will be carried out. If yes, please specify:
No

4.6 Indicate whether explosives will be used. If yes, please specify type and trade name, chemical content, depth of trade class and stowage, size, depth of detonation, frequency of detonation, and position in latitude and longitude:
No

4.7 Indicate whether protected species be studied. If yes, please specify:
No

5. Installations and Equipment

Details of installations and equipment (including dates of laying, servicing, method and anticipated timeframe for recovery, locations and depth, and measurements):
No

6. Dates

6.1 Expected dates of first entry into and final departure from the research area by the research vessel and/or other platforms:
Project Start Date: Oct 01, 2013
Project End Date: Oct 30, 2013

6.2 Coastal State-specific details:		
Coastal Area	Estimated Entry Date	Estimated Departure Date
Dominican Republic	Oct 04, 2013	Oct 19, 2013
Explanation of multiple entries: N/A		
Research will be performed: within 12 nm		
Extent to which Dominican Republic will be enabled to participate or to be represented in the research project: Invited participation onboard research vessel		
Name, affiliation and contact information for all participants from coastal state Dominican Republic:		
Coastal Area	Estimated Entry Date	Estimated Departure Date
United Kingdom	Oct 04, 2013	Oct 19, 2013
Explanation of multiple entries: N/A		
Research will be performed: within 12 nm		
Extent to which United Kingdom will be enabled to participate or to be represented in the research project: Invited participation onboard research vessel		
Name, affiliation and contact information for all participants from coastal state United Kingdom:		

7. Port Calls

No port calls

8. Participation of the representative of the coastal State

8.1 Modalities of the participation of the representative of the coastal State in the research project:
See Section 6.2.

8.2 Proposed dates and ports for embarkation/disembarkation:
See Section 6.2.

9. Access to Data, Samples and Research Results

9.1 Expected dates of submission to coastal State of preliminary report, which should include the expected dates of submission of the data and research results:
No more than 60 days from the end date of the research as provided in Section 6.1.

9.2 Anticipated dates of submission to the coastal State of the final report:
No more than 2 years from the end date of the research as provided in Section 6.1.

9.3 Proposed means for access by coastal State to data (including format) and samples:
Data will be provided through official channels at no cost to the coastal State(s). Samples will be provided upon request.

9.4 Proposed means to provide coastal State with assessment of data, samples and research results:
Assessment of data, samples and research results will be provided at no cost to the coastal State(s).

9.5 Proposed means to provide assistance in assessment or interpretation of data, samples and research results:
Assistance in further assessment or interpretation will be provided upon request.

9.6 Proposed means of making results internationally available:
All digital data will be given to the coastal state representative on external hard drives at the conclusion of the cruise. It may take up to 1 month to provide video data because files are very large (1 TB/day video collected) and it takes a significant amount of time to copy. Some data will also be available in real-time on a web-based portal, and will be archived at the University of Rhode Island Inner Space Center for access after the cruise. Rocks and Sediment: Marine Geological Sample Lab (Graduate School of Oceanography, University or Rhode Island) Biological Specimens: Harvard Museum of Comparative Zoology Genetic Subsamples: Ocean Genome Legacy

10. List of Supporting Documentation

10.1 List of attachments, such as additional forms required by the coastal State, etc.:

Attachment Type	Description	Attachment	Submission Date
Proposed Cruise Track	Proposed cruise working areas	5471406250_NA032 Map.pdf	Mar 29, 2013
Supplemental Material	Support letter for proposed research	2988437500_NA032 Nautilus cruise support letter.pdf	Apr 03, 2013