Final Project Instructions

Date Submitted: Friday July 15, 2011

Platform: NOAA Ship *Okeanos Explorer*

Cruise Number: EX-11-04

Project Title: Mid-Cayman Rise Exploration

Cruise Dates: August 01 – August 18, 2011

Prepared by: Kelley Elliott
Office of Ocean Exploration & Research

Approved by: _____ Dated: 7/15/11
Craig W. Russell
Program Manager
Office of Ocean Exploration & Research

Approved by: _____ Dated: 7/25/11
Captain David Score, NOAA
Commanding Officer
Marine Operations Center – Atlantic

I. **Overview**

A. Cruise Plan Period

This cruise plan covers the ships transit and underway data collection from Balboa, Panama (departing August 1, 2011) to the project operating area at the Mid-Cayman Rise, and finally to Key West, FL. Underway data will be collected during transits to and from the operating area in all coastal states (*permit pending*) except Columbia and Cuba. Primary mapping, CTD and ROV operations will be conducted in Cayman Islands waters under British jurisdiction.

B. Operating Area

The primary operating area will be in British national waters in the vicinity of the Cayman Islands. Significant transits through other coastal state EEZ's are required to get to and from the primary operating area.

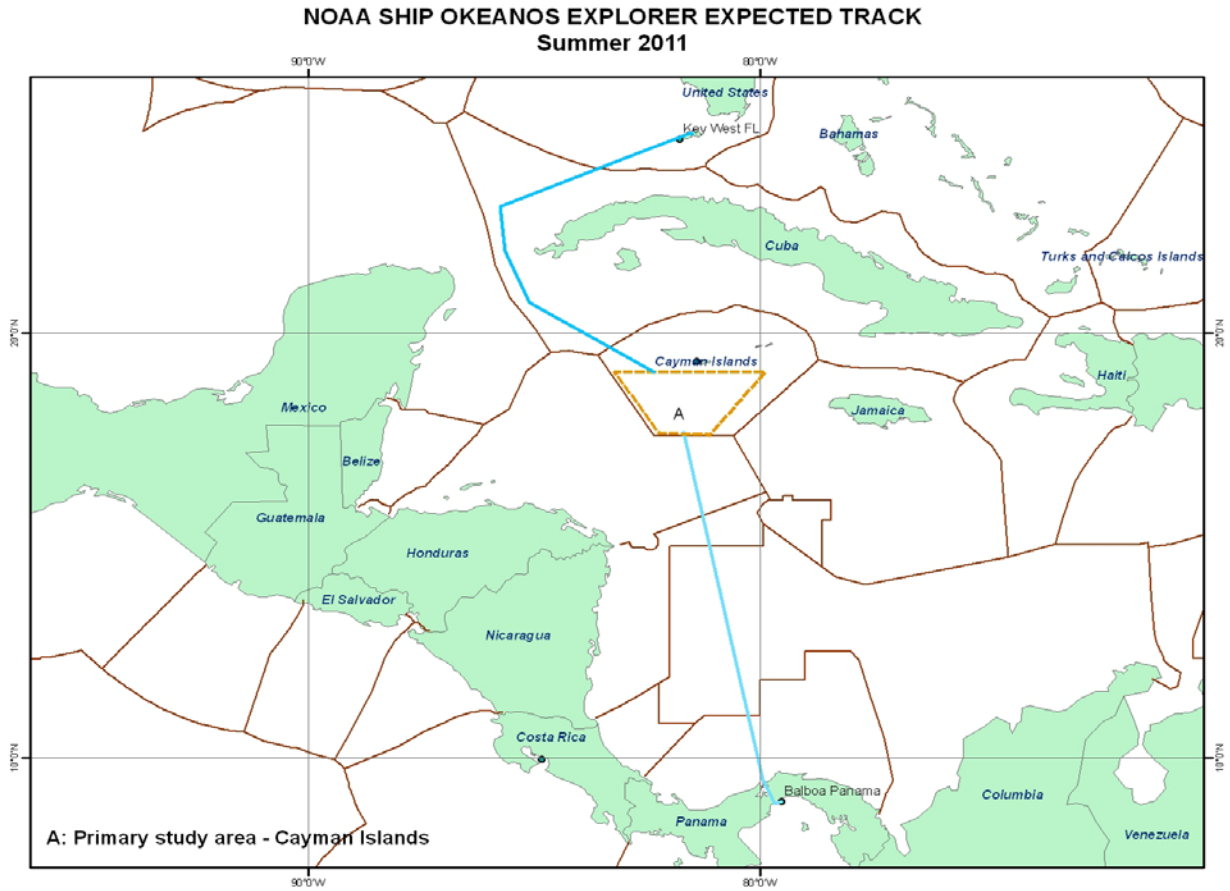

Figure 1. Depiction of general ship track including transit from Balboa, Panama to the primary operating area, and the transit to Key West, Florida. The dotted line represents flexible operating area boundaries in the vicinity of the Cayman Islands. Polygon A corresponds to the geographic area highlighted in Figure 2 below. The solid brown lines depict EEZ boundaries. The actual cruise tracks may vary.

General Transit Waypoints (Approximate)			
Point ID	**Latitude (N)**	**Longitude (W)**	**Depth**
T1	10.9989	-80.2801	Approximate entrance to Columbia EEZ
T2	14.9900	-81.0782	Approximate exit of Columbia EEZ, Entrance to Nicaragua
T3	15.7039	-81.2791	Approximate exit of Nicaragua EEZ, Entrance to Honduras EEZ
T4	17.5857	-81.6723	Approximate exit of Honduras EEZ, Entrance to Cayman Islands EEZ
T5	17.6580	-81.6885	Approximate entrance to primary operations area *(see figure 2)*
T6	19.1283	-82.0299	Approximate exit of primary operations area *(northwest corner, figure 2)*
T7	19.7611	-83.1746	Approximate entrance to Cuban EEZ
T8	23.8765	-83.5657	Approximate exit of Cuban EEZ

Table 1: General waypoints for the transit from Balboa, Panama to the Mid-Cayman Rise operating area, and on to Key West, Florida. The actual cruise tracks and way points may vary.

MSR Permit Request Operating Area			
Point ID	**Latitude (N)**	**Longitude (W)**	**Notes**
SE	17.65497713	-81.14671815	Southeast corner
NE	19.12083723	-79.98551435	Northeast corner
NW	19.12398889	-83.09545811	Northwest corner
SW	17.65358101	-82.17019371	Southwest corner

Table 2: Boundary coordinates for the operating area submitted to State as part of the Marine Scientific Research (MSR) permit request (polygon A in figure one, white polygon in Figure 2)

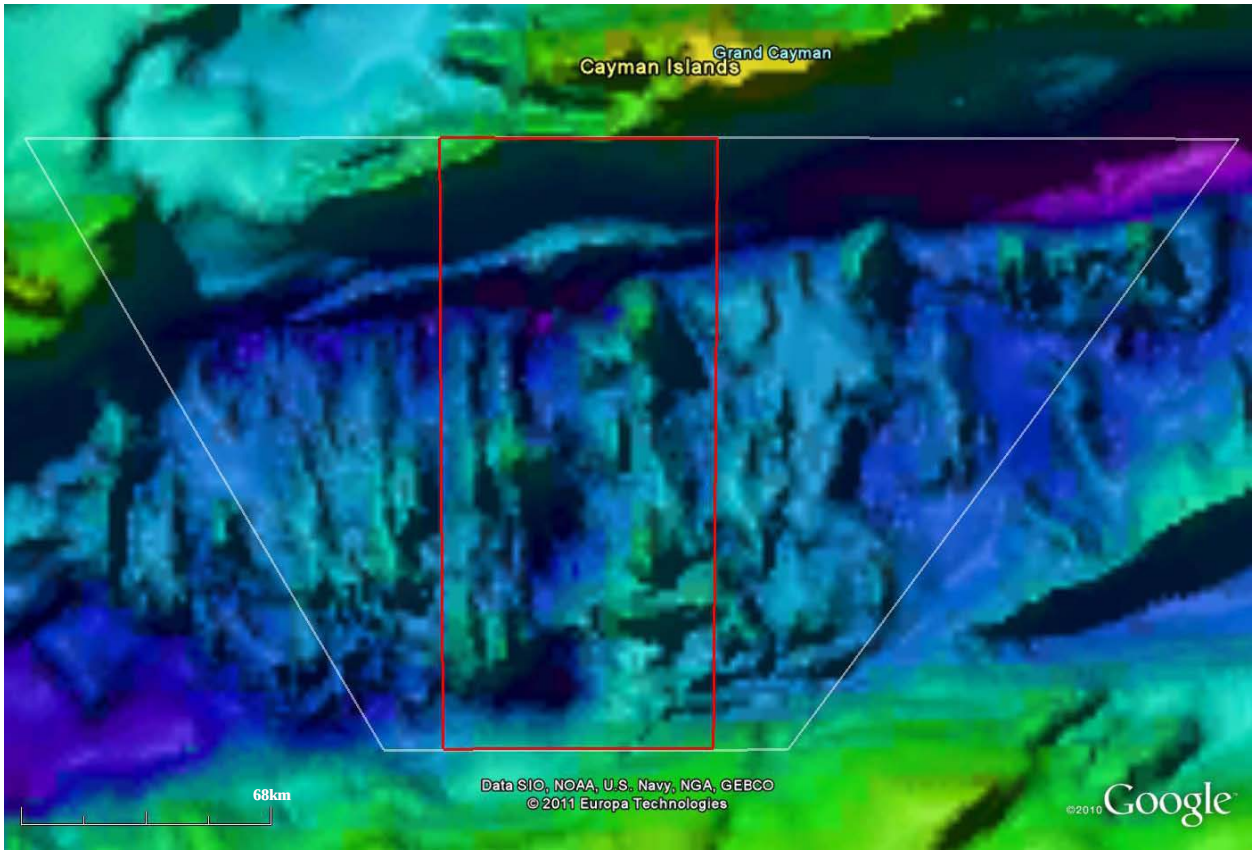

Figure 2.Closer look at the Google Earth image of the Mid-Cayman Rise (MCR) operating region highlighted in the yellow polygon in Figure 1. The white line represents the operating area outlined in the MSR permit request; the red box outlines the focused area of operation. Image created in GoogleEarth. Not for navigation.

Focused Operations Area			
Point ID	**Latitude (N)**	**Longitude (W)**	**Notes**
OpsSW	17.65707971	-82.01973782	Southwest corner
OpsSE	17.65940439	-81.33510327	Southeast corner
OpsNE	19.12734844	-81.32265185	Northeast corner
OpsNW	19.12828654	-82.02988574	Northwest corner

Table 3: Boundary coordinates for focused operations to be conducted during EX1104 (This is represented by the red box in Figures 2 and 3).

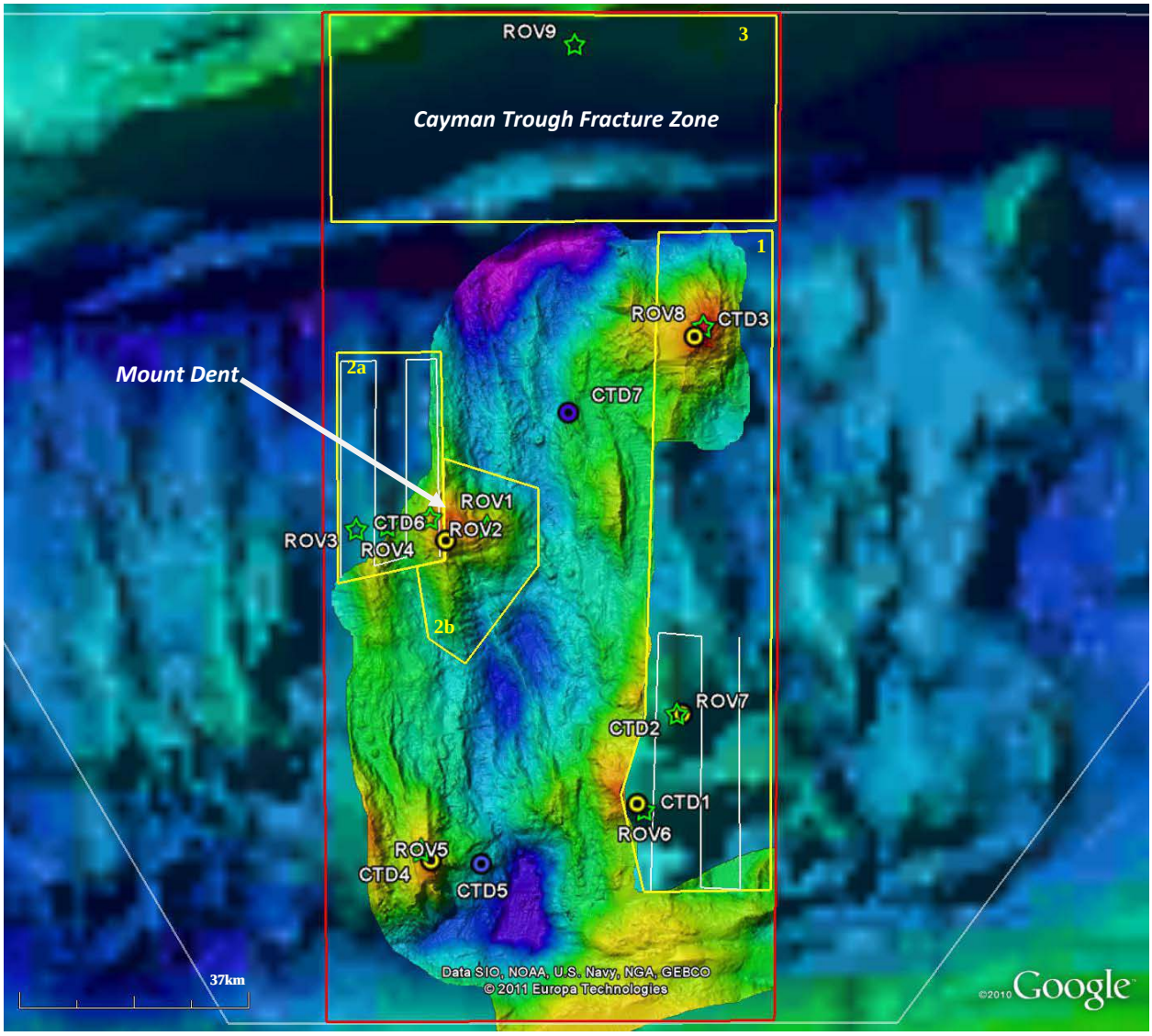

Figure 3. Projected EX1104 focused operations area. The yellow polygons outline priority mapping areas; the yellow and blue dots show the approximate location of potential CTD casts; and the green stars show the approximate location of possible ROV dives. The high-resolution imagery was acquired with funding from the French government and has been provided for operations and planning purposes. Image created in GoogleEarth. Not for navigation.

Mapping Area 1			
Point ID	**Latitude (N)**	**Longitude (W)**	**Notes**
1SW2	17.98948491	-81.56963025	Mapping Area 1, SW point 2
1SW	17.84785928	-81.53484869	Mapping Area 1, SW Corner
1SE	17.85062757	-81.34122519	Mapping Area 1, SE Corner
1NE	18.80897012	-81.33680620	Mapping Area 1, NE Corner
1NW	18.80609674	-81.51146130	Mapping Area 1, NW Corner

1SW3	18.10381852	-81.53268935	Mapping Area 1, SW point 3
Mapping Area 2a			
Point ID	**Latitude (N)**	**Longitude (W)**	**Notes**
2aSE	18.33031809	-81.83939224	Mapping area 2a, SE corner
2aNE	18.63244594	-81.84505589	Mapping area 2a, NE corner
2aNW	18.63166044	-82.00491981	Mapping area 2a, NW corner
2aSW	18.29657317	-82.00215541	Mapping area 2a, SW corner
Mapping Area 2b			
Point ID	**Latitude (N)**	**Longitude (W)**	**Notes**
2bNW1	18.33031865	-81.83850737	Mapping area 2b, Northwest point
2bNE2	18.32105930	-81.88183627	Mapping area 2b, Northeast point
2bSW5	18.21642717	-81.86374925	Mapping area 2b, Southwest point
2bSE4	18.18056124	-81.80718024	Mapping area 2b, Southeast point
2bE3	18.32196206	-81.69611678	Mapping area 2b, Eastern point
2bW7	18.43451591	-81.69523817	Mapping area 2b, Western point
2bW6	18.47834235	-81.84171338	Mapping area 2b, Western point
Mapping Area 3			
Point ID	**Latitude (N)**	**Longitude (W)**	**Notes**
3NE	19.12313468	-81.32934969	Mapping Area 3, NE Corner
3NW	19.12512576	-82.01763798	Mapping Area 3, NW Corner
3SW	18.82189293	-82.01432524	Mapping Area 3, SW Corner
3SE	18.82331704	-81.33144906	Mapping Area 3, SE Corner

Table 4: Boundary coordinates of priority mapping areas for EX1104 (This is represented by the yellow polygons in Figure 3).

CTD Cast Locations (Approximate)			
Point ID	**Latitude (N)**	**Longitude (W)**	**Depth**
CTD 1	17.97854407	-81.54274563	TBD
CTD 2	18.10897791	-81.47430323	TBD
CTD 3	18.25558105	-81.59799939	TBD
CTD 4	17.89590742	-81.85767764	TBD
CTD 5	17.89095368	-81.78086998	TBD
CTD 6	18.36105126	-81.83514043	TBD
CTD 7	18.54666667	-81.64783901	TBD

Table 5: Approximate location of potential CTD casts (This is represented by the yellow and blue dots in Figure 3).

Potential ROV Dive Sites (Approximate)			
Point ID	**Latitude (N)**	**Longitude (W)**	**Depth**
ROV 1	18.37918194	-81.77402128	TBD
ROV 2	18.39211861	-81.86083715	TBD

ROV 3	18.37563294	-81.97417846	TBD
ROV 4	18.38089005	-81.92657575	TBD
ROV 5	17.90886193	-81.87440669	TBD
ROV 6	17.96812935	-81.53361935	TBD
ROV 7	18.10765553	-81.48387684	TBD
ROV 8	18.67015882	-81.44267415	TBD
ROV 9	19.08147946	-81.63986916	TBD

Table 6: Approximate location of potential ROV dives
(This is represented by the green stars in Figure 3).

C. Summary of Objectives

Transit to and from the primary operating area

NOAA Ship Okeanos Explorer will collect underway multibeam and meteorological/ oceanographic (METOC) data during the transit to and from the primary area of operations at the Mid-Cayman Rise, except while in Columbian and Cuban EEZ's (no clearance request was submitted). The projected cruise track displayed in Figure 1 is provided as a general guide for the transit. Deviation from this is acceptable assuming that the final waypoints do not add considerable time to the transit.

Objectives during the transit to and from the operating area include:

1. Collection of EM302 data in coastal state waters for countries who have accepted the submitted Marine Scientific Research Clearance request.
2. Collect METOC data
3. Test and ensure telepresence communications
4. Test ship-to-shore collaboration tools (e.g. *Okeanos Explorer* portal, ftp site)
5. See the Data Management Plan *(Appendix I)*

Mid-Cayman Rise Exploration

These operations are expected to cover 10 days and 11-12 nights. Primary objectives include utilization of the full suite of *Okeanos Explorer* and mission capabilities (i.e., ROV, mapping, CTD and telepresence). Daytime operations will largely focus on ROV dives to explore targets identified using multibeam bathymetry (existing and acquired by NOAA Ship *Okeanos Explorer*) and CTD/rosette data. Evening/night operations will focus on acquiring multibeam data and conducting CTD/rosette operations. Operations are subject to change based on actual or potential discoveries.

1. Science
    - Locate, precisely, the first hydrothermal field (Von Damm) to be found on Mt Dent, characterize its geologic setting and use the ROV to obtain the first high quality HD video of both the geology of the site and the biological community present.

- Explore the rest of the summit of Mt Dent to understand its geologic setting and, ideally, locate a 2nd hydrothermal field (Europa) for which preliminary evidence exists (predicted to be of a Lost City type) to compare and contrast with the first site (Von Damm)
- Continue mapping off-axis to define the size and shape of the multiple other "Oceanic Core Complexes (OCCs)" that are geologically similar to Mt Dent, and line the walls of the Mid Cayman Rise.
- Use the CTD system, its *in situ* sensors, and shipboard analysis of samples for their dissolved methane concentrations to seek tell-tale signs of additional hydrothermal sources that may be hosted elsewhere along the Mid-Cayman Rise, including on top of the other OCCs we will map.
- Track any additional hydrothermal sites to source using the CTD and ROV in concert.
- Use the ROV to explore the top of at least one other OCC, even if we do not find evidence for more hydrothermal activity
- Map the north wall of the Cayman Trough fracture zone, immediately north of the Mid Cayman Rise
- Explore the cliff face of the Cayman Trough fracture zone using the ROV to examine what rock-types are exposed and what animals exist on the cliff face

2. ROV Operations
   - Daytime ROV dives on exploration targets
   - Ongoing training of pilots
   - Ongoing system familiarization and training

3. Telepresence (VSAT 20 Mbps ship-to-shore planned; 5 Mbps ship-to-shore if VSAT repairs are not successful; 1.54 Mbps shore–to-ship)
   - Test data and information sharing tools between ship and shore
     1. *Okeanos Explorer* Image Gallery
     2. ProBrowse
   - Continue to apply and refine SOP's
     1. *Okeanos Explorer* Portal
     2. *Okeanos Explorer* FTP Site
     3. iChat instant messaging
     4. *Okeanos Explorer* Image Gallery
     5. iChat eventlog chat room
     6. ProBrowse
   - Ongoing system familiarization and training

4. Mapping Operations
   - Conduct mapping operations of priority mapping areas identified by the science team
   - Continue cross training of ROV/mapping personnel
   - Continue testing data pipeline for daily transfer of raw .all files to shore.

5. CTD operations
    - Conduct vertical casts on exploration targets
    - Process water samples for methane using gas chromatograph (*see appendix II*)
    - Preserve water samples for post-cruise microbe and total carbon analysis (*see appendices III and IV*)
    - Conduct CTD Tow-Yo operations if requested during cruise

6. Communications between ship and shore
    - Test the engagement of scientists via internet1 if this becomes available, and the internet1-based collaboration tools

7. URI Exploration Command Center
    - Test the newly refurbished Exploration Command Center at URI
    - Train scientists how to use the online collaboration tools and technologies to conduct remote science; refine SOPs
    - Test the shore-side development of video products during an *Okeanos Explorer* Expedition
    - Test and refine new SOPs and products focused on providing situational awareness for operations, education & outreach
    - Test and refine shore-side web coordination SOPs
    - Ongoing system familiarization and training

8. Data management
    - See the Data Management Plan *(Appendix I).*
    - Deliver all data acquired within coastal state boundaries to the coastal state within 30 days of cruise completion.

9. Education and Outreach
    - Possible telepresence event August 8th (backup date August 9th) with media availability at the URI/ISC ECC. Senator Whitehouse and others from the RI delegation to give an early welcome to *Okeanos Explorer* as she gets closer to homeporting in Davisville, RI. Live feeds would be streamed to shore, and someone on the ship would speak to shore-side participants from the control room. Live feeds from E/V *Nautilus* may be streamed to URI's ISC as well.
    - During the cruise, OER personnel will collect underwater and topside video for overall NOAA use and for potential use in a National Geographic Television series. There may be specific times when we consider altering operations to ensure the best footage is obtained. Expedition Coordinator and ROV team leader will work with the ship to plan and execute the operations and related activities (e.g., interviews, etc)

D. Participating Institutions

National Oceanic and Atmospheric Administration (NOAA) Office of Ocean Exploration and Research (OER) 1315 East-West Hwy, Silver Spring, Maryland 20910

University of Rhode Island, Graduate School of Oceanography, Inner Space Center, Narragansett, Rhode Island, 02882

Woods Hole Oceanographic Institution MS24 Clark Laboratory, Woods Hole, MA 02543-1049

NOAA Pacific Marine Environmental Lab 7600 Sand Point Way NE, Seattle, WA 98115

Indonesia Agency for Marine and Fisheries Research Ministry of Marine Affairs and Fisheries (KKP) Jl Pasir Putih I Ancol Timur Jakarta Utara 14430 DKI Jakarta, Indonesia

Indonesia Agency for the Assessment and Application of Technology (BPPT) Technology Center for Marine Survey Jalan MH. Thamrin 8, BPPT Building I, 18th Floor, Jakarta Pusat, Indonesia 10340

University of New Hampshire (UNH) Center for Coastal and Ocean Mapping (CCOM) 24 Colovos Road, Durham, NH 03824 USA

Embassy of the United States – Jakarta, Indonesia Jl. Medan Merdeka Selatan No. 3 – 5 Jakarta 10110, Indonesia

University Corporation for Atmospheric Research (UCAR), Joint Office for Science Support (JOSS) PO Box 3000 Boulder, CO 80307

National Oceanography Centre, Southampton, University of Southampton Waterfront Campus, European Way, Southampton SO14 3ZH

Duke University Marine Lab, 135 Duke Marine Lab Road, Beaufort, NC 28516

University of Wyoming, Geology & Geophysics Department, 1000 E. University Ave. Laramie, WY 82071

National Geographic Society, 1145 17th Street N.W., Washington, D.C. 20036-4688

Marine Biological Laboratory, 7 MBL Street, Woods Hole, MA 02543

E. Personnel (Science Party)

	NAME	AFFILIATION	ROLE	M/F	STATUS	ON PREVIOUS LEG
1	Kelley Elliott	OER	Expedition Coordinator	F	US Citizen	N
2	Chris German	WHOI	Science Team Lead	M	UK Citizen/ P. Resident	N
3	Dave Lovalvo	OER	ROV Team Lead	M	US Citizen	Y
4	Meme Lobecker	OER	Mapping Team Lead	F	US Citizen	N
5	Webb Pinner	OER	Telepresence lead	M	US Citizen	Y
6	Dave Wright	UCAR	ROV Pilot/Co-pilot	M	US Citizen	Y
7	Tom Kok	UCAR	ROV Pilot/Co-pilot	M	US Citizen	Y
8	Bobby Mohr	UCAR	ROV Pilot/Co-pilot	M	US Citizen	Y
9	Chris Ritter	UCAR	ROV Pilot/Co-pilot	M	US Citizen	N
10	Karl McLetchie	UCAR	ROV Pilot/Co-pilot	M	US Citizen	Y
11	Jeff Williams	UCAR	ROV Pilot/Co-pilot	M	US Citizen	Y
12	Vincent Howard	UCAR	ROV Nav/Mechanical Engineer	M	US Citizen	Y
13	Jon Mefford	UCAR	ROV Nav/Mechanical Engineer	M	US Citizen	N
14	Roland Brian	UCAR	ROV Video Engineer	M	US Citizen	Y
15	Joe Biscotti	UCAR	ROV Video Engineer	M	US Citizen	Y
16	Brian Brinckman	UCAR	ROV Video Engineer	M	US Citizen	Y
17	Gregg Diffendele	UCAR	Data	M	US Citizen	Y
18	Paul Tyler	NOC	Scientist	M	UK Citizen	N
19	Cameron McIntyre	WHOI	Science Technician	M	Australian Citizen	N

Table 7: Full list of the science party and their affiliation

Shore-side Participants (Location and duration of participation will vary):

NAME		INSTITUTION	NOTE
Catalina	Martinez	NOAA	RI Regional Manager
Keeley	Belva	NOAA	Web Coordinator
Mike	Cheadle	U. Wyoming	Geologist
Barbara	John	U. Wyoming	Geologist
Jeff	Seewald	WHOI	Marine chemistry & geochemistry

Jill	McDermott	WHOI	Marine chemistry & geochemistry
Julie	Huber	MBL	Microbiology
Julie	Smith	MBL	Microbiology
Cindy	Van Dover	Duke	Biologist
Jameson	Clarke	Duke	Cindy's PhD Student
Diva	Amon	NOC	UK Scientist, Benthic biologist
Andreas	Hutahaean	BRKP	Indonesian Scientist
Max	Coleman	NASA JPL	Participate via I2 at NASA JPL
Sara	Bennett	NASA JPL	Participate via I2 at NASA JPL
Brendan	Reeser	NOAA NCDDC	OER Data Team

Table 8: List of the shore-side science participants to be based at the URI ISC during EX1104 (unless otherwise noted). Not all will participate for the entire duration of the cruise.

F. Administrative

Key Points of Contact

Ship Operations

Marine Operations Center, Atlantic (MOA)
439 West York Street
Norfolk, VA 23510-1145
Telephone: (757) 441-6776
Fax: (757) 441-6495

Chief, Operations Division, Atlantic (MOA)
LCDR Jennifer Pralgo
Telephone: 757-441-6716
E-mail: ChiefOps.MOA@noaa.gov

Marine Operations Center, Pacific (MOP)
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Telephone: (541) 867-8700

Chief, Operations Division, Pacific (MOP)
CDR Michael Hopkins
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Email: ChiefOps.MOP@noaa.gov

Mission Operations

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Meme Lobecker, Mapping Lead
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Catalina Martinez, RI Regional Manager
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Email: Catalina.martinez@noaa.gov

Webb Pinner, Systems Engineer
NOAA Ocean Exploration & Research (2020, Inc.)
Phone: 401-749-9322
Email: webb.pinner@noaa.gov

Dwight Coleman, Director
URI Inner Space Center
Phone: 401-874-6637
Email: dcoleman@gso.uri.edu

Shipments

Be sure to send an email to *Okeanos Explorer* Operations Officer OPS.Explorer@noaa.gov indicating the size and number of items being shipped and the name of the person it is being shipped to.

Okeanos Explorer
C/O MLS Panama/Norton Lilly
Air Sea Cargo Express
Panama City, Panama
+507 236 8411

Please ensure copies of all documents forwarded to: panama@mlscorporation.com.

G. Diplomatic Clearances

This cruise involves Marine Scientific Research (MSR) in waters under the jurisdiction of Panama, Nicaragua, Honduras, the Cayman Islands and United States. Diplomatic clearance to conduct MSR in these countries has been requested. An MSR clearance request for Cuba and Columbia will not be submitted.

Cayman Islands
A request to conduct MSR within 12nm of the Cayman Islands was submitted to the State Department on June 2, 2011. Clearance was granted by the Maritime Policy Unit (legal advisors) of the Foreign and Commonwealth Office of the United Kingdom on June 10, 2011 (document reference 049/2011). Clearance for *Okeanos Explorer* (F2011-43) to conduct MSR from August 1-31, 2011 was granted subject to the conditions outlined in the clearance *(Appendix V)*.

This requires that all pertinent data collected in Cayman Island waters be delivered to the coastal state.

The primary area of operations for this expedition involves MSR in waters under the jurisdiction of the Cayman Islands. Full mapping, CTD, ROV and telepresence operations are planned, and correlating datasets collected. The ship will have a UK Citizen (US Permanent Resident) onboard as the science team lead, coordinating a broader team of scientists remotely engaged in real-time from shore through the use of telepresence technology. Additional scientists from the UK's National Oceanography Center will be fully engaged in the expedition as part of the core science team, both on board the ship and remotely participating in real-time from shore.

As of July 15, 2011 all requested Marine Scientific Research (MSR) clearances in other foreign waters are ***pending***. The following clearances were originally submitted on April 27, 2011:

- **Panama** – within 12nm from shore (to 200nm). This requires that all pertinent data collected in Panama waters be delivered to the coastal state. Only underway data (e.g., multibeam, METOC data) is planned to be collected;
- **Nicaragua** - between 12 and 200nm from shore. This requires that all pertinent data collected in Nicaragua waters be delivered to the coastal state. Only underway data (e.g., multibeam, METOC data) is planned to be collected;
- **Honduras** - between 12 and 200nm from shore. This requires that all pertinent data collected in Honduras waters be delivered to the coastal state. Only underway data (e.g., multibeam, METOC data) is planned to be collected.

<u>Coastal state data distribution</u>

Data acquired in coastal state waters will be packaged together and provided to the coastal state through official routes within 30 days following the completion of MSR.

H. Licenses and Permits

The program is still investigating whether a permit is required to conduct multibeam operations in the U.S. EEZ during the transit into Key West.

II. Operations

A. Cruise Plan Itinerary

Date	Operations	Remarks
07/28/2011	Ship arrives at Balboa, Panama	Any shipments to the ship in Panama to be addressed to: Okeanos Explorer C/O MLS Panama/Norton Lilly Air Sea Cargo Express Panama City, Panama +507 236 8411
07/31/2011	Mission participants arrival completed	
08/01-08/02/2011	Departure from Balboa, Panama	Transit through Panama Canal
~ 08/03/2011	Entering Columbia EEZ	Secure all the sensors
~ 08/04/2011	Entering Nicaragua EEZ	Turn on all the sensors (pending clearance)
~ 08/04/2011	Entering Honduras EEZ	Package Nicaragua state data
~ 08/04/2011	Entering Cayman Island EEZ	Package Honduras state data
~ 08/04/2011	Entering primary operations area	Commence mapping in box 1
~ 08/04-08/05/2011	Mapping operations in box 1	See table 4/figure 3
~ 08/05/2011	First ROV dive, anticipated at Mount Dent	See table 6/figure 3
~08/05-08/06/2011	Mapping/CTD operations in box 2a	See figure 3, tables 4-5
~ 08/05-08/15/2011	Continue ROV dive operations during the day and mapping /CTD operations at night	See tables 4-6/figure 3
08/08 or 08/09/2011	Telepresence event	Media event between ship and shore on August 8th or 9th with the URI ECC. Live feeds would be streamed to shore, and someone on the ship would speak to shore-side participants from the

		control room.
~ 08/15/2011	Start transit to Key West	
~ 08/15/2011	Entering CUBA EEZ	Secure all sensors
~ 08/17/2011	Entering US EEZ	Turn on all the sensors
08/18/2011	Arrive Key West, FL	Secure all the sensors
08/18-19/2011	Prepare the ship for mission party departure	Securing the ROV, cleaning the mission space, offload science equipment and ship samples, etc

B. Staging and de-staging:

A methane prospecting survey of opportunity involving use of a gas chromatograph will be conducted during this cruise. This requires cylinders of nitrogen and air that were purchased and delivered to the ship in Costa Rica on July 6, 2011. The MSDS forms were provided to the ship prior to loading. These tanks will be securely stored until the EX1104 cruise.

The Gas Chromatograph, hydrogen gas generator and 2 small cylinders of compressed nitrogen (with trace concentrations of methane) will be sent to the ship for arrival and loading in Balboa, Panama between July 28 and August 1, 2011. Two additional requests for water sample preservation have also been made by the science team; one requires hydrochloric acid to be sent to the ship in this same time period. The science team is making shipping arrangements. A list of HAZMATs, associated MSDS forms, and buffer materials will be provided prior to or at the time of loading.

Offloading of all science gear, and shipment of water samples will take place August 18-19 following arrive in Key West, FL.

C. Dive Plan (SCUBA)

NOT APPLICABLE TO THIS CRUISE

D. Applicable Restrictions

NOT APPLICABLE TO THIS CRUISE

III. **Equipment**

A. Equipment and capabilities provided by the ship

- Kongsberg Simrad EM 302 Multibeam Echosounder (MBES)
- Kongsberg Simrad EK60 Deepwater Echosounder (SBES)

- Knudsen 3260 Sub-bottom profiler (SBP)
- LHM Sippican XBT (various probes)
- Seabird SBE 911Plus CTD
- (2) Light Scattering Sensor (LSS)
- Oxidation-Reduction Potential (ORP)
- Dissolved Oxygen (DO) sensor
- Altimeter Sensor
- Seabird SBE 50 CTD Stand
- CNAV GPS
- POS/MV
- Seabird SBE-45 (Micro TSG)
- Kongsberg Dynamic Positioning-1 System
- Net App mapping storage system
- CARIS HIPS Software
- IVS Fledermaus Software
- SIS Software
- Hypack Software
- Scientific Computing System (SCS)
- ECDIS
- Met/Wx Sensor Package
- Telepresence System
- VSAT High-Speed link
- Cruise Information Management System (CIMS)
- Little Hercules ROV
- Seirios Camera Platform

B. Equipment and capabilities provided by the scientists

- Gas chromatograph
- Hydrogen gas generator
- Chemicals and equipment for preservation of water samples

IV. **Hazardous Materials**

A. Policy and Compliance

All HAZMAT brought aboard by visiting scientists for EX1104 operations will comply with MOCDOC 15, Fleet Environmental Compliance #07, Hazardous Material and Hazardous Waste Management Requirements for Visiting Scientists, released July 2002.

<u>Hazardous Materials (HAZMAT) Anticipated to be brought aboard by science</u>

- Hydrochloric Acid (HCl), 12 M – Quantity: 500 ml stored in a glass bottle.

- Compressed Nitrogen – Quantity: Size K compressed gas cylinder, approximately 4.5' tall and 10" wide, weighing ~80lbs
- Compressed Air – Quantity: Size K compressed gas cylinder, approximately 4.5' tall and 10" wide, weighing ~80lbs
- Two 1-liter cylinders of compressed nitrogen at relatively low pressure (~200 PSIA), containing trace concentrations of methane (~100ppm). These will be used for calibration of the gas chromatograph detector. (At this concentration of methane, the gases are non-flammable due to the balance being nitrogen. Due to the relatively small cylinder size (~1 liter) and quantity of gas contained within (~14 liters), they do not represent a suffocation risk for normal laboratory conditions.)

Neutralizing agents, buffers and/or absorbents required for HAZMAT

- Hydrochloric Acid (HCl): Sodium bicarbonate (Baking soda) for neutralizing spills. Kitty litter for adsorbing the liquid. A "spill kit" has been requested.

See appendix VI for HAZMAT material safety data sheets (MSDS).

Guest scientists and the Expedition Coordinator are responsible for ensuring the HAZMAT are listed, packaged, labeled and transported in compliance with DOT regulations

B. Radioactive Isotopes

NOT APPLICABLE TO THIS CRUISE

C. Inventory

Okeanos Explorer has the following chemicals onboard for scientific use:

- Formaldehyde 37% solution – Quantity: (2) 2L
- Formaldehyde 37% solution – Quantity: (1) 3.8L
- Formalin 10% solution – Quantity: (7) 1L
- Ethyl Alcohol 190 Proof – Quantity: (1) 5 gal

V. **Additional Projects**

A. Supplementary ("Piggyback") Projects

"Shipboard methane determination during exploration of the Mid-Cayman Spreading Center"

Buoyant plumes of high temperature hydrothermal fluids rise hundreds of meters above the seafloor before being dispersed laterally by deep-ocean currents. In part, due to their high initial methane (CH4) concentrations, such plumes can be traced over long distances (tens of km) through the water column (e.g. Lilley et al., 1995). The science goal is to conduct shipboard dissolved CH4 analysis on seawater samples collected with the CTD rosette. The objective is to identify hydrothermal vent plumes in the water column, in order to identify seafloor targets for

further exploration and identification of active vent fields. *See appendix II for more detailed information.*

Sampling for Total Organic Carbon (sample acquired during the cruise, processed post-cruise)

Scientists are interested in Total Organic Carbon (TOC) because hydrothermal systems represent a biological niche which has been considered independent from the rest of the ocean. However, hydrothermal systems can act as a transport mechanism of organic carbon from within the crust and surrounding areas of diffuse flow, out into the water column. Very few studies exist on the presence of organic carbon in hydrothermal plumes. A participating scientist has carried out two studies, one at the East Pacific Rise (EPR) and one at the Loihi Seamount. At the EPR, she found very little elevation in DOC, but at Loihi the DOC concentrations were elevated. She thinks this is due to differences in the chemistry and biology of these two environments. If different venting environments in the Cayman Trough are explored, it would be interesting to compare the plumes from different sites for organic carbon. This in itself will be an interesting study, but would also guide scientists on their return to the Mid Cayman Rise in 2012. *See appendix IV for more detailed information.*

Total Cell Counts (sample acquired during the cruise, processed post-cruise)

Microbial communities are often enriched in hydrothermal plumes, meaning the number of cells is elevated above background seawater due to all the energy sources in the plume, making them another good indicator of hydrothermal activity. Scientists will visually examine the fluids with microscopy to look for particles and interesting cells, as well as count the cells and compare them to background seawater. During our plume search, any sample that has any indication of a plume should be preserved, as well as 2-3 samples on either side of it, to get background levels. *See appendix III for more detailed information.*

B. NOAA Fleet Ancillary Projects

NOT APPLICABLE TO THIS CRUISE

VI. Disposition of Data and Reports

A. Data Responsibilities

All data acquired on *Okeanos Explorer* will be provided to the public archives without proprietary rights. All data management activities shall be executed in accordance with NAO 212-15, Management of Environmental and Geospatial Data and Information [http://www.corporateservices.noaa.gov/ames/NAOs/Chap_212/naos_212_15.html].

Ship Responsibilities

The Commanding Officer is responsible for all data collected for missions until those data have been transferred to mission party designees. Data transfers will be documented on

NOAA Form 61-29. Reporting and sending copies of project data to NESDIS (ROSCOP form) is the responsibility of OER.

NOAA OER Responsibilities

The Expedition Coordinator will work with the *Okeanos Explorer* Operations Officer to ensure data pipeline protocols are followed for final archive of all data acquired. The full data management plan is included in Appendix I.

Deliverables

a. At sea
   - Daily plans of the Day (POD)
   - Daily situation reports (SITREPS)
   - Daily mapping progress bathymetry files
   - ROV tracklines
   - Raw video clips from ROV dives, onboard cameras
   - Still image frame grabs from underwater video; topside still images
   - Daily "eventlog" files, including hourly updates detailing ongoing ship operations
   - Regular cruise logs providing the context of a given day at sea or at an ECC

b. Post cruise
   - Refined SOPs for all pertinent operational activities
   - Assessments of all activities
   - Provide applicable data to Coastal States in accordance with State Department Marine Science Research permit

c. Science
   - Multibeam and XBT raw and processed data, a full description is available in the data management plan.
   - ROV dive site maps
   - ROV dive summaries
   - CTD/rosette operation summaries
   - Results of water sample processing for methane
   - HD footage archived at the NOAA Central Library
   - Highlight Video Imagery with descriptive captions
   - Highlight still imagery with descriptive captions
   - Raw CTD Data
   - Quick Look Report
   - Mapping Data Report
   - Cruise Report

Archive

- The Program and ship will work together to ensure documentation and stewardship of acquired data sets in accordance with NAO 212-15. The Cruise Information Management System is the primary tool used to accomplish this activity.

B. Pre and Post Cruise Meeting

Pre-Cruise Meeting

Prior to departure, the Expedition Coordinator will conduct a meeting of the scientific party to inform them of cruise objectives. Some vessel protocols, e.g., meals, watches, etiquette, etc. will be presented by the ship's Operations Officer.

Post-Cruise Meeting

Upon completion of the cruise, a meeting will be held (unless prior alternate arrangements are made) and attended by the ship Survey Technicians, the Expedition Coordinator, the Operations Officer and members of the scientific party to review the cruise. Concerns regarding safety, efficiency, and suggestions for improvements for future cruises should be discussed.

Shipboard Meetings

Daily Operations Briefing meetings will be conducted by the Operations Officer and held at 1500 in the forward lounge to review the current day, and define operations, associated requirements and staffing needs for the following day. A Plan of the Day (POD) will be posted each evening for the next day in specified locations throughout the ship. A safety brief and overview of POD will occur on the Bridge each morning at 0800. Daily Situation Reports (SITREPS) will be posted as well and shared daily through e-mail and/or the *Okeanos Explorer* PLONE site (http://terra.gso.uri.edu/NOAAShipOkeanosExplorer).

C. Ship Operation Evaluation Report

Within seven days of the completion of the cruise, a Ship Operation Evaluation form is to be completed by the Expedition Coordinator. The preferred method of transmittal of this form is via email to OMAO.Customer.Satisfation@noaa.gov. If email is not an option, a hard copy may be forwarded to:

Director, NOAA Marine and Aviation Operations
NOAA Office of Marine and Aviation Operations
8403 Colesville Road, Suite 500
Silver Spring, MD 20910

VII. **Miscellaneous**

A. Meals and Berthing

Meals and berthing are required for up to 19 scientists. Meals will be served 3 times daily beginning one hour before scheduled departure, extending throughout the cruise, and ending two hours after the termination of the cruise. Since the watch schedule is split between day and night, the night watch may often miss daytime meals and will require adequate food and beverages (for example a variety of sandwich items, cheeses, fruit, milk, juices) during what are not typically meal hours. Special dietary requirements for scientific participants will be made available to the ship's command at least twenty one days prior to the survey (e.g., Expedition Coordinator is allergic to fin fish).

Berthing requirements, including number and gender of the scientific party, will be provided to the ship by the Expedition Coordinator. The Expedition Coordinator and Operations Officer will work together on a detailed berthing plan to accommodate the gender mix of the scientific party taking into consideration the current make-up of the ship's complement. The Expedition Coordinator is responsible for ensuring the scientific berthing spaces are left in the condition in which they were received; for stripping bedding and linen return; and for the return of any room keys which were issued. The Expedition Coordinator is also responsible for the cleanliness of the laboratory spaces and the storage areas utilized by the scientific party, both during the cruise and at its conclusion prior to departing the ship.

All NOAA scientists will have proper travel orders when assigned to any NOAA ship. The Expedition Coordinator will ensure that all non-NOAA or non-Federal scientists aboard also have proper orders. It is the responsibility of the Expedition Coordinator to ensure that the entire scientific party has a mechanism in place to provide lodging and food and to be reimbursed for these costs in the event that the ship becomes uninhabitable and/or the galley is closed during any part of the scheduled project.

All persons boarding NOAA vessels give implied consent to comply with all safety and security policies and regulations which are administered by the Commanding Officer. All spaces and equipment on the vessel are subject to inspection or search at any time. All personnel must comply with OMAO's Drug and Alcohol Policy which forbids the possession and/or use of illegal drugs and alcohol aboard NOAA Vessels.

B. Medical Forms and Emergency Contacts

The NOAA Health Services Questionnaire (NHSQ, Revised: 08/08) must be completed in advance by each participating scientist. The NHSQ can be obtained from the Expedition Coordinator or the NOAA website at NOAA HEALTH SERVICES QUESTIONNAIRE. The completed form should be sent to the Regional Director of Health Services at Marine Operations Center. The participant can mail, fax, or scan the form into an email using the contact information below. The NHSQ should reach the Health Services Office no later than 4 weeks

prior to the cruise to allow time for the participant to obtain and submit additional information that health services might require before clearance to sail can be granted. Please contact MOC Health Services with any questions regarding eligibility or completion of the NHSQ. Be sure to include proof of tuberculosis (TB) testing, sign and date the form, and indicate the ship or ships the participant will be sailing on. Clearances are valid for 2 years for personnel under age 50 and 1 year for age 50 and over. All PPD's expire after one year from the date of administration. The participant will receive an email notice when medically cleared to sail if a legible email address is provided on the NHSQ.

Contact information:

Regional Director of Health Services
Marine Operations Center – Atlantic
439 W. York Street
Norfolk, VA 23510
Telephone 757.441.6320
Fax 757.441.3760
E-mail: MOA.Health.Services@noaa.gov

Prior to departure, the Expedition Coordinator must provide a listing of emergency contacts to the Operations Officer for all members of the scientific party, with the following information: name, address, relationship to member, and telephone number.

Emergency contact form is included as Appendix VIII.

C. Shipboard Safety

Wearing open-toed footwear or shoes that do not completely enclose the foot (such as sandals or clogs) outside of private berthing areas is not permitted. Steel-toed shoes are required to participate in any work dealing with suspended loads, including CTD deployments and recovery. The ship does not provide steel-toed boots. Hard hats are also required when working with suspended loads. Work vests are required when working near open railings and during small boat launch and recovery operations. Hard hats and work vests will be provided by the ship when required.

Operational Risk Management: For every operation to be conducted aboard the ship (NOAA-wide initiative), risk management procedures will be followed. For each operation, risks will be identified and assessed for probability and severity. Risk mitigation strategies / measures will be investigated and implemented where possible. After mitigation, the residual risk will have to be assessed to make Go-No Go decisions for the operations. Particularly with new operations, risk assessment will be ongoing and updated as necessary. This does not only apply to over-the-side operations, but to everyday tasks aboard the vessel that pose risk to personnel and property.

- CTD and ROV (and other pertinent) ORM documents will be followed by all personnel working on board *Okeanos Explorer*
- All personnel on board are in the position of calling a halt to operations/activities in the event of a safety concern.

D. Communications

A daily situation report (SITREP) on operations prepared by the Expedition Coordinator will be relayed to the program office. Sometimes it is necessary for the Expedition Coordinator to communicate with another vessel, aircraft, or shore facility. Through various modes of communication, the ship is able to maintain contact with the Marine Operations Center on an as needed basis. These methods will be made available to the Expedition Coordinator upon request, in order to conduct official business. The ship's primary means of communication with the Marine Operations Center is via e-mail and the Very Small Aperture Terminal (VSAT) link. Standard VSAT bandwidth at 128kbs is shared by all vessels staff and the science team at no charge. Increased bandwidth in 30 day increments is available on the VSAT systems at increased cost to the scientific party. If increased bandwidth is being considered, program accounting is required it must be arranged at least 30 days in advance.

Specific information on how to contact the NOAA Ship *Okeanos Explorer* and all other fleet vessels can be found at: http://www.moc.noaa.gov/phone.htm

Important Telephone and Facsimile Numbers and E-mail Addresses

Ocean Exploration and Research (OER):

OER Program Administration:
Phone: (301) 734-1010
Fax: (301) 713-4252
E-mail: Firstname.Lastname@noaa.gov

University of New Hampshire, Center for Coastal and Ocean Mapping

Phone: (603) 862-3438
Fax: (603) 862-0839

NOAA Ship Okeanos Explorer - Telephone methods listed in order of increasing expense:

Okeanos Explorer Cellular:
Ship (401) 932-4114
OOD (401) 378-7414

Okeanos Explorer Iridium:
(808) 659-9179

Okeanos Explorer INMARSAT B
Line 1: 011-872-764-852-328
Line 2: 011-872-764-852-329

Voice Over IP (VoIP) Phone:
301-713-7772 (expect a delay once picked up by directory)

E-Mail: Ops.Explorer@noaa.gov (mention the person's name in SUBJECT field)
expeditioncoordinator.explorer@noaa.gov - For dissemination of all hands emails by Expedition Coordinator while on board. See ET for password.

E. IT Security

Any computer that will be hooked into the ship's network must comply with the NMAO Fleet IT Security Policy prior to establishing a direct connection to the NOAA WAN. Requirements include, but are not limited to:

1. Installation of the latest virus definition (.DAT) file on all systems and performance of a virus scan on each system.
2. Installation of the latest critical operating system security patches.
3. No external public Internet Service Provider (ISP) connections.

Completion of these requirements prior to boarding the ship is preferable.

Non-NOAA personnel using the ship's computers or connecting their own computers to the ship's network must complete NOAA's IT Security Awareness Course within 3 days of embarking.

F. Foreign National Guests Access to OMAO Facilities and Platforms

All foreign national access to the vessel shall be in accordance with NAO 207-12 and RADM De Bow's March 16, 2006 memo. OER is currently working with Yolanda Cooper on FNG requirements.

The following are basic requirements. Full compliance with NAO 207-12 is required.

Responsibilities of the Expedition Coordinator:

1. Provide the Commanding Officer with the e-mail generated by the FRNS granting approval for the foreign national guest's visit. This e-mail will identify the guest's DSN and will serve as evidence that the requirements of NAO 207-12 have been complied with.

2. Escorts – The Expedition Coordinator is responsible to provide escorts to comply with NAO 207-12 Section 5.10, or as required by the vessel's DOC/OSY Regional Security Officer. **The Foreign National Guest Sponsor for this expedition is Jeremy Potter. The Foreign National Guest escort for this expedition is TBD.**
3. Ensure all non-foreign national members of the scientific party receive the briefing on Espionage Indicators (NAO 207-12) at least annually or as required by the servicing Regional Security Officer.
4. Export Control - The NEFSC currently neither possesses nor utilizes technologies that are subject to Export Administration Regulations (EAR).

The Commanding Officer and the Expedition Coordinator will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.

Responsibilities of the Commanding Officer:

1. Ensure only those foreign nationals with DOC/OSY clearance are granted access.
2. Deny access to OMAO platforms and facilities by foreign nationals from countries controlled for anti-terrorism (AT) reasons and individuals from Cuba or Iran without written NMAO approval and compliance with export and sanction regulations.
3. Ensure foreign national access is permitted only if unlicensed deemed export is not likely to occur.
4. Ensure receipt from the Expedition Coordinator or the DSN of the FRNS e-mail granting approval for the foreign national guest's visit.
5. Ensure Foreign Port Officials, e.g., Pilots, immigration officials, receive escorted access in accordance with maritime custom to facilitate the vessel's visit to foreign ports.
6. Export Control - 8 weeks in advance of the cruise, provide the Expedition Coordinator with a current inventory of OMAO controlled technology onboard the vessel and a copy of the vessel Technology Access Control Plan (TACP). Also notify the Expedition Coordinator of any OMAO-sponsored foreign nationals that will be onboard while program equipment is aboard so that the Expedition Coordinator can take steps to prevent unlicensed export of Program controlled technology. The Commanding Officer and the Expedition Coordinator will work together to implement any access controls necessary to ensure no unlicensed export occurs of any controlled technology onboard regardless of ownership.
7. Ensure all OMAO personnel onboard receive the briefing on Espionage Indicators (NAO 207-12) at least annually or as required by the servicing Regional Security Officer.

Responsibilities of the Foreign National Sponsor:

1. Export Control - The foreign national's sponsor is responsible for obtaining any required export licenses and complying with any conditions of those licenses prior to the foreign national being provided access to the controlled technology onboard regardless of the technology's ownership.

2. The DSN of the foreign national shall assign an on-board Program individual, who will be responsible for the foreign national while on board. The identified individual must be a U.S. citizen, NOAA (or DOC) employee. According to DOC/OSY, this requirement cannot be altered.
3. Ensure completion and submission of the Certification of Conditions and Responsibilities for a Foreign National Guest as required by NAO 207-12 Section 5.03.h.

G. Foreign Port Entry/Exit Requirements and Visas

Panama Entry/Exit Requirements: Tocumen International Airport (PTY), just outside Panama City, is the closest airport to the *Okeanos Explorer* port of call in Balboa, Panama. U.S. citizens traveling by air to and from Panama must present a valid passport when entering or re-entering the United States. Sea travelers must have a valid U.S. passport. Travelers must present a passport valid for at least three months. U.S. citizens entering Panama as tourists will be charged $5.00 for a tourist card when they purchase their travel ticket. As of April, 2010, U.S. tourists are allowed to stay in Panama for 180 days, without extension. Travelers can also obtain a multiple entry visa from a Panamanian embassy or consulate before traveling to Panama. Further information may be obtained from the Embassy of Panama, 2862 McGill Terrace NW, Washington, DC 20009, tel. (202) 483-1407, or the Panamanian consulates in Atlanta, Boston, Chicago, Honolulu, Houston, Los Angeles, Miami, New Orleans, New York, Philadelphia, San Diego, San Francisco, San Juan or Tampa.

U.S. citizens transiting the Panama Canal as passengers, regardless of their intention to disembark from the ship or not do not need to obtain visas, or pay any fees. U.S. State Department: http://travel.state.gov/travel/cis_pa_tw/cis/cis_994.html#entry_requirements

******NOTE: The areas EX1104 personnel will enter in Panama have a low risk of malaria. Personnel should see their medical provider for consideration of prophylactic medication.******

Appendix I

EX1104 Data Management Plan

Okeanos Explorer

EX-11-04: Mid-Cayman Rise Exploration
Data Management Plan

Document Purpose

This document is an addendum to the overarching Okeanos Explorer FY11 Data Management Plan (Appendix VII) and is specific to the EX-11-04 mission entitled "Mid-Cayman Rise Exploration" For more detailed information on the data management effort for the Okeanos Explorer in FY11, please refer to that document.

Data Management Overview

The fourth *Okeanos Explorer (EX)* mission of the FY11 field season will take the ship from Balboa, Panama to Key West, Florida and along the way, will explore the Mid-Cayman Rise in British waters around the Cayman Islands. During transits to and from the primary operating area, underway meteorological and oceanographic data and multibeam mapping survey data will be collected. During the approximately ten days at the Mid-Cayman Rise, multibeam mapping, CTD/rosette casts and ROV dive operations will be performed. High-definition imagery, water samples, gas chromatography, CTD and multibeam data will be generated and managed from this mission. The ship will segment bathymetric survey tracks when crossing over EEZ areas so that each coastal state through whose waters the EX cruises will receive a data package of all data collected in their waters after the mission is complete. The expedition coordinator will mark the dates/times of the EEZ crossings so that the data management team can segment the underway data for the coastal states data delivery. No data, underway or operational, will be collected in Columbian or Cuban waters during this mission.

Assumptions

All data from the entire mission will be publicly releasable. No protected sites have been identified.

EX-11-04: Mid-Cayman Rise Exploration (August 2 – August 18, 2011)

Data Management Objectives

The DMT's objectives for this mission are:

- Develop ISO metadata for collection-level and dataset-level records (multibeam, CTD, SCS, gas chromatograph, water sample analysis, imagery, and video) for NOAA and for delivery with foreign data sets.
- Ensure the near real-time update of the *Okeanos Atlas* with
  - Add new data layers as contextual data to the display, including primary operating area, planned survey boundaries, and any other appropriate data layers found.
  - Ship track and hourly observations received via email.
  - CTD launch sites and profiles received via URI SRS. DMT will post-process and thin the profiles for quicker display on the site.
  - Daily logs pulled from URI through RSS feeds and links to related images on oceanexplorer.noaa.gov website.
  - Daily cumulative bathymetric image overlays received via URI SRS.

- Test new ship track KML received via URI SRS, if applicable.
- Cross train backup personnel in SOPs.

- Post-Mission:
  - Execute multibeam data, METOC data, and video/image data pipelines.
  - Deliver ISO metadata and corresponding data collected within the EEZ of foreign coastal states to those states.

Expedition Principals for Data Management

Kelley Elliott, OER Expedition Coordinator
Lt. Megan Nadeau, OMAO, Okeanos Explorer Operations Officer
Webb Pinner, OER Telepresence, EX Data and Information Lead
Sharon Mesick, NCDDC, Federal Program Manager, IPT Chair
Susan Gottfried, NCDDC, OER Data Management Coordinator
Andrew Navard, NCDDC, Okeanos Atlas Developer
David Fischman, NGDC, Geophysical Data Officer
Thomas Ryan, NODC, Oceanographic Data Officer
Anna Fiolek, NCL, Multimedia Librarian

Appendix II

Survey of Opportunity:
Shipboard methane determination

SURVEYS OF OPPORTUNITY - INITIAL REQUEST FORM

A surveys of opportunity is a small, exploratory expedition that takes advantage of the elastic schedules of ocean-going, research vessels, - in this case, the Okeanos Explorer - by maximizing transit times between ports or projects, or by filling smalls gaps in the ship's calendar.

Given the ship's unique technology and capabilities, NOAA's Office of Ocean Exploration and Research (OER) invites regional researchers to help acquire additional data within the vessel's operating areas to assess specific but poorly known sites, adding to an inventory of submerged resources. In circumstances where individuals cannot serve on a "survey of opportunity", then OER ensures that acquired data and any other pertinent information are transferred to the appropriate researchers after the expedition. Previously successful surveys of opportunity have included mapping geological features, locating and characterizing shipwrecks, and defining marine protected areas. Some surveys are completed in only a few hours, while others last a couple days.

Although exploration potential and scientific merit play a role in which opportunistic surveys are conducted, they are not chosen through a peer-reviewed process. Rather, their selection is based more on the vessel operating in the right place with the right equipment at the right time, and the ship's calendar and on-board resources allow for the added work. All requests for a survey of opportunity are archived with OER and the ship, and expire only when the survey work is completed. There is no guarantee that any request for a survey will be accomplished, nor is there any system of prioritization or ranking. Keep in mind that this proposal may be available to the public upon request except for privileged information and material that is personal, proprietary or otherwise exempt from disclosure under law.

Survey or Project Name

Shipboard methane determination during exploration of the Mid-Cayman Spreading Center

Points of Contact (POC)

Lead POC or Principle Investigator (PI & Affiliation)	*Supporting Team Members*
Jeffrey Seewald	**Jill McDermott** **Chris German**

Activities Description(s) *(Include goals, objectives and tasks)*

Buoyant plumes of high temperature hydrothermal fluids rise hundreds of meters above the seafloor before being dispersed laterally by deep-ocean currents (Lupton, 1995). In part, due to their high initial methane (CH4) concentrations, such plumes can be traced over long distances (tens of km) through the water column (e.g. Lilley et al., 1995). Our goal is to conduct shipboard dissolved CH4 analysis on seawater samples collected with the CTD rosette. The objective is to identify hydrothermal vent plumes in the water column, in order to idenitfy seafloor targets for further exploration and identification of active vent fields.

PROCEDURE FOR SHIPBOARD METHANE ANALYSIS

Water samples for methane (CH4) analysis (20 ml) will drawn from the Niskin bottles mounted on the CTD in 60 mL plastic syringes. Dissolved methane concentrations will be determined by gas chromatography using a Hewlett Packard 5890 II gas chromatograph fitted with a 6-foot 5 Å molecular sieve column and a flame ionization detector following a headspace extraction. The headspace extraction involves connecting the 60 ml plastic syringe containing the water sample to a purpose built interface connected directly to the gas chromatograph and drawing ~40 ml of nitrogen into the syringe. The headspace is allowed to equilibrate with the water sample before depressing the plunger to transfer the headspace gas into a sample loop for injection onto the chromatography column for chromatographic separation.

The compressed gases necessary for this analysis include nitrogen (N2), air, and hydrogen (H2) all

at an initial cylinder pressure of 2000 PSIA. The nitrogen is used as a carrier gas for the gas chromatography column and is connected directly to the gas chromatograph with 1/8" copper tubing. The flow rate is set to ~30 mL/min and flow is continuous for the duration of the cruise once the instrument is set up in port. The air and hydrogen are used as fuels for the flame ionization detector. They are connected directly to the gas chromatograph with 1/8" copper tubing. The flow rates are 400 mL/min for the air and 30 mL/min for the hydrogen. These gases are only flowing when the instrument is in use and serve as a fuel for a very small flame that is fully enclosed within the detector of the gas chromatograph. When not in use these gases are turned off at the compressed gas cylinder valve. The only other chemicals involved in this analysis are gas standards used for calibration of the gas chromatograph detector. These consist of trace concentrations of methane (~100 ppm) in nitrogen at relatively low pressure (~200 PSIA). At this concentration of methane, the gases are non-flammable due to the balance being nitrogen. Due to the relatively small cylinder size (~1 liter) and quantity of gas contained within, they do not represent a suffocation risk for normal laboratory conditions.

List of Participating Organizations

Woods Hole Oceanographic Institution

Duration *(specific start and end dates, or expected length of survey)*

Approximately 10 nights during CTD rosette operations.

Area of Survey and Cruise Track Descriptions *(please attach appropriate charts and include chart reference numbers)*

Mid-Cayman Spreading Center. Location of CTD casts to be determined during future discussions that consider scientific objectives of all cruise participants.

Conditions and Dependencies *(e.g, water depths, special sea conditions, time constraints, etc)*

Will collect samples to depths of ~5000 m.

Equipment/Systems Needed

☐ DP	☐ Sled
☐ A-Frame	☐ xBot
☐ Traction Winch	☐ Seawater flow-through system
☐ Hydro Winch	☐ Fluorometer
☐ ROV Crane	☒ CTD (deck unit)
☐ General Purpose Crane	☒ CTD Rosette
☐ EM302	☐ SCS Outputs
☐ Deep Water Echo Sounder	☐ Hazardous Storage
☐ VSAT Pipe Mbps # days full pipe	Describe:
☐ Cameras ☐ Telepresence ☐ CCTV	☐ Other ship's equipment(s):
☐ ROV	Describe All:

Special Equipment *(identify any PI-supplied gear that the ship will be requested to deploy)*

Gas chromatograph. This is a stardard Hewlett Packard (now Agilent) 5890 GC that takes up approximately 60 sq inches (30"x30") with access required at the front and left side.

Three size K compressed gas cylinders - one nitrogen, one hydrogen, and one compressed air. Tanks are approximately 4.5 feet tall and 10 inches wide, weighing roughly 80 lbs. (The tanks could be located at a distance from the GC if there is a sufficient chase available to run 1/8" copper lines). The gases will be used by connecting them via a regulator and running them through the GC for the various needs.

Lead Time and Long Lead Time Items *(e.g., permits, etc)*

Shore-side support *(besides staffing, what other coordination is needed, e.g. telepresence center)*

Telepresence with other shore-based members of the science team.

The gases will be delivered to the ship or ship's agent (whichever you prefer) by Praxair. Currently, this is set up for Puntarenas, but could be changed to Panama if necessary. At the end of the cruise, the cylinders will be vented to the atmosphere and disposed of in a dumpster. Alternatively, if possible, the science team may make arrangements for the the cylinders to be stored in Key West until their NSF/NASA cruise in January 2012 that will be departing out of Key West.

Data, Products and Outputs *(requested shipboard data processing, archiving and product generation, such as sonar processing, GIS layer creation, mosaic, video archiving, etc)*

Data processing of methane concentrations will be conducted by the shipboard science team. The resulting data will become part of the Okeanos Explorer data/product suite and will go through the standard EX data pipeline to public archive.

QUALITATIVE PARAMETERS

Why is this project considered "exploration"?

Hydrothermal alteration of ultramafic rocks, such as those found in the Mid-Cayman Spreading Center, is of special interest to Astrobiologists bacause both high- and low- temperature ultramafic systems can host abiotic organic synthesis that may be important to pre-biotic chemistry and the origins of life on early Earth (Holm & Charlou, 2001; Proskurowski et al., 2008). While the eruption of komatiitic lavas may have made such vent-systems common on early Earth (e.g. Brasier et al., 2002), it is only under the tectonic controls peculiar to slow and ultra-slow ridges that ultramafic rocks are likely to be exposed to hydrothermal reactions today (German & Von Damm, 2004). To date, relatively few areas of hydrothermal activity hosted in ultramafic crust have been studied. This is exactly what has been identified at 18°21-24'N, 81°44-50'N and, potentially, elsewhere along the rift-valley walls of the Mid-Cayman Spreading Center. Exploring this area for the extent and nature of hydrothermal systems represents a substantial opportunity to contribute to our understanding of a broad range of processes associated with serpentinization at present-day ridge crest hydrothermal systems and on early Earth.

In many cases, plume signals are dispersed by lateral currents, and temperature anaomalies are too weak to be detected by conventional CTD sensors. Shipboard determination of CH4 is a particalry sensitive technique that will provide three-dimensional information concerning the nature and location of seafloor hydrothermal vent targets, which enables most effective use of the Little Hercules ROV. Methane determination is a particularly good exploration tool because it facilitates the idenitification of low- temperature serpentinization reactions at the rift-valley walls. The latter do not release high concentrations of dissolved metals at the seafloor like conventional "black smokers" (e.g. Kelley et al., 2001), but instead can be readily detected from the high dissolved methane concentrations they release into the adjacent water column (Charlou et al., 1998). Accordingly, shipboard CH4 measurement will broaden the range of vent styles that can be detected during water column surveys at the Mid-Cayman Spreading Center and substantially increase the potential for new discoveries.

How is this survey multidisciplinary? *(Will various types of data be acquired by different user groups during the survey? Will the data products will be used by different users after the survey?)*

Identification of the location of hydrothermal activity is a primary goal for biologists, geologists, geochemists, and geophysicists, examining chemical, physical, and biological processes associated with crustal generation at the ultra-slow Mid-Cayman Spreading Center.

What is the public outreach potential for this project?

Locating hydrothermal vents on the seafloor is not a trivial task. Through real-time blogs, the public can follow the sequence of events that leads to the discovery of new vent fields on the seafloor.

What will become of the data, imagery, information and samples after this survey? *(Who is responsible for data archiving? How will the information be archived? Are there any intended publications from this survey? Will this data be used as leverage for follow-up investigation?)*

Data will be made publicly available via the standard Okeanos Explorer data pipelines, and will be provided to other researchers working in the area upon request. The data represents valuable information that will be used to direct future oceanographic research cruises in the area during 2012.

What restrictions of confidentiality are placed on this request? *(Can this request be shared with OER partners operating in the area who might be able to acquire these data? Is any part of this intended dataset sensitive and restricted? Are you willing to work with NOAA public affairs officials to report any discoveries made by this survey?*

The resultant dataset will be made publicly available via the standard Okeanos Explorer data pipeline.

Through real-time blogs on the oceanexplorer.noaa.gov website, the public can follow the sequence of events that leads to the discovery of new vent fields on the seafloor.

If this project is maritime archeologically-focused, what is the site's archaeological or historical importance?

N/A

If this project is maritime archeologically-focused, who has jurisdiction over the site, and have the appropriate agencies been contacted?

N/A

Procedure for Shipboard Methane Analysis

Water samples for methane (CH_4) analysis (20 ml) will drawn from the Niskin bottles mounted on the CTD in 60 mL plastic syringes. Dissolved methane concentrations will be determined by gas chromatography using a Hewlett Packard 5890 II gas chromatograph fitted with a 6-foot 5 Å molecular sieve column and a flame ionization detector following a headspace extraction. The headspace extraction involves connecting the 60 ml plastic syringe containing the water sample to a purpose built interface connected directly to the gas chromatograph and drawing ~40 ml of nitrogen into the syringe. The headspace is allowed to equilibrate with the water sample before depressing the plunger to transfer the headspace gas into a sample loop for injection onto the chromatography column for chromatographic separation.

The compressed gases necessary for this analysis include nitrogen (N_2), air, and hydrogen (H_2) all at an initial cylinder pressure of 2000 PSIA. The nitrogen is used as a carrier gas for the gas chromatography column and is connected directly to the gas chromatograph with 1/8" copper tubing. The flow rate is set to ~30 mL/min and flow is continuous for the duration of the cruise once the instrument is set up in port. The air and hydrogen are used as fuels for the flame ionization detector. They are connected directly to the gas chromatograph with 1/8" copper tubing. The flow rates are 400 mL/min for the air and 30 mL/min for the hydrogen. These gases are only flowing when the instrument is in use and serve as a fuel for a very small flame that is fully enclosed within the detector of the gas chromatograph. When not in use these gases are turned off at the compressed gas cylinder valve. The only other chemicals involved in this analysis are gas standards used for calibration of the gas chromatograph detector. These consist of trace concentrations of methane (~100 ppm) in nitrogen at relatively low pressure (~200 PSIA). At this concentration of methane, the gases are non-flammable due to the balance being nitrogen. Due to the relatively small cylinder size (~1 liter) and quantity of gas contained within, they do not represent a suffocation risk for normal laboratory conditions.

Appendix III

Survey of Opportunity:
Total Cell Counts

How to Preserve CTD Fluids for Total Cell Counts

Julie Huber
jhuber@mbl.edu

Microbial communities are often enriched in hydrothermal plumes, meaning the number of cells is elevated above background seawater due to all the yummy energy sources in the plume, making them another good indicator of hydrothermal activity. We like to visually examine the fluids with microscopy to look for particles and interesting cells, as well as count the cells and compare them to background seawater. During our plume search, any sample that has any indication of a plume should be preserved, as well as the 2-3 samples on either side of it, to get background levels. Every sample needs to be preserved in duplicate. The water gets preserved in 37% formaldehyde (final concentration 3.7%) and stored at 4 ºC. Formaldehyde should be used in a hood if one is available. You can pour 50 ml into a 50 ml falcon tube and use that as a working solution, leaving the large bottle in the HazMat cabinet.

- Scintillation vials for samples
- 25 ml disposable sterile pipettes and bulb for distributing CTD sample water
- 1 ml pipette and tips for dispensing formaldehyde
- Labels for scintillation vials

1. Fill scintillation vial with CTD sample water directly off the Niskin bottle. Use the 25 ml pipette and bulb to remove 18 ml, dump out remainder, and distribute the 18 ml back into the vial. For each sample, you will have 2 vials of 18 ml each and you can use the same pipette for the duplicates.

2. Add 1.8 ml of 37% formaldehyde to the vial using the 1 ml pipette (set it to 900 µl and dispense 2x).

3. Cap, invert a few times, label. You can write on the top with a sharpie, and for duplicates, please label samplename-1, samplename-2. We usually only count -1 but like to have -2 in case we have problems. We will also supplied labels that can stick on in case you want to pre-label or your sharpie appears to be rubbing off or whatever.

4. Store at 4 ºC.

Let me know if you have any questions!

Thanks,
Julie

Appendix IV

Survey of Opportunity:
Sampling for Total Organic Carbon

Subject: Sampling of the CTD for DOC on the EX
From: "Bennett, Sarah A (382D-CalTech)" <Sarah.A.Bennett@jpl.nasa.gov>
Date: Thu, 09 Jun 2011 12:23:57 -0700
To: "Kelley.Elliott@noaa.gov" <Kelley.Elliott@noaa.gov>, "cgerman@whoi.edu" <cgerman@whoi.edu>, "Coleman, Max (382D)" <max.coleman@jpl.nasa.gov>

Hi Kelley and Chris,

Sorry I didn't make it for the CTD call, Max filled me in on the details and today's call also gave me a good overview. I believe Max mentioned our interest in organic carbon and we have discussed and would like the possibility of sampling for total organic carbon (TOC) in plume samples collected by the CTD rosette. It is relatively simple and we have chosen TOC rather than DOC/POC (dissolved and particulate organic carbon), due to sample processing issues and the amount of water required (10L). So our requirements would be the following:

1) Samples from 'juicy' plumes - i.e. Eh anomalies, along with background samples above and below the plume, AND samples from directly above a vent site - if carried out at Von Damm and Europa

2) 40 ml taken directly from the CTD bottle into TOC glass vials (we will provide)

3) Samples acidified with trace metal grade HCl - 0.1%, i.e. 40 ul in 40ml sample (Again we will send the acid out to the ship)

We are interested in TOC because hydrothermal systems represent a biological niche which has been considered independent from the rest of the ocean. However, hydrothermal systems can act as a transport mechanism of organic carbon from within the crust and surrounding areas of diffuse flow, out into the water column. However, very few studies exist on the presence of organic carbon in hydrothermal plumes. I have carried out two studies, one at the East Pacific Rise and one at the Loihi Seamount. At the EPR, I found very little elevation in DOC, but at Loihi the DOC concentrations were elevated. I think this is due to differences in the chemistry and biology of these two environments. If indeed we have different venting environments in the Cayman Trough, it would be interesting to compare the plumes from different sites for organic carbon. This in itself will be an interesting study, but will also guide us on our return to the Cayman in January.

Let me know what you think,

Best wishes,
Sarah

PS Please update your email to this JPL address - Thanks!

Appendix V

Clearance to Conduct Marine Scientific Research in Cayman Island Waters

Foreign &
Commonwealth
Office

Date: 10th June 2011

Ref: 049/2011

The Maritime Policy Unit (Legal Advisers) of the Foreign and Commonwealth Office presents its compliments to the Embassy of the United States of America and has the honour to refer to the US Embassy's application requesting permission to undertake a research cruise by the **Okeanus Explorer** in **the territorial waters of the Cayman Islands.**

The appropriate United Kingdom authorities have been informed of the research cruise **OKEANUS EXPLORER F2011-43** of **1st AUGUST** to **31st AUGUST 2011** and hereby give clearance for the cruise, subject to the following conditions.

It is requested that the vessel should at all times comply with the International Regulations for Preventing Collisions at Sea 1972 (as amended) as set out in the Schedule to the Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1989 (SI 1989 No 1798). In particular, the vessel should comply with the requirements of Rule 10 of the Collision Regulations when operating within the vicinity of traffic separation schemes approved by the IMO. In this connection, the Embassy's attention is drawn to the Admiralty Notice to Mariners No 17 of 99 and Merchant Shipping Notice M1448.

Attention is also drawn to: a) the safety zone established in accordance with international law and extending to 500 metres around all water off-shore installations (it is an offence to enter such safety zones without permission from the Minister of State for Energy (Part III of the Petroleum Act 1987)) and b) oil and gas Development Areas which are marked on Admiralty Charts.

The Department for Environment, Food and Rural Affairs would like the following to be brought to the US Embassy's attention; the master of the cruise vessel must be made aware of the possibility of encountering fixed, poorly lit and marked, fixed fishing gear. Care should be taken not to interfere with the activities of commercial fishing vessels when undertaking scientific trials. In the event of any fouling the vessel should report details direct to the Marine Fisheries Agency at the earliest opportunity.

The cruise is planned in an area of possible live cables. The master should obtain the latest Cable Awareness charts from www.kisca.org.uk and should not bottom trawl within 500m of any in-use cables.

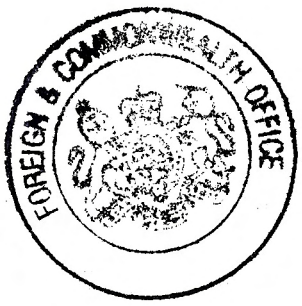
The appropriate United Kingdom authorities have been informed of the proposed testing and hereby give clearance for said testing to proceed subject to the following conditions.

Please provide copies of the original cruise reports including that resulting from the above mentioned test data, in digital format if possible, to:

- Foreign and Commonwealth Office, Maritime Policy Unit
- Ministry of Defence: Lt Cdr P R Newell RN, DI ICSP MARPLANS02, Room 252, Old War Office Building, Whitehall, London SW1A 2EU / colin.thomson923@mod.uk (please also provide all raw and processed data and resulting research within the UK Exclusive Economic Zone).
- Director of the Fisheries Research Services, Marine Scotland Science, 101 Victoria Road, Torry, Aberdeen AB9 8DB / Iain.Gibb@scotland.gsi.gov.uk
- UK Hydrographic Office: Nick.Weaver@UKHO.gov.uk / Head of MEIC, UK Hydrographic Office, Taunton, Somerset TA1 2DN (please also provide all raw and processed data and resulting research).
- British Oceanographic Data Centre: gaev@bodc.ac.uk / Dr Gaynor L Evans, Proudman Oceanographic Laboratory, Joseph Proudman Building, 6 Brownlow Street, Liverpool L3 5DA.
- Jane Thompson, RSU Operations, NERC Research Ship Unit, National Oceanographic Centre, Empress Dock, Southampton SO14 3ZH / rvsops@sea.noc.soton.ac.uk
- As a condition of entry, in accordance with article 249 of UNCLOS, the Joint Nature Conservation Committee requests that access to all data collected from within waters under UK jurisdiction is granted. Pre-reports should be forwarded to the Joint Nature Conservation Committee when they are immediately ready. In addition, the scientist in charge of that part of the expedition taking place within waters under UK jurisdiction will submit to the JNCC Offshore Survey Programme Manager, JNCC, Monkstone House, City Road, Peterborough, PE1 1JY, UK when it is immediately ready, 2 copies of a short expedition narrative describing the expedition and its preliminary results and the ships expedition track chart (Latitude and Longitude positions to be supplied as MS Excel spreadsheet or ArcGIS shapefile). Subsequently, 2 copies of the full expedition report including an assessment of the results of the expedition and two copies of all publications arising out of the expedition should be provided to: - JNCC Offshore Survey Programme Manager, JNCC, Monkstone House, City Road, Peterborough. PE1 1JY.

The Maritime Policy Unit avails itself of this opportunity to renew to the Embassy of the United States of America the assurances of its highest consideration.

MARITIME POLICY UNIT
LEGAL ADVISERS
FOREIGN AND COMMONWEALTH OFFICE
LONDON
SW1A 2AH



10th June 2011

Appendix VI

Material Safety Data Sheets

Fisher Scientific

Part of Thermo Fisher Scientific

Material Safety Data Sheet

Creation Date 24-Aug-2009 **Revision Date** 23-Sep-2009 **Revision Number** 1

1. PRODUCT AND COMPANY IDENTIFICATION

Product Name **Hydrochloric acid, Trace Metal Grade**

Cat No. **A508-4; A508-212; A508-500; A508P212; A508P500; A508SK212**

Synonyms Muriatic acid; Hydrogen chloride, HCl

Recommended Use Laboratory chemicals

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Emergency Telephone Number
CHEMTREC®, Inside the USA: 800-424-9300
CHEMTREC®, Outside the USA: 703-527-3887

2. HAZARDS IDENTIFICATION

DANGER!

Emergency Overview

Causes burns by all exposure routes. May be harmful if inhaled.

Appearance Colorless **Physical State** Liquid **odor** pungent

Target Organs Skin, Respiratory system, Eyes, Gastrointestinal tract (GI), Liver, Kidney, Teeth

Potential Health Effects

Acute Effects
Principle Routes of Exposure

Eyes	Causes burns.
Skin	Causes burns. May be harmful in contact with skin.
Inhalation	Causes burns. May be harmful if inhaled.
Ingestion	Causes burns. May be harmful if swallowed.

Chronic Effects Experiments have shown reproductive toxicity effects on laboratory animals. May cause adverse liver effects. May cause adverse kidney effects. Chronic exposure to corrosive fumes/gases may cause erosion of the teeth followed by jaw necrosis. Bronchial irritation with chronic cough and frequent attacks of pneumonia are common. Gastrointestinal disturbances may also be seen.

See Section 11 for additional Toxicological information.

Aggravated Medical Conditions Preexisting eye disorders. Skin disorders.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Haz/Non-haz

Component	CAS-No	Weight %
Water	7732-18-5	62-65
Hydrochloric acid	7647-01-0	35-38

4. FIRST AID MEASURES

Eye Contact Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes. Immediate medical attention is required.

Skin Contact Wash off immediately with plenty of water for at least 15 minutes. Immediate medical attention is required.

Inhalation Move to fresh air. If breathing is difficult, give oxygen. Do not use mouth-to-mouth resuscitation if victim ingested or inhaled the substance; induce artificial respiration with a respiratory medical device. Immediate medical attention is required.

Ingestion Do not induce vomiting. Call a physician or Poison Control Center immediately.

Notes to Physician Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Flash Point No information available.
Method No information available.

Autoignition Temperature No information available.

Explosion Limits
Upper No data available
Lower No data available

Suitable Extinguishing Media Substance is nonflammable; use agent most appropriate to extinguish surrounding fire..

Unsuitable Extinguishing Media No information available.

Hazardous Combustion Products No information available.

Sensitivity to mechanical impact No information available.
Sensitivity to static discharge No information available.

Specific Hazards Arising from the Chemical
Corrosive Material. Causes burns by all exposure routes. Thermal decomposition can lead to release of irritating gases and vapors.

Protective Equipment and Precautions for Firefighters
As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

NFPA **Health** 3 **Flammability** 0 **Instability** 1 **Physical hazards** N/A

6. ACCIDENTAL RELEASE MEASURES

Personal Precautions Use personal protective equipment. Ensure adequate ventilation. Evacuate personnel to safe areas. Keep people away from and upwind of spill/leak. Do not get in eyes, on skin, or on clothing.

Environmental Precautions Should not be released into the environment.

Methods for Containment and Clean Up Soak up with inert absorbent material. Keep in suitable and closed containers for disposal.

7. HANDLING AND STORAGE

Handling Use only under a chemical fume hood. Wear personal protective equipment. Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. Do not ingest.

Storage Keep containers tightly closed in a dry, cool and well-ventilated place. Corrosives area.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering Measures Use only under a chemical fume hood. Ensure that eyewash stations and safety showers are close to the workstation location.

Exposure Guidelines

Component	ACGIH TLV	OSHA PEL	NIOSH IDLH
Hydrochloric acid	Ceiling: 2 ppm	Ceiling: 7 mg/m^3 Ceiling: 5 ppm (Vacated) Ceiling: 5 ppm (Vacated) Ceiling: 7 mg/m^3 Ceiling: 7 mg/m^3	IDLH: 50 ppm Ceiling: 5 ppm Ceiling: 7 mg/m^3

Component	Quebec	Mexico OEL (TWA)	Ontario TWAEV
Hydrochloric acid	Ceiling: 7.5 mg/m^3 Ceiling: 5 ppm	Peak: 7 mg/m^3 Peak: 5 ppm	CEV: 2 ppm

NIOSH IDLH: *Immediately Dangerous to Life or Health*

Personal Protective Equipment

Eye/face Protection Wear appropriate protective eyeglasses or chemical safety goggles as described by OSHA's eye and face protection regulations in 29 CFR 1910.133 or European Standard EN166

Skin and body protection Wear appropriate protective gloves and clothing to prevent skin exposure

Respiratory Protection Follow the OSHA respirator regulations found in 29 CFR 1910.134 or European Standard EN 149. Use a NIOSH/MSHA or European Standard EN 149 approved respirator if exposure limits are exceeded or if irritation or other symptoms are experienced

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State	Liquid
Appearance	Colorless
odor	pungent
Odor Threshold	No information available.
pH	< 1
Vapor Pressure	125 mbar @ 20 °C
Vapor Density	1.27 (Air = 1.0)
Viscosity	1.8 mPa.s @ 15°C
Boiling Point/Range	57°C / 135°F@ 760 mmHg
Melting Point/Range	-35°C / -31°F
Decomposition temperature	No information available.
Flash Point	No information available.
Evaporation Rate	No information available.
Specific Gravity	1.18
Solubility	Soluble in water
log Pow	No data available
Molecular Weight	36.46
Molecular Formula	HCl.H2O

10. STABILITY AND REACTIVITY

Stability	Stable under normal conditions.
Conditions to Avoid	Incompatible products. Excess heat.
Incompatible Materials	Strong oxidizing agents, Reducing agents, Bases, Metals
Hazardous Decomposition Products	Carbon monoxide (CO), Carbon dioxide (CO_2), Hydrogen chloride gas
Hazardous Polymerization	Hazardous polymerization does not occur.
Hazardous Reactions .	None under normal processing..

11. TOXICOLOGICAL INFORMATION

Acute Toxicity

Component Information

Component	LD50 Oral	LD50 Dermal	LC50 Inhalation
Water	90 mL/kg (Rat)	Not listed	Not listed
Hydrochloric acid	700 mg/kg (Rat)	5010 mg/kg (Rabbit)	3124 ppm (Rat) 1 h

Irritation	Causes burns by all exposure routes
Toxicologically Synergistic Products	No information available.

Chronic Toxicity

Carcinogenicity The table below indicates whether each agency has listed any ingredient as a carcinogen.

Component	ACGIH	IARC	NTP	OSHA	Mexico
Hydrochloric acid	Not listed	group 3	Not listed	Not listed	Not listed

IARC: (International Agency for Research on Cancer)
IARC: (International Agency for Research on Cancer)
Group 1 - Carcinogenic to Humans
Group 2A - Probably Carcinogenic to Humans
Group 2B - Possibly Carcinogenic to Humans

Sensitization No information available.

Mutagenic Effects Mutagenic effects have occurred in experimental animals.

Reproductive Effects Experiments have shown reproductive toxicity effects on laboratory animals.

Developmental Effects Developmental effects have occurred in experimental animals.

Teratogenicity Teratogenic effects have occurred in experimental animals..

Other Adverse Effects See actual entry in RTECS for complete information.

Endocrine Disruptor Information No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity

Do not empty into drains.

Component	Freshwater Algae	Freshwater Fish	Microtox	Water Flea
Hydrochloric acid	Not listed	282 mg/L LC50 96 h	Not listed	Not listed

Persistence and Degradability No information available

Bioaccumulation/ Accumulation No information available

Mobility .

Component	log Pow
Water	-1.87

13. DISPOSAL CONSIDERATIONS

Waste Disposal Methods Chemical waste generators must determine whether a discarded chemical is classified as a hazardous waste. Chemical waste generators must also consult local, regional, and national hazardous waste regulations to ensure complete and accurate classification.

14. TRANSPORT INFORMATION

DOT

UN-No	UN1789
Proper Shipping Name	HYDROCHLORIC ACID
Hazard Class	8
Packing Group	II

TDG

UN-No	UN1789
Proper Shipping Name	HYDROCHLORIC ACID
Hazard Class	8
Packing Group	II

IATA

UN-No	UN1789
Proper Shipping Name	Hydrochloric acid
Hazard Class	8
Packing Group	II

IMDG/IMO

UN-No	UN1789
Proper Shipping Name	Hydrochloric acid
Hazard Class	8
Packing Group	II

15. REGULATORY INFORMATION

International Inventories

Component	TSCA	DSL	NDSL	EINECS	ELINCS	NLP	PICCS	ENCS	AICS	CHINA	KECL
Water	X	X	-	231-791-2	-		X	-	X	X	X
Hydrochloric acid	T	X	-	231-595-7	-		X	X	X	X	KE-20189 X

Legend:
X - Listed
E - Indicates a substance that is the subject of a Section 5(e) Consent order under TSCA.
F - Indicates a substance that is the subject of a Section 5(f) Rule under TSCA.
N - Indicates a polymeric substance containing no free-radical initiator in its inventory name but is considered to cover the designated polymer made with any free-radical initiator regardless of the amount used.
P - Indicates a commenced PMN substance
R - Indicates a substance that is the subject of a Section 6 risk management rule under TSCA.
S - Indicates a substance that is identified in a proposed or final Significant New Use Rule

T - Indicates a substance that is the subject of a Section 4 test rule under TSCA.
XU - Indicates a substance exempt from reporting under the Inventory Update Rule, i.e. Partial Updating of the TSCA Inventory Data Base Production and Site Reports (40 CFR 710(B).
Y1 - Indicates an exempt polymer that has a number-average molecular weight of 1,000 or greater.
Y2 - Indicates an exempt polymer that is a polyester and is made only from reactants included in a specified list of low concern reactants that comprises one of the eligibility criteria for the exemption rule.

U.S. Federal Regulations

TSCA 12(b) Not applicable

SARA 313

Component	CAS-No	Weight %	SARA 313 - Threshold Values %
Hydrochloric acid	7647-01-0	35-38	1.0

SARA 311/312 Hazardous Categorization

Acute Health Hazard	Yes
Chronic Health Hazard	No
Fire Hazard	No
Sudden Release of Pressure Hazard	No
Reactive Hazard	No

Clean Water Act

Component	CWA - Hazardous Substances	CWA - Reportable Quantities	CWA - Toxic Pollutants	CWA - Priority Pollutants
Hydrochloric acid	X	5000 lb	-	-

Clean Air Act

Component	HAPS Data	Class 1 Ozone Depletors	Class 2 Ozone Depletors
Hydrochloric acid	X		-

OSHA

Component	Specifically Regulated Chemicals	Highly Hazardous Chemicals
Hydrochloric acid	-	TQ: 5000 lb

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302)

Component	Hazardous Substances RQs	CERCLA EHS RQs
Hydrochloric acid	5000 lb	5000 lb

California Proposition 65
This product does not contain any Proposition 65 chemicals.

State Right-to-Know

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island

Component	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Hydrochloric acid	X	X	X	X	X

U.S. Department of Transportation

Reportable Quantity (RQ): Y
DOT Marine Pollutant N
DOT Severe Marine Pollutant N

U.S. Department of Homeland Security

This product contains the following DHS chemicals:

Component	DHS Chemical Facility Anti-Terrorism Standard
Hydrochloric acid	0 lb STQ (anhydrous); 11250 lb STQ (37% concentration or greater)

Other International Regulations

Mexico - Grade No information available

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS Hazard Class
D1A Very toxic materials
E Corrosive material

16. OTHER INFORMATION

Prepared By Regulatory Affairs
Thermo Fisher Scientific
Tel: (412) 490-8929

Creation Date 24-Aug-2009

Print Date 23-Sep-2009

Revision Summary "***", and red text indicates revision

Disclaimer

The information provided on this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guide for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered as a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other material or in any process, unless specified in the text.

End of MSDS

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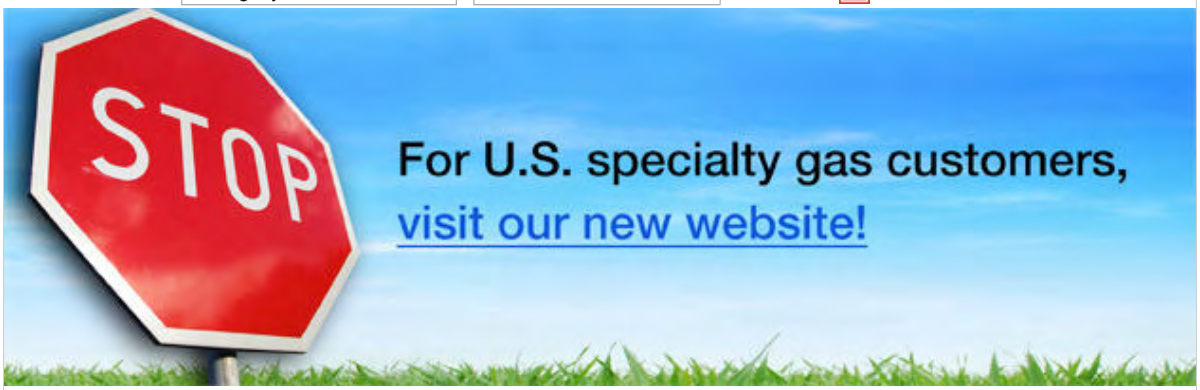

MATERIAL SAFETY DATA SHEETS

Back | Printer-Friendly

MSDS No: M-22751
Date: 03/09/2001

SUPPLIER ADDRESS: 6141 Easton Road, Bldg. 1
PO Box 310
Plumsteadville, PA 18949-0310

EMERGENCY PHONE NUMBER: (215) 766-8861

1. CHEMICAL PRODUCT

PRODUCT NAME: METHANE IN NITROGEN SYNONYMS:None

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS #	Concentration	Exposure Limits (PPM) ACGIH TLV	OSHA PEL	MAC	Other STEL
METHANE	CH4	74-82-8	.0001-11.9999 PCT	S/A	S/A	S/A	S/A
NITROGEN	N2	7727-37-9	BALANCE	S/A	S/A	S/A	S/A

Note: NE = NONE ESTABLISHED S/A = SIMPLE ASPHYXIANT

3. HAZARD INDENTIFICATION

* * * EMERGENCY OVERVIEW * * *
High pressure gas.
Can cause rapid suffocation.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation

ACUTE EFFECTS: Mixture acts as a simple asphyxiant by displacing air necessary for life. Symptoms include rapid respiration, muscular incoordination, fatigue, dizziness, nausea, vomiting, unconsciousness, and death.

CHRONIC EFFECTS: None known

MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known

OTHER EFFECTS OF OVEREXPORSURE: None

CARCINOGENICITY (US ONLY):

NTP - No
IARC MONOGRAPHS - No
OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

EYE CONTACT: None

SKIN CONTACT: None

INGESTION: None

IN EVENT OF EXPOSURE, CONSULT A PHYSICIAN

NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: Nonflammable

AUTOIGNITION TEMPERATURE: N/Ap

FLAMMABLE LIMITS: Nonflammable

LOWER:
UPPER:

EXTINGUISHING MEDIA: Use what is appropriate for surrounding fire.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Keep fire exposed cylinders cool with water spray.

HAZARDOUS COMBUSTION PRODUCTS: None

UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Remove leaking cylinder to exhaust hood or safe outdoor area. Shut off source if possible and remove source of heat.

SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

PRECAUTIONS TO BE TAKEN IN STORAGE: Store in well ventilated areas. Keep valve protection cap on cylinders when not in use.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to avoid asphyxiation.

EYE / FACE PROTECTION: Safety glasses

SKIN PROTECTION: None

RESPIRATORY PROTECTION: In case of leakage, use self-contained breathing apparatus.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless

ODOR: Odorless

PHYSICAL PRESSURE: Gas

VAPOR PRESSURE: N/Ap

VAPOR DENSITY (AIR=1): 0.968-0.926

BOILING POINT (C): N/Ap

SOLUBILITY IN WATER: Insoluble

SPECIFIC GRAVITY (H2O=1): Gas

EVAPORATION RATE: Gas

ODOR THRESHOLD: None

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.

CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source.

MATERIALS TO AVOID: Strong acids, oxidizers, and active metals. BrF5, Cl2,ClO2, NF3, liquid O2, and OF2. Nitrogen reacts with Li, Nd, and Ti at high temperatures.

HAZARDOUS POLYMERIZATION: Will not occur.

HAZARDOUS DECOMPOSITION: None

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): None established

LETHAL DOSE 50 (LD50): N/Ap

TERATOGENICITY: N/Ap

REPRODUCTIVE EFFECTS: N/Ap

MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place.

14. TRANSPORT INFORMATION

CONCENTRATION: 0.0001-11.9999%

DOT DESCRIPTION (US ONLY):

PROPER SHIPPING NAME: Compressed gases, n.o.s.
HAZARD CLASS: 2.2 (nonflammable)
INDENTIFICATION NUMBER: UN1956
REPORTABLE QUANTITIES: None
LABELING: NONFLAMMABLE GAS

ADR / RID (EU Only): Class 2, 1A

SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Materials are not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemicals.

TSCA: Mixture is not listed in TSCA inventory.

SARA: The threshold planning quantity for this mixture is 10,000 lbs.

EU NUMBER: N/Ap

NUMBER IN ANNEX 1 OF DIR 67/548: Mixture is not listed in annex 1.

EU CLASSIFICATION: N/Av

R: 20

S: 9

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

ABBREVIATIONS: N/Ap - Not Applicable N/Av - Not Available SA - Simple Asphyxiant NE - None Established

DISCLAIMER: Information included in this document is given to the best of our knowledge, however, no warranty is made that the information is accurate or complete. We do not accept any responsibility for damages by the use of the document.

Appendix VII

Emergency Data Sheet

EMERGENCY DATA SHEET
NOAA OKEANOS EXPLORER

PRINT CLEARLY

NAME: _____
(Last, First, Middle)

Mailing Address _____

_____

_____
(Other than the ship address)

Phone (Home) _____

(Cell) _____

Date of Birth _____

Emergency Contact: _____
(Name and Relationship)

Address: _____

_____

_____

Phone (Home) _____

(Work) _____

(Cell) _____

Email: _____

Signature _____ Date _____