NOAA Workshop on Systematic Telepresence-Enabled Exploration in the Atlantic Basin, May 10-11, 2011, Coastal Institute Building, University of Rhode Island, Narragansett, Rhode Island

Workshop Summary

October 1, 2011

National Oceanic and Atmospheric Administration
Office of Oceanic and Atmospheric Research
Office of Ocean Exploration and Research

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1 Overview

In May 2011, NOAA's Office of Ocean Exploration and Research (OER) hosted a workshop at the Coastal Institute on the University of Rhode Island's Narragansett Bay campus with members of the science community and federal and state partners to discuss potential targets for systematic, telepresence-enabled exploration in the Atlantic Basin, including the Gulf of Mexico and Caribbean Sea. This document summarizes the background, workshop objectives, key discussions, recommended targets and other important topics identified by the participants. Appendices are also attached for additional information about the workshop and related activities.

2 Background

The NOAA Office of Ocean Exploration and Research (OER) was created to increase the Nation's understanding of unknown and poorly known ocean areas and phenomena, generate new lines of scientific inquiry and research, increase the pace and efficiency of ocean exploration through the use of advanced techniques and technologies, and disseminate discoveries and findings to a broad spectrum of users. The mission of OER is:

> *Develop and use state-of-the-art technology to increase our scientific knowledge of the Earth's largely unknown ocean, in all its dimensions, to support NOAA and national objectives.*

OER in collaboration with the Ocean Exploration Trust, the Institute for Exploration (IFE), the University of Rhode Island (URI), the University of New Hampshire (UNH), and with support from the Ocean Exploration Advisory Working Group (OEAWG – a standing subcommittee of the NOAA Science Advisory Board) recently launched a new program of "systematic" exploration. Using the NOAA Ship *Okeanos Explorer* (EX) and the Ocean Exploration Trust's *E/V Nautilus*, explorers investigate new ocean areas and phenomena from shore-based Exploration Command Centers (ECCs) equipped to receive data and information – including high-definition video – in real-time. Information also can be transmitted over the Internet to other explorers and interested parties.

The systematic exploration paradigm involves surveying large areas at speeds up to 10 kt to provide high-resolution maps of the seafloor. These maps are used to define areas to be explored in greater detail using advanced remotely operated vehicles outfitted with high-definition video cameras and an array of sensors. In contrast to targeted exploration focused on meeting the objectives of individual

projects, systematic exploration is designed to search for, locate, and describe new habitats and phenomena, establishing a rich foundation of information that will catalyze further exploration, research, technology development and education. Systematic exploration is also designed to engage the public and stimulate the imagination by engaging viewers in the excitement of real-time exploration and discovery.

3 Workshop Purpose

The purpose of this workshop was to develop an inventory of targets to inform decisions on areas to be explored by the EX, the *Nautilus*, or other telepresence-enabled platforms over the next several years starting in 2012. This will enable OER and partners to develop a long-term strategy for the placement and operation of these assets over time.

This workshop sought input from members of the ocean community selected by OER to represent the entire scientific community. Workshop participants were selected based on several criteria: (1) target idea(s) they proposed in response to a pre-workshop solicitation for target ideas that would have the highest potential for discovery and lay the groundwork for further scientific investigations; (2) specific discipline, experience, interest or skill-set to ensure representation from all major scientific disciplines, areas of study and geographic regions; and, (3) willingness and availability to travel and participate in the workshop on behalf of the community not just for individual ideas.

Three primary objectives underpinned the Workshop: (1) familiarizing the ocean science community with Systematic and Telepresence-Enabled Exploration; (2) identification of areas to be explored using systematic and telepresence-enabled assets; and, (3) acquiring feedback on issues or challenges presented by this approach.

The following sections summarize the workshop agenda, plenary and breakout group discussions and target ideas by breakout group region. Additional topics discussed during the workshop are also summarized below.

4 Summary of Workshop Discussions

This section details the plenary and breakout discussions and results.

4.1 Familiarizing the ocean community with systematic and telepresence-enabled exploration

The Day 1 morning session was dedicated to providing participants with an overview of the history of the development of systematic and telepresence-enabled exploration. OER's Acting Director and Chairs of the OEAWG discussed the origin of this new paradigm, how it evolved over the last ten years and its importance for advancing the pace of ocean exploration, technology and creating public awareness and support for the ocean and ocean issues.

OER and IFE staff detailed the major technology and operational developments and lessons learned during the conversion of the two ships, field trials and initial operations. This gave participants an understanding of the major capabilities, operations, staffing requirements, data and products generated by each vessel and the supporting shore-based ECCs.

During the lunch break, staff from the University of Rhode Island's Inner Space Center (ISC) provided tours to participants and answered questions about the role for the ISC, its technologies and capabilities and technical details of ECCs.

With this background, participants were equipped to undertake an informed discussion of how best to utilize the vessels, shore infrastructure and paradigm for exploration.

4.2 Identification of areas to be explored using systematic and telepresence enabled exploration.

The Day 1 afternoon plenary provided participants with instructions for identifying criteria for determining if the target ideas proposed during the pre-solicitation were appropriate for the systematic approach. Participants then split into four regionally focused breakout groups for North Atlantic, South Atlantic, Gulf of Mexico and Caribbean Sea. Each group was composed of participants with expertise or interests inside and outside the geographic region in discussion. Participant breakout group assignments were made to ensure each group had a mix of scientific disciplines, and to minimize individual advocacy of specific targets.

To lead off the discussions, facilitators from OER and the OEAWG asked participants to consider and evaluate ideas for what made an idea a highly valued target. Ideas included criteria (e.g., high energy, anomalous regions, isolation, etc), geographic areas (mid-ocean ridges, major ocean intersections, etc.), subjects (seamounts, spatial/temporal aggregations or organisms), processes (currents/streams, spreading centers, etc), themes (e.g., path of the albatross), educational value, potential for political support and other major considerations identified by the breakout groups.

Breakout groups then discussed and evaluated the solicited target ideas within the analytical framework and considerations identified in their initial discussions. A report out at the end of the day identified each group's initial ideas and recommendations and additional topics the groups wished to discuss in plenary.

During the morning breakout session on Day 2, each group resumed their prior discussions and also discussed additional target ideas generated by the group. At the conclusion of the morning breakout session, each group reported out their findings, recommendations, evaluation framework and thoughts on additional challenges or discussions topics.

4.3 Acquiring scientific community feedback on several issues or challenges presented by this approach

Participants identified, discussed and provided feedback on several issues or challenges presented by the systematic telepresence-enabled approach to exploration. Section 6 elaborates on these discussions in further detail.

5 Summary of Breakout Group Discussions

The results of the breakout group discussions are captured below. Since the discussions were to be participant driven, facilitators were provided general guidance and worked with the participants to structure the discussions to yield what each group determined to be of greatest importance for each region. Accordingly, each group covered similar and different topics and group summaries reflect the diversity of those discussions. Detailed notes and breakout group participant lists are provided in the Appendices.

5.1 South Atlantic Region

Target Areas. There were four sites recommended for the South Atlantic (SA) region in the pre-workshop solicitation request. Sites were discussed in the context of what story they could help tell. There was a general recognition that the SA has had much less scrutiny than the North Atlantic and therefore work in any area of the SA could yield discoveries.

Much of the discussion was focused on the equatorial Atlantic. This was primarily because there seemed to be a confluence of disciplines that could benefit from exploration of this area. The important questions exploration in this area could yield included:

- Biology by continuing the work done in the Census of Marine Life and mirroring work done in the North Atlantic on deep corals and hydrothermal vents
- Geology and geophysics by exploring the poorly known equatorial Mid Atlantic Ridge and its very large offset transform faults
- Archeology by searching along historical ship routes related to the slave trade, early exploration and marine commerce between North and South America and Africa and Europe.
- Oceanography by investigating water exchange through areas of extreme topography like the equatorial Mid Atlantic Ridge and its associated transform faults
- Geography by creating high quality seafloor maps where they don't currently exist

Areas further south such as the Walvis Ridge and Santos Basin, while recognized as important, presented fewer multidisciplinary opportunities and logistical difficulties due to the weather and long transits.

Characterization. The SA group did not devote significant time to the topic of characterization.

Data Synthesis. Given the relatively little research that has been done in the equatorial and South Atlantic, and the very large areas that have yet to be explored, the SA group discussed, in detail, how to synthesize data to help determine specific sites for exploration.

One concept supported by the group involves utilizing a multidisciplinary mentor program to investigate an area. Under this concept, mentors from various disciplines would be assigned to guide the data searches of students or interns. The mentees could be graduate or undergraduate students in their respective disciplines or, with more oversight, could be high school students from a program like the URI Graduate School of Oceanography honors program or NOAA's Maritime Heritage program. It was also recommended that the program could be used to promote diversity in the marine sciences.

Participants would research and collect data in their respective disciplines for a large area of the ocean such as the Atlantic Ocean between 10°N and 10°S. The data could include:

- Previously collected multibeam tracks and other seafloor maps (NGDC and the Global Multi-Resolution Topography Data Portal at http://www.marine-geo.org/portals/gmrt/)
- Seismicity
- Reports from past cruises
- Published results
- Historical data such as trade routes and information about lost vessels

- GEBSCO (SIO-Oct.11)(Hall)
- Census of Marine Life

It was noted that in the SA, investigators from other countries (e.g. France and Russia) have done significant work in some areas and could prove to be a valuable resource. Specific to the equatorial Atlantic, researchers from Woods Hole Oceanographic Institution in collaboration NOAA Pacific Marine Environmental Lab plan to install hydrophones in the equatorial Atlantic in 2012 and can help contribute to this effort. The hydrophone array will record the seismicity between 20°N and 10°S for two years. As of October 2011, four hydrophones have been deployed from the R/V *Ron Brown,* and a fifth hydrophone will be deployed in Fall 2011. Three additional hydrophones will be deployed in 2012. Similarly, maritime archeologists from NOAA sanctuaries can help with information about the slave trade and other historic wrecks that might be in the area.

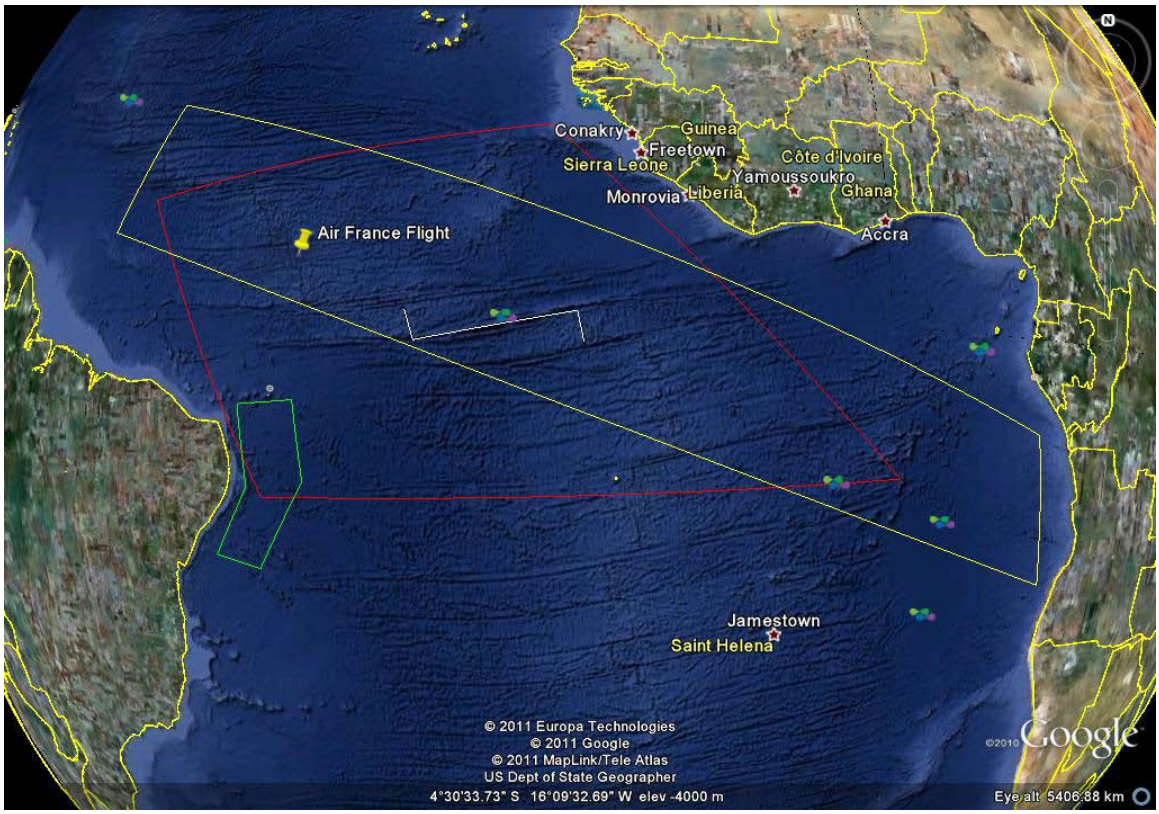

Figure 1. South Atlantic Region Breakout Group Recommended Target Areas

5.2 North Atlantic Region

Target Areas. Twenty-one target areas were recommended for the North Atlantic (NA) region in the pre-workshop solicitation request. Targets are characterized as marine archaeology/early human occupation, mesophotic corals, deep sea corals,

biodiversity hot-spots, seamounts, canyons, trenches and Mid-Atlantic Ridge (MAR) vents, volcanoes and seamounts. Noticeable gaps in target ideas were identified for microbiology, the abyssal plains, megafauna and water column chemistry and plankton.

Discussions of criteria for selecting targets highlighted the importance of areas of high value to a broader community, high energy areas, anomalous and/or isolated areas, limited previous exploration or research, difficult to access, potential for outreach, connection to the public and ability to show human impact, representation of Atlantic diversity, natural hazard potential and political interest. Discussions also highlighted the importance of capitalizing on the capabilities of each vessel and leveraging other vessels and assets to expand the possible opportunities for further exploration, such as NOAA and UNOLS vessels, including potentially modifying their cruise tracks slightly to accomplish exploration objectives (e.g., seamount mapping).

Discussions of geographic areas emphasized the MAR, central transport issues/geological activity, intersections of features, seamounts, canyons from shelf to abyss, location of temporal and/or spatial aggregations and unique habitats. Processes discussed included currents, spreading centers, vent chemistry and variations in biology along MAR, genetic isolation and transport among vents and microbial activity.

Priority Targets. The following five areas were identified as high priority areas for explorations:

1. *Canyons of the NE (US) region.* Though much work has been done in this topic, two or three canyons are not yet studied.
2. *New England Continental Margin.* This is a biodiversity hot spot in need of understanding of its role in biodiversity.
3. *Telegraph Axial Volcano MAR.* This would capitalize on all disciplines, including bacterial analysis.
4. *Equatorial MAR.* Would provide a good comparison with areas north and also in the South Atlantic.
5. *MAR and Azores Seamounts.* Seamounts are synthetic areas for covering all major topics or disciplines, provide value for management and comparison between depths and new and old seamounts.

Other potential target areas recommended for further discussion include the Laurentian Fan, revisiting the Challenger sites soundings, unexplored areas of the Gulf of Maine and southeast Hudson Canyon, areas previously surveyed by the Atlantic Crossing Glider, whale migration corridors, taking samples/cores/photographs at previous Ewing sites and looking at results from GeoSec and Geotrace efforts to identify possible targets.

Characterization Data Needs. A general discussion about characterization yielded the need for CTD, pH, DIC, DO2, fluorescence, transmissometer, T-probes, fluid sample, slurp sample, plume particles and gravity/magnetometry data.

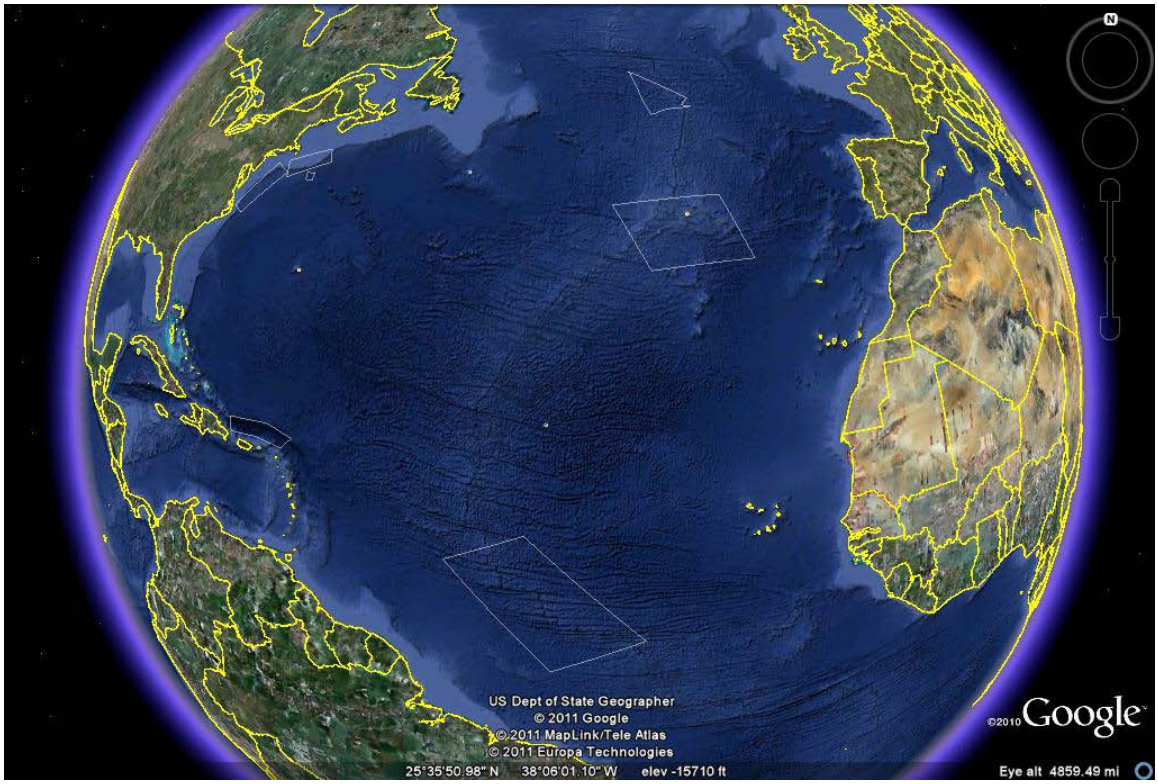

Figure 2. North Atlantic Breakout Group Recommended Target Areas

5.3 Gulf of Mexico Region

Target Areas. Twelve target areas were recommended for the Gulf of Mexico (GoM) region in the pre-workshop solicitation request.

Targets of importance include areas of tectonic unknowns, biogeographic transitions, historical significance, previously unmapped, canyons, deep sea corals, seeps, tectonically important, geodynamic processes, "deepest spot" mapping, abrupt topography and passes, paleological/archaeological sites west of Florida, coastal canyons, key spots for new species. The group recognized the opportunity to investigate seep sites using the EX multibeam system. The group offered that there are likely large areas in the GoM with limited to no information on biology and there has been no seismic velocity mapping of the GoM.

During discussions the group raised three yet to be answered philosophical questions: (1) If a wreck is known but not explored, is it exploration under this paradigm; (2) If an area has been mapped but the data is not publicly available is that a suitable target; and (3) Are areas known to be important to management (e.g, Sanctuaries, Habitat Areas of Particular Concern, Reserves) suitable to this paradigm. The questions suggest that a fair amount may already be known about an area in order to be of interest to natural resource managers and existing agencies with management responsibilities should have resources to pursue their specific information needs. In general, any work in or near sanctuaries or managed marine areas that can help establish new managed areas or boundaries are very valuable.

Priority Targets. The following areas were identified as high value exploration targets but require further assessment and discussion:

1. *Last Glacial Maximum.* Significant geological, coral and paleological interest and value.
2. *Florida Straits/Deep Sea Coral Reefs.* Deeper than 1000m unexplored. Interest in wrecks, biology, deep sea corals, crust/tectonic characteristics, current flow.
3. *Florida Escarpment.* Cold seep, brine seeps, freshwater seeps, canyon formations, ecology, deepwater corals.
4. *New Seeps Near Deep Water Horizon site/DeSoto Canyon/Mississippi Canyon.* Provides opportunity to test new way of exploring water column to identify gas seeps. Wrecks near historic shipping routes, canyon processes and coral interests.
5. *Yucatan Sill/Strait.* Bioegeography, deep corals, connectivity between Gulf of Mexico and Caribbean Sea, early travelers/archaeology.
6. *West Florida Shelf.* Reefs, Corals.
7. *Chicxulub Impact Crater.* Interesting surface bathymetry, perhaps too shallow and not enough broad interest.
8. *Campeche Bay. Asphalt seeps,* wrecks, gold, vessels sailing out of Veracruz.
9. *"Jamie's Tongue".* High interest in oil and gas by Cuba and Mexico.
10. *Sigsbee Deep/Knolls.* High interest in mapping and ROV work.

Other topics raised for further discussion:

- Defining/Refining the standard suite of tools for site characterization and measurements
- Determining when to decide it is time to leave an area (e.g., based on national/international obligations, characterization level, etc).
- How do you define a "stick" exploratory transit? Develop protocols. How best to take advantage of transit time? (e.g., Prey field of sperm whale)

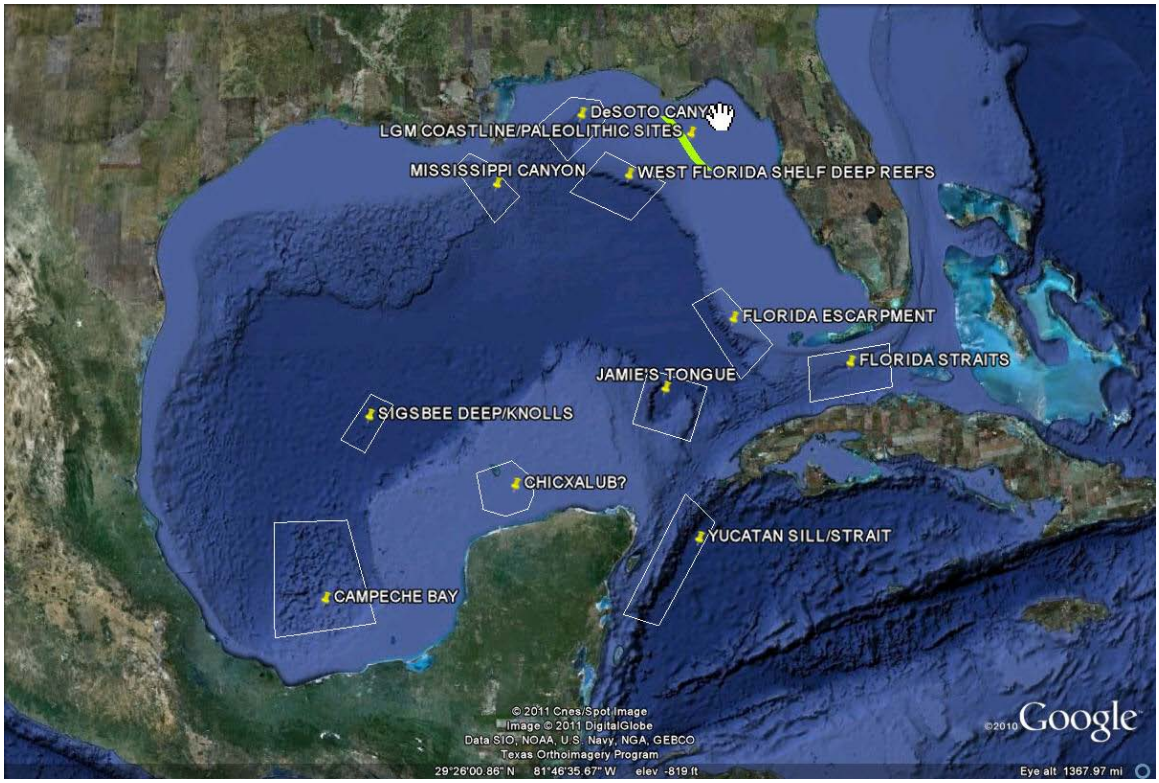

Figure 3. Gulf of Mexico Breakout Group Recommended Target Areas.

5.4 Caribbean Sea Region

Target Areas. Eleven target areas were recommended for the Caribbean Sea (CS) region in the pre-workshop solicitation request.

The Caribbean Sea is an ideal region with significant transitions or "Passages". When the group came to consensus, the idea of transitions seemed very fitting as a focal point of the Caribbean [the transition zone from the South Atlantic to the Caribbean Sea and the Caribbean Sea to the Gulf of Mexico and the North Atlantic (by way of the northwest and windward passage)]. The theme of passages captures the physical transitions between the various bodies of water through the water currents. Transitions also capture passages of the maritime heritage and cultural aspect from the old world to the new world and the passages between the Americas and the Inter American Sea (Gulf of Mexico and the Caribbean Sea). The region is rich in history as well as a confluence of disciplines that could benefit from exploration of this area. Important themes of exploration in this area could address include:

- Physics/Biology/Geology
    - Event driven phenomena (catastrophic [i.e. quakes/coral bleaching event, tectonics, weather)
- Maritime heritage (e.g., slave trade)

- Physical oceanography (i.e., topography, currents, water mass exchange)
- Geology and geophysics (i.e., bathymetry, major plate boundaries)

Priority Targets. The potential sites for Caribbean Sea exploration should ideally be:

- Unexplored, and have a high potential for discovery
- Have a unique combination or confluence of features/processes/factors
    - Physics, topography, biology (currents plus geology), maritime heritage (slave trade)
    - Synthetic exercise (see Section 6.2) by graduate students and regional partners
    - Water Mass exchange
    - Major Plate boundaries
- Have maritime heritage associated e.g.
    - History
    - Number and importance of potential sites (i.e. trade/travel routes)
- Possibility of International Partners (industry partners, Brazil synergy in SA, Argentina)
- Should have High Public Interest
    - Tourism
    - Diplomacy
    - Management

Data Synthesis. It would be strategic to initially target the US Extended Economic Zone (EEZ), but more research has to be done prior to suggesting potential routes for systematic exploration. This is especially important given the complexity of adjacent EEZ boundaries of the countries in the region. The CS group thought it would be strategic and prudent that outreach efforts lead the way to fostering international partnerships leading to collaborations.

Pre-Expedition Synthesis

- Using databases
    - NGDC/MBES/Side Scan (E.G., Puerto Rican trench has been mapped, but still need significant synthesis data)
    - Cultural Resources/Shipwreck database –US Navy database
    - Query specimen database in US and European museums
    - LDEO/USGS geological database
    - Potentially ask oil companies to release bathy maps
    - Paul Mann Caribbean Basin (CBTH) Database
    - GEOPRIZM (NSF)
    - www.vliz.be/vmdcdata/marbound/query.php
    - IBC/Jebco website effort to share bathymetry data
    - USGS database on what was mapped
    - Barbados Accretionary prism is an area mapped by the French
- Seasonal Considerations

    - Need to have input from someone who is knowledgeable of Caribbean weather patterns (e.g., avoid unfavorable weather/hurricane seasons)
- Permits
    - CITES and USFWS— imports, fisheries and protected species
    - Smithsonian Research Institute in Panama (STRI)-clearing house for permits and could help since they would have knowledge of who to contact for permits
    - Archaeology collections – controlled by countries

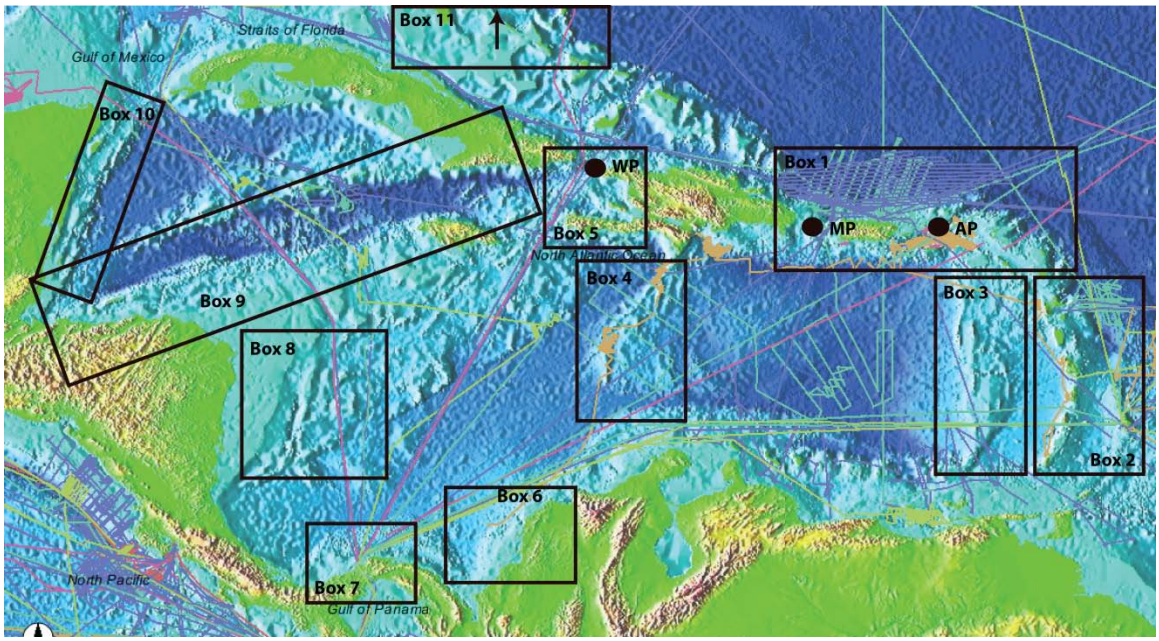

Figure 4. Caribbean Sea Breakout Group Recommended Target Areas.

6 Scientific community feedback on several issues or challenges presented by this approach

During the breakout discussions participants identified several topics that warranted additional discussion during the afternoon plenary, including access to data, how to get involved in the expeditions, the necessary information, research and syntheses needed to ensure appropriate targets are selected, and what constitutes "characterization" under the systematic model.

6.1 Data Access and Rights

During plenary sessions, NOAA described how data is made publicly available without proprietary rights on public web sites and archive centers once processing is complete. A healthy dialog ensued about this policy. Several participants highlighted the importance of proprietary rights for publishing and career development and others emphasized the movement already underway in academia and the scientific community to open source data and publishing. For example, in 2010, the Institute for Exploration published a supplement in Oceanography that described the capabilities, operations, data and results of telepresence-enabled exploration aboard the E/V Nautilus. OEAWG members proposed the development of a PLoSOne ocean exploration journal to provide open access to data and resulting papers from EX and Nautilus explorations and provide a venue for community peer review and dialog on data and findings. Also suggested was the development of an open file synthesis report to ensure data is readily available with supporting documentation. This would complement the accessibility of the data in the archives and bring together the data, analyses and findings in one product. Finally, it was suggested that an article in AGU's magazine EOS about the data now available for scientific research might be appropriate. The NOAA team is investigating how best to implement this and has already begun the process of testing an open file type product beginning with mapping data. One of the key constraints to creating an all-in-one product is the disk storage required for the video collected to be included.

6.2 Regional Data Synthesis/Analysis

It was noted in several breakout groups that access to previously collected data by others is a pre-requisite to efficiently planning missions. In planning for missions, it was recommended that teams from academia (faculty and students) be compensated to research and develop regional data syntheses and analyses to improve target selection and assist with overall expedition planning. This would ensure previously visited areas are not revisited too soon, include consideration of political and logistical conditions and provide an opportunity to identify important collaborators and contributors to expedition planning and execution, remotely or onboard.

6.3 Participating in Expeditions

One of the primary goals of equipping the *Nautilus* and EX with telepresence-capabilities is to be able to engage a large number of explorers in the expeditions and not be constrained by berthing as on a ship. Since the expeditions are systematic and all operations are geared towards benefiting the entire community, NOAA and IFE engage in-house senior scientists and respective advisory boards to assist with identifying a core team of scientists to assist planning expeditions. These core teams assisted with refined target identification and preliminary cruise planning. They then work to further broaden the participation in the science community by engaging other scientists to increase the diversity of expertise

brought to the mission. These scientists receive minimal travel support to an ECC so that a core team of scientists is actively participating or are "on duty" throughout the expedition. This team is complemented with scientists who may be participating passively or periodically "on call" and actively engaging only when called upon by the core team. Anyone with an internet 2 connection and more recently a commodity internet connection can view and record with their own systems the live video and data as it is streamed to shore.

While this model has served effectively during the recent field trial seasons, it was identified that a more expansive model could be utilized whereby a call is made to request offers from competing teams of scientists. These teams would be required to collaborate with the IFE and NOAA teams on expedition planning, execution and product development as is done under the core team approach. The NOAA and IFE teams will continue to investigate this and other options to improve the science team selection process.

It was also noted that regardless of the model of engagement, guidelines will need to be in place to ensure there is equal opportunity for all disciplines. The careful selection of core teams who represent the community ensures that no discipline is left out. It was noted that exploration is and should be inherently interdisciplinary.

This raises an ongoing challenge in such a distributed and participatory exploration model – how to make operational decisions such as when to stop, when to move on and when are we "done". Tools that notify the community for real time feedback and not just single scientist 'call-outs' would be valuable to both the science community and the expedition team. NOAA plans to continue to engage the science community in this discussion to develop a robust and inclusive model of participation and decision making.

6.4 Defining Characterization

One of the important products of exploring an area is its characterization. In plenary sessions and breakout groups, the question frequently arose as to what defines characterization. Several breakout groups and the final plenary engaged in brief discussions to provide some ideas for consideration in defining characterization. Consistently, the consensus was that characterization is feature and discipline specific. For example, a hydrothermal vent requires different characterization than a coral mound. It may also be team specific in that different teams may approach characterization differently. Concerns were expressed that if characterization is team specific then gaps might occur. This was countered with the recognition that anyone participating remotely should be able to engage with the core science team to ensure critical gaps are filled. Identifying the critical elements of an open file report will also help ensure appropriate data is collected and iconographic products are developed. These products would have to meet the science community's requirements for using the results of systematic exploration to

generate follow on hypotheses and research proposals. This would facilitate the transition of investigation from exploration discoveries to new research (E2R).

6.5 Follow-on Research

A key goal of exploration is to enable and provide supporting products and information support the E2R transition. Currently, outside of the NOAA funding streams there is no other source for rapid research following exploration. It was proposed that NSF could setup an E2R fund to enable this rapid response. In favorable budget environments, OER could also establish an E2R fund and engage OER's Research Division. Critical to sharing information and findings from systematic explorations is building and supporting knowledge communities at multiple levels (e.g., students, researchers, managers) through web-based tools, such as PLoSOne and others. This would allow rapid information sharing, peer review and community discussion of next steps in E2R.

7 Next Steps

First and foremost, we seek comments and input from the community on this draft summary. Please email comments or questions to Nicolas.Alvarado@noaa.gov by September 27, 2011.

This workshop raised a variety of additional questions that warrant follow-on discussions with the community – from team identification and engagement, exploration tools and technologies, decision making processes, data access tools, open file reporting and others. OER recognizes the value of these discussions for answering these important questions and familiarizing the community with the model of systematic, telepresence-enabled exploration. As these discussions continue we will continue to keep the community apprised and actively engaged.

Similarly, in order to move out on developing a robust expedition schedule for the next several years, the following steps are required.

7.1 Compare workshop results with major NOAA initiatives.

NOAA's Next Generation Strategic Plan and Annual Guidance Memorandum outline major initiatives NOAA is undertaking that become a framework or foundation for exploration. Close comparison and alignment of goals will ensure full NOAA support. Internal OER discussions with NOAA programs will be held to similarly identify potential targets. Targets from this workshop and internal NOAA discussions will be binned to identify those that best align to the overarching NOAA goals.

7.2 Evaluate logistics.

In a budget-limited environment, logistics and available resources can significantly constrain the kind and amount of exploration that can be accomplished. Cost-estimates for binned targets will be conducted to determine which targets are feasible to prosecute given anticipated budgets and available ship time and other operational considerations.

7.3 Develop schedule.

Information from Sections 7.1 and 7.2 provide the bounding parameters within which to develop a schedule. OER will incorporate this information into a schedule for approval by NOAA's Fleet Council.

7.4 Develop engagement strategy.

The schedule approved in Section 7.3 will be used to develop an engagement strategy with partners, governments and the scientific, education and outreach communities. This would include pre-planning data syntheses and analyses, detailed target and transit planning, and operations (including ship, shore, education and outreach) planning and execution and feedback on the schedule for the following year.

8 Conclusion

The systematic telepresence-enabled approach to exploration holds promise for yielding new discoveries, stimulating new technology and research, providing valuable information for management, training the next workforce and educating and exciting students and the general public. The success of this workshop and these endeavors are dependent upon the active engagement and collaboration between NOAA, its partners, the scientific community and the public. In a time of tremendous strain on research and exploration budgets, these collaborations will help us achieve maximum efficiency for every exploration dollar spent and support important follow-on research and publications. While this report concludes this workshop, it begins an ongoing dialog and partnership between NOAA and the community to further our collective exploration mission.

9 Appendices

9.1 Appendix A. Workshop Agenda

Telepresence-Enabled Expeditions Workshop
Atlantic Basin
University of Rhode Island, Narragansett Bay Campus
Coastal Institute Building
May 9, 2011

Agenda

OBJECTIVES – The objectives of this workshop are to:

1. *Describe a new program of "telepresence-enabled" exploration*
2. *Provide examples of how this new paradigm is being implemented and some preliminary results*
3. *Identify unknown and poorly known areas in the Atlantic basin (both North and South), including the Gulf of Mexico and Caribbean Sea where this ocean exploration initiative may be best applied*

MAY-9: DAY 1 – (Plenary in CI Auditorium; breakout rooms as assigned)

8:30	Coffee and light refreshments		
9:00	Convene in plenary session – Welcome		*(Dennis Nixon, URI GSO Associate Dean)*
9:15	Introductions – OER staff and OEAWG		*(John McDonough/Robert Ballard)*
9:30	Overview of the workshop – objectives and logistics		*(Craig Russell)*
9:45	Overview and background:		
	9:45	OER history and background	*(John McDonough)*
	10:15	A new paradigm for exploration – overview	*(Robert Ballard/Larry Mayer/John McDonough)*
	10:45	BREAK	
	11:00	Example 1 – Pilot Programs - NOAA OER at URI – partnerships - R&D and joint expeditions - Current path - Vision for the future	*(Catalina Martinez)*
	11:30	Example 2 – INDEX 2010 - *Okeanos Explorer* overview of capabilities - Expedition objectives - Overview of operations - Results	*(Craig Russell)*
	12:00	Example 3 – Black Sea and Mediterranean 2010 - EV *Nautilus* overview of capabilities - Expedition objectives - Overview of operations - Results	*(Katy Croff-Bell)*
12:30	LUNCH		

1:30	TOUR – The Inner Space Center	*(Dwight Coleman/Catalina Martinez)*
2:30	Reconvene in plenary – instructions to breakout groups	*(Craig Russell)*
2:45	Convene in breakout groups to discuss recommended targets to explore	
	North Atlantic (participants will be assigned)	*(Paula Keener / Nathalie Valette-Silver)*
	South Atlantic (participants will be assigned)	*(Jamie Austin / Derek Michelin)*
	Gulf of Mexico (participants will be assigned)	*(Larry Mayer / Susan Haynes)*
	Caribbean (participants will be assigned)	*(Andy Shepard / Nicolas Alvarado)*
4:45	Reconvene in plenary – brief reports from breakout groups	
5:30	ADJOURN – dinner on your own	

Telepresence-Enabled Expeditions Workshop
Atlantic Basin
University of Rhode Island, Narragansett Bay Campus
Coastal Institute Building
May 10, 2011

Agenda

8:30	Coffee and light refreshments	
9:00	Convene in plenary session – brief summary of Day-1 and overview of Day-2 *(Russell)*	
9:15	Reconvene in breakout groups – review progress and identify additional targets	
	North Atlantic (participants will be assigned; floating allowed)	*(Paula Keener / Nathalie Valette-Silver)*
	South Atlantic (participants will be assigned; floating allowed)	*(Steve Hammond / Derek Michelin)*
	Gulf of Mexico (participants will be assigned; floating allowed)	*(Larry Mayer / Susan Haynes)*
	Caribbean (participants will be assigned; floating allowed)	*(Andy Shepard / Nicolas Alvarado)*
11:00	Reconvene in plenary – 10-12 minute summary comments from each breakout group & OER summary	
12:00	LUNCH	
1:00	Reconvene in plenary	
1:15	OER Education Program Overview	*(Paula Keener)*
1:45	Plenary Discussion: Approach to Systematic Exploration	*(All)*
2:45	BREAK	
3:00	Plenary Discussion: Synthesis/Documentation/Products	*(All)*
3:45	Wrap-up and next steps	*(John McDonough/Robert Ballard)*
4:00	ADJOURN	

9.2 Appendix B. List of Participants and Breakout Group Assignments

9.2 App B List of Participants and Groups.pdf

9.3 Appendix C. Pre-Workshop Announcement

9.3 App C Workshop Announcement.pdf

9.4 Appendix D. Pre-Workshop Target Ideas

9.4 App D Target Ideas 2011 FINAL.pdf

9.5 Appendix E. EX and Nautilus Capabilities Document

9.5 App E Okeanos Explorer and Nautilus Capabilities.pdf

9.6 Appendix F. 3-Modes of Systematic Exploration

9.6 App F Three modes of Exploration.pdf

9.7 Appendex G. 10 Years of Ocean Exploration at NOAA

9.7 App G Ten Years of Exploration at NOAA.pdf

9.8 Appendix H. 2007 OEAWG Okeanos Explorer Maiden Voyage Workshop Summary

9.8 App H OEAWG May 2007 Workshop Report.pdf