

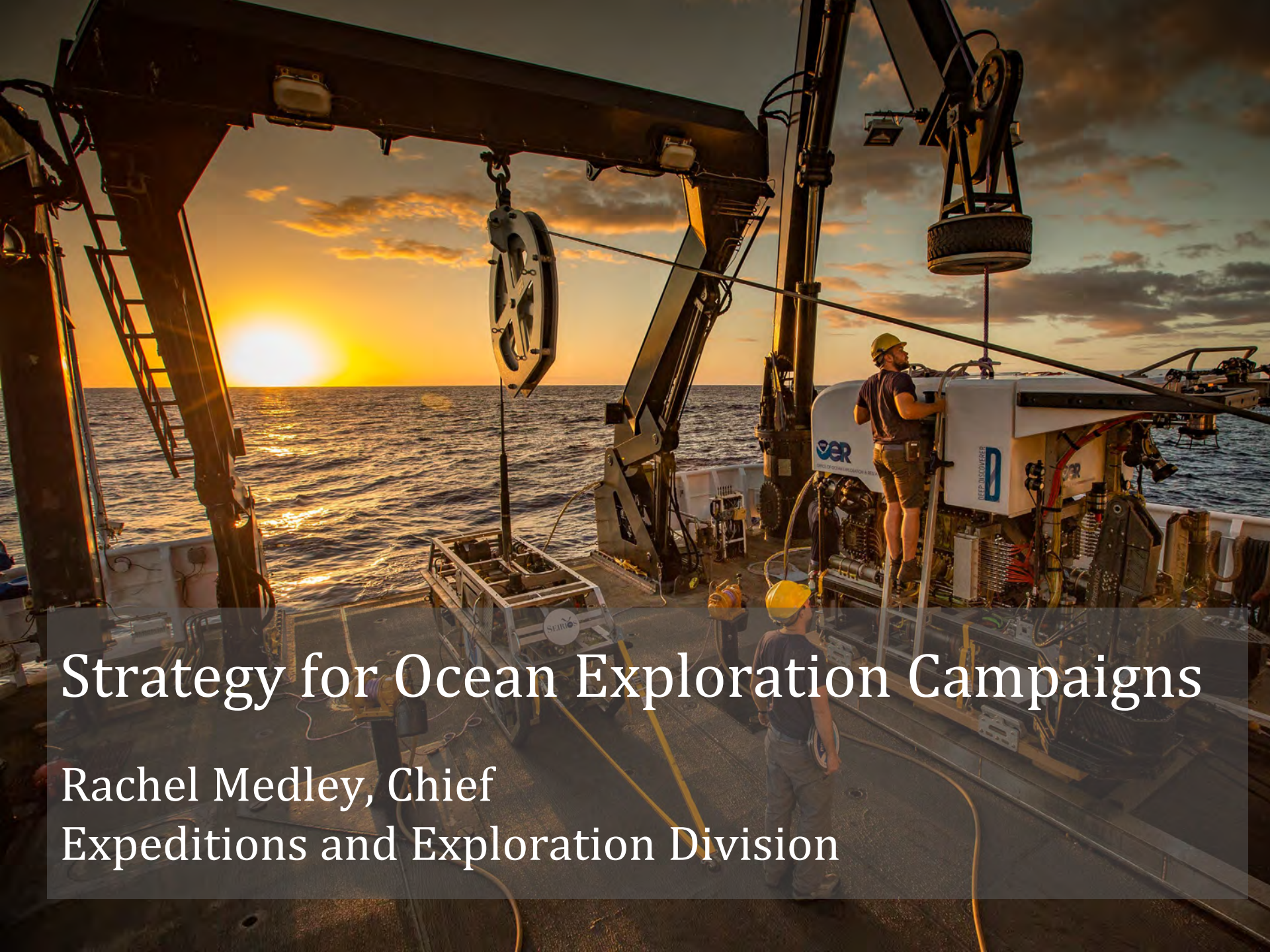


Exploration: Mapping and Characterization

Rachel Medley

Kelley Elliott

Craig Russell



Strategy for Ocean Exploration Campaigns

Rachel Medley, Chief
Expeditions and Exploration Division

Executing on Our Vision: Exploration Campaigns



A series of expeditions over multiple years to a geographic area or theme of **exploration priority** interest



Complementary expeditions using a wide variety of **platforms, technologies,** and strategies



Package of **data and information sharing** across platforms serves as foundation of environmental intelligence



Robust **engagement** in education and outreach efforts are integral activities



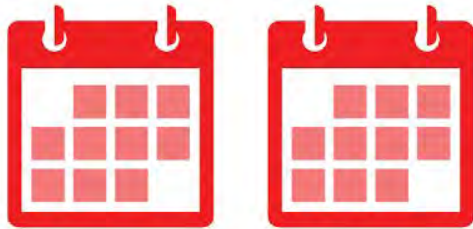
Partners focus messaging on the breadth of work

ACUMEN

Atlantic Canyons Undersea Mapping Expeditions



Ocean Exploration
and Research



CAPSTONE

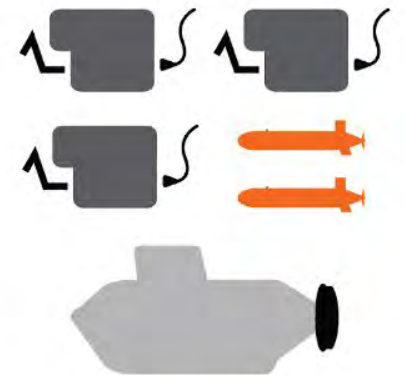
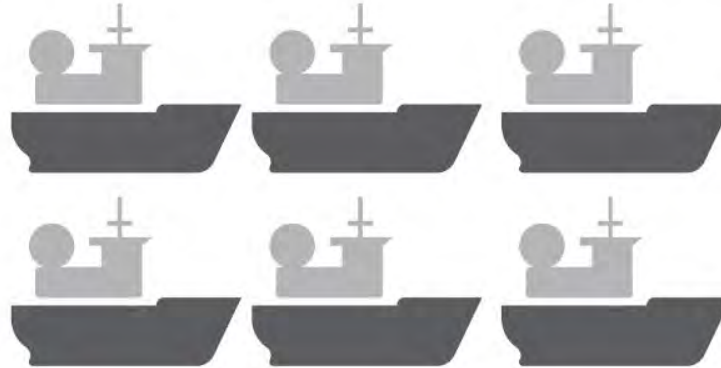
Campaign to Address Pacific Monument Science,
Technology, and Ocean Needs



Ocean Exploration
and Research



Atlantic Seafloor Partnership for Integrated Research and Exploration



Nested Approach to Expedition Planning

CAMPAIGN

The highest level is development of a Campaign in an operating region or basin focused on themes, agreements, or interests of key partners that connect multiple expeditions and platforms in support of common goals

COMMUNITY WORKSHOP

Conduct a community workshop to identify exploration priorities, themes, and partners in a region.

CALL FOR INPUT

A “Call for Input” to solicit general mapping, CTD, and ROV dive targets in the operating area from the science and management community.



CONSULTATIONS

Expeditions require the Expedition Manager to identify and consult with key partners in the region to understand their priorities, data needs, and interests.

EXPEDITION PARTICIPATION

Any interested scientist, student, or manager with a relevant expertise is invited to join the expedition science and participate in the cruise and cruise planning meetings.

ACUMEN - Results

Atlantic Canyons Undersea Mapping Expeditions

- Mapped canyons from North Carolina to Maine
- Discovered each canyon is a different environment with distinct characteristics
- Revealed 570+ methane seeps along the U.S. East Coast
- Routine transit line bathy acquisition provided a model for data acquisition



13 cruises



45,530 km² mapped



CAPSTONE - Results

Campaign to Address Pacific monument Science, Technology, and Ocean Needs

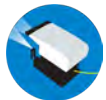
- Exponentially increased understanding of deep sea corals e.g. abundance & distribution
- New lines of scientific inquiry surrounding biogeographic patterns throughout the Pacific
- Discovered dozens of new species
- E/V *Nautilus* now building on initial CAPSTONE expeditions



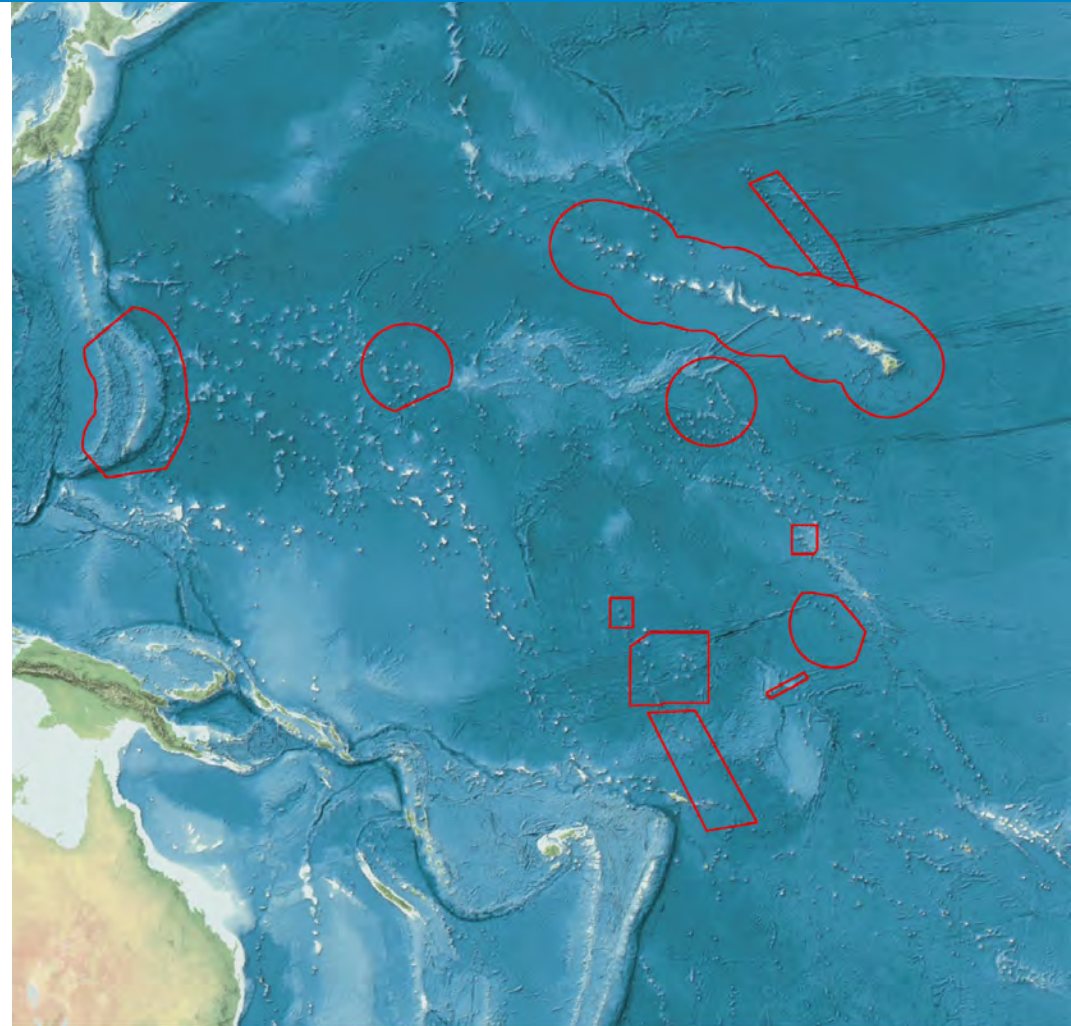
23 cruises



597,230 km² mapped



187 vehicle dives

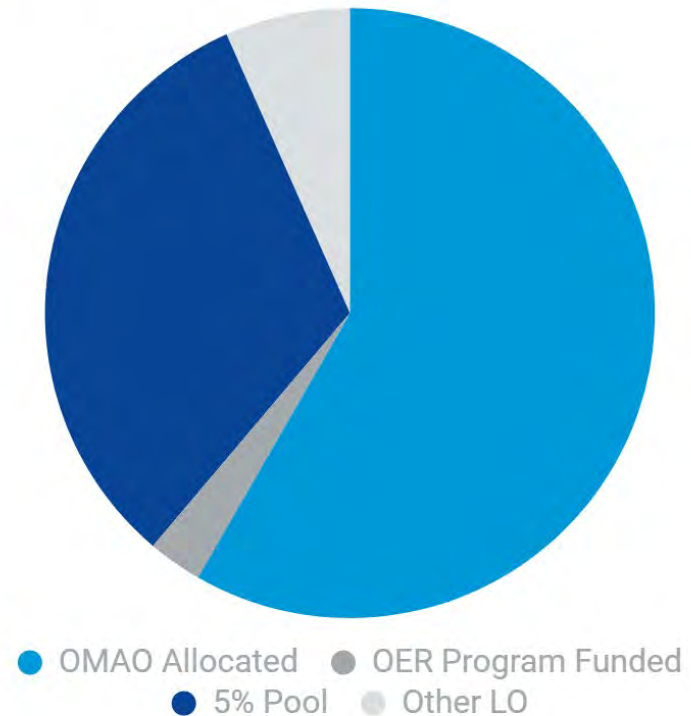


CAPSTONE: Capitalizing on Cross-NOAA Partnerships

- CAPSTONE was the first time NOAA line offices recognized value of ocean exploration in terms of “hard currency:” DAS
- Capitalized on NOAA corporate 5% pool for cross-NOAA projects
- Leveraged variety of mechanisms for DAS needed over three years

FY15-FY17 CAPSTONE Ship Time Funding Sources

Total Funding: \$8.6M



Community-based Exploration Priorities



The screenshot displays the NOAA Ocean Explorer web application interface. At the top, the NOAA logo and "NOAA Ocean Exploration" text are visible, along with the "seasketch" logo. The main area features a map of the Pacific Ocean with several exploration sites marked by yellow dots and blue hatched polygons. A sidebar on the right contains navigation tabs for "Data Layers", "My Plans", and "Participate". Below these tabs, a search bar shows "Surveys" and "Okeanos Explorer 2017 Johnston Atoll & ...". The selected survey is titled "2017 Okeanos Explorer Central Pacific Exploration: Johnston Atoll & Musicians Seamounts". The sidebar text describes the survey as the third and final year of NOAA's Campaign to Address the Pacific monument Science, Technology, and Ocean NEeds (CAPSTONE). It invites the community to submit areas and sites for deepwater acoustic seafloor mapping and remotely operated vehicle (ROV) investigation within the summer 2017 operating area. A list of specific locations is provided at the bottom of the sidebar.

NOAA Ocean Exploration
NOAA Office of Ocean Exploration and Research admin

English take a tour help Caitlin Adams

Data Layers My Plans Participate

Surveys Okeanos Explorer 2017 Johnston Atoll & ...

2017 Okeanos Explorer Central Pacific Exploration: Johnston Atoll & Musicians Seamounts

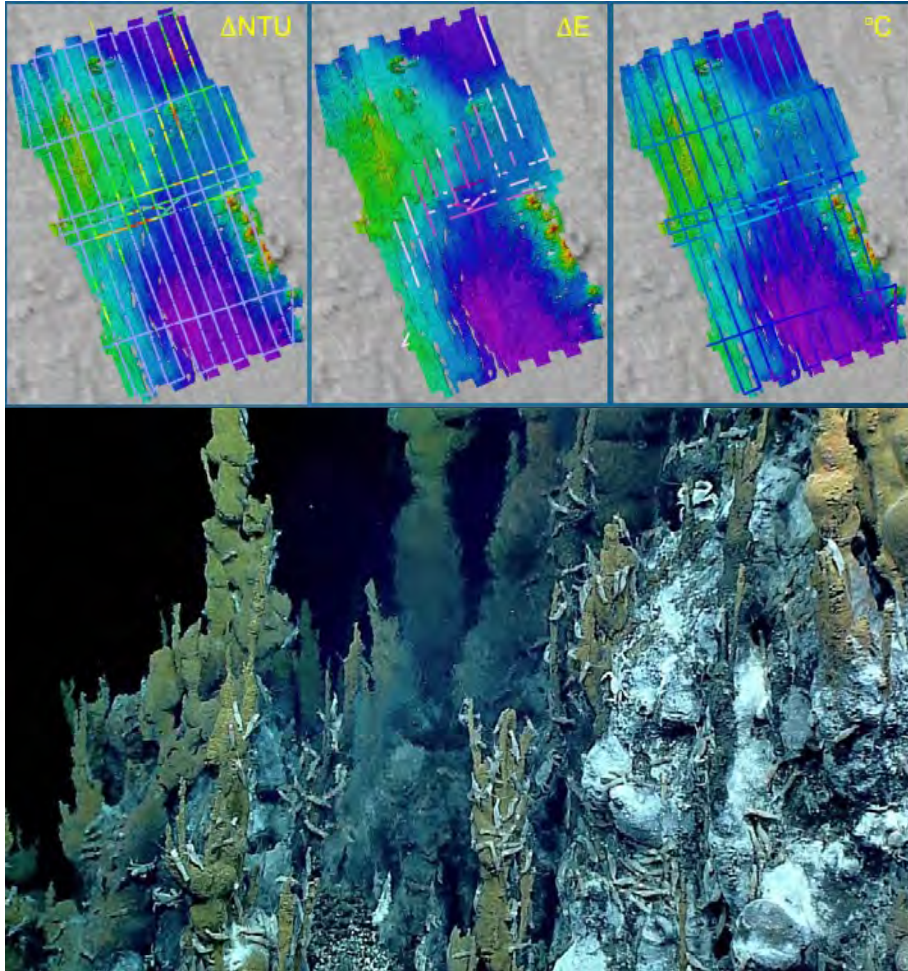
2017 is the third and final year of NOAA's Campaign to Address the Pacific monument Science, Technology, and Ocean NEeds (CAPSTONE) - a major multi-year foundational science effort focused on deepwater areas of U.S. marine protected areas in the central and western Pacific. NOAA conducts telepresence-enabled mapping and remotely operated vehicle (ROV) operations in poorly known ocean areas with NOAA Ship Okeanos Explorer to support deepwater habitat characterization and spur follow-on investigations.

On behalf of NOAA, OER invites members of the ocean science and management community to submit areas and sites for deepwater acoustic seafloor mapping and remotely operated vehicle (ROV) investigation within our summer 2017 operating area. The information received will be used to refine our cruise tracks, and a selection of these targets and areas will be explored during upcoming expeditions. In summer 2017, NOAA intends to investigate and document the diversity and distribution of deep-water environments in and around:

- The Johnston Atoll unit of the Pacific Remote Islands Marine National Monument;
- The Musicians Seamounts north of the Hawaiian archipelago; and
- U.S. and high seas locations crossed during transits to and from specified operating areas and Honolulu, Hawaii.

Esri, HERE, Garmin, NGA, USGS | Powered by Esri and SeaSketch

Collaborating beyond *Okeanos Explorer*



- Leveraged across platforms and projects: NSF, ECS, Falkor, PMEL, HURL, and OER grant funded scientists
- Leveraged data to complement operations
- Collaboratively planned expeditions across deep ocean community capitalizing on concurrent or near-concurrent expeditions on multiple platforms

ASPIRE Outcomes to date

Atlantic Seafloor Partnership for Integrated Research and Exploration

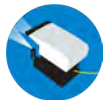
- Extensive, previously unknown, deep sea coral habitats identified and characterized
- First U.S. government-led, focused mapping survey in support of the Atlantic Seabed Mapping International Working Group (ASMIWG)
- Significant contributions to mapping bathy gaps of US East Coast EEZ >200m



20 cruises



244,000+ km² mapped



122 vehicle dives



ASPIRE EXPEDITIONS

Northern Neighbors: Transboundary Exploration of Deepwater Communities

June 2017, June 2019

NOAA NMFS/Dalhousie University, NOAA Ship *Henry B. Bigelow*

Northeast US Tech Demonstration

July 2019

NOAA OER, NOAA Ship *Okeanos Explorer*

Carolina Canyons

August 2016, August 2017

NOAA NMFS, NOAA Ship *Pisces*

DEEP SEARCH

2017-2019

BOEM/USGS/NOAA, Multiple Platforms

Blake Plateau Mapping

Spring 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

Southeast US ROV and Mapping

Summer 2018, Spring 2019

NOAA OER/NMFS/ONMS, NOAA Ship *Okeanos Explorer*

US-Canada ROV and Mapping

Summer 2019

NOAA OER/ONMS, NOAA Ship *Okeanos Explorer*

Canada Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

Mid-Atlantic Ridge ROV and Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

Southeast US ROV and Mapping

Fall 2019

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

US Southeast and Bahama Ridge Mapping

October 2018

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

ASMIWG Pilot Area Mapping

July 2018

NOAA OER, NOAA Ship *Okeanos Explorer*

US Caribbean ROV and Mapping

Fall 2018

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

US Caribbean Tech Demonstration

Spring 2020

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

US Caribbean Mapping

Spring 2020

NOAA OER/OCS, NOAA Ship *Okeanos Explorer*

Mid-Atlantic Ridge ROV and Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

Mid-Atlantic Ridge Mapping

Summer 2020

NOAA OER, NOAA Ship *Okeanos Explorer*

Last updated: October 8, 2019


Expanding impacts: *Okeanos Explorer* and DEEP SEARCH

HUFFPOST

Scientists Discover Giant Deep-Sea Coral Reef Off Atlantic Coast

The chief scientist on the expedition said it was like nothing he'd seen before.

By Dan Ohman



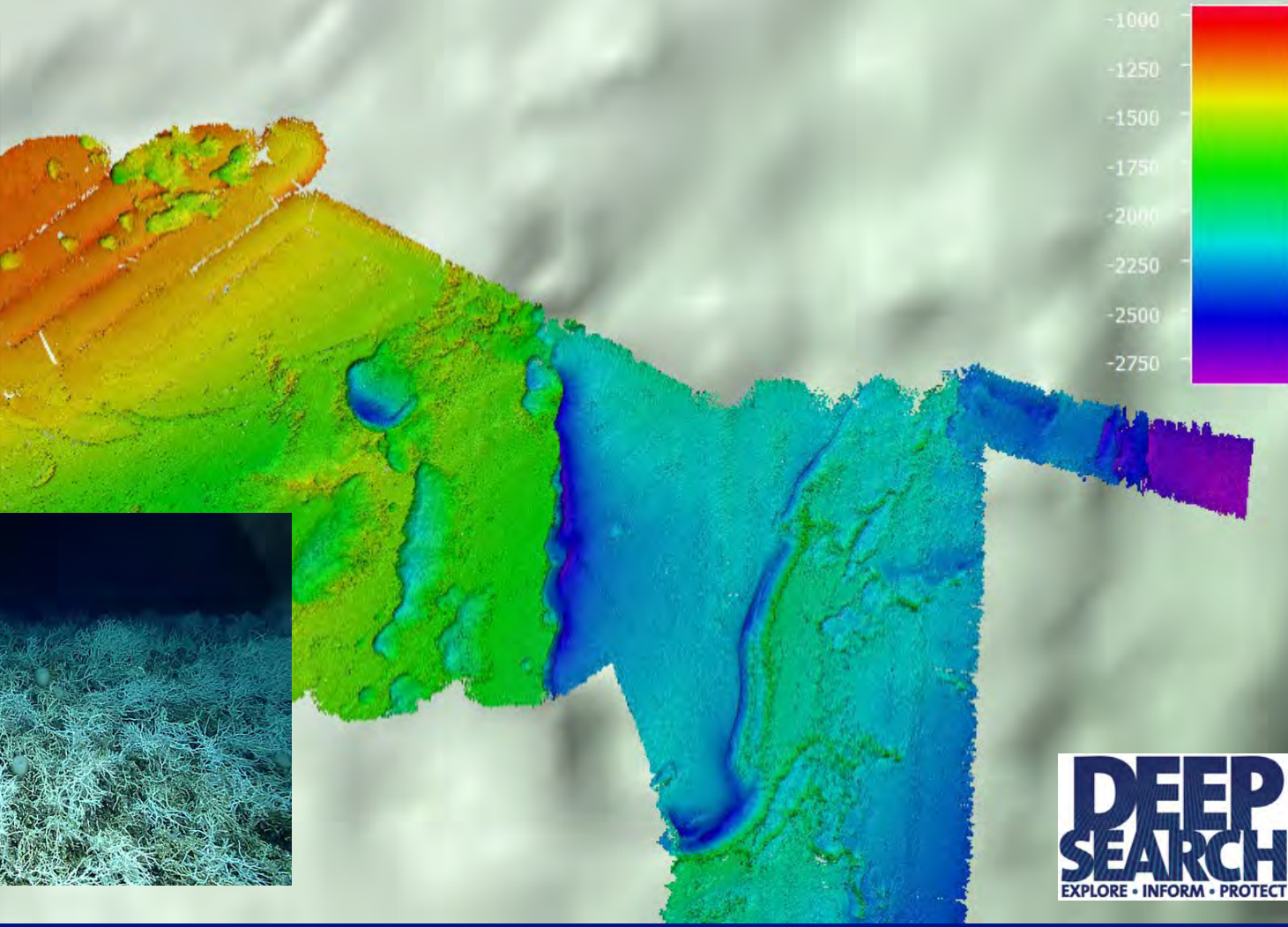
Sprint
Unlimited Talk, Text, and Data
Unlimited Kickstar
\$25
NO. REALL
Streaming Video, Gaming and Music

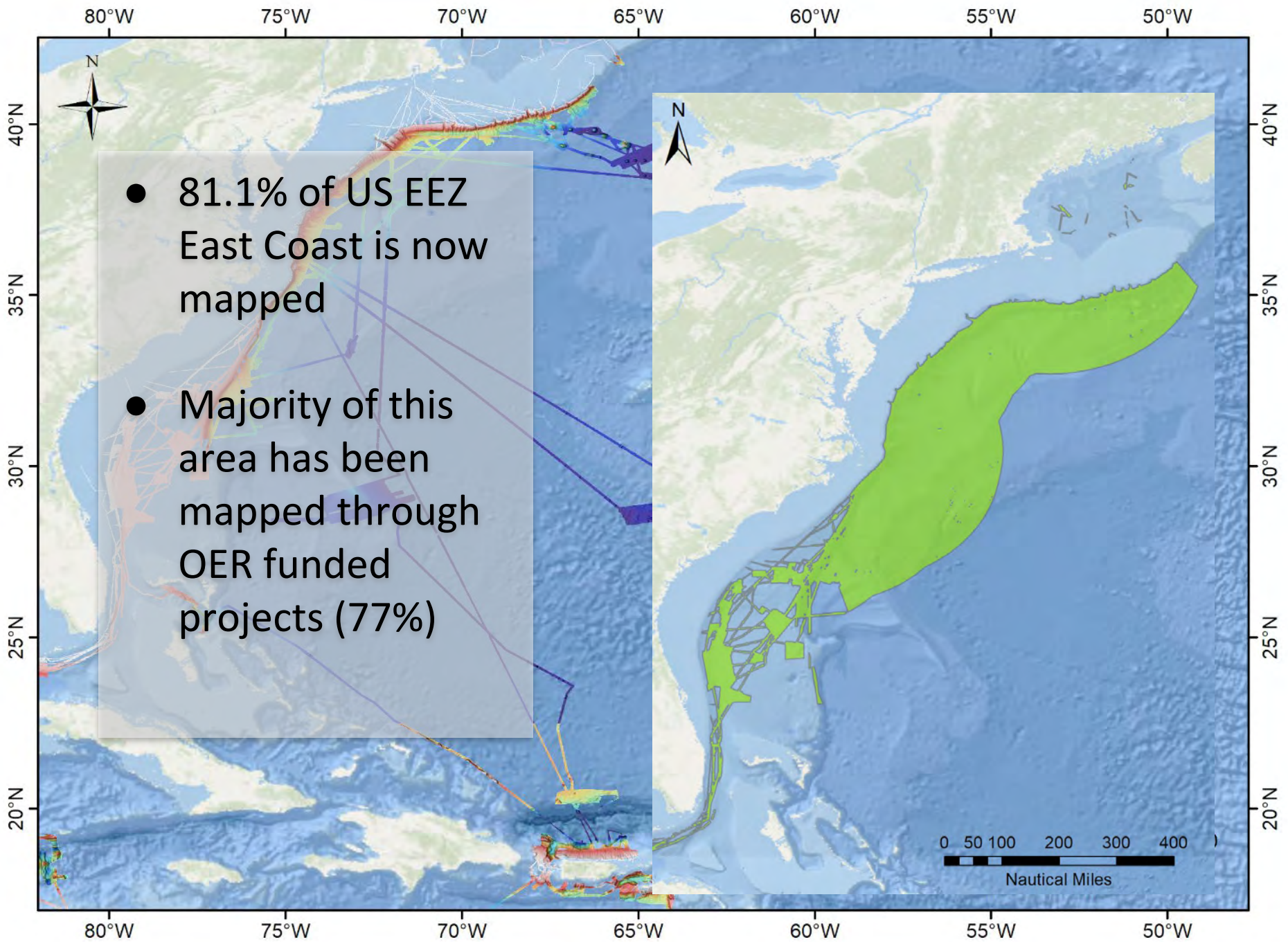
SEEKING
Serenity Williams' Love
Taps to Another Species
By The U.S. Open

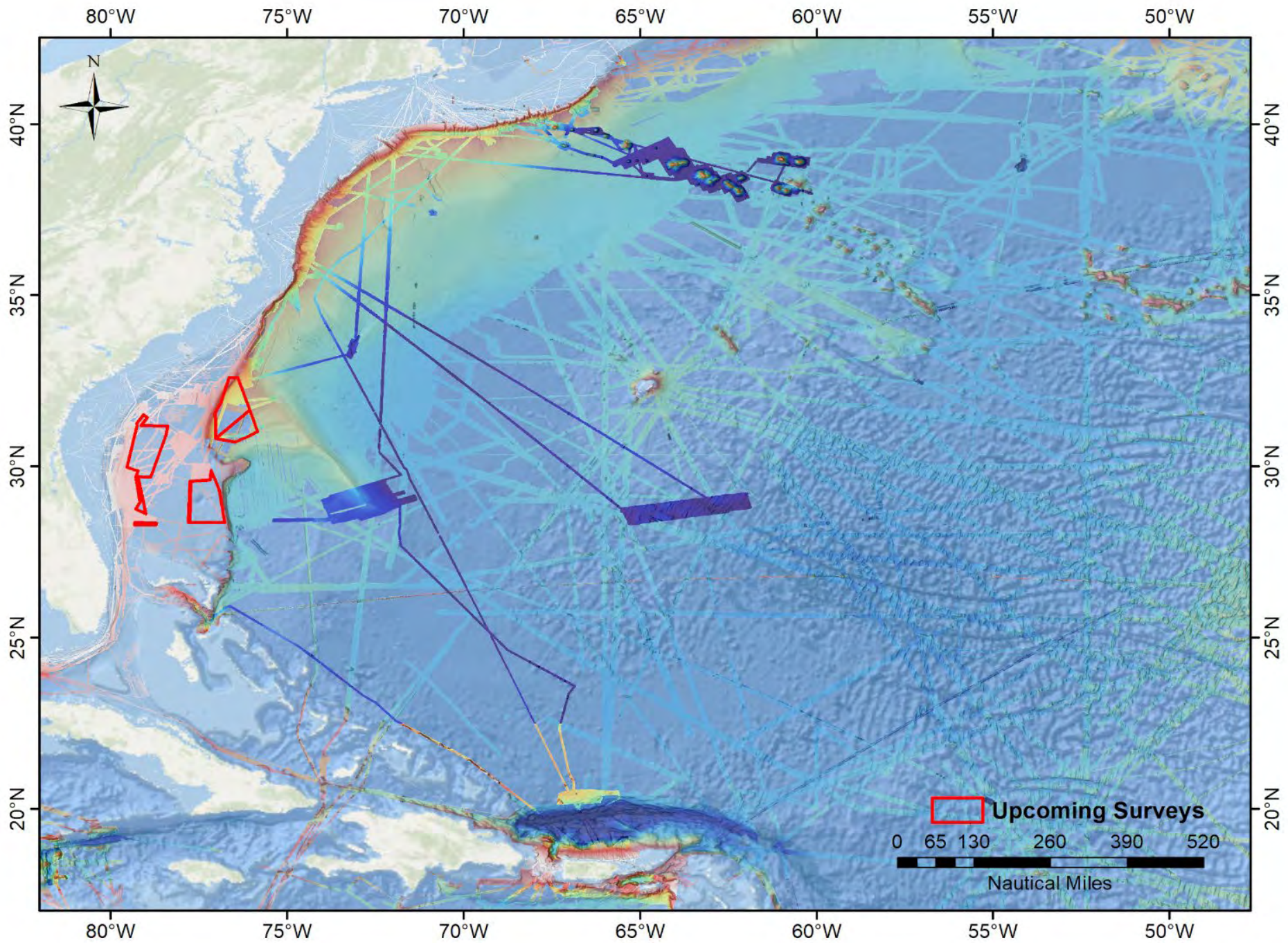
At 1,000 meters, scientists have the largest of the giant *Ophiomastix* at 1,000 meters (3,280 feet) deep. The reef is the largest ever discovered in the Atlantic Ocean.

THE ATLANTIC OCEAN — As the research vessel *Albatross* made its way out to sea from Woods Hole, Massachusetts, last week, expedition chief scientist Erik Cordes [predicted](#) the team would discover something no one has ever seen before. It didn't take long.

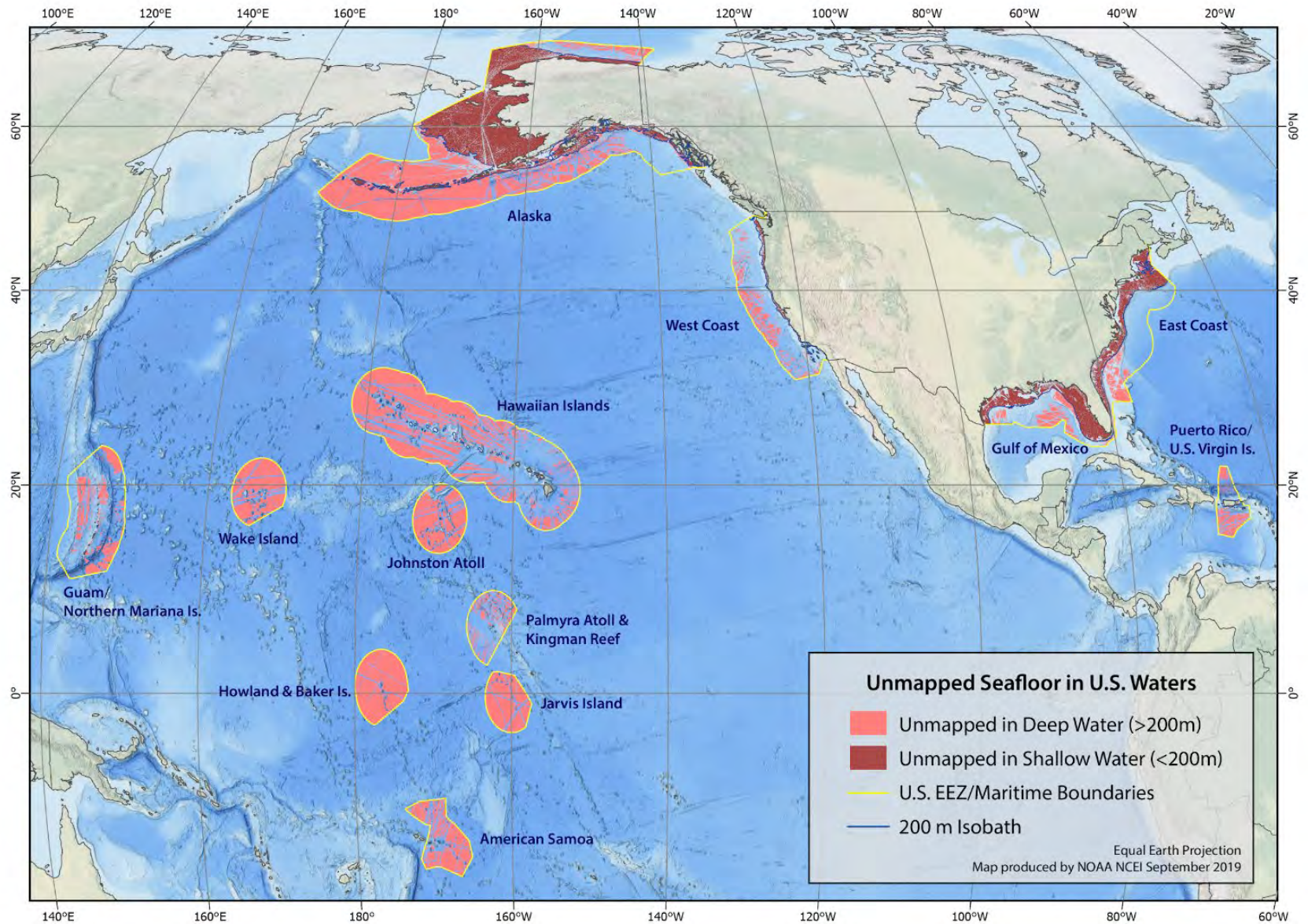
Some 100 miles off the coast of Charleston, South Carolina, a half mile below the ocean surface, is a dense forest of cold water corals. And based on their observations and recent sonar mapping of the ocean floor, researchers estimate that the reef runs for at



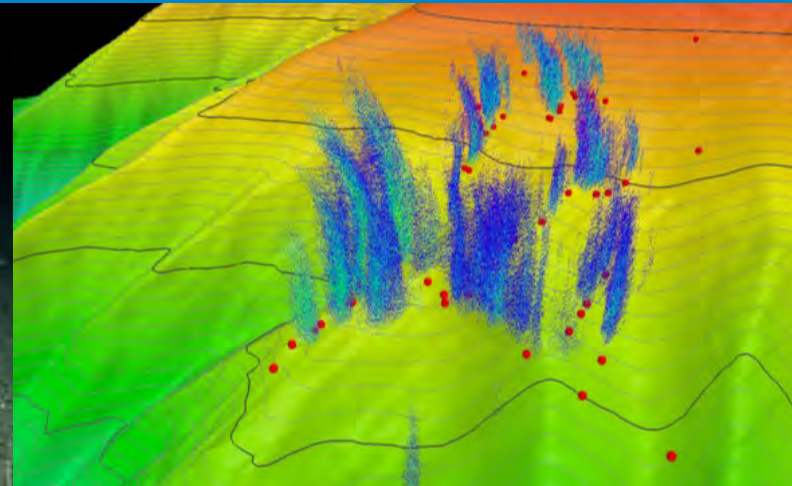




Looking to the Future



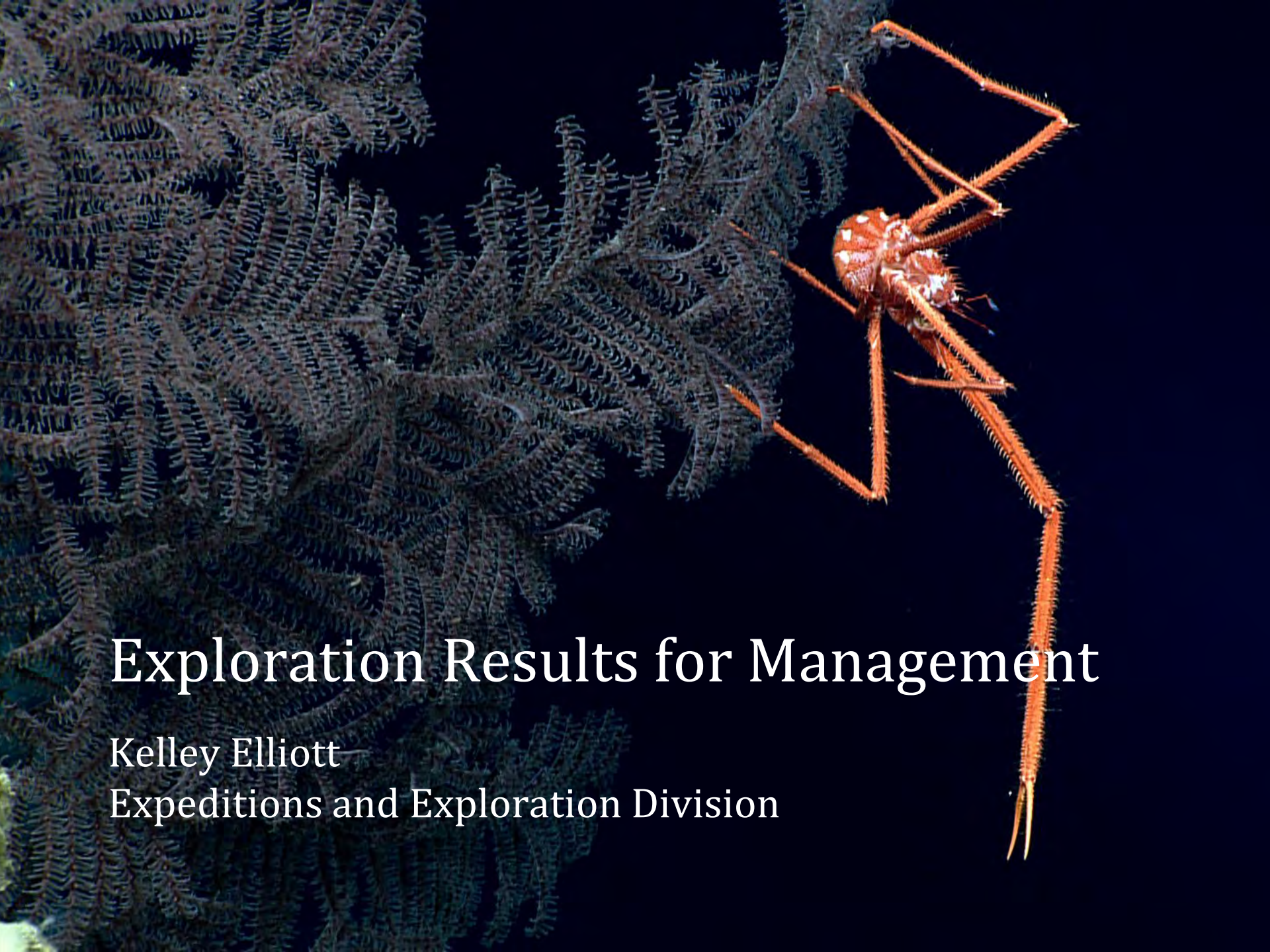
Campaign Strategies for Decision Support



OceanExplorer.NOAA.gov



**Ocean Exploration
and Research**



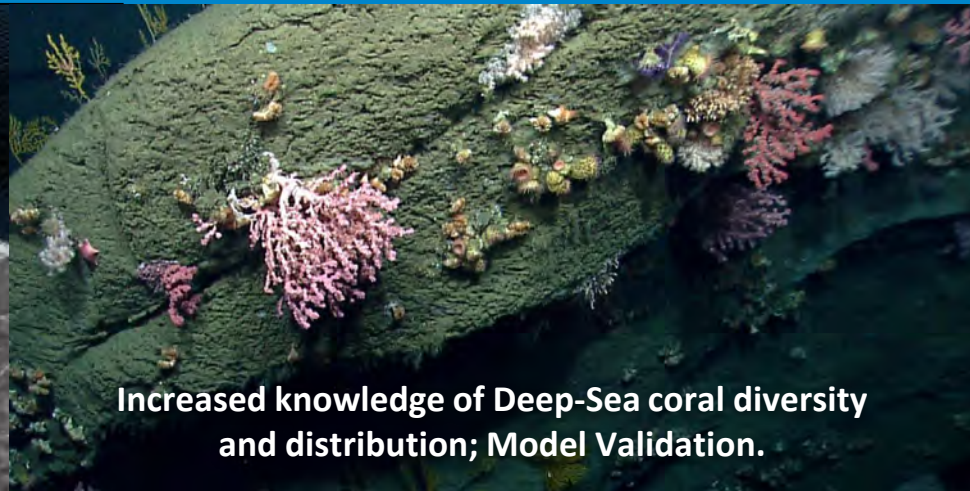
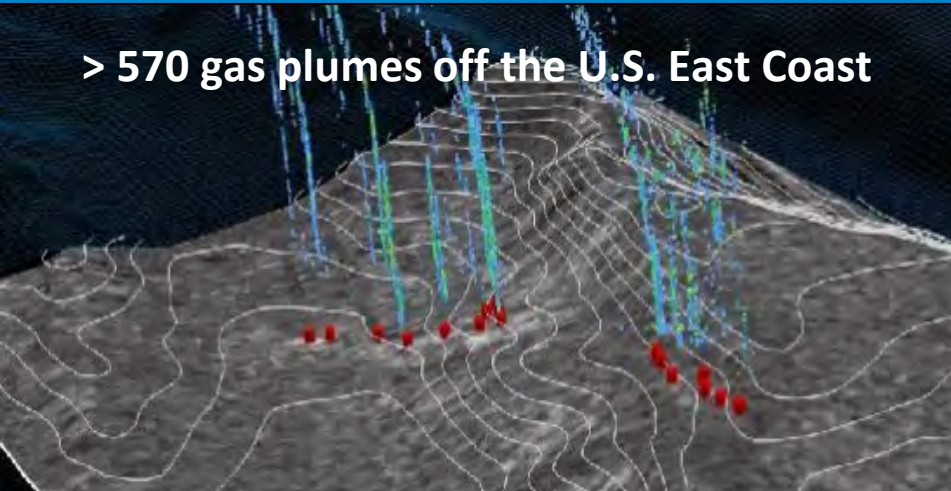
Exploration Results for Management

Kelley Elliott

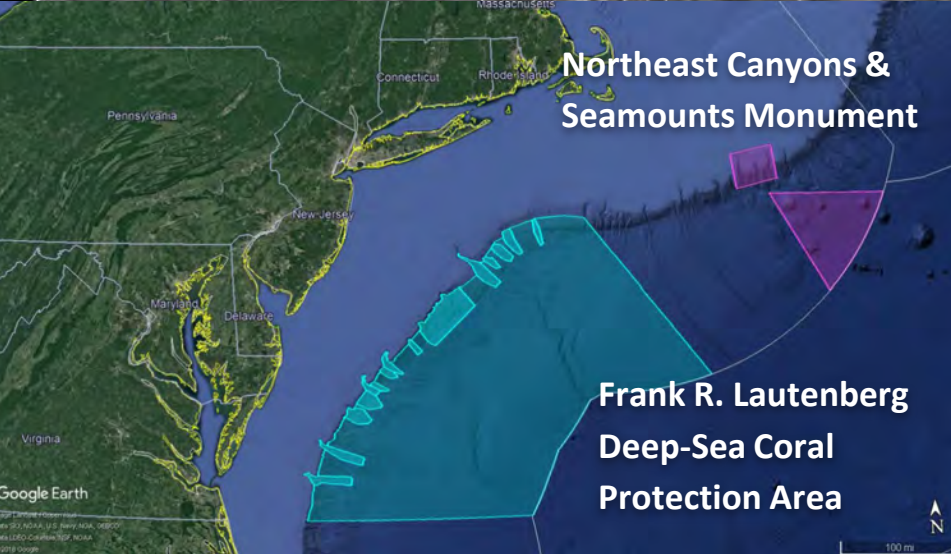
Expeditions and Exploration Division

Northeast Canyons Management Highlights

> 570 gas plumes off the U.S. East Coast



Increased knowledge of Deep-Sea coral diversity and distribution; Model Validation.

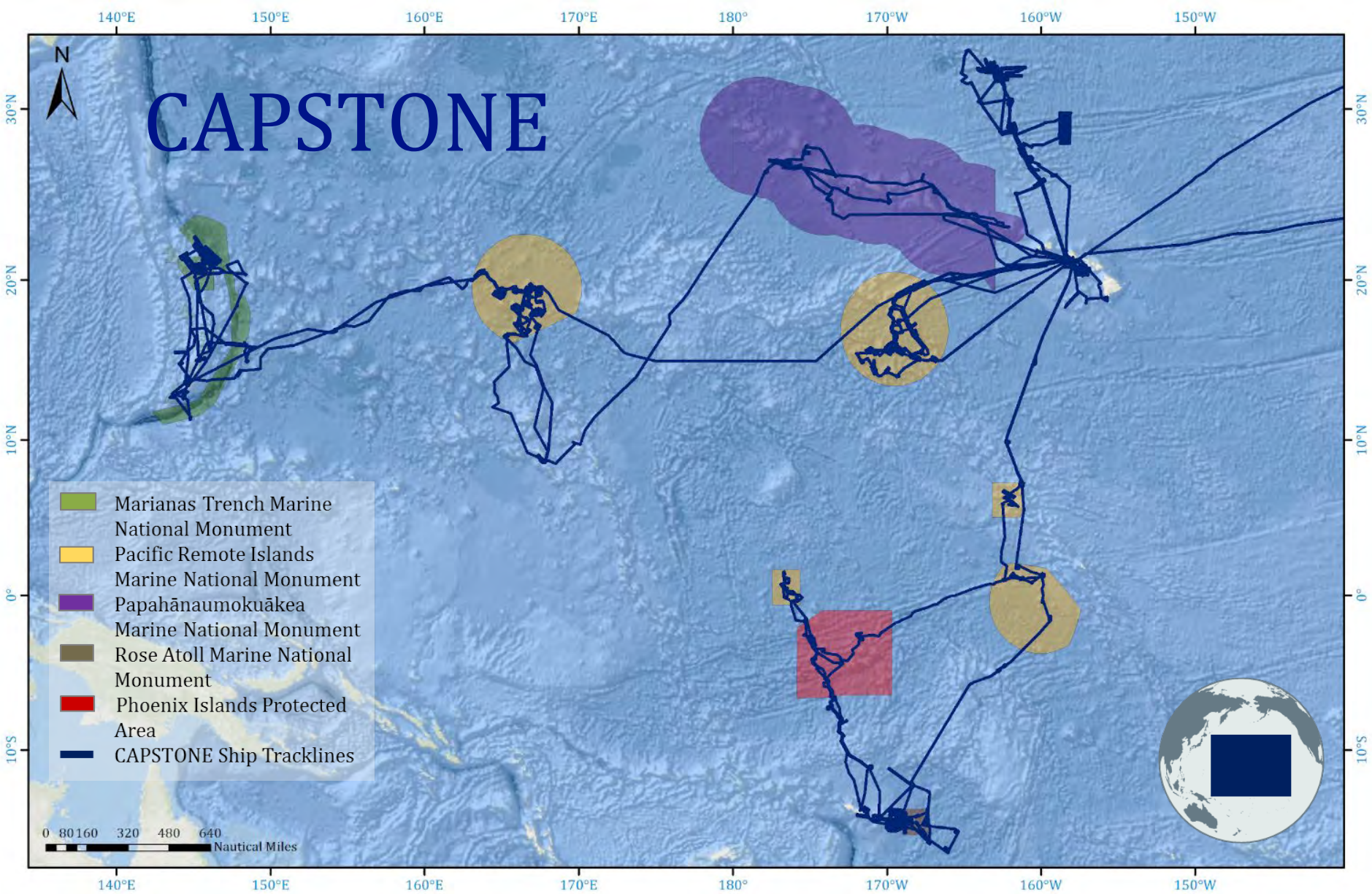


Northeast Canyons & Seamounts Monument

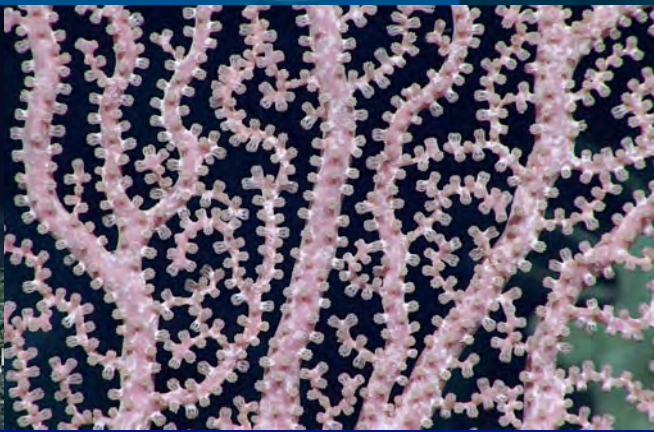
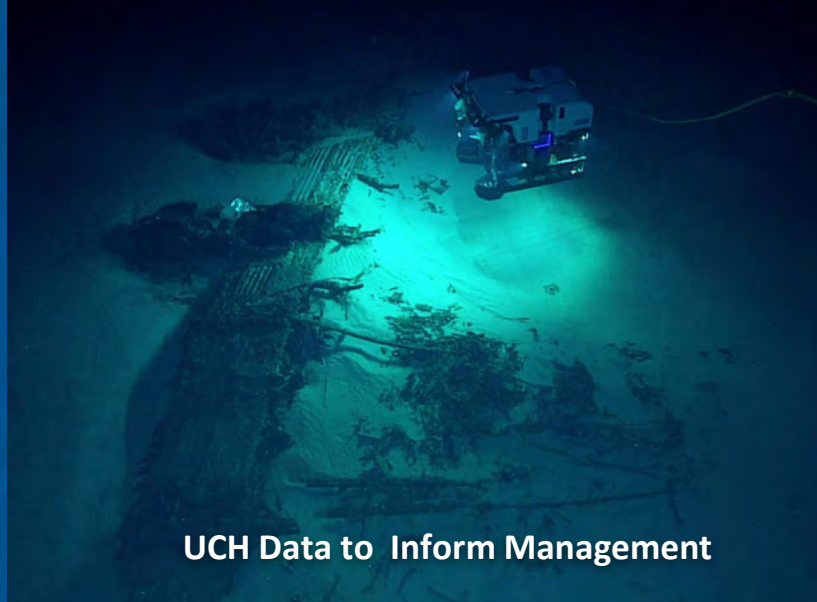
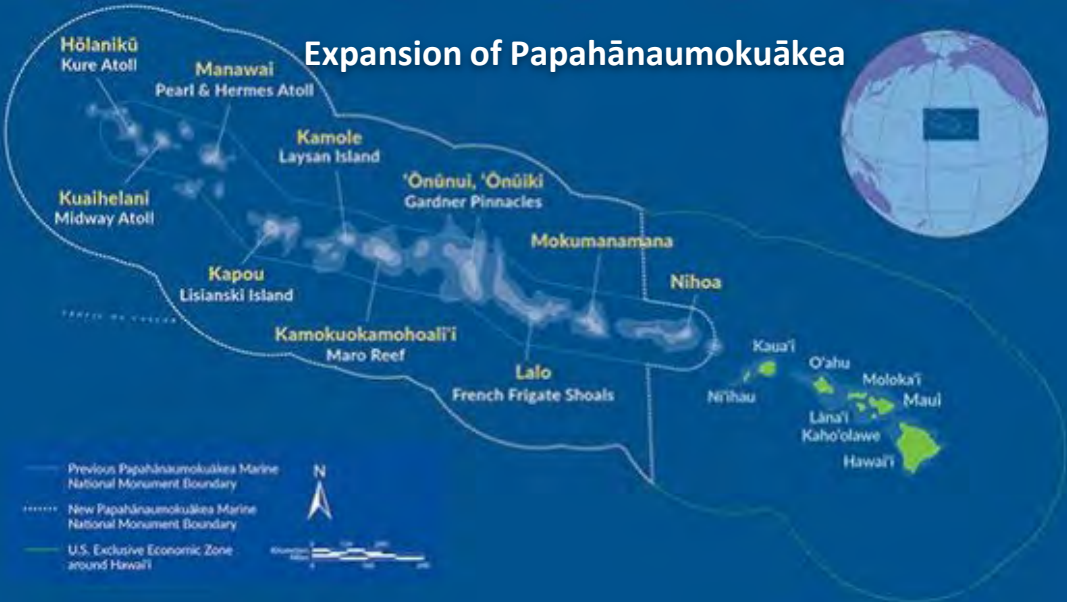
Frank R. Lautenberg Deep-Sea Coral Protection Area



“Billy Mitchell Fleet” Nominated to National Register of Historic Places

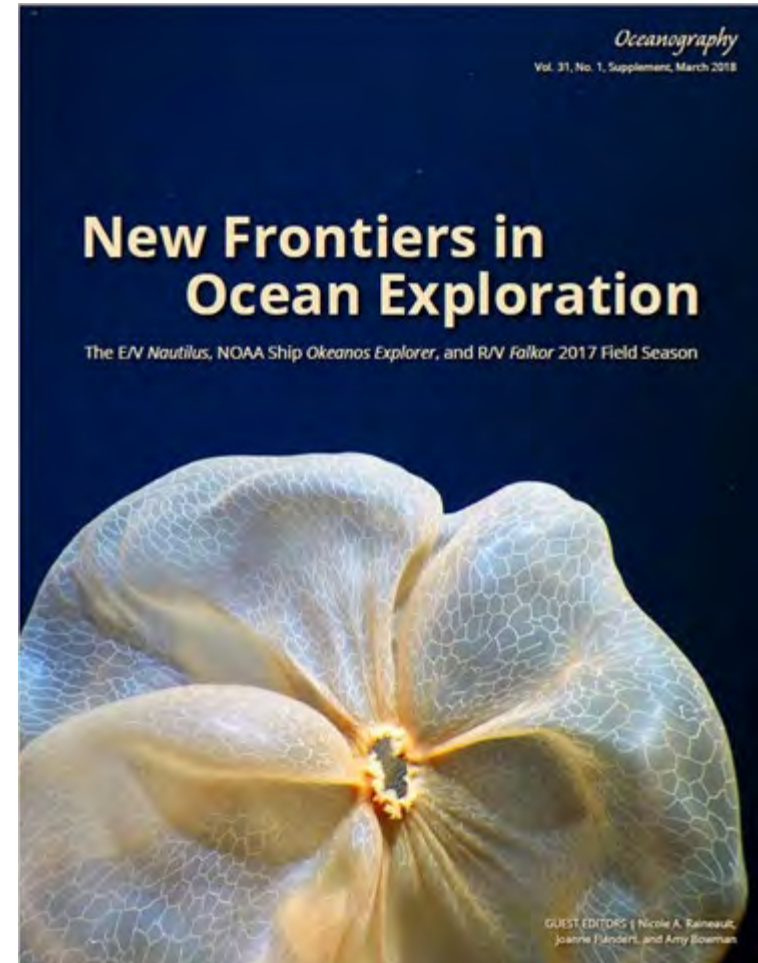


CAPSTONE Results: Management Highlights

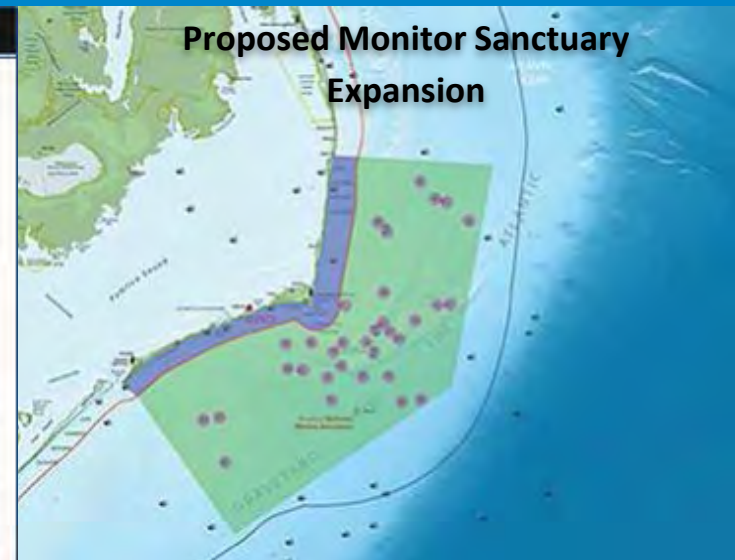
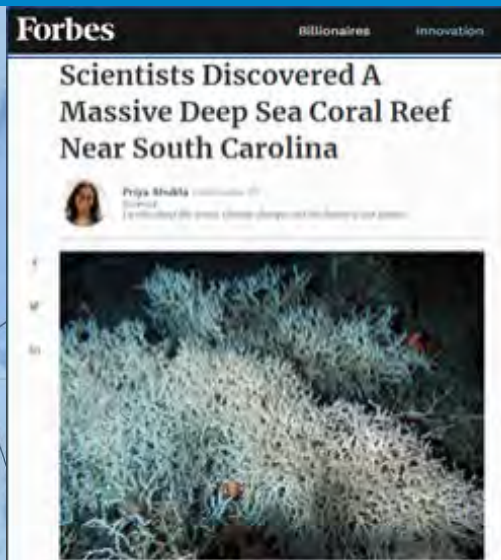
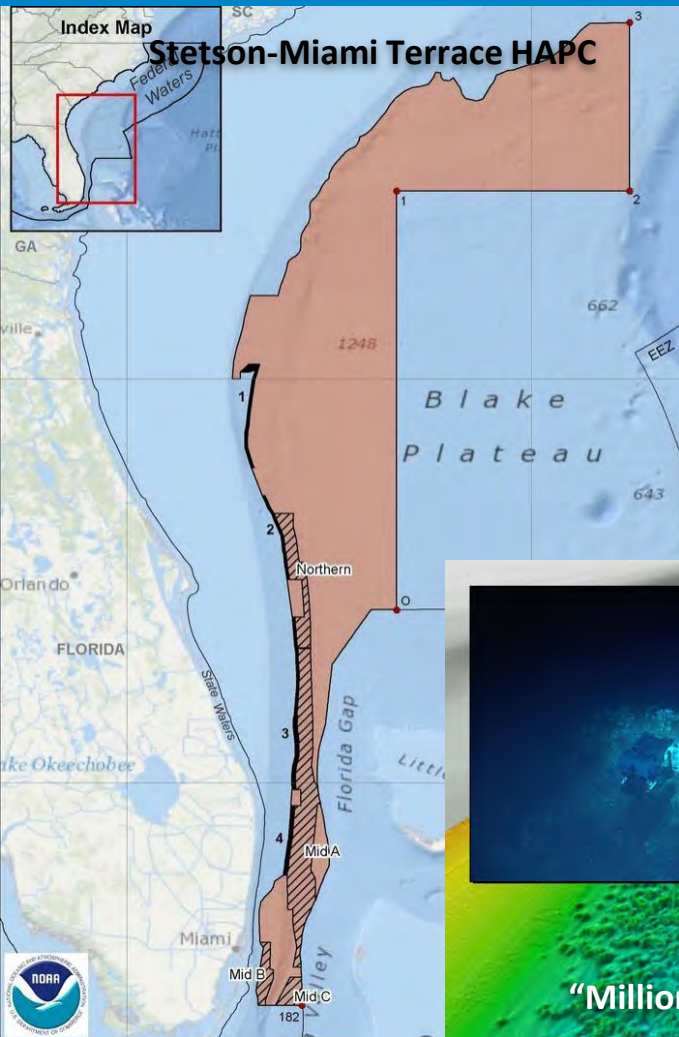


CAPSTONE Science Products

- Oceanography supplement
- Ocean Sciences session
- Frontiers in Marine Sciences research topic
- Deep-Sea Animal Guide
- DSCRTP database Annotations
- Cruise reports
- A foundation of public data

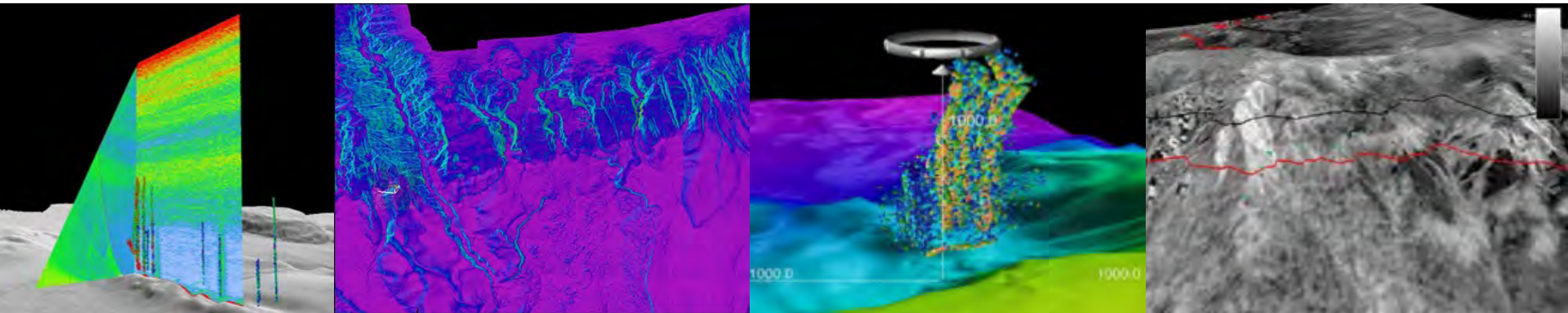


ASPIRE Results to Date



What's Next?

- CAPSTONE and ASPIRE Results Continued...
 - Additional lines of inquiry and analysis
 - Future management decisions and delineations
- Assessment of data & product improvements to enhance future data analysis



How technology can get us to the next level for decision making





OceanExplorer.NOAA.gov



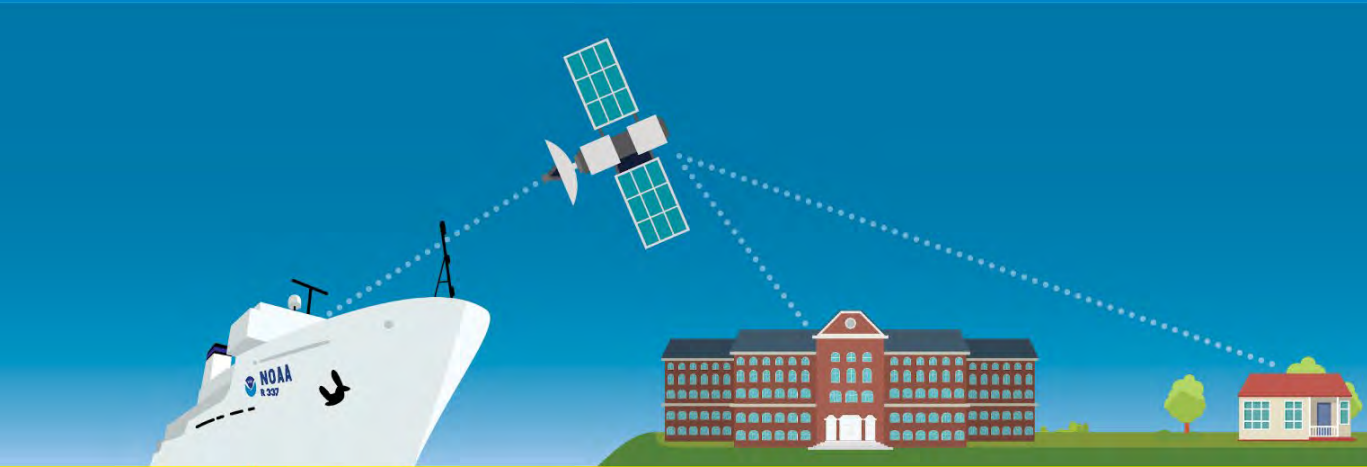
**Ocean Exploration
and Research**

Innovation for Exploration



Craig Russell
Okeanos Explorer Program Manager

Dedicated Exploration Platform



Telepresence-Enabled Science



Telepresence-Enabled Science



Standard Protocols and Tools

Ocean Networks Canada SeaTube v2
Oceans 2.0

Logged in as Kasey Cantwell | Profile | Help | Logout


Data Preview Data Search Plotting Utility SeaTube Digital Fishers Cameras More Admin

Videos Playlists Dive

Hide Map Hide Video

Dive: EX1811-Dive13
PI: Wagner, Daniel
Area: U.S. Caribbean Sea
Start Date: 13-Nov-2018 10:00:00
End Date: 13-Nov-2018 23:00:00
Dive Plan: This dive will explore an escarpment at 400-535 m depths located northeast off Mona Island inside the Isla de Mona Natural Reserve. This dive will target the potential habitats of deepwater fish species, including snappers and groupers.

Camera #1 Resolution: Low



Annotations

Time	Species	Depth (m)	Count
13:04	shiptest	431 m	1
13:07	Test2	481 m	1
13:15	Callogorgia ID: 125317 [WORM]	566 m	x1
13:15	Chirostylidae (squat lobsters) ID: 106732 [WORM]	567 m	1
13:16	Ophiuroidea (brittle stars, brittlestars) ID: 123084 [WORM]	567 m	1
13:18	Plumarella ID: 177839 [WORM]	567 m	x3
13:18	-	567 m	1
13:19	Astroidea (starfish; sea stars) ID: 123080 [WORM]	567 m	1
13:20	Demospongiae (horny sponges; demosponges) ID: 164811 [WORM]	567 m	many
13:22	Octocorallia ID: 1341 [WORM]	568 m	1
13:23	Stylasteridae (lace corals) ID: 22805 [WORM]	568 m	1
13:23	Porifera (sponges) ID: 558 [WORM]	568 m	several small
13:23	Stylasteridae (lace corals) ID: 22805 [WORM]	568 m	Crypthelia? x1
13:24	Astroidea (starfish; sea stars) ID: 123080 [WORM]	568 m	1
13:26	Porifera (sponges) ID: 558 [WORM]	566 m	many

Search Show Filter 333 / 333

Auto-Refresh

Time Capture Time To Be Reviewed

Select a Taxonomy... Type First Three Characters...

Add Attribute

Enter free text here...

Save Save/Keep Time Clear

Show Quick Entry

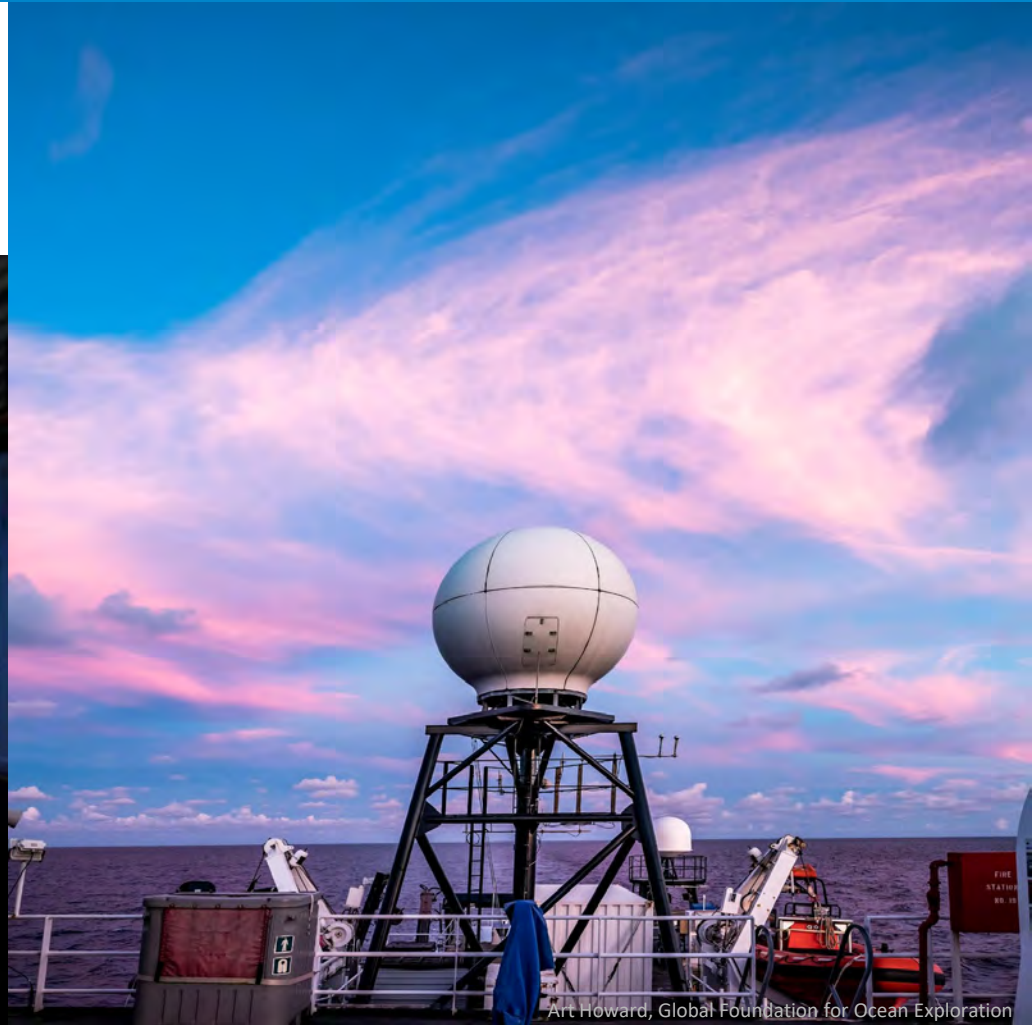
Sensor Values Show Sensor Values

Advanced Telepresence Network



VSAT & Network

GLOBAL FOUNDATION
FOR OCEAN EXPLORATION



Art Howard, Global Foundation for Ocean Exploration



Catalyzing Others

Fly-away VSAT for EXPRESS Campaign on
NOAA ship *Reuben Lasker* - Underway



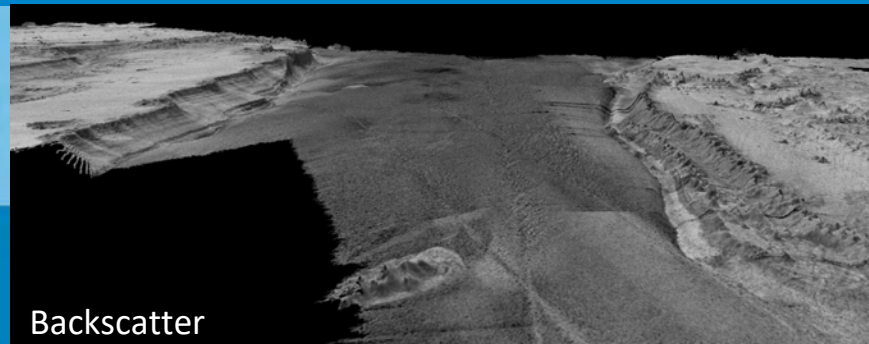
Ocean Mapping Innovation

NOAA Ship *Okeanos Explorer* has mapped in excess of

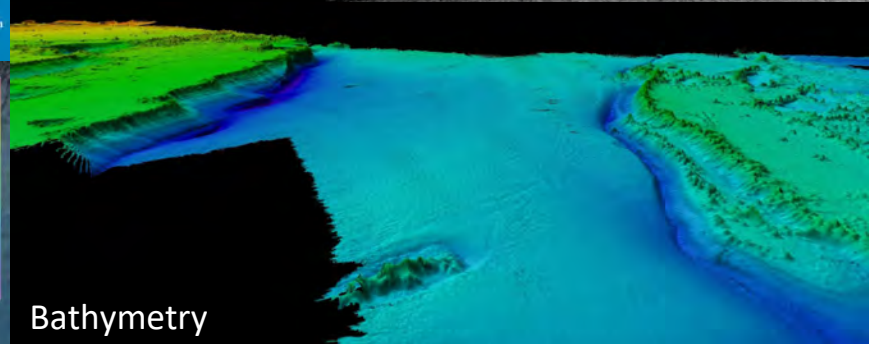
1,970,000
square kilometers



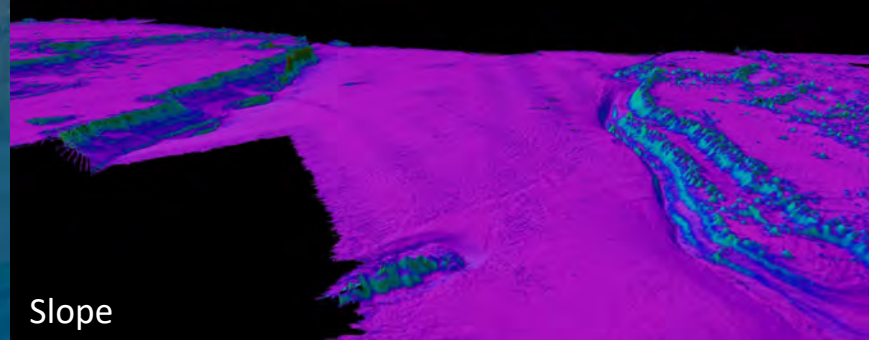
That's bigger than
Alaska and California
combined!



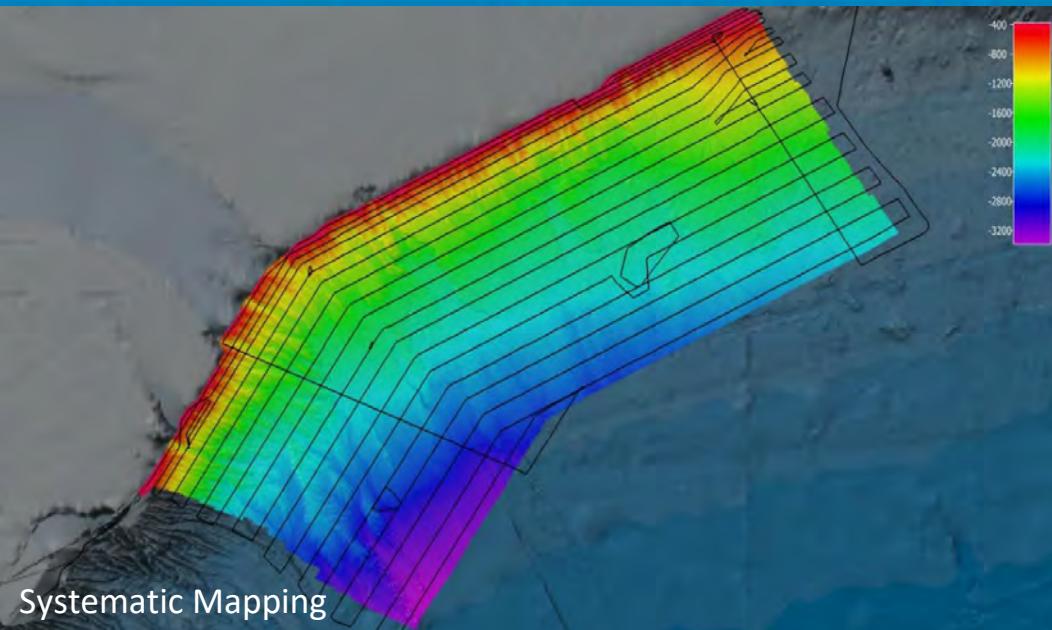
Backscatter



Bathymetry



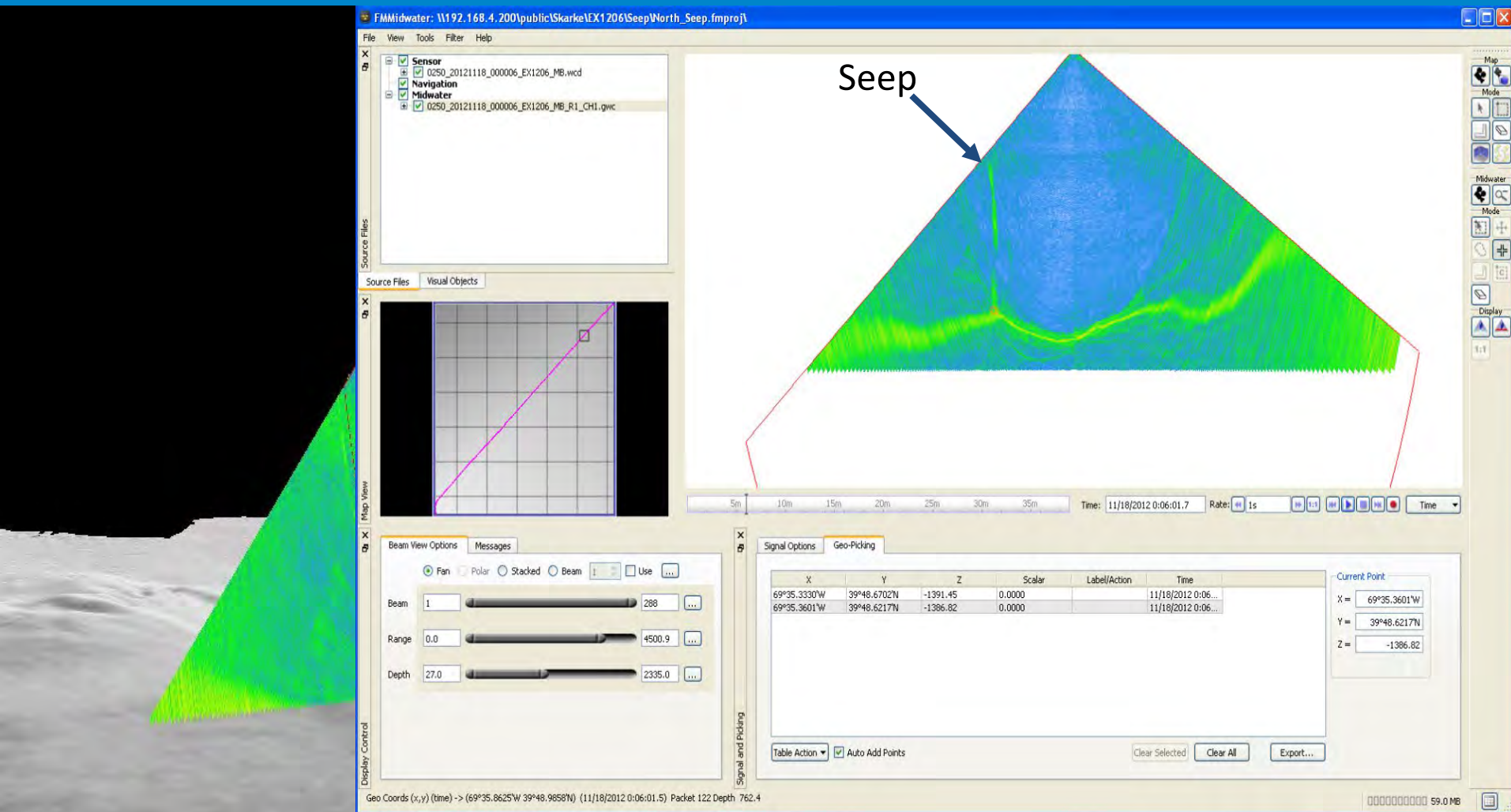
Slope



Systematic Mapping



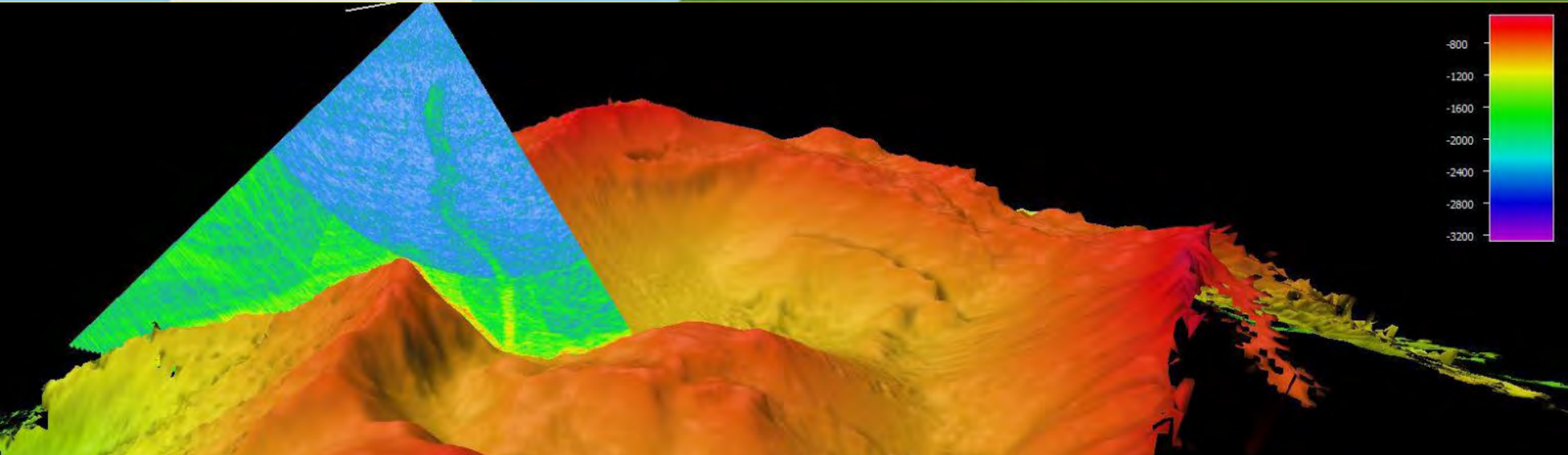
Ocean Mapping Innovation



Acoustic Calibration Innovation



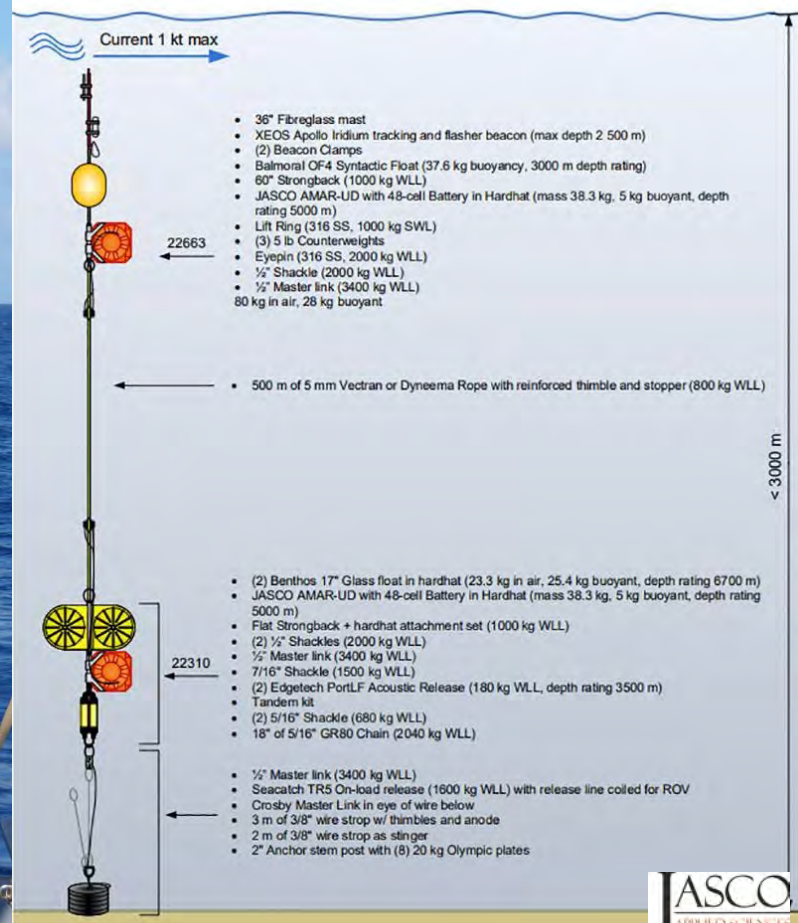
Tele-mapping Innovation



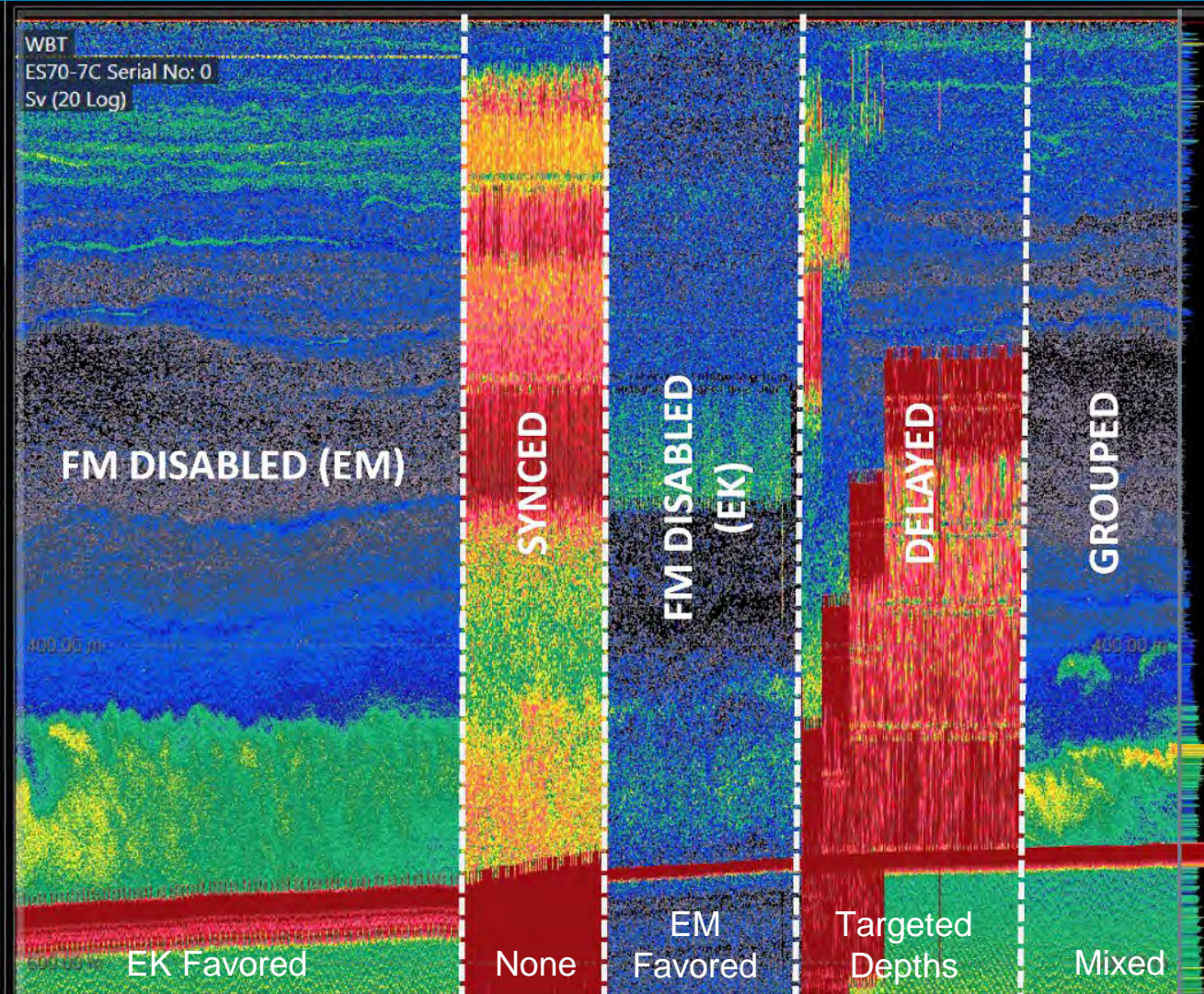
Ocean Mapping Innovation



Mooring Diagram 223



Ocean Mapping Innovation



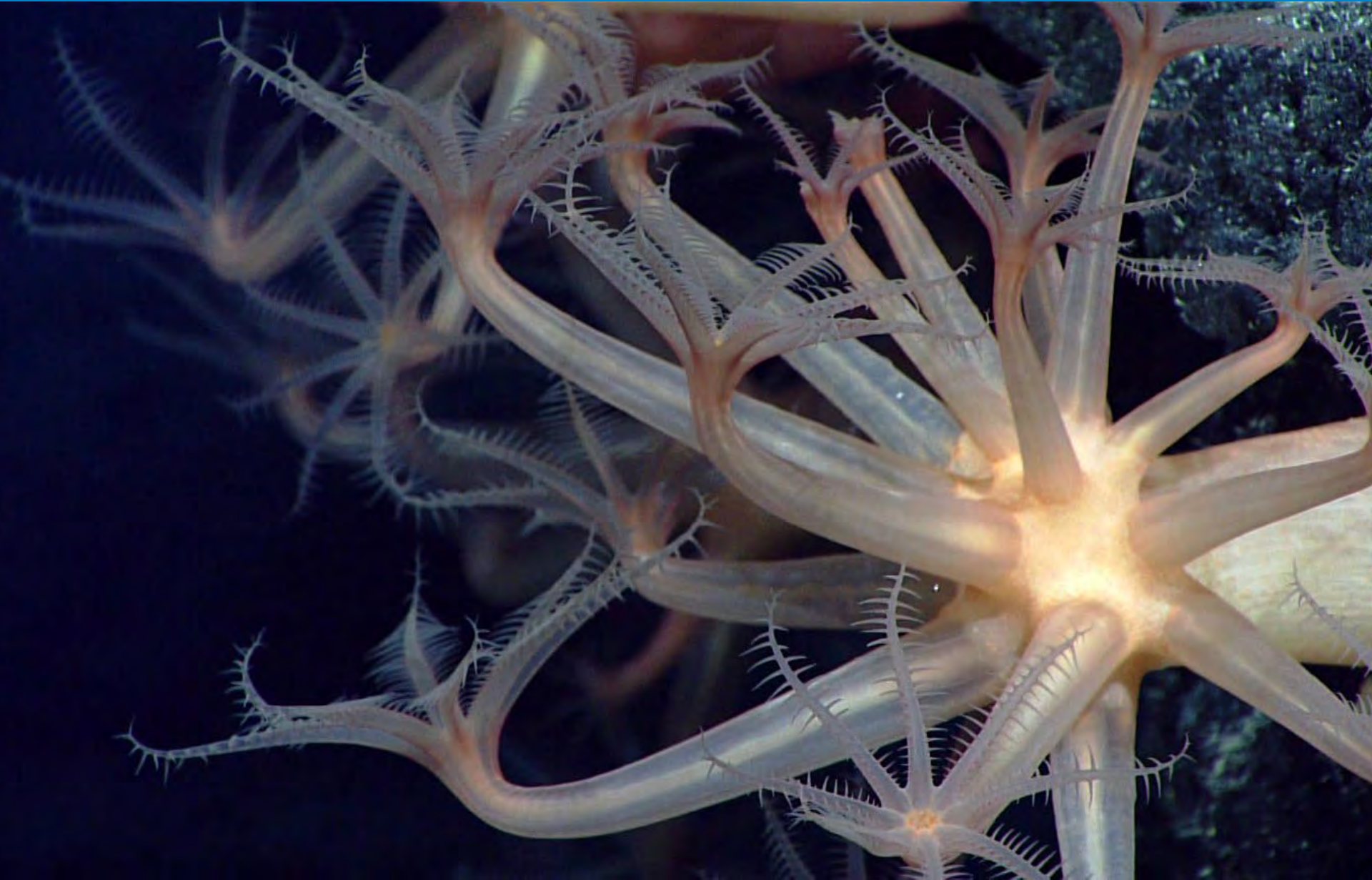
DEEP (FM) *SYNCHRONIZATION* *OPTIONS*

1. Disable FM in EM302
2. Synchronize all sonars to fire at once
3. Disable FM in EK80 70 kHz
4. Delay EK in EK80 software
5. Group in KSync

ROV Operations Innovation



ROV Operations Innovations



ROV Operations Innovations



Sample Collections Legacy

1248 Biological Samples
(including associates)

383 Geological Samples

Smithsonian National Museum of Natural History

Visit Exhibits Research Education Events About Join Us

NMNH Home | NMNH Research & Collections | Invertebrate Zoology | Collections

Search the Department of Invertebrate Zoology Collections New Search

Keyword Search Results - Grid View

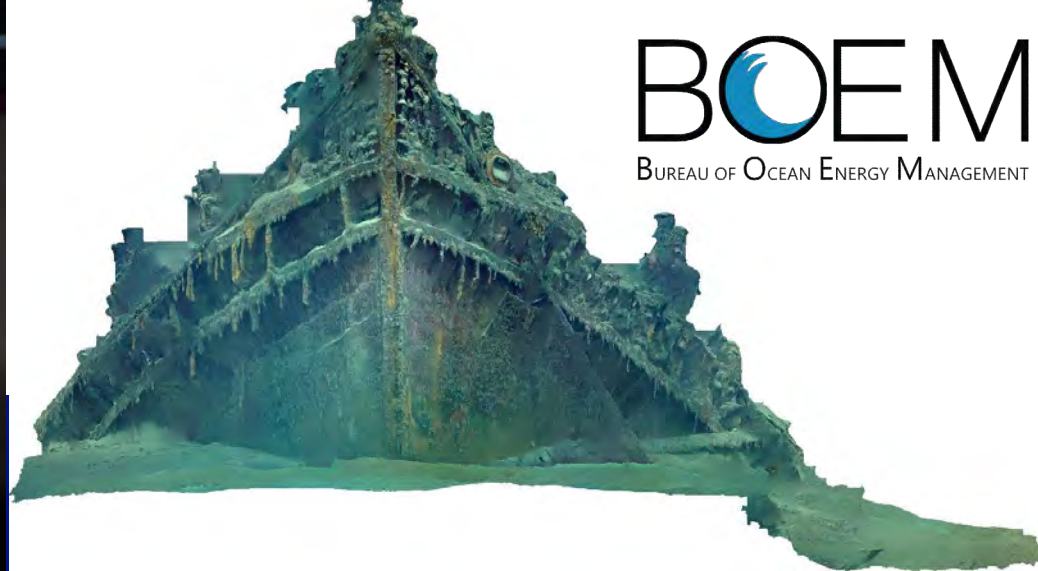
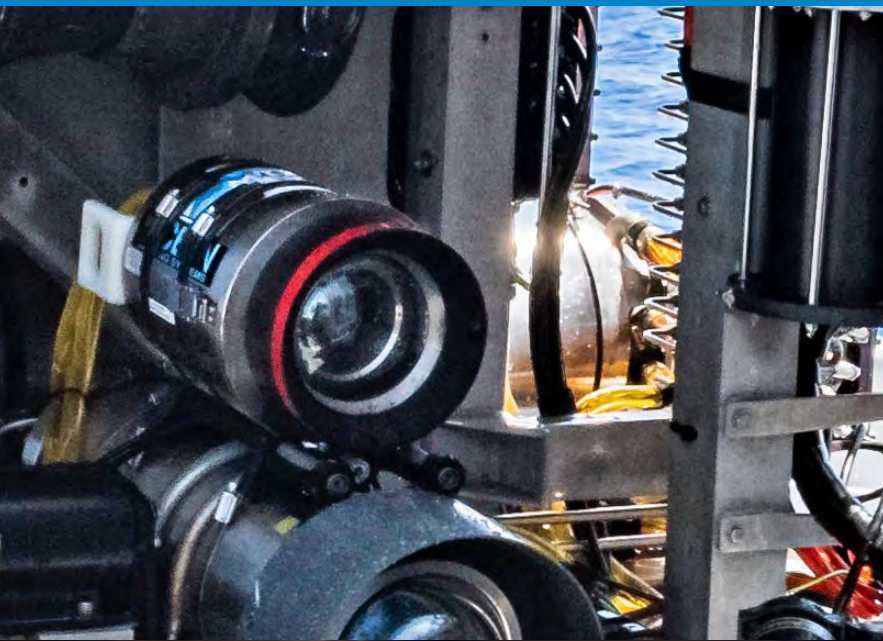
Catalog#	Kind of Object	Scientific Name	Family	Phylum	Ocean	Country	Province/State
1292601	Specimen/Lot		Zenometridae	Echinodermata	North Pacific ...	United States	Hawaii
1292603	Specimen/Lot		Hyocrinidae	Echinodermata	North Pacific ...	United States	Hawaii
1412989	Specimen/Lot			Cnidaria	North Pacific ...	United States	Hawaii
1297865	Specimen/Lot		Ophieacanthidae	Echinodermata	North Pacific ...	United States	Hawaii
1424224	Specimen/Lot			Cnidaria	North Pacific ...	United States	
1424050	Specimen/Lot			Cnidaria	North Pacific ...	United States	
1424053	Specimen/Lot		Chrysogorgiidae	Cnidaria	North Pacific ...	United States	
1424055	Specimen/Lot			Porifera	North Pacific ...	United States	
1424056	Specimen/Lot			Echinodermata	North Pacific ...	United States	
1424057	Specimen/Lot			Annelida	North Pacific ...	United States	

Page 1 of 159 | Clear Selections | Export as KML | Export All Results as CSV | Displaying records 1 - 10 of 1582

Oregon State University
MARINE AND GEOLOGY REPOSITORY
Supporting Earth, Ocean, and Antarctic Sciences

General Information	Whole Rock	Transmitted Light
<p>Sample Name (ENR) EX311-09-2</p> <p>Acquisition Event Success</p> <p>Sample Location Puente Alto - Japane Spur</p> <p>Geology Area</p> <p>Sample ID</p> <p>Project ID</p> <p>Project 1</p> <p>Project 2</p> <p>Project 3</p> <p>Project 4</p> <p>Project 5</p> <p>Project 6</p> <p>Project 7</p> <p>Project 8</p> <p>Project 9</p> <p>Project 10</p> <p>Project 11</p> <p>Project 12</p> <p>Project 13</p> <p>Project 14</p> <p>Project 15</p> <p>Project 16</p> <p>Project 17</p> <p>Project 18</p> <p>Project 19</p> <p>Project 20</p> <p>Project 21</p> <p>Project 22</p> <p>Project 23</p> <p>Project 24</p> <p>Project 25</p> <p>Project 26</p> <p>Project 27</p> <p>Project 28</p> <p>Project 29</p> <p>Project 30</p> <p>Project 31</p> <p>Project 32</p> <p>Project 33</p> <p>Project 34</p> <p>Project 35</p> <p>Project 36</p> <p>Project 37</p> <p>Project 38</p> <p>Project 39</p> <p>Project 40</p> <p>Project 41</p> <p>Project 42</p> <p>Project 43</p> <p>Project 44</p> <p>Project 45</p> <p>Project 46</p> <p>Project 47</p> <p>Project 48</p> <p>Project 49</p> <p>Project 50</p> <p>Project 51</p> <p>Project 52</p> <p>Project 53</p> <p>Project 54</p> <p>Project 55</p> <p>Project 56</p> <p>Project 57</p> <p>Project 58</p> <p>Project 59</p> <p>Project 60</p> <p>Project 61</p> <p>Project 62</p> <p>Project 63</p> <p>Project 64</p> <p>Project 65</p> <p>Project 66</p> <p>Project 67</p> <p>Project 68</p> <p>Project 69</p> <p>Project 70</p> <p>Project 71</p> <p>Project 72</p> <p>Project 73</p> <p>Project 74</p> <p>Project 75</p> <p>Project 76</p> <p>Project 77</p> <p>Project 78</p> <p>Project 79</p> <p>Project 80</p> <p>Project 81</p> <p>Project 82</p> <p>Project 83</p> <p>Project 84</p> <p>Project 85</p> <p>Project 86</p> <p>Project 87</p> <p>Project 88</p> <p>Project 89</p> <p>Project 90</p> <p>Project 91</p> <p>Project 92</p> <p>Project 93</p> <p>Project 94</p> <p>Project 95</p> <p>Project 96</p> <p>Project 97</p> <p>Project 98</p> <p>Project 99</p> <p>Project 100</p>		
<p>Whole Rock Summary</p> <p>A conglomerate with a fine grained matrix. Coarser large round to sub-round clasts of calcite as well as highly modified igneous clasts. Most clasts are 3-4 mm in diameter although some calcite clasts get up to >10 cm. Igneous clasts are typically <1 cm. Sample is soft with a thin fields coating.</p> <p>This section Summary</p> <p>A conglomerate with a highly altered fine grained matrix and both igneous and sedimentary clasts. Most of the clasts are oligoclase +/- andesine/plagioclase feldspar with high altered groundmass. The igneous groundmass commonly contain plagioclase rims and rounded vesicles and Fe oxides. The oligoclase and plagioclase grains are typically subhedral and range up to 1.25 cm length. Some grains are twinning in the matrix and others the rock may be a volcanic breccia that entrained a fine rounded breccia. The larger clasts appear to be fine grained limestone with some teeth pitted.</p>	<p>PHENOCRYSTS (Ph)</p> <p>OL</p> <p>PLAG</p> <p>OPX</p> <p>CPX</p> <p>SPINEL</p> <p>OTHER</p> <p>VESICLES (Vs)</p> <p>GRANDM (Gr)</p>	<p>Cross Polarized</p>

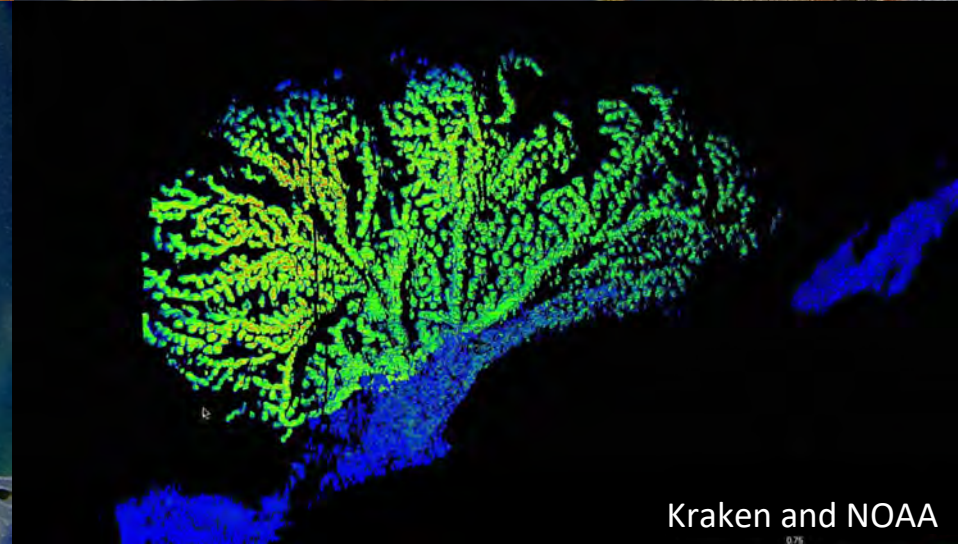
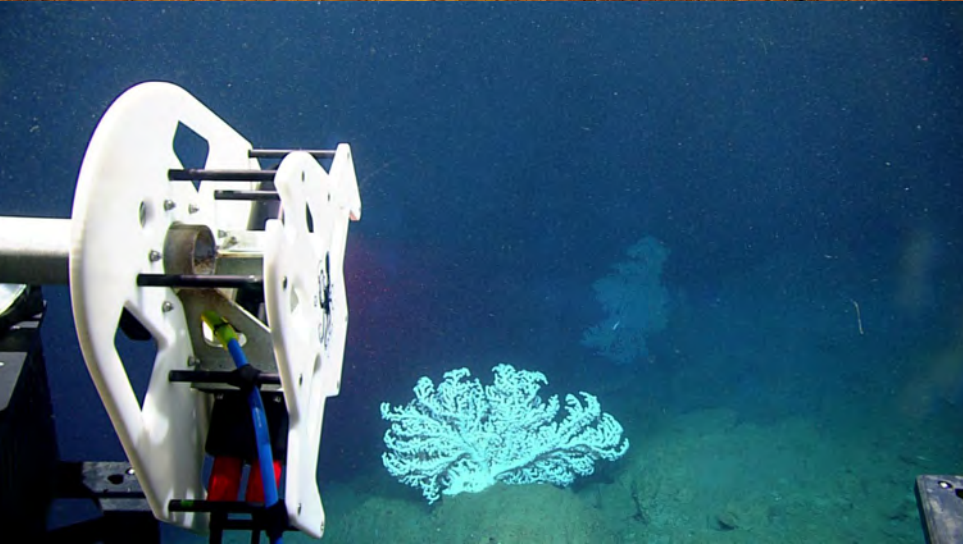
ROV Operations Innovations



Technology Demonstrations

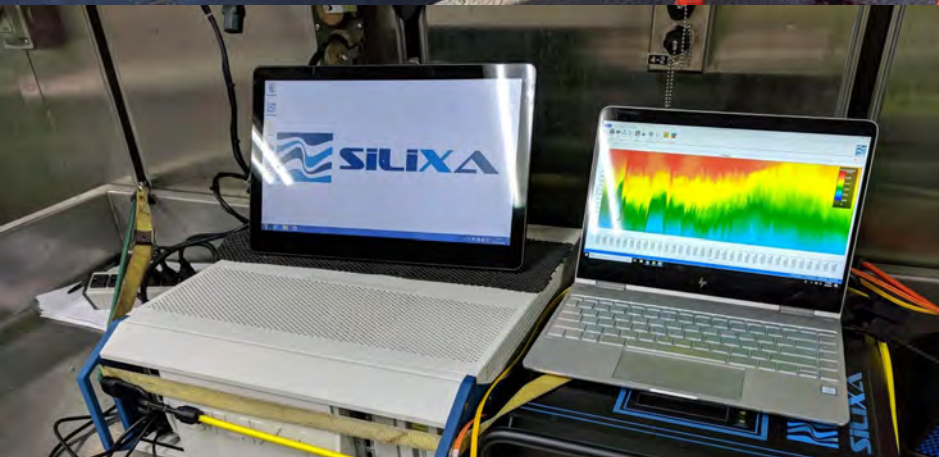
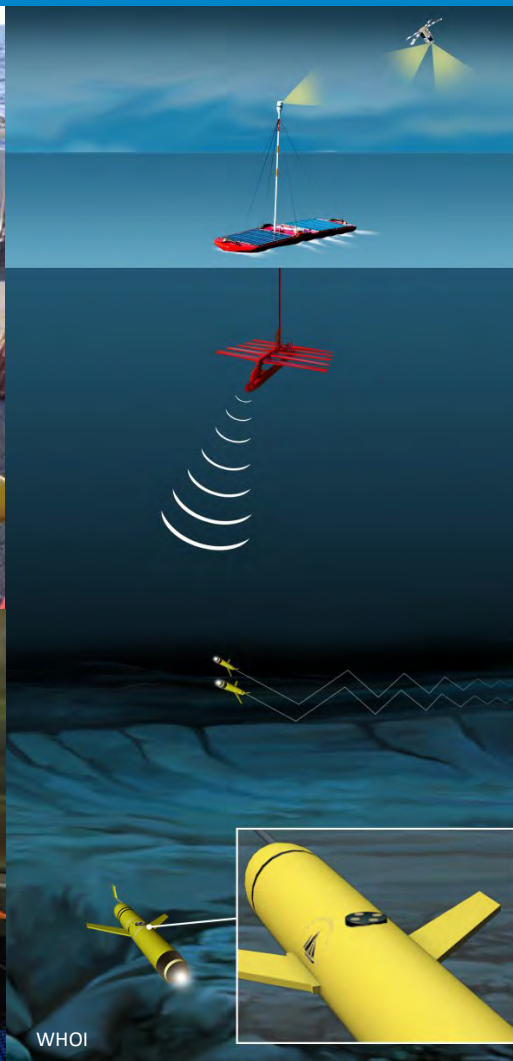
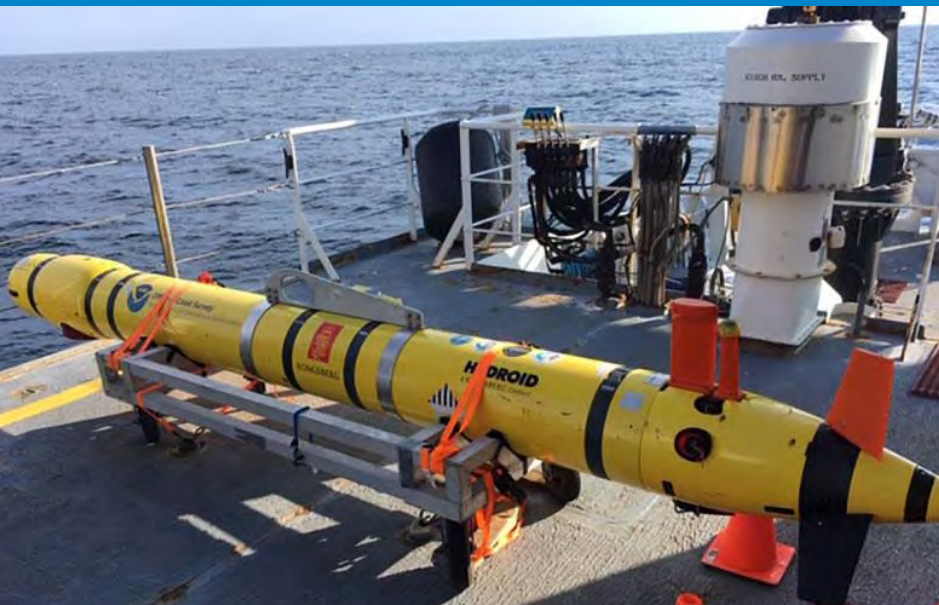


Barry Eakins, CIRES/NCEI



Kraken and NOAA

Technology Demonstrations



Looking to the Future



Full Tele-mapping Test

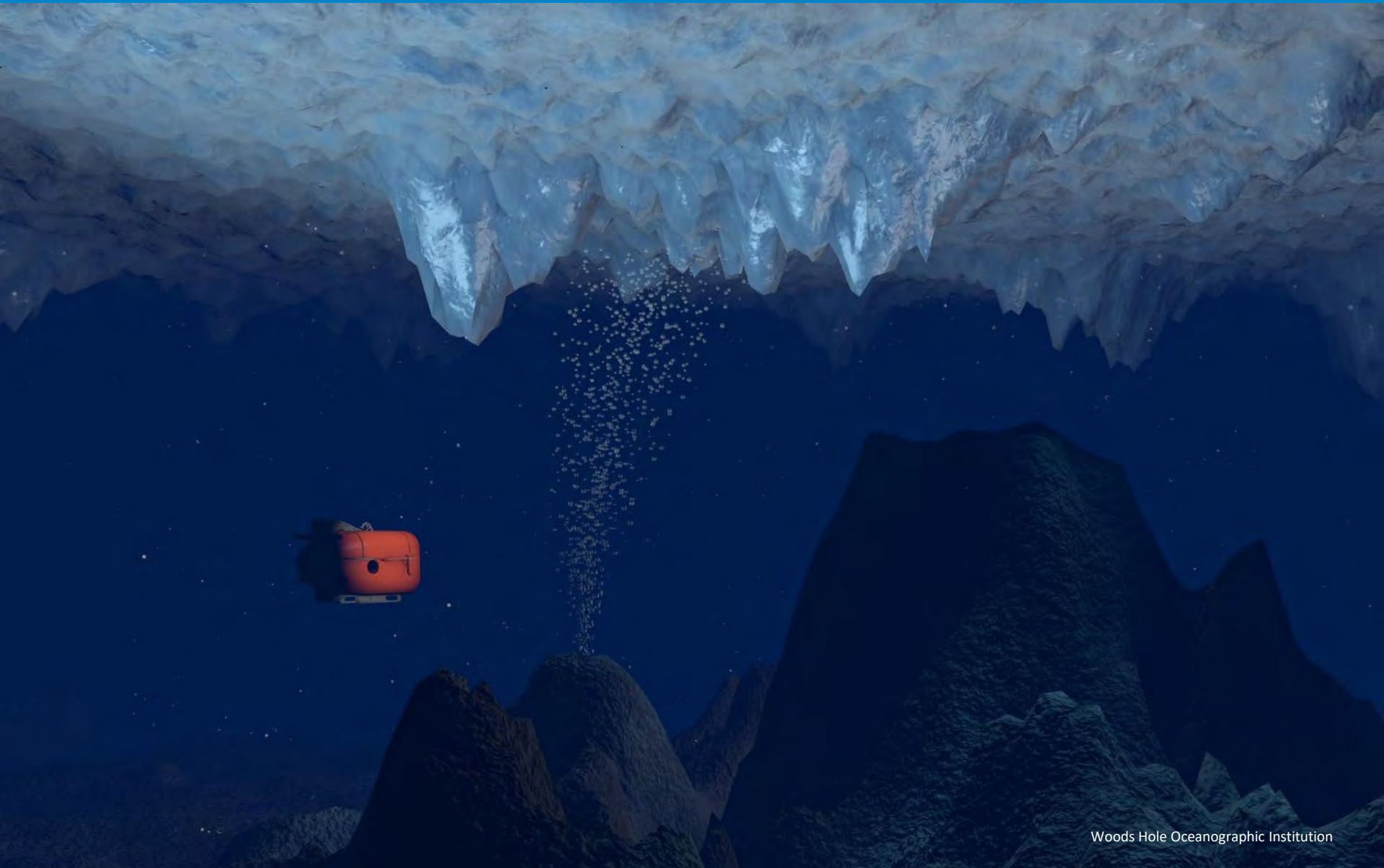


OCEAN INFINITY
Seabed Intelligence

New CRADA Collaborations

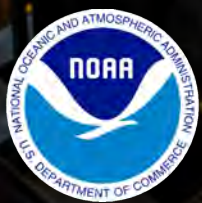


Technology Development, Application, and Program Use





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**Ocean Exploration
and Research**