



Ocean Exploration
and Research

Systematic Telepresence- enabled Ocean Exploration

Telepresence-enabled Exploration: What We Do

Collaborative systematic baseline deep ocean characterization

- Plan and conduct multi-year campaigns of deep ocean exploration expeditions to produce baseline characterizations
- Produce high-quality and publicly share real-time data to catalyze management, research, and economic activity
- Advance a new paradigm for telepresence-enabled exploration or ocean tele-exploration, transitioning advances to other ocean platforms and applications
- Test, develop, and implement advanced technologies and best practices to increase the pace and efficiency of ocean exploration

Okeanos Explorer Capabilities

Mapping: Sub-bottom, bottom, and water column characterization to 7,000 meters

ROVs: High-definition characterization imaging and sensing to 6,000 meters

Telepresence: Up to 20 mbps ship to shore, live distributed event logging, unlimited science community collaboration, shore-based Exploration Command Centers, and public web streaming

Data: Fully documented, high-quality data pipeline, dock to archive in 45 days or less.



Ocean Exploration
and Research

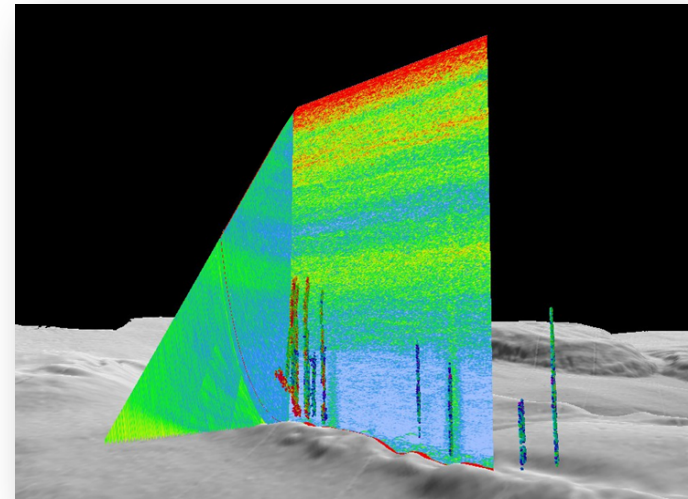
Telepresence-enabled Exploration: Why We Do It

Serving NOAA, the nation, and the public

Fulfill Public Law 111-11 Mandates to conduct ocean exploration expeditions

Advance NOAA's Observational Infrastructure and Resilient Coastal Communities goals by:

- Providing deep ocean environmental intelligence for informed critical decisions
- Advancing technology to increase the pace of characterization in the deep ocean
- Engage scientists, managers, industry, students, and the citizen explorers to improve understanding and decisions



Telepresence-enabled Exploration: What We Achieve

Campaigns Produce Data

- ACUMEN Campaign: From 2011-2014, *Okeanos* mapped all U.S. Atlantic margin canyons from Cape Hatteras to U.S./Canadian EEZ border
- Provided all *Okeanos* bathymetry to NOAA Coast Survey for incorporation into and updating of nautical charts
- Over 30% of NGDC multibeam holdings are from *Okeanos Explorer*

NOAA > NESDIS > NGDC > MGG > Multibeam Bathymetry

NOAA NATIONAL GEOPHYSICAL DATA CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Multibeam Bathymetric Data
National Geophysical Data Center

privacy policy

Multibeam Survey List

Number of records found: 12

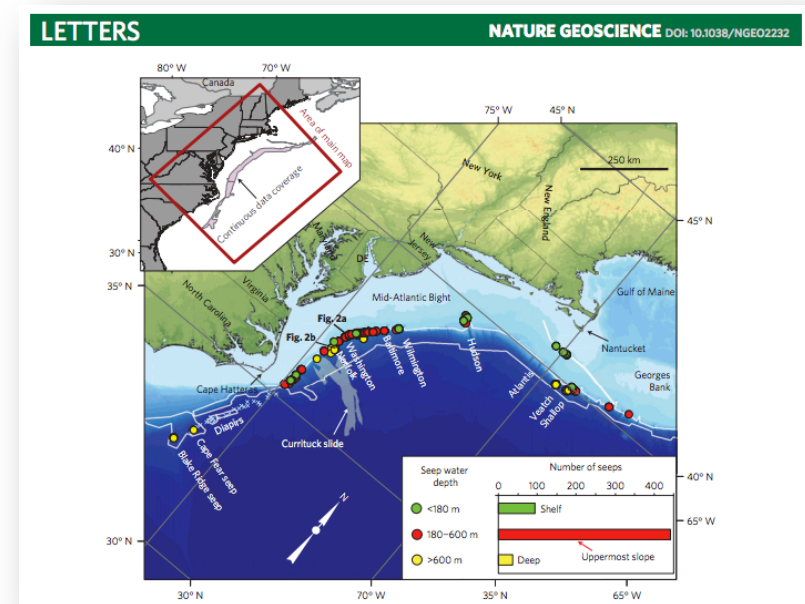
Select the surveys for which to download all data files, or click on the NGDC ID link (if present) to view/download individual data files.

Select	Survey Name	NGDC ID	Ship	Source	Chief Scientist	Instrument	Departure Port	Arrival Port	Start	End
<input type="checkbox"/>	EX1301	NEW2009	Okeanos Explorer	National Oceanic and Atmospheric Administration (NOAA)	Lobecker, Elizabeth	Kongsberg EM302	North Kingstown, RI	North Kingstown, RI	2013-03-18	2013-04-05
<input type="checkbox"/>	EX1302	NEW2046	Okeanos Explorer	National Oceanic and Atmospheric Administration (NOAA)	Lobecker, Elizabeth	Kongsberg EM302	Charleston, SC	North Kingstown, RI	2013-05-13	2013-06-06
<input type="checkbox"/>	EX1303	NEW2052	Okeanos Explorer	National Oceanic and Atmospheric Administration (NOAA)	Skarke, Adam	Kongsberg EM302	North Kingstown, RI	North Kingstown, RI	2013-06-11	2013-06-29
<input type="checkbox"/>	EX1304Leg1	NEW2054	Okeanos Explorer	National Oceanic and Atmospheric Administration (NOAA)	Lobecker, Elizabeth	Kongsberg EM302	North Kingstown, RI	New York, NY	2013-07-08	2013-07-25
<input type="checkbox"/>	EX1304Leg2	NEW2075	Okeanos Explorer	National Oceanic and Atmospheric Administration (NOAA)	Skarke, Adam	Kongsberg EM302	New York, NY	North Kingstown, RI	2013-07-31	2013-08-17
<input type="checkbox"/>	EX1305	NEW2076	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	Hare, Jon A.	Kongsberg EM302	North Kingstown, RI	North Kingstown, RI	2013-08-24	2013-09-05
<input type="checkbox"/>	EX1401	NEW2089	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	Lobecker, Elizabeth	Kongsberg EM302	North Kingstown, RI	North Kingstown, RI	2014-02-06	2014-02-09
<input type="checkbox"/>	EX1402L1	NEW2118	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	Lobecker, Elizabeth	Kongsberg EM302	North Kingstown, RI	Galveston, TX	2014-02-24	2014-03-15
<input type="checkbox"/>	EX1402L2	NEW2119	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	McKenna, Lindsay	Kongsberg EM302	Galveston, TX	Pascagoula, MS	2014-03-19	2014-04-04
<input type="checkbox"/>	EX1402L3	NEW2136	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	Lobecker, Elizabeth	Kongsberg EM302	Pascagoula, MS	St. Petersburg, FL	2014-04-10	2014-05-01
<input type="checkbox"/>	EX1403	NEW2158	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	Sowers, Derek	Kongsberg EM302	St. Petersburg, FL	North Kingstown, RI	2014-05-07	2014-05-22
<input type="checkbox"/>	EX1404L1	NEW2166	Okeanos Explorer	NOAA Office of Ocean Exploration and Research (OER)	Sowers, Derek	Kongsberg EM302	North Kingstown, RI	North Kingstown, RI	2014-08-09	2014-08-30

Telepresence-enabled Exploration: What We Achieve

Expedition Results Catalyze Science and Management

- Discovered major new world deep ocean gas seep province of over 500 gas seeps on U.S. Atlantic Margin with significant implications for NOAA and DOI
- Baseline Atlantic canyon data incorporated into management and conservation initiatives by NEFSC, MAFMC, NEFMC, BOEM, USGS, MARCO States, and NGOs (Pew, TNC, NRDC)
- Provided critical data that supported sanctuary expansion efforts on West Coast and Gulf of Mexico, leading to expansion of Gulf of Farallones and Cordell Bank NMSs
- Provided mapping data to USGS for slope failure and tsunamigenesis assessments and to NWS and PMEL for improvement of U.S. tsunami warning system for non-seismic tsunamis



A. Skarke, et al., Nov 2014. Nature Geoscience, Vol 7
<http://www.nature.com/ngeo/journal/v7/n9/pdf/ngeo2232.pdf>



Ocean Exploration
and Research

Telepresence-enabled Exploration: What We Achieve

Expedition Results Catalyze Science and Management

Increased efficiency of several ocean research sampling and exploration expeditions in Gulf of Mexico and Atlantic margin by providing open data in real- and near-real time

“I am writing because it is plain that having the high-resolution bathymetry data that *Okeanos Explorer* collected during its Gulf of Mexico surveys has lifted our ability to work smart in the DeSoto Canyon by an order of magnitude or more.”

Dr. Ian R. MacDonald, FSU
DEEP-C PI, Letter to OE, 12 Oct 2012



Telepresence-enabled Exploration: What We Achieve

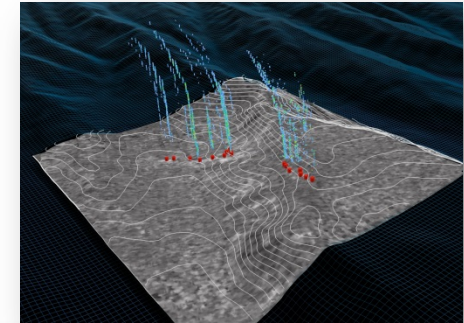
Transitioning Proven Methods to Increase Pace and Efficiency of Exploration

Tested and set standards for:

- Detecting and collecting water column data with EM302 sonars
- Utilizing telepresence for collaborative remote exploration

Telepresence paradigm increasingly used and adapted by UNOLS and others:

- Collaboration and data protocols transferred to *Falkor*, *Nautilus*
- Telepresence capability incorporated into *Sikuliaq* and new RCRV vessel designs, UNOLS VSAT refresh



Through telepresence capabilities and satellite communications the RCRVs will bring science at sea to classrooms, the public, and researchers ashore.

RCRV Brochure

University of Alaska Fairbanks

Contract No. UAF 14-0062

Page 4 of 12

Scope of Work
for Design and Implementation of Shipboard
Telepresence System aboard the R/V SIKULIAQ



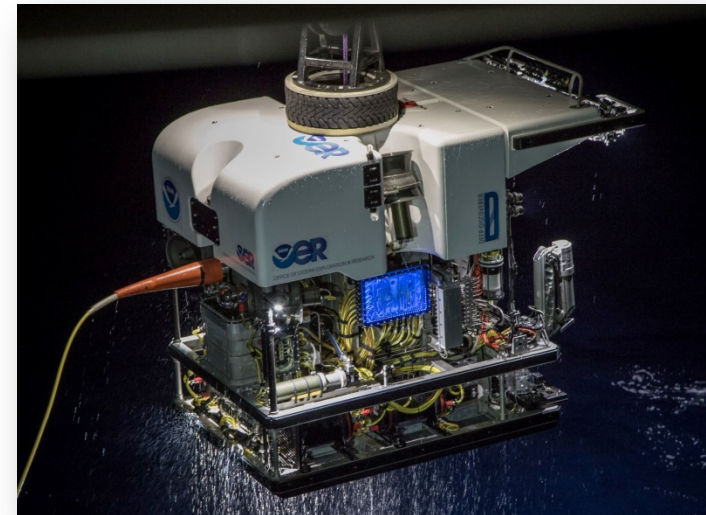
Ocean Exploration
and Research

Telepresence-enabled Exploration: Challenges

- Sustaining and advancing current assets and model
- Transitioning telepresence model to other platforms
- Program scientific leadership
- *Okeanos Explorer* retires in 2024 or sooner
 - What next? A new Exploration Class vessel, autonomous technologies, fly away capabilities, etc.?
- Data integration and analytics tools for data from *Okeanos* and other vessels and observing systems
- New partnerships to continue to innovate and maintain the cutting edge

Telepresence-enabled Exploration: What's Next

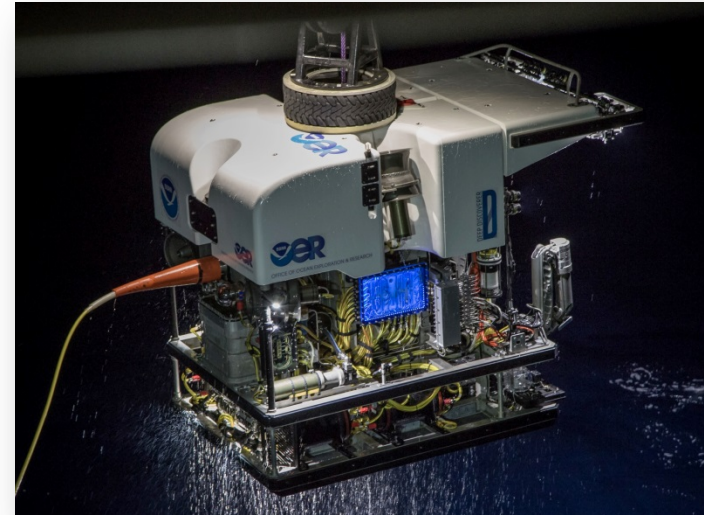
- Caribbean Exploration – Two months of mapping and ROV characterization – Winter/Spring 2015
- CAPSTONE: Two years of cross-NOAA, cross-agency collaborative exploration of existing and expanded monuments and surrounding areas in central and western Pacific ocean – Summer 2015
- Indian Ocean campaign with EU?



Telepresence-enabled Exploration: What's Next

New Capabilities List:

- 3-D model production workflow in partnership with GFOE and GEOMAR (2015)
- ROV sensor testing and integration (ongoing)
- ADCP and four new EK60 transducers (2016)
- Virtual sample analysis van (TBD)
- Identify standard UxS operations (TBD)
- Multibeam system for ROV (TBD)





Ocean Exploration
and Research

The U.S. Interagency Extended Continental Shelf Project

U.S. ECS Project: What We Do

The ECS Task Force was established in April 2007 by the Interagency Committee on Ocean Science and Resource Management Integration. The Task Force is chaired by Department of State, with co-vice chairs from Department of the Interior and National Oceanic and Atmospheric Administration.

The Task Force now reports to the National Ocean Council (NOC) Steering Committee. A revised ECS charter was adopted by the NOC on September 24, 2010.



U.S. ECS Project: Why We Do It

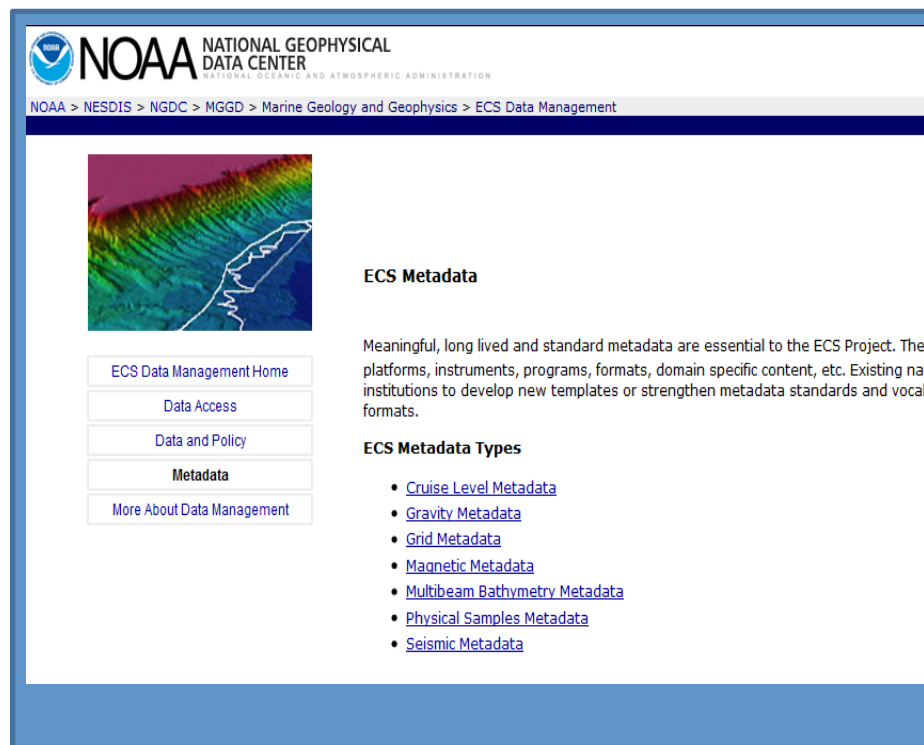
- Improve understanding of geology, extent of U.S. ECS (UNCLOS implications)
- Contribute to national continental shelf mapping priorities
- Make high-resolution bathymetric mapping data publicly available



2003-2014 equivalent area mapped over 2 million km² mapped at 100-m resolution

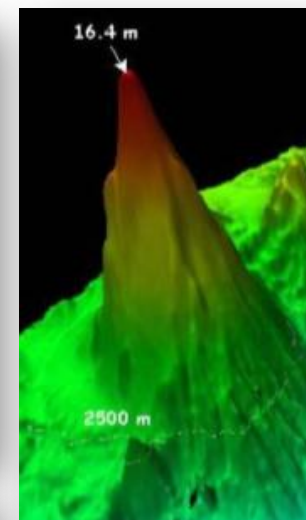
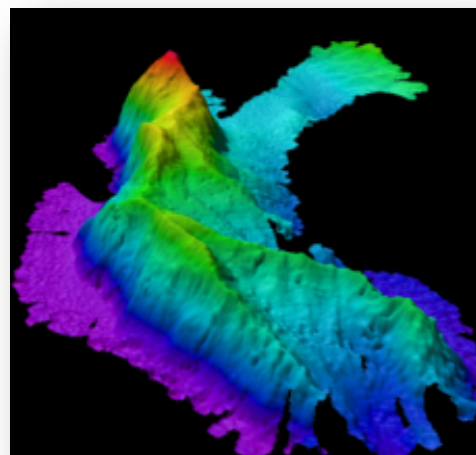
U.S. ECS Project: What We Achieve

- Over 36 ECS-funded cruises, collecting data and mapping +2 million km²
- Development of common metadata standards from U.S. ECS project data
- Over 70 scientific papers, conference proceedings, and cruise reports



U.S. ECS Project: Other ECS Exploration Results

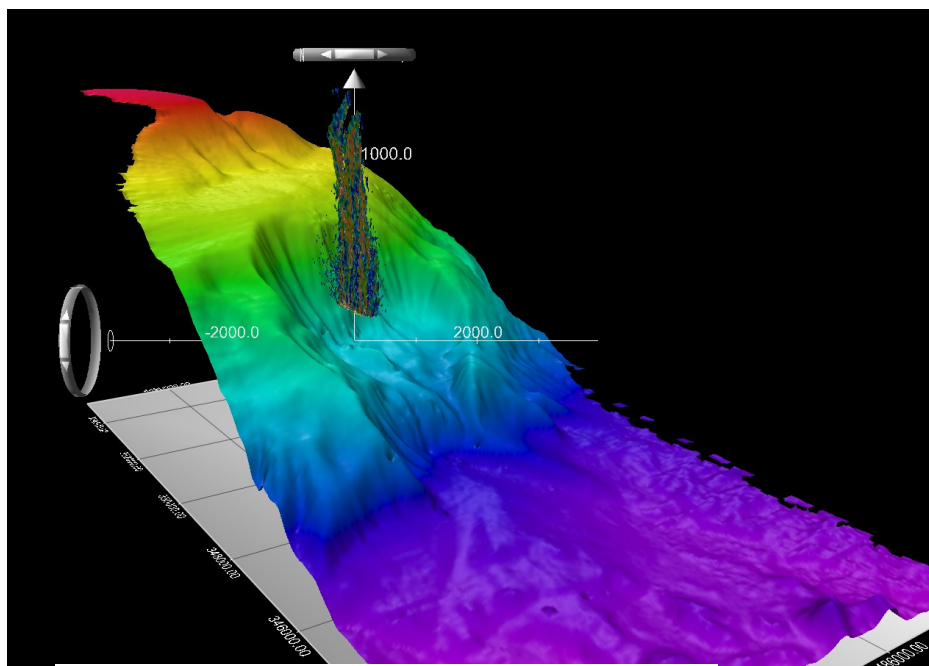
- Discovering Healy Seamount in Arctic
- Mapping seamounts and guyots off Mariana Islands
- Finding gas hydrates in Arctic
- Collecting Arctic dredge samples
- Assessing gas hydrate resources in Bering Sea
- Mapping Challenger Deep
- Discovery of methane plume off California



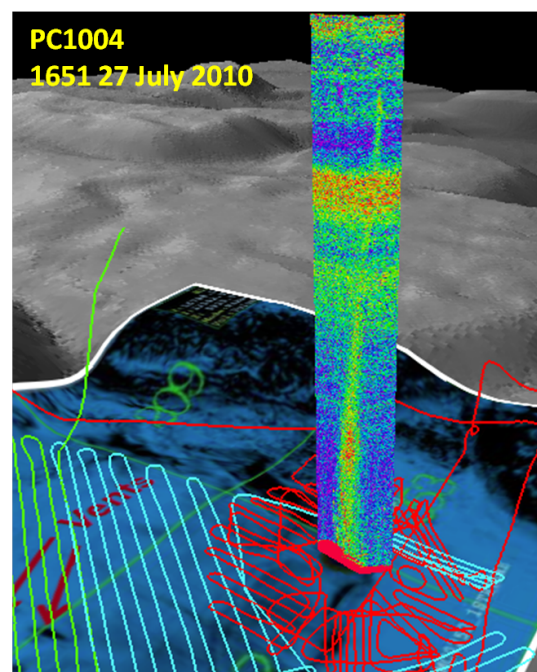
Ocean Exploration
and Research

U.S. ECS Project: Other ECS Exploration Results

Technology and methodology innovation: water column acoustic backscatter analysis



Methane plume off Mendocino



Well-head integrity monitoring for
Deepwater Horizon

U.S. ECS Project: Potential Results

Exclusive rights (*and responsibilities*) over the natural resources on and under the continental shelf, such as:

- Mineral resources (manganese nodules, ferromanganese crusts, and polymetallic sulfides, etc.)
- Petroleum (oil, gas, and gas hydrates)
- “Sedentary” species (clams, crabs, scallops, sponges, corals, mollusks, etc.)



U.S. ECS Project: Challenges

- The United States has not acceded to UNCLOS
- The quantity of data collection and quality of analysis can make a difference to the size of the U.S. ECS entitlement; resource constraints may compromise the full entitlement
- There is no certain funding to leverage the rich ECS project results for science, or to map and characterize this newly explored environment for NOAA's environmental intelligence mission
- No policy exists to authorize or monitor offshore exploitation; there is no effective liability regime for offshore oil and gas activity (with important implications for NOAA's management mission)

U.S. ECS Project: What's Next?

FY 15

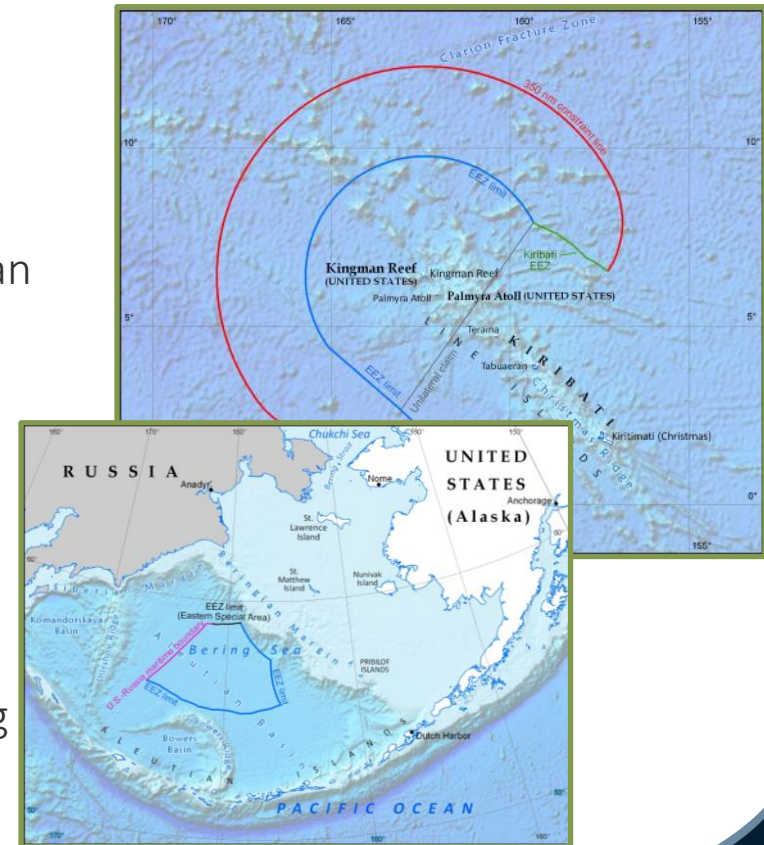
- Regional Analyses of the Bering Sea, Mendocino Ridge, and Atlantic Margin
- Bathymetric Cruise to either the Atlantic or Kingman Reef WestPac
- Atlantic seismic cruise

FY 16-17

- Additional Regional Analyses
- Expeditions to targeted areas in 2016 and 2017 will likely complete the mapping requirement to define potential extensions in the Atlantic and surrounding U.S. territories in the Pacific

FY 18

To be determined





Ocean Exploration
and Research

Marine Archaeology

Marine Archaeology: What We Do

Coordinate within NOAA, across agencies, and with outside organizations to discover archaeological evidence that contributes to our better understanding of past human culture.

- Contribute to NOAA's submerged cultural heritage mission leading to
- Support marine archaeology through the OER competitive grants program
- Leverage partnerships with BOEM, Office of Naval Research, Boeing, and others
- Support the use of advance undersea technologies for marine archaeology



Marine Archaeology: Why We Do It

To support NOAA's mission to discover and scientifically characterize archaeological resources that fill the gaps in our knowledge of the human past

- Required under 33 U.S.C. 3403 (PL 111-11)
- To address cultural resource management and protection issues important to NOAA, federal partners, and others
- To address current relevant topics in the study of past human cultures
- To increase capabilities, efficiency, and accuracy of archaeological characterization

Marine Archaeology: What We Achieve

Advance the field of marine archaeology and protecting underwater cultural heritage through partnerships, funding, and new technology applications

- Support for successful efforts to expand the Thunder Bay National Marine Sanctuary and plans to expand the Monitor National Marine Sanctuary
- Coordinated highly successful interdisciplinary archaeological missions using telepresence capabilities on *Okeanos Explorer* and *Nautilus*
- Engaged in partnership with ONR to apply cutting-edge mine-hunting technology to marine archaeology expeditions
- Funded over 70 marine archaeology proposals through the competitive grants process since 2001

Marine Archaeology: Challenges

- Protecting new discoveries within the existing framework of U.S. cultural heritage laws
- Competing for resources within NOAA (e.g., ship and other platform time)
- Uneven support for a robust peer review grant program for marine archaeology



Marine Archaeology: What's Next

- Offer dedicated funding for marine archeology under the competitive grants program in FY 15
- Develop capabilities for ROV *Deep Discover* to map and sample archaeological sites
- Collaborate with BOEM and other partners on work in the Gulf of Mexico, on the west coast, and in the Pacific
- Support advanced technology for marine archaeology

