A New Era of Ocean Exploration

a systematic search and investigation of the ocean for the primary and initial purpose of discovery

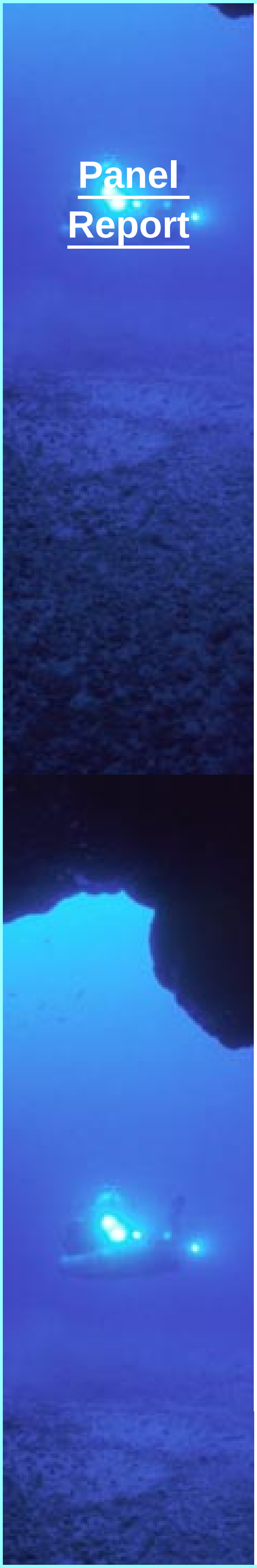
Ocean Exploration

Similar to President Thomas Jefferson's desire to explore the American West in the 19th Century, President William Jefferson Clinton has directed the Department of Commerce to convene a panel of leading ocean explorers, scientists and educators to recommend a national strategy for a new era of ocean exploration. Exploring the Earth's final frontier may hold clues to the origin of life on our blue planet, cures for human disease, answers on how to achieve sustainable use of our oceans, links to our maritime history, and information to protect the endangered species of the sea. This Web site will provide the backbone of information needed for the Ocean Exploration Panel to provide recommendations to the President of the United States of America. The Panel report entitled "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration" is a historic accomplishment because it is the only national strategy proposed for exploration of the global oceans by any country in the world. The final printed version of this report will be available by January 2001, if you have any further questions regarding the Ocean Exploration Panel report, please contact NOAA Public Affairs at 202.482.6090.

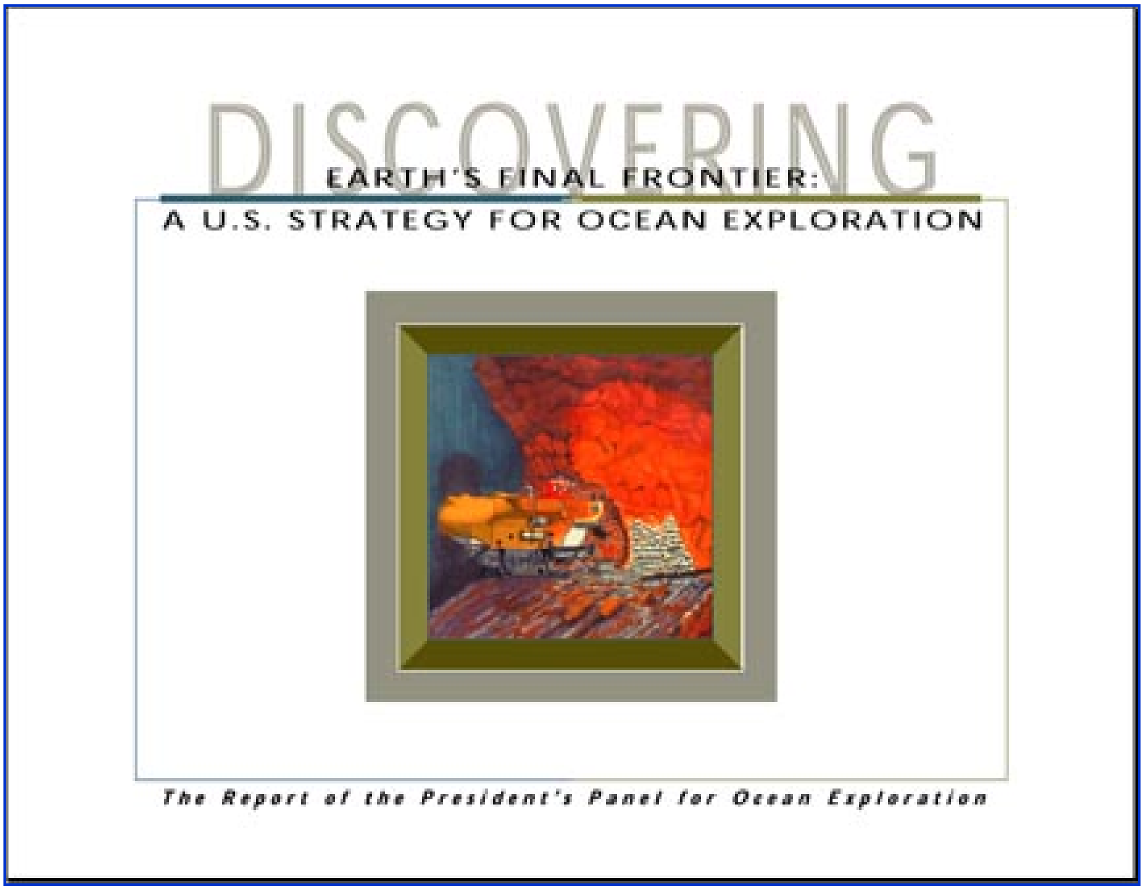
Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration is now available. Contact NOAA Public Affairs for your free copy of the report.

U.S. Department of Commerce, NOAA
Office of Constituent and Public Affairs
14th and Constitution Ave., N.W.
Washington, DC 20230

202.482.6090



Ocean Exploration Panel Report



Resources are available as downloadable files in Portable Document Format (PDF). These files can be accessed on computers that have installed a recent version of Adobe Acrobat Reader (free software).

If you would like information about any technical aspects of this site, please send an email to Claire Johnson

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TOP OF PAGE

Revised February 15, 2001 by Webmaster
http://oceanpanel.nos.noaa.gov

A New Era of Ocean Exploration

a systematic search and investigation of the ocean for the primary and initial purpose of discovery

Background

This page includes background information on the Ocean Exploration Directive and position papers for the 2002 Ocean Exploration Initiative.

Welcome Speech *(12 kb, PDF)* from the Secretary of Commerce, Norm Mineta, to the Ocean Exploration Panel.

Memo to the Panel *(32 kb, PDF)* Ocean Exploration Panel Chair, Marcia McNutt of MBARI, has written a memo to all panel members regarding the Directive from President William Jefferson Clinton.

Ocean Exploration Directive *(8 kb, PDF)* The Clinton Administration has announced steps to immediately develop a long-term exporation strategy to represent the start of a new era of ocean exploration. This Ocean Exploration directive has requested a panel convene, comprised of leading ocean explorers, educators, and scientists who will provide recommendations for a national oceans exploration strategy.

The Oceans Act of 1999 *(32 kb, PDF)* The Oceans Act of 1999 is a bill to establish a National Ocean Council, a Commission on Ocean Policy, and for other purposes; to the Committee on Commerce, Science, and Transportation.

The Oceans Act of 2000 *(32 kb, PDF)* The purpose of this act is to establish a commission to make recommendations for a coordinated and comprehensive national ocean policy.

Greenwood Bill *(8 kb, PDF)* A bill to direct the Secretary of Commerce to contract with the National Academy of Sciences to establish the Coordinated Oceanographic Program Advisory Panel to report to the Congress on the feasibility and social value of a coordinated oceanography program.

2002 Ocean Exploration Initiative Position Papers

2002 Ocean Exploration and Research Initiative *(96 kb, PDF)* Summary descriptions of all 2002 ocean exploration initiatives.

Water Masses and Ocean Fronts *(16 kb, PDF)* This document focuses on the exploration and study of ocean frontier areas, including water masses (e.g., upwellings, eddies, convergences), ocean fronts (e.g., Gulf Stream wall) and boundary layers, and the living resources associated with them.

Submarine Volcanoes *(8 kb, PDF)*This document focuses on the exploration, mapping, and study of ocean frontier areas, such as submarine volcanoes.

Deep Ocean Trenches *(8 kb, PDF)* This document focuses on the exploration, mapping, and study of ocean frontier areas, such as deep ocean trenches.

Hydrocarbon Seeps and Hydrate Beds *(8 kb, PDF)* This document focuses on exploration and study of the earth's molten interior which, lets out streams of magna, chemicals or boiling water. In many more places on the ocean floor, cold seeps ooze, bubble and vent a variety of materials such as methane gas, ice crystals imbued with natural gas, and crude oil.

Seamounts *(8 kb, PDF)* There is still the general impression that most of the deep sea is featureless and barren. Among the most impressive exceptions to this notion are seamounts, large submarine mountains rising to more than 1,000 m above the surrounding deep-sea floor.

Polar Environments *(16 kb, PDF)* The goal is to gain better definition of the abiotic and biotic resources of the polar seas and of the controlling physical and biogeochemical processes affecting those resources.

Submerged Heritage Resources *(24 kb, PDF)* The maritime historical record of the United States is largely underwater and awaiting discovery and documentation. As undersea exploration technology has developed, a recovery range has similarly evolved to the point where virtually anything sunk or lost at sea can now be found and explored, regardless of depth.

Deep Coral Communities, Reefs and Live Bottom *(20 kb, PDF)* This document focuses on the exploration and study of ocean frontier areas, including deep coral communities, reefs and benthic live bottom areas.

Ocean Data *(12 kb, PDF)* NESDIS proposes to capture and integrate multiple, large data streams from the ocean floor into NOAA's data systems and archives to facilitate access to and re-use of the data for ocean research and exploration.

Submarine Canyons *(8 kb, PDF)* This document focuses on the exploration, mapping, and study of ocean frontier areas, such as submarine canyons.

Marine Biotechnology *(12 kb, PDF)* The biotechnology revolution has impacted diverse fields of science and many sectors of the economy. In the environmental arena, application of molecular technologies has brought new ways to identify and mitigate ecological stresses and may hold the keys to remediation.

Sound in the Sea *(12 kb, PDF)* The major objectives of this program are to 1) create a global network for monitoring marine sound of natural and human origin, and 2) determine the effects of this noise on marine mammals and turtles.

2002 Ocean Exploration Work Plan *(8 kb, PDF)* This work plan describes the strategy and program/tasks of the 2002 Ocean Exploration Initiative.

Ocean Exploration Educational Program Plan *(8 kb, PDF)* This document provides the objectives of the Ocean Exploration Initiative educational programs.

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TOP OF PAGE

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Secretary of Commerce Norm Mineta Remarks to the Ocean Exploration Panel Meeting
August 21, 2000

Good morning fellow explorers

I say fellow explorers because I believe that each and every one of us is an explorer at heart. You just had the good sense to make it your life's work!

As space explorers observed over 30 years ago, Earth is a blue planet, an ocean planet.

And just as those early explorers set the nation's commitment to space exploration, it is up to us today to build a foundation for a renewed commitment to ocean exploration.

On June 12, President Clinton directed the Secretary of Commerce to put together a panel of America's finest explorers, scientists and educators.

He wanted the best people to work on a very, very important task: to develop a national strategy for ocean exploration.

I thank each of you for responding to the call.

Whenever we explore new frontiers – from the American west to outer space – we reap multiple benefits – to our economy, our technology, our health and our culture.

And, as we embark on this new era of ocean exploration, we can envision extraordinary benefits.

For example, the economic potential of America's unexplored oceans is vast. Gas hydrates may hold more than 1000 times the fuel in all other estimated oil and gas sources combined.

Already one new anti-cancer medicine (called Bryostatin) comes from a marine sponge. This drug is estimated to have an annual market value of over $1.2 billion.

And there is more history under the sea than in all the museums of the world. The ocean is home for treasures of antiquity, sunken vessels and the legacy of our maritime past. And we have taken steps to protect this heritage.

The first national marine sanctuary protects the remains of the Civil War ironclad USS ***Monitor***. The newest marine sanctuary -- the Thunder Bay National Marine Sanctuary -- will protect a collection of shipwrecks in Lake Huron.

It's been said, rightly, I believe, that we only protect that which we understand. By setting out on voyages of exploration and discovery, we build a foundation for conservation.

Technology is already bringing once inaccessible areas of the ocean within reach of fishermen, miners, and bio-prospectors.

In some ways, we are playing catch-up to these advances. But, as we have learned on land, protection must go hand in hand with exploration.

Deep ocean exploration presents huge technological challenges. And as we have seen with space exploration, the solutions often have broad benefits.

In turn, we will bring back discoveries of new life forms, geological features and chemical processes. Unraveling their mysteries will spur new developments.
In the days of Lewis and Clark, Americans waited months to learn about their discoveries.

Today, through Internet and satellite communications, you can take us along. As many of you have shown, students and teachers can share in the excitement of planning and undertaking an expedition.

As President Clinton noted in calling for a new era of ocean exploration, America needs a sustained investment to reap the full benefits for society.

Exploration is not partisan, nor is it the exclusive domain of any agency. It requires the full participation of government and the private sector.

And, above all, a successful ocean exploration strategy must engage the public.

A truly successful report will give us a strategy to make all citizens explorers -- and move ocean issues beyond this esteemed panel here today.

The effort to reach out and bring the excitement of these endeavors into America's classrooms is one of the best investments we can make.

It is often said that children are natural scientists. This great exploration endeavor has the potential to spark and nurture that curiosity through film, television, and the Internet.

But let's also remember the adults out there – remember to reach out to the explorer in all of us.

Ask yourself: Where were you when man first walked on the moon?

That amazing event remains so vivid in our minds because all Americans, indeed the world, were able to see it live on TV.

That day inspired a whole new generation of explorers.

How will Americans be able to join you on your expeditions to new ocean frontiers? Will today's explorations inspire the next generation of ocean scientists – and at home explorers?

An ocean exploration strategy that reaches its full potential must tap all the expertise and resources available to us.

The exploration of the world's oceans cannot be accomplished by one government agency, nor can it be accomplished by government alone.

I urge you, in your deliberations, to envision a new collaboration among governments, academia, and the private industry that reaches out to everyone.

In addition, a successful ocean exploration strategy should explore through time.

Voyages to remote places are essential, but so are those that occur through time as well. The establishment of networks, observatories, and data arrays on the seafloor and in the ocean's water column often reveals more to science than a snapshot approach ever will.

Two hundred years after Lewis and Clark forever changed the American landscape, you can chart a new course to explore the American seascape.

My hope is that, with public outreach, future generations will view this commission as a turning point for exploration of the oceans.
Thank you all for your willingness to be part of this critical task for our future. I eagerly await your report.

May it mark a new era of ocean exploration and conservation – a new era of stewardship for the oceans.

9 August, 2000

Dear Ocean Exploration Panelist:

I am delighted to learn that you have agreed to participate on the Ocean Exploration Panel. As you may know, Dr. Baker has asked me to chair this important undertaking, and I am very much looking forward to working with you in completing our charter.

Our terms of reference, which are appended in full to this letter, state that we must prepare a consensus report to the President through the NOAA Science Advisory Board. Our report must include recommendations and advice on how the nation should explore the oceans for the full range of benefits they provide, with conservation and sustainability as goals. There are 5 key components of our charter, which I would summarize as follows:

(1) Define objectives and priorities for exploration, including geographic targets;
(2) Recommend how various organizations (educational, research,, government) can create partnerships to better work together to reach objectives;
(3) Discuss implications of new technologies for reaching objectives;
(4) Draft up a procedure for deciding how and when newly explored regions warrant additional protection under the Marine Protected Area Center;
(5) Draft up a procedure for ensuring that discoveries with commercial potential obtain the necessary additional R&D.

My first impression is that component #1 is something that we all need to do together as a panel. Therefore, I am asking you all to come prepared at our first meeting on August 22, 2000 with your ideas on the objectives, priorities, and top geographic targets. If you want to send me some thoughts ahead of time by email (mcnutt@mbari.org), I will attempt to synthesize them for the group at our first meeting. I would propose that we attempt to deal with the next 4 components of the charter via subcommittee – e.g., subgroups to deal with Partnerships, Technologies, Preserves, and Pre-Commercial Development (or something like that). Please be thinking about to which group you feel you could contribute the most. All panelists will be given the opportunity to provide input and feedback on all aspects of the charter.

Finally, there is the matter of how our panel can receive input from those federal agencies that will presumably be guided by our report without making this an agency report. Our strategy is two fold. On the first day of our meeting, we will receive short reports from all of the federal agencies involved in ocean exploration. These can be used to give us background and some ground truth for our deliberations. Second, we recognize that there are a number of very knowledgeable individuals with expertise pertinent to our charter that just happen to work at a federal agency. I have invited each agency to send up to 2 individuals as agency advisors to our panel as long as their expertise is relevant to our charter and complements that of the committee. They will not serve as "agency representatives." But ultimately it will be the responsibility of the panel members to craft the final recommendations and stand behind them.

Please note that our time scale in extremely short. We are to have a report by October 10. So please come to D.C. full of good ideas and be prepared for lots of work in the next 6 weeks. Thanks again for you help!

Sincerely yours,

Marcia McNutt
President and CEO

THE PRESIDENT'S OCEAN EXPLORATION PANEL

TERMS OF REFERENCE

Background

On June 12, 2000, President Clinton directed the Secretary of Commerce to convene a panel of experts to report back to him within 120 days (October 10) with recommendations for a national ocean exploration strategy. Responsibility for carrying out the directive has been delegated through the National Oceanic and Atmospheric Administration (NOAA), to the Office of Oceanic and Atmospheric Research (OAR).

Panel

A panel of ocean exploration experts and a chair will be selected by the NOAA Science Advisory Board. The panel will consist of individuals with demonstrated expertise as ocean explorers, scientists and educators, and/or established records of accomplishment in industrial applications of ocean resources or representation of broad environmental ocean concerns.

Report

The final product of the panel will be a consensus report to the President through the NOAA Science Advisory Board, in the form of recommendations and advice on moving the nation forward through exploring the oceans for the full array of benefits they provide. The strategy recommended will support national efforts to conserve and ensure the sustainable use of valuable ocean resources. Specifically, the strategy will:

1. Define key objectives and priorities to guide ocean exploration, including the identification of key sites of scientific, historic and cultural importance;

2. Recommend ways of creating new partnerships to draw on the tools and talents of educational, research, private sector, and government organizations, including opportunities for Federal agencies to provide in-kind support for private ocean exploration initiatives;

3. Examine the potential for new technologies - including manned and unmanned vehicles and undersea platforms - to observe and explore the oceans from surface to seafloor and recommend ways to explore the oceans remotely using new observatories and sensors and other innovative uses of technology;

4. Recommend mechanisms to ensure that information about newly explored areas warranting additional protection is referred to the newly established Marine Protected Area Center, and;

5. Recommend mechanisms to ensure that newly discovered organisms or other resources with medicinal or commercial potential are identified for possible research and development.

Meetings

The panel will meet at least twice to gather information and discuss preparation of the report. Participation in the meetings will be limited to Panel Members, guests and/or advisors invited by the Chair, and selected support staff.

Public Input

An opportunity for public input to the panel will be provided through written statements submitted prior to the first meeting of the panel, oral statements at the first meeting and through and review comment prior to completion of the final report.

Federal Agency Input

Interested Federal agencies will be provided an opportunity to present their plans and ideas on ocean exploration to the panel at the first meeting of the panel and through subsequent comment on recommendations.

Staff Support

NOAA will provide administrative and technical support staff to assist the panel in its work.

THE WHITE HOUSE

Office of the Press Secretary

June 12, 2000

MEMORANDUM FOR THE SECRETARY OF COMMERCE

SUBJECT: A New Era of Ocean Exploration

Two years ago, the Vice President and I joined you, other members of my Cabinet, and hundreds of others from across the country at the National Ocean Conference in Monterey. This historic gathering drew together for the first time representatives from government, industry, and the scientific and conservation communities to begin charting a common oceans agenda for the 21st century.

At the Conference, I directed my Cabinet to report back with recommendations for a coordinated, disciplined, long-term Federal ocean policy. In its report to me last year, *Turning to the Sea: America's Ocean Future*, the Cabinet outlined an ambitious and detailed strategy to ensure the protection and sustainable use of our ocean resources. I am proud of the actions my Administration is taking to begin implementing this strategy, including the Executive Order I issued last month to strengthen our national network of marine protected areas.

One of the Cabinet’s key recommendations was that the Federal Government establish a national strategy to expand exploration of the oceans. Although we have learned more about our oceans in the past 25 years than during any other period in history, over 95 percent of the underwater world is still unknown and unseen. What remains to be explored may hold clues to the origins of life on Earth, cures for human diseases, answers to how to achieve sustainable use of our oceans, links to our maritime history, and information to protect the endangered species of the sea.

Today, I am announcing steps to immediately enhance our ocean exploration efforts and to develop the long-term exploration strategy recommended by you and the rest of the Cabinet. Together, these actions represent the start of a new era of ocean exploration.

First, I am announcing the launch of three new expeditions off the Atlantic, Gulf, and Pacific coasts. As you know, these expeditions, led by the Department of Commerce in collaboration with private partners, will allow the first detailed exploration of the Hudson River Canyon off New York, the Middle Grounds and Big Bend areas off central Florida, and the Davidson Seamount off central California. Researchers will employ the latest submersible technologies and will share their discoveries with schoolchildren and the public via the Internet and satellite communications.

Second, to ensure that these new expeditions are only the start of a new era of ocean exploration, I am directing you to convene a panel of leading ocean explorers, educators, and scientists and to report back to me within 120 days with recommendations for a National oceans exploration strategy. In implementing this directive, you shall consult with the National Science Foundation, the National Aeronautics and Space Administration, the Department of the Interior, the Environmental Protection Agency, and other agencies, as appropriate. The strategy should consider the full array of benefits that our oceans provide, and should support our efforts to conserve and ensure the sustainable use of valuable ocean resources. Specifically, the strategy should:

1. Define objectives and priorities to guide ocean exploration, including the identification of key sites of scientific, historic, and cultural importance;

2. Recommend ways of creating new partnerships to draw on the tools and talents of educational, research, private-sector, and government organizations, including opportunities for Federal agencies to provide in-kind support for private ocean exploration initiatives;

3. Examine the potential for new technologies -- including manned and unmanned vehicles and undersea platforms -- to observe and explore the oceans from surface to seafloor and recommend ways to explore the oceans remotely using new observatories and sensors and other innovative uses of technology; and

4. Recommend mechanisms to ensure that information about newly explored areas warranting additional protection is referred to the newly established Marine Protected Area Center, and that newly discovered organisms or other resources with medicinal or commercial potential are identified for possible research and development.

In the early years of the 19th century, President Thomas Jefferson commissioned Captain Meriwether Lewis to explore the American West. What followed was the most important exploration in this country's history. As America prepares to celebrate the 200th anniversary of the Lewis and Clark Expedition, we have an opportunity to set our sights on a much broader horizon. The time has come to take exploration farther west, and east, and south, to our submerged continents. In so doing, we can challenge and rekindle American's spirit of exploration, open up a whole new underwater world of possibilities, and help preserve our extraordinary marine heritage for future generations.

WILLIAM J. CLINTON

CONGRESSIONAL RECORD: May 5, 1999
PAGE S4792

[pS4792]

STATEMENTS ON INTRODUCED BILLS AND JOINT RESOLUTIONS BY MR. HOLLINGS (FOR HIMSELF, MR. STEVENS, MR. KERRY, MR. INOUYE, MR. BREAUX, MR. KENNEDY, MRS. BOXER, MR. BIDEN, MR. LAUTENBERG, MR. AKAKA, MR. MURKOWSKI, MR. THURMOND, MRS. MURRAY, MR. CLELAND, AND MR. WYDEN):

S959. A bill to establish a National Ocean Council, a Commission on Ocean Policy, and for other purposes; to the Committee on Commerce, Science, and Transportation.

THE OCEANS ACT OF 1999

Mr. HOLLINGS. Mr. President, I rise today to introduce the Oceans Act of 1999, legislation that the Senate unanimously passed in November 1997. I am pleased to be joined in this endeavor by Senators STEVENS, KERRY, BREAUX, INOUYE, KENNEDY, BOXER, BIDEN, LAUTENBERG, AKAKA, MURKOWSKI, THURMOND, MURRAY, CLELAND, and WYDEN. Mr. President, plainly and simply, this bill calls for a plan of action for the twenty-first century to explore, protect, and use our oceans and coasts through the coming millennium.

This is not the first time we have faced the need for a national ocean policy. Three decades ago, our Nation roared into space, investing tens of billions of dollars to investigate the moon and the Sea of Tranquility. During that golden era of science, some of us also recognized the importance of exploring the seas on our own planet. In 1966, Congress enacted the Marine Resources and Engineering Development Act in order to define national objectives and programs with respect to the oceans. That legislation laid the foundation for U.S. ocean and coastal policy and programs and has guided their development for three decades. I was elected to the Senate just three months after the 1966 Act was enacted into law, but I am pleased that both Senators INOUYE and KENNEDY, the two cosponsors of the 1966 Act still serving in the Senate, have agreed to join me today in introducing the Oceans Act.

One of the central elements of the 1966 Act was establishment of a presidential commission to develop a plan for national action in the oceans and atmosphere. Dr. Julius A. Stratton, a former president of the Massachusetts Institute of Technology and then-chairman of the Ford Foundation, led the Commission on an unprecedented, and since unrepeated, investigation of this nation's relationship with the oceans and the atmosphere. The Stratton Commission and its congressional advisors (including Senators Warren G. Magnuson and Norris Cotton) worked together in a bipartisan fashion. In fact, the Commission was established and carried out its mandate in the Democratic Administration of Lyndon Johnson and saw its findings implemented by the Republicans under President Richard Nixon. With a staff of 35 people, the commissioners hear and consulted over 1,000 people, visited every coastal area of this country, and submitted some 126 recommendations in a 1969 report to Congress entitled

Our Nation and the Sea. Those recommendations led directly to the creation of the National Oceanic and Atmospheric Administration in 1970, laid the groundwork for enactment of the Coastal Zone Management Act (CZMA) in 1972, and established priorities for federal ocean activities that have guided this Nation for almost thirty years.

While the Stratton Commission performed its job with vision and integrity, the world has changed since 1966. Today, half of the U.S. population lives within 50 miles of our shores and more than 30 percent of the Gross Domestic Product is generated in the coastal zone. Ocean and coastal resources once considered inexhaustible are severely depleted, and wetlands and other marine habitats are threatened by pollution and human activities. In addition, the U.S. regulatory and legal framework has developed over the years with the passage of a number of statutes in addition to CZMA. These include the Endangered Species Act, the Marine Mammal Protection Act, the Marine Protection, Research, and Sanctuaries Act, the Magnuson-Stevens Fishery Conservation and Management Act, the Coastal Barrier Resources Act, and the Oil Pollution Act. It is time to conduct a review that looks at coordination and duplication of programs and policies developed under these laws.

Today people who work and live on the water face a patchwork of confusing and sometimes contradictory federal and state regulations. This bill would allow us to reduce conflicts while maintaining environmental and health safeguards. One illustration of the type of situation that must be corrected is the southeast shrimp trawl fishery. Shrimpers are required under the Endangered Species Act to use panels or grates (known as turtle excluder devices or TEDs) in their nets to protect endangered sea turtles. The panels also reduce catches of small fish (bycatch), a new requirement of the Magnuson-Stevens Act. Unfortunately, however, the government has approved one TED for turtle protection and another for bycatch reduction-forcing the fishermen to use two separate devices, cut two holes in their nets, and double their shrimp loss. Anyone who wonders about public interest in regulatory reform has only to talk to a McClellanville, SC shrimper.

The Oceans Act is vital to the continued health of the oceans and prosperity of our coasts. It is patterned after and would replace the 1966 Act. Like that Act, it is comprised of three major elements:

First, the bill calls for development and implementation of a coherent national ocean and coastal policy to conserve and sustainably use fisheries and other ocean and coastal resources, protect the marine environment and human safety, explore ocean frontiers, create marine technologies and economic opportunities, and preserve U.S. leadership on ocean and coastal issues.

Second, the bill would establish a 16-member Commission, similar to the Stratton Commission, to examine ocean and coastal activities and report within 18 months on recommendations for a national policy. Commission members would be drawn from State and local governments, industry, academic and technical institutions, and public interest organizations involved in ocean and coastal activities. In developing its recommendations, the Commission would assess federal programs and funding priorities, ocean-related infrastructure requirements, conflicts among marine users, and technological opportunities. The bill authorizes appropriations of $6 million over two years to support Commission activities; last year's Omnibus Appropriations bill included $3.5 million to fund such a Commission.

Third, the bill would create a high-level federal interagency Council that would include the heads of the Departments of Commerce, Navy, State, Transportation, and the Interior, the Environmental Protection Agency, the National Science Foundation, the Office of Science and Technology Policy, the Office of Management and Budget, the Council on Environmental Quality, and the National Economic Council. This Council would advise the President and serve as a forum for developing and implementing an ocean and coastal policy, provide for coordination of federal budgets and programs, and work with non-federal and international organizations.

By establishing an action plan for ocean and coastal activities, the Oceans Act should also contribute substantially to national goals and objectives in the areas of education and research, economic development, and public safety. With respect to education and research, our view of the oceans thirty years ago was based on a remarkably small amount of information. When Jack Kennedy was in the White House, we were just beginning to develop the capability for exploring the oceans, and the driving factor was the military need to hide our submarines from the Soviets during the Cold War. What we knew of the oceans at that time was based as much on what fishermen brought up in their nets as it was on reliable scientific investigation.

Nowhere is the need for U.S. leadership more evident than in the area of ocean exploration. Today, we still have explored only a tiny fraction of the sea, but with the use of new technologies what we have found is truly incredible. For example, hydrothermal vents, hot water geysers on the deep ocean floor, were discovered just 20 years ago by oceanographers trying to understand the formation of the earth's crust. Now this discovery had led to the identification of nearly 300 new types of marine animals with untold pharmaceutical and biomedical potential. In recent years, scientists from 19 nations have joined in an international partnership, headed by Admiral Watkins, to explore the history and structure of the Earth beneath the oceans basins. Their ship, the Resolution, is the world's largest scientific research vessel and can drill in water depths of up 8,200 meters. Over the past 12 years, it has recovered more than 115 miles of core samples through the world oceans. Recently ship scientists worked off the coast of South Carolina collecting new evidence of a large meteor that struck the Earth 65 million years ago, and is thought to have triggered climate change that may be linked to the disappearance of the dinosaurs.

Many of our marine research efforts could have profound impacts on our economic well-being. For example, research on coastal ocean currents and other processes that affect shoreline erosion is critical to effective management of the shoreline. Oceanographers are working with federal, state, and local managers to use this new understanding in protecting beachfront property and the lives of those who reside and work in coastal communities. Development of underwater cameras and sonar, begun in the 1940s for the U.S. Navy, has led to major strides not only for military uses, but for marine archaeologists and scientists exploring unknown stretches of sea floor. Consumers have benefited from the technology now used in video cameras. Sonar has broad applications in both the military and commercial sector.

Finally, marine biotechnology research is thought to be one of the greatest remaining technological and industrial frontiers. Among the opportunities which it may offer are to: restore and protect marine ecosystems; monitor human health and treat disease; increase food supplies through aquaculture; enhance seafood safety and quality; provide new types and sources of industrial materials and processes; and understand biological and geochemical processes in the world ocean.

In addition to the economic opportunities offered by our marine research investment, traditional marine activities play an important role in our national economic outlook. Ninety-five percent of our international trade is shipped on the ocean. In 1996, commercial fishermen in the United States landed almost 10 billion pounds of fish with a value of $3.5 billion. Their fishing-related activities contributed over $42 billion to the U.S. economy. During the same period, marine anglers contributed another $20 billion. Travel and tourism also contribute over $700 billion to our economy, much of which is generated in coastal areas. With a sound national ocean and coastal policy and effective marine resource management, these numbers have nowhere to go but up.

With respect to public safety, it is particularly important to develop ocean and coastal priorities that reflect the changes we have seen in recent years. Before World War II, most of the U.S. shoreline was sparsely populated. There were long, wild stretches of coast, dotted with an occasional port city, fishing village, or sleepy resort. Most barrier islands had few residents or were uninhabited. After the war, people began pouring in, and coastal development began a period of explosive growth. In my state of South Carolina, our beaches attract millions of visitors every year, and more and more people are choosing to move to the coast-making the coastal counties the fastest growing ones in the state. Seventeen of the twenty fastest growing states in the nation are coastal states-which compounds the situation that the most densely populated regions already border the ocean. With population growth comes the demand for highways, shopping centers, schools, and sewers that permanently alter the landscape. If people are to continue to live and work on the coast, we must do a better job of planning how we impact the very regions in which we all want to live.

There is no better example of how our ocean and coastal policies affect public safety, than to look at the effects of hurricanes. Throughout the 1920s, hurricanes killed 2,122 Americans while causing about $1.8 billion in property damages. By contrast, in the first five years of the 1990s, hurricanes killed 111 Americans, and resulted in damages of about $35 billion. While we have made notable advances in early warning and evacuation systems to protect human lives, the risk of property loss continues to escalate and coastal inhabitants are more vulnerable to major storms than they ever have been. In 1989, Hurricane Hugo came ashore in South Carolina, leaving more than $6 billion in damages. Of that total from Hugo, the federal government paid out more than $2.8 billion in disaster assistance and more than $400 million from the National Flood Insurance Program. The payments from private insurance companies were equally staggering. In 1992, Hurricane Andrew struck southern Florida and slammed into low lying areas of Louisiana, forever changing the lives of more than a quarter of a million people and causing an estimated $25 to $30 billion dollars in damage. Hurricanes demonstrate that the human desire to live near the ocean and along the coast comes with both a responsibility and a cost.

The oceans are part of our culture, part of our heritage, part of our economy, and part of our future. Those who doubt the need for this legislation need only pick up a newspaper and they will be face to face with pressing ocean and coastal issues. And while our coastal waters are governed by the United States or all of us, beyond our waters progress relies primarily on international cooperation. There are no boundaries at sea, no national borders with fences and checkpoints. Deciding how to manage all these problems and use the seas is one of the most complicated tasks we can tackle.

Therefore, we need to be smart about ocean policy-we need the best minds to come together and take a look at what the real challenges are. It is not enough to sit back and assume the role of caretakers. We must be proactive and develop a plan for the future.

The United Nations declared 1998 to the be the Year of the Ocean in part to encourage governments and the pubic to pay adequate attention to the need to protect the marine environment and to ensure a healthy ocean. This is an unprecedented opportunity to follow up the Year of the Ocean activities by celebrating and enhancing what has been accomplished in understanding and managing our oceans.

The Stratton Commission stated in 1969: "How fully and wisely the United States uses the sea in the decades ahead will affect profoundly its security, its economy, its ability to meet increasing demands for food and raw materials, its position and influence in the world community, and the quality of the environment in which its people live." Those words are as true today as they were 30 years ago.

Mr. President, it is time to look towards the next 30 years. This bill offers us the vision and understanding needed to establish sound ocean and coastal policies for the 21st century, and I thank the cosponsors of the legislation for joining with me in recognizing it significance. We look forward to working together in the bipartisan spirit of the Stratton Commission to enact legislation that ensures the development of an integrated national ocean and coastal policy well into the next millennium. I ask unanimous consent that the text of the bill be printed in the RECORD.

There being no objection, the bill was ordered to be printed in the RECORD, as follows:

[pS4794]

S959

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, SECTION 1. SHORT TITLE.

This Act may be cited as the "Oceans Act of 1999". SEC. 2. CONGRESSIONAL FINDINGS; PURPOSE AND OBJECTIVES.

(a) FINDINGS.-The Congress makes the following findings:

(1) Covering more than two-thirds of the Earth's surface, the oceans and Great Lakes play a critical role in the global water cycle and in regulating climate, sustain a large part of Earth's biodiversity, provide an important source of food and a wealth of other natural products, act as a frontier to scientific exploration, are critical to national security, and provide a vital means of transportation. The coasts, transition between land and open ocean, are regions of remarkable high biological productivity, contribute more than 30 percent of the Gross Domestic Product, and are of considerable importance for recreation, waste disposal, and mineral exploration.

(2) Ocean and coastal resources are susceptible to change as a direct and indirect result of human activities, and such changes can significantly impact the ability of the oceans and Great Lakes to provide the benefits upon which the Nation depends. Changes in ocean and coastal processes could affect global patterns, marine productivity and bio-diversity, environmental quality, national security, economic competitiveness, availability of energy, vulnerability to natural hazards, and transportation safety and efficiency.

(3) Ocean and coastal resources are not infinite, and human pressure on them is increasing. One half of the Nation's population lives within 50 miles of the coast, ocean and coastal resources once considered inexhaustible are not threatened with depletion, and if population trends continue as expected, pressure on and conflicting demands for ocean and coastal resources will increase further as will vulnerability to coastal hazards.

(4) Marine transportation is key to United States participation in the global economy and to the wide range of activities carried out in ocean and coastal regions. Inland waterway and ports are the link between marine activities in ocean and coastal regions and the supporting transportation infrastructure ashore. International trade is expected to triple by 2020. The increase has the potential to outgrow

(A) the capabilities of the marine transportation system to ensure safety; and

(B) the existing capacity of ports and waterways.

(5) Marine technologies hold tremendous promise for expanding the range and increasing the utility of products from the oceans and Great Lakes, improving the stewardship of ocean and coastal resources, and contributing to business and manufacturing innovations and the creation of new jobs.

(6) Research has uncovered the link between oceanic and atmospheric processes and improved understanding of world climate patterns and forecasts. Important new advances, including availability of military technology have made feasible the exploration of large areas of the ocean which were inaccessible several years ago. In designating 1998 as "The Year of the Ocean", the United Nations high-lighted the value of increasing our knowledge of the oceans.

(7) It has been more than 30 years since the Commission on Marine Science, Engineering, and Resources (known as the Stratton Commission) conducted a comprehensive examination of ocean and coastal activities that led to enactment of major legislation and the establishment of key oceanic and atmospheric institutions.

(8) A review of existing activities is essential to respond to the changes that have occurred over the past three decades and to develop an effective new policy for the twenty-first century to conserve and use, in a sustainable manner, ocean and coastal resources, protect the marine environment, explore ocean frontiers, protect human safety, and create marine technologies and economic opportunities.

(9) Changes in United States laws and policies since the Stratton Commission, such as the enactment of the Coastal Zone Management Act, have increased the role of the States in the management of ocean and coastal resources.

(10) While significant Federal and State ocean and coastal programs are underway, those Federal programs would benefit from a coherent national ocean and coastal policy that reflects the need for cost-effective allocation of fiscal resources, improved interagency coordination, and strengthened partnerships with State, private, and international entities engaged in ocean and coastal activities.

(b) PURPOSE AND OBJECTIVES.-The purpose of this Act is to develop and maintain, consistent with the obligations of the United States under international law, a coordinated, comprehensive, and long-range national policy with respect to ocean and coastal activities that will assist the Nation in meeting the following objectives:

(1) The protection of life and property against natural and manmade hazards.

(2) Responsible stewardship, including use, of fishery resources and other ocean and coastal resources.

(3) The protection of the marine environment and prevention of marine pollution.

(4) The enhancement of marine-related commerce and transportation, the resolution of conflicts among users of the marine environment, and the engagement of the private sector in innovative approaches for sustainable use of living marine resources.

(5) The expansion of human knowledge of the marine environment including the role of the oceans in climate and global environmental change and the advance of education and training in fields related to ocean and coastal activities.

(6) The continued investment in and development and improvement of the capabilities, performance, use, and efficiency of technologies for use in ocean and coastal activities.

(7) Close cooperation among all government agencies and departments to ensure

(A) coherent regulation of ocean and coastal activities;

(B) availability and appropriate allocation of Federal funding, personnel, facilities, and equipment for such activities; and

(C) cost-effective and efficient operation of Federal departments, agencies, and programs involved in ocean and coastal activities.

(8) The enhancement of partnerships with State and local governments with respect to oceans and coastal activities, including the management of ocean and coastal resources and identification of appropriate opportunities for policy-making and decision-making at the State and local level.

(9) The preservation of the role of the United States as a leader in ocean and coastal activities, and, when it is in the national interest, the cooperation by the United States with other nations and international organizations in ocean and coastal activities.

[pS4795]

SEC. 3. DEFINITIONS.

As used in this Act

(1) The term "Commission" means the Commission on Ocean Policy.

(2) The term "Council" means the National Ocean Council.

(3) The term "marine environment" includes

(A) the oceans, including coastal and off-shore waters and the adjacent shore lands;

(B) the continental shelf;

(C) the Great Lakes; and

(D) the ocean and coastal resources thereof.

(4) The term "ocean and coastal activities" includes activities related to oceanography, fisheries and other ocean and coastal resource stewardship and use, marine aquaculture, energy and mineral resource extraction, marine transportation, recreation and tourism, waste management, pollution mitigation and prevention, and natural hazard reduction.

(5) The term "ocean and coastal resource" means, with respect to the oceans, coasts, and Great Lakes, any living or non-living natural resource (including all forms of animal and plant life found in the marine environment, habitat, biodiversity, water quality, minerals, oil, and gas) and any significant historic, cultural or aesthetic resource.

(6) The term "oceanography" means scientific exploration, including marine scientific research, engineering, mapping, surveying, monitoring, assessment, and information management, of the oceans, coasts, and Great Lakes

(A) to describe and advance understanding of

(i) the role of the oceans, coasts and Great Lakes in weather and climate, natural hazards, and the processes that regulate the marine environment; and

(ii) the manner in which such role, processes, and environment are affected by human actions;

(B) for the conservation, management and stewardship of living and nonliving resources; and

(C) to develop and implement new technologies related to the environmentally sensitive use of the marine environment. SEC. 4. NATIONAL OCEAN AND COASTAL POLICY.

(a) EXECUTIVE RESPONSIBILITIES.-The President, with the assistance of the Council and the advice of the Commission, shall

(1) develop and maintain a coordinated, comprehensive, and long-range national policy with respect to ocean and coastal activities consistent with obligations of the United States under international law; and

(2) with regard to Federal agencies and departments

(A) review significant ocean and coastal activities, including plans, priorities, accomplishments, and infrastructure requirements;

(B) plan and implement an integrated and cost-effective program of ocean and coastal activities including, but not limited to, oceanography, stewardship of ocean and coastal resources, protection of the marine environment, maritime transportation safety and efficiency, marine recreation and tourism, and marine aspects of weather, climate, and natural hazards;

(C) designate responsibility for funding and conducting ocean and coastal activities; and

(D) ensure cooperation and resolve differences arising from laws and regulations applicable to ocean and coastal activities which result in conflicts among participants in such activities.

(b) COOPERATION AND CONSULTATION.-In carrying out responsibilities under this Act, the President may use such staff, interagency, and advisory arrangements as the President finds necessary and appropriate and shall consult with non-Federal organizations and individuals involved in ocean and coastal activities. SEC.

5. NATIONAL OCEAN COUNCIL.

(a) ESTABLISHMENT.-The President shall establish a National Ocean Council and appoint a Chairman from among it members. The Council shall consist of

(1) the Secretary of Commerce;

(2) the Secretary of Defense;

(3) the Secretary of State;

(4) the Secretary of Transportation;

(5) the Secretary of the Interior;

(6) the Attorney General;

(7) the Administrator of the Environmental Protection Agency;

(8) the Director of the National Science Foundation;

(9) the Director of the Office of Science and Technology Policy;

(10) the Chairman of the Council on Environmental Quality;

(11) the Chairman of the National Economic Council;

(12) the Director of the Office of Management and Budget; and

(13) such other Federal officers and officials as the President considers appropriate.

(b) ADMINISTRATION.

(1) The President or the Chairman of the Council may from time to time designate one of the members of the Council to preside over meetings of the Council during the absence or unavailability of such Chairman.

(2) Each member of the Council may designate an officer of his or her agency or department appointed with the advice and consent of the Senate to serve on the Council as an alternate in the event of the unavoidable absence of such member.

(3) An executive secretary shall be appointed by the Chairman of the Council, with the approval of the Council. The executive secretary shall be a permanent employee of one of the agencies or departments represented on the Council and shall remain in the employ of such agency or department.

(4) For the purpose of carrying out the functions of the Council, each Federal agency or department represented on the Council shall furnish necessary assistance to the Council. Such assistance may include

(A) detailing employees to the Council to perform such functions, consistent with the purposes of this section, as the Chairman of the Council may assign to them; and

(B) undertaking, upon request of the Chairman of the Council, such special studies for the Council as are necessary to carry out its functions.

(5) The Chairman of the Council shall have the authority to make personnel decisions regarding any employees detailed to the Council.

(c) FUNCTIONS.-The Council shall

(1) assist the Commission in completing its report under section 6;

(2) serve as the forum for developing an implementation plan for a national ocean and coastal policy and program, taking into consideration the Commission report;

(3) improve coordination and cooperation, and eliminate duplication, among Federal agencies and departments with respect to ocean and coastal activities; and

(4) assist the Presdient in the preparation of the first report required by section 7(a).

(d) SUNSET.-The Council shall cease to exist one year after the Commission has submitted its final report under section 6(h).

(e) SAVINGS PROVISION.

(1) Council activities are not intended to supersede or interfere with other Executive Branch mechanisms and responsibilities.

(2) Nothing in this Act has any effect on the authority or responsbility of any Federal officer or agency under any other Federal law.

[pS4796]

SEC. 6. COMMISSION ON OCEAN POLICY.

(A) ESTABLISHMENT.

(1) IN GENERAL.-The President shall, within 90 days after the enactment of this Act, establish a Commission on Ocean Policy. The Commission shall be composed of 16 members including individuals drawn from State and local governments, industry, academic and technical institutions, and public interest organizations involved with ocean and coastal activities. Members shall be appointed for the life of the Commission as follows:

(A) 4 shall be appointed by the President of the United States.

(B) 4 shall be appointed by the President chosen from a list of 8 proposed members submitted by the Majority Leader of the Senate in consultation with the Chairman of the Senate Committee on Commerce, Science, and Transportation.

(C) 4 shall be appointed by the President chosen from a list of 8 proposed members submitted by the Speaker of the House of Representatives in consultation with the Chairman of the House Committee on Resources.

(D) 2 shall be appointed by the President chosen from a list of 4 proposed members submitted by the Minority Leader of the Senate in consultation with the Ranking Member of the Senate Committee on Commerce, Science, and Transportation.

(E) 2 shall be appointed by the President chosen from a list of 4 proposed members submitted by the Minority Leader of the House in consultation with the Ranking Member of the House Committee on Resources.

(2) FIRST MEETING.-The Commission shall hold its first meeting within 30 days after it is established.

(3) CHAIRMAN.-The President shall select a Chairman from among such 16 members. Before selecting the Chairman, the President is requested to consult with the Majority and Minority Leaders of the Senate, the Speaker of the House of Representatives, and the Minority Leader of the House of Representatives.

(4) ADVISORY MEMBERS.-In addition, the Commission shall have 4 Members of Congress, who shall serve as advisory members. One of the advisory members shall be appointed by the Speaker of the House of Representatives. One of the advisory members shall be appointed by the minority leader of the House of Representatives. One of the advisory members shall be appointed by the majority leader of the Senate. One of the advisory members shall be appointed by the minority leader of the Senate. The advisory members shall not participate, except in an advisory capacity, in the formulation of the findings and recommendations of the Commission.

(b) FINDINGS AND RECOMMENDATIONS.-The Commission shall report to the President and the Congress on a comprehensive national ocean and coastal policy to carry out the purpose and objectives of this Act. In developing the findings and recommendations of the report, the Commission shall

(1) review and suggest any necessary modifications to United States laws, regulations, and practices necessary to define and implement such policy, consistent with the obligations of the United States under international law;

(2) assess the condition and adequacy of investment in existing and planned facilities and equipment associated with ocean and coastal activities including human resources, vessels, computers, satellites, and other appropriate technologies and platforms;

(3) review existing and planned ocean and coastal activities of Federal agencies and departments, assess the contribution of such activities to development of an integrated long-range program for oceanography, ocean and coastal resource management, and protection of the marine environment, and identify any such activities in need of reform to improve efficiency and effectiveness;

(4) examine and suggest mechanisms to address the interrelationships among ocean and coastal activities, the legal and regulatory framework in which they occur, and their inter-connected and cumulative effects on the marine environment, ocean and coastal resources, and marine productivity and biodiversity;

(5) review the known and anticipated demands for ocean and coastal resources, including an examination of opportunities and limitations with respect to the use of ocean and coastal resources within the exclusive economic zone, projected impacts in coastal areas, and the adequacy of existing efforts to manage such use and minimize user conflicts;

(6) evaluate relationships among Federal, State, and local governments and the private sector for planning and carrying out ocean and coastal activities and address the most appropriate division of responsibility for such activities;

(7) identify opportunities for the development of or investment in new products, technologies, or markets that could contribute to the objectives of this Act;

(8) consider the relationship of the ocean and coastal policy of the United States to the United Nations Convention on the Law of the Sea and other international agreements, and actions available to the United States to effect collaborations between the United States and other nations, including the development of cooperative international programs for oceanography, protection of the marine environment, and ocean and coastal resource management; and

(9) engage in any other preparatory work deemed necessary to carry out the duties of the Commission pursuant to this Act.

(c) DUTIES OF CHAIRMAN.-In carrying out the provisions of this subsection, the Chairman of the Commission shall be responsible for

(1) the assignment of duties and responsibilities among staff personnel and their continuing supervision; and

(2) the use and expenditures of funds available to the Commission.

(d) COMPENSATION OF MEMBERS.-Each member of the Commission who is not an officer or employee of the Federal Government, or whose compensation is not precluded by a State, local, or Native American tribal government position, shall be compensated at a rate equal to the daily equivalent of the annual rate payable for Level IV of the Executive Schedule under section 5315 of title 5, United States Code, for each day (including travel time) during which such member is engaged in the performance of the duties of the Commission. All members of the Commission who are officers or employees of the United States shall serve without compensation in addition to that received for their services as officers or employees of the United States.

(e) STAFF.

(1) The Chairman of the Commission may, without regard to the civil service laws and regulations, appoint and terminate an executive director who is knowledgeable in administrative management and ocean and coastal policy and such other additional personnel as may be necessary to enable the Commission to perform its duties. The employment and termination of an executive director shall be subject to confirmation by a majority of the members of the Commission.

(2) The executive director shall be compensated at a rate not to exceed the rate payable for Level V of the Executive Schedule under section 5316 of title 5, United States Code. The Chairman may fix the compensation of other personnel without regard to the provisions of chapter 51 and subchapter III of chapter 53 of title 5, United States Code, relating to classification of positions and General Schedule pay rates, except that the rate of pay for such personnel may not exceed the rate payable for GS-15, step 7, of the Schedule under section 5332 of such title.

(3) Upon request of the Chairman of the Commission, after consulting with the head of the Federal agency concerned, the head of any Federal Agency shall detail appropriate personnel of the agency to the Commission to assist the Commission in carrying out its functions under this Act. Federal Government employees detailed to the Commission shall serve without reimbursement from the Commission, and such detailee shall retain the rights, status, and privileges of his or her regular employment without interruption.

(4) The Commission may accept and use the services of volunteers serving without compensation, and to reimburse volunteers for travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code. Except for the purposes of chapter 81 of title 5, United States Code, relating to compensation for work injuries, and chapter 171 of title 28, United States Code, relating to tort claims, a volunteer under this section may not be considered to be an employee of the United States for any purpose.

(5) To the extent that funds are available, and subject to such rules as may be prescribed by the Commission, the executive director of the Commission may procure the temporary and intermittent services of experts and consultants in accordance with section 3109 of title 5, United States Code, but at rates not to exceed the daily rate payable for GS-15, step 7, of the General Schedule under section 5332 of title 5, United States Code.

(f) ADMINISTRATION.

(1) All meetings of the Commission shall be open to the public, except that a meeting or any portion of it may be closed to the public if it concerns matters or information described in section 552b(c) of title 5, United States Code. Interested persons shall be permitted to appear at open meetings and present oral or written statement on the subject matter of the meeting. The Commission may administer oaths or affirmations to any person appearing before it.

(2) All open meetings of the Commission shall be preceded by timely public notice in the Federal Register of the time, place, and subject of the meeting.

(3) Minutes of each meeting shall be kept and shall contain a record of the people present, a description of the discussion that occurred, and copies of all statements filed. Subject to section 552 of title 5, United States Code, the minutes and records of all meetings and other documents that were made available to or prepared for the Commission shall be available for public inspection and copying at a single location in the offices of the Commission.

(4) The Federal Advisory Committee Act (5 U.S.C. App.) does not apply to the Commission.

(g) COOPERATION WITH OTHER FEDERAL ENTITIES.

(1) The Commission is authorized to secure directly from any Federal agency or department any information it deems necessary to carry out its functions under this Act. Each such agency or department is authorized to cooperate with the Commission and, to the extent permitted by law, to furnish such information to the Commission, upon the request of the Chairman of the Commission.

(2) The Commission may use the United States mails in the same manner and under the same conditions as other departments and agencies of the United States.

(3) The General Services Administration shall provide to the Commission on a reimbursable basis the administrative support services that the Commission may request.

(4) The Commission may enter into contracts with Federal and State agencies, private firms, institutions, and individuals to assist the Commission in carrying out its duties. The Commission may purchase and contract without regard to sections 303 of the Federal Property and Administration Services Act of 1949 (41 U.S.C. 253), section 18 of the Office of Federal Procurement Policy Act (41 U.S.C. 416), and section 8 of the Small Business Act (15 U.S.C. 637), pertaining to competition and publication requirements, and may arrange for printing without regard to the provisions of title 44, United States Code. The contracting authority of the Commission under this Act is effective only to the extent that appropriations are available for contracting purposes.

(h) REPORT.-The Commission shall submit to the President, via the Council, and to the Congress not later than 18 months after the establishment of the Commission, a final report of its findings and recommendations. The Commission shall cease to exist 30 days after it has submitted its final report.

(i) AUTHORIZATION OF APPROPRIATIONS.-There are authorized to be appropriated to support the activities of the Commission a total of up to $6,000,000 for fiscal years 2001 and 2002. Any sums appropriated shall remain available without fiscal year limitation until the Commission ceases to exist.

[pS4797]

SEC. 7. REPORT AND BUDGET COORDINATION.

(a) BIENNIAL REPORT.-Beginning in January, 2000, the President shall transmit to the Congress biennially a report, which shall include

(1) a comprehensive description of the ocean and coastal activities (and budgets) and related accomplishments of all agencies and departments of the United States during the preceding 2 fiscal years; and

(2) an evaluation of such activities (and budgets) and accomplishments in terms of the purpose and objectives of this Act. Reports made under this section shall contain such recommendations for legislation as the President may consider necessary or desirable.

(b) BUDGET COORDINATION.

(1) Each year the President shall provide general guidance to each Federal agency or department involved in ocean or coastal activities with respect to the preparation of requests for appropriations.

(2) Each agency or department involved in such activities shall include with its annual request for appropriations a report which

(A) identifies significant elements of the proposed agency or department budget relating to ocean and coastal activities; and

(B) specifies how each such element contributes to the implementation of a national ocean and coastal policy. SEC. 8. REPEAL OF 1966 STATUTE.

The Marine Resources and Engineering Development Act of 1966 (33 U.S.C. 1101 et seq.) is repealed.

S. 2327

One Hundred Sixth Congress of the United States of America

AT THE SECOND SESSION

Begun and held at the City of Washington on Monday, the twenty-fourth day of January, two thousand

An Act

To establish a Commission on Ocean Policy, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Oceans Act of 2000".

SEC. 2. PURPOSE AND OBJECTIVES.

The purpose of this Act is to establish a commission to make recommendations for coordinated and comprehensive national ocean policy that will promote—

(1) the protection of life and property against natural and manmade hazards;

(2) responsible stewardship, including use, of fishery resources and other ocean and coastal resources;

(3) the protection of the marine environment and prevention of marine pollution;

(4) the enhancement of marine-related commerce and transportation, the resolution of conflicts among users of the marine environment, and the engagement of the private sector in innovative approaches for sustainable use of living marine resources and responsible use of non-living marine resources;

(5) the expansion of human knowledge of the marine environment including the role of the oceans in climate and global environmental change and the advancement of education and training in fields related to ocean and coastal activities;

(6) the continued investment in and development and improvement of the capabilities, performance, use, and efficiency of technologies for use in ocean and coastal activities, including investments and technologies designed to promote national energy and food security;

(7) close cooperation among all government agencies and departments and the private sector to ensure—

(A) coherent and consistent regulation and management of ocean and coastal activities;

(B) availability and appropriate allocation of Federal funding, personnel, facilities, and equipment for such activities;

(C) cost-effective and efficient operation of Federal departments, agencies, and programs involved in ocean and coastal activities; and

(D) enhancement of partnerships with State and local governments with respect to ocean and coastal activities, including the management of ocean and coastal resources and identification of appropriate opportunities for policymaking and decision-making at the State and local level; and

(8) the preservation of the role of the United States as a leader in ocean and coastal activities, and, when it is in the national interest, the cooperation by the United States with other nations and international organizations in ocean and coastal activities.

SEC. 3. COMMISSION ON OCEAN POLICY.

(a) ESTABLISHMENT.—There is hereby established the Commission on Ocean Policy. The Federal Advisory Committee Act (5 U.S.C. App.), except for sections 3, 7, and 12, does not apply to the Commission.

(b) MEMBERSHIP.—

(1) APPOINTMENT.—The Commission shall be composed of 16 members appointed by the President from among individuals described in paragraph (2) who are knowledgeable in ocean and coastal activities, including individuals representing State and local governments, ocean-related industries, academic and technical institutions, and public interest organizations involved with scientific, regulatory, economic, and environmental ocean and coastal activities. The membership of the Commission shall be balanced by area of expertise and balanced geographically to the extent consistent with maintaining the highest level of expertise on the Commission.

(2) NOMINATIONS.—The President shall appoint the members of the Commission, within 90 days after the effective date of this Act, including individuals nominated as follows:

(A) 4 members shall be appointed from a list of 8 individuals who shall be nominated by the Majority Leader of the Senate in consultation with the Chairman of the Senate Committee on Commerce, Science, and Transportation.

(B) 4 members shall be appointed from a list of 8 individuals who shall be nominated by the Speaker of the House of Representatives in consultation with the Chairmen of the House Committees on Resources, Transportation and Infrastructure, and Science.

(C) 2 members shall be appointed from a list of 4 individuals who shall be nominated by the Minority Leader of the Senate in consultation with the Ranking Member of the Senate Committee on Commerce, Science, and Transportation.

(D) 2 members shall be appointed from a list of 4 individuals who shall be nominated by the Minority Leader of the House in consultation with the Ranking Members of the House Committees on Resources, Transportation and Infrastructure, and Science.

(3) CHAIRMAN.—The Commission shall select a Chairman from among its members. The Chairman of the Commission shall be responsible for—

(A) the assignment of duties and responsibilities among staff personnel and their continuing supervision; and

(B) the use and expenditure of funds available to the Commission.

(4) VACANCIES.—Any vacancy on the Commission shall be filled in the same manner as the original incumbent was appointed.

(c) RESOURCES.—In carrying out its functions under this section, the Commission—

(1) is authorized to secure directly from any Federal agency or department any information it deems necessary to carry out its functions under this Act, and each such agency or department is authorized to cooperate with the Commission and, to the extent permitted by law, to furnish such information (other than information described in section 552(b)(1)(A) of title 5, United States Code) to the Commission, upon the request of the Commission;

(2) may enter into contracts, subject to the availability of appropriations for contracting, and employ such staff experts and consultants as may be necessary to carry out the duties of the Commission, as provided by section 3109 of title 5, United States Code; and

(3) in consultation with the Ocean Studies Board of the National Research Council of the National Academy of Sciences, shall establish a multidisciplinary science advisory panel of experts in the sciences of living and non-living marine resources to assist the Commission in preparing its report, including ensuring that the scientific information considered by the Commission is based on the best scientific information available.

(d) STAFFING.—The Chairman of the Commission may, without regard to the civil service laws and regulations, appoint and terminate an Executive Director and such other additional personnel as may be necessary for the Commission to perform its duties. The Executive Director shall be compensated at a rate not to exceed the rate payable for Level V of the Executive Schedule under section 5136 of title 5, United States Code. The employment and termination of an Executive Director shall be subject to confirmation by a majority of the members of the Commission.

(e) MEETINGS.—

(1) ADMINISTRATION.—All meetings of the Commission shall be open to the public, except that a meeting or any portion of it may be closed to the public if it concerns matters or information described in section 552b(c) of title 5, United States Code. Interested persons shall be permitted to appear at open meetings and present oral or written statements on the subject matter of the meeting. The Commission may administer oaths or affirmations to any person appearing before it:

(A) All open meetings of the Commission shall be preceded by timely public notice in the Federal Register of the time, place, and subject of the meeting.

(B) Minutes of each meeting shall be kept and shall contain a record of the people present, a description of the discussion that occurred, and copies of all statements filed. Subject to section 552 of title 5, United States Code, the minutes and records of all meetings and other documents that were made available to or prepared for the Commission shall be available for public inspection and copying at a single location in the offices of the Commission.

(2) INITIAL MEETING.—The Commission shall hold its first meeting within 30 days after all 16 members have been appointed.

(3) REQUIRED PUBLIC MEETINGS.—The Commission shall hold at least one public meeting in Alaska and each of the following regions of the United States:

(A) The Northeast (including the Great Lakes).

(B) The Southeast (including the Caribbean).

(C) The Southwest (including Hawaii and the Pacific Territories).

(D) The Northwest.

(E) The Gulf of Mexico.

(f) REPORT.—

(1) IN GENERAL.—Within 18 months after the establishment of the Commission, the Commission shall submit to Congress and the President a final report of its findings and recommendations regarding United States ocean policy.

(2) REQUIRED MATTER.—The final report of the Commission shall include the following assessment, reviews, and recommendations:

(A) An assessment of existing and planned facilities associated with ocean and coastal activities including human resources, vessels, computers, satellites, and other appropriate platforms and technologies.

(B) A review of existing and planned ocean and coastal activities of Federal entities, recommendations for changes in such activities necessary to improve efficiency and effectiveness and to reduce duplication of Federal efforts.

(C) A review of the cumulative effect of Federal laws and regulations on United States ocean and coastal activities and resources and an examination of those laws and regulations for inconsistencies and contradictions that might adversely affect those ocean and coastal activities and resources, and recommendations for resolving such inconsistencies to the extent practicable. Such review shall also consider conflicts with State ocean and coastal management regimes.

(D) A review of the known and anticipated supply of, and demand for, ocean and coastal resources of the United States.

(E) A review of and recommendations concerning the relationship between Federal, State, and local governments and the private sector in planning and carrying out ocean and coastal activities.

(F) A review of opportunities for the development of or investment in new products, technologies, or markets related to ocean and coastal activities.

(G) A review of previous and ongoing State and Federal efforts to enhance the effectiveness and integration of ocean and coastal activities.

(H) Recommendations for any modifications to United States laws, regulations, and the administrative structure of Executive agencies, necessary to improve the understanding, management, conservation, and use of, and access to, ocean and coastal resources.

(I) A review of the effectiveness and adequacy of existing Federal interagency ocean policy coordination mechanisms, and recommendations for changing or improving the effectiveness of such mechanisms necessary to respond to or implement the recommendations of the Commission.

(3) CONSIDERATION OF FACTORS.—In making its assessment and reviews and developing its recommendations, the Commission shall give equal consideration to environmental, technical feasibility, economic, and scientific factors.

(4) LIMITATIONS.—The recommendations of the Commission shall not be specific to the lands and waters within a single State.

(g) PUBLIC AND COASTAL STATE REVIEW.—

(1) NOTICE.—Before submitting the final report to the Congress, the Commission shall—

(A) publish in the Federal Register a notice that a draft report is available for public review; and

(B) provide a copy of the draft report to the Governor of each coastal State, the Committees on Resources, Transportation and Infrastructure, and Science of the House of Representatives, and the Committee on Commerce, Science, and Transportation of the Senate.

(2) INCLUSION OF GOVERNORS' COMMENTS.—The Commission shall include in the final report comments received from the Governor of a coastal State regarding recommendations in the draft report.

(h) ADMINISTRATIVE PROCEDURE FOR REPORT AND REVIEW.—Chapter 5 and chapter 7 of title 5, United States Code, do not apply to the preparation, review, or submission of the report required by subsection (e) or the review of that report under subsection (f).

(i) TERMINATION.—The Commission shall cease to exist 30 days after the date on which it submits its final report.

(j) AUTHORIZATION OF APPROPRIATIONS.—There are authorized to be appropriated to carry out this section a total of $6,000,000 for the 3 fiscal-year period beginning with fiscal year 2001, such sums to remain available until expended.

SEC. 4. NATIONAL OCEAN POLICY.

(a) NATIONAL OCEAN POLICY.—Within 120 days after receiving and considering the report and recommendations of the Commission under section 3, the President shall submit to Congress a statement of proposals to implement or respond to the Commission's recommendations for a coordinated, comprehensive, and long-range national policy for the responsible use and stewardship of ocean and coastal resources for the benefit of the United States. Nothing in this Act authorizes the President to take any administrative or regulatory action regarding ocean or coastal policy, or to implement a reorganization plan, not otherwise authorized by law in effect at the time of such action.

(b) COOPERATION AND CONSULTATION.—In the process of developing proposals for submission under subsection (a), the President shall consult with State and local governments and non-Federal organizations and individuals involved in ocean and coastal activities.

SEC. 5. BIENNIAL REPORT.

Beginning in September, 2001, the President shall transmit to the Congress biennially a report that includes a detailed listing of all existing Federal programs related to ocean and coastal activities, including a description of each program, the current funding for the program, linkages to other Federal programs, and a projection of the funding level for the program for each of the next 5 fiscal years beginning after the report is submitted.

SEC. 6. DEFINITIONS.

In this Act:

(1) MARINE ENVIRONMENT.—The term "marine environment" includes—

(A) the oceans, including coastal and offshore waters;

(B) the continental shelf; and

(C) the Great Lakes.

(2) OCEAN AND COASTAL RESOURCE.—The term "ocean and coastal resource" means any living or non-living natural, historic, or cultural resource found in the marine environment.

(3) COMMISSION.—The term "Commission" means the Commission on Ocean Policy established by section 3.

SEC. 7. EFFECTIVE DATE.

This Act shall become effective on January 20, 2001.

Speaker of the House of Representatives.

Vice President of the United States and
President of the Senate.

A BILL

To direct the Secretary of Commerce to contract with the National Academy of Sciences to establish the Coordinated Oceanographic Program Advisory Panel to report to the Congress on the feasibility and social value of a coordinated oceanography program.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the `Exploration of the Seas Act'.

SEC. 2. FINDINGS.

Congress finds the following:

(1) During the past 100 years, scientists working with marine fossils, both underwater and high in the mountains, have traced the origins of life on Earth to the sea , beginning approximately 3 billion years ago. Today, life on our planet remains dependent on the vitality of the sea.

(2) More than two-thirds of the Earth's surface is covered by water, with oceans and inland seas accounting for almost 140 million square miles.

(3) The United Nations forecasts a worldwide population of 8.9 billion by the year 2050, a 50 percent increase from 5.9 billion in 1999. As this trend in population growth continues, increasing demands will be placed on ocean and coastal resources, not only as a result of population growth in coastal regions, but also from the need to harvest increasing amounts of marine life as a source of food to satisfy world protein requirements, and from the mining of energy-producing materials from offshore resource deposits.

(4) The ocean remains one of the Earth's last unexplored frontiers. It has stirred our imaginations over the millennia, led to the discovery of new lands, immense mineral deposits, and reservoirs of resources, and produced startling scientific findings.

(5) The seas possess enormous economic and environmental importance. Some ocean resources, such as fisheries and minerals, are well recognized. Oil use has increased dramatically in recent times, and the sea bed holds large deposits of largely undiscovered reserves. Other ocean resources offer promise for the future. In addition to fossil fuels, the ocean floor contains deposits of gravel, sand, manganese crusts and nodules, tin, gold, and diamonds. Marine mineral resources are extensive, yet poorly understood.

(6) The oceans also offer rich untapped potential for medications. Marine plants and animals possess inestimable potential in the treatment of human illnesses. Coral reefs, sometimes described as the rain forests of the sea , contain uncommon chemicals that may be used to fight diseases for which scientists have not yet found a cure, such as cancer, Acquired Immunodeficiency Syndrome (AIDS), and diabetes. While the number of new chemical compounds that can be derived from land based plants and microbial fermentation is limited, scientists have only just begun to explore the sea's vast molecular potential.

(7) In spite of the development of new technologies, comparatively little of the ocean has been studied. The leadership role of the United States has been eroded by a gradual decrease in funding support, even while public opinion surveys indicate that ocean exploration is at least as important as space exploration .

(8) The National Academy of Sciences has the means by which to study and make determinations regarding the adoption and establishment of a coordinated oceanography program for the exploration of the seas, in which the National Oceanic and Atmospheric Administration could participate in a role similar to that of the National Aeronautics and Space Administration with regard to the International Space Station.

SEC. 3. COORDINATED OCEANOGRAPHIC PROGRAM ADVISORY PANEL.

(a) IN GENERAL- Not later than 60 days after the date of enactment of this Act and subject to the availability of appropriations, the Secretary of Commerce shall contract with the National Academy of Sciences to establish the Coordinated Oceanography Program Advisory Panel (in this Act referred to as the ‘Panel'), comprised of experts in ocean studies, including individuals with academic experience in oceanography, marine biology, marine geology, ichthyology, and ocean related economics.

(b) CHAIRPERSON AND VICE CHAIRPERSON- The Panel shall elect a chairperson and a vice-chairperson.

(c) TERMINATION- The Panel shall cease to exist 30 days after submitting its final report and recommendations pursuant to section 4.

SEC. 4. REPORT AND RECOMMENDATIONS.

(a) IN GENERAL- No later than 18 months after its establishment the Panel shall report to the Committee on Resources of the House of Representatives and the Committee on Commerce, Science, and Transportation of the Senate on the feasibility and social value of a coordinated oceanography program. In preparing its report, the Panel shall examine existing oceanographic efforts and the level of coordination or cooperation between and among participating countries and institutions.

(b) INTERNATIONAL WORKSHOP- To assist in making its feasibility determination under subsection (a), the Panel shall convene an international workshop with participation from interested nations and a broad range of persons representing scientists, engineers, policy makers, regulators, industry, and other interested parties.

(c) FINAL REPORT- The Panel shall include in its final report--

(1) an identification of countries and organizations that would be likely to participate in a coordinated program;

(2) a description of those areas of study in which national or international oceanographic cooperation is currently being undertaken; and

(3) an identification of areas of study in which knowledge of the oceans is inadequate.

(d) IMPLEMENTATION- If the Panel determines that a coordinated oceanography program is feasible and has significant value towards advancing mankind's knowledge of the ocean, the Panel shall include in its final report recommendations for implementing such program, including recommendations regarding--

(1) the institutional arrangements, treaties, or laws necessary to implement a coordinated oceanography program;

(2) the methods and incentives needed to secure cooperation and commitments from participating nations to ensure that the benefit that each nation that is a party to any international agreement establishing a coordinated oceanography program receives is contingent upon meeting the nation's obligations (financial or otherwise) under such an agreement;

(3) the costs associated with establishing a coordinated program; and

(4) the types of undersea vehicles, ships, observing systems, or other equipment that would be necessary to operate a coordinated program.

SEC. 5. OBTAINING DATA.

Subject to National security restrictions, the Panel may obtain from any department or agency of the United States information necessary to enable it to carry out this Act. Upon request of the chairperson of the Panel, the head of any department or agency shall furnish that information at no cost to the Panel.

SEC. 6. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated for the purposes of carrying out this Act, and to be made available until such sums are expended, $1,500,000.

2002 Ocean Exploration and Research Initiative

NOAA Management Presentation
14 April 2000

Summaries of Sub-Initiatives:

2002 Ocean Exploration Initiative

Undersea Exploration of Polar Environments (0 FTE; [redacted])

Goal: Better definition of the abiotic and biotic resources of the polar seas and of the controlling physical and biogeochemical processes affecting those resources.

Background/Scope: The Arctic Ocean and the Southern Ocean, i.e., the polar seas, need to be explored to better define their resources, governing processes, and roles in global change. This includes the connecting oceans (e.g., Bering, Chukchi, Beaufort, etc.) and basins and other features. For example, the fishery resources of the Bering Sea are unmatchedBthe high productivity of the Bering Sea which leads to the large biomass of birds, mammals and fishes has long been an ecological enigma. The Bering Sea supports over 50 commercially important species and at least 50 species of marine mammals. It is unmatched in terms of commercial value of the fishery resources.

Another example of the biological importance of the polar areas relate to krill. Krill, small shrimp-like crustaceans, occur in the frigid Antarctic waters and are a keystone prey species. As a food supply, they support animals from whales, seabirds, fishes and squids, to seals and penguins. Krill have shown a general decline in reproductive success since 1984. In a NMFS-supported study, low temperatures and extensive winter sea-ice development over a two year period were found to favor krill, while warmer temperatures and limited sea-ice development favored salps. Salps not only compete with krill for food, but also form an ecological 'dead end' in that they provide comparatively little food value for Antarctic predators.

Since global change under scenarios of greenhouse warming are forecast by OAR to affect the polar regions, particularly the Arctic, more so than the mid-latitudes, there is concern over the biological susceptibility of temperature change and increased ultraviolet exposure of the base of the food web. This could lead to indirect effects such as decreases in the immune systems of innate ocean biota, to effects on the bioavailability of contaminants in these regions, to changes in the species that comprise the food web. On the abiotic side, it could also lead to unstable gas hydrates which would cause an increase in the input of methane into the atmosphereBgiving rise to a positive feedback loop in the global warming process. A molecule of methane is 20-times more effective as a greenhouse gas when compared with one molecule of carbon dioxide. And, extensive gas hydrate beds exist on the underwater shelves of the Arctic, as well as in terrestrial arctic permafrost.

The undersea hydrothermal vents that exist at the spreading ridges have been shown through NOAA VENTS Program to be regions of efflux of mass and heat; they have also be shown to be very diverse regions of totally new species of biota. This also applies the cold water seeps that exist in the undersea regions of subduction. Although specific areas (e.g., Juan de Fuca/Gorda Ridge system offshore of Oregon and Washington) have been studied, these are just snapshots of the totality of effects of these systems on a global basis. Such systems are quite extensive in the polar seas. Not only do they affect the global balance of mass and heat, they are also regions of instability that given rise to some of the largest tsunamis.

Objectives: As alluded to under the background, environmental facets of the polar seas are vast. Exploration in that environment would have to be focused and phased in a program that is timely, cost-effective, feasible, and of beneficial to society. Undersea research is expensive. It is particularly expensive in the polar oceans, and a program of exploration would have to be well chosen to maximize the benefits. The effort would have the following objectives:

$ **Discover** new biotic resources, especially those related to deep, cold water fisheries of commercial potential.
$ **Discover** abiotic resources, e.g., gas hydrates, and define the processes that lead to their formation, stability, and sustainability.
$ **Refine** the global implications of vents and seeps that are associated global ocean mass balances of

chemicals and heat.

$ **Discover** new extremophiles associated the polar environments, and conduct research on their biotechnical applications to, e.g., new pharmaceuticals.

$ **Discover** changes in the polar oceanic environment that are associated with potential global change.

Scientific and Technical Development: As with the exploration of the farther reaches of space, exploration will depend on the continued use and further development of AUVs and fixed seafloor observatories in the polar ice-covered seas. AUVs need to become more reliable, capable of doing a variety of tasks, and capable of larger range. Fixed, or multi-deployable, seafloor observatories also need to be developed and deployed to examine, *in situ*, new polar scientific discoveries. Larger numbers of ROVs will also be essential. They must have better sensor capability, and be suited for a variety of tasksBfrom the small ones that can explore smaller crevices to large ones that better equipped for larger payloads. Polar seas exploration will also continue to be dependent upon manned submersibles (e.g., especially of the type as the U.S. Navy=s nuclear-powered NR-1)--there is no mistaking the value of the human eye and brain to explore phenomena and resources of the undersea environment, including that of polar seas. Overall success will be dependent upon development of greater sensor capabilityBe.g., better and smaller electrical, acoustical, and optical sensors. The outcomes of the exploration of the polar seas in the new millennium will be scientific discoveries, never before imagined, that will benefit society and our environmental stewardship of planet Earth.

Outreach and Education: The outreach and education effort in the polar sea exploration is envisioned to utilize the capabilities of Sea Grant, partnerships with the National Geographic Society and the JASON Foundation, and collaboration with interagency efforts concerning the Arctic (e.g., Interagency Arctic Research Policy Committee and the Arctic Research Commission) and international bodies such as the International Arctic Science Committee (IASC) and the Arctic Environmental Protection Strategy (AEPS). Partnerships with similar bodies would also be established for the southern polar areas. Communication efforts will include the development of print media, web sites, radio and television programs which will inform the public about the Federal investment in polar exploration, the highlights of the investments, and benefits to the public.

Budget: In the harsh and remote areas of the polar seas, success scientific exploration will be dependent upon an adequate budgetBthere is nothing cheap about venturing into this environment. A minimum budget to ensure successes would be on the order of $10M per year.

2002	2003	2004	2005	2006
[redacted]				

2002 NOAA Initiative

Ocean Exploration and Research Initiative-- Deep Coral Communities, Reefs and Live Bottom (0 FTE, +$[redacted]): NOAA requests an increase of $[redacted] to explore and study ocean frontier areas, including deep coral communities, reefs and benthic live bottom areas.

Background: The most biodiverse and productive seafloor habitats are those dominated by larger invertebrates such as corals and sponges, because of the architectural complexity, shelter and microhabitats these animals add to the benthos. Coral reefs are the premier example of such a system but these are generally limited to shallow tropical and sub-tropical waters. In deeper water below the reach of divers (50 to 1000 m depths), at all latitudes, important benthic communities are densely populated by many forms of attached species. They cluster where appropriate substrate is available for attachment. Hard substrate inhabited by dense growth of sessile forms, including algae, corals, and sponges is often called "live bottom." Oil and gas companies are specifically prohibited from drilling into Alive bottom,@ as defined. Most of the nation's National Marine Sanctuaries intentionally bound "live bottom" areas.

Similar to shallow water coral reefs, deeper "live-bottom" areas attract large numbers of commercially important species and their preferred prey. They are, however, much more extensive and of more widespread economic importance than tropical coral reefs. In the South Atlantic Bight, for example, 70% of the offshore fish are concentrated on 10% of the continental shelf that is live bottom. Knowing this, states and local agencies have established artificial reef programs to facilitate recreational fishing activity. Many of these wrecks are offshore so as not to be hazards to navigation, thus, hard to reach and study. Rather than helping resources by encouraging development of new productivity and live bottom, these reefs may contribute to demise of fisheries by making it easier to hunt and capture fish.

As coastal systems become over-exploited, fishermen hunt deeper offshore fisheries resources. Areas of the outer shelf and upper slope that were once lightly fished are now being intensely exploited. There is growing evidence that such deeper water coral/sponge assemblages are being extensively damaged in both the North Atlantic and Pacific Oceans due to the destructive fishing practices such as trawling and dragging. These productive offshore systems are being destroyed before we have even had a chance to document their distribution and character, nor even understand the ecology of their major components, and interactions that are so important to their sustainability.

There is growing awareness that deep sea corals and sponges influence the distribution of a variety of other organisms and support diverse communities that may be pharmacological storehouses. Further, these animals are extremely slow growing so human caused disturbance and removals can have long lasting effects on these communities (e.g., a moderate size specimen of deep sea coral *Primnoa* collected off northern Georges Bank had an estimated age of 500 years). These communities are inadequately conserved, partly as a result of ignorance about their importance, that at least in some cases serve as essential habitat for juvenile fishes.

Proposed Actions: Research is needed to determine the distribution, species associations, growth and recruitment rates in live bottom areas, and effects of human caused disturbances on deep sea coral and sponge communities. We propose an approach similar to that adopted for coral reefs by the US Federal Coral Reef Task Force:

$ map targeted mid-depth live-bottom areas
$ conduct monitoring and assessment of the health of these communities
$ establish ecosystem research programs and long-term reference sites to identify and monitor threats to the health of these systems.
$ identify causes and rates of habitat destruction, and options for restoration.

Targeted areas will be frontier areas for which we lack required scientific understanding needed to manage related resources. They have special ecological, economic and management significance. Examples (not inclusive) include:

Georges Bank: decline of commercial species due to over fishing and disturbance of the sea bed by dredging and trawling; large areas of the bank now closed to fishing; monitor habitat recovery in a gravel substrate to determine recovery rates and species succession; assess role of recovering gravel habitat as refuge for juvenile cod and as spawning ground for herring; monitor the growth of observed scallop populations that have colonized the area since fishing halted in 1995.

West Florida Shelf: highly productive commercial and sport fishery, accounting for over 90% of the landings in the Gulf of Mexico for several economically important species; Gulf of Mexico Fishery Management Council closed 540 square nautical miles along the 40 fathom (73 m) isobath to all reef fishing year-round to protect spawning and feeding aggregations of reef fish (e.g., gag grouper); map, characterize (at approximately 200nmi^2/yr), and relate the geology of the seabed to the distribution and abundance of spawning adults, eggs and juveniles.

Shelf/slope along the U.S. West Coast: groundfish populations declining all along the U.S. West Coast; many of these species are associated with rugged, heterogeneous substrata, thus, difficult to assess using conventional survey techniques; west coast research programs developing systematic approach to habitat classification in deep water using in situ methodologies and remote geophysical mapping techniques; need to expand this habitat characterization effort to spatial scale relevant to animal distributions, and physical, biological and anthropological (e.g., fishing gear impacts) processes that influence them.

Central Gulf of Alaska: important rearing area and migratory corridor for juvenile and molting crabs, and rich stocks of groundfish; North Pacific Fisheries Management Council closed an 1500 km^2 area known as Marmot Flats near Kodiak, Alaska to bottom trawling; map, characterize (at approximately 400 nmi^2/yr), and relate the geology of the seabed to the distribution and abundance of crab and groundfish stocks.

Northwest Hawaiian Islands: coral reefs that extend below dive depth are heavily fished and covered with debris from Pacific fishing activities (e.g., long-lines and ghost nets); deep coral beds are targeted for precious coral trade; these beds are habitat for deep fisheries and foraging for endangered monk seal; map, assess, and study reef and coral community health; continue debris removal efforts begun in 2000.

Partnerships: Partnerships are critical to the success of this program. The model for these regional efforts will be the cooperative research program in marine habitat studies for the west coast region now being developed by the NOAA/NMFS laboratories of the Southwest and Northwest Fisheries Science Centers (La Jolla, Pacific Fisheries Environmental Lab, Santa Cruz/Tiburon, Newport, and Montlake). Their plan takes advantage of each laboratory's strengths (e.g., habitat classification, in situ technologies, molecular techniques, early life history studies, fishing gear development and operation). Funding and/or operational support from OAR/NURP, OAR/Sea Grant, NOS Sanctuary programs, and the Sustainable Seas Expeditions funded in part by NOS, will assist in ongoing projects relevant to these objectives.

Benefits: The cost of the failed groundfish stocks in the northeast U.S. has been easily in the billions of dollars. NOAA is still spending millions each year to buy back vessels. The Northeast Fisheries Center spent most of its dollars on stock assessment efforts using traditional fishing techniques. Management tools have been limited in their scope and effectiveness; they have not worked. The missing element in managing these stocks has been understanding of ecology. Trawls cannot effectively assess juvenile fish that hide under rocks and worse, kill them in the process of trying to find them. Marine Protected Areas are fast becoming recognized as the only realistic and effective management tool in many situations. They have saved declining fisheries in many areas of the world. The process of selecting and managing a protected area requires understanding of where and how the animals live-- the focus of ecology. NOAA will need this data to avoid litigation brought on by displaced fishermen.

Performance Measures:

	2002	2003	2004	2005	2006
PM: *By 2006, 10% fewer overcapitalized fisheries (economic and social aspects)*					
Milestone (Refugia): Evaluate effects of refugia on spawning stocks, fishing efforts, and fishing communities	describe two MPAs; east and west coast	Monitor MPAs and adjacent un-protected areas	continue monitoring and research to explain differences	continue monitorin g and research	publish results
PM: *By 2006, 60% of stocks have "essential fish habitat"*					
Milestone (Refine EFH): Identify EFH for specific life history stages of important species	Describe EFH for at least two (east and	Describe EFH for two more species	Determine fish/habitat associations by life stage	Target spawning and nursery	publish results

	west coast) over-fished species			grounds, determine critical features	

Budget Growth ($K):

Year	2002	2003	2004	2005	2006
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Activities by year:

Regional Expeditions:
2002 -- Northeast Pacific; work with state, NMFS and OAR partners to map and characterize rockfish habitat; combine in situ technologies with towed acoustic and optical mapping gear to do a synoptic comparison; target area to be determined by NMFS and best available bathymetric data; total cost for 30 day expedition, including system time, ship time, science support data management and outreach activities, approximately $2.5 million
outyears: expeditions move, similar activities

Collaborations:
Northwest Hawaiian Islands: deep dive support for NMFS/Honolulu to assess extent and impacts of lobster fishery on deep reefs; with NURC/Hawaii Undersea Research Lab (HURL) and Univ. of Hawaii to study deep coral beds (gold, pink, black); lease American Divers DeepWorkers and support ship for 10 days to extend depth range of NMFS studies; total $400,000
Gulf of Mexico-- with FL Keys National Marine Sanctuary, NCCOS/Beaufort Lab, NMFS/SEFC, and NURC/southeast and Gulf of Mexico (SEGM) region; map and ecological assessment of deep areas of new Dry Tortugas Reserve; $500,000
Gulf of Mexico-- with Flower Garden Banks NMS; piggy-back to provide assessment gear for mapping and characterization of Sanctuary below 50 meters, including Stetson Bank; $300,000
Gulf of Mexico-- with NMFS and NURC/SEGM; characterize new FL Middle Grounds/Big Bend MPA; $500,000
Southwest Atlantic-- with NMFS to continue characterization and restoration of Oculina Banks; $400,000
Northwest Atlantic-- with NMFS, Stellwagen Bank NMS, NURC/North Atlantic and Great Lakes (NAGL) to characterize new closed area on Stellwagen Bank; similar cruise to Georges Bank closed area; assess gear impacts and MPA effectiveness; $500,000
Outreach and Data management for all these activities = $300,000

Technology R&D:
2002 -- design portable laser-line scan system that can be used in towed mode or from submersible; $30,000
2003-- construct and test portable LLS; $1 million

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Submarine Canyons

Dinosaurs once roamed the edge of the continental shelf. Their beach front property is now under hundreds of meters of seawater along the edge of the shelf. Off the edge of the shelf, the seafloor steepens as the continental slope drops away to the deep sea. When the shelf was dry and the slope was the coast, rivers cut through the shelf edge and exited on the slope. All along the shelf edge and upper slopes of the world, submarine canyons mark these ancient river beds. In other areas of the world, faulting and folding of the earth surface create canyons and rifts. These are the deepest spots on earth. Canyons like the Hudson Canyon off New York, Hatteras Canyon off North Carolina and Monterey Canyon off California are examples of different types of canyons in terms of how they formed, by erosion or faulting. They are all the same, however, in that they support more life than surrounding slope. They have steep walls that fold and crack creating holes and nooks for small animals. They funnel and concentrate organic matter down their axes. Rocks and cliffs provide perches for attached species such as corals and sponges that add to the habitat value of canyons. Like coral reefs in the shallows, these deep canyons are where fish live and the diversity of deep sea life is greatest.

Line Offices:
- OAR, NOS

Objectives:
- map canyon walls and floor
- describe geology of canyon walls and floor
- determine the vertical distribution of canyon biota
- relate biota to geology and habitats
- determine the flux rate of materials down canyon axis
- correlate biota with depocenters and material fluxes

Strategies:
- Develop RFP in conjunction with NMFS
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry, biology and geology of target site, current resources that may target canyon habitats, and research to address priority objectives
- 3 year field program and 2 years of data analysis and publication costs
- seek partnerships with education programs to feature research in education and outreach media and activities, e.g., Hudson Canyon Exploration program with Columbia Univ.

Special Technologies:
- NOS and USGS- mapping data
- OAR/NURP- submersibles for ground-truth of towed mapping technologies, and fine scale geochemical samples and studies, biological and geological sampling of canyon walls and floor
- NMFS- fish data

Benefits:
- exploring the unknown, in particular species diversity of the deep ocean
- deep water habitats are critical to many commercially valuable fisheries, such as lobster and tilefish on northeast US coast
- more accurate models of carbon flux in the ocean
- outreach value of linking remote frontiers to the classroom

Budget:
[redacted]

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Deep Ocean Trenches

Line Offices:
- OAR, NOS, NESDIS

Objectives:
- Locate and map the walls and floor of the deepest locations on earth
- describe geology of trench walls and floor
- determine the vertical distribution of trench biota
- relate biota to geology and habitats

Strategies:
- Develop RFP in conjunction with NSF
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry, biology and geology of target site, current resources that may target trench habitats, level of seismic activity, proximity of target site to coastal communities and potential threats due to seismic activities, potential as source of valuable mineral resources, and research to address priority objectives
- Seek partnership with NSF for basic research as extension of LeXen
- 3 year field program and 2 years of data analysis and publication costs

Special Technologies:
- NESDIS satellite gravimetric data for regional mapping
- NOS and USGS- acoustical and optical mapping data
- OAR/NURP- submersibles for ground-truth of towed mapping technologies, and fine scale geochemical samples and studies, biological and geological sampling of trench walls and floor
- Japan- use of deep ROV to reach deepest ocean depths

Benefits:
- exploring the unknown, in particular species diversity of the deep ocean
- outreach value of reaching the deepest ocean, seen once in history
- Accurate prediction of seismic activity and early tsunami warning system will save lives and billions of dollars of coastal properties in some areas

Budget:
[redacted]

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Submarine Volcanoes

Line Offices:
OAR, NOS, NESDIS

Objectives:
- broad-scale regional mapping of target regions using satellite gravimetric data
- Determine flux of heat and chemicals into ocean and their contribution to global budgets for heat, carbon and greenhouse gases
- Describe life in extreme conditions
- Assess extremophiles for potential bioproducts
- Survey and assess mineral resources associated with volcanos
- Monitor volcanic activity and determine correlation with seismic activity that may threaten coastal communities through quakes and tsunamis

Strategies:
- Develop RFP in conjunction with NSF
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry and geology of target site, level of volcanic activity, proximity of target site to coastal communities and potential threats due to seismic activities, potential as source of valuable mineral resources, and research to address priority objectives
- Seek partnership with NSF for basic research as extension of LeXen
- 3 year field program and 2 years of data analysis and publication costs

Special Technologies:
- NESDIS satellite gravity data and imagery
- OAR/ERL- towed plume detection technologies
- OAR/NURP- submersibles for ground-truth of towed mapping technologies, and fine scale geochemical samples and studies
- Navy- Laser line scan for mapping and identification of seafloor mineral resources (e.g., nodules)

Benefits:
- Accurate models for global heat and carbon are needed to predict and potentially mitigate climate swings
- Estimated gold deposits on flanks of Loihi possibly worth tens to hundreds of millions of dollars
- Accurate prediction of seismic activity and early tsunami warning system will save lives and billions of dollars of coastal properties in some areas

Budget:
[redacted]

2002 Ocean Exploration Initiative

Ocean FrontiersB Hydrothermal Vents

Seafloor Microbial Biosphere Observatory Component

Summary

Establishment of a permanent deep ocean observatory will provide NOAA with a unique and effective means for conducting ocean exploration by making it possible to effectively study, for the first time, processes which have profound effects on the global ocean environment. Such an observatory will enable NOAA to conduct long-term, in situ research, including that focused on the newly discovered deep, hot microbial biosphere, it will function as a unique facility for development and testing of state-of-the-art ocean technologies, and it will provide NOAA with a powerful means to promote ocean-related public and educational outreach through the observatory=s real-time links to the Internet.

Beginning in 1984, and continuing to the present, NOAA conducts interdisciplinary research focused on understanding ocean environmental impacts of submarine volcanic eruptions and hydrothermal venting. This research, focused on understanding and assessing the impacts of the Earth=s largest and most active volcanic system on the global ocean, has made clear the need and benefits for establishing a permanent seafloor observatory. Such an observatory will, however, have applications and benefits far beyond the scope of the present research mission.

Background

The vast majority of the Earth=s volcanic eruptions occur in the deep ocean and NOAA scientists, in longstanding partnerships with scientists from other agencies and institutions, have discovered that this volcanic and hydrothermal activity affects the chemical, thermal, and biological state of the ocean. Based primarily on a program of long-term, in situ research along the volcanically and hydrothermally active seafloor spreading centers in the northeast Pacific, NOAA has been successful in showing how such effects are global in extent.

Very recently, in arguably the most important discoveries associates with this research to date, NOAA has discovered that episodic, deep volcanic eruptions provide access to, and critical information about, the newly discovered deep microbial biosphere that is now known to exist beneath all volcanically heated portions of the ocean floor. Unusual attributes of these microbes (which belong to a new kingdom called Archaea) include genetic affinities to humans and optimal living environments by high pressures and temperatures which frequently exceed. 100 degrees Centigrade. The biomass of these organisms is estimated to rival the biomass of living organisms on land and the species diversity of the biosphere is unknown but clearly vast. It is also clear that study of these organisms will provide not only insights into the source and evolution of life on Earth but, also, immense potentials for development of new pharmaceuticals and application to a wide variety of biotechnical applications. .

New Millenium Observatory (NeMO): NOAA=s Observatory For Deep Ocean Environmental Research And Technology Development

Current Status

Building on current efforts, this initiative will aggressively expand the research through establishment of a unique permanent deep ocean observatory dedicated to the study of the deep microbial biotope and access to its unique organisms. Initial steps to establish this observatory, known as NeMO (New Millennium Observatory) took place in FY 1999-2000. The observatory is located at the summit of an active submarine volcano off the coasts of Washington and Oregon. The most recent volcanic eruption of the volcano occurred in January, 1998. Samples from hydrothermal fluids from the observatory site are characterized by very high numbers of high-temperature Archaea, those of most intense interest for development of pharmaceutical and/or biotechnical applications.

What Is Needed

The observatory will conduct geological, physical, chemical, and biological oceanographic research which will begin the effort to understand how the biosphere is sustained by volcanic heat and chemicals Other observatory research objectives will include increasing the ability to culture biosphere microbes and assessment of the biosphere=s species diversity.

In order to accomplish these, as well as a wide variety of other scientific objectives, it will be necessary to conduct a vigorous parallel program of technology development. NOAA is already an acknowledged leader in technology development for physical and chemical sampling. What is essential now is development of new technologies that will enable scientists to acquire data and samples at critical times, particularly when episodic volcanic and hydrothermal events occur. And additional critical aspect of such technology development will be the ability to access samples and data remotely using real-time satellite (and eventually cable) systems.

An example of critical technology development will be the use of Autonomous Undersea Vehicals (AUVs). At NeMO, it is essential to understand how of episodic events, triggered by seismic activity, volcanic eruptions, and even tidal fluctuations, perturb the biosphere. AUVs, permanently stationed within the NeMO site will be needed to conduct a variety of sampling and survey tasks when remotely commanded through remote satellite links. The technology to support AUV development and this application has been established, but no one has yet deployed this technology in the deep sea. Use of AUVs in the above manner will achieve results heretofore obtainable only by manned submersibles, or at present, by ship-based remotely operated vehicles. AUVs are critical for achieving an interactive telepresence in the deep ocean.

NOAA=s Role

In order for NOAA to be able to effectively and credibly fulfill its ocean stewardship role, it must undertake a greatly enhanced role in ocean exploration. A permanent, in situ, seafloor observatory will make a major positive contribution to this objective by enabling NOAA to gain quantitative understanding of processes that are active throughout the global ocean.

NOAA, through its present volcanic and hydrothermal research activities, is already achieving major discoveries that have global physical, chemical, and biological oceanographic implications. For example, NOAA is the only civilian research agency in the world with real-time access to acoustic technology capable of detecting deep submarine volcanic activity, i.e., the U.S. Navy=s SOund Surveillance System (SOSUS). It was this capability that enabled NOAA scientists to detect, locate, and study an active deep volcanic eruption and its effects on the ocean in 1993. This was the first time the most frequently occurring kind of volcanic eruption on Earth had ever been studied while such an eruption was in progress. A combination of this capability and that of AUVs at the NeMO site will provide NOAA with unique and essential capabilities for understanding and accessing the deep biosphere.

Other NeMO Roles And Benefits

NOAA has, at present, collaborative research agreements with numerous U..S. and foreign agencies and universities. Establishment of NeMO, replete with a diverse suite of chemical, physical, and biological sensorsCincluding AUVsC will be of great interest to other NOAA constituents, including educational organizations such as the National Geographic Society, the JASON Foundation, and the Smithsonian Institution as well as potential new constituencies including private sector pharmaceutical and biotechnical companies. All research activities, particularly those conducted in real-time via satellite links, will be available to anyone via expanded, interactive NOAA websites.

NeMO will grow to include roles and impacts on other ocean-related research and marine resources issues. Those presently envisioned include evaluation of potential new fisheries resources (e.g., deep and mid-water species), ocean mining (precious metals from hydrothermal sulfides are beginning to be exploited), and ocean environmental assessments (e.g., fisheries habitat and pollution remediation).

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Seamounts

There is still the general impression that most of the deep sea is featureless and barren. Among the most impressive exceptions to this notion are seamounts, large submarine mountains rising to more than 1,000 m above the surrounding deep-sea floor. Over 25,000 seamounts taller than 1000 meters occur in all major ocean basins. Many are active volcanoes. Some poke above the water and are topped with productive coral reefs. Many are home for productive seafloor communities that grow on the rocky surfaces, and fish attracted to them. We have seen less than 0.1% of these deep sea oases. One of the more famous under water volcanoes is Lo'ihi, the youngest Hawaiian volcano and perhaps the next island in the chain (www.soest.hawaii.edu). Australia is now considering establishment of the deepest marine protected area in the Pacific to protect unique marine life forms on undersea mountains south of Tasmania. Research showed the seamounts contain a diversity of life forms, many of which are new to science and are highly vulnerable to trawling. Similarly productive seamounts lie off Alaska and northern California.

Line Offices:
OAR, NOS, NMFS, NESDIS

Objectives:
- Regional mapping at low resolution using satellite gravimetric data
- Accurate detailed acoustical and optical mapping of seamounts with target fisheries
- Describe benthic communities and fish population dynamics
- Determine impact of fishing activities on benthic communities
- Integration of remotely sensed and in situ data into GIS seamount survey database

Strategies:
- Develop RFP in conjunction with NMFS
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry and ecology of target site, value of target site as EFH, level of fishing activities and potential threat to habitat, and research to address priority objectives
- Marine Protected Areas will be targeted
- Seek partnership with NSF for basic research as extension of LeXen

Special Technologies:
- NOS and USGS- meter scale bathymetry
- NESDIS satellite gravity data and imagery
- Navy- Laser-line scan systems for detailed habitat maps
- NURP- submersibles for ecological studies of representative habitats and communities, and experimental studies of trawled and untrawled areas
- 3 year field program and 2 years of data analysis and publication costs

Benefits:
- Seamounts are target of offshore fisheries worth $100 million
- Habitat includes deep coral beds that are old and susceptible to permanent fishing gear damage
- Seamounts are unexplored and harbor new species, some with bioproduct potential

Budget:
[redacted]

2002 Ocean Exploration Initiative

Ocean Exploration and Research Initiative-- Water Masses and Ocean Fronts (0 FTE, +$[redacted]): NOAA requests an increase of $[redacted] to explore and study ocean frontier areas, including water masses (e.g., upwellings, eddies, convergences), ocean fronts (e.g., Gulf Stream wall) and boundary layers, and the living resources associated with them.

Background: The oceans cover 71% of the planet, a volume of over 330 million cubic miles, and 99% of the living space on earth, 97% of which lies below the reach of sunlight. Like air, the oceans are a dynamic, intertwined mosaic of masses, gyres and currents. Unlike air, they are inhabited by a variety of endemic ecosystems separated by ocean fronts. These fronts are not sharp walls, but transition areas with rich and varied ecotones, zones of gradation between ecosystems. Ocean pelagic (mid-water) life is often most diverse and abundant along these fronts because that is where food tends to be. A thermocline, for example, is a front between cold and warm water. Often, cold water holds more nutrients in solution and is denser than adjacent warm water, whereas the warm waters favor more life. The boundary between them, often associated with the particle maxima zone in the water column, tends to concentrate plankton that float on the dense water and feed on the available nutrients. Plankton, in turn, attract higher trophic levels.

Water masses and fronts are essential fish habitat. Exploited and protected species rely on these boundaries for food and shelter. Giant bluefin tuna roam the oceans of the world and, like transoceanic ships, normally follow major ocean currents. From what little is known about their life history, it is believed that they spawn along boundary current fronts and eddies. Upwellings fuel the most productive fisheries on earth, such as anchovies and herring. Many new and exotic life forms populate fronts, such as the elusive giant squid, 10 meter long colonies of siphonophores, undescribed species of deep sea fishes, mid-water octopi, and a variety of translucent jellyfish. These creatures are not easily captured in nets, or if caught, they are most often too mangled to identify.

Recent observations have described the larger scale dynamics of ocean ecosystems over decadal timescales. Regime shifts in ocean community characteristics may result from human activities such as selective fishing pressures or from shifts in global weather patterns and regional climate. Whales and other marine mammals depend on krill as their major food source. Krill concentrate round water mass fronts where their planktonic food exists. They compete for this food with other species such as jellyfish that are not favored prey for whales. Recent warming of Alaskan and Arctic waters has favored salp populations on traditional whale feeding grounds.

The health of ocean ecosystems may be best assessed through indicators that integrate across space and time scales. For example, the condition of large vertebrates and apex predators can serve as a benchmark for assessing overall ecological integrity and sustainability. These species concentrate along water mass boundaries.

Proposed Actions:

- Assess existing and historical information to target relatively fixed (perennial) water mass and frontal features that represent the biome characteristics of major pelagic marine ecosystems
- Based on assessment, establish a global network of open ocean reference stations at each reference site, define the biological signature or fingerprint of that ecosystem
- Coordinate with all field expeditions to piggy-back protected species observations and mid-water studies, for example, in NE Pacific (Gulf of Alaska upwelling), Gulf of Mexico (Loop Current eddies), and NW Atlantic (Georges Bank gyre)
- Conduct dedicated cruises to target locations, e.g., Southern California upwelling and Cape Hatteras/Gulf Stream convergence zone, and reference station sites
- Utilize traditional biological sampling methods to link to historical information
- Employ underwater observation technologies, such as submersibles and remote sensing technologies, to characterize and study ecotones and adjacent ecosystems
- Deploy remote moored systems at selected reference locations to sample oceanographic and biotic conditions.

Benefits:

The most popular sport fisheries, worth billions each year to the U.S. economy, are the pelagic giants. One bluefin tuna can be worth up to $30,000. These fisheries are in trouble. Fishing on marine mammals may be stopped, but several species continue to decline or are not coming back. Understanding and protecting the mid-water habitats where they live, is as important as the fight to save coral reefs.

Partners:

Climate and Eastern Ocean Systems (CEOS) Program
Pacific Fisheries Environmental Lab
Gulf of Farallons NMS
CalCOFI
NCCOS Lab, Beaufort, NC

Budget Growth ($K):

Year	**2002**	**2003**	**2004**	**2005**	**2006**
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Potential Activities by year:

Regional Expeditions:
2002, 2004, 2006 -- Northeast Pacific; California Current System-- sampling and monitoring upwelling along coast particularly salmon grounds/routes and Gulf of Farallons NMS (existing data from Steger, 1998); Gulf of Alaska down-welling region; ice edge and polynas in Bering Sea
2003, 2005 – Cape Hatteras, Gulf Stream Convergence Zone; bluefin tuna grounds, Sargassum habitat studies, including use by sea turtles, carbon depocenter for mid-Atlantic Bight, most abundant seabird populations in North Atlantic, marine mammal migration route and feeding grounds

Collaborations:
Northwest Hawaiian Islands: establish reference site in Humpback Sanctuary
Gulf of Mexico-- establish reference station in FL Keys National Marine Sanctuary, Dry Torutgas Reserve
Gulf of Mexico-- establish reference station in with Flower Garden Banks NMS
Cape Hatteras-- establish reference station in off Cape Hatteras in vicinity of the Point
Northwest Atlantic-- establish reference station in Stellwagen Bank NMS

Technology R&D:
2002 – AUVs are critical, equipped with optical sensors for basin-wide surveys of plankton and particle abundance and oceanographic parameters

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers-- Hydrocarbon Seeps and Hydrate Beds

The ocean floor is an active place where water, chemicals, and life is always entering and exiting. In many places, doors open to the earth's molten interior, letting out streams of magna, chemicals or boiling water. In many more places on the ocean floor, cold seeps ooze, bubble and vent a variety of materials such as methane gas, ice crystals imbued with natural gas, and crude oil. These conditions are far from toxic to the local inhabitats. On the contrary, they support some of the most productive ecosystems on the planet. These seafloor forests were discovered less than 30 years ago. We have been to a handful of the vents that occur along the entire length of the mid-ocean ridges that split the major oceans. Green Canyon in the Gulf of Mexico is the best known hydrocarbon seep. Noone has yet explored below 1000 meters in Green Canyon, where oil companies are now setting up new drill sites. New species discovered at these hot vents and cold seeps have produced new potential medicines now being tested for treatment of arthritis, cancer and AIDS.

Line Offices:
OAR/ SG, NURP, ERL, NESDIS

Objectives:
- Determine the rate of flux of hydrocarbon fluids and gases from the seafloor
- Understand ecology of chemosynthetic communities
- Monitor the stability of hydrate beds
- Discovery of new bioproducts from seep species

Strategies:
- Utilize Joint Oceanographic Institutions drilling ship, to be deployed in the northern Gulf of Mexico in 2002, as platform for in situ studies of nearby seep communities
- Provide ROV and AUV for 60 day cruise and surveys of benthic communities in the vicinity of the drill ship
- Extend surveys and experimental studies using manned submersible for 30 day cruise
- partner with NRL and DOE to support hydrate research

Special Technologies:
- JOI drilling ship
- NURC/NAGL’s ROV Kraken
- Subsea’s Theseus AUV equipped with NRL methane sensor (“peeper”)

Benefits:
- Hydrates may be largest sink of carbon on the planet, twice the amount in all other fossil fuels
- Methane hydrate stability is a threat to oil and gas structures now moving to deeper OCS
- Massive meltdowns of methane hydrates implicated in past climate regime shifts
- Chemosynthetic communities inhabited by new species to exploit for biotechnical and medical applications

Budget:
[redacted]

2002 Ocean Exploration Initiative

Theme:
Living and Working in the Sea

Line Offices:
- OAR/National Undersea Research Program
- OAR/International Affairs

Sub-theme/Location:
International Underwater Station

Objectives:
- Develop a new underwater habitat capable of working anyplace around the globe
- Assess the condition of sensitive coastal ecosystems to increasing coastal development
- Support research to restore degraded coastal habitats

Strategies:
Convene international panel of experts to:
- Conduct review of habitats
- assess the need for saturation science versus alternative in situ approaches
- define the most desirable features of the next generation of undersea laboratories
- propose appropriate consortium of countries to participate in developing and funding the new International Underwater Station (IUS), similar to the consortium developing the International Space Station (ISS)

Special Technologies:
- US- operating only underwater lab in world, Aquarius
- Japan- plans complete for habitat similar to Aquarius
- France- developed last truly mobile habitat, SAGA
- Oil and Gas industry- leading world in deep saturation technologies
- Navy- wealth of experience and technology in saturation operations
- NASA- increasing interest in long-term human deployments in space (ISS, Mars)

Benefits:
Science that cannot be done any other way, for example:
- Experimental studies of deep coral reefs and other complex ecosystems inaccessible to scuba divers or surface sampling
- Real-time communications allowing internet access to experiments and data streams
- Ecological studies at individual organism level

Outreach and education for the public- Observation and documentation of rare behavioral and biological phenomena

Budget:
[redacted]
2004-6 – dependent on findings of panel

LIVING AND WORKING IN THE SEA

What needs to be done?

[based on Miller, S. 1998. The Aquarius 2000 Program: Science, Education, and Public Outreach. MTS, http://www.uncwil.edu/nurc/aquarius/mtsci1.htm]

AQUARIUS I -- Why live underwater?

Human presence in space and beneath the sea first captured the attention and imagination of the nation in the 1960s. Trips to the moon helped provide global perspective about the smallness and fragility of our planet. The voyages of Jacques Cousteau and his images of our oceans helped demonstrate that the vastness of the oceans was not protection against pollution or misuse. During the early days of space exploration there were also programs developed to explore the oceans. Questions about whether or not people could live and work in space, or underwater, for extended periods of time were major research efforts. Exploration of space and travel to the moon developed into a major national objective. At the same time, underwater habitats were built and tested, but most programs were short-lived.

Funding for ocean exploration and underwater living was always a problem, programs were not designed with compelling science objectives, and in some cases injuries or fatalities shut things down. Despite these obstacles, one such program still survives. Indeed, as we move to the next century, one program is poised to do what has never previously been achieved -- earning credibility among scientists while at the same time attracting public interest and support. Perhaps surprisingly, Aquarius is the world's only saturation diving laboratory in our oceans today, despite its legacy that dates to the early days of exploration in the 1960s.

Aquarius is operated and administered by the National Oceanic and Atmospheric Administration's (NOAA) National Undersea Research Program at the University of North Carolina at Wilmington. Nearly 60 habitat programs have come and gone in the last 35 years, and together with Hydrolab, the predecessor to Aquarius, the two programs reflect the longest running and most successful underwater laboratory programs in the history of underwater living. NOAA has successfully administered the programs for over 20 years. Approximately 180 Hydrolab missions were conducted in the Bahamas (100 missions in the early to mid 1970s) and St. Croix, USVI (80 missions from 1977 to 1985), and over 40 missions have already been completed using Aquarius, first in St. Croix, USVI (13 missions), and currently in the Florida Keys National Marine Sanctuary (28 missions as of July 1999, with five more scheduled between August and November).

There are several lessons learned during the many years of program research in underwater living that provide the foundation upon which future of habitat operations are built. The hazards of underwater living are well known and minimally restrict scientists who conduct underwater research. People can live and work comfortably in underwater laboratories for missions of two weeks or more, without threat to their health or safety. The question of safe operations is paramount throughout all Aquarius activities. A simple risk analysis demonstrates that the chance of a catastrophic accident occurring during Aquarius missions is quite small, as it should be since scientists should not have to risk their lives to study coral reefs. The combined success rate for Hydrolab and Aquarius, where success is defined as not having a catastrophic accidental surfacing or injury (producing a fatality), is 100 percent.

One accidental surfacing occurred during a Hydrolab mission and the aquanauts were quickly recovered and returned to pressure without residual affects. This one surfacing event, with over 220 missions conducted in the two programs and over 900 aquanaut participants, results in a mission success rate (defined as no accidental surfacings) per mission or per participant of 99.54 and 99.78 percent, respectively. Considering the variable levels of dive skills found in the science community, the success rates reflect the high quality of pre-mission training conducted by staff, and the inherent safety of saturation operations.

Programs are always required to justify their existence in terms of money spent and products produced. The return on the Aquarius investment is unambiguous. Information produced by Aquarius addresses specific national and regional needs defined by NOAA, and the results of Aquarius-supported science are of immediate value. For example, a recent Aquarius mission documented changes to deep coral reef environments to depths of 90 feet, but discovered that the deepest reefs at the work site (105 to 115 feet deep) were in good condition. This contrasts with observations in shallower waters where coral reefs are generally in serious decline. Additional science achievements of the program include:

- discoveries related to the damaging effects of ultraviolet light on coral reefs

- geological studies that use fossil reefs to better understand the significance of present-day changes to coral reefs
- research that is rewriting the book on how corals feed
- water quality studies that evaluate sources of pollution
- long-term studies of reefs to help distinguish changes caused by natural system variability or humans (due to pollution and overharvesting).

Related to funding and other indirect types of program support, Aquarius represents a unique partnership among government, industry, academia, and a nonprofit organization. The University of North Carolina at Wilmington operates and administers the program. NOAA owns and funds Aquarius. Harbor Branch Oceanographic Institution assisted during refurbishment with engineering support and in-kind services. NOAA's National Data Buoy Center provided the 10 meter discus buoy that was converted by the partners to support Aquarius 2000 operations. The partnership allowed the program to refurbish the habitat in 1997 and implement more efficient saturation operations that include:

- Nearly unlimited bottom time to conduct experiments and make observations in a cost effective manner
- Sophisticated computer and electronic capability for in situ studies
- Unique access to the ocean without restrictions typical of surface-based operations.

Each of these capabilities contribute to an overall program that facilitates research that could not be accomplished using conventional technology. For example, 10 day Aquarius missions would take more than 60 days if conducted using surface-based technology. Few scientists have the time to spend months in the field, when a 10 day Aquarius mission can be used to accomplish the same goals. This assumes that the work could even be conducted from the surface, which many times is not the case because Aquarius provides unique laboratory capabilities (not available using boats). Significantly, the conversion data from Aquarius to surface-based diving assumes an unreasonably rigorous dive schedule and no weather delays.

While time can often constrain the ability to complete field work, cost is also an important consideration. It is expensive to implement a major surface-based operation. Sixty days in the field using four divers can easily approach $60,000 ($700/day for a boat and dive support, $120 day per diem for four people, and $120/day hotel expenses for two rooms). In practice, it will take more time and cost more than the above estimate to convert Aquarius diving to a surface-based project. At the depths worked from Aquarius, surface-based diving is significantly more rigorous than saturation diving. Four divers cannot maintain a rigorous schedule for more than a couple of weeks without significant time off. Over a period of even one week, multiple dives to the depth limits defined by NOAA, even using nitrox, produce fatigue and greater risk of decompression sickness. Therefore, the above costs reflect a conservative assessment.

By comparison, the operating costs of the Aquarius 2000 program are estimated at about $10,000 per day (total cost of program divided by the number of saturation days), a higher day rate than surface-based diving. However, if expenses are compared on a per project basis, a 10 day saturation mission costs $40,000 more than a 60 day surface-based program - assuming the work could even be conducted from the surface, which in many cases is not possible. Finally, Aquarius 2000 provides significant media access and public outreach capabilities that are not possible in conventional dive operations, and while the program's science mission is paramount these other activities are valuable, too.

Bottom time is not the only advantage afforded aquanauts. The new computer network in Aquarius, linked to the watch desk seven miles away on shore, with high speed links to the internet, provides scientists with email and communication to anywhere in the world. Video conferencing is possible with outside groups. Digital images of new or unknown species can be sent to laboratories for identifications when needed. Data can be sent to laboratories in real-time from experiments in Aquarius or out on the reef, along with routine oceanographic monitoring. The first science mission in 1999 included the first "virtual" aquanaut, where the principal investigator did not saturate but was able to receive data, trouble shoot electronic equipment, and interact with Aquarius aquanauts from mission control on shore. While extensive development of the Aquarius homepage (www.uncwil.edu/nurc/aquarius) provides the public with a window into Aquarius, the same technology provides scientists with access to research support during missions that could not previously be imagined.

In summary, the Aquarius program is the result of over 35 years of technological progress directed to better understand our oceans. As the world's only seafloor laboratory for marine science, Aquarius addresses critical issues related to understanding the health of ocean environments and resources. Aquarius 2000 provides unparalleled access to the ocean for scientists, managers, teachers, students, and the public.

AQUARIUS II -- EXPLORING NEW REEFS

Aquarius I has another decade (or more) of useful science, education, and outreach left and is welcome and needed in the Florida Keys, where the problems of coastal development continue and Aquarius science is helping to save the reefs. With new resources, a new and improved habitat should fulfill the vision that originally led to funding of Aquarius and the National Undersea Research Program. In 1980, the NRC Ocean Sciences Board prepared a report called the "OceanLab Concept Review." Their recommendations included two lines of development for the OceanLab Program: 1) establishment of NURP to utilize existing assets to support undersea science and 2) research and development of the best, relevant technologies. NURP has been the most productive undersea science program, in terms of putting the nation's science community underwater for the longest time using a suite of technologies, including divers, submersibles and habitats. Although under-funded by international standards, it continues to serve this mission. However, there has been comparatively little progress on line 2, development of new technologies. Aquarius was built in 1986, the last saturation habitat to be built in the nation. Since then, there have been significant technological advances in materials science, computers and telecommunications.

Aquarius I is forty three feet long and weighs 80 tons in air. The base plate is larger and weighs 120 tons. Aquarius and its baseplate are difficult and expensive to move-- a constraint that cannot be eliminated within current operational capabilities. Directions to move in future habitats should include modular construction of some systems (e.g., baseplate and other support systems), or ultimately a self-contained system that includes propulsion to relocate among sites (or to avoid damage from storms), to different depths, and that also includes internal power and atmospheric control.

Evolutionary Aquarius II ($20 million):

There are at least two directions to go for the next generation of Aquarius: the first would be a slower evolutionary process and the second a revolutionary process costing much more. The first option results in a more mobile system then Aquarius I, but one that is still limited and should be deployed for multiple years to be operationally and cost-effective.

Immediate improvements that are envisioned as part of this Aquarius II concept include: 1) new energy sources to improve the autonomy of operations and reduce reliance on combustion engines for power; 2) modular plumbing and fittings to facilitate maintenance and removal to shore when the habitat is inactive, thus, reducing corrosion and fouling problems; and 3) optical fibers and novel umbilical connections to enhance data communications, and reduce the size and failure rate of the umbilical. These improvements will reduce reliance on surface-based systems, improve cost efficiencies and maintain the highest levels of safety.

Revolutionary Aquarius II ($50 million):

The ultimate underwater laboratory for mobility and technical capabilities would be a submarine/habitat with saturation and diver lock-out capabilities to depths that encompass a majority of the U.S. continental shelf. Saturation diving would be integral to operations, but a full suite of undersea technology would be employed, including AUVs, ROVs, linkage to networks of seafloor observatories, and 1 atmosphere diver operations. Costs for such a system would be NASA or Navy submarine-scale and probably exceed $50 million.

Education and Outreach Opportunities

In addition to science achievements, Aquarius also serves as a presentation platform to capture the attention and imagination of the public (e.g., www.uncwil.edu/nurc/aquarius), so scientists and managers can explain their work and highlight critical environmental science issues related to the condition of our oceans. Dedicated missions and Web materials feature coordinated media coverage and development of educational programs that target secondary school students and teachers. World-class scientists who participate with the program also contribute time and expertise to get the message out about what they do, and why it's important.

Aquarius II may be approached as an international program like the International Space Station (ISS). Relocation to remote sites for periods of 2 years will encourage partners from other countries. Several countries are developing man-in-the-sea technologies such as Japan and France.

Development of Technology and Expertise

Technology developments are discussed above. NASA is now funding a partnership with NOAA called CLOUT, Collaborating and Leveraging OuterSpace and Undersea Technologies. The purpose is to promote technology transfer between ocean and space scientists and engineers. Aquarius II can benefit from many of NASA's capabilities.

Data and Information Management

Aquarius I and II provide real-time, all-the-time data streams, including video and oceanographic data. Data products are currently being developed to use the internet in innovative ways as part of educational curricula.

Budget-- 2002-2006

Concept I-- Evolutionary AQII:

- 2002-3 -- $25 million for construction of new Aquarius laboratory
- 2003-4 -- $5 million for buoy and umbilical and planning for deployment
- 2005 -- $3.0 million in year three for deployment at first site
- 2006 and beyond -- $2.5 million per year afterwards for operations, including surface-based, wider area dive program
- Total for 5 years = $33.5 million

Concept II-- Revolutionary AQII:

2002-3-- $50 million for construction of new Aquarius laboratory, submarine with saturation and lock-out capabilities
2004 and beyond -- $2.5 million per year afterwards for operations, including surface-based, wider area dive program
Total for 5 years = $57.5 million

Exploring New Resources from the Sea

Marine Natural Products and Gas Hydrates

What Needs to Be Done: One of the primary goals of ocean exploration is to discover and make use of new resources from the sea. This initiative describes two resources, **marine natural products and gas hydrates**, which together could generate incredible new value from the sea **if** research and technology development to explore these resources is supported.

Section I - Marine Biotechnology - Marine Natural Products and Processes

The biotechnology revolution has impacted diverse fields of science and many sectors of the economy. Sales of products developed through biotechnology were up 17 percent in 1998 to $13 billionBa figure with the potential to reach $24 billion in 2005. Remarkably, these developments have been largely based upon the molecular genetic characteristics of terrestrial organisms, even though more than 80 percent of all the Earth=s phyla are found only in the sea. Studies that extend biotechnology to the marine environment are few despite numerous, compelling incentives. Marine plants, animals and microorganisms exhibit processes and produce substances unknown in terrestrial organisms. The potential economic and public health benefits of pharmaceuticals, pesticides, hormones, enzymes, and polymers derived from marine organisms are high, yet unexploited. There is a track record for the study of natural products, both from marine and terrestrial sources. For instance the structure of AZT, an antiviral drug used to treat AIDS, was derived from a nucleoside discovered in a marine sponge. Another terrestrial example is the natural product, Taxol, used to treat breast cancer, which was derived from the bark of a yew tree and works uniquely to bind to tubulin causing polymerization and inhibiting cell division. These are but two examples of the potential of natural products to solve still unsolved problems such as anti-biotic resistance, cancer and AIDS treatments as well as addressing industrial efficiency with unique enzymes. If the United States is to realize the benefits to be derived from marine organisms as sources of new products and processes, and develop viable strategies to conserve them, an increased investment in marine biotechnology is essential.

Recent Trends

! Recent advances in molecular and cellular biology and bioengineering have greatly expanded the ability to find, manipulate and utilize marine organisms sustainably.

! Presently, only about 1.2 percent of federal investment in biotechnology research is focused on marine opportunities and problems. In 1992, the U.S. invested $40 million in marine biotechnology. In contrast, Japan spent $519 million, recognizing marine biotechnology as the Agreatest remaining technology and industrial frontier.@

! Despite limited public funding, investment in marine biotechnology has led to at least 190 U.S. patents and over 700 publications. Research in marine biotechnology has yielded at least 8 marine products (targeting cancer, inflammation and AIDS) to reach the stage of preclinical trials. The market value of just five of these has been estimated to be $2 billion.

Research Objective: Marine Biotechnology - Marine Natural Products and Processes Discovery and Development

The purpose of investment in this area is to develop and utilize the tools of molecular and cellular biology (biotechnology), chemistry, biology, pharmacology and ecology, to promote the discovery, understanding and sustainable development of novel natural products and processes (including a focus on symbiosis) found in marine organisms. This area will include investigating and evaluating unique ocean environments such as deep sea vents, coral reefs and arctic waters for novel organisms, products and processes including unique enzymes. It will also include bioengineering (including pharmacogenomics) cell and tissue culture, fermentation, and chemical synthesis (including combinatorial synthesis) to assure production of sufficient material to proceed with novel product development. These studies will provide us with novel products for use as pharmaceuticals and in industry, and will target developing production capabilities for natural products so as to provide industry with sufficient quantities for future investment and development. It is expected that this initiative will advance U.S. economic growth, enhance international competitiveness, and promote sustainable development. In support of Administration and DOC programs to achieve these goals, NOAA proposes to develop marine biotechnology to broaden the choices available to the pharmaceutical and agrochemical industries.

Marine Biotechnology -Marine Genomics

There is a great need for enhanced efforts in the development of the knowledge base of marine genomics to augment the area of scientific research cited in this initiative, marine natural products discovery and development. To take advantage of the power of genomics there is a critical need to sequence the genomes of key groups of organisms in the ocean, similar to what has been done in the terrestrial environment. These include viruses, archaea, free-living and symbiotic bacteria, protozoans, phytoplankton, and microzooplankton . Once the basic genomes are determined, the next challenge will be to relate the genome sequences to organism function in ecosystems. Though this represents a vast undertaking, the analysis of the genomic diversity and organization of marine organisms will make it possible to address fundamental questions necessary to harness the productivity of marine organisms on an unprecedented scale. It is suggested that these studies be undertaken following a workshop with the scientific community (federal, academic and industry) to determine what has been accomplished to date and what are the priority species to sequence in the marine environment under this investment portfolio.

Outreach and Education: The outreach and education effort in marine biotechnology is envisioned to encompass the following:

Education - Efforts on education will include the preparation of lessons and lesson plans, fit into state standards for education, utilizing marine biotechnology to teach core science topics. It will include teacher training in marine biotechnology, perhaps through established programs such as COAST. Other efforts in this area may focus on AJason@ like linkages between scientists and classrooms which will allow students to study Aside by side@ with scientists exploring unique marine environments such as deep sea vents, coral reefs and arctic ice caps.
Extension - Efforts in outreach will include the use of Aquariums nation wide to develop exhibits highlighting marine biotechnology and its applications to solving public health issues and environmental issues. Efforts in this area will also include establishing two national marine biotechnology outreach positions, on both the east and west coasts to serve as a link between the scientific community, industry, and the public. Efforts will be made to enhance the presentation of scientific results at industry biotechnology meetings.
Communication - Communication efforts will include the development of print media, web sites, radio and television programs which will inform the public about the Federal investment in marine biotechnology and highlight results of those investments, address issues of concern to the public, and provide background information to generate an understanding among the public for the potential of marine biotechnology. The communication efforts will also involve publishing research results both individually and in summary volumes to document the results of this investment.

Strategies/Milestones

- Develop the technology and the science needed to recover, isolate, and culture novel organisms from unique environments such as deep sea vent systems.
- Discover and identify unique bioactive compounds with commercial potential from associated with marine organisms.
- Sequence the genomes of important marine microorganisms identified in the studies above
- Develop biotechnology (molecular and cellular biology) necessary for constructing novel products in the laboratory, thus protecting the natural resource. Design management plans to guide any harvesting that may be necessary until laboratory-based production is developed.
- Education and outreach through: web-based interactive expeditions; web-based and more traditional courses introducing marine biotechnology to the public; outreach exhibits at museums, aquaria, and visitor centers at NOAA facilities.

Benefits to the Nation

The potential of marine biotechnology to benefit the health of our citizens and the national economy is unlimited. According to a recent report by the NSTC, A Modest investments now in several rapidly developing areas of biotechnology research will lead to major economic and societal benefits ...@. Marine natural products, many of which have yet to be discovered, are the key to the development of new types of drugs and products which will allow us to address public health and environmental issues in the next century. For instance, just five drugs developed over the past few years by Sea Grant, with a relatively small investment of funds, have a market potential of almost $2B annually and address human diseases such as cancer and AIDS, inflammation, new biodegradable agricultural fertilizers, natural antifreeze, and industrial surfactants. One marine product alone, the anti-inflammatory agent *Pseudoterosin*, derived from the sea whips (soft corals) found in Florida and elsewhere has yielded royalties in excess of $1.2 million, and has projected sales of up to $100 million.

Human kind must adhere to boundaries for harvesting living resources from the sea in order to ensure a resources for future generations. Nonetheless, a large percentage of the nation depends on the sea=s living resources for its economic viability. Therefore, we must actively and aggressively seek alternate and additional value from the nation=s living marine resources in the form of **new products**, discovered in the sea and then produced through biotechnology or generated through aquaculture or cell culture. NOAA recognizes that as we enter the 21st century, we are moving into an exciting period of opportunity for sustainable development of marine resources. This initiative will focus the talents of the nation=s federal and academic research community to develop a suite of new products that will provide **economic value** and benefit the health of US citizens while maintaining the integrity of the marine environment.

Budget

FY02	FY03	FY04	FY05	FY06
[redacted]				

Funds to be allocated competitively to academic and NOAA researchers and academic outreach projects. Funds will include necessary shiptime support. It is assumed that natural product discovery and development will be accomplished in parallel to the marine genomics portfolio.

Section II. Gas Hydrates - Geochemistry, ecology and stability of seafloor gas hydrate Beds

Background:
Gas hydrate reserves found along ocean margins are estimated to exceed present known petroleum reserves by about a factor of three. Off the southeastern United States, a small area (only 3,000 square kilometers) beneath a ridge formed by rapidly-deposited sediments appears to contain a volume of methane in hydrate that is equivalent to approximately 30 times the U.S. annual consumption of gas (Dillon WP 1995. Distribution and Controls on Gas Hydrate in the Ocean Floor Environment, Abstract for presentation at AAAS meeting.) In response, Japan, Korea, Norway, India and Canada are actively investigating the acquisition of methane from hydrates as an energy source. Access to methane in hydrates has the potential to restructure the global economy. Equally important, hydrates are known to substantially influence ocean carbon cycling, global warming, and coastal sediment stability. Methane hydrates are a significant, emerging research issue with national economic significance.

Undersea research on gas hydrates is conducted by several regional NURP Centers, including recent projects in the Gulf of Mexico and off Oregon. Gas hydrates are common in polar regions and the deep sea, with the world=s largest concentration is thought to occur in the Arctic. Although subsea hydrates are often buried beneath sediments, recent discoveries include exposed beds located on the continental shelf and slope off many areas of the country. Using NURP technologies such as remotely operated vehicles and manned submersibles, scientists directly study hydrate chemistry and physics, and associated biological communities. Pressurized cores and insulated sample containers allow collection of hydrates and stable transport back to surface laboratories. Submersibles can accurately place monitoring equipment on or near the beds in order to assess the impacts of near-bottom temperature changes on hydrate dissolution - a potential source of greenhouse gas emissions now thought to be responsible for causing major climate swings in the geologic record (Anon 3/22/1997. Could gas blast have warmed globe? Science News; Dickens, G. R., Paull, C. K., and Wallace, P., 1997, Direct measurement of In situ methane quantities in a large gas-hydrate reservoir, Nature, v. 385, p. 426-428).

Objectives: NOAA is now a partner in the Methane Hydrate Act (HR 1753). The Act cites the following objectives:

! conduct basic and applied research to identify, explore, assess, and develop gas hydrate as a source of energy;
! assist in developing technologies required for efficient and environmentally sound development of gas hydrate resources;
! undertake research programs to provide safe means of transport and storage of gas produced from gas hydrates;
! promote education and training in gas hydrate resource research and resource development;
! conduct basic and applied research to assess and mitigate the environmental impacts of hydrate degassing (including both natural degassing and degassing associated with commercial development); and
! develop technologies to reduce the risks of drilling through gas hydrates.

The initiative proposed here requires undersea technologies and capabilities located within NURP to accomplish these objectives. As required by the Act, approved projects will be selected through NURP's established peer review process.

Collaborations:

NURP will work with other elements of NOAA, including the Environmental Research Laboratories and the Arctic Initiative in OAR. Co-funding will be sought through the latter and through the Department of Energy, lead agency on HR1753.

Budget ($K):

Year	2002	2003	2004	2005	2006
	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The first three years involve field operations and the last two focus on data analysis and publications.

Sound 1

Sound 2

Sound 3

<u>Ocean Exploration Initiative</u>
<u>National Ocean Service</u>

Reducing the knowledge gap of the undersea by 50% over the next 10 years

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<u>Exploring and Discovering Submerged Heritage Resources</u>

Introduction
The maritime historical record of the United States is largely underwater and awaiting discovery and documentation. A brief but invaluable inventory of that record has been preserved by public and private museums and educational institutions,[1] though this inventory pales in comparison with the estimated 50,000 shipwrecks in US waters[2]. Recent successful expeditions to locate and explore the RMS Titanic, the German battleship Bismark, and other sites have demonstrated the continuing development of remarkable deep sea technology, and that public interest in these subjects is very high.

As undersea exploration technology has developed, a recovery range has similarly evolved to the point where virtually anything sunk or lost at sea can now be found and explored, regardless of depth. In circumstances involving great opportunities for wealth, private investors have positioned themselves to exploit shipwrecks for the valuables contained within, rather than the significant history that abounds at these sites. After a commercial location and excavation of a shipwreck comes announcements of great wealth for the participants and chagrin for having failed to protect the historical integrity of the site. Our maritime heritage can only be protected by knowing the extent of these resources at the pre-exploitation stage. Private investors seek vessels of great wealth, rather than vessels of significant maritime history. Only a public effort can support the collective

The US territorial waters and EEZ contain tens of thousands of shipwrecks. Various government agencies, museums, scholars, and private entities have valuable information on many of these vessels. The public has an interest in their national history. A national Shipwreck Survey and Inventory will locate, quantify, and characterize the submerged maritime heritage of our Nation and beyond.

Objective: *To learn the location of US shipwrecks as well as we know the moon=s craters.*

This initiative pushes the development and application of deep ocean technology to survey and map the location and characteristics of shipwrecks in US waters and beyond. The Shipwreck Survey and Inventory will produce a national data base that locates, describes, and possibly identifies sunken vessels. From this data base, managers will know what resources exist, determine necessary protections, and determine the appropriateness of commercial opportunities for exploitation and recovery.

Scope of Work:
Consolidate existing data bases regarding known shipwreck locations or suspected losses. Navy, NOAA, USGS, USCG, National Archives, Library of Congress, States, Universities, pipeline and telecommunications survey companies, and others have accumulated significant data bases on shipwrecks. These need to be consolidated and vetted.
Time: Years 1 and 2.

2: **Develop density maps** of shipwrecks based on known locations of shipwreck sites and existing sonar records.
Time: Years 1 and 2.

3. **Develop reference maps** of suspected sinkings of losses based on written historical records.
Time: Years 1 and 2.

4. Coordinate public and private **assets and technology** needs. Fill these needs with gear development technology investments and grants.
Time: Years 1, 2, and 3.

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[1] *USS Constitution, USS Olympia, SS Peking*, Nantucket Light Ship, *USS Intrepid*.

[2] Turning to the Sea: America=s Ocean Future. 1999.

5. Conduct **at sea survey** with multi-beam technology and side scan sonar to cover areas of high density shipwrecks (approaches to colonial or traditional ports) and all National Marine Sanctuaries. (Area specific surveys.) Conduct at sea surveys with multi-beam and side scan technologies to focus on specific areas of suspected sites for historically important shipwrecks based on the written record. (Site specific surveys.)
   Time: Years 1, 2, 3 and 4.
6. Conduct exploratory **site visits** with diver, submersible, ROV, AUV, portable habitat units, or other technologies developed under this initiative. Archaeologists perform assessments and survey of the historical value of the sites visited.
   Time: Years 2, 3, and 4.
7. Develop **data archive** from explorations and survey and establish public data base relating location with character profile of shipwreck, historical value, and records of preliminary exploration. Future expeditions would add to the data base. Resource managers would use assessments from this data base for decisions on future management needs.
   Time: Years 3, 4, and 5. (Partners could continue this effort thereafter.)

Benefits:

1. Academic and public knowledge will be enriched.

2. Public resource management decisions will be based on better information.

3. Safe navigation will be enhanced with a thorough knowledge of submerged obstructions beyond the depth of a vessel=s keel as the fishing industry works deeper, scientific instrumentation deployment becomes more comprehensive.

4. National environmental security will be enhanced by knowing the location, status, and nature of risk posed by sunken oil-fired ships (WWII generation ships may be approaching the exhaustion of their tank metals) and munitions aboard (WWII actions resulted in many losses of ships, submarines, and aircraft).

5. Deep ocean exploration and discovery has co-evolved with the sophistication of the engineering technologies. Investments in ocean discovery will produce the necessary technologies driving private sector investments and profits for ocean science, and ocean technology companies.

6. Commercial exploitation can be targeted and guided to make compatible the goals of historical recovery and preservation, and the goal of commercial enterprise. Protection should not be a frustrated afterthought but a planned activity from a thorough knowledge base. Incorporating historical preservation goals in commercial salvage operations through judicial pathways has been a demonstrated successfully as in the Columbus America Discovery Group salvage of the *SS Central America.* As the US contemplates the draft UNESCO Convention on the Protection of the Underwater Cultural Heritage, a national position can be developed based upon what we know and need to protect, rather than what we feel we need to protect because we do not know.

Partnerships:

NOAA possesses the ability to conduct much of this work, but not at the scale or time envisioned by this initiative. Partnerships with private industry, universities, other government agencies, educational media, museums and aquaria will be necessary to conduct the scope of work, and will last long beyond the exercise of the field operations. Examples of partnerships:

<u>Universities</u>: Scholars and students will provide the archival research and literature reviews to develop the initial data bases for determining site locations and survey target densities. Students and credentialed professionals will provide the expertise in marine archaeology, site identification, and assessments of the historical worth of the sites.

<u>Private Industry</u>: Survey companies can provide ship time in excess of NOAA=s fleet capacities. Technology companies will provide innovative survey technologies, mapping programs, charting software, sonars, multi-beam systems, ROVs and other technologies to locate explore, and record the survey areas and sites discovered.

<u>Ocean Explorers and Archaeologists</u>: Numerous individuals and institutions have demonstrated their remarkable success in such projects as this, and their participation would be critical in the success of this endeavor. These would include Dr. Robert Ballard, Dr. Gordon Watts, the Institute for Exploration, Harbor Branch Oceanographic Institution, Woods Hole Oceanographic Institution, and numerous others. The contributions range from vessels, ROVs, search and survey equipment, and the expertise in identifying the contents of sites discovered.

Government Agencies: The states would benefit from the application of technology to their coastal waters, in which lie most of the unknown sites and for which they lack the knowledge of their existence or the ability to locate. Many states have shipwreck inventories, ranging from preliminary efforts to refined assessments. Navy continues to be an active partner in applying diving technologies for training and readiness on the Monitor National Marine Sanctuary, and has a rich body of data, plus technologies for the location and survey of shipwrecks. USGS has survey data of value. The National Archives house a rich body of historical information ranging from reports of the early coastal lifeboat stations to the Naval War Diaries of WWII..

Museums: Existing partnerships can be strengthened and new ones established along the model of the Newport News Maritime Museum. This museum has accepted custody of the recovered portions of the *USS Monitor* and assumes conservatory responsibilities and public display for the same. Museums will become the repository of historical artifacts along a regional or thematic focus. Other examples include the Mystic Aquarium, Mystic Seaport Museum, San Francisco Maritime Museum, and the South Street Seaport Museum.

Educational Media: The public appetite for this subject will be rewarded by participation of such educational media as the National Geographic Society, Discovery Channel, History Channel, JASON Foundation for Education (an existing NOAA partner), and provide opportunities for public education long after the completion of the discovery expeditions.

Budget:

Year:	1	2	3	4	5
Activity					

[redacted]

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[3]Sea survey activity may overlap with requirements stated elsewhere in the Initiative, thereby reducing the actual cost.

[4]Archiving will continue after direct funding expires. Partnerships and matching funds can extend this activity.

2002 Ocean Exploration Initiative

Ocean Exploration and Research Initiative-- Water Masses and Ocean Fronts (0 FTE, +$[redacted]): NOAA requests an increase of $[redacted] to explore and study ocean frontier areas, including water masses (e.g., upwellings, eddies, convergences), ocean fronts (e.g., Gulf Stream wall) and boundary layers, and the living resources associated with them.

Background: The oceans cover 71% of the planet, a volume of over 330 million cubic miles, and 99% of the living space on earth, 97% of which lies below the reach of sunlight. Like air, the oceans are a dynamic, intertwined mosaic of masses, gyres and currents. Unlike air, they are inhabited by a variety of endemic ecosystems separated by ocean fronts. These fronts are not sharp walls, but transition areas with rich and varied ecotones, zones of gradation between ecosystems. Ocean pelagic (mid-water) life is often most diverse and abundant along these fronts because that is where food tends to be. A thermocline, for example, is a front between cold and warm water. Often, cold water holds more nutrients in solution and is denser than adjacent warm water, whereas the warm waters favor more life. The boundary between them, often associated with the particle maxima zone in the water column, tends to concentrate plankton that float on the dense water and feed on the available nutrients. Plankton, in turn, attract higher trophic levels.

Water masses and fronts are essential fish habitat. Exploited and protected species rely on these boundaries for food and shelter. Giant bluefin tuna roam the oceans of the world and, like transoceanic ships, normally follow major ocean currents. From what little is known about their life history, it is believed that they spawn along boundary current fronts and eddies. Upwellings fuel the most productive fisheries on earth, such as anchovies and herring. Many new and exotic life forms populate fronts, such as the elusive giant squid, 10 meter long colonies of siphonophores, undescribed species of deep sea fishes, mid-water octopi, and a variety of translucent jellyfish. These creatures are not easily captured in nets, or if caught, they are most often too mangled to identify.

Recent observations have described the larger scale dynamics of ocean ecosystems over decadal timescales. Regime shifts in ocean community characteristics may result from human activities such as selective fishing pressures or from shifts in global weather patterns and regional climate. Whales and other marine mammals depend on krill as their major food source. Krill concentrate round water mass fronts where their planktonic food exists. They compete for this food with other species such as jellyfish that are not favored prey for whales. Recent warming of Alaskan and Arctic waters has favored salp populations on traditional whale feeding grounds.

The health of ocean ecosystems may be best assessed through indicators that integrate across space and time scales. For example, the condition of large vertebrates and apex predators can serve as a benchmark for assessing overall ecological integrity and sustainability. These species concentrate along water mass boundaries.

Proposed Actions:

- Assess existing and historical information to target relatively fixed (perennial) water mass and frontal features that represent the biome characteristics of major pelagic marine ecosystems
- Based on assessment, establish a global network of open ocean reference stations at each reference site, define the biological signature or fingerprint of that ecosystem
- Coordinate with all field expeditions to piggy-back protected species observations and mid-water studies, for example, in NE Pacific (Gulf of Alaska upwelling), Gulf of Mexico (Loop Current eddies), and NW Atlantic (Georges Bank gyre)
- Conduct dedicated cruises to target locations, e.g., Southern California upwelling and Cape Hatteras/Gulf Stream convergence zone, and reference station sites
- Utilize traditional biological sampling methods to link to historical information
- Employ underwater observation technologies, such as submersibles and remote sensing technologies, to characterize and study ecotones and adjacent ecosystems
- Deploy remote moored systems at selected reference locations to sample oceanographic and biotic conditions.

Benefits:

The most popular sport fisheries, worth billions each year to the U.S. economy, are the pelagic giants. One bluefin tuna can be worth up to $30,000. These fisheries are in trouble. Fishing on marine mammals may be stopped, but several species continue to decline or are not coming back. Understanding and protecting the mid-water habitats where they live, is as important as the fight to save coral reefs.

Partners:

Climate and Eastern Ocean Systems (CEOS) Program
Pacific Fisheries Environmental Lab
Gulf of Farallons NMS
CalCOFI
NCCOS Lab, Beaufort, NC

Budget Growth ($K):

Year	2002	2003	2004	2005	2006
	$2500	$2500	$2700	$2700	$3000

Potential Activities by year:

Regional Expeditions:
2002, 2004, 2006 -- Northeast Pacific; California Current System-- sampling and monitoring upwelling along coast particularly salmon grounds/routes and Gulf of Farallons NMS (existing data from Steger, 1998); Gulf of Alaska down-welling region; ice edge and polynas in Bering Sea
2003, 2005 – Cape Hatteras, Gulf Stream Convergence Zone; bluefin tuna grounds, Sargassum habitat studies, including use by sea turtles, carbon depocenter for mid-Atlantic Bight, most abundant seabird populations in North Atlantic, marine mammal migration route and feeding grounds

Collaborations:
Northwest Hawaiian Islands: establish reference site in Humpback Sanctuary
Gulf of Mexico-- establish reference station in FL Keys National Marine Sanctuary, Dry Torutgas Reserve
Gulf of Mexico-- establish reference station in with Flower Garden Banks NMS
Cape Hatteras-- establish reference station in off Cape Hatteras in vicinity of the Point
Northwest Atlantic-- establish reference station in Stellwagen Bank NMS

Technology R&D:
2002 – AUVs are critical, equipped with optical sensors for basin-wide surveys of plankton and particle abundance and oceanographic parameters

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Submarine Volcanoes

Line Offices:
OAR, NOS, NESDIS

Objectives:
- broad-scale regional mapping of target regions using satellite gravimetric data
- Determine flux of heat and chemicals into ocean and their contribution to global budgets for heat, carbon and greenhouse gases
- Describe life in extreme conditions
- Assess extremophiles for potential bioproducts
- Survey and assess mineral resources associated with volcanos
- Monitor volcanic activity and determine correlation with seismic activity that may threaten coastal communities through quakes and tsunamis

Strategies:
- Develop RFP in conjunction with NSF
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry and geology of target site, level of volcanic activity, proximity of target site to coastal communities and potential threats due to seismic activities, potential as source of valuable mineral resources, and research to address priority objectives
- Seek partnership with NSF for basic research as extension of LeXen
- 3 year field program and 2 years of data analysis and publication costs

Special Technologies:
- NESDIS satellite gravity data and imagery
- OAR/ERL- towed plume detection technologies
- OAR/NURP- submersibles for ground-truth of towed mapping technologies, and fine scale geochemical samples and studies
- Navy- Laser line scan for mapping and identification of seafloor mineral resources (e.g., nodules)

Benefits:
- Accurate models for global heat and carbon are needed to predict and potentially mitigate climate swings
- Estimated gold deposits on flanks of Loihi possibly worth tens to hundreds of millions of dollars
- Accurate prediction of seismic activity and early tsunami warning system will save lives and billions of dollars of coastal properties in some areas

Budget:
2002 – $1.5 million
2003 – $1.5 million
2004 – $1.5 million
2005 – $300,000
2006 – $300,000

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Deep Ocean Trenches

Line Offices:
- OAR, NOS, NESDIS

Objectives:
- Locate and map the walls and floor of the deepest locations on earth
- describe geology of trench walls and floor
- determine the vertical distribution of trench biota
- relate biota to geology and habitats

Strategies:
- Develop RFP in conjunction with NSF
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry, biology and geology of target site, current resources that may target trench habitats, level of seismic activity, proximity of target site to coastal communities and potential threats due to seismic activities, potential as source of valuable mineral resources, and research to address priority objectives
- Seek partnership with NSF for basic research as extension of LeXen
- 3 year field program and 2 years of data analysis and publication costs

Special Technologies:
- NESDIS satellite gravimetric data for regional mapping
- NOS and USGS- acoustical and optical mapping data
- OAR/NURP- submersibles for ground-truth of towed mapping technologies, and fine scale geochemical samples and studies, biological and geological sampling of trench walls and floor
- Japan- use of deep ROV to reach deepest ocean depths

Benefits:
- exploring the unknown, in particular species diversity of the deep ocean
- outreach value of reaching the deepest ocean, seen once in history
- Accurate prediction of seismic activity and early tsunami warning system will save lives and billions of dollars of coastal properties in some areas

Budget:
2002 – $1.5 million
2003 – $1.5 million
2004 – $1.5 million
2005 – $300,000
2006 – $300,000

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers-- Hydrocarbon Seeps and Hydrate Beds

The ocean floor is an active place where water, chemicals, and life is always entering and exiting. In many places, doors open to the earth's molten interior, letting out streams of magna, chemicals or boiling water. In many more places on the ocean floor, cold seeps ooze, bubble and vent a variety of materials such as methane gas, ice crystals imbued with natural gas, and crude oil. These conditions are far from toxic to the local inhabitats. On the contrary, they support some of the most productive ecosystems on the planet. These seafloor forests were discovered less than 30 years ago. We have been to a handful of the vents that occur along the entire length of the mid-ocean ridges that split the major oceans. Green Canyon in the Gulf of Mexico is the best known hydrocarbon seep. Noone has yet explored below 1000 meters in Green Canyon, where oil companies are now setting up new drill sites. New species discovered at these hot vents and cold seeps have produced new potential medicines now being tested for treatment of arthritis, cancer and AIDS.

Line Offices:
OAR/ SG, NURP, ERL, NESDIS

Objectives:
- Determine the rate of flux of hydrocarbon fluids and gases from the seafloor
- Understand ecology of chemosynthetic communities
- Monitor the stability of hydrate beds
- Discovery of new bioproducts from seep species

Strategies:
- Utilize Joint Oceanographic Institutions drilling ship, to be deployed in the northern Gulf of Mexico in 2002, as platform for in situ studies of nearby seep communities
- Provide ROV and AUV for 60 day cruise and surveys of benthic communities in the vicinity of the drill ship
- Extend surveys and experimental studies using manned submersible for 30 day cruise
- partner with NRL and DOE to support hydrate research

Special Technologies:
- JOI drilling ship
- NURC/NAGL’s ROV Kraken
- Subsea’s Theseus AUV equipped with NRL methane sensor (“peeper”)

Benefits:
- Hydrates may be largest sink of carbon on the planet, twice the amount in all other fossil fuels
- Methane hydrate stability is a threat to oil and gas structures now moving to deeper OCS
- Massive meltdowns of methane hydrates implicated in past climate regime shifts
- Chemosynthetic communities inhabited by new species to exploit for biotechnical and medical applications

Budget:
2002 – $1 million
2003 – $1 million
2004 – $1 milion
2005 – $1 million
2006 – $1 million

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Seamounts

There is still the general impression that most of the deep sea is featureless and barren. Among the most impressive exceptions to this notion are seamounts, large submarine mountains rising to more than 1,000 m above the surrounding deep-sea floor. Over 25,000 seamounts taller than 1000 meters occur in all major ocean basins. Many are active volcanoes. Some poke above the water and are topped with productive coral reefs. Many are home for productive seafloor communities that grow on the rocky surfaces, and fish attracted to them. We have seen less than 0.1% of these deep sea oases. One of the more famous under water volcanoes is Lo'ihi, the youngest Hawaiian volcano and perhaps the next island in the chain (www.soest.hawaii.edu). Australia is now considering establishment of the deepest marine protected area in the Pacific to protect unique marine life forms on undersea mountains south of Tasmania. Research showed the seamounts contain a diversity of life forms, many of which are new to science and are highly vulnerable to trawling. Similarly productive seamounts lie off Alaska and northern California.

Line Offices:
OAR, NOS, NMFS, NESDIS

Objectives:
- Regional mapping at low resolution using satellite gravimetric data
- Accurate detailed acoustical and optical mapping of seamounts with target fisheries
- Describe benthic communities and fish population dynamics
- Determine impact of fishing activities on benthic communities
- Integration of remotely sensed and in situ data into GIS seamount survey database

Strategies:
- Develop RFP in conjunction with NMFS
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry and ecology of target site, value of target site as EFH, level of fishing activities and potential threat to habitat, and research to address priority objectives
- Marine Protected Areas will be targeted
- Seek partnership with NSF for basic research as extension of LeXen

Special Technologies:
- NOS and USGS- meter scale bathymetry
- NESDIS satellite gravity data and imagery
- Navy- Laser-line scan systems for detailed habitat maps
- NURP- submersibles for ecological studies of representative habitats and communities, and experimental studies of trawled and untrawled areas
- 3 year field program and 2 years of data analysis and publication costs

Benefits:
- Seamounts are target of offshore fisheries worth $100 million
- Habitat includes deep coral beds that are old and susceptible to permanent fishing gear damage
- Seamounts are unexplored and harbor new species, some with bioproduct potential

Budget:
2002 – $1 million
2003 – $1 million
2004 – $1 million
2005 – $250,000
2006 – $250,000

Undersea Exploration of Polar Environments (0 FTE; + $10M)

Goal: Better definition of the abiotic and biotic resources of the polar seas and of the controlling physical and biogeochemical processes affecting those resources.

Background/Scope: The Arctic Ocean and the Southern Ocean, i.e., the polar seas, need to be explored to better define their resources, governing processes, and roles in global change. This includes the connecting oceans (e.g., Bering, Chukchi, Beaufort, etc.) and basins and other features. For example, the fishery resources of the Bering Sea are unmatched–the high productivity of the Bering Sea which leads to the large biomass of birds, mammals and fishes has long been an ecological enigma. The Bering Sea supports over 50 commercially important species and at least 50 species of marine mammals. It is unmatched in terms of commercial value of the fishery resources.

Another example of the biological importance of the polar areas relate to krill. Krill, small shrimp-like crustaceans, occur in the frigid Antarctic waters and are a keystone prey species. As a food supply, they support animals from whales, seabirds, fishes and squids, to seals and penguins. Krill have shown a general decline in reproductive success since 1984. In a NMFS-supported study, low temperatures and extensive winter sea-ice development over a two year period were found to favor krill, while warmer temperatures and limited sea-ice development favored salps. Salps not only compete with krill for food, but also form an ecological 'dead end' in that they provide comparatively little food value for Antarctic predators.

Since global change under scenarios of greenhouse warming are forecast by OAR to affect the polar regions, particularly the Arctic, more so than the mid-latitudes, there is concern over the biological susceptibility of temperature change and increased ultraviolet exposure of the base of the food web. This could lead to indirect effects such as decreases in the immune systems of innate ocean biota, to effects on the bioavailability of contaminants in these regions, to changes in the species that comprise the food web. On the abiotic side, it could also lead to unstable gas hydrates which would cause an increase in the input of methane into the atmosphere–giving rise to a positive feedback loop in the global warming process. A molecule of methane is 20-times more effective as a greenhouse gas when compared with one molecule of carbon dioxide. And, extensive gas hydrate beds exist on the underwater shelves of the Arctic, as well as in terrestrial arctic permafrost.

The undersea hydrothermal vents that exist at the spreading ridges have been shown through NOAA VENTS Program to be regions of efflux of mass and heat; they have also be shown to be very diverse regions of totally new species of biota. This also applies the cold water seeps that exist in the undersea regions of subduction. Although specific areas (e.g., Juan de Fuca/Gorda Ridge system offshore of Oregon and Washington) have been studied, these are just snapshots of the totality of effects of these systems on a global basis. Such systems are quite extensive in the polar seas. Not only do they affect the global balance of mass and heat, they are also regions of instability that given rise to some of the largest tsunamis.

Objectives: As alluded to under the background, environmental facets of the polar seas are vast. Exploration in that environment would have to be focused and phased in a program that is timely, cost-effective, feasible, and of beneficial to society. Undersea research is expensive. It is particularly expensive in the polar oceans, and a program of exploration would have to be well chosen to maximize the benefits. The effort would have the following objectives:

- Discover new biotic resources, especially those related to deep, cold water fisheries of commercial potential.
- Discover abiotic resources, e.g., gas hydrates, and define the processes that lead to their formation, stability, and sustainability.
- Refine the global implications of vents and seeps that are associated global ocean mass balances of chemicals and heat.
- Discover new extremophiles associated the polar environments, and conduct research on their biotechnical applications to, e.g., new pharmaceuticals.
- Discover changes in the polar oceanic environment that are associated with potential global change.

Scientific and Technical Development: As with the exploration of the farther reaches of space, exploration will depend on the continued use and further development of AUVs and fixed seafloor observatories in the polar ice-covered seas. AUVs need to become more reliable, capable of doing a variety of tasks, and capable of larger range. Fixed, or multi-deployable, seafloor observatories also need to be developed and deployed to examine, *in situ*, new polar scientific discoveries. Larger numbers of ROVs will also be essential. They must have better sensor capability, and be suited for a variety of tasks–from the small ones that can explore smaller crevices to large ones that better equipped for larger payloads. Polar seas exploration will also continue to be dependent upon manned submersibles (e.g., especially of the type as the U.S. Navy's nuclear-powered NR-1)--there is no mistaking the value of the human eye and brain to explore phenomena and resources of the undersea environment, including that of polar seas. Overall success will be dependent upon development of greater sensor capability–e.g., better and smaller electrical, acoustical, and optical sensors. The outcomes of the exploration of the polar seas in the new millennium will be scientific discoveries, never before imagined, that will benefit society and our environmental stewardship of planet Earth.

Outreach and Education: The outreach and education effort in the polar sea exploration is envisioned to utilize the capabilities of Sea Grant, partnerships with the National Geographic Society and the JASON Foundation, and collaboration with interagency efforts concerning the Arctic (e.g., Interagency Arctic Research Policy Committee and the Arctic Research Commission) and international bodies such as the International Arctic Science Committee (IASC) and the Arctic Environmental Protection Strategy (AEPS). Partnerships with similar bodies would also be established for the southern polar areas. Communication efforts will include the development of print media, web sites, radio and television programs which will inform the public about the Federal investment in polar exploration, the highlights of the investments, and benefits to the public.

Budget: In the harsh and remote areas of the polar seas, success scientific exploration will be dependent upon an adequate budget–there is nothing cheap about venturing into this environment. A minimum budget to ensure successes would be on the order of $10M per year.

2002	2003	2004	2005	2006
$10M	$12M	$14M	$16M	$18M

Ocean Exploration Initiative National Ocean Service

Reducing the knowledge gap of the undersea by 50% over the next 10 years

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Exploring and Discovering Submerged Heritage Resources

Introduction
The maritime historical record of the United States is largely underwater and awaiting discovery and documentation. A brief but invaluable inventory of that record has been preserved by public and private museums and educational institutions,[1] though this inventory pales in comparison with the estimated 50,000 shipwrecks in US waters[2]. Recent successful expeditions to locate and explore the RMS Titanic, the German battleship Bismark, and other sites have demonstrated the continuing development of remarkable deep sea technology, and that public interest in these subjects is very high.

As undersea exploration technology has developed, a recovery range has similarly evolved to the point where virtually anything sunk or lost at sea can now be found and explored, regardless of depth. In circumstances involving great opportunities for wealth, private investors have positioned themselves to exploit shipwrecks for the valuables contained within, rather than the significant history that abounds at these sites. After a commercial location and excavation of a shipwreck comes announcements of great wealth for the participants and chagrin for having failed to protect the historical integrity of the site. Our maritime heritage can only be protected by knowing the extent of these resources at the pre-exploitation stage. Private investors seek vessels of great wealth, rather than vessels of significant maritime history. Only a public effort can support the collective

The US territorial waters and EEZ contain tens of thousands of shipwrecks. Various government agencies, museums, scholars, and private entities have valuable information on many of these vessels. The public has an interest in their national history. A national Shipwreck Survey and Inventory will locate, quantify, and characterize the submerged maritime heritage of our Nation and beyond.

Objective: *To learn the location of US shipwrecks as well as we know the moon=s craters*.

This initiative pushes the development and application of deep ocean technology to survey and map the location and characteristics of shipwrecks in US waters and beyond. The Shipwreck Survey and Inventory will produce a national data base that locates, describes, and possibly identifies sunken vessels. From this data base, managers will know what resources exist, determine necessary protections, and determine the appropriateness of commercial opportunities for exploitation and recovery.

Scope of Work:

1. **Consolidate existing data bases** regarding known shipwreck locations or suspected losses. Navy, NOAA, USGS, USCG, National Archives, Library of Congress, States, Universities, pipeline and telecommunications survey companies, and others have accumulated significant data bases on shipwrecks. These need to be consolidated and vetted.
   Time: Years 1 and 2.
2: **Develop density maps** of shipwrecks based on known locations of shipwreck sites and existing sonar records.
   Time: Years 1 and 2.
3. **Develop reference maps** of suspected sinkings of losses based on written historical records.
   Time: Years 1 and 2.
4. Coordinate public and private **assets and technology** needs. Fill these needs with gear development technology investments and grants.

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[1] *USS Constitution, USS Olympia, SS Peking*, Nantucket Light Ship, *USS Intrepid.*

[2] Turning to the Sea: America=s Ocean Future. 1999.

Time: Years 1, 2, and 3.

5. Conduct **at sea survey** with multi-beam technology and side scan sonar to cover areas of high density shipwrecks (approaches to colonial or traditional ports) and all National Marine Sanctuaries. (Area specific surveys.) Conduct at sea surveys with multi-beam and side scan technologies to focus on specific areas of suspected sites for historically important shipwrecks based on the written record. (Site specific surveys.)
Time: Years 1, 2, 3 and 4.

6. Conduct exploratory **site visits** with diver, submersible, ROV, AUV, portable habitat units, or other technologies developed under this initiative. Archaeologists perform assessments and survey of the historical value of the sites visited.
Time: Years 2, 3, and 4.

7. Develop **data archive** from explorations and survey and establish public data base relating location with character profile of shipwreck, historical value, and records of preliminary exploration. Future expeditions would add to the data base. Resource managers would use assessments from this data base for decisions on future management needs.
Time: Years 3, 4, and 5. (Partners could continue this effort thereafter.)

Benefits:

1. Academic and public knowledge will be enriched.

2. Public resource management decisions will be based on better information.

3. Safe navigation will be enhanced with a thorough knowledge of submerged obstructions beyond the depth of a vessel=s keel as the fishing industry works deeper, scientific instrumentation deployment becomes more comprehensive.

4. National environmental security will be enhanced by knowing the location, status, and nature of risk posed by sunken oil-fired ships (WWII generation ships may be approaching the exhaustion of their tank metals) and munitions aboard (WWII actions resulted in many losses of ships, submarines, and aircraft).

5. Deep ocean exploration and discovery has co-evolved with the sophistication of the engineering technologies. Investments in ocean discovery will produce the necessary technologies driving private sector investments and profits for ocean science, and ocean technology companies.

6. Commercial exploitation can be targeted and guided to make compatible the goals of historical recovery and preservation, and the goal of commercial enterprise. Protection should not be a frustrated afterthought but a planned activity from a thorough knowledge base. Incorporating historical preservation goals in commercial salvage operations through judicial pathways has been a demonstrated successfully as in the Columbus America Discovery Group salvage of the *SS Central America.* As the US contemplates the draft UNESCO Convention on the Protection of the Underwater Cultural Heritage, a national position can be developed based upon what we know and need to protect, rather than what we feel we need to protect because we do not know.

Partnerships:

NOAA possesses the ability to conduct much of this work, but not at the scale or time envisioned by this initiative. Partnerships with private industry, universities, other government agencies, educational media, museums and aquaria will be necessary to conduct the scope of work, and will last long beyond the exercise of the field operations. Examples of partnerships:

<u>Universities</u>: Scholars and students will provide the archival research and literature reviews to develop the initial data bases for determining site locations and survey target densities. Students and credentialed professionals will provide the expertise in marine archaeology, site identification, and assessments of the historical worth of the sites.

<u>Private Industry</u>: Survey companies can provide ship time in excess of NOAA=s fleet capacities. Technology companies will provide innovative survey technologies, mapping programs, charting software, sonars, multi-beam systems, ROVs and other technologies to locate explore, and record the survey areas and sites discovered.

<u>Ocean Explorers and Archaeologists</u>: Numerous individuals and institutions have demonstrated their remarkable success in such projects as this, and their participation would be critical in the success of this endeavor.

These would include Dr. Robert Ballard, Dr. Gordon Watts, the Institute for Exploration, Harbor Branch Oceanographic Institution, Woods Hole Oceanographic Institution, and numerous others. The contributions range from vessels, ROVs, search and survey equipment, and the expertise in identifying the contents of sites discovered.

Government Agencies: The states would benefit from the application of technology to their coastal waters, in which lie most of the unknown sites and for which they lack the knowledge of their existence or the ability to locate. Many states have shipwreck inventories, ranging from preliminary efforts to refined assessments. Navy continues to be an active partner in applying diving technologies for training and readiness on the Monitor National Marine Sanctuary, and has a rich body of data, plus technologies for the location and survey of shipwrecks. USGS has survey data of value. The National Archives house a rich body of historical information ranging from reports of the early coastal lifeboat stations to the Naval War Diaries of WWII..

Museums: Existing partnerships can be strengthened and new ones established along the model of the Newport News Maritime Museum. This museum has accepted custody of the recovered portions of the *USS Monitor* and assumes conservatory responsibilities and public display for the same. Museums will become the repository of historical artifacts along a regional or thematic focus. Other examples include the Mystic Aquarium, Mystic Seaport Museum, San Francisco Maritime Museum, and the South Street Seaport Museum.

Educational Media: The public appetite for this subject will be rewarded by participation of such educational media as the National Geographic Society, Discovery Channel, History Channel, JASON Foundation for Education (an existing NOAA partner), and provide opportunities for public education long after the completion of the discovery expeditions.

Budget:

Activity	Year:	1	2	3	4	5	
Review Data Bases		0.3	0.3				0.6
Density Maps		0.3	0.3				0.6
Reference Maps	0.3	0.3	0.3			0.9	
Asset/Technology		0.5	1.5	0.7			2.7
Sea Surveys[3]		0.5	2.0	3.0	2.0		7.5
Site Surveys			1.5	2.0	3.0		6.5
Data Archive[4]				0.5	0.5	0.5	1.5
		1.9	5.9	6.5	5.5	0.5	**20.3M**

[3]Sea survey activity may overlap with requirements stated elsewhere in the Initiative, thereby reducing the actual cost.

[4]Archiving will continue after direct funding expires. Partnerships and matching funds can extend this activity.

2002 NOAA Initiative

Ocean Exploration and Research Initiative-- Deep Coral Communities, Reefs and Live Bottom (0 FTE, +$6,000,000): NOAA requests an increase of $6,000,000 to explore and study ocean frontier areas, including deep coral communities, reefs and benthic live bottom areas.

Background: The most biodiverse and productive seafloor habitats are those dominated by larger invertebrates such as corals and sponges, because of the architectural complexity, shelter and microhabitats these animals add to the benthos. Coral reefs are the premier example of such a system but these are generally limited to shallow tropical and sub-tropical waters. In deeper water below the reach of divers (50 to 1000 m depths), at all latitudes, important benthic communities are densely populated by many forms of attached species. They cluster where appropriate substrate is available for attachment. Hard substrate inhabited by dense growth of sessile forms, including algae, corals, and sponges is often called "live bottom." Oil and gas companies are specifically prohibited from drilling into Alive bottom,@ as defined. Most of the nation's National Marine Sanctuaries intentionally bound "live bottom" areas.

Similar to shallow water coral reefs, deeper "live-bottom" areas attract large numbers of commercially important species and their preferred prey. They are, however, much more extensive and of more widespread economic importance than tropical coral reefs. In the South Atlantic Bight, for example, 70% of the offshore fish are concentrated on 10% of the continental shelf that is live bottom. Knowing this, states and local agencies have established artificial reef programs to facilitate recreational fishing activity. Many of these wrecks are offshore so as not to be hazards to navigation, thus, hard to reach and study. Rather than helping resources by encouraging development of new productivity and live bottom, these reefs may contribute to demise of fisheries by making it easier to hunt and capture fish.

As coastal systems become over-exploited, fishermen hunt deeper offshore fisheries resources. Areas of the outer shelf and upper slope that were once lightly fished are now being intensely exploited. There is growing evidence that such deeper water coral/sponge assemblages are being extensively damaged in both the North Atlantic and Pacific Oceans due to the destructive fishing practices such as trawling and dragging. These productive offshore systems are being destroyed before we have even had a chance to document their distribution and character, nor even understand the ecology of their major components, and interactions that are so important to their sustainability.

There is growing awareness that deep sea corals and sponges influence the distribution of a variety of other organisms and support diverse communities that may be pharmacological storehouses. Further, these animals are extremely slow growing so human caused disturbance and removals can have long lasting effects on these communities (e.g., a moderate size specimen of deep sea coral *Primnoa* collected off northern Georges Bank had an estimated age of 500 years). These communities are inadequately conserved, partly as a result of ignorance about their importance, that at least in some cases serve as essential habitat for juvenile fishes.

Proposed Actions: Research is needed to determine the distribution, species associations, growth and recruitment rates in live bottom areas, and effects of human caused disturbances on deep sea coral and sponge communities. We propose an approach similar to that adopted for coral reefs by the US

Federal Coral Reef Task Force:

$	map targeted mid-depth live-bottom areas
$	conduct monitoring and assessment of the health of these communities
$	establish ecosystem research programs and long-term reference sites to identify and monitor threats to the health of these systems.
$	identify causes and rates of habitat destruction, and options for restoration.

Targeted areas will be frontier areas for which we lack required scientific understanding needed to manage related resources. They have special ecological, economic and management significance. Examples (not inclusive) include:

Georges Bank: decline of commercial species due to over fishing and disturbance of the sea bed by dredging and trawling; large areas of the bank now closed to fishing; monitor habitat recovery in a gravel substrate to determine recovery rates and species succession; assess role of recovering gravel habitat as refuge for juvenile cod and as spawning ground for herring; monitor the growth of observed scallop populations that have colonized the area since fishing halted in 1995.

West Florida Shelf: highly productive commercial and sport fishery, accounting for over 90% of the landings in the Gulf of Mexico for several economically important species; Gulf of Mexico Fishery Management Council closed 540 square nautical miles along the 40 fathom (73 m) isobath to all reef fishing year-round to protect spawning and feeding aggregations of reef fish (e.g., gag grouper); map, characterize (at approximately 200nmi^2/yr), and relate the geology of the seabed to the distribution and abundance of spawning adults, eggs and juveniles.

Shelf/slope along the U.S. West Coast: groundfish populations declining all along the U.S. West Coast; many of these species are associated with rugged, heterogeneous substrata, thus, difficult to assess using conventional survey techniques; west coast research programs developing systematic approach to habitat classification in deep water using in situ methodologies and remote geophysical mapping techniques; need to expand this habitat characterization effort to spatial scale relevant to animal distributions, and physical, biological and anthropological (e.g., fishing gear impacts) processes that influence them.

Central Gulf of Alaska: important rearing area and migratory corridor for juvenile and molting crabs, and rich stocks of groundfish; North Pacific Fisheries Management Council closed an 1500 km^2 area known as Marmot Flats near Kodiak, Alaska to bottom trawling; map, characterize (at approximately 400 nmi^2/yr), and relate the geology of the seabed to the distribution and abundance of crab and groundfish stocks.

Northwest Hawaiian Islands: coral reefs that extend below dive depth are heavily fished and covered with debris from Pacific fishing activities (e.g., long-lines and ghost nets); deep coral beds are targeted for precious coral trade; these beds are habitat for deep fisheries and foraging for endangered monk seal; map, assess, and study reef and coral community health; continue debris removal efforts begun in 2000.

Partnerships: Partnerships are critical to the success of this program. The model for these regional efforts will be the cooperative research program in marine habitat studies for the west coast region now being developed by the NOAA/NMFS laboratories of the Southwest and Northwest Fisheries Science Centers (La Jolla, Pacific Fisheries Environmental Lab, Santa Cruz/Tiburon, Newport, and Montlake). Their plan takes advantage of each laboratory's strengths (e.g., habitat classification, in situ technologies, molecular techniques, early life history studies, fishing gear development and operation). Funding and/or operational support from OAR/NURP, OAR/Sea Grant, NOS Sanctuary programs, and the Sustainable Seas Expeditions funded in part by NOS, will assist in ongoing projects relevant to these objectives.

Benefits: The cost of the failed groundfish stocks in the northeast U.S. has been easily in the billions of dollars. NOAA is still spending millions each year to buy back vessels. The Northeast Fisheries Center spent most of its dollars on stock assessment efforts using traditional fishing techniques. Management tools have been limited in their scope and effectiveness; they have not worked. The missing element in managing these stocks has been understanding of ecology. Trawls cannot effectively assess juvenile fish that hide under rocks and worse, kill them in the process of trying to find them. Marine Protected Areas are fast becoming recognized as the only realistic and effective management tool in many situations. They have saved declining fisheries in many areas of the world. The process of selecting and managing a protected area requires understanding of where and how the animals live-- the focus of ecology. NOAA will need this data to avoid litigation brought on by displaced fishermen.

Performance Measures:

	2002	2003	2004	2005	2006
PM: *By 2006, 10% fewer overcapitalized fisheries (economic and social aspects)*					
Milestone (Refugia): Evaluate effects of refugia on spawning stocks, fishing efforts, and fishing communities	describe two MPAs; east and west coast	Monitor MPAs and adjacent un-protected areas	continue monitoring and research to explain differences	continue monitorin g and research	publish results
PM: *By 2006, 60% of stocks have "essential fish habitat"*					
Milestone (Refine EFH): Identify EFH for specific life history stages of important species	Describe EFH for at least two (east and west coast) over-fished species	Describe EFH for two more species	Determine fish/habitat associations by life stage	Target spawning and nursery grounds, determine critical features	publish results

Budget Growth ($K):

Year	2002	2003	2004	2005	2006
	$6000	$6500	$6500	$6700	$7000

Activities by year:

Regional Expeditions:

2002 -- Northeast Pacific; work with state, NMFS and OAR partners to map and characterize rockfish habitat; combine in situ technologies with towed acoustic and optical mapping gear to do a synoptic comparison; target area to be determined by NMFS and best available bathymetric data; total cost for 30 day expedition, including system time, ship time, science support data management and outreach activities, approximately $2.5 million
outyears: expeditions move, similar activities

Collaborations:
Northwest Hawaiian Islands: deep dive support for NMFS/Honolulu to assess extent and impacts of lobster fishery on deep reefs; with NURC/Hawaii Undersea Research Lab (HURL) and Univ. of Hawaii to study deep coral beds (gold, pink, black); lease American Divers DeepWorkers and support ship for 10 days to extend depth range of NMFS studies; total $400,000
Gulf of Mexico-- with FL Keys National Marine Sanctuary, NCCOS/Beaufort Lab, NMFS/SEFC, and NURC/southeast and Gulf of Mexico (SEGM) region; map and ecological assessment of deep areas of new Dry Tortugas Reserve; $500,000
Gulf of Mexico-- with Flower Garden Banks NMS; piggy-back to provide assessment gear for mapping and characterization of Sanctuary below 50 meters, including Stetson Bank; $300,000
Gulf of Mexico-- with NMFS and NURC/SEGM; characterize new FL Middle Grounds/Big Bend MPA; $500,000
Southwest Atlantic-- with NMFS to continue characterization and restoration of Oculina Banks; $400,000
Northwest Atlantic-- with NMFS, Stellwagen Bank NMS, NURC/North Atlantic and Great Lakes (NAGL) to characterize new closed area on Stellwagen Bank; similar cruise to Georges Bank closed area; assess gear impacts and MPA effectiveness; $500,000
Outreach and Data management for all these activities = $300,000

Technology R&D:
2002 -- design portable laser-line scan system that can be used in towed mode or from submersible; $30,000
2003-- construct and test portable LLS; $1 million

FY 2002 Budget Initiative
(Ocean Exploration and Research Initiative: Ocean Data)

Description: NESDIS proposes to capture and integrate multiple, large data streams from the ocean floor into NOAA's data systems and archives to facilitate access to and re-use of the data for ocean research and exploration. Targets of this capture include data from the current international Ocean Drilling Program (ODP) (ending in 2003), data from its successor, and if available, data from the proposed Deep Seafloor Observatories "Neptune" initiative in which NOAA is a partner. Once captured, these data will be integrated into NOAA's data systems where they will be fully available to researchers and permanently archived. Currently, the ODP is generating the most comprehensive research-quality database characterizing global ocean history ever created. We anticipate that its successor, beginning in 2003, will continue to expand and improve this data stream. ODP data provide unique and critical input to the understanding and nature of long-term climate variability. Data from the present phase need to be completed, archived, and made available to the public while the ODP database management system is still operational. Planning needs to begin now to integrate NOAA into data management for the next phase of drilling, and to play a critical data management role in the new Neptune initiative. The objective of this proposal is to ensure that sufficient resources are available to integrate crucial data from all these interagency and international sources into NOAA's environmental data management systems, where they will be properly archived, and made fully available to NOAA's climate and global change researchers, as well as to the scientific community.

Background: NOAA has been charged by the Stratton Commission to assume a leadership role in ocean research and exploration. A critical component of this leadership is preserving and providing access to data collected during ocean research and exploration. The volume and complexity of data collected during this ocean research and exploration is growing exponentially and NOAA's NESDIS needs additional resources to perform this vital task. The legacy of interagency and international ocean research and exploration programs hangs in the balance. NOAA's NGDC has a long-standing interagency agreement with the National Science Foundation to archive and make available data from the single largest international ocean exploration program ever launched, the ODP. NOAA, as a partner in the new Neptune initiative, needs to provide resources to fulfill its data management responsibilities for this interagency program, in agreement with data management policies and practices to be outlined in the upcoming National Academy of Sciences "Report on Seafloor Observatories" resulting from the January 2000 Ocean Studies Board Symposium. For more information on the Ocean Drilling Program, please refer to URL: http://www.oceandrilling.org/ for more information about the Neptune initiative, please see URL: http://www.neptune.washington.edu/

Expected Outcome: Enhanced research capability for NOAA global change researchers and scientists worldwide through improved access to enormously important new and existing data from major interagency and international oceanographic research programs. Data from past phases of ocean drilling, (already available through NOAA/NGDC) have already proved plate tectonics, revolutionized stratigraphy, and drastically changed scientists' understanding of how earth works. Direct access to the entire suite of both ocean drilling and seafloor observatory data through integrated NOAA/NGDC and NODC data management will facilitate additional advances in global research.

Strategic Goals: This initiative addresses the "Predict and Assess Decadal to Centennial Change" element of the NOAA Strategic Plan. Specifically, to “understand the role of oceans in global change,” and to “Update and improve global databases of decadal to millennial length time series of climatic change to provide a better baseline against which human-caused changes can be compared."

Cost Savings: If work begins now on capturing the ODP data stream, it will be a matter of completing data types in the database and writing scripts to extract it. If delayed, a multi-million dollar effort will be required to reconstruct or port the database to a new system before the data would be accessible. A delay in transfer of similar data from the predecessor of the ODP resulted in not only extra time and effort in data processing as well as data loss. If we begin working with the successor to the ODP now, by cooperating on transition teams and participating in data management planning, we can integrate our efforts with those of the new program for maximum cost savings and efficiency. Advance planning for capturing the anticipated data stream from the Neptune initiative will result in similar savings and prevent data loss.

Key Schedule of Milestones for Implementation:

1) FY03 - Completion of a parallel data system for ODP data, and population of that system with data. Replication of existing access software from ODP so that when the ODP rdbms is taken offline it will continue at NGDC. Active NGDC and NODC participation in database management panels and working groups to ensure integration into the next phase of ocean drilling and planning for management of seafloor observatories data.
2) FY04 - Construction of data systems at NGDC and NODC to accommodate new data streams from ocean drilling and seafloor observatories. Preliminary population of systems with available data. Scripts and

programs in place to produce a long-term archival copy of ODP and seafloor observatory data. Data archival accomplished.

3) FY05 - Population of new drilling and observatory data systems. Software in place for data access and archive.
4) FY06 - Continued active participation in the new drilling and observatory programs to proactively capture those data streams. Continued tuning and enhancement of systems to meet research needs.

Agency and Political Impacts: The ODP, and its successor are high profile, multi-national cooperative programs to acquire state-of-the-art marine geological and geophysical data from the deep sea floor costing millions of dollars per year. NOAA/NGDC, by interagency agreement with the US National Science Foundation, is responsible for providing a permanent archive for data from the current ODP and its predecessor, the Deep Sea Drilling Project. The ODP is administered by the Joint Oceanographic Institutions, Inc. (JOI), of which our Undersecretary for Oceans and Atmosphere, Dr. James Baker is a former director. In addition to being responsible for data generated by the ODP, NGDC is also the nominal US archive for marine geological and geophysical data collected with public funds, and operates the World Data Center for Marine Geology and Geophysics. With budget cuts and attrition, NGDC and NODC no longer have the staff, equipment, or other resources to integrate large sea floor data streams, including ODP or Neptune data, into its systems. NGDC and NODC do not even have the resources to actively participate in the data management planning processes for these programs. Politically, NOAA cannot afford to breach its interagency agreement with NSF, or to ignore its role as a World Data Center. These are literally the largest data streams ever created describing the world's oceans, their history, and their impact on the environment. NOAA is a full partner in the new Neptune initiative (Neptune: A Fiber Optic "Telescope" to Inner space). Neptune is expected to generate a huge stream of data including marine geologic observations and biological, chemical and physical data, as well.

Performance Measures: 1) NGDC fulfills its obligation to provide an archive of data from the existing ODP in accordance with interagency agreements. 2) NGDC and NODC actively participate in planning for new phases of drilling and seafloor observatories to ensure good data management practices, and 3) NGDC and NODC successfully incorporate these new data streams, providing access and archival.

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Email: gsharman@ngdc.noaa.gov

Estimated cost: NGDC (for access, management, and archival of geological and geophysical data)~ $1M/year, 5 years
NODC (for access, management, and archival of oceanographic data) ~ $340K/year, 5 years

	FY 02	FY 03	FY 04	FY 05	FY 06	To Complete	Total
Labor	$405K	$426K	$450K	$474K	$498K	--	$2253K
Benefits	$87K	$75K	$96K	$99K	$105K	--	$462K
Travel	$30K	$30K	$30K	$30K	$30K	--	$150K
Contracts	$500K	$500K	$500K	$450K	$400K	--	$2350K
Supplies	$150K	$60K	$30K	$30K	$30K	--	$300K
Equipment	$200K	$135K	$60K	$60K	$60K	--	$515K
Communications	--	--	--	--	--		
Other							
Total	$1372K	$1226K	$1166K	$1143K	$1123K		$6,030,000

FTE's 6 new FTE's in FY02, continuing

2002 Ocean Exploration Initiative

Theme:
Ocean Frontiers -- Submarine Canyons

Dinosaurs once roamed the edge of the continental shelf. Their beach front property is now under hundreds of meters of seawater along the edge of the shelf. Off the edge of the shelf, the seafloor steepens as the continental slope drops away to the deep sea. When the shelf was dry and the slope was the coast, rivers cut through the shelf edge and exited on the slope. All along the shelf edge and upper slopes of the world, submarine canyons mark these ancient river beds. In other areas of the world, faulting and folding of the earth surface create canyons and rifts. These are the deepest spots on earth. Canyons like the Hudson Canyon off New York, Hatteras Canyon off North Carolina and Monterey Canyon off California are examples of different types of canyons in terms of how they formed, by erosion or faulting. They are all the same, however, in that they support more life than surrounding slope. They have steep walls that fold and crack creating holes and nooks for small animals. They funnel and concentrate organic matter down their axes. Rocks and cliffs provide perches for attached species such as corals and sponges that add to the habitat value of canyons. Like coral reefs in the shallows, these deep canyons are where fish live and the diversity of deep sea life is greatest.

Line Offices:
- OAR, NOS

Objectives:
- map canyon walls and floor
- describe geology of canyon walls and floor
- determine the vertical distribution of canyon biota
- relate biota to geology and habitats
- determine the flux rate of materials down canyon axis
- correlate biota with depocenters and material fluxes

Strategies:
- Develop RFP in conjunction with NMFS
- Conduct a peer review to determine best science and target locations
- Projects should include: assessment of existing data on bathymetry, biology and geology of target site, current resources that may target canyon habitats, and research to address priority objectives
- 3 year field program and 2 years of data analysis and publication costs
- seek partnerships with education programs to feature research in education and outreach media and activities, e.g., Hudson Canyon Exploration program with Columbia Univ.

Special Technologies:
- NOS and USGS- mapping data
- OAR/NURP- submersibles for ground-truth of towed mapping technologies, and fine scale geochemical samples and studies, biological and geological sampling of canyon walls and floor
- NMFS- fish data

Benefits:
- exploring the unknown, in particular species diversity of the deep ocean
- deep water habitats are critical to many commercially valuable fisheries, such as lobster and tilefish on northeast US coast
- more accurate models of carbon flux in the ocean
- outreach value of linking remote frontiers to the classroom

Budget:
2002 – $1.5 million
2003 – $1.5 million
2004 – $1.5 million
2005 – $300,000
2006 – $300,000

Marine Biotechnology: Creating New Value from the Sea

The biotechnology revolution has impacted diverse fields of science and many sectors of the economy. In the environmental arena, application of molecular technologies has brought new ways to identify and mitigate ecological stresses and may hold the keys to remediation. Sales of products developed through biotechnology were up 17 percent in 1998 to $13 billion–a figure with the potential to reach $24 billion in 2005. Remarkably, these developments have been largely based upon the molecular genetic characteristics of terrestrial organisms, even though more than 80 percent of all the Earth's phyla are found only in the sea.

Studies that extend biotechnology to the marine environment are few despite numerous, compelling incentives. Marine plants, animals and microorganisms exhibit processes and produce substances unknown in terrestrial organisms. The potential economic and public health benefits of pharmaceuticals, pesticides, hormones, enzymes, and polymers derived from marine organisms are high, yet unexploited. If the United States is to realize the benefits to be derived from marine organisms as sources of new products and processes, and develop viable strategies to conserve them, an increased investment in marine biotechnology is essential.

Recent Trends

- Recent advances in molecular genetics, sensor biology, environmental remediation and bioengineering have greatly expanded the ability to find, manipulate and utilize marine organisms in a sustainable manner.

- Presently, only about 1.2 percent of federal investment in biotechnology research is focused on marine opportunities and problems. In 1992, the U.S. invested $40 million in marine biotechnology. In contrast, Japan spent $519 million, recognizing marine biotechnology as the "greatest remaining technology and industrial frontier."

- Despite limited public funding, investment in marine biotechnology has led to at least 190 U.S. patents. Research in marine biotechnology has yielded at least 30 marine products (targeting cancer, inflammation and AIDS) to reach the stage of preclinical trials. The market value of just five of these has been estimated to be $2 billion.

- New applications of molecular techniques have given researchers and managers the ability to diagnose emerging diseases and the impacts of pollutants on target organisms as well as ecosystems.

Objective

The objective of this initiative is to accelerate the discovery of new products and technologies from unique marine organisms. The development of novel products from the sea has the potential to greatly contribute to new treatment for diseases, eliminating drug resistance, providing safe and abundant seafood and in cleaning up the coastal environment. It is expected that this initiative will advance U.S. economic growth, enhance international competitiveness, and promote sustainable development. In support of Administration and DOC programs to achieve these goals, NOAA proposes to develop marine biotechnology to broaden the choices available to the pharmaceutical, agrochemical, and seafood industries, as well as to those concerned with environmental management. Research and technology transfer programs will develop fundamental knowledge of natural products and processes of marine organisms to provide models for new commercial products and new approaches to industrial processing and bioprocessing. Initial emphasis will be on developing products and processes based on deep-sea microbial communities from areas of intense biological activity and extreme conditions.

Benefits to the Nation

The potential of marine biotechnology to benefit the health of our citizens and the national economy is unlimited. According to a recent report by the NSTC, " Modest investments now in several rapidly developing areas of biotechnology research will lead to major economic and societal benefits ...". Marine natural products, many of which have yet to be discovered, are the key to the development of new types of drugs and products which will allow us to address public health and environmental issues in the next century. For instance, just five drugs developed over the past few years by Sea Grant, with a relatively small investment of funds, have a market potential of almost $2B annually and address human diseases such as cancer and AIDS, inflammation, new biodegradable agricultural fertilizers, natural antifreeze, and industrial surfactants. Marine biotechnology, already a multibillion dollar industry worldwide, has a projected growth of 15-20% annually over the next 5 years. One marine product alone, the anti-inflammatory agent ***Pseudoterosin,*** derived from the sea whips (soft corals) found in Florida and elsewhere has yielded royalties in excess of $1.2 million, and has projected sales of up to $100 million.

Humankind must adhere to boundaries for harvesting living resources from the sea in order to ensure a resources for future generations. Nonetheless, a large percentage of the nation depends on the sea's living resources for its economic viability. Therefore, we must actively and aggressively seek alternate and additional value from the nation's living marine resources in the form of **new products**, discovered in the sea and then produced through biotechnology or generated through aquaculture. NOAA recognizes that as we enter the 21st century, we are moving into an exciting period of opportunity for sustainable development of marine resources. This initiative will focus the talents of the nation's federal and academic research community to develop a suite of new products that will provide **economic value** and benefit the health of US citizens while maintaining the integrity of the marine environment.

Sound in the Sea

Objectives

The major objectives of this program are to 1) create a global network for monitoring marine sound of natural and human origin, and 2) determine the effects of this noise on marine mammals and turtles. Listening to underwater sound can reveal objects thousands of miles away. Until now, ocean sound has only been monitored by the military. However, the need to locate earthquakes and whales, the alarming rise of human noise, and the possible harmful effects of noise on animals make it imperative that a civilian network now be created.

Scope

The geographic scope of the sound monitoring network includes the entire northern hemisphere within five years with extension into the southern hemisphere thereafter. The network will enable NOAA to: 1) locate underwater earthquakes, tectonic activity, volcanism and other geological processes, 2) follow the movements of populations of large whales, and 3) measure the rise and spread of human noise that may have negative impacts on animals. The scope of research on these negative impacts includes laboratory and field studies on marine mammals and turtles exposed to explosions, impulses, and continuous sound. The sound program includes components of both Exploration and Research. Many marine sounds are from unknown origins, such that tracing them is a matter of exploration. On the other hand, documenting geological activity, whale populations, and the rise and spread of noise pollution are matters of research. Both are of interest to the general public.

What needs to be done

The NOAA sound network will initially sample the data stream coming from existing monitoring stations maintained by the Navy and Air Force. Later these stations will be supplemented with NOAA monitors in areas that are not covered by existing stations. Calibration trials on ship traffic will be held at selected shallow and deep water sites. As NOAA measures the growth of sound levels into the future it will also trace the historic rise of ocean background noise by analyzing archived Navy data. Finally, NOAA needs to describe normal hearing in many marine species, and to measure the behavioral disruption, masking, and temporary hearing loss that noise causes.

Education/Outreach

The NOAA sound program would begin its work by holding a workshop of academics, environmentalists, military, and other stakeholders in the problem of underwater sound. The workshop would design the network and the research into the effects of noise. The data from the sound monitoring network will be made available on the internet so that the public may experience NOAA exploration and research. This display will include the locations of earthquakes, volcanic activity, and the movements of vocalizing whales in an ocean basin on a yearly basis, as well as samples of the actual sound made by these events, and some sounds of unknown origin.

Scientists/Technology Development and Accessibility

NOAA will partner with the Navy to set up post doctoral fellowships for special advanced training in some aspects of the field of marine noise. The program will develop new sensors for high frequency sounds that present-day sound monitors do not record. These devices would be moved from site to site where high frequency human noise is being produced, unlike low frequency monitors which remain stationary.

Data and Information Handling

Sampling data from military sources, collecting data from NOAA monitors with dissimilar frequency characteristics, avoiding recording classified sources, funneling the data to one site, compiling it for different uses, and making it broadly available will require sampling and network designs that do not yet exist. The program will develop these capabilities as well as the capacity to handle a large data flow.

Studies/reports

Marine noise is such a newly recognized form of pollution that it has not been included in previous government reports. However, in 1999 noise was one of the top 10 items listed for action in the NOAA constituent's meeting. The problems of human noise, and the need for concerted international action on noise were detailed in "Marine Mammals and Noise" (Richardson et al., 1995; Academic Press, NY). The Natural Resources Defense Council published a white paper entitled, "Sounding the Depths: The Rise of Supertankers, Sonar and Undersea Noise' (NRDC, 1999) which calls for NOAA to perform all of the actions proposed above, as well as other actions.

Five year Budget (thousands)

Item[1]	Year 1	Year 2	Year 3	Year 4	Year 5
Planning/coordination	300	100	100	100	100
Effects of noise on animals	1,000	1,100	1,200	1,300	1,400
Calibration Experiments	2,000	1,500	1,500	1,500	1,500
Integrate Data Streams	700	725	700	725	750
Extend Tao Array	805	980	675	675	675
Extend PIRATA Array	545	225	225	225	225
Occupy existing Atlantic sites	1,225	450	125	125	125
Build & deploy new Pacific sites[2]	1,900	2,500	2,900	3,175	3,200
Build & deploy new Atlantic sites[2]	2,110	2,255	2,855	2,875	3,125
Total	10,040	10,105	10,180	10,950	10,400

[1] Table assumes that NOAA is the sole agency conducting these activities. Actual costs will be lower due to partners sharing costs, but these savings cannot yet be estimated.
[2] Cost is largely ship time for deploying monitors

Ocean Exploration Initiative:

2002 Work Plan:

Strategy	Program/Task	Budget %
Regional Expeditions:	- Northeast Pacific expedition (Alaska to northern California): 90 day cruise to study seamounts, a submarine volcano and vent region, deep sea fishing grounds and protected areas, and hydrocarbon cold seeps, including ship, manned sub and ROV, and science support; deploy sound monitors; collect and process samples for new bioproducts - Planning workshops for planning subsequent expeditions	55
Collaborations:	- Gulf of Mexico: collaboration with JOI drill ship; deep ROV on-board for 30 days with science support; collaboration with Navy and MMS on manned sub cruise; ship-time from partners, 30 days of sub time plus science support; deploy sound monitors; collect and process samples for new bioproducts - Arctic: USCG Healy cruise, ROV support for 60 days and science support; midwater and benthic objectives - National Marine Sanctuaries: establish ROV and deep diving training program for sanctuary staff; support acoustic surveys of Sanctuaries for wrecks	15
Rapid Response:	- Juan De Fuca: establish listening station for monitoring eruptions and seismic activity; 20 days of ship and ROV field operations to respond to events - monitor data streams from existing NOAA and Navy listening stations; respond to extreme events with science program to detect source and impacts	10
Technology R&D:	- Development and testing of AUV for sensing and observing seafloor venting and seepage; development and testing of related sensors - Planning for next generation of Aquarius undersea laboratory	5
Educational Outreach:	- k-12 curriculum development, graduate fellowship, undergraduate internship, public media productions	10
Data Management:	- GIS data archive with Web access, including seafloor features, habitat types, shipwrecks and data from OEI research efforts	5
		100%

Ocean Exploration Initiative
Educational Program Plan: 2002

Objectives of the Ocean Exploration Initiative (OEI) Educational Programs:

During its five-year timeline, the OEI will strive to:

- Foster public awareness and interest in ocean issues, with special emphasis on elevating people's understanding of the value and importance of ocean resources.
- Target an international audience for OEI educational initiatives.
- Foster the integration of ocean studies into school curricula by directly involving teachers and students in OEI activities through educational materials, workshops and the Web.
- Encourage the integration of science and education, focusing on ocean frontiers, the use of technology for greater outreach, and the promotion of new tools (e.g., multi-media interactive programs) for use in education.
- Promote partnerships to leverage OEI funding and funding shortfalls in marine-education priorities.

OEI Education Advisory Committee:

OEI will enlist the aid of education specialists from around the world to assist in accomplishing the OEI objectives. Members will include teachers, education program managers, and education and outreach specialists from ocean programs. Their purpose will be to advise the OEI program management on 1) development of the OEI education plan and 2) identify opportunities for education activities and partnerships.

OEI Education Plan:

Background

In April 1998, National Geographic Society, in partnership with NOAA, launched the 5 year Sustainable Seas Expeditions (SSE). One of the SSE's primary goals is to mount an intensive public education campaign, using the drama of path-breaking exploration and the compelling visual evidence of high-quality photographs and videotapes to arouse, astonish, and engage regional and national interest in the marine sanctuaries. To achieve this goal, the Society has worked closely with NOAA to establish a team to develop education programs based on the results of the Expedition missions and also to address the national need for increased marine education for the public and K-12 students. SSE has been wildly successful in its education and outreach goals, reaching millions of people during its first year.

One of the biggest challenges facing efforts to support marine education is that the National Science Standards at the K-12 level do not include the oceans and coasts as required areas of study. This omission has resulted in a dearth of marine science textbooks and little incentive for teachers to routinely include marine science education in their classes. Paradoxically, studying the oceans is, by definition, an inherently interdisciplinary process that integrates the physical and natural sciences with environmental, social, cultural, historical, and policy issues. The ocean science community is also poised to involve students and their teachers in a wealth of new information and a variety of cutting-edge technologies.

The challenge, however, is communicating this information to the education community in an effective and meaningful way. Teachers can be easily overwhelmed by the quantities of data available and may not have the time or expertise to use raw data sets that are available on the Web. Just as SSE has successfully done, OEI will help bridge this gap by bringing attention to the importance of teaching marine education and providing a portal to ocean science data sets through its exploration activities. Just as importantly, OEI will increase awareness of the oceans as a central feature of scientific literacy and development of a conservation ethic.

The purpose of this plan is to provide a framework for ensuring that OEI exploration activities are effectively presented to educators and the public, and to highlight opportunities for further collaboration in education.

Education Plan Elements

OEI proposes to focus its education program on four primary program elements, including development of:

- teaching materials
- teacher professional opportunities
- student programs
- informal education.

Development of teacher materials will be based on multi-media class room materials targeting the widest audience possible. Teacher professional development will provide the instruction support necessary for teachers to take advantage of these new materials. Student programs will provide hands-on activities for students to learn about the ocean and become participants in OEI and its field missions. Informal education will use the enormous reach of NOAA through the Internet, exhibits, family activities, public programs, books, television stories and magazine articles as the public outlet for OEI's ocean stewardship message and mission findings.

Partnerships

The overarching goal of the OEI education program is to foster increased public awareness and understanding of the importance of ocean resources and environments through improved marine education. This is an enormous undertaking that will require collaboration with many different partners, including the NGS Alliances, National Science Teachers Association (NSTA), National Marine Educators Association (NMEA), Consortium for Oceanographic Research and Education (CORE), National Ocean Partnership Program (NOPP), National Science Foundation (NSF), NASA, Coastal America, JASON Foundation for Education, and others.

Summary

During the course of five years, OEI will provide the opportunity to explore areas of the planet never seen before, using innovative technologies and to bring the excitement of these expeditions and their findings to the public and to schools across the country. Resulting materials will provide a backbone for bringing the ocean into classrooms at a national level, and linking the ocean to national and state instruction standards that will lead to an informed public and the scientists of tomorrow.

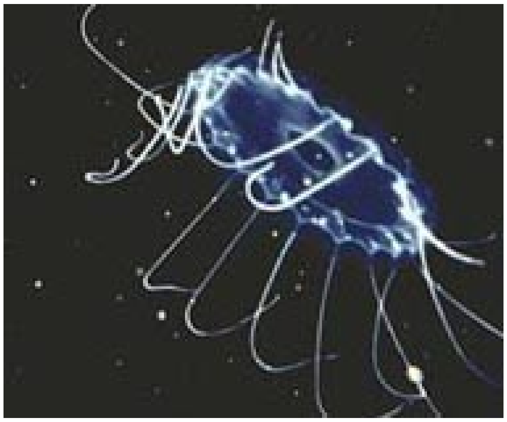
Main Page
Background
Calendar of Events
Ocean Exploration Panel
Meeting

Calendar of Events

Important meetings are listed in this calendar, please check back on a regular basis to confirm the date and location of these events.

August 4, 2000
Interagency Task Force Meeting
NOAA Headquarters, Silver Spring, Maryland
Meeting Minutes Available

August 22-23, 2000
Ocean Exploration Panel Meeting
Key Bridge Marriott, Roslyn, Virginia



September 6, 2000
Interagency Task Force Meeting
NOAA Headquarters, Silver Spring, Maryland
Meeting Minutes Available

September 14-15, 2000
Ocean Exploration Panel Meeting
Hilton Monterey, Monterey, California

September 20, 2000
Interagency Task Force Meeting*
NOAA Headquarters, Silver Spring, Maryland

*Draft of Panel Report will be available by this date

Meeting Minutes Available

September 29, 2000

Science Adivory Board (SAB) Meeting to review the Panel report
Herbert C. Hoover Building (HCHB), Rooms 6800 and 6802
14th and Constitution N.W.
Washington, DC

NOAA SAB Resolution

October 10, 2000

Panel report submitted to Secretary of Commerce
Washington, DC

TOP OF PAGE

Oceans Exploration Task Force Meeting
Friday August 4, 2000
9:00- 11:00 am
1315 East-West Highway
SSMC 3 Room 11836

Handouts

- Meeting Agenda
- Directive from President Clinton to the Department of Commerce
- NOAA Science Advisory Board Charter
- List of NOAA Science Advisory Board (SAB) Members
- List of SAB nominations for the Oceans Exploration Panel (Panel)
- Interagency Task Force Roster
- Panel Process and Schedule- including Task Force Activity

Timeline

August 22-23, 2000: First Panel meeting
Key Bridge Marriott, Roslyn, Virginia
September 14-15, 2000: Second Panel meeting
Hilton Monterey, Monterey, California
September 29, 2000: SAB meeting to review the Panel report
Washington, DC
October 10, 2000: Report submitted by the SAB to the President
Washington, DC

ACTION ITEMS

1. All agencies to prepare a 10-15 minute presentation for the August 22 Panel meeting.
Presentations in Microsoft PowerPoint
Approximately 15 slides/view graphs in length
Due COB Friday August 18, 2000 to Michael Kelly
Upload to an ftp site or FedEx a CD ROM to:
Michael Kelly
NOAA/PCO
14th and Constitution Ave. Room 5811
Washington, DC 20230
Have backup hard copies of slides on overheads with you on August 22

If you would like to have your presentation or materials included in a briefing book that NOAA will prepare for the Panel, please provide Michael Kelly with 30 copies no later than August 18. They will then be provided to the Panelists when they arrive in D.C. Otherwise bring 3-hole punched copies with you on the morning of the presentation.

2. Add Coast Guard representative Jonathan Berkson to the Interagency Task Force, Michael Kelly will notify USCG and make the invitation.

Suggested Presentation Outline

1. Agency definition of ocean exploration
2. Agency ideas on short, medium, and long term objectives/goals
   Mission/vision in the area of ocean exploration
3. Which current or planned agency activities have ocean exploration elements
   Describe activities using the 5 elements from the directive:
   a. Scientific, cultural, historical aspects
   b. New partnerships
   c. Potential for new technologies
   d. Marine Protected Area Center role
   e. R&D on new organisms with medicinal/commercial value
4. Who are the partners with the Agency in these activities
5. What are the compelling issues/hurdles/showstoppers
   Focus on capabilities, not resource issues
6. Recommendations for addressing the Presidential memo
   Refer to the five areas in the memo listed above

Meeting Notes

Introductions and Overview

Elgie Holstein

This activity capitalizes on a new interest at the highest political levels in ocean exploration. It will be difficult to meet the October 10 deadline in the President's memo without the input of the Task Force.

Barbara Moore

The 120 day timeframe in the President's memo means the report is due by Tuesday October 10, 2000. The memo outlines objectives and priorities for ocean exploration in 5 areas:

1. Define objectives and priorities to guide exploration, including identifying key scientific, historic, and cultural sites

2. Recommend ways to create new partnerships between educational, research, private sector, and government organizations.
3. Examine the potential for new technologies
4. Recommend mechanisms to ensure that information about newly explored areas requiring protection are referred to the Marine Protected Area Center
5. Recommend mechanisms to ensure that newly discovered organisms with medicinal or commercial potential are identified for possible research and development.

The Panel that will produce this report and will function as a working group of the NOAA Science Advisory Board (SAB).

Mike Uhart
Speaking on behalf of Al Beeton, Chair, NOAA SAB
The SAB is a FACA committee, the working group can be non-FACA, includes public and private participants. Fed Register Notices are not required for Oceans Panel meetings. The September 29, 2000 meeting of the NOAA SAB where the Panel report will be reviewed will be FACA compliant. However, a Federal Register notice will be sent out. The meeting will be in Washington, DC, the SAB nominated approximately 28 individuals for the Panel. The nominees include explorers, scientists, educators, and NGO representatives. The Chair of the SAB can make substitutions for those who are unavailable to participate

Michael Kelly
Panel Staff Support
Michael Kelly, NOAA Program Coordination Office- Support Team Leader
Claire Johnson, NOS
Christine Maloy, OAR
Information packets will be sent to the Panel members prior to the Panel meetings

Discussion

No agency should feel that they were not able to get their ideas across to the Panel. The Federal employees on the Panel were chosen for their particular expertise, not because of the agency they are currently with.
The first meeting of the panel is an opportunity for each agency to present their strategies/recommendations to the Panel.
The relationship to industry will be explored in the first day of the first Panel meeting. Specifically invite industry reps to participate- Chevron is a good candidate.

Agency Presentations

Each agency will do independent presentations, but move towards hitting the same points. Be up front about the fact that there was no coordination between agencies on the substance of each individual presentation. Let the Panel ask the agencies for more information, yet keep presentations short.

Objectives

Provide the Panel with background from each agency on their ocean exploration expertise and current activities.
Give the Panel the Agency view on the direction oceans exploration is heading in.
The template presented is a good starting point for each agency to organize itself, but may too specific, and lend itself too easily to getting away from the "bigger, more strategic picture" for the presentations to the Panel.
See the common themes and areas of coordination emerge through the string of agency presentations.
The goal is to think in big terms: near, medium, and long term objectives.

Suggested Presentations from other groups

- National Ocean Partnership Program
- Marine Protected Area Center
- IGOS
- Ocean Task Force—Ellen Athis at CEQ is heading this- their report is due out mid-September

NEXT INTERAGENCY TASK FORCE MEETING: Monday, August 28 (9:00 AM)
Tentative Agenda Items

Results of the first Panel meeting
Next steps for Task Force activity

Minutes

Oceans Exploration Interagency Task Force Meeting
Wednesday, September 6, 2000 2:00- 4:00 PM
1315 East West Highway Room 11836
Silver Spring, Maryland

Attendees:

Last Name	*First Name*	*Agency*	*Phone*	*Ext*	*Fax*	*E-mail*
Barrientos	Celso	NOAA	(301) 763-8102		(301) 763-8020	Celso.S.Barrientos@noaa.gov
Cuff	Tom	Navy	(202) 762-0251		(202) 762-0208	Cuff.Thomas@hq.navy.mil
Davies	Tudor	EPA	(202) 260-5403		(202) 260-5711	DaviesT@epa.gov
Gentry	Roger	NOAA	(301) 713-2322	155	(301) 713-4060	Roger.Gentry@noaa.gov
Guthrie	Hugh	DOE	(304) 285-4632		(304) 285-4469	hguther@netl.doe.gov
Johnson	Claire	NOAA	(301) 713-3000		(301) 713-4384	Claire.Johnson@noaa.gov
Maloy	Christine	NOAA	(301) 713-1671	142	(301) 713-1674	Christine.Maloy@noaa.gov
Moore	Barbara	NOAA	(301) 713-2427	127	(301) 713-1967	Barbara.Moore@noaa.gov
Myers	Ed	NOAA	(301) 713-2427		(301) 713-1967	Ed.Myers@noaa.gov
Rowles	Teri	NOAA	(301) 713-2322		(301) 713-4060	Teri.Rowles@noaa.gov
Silva	Robert	DOE	(202) 586-7297		(202) 586-6221	robert.silva@hq.doe.gov
Tenney	Anne	NSF	(703) 292-7578			atenney@nsf.gov
Turgeon	Ken	DOI	(703) 787-1726		(703) 787-1053	ken.turgeon@mms.gov

Action Items:

By Monday September 11, 2000:

- **Provide materials for boxes on programs or projects to Christine Maloy**
- **Provide information on current/planned agency programs to Christine Maloy**

By Wednesday September 20, 2000:

- **Draft report released for public comment**
- **9:00 am Next Interagency Task Force Meeting in NOAA conference room**

By Friday September 22, 2000:

- **Provide comments on draft report for inclusion in report version to be discussed by SAB on Friday September 29, 2000**
- **Provide one paragraph summary of Agency Presentation from August Panel meeting to be included in the final report**

Re-send any materials sent to Michael Kelly to Christine Maloy at christine.maloy@noaa.gov by COB Monday September 11, 2000.

1. Overview of the August 22-23, 2000 Panel Meeting in Arlington, VA

General

Panel now writing first draft of report

Robert Frosch will be off the panel—he is unable to be at the Panel meeting in Monterey

Agency and Private Sector entities presentations up on the Panel Web site at http://oceanpanel.nos.noaa.gov

Claire Johnson will get NSF, DOE and EPA presentations on the Web site as soon as possible

Budget information on current and planned programs- any information that was e-mailed to Michael Kelly, please forward to Christine Maloy.

Michael is currently on travel and does not have access to his email.

Closed session results- four subgroups formed, each writing chapter of final report:

1) Partnerships
(international, industry, education, government, research…)
Members: Merrell (chair), Orcutt, Sissenwine, Sexton, Maxwell, Hendrickson, Frosch
2) Technology
Members: Fornari (chair), Earle, Lindstrom, Embley, Morrison, Ballard, Gordon, Curtin
3) Mechanisms to get information for protection
Members: Grassle (chair), Douglas, Ausubel, Schwab, Pikitch
4) Transition to pre-commercial research and development
Members: Pomponi (chair), Alexander, Chance, Stein

2. Review Draft Report materials received as of September 6, 2000

Chapter 1 of report, concerning the objectives and priorities of a National Ocean Exploration Strategy, was mostly written by Panel Chair, Marcia McNutt. It has been circulated for comment.

Task Force members can forward comments on Chapter 1 to Christine Maloy by COB Monday September 11

Budget numbers the Interagency Task Force has been asked to provide on current and planned Ocean Exploration activity

- Deal in generalities
- Budget numbers are only intended to show order of magnitude of programs
- Budget numbers will be reviewed carefully, recommend that they not be published in the Panel's final report

3. Discussion of report process and roles:

Task Force:

By Monday September 11:

- Provide any material for boxes (programs or projects) to Christine Maloy
- Provide information on current/planned agency programs to Christine Maloy

On Wednesday, September 20:

- Next Interagency Task Force Meeting, 9:00 AM in the NOAA conference room (SSMC 3, 11th floor large conference room)

By Friday September 22:

- Provide comments on the report released for public comment on September 20
- Teri Rowles will alert marine research listservs that the report will be on the Ocean Panel Web site for public review

Agency Advisors:

Encouraged to participate with the Panel in the September 14-15, 2000 meeting in Monterey

4. Preparation for the September 14-15, 2000 Panel meeting in Monterey, CA

- Discuss with the panel how public comments received before the September 29 SAB meeting are to be handled
- Make sure Panel has an outline of recommendations by the end of the Monterey meeting

Panel Schedule:

- Friday September 8: Draft sections of report due to Michael Kelly
- Wednesday September 13: Travel to Monterey, CA
- Thursday-Friday September 14-15: Second Panel Meeting, Monterey, CA
- Monday September 18: Revised draft report compiled
- Wednesday September 20: Report released for public comment
- Friday September 29: SAB meeting
- Report will be discussed during public session in the morning

5. Review the list of current and proposed ocean exploration activities provided by the agencies presented on the Task Force

6. Discussion of any obstacles agency representatives are aware of that may hold up the report approval process in early October.

- Difficult to determine until draft report can be reviewed in it's entirety
- Definition of Ocean Exploration may be problematic
- Budget numbers may pose problems-
- Recommend that specific numbers be kept out of this report
- Focus on grand strategy instead

Contacts:

OSTP: Martin Offutt
CEQ: Randy Beardsworth or Ellen Athis
OMB: Probably the NOAA OMB examiners

7. Next Task Force Meeting Scheduled for Wednesday September 20, 2000
1315 East-West Highway (SSMC-3), Room 11836
Silver Spring, MD 20910

8. NOAA Science Advisory Board public meeting Scheduled for Friday September 29, 2000:

Main Commerce Building
14th Street and Constitution Avenue, NW
Room 1414

Ocean Exploration Panel Report tentatively scheduled for discussion in the morning.

Oceans Exploration
Interagency Task Force Meeting
Wednesday, September 20, 2000
SSMC 3 Room 11836
Silver Spring, MD 20910

Action Items:

- **Each Agency to send in one paragraph on what they do in Ocean Exploration by COB Friday September 22, 2000**

- **Claire Johnson will send notice to all Task Force members on where to e-mail comments on the report**

Monterey Meeting Summary and Next Steps for the Report

- Came out with report in draft form, not polished
- Agreement from everyone at the meeting on contents of Executive Summary
- Draft report will not be put on the Ocean Panel website
- Task Force comments on the Report are due by Friday September 22, 2000 COB
- Boxes will be distributed for comment today
- Agencies asked to submit paragraphs on current exploration activities for inclusion in report appendix by Friday September 22, 2000 COB
- Report will go to the NOAA Science Advisory Board in more polished draft form, including boxes on Monday September 25, 2000
- September 29 SAB meeting- report will be discussed/passed by the SAB
- October 10- Report sent to the President
- October 17- MPA Center event- possible to fold report presentation into this event
- Michael to talk to NOAA Senior Management about this

Comments from the Task Force on the draft report

- DOE Box on Conoco, Industry cooperation on the seafloor platform is missing from draft
- boxes
- Lack of acknowledgement of work done before
- Navy and Industry in particular
- Concept of leveraging current work to springboard future exploration is missing
- Idea is to complement/supplement what is already being done
- Clarify what the $75 million is for
- Be clear on what is included/excluded from the capitalization
- Concept of the Forum or yearly/semi-annual review needs more discussion
- Concept of grants meaning data is gathered for the public good should focus only on exploration grants
- This resolves the problem of data gathered for research, which is not typically immediately available in the public domain

Report Clearance Process

- Michael Kelly meeting with NOAA upper management today to discuss
- As far as publicity of the report, most people will only see press releases or website blurbs

Friday September 29, 2000 NOAA Science Advisory Board Meeting

- Starts at 9:00 in HCHB 4830
- Open to the public in the morning, when the Panel Report will be considered
- The three SAB members who were on the Panel will be at the meeting
- Task Force members are encouraged to attend

Greenwood Bill (HR 2090)

- Included provisions from the Ocean Panel's directive in the bill
- This went through House Resources, not House Science
- Good intentions, but not the best approach
- The Administration did not put out a SAP on this bill
- The position of record is NOAA's earlier testimony
- This is an authorization, not an appropriation

National Oceanic and Atmospheric Association
Science Advisory Board Report
President's Panel Report on Ocean Exploration

1) The SAB wishes to express its profound respect and appreciation to the members of the Ocean Exploration Panel who contributed their time and expertise in the preparation of the report "Discovering the Earth's Final Frontier" and urges the Administrator of NOAA and the Secretary of Commerce to provide special recognition to the members of the Panel for their public service;

2) The SAB extends special appreciation to the Panel's Chair, Dr. Marcia McNutt, and the agency staff, Barbara Moore, Michael Kelly, Christine Maloy and Claire Johnson, who performed the substantive work of report preparation;

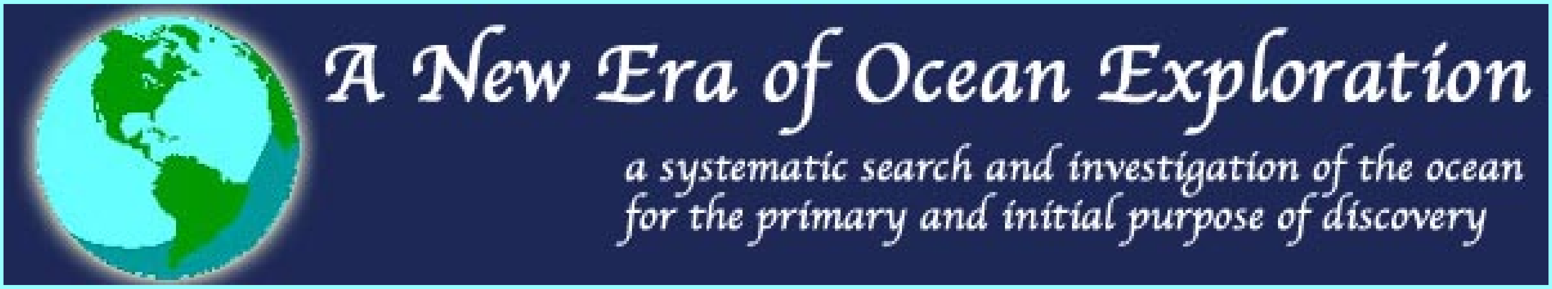
3) The SAB has reviewed the Ocean Exploration Panel's report and hereby adopts the report and further hereby authorizes the SAB Chair and the Panel's Chair, Dr. McNutt to make any additional minor changes they deem necessary and appropriate;

4) The SAB, in its letter of transmittal, recommends that the President, upon receipt of the report entitled, "Discovering Earth's Final Frontier", expeditiously establish an interim taskforce to prepare recommendations for the implementation of the report, including identification of possible institutional organizational arrangements, that can be used to inform future discussions relative to ocean exploration and in order to maintain the momentum now established to carry out the Nation's ocean exploration strategy.

5) The SAB, in adopting the report, "Discovering Earth's Final Frontier", recognizes that this report is a historic accomplishment because it is the only national strategy proposed for exploration of the global oceans by any country in the world;

6) The SAB also requests that the Administrator, when appropriate, transmit a copy of this report to the soon to be constituted National Ocean Commission and Pew Ocean Commission for their consideration and use.

7) The SAB also urges that the data collection, storage and transmittal procedures called for in the report include coordination and possible integration into existing or emerging international data collection and retrieval systems or programs.



Main Page

Background

Calendar of Events

Ocean Exploration Panel

Meeting Information

Ocean Exploration Panel

President Clinton's Ocean Exploration Directive has requested that the Department of Commerce consult with NASA, EPA, U.S. Navy, Department of the Interior, among other agencies to convene a panel of leading ocean explorers, scientists and educators to provide recommendations for a national oceans exploration strategy. Members of the Ocean Exploration Panel were nominated and selected by NOAA's Science Advisory Board (SAB). Agency Science Advisors have been selected to provide technical expertise to the Panel in various specific fields. The Panel is also supported by the Interagency Task Force, which is comprised of representatives from the various organizations that the Department of Commerce is consulting.

Ocean Exploration Panel

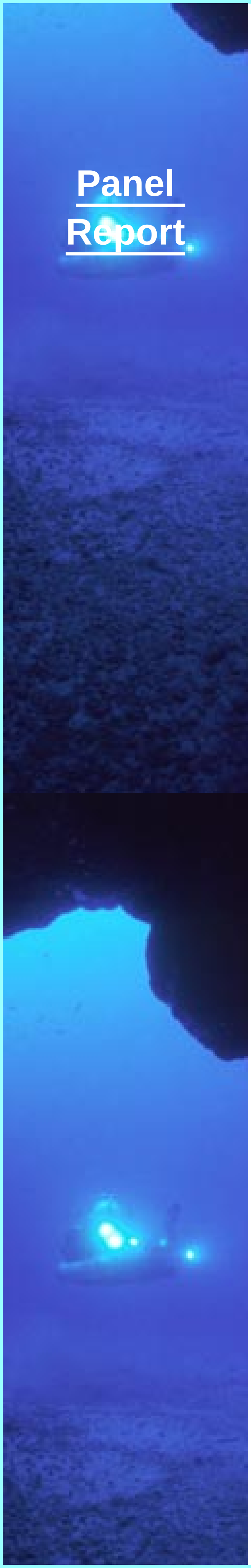
Agency Science Advisors

Interagency Task Force

Ocean Exploration Panel Members

Chair

Dr. Marcia McNutt	**Director** **Monterey Bay Aquarium Research Institute**



Panel Members

Dr. Vera Alexander	Dean School of Fisheries and Ocean Sciences University of Alaska, Fairbanks
Mr. Jesse Ausubel	Program Director Alfred P. Sloan Foundation
Dr. Robert Ballard	Explorer-in-Residence National Geographic Society
Mr. Thomas Chance	President C & C Technologies, Inc.
Mr. Peter Douglas	Executive Director California Coastal Commission
Dr. Sylvia Earle	Explorer-in-Residence National Geographic Society
Dr. James Estes	Adjunct Professor University of California, Santa Cruz Department of Biology
Dr. Dan Fornari	Chief Scientist for Deep Submergence Woods Hole Oceanographic Institution
Dr. Arnold L. Gordon	Head of Physical Oceanography Lamont-Doherty Earth Observatory, Columbia University
Dr. Fred Grassle	Director Marine and Coastal Science Rutgers University
Ms. Susan Hendrickson	Underwater Archeologist
Ms. Paula Keener-Chavis	President National Marine Educators Association
Dr. Art Maxwell	Professor Emeritus University of Texas
Dr. Larry Mayer	Director, Center for Coastal and Ocean Mapping, University of New Hampshire
Dr. William J. Merrell	President The H. John Heinz III Center
Dr. John Morrison	Professor of Oceanography North Carolina State University
Dr. John Orcutt	Director Scripps Institution of Oceanography Green Institute of Geophysics and Planetary Science

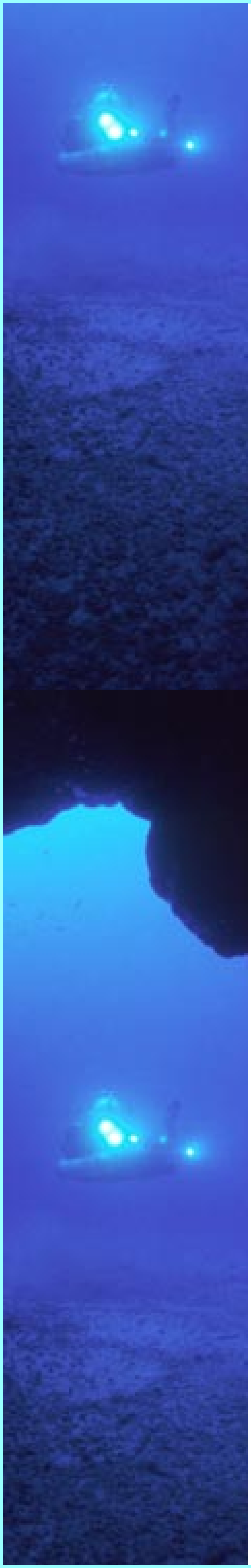
Dr. Ellen Pikitch	**Director** **Marine Conservation** **Wildlife Conservation Society**
Dr. Shirley Pomponi	**Director** **Division of Biomedical Marine Research** **Harbor Branch Oceanographic Institution**
Ms. Ursula Sexton	**NSTA Teacher of the Year**
Dr. Jeffrey Stein	**Quorex Pharmaceuticals, Inc.**

TOP

These Science Advisors have been selected as representatives from different agencies that will provide technical expertise to the Panel in various specific fields.

Agency Science Advisors

George Boehlert	**NOAA**
Joan Cleveland	**Navy**
Tom Curtin	**Navy**
Bob Embley	**NOAA**
Eric Lindstrom	**NASA**
Mike Purdy	**NSF**
Michael Reeve	**NSF**



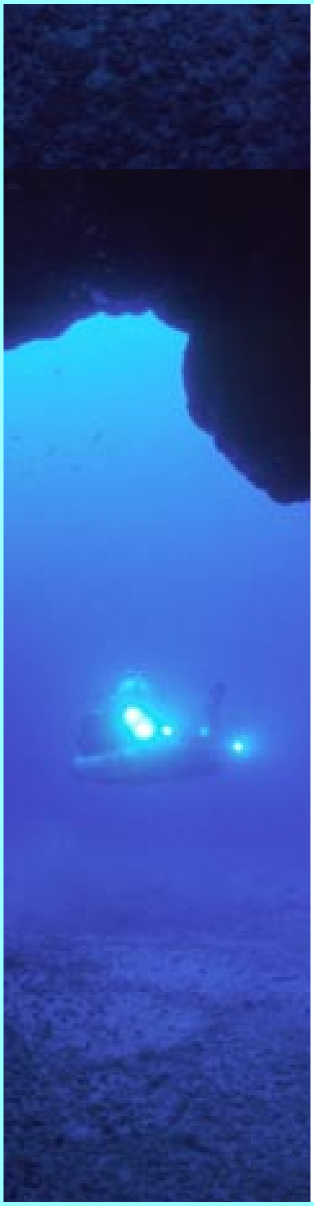
Bill Schwab	USGS
Michael Sissenwine	NOAA
Richard Spinrad	Navy

TOP

The Interagency Task Force is comprised of representatives from various organizations that are working with the Department of Commerce and will be supporting the Ocean Exploration Panel in these recommendations to President Clinton.

Interagency Task Force

Dan Basta	NOAA	301.713.3125 ext. 110
Elizabeth Clarke	NOAA	301.713.1875 ext. 159
Dennis Conlon	ONR	703.696.4720
Thomas Cuff	ONR	202.762.0251
Tudor Davies	EPA	202.260.5403
Hugh Guthrie	DOE	304.285.4632
John Haines	USGS	703.648.6422
Barbara Moore	NOAA	301.713.2427 ext. 127
Norine Noonan	EPA	202.564.6620



Tom Pyle	NSF	703.292.8029
Robert Silva	DOE	202.586.7297
Richard Spinrad	US Navy	202.762.1697
Joseph Strakey	DOE	412.386.6124
Anne Tenney	NSF	703.292.7578
Bradley Tomer	DOE	304.285.4692
Ken Turgeon	DOI	703.787.1726

TOP

For more information on the NOAA Science Advisory Board

TOP OF PAGE

A New Era of Ocean Exploration

a systematic search and investigation of the ocean for the primary and initial purpose of discovery

Meeting Information

The scheduled meetings are listed below with pertinent information available for each of them. Please direct any questions to Michael Kelly.

Agency Presentations from the August 22-23, 2000 Panel meeting.

August 4, 2000

Interagency Task Force Meeting

NOAA Headquarters (SSMC 3, 11th floor, Room 11836)
Silver Spring, Maryland

August 4th Task Force Minutes *(32 kb, PDF)* This document contains meeting discussion, action items and other pertinent information obtained during the Interagency Task Force meeting.

August 22—23, 2000

Ocean Exploration Panel Meeting

Key Bridge Marriott
1401 Lee Highway
Arlington, VA 22209
703.284.1460
Fax: 703.243.3280

Meeting Information

Agenda *(32kb, PDF)* The agenda for the August 22-23 meeting in Washington, DC is now available for the Ocean Exploration Panel and Interagency Task Force members.

Agency Presentations

NOAA Presentation *(922 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

Navy Presentation *(24 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

MMS Presentation *(420 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

USGS Presentation *(416 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

NASA Presentation *(3.7 mb, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

DOE Presentation *(1.1 mb, PDF)* This presentation to the Ocean Exploration

Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

EPA Presentation *(992 k, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

NSF Presentation *(960k, PDF)* This presentation to the Ocean Exploration Panel reviews the agency definition of ocean exploration, short and long-term objectives, current or planned agency objectives, partnerships and compelling issues, hurdles and showstoppers.

TOP

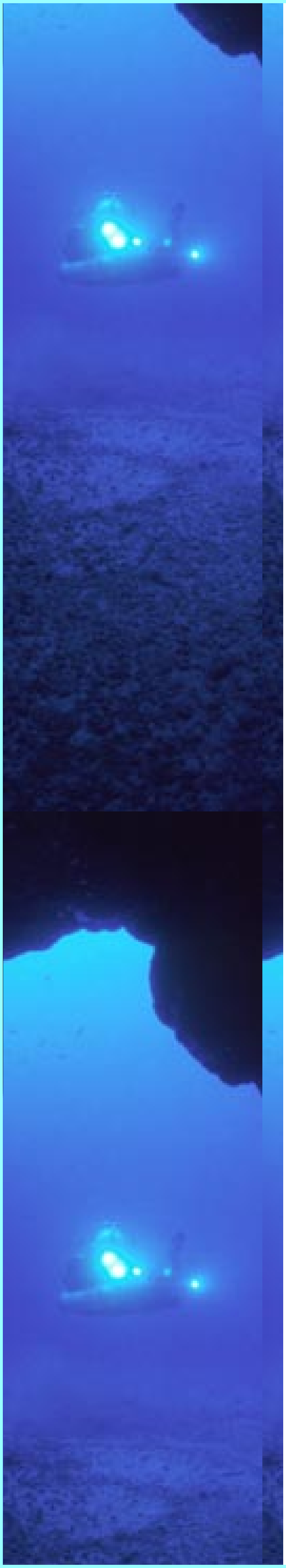
Other Agency Presentations

Center for Marine Conservation Presentation *(24 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the company's definition of ocean exploration, short and long-term objectives, current or planned objectives, partnerships, compelling issues, hurdles and showstoppers and recommendations to the panel.

Oceaneering Presentation *(32 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the company's definition of ocean exploration, short and long-term objectives, current or planned objectives, partnerships, compelling issues, hurdles and showstoppers and recommendations to the panel for a national strategy on ocean exploration.

TomoSeis Presentation *(704 kb, PDF)* This presentation to the Ocean Exploration Panel reviews the company's definition of ocean exploration, short and long-term objectives, current or planned objectives, partnerships, compelling issues, hurdles and showstoppers and recommendations to the panel for a national strategy on ocean exploration.

NOIA Presentation *(3 mb, PDF)* This presentation to the Ocean Exploration Panel reviews the company's definition of ocean exploration, short and long-term objectives, current or planned objectives, partnerships, compelling issues, hurdles and showstoppers and recommendations to the panel for a national strategy on ocean exploration.



September 6, 2000

Interagency Task Force Meeting

NOAA Headquarters (SSMC 3, 11th floor, Room 11836)
Silver Spring, Maryland

September 6th Task Force Minutes *(32 kb, PDF)* This document contains action items, overview of the first Panel meeting and other information important to the Interagency Task Force.

September 14—15, 2000

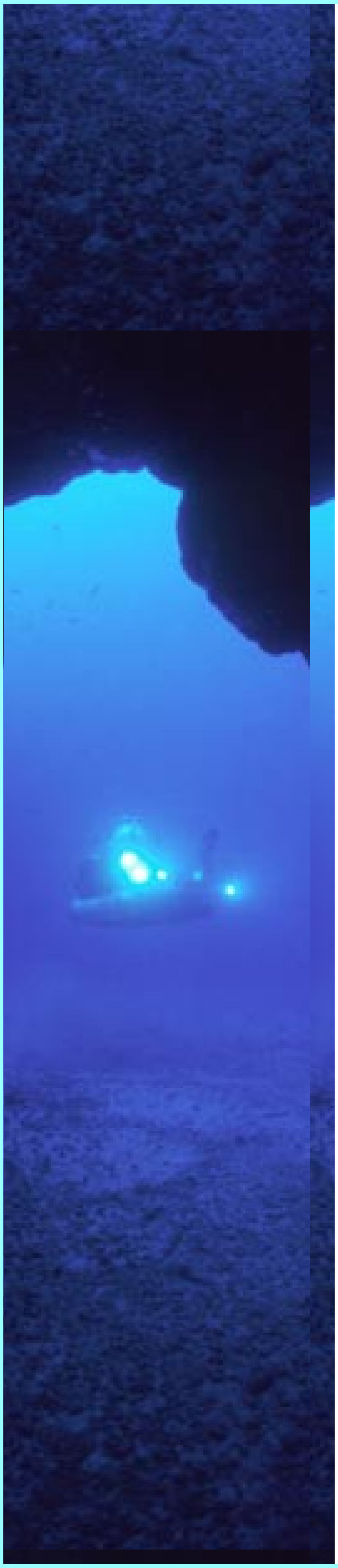
Ocean Exploration Panel Meeting

Hilton Monterey Hotel
1000 Aguajito Road
Monterey, CA 93940
831.373.6141
Fax: 831.655.8608

Meeting Information

Agenda *(32 k, PDF)* The agenda for the September 14-15 meeting in Monterey, CA is now available for the Ocean Exploration Panel members and Agency Science Advisors.

September 20, 2000



Interagency Task Force Meeting

NOAA Headquarters (9:00-10:30 AM, SSMC 3, 11th floor, Room 11836)
Silver Spring, Maryland

Agenda *(64 k, PDF)* The agenda for the September 20 Interagency Task Force meeting.

September 20 Task Force Minutes *(64 k, PDF)* This document contains action items, overview of the first Panel meeting and other information important to the Interagency Task Force.

September 29, 2000

NOAA Science Advisory Board Meeting

Herbert C. Hoover Building (HCHB), Rooms 6800 and 6802
14th and Constitution N.W.
Washington, DC

NOAA Science Advisory Board Report *(64 kb, PDF)* A summary of the NOAA Science Advisory Board meeting in reference to the Panel report entitled **"Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration"**.

TOP OF PAGE

Ocean Exploration Panel Meeting
Washington, D.C.

August 21, 2000

5:00 p.m. to 7:30 p.m.	Panel Reception Secretary's Dining Room US Department of Commerce

August 22, 2000

8:30 a.m. to 2:30 p.m.	Interagency Task Force Presentation Key Bridge Marriott Hotel
2:30 p.m. to 4:30 p.m.	Public Session Key Bridge Marriott Hotel
6:30 p.m. to 8:00 p.m.	Panel Reception Key Bridge Marriott Hotel

August 23, 2000

8:30 a.m. to 3:30 p.m.	Closed Working Session Key Bridge Marriott Hotel

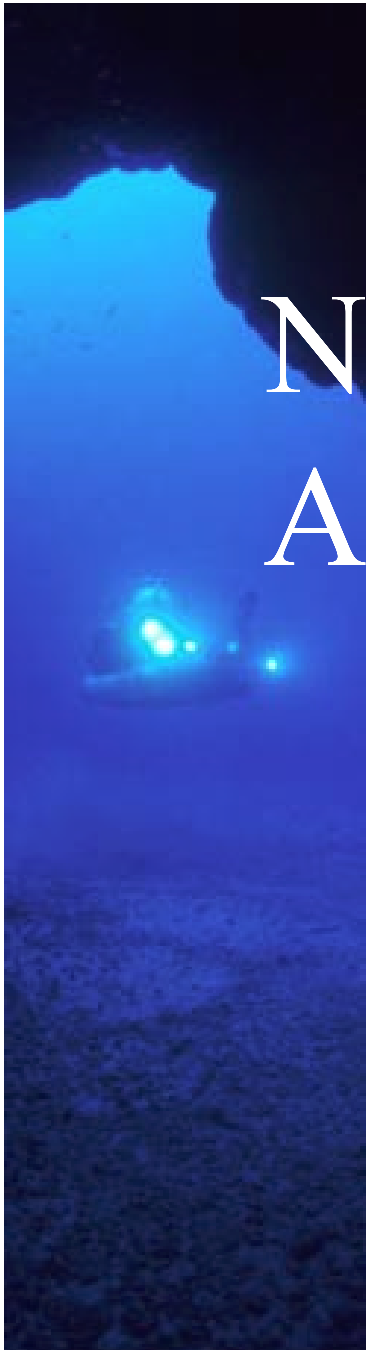
Ocean Exploration Panel Meeting
Key Bridge Marriott Hotel
August 22, 2000

AGENDA

8:30 a.m.	Welcome by Mr. Elgie Holstien Senior Advisor to the Secretary, NOAA
8:40 a.m.	Remarks by U.S. Secretary of Commerce, Mr. Norman Mineta
9:00 a.m.	Introduction of Interagency Presentations and Process, David Evans Introduction of Dr. Marcia McNutt
9:15 a.m.	Agency Presentations
10:45 a.m.	Morning Break
11:00 a.m.	Agency Presentations
12:30 p.m.	Lunch Break
1:30 p.m.	Agency Presentations
2:30 p.m.	Public Presentations
3:15 p.m.	Afternoon Break
3:30 p.m.	Other Public Input
4:30 p.m.	Closed Session
6:30 p.m.	Panel Reception Key Bridge Marriott Madison Room (3rd floor)

Ocean Exploration Panel Meeting
Key Bridge Marriott Hotel
August 23, 2000

8:30 a.m.	Panel reconvenes in closed session
8:30-9:00	Organization of panel's charter into subsections for the report
9:00-9:30	Define membership of breakout groups
9:30-12:00	Subgroups work on sections of report, integrating agency input from previous day into an outline
12:00-1:00	Working lunch (?) with presentation of outlines by subgroup leaders
1:00-3:00	More work in subgroups
3:00-3:30	Reconvene to discuss assignments and timeline for completing
3:30	Adjourn



National Oceanic and Atmospheric Administration

A New Era of Ocean Exploration

Ocean Exploration Panel
August 22, 2000

Ocean Exploration

Exploration is the systematic search and investigation for the initial purpose of discovery

- **Multi dimensional in time and space**
- **Directed and driven by scientific and management needs**

Ocean Exploration Panel
August 22, 2000

Our Mission

- Describe and predict changes in earth's environment
- Conserve and wisely manage the Nation's coastal and marine resources

- **Exploration is first step in:**
  – Understanding earth's environment
  – Wise stewardship of resources
  – Understanding ecosystem functioning
  – Improving information for decision-making

Our Objectives

- **Find new resources**
  - Bioprospecting; materials from exotic species
  - New life forms
  - Gas hydrates & associated ecosystems
  - Mineral rich geologic deposits
- **Protect, develop, and conserve poorly understood resources**
  - Unexplored fisheries and other life forms, their habitats and ecosystems
  - Deep corals and live bottoms
  - Cultural heritage
    - shipwrecks and submerged cultural resources

Our Objectives

- **Understand Ocean Noise**
  - Natural sound levels
  - Human induced
  - Effects on marine animals
- **Technologies to Support Exploration**
  - Access to remote, difficult environments, surface to sub seafloor
  - Long-term observations and sampling -- biota and environment
- **Education and Outreach**
  - Build ocean constituency
  - Educate public on ocean issues
  - Increase public participation

Existing NOAA Exploration

- National Undersea Research Program
- Sustainable Seas Expeditions
- VENTS
- Miscellaneous Efforts

Existing NOAA Exploration

- **Miscellaneous Efforts**
  - – Assess distribution and abundance of little known species
  - – Map and characterize habitats, including sanctuaries & potential protected areas
  - – Link physical, chemical, and acoustic data with ecosystem information
  - – Develop supporting technologies -- sampling gear, acoustic and optical systems
  - – Link satellite and airborne imagery to ecosystems

Planned NOAA Exploration

- **Ocean Exploration Initiative for FY 2002**
  - Discover new resources
  - Understand ocean sound
  - Explore frontier areas
  - Protect America’s maritime heritage
- **Education and Outreach**
  - Data management
- **Census of Marine Life**
- **Technology Development**
  - Fish and habitat assessment

Partnerships-Existing and New

- Academia
- Air Force
- NASA
- Navy
- USGS
- USCG
- DOE
- MMS
- NSF

- Jason Foundation
- Institute for Exploration
- National Geographic Society
- Discovery Channel
- Commercial Fishing Industry
- Recreational Fishing Industry
- JOI
- NGOs
- States

Technologies Used and Planned

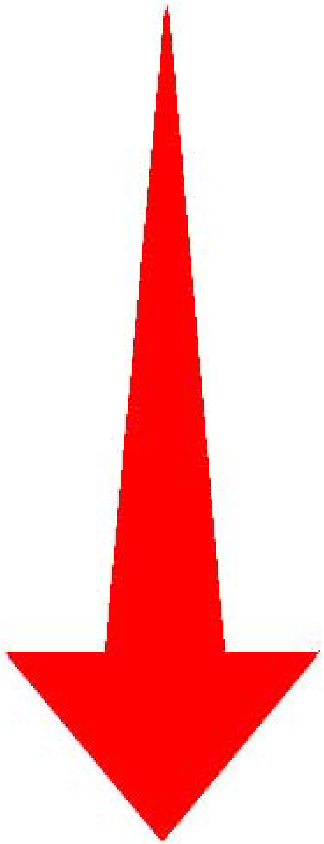
- Manned Submersibles
- ROVs
- AUVs
- Seafloor Observatories
- Underwater Laboratories
- Critter Cams
- Samplers, Sensors

- Survey & Mapping Technologies
- Communication Technologies

What We Know

- **Enormous potential payoff**
  - Biotechnology
  - New materials
  - Responsible stewardship
- **Little public awareness of benefits**
- **Americans love exploration and new frontiers**
- **Federal effort in ocean exploration is fractured, sporadic**
- **Partnerships and International collaboration -- essential**

What We Need

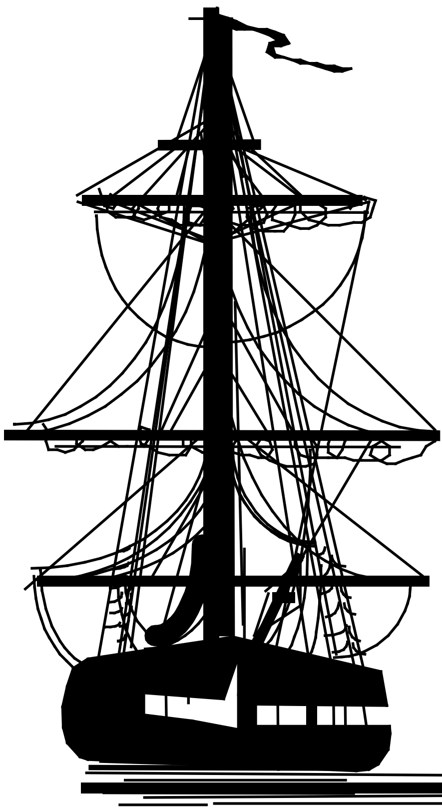


FUTURE VISION

- Technologies
- Expanded infrastructure
- Attract scientific specialists
- Create Ocean literacy
- Raise priority of exploration within DOC
- Unified Federal strategy

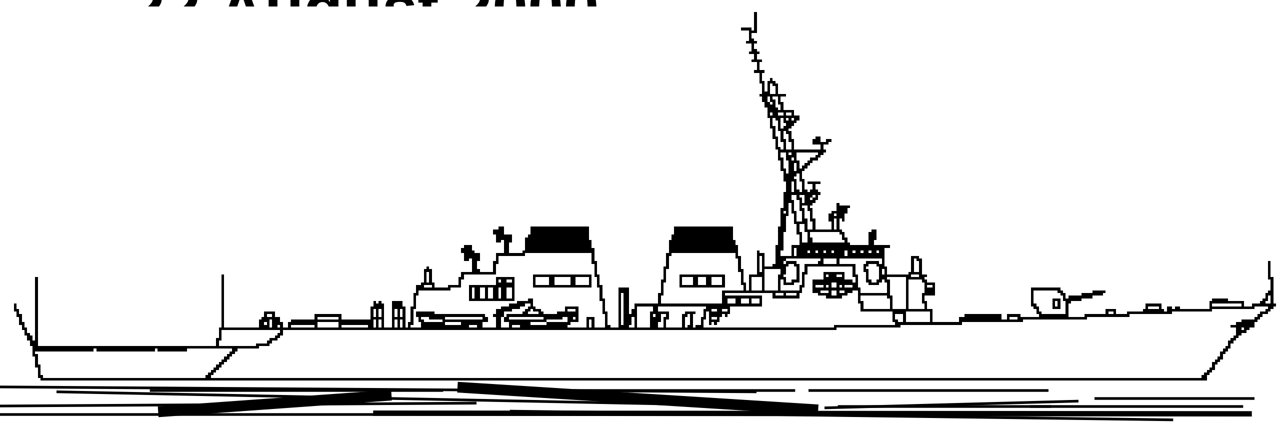
Panel on Ocean Exploration

Ocean Exploration in the U.S. Navy



Melbourne G. Briscoe
Office of Naval Research

22 August 2000



1769	Benjamin Franklin begins mapping the Gulf Stream (for faster mail service with Britain)
1775	Establishment of the U.S. Navy
1798	Establishment of the Department of the Navy
1830	Establishment of Depot of Charts and Instruments
1831	H.M.S. Beagle voyage begins
1837	Charts of Antarctica published from surveys of LT Charles Wilkes, head of the U.S. Exploring Expedition
1855	LT Matthew Fontaine Maury, “Pathfinder of the Seas,” first Hydrographer of the Navy, publishes first ocean textbook “The Physical Geography of the Sea”
1863	National Academy of Sciences formed as an advisory agency for the Navy Department
1872	H.M.S. Challenger Expedition begins, to investigate “everything about the sea.” All oceans but the Arctic.
1925	German Navy’s Meteor Expedition begins in S. Atlantic
1946	Office of Naval Research established
1950	National Science Foundation established
1957	International Geophysical Year (Antarctica)
1970s	International Decade of Ocean Exploration
1990s	U.S. Global Change Research program
2000s	???

Guidance

1. Agency definition of ocean exploration

2. Agency ideas on short, medium, and long term objectives/goals;
   Mission/vision in the area of ocean exploration

3. Which current or planned agency activities have ocean exploration elements

   Describe activities using the 5 elements from the directive:
   1. Scientific, cultural, and historical aspects
   2. New partnerships
   3. Potential for new technologies
   4. Marine Protected Area Center role
   5. R&D on new organisms with medicinal/commercial value

4. Who are the partners with the Agency in these activities

5. What are the compelling issues/hurdles/showstoppers
   Focus on capabilities, not resource issues

6. Recommendations for addressing the Presidential memo
   Refer to the five areas in the memo listed above

What is Ocean Exploration?

National Geographic Society:

one explores to obtain information about areas that are largely or completely unknown

Explorer's Club:

"field studies and scientific exploration"

National Science Foundation (IDOE):

systematic surveys of the world oceans, to support anticipated uses of marine resources and scientific curiosity

Navy definition: Ocean Exploration

Systematic examination ***for the purposes of discovery***; cataloging/ documenting what one finds; boldly going where no one has gone before; providing an initial knowledge base for hypothesis-based science and for exploitation.

What is NOT Ocean Exploration?

Hypothesis-based testing of scientific questions…

Suggested Interagency Long-term Objectives

Navy proposes the following topical areas as suitable for National commitments and interagency efforts in ocean exploration:

- Seafloor exploration & mapping (e.g., Neptune, GOMaP)
- Hyperspectral sensing from space
- Long-time series in U.S. waters as part of an integrated ocean observing system (OCEAN.US)
- Cooperative coastal efforts with other nations
- Inventories of marine life (***e.g.*** a census of marine mammals)
- Inventories of polar ice caps
- Marine archaeology

The Navy niche in these partnership efforts is a mixture of technology, data management, operational oceanography, cutting-edge science, and the opportunity for pure discovery.

Navy Activities in Ocean Exploration

A. ONR is evolving its overall Science and Technology programs into a two-part structure, each with about $600M/year:

- Discovery and Invention
- Exploitation and Delivery

Ocean Exploration – the quest for discovery – is aligned with the "D&I" thrusts. Ocean Science accounts for about $120M/yr of "D&I." Approximately 20% of Ocean Science is aimed at Exploration.

B. The Oceanographer of the Navy is responsible for all operational oceanography in Navy, including advanced R&D to support it. Ocean Exploration is an outcome and benefit of systematic ***in situ*** and remote data collection activities to map the ocean bottom and diagnose its structure and behavior in support of military operations. Science and exploitation are built upon these ocean survey results.

Navy Vision for National Goals in Ocean Exploration

- **U.S.-based: Describe the EEZ**

  Agency-academic-industrial partnerships to map the bottom and sub-bottom to high-resolution and to characterize the water column and its contents of the U.S. Exclusive Economic Zone and U.S. territorial waters, on a continuing basis for those aspects that vary with time, for purposes of discovery and to set the background for science and exploitation.

- **Global**

  - Census of Marine Life (including marine mammals)
  - Global Ocean Data Assimilation Experiment
  - Cooperative Coastal efforts through GOOS

Mechanism: ***interagency cooperation through NOPP***

President's Memo

- Define objectives and priorities to guide exploration, including identifying key scientific, historic, and cultural sites.
  Do not base solely on existing agency programs and initiatives.

- Recommend ways to create new partnerships between educational, research, private sector, and government organizations.
  Not needed; National Oceanographic Partnership Program in place.

- Examine the potential for new technologies.
  Historical Navy niche. Must include hyperspectral satellites, AUVs.

- Recommend mechanisms to ensure information about newly explored Areas requiring protection are referred to the Marine Protected Area Center.
  No Navy comment.

- Recommend mechanisms to ensure that newly discovered organisms with medicinal or commercial potential are identified for possible research and development.
  No Navy comment.

Mission -- 2-fold

❶ Manage the oil and gas and other mineral resources on the Outer Continental Shelf in a safe and environmentally sound manner

❷ Collect, verify and distribute mineral royalties from tribal and federal offshore and onshore lands

MMS Minerals Management Service U.S. Department of the Interior

MMS Research

- MMS conducts environmental and engineering research to provide information for management decisions on the leasing and development of oil and gas and hard mineral resources on the outer continental shelf

- MMS research is <u>directly focussed</u> to meeting management needs for informed decision making

MMS Minerals Management Service — U.S. Department of the Interior

- **MMS FY2000 env. res. budget is $19.5 million**

- **Most MMS research is conducted by others**

- **MMS researchers include:**
  - **> academia (universities and research institutions)**
  - **> private sector contractors (consulting firms)**
  - **> other federal agencies (NOAA, USGS, etc)**
  - **> state agencies**

- **MMS has cost-sharing env. research partnerships --*Coastal Marine Institutes*--with Louisiana, Alaska and California through LSU, UAKF and UCSB**

Exploration

- **Classical:** **"To go, at great risk, where no person has previously or successfully gone before for the purpose of discovery and knowledge"**

- **MMS mission related:** **"expand the boundaries of knowledge as it may be applied to protecting the environment, ensuring safe OCS mineral development, and providing for the availability of OCS mineral resources to the American public"**

MMS Minerals Management Service U.S. Department of the Interior

MMS "Exploration-related" Research

- **Deepwater research in the Gulf of Mexico**

  > search for chemosynthetic & other unique communities

  > marine mammal occurrences, distributions & abundance (recent sperm whale survey in the central GOM)

  > 3-d surface-to-bottom water transportation/movement

  > determine behavior of oil spills at depth

  > develop new techniques for locating historic ship wrecks

  > map gas hydrate formations and other geohazards

MMS "Exploration-related" Research

- **Alaska (harsh environment)**
  - > **Beaufort Sea shelf circulation & oceanography**
  - > **Benthic ecology of Stefansson Sound boulder patch**
  - > **satellite tagging of bowhead whales**
  - > **traditional knowledge of Alaska Inupiat**

- **Federal waters in general**
  - > **geological and geophysical--*seismic and vibracoring*-- field work to locate OCS sand resources**
  - > **testing of new technologies for locating sand resources**
  - > **improved telemetry tags for tracking marine mammals**

- **Marine Biotechnology -- new thrust for MMS**

recognizing concern for negative impacts that bioprospecting and bioharvesting could have on a region's marine ecology and biodiversity, MMS is entering into cost-shared partnerships with LSU and UCSB to investigate oil and gas platform "biofouling" species for active compounds with potential pharmaceutical and other commercial applications

Limitations to current research efforts

- **Technology:**
  - > **battery size/life for long-term remote tracking**
  - > **AUVs (to replace tethered ROVs)**
  - > **satellite sensors (need to be able to "see" below surface)**
  - > **integrated *real time* ocean observing/information system**

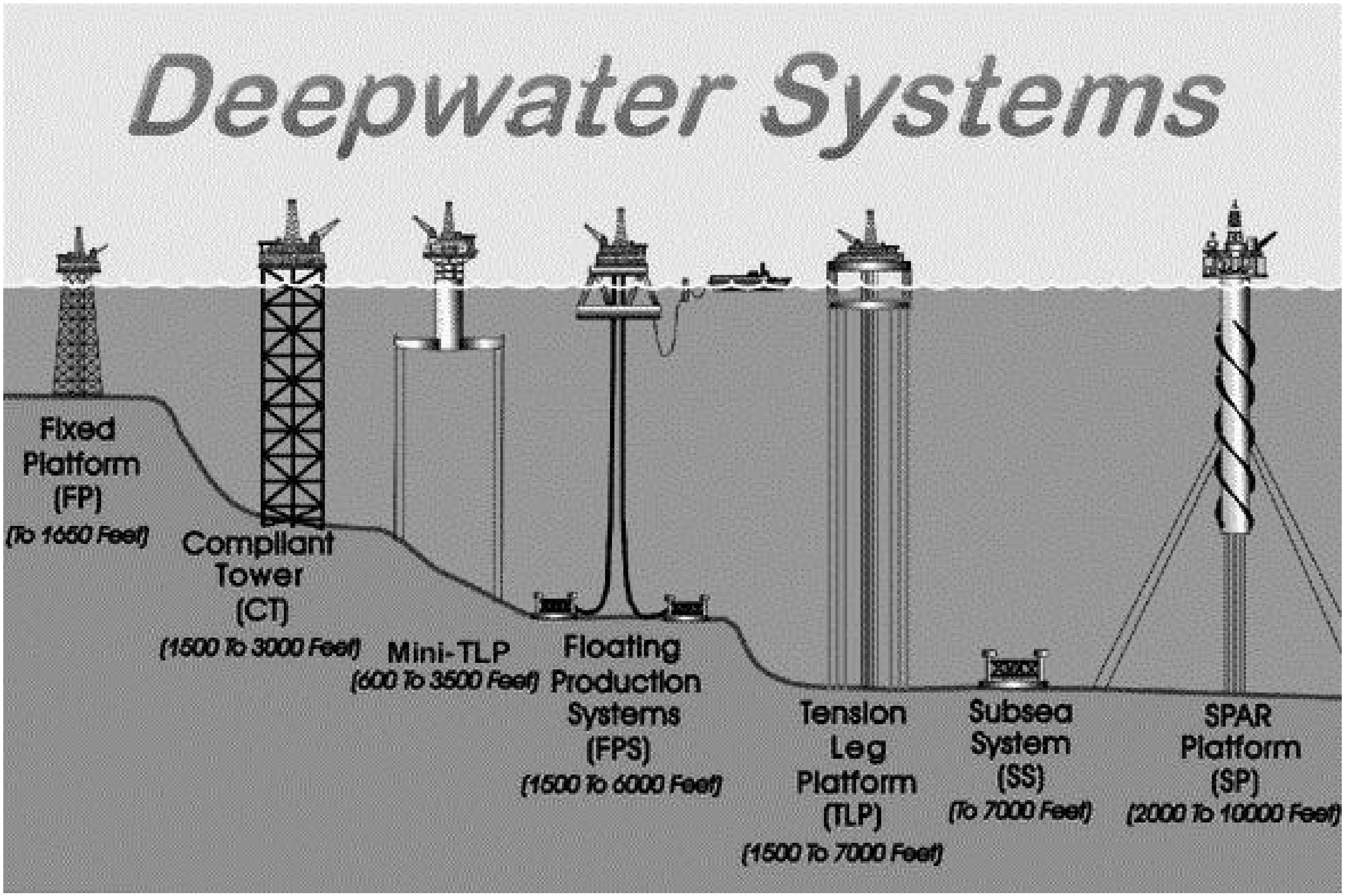
- **Taxonomists/Systematists -- a dying field????**

Potential future challenges for MMS

- **Development of methane hydrates for energy**
- **Deepwater OCS mining of strategic minerals**
- **Offshore oil and gas development in US Arctic seas**
  (some development exists in state and near-shore OCS waters)
- **Keeping up with industry's ability to drill and produce in greater and greater water depths**

MMS Minerals Management Service

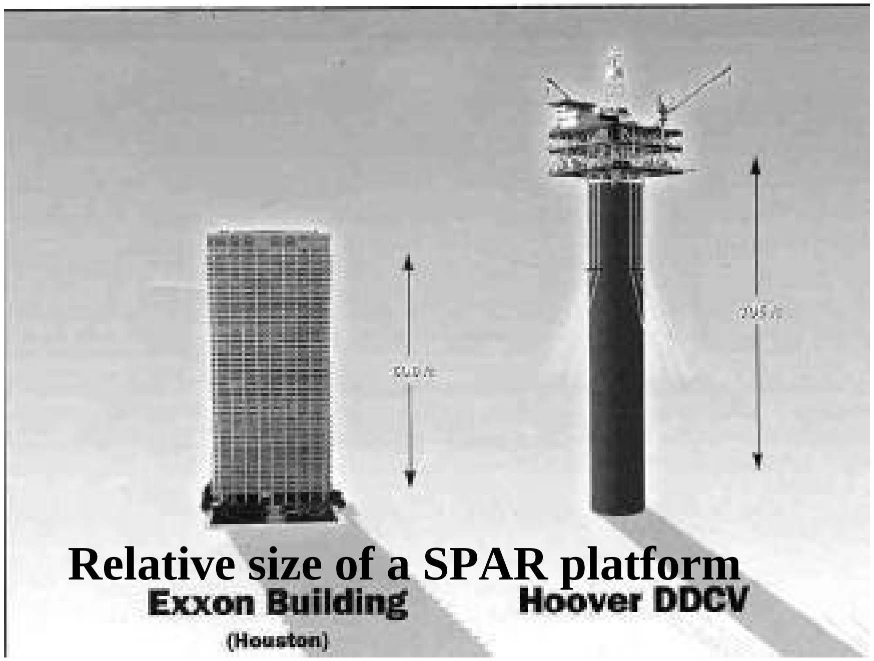
U.S. Department of the Interior



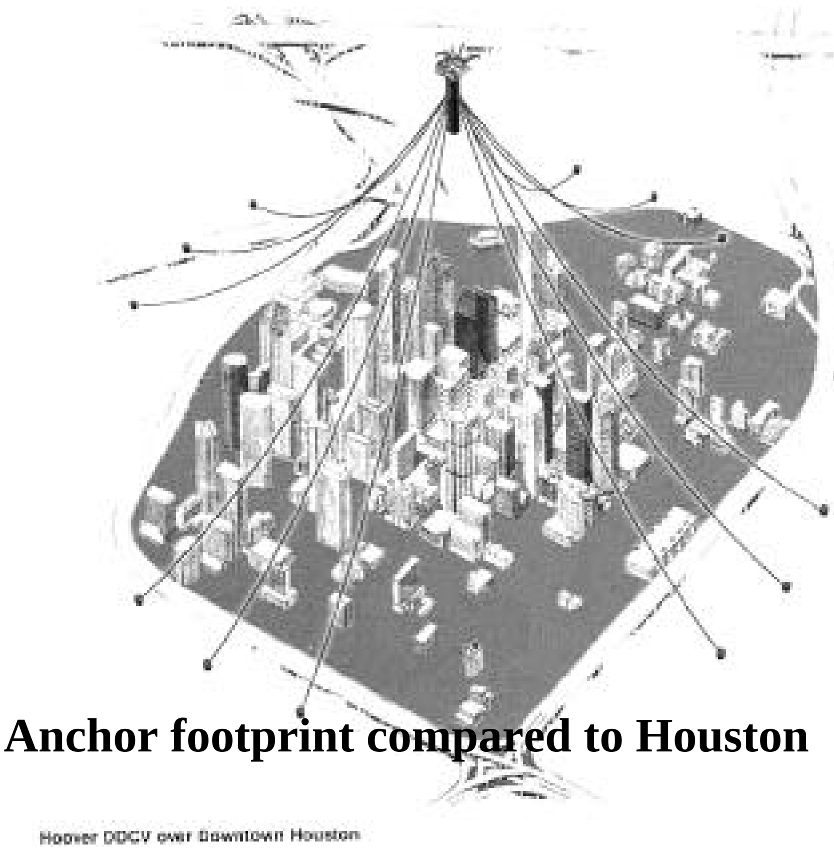
MMS

Floating production, storage and offloading system (FPSO)

Oil and gas industry considering using this technology in the deepwater Gulf of Mexico



Relative size of a SPAR platform



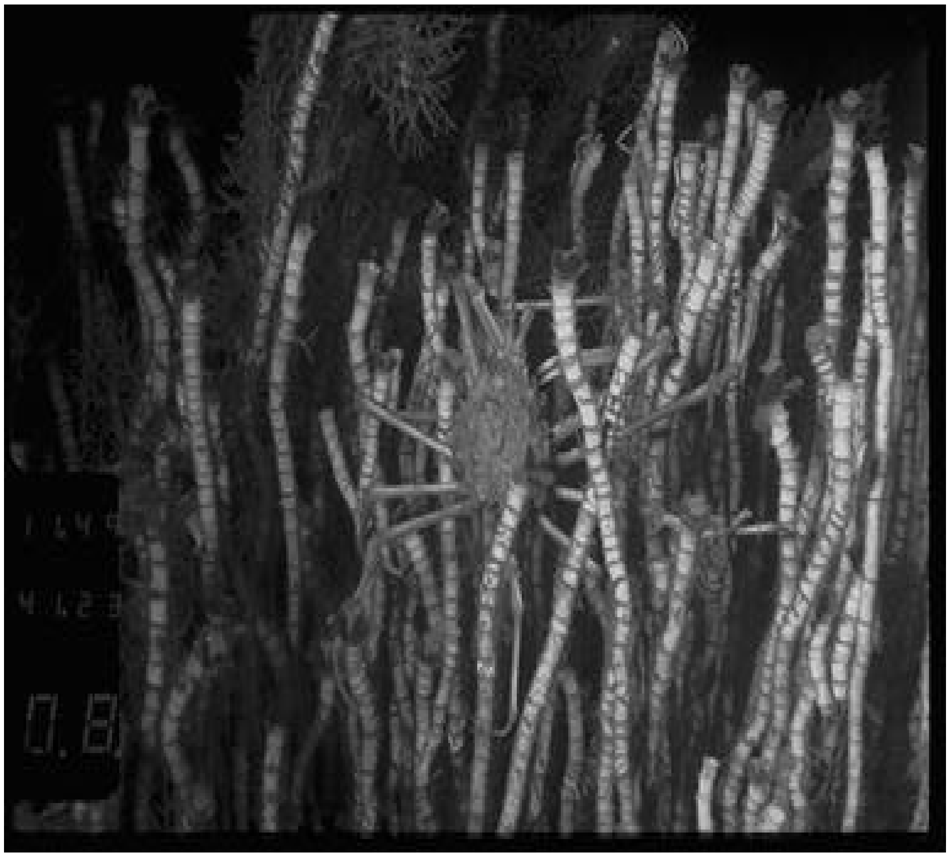
Anchor footprint compared to Houston

MMS

MMS sponsored chemosynthetic community research project: collecting tube worm samples

MMS

Chemosynthetic Communities in the Gulf of Mexico



Tube Worms

Mussels

MMS

New Species of Polychaete Worm on Methane Hydrate Outcropping

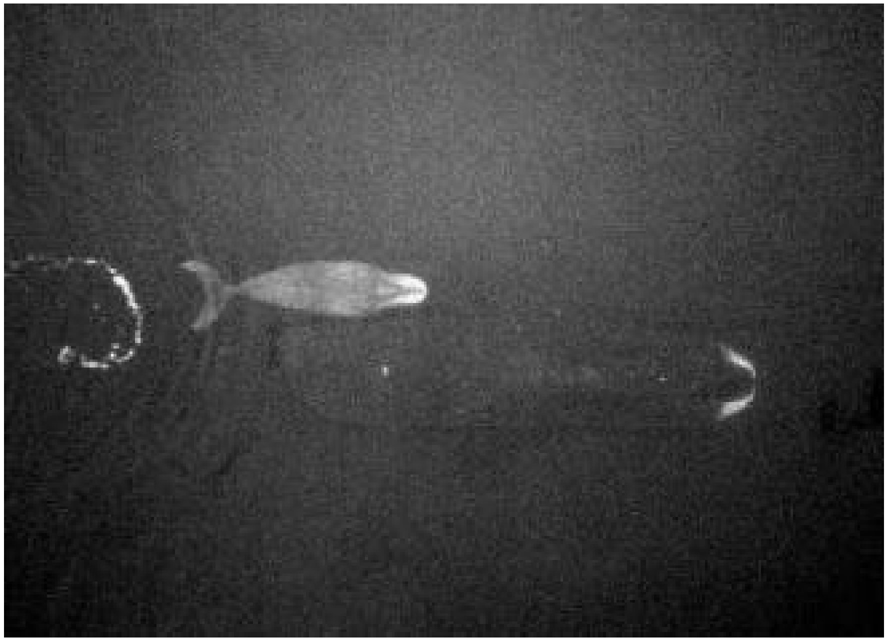
Discovered on a joint MMS-NOAA cruise in July 1997

Approx.
3 cm long

MMS

Two fin whales in the Gulf of Mexico

MMS



Bowhead whale and calf

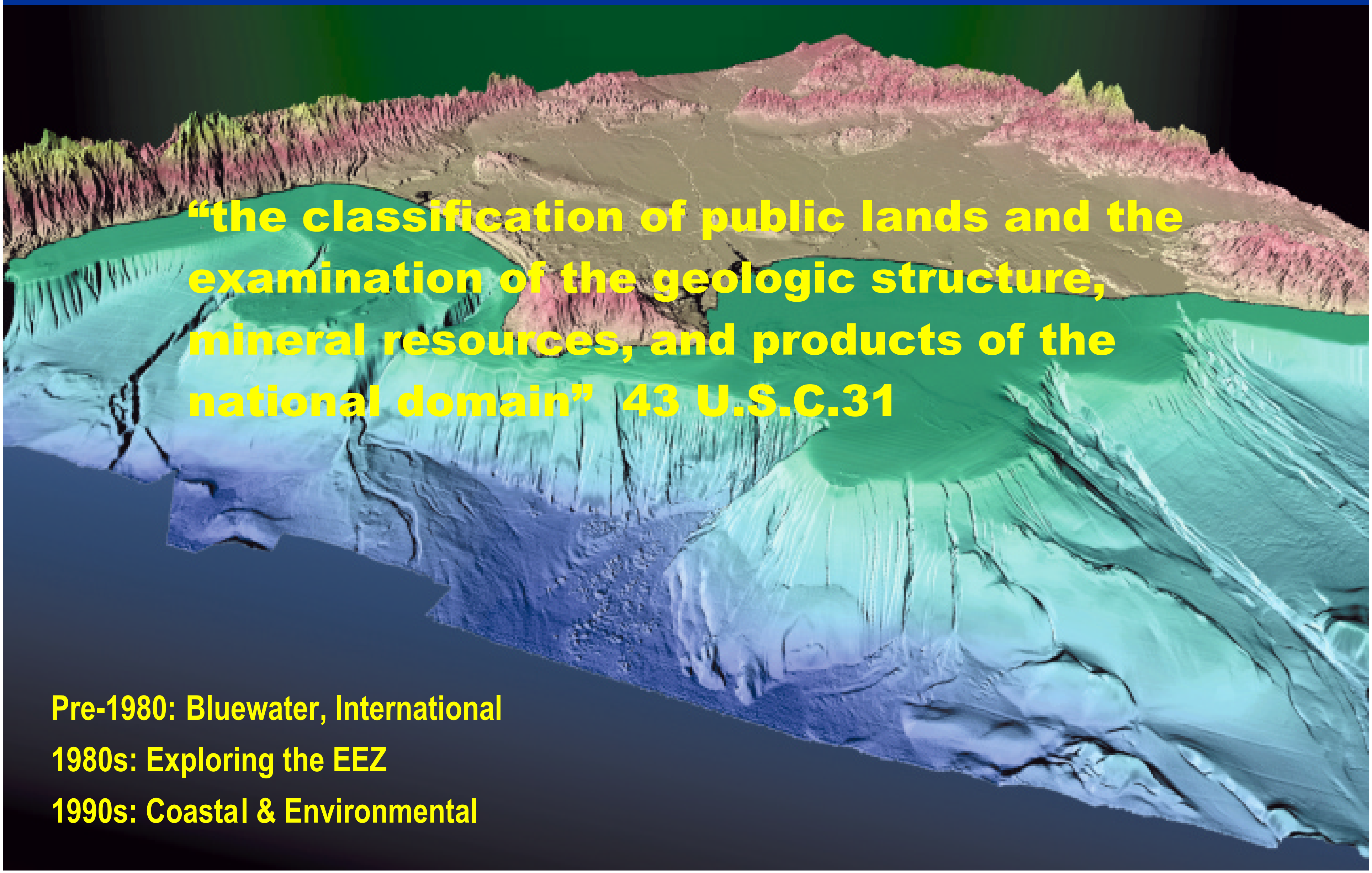
Inupiat hunters scanning for bowhead whales

MMS

“Biofouling” on offshore oil & gas platforms

MMS

USGS
science for a changing world

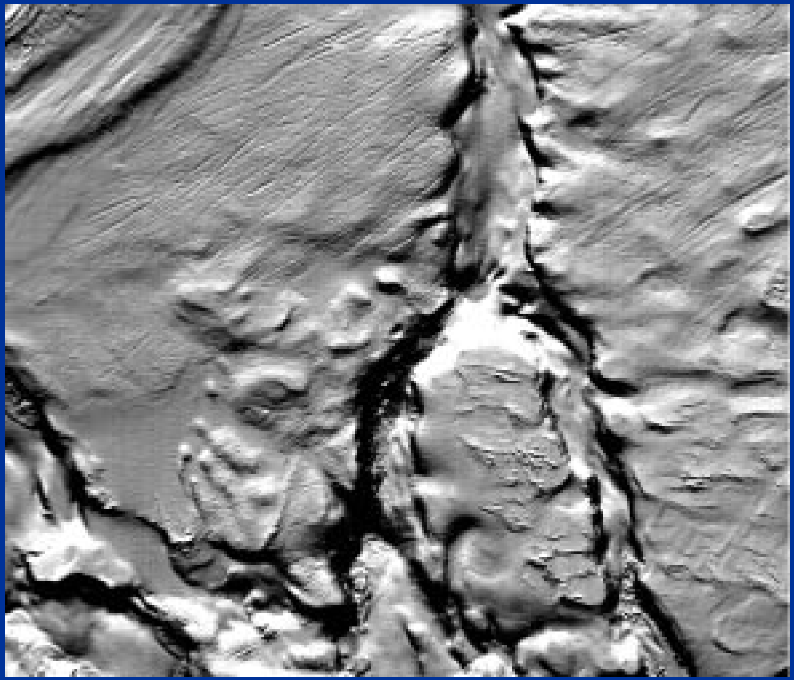


"the classification of public lands and the examination of the geologic structure, mineral resources, and products of the national domain" 43 U.S.C.31

Pre-1980: Bluewater, International

1980s: Exploring the EEZ

1990s: Coastal & Environmental



Stellwagen Bank Topography

HAZARDS: Earthquakes, Tsunami, Landslides
Storms, sea-level rise, erosion

ENVIRONMENT: Benthic Habitats, Corals, Wetlands
Pollution, Sanctuaries & MPAs

RESOURCES: Energy, Hydrates, Minerals, Water

ALL require a regional *description* and *understanding* of geologic framework and processes

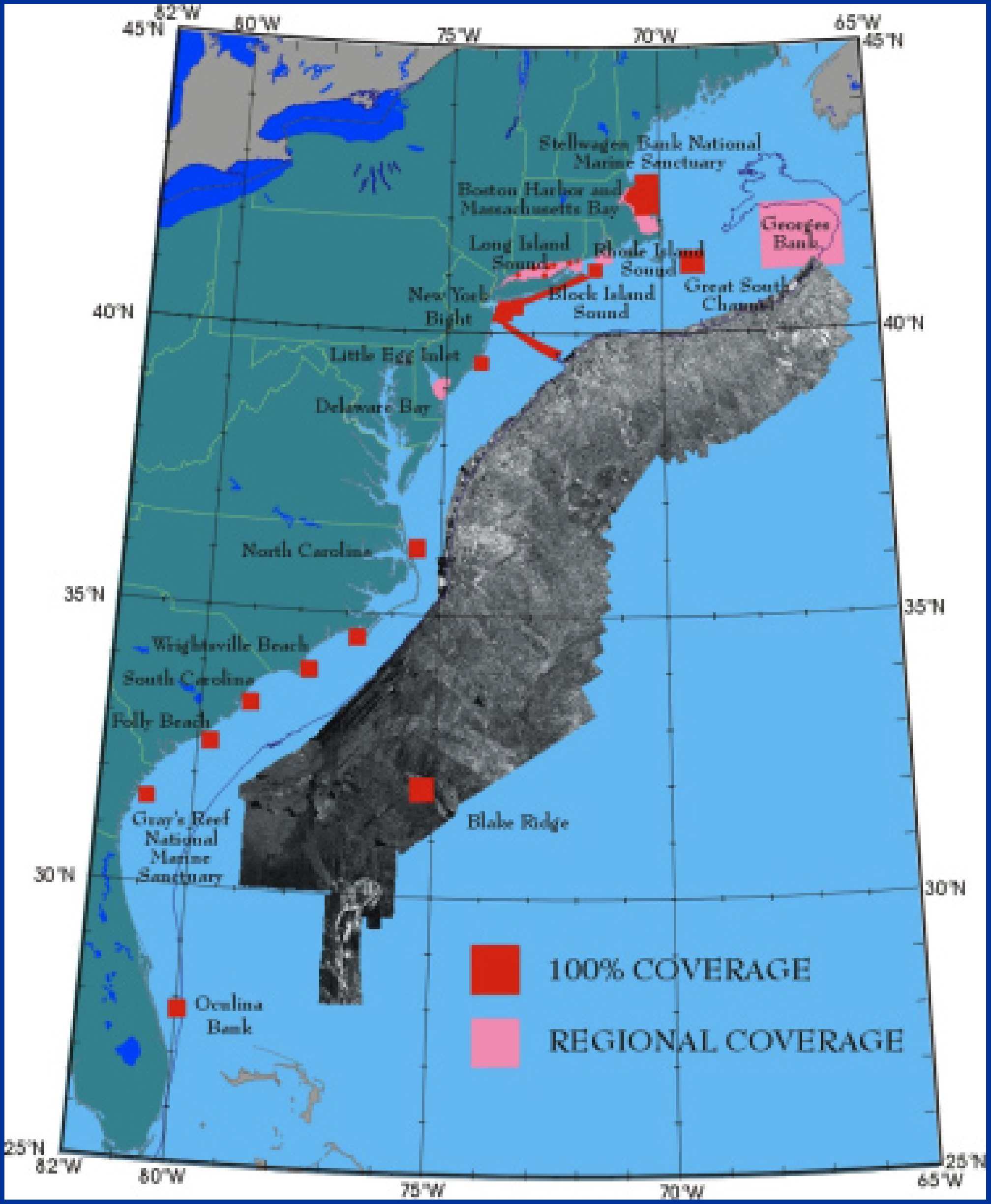
USGS

Scientific mapping and characterization of the sea floor is fundamental to ocean exploration

The USGS has mapped the deep parts of the US EEZ using GLORIA systems

New swath and LIDAR technology is now available to map from the shoreline to the shelf edge in the EEZ

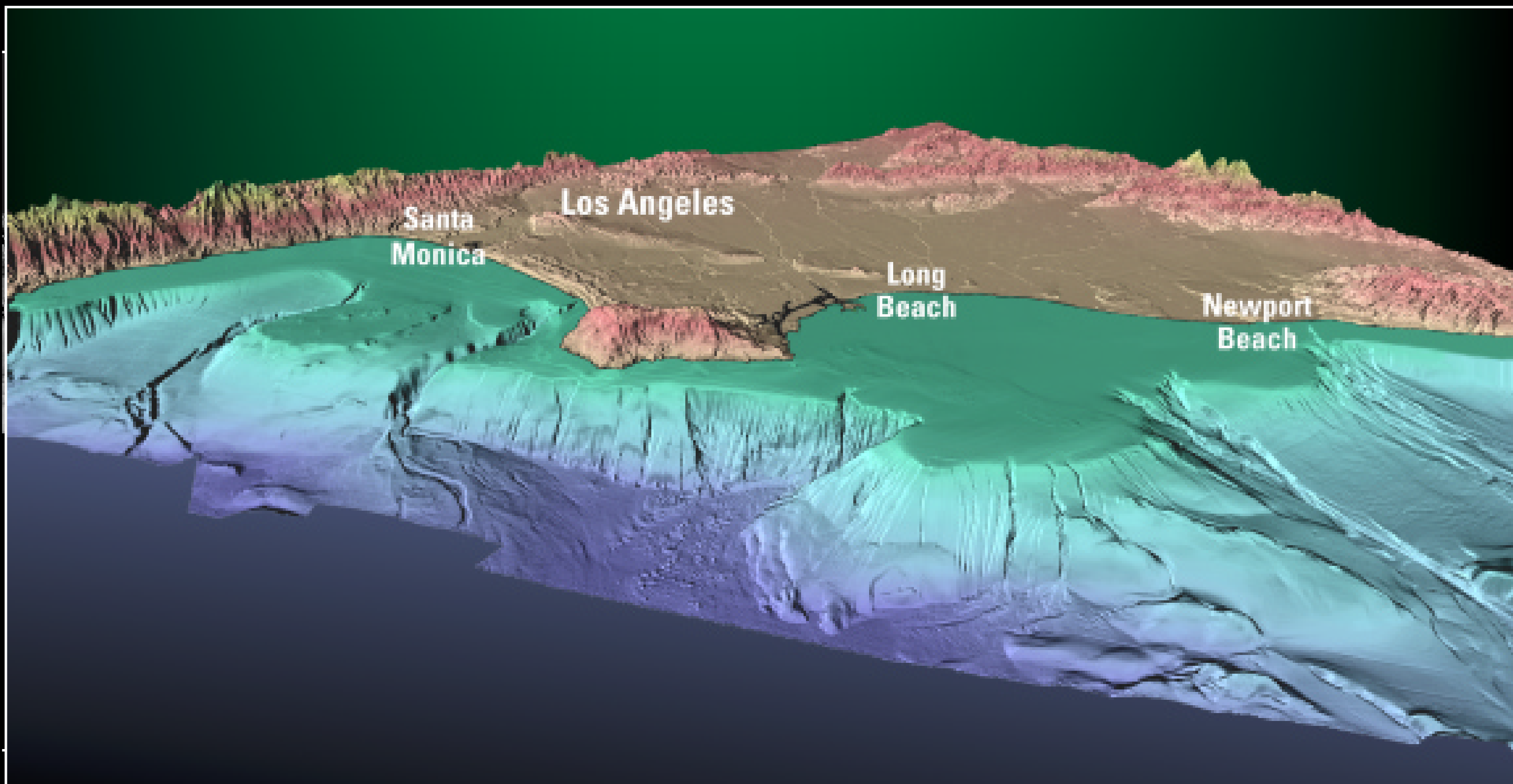
These maps will provide new insights and a framework critical for research and wise management of America's ocean resources.



USGS

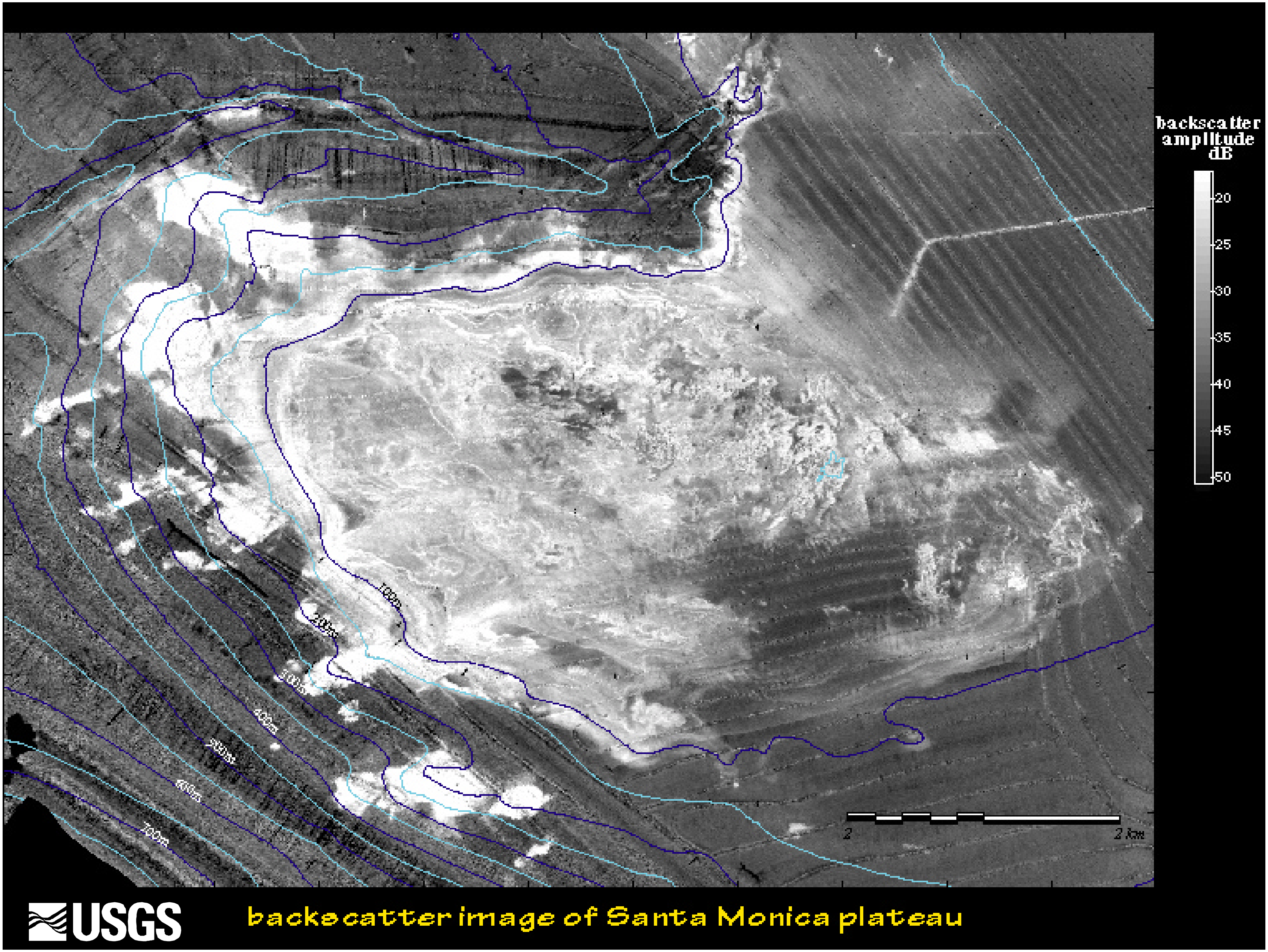
oblique view of LA margin
(20 to 800 M)

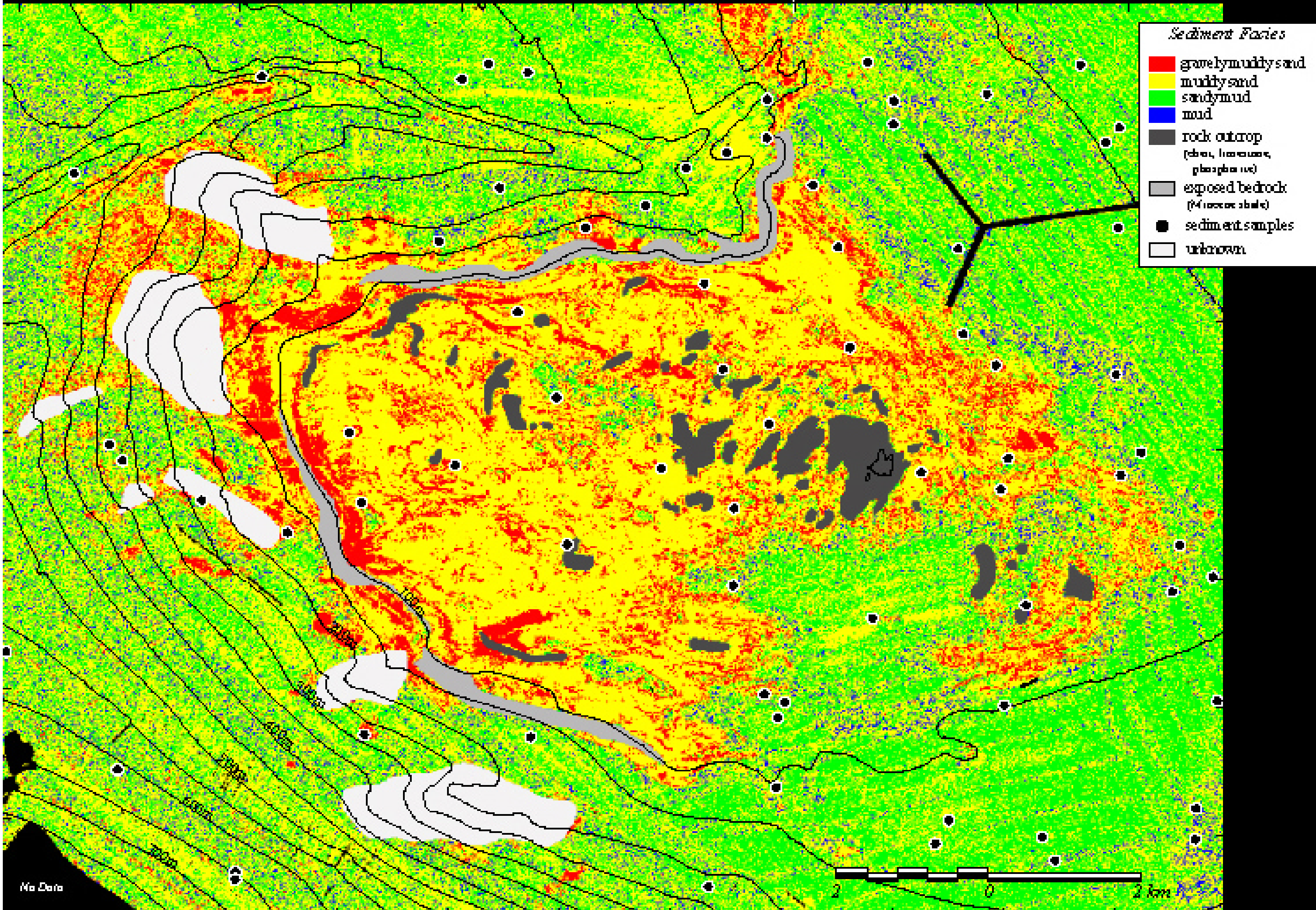
3 different multibeams, three different years



- systematic surveys
- compatable state-of-the-art technologies
- georeferenced databases
- onshore to offshore

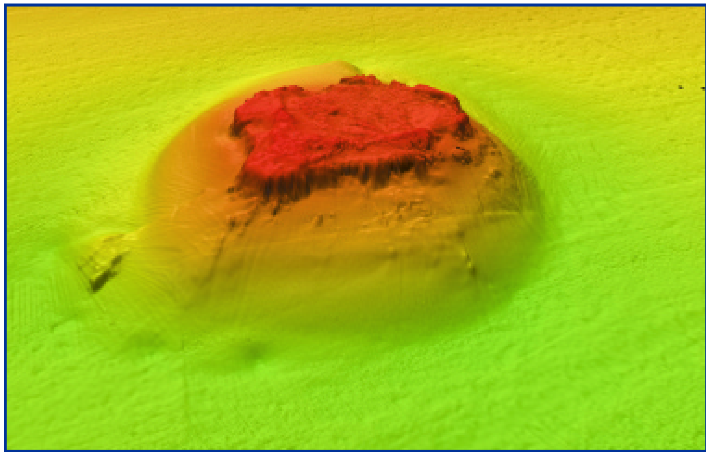
USGS


backscatter amplitude dB
20
25
30
35
40
45
50
100m
2 km
backscatter image of Santa Monica plateau

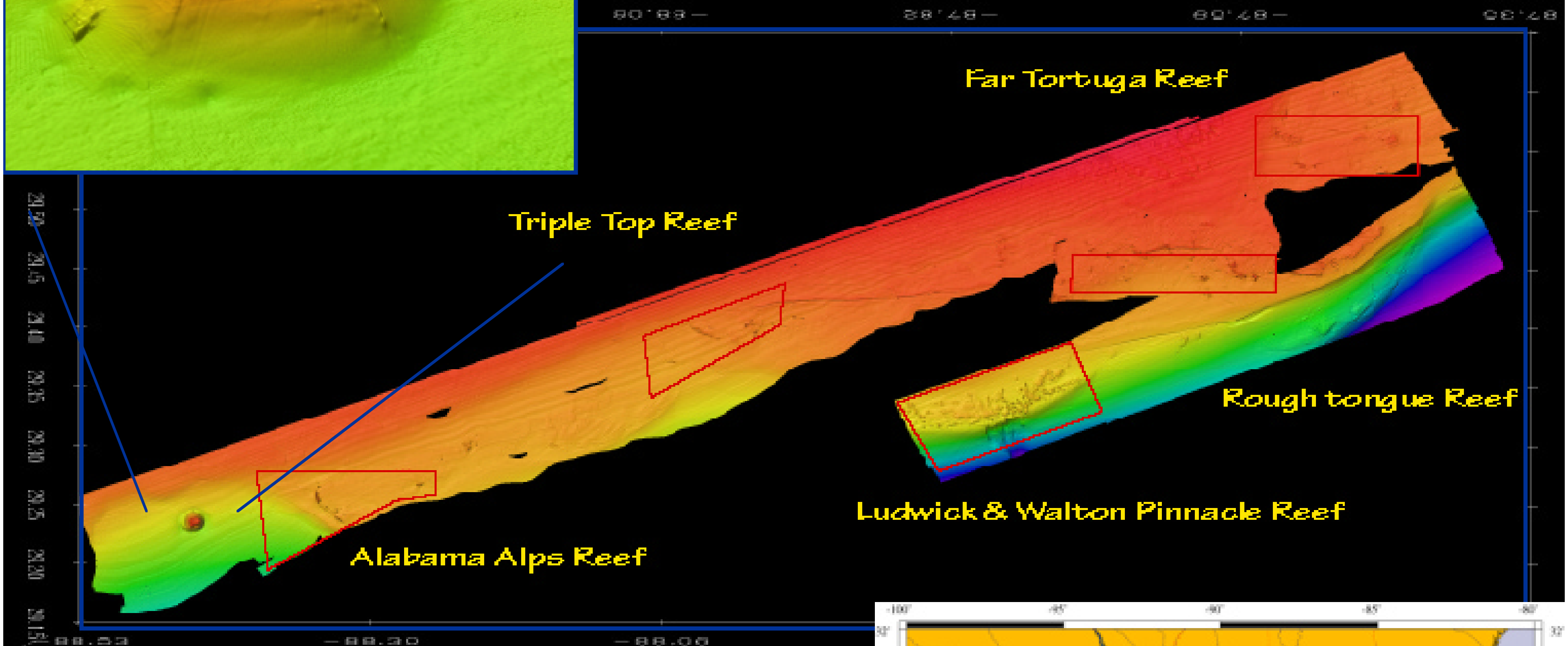


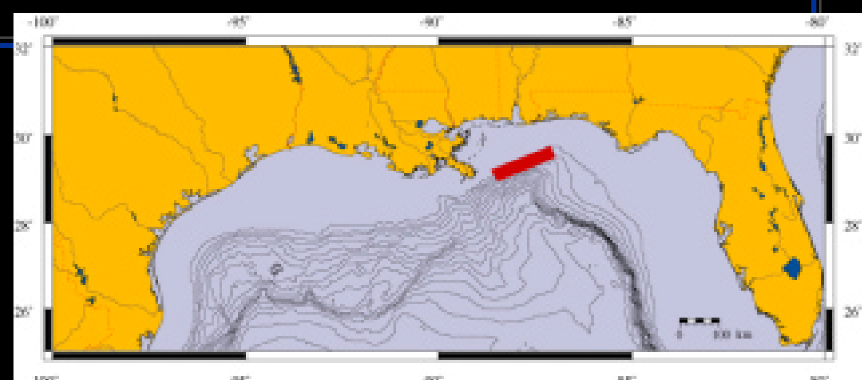
USGS

Santa Monica plateau facies map



newly discovered salt-dome reef

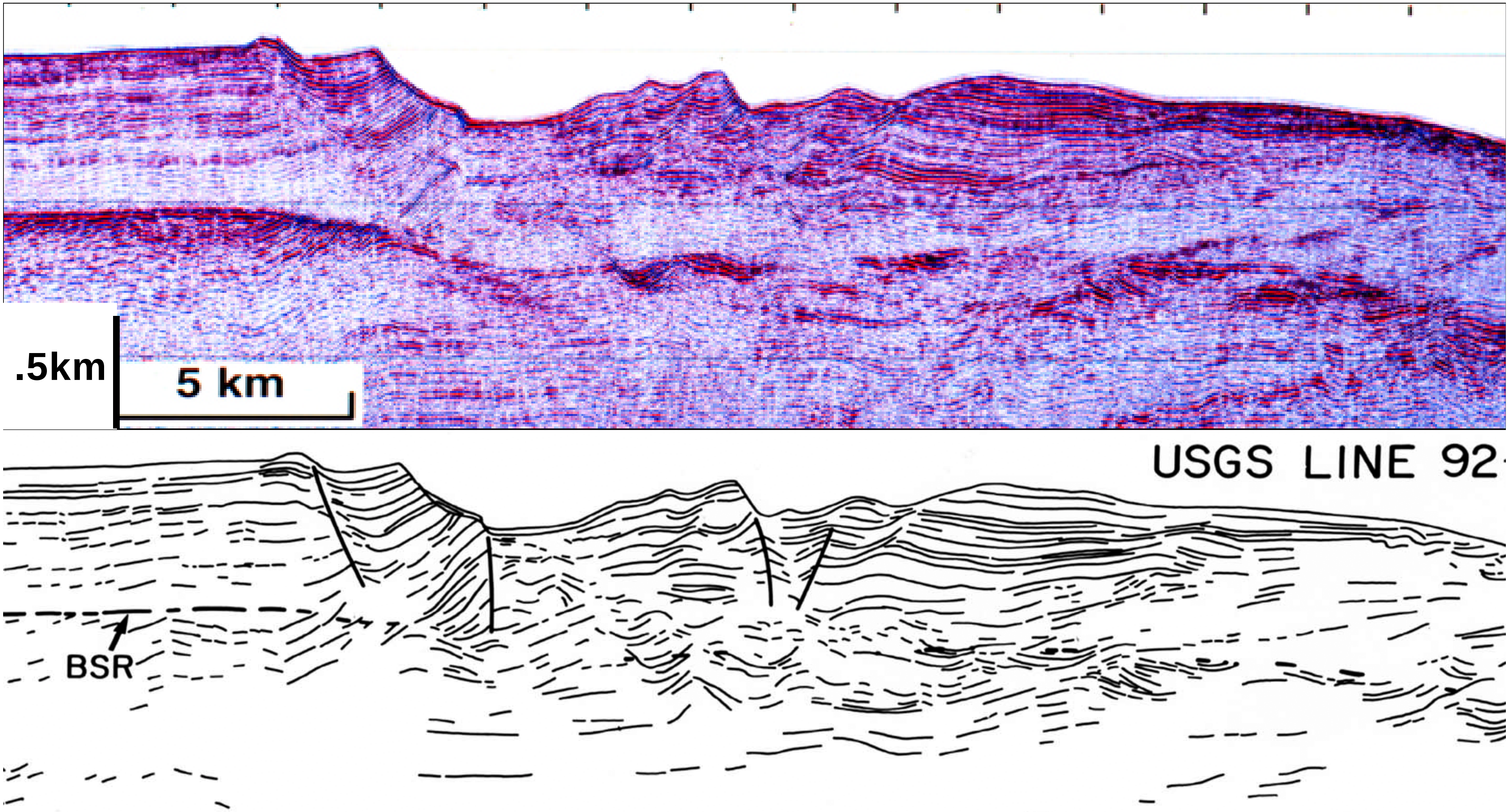




GOM Pinnacles area of

Deep-water reefs (5/2000)

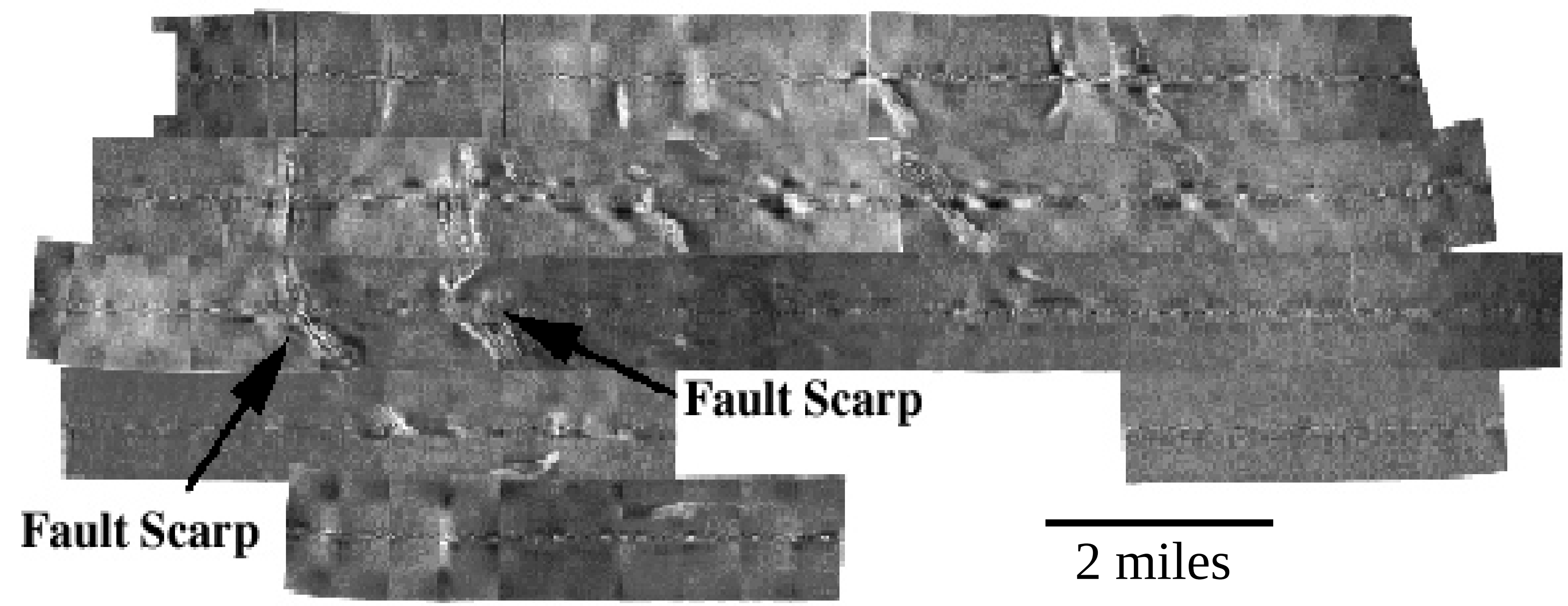
USGS



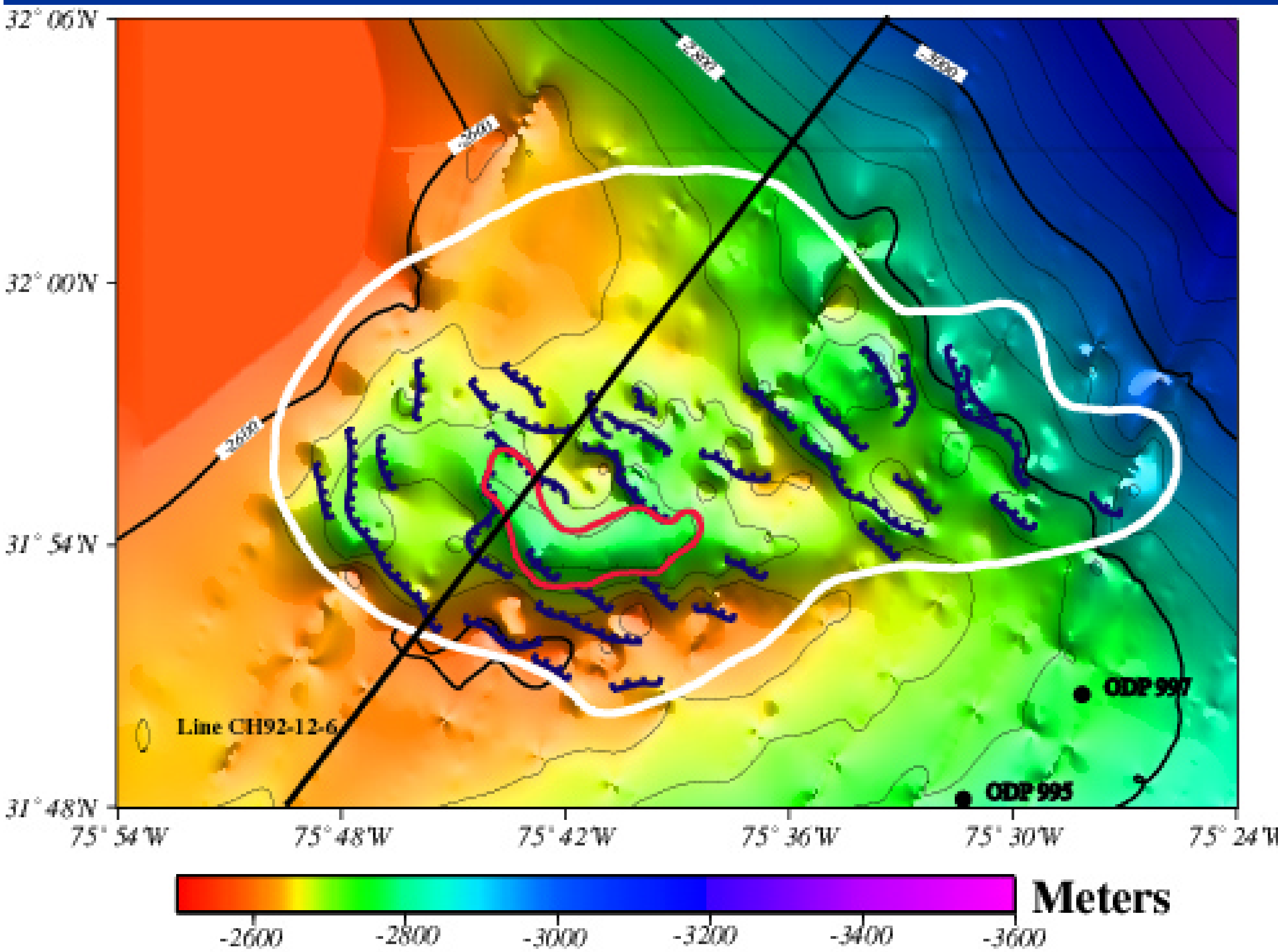
Seismic profiles show major collapse of the Blake Ridge crest related to gas hydrate processes (water depth ~2700 m)

Issue: Gas hydrate influence on seafloor stability and drilling safety

USGS



Deep-towed sidescan imaging defines fault pattern

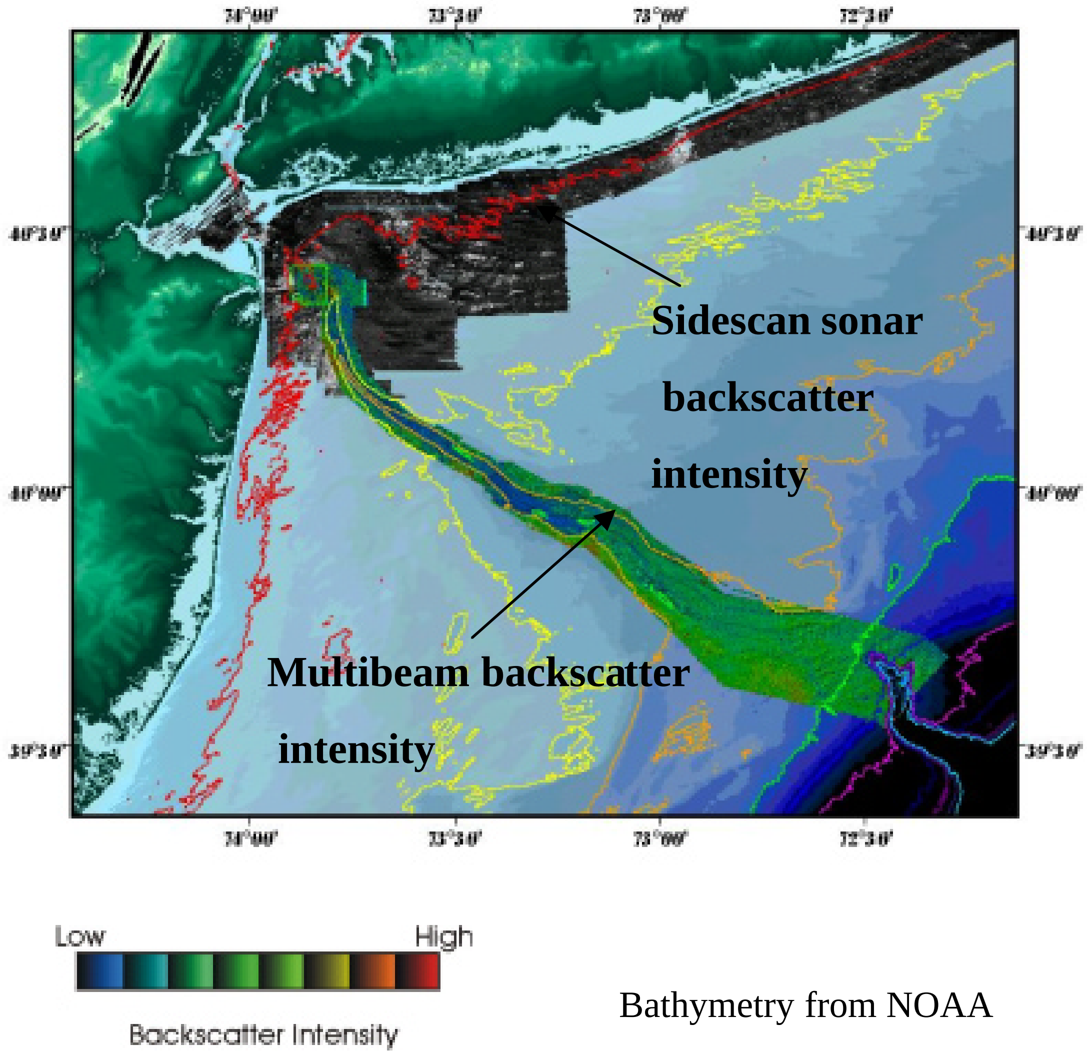


Mapping discloses a volume loss of greater than 13 km^3 estimated to have contained ~4% of the present atmospheric methane volume.

Issue: Gas hydrate influence on climate

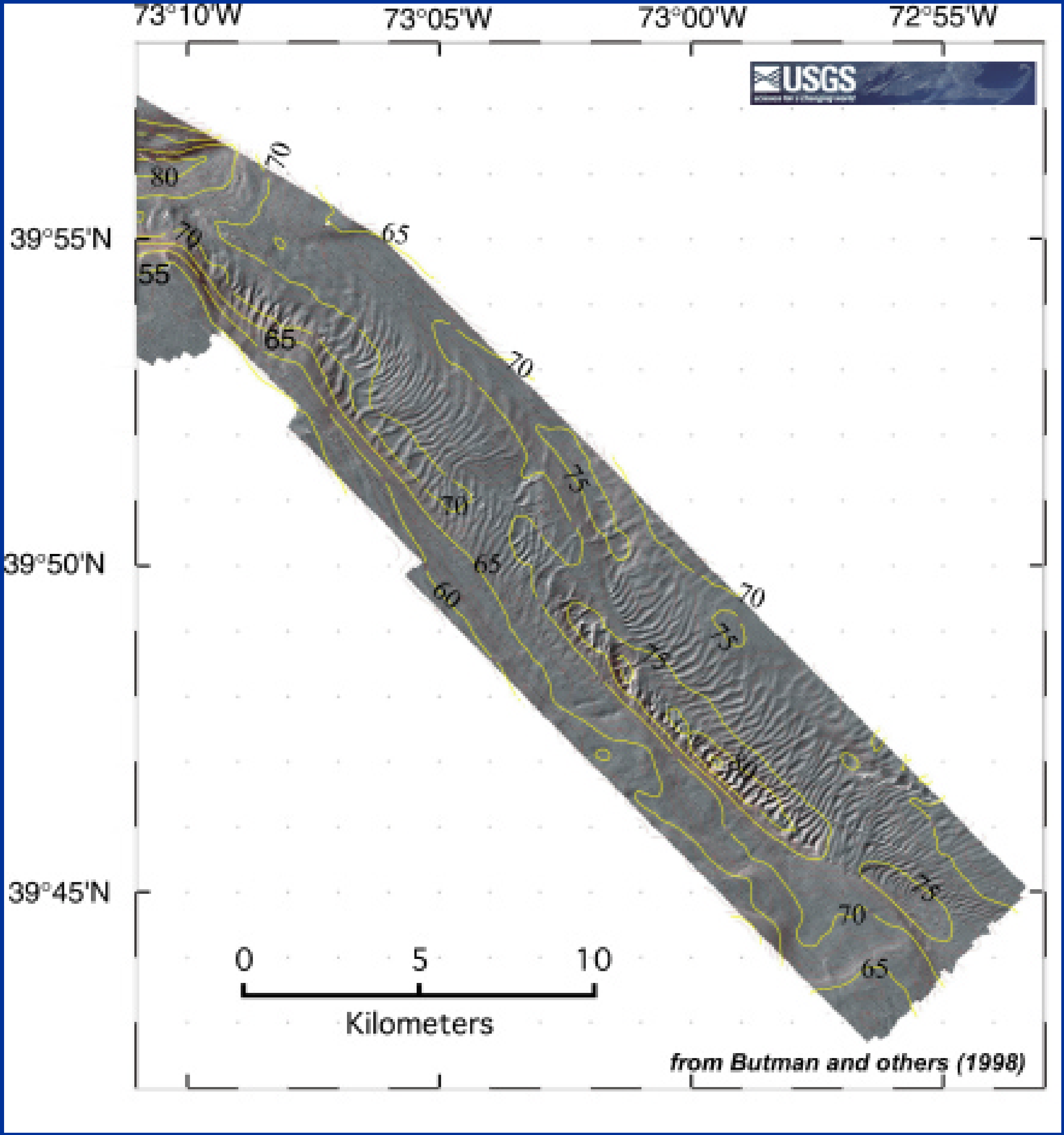
USGS

Scientific mapping of the seafloor offshore of New York is providing a critical framework for pollution, resource and habitat studies as well as new insights into climate and the geologic history of the region.



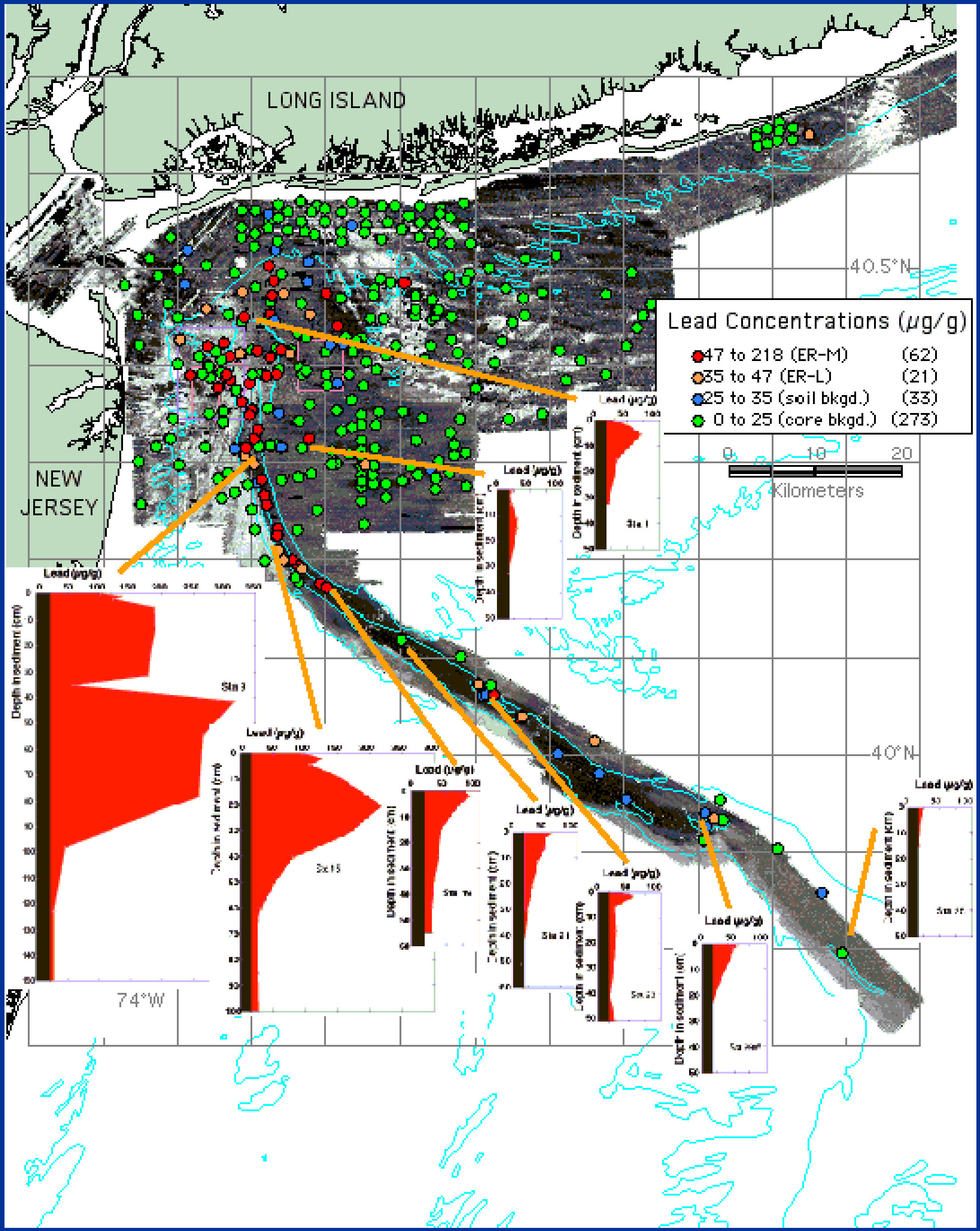
Bathymetry from NOAA

Shaded relief image of multibeam echo sounder data showing a field of bedforms discovered in the lower Hudson Shelf Valley, thought to be the formed by the catastrophic drainage of a glacial lake that occured ~12,000 years ago.



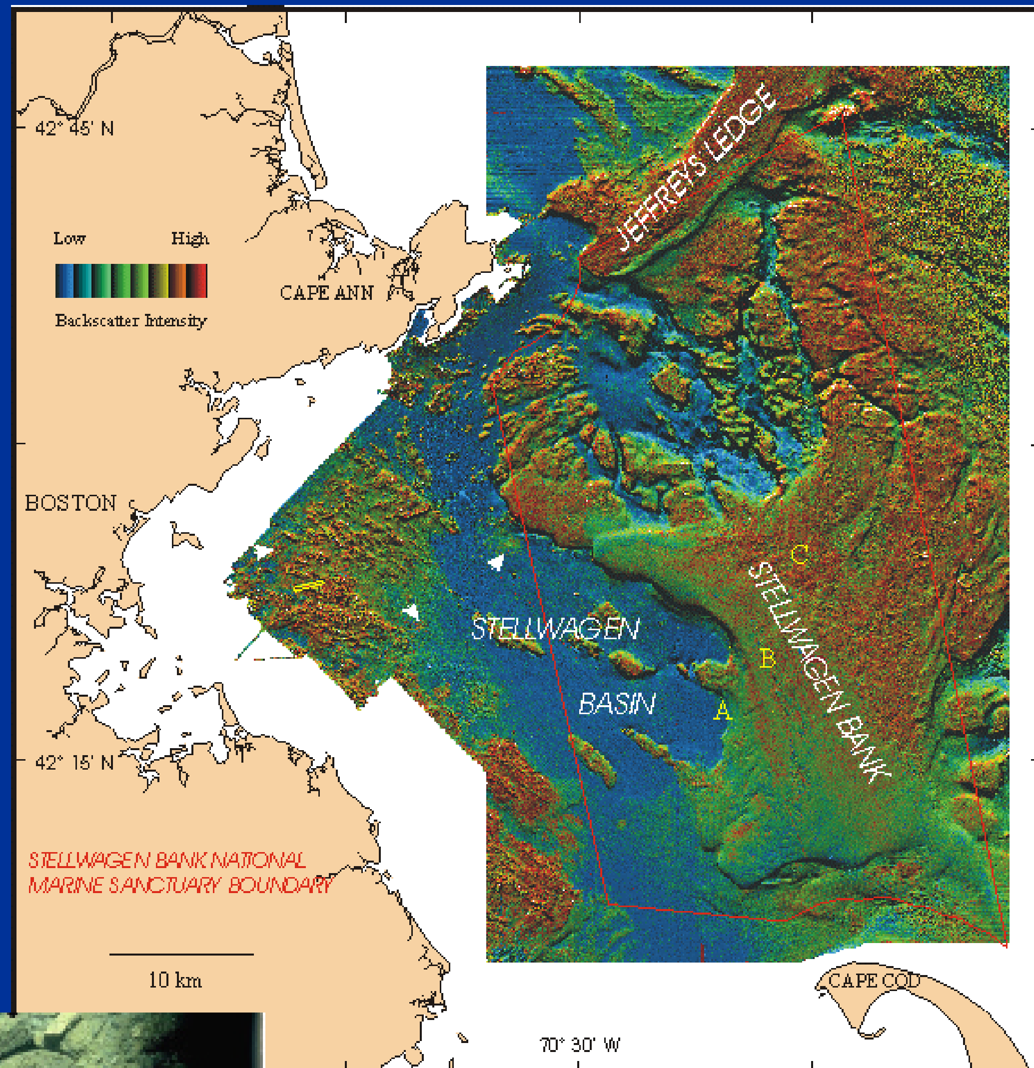
USGS

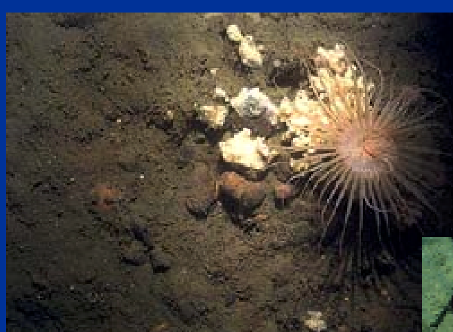
Contaminants from disposal of sewage sludge and from dredged material offshore of New York have accumulated in the upper portion of the Hudson Shelf Valley. Traces are found as far as 100 km down valley.



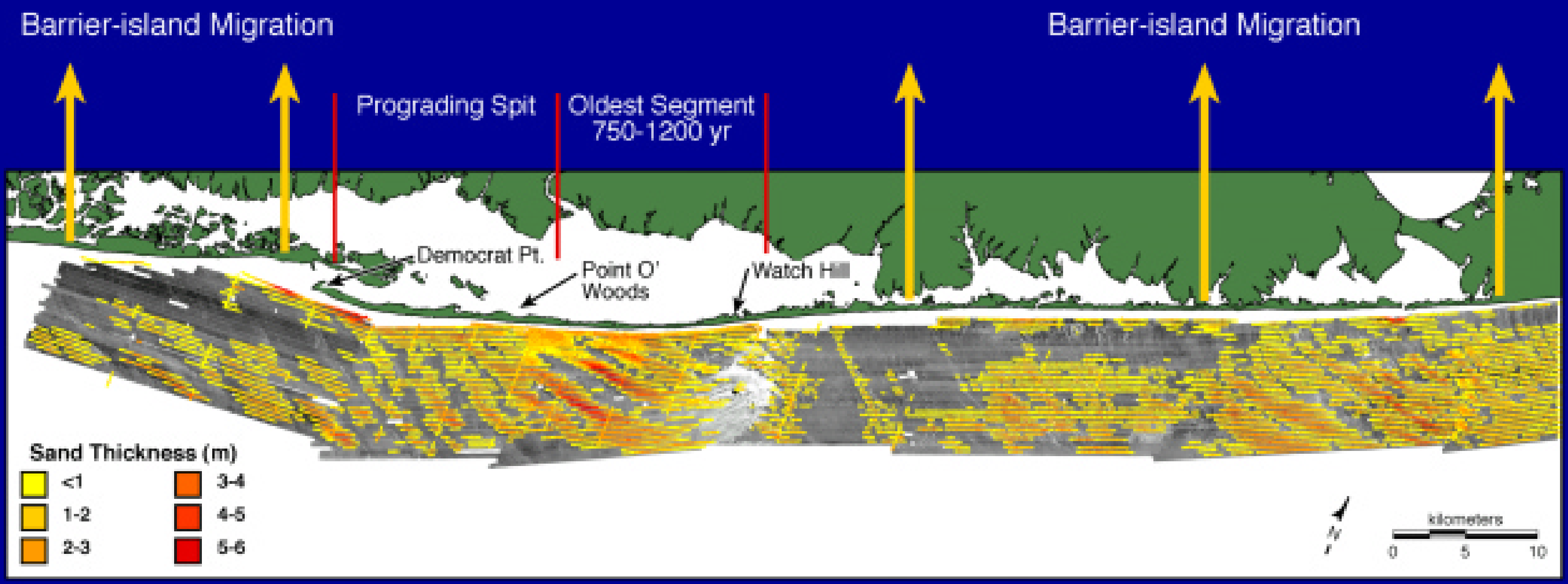
USGS

The seafloor environment in Massachusetts Bay varies from mud in the depositional basins to coarse sand, gravel and bedrock on the topographic highs.





USGS



Exploration of the inner shelf using modern mapping techniques (sidescan, bathymetry, seismics) have revealed a direct relation between the shallow geologic framework and coastal evolution/behavior. Off Long Island, New York, the rate of landward migration of the barrier-island system is clearly linked to the amount of sediment available on the inner shelf.

USGS

Earth Science Enterprise
National Aeronautics and Space Administration

Dr. Eric Lindstrom

NASA Oceanography Program Scientist

Interagency Task Force and Ocean Exploration Panel

August 22, 2000

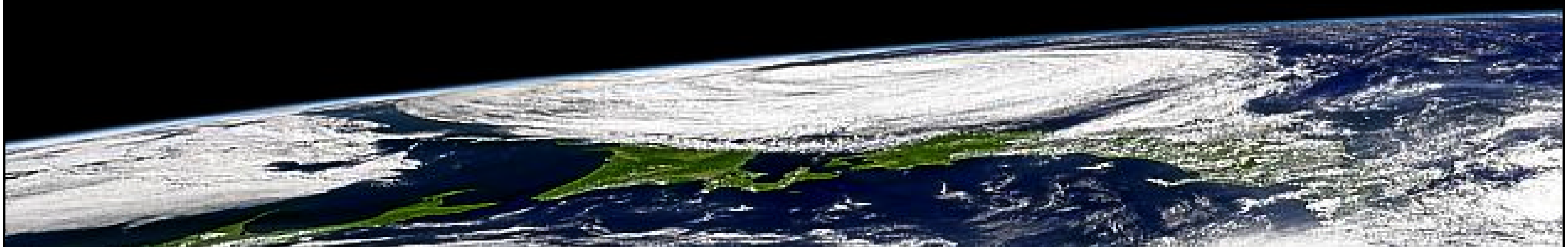
Earth Science Enterprise
National Aeronautics and Space Administration

NASA's Vision for Ocean Exploration

Using the unique vantage point of space
NASA provides practical benefits to society
by developing ocean observing technology and
enabling global ocean science.

★

NASA also helps to educate and train
our next generation of ocean explorers.



Exploring Our Ocean Planet from Space

NASA Oceanography
oceans.nasa.gov

Defining Themes for NASA's Role in Ocean Exploration

- **Science:** Conduct ocean observing missions that reveal the new and unforeseen phenomena of Earth's oceans.

- **Technology:** Develop enabling technology for ocean observing missions throughout the solar system.

- **Applications:** Contribute the development of an integrated ocean observing system serving society with practical applications of ocean science.

- **Education:** Use ocean science and technology as the vehicle for the education of explorers of all ages.

Science

NASA is an Earth Science discovery agency. Scientific exploration of the Earth is an essential step in our understanding of weather, climate and natural hazards. It may also assist in the quest for the origins of life :

- Understanding the physical and biological processes of our ocean planet.

- Preparing to explore extraterrestrial oceans (e.g. Europa.)

Technology

NASA is a technology agency. We conduct research missions that explore the techniques for ocean observation :

- •New satellite technologies and sensors for ocean remote sensing (e.g. salinity)
- •In-situ ocean sensors made ready for space environments and visa versa (e.g. CLOUT)
- •Models of the ocean are refined and made ready to simulate the ocean

Applications

NASA explores practical application of its discoveries in ocean science:

- Observing patterns of global change (e.g. USGCRP.)
- Refining the methods to be used in predicting climate (e.g. NASA's Seasonal-to-Interannual Prediction Program.)
- Develops partnerships through the National Oceanographic Partnership Program to enable better models and simulations of ocean behaviors (e.g. ECCO, Monterey, Narragansett.)

Education

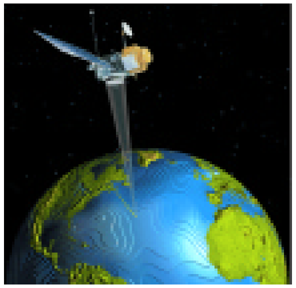
NASA explores new ways to expand public knowledge and appreciation of the oceans:

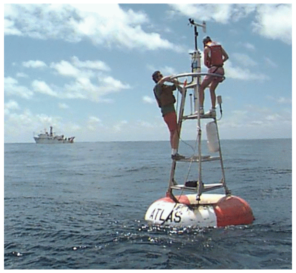
- **Promoting a global view of our ocean environment.**
- **Expanding use of remote sensing for description and prediction (e.g. TOPEX Outreach.)**
- **Using Internet technologies and satellite communications to bring the ocean to the classroom (e.g. SSE.)**

Data Assimilation : The Ultimate Synthesis

Data assimilation is the conduit of information between the observing systems and the user community.

Observing Systems



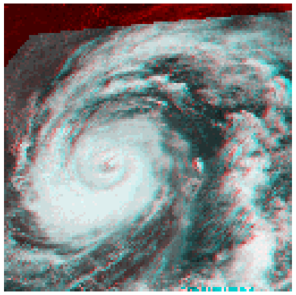


Data

Computer Ocean Models

Synthesis Products

User Community



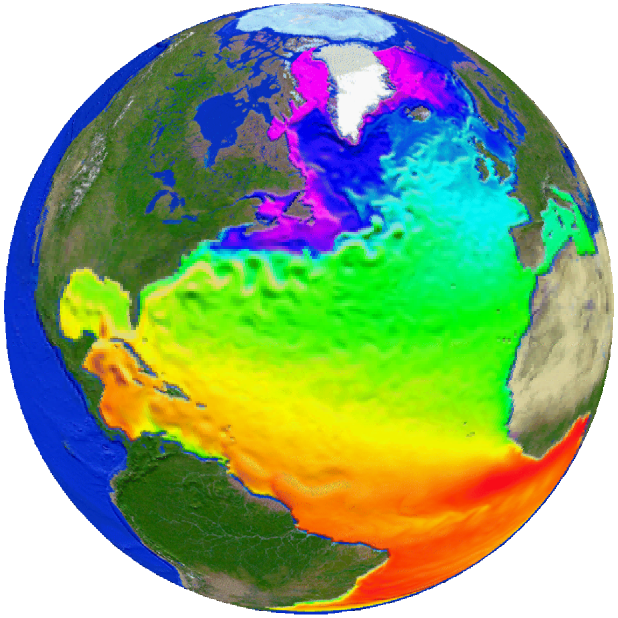
Ocean Observing

NASA develops technologies that observe several geophysical variables of Earth's oceans:

- Sea surface temperature
- Ocean surface wind
- Ocean surface topography
- Ocean color
- Sea surface salinity
- Mixed Layer Depth

Estimating the 3-Dimensional Structure of the Ocean

The ocean may never be completely observed. Mixing on scales of millimeters cannot be observed directly and globally. Yet mixing is essential to ocean's capacity for heat and carbon dioxide.



Numerical ocean models simulate the important ocean processes, including mixing. Recent advances in computer technologies have greatly improved such global models.

Computer simulation of the Atlantic Ocean. The color shades represent sea surface temperature:
Orange and red are warm temperatures;
Blue and purple are cold temperatures.
(The meandering Gulf Stream and its associated eddies are prominent features off the U.S.)

Sea Surface Temperature (SST)

SST measurements reflect air and sea interactions, a key factor in understanding climate change:

- **Modern Heritage: AVHRR technologies developed at NASA and used operationally by NOAA.**

- **Next Generation: All-weather microwave SST (e.g. TMI on TRMM) and high resolution infrared (e.g. MODIS on Terra and Aqua satellites.)**

Ocean Surface Vector Wind

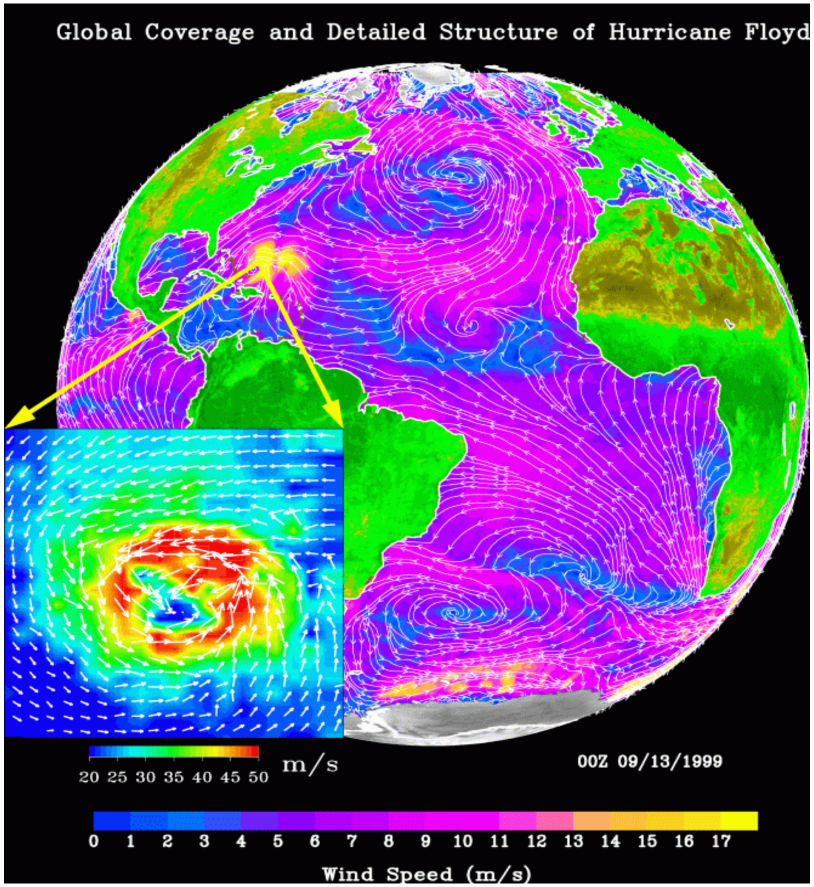
Allows for better weather analysis and provides accurate forcing for ocean models:

- Modern Heritage: NSCAT mission followed by Seawinds on QuikSCAT.
- Successive missions targeted toward measurement and technology that can be used operationally.
- Next Generation – AlphaSCAT will be smaller and lighter.

Wind Vector: Scatterometry

Global Weather and Marine Storms

- Synoptic view of the winds over global ocean
- Improved weather forecast
- Detailed structure of marine storms
- Wind-driven ocean circulation and ecological changes.



Ocean Surface Topography

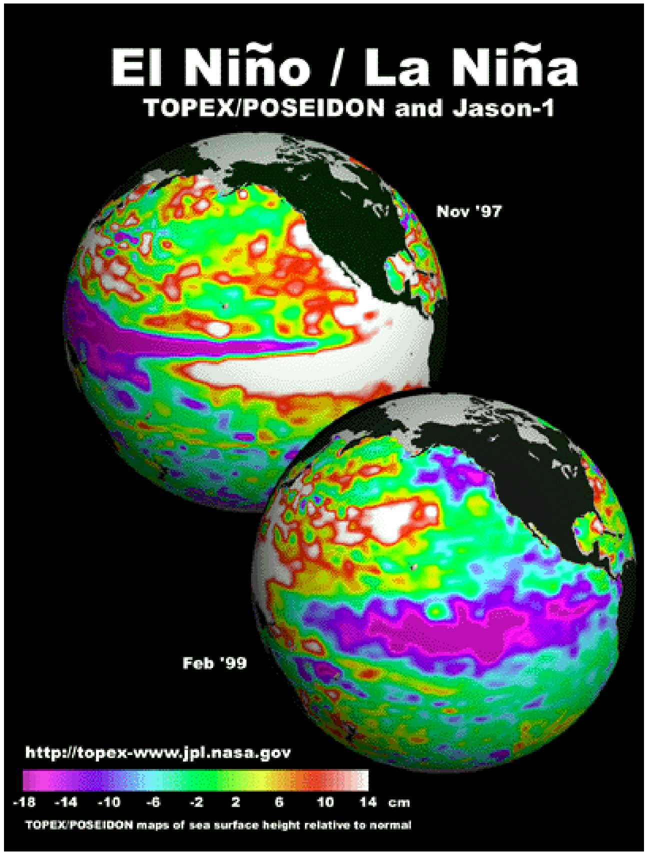
Used to explore the ocean's response to wind and buoyancy forcing:

- Modern Heritage: TOPEX/Poseidon development and improvement of altimetry in cooperation with the French space agency.

- Next Generation: Jason-1 (to launch Feb. 2001.)

- Numerous applications: Improves global climate predictions, fish harvesting, circulation simulation.

Ocean Topography From Altimetry



El Niño / La Niña

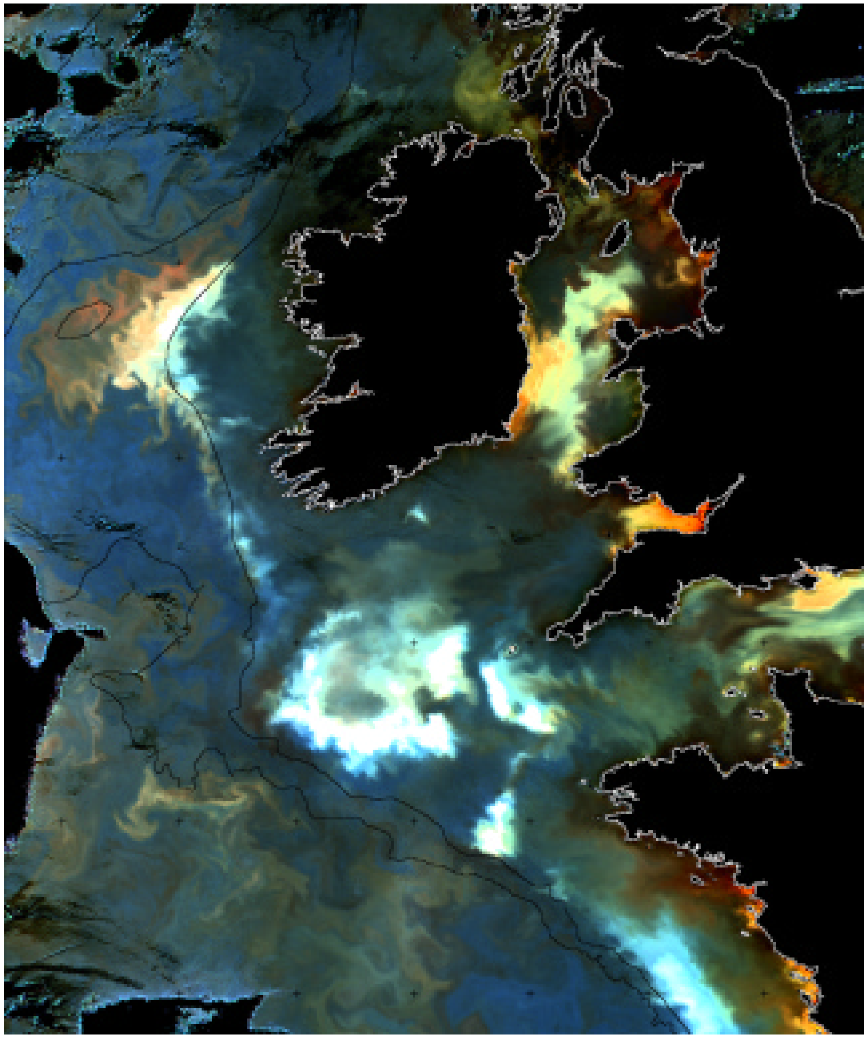
The early detection of the 1997-98 El Niño was a great success of the mission. The loss of lives and property from the strongest El Niño on record was kept to a minimum owing to the early warnings. The data have been routinely used by NOAA to improve the forecast of El Niño and other climatic events.

TOPEX/Poseidon Ocean topography of the Pacific Ocean during El Niño and La Niña.
- Red and orange represent highs;
- Purple and blue represent lows.

Ocean Color

Used to estimate the chlorophyll in the ocean and investigate the global carbon cycle:

- Modern Heritage: SeaWiFS and MODIS on Terra.
- Next Generation: Sensors with finer resolution, better algorithms, and more spectral resolution.
- Numerous applications: Ocean productivity, fisheries, plankton dynamics.



We are able to view ocean color, as never before, to be able to answer the question, "What factors regulate the community structure of ocean ecosystems?"

SeaWiFS color composite image (555, 510 and 443 nm bands) for N E Atl, UK shelf seas, 18 May 1998. B=blue (clear) ocean; G= green (phytoplankton plant pigments, chlorophyll), W= White (C, coccolithophores, calcite covered plants reflecting at all wavelengths)
and IS=brown (suspended sediments) in the Irish Sea.

Sea Surface Salinity

Future mission: Aims to explore the variability of surface salinity in the oceans.

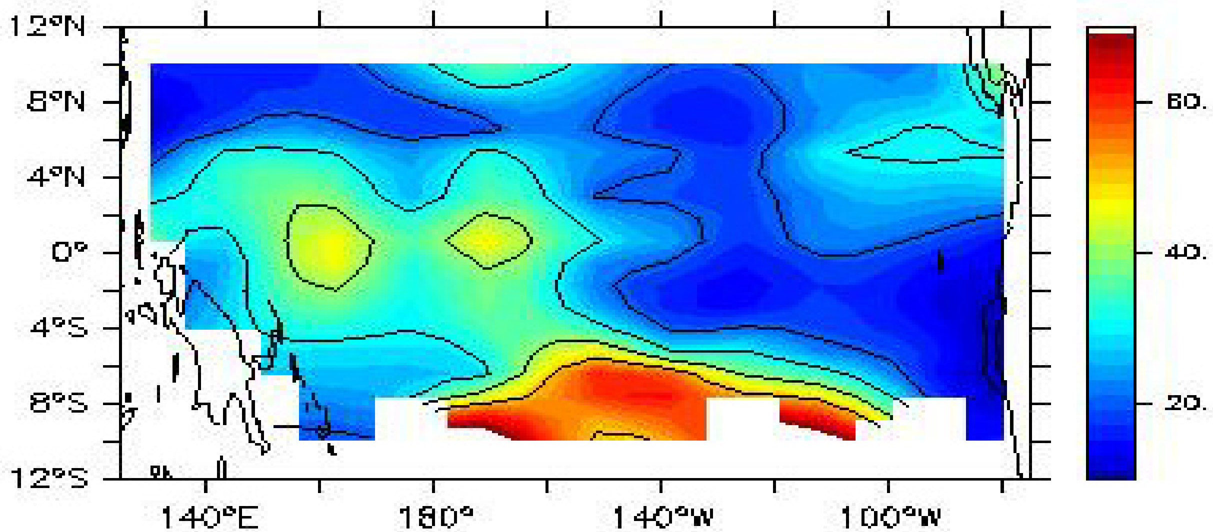
- **Requires improved antennas, signal processing, and algorithms.**

- **Remotely sensed salinity data will greatly improve our knowledge of an important driver of significant climate signals.**

Salinity-Related Science

Example I: El Nino Prediction

In the western tropical Pacific Ocean, the birth place of El Nino, the effect of salinity on the density and thereby ocean topography can be equal to or more than the effect of temperature.



Percentage of ocean topography variability due to salinity (Maes and Behringer, 2000)

Mixed Layer Depth

Future mission : Aims to observe mixed layer depth, a dynamic quantity never before explored synoptically.

- **Creating techniques for observations below the ocean surface using lasers and photo receptors.**

- **Knowledge of this property will allow oceanographers to better constrain their ocean simulations.**

Technology Development

NASA develops technologies as tools for discovery :

- CLOUT: Space and sea technology transfer.
- Neptune: Underwater communication sensors.
- Improved numerical models of the ocean.
- Data assimilation techniques.
- High-performance supercomputer applications.
- Enabling access to large data sets.

Application of Science

- NSIPP (NASA Seasonal-to-Interannual Prediction Project): a productive partnership of NASA GSFC and the University community to advance national climate prediction capabilities.

- NOPP (National Oceanographic Partnership Program): Data assimilation and climate prediction projects serving as pathfinders and tool developers for a wide array of applications.

- IGOS (Integrated Global Observing Strategy): An international partnership enabling development of an integrated ocean observing system.

Education of Explorers

Through ongoing funding initiatives and educational programs we create an environment of learning and ocean exploration from space:

- K-12 activities: SSE, Ocean STEWARD 2000, Classroom units.
- College preparation: National Ocean Science Bowl.
- Graduate research fellowships: Universities nationwide.
- Ongoing research activities: 1600 research grants.

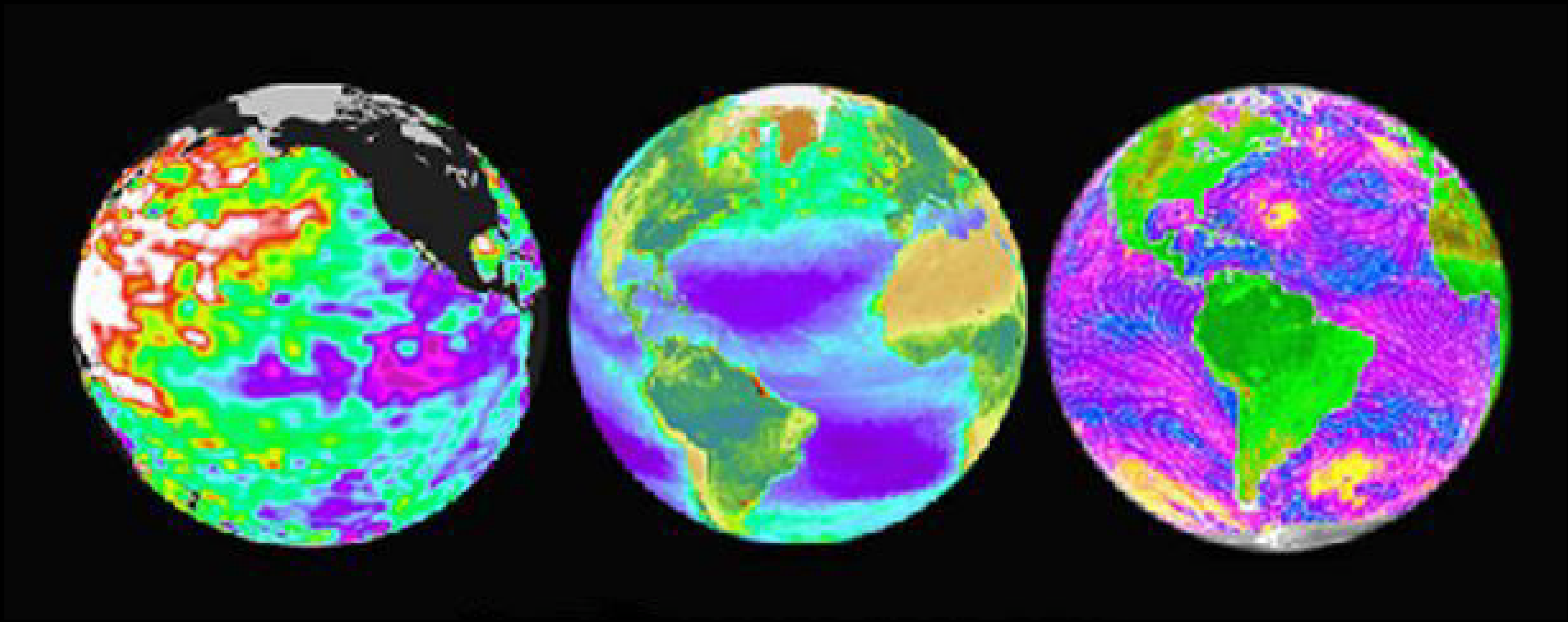
Achieving Our Vision

- Support the migration of ocean observing techniques from research to operational use.

- Expand scientific exploration of our oceans by conducting and preserving high-quality, long-term, systematic measurements of the oceans.

- Facilitate data exchange and real-time assimilation within an integrated ocean observing system.

- Bring to the public awareness the critical role the oceans play in our lives on Earth.



Exploring Our Ocean Planet from Space

NASA Oceanography
oceans.nasa.gov

Department of Energy and Ocean Exploration

Presented by:

Guido DeHoratiis
Office of Natural Gas and Petroleum Technology

Presented to:

Oceans Exploration Panel

August 22, 2000

Outline

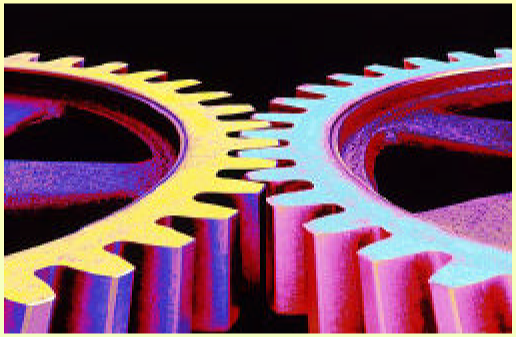
- Background
- Partnerships
- Research
- Summary

Background

Oceans and Energy

- **Energy Mission**
  - Clean
  - Affordable
  - Dependable

- **Oceans and Energy**
  - Sources
  - Transport Medium
  - Creative Solutions



Partnerships

- Industry
- Academia
- Stakeholders

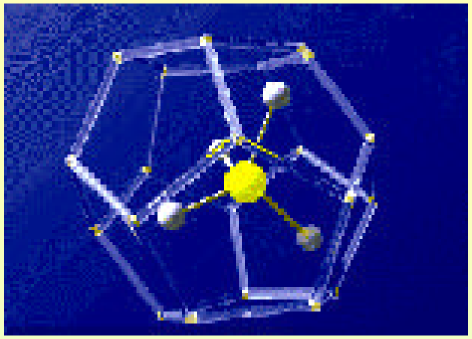
Tools:

- Piggy Back
- Roadmapping

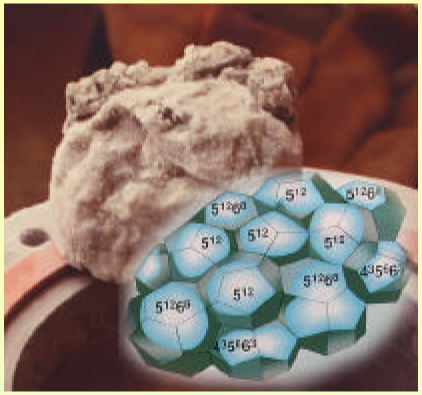
Research Efforts

- Offshore Oil and Gas Exploration
- Hydrates
- Climate Change and Carbon/CO_2 Sequestration
- Energy from the Oceans

Offshore Oil and Natural Gas Production



Hydrates



Locations of known and inferred hydrate deposits

Carbon/CO_2 Sequestration

- **Climate Change**
- **Carbon Cycle in the Oceans**
- **Molecular Marine Biology**

Energy from the Oceans

- Tidal Power
- Ocean Thermal Energy Conversion

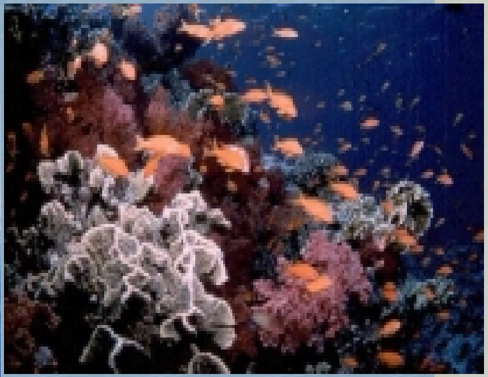
PRESENTATION OF US ENVIRONMENTAL PROTECTION AGENCY

Oceans Exploration Panel Meeting
Rosslyn, VA   Aug. 22, 2000

EPA'S GOAL

- To protect and restore the environmental quality of ocean ecosystems, particularly near coastal waters

- "The public expects and deserves beaches that are safe for swimming, fish that are safe for eating, and an ocean ecosystem that is healthy and thriving"



THREATS FACING OUR OCEANS

Environmental threats facing our oceans include:

- Pollution discharges from point and non-point sources
- Global warming
- Overexploitation of resources
- Increase in coastal development
- Marine debris
- Physical alterations of ecosystems
- Introduction of non-native species

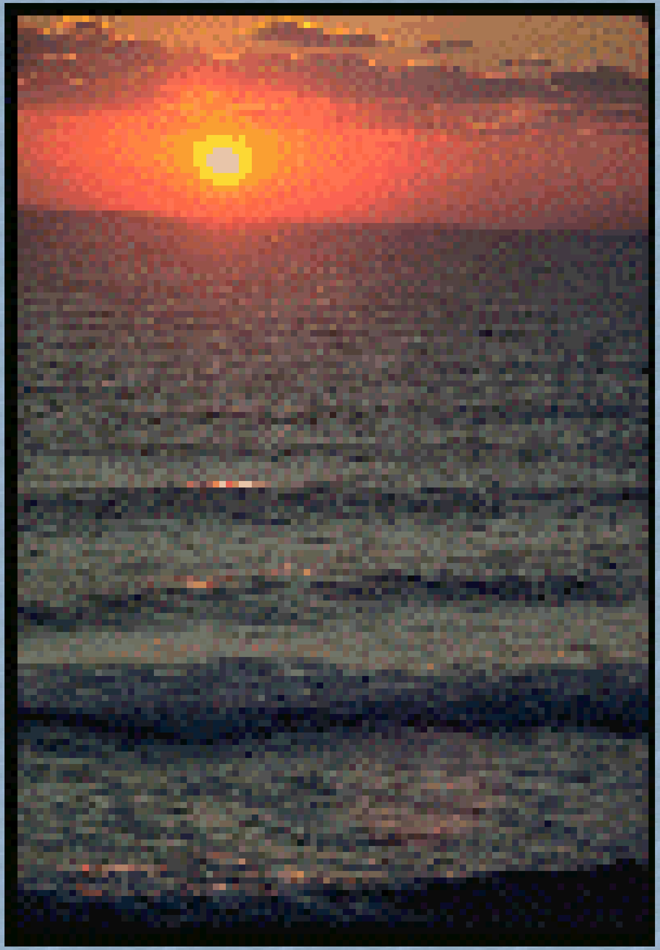


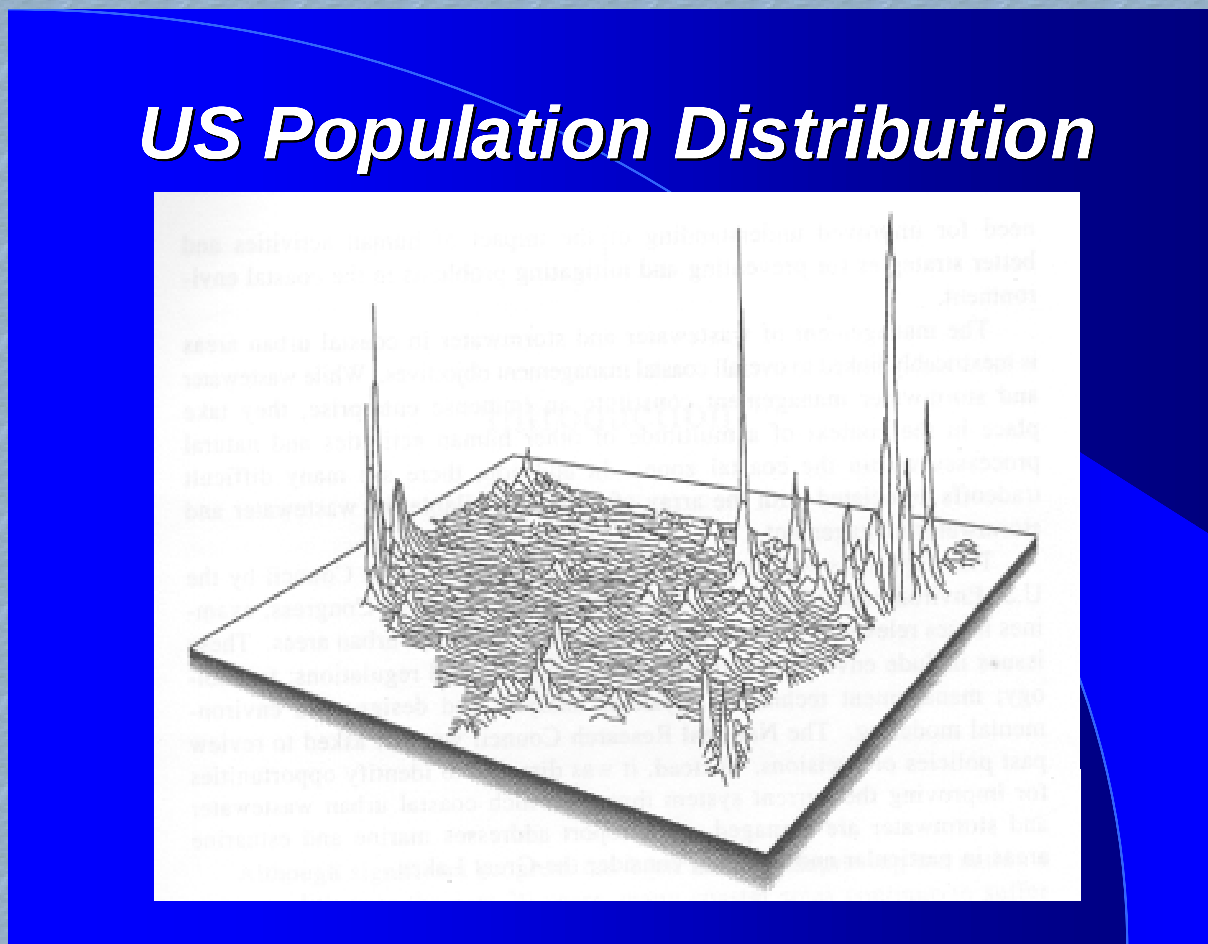
Photo by: National Oceanic and Atmospheric Administration /Department of Commerce

COASTAL/OCEAN POLLUTION PROBLEMS

- Harmful Algal Blooms on the Rise
  - Red Tides, Green Tides, Brown Tides
  - Beach Closures and Human Health Impacts
- Hypoxia - Gulf of Mexico’s Dead Zone: 7,000 square miles in 1999
- 40% of surveyed beaches posted warnings or closed in 1998 due to contamination (e.g., pathogens, debris).
- 60% of the world’s coral reefs are threatened by pollution; 10% have been lost.
- In 1998, 60% of coastal waters had fish advisories due to toxic chemicals.
- Coastal wetlands loss (e.g. 65 sq. km/yr. in Louisiana)

POPULATION PRESSURE ON COASTAL OCEAN WATERS

- Over 50% of the population lives by the coast today and by 2025 is expected to reach 75%

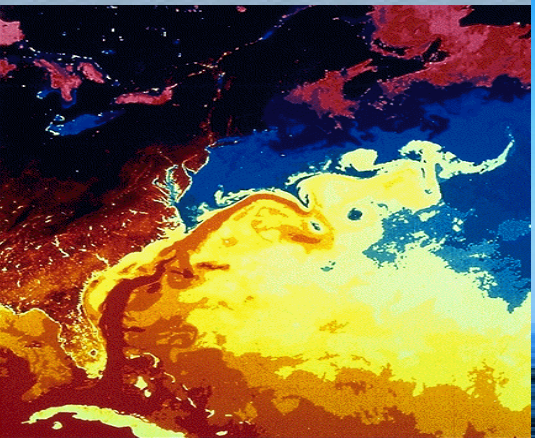


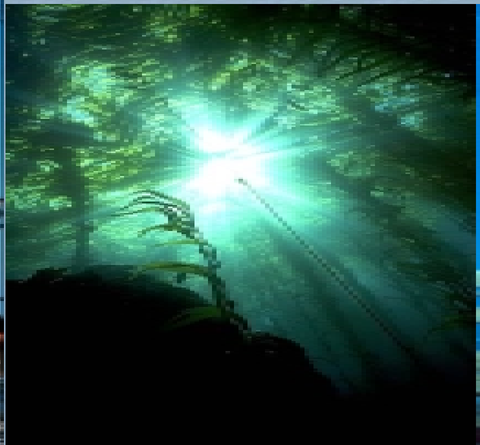
EPA OBJECTIVES: EXPLORATION

- Improved assessment and understanding of coastal ocean system dynamics

- Understanding the effects of anthropogenic impacts on the ocean environment

- Ensure resource sustainability by minimizing adverse impacts from resource exploitation




DEVELOP AND IMPLEMENT MONITORING STRATEGIES AND TECHNOLOGIES FOR ASSESSMENT

- Coastal Monitoring and Research Strategy (CWAP)

  Developed in collaboration with NOAA, USGS, USDA, other Federal, State, and local agencies, Tribes, and NGOs

  - Provide nationally consistent monitoring and observing guidelines;
  - Document status and assess trends in environmental conditions;
  - Evaluate the causes and consequences of changes;
  - Support programs and policies to correct problems

STRATEGIES AND TECHNOLOGIES (cont.)

- Provide and facilitate accessibility to information for public; “right to know”

- Real time monitoring and prediction capabilities

  - Proactive response to HABs, exotic species

  - Remote sensing techniques; fixed buoys, towed sensors, low altitude reconnaissance, satellite imagery

ENSURE RESOURCE SUSTAINABILITY BY MINIMIZING ADVERSE IMPACTS FROM RESOURCE EXPLOITATION

EXPLORATION ➨ EXPLOITATION

- Fisheries resource management
  - Fisheries collapse, Bristol Bay, George's Bank

- Gas and oil exploration/extraction
  - Valdez spill, operational maintenance

RESOURCE SUSTAINABILITY (cont.)

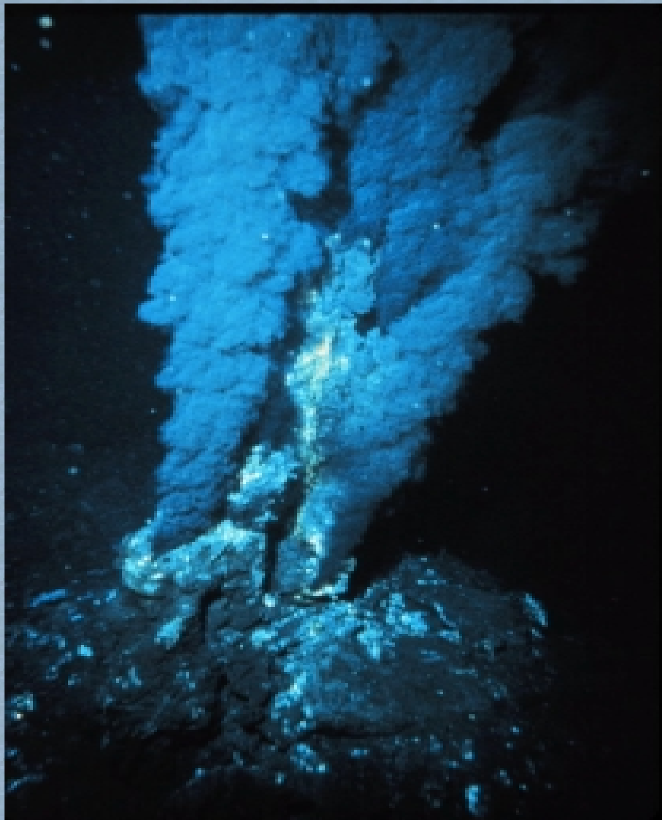
- Biotechnology

  - Exploitation of unique habitats and organisms, e.g. harvesting sea whip coral, horseshoe crabs, chemosynthetic life from hydrothermal vents

- Aquaculture

  - genetic and disease consequences for wild stocks,
  - introduction of exotic species

- Ocean Mining



EPA'S EMERGING OCEAN PROTECTION INITIATIVE

- Establishing Marine Protected Areas:

  - Under CWA § 403, EPA will specify Special Ocean Sites (SOS) that will include waters in the marine environment possessing special ecological characteristics of productivity, habitat structure, or diversity

  - SOS may be designated as areas in which no discharge permits will be allowed, or may require discharges to meet more stringent requirements than a conventional NPDES permit

OTHER EPA OCEAN ACTIVITIES

- EPA's Ocean Survey Vessel Peter Anderson: Monitoring
- National Estuary Program
- Clean Water Action Plan
- Coastal 2000 Monitoring Initiative
- Coral Reef Task Force
- Atmospheric Long Range Transport Monitoring

THE CHALLENGE

- Exploration for Improved Assessment and Understanding of Impacts From Land and Sea Based Activities on Coastal/Ocean Waters

- Environmentally Responsible Exploration to Ensure Sustainable Resources

A New Era of Ocean Exploration

Dr. Margaret Leinen
National Science Foundation

August 22, 2000

Exploration is the observational activity that leads to discovery.

Goals

- Generate new knowledge and understanding through the quantification of properties and **processes** related to the chemistry, physics, biology, geophysics and geology of the ocean, and of the crust and upper mantle that underlies the ocean.

- Engage individuals of all ages in both the process and results of exploration activities for educational purposes.

The Broad Range of Ongoing NSF Programs

- Disciplinary Programs - Biology, Chemistry, Physical, Marine Geology and Geophysics including those in polar regions
- Ocean Drilling Program (ODP)
- Continental Margins (MARGINS)
- Life in Extreme Environments (LExEn)
- Ecology of Harmful Algal Blooms (ECOHAB)
- Coastal Ocean Processes (CoOP)
- Environmental Geochemistry and Biogeochemistry (EGB)
- World Ocean Circulation Experiment (WOCE)
- US Joint Global Ocean Flux Study (JGOFS)
- Ridge Inter-disciplinary Global Experiments (RIDGE)
- Global Ocean Ecosystems Dynamics (GLOBEC)
- Marine Aspects of Earth System History (ESH)
- Climate Variability and Predictability (CLIVAR)
- Long-Term Ecological Research (LTER)
- Surface Heat Budget of the Arctic Ocean (SHEBA)
- Science Ice Exercise (SCICEX)
- Shelf-basin Interactions in the Arctic (SBIA)

NSF Usage of Research Vessels

- Academic Research Fleet -

  ~2800 days/year in FY 2000

  (approximately 60% of total operation support)

- Polar Vessels
  - Palmer, Gould - ~600 days/year
  - USCGC Healy - ~200 days/year

    (anticipated beginning in FY 2001)

Partnerships

- International Programs - e.g., ODP, WOCE, JGOFS, CLIVAR, GLOBEC
- Internationally Coordinated Programs - e.g., RIDGE, MARGINS, SHEBA
- Interagency Programs
  - NOPP - agencies, academia, industry, NGOs
  - e.g., LExEn, ECOHAB, GLOBEC, CoOP, ESH
- Individual Awards

Merit Review

Scientific community drives NSF investments through:

- General planning guidance
  - advisory/steering committees, workshops, NAS
- Merit review process
  - ensures quality research on the highest priority topics
  - provides flexibility to shift resources in new directions

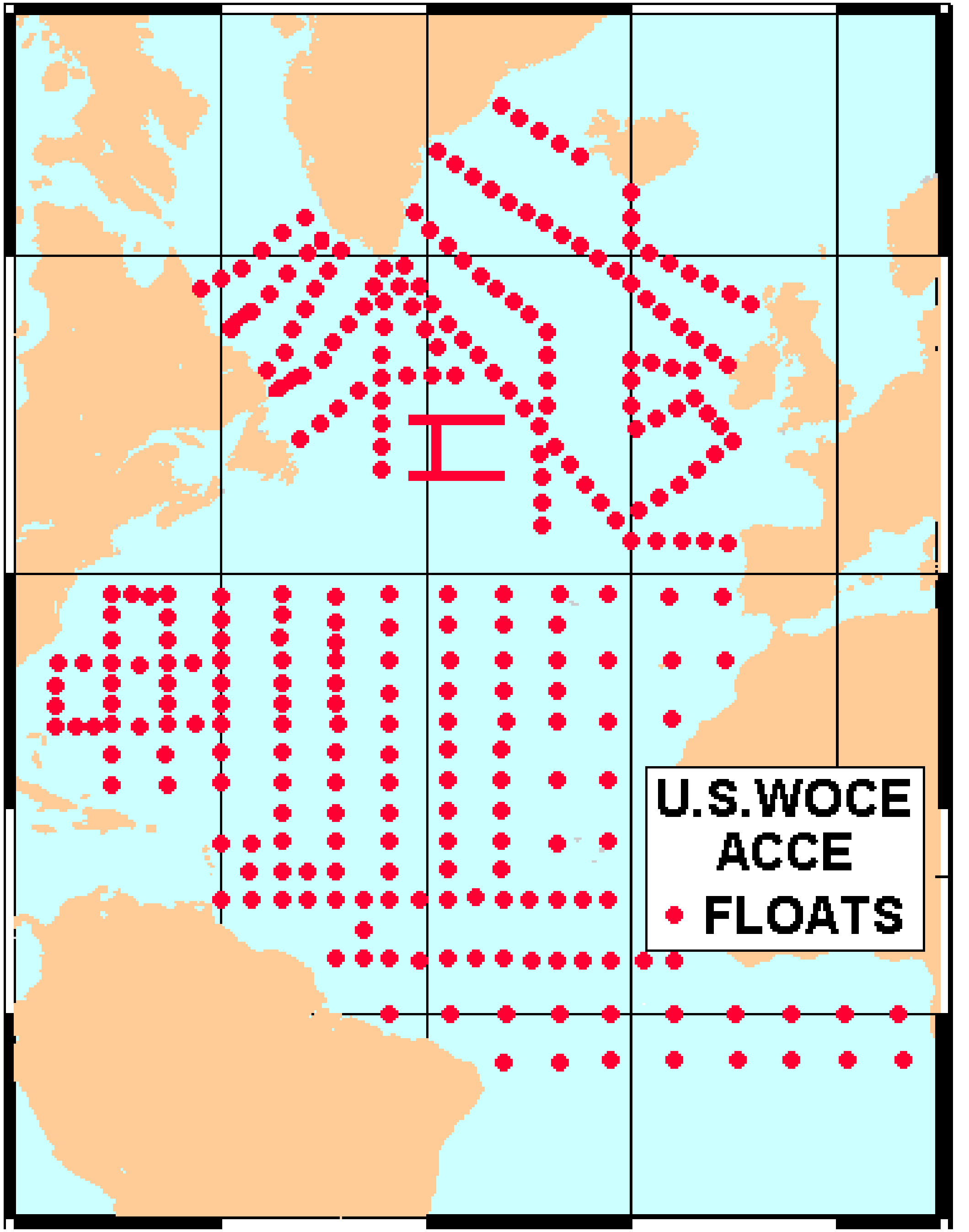
Allowing the scientific community to drive our investments keeps NSF at the frontier of exploration.

Technology and Infrastructure

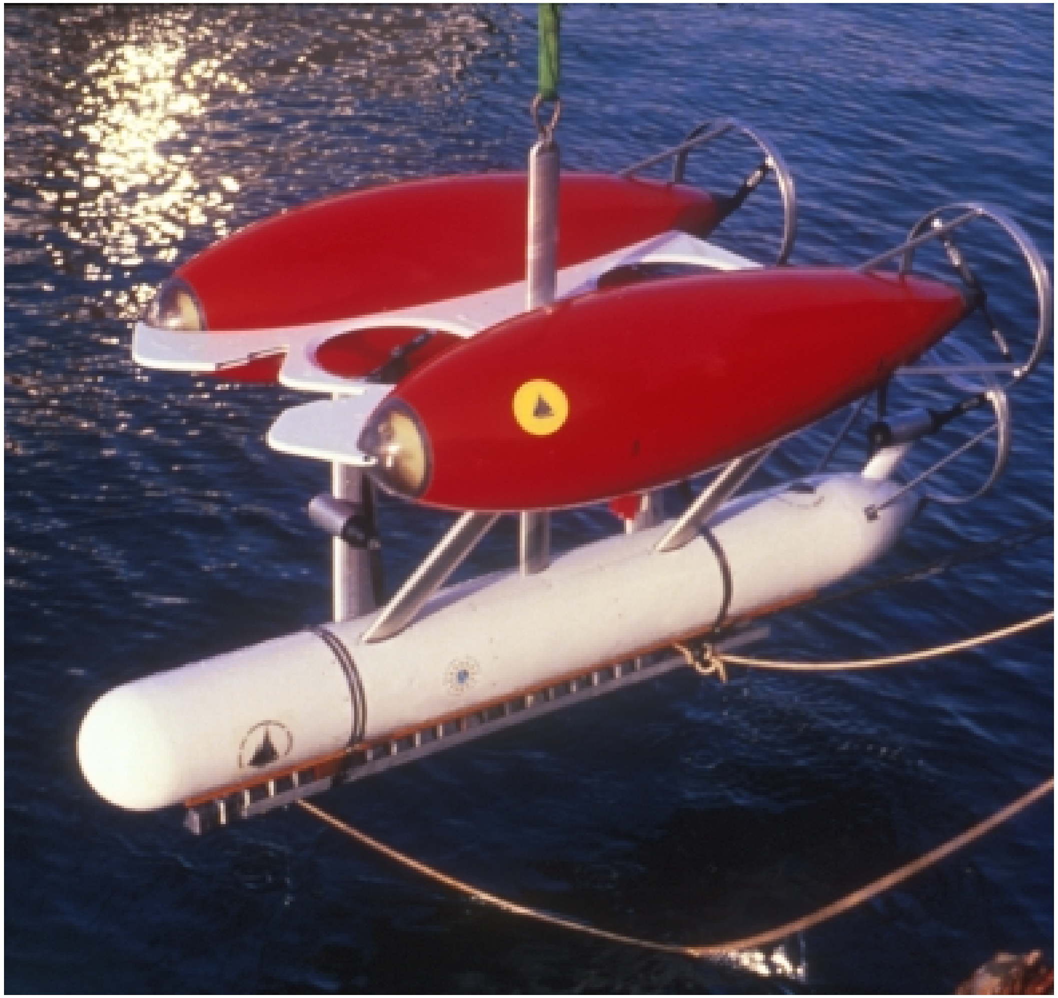
- Research Fleet
  - New capabilities on conventional surface vessels are fundamental
  - New technologies include satellite data transfer capabilities and new sonar systems
- Access to Polar Regions
  - Polar vessels (e.g., Palmer, Gould), USCG Icebreakers, USCGC Healy, submarine
- Autonomous Instruments/Vehicles
  - PALACE floats
  - Autonomous Benthic Explorer
  - Long-range AUV in Arctic
- Deep Submergence Capabilities
  - National Deep Submergence Facility
  - Major Upgrade of ROV capability
  - Major support for manned submersible activities (in FY2000, NSF is supporting 103 of 129 Alvin dives)
- Observatories
  - Pilot projects - LEO XV, HUGO, H2O, North Pole Environmental Observatory
- Ocean Drilling Program
  - IODP - Riser drilling capability post 2003

Initial Deployment of Atlantic Circulation and Climate Experiment (ACCE) Floats

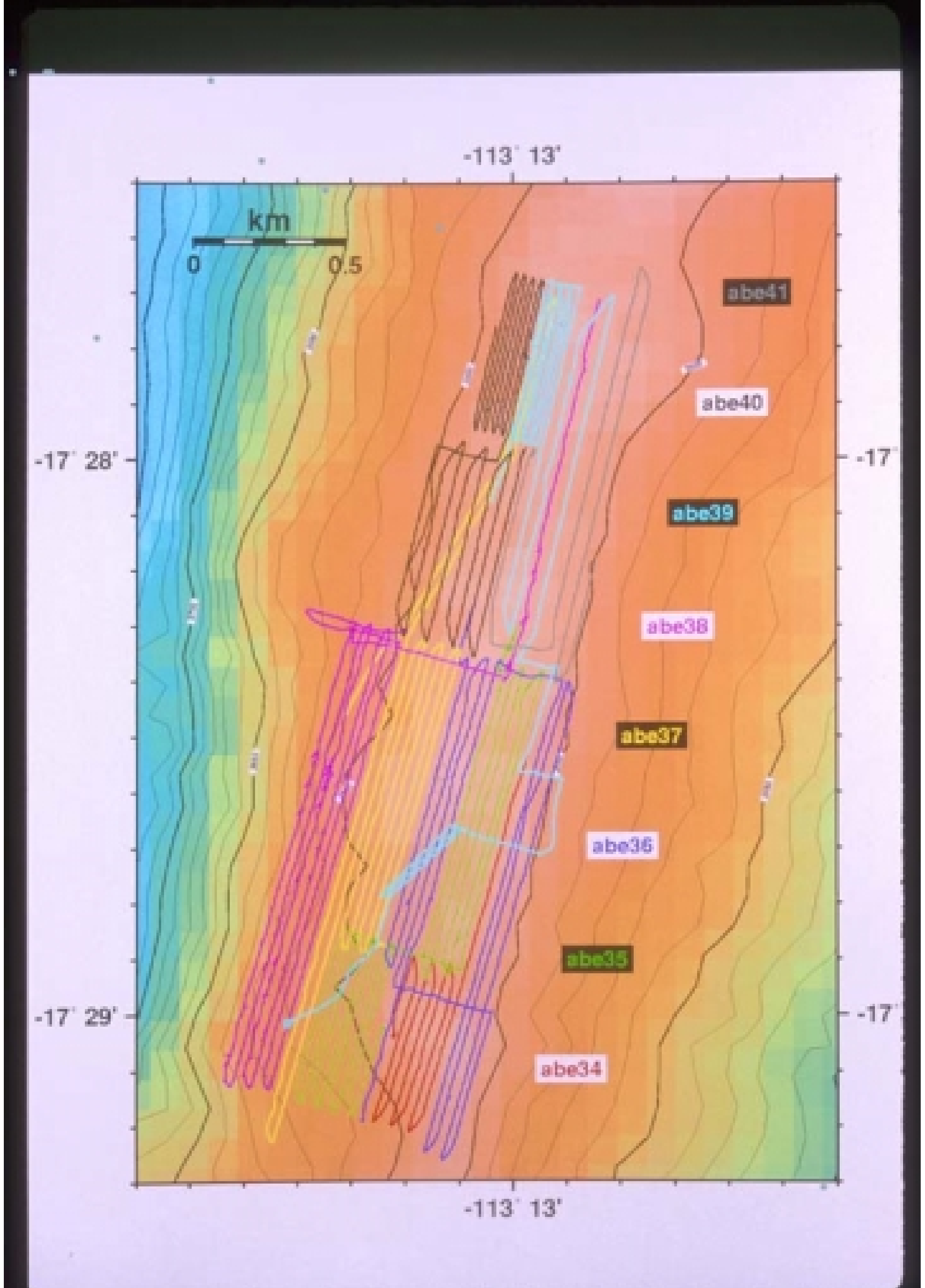
1998-1999



Autonomous Benthic Explorer (ABE)

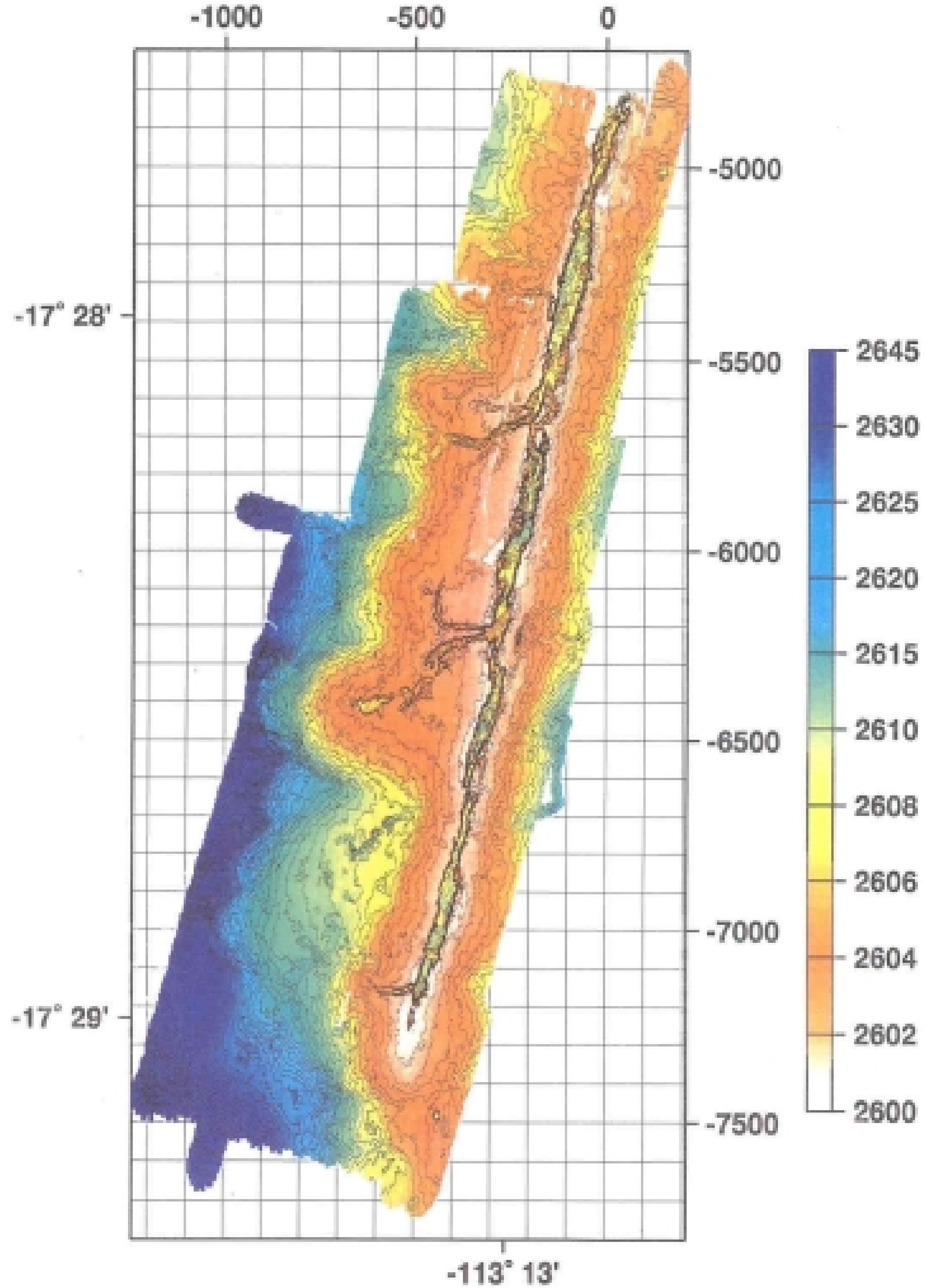


ABE Tracks: southern East Pacific Rise



Cormier, M. and W. Ryan, 1999

ABE Bathymetry Imaging



Cormier, M. and W. Ryan, 1999

Future Directions

- Exploring the Least Known Regions of the Ocean

  (three-dimensional space)

  – deep biosphere

  – polar oceans

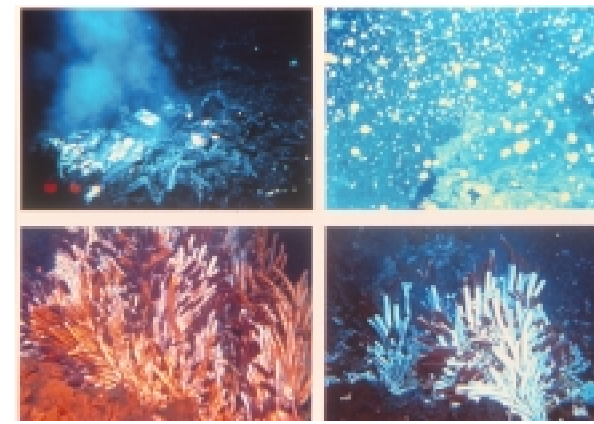
- Exploring In Time (the fourth dimension)

  – understanding dynamic processes

The Least Known Regions of the Oceans: Priority Areas

Deep biosphere

- The deep biosphere, including the subsurface biosphere, is among the most exciting geographic venues for ocean science
- Involves all disciplines, including ocean drilling
- Long-term in situ observatories needed to monitor complex interplay between magmatic, tectonic, hydrothermal, and biological processes
- Biotechnology potential substantial due to genetic isolation and distinctive selective forces



WHOI

The Least Known Regions of the Oceans: Priority Areas

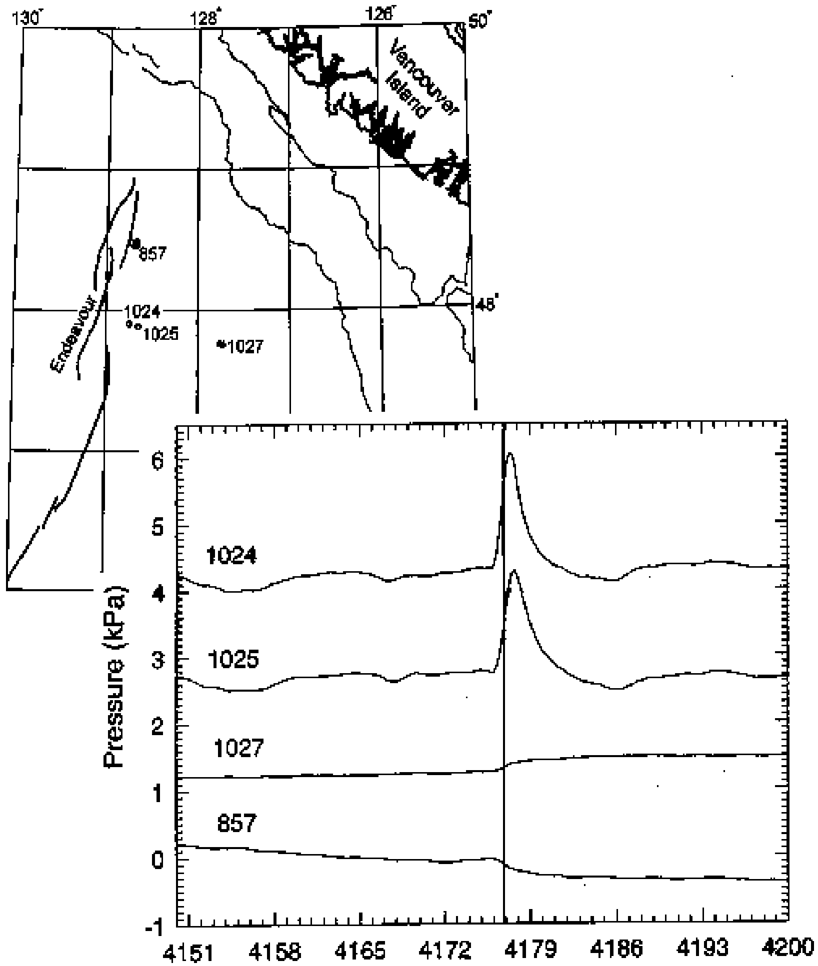
Polar Oceans

- Little known about most basic characteristics
- Contribution to climate processes critical, yet

  Arctic and subarctic processes poorly modeled
- Access is limited both by season and by multi-year ice
- Technology needed includes long-range AUVs, ice-resistant moorings, retrievable seafloor instrumentation, through-ice communications
- Biotechnology potential of extremophiles

Exploring in Time

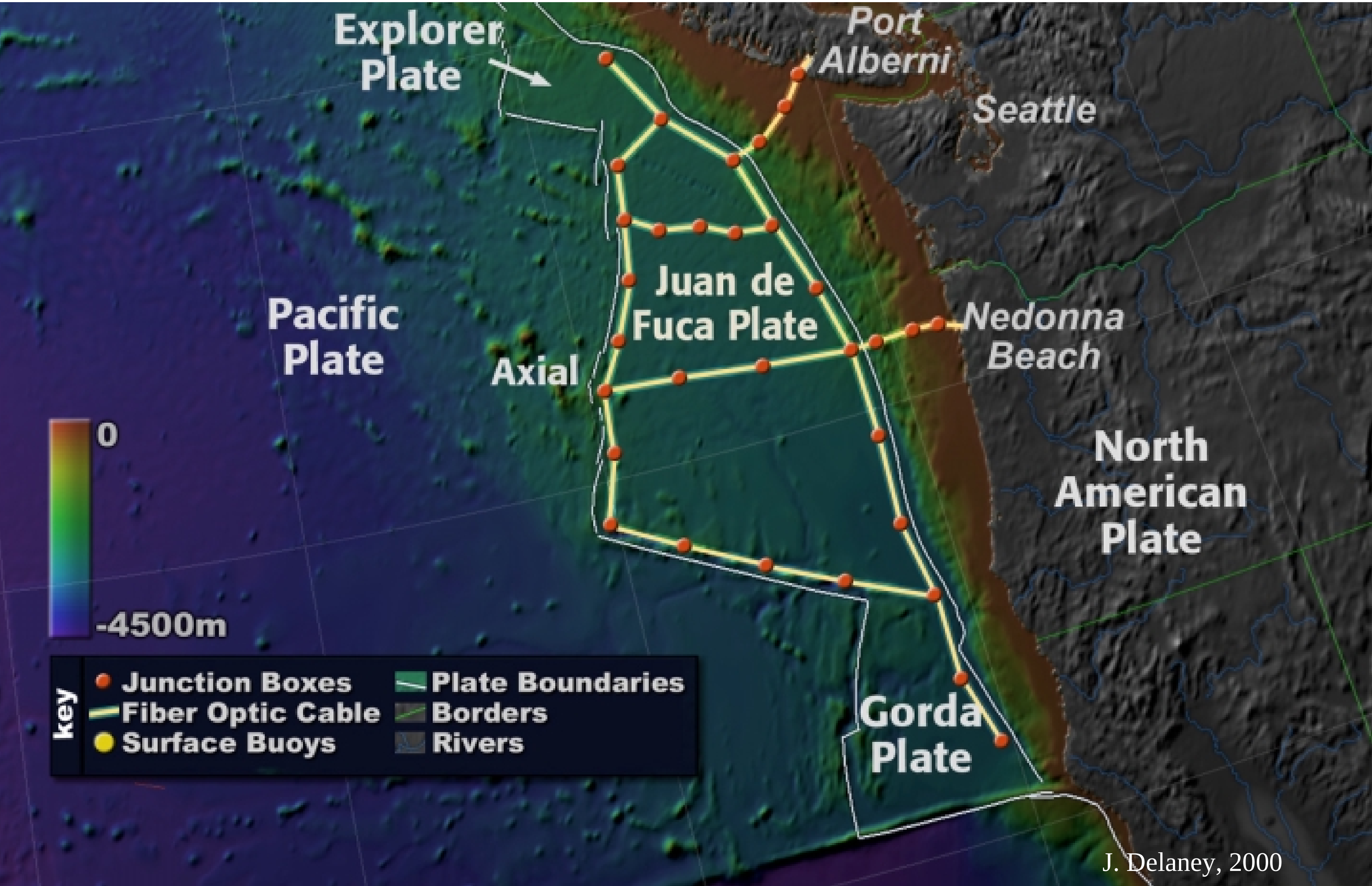
- Understanding of dynamic processes requires sustained time series observations
- Repeatedly in recent years, long time series have revealed important and unexpected results
- Despite advances, much of the technology needed to build an effective ocean observations system remains in development
- NOPP - Ongoing planning for an integrated ocean observation system
- NAS Report - Recent report confirms need for seafloor observing system



Magnitude 2.8 Endeavour Ridge

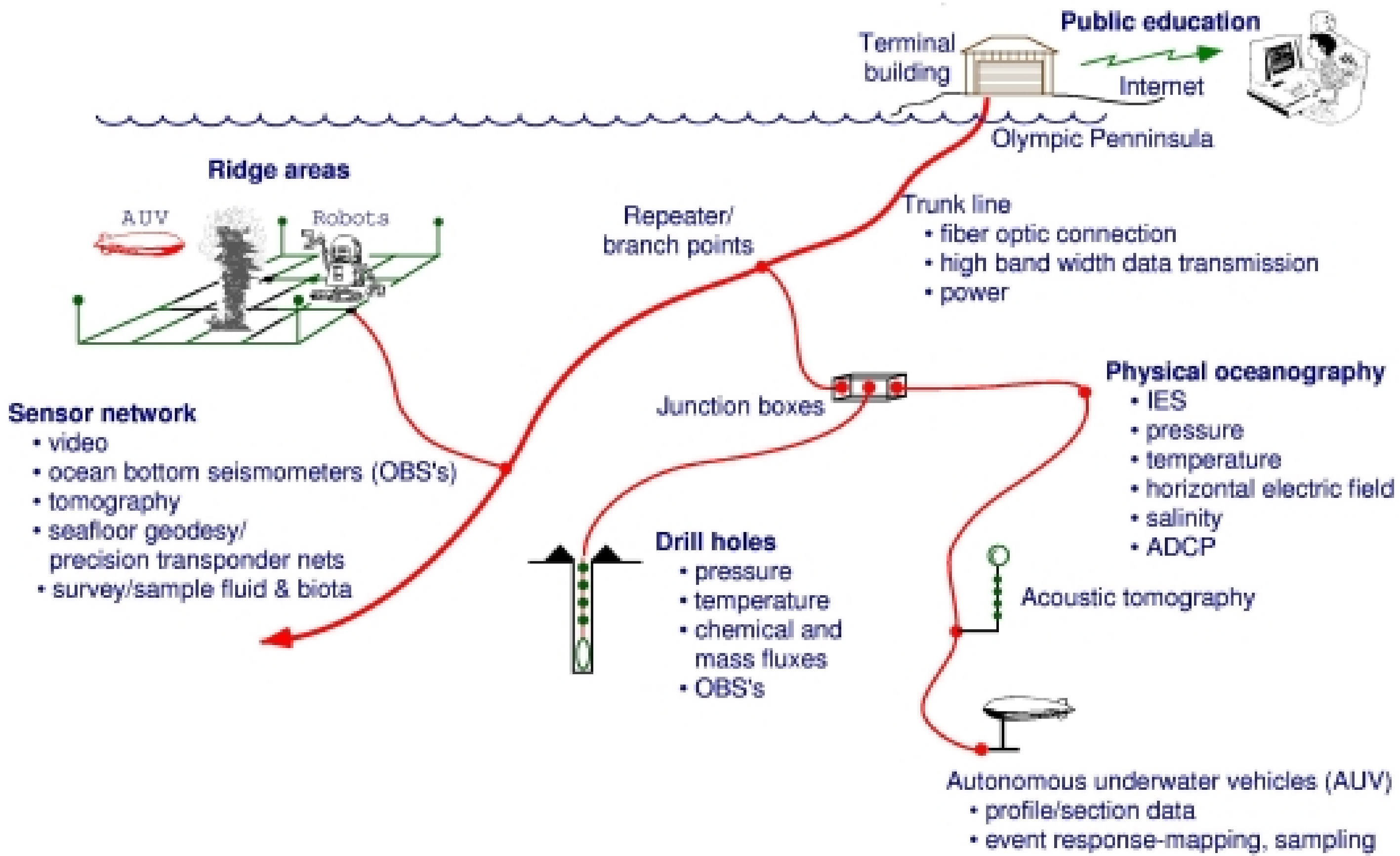
E. Davis, 2000

Cable System for Interactive Seafloor Observatory



J. Delaney, 2000

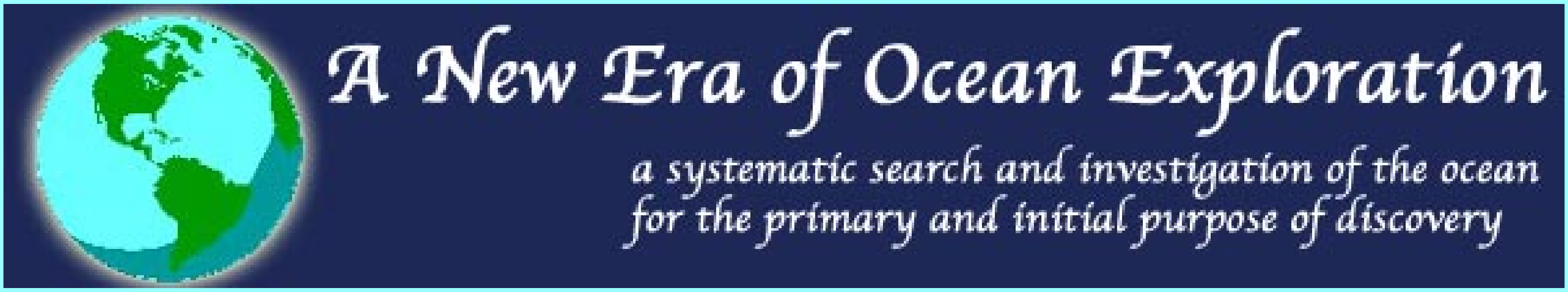
Linked Seafloor Observatories: Submarine Fiber-Optic Cable Networks



B. Howe, 2000

The Four Characteristics of an Effective Exploration Strategy

- Diverse Portfolio - discoveries cannot be predicted
- Priority-Setting and Flexibility - process of ***continuous*** community review that drives shifts in emphases based on new information
- New Generation of Tools
- Sustained National Commitment



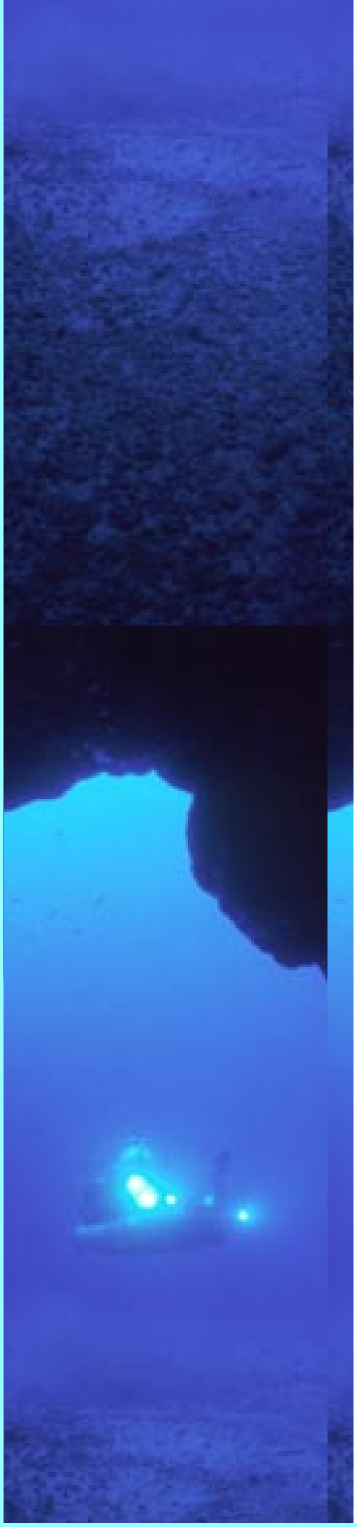
Panel Report

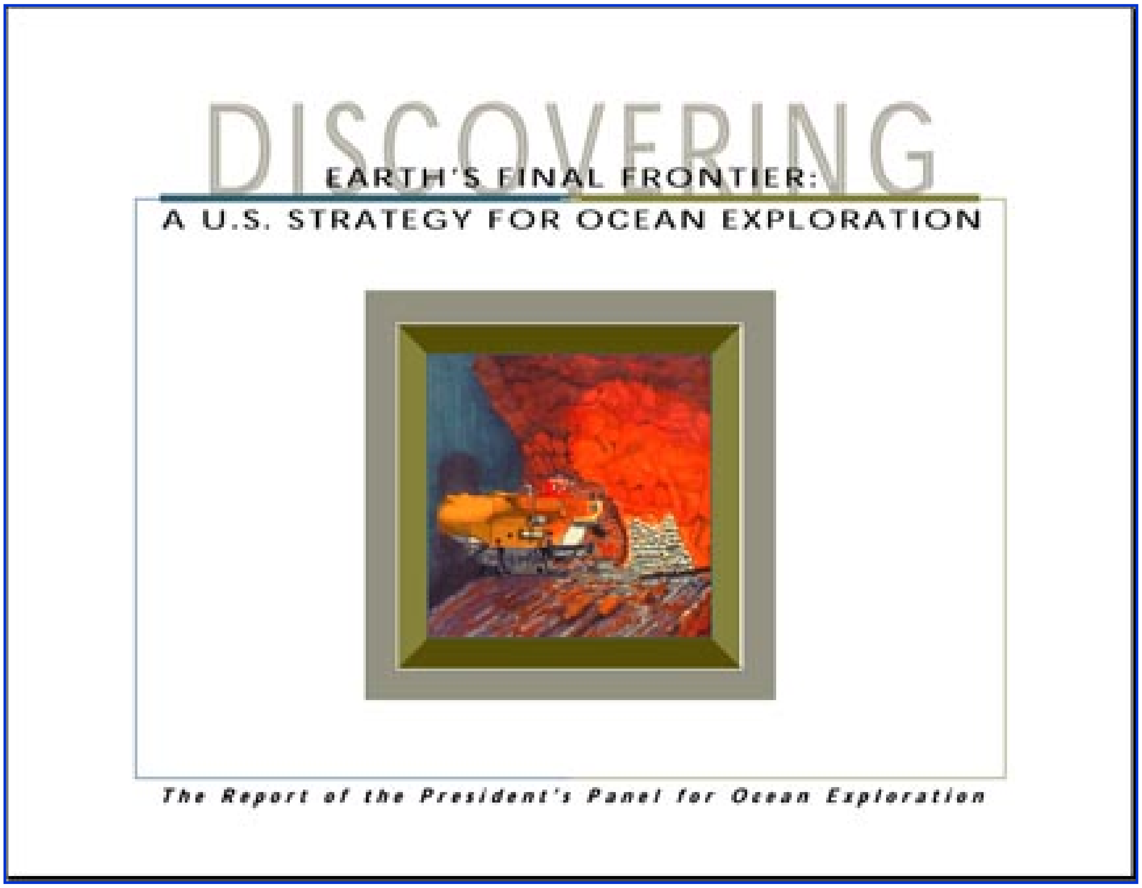
The Ocean Exploration Panel, which is comprised of leading ocean explorers, scientists, and educators has collaborated with Agency Science Advisors and the Interagency Task Force to produce recommendations for a U.S. strategy for ocean exploration. This Panel report entitled "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration" was passed along to the Secretary of Commerce, Norman Y. Mineta on October 10, 2000. The report will be announced in the near future. This is a historic accomplishment because it is the only national strategy proposed for exploration of the global oceans by any country in the world. The final printed version of this report will be available by January 2001, if you have any further questions regarding the Panel report, please contact NOAA Public Affairs at 202.482.6090 or 301.713.2483 ext. 181.

Ocean Exploration Panel Report

Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration

Cover and Executive Summary ***(2.4 Mb, PDF)***





Chapter 1: Motivation for Exploration *(6.7 Mb, PDF)*

Chapter 2: Exploration Objectives and Priorities *(7.9 Mb, PDF)*

Chapter 3: Ocean Exploration Partnerships and Chapter 4: Technology Required for Ocean Exploration ***(3.3 Mb, PDF)***

Chapter 5: Realizing the Potential of Our Discoveries and Protecting New Resources and Appendices A - E ***(1 Mb, PDF)***

Resources are available as downloadable files in Portable Document Format (PDF). These files can be accessed on computers that have installed a recent version of Adobe Acrobat Reader (free software).

If you would like information about any technical aspects of this site, please send an email to Claire Johnson.

TOP OF PAGE

DISCOVERING EARTH'S FINAL FRONTIER:

A U.S. STRATEGY FOR OCEAN EXPLORATION

The Report of the President's Panel for Ocean Exploration

DISCOVERING EARTH'S FINAL FRONTIER:

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PRESIDENT'S PANEL ON OCEAN EXPLORATION

Chair

DR. MARCIA McNUTT
Monterey Bay Aquarium Research Institute

Members

DR. VERA ALEXANDER
University of Alaska, Fairbanks

MR. JESSE AUSUBEL
Alfred P. Sloan Foundation

DR. ROBERT D. BALLARD
National Geographic Society,
Institute for Exploration

MR. THOMAS CHANCE
C & C Technologies, Inc.

MR. PETER DOUGLAS
California Coastal Commission

DR. SYLVIA EARLE
National Geographic Society,
Sustainable Seas Expeditions

DR. JAMES ESTES
University of California, Santa Cruz

DR. DANIEL J. FORNARI
Woods Hole Oceanographic Institution

DR. ARNOLD L. GORDON
Lamont-Doherty Earth Observatory,
Columbia University

DR. FRED GRASSLE
Rutgers University

DR. SUE HENDRICKSON
Underwater Archaeologist

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National Marine Educators Association

DR. LARRY MAYER
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DR. ELLEN PIKITCH
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DR. RICHARD SPINRAD*
United States Navy

* Agency Science Advisor

CONTENTS

LETTER OF TRANSMITTAL

Secretary of Commerce, Norman Y. Mineta

October 10, 2000

To the President:

On June 12, 2000, at the Millenium Council presentation "Under the Sea, Beyond the Stars," you ushered in a new era of Ocean Exploration by directing the Secretary of Commerce to convene a panel of America's finest ocean explorers, scientists, and marine educators. You called on the nation's best people to develop a national strategy for ocean exploration.

Your challenge has been met by the Ocean Exploration Panel. Members of the Panel represented the full array of ocean interests, including industry, conservation, educators, academia, and government, who worked together to create this crucial strategy. I am pleased to present their report, "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration."

Our nation's history, from colonization and westward expansion to the deployment of the Hubble telescope, is testament to the fact that America is a country of explorers. Our pride as a nation is founded upon our yearning to make new discoveries and to seek out new knowledge. Exploration of the oceans responds to a growing national interest in our seas and an acknowledgement of their importance to our environment and quality of life.

We are growing in the awareness that the ocean influences our daily lives in hundreds of ways. From providing fisheries resources or cures for disease, to unlocking the secrets of long-term climate, we are constantly reminded of the ocean's importance in sustaining life. Truly, our economic, environmental, and national security depend on our ability to understand the ocean frontier, as well as balancing the competing interests of conservation and economics.

Within the Department of Commerce, we have had over 30 years experience in managing the conservation, sustainable use, and commercial aspects of our oceans. For this reason, I am proud to offer the National Oceanic and Atmospheric Administration as the lead agency for new national efforts in ocean exploration.

For too long, our natural resource agencies have pursued a course of ocean resource management rather than ocean exploration. We now know the futility of trying to manage systems without complete knowledge of them. This report outlines a coordinated, focused approach that will ensure a better understanding of the oceans for generations to come.

This report envisions a new collaboration among governments, academia, and private industry that reaches out to everyone and marks a turning point for exploration. May it also mark a new era of ocean stewardship.

Norman Y. Mineta
Secretary of Commerce

EXECUTIVE SUMMARY

***WITHIN** the past few decades, advances in undersea technology have revolutionized the way we think about the oceans and the life within them.*

New exploration tools can place researchers into the deepest reaches of the oceans, either directly or by telepresence. Hundreds of new marine species and entirely new ecosystems have been discovered. The benefit attributed to these advances has been enormous; for example, a new industry, marine biotechnology, has shown impressive returns. Understanding biodiversity of the oceans is critical to sustaining their immense global economic value. Furthermore, the deep oceans may hold the keys to the origin of life itself. Despite these gains, 95 percent of the oceans remain unknown and unexplored.

On June 12, 2000, President Clinton announced the commencement of a new era of ocean exploration. In an Executive Directive to the Secretary of Commerce, the President requested that the Secretary convene a panel of leading ocean explorers, scientists, and educators to develop a national strategy for exploring the oceans. The Panel has completed its work and presents its recommendations for a national strategy in this report.

The Panel recommends that the U.S. undertake a national program in ocean exploration in which discovery and the spirit of challenge are the cornerstones. Multidisciplinary exploration approaches, covering all three dimensions of space, as well as the fourth dimension of time, should include natural and social sciences as well as the arts. The U.S. Ocean Exploration Program should be global in scope, but concentrated initially in areas under U.S. jurisdiction. Results must be carefully documented and widely disseminated; the program must be innovative and bold.

The President requested objectives and priorities to guide ocean exploration, as well as identification of key sites of scientific, historic, and cultural importance. The Panel identified the following key objectives of an Ocean Exploration Program:

1 |

Mapping the physical, geological, biological, chemical, and archaeological aspects of the ocean, such that the U.S. knowledge base is capable of supporting the large demand for this information from policy makers, regulators, commercial ventures, researchers, and educators;

2 |

Exploring ocean dynamics and interactions at new scales, such that our understanding of the complex interactions in the living ocean supports our need for stewardship of this vital component of the planet's life support system;

3 |

Developing new sensors and systems for ocean exploration, so as to regain U.S. leadership in marine technology; and

4 |

Reaching out in new ways to stakeholders, to improve the literacy of learners of all ages with respect to ocean issues.

The Panel notes that the United States currently does not support a program in ocean exploration, despite our inadequate understanding of the ocean and the living and nonliving resources it contains, and its undeniable importance to the health of the planet and the wealth of our nation. Furthermore, in a number of areas, the U.S. has fallen behind other nations in our capabilities for undertaking ocean exploration. American leadership in ocean exploration can be achieved through the following recommendations.

The U.S. government should establish an Ocean Exploration Program for an initial period of 10 years, with new funding at the level of $75M/year, excluding capitalization costs. The program should include:

— ***Interdisciplinary voyages of discovery within high-priority areas, including the U.S. Exclusive Economic Zone (EEZ) and the continental margin, the Arctic, and poorly known areas of the southern oceans and inland seas. The U.S. inventory of the living and nonliving resources in the ocean should be second to none, particularly within our own EEZ and continental margins.***

— ***Platform, communication, navigation and instrument development efforts, including the capitalization of major new assets for ocean exploration, in order to equip our explorers with the very best in marine research technology.***

— ***Data management and dissemination, so that discoveries can have maximum impact for research, commercial, regulatory, and educational benefit.***

— ***Educational outreach, in both formal and informal settings, to improve the science competency of America's schoolchildren and to realize the full potential of a citizenry aware and informed of ocean issues.***

Partnerships are essential if the full benefits of ocean exploration are to be realized. Mechanisms must be developed for forming appropriate partnerships between federal, state, local, and tribal governments, industry, academic institutions, formal and informal educators, mass media and nongovernmental organizations. These partnerships will greatly expand the opportunities to undertake voyages of discovery, technology development, and educational outreach. The Panel recognizes that the framework for accommodating collaboration in ocean exploration depends upon its broader organizational strategy. Therefore, recommendations concerning partnerships must also consider larger organizational issues.

The President of the United States should instruct the White House Science Advisor and appropriate Cabinet officials to design the management structure for this program. Elements of governance should include:

— ***Designating a lead agency to be in charge of the program and accountable for its success using benchmarks appropriate for ocean exploration, such as the number of new discoveries, dissemination of data, and the impact of educational outreach.***

— ***Using existing interagency mechanisms to ensure federal cooperation among agencies.***

— ***Establishing an Ocean Exploration Forum that would include commercial, academic, private, and nongovernmental organizations, and government stakeholders in ocean exploration, to encourage partnerships and promote communication.***

New technologies will enable the next generation of ocean exploration, but if the U.S. is to be a leader in this area, we must make a commitment to provide the very best technology. Of particular importance are the development of: ***1)*** Underwater navigation and communication technologies; ***2)*** State-of-the-art sensors; and ***3)*** Deployment strategies for multidisciplinary, in-situ and remote-sensing measurements of biological, chemical, physical and geological processes at all levels in the ocean. Therefore, recommendations concerning new technologies must consider:

— ***Undertaking the development of underwater platforms, communication systems, navigation, and a wide range of sensors, including the capitalization of major new assets for ocean exploration.***

The Panel was also charged with recommending mechanisms to ensure that information gathered through ocean exploration is referred to the newly established Marine Protected Areas Center and to appropriate commercial interests for possible research and development. The President can ensure that knowledge gathered during ocean exploration is effectively made available for informed decision-making relative to Marine Protected Areas by:

— ***Assigning leadership in this activity to an appropriate federal agency.***

— ***Establishing a broad-based task force to design and implement an integrated, workable, and comprehensive data management information processing system for information on unique and significant features.***

With respect to assuring that potential opportunities for developing new resources into useful products to benefit mankind are encouraged, the Panel recommends that U.S. laws be re-examined to provide proper incentives for potential commercial users of ocean discoveries. Examples of some areas in which policies could encourage the appropriate use of exploration results include:

— ***Enhancing funding within federal agencies to support early-phase research on discoveries with commercial potential.***

— ***Providing incentives to private industry to encourage the funding of research and development of discoveries with commercial potential.***

— ***Designing mechanisms whereby those who directly profit from the exploitation of marine resources support research on their environmentally sustainable use.***

The Panel advocates a new national Ocean Exploration Program to permit exploratory expeditions for two reasons: ***1)*** The initial phase of oceanographic discovery ended before a significant portion of the oceans was visited in even a cursory sense; and ***2)*** Marvelous new tools now exist that permit exploration in spatial and temporal dimensions that were unachievable 50 years ago. For these reasons, we must go where no one has ever gone before, “see” the oceans through a new set of technological “eyes,” and record these journeys for posterity.

MOTIVATION FOR EXPLORATION

EXPLORATION *is fundamental to the human spirit. Since the dawn of our species we have been explorers, with the motivation for these journeys ranging from survival to spiritual inspiration.*

With the rise of civilization, the search for new wealth and the elevation of national pride drove explorers to risk their lives and benefactors to empty their coffers in the quest for discovery. All of these factors — survival, inspiration, wealth, and national pride — provide the fundamental justification for proposing the most ambitious chapter ever in the history of human discovery of this planet: the exploration of Earth's oceans.

It has been stated many times that we know more about the backside of the Moon than we do about the bottom of our ocean. And that statement just refers to its depth. There exists on our planet, for example, a virtually unstudied ecosystem which rivals all the other known ecosystems on Earth — the mid-water environment in the oceans. This biologically rich and complex domain is known to contain many times the biomass of all the Earth's rainforests and terrestrial biota. Despite this area's size and importance, the biology of the organisms which inhabit the mid-water levels in the oceans, and the complex dynamics between this zone and the upper and lower levels of the ocean, are virtually unknown. We have just begun to learn about the diversity of life in all reaches of the ocean, and the cycling of its critical elements that support life and regulate climate. New physical processes that transport mass and energy await discovery, and most of the record of ancient Earth and human history contained in the cold sediment floor is still unread. To be sure, the United States has a superb record of basic and applied ocean research funded through a variety of federal agencies and private industry in support of U.S. national defense, weather prediction, resource assessments, and the testing of specific scientific hypotheses. What has been lost in this diverse research portfolio, however, is the opportunity to broadly explore on a global basis and across many scientific, cultural, and technological disciplines.

Fifty years ago, during the early days of modern oceanographic research, expeditions were exploratory. Ships were staffed with inter-disciplinary teams of physical and chemical oceanographers, marine biologists, and geologists. The oceanographers made all conceivable measurements, secure in the knowledge that those observations would eventually prove worth-while. Today, expedition personnel tend to be from a narrower range of disciplines, and ship time is allocated for measurements to test the hypothesis and carry out the objectives at hand, with little time left over for unrelated observations.

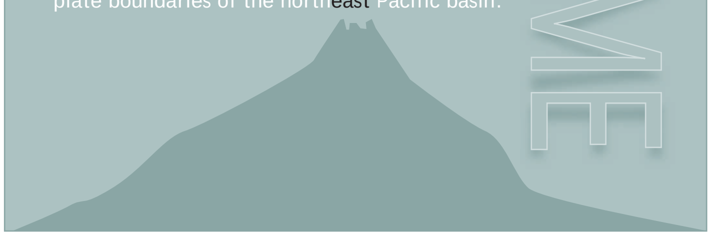
This Panel advocates a national program to permit exploratory expeditions for two reasons: ***1)*** The initial phase of oceanographic discovery ended before a significant part of the oceans were visited in even a cursory sense; and ***2)*** We now have marvelous new tools now that permit exploration in spatial and temporal dimensions that were unachievable 50 years ago. In other words, we will not only go where no one has ever gone, but we will also "see" the oceans through a new set of technological "eyes" and record these journeys for posterity.

What is Exploration?

For the purposes of this report, exploration is defined as discovery through disciplined diverse observations and the recording of the findings. An explorer is distinguished from a researcher by virtue of the fact that an explorer has not narrowly designed the observing strategy to test a specific hypothesis. A successful explorer leaves a legacy of new knowledge that can be used by

A MYSTERIOUS PLUME

In July 1986, while on a survey of hydrothermal vents on the Juan de Fuca Ridge off the Oregon coast, scientists from NOAA's Pacific Marine Environmental Laboratory began documenting elevated water temperatures at greater heights off the seafloor than ever previously recorded. Most plumes from hydro-thermal vents along the Mid-Ocean Ridge rise only a few hundred meters before reaching temperatures of the surrounding water. However, in this case, the anomalous water was still much higher in temperature than the surrounding water at a height of more than 700 meters above the seafloor and the plume had spread out over an area that measured 20 km in diameter. A plume this size with this temperature was calculated to be the equivalent of approximately an entire year's worth of "normal" hydrothermal out-put from the ridge. However, when the ship returned to the same site a month later, no evidence of this "megaplume" was found. Scientists suspected that the culprit was a deep-sea eruption which is, by nature, a very short-lived oceanographic event. Subsequent studies of the seafloor in the region revealed the presence of very fresh lava and new hydrothermal venting stretching over tens of kilometers along the ridge. The unanticipated discovery of this deep-sea eruption provided a strong rationale for utilizing the Navy's SOSUS system in the area in 1991. The use of this system has led to the detection and intense study of three more seafloor eruptions and several other anomalous earthquake swarms that were essentially inaudible to land-based seismometers along the tectonic plate boundaries of the northeast Pacific basin.



The Arctic Ocean is the least explored of the world's oceans. Every voyage through the region, whether by ice-breaking vessel, surface expedition across the ice, or nuclear submarine under the ice, has yielded completely new knowledge and unexpected insights. The role of the Arctic region in global processes is not well understood. More information is needed to understand and predict how freshwater input, variability in sea-ice thickness, and the transport of heat into the Arctic Ocean, affect global climate. Future work in this area will require robust investigative tools and build on entirely new knowledge about the region.

In the summer of 1994, a remarkable expedition to the North Pole was conducted that generated several historic firsts. The expedition included the northernmost rendezvous ever of surface ships from the three largest Arctic nations: Russia, the U.S., and Canada, on August 23. The rendezvous occurred when American and Canadian ships that were the first surface vessels to cross the Arctic Ocean via the North Pole, joined the Russian ship. Significant findings from this expedition were the first observation of direct evidence of overall warming of the entire Atlantic layer, and the discovery of much higher levels of biological activity than previously assumed — from plankton to polar bears. The expedition was truly exploratory in that the findings were not predictable. Its rigorous scientific approaches enabled the new information acquired to advance understanding of the Arctic and paved the way for future scientific exploration and research.

With the Arctic covered by ice much of the year, scientists have never been able to accurately measure the temperature of this vast ocean. A newly emerging technique, using sound sources and arrays of receivers, may finally change that. Initial results have shown that the Arctic Ocean has warmed more dramatically than climatologists had predicted. Clearly, the discoveries in this region demonstrate that the Arctic is ripe for future exploration.

THE ARCTIC OCEAN

those not yet born to answer questions not yet posed at the time of the exploration. This new knowledge may also have immediate beneficial applications in answering the needs of contemporary ocean scientists, natural resource managers, educators, and industries.

New discoveries come about both in the context of directed, hypothesis-driven research and in the process of pure exploration. Research journals and Nobel prizes give testament to the numerous cases of serendipitous discoveries stumbled upon in the course of directed research undertaken for completely different reasons. Several examples of this sort of fortuitous discovery are described in sidebars contained within this report. The Panel advocates continuing the basic and applied research undertaken by many federal agencies, and in addition, proposes adding a new program in ocean exploration that will expand scientific investigations into new areas. Answering questions and following up on ideas will still be cornerstones of the new program. While hypotheses may be less specific, and their outcome less predictable, than the current norm, the observations will be more broadly based, and the program more interdisciplinary. The potential for payoffs from this endeavor will be enormous.

Characteristics of a U.S. Ocean Exploration Program

The U.S. will greatly benefit from a renewed commitment to exploration. A modern exploration initiative should be designed with the following desirable characteristics in mind.

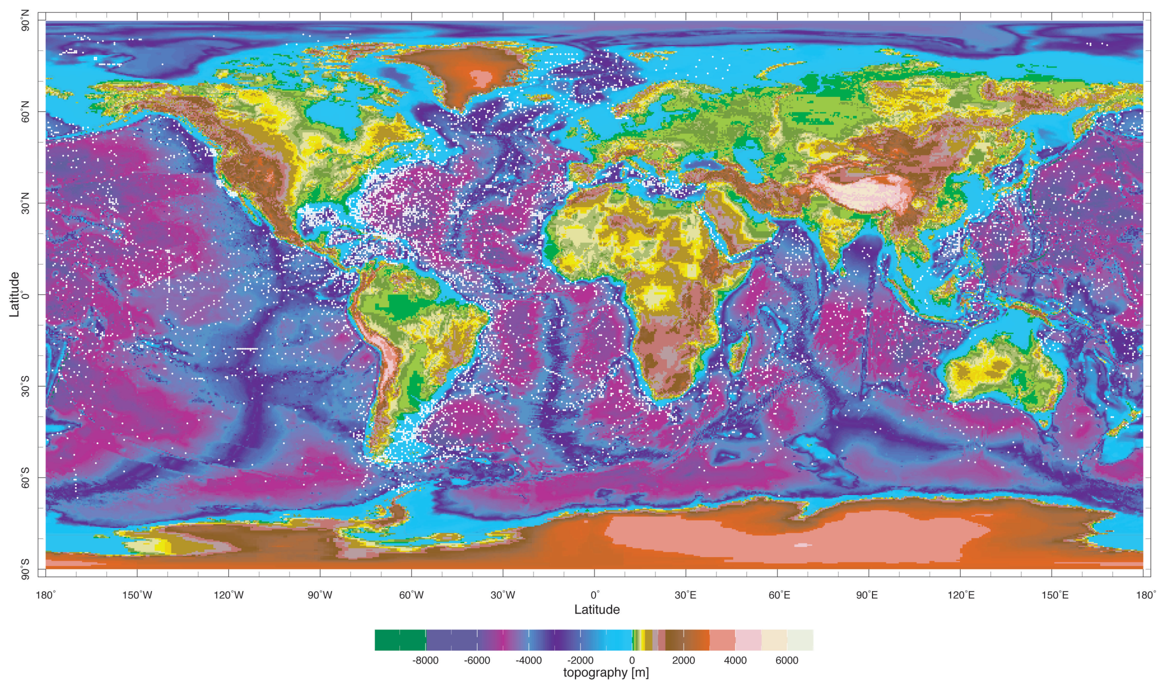
— **DISCOVERY AND THE SPIRIT OF CHALLENGE SHOULD BE CORNERSTONES.** *The tendency in oceanographic research in recent years has been to return again and again to areas visited before as scientific hypotheses become increasingly refined. The emphasis in exploration will be to survey new areas to provide baseline information that may well inspire future hypothesis-driven research.*

— **EACH FACET OF EXPLORATION IS NECESSARILY MULTIDISCIPLINARY** *and should include aspects of the natural sciences, social sciences, and artistic expression. Disciplines that are historically under represented in ocean exploration and can bring to bear new concepts*

LAMONT cores

In the 1950s and 1960s, during the reign of Maurice ("Doc") Ewing at Columbia University's Lamont-Doherty Earth Observatory, Lamont's vessels were under strict orders to stop every day at noon to take a sediment core, no matter where the ship was or what else it was doing. Doc did this purely in the spirit of exploration, understanding that we knew so little about the seafloor and ocean history that a global core database would inevitably be of value. "Value" has turned out to be an understatement. This core database (core locations shown as white dots in figure) has become the foundation of our understanding of climate change mechanisms. A core taken by the vessel *Robert Conrad* in 1967 recorded a particularly complete and high- resolution record of changes in benthic and surface biota over the last 250,000 years.

Nearly a decade later, the pioneering work of John Imbrie, Jim Hays and Nick Shackleton used the cyclic variations found in this core to substantiate the Milankovitch Hypothesis. This hypothesis puts forward the theory that the waxing and waning of ice ages can be attributed in part to variations in orbital parameters that occur at periods of 19, 22, 41, and 100 thousand years. The Lamont core suite also provided the early scientific basis for motivating the Deep Sea Drilling and Ocean Drilling programs. This example of routine data collection that leads to discovery has been repeated frequently over the past 50 years of oceanographic data collection and underscores the importance of the full utilization of existing data sets and serendipitous discoveries in the oceanographic sciences.



and rich experiences should be challenged to participate.

— **THE OCEAN EXPLORATION PROGRAM SHOULD INCLUDE AN EDUCATIONAL COMPONENT** *that encompasses both formal and informal educational institutions as well as the general public. These efforts should incorporate existing programs and organizations that support marine and ocean science education.*

— **THE OCEAN EXPLORATION PROGRAM SHOULD CONSIDER ALL THREE DIMENSIONS OF SPACE, AS WELL AS THE FOURTH DIMENSION OF TIME.** *Exploration must go beyond mapping the seafloor. It cannot ignore the fact that the ocean is forever changing in time, and that human impacts are already substantial. Explorations into all four dimensions will also challenge our knowledge of scales of variability. For example, previously unknown microbial phenomena may yield discoveries as grand as those resulting from basin-scale explorations. Resolving picosecond variability may prove to be as challenging as exploring the changes observed over millennia.*

— **THE OCEAN EXPLORATION PROGRAM SHOULD BE GLOBAL IN SCOPE BUT CONCENTRATED INITIALLY IN REGIONS UNDER U.S. JURISDICTION.** *This focus will provide the best opportunities for immediate benefit to the American people, while controlling the use of national resources and protecting valuable marine life and habitats under U.S. management authority*

— **THE RESULTS OF THE EXPLORATIONS MUST BE CAREFULLY DOCUMENTED** *using the latest in database technology, communications, and recording media. The documentation should take a variety of forms, from the archiving of digital data to the production of multimedia programming and other educational resources and tools for the public.*

— **THE RESULTS MUST BE WIDELY DISSEMINATED,** *through a variety of formats, and particularly the Internet, to reach a large number of potential beneficiaries. Shipboard activities should be available in near real-time to enhance the outreach opportunities provided by a program of this scope and visibility. The results should excite the public imagination as well as challenge and encourage public involvement.*

— **THE OCEAN EXPLORATION PROGRAM NEEDS EXPLORERS, CHAMPIONS, AND ROLE MODELS** *who may not themselves directly benefit from the data being collected. The "human element" is essential to humanize the science and provide role models for future explorers.*

— **THE OCEAN EXPLORATION PROGRAM SHOULD MAKE EVERY ATTEMPT TO WORK WITH INTERNATIONAL PARTNERS** *when appropriate. This is essential for work in waters under the jurisdiction of other nations and will serve to expand the program and leverage its resources in international waters.*

— **THE OCEAN EXPLORATION PROGRAM SHOULD CAPITALIZE ON JOINT OPPORTUNITIES WITH OTHER COMPATIBLE GOVERNMENT MISSIONS AND INDUSTRY** *where appropriate. For example, survey missions of NOAA's nautical charting program, the U.S. Geological Survey, and the Oceanographer of the*

Navy can substantially contribute to ocean exploration. Joint planning and funding of these missions should be made when mutually beneficial.

— **THE OCEAN EXPLORATION PROGRAM MUST BE SYSTEMATIC IN ITS COLLECTION OF DATA,** *to facilitate the joint interpretation of data collected at different times and in different places. A systematic program will also help to avoid duplication of effort.*

— **THE OCEAN EXPLORATION PROGRAM SHOULD CHALLENGE EXISTING TECHNOLOGY.** *Just as space exploration has become a leading arena for technology development and transfer, ocean exploration must use the latest capabilities and should provide an incentive for creating new tools. Technology partnerships with the petroleum and oil service industries could, for example, tap into their already massive investments in deep-water and ocean technologies. All technologies should be brought to bear — human occupied submersibles: remotely operated vehicles (ROVs); and autonomous underwater vehicles (AUVs); platforms under, on, and above the sea surface; advanced sensor technologies; and information storage and transfer technologies — to meet the challenges of the years to come.*

— **ALL STAKEHOLDERS IN THE OCEAN EXPLORATION PROGRAM MUST BE ENCOURAGED TO ACCEPT RISKS WHERE BENEFITS ARE LARGELY UNKNOWN.** *It is possible that the technology might not work, and that objectives might not be achieved within the specified timeframe. Nevertheless, exploration should be considered a success regardless of what is discovered.*

The Ocean Exploration Program must be innovative and bold. “Business as usual” will not achieve the goals.

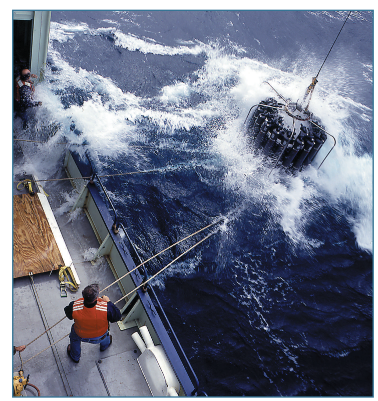
The Fruits of Exploration

Experience has shown that observations from the oceans are eventually put to myriad uses. They result in scientific, cultural, and historic understanding of how our planet functions, who we are, and how we got where we are today. The beauties and mysteries of the oceans inspire artists, authors, and musicians. We cannot protect what we do not know, and thus, without ocean exploration, we are ignorant of what needs to be conserved in a realm that covers most of the surface of the Earth. The ocean provides a bounty of renewable resources, but without knowledge of what’s out there, how abundant it is, and how quickly it is replenished, we cannot plan for its environmentally sustainable use. We also know that the oceans provide a storehouse of non-renewable mineral resources essential for maintaining our quality of life, though much of that wealth remains undiscovered. Every day, governments make decisions on how to best regulate the use of the oceans, yet they lack the basic knowledge to make informed choices. Accurate knowledge of the oceans is essential for environmental, economic, and national security. Designing and building platforms and observing systems for the extremely demanding and unforgiving ocean environment pushes our technology to its limits and leads, more often than not, to commercial spin-offs.

Despite the fact that we can confidently predict that ocean exploration will lead to discoveries that directly benefit the nation, it is impossible to predict when we embark upon the voyage of discovery exactly how that benefit will be manifest. Today, we may discover a new organism with enzymes that render inert a particular environmental carcinogen, or tomorrow, we may learn more about the mechanisms that triggered a catastrophic global warming and led to mass extinctions many millions of years ago. Discovery is the prelude to new paradigms; it jolts us out of the ruts of incremental scientific progress and fuels the great leaps forward.

UNITED STATES DEPARTMENT OF ENERGY EXPLORATION AND PRODUCTION PARTNERSHIP

Nearly one-third of today's U.S. gas supply and one-quarter of the nation's oil come from the ocean coastal zones and continental shelf. Exploring for and producing these resources has steadily moved into ever-deeper waters — from a depth of 300 feet 30 years ago to 6,000 feet today, with future plans to explore new depths below 10,000 feet tomorrow. Thus, there is an ever-increasing demand for advanced technologies that will facilitate the economic, safe, and environmentally benign production of underwater oil and gas resources. To help achieve that goal, DOE through the Exploration and Production Program will partner with industry, academia, national laboratories, and other agencies. For example, DOE is initiating a partnership with industry, for testing of an ocean-floor module for production of oil and gas. If successful, this technology will provide much greater access to underwater oil and gas resources at a lower cost, and it will provide an opportunity to gain knowledge of the sea-floor and its ecosystems. Exploration programs will benefit, particularly those involving methane hydrates—ice-like cages of water molecules containing methane on the ocean floor and below. They have a resource potential estimated to exceed all other oil, gas, and coal resources. The technology will also enhance our understanding of how the oceans affect the Earth's carbon cycle and the causes of global climate change.



OCEAN EXPLORATION

OBJECTIVES AND PRIORITIES

N *charting a course of discovery we forsee a captivating set of results and products derived from ocean exploration.*

EXPLORATION OBJECTIVES

We are faced with fascinating challenges, founded upon the balance of our current understanding and our expectations for future capabilities. These challenges are, by design, ambitious in nature. Four challenges will constitute the objectives of the Ocean Exploration Program:

— ***Mapping at New Scales Emphasizing Regions not Previously Observed;***

— ***Exploring Ocean Dynamics and Interactions at New Scales;***

— ***Developing New Technologies; and***

— ***Reaching Out in New Ways to Stakeholders.***

Mapping at New Scales Emphasizing Regions not Previously Observed

The most notable product of exploration is the creation of new ways to show others what lies beyond our current understanding. This documentation of discovery is typically articulated in a new or improved map. But current and evolving spatial information systems have redefined the standard notion of a map. The Ocean Exploration Program will recognize these new technologies and produce new generations of maps that include all imagery characterizing ocean geography, physics, chemistry, geology, and biology. These maps will also define sites of archaeological significance and define changes in regions over time. The mapping process should be broadly constituted to include:

— ***Archaeological sites***
We will find and systematically explore dozens of new sites.

— ***Resources, living and non-living***
We will explore what they are, where they are, and how abundant they are, within the U.S. Exclusive Economic Zone (EEZ) and continental margins.

— ***New species***
We will discover thousands of undescribed species.

— ***Ecosystems***
We will find and describe several new communities of organisms displaying novel relationships with their physical, chemical, and geological environments.

DISCOVERIES at our FINGERTIPS
BURIED

A spectacular geological event took place on the Atlantic margin of North America about 35 million years ago. A giant meteorite, 3-5 km wide, struck the seafloor and blasted a crater twice the size of Rhode Island and as deep as the Grand Canyon. The evidence for this Chesapeake Bay impact crater is now buried about 200 km south of Washington, D.C. The story of the discovery of this sixth largest impact crater on Earth 50 years of exploration, observation, changing hypotheses, rapidly improving technologies, and serendipity.

The anomalous ejecta unit associated with the impact was first observed in drill cutting more than 50 years ago. Three decades later, clear evidence for the chaotic nature of the unit came from continuously cored sections (a technological improvement); the unit was attributed to a giant submarine landslide. In the 1980s, the discovery of 35-million-year-old microtektites suggested an extraterrestrial explanation, although the unit was then thought to be deposited by a super tsunami. Technology again improved our understanding when a series of marine seismic imaging systems revealed the enormous buried circular structure. Serendipity came into play because one researcher was either directly or indirectly involved in many of these observations and discoveries and could link the disparate data sets. The discovery of the impact structure and the difficulty identifying it during 50 years of research show the importance of using new technologies and multidisciplinary approaches to explore and reexamine the Earth at different scales. What other exciting discoveries lay buried at our fingertips, awaiting improved technologies and innovative approaches to reveal themselves?

— ***Ocean's interior***

We will explore the temporal and spatial variability of the ocean as well as variations in the interior of the Earth beneath it.

— ***Ocean floor***

We will completely map the ridges, canyons, faults, and other key features of the U.S. EEZ and the continental margins that have economic, hazard assessment, or other scientific or cultural importance.

More than all the world's museums combined, the ocean holds the artifacts that document mankind's historical relationship with the ocean. The Panel recommends that any new program in ocean characterization document and reference historical shipwrecks, submerged villages, and sites of archaeological significance. While the history of ships that sunk while transporting silver and gold is recorded with some accuracy,

LOST WHALING FLEET OFF ALASKA EXPLORED USING 3-D TECHNOLOGY

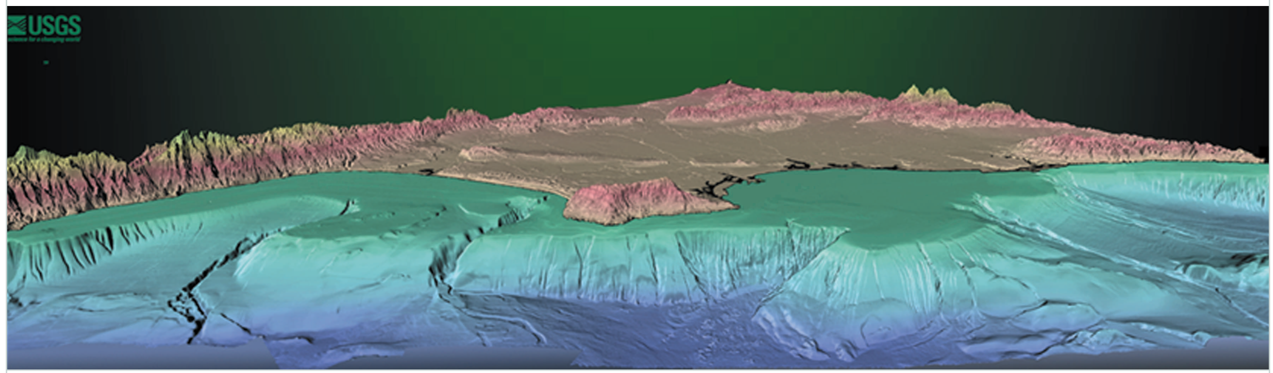
In the winter of 1871, a fleet of whaling vessels was lost off the northern Alaska coast. The fleet of 32 ships became locked in heavy ice, where they were crushed and sank. Over 1,200 passengers and crew abandoned ship with no loss of life. The sunken fleet has been located and preliminary surveys using a remotely operated vehicle (ROV) equipped with stereoscopic cameras with adapted planetary exploration software has been used to document the condition of the whaling vessels.

hundreds of ships that brought slaves to this country also sunk, leaving little or no trace for historians to follow.

A further goal for the Ocean Exploration Program should be to largely complete the mapping of the U.S. continental shelf. Maps that interpret

MAPPING

the shape of earth beneath the oceans



Historically, the seafloor and the water column have been mapped by discrete sampling techniques. Trawls, net tows, leadlines, and echosounders have provided a useful, but very sparse, picture of the distribution of marine life, morphology, and relief of seafloor features. Recent advances in sonar technology, which have been led by industry, have revolutionized our view of the water column and the seafloor. Multibeam sonars have the ability to form many (>100) narrow beams across a wide swath, which permits ensonification of large areas while maintaining high lateral (typically better than 2 – 5% of water depth) and vertical (typically better than .05% of water depth) resolution.

These systems can also collect simultaneous sonar backscatter data, resulting in an added layer of structural and textural information that can provide insight into the nature of the seafloor or mid-water properties. The nearly complete coverage provided by these systems results in unprecedented, detailed images of large volumes of the seafloor and the water column. The inherent density of these data sets permits exploration with interactive visualization techniques, allowing marine scientists to be “virtually immersed” in their data. Even more important, when expeditions are broadcast over the Internet, students, educators and the public can share in the excitement of ocean exploration.

the seafloor provide a fundamental framework for research and management of the world ocean and are a prerequisite for identification of regions that warrant protection. They show composition of the seabed, its shape (topography), areas of anthropogenic impact, and areas of historical and cultural interest. They provide information on the transport of sediment and help to define biological habitats. All this information can be used to develop predictive models to guide habitat and resource management, monitoring strategies, and other research / exploration goals. Obviously, all marine life, ecosystems, archaeological sites, and seafloor features cannot be mapped and inventoried immediately. A strategic hierarchical approach to mapping must be considered, perhaps beginning with larger, more obvious species, features and sites on a large geographic scale, and working toward the finer resolution of the identification of biodiversity within the marine system.

Although the production of high-resolution base maps is the first step in a systematic strategy, it is a daunting task, considering how little of the sea-floor has been mapped. For example, less than five percent of the total U.S. EEZ has been mapped in high-resolution. While the United States has always taken great pride in being a world leader in the development of approaches to the under-standing and stewardship of the oceans, we now find that other nations are far ahead of us. England, Canada, and Australia are well along in developing plans for the complete mapping of their EEZs, and New Zealand and Ireland have already begun multi-year, multi-million-dollar programs to be systematically explore their EEZs. It is critical that the United States also begin this important task immediately.

In the summer of 1700, the English merchant ship *Henrietta Marie* sank off the Florida coast shortly after unloading a cargo of enslaved Africans in Jamaica. The ship had been traveling along the infamous triangular route favored by slavers: Great Britain to West Africa to the West Indies and back to England.

the HENRIETTA MARIE slave ship

The *Henrietta Marie* was discovered in 1972 by noted treasure hunter Mel Fisher. She was subsequently researched and excavated by a team of marine archaeologists and members of the National Association of Black Scuba Divers in 1983. The shipwreck and its artifacts have become part of a national traveling exhibit, which is partially devoted to the wreck. The effort to conserve the artifacts recovered from the wreck is highlighted through displays of items in varying stages of the process.

The ship contained no material “treasure” of note. After six archaeological expeditions to the site, divers have recovered only a handful of coins. However, the more than 7,500 items found near the wreck are far more significant than gold or jewels, because artifacts from any aspect of the maritime slave trade are extremely rare. An equally valuable treasure is less tangible: the wealth of information researchers have uncovered about the complex slave trade.

"ICE WORMS" DISCOVERED IN GULF OF MEXICO

On a mission to study marine life associated with oil seeps on the floor of the Gulf of Mexico, scientists recently discovered a brand-new animal living in the cold, deep depths. The discovery was made because scientists using the Johnson-Sea-Link submersible decided to investigate a curious formation they had glimpsed on an earlier dive. What they found were pink worms (now called "ice worms") that are about 1-2 inches long and apparently sculpt the surface of gas hydrates, which are natural methane water ices that form under conditions

of high pressure and temperature in many areas of the ocean floor. It is not yet known to what extent these worm colonies use the hydrate mounds for protection or nutrition, but they are the only known animal to inhabit this unique habitat. Researchers speculate that these worms may graze on chemosynthetic bacteria that grow on the methane, or may live in symbiosis with them. This discovery exemplifies that we must discard the old view that the deep sea bottom is a biologically impoverished zone.

A minimum level of exploration would help identify areas of unique value and global importance. The results of these exploration efforts should be sufficient to guide future exploration and action items for resource managers. Systematic preliminary site surveys should be conducted in advance of more focused expeditions to discover new environments inhabited by presently unknown organisms. Information from satellites should also be used to provide maps of surface water characteristics needed to plan exploration of the EEZ.

While these goals focus on U.S. waters, international efforts should not be ignored. For example, the World Conservation Union objectives for Marine Protected Areas are consistent with the goals identified here, and we should investigate collaborations with other national and international efforts.

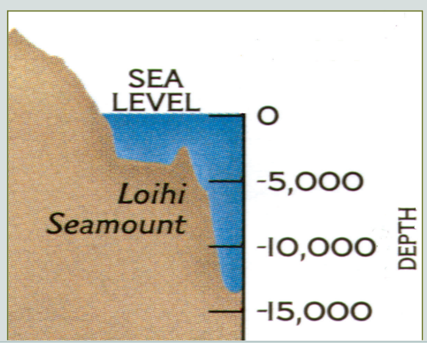
Exploring Ocean Dynamics and Interactions at New Scales

Ocean phenomena, which support complex ecosystems, operate over a broad range of unexplored spatial and temporal scales. Examples of dynamic features to be explored include:

— ***Ocean properties***
We will discover dozens of new oceanographic features changing over spatial scales from 10 to

EXPLORING THE BIRTH OF A NEW HAWAIIAN ISLAND

The recent collapse of the lava dome of the underwater volcano Loihi off Hawaii is giving scientists in a research submersible the opportunity to witness the birth of the next Hawaiian island. Several years after this event, which created an underwater crater more than a half-mile wide and 1,000 feet deep, superheated water and dissolved minerals have



combined to form mats of chemosynthetic life. The bacteria that make up these mats now form the base of elaborate food chains that draw in higher life forms like fish, making the summit of Loihi, some 3,000 feet beneath the surface, a place of rich marine biodiversity.

10,000 km, and temporal scales from picoseconds to millennia. These features include the ocean's interaction with the atmosphere and as a key component of the global hydrological cycle.

— ***Sea surface***
Hyperspectral sensing of the sea surface will reveal unexpected changes in temperature, salinity, photo-synthesis, and ocean circulation over a wide range of time scales.

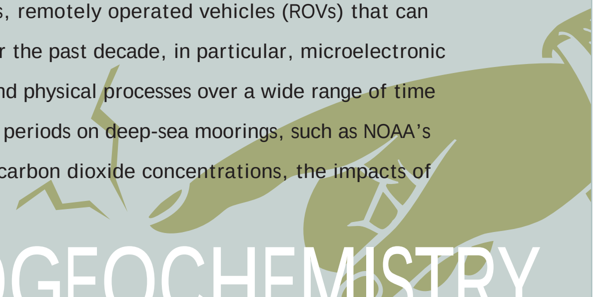
— ***Biological, geological, chemical, and physical interaction***
We will unravel dozens of processes affecting the interactions among species and the cycling of organic materials in the sea and in the coastal zone. We will explore the connection of living and nonliving systems in the largest environment on the planet — the world's ocean.

Until just two decades ago, it was thought that all living things, plants and animals, were supported in a variety of ecosystems that based their supply of energy on photosynthesis, the process by which green plants transform the sun's energy into simple sugars. But in 1977, dives of the deep-sea submersible *Alvin* found marine life thriving in the darkest depths of the ocean on the energy released when chemosynthetic bacteria break down methane and sulfur compounds carried by fluids venting from the seafloor.

In the summer of 2000, biologists discovered yet another mechanism by which marine life can harness energy. As much as 20 percent of the bacterial life in the deep sea might directly convert light to energy for powering cellular processes via a photon pump, thus sidestepping the more complex photosynthesis process entirely. This ability gives these organisms a survival advantage in low-nutrient environments.

These discoveries are rewriting the biology and oceanography textbooks. Science can only speculate what other novel means for powering life might exist in the world's oceans, and how their discovery may revolutionize the understanding of energy transfer in ecosystems.

While the discoveries mentioned above had an immediate impact on our understanding of the ocean, the Ocean Exploration Program must also foster observations over long periods of time to discover new processes and systems in the ocean that are not readily apparent. For example, nearly 15 years ago, scientists began collecting oceanographic and atmospheric data in the Equatorial Pacific. Every year, scientists collected salinity, temperature, wind speed, atmospheric pressure, and sea height data. After many years, Man's ability to intelligently explore the deep sea has been significantly enhanced by the advent of novel, autonomous platforms, remotely operated vehicles (ROVs) that can be submerged for extended periods of time, and satellite communication technology that is used to report data to scientists. Over the past decade, in particular, microelectronic equipment has made it feasible to outfit these platforms with sophisticated sensors that measure a wide variety of chemical, biological, and physical processes over a wide range of time scales. It is now possible, for example, to measure the difference in carbon dioxide concentration in the sea and the air above it over long periods on deep-sea moorings, such as NOAA's TAO-TRITON array in the Equatorial Pacific. Such measurements are required to understand the influence of the ocean on atmospheric carbon dioxide concentrations, the impacts of events such as El Niño, and the feedback processes that act to control the heat balance of the atmosphere.



SENSORS for OBSERVATION of OCEAN BIOGEOCHEMISTRY

In areas closer to land, the extent, frequency, and nature of Harmful Algal Blooms (HABs) have been difficult to document. This is due to the fact that traditional sampling, in order to be effective, had to keep up with the plankton growth rate (the population doubles every 12 hours), and plankton identification was done visually with the aid of a microscope. However, the revolution in biotechnology now makes it possible to conduct rapid, quantitative plankton species identification using only their DNA. A number of HAB species can now be identified automatically from ship-based laboratories. This automation should be adapted for autonomous platforms in the near future to facilitate the remote, quantitative observation of ocean ecosystem structures.

patterns in the data began to emerge and led to our ability to detect the onset of El Niño.

Developing New Technologies

Many of the tools currently used in ocean studies have been borrowed from substantial investments in technology by the Navy and the offshore oil industry. Whereas two decades ago, those tools available to academic researchers were second to none, a number of systems and facilities are aging. Cuts in the budget for Department of Defense development efforts have been felt by the marine technology community that relied on investments in new instruments and platforms by the Office of Naval Research. The deep-sea drilling and multi-channel seismic capabilities in the academic fleet have been eclipsed by new drilling ships and seismic systems routinely deployed in the offshore oil industry and by other countries and foreign investors. Our deep submergence assets are overall older and have shallower depth ratings than those deployed by the Japanese, for example.

What has kept the U.S. marine research program unsurpassed has not been the fact that we equip our investigators with the very best technology, but rather that we have developed the best mechanisms for selecting research programs and for operating our assets for the benefit of those programs. For example, the institutions operating the University Ocean Laboratory System (UNOLS) ships and deep submergence systems have been very responsive to the needs of their user base. Existing systems are constantly being improved, extended, and upgraded. Access to these assets is open to the oceanographic community at large, and program selection is based on some form of merit review. Operations groups in the U.S. pride themselves on the large number of operating days they are able to provide the science community and the low incidence of mechanical failures. Nevertheless, we cannot continue to depend on the ingenuity of our scientists and the dedication of our operations groups to more than compensate for a steady loss in U.S. position relative to other nations with respect to technical capability. By equipping the best researchers and the best marine operators with technology unsurpassed anywhere in the world, the possible benefits from a U.S. program in ocean exploration would be unlimited.

The Ocean Exploration Program can provide the mechanism for reinvesting in American leadership in ocean technology by supporting the following general development efforts:

— ***Remote sensors and in-situ capabilities***
We will invent, build and adapt the wide array of tools necessary for interrogating (measuring, mapping and exploring) the physical, geological, chemical, and biological parameters of the ocean.

— ***Synoptic 4-D capabilities***
We will create new concepts and methods for viewing the whole ocean through time, from anywhere.

The scientific drama surrounding a human voyage beneath the sea first captured the attention and imagination of the nation in the 1960s. The well-documented voyages of Jacques Cousteau captivated American audiences. These images helped demonstrate the vastness of the oceans and the importance of protecting them against pollution and misuse. During the early days of space exploration, underwater vessels and habitats were built to test human endurance in confined spaces, but funding for most programs was sporadic, and research projects were short-lived. While space exploration has evolved and grown with new tools and technologies since the days

LINKING EXPLORERS... ...WITH THE PUBLIC

Live from Monterey Canyon, a joint venture between the Monterey Bay Aquarium Research Institute (MBARI) and the Monterey Bay Aquarium (MBA), exposes Aquarium visitors to the wonders of deep sea exploration via telepresence. A microwave connection between MBARI's research ships and the Aquarium's auditorium allows two-way communication between the public and the researchers exploring Monterey Bay. Video images from MBARI's ROVs are projected on to a large screen. The researchers and their conversations are transmitted to the audience via cameras on board the vessel, and they are able to hear and respond to questions from the virtual visitors. The success of the program is largely due to the presence in the auditorium of an interpreter who is able to put the day's activities and unforeseen events into an educational context. The interpreter takes advantage of an electronic podium with an interactive, visual encyclopedia for deep-sea research. The interpreter can move back and forth between the live action and the archived material depending on the circumstances and the questions being asked by the audience.

of Apollo, the U.S. effort in human-occupied underwater technology has evolved little since the 1960s.

Not all technologies require placing scientists in-situ underwater. The continued development of remote and autonomous underwater vehicles will allow scientists to study ocean features without actually visiting them. In fact, programs already exist that allow scientists in California to take measurements and manipulate sensors located underwater in the Atlantic Ocean off the shore of New Jersey. Sensors can be deployed to measure ocean parameters and relay data to shore stations that broadcast information in near real-time over the Internet. These capabilities open access to underwater regions in remarkable ways. With the right assembly of underwater tools, scientists can remotely sense episodic ocean events and deploy the means to study them.

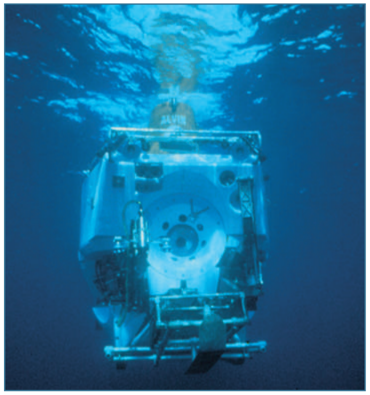
The Ocean Exploration Program will respond to shortcomings in our national underwater infrastructure and capital assets by developing new sensors, vehicles, and capabilities to bring science to the underwater environment.

Reaching Out in New Ways to Stakeholders

The oceans are a common global heritage. The Ocean Exploration Program must build in mechanisms to incorporate the interests and needs of a variety of stakeholders. These stakeholders include state, local and tribal governments, municipal authorities, industries, students, and ocean resource users of all types. Outreach has the potential to transform these stakeholders into concerned and informed constituents of the oceans, who will support the sustained investment that ocean exploration requires. Maintaining open channels of communication with these groups, both for input into the development of exploration plans and output in the form of new information and data products, will strengthen and diversify exploration programs. The program will concentrate on reaching the following stakeholders:

— ***Students***
We will establish the ability to broadcast ocean expeditions to reach every school district in the nation.

— ***The public***
We will lead the world in developing new technologies



that bring scientists and explorers into formal and informal educational settings, and students, educators, and the general public into the field.

— ***Industrial partners***
Petroleum, fisheries, and biomedical industries will make hundreds of discoveries of new materials, pharmaceuticals, and enzymes using the knowledge gained from ocean exploration.

The measure of success in educational outreach will be found in the numbers of new "students" of all ages interested in ocean science. Internet technology and webcasts bring new capacity to outreach programs. Ocean exploration provides rich content that easily captures the imagination of the concerned public. Outreach cannot be viewed as an afterthought of science, but rather a vital step in the scientific process.

EXPLORATION PRIORITIES

The Panel believes that these objectives can be met by establishing a new Ocean Exploration Program. The Program should be comprised of the following critical components within the organizational structure and governance discussed later in this document:

— ***Voyages of Discovery***

— ***Tools for Probing the Ocean***

— ***Data Management and Dissemination***

— ***Education and Outreach***

— ***Capital Investment***

Voyages of Discovery

The Ocean Exploration Program will require a wide range of field and laboratory equipment distributed throughout the United States as well as marine assets deployed around the world. In order to provide a focus for the program, the Panel proposes that the centerpiece of the Program be a Signature Mission -- a multi-year voyage of discovery. Complementary expeditions to the Signature Mission will use a wide variety of ships, submersible vehicles, and other investigative strategies that help foster exploration and provide the information base to capitalize on exploration opportunities.

All of the exploration missions envisioned in the Ocean Exploration Program will meet the highest scientific standards and will be carried out by highly qualified, multi-disciplinary staff. Achieving the goals will involve individuals from academia, the private sector, and government, and will, at fundamental levels, involve teachers and students so that the fruits of exploration are provided to the broadest audience possible. The goal of the voyages of discovery will be to make the United States second to none in terms of our knowledge of the oceans.

Expeditions that are complementary to the Signature Mission will play an important role in facilitating discoveries in remote areas and in capitalizing on opportunities for multi-faceted investigations. For example, the exploration of the Arctic will require an icebreaker, perhaps a nuclear submarine, active satellite sensors (e.g., radar and laser), or, at a minimum, an ice-hardened ship and AUVs with specialized sensors and capabilities for exploring the harsh Arctic

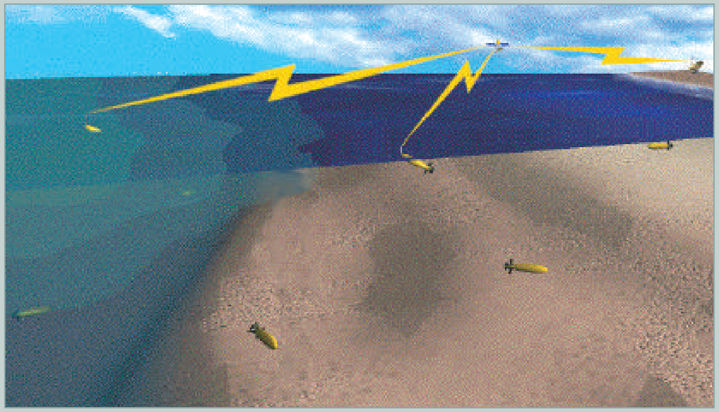
WANTED

OCEAN EXPLORERS

QUALIFICATIONS: CURIOSITY, WEB PROFICIENCY, BASIC SCIENCE LITERACY

HEY KIDS!!! Do you imagine yourself as a modern-day explorer, eager to probe uncharted territory and discover new worlds? Join the Ocean Explorer Corps! Pilot your own inner-spaceship and report new findings!

The combined technologies of the Internet, wireless communications, global positioning systems, miniaturized sensors and intelligent, robotic undersea platforms now make it possible for you to purchase and operate your own customized ocean exploration vehicle. Several models and a variety of sensor payloads are available to observe, listen to or measure the vital signs of the oceans. All are affordable, with a number of subsidized financing options. Interactive wizards will help you configure your ship and identify the part of the global ocean you wish to explore. Initial vectors will be pre-programmed into your vehicle for transit from your homeport, but you can change course at any time after launch, using your web-based controller o investigate new discoveries.



You will be registered as an active member of the fleet, and your vehicle's name and position will appear daily on the global grid of operating explorers. The data you collect will be universally available on-line in near real-time, and will be archived in an easily accessible global database. At any time, you will be able to locate from the global grid other explorers throughout the world operating in your region. You may wish to coordinate with them and organize a cooperative expedition to investigate a particular feature or phenomenon. This can all be accomplished interactively on the Web.

For more information, log on to Ocean Exploration Headquarters today! (www.exploreocean.gov)*

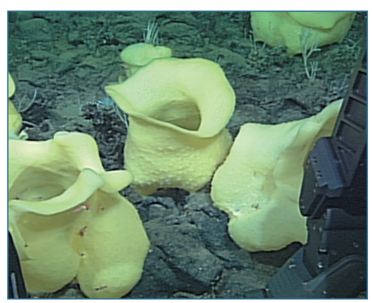
*Note: This is a future scenario and a proposed web site.

Signature Mission

The Panel proposes that a Signature Mission be designed as an important part of the U.S. exploration strategy and as a symbol of U.S. commitment to ocean exploration. Addressing the exploration challenges described in this report, the Signature Mission would explore the global ocean, circumnavigating the globe from pole to pole. It would concentrate on the U.S. EEZ and continental margins, but also take advantage of opportunities for visiting the most unexplored reaches of the global ocean. This mission will actually need to be more than a single shipboard expedition; it will be the first undertaking of its kind. The pole-to-pole routing will require a variety of vessels and platforms over a period of several years. All means of exploration will be folded into the Signature Mission, including satellites, seafloor moorings, specially outfitted ships, and submersible vehicles. Over several years, the Signature Mission would work its way south

from Maine, through the North and South Atlantic to Antarctica, incorporating international cooperation with coastal nations along the route. The Mission would then proceed eastward around Antarctica, adding to the southern ocean information void, with expeditions into the southern Indian Ocean and into the western Pacific before exploring the west coast of North America. The final goal of the Signature Mission will be to explore the Arctic Ocean beneath the polar sea ice cover.

environment. Information from a global acoustic monitoring system, a facility that is considered to be critical to global ocean exploration, might guide the Signature Mission to areas where submarine eruptions, earthquakes, or concentrations of marine mammals are occurring. Seafloor observatories, whether deployed as part of this Program or other initiatives, will explore geological, biological, and chemical processes as they occur. These seafloor observatories will be linked to shore-based laboratories and will employ state-of-the-art sensors and AUVs. Real-time results from seafloor observatories will also be used to help guide the Signature Mission.



Tools for Probing the Ocean

In addition to the voyages of discovery, the Ocean Exploration Program should fund the creation of technology to probe the ocean in new ways. In many areas of ocean technology, the systems available to the U.S. research community are no longer state-of-the-art, and the submersibles available to U.S. academic researchers are limited to depths less than 4,500 meters. Engineering development projects will often best be undertaken via partnerships with groups developing technology for other uses (e.g., national defense and the petroleum industry), but the availability of funds under the Ocean Exploration Program will make the difference as to whether the resulting systems are relevant to, and capable of, ocean exploration. Furthermore, the Panel fully expects that technology developed under this program will lead to spin-off applications elsewhere in ocean research and development (e.g., in-situ sensors for monitoring ocean health).

Data Management and Dissemination

An essential element of this program is data management and dissemination. The database must incorporate a variety of data types, including biological observations. It should be easy to put data into the archive as well as to extract it. A properly designed database should use widely accepted standards, whenever possible, and set new standards when none exist. Flexibility, however, is the key to integrating a broad range of data; rigid conformity to standards can discourage such integrations. The program should incorporate older, historic data sets relevant to exploration into the new database.

A goal for this program should be to develop by 2005, a plan for a Geographic Information System (GIS) for exploration data. Many federal agencies already have made substantial investment in modern data systems (e.g., Navy's Fleet Numerical Data Center, NASA's Earth Observing System Data and Information System [EOS-DIS], NOAA's National Geophysical Data Center). Thus, the first step in building this comprehensive system should be to draw on this collective experience. Furthermore, all federal agencies engaging in activities that lead to the accumulation of oceanographic, biologic, or geological data should commit to placing their data in a compatible system in the public domain. The GIS should include proprietary and classified data, as much as possible. This system must allow for timely access of usable, comprehensive data.

Some mechanism must also be developed to assure timely review of data and responses to recommendations from users. This may include a formal structure, such as a standing committee responsible for biennial or annual review of data within the GIS. To ensure quality data, standards and protocols for data collection, storage, and dissemination must also be developed.

Education and Outreach

The Program should include a coordinated effort to improve and promote ocean science education. Children and adults alike are intrinsically fasci-

Creating an Integrated Sustained Ocean Observing System

OCEAN.US

The impact of our inadequate ocean knowledge has become increasingly apparent. Following calls by Congress to plan for "a truly integrated ocean observing system," the National Ocean Research Leadership Council approved the establishment of the OCEAN.US office in May 2000.

OCEAN.US will integrate existing and planned observational activities and databases into an integrated observing system. This system will be comprised of real-time operational ocean observations, long-term research observations, technology development, and web-based access to models, algorithms, numerical techniques, etc., for improved predictions by the users. All ocean and ocean-related data — chemical, biological, physical — will be formatted, assimilated, and shared through the program using existing resources, such as the U.S. Global Ocean Data Assimilation Experiment (GODAE) server, to provide vital knowledge to many different users.

OCEAN.US

nated by the ocean and its unfamiliar creatures and habitats. This natural curiosity provides an excellent opportunity to increase science literacy, which is an essential ingredient for U.S. competitiveness in the 21st century. Ocean Exploration Program educational materials and resources should be widely available and easily accessed by teachers, students, and the general public. The program should expand efforts to create discovery-driven interactive web sites. Efforts should be made to build upon and expand partnerships and networks with educational groups (e.g., National Marine Educators Association, National Science Teachers Association, and Association of Zoos and Aquaria) and federal agencies that promote and fund education and outreach in ocean science. A high priority should be placed on interactions with informal science education centers (e.g., museums and aquaria) because of their proven ability to reach large numbers of people, including traditionally under represented groups. Additionally, these centers have demonstrated the ability to reach large numbers of teachers through high-quality professional development programs, and could serve as "portals" through which teachers, students, and the public can become involved in the world of the explorers. In this regard, the Panel recommends launching the Ocean Exploration Program with a national competition to name the Signature Mission.

The creation of an Ocean Exploration Program could reverse the current tendency for graduate oceanography programs in the United States to educate increasingly specialized professionals. Several top programs no longer require students to obtain some proficiency across the allied disciplines of marine biology, geology and geophysics, chemistry, archaeology, ocean engineering, and physical oceanography. Because our modern-day explorers will be specifically chosen from the ranks of those conversant across fields, graduate programs will need to adapt if their students are to take advantage of this new opportunity. Overall, the Panel would view this adjustment as beneficial, since many new discoveries await at the interfaces of established disciplines.

Capital Investment

Given the long lead time necessary to develop the capabilities and realize the potential for the Ocean Exploration Program, the Panel recommends funding the Program for an initial period of 10 years. The approximate level of new funding for annual operation of the Program should be on the order of $75 million. The Panel believes that this relatively small investment (less than one-hundredth of one percent of the federal discretionary budget) will serve as a magnet to attract other public and private assets that could amount to several hundred million dollars per year. “Seed” money from the federal government will be a critical catalyst in making this happen.

Some assets and capabilities required by the Ocean Exploration Program already exist and can be provided by academia, industry, and the government. The Program should take advantage of these when beneficial; however, some capital investment will be required. With the personnel effort and ship / vehicle time that will be devoted to the Program, it would be imprudent to use anything but the latest technology in platforms,

DIVE and DISCOVER

BRINGING OCEANOGRAPHIC RESEARCH INTO THE CLASSROOM AND TO THE GENERAL PUBLIC VIA THE INTERNET

Using funds from the National Science Foundation’s Awards for Geoscience Education Program, the Woods Hole Oceanographic Institution has developed a web-based education and communications platform for providing near real-time access to ongoing oceanographic research at sea. The Dive and Discover website is targeted at middle school students (Grades 6-8) and the public. It is structured to provide multiple layers and levels of information on the basic scientific concepts at the core of the research being carried out. More important, the site provides daily updates from the research ship, including still and video images from shipboard operations and the bottom of the ocean, graphical representations of a wide variety of oceanographic data, explanations about the technology being used, and general information about life at sea for the scientists, engineers, and shipboard support crews that make oceanographic research and exploration possible.

Dive and Discover also provides sea-going scientists with web-based templates so that they can easily incorporate their scientific and field objectives into an expandable and easy-to-use web structure to broadly communicate their work.

http://www.divediscover.whoi.edu

systems, and sensors. There are a number of good arguments for mounting as many of these systems as possible on a state-of-the-art research ship, as a flagship for the Ocean Exploration Program. Outfitting a flagship will avoid the mobilization costs and compatibility problems when new systems are installed on vessels of opportunity. A properly equipped flagship will also facilitate multidisciplinary data management and educational outreach by centralizing much of the data collection and outreach technologies on a dedicated platform. The flagship could be purchased or leased, depending on platform availability and the final list of expedition requirements. In addition to capitalizing this flagship, the Program will need to acquire other technologies, which may include submersibles, sensors and communications, and information technology.

The approximate costs of capitalizing this program over the 10-year period will be two to three times the annual operating costs. Thus, some of the initial capitalization could conceivably be funded in place of operational costs during the first few years of the Program, while operations are starting up.

Priority Sites

The Panel concluded that the following sites are the highest priority areas for the Program:

— ***U.S. EEZ and continental margins***
Americans are the stewards of these areas, and thus, have a moral obligation to concentrate efforts here.

— ***The Arctic***
This region is largely unexplored, and yet is believed to be the most sensitive to climate change of any place on Earth.

— ***Southern oceans***
This vast region of the planet's ocean is also largely unexplored. Opportunities for fundamental discovery are particularly great.

— ***Inland seas, including the Great Lakes***
Other water bodies (e.g., Mediterranean and Red Sea) are also important targets, assuming international collaboration. These regions contain a significant amount of the world's cultural heritage.

RECOMMENDATIONS

The Ocean Exploration Program will be designed to map and document discoveries in new ways that maximize the use of the best technology available for this purpose, and track changes over time. The initial focus of this mapping effort should be the U.S. Continental Shelf and EEZ. Along with mapping the physical features of the ocean, ocean processes and dynamics should be studied

at new scales to help increase our knowledge of the poorly understood energy transfer systems present in this complex environment. The success of the Ocean Exploration Program will also depend on efforts to recapture the public imagination with regard to exploring the vast ocean, and to promote U.S. leadership in this arena. Broad, sustained popular support for investment in the Ocean Exploration Program will ensure that the best possible tools and resources are made available to those who will work to overcome the obstacles in carrying out such an ambitious program.

The Panel notes that the United States currently does not support a program in ocean exploration, despite our inadequate understanding of the ocean, the living and nonliving resources it contains, and its undeniable importance to the health of the planet and the wealth of our nation. Furthermore, in a number of areas, the United States has fallen behind other nations in its capabilities for undertaking ocean research. American leadership in ocean exploration can be achieved by first addressing the objectives of the Ocean Exploration Program discussed above, and then implementing the Program as follows:

The U.S. government should establish the Ocean Exploration Program for an initial period of 10 years, with new funding at the level of $75M / year, excluding capitalization costs. The Panel envisions that a program funded at that level would include the following critical elements:

— ***Interdisciplinary voyages of discovery in high-priority areas***
This includes the U.S. EEZ and the continental margins, the Arctic, and poorly known areas of the southern oceans and inland seas. U.S. knowledge of the living and nonliving resources in the ocean should be second to none, particularly within its own EEZ and continental margins.

— ***Platform, communication, navigation and instrument development efforts***
This includes the capitalization of major new assets for ocean exploration, in order to regain U.S. leadership in marine research technology.

— ***Data management and dissemination***
This ensures that discoveries can have maximum impacts in the research, commercial, regulatory, and educational realms.

— ***Education and outreach***
This will take place in both formal and informal settings to improve the scientific literacy of America's schoolchildren and to realize the full potential of a citizenry aware of and informed about ocean issues.

OCEAN EXPLORATION PARTNERSHIPS

OVER *the course of history, humankind has explored the oceans in search of natural resources, knowledge to support transportation and military ventures, and to learn more about the things that were in the vast unknown.*

More recently, exploration has laid the foundation for understanding the critical role that the oceans play in sustaining the biosphere. People's seemingly endless thirst for knowledge about the oceans' enormity, extremes in conditions, beauty, complexity, and association with human history can now be quenched with modern communications. While there have been, and still are, many reasons for ocean exploration, it is safe to say that ocean exploration is almost always accompanied by unanticipated discoveries, including knowledge that is invaluable for other purposes. Yet, ironically, most exploration to date has been relatively narrow in its purpose, and knowledge that does not serve the purpose of specific expeditions has not been shared.

Partnerships among all ocean exploration interests are needed if the full benefits of ocean exploration are to be realized. Partners should come from:

— ***Industries*** *seeking knowledge to support commercial activities such as fishing, energy and mineral extraction, pharmaceuticals, and other, as yet unknown, potentials.*

— ***Government agencies (both state and federal)*** *seeking knowledge about how the oceans function and to support their missions of national security, transportation, and the conservation and management of natural resources.*

— ***Academic institutions*** *concerned with ocean research.*

— ***Formal and informal educators*** *at all academic levels.*

— ***Mass media and media companies*** *seeking ways to inform and entertain the public.*

— ***Non governmental organizations*** *groups with a wide array of ocean interests, such as conservation, protection, education, entertainment, and research.*

Ocean exploration partners can play many different roles. Some of the partners will be the primary explorers. They will collect data from above, on and beneath the ocean's surface. Others will use the information collected by ocean exploration (e.g., for the design of future research, commercial enterprises, education, and conservation advocacy). It is also critical for users to be included in ocean exploration partnerships so that their interests are served. It must be recognized, however, that ocean exploration is not intended to be so tightly coupled with any particular user group's needs that the exploration endeavor loses the excitement of unanticipated discovery.

It is also important to recognize the vitality that a diversity of ideas will provide in the development of partnerships in ocean exploration. Some fear that ocean exploration will lead to ocean exploitation that is undesirable from their perspective. Others envision exploitation as the desired outcome. It is not necessary that all partners in ocean exploration share the same vision of the oceans for the future; however, ocean exploration should be neutral with respect to diverse views about how the oceans are used and conserved. If ocean exploration is successful in producing new information that excites and informs the public and officials with responsibility for the oceans, then the activity will likely lead to sound public policy choices that seek to balance diverse interests.

Ocean exploration requires both domestic and international partnerships. Most of the oceans are beyond the jurisdiction of any nation. Yet, the United States has a unique responsibility for the exploration of a larger ocean area (two million square kilometers) than any other nation.

After discovering the wreck of the *RMS Titanic* in 1985, Dr. Robert D. Ballard received thousands of letters from students around the world wanting to go with him on his next expedition.

The JASON Foundation for Education
an educational partnership

In order to bring the thrill of discovery to millions of students worldwide, Dr. Ballard founded the JASON Project, a year-round scientific expedition designed to excite and engage students in science and technology and to motivate and provide professional development for teachers. The JASON Project has been a leader in distance learning programs, and continues to expand its reach by adding more components each year. Funded by a combination of private industry and government, the program is now in its 12th year.

More information on the JASON Project is available at: **http://www.jason.org/**

Census of Marine Life: a Grand Challenge

The Census of Marine Life has been conceived as a bold program of discovery designed to capture the imagination of the American people. The challenge is to respond to important and fascinating questions about the amount, type and global distribution of marine life. These questions apply to past as well as current conditions, in order to prepare for anticipated future conditions. The planning for, and design of, the Census was a grassroots effort that involved the talents of many scientists from around the world, primarily supported by nongovernmental funds. The program they suggested includes the development of an Ocean Biogeographical Information System (OBIS), a research program to understand the history of marine animal populations and a plan for regional censuses to be taken to test technology and strategies. The Census program is now under way. This program will help fill in the gaps that currently exist in the area of marine biodiversity in order to help conserve endangered or overfished species. Without in-depth knowledge, species will be lost without people ever having known they existed. The sense of urgency surrounding this project is heightened by the expansion of fisheries into depths of a thousand meters or more in order to catch new species of fish. Many of these species are part of fragile ecosystems vulnerable to overfishing. Until the Census of Marine Life is complete, it will be extremely difficult to implement responsible management programs to address this situation.

More information on the Census of Marine Life can be found at **http://www.coml.org**

Characteristics of Ocean Exploration Partnerships

Ocean exploration is a broad endeavor, encompassing both vast geographic expanses and a wide range of disciplines (e.g., biology, geology, physical and chemical processes, archaeology). Many different technologies are used for ocean exploration. Thus, partnerships that are flexible in nature will best serve the goals of exploration. Nevertheless, some characteristics of these partnerships should be universal. They include:

— ***Partnership in planning***
An exploration partnership includes a shared plan with consensus building and maintenance. The plan should identify goals, strategies, responsibilities and access to information. All of the partners should stand behind the entire plan, rather than solely advocating their own self-interests.

— ***Multiple use of exploration platforms and sharing of other assets***
The assets needed for exploration include ships, submersibles, observatories, airplanes, satellites, and databases. Many types of sensors and collection devices are used, and often, they can collect multiple types of information on the same mission. A successful partnership for ocean exploration will take advantage of the opportunity to gain as much knowledge as possible from its assets.

— ***Interdisciplinary partnerships***
It will be common for partners in ocean exploration to have multiple interests. As noted above, the assets for ocean exploration may be capable of collecting multiple types of information. Thus, ocean exploration partnerships should be interdisciplinary.

— ***Information sharing***
Information derived from ocean exploration will be accessible in the public domain so that it can achieve its full value, including the intangible value of informing the public.

— ***Partnerships in education***
Partnerships with this group are essential. One mechanism to enhance this partnership would be the creation of an Ocean Corps of students of all ages who dedicate time and energy to specific expeditions. Members of the Ocean Corps would assist in ocean exploration and communicate their experiences to the education community. They will also communicate — often in real-time — to others through the Web and other media. This would provide a unique foundation for school-to-career and public service learning opportunities.

Arrangements for Partnerships

Many existing organizations are capable of planning and / or managing ocean exploration. These include domestic and international, and governmental and nongovernmental organizations. Whenever practicable, existing organizations should be used to avoid creating unnecessary bureaucracy and expenses. In some cases, new arrangements may be necessary to oversee a partnership for exploration, but these should have a finite life span to match the duration of the mission(s) undertaken by the partnership.

While existing organizations will play a critical role in the Program, a Forum must be established to bring together all stakeholders to exchange views, promote communication and networking, and continually inform the participants. Such a Forum will be well suited to identify stakeholders' opportunities and interests as a precursor to forming partnerships.

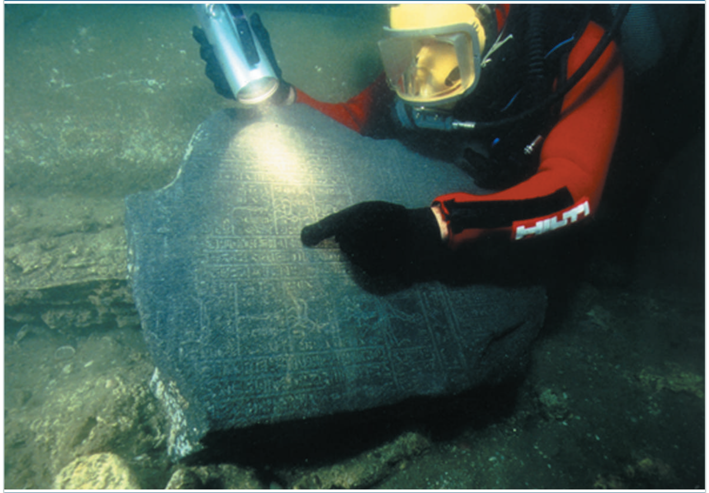
Vision for Coordinated Federal Ocean Exploration Program

In creating the framework for governing new activities in ocean exploration, the Panel advocates the following steps be taken.

— ***The President should instruct the White House Science Advisor and appropriate Cabinet officials to ensure the successful initiation and implementation of a national Ocean Exploration Program. The Panel also recommends instituting a follow-on group to maintain momentum and provide more detailed planning.***

The European Institute for Underwater Archaeology (IEASM) is a privately funded, multilevel partnership for international underwater archaeology, carried out in collaboration with national governments, museums, and navies of the host countries. Products of the partnership include traveling and permanent museum exhibitions, extensive publications of archaeological reports, popularized high-quality publications for public consumption, film documentaries, educational CDs for students and extensive websites published during field projects. IEASM currently has projects in:

EUROPEAN INSTITUTE FOR



UNDERWATER ARCHAEOLOGY

EGYPT Projects include Alexandria, the Bay of Abou Kir, Napoleon's fleet, and ongoing magnetometer and side-scan surveys.

PHILIPPINES Projects include the San Diego, five Chinese shipwrecks ranging from the 12th to the 16th centuries, and two 18th century East India Company shipwrecks.

CUBA Project consists of extensive surveying and searching for a 16th century shipwreck.

http://www.franckgoddio.org

ACADEMIA and NOAA

The National Undersea Research Program (NURP) is one example of a NOAA program that works directly with academia to carry out its research and exploration. With a mission of providing the expertise and technologies to place scientists underwater, either in person or remotely this program works through a network of regional centers operated by universities or private foundations. Each Center carries out a competitive, peer-reviewed science program supporting the undersea research needs of NOAA and the nation. You can find NURP's web site at:

http://www.nurp.noaa.gov

NOPP: the National Oceanographic Partnership Program

NOPP was established in 1997 by the National Oceanographic Partnership Act to integrate national efforts in ocean science and technology, including both research and education. NOPP's goal is to promote broad national needs by enabling coordinated national investments in ocean research and education. NOPP shares resources, data, intellect and experience between its partners in government, academia, industry, and other members of the ocean sciences community. Leadership is provided by the National Ocean Research Advisory Panel, which includes representatives from the National Academies of Science and Engineering, the Institute of Medicine, ocean industries, state governments and academia. The Partnership was formed by Congress to provide a mechanism for effective coordination of complex studies of the ocean and long-term monitoring between government agencies and the other partners.

For more information, log on to the NOPP web site at:

http://core.cast.msstate.edu/NOPPpg1.html

— ***Institutional arrangements should clearly identify and rely on existing interagency mechanisms to ensure federal cooperation, coordination, and efficient use of resources and effectiveness.***

— ***A single lead agency should be designated as in charge and accountable for the program and its budget. Leadership should be assigned to the agency most likely to champion a broad spirit of exploration and least likely to divert ocean exploration toward narrower, mission-oriented activities.***

— ***New support resources and staffing should be allocated to implement and sustain the program.***

— ***The federal Ocean Exploration Program must identify and promote processes to establish effective partnerships and the involvement of stakeholders in all phases of program development and implementation.***

— ***Accountability should be articulated in advance through benchmarks and performance measures to evaluate outcomes. The benchmarks should be appropriate for ocean exploration, and measure the degree to which the Program is following the desired characteristics and meeting the challenges described in the first chapter of this report. The lead agency should, every three years, report on progress toward meeting performance goals, and review funding needs to the President and Congress.***

— ***Program participants should agree on criteria for the selection of projects to assure high scientific quality and visionary oversight.***

— ***The Program should include a global perspective promoting international partnerships.***

— ***The Program should be recognized as requiring implementation over an extended period of time (e.g., several decades).***

— ***The Program should be implemented in a manner that allows public involvement and oversight.***

IRISH SEABED SURVEY REVEALS RICHES

A seven-year project to map the seabed off Ireland's coastline is under way and already delivering results. Ireland's seabed survey has mapped nearly 18 percent of the territory and researchers say they hope to have the first definitive results by next summer. Potential gas reserves associated with carbonate mounds have been identified in preliminary findings, which were released at a Geological Survey of Ireland (GSI) seminar in Dublin last month. According to a spokesman, two ships have been dedicated to the seven-year survey by the agency, the 79.25-meter *R/V Bligh*, a former British navy ship, and the 68-meter *R/V Siren*. Both are owned and run by Global Ocean Technologies Ltd. (Gotech), which was contracted by the GSI as manager of the initiative. The Waterford-based company, which has been involved in seabed projects around the world, believes that this is the most ambitious survey of its type. Ireland has one of the largest offshore exclusive economic zones in Europe, some 850,000 square kilometers. Presenting an overview of progress to date, Gotech's Noel Hanley and the GSI team of Deepak Inamdar, Helen Gwinnutt, Mick Geoghegan, and Garrett Duffy reported that 72,563 square kilometers had been mapped. The main focus initially has been on Zone 3, the more distant and deeper part of the seabed. The multibeam sonar employed, Kongsberg Simrad's EM120, proved to be very successful, according to Hanley. "Its area of coverage is five times as wide as the water depth. It can penetrate the sediment and is fitted with a yaw correction to stabilize images in bad weather", he noted. The high-resolution data collected include an image of the wreck of the *Lusitania*. The wreck has been lying in 100 meters of water 18 kilometers south of the Old Head of Kinsale since its sinking by a first World War torpedo in 1915 with the loss of 1,200 lives. A hydrographic survey ship using echosounders in 1937 first located the wreck. The *Bligh* and *Siren* are also using sub-bottom profiling to detect rocks, gas, and other minerals. They are also fitted with magnetometers and gravity meters. Some 15 major canyons on the side of the Rockall trough were identified in earlier work, and the GSI's reconnaissance survey of the Irish continental shelf and shelf edge in 1996 is regarded as essential groundwork for this initiative.

RECOMMENDATIONS

The President of the United States should instruct the White House Science Advisor and appropriate Cabinet officials to design the management structure for this program. Elements of governance should include:

— ***Designating a lead agency to be in charge of the Program and accountable for its success using benchmarks appropriate for ocean exploration, such as the number of new discoveries, dissemination of data, and the impact of educational outreach.***

— ***Using existing interagency mechanisms to ensure federal cooperation among agencies.***

— ***Establishing an Ocean Exploration Forum to encourage partnerships and promote communication among commercial, academic, private, non governmental organizations and government stakeholders.***

TECHNOLOGY REQUIRED FOR OCEAN EXPLORATION

BECAUSE *the ocean contains the most hostile, dynamic, and complex environments on Earth, the technologies used to unlock its secrets must be innovative, robust, and capable of a broad range of measurements, over time spans from seconds to years.*

These instruments will often be required to operate in chemically caustic and high-pressure conditions, and to transmit the collected data back to shore-based laboratories for further analysis and real-time interaction with seafloor or oceanographic experiments. Such will be the demanding nature of ocean exploration in the coming century and beyond. The past 40 years of outer space exploration has prepared us for what will be the ultimate technological challenge facing the human species — the exploration of the Earth's oceans.

The past half-century of oceanographic research has demonstrated that the oceans and seafloor hold the keys to understanding many of the processes responsible for shaping our planet. The Earth's ocean floor contains the most accurate and complete record of geologic and tectonic history for the past 200 million years. For the past 30 years, the exploration and study of seafloor terrain, and the unraveling of plate boundary processes within the paradigm of seafloor spreading have revolutionized earth and ocean sciences. This new view of how the Earth works has provided a quantitative context for mineral exploration, land utilization and earthquake hazard assessment, as well as conceptual models that scientists use to understand the structure and morphology of other planets in our solar system. Much of this new knowledge stems from studying the seafloor — its morphology, geophysical structure and characteristics, and the chemical composition of the rocks of which it is comprised. Similarly, the discovery of deep-sea hydrothermal vents at the mid-ocean ridge, and the chemosynthetic-based animal communities that inhabit the vents have revolutionized biological sciences. This discovery has also provided a quantitative context for understanding global ocean chemical processes, and suggests modern analogs for both the origin of life on Earth and extraterrestrial life. Intimately

FLOATS & GLIDERS

Satellite-based sensors have provided a remarkable view of nearly the entire global ocean surface at a spatial resolution as small as 1 to 10 kilometers. They have revealed a complexity of patterns that most likely extends into the deeper ocean, but that cannot be measured with ship deployed samplers and sensors. Efforts are being made to improve our ability to image the horizontal scales of the ocean below the sea surface. The Argo program is an international effort that seeks to deploy thousands of pop-up floats throughout the world ocean that will record ocean properties from the sea surface to their "parking" depth and transmit the data back to shore via satellite links. An armada of such floats spread over the ocean will monitor the temperature, salinity and oxygen structure of the ocean. Other parameters, e.g., shear, may also be measured. Sensors to directly measure other parameters from the floats, such as nutrients and tracer elements, need to be perfected. It is anticipated that soon, CO_2 concentrations and the DNA of a number of plankton species will also be able to be determined from autonomous underwater vehicles. A new generation of gliding vehicles is yet to be developed. These instruments could descend and ascend as floats, but more important, they could use the position fixes obtained when they surface to navigate along a prescribed track. Gliders will be able to traverse the ocean along the same track to provide high-resolution, repeat sections across oceanographic fronts and currents.

& AUVs

Over the past decade, Autonomous Underwater Vehicle (AUV) technology has advanced to the point where a variety of AUVs have begun to make unique oceanographic measurements. The original concept of the AUV called for it to perform surveys similar to those done with human-occupied submersibles or tethered vehicles, though at a lower cost and with less dependence on support vessels. These capabilities have been proven. AUVs have been shown to make many types of measurements better than other existing devices, especially those that require repeated time-series measurements in hostile weather environments. The new generation of AUVs are capable of reliably determining their position, using the computed position to automatically follow preprogrammed tracks, and following the bottom using measurements from an array of acoustic sensors. With a focused development program, AUVs will soon be capable of deploying a wide range of mapping and sampling systems to any position in the water column. Future programs of synoptic ocean exploration will rely on fleets of AUVs dispersed throughout large areas of the oceans. These AUVs will begin to record data sets rich in both spatial and temporal resolution of complex oceanographic processes. Key technological challenges related to AUV development entail increasing their endurance through innovative power systems, and improving global navigation schemes to permit unattended operation in remote areas over long periods of time.

tied to these research themes is the study of physical and chemical oceanography which has resulted in unprecedented perspectives on the processes which drive climate and climate change on our planet. These are but a few of the many examples of how basic oceanographic research has revolutionized our understanding of Earth's history and provided a glimpse at the diversity of scientific frontiers still awaiting exploration.

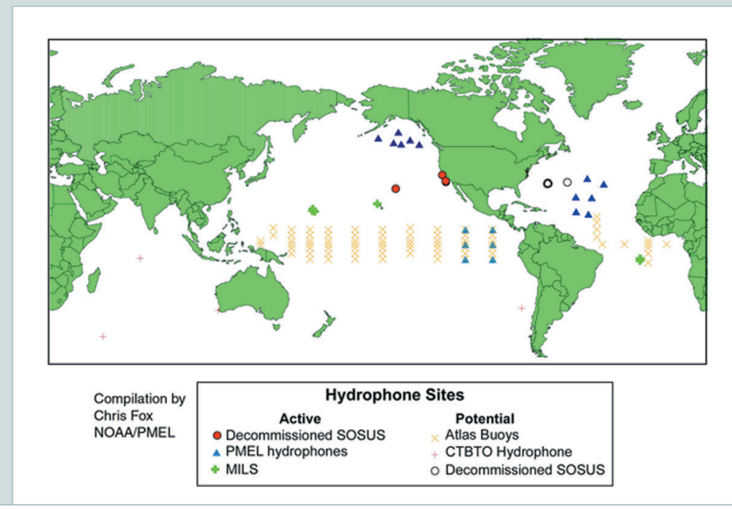
These breakthroughs resulted from the intensive exploration that typified oceanographic expeditions from the 1950s through the 1970s and focused the development of oceanographic technology and instrumentation that facilitated discoveries on many disciplinary levels. Significant among these enabling technologies were satellite communication, global positioning, microchip technology, the widespread development of computers that could be taken into the field, and increasingly sophisticated geophysical and acoustic modeling and imaging techniques.

In addition, traditional 19th and early 20th century methods for imaging the seafloor from the beach to the abyss, and sensing chemical and

EXPLORING the GLOBAL OCEAN

Using passive underwater acoustics to listen to the ocean is an ideal way to monitor oceanographic and tectonic phenomena on a global basis. The presence of an underwater sound channel at ~1000 m in the ocean allows the propagation of low-frequency acoustic energy over ocean-basin scales. Examples of significant discoveries already made using dual-use U.S. real-time hydrophone arrays include the detection of deep-sea volcanic eruptions and the tracing of migratory paths of the blue whale. These listening efforts initially depended on the U.S. Navy Sound Surveillance System (SOSUS). However, other low-cost, portable monitoring systems and devices have been developed and deployed in several ocean areas. Government agency partnerships to promote further development and use of this technology are already in place with NOAA, various Navy commands, academic institutions, and international partners, including the NOPP Ocean Acoustic Observatory Federation. The goal of sensing the "pulse" of the Earth and oceans via a global network of passive acoustic monitors is achievable with appropriate planning and funding, and will result in dramatic new views of the processes and events that shape our planet and its ocean.

USING PASSIVE UNDERWATER ACOUSTICS



biological processes at all levels in the ocean, were supplanted by submersible vehicles of various types, remote-sensing instruments, and sophisticated acoustic systems designed to resolve a wide spatial range of ocean floor and oceanographic features and processes.

Technology will enable the next generation of ocean exploration, but if the United States is to be a leader in this area, we must make a commitment to recapitalize our explorers with the very best technology. New instruments will need to be developed, and existing systems and data will need to be upgraded and fully utilized. In addition, new systems of telecommunication and global positioning infrastructure will be required to collect data from remote parts of the global ocean, especially the polar regions and the southern ocean.

Taking the Cognitive Brain and Spirit into the Ocean

Since ancient times, the human spirit has sought to understand the mysteries of the ocean. For the past 40 years, this need has been met by the ability to take the unique human visual and cognitive abilities into the ocean and down to the seafloor to make observations and facilitate measurements in submersible vehicles. Various types of submersibles were initially developed to support strategic naval operations of several nations. As a result of this effort, in 1963, the deep diving submersible *Alvin* was constructed by the United States. *Alvin* is still is use today as part of the National Deep Submergence Facility (NDSF) funded by the Navy, the NSF, and NOAA, and operated by the Woods Hole Oceanographic Institution (WHOI). It provides routine access to ocean depths as great as 4,500 meters for one pilot and two scientists or engineers at a time. Capable of reaching about 60% of the seafloor, *Alvin* usually dives for 8-9 hours per day and spends about 5 hours a day traversing the seafloor, making observations, sampling, and taking high-resolution still and video photography. Throughout its more than 35-year history, *Alvin* has completed over 3,600 dives (more than any other submersible of its type), and participated in making several key discoveries. These discoveries include mapping the structure of the mid-ocean ridge (MOR), transform faults and submarine canyons, discovering hydrothermal vents, and collecting samples and making time-series measurements of biological communities at the hydrothermal vents. In 1991, scientists in *Alvin* were the first to witness the vast biological repercussions of eruptions at the MOR axis, which provided the first hint that an enormous subsurface biosphere exists in the crust of the Earth on the seafloor.

Despite these significant successes and recent improvements to *Alvin*'s operational systems, deep submergence technology and vehicle system capability in the United States now lag behind Japan and France. These countries have government / industry collaborations, that have been well capitalized for over a decade and that continue to be supported at annual funding levels that vastly exceed U.S. spending on the NDSF and related diving capabilities. The latest French and Japanese submersibles can dive to 6,000 m and 6,500 m, respectively, depths that allow scientists using those vehicles to access more than 98% of the global seafloor. The Japanese deep-diving remotely operated vehicle, *Kaiko*, is capable of reaching virtually all ocean depths. Given these facts, the U.S. needs to rapidly increase the level of its capitalization and construction of new facilities available to ocean explorers.

Enhanced data transmission is needed from all levels in the ocean to the surface and from there to shore-based laboratories. This will require the development of an effective global data communications system and a strategy to bring the fruits of exploration not only to scientists, but also to the public and students at all levels, so that the broadest spectrum of people can benefit from 21st century ocean exploration.

Development of state-of-the-art sensors and deployment strategies will also prove essential for multidisciplinary, in-situ, and remote-sensing measurements of biological, chemical, physical, and geological processes throughout the ocean. This must include real-time remote-sensing of the global ocean via acoustic and seismic monitoring and other means in order to calibrate and study the "pulse" of the Earth and life in the oceans. The construction of new, innovative deep ocean vehicles and ocean-floor observing systems will be needed to facilitate exploration. The types of systems that will be required include human-occupied submersibles, remotely operated vehicles (ROVs), Autonomous Underwater Vehicles (AUVs), mobile observatories for seafloor and oceanographic measurements, and vehicle systems capable of facilitating marine archeological exploration and excavation.

RECOMMENDATIONS

— ***Undertake development of underwater platforms, communication systems, navigation, and a wide range of sensors, including the capitalization of major new assets for ocean exploration, to regain U.S. leadership in marine research technology.***

Measurements of trace chemicals in saltwater and sediments on the seafloor are required to understand a wide range of exchange processes that affect ocean chemistry and biology. One system currently under development by Professor George Luther at the University of Delaware will monitor chemical reactions in environments ranging from microbial mats to sediments to hydrothermal vents. A solid-state, gold-amalgam voltammetric microelectrode is the key component of part of this portable electrochemical system. It can “sniff out” trace chemicals that exist in extreme environments. The new microelectrode can measure dissolved oxygen, sulfide, iodide, Fe(II), Mn(II), and FeS. Each chemical species, if present, produces a current that can be detected in one potential scan. This type of technology represents the vanguard of microsensors that will be capable of detecting and quantifying small changes in chemistry in the myriad of chemical and biological processes occurring in the ocean and on the seafloor.

SOLID STATE VOLTAMMETRY SMELLING UNDERWATER

REALIZING THE POTENTIAL OF OUR DISCOVERIES AND PROTECTING NEW RESOURCES

NCREASED *knowledge and information about marine environments and resources are of great benefit to people the world over.*

Ocean explorers have a moral, if not legal, obligation to share information about important natural and cultural marine resources with all entities having responsibility for governance of the identified areas. Doing so will promote sound resource stewardship for the benefit of current and future generations.

Restoring and Protecting Ocean Resources

There is growing evidence that marine ecosystems have been severely impacted by human activities, most notably the exploitation of living resources. Because of typically strong food-web linkages, the depletion of target species can have ecosystem-level impacts. Marine Protected Areas (MPAs)are widely regarded as one of the more effective means of protecting and restoring these systems to environmentally sustainable levels. MPAs can also serve to protect marine resources for their intrinsic values, and to maintain the numerous life-support systems and ecosystem services that our oceans provide. Increasingly, countries around the world are identifying marine resources and marine areas of particular concern that deserve special protection. American exploration activities can result in discoveries and the collection of information that can be used in decision-making relative to MPAs throughout the world. To achieve this purpose, however, the information must be collected and disseminated to the appropriate decision-making entities in a timely and effective manner.

Although numerous MPAs already exist, nearly all of them are very small and restricted to shallow coastal areas. Thus, a number of fundamental questions remain to be answered relative to establishing and managing an effective system of MPAs: ***1)*** What are the goals and purposes of establishing Marine Protected Areas? ***2)*** How large must they be? ***3)*** How many should there be? ***4)*** Where should they be located? ***5)*** What tools (i.e., the ways and means) are necessary to effectively manage them? Information gathered by exploration can help answer these questions.

It is reasonable to expect that information about significant natural and cultural resources discovered anywhere in the global ocean in the course of exploration supported or sanctioned by the United States will be passed on to the MPA Center called for by the President in Executive Order 13158. This information should also be passed on to the appropriate country or international entity for use in making informed decisions about establishing new or expanding existing MPAs throughout the world.

To ensure that such information is made available to the MPA Center, protocols should be developed and adopted relating to collecting, documenting, storing, accessing and disseminating data. The President should assign leadership to an appropriate federal entity, and create a broad-based task force to implement this portion of the ocean exploration strategy. Representatives should come from affected federal agencies, (e.g., state resource agencies), academia and the non governmental ocean exploration community. While the culture of information sharing among marine scientists is evolving, more should be done to promote accessibility to data, including data that is proprietary and classified. After an integrated, workable and comprehensive information processing system is established, steps must be taken to ensure that the system is implemented, monitored for effectiveness and reliability, and modified, as necessary, based on experience. Implementation should include appropriate institutional arrangements and agreements that are binding and that have leadership support within the respective agencies. In addition, appropriate levels of new funding necessary to sustain the effort should support the information-sharing system.

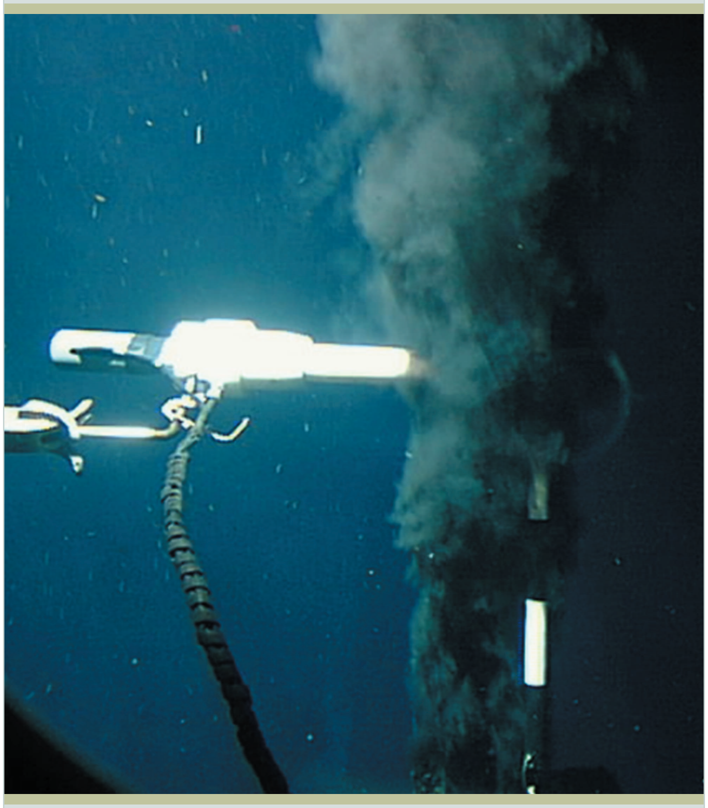
Because Marine Protected Areas often involve prohibitions against the extraction of resources (e.g., fish and minerals) and other uses (e.g., individual watercraft, mineral prospecting), their designations are controversial and often challenged in court. A major exploration initiative focused initially on the U.S. EEZ that is designed to gather information useful to marine resource managers, would be invaluable in carrying out the President's Executive Order calling for the expansion of a national system of MPAs. To be useful to resource managers, the data collected must be of a type, scale and quality that can be applied to management decision-making in a timely and effective manner, so that it can help promote public support and that can withstand legal scrutiny.

Ocean Resources with Commercial Potential

Mankind has benefited tremendously from the relatively small historic investment in ocean exploration. Multichannel seismic mapping of the ocean sub bottom during the 1970s accelerated deep-water oil and gas exploration. During the past two decades, a renewed interest in marine bioprospecting has led to the discovery of thousands of unique products from marine plants, animals, and microbes, with commercial applications such as pharmaceuticals, nutritional supplements, cosmetics, enzymes, pigments, and fine chemicals. What is remarkable is that the discovery of these thousands of chemicals has come from exploring only a few coastal, and even fewer deep ocean, environments. We have barely begun to tap the potential of the world's oceans to yield useful chemicals. While many fisheries are over exploited, the search continues for environmentally sustainable fisheries to feed our ever-increasing global population. Recent discoveries of gas hydrates, and the unique fauna that live in, on, or because of them, suggest that clean energy for America's future needs may lie within our own unexplored waters. Finally, citizens are eager to share in the exploration of our rich heritage of maritime history, unique archaeological sites, and exotic flora and fauna.

VENTS

The key to understanding the effects of deep ocean volcanism and hydrothermal venting requires voyages of exploration in the time domain. Frequent, in-situ observations, sustained for long periods of time, give scientists information that a snapshot view cannot provide. NOAA's VENTS Program is pursuing this strategy using a wide variety of sensors at seafloor observatories at venting sites. VENTS researchers conduct field operations for at least two months every year at observatories such as the NEw Millenium Observatory (NeMO) at Juan de FucaRidge, using research vessels, submersibles and remotely operated vehicles.



EXAMPLES OF COMMERCIALLY AVAILABLE MARINE BIOPRODUCTS		
PRODUCT	**APPLICATION**	**ORIGINAL SOURCE**
Ara-A	antiviral drug	marine sponge (from U.S. coastal waters)
Ara-C	anticancer drug	marine sponge (from U.S. coastal waters)
Okadaic acid	molecular probe for biomedical research	marine microalga
Manoalide	molecular probe for biomedical research	marine sponge
Vent™ DNA polymerase enzyme	polymerase chain reaction	deep sea hydrothermal vent bacterium
Formulaid® (Martek Biosciences)	fatty acids used as additive in infant formula, nutritional supplement	marine microalga
Aequorin Green Fluorescent Protein (GFP)	bioluminescent calcium, indicator reporter gene	bioluminescent jellyfish
Phycoerythin	conjugated antibodies used in ELISAs and flow cytometry	red algae
Resilience® (Estee Lauder)	“marine extract,” an ingredient in skin care products	Caribbean gorgonian (sea fan)

Exploring the world’s oceans and discovering new resources, both living and non living, will lead scientists to further evaluate the potential of these resources to be developed into useful products to benefit mankind. Ensuring the identification and subsequent research and development of these discoveries is a necessary follow-up to exploration. Thus, important components of a U.S. Ocean Exploration Program will be the support of research by:

— ***Enhancing funding initiatives within federal agencies to support early-phase research on discoveries with commercial potential. Identifying the commercial potential of both living and non living resources will require a multidisciplinary, coordinated, and integrated approach to exploration. Newly discovered plants, animals, microbes, and minerals must be analyzed using state-of-the-art technology to determine their usefulness as pharmaceuticals, nutritional supplements, and fine chemicals for research and industrial applications. Relevant federal agencies must ensure support for early-phase research by establishing new programs specifically targeted for research on discoveries from the Ocean Exploration Program. In addition to the programs that currently exist to support short-term, high-risk research on the living and non living "products" of exploration, federal agencies need to emphasize, prioritize, and fast-track research initiatives on the "products" of the Ocean Exploration Program.***

— ***Providing incentives (such as tax credits, grants, and favorable licensing terms) to private industry to encourage the funding of research and development of discoveries with commercial potential. Private-sector involvement is critical. Although mechanisms exist to support and encourage partnerships between industry, academia, and government (e.g., Small Business Innovation Research [SBIR] and Small Technology Transfer Research [STTR] programs), these programs are not oriented to support the early-phase research that is necessary to identify discoveries with commercial potential. Incentives should be provided to industrial sponsors of high-risk, early-phase, research who are willing to support research directly or through ancillary program support. These incentives should include, but not be limited to, tax credits, grants, and favorable licensing terms. Special attention should be given to incentives for ocean industries to provide platforms for data gathering (e.g., offshore oil/gas platforms, seismic vessels, drill ships) during routine operations and during windows of opportunity for dedicated data gathering during ocean***

transits (e.g., mobilization and demobilization from remote areas).

— ***Promoting stakeholder support of research on the environmentally sustainable use of marine resources. Finally, and most important, it is recognized that along with identifying marine resources with commercial potential comes the obligation to protect such resources from over exploitation. Developers of products that require the extraction of resources should be strongly encouraged to support research on the potential for biological removal of living resources, including stock assessment, rates of growth and reproduction, and environmental sustainability of the resource and its habitat. The Panel endorses a precautionary approach to minimize the likelihood of detrimental effects. In most cases, taking from wild populations will not be a viable option to supply the development and marketing of marine bioproducts. Therefore, as a follow-up to exploration, both federal agencies and private-sector stakeholders must support research on the environmentally sustainable use of marine resources, including, but not limited to, bulk supply options such as aquaculture, microbial fermentation, chemical synthesis, and transgenic production.***

RECOMMENDATIONS

The President can ensure that the knowledge gained from ocean exploration is effectively made available to ensure informed decision-making relative to Marine Protected Areas by:

— ***Assigning leadership in this activity to an appropriate federal agency.***

— ***Establishing a broad-based task force to design and implement an integrated, workable, and comprehensive data management, information processing system for all information, including unique and significant features.***

— ***Enhancing funding within federal agencies to support early-phase research on discoveries with commercial potential.***

— ***Providing incentives to private industry to encourage the funding of research and development of discoveries with commercial potential. U.S. laws should be reexamined to provide proper incentives for potential commercial users of ocean discoveries.***

— ***Designing mechanisms whereby those who directly profit from the exploitation of marine resources support research on their environmentally sustainable use.***

OCEAN EXPLORATION DIRECTIVE

The White House
Office of the Press Secretary

June 12, 2000
Memorandum for:
The Secretary of Commerce

Subject:
A New Era of Ocean Exploration

Two years ago, the Vice President and I joined you, other members of my Cabinet, and hundreds of others from across the country at the National Ocean Conference in Monterey. This historic gathering drew together for the first time representatives from government, industry, and the scientific and conservation communities to begin charting a common oceans agenda for the 21st century.

At the Conference, I directed my Cabinet to report back with recommendations for a coordinated, disciplined, long-term federal ocean policy. In its report to me last year, *Turning to the Sea: America's Ocean Future*, the Cabinet outlined an ambitious and detailed strategy to ensure the protection and sustainable use of our ocean resources. I am proud of the actions my Administration is taking to begin implementing this strategy, including the Executive Order I issued last month to strengthen our national network of marine protected areas.

One of the Cabinet's key recommendations was that the Federal Government establish a national strategy to expand exploration of the oceans. Although we have learned more about our oceans in the past 25 years than during any other period in history, over 95 percent of the underwater world is still unknown and unseen. What remains to be explored may hold clues to the origins of life on Earth, cures for human diseases, answers to how to achieve sustainable use of our oceans, links to our maritime history, and information to protect the endangered species of the sea.

Today, I am announcing steps to immediately enhance our ocean exploration efforts and to develop the long-term exploration strategy recommended by you and the rest of the Cabinet. Together, these actions represent the start of a new era of ocean exploration.

First, I am announcing the launch of three new expeditions off the Atlantic, Gulf, and Pacific coasts. As you know, these expeditions, led by the Department of Commerce in collaboration with private partners, will allow the first detailed exploration of the Hudson River Canyon off New York, the Middle

Grounds and Big Bend areas off central Florida, and the Davidson Seamount off central California. Researchers will employ the latest submersible technologies and will share their discoveries with schoolchildren and the public via the Internet and satellite communications.

Second, to ensure that these new expeditions are only the start of a new era of ocean exploration, I am directing you to convene a panel of leading ocean explorers, educators, and scientists and to report back to me within 120 days with recommendations for a National oceans exploration strategy. In implementing this directive, you shall consult with the National Science Foundation, the National Aeronautics and Space Administration, the Department of the Interior, the Environmental Protection Agency, and other agencies, as appropriate. The strategy should consider the full array of benefits that our oceans provide, and should support our efforts to conserve and ensure the sustainable use of valuable ocean resources. Specifically, the strategy should:

1 |

Define objectives and priorities to guide ocean exploration, including the identification of key sites of scientific, historic, and cultural importance;

2 |

Recommend ways of creating new partnerships to draw on the tools and talents of educational, research, private-sector, and government organizations, including opportunities for federal agencies to provide in-kind support for private ocean exploration initiatives;

3 |

Examine the potential for new technologies — including manned and unmanned vehicles and undersea platforms — to observe and explore the oceans from surface to seafloor and recommend ways to explore the oceans remotely using new observatories and sensors and other innovative uses of technology; and

4 |

Recommend mechanisms to ensure that information about newly explored areas warranting additional protection is referred to the newly established Marine Protected Area Center, and that newly discovered organisms or other resources with medicinal or commercial potential are identified for possible research and development.

In the early years of the 19th century, President Thomas Jefferson commissioned Captain Meriwether Lewis to explore the American West. What followed was the most important exploration in this country's history. As America prepares to celebrate the 200th anniversary of the Lewis and Clark Expedition, we have an opportunity to set our sights on a much broader horizon. The time has come to take exploration farther west, and east, and south, to our submerged continents. In so doing, we can challenge and rekindle American's spirit of exploration, open up a whole new underwater world of possibilities, and help preserve our extraordinary marine heritage for future generations.

William J. Clinton

MARINE PROTECTED AREAS
EXECUTIVE ORDER

THE WHITE HOUSE
Office of the Press Secretary

May 26, 2000

EXECUTIVE ORDER:
Marine Protected Areas

By the authority vested in me as President by the Constitution and the laws of the United States of America and in furtherance of the purposes of the National Marine Sanctuaries Act (16 U.S.C. 1431 et seq.), National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-ee), National Park Service Organic Act (16 U.S.C. 1 et seq.), National Historic Preservation Act (16 U.S.C. 470 et seq.), Wilderness Act (16 U.S.C. 1131 et seq.), Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et seq.), Coastal Zone Management Act (16 U.S.C. 1451 et seq.), Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), Marine Mammal Protection Act (16 U.S.C. 1362 et seq.), Clean Water Act of 1977 (33 U.S.C. 1251 et seq.), National Environmental Policy Act, as amended (42 U.S.C. 4321 et seq.), Outer Continental Shelf Lands Act (42 U.S.C. 1331 et seq.), and other pertinent statutes, it is ordered as follows:

Section 1. Purpose. This Executive Order will help protect the significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the Nation's system of marine protected areas (MPAs). An expanded and strengthened comprehensive system of marine protected areas throughout the marine environment would enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. To this end, the purpose of this order is to, consistent with domestic and international law (a) strengthen the management, protection, and conservation of existing marine protected areas and establish new or expanded MPAs; (b) develop a scientifically based, comprehensive national system of MPAs representing diverse U.S. marine ecosystems, and the Nation's natural and cultural resources; and (c) avoid causing harm to MPAs through federally conducted, approved, or funded activities.

Section 2. Definitions. For the purposes of this order: (a) "Marine protected area" means any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein. (b) "Marine environment" means those areas of coastal and ocean waters, the Great Lakes and their connecting waters, and submerged lands thereunder, over which the United States exercises jurisdiction, consistent with international law. (c) The term "United States" includes the several States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands of the United States, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands.

Section 3. MPA Establishment, Protection, and Management. Each Federal agency whose authorities provide for the establishment or management of MPAs shall take appropriate actions to enhance or expand protection of existing MPAs and establish or recommend, as appropriate, new MPAs. Agencies implementing this section shall consult with the agencies identified in subsection 4(a) of this order, consistent with existing requirements.

Section 4. National System of MPAs. (a) To the extent permitted by law and subject to the availability of appropriations, the Department of Commerce and the Department of the Interior, in consultation with the Department of Defense, the Department of State, the United States Agency for International Development, the Department of Transportation, the Environmental Protection Agency, the National Science Foundation, and other pertinent Federal agencies shall develop a national system of MPAs. They shall coordinate and share information, tools, and strategies, and provide guidance to enable and encourage the use of the following in the exercise of each agency's respective authorities to further enhance and expand protection of existing MPAs and to establish or recommend new MPAs, as appropriate:

(1) science-based identification and prioritization of natural and cultural resources for additional protection;

(2) integrated assessments of ecological linkages among MPAs, including ecological reserves in which consumptive uses of resources are prohibited, to provide synergistic benefits;

(3) a biological assessment of the minimum area where consumptive uses would be prohibited that is necessary to preserve representative habitats in different geographic areas of the marine environment;

(4) an assessment of threats and gaps in levels of protection currently afforded to natural and cultural resources, as appropriate;

(5) practical, science-based criteria and protocols for monitoring and evaluating the effectiveness of MPAs;

(6) identification of emerging threats and user conflicts affecting MPAs and appropriate, practical, and equitable management solutions, including effective enforcement strategies, to eliminate or reduce such threats and conflicts;

(7) assessment of the economic effects of the preferred management solutions; and

(8) identification of opportunities to improve linkages with, and technical assistance to, international marine protected area programs.

(b) In carrying out the requirements of section 4 of this order, the Department of Commerce and the Department of the Interior shall consult with those States that contain portions of the marine environment, the Commonwealth of Puerto Rico, the Virgin Islands of the United States, American Samoa, Guam, and the Commonwealth of the Northern Mariana Islands, tribes, Regional Fishery Management Councils, and other entities, as appropriate, to promote coordination of Federal, State, territorial, and tribal actions to establish and manage MPAs.

(c) In carrying out the requirements of this section, the Department of Commerce and the Department of the Interior shall seek the expert advice and recommendations of non-Federal scientists, resource managers, and other interested persons and organizations through a Marine Protected Area Federal Advisory Committee. The Committee shall be established by the Department of Commerce.

(d) The Secretary of Commerce and the Secretary of the Interior shall establish and jointly manage a Web site for information on MPAs and Federal agency reports required by this order. They shall

Section 6. Accountability. Each Federal agency that is required to take actions under this order shall prepare and make public annually a concise description of actions taken by it in the previous year to implement the order, including a description of written comments by any person or organization stating that the agency has not complied with this order and a response to such comments by the agency.

Section 7. International Law. Federal agencies taking actions pursuant to this Executive Order must act in accordance with international law and with Presidential Proclamation 5928 of December 27, 1988, on the Territorial Sea of the United States of America, Presidential Proclamation 5030 of March 10, 1983, on the Exclusive Economic Zone of the United States of America, and Presidential Proclamation 7219 of September 2, 1999, on the Contiguous Zone of the United States.

Section 8. General. (a) Nothing in this order shall be construed as altering existing authorities regarding the establishment of Federal MPAs in areas of the marine environment subject to the jurisdiction and control of States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands of the United States, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, and Indian tribes. (b) This order does not diminish, affect, or abrogate Indian treaty rights or United States trust responsibilities to Indian tribes. (c) This order does not create any right or benefit, substantive or procedural, enforceable in law or equity by a party against the United States, its agencies, its officers, or any person.

William J. Clinton

REMARKS TO THE OCEAN EXPLORATION PANEL

Secretary of Commerce, Norman Y. Mineta

Ocean Exploration Panel Meeting

August 21, 2000

Good morning fellow explorers! I say fellow explorers because I believe that each and every one of us is an explorer at heart. You just had the good sense to make it your life's work! As space explorers observed over 30 years ago, Earth is a blue planet, an ocean planet. And just as those early explorers set the nation's commitment to space exploration, it is up to us today to build a foundation for a renewed commitment to ocean exploration.

On June 12, President Clinton directed the Secretary of Commerce to put together a panel of America's finest explorers, scientists and educators. He wanted the best people to work on a very, very important task: to develop a national strategy for ocean exploration. I thank each of you for responding to the call. Whenever we explore new frontiers — from the American west to outer space — we reap multiple benefits — to our economy, our technology, our health and our culture. And, as we embark on this new era of ocean exploration, we can envision extraordinary benefits. For example, the economic potential of America's unexplored oceans is vast. Gas hydrates may hold more than 1000 times the fuel in all other estimated oil and gas sources combined. Already one new anti-cancer medicine (called Bryostatin) comes from a marine sponge. This drug is estimated to have an annual market value of over $1.2 billion. And there is more history under the sea than in all the museums of the world. The ocean is home for treasures of antiquity, sunken vessels and the legacy of our maritime past. And we have taken steps to protect this heritage.

The first national marine sanctuary protects the remains of the Civil War ironclad *USS Monitor*. The newest marine sanctuary — the Thunder Bay National Marine Sanctuary — will protect a collection of shipwrecks in Lake Huron. It's been said, rightly, I believe that we only protect that which we understand. By setting out on voyages of exploration and discovery, we build a foundation for conservation.

Technology is already bringing once inaccessible areas of the ocean within reach of fishermen, miners, and bio-prospectors. In some ways, we are playing catch-up to these advances. But, as we have learned on land, protection must go hand in hand with exploration. Deep ocean exploration presents huge technological challenges. And as we have seen with space exploration, the solutions often have broad benefits.

In turn, we will bring back discoveries of new life forms, geological features and chemical processes. Unraveling their mysteries will spur new developments. In the days of Lewis and Clark, Americans waited months to learn about their discoveries. Today, through Internet and satellite communications, you can take us along. As many of you have shown, students and teachers can share in the excitement of planning and undertaking an expedition.

As President Clinton noted in calling for a new era of ocean exploration, America needs a sustained investment to reap the full benefits for society. Exploration is not partisan, nor is it the exclusive domain of any agency. It requires the full participation of government and the private sector. And, above all, a successful ocean exploration strategy must engage the public. A truly successful report will give us a strategy to make all citizens explorers — and move ocean issues beyond this esteemed panel here today. The effort to reach out and bring the excitement of these endeavors into America's classrooms is one of the best investments we can make. It is often said that children are natural scientists. This great exploration endeavor has the potential to spark and nurture that curiosity through film, television, and the Internet. But let's also remember the adults out there — remember to reach out to the explorer in all of us.

Ask yourself: Where were you when man first walked on the moon? That amazing event remains so vivid in our minds because all Americans, indeed the world, were able to see it live on TV. That day inspired a whole new generation of explorers.

How will Americans be able to join you on your expeditions to new ocean frontiers? Will today's explorations inspire the next generation of ocean scientists — and at home explorers? An ocean exploration strategy that reaches its full potential must tap all the expertise and resources available to us. The exploration of the world's oceans cannot be accomplished by one government agency, nor can it be accomplished by government alone.

I urge you, in your deliberations, to envision a new collaboration among governments, academia, and the private industry that reaches out to everyone. In addition, a successful ocean exploration strategy should explore through time. Voyages to remote places are essential, but so are those that occur through time as well. The establishment of networks, observatories, and data arrays on the seafloor and in the ocean's water column often reveals more to science than a snapshot approach ever will.

Two hundred years after Lewis and Clark forever changed the American landscape, you can chart a new course to explore the American seascape. My hope is that, with public outreach, future generations will view this commission as a turning point for exploration of the oceans. Thank you all for your willingness to be part of this critical task for our future. I eagerly await your report. May it mark a new era of ocean exploration and conservation — a new era of stewardship for the oceans.

Norman Y. Mineta

AGENCY SUMMARIES OF OCEAN EXPLORATION ACTIVITIES

Environmental Protection Agency (EPA)

The EPA's mission is to protect and restore the environmental quality of ocean ecosystems. A priority must be established for the exploration of coastal ecosystems because they are particularly threatened by pollution, coastal development, and overexploitation of resources. These stressors can cause habitat loss, nuisance algal blooms, hypoxia, toxic contamination of marine life, and ecological degradation. Although coastal systems are the most easily accessible to study, our understanding of how they are structured and how they function is still not well established.

To ensure that we manage these systems in a sustainable manner, we must understand them. We should explore coastal ecosystems with new and efficient measurement techniques to establish baselines for status and trends and to allow us to interpret the causes and consequences of change. We must ensure that exploration and discovery of the resources in the oceans do not lead to overexploitation and degradation of these same resources, as they often have in the past.

National Aeronautics and Space Administration (NASA)

NASA is one of the earth science discovery agencies of the federal government. Scientific exploration of the Earth is an essential step in understanding weather, climate and natural hazards. It may also assist in the quest for the origins of life. NASA's mission in the area of ocean exploration is to support the migration of ocean observing techniques from research to operational use, conduct and preserve high-quality, long-term, systematic measurements of the oceans, facilitate data exchange and real-time assimilation within an integrated ocean observing system, and increase public awareness of the critical role the oceans play in our lives on Earth.

To achieve this mission, NASA conducts ocean-observing missions that reveal the new and unforeseen phenomena in Earth's oceans. NASA also develops enabling technology for ocean observing missions throughout the solar system, and contributes to the development of an integrated ocean observing system. NASA also conducts research missions that explore techniques for ocean observation, including new satellite technologies and sensors for ocean remote sensing, in-situ ocean sensors made ready for space environments and vice versa, and creating or refining ocean circulation models.

NASA explores the practical application of its discoveries in ocean science though several partnerships and programs, including the U.S. Global Climate Research Program (USGCRP), National Ocean Partnership Program (NOPP), Integrated Global Observing Strategy (IGOS), and NASA's Seasonal-to-Interannual Prediction Program (NSIPP).

National Science Foundation (NSF)

The National Science Foundation is a primary player in ocean exploration and discovery. NSF supports disciplinary and interdisciplinary research efforts and the means, particularly ships and other equipment, necessary to access the oceans from the surface to deep in the sea floor.

Core programs include investigator-initiated research in biology, chemistry, physical oceanography, and marine geology and geophysics, including research within polar regions. Focused programs include Continental Margins (MARGINS), Life in Extreme Environments (LExEn), Ecology of Harmful Algal Blooms (ECOHAB), Coastal Ocean Processes (CoOP), Environmental Geochemistry and Biogeochemistry (EGB), World Ocean Circulation Experiment (WOCE), U.S. Joint Global Ocean Flux Study (JGOFS), Ridge Interdisciplinary Global Experiments (RIDGE), Global Ocean Ecosystems Dynamics (GLOBEC), Marine Aspects of Earth System History (ESH), Surface Heat Budget of the Arctic Ocean (SHEBA), Science Ice Exercise (SCICEX), and Shelf-basin Interactions in the Arctic (SBIA). Integrating research and education is a high priority for NSF.

NSF provides significant support to facilities and technologies that enable access to various regions of the ocean and ensure effective research and communication capabilities. NSF is the primary supporter of numerous surface vessels, including the academic research fleet (consisting of 28 ships of various sizes), polar vessels, and icebreakers. NSF is also a major supporter of manned submersible activities. Other support includes both the technological development and emplacement of seafloor observatories, remotely operated vehicles, autonomous underwater vehicles, and other instrumentation such as communications technology. Finally, the Ocean Drilling Program, supported by NSF in concert with numerous international partners, enables access to the Earth's undersea crust by drilling into the sea floor to recover rocks and sediment.

United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)

Exploration is the first step in understanding Earth's environment, undertaking wise stewardship of resources, and understanding ecosystem functioning. NOAA's mission in this area includes finding new resources, bioprospecting materials from exotic species, inspecting new life forms, investigating gas hydrates and associated ecosystems, and exploring mineral-rich geologic deposits. Additionally, NOAA is charged with protecting, developing, and conserving poorly understood resources, including unexplored fisheries, their habitats and ecosystems, deep corals and live bottoms, and our cultural heritage, which encompasses shipwrecks and submerged cultural resources. In addition, NOAA's ocean management programs, such as the National Marine Sanctuary System, seek to fill large gaps in our fundamental understanding of coastal and ocean phenomena through use of exploration technologies and programs. NOAA is also seeking to understand ocean noise, both natural sound levels and human-induced noise, and their effects on marine animals. The organization also works toward developing technologies to support exploration, which will facilitate access to remote, difficult environments, surface to sub-sea floor, and long-term observations and sampling of the biota and environment. NOAA's mission also includes a mandate to conduct education and outreach activities to build an ocean constituency and educate the public on ocean issues. The three most prominent ocean exploration programs currently housed at NOAA are the National Undersea Research Program, the Sustainable Seas Expeditions, and the VENTS Program. NOAA is also hoping to introduce an Ocean Exploration Initiative for FY 2002, which would support discovering new resources, understanding ocean sound, exploring frontier areas, protecting America's maritime heritage, education and outreach activities, as well as data management activities. NOAA strongly supports the concept of a Census of Marine Life, and technology development to improve fish stock assessments.

United States Department of Interior, Minerals Management Service (MMS)

The MMS, a bureau of the U.S. Department of the Interior, is this nation's manager of mineral resources on and under the sea bed of the outer continental shelf (OCS). The bureau has a two-fold mission: ***1)*** Collect, verify and distribute mineral royalties from tribal and federal offshore and onshore lands and ensure a fair return to the American public; and ***2)*** Manage the oil and gas and other mineral resources of the OCS in a safe and environmentally sound manner.

In order to meet its environmental and safety responsibilities, the MMS conducts environmental and engineering research to provide information for management decisions on all phases of mineral resource development activities on the OCS. This research is focused to meet management needs for informed decision making. Environmental research is conducted through the Environmental Studies Program, which has been funded at $19.5 million per year for the past several years. Scientists from academic and research institutions, the private sector, state agencies and other federal agencies conduct virtually all of MMS's research. The MMS has formal research partnerships, called "Coastal Marine Institutes," with Louisiana State University, the University of Alaska at Fairbanks, and the University of California at Santa Barbara.

While MMS research is directed to specific information needs for OCS mineral management purposes, some of that research has been exploratory in nature and has led to major scientific discoveries. Some examples are: discovery of chemosynthetic communities and species in the Gulf of Mexico; initial understanding of noise impacts on marine mammals; better understanding of three-dimensional water circulation on the shelf and slope; and knowledge about the migration patterns of several species of endangered whales via satellite telemetry. Extensive MMS research efforts in the 1970s and 1980s led to the discovery and classification of numerous new species of benthic invertebrates from the OCS.

Beginning in FY 2001, MMS will initiate a marine biotechnology effort. Specifically the bureau, working through its California and Louisiana Coastal Marine Institutes, will conduct research on the taxonomic and genetic biodiversity found on offshore oil and gas platforms, and analyze selected taxa for bioactive compounds that may have pharmaceutical and other commercial applications. Other research initiatives are the intensive investigation of the physical oceanography and benthic ecology of the deep water (water depths greater then 350 meters) Gulf of Mexico, and continued field investigations of the impacts of human-induced noise on marine mammals.

United States Department of Energy (DOE)

Ocean exploration to DOE is the search for energy resources in the ocean's coastal zones and continental shelf. Offshore oil and gas production has been an integral part of domestic and global energy supply for more than 30 years. That contribution has been made possible by a vast investment in the knowledge, technology, and infrastructure needed for production at steadily increasing water depth. With the continuing decline in our domestic onshore oil production and the projected increase in natural gas use, the economic, safe, and environmentally benign production of oil and gas resources in deep- and ultra-deep water will be even more important. To achieve that goal, DOE will partner with other agencies, industry, academia, the national laboratories, and other stakeholders in developing the knowledge and technologies needed. DOE will also be seeking an understanding of the role the oceans play in the Earth's carbon cycle, and how this understanding can contribute to climate change. DOE has also been given the lead responsibility for an interagency program on methane hydrates — ice-like structures containing methane — which are estimated to have a resource potential exceeding that of all other fossil resources. Understanding the nature and behavior of hydrates and their possible impacts on deep-water oil and gas production and climate change, as well as determining whether their contained methane can be economically and safely produced, will be important elements in our understanding of the ocean and its resources.

United States Navy

With the ocean critical to our national security and its primary operating environment, the Navy plays a key role in federal ocean programs. The Office of Naval Research supports ocean exploration as part of its discovery and invention program. The Oceanographer of the Navy is responsible for all operational oceanography in the Navy, including advanced research and development to support it. Ocean exploration is often an outcome and benefit of systematic in-situ and remote data collection activities that the Navy undertakes to map the ocean bottom and diagnose its structure and behavior in support of military operations. Science and exploitation are often built upon such ocean survey results.

Navy niches in such partnership efforts include technology, data management, operational oceanography, cutting-edge science, and the opportunity for pure discovery.

United States Geological Survey (USGS)

Maps, in the broadest sense, are one of the most valuable products of exploration. The mapping of the deep EEZ through the mid-1980s showed that systematic mapping can be carried out on a large scale. The value of a systematic and phased effort was also demonstrated. Detailed seafloor maps invariably expose new features and provide evidence of unknown processes. As map coverage expands, the variety and large-scale structure of the seafloor is revealed. Subsequent developments have enabled high-resolution mapping in shallow waters. Results from the shallow shelf are no less exciting and no less surprising. Mapping is only one facet of exploration, but a critical one that returns a picture of the previously unknown and guides further exploration.

OCEAN EXPLORATION PANEL PROCESS

On June 12, 2000, the President directed the Secretary of Commerce to convene a panel of leading ocean explorers, scientists, and educators to recommend a national ocean exploration strategy. The responsibility for convening the panel of experts within 120 days was delegated to the National Oceanic and Atmospheric Administration (NOAA), within the U.S. Department of Commerce. At the request of the Undersecretary for Oceans and Atmosphere, Dr. D. James Baker, the NOAA Science Advisory Board (SAB) selected the panel of experts, and specifically designated the Chair of the Panel. Technical experts within the federal government were added to the Panel in an advisory capacity.

The Ocean Exploration Panel was designated as a working group of the NOAA SAB, a federal advisory committee. The 23-member Panel met twice. At the first meeting in Washington, D.C., on August 22-23, 2000, they reviewed current ocean exploration activities presented by government agencies, industry, and non-profit organization representatives. Following this meeting, the Panel drafted their report. A notice of the meeting was published in the Federal Register and public input was solicited. The Panel met again on September 14-15, 2000, in Monterey, California, to review progress on the report. The Panel's work on this report was completed through the extensive use of e-mail following the meeting in Monterey. To consult with various federal agencies during this process, an Interagency Task Force was created. NOAA, NASA, DOE, EPA, USGS, MMS, NSF and the Navy were represented on this Task Force. NOAA provided all necessary administrative and logistical support to the Panel to carry out this assignment. Information and points of contact were provided throughout the process on a public website maintained by NOAA.

ACKNOWLEDGEMENTS

Norman Y. Mineta
Secretary of Commerce

The Secretary of Commerce, Norman Y. Mineta, wishes to acknowledge the work of Dr. Marcia McNutt and the Ocean Exploration Panel. The Panel maintained a rigorous schedule to create this report within a mandated 120-day period. Additionally, the hard work of the Science Advisors to the Panel assured that this report will meet the needs of a community of ocean technology and scientific experts.

The Secretary also wishes to thank Marcia Collie, Claire Johnson, Michael Kelly, Christine Maloy, Barbara Moore, and Pam Rubin, the NOAA support team whose hard work and dedication produced this document and organized the working of the Panel.

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CREDITS / DESCRIPTIONS

Photographs and Illustrations

Cover
Kerby, Terry. National Undersea Research Program/University of Hawaii

Page 8
Map of Lamont Core distribution. Columbia University's Lamont-Doherty Earth Observatory

Page 11
Deployment of a scientific device from an oceanographic vessel that tests the Conductivity, Temperature, and Density of water (also known as a CTD).

Page 13
Map of the sixth largest impact crater on Earth found about 200 km south of Washington, D.C.
United States Geological Survey

Page 14
Multibeam sonar images permits in-depth characterization and mapping of the sea floor. United States Geological Survey

Page 16 *(top)*
Ice worms are the only known animal to inhabit gas hydrates on the seafloor. National Undersea Research Program

Page 16 *(bottom)*
Map provided courtesy of the National Geographic Society © NGS

Page 19
Education and outreach captivates students, educators, and the general public. Wilder, Randy © Monterey Bay Aquarium

Page 21 *(top left)*
The *Alvin* submersible. Woods Hole Oceanographic Institution © WHOI

Page 21 *(top center)*
The head of a statue in basalt representing a Pharao, which had been found during excavation of an archaeological site.
Gerigk, Christoph © Hilti Foundation/Franck Goddio/ Discovery Channel

Page 21 *(top right)*
A rendezvous between the *DeepWorker 2000* submersible and the *Atlantis* passenger submarine off the coast of Hawaii during the January 2000 Sustainable Seas Expeditions. Evans, Kip F./National Geographic Society © NGS

Page 22
Future scenario of global ocean exploration grid. U.S. Navy

Page 23 *(left)*
Oceanographic vessel at sea.

Page 23 *(right)*
Dense patch of sponges found at Davidson Seamount. Monterey Bay Aquarium Research Institute © 2000 MBARI

Page 28 *(left)*
Vibrant christmas tree worms. National Oceanic and Atmospheric Administration

Page 28 *(center)*

Vampyroteuthis infernalis, vampire squid. Reisenbichler, Kim/Monterey Bay Aquarium Research Institute ©1996 MBARI

Page 28 *(right)*

Polyorchis pencillatus, midwater jelly. Raskoff, Kevin/Monterey Bay Aquarium Research Institute ©1998 MBARI

Page 30

The Jason XII Expedition to Hawaii 2001 logo: A Living Laboratory. © The Jason Project

Page 32

A diver examining a marine archaeological artifact. Gergk, Christoph © Hilti Foundation/Franck Goddio/Discovery Channel

Page 36 *(top)*

Three seagliders aboard the *R/V Miller* in Puget Sound, WA. Seagliders are small remotely controlled autonomous vehicle that repeatedly glide down and up through the ocean as they measure temperature, salinity, current, oxygen, chlorophyll, and other properties. They are designed to dive as deep as 2 km, operate for many months, and travel as far as a quarter of the way around the world. Woods Hole Oceanographic Institution © WHOI

Page 36 *(bottom)*

The Autonomous Benthic Explorer known as ABE. Woods Hole Oceanographic Institution © WHOI

Page 37

Compilation of hydrophone sites for passive underwater acoustics. Fox, Chris/National Oceanic and Atmospheric Administration

Page 38

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Page 42

The *Alvin* submersible with microchemical sensor in manipulator at a hydrothermal vent. Woods Hole Oceanographic Institution © WHOI

Page 44

A molecular biologist refines probes for detecting toxic algae. Leet, M. Monterey Bay Aquarium Research Institute © 1997 MBARI

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