EXPLORE

NOAA OFFICE OF

OCEAN EXPLORATION

2002 ANNUAL REPORT

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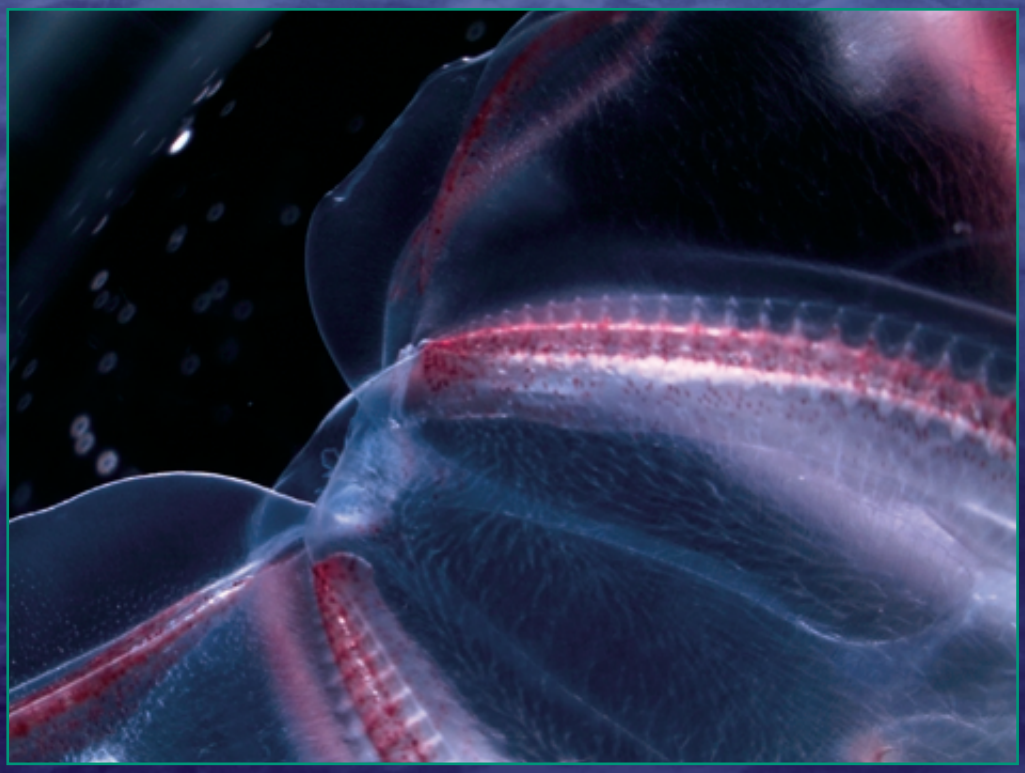


MESSAGE FROM UNDERSECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE AND NOAA ADMINISTRATOR

Welcome to the new era of exploration.

When most of us think of explorers, we envision historical figures from the Age of Sail to the "wild west." Notables like Ferdinand Magellan, Sir Francis Drake, Lewis and Clark, and others expanded our understanding of, and appreciation for, our planet. We mark human achievement with milestones in exploration: the date we landed on the moon; Columbus's discovery of the new world, and Charles Lindberg's Atlantic crossing. And while we celebrate the tremendous achievements gained through historical exploration, we realize that the greatest age of exploration has just begun: The exploration of Earth's oceans.

A little over two years ago a panel of leading ocean scientists, explorers, and educators developed a national strategy for ocean exploration. Their report, "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration", opened the door to a new way of thinking about ocean exploration and inspired NOAA to embark on a mission to expand knowledge and appreciation of the oceans around us. Since the publication of their report, NOAA and partner organizations and institutions have made significant progress in exploring vast unknown ocean regions.

Having finished our second field season, I am proud to present the 2002 Annual Report for NOAA's Office of Ocean Exploration. Expeditions and projects undertaken this year built on our inaugural work in 2001 and set a precedent of high quality discovery based ocean research. Results from this year's work include new maps of previously unknown ocean areas, the discovery of new marine species, and volumes of new data for scientists, natural resource managers and decision makers. This year, we have seen the discovery of important shipwrecks, the creation of new research partnerships, and the development of new tools for educators so that explorers of all ages can join us in our discoveries.

Vice Admiral Conrad C. Lautenbacher, Jr., U.S. Navy (Ret.)

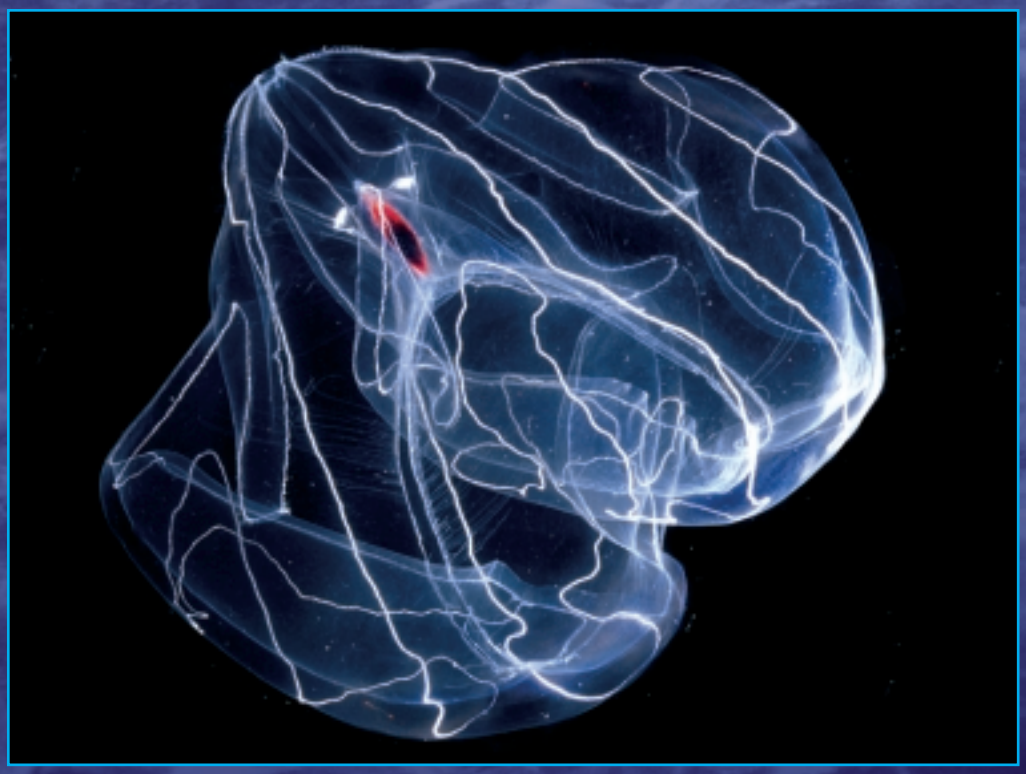
Undersecretary of Commerce for Oceans and Atmosphere and NOAA Administrator

ACKNOWLEDGMENTS

THE NOAA OFFICE OF OCEAN EXPLORATION WISHES TO ACKNOWLEDGE AND THANK THE FOLLOWING EXPLORATION PARTNERS FOR THEIR CONTRIBUTIONS DURING THE 2002 FIELD SEASON.

The Alaska Native and Minority Student Internship Program, Aquarius, Brown University, Canadian Coast Guard, Canadian Institute for Marine Science, Canadian Scientific Submersible Facility, Carleton University, Charleston County (SC) School District, Chinese Arctic and Antarctic Administration, City of Newport News, Coastal Carolina University, College of Charleston, Dalhousie University, Darwin Research Station, Deep Sea Systems International, Inc., Department of Environment Puerto Rico, Department of Fisheries and Oceans Canada, DePaul University, East Carolina University, First Light Films, Florida Keys National Marine Sanctuary, Georgia Institute of Technology, Girl Scouts of the USA, Global Industries Inc., Government of Ecuador, Gray's Reef National Marine Sanctuary, Harbor Branch Oceanographic Institution, Hatfield Marine Science Center, Hawaii Undersea Research Laboratory, Hunter College at the City University of New York, Institute for Exploration, Institute for Genomic Research, Jacques Cousteau National Estuarine Research Reserve, Japan Marine Science and Technology, Kennedy Space Center, Laboratoire de Geosciences Marines, Lexington County (SC) School District, Louisiana State University, Manson Gulf Inc., Marine Conservation Biology Institute, Mariner's Museum, Massachusetts Institute of Technology, McGill University, Mill Street Elementary School, Miller Place School, Mobile Diving and Salvage Unit Two, Monitor National Marine Sanctuary, Monterey Bay Aquarium, Monterey Bay Aquarium Research Institute, Monterey Bay National Marine Sanctuary, Monterey Peninsula College, Moss Landing Marine Laboratories, National Aeronautics and Space Administration, National Geographic Society, National Park of the Galapagos, National Science Foundation, National Undersea Research Center at the University of North Carolina at Wilmington, National Undersea Research Program, Naval Sea Systems Command, NOAA Fisheries, NOAA Ocean Service, NOAA Office of Oceanic and Atmospheric Research, NOAA Pacific Marine Environmental Laboratory, North Carolina Division of Marine Fisheries, North Carolina National Estuarine Research Reserve, North Carolina State Museum of Natural Sciences, North Pacific Fisheries Observer Training Center, Northrop Grumman Newport News, Norwegian University of Science and Technology, Ocean Properties, Oregon Sea Grant, Oregon State University, Pennsylvania State University, Phoenix International Inc., Polar Institute of China, Portland State University, Rutgers University, Second Institute of Oceanography, China, Sci-Tek Communications, Smithsonian Institution, South Carolina Department of Natural Resources, Stanford University, Stennis-Scott Aquarium, Texas A & M University, Thunder Bay National Marine Sanctuary, U.S. Coast Guard, U.S. Naval Academy, U.S. Navy, U.S. Geological Survey, University of Alaska at Anchorage, University of Alaska at Fairbanks, University of California at Berkeley, University of California at Santa Cruz, University of Connecticut at Avery Point, University of Florida, University of Georgia, University of Hawaii, University of Lisbon, University of Maine, University of Maryland, University of Minnesota, University of Missouri, University of North Carolina at Wilmington, University of Oregon, University of Quebec at Montreal, University of the Algarve, University of the Azores, University of Toronto, University of Victoria, University of Virginia, University of Washington, University of Wisconsin at Green Bay, Washington State University, Western Washington University, and the Woods Hole Oceanographic Institution.

INTRODUCTION



THE MISSION

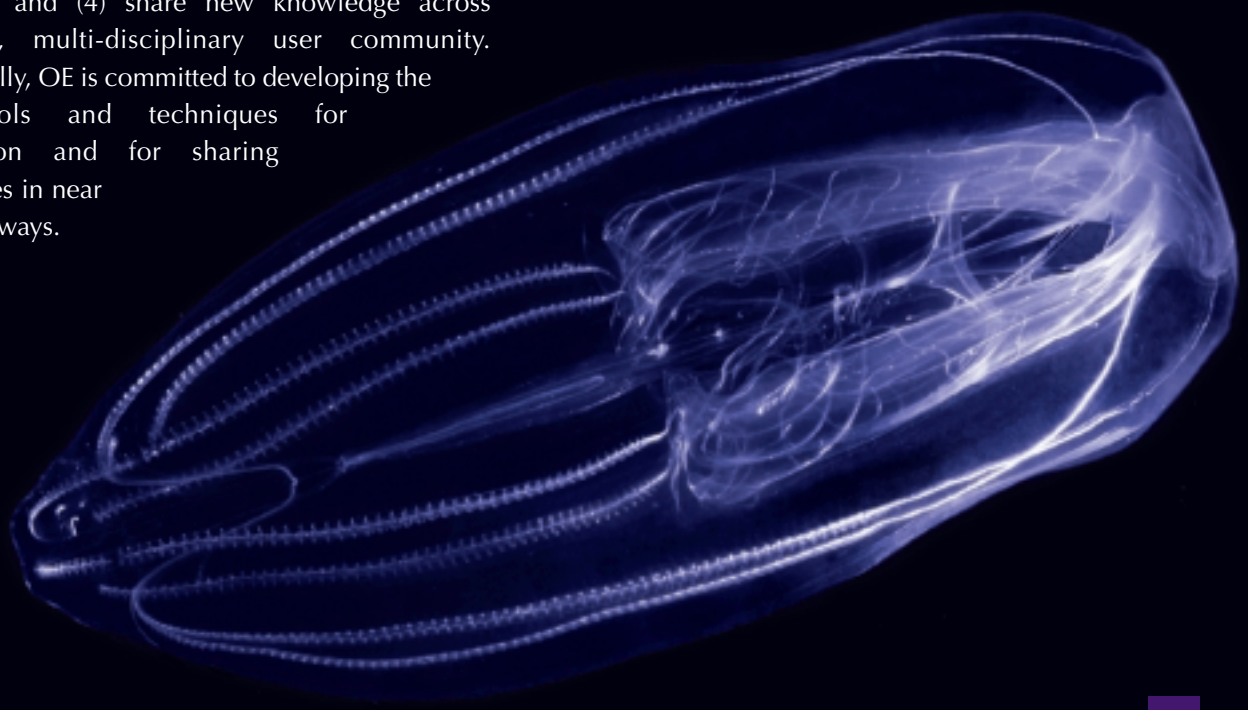
In August 2000, the Secretary of Commerce convened a U.S. panel of leading ocean scientists, explorers, and educators to create a National Strategy for Ocean Exploration. Their report, *Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration,* (http://oceanpanel.nos.noaa.gov/panelreport/ocean_panel_report.html) represents the first comprehensive national plan for ocean exploration. In its final recommendations, the panel called for a new Ocean Exploration Program driven by the quest for discovery and the spirit of challenge. The result was the creation of a National Ocean Exploration Program to be led by the nation's ocean agency, the National Oceanic and Atmospheric Administration (NOAA).

As a principal component of the national strategy contained in the panel's report, NOAA's Office of Ocean Exploration (OE) seeks to bring the best of the nation's scientists to the leading edges of ocean science and technology to (1) discover more about life and processes within the oceans, (2) learn more about maritime cultural resources and heritage, (3) provide a knowledge base that will help enable wise use of the ocean's biological and mineral resources and (4) share new knowledge across a broad, multi-disciplinary user community. Additionally, OE is committed to developing the new tools and techniques for exploration and for sharing discoveries in near real-time ways.

OE accomplishes many of these objectives through interdisciplinary expeditions to unknown, or poorly known, regions and through innovative experiments. The Program advocates discovery-based science and collaboration between multiple partners and disciplines. Education and outreach are priorities of NOAA's OE Program.

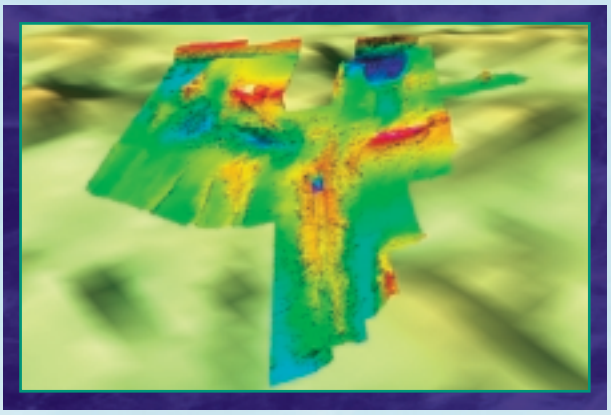
NOAA funded pioneering ocean exploration projects in 2002. Exploration projects are peer-reviewed with an approximate 75% of 2002 funds going to non-NOAA investigators. These projects and expeditions brought ocean scientists, outreach specialists and educators together to pursue exploration in the Arctic, Pacific and Atlantic Oceans, the Bering and Black Sea, the English Channel, the Great Lakes and the Gulf of Mexico. These expeditions brought NOAA to the ocean frontier while sharing the experience with millions of explorers across the Nation.

This report details NOAA's Office of Ocean Exploration accomplishments for 2002 and describes each major expedition and project undertaken during the program's second year.



SUMMARY OF ACCOMPLISHMENTS

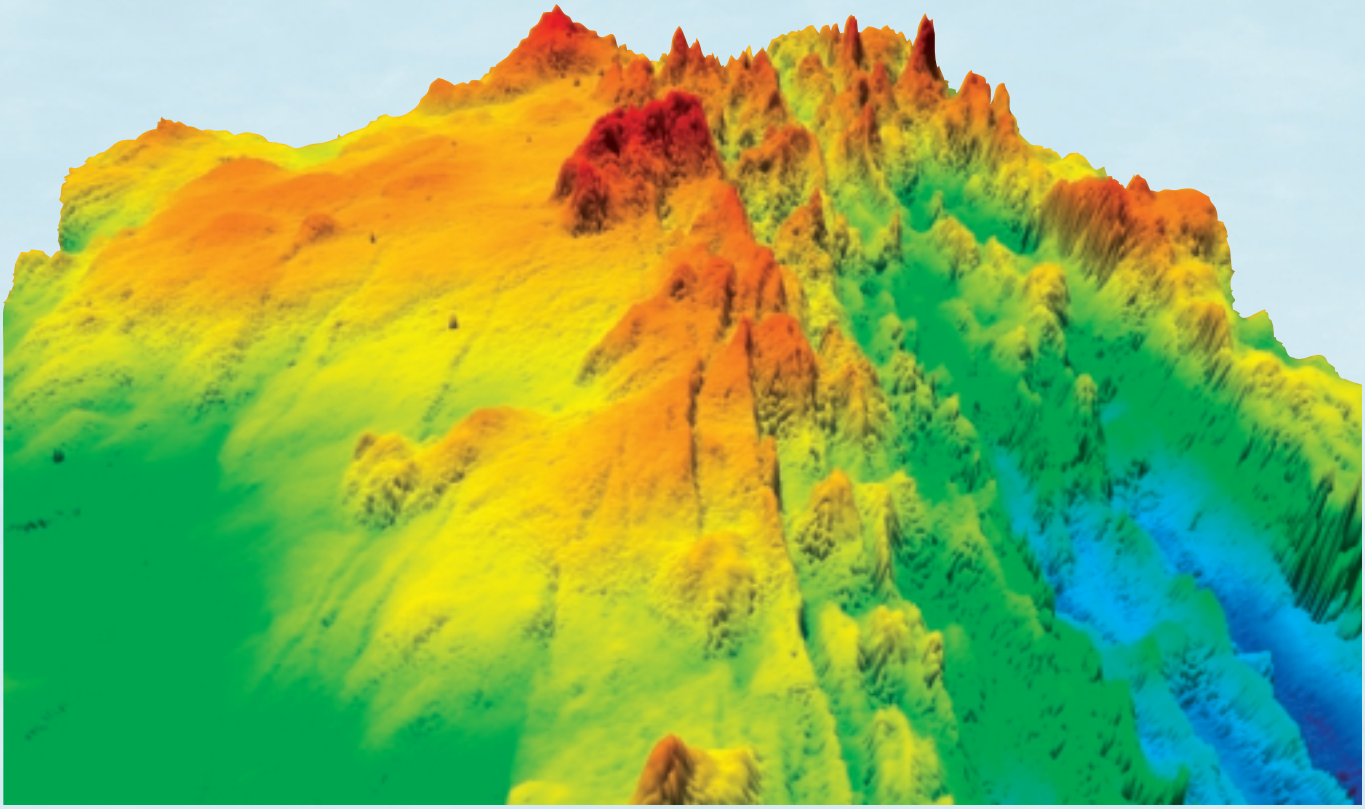
The NOAA Ocean Exploration (OE) 2002 field season encompassed dozens of ocean science and outreach projects with benefits for natural resource managers, scientists, educators and students. OE conducts and supports exploratory activities in the ocean and shares these experiences with the public through various outreach and education activities. Its mission fits into four distinct areas as defined by the President's Panel on Ocean Exploration:

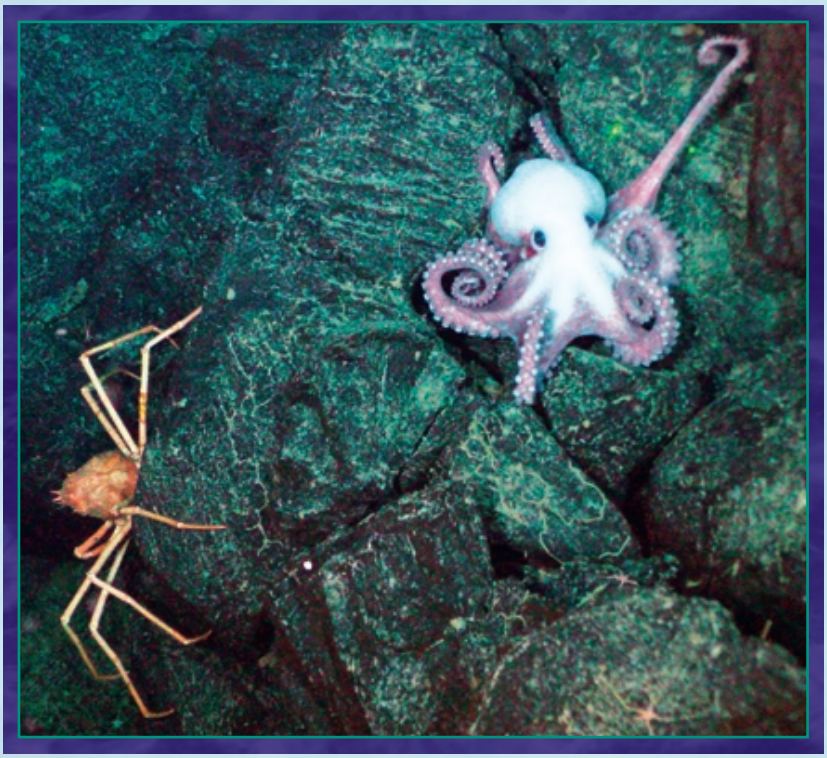


MAPPING THE OCEAN IN NEW WAYS

A primary product of exploration is new and improved maps. These maps differ from nautical charts by characterizing ocean regions and documenting more than the physical environment. OE's expedition teams collect data representing multiple facets of the ocean environment including bathymetry, biology, geology, chemistry, temperature, and even historic resources.

This year, nearly 30,000 square nautical miles were mapped using high-resolution tools (an area almost as large as South Carolina). These maps provide new definition of ocean regions and features. This information will serve as the foundation for new ocean science and exploration. Given the critical need for detailed maps of the ocean for ocean science, policy and management, OE places a high priority on new mapping endeavors.





UNDERSTANDING OCEAN INTERACTIONS

Documentation of ocean areas begins with descriptions of physical features of an ocean region, and then adds a variety of other environmental data to render a more complete picture of ocean ecosystems. After an initial account of the physical parameters of an area, the next step is to comprehend how the physical environment and its biological components fit together and relate to one another. Understanding an area's dynamic interactions is a vital component of exploration activities. Through discovery and observation of ocean organisms in the ocean systems they are a part of, ocean exploration is providing a new understanding of complex biological interactions and giving NOAA new baselines for understanding ocean ecosystems.

Advances in biological science have occurred this year. New marine species were discovered and the known habitat range of others has been extended. OE and its partners collected species from diverse ocean habitats, ranging from deep ocean vents to ice flows. Preliminary results indicate that several new marine organisms have been discovered, and many species, that were collected or documented, remain unidentified.

Other important ocean interaction breakthroughs in 2002 include the discovery of new hydrothermal vents and the discovery that other vents have disappeared. While we are still far from attaining a comprehensive understanding of hydrothermal vent ecology, huge steps were made this year in our understanding of how geologic ocean conditions regulate deep ocean life.

A core ethic of NOAA Ocean Exploration program is data sharing. Giving access to OE data, sometimes in near real-time, to the broadest reaches of the ocean exploration and science community enriches all of science. This year, together with The Institute for Genomic Research, a collection of curated databases from organisms collected during OE missions, that includes DNA and protein sequence, gene expression, cellular role, protein family, and taxonomic data, is now available. This data is provided to researchers as part of the Comprehensive Microbial Resource, a tool that allows researchers to access all the bacterial genome sequences completed to date.

DEVELOPING NEW SENSORS AND TOOLS

Bringing science to ocean frontiers is one of OE's fundamental challenges. This year, OE logged more than 400 days at sea aboard many different research vessels. These ships ranged from 14-foot patrol boats to 274-foot Class I ocean research vessels. In addition, OE logged almost 1,000 hours underwater (over five weeks) in submersibles, Remotely Operated Vehicles (ROV), Autonomous Underwater Vehicles (AUV) and SCUBA diving.

Pushing the limits of existing technology and expanding the application of current tools puts NOAA on the leading edge of ocean technology. This year, new imaging systems were developed and deployed, new sampling technology was tested for

specimen collection, and a jointly sponsored symposium paired NASA's space explorers with NOAA's ocean explorers to plan advanced technology development and transfer.

The expense of utilization and development of ocean platforms and tools requires a sustained investment in exploration infrastructure. The U.S. Panel on Ocean Exploration envisioned a $75 million/year program with capital costs up to three times that amount. OE's current budget limits NOAA's ability to invest in technology development that would lead to regaining U.S. leadership in this field.

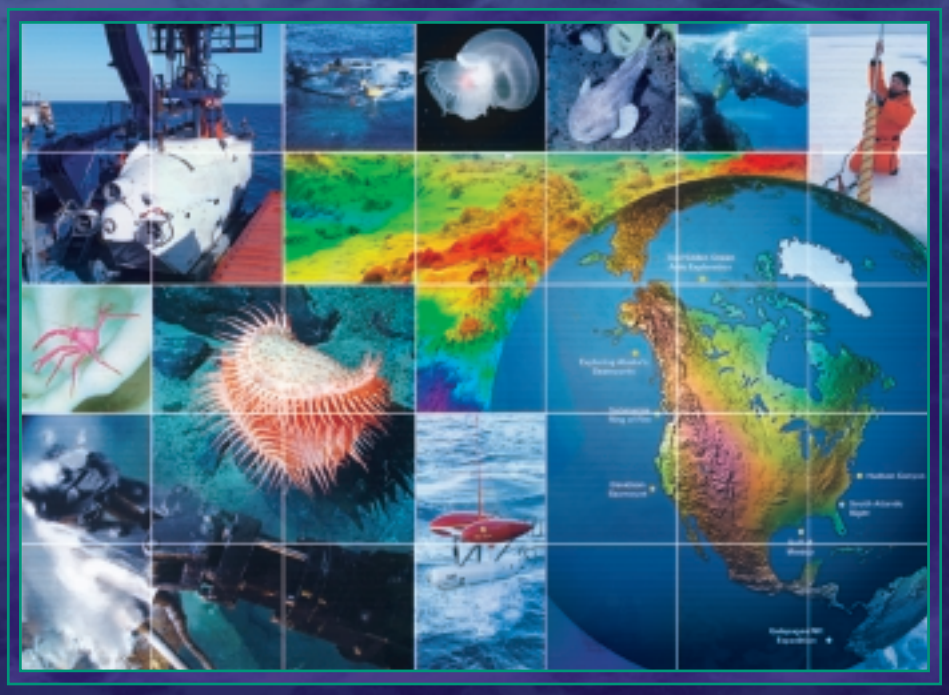
REACHING OUT IN NEW WAYS

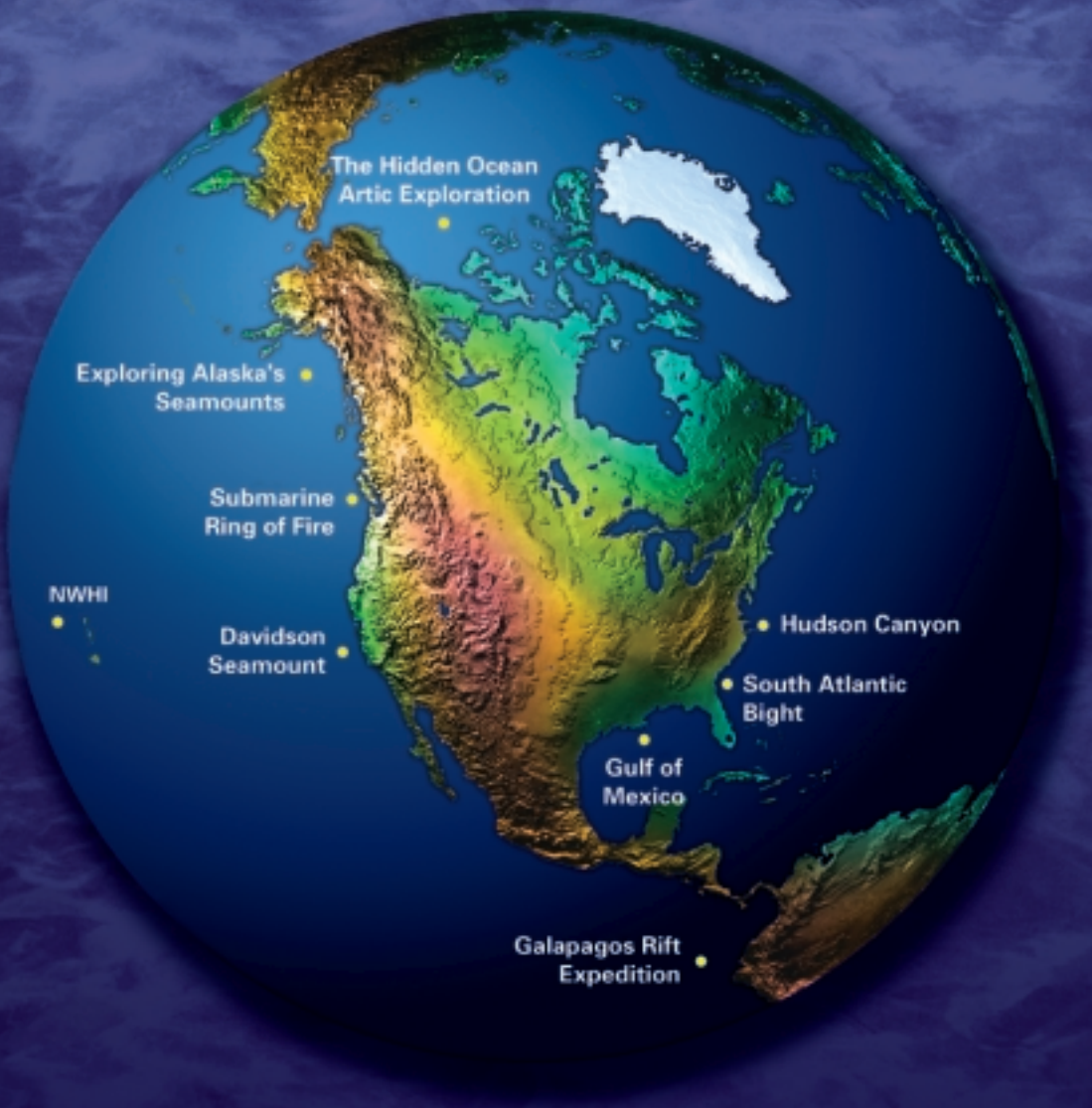
The Ocean Explorer web site (www.oceanexplorer.noaa.gov) is NOAA's primary education and outreach vehicle for exploration. The site grew from an average of 1,400 hits per day in 2001 to an average of over 4,000 hits per day in 2002. The site contains more than 3,500 pages of new information including 71 educational products developed this year. Other products for educators include an entire issue of the National Marine Educators Association's professional journal "Current, The Journal of Marine Education" dedicated to ocean exploration, professional development opportunities for educators, and the completion of a National Education Workshop to guide NOAA ocean exploration education activities.

Other outreach activities included eight regional ocean exploration workshops to collect information on regional exploration needs and priorities and to build new partnerships. NOAA also partnered with outreach collaborators including the Girl Scouts of the USA, the Smithsonian Associates, the National Geographic Society, and many others to enhance the environmental literacy of the American public.

Finally, NOAA hosted Ocean Exploration port events in 2002 in Charleston, South Carolina; New York City, New York; and Kodiak, Alaska. These port events gave the public, including a number of school groups, a chance to see the ships and technology used for exploration and visit with expedition science teams. ■

EXPEDITIONS AND PROJECTS

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Artic Exploration
Exploring Alaska's
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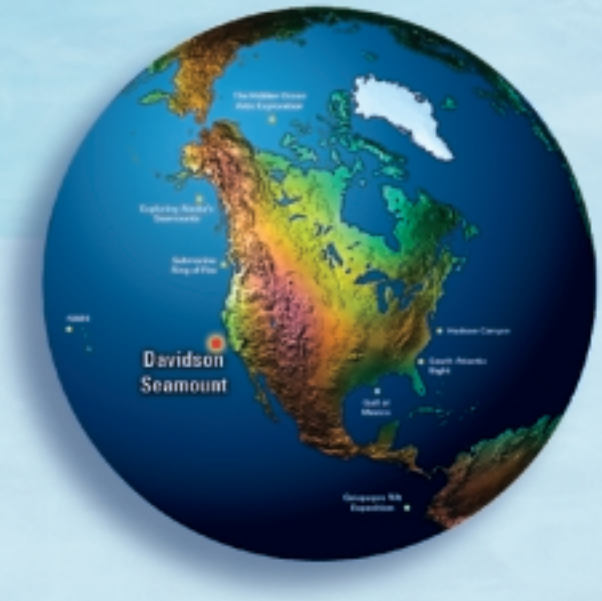
Hudson Canyon
South Atlantic
Bight
Gulf of
Mexico
Galapagos Rift
Expedition

EXPEDITIONS AND PROJECTS

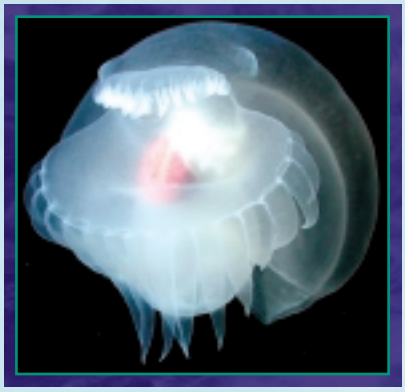
In collaboration with over 100 partners including universities, international, federal, state and tribal science agencies, private research and outreach organizations, civic groups, aquariums and museums, NOAA is expanding knowledge about our oceans. In 2002, NOAA engaged in nine major expeditions and sixteen projects around the world. This map highlights several NOAA missions from the 2002 field season. The following pages detail major expeditions to the Arctic, the Galapagos Rift, the Explorer Ridge, Hudson Canyon, the Gulf of Mexico, the Gulf of Alaska, Davidson Seamount, the South Atlantic Bight, and the Northwestern Hawaiian Islands.

Project descriptions articulate NOAA activities in ocean exploration smaller in scope than major expeditions, or where the NOAA Ocean Exploration component of work, accomplished in partnership with others, consisted of a small portion of the total effort.

EXPLORATION AT DAVIDSON SEAMOUNT



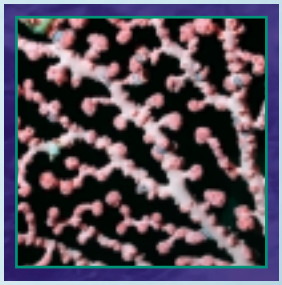
The Davidson Seamount is an intriguing geologic feature, first mapped as a "sea mountain" in 1933. The seamount is an inactive volcano roughly as tall as the Sierra Mountains (2,300 m) and as wide as Monterey Bay (40 km), yet its summit is far below the ocean surface (1,300 m). This geologic feature is so impressive that it was the first to be called a "seamount" and is named after George Davidson, a marine scientist who's greatest work included making maps of the Pacific in the 1850's. Davidson was responsible for identifying the first accurate latitude and longitude positions of prominent points along the west coast and chose the sites for many of today's west coast lighthouses. The Davidson Seamount is located 120 km southwest of Monterey, California and despite the site's proximity to California's central coast, it has been subject to only a few brief scientific investigations. These early investigations provided scientists with glimpses of an area that appeared to be fascinating and unique, but too remote for systematic investigation. Today, technology allows us to visit and document the habitats and species on this remarkable submarine territory.



In May 2002, a team of NOAA, Monterey Bay Aquarium Research Institute (MBARI), Moss Landing Marine Laboratory and Monterey Bay Aquarium scientists and explorers spent eight days aboard MBARI's R/V *Western Flyer* exploring Davidson Seamount. Other team members included resource managers from the nearby Monterey Bay National Marine Sanctuary. MBARI's ROV *Tiburon* was used to make six dives to the seamount, for a total of 72 hours of bottom time. *Tiburon* was equipped with tools for sample collection, high definition imaging of the seamount environment, and sensors to measure environmental parameters.

The mission of the Davidson Seamount Expedition was to more fully characterize the geological and biological aspects of the seamount and surrounding environment. Scientists documented new and rare species, collected samples, and described the unusual marine environment.

In geological terms, Davidson Seamount is young, having only celebrated it's 12 millionth birthday. Despite its youth, Davidson Seamount is host to remarkable biological communities, including large, dense patches of sponges and coral forests that appear to be over 100 years old, with individuals commonly reaching more than three meters in height. Rare species, such as the black-footed albatross and the federally listed endangered sperm whale have been sighted at the seamount.



The tremendous biodiversity of seamounts was confirmed by dives at Davidson. Assemblages of fish and invertebrates were surveyed by *Tiburon* through a quantitative video transect. This survey allowed

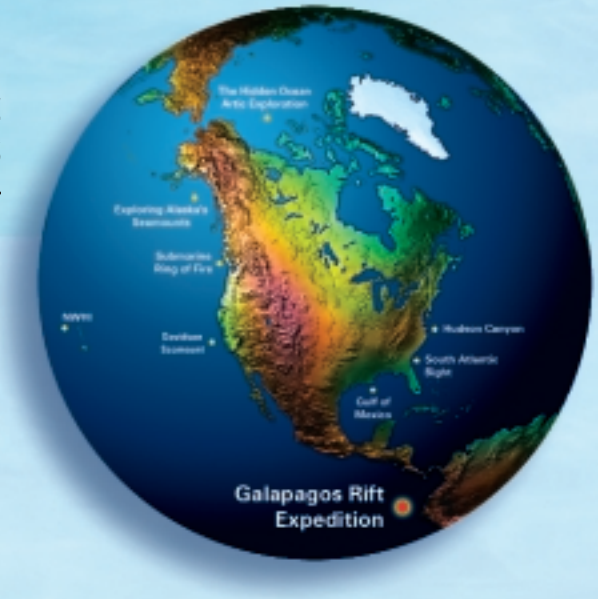
rapid and detailed observations of benthic invertebrates, bottom fishes, and their habitats. The environments explored during this expedition are difficult to sample with traditional techniques such as bottom trawls and grabs. Comprehensive assessments and complete identification of fast moving or small animals from ROV videos were difficult, and in some cases, impossible. Since visual surveys may miss organisms that are cryptically colored, occupying hidden microhabitats, or avoiding camera and lighting systems, surveys were complemented with baited traps to identify those fishes and invertebrates that are attracted to bait but are not often seen by the ROV. Video collected during the expedition is expanding on MBARI's previous video surveys of bottom communities in the region.

The unusual marine environment on Davidson Seamount includes volcanic rocks. When this undersea volcano erupted, its lavas were highly viscous and formed short, thick flows and steep-sided knobby structures at hydrothermal vents. The high viscosity of these lavas also likely inhibited the loss of gas bubbles, making the eruptions more explosive. When the seamount was being formed, erupting lavas contained coarsely crystallized fragments and rare rocks from deep inside the earth's mantle.

A potentially new species was found and four rare species of fish were sighted on the seamount. More than 100 rock and 24 core samples were taken during the expedition and are giving scientists a new understanding of the geologic processes that form seamounts.

As the Monterey Bay National Marine Sanctuary Management Plan is being reviewed, one option is to include the Davidson Seamount within its boundaries. Resource managers and decision makers are using the findings from this expedition to help address the conservation and protection measures of the management plan. ■

RETURNING TO THE GALÁPAGOS RIFT: CELEBRATING THE 25TH ANNIVERSARY OF THE DISCOVERY OF LIFE AT HYDROTHERMAL VENTS



The discovery of deep sea hydrothermal vents and associated biological communities on the Galápagos Rift in 1977 profoundly and permanently changed our view of life on earth. Revolutionizing our understanding of the requirements of life in the ocean, the discovery of chemosynthetic life thriving in what was considered the most inhospitable environment on earth is often noted as one of the most remarkable scientific discoveries of the last century. The discovery has allowed biologists, chemists, and geologists to better understand the complex interactions between hydrothermal, magmatic, and chemical processes at mid-ocean ridges.

The Galápagos Rift is an area where the seafloor is formed in a rift valley by continent-sized geologic plates that slowly move apart. As the plates move, magma from deep inside the Earth is pushed upward and is met by the pressure of a mile and a half of the Pacific Ocean bearing down upon it. This dynamic interchange between the earth and ocean creates an environment of extreme heat, pressure, and geologic, volcanic and chemical activity. If you can imagine the inside of a huge furnace at the bottom of the ocean, filled with toxic chemicals and the fury of volcanic heat, then you can begin to imagine the environment of hydrothermal vents. This environment is home to strange seafloor formations, and bizarre and undocumented forms of life. Superheated water surges out of the ocean floor, bringing with it a soup of microbial life that flourishes in this extreme environment.

In May-June 2002, NOAA joined with the Woods Hole Oceanographic Institution (WHOI) and a coordinated team of scientists for a return to the Galápagos Rift. The underlying mission for this return expedition was to reexamine vents in the ocean floor, where underwater hot springs release shimmering, mineral-rich fluids into the cold, dark depths, providing an integrated foundation for studies along the Galápagos Rift. Like the discovery made 25 years earlier, these vents were found to be brimming with extraordinary, unexpected life.

The Galápagos Rift expedition resulted in major discoveries at the site of the famous Rose Garden hydrothermal vent. The Rose Garden is one of the sites along the Rift where, 25 years ago, hydrothermal vents were first discovered and where chemosynthetic organisms were first seen. However, observations during the cruise strongly supported the possibility that the Rose Garden no longer exists. The vent field was covered by a lava flow, probably occurring within the past ten years. Although several dives were dedicated to finding the Rose Garden site, there appeared to be no trace of it. All of the Rose Garden vent fauna have apparently been obliterated. There was also no evidence of the many *Alvin* dive weights dropped in the vicinity of the Rose Garden vent over the past quarter century.

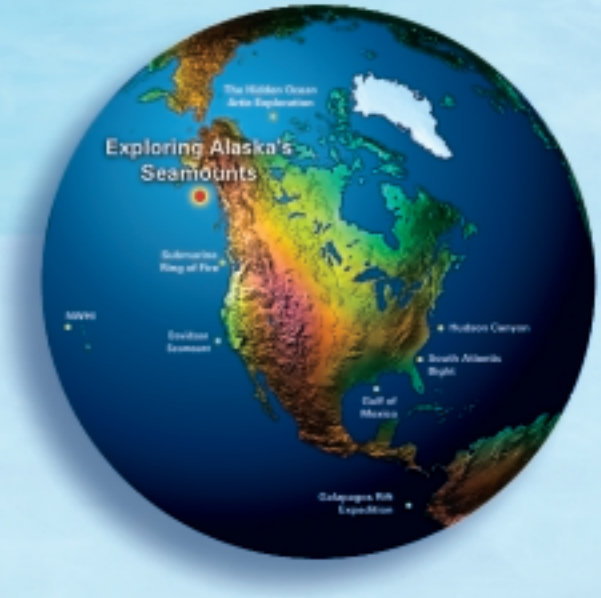
Throughout the expedition, a synergistic array of deep-ocean vehicles was used to collect data. *Alvin* and a new digital towed camera made seafloor observations, acquired digital imagery, and collected samples. The autonomous vehicle ABE (Autonomous Benthic Explorer) acquired meter scale bathymetry, near-bottom magnetics, and bottom water properties in search of new active hydrothermal vents. Finally, water column profiles were taken using a CTD/rosette to explore for temperature plumes. A total of nine Alvin dives, seven ABE dives, five camera tows and six CTD casts were conducted.

As a primary tool for exploration in the area, and a product for future exploration and science, a new meter scale resolution map of the Galápagos Rift was created with a multibeam sonar on ABE. Together, 1,029 square nautical miles were mapped.

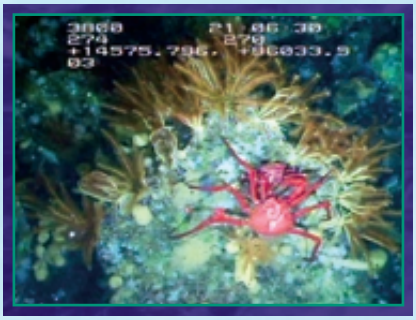
The study of hydrothermal vents and animals continues to yield significant new discoveries. One example is a seafloor microbial habitat where large quantities of microorganisms live in extreme conditions of heat and chemistry. These microorganisms could potentially be used in biotechnology and pharmaceutical applications.

One of the most significant findings made during this mission was the first-ever discovery of sponges at hydrothermal vents. These sponges, never before seen in association with vent ecosystems, seem to live in an unusual symbiotic relationship with vent resident snails. More information about this discovery will be available soon, as mission scientists are preparing journal publications and presentations. ■

EXPLORING ALASKA'S SEAMOUNTS



The cold, nutrient-rich waters of the Gulf of Alaska (GOA) support a diverse ecosystem that includes numerous species of fish and shellfish, as well as many marine mammals and large colonies of birds. Due to the high productivity of the region, large-scale fishing for several commercially important fisheries such as crab, shrimp, pollock, salmon, and halibut occur in the GOA. This geologically active region is also home to some of the largest glaciers on Earth and was the location of the second largest earthquake and resulting tsunami in recorded history. The geologic activity in the GOA has resulted in several volcanic seamount chains that have intrigued scientists from around the world. These deep sea volcanoes contribute to the biological richness of the GOA and were the focus of NOAA's 2002 Exploring Alaska's Seamounts Expedition.



In June 2002, NOAA led an interdisciplinary team of scientists who spent 24 days aboard the Woods Hole Oceanographic Institution's research vessel Atlantis and used the manned submersible *Alvin* to explore and map five previously unexplored volcanic seamounts in the GOA. Due to their geographic isolation, seamounts are known to support unique ecosystems. Most seamounts in the GOA have never been explored scientifically so there was great potential for the discovery of one of a kind and endemic species during this expedition.

The major objectives of this NOAA expedition were to characterize the unique biota and habitats of the seamounts and to determine how they were formed. *Alvin* was used at each seamount to collect samples and to develop a photographic inventory of benthic macrofauna. Depth transects were conducted with the *Alvin* to examine distribution, habitat utilization, and community structure of seamount organisms. A full-coverage swath bathymetric map of each seamount was produced to search for tectonic and volcanic structures, and rock exposures were sampled for age, duration, composition, and distribution of volcanic eruptions and for microbiological studies. Reef-building deep sea corals and sclerosponges were collected to determine their age and their potential for providing information about climate-ecosystem variability in the GOA.

The genetic structure of deep sea gorgonian corals was examined to determine whether seamount populations are genetically isolated. The reproductive biology of some deep sea coral samples was also studied. Species distribution and habitat utilization

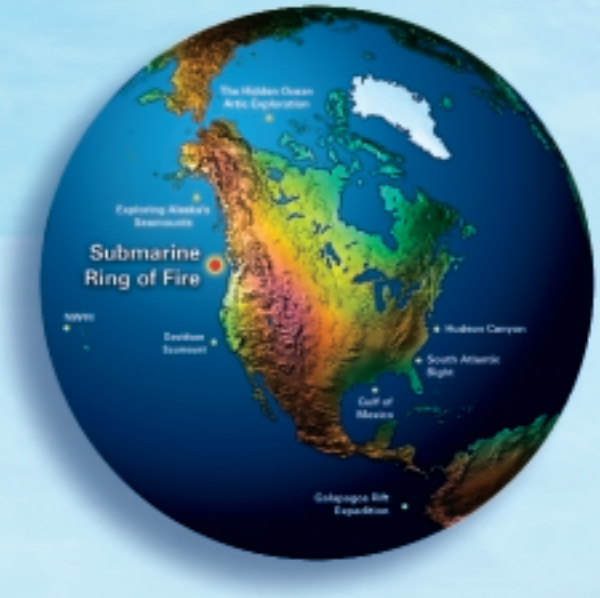
of deep sea crabs was examined and live samples were collected to determine biological characteristics such as species, sex, and reproductive condition. A 'gentler' manipulator claw was developed and tested on the *Alvin*, which aided in the collection of live crabs. Observations were made at various depth ranges where particular crab species were most abundant to document reproductive or aggregative behaviors and interactions with other species.

During the expedition, scientists discovered juvenile king crab habitat and found commensal amphipods on two crabs at depths deeper than previously recorded. Eight different species of deep sea crabs were collected, as were 15 to 20 different coral species, including several bamboo corals not previously known to the region. The known distribution of several families of deep sea corals was also expanded through the findings of this expedition.

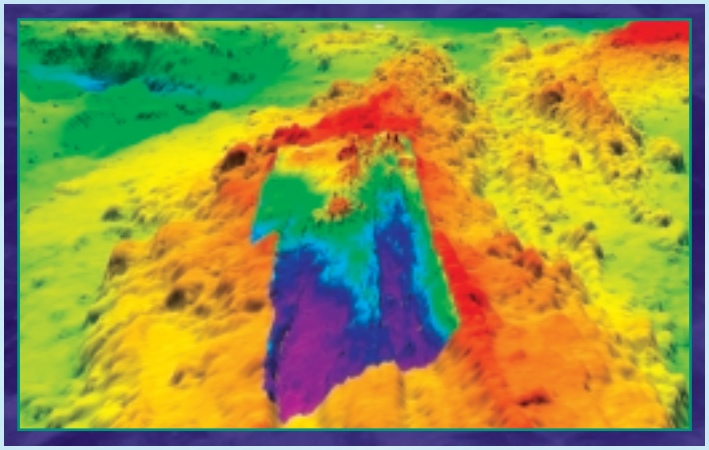
Through 13 successful *Alvin* dives, more than 160 hours of video footage was collected. This data demonstrated extraordinary biological diversity, and showed that original volcanic rocks remain well exposed on GOA seamounts with pillow basalts, lava conduits, and columnar jointing standing out in amazing detail. Over 700 square nautical miles of high-resolution multibeam bathymetric maps were made of the five GOA seamounts, and a sixth seamount that had been mapped on a previous expedition was explored and sampled.

Not only were the seamounts mapped during this expedition, but their importance as essential habitat for many species of crabs and fishes, and other deep-water organisms, was extensively documented as well. The last seamount explored during the GOA expedition was Warwick Seamount, which was so biologically rich and unique that it was referred to as 'The Garden of Eden.' Vast forests of hot pink paragorgia corals teeming with life were discovered, as were many other species of corals, crabs, fishes, brittle stars, and other invertebrates. Enormous vase and elephant sponges, some as tall as the *Alvin,* were also discovered. This thriving community exists on a seamount that, at approximately seven million years old, is believed to be the youngest of those explored. ■

THE SUBMARINE RING OF FIRE EXPEDITION TO EXPLORER RIDGE



Submarine volcanic ridges lying as close as 60 nautical miles off the northwest U. S. and Canada are part of the mid-ocean ridge system of seafloor spreading centers encircling the entire planet. The mid-ocean ridge is the beginning of a giant conveyor belt. Here submarine volcanoes create new ocean floor and weld it to giant moving plates that are ultimately recycled at island arcs and deep-ocean trenches. Explorer Ridge, a largely unexplored segment of the Pacific basin mid-ocean



ridge system in the "Submarine Ring of Fire," is about 160 km (100 nautical miles) south of Vancouver Island. This area is home to submarine volcanoes, earthquakes and hydrothermal vents. It is a geologically dynamic place where new earth boils up in submarine eruptions and bizarre life thrives in sunless ecosystems. Explorer Ridge is located a mile-and-a-half underwater where strong Pacific weather systems and fast ocean currents make exploration difficult, yet it is also the site of exciting new ocean discoveries made last summer.

An interdisciplinary exploration team of NOAA and U.S. and Canadian university scientists explored the ridge in the summer of 2002 as part of a new "Submarine Ring of Fire Expedition." Using an array of new mapping and imaging tools, the seafloor has been brought to the surface for examination, discussion and analysis. The expedition team collected a remarkable amount of new information about the northeast Pacific "Submarine Ring of Fire," and these data will be disseminated to the broader scientific community for collective analyses and discovery in the months and years ahead.

This expedition was successful in being the first ever to use a multibeam mapping unit aboard the *Autonomous Benthic Explorer (ABE)*, providing scientists mapping data with detail never seen before. An EM-300 multibeam system, mounted on

the University of Washington's R/V *Thomas G. Thompson*, imaged 1,050 square nautical miles. When the highest priority sites were identified on the new map, the Woods Hole Oceanographic Institution's *ABE* was deployed for five square nautical miles of meter scale mapping. The maps will provide generations of scientists with newly available seafloor detail.

ABE was deployed on seven dives and spent 85 hours on the bottom. By pinpointing dive targets identified during the mapping mission, scientists were able to optimize the deployments of the Canadian Scientific Submersible Facility's *ROPOS* ROV. A total of eight *ROPOS* dives encompassing 88 hours of bottom time provided the team significant opportunities to explore the ridge.

An important achievement of this expedition was the deployment of a recently developed high-resolution digital camera system on board the ROV ROPOS. This camera, the first of its kind, captured images with such clarity and detail, that scientists were often able to identify biological and geological features of the site only after reviewing images. At least 30 active vents were discovered, ranging in temperature from 20 degrees C to 311 degrees C. ■