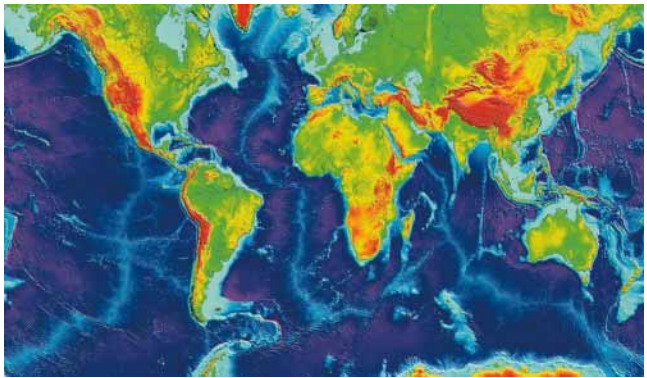




Chris Small

Mid-ocean ridges and other geological highs appear as lighter blue in this chart of Earth topography.

DEEP OCEAN EXPLORATION INSTITUTE

INVESTIGATING EARTH'S DYNAMIC PROCESSES

Earth is a dynamic planet—its surface is in constant motion and continually changing. Driven from deep within the earth, movements of the great tectonic plates are the fundamental driving forces that change the shape of our planet. On geological time scales, these forces tear apart continents and build mountain ranges. On human time scales, they generate earthquakes and volcanic eruptions. Many of the most dynamic processes occur beneath the oceans, yet they can impact human populations in devastating ways.

So to really understand how our planet works, we must look beneath the ocean.

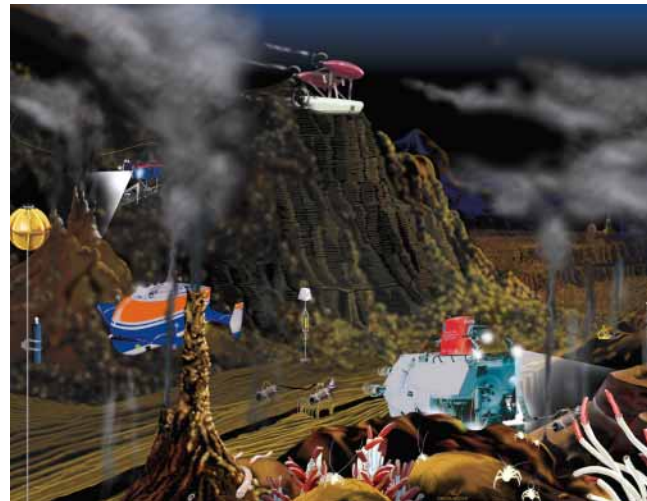
The Deep Ocean Exploration Institute seeks to understand how Earth works. Its goal is to promote interdisciplinary investigations of the planetary processes that shape Earth's surface, regulate the chemistry of its ocean, and impact its inhabitants. Because many of Earth's most dynamic regions are beneath the ocean, promoting development of technology for accessing the seafloor is a key component of the Institute's activities. Through deep ocean exploration, the Institute seeks discoveries that both provide a fuller understanding of the planet we live on and offer substantial benefits to humankind.

Research Themes

Deep Ocean Exploration Institute themes include:

- Exploration of unknown oceanic environments
- Dynamics of Earth's interior
- Creation and destruction of Earth's crust
- Submarine earthquakes and volcanoes
- Giant submarine landslides
- Hydrothermal systems and their biological communities
- Life on and below the seafloor in the "deep biosphere"
- Oil, gas, and mineral resources
- Technology development to provide new windows into the oceans and the planet.

The dominant cross-cutting research theme for 2001 was "Seafloor Observatory Science and Instrumentation." In 2002, Institute scientists are pursuing an additional theme, "Fluid Flow in Geologic Systems." It focuses on how fluid flow and resulting physical and chemical reactions geologically modify the earth, influencing where and how life exists.



E. Paul Oberlander

An artist's rendering depicts a well-instrumented seafloor observatory with several vehicles exploring the terrain.



Craig Dickson

DSV Alvin is hoisted aboard R/V Atlantis following a dive.

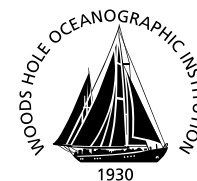
WOODS HOLE OCEANOGRAPHIC INSTITUTION's four Ocean Institutes (Ocean Life, Coastal Ocean, Deep Ocean Exploration, and Ocean and Climate Change) were initiated in 2001 to focus on critical ocean-related issues that have substantial impact on society.

The Ocean Institutes' concurrent mission is to shorten the lag time between acquiring knowledge and making it accessible to decision makers who can use it to save lives, stimulate economic growth, and enhance our quality of life.

The Ocean Institutes identify and sustain interdisciplinary research initiatives to spur advances in ocean science and provide a rich, productive educational environment for future oceanographers. They convene meetings of key scientists and leaders from academia, government, and industry to delve into oceanographic research issues that are relevant to life on our planet.



Cover Photo: Composite deep-sea hydrothermal vent scene shows a "black smoker" erupting very hot, mineral-laden water into the cold, deep-seafloor environment and specialized tubeworms that thrive near vents. (IMAX film by William Reeve and Stephen Low, Stephen Low Productions)



DEEP OCEAN EXPLORATION INSTITUTE

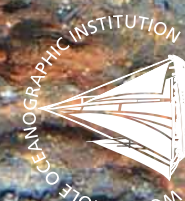
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DEEP OCEAN EXPLORATION INSTITUTE

INVESTIGATING EARTH'S DYNAMIC PROCESSES



Institute Fellows

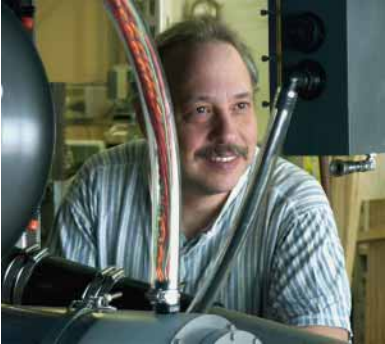
Three Institute Fellows were named in 2001 to pursue scientific research and technological developments that will further our ability to effectively use seafloor observatories to answer key scientific questions. Deep Ocean Exploration Institute Fellows receive two to three months of salary support annually for a three-year term.



Meg Tivey

Meg Tivey (Marine Chemistry and Geochemistry) is drawing on several years' involvement in national observatory efforts at hydrothermal vents to create a cross-departmental, interdisciplinary group of WHOI scientists and engineers to stimulate interchange of ideas and examine potential crossover of approaches and instrumentation for observatories in different marine environments.

Dana Yoerger (Applied Ocean Physics and Engineering) develops deep submergence vehicles that provide access to the deep ocean and seafloor, meshing remotely operated and autonomous underwater vehicle capabilities with the needs of scientists who plan to use seafloor observatories.



Dana Yoerger

Jean Whelan (Marine Chemistry and Geochemistry) is developing chemical sensors to detect and measure the properties of fluids, such as gas and oil, that are naturally venting along the US continental margins.



Jean Whelan



Study of seafloor movements will enhance understanding of earthquakes that can be so devastating on land.

Research Support

The Deep Ocean Exploration Institute supports research and technology projects that emphasize interdisciplinary studies and new approaches consistent with Institute themes. An *ad hoc* panel reviews proposals and makes two-year project awards. In the first two years, awards have gone to investigators from four departments and the Marine Policy center. The research programs include:

- Analysis of the timing and distribution of earthquakes on oceanic transform faults and the implications for observatory design (Jian Lin and Greg Hirth)
- Investigating the geochemical effects of microbial alteration of the oceanic crust (Wolfgang Bach and Katrina Edwards)
- Construction of a sensor for measuring flow rates at hydrothermal vents (Meg Tivey and Al Bradley)
- A pilot study to test a new electromagnetic system to map regions of shallow gas hydrates in the Gulf of Mexico (Rob Evans)
- Examining the factors that govern the distribution and morphology of fluid flow channels in solid, porous media (Peter Kelemen, Jack Whitehead, Mike Braun, and Keith Bradley)
- Design of a high-speed, inexpensive, acoustic communications system for seafloor observatories (Lee Freitag)



Stan Hart (Geology and Geophysics) collects a fresh lava sample from Kilauea volcano in Hawaii.

Educational & Outreach Activities

The Deep Ocean Exploration Institute conducts the following activities to educate the next generation of scientists, and to broadly communicate scientific results in a timely, objective, and effective manner to all segments of society:

Graduate Students and Postdoctoral Investigators

Graduate students and postdoctoral investigators are a vital source of energy and ideas to the Institution. In 2002, the Institute is supporting one graduate student and one Postdoctoral Scholar. Robyn Kelly is a WHOI-MIT Joint Program student conducting geophysical and geochemical studies on subduction zones and the associated volcanic activity. Alexei Milkov is a Postdoctoral Scholar interested in fluid migration and gas hydrates in the submarine environment, and their significance in energy resource estimation, geohazards, and global change.



Geodynamics Seminar students and faculty crowd over slumped blocks of gabbro and penetrating peridotite "fingers" during the 2002 summer field trip to the Isle of Rum, Scotland.

Geodynamics Seminar

With the Education Office, the Institute cosponsors a spring Geodynamics Seminar. Each year, the seminar focuses on a different interdisciplinary research topic, bringing national and international experts to discuss their work with faculty and students. The seminar culminates in a field trip to an area of relevance to the year's topic. The 2002 seminar topic, "Fluid Flow Networks," encompassed fluid flow in different submarine geological environments and its chemical and biological consequences.

"Dive and Discover" Web Site (www.divediscover.whoi.edu)

Just less than two years ago, WHOI scientists and multimedia and graphic artists developed the "Dive and Discover" Web site to bring research expeditions to students and the general public in near real time through the Internet. The Deep Ocean Exploration Institute now coordinates the "Dive and Discover" project that highlights one or two oceanographic expeditions each year.



Oceanographers study volcanic eruptions on land to better understand those beneath the ocean.

Symposia and Workshops

The Deep Ocean Exploration Institute sponsors meetings that bring diverse groups together to share information, define outstanding problems, and develop strategies for future research and technology development. Over the next two years the Institute will sponsor two major workshops:

Seafloor Deformation

Over the last 10 years, new measurement techniques have significantly improved our understanding of processes that shape Earth's continents (for example, deformation caused by earthquakes, magma chamber inflation, landslides, glacial flows). This workshop, to be held in October 2002, will examine how such techniques can be adapted to study deformation on the seafloor—an issue that has implications for seafloor stability, movements on and within Earth, and the generation of tsunamis.

Arctic Ocean Exploration

The Arctic Ocean presents extraordinary challenges for exploration and scientific study, and yet it plays a critical role in many Earth processes, including creation of new seafloor and global climate change.

Investigators from four WHOI departments will convene the Arctic Ocean Exploration workshop, scheduled for fall 2003. Their goals are to identify the most important Arctic scientific issues and the critical enabling technologies for interdisciplinary Arctic research, and to develop strategies for future work.



An Institute workshop will consider the challenges of Arctic Ocean exploration.