The Ocean Observatories Initiative

at the University of Washington

Beyond the sandy beach, beyond the rocky shore lies the mysterious, dangerous, and unexplored world of the deep sea

A complex symphony of ocean phenomena makes our planet liveable: the great currents modulate climate, the waters absorb greenhouse gases, and tiny plants at the surface form the foundation of life for fish, whales, and dolphins. Events in the ocean also create threats: earthquakes, tsunamis, storms.

Our understanding of these phenomena is limited by the traditional tools of ocean science—ships, satellites, and isolated moorings—even though the discoveries made have been numerous, exciting, and valuable. We now know that there are subseafloor life forms associated with deep-sea volcanoes far below the reach of sunlight and thriving on the heat and toxic chemicals issuing from the rocks below the seafloor. We have learned that changes in sea surface temperature in the equatorial Pacific are responsible for the El Niño climate events that trigger floods, droughts, and farming failures on the continents. We have launched studies of the genetics of ocean life and the origins of life on earth. We have discovered vast reservoirs of methane hydrates that may be a new source of energy or a serious threat to global climate if released into the atmosphere.

Yet for all the excitement and value and wonder of these and many other discoveries, they are only a few bars, a few notes within the whole symphony. We have reached the point where the questions we can ask cannot be answered with the tools at hand. It is time to add new approaches.

For years oceanographers have craved the ability to be in the oceans all the time, no matter the season, no matter the weather, no matter the life span of batteries in instruments that collect data and cannot be retrieved until the next year, the next field season. It is impractical, impossible to put humans in these extreme environments for long periods of time. But what about tele-presence, a system that could continuously collect information and respond to events—the passage of blue whales, an undersea landslide, an increase in the carbon dioxide, an earthquake in the ocean crust that releases a massive "cloud" of chemosynthetic microbes. What about capitalizing on the recent leaps forward in Internet technology, in our ability to provide continuous electrical power to our proxies in the deep sea—instruments, sensors, robots—by creating an underwater observatory?

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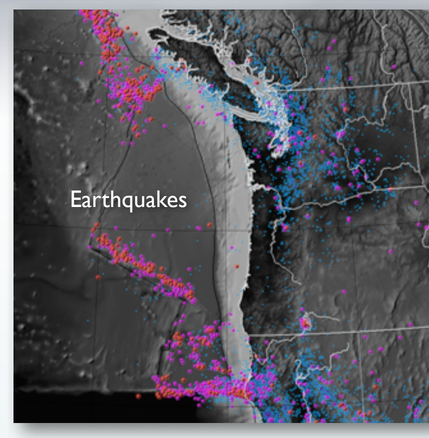
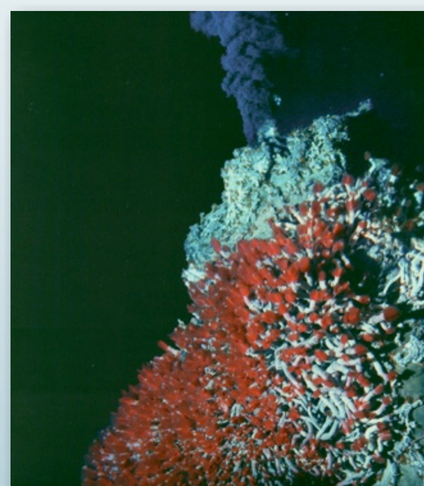


Earthquakes (noted in pink) occur frequently within the seafloor of the northeast Pacific Ocean and are associated primarily with the interactions of tectonic plates. Potentially devastating earthquakes could occur on the northwest coast of the North American continent.



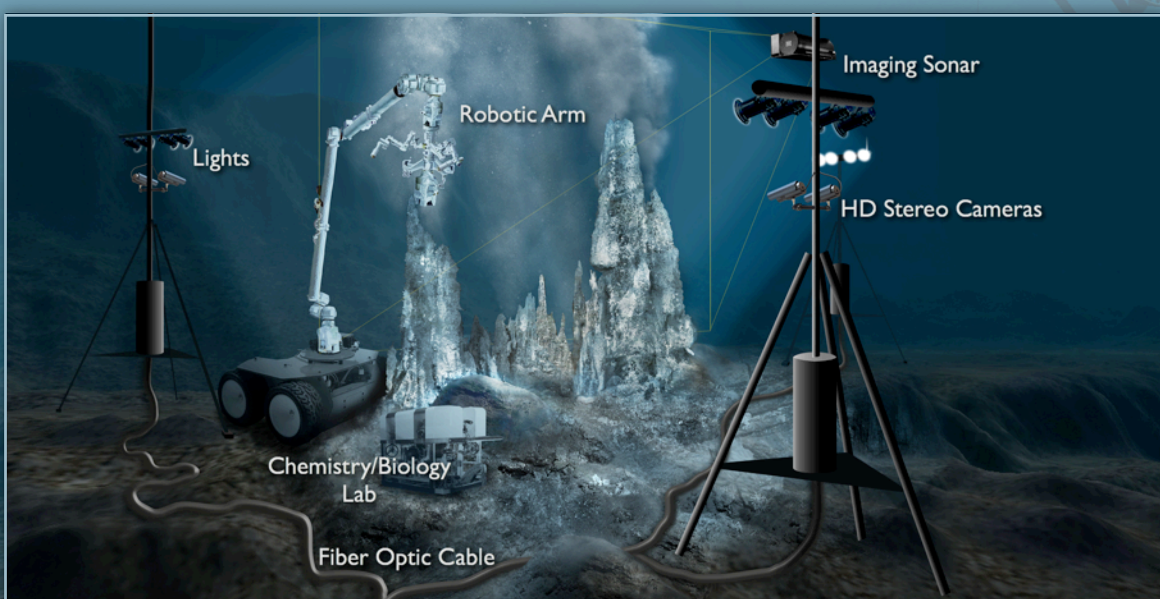
Nearly 200 miles off the Washington coast and 7000 feet deep, tubeworms with bright red plumes cling to a structure known as a black smoker chimney. The "smoke" forms when 600˚F fluid from a hydrothermal vent at the seafloor surges into 36˚F seawater and dissolved metals crystallize.

The U.S. regional ocean observatory m(modeled after the NEPTUNE system developed by the University of Washington and partners) and the complementary NEPTUNE Canada program will both be associated with the Juan de Fuca tectonic plate, one of a dozen or so major plates that make up the surface of the earth. Fiber-optic cables will run from shore landings to experimental sites (orange dots) located in areas of highest scientific interest. The observatories will operate 24/7/365.

This vision is on the threshold of becoming a reality thanks to the Ocean Observatories Initiative of the U.S. National Science Foundation and overseen by Joint Oceanographic Institutions. The $330 million Initiative will create new research and education opportunities that will dramatically accelerate understanding of the ocean and seafloor. The University of Washington is leading the effort to build one component of this facility: a regional ocean observatory off the coasts of Oregon and Washington.

A network of fiber-optic cables will provide power and communications to thousands of instruments and sensors throughout the seafloor and overlying ocean. Associated with the Juan de Fuca tectonic plate where a suite of global phenomena is represented, the network will have a lifetime of 25 years. The key to success will be interactivity; the key to interactivity is high-bandwidth communications carrying commands from land to sea and live video and other data from ocean to shore.

The information from this little-understood world of the deep sea will be distributed worldwide and in near real time via the Internet. Students, educators, decision makers, and the general public will be able to access the data and join scientists on their journeys of exploration and discovery. The vast amounts of information sent ashore will allow unprecedented and comprehensive long-term studies as well as insights into the complex relationships among ocean phenomena. The full score of the symphony will be revealed. The world will be able to listen.



Conceptual representation of a seafloor laboratory of the future on the regional ocean observatory.

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