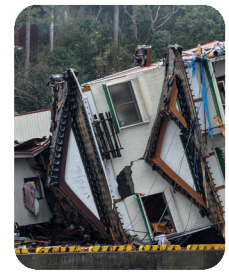


# THE IMPACT OF SCIENTIFIC OCEAN DRILLING

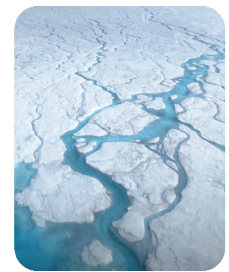
Scientific ocean drilling advances understanding of how the Earth system has operated in the past by providing the means to access archives of sediment and rock that lie deep beneath the seafloor and by instrumenting borehole observatories to monitor the subseafloor and conduct experiments. Scientific ocean drilling has an impact on a wide range of issues of broad interest to society, exemplified here.



## Advancing earthquake studies

Studies of **earthquake generation** at subduction zones are hampered by a lack of in situ samples and measurements from active plate boundary faults. In a rapid response to the magnitude 9.1 Tōhoku-oki earthquake in 2011, scientific ocean

drilling penetrated the fault zone that ruptured during the earthquake and measured the frictional heating generated by it. Such data provide important constraints on the forces that influence earthquake hazards. Only by deploying a drilling platform that can penetrate into deep fault zones and by implementing sophisticated downhole technologies under challenging borehole conditions can scientists collect and record such important in situ data.



## Improving climate models

Studies of cores recovered globally through scientific ocean drilling have allowed reconstruction of the past 180 million years of Earth's climate history. Continued advances in drilling technology and analytical techniques and recovery of cores from

carefully selected sites will increase the temporal and spatial resolution of assembled paleoclimate and paleoceanographic records. These records are needed to **ground truth**, and thus improve, global climate forecasts. They will also be used to test more refined hypotheses about the rates of change in temperature and sea levels as our climate warms and to pinpoint tipping points in the climate system.



## Discovering the deep biosphere

Through new approaches to drilling and coring that allow collection of pristine samples, scientific ocean drilling has contributed to advancing understanding of the quantity, diversity, and global significance of life in subseafloor sediments and

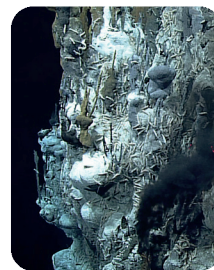
rocks. This deep biosphere may be the largest ecosystem on Earth, driving subseafloor geochemical processes, the global carbon cycle, and the alteration of sediments and rocks. Deep biosphere studies also seek to reveal how life can survive in hot, nutrient-deprived, high-pressure environments. These studies will lead to a better understanding of the **limits of life** on Earth and the potential for life elsewhere in the **universe**. Simultaneously, discoveries of new species within the subseafloor biosphere may offer opportunities to develop novel pharmaceuticals.



## Assessing future ocean health

Seafloor sediments preserve information about the responses of ocean biological activity to natural cycles and catastrophic perturbations over geologic time. Shifts in biogeochemical cycles modulate the recovery of life following mass extinctions and

episodes of rapid climate change. Cores recovered by scientific ocean drilling will provide baseline information about the abundance and diversity of microscopic organisms living in the pre-Anthropocene ocean. Comparing these data to contemporary responses of the ocean-biosphere system to changes in greenhouse gas emissions, nutrient levels, weathering, and the exploitation of marine organisms will contribute to projections of the **ocean's future health** and habitability.



## Investigating the deep Earth

Geochemical exchanges between the solid Earth, ocean, atmosphere, and biosphere have influenced Earth's surface environment throughout its history. Emerging drilling, coring, logging, and monitoring technologies, will permit investigation of the

interconnected magmatic, tectonic, hydrothermal, and microbial processes in seafloor spreading and **oceanic lithosphere** evolution that are responsible for the unique characteristics of Earth's surface.