



# Exploring Earth

## BY SCIENTIFIC OCEAN DRILLING



### What is Scientific Ocean Drilling?

Scientific ocean drilling addresses fundamental questions about the interconnected processes that characterize the complex Earth system and shape our planet's future. It uses sophisticated technologies to collect sediment, rock, microbial, and fluid samples from beneath the seafloor and deploys state-of-the-art measurement devices and long-term observatories within subseafloor boreholes. These activities supply critical details about geologic processes as well as natural hazards that pose risks to society. Analyses of samples recovered by scientific ocean drilling establish the geologic context for interpreting human impact on climate and the environment, providing the data needed to improve the accuracy of computer models that predict the pace of rising sea levels and the melting of polar and glacial ice. Sampling and analyses also offer glimpses of the types of microbial life that might exist elsewhere in our solar system and beyond.

### About the 2050 Science Framework

The *2050 Science Framework* guides scientists on important research frontiers that scientific ocean drilling should pursue. It focuses on the many ways in which scientific ocean drilling will increase understanding of the fundamental connections among Earth system components while addressing a range of natural and human-caused environmental challenges facing society.

### Who We Are

We are an international scientific community pioneering global-scale interdisciplinary research below the seafloor of the world ocean.

#### WE RESEARCH

the processes that connect the solid Earth, ocean, life, climate, and society.

#### WE EXPLORE

the interconnected Earth in places that can only be accessed and understood through scientific ocean drilling.

#### WE TRAVERSE TIME

to reveal the many interactions that shaped Earth's geologic past to illuminate our future.

#### WE COMMUNICATE

knowledge gained through scientific ocean drilling to the global community.

### Countries Involved in the Development of the 2050 Science Framework

Australia, Austria, Brazil, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, South Korea, Spain, Sweden, Switzerland, United Kingdom, United States of America

### Full Report

Koppers, A.A.P., and R. Coggon, eds. 2020. *Exploring Earth by Scientific Ocean Drilling: 2050 Science Framework*. 124 pp., <https://doi.org/10.6075/J0W66J9H>.

# The 2050 Science Framework Structure



## STRATEGIC OBJECTIVES

The *Strategic Objectives* comprise broad Earth science research areas that form the foundation of scientific ocean drilling through 2050. Each objective focuses on understanding the interconnections within the Earth system.

**Habitability and Life on Earth.** Defining the conditions for, and the role of, life in the marine realm.

**The Oceanic Life Cycle of Tectonic Plates.** Investigating the genesis, aging, motion, and destruction of oceanic plates.

**Earth's Climate System.** Unraveling ice sheet history, sea level changes, and ocean-atmosphere interactions.

**Feedbacks in the Earth System.** Constraining the processes that regulate or destabilize the Earth system.

**Tipping Points in Earth's History.** Using Earth's geological past to illuminate future environmental change.

**Global Cycles of Energy and Matter.** Determining the role, mechanisms, and magnitude of Earth system cycles.

**Natural Hazards Impacting Society.** Understanding natural hazards in the marine environment.



## ENABLING ELEMENTS

*Enabling Elements* advance the aims of scientific ocean drilling through numerous and varied broader impacts and outreach initiatives, partnerships and collaborations with organizations that have complementary goals, technology development, and big data analytics.



## FLAGSHIP INITIATIVES

The *Flagship Initiatives* comprise long-term, multidisciplinary research endeavors that aim to test scientific paradigms and hypotheses that inform issues of particular relevance or interest to society. They typically combine research goals from multiple Strategic Objectives. Their implementation will be shaped by proposals from the scientific community that develop coordinated strategies that include long-term planning, technology development, and innovative applications of existing and new scientific ocean drilling data products.

**Ground Truthing Future Climate Change.** By collecting the robust data required for reconstructing global climate evolution over extended geologic time periods, scientific ocean drilling will provide information that is critical for improving climate model performance.

**Probing the Deep Earth.** By penetrating deep within oceanic crust, scientific ocean drilling will lead to a better understanding of Earth's formation and evolution and the connections between tectonics, earthquake and volcanic hazards, climate, and our planet's habitability.

**Assessing Earthquake and Tsunami Hazards.** By acquiring samples and deploying instruments in offshore and nearshore fault zones, scientific ocean drilling will enable more reliable assessments of the risks posed by major earthquakes and tsunamis and will facilitate improved hazard preparedness and response.

**Diagnosing Ocean Health.** By retrieving sedimentary records that preserve key information about past responses of biological activity to natural cycles and catastrophic events, scientific ocean drilling will enable a more informed assessment of the expected rates, duration, and magnitudes of future ocean health deterioration.

**Exploring Life and Its Origins.** Scientific ocean drilling and monitoring in borehole observatories will advance research into the distribution and limits of deep microbial life, novel microbes and their biotechnological applications, the emergence and evolution of life on Earth, and the possibility of life on other worlds.

