

Goals of Future Scientific Ocean Drilling

Although the U.S. no longer operates the *JOIDES Resolution*, its workhorse drilling vessel for the past 40 years, ocean drilling using mission specific platforms must remain a national priority. The oceans cover more than 70% of Earth's surface, yet the seafloor remains one of the least explored regions of the planet. The National Academies of Sciences, Engineering and Medicine have concluded that ***“The need to obtain vital records from the seafloor in carefully selected locations is ongoing and urgent”*** [NASEM 2024. Pub no. 27414]. Scientific ocean drilling is not simply a research program—it is national infrastructure for understanding Earth systems, assessing hazards, discovering resources, training scientists and engineers, and maintaining U.S. leadership in marine science and technology.

Identified community goals for the next era of U.S. scientific ocean drilling include

- **Anticipating geohazards.** Extend records of earthquakes, tsunamis, volcanic eruptions, and submarine landslides from decades to millennia and install observatories in active subduction zones such as Cascadia and Alaska to monitor fault stress and fault behavior, which will improve numerical models and strengthen coastal and infrastructure risk assessment.
- **Ground-truthing climate change.** Recover high-resolution sediment records from past warm periods (Pliocene, Miocene, Eocene) to test, improve, and refine the models used to project future warming, sea level rise, ocean acidification, and changes in ocean circulation.
- **Detecting tipping points.** Identify past thresholds—ice sheet collapse, ocean anoxia, and abrupt shifts in currents such as the Gulf Stream and AMOC (Atlantic Meridional Overturning Circulation)—that warn of large and potentially irreversible change, to improve understanding of the climatic conditions that define mode switches.
- **Constraining ice sheets and sea level.** Collect drill cores from the margins of Antarctica and Greenland to reduce the single largest uncertainty in projections of future sea level rise.
- **Understanding the carbon cycle and storage.** Document how carbon has cycled among the ocean, atmosphere, and seafloor over millions of years, including the poorly constrained role that subsurface seawater circulation plays in the carbon cycle, and evaluate the carbon dioxide storage potential of oceanic sediments and basalts.
- **Diagnosing ocean health.** Reconstruct the history of ocean acidification, deoxygenation, and ecosystem stress to forecast the future health and habitability of the global ocean, with potential to elucidate the resilience of marine fisheries and ecosystems to rapid global change, filling in geographic areas and paleoenvironments with limited records.
- **Exploring life beneath the seafloor.** Refine our understanding of the limits of life, how biological communities interact and move, and their distribution in space and time. Use the ongoing technological boom and development of new genomic tools that require freshly preserved cores to learn how deep seafloor microbes impact the global carbon, nitrogen, sulfur, and iron cycles, with applications in biotechnology, bioremediation, and medicine.
- **Probing the deep Earth.** Drill deeper into the ocean crust and toward the mantle to constrain our understanding of the formation and evolution of ocean crust and upper mantle and the exchange of heat, fluids, and matter between the solid Earth and the ocean, which also impacts the production of mineral resources.
- **Connecting planets and resources.** Study sediments, ocean crust, and impact craters as natural laboratories for the habitability of life on Earth and the evolution of life on other rocky or icy worlds, and support science-based assessment of seafloor minerals critical to national supply chains.
- **Sustaining people, data, and access.** Train the next generation of scientists, broaden public outreach, and maximize the scientific value of existing cores, boreholes, and data.