

## Exploring planetary habitability beneath the oceans

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Since Ocean Drilling Program (ODP) Leg 201 in 2002 off Peru and eastern equatorial Pacific, numerous geochemists and microbiologists have participated in multiple expeditions of scientific ocean drilling to explore seafloor life and the deep biosphere beneath the oceans. The discovery of diverse microbial life in marine sediments and oceanic crusts worldwide points to a notion that seafloor microbial ecosystems may have uniquely co-evolved with Earth's dynamics and this inevitable interrelationship has shaped environments for more than 3 billion years. Expanding our knowledge of the comprehensive ocean-Earth-life system through scientific ocean drilling inspires new insights into the essence of "planetary habitability"—down to the Earth's upper mantle, which with today's drilling technology provides the deepest yet accessible limit. The deep ocean offers windows into thick piles of ocean sediment and the Earth's interior that has vast potentials for the development of sustainable ocean-Earth-life system in the past but also into the future, yet there is still a large insufficiency in our knowledge of the habitability extent of our own planet. Such explorations towards deep frontiers will lead us to an understanding of how and why life emerged on our planet, as well as an estimation (prediction) of the possible trajectories of life on Earth, and finally, will provide hints as to whether life persists in the other celestial bodies, and which ones are the most likely to be habitable and even inhabited.

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