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THEME 4. Microbial Life Deep Beneath the Seafloor



Sampling aboard Expedition 329,
South Pacific Gyre. Photo credit:
Fumio Inagaki, JAMSTEC



During the initial phases of scientific ocean drilling 50 years ago, it was tacitly assumed that the deep subsurface was devoid of life, an environment where only buried fossils were preserved as remnants of past surface biosphere activity. The subsurface, characterized by harsh conditions, was seen as too old and too dark for any known life forms to flourish. Over the last two decades, this view has been fully reversed as scientific ocean drilling has enabled the discovery of a rich, deep seafloor biosphere.

Since the first deep biosphere-dedicated expedition—Ocean Drilling Program Leg 201 in 2002 aboard *JOIDES Resolution* off Peru and the eastern equatorial Pacific—many microbiologists and biogeochemists, including new generations of graduate students and early career scientists, have participated in and spearheaded deep biosphere scientific ocean drilling expeditions. Their work has vastly expanded our knowledge of this least-explored frontier deep beneath the ocean floor. Accumulating evidence and new discoveries from offshore expeditions and laboratory-based analyses show that a wide array of microorganisms indeed thrive in the sediment and underlying oceanic crustal habitats, even in energetically and geophysically challenging environments. However, key questions related to the origins, limits, evolution, and functionality of deep seafloor life and its biosphere remain unanswered, requiring enhanced systematic and transdisciplinary explorations, big data integration analyses, and new imaginative experimentation through future scientific ocean drilling projects and post-drilling investigations.

This special issue of *Oceanography* reviews and highlights several representative achievements of deep biosphere research enabled through scientific ocean drilling and discusses the fundamentally significant issues and mysteries that remain to be solved.

– Fumio Inagaki