

Exploration of the Deep Coalbed Biosphere off Shimokita (IODP Expedition 337): Overview and Perspectives

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Among the least characterized Earth systems that can be addressed by scientific ocean drilling are deeply buried hydrocarbon reservoirs in sediments along continental margins. In particular, the role of seafloor microbial ecosystems for the formation and fate of these reservoirs remains poorly understood. The IODP Expedition 337 was the first expedition dedicated to seafloor microbiology that used riser-drilling technology on the drilling research vessel CHIKYU. The drilling site C0020 is located in a forearc basin formed by the subduction of the Pacific Plate off the Shimokita Peninsula at a water depth of 1,180 meters. During Expedition 337, we penetrated a 2,466 meters-deep sedimentary sequence with a series of coal (i.e., lignite) layers at around 2 km below the seafloor. Hole C0020A is currently the deepest hole in the history of scientific ocean drilling. Riser drilling at Site C0020 provided an unprecedented record of dynamically changing depositional environments in the former forearc basin off the Shimokita Peninsula during the late Oligocene and Miocene. This record is comprised of a rich diversity of lithological facies reflecting environments ranging from warm-temperature coastal back-swamps to cool water continental shelf. The use of riser-drilling technology in very deep sediments created both unique opportunities and new challenges the study of seafloor life. Downhole logging operations yielded data of unprecedented quality that provide a comprehensive view of sediment properties and water mobility at Site C0020. Onboard analysis of gas chemistry and isotopic compositions provided the first indication of the existence of a seafloor biosphere in deep coalbed horizons. Expedition 337 also provided a test ground for the use of riser drilling technology to address geobiological and biogeochemical objectives and was therefore a crucial step toward the next phase of deep scientific ocean drilling.

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