# Exploration of the deep coalbed biosphere (IODP Expedition 337)

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Integrated Ocean Drilling Program (IODP) Expedition 337 was the first expedition dedicated to subseafloor microbiology that used riser drilling technology [1]. IODP drill 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 m. Seismic profiles suggested the presence of deep, coal-bearing horizons at ~2 km subseafloor depth. Our primary objectives during Expedition 337 were to study the relationship between the deep microbial biosphere and the subseafloor coalbed and to explore the limits of life in horizons deeper than ever probed before by scientific ocean drilling. Among the questions that guided our research strategy was: Do deeply buried hydrocarbon reservoirs such as coalbeds act as geobiological reactors that sustain subsurface life by releasing nutrients and carbon substrates? To address this question and other objectives, we penetrated a 2,466 m deep sedimentary sequence with a series of coal layers at ~2 km below the seafloor. Hole C0020A is currently the deepest hole in the history of scientific ocean drilling [1].

During Expedition 337, over 1,700 microbiological and biogeochemical samples have successfully been obtained, for which rigorous contamination controls enable differentiation of contaminants from indigenous microbial communities. We conducted gas chemistry and isotopic analyses using a new mud-gas monitoring laboratory during riser-drilling operation [1], which provided the first indication of biologically mediated $CO_2$ reduction to methane at the 2 km-deep coalbed layers. The numbers of microbial cells are generally less than $10^3$ cells $cm^{-3}$; however, increase of biomass was observed at the coal layers. Potential rates of organoclastic sulfate reduction are elevated in coalbed-bearing strata.

[1] Inagaki, Hinrichs, Kubo and Expedition 337 Scientists. *IODP Prel. Rept.*, 337 (2012).

# Studies on the concentration of I-129 and I-131/I-129 ratios in soil samples collected from Fukushima Prefecture

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A large amount of I-131 was released from the Fukushima nuclear power plant accident. Radioiodine accumulates in thyroid gland and radiation risk would be enhanced. Therefore, it is necessary to obtain deposition date of I-131 in Fukushima Prefecture. Because of the short half-life of I-131 (8 days), it was below the detection limit after a few months. On the other hand, I-129 released simultaneously with I-131 still remained in soil, due to its long half-life of $1.57\times10^7$ years. Therefore, I-129 can be used in the estimation of the I-131 depotition. For this purpose, it is essential to obtain I-131/I-129 ratios for calculating the amount of I-131 deposition from the I-129 analysis.

We used Fukushima soil samples in which I-131 had been measured. Iodine was separated by pyrohydrolysis and the evaporated iodine was collected in a trap solution. Stable iodine (I-127) concentrations in the trap solution were measured by ICP-MS. Solvent extraction was performed, and iodine was purified. Silver nitrate was added to precipitate AgI as a target for AMS and the I-129/I-127 ratios were measured by AMS at MALT, the University of Tokyo. For the estimation of I-129 concentrations (Bq/kg) the I-129/I-127 ratios and I-127 concentrations were used.

We obtained concentration (Bq/kg) of I-129 in soil and deposition density ($Bq/m^2$) for more than 100 samples collected from different locations in Fukushima. It is interested to note that a good correlation was found between the concentrations of I-131 and I-129 in soil samples. This finding suggests the possibility to estimate I-131 levels in soil at the early stage of the accident through the analysis of I-129. We obtained an average I-131/I-129 ratio as $(2.1 \pm 0.7) \times 10^7$, although these are still uncertainties.

We also studied the concentrations of I-129 according to the soil depth. Compared to the depth profile of radiocesium, radioiodine was found to migrate faster into the deeper soil layer.


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