

Gamma-ray measurement around methane seep sites: examples from off Joetsu in Japan Sea and off southwest Taiwan

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The measurement of natural radiation provides one of the important data not only for understanding the ocean environment, but also for interpreting the tectonics and mass wasting below seafloor. Since 1997, JAMSTEC has conducted the ocean bottom gamma-ray measurement using ROV Dolphin-3K, Manned Research Submersible Shinkai 2000, and Shinkai 6500. Their results are posted on JAMSTEC website as a database. On the basis of past achievements, we present the results of the ocean bottom gamma-ray measurement at the methane seep sites related to gas hydrate off Joetsu in the eastern margin of Japan Sea and off southwest Taiwan.

Gamma-ray spectrometer utilizes 3 inch spherical NaI(Tl) scintillator and the signal processor including DA converter in a pressure case. The data (digitalized 256 channel data) are transmitted to the onboard through RS-232C line. After processing data, we get total count rate (intensity value: count per second (cps)) of gamma ray and contents of K, U-, and Th-series radionuclides. The sensor was equipped to the left side of the sample basket of the ROV Hyper-Dolphin, and always touches the seafloor when ROV completely landed. The results of the ocean bottom gamma-ray measurement in each survey areas are summarized as follows.

Off Joetsu in the eastern margin of Japan Sea: A number of mounds, large pockmarks (20 - 50 m deep and 200 - 500 m across), gas plumes, and methane hydrate are found at water depth of 900 - 1000 m in the Umitaka Spur and the Joetsu Knoll. Gamma-ray intensity values are 50 - 70 cps in normal muddy seafloor. On the other hand, the intensity values are 100 - 200 cps around methane venting sites, bacteria mats, and 'methane blowout zone' which has an undulating, rugged seafloor with carbonate nodules and gravels. Contents of each radionuclide are also high. Low U/Th ratio suggests that there is less contribution of Rn accompanied with a recent fault activity.

Off southwest Taiwan: Large, dense chemosynthetic communities, associated with carbonate pavements, were discovered at water depth of about 1100 - 1200 m on the top of the Formosa Ridge. Gamma-ray intensity values in normal muddy seafloor (120 - 150 cps) are higher than those around Japan. Since Th-series radionuclide easily absorbs other particles, it is commonly included in surface sediments. This may cause higher content of Th-series radionuclide in normal muddy seafloor. On the other hand, anomaly of gamma-ray intensity (200 - 300 cps) shows a methane seep activity from subsurface.

It is hard to pinpoint the location and occurrence of seeps and fault without biotic activities. The ocean bottom gamma-ray measurement is one of the effective tools, though their values are different among areas and are not quantitative.