Distribution of novel microbial population in deep-sea subsurface of the hydrothermal vent field

Hiroyuki Kimura[1], Ryuji Asada[2], Takeshi Naganuma[1]

[1] School of Biosphere Sci., Hiroshima Univ., [2] School of Natural Sci. and Tech., Kanazawa Univ.

http://home.hiroshima-u.ac.jp/hubol/

Since the discovery of deep-sea high-temperature hydrothermal vents in 1979, diverse microbial species including thermophilies and hyperthermophiles have been isolated from hydrothermal fluids and hydrothermal vent chimneys. However, distribution and diversity of the microbial communities in the vent subsurface (sub-vent) have been little studied. In 2000, hydrothermal vent drilling (Ocean Drilling Program, ODP, Leg193) was carried out in the PACMANUS hydrothermal field of Manus Basin. Drillings of the hydrothermal fields were previously performed in the mid-oceanic ridges such as Mid-Atlantic Ridge (Leg158) and Juan de Fuca Ridge (Leg169). ODP Leg193 drilled the Hole1188 and Hole1189. Although the recovery rate was as low as 10 %, core samples to 387 m below seafloor (mbsf) at Hole1188 and 195 mbsf at Hole1189 were recovered. This was the first drilling of sub-vent biosphere in back-arc basins. Microbial cells were observed and counted on board by epifluorescence microscopy. Microbial ATP concentration was measured on bard, too. Parts of the core samples were directly incubated at 60C and 90C in marine broth.

Upper part of the core collected in the Leg193 (to 45 mbsf in Hole1188, to 15 mbsf in Hole1189) was aphyric dacite or andesite. The deeper part of the core was volcanic rock or breccia showing thermal denaturation. A large number of veins were observed in the deeper cores. Pyrite and charcopyrite pyrite were crystalized in the vein. Temperature at the bottom of Hole1188 reached higher than 300C after 1 week of drilling. On the other hand, the temperature of Hole1189 bottom stayed at about 80C, and it would mark higher values if monitored for a longer period. The thermometry indicates that the core samples were from high-temperature sub-vent habitat.

Contamination test using perfluorocarbon tracer (PFT) was carried out in ODP Leg193. PFT was detected from the rock core outside (6.5 cm diameters). The result showed that the drilling fluid contaminated the core surface. On the other hand, the drilling fluid did not enter the inside of cores (subcores), as PFT was not detected from inside (1.5-2.0 cm diameters). Therefore, only subcores were used as the samples for microbiological procedures.

Microbial cells were observed in the subcores collected from upper part than 100 mbsf, while ATP was detected in the subcores from upper than 50 mbsf. In addition, growth of the microorganism was observed in the subcores at 60C from 60-90 mbsf in anaerobic cultivation, and at 90C from 70-130 mbsf in anaerobic cultivation. This study demonstrated the existence of microbial populations in the sub-vent biosphere.