

執筆者の意向によりオンラインでは要旨のみ公開しています。

## I. Abstract

To investigate the influence of bacterial endosymbionts on host distributions in deep-sea chemosynthetic ecosystems, bacterial endosymbionts of bivalves collected from two unique reduced environments were characterized by transmission electron microscopic observation and molecular phylogenetic analyses.

From hydrothermal vents with high methane concentrations, methanotrophic endosymbionts were discovered within the gill tissues of two deep-sea mussels, *Bathymodiolus platifrons* and *B. japonicus*. This is the first report of deep-sea mussels containing only methanotrophs (lacking thioautotrophs) from hydrothermal vents. The known distribution of other invertebrates containing only methanotrophs has thus far been limited to cold seep environments with high methane concentrations in the interstitial water. Thus, it is likely that the distribution of methanotrophic symbioses is strongly influenced by the methane or hydrocarbon concentrations present at hydrothermal vent and cold seep sites. Specifically, methanotrophic symbionts are required for the survival of host mussels in methane-rich environments.

Two phylotypes of intracellular endosymbionts were discovered within the gill tissues of a thyasirid clam *Maorithyas hadalis* from the deepest known chemosynthetic communities. One type was affiliated with thioautotrophic symbionts of deep-sea bivalves and the other type was not related to any known symbiotic or free-living bacteria. Spatial partitioning between two phylotypes of the intracellular symbionts was observed in the gill tissues—the first such report in marine invertebrates. Symbionts of *M. hadalis* occur intracellularly, while symbioses in other thyasirid clams are extracellular. It is likely that this dual symbiosis

resulted from adaptation to a sulfide-rich environment at great depth due to the following reasons: the characteristics of this symbiosis are unique; the environment of *M. hadalis* is considered to be relatively challenging; and no other chemotrophic symbioses have been reported deeper than 7,000 m.

These results support the hypothesis that bacterial chemotrophic endosymbionts as well as the mode of symbiosis influence host distributions in deep-sea chemosynthetic ecosystems.