CHEMOSYNTHESIS-BASED COMMUNITIES ASSOCIATED WITH FLUIDS IN DEEP MEDITERRANEAN MUD-VOLCANOES

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Abstract

Dense living chemosynthetic-based communities were for the first time observed at 1700m depth in Mediterranean southwestern to Turquia. These assemblages, mainly composed of bacterial mats, tube worms, small bivalve molluscs (Lucinidae, Mytilidae , Vesicomyidae) and an Echinidae sea urchin, occur usually at the top of mud volcanoes or along fault zone and are associated with methane seeps.Tube worms and bivalve molluscs are sustained, through bacterial symbiotic associations, either by sulfide present in the sediments or by both sediment- sulfide and methane abundant in the seeps.

Key Words: Eastern Mediterranean Sea, Mud-volcanoes,Chemosynthetic populations

Introduction

Following the discovery of dense chemosynthetic-based populations associated with hydrothermal vents in the deep rift system (1) submersible and remotely operated vehicle investigations discovered number of seep sites indicating that seeping is a general feature of the geohydrologic system of continental margins.

Since first discovery of communities in the Gulf of Mexico (2) and immediatly after in Japan trenches (3) number of sites were described in continental margins between 400 and 6000m in different geological contexts (reviewed in Sibuet and Olu - 4) and more recently even till 7326m (5). In all sites, Chemosynthetic-based communities are restricted to areas where hydrogen sulfide and/or methane rich seeps out along geological faults.

The food webs of hydrothermal vent and cold seep communities entirely rely on the production of organic matter via bacterial chemoautolithotrophy (6), the two main sources of energy in these zones appear to be sulfide or/and methane (7, 8)

Among these geological contexts, mud volcanoes has been identified as one of the contexts favorizing to the exploitation by chemosynthetic-based symbioses of cold seeps rich in methane (9).

Results and Discussion

The Anaximender area (southwester Turkey) was explored with the submersible *Nautile* during the French-Dutch MEDINAUTE expedition (1998).

Dense living chemosynthetic-based communities were for the first time observed at 1700m depth in Mediterranean southwestern to Turkey. These assemblages occur usually at the top of mud volcanoes or along fault zones and are associated with methane seeps. Living individuals were mainly sampled on the top of Kazan mud volcanoe at 1707m (35°25.983N ; 24°33.594E) , large site composed of a mixture of grey-dark sediment and pieces of calcareus crusts and densily populated. The main componant of the community is a lucinid bivalve, identified as *Myrtea sp.*. Others living symbiotic bivalves include a small vesicomyid, *Vesycomya sp.* and an unknown small mytilid settled on carbonated crusts. Few vestimentiferan tubes with living worms were also collected on this site. Lying on the heavily reduced sediment, white-grey bacterial mats were observed as well as many unknow sea urchins and number of undetermined crabs.

Transversal sections of *Myrtea sp.* gill filaments observed by TEM demonstrated them mainly composed by bacteriocytes housing sulfur-oxidizing type bacteria. This type of symbionts was also observed in gill cells of *Vesicomya sp.* as well as in the trophosome of the undetermined vestimentiferan worm . The undetermined mytilid appeared as an additionnal exemple of symbiosis using both reduced sulfide components and possibly methane as potential source of energy. TEM observations show that the great majority of the gill cells contains two distinct morphological types of symbionts. The first type is small (mean diameter: 0.35 μm) coccoids or short rods and similar to the sulfide-oxidizing symbionts observed in *B. thermophilus*. The second type are large (mean diameter: 1.25 μm) coccoid-shaped bacteria resembling type I methylotrophs with stacked intracytoplasmic membranes.

13C/12C isotopic ratios clearly enhanced the hypothesis of chemosynthetic based organic material with values ranging from –27.7‰ to – 30.5‰ for *Myrtea sp*, from –29.3‰ to –30.1‰ for *Vesicomya sp.* and from –23.6‰ to –26.6‰ for the vestimentiferan worm, values similar to others symbiotic chemosynthetic-based bivalves or vestimentiferan worms housing sulfur-oxydizing symbionts and found in different vent or cold seep sites .

The values obtained for the mytilid are more depleted : ranging from 44.2‰ to -44.6‰ they are in agreement with the presence of methylotrophic symbionts possibly using methane as energy source. The 15N/14N isotopic ratios are also in agreement with data obtained on other bivalves or vestimentiferan worms found in other vent or cold seep sites ranging from -1.0 to 1.4 ‰ for *Myrtea sp.*, from 0.2 to 0.4‰ for the mytilid, to-1.6 to 1.9‰ for *Vesicomya sp.* and from -0.8 to 0.2‰ for the vestimentiferan worm.

Conclusion

The results demonstrated for the first time the presence of living chemosynthetic-based populations associated with fluids in deep Mediterranean mud volcanoes . These populations obviously got their energy either from sufide abundant in reduced sediments of these zones or from both sediment-sufide and of methane expelled in large amount in the cold seeps.

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