COLD SEEP COMMUNITIES IN THE DEEP MEDITERRANEAN SEA (SOUTH OF CRETE AND TURKEY): FAUNAL COMPOSITION AND SPATIAL DISTRIBUTION

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Abstract

Cold seep communities were observed by submersible on mud volcanoes and along a faulted ridge between 1700 and 2000 m depth along the Mediterranean Ridge south of Crete and South of Turkey. Methane rich fluids sustain benthic communities dominated by large size pogonophorans and several species of bivalves associated with symbiotic chemoautotrophic bacteria. Exceptionally dense and large fields of bivalve shells and bushes of tens to hundreds of pogonophorans were observed and mapped. The diversity of the "symbiotic" fauna is high compared to other cold seep site at similar depths. This discovery of diverse communities with high densities contrasts with the assumed poverty of the deep Mediterranean fauna.

Kew Words: Eastern Mediterranean Sea, Mud volcanoes, Cold seep communities, bivalves, pogonophorans

Introduction

Number of cold seep communities has been discovered on continental active or passive margins of the Pacific and Atlantic oceans (see for review ref.1). Mud volcanoes where methane rich fluids are expelled are one of the most common environments that favour their development. Chemosynthesis-based benthic communities have been described on mud volcanoes, diapirs and pockmarks along the Barbados accretionary prism (2, 3), in the Gulf of Mexico (4, 5) and in the Norvegian Sea (6). The communities are generally dominated by large-size bivalves (mytilids and/or vesicomyids) and pogonophorans. Lucinids and thyasirids living partially or totally buried in the sediment occur in lower abundance at the shallowest sites (1).

Two mud volcano fields were explored during the french-dutch MEDINAUT cruise with the submersible Nautile, south of Crete along the Mediteranean Ridge at about 2000m depth (Olimpi mud field) and south of Turkey between 1700 and 2000 m depth (Anaximander mud field). High methane concentrations were measured in the water sampled over the mounds (7). Methane is oxidised and sulphide is produced in the sediment with contribution of a consortium of bacteria and Archea (8). Methane and sulphide are therefore available for other chemoautotrophic bacteria including invertebrate symbionts.

Results and discussion

Chemosynthesis-based communities dominated by bivalves and pogonophorans including large size Lamellibrachia sp. were observed and sampled on 6 mud volcanoes upon the 7 explored and along a faulted ridge. Five bivalve species, belonging to 4 families commonly found in cold seep environments, were sampled: two presumed new species of Lucinidae (Lucinoma sp. and Myrtea sp.), the Mytilidae *Idas modiolaeformis, Isorropodon perplexum* (Vesicomyidae) and *Thyasira striata* (Thyasiridae). Shell sizes are from 2 to about 20 mm, and up to 40 mm for Lucinoma sp., which is less than bivalves usually living at seeps but large compared to deep Mediterranean sea species. Two pogonophorans, large size (tubes up to 80 cm long) Lamellibrachia sp. (*Pogonophora Obturata*) and small size Siboglinum sp. (*Pogonophora Monilifera*) were sampled in both areas. Iotopic ratio measurements evidence use of chemosynthesis originated carbon (Fiala-Médioni, this issue) by three bivalve species and the Lamellibrachia sp. assumed to be associated with chemoautotrophic bacteria. Exceptionally large specimens sponge *Rhizaxinella pyrifera* may be also associated with symbiotic bacteria. Analysis of samples and of video records reveals a great diversity of the "symbiotic" mega- and macrofauna, compared to other cold seep areas at similar depths. Four bivalve species and one gastropod were described from the Nile cone (9) where similar environmental conditions may occur. Associated fauna appeared to be abundant in terms of vagile species (fishes, shrimps and crabs) and detritivorous species such as echinids, which may be attracted by the local enrichment. Eigth species of gastropods were sampled on all the volcanoes and the ridge. Negative values of $\delta^{13}C$ of the tissue of one Echinus sp. (from –35.67‰ to –42.33‰) indicate a nutrition using chemosynthesis origin carbon.

Spatial analysis of community distribution on 3 volcanoes show that dense bivalve shell accumulations (mainly lucinids) spread over large areas, from 10 to 25 % of the explored areas (3000 to 15000 m_) on the different volcanoes. The pogonophora Lamellibrachia sp. shows variable density on the different volcanoes (mean density from 0.02 to 0.44 ind./m_). Bushes of several hundreds of individuals were observed at some places in the Anaximander area. This observation, together with contrasts in number of sampled living bivalves and gastropods, and differences in terms of diversity suggest that the Anaximander area is presently more active than the Olimpi area.

These dense and rich cold seep communities contrast with the assumed poverty of the deep Mediterranean. Abundant associated fauna was observed and the food web complexity has to be further studied. Differences in faunal distribution, abundance and diversity between mud volcanoes suggest different activity stages. Dating of bivalve shells and relation with geology processes should help in understanding temporal evolution of these fluid emissions.

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