EVALUATION OF ABYSSAL METAZOAN MEIOFAUNA FROM A MANGANESE NODULE AREA OF THE EASTERN SOUTH PACIFIC

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ABSTRACT - The metazoan meiofauna from a manganese nodule area of the eastern South Pacific (Peru Basin) was investigated. Nodule coverage in this area ranged from 5-30% with many highly mammillated, botryoidal nodules exceeding 10 cm in diameter. Metazoan meiofaunal density in the sediment was about 147 ind./10 cm$^2$. The predominant taxa in the sediment (excluding Foraminiferida) were Nematoda (82%) and Harpacticoida (15%); other taxa occurred sporadically (3%). While breaking-up some of the manganese nodules during an inspection for epifauna, a crevice fauna was discovered, living in the sediment-filled crevices and cracks between the mammillae. Metazoan meiofaunal density in the nodules was about 116 ind./nodule (diameter 8-12 cm) or 29 ind./10 cm$^2$ nodule plane, respectively. The predominant taxa in the nodules were Nematoda (89%) and Harpacticoida (10%); other taxa were very rare (1%). Most of the nematode species (66%) from this manganese nodule area possess minute buccal cavities without teeth; these nematodes are assumed to feed on bacteria and bacterial secretions. Many nematode species build sediment tubes and structure the uppermost sediment layer.

INTRODUCTION

World-wide, nematodes are the predominant metazoan meiofauna (excluding foraminifera) in deep-sea sediments. meiofaunal associations from manganese nodule areas are known from very few studies (Hessler & Jumars 1974; Mullineaux 1987; Renaud-Mornant & Gourbault 1990; Snider et al. 1984; Wilson & Hessler 1987).

In our 'Disturbance and recolonization (DISCOL) experiment in a manganese nodule area of the abyssal eastern South Pacific' we considered nematodes and harpacticoids as indicator taxa (Schriever et al. 1991; Thiel et al. 1992) assuming that their closer taxonomic study (Bussau 1993) would allow the evaluation of an experimental disturbance. The DISCOL project is the first long-term, large-scale, disturbance-recolonization experiment relating to the environmental effects.

To date, no published reports exist on the meta zoan meiofaunal assemblages from the manganese nodules (nodule endofauna and epifauna). This paper presents information on the metazoan meiofauna from a manganese nodule area; it turns attention to the recently discovered nodule crevice fauna and to the feeding ecology of nematodes.

MATERIAL AND METHODS

Work at sea was carried out in February-March 1989 (Cruise DISCOL 1). The study site was a manganese nodule area in the Peru Basin, centered upon 07°04′40″S-88°27′60″W in water depths of 4100-4200 m. Sediment samples were collected with a multiple corer, manganese nodules with a box corer. The nodules were inspected for epifauna and endofauna. The material was preserved in 4% formaldehyde-seawater solution. Numbers and percentages were calculated on twenty sediment samples (each 10 cm$^3$) from different sediment layers (0-1 cm, 1-2 cm, 2-4 cm, 4-6 cm; five samples from each layer) and six nodules (five from the sea floor and one from the underlying sediment). Detailed information on material and methods may be found in Thiel & Schriever (1989) and Bussau (1993).

RESULTS

1. Biotope

The biotope 'manganese nodule area' is constituted of two sub-biotopes: the manganese nodules and the sediment around them (Fig. 1). The metazoan meiofauna populates the nodule surface (nodule epifauna), the sediment-filled crevice systems of the manganese nodules (nodule endofauna) and the sediment (sediment fauna).

Nodule coverage in our study area ranged from 5-30% with many highly mammillated, botryoidal nodules exceeding 10 cm in diameter. The nodules are of the 'cauliflower type' (Fig. 2). The shape of the nodules (diameter 3-18 cm) is globular to conical. The lower two-thirds of the nodule (the frustum of the cone with the largest diameter) is in the sediment, the upper third (the top of the cone) projects over the sediment surface. The lower surface of the nodules is almost smooth. In contrast, the upper surface is rough and composed of independently growing subnodules (mamillae) with coarsely porous to gritty surface textures. By approaching each other through growth, the subnodules build up an irregular and interconnected, sediment-filled labyrinth between them. This constitutes the sediment-filled crevice system. About 95% of the nodules are found on the sea floor and a few in the underlying sediment. Photographic evidence showed that the nodules were covered with a thin, irregular layer of sediment, concentrated in the recesses between the subnodules, leaving their upper surfaces rather bare.

The sediment showed the following stratification: the 0-6 cm layer (brown) was very soft, the 6-10 cm layer (brown) was semiliquid and the 10-40 cm layer (grey) had a stiff clay consistency.

2. Faunal compositions and densities

2.1. Sediment fauna

The major taxa in the sediment (excluding Foraminiferida) are Nematoda (average 82%; range 77-87%) with Harpacticoida (average 15%; range 11-19%) second in dominance. Gastrotricha, Kinorhyncha, Loricifera, Tardigrada, Polychaeta and Ostracoda are of sporadic occurrence (average 3%, range 1-4%) (Fig. 3 A).

The average density of metazoan meiofauna in the sediment is 147 ind./10 cm$^2$ (range 76-216 ind./10 cm$^2$), with the main groups Nematoda (average 121 ind./10 cm$^2$; range 66-177 ind./10 cm$^2$) and Harpacticoida (average 22 ind./10 cm$^2$; range 8-34 ind./10 cm$^2$). The other meiofaunal groups are very rare (average 4 ind./10 cm$^2$; range 2-5 ind./10 cm$^2$) (Fig. 3 B).

2.2. Nodule endofauna

Both, surficial and buried nodules possess a crevice fauna. Nematoda (average 89%; range 83-100%) and Harpacticoida (average 10%; range 0-15%) are the most dominant taxa inhabiting the nodule crevices; Kinorhyncha, Tardigrada and Polychaeta make up the rest of the metazoan meiofauna (average 1%, range 0-4%) (Fig. 3 A).

Meiofaunal density in the manganese nodules (diameter 8-12 cm) averages 116 ind./nodule (range 67-150 ind./nodule), the main groups are Nematoda (average 104 ind./nodule; range 67-124 ind./nodule) and Harpacticoida (average 12 ind./nodule; range 0-23 ind./nodule); the rest of the meiofauna occurs sporadically (2 ind./nodule, range 0-5 ind./nodule) (Fig. 3 B). A slightly conical nodule which has a diameter of 8-12 cm covers about 40 cm$^2$ of the sediment surface, therefore the meiofaunal density in this sub-biotope is about 29 ind./10 cm$^2$ nodule plane.
2.3. Nodule epifauna

Very few nematodes (*Enoploides* sp., *Acantholaimus* sp.) inhabit the thin sediment layer which covers each manganese nodule.

3. Nematoda

The nematodes include about 300 species belonging to some 60 genera; each species has a low density, and nearly all of the species are new.
to science, as is typical in newly investigated areas in the deep sea (Bussau 1993).

Distinct differences are encountered between the nodule fauna and the sediment fauna. Thirty-five species have relative abundances ≥ 1% of the total number of individuals in one or both of the sub-biotopes. The distribution of these species (Table I) shows their habitat preferences.

The sediment is largely dominated by genera belonging to the following major families: Chromadoridae (genus *Acantholaimus*), Microlaimidae (genus *Microlaimus*), Monhysteridae (genus *Thalassomonhysteria*), Xyalidae, Diplopeltidae (genus *Diplopeltula*), Desmoscolecidae (genera *Desmoscolex*, *Tricoma*), Oxystominidae (genus *Halalaimus*).

The nodules are largely dominated by genera belonging to the following major families: Chromadoridae (genus *Acantholaimus*), Cyatholaimidae (genus *Paracyatholaimus*), Desmodoridae (genus *Molgolaimus*), Leptolaimidae (genus *Camacolaimus*), Monhysteridae (genus *Thalassomonhysteria*), Xyalidae, Ironidae (genus *Syringolaimus*), Trefusiidae (genus *Trefusia*).

Thus the Microlaimidae, Diplopeltidae, Desmoscolecidae and Oxystominidae are mainly or solely found in the sediment, whereas the Cyatholaimidae, Desmodoridae, Leptolaimidae, Ironidae and Trefusiidae occur mainly or solely in the nodules.

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**Fig. 2.** A manganese nodule of the ‘cauliflower type’, diameter 10 cm.

**Table I.** Habitat preferences of 35 nematode species (with relative abundances ≥ 1% of the total number of individuals) from a manganese nodule area of the eastern South Pacific; lines = frequent occurrence, points = sporadic occurrence, without lines or points = no occurrence.

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<th>Taxa</th>
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4. Harpacticoida

The most dominant family in the sediment is the Cletodidae followed by the Ectinosomatidae, Ameiridae and Tisbidae. Also present are the families Diosaccidae, Cerviniidae and Tetragonicipitidae. As in nearly all deep sea investigations most of the species are unknown to science. The description of four new species of the Cletodidae and eight of the Diosaccidae is in preparation.

The harpacticoid specimens of the nodule infauna are very small (< 400 μm) and not yet identified.

5. Tardigrada

The examination (Bussau 1992) revealed three species (Moebjergarctus manganis, Angura capsula, A. lingua), all belonging to the family Halechiniscidae.

6. Vertical distribution

The majority of Nematoda (72%) and Harpacticoida (82%) inhabit the uppermost 0-2 cm sediment layer; 19% of the Nematoda and 14% of the Harpacticoida occur in the 2-4 cm layer; only 9% of the Nematoda and 4% of the Harpacticoida are found in the 4-6 cm sediment layer. The Gastrotricha, Kinorhyncha, Loricifera, Tardigrada, Polychaeta and Ostracoda live exclusively in the 0-2 cm sediment layer. Very few nematodes are found down to 20 cm depth (Fig. 3 C).

7. Horizontal dispersal

The densities of the nematodes in the uppermost 0-1 cm sediment layer vary from 39-107 ind./10 cm² (harpacticoids: 8-21 ind./10 cm²). The meiofauna has a patchy, small-scale spatial distribution. Consequently, attractive spots which are densely populated by meiofauna are assumed to exist in the sediment; in contrast, the meiofauna might avoid unattractive spots. Attractive spots could be present for a short period (minutes, e.g., a particle of food) or for a long time (weeks, months, years, e.g., macrofauna burrows). Many nematode species from our study site build mucus sediment conglomerations (200-1000 μm in diameter) which are assumed to be densely populated by bacteria (Riemann 1986). These structures can attract nematodes which may feed on bacteria. We investigated the sediment surface in detail (multiple corer samples) and realized that innumerable mucus sediment aggregates were structuring the sediment surface (Fig. 4 A).

8. Tube-building nematodes

Many nematode species from our study site (Acantholaimus spp., Microlaimus spp., Thalassomonhystera spp., Halalaimus spp.) were lying in obvious self-made sediment conglomerations which surround the nematodes like tube-shaped overcoats. These nematodes are assumed to secrete large amounts of mucus, paste sediment
Fig. 4. – A, sediment surface with a mucus-sediment-structure containing three nematodes; B, a nematode of the family Microlaimidae within a sediment tube.
particles together and build light, lump-shaped or tube-shaped sediment structures, in which they might be able to move easily. The tubes seem to be elastic and the bending of the nematode body could cause the shape of the flexible tubes; i.e. in the case of a nematode which is curled up, a lump-shaped sediment structure arises (Fig. 4 B). The tube-building species are assumed to lead a hemisessile mode of life, and to feed on bacteria and bacterial secretions (bacterial gardening).

9. Nematode feeding types

Much of the literature on feeding and general ecology of marine nematodes is based upon Wieser's 1953 classification of four feeding types recognized from nematode buccal cavity morphology. We use a slightly modified scheme (see Bussau 1993) with five feeding types:

- Feeding type 1: without mouth
- Feeding type 2: buccal cavity weakly cuticularized, small, unarmed
- Feeding type 3: buccal cavity weakly cuticularized, small, with small teeth
- Feeding type 4: buccal cavity strongly cuticularized, large, unarmed
- Feeding type 5: buccal cavity strongly cuticularized, large, with large teeth

Most nematode species (66%) from the manganese nodule area of the eastern South Pacific belong to feeding type 2; these species are assumed to feed on bacteria and bacterial secretions. Feeding type 3 comprised 17% of the nematode species present; these possess small teeth for rasping and puncturing allowing for food particles to be scraped off surfaces and the food object pierced or damaged and its content sucked out. Some species (11%) belong to feeding type 5; they are assumed to live as predators and scavengers, and may either swallow whole prey or puncture it with their teeth and suck out its contents. Species of the family Benthamermithidae (3%) belong to feeding type 1; they are characterized by their reduced-sized mouth and anal openings and their intestine modified into a trophosome. The free-living males and females of this family are assumed to be dependent on a trans-epidermal uptake of dissolved organic matter or it is possible that they do not take up any food. Few species (3%) belong to feeding type 4; these are assumed to be predators and scavengers which catch their prey with wide open mouths swallowing it or large particles of food whole. They may not be able to puncture food objects. The percentages of nematodes belonging to the five different feeding categories are shown in Fig. 5.

DISCUSSION

One of us (H.T.) discovered that sediment occurs inside the nodules and that animals live in the sediment-filled crevice system of the nodules (Thiel et al. 1993). Additionally, although expected, it was not known that the thin sediment layer on the surface of the manganese nodules is inhabited by nematodes. Some of the nematodes are probably washed down from the nodule surface during the retrieval of the box corer and the sample processing on shipboard. Therefore not all the nematodes may have remained in their original position on the nodule surface.

The high nematode dominance at our study site shows a close correspondence with data presented by other authors (see e.g., Coull 1988, Heip et al. 1985, Thiel 1983). Renaud-Mornant & Gourbault (1990) reported nematode percentages of 84-100% in the sediment from a manganese nodule area of the central Pacific in water depths of 4960-5154 m. This is close to our findings (77-87%).

The density of the metazoan meiofauna in the sediment from the manganese nodule area of the eastern South Pacific (76-216 ind./10 cm²) is comparable with results obtained by several authors from different ocean regions (see e.g., Thiel 1983 and references cited therein). Renaud-Mornant & Gourbault (1990) found that in the sediment of a manganese nodule area of the central Pacific (4960-5154 m) meiofaunal densities were 45-89 ind./10 cm². The range of nematode densities of 66-177 ind./10 cm² in the sediment of our study area is close to findings presented by Tietjen (1984), who reported nematode densities of 36-94 ind./10 cm² from the Venezuela Basin in water depths of 3517-5054 m. The higher numbers of meiofauna and nematodes in our study area compared with those in the cited papers may relate to different production and sedimentation systems. Energy input to the seafloor, for example, may be higher in the eastern South Pacific. However, the average density per unit area of the meiofauna in
the sediment (147 ind./10 cm²) is greater than that in the nodules (29 ind./10 cm² for an 8-12 cm diameter nodule). The nodule coverage in our study area ranged from 5-30%. Assuming each nodule (of average diameter 8-12 cm) covers an area of 40 cm² we calculated the average density in the study area (i.e. sediment and nodules) to range from 112-141 ind./10 cm². This is a rough estimate because small nodules (diameter 3-5 cm) do not possess a well developed sediment-filled crevice system. These figures combined for sediment and nodule faunas are closer to those reported by Renaud-Mornant & Gourbault (1990) and Tietjen (1984).

Any comparison of faunal densities must be undertaken with great care, specifically, when limited size classes such as the meiofauna are solely considered and when biotope structures are different. Comparisons are generally based on the assumption that community structures are similar. This is certainly not the case, when pure sediment areas are compared with those with sediment and hard substrate, like the manganese nodule areas, because biotopes with hard substrates are inhabited additionally by a diverse epifauna. Our samples and photographs have shown Porifera, Hydrozoa, Scyphozoa, Anthozoa, Brachiopoda, Bryozoa, Polychaeta, Crustacea, Echinodermata and Ascidia living attached to the nodules. The density of these metazoa is generally low in the deep sea but almost all nodules are inhabited by some specimens of those taxa, competing for the settling food particles. Additionally, Foraminiferida live in high densities on the nodule surfaces, as they do in the sediment. Theoretically, both sub-biotopes of the manganese nodule area, the sediment and the nodules, get equal amounts of energy (i.e. food particles) settling to the seabed. In the nodules the density of the metazoa meiofauna is much lower than in the sediment. Thus, the energy input in the nodule sub-biotope is partitioned to a higher degree to the nodule epifauna.

The nematode composition at our study site generally corresponds with the data of Dinet & Vivier (1979), Bay Biscayne, 1920-4725 m; Jensen (1988), Norwegian Sea, 970-3284 m; Renaud-Mornant & Gourbault (1990), eastern central Pacific, 4960-5154 m; Wilson & Hessler (1987), eastern central Pacific, 4400-4600 m; Thistle & Sherman (1985), North Atlantic, 4626 m; Tietjen (1971, 1976), West Atlantic, off North Carolina, 600-2500 m; Tietjen (1984), Venezuela Basin, 3517-5054 m; Tietjen (1985), West Atlantic, Puerto Rico Trench, Hatteras Abyssal Plain, 2217-8380 m. The families Chromadoridae, Microlaimidae, Leptolaimidae, Monhysteridae, Xyalidae, Diplopeltidae, Desmoscolecidae, Ironidae, Oxy-stominidae seem to be dominant in the deep sea world-wide.

That nematodes do occur in greatest numbers close to the surface of the sediment has been demonstrated in many studies (see e.g., Heip et al. 1985, Thiel 1983). Thistle & Sherman (1985) found that 64% of the nematodes from a deep-sea site (4626 m) in the North Atlantic occurred in the upper 2 cm of the sediment. This is very close to our results (72%).

The deep-sea floor is structurally complex at small scales. Organisms alter the surface of soft bottom seafloors in a variety of ways: they make burrows, tracks, feeding traces, build tubes and tests and produce piles of fecal material (Thistle & Eckman 1988, 1990). At our study site many nematodes build mucus sediment conglomerations and innumerable aggregates of this kind are structuring the sediment surface. In the deep sea these biologically produced structures are assumed to persist for long periods, even after they are vacated. The mucus sediment conglomerations may be a major source of patchiness in the meiofaunal communities, play an important role in creating biotope heterogeneity and be important in maintaining the high diversity that characterizes the deep sea.

Less information is available about the feeding of harpacticoids in the deep sea. Potential food sources are obviously mucus together with its incorporated bacteria, ciliates and particulate organic matter as well as marine ‘snow’ (see Hicks & Coull 1983 and references therein). Therefore the tubes built by nematodes (see this paper) which can also be inhabited by harpacticoids set up an important food resource for harpacticoids. Some harpacticoids are able to build sediment tubes or coats, as previously mentioned in the literature, but we found no tube-dwelling specimens in our samples. Information on feeding mechanisms and food availability for harpacticoids in situ is still a gap in deep-sea harpacticoid biology.

Riemann (1974) gives the first record of tube-building deep-sea nematodes. What influence does the mucus of the nematodes have on the sediment texture of the deep-sea bottom? The deep-sea mud consists of very fine sediment particles which would be densely packed if organisms were absent. In this hypothetical case (no organisms in the sediment) an extensive interstitial system would be absent. As a result of the mucus secreted by the nematodes, the sediment texture could change (Bussau 1993). Nematodes are assumed to build a network of closely spaced burrows in the uppermost (0-1 cm) layer of the very soft deep-sea sediment. Sediment particles may be agglutinated with the binding mucus and lump-shaped or tube-shaped conglomerations can arise. As a result, a narrow, imperfect lacunary system might develop which could enable an interstitial, non-boring meiofaunal community to thrive (Riemann 1974). The mucus secreting and tube building nematodes
may thus play an important role at the sediment-water interface by increasing pore water exchange, improving the O₂-provision of the uppermost sediment layer (the movements of the nematodes within their tubes produce water transport in the uppermost sediment layer), stabilizing newly sedimented detritus with binding mucus, and counteracting resuspension. Of what use is the mucus secretion to the nematodes themselves? Sediment tubes afford many potential advantages to nematodes including avoidance of drift into unfavourable areas, a refuge in case of danger, and a place to outlast unfavourable environmental factors (dormant life period). The sediment tube could also be part of the feeding strategy (mucus-trap hypothesis, Riemann & Schrage 1978) because the tube could be densely populated with bacteria (bacterial gardening). It is further possible that the sediment tube is related to some form of maternal brood-care which has not yet been observed (Blome & Riemann 1987).

Tietjen (1971) states, "For deep-sea benthos there are essentially two main sources of food: detritus, either derived from the euphotic zone or formed in situ, and bacteria". Bacteria are the basic producers in the deep-sea benthos, producing the nutrient matrix, and most deep-sea animals are assumed to feed on bacteria or bacterial products (Thiel 1973). Therefore it is not surprising that most deep-sea nematode species (66%) in our study area possess weakly cuticularized, small buccal cavities without teeth; such species are considered to lead a more or less passive, hemisessile mode of life, to feed on bacteria and bacterial secretions, to build sediment tubes and to practise bacterial gardening (Bussau 1993). Jensen (1988), Renaud-Mornant & Gourbault (1990) and Tietjen (1984) made similar observations of the nematode feeding types in other deep-sea regions. The few nematodes (14%) which have strongly cuticularized, large buccal cavities with or without large teeth (predators or scavengers) in the present study, which also can be deduced from other deep-sea benthos studies (Tietjen 1971, 1976, 1989), could be taken as an indication of the low densities of carcasses and prey organisms. Deep-sea benthic ecosystems are governed by constantly limited food availability (Thiel 1975) and are fuelled by organic matter produced in surface waters (Pfannkuche 1985). The organic matter is recycled in the food web, partitioned in surface waters and reaches the abyss mostly in a refractory stage as small-sized, probably aggregated particles which sink down to the bottom and concentrate in the sediment surface. From the energy point of view, the active mode of life as predators or scavengers seems to be too costly because the density of their food is too low. Thus, a cost-effective way of food acquisition is the passive waiting for particles as exhibited by most deep-sea organisms.

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REFERENCES


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