Observations of the Pelagic Fauna over the Pac Manus Site, in the Manus Basin, Papau New Guinea: preliminary results

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On November 16, 1998, a submersible dive of the *Shinkai 2000* was conducted in the Manus Basin of Papau New Guinea, as part of on ongoing biological survey known as BIO-ACCESS. This was the first submersible dive in the basin devoted solely to the exploration and characterization of the mesopelagic fauna and the near bottom fauna. This preliminary report serves to broadly categorize the water column and give initial observations of the pelagic species from the Manus Basin. Brief notes regarding the location and in some cases behavior of species is also given. Future dives are being planned to investigate the pelagic species observed during this first dive in greater detail.

Key words : Pelagic, gelatinous, Manus Basin, BIO-ACCESS, submersible

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1. Introduction

The use of submersibles to investigate the behavior and ecology of pelagic species has resulted in new information regarding little known faunas which are difficult to access. Submersible cameras are the only tools currently available with which specific in situ behavioral information about some deep-living species can be collected. Though anecdotal, preliminary observations and impressions are of note given that such data are very scarce -- especially for new geographic areas.

The Manus Basin off Papau New Guinea has been explored recently, focusing on the geology and resources of the area (see Binns and Scott, 1993; Binns et al., 1995). Scientific submersible survey studies of the area began in earnest with the joint Japanese/French cooperative program deemed "New STARMER" in 1995. Subsequently, cruises designed specifically to explore the biology of the region were begun in 1996, under the international cooperative program called "BIO-ACCESS" employing scientists from Japan, France, and Papau New Guinea (see Hashimoto and Ohta, 1997). This program has focused on the biology and ecology of the chemosynthesis-based communities surrounding geologically active hydrothermal vent areas. Specifically, biological focus has thusfar been limited to studies of the benthic faunas and targeted chemosynthetic species (or species harboring chemosynthetic symbionts). Such communities are becoming well studied and documented (see Sibuet and Olu, 1997; Tunnicliffe et al., 1998)

A second BIO-ACCESS cruise conducted in November of 1998 included the first submersible dive dedicated to investigating the mesopelagic and benthopelagic communities in the Manus Basin. The use of JAMSTEC submersibles to study pelagic forms (see Hunt et al., 1997) and the development of a standardized methodology for such dives (see Hunt and Lindsay, 1999) has resulted in acquiring new information about pelagic species in general from Japanese waters (see Toyokawa et al., 1998; Hunt and Lindsay, 1999), specific suites of species such as the benthopelagic fauna from Sagami Bay (Lindsay et al., 1998), as well as specific observations on the trophic ecology of two important pelagic species (Hunt and Lindsay, 1998). Hunt and Lindsay (1998) is a good example of how single anecdotal observations can still be instructive about such poorly known species. The hypothesis being tested (given a complete lack of information for pelagic species for the area) was that hydrothermal plumes and bottom topography (features such as smokers and chimneys) would have an effect upon the distributions and abundances of the pelagic fauna living nearby. This report is a summary of the preliminary observations made on this first pelagic submersible dive conducted in the Manus Basin region off Papau New Guinea.

2. Methods & Materials

On November 16, 1998, the first mesopelagic dive in the Manus Basin of the submersible *Shinkai* 2000 was conducted as part of an ongoing study of the biology and ecology of the area (known as the BIO-ACCESS cruises). The survey site was located at 3^0 43.618' S latitude by 151^0 40.352'E longitude, with a bottom depth across the survey area ranging from 1438m to 1679m. The survey site is known as "Pac Manus" (figure 1).

Physico-chemical data was recorded by a SeaBird SBE-19 CTD unit attached to a dissolved oxygen meter. Oxygen readings were reviewed to estimate the depths at which dissolved oxygen levels were lowest.

The *Shinkai* 2000 observational platform includes a Victor GF - S1000 HU three chip CCD camera specially modified for the vehicle. Video footage was recorded onto BCT - D124L Digital Betacam videotapes, which were reviewed in their entirety, animals being identified wherever possible. Furthermore, comments by the observing scientist were recorded on the audio portion of these tapes. Thus the final database was the result of combined video-recorded data and the live observations made through the observation port of the vehicle by the scientist. There were eight lights on the *Shinkai* 2000: five 250 Watt SeaLine SL - 120/250 halogen lamps and three 400 Watt SeaArc HMI/MSR metal halide lamps.

Additional equipment, not standard to the vehicle, was attached for this dive. A six-canister suction sampler, developed at JAMSTEC for the collection of gelatinous midwater fauna, a cage for collecting gastropods, and two Niskin water samplers were employed.

The dive proposal included five objectives: 1) to collect data on the vertical distribution of the mesopelagic community in Manus Basin; 2) to collect data on the benthopelagic community both near to and far from an active chemosynthetic site; 3) to collect representative specimens of key taxa for positive identification and possible morphometric analyses; 4) to correlate physico-

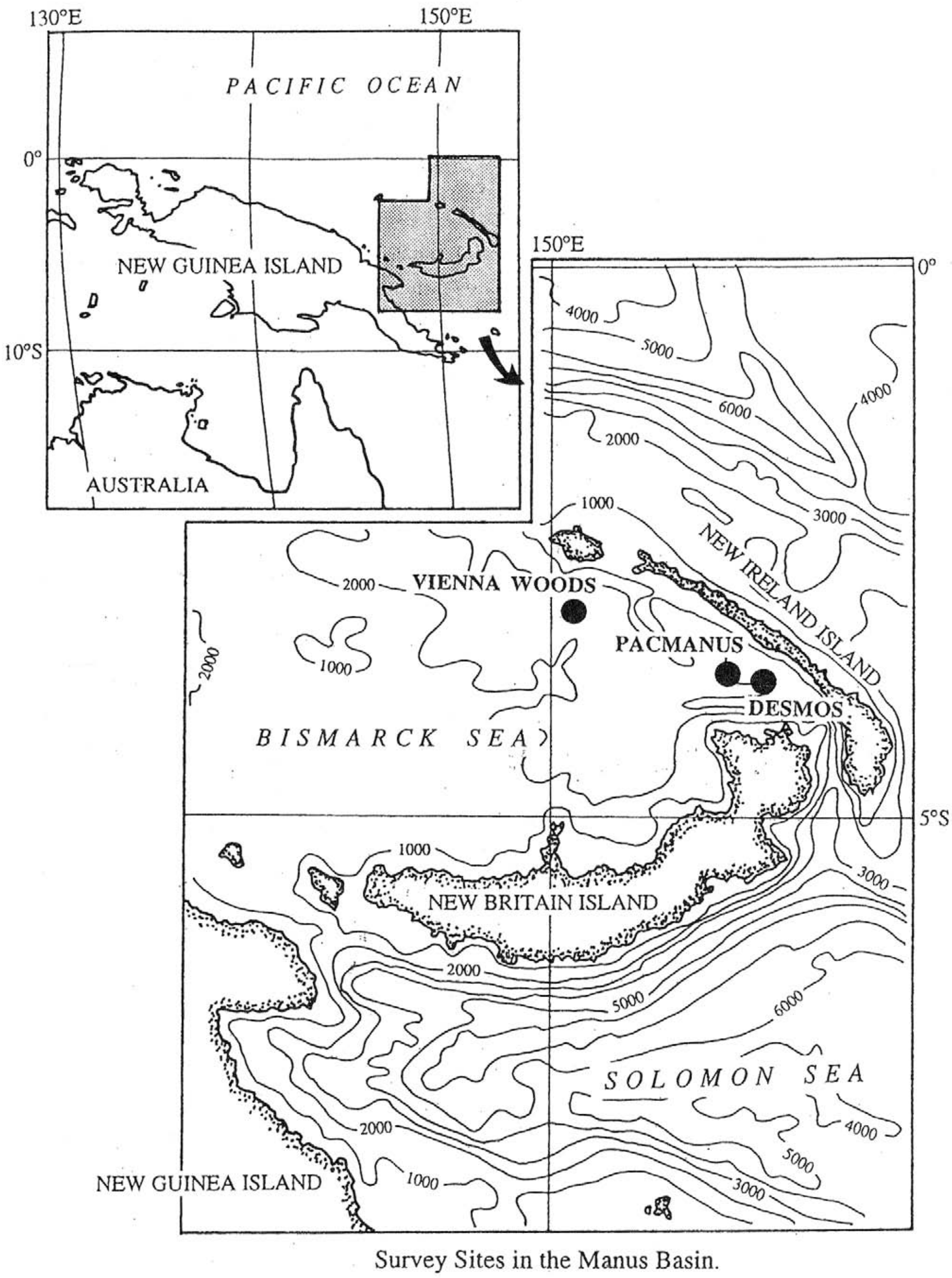

Fig. 1 Map of the survey area in Manus Basin, Papau New Guinea. The pelagic dive (Shinkai 2000 #1070) was conducted at the point marked "PACMANUS."

chemical data with species observed on the dive; 5) to deploy the gastropod cage for Dr. Jun Hashimoto 6) to collect water samples for analyses using two Niskin-type water collectors. We intended to investigate the general affects on abundance of animals near chemosynthetically active areas, above active chimneys, and in the water column in general.

3. Results

3.1 Dive summary:

The dive began at 9:00 am, with decent commencing at 9:08. Lights were turned on at 300m and a water column profile was made from this depth to the seafloor. After a short transit to field 'E,' the gastropod cage was deployed. A transect was conducted due west until south 600m, west 400m. The first Niskin water sample was collected within two meters of the seafloor. A second transect was conducted due south until reaching the Tak site. Patchiness in the abundance of errant fauna, especially polychaetes, was noted. Observations were conducted along the tallest smoker from base to top, including a search 5-10 meters above the smoker, where the second Niskin sample was collected. A survey of pelagic forms directly over the smoker to an altitude of 100+m was conducted. On ascent, tests were performed on the bioluminescent activity within the water column.

3.2 Preliminary dive report

The upper 100m was observed without the aid of artificial lighting. Few animals were observed. One lobate, and several salps were the only identifiable forms at this depth. Marine snow seemed very sparce and the relative abundance of gelatinous forms was low in these upper reaches. However, the general impression during descent was that both species richness and diversity were quite high as compared to areas observed directly around Japan. Yet several appreciable differences were noted. Among them, siphonophores seemed to be quite sparse, especially in the uppermost 400m of water. Conversely, hatchet fish were observed in abundance. Indeed, more were observed in this dive than in all other pelagic dives conducted at JAMSTEC combined. Other taxa which appeared in great numbers were larvaceans in the genus *Oikopleura* as well as at least three distinct forms of pelagic polychaete (figures 2 - 4).

As expected by the oxygen profile, the abundance and diversity of species decreased through the zone containing the lowest oxygen concentration, at around 800 - 1100 m. But the diversity and abundance increased again as the seafloor was approached. Along the sea floor, a distinct benthopelagic fauna was observed. Most of the individuals observed here were of only a few taxa including small medusae, pelagic holothuroids and cydippid ctenophores. The transect from an area without the influence of smokers showed less animals than within the sphere of influence, as measured by an increasing rate of exposure to animals as the submersible approached hydrothermally active areas. The areas immediately above the active smokers showed the fewest pelagic animals. The highest overall effect from the geologic features in this portion of Manus Basin on the pelagic fauna appeared to be within a few meters of the smoker . Composition of species as well as numbers of individuals increased the most in this area.

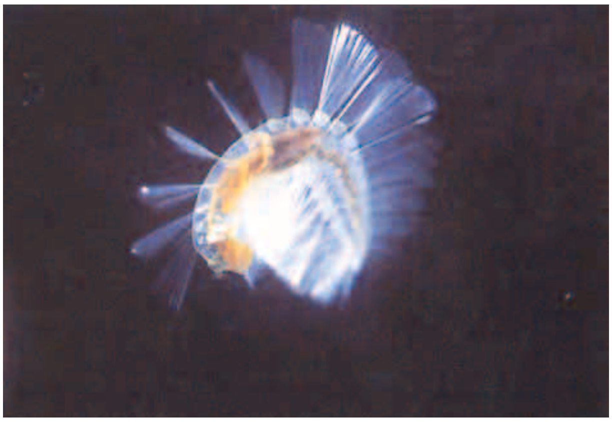

Fig. 2 The “MB type-1” polychaete observed from the Shinkai 2000 in the Manus Basin.

Fig. 3 The “MB Type-1” polychaete observed from the Shinkai 2000 in the Manus Basin, illustrating the form during swimming most associated with this species.

Fig.4 The “MB Type-3” polychaete observed from the Shinkai 2000 in the Manus Basin.

3.3 Specific observations:

Fishes. As previously mentioned, hatchetfishes were common between 400m and 600m during the descent. All had eyes which were not tubular and thus were probably a species of *Sternoptyx*. Although several individuals were observed at the same time in several cases, distances between individuals remained large compared to body length. They were not moving in a coordinated fashion and thus were not schooling, though they did group together in distinct patches.

Along the bottom near geologically active areas, zoarcids were common. These fish were not observed in the water column, nor in the benthopelagic layer in areas away from hydrothermally active areas. We noted that zoarcids living near the bottom were never observed to curl up as has been described for other members of the family (Robison, 1999). The proposal that midwater zoarcids curl to a circular shape to mimic the body form of medusae is anecdotally supported by this observation, as such mimicry would presumably not be necessary along the bottom at these depths.

Octopuses. Two species of octopus were observed during this dive, though neither could be identified to family. One, a large incirrate octopus was observed curled up under a rock next to an active smoker at 1671 m. When approached by the submersible for observation, it curled its arms tighter around the mantle and eyes. The suckers were exposed and appeared to be in two rows. However, closer inspection showed that the connective tissue between the suckers was in a zig-zag pattern alternating between suckers in both rows. This pattern has been observed before in several deep-sea octopods which, when preserved, have suckers aligned in one row (Hunt, pers. obs.), Thus deep-sea octopod families with one row of suckers often move those suckers so as to create two functional rows.

The other specimen was a small cirrate (total length estimated as less than 5 cm.) which began swimming soon after the submersible lights were trained on it. Although observed close-up and in good detail, an identification could not be made because this cirrate appears inconsistent with any species description currently in the literature (Hunt, pers. obs.). It had minuscule eyes. Indeed the eyes were so small as to go unnoticed at first. Only with concerted effort at finding the eyes were they eventually observed. Whether or not this represents a new cirrate species or a juvenile form of a described species is unknown.

Polychaetes. Three distinct forms of polychaetes were observed in relatively high abundances. One form (MB type-1) had long bristle-like parapodia and a brownish-yellow gut (figures 2 - 3). A second form (MB type-2) looked morphologically similar to the first form except with a bright red stripe down the median third of the dorsal and ventral surfaces (picture not available). The final form (MB type-3) was quite different from the first two. The body was stouter, with short parapodia (or with parts of the parapodia broken off or autotomized), a dark brown head, with a single dark stripe created by the gut (figure 4).

The behavior of these forms differed. The first two forms were always errant, swimming forward with a serpentine movement of the body (see figure 3). Close examination of live specimens showed that the length of parapodia and arc of the body during swimming were such that the distal tips of the parapodia barely touched as the parapodia moved metachronically to create waves moving in opposition to the direction of travel. Conversely, the third type of polychaete was rarely observed moving, but rather usually observed hovering stationary above the seafloor. The body was curved slightly with the head angled down. When disturbed, the body flexed back and forth, arcing both the head and tail ends. This motion appeared inefficient for traveling and it is assumed that this species does not travel great distances from the bottom (it was also observed only within 20 m of the seafloor).

4. Discussion

Although there is insufficient observation time to draw any certain conclusions, it appears from the data available that the hydrothermal activity associated with active smokers does have some affect on the abundances of the bottom-associated pelagic fauna. The highest abundances of pelagic specimens were observed in areas proximate to the highest abundances of chemosynthesis-based communities. We note two possibilities to explain this result. First, it is possible that some pelagic species aggregating near chemosynthetically active areas are using the increased biomass of the chemosynthesis-based communities as a source of food. Though there is no direct evidence as to what these pelagic species are ingesting. Second, it is possible that these species are gaining a defensive benefit, either from the complex topography of the region or the toxicity of the chemicals venting. Both methane and sulfide are toxic to most organisms. Species occurring in chemosynthesis-based communities are classified into three types: endemic, colonists, and vagrants (see Carney, 1994; Fujikura et al., 2000). Thus it is possible to borrow this terminology to describe the aggregation of gelatinous forms and benthopelgic species as possible vagrants.

The overall abundances of the pelagic community appeared higher than at other survey sites around Japan (Hunt, pers. obs.). Some of these preliminary observations cannot be readily explained, such as the apparent low abundances of siphonophores or the high abundances of hatchet fish. Other observations are easy to explain. The low diversity and occurrences of animals within the zone of low oxygen reflects the physiological limitations incurred in living in such areas. Similar results have been noted and discussed regarding pelagic taxa (Hunt, 1996).

Conversely, the abundances of pelagic animals directly above an active smoker were minimal. The toxicity of the plume obviously prevents pelagic species from residing within its sphere of influence. There were fewer animals observed on ascent than on decent in the waters above the tallest active smoker at the survey site. However, as this is common due to the interference of the submersible itself with pelagic forms as it ascends, it was impossible to say with certainty where the effect of the smoker ended. Using these preliminary observations, future dives can target specific areas, using transects above and to the side of an active smoker, to ascertain just how influential the effects of hydrothermal plumes are on the benthopelagic species as well as the effect, if any, on the mesopelagic species living well above the plume.

While it was not possible to categorize and quantify the effects from a single dive, it appears the hypothesis that chemosynthetically active areas such as hydrothermal vents which create topographically complex areas does have an effect on the composition and abundances of the pelagic community. Future dives should clarify these observations and eventually quantify the specific influences of such areas on pelagic organisms.

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(Manuscript received 24 December 1999)