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STUDIES OF *NAUTILUS BELAUENSIS* IN PALAU

Observation of the Sea Bottom in the Habitat of *Nautilus* by a small Remotely-Operated Vehicle

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Introduction

A remotely- operated vehicle (ROV) is a kind of tethered unmanned self- propelled underwater vehicle which is used for remote real time observations and works without the aid of a man in the sea. Real- time observations are provided by colour TV(s) or black and white TV(s) installed on the vehicle and lighting for the TV(s) camera is provided by underwater lights. A control unit, TV monitor(s) and other handling devices are kept on the deck of the support ship. The control unit and the vehicle are connected by a cable for communication and electric power transmission. A pilot controls the vehicle with a small joystick by watching the TV monitor(s) while other personnel observe the real- time pictures of the sea bottom or other interesting features.

Since early 1970 more than 1,300 units of tethered ROVs of various sizes and functions have been manufactured in the world and about 130 of these were manufactured in Japan.

In these years ROVs were mainly used in other countries by off-shore oil industries and for mine hunting by Navies, however, most of the ROVs in Japan were used for fisheries related jobs, scientific surveys, submarine cable maintenance and repair, dump site inspection for electric power generation and harbour civil engineering. In recent years, the utilization of ROVs for scientific surveys has progressed, especially in Japan (1) (2) and the USA(3).

Since 1979, the writer and his staff in JAMSTEC have developed, tested, and operated several types of ROVs for scientific use which have ranged from very small, shallow depth ROVs (100 to 300m), and small size ROVs to large, deep water ROVs (3,300m).

Small still cameras play very important roles for the observation of *Nautilus* at living sites as shown by Saunders (4) and Hayasaka *et al.* (5). The results have been very successful and have provided information relevant to *Nautilus* as well as associated bottom organisms and bottom sediments. Moreover, the still camera has many advantages, such as small size, light weight, simple controls, easy handling and low cost. However, the still camera has some limitations for broad environmental observations around living sites of *Nautilus*.

Towing TV and ROV are applicable for relatively broad bottom surveys, but towing TV is thought to be dangerous for very irregular and rugged sea bottom areas, such as the area studied. A small ROV is suitable for a bottom survey, but

it has limitations in depth. Usually, a small handy ROV is designed for a maximum operating depth of about 100 to 150 meters. It was considered that the required depth of ROV for the study of *Nautilus* should be more than 150m and 300 to 500m was preferred. But there are no ROVs which can operate in depths of more than 150m and be transported by air in hand baggage as the size and weight of such ROVs is beyond the weight limit allowed in airplanes.

The smallest ROV in Japan was selected for this study. The maximum depth capability of the ROV (△-100 of Q.I.Inc., Tokyo) was 200m, but it usually can exceed this limit using another cable of 100m in length. The special optional cable of 150m was borrowed together with the ROV from Q.I.Inc. This depth limit was not sufficient to observe *Nautilus* in their living sites, but this is the first attempt to use an ROV for *Nautilus* study and observation of the shallow part of the wall of the reef is interesting and provides a very important experience for future operations of ROVs which have deeper depth capabilities. The other purpose to use an ROV is to observe the sinking behaviour of *Nautilus* with tags when they are released.

System description of ROV, △-100

The system is composed of deck units and the underwater cable and the vehi-

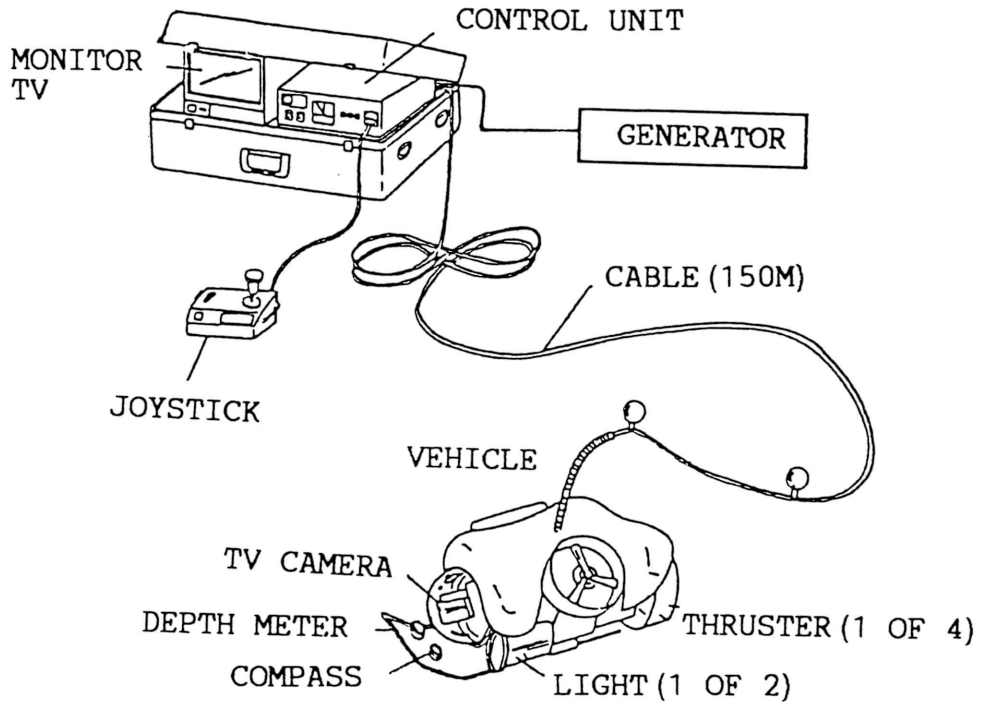


Fig. 1 System configuration of ROV, △-100

Table 1 Specifications of △-100 ROV

Vehicle
- Max. operating depth: 200m
- Size : 42(W) x 49(D) x 28(H) in cm
- Weight : 16kg in air 0kg in water
- Speed : 2.5knots(forward)
- Thrusters : 4 x 70WDC
- TV camera : 2/3〃CCD color, resolution 350 lines, sensitivity 5 Lux lense 4.5mm Fl.8 with remote focus and tilt(±45°) control viewing angle horizontal 95°, vertical 74°
- Light : Halogen lamp (2 x 100V, 200W)

Control unit
- Size : 65(W) x 54(D) x 31(H) in cm
- Weight : 19kg with a container
- Power requirement : AC 100V 2KVA

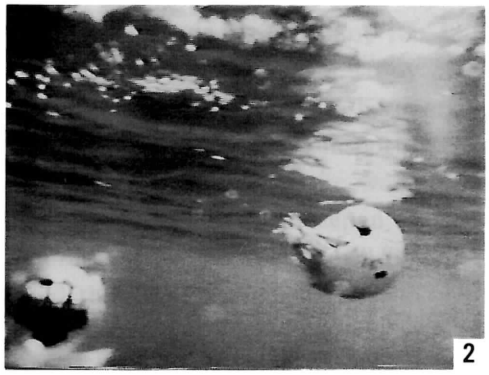
Monitor TV : 10kg
Cable : 27kg(150m)
VTR : 4kg
Generator : 37kg
Container : 5kg(for the vehicle)

Total weight : 120kg(Approximate)

cle. Deck units are composed of control units, joystick, TV monitors and an electric power generator. Fig.1. shows the system configuration and Table 1 shows the specifications of the system. The total weight of the system used was about 120kg including the electric power generator. The total system can be transported and operated by two people.

Observation of released Nautilus by ROV

Trapped *Nautilus* were released with tags except for specimens which were cultured at MMDC and for collected specimens. The observation of released *Nautilus* was carried out once at the time of release. Several nautili were released on the surface of the sea and many of them proceeded to deeper waters several minutes after their release. One of them was observed by ROV, but this one did not move soon (Fig.2), so a diver took the *Nautilus* to a depth of 15 meters and released it. This particular *Nautilus* protruded its tentacles and seemed to go down (Fig. 3) but it gradually ascended. The diver tried to release it at the depth of 15 meters but the *Nautilus* ascended to the surface again. Finally it was seen drifting away beyond the limit of the ROV. The observation of the descending behaviour of *Nautilus* was therefore not successful.



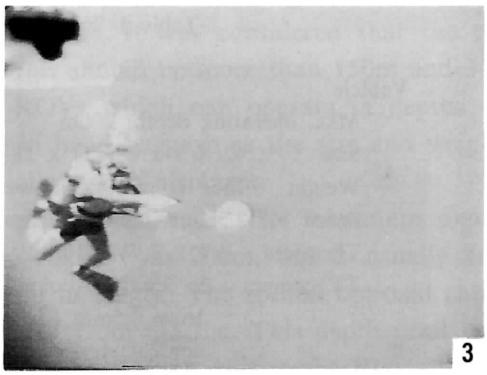


Fig. 2. *Nautilus* released on the surface of the sea.
Fig. 3. *Nautilus* released by a diver to the depth of about 15m.

Observation of the reef wall by ROV

Observation of the upper part of the wall of the Augulpelu Reef was carried out at maximum depth of about 120 meters. Two stations are shown in (Fig. 4～Fig. 11) as MU- TV2 and MU- TV3. At MU- TV3 (the Northwest wall of the reef), the observations were carried out at depths between 30m to 120 meters. A massive limestone rigid cliff was observed at a depth of about 90 to 120m (Fig. 4). The vehicle was propelled above the ridge; the topography of the ridge was rather flat on the top and ragged on the side wall. There was a terrace at 80 to 90 meters and the top of the terrace was composed of indurated coral and algae and had no living organisms (Fig. 5). On the side wall of the ridge there were living organisms as shown in Fig. 6 to Fig. 8. At depths of about 70m to 80m several mounds were observed; the depth of the mounds was about 1 meter with a height of about 20 to 30 cm (Fig. 9). There was debris of coral and algae and white-coloured medium to coarse sand which filled the space between the debris depth between 30 to

Fig. 4. Massive limestone forming steep cliff was observed at depth of about 90m.
Fig. 5. Flat part composed of indurated debris at the top of the ridge of depth about 80m.

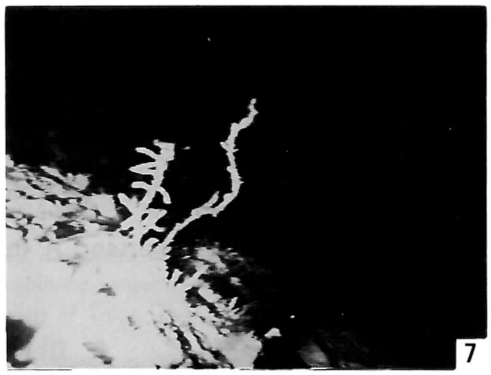


Fig. 6-8. Living fauna observed at the side wall of the ridge.

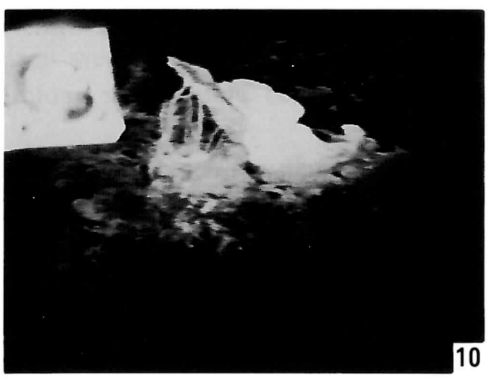


Fig. 9. A mound observed at depth about 70 to 80 meters.

Fig. 10-11. Living coral observed at a depth of about 30 meters.

70 meters. Living coral was observed at depths shallower than 30 meters (Fig. 10, Fig. 11).

Concluding remarks

The first trial of the ROV did not seem so successful because of the depth limitation. But the experience itself as well as some observations about the wall of the ridge of the reef are important. A more powerful and deep operating ROV will be used in future trials.

References

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