

# XI. DRILLING WORK WITH THE SUBMERGED ROCK DRILL MODEL MD500H ON BANKS NORTHEAST OF HACHIJOJIMA ISLAND

*Eiji Inoue, Yasumasa Kinoshita, and Makoto Yuasa*

## Introduction

The submerged rock drill MD500H was used at three sites where rock sampling by rock-corer, dredge and grab was difficult because of the flat surface and hard rocks of the sea floor (Fig. XI-1). The Kitakurose and Shinkurose

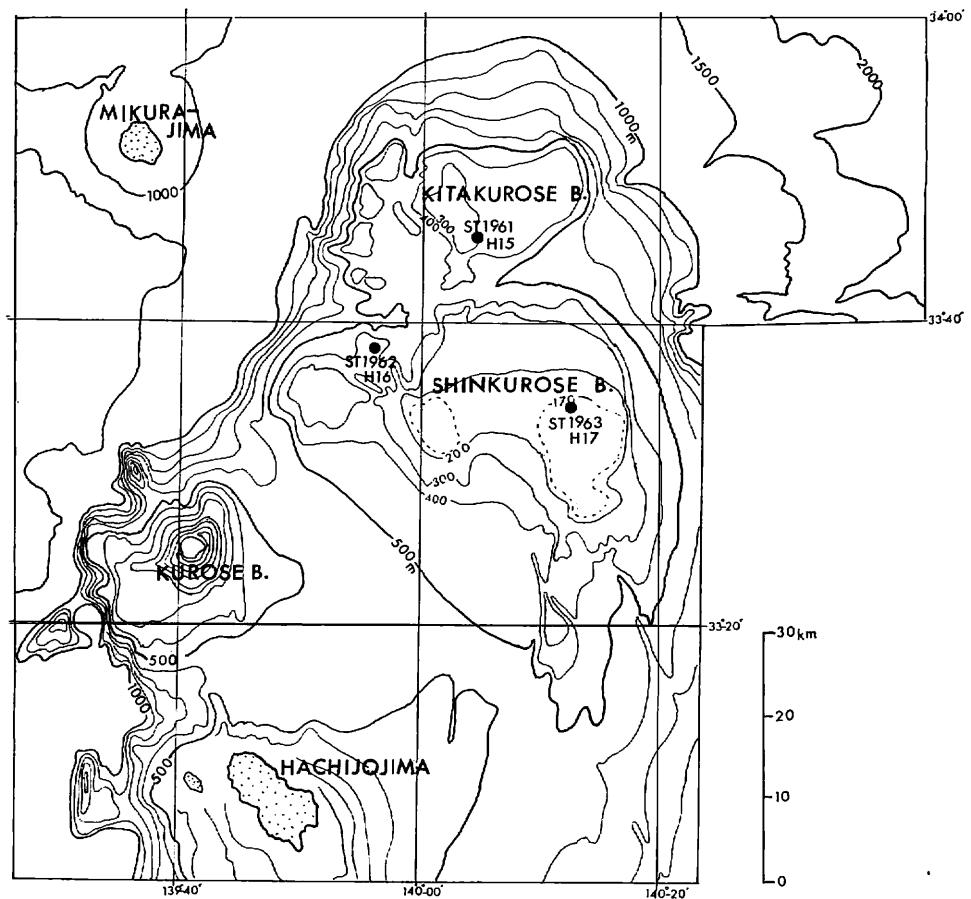


Fig. XI-1 Drilling sites of rock drill MD500H.

Banks on which drilling was performed are situated north of Hachijojima Island on the Shichito Ridge. The banks are small plateaus with wide and nearly flat tops. In dimensions, the Kitakurose and the Shinkurose Banks are 20 and 35 km from east to west, and 10 and 20 km from north to south respectively, and the tops of the banks are 300 to 400 m and 200 to 300 m below sea-level respectively.

Although the banks are composed of volcanic rocks, the uppermost parts are covered by limestone or sedimentary rocks of probable Quaternary age. During cruise GH79-4 in July, 1979, the MD500H machine was used for taking rock samples from three sites at the western limit of the top of the Shinkurose Bank and the top of the Kurose submarine caldera. As a result of this work, rock cores of limestone and tuff breccia were recovered (INOUE, HONZA and ISHIHARA, 1979, and INOUE and YUASA, 1981).

During the present cruise, the machine was again used at three different sites on the tops of the Kitakurose and Shinkurose Banks to determine the composition of the banks. As a result of the work, two short rock cores were obtained from the banks. This report is related to the progress of drilling operations with the MD500H machine.

#### Specification of model MD500H

The machine (Fig. XI-2) can take a rock core of 6 m in length from the

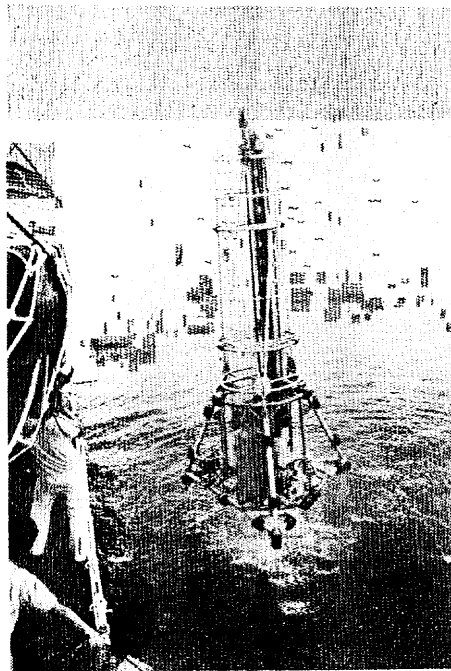


Fig. XI-2 Submersible rock drill MD500H.

sea floor at a maximum depth of 500 m. It is driven by 48 V battery and remote-controlled by a sonar control system on board. The specifications of the machine are as follows.

Model	MD500H Marine Drill
Method	Submerged core drill, 1 cycle automatic drilling DC motor and batteries
Water depth and sea current	Maximum 500 m and less than 3 knots
Rock core	44 mm in diameter and 600 cm in length
Length of stroke	630 cm
Drill head	Bit thrust pressure 0-450 kg, torque 377 rpm
Water pump	28 lit/min
Control system	Automatic including sonic control system
Motor	DC submerged motor of 3 kw
Battery	48 V
Dimensions	7.8 m in height, 3.2 m in length and 3.7 m in width
Weight	3,300 kg in air and 2,200 kg in water

In addition, a Hydroproducts undersea camera was attached to the bottom frame of the machine for observation of the sea bottom at the drilling sites.

#### **Method of drilling**

The drilling was done by the same method as used in previous cruises (INOUE and YUASA, 1981, MARUYAMA, OSHIKA, INOUE, and YUASA, 1978). In order to avoid the difficulty of having the machine fall to the sea floor during the drilling work under the pull of the wire rope of vessel, three buoys with a total buoyancy of 105 kg and a total weight of 100 kg were attached to the wire rope; that is, the distances of the buoys and the weight from the machine were 40 m and 80 m along the wire rope respectively.

To understand the ship drift simple tests were carried out at the drilling site before drilling was commenced. The tests were based on the behaviour of a wire rope hung from the block and the weight of on the sea floor, and were continued for about thirty minutes at each drilling site.

For drilling the sea bed, metal chip and diamond chip bits were used and the thrust pressure, drilling time and maximum workable inclination of the machine were set at 220 to 275 kg, 45 minutes and 10 degrees respectively.

#### **Results of the drilling work**

The drilling work was carried out at three sites on the tops of the banks on July 28 and 29, and rock cores were obtained from two sites. The results of the work are summarized in Table XI-1.

St. 1961 (H15): The site was situated at a depth of 300 m on the top of the Kitakurose Bank where a current flowed southeastward at about 1.5 knots. The work was carried out in almost calm sea conditions and fine weather during the afternoon of July

Table XI-1 Rock drill MD500H operation data

Sample No. & station No.		H 15 (ST1961)	H 16 (ST1962)	H 17 (ST1963)
<b>Station</b>				
Places		Kitakurose bank	West part of shin-kurose	Top of Shinkurose bank
Latitude		33°-45.4'	33°-38.0'	33°-33.65'
Longitude		140°-04.4'	139°-56.6'	140°-12.2'
Depth of water		300 m	347 m	170 m
<b>Drill condition</b>				
Bit used		Metal tip	Diamond bit	Diamond bit
Thrust		220 kg	275 kg	275 kg
Rotation		377 rpm	377 rpm	377 rpm
<b>Operation condition</b>				
Buoy attached		3 × 35 kg	3 × 35 kg	3 × 35 kg
Weight attached		100 kg	100 kg	100 kg
Distances of buoy & weight from machine		50 m & 100 m	50 m & 100 m	50 m & 100 m
Lowering speed of wire rope		30m/min.	30m/min.	30m/min.
Extention of wire		600 m	355 m	400 m
<b>Results</b>				
Penetration		110 cm	0	160 cm
Length of core		85 cm	0	90 cm
Rock core		Calcareous coarse sandstone	—	Algal limestone
<b>Day &amp; time</b>				
Date		28, July, 1980	29, July, 1980	29, July, 1980
Time	Start	11 : 26	08 : 31	13 : 14
	Finish	14 : 02	10 : 30	15 : 05
	Drilling duration	45'	—	45'
	Total duration	156'	119'	111'
<b>Weather &amp; sea condition</b>				
Weather		Clear	Clear	Clear
Wind		NE 5 m/sec	NE 2 m/sec	NNE 3 m/sec
Wave Height		<1 m	<0.1 m	<0.1 m
Water current		SE 1.5 kt	ESE→NE 1.5 kt	SW 2 kt
Remarks	Process	11:26 Start of lowering machine	08:31 Start of lowering machine	13:14 Start of lowering machine
		33-35 Buoy & weight attachment	40 Attached buoy	19 Attached buoy
		46 Machine arrived at bottom, but Machine	50-09:30 Moved ship for correct position	24 Attached weight
			40 Machine arrived at	43 Machine arrived at bottom

Sample No. & station No.	H 15 (ST1961)	H 16 (ST 1962)	H 17 (ST 1963)
	dipped	bottom, but	47 Start of
12:00	Again	machine	drilling
	arrived at	dipped	14:34 Finish of
	bottom, no	52 Machine	drilling
	dipping	arrived at	36 Start of
12:30	Start of	bottom	lifting
	drilling	again	machine
13:19	Finish of	58 Machine	48 Machine left
	drilling	unmoved	bottom
23	Pulling up	for	54-58 Took off
	machine	abnormal	buoy &
38	Machine	state	weight
	left bottom	10:11 Machine	15:05 Recovered
48-52	Took off	left bottom	machine on
	buoy &	10:30 Recovered	board
	weight	machine on	
14:02	Recovered	board	
	machine on	Failed for drilling	
	board		

28, without serious trouble from the machine. The penetration of the core barrel was only 1.1 m owing to jamming inside of the barrel, although the machine was operating throughout the drilling time. A core of 85 cm length of pebbly, calcareous, coarse sandstone was obtained (Fig. XI-3).

St. 1962 (H16): The site was located at a water depth of 347 m on the western ridge of the Shinkurose Bank and drilling took place during the morning of July 29. Sea conditions and weather were calm throughout the drilling operations. The machine was lowered into the sea, but it failed to reach the sea bottom at the correct inclination, (i.e. less than 10 degrees), and so the motor of the machine stopped. It was presumed that the abnormal inclination of the machine was caused by a strong bottom current differing from the surface current.

St. 1963 (H17): The machine was operated at a depth of 170 m on the flat top of the Shinkurose Bank during the afternoon of July 29. The site was near the old drilling site (H11) where no rock core had been obtained by the machine during cruise GH79-4. Sea conditions and weather were reasonably quiet, but a current flowed southwestward at about 2 knots. The drilling work proceeded favourably. The penetration of the core barrel into the sea bed was 1.6 m, and 90 cm of rock core of sandy algal limestone was obtained (Fig. XI-3). The short penetration was due to jamming inside the core barrel.

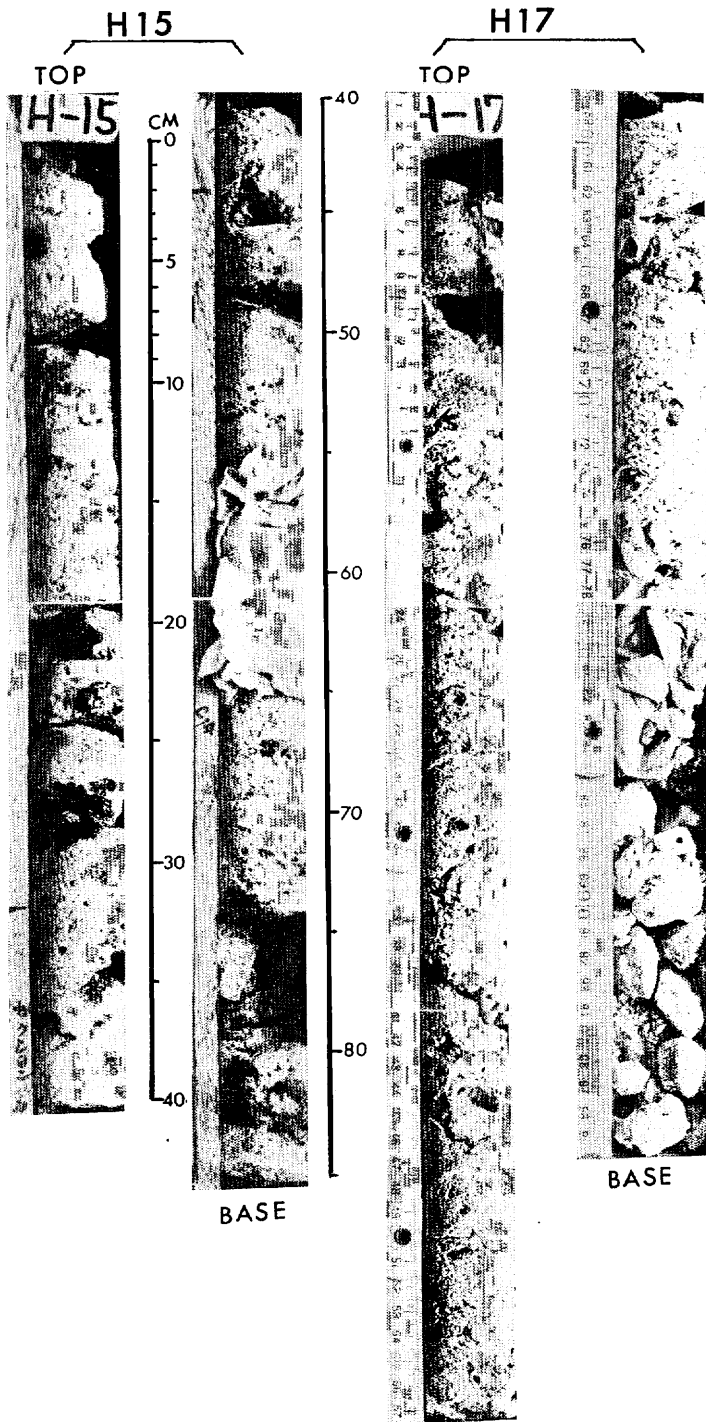


Fig. XI-3 Rock cores obtained by the drill. H15 is a core of calcareous, coarse sandstone from top of the Kitakurose Bank. H17 is a core of sandy, algal limestone from the top of Shinkurose Bank.

## Conclusions

The results of the drilling operations indicate that the flat, top areas of the Kitakurose and Shinkurose banks are mainly composed of calcareous sedimentary rocks of probable Quaternary age.

With respect to the engineering and operation of the machine, there are some problems to be overcome in the short penetration of core barrel into hard rock formations and trouble with transmission between the sonic control system on board and the machine on the sea bottom. In relation to the former of these problems, it is necessary to increase the power of the water pump of the machine in order to prevent jamming and to use a bit more suited to the nature of the rock. The latter trouble may be avoided by changing the position of the transducer attachment of the sonic control system.

## References

- INOUE, E., MARUYAMA, S., YUASA, M., and OSHIKA, H. (1978) Submerged rock drill, MD-500H. *Reprint of the 5th International Ocean Development Conference*, Tokyo. B2, p. 41-46.
- MARUYAMA, S., OSHIKA, H., INOUE, E., and YUASA, M. (1978) Development of submerged rock drill MD500H and results of drilling works. *Geological News*, no. 292, p. 34-41 (in Japanese).
- INOUE, E., HONZA, E., and ISHIHARA, T. (1979) Marine geological activity around Japan: Research cruises of Hakurei-maru in 1979. *Geological News*, G.S.J. no. 304, p. 10-26 (in Japanese).
- INOUE, E. and YUASA, M. (1981) Rock core sampling from the banks north of Hachijo Island using the submerged rock drill "MD500H". *Cruise Report*. no. 14, p. 123-129.