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Summary

While engaged in seismic operations in Tayabas Bay, Luzon, the Philippines, the Australian registered research vessel Rig Seismic grounded on an uncharted reef.

The vessel was refloated without assistance.

No pollution occurred and the vessel suffered only minor damage.

Sources of information

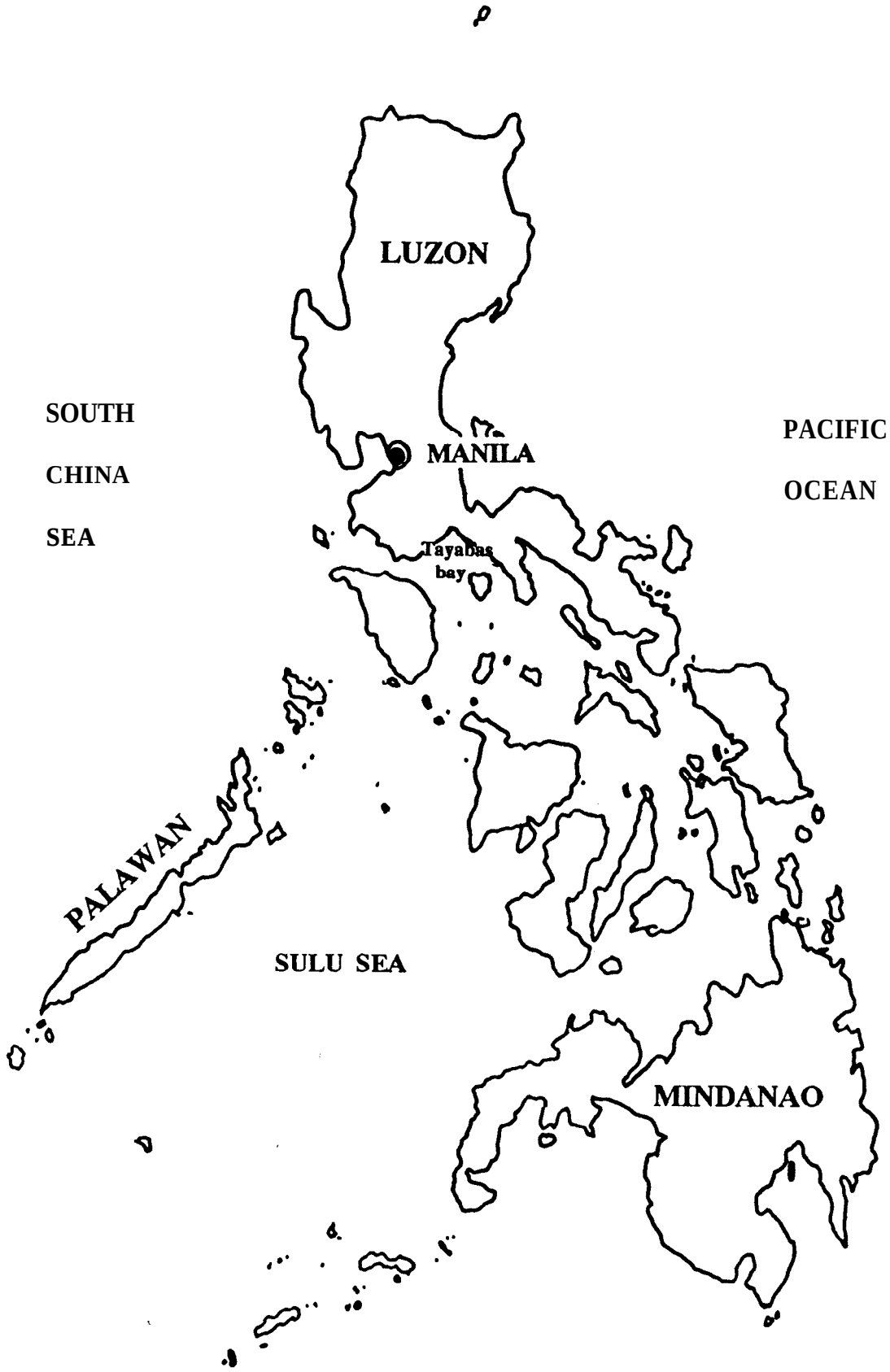
The Master and the Integrated Rating/Diver of the Rig Seismic were interviewed on board the ship in Darwin on 16 May 1992.

The Assistant Manager, Ships Operations, Australian Maritime Safety Authority, Brisbane, provided information regarding his visits to the Philippines.

The Bureau of Mineral Resources, Department of Primary Industries and Energy, provided information on the enhanced satellite imagery.

Under the provisions of sub-regulations 16(3) and (4) of the Navigation (Marine Casualty) Regulations if a report, or part of a report, refers to a person's affairs to a material extent, the Inspector must, if it is reasonable, give the person the report, or part of the report, to allow the person to provide written comments or information relating to the report.

The Assistant Manager, Ship Operations and the Master both provided additional advice and background information concerning the commercial and procedural aspects of the operation.



PHILIPPINES

PHILIPPINE ISLANDS

TABLAS STRAIT

WITH PART OF

SIBUYAN SEA

FROM THE UNITED STATES GOVERNMENT CHARTS TO 1935.

All Bearings are True (from 000° round) and are given from Seaward.
All Heights are expressed in Feet above High Water Springs.
For Abbreviations see Admiralty Chart 5011.

SOUNDINGS IN FATHOMS
(under Eleven in Fathoms and Feet)
reduced approximately to the level of Mean Lower Low Water

Natural Scale [illegible] (at Lat 12°00')

LUZON

TAYABAS BAY

ENTRANCE TO

VERDE ISLAND

PASSAGE

MOMPOG PASS

CABRA

CALUCENA

Cabalitan

Tagbilaran

Grumalan

Talipanan

Malabrigo Pt

Ramirez Pt

Balatasan Pt

Lupak Pt

Salmague I.

Salmague Pt

Gasper I.

Malcher I.

Balbazar I.

Marlanga Pt

Marlanga R.

Tres Reyes Is.

Sibay

Sibuyan Sea

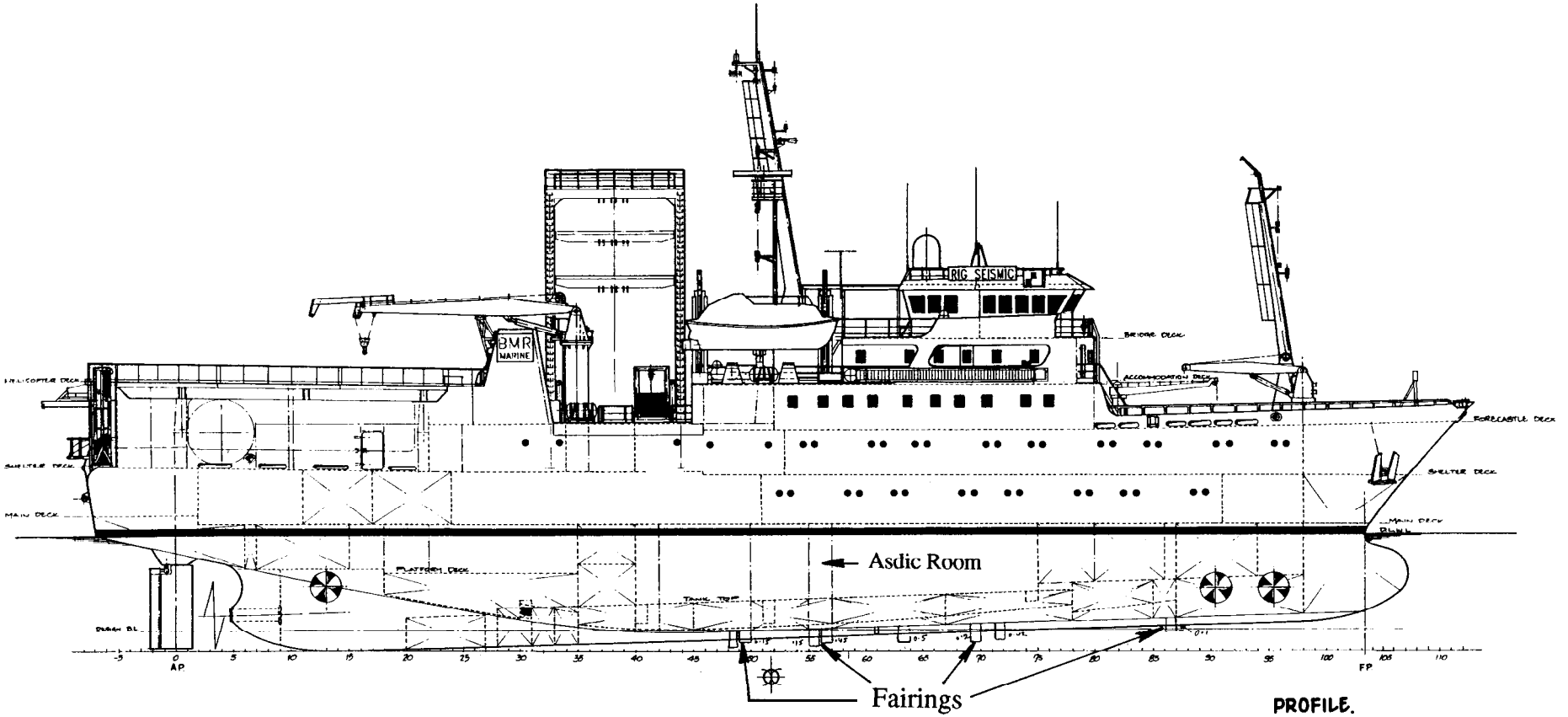
Tide Information

Place	Lunitidal Interval		Height above datum of soundings	
	H.W. Mean	L.W. Mean	Mean H.W.	Mean Lower Low
Cuyo				
Leaman	11h 30m	XVIIh 37m	4½ feet	3½ feet
Pingy	11 . 30 .	XVII . 31 .	4½ .	3½ .
Rasacasa	11 . 30 .	XVII . 33 .	5½ .	4½ .
Agutaya Bay	11 . 32 .	XVII . 35 .	5½ .	4½ .
Manamboque -				
P. Balamban	11 . 25 .	XVII . 14 .	5 .	3½ .
8th Cove	11 . 30 .	XVII . 31 .	5 .	3½ .
Tonque	11 . 25 .	XVII . 26 .	5½ .	3½ .
Manares to Campon				
P. Concepcion	11 . 16 .	XVII . 24 .	5 .	3½ .
Mindoro -				
Mansalat	11 . 15 .	XVII . 21 .	5 .	3½ .
Tablas -				
P. Look	11 . 17 .	XVII . 24 .	5½ .	3½ .
Romblon I. -				
Romblon	11 . 20 .	XVII . 33 .	5½ .	3½ .

CAUTION - owing to the large Diurnal tide, information obtained from these constants may be considerably in error

SOUTH ISLET - METRES

FATHOMS	1	2	3	4	5	6	7	8	9	10
FEET	6	12	18	24	30	36	42	48	54	60
	18	36	55	73	91	110	128	146	165	183
1	01	21	39	58	76	94	113	131	149	168
2	08	24	43	61	79	97	116	134	152	170
3	09	27	45	64	82	100	119	137	155	173
4	11	30	48	67	85	103	122	140	158	177
5	13	33	52	70	88	107	125	143	161	180



RIG SEISMIC - GENERAL ARRANGEMENT

Details of ship

Name:		Rig Seismic
Port of Registry:		Newcastle
Builder:		Flekkefjord Slipp and Mask A/S
Year Built:		1982
Type of Ship:		Research, Seismographic
Owner:		Galerace Ltd, Great Britain
Operator:		Australian Maritime Safety Authority
Crew:		Australian
Classification Society:		Det Norske Veritas
Length overall:		72.52m
Beam:		13.81m
Depth Moulded		8.20m
Draught:		6.70m
Tonnages:	Gross	1545
	Nett	372
	Deadweight	1500
Main Engine:		Vee Oil 4SA 12 cylinder, 1942 kW constant speed
Propeller:		Single, four blade, variable pitch

Background

The Rig Seismic is a geoscientific research ship, designed for collecting information for hydrocarbon and mineral resource evaluation and assessment.

The ship had been chartered under the Australian Aid Program, to assist the Government of the Republic of Philippines in undertaking technical and geoscientific programs to promote exploration for petroleum in offshore Philippines basins.

The project involved the collection of 2500Km of multi-channel seismic reflection data plus hydrocarbon-detection, geochemistry data and other underwater geophysical data, to be carried out during April and May 1992.

The Rig Seismic was required to carry out seismic operations in two different areas: Area 1 in the Sulu Sea, in waters to the east of Palawan Island; and Area 2 in waters either side of the Bondoc Peninsula, Luzon.

Preparations

Before the ship proceeded to the Philippines, the Assistant Manager, Ships Operations visited companies, both in the Philippines and in Singapore, which had conducted similar types of operations in Philippines waters, to seek their advice and to obtain as much information as possible on the operational areas.

Satellite imagery photographs were obtained, and compared with the available US Coastguard, British Admiralty and Philippine Government charts and the information contained in the relevant pilot books.

After careful comparison of the charts it was decided that the Philippine Coast and Geodetic Survey chart number 4272 would be used for the operations in Tayabas Bay. This chart, published in February 1962 and revised in May 1977, was apparently based upon the US Coastguard chart of the area, its advantage being that it did not have the LORAN hyperbolic curves and, therefore, the seismic grid courses would be easier to see. However, all the available charts were provided to the ship for reference.

Before the Rig Seismic sailed from Australia the Assistant Manager, Ships Operations paid a further visit to the Philippines, this time taking the ship's Master with him. During the visit they flew over the areas in which the seismic operations were to be conducted, comparing the charts and satellite imageries with the visual aeriel view. Due to fuel limitations of the aircraft towards the end of the flight, a choice had to be made between flying over either the stretch of coastline bordering Tayabas Bay or the north

coast of Marinduque Island. As mine tailings dumping on the north coast of Marinduque Island protruded towards the operational area, it was decided to fly over that area of coastline. During the flight, reefs and shoals had shown up clearly and were checked against the charts, which were found to accurately depict the reefs. It was considered therefore, as the satellite imagery indicated no uncharted reefs in the Tayabas Bay area, the charts of that section of coastline would also be reasonably correct.

Arrangements were made for the charter of a small local vessel, to act as support and 'chase' boat. The 21m twin screw African Queen II was chartered for this purpose, the Master of which was very experienced in survey and salvage operations.

Normally the Rig Seismic is operated with a Master and two Deck Officers, the Master standing the 8-12 watch. However, for the Philippines operation it was decided that an additional Deck Officer would be carried, thus relieving the Master of watchkeeping duties.

The operation

The Rig Seismic commenced operations in Area 1 on 31 March 1992, completing in that area on 10 April 1992, after which it proceeded to the port of Mabini, for operational discussions with the charterers. Operations commenced in the Tabayas Bay section of Area 2 on 12 April 1992.

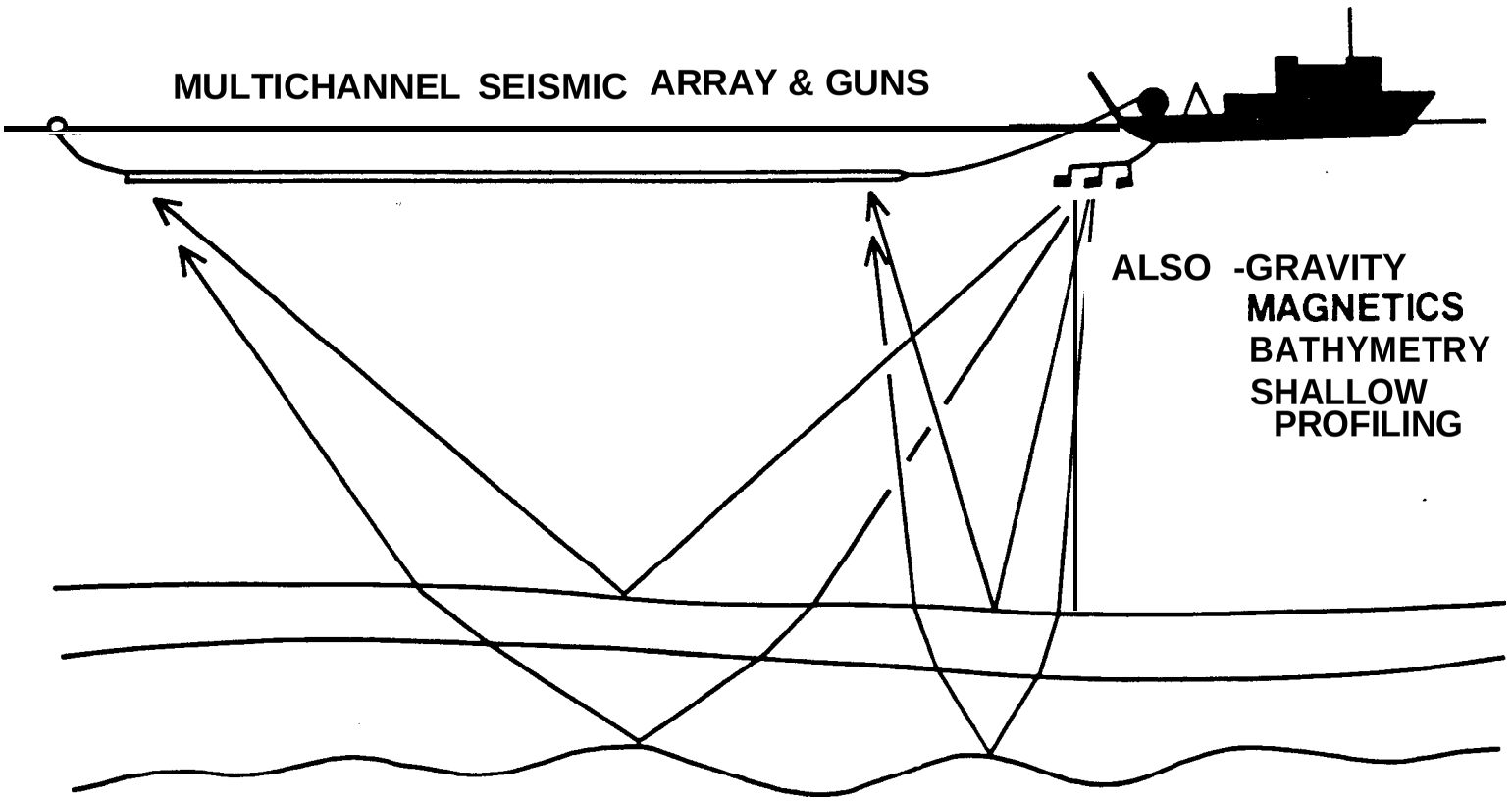
For seismic surveys the Rig Seismic tows an arrangement of lines consisting of the seismic cable and two gun arrays.

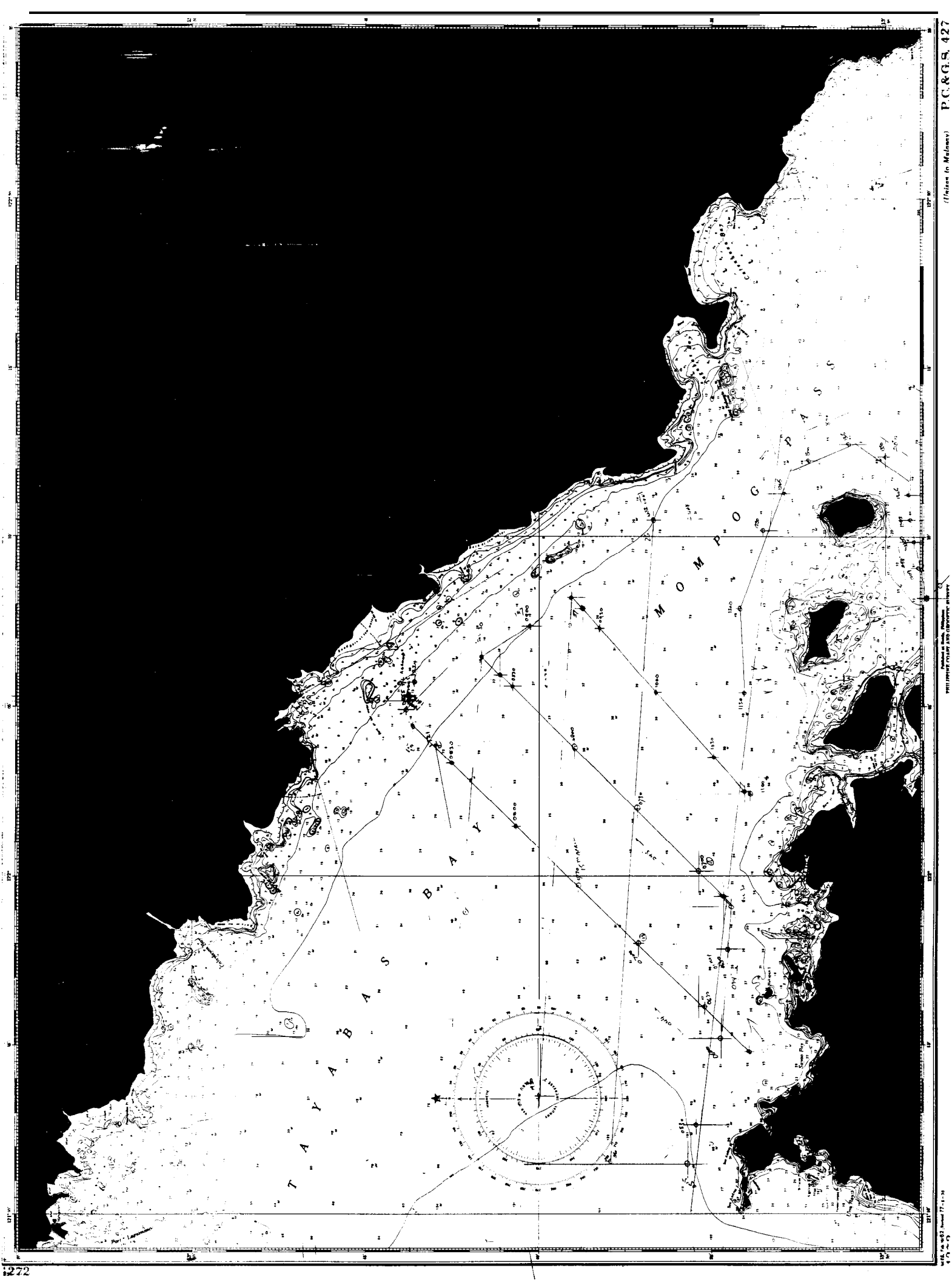
The seismic cable, a hollow synthetic tube filled with a kerosene-based fluid, to provide near-neutral buoyancy, and containing electronic receivers, extends 2600m astern of the ship at a depth of 8m. The end of the cable is marked by a buoy equipped with a flashing light and a radar reflector.

The two gun arrays - lines containing a series of eight equally spaced pneumatic "sound guns" and streamed one from each quarter - extend about 60m astern of the ship. Other equipment may also be deployed, depending upon other information being collected.

The ship is required to run a series of parallel straight line courses, or survey lines, criss-crossing the area to be surveyed. The grid of survey lines is determined by the cruise leader, the senior scientist on board, in consultation with the Master, the Master having the final word on where the ship may safely operate.

UNDERWAY OPERATIONS





PART PC & GS 4272 PHILLIPINES

For accuracy of position maintenance along the survey lines, the Rig Seismic was equipped with a differential global positioning system (GPS) (see Annex), providing great accuracy. Position information was given on two video screens, providing constant digital and graphical information to the officer of the watch on the ship's geographical position and the position relative to the survey line. The African Queen II was also provided with a portable GPS unit.

In open waters, the Rig Seismic would proceed half a mile beyond the end of survey line position before commencing to turn towards the next survey line, ensuring the maximum coverage of the line by the seismic cable. The mrns were carried out at a rate of 10 degrees a minute, executed by 5-degree adjustments to the automatic steering control every 30 seconds, which provided a steady alteration and caused no problems with the towed cables. At the operational speed of 5 knots this resulted in an advance of 0.5 miles and a sideways transfer of 0.5 miles for a 90-degree alteration. Having altered course 90 degrees the Rig Seismic would then proceed to the next parallel survey line.

The British Admiralty Philippine Islands Pilot, in the section on Tayabas Bay, north-eastern side, states:

> "If coasting, the shoreline should be given a berth of at least 2.5 miles, as dangerous reefs lie nearly that distance offshore."

With this in mind, the Master found it was possible to work on the principal of ending survey lines that were approaching the coast at a distance of one mile seaward of the 10 fathom line, which ran approximately two miles offshore. In these instances the 90-degree turn would be commenced at the "end of line" point, resulting in the ship not becoming closer to the shore than 2.5 miles.

The African Queen II's function during seismic runs was to proceed ahead of the Rig Seismic, to keep fishing vessels clear of the Rig Seismic's path and to warn of fishing nets and fish lures. Large local fishing fleets operate in the area and fishing lures are commonly used, The fish lures consist of a floating platform, usually marked by palm fronds for identification and location purposes, below which are suspended further palm fronds, which attract small fish, which in turn attract the tuna. The lures are attached to anchor lines, which could cause considerable damage to the seismic cable and gun arrays.

The African Queen II normally operated 1.5 miles ahead of the Rig Seismic. This distance allowed sufficient time for those on the Rig Seismic to decide upon evasive action and to execute a controlled alteration of course, should it be necessary.

The African Queen II also checked the depth of water by echo sounder and had instructions to report any major changes that could affect the deployed survey equipment or the safety of the ship.

At the end of each survey line the African Queen II would be instructed how and when to turn. In the instances where the survey line ran towards the coast the African Queen II would be instructed to continue on the same course line for 4.5 to 5.0 cables beyond the "end of line" point and then to alter course 90 degrees to port or to starboard,

whichever was required. This would result in the African Queen II making the same 0.5 mile advance as the Rig Seismic.

Due to the large numbers of fishing vessels and lures, particularly in Area 2, the Master decided that it would be dangerous to conduct seismic runs at night. Therefore seismic operations were conducted mainly between the hours of 0600 and 1700. During the hours of darkness the ship normally proceeded to deeper water, clear of the fishing vessels, where other survey operations, such as direct hydrocarbon sampling, were conducted. The seismic cable and gun arrays were left deployed, in readiness for the next day's operations.

Although the three deck officers maintained a three watch routine of four hours on, eight hours off, the Master tended to work very long hours. His normal routine was to be called at 0530, his standing instructions being that he was to be called 30 minutes before the start of each line, and he would go to the bridge shortly afterwards. He would then be on the bridge for most of the morning. The afternoon was usually the easiest part of the day and very often the Master was away from the bridge from around noon until 1430. He would then be back on the bridge until late evening. At night the Master's presence on the bridge depended upon the area in which the ship was and the type of operations being carried out. Occasionally, as happened on the night of 13/14 April, he did not get to bed at all, although normally he managed to get to bed at about midnight. Night-time sleep was usually augmented by "cat naps" during the day.

The incident

On 15 April the Master was called at 0530 and joined the Mate, the officer of the watch, on the bridge at about 0540. Seismic operations commenced at 0612, when the Rig Seismic commenced the run on line 109/29 on a course of 044 degrees at a speed of 5.0 knots. Steering was in the automatic mode.

At 0650 the Master left the bridge, to go to the saloon for breakfast. On his return, at 0710, he took over the watch from the Mate, so that he too could go for breakfast.

The Extra Second Mate took over the watch from the Master at 0800, when the ship was four miles from the end of line position. The weather was stated to be fine, with a 4 to 6 knot south-westerly wind, the sea was very slight, with glare on the water ahead from the sun.

Having checked that all equipment was functioning correctly, the Extra Second Mate made contact with the African Queen II on VHF. In accordance with standard practice, the African Queen II was instructed to continue for 0.5 miles beyond the “end of line” position and then alter course 90 degrees to starboard, also to provide details of soundings and changes in water depth.

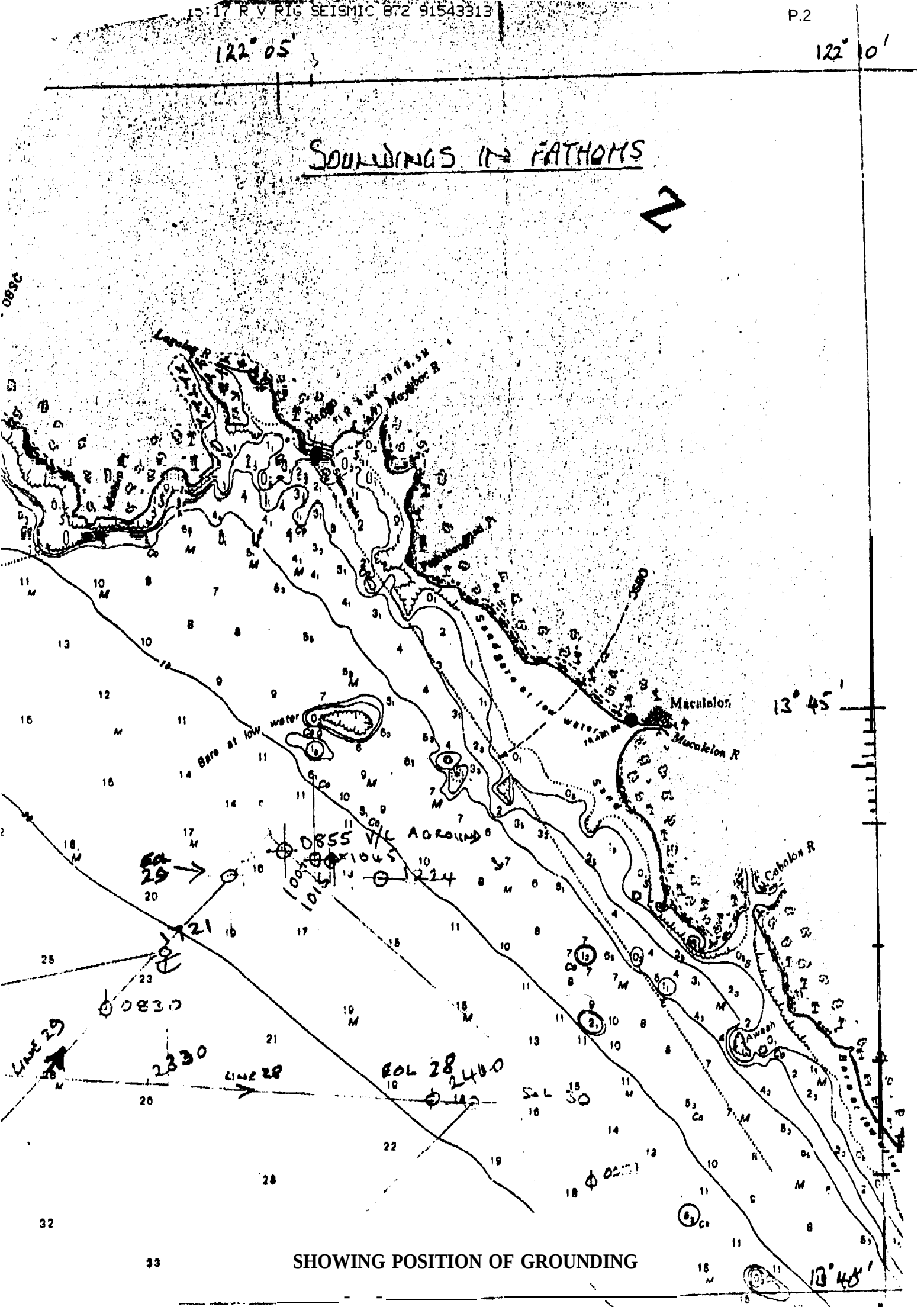
The African Queen II arrived at the “end of line” position at 0838 and reported a water depth of 32m, after which a gradual rise of seabed was reported, rising to 2 lm at a position 0.5 miles beyond the “end of line”. The African Queen II then executed a 90-degree turn to starboard and continued reporting water depths of around 20m.

The Rig Seismic arrived at the “end of line” at 0850 and the Extra Second Mate immediately commenced a controlled turn to starboard, altering the automatic steering control by five degrees. The Master took up station to the left of the Extra Second Mate, where he was able to keep an eye on the echo sounder and look for visual signs of shoaling on the water surface. However, the ship was turning “through the sun” and the glare on the water was such as to obscure any changes in water colour.

At 0855 a rumbling noise was heard and the Master ordered the propeller pitch to zero. The ship’s head at this time was stated to be 102 degrees. The research personnel in the instrument room were advised immediately that the ship had run aground and were requested to recover all the equipment as quickly as possible. The gun arrays and a magnetometer were recovered first, after which a start was made on recovering the 2600m seismic cable.

The ship’s engineers were also immediately informed of the grounding. They checked all tank soundings for any ingress of water and also started up the diesel generators. The diesel generators had to be started before the main engine could be stopped, all the ship’s power having been supplied by the shaft generator while the ship was under way

Checks on the soundings indicated that the ship’s tanks were intact. However, soon after the grounding a considerable ingress of water into the asdic room was discovered. The Asdic room is a small watertight compartment housing various items of equipment and it



SHOWING POSITION OF GROUNDING

was concluded that one of the transducers protruding from the bottom of the ship had been damaged. As the compartment is watertight its flooding caused no immediate problems.

The crew were immediately organised in preparing the zodiac inflatable boat for launching. One of the crew of the Rig Seismic was a trained diver, as was the Master of the African Queen II and at 0921 the zodiac was sent over to the African Queen II to collect him.

The divers found that the ship was only very lightly aground. The propeller had been damaged, three of the blades having been bent slightly, but the main damage had been sustained by two fairings projecting from the bottom of the ship, one being bent towards the stern, the other having been torn off completely.

The ship was found to be over the top of a small reef, not more than 5Om in diameter, which could now be clearly seen from the ship.

As all appeared stable, the Master's main concern was to retrieve the survey equipment. The gun arrays were retrieved quite quickly, but the seismic cable was leading out to the side, and recovery was very slow. At 0923 the African Queen II was sent to tow the tail buoy so as to correctly align the cable, to facilitate its recovery. While the seismic cable was being recovered the Master advised the ship's management in Brisbane of the grounding.

At 0945 the Rig Seismic drifted clear of the reef and the Master used the forward bow thruster to pivot the ship to align it with the cable. However, at 1007 the water was noticed to be shoaling again, but as the divers were under the ship there was nothing the Master could do until they surfaced, which was about five minutes later. Once the divers were out of the water the Master put the propeller pitch to 20 per cent astern, moving the ship gently astern, but this resulted in the rudder becoming embedded in the top of a coral head.

The seismic cable was fully recovered at 1045, after which the Master was able to concentrate fully on clearing the ship from the reef. The divers conducted a full survey of the reef, which proved to be in two sections, with a gully between them and with a number of coral heads, or bommies. The divers were then able to advise the Master on how he should manoeuvre the Rig Seismic so as to become free from the coral head and then clear the reef.

Using the African Queen II as a tug, the bow thruster and using easy movements ahead on the propeller, the rudder was freed from the coral head, the stern swung clear and the ship then eased stern first clear of the reef. The ship was all clear at 1210. With the African Queen II proceeding close ahead, sounding the way, the Rig Seismic was moved clear of the reef and anchored at 1236.

The divers then went back to work and, using pillows, were able to plug the damaged transducer, so that the asdic room could be pumped out. Once this was achieved, the engineers were able to cut the transducer stem and push it out through the bottom of the ship, after which it was possible to close the gate valve and regain watertight integrity.

Having ascertained that there was no other ingress of water, the Master, in consultation with the ship's management in Brisbane, decided to postpone the remaining survey work. The Rig Seismic then proceeded to Mabini to undergo inspection by the Classification Society surveyor.

Following satisfactory inspection and report by the Classification Society surveyor the Rig Seismic returned to the operational area and completed the seismic survey.

Analysis of the grounding.

On 15 April 1992, sunrise in Tayabas Bay was at 0540. At the time of the grounding the sun would have been bearing about 088.5 degrees at an altitude of about 44 degrees.

In altering course 90 degrees to starboard from a course of 044 degrees the ship was altering "through the sun" and it is accepted that there was probably considerable reflected glare on the sea surface. Such glare would obscure any visual signs there may have been indicating the presence of the reef.

The area in which the Rig Seismic grounded is a space between soundings on all three of the navigational charts provided to the ship, the adjacent soundings indicating depths of 13 to 14 fathoms (24 to 26m). The closest charted reef lies about 8 cables (1480m) to the north of the grounding position. The satellite imagery of the area provided to the ship, which clearly depicts the charted reef to the north, does not depict the reef on which the ship grounded.

Following the grounding of the Rig Seismic, the Bureau of Mineral Resources, Department of Primary Industries and Energy, arranged for enhanced imagery of the satellite information, using a pixel coverage of 30 square metres. This enhanced imagery also did not depict the shoals on which the Rig Seismic grounded. However, it did indicate an uncharted reef, about 200m long and 50 to 100m wide, located some 600m to the north-west of the grounding position. This would appear to confirm that there are a number of uncharted reefs in that area of Tayabas Bay

It is therefore accepted that the Rig Seismic grounded on an uncharted and unknown reef (unknown to the Master and officers of the Rig Seismic and to the hydrographic offices) and that the grounding was not due to an error in navigation.

One of the African Queen II's duties was to proceed ahead of the Rig Seismic at the end of line turns and advise on the depth of water. The African Queen II was instructed by the Officer of the Watch, acting on instructions from the Master, how and when to make the turn.

On the occasion of the grounding the Extra Second Mate instructed the African Queen II to proceed 0.5 miles beyond the end of line point and then to alter 90 degrees to starboard. In making a controlled turn however, the Rig Seismic commenced the turn immediately on reaching the end of line position. Although both vessels would have ended up on the same course track at 90 degrees to the survey line once their respective turns were complete, they did not cover the same track in getting there (Diagram 1). At the point of fnrthest diversion the African Queen II's track was some 350m from that of the Rig Seismic. In proceeding on the different track and in taking echo soundings directly underneath the vessel (not side sonar, for which it was not equipped), the African Queen II did not detect the existence of the reef on which the Rig Seismic grounded.

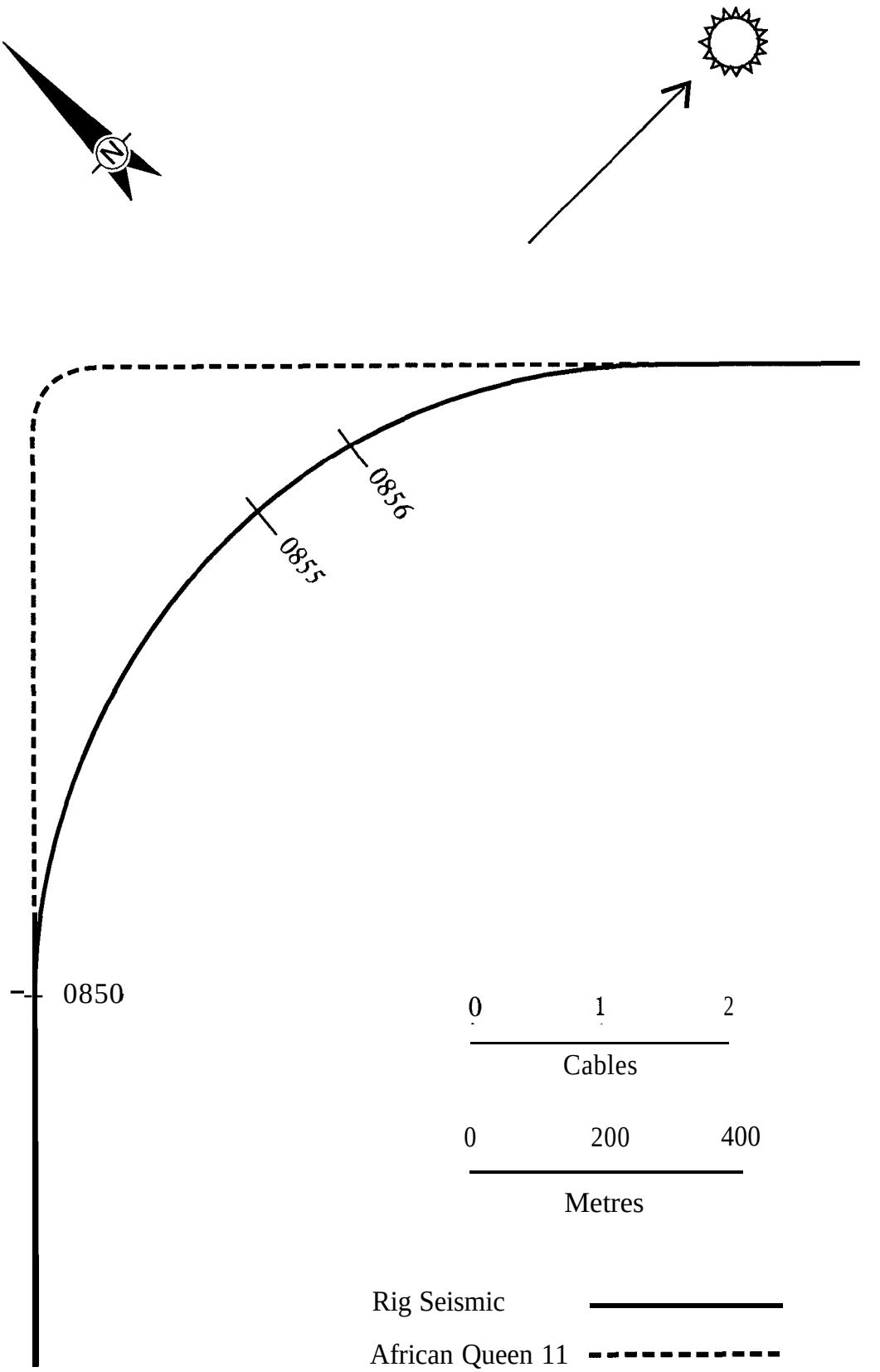
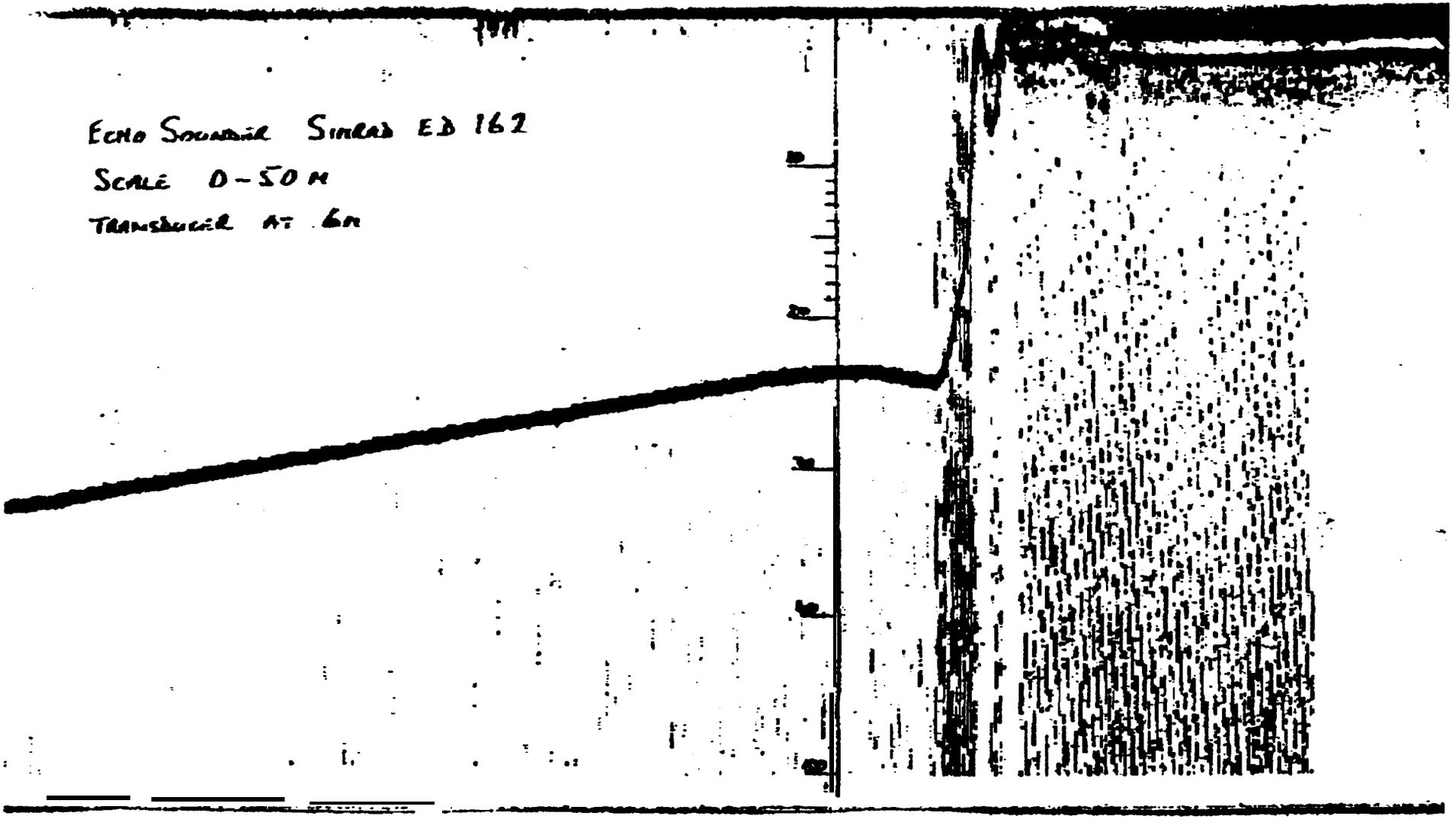


Diagram 1: Differing tracks of Rig Seismic and African Queen 11 during turn



COPY OF ECHO SOUNDER TRACE

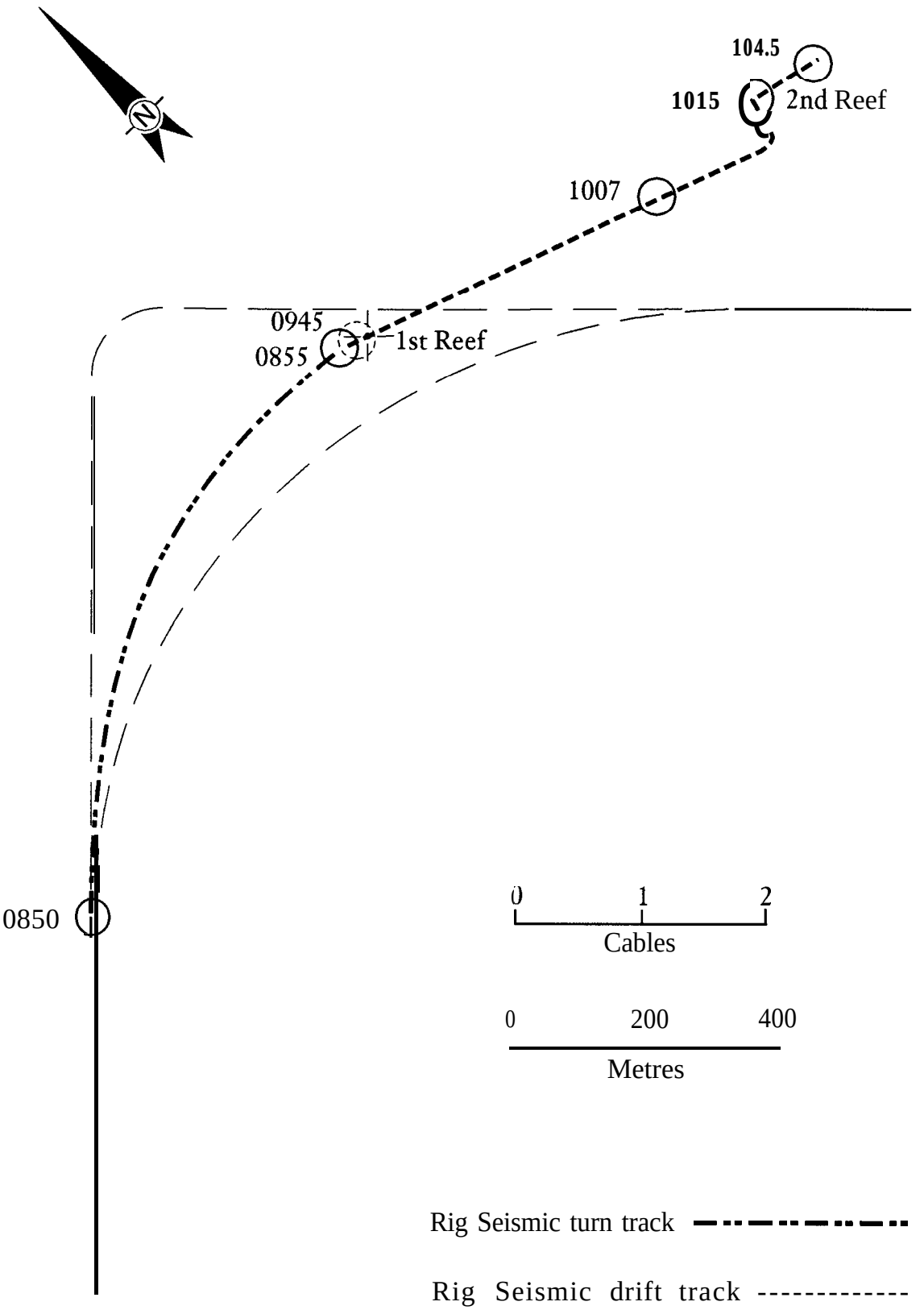


Diagram 2: Rig Seismic actual turn track and grounding positions

The disadvantages of the African Queen II proceeding on a different track during the 90-degree turns had been discussed on board, but no practical alternative found. However, after the incident a slightly modified operation was put in place, which resulted in a slightly closer track by the African Queen II during turns.

The trace on the Rig Seismic's echo sounder chart shows a gradual rise of the seabed, in accordance with the charted information and the echo sounder depths as reported by the African Queen II. The abrupt decrease in depth as the Rig Seismic passed over the edge of the reef provided insufficient warning to enable those on the bridge to respond.

The time of the grounding was said to have been 0855, five minutes after passing the "end of line" position. At this time, at the standard rate of turn of 10 degrees a minute, the ship's heading should have been 094 degrees. According to the Extra Second Mate, the heading at the time of grounding was 102 degrees, which indicates a time of grounding of just before 0856. However, the precise time of the grounding is not considered to be material to the cause.

Study of the times and positions recorded from the time the ship first grounded until it was manoeuvred clear, indicates that there was not just one reef, but a number of reefs in the area (Diagram 2). The reef on which the ship first grounded was said to be about SOm in diameter. After drifting clear at 0945 the ship drifted about 600m in an easterly direction before drifting into shoaling water and embedding the rudder in a coral head. On inspection by the divers, this second shoal area was found to consist of two coral reefs, divided by a gully and surrounded by a number of coral heads of varying sizes.

The design of the Rig Seismic is somewhat unusual when compared with normal ships in that there is a rake of keel from stem to stern, the after end of the ship lying 2m deeper in the water than the forward end when the deck is even. Also, there are a number of "fairings" protruding from the bottom of the hull, their purpose being to improve the water flow to instruments such as the paddle log and Doppler transducer.

When the Rig Seismic first grounded on the reef it is apparent that the only sections of the ship to come into contact with the reef were the after two fairings, the after section of the raked keel and the tips of the propeller blades.

Comment on operational procedures

Before the seismic cruise commenced, the Assistant Manager, Ships Operations and the Master - in visiting the Philippines, collecting the charts and other available information and making a flight over the survey areas - made every effort to obtain local knowledge and familiarise themselves with the area. The time and fuel limitations on the flight over the operational area were unfortunate. However, from the satisfactory results of the observations on the flight paths undertaken, plus the evidence of the satellite imagery, their conclusion as to the satisfactory nature of the charts of Tayabas Bay is considered to be not unreasonable.

The use of the African Queen II to sound ahead of the Rig Seismic was a practical check and the information relayed back to the Rig Seismic tended to support the accuracy of the navigation charts.

It is considered that the management and the ship's Master took all reasonable precautions to confirm the accuracy of the navigation charts and to ensure the safety of the ship.

The Master took every interest in the conduct of the Rig Seismic while at the same time permitting full operational responsibility to the officers. In being on the bridge at the time of the alteration of course at the "end of line" at 0850 the Master was providing an extra pair of eyes for observation of the sea surface and he was also able to monitor the echo sounder.

In maintaining such prolonged periods on the bridge, with the resultant reduction of sleeping time, the Master must have been suffering to some extent from the effects of tiredness. However, the strict operational regime for turns was maintained and the officer of the watch, although acting to the Master's instructions, was in charge of the ship at the time. The officers were maintaining regular four-hour watches, and therefore had ample time for rest and sleep. The weather was calm and the ship was operating at the slow speed of five knots, a speed at which vibration would be negligible and therefore unlikely to disturb sleeping habits. Fatigue, therefore, is not considered to have been a contributing factor to the grounding.

The fact that one of the Rig Seismic crew members and also the Master of the African Queen II were both qualified divers was providential and instrumental in the Rig Seismic being able to manoeuvre safely clear of the reef. Also, by their efforts the problem of the water ingress into the asdic room was effectively resolved.

It is considered that the actions of ail personnel following the grounding, in recovering the seismic and other scientific equipment, in manoeuvring clear of the reef and in securing the watertight integrity, were all carried out in a professional and timely manner.

Conclusions

It is considered that:

1. The reef on which the Rig Seismic grounded was uncharted.

2. The Assistant Manager, Ships Operations and the ship's Master made every reasonable effort to collect available information on and to familiarise themselves with the operational areas.

3. The Master's use the African Queen II to sound ahead of the Rig Seismic was a sound precautionary measure.

4. The Africa Queen II did not locate the reef on which the Rig Seismic grounded due to its different turn track.

5. The actions of all personnel after the grounding were all carried out in a professional and timely manner.

6. Although the Master, due to his prolonged periods on the bridge, would have been tired to some extent, fatigue is not considered a contributing factor to the grounding.

Annex

Satellite imagery accuracy

The accuracy of detail of satellite imagery is based on the area coverage of the individual pixels or dots that make up the "photographic image". In this instance each pixel covered an area of the earth's surface of about 40 square metres, therefore it was possible for small areas of reef to go completely undetected. The reef on which the Rig Seismic grounded was found to be small in area and thus had not been depicted on the satellite imagery provided to the ship.

Global positioning system

The global positioning system utilises a series of satellites, initially designed for military/defence purposes, and ship-bourne receivers/computers. The signals received by commercial vessels provide a position accuracy of about 100m. However, much greater accuracy is obtainable where a shore-based receiver station is used in conjunction with the ship receiver. The shore receiver station automatically computes corrections based on the movement of the satellites and transmits these to the ship, where they are automatically applied to the ship's computed position. This system is known as differential GPS and provides accuracy to within 3m.

For the seismic operation, a shore receiver station was established in Manila, providing the Rig Seismic with very accurate positions and station-keeping ability.