Report on Oceanographic Cruise of O. R. V. Sagar Kanya

CRUISE No. 83

27th April to 15th May, 1993

National Institute of Oceanography
Dona Paula-403 004, Goa
INDIA

NATIONAL INSTITUTE OF OCEANOGRAPHY
(Council of Scientific & Industrial Research)
Dona Paula, Goa - 403 004

REPORT ON

83RD OCEANOGRAPHIC CRUISE OF

O.R.V. SAGAR KANYA

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C O N T E N T S

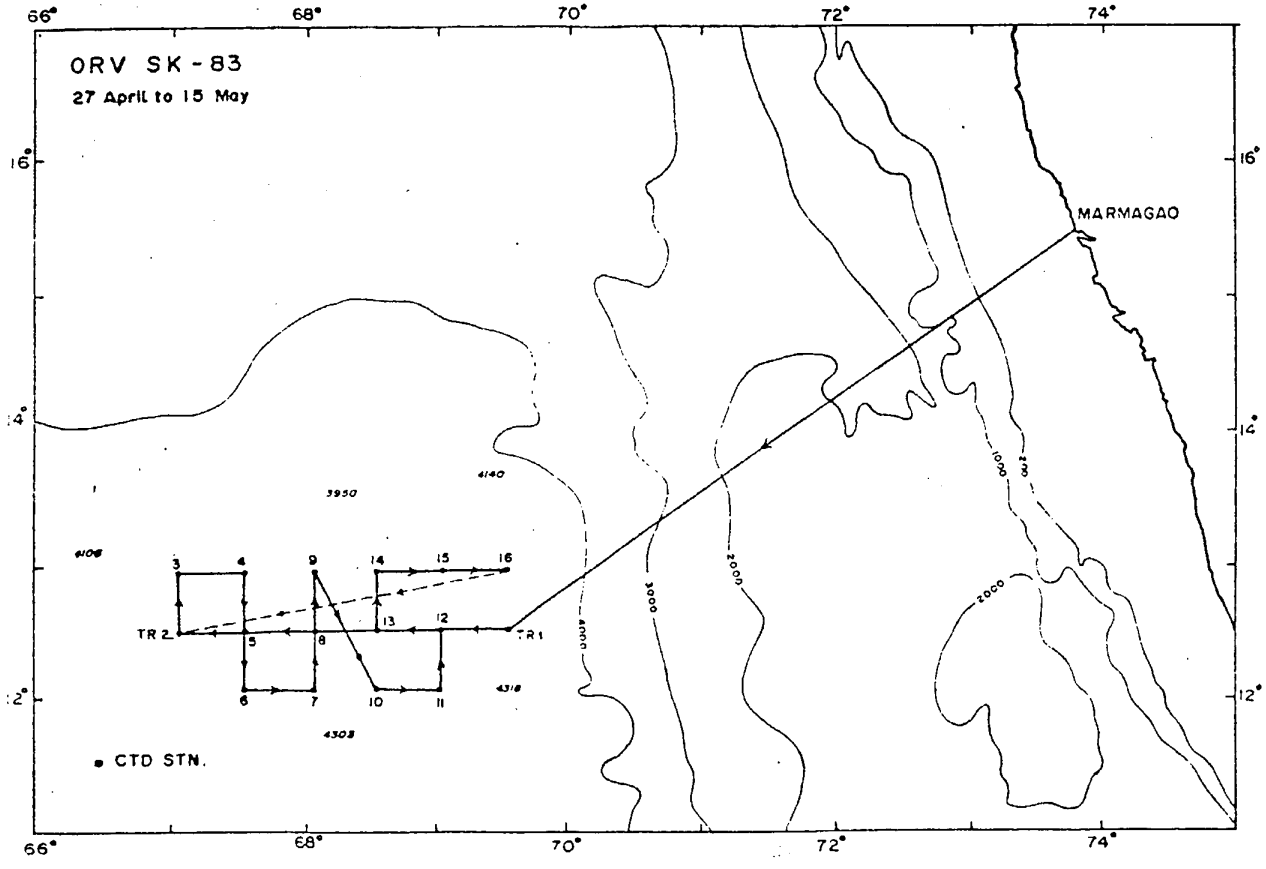
ORV SK-83
27 April to 15 May
66°
68°
70°
72°
74°
16°
14°
12°
MARMAGAO
TR 2
TR 1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
3950
4140
4108
4318
4308
1000
2000
3000
CTD STN.

Figure-1

2. CRUISE SUMMARY

The cruise 83 of O.R.V. Sagar Kanya commenced from Mormugao harbour on 27 April, 1993 and ended in the same harbour on 15 May, 1993. There were 18 participants in the cruise including 11 from NIO, 3 from PRL, Ahmedabad, one from IIT, Madras and 3 shipboard trainees.

The main objective of the cruise was to carry out accoustic transmission/tomography experiment by mooring transceiver systems in the Arabian Sea along 12.5°N lat. Simultaneously, detailed bathymetric survey using hydrosweep and hydrographic survey using CTD system were also carried out to delineate the characteristics of acoustic field in this region. Studies towards large scale oceanic mixing were also conducted by collecting bulk water samples from this region.

Further, surface meteorological observations and studies on air-sea exchange of gases were also carried out.

3. PARTICIPANTS

a) Scientific component

S. Prasanna Kumar	-	Chief Scientist
Y.K. Somayajulu		
A.K. Saran		
G.S. Navelkar		
A.A. Almeida		
Fernando Vijayan		National Institute of Oceanography, Goa.
Vijay Kodagali		
Pratima Johry		
D. Pathak		
Arif Sardar		
B. Subramanyam		
Ganesh Chandavale		Shipboard trainees
C. Ravi		
Arul Chelvan		
Prof. B.L.K. Somayajulu		PRL, Ahmedabad
J.P. Bhavsar		
Ravi Bhushan		
R. Mahadevan		I.I.T., Madras

b) Ship's complement

Capt. Arun D. Divekar	-	Master
Gurcharanjit Singh	-	Chief Officer
Naresh S. Mafrey	-	Third Officer
Avinash R. Thosar	-	T W K C
Albert Rocha	-	Radio Officer
Shakti Bhadran	-	Purser
Dr. A.K. Malarmani	-	Medical Officer
Anil G. Sukhthankar	-	Chief Engineer
Jehangir Madon	-	Second Engineer
Sukanta Dutta	-	Third Engineer
Sishir Kanti Sikder	-	Fifth Engineer
P.V. John	-	Electrical Officer
V.P. Parameshwaran Nair	-	Electrical Officer
Morris Fernandes	-	Catering Officer
C. Veerapandian	-	A/Ctg. Officer

4. OBJECTIVES

(1) To carry out the acoustic transmission/tomography experiment by mooring two transceiver systems separated by a distance of 270 x 10^3m for a period of ten days in the Arabian Sea (Fig. 1) and recording the travel times of the acoustic signals along with the acoustic intensities;

(2) to operate hydrosweep for detailed bathymetric features, if any, in the region of the above experiment;

(3) to collect the surface meteorological and wave data for sea truth observational programme for remote sensing studies; and

(4) to study air-sea exchange of gases, notably CO_2 using ^{14}C, in the Arabian Sea and to evaluate horizontal and vertical eddy diffusivities in the upper 300 m water column using ^{228}Ra.

5. CRUISE DETAILS

Cruise itinerary

Embarkation	Mormugao	27-4-93	at	1500 hrs.
Disembarkation	- do -	15-5-93	at	1800 hrs.

On-board preparatory work

All the participants boarded O.R.V. Sagar Kanya on 27 May, 1993 at 1500 hrs.

The preparatory work for mooring assembly was started immediately after boarding the vessel. These included

(a) marker buoy assembly carrying the radio beacon and flash light;

(b) assembly of kevlar and polypropylene ropes with shackles;

(c) assembly of subsurface buoys, fixing of wide sheaved pulleys to the jib-boom; and

(d) fixing of mooring drum to the deep-sea winch.

On completion of loading the mooring lines on to the drums, the acoustic releases were checked, the radio beacon, flash light and the tilt meter were tested for their performance and battery voltage levels.

The electronic module of the acoustic transceivers were tested and the clock synchronisation made prior to loading inside the pressure casings along with the battery stacks. The system was run using the task schedule designed for the experiment on board for one full day. After this, the actual task for 10 days transmission were loaded on to both the transceiver systems.

In all, four tasks were down loaded for both the systems. The first task was to transmit 3 sequences and acquire 1 sequence to obtain channel signal to noise ratio (S/N) and also to quantify, if any, the prevailing clock offset. This task was switched on on 2 May, 1993 for one full day, with the transmission taking place every hour while reception at every half hour for one system TR1 (# sys 03) and vice-versa for the other TR2 (# sys 04).

The second task was to transmit 17 sequences with a duration of 87.47 sec. and acquire 16 sequences from 3 to 6 May. The transmissions were at one hour intervals while reception at every half-hour interval for TR1 and vice-versa for TR2.

The third task was to transmit 9 sequences of 45.99 sec. duration and acquire 8 sequences from 6 to 9 May, maintaining the transmission and reception as above for TR1 and TR2.

The fourth task was to transmit 12 sequences of duration of 61.32 sec. and acquire 11 sequences from 9 to 12 May, with the operation cycle remaining constant.

The ship occupied the location 12°.5 N and 69°.5 E position on 1 May, 1993 by 0230 hrs. A CTD profile was taken to a depth of 3500 m depth while the actual depth of water was about 4260 m.

Deployment of TR1 mooring

The TR1 mooring (Fig. 2) was designed to keep the transceiver submerged at a depth of 1750 m from sea surface. It consisted of a marker buoy (four 17" Benthos glass floats bolted to a frame with a radio beacon and a flash light), an array of 18 glass floats followed by transceiver, tilt meters, 750 m of 9/16" dia. kevlar rope, array of 9 floats, 750 m kevlar rope, 750 m kevlar rope, array of 9 floats, 2 Benthos acoustic releases connected in parallel, 220 m of 18 mm dia. polypropylene rope and two pairs of railway wheels, weighing 1100 kg, chained to act as deep sea anchor.

Deployment of the mooring TR1 was started at 0630 hrs. on 1 May, 1993. Due to the leakage of hydraulic oil from one of the pipes of the ATLAS crane, the operation was suspended for some time. The problem was rectified soon and the deployment operation resumed. Radio beacon transmitter and flash light were switched on. The marker buoy touched down the water at 1035 hrs., followed by the chain, subsurface buoys, transceiver and the tilt meter. After this, 750 m of kevlar rope was paid out from the deep sea winch at 1125 hrs., followed by a set of 9 buoys, and 2nd spool of kevlar rope and tilt meter. The 3rd spool of 750 m kevlar rope was lowered

at 1325 hrs. followed by a set of 9 buoys, 2 Nos. of acoustic release in parallel, 200 m of polypropylene rope, chain and anchor weight. The anchor weight was released at 1520 hrs. During the intervening time the vessel drifted to a new position 12°27'.8682 N and 69° 31'.6813 E. The depth at that position was 4250 m.

Triangulation and determination of the exact position of the mooring

After the anchor weight was dropped, its descent was monitored using Benthos acoustic release deck unit by keeping the transducer at about 10 m below the sea surface. From the slant range, the estimated time of the anchor weight touching the bottom was about 45 minutes. From this position, the ship moved one nautical mile to fix the slant range. From this, the arc length (base of the right angle triangle) was calculated. This was repeated twice to obtain in all 3 positions that would form the 3 vertices of an equilateral triangle. This would enable finding the actual position of the mooring. The triangulation work was over by 1750 hrs. and the ship sailed towards position TR2.

Deployment of TR2 mooring

The vessel reached TR2 position (12.5°N, 67.0°E) on 2 May, 1993 at 1010 hrs. The station depth was 4175 m. TR2 mooring (Fig. 3) is a replica of TR1 except the fact that the polypropylene rope attached above the anchor chain and below the acoustic release was shorter by 20 m. Mooring deployment started at 1030 hrs. Radio beacon transmitter and flash light were switched on. The marker buoy touched down the water at 1037 hrs., followed by the chain, subsurface buoys (18 Nos.), transceiver and the tilt meter. After this, 750 m of kevlar rope was paid out from the deep sea winch at 1100 hrs., followed by a set of 9 buoys, and 2nd spool of kevlar rope and tilt meter. The 3rd spool of 750 m kevlar rope was lowered at 1250 hrs. followed by a set of 9 buoys, 2 Nos. of acoustic release in parallel, 200 m of polypropylene rope, chain and anchor weight. The anchor weight was released at 1400 hrs. and at that time the position of the vessel was 12° 29'.6240 N and 67° 01'.9633 E. Water depth at that position was 4175 m.

Triangulation and determination of the exact position of the mooring

After the anchor weight was dropped, its descent was monitored using acoustic release deck unit by lowering the

on board transducer to a depth of 10 m. From the slant range, the estimated time of the anchor weight touching the bottom was about 45 minutes. From this position the ship moved one nautical mile and again the slant range was obtained as was done for TR1 mooring.

Recovery of moorings

On completion of the assigned transmissions, the transceivers TR2 and TR1 were recovered on 13 and 14 May, 1993 respectively. Subsequent to the recovery and securing all the elements of the mooring assembly, the data from the hard disc of each of the transceivers was down loaded to the PC along with the data from the inclinometers for subsequent processing and analysis at the shore laboratories.

CTD operations and water sample collection

During the acoustic transmissions, the ship moved out to make CTD casts and collect water samples. CTD was lowered to a depth of 3500 m. Water samples were collected using GO FLO bottles of 100 litre capacity for radium and carbon-14. In all 16 CTD profiles, 3 ^{14}C profiles and 2 radium profiles were collected (Table 1). For ^{14}C profile 100 litres water was collected from 3 to 4 depths between surface and 120 m.

In the case of radium also, 100 litre water samples were collected from 4 depths within the top 300 m.

Surface met observations

Surface meteorological observations were taken in the area of this survey and wave recorder was operated once. Subsequently, due to suspected water leakage into the sensor, believably, from the engine room, further recordings were not possible.

Air samples

From the atmospheric air, about 5 l CO_2 sample was collected when the ship was in motion. Four such samples were collected, with each sample collection spread over 3 days.

Hydrosweep operation

Multibeam echosounding survey was carried out between mooring stations TR1 and TR2 using hydrosweep equipment. The instrument can sample a total of 59 depth points covering 29 each on the starboard and portside with one central beam. Area between 67°E and 13° 12'N and 68° 34'E and 12° 20'N was covered completely during this period. In all, 17,000 sq.km area was covered. The average depth in this region was 4200 m and the survey was carried out with a line spacing of 4 nm. In

addition, data also was collected between the CTD stations, at TR2 and during the return journey to Mormugao (Fig. 1). Two deep sea channels were identified during the first phase of the survey. These channels representing the Indus fan, have a depth of 20 - 30 m with a meandering course extending from north to south. The phase two of the survey was aimed at tracing the northward extension of these channels.

6. SYNOPSIS OF OBSERVATIONS

(1) A total of 480 acoustic transmissions were carried out.

(2) 16 CTD profiles were taken to a maximum depth of 4000 m.

(3) 17,000 sq.km was covered by hydrosweep operations.

(4) Surface meteorological observations were taken as a part of sea truth program of remote sensing.

(5) 3 carbon-14 profiles and 2 Radium profiles were collected.

7. ACKNOWLEDGEMENT

The Chief Scientist and other participants of the cruise thank the Captain and his crew for their assistance and co-operation in the successful completion of the cruise.

Table 1 CTD STATION DETAILS ORV SK-83

Stn no.	Lat. N (o)	Long. E (o)	Time IST (hrs)	Date	Bottom depth (m)	SST (oC)
CTD1	12 30.26	69 29.83	0250	1.5.93	4260	29.5
CTD2 #!	12 35.00	67 02.87	1700	2.5.93	4175	29.5
CTD3	12 59.00	67 00.00	0200	3.5.93	4253	29.5
CTD4	12 59.85	67 30.91	0730	3.5.93	4167	29.4
CTD5	12 30.96	67 29.92	1255	3.5.93	4170	29.8
CTD6	12 00.53	67 30.96	1820	3.5.93	4260	29.7
CTD7	12 00.80	67 59.73	2350	3.5.93	4303	29.5
CTD8	12 30.00	67 59.90	0530	4.5.93	4243	29.5
CTD9 #	12 59.57	67 59.97	1155	4.5.93	4200	29.6
CTD10 #	12 00.09	68 30.29	1155	6.5.93	4321	30.0
CTD11	12 00.00	69 00.20	1825	6.5.93	4305	30.3
CTD12	12 30.14	69 00.04	0050	7.5.93	4250	29.7
CTD13	12 30.29	68 29.84	0645	7.5.93	4237	29.9
CTD14	12 59.73	68 30.12	1210	7.5.93	4186	29.7
CTD15	12 59.85	69 00.14	1730	7.5.93	4190	30.0
CTD16 #!	12 59.90	69 30.00	0005	8.5.93	4225	29.8

Water samples (100 l GO FLO) for ^{14}C were collected

! Water samples (100 l GO FLO) for Radium were collected

MOORING CONFIGURATION TR_1

ORV SK-83

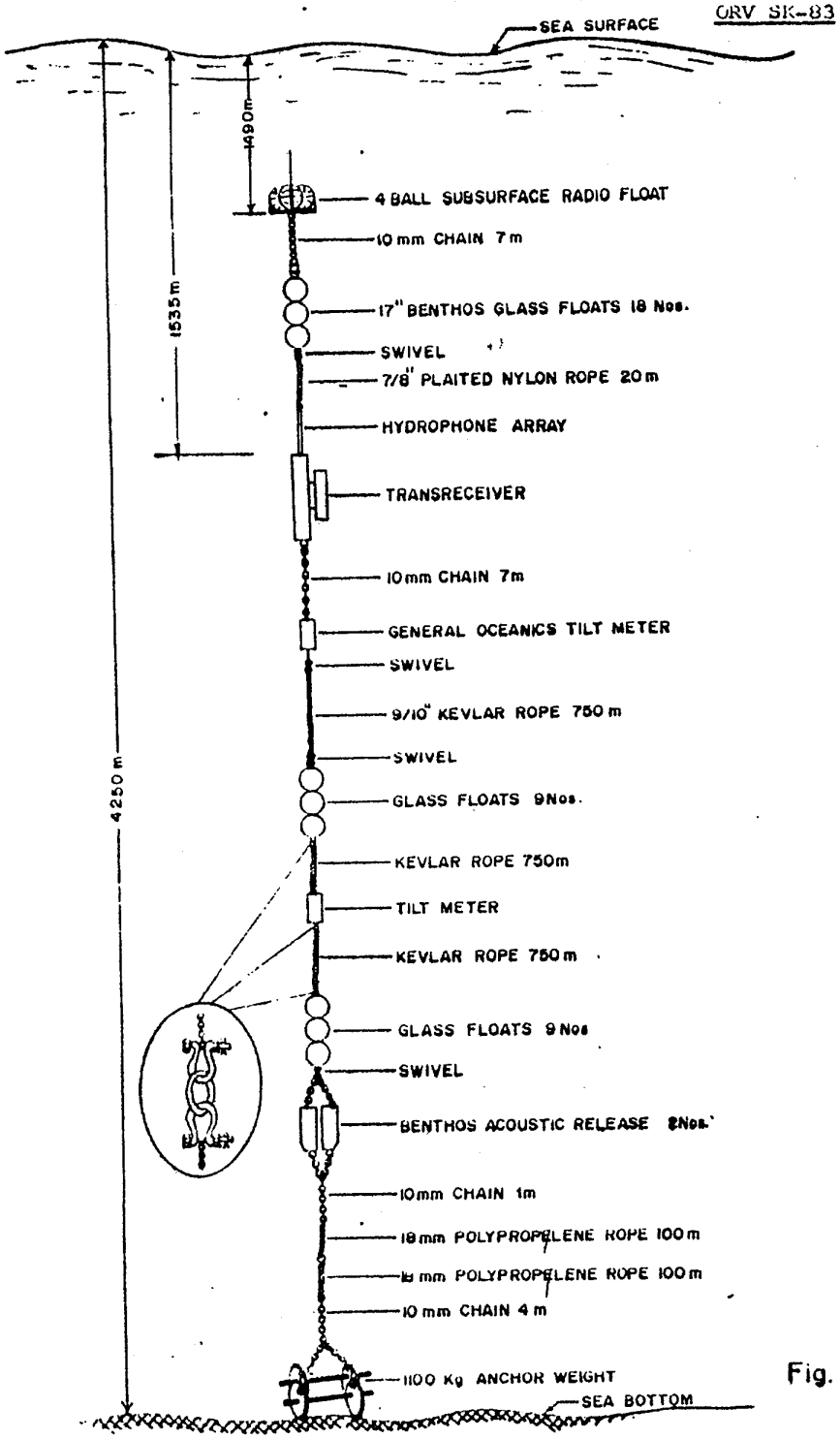

Fig. 2

MOORING CONFIGURATION TR_2

ORV SK-83

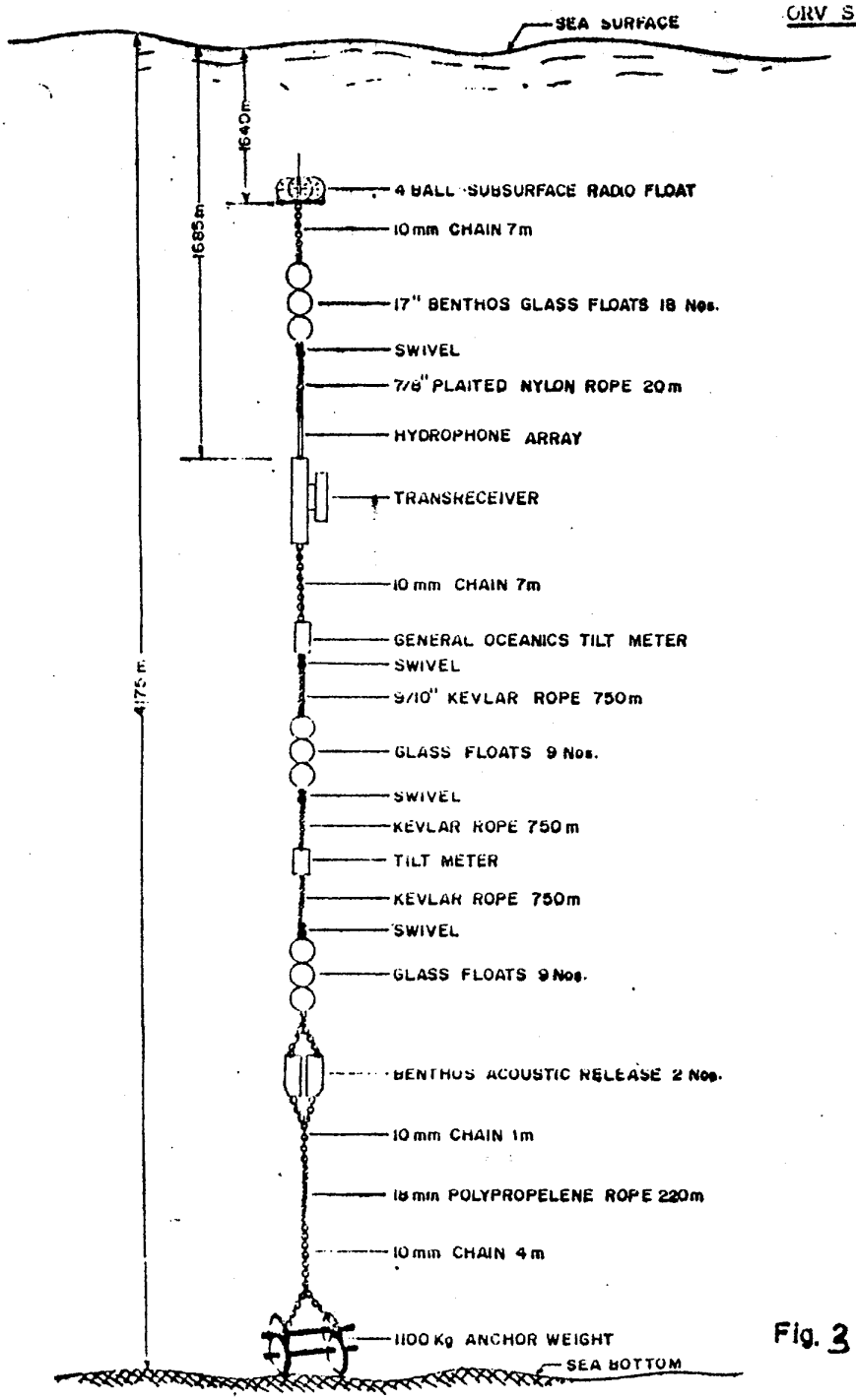

Fig. 3