I.O.S.

GEOCHEMICAL SAMPLING IN THE CAPE BASIN

16 - 27 JANUARY 1979

R. R. S. DISCOVERY
CRUISE 99

CRUISE REPORT NO. 78
1979

INSTITUTE OF OCEANOGRAPHIC SCIENCES
NATURAL ENVIRONMENT RESEARCH COUNCIL

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Institute of Oceanographic Sciences,
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ITINERARY

Depart Cape Town 1130 16 January 1979

Arrive Cape Town 0945 27 January 1979

SCIENTIFIC PERSONNEL

J.M. Baptist	I.O.S.
G. Birch	University of Cape Town
M. Bremner	University of Cape Town
J. Burnham	R.V.S.
D. Burton	University of Southampton
S.E. Calvert	I.O.S. (Principal Scientist)
C. Chittenden	I.O.S.
Miss H. Coyle	I.O.S.
F. Culkin	I.O.S.
E. Darlington	I.O.S.
R.H. Edge	I.O.S.
M.J. McCartney	I.O.S.
R.J. Morris	I.O.S.
R.D. Peters	I.O.S.
Miss E. Reid	University of Southampton
P. Ridout	I.O.S.
W.R. Simpson	I.O.S.
P. Statham	University of Southampton
J. Thomson	I.O.S.
T.R.S. Wilson	I.O.S.

SHIP'S OFFICERS

M.A. Harding	Master
D. Noden	Chief Officer
S. Sykes	2nd Officer
P. Pepler	3rd Officer
A. Coombs	Chief Engineer
N. de Rose Wilson	2nd Engineer
H. Peck	3rd Engineer
D. Hornsby	4th Engineer
A. Greenhorn	5th Engineer
L. Wilson	Electrician
J.W. Field	Radio Officer
R. Cridland	Purser/Catering Officer
C.A. Chivers	Doctor

OBJECTIVES

1. The collection of large-volume water samples for analyses of selected trace metals and nutrients.

2. The collection of samples of suspended particulate material from large-volume water samples for geochemical studies.

3. The collection of integrated samples of settling particulate material by a particle trap.

4. The collection of bottom sediment samples, by gravity- and box-coring, for geochemical studies.

5. The collection of a series of sediment pore water samples by in situ techniques and by squeezing cored sediments.

6. The collection of near-surface and surface plankton samples for biochemical studies.

7. The collection of samples of the sea-surface microlayer for geochemical and biochemical studies.

NARRATIVE

Discovery sailed from Cape Town at 1130 h on 16th January 1979. After clearing the harbour, a course was set for the first station on the continental slope. The echo-sounder fish was launched at 1330 and normal watches were started. The ship steamed into a heavy south-westerly swell with winds varying between 15 and 20 knots.

Work on the first station (9934) was started at 1807/16 January. This consisted of hydrographic casts, coring and the setting of a particle trap mooring in 2485 m depth. The latter was in position at 1818/16 January with the release monitor operating normally.

High wire angles were experienced during this station, making bottle work difficult and hazardous. A 2 knot subsurface current from approximately 270° was indicated.

Upon completion of the station, Discovery proceeded on a westerly course for a series of stations down the slope and onto the abyssal plain of the Cape Basin. Hydrographic casts were made and sediment cores and pore water samples were collected along this track; plankton tows and/or neuston net tows were made at the end of some of the stations. Wind speeds increased steadily as we worked the stations; the ship's speed was reduced to 5-6 knots (using 2 engines) in force 7 conditions during our approach to Station 9938. From this station to 9941, the winds abated somewhat until force 3 conditions prevailed at the end of the profile.

Sediment coring, using the Kastenlot corer and the box corer, was most successful. Undisturbed samples of pale cream to grey calcareous ooze to reddish brown clay containing ferromanganese micro-nodules were recovered. The new pore water sampler was only partially successful due to problems with the hydraulic system.

On Station 9942, in 5200m depth, 2 hydrographic casts were completed and a box core and a pore water sampling attempt were both unsuccessful. The Kastenlot corer, after having taken a core, was lost together with 4957m of the main warp due to the wire parting on deck immediately forward of the dynamometer block on deck. No extra loading had been recorded during core recovery, and the warp was essentially vertical in the water when the loss occurred. The winch was stopped using the normal controls, and no personnel were injured.

Upon completion of the station, a new course was set to the south-east for a deep hydrographic cast before proceeding to the slope for further work with the remaining length of the main warp. On passage, the warp was streamed at 6 knots in order to carry out an inspection and to measure the remaining length. A total of 4050m was measured, with one complete wrap left on the drum. A broken strand was located at 505m and a further 600m was therefore cut off. This length, together with the broken end, were preserved for later inspection and testing.

On Station 9944, following the completion of the hydrographic work, a sample of the sea-surface microlayer was taken from an inflatable rubber boat upwind from the ship. Weather conditions were good, with very little wind and a 1 metre swell.

A series of plankton stations (9945-47) was occupied on a course of 072° from Station 9944, and sea surface microlayer samples were attempted on Stations 9946 and 9947; bad weather prevented the collection of a sample on the latter station. Hydrographic work was resumed on Station 9948 and coring and pore water sampling were resumed on Station 9950 in 1800m water depth.

Upon completion of station 9951, Discovery proceeded to the position of the particle trap mooring which was located by switching on the communication channel of the acoustic release monitor. The trap position was then reconfirmed by Decca and by the satellite navigation. Since the trap blinds had not yet closed, a further Station (9952) was occupied north-west of the trap position where a partially successful deployment of the pore water sampler was completed. The ship then returned to the trap position and the acoustic release was actuated at 1939/26 January. The release beacon was successfully tracked to the surface and

then lost. A search was initiated at 2109h and the trap was found at 2203h, sighted at 2220h and was finally on board at 2304h.

Discovery then sailed for Cape Town where she docked at 0945/27 January 1979.

REPORTS OF PROJECTS

HYDROGRAPHIC WORK

Casts were made at the stations listed in Table 1, using combinations of 1-, 8- and 30-litre sampling bottles. The 1-litre bottles, fitted with standard reversing thermometers to provide thermometric depths, and positioned 10m above each large-volume bottle, provided samples for the determination of salinity, dissolved oxygen, dissolved silicon and reactive phosphate on board using standard procedures. Samples from the large-volume bottles were used for the collection of suspended particulate material and for trace metal and organic carbon analyses.

Suspended particulate samples were recovered by pressure filtering the contents of the 8- and 30-litre bottles through 47 mm-diameter, 0.4 μm pore size Nuclepore membranes in Lucite holders. The samples were washed three times with 50ml aliquots of buffered distilled water in order to remove most of the trapped sea salt and stored in petri slides for analysis at Wormley.

Aliquots of the filtrate from the large-volume bottles were processed on board for the preconcentration of dissolved trace metals. 500ml volumes were extracted with ammonium pyrrolidine dithiocarbamate-diethyl dithiocarbamate into Freon and back extracted with nitric acid into aqueous solution. Approximately 10 samples were processed per hour, yielding a 50-fold concentration of the metals. The analyses will be completed at Wormley.

Unfiltered water samples were taken from some of the large-volume bottles before they were connected to the pressure lines for the determination of arsenic. After vacuum filtration through 0.45 μm sartorius membrane filters, the arsenic in the filtrates was totally reduced to As(III). After acidification, the arsenic was separated, as arsine, by treatment with sodium borohydride. The evolved arsine was trapped and stabilized in a small volume of potassium iodine/iodine solution for subsequent determination by atomic adsorption spectrophotometry at Southampton University. A duplicate set of filtered samples was frozen and returned to Southampton for further work.

On several profiles, duplicate samples were subjected to UV irradiation, using a 1 kW mercury arc lamp, in order to photo-oxidize the dissolved organic material. The samples were subsequently analyzed for total phosphorus or used for the separation of total arsenic in order to examine the occurrence of organic forms of

these elements.

A set of samples was also taken for the determination of dissolved organic carbon. They were filtered through pre-combusted glass-fibre filters and stored frozen for later analysis at Southampton.

D. Burton
C. Chittenden
F. Culkin
M. McCartney
W. Simpson
P. Statham

SEDIMENT SAMPLING

GRAVITY CORING

A stainless steel gravity corer, with 10-cm diameter barrels 1 and 2m in length, was used to collect sediment cores. They were removed from the corer in a vertical position, sealed and stored frozen. Details of sample recovery are given in Table 1.

BOX CORING

A standard IOS box corer was used to collect undisturbed samples of the near-surface sediments. Good quality samples were obtained, especially in deep water, with the sediment surface being intact. Problems were encountered with weakened springs in the no-load release which prevented the arms closing to retain the core. Details of cores recovered are given in Table 1.

KASTENLOT CORING

A Kastenlot corer (purchased from Hydrowerkstätten, Kiel, West Germany) was used for the first time from Discovery. The corer consists of a bronze weight-stand, containing up to 1000 kg lead weights in bronze castings, and a square section (15 x 15cm) galvanized steel core box in lengths of 2,4 and 6m, that can be opened longitudinally in two sections. A simple flap valve closes the top end of the weight-stand. The core catcher consists of a pair of spring-loaded, overlapping doors that can be locked in the open position by means of a pair of trip-levers.

The corer was used with a 2m box on 6 stations with a 50% success rate (Table 1). The corer was launched and recovered in the horizontal position and was lifted on a strop attached to the weight-stand. Some disturbance of the core tops resulted from this handling.

The core boxes were opened on deck and the cores subsampled extensively for water content and bulk density determinations, mineralogy and geochemistry, organic

chemistry and pore water studies. These analyses will be carried out at Southampton, Leeds and Cape Town Universities and at IOS Wormley.

The corer, with a 4m core box attached, was unfortunately lost on Station 9942 immediately after it had been pulled out of the bottom.

G. Birch
M. Bremner
S. Calvert
H. Coyle
R. Edge
R. Morris
R. Peters
E. Reid
P. Ridout
J. Thomson

PORE WATER SAMPLING

The two major objectives for the pore water programme were the sampling of pore waters within the upper 50cm of sediment in a transect across the carbonate compensation depth and the testing of a new design of in situ pore water sampler, the Mk II harpoon, designed to sample with no disturbance of the sediment-water interface. In addition, it was hoped to obtain deeper samples for shipboard squeezing from the Kastenlot corer and to obtain some samples from the continental slope.

Sediment samples were obtained from box cores at five stations for squeezing in a cooled nitrogen-filled glove box. A total of 24 box core samples were squeezed and about 370ml of pore-water from these samples was frozen for shore based analysis. Deeper samples were obtained from 3 Kastenlot cores. Owing to the loss of the main warp, the objective of sampling across the compensation depth was not realised, but slope samples were obtained at Stations 9934 and 9951.

The Mk II sample was tested at seven stations. Initial failures were traced to a pressure-lock in the penetration retarder hydraulic cylinder. After this was modified, samples were obtained on the third drop (Station 9940). Additional problems at Station 9942 were traced to low battery voltage resulting from a small seawater leak in the battery pressure case. Attempts to obtain samples from slope sediments were initially unsuccessful due to insufficient penetration; this was overcome by the addition of a 50 kg lead weight to the sampling head. Samples were obtained at Station 9952 in 1500m depth even though the unit towed over after five minutes sampling due to rapid drift of the ship.

In summary, useful samples were obtained during the cruise from an area not previously sampled, although the full objectives of the programme were not achieved.

Valuable experience of the Mk II sampler was obtained; several minor modifications will be made in the light of the experience gained, in addition to the modifications made during the cruise. It is hoped to install an improved acoustic telemetry system so that a quatitative assessment of sampling success can be made during the sampling process.

M. Baptist
P. Ridout
T. Wilson

BIOCHEMISTRY

Two sets of experiments were conducted on the involvement of deep water sediment bacteria in the early diagenesis of natural product compounds derived from the plankton. Culture flasks were attached to the particle trap on Station 9934 in order ot obtain samples of colonising bacteria for further biochemical analyses. Samples of the sediment interface, collected by box coring, were obtained from several stations, including 9934, and cultured with a number of typical marine lipids. These will be compared with similar analyses of samples taken below the sediment interface, where the bacterial bromass is much smaller, and with samples from the particle trap itself.

Near-surface oblique plankton tows were made on several night stations and the material used to establish a series of experiments in the constant temperature laboratory on the decomposition of fresh organic material. Initial analyses suggested that inorganic phosphate-phosphorus is released rapidly from the cultures. In the second half of the cruise, large swarms of Pyrosoma were encountered during night stations and several bulk samples were collected and deep-frozen for later work on their sterol chemistry.

R.J. Morris

SURFACE FILMS

Only one sample of the sea surface microlayer was obtained, due to heavy swells, high winds and some rain. Neuston net tows were made regularly, however, the results suggesting that substantial concentrations of floating material of anthropogenic origin (plastic, tar balls, etc.) are present in the South Atlantic Ocean.

C. Chittenden
R.J. Morris
R. Peters
E. Reid
P. Ridout

PARTICLE TRAP

A free-fall particle trap was deployed on the continental slope off Cape Town (Table 1) in 2485 in water depth. The trap was first used on Shackleton Cruise 5/78 and had minor modifications to the mechanism for holding the filter membranes in the collecting cells. The timer was set to open the blinds 2 hours 21 minutes after the mooring was in position and to close the blinds after a further 200 hours (8.33 days).

The trap was recovered with one of the blinds in the open position; this was due to a break in the line from the blind to the closing weight. No samples were therefore retained in the open tray, but reasonable samples of faecal matter, foraminifera, pteropods and exoskeletons were obtained in the second tray. The samples were concentrated by vacuum filtration and stored frozen for analysis at Wormley.

S.E. Calvert
M.J. McCartney

COMPUTING

The main task of the computer system during the cruise was to provide accurate navigation and depth-annotated track charts for the area, together with thermometer corrections at each hydrographic station using the data file CALF and the program CALVE. The file CALF was expanded to hold calibration records for up to 150 thermometers. Program BIOS was used to log and record station data.

The program NETPL was written in order to plot net monitor calibration data. This will be expanded during Cruise 100 to produce the net monitor "sticks" used in conjunction with the Mufax records.

Some ancilliary programming help was given in writing a salinity calibration program.

J. Burnham

TABLE 1

STN.	DATE 1979	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	SAMPLING TIME GMT	REMARKS	MEAN SOUNDING M.
9934	16/ 1	34 1.0S	17 4.4E	1WB 1	990-2200	2220-2245	DEEP HYDRO CAST	2213
# 1		34 1.0S	17 3.8E	2WB 7.4 3WB 30				
9934	17/ 1	34 0.9S	17 0.2E	1GRAV CORER	2710-2710	0214-0215	120 CM CORE	2710
# 2		34 0.9S	17 0.1E					
9934	17/ 1	33 59.4S	16 55.2E	1BOX CORER	2730-2730	0530-0532	NO CORE	2730
# 3		33 59.3S	16 55.2E					
9934	17/ 1	33 56.1S	16 53.8E	1BOX CORER	2465-2465	0840-0841	NO CORE	2465
# 4		33 56.1S	16 53.8E					
9934	17/ 1	33 51.7S	16 52.8E	1WB 1	1-1250	1335-1350	SHALLOW CAST TO 1250M	2415
# 5		33 51.2S	16 52.8E	2WB 7.4 3WB 30				
9934	17/ 1	33 49.7S	16 52.4E	1KASTENLOT	2660-2660	1454-1455	PARTIAL FAILURE SMALL SAMPLE	2660
# 6		33 49.6S	16 52.4E					
9934	17/ 1	33 47.1S	16 53.6E	1BOX CORER	2485-2485	1725-1726	42 CM CORE	2485
# 7		33 47.1S	16 53.6E					
9934	17/ 1	33 45 9S	16 54.1E	1PTM	2485-2485	1818-	TRAP MOORED TO SAMPLE 9 DAYS	2485
# 8								
9935	17/ 1	33 43.8S	16 25.3E	1NN	0- 0	2204-2239		2065
# 1		33 43.7S	16 17.4E					
9936	18/ 1	33 42.7S	15 39.6E	1KASTENLOT	3808-3808	0500-0502	78 CM CORE	3808
# 1		33 42.6S	15 39.6E					
9936	18/ 1	33 40.9S	15 38.6E	1PW SAMPLER	3790-3790	0748-0803	NO SAMPLES	3790
# 2		33 40.8S	15 38.5E					
9936	18/ 1	33 39.6S	15 36 4E	1BOX CORER	3760-3760	1250-1252	46 CM CORE	3760
# 3		33 39.7S	15 36.2E					

STN.	DATE 1979	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	SAMPLING TIME GMT	REMARKS	MEAN SOUNDING M.
9936 # 4	18/ 1	33 40.8S 33 40.4S	15 19.9E 15 10.7E	1NN	0- 0	1411-1453		3760
9937 # 1	18/ 1	33 42.2S 33 42.3S	14 18.2E 14 18.2E	1WB 1 2WB 7.4 3WB 30	1490-4400	2303-2318	DEEP CAST TO 4400 M	4282
9937 # 2	19/ 1	33 43.1S 33 43.1S	14 18.5E 14 18.5E	1KASTENLOT	4290-4290	0206-0208	192 CM CORE	4290
9937 # 3	19/ 1	33 43.3S 33 43.3S	14 18.6E 14 18.6E	1WB 1 2WB 7.4 3WB 30	1-1250	0439-0450	SHALLOW CAST TO 1250 M	4290
9937 # 4	19/ 1	33 42.7S 33 42.7S	14 16.0E 14 15.9E	1BOX CORER	4295-4295	0748-0749	57 CM CORE	4295
9937 # 5	19/ 1	33 44.8S 33 46.0S	14 3.5E 13 56.4E	1NN	0- 0	0908-0955		4304
9938 # 1	19/ 1	33 59.5S 33 59.7S	12 24.5E 12 24.5E	1OXF 1M	0- 50	2308-2334		4675
9938 # 2	20/ 1	34 0.0S 34 0.0S	12 24.2E 12 24.3E	1WB 1 2WB 7.4 3WB 30	1490-4600	0210-0235	DEEP HYDRO CAST TO 4600 M	4678
9938 # 3	19/ 1	33 43.3S 33 43.4S	12 18.6E 12 18.6E	1KASTENLOT	4680-4680	0538-0539	NO CORE	4680
9938 # 4	20/ 1	34 1.5S 34 1.5S	12 22.6E 12 22.5E	1PW SAMPLER	4680-4680	0906-0919	NO SAMPLES	4680
9938 # 5	20/ 1	34 1.2S 34 1.2S	12 21.2E 12 21.2E	1BOX CORER	4675-4675	1245-1247	NO CORE	4675

STN.	DATE 1979	POSITION LAT	POSITION LONG.	GEAR	DEPTH (M)	SAMPLING TIME GMT	REMARKS	MEAN SOUNDING M.
9938	20/ 1	34 1.0S	12 21.1E	1WB 1	1-1250	1519-1529	SHALLOW CAST TO 1250 M	4675
# 6		34 1.0S	12 21.1E	2WB 7.4				
				3WB 30				
9938	20/ 1	34 1.3S	12 12.4E	1KASTENLOT	4685-4685	1822-1824	15 CM CORE	4685
# 7		34 1.4S	12 11.7E					
9939	20/ 1	34 4.5S	11 24.5E	1OXF 1M	0- 50	2303-2330		4825
# 1		34 4.8S	11 18.8E					
9940	21/ 1	34 10.8S	9 57.8E	1KASTENLOT	4975-4975	0959-1001	166 CM CORE	4975
# 1		34 10.8S	9 57.8E					
9940	21/ 1	34 10.7S	9 58.0E	1PW SAMPLER	4980-4980	1319-1351	45% SAMPLES	4980
# 2		34 10.7S	9 58.0E					
9940	21/ 1	34 11.7S	10 0.7E	1BOX CORER	4970-4970	1734-1736	64 CM CORE	4970
# 3		34 11.8S	10 0.9E					
9940	21/ 1	34 13.8S	9 45.9E	1NN	4975-4975	1858-1941		4975
# 4		34 14.9S	9 36.5E					
9941	21/ 1	34 19.2S	9 10.8E	1OXF 1M	0- 50	2241-2328		4997
# 1		34 20.2S	9 0.6E					
9942	22/ 1	34 31.8S	7 35.0E	1WB 1	1490-5000	1018-1050	DEEP CAST TO 5000 M	5140
# 1		34 32.0S	7 35.2E	2WB 7.4				
				3WB 30				
9942	22/ 1	34 32.9S	7 36.2E	1BOX CORER	5125-5125	1418-1420	SINGLE SHARK TOOTH RECOVERED	5125
# 2		34 32.9S	7 36.3E					
9942	22/ 1	34 33.7S	7 37.8E	1PW SAMPLER	5231-5231	1720-1742	NO SAMPLES	5231
# 3		34 33.5S	7 40.1E					
9942	22/ 1	34 33.8S	7 44 5E	1NN	0- 0	1916-1940		5140
# 4		34 33.9S	7 44.7E					

STN.	DATE 1979	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	SAMPLING TIME GMT	REMARKS	MEAN SOUNDING M.
9942 # 5	22/ 1	34 29.4S 34 29.4S	7 38.7E 7 38.6E	1KASTENLOT	5130-5130	2114-2116	MAIN WARP AND GEAR LOST	5130
9942 # 6	22/ 1	34 30.4S 34 30.6S	7 38.2E 7 38.1E	10XF 1M	0- 50	2244-2303		5130
9942 # 7	22/ 1	34 30.8S 34 33.6S	7 38.1E 7 40.0E	1WB 1 2WB 7.4 3WB 30	1-1250	2320-2340	SHALLOW CAST TO 1250 M	5135
9943 # 1	23/ 1	36 2.0S 36 5.8S	8 48.8E 8 52.7E	1NN	0- 0	1111-1137		5010
9944 # 1	23/ 1	36 10.3S 36 10.5S	9 0.7E 9 0 7E	1WB 1 2WB 7.4 3WB 30	1490-5000	1620-1649	DEEP CAST TO 5000 M	5014
9944 # 2	23/ 1	36 10.2S 36 10.6S	9 0.6E 9 0.7E	1SFS	0- 0	1549-1657		5016
9944 # 3	23/ 1	36 10.2S 36 8.3S	9 0.3E 9 5.3E	1WB 1 2WB 7.4 3WB 30	1-1250	1932-2000	SHALLOW CAST TO 1250 M	5020
9945 # 1	23/ 1	35 57.9S 35 57.5S	9 32.3E 9 34.6E	10XF 1M	0- 50	2248-2305		5015
9946 # 1	24/ 1	35 19.1S 35 19.3S	11 49.8E 11 56.5E	1SFS	0- 0	1100-1117		4936
9947 # 1	24/ 1	35 16.6S 35 15.4S	12 35.7E 12 38.7E	1SFS	0- 0	1437-1454	NO SAMPLE. RAIN	4820
9948 # 1	25/ 1	34 19.7S 34 19.4S	16 15.5E 16 16.0E	1WB 1 2WB 7.4 3WB 30	1490-3850	0830-0905	DEEP CAST TO 3850 M	3868

STN.	DATE 1979	POSITION LAT	POSITION LONG	GEAR	DEPTH (M)	SAMPLING TIME GMT	REMARKS	MEAN SOUNDING M.
9948	25/ 1	34 20.0S	16 23.0E	1WB 1	1-1250	1255-1315	SHALLOW CAST TO 1250 M	3870
# 2		34 19.7S	16 27.1E	2WB 7.4				
				3WB 30				
9949	25/ 1	34 20.7S	16 38.6E	1NN	0- 0	1418-1442		3290
# 1		34 21.1S	16 43.5E					
9950	25/ 1	34 26.7S	17 23.1E	1GRAV CORER	1830-1830	2128-2129	20 CM CORE	1830
# 1		34 26.7S	17 23.1E					
9950	25/ 1	34 26.2S	17 23.3E	1PW SAMPLER	1820-1820	2301-2305	NO SAMPLES	1820
# 2		34 26.2S	17 23.3E					
9950	26/ 1	34 23.1S	17 18.5E	1BOX CORER	1840-1840	0048-0050	NO CORE	1840
# 3		34 22.7S	17 17.8E					
9950	26/ 1	34 14.3S	17 10.3E	1BOX CORER	1860-1860	0236-0238	NO CORE	1860
# 4		34 14.1S	17 10.2E					
9951	26/ 1	34 1.4S	17 9.0E	1BOX CORER	2388-2388	0935-0936	43 CM CORE	2388
# 1		34 1.4S	17 9.0E					
9951	26/ 1	33 52.3S	16 57.9E	1PW SAMPLER	2352-2352	1134-1205	NO SAMPLES	2352
# 2		33 50.8S	16 59.0E					
9952	26/ 1	33 44.1S	16 52.8E	1PW SAMPLER	1500-1500	1710-1717	32 % SAMPLES	1500
# 1		33 44.8S	16 53.4E					
9953	26/ 1	33 44.1S	16 50.5E	1PTM	2385-2385	1939-2010	PARTICLE TRAP RECOVERED	2485
# 1		33 45.0S	16 51.9E					

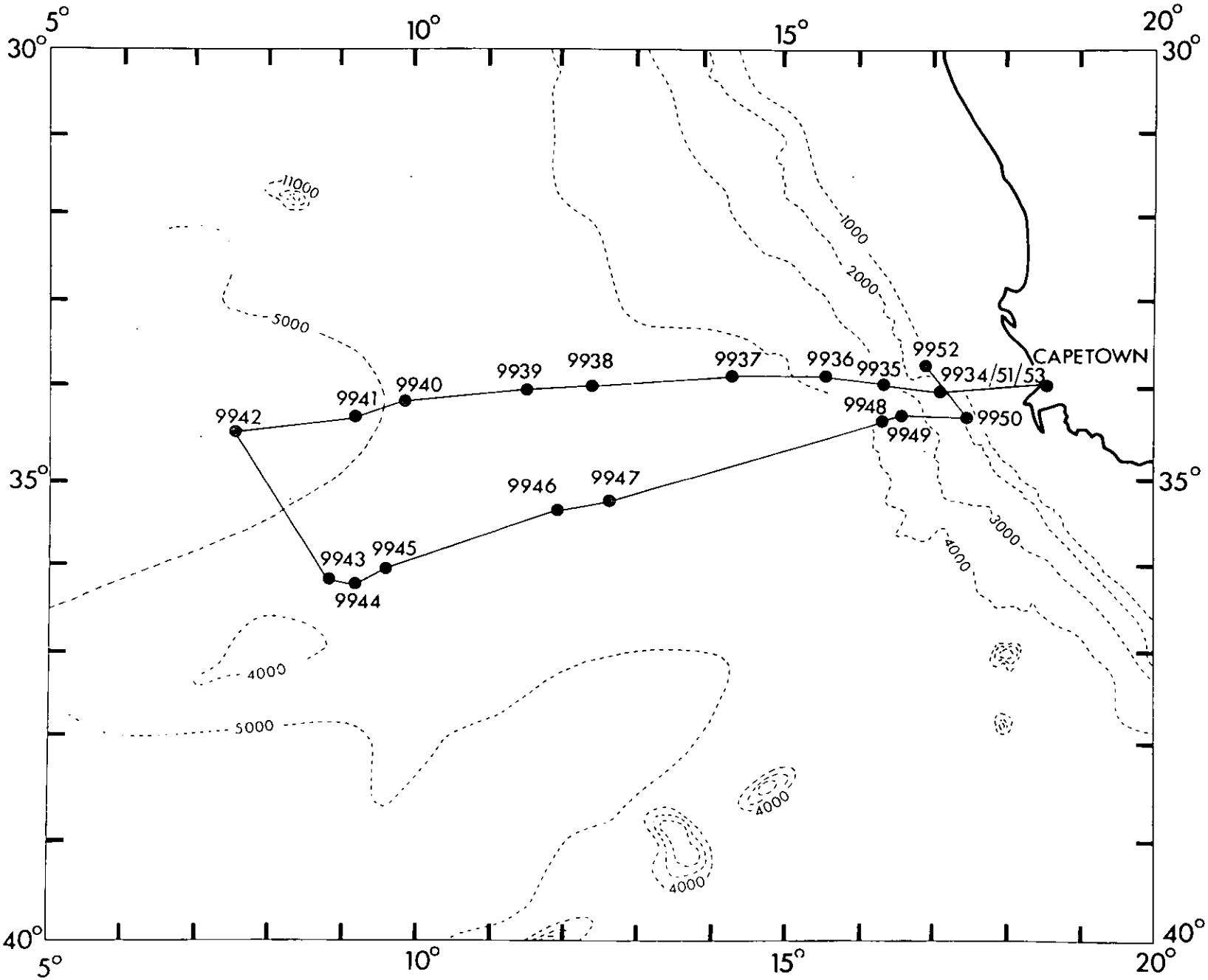

Fig. 1 Discovery Cruise 99 track and station positions

CRUISE REPORTS

RRS DISCOVERY

CRUISE NO		REPORT NO
1	JUN - AUG 1963	1*
2	AUG - DEC 1963	2*
3	DEC 1963 - SEP 1964	3*
		NIO CR**
4	FEB - MAR 1965	4
TO	TO	TO
37	NOV - DEC 1970	37
38	JAN - APR 1971	41
39	APR - JUN 1971	43
40	JUN - JUL 1971	44
41	AUG - SEP 1971	45
42	SEP 1971	49
43	OCT - NOV 1971	47
44	DEC 1971	46
45	FEB - APR 1972	50
46	APR - MAY 1972	55
47	JUN - JUL 1972	52
48	JUL - AUG 1972	53
49	AUG - OCT 1972	57
50	OCT 1972	56
51	NOV - DEC 1972	54
52	FEB - MAR 1973	59
53	APR - JUN 1973	58
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54	JUL - AUG 1973	2
55	SEP - OCT 1973	5
56	OCT - NOV 1973	4
57	NOV - DEC 1973	6
58	DEC 1973	4
59	FEB 1974	14
60	FEB - MAR 1974	8
61	MAR - MAY 1974	12
62	MAY - JUN 1974	11
63	JUN - JUL 1974	12
64	JUL - AUG 1974	13
65	AUG 1974	17
66	AUG - SEP 1974	28
68	NOV - DEC 1974	16
69	JAN - MAR 1975	51
73	JUL - AUG 1975	34
74/1+3	SEP - OCT 1975	35
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78	SEP - OCT 1976	52
79	OCT - NOV 1976	54
82	MAR - MAY 1977	59
83	MAY - JUN 1977	61
84	JUN - JUL 1977	64
86	SEP 1977	57
87	OCT 1977	58
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92	APR - MAY 1978	70
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