

TR-036

CRUISE REPORT

CRUISE TR-36 (DEEFDIP)

26 September--19 December 1966

R/V TRIDENT

An eighty-five day cruise has been completed between Narragansett Bay and the Caribbean area. Geological, biological and biogeochemical studies were involved.

- Leg 1 26 September--11 October 1966 -- Narragansett, Rhode Island to San Juan, Puerto Rico (16 days).
2-3 October 1966 -- St. Georges, Bermuda
11-14 October 1966 -- San Juan, Puerto Rico.
- Leg 2 14-20 October 1966 -- San Juan, Puerto Rico to Barranquilla, Colombia (7 days).
20-23 October 1966 -- Barranquilla, Colombia.
- Leg 3 23 October 1966 -- 18 November 1966 -- Barranquilla, Colombia to Cristobal, Panama (27 days).
30 October 1966 -- Oranjestad, Aruba.
18-23 November 1966 -- Cristobal, Panama.
- Leg 4 23-30 November 1966 -- Cristobal, Panama to Kingston, Jamaica (8 days).
30 November 1966--1 December 1966 -- Kingston, Jamaica.
- Leg 5 1-7 December 1966 -- Kingston, Jamaica to Port Everglades, Florida (7 days).
7-9 December 1966 -- Port Everglades, Florida.
- Leg 6 9-19 December 1966 -- Port Everglades, Florida to Narragansett, Rhode Island. (11 days).
12-13 December 1966 -- Jacksonville, Florida.

Scientific Party

Dr. Dale C. Krause, Geology (legs 3-4)
Bonnie McGregor, Geology (legs 2-5)
Robert Howe, Geology (all legs)
Dr. Keith Chave, Geology (leg 5) Lehigh University
Steve Smith, Geology (leg 5), Lehigh University
Dr. Jason Morgan Geology (leg 3) Princeton University
Ronald Lewis, Geology (leg 3) Princeton University
James Hedberg, Geology (leg 3) Princeton University
Robert O. Fournier, Biology (leg 1)
Ellsworth Wheeler, Biology (leg 1)
Dr. James Corless, Geochemistry (leg 1)
David Hallett, Geochemistry (leg 1)
Bruce Keck, Geochemistry (leg 1)
Donald Roy, Geochemistry (leg 1)
Stanley Cobb, Biology (legs 1-5)
Susan Betzer, Biology (legs 1-2)
Peter Betzer, Geochemistry (legs 1-2)
Paul Perkins, Biology (leg 6)
Timothy Kennard, Oceanographic specialist (legs 4-6)
Arthur Buddington, Oceanographic specialist (all legs)

TR-036

Ship Personnel

B. Collinson, Master	J. Fratus, Ordinary Seaman
C. Sawyer, Chief Mate	D. Neves, Steward
N. Culeberly, 2nd Mate	R. Layfield, 2nd Cook
A. Ells, Bos'n	J. Evans, Radio Operator
H. Martin, Able Bodied Seaman	J. Symonds, Chief Engineer
J. Dwyer, " " "	D. Symonds, 1st Ass't Engineer
T. Morrison, " " "	T. Densmore, 2nd " "
J. Stohlberg, Jr., Ordinary Seaman	H. Ellsworth, Oiler
L. Beliveau, Jr., " "	T. Devine, " "
	G. Alves, " "

Biology and Biogeochemistry

Ten stations were taken by R. Fournier between Narragansett and San Juan (see Table 1) to determine the distribution and viability of microflagellates throughout the water column. Usually five samples were taken per station using sterile Niskin-bag water samplers. These samplers removed the doubt that previous observations made on these flagellates might have been influenced by contamination. Experiments to determine the rate of uptake of dissolved organic material by these organisms were negative.

In conjunction with 17 of the 20 P. Betzer stations, (see Table 1) a series of culture experiments using natural phytoplankton populations was carried out by Susan Betzer between Narragansett and Barranquilla, Colombia. Water taken in 30-liter Niskin bottles from a depth of 50 meters was utilized for both inoculum and base for the culture media. The inoculum was obtained by millipore filtering of the sea water. Half of the inoculum was passed through an ion exchange column to remove trace metals, while the other half of the inoculum was untreated. To aliquots of each half, three enrichments were added: Guillard's medium f/10 a) complete, b) minus trace metals, c) minus silicate. The cultures were incubated and preserved for analysis after inoculation of the medium.

Seven successful stations were made between Narragansett and San Juan, Puerto Rico by Ellsworth Wheeler (see Table 1). A large Clarke-Bumpus plankton sampler provided samples of deep-sea Copepoda from the 2000 to 4000 meter depth interval. These samples are presently being analyzed.

In the Caribbean Stanley Cobb took 95 zooplankton samples from the surface using a 000 mesh net with an opening 1 M by 1/3M. All tows were made at 6.5 knots for one-half hour. Samples were taken at noon, sunset, and midnight between October 19 and November 29, 1966. Bucket temperatures and weather observations were made simultaneously. (See map 3 for area covered.) Specimens include insects, large copepods, amphipods, isopods, euphausiids, chaetognaths, larval fish, myctophids and flying fish.

Peter Betzer occupied 20 stations between Narragansett Bay and Barranquilla, Colombia in an effort to monitor soluble and particulate trace metal concentrations as well as existing phytoplankton populations. It is hoped that relationships that exist between the photosynthetic organisms and the ionic metals characterizing their environment will be discovered. Samples were taken

at 0, 25, 50, 75, and 100 meter depths with the aid of 30 liter, polyvinylchloride Niskin bottles. Two hundred milliliter samples from each depth were preserved and will be used to study the phytoplankton populations. The remainder of the samples was run through an ion exchange column in order to remove soluble trace metals. A 0.45 micron millipore filter pad was used as a prefilter for the ion exchange columns and, as such, retained particulate matter greater than 0.45 microns. The filter pads were saved for subsequent trace metal analysis. At two stations (PB 5 and PB 15) culture studies utilizing natural phytoplankton populations from 25 meters were inoculated with various trace metal mixtures in a effort to discern the relative importance of the various metal species to members of the euphotic zone. After being incubated for 10 days, the cultures were fixed and saved for enumeration.

The objectives of the bio-acoustic studies off the southeastern U.S. Atlantic coast were:

1. Locate and magnetic tape record the spawning sounds of: (a) Atlantic croakers (*Micropogon undulatus*), (b) Spot (*Leiostomus xanthurus*).
2. Record sounds of any whales that may be encountered transiting between stations.

This was a bio-acoustic survey for the fall and winter. The spring and summer survey was conducted in May of 1966 at the same stations. Spawning sounds and their locations were found for the Atlantic Croaker. The Spot was not seen or heard. Additional sounds were recorded from the "Thumper," "Clicker" and another unknown source, presumably of biological origin. Many hours of tape recordings were made of three different species of porpoise sounds and over 600 feet of 16MM color movie film made of these porpoise at the bow of the TRIDENT underway at 10 knots. These will be used for communication sound pattern studies where three different species meet the same ship, times are all diferent, but all other circumstances are exactly the same (ship, speed, off the bow position, etc.). TRIDENT spent December 13 in port, Jacksonville, Florida, to await out bad weather and have one crewman checked over by a doctor. On station, hand/pole line fishing coordinated catch results with sound results. Different fish speices were caught and some were brought back to Narragansett aboard R/V TRIDENT alive, others were frozen for further study. There are about twelve different species of fish which were brought back that are presently in the temperature controlled aquaria in the BAC house at NML. These include a ten-inch kingfish, several Atlantic croakers, etc. Six out of eight bio-acoustic stations were completed. Bad weather caused the cancellation of two stations.

James Corless and his group took water samples for amino acid analysis at approximately 37°12'N, 69°39'W and 33°N, 65°W. Samples were either frozen or filtered and put through Cu-Chelex columns on board.

D.W. Hallett's program is aimed at measuring the concentration of Cu, Mn, Ni, and Zn in sea water from the euphotic zone and below. The analytic procedures being tested are designed to measure the concentrations of the trace elements in 2 dissolved states, ionic and organic complexed. In situ dialysis was one method used for the former and electro dialysis for the latter. Samples were taken at the following stations and depths:

Station 5	33 09	3m	33m	2000m	4000m
	64 51				
		<u>In situ</u> Dialysis at surface			
9	24 33	3	30	100	500
	69 30				
10	22 10	3	33	2500	5000
	68 53				

Sta. 11 19 32 3m
68 08

In situ Dialysis at surface

Geology and Geophysics

L-3
L-4

A model for the origin of the western Caribbean basin was geologically and geophysically investigated by D.C. Krause on legs 3 and 4 (23 October -- 30 November 1966). The investigations consisted of two parts: (1) a detailed survey (echo sounder, proton magnetometer, pneumatic seismic profiler) along the northern margin of Colombia and (2) traverses across the Caribbean between Colombia and Cuba. In addition, the Princeton group (Jason Morgan, Ronald Lewis, and James Hedberg) followed the Quiza fault and related faults from the Guajira Peninsula east into the Gulf of Venezuela using echo sounding, magnetometry and seismic profiling (27-29 October). Rock samples were collected from the island Monge del Norte to supplement their ship-collected data. Other aspects of structure and sedimentation were revealed by their survey, especially the continental margin.

The Colombia survey (23 October -- 12 November) consisted of about 30 lines oriented north-south with 5-10 mile spacing and 50-140 mile lengths into the deep basin. The echo sounder and magnetometer were operated throughout. The seismic profiler consisted of three 10-cu. in. pneumatic acoustic repeaters (Bolt Assoc, PAR, i.e., "air guns") operating together once per five seconds (one or two PAR's for one or two second repetition rate) and towed from the stern. The hydrophone consisted of 10 elements in a 25-foot tube towed 500 feet behind the ship. The array was towed a 5 knots. Because of the slow speed necessary, only selected lines were made with the profiler. The air compressor malfunctioned but enough profiler data had been collected so that the survey as a whole could be interpreted. The survey revealed a great deal of Cenozoic sediment deposited on or draped over east-west trending topography which seems to have undergone at least some vertical movement. The Quiza fault could be carried from the Guajira Peninsula westward along the coast and seems to be the most easily identified fault. Magnetic anomalies on the seaward side of the survey roughly parallel the coast. Photographs and 2 gravity cores were taken on the inferred diapir near 11°32'N, 74°37'W, at the request of Dr. F.P. Shepard. A third gravity core was taken nearby for comparison.

3 Cores taken
on 7 Nov 66.
1 Core - no data
CORES
Total of 4 Cores

1600-1950 4 Cores 11°30'N:74°37'W

The echo sounding and magnetometry traverses between Colombia and Cuba via Jamaica (12-30 November) were made to test the application of F.J. Vine's sea-floor spreading hypothesis in the Caribbean with the following results. Using Vine's assumptions on reversals of the earth's magnetic field and rates of crustal spreading in the northern Pacific, magnetic profiles across the western Caribbean reveal that the basin was probably formed by crustal spreading during the period of 75 to 65 million years ago (Late Cretaceous). The movement rate on a single limb would be 6.5 cm/year. The central rift is still preserved and lies south of Jamaica.

L-5

Kieth Chave of Lehigh University used the R/V TRIDENT to seek land-derived minerals in suspension in the water west of Jamaica. The TRIDENT left Kingston, Jamaica, on 1 December 1966. Three north-south lines were run at 78°05', 79°45' and 80°35' between 17°45' and 19°00'. Fifteen of the eighteen planned stations were occupied. Weather caused cancellation of the last three stations. In most cases 15 liter water samples, from the surface to 900 meters, were filtered to obtain the suspended minerals. Most samples contained quartz, reef-derived carbonates and what appears to be barite (BaSO₄). Semiquantitative estimation of

concentrations suggest derivation from both the north and south coasts of Jamaica, with a shadow due west of the Island. Carbonates appear to be sinking at a rate of about 500 meters in fifty miles. Barite (?) has a faster sinking rate. Quartz distribution is complex, perhaps because much of it is wind-derived. It appears that suspended minerals may be very useful for tracing movements of water masses. The leg ended in Port Everglades on 7 December 1966.

TR-36 LEGS 1 and 2 STATIONS

TABLE 1

Sta. No.	SAMPLING PERSONNEL	LATITUDE	LONGITUDE	DATE	DEPTH METERS
1	PB 1	40°20'N	70°50'W	9-27-66	110
2	PB 2, RO 1	39°18'N	70°33'W	9-27-66	2800
3	PB 3, RO 2, JC1, EW 1	37°12'N	69°39'W	9-28-66	4300
4	PB 4, RO 3	32°30'N	65°05'W	10-1-66	4400
5	PB 5, RO 4, JC 2, DH 1	33°09'N	64°51'W	10-1-66	4700
6	PB 6, RO 5, EW 2	30°38'N	65°02'W	10-4-66	4470
7	PB 7, RO 6, EW 3	28°55'N	69°49'W	10-5-66	5390
8	RO 7, EW 4	26°59'N	70°07'W	10-6-66	5420
9	PB 8, RO 8, EW 5, DH 2	24°33'N	69°30'W	10-7-66	5550
10	PB 9, RO 9, EW 6, DH 3	22°10'N	68°53'W	10-8-66	5450
11	PB 10, RO 10, EW 7, DH 4	19°32'N	68°08'W	10-10-66	8135
12	PB 11	19°35'N	68°14'W		
13	PB 12	18°25'N	67°49.2'W	10-15-66	385
14	PB 13	18°16'N	71°02'W	10-16-66	850
15	PB 14	16°48'N	71°45'W	10-16-66	2565
16	PB 15	15°29'N	71°54'W	10-17-66	3720
17	PB 16	14°41.6'N	73°11.5'W	10-18-66	2600
18	PB 17	13°24'N	73°14.9'W	10-18-66	4006
19	PB 18	12°22'N	74°54.8'W	10-19-66	3630
20	PB 19	11°52'N	74°52.5'W	10-19-66	3265
21	PB 20	11°14'N	74°53'W	10-20-66	650

The Accompanying No. Indicates Station as Keyed to the Individual

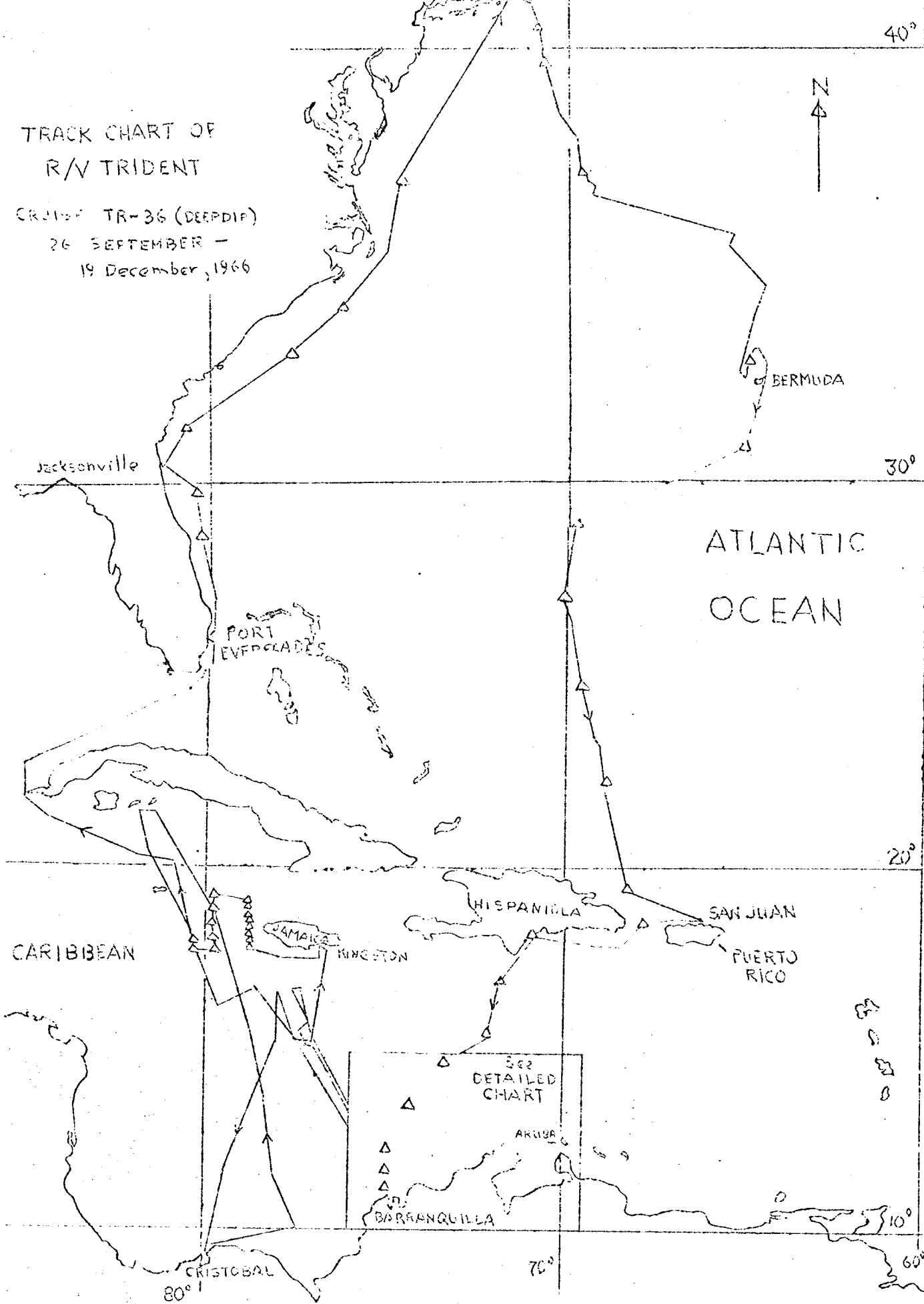
PB: Peter Betzer
 RO: Robert Fournier
 JC: James Corless
 EW: Ellsworth Wheeler
 DH: David Hallett

TRACK CHART OF
R/V TRIDENT

CRUISE TR-36 (DEEPDIP)

26 SEPTEMBER -

19 December, 1966



CARIBBEAN

SEA

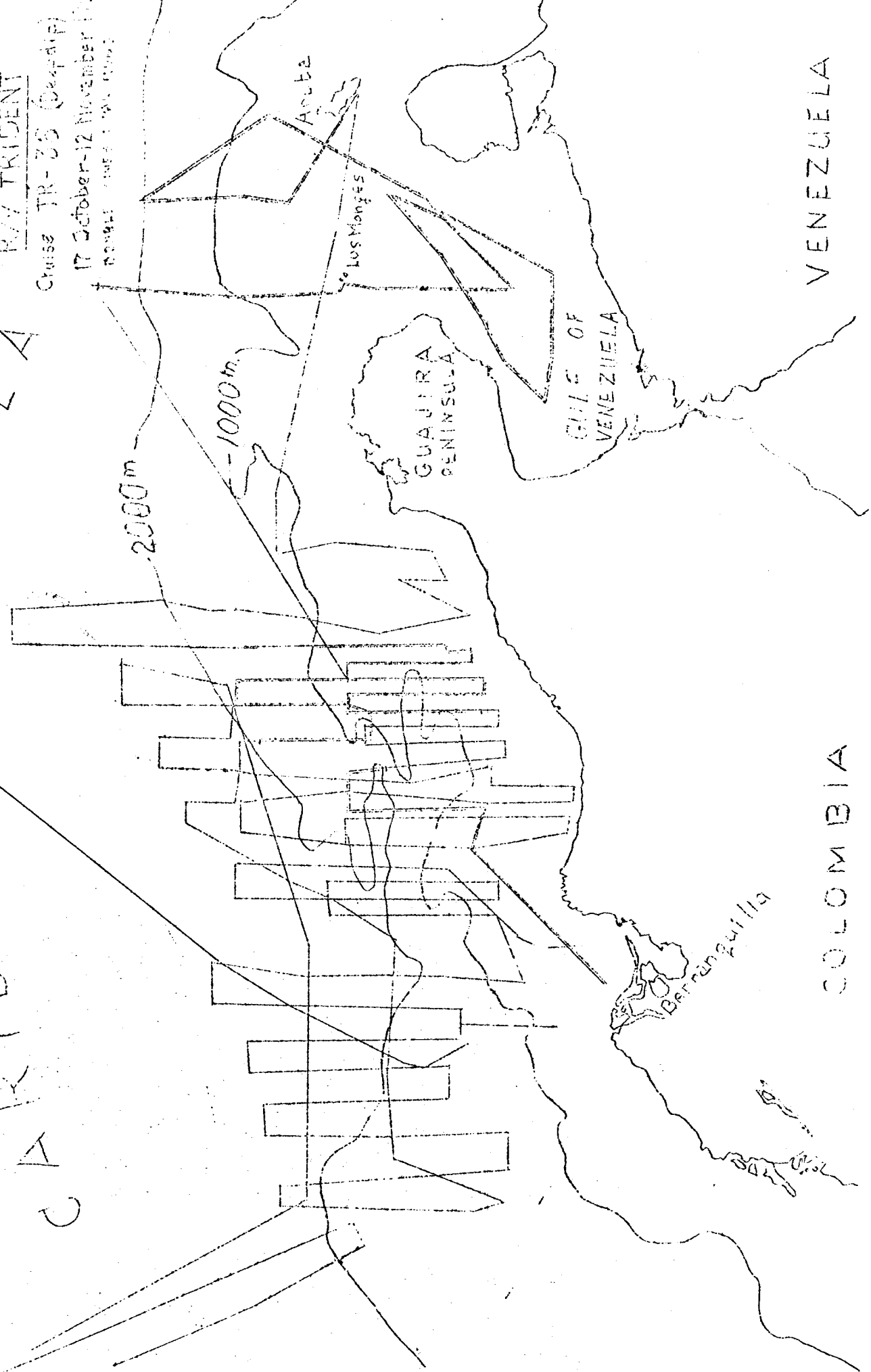
TRACK CHART

of
R/V TRIDENT

Cruise TR-25 (Deep dip)

17 October-12 November 1967

DEPT. OF COMMERCE, U.S. GOVERNMENT



R/V IRIDENT #1036 - COB
SURFACE Zooplankton Samples
200 Net Oct 15 - Nov 29, 1966

