

GRADUATE SCHOOL OF OCEANOGRAPHY, UNIVERSITY OF RHODE ISLAND, KINGSTON, R.I.

CRUISE REPORT TR-122

R/V TRIDENT

"PICO"

SCHEDULE

Departed Ponta Delgada on San Miguel 21 August 1972, 1915
Arrived Ponta Delgada 5 September 1972, 1440

GRANTS

D. C. Krause and J-C. Schilling, NSF Grant GA-30677x = 16 days.

PROGRAM

This 16-day cruise conducted geophysical, geological and hydrographical-geochemical studies in the rift zones passing through the Azores Islands. The research investigated the effects of the tectonic triple junction of the American, Eurasian and African crustal plates.

SCIENTIFIC PARTY

Prof. Dale C. Krause, URI and AOML/NOAA*, Cruise Leader, Faculty
Dr. David L. Johnson, URI, geochemistry, Graduate Student
Bonnie A. McGregor, AOML/NOAA, geophysics, Staff
Martin R. Fisk, URI, geophysics, Graduate Student
Arthur B. Buddington, URI, geophysics, Staff
Edward Weitzner, URI, hydrography, Staff
Edward E. Hood, URI, hydrography, Staff
Mark Zajac, URI, geology, Staff

*Atlantic Oceanographic and Meteorological Laboratories of the National Oceanic and Atmospheric Administration, Miami, Florida.

CREW

T. Hansen, Master	J. Symonds, Chief Engineer
R. Reusswig, Chief Mate	T. Surette, 1st Asst. Engineer
S. Beuth, 2nd Mate	G. Freeman, 2nd Asst. Engineer
W. James, Radio Officer	J. Moscatelli, Oiler
J. Stohlberg, Bosun	R. Gosinkski, Oiler
P. Russell, A.B.	D. Smith, Oiler
O. Palardy, A.B.	P. Neves, Chief Cook
B. H. Story, A.B.	E. Buehrens, 2nd Cook
A. Sexton, O.S.	
T.R. Hanna, O.S.	

GEOPHYSICS

Cruise TR-122 is designed to complete research begun on Cruise TR-21 in 1964 and carried through cruises TR-23 (1965), TR-36 (1970) and TR-39 (1970). Specifically the research was designed to: (1) investigate the central portion of the active Terceira Rift, (2) localize the intersection of the Terceira Rift and Mid-Atlantic Rift, and (3) test the inferred locations of the Mid-Atlantic Rift and associated fracture zones.

The intersection of the Terceira Rift and Mid-Atlantic Rift represents the tectonic triple junction of the following large crustal plates: American, Eurasian, and African. Earlier cruises have shown the intersection to be very complex.

Cruise TR-122 shows that the modern Mid-Atlantic Rift north of 39°N latitude to be typical and simple, showing a well developed rift with characteristic magnetic anomalies. The triple junction lies near 39° N. latitude. South of there, the rift is poorly developed, as are the magnetic anomalies. This indicates that in this locality, the recent tectonic activity is very different between the American and African plates than that between the American and Eurasian plates to the north.

The detailed surveys of TR-122 and TR-39 show the modern Terceira Rift passes into the complex bathymetry of the ridge. Detailed analysis of the survey should show the continuations.

Four lines across the Mid-Atlantic Rift were run north of 39½° N lat. as a joint URI-WHOI (Woods Hole) project.

The magnetometer and echo sounder were operated throughout. The airgun (40 cu. in, 1300 psi) was operated at a ship's speed of 7.5 kt where time permitted (see table). The hydrophone and/or receiving system gave considerable problems at first and was barely satisfactory for the rest of the cruise.

The geophysical program was carried on by D. C. Krause, B. A. McGregor, M. Fisk, A. B. Buddington and M. Zajac.

PAR RUNS (AIR-GUN): TR-122 (PICO)

<u>Time for run</u>	<u>Total time</u>
2000 (21 Aug) - 0015 (22 Aug)	4 hr 15 min
1605-1710 (22 Aug)	1 hr 5 min
2000-2340 (22 Aug)	3 hr 40 min
1530-1940 (24 Aug)	4 hr 10 min
0525 (25 Aug) - 0010 (26 Aug)	18 hr 45 min
0005 (23 Aug) - 0655 (29 Aug)	30 hr 50 min
1945 (29 Aug) - 0255 (30 Aug)	7 hr 10 min
1930 (31 Aug) - 0635 (1 Sept)	13 hr 5 min
2345 (1 Sept) - 0855 (4 Sept)	57 hr 10 min
1055-2215 (4 Sept)	11 hr 20 min

6 days 7 hrs 25 min = 6.3 days
@ 7.5 kt = 1135 n. miles

GEOCHEMISTRY-HYDROGRAPHY

Investigations of the water were made in seven deep, silled basins in the Terceira Rift (three basins) and the Mid-Atlantic Rift (four basins). The study is aimed at: (1) investigation of geochemical anomalies which may be caused by solutions leaking from the rifts and (2) hydrology of the basins in terms of water renewal and dynamics, especially near the sills. Water samples were taken for analysis of temperature, salinity, oxygen, phosphate and arsenic (Dr. Johnson). The STD probe with oxygen sensor was used to measure continuous profiles of pressure, temperature, salinity and oxygen to a maximum of 3000 m depth. All measures were made down to within 10-20 m of the basin floor where possible. The tables give pertinent data on location and sampling depths.

A preliminary analysis does not reveal any significant geochemical anomalies deep within the basins. Deep water in the basins in most, perhaps all, cases shows constant salinity, phosphate and oxygen with an adiabatic temperature gradient.

In contrast, the continuous recordings reveal much hydrographic activity near the sill depths with transitional layers 250 m to 650 m thick with abundant step structures. Only one basin, STD Station #6 in the Mid-Atlantic Rift, showed a sharp discontinuity with only a 60 m thick transitional layer. Note that the closures of the basins below the sill range from 300 m (STD Station #6) to 1660 m (STD Station #2) deep.

A layer of supersaturated oxygenated water lay at 30-80 m consistently throughout the area. The oxygen minimum was found everywhere at 700-800 meters depth. The Mediterranean water similarly was constantly present ranging 750 to 1100 m depth.

The geochemical-hydrographic program was carried on by D.L. Johnson, E. Weitzner, E. Hood and D.C. Krause.

GEOCHEMICAL-HYDROGRAPHIC CASTS: TR-122 "PICO"

<u>Cast</u>	<u>Date</u> 1972	<u>Position</u>	<u>Location</u>	<u>Basin</u> <u>depth</u>	<u>Approximate</u>	<u>Last bottle</u>	<u>sill depth</u>	<u>above</u>	<u>bottom</u>
1	22 Aug	37°37.6'N 24°54.9'W	San Miguel-Formigas Basin	2330m (2390m at first cast)	1900m	27m			
2	23 Aug	37°58.3'N 26°11.7'W	San Miguel-Terceira Basin	3203m	1650m	15m			
3	24 Aug	33°56.0'N 27°41.5'W	Terceira-Graciosa Basin	2475m	1450m	15m			
4	26 Aug	40°32.7'N 29°31.5'W	Mid Atlantic Rift (MAR) Basin #1 (reoccupy sta #10 , TR-35)	3235m	2300m	15m			
5	27 Aug	39°31.2'N 29°47.9'W	MAR Basin #2	2125m	2000m	15m			
6	30 Aug	37°35.3'N 31°50.3'W	MAR Basin #3	2760m	1990m	17m			
7	1 Sept	33°23.3'N 30°24.1'W	MAR Basin #4 (reoccupy station of TR-23)	2330m	1750m	17m			

STD-O₂ CASTS: TR-122 "PICO"

<u>Cast</u>	<u>Date</u> <u>1972</u>	<u>Position</u>	<u>Location</u>	<u>Basin</u> <u>depth</u>	<u>Approximate</u> <u>sill depth</u>
1	22 Aug	37°34.3'N 24°53.5'W	San Miguel-Formigas Basin	2875m	1900m
2	23 Aug	33°00.2'N 26°09.6'W	San Miguel-Terceira Basin (SE end)	3210m	1650m
3	24 Aug	33°18.2'N 26°23.9'W	San Miguel-Terceira Basin (NW end)	2342m	1650m
4	25 Aug	33°57.2'N 27°41.1'W	Terceira-Graciosa Basin	2475m (no O ₂ data)	1450m
5	26 Aug	40°32.9'N 29°31.9'W	Mid-Atlantic Rift basin #1 (reoccupy TR-85 station)	3120m	2300m
6	27 Aug	39°32.5'N 29°45.5'W	MAR basin #2	approx. 2300m	2000m
7	30 Aug	37°35.2'N 31°47.4'W	MAR basin #3	2335m	1900m
8	1 Sept	33°23.6'N 30°23.3'W	MAR basin #4	2872m	1750m

GEOCHEMICAL-HYDROGRAPHIC CASTS, APPROXIMATE DEPTH OF SAMPLES: TR-122 PICO

	1	2	3	4	5	6	7
	1370m	693m	665m	1725m	115m	1243m	1363m
	2270	1193	965	1975	1115	1743	1363
	2470	1693	1265	2225	1365	1943	2063
	2670	2193	1565	2475	1715	2148	2263
	2770	2693	1865	2825	1915	2343	2463
	2795	2943	2165	3025	2015	2543	2663
	2320	3143	2365	3125	2045	2643	2763
	2313	3153	2395	3155	2070	2673	2793
	2323	3163	2430	3190	2030	2713	2333
	2333	3173	2440	3200	2090	2723	2343
	2343	3183	2450	3210	2100	2733	2353
	2353	3193	2460	3220	2110	2743	2363
Bottom	2880	3203	2475	3235	2125	2760	2330
1 depth	1900	1650	1450	2300	2000	1900	1750

ROCK DREDGING

Dredges D-1 and D-2 (see table) sampled near the 1300 volcanic eruption on the São Jorge ridge south of Terceira. Dredge D-3 sampled the Mid-Atlantic Rift north of the tectonic triple junction and was very successful in recovering much fresh basalt. Adjacent samples D-4 and D-5 sampled basaltic greenstone pillows somewhat older than the main rift. Dredge D-6 was lost on a rock outcrop after passing through soft bottom on a site chosen on TR-119. Hurricane "Betsy" forced cancellation of another dredge station between D-3 and D-4.

This is part of a joint D.C. Krause-J.G. Schilling effort to sample systematically the Terceira Rift and the Mid-Atlantic Rift in this region.

ROCK DREDGE HAULS: TR-122 "PICO"

<u>Haul</u>	<u>Date</u> 1972	<u>Position</u>	<u>Location</u>	<u>Depth Dredged</u>	<u>Sample Description</u>
D-1	24 Aug	33°25.5'N 27°20.8'W	Ridge south of Terceira	400-600 m	Lithified calcareous sediment, silica sponges, deep-sea corals, basalt cobbles.
D-2	24 Aug	33°25.5'N 27°20.8'W	Ridge south of Terceira	380-430 m	Lithified calcareous sediment, silica sponges. Same station as D-1.
D-3	26 Aug	40°13.9'N 29°35.4'W	Mid-Atlantic Rift (MAR)	2600-2750 m	500 kg fresh basalt, large pillow fragments
D-4	30 Aug	37°44.5'N 31°30.4'W	MAR	1215-1275 m	Deep-sea coral and basalt greenstone.
D-5	30 Aug	37°43.6'N 31°28.2'W	MAR	1630-1670 m	Two basalt greenstone pillows. Same station as D-5.
D-6	31 Aug	37°09.8'N 32°19.5'W	MAR	2450-2575 m	Dredge lost in rough bottom.

Dredged by B.A. McGregor, M. Zajak and M. Fisk

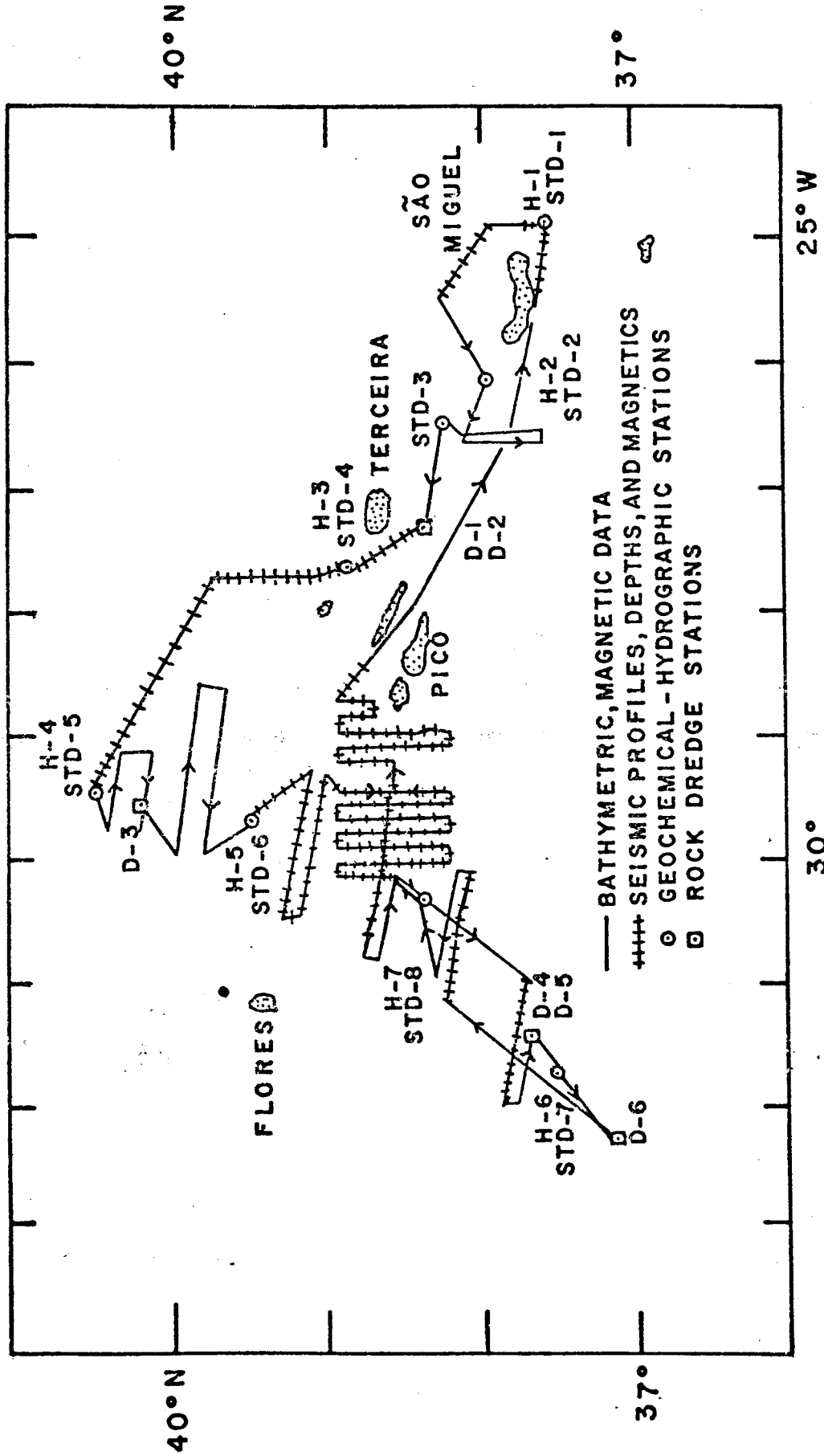
ACCOUNTING

The time for the cruise is accountable as follows:

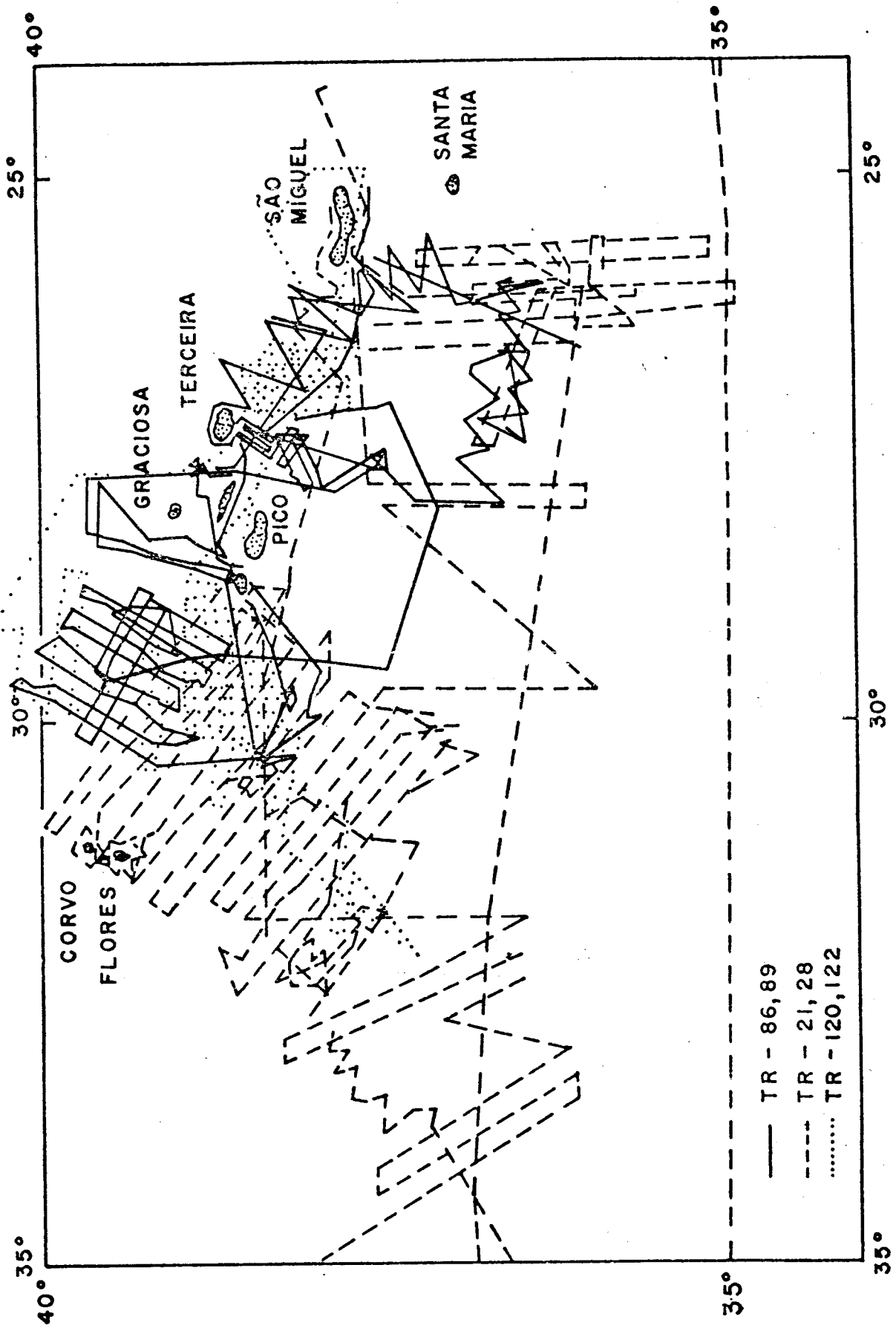
Geochemistry-hydrography: station time running	2 days 21.5 hours
associated with	
establishing station	<u>20.5 hours</u>
	3 days 13 hours
Rock dredging: station time	21 hours
running	<u>13 hours</u>
	1 day 10 hours

(Note: a large amount of time consumed running to and from these stations has been assigned to "geophysics")

Geophysics: magnetics and echo sounding	9 days 15 hours
of which seismic profiling accounts for	6 days 7.5 hours
and of which the URI-WHOI traverses	
account for	<u>1 day 15 hours</u>
TOTAL TIME	14 days 19 hours



CRUISE TRACK R/V TRIDENT CRUISE TR-122 "PICO"
 21 AUGUST - 5 SEPT. 1972



— TR - 86, 89
 - - - TR - 21, 28
 TR - 120, 122

TRIDENT TRACKS IN THE AZORES ISLANDS

GRADUATE SCHOOL OF OCEANOGRAPHY, UNIVERSITY OF RHODE ISLAND, KINGSTON
RHODE ISLAND

PROSPECTUS FOR CRUISE ~~121~~ OF R/V TRIDENT

122

SCHEDULE

Depart	St. Georges, Bermuda	17 September 1972
Arrive	Narragansett, Rhode Island	25 September 1972

SCIENTIFIC PERSONNEL (tentative)

P. Bedard	Electronic Engineer, GSO
L. Dantzler	Johns Hopkins University
W. Hahn	Electronics Technician
F. Steinhelper	Marine Technician
R. Scarlett	Co-investigator, MIT
W. Sturges	Chief Scientist, URI
E. Swift	Co-investigator, URI
E. Weisner	Marine Technician
4 Students	URI - MIT

LOADING

Items to be loaded before TRIDENT leaves Narragansett must be aboard before the 19 June departure for the Azores.

TRAVEL

The scientific party will meet the ship in Bermuda.

SYNOPSIS OF WORK PLANNED

(1) The primary objective is to recover 3 current-meter arrays launched near 28°N , 70°W on cruise 115 (late May).

(2) While we are in the area near the current meters, we will make hydrographic sections, using the STD and in-situ sampler, between the current meter positions. Only 1 or 2 days is available for this work.

(3) Dr. Swift will make plankton tows in the same region, in the upper mixed layer, principally between midnight and dawn.

(4) The ship may be diverted slightly on the homeward leg to make an echo-sounding track across our current-meter station near 36°N , 70°W .

REQUIREMENTS FOR FIELD EQUIPMENT FROM THE SCIENTIFIC POOL

- a. Satellite Navigator
- b. Inductive salinometer
- c. Beckman DU
- d. O_2 rig
- e. Protected and unprotected reversing thermometers
- f. Five liter Niskin bottles
- g. 30-liter Niskin bottles
- h. Mechanical BT and 20 Slides
- i. Deionized water system - 16 days
- j. XBT's; about 10

R/V TRIDENT CRUISE 121 (cont.)

- k. Bottom finding pinger
- l. STD with sampler

REQUIREMENTS OF TRIDENT EQUIPMENT AND SERVICES

- a. Winch for BT operable
- b. PESR - 5 days operation
- c. Scientific locker-type freezer empty
- d. Laboratory refrigerator and range will be used
- e. Dark room clear, drawers and sink empty, work surfaces clear
- f. On-deck pumping system for sea water cooling of experiments.