

CRUISE REPORT  
CRUISE TR 28 (CASBAH)  
R/V TRIDENT

A 71-day cruise was made in the North Atlantic Ocean from 11 October to 20 December 1965. The operations involved geological, geochemical and biological studies.

- Leg 1 11-25 October 1965, Narragansett, Rhode Island -- Horta, Fayal, Azores Islands (14 days).  
25-26 October 1965 Horta
- Leg 2 26 October-10 November 1965  
Horta, Fayal -- Ponta Delgada, São Miguel, Azores I. (15 days)  
10-13 November 1965, Ponta Delgada
- Leg 3 13-29 November 1965,  
Ponta Delgada, São Miguel -- Casablanca, Morocco (16 days)  
29 November - 1 December 1965, Casablanca
- Leg 4 1-20 December 1965, Casablanca -- Narragansett (18 days).

Scientific Party

Dr. Dale C. Krause (Scientific Leader), Geology (all legs)

Bonnie McGregor, Geology (all legs)

Arthur Gaines, Biology (all legs)

Robert O. Fournier, Biology (legs 1-3)

Kent A. Fanning, Geochemistry (leg 3)

Arthur Buddington, Oceanographic specialist (all legs)

George F. Hoskins, Oceanographic specialist (all legs)

John P. Piety, Oceanographic specialist (legs 1-3)

Dr. Frederico Machado, volcanology (Junta de Investigações do Ultramar, Lisbon, Portugal) (leg 2, Fayal I.-- Flores I.)

Jão Pacheco, Marine geology (Junta de Investigações do Ultramar and Universidade Técnica de Lisboa, Lisbon, Portugal) (leg 2).

(Leg 1--7 persons; leg 2--9 persons; leg 3--8 persons, leg 4--5 persons).

Ship Personnel

B. Collinson, Master	R. Mortensen, Steward Cook
Edw. Salisbury, Chief Mate	A. Santiago, Messman
M. Fanning, 2nd Mate	W. James, Radio officer
P. Ouellette, Bosn.	J.D. Symonds, Ch. Eng.
H. Martin, A.B.	D.F. Symonds, 1st Assistant Eng.
J. Burnett, A.B.	C. Casey, 2nd Assistant Eng.
M. Hansen, O.S.	L. Siebrand, Electrician
J. Waldeck, O.S.	E. Martinez, Oiler
E. Collins, O.S.	G. Alves, Oiler
	T. Lagasse, Oiler

Geology

Soundings and magnetic readings were obtained routinely with, respectively, a metric Alpine PESR coupled to an EDO echo sounder and a Varian ship-towed magnetometer. A sub-bottom profiler was used in various study areas. It consisted of compressed air, 123 cu. in. Bolt Associates PAR (Pneumatic Acoustic Repeater) sound source coupled with a Bolt Associates receiving system. Information was displayed on an Alpine PESR in trigger mode and was also tape recorded.

Sediment cores were taken with a 150 lb. gravity corer. Rock samples were taken with a Woods Hole type dredge.

Throughout the cruise, the ship track was chosen wherever possible to complement earlier information mostly that of the Trident. Weather interfered with this several times, such as hurricane Elena during leg 1.

The first special geological operation was a sub-bottom profile of Bear Seamount which showed its seaward flank buried by at least a kilometer of sediment.

A major objective of this cruise was to study the relationship of the Mid-Atlantic rift to the Azores platform by means of topography magnetism, sub-bottom profiles, dredge samples, sediment cores and bottom photographs. Some information was already available from the AZORES cruise of Sept.-Nov. 1964. The survey began on leg 1 and included one PAR run to Fayal I. Leg 2 was almost completely devoted to this study which lay between Fayal and Flores I. The first half of leg 1 consisted of a regular survey including two PAR runs. The second half was devoted to more detailed surveys, another PAR run, 4 rock dredge stations, 4 core stations and 5 camera stations. One special hydrographic station was made in the area to test the water in a deep (2870 m) closed basin-- the basin has a sill depth of about 2000 m and is well flushed.

The study revealed the following. The Mid-Atlantic rift trends north-northeasterly through the western Azores platform with Flores and Corve Islands to the west of the rift zone. The rift zone shows most of the generalized characters of the typical ocean rift but with superimposed complexity. The rift zone has parallel, discontinuous deeps and ridges blocked by numerous volcanoes. A central very high magnetic anomaly of generally greater than 1500 gammas exists as do very magnetic seamounts. Seamounts and ridges outside the rift zone are magnetic but generally less so. The rift zone is flanked by a trough on either side which in turn is flanked by a ridge. The troughs contain 100-300 meters of sediment overlying an irregular topography. Relative elevatinn changes are shown by extensive erosional terraces as deep as 1000 meters. A deeper platform of 2000 meters represents 100-500 meters of sediment deposition over a predominantly rougher surface. A major change in character of the Mid-Atlantic ridge and rift zone occurs near 38°N. latitude which includes

changes in direction of major trends and the crossing of the northeasterly trend of the Mid-Atlantic ridge by the westerly trend of the East and West Azores fracture zones. The main character of the Azores platform is due to volcanism and faulting associated with the rift zone and with the interaction of the westerly-trending structure and the Mid-Atlantic ridge. This character has been modified by erosion and sedimentation.

Legs 3 and 4 revealed that the eastern one-third of the Atlantic basin is largely non-magnetic with regard to anomalies. The western Mediterranean is somewhat this way but less so.

PAR runs were made west from the Straits of Gibraltar, eastward to Mehedia, Morocco, westward from Casablanca, Morocco, in the deep abyssal plain south of Madeira I. and over the southern end of the Sohm abyssal plain. The Gibraltar run revealed a weak reflector at 500 m sub-bottom in 1500 m of water. In one place, a rise in the reflector was marked by a 100 m topographic high on the sea floor. At least two good reflectors were recorded to 400 meters sub-bottom on the run into Mehedia. This run will be correlated with Dr. McMaster's sparker run off Mehedia on MOHARA. The run off Casablanca showed a good reflector at 450 m sub-bottom. The deep water runs gave very weak returns and will have to be examined closely for results.

#### McGregor's Survey

A grid survey lasting 3 days was conducted between  $52^{\circ}40'$  and  $54^{\circ}20'W$ . longitude and  $28^{\circ}40'$  and  $27^{\circ}50'N$ . latitude. This area is at the southern terminous of the Sohm Abyssal Plain. The purpose of the survey was to trace to its terminous one of the sediment fingers and its associated parallel ridge structures that extend south from the abyssal plain into the abyssal hills. Nine crossings of the area were made

obtaining bathymetric and magnetic data. On one of the crossings the PAR was also run to obtain information of the sediment thickness in the area. Information on the sedimentation and structural characteristics of the area will be obtained from analysis of the data.

### Biology

Deep microflagellates were studied by R. Fournier at twenty stations in the Atlantic Ocean and four in the western Mediterranean Sea. Five Niskin bottles of five and twenty-five liters sampled water between the sea floor and 500 m depth.

Carbon-14 in situ incubation experiments were made at a few stations. A. Gaines made complementing bacterial studies on Fournier's samples. He also used water samples in the Mediterranean for chlorophyll studies.

Deep microflagellates were found at all stations but increasing in abundance toward the continents and abundant in the Mediterranean Sea.

### Geochemistry

Twenty-eight (28) hydrographic stations for silica samples were occupied on the cruise: 5 on leg 1, 1 on leg 2, 21 on leg 3 and 1 on leg 4. Provisional positions and depths are appended. The casts were made to the sea floor and thus measured the entire water column. The following measurements were made routinely: temperature, salinity, oxygen, phosphate and silicate. On several stations, a device (Kamakazi) was used to take water samples at one meter intervals above the sea floor.

Of the proposed stations the following were missed due to bad weather and sea conditions: CA (4), (5), (7), (8), (11), (12) and (13). Station CA (11) was not entirely lost since samples drawn from Fournier's Niskin bottles were analyzed. An unplanned station, hydrostation No. 3 taken off

Ponta Delgada, was also run for silica. Bottom samples using the Kamakazi were obtained at CA (1), (3), (5) and (8). At station CA (9) the Kamakazi was lost so a rig using the pinger and five Nansen bottles was used to bring up bottom water samples at CA (24), (17), (14), (15) and (16). Cores were taken at CA (1), (2), (3), (5), (7), (8), (9), (24), (14), (15) and (16) for a total of eleven.

In addition to the silica samples and cores, six samples were collected with the sponge dragger and stored in HCl. for later silica-silica 32 analysis and samples to be analyzed for molybdate by Dr. Chow (WHOI) were collected at CA (4), (7), and (9) and were stored frozen.

CA (8) was a "special station" at which a mid-water Kamakazi, as well as a bottom Kamakazi and core, was successfully attempted. Both the deep and shallow hydrocasts were run in duplicate and duplicate samples were collected from each Nansen bottle--one to be run by each of the two analysts.

CA (6) was occupied to test water in a closed basin of 2865 meters depth within the rift zone of the Mid-Atlantic ridge. The hydrography revealed a sill depth of 2000 meters and that the basin was well flushed with no change in oxygen values below the sill.

## Hydrostations TR-28

Sta. No.	Latitude	Longitude	Depth	Date
1	39°50'N.	66°59'W.	3455	12-10-65
2	38°28'N.	63°30'W.	4965	14-10-65
3	36°31.5'N.	59°58'W.	5050	15-10-65
4	36°27'N.	46°55'W.	4775	19-10-65
5	37°31'N.	31°44'W.	2550	24-10-65
6	38°27'N.	30°28.5'W.	2865	8-11-65
7	37°57'N.	24°15'W.	3220	13-11-65
8	37°06'N.	11°37'W.	5075	17-11-65
9	37°00'N.	12°22'W.	5065	18-11-65
10	37°03'N.	10°34'W.	3205	19-11-65
11	37°00'N.	10°05'W.	3860	19-11-65
12	37°00'N.	9°35'W.	1770	19-11-65
13	36°50'N.	8°40'W.	300	20-11-65
14	36°02'N.	3°45'W.	1110	22-11-65
15	36°33'N.	0°45'W.	2615	22-11-65
16	37°03'N.	1°30'E.	2715	23-11-65
17	35°49'N.	6°40'W.	715	25-11-65
18	35°53'N.	8°36.2'W.	2910	26-11-65
19	35°59'N.	8°38'W.	3275	26-11-65
20	36°10'N.	8°40'W.	2350	26-11-65
21	36°18'N.	8°37.5'W.	2735	26-11-65
22	36°31.8'N.	8°40'W.	1430	27-11-65
23	36°38.2'N.	8°40'W.	730	27-11-65
24	35°29.6'N.	8°34.5'W.	2650	27-11-65
25	35°42.5'N.	8°40'W.	2840	27-11-65
26	35°00'N.	8°40'W.	3425	28-11-65
27	34°29.5'N.	8°40'W.	3760	28-11-65
28	34°00'N.	8°40'W.	2525	2-12-65

## Fournier Stations TR-28

Sta. No.	Latitude	Longitude	Depth	Date
F01	39°52'N.	66°57'W.	3200	12-10-65
F02	38°30'N.	63°45'W.	4965	13-10-65
F03	37°09'N.	61°27'W.	5065	15-10-65
F04	36°33.5'N.	47°01'W.	4740	19-10-65
F05	36°16'N.	35°43'W.	2860	21-10-65
F06	37°31'N.	31°44'W.	2550	24-10-65
F07	38°30'N.	29°24'W.	1775	28-10-65
F08	39°15'N.	31°00'W.	1790	31-10-65
F09	37°57'N.	30°05'W.	3240	2-11-65
F10	38°27'N.	30°28.5'W.	2855	8-11-65
F11	37°57'N.	24°15'W.	3180	13-11-65
F12	38°03'N.	20°50'W.	4585	14-11-65
F13	37°06'N.	11°42'W.	5070	17-11-65
F14	37°07.2'N.	12°27.5'W.	5065	18-11-65
F15	37°00'N.	10°10'W.	3885	19-11-65
F16	36°50'N.	8°40'W.	300	20-11-65
F17	36°02'N.	3°45'W.	1305	21-11-65
F18	36°33'N.	0°45'W.	2610	22-11-65
F19	37°03'N.	1°30'E.	2710	23-11-65
F20	35°49'N.	6°40'W.	715	25-11-65
F21	35°53'N.	8°36.2'W.	2840	26-11-65
F22	36°10'N.	8°40'W.	2675	26-11-65
F23	35°00'N.	8°40'W.	3350	27-11-65
F24	34°00'N.	8°40'W.	3000	2-12-65



## Geochemical Cores TR-28

Sample No.	Hydro Sta. No.	Latitude	Longitude	Depth (Meters)	Date	Length
CA 1	1	39°50'N.	66°59'W.	3455	12 Oct. 65	51 cm
CA 2	2	38°28'N.	63°30'W.	4965	14 Oct 65	25 cm
CA 3	3	36°31.5'N.	59°58'W.	5050	15 Oct 65	100 cm
CA 9	5	37°31'N.	31°44'W.	2550	24 Oct 65	25 cm
CA 10	7	37°57'N.	24°15'W.	3220	13 Nov 65	
CA 15	8	37°06'N.	11°37'W.	5075	17 Nov. 65	
CA 14	9	37°00'N.	12°22'W.	5065	18 Nov 65	
CA 32	14	36°02'N.	3°45'W.	1110	22 Nov 65	
CA 33	15	36°33'N.	0°45'W.	2615	22 Nov. 65	
CA 34	16	37°03'N.	1°30'E.	2715	23 Nov. 65	
CA 27	24	35°29.6'N.	8°34.5'W.	2650	27 Nov. 65	25 cm

## Geological Samples

Sample No.	Latitude	Longitude	Depth	Date
28 D-1	37°05'N.	30°10'W.	3070-2600 m	4 Nov 1965
Dredge haul tried over Santa Maria ridge. No sample recovered because of soft calcareous ooze.				
28 D-2	37°30'N.	30°45'W.	335-500 m	5 Nov 1965
Lost one dredge and damaged another on basaltic Princess Alice ridge				
28 D-3	38°22'N.	31°28'W.	995-1130 m	7 Nov 1965
Basalt cobbles, basalt agglomerate and manganese nodules from terraced ridge northwest of rift zone.				
28 D-4	38°47'N.	30°28'W.	550-675 m	8 Nov 1965
Coquina of old and live shells, coral, etc from terrace on seamount in middle of rift zone.				
28 C-5	37°10'N.	30°13'W.	2415 m	4 Nov 1965
137 cm core of globigerina ooze with some gut over Santa Maria ridge. Associated with dredge 28 D-1.				
28 C-6	37°30'N.	30°45'W	350 m	5 Nov 1965
Basalt pebble and glass sponges from Prince Alice ridge. Associated with dredge 28 D-2.				
28 C-7	37°42'N.	30°36'W.	1740 m	5 Nov 1965
35 cm of reddish sediment over 39 cm of Globigerina ooze in flat through northwest of Princess Alice ridge. Northwest of core 28 C-6.				
28 C-8	38°22'N.	31°35'W.	955 m	7 Nov. 1965
Over ridge northwest of rift zone. 5 small basalt fragments. Associated with dredge 28 D-3.				

---



---

 Camera Stations TR-28
 

---



---

Station	Latitude	Longitude	Depth	Date
28 CAM-1	37°06'N.	30°18'W.	2440 m	4 Nov. 1965
	Pictures of calcareous ooze over Santa Maria ridge at site of core 28 C-5 and dredge 28 C-1.			
28 CAM-2	37°30'N.	30°45'W.	510-610 m	5 Nov. 1965
	Pictures of deep terrace on north west side of Princess Alice ridge. Top of terrace at 560 m.			
28 CAM-3	37°30'N.	30°45'W.	500-340 m	5 Nov. 1965
	Over Princess Alice ridge near site of core 28 C-6 and dredge 28 C-2.			
28 CAM-4	38°22'N.	31°28'W.	950 m	7 Nov. 1965
	Over terraced ridge northwest of rift zone near site of core 28 C-7 and dredge 28 C-3			
28 CAM-5	38°45'N.	30°27'W.	960-1010 m	8 Nov. 1965
	Over terrace on seamount in middle of rift zone near site of core 28 C-8 and dredge 28 C-4. Top of terrace at 975 m.			

## PAR Runs Tr-28

Run No.	Date	Time	Approximate Position			
			Start Lat.	Start Long.	End Lat.	End Long.
1	12 Oct.	0915-1306	40°01.5'N.	67°38'W.	39°55'N.	67°15'W.
	Over Bear Seamount.					
2	25 Oct.	0828-1123	38°27'N.	29°33'W.	38°25'N.	29°10'W.
	East from rift zone toward Fayal.					
3	27-28 Oct.	1543-1425	39°57'N.	31°04'W.	38°32'N.	28°56'W.
	Southeast across rift zone from northeast of Coro to Fayal-crossing #2.					
4	31 Oct-1 Nov.	1918-2115	37°55'N.	29°13'W.	39°17'N.	31°36'W.
	Southeast across rift zone from southwest of Flores to southwest of Fayal-crossing #7.					
5	4-5 Nov.	2140-0423	36°52'N.	30°18'W.	37°30'N.	30°45'W.
	Northwest over Santa Maria ridge toward rift zone					
6	25-26 Nov.	1217-0531	35°49'N.	6°10'W.	35°49'N.	7°56'W.
	West from the Straits of Gibraltar.					
7	28-29 Nov.	1013-0500	34°36'N.	8°43'W.	34°22'N.	6°48'W.
	East from 3700 meters to Mehedia, Morocco. End position for time 0204.					
8	2-3 Dec.	1434+0345	33°10'N.	8°17'W.	34°11'N.	9°07'W.
	West from Casablanca to 3730 meters.					
9	5 Dec.	1712-1915	31°01'N.	21°30'W.	30°54'N.	21°45'W.
	South of Maderia on abyssal plain.					
10	12-13 Dec.	1418-0620	28°30'N.	54°26'W.	28°20'N.	52°45'W.
	Southern extremity of Sohm abyssal plain.					

