

TR-086

Narragansett Marine Laboratory

Graduate School of Oceanography

J-G / (KRAUSE)

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**ASAF ASHRAF**

CRUISE REPORT - R/V TRIDENT

CRUISE TR-86 (TERCEIRA I)

23 July-4 August 1970

(Also 6-10 August 1970)

AZORES ISLANDS

Core Laboratory

Graduate School of Oceanography

University of Rhode Island

SCHEDULE

A 13-day cruise was made in the Azores Islands region of the North Atlantic Ocean from 23 July to 4 August 1970. The operations involved geological and geophysical studies. In addition, bathymetric and magnetic data was collected in transit from Ponta Delgada (Azores) to Rota (Spain) during the 5 days of 6-10 August 1970.

Leg I 23-29 July 1970. Ponta Delgada (San Miguel I) to Angra do Heroismo (Terceira I) (7 days).

Leg II 30 July-4 August 1970. Angra do Heroismo to Ponta Delgada (6 days).

In port 4-6 August 1970. Ponta Delgada

In transit 6-10 August 1970. Ponta Delgada-Rota (Spain) (5 days).

SCIENTIFIC PARTY

Dr. Dale C. Krause, co-chief scientist, URI (Legs I, II, in transit)

Dr. Jean-Guy Schilling, co-chief scientist, URI (Leg I)

Martin Fisk, graduate student, URI (Legs I, II, in transit)

John W. Richmond, Jr., graduate student, URI (Legs I, II, in transit)

William Hahn, oceanographic technician, URI (Legs I, II, in transit)

Joel Knee, oceanographic technician, URI (Legs I, II, in transit)

Dr. Frederico Machado, volcanologist, Ministerio do Ultramar, Portugal (Legs I, II, in transit)

J. Hipolito Monteiro, geologist, Instituto Hidrografico, Portugal (Legs I, II)

Fred W. Haug, Jr., graduate student, University of New Hampshire (Legs I, II)

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### SHIP'S COMPANY

Barnes Collinson, master	David Bennett, second cook
C.A. Sawyer, chief mate	Fred Russell, AB seaman
David LaCasse, second officer	Robert Jenkins, AB seaman
Henry Martin, bos'n	Richard Boardman, AB seaman
Kyle Birk, radio officer	Oscar Ammons, ordinary seaman
Herbert Stein, chief engineer	Joseph Moscatelli, ordinary seaman
H. Carlson, first assistant engineer	Brad McGuire, ordinary seaman
Theo. Surette, second assistant engineer	Ernest Cherry, oiler
Harry Rougas, electrician	Allen Stopyra, oiler
Pat Neves, steward	C. Melson, oiler

### OPERATIONS

The cruise, "Terceira I", is the first of a two-part cruise (TR-86 and TR-89) designed to study the geologic evolution of the Azores region and to test the Krause-Watkins Azores tectonic model. The name is derived from the following facts: (1) this is the third cruise to the Azores (after TR-21 in 1964 and TR-28 in 1965), (2) the cruise is designed to study a crustal triple-junction and (3) the region of most intense study concerned the Terceira rift. The study was split into two parts in order to mesh with the TRIDENT's Mediterranean operations.

The cruise was initially planned to be devoted mainly to rock dredging operations (controlled by simultaneous bathymetric, magnetic and seismic profiling studies). However, at mid-cruise, a winch malfunction forced postponement of the remaining sampling program until October (TR-89).

### LEG I. Ponta Delgada - Angra do Heroismo

Leg I was mainly devoted to the ridge along the southern flank of the East Azores Fracture Zone. The ridge is herein tentatively named "Agostinho Ridge" after the Azorean scientist, Jose Agostinho. He has been the long-famed and respected naturalist of the Azores for more than a half century. He is now living at the age of 90 in Angra de Heroismo, Terceira, and is often consulted by visiting scientists. He is the author of, among others, many geological papers about the Azores and teacher of Dr. Frederico Machado.

The seismic profiler was used to find outcrops which were then sampled. Eleven stations (see Table 1) were made of which nine were dredge stations and one each camera and gravity core stations. Of the dredge stations, coarsely crystalline gabbro was recovered on three (4D, 5D, 6D) and lithified calcareous ooze was found on six (2D,3D,4D,6D,8D,9D). Manganese coatings of variable thickness occurred on five stations (3D,5D,6D,8D,9D).

In all places, a thick cap of pelagic ooze up to 500 meters thick covered the ridge. Basement, however, was exposed on the very steep, north facing scarps. The ridge decreased in height westward. A thickness of up to 1 km of turbidites and ooze are trapped on the north side of the ridge in a long linear trough.

Seismic (see Table 2), magnetic and bathymetric profiles were made over the shallow ridge trending south from San Miguel Island, over a northern portion of the East Azores Fracture Zone and across the Azores Plateau to Terceira (see Table 3 for equipment).

At Terceira, Schilling transferred direction of the cruise to Krause and departed.

#### LEG II. Angra do Heroismo - Ponta Delgada

Leg II was devoted to the study of the magnetic pattern, the sediment distribution and the bathymetry associated with the proposed Terceira Rift trending through Graciosa, Terceira and San Miguel Islands. Given the time, the study could not be detailed. However, several "survey experiments" were carried out.

(1) Terceira trend experiment. Five lines spaced  $2\frac{1}{2}$  miles apart were run south of Terceira. As of this writing, the interpretation of the data is that magnetic trend is parallel to Terceira Rift.

(2) Azores plateau trends. South of the San Jorge trend, the magnetic anomaly pattern is not yet clear from the data. South of the Faial-Pico trend, the pelagic sediment overlies a more or less smoothly undulating basement whose magnetic trend is not yet clear.

(3) Junction experiment. At the suggestion of J.H. Monteiro a series of lines were run across the Terceira Rift west of Terceira in such a way as to test anomalies formed by the Terceira Rift and by the Mid-Atlantic Rift. Tentatively, the pattern is as expected from the Krause-Watkins model out to 13 million years. The crossings of the Terceira Rift approximately fit the theoretical model except for an absence of a large central anomaly sediment distribution is consistent with spreading of the Terceira Rift.

(4) Structure between Terceira and San Miguel. Six reconnaissance lines were run across the Terceira Rift in this region. A large topographic rift exists with a suitable sediment pattern. The magnetic pattern is permissible regarding the model.

These results were used to control dredging on cruise TR-89. Cruise TR-86 was supported by ONR contract N00014-68-A-0215-0003 and NSF Grant GA-21164.

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TABLE 1. SAMPLING STATIONS

Station No.	Type	Provisional Latitude	Provisional Longitude	Date 1970	Time on bottom	Depth <sub>m</sub>	Chief Operator	Results
1C	<u>Core</u> G-c	36°38'N	25°59'W	24 July	1550	3665	Krause	Calcareous ooze, length = <u>100</u> cm in trough
2D	Dredge	36°36'	25°58'	24 July	1753-2254	2900-3600	Schilling	* 50 kg calcareous ooze north side of ridge
3D	Dredge	36°35'	26°34'	25 July	1045-1615	3400-3700	Schilling	100 kg of soft calcareous ooze and 75 kg manganese covered indurated calcareous ooze north side of ridge
4D	Dredge	36°35'	26°32'	25 July	2029-2045	3000-3400	Krause	25 kg gabbro, 50 kg indurated calcareous ooze north side of ridge
5D	Dredge	36°34'	26°31'	26 July	1945-2230	2800-2860	Schilling	10 kg gabbro and manganese crust north side of ridge
6D	Dredge	36°34'	26°31'	26 July	0110-0222	2750-3000	Krause	10 kg manganese coated gabbro and indurated calcareous ooze
7F	Photo	36°33'	26°30'	27 July	0522-0547	2250-2300	Hahn	Manganese coated outcrops of indurated ooze and ripple marked drifts of soft ooze. Upper part of ridges north side. Plus-X film. F-8 = F stop
8D	Dredge	36°34'	26°29'	27 July	0824-1030	2450-2700	Schilling	100 kg soft and manganese-coated indurated calcareous ooze, a few igneous fragments. North side of ridge

TABLE 1. (continued)

Station No.	Type	Provisional Latitude	Provisional Longitude	Date 1970	Time on bottom	Depth m	Chief operator	Results
9D	Dredge	36° 30' N	26° 27' W	27 July	1345-1550	2500-2900	Schilling	50 kg manganese coated calcareous ooze and 1 rounded schist (quartz biotite) cobble (probable glacial erratic). South side of ridge
10D	Dredge	36° 35'	26° 40'	27 July	1945-2103	3500-3600	Krause	No sample despite abundant action and "hangups". Base of north cliff
11D	Dredge	36° 35'	26° 39'	27-28 July	0051-0315	3135-3385	Krause	Pinger used 200 m above dredge. Dredge lost when winch links broke during severe "hangup." Winch malfunction. North side of ridge

1 G.C.

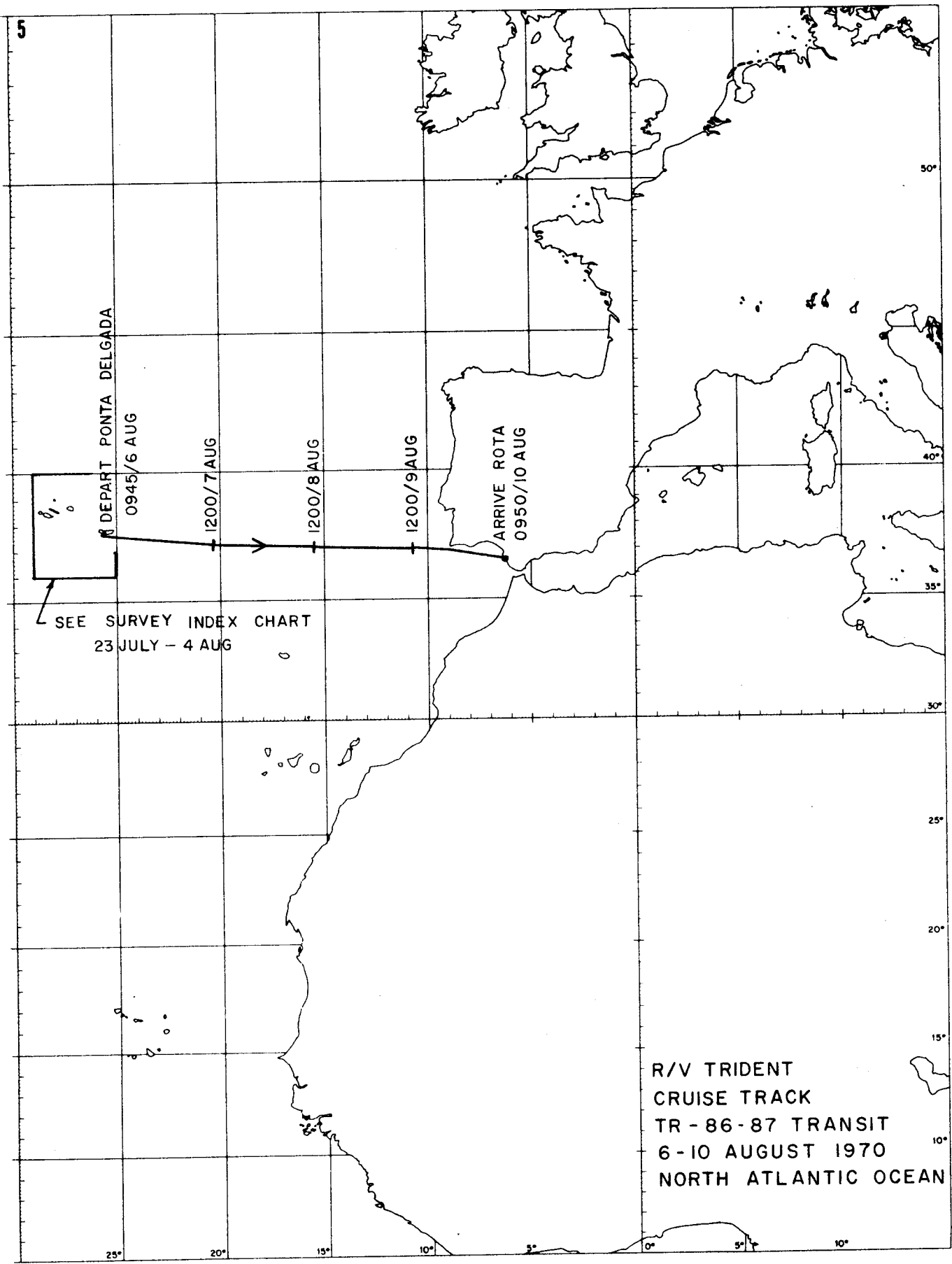
\*Weights approximate

TABLE 2. Seismic profiles. Except for minor gaps for maintenance and repair, the TRIDENT made the following seismic profiles.

<u>Date</u>	<u>Distance</u>	<u>Location</u>
1156, 23 July - 1140, 24 July	371 km (201 n.m.)	South of San Miguel I.
0052-0832, 25 July	120 km (65 n.m.)	Agostinho Ridge
0013-1809, 26 July	278 km (150 n.m.)	Agostinho Ridge
0824, 28 July - 1634, 29 July	496 km (268 n.m.)	East Azores Fracture Zone to Terceira I.
0636-1737, 30 July	189 km (102 n.m.)	South of Terceira I.
1925, 30 July - 0612, 1 Aug.	552 km (298 n.m.)	South and west of Terceira I.
0918, 1 Aug. - 1313, 2 Aug.	474 km (256 n.m.)	West of Graciosa I.
1828, 2 Aug. - 0412, 4 Aug.	540 km (292 n.m.)	Around Terceira I. and traverses across rift to San Miguel I.
0714-0806, 4 Aug.	12 km (7 n.m.)	Off San Miguel I.
Total: 5 days 22 hours	3032 km (1639 n.m.)	

Table 3. Scientific Equipment

Echo sounder:	Alpine PESR recorder coupled with EDO sounder
Magnetometer:	Varian adapted station magnetometer
Seismic profiler:	Bolt air gun, WHOI-type 2000-element hydrophone, Raytheon PFR recorder, Sanborn 7-track FM tape recorder
Gravity corer:	SIO-type
Rock dredge:	chain bag, URI modified
Bottom camera:	EGG single camera and stroke, Benthos pinger



DEPART PONTA DELGADA  
0945/6 AUG

1200/7AUG

1200/8AUG

1200/9AUG

ARRIVE ROTA  
0950/10 AUG

SEE SURVEY INDEX CHART  
23 JULY - 4 AUG

R/V TRIDENT  
CRUISE TRACK  
TR - 86 - 87 TRANSIT  
6 - 10 AUGUST 1970  
NORTH ATLANTIC OCEAN

