Lamont - Doherty Geological Observatory | *Palisades, N.Y. 10964*
of Columbia University

Cable: LAMONT, Palisades, New York State

Telephone: Code 914, Elmwood 9-2900
Twx: 710-576-2653

CRUISE REPORT

Ship Name: R/V CONRAD   Cruise No: 21-04

Departure: 17 December 1977 (Date) from Bridgetown, Barbados (Port)

Arrival: 16 January 1978 (Date) at Rio de Janeiro (Port)

Days at Sea: 30   Days Foreign Port: 3 (No. of days in arrival port)

Area of Operation: Vema Fracture Zone, 11°N, 43°30'W

Program Description: This cruise was primarily a geophysical survey concentrated at the junction of the fracture zone with the axis of the mid-Atlantic ridge near 43°30'W. A major portion of the work consisted of marine geophysical survey of MAR north of Vema FZ, seismic refraction profiles over the transverse ridge, median valley, and transform fault using OBS's, OBH's and long-range sonobuoys. Seismic reflection profiles of fracture zone sediments with penetration to basement (obtained by using the big air guns) played an important part of the study of the junction. Dredging of the transverse ridge and north wall of the fracture zone at several locations completed the studies of the fracture zone during the cruise.

Participants: (All L-DGO unless otherwise specified)

H. Rowlett
J. Diebold
D. Forsyth, Brown Univ.
M. Rawson
G. Gunther
P. Pozzi, HIG
S. McNutt
R. Sartori, Univ. of Bologna, Italy
A. Sobolov, Univ. of Moscow, USSR
P. Hamlyn
J. Hauptman
P. Beck

All inquiries regarding cruise should be made to the chief scientist.

Cruise Report for R/V CONRAD 21-04

I. Program Operations and Equipment Performance

Cruise 21-04 was at sea 30 days with approximately 15½ days devoted to detailed geophysical and geological studies of the western portion of the transform section of the Vema Fracture Zone (11°N) and adjacent rift valley of the mid-Atlantic ridge. The remainder of the cruise consisted of conventional geophysical surveying while in transit to the Vema Fracture Zone and Rio de Janeiro.

Approximately 59% of the time spent at the Vema Fracture Zone consisted of detailed surveying of the axial valley and its junction with the transform, the deployment of an eight-station array of OBS's to monitor microseismicity at the junction, and several refraction profiles over different tectonic features of the spreading system. OBS's, long-range sonobuoys (LRS's), and newly built OBH's were deployed along the refraction profiles. Dredge operations on the north and south walls of the fracture zone, with special emphasis on dredging the transverse ridge, completed the remaining 41% of ship time at the Vema Fracture Zone.

The seismic studies represented a cooperative study with the Hawaii Institute of Geophysics (HIG). The main contribution of HIG to the field program was the use of 5 of their OBS's. Lamont provided 3 OBS's and 3 OBH's. Thus, this cruise deployed the largest number of bottom seismic instruments ever deployed by a Lamont vessel. We made a total of 13 deployments and 11 recoveries. Nine of the recovered instruments recorded usable data. Two OBH's did not record any data. A Lamont OBS and OBH were not recovered. (These two losses are discussed below.) All of the OBS's of HIG were recovered and data from these instruments make up most of the data from the microearthquake monitoring and refraction experiments. A total of 10 days of microearthquake monitoring by six OBS's that were on the sea-floor at the same time represents probably the best data set of seismicity obtained to date along the mid-ocean ridge system.

We were able to obtain data from split and reverse refraction profiles recorded by both surface and bottom instruments in the central valley of the fracture zone and over the transverse ridge that forms the southern wall of the western portion of the transform. Data from these experiments should provide new information on the heterogeneity and velocity structure of crust and upper mantle beneath the fracture zone and on the possible structure of the crust/mantle boundary beneath the transverse ridge. Unfortunately, we were not able to realize a detailed refraction experiment that was to be shot over three bottom instruments along the axial valley. One OBS released before the refraction experiment (this instrument is discussed below), the tape recorder on one OBH jammed and another OBH was not recovered. Inquiries concerning the details of the OBH's should be made to J. Diebold. We did, however, obtain data from a reversed profile between a LRS at the northern portion of the axial valley and an OBS located just within the fracture zone.

Seismic reflection profiling using two 400 cubic inch air guns as sources played an important part of the survey of the fracture zone because of thick sediments in the central valley. The profiling showed that the basement of the Vema Fracture Zone is extremely rough and enabled us to describe faulting in the sediments and basement associated with the junction of the transform and the axial valley. It will be important to compare this data with the location of microearthquakes recorded by the bottom instruments.

These profiles will also allow us to make the proper travel-time corrections for the refraction profile that we shot along the fracture zone.

Dredge operations were also a major part of the work in the Vema Fracture Zone. A total of 19 dredges were attempted at several locations. Of these, 12 dredges recovered rock. Most of the dredge sites were located on both sides of the transverse ridge. Several dredges were located on the north wall. Almost all of the igneous rocks were not recovered in situ. Corals and limestones from near the top of the transverse ridge, however, are probably broken from the sea-floor by the dredge. Part of the difficulty in recovery of in situ samples was due to the design of the dredge. The dredge was too light and the leading edge of the dredge did not have a sharp blade or tooth-like protrusions. Dredge operations ended earlier than planned because the dredge wire broke approximately 100 fathoms above the figue fitting. Approximately 600 fathoms of the wire had to be cut. Inquires about the details of the dredge operations should be made to Michael Rawson.

II. Special Difficulties and Suggestions

One of the major problems we encountered was the early release of a Lamont OBS. We recovered an OBS drifting on the surface 30 nautical miles west of its deployment site 6 days before it was scheduled to release. Preliminary inspection of the instrument on board the ship showed that the burn-wire release had corroded causing its release from the sea-floor. The main release, a squib, had not fired. Factors causing the corrosion of the wire have not been determined, but apparently there was not a leakage of voltage from the release circuit. Playback of the data tape shows that the instrument released after 29 hours on the bottom.

The OBS that was lost is suspected to have released early in the experiment and probably drifted out of the work area. There was no contact with the instrument even though we were at the site early and under very favorable recovery conditions. We remained at the site 6 hours after its scheduled surface time. A search pattern was conducted.

It is suggested that the release of the Lamont OBS be modified either to the old two-squib configuration or to an explosive bolt configuration similar to the one used by HIG. The present configuration is unacceptable.

We also experienced difficulties in programing the microprocessors of the new OBH's. Considering that the OBH's were built just a week before the cruise this is understandable. J. Diebold has made a list of improvements for the OBH system.

The OBH that was lost had a successful deployment earlier in the cruise. For the second recovery of this instrument, weather during the time the instrument was to surface was excellent. A search pattern was conducted that should have made contact with the instrument if it had surfaced. Thus, there is a good possibility that the instrument did not surface. The reasons that would cause the OBH not to surface are open to debate, but failure of the glass ball is a likely candidate.

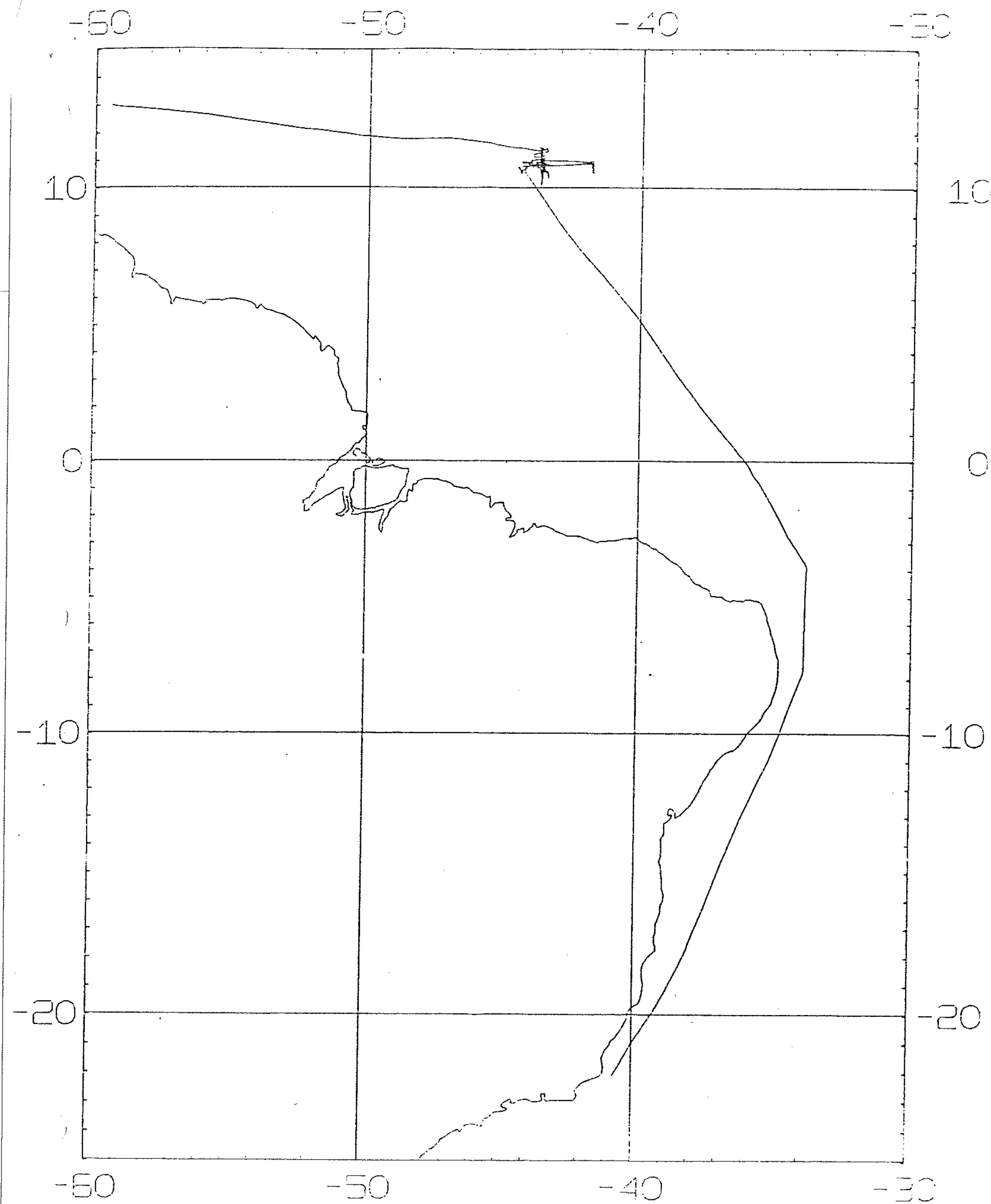
Over all, the ship's equipment performed adequately. The gravimeter, however, did not perform reliably during portions of the cruise. Most of the problems with the gravimeter appeared to be with the servo-motors that adjust the stable platform. A letter describing these problems has been sent by the ET to the appropriate persons at Lamont.

We did have to operate one eel with only one pre-amplifier on board. Since profiling is a major portion of every cruise, this should not be the case in the future.

No doubt we could have benefited from the use of a computer on board. We had 10 days of transit time to Rio De Janeiro after our work at the Vema Fracture Zone was completed. Ten days on board ship is enough time to reduce a considerable amount of data.

Hugh Rowlett

Hugh Rowlett
Chief Scientist 21-04



C 2104