

#70011

CRUISE REPORT - USNS J. W. GIBBS (T-AGOR-1), OPERATION 70-01-06
BY RAY G. MARTIN

Fourteen days of ship time were utilized in October 1970 to obtain approximately 1400 miles of seismic reflection profiles as a part of a multidiscipline oceanographic experiment in the northeastern Caribbean Sea conducted by the U. S. Naval Research Laboratory. Bathymetric and magnetic data were taken concurrently along the seismic tracks shown in Exhibit A. One and a half days of the cruise were used for a detailed bathymetric survey of a ridge extending from eastern St. Croix toward St. John. This was done as a preliminary investigation of a power-cable route for the Virgin Islands government. Following the seismic and bathymetric studies, 10 gravity cores were taken in the operation area: 5 in the basins between the St. Croix ridge and Puerto Rico-Virgin Islands platform and 5 in the Muertos trough area (Exhibit A).

The survey utilized a Bolt 30 cu. in. air gun programmed to discharge at 15-sec intervals while being towed at an average of 8 knots. The gun was positioned approximately 25 feet off the fantail at a depth of 20 ft. Bottom and subbottom reflections were received by a 50 ft., 16 crystal hydrophone array towed approximately 300 ft. astern. Impulses received by the phones were preamplified and filtered in the hydrostreamer and were recorded on a Raytheon Precision Seismic Recorder (PSR-1910C) and a Westrex Mark X dry paper recorder. Bathymetric profiles were made with a hull-mounted Edo 248A transceiver and displayed ^{on dry paper} by a Raytheon PFR-193C recorder. Magnetic data were obtained using a non-commercial surface proton magnetometer and displayed in both graphic and digital modes. The ship's position was determined by satellite navigation supplemented by radar and visual fixes. Members of the scientific crew are listed in Exhibit B.

Seismic reflection data, though of fair resolution, are good and will yield an adequate picture of the general structural framework of the study area. Penetration varies from 0 to 1.5 sec over the area being greatest across the axis of Muertos trough. Preliminary examination of the data (at time of recording) indicates the following:

1) Vertical movement of considerable displacement has been the primary factor in the formation of the Muertos trough. Horizons A" and B" of the Venezuela basin subbottom are seen to dip northward toward the steep south flank of the Antillean ridge. Their gradients are greatest directly south of Puerto Rico where it appears that the Venezuela basin has been uplifted forming a moderate escarpment along the southern edge of the trough. In this area the trough has been filled in excess of 1.5 sec of layered material which apparently has been disturbed by compaction and/or folding. Horizon A" may prove to be the trough subfloor but it is not known if the data will bear out this hypothesis.

2) The topography of the southern flank of the Antillean ridge south of Puerto Rico is generally rugged. Numerous pinnacles and/or ridges, perched basins, and benches, are evident in the records. First impressions are that this slope has been cut by numerous down-to-basin faults; grabens may be present locally. Seismic penetration on the slope is poor except in perched basins. There is, however, some indication of layered sediment in the subbottom, particularly in the upper slope. In contrast, the southern flank of St. Croix ridge is generally smooth. Of more importance is the presence of approximately 0.5 sec of layered

sediment concordant with the seafloor extending from the ridge crest near St. Croix down slope to the eastern end of Muertos trough. Several faults were noted, in particular a major graben present off the southwest coast of St. Croix. Projection of this structure to the major graben transecting the island is indeed tempting.

3) The north slope of the St. Croix ridge and the south slope of the Virgin Islands platform are, to say the least, steep. Between these precipitous slopes lies the Virgin Islands basin. The basin floor is near horizontal. The basin is filled in excess of 1.0 sec of layered sediment which has been subjected to some degree of disturbance as evidenced by minor folding and faulting. The basin appears to be bounded on the north and south by major normal faults. This is not to say that there has been no lateral displacement associated with vertical^c movement. There may be evidence that the fault which passes just north of St. Croix extends eastward along the southern edge of the St. Croix basin and westward to the vicinity of Grappler Bank. Evidence of faulting along the northern edge of the Virgin Islands basin and through Anegada trough is not quite so clear.

4) The numerous banks in the eastern portion of the study area are quite interesting. The northwestern edge of Saba bank, east of St. Croix, is capped by a minimum of 0.25 sec of sedimentary rock which appears similar in ^{acoustical} character to that present on the St. Croix ridge. Barracuda bank, southeast of Virgin ^oGarda, shows little in the way of sedimentary layers, however, the numerous banks in its vicinity appear to consist of

layered rock. There are indications that this area has been subjected to major block faulting.

The sediments sampling phase of the program was successful. Ten cores were retrieved in eleven attempts, the only failure occurring on the northwestward trending ridge northeast of St. Croix. Core 1 in St. Croix basin, obtained 53 in. of gritty tan carbonate(?) mud; some shell fragments were observed. Cores 2 and 3 in the Virgin Island basin, penetrated only 7-to 8-in. of carbonate(?) mud with admixed shell fragments and coral(?) sand. Core 4 at the western end of this basin was more successful. Fourteen inches of light brown to tan mud overlying approximately 9-inches of coarse sand and shell fragments were recovered. Core 5 sampled the small basin which lies between Grappler bank and Puerto Rico. ^{sixty-four} ~~A total of 64~~ inches of alternating layers of mud and coarse sand ^{were} ~~was~~ cored. Cores 6 through 10 were taken in Muertos trough. A definite increase in grain size in the trough is apparent from east to west. Core 10 was taken in the trough basinward from the mouth of Guayanilla canyon and exhibited coarse sand abundant with dark minerals interbedded with thin layers of light brown mud. Core 9 sampled the Venezuela basin south of the trough and some 600 meters above the trough floor. The core appeared uniform consisting of light brown to tan mud, with occasional visible sand grains.

Magnetic data taken concurrently with the air gun profiles appear to be good and will undoubtedly serve to refine the magnetic patterns that have been published.

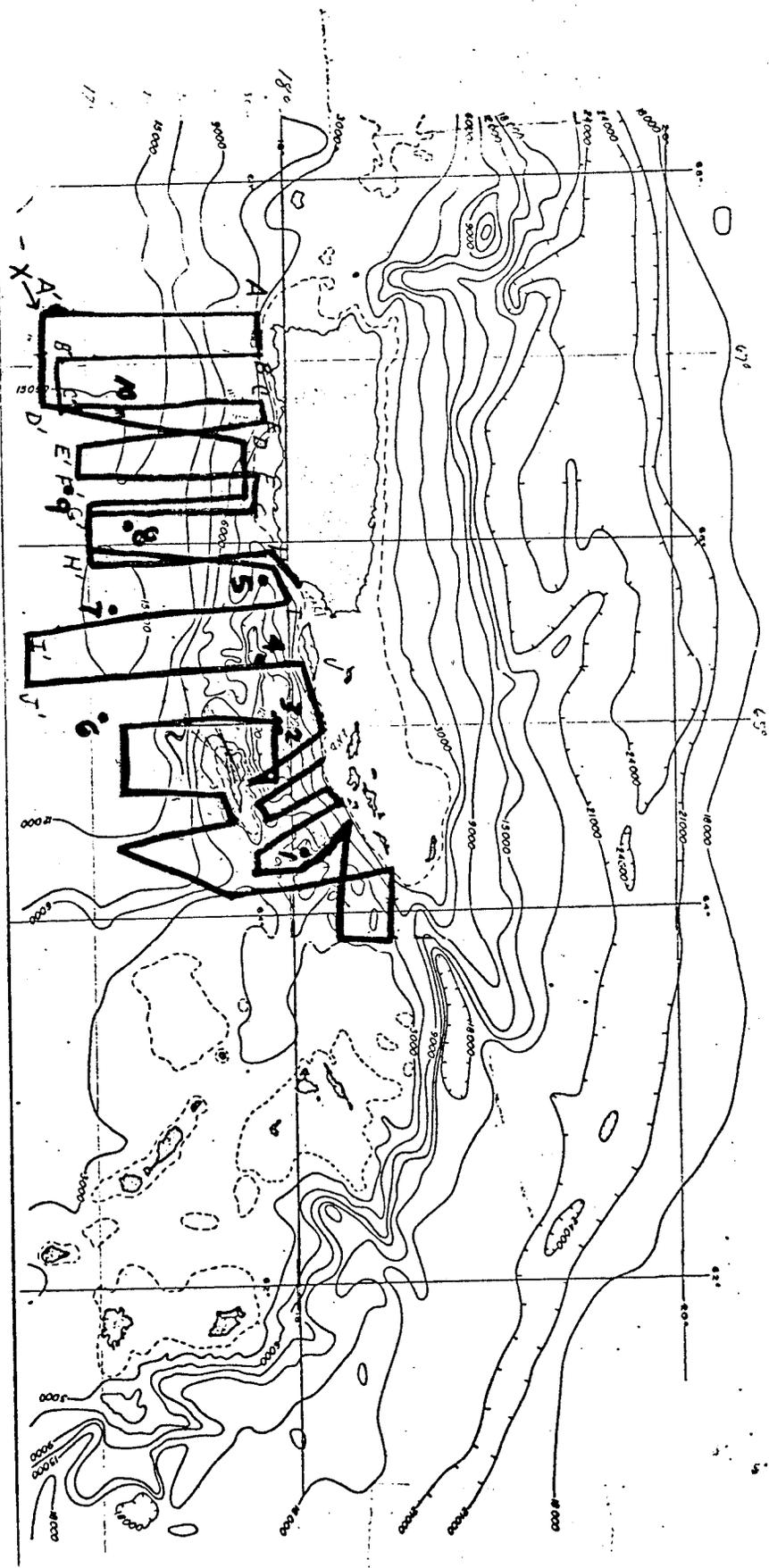
Of final interest is the discovery of a possible seamount at point X in Exhibit A. The reflection profile across this feature shows that it is clearly intrusive, piercing horizons A" and B" and perhaps some or most of the transparent zone above A". The feature stands approximately 500 m above the present seafloor and exhibits no internal structure. Horizons A" and B" are displaced several tens of meters vertically across the structure. Reflections from within the "transparent" zone above A" shows signs of disturbance caused by either the intrusion or subsequent compaction.

Bathymetric data reveal a number of discrepancies on the bottom contour chart this office plans to use for the Miscellaneous Investigations map. Perhaps the new data can be worked into the chart, time and ~~money~~^{funds} permitting.

The seismic and magnetic data will be loaned to this office for copying within the next several weeks. It is understood that it is imperative that a publishable report(s)^{be} produced well within six months of this date to avoid security classification problems. NRL is to request that NAVOCEANO work up the physical properties of the cores; this office is to be responsible for the trace elements analyses.

NORTHEASTERN WEST INDIES

BATHYMETRY FROM N. M. HESS (MS)
CONTOUR INTERVAL 5000 FEET
DEPTHS IN FEET



Sketch A

SCIENTIFIC STAFF - USNS GIBBS CRUISE 70-01-06

Mr. Robert Perry	Senior Scientist	Naval Research Lab.
Dr. Richard Rojas	Acoustics Engineer	" " "
Mr. J. (Rusty) Massingill	Oceanographic Tech.	" " "
Mr. Anthony Zuccaro	Project Navigator	" " "
Mr. Chester Brier	Electronics Tech.	" " "
Mr. Ruben Nab ^{er}	" "	" " "
Mr. Jason Taylor (RUSTY)	Equipment Spec.	" " "
Mr. Ray Phalen	" "	" " "
Mr. Ray Martin	Marine Geologist	U. S. Geological Survey

EXHIBIT B