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DEPARTMENT OF OCEANOGRAPHY



OCEANOGRAPHIC SURVEY OF THE GULF OF MEXICO

Office of Naval Research
Contract N7 onr-48702
Bureau of Ships
NE 120219-5

Navy Department
Project NH 083 036
Status Report
July 1953

Annual Report For Period
15 June 1952 To 30 June 1953

Research Conducted through the
Texas A. & M. Research Foundation
COLLEGE STATION, TEXAS

THE AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS
Department of Oceanography
College Station, Texas

Research conducted through the
Texas A. & M. Research Foundation
in cooperation with the
Fisheries Biology Division of the
U. S. Fish and Wildlife Service

Project 24

ANNUAL REPORT: 15 June 1952 - 30 June 1953

Project 24 is an Oceanographic Survey of the Gulf of Mexico sponsored by the Office of Naval Research (Project NR 083 036, Contract N7onr-487 T.O. II) and the Bureau of Ships (NE 120219-5). The work reported herein is of a preliminary nature and the results are not necessarily in final form.

Report prepared 30 July 1953
by
Richard M. Adams

Dale F. Leipper
Project Supervisor

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TASK ORDER

The Contractor shall furnish the necessary personnel and facilities for and, in accordance with any instructions issued by the Scientific Officer or his authorized representative, shall conduct a systematic survey of the Gulf of Mexico to procure information on oceanography and meteorology with appropriate analyses of the data collected, including salinity determination.

ABSTRACT

Acquisition of the government furnished vessel ALBEMARLE and the donation of the ATLANTIC to the Texas A. & M. Research Foundation are discussed.

Reports are made of the three cruises of the U. S. Fish and Wildlife vessel ALASKA during the year 1952-1953 in which members of this project participated for the collection of oceanographic and meteorological data. A survey of Mobile Bay and analysis of the resulting data are briefly summarized.

Processing of the data from the first five cruises of the ALASKA in the Gulf has been completed. Processing of data from later cruises is continuing with appropriate analyses being made. A group of figures showing temperature distribution in the Gulf are presented. A study to determine a level of no motion in the Gulf is underway.

A list of the technical reports prepared during the year by the project is presented and the equipment acquired by the project during that time is listed. Finally, plans for the coming year are discussed.

INTRODUCTION

On 8 July 1952, the ALBEMARLE, an eighty-six foot, two hundred twenty ton diesel tug, arrived in Galveston, Texas from Wilmington, South Carolina. This vessel was loaned to the Texas A. & M. Department of Oceanography by the Office of Naval Research for conversion to an oceanographic research vessel. Preliminary specifications were drawn up for the conversion of the tug and rather detailed modification plans were made. An estimate of the vessel's stability after conversion, based upon the necessary additions and modifications, was made. This analysis showed that full conversion of the tug for deep sea work would not be feasible.

Thus it was indicated that the ALBEMARLE must either be replaced by a ship suitable for conversion or retained for near shore work after partial conversion. However, on 12 January 1953, Mr. Robert and Mr. Erwin C. Uihlein of Milwaukee, Wisconsin presented the Texas A. & M. Research Foundation with the ATLANTIC, a 120 foot, 3 masted auxiliary schooner. (Figure 1) As the ATLANTIC is much better suited for oceanographic work than the ALBEMARLE, a request was submitted and subsequently granted to use ONR funds formerly allotted for use on the ALBEMARLE for the installation of government furnished equipment on the ATLANTIC. (The ALBEMARLE is being maintained by this project but it is not planned to use her as an oceanographic research vessel.) Mr. Honor L. Hadley, former captain of the ALBEMARLE, was named captain of the ATLANTIC and Mr. Henry L. von der Hofen was chosen mate. These men with the assistance of others, brought the ship from Milwaukee to Galveston during latter March and early April. The ship is now docked in Galveston, Texas. Preliminary conversion has been initiated with the construction of a deck house laboratory and the installation of some winches. Major conversion is pending the arrival of government furnished equipment. A description of and list of equipment to be obtained and installed on the ATLANTIC will be found on pages 14 and 15.

It is planned that the ATLANTIC be assigned to carry out the work of this task order and in addition the work of other task orders and the various functions of the Department of Oceanography which will be sponsored by the College.

The cooperative arrangement with the U. S. Fish and Wildlife Service in Galveston was continued during this year. Three cruises were made in which members of this project participated for the collection of data.

COLLECTION, PROCESSING AND ANALYSIS OF DATA

Cruise 6 (ALASKA)

For cruise 6, plans were made to occupy a "drift" station in the Sigsbee Deep area for a period of several days. The cruise was abruptly terminated however when on the first hydrographic station, the hydrographic cable was lost. No equipment belonging to this project was on the cable at the time. Meteorological and BT observations were taken on the way to and from the Sigsbee area.

Cruise 7 (ALASKA)

This project did not participate in Cruise 7 of the ALASKA, the cruise being for the purpose of a strictly biological study of red tide off the coast of Florida.

Cruise 8-3C (ALASKA)

Three members of the Department of Oceanography took part in cruise 8-3C of the U. S. Fish and Wildlife vessel ALASKA. These were Mr. Adams, Mr. Sparger, and Mr. Stein. Approximately 2160 miles were steamed on this cruise with ports of call being Mobile, Alabama, Panama City, Florida, and Key West, Florida. The ALASKA left Galveston at 1100 (CST) on Thursday, February 12, 1953, and followed the ten fathom contour curve to make the first few stations. Shortly after station 6 (near the mouth of the Mississippi) was occupied a very heavy sea was encountered and the ship steamed for Mobile Bay in order to anchor in the lee of the developing storm. During the next few hours waves of heights up to 25 ft. and winds of 50-60 mph were observed. After obtaining a few minor repairs in Mobile, the ship resumed the regular cruise plan, omitting station 7. However, it was again necessary to put into port at Panama City, Florida due to bad weather, and heavy seas caused the omission of station 12. The ship then proceeded to Key West, Florida without encountering further bad weather. While in Key West, the A. & M. personnel were shown aboard the University of Miami research vessel PHYSALLA and also had the opportunity of looking over the U. S. Navy Hydrographic Survey Vessel GS 17.

After leaving Key West, four shallow water stations were occupied before beginning a line of twelve deep water stations. On this cruise, 12 Ballauf bottles belonging to the U. S. Fish and Wildlife Service in Galveston were used in conjunction with 5 Nanson bottles belonging to the Department of Oceanography. On the first deep station, considerable difficulty was experienced in making the practically unused Ballauf bottles trip properly. Three casts were made without obtaining satisfactory results. This condition was alleviated by reworking the tripping mechanisms and putting new wire on all the messengers. No further difficulty was encountered in the tripping of the Ballauf bottles.

On station 28 (25°14'N, 88°04'W) a wire angle of 42° was observed with the angle beginning to develop after approximately 150 meters of wire had been paid out. On the next station, only 40 miles northwest of station 28, no wire angle was encountered, indicating an interesting change in currents.

Due to malfunctioning of the hydrographic winch, no cast was made below 1200 meters. In all, 34 stations, of which 11 were in water deeper than 1000 fathoms, were occupied. Sixty-six BT observations were made, 2 lowerings being made on each deep station (one preceding and one following the hydrographic cast) and lowerings at two hour intervals between stations. Wet and dry bulb temperature readings at three levels (2', 8' and 20') were made at six hour intervals throughout the cruise.

A very high concentration of Physalia and Vallela was observed in the vicinity of stations 32-34, (see Figure 2). The ALASKA returned to Galveston on 28 February 1953.

Cruise 9 (ALASKA)

This cruise was one of a specialized nature in the Corpus Christi region in which this project did not participate.

Cruise 10-2B (ALASKA)

The U. S. Fish and Wildlife Service vessel ALASKA left Galveston, Texas on 13 April 1953 on the first half of Cruise 10-2B in the western Gulf. Representing this project for the collection of physical and meteorological oceanographic data was Mr. Richard M. Adams. He was assisted by Albert K. Sparks and Julius Marcus, both employed by the Texas A. & M. Research Foundation.

Due to rough weather the first two stations were omitted and the ship put into Port Aransas harbor until the seas abated. The cruise was continued the next day starting with station 3. The ALASKA proceeded south, remaining roughly fifteen miles offshore, to the 20th parallel, moved eastward to the 94th meridian and followed this meridian northward. Heavy seas again were encountered which caused the omission of four additional stations. The first half of the cruise was completed on 21 April 1953.

On 30 April 1953 the second half of Cruise 10 was begun. It was planned to make lines of stations along the 92nd and 94th meridians but the complete breakdown of the hydraulic motor furnishing power to the hydrographic winch caused termination of the cruise after only seven stations had been occupied. Thus only 29 of the 55 planned stations on Cruise 10-2B were occupied successfully.

In addition to the hydrographic and bathythermograph casts made on each station, BT lowerings were made at two hour intervals between stations. Meteorological observations, consisting of sling psychrometer readings taken at three levels, wind, cloud and other auxiliary data, were made at six hour intervals.

Cruise 53-1 (ATLANTIC)

On 30 June 1953, the ATLANTIC departed Galveston, Texas on a short "shakedown" cruise. Six members of the Department of Oceanography took part in the cruise, this project being represented by Dr. Dale F. Leipper, Dr. Koji Hidaka and Mr. George B. Austin, Jr.

The original cruise plan called for the completion of two triangles, one outside and one inside the 100 fathom contour line. Bathythermograph, sea surface temperature and meteorological observations were planned along the entire route. Due to the adverse condition of the sea and to an injury to the mate, the original cruise plan was modified to a 100 mile line running nearly due south from Galveston and return. The observations mentioned above were made on both legs of the cruise.

This cruise served the valuable purpose of pointing out certain features in connection with the ship which need modification or correction. Things learned on this cruise will be of great value in the process of conversion. After conversion is completed and all instruments installed, it is planned to make a cruise similar to this before attempting a full scale operation.

Mobile Bay Survey

Mr. George B. Austin with the aid of Mr. Walter Lang conducted a short hydrographic survey of Mobile Bay, Alabama during the period 24-31 October. Other persons participating or aiding in the survey were: Mr. John Rockwell, Chief, Department of Conservation at Mobile; Mr. Harold Loesch, marine biologist for the state of Alabama; Mr. Fred Bosarge, Mr. Richard Bosarge and Mr. James Allen, all of whom are with the Department of Conservation at Mobile.

The purpose of this survey was to acquire physical and chemical data of a nature suitable for the determination of the circulation and tidal flushing within the bay. Samples of temperature, chlorinity and current velocity were taken at several depths for all stages of the tide at 28 selected stations in the bay. A fast speed boat, furnished by the Alabama State Department of Conservation, was used to obtain as near a synoptic situation as possible.

Figure 3 illustrates the area which was surveyed and the stations which were occupied during the survey. The chart further illustrates the manner of division of the Mobile Rivers and Bay into sections from which were determined volume segments according to a method described by B. H. Ketchum (1951). The large Roman numerals indicate the volume segments (bounded by the heavy lines) which were used in the final analysis of the October survey. The dashed lines indicate the boundaries of the volume segments initially chosen for the October survey and along which 28 hydrographic stations were planned and occupied. The variation in the location of the volume segment boundaries is due primarily to the difference between the estimated mean river flow R for the period of the survey and the actual mean river flow as reported later by the U. S. Geological Survey, Montgomery, Alabama.

Two basic methods were employed in the determination of the flushing relationships and an attempt was made to evaluate the two methods using the observed distribution of temperature and salinity of successive tidal stages as a control. The first method employed was one described by B. H. Ketchum in "The Exchange of Fresh and Salt Water in Tidal Estuaries", Jour. of Mar. Res., Vol. 10, no. 1, pp. 18-38, 1951. The second method studied was one described by H. Stommel, and A. B. Arons in the paper "A Mixing Length Theory of Tidal Flushing", Transactions A. G. U., Vol. 32, no. 3, pp. 419-421, 1951.

An analysis of the Mobile Bay Survey was completed in May, 1952, at which time the results of this analysis were described by Mr. Austin in a thesis for the Master of Science degree at the A. & M. College of Texas. The thesis is in the process of being revised for publication and a technical report entitled "On the Circulation and Tidal Flushing of Mobile Bay, Alabama" is expected to be distributed at an early date.

It was not possible to repeat the Mobile Bay Survey in April of this year as anticipated. Personnel requirements necessary to man the ATLANTIC on its trip from Milwaukee to Galveston prevented attempting another survey in Mobile. It is hoped that a similar survey may be undertaken during the coming year if personnel, equipment, transportation and analysis requirements permit.

Processing and Analysis of Cruise Data

Processing of the data from the first five cruises of the ALASKA in the Gulf has been completed. The data from cruises 1, 2, and 3 were distributed as Data Report No. 1. Data Report No. 2, containing the original and processed data from cruise 4, was also distributed. It is planned to continue the general distribution of these reports until a substantial quantity of data from the Gulf has been made generally

available. The subsequent reports will then be given a very limited distribution. Cruise 5 data are now at the Hydrographic Office where IBM computations of σ_t and ΔD are being made.

Preliminary processing of data from cruises 8 and 10 is underway. When finished, these will be sent to the Hydrographic Office for the necessary computations.

In Figure 4, the currents referred to the 500 decibar pressure surface as computed from dynamic computations are shown for Cruise 4-2A. This figure presents a slightly different pattern of currents in the eastern Gulf from that illustrated in the Annual Report for 1952. An analysis of both these patterns indicates that the water entering through the Yucatan Channel may follow a sequence of current patterns. It may first take a fairly direct route to the Florida Straits. The current then may begin to flow farther north before turning east until the circulation as pictured in the Annual Report for 1952 (Figure 4) is established. This pattern may continue with the water flowing farther and farther north until the cell shown in Figure 4 of this report breaks off and the original circulation pattern is reestablished. When data from cruises 5 and 8 are ready for analysis, it will be possible to obtain a much clearer picture of the Eastern Gulf current patterns.

A study is underway to determine a level of no motion in the Gulf. Two methods are being employed. The first is that of Defant (1941) which presupposes that the anomaly distance between isobaric surfaces remains nearly constant within certain depth intervals. The second is that of Hidaka in which the distribution of salinity is considered. In this second method, the assumption is made that vertical mixing prevails. If this assumption is valid, the vanishing of the second derivative of salinity should indicate a layer of no motion.

Data from Cruises 1, 2, 3, and 4 have been used in this study. The necessary computing has been finished and contours of the motionless surfaces drawn using both methods. The results of this study will be presented in a technical report which will be distributed in the near future.

Temperatures

Figures 5 through 9 show the sea surface isotherms for cruises 1-5 of the ALASKA. These isotherms were drawn using values of surface temperature obtained on each station on the various cruises. Probably the most used surface temperature isotherms are those of Mr. F. C. Fuglister of WHOI, published in 1947. These are mean isotherms and

show the variation from month to month. It is interesting to note that considerable variations from Fuglister's mean charts may exist at any given time. For example, in August the mean charts show a temperature of 84°F throughout the Gulf whereas ALASKA data show variations from 85 to 89°F for the northeastern Gulf.

Figure 10 illustrates a method for presenting pictorially sectional views of the distribution of a physical parameter (e.g. temperature). It should be noted that Figure 10 does not retain the detail found in the original drawing due to the reduction in size necessary in the publication of this material.

Temperature - depth sections from the sea surface down to 1000 m of the first three oceanographic cruises of the ALASKA are presented here in one illustration. Station positions and cruise lines for each of the three oceanographic cruises are incorporated into the illustration as an easy guide or reference in the orientation of the temperature-depth sections. In the legend is included a scale of depths (100 meter intervals) along with a key to the temperature ranges. Temperature-depth sections for the shallow continental shelf areas are omitted and the omission is indicated by the dashed cruise lines (i.e. Western Gulf and Northwestern Gulf). It is expected that similar presentations of salinity or density data can be made provided that sufficient data are available for the construction of good continuous sections.

In order to avoid an apparent temperature variation with depth in this isometric presentation, the sections were displaced either to the left or to the bottom of the cruise lines and a straight line section running the length of each predominant cruise leg was made. An earlier drawing which was attempted had the sections drawn parallel to the cruise lines between stations with the cruise line serving as the line of zero depth for the section. For every slight deviation in a cruise line this presentation resulted in what might have been taken as a variation in temperature.

Instrument Calibration

The reversing thermometers being used by the project were calibrated for index corrections at the Scripps Institution of Oceanography during latter June, 1952. New index curves resulting from this calibration were drawn for the thermometers. "Q" casts made on cruise 5 of the ALASKA made possible the computation of more reliable values of the factor $1/Q_p$ for all unprotected thermometers.

A thermometer calibration tank has been designed by Dr. Kenneth Harwell of this department (Contract NObsr-57244 BuShips) and is now

in the process of construction. This tank, due to be completed within the next few months, is being built in cooperation with this project and will be available to it.

Five bathythermographs were calibrated in July and August, 1952 at the U. S. Navy Electronics Laboratory in San Diego, California by Mr. Harold Murray.

TECHNICAL REPORTS

In February 1953, since its appearance in published form was delayed, Technical Report No. 5, Marine Meteorology of the Gulf of Mexico, A Brief Review, by Dale F. Leipper, was distributed. The report was based in part upon work done under the sponsorship of the Air Forces Cambridge Research Center.

Technical Report No. 6, A Contribution to the Theory of Upwelling, by Koji Hidaka, was distributed. This report constituted the first half of a paper by Dr. Hidaka which has been submitted to the American Geophysical Union for publication. It is planned to distribute the second half of this work as another technical report in the near future.

Technical Report No. 7, Determination of Inorganic Phosphates in Sea Water by a Butanol Extraction Procedure, by Charles Proctor, was released in June, 1953. This method has been found to be an order of magnitude more sensitive than methods currently in use and has the same relative accuracy. Moreover, arsenic and silicate, in the amounts ordinarily encountered in sea water, do not interfere.

EQUIPMENT

The facilities of the machine shop have been expanded through the acquisition of several items of surplus equipment from military agencies. These include:

1. Portable Sander, belt type
2. Sander, double disc, Jones Superior Machine Co.
3. Drill Press, bench type, Atlas Drill Press Co.
4. P. and H. Arc Welder, generator type
5. Band Saw (Wood), Walker and Turnor, with motor
6. Grinder, bench type, Black and Decker, heavy duty
7. Assorted Metal Stock, including bars and sheets of brass, monel, and lead

In addition to these items, a high speed South Bond Lathe with its accessory tools and a Delta tool grinder with pedestal have been purchased.

Other items of equipment for use aboard ship have been obtained from lists of surplus materials. Two small items are a Mark II Sextant manufactured by the David White Co. and a 3 arm, right handed Protractor, made by Warren-Knight Co. Also included are three pairs of Bausch and Lomb binoculars (7 x 50).

Another surplus property item is "Material and Equipment for a 'Type A' Weather Station". This includes an aneroid barometer, a microbarograph, a Hygro-Thermograph, an anemometer, and a theodolite as well as accessory balloons, plotting equipment, and gas for the balloons. This equipment is to be installed on the ATLANTIC.

A tubular steel Antenna Mast is on hand to be installed on the ship. Also available is a Wind Measuring Set, An/UMQ-5, made by Bendix Aviation Corp. A high speed plain bench Lathe has also been obtained.

Two major pieces of equipment to be installed during conversion of the Foundation's research vessel are a Sonar Sounding Set, An/UQN-1B made by the Ede Corporation of Collogo Point, N. Y., and the Leeds-Northrup Geomagnetic Electrokinetograph.

A Gerware Salinity Testing Set has been purchased from Kahl Scientific Corp. It consists of three hydrometers and a jar equipped with a thermometer for obtaining the temperature of the sample. The ranges in % of salinity of the hydrometers are 0-15, 14-32, and 28-42. Three protected thermometers, range -2 to plus 35° C in 0.1° were also procured.

The BT cable lost on cruise 5 has been replaced and has been in use on succeeding cruises of the ALASKA. One 200-foot bathythermograph was lost on the first cruise of the ATLANTIC.

Several items of equipment to be used in connection with processing data, general office work, and salinity determinations have been put into use during the year. Included in this group are two dental cabinets which are used in the chemistry laboratory. The project has a Remington Rand Superwriter which has several extra keys for special mathematical symbols. Other items of office equipment include a Keuffel and Esser planimeter, a Dictaphone Electric Speech Recorder, and an Edison Voicewriter.

The circular slide rule constructed by Mr. William H. Clayton for use in computing temperature - and salinity - dependent anomalies and

signa-t has been etched on 24-ST aluminum. The rule must now be cut out and mounted on a suitable frame. A report concerning the construction, accuracy and uses of the slide rule is being planned.

TRAVEL

In October 1952 Dr. Koji Hidaka and Mr. Richard M. Adams motored to Brownsville, Texas where Mr. Adams gave a talk at a meeting of the Gulf States Marine Fisheries Commission.

Mr. G. B. Austin and Mr. W. S. Lang journeyed to New Orleans, Louisiana and to Mobile, Alabama during October and early November for a dual purpose: 1) to conduct a hydrographic survey of Mobile Bay, Alabama; and 2) to investigate at New Orleans and Mobile the feasibility of acquiring a surplus government or other type vessel, suitable for oceanographic research.

Mr. R. O. Reid in late October attended a seminar on the Dynamics of Estuaries at the Chesapeake Bay Institute, Maryland.

In November Dr. D. F. Loipper, Dr. Koji Hidaka and Mr. Richard M. Adams attended a meeting of the Gulf and Caribbean Fisheries Institute at Miami Beach, Florida. Dr. Loipper and Dr. Hidaka gave talks at this meeting and Dr. Hidaka conducted a seminar at the Florida State University of his return trip to Collogo Station, Texas.

In March Mr. Lang flew to Woods Hole, Massachusetts to investigate and report on the recommended plans and procedures for outfitting an oceanographic vessel. From Woods Hole, Mr. Lang journeyed to Milwaukee, Wisconsin where the newly acquired Schooner ATLANTIC was berthed. He aided in the task of bringing the vessel down the Illinois and Mississippi rivers to New Orleans, Louisiana, and from there to Galveston, Texas.

Mr. Austin flew to Mobile, Alabama in mid-April in order to attend a meeting of the Gulf States Marine Fisheries Commission and to confer with Mr. H. Loesch, Marine Biologist for the State of Alabama, concerning future survey plans for Mobile Bay.

In May Dr. Hidaka travelled to Washington, D. C. to represent the project and present two Oceanographic papers at the annual meeting of the American Geophysical Union.

FUTURE PLANS

This project has in the past operated in cooperation with the U. S. Fish and Wildlife Service in Galveston, Texas in carrying on its survey in the Gulf of Mexico. All survey type cruises conducted by this project to date have been made aboard the Fish and Wildlife vessel ALASKA. This cooperative arrangement has been discontinued due in part to the acquisition by the A. & M. Research Foundation of a vessel of her own and in part to the cut in appropriation suffered by the Fish and Wildlife Service necessitating the laying up of the ALASKA for an indefinite period. Thus future cruises of this project will be made for the most part on the Research Foundation vessel ATLANTIC.

Approval has been granted for the continuation of this project until 30 April 1954. At that time the various ONR projects operating at Texas A. & M. are expected to be combined under one task order.

A fairly good determination of existing current patterns for the Eastern Gulf will be available when cruise 5 and cruise 8 data are ready for analysis along with cruises 1, 3, and 4. However, such is not the case for the Western Gulf. Comparatively little is known about the current patterns in existence there. Two cruises have been made in this area but several stations were missed on the first due to rough weather. Failure of the hydraulic winch caused the cancelling of the second cruise after it was only half completed. For this reason it is planned to make at least one comprehensive coverage of the western Gulf during the next year.

The contract funds available for the next ten months operation will permit 32 days at sea. Roughly half of these will be spent in the western Gulf. Further analysis of existing data will make possible the decision as to the area in which the best possible use of the remaining time can be spent.

PERSONNEL

Richard M. Adams, Assistant Oceanographer

George B. Austin, Jr., Assistant in Oceanography

Sarah Austin (Mrs.), Secretary-computer, half-time

Bortha Darrow (Mrs.), Secretary, one-quarter time

Koji Hidaka, Oceanographer, (through September 1953)

Dale F. Leipper, Project Supervisor

Robert O. Reid, Oceanographer, part-time

Liz Miller (Miss), Secretary-computer, part-time

Myrtis Shrode (Mrs.), Laboratory technician

OCEANOGRAPHIC RESEARCH VESSEL ATLANTIC

Owner: Texas A. & M. Research Foundation

Home Port: Galveston, Texas

Length: 120 ft.; Beam: 25 ft.; Draft: 8 ft.; Displacement: 198 tons

Hull: Metal; No. of screws: 1; Year built: 1923

Type: 3 masted Auxiliary C. B. Marconi Schooner

Cruising Range: 3000 miles

Speed: 13 knots maximum, 9 knots cruising

Complement: 8 crew, 6 scientists

Navigation Equipment:

Celestial
Loran, Type DAS

Auxiliary Electrical Power:

115 volts D. C., 10 KW
115 volts D. C., 5 KW

Special Equipment:

Fathometer, Edo (0-6000 fathoms)
Depthometer, Bludworth (0-180 ft.)
Bathythermographs: 180 ft., 2; 450 ft., 1; 900 ft., 2.
BT winch with 1000 ft. wire
Net Haul winch
600 ft. 1/4 inch wire cable
Nansen bottles, 32
Reversing thermometers: protected 35, unprotected, 14
Current meters, 2; Price and Pritchard
GEK
Secchi Disc
Multiple Sea Sampler (On order)

GOVERNMENT FURNISHED EQUIPMENT
REQUESTED FOR INSTALLATION ON ATLANTIC

Navigation Equipment:

Radar, RMCA-CR-106 or 104
Gyro compass, Sperry
Automatic Pilot, Sperry

Auxiliary Electric Power:

440 volts, AC, 30 KW Generator Sets (2)

Communication Equipment:

Transmitter, TCP-3, 75 W, AC
Receiver, TCP-3

Special Equipment:

Hydrographic winch, electric
Hydrographic wire, 3/16", 20,000 ft.
BT wire, 3/32", 1200 ft.
Current meter (Roberts, Eckman or Feldstadt)
Aqualungs, 2

Miscellaneous Equipment:

Magnetic Compass Pilot Set
Power Steering Set
Gyro Compass
Deep Freeze

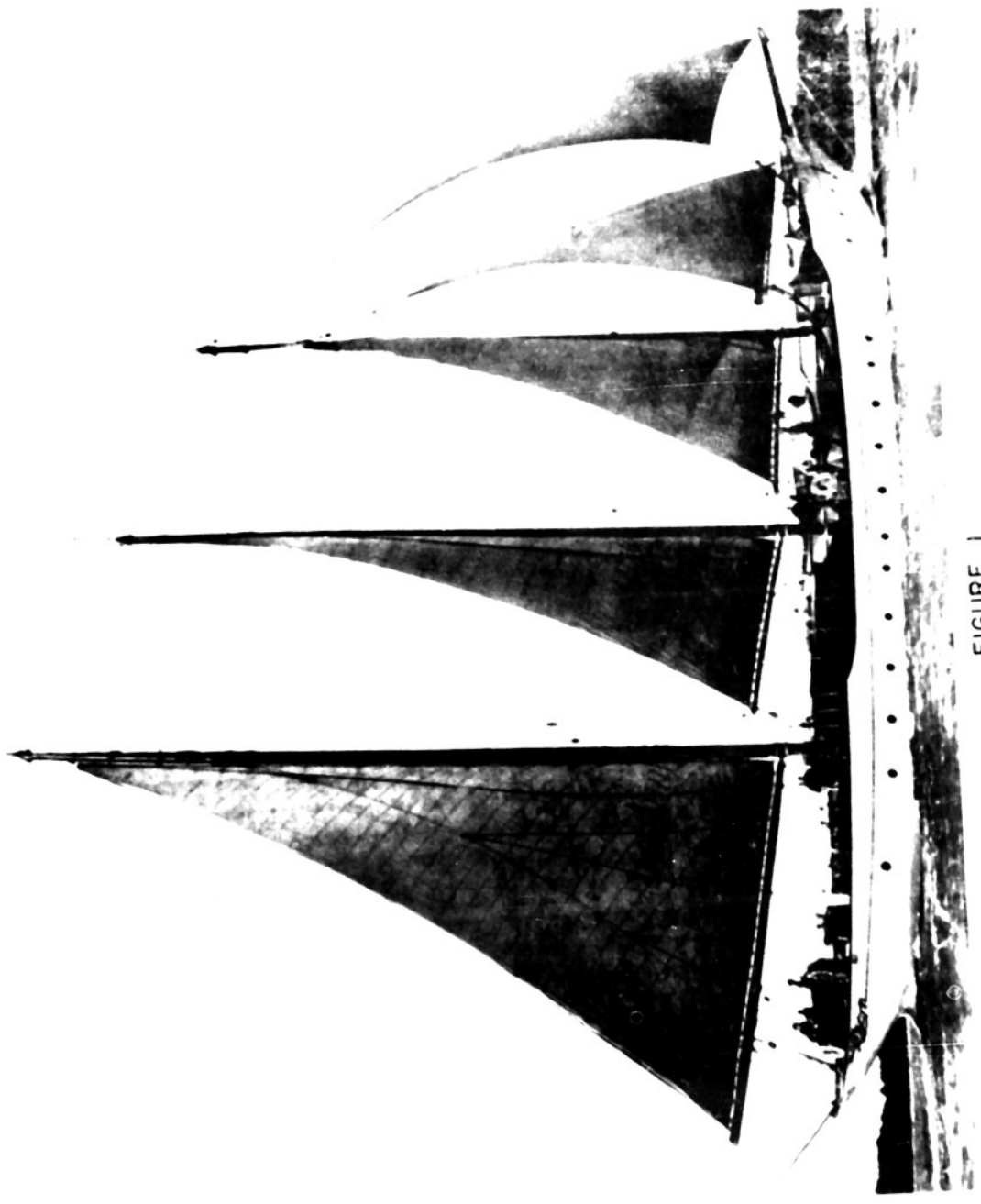


FIGURE 1

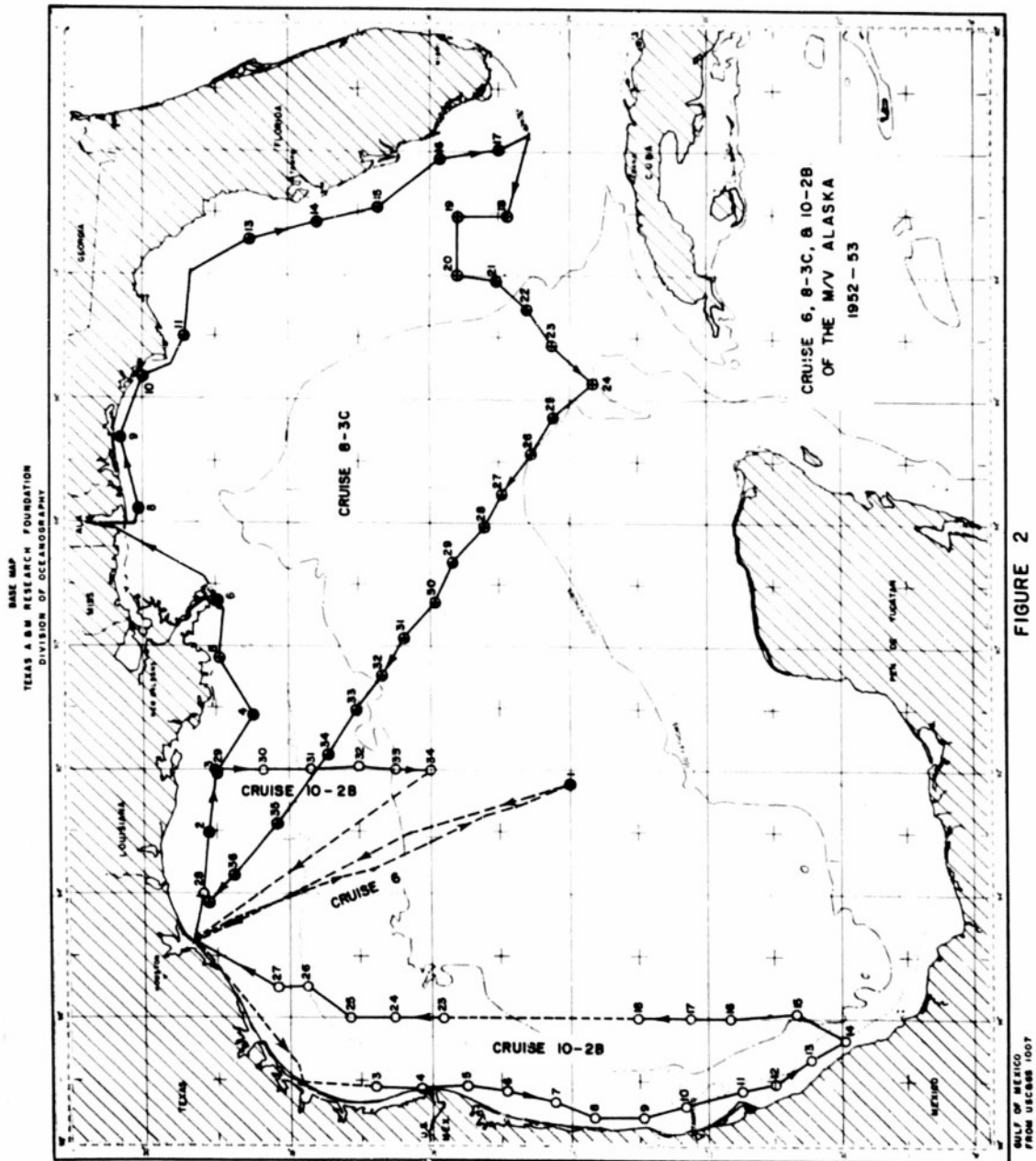


FIGURE 2

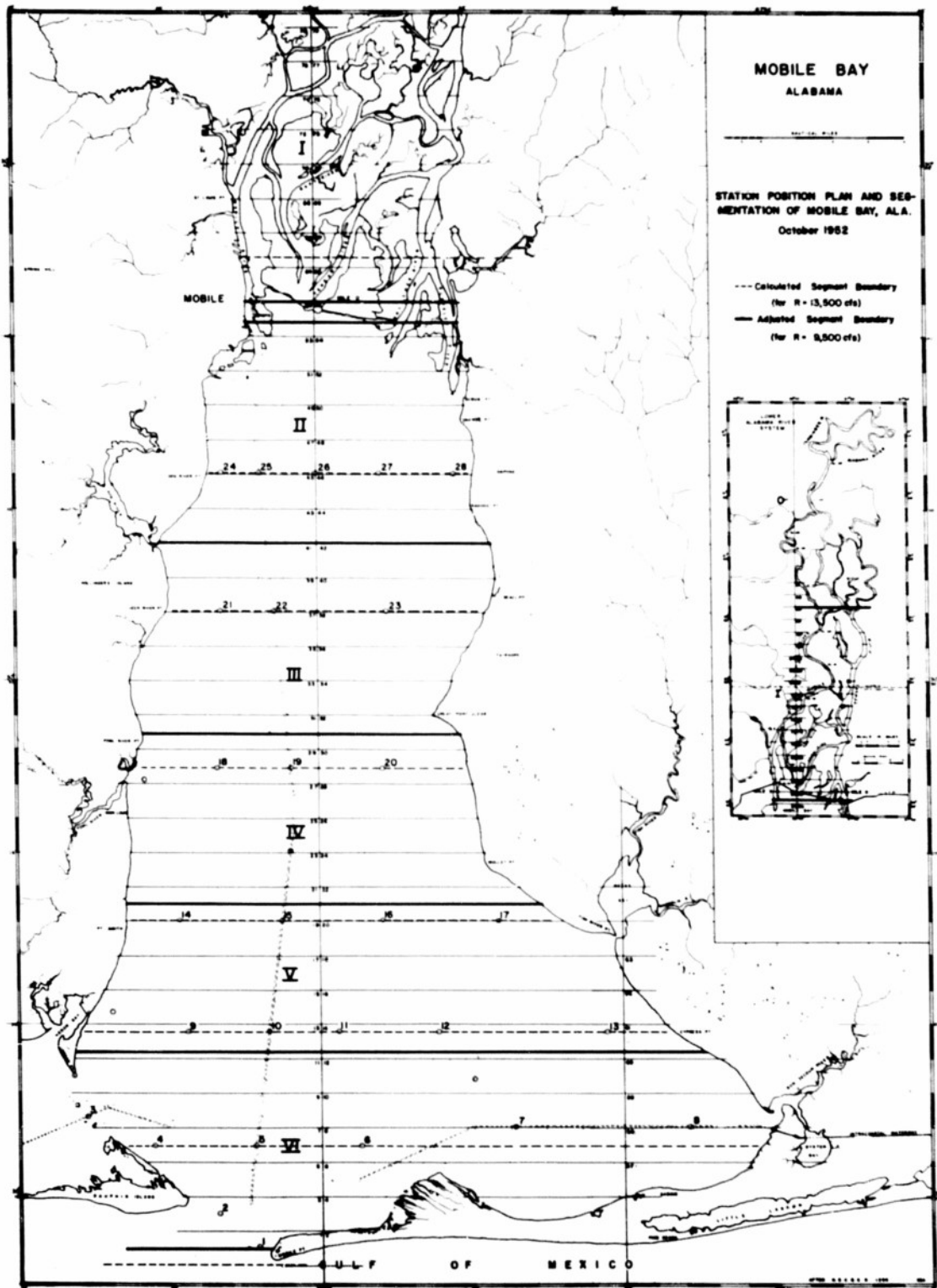


FIGURE 3

SURFACE CURRENTS IN THE GULF OF MEXICO
 (AS DETERMINED FROM DYNAMIC COMPUTATIONS OF CRUISE 4-2A)

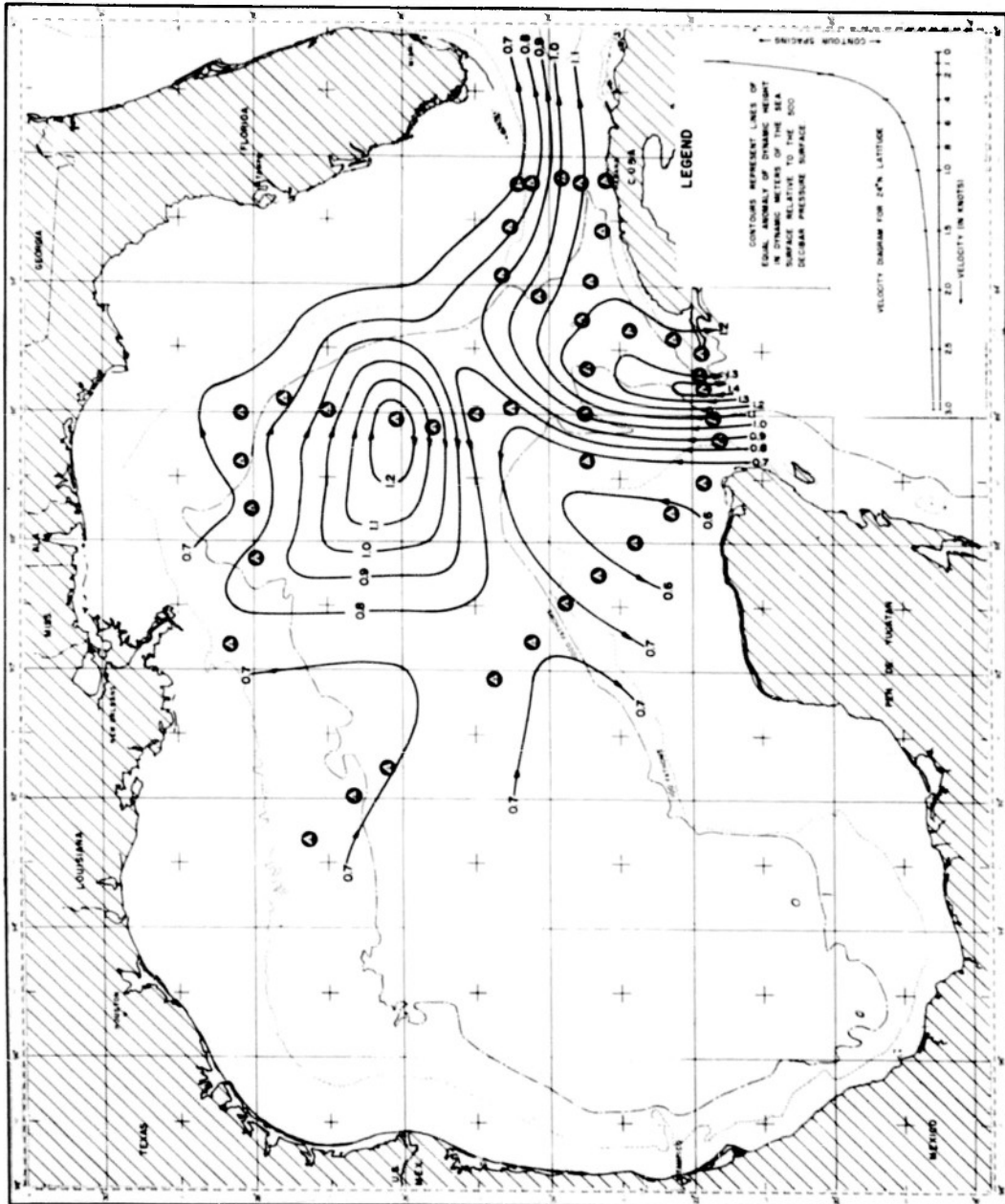


FIGURE 4

GULF OF MEXICO
 FROM USCGS 1007

BASE MAP
TEXAS A & M RESEARCH FOUNDATION
DIVISION OF OCEANOGRAPHY

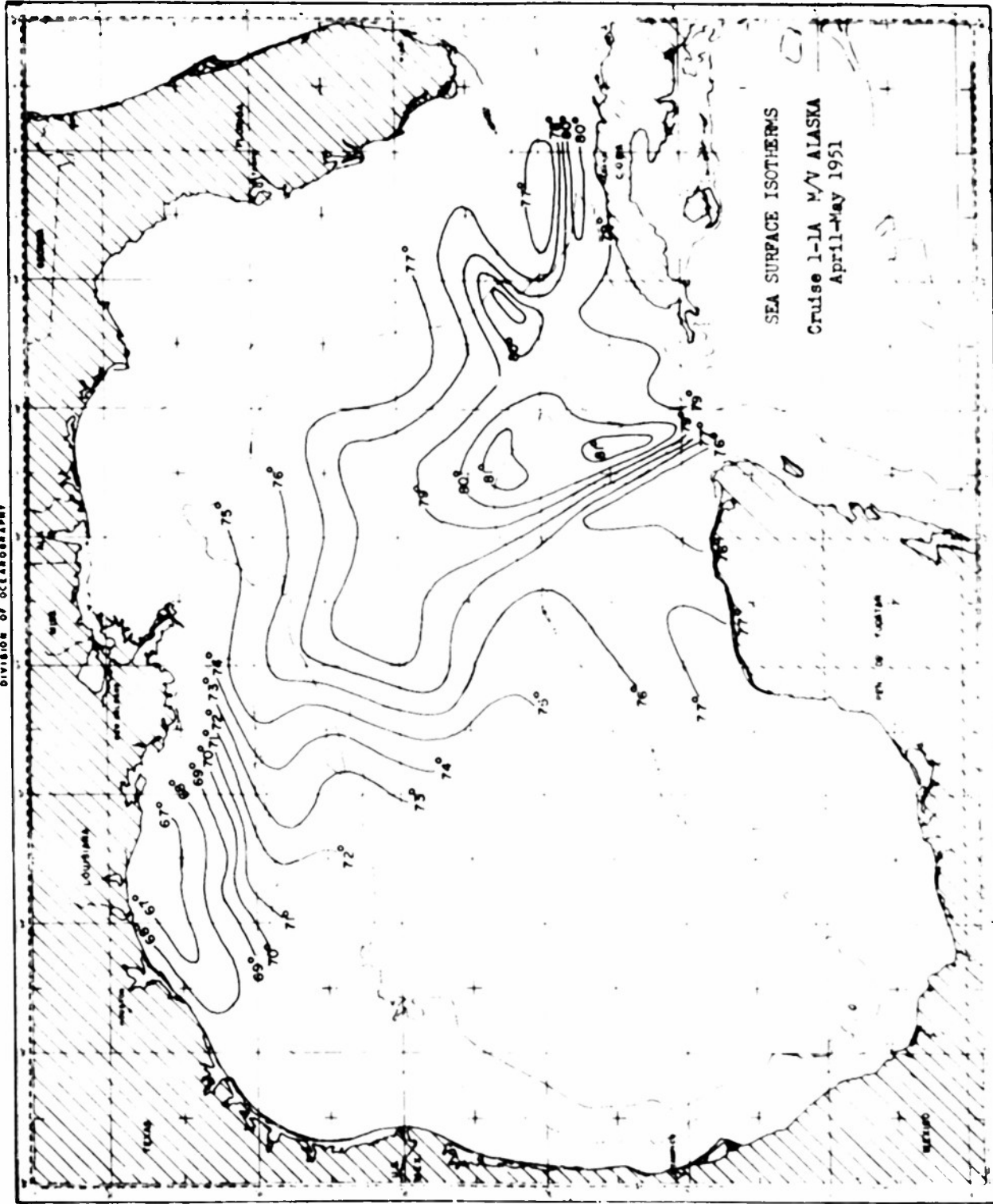


FIGURE 5

BASE MAP
TEXAS A & M RESEARCH FOUNDATION
DIVISION OF OCEANOGRAPHY

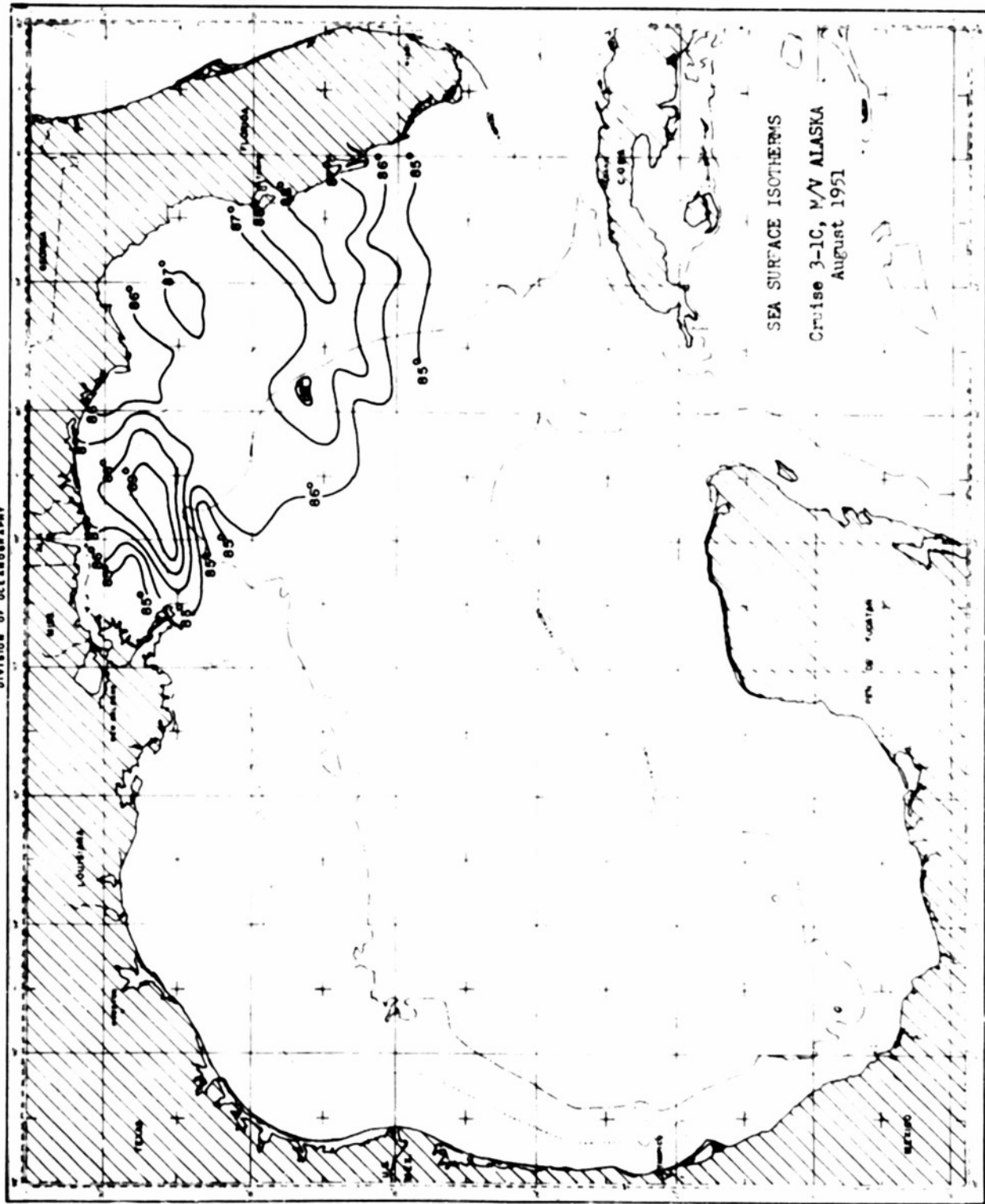


FIGURE 7

BASIC MAP
TEXAS A&M RESEARCH FOUNDATION
DIVISION OF OCEANOGRAPHY

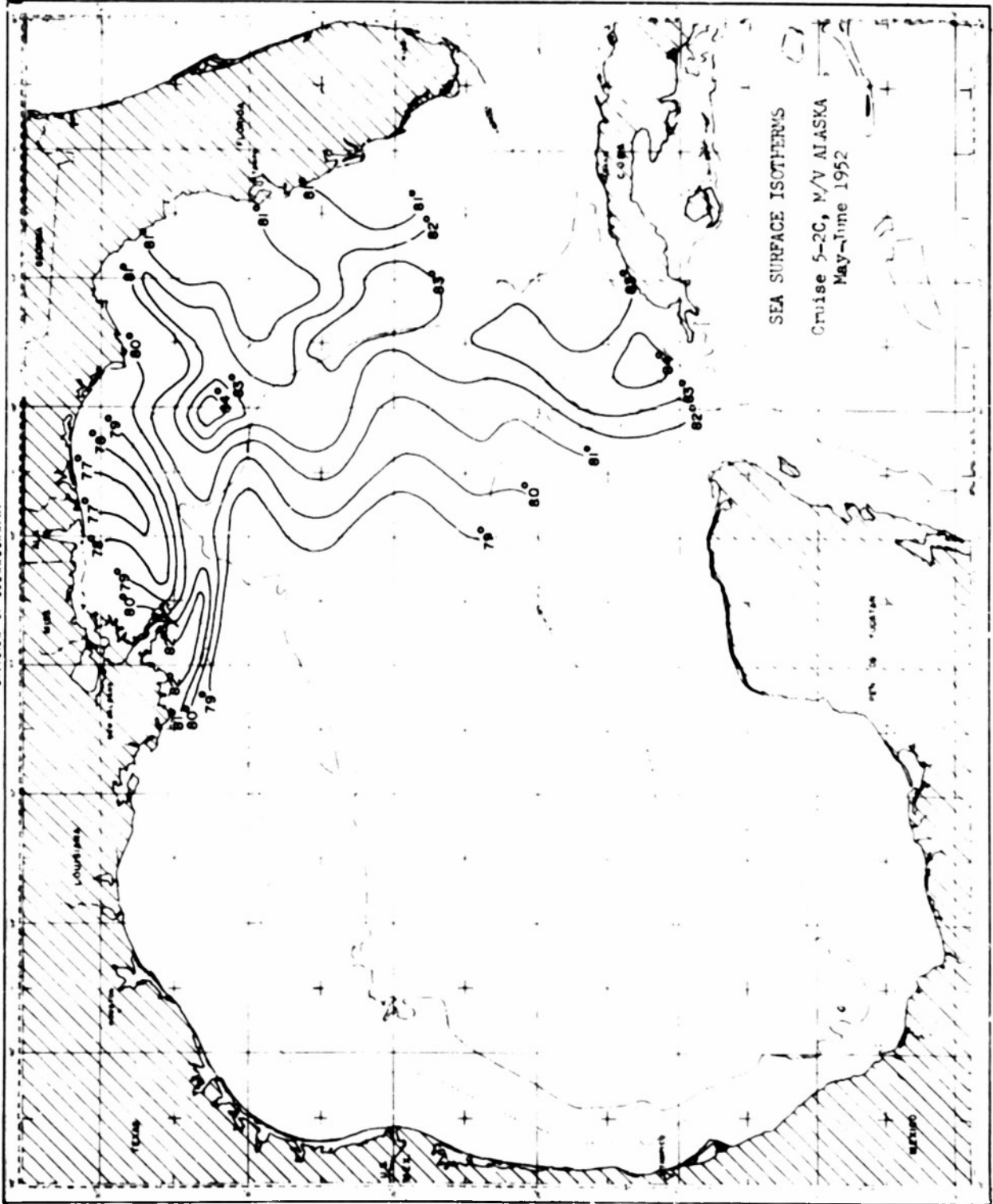
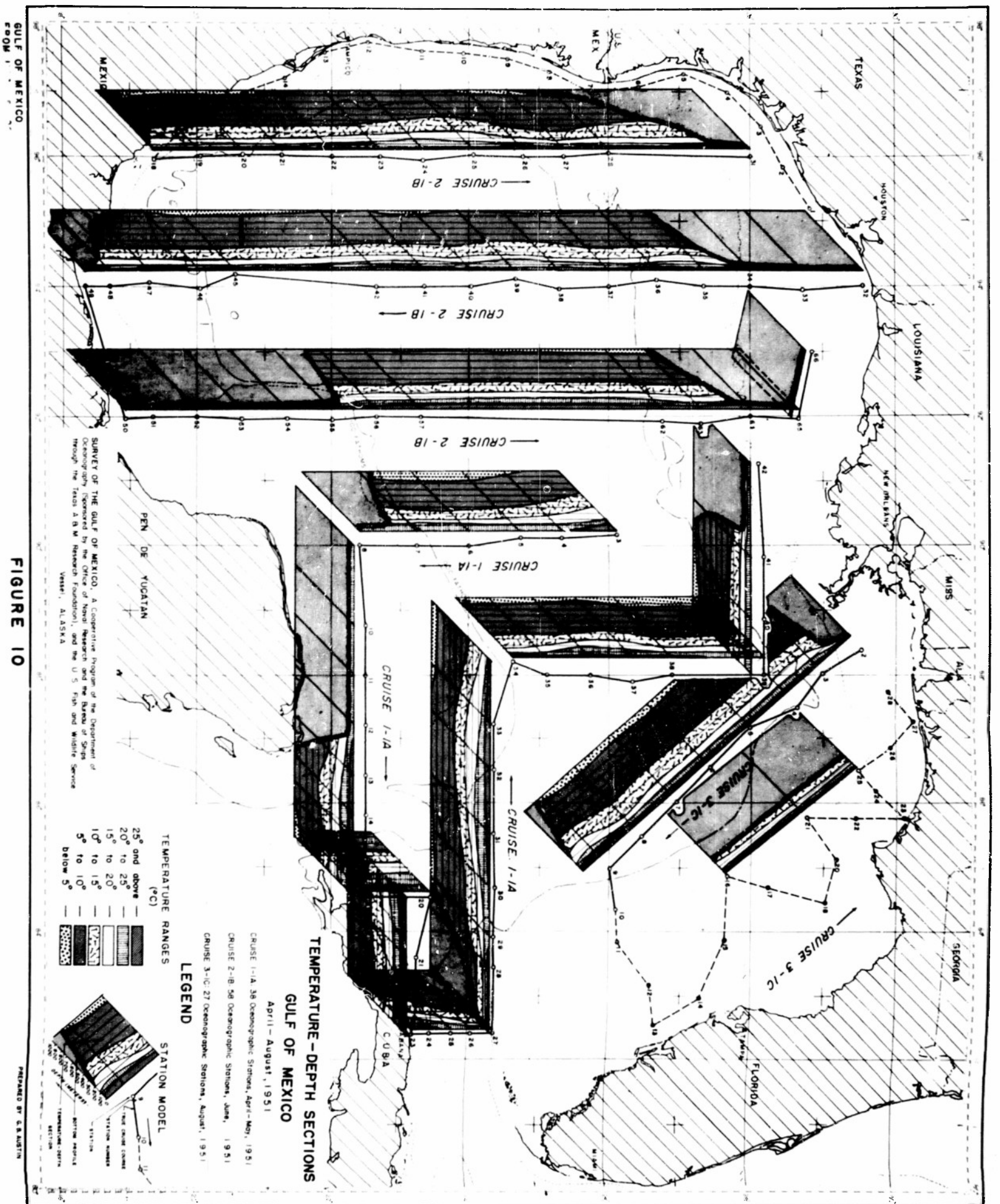


FIGURE 9

GULF OF MEXICO
FROM USCGS 1007



GULF OF MEXICO FROM

FIGURE 10

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