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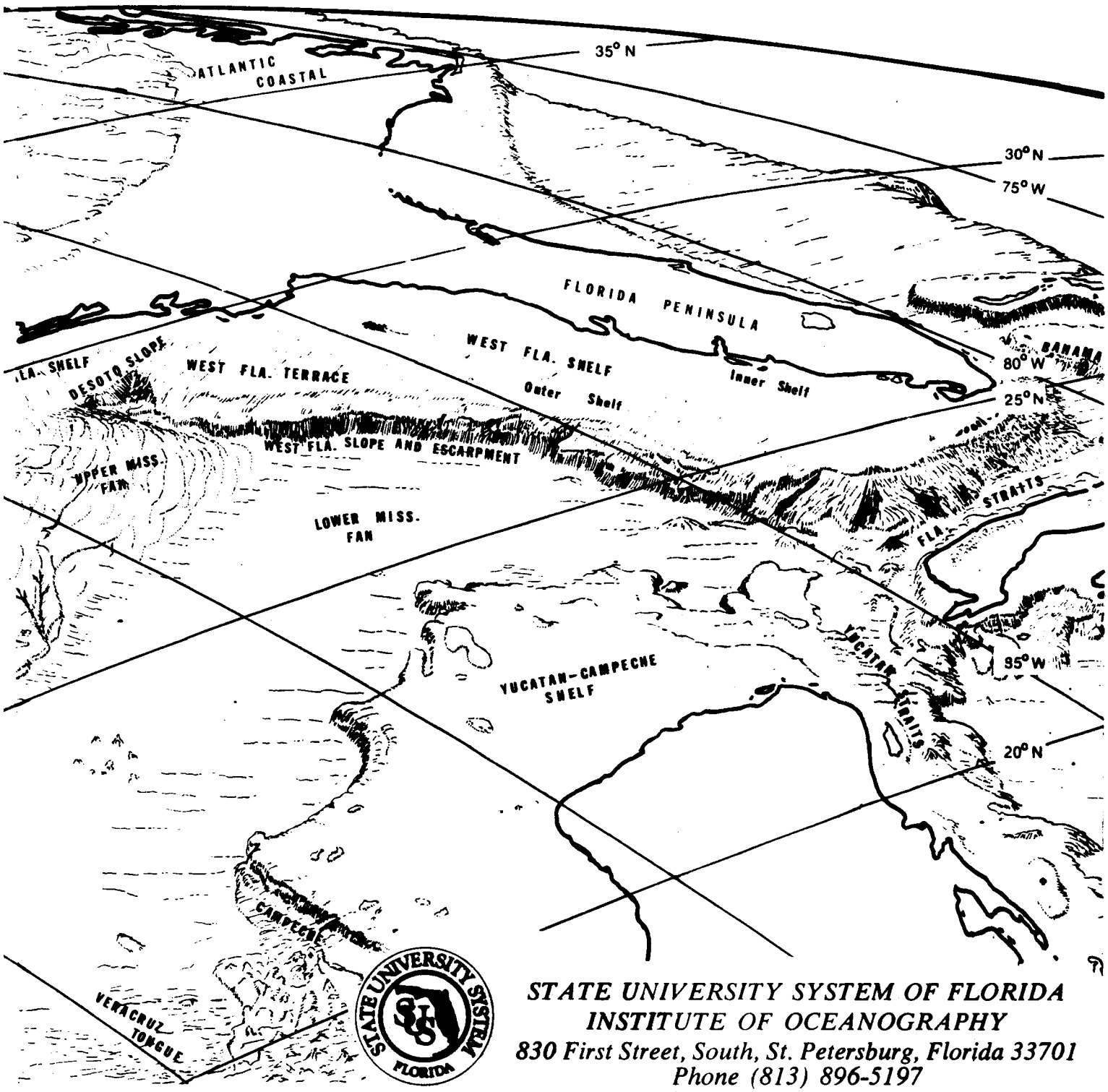
BASELINE MONITORING STUDIES, MISSISSIPPI, ALABAMA, FLORIDA OUTER CONTINENTAL SHELF, 1975-1976

BLM CONTRACT NO. 08550-CT5-30

VOLUME II

INTRODUCTION AND METHODS



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BASELINE MONITORING STUDIES,

MISSISSIPPI, ALABAMA, FLORIDA,

OUTER CONTINENTAL SHELF, 1975-1976

A Report to the Bureau of Land Management

in fulfillment of

Contract No. 08550-CT5-30

Submitted by

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J.E.A.

TABLE OF CONTENTS

Table of Contents - continued

Table of Contents - continued

Table of Contents - continued

Table of Contents - continued

LIST OF TABLES

This report has been reviewed by the Bureau of Land Management and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Bureau, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

List of Tables - continued

List of Tables - continued

List of Tables - continued

List of Tables - continued

List of Tables - continued

List of Tables - continued

List of Tables - continued

LIST OF FIGURES

List of Figures - continued

List of Figures - continued

List of Figures - continued

List of Figures - continued

List of Figures

List of Figures - continued

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List of Figures

List of Figures - continued

INTRODUCTION

In 1953, the Outer Continental Shelf (OCS) Lands Act (67 Stat. 462) was passed establishing Federal jurisdiction over the mineral rights of submerged lands of the Continental Shelf seaward of state boundaries as previously established in The Submerged Lands Act (67 Stat. 29). The Secretary of the Interior was delegated the responsibility for the administration of the mineral exploration and development of the OCS and authorized to formulate regulations so that the provisions of the Act might be met.

In conjunction with this authority, the Department of the Interior adopted three overall minerals management goals:

1. receipt of fair market value for the minerals leased;
2. orderly development of resources;
3. protection of the environment.

Subsequent to the passage of the OCS Lands Act of 1953, the Secretary of the Interior designated the Bureau of Land Management (BLM) as the administrative agency for leasing submerged Federal lands, and the Geological Survey for supervising production.

In 1969, the National Environmental Policy Act was implemented. This act requires all Federal agencies to utilize a systematic, interdisciplinary approach that will insure the integrated use of the natural and social sciences in any planning and decision-making which may have an impact on man's environment. The Bureau of Land Management's (BLM) efforts in this direction are Environmental Impact Statements (EIS),

environmental assessment teams, environmental studies, literature surveys, socio-economic studies, public conferences on problems affecting man's environment, and special studies that contribute to an understanding of the processes affecting this environment.

To satisfy the requirements of these acts, the BLM laid out broad programs for leasing, impact analyses (environmental and socio-economic) and environmental studies. The objectives of these studies are:

1. to acquire information about the OCS environment that will enable the Department and the Bureau to make sound management decisions regarding the development of mineral resources on the Federal OCS;
2. to acquire information which will enable BLM to answer questions about the impact of oil and gas exploration and development on the marine environment;
3. to acquire impact data that may result in modification of leasing regulations, operating regulations, or OCS operating orders to permit more efficient resource recovery with maximum environmental protection.

The environment information required by BLM management can generally be categorized as benchmark, descriptive, and predictive plus supportive data.

1. Benchmark are those data which are quantitative and for which statistical significance can be established. Such data must be established prior to oil and gas production so that changes can be detected by monitoring the same parameters during production.

2. Descriptive data are of two general types. The first type is data that are non-quantitative, or semi-quantitative, and which describe the morphological aspects of the environment and identify unique or special environments. The second involves biological or chemical data for which statistically significant spatial or temporal variability cannot feasibly be determined. These data are primarily used in support of the interpretation of benchmark and/or predictive data. They should also serve as a flag that will trigger studies to pinpoint sources of stress and determine effects of the stress.
3. Predictive information is primarily composed of physical processes data which can be used to determine the fate of pollutants, and biological effects data which can be used to predict and determine stress levels imposed by oil and gas development.

To assist BLM in accomplishing its objectives in the Eastern Gulf of Mexico, a Conference/Workshop was held in St. Petersburg, Florida, early in 1974. The major goal of this meeting was to define the critical research and information needs relevant to impending oil exploration and production activities in this region of the Gulf. Stewart (1974), in his summary of the conclusions and recommendations emanating from the Conference/Workshop, suggested that environmental objectives of the BLM in the Mississippi-Alabama-Florida (MAFLA) area of the Eastern Gulf of Mexico could be met through:

1. an initial or short-term baseline study of the present lease tracts and

2. a continuing or long-term study in the Eastern Gulf of Mexico, including the areas specified above.

The BLM subsequently contracted with the State University System of Florida, Institute of Oceanography (SUSIO) to obtain initial or short-term benchmark data in the lease tracts of the Eastern Gulf of Mexico prior to oil and gas explorations. The resultant work statement focused on a multidisciplinary study, including chemical (especially trace metals and hydrocarbons), biological, geological and limited physical oceanography, of the above region in June-July, 1974.

Specifically, scientific data was to be gathered in two major areas:

1. The water column, to include phytoplankton, zooplankton and neuston, such basic water properties as temperature, salinity, dissolved oxygen, nutrients, and trace metals and hydrocarbons along an extended traverse with sampling stations concentrated in the lease sites and with a limited number of control stations outside the lease areas.
2. A sea floor survey employing a relatively limited number of master stations (65) with sufficient subsamples (10 at each master station) to obtain a statistically significant evaluation of the existing benthic community in the lease areas. Epifaunal assemblages were also evaluated and selected organisms were examined for their trace metal and hydrocarbon content as well as their histopathologic condition. The geologic properties of the sediments (carbonate content, grain size, clay mineralogy, petrographic description), carbonate skeletal and organism remains in addition to the trace metal and hydrocarbon concentrations

were also determined.

The study sites for this project were as shown in Figure 1.

The results of these initial benchmark studies in the Eastern Gulf of Mexico indicated that crude oil-like hydrocarbons were not present in the sediments, bottom organisms, or organisms or phases in the water column in Areas I, II and III. Moreover, the abundance and diversity of organisms, as well as evidence of similar populations living in the same niches on the shelf in the recent past, suggest that these organisms are living in an essentially pristine and natural ecological state, and show no evidence of stress owing to influx of pollutants.

The situation was more complex in Areas IV and V. Some sediments in the former showed evidence of petroleum-type hydrocarbons in the aliphatic components of lipids, whereas others show only the odd-number predominance typical of biologically synthesized hydrocarbons. Area V sediments revealed indications of petroleum hydrocarbons in the sediments. Organism analyses showed similar divergent trends.

Trace metals in sediments, waters, organisms or suspended matter did not show concentrations beyond those expected for comparable non-polluted areas.

As a basis for future determinations relevant to the impact of oil and gas leasing in the MAFLA area the 1974 study was expanded and continued in 1975-1976. Such continuation reflects the recognition by BLM and the scientific community of the need for long-term studies to collect the appropriate data required for rational management decisions. Studies of

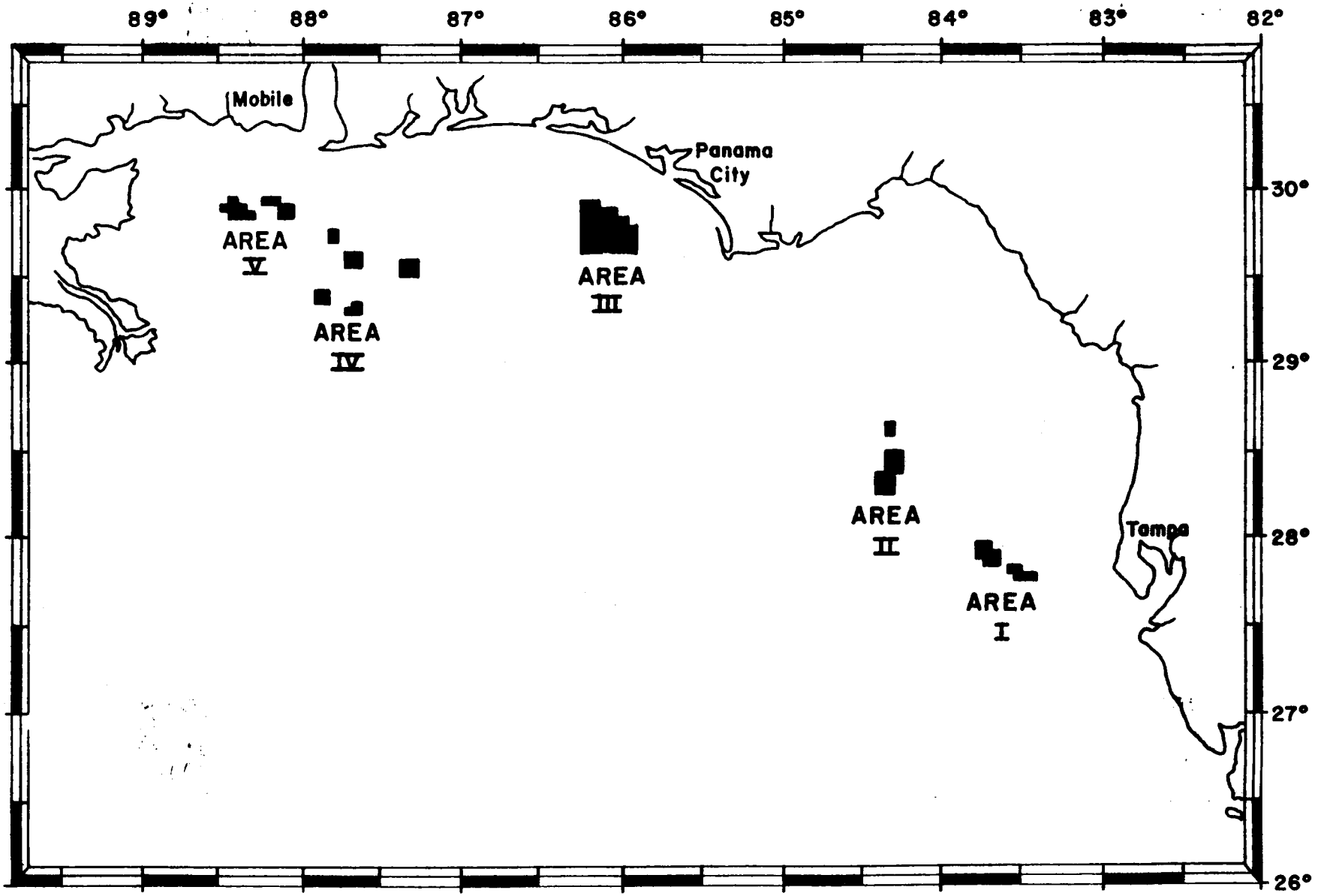

Figure 1. MAFLA benchmark study area.

three year duration are normally considered as the minimum for this.

In 1975-1976 the study area was broadened to include the entire shelf (beyond state boundaries). Prior to the preparation of the study plan for the 1975-1976 MAFLA program a special BLM study (SUSIO, 1975) was completed. The main focus of this effort was to assemble and synthesize the historical and contemporary physical and associated meteorologic data pertinent to the Northeast Gulf of Mexico. Within this study were recommendations on sampling locations for future biological, chemical, geological, and physical oceanographic investigations. Recommendations were also included for the physical oceanographic study of the MAFLA Continental Shelf which was to address the meteorology, hydrography, horizontal currents, sea level, bottom pressure and river run-off. The hydrographic section contained recommendations for the location of the transects and the stations for future biological, chemical, geological and physical oceanographic investigations.

Within the 1975-1976 SUSIO program, the BLM elected to address only the shelf hydrographic section in its water column program. Those hydrographic inputs required in such a study for the deep basin (Loop Current) were to be covered in a "special BLM numerical modelling project".

The recommendations for the hydrographic component included a monthly occupation of approximately ten standard stations on each side of eight transect grid lines across the shelf and slope regions (Figure 2). At each of these stations a standard STD cast plus occasional water samples for dissolved oxygen and nutrients were to be taken so that the major features of the seasonal evolution of the hydrographic fields could be determined.

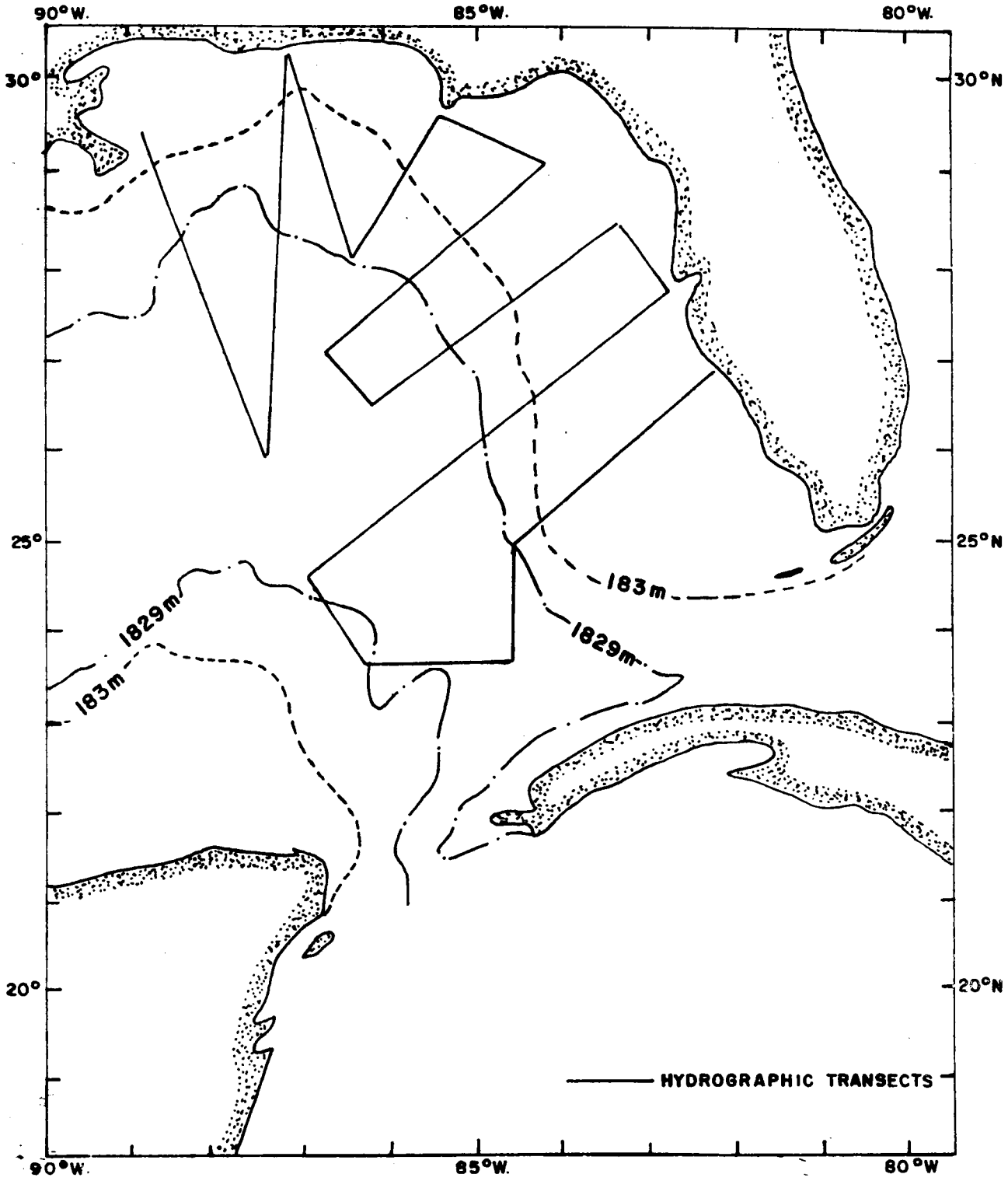

Figure 2. Recommended Hydrological Transects (From "Compilation & Summation of Historical & Existing Physical Oceanographic Data From the Eastern Gulf of Mexico - SUSIO, 1975)

These recommended sampling grid transects were modified to insure that 1975-1976 water column transects crossed through the five MAFLA lease block areas. They were further reduced to four transects in an attempt to (1) document the environmental conditions in selected hydrobiological areas on the shelf, (2) describe the influence of the motion inducing forces on the general circulation, (3) supply input to the numerical models, and (4) to connect, where possible, with the BLM Special Study Program. This would enable the interdisciplinary participants of the BLM program to draw on the existing MAFLA data bank (housed at NODC) and supplement the physical measurements to be taken during the BLM special studies program.

The rationale for this change in numbers and locations of the sampling grid was related to (1) the existence of monthly or seasonal historical data files on which one could draw for a determination of the normality of the data being generated in any one year, (2) the four run-off sub-areas based on Schroeder (1975), (3) marine summary and hydrobiological zones (Figure 3), (4) limitations on the scientific capacity and resources to perform the chemical analyses and supporting water column work, and (5) no attempt was to be made to collect synoptic data.

The above recommended sampling grid was not used for the benchmark program since the compilation and summation of the historical data was being completed during the same time period. In the 1975-1976 study four water column grid transects (Figure 4 and Table 1) were established

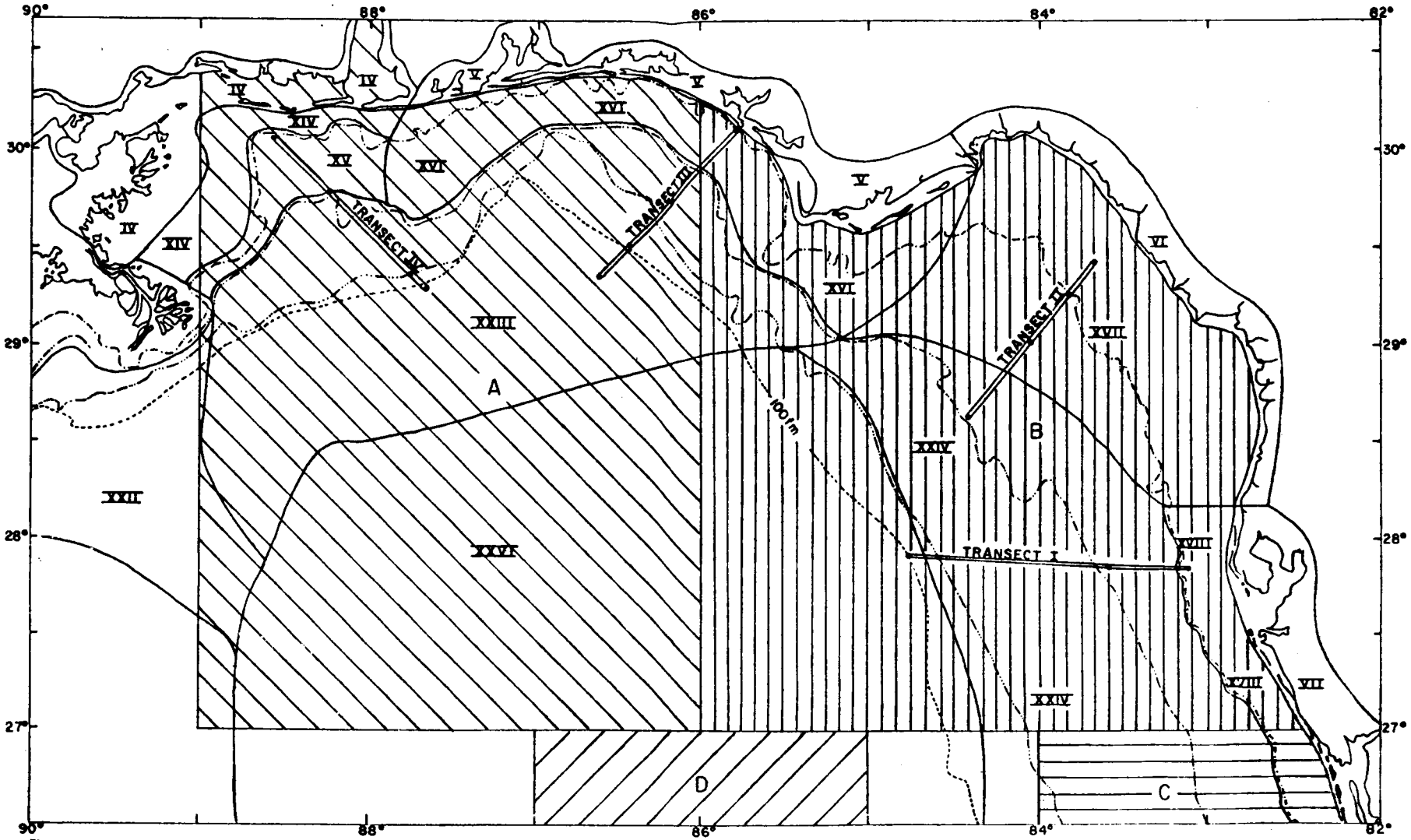

Figure 3. Delineation of Boundaries of Dissimilar Hydro-Biological Zones IV – VII, XIV - XVIII, XXII - XXIV & XXVI Eastern Gulf of Mexico in the Bays, Lagoons, Estuaries & Nearshore Regions, the Intermediate Shelf Regions, & Oceanic Gulf Regions. Marine Meteorological Summary Areas A, B, C & D Indicated by Hatced Markings (From "A Report on the Hydro-Biological Zones on the Eastern Gulf of Mexico [Abridged"]- SUSIO, 1972)

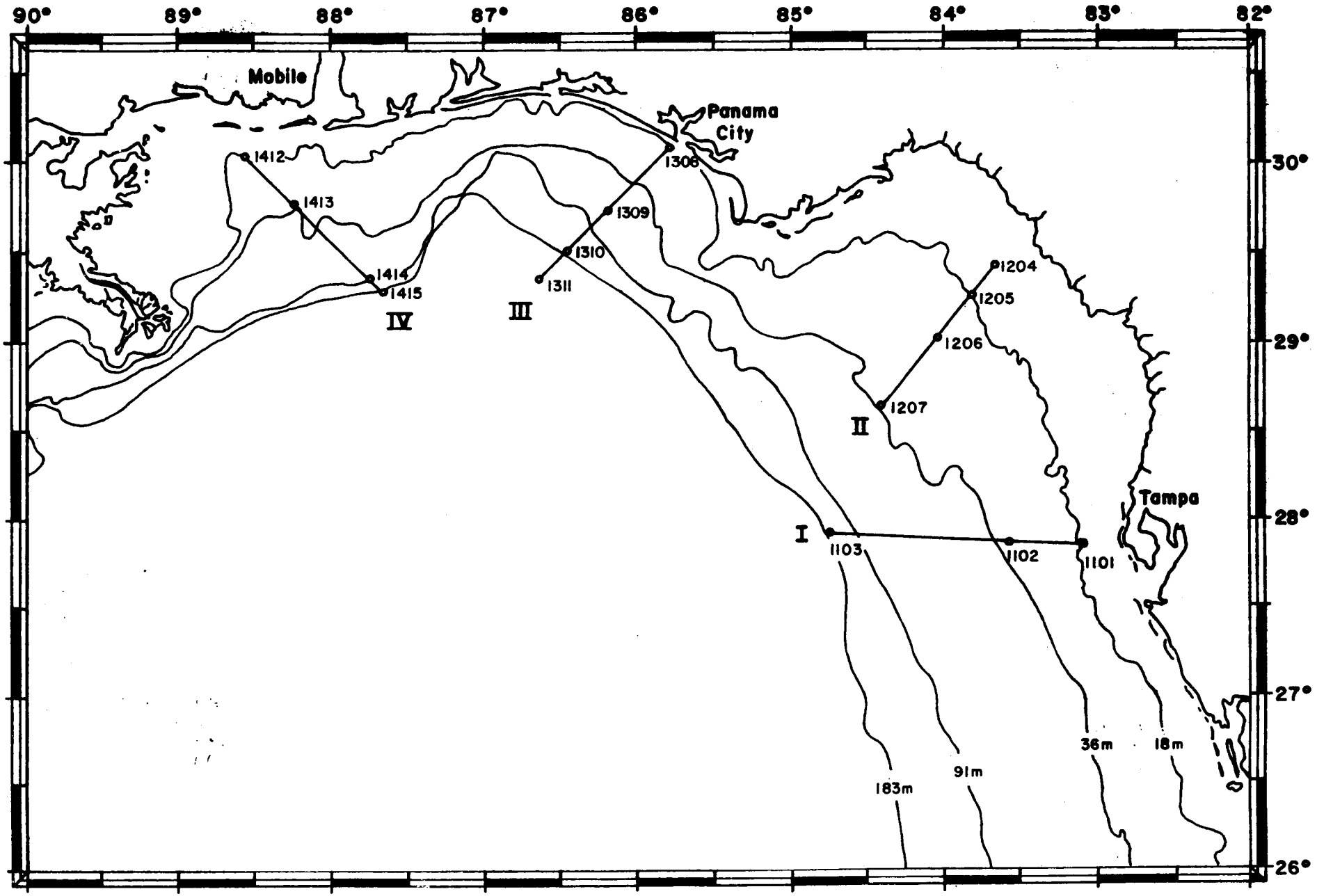

Figure 4. MAFLA water column stations, 1975 / 1976.

Table 1. Water column station locations sampled in the MAFLA area during the summer, fall (1975) and winter (1976).

Master Station Number	Position Latitude N.	Longitude W.	Transect Number
1101	27°51'	83°06'	I
1102	27 52	83 35	I
1103	27 55	84 45	I
1204	29 26	83 40	II
1205	29 16	83 49	II
1206	29 01	84 03	II
1207	28 38	84 24	II
1308	30 07	85 47	III
1309	29 44	86 12	III
1310	29 31	86 27	III
1311	29 21	86 38	III
1412	30 04	88 33	IV
1413	29 47	88 13	IV
1414	29 22	87 46	IV
1415	29 17	87 40	IV

and occupied during June-July and September-October, 1975 and January-February, 1976.

In planning the water column sampling program, it was assumed that the major source of chemical contamination on the shelf would be associated with the low salinity surface pockets resulting from drainage run-off. Measurements for chemical samples were set at ten meters since historical chemical data indicated that a sampling depth of five to ten meters would be required to reduce the possibility of contamination from the vessel, and physical data indicate that these low salinity surface pockets in the MAFLA area were usually 15 m deep.

The benthic sampling program was broadened to cover the same lateral extent that the water column studies covered. Six transects were established (Figure 5 and Table 2) across the MAFLA Continental Shelf and sufficient stations were established along each of these to allow for optimal utilization of MAFLA baseline stations and also to allow for adequate coverage of the known hydro-biological zones.

Transect I (Figure 6), extended due west across the Continental Shelf along latitude 26°25'N. This transect was composed of all new MAFLA stations and was added because of the possible sale of new leases in the Fort Myers area after the start of the 1975-1976 study and the need for baseline data if the leases were sold. Transect II was established in the area offshore of Clearwater, Florida, from latitude 27°56'N, and extended through MAFLA Baseline Study Area I (BLM Contract No. 08550-CT4-11). Transect III was established outward across the Continental Shelf and extended through MAFLA Baseline Study Area II (BLM Contract No. 08550-CT4-11).

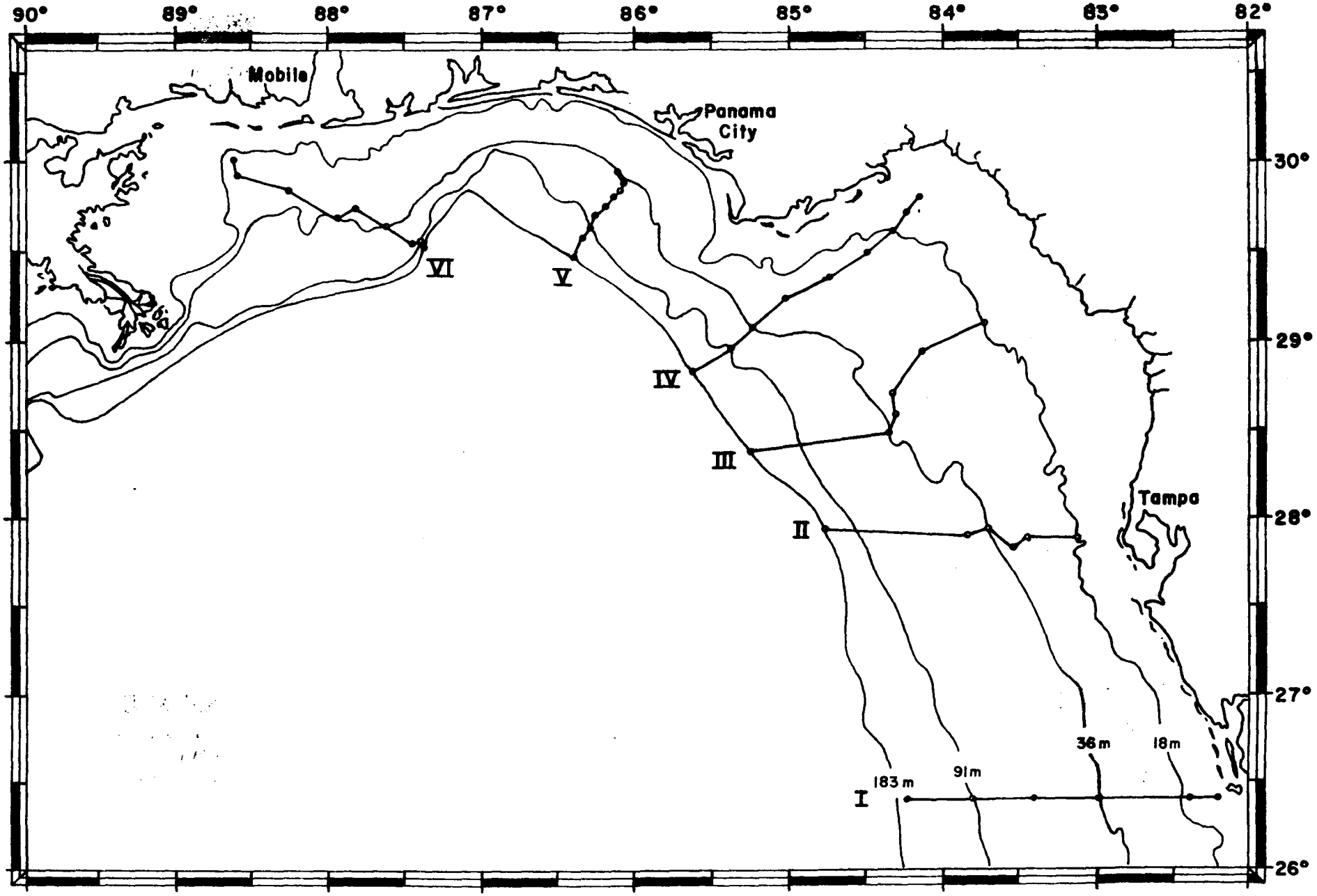

Figure 5. MAFLA boxcore stations, 1975 / 1976.

Table 2. Box Core Station Locations and Depths

Transect No.	Master Station Number 1975-76	MAFLA Station Number 1974	Position Lat. N.	Position Long. W.	Depth (m)
I	2101	--	26°25'	82°15'	11
I	2102	--	26 25	82 25	18
I	2103	--	26 25	82 58	37
I	2104	--	26 25	83 23	53
I	2105	--	26 25	83 50	90
I	2106	--	26 25	84 15	168
II	2207	--	27 57	83 09	19
II	2208	63	27 56	83 27.5	31
II	2209	61	27 52.5	83 34	34
II	2210	57	27 57.5	83 42.5	37
II	2211	55	27 56.5	83 53	43
II	2212	--	27 57	84 48	189
III	2313	--	28 24	85 15	176
III	2314	48	28 29	84 21	29
III	2315	47	28 34	84 20.2	29
III	2316	46	28 42	84 20	35
III	2317	--	28 56	84 06	29
III	2318	--	29 05	84 45	20
IV	2419	--	29 47	84 05	10
IV	2420	--	29 42	84 11	14
IV	2421	--	29 37	84 17	19
IV	2422	--	29 30	84 27	24
IV	2423	--	29 20	84 44	30
IV	2424	--	29 13	85 00	28
IV	2425	--	29 05	85 15	36
IV	2426	--	28 58	85 23	82
IV	2427	--	28 50	85 37	171
V	2528	--	29 55	86 05	37
V	2529	34	29 56	86 06.5	38
V	2530	35	29 51	86 06.5	41
V	2531	31	29 48	86 09.5	45
V	2532	30	29 46	86 12.5	52
V	2533	28	29 43	86 15.5	67
V	2534	--	29 40	86 17	73
V	2535	--	29 37	86 20	117
V	2536	--	29 30	86 25	189
VI	2637	--	30 02	88 37	21
VI	2638	2	29 55.5	88 33.5	24
VI	2639	9	29 53.5	88 12.5	32
VI	2640	11	29 43.5	87 54.5	35
VI	2641	12	29 45.5	87 46.5	37
VI	2642	16	29 40.5	87 37	36
VI	2643	17	29 36.5	87 27	69
VI	2644	19	29 36.2	87 23.5	75
VI	2645	--	29 35	87 20	106

Transect IV was established outward across the Continental Shelf in the area offshore from Apalachee Bay. No MAFLA baseline stations had been established in this area. Transect V extended outward across the Continental Shelf and through Baseline Study Area III (BLM Contract No. 08550-CT4-11). Transect VI extended through MAFLA Baseline Study Areas IV and V (BLM Contract No. 08550-CT4-11) in a southeastward direction across the Continental Shelf.

The rationale behind the selection of these transects was based upon the need for the assessment of the benthic biotopes in the MAFLA area. Transect I was a totally new transect and on the average it is influenced by Loop Current waters 33% of the time (SUSIO, 1975) and has a much greater assemblage of Caribbean species than the more northern transects. Transects II, IV, V and VI were selected because they cross existing lease areas and new stations were added to these transects to allow for proper assessment of the different hydro-biological zones (Figure 4) not previously sampled. Transect III encompasses an area for which there is little benthic biological information and which is overlain by a water mass structure somewhat unique to the MAFLA area.

The total number of stations were reduced from 65 to 45 based on the similarity of the data from the 1974 study in certain lease areas. The 45 stations were established along the six transects as described above. The 45 stations were sampled three times during the contract year resulting in a total of 135 discrete box core samplings.

The restriction of the 1974 program to the lease block areas allowed for the extensive use of divers to collect the appropriate

materials. The expansion of the program precluded much of the efforts of the divers and trawling and dredging was conducted at three stations on each transect (Figure 6 and Table 3) to supplement the box coring program.

For this, six transects were established within the MAFLA area each consisting of stations located at approximately the 37, 91 and 183 m depth contour. The stations were located within the selected depth interval based on the examination of historical data which suggested that these depths were representative of biological zones. The first sampling period would determine the exact location of the stations based upon the bathymetry at the general station locations (this was to insure that an adequate sample could be obtained without damage to the collecting gear).

The northernmost two transects (VI, located south of Mobile Bay, and V located south of Pensacola Bay) lay partially over the steep slopes of the northern sector of the DeSoto Canyon, which resulted in close proximity of the stations within each transect (especially the 91 and 183 m stations). Transect III traversed the Florida Middle Grounds area and this placed the inner station amongst scattered coral reefs. Transect I extended westward from the Fort Myers area and bordered on tropical substrate. The inner station on this transect was characterized by considerable biogenic relief. Transects II and IV were located on gently sloping shelf bottom with no outstanding topographic features.

The Florida Middle Ground is an area of recognized biological sensitivity due to the presence of a substantial system of viable hermatypic corals. Special emphasis was placed on the Florida Middle Ground

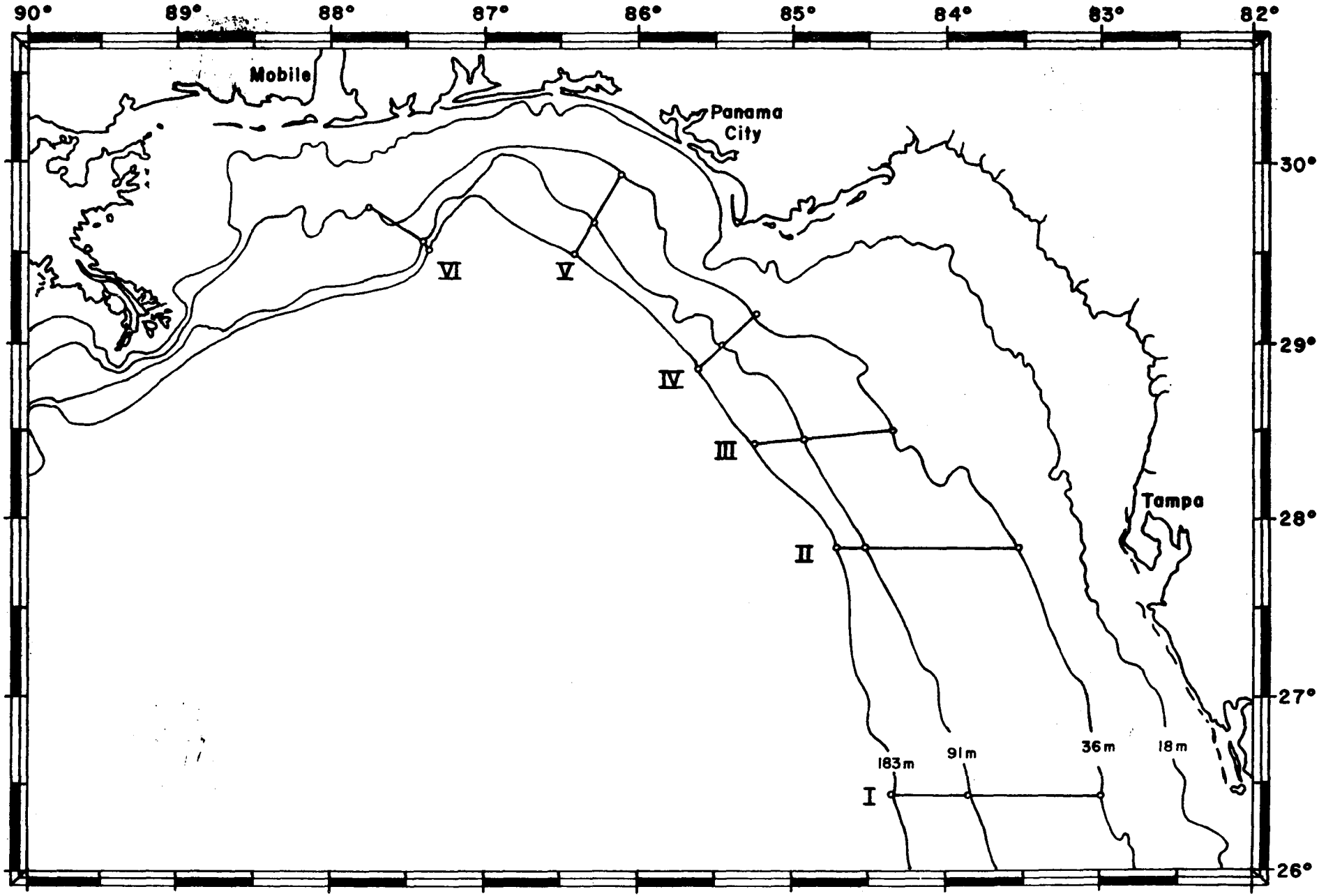

Figure 6. MAFLA dredge/trawl stations, 1975/1976.

Table 3. Trawling and dredging station locations.

Transect	Master Station Number 1975-76	MAFLA Station Number 1974	Position Lat. N.	Long. W.
I	I-A	-	26°25'	82°58'
I	I-B	-	26 25	83 50
I	I-C	-	26 25	84 20
II	II-A	62	27 50	83 31
II	II-B	-	27 50	84 31
II	II-C	-	27 50	84 42
III	III-A	48	28 29	84 21
III	III-B	-	28 26	84 56
III	III-C	-	28 24	85 15
IV	IV-A	-	29 04	85 14
IV	IV-B	-	28 58	85 24
IV	IV-C	-	28 50	85 37
V	V-A	34	29 56	86 06.5
V	V-B	-	29 39	86 18
V	V-C	-	29 30	86 24
VI	VI-A	12	29 45.5	87 46.5
VI	VI-B	18	29 33	87 24
VI	VI-C	-	29 31	87 22

based on the high priority and interest expressed in this unique reef community by the U. S. Department of the Interior. Qualified diver-scientists were utilized to conduct in situ observations at six stations on the reef and to collect the appropriate materials during each of the three sampling seasons. Two additional stations located off Clearwater, Florida were sampled for reference purposes. The location of these stations is shown in Figure 7 and Table 4.

Table 4. Florida Middle Ground dive station locations sampled in the MAFLA area during the summer, fall (1975) and winter (1976).

Master Station Number	Position	
	Latitude N.	Longitude W.
047	28°33'53"	84°20'11"
146	28 41 05	84 23 11
147	28 36 50	84 20 30
151	28 32 16	84 18 45
247	28 36 16	84 15 51
251	28 32 33	84 16 06
062	27 49 56	83 30 55
064	27 50 08	83 25 03

In addition to the monitoring aspects of the water column and sea floor programs discussed above, two special projects were incorporated into the program. The first of these involved the compilation of a lithologic map of the MAFLA area which would also incorporate the

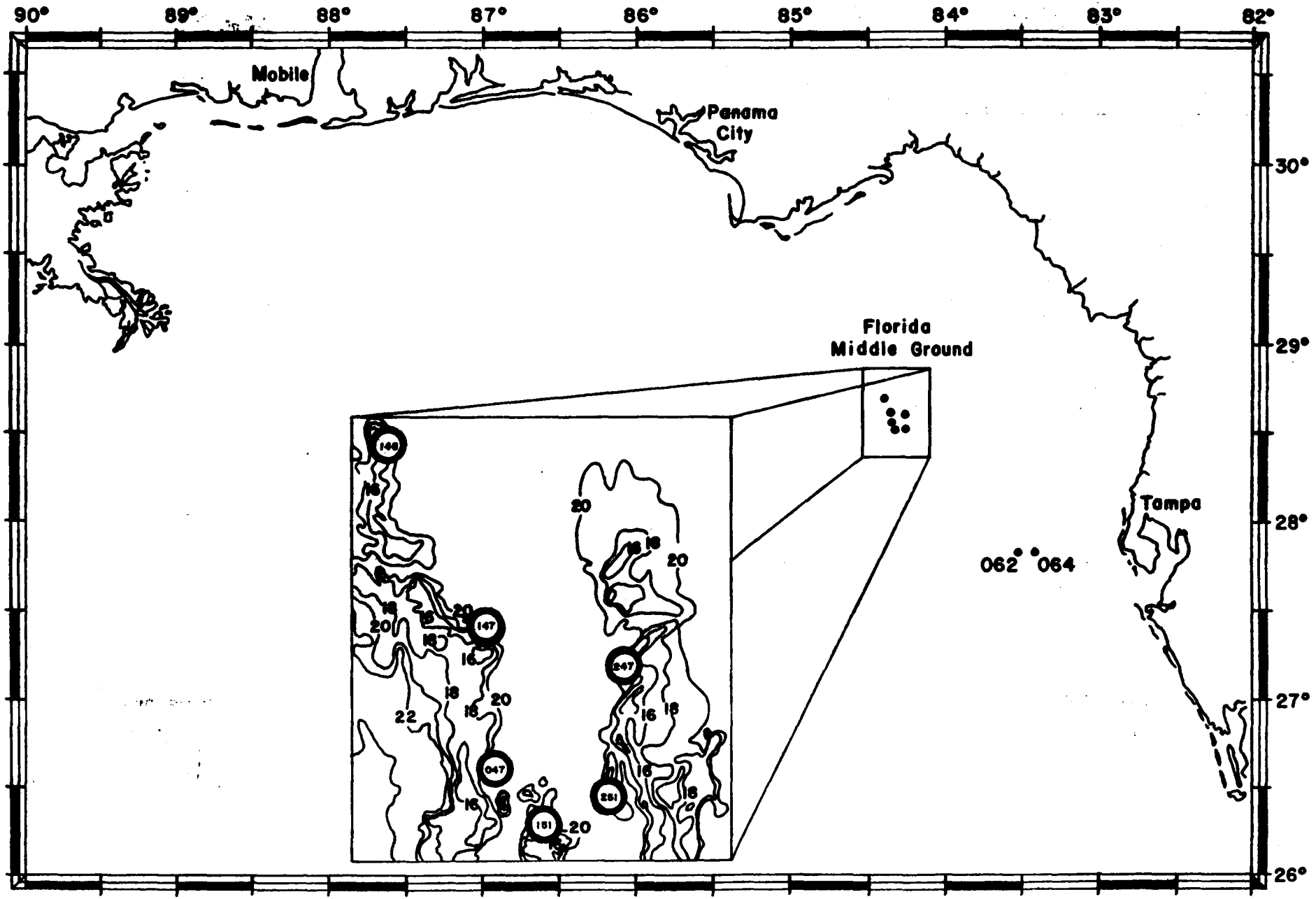

Figure 7. MAFLA dive stations, Florida Middle Ground and Clearwater (062 and 064) sites. Depth contours in meters.

available historical data on the distribution of benthic organisms. As an adjunct to this a review of the existing high-resolution seismic data at the University of South Florida and acquisition of 2000 miles of new geophysical data including side-scan sonar, uniboomer, 3.5 kHz and bathymetric profiles were to be made. The new data was to be obtained from as nearshore as possible out to water depths of 200 m. Survey lines were to cover transects established for the benthic sampling program.

After review and analysis of the geophysical data the interpretations were to be plotted at appropriate scales and integrated with the results obtained from the benthic biologists which pertained to the distribution of macrobenthos and with data from the sedimentologists. This would help delineate major provinces of surface sediment distribution, location of near-surface structural features and areas of rock outcrops, reef buildups, etc. Existing bathymetric maps, charts and profiles in the public domain were to be used as compilation bases.

The second special project involved a site-specific study which was designed to provide a pre-, during, and post-operational assessment of selected biological, chemical, and geological aspects of the environment in the immediate vicinity of an exploratory drill rig in an area selected by the Bureau of Land Management. Originally this site-specific study was to have been conducted in the Eastern Gulf of Mexico. However, due to a lack of drilling activities in this area during the contractual period, these efforts were relocated to the South Texas OCS region.

The actual site to be monitored was chosen on the basis of inquiry by BLM through the USGS. The experimental design took into consideration

the following points:

1. Exploratory activity on the site was to have a duration ranging from 15-90 days. Sampling was to be conducted in a comparable manner during the pre-, during, and post-operations and a diver collection was preferred.
2. The rig that was monitored was temporary and not a permanent structure.
3. The site selected that was monitored was representative of broad hydro-biologic zones and
4. Because of the greater potential for adverse impacts and ease of access the site was to be located in relatively shallow water depths (<36 m to allow for the diver collection system).

The rig monitoring survey was centered on a drilling location near the north lease line of Mustang Island (Texas), Block 792. The location of the drilling rig was:

Latitude:	27°37'13.87"N
Longitude:	96°57'55.17"W

The need for this special study relates to the fact that numerous substances, including hydrocarbons, may be introduced into the marine environment from drilling rigs and production platforms during offshore petroleum development. For instance, from a typical well (3000 m in depth) approximately 900,00 kg of drill cuttings alone are discharged before production commences and large volumes of drilling muds may be put over the side as well. Considerable quantities of brine (from formation waters) may also be discharged overboard, depending upon the geologic formation, and hydrocarbons may be released from minor spills and

support activities (these are considered routine and unavoidable for practical reasons). In spite of the potentially large quantities of these introduced substances, there is, at the present time, little public information available on their fate and effects.

The rationale of this research is based on the supposition that offshore drilling operations have an impact on the environment in which they are conducted. The purpose of this study was to determine the spatial and temporal impacts on the immediate environment during all stages of offshore oil and gas exploration.

Specific assumptions that were made in the experimental design included the following: (1) an understanding of general water circulation patterns would have been defined and quantified as a result of baseline investigations and associated research; (2) temporal and spatial variations in water and sediment chemistry would have been quantified over each of the base areas; (3) areas occupied by unique benthic organisms within the base areas would have been identified; (4) data from the baseline study would be complete and available; and (5) future locations of sampling stations within the lease areas would be at least tract specific.

Once the drilling site had been selected, a sampling pattern was laid out in the form of a wheel (Figure 8) with eight spokes, the drill site being the hub. Two of the spokes were oriented parallel to the bottom isobath; two of the other spokes were perpendicular to these. The remaining four intersected each established quadrant at an angle of 45° thereby resulting in eight spokes.

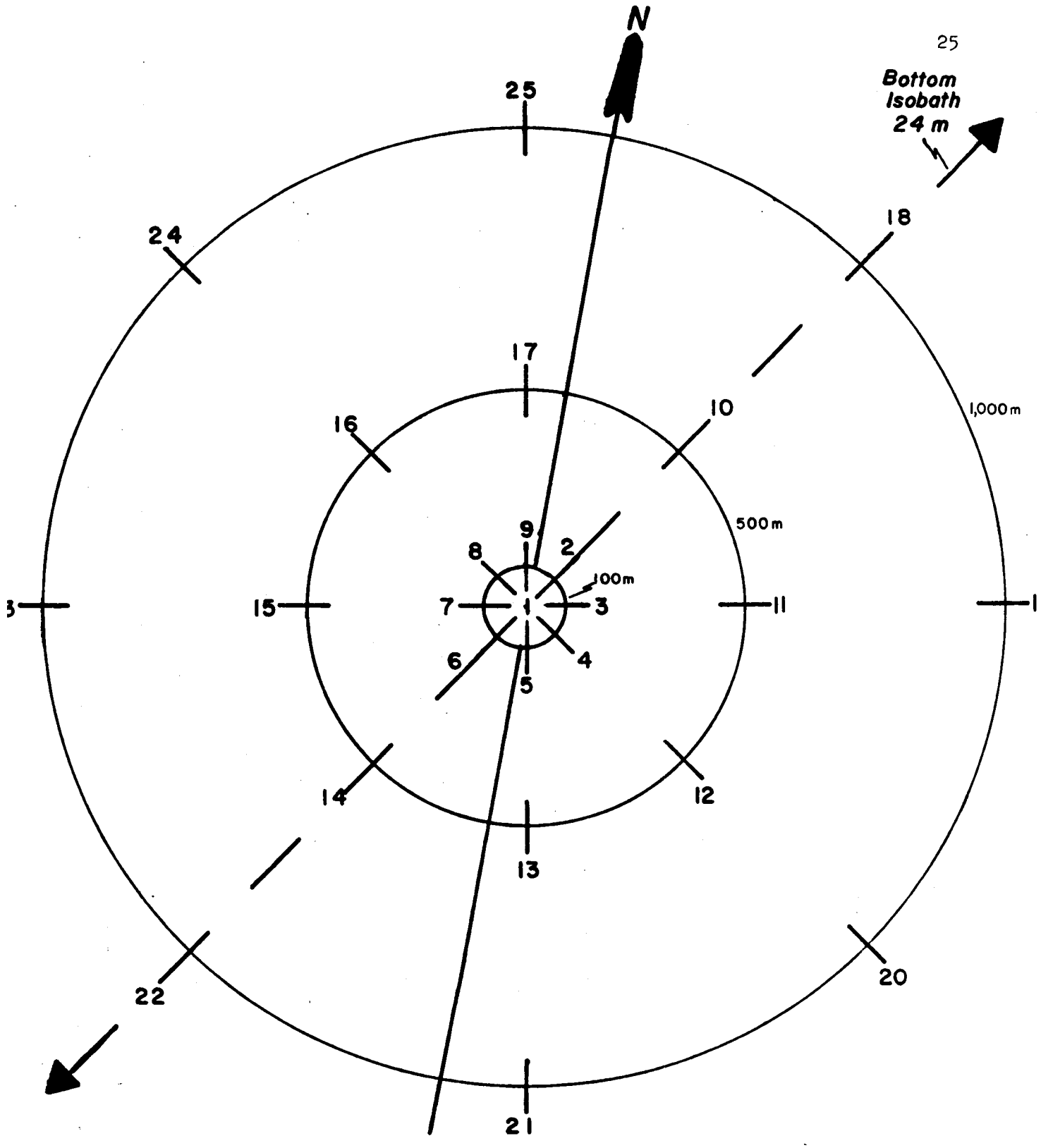

Figure 8

Station Arrangement for Rig Monitoring

Drilling occurred at Station 1

One sampling point was established at the proposed drill site and additional points at distances of 100, 500 and 1000 m from the site along each spoke, thus producing 25 sampling points (24 during the second phase).

Sampling was conducted primarily by diver-scientists and supplemented, when necessary, by a 30-foot (9.1 m) balloon trawl. Operations were conducted before, during, and after drilling.

Navigation

The accuracy and precision of the navigation systems employed in the various aspects of this program varied as a function of the work element. High precision navigation equipment was utilized in the box coring and diving programs to ensure repeatability of sampling, not only within a season but also between seasons. This same equipment was also used to locate the vessel during the three phases of the rig monitoring study. In the dredge/trawl and water column studies LORAN A was used to position the vessels.

Individual station locations and vessel navigation for the box coring and diving operations were provided by LORAC Services Corporation, Houston, Texas for the June-July, 1975 sampling effort. The LORAC radio location network consisted of semi-permanent land transmitting stations and one or more receiving units (located on board ship) designed and operated to ascertain the position of such ships to within $\pm$15.2 m. Due to operational difficulties experienced with the LORAC System during the June-July sampling season, the DECCA Hi Fix System was utilized for the remainder of these studies. The navigational accuracy of this system was equivalent to LORAC.

Five research vessels were involved in the collection of these data during the 1975-1976 sampling season. The vessels, their assignments and their navigational equipment are shown in Table 5.

Table 5. Vessels, their assignments and navigational equipment used in MAFLA.

Effort	Vessel	Navigation
Benthic		
Box Coring	R/V COLUMBUS ISELIN	LORAC
	R/V GYRE	DECCA Hi Fix
Dredging/Trawling	R/V GYRE	LORAN A
	R/V BELLOWS	LORAN A
Diving	R/V BELLOWS	LORAC, DECCA Hi Fix
Geophysics	M/V DECCA PROFILER	DECCA Hi Fix
Water Column	R/V TURSIOPS	LORAN A

METHODS

Field Operations

The sampling program consisted of two major investigative efforts: (1) water column and (2) sea floor (benthic). The sea floor program was comprised of three different sampling efforts: (1) box core, (2) dredge/trawl and (3) dive. Each of these had different requirements in ships, navigation, scientific crews, etc. and is discussed separately. The sampling efforts for the water column and the sea floor programs were conducted during three seasons of the year which correspond to spring-summer (June-July), summer-fall (September-October) and winter (January-February).

Water Column

The R/V TURSIOPS was used for the collection of the physical, biological, chemical and geological data. During each sampling season 15 stations were occupied along four separate transects extending from inshore to beyond the outer edge of the Continental Shelf (Figure 5). The inshore stations were located such that the probability of their containing waters from the major run-off areas would be high. Each station was assigned a master station number composed of four digits. The first digit defined it as a hydrographic station, the second indicated the transect number and the third and fourth digits contained the station number. Table 2 lists the locations of the stations sampled during June-July and September-October, 1975 and January-February, 1976.

Physical

STD and XBT

At least one STD lowering was made at each of the 15 master stations. The casts were made with a Plessey Model 9060 STD unit which was calibrated at each station by utilizing 1.7-ℓ Niskin bottles equipped as required with protected reversing thermometers. For each cast one calibration bottle was set at the surface and the other two meters above the bottom of the STD sensors. Once the cast reached the surface, the reversing thermometers were read and recorded and a salinity sample was drawn for subsequent analysis (in most instances duplicate salinity samples were taken). Additional temperature (or temperature-salinity) profiles were obtained between the master stations. Where only temperature was determined, an XBT equipped with T-10 probes was launched and a reading was taken from a bucket thermometer for calibration purposes.

Transmissometry

The distribution of light transmission (a measure of the particulate concentrations) in the water column was measured with a Montedoro-Whitney unit (primary) or a Hydro-Products (back-up). Major malfunctions experienced with the primary unit resulted in most of the profiles being obtained with the Hydro-Products unit which limited the data to 100 m of depth. Transmissometer lowerings were made at and between each of the master stations and at two time series stations (Master Stations 1412 and 1207). The frequency of observations within each time series effort was four lowerings over a 24-hr period.

The Montedoro-Whitney unit was attached directly to the hydro cable and an analog trace was obtained from each lowering. The Hydro-Products unit was lowered on its own conductor cable leading directly from the deck readout system. Transmissometry readings were taken at selected depths which were dependent on the temperature and/or salinity regime (determined from a hydrocast made immediately before).

Biological

Phytoplankton

Primary Productivity

Thirty-liter Niskin bottles were used to collect water samples from the surface and from the bottom (or the one percent light level) for the determination of the primary productivity. Triplicate determinations were made at each depth level and samples were collected twice daily (morning and afternoon). The one percent light level was calculated from the following equations:

$$(1)\quad K = \frac{\ell n\ I_5/I_{20}}{15}$$

$$(2)\quad Z = \frac{4.61}{K}$$

where: I_5 = light intensity at 5 m immediately after sunrise;

I_{20} = light intensity at 20 m immediately after sunrise;

Z = depth, m

The station depth was used as the one percent light level if Z exceeded the bottom depth of the station.

Three 183 ml aliquots were drawn from the 30-ℓ Niskin bottles

and inoculated with either five or ten microcuries of $NaHCO_3$-C^{14} depending on the phytoplankton density. After inoculation, the bottles were placed in one of two incubators, cooled with running seawater and incubated for at least three hours. One incubator was covered with blue plastic which had an absorption spectrum approximating the absorption spectrum of seawater. Temperature in the boxes was regulated by pumping seawater from the sea chest through the deck incubator. Solar radiation was measured continuously for the surface-simulated light intensity deck box with a Lambda Corporation submarine quanta-meter equipped with readout through a Hewlett Packard portable strip chart recorder, or Lambda Corporation integrator. The ratio of solar radiation received by samples incubated under the surface-simulated radiation conditions to solar radiation received by samples incubated under near-bottom or one percent light depth radiation conditions was determined. After incubation, the samples were filtered through Whatman GF/C scintillation grade glass fiber filters. The individual filters were then placed in separate plastic containers and frozen until analysis.

Chlorophyll a

Three two-liter samples were removed from the same Niskin samplers from which the productivity samples were removed. Each of these was filtered through separate GF/A glass fiber filters and frozen. The samples were returned to a shore laboratory for subsequent analysis.

Zooplankton

Zooplankton samples were collected for taxonomic, hydrocarbon and trace metal analyses. Duplicate oblique zooplankton tows were made from bottom to surface once during the day at each of the stations

during each of three sampling seasons. The first net (for taxonomy) was fished for fifteen minutes; the towing time for the second net was determined from the amount of material recovered in the first tow. The aim of the second tow was to recover an adequate amount (at least 50 g) of zooplankton for hydrocarbon and trace metal analyses.

The samples were collected with 0.5 m gape Nytex plankton nets having a mesh size of 202 μm. Each net was equipped with a calibrated flowmeter suspended approximately midway between the center and outer edge of the net mouth (gape).

The contents of the first tow were thoroughly washed down from the outside of the net and samples were placed in five percent buffered formalin for taxonomic analyses.

The cod end from the net of the second tow was removed without net washing. The contents were transferred to a cleaned Folsom splitter, drained, transferred to specially cleaned jars fitted with Teflon-lined lids and frozen until analysis for hydrocarbons and trace metals could be performed. Sample containers had been previously cleaned with chloroform and/or acid.

Neuston

Neuston samples were collected with a Kahlsico Floating Plankton Sampler using a one-meter, 5:1, 202 μm (#8) Nytex net. The samples were collected twice daily (daylight and dark), at each of the fifteen master water column stations. The net was towed at approximately two knots for 4-30 min. Nets were fished three meters from the leeward side of the ship.

Neuston collections for taxonomic analyses were flushed into clean ten-liter plastic sorting trays and then transferred to glass jars in which

they were fixed in a solution of five percent formalin-seawater buffered with sodium borate. When large amounts of Sargassum were collected, the total volume was estimated and one gallon was preserved. All Sargassum were thoroughly shaken to remove associated and/or entrapped animals. Collections for trace metal and hydrocarbon analyses were placed into acid-washed glass jars fitted with Teflon-lined lids and frozen for onshore processing. Prior to freezing, excess water was removed from the trace metal/hydrocarbon samples by means of a 202 μm acid-washed net.

Chemical

With the exception of zooplankton and neuston samples, all samples were collected at a depth of ten meters.

Particulate and Dissolved Organic Carbon (POC and DOC)

Acid-cleaned 30-ℓ Niskin samplers equipped with Teflon fittings were used to collect the samples. A subsample of 10-20 ℓ was transferred (via Teflon tubing) to a carboy. For particulate organic carbon a well agitated 200 ml sea water sample was filtered under five centimeters of vacuum through a pre-combusted 2.4 cm Whatman GF/C glass fiber filter using a Gelman filter funnel on a Millipore manifold. The filter was removed with acid-washed Teflon forceps, folded cylindrically, placed in a pre-combusted ten milliliter ampoule, capped with aluminum foil and frozen. Three replicate filtrations were performed. Approximately 100 ml of the filtrate from each of the above operations was placed in separate four ounce (118.3 ml) acid-washed, Teflon-capped glass bottles, poisoned with mercuric chloride to prevent biological alteration of the carbon content and refrigerated in the dark at 4°C until subsequent processing ashore.

Particulate Hydrocarbons ($>C_{14}$)

Samples were collected utilizing the same Niskin samplers used for the organic carbon collection. The bottles were attached to a polyethylene sheathed hydrowire which was wiped clean with a chloroform-soaked cloth between casts.

Eighty to 86 ℓ of water for each sample were filtered through pre-combusted glass fiber filters housed in a stainless steel, Millipore filter holder. The filters were folded into pre-combusted aluminum foil and frozen until analyzed. The filtrate was processed for dissolved hydrocarbon analysis.

Dissolved High Molecular Weight Hydrocarbons ($>C_{14}$)

The filtrate resulting from the on-board processing for particulate hydrocarbons was drawn into acid/$CHCl_3$-cleaned stainless steel containers and poisoned with 50 ml of $CHCl_3$ to await analysis at a shore-based laboratory.

Trace Metals (Particulate)

The samples were collected utilizing 30-ℓ Niskin bottles equipped with internal rubber closures. The bottles were attached to a polyethylene-sheathed hydrocast cable which was cleaned before each cast.

To separate trace metals associated with particulate matter from those associated with very finely divided (0.4 μm diameter) "colloidal" particles and from those in solution, all water samples were filtered immediately through 47 mm diameter, 0.4 μm pore size, Nuclepore membranes. All of the Nuclepore membranes were weighed prior to the "at sea"

sampling program on a six place (one microgram) Mettler Model M5 balance in a clean room at the University of South Florida. After weighing, each filter was placed in a separate in-line filter holder. This operation was conducted in a Baker (Model EG3220) clean bench. Each of the in-line filter holders was then placed in an individual plastic bag which was sealed until needed on station. These procedures were followed to minimize the exposure of the filtering equipment to the contaminated atmosphere of the ship.

The filtration of the water samples collected at sea was carried out in a closed system using the techniques of Betzer (1971). The filtering system consisted of 9.5 mm I.D. silicon rubber (leached with 4 N HCl prior to sampling) which carried the water from the Niskin bottle to the Millipore filter head. To minimize contamination between stations the disconnected tubing was covered with a polyethylene bag. Prior to filtering a new sample the tube was flushed with approximately one liter of that sample. Filtration was forced by pressurizing the Niskin bottle with 0.35 kg/cm^2 (5 lb/in^2) of filtered nitrogen. Gas filtration was accomplished by placing two Millipore filter heads (each equipped with 47 mm, 0.1 μm pore size Nuclepore membranes) between the nitrogen source and the Niskin bottles. Filtration was continued until approximately nine liters of water had been filtered or until the filter clogged. The water obtained from the filtering process was retained in a polyethylene reservoir for volume measurement.

After filtration had been completed, the Nuclepore membranes were rinsed with 25 ml of distilled water to remove any residual salt. The filter heads were then transferred immediately to polyethylene bags

containing desiccant which were sealed and stored at 4°C until they were returned to a shore-based laboratory for subsequent analysis.

Geological

Suspended Sediment Mineralogy

The water remaining from the particulate trace metal filtration process was filtered through a 0.45 µm Millipore filter until the filter was clogged or the water was used. Filters were placed in clearly labeled containers and stored at 4°C for shipment to the laboratory for subsequent analysis.

Sea Floor

Box Core

Figure 5 shows the general location of each of the box coring stations sampled during the summer and fall, 1975 and winter of 1976. Table 3 gives the geographic coordinates for each station along each transect.

Samples were collected with a stainless steel box corer which removed a sediment plug measuring 21.3 cm x 30.5 cm in surface dimensions. Depth of the sediment plug varied (maximum 43.2 cm) depending upon sediment thickness and penetrability.

Eleven replicate samples were collected from each station where an adequate core could be obtained (nine of these were utilized to obtain a statistically significant evaluation of the macro-infaunal community). If after two attempts, an adequate sample was not collected, two samples were collected with a 1/4 size Sanders Anchor Dredge.

Geological

After each box core was brought on board, a side and top

view color photograph was taken (the flash camera was fixed on a frame). Each photograph included the identification tag, a color code system, a linear scale and designation of the top of the core. A visual description was made of each core.

One box core at each station was subsampled with a five centimeter deep subcore for sediment archiving. A visual description was made, and a slab was taken from this core which was X-radiographed for sedimentary structures. An epoxy relief peel was also taken for detailed substrate characterization; if it was not possible to obtain a peel, the reason was stated in the deck log.

Two box cores at each station cored were subsampled with a five centimeter diameter subcore for sediment analysis. These samples were placed in clearly labeled containers for shipment to a shoreside laboratory where subsequent analysis was performed.

Radiography

From one box core at each station a vertical slice was taken and held in a plexiglas form. Slices were trimmed to the size of the form (approximately 1.9 cm in thickness) to provide an even surface for X-radiography and for producing relief peels.

Each sample was radiographed, using a self-contained Faxitron unit, and then a relief peel was made, where possible, using epoxy glue and 1.6 mm thick masonite boards. Procedures for making the peel consisted of spreading epoxy evenly on a pre-cut masonite board, then placing the board (epoxy side down) on the sediment sample which was held in the plexiglas form. Board and sediment were carefully inverted and the form removed, leaving a cake of sediment on the board. Each sample was allowed to

harden, then stored for processing in the laboratory.

Biological

Foraminifera

A 2.5 cm diameter x 15 cm plug was removed from each of two cores. The top three centimeters of each plug was preserved in glutaraldehyde for later identification of living foraminifera. The remainder of each plug from the first sampling season was archived for analyses of fossil fauna.

Micromolluscs

A 5.5 cm diameter x 5 cm plug was removed from each of two box cores and preserved in alcohol for later identification of living micromolluscs.

Meiofauna

Two quantitative samples (3.4 cm diameter x 5 cm plug) were taken from each of three box cores using a "meiostecher". Each pair per box core was pooled to yield one single sample resulting in three pooled samples per box core station. These were extracted with $MgCl_2$ for ten minutes and fixed in ten percent buffered formalin. One sample (5 cm diameter x 15 cm plug) was collected from one box core and refrigerated for analysis of living specimens.

Macrofauna

Nine of the 11 replicate box cores (21.3 cm x 30.5 cm) were taken for macroinfaunal analysis at each of the 45 stations. A sample (5 cm diameter/depth of core) was taken from two of the nine replicates for sediment analysis leaving a total of approximately 0.54 m^2 for macro analysis. The top 15 cm of each of the nine replicates (after

sediment plug removal) was sieved through a 500 μm mesh Nytex screen. The material remaining on the screen was placed in a cloth bag and narcotized for 30 minutes in 15% $MgSO_4$ after which it was preserved in ten percent buffered formalin.

ATP

Six to ten two-cubic centimeter volumes of sediment were collected at each sampling station by inserting sterile glass tubes into one of the box cores. The sediment samples were transferred to culture tubes and refrigerated until extraction.

The ATP was extracted by mixing two cubic centimeters of sediment with five milliliters of 0.6 N H_2SO_4 maintained at 5°C in a vortex mixer for a period of one minute. Internal standards of ATP were added to three of the sediment samples before addition of H_2SO_4.

After the sediment had settled, the supernatant was withdrawn from the test tube quantitatively and transferred to a ten milliliter beaker. One milliliter of EDTA solution (18 mg EDTA per ml) was added along with one milliliter of TRIS buffer solution; for carbonate sediments, two milliliters of EDTA were added. The solution was brought to pH 7.8 by adding NaOH. Then the entire extract was brought to a final volume of ten milliliters with TRIS buffer solution, placed in Whirl-paks and frozen until assayed.

Chemical

One box core at each station was designated for chemical analysis for hydrocarbons and trace metals in the sediments. Two subsamples were taken from the box core; one for high molecular weight (HMW) hydrocarbon analysis, one for trace metal analysis; and an identical

sample was taken, as needed, for high molecular weight hydrocarbon and trace metal quality control. All samples were handled with extreme care to avoid contamination during recovery, handling, and storage.

Trace Metals

A subsample was taken by inserting a pre-cleaned two centimeter diameter plastic tube into the sediment, the ends were capped and the tube was frozen for shipment to the laboratory. This subsample was not taken near the metal portions of the coring device itself. An identical sample was taken, as needed, for the BLM quality control laboratory.

Hydrocarbons

A 2000 g subsample was taken when available from the upper ten centimeters of the box and frozen. An identical sample, weighing at least 100 g was taken, as needed, for the BLM quality control laboratory.

Total Organic Carbon

A ten cubic centimeter subsample was removed from the hydrocarbon sample when it was processed in the laboratory.

Dredge and Trawl

General

A 30-foot (9.1 m) semi-balloon trawl was used for sampling the epibenthos at three intervals along each of the six transects. A Capetown dredge was used to make the dredge tows at each of the stations. The approximate bottom depth of each of the transect intervals for all six transects was as follows:

Interval A	4.9 - 6.1 m
Interval B	12.8 - 16.8 m
Interval C	28.0 - 35.0 m

Both the dredge and trawl were towed at one to four knots for 15 minutes on the bottom along Intervals A and B. On Interval C, both the dredge and trawl were towed at the same speed for 30 minutes on the bottom. Table 3 and Figure 6 list and show the locations of the various transects and stations.

One trawl sample was taken during each sampling period at each station. All trawling samples were taken with a 30-foot (9.1 m) semi-balloon trawl, with fine (9.5 mm) mesh cod-end liner. Trawls were taken in a direction generally paralleling that of the transect, but occasionally, topographic features or vessel operational procedures required deviation from this preferred pattern.

Two dredge samples were taken at each station. A standard Capetown dredge with fine mesh (1.25 cm or less, depending on bottom composition) metal screen liner was used for obtaining samples. Towing procedure for dredge samples paralleled those for the trawl.

Both trawl and dredge samples were deposited directly into a plastic coated sorting tray (which was thoroughly cleaned before each trawl or dredge catch was placed on it).

Selected biota (predominant and commercially important species) were removed from the trawl sample for trace metal, hydrocarbon, and histopathological analyses. The remaining material was utilized for taxonomic determinations and community characterizations. At each station three to five species (excluding demersal fishes) were sampled where possible for trace metal analyses with at least three to five individuals per species or at least one gram dry weight (three to four grams wet weight).

Samples for hydrocarbon analyses and histopathology were processed as discussed below. Samples of skeletal muscle were also removed from commercially important demersal fish and frozen for future hydrocarbon and trace metal analyses. For these analyses the left side of the fish was reserved for the trace metal analyses and the right side for hydrocarbon analyses. Trace metal samples were stored in plastic bags and the hydrocarbon samples were stored in hexane-washed aluminum foil.

Biological

Macrofauna

That portion of the sample not used for chemical or histopathological analyses was grossly sorted and preserved as described in the laboratory analysis section of this report.

Macroflora

These organisms were sorted from the sample and preserved in buffered formalin-seawater and stored in plastic buckets until subsequent analysis ashore.

Demersal Fish

All demersal fish species were sorted, and a representative subsample identified, counted and placed in plastic containers with ten percent buffered formalin. The body cavity was opened onshore on all preserved specimens larger than ten centimeters and after five to ten days from return to the laboratory the fixed specimens were washed for 24 hours in water and stored in 40% isopropyl alcohol.

Histopathological

Samples were obtained for preparation of histopathological slides from each trawl station, and from dredge hauls. Samples consisted

of from one to three species per station and up to fifty animals per species. Species to be collected were designated by Dr. N. Blake, responsible for slide preparation. Organisms were trimmed (removed from shells and cut into pieces), and each organism was numbered and placed in a plastic bag, which was then immersed in Dietrich's fixative.

Chemical

Subsamples for trace metal (macroinvertebrates) analyses were frozen in plastic bags. Subsamples designated for determination of hydrocarbons in flora macroinvertebrates and the appropriate quality control samples were placed in glass containers (pre-washed with chloroform), clearly labeled, and then frozen for storage.

Dive

Florida Middle Ground

This area was sampled by diver scientists employing open circuit SCUBA and consisted of *in situ* observations (and collections) at the MAFLA Baseline Stations previously listed.

The mode of collection during diving operations, while it included the use of nets, bags, trawls, and scoops, was principally by hand. Photography was accomplished with hand-held 35 mm Nikonos II cameras using close-up, 28 mm and 35 mm lenses and Sub Sea Mk 150 strobes for illuminations. In addition, Super 8 movies were taken with a Nikon Super 8 Camera or a Kodak XL 55 Super 8 Camera in a pressure resistant housing outfitted with dual 100 w cinema lights. Only color film was used.

Quantitative measurements involving individuals per area were done by two methods as appropriate to the task.

1. The 5 m^2 system - at each of the Florida Middle Ground (FMG) stations, a 5 m x 50 m strip transect was deployed. The strip transect was further segmented into five meter sub-units by attaching cross lines at five meter intervals along the 50 m line thus producing ten 5 m^2 quadrats. As a point of reference, quadrat one was always the deepest quadrat with quadrat ten intended to be the shallowest in as much as the strip transect was intended to lay in consort with a deep to shallow axis.

This system was used to delineate "Community Structure" at the dive site, and for quantitative studies of Scleractinia and Octocorallia.

2. The 0.25 m^2 system - at each of the FMG and Clearwater stations a 0.25 m grid (inside area) was employed to count and measure suitable biota, e.g., algae. This grid was deployed in the study area for both random and biased collections for algal species diversity and biomass.

Analytical Methods

The analytical methods used are reported in the following section. As in the Field Operations, it has been divided into Water Column and Sea Floor subsections and follows the previous format.

Water Column

Physical

STD and XBT

STD traces were corrected based on salinity and temperature observations collected at the same time as the lowerings. Salinities were determined on a Plessey conducting salinometer. XBT traces were corrected as necessary from surface temperatures measured at the time of the cast.

Transmissometry

A Hydro Products Model 912 transmissometer, equipped with a 107 m cable was used for most measurements. Originally a cable-less Montedoro-Whitney unit was intended to be used as the primary unit but poor design of the self-contained chart recording system permitted limited use only.

Laboratory calibration of the transmissometer to relate percent transmission (T) to suspensoid concentration was accomplished by collecting suspended prticulates from the water under investigation and preparing known concentrations.

Clay Mineralogy of Suspended Materials

Filter papers which contained particulates were first rinsed thoroughly with deionized water to remove residual salts. The particulates were then resuspended and filtered through Selas Flotronic silver membranes (0.45 μm pore size and 25 mm diameter) for X-ray analysis. In order to obtain a complete analysis of both clay and non-clay minerals in particulates, the samples were first X-rayed without treatment, and then X-rayed following various treatments with ethylene glycol vapor for twelve hours, with drying at 25°C, and heating at 110°C, 300°C, and 550°C. The X-ray analysis was carried out on a Norelco diffractometer using CuK_{α}, nickel filtered radiation generated with 35 Kv and 20 ma. A 1° beam slit and 1.2 mm receiving slit were used throughout scanning (2° to 33° 2θ) except for lower 2θ peaks (3° to 9° 2θ) where a 0.25° beam slit was used. The scanning speed was set at 0.5° 2θ per minute with chart paper on 76.2 cm per hour. Relative percentages of clay and non-clay

minerals were also estimated following the method described by Huang, et al. (1975).

Biological

Phytoplankton-Chlorophyll a

Frozen filters were cut into small pieces and homogenized in 90% acetone while the cup was immersed in an ice bath before being processed. Homogenized samples were filtered and analyzed according to the methods given in Strickland and Parsons (1972) using the SCOR-UNESCO wave lengths.

Primary Productivity

To determine primary productivity, each sample was thawed, placed in a Liquid Scintillation Spectrometer using an appropriate "cocktail" and counted. This analysis determines the rate of carbon fixation and is reported as $mgC/m^3/hr$. Together with the results of chlorophyll a in the sample, the assimilation number was then computed and reported as mgC/mg Chlorophyll a/hour X unit quanta.

Zooplankton

Taxonomy

In the laboratory, samples were initially split into halves using a Folsom plankton splitter. One-half was archived and the other was used for counting purposes. The aliquot to be counted was split further until a subsample of approximately 200 animals was obtained. This sample was then counted in a channeled counting tray using a binocular dissecting-type microscope.

Biomass

Dry weight biomass determinations were accomplished

by washing a subsample in distilled water, placing it in a pre-weighed beaker (which was kept in a desiccator), drying the sample to constant weight at 60°C, and weighing it.

All samples, except that used for dry weight biomass, were clearly labeled and stored in five percent buffered formalin seawater solution.

Neuston

Taxonomy

Specimens were counted using a binocular dissecting microscope. Non-larval fishes were measured to the nearest millimeter (standard length). The level of identification was as far as practical, but at least to Family level. Species identifications were made when possible. Larval forms were identified to the lowest taxa practicable. Larval types and stages were identified. Specimens were stored in 70% ethanol.

Chemical

Particulate and Dissolved Organic Carbon (POC and DOC)

POC and DOC were analyzed by standard methods as described in the instruction manual for the Oceanography International Carbon Analyzer Model 0524. All POC and DOC determinations were run in triplicate and averaged.

The precision of the analytical technique for the organic carbon determinations was based upon triplicate determinations for all samples. Table 6 provides the average standard deviations and precision at the 95% confidence limit for each of the seasonal sampling periods by category of determination.

Table 6. Precision of organic carbon data.

	June/July, 1975		Sept./Oct., 1975		Jan./Feb., 1976	
	POC	DOC	POC	DOC	POC	DOC
Average Standard Deviation	0.011	0.125	0.007	0.057	0.016	0.238
Average 95% Confidence Interval (±)	0.027	0.31	0.017	0.14	0.040	0.59

Hydrocarbons

High Molecular Weight (HMW) Hydrocarbons (>C_{14}) in Zooplankton and Neuston

Samples were thawed and, under a dissecting microscope, tar balls and other non-plankton materials were picked out. The tar balls were saved for hydrocarbon analysis. Plankton was dried overnight at 60°C in a tared container to obtain constant dry weight. The sample was then homogenized and extracted in a benzene-methanol-KOH solution[1] three times or until the final extract was colorless. The extraction mixture was refluxed at the boiling temperature of methanol to remove esters and fatty acids.

An equal volume of water was added to the saponification mixture. Non-sapionifiables were extracted into benzene. The benzene extract was taken to dryness under nitrogen and redissolved in one milliliter of hexane for column chromatography. A column of 1:5 (v/v) microneutral alumina overlying silica gel[2] was washed with three column volumes of hexane.

1. KOH was dissolved in methanol to make a 0.1 N solution. This was then mixed in a 1:1 ratio with benzene.
2. Both the alumina and the silica gel were activity one.

The sample was then charged onto the column, allowed to percolate in, and then rinsed into the column with several small volume rinses of hexane, allowing each to percolate into the column. Aliphatic hydrocarbons were then eluted with three column-volumes of hexane, and aromatics eluted with three column-volumes of benzene. Extracts were reduced by evaporation under nitrogen to small volume in a pre-weighed container, reweighed and then analyzed by gas chromatography. The primary column was a 2.2 mm I.D. x 2 m stainless steel chromasorb Z, 80/100 mesh.

Linear temperature programming and flame ionization detectors were utilized, and retention indices were computed based on known standards.

Dissolved High Molecular Weight (HMW) Hydrocarbons ($>C_{14}$)

The sample water was acidified to pH 2 with concentrated HCl and extracted with $CHCl_3$ in a separatory funnel. Extracts from each sample were combined and reduced to a small volume using a rotary evaporator and then stored in a freezer at -20°C or less until sufficient samples had been collected to proceed to the next step.

When analysis proceeded, the sample was taken to dryness under nitrogen at room temperature and saponified overnight in ten milliliters of 0.1 N KOH in methanol. Column chromatography and gas chromatographic analyses were carried out in the same manner described for zooplankton hydrocarbon analysis.

Particulate High Molecular Weight (HMW) Hydrocarbons ($>C_{14}$)

The filters were thawed and extracted in the same manner described for zooplankton hydrocarbon analysis. Saponification,

column chromatography, and gas chromatography were carried out on the extracts in the same manner described for zooplankton hydrocarbon analysis.

Intercalibration for High Molecular Weight (HMW) Hydrocarbons ($>C_{14}$)

Procedural blanks were employed following the same experimental techniques (extraction, fractionation, and analysis) as were used in sample analysis. Samples of fuels and lubricants used on the collection platform were analyzed since they were possible sources of contamination.

Extraction and recovery procedures were checked periodically by spiking a native sample with $\underline{n}$-C_{32} for alkanes and naphthalene for aromatics.

Intercalibration was performed between all laboratories participating in HMW hydrocarbon analysis. Four standard crude oils (API oils) and aliquots of three environmental samples collected under this contract were distributed to all participating laboratories for intercalibration analysis. The participating laboratories were the Florida State University, Department of Oceanography; the Gulf Coast Research Laboratory; and the University of Michigan, Department of Atmospheric and Oceanic Science. (See Tables 7 to 14.)

Trace Metals

Particulate Matter

The filter pads were removed in a clean bench from the in-line filter holders, rinsed with ~12 ml deionized water and placed in polypropylene jars containing silica gel. After drying for

Table 7. Gravimetric Intercalibration, 1974-1975

Laboratory	Southern Louisiana Crude Oil Wt. % Aliphatic	Wt. % Aromatic	No. of Analyses
Calder	53.8±1.4	17.8±0.6	3
Lytle	58.1±0.6	16.7±0.7	2
Meyers	45.7±1.5	9.05±0.4	4
Pierce	38±7	11±4	3
Winters*	56	24	?
Average	50.3±8.3	15.7±5.9	

Laboratory	Bunker C Residual Wt. % Aliphatic	Wt. % Aromatic	No. of Analyses
Calder	17.1±0.8	42.6±1.0	3
Lytle	21.4±0.6	43.2±1.9	2
Meyers	30.7	18.8	1
Pierce	21±7	42±5	3
Winters*	24	60	?
Average	22.8±5.0	41.3±14.7	

* University of Texas, Port Aransas, Texas

Table 8. Southern Louisiana Crude Oil Intercalibration, 1975-1976.

Gravimetric Analysis	Calder	Lytle	Meyers
% Hexane Fraction	58.1±4.1(3)	64.5±3.4(3)	---
% Benzene Fraction	15.7±3.8	20.6±0.8	---
% MeOH Fraction	3.9±2.5	9.0±2.3	---
G.C. Derived*			
Aliphatics mg/g	42.1±6.0(3)	79±7(3)	---
Aromatics mg/g	27.6±15.0	23±1	12.08±2.73(3)
n-Alk mg/g	26.4±4.5	44±3	---
Pris/Phyt	1.9±0.1(3)	1.8±0.1(3)	1.8±0.1(3)
Pris/nC_{17}	0.79±0.02	.92±0.1	1.3±0.1
Phyt/nC_{18}	0.42±0.03	.52±0.1	0.8±0.0
Pris + Phyt/ΣnAlk	.07±0.00	0.092±0.01	0.18±0.03
ΣnAlk/nC_{16}	12.7±0.2	15±0	11.7±3.4
o/e	0.87±0.02	0.93±0	1.12±0.08
o/e$\leq nC_{20}$	0.83±0.03	0.84±0.2	1.21±0.02
o/e$\geq nC_{21}$	1.06±0.06	1.2±0	0.89±0.07
$\leq nC_{20}/\geq nC_{21}$	3.8±0.3	2.3±0.1	5.4±3.2

* G.C. data presented in Tables 7-8 were obtained using 3.18 mm packed columns with FFAP liquid phase. Exact operating conditions varied.

Table 9. Bunker C Residual Intercalibration, 1975-76

Gravimetric Analysis	Calder	Lytle	Meyers
% Hexane Fraction	20.29(1)	25.7±3.2(3)	---
% Benzene Fraction	47.52	60.2±5.9	---
% MeOH Fraction	12.00	14.6±3.9	---
G.C. Derived			
Aliphatics mg/g	15.98(1)	23.67±3.51	---
Aromatics mg/g	82.75	110.67±20.21	78.20(1)
n-Alk mg/g	10.74	15.0±1.73	---
Pris/Phyt	1.34	1.57±0.06	1.61(1)
Pris/nC_{17}	0.60	0.66±0.02	1.04
Phyt/nC_{18}	0.37	0.40±0.01	0.69
Pris + Phyt/ΣnAlk	0.05	0.08±0.02	0.15
ΣnAlk/nC_{16}	20.27	18.67±1.53	12.49
o/e	0.89	1.02±0.07	0.97
o/e$\leq nC_{20}$	0.78	0.84±0.01	1.15
o/e$\geq nC_{21}$	1.04	1.2±0.1	0.8
$\leq nC_{20}/\geq nC_{21}$	1.3	1.3±0.1	1.35

Table 10. Kuwait Crude Oil Intercalibration, 1975-76.

Gravimetric Analysis	Calder	Lytle	Meyers
% Hexane Fraction	35.85(1)	43.53±4.0(3)	---
% Benzene Fraction	31.73	36.77±1.18	---
% MeOH Fraction	3.36	15.37±5.65	---
G.C. Derived			
Aliphatics mg/g	31.58	70.0±0(3)	---
Aromatics mg/g	11.64	12.0±1.0	7.4(1)
n-Alk mg/g	21.60	32.67±2.08	---
Pris/Phyt	1.10	0.61±0	1.21(1)
Pris/nC_{17}	0.35	0.18±0	0.54
Phyt/nC_{18}	0.27	0.29±0.1	0.52
Pris + Phyt/ΣnAlk	0.03	0.04±0	0.09
ΣnAlk/nC_{16}	13.9	11.3±1.5	9.64
o/e	0.85	1.1±0	0.99
o/e$\leq nC_{20}$	0.80	1.1±0	1.12
o/e$\geq nC_{21}$	1.05	1.1±0	0.89
$\leq nC_{20}/\geq nC_{21}$	3.13	1.3±0	3.02

Table 11. No. 2 Fuel Oil Intercalibration, 1975-76

Gravimetric Analysis	Calder	Lytle	Meyers
% Hexane Fraction	51.77±2.34(3)	67.13±2.45	---
% Benzene Fraction	30.21±1.00	26.94±3.35	---
% MeOH Fraction	7.80±1.34	6.23±3.97	---
G.C. Derived			
Aliphatics mg/g	192.7±107.4(3)	114.3±16.6(3)	---
Aromatics mg/g	82.8±13.4	143.7±67.7	138.9±8.9(3)
n-Alk mg/g	88.9±44.6	58.3±8.5	---
Pris/Phyt	3.09±0.8	2.07±0.4	1.63±0.08
Pris/nC_{17}	1.02±0.2	0.69±0.12	1.21±0.02
Phyt/nC_{18}	0.43±0.1	0.35±0.06	0.81±0.02
Pris + Phyt/ΣnAlk	0.11±0.00	0.09±0.01	0.27±0.02
ΣnAlk/nC_{16}	9.22±0.95	9.67±1.17	8.02±0.78
o/e	1.07±0.24	0.97±0.03	0.93±0.11
o/e$\leq nC_{20}$	1.04±0.26	0.90±0.05	1.11±0.04
o/e$\geq nC_{21}$	1.60±0.46	2.57±0.4	1.27±0.74
$\leq nC_{20}/\geq nC_{21}$	14.19±5.26	11.0±0	9.7±10.6

Table 12. Sea Urchin Intercalibration, 1975-76.

G.C. Derived	Calder	Lytle	Meyers
Aliphatics µg/g	11.58	106.5	0.28
Aromatics µg/g	17.51	285.0	---
n-Alkanes µg/g	4.43	4.84	0.17
Pris/Phyt	5.00	∞	2.67, 2.66
Pris/nC_{17}	0.18	0.37	0.55, 0.50
Phyt/nC_{18}	0.27	0	0.33, 0.35
Pris + Phyt/ΣnAlk	0.016	0.146	0.234, ---
ΣnAlk/nC_{16}	59.84	∞	16.42, 25.05
o/e	0.78	1.46	0.98, 2.71
o/e$\leq nC_{20}$	0.72	1.46	1.12, 1.66
o/e$\geq nC_{21}$	2.46	0	0.76, 3.82

Table 13. Neuston Intercalibration, 1975-76.

G.C. Derived	Calder*	Lytle	Meyers
Aliphatics µg/g	794.6(290)	106.5	Not reported
Aromatics µg/g	3,168.9	285.0	Not reported
n-Alkanes µg/g	517.2(12.2)	4.84	Not reported
Pris/Phyt	∞	84.9	Not reported
Pris/nC_{17}	∞	12.8	Not reported
Phyt/nC_{18}	0	0.79	Not reported
Pris + Phyt/ΣnAlk	0.09(3.87)	4.08	Not reported
ΣnAlk/nC_{16}	∞	33.2	Not reported
o/e	0.002(0.10)	2.00	Not reported
o/e$\leq nC_{20}$	0.00(0.10)	4.35	Not reported
o/e$\geq nC_{21}$	0.07(0.07)	0.68	Not reported

* = numbers in parentheses calculated by omitting very large nC_{12}peak.

Table 14. Sargassum Intercalibration, 1975-76.

G.C. Derived	Calder(2)	Lytle	Meyers
Aliphatics µg/g	2.02	19.90	Not reported
Aromatics µg/g	39.9	12.00	Not reported
n-Alkanes µg/g	1.45	6.21	Not reported
Pris/Phyt	∞	0.77	Not reported
Pris/nC_{17}	0.06	0.04	Not reported
Phyt/nC_{18}	0	2.87	Not reported
Pris + Phyt/ΣnAlk	0.02	0.04	Not reported
ΣnAlk/nC_{16}	∞	71.4	Not reported
o/e	16.15	4.94	Not reported
o/e$\leq nC_{20}$	30.0	20.33	Not reported
o/e$\geq nC_{21}$	1.37	1.29	Not reported

Analytical Accuracy

Standard clay (W-1) in amounts bracketing our suspended loads were analyzed for the certified constituents with the procedure outlined for refractory suspended material. Recoveries were within the range of reported values (Table 15).

Table 15. Elemental recovery of USGS - W-1 standard clay. Values presented as average percentage composition.*

Element	Standard Clay (W-1)	Standard Clay (Determined)
SiO_2	52.6	52.4±1.4
Al_2O_3	16.9	14.7±0.7
Fe_2O_3	11.2	11.0±0.4
CaO	10.96	10.89±0.21

* Mean values obtained from 2 x 3 group analyses during fall and winter sampling periods.

The digestion procedure is a reliable means of dissolving clay and refractory materials (Eggiman and Betzer, 1976). Treatment of between 100 and 2000 µg of the U.S.G.S. W-1 standard and the National Bureau of Standards Plastic Clay (98a) show that the recovery of the certified elements (Al, Cr, Fe, Mg and Si) was within one standard deviation of 100%, indicating that there was complete dissolution of these materials (Eggiman and Betzer, 1976). The amount of reference material used in testing the digestion procedure was chosen to encompass the normal range of open-ocean suspended matter samples. However, in this sample range,

48 hr, the filters were weighed on a six-place (one microgram) desiccated balance so that a calculation of the mass of suspended particulate matter to be analyzed for trace metals could be made. After weighing, the filters were leached in 25% v/v acetic acid for two hours. The leachate was then drained into an acid-cleaned polyethylene bottle, and the filter pad was rinsed twice with deionized water which was also placed in the bottle.

The filter pad was removed and the receptacle rinsed with deionized water. The solution was transferred to a 25 ml volumetric flask, and 500 µl of Ultrex HCl was injected. The solution was brought to volume and transferred back to the polyethylene bottle. This solution was then analyzed for cadmium, chromium, copper, iron, lead, nickel and vanadium using a flameless atomic absorption spectrophotometric method.

For the determination of refractory trace metals, all filters, whether leached or not, were dried and sealed in all-Teflon bombs and digested with one milliliter aqua regia* and 0.05 ml hydrofluoric acid* using a modification of the methods specified in Bernas (1968) and Buckley and Cranston (1972). The digested material was transferred from the all-Teflon bomb to a 100 ml volumetric flask and diluted to volume using double deionized, redistilled water.

This solution was then analyzed for cadmium, chromium, copper, iron, lead, nickel and vanadium using a flameless atomic absorption spectrophotometric method.

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* In order to maximize signal to noise ratios, the acids used in the dissolution of the suspended material was either J. T. Baker "Ultrex" grade or reagent grade acids which had been redistilled in a sub-boiling silica still.

the low levels of the remaining certified elements (Fleischer, 1969) determined in this study (Cd, Cu, Pb and Ni) resulted in concentrations below the detection limit for flameless atomic absorption. It was therefore not possible to ascertain whether these elements were completely recovered, although the complete recovery of the other certified elements suggests that there was total destruction of the clay lattice and, therefore, complete recovery of the trace elements also.

Zooplankton and Neuston

The dried samples (65°C) were ground in an acid-rinsed agate mortar and pestle or porcelain lined Spex mixer mill. Approximately 0.5 g samples were pre-oxidized in an International Plasma, Low Temperature Asher and the remaining ash transferred to an all-Teflon bomb. Three milliliters of Ultrex nitric acid were added, and the bomb sealed and placed in a 95°C water bath for six hours. After cooling, the homogenate was transferred to a 50 ml polypropylene volumetric flask and diluted to volume using double-deionized, redistilled water. The solution was analyzed for cadmium, chromium, copper, iron, lead, nickel and vanadium using a flameless atomic absorption spectrophotometric method.

The accuracy and precision of the method were checked by analyzing a National Bureau of Standards Standard sample. The results of these analyses as shown in Table 16 were in agreement.

Table 16. Accuracy and Precision of the Tissue Samples (concentrations in ppm dry weight)

Element	Bovine Liver (NBS)	Bovine Liver (Determined)*
Cd	0.27±0.04	0.32±0.03
Cu	193±10	187±8
Fe	270±20	252±12
Pb	0.34±0.08	0.35±0.1

*Mean values obtained from 20 separate analyses.

Intercalibration

All laboratories performing analyses for trace metals analyzed all solvents and reagents to determine the levels of possible contaminants. Procedural blanks were employed following the same experimental techniques as were used in sample analysis.

Where more than one laboratory was involved in the analytical effort the laboratories exchanged samples of various types, analyzed them independently, and compared results. Regular intercalibration meetings were held between laboratories. The participating laboratories were the University of South Florida, Department of Marine Science and the Texas A&M University, Department of Oceanography. The results are shown in Tables 17 and 18.

Table 17. Intercalibration Analyses of Standard Rock, and Sediment Samples.

Investigator	Fe(%)	Ba (ppm)	Cd (ppm)	Cr (ppm)	Cu (ppm)	Pb (ppm)	Ni (ppm)	V (ppm)
USGS Rock AGV-1	4.74	1208	0.09	12.2	59.7	35.1	18.5	125
TAMU*	4.57	1020	0.10	15	59	35	18	-
USF*	5.23	-	0.16	-	-	31	10	-
Station 2638								
TAMU	3.10	541	0.2	58	14	18	19	79
USF	3.35	-	0.1	-	7	18	18	-
1974, Area 5 Station 7								
TAMU	1.13	-	<0.1	21	6	10	10	29
USF	1.31	-	0.03	15	3	11	9	26

*TAMU = Texas A&M University
USF = University of South Florida

Table 18. Intercalibration Analyses of Organisms.*
(Concentrations in ppm dry weight.)

Species Name	Sta. No.	Lab of Analysis+	Cd	Cr	Cu	Fe	Pb	Ni	V†
Zooplankton	1206	USF	5.32	0.39	12.5	118	0.37	1.3	2.9
		TAMU	4.50	1.70	9.8	123	0.34	0.9	-
Zooplankton	1309	USF	4.66	0.98	19.4	224	0.94	3.2	1.8
		TAMU	4.10	1.20	29.0	257	0.62	3.7	-
Stenorhynchus seticornis	146	USF	0.40	0.16	25.6	56.4	0.22	<0.2	<0.4
		TAMU	0.53	0.98	35.6	50.0	2.7	<0.5	-
Cinachyra sp.	251	USF	0.36	0.80	6.5	157	0.55	10.5	3.9
		TAMU	0.30	<0.10	7.0	170	2.0	15.0	-
Clypeaster raveneli	II - B	USF	0.28	0.77	6.8	148	0.56	0.6	1.0
		TAMU	0.30	0.40	4.6	148	2.0	<0.5	-

*All samples collected from third sampling period
+USF = University of South Florida (Betzer)
TAMU = Texas A&M University (Presley)
†Vanadium values not yet available from TAMU

Geological

Suspended Sediment Mineralogy

Filter papers containing particulars were dissolved in organic solvents. Particulates were resuspended and filtered through 0.45 µm silver membrane filters. If the suspended load was high, two separate oriented mounts were made, and analyzed for clay and non-clay minerals by X-ray diffraction techniques.

Minerals were identified, and their abundances determined on a semi-quantitative basis.

Sea Floor

Box Core

Geological

Standard Sediment Parameters

The top ten centimeters of each sub-core and splits of each scoop sample were analyzed for grain size and percent calcium carbonate. In the former, the core samples were split and wet sieved through 62 µm mesh. If the percentage of finer-than-sand sized sediments exceeded ten by weight, pipette analysis was conducted to determine the percentage of silt and clay in the sample. Sediments coarser than 62 µm were sieved for 15 min through one phi interval nested 76.2 cm sieves. A second split of sediment from each sample coarser than 62 µm was run through the rapid sediment analyzer.

Percent calcium carbonate was determined for each sample by leaching a known weight of sample with dilute hydrochloric acid until no more gas was given off, followed by washing, drying, and reweighing.

Clay Mineralogy

In the laboratory, the upper ten centimeters of sediments from the sub-cores were digested in deionized water overnight

to insure complete dispersion. The clay fractions (<2 μm) were completely separated from the bulk sample by treating with one milliliter of 2.5 M NH_4OH (dispersing agent) prior to centrifuging for two minutes at 1000 RPM. Two oriented clay slides were prepared for each sample by treatment with Mg-glycerated saturation and K-saturation. To minimize any experimental variation for an estimate of relative percentages of individual clays, a 35 μm clay film was prepared on ceramic tiles for X-ray analysis. X-ray diffractograms were obtained for each sample from (1) the Mg-glycerated saturated clays which were X-rayed after consecutively drying the air at 25°C, and heating at 110°C for 12 hr; and (2) from the K-saturated clays, which were X-rayed afger consecutively drying in the air at 25°C, and heating at 110°C for 12 hr, at 300°C for four hours, and finally at 550°C for one hour.

Since clay fractions of surface sediments, particulary from the West Florida Shelf, contain noticeable amounts of carbonate, about one to two milliliters of dilute HCl (3%) were added directly to the clay film to enhance peaks of clay minerals in samples. Results of the acid treatment showed no adverse effects, as also discussed by Huang, et al. (1975).

Identification of the 14 Å chlorite-vermiculite mixed layers follows the criteria as pointed out by Huang, et al. (1975).

Relief Peels

To minimize damage during transit to the laboratory, excess sediment was not removed from the relief peels while on board ship. In the laboratory excess sediment was removed with a gentle flow of water. Finished peels were photographed and stored.

Carbonate Sediment Analysis

Sediments from 42 box core stations (three stations were dredged) and the eight diving stations samples collected during the

first sampling season were analyzed for carbonate and biogenic constituents. The non-living material retained on the 500 μm mesh Nitex screen from two box cores from each of the 42 stations during the first sampling season was preserved in 70% isopropyl alcohol.

The coarser that 62 μm sediment was analyzed as follows:

1. A general description was obtained by microscopic examination of the sediment to include color, surface textural attributes, degree of fragmentation of different grain constituents, and constituent composition.

2. Grain counts of 300 carbonate grains in each size fraction (greater than 400, 4000-2000, 2000-1000, 1000-500, 500-250, 250-125, 125-62 μm) were obtained for constituent analysis of skeletal grain types, non-skeletal grain types, and silica skeletal remains.

3. Concurrent grain count of carbonate versus non-carbonate grains was obtained for each size fraction based on a total of 300 carbonate counts.

If less than 300 grains were present in a sample fraction, analysis was made on the total number of grains. For any samples in which grains were too abraded or bio-corroded for doing microscopic point count, analysis was conducted on an impregnated whole sample. Constituent composition for the sample was then made by point count analysis of the thin section using petrologic characteristics of skeletal microstructure for identification.

In the greater than 4000 μm fraction, molluscan skeletal remains and their weathering characteristics were identified to characterize substrate processes and for comparison with living assemblages.

Each sample was separated by dry sieving and the less than 62 μm fraction was retained by the standard sediment parameter group.

Loose Grain Analysis

For each size fraction of each sample, the following descriptions and analyses were made by examination under binocular microscope:

1. General color of sediment in each size fraction;
2. General characterization of sediment type (dominant constituents) in each size fraction;
3. Description of the major carbonate grain types in each size fraction including:
   a. Surface texture (fresh, worn, corroded, encrusted, dull, frosted, pitted, smooth, shiny);
   b. Degree of fragmentation (whole, chipped, fragmented);
   c. Presence of sediment infilling of grains;
   d. Color of grains if at variance with general color of sediment (blackened, tan, brown);
   e. Consistency of unidentified and non-skeletal grains (friable, lithified);
   f. Probable grain type classification of majority of unidentifiable grains (based on size, shape, color and surface texture relations with identifiable grains in that fraction);
   g. General description of non-carbonate portions of each size fraction.
4. Grain count of constituent types in each size fraction. Where sufficient number of grains were present, at least 300 carbonate grains were identified. Where less than 300 carbonate grains were present, the total number of grains were identified. Concurrent count of non-carbonate grains was made.

The following skeletal grain types were differentiated:

Mollusc	Sponge spicula (including opalline silica)
Benthic foraminifera	Alcyonarians
Pelagic foraminifera	Bryozoan
Halimeda	Coralline Algae
Echinoderm	Coral
Ostracod	Tubes

The following non-skeletal and other grain types were differentiated:

Pellets (whole, ovoid, friable aggregate grains of probable fecal origin);
Intraclasts (rounded to angular, irregular, friable aggregates of finer carbonate and non-carbonate particles);
Carbonate rock fragments (well-lithified carbonate grain aggregates);
Blackened carbonate grains (unidentifiable skeletal or non-skeletal carbonate grains with blackish color.

Classified under the heading "unidentifiable carbonate" grains are those skeletal and non-skeletal grains that could not be given certain classification as to origin in loose grain analysis.

Other possible types (ooids, pteropods, diatoms, and radiolarians) were not observed in loose grain analysis.

Thin Section Analysis

A number of samples contained over 20% grains that had to be classified as "unidentifiable carbonate" in loose grain analysis. Petrographic thin sections were first made of representative size fraction(s) from these samples and analyzed underpetrographic microscope to assess the origin of these grains. The 500-250 μm fraction was generally used as being representative. Grains were first impregnated in polyester resin under vacuum which was then cut into chips and thin sections. Before covering, a part of each thin section was stained with clayton yellow to differentiate high magnesium calcite (stains red) from other calcium carbonate.

Coarse Fraction Analysis

The samples contained all the non-living materials retained on a 500 μm Nitex screen from the box core sample. A regular constituent composition analysis was performed on the samples. Since in the composition of the greater than 1000 μm fractions less than 300 grains were present, these fractions were analyzed only for loose grain constituent composition.

Molluscan Lithotope

When the non-living material retained on a 500 μm mesh Mitex screen was received at the laboratory, each sample was usually transferred to separate containers. In one instance in which this procedure was not followed, sample 2528 was lost due to the disintegration of the cloth bag containing it.

The samples were wet sieved through sieves of 4000, 2000, and 1000 μm, dried in an oven, and each fraction weighed and stored in plastic bags.

The molluscan death assemblage in the greater than 4000 μm fraction was analysed in detail. Usually all of the material was analyzed. However, with some large samples, a sub-sample was analyzed. Identifications were based on Abbott (1974), Warmke and Abbott (1962), Parker (1960), and some supplemental material. A reference collection was made representing each species encountered. Photomacrographs (10.6 x 12.7 cm) of selected species also aided the sorting and identification. Identifications of the specimens in the reference collection were confirmed or, in a few cases, corrected by Dr. Donald Moore and Mr. Jack Meeder.

Whole valves, half to whole valves, quarter to half valves and less than quater valves were counted separately, The latter three of these

categories were multiplied by factors of 0.5, 0.25 and 0.125 respectively, which yielded their equivalent whole valve size. These were then summed and entered on the data sheets as "fragments." "Whole" valves were entered separately, and the "whole" valves and "fragment" valves were also summed to give the total number of equivalent whole valves in the sample.

Within each of the four categories listed above, the "worn" and "unworn" valves and fragments were separated and within each of these two categories, the material was further divided into categories of "plain," "encrusted," or "bored." Shells classified as "unworn" had no, or very little, surface weathering. Those listed as "worn" showed weather corrosion, including the loss of the gloss characteristic of many species. "Encrusted" shells were those with any obvious macroscopic encrusting organisms on their surfaces. Shells with holes characteristics of the sponge Cliona sp. were listed as "bored."

The procedure of sorting the sample into whole, half to whole, quarter to half, and eighth to quarter valves, etc., worked quite well. It yielded far more data than counting only whole valves, and was far more accurate than counting all the whole valves and fragments together. Obviously there is an inherent bias in favor of species larger than about 20 mm, since fragments smaller than 0.125 valve could be retained on the 4000 μm screen. On the other hand, there is a bias against species smaller than about ten millimeters since 0.125 valve fragments could pass through the screen. Therefore, whole valve size most accurately sampled was about 15 mm. However, the equivalent whole valve size was rarely greater than 20 mm, and the 0.125 valve fragments of shells smaller than ten millimeters would not be recognizable to species in most cases. Therefore, the 4000 μm mesh screen was considered a good compromise for this method with these samples. 3000 μm could possible have been a better choice.

Sorting shells into weathering categories proved to be difficult, since it involved a value judgment, and the various species have different weathering characteristics. It is suggested that future attempts use three weathering categories: "fresh," "dull," and "worn"; "fresh" meaning those which show no weathering at all and "worn" meaning any which are worn or corroded. "Dull" would then be used for those shells which have lost little, if any, material to weathering processes, but which have lost their gloss, are discolored, or are otherwise altered from their "fresh" appearance.

Separation of shells into "plain," "bored," or "encrusted" was fairly straight-forward. It would have been helpful if differentiation had been made between living or fresh encrustations and dead-worn encrustations since there is often a sharp demarcation in a smaple between these two categories.

Biological

Living Microbial Biomass - Adenosine Triphosphate (ATP) in Sediments

Each sample was thawed and one milliliter of extract placed in a Liquid Scintillation Counter (LSC) vial along with 0.5 ml of TRIS buffer and 0.5 ml luciferin-luciferinase enzyme substrate preparation. In addition, 0.5 ml of STP standard was added to one sample to serve as an internal standard. The vials were counted in an LSC for light emission during the time period 0.1 - 1.1 min following enzyme injection. Light output was compared to a standard curve and ATP concentrations computed.

Meiofauna

Living specimens of meiofauna were removed from the sediment in two ways. The first method is referred to as the Uhlig-

seawater-ice technique. The second method involved relaxation of the animals with $MgCl_2$, dislodging them from the sediment and decanting through sieves.

Extraction of Samples

The preserved sample was washed into a modified Boisseau tube. A jet of tap water entered from the bottom of the tube so that the sediment was continually stirred, and the animals are floated up into the water column. The water column overflowed 60 cm above the sediment into a sieve constructed of 64 μm Nitex monofilament nylon mesh. Elutration to maintain water column speed between 32 and 35 cm/min, except that at the beginning of extraction and after one and two minutes water flow was briefly increased enough to completely suspend the sediment sample in the water column, thus freeing any animals which might tend to become trapped in the sediment.

If sediment accumulated of the sieve, it was transferred to a beaker for secondary extraction. The beaker was tilted and the sediment vigorously stirred by a water jet from a wash bottle. The water was decanted through a 64 μm sieve just as the sediment settles - no more than 5 seconds after stirring. This was repeated five (5) times. When necessary, it was repeated for the sediment caught on the second sieve.

When extracted samples contained fecal pellets or organic detritus, they were suspended in water and treated in an ultrasonic cleaner for 20 seconds and then poured through a 64 μm sieve.

Emphasis was placed on those meiofaunal species less than one millimeter such as Turbellaria, Gastrotricha, and Gnathnostomulida, and smaller taxa such as interstitial Cnidaria, Ascidacia, and Tardigrada. Hard-bodied forms such as Nematoda and Harpacticoida were sorted to major groups and archived or referred to consultants. All specimens were archived in clearly-labeled containers in 70% alcohol.

Foraminifera

In the laboratory the top three centimeters of the sample were removed and washed with distilled water. It was then examined wet to determine live/dead ratios of foraminifera based on a count of three hundred specimens. Specimens with protoplasm were picked from the sample and a 300 specimen count was done on these to determine live species composition. Species identification was done on all specimens.

Data were reported as percentage distribution of every species at each station, live/dead ratios, and dominant species based on occurrence of five percent or greater in each sample. For comparison with the surface sample, the interval 12-15 cm from one of the samples collected at each station from the first sampling season was also examined for species composition.

Micromolluscs

The samples were washed with tap water on a 250 μm screen and examined for living fauna. Samples from the first sampling period were dried and examined for fossil fauna.

Macroinfauna

The relatively less dense fauna (small polychaetes, crustaceans) were removed from the samples by flotation in a saturated NaCl solution. The remaining fauna were stained with one percent rose bengal and sorted from the sediment. Fauna were divided into five groups (polychaetes, molluscs, crustaceans, echinoderms, and other) and stored in 70% ethyl alcohol. Wet weight biomass determinations were made for each group to the nearest 0.1 mg.

Only polychaetes and molluscs were identified to the lowest practical taxonomic level. All molluscs were identified to at least the family level. The key reference for molluscan identifications was Abbott (1974).

Macrofauna and Flora

Faunal identifications were made through the use of a Wild M-20 binocular compound phase microscope, or a Nikon binocular dissecting microscope, depending on material examined.

Identifications were carried out to the family level and to genus and species for polychaetes and molluscs where possible. On the Florida Middle Ground all organisms were identified to the species level. Algae and sea grass were also identified to the species level.

Numerical Analysis

Faunal Similarity - In order to determine faunal similarities between samples (i.e., station locations) the "index of similarity" (S) used by Bray and Curtis (1957) was used:

$$S = \frac{2C}{A + B}$$

where:

A = number of species in Sample A
B = number of species in Sample B
C = number of species common to both samples

the results of which were plotted by way of a matrix with stations or transects linearly arranged. A "Sanders type" (Sanders, 1960) "trellis diagram" can be adopted by arranging the stations so that samples with highest values are brought into closer proximity.

Species diversity of selected biota were based on the Shannon measure of diversity (Pielou, 1966) where:

$$H = -\Sigma p_i \ln p_i$$

in which p_i represents the proportion of the i-th species. In order to

measure the evenness with which individuals are divided among species found, Pielou's (Pielou, op. cit.) measure of evenness was used:

$$J' = H'/H' \text{ max}$$

in which H' max = log s and s = number of species present.

Chemical

High Molecular Weight (HMW) Hydrocarbons ($>C_{14}$) in Sediments

Forty-two samples from the first season's sampling, and 18 samples from the third season's sampling were analyzed. The frozen sediment was allowed to thaw in a Buchner funnel and as much water as possible was filtered off. Approximately 100 g was removed and reserved for total organic and inorganic carbon analyses. Water removal was completed by addition of methanol to the filter cake. The filtrate was back-extracted with hexane, and the hexane was retained for later addition to the sediment extract.

The water-free sediment was extracted overnight with chloroform, then treated for 15 min with sonification and stirring. The sediment was filtered, and extracted two more times or until the extract was colorless. The extracted sediment sample was oven dried at 100°C to constant weight, and weighed. All extracts (hexane and chloroform) were combined and reduced to a small volume in a rotary evaporator. Elemental sulfur was removed from the lipid extract by refluxing with activated copper wool after which the copper was washed with chloroform. The combined extracts were washed with acidified water (pH 4) several times (until the water remained clear) and then brought to dryness under nitrogen at room temperature.

Extracts were refluxed overnight in ten milliliters of 0.5 N KOH in methanol after which equal volumes of water were added. The nonsaponifiables were extracted three times with ten milliliters of benzene. The volume of nonsaponifiable extract was reduced to dryness under nitrogen, taken up in one milliliter of hexane, separated by column chromatography, and analyzed by gas chromatography in the same manner prescribed for zooplankton analysis.

Carbonate and Total Organic Carbon

The sediment aliquot was dried at 40°C to constant weight and a weighed portion acidified with 6 N hydrochloric acid. After filtering and washing, the filter cake was again dried at 40°C to constant weight.

Total organic carbon was determined on the carbonate-free sediment using a LECO Automatic Direct Reading Carbon Determinator.

Trace Metals in Sediments

Forty-two samples from the first season's sampling and 21 samples selected from the third season's sampling were analyzed. The entire sample was dried at 105°C and then ground to a fine powder with a porcelain-lined mixer mill. Approximately two grams of the powder was heated in a muffle furnace at 350°C for eight hours to ash the organic matter. After ashing, the samples were transferred to Teflon beakers and calcium carbonate present was removed by dropwise addition of 1 N nitric acid. The resulting solution was removed and set aside. Next, five milliliters of hydrofluoric acid (48%) and two milliliters of perchloric acid were added, the acid-sediment mixture refluxed for approximately two hours and then heated to near dryness. A second acid mixture (three milliliters

of hydrofluoric to two milliliters of perchloric) was added and the mixture again heated to near dryness. The residue was redissolved in two milliliters of 16 N nitric acid, recombined with the calcium solution which had been set aside, and the whole diluted with deionized water to 25 ml.

Analysis for cadmium, chromium, copper, lead and nickel was performed by direct aspiration in a Jarrell-Ash model 810, two channel, atomic absorption spectrophotometer. Iron was determined after appropriate dilution by the same technique. Background absorbance, due to molecular absorption was monitored by simultaneously measuring the absorbance at a nonresonance line and the analytical line of the element being measured. Cadmium and chromium concentrations were also checked by flameless atomic absorption techniques using a Perkin-Elmer Model 306 atomic absorption spectrophotometer equipped with an HGA-2100 graphite furnace and a deuterium background corrector.

Barium and vanadium were determined by instrumental neutron activation. Samples were prepared by accurately weighing approximately 0.5 g of sediment, which had been dried at 105°C, into a one gram capacity polyethylene vial. The vial was heat-sealed to prevent any loss of sample during analysis. For vanadium analysis, each sample was placed in a secondary polyethylene vial together with an aluminum flux monitor, irradiated separately for two minutes in the TAMU one MW Triga reactor. After return of the sample and a one-minute delay, the aluminum flux monitor was counted by a multichannel pulse height analyzer. After an appropriate delay period (usually three to five minutes), the irradiated sediment sample was placed on a Ge (Li) detector and counted using a separate

channel multichannel pulse height analyzer. The analyzer was set for a gain of 1.0 KeV per channel. The vanadium peak for the ^{52}V analyzed is at 1434 KeV. After a five minute counting period, the spectrum was stored on a magnetic tape.

Peak intensities were calculated and converted to concentration by comparison with appropriate USGS standard rocks (DTS-1 and AGV-1). Corrections were made for varying delay times, dead times, and neutron fluxes.

For barium analysis, the sediments were irradiated for a 14-hr period. The samples were placed in aluminum Swagelok tubes along with standards and blanks and set in a rotisserie in the reactor core. After irradiation, the samples were allowed to "cool" for two weeks.

The irradiated samples were counted for 3000 sec using a Ge (Li) detector and a 1024 channel multichannel pulse height analyzer. The peak of interest was the barium-131 gamma at 497 KeV. Data reduction was done by comparison with USGS standard rock GSP-1 (1300 ppm Ba).

USGS standard rocks were analyzed to obtain some idea of the accuracy of the analyses. The agreement for replicate analyses is, overall, quite good with the results being consistently within ten percent of the published values. The precisions of the metal analyses were considerably lower for sediments with high metal content than for sediments with low metal content. Quadruplicate dissolutions and analyses were made on separate sediment aliquots for five of the study samples. The selected sediments are representative of the predominance of low metal-bearing samples received. Precisions were calculated by dividing standard deviation

by the mean and are as follows: Cd, 35%; Cr, 20%; Cu, 12%, Fe, 9%; Pb, 15%; Ni, 11%; and V, 25%.

Dredge and Trawl/Dive

Biological

Epifauna and Flora

All epifaunal and floral samples from the benthic trawls and both Capetown dredges were treated in the same manner as were infauna except that no biomass determinations were made.

All samples of flora were identified to species level. Key flora included green, brown, and red algae and sea grasses.

In the case of diver-collected samples, all organisms were identified to species level, labeled, and archived.

Demersal Fishes

Laboratory studies included length frequency tabulations by species for specimens collected, total frequency, and biomass estimates for specimens collected. Specimens were clearly labeled and archived in an appropriate preservative.

Histopathology

In the laboratory, samples were removed from their containers and washed in flowing tap water to remove the fixative. They were then processed on a Technicon processor for 15.5 hr using the S-29--UC760-- paraplast technique. Tissues were then embedded in paraplast and six micron sections prepared and stained with hematoxylin-eosin. Two slides were made from each block. Each slide was clearly labeled and an inventory of all slides was kept.

These slides were examined to determine normal reproductive cycles

based upon the three sampling seasons and the presence of pathological conditions occurring in the tissues. All findings are reported by a textual description of those features examined. The text is augmented by representative microphotographs of tissue sections.

Chemical

High Molecular Weight (HMW) Hydrocarbons ($>C_{14}$) in Benthic Macrofauna

A known weight of dried-homogenized tissue was saponified, separated by column chromatography and analyzed by gas chromatography in a manner similar to that described for zooplankton hydrocarbon analysis. Hard coral samples were decalcified with 3 N hydrochloric acid and the tissue isolated, dried and weighed before saponification.

High Molecular Weight (HMW) Hydrocarbons ($>C_{14}$) in Benthic Flora

In the laboratory, samples were thawed, macerated in methanol, filtered, and extracted three times in chloroform using sonification. The combined extracts were taken to a small volume in a rotary evaporator at room temperature, and washed with acidic (pH 4) water to remove salts. An aliquot was taken of the lipid extracts for weight of total extractables.

Immediately before saponification, the extracts were taken to dryness under prepurified nitrogen at room temperature. The extracts were saponified overnight in ten milliliters of 0.5 N KOH in methanol. An equal volume of water was added after saponification, and the nonsaponifiables were extracted three times with ten milliliters of benzene. The volume of

nonsaponifiable extract was then reduced to dryness (under nitrogen), the dried extract taken up in one milliliter of hexane, separated by column chromatography and analyzed by gas chromatography in a manner similar to that described for zooplankton hydrocarbon analysis.

Trace Metals in Benthic Macrofauna

Samples were thawed, weighed, dried to constant weight at 60°C, and reweighed. The dried samples (except hard corals) were then ground using a porcelain-lined Spex mixer-mill. A weighed portion was then placed in a low temperature asher to remove organic matter. Hard corals were broken into small pieces before placing in the asher. After ashing, the ash was transferred to an all-Teflon bomb. Concentrated, Ultrex grade nitric acid (three milliliters) was added to the bomb, and the sample then digested five hours in a hot water bath at ∿85°C. After cooling, the solution was transferred from the bomb to a 50 ml polypropylene volumetric flask and diluted to volume using double-deionized, redistilled water. The solution was analyzed for cadmium, chromium, lead, nickle and vanadium using a flameless atomic absorption spectrophotometric method and deuterium background corrections. In the case of copper and iron, which are abundant in the MAFLA benthic macrofauna and zooplankton, atomic absorption analysis was made using air-acetylene flame.

DATA MANAGEMENT

Scientific Data Base

The Data Management and Statistical Analysis Group (DMSAG), University of South Florida was responsible for the creation and maintenance of the data base for the Environmental Baseline and Rig Monitoring Study

of the MAFLA OCA Program. DMSAG was responsible for the preparation of various inventory reports, completion of miscellaneous management requests (i.e., forms for shipboard logistics operations and laboratory analyses and statistical analyses relative to the data base), performance of statistical analyses and other analytical manipulations of the scientific data as required by the investigators under the conditions of the contract.

During the course of the contract DMSAG created and maintained on magnetic tape a data base of scientific data that consisted of data concerning the initial collection and transferral of samples for the respective principal investigators (P.I.'s) and the data obtained from the analysis of those samples by these same P.I.'s. While the exact structure of the data base changed as time went on, it basically consisted of five sections. These five sections were as follows (Table 19).

Table 19. Basic composition of MAFLA data base.

Data Set Name	Contents
1. MAFLA.WORK	All Unedited Data
2. MAFLA.INV	All Inventory Data
3. MAFLA.SCI	All Scientific Data
4. MAFLA.TAX	All Taxonomic Abundance Data
5. MAFLA.HC	All Hydrocarbon Data

All data, when first entered into the data base, was put into MAFLA WORK until verified and corrected and was then transferred to one of the other sections for final storage. A section was created for the hydrocarbon

data after difficulties with the data submitted via magnetic tape to DMSAG. As these difficulties were clarified, the data was transferred to MAFLA SCI.

The final corrected data base was contained on a single magnetic tape. It was created using the following attributes: record format-fixed blocks, logical record length-80 bytes, block size-16,000 bytes, and labels. This one tape is called MAFL01 and was initialized and constructed on an IBM 360 system. Further, it is a nine track magnetic tape with 1600 BPI (bytes per inch).

The tape, MAFL01. contains all data supplied to DMSAG by the P.I.'s both in the Area Monitoring and Rig Monitoring phases of the program. Table 20 shows how the data was organized after all data was received and verified by the submission investigator.

The column "number of records" deals with the number of 80 byte card images contained in each file. Thus, if any of the files were to be punched out onto a card deck each record would correspond to one card.

The data appearing on the tape is in two forms. All scientific and inventory data can be retrieved from the tape by using the entire DMSAG file name. For example, to retrieve sediment ATP data you tell the computer to accept only cards having MAFL0218 as the first eight characters. The second form that data appears in has no DMSAG file name on each record. Instead a keycard appears before and after each file to designate the file. These keycards take the DMSAG file name with the words BEGIN or END following the name. To retrieve mollusc abundance data you would tell the computer to accept all cards after MAFL0205ABEGIN

and accept all cards before MAFL0205AEND. An asterisk has been placed in front of the DMSAG file name for all files needing to be accessed by this second method. To distinguish Area Monitoring and Rig Monitoring data the following codes were used: For Area Monitoring-MAFL and for Rig Monitoring-RIGM.

Table 20. Contents of MAFLA Scientific Data Base.

DMSAG File	File Name	Number of Records	Responsible P.I.
MAFL0100	BLM Cruise Station Data	457	
MAFL0101	Box Core Program	1,607	
MAFL0102	Dive Program	1,256	
MAFL0103	Dredge/Trawl Program	605	
MAFL0104	Water Column Program	616	
RIGM0100	BLM Cruise Station Data	134	
RIGM0102	Dive Program	669	
RIGM0103	Dredge/Trawl Program	754	
MAFL0203N	Neuston Trace Metal Data	64	P. Betzer
MAFL0203R	Refractory Trace Metal Data	46	P. Betzer
MAFL0203W	Weak-Acid Soluble Trace Metal Data	44	P. Betzer
MAFL0203Z	Zooplankton Trace Metal Data	46	P. Betzer
MAFL0204M	Macro-Invertebrate Trace Metal Data	227	S. Betzer
MAFL0204R	Replicated Trace Metal Data	75	S. Betzer
MAFL0204T	Invertebrate Taxonomic Trace Metal Data	221	S. Betzer
MAFL0205A	Mollusc Abundance Data	2,219	N. Blake
MAFL0205B	Macro-Invertebrate Biomass Data	316	N. Blake

Table 20. Continued.

DMSAG File	File Name	Number of Records	Responsible P.I.
MAFL0206A	Foraminifera Abundance Data	9,229	W. Bock
MAFL0206B	Foraminifera Sample Density Data	270	W. Bock
MAFL0206R	Foraminifera Relic Abundance Data	2,178	W. Bock
MAFL0207L	Demersal Fish Meristics Data	820	S. Bortone
MAFL0207N	Demersal Fish Count Data	389	S. Bortone
MAFL0209C	Calculated Data Analysis	3,071	J. Calder
MAFL0209H	Hydrocarbon Peak Data	14,457	J. Calder
MAFL0209R1	Hydrocarbon Ratios Card 1	449	J. Calder
MAFL0209R2	Hydrocarbon Ratios Card 2	449	J. Calder
MAFL0209S1	Hydrocarbon Summary Card 1	449	J. Calder
MAFL0209S2	Hydrocarbon Summary Card 2	449	J. Calder
MAFL0210A	Neuston Collection (Oceanographic) Data	92	S. Collard
MAFL0210B	Neuston Collection (Meteorological Data	92	S. Collard
MAFL0210F	Fish Abundance Data	93	S. Collard
MAFL0210I	Invertebrate Abundance Data	284	S. Collard
MAFL0210L	Larvae Abundance Data	126	S. Collard
MAFL0210T	Neuston Totals and Volume/Weight Data	92	S. Collard
MAFL0211A	Standard Sediment Parameter Data	542	L. Doyle
MAFL0211B	Box Core Color Description Data	1,376	L. Doyle
MAFL0213Q	Dive Station Quadrat Data	120	T. Hopkins

Table 20. Continued.

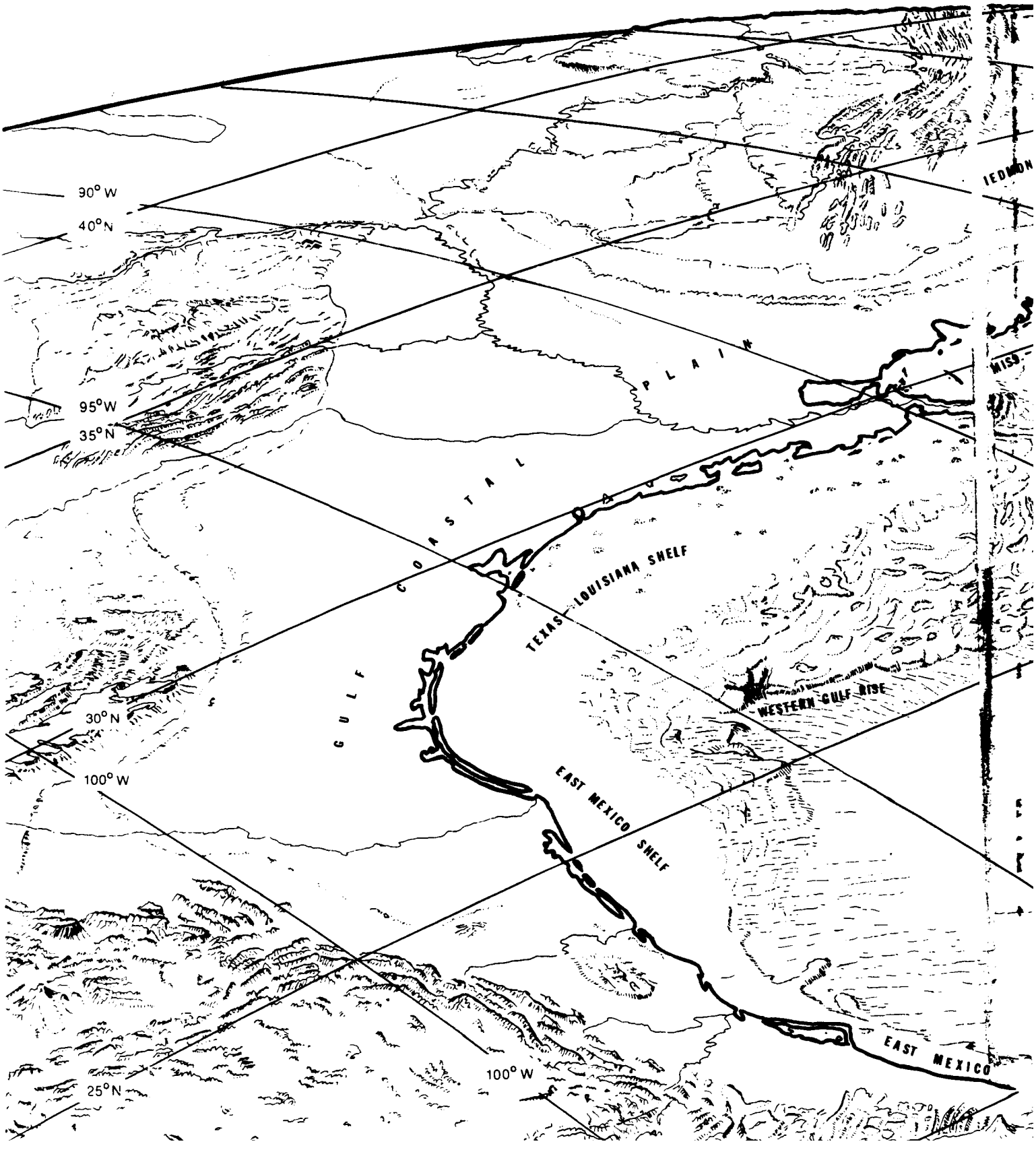
DMSAG File	File Name	Number of Records	Responsible P.I.
MAFL0214A	Surface Sediment Clay Mineralogy Data	83	W. Huang
MAFL0214B	Suspended Mineralogy Data	46	W. Huang
MAFL0215	Phytoplankton Primary Productivity Data	182	R. Iverson
MAFL0216	DOC, POC Data	45	G. Knauer
MAFL0217B	Macro-Invertebrate Biomass Data	379	H. Kritzler
MAFL0218	Sediment ATP Data	128	P. LaRock
MAFL0219A	Sediment Organic Carbon Data	45	J. & T. Lytle
MAFL0219B	Hydrocarbon Benthic Ratio Data	36	J. & T. Lytle
MAFL0219H	Hydrocarbon Peak Data	4,417	J. & T. Lytle
MAFL0219R	Sediment Organic Carbon Ratio Data	45	J. & T. Lytle
MAFL0219S	Summary of Gas Chromatography Data	66	J. & T. Lytle
MAFL0221	Transmissometry Data	1,087	F. Manheim
MAFL0222C	Zooplankton Collection Data	47	F. Maturo/ J. Caldwell
MAFL0223L	Demersal Fish Meristics Data	753	G. Mayer
MAFL0225H	Hydrocarbon Peak Data	9,132	P. Meyers
MAFL0225R1	Hydrocarbon Ratio Data Card 1	134	P. Meyers
MAFL0225R2	Hydrocarbon Ratio Data Card 2	134	P. Meyers
MAFL0225S	Summary of Gas Chromatography Data	265	P. Meyers
MAFL0225T	Taxonomic Hydrocarbon Data	185	P. Meyers
MAFL0227A	Sediment Trace Metal Data	63	B. Presley

Table 20. Continued.

DMSAG File	File Name	Number of Records	Responsible P.I.
MAFL0229L	Demersal Fish Meristics Data	1,015	R. Shipp
MAFL0232B	Macro-Invertebrate Biomass Data	486	B. Vittor
MAFL0233N	Carbonate and Skeletal Sand Constituent (Particle Counts)	84	H. Wanless
MAFL0233P	Carbonate and Skeletal Sand Constituent (Percentage)	652	H. Wanless
MAFL0235S	STD Data	2,245	M. Rinkel
MAFL0235X	XBT Data	535	M. Rinkel
MAFL0217A	Polychaete Abundance Data	8,589	H. Kritzler
MAFL0232A	Polychaete Abundance Data	5,461	B. Vittor
MAFL0223N	Demersal Fish Count Data	278	G. Mayer
MAFL0229N	Demersal Fish Count Data	444	R. Shipp
MAFL0222Z	Zooplankton Abundance Data	4,104	F. Maturo/ J. Caldwell
MAFL0213A	Epifaunal-Epifloral Abundance Data	664	T. Hopkins
MAFL0226A	Micro-Mollusc Abundance Data	84	D. Moore
MAFL0226R	Micro-Mollusc Relic Abundance Data	423	D. Moore
MAFL0222M	Meiofaunal Abundance Data	2,952	F. Maturo/ M. Crezee
RIGM0206A	Foraminifera Abundance Data	1,465	W. Bock
RIGM0206B	Foraminifera Sample Density Data	74	W. Bock
RIGM0211A	Standard Sediment Parameter Data	148	L. Doyle
RIGM0214A	Surface Sediment Clay Mineralogy Data	74	W. Huang

Table 20. Continued.

DMSAG FILE	File Name	Number of Records	Responsible P.I.
RIGM0219A	Sediment Organic Carbon Data	74	J. & T. Lytle
RIGM0219B	Hydrocarbon Benthic Ratio Data	73	J. & T. Lytle
RIGM0219H	Hydrocarbon Peak Data	5,342	J. & T. Lytle
RIGM0219R	Sediment Organic Carbon Ratio Data	74	J. & T. Lytle
RIGM0225H	Hydrocarbon Peak Data	9,941	P. Meyers
RIGM0225R1	Hydrocarbon Ratio Data Card 1	141	P. Meyers
RIGM0225R2	Hydrocarbon Ratio Data Card 2	141	P. Meyers
RIGM0225S	Summary of Gas Chromatography Data	282	P. Meyers
RIGM0225T	Taxonomic Hydrocarbon Data	78	P. Meyers
RIGM0227A	Sediment Trace Metal Data	74	B. Presley
RIGM0227M	Invertebrate Trace Metal Data	148	B. Presley
RIGM0227T	Invertebrate Taxonomic Trace Metal Data	148	B. Presley


90° W
40° N
95° W
35° N
30° N
100° W
25° N
100° W
GULF COASTAL PLAIN
TEXAS-LOUISIANA SHELF
WESTERN GULF RISE
EAST MEXICO SHELF
EAST MEXICO