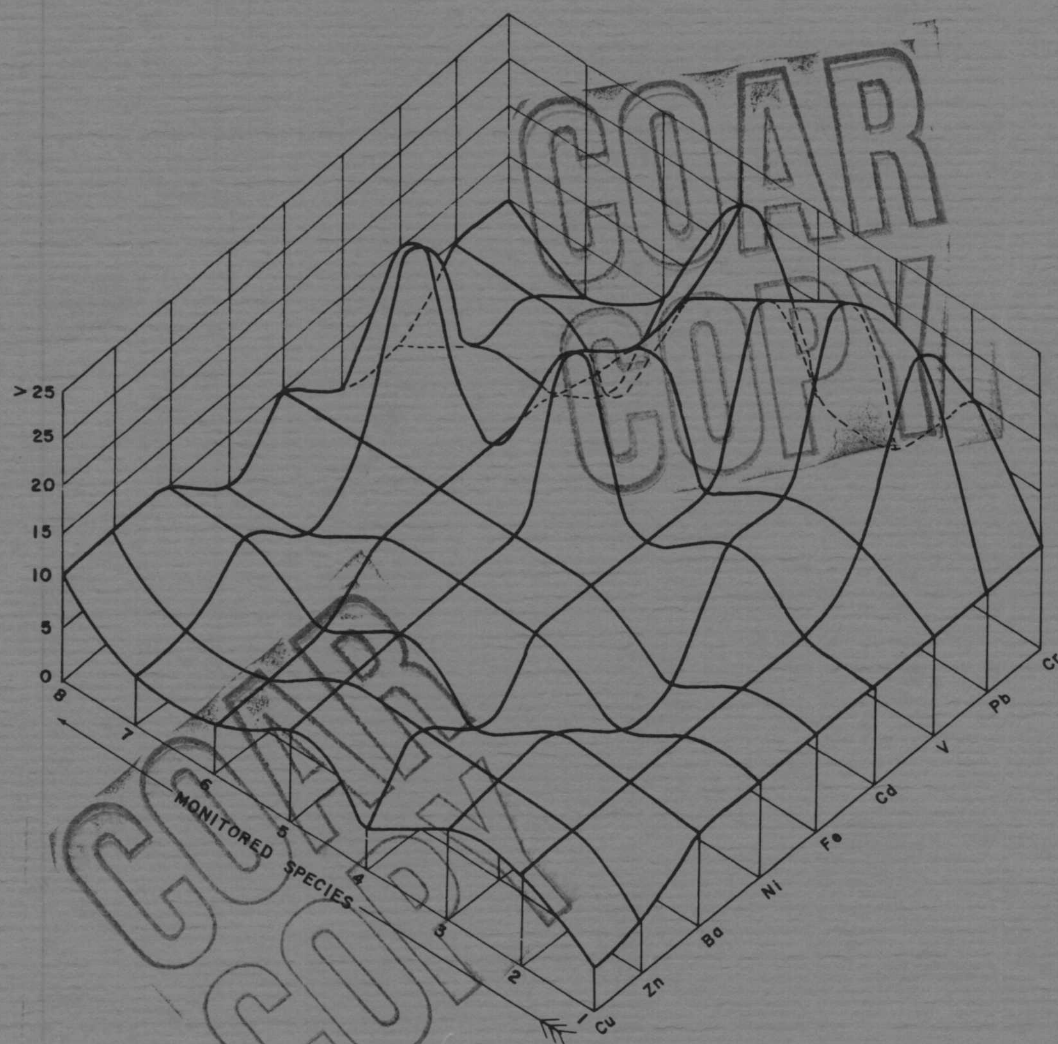
MAFLA

FINAL REPORT

THE MISSISSIPPI, ALABAMA, FLORIDA, OUTER CONTINENTAL SHELF BASELINE ENVIRONMENTAL SURVEY

1977/1978



Prepared by Dames & Moore for the Bureau of Land Management

Contract AA550-CT7-34 January 26, 1979

Volume I-B : Executive Summary Report

FINAL REPORT

MISSISSIPPI, ALABAMA, FLORIDA OUTER CONTINENTAL SHELF

BASELINE ENVIRONMENTAL SURVEY; MAFLA, 1977/78

PREPARED FOR U.S. DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT

CONTRACT AA550-CT7-34

VOLUME I-B

EXECUTIVE SUMMARY REPORT

DAMES & MOORE JOB NO. 08699-008-88

NEW ORLEANS, LOUISIANA

JANUARY 26, 1979

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INTRODUCTION

As a result of its designation by the U.S. Department of the Interior as the agency responsible for leasing submerged Federal lands, the Bureau of Land Management (BLM), in compliance with the National Environmental Policy Act of 1969, implemented the Marine Environmental Studies Program. The prime purpose of the program is the determination of ongoing or potential impacts on the outer continental shelf (OCS) environment from oil and gas development.

The first of these very large-scale marine environmental baseline surveys was begun in 1974 in the eastern Gulf of Mexico (Figure 88). In June 1977, Dames & Moore was contracted by BLM to undertake a third year sampling program and to produce a synthesis report summarizing the results of the program since its inception. This volume constitutes the Executive Summary Report for that synthesis effort as required in our Contract AA550-CT7-34.

The purpose of the Executive Summary Report is to highlight the principal findings and to provide a broad overview of the Mississippi, Alabama, Florida (MAFLA) OCS environment. To keep this document compact, only conclusory statements are included. Many of these statements can only be supported by reference to their sources, and this document is not designed to be inclusive of either the detail or the background material of the supporting volumes. The bases for these conclusions are described in the Program Synthesis Report, Volume I-A, and the Compendium of Work Elements Report, Volume II.

As prime contractor, Dames & Moore was responsible for program management, data management and data synthesis, logistics, schedule and budget, and preparation of reports. Major contributions came from Principal Investigators at universities and private laboratories as listed in Table 25.

The remainder of this volume is organized along the same lines as the Program Synthesis Report, with sections on methodology, geology, physical oceanography, chemistry and biology. A brief summary and lists of recommended monitoring parameters and major deficiencies in the data base are also included. No attempt has been made to support those lists in detail or uniformly within the text of this volume. However, the reader requiring such backup is again referred to Volume I-A from which both lists were derived.

SCOPE AND METHOD OF STUDIES

The four cruises carried out during the 1977/78 MAFLA program included benthic and water column sampling during three seasons: August-September 1977, October-November 1977, and February 1978. Steel hulled work boats of 45 to 65 m length (150-215 feet) and fitted with portable or fixed laboratory space allowed work to continue under most conditions experienced, and allowed station keeping capability in all conditions met. Benthic samples were collected along eight transects (21XX-27XX and 29XX in Figure 88) and a series of intertransect stations (28XX). Standard 30 and

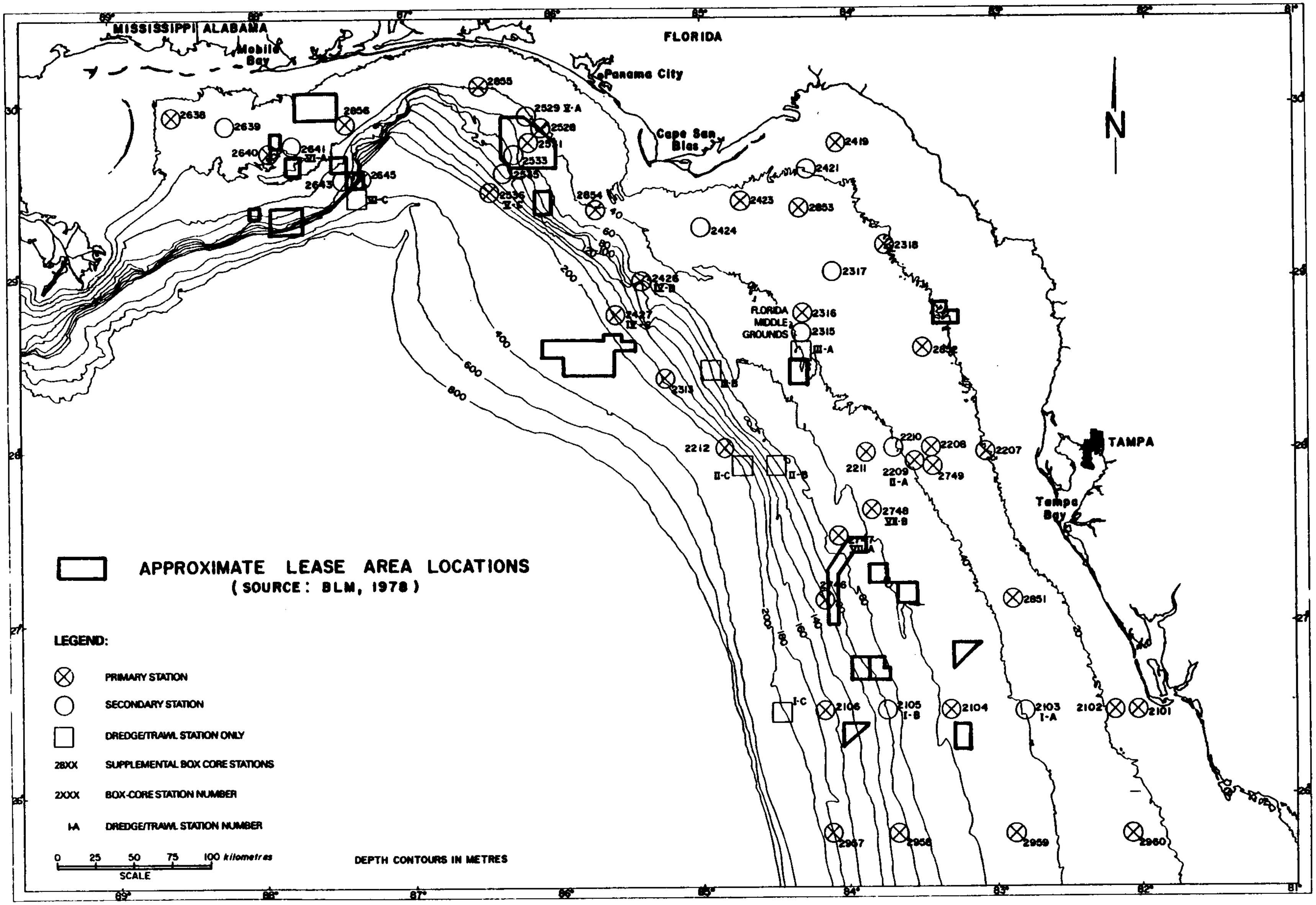


FIGURE 88

MAFLA PROPOSED AND ACTIVE LEASE AREAS AND 1977/1978 STATION LOCATIONS

TABLE 25

1977/78 MAFLA PROGRAM PARTICIPANTS

PRINCIPAL INVESTIGATORS	AFFILIATION	PROGRAM WORK ELEMENT
Dr. Wayne Bock	University of Miami	Foraminifera Taxonomy
Dr. Keith Cooksey	University of Miami	Biomass of Microorganisms (ATP)
Dr. Peter Betzer	University of South Florida	Water Column Trace Metals
Dr. Norman Blake	University of South Florida	Histopathology Macroinfauna Taxonomy/Molluscs
Dr. Kendall Carder	University of South Florida	Transmissometry (Water Clarity)
Dr. Larry Doyle	University of South Florida	Standard Sediment Parameters, Clay Mineralogy
Mr. John Caldwell/Dr. Frank Maturo	University of Florida	Zooplankton Taxonomy
Dr. Steve Bortone (with Dr. Robert Shipp)	University of West Florida	Demersal Fish Taxonomy
Dr. Sneed Collard	University of West Florida	Neuston Taxonomy
Dr. Richard Heard	University of Alabama Marine Lab	Macroinfauna Taxonomy/Crustaceans
Dr. Thomas Hopkins	University of Alabama	Macroepifauna Taxonomy
Dr. Susan Ivester	University of Alabama	Meiofauna Taxonomy
Dr. Robert Shipp (with Dr. Steve Bortone)	University of Alabama	Demersal Fish Taxonomy
Dr. Barry Vittor	Barry A. Vittor & Associates, Inc.	Macroinfauna Taxonomy/Polychaetes
Dr. Lela Jeffrey	Texas A&M University	Water Column Hydrocarbon and Organic Carbon
Dr. John Trefry	TerEco Corporation	Sediment Trace Metals
Dr. Robert Shokes	Science Applications, Inc.	Barium, Vanadium Chemistry
Dr. George Gould/Dr. Bud Moberg	Analytical Research Laboratories, Inc.	Hydrocarbon Chemistry/Benthos and Zooplankton; Trace Metal Chemistry, Macrofauna
Mr. Lee Fausak	Dames & Moore	Salinity, Temperature, Density
Dr. Harold Palmer	Dames & Moore	Technical Advisory Committee Chairman
Mr. Peter Feldhausen	Dames & Moore	Data Manager
Dr. Thomas Scanland	Dames & Moore	Program Manager

90 water samplers were used to collect most dissolved and particulate water column chemistry samples, while an STD, smaller water samplers and reversing thermometers were used to collect salinity and temperature data. A transmissometer and a photometer were used to gather data on water clarity and light penetration. A box core was used to gather bottom sediment samples of about 600 cm^2 in surface area to a depth of about 40 cm. A 10 m trawl and 1 m dredge were used to collect epifauna and demersal fish. Details of cruises, sampling methods, station locations, subsampling procedures, numbers of replicates and all subsequent sample and data handling are covered in detail in Volumes I-A and II of this report. Table 25 provides a list of the study disciplines, which are grouped in the following discussion into geology, physical oceanography, hydrocarbon chemistry, trace metal chemistry, and marine biology.

RESULTS

GEOLOGY

The sediments of the MAFLA area are the results of agents and processes acting on two very different sedimentary regions. The Mississippi-Alabama Shelf is an actively prograding feature strongly influenced by the Mississippi River. Fine sediments with very low calcium carbonate content dominate the northwest, and these deposits grade into quartz sands to the east (Figure 89). The West Florida Shelf has very little active sedimentation and is primarily a high carbonate sand offshore and a quartz sand nearshore. The two regions merge and intermix in the vicinity of Cape San Blas. Total organic carbon and percent fines (sediments $< 63\ \mu m$) increase offshore and to the north, while $CaCO_3$ increases offshore and to the south. The trends in surficial sediment distribution derived from samples collected in this program from 1974-1978 and from literature sources were used by Doyle (Volume II, Chapter 2) to produce the facies chart on Figure 89. Multivariate analyses techniques performed under the program (see Volume I-A) suggest the same trends.

PHYSICAL OCEANOGRAPHY

The major oceanographic influences in the MAFLA area are the Mississippi River and the Loop Current. The latter intrudes at irregular intervals onto the shelf and carries with it both tropical larvae and some trace metals. Structure in the water column (Figure 90) can show high, short-term variability, with short-term intrusions changing the water column from highly stratified to completely mixed, and back in a matter of hours. In general, the water column tended to be nearly homogeneous in central and southerly MAFLA stations, and more structured in the north. Figure 90 also shows that high-amplitude short-term changes in both surface and bottom clay minerals occur, but no clear causal mechanisms could be defined. Large scale changes in benthic sediment clay minerals within the space of a few months were also recorded. Bottom water temperature ranges within transects was greater than surface ranges, and were greater in the summer, while surface temperature ranges were at their minima (Figure 91). Annual water temperature varied from less than 10°C in winter to 30°C in summer (both surface, inshore values).

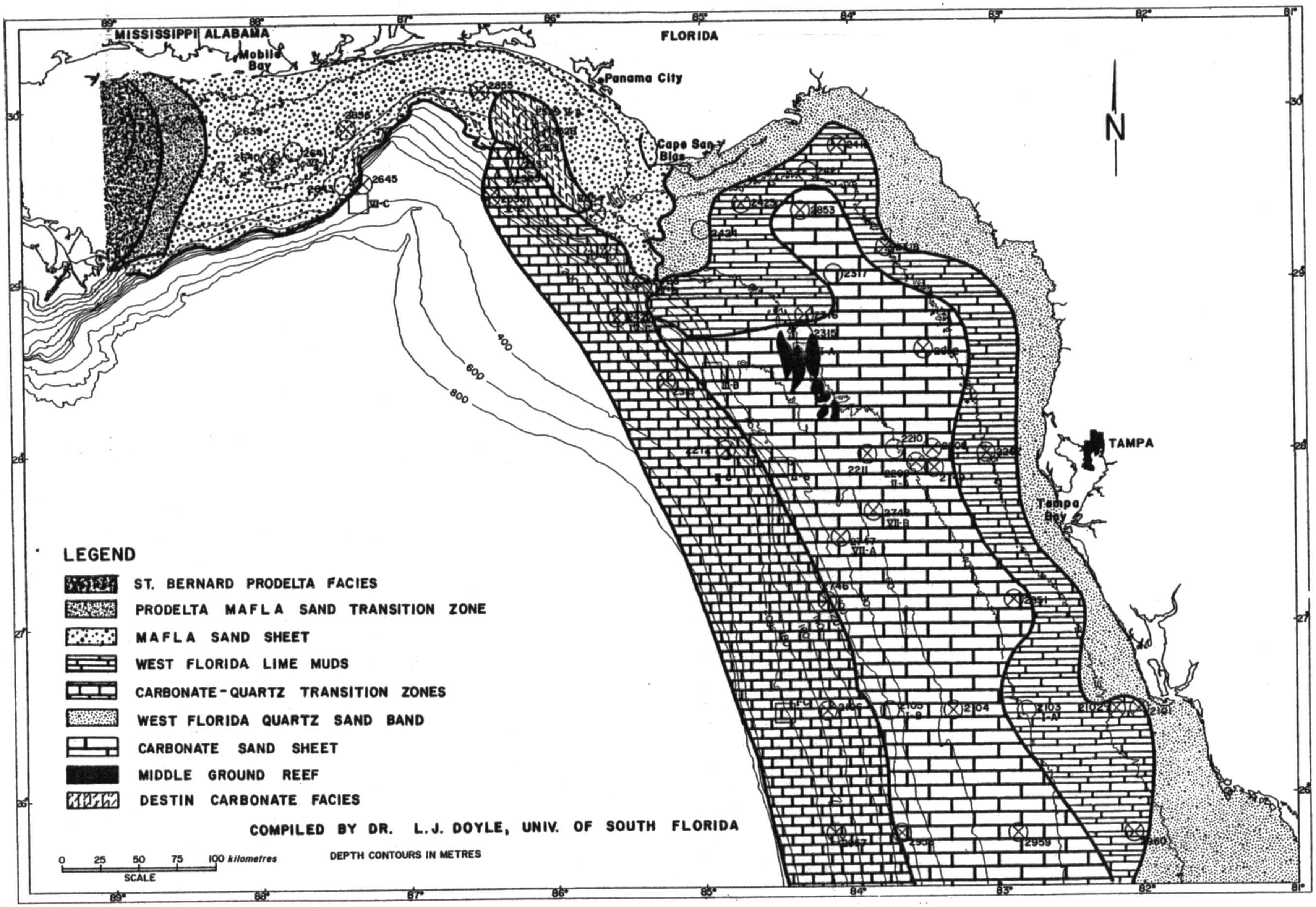


FIGURE 89

MAFLA SEDIMENT FACIES CHART

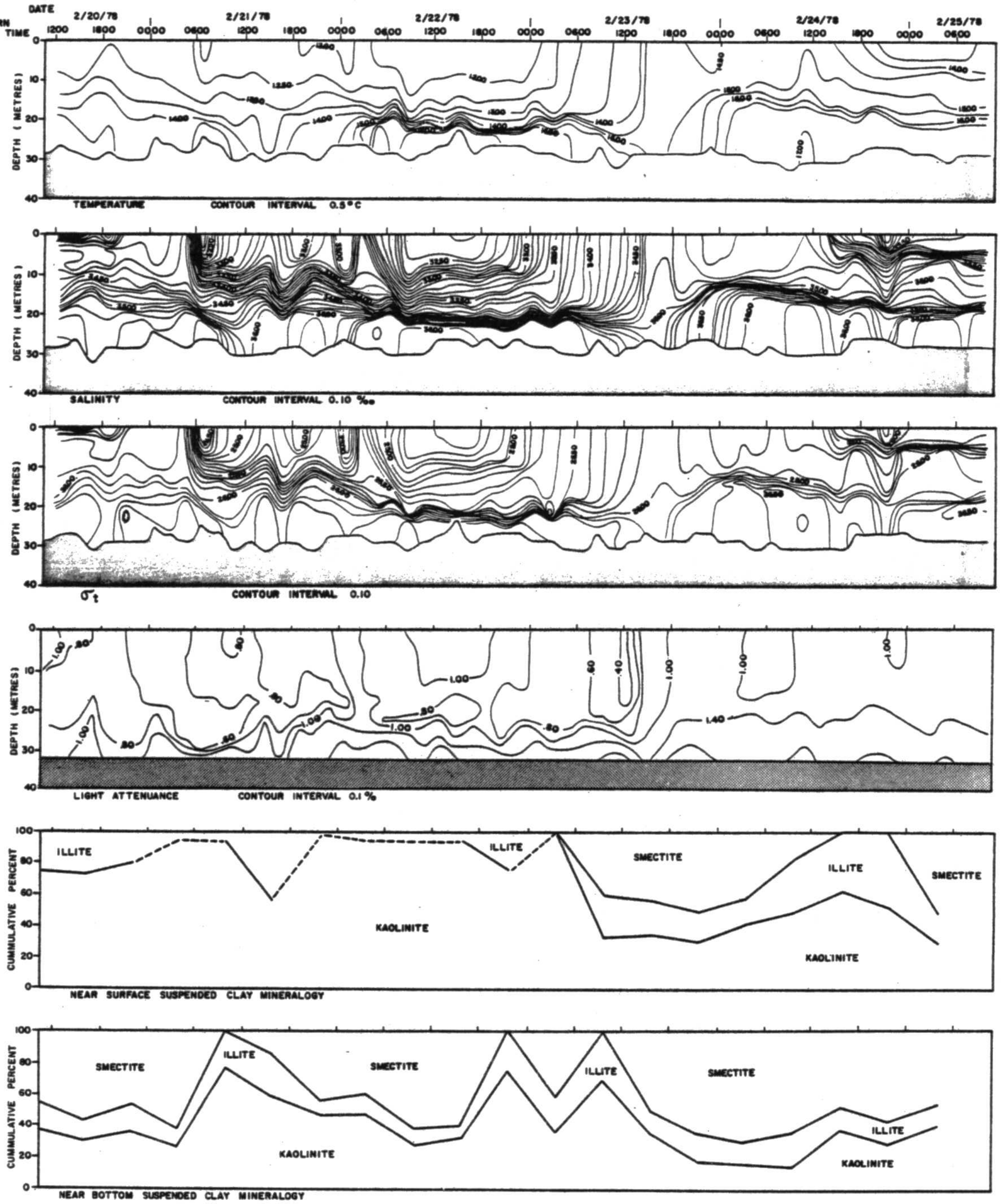


FIGURE 90

TIME SERIES PLOTS OF TEMPERATURE, SALINITY, DENSITY, ATTENUATION COEFFICIENT (C_p), AND SURFACE AND BOTTOM SUSPENDED CLAY MINERALOGY AT STATION 2639, WINTER 1978

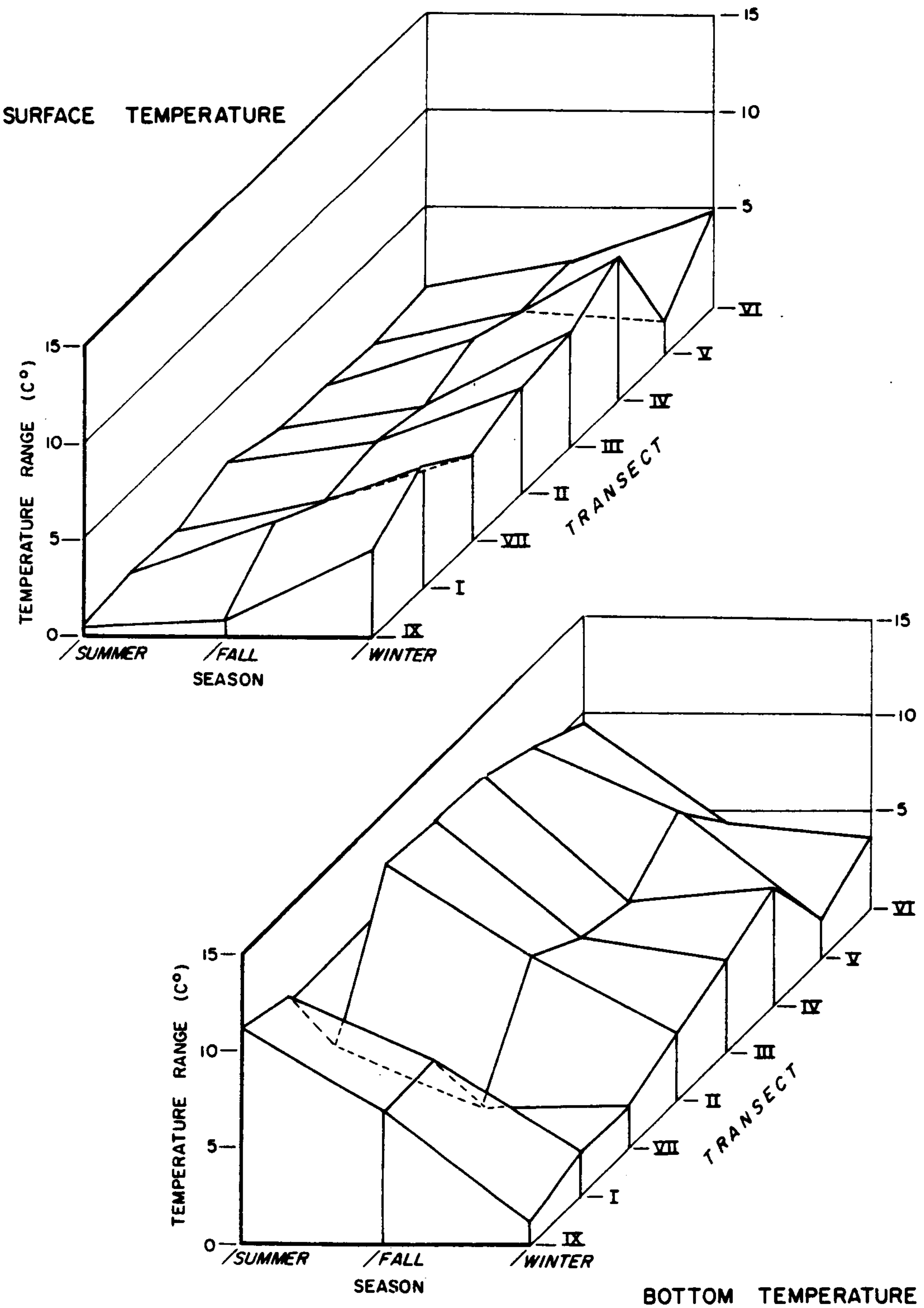


FIGURE 91

RANGE OF SURFACE AND BOTTOM TEMPERATURES FOR ALL 1977/1978 STATIONS BY SEASON AND TRANSECT

HYDROCARBON CHEMISTRY

MAFLA area sediments were grouped into three geochemical provinces based upon the sources of hydrocarbons they contained. In the nearshore, < 50 m depth, West Florida Shelf no evidences were found of anthropogenic (introduced through man's use of hydrocarbons, e.g., combustion products) or petrogenic (petroleum source) hydrocarbons. Typical gas chromatograms from this region were flat (Figure 92), having one or two dominating peaks which were of marine biogenic origin (that is, the hydrocarbons resulted from geologically recent synthesis by marine organisms). Any petrogenic input to this province would be qualitatively obvious by inspection of gas chromatograph (GC) traces of long chain or cyclic sediment hydrocarbons (compare Figures 92 and 93, for example).

The deeper water area of the West Florida Shelf (see Figure 41, Volume I-A) is characterized by accumulations of fine sediments and high total organic carbon (TOC) values, much of which are of Mississippi River origin. The GC traces from this region are strongly influenced by terrigenous (land derived) biogenic compounds added to anthropogenic compounds. TOC is composed of living organic matter, biogenic hydrocarbons and any present anthropogenic and petrogenic hydrocarbons. In the MAFLA area living organic matter accounts for a very minor portion of TOC (less than 1% in most samples), and TOC can, therefore, be related to the amounts of biogenic and nonbiogenic ("pollutant") hydrocarbons in the sediments. Boehm (Volume II, Chapter 10) has done this, and provides the following empirical relationship for the balance of sources of TOC in the offshore West Florida Shelf:

$$TOC = 7.07A - 14.54B + 0.149 \qquad (1)$$

In Equation (1), TOC is the percent total organic carbon which should be present in a sample of sediments from the included region; the variable A is the concentration of hydrocarbons with a retention index (RI) of 2900 (RI is a measure of the amount of time required to separate a hydrocarbon peak on a GC trace; it represents the molecular weight of the compound, in this case, a straight chain hydrocarbon with about 29 carbon atoms); B is the concentration of the compound Pristane. The RI 2900 compound is concluded to be a terrigenous biogenic compound and Pristane is a marine biogenic compound. If the TOC level measured from a sample in this area in the future is higher than that calculated from the measurement of future RI 2900 and Pristane concentrations (biogenics), then a greater impact of nonbiogenics has been realized, i.e., the region's environmental quality would have degraded.

A third region lies on the Mississippi-Alabama Shelf and extends to Transect IV (Stations 24XX in Figure 88). The sediments yielded hydrocarbon traces which showed strong influences of petrogenic, anthropogenic and terrigenous biogenic compounds (Figure 93). In Figure 93 the double "hump" of unresolved compounds and regular series of n-alkane (a series of straight chain hydrocarbons with increasing numbers of carbon atoms) peaks together strongly suggest a petrogenic source. For the region as a whole Boehm has derived the following empirical relationship between biogenic hydrocarbons and TOC:

$$TOC = 15.73C - 0.134 \qquad (2)$$

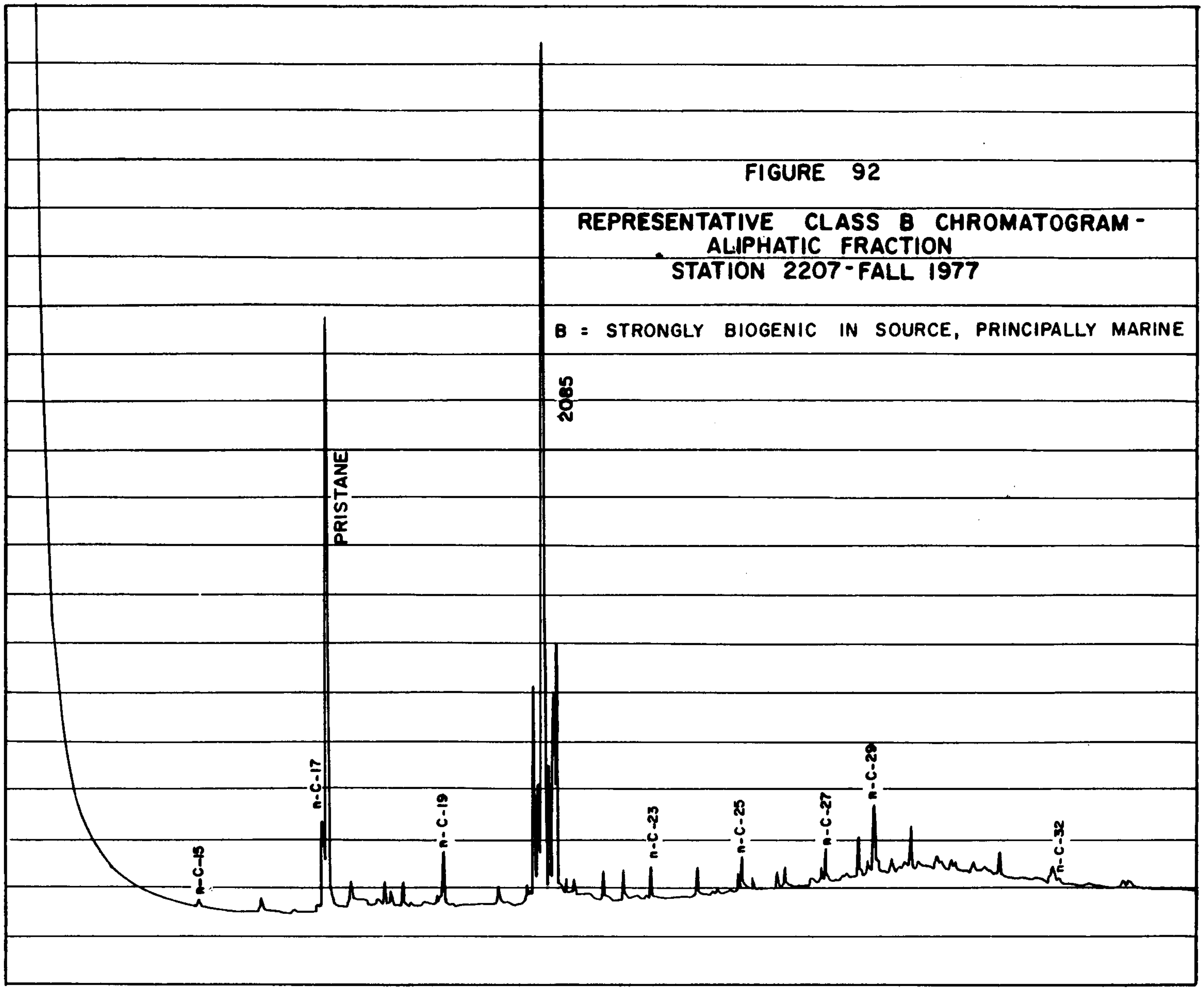


FIGURE 92

REPRESENTATIVE CLASS B CHROMATOGRAM - ALIPHATIC FRACTION
STATION 2207 - FALL 1977

B = STRONGLY BIOGENIC IN SOURCE, PRINCIPALLY MARINE

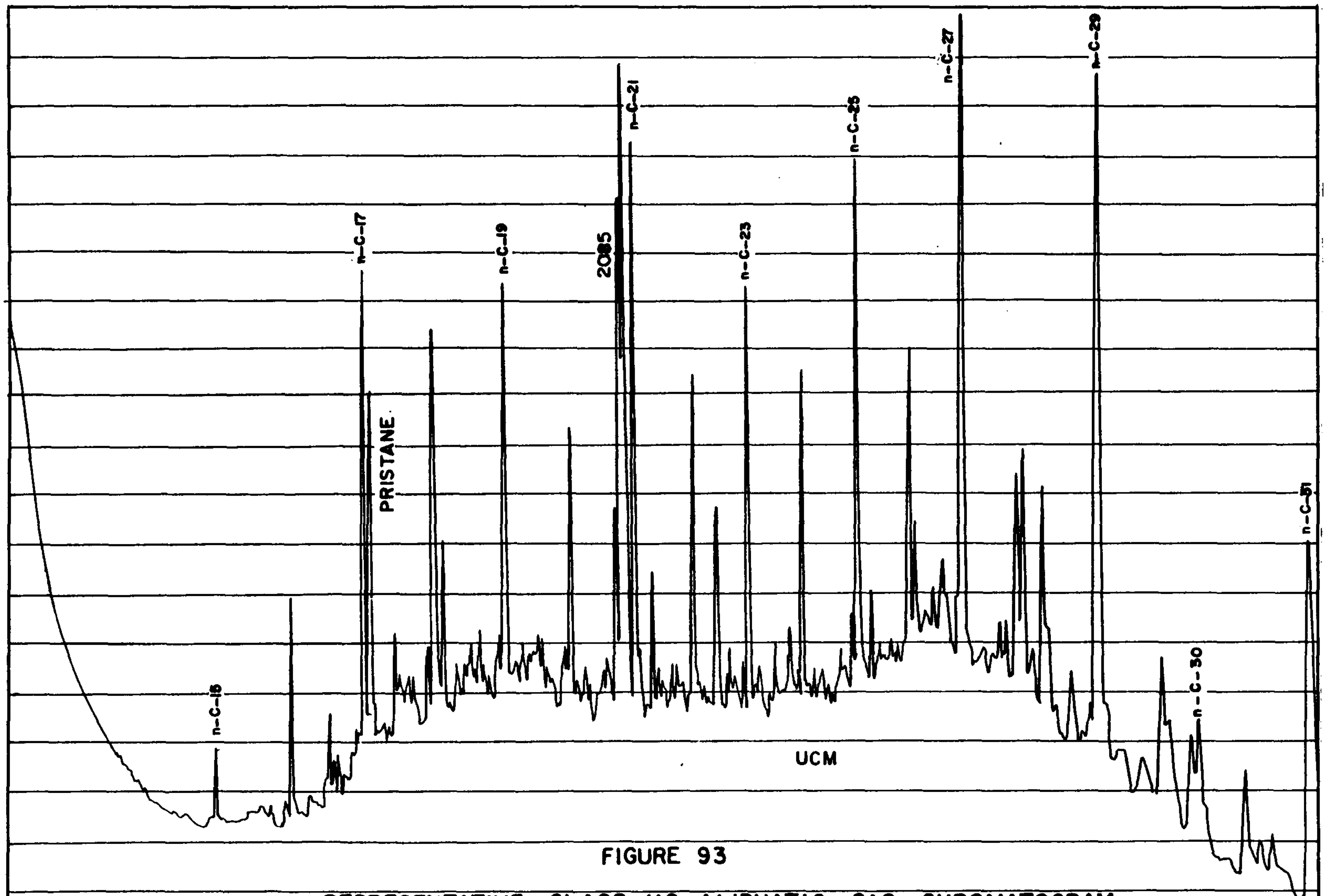


FIGURE 93

REPRESENTATIVE CLASS U2 ALIPHATIC GAS CHROMATOGRAM
STATION 2639 WINTER 1978 (TU2BL*)

U2 = HAVING A BIOMODAL UCM

Here the large amounts of TOC relative to the biogenic peak (C = RI 2085, a hydrocarbon near n-C-21) clearly identify the area as one under considerable nonbiogenic hydrocarbon input (note from Figure 88 that the position of Station 2639 in Figure 93 is very near the major sources of riverine input to the MAFLA area). Figure 94 is a similarity matrix for the shallow West Florida Shelf region. The relationship of hydrocarbon peaks and fractions against each other and against other covariables and independent variables are shown as regression indices (scale of 0 to 1 with only values $\geq$ 0.60 shown). The high relationship of TOC and RI 2085 indicates the biogenic nature of the TOC, and the high relationship between resolved hexane and two biogenic peaks indicates that most of the aliphatic (open chain compounds as opposed to the closed rings of aromatic compounds) hydrocarbons are probably biogenic. Lastly, the connection of RI 1700 (including pristane) to the resolved and unresolved benzene soluble fraction indicates that those compounds are probably olefins and not aromatic hydrocarbons. That finding was in agreement with water column hydrocarbon values (both dissolved and particulate) which had very low (oceanic) levels, and no indications from GC/MS analysis that any of the benzene soluble fraction was aromatic hydrocarbons. Zooplankton and macroepifaunal hydrocarbons were similarly free of petrogenic indicators, and several good cases for diet-mediated sources of tissue biogenic hydrocarbons could be discerned from multivariate statistical analysis of the tissue hydrocarbon data. The demersal fish were likewise free of petrogenic contamination except for winter samples from Transect V (25XX in Figure 88). Figure 95 is illustrative of the GC traces from these specimens. The small "hump" may be an artifact, but the regular n-alkane series suggests a petrogenic source of some of these tissue hydrocarbons. This area had strong petrogenic influence in its sediments as well, despite the rather low (~5%) amount of fine sediments. In general, the frequency of detection of petrogenic compounds in the MAFLA area followed the trend:

sediments > fish > macroinvertebrates > zooplankton > water

None of the values indicated recent local petroleum contamination; rather, the high amounts of terrigenous hydrocarbons and high similarity matrix connection to trace metals in the northwestern MAFLA region (Volume II, Chapter 10) indicate riverine transport from terrigenous sources of petrogenic compounds.

TRACE METAL CHEMISTRY

There was no evidence of trace metal pollution at any of the stations sampled for any of the nine trace metals analyzed (barium, Ba; cadmium, Cd; chromium, Cr; copper, Cu; iron, Fe; lead, Pb, nickel, Ni; vanadium, V; and zinc, Zn). These metals represent a wide array of possible pollutants which are associated with crude oil (Ni, V), drilling fluids (ba, Cr), and offshore construction activities (Cd, Cu, Pb, Zn). Iron has been shown through prior MAFLA work to be a good standard against which to measure other metal levels. Regressions of iron against other metal levels, when aided by estimates of natural variability, can be used to determine if a particular value is abnormally high. No such abnormalities were discovered during the 1974-1978 MAFLA program. Sediment trace metals generally increased in concentration offshore and toward the northwest. For predicting sediment

	TOC	MED SAND	FINE SAND	VERY FINE SAND	FINES (SILT & CLAY)	SILT	CLAY	Cd	Cr	Cu	Fe	Ni	Pb	V	Zn	2900	1700	PRISTANE	2085	RES. HEXANE	UCM HEXANE	RES. BENZENE	UCM BENZENE	Ba	$CaCO_3$
2900	.67		.66	.71	.69	.74	.71			.65				.72					.73	(.81)	.69			.66	.65
1700																						(.72)	(.72)		
PRISTANE			.71																						
2085	(.74)				.76	.72	.60													(.76)					
RES. HEXANE	.66				.68	.73	.61							.62							.64				
UCM HEXANE		.72					.62		.66	.62	.65	.65	.65		.68										
RES. BENZENE																							.79		
UCM BENZENE																									

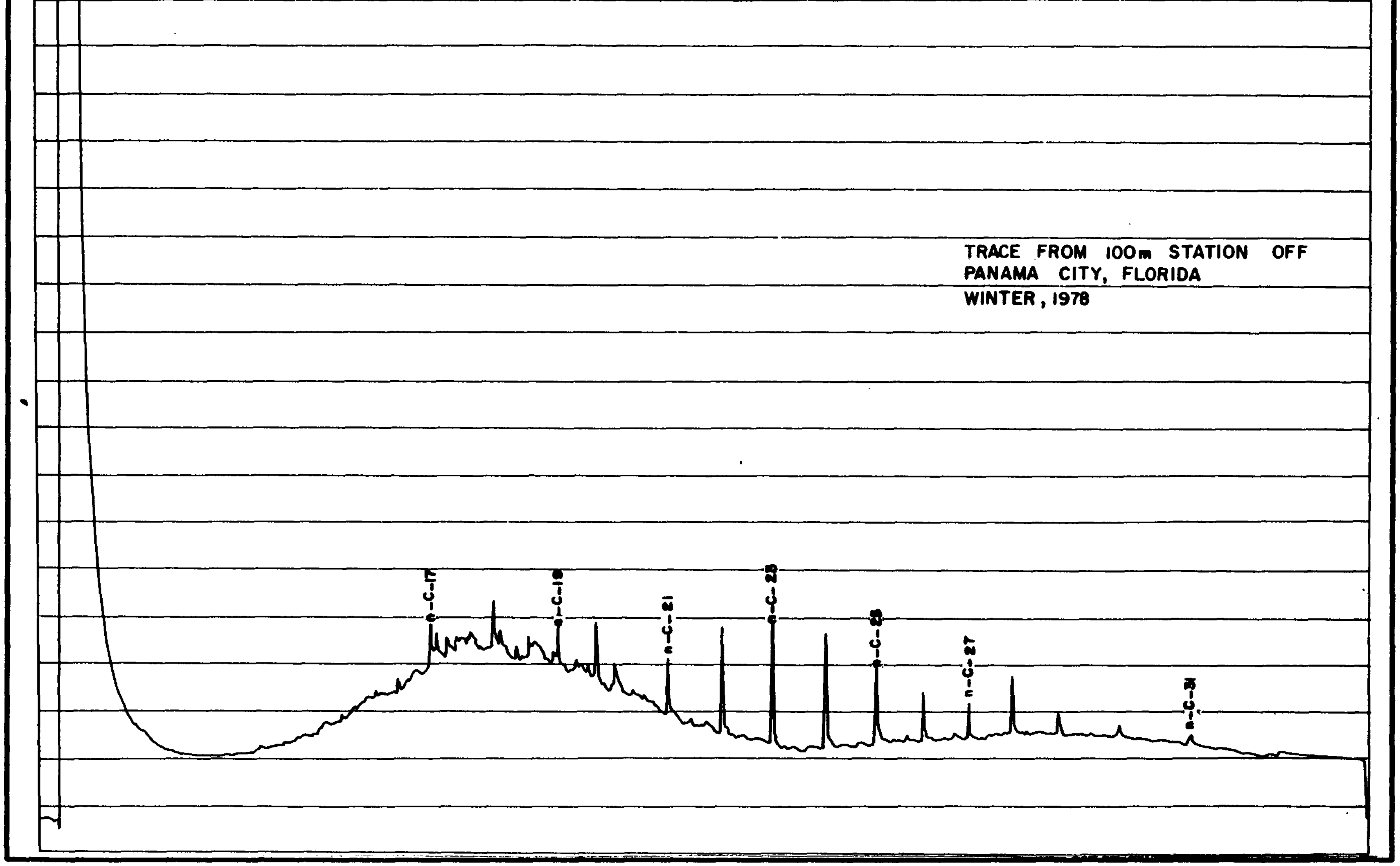
◯ = DISCUSSED IN TEXT

FIGURE 94

SIMILARITY MATRIX OF SELECTED HYDROCARBONS VS POTENTIAL DEPENDENT VARIABLES
REGION I

FIGURE 95

UNRESOLVED HUMP AND REGULAR n-ALKANE SERIES INDICATIVE OF OIL CONTAMINATION IN SYACIUM PAPILLOSUM



trace metal levels in the MAFLA area, the effect of independent variables on concentrating metals has been shown to follow the trend:

% fines > TOC > $CaCO_3$ (Figure 96)

Cadmium, unlike most of the metals, had its highest values in offshore southern (29XX) locations where it appeared to be associated with high (> 95%) $CaCO_3$ and moderate (~20%) fine sediments. The suggestion that the Mississippi River is the source of deep water (100-200 m) bottom sediment trace metal concentrations off the West Florida Shelf was supported by the relatively higher suspended particulates in northern water column stations (although the variance of the data was very high). Demersal fish trace metal values were very closely related to the "weak" acid soluble ("bio-available") metals in sediments. Figure 97 is a plot of the similarity of tissue trace metals of demersal fish by station, with the numbered points representing a "mean position" of all replicates of all metals. In this analysis each station's replicates were compared to every other station on the basis of all of the input metals. Proximity of points indicates similarity of tissue trace metal composition. The stations were then enveloped by lines representing the similarity of sediment trace metals for those same stations. The lack of overlap of these envelopes demonstrates a very strong connection between demersal fish (the Dusky Flounder, Syacium papillosum) tissue trace metal burdens and the sediment trace metals at the stations where they were collected. The three outlying data points are from stations where no site specific sediment trace metals were available.

To examine the effects of feeding type and taxonomic group on tissue trace metals, a similar data field was generated using some 50 species of invertebrates along with the demersal fish (Figure 98). Each point represents the similarity of trace metal burdens of the tissues of all individuals (and all metals) for any sample location of each species. Envelopes of higher taxonomic groupings and of feeding types were then superimposed on the array to examine the effects of these variables on species' trace metal burdens. Filter feeders (scallops and sponges) tended to be widely scattered and reflected collection location more closely than taxonomic similarity. The shrimps and echinoderms formed two separate groups of deposit feeders, and a mixed group of predators filled the middle of the data spread, and their envelope overlaped that of their prey. Lastly, the fish, Syacium was shown to be related very closely in its trace metal composition to the concentrations of trace metals in the tissues of the shrimp species upon which it feeds. The figure suggests that filter feeders are more controlled by location, while other feeding types are more influenced by diet and taxonomic affinity in their trace metal compositions. The well established tendency of some groups of invertebrates to concentrate specific metals to much higher levels than surrounding sediments, or even beyond crustal abundance levels, was in evidence during this study. Figure 99, for example, shows that crustaceans (crabs and shrimp) concentrate copper, a metal they use in their blood pigment molecule, hemocyanin, and that molluscs (especially scallops) concentrate cadmium to much higher levels than seen in other taxonomic groups analyzed. None of these metal levels were above comparable values from the previous MAFLA studies or from other studies in the region, and none represent tissue contamination. For the most part trace metal values were low in the water column, in sediments and in animal tissues in the MAFLA area.

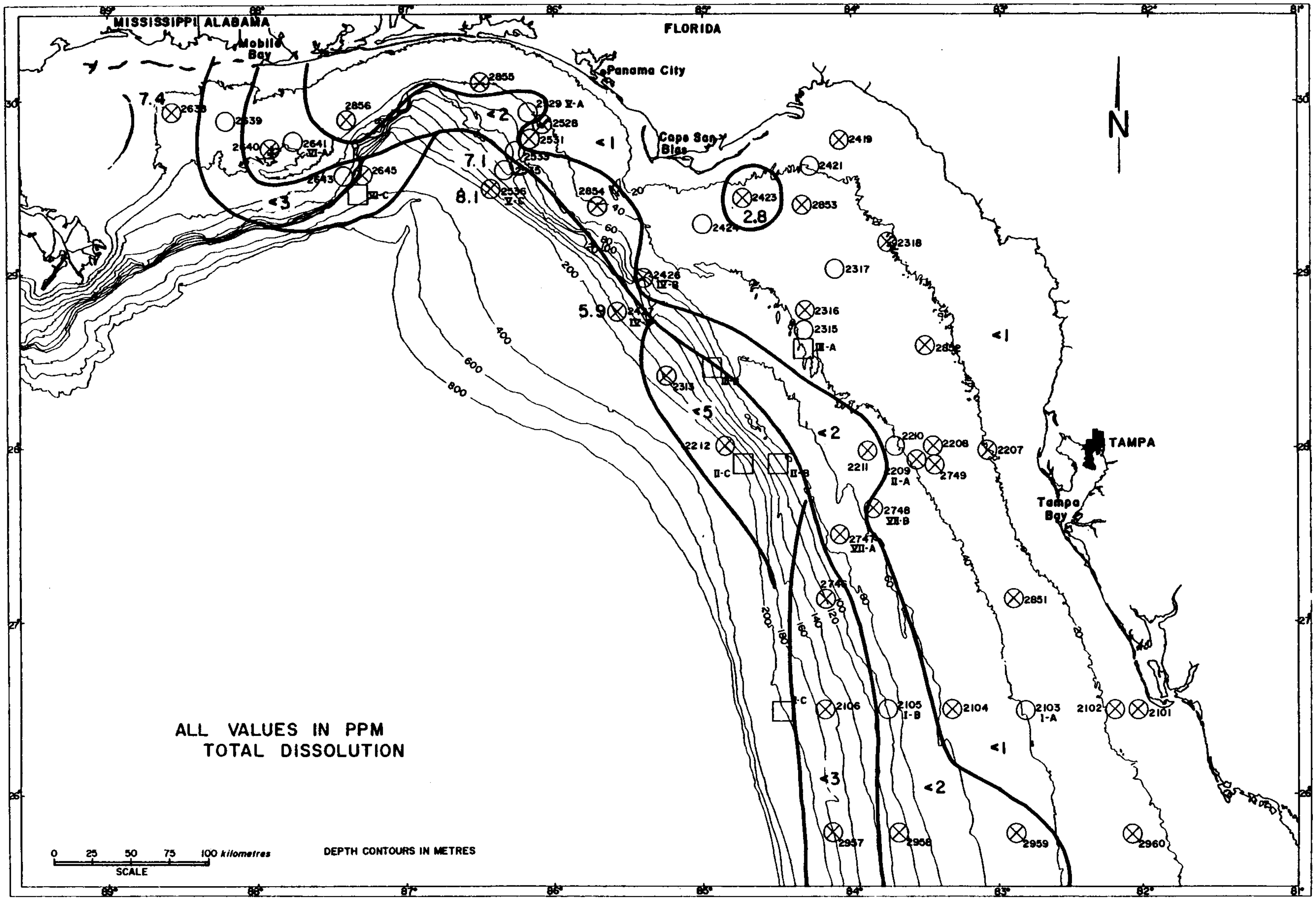


FIGURE 96
TYPICAL SEDIMENT TRACE METAL TREND (Cu)

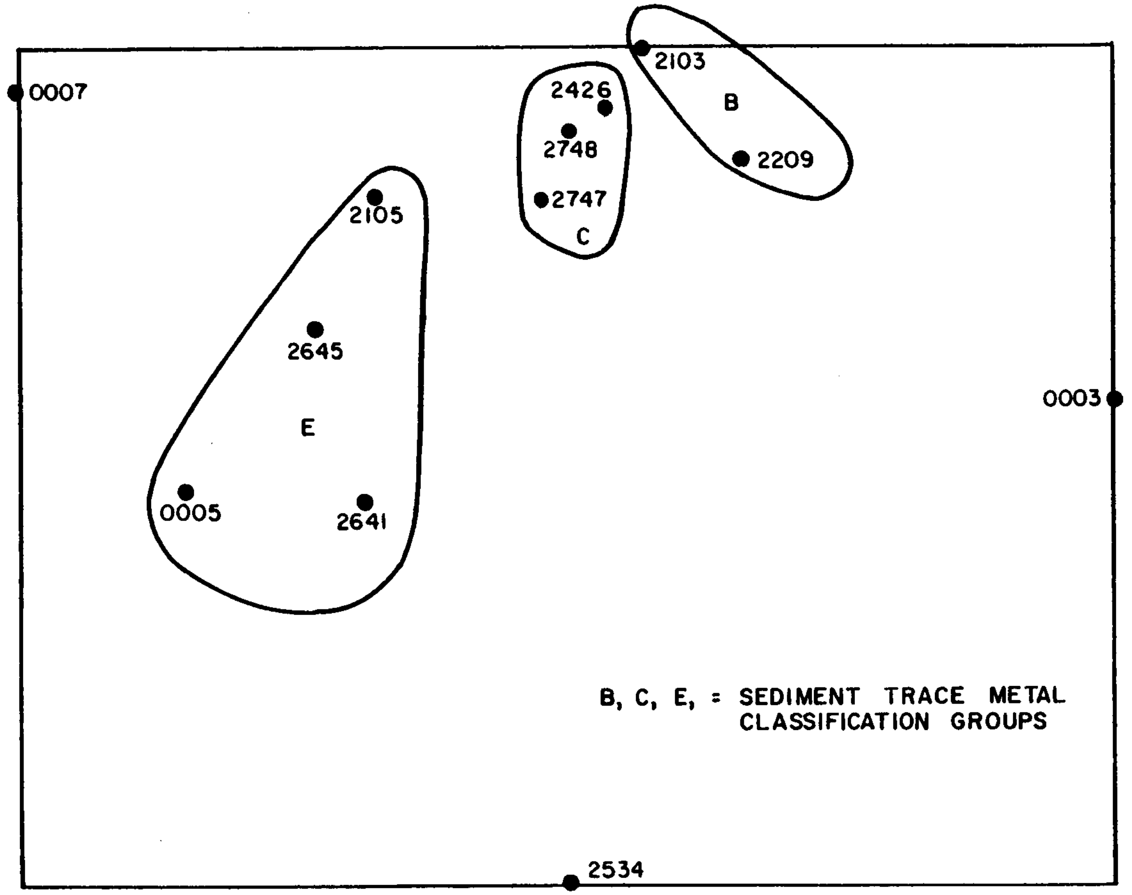


FIGURE 97

BRAY CURTIS Q MODE CLUSTER OF 6 TRACE METALS IN _SYACIUM_
PLOTTED IN ORDINATION

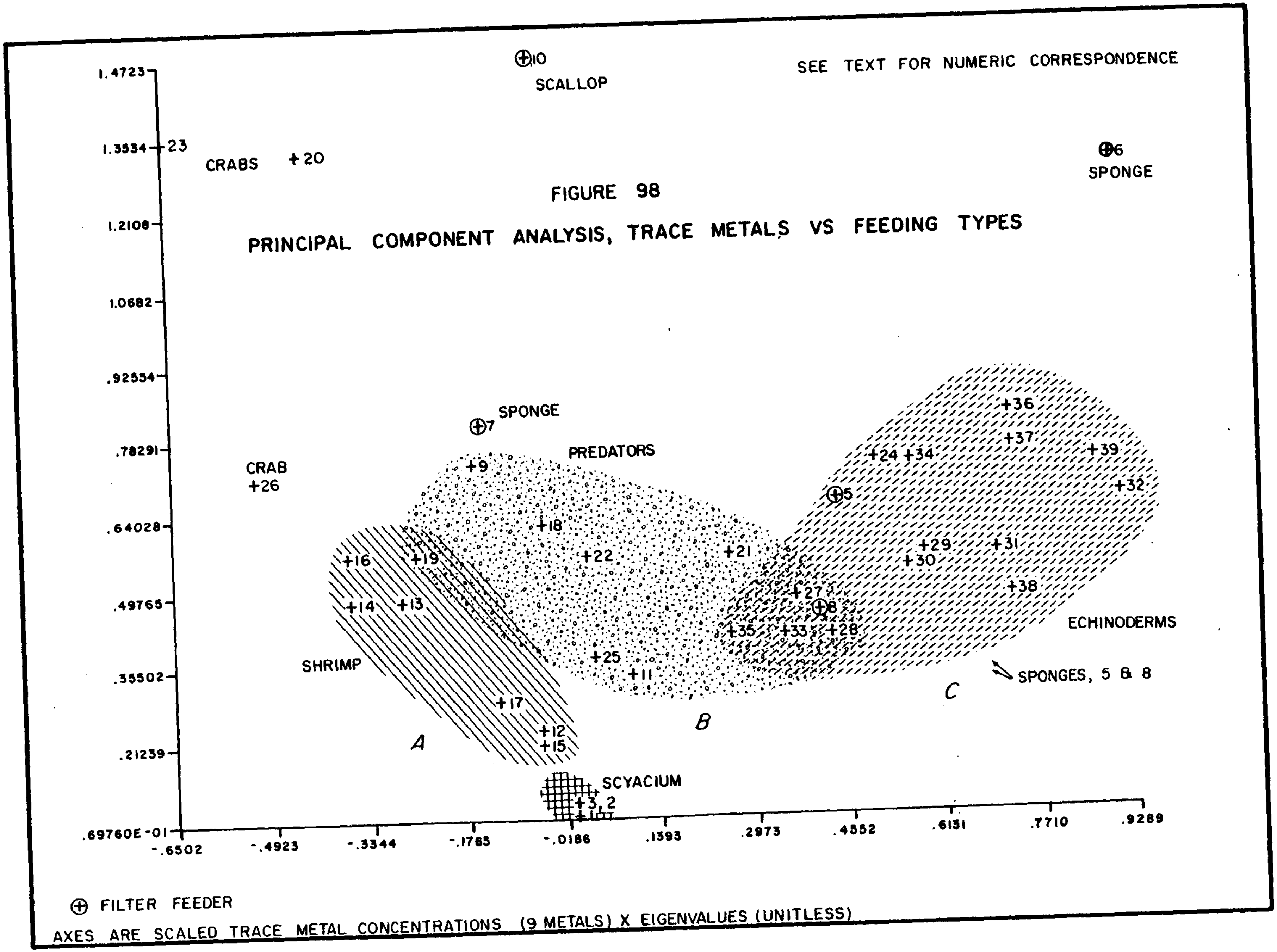


FIGURE 98

PRINCIPAL COMPONENT ANALYSIS, TRACE METALS VS FEEDING TYPES

AXES ARE SCALED TRACE METAL CONCENTRATIONS (9 METALS) X EIGENVALUES (UNITLESS)

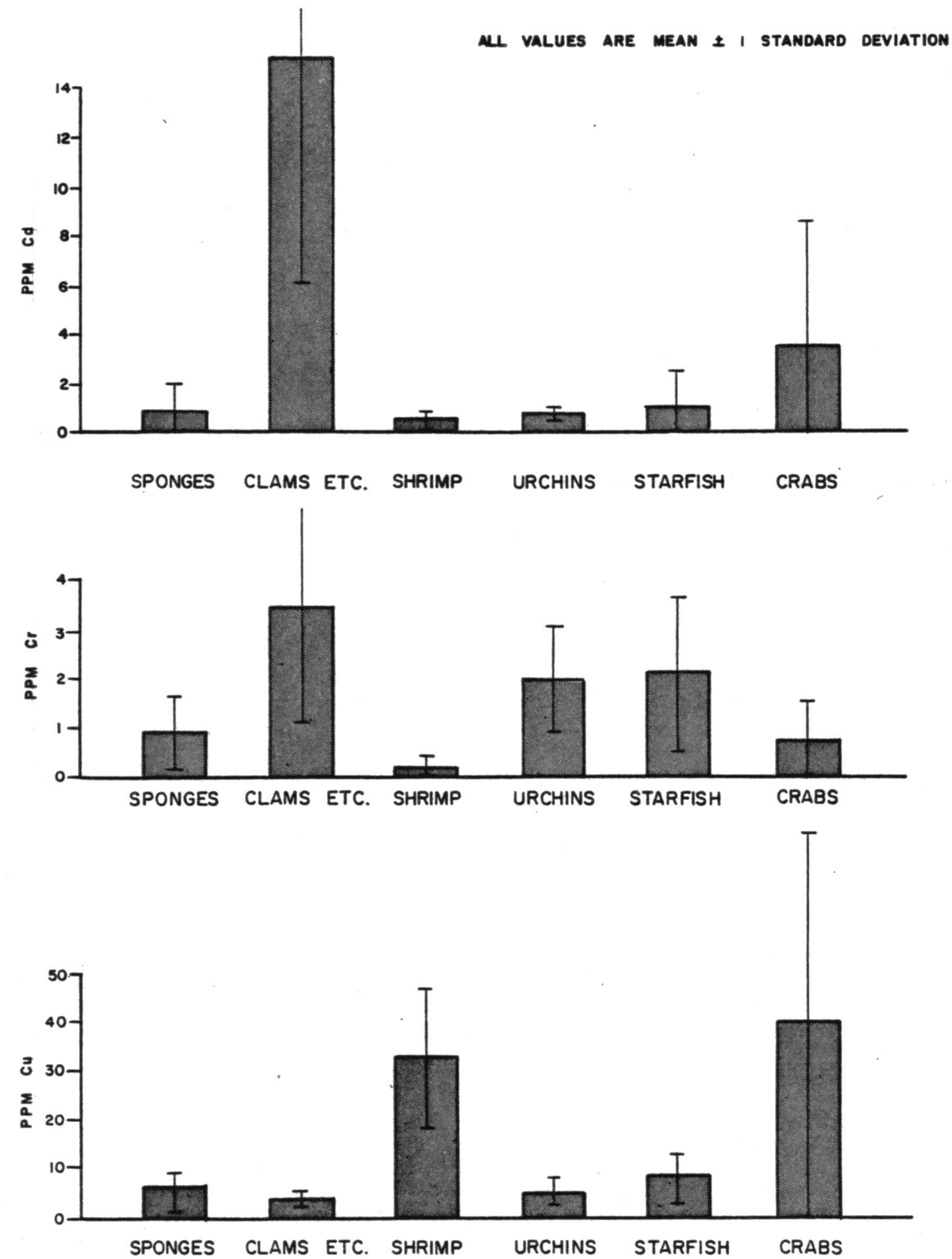


FIGURE 99

DISTRIBUTION OF TRACE METALS BY MAJOR TAXONOMIC GROUP
CADMIUM, CHROMIUM AND COPPER

MARINE BIOLOGY

Microbial Biomass

Adenosine triphosphate (ATP) is a molecule used by all living organisms to store easily usable energy. An empirical relationship relates it to living organic carbon, and it is often assumed that most of the living organic carbon in small sediment samples will be composed of microbial biomass. ATP showed high short-term (months) variability in patterns which had some geographic continuity to them. Very roughly, living carbon appeared to account for about 0.25% of TOC. Problems in the current methodology and with the underlying assumptions are discussed in detail in Volume I-A.

Foraminifera

Foraminiferal distributions have been shown to be good indicators of general environmental conditions and thus, can be used for either characterizing environments or as indicators of specific habitat conditions (e.g., reefs, deltaic conditions, and stress conditions). Figure 100 presents the distribution of foram associations in the MAFLA area. The general tendency of the assemblages to parallel depth contours followed that of other faunal groups. However, forams increased in abundance offshore and to the north in a positive association with fine sediments. This trend was contrary to that found in all other faunal groups. Group IV in Figure 100 was governed by the presence of a stress indicator species (a species known to be abundant only under conditions of environmental stress). Sources of the stress appeared to be natural (e.g., salinity, temperature and/or sedimentation patterns not related to man's activities). The wide distribution of a relict reef fauna indicates the once much more widely spread presence of reefs along the 60 to 100 m contour in the MAFLA area.

Meiofauna

Meiofauna were extremely patchy (Figure 101) in their distribution in the MAFLA area, both in time and areal extent. Their overall densities followed the same trends as for macrofauna (i.e., no latitudinal trends), with decreasing densities offshore and with high concentrations of fines. Their very high natural levels of variability and the complexity in dealing with their identification make them a poor monitoring parameter.

Macroinfauna

Species variety and density of infauna both decreased offshore and to the far west. Both density and variety are inversely related to fine sediment concentration. Polychaetes overwhelmed the infaunal samples, comprising more than 60% of the species and more than three quarters of the 100 most abundant species. Figure 102 shows the species associations derived from multivariate analysis statistics as applied to data on the 100 most abundant species from 1975-1978. These associations followed depth contours in general. The shallow stations at either end of the MAFLA sampling region were distinct from the shallow water association, as they were in the case of the foram associations. Natural stress and overlap with

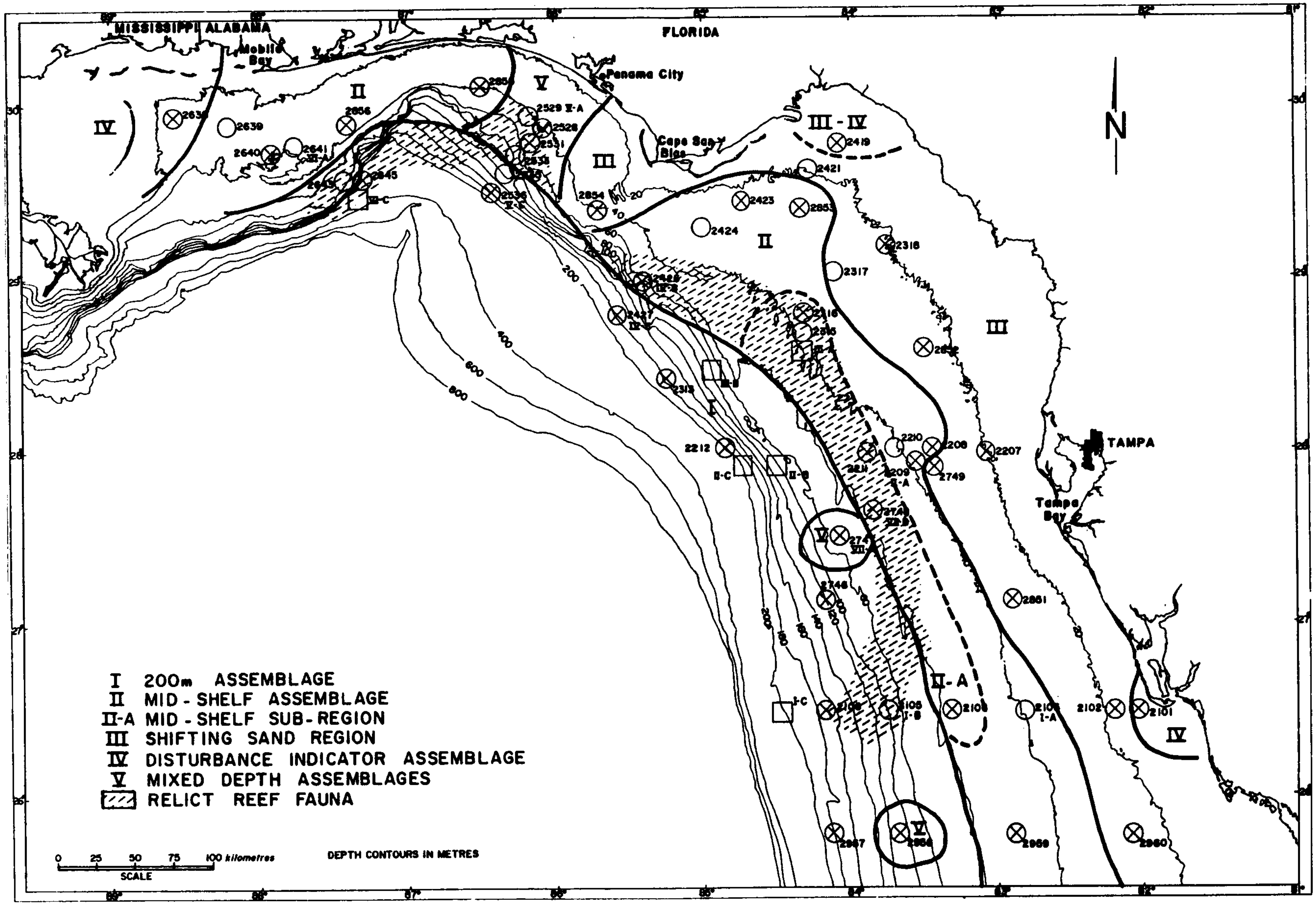


FIGURE 100

FORAMINIFERAL ASSEMBLAGES IN THE MAFLA REGION

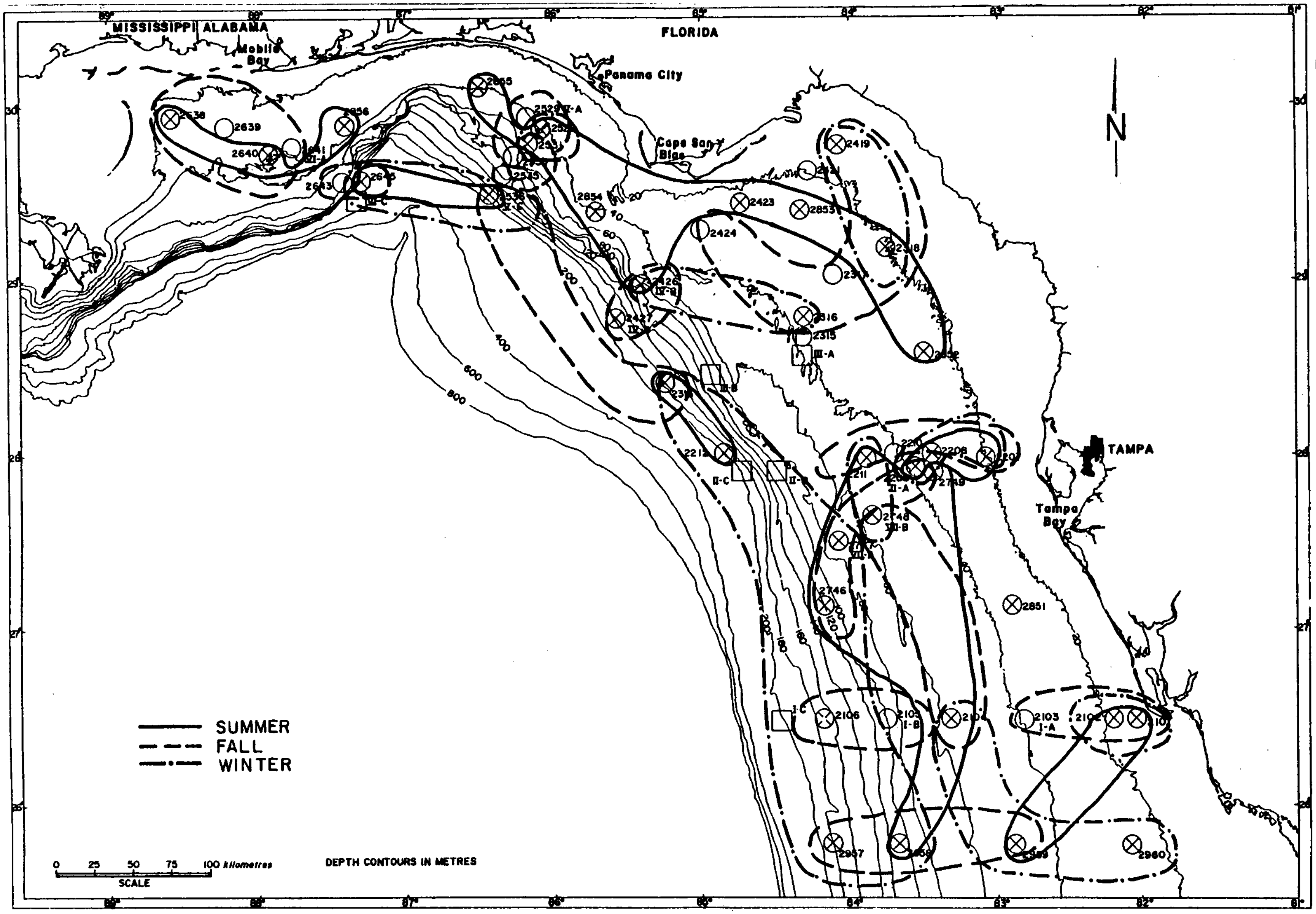


FIGURE 101

MEIOFAUNAL SIMILARITY BETWEEN STATIONS 1977/1978

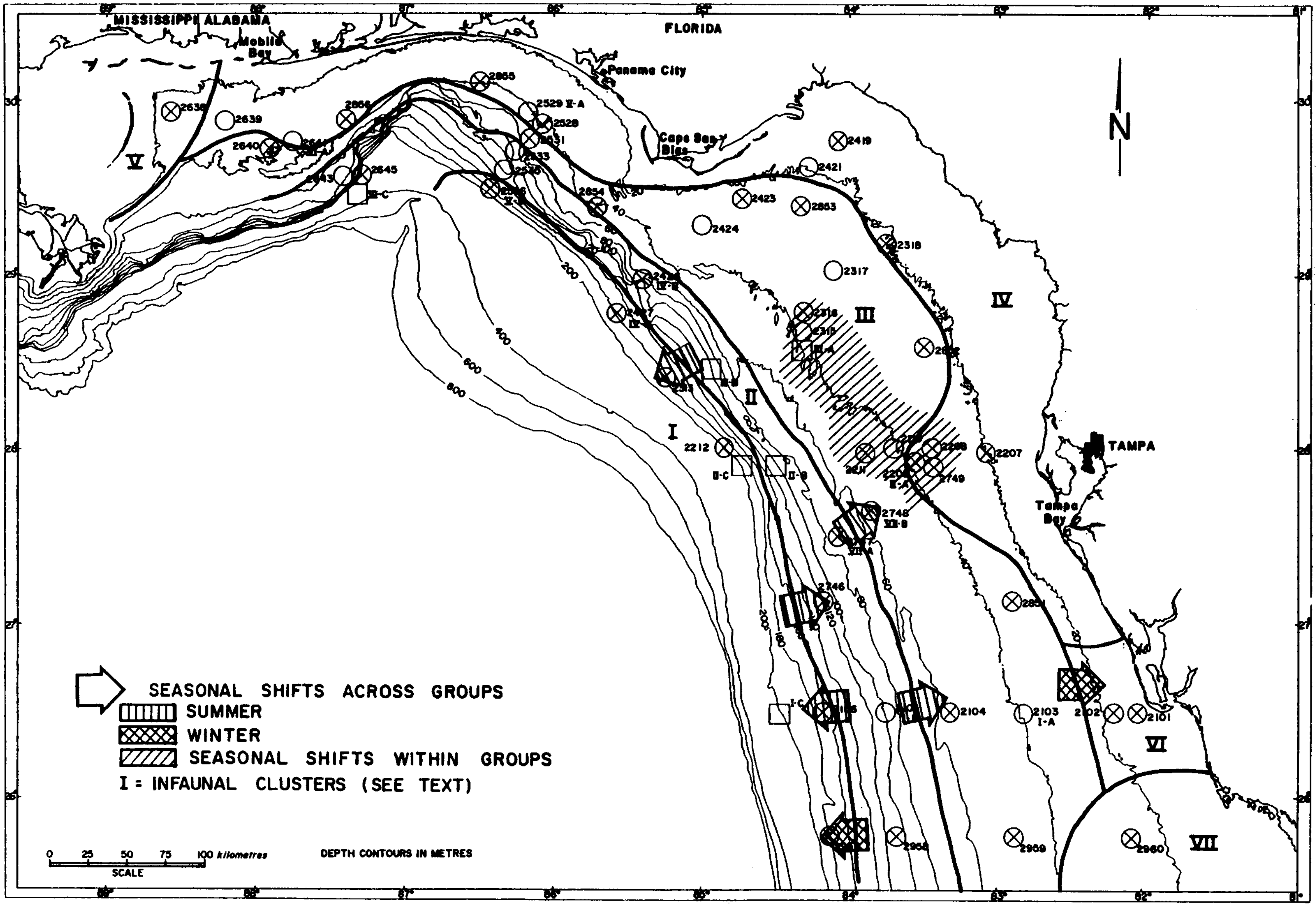


FIGURE 102

MACROINFAUNAL ASSOCIATIONS MAFLA 1977/1978 SURVEY adjacent zoogeographic subregions were thought to be causative factors. Seasonality was not nearly as severe as in the meiofauna, and macroinfaunal species associations were both broad and relatively stable.

Macroepifauna

The distribution of macroepifaunal species was similar to that of the infauna, except that the stability was greater, seasonality less, and overall abundance much less (a ratio of 1:20,000). Their general pattern of decreasing variety and abundance in an offshore direction is shown in Figure 103. Note that the transect which had the evidence of fish tissue hydrocarbon contamination (25XX) was not depleted in either species or individuals relative to other stations of comparable depths. None of the measures of community structure (variety, density, diversity) suggest that Transect V is abnormal in either infaunal or epifaunal comparisons. Macroepifaunal species associations indicate that the Florida Middle Grounds are a unique habitat, but have faunal links to other stations with solid substrate habitats.

Demersal Fish

Bottom fish communities followed the same general trends as for macroepifauna and macroinfauna. Length frequency data from the species selected for histochemical analyses (Syacium papillosum) indicated that that species probably lives through two year classes, and that about a quarter of the population is made up of mature individuals. That species' utility as a monitoring tool is discussed in detail in Volume I-A. As with the foraminifera, certain species of fish were good indicators of specific habitats.

Histopathology

More than 14,000 slides were prepared from more than 70 different species of macroinvertebrates to examine tissues for abnormalities. This year's data reinforced the results of the 1975/76 study, in that no pathologies have yet been found. The total absence of pathologies in the macroinfauna indicate the highly pristine condition of the MAFLA area.

SUMMARY

From ecological, histopathological and histochemical standpoints, the MAFLA area is a pristine and healthy area. Parts of the area's sediments are still essentially free of any detectable petrogenic or anthropogenic hydrocarbons, and the water column shows no signs of any but biogenic sources. Sediment and water column trace metal loads are low, and are reflected in the low levels of trace metals in animal tissues. These conditions provide an ideal base for a monitoring program. Listed below are the parameters recommended for use in any future monitoring of the MAFLA OCS. For substantiation of these choices, see the last section of each subject heading in Volume I-A, and the Conclusions section of that volume, pages 257-259. Also listed below are the major areas in which the data base is concluded by Dames & Moore to be deficient.

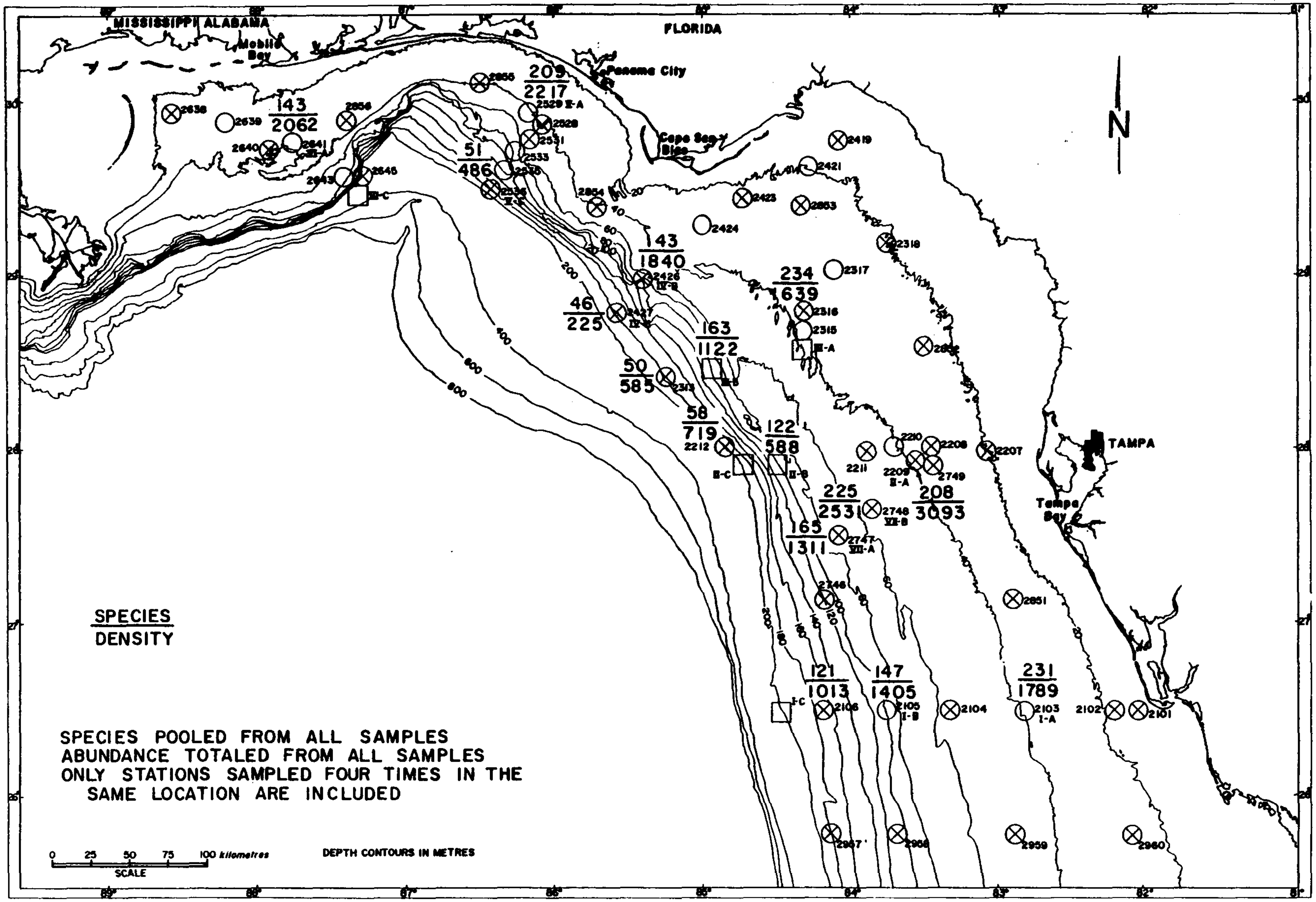


FIGURE 103

SPECIES VARIETY AND TOTAL COUNTS OF MACROEPIFAUNA 1976/1978

PARAMETERS RECOMMENDED FOR MONITORING USE

Direct Variables

Histopathology of demersal fish and invertebrates

Histochemistry of a variety of fish and more replicates of fewer species of invertebrates

Sediment hydrocarbons + TOC

Water column hydrocarbons including low molecular weight compounds + POC/DOC

Sediment trace metals

Macroinfauna (polychaetes + crustaceans)

Foraminifera

Support Variables

STD, transmissometry and currents

Standard sediment parameters including clay mineralogy

Demersal fish ecology

Macroepifauna ecology

Qualitative zooplankton

PRINCIPAL WEAKNESSES OF EXISTING DATA BASE

1. Incomplete analysis and interpretation of existing data
2. Lack of water current data for the continental shelf
3. Lack of fish histopathology
4. Insufficient variety of demersal fish data for histochemistry
5. Insufficient replication of epifaunal species for histochemistry
6. No data on sediment water interface
7. No controlled data on water column and sediment changes with hurricane passage
8. No replication (simultaneous, paired taxonomic tows) of zooplankton
9. No concurrent measurement of phytoplankton in 1977/78
10. Insufficient small scale ($\sim$2000 m) replication of demersal fish and macroepifaunal data

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.