INTERIM TECHNICAL REPORT IV

Pollutant Transport in Mississippi Sound

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Thomas F. Lytle
Analytical Chemistry Section
Gulf Coast Research Laboratory
Ocean Springs, Mississippi 39564

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Julia S. Lytle
Environmental Chemistry Section
Gulf Coast Research Laboratory
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MISSISSIPPI-ALABAMA
SEA GRANT CONSORTIUM

Grant No.: NA81AA-D-00050
Project No.: R/ER-2 (1982)

MASGP-82-035

This work is a result of research sponsored in part by NOAA Office of Sea Grant, Department of Commerce under Grant # NA81AA-D-00050, the Mississippi-Alabama Sea Grant Consortium and the Gulf Coast Research Laboratory. The U. S. Government is authorized to produce and distribute reprints for governmental purposes notwithstanding any copyright notation that may appear hereon.

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ANNUAL SUMMARY

Introduction

Mississippi Sound is an elongated shallow embayment bordered on the north by a series of small bays, marshes, bayous and rivers and on the south by a chain of offshore islands. The coastal region has experienced extensive residential and industrial growth during the past decade, and coastal waters are now being considered for mineral exploration. Pollution in this area received minimal attention in the past and was simply viewed as a necessary by-product of progressive growth. Compounding the problem of such a carefree attitude towards pollution was the fact that very little real scientific information regarding the extent of pollution existed. Therefore, this study was begun in 1979 to give the proper scientific perspective to this pollution problem by characterizing the pollutants in Mississippi Sound, clarifying those processes responsible for pollutant movement and developing criteria necessary for more responsible coastal management. To meet these needs, an extensive sampling and analysis program was initiated in 1979, involving both surface sediments and cores from the entire Mississippi Sound. Several other laboratory studies were begun in 1980 and have continued through June 1983 to describe the fate of pollutants in the estuary, document actual toxicity of polluted sediments and to develop a system of rating each sedimentary environment according to potential environmental harm each may pose.

During 1982, the final year of this four-year project, emphasis of the analysis program was shifted from the eastern and central sections of the Sound, treated earlier in the project, to the western extremities of the Sound. The areas of primary interest were St. Louis Bay, Heron Bay and island passes south of these bays. To maintain objectivity, the scope of chemical analysis has remained as broad as possible throughout this study. However, the preponderence of evidence gathered in the first 3 years of the study indicated that hydrocarbons and specifically aromatic hydrocarbons were the class of compounds that posed the most serious threat to the Mississippi estuarine environment. Therefore, in 1982 an additional effort was exerted to give more comprehensive information about these compounds in Mississippi Sound sediments. The concept of a numerical rating of all physical, chemical and biological characteristics that affect the impact of pollutants was termed the 'Environmental Stress Index' and was applied to western Sound samples in 1982. As part of this program to assess potential damage of polluted sediments, efforts were made in 1982-1983 to examine those processes responsible for transport of sediment pollutants in the western Sound. Furthermore, by examination of sediment cores collected from this region, the 1982 study continued earlier efforts in this program to document diagenetic changes that occur to pollutants after they are depositied in the sedimentary column.

Allowance was made to expand studies conducted earlier in the program. These re-examinations were directed primarily at giving a more comprehensive evaluation of toxic sediments residing in the Bayou Casotte region of the Mississippi Sound.

Considerable attention in the final year of this program was devoted to converting the scientific data generated throughout the program to scientific information, thereby assuring greater utility of the data. This information was aimed at two primary audiences, the scientific and regulatory-enforcement agency groups and also to the general public. The ultimate goal of this dissemination of scientific information was to promote an attitude towards development and regulation based upon the fullest knowledge of environmental consequences of pollution in the Mississippi Sound.

Sample Collection and Analysis

In 1982, nine 10-foot sediment cores were collected from the western region of the Sound. These sites were located in mouths of bays and rivers to monitor transport of land derived pollutants into the sound. The core at Pass Marianne was chosen to monitor input from Lake Borgne, Louisiana and the cores from Ship and Horn Islands, to monitor input in and out of the Gulf. A total of 43 cores have been taken in the Mississippi Sound, these last nine completing the core sampling program for this research program. In addition, eight surface sediment samples and site water from other sites in the western Sound were collected to gain information regarding pollution distribution and to provide chemical data in assessing an 'Environmental Stress Index' at these locales. Because results of chemical analyses from some sites in the central Sound sampled in 1981 indicated a need for additional analyses, four surface sediments were also taken from that region during the 1982 program. A total of 78 surface samples were collected during the 4-year study period. Table 1 and Table 2 provides locations of and reasons for collection of all surface and core samples collected during the 4-year study program. A map of all sampling sites is shown in Fig. 1.

Management of Core Sediments

During the 1982 program, analysis has been completed on all cores collected from the central and western Sound. Sediment samples were handled according to the scheme shown in Fig. 2. After opening, cores were viewed and described by geologist, Dr. Ervin Otvos, followed by careful sectioning along geological boundaries. If sediments were homogeneous throughout the core, the core was sectioned into 10 or 20 cm lengths. Each section of a core was subsampled for individual analysis including total phenols, total organic carbon (TOC), total Kjeldahl nitrogen (TKN), hydrocarbons (aliphatic and aromatic), heavy metals and grain size. Hydrocarbon analysis of sediments constituted the most exhaustive analysis applied to these samples and followed the scheme shown in Fig. 3. The multi-step procedure consisted of extraction, separation and analysis. The latter was accomplished primarily with gas chromatography and combined gas chromatography-mass spectrometry. All geological descriptions were recorded by videotape and written document to correlate chemical and geological characteristics. A format was used to give an overall pictorial view of the core data including those features needed to make reasonable decisions regarding sediment disturbance such as dredging. Several of the core profiles from the central and western region of the Sound are included in this report to demonstrate the significance of using this graphic format.

Transport of Pollutants in the Western Sound

The Mississippi Sound is bounded on the east and west by bodies of water receiving a much greater load of pollutant materials than is discharged directly into the Sound. Exchange with Mobile Bay on the eastern end has been addressed in earlier annual reports, but in 1982, input from Lake Borgne and the Mississippi River to the western extremities was the subject of the question, "Can migration of pollutants into the Sound from Louisiana waters be detected?" Furthermore one would like to know how effectively pollutants are moved within the Sound from their local sources to the sites of deposition in the sediments. The profiles of geochemical data secured from sediment cores in the western Sound are displayed in Figs. 4-14. These profiles and surface sediment pollutant levels listed in Table 3 accurately record the migration paths and extent of pollution in the western Sound. The core profiles from the western edge of the Sound at Heron Bay, Pass Marianne and Cat Island Channel (Figs. 4-6) do not indicate a tremendous enrichment in the organic constituents of the sediments, therefore, the influence of transport from Lake Borgne, though certainly not excluded, seems not to have a profound effect on the pollutant levels in this part of the Sound. The region that would have experienced the greatest input from Lake Borgne would be near Pass Marianne (Fig. 5). The geochemical profile at this site shows many similarities to other sites in the western Sound. Total hydrocarbons show an approximate two-fold increase in the surface segments of the core compared to deeper segments. Just beneath recent depositions, the contours of the hydrocarbon concentrations with depth duplicate that of % clay with depth in the sediment. This is apparent in the Pass Marianne core where a large increase in clay contribution at the 200 cm depth is accompanied by a dramatic enrichment in total hydrocarbons. At similar depths in other cores (depicted in Figs. 4-6, 8-14), except Wolf River (Fig. 7) the same phenomenon is noted.

Levels of hydrocarbons in surface sediments at all western Sound sites exceed that which the % clay would have suggested. Gas chromatography and mass spectrometry have indicated that the natural hydrocarbons are supplemented in surface sediments by hydrocarbons of petroleum origin accounting for the surface enrichment. However this enrichment only brings the hydrocarbon levels to 20-60 ppm in surface sediments of the western Sound.

The uniformity of pollutant distributions at all sites in the western Sound, clearly seen in Table 3, indicate that there are not significant point sources in the immediate vicinity. These distributions point to remote sources of pollutants of sufficient distance from the area that the pollutant-laden sediments are well-mixed when arriving at deposit sites throughout the western Sound. Probably the more significant sources are Lake Borgne, the Mississippi River and Biloxi Bay. Contributions from the Pearl River certainly do not leave any indelible imprints in the pollutant record of Heron Bay, a probable deposit site for Pearl River sediments. The similarities of Heron Bay sediments (Fig. 4) and other western Sound sites far removed from the Pearl River indicate a relatively small role for the Pearl River in adding a significant load of pollutants to the Sound.

Profiles of areas from the two rivers emptying into St. Louis Bay, the Wolf (Fig. 7) and Jourdan (Fig. 8) display organic components that yield contours mirroring very closely that of % clay in both regions. Evidence of slight oil pollution, from residential and boating activity, exists in surface sediments at both sites, but overall levels are low compared to those found at the mouth of the bay at the St. Louis Bay Bridges site (Fig. 9). The similarity of the profile at this site and other western Sound sites suggests tidal input of pollutants from the Sound as the predominant source for St. Louis Bay.

The outstanding characteristic of organic composition of the western Sound sediments lies not in differences of concentrations, types or sources of pollutant hydrocarbons which are of insufficient magnitude to be distinctive but in the distribution of the natural hydrocarbon component of the sediments. Sediments from Pass Marianne (Fig. 5) and those sites closer to shore indicate both terrestrial and marine hydrocarbons as the natural hydrocarbon source with a dominance of the former. However, Cat Island Channel sediments (Fig. 6) and to lesser extent those from Ship Island and Ship Island Pass (Figs. 13 and 14) contain hydrocarbons derived from marine sources. This signature of terrestrial hydrocarbons within the Sound indicates that the primary area influenced by land-derived pollutants, which would behave as the terrestrial hydrocarbons, does not extend beyond the offshore islands. Consequently it may be presumed that organic pollutants found in sediments outside the islands of the western Sound can most likely be traced to an origin other than those found along the Mississippi Coast.

Accumulation and distribution of pollutants.

Another question arises when considering fate and effect of pollutants, "Once introduced to Mississippi Sound waters, where do pollutants go?" A preponderance of the data from this study indicates very strongly that most pollutant material discharged into the rivers emptying into the Sound are deposited in the sediments very near the site of pollutant origin (Lytle and Lytle, 1981, 1981a, 1982). Therefore, it appears that only a small fraction of these pollutants ever reaches the Sound. In additon to this limited input, other inputs exist from disposal of wastes from commercial and recreational boats and transport through the island passes from Lake Borgne, the Mississippi River, Mobile Bay and the Gulf of Mexico. Almost without exception significant levels of pollutants occurring in any sediments of the Mississippi Sound are accompanied by enrichments in the clay composition of these sediments. Therefore, it is not surprising that the sediments within the eastern Mississippi Sound, though in close proximity of the largest industrial complexes of the coast, contained low levels of pollutant residues because of a very high sand/low clay content. on the other hand, surface sediments of the western Sound are greatly enriched in clay compared to central and eastern Sound sediments (Otvos, 1976). Surface segments of cores collected from open areas of the western Sound contain significantly higher levels of all organic pollutants than do those collected from sites further east in the Sound (Lytle and Lytle, 1982, 1983). This region appears to serve as the site of accumulation of the vast majority of pollutant residues that are transported into the open Sound.

Environmental Stress Index

Throughout this study the prevailing sentiment has been that a survey of pollutant levels in Mississippi Sound in itself is very limited in its overall usefulness. The presence of pollutants in the sediments of a particular region is sufficient reason for concern because it indicates lack of necessary control of pollutant discharge, however, there are factors besides concentration of pollutants that decide the possible effects of sediment pollutants. Answers to the question, "What pollutants are there and how much?" can only underline the question that naturally follows, "So what?" This "so what" question was the inspiration for several segments of this study that have been collectively referred to as the 'Environmental Stress Index'. The index rating was devised as a system to numerically rate the most important factors bearing upon the potential harm associated with polluted sediments. For the purposes of this rating the Mississippi Sound was divided into 35 compartments, each defined as a zone where evidence suggested that polluted sediments should collect.

All but one of the 35 'Environmental Stress Index' stations listed in Table 4 received the complete rating which entailed four areas of concern that should be considered after any disturbance of polluted sediments. Of immediate importance is the question of exposure mortality, i.e., "How toxic are the sediments to ecologically important organisms?" In 1982 bioassays, used to appraise sediment toxicity, were applied to some sediments from the Biloxi Bay System, all sediments from the St. Louis Bay system and some from the Mississippi Sound System. All stations are listed in Table 4. Complete results of these tests run by the Toxicology Lab at the Gulf Coast Research Laboratory (GCRL) are contained in Table 5. Abbreviated results in a rating format are listed in Table 4. Toxicities with the exceptions of a few locations were less in the central Sound (Biloxi Bay System) than those found in the eastern Sound (the Pascagoula River System), and considerably less for the western segments of the Sound. These results suggest that under identical circumstances, suspension of western Sound sediments would cause lesser damage to the organisms than would those from the central and eastern Sound (primarily bay and river areas). Of no less importance in viewing the impact of sediment pollutants is the concept of suspension stability which addresses the question, "How much of the sediments will be suspended after a disturbance and for how long?" A carefully designed laboratory experiment measured both the amount of suspended material after a simulated sediment disturbance and the length of time for this material to settle out. Both considerations, total suspension and settling rate, are evaluated in Table 4 and indicate not much difference in sediments from any of the broad regions of the Sound, with the western Sound sites having sediments whose suspension characteristics are about average for the Sound. Therefore, after a sediment disturbance the exposure times for western Sound sediments would not be significantly different from other areas of the Sound. Another major factor for consideration was prompted by the question, "Just how likely are disturbances to occur in this area?" Relying upon the knowledge and field experience of several key investigators, a rating was given to the 35 zones based upon such activities as fish trawling, boating activity and maintenance dredging. Bill Demoran and James Warren from GCRL and Ron Herring, Tom VanDevender and Chris Synder from the Mississippi Bureau of Marine Resources formulated the ratings by those guidelines described in Table 4. Ratings for the western portions of the Sound indicate a probable low incidence of sediment disruption in St. Louis Bay and Heron Bay but relatively high probabilities of disturbance for sediments located between these bays and the offshore islands. The last area of concern regarding contaminated sediments, "biota susceptiblity", relates to the serious question, "Since the animals living in these 35 areas are so different, then how would all these diverse communities react to a pollution incident?" Dr. Tom McIlwain, Dick Waller, Harriet Perry and Bill Demoran of GCRL, having conducted biota community surveys for over a decade in all regions of the Sound, were called upon to assess the potential biological harm that would result in the 35 zones. In their rating decisions, thought was given to the ecological significance of resident organisms, how mobile these organisms are, the presence of early life stages during much of the year and known sensitivity of specific organisms to toxic agents. As Table 4 indicates, there is a great deal of uniformity in this regard for all segments of the Mississippi Sound including the western third.

Giving each of the four major factors equal weight, a product of the separate ratings was calculated and is referred to as the 'Environmental

Stress Index'. Because of fairly low values in the areas of toxicity and disturbance probability, western Sound sediments have indices that are low compared to those in the central and eastern regions. These lower indices indicate that under present conditions, sediment pollutants pose a lesser threat to the environments of the western portions of the Sound than do those polluted sediments in the other segments of the Mississippi coastal zone. However, if levels of toxic materials increase in these sediments or if development activity increases dramatically, this rating of "fairly safe" would be seriously offset to create a state of potential damage that equals that which exists in certain areas of the Pascagoula-Escatawpa River and Bayou Casotte (Lytle and Lytle, 1981, 1981a, 1982, 1983).

Use of Scientific Information

A primary objective of this study has been the conversion of the large data base into scientific information thus assuring the maximum usefulness to the scientific and non-scientific community. The user groups initially targeted for use of the information have been given the most consideration in the development of formats to present the data, but consideration was also given to a broader audience with unspecified interests and informational needs about pollution. In 1979 the program was envisioned ultimately to provide information to federal, state and local agencies, private enterprise and interested individuals. User groups in 1982 have come from all of these disciplines.

At the federal level this study has provided information to the U.S. Army Corps of Engineers, Mobile Branch in proposal request preparations and in the design of dredge spoil disposal studies. The Vicksburg Branch of the Corps has been given help in designing a hydrocarbon analysis program and also in the development of a sediment evaluation scheme using concepts included in the 'Environmental Stress Index'. Requests for data to be placed in data banks have been received by several agencies including the Federal Toxic Water Watch. Following a estuarine research workshop in which the PIs presented goals and accomplishments of this study, NOAA officials requested information on the 'Environmental Stress Index' to help in the development of a similar technique to be used on a national scale.

During the final year of this study a number of requests have come from the Mississippi Bureau of Pollution Control for information and advice concerning results of this study. Specifically the area of most interest has been the Industrial Seaway of Bernard Bayou. Requests have also been received by the Mississippi Research and Development Center to include the data of this program in their data bank. Representatives from International Paper Company have obtained information on our study results that are relevant to the operation of their plant on the Escatawpa River. In a similar vein, representatives of Southern Corporation Services, representing several Mississippi power plants, have asked for data collected near power plants along the Mississippi coast. The principal investigators have had several data and informational exchange meetings with Chevron U.S.A. about operations of the oil refinery in Bayou Casotte. Primarily the meetings were aimed at shedding light on all possible sources of the vast quantities of pollutants found in Bayou Casotte sediments. Several private consulting firms have contacted the PIs for help in writing and appraising dredging impact statements pertaining to Mississipp Sound waters. A number of other scientific investigators have taken advantage of knowledge and insight gained through this study. Results of the study were of particular use to Dr. Charles Rhyne of Jackson State University in the design of a sampling program. At least one foreign visitor has taken advantage of study results; Dr. Jean-Pierre Desmarquest visited the PIs representing the French government, in response to issues raised by the PIs at an international conference which they presented results on this study (Lytle and Lytle, 1983).

Education

During 1982 the educational efforts of this study were expanded to include areas not explored in earlier phases of the study. Videotapes of all aspects of the sampling and analysis program have preserved certain features of the study for use in educational programs. Geological descriptions of all the discrete sampling areas of the Sound have also been recorded on videotape for future reference by visiting groups. The public has received bulletins of the progress and results of this study by several radio and television broadcasts, news releases in Marine Briefs (of GCRL) and local newspapers and through informal encounters with various special interest groups. In preparation now are two booklets to be followed by others giving a lay-language account of the 'Environmental Stress Index' and sediment pollutant profiles. Enrichment groups both from Long Beach and Ocean Springs schools have visited the PIs for in-depth discussions of this project and how the interest of these students in pollution could eventually work to improve the environment. As a testimony to efforts made to convey this pollution information to the public, the Mississippi and National Wildlife Federation recognized the PIs with the 1983 Conservation Award in Water and Soil Conservation. Increasing the awareness of the public to pollution, raising their level of concern for their environment, and encouraging a more rational view of industry's obligation to control pollution have been among the principal benefits of this program.

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Otvos, Ervin G.. 1976. Mississippi Offshore Inventory and Geological Mapping Project, Mississippi Marine Resources Council.

Figure 1. Map of the sampling sites in Mississippi Sound. Location labels for the surface sediment samples are fully explained in Table 1 of this report. The 43 core sediments sites are described in Table 2.

Figure 1

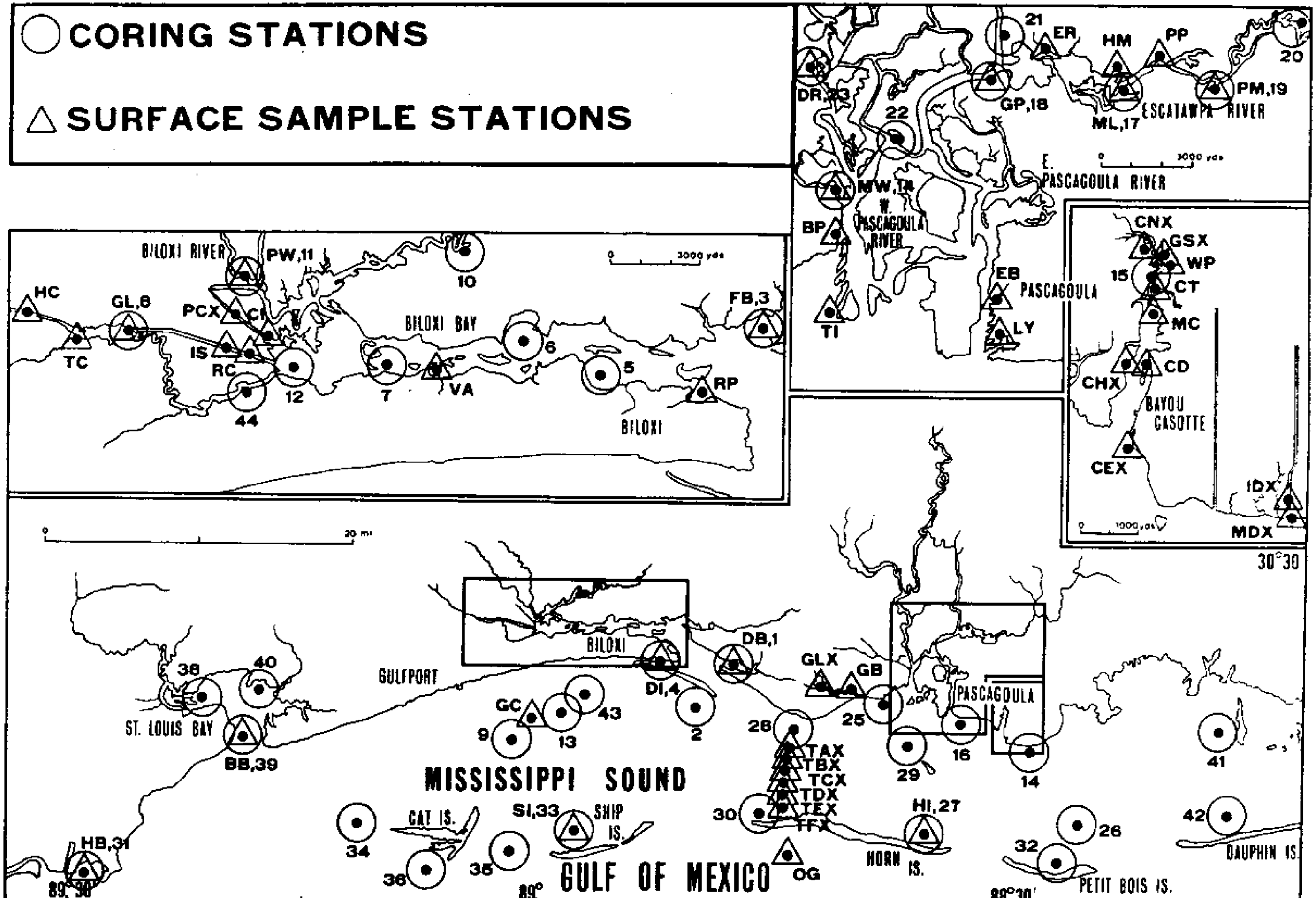

CORING STATIONS
SURFACE SAMPLE STATIONS
BILOXI RIVER
BILOXI BAY
BILOXI
E. PASCAGOULA RIVER
W. PASCAGOULA RIVER
ESCATAWPA RIVER
PASCAGOULA
BAYOU CASOTTE
MISSISSIPPI SOUND
GULF OF MEXICO
GULFPORT
ST. LOUIS BAY
CAT IS.
SHIP IS.
HORN IS.
PETIT BOIS IS.
DAUPHIN IS.
89°30'
89°
88°30'
30°30'

Figure 2. Sediment Analysis Scheme. After geological examination of sediment cores and surface grab samples were treated to the same analysis including grain size distribution, trace metals (presently being archived), certain chemical tracer techniques, total phenols, total organic carbon, Kjeldahl nitrogen and hydrocarbons. In addition surface grabs were characterized for leachability of nutrients, suspension and settling rate properties and bioassay toxicities.

Figure 2

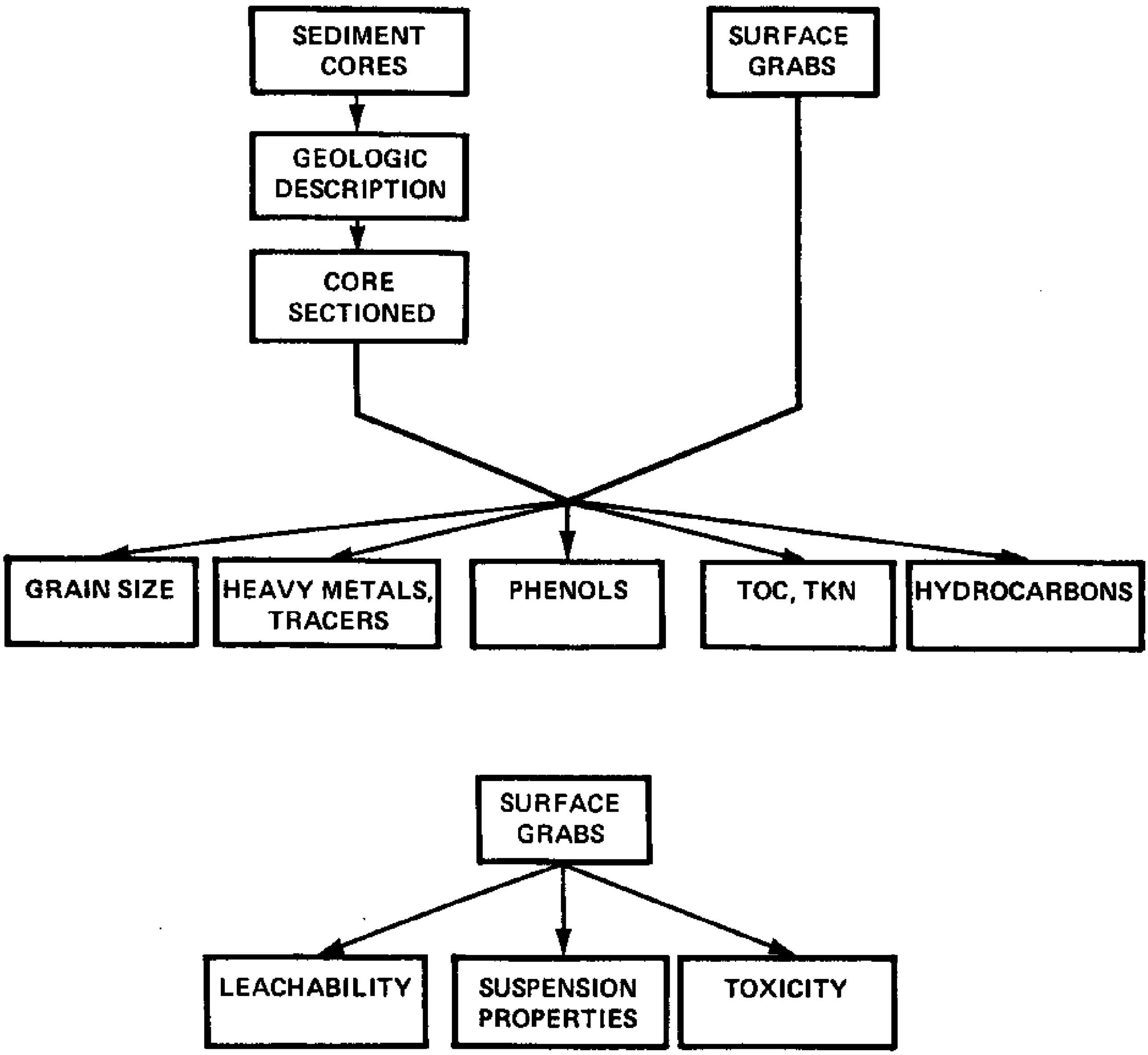
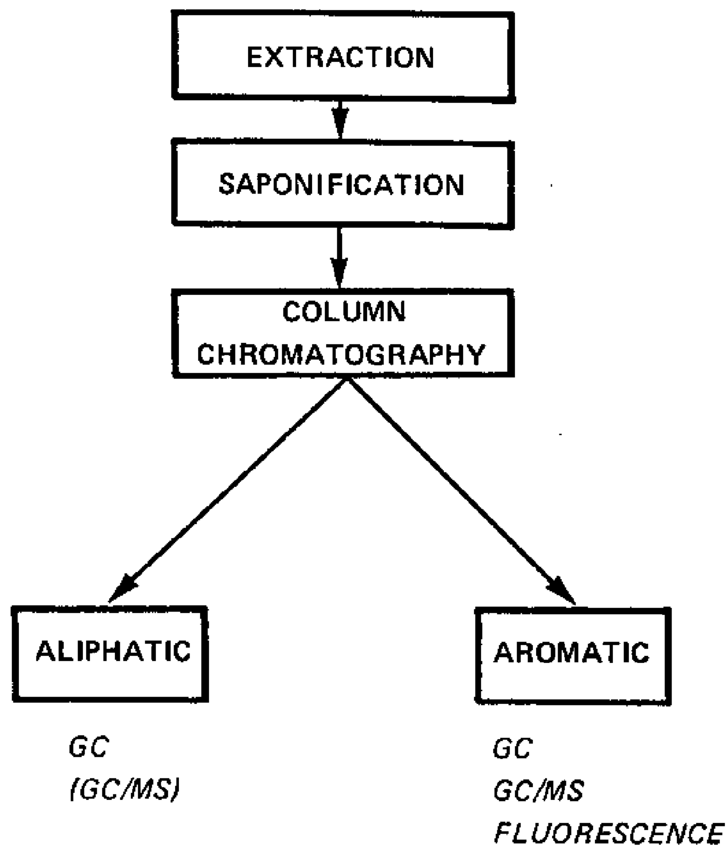

SEDIMENT CORES
GEOLOGIC DESCRIPTION
CORE SECTIONED
SURFACE GRABS
GRAIN SIZE
HEAVY METALS, TRACERS
PHENOLS
TOC, TKN
HYDROCARBONS
SURFACE GRABS
LEACHABILITY
SUSPENSION PROPERTIES
TOXICITY

Figure 3. Hydrocarbon Analysis Scheme. Sediments were solvent extracted, the extract saponified to remove esters then chromatographed on silica gel/alumina to isolate aliphatic and aromatic hydrocarbons. Aliphatics and aromatics were identified by fused silica gas chromatography on a DB-1 column 15m x 0.25mm i.d., programmed at 90° to 250°C at 4°/mm with a Perkin Elmer 3920 or Sigma 2000 GC attached to a Perkin-Elmer Sigma 10 data station. A few aliphatic and a considerable number of aromatics were further characterized by gas chromatography/mass spectrometry (GC/MS) at the GC/MS Center at the University of Alabama, Birmingham. Fluorescence scans were also obtained on all aromatic fractions with a Perkin-Elmer MPF-44 fluorescence spectrophotometer.

Figure 3

HYDROCARBON ANALYSIS



Figures 4-14. Chemical-geological profiles of sediment cores from the western Mississippi Sound. Total organic carbon (TOC), total Kjeldahl N (TKN) and phenols are reported as wt % or μg/g (ppm) of dry sediment. Hydrocarbon weights are the sums of gravimetric weights of aliphatic and aromatic fractions. Comments along the right margin are summaries of examinations of gas chromatograms, mass spectra of selected samples and fluorescence spectra. Foraminifera records were used to establish the Holocene-Pleistocene boundaries.

Figure 4

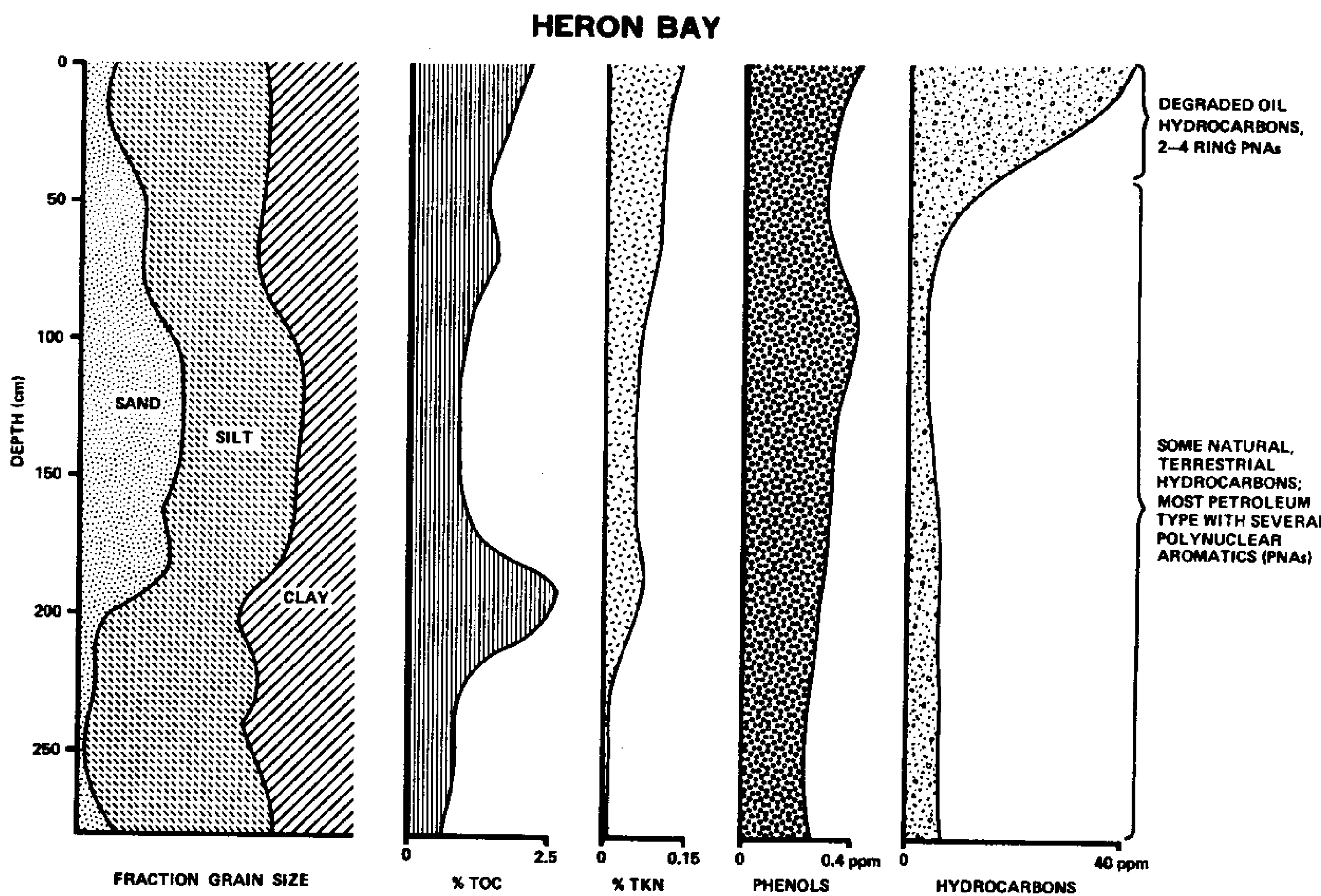

HERON BAY
DEPTH (cm)
0
50
100
150
200
250
SAND
SILT
CLAY
FRACTION GRAIN SIZE
0
2.5
% TOC
0
0.15
% TKN
0
0.4 ppm
PHENOLS
0
40 ppm
HYDROCARBONS
DEGRADED OIL HYDROCARBONS, 2–4 RING PNAs
SOME NATURAL, TERRESTRIAL HYDROCARBONS; MOST PETROLEUM TYPE WITH SEVERAL POLYNUCLEAR AROMATICS (PNAs)

Figure 5

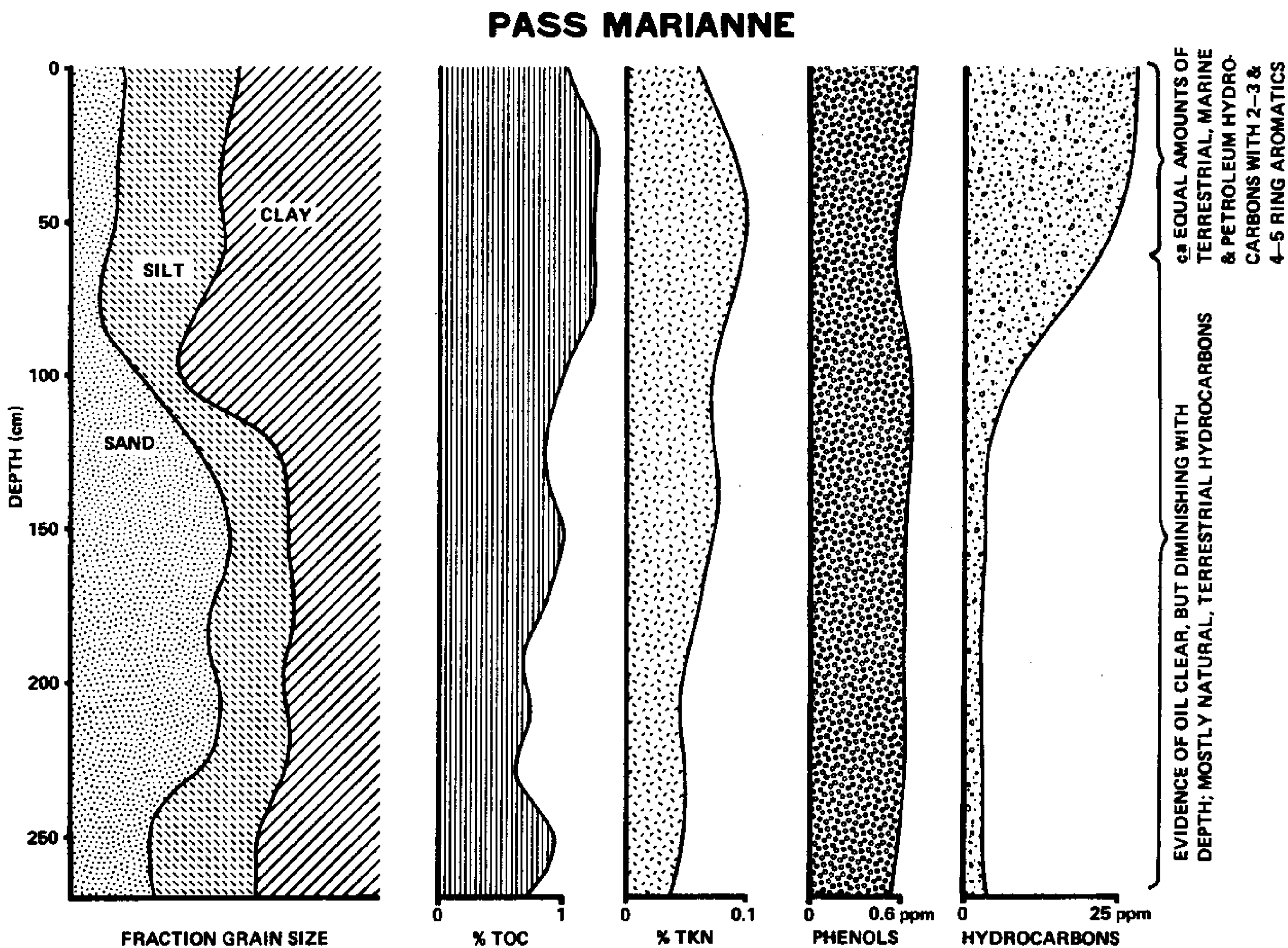

PASS MARIANNE
DEPTH (cm)
0
50
100
150
200
250
SAND
SILT
CLAY
FRACTION GRAIN SIZE
0
1
% TOC
0
0.1
% TKN
0
0.6 ppm
PHENOLS
0
25 ppm
HYDROCARBONS
ca EQUAL AMOUNTS OF TERRESTRIAL, MARINE & PETROLEUM HYDRO-CARBONS WITH 2–3 & 4–5 RING AROMATICS
EVIDENCE OF OIL CLEAR, BUT DIMINISHING WITH DEPTH; MOSTLY NATURAL, TERRESTRIAL HYDROCARBONS

Figure 6

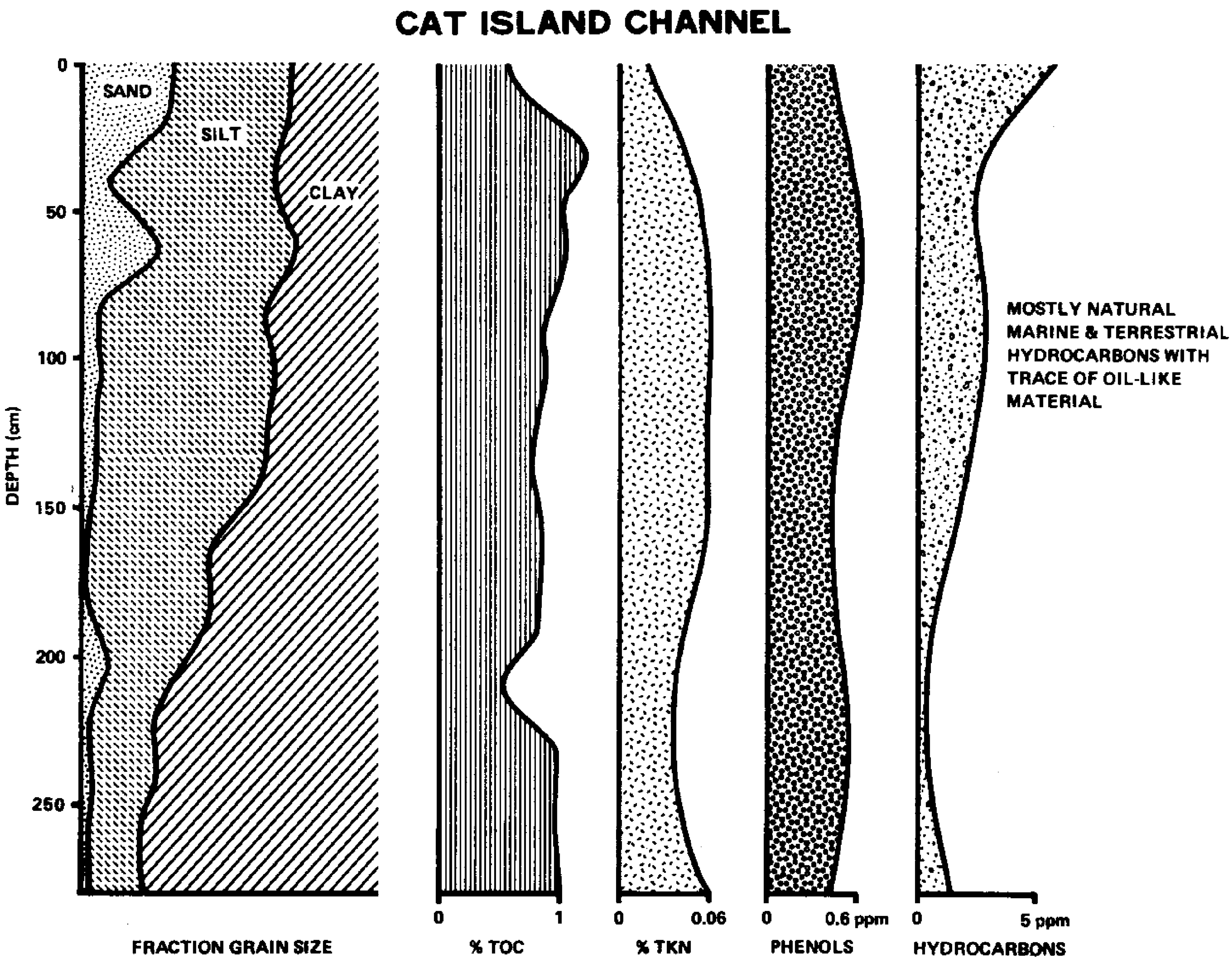

CAT ISLAND CHANNEL
DEPTH (cm)
0
50
100
150
200
250
SAND
SILT
CLAY
FRACTION GRAIN SIZE
0
1
% TOC
0
0.06
% TKN
0
0.6 ppm
PHENOLS
0
5 ppm
HYDROCARBONS
MOSTLY NATURAL
MARINE & TERRESTRIAL
HYDROCARBONS WITH
TRACE OF OIL-LIKE
MATERIAL

Figure 7

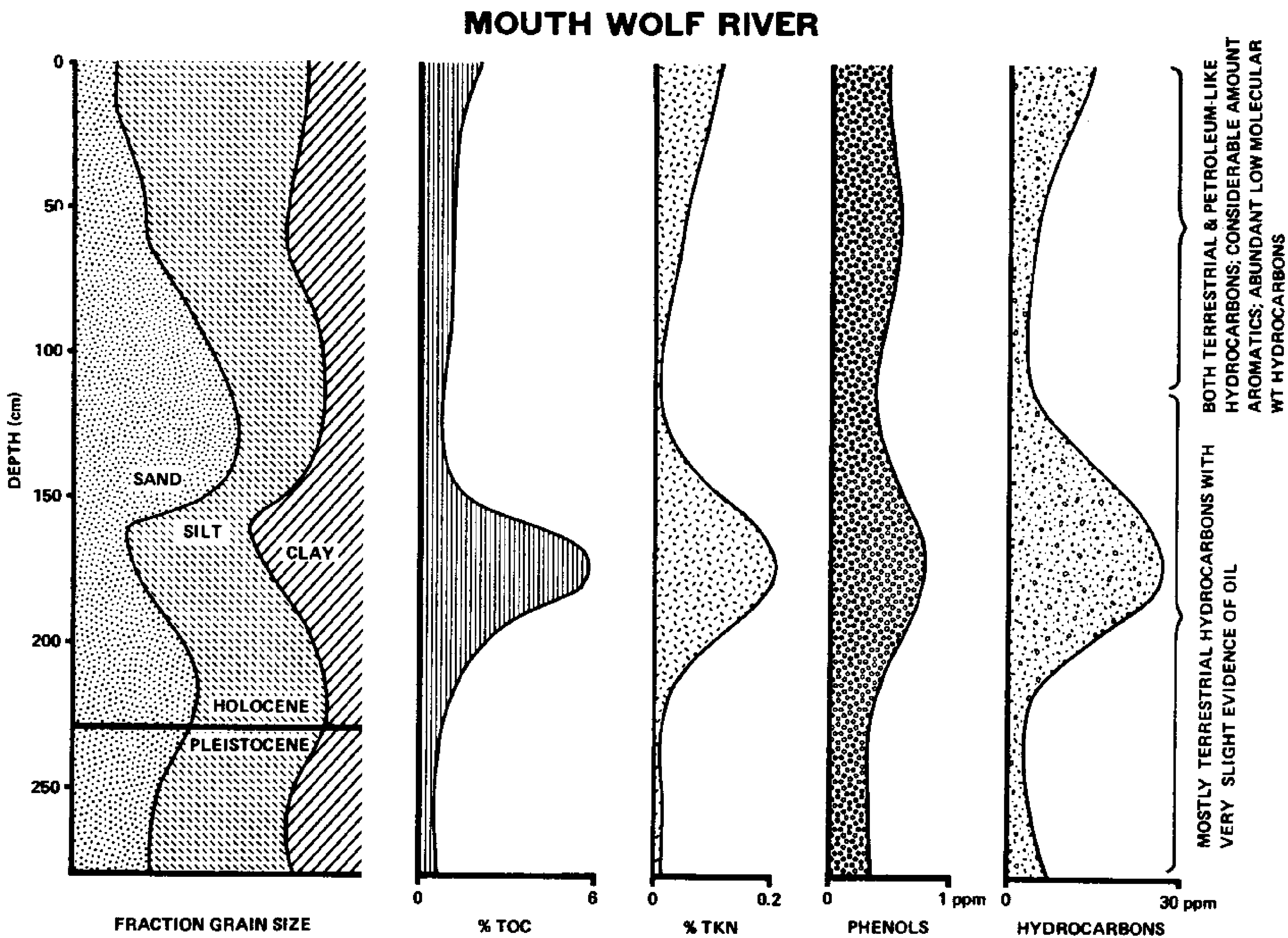

MOUTH WOLF RIVER
DEPTH (cm)
0
50
100
150
200
250
SAND
SILT
CLAY
HOLOCENE
PLEISTOCENE
FRACTION GRAIN SIZE
0
6
% TOC
0
0.2
% TKN
0
1 ppm
PHENOLS
0
30 ppm
HYDROCARBONS
BOTH TERRESTRIAL & PETROLEUM-LIKE HYDROCARBONS; CONSIDERABLE AMOUNT AROMATICS; ABUNDANT LOW MOLECULAR WT HYDROCARBONS
MOSTLY TERRESTRIAL HYDROCARBONS WITH VERY SLIGHT EVIDENCE OF OIL

Figure 8

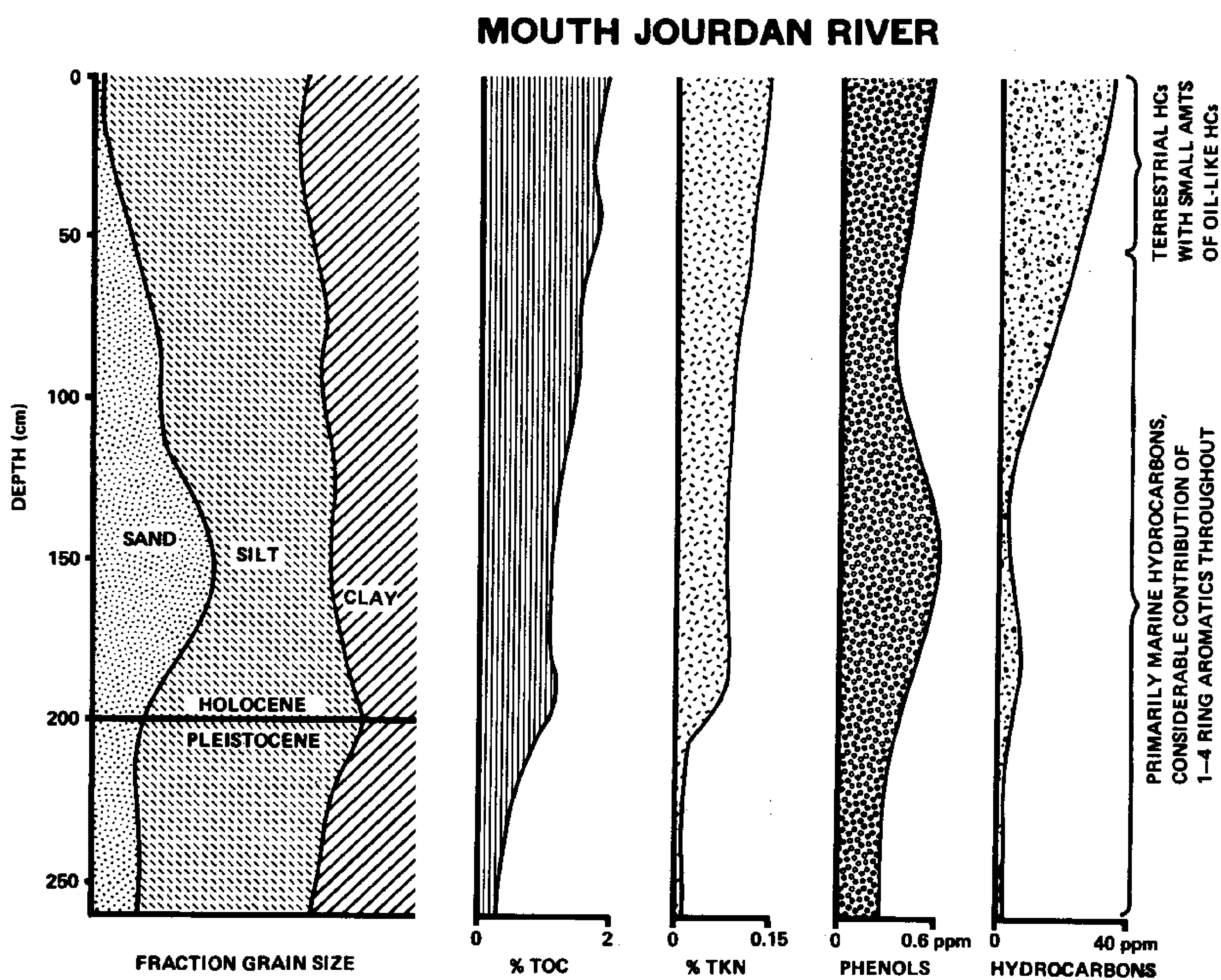
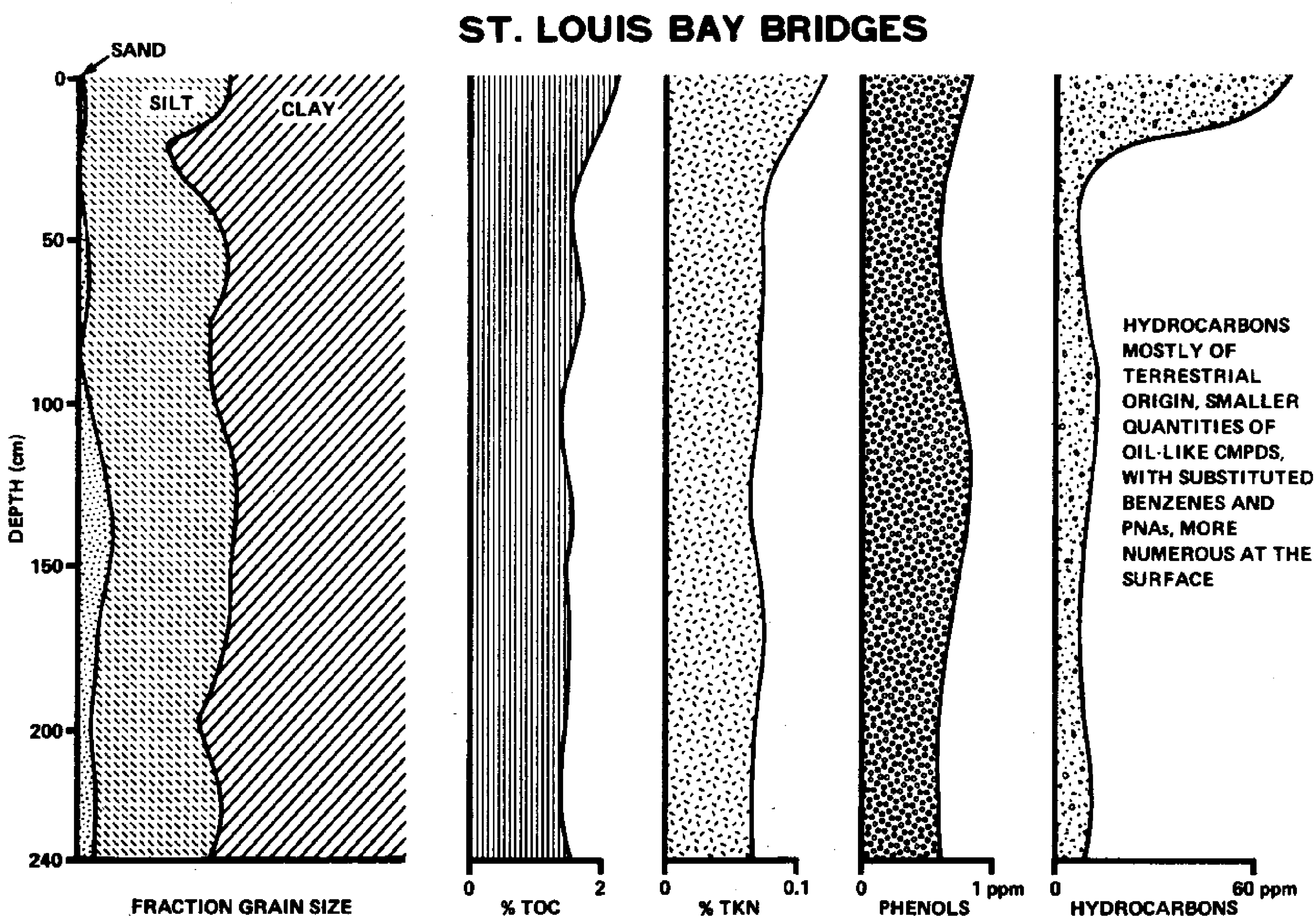

MOUTH JOURDAN RIVER
DEPTH (cm)
0
50
100
150
200
250
SAND
SILT
CLAY
HOLOCENE
PLEISTOCENE
FRACTION GRAIN SIZE
0
2
% TOC
0
0.15
% TKN
0
0.6 ppm
PHENOLS
0
40 ppm
HYDROCARBONS
TERRESTRIAL HCs WITH SMALL AMTS OF OIL-LIKE HCs
PRIMARILY MARINE HYDROCARBONS, CONSIDERABLE CONTRIBUTION OF 1—4 RING AROMATICS THROUGHOUT

Figure 9



ST. LOUIS BAY BRIDGES
SAND
SILT
CLAY
DEPTH (cm)
0
50
100
150
200
240
FRACTION GRAIN SIZE
0
2
% TOC
0
0.1
% TKN
0
1 ppm
PHENOLS
0
60 ppm
HYDROCARBONS
HYDROCARBONS MOSTLY OF TERRESTRIAL ORIGIN, SMALLER QUANTITIES OF OIL-LIKE CMPDS, WITH SUBSTITUTED BENZENES AND PNAs, MORE NUMEROUS AT THE SURFACE

Figure 10

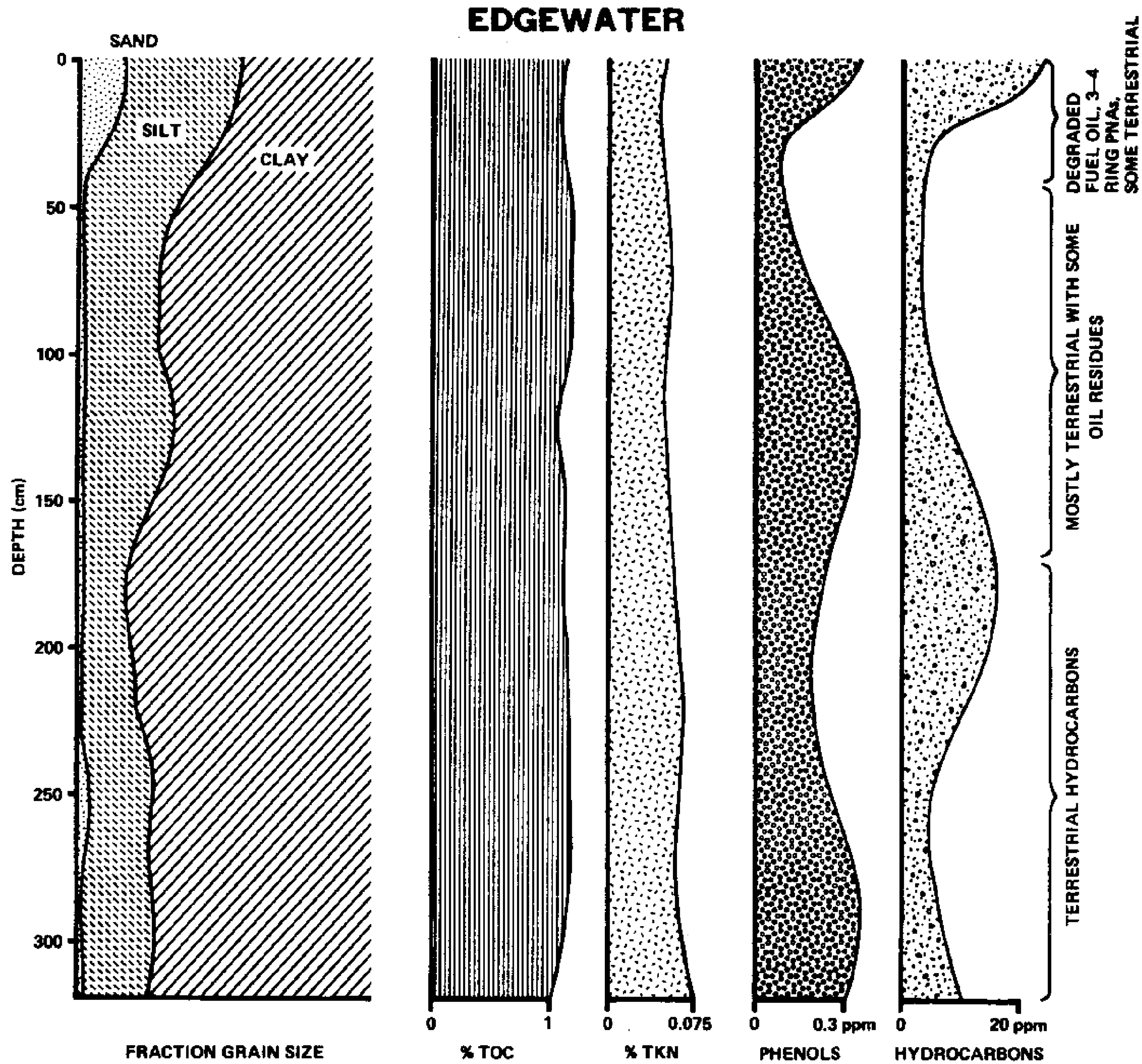

EDGEWATER
SAND
SILT
CLAY
DEPTH (cm)
0
50
100
150
200
250
300
FRACTION GRAIN SIZE
0
1
% TOC
0
0.075
% TKN
0
0.3 ppm
PHENOLS
0
20 ppm
HYDROCARBONS
DEGRADED FUEL OIL, 3–4 RING PNAs, SOME TERRESTRIAL
MOSTLY TERRESTRIAL WITH SOME OIL RESIDUES
TERRESTRIAL HYDROCARBONS

Figure 11

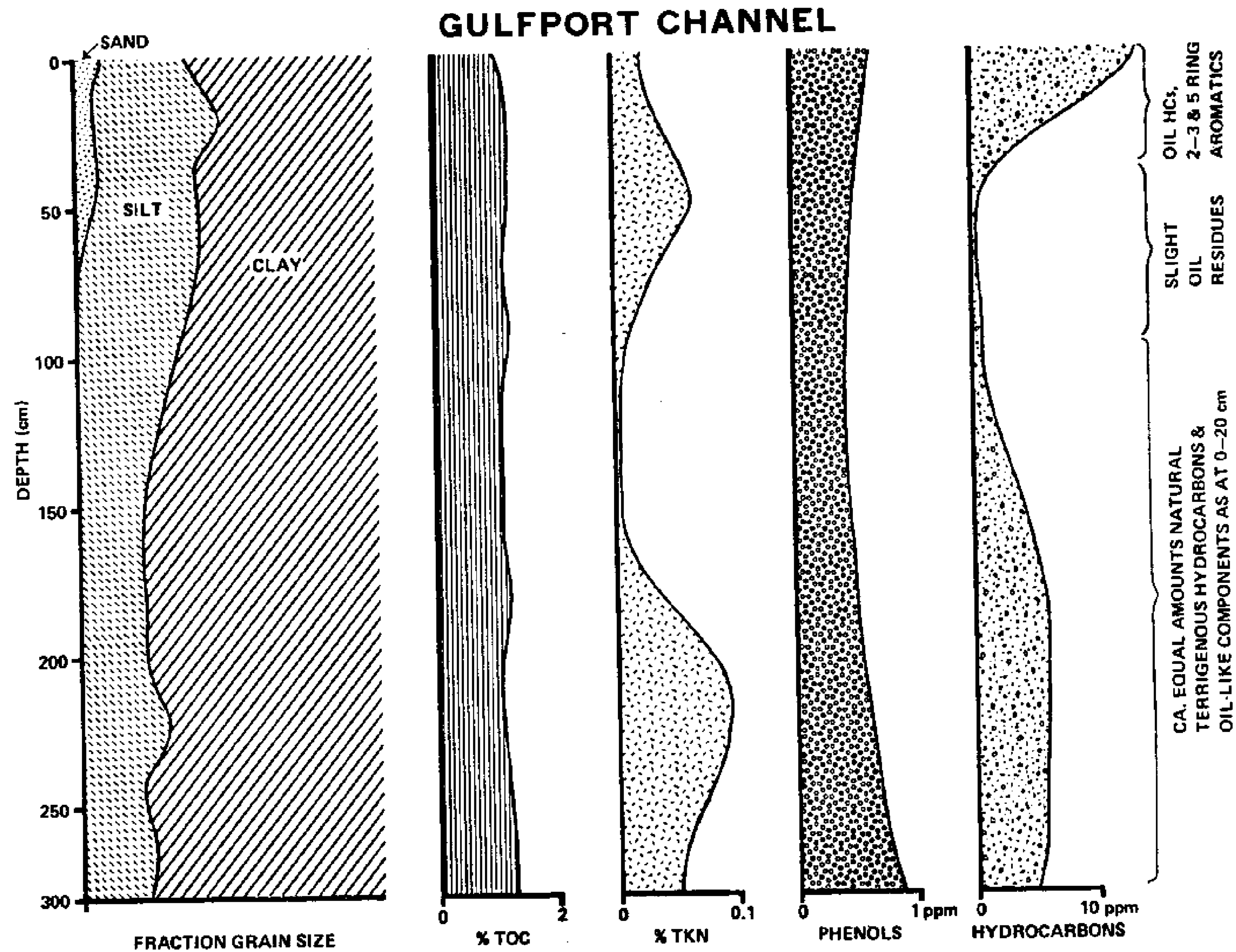

GULFPORT CHANNEL
SAND
SILT
CLAY
DEPTH (cm)
0
50
100
150
200
250
300
FRACTION GRAIN SIZE
0
2
% TOC
0
0.1
% TKN
0
1 ppm
PHENOLS
0
10 ppm
HYDROCARBONS
OIL HCs, 2–3 & 5 RING AROMATICS
SLIGHT OIL RESIDUES
CA. EQUAL AMOUNTS NATURAL TERRIGENOUS HYDROCARBONS & OIL-LIKE COMPONENTS AS AT 0–20 cm

Figure 12

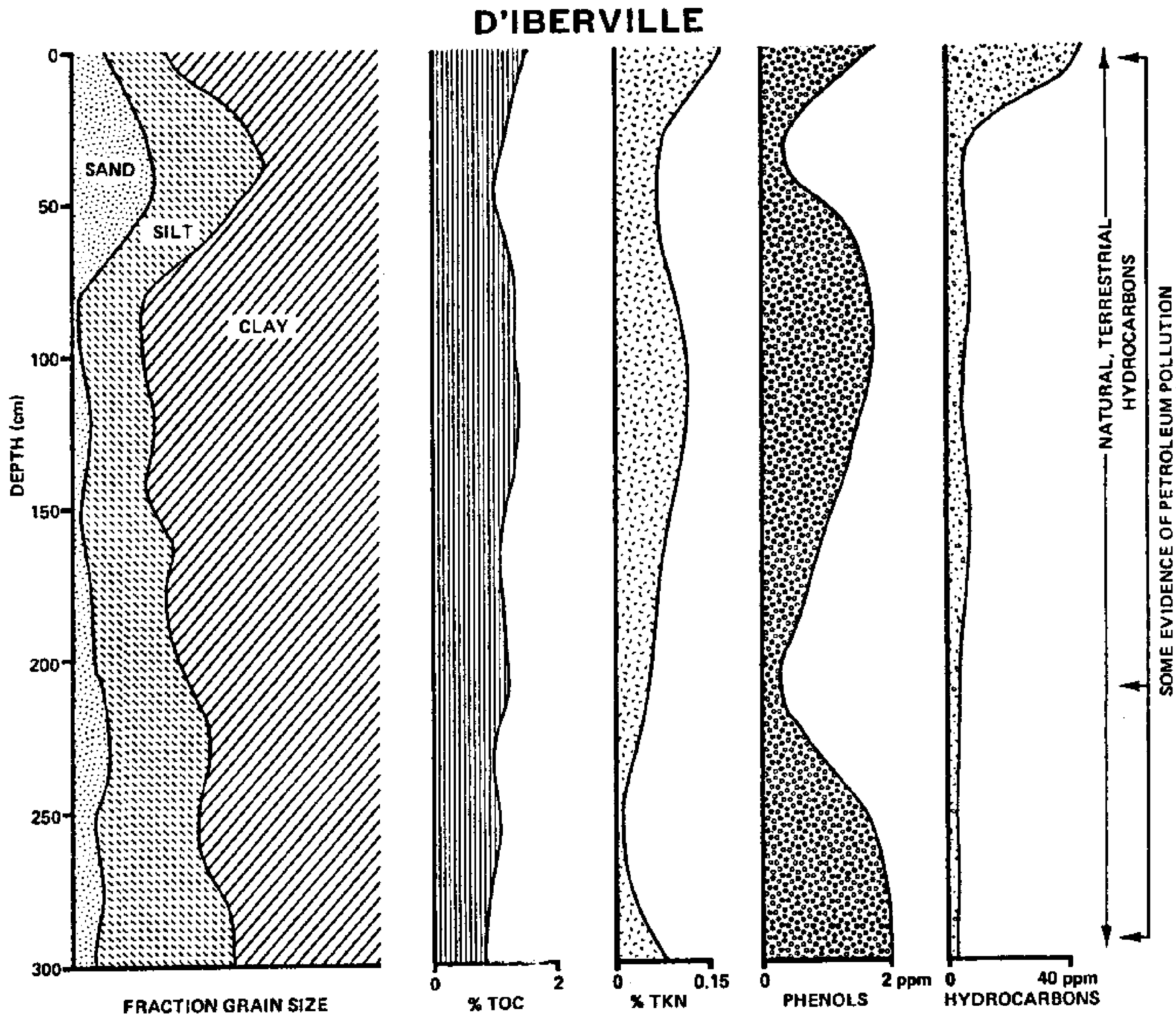

D'IBERVILLE
DEPTH (cm)
0
50
100
150
200
250
300
SAND
SILT
CLAY
FRACTION GRAIN SIZE
0
2
% TOC
0
0.15
% TKN
0
2 ppm
PHENOLS
0
40 ppm
HYDROCARBONS
NATURAL, TERRESTRIAL HYDROCARBONS
SOME EVIDENCE OF PETROLEUM POLLUTION

Figure 13

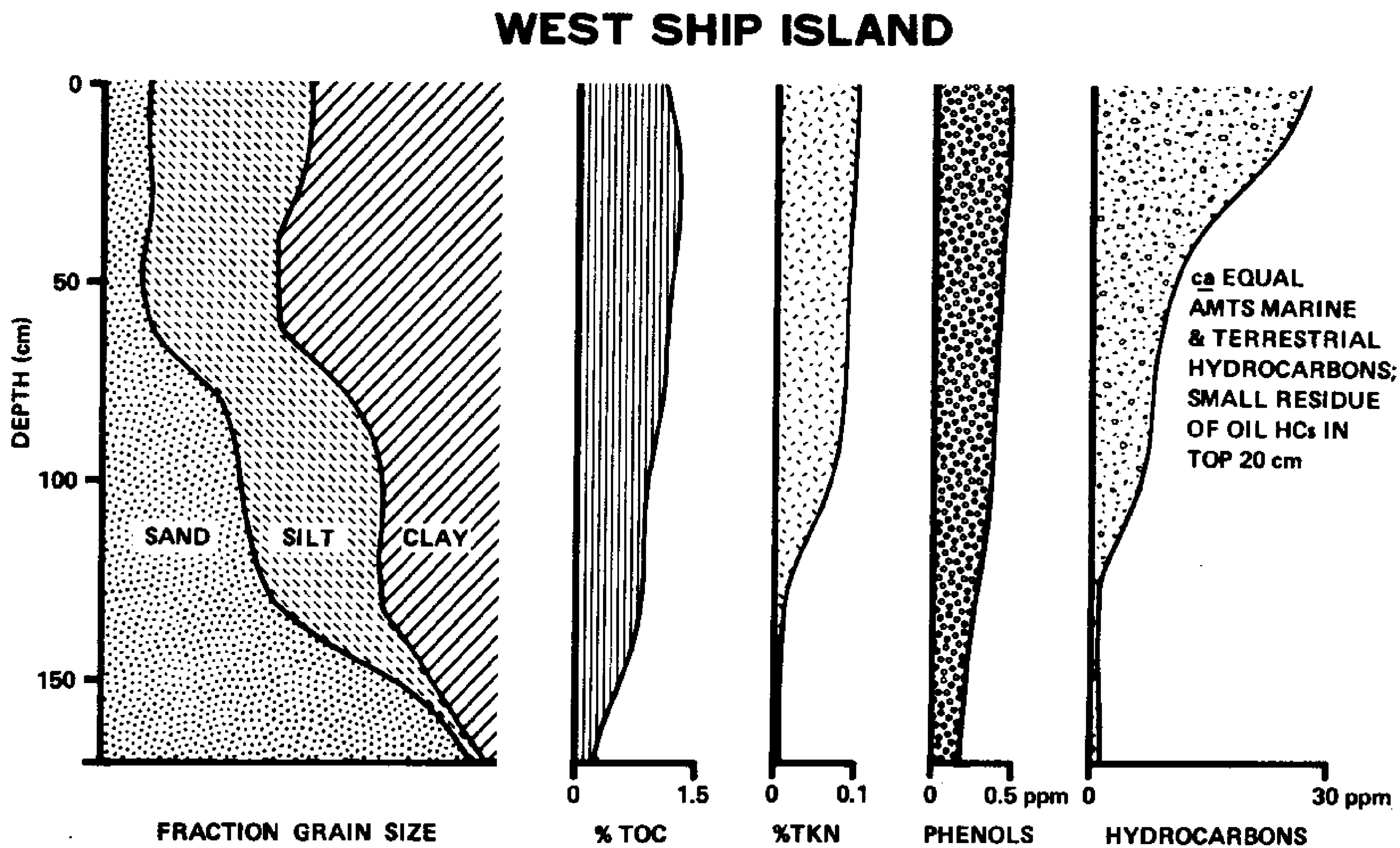

WEST SHIP ISLAND
DEPTH (cm)
0
50
100
150
SAND
SILT
CLAY
FRACTION GRAIN SIZE
0
1.5
% TOC
0
0.1
%TKN
0
0.5 ppm
PHENOLS
0
30 ppm
HYDROCARBONS
ca EQUAL
AMTS MARINE
& TERRESTRIAL
HYDROCARBONS;
SMALL RESIDUE
OF OIL HCs IN
TOP 20 cm

Figure 14

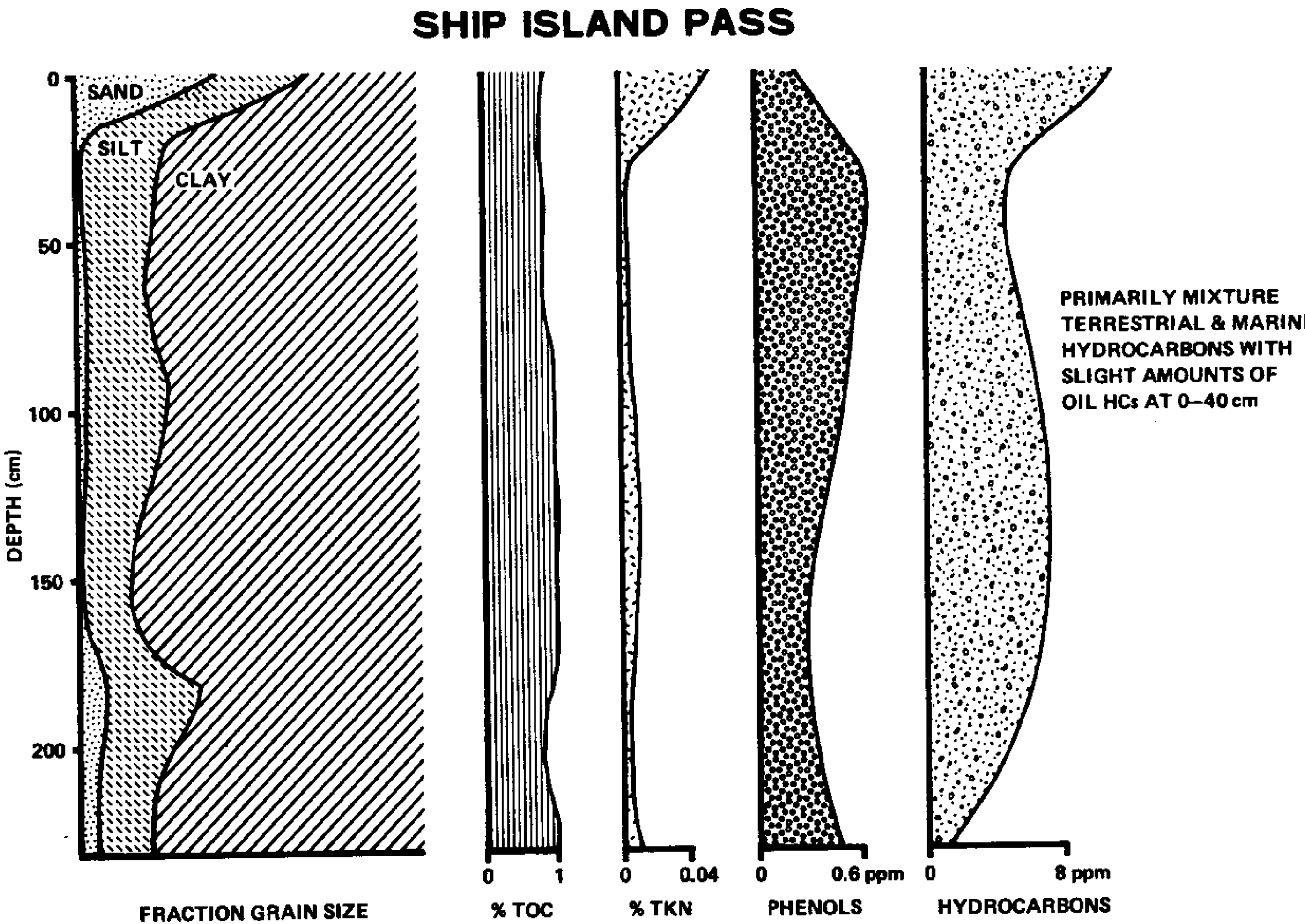

SHIP ISLAND PASS
SAND
SILT
CLAY
DEPTH (cm)
0
50
100
150
200
FRACTION GRAIN SIZE
0
1
% TOC
0
0.04
% TKN
0
0.6 ppm
PHENOLS
0
8 ppm
HYDROCARBONS
PRIMARILY MIXTURE
TERRESTRIAL & MARINE
HYDROCARBONS WITH
SLIGHT AMOUNTS OF
OIL HCs AT 0–40 cm

Table 1

Surface Sample Station Location and Description

Map Key[1]	Station Name	Location	Selection Rationale
BB	St. Louis Bay Bridges	Between L&N and Hwy 90 bridges	Same as location of core #39[2]
BP	Bayou Pierre	W. Pascagoula River	Railroad trestle, marina; chemical industry
CD	Chevron North Dock	Bayou Casotte docks for Chevron U.S.A.	Site of 2000 barrel oil spill
CI	Coley Island	Confluence of Biloxi River and Bernard Bayou	Mixing zone for effluents from power plant and chemical industries with river discharges
CT	Cooling Tower Canal	Above dredged area in Bayou Casotte	Some effluent in canal; deposit deposit site of recent sediments in bayou
DB	Davis Bayou	Site of Gulf Islands National Park Headquarters	Same as location of core #1[2]
DI	Deer Island	West of mouth of Biloxi Bay	Same as location of core #4[2]
DR	Dead River	West Pascagoula River	Same as location of core #23[2]
EB	Elevator Bayou	East bank, near mouth of East Pascagoula River	Down river from most pollutant sources
ER	Escatawpa River Bridge	Old bridge on river	Several industries in vicinity
FB	Old Ft. Bayou	East of mouth of Biloxi Bay	Same as location of core #3[2]

Map Key[1]	Station Name	Location	Selection Rationale
GB	Graveline Bayou	Mouth of Bayou	Municipal sewage in bayou, prohibited oyster beds
GC	East Gulfport Channel	Mid distance between Coliseum and Ft. Mass. in Sound	Collection site of river, harbor discharges into western Sound
GL	Gulfport Lake	Back Bay Biloxi	Same as location of core #8[2]
GP	Griffen Point	Escatawpa River	Same as location of core #18[2]
HB	Heron Bay	East of Pearl River mouth	Same as location of core #31[2]
HC	Hewchem Industrial Canal	West end of Industrial Canal in Back Bay Biloxi	Numerous industrial waste inputs
HI	Horn Island	South side of island	Collection site of riverine and tidal pollutants
HM	Halter Marine	Escatawpa River	Shipbuilding; other industry in vicinity
IS	Industrial Seaway	West end of Back Bay Biloxi	Transportation route for industry in Gulfport Lake
LY	Lake Yazoo	Mouth East Pascagoula River	Near shipbuilding; depository for acetylene production waste; residential area
MC	Mississippi Chemical East Bank	Bayou Casotte, dredged area	Region of several large chemical industries
ML	McInnis Lake	Escatawpa River	Same as location of core #17[2]
MW	Mary Walker Bayou	West Pascagoula River	Same as location of core #24[2]
OG	Open Gulf	South of Horn Island in Gulf of Mexico	Mixture of land-derived and marine pollutants
PM	Paper Mill	Escatawpa River	Same as location of core #19[2]

Map Key[1]	Station Name	Location	Selection Rationale
PP	Pogey Plant	Escatawpa River	Fishmeal processing; chemical plant
PW	Power Plant	Biloxi River near barge entrance to Jack Watson Power Plant	Same as location of core #11[2]
RC	Reichhold Industrial Canal	East end of Industrial Canal in Back Bay Biloxi	Site of industrial waste leaking into canal
RP	Rhodes Point	Back Bay Biloxi	Multi-use industrial zone
SI	Ship Island	West end of island, North of Ft. Massachusetts	Same as location of core #35[2]
TC	Turkey Creek	Bernard Bayou at West end of Gulfport Lake	Variety of industries; residential area
TI	Twin Islands	Mouth of West Pascagoula River	Down river from all pollutant sources in river
VA	VA Hospital	South bank of mid Back Bay Biloxi	Sewage treatment plant
WP	West Prong	Bayou Casotte	Upstream from industrial complex
CEX	Corning East Bank	Mouth Bayou Casotte	Industrial site
CHX	Chevron West Bank	Bayou Casotte, west of Chevron U.S.A.	Industrial site
CNX	Control	Upper reaches Bayou Casotte	Control site above all industry in Bayou Casotte
GLX	Graveline Lake	Upstream of Graveline Bayou	Sewage outfall
GSX	Gypsum Stack	Above dredged region of Bayou Casotte	Deposit site of industrial effluents

Map Key[1]	Station Name	Location	Selection Rationale
IDX	Inner Discharge Canal	Pt. aux Chenes, up drainage canal for oil refinery	Refinery effluent
MDX	Mouth Discharge Canal	Pt. aux Chenes, mouth refinery discharge canal	Refinery effluent
TAX	Pascagoula Transect #1	Transect point closest to Belle Fountaine Pt. extending to Dog Keys Pass	High river flow from Pascagoula River across Mississipp Sound
TBX, TCX, TDX, TEX, TFX	Pascagoula Transect #2-6	Increasing distances from Belle Fountain Pt. on transect	High river flow from Pascagoula River across Mississippi Sound
PCX	Power Plant Canal	Canal leading to Jack Watson Power Plant	Cooling water discharge from power plant

[1]See Figure 1.
[2]See Core site descriptions in Table 2.

Table 2

Sediment Core Sample Sites in Mississippi Sound

Station No.	Name	Date Sampled	Coordinates		Description
1	Davis Bayou	October 1981	30°23.1'N	88°48.9'W	Near mouth of Davis Bayou; nursery area; historical data station; non-point source site.
2	South Deer Island	October 1981	30°20.3'N	88°50.0'W	Mouth of Biloxi Bay; historical data station; non-point source site.
3	Old Fort Bayou	October 1981	30°25.2'N	88°51.0'W	Ocean Springs residential area; non-point source site.
4	Deer Island	October 1981	30°22.9'N	88°53.0'W	Fine-grained depository from Biloxi Bay.
5	Goat Island	October 1981	30°24.6'N	88°54.5'W	Near I-110 bridge into Biloxi; non-point source site.
6	Keesler AFB	October 1981	30°25.1'N	88°55.8'W	Historical data station; non-point source site at mid-point in Biloxi Bay
7	Popps Ferry	October 1981	30°24.7'N	88°58.4'W	W. Biloxi Bay, spoil and bridge construction area; non-point source site.
8	Gulfport Lake	October 1981	30°25.2'N	89°04.1'W	Junction at Bernard Bayou and Industrial Seaway; heavy industrial area, major sewage outfall; fisheries trawl station.
9	Gulfport Channel	October 1981	30°18.8'N	89°01.8'W	E. of spoil bank on east side of Ship Channel trans-sound site.
10	Cedar Lake	October 1981	30°26.5'N	88°56.9'W	Above most industrial development; historical data station; non-point source site.
11	Power Plant in Biloxi River	October 1981	30°26.1'N	89°01.1'W	In oxbow lake near power plant in Biloxi, MS.

Station No.	Name	Date Sampled	Coordinates		Description
12	Big Lake	October 1981	30°24.5'N	89°00.2'W	Discharge canal from power plant; confluence of several waterways.
13	Edgewater	October 1981	30°20.4'N	88°58.2'W	South of Beauvoir or Edgewater Plaza; trans-Sound site.
14	Point aux Chenes	November 1979	30°18.7'N	88°29.2'W	Oil refinery discharge canal into MS Sound; historical data station.
15	Bayou Casotte	November 1979	30°21.3'N	88°30.9'W	Heavy boat traffic, industrial park east of E. Pascagoula River mouth.
16	Mouth E. Pascagoula River	November 1979	30°20.2'N	88°33.5'W	Large shipbuilding industry nearby; mouth of river with serious pollution problems.
17	McInnis Lake	November 1979	30°24.9'N	88°31.4'W	Escatawpa River; bridge construction; sewage outfall.
18	Griffin Point	November 1979	30°25.2'N	88°34.1'W	Sewage outfall; historical data station; below confluence at Escatawpa and E. Pascagoula Rivers.
19	Paper Mill	November 1979	30°25.1'N	88°29.5'W	Escatawpa River; canal adjacent to large paper mill.
20	Escatawpa R. Control	November 1979	30°26.4'N	88°28.3'W	Above most industry on Escatawpa River.
21	E. Pascagoula North of I-10	November 1979	30°26.3'N	88°33.6'W	Above confluence with Escatawpa River; near I-10 bridge construction; non-point source site.
22	Bayou Chemise	November 1979	30°24.1'N	88°35.7'W	Natural channel between E. & W. Pascagoula Rivers; non-point source site.
23	Dead River	November 1979	30°25.6'N	88°37.2'W	W. Pascagoula River; oxbox lake with adjacent marina and residential area.

Station No.	Name	Date Sampled	Coordinates		Description
24	Mary Walker Bayou	November 1979	30°23.4'N	88°36.8'W	Heavy boat traffic; W. Pascagoula River.
25	Mouth W. Pascagoula	November 1979	30°21.0'N	88°38.4'W	Below all riverine pollutant sources.
26	East Mississippi Sound	November 1979	30°15.9'N	88°25.8'W	Trans-Sound site.
27	Horn Island	October 1980	30°14.7'N	88°35.4'W	North central portion of island; trans-Sound sample.
28	Bellefontaine Point	November 1979	30°18.5'N	88°43.8'W	Beachfront between Ocean Springs and Pascagoula; western most extent of shoreward flow of W. Pascagoula River.
29	Round Island	November 1979	30°19.1'N	88°36.2'W	South of E. Pascagoula River and in path of discharge.
30	W. Horn Island	June 1982	30°14.9'N	88°45.9'W	Western end of Horn Island; trans-Sound site.
31	Heron Bay	June 1982	30°10.4'N	89°28.4'W	Between St. Louis Bay and Pearl River; deposit site for latter.
32	Petit Bois	October 1980	30°12.4'N	88°27.0'W	North side of island; trans-Sound site.
33	W. Ship Island	June 1982	30°13.6'N	88°57.5'W	Western end of W. Ship Island; trans-Sound site.
34	Pass Marianne	June 1982	30°14.3'N	89°11.5'W	North of Cat Island; deposit site for sediments from Lake Borgne.
35	Ship Island Pass	June 1982	30°12.9'N	89°02.8'W	North of Camille cut in Ship Island; trans-Sound site.
36	Cat Island Channel	June 1982	30°11.6'N	89°07.0'W	Southwest of "Spit Cove" on southern tip of Cat Island; monitoring input from west.

Station No.	Name	Date Sampled	Coordinates		Description
38	Mouth Jourdan River	June 1982	30°20.9'N	89°21.2'W	Input from Jourdan River into St. Louis Bay.
39	St. Louis Bay Bridges	June 1982	30°18.5'N	89°18.7'W	Between railroad and hwy bridges; sediments from St. Louis Bay.
40	Mouth Wolf River	June 1982	30°21.0'N	89°18.3'W	East of Grassy Point; input from Wolf River.
41	Bayou La Batre	October 1980	30°20.1'N	88°17.1'W	Heavy industrial park east of Mississippi-Alabama line.
42	Dauphin Island	October 1980	30°16.1'N	88°16.0'W	North side of island; trans-Sound site.
43	D'Iberville	October 1981	30°22.4'N	88°57.3'W	South of D'Iberville Hotel; deposite site for Biloxi Bay sediments.
44	Bernard Bayou	October 1981	30°24.3'N	89°00.9'W	In southern "elbow" of bayou; non-point source site.

Table 3

Organic Components of Mississippi Sound Surface Sediments

General Location	Location Name[1]	Location Code[2]	TKN[3], mg/g	TOC[4], %	Total HCs[5], µg/g	Aromatic HCs[6], µg/g	Phenols[7], µg/g
Pascagoula River System	McInnis Lake	17/ML	4.24/--	14.0/--	1510/--	246/--	1.56/--
	Griffin Point	18/GP	2.79/--	3.30/--	338/--	57.1/--	1.30/--
	Paper Mill	19/PM	3.81/--	12.2/--	306/--	0.00 /--	2.43/--
	Dead River	23/DR	0.86/2.09	0.145/--	137/--	0.032/--	0.861/--
	Mary Walker Bayou	24/MW	-- /3.26	-- /3.64	855/--	139 /--	1.09/--
	Point aux Chenes	14	.000	0.277	0.2	0.00	0.120
	Bayou Casotte	15	1.19	2.66	4660	325	0.836
	Mouth E. Pascagoula Rvr.	16	.000	0.863	14.8	3.93	0.462
	Escatawpa River Con.	20	3.18	7.14	794	113	0.687
	E. Pascagoula Rvr./I-10	21	0.73	1.94	51.2	14.5	0.806
	Bayou Chemise	22	0.45	0.828	6.96	1.20	0.000
	Mouth W. Pascagoula Rvr.	25	0.73	0.850	12.9	3.30	0.246
	Round Island	29	0.51	1.82	90.6	10.0	0.534
	Lake Yazoo	LY	0.573	2.49	9850	1930	0.907
	Elevator Bayou	EB	1.84	3.86	56.8	11.1	1.36
	Twin Islands	TI	0.571	0.206	3.59	0.717	0.480
	Halter Marine	HM	2.20	6.51	-	-	1.84
	Pogey Plant	PP	1.15	4.85	31.1	1.79	0.865
	Miss. Chem. E. Bank	MC	--	4.17	149	22.2	--
	Bayou Pierre	BP	2.15	3.96	577	374	0.415
	Mississippi Hwy. Dept.[8]		0.54	11.4	1730	197	1.10
	Escatawpa River Bridge[8]	ER	-	10.9	1870	110	1.84
	W. Prong Bayou Casotte	WP	1.06	2.82	13,300	1000	2.75
	Graveline Bayou	GB	0.395	0.454	98.0	28.2	2.07
	Chevron N. Dock	CD	0.71	1.37	95.1	15.6	0.437
	Cooling Tower Canal	CT	0.809	2.61	8460	684	
Biloxi Bay	Davis Bayou	1/DB	0.76/--	1.58/--	18.4/--	8.13/--	1.17/--
	Old Fort Bayou	3/FB	0.71/--	1.35/--	3.69/--	0.963/--	0.299/--
	Deer Island	4/DI	0.55/--	0.692/--	170/--	77.1/--	0.763/--
	Gulfport Lake	8/GL	1.08 /--	3.67/--	24.3/--	10.6/--	0.354/--
	Power Plant	11/PW	0.23/--	0.315/--	1.15/--	0.410/--	0.505/--
	South Deer Island	2	0.220	0.866	5.44	1.62	0.254

General Location	Location Name[1]	Location Code[2]	TKN[3], mg/g	TOC[4], %	Total HCs[5], μg/g	Aromatic HCs[6], μg/g	Phenols[7], μg/g
Biloxi Bay (Cont.)	Goat Island	5	0.99	1.62	101	8.45	2.39
	Keesler AFB	6	1.59	2.04	99.4	10.1	0.335
	Popps Ferry	7	0.69	1.58	25.2	7.91	0.490
	Cedar Lake	10	0.76	1.44	7.56	3.15	0.260
	Big Lake	12	1.41	2.30	243	50.9	1.15
	Bernard Bayou	44	0.07	0.868	38.0	6.34	0.285
	Rhodes Point	RP	0.719	2.00	217	41.9	0.324
	V.A. Hospital	VA	1.60	2.65	109	21.2	0.297
	Industrial Seaway	IS	0.307	2.93	8600	2610	0.548
	Turkey Creek	TC	1.28	1.99	704	156	0.632
	Reichhold Indus. Canal	RC	2.59	2.62	1900	419	0.580
	Hewchem Indus. Canal	HC	0.88	1.53	550	89.5	0.347
	Coley Island	CI	0.31	1.31	227	2.91	0.492
St. Louis Bay	Heron Bay	31/HB	1.32/--	0.328/--	37.0/--	9.15/--	0.378/--
	St. Louis Bay Bridge	39/BB	1.07/--	2.08/--	63.9/--	9.77/--	0.773/--
	Mouth Jourdan River	38	1.39	1.83	32.5	7.04	0.537
	Mouth Wolf River	40	0.97	1.56	12.8	3.52	0.485
Mississippi Sound	Horn Island	27/HI	0.112/--	0.0959/--	0.985/--	0.070/--	0.224/--
	West Ship Island	33/SI	0.97/1.07	1.19/1.29	29.9/--	3.52/--	0.470/--
	Gulfport Channel	9	0.26	1.17	11.7	1.91	0.602
	Edgewater	13	0.44	1.10	20.7	3.63	0.302
	East Mississippi Sound	26	0.07	0.370	2.13	0.071	0.319
	Bellefontaine Point	28	0.44	0.526	16.1	2.90	0.390
	West Horn Island	30	0.26	0.597	6.37	0.826	0.282
	Petit Bois	32	1.08	0.303	69.9	3.99	1.77
	Pass Marianne	34	0.69	1.11	27.5	2.42	0.655
	Ship Island Pass	35	0.39	0.883	8.77	1.05	0.341
	Cat Island Channel	36	0.26	0.678	4.80	0.547	0.456
	Bayou La Batre	41	0.0045	0.563	12.3	1.54	0.842
	Dauphin Island	42	0.048	1.31	27.4	11.0	1.62
	D'Iberville	43	1.45	1.36	38.8	6.60	1.15
	Open Gulf	OG	0.73	1.09	18.9	3.77	0.285
	East Gulfport Channel	GC	1.55	1.36	34.5	5.91	0.529

General Location	Location Name[1]	Location Code[2]	TKN[3], mg/g	TOC[4], %	Total HCs[5], μg/g	Aromatic HCs[6], μg/g	Phenols[7], μg/g
Secondary Locations	Mouth Discharge Canal	MDX	--	--	822	214	--
	Inner Discharge Canal	IDX	--	--	134	48.0	--
	Corning East Bank	CEX	--	2.98	27.5	3.88	--
	Chevron West Bank	CHX	--	0.891	181	4.87	--
	Gypsum Stack	GSX	--	3.24	67.0	5.56	--
	Control	CNX	0.31	4.24	1580	163	0.488
	Graveline Lake	GLX	1.38	1.57	238	37.8	--
	Pascagoula Transect #1	TAX	0.12	0.133	7.74	3.87	0.038
	Pascagoula Transect #2	TBX	0.41	0.389	7.82	2.11	0.860
	Pascagoula Transect #3	TCX	0.30	0.304	11.1	--	0.860
	Pascagoula Transect #4	TDX	1.36	1.65	18.3	11.6	2.05
	Pascagoula Transect #5	TEX	0.75	1.31	63.5	14.1	3.37
	Pascagoula Transect #6	TFX	1.11	0.997	25.6	4.67	2.41
	Power Plant Canal	PCX	8.48	24.7	98.5	41.5	1.15

[1]A detailed description of core and surface sample locations may be found in Tables 1 and 2.
[2]Master stations are either surface grabs (2 letter code) where complete bio-geo-chemical analyses were performed or core samples (2 digit code) or both. Secondary stations (3 letter code) were sites for only select chemical data collection. Refer to Figure 1 for geographic locations.
[3]Total Kjeldahl nitrogen, dry sediment wt. basis.
[4]Total organic carbon, dry sediment wt. basis.
[5]Total gravimetric wt., of aliphatic and aromatic hydrocarbons, dry sediment wt. basis.
[6]Gravimetric wt., dry sediment basis.
[7]Total phenols, measured colorimetrically, reported dry sediment basis.
[8]Stations from essentially same location.

Table 4

Environmental Stress Index[1]

	Category I[2] Exposure Mortalities, 3-Phase							Category II[3] Suspension Stability				Category III[4]	Category IV[5]	
	Mysid Shrimp			Sheepshead		Amphipod		Initial Suspended						
Site Name	LP	PP	SP	LP	PP	SP	Average	Solids	$t_{1/2}$	$t_{1/4}$	Average	Disturbance Probability	Biota Susceptibility	Index Product[6]
Pascagoula River System														
Paper Mill	1	5	5	2	1	5	3.2	3	2	2	2.50	3.4	2.67	72.6
Pogey Plant	5	5	5	1	1	5	3.7	4	5	5	4.50	4.0	2.00	133.2
Halter Marine	5	1	1	1	1	1	1.7	1	2	5	2.25	3.2	3.00	36.7
Escatawpa River Bridge	1	3	4	1	1	2	2.0	1	4	5	2.75	5.0	3.00	82.5
McInnis Lake	1	1	1	1	1	1	1.0	2	5	5	3.50	1.4	2.67	13.1
Griffin Point	1	1	4	1	1	5	2.2	4	5	5	4.50	2.8	3.00	83.2
Elevator Bayou	1	1	1	1	1	1	1.0	5	2	2	3.50	5.0	3.33	58.3
Lake Yazoo	5	5	5	5	5	5	5.0	4	3	2	3.25	2.0	4.33	141.0
Dead River	1	1	1	1	1	1	1.0	5	1	2	3.25	1.0	3.33	10.8
Mary Walker Bayou	1	1	3	1	1	5	2.0	2	4	5	3.25	2.4	3.33	51.9
Bayou Pierre	1	1	1	1	1	1	1.0	2	5	5	3.50	4.4	3.75	57.8
Twin Islands	1	1	1	1	1	1	1.0	1	4	5	2.75	2.2	3.33	20.1
Chevron N. Dock	1	1	1	1	1	1	1.0	4	2	2	3.00	5.0	3.33	50.0
Cooling Tower Canal	5	5	5	1	1	2	3.2	4	3	2	3.25	2.0	3.00	62.4
West Prong	5	5	4	1	1	2	3.0	5	3	2	3.75	2.0	3.33	74.9
Mississippi Chemical E. Bank	1	3	1	1	1	1	1.3	3	4	4	3.50	5.0	3.33	75.8
Graveline Bayou	1	1	1	1	1	1	1.0	2	3	5	3.00	2.6	3.67	28.6
Biloxi Bay System														
Hewchem Industrial Canal	2	4	5	1	1	5	3.0	4	1	1	2.50	3.8	3.33	94.9
Turkey Creek	1	1	1	1	1	1	1.0	5	3	3	4.00	3.0	3.00	36.0
Gulfport Lake	1	4	5	1	1	5	2.8	5	1	1	3.00	4.0	3.00	100.8
Industrial Seaway	1	1	3	1	1	1	1.3	4	3	2	3.25	4.0	3.00	50.7
Reichhold Industrial Canal	1	1	3	1	1	2	1.5	4	1	2	2.75	4.0	3.00	49.5
Coley Island[7]	–	–	–	–	–	–	–	5	1	1	3.00	3.0	4.33	––
Power Plant	1	1	1	1	1	1	1.0	3	1	1	2.00	2.4	3.67	17.6
VA Hospital	1	1	1	1	1	1	1.0	5	3	3	4.00	2.0	4.00	32.0
Rhodes Point	1	1	1	1	1	1	1.0	5	3	2	3.75	5.0	3.33	62.4
Deer Island	1	1	1	1	1	1	1.0	5	3	2	3.75	4.2	3.67	57.8
Old Ft. Bayou	1	1	1	1	1	1	1.0	4	2	1	2.75	3.2	4.00	35.2
Davis Bayou	1	1	1	1	1	1	1.0	5	1	1	3.00	2.6	4.33	33.8
St. Louis Bay System														
St. Louis Bay Bridges	1	1	1	1	1	1	1.0	2	2	3	2.25	2.4	3.00	16.2
Heron Bay	1	1	1	1	1	1	1.0	3	5	4	3.75	1.6	3.67	22.0
Mississippi Sound System														
E. Gulfport Channel	1	1	1	1	1	1	1.0	4	3	2	3.25	4.0	3.00	39.0
Ship Island	1	1	1	1	1	1	1.0	5	3	2	3.75	2.4	3.00	27.0
Horn Island	1	1	1	1	1	1	1.0	4	3	2	3.25	2.0	3.00	19.5
Open Gulf	2	1	1	1	1	1	1.2	5	3	2	3.75	2.0	2.83	25.5

[1] Higher number ratings indicate greater potential risk from polluted sediment in area.

[2] EPA Procedure. Exposure to soluble components of sediment (LP), suspended and solubles (PP) and settled sediment (SP). Test organisms are Mysid shrimp (*Mysidopis almyra*), sheepshead minnows (*Cyprinodon variegatus*), and an amphipod (*Gammarous mucronatus*). Ratings derive from mortalities at the end of 96 hr exposure to undiluted sediment/water preparations. The rating system is 5 for 80–100% significant mortality, 4 (60–79%), 3 (40–59%), 2 (20–39%), and 1 (<20%). The final column is an arithmetical average of the 6 tabulated ratings.

[3] Sub-category ratings derive from the highest rating value in the following scheme: 5 for initial suspended solids (after dispersion in water) (ISS) $\geqslant$ 30,000 mg/l, time for initial solids to drop to ½ original value ($t_{1/2}$) $\geqslant$ 15 min, ¼ original value time ($t_{1/4}$) $\geqslant$ 30 min; ratings of 4 for ISS $\geqslant$ 20,000 mg/l, $t_{1/2} \geqslant$ 10 mm, $t_{1/4} \geqslant$ 20 min; ratings of 3 for ISS $\geqslant$ 10,000 mg/l, $t_{1/2} \geqslant$ 5 min, $t_{1/4} \geqslant$ 10 min; ratings of 2 for ISS $\geqslant$ 1,000 mg/l, $t_{1/2} \geqslant$ 2 min, $t_{1/4} \geqslant$ 4 min; and ratings of 1 for ISS < 1,000 mg/l, $t_{1/2}$ < 2 min and $t_{1/4}$ < 4 min. Average is computed by formula, $[2\,(\mathrm{ISS}) + t_{1/2} + t_{1/4}]/2$.

[4] Rating determined by probability of sediment disturbance in this area: 5–high risk due to boat traffic, dredging, main stream flow, etc.; 4–restricted boat traffic, some natural protection; 3–infrequent disturbance except for tides; 2–isolated from main river flow, and sporting activity; 1–disturbed only in rare circumstances.

[5] Vulnerability of organisms living in area. Considerations are: escape routes, ecological importance of indigenous species, life stages present, species diversity, mobility and susceptibility to stress.

[6] Mathematical product of Category I average, II average, III and IV.

[7] Partial rating.

Table 5

Sediment Bioassay Mortalities[1]

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities											
			24 hrs			48 hrs			72 hrs			96 hrs		
			LP	PP	SP	LP	PP	SP	LP	PP	SP	LP	PP	SP
St. Louis Bay Bridges	Mysid shrimp	100	5	0	→[4]	5	0	→	5	0	→	5	0	5
		50	0	0	-[5]	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	12.5
Bayou Pierre	Mysid shrimp	100	0	5	→	0	5	→	0	5	→	0	5	15
		50	0	0	-	0	5	-	0	5	-	0	5	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	17.5
Chevron N. Dock	Mysid shrimp	100	10	0	→	15	0	→	20	0	→	20	0	0
		50	5	0	-	5	0	-	5	0	-	5	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	15
Cooling Tower	Mysid shrimp	100	85[6]	65*	→	100*	95*	→	100*	100*	→	100*	100*	100*
		50	40*	20	-	70*	75*	-	90*	95*	-	90*	95*	-
		10	0	5	-	5	25*	-	10	30*	-	15	40*	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	47.5*
Davis Bayou	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	0	0
		50	0	0	-	0	0	-	0	0	-	10	5	-
		10	0	0	-	0	5	-	0	5	-	0	5	-
	Sheeps-head	100	0	0	-	0	5	-	0	5	-	0	5	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	-	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	17.5

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities											
			24 hrs			48 hrs			72 hrs			96 hrs		
			LP	PP	SP	LP	PP	SP	LP	PP	SP	LP	PP	SP
Deer Island	Mysid shrimp	100	10	0	→	10	0	→	10	0	→	10	0	5
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	5	-	0	5	-	0	10	-	0	15	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	17.5
Dead River	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	5	0	10
		50	0	0	-	5	0	-	5	0	-	10	5	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	5	0	-	5	0	-	5	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	20
Elevator Bayou	Mysid shrimp	100	0	5	→	0	10	→	0	10	→	10	10	5
		50	5	10	-	10	10	-	10	10	-	15	20	-
		10	5	-	-	5	0	-	5	0	-	20	5	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	5
Escatawpa River Bridge	Mysid shrimp	100	0	0	→	0	25*	→	5	35*	→	5	45*	60*
		50	0	0	-	0	0	-	10	35*	-	20	40*	-
		10	0	0	-	0	0	-	5	10	-	10	10	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	5	0	-	5	0	-	5	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	22.5
Old Fort Bayou	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	5	15
		50	0	0	-	0	0	-	0	0	-	0	10	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	12.5

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities											
			24 hrs			48 hrs			72 hrs			96 hrs		
			LP	PP	SP	LP	PP	SP	LP	PP	SP	LP	PP	SP
Graveline Bayou	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	0	5
		50	0	5	-	0	5	-	0	5	-	5	10	-
		10	0	0	-	0	0	-	10	0	-	10	0	-
	Sheeps-head	100	0	0	-	0	0	-	5	0	-	5	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	2.5
East Gulfport Channel	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	0	0
		50	0	0	-	5	0	-	5	0	-	5	5	-
		10	0	0	-	0	0	-	0	0	-	5	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	10
Gulfport Lake	Mysid shrimp	100	5	0	→	5	35*	→	5	55*	→	5	65*	80*
		50	0	0	-	0	5	-	0	10	-	0	20*	-
		10	15	0	-	15	5	-	15	10	-	15	10	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	5	-	0	10	-	0	10	-	0	10	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	85*
Griffin Point	Mysid shrimp	100	10	10	→	10	10	→	10	25	→	10	25	60*
		50	0	5	-	0	5	-	5	5	-	15	10	-
		10	5	5	-	5	5	-	15	5	-	15	15	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	5	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	87.5*
Heron Bay	Mysid shrimp	100	5	5	→	5	10	→	5	10	→	10	10	10
		50	0	10	-	0	10	-	0	10	-	0	20	-
		10	5	0	-	5	0	-	5	0	-	5	5	-
	Sheeps-head	100	0	0	-	0	5	-	0	5	-	0	5	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	10

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities											
			24 hrs			48 hrs			72 hrs			96 hrs		
			LP	PP	SP	LP	PP	SP	LP	PP	SP	LP	PP	SP
Hewchem Industrial Canal	Mysid shrimp	100	15	0	→	25	30*	→	30*	35*	→	35*	60*	95*
		50	10	5	-	15	5	-	15	5	-	15	15	-
		10	0	0	-	0	5	-	0	5	-	0	15	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	92.5*
East Horn Island	Mysid shrimp	100	0	0	→	5	0	→	5	0	→	5	0	0
		50	0	0	-	0	0	-	0	0	-	5	0	-
		10	0	10	-	0	10	-	0	10	-	0	10	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-	100	-	-	→	-	-	→	-	-	→	-	-	5
Halter Marine	Mysid shrimp	100	0	5	→	20	10	→	35*	10	→	85*	15	20
		50	0	0	-	0	0	-	0	0	-	30	0	-
		10	0	0	-	5	5	-	10	5	-	10	5	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	10
Industrial Seaway	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	0	55*
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	5	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	50
Lake Yazoo	Mysid shrimp	100	100*	100*	100[7]	100*	100*	100[7]	100*	100*	100[7]	100*	100*	100*
		50	100*	100*	-	100*	100*	-	100*	100*	-	100*	100*	-
		10	15	0	-	35*	0	-	45	0	-	50	0	-
	Sheeps-head	100	100*	100*	-	100*	100*	-	100*	100*	-	100*	100*	-
		50	0	0	-	0	5	-	0	5	-	0	5	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	100[7]	-	-	100[7]	-	-	100[7]	-	-	100*

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities 24 hrs LP	PP	SP	48 hrs LP	PP	SP	72 hrs LP	PP	SP	96 hrs LP	PP	SP
McInnis	Mysid	100	0	0	→	0	0	→	0	0	→	10	0	5
Lake	shrimp	50	5	0	-	10	0	-	10	0	-	15	5	-
		10	5	0	-	5	0	-	5	0	-	5	10	-
	Sheeps-	100	0	0	-	0	0	-	0	0	-	0	0	-
	head	50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	20
Mary	Mysid	100	0	0	→	0	0	→	10	0	→	10	0	42.5*
Walker	shrimp	50	0	0	-	5	0	-	5	0	-	5	0	-
Bayou		10	0	0	-	0	0	-	5	6.3	-	5	14.3	-
	Sheeps-	100	0	0	-	0	0	-	0	0	-	0	0	-
	head	50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	τ	-	-	→	-	-	→	-	-	90*
Paper Mill	Mysid	100	0	0	→	0	20	→	15	?	-	45	80*	100*
	shrimp	50	0	0	-	0	25	-	0	25	-	6.7	25	-
		10	0	5	-	5	10	-	10	30	-	20	30	-
	Sheeps-	100	0	0	-	25*	0	-	25*	5	-	25*	5	-
	head	50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	100*
Pogey	Mysid	100	60*	100*	→	80*	100*	→	100*	100*	→	100*	100*	100*
Plant	shrimp	50	20	100*	-	50*	100*	-	90*	100*	-	100*	100*	-
		10	35*	65*	-	55*	90*	-	60*	100*	-	80*	100*	-
	Sheeps-	100	0	0	-	0	0	-	0	0	-	0	0	-
	head	50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	5	-	0	5	-	0	5	-	0	5	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	80*
Power	Mysid	100	0	0	→	0	5	→	0	5	→	0	5	0
Plant	shrimp	50	5	0	-	5	0	-	5	0	-	5	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-	100	0	0	-	0	0	-	0	0	-	0	0	-
	head	50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	12.5

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities 24 hrs LP	24 hrs PP	24 hrs SP	48 hrs LP	48 hrs PP	48 hrs SP	72 hrs LP	72 hrs PP	72 hrs SP	96 hrs LP	96 hrs PP	96 hrs SP
Reichhold Industrial Canal	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	15	50*
		50	0	0	-	0	0	-	0	0	-	5	10	-
		10	0	0	-	0	0	-	0	0	-	5	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	5	0	-	5	0	-	5	0	-	5	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	30*
Rhodes Point	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	5	0	5
		50	0	0	-	0	0	-	0	5	-	0	5	-
		10	0	0	-	0	0	-	5	0	-	5	5	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	12.5
Ship Island	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	0	0
		50	5	5	-	5	5	-	5	5	-	10	10	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	20
Turkey Creek	Mysid shrimp	100	0	0	→	0	0	→	0	0	→	0	5	0
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	10
Twin Islands	Mysid shrimp	100	5	0	→	10	0	→	10	0	→	10	0	30
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	10	-	0	10	-	0	10	-
	Sheeps-head	100	5	15	-	5	15	-	10	15	-	10	20	-
		50	0	0	-	0	10	-	5	10	-	5	10	-
		10	0	0	-	0	0	-	5	0	-	5	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	10

Site Name	Test Organism[2]	% Conc.[3]	% Mortalities 24 hrs			48 hrs			72 hrs			96 hrs		
			LP	PP	SP	LP	PP	SP	LP	PP	SP	LP	PP	SP
V.A. Hospital	Mysid shrimp	100	0	0	→	0	0	→	5	0	→	5	0	0
		50	0	0	-	5	0	-	5	0	-	5	0	-
		10	5	0	-	5	0	-	5	0	-	5	5	-
	Sheeps-head	100	0	0	-	0	5	-	0	5	-	0	5	-
		50	5	0	-	10	0	-	10	0	-	10	0	-
		10	0	5	-	0	10	-	0	10	-	0	10	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	15
West Prong	Mysid shrimp	100	45*	60*	→	80*	90*	→	85*	95*	→	85*	100*	75*
		50	15	20	-	30*	40*	-	45*	50*	-	50*	65*	-
		10	15	0	-	15	0	-	20	0	-	20	0	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pod	100	-	-	→	-	-	→	-	-	→	-	-	25
Open Gulf	Mysid shrimp	100	0	0	→	5	0	→	20	10	→	20	10	5
		50	0	0	-	5	5	-	10	10	-	15	15	-
		10	0	0	-	0	0	-	0	5	-	5	5	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pod	100	-	-	→	-	-	→	-	-	→	-	-	15
MS. Chem. East Bank	Mysid shrimp	100	0	15	→	0	25	→	40	45	→	40	60*	25
		50	20	15	-	20	25	-	20	35	-	20	35	-
		10	20	20	-	30	20	-	35	25	-	35	35	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pod	-	-	→	-	-	→	-	-	→	-	-	→	25
Cooling Tower	Mysid shrimp	100	25*	30*	→	67*	67*	→	89*	94*	→	100*	100*	80*
		50	5	20*	-	20	45*	-	45*	60*	-	75*	65*	-
		10	0	0	-	0	0	-	0	0	-	15	15	-
	Sheeps-head	100	0	0	-	0	0	-	0	0	-	0	0	-
		50	0	0	-	0	0	-	0	0	-	0	0	-
		10	0	0	-	0	0	-	0	0	-	0	0	-
	Amphi-pods	100	-	-	→	-	-	→	-	-	→	-	-	22.5*

[1]% Mortalities at 24 hr intervals in 96 hr exposure tests are tabulated. Percentages are cumulative for the test period. The EPA 3-phase bioassays consisted of exposures to the soluble component of sediments (LP), to the soluble and suspended material after introducing sediment to test water (PP) and to material that settles after dispersion (SP)

[2]Test organisms were mysid shrimp (Mysidopsis almyra), sheepshead minnows (Cyprinodon variegatus) and an amphipod (Gammarous mucronatus)

[3]Concentrations of test solutions based upon 100% representing the usual conditions of testing i.e. preparation by mixing site water and sediment in 4:1 ration (v:v). 50% and 10% preparations are 100% preparations diluted respectively 1:1 and 1:9 with ocean water that has been adjusted to proper salinity

[4]Arrows indicate periods where mortalities not measured for solid phase tests. Only the 96 hr cumulative total was measured

[5]No tests for these conditions

[6]Significantly different from control test

[7]100% mortality noted at beginning of exposure test

[8]A second set of conditions in which ocean water was substituted for site water