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DISCHARGE AND SEDIMENT DATA FOR BARATARIA PASS, LOUISIANA, 1983

By George J. Arcement, Jr.

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FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM OF UNITS (SI)

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot (ft)	0.3048	meter (m)
foot per second (ft/s)	0.3048	meter per second (m/s)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
micromhos per centimeter at 25° Celsius (μmhos/cm)	1	microsiemens per centimeter at 25° Celsius (μS/cm)
square foot (ft^2)	0.0929	square meter (m^2)
inch (in.)	2.54	centimeter (cm)
	25.4	millimeter (mm)
tons per day (tons/d)	0.9072	metric tons per day

To convert temperature in degree Celsius (°C) to degree Fahrenheit (°F), multiply by 9/5 and add 32.

DISCHARGE AND SEDIMENT DATA FOR BARATARIA PASS, LOUISIANA, 1983

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ABSTRACT

Discharge and sediment data were collected in Barataria Pass on three occasions between September and November 1983. Nine sets of velocity profiles were determined in Barataria Pass and additional velocity profiles were determined at selected sites in Barataria Bay and the Gulf of Mexico near the mouth of Barataria Pass. Twelve measurements of discharge on the ebbtide ranged from 26,100 to 195,000 cubic feet per second, and two measurements on the floodtide were each 125,000 cubic feet per second. These measurements were made using velocity-profile data and moving-boat discharge methods.

Suspended-sediment samples were collected in Barataria Pass and at selected sites in Barataria Bay and the Gulf of Mexico near the mouth of Barataria Pass. Concentrations ranged from 13 to 196 milligrams per liter. Bottom-material samples were also collected at these sites and the percentage of sand, silt, and clay was determined for each sample.

Data on velocity, discharge, suspended sediment, and bottom material are presented in tables and figures.

INTRODUCTION

The Louisiana coast, east of Atchafalaya Bay, is rimmed by low-lying barrier islands, which form the State's outermost land boundary and protect valuable wetlands from destruction by the Gulf of Mexico. These barrier islands are being eroded at a relatively rapid rate.

The environmental and economic consequences of erosion of the barrier islands are of great concern (Louisiana State University, 1982). Barrier islands protect marshes and estuaries by acting as a buffer zone to limit saltwater intrusion and minimize damage from hurricane surges. The barrier islands provide habitats for wildlife and shelter for endangered and threatened species. Also, oil and gas facilities, which are located in the marshes and which generate a large income for Louisiana, are affected as erosion moves the shoreline toward them. Because the 3-mi limit of Louisiana's territorial waters is measured from the outer limit of the barrier islands, their landward retreat means a loss to the State in oil and gas revenues from mineral leases. All of these factors make the barrier islands extremely valuable to Louisiana.

A better knowledge of the natural processes that control the development of barrier islands will lead to better management methods to help control erosion and ensure that adverse environmental impacts are minimized. The Louisiana coastal area is geographically extensive and hydrologically complex. Very few quantitative studies of the hydraulics and sediment transport in the area have been made. The Barataria Pass area was selected for a preliminary study of flow and sediment. It is representative of the type of passes associated with the Barataria basin and will be used in developing initial concepts needed in implementing detailed studies.

Purpose

The purpose of the study was to document flow and sediment-transport characteristics in Barataria Pass and to determine the appropriate methods for defining these processes. Methods for measuring discharge and velocity and defining sediment transport were compared to determine the most accurate and trouble-free procedures for obtaining these data in the tidal dominated and rough-water conditions typical of coastal areas. These procedures are needed for planned studies of coastal areas.

Description of Study Area

Louisiana's coastline is characterized by a series of shallow bays and estuaries, surrounded by extensive marsh and adjacent lowlands on the inland side and by barrier islands toward the gulf. This coastal environment is a result of the current and many past Mississippi River deltas and their associated distributary channels. Extensive flood control and navigation development within the coastal environment has significantly altered the natural-flow conditions of the delta system.

The Barataria basin is a typical coastal environment with a fairly well-defined contributing area. (See fig. 1.) It comprises the land that lies between the Mississippi River on the east and Bayou Lafourche on the west. Drainage in the Barataria basin generally flows southward from the levees of the Mississippi River and Bayou Lafourche. Water flows from the upper part of the basin through a series of interconnected bayous, lakes, and canals into Barataria Bay. Barataria Bay is shallow with depths less than 10 ft except in passes and dredged navigation channels. Barataria Pass is the largest channel, approximately 2,500-ft wide and has a maximum depth of about 55 ft, connecting Barataria Bay with the Gulf of Mexico. The flow through Barataria Pass is influenced by a diurnal tidal cycle, having a normal range of about 1 ft.

The basin is largely wetlands and is very productive for fish and wildlife. Most urban areas and agricultural lands within the basin are located along the Mississippi River and Bayou Lafourche. Recreational developments and petroleum-support facilities are well established on Grand Isle, which is the largest of the barrier islands fronting Barataria Bay.

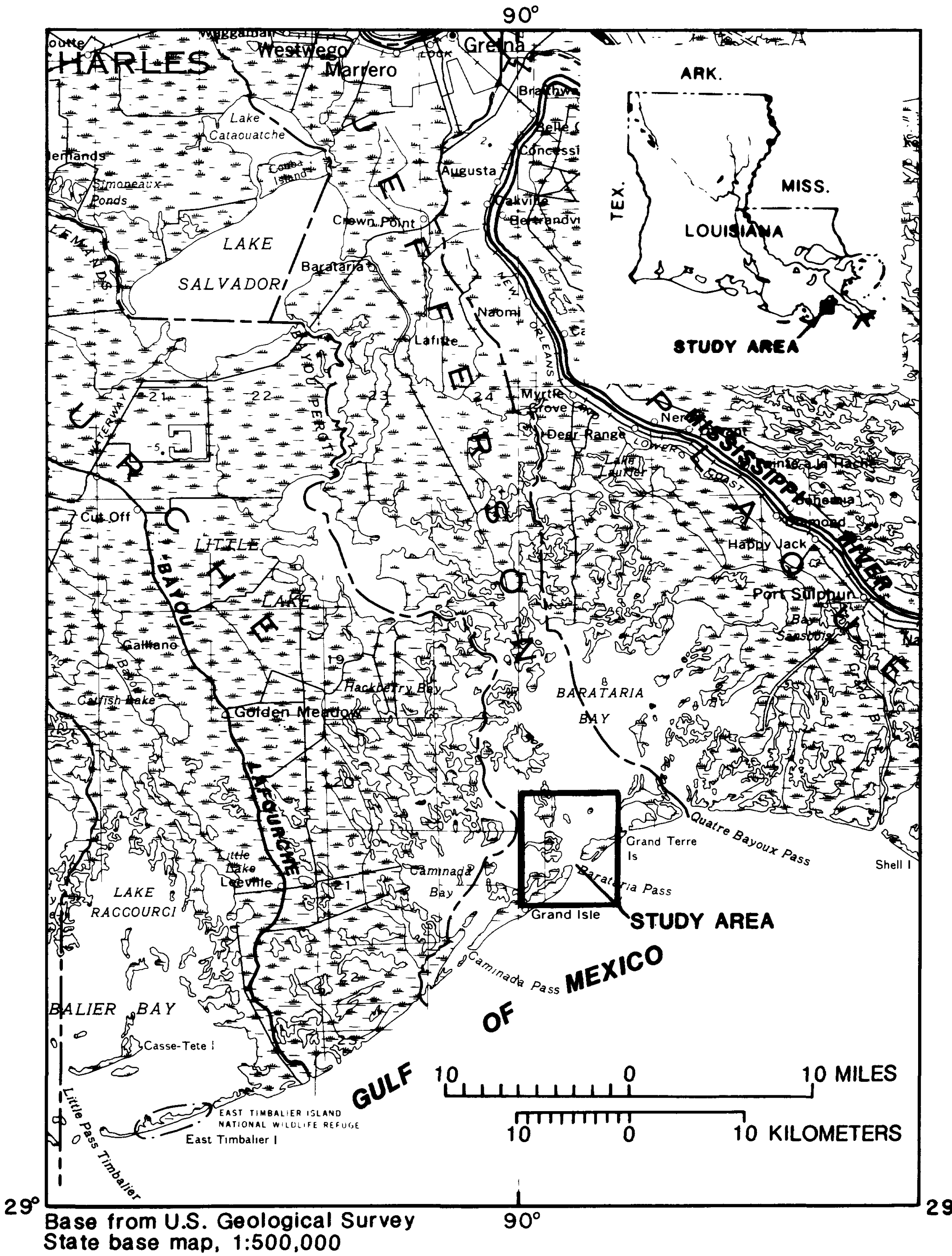

Figure 1.--Location map of Barataria Pass study area.

DATA COLLECTION

Three data-collection trips were made to the study area in the fall of 1983. Data were collected in Barataria Pass and at selected sites in the bay and in the Gulf of Mexico near Barataria Pass. Velocity profiles, discharge measurements, and suspended-sediment and bottom-material samples were obtained. Locations of the data sites are shown in figure 2.

Nine sets of velocity profiles were obtained in Barataria Pass during the three data collection trips. A cross section of the data site is shown in figure 3. Eight sets of velocity profiles were made during ebbtide, and one set was made during floodtide (figs. 4-12). Each set of profiles consisted of seven velocity profiles made along the measuring cross section, using five points in each vertical section. The velocities were measured using a Neil-Brown direct-reading current meter system[1] mounted on a suspended-cable system from a boat. This current meter determines velocity and direction of flow. The boat was held stationary on the cross section by use of the boat motors. The position of the boat in reference to the shoreline was determined by electronic distance-measuring equipment.

Velocity profiles were also measured at other sites in Barataria Pass and at selected sites in Barataria Bay and the Gulf of Mexico near the mouth of the Pass. The locations of these sites are shown in figure 2 and the velocity profiles are shown in figures 13 and 14.

Discharge in Barataria Pass was determined by conventional methods using velocity observations at 0.2, 0.6, and 0.8 of the depths (Buchanan and Somers, 1965). The discharge, cross-section area, and the mean velocity for each measurement are listed in table 1. Five sets of moving-boat discharge measurements (Smoot and Novak, 1969) were made in the same cross section and also are given in table 1.

The velocity equivalent to the mean velocity in a profile was generally located between the 0.6 and 0.7 depth. The direction of flow (azimuth) for the eight sets of profiles made in Barataria Pass during ebb flow in the tide cycle was about 130° from magnetic north. The one set of profiles made during floodtide had a direction of flow of about 320° from magnetic north. Ebbtide flow is shown as positive flow and floodtide flow as negative flow in table 1. The discharge measured during ebbtide ranged from 26,000 to 195,000 ft^3/s. The discharge measured during the floodtide was 125,000 ft^3/s. The highest mean velocity from all of the discharge measurements was 3.01 ft/s.

Tide stages were obtained from a gage (operated by the National Oceanic and Atmospheric Administration) located near Barataria Pass on the east end of Grand Isle at the Coast Guard station (fig. 2). Tide hydrographs, along with times of discharge measurements, are shown in figure 15.

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[1]Use of trade names in this report is for identification purposes only and does not constitute endorsement by the U.S. Geological Survey or the Louisiana Geological Survey.

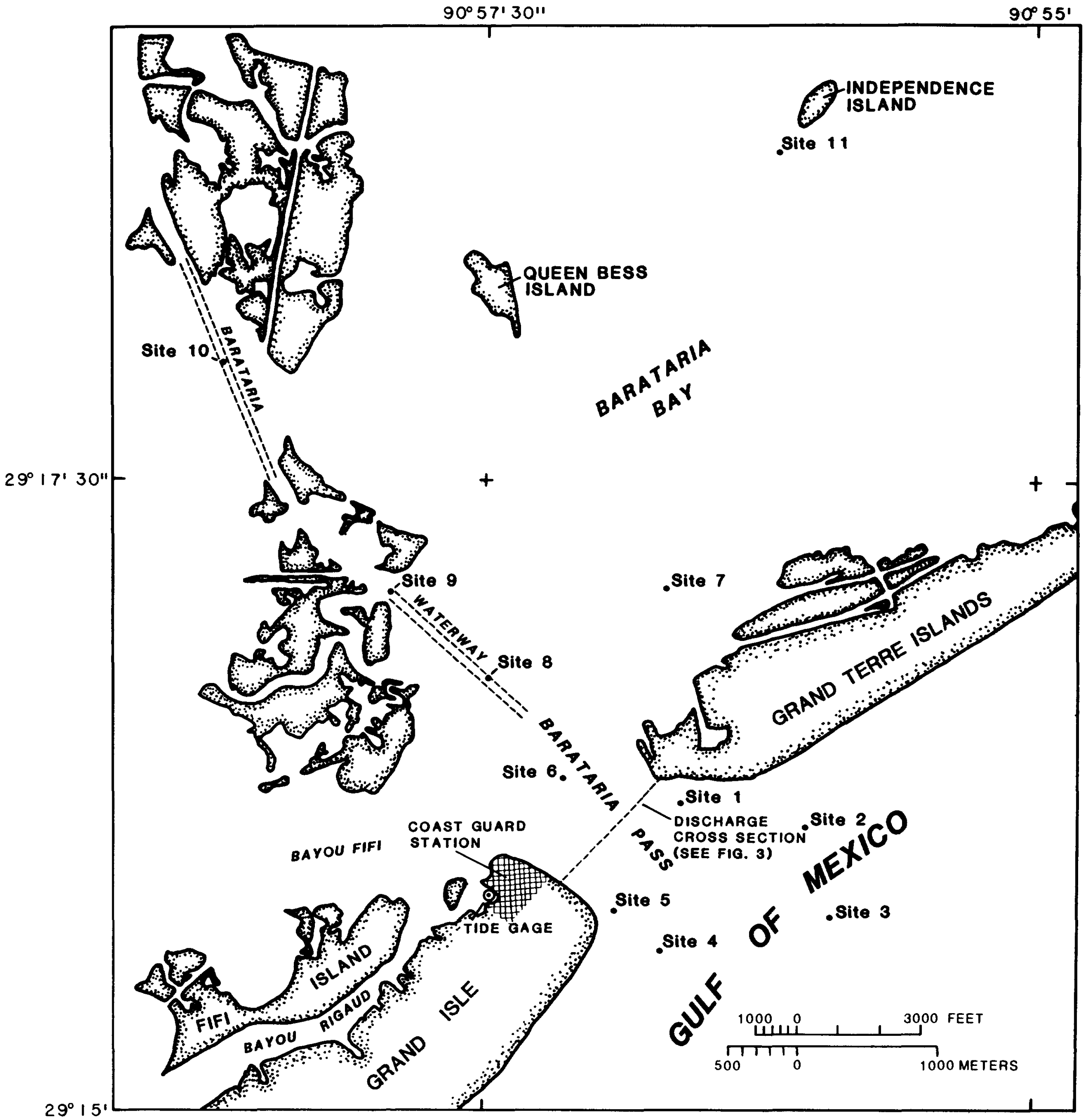


Figure 2.--Location of discharge cross section in Barataria Pass and selected data sites in Barataria Bay and Gulf of Mexico.

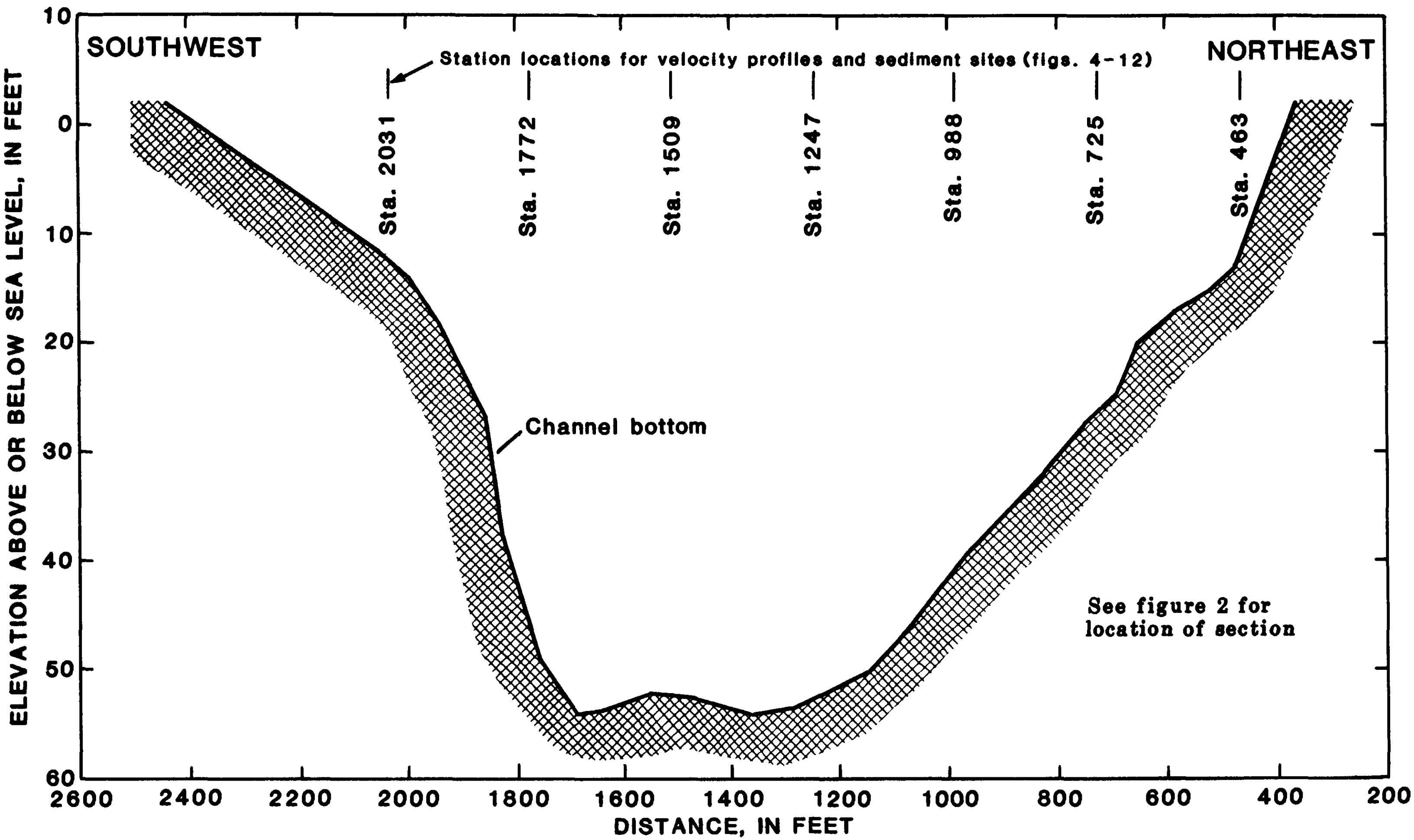


Figure 3.--Depth profile across Barataria Pass.

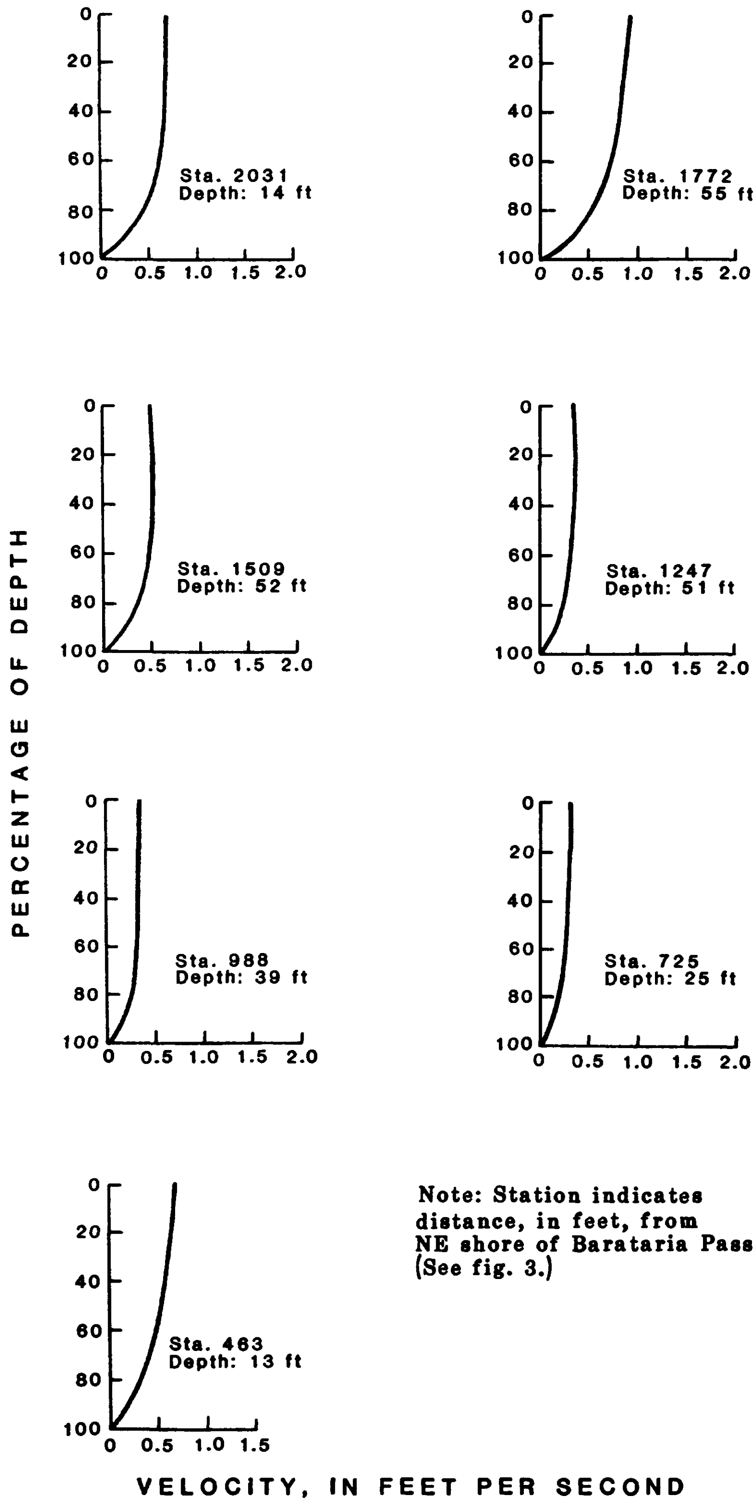


Figure 4.--Velocity profiles along Barataria Pass cross section, September 27, 1983, from 1508 to 1547 hours.

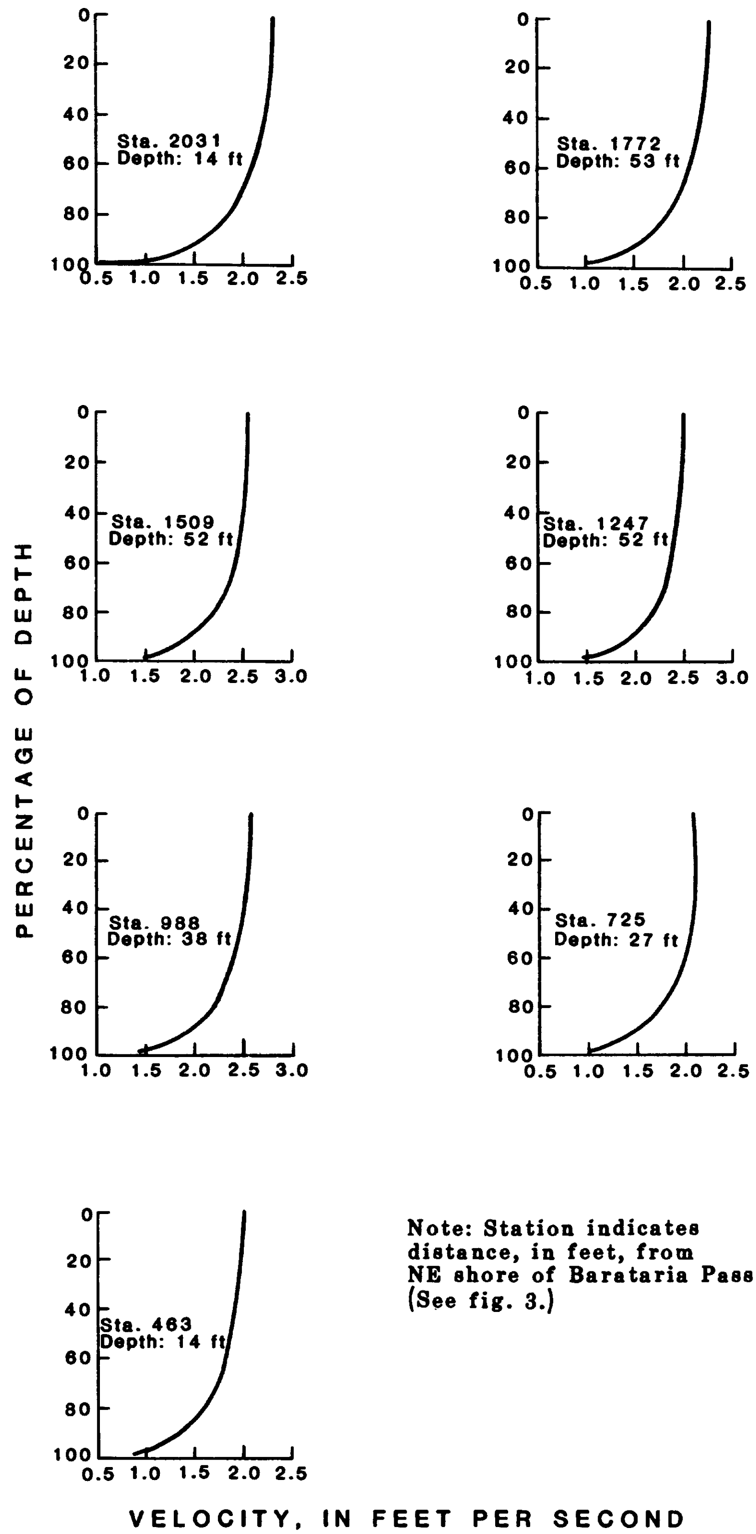


Figure 5.--Velocity profiles along Barataria Pass cross section, September 28, 1983, from 0740 to 0847 hours.

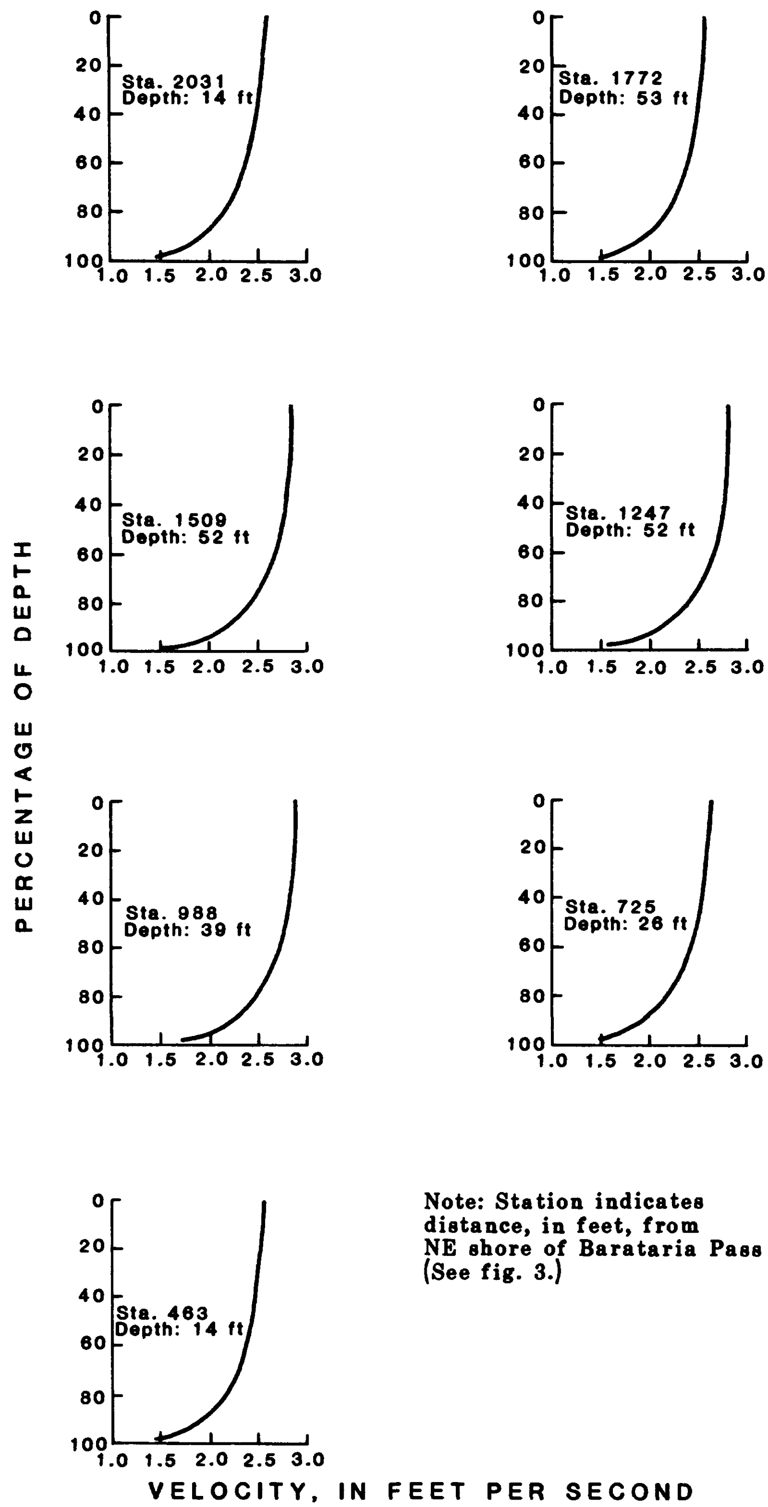


Figure 6.--Velocity profiles along Barataria Pass cross section, September 28, 1983, from 1002 to 1056 hours.

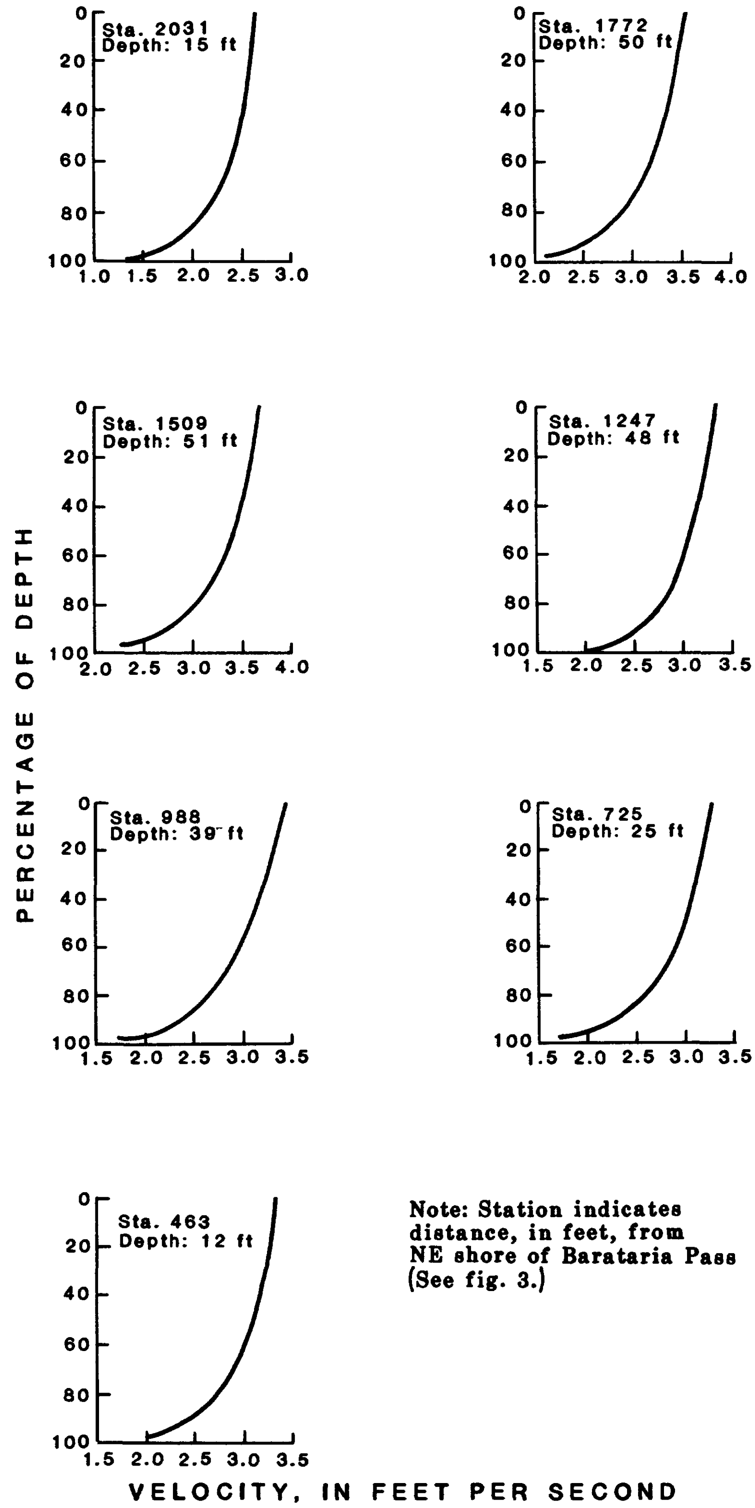


Figure 7.--Velocity profiles along Barataria Pass cross section, October 27, 1983, from 0950 to 1056 hours.

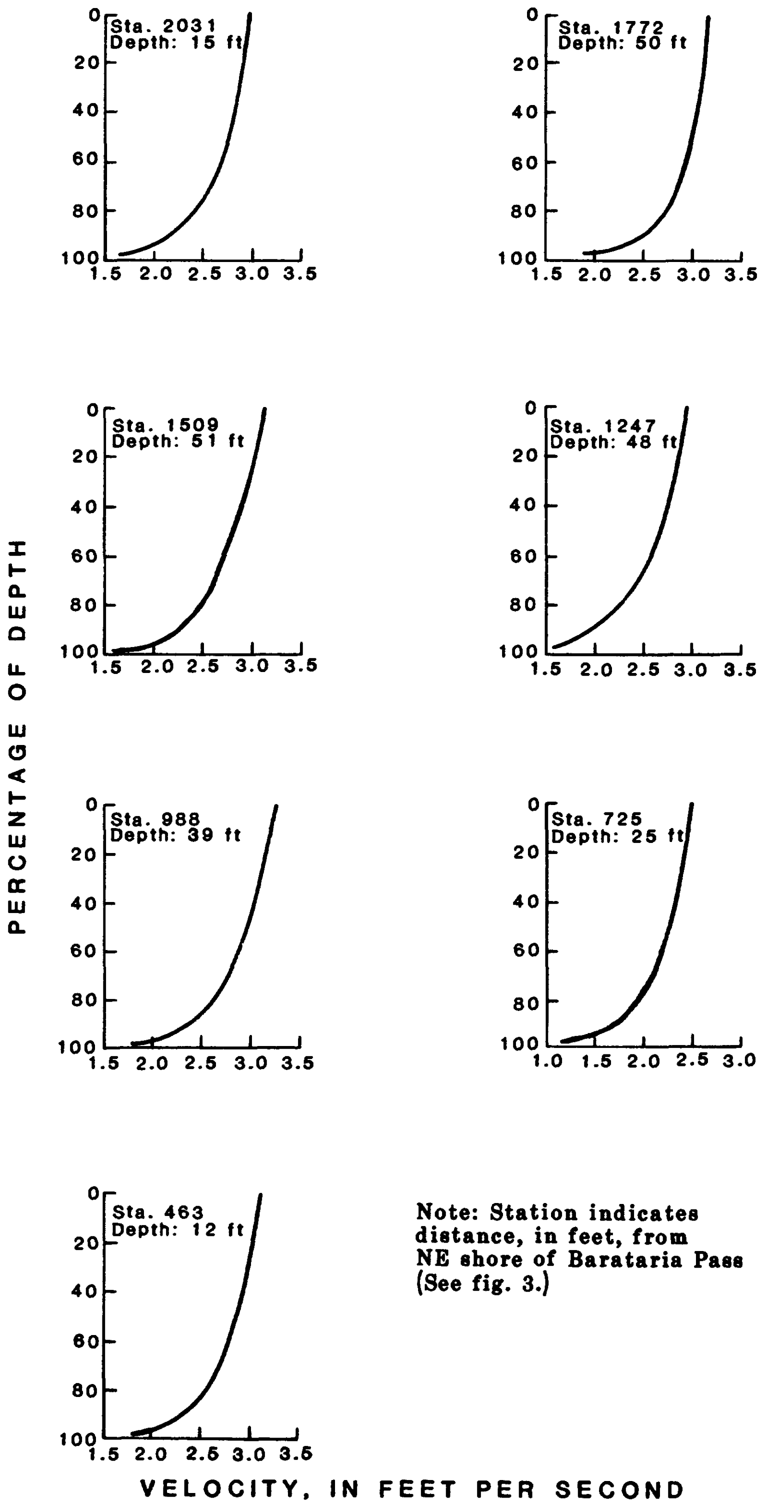
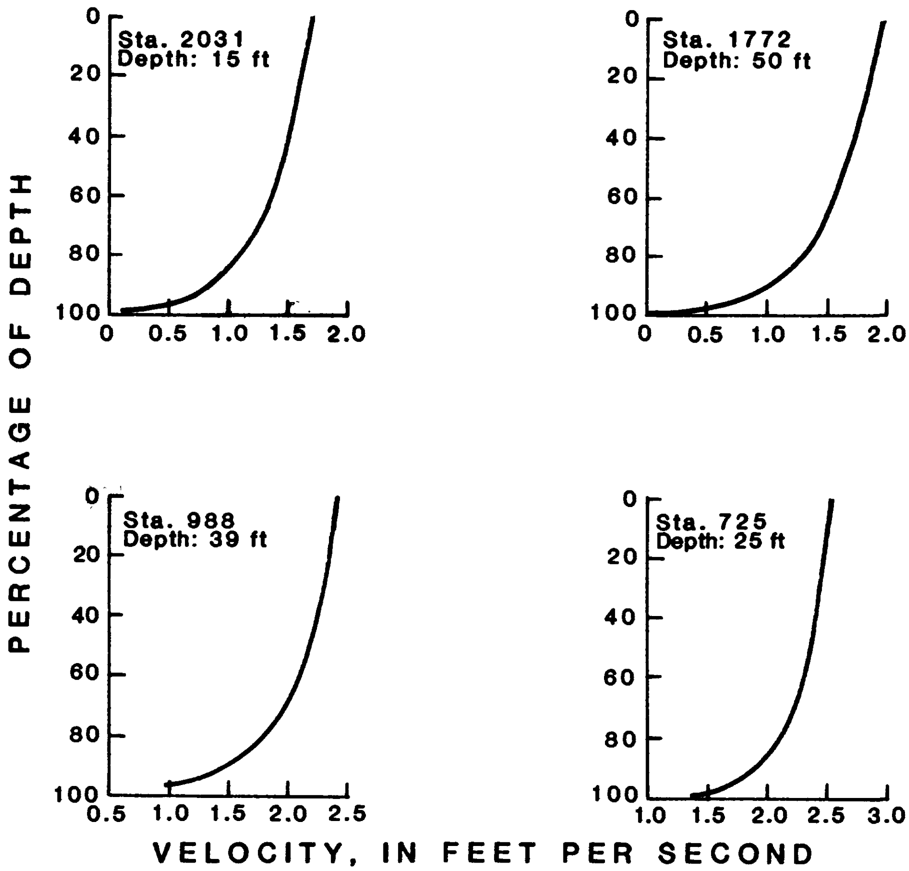


Figure 8.--Velocity profiles along Barataria Pass cross section, October 27, 1983, from 1105 to 1148 hours.



Note: Station indicates distance, in feet, from NE shore of Barataria Pass (See fig. 3.)

Figure 9.--Velocity profiles along Barataria Pass cross section, October 27, 1983, from 1805 to 1834 hours.

Samples of suspended sediment and bottom material were collected at seven verticals in the Barataria Pass cross section and at selected sites in Barataria Bay and in the Gulf of Mexico (fig. 2). Suspended sediment was collected according to methods listed in Szalona (1982) and Guy and Norman (1970). Suspended-sediment samples were collected using a bag sampler and P-63 sampler on the first and second collection trips and only a P-63 sampler on the third trip. On the first and second trips, samples were depth integrated using the bag sampler in deep water and the P-63 sampler in shallow water. On the third trip, the P-63 sampler was used to depth integrate in increments of 20 ft and the results for each vertical section were composited.

The suspended-sediment and bottom-material samples were analyzed according to methods in Guy (1969) and Skougstad and others (1979). Suspended-sediment samples were analyzed for concentration and the percentage finer than sand (0.062 mm). Samples from the first data-

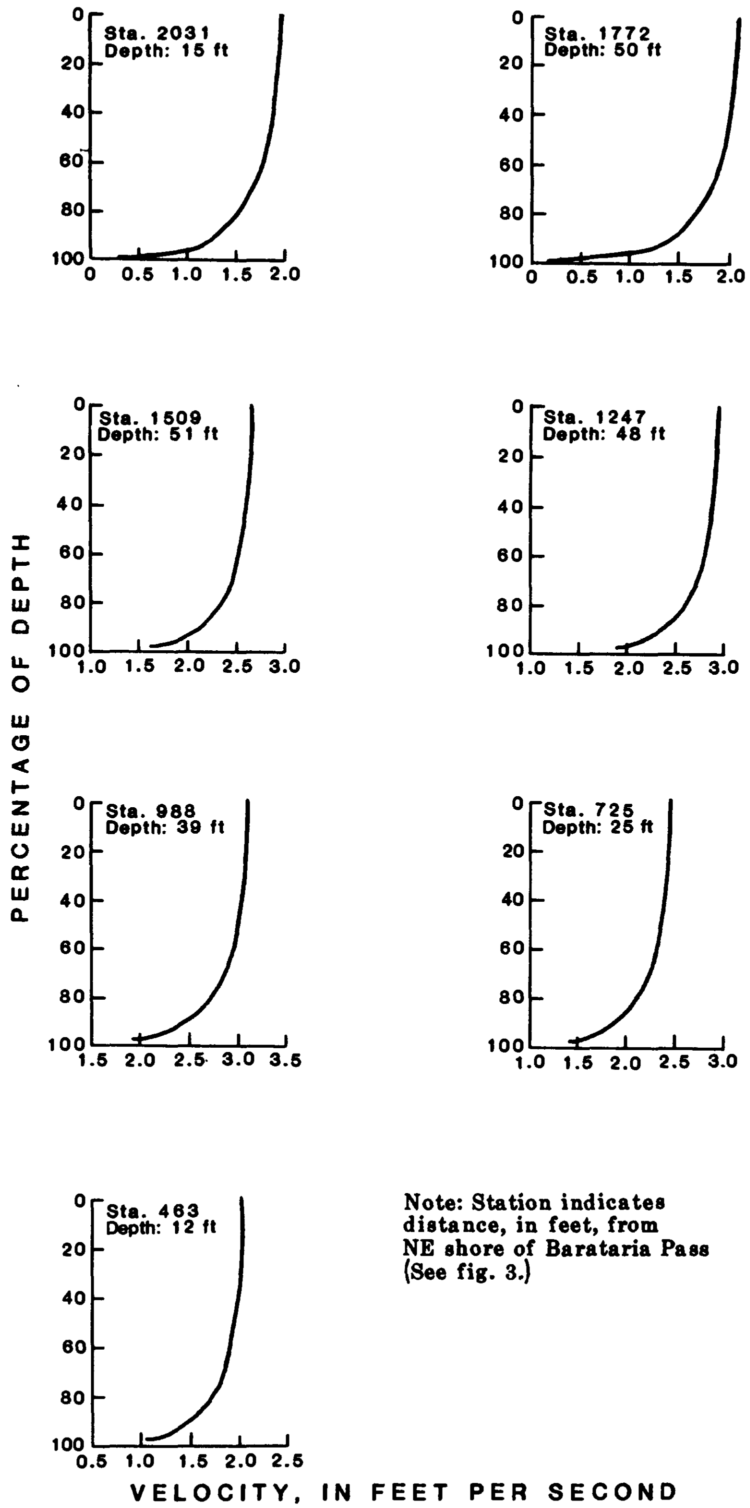


Figure 10.--Velocity profiles along Barataria Pass cross section, October 28, 1983, from 0815 to 0913 hours.

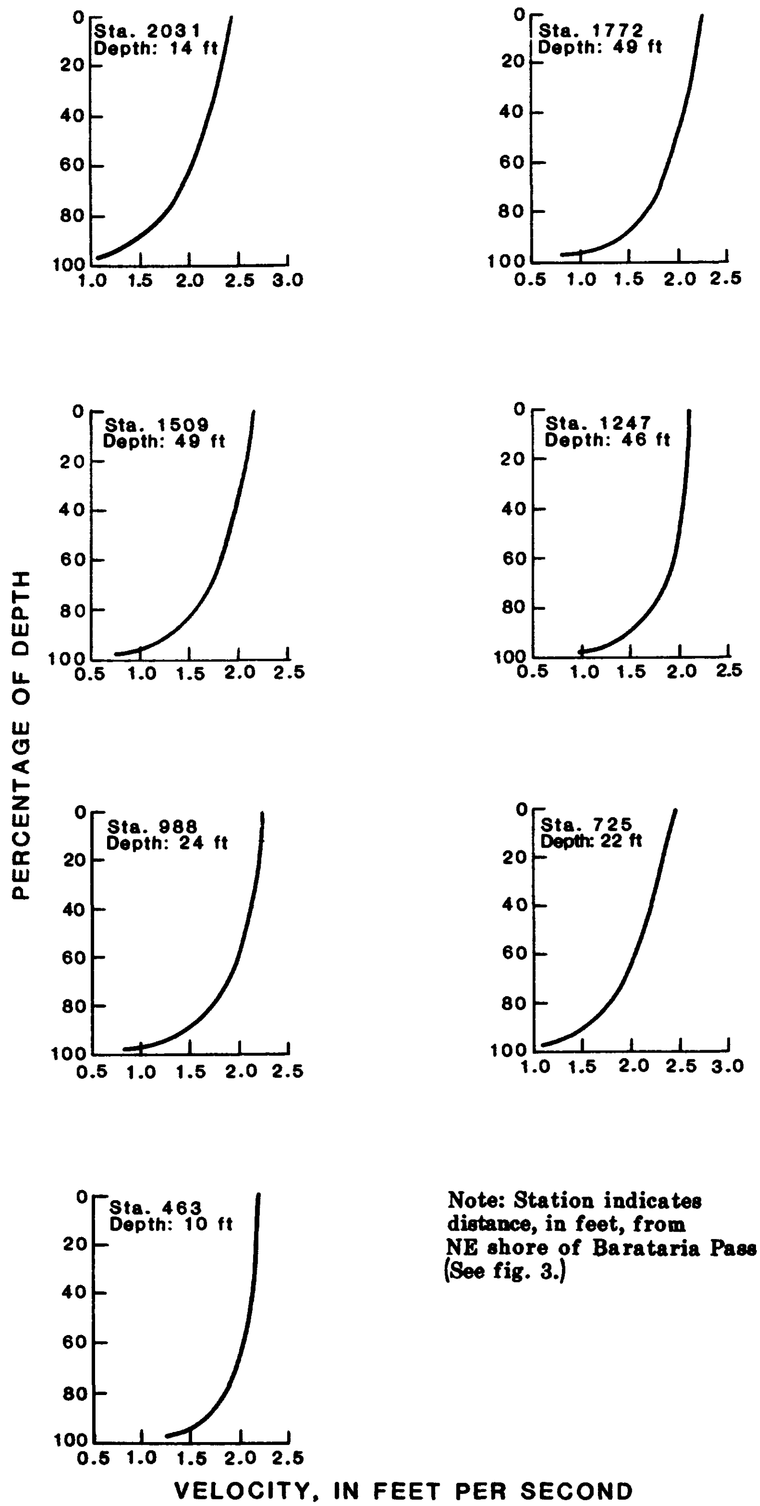


Figure 11.--Velocity profiles along Barataria Pass cross section, November 10, 1983, from 1145 to 1235 hours.

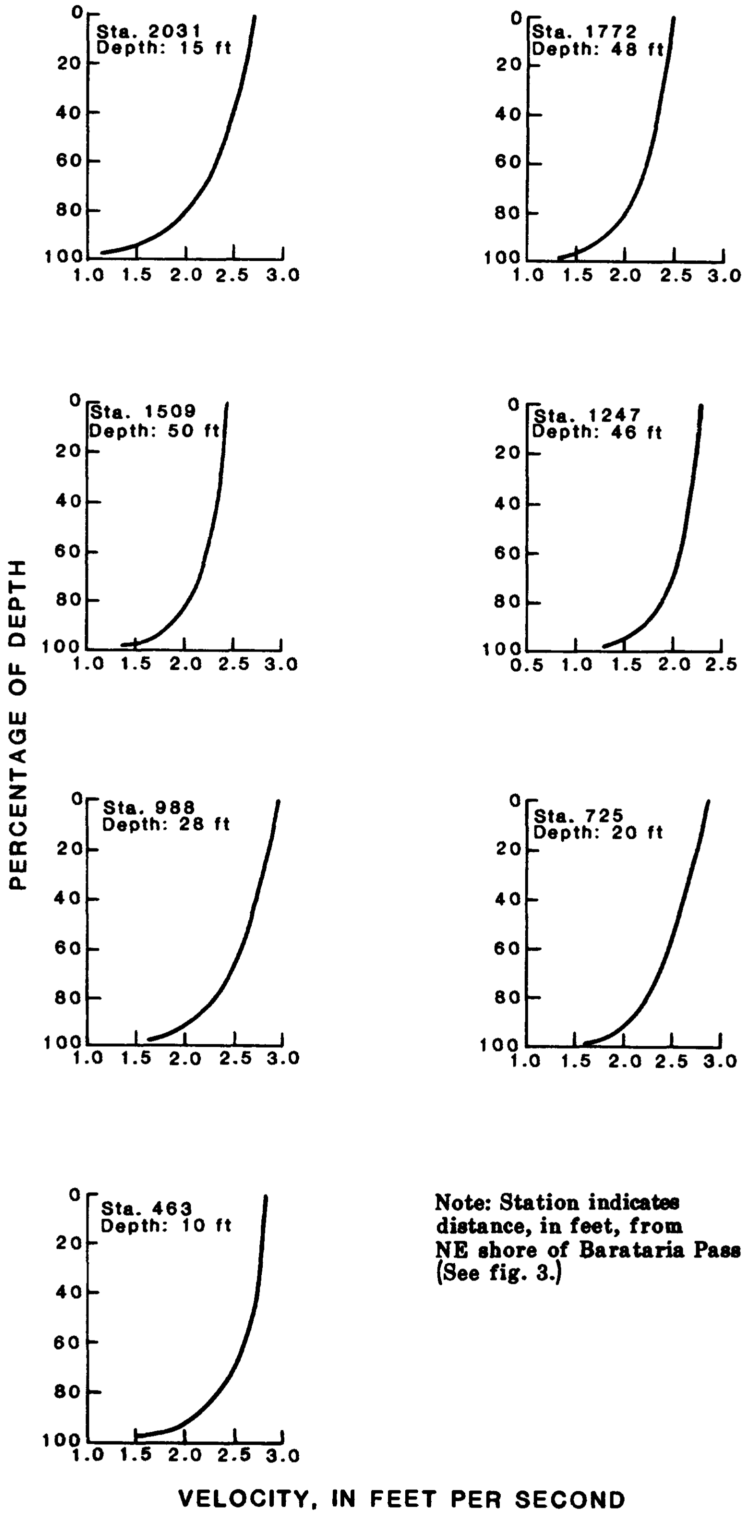


Figure 12.--Velocity profiles along Barataria Pass cross section, November 11, 1983, from 0733 to 0828 hours.

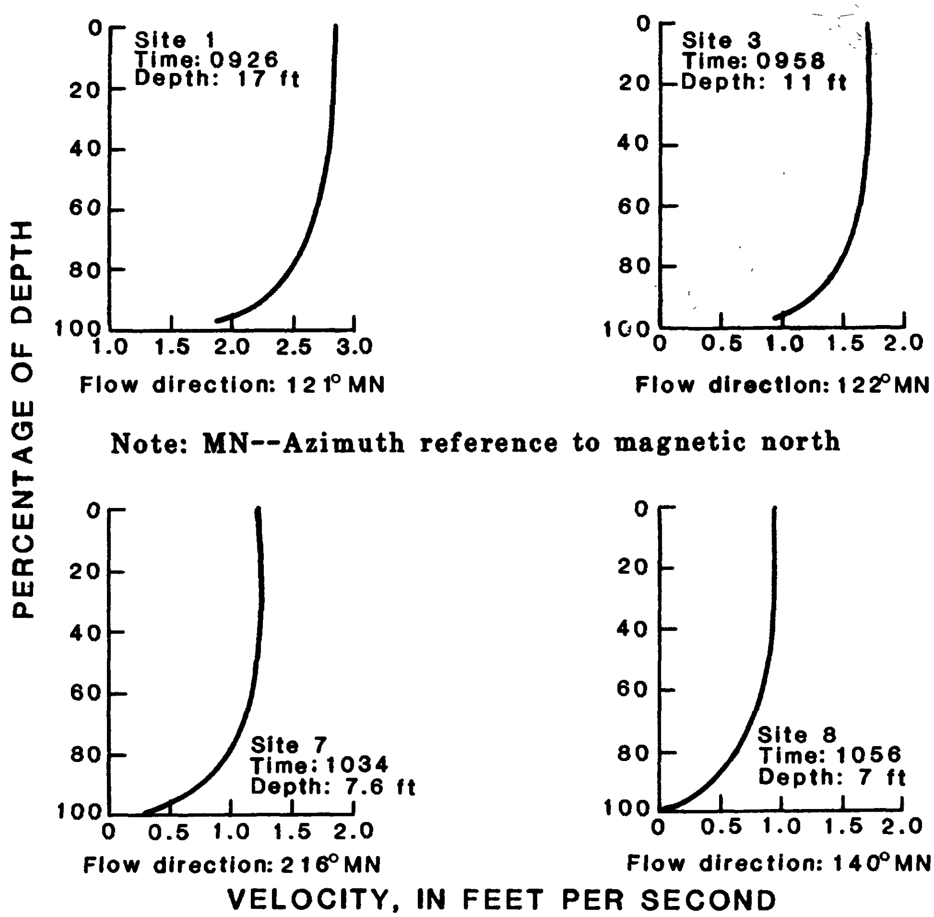


Figure 13.--Velocity profiles at selected sites in Barataria Pass, Barataria Bay, and Gulf of Mexico for October 28, 1983.

collection trip were found to contain large amounts of organic material in the sand fraction of the suspended sediment. Therefore, the sand fraction of the suspended-sediment samples collected on the second data trip was analyzed for organic material present by a loss-on-ignition method (Skougstad and others, 1979). The material coarser than 0.062 mm was ashed at 550°C to determine the amount of organic material present within the sand fraction. The loss-on-ignition method was not used for the data set for the third trip because of the possible effect on weight change of the samples due to the high combustion temperature used. Instead, the density-separation method (White and Lindholm, 1950) was used to separate the organic matter from the sand fraction in the samples. Separations were accomplished with a mixture of bromoform and acetone adjusted to a specific gravity of 1.95. The concentrations of sand and organic material and the percentage of organic matter in the coarse material are shown in table 2.

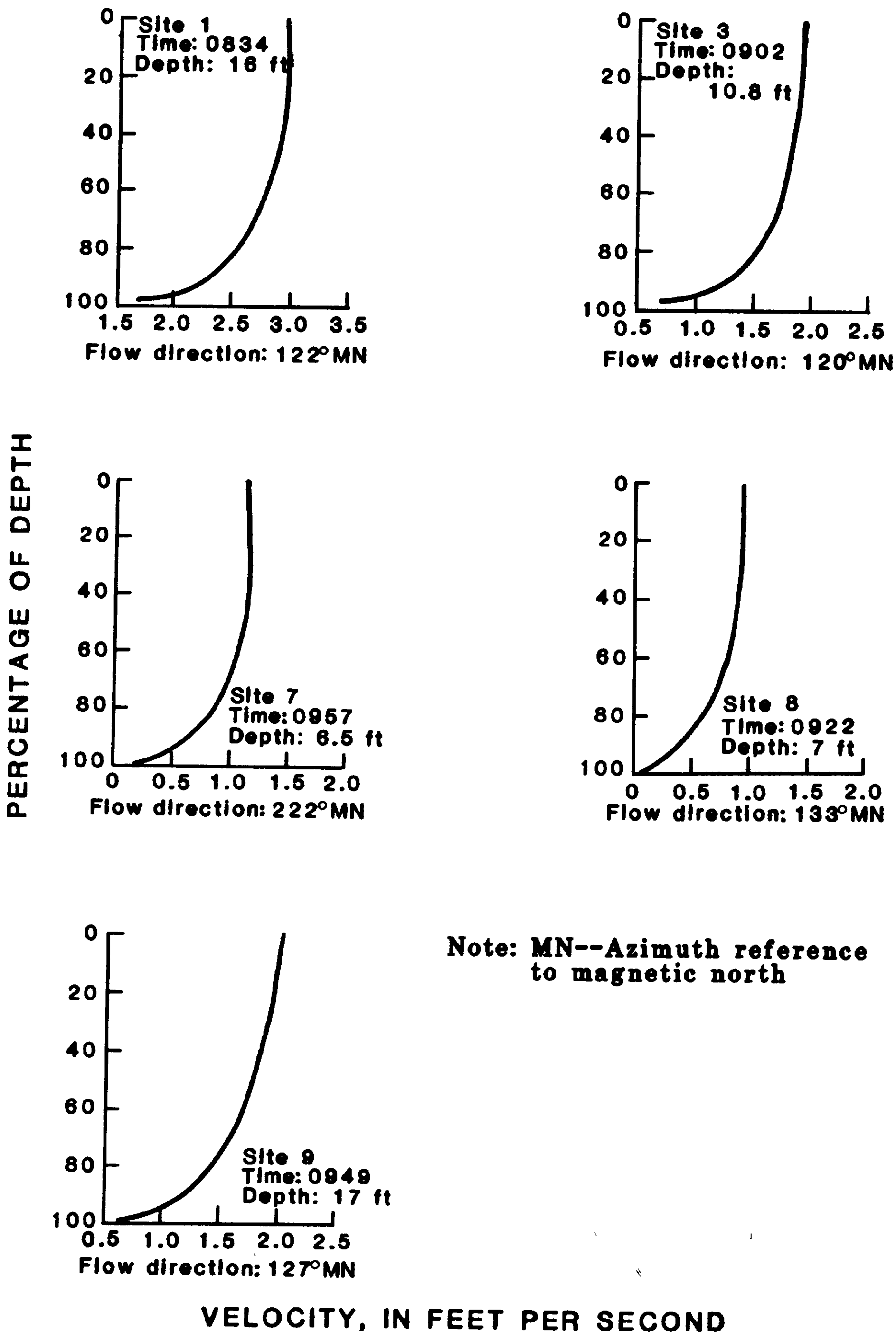


Figure 14.--Velocity profiles at selected sites in Barataria Pass, Barataria Bay, and Gulf of Mexico for November 11, 1983.

Table 1.--Discharge measurements in Barataria Pass using conventional and moving-boat methods

[C, conventional discharge method; MB, moving-boat discharge method]

Date (1983)	Time	Method	Discharge[1] (cubic foot per second)	Area (square foot)	Mean velocity (foot per second)	Stage,[2] in feet above sea level
9-27	0830	MB	138,000	64,200	2.15	2.10
9-27	1530	C	26,100	64,900	.40	1.47
9-28	0800	MB	142,000	64,800	2.19	2.35
9-28	0815	C	147,000	67,200	2.57	2.35
9-28	1030	C	167,000	65,100	2.57	1.98
10-27	0910	MB	195,000	70,700	2.76	1.50
10-27	1023	C	190,000	63,100	3.01	1.25
10-27	1130	C	172,000	63,100	2.73	1.05
10-27	1820	C	-125,000	64,900	1.93	.68
10-27	1820	MB	-125,000	70,300	1.78	.68
10-28	0845	C	148,000	63,100	2.35	1.95
11-10	1210	C	103,000	54,800	1.88	1.45
11-11	0830	MB	138,000	69,400	1.99	1.67
11-11	1220	C	125,000	55,500	2.25	1.10

[1]Minus sign indicates floodtide.
[2]Stage determined from tide gage at Coast Guard station.

Data were sufficient to compile suspended-sediment discharges for two sets of data, both collected on ebbtide. The suspended-sediment discharges were compiled using discharge-weighted methods. On October 27, 1983, at a discharge of 190,000 ft^3/s the suspended-sediment discharge was 51,200 tons/d; and on November 10, 1983, at a discharge of 103,000 ft^3/s the suspended-sediment discharge was 29,100 tons/d.

The bottom-material samples were collected using a Shipek grab sampler. The percentages of sand, silt, and clay in the samples are listed in table 2.

The water in Barataria Pass was well mixed; no significant density stratification of flow was found. Specific conductance was measured during each set of velocity profiles and had a range of 32,700-33,500 μmhos/cm from top to bottom during minimum-salinity conditions to 43,000-45,600 μmhos/cm, during maximum-salinity conditions.

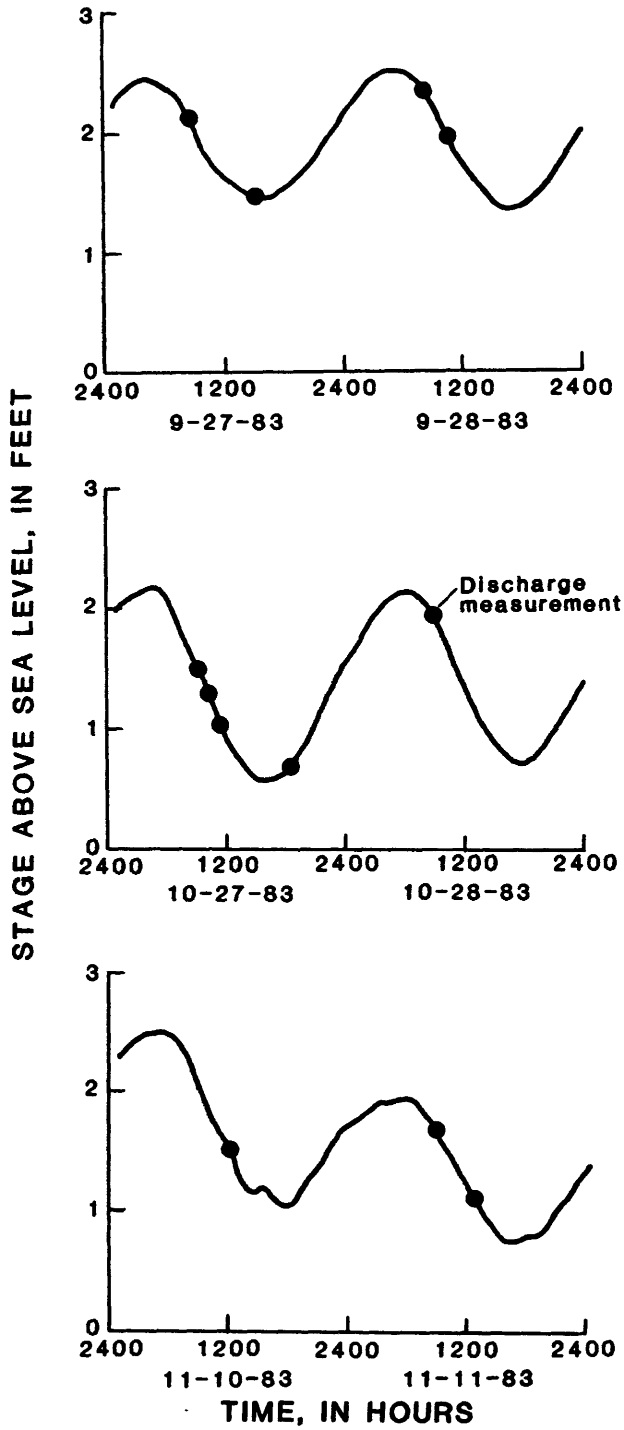


Figure 15.--Tide stages and times of discharge measurements in Barataria Pass for September 27-28, October 27-28, and November 10-11, 1983.

Table 2.--Suspended sediment and bottom material from Barataria Pass and selected sites in Barataria Bay and Gulf of Mexico near the mouth of Barataria Pass

[BP, locations are distances in feet along Barataria Pass discharge cross section shown in figure 3]

	Suspended sediment							Bottom material		
Location and site[1]	Date (1983)	Depth (feet)	Total concentration (mg/L)	Percentage finer than 0.062 mm	Concentration of sand and organic material (mg/L)	Percentage of organic matter in coarse material	Sampler type	Percentage Sand	Percentage Silt	Percentage Clay
BP- 463	9-27	13	---	--	--	--	----	25	37	38
BP- 725	9-27	25	180	72	--	--	Bag	44	39	17
BP- 988	9-27	39	196	54	--	--	Bag	38	44	18
BP-1247	9-27	51	174	43	--	--	Bag	30	34	36
BP-1509	9-27	52	135	76	--	--	Bag	74	[2]36	(2)
BP-1772	9-27	55	133	77	--	--	Bag	72	20	8
BP-2031	9-27	14	137	91	--	--	Bag	86	[2]14	(2)
Site 6	9-27	87	---	--	--	--	----	20	25	55
BP- 463	10-27	12	---	--	--	--	----	22	56	22
BP- 725	10-27	25	---	--	--	--	----	35	35	30
BP- 988	10-27	39	83	59	34	15	Bag	13	48	39
BP-1247	10-27	48	97	64	35	17	Bag	6	51	43
BP-1509	10-27	51	120	81	23	17	Bag	29	38	33
BP-1772	10-27	50	97	75	24	12	Bag	88	[2]5	(2)
BP-2031	10-27	15	92	73	25	12	Bag	88	9	3
Site 2	10-28	13	43	63	16	--	P-63	55	34	11
Site 4	10-28	9	45	69	14	--	P-63	96	[2]4	(2)
Site 5	10-28	15	48	56	21	--	P-63	86	[2]14	(2)
Site 10	10-28	3	13	62	5	--	P-63	53	34	13
Site 11	10-28	10	33	58	14	--	P-63	73	15	12
BP- 463	11-10	10	50	90	5	0	P-63	--	--	---
BP- 725	11-10	22	53	98	1	0	P-63	--	--	---
BP- 988	11-10	24	69	98	2	--	P-63	--	--	---
BP-1247	11-10	46	107	96	4	23	P-63	--	--	---
BP-1509	11-10	49	131	92	11	11	P-63	--	--	---
BP-1772	11-10	49	136	93	10	20	P-63	--	--	---
BP-2011	11-10	14	87	83	15	7	P-63	--	--	---
Site 3	11-11	10	68	96	3	0	P-63	67	26	7
Site 7	11-11	5	45	93	3	67	P-63	57	33	10
Site 8	11-11	6	70	99	2	0	P-63	43	40	17
Site 9	11-11	10	86	93	5	70	P-63	46	38	16

[1]Site locations are selected sampling sites in study area shown in figure 2.
[2]Silt and clay combined.

SUMMARY AND CONCLUSIONS

Velocity profiles for Barataria Pass seem to follow the standard velocity profile for a tidal channel. The velocity equivalent to the mean velocity for the profiles was usually located between the 0.6 and 0.7 depth. A maximum depth of 55 ft was measured along the cross section. The direction of flow (azimuth) for the eight sets of profiles made during ebbtide was about 130° from magnetic north. The one set of profiles made during floodtide (negative flow) had a direction of flow of about 320° from magnetic north. The discharge during ebbtide ranged from 26,000 to 195,000 ft^3/s. The discharge measured during the floodtide was 125,000 ft^3/s. The highest mean velocity from all of the discharge measurements was 3.01 ft/s.

The water in Barataria Pass was well mixed; no significant density stratification of flow was found. Specific conductance was measured during each set of velocity profiles and had a range of 32,700-33,500 μmhos/cm from top to bottom during minimum-salinity conditions to 43,000-45,600 μmhos/cm, during maximum-salinity conditions.

Suspended-sediment and bottom-material samples were collected at Barataria Pass and selected sites in Barataria Bay and the Gulf of Mexico near the mouth of the pass. Total concentration of sediment, percentage finer than sand (0.062 mm), concentration of sand and organic material, and percentage of organic matter in coarse material were determined and are included in this report. The percentage of sand, silt, and clay for the bottom-material samples was also determined.

Suspended-sediment discharges were computed for two sets of data. On October 27, 1983, at a discharge of 190,000 ft^3/s the suspended-sediment discharge was 51,200 tons/d; and on November 10, 1983, at a discharge of 103,000 ft^3/s the suspended sediment discharge was 29,100 tons/d.

On the basis of results of the limited study, the use of velocity profiles to compute conventional discharge measurements seems to be the most appropriate method for measuring discharge in Barataria Pass, particularly for computation of suspended-sediment discharge. Using a directional velocity meter provides valuable information on flow conditions that the moving-boat method does not provide. The moving-boat discharge method did seem to give comparable results to the conventional method, but more comparisons of measurement techniques in Barataria Pass need to be made to verify the vertical velocity coefficient needed for the moving-boat discharge method. The vertical velocity coefficient used for measurements in this report was computed to be 0.84.

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