

BUREAU OF ECONOMIC GEOLOGY

The University of Texas

Austin, Texas

Peter T. Flawn, Director

Report of Investigations — No. 60

Sand Resources of Texas Gulf Coast

By

L.E. Garner



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SAND RESOURCES OF TEXAS GULF COAST

L. E. Garner

ABSTRACT

This report deals with the occurrence and potential production of industrial sand in the Gulf Coast area of Texas. The study area covers approximately 23,000 square miles underlain by alluvial, deltaic, beach, and eolian deposits of Pleistocene and Recent age. Deposits are intermixed and interbedded sands, gravels, silts, and clays. Sand bodies are irregular in size and shape depending on environment of deposition; they vary in physical character and mineralogical and chemical composition. Pleistocene sand deposits along the Texas Gulf Coast occur in the Willis, Lissie, Montgomery, and Beaumont Formations which underlie regional coastwise terraces or erosional surfaces. Recent deposits include those currently being deposited along the modern

coast and major streams.

The report includes Aransas, Austin, Brazoria, Calhoun, Cameron, Colorado, Chambers, Fort Bend, Galveston, Harris, Hardin, Hidalgo, Jackson, Jefferson, Kleberg, Kenedy, Liberty, Matagorda, Nueces, Orange, Refugio, San Patricio, Victoria, Wharton, Waller, and Willacy counties. There is current industrial sand production within this area in Columbus, Hardin, and Liberty counties. A few other sand deposits have a relatively low content of iron oxide and suitable grain size, but most deposits require beneficiation to meet specifications for industrial use. Most counties have some constructional sand or gravel production.

INTRODUCTION

Sand resources were studied in southeast Texas in an area of about 23,000 square miles adjacent to the Gulf of Mexico and extending from Louisiana to Mexico; the following counties are included: Aransas, Austin, Brazoria, Calhoun, Cameron, Colorado, Chambers, Fort Bend, Galveston, Harris, Hardin, Hidalgo, Jackson, Jefferson, Kleberg, Kenedy, Liberty, Matagorda, Nueces, Orange, Refugio, San Patricio, Victoria, Wharton, Waller, and Willacy (fig. 1).

Study of surficial sand deposits was undertaken to provide information on their general character, areal distribution, and industrial utilization. Information presented provides a general basis for more detailed prospecting and evaluation. Although this report is essentially concerned with sand resources of the Texas Gulf Coast area, reference is made to State-wide production and consumption to provide a comparison of value and market.

ACKNOWLEDGMENTS

The writer expresses appreciation to P. T. Flawn, Director, Bureau of Economic Geology, for his interest and support during the course of this study and his constructive criticism of the manuscript and to W. L. Fisher and P. U. Rodda, Research Scientists, Bureau of Economic Geology, for their helpful suggestions and critical reading of the manuscript. M. O. Hayes contributed statistical information and grain size analyses of sand dune samples from Padre Island and the South Texas dune plain. Physical testing and sample preparation were performed by the Mineral Studies Laboratory of the Bureau of Economic Geology, supervised by D. A. Schofield. J. W. Macon supervised preparation of illustrations. Edgar Tobin Aerial Surveys, San Antonio, Texas, provided the aerial photo mosaics used as illustrations in this report.

Several industrial concerns provided information concerning mining and processing operations and local occurrence of sand and gravel deposits, permitted sampling and inspection of their operations, or cooperated in other ways. These in-

clude:

Barry & Barry Sand Company, Voth, Texas
Cleveland Sand & Gravel Company, Cleveland, Texas

The Fordyce Company, Corpus Christi, Sullivan City, and Victoria, Texas

Gulf Concrete Company, Victoria, Texas

Hayes-Sammons Chemical Company, Mission, Texas

Holdenfels Bros., Corpus Christi and Victoria, Texas

Horton & Horton, Columbus, Texas

Nueces Foundry, Inc., Corpus Christi, Texas

Parker Bros. & Company, Inc., Alleyton, Texas

Rio Grande Industries, Inc., Crow Iron and Gravel Company, La Joya, Texas

Texas Construction Material Company, Columbus, Eagle Lake, and Romayor, Texas

Thorstenberg Materials Company, Alleyton, Texas

M. P. Wright Sand and Gravel Company, Callen, Texas

STRATIGRAPHY

Sedimentary units cropping out along the Texas Gulf Coast consist of Pleistocene alluvial, deltaic, and barrier bar deposits, and Recent alluvial, deltaic, barrier island, and dune (coastal and inland) deposits. There are four depositional surfaces or terraces of Pleistocene age developed on the Texas Coastal Plain. These terraces are underlain by similar rock sequences which are designated as formations (i.e., the Willis, Lissie, Montgomery, and Beaumont Formations underlie

the Willis, Lissie, Montgomery, and Beaumont terraces, respectively). Pleistocene coastwise terraces are deltaic sequences deposited by coalescing streams and distributary systems of streams and rivers which flowed into the Gulf and are coastwise equivalents of upstream Pleistocene river terrace deposits. Sediments are mostly interbedded gravels, sands, silts, and clays; generally, basal coarse-grained material grades upward to fine-grained material. Rock units uncon-

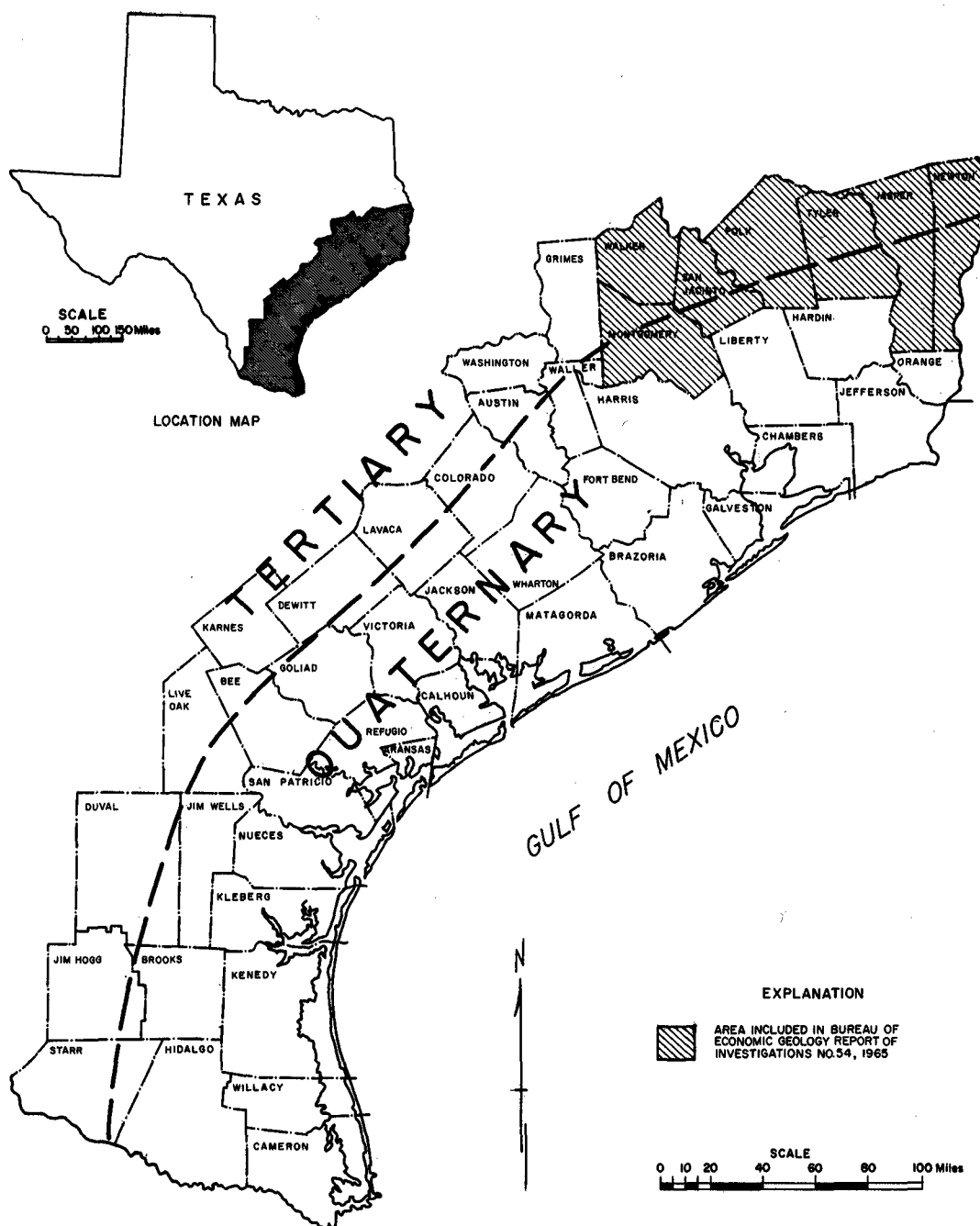


Fig. 1. Index map of study area.

formably overlap each other and underlying Tertiary formations in areas where rivers have entrenched older units. Pleistocene deposits extend 60 to 90 miles inland in a belt sub-parallel to the Gulf of Mexico (Pl. I, in pocket).

Formations are delineated chiefly on the basis of physiographic features; gross lithology is similar for all units. Elevation ranges, characteristic seaward slopes, and drainage patterns are primary distinguishing criteria. Soils are useful in mapping the formations and delineating features at or near the surface, such as ancient channels and beach ridges (fig. 2). Physiographic units and depositional and erosional features, such as beach ridges, channels, pimple mounds, soil types, and vegetation, can be mapped on aerial photographs (Pls. II and III).

Pleistocene surfaces recognized by Bernard and LeBlanc (1965) are (oldest to youngest): Willis, Lower Lissie, Upper Lissie (equal to Montgomery of Louisiana and unnamed second terrace of Bernard et al., 1962), and Beaumont terraces (Pl. I). These units have been mapped along parts of the Texas Coastal Plain from Louisiana to Mexico (Bernard, 1950; Bernard et al., 1962; Deussen, 1914 and 1924; Doering, 1935 and 1956; Price, 1933 and 1947; and others). According to Bernard et al. (1962) and Bernard and LeBlanc (1965) the Texas coastwise terraces and associated formations are equivalent to those named by Fisk (1938, 1940, 1944) in Louisiana and were developed during the high-standing sea level substages of the Aftonian, Yarmouth, Sangamon, and Peorian Interglacial Stages. Erosional surfaces were developed on the deposits during the low sea level substages of the Nebraskan, Kansan, Illinoian, Early and Late Wisconsin Glacial Stages, and the rising sea level substages of the early interglacial substages.

Pleistocene Series

Willis Formation.—The Willis Formation crops out in the southern, central, and northern parts of the area (Pl. I). The original surface has been extensively dissected and eroded; only the basal deposits are exposed at many localities in the northern part of the area. The lower contact of the Willis is distinct because the quartzose sands and gravels of the Willis contrast with the interbedded calcareous clays and gravels of the underlying Tertiary formations. The Willis terrace has an elevation range from about 200 to 400 feet and a seaward slope of about 10 feet/mile.

Outcrop width of the Willis is 10 to 20 miles and thickness is approximately 80 feet. Basal Willis is composed of approximately 30 feet of poorly sorted, quartzose, iron-stained, gravelly sand. Grain size ranges from very fine sand to pebbles. Gravel is predominantly light-colored quartz and chert but also includes many dark-colored pebbles. Gravel is scattered except

where it occurs locally in small, flat, irregular lenses. Overlying the gravelly sand is approximately 30 feet of ferruginous, quartzose sand which contains disseminated clay and local clay beds. This part of the Willis is recognized in outcrop by the presence of limonite deposits and ferruginous nodules formed at the surface by weathering. Cementing by iron oxide is sufficient to make this part of the Willis Formation more resistant. The upper part of the Willis consists of about 20 feet of light-colored, fine-grained, soft, quartz sand which is present as a thin sand cap on the crest of ridges overlying the ferruginous sand; generally it is found only as a weathered sandy soil.

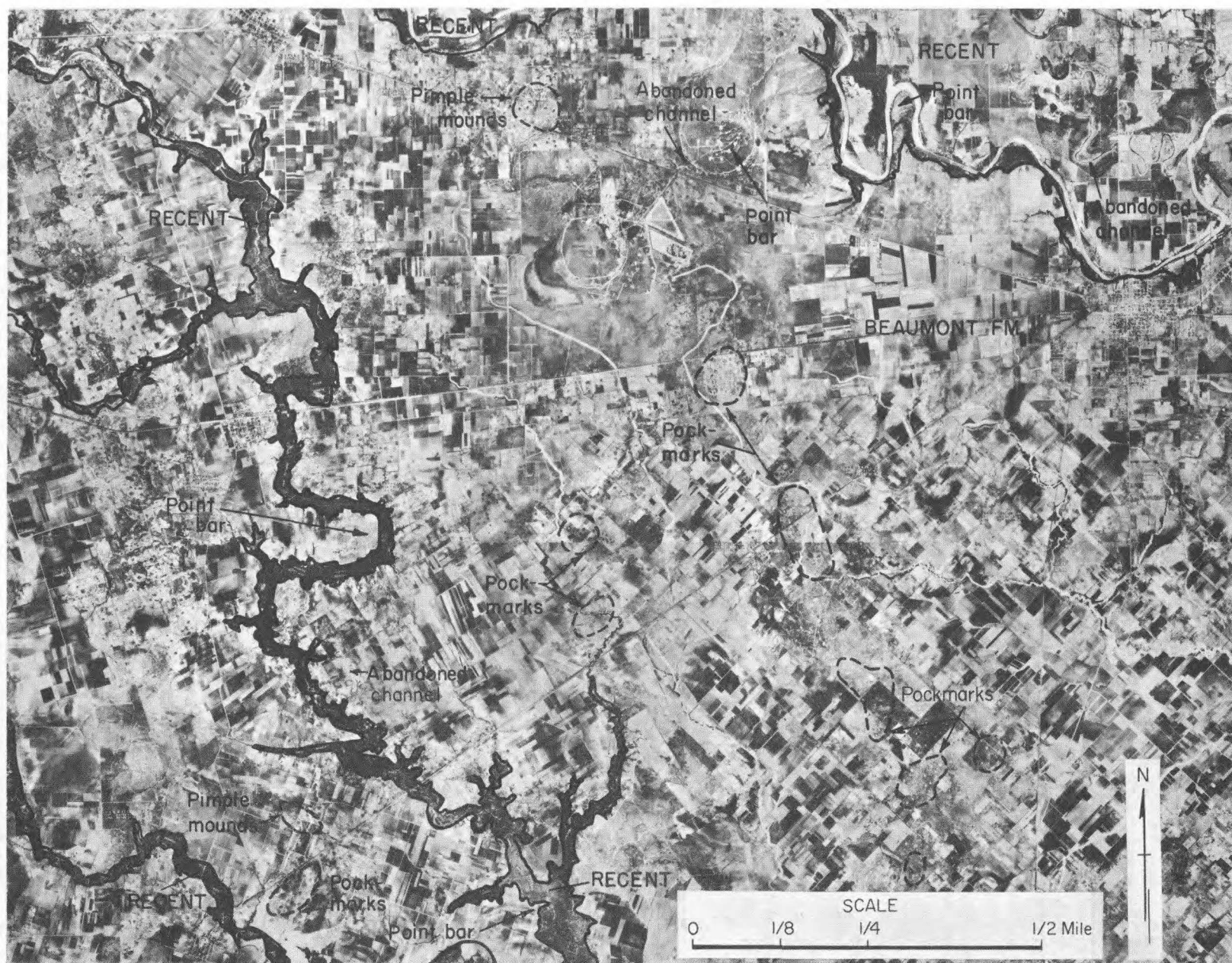
Distinctive soils are developed on the Willis in most of the area covered by this report. Soil maps (fig. 3) show Hockley soils primarily developed on the Willis in Harris County and mostly Goliad soils developed in Victoria and San Patricio counties. Hockley soils are light to dark brown, very fine and fine sandy loam and fine sand soils, 10 to 12 inches thick, with a yellow and yellow-brown subsoil containing intermixed iron concretions and quartz and chert gravel. Goliad soils are dark brown to reddish-brown sandy loam and fine sand soils, 8 to 10 inches thick, with a dark red subsoil which contains lime concretions in the lower few inches. No distinctive soils are developed on the Willis in the southern part of the area; this may be due to a similarity of the Lissie and Willis deposits or the thin covering of wind-blown sand derived from the South Texas dune plain.

Lissie Formation.—The Lissie Formation crops out in a belt 20 to 25 miles wide sub-parallel to the Gulf (Pl. I) and unconformably overlies the Willis Formation. The Lissie terrace has a seaward slope between 3.5 and 4 feet/mile and ranges in elevation from 100 to 160 feet. The Lissie terrace is not dissected extensively and in most areas has a low topographic relief; therefore, deposits underlying the Lissie terrace are generally poorly exposed. However, in the area north and northeast of Houston and in northern Hardin County, Lissie deposits are well exposed at several localities.

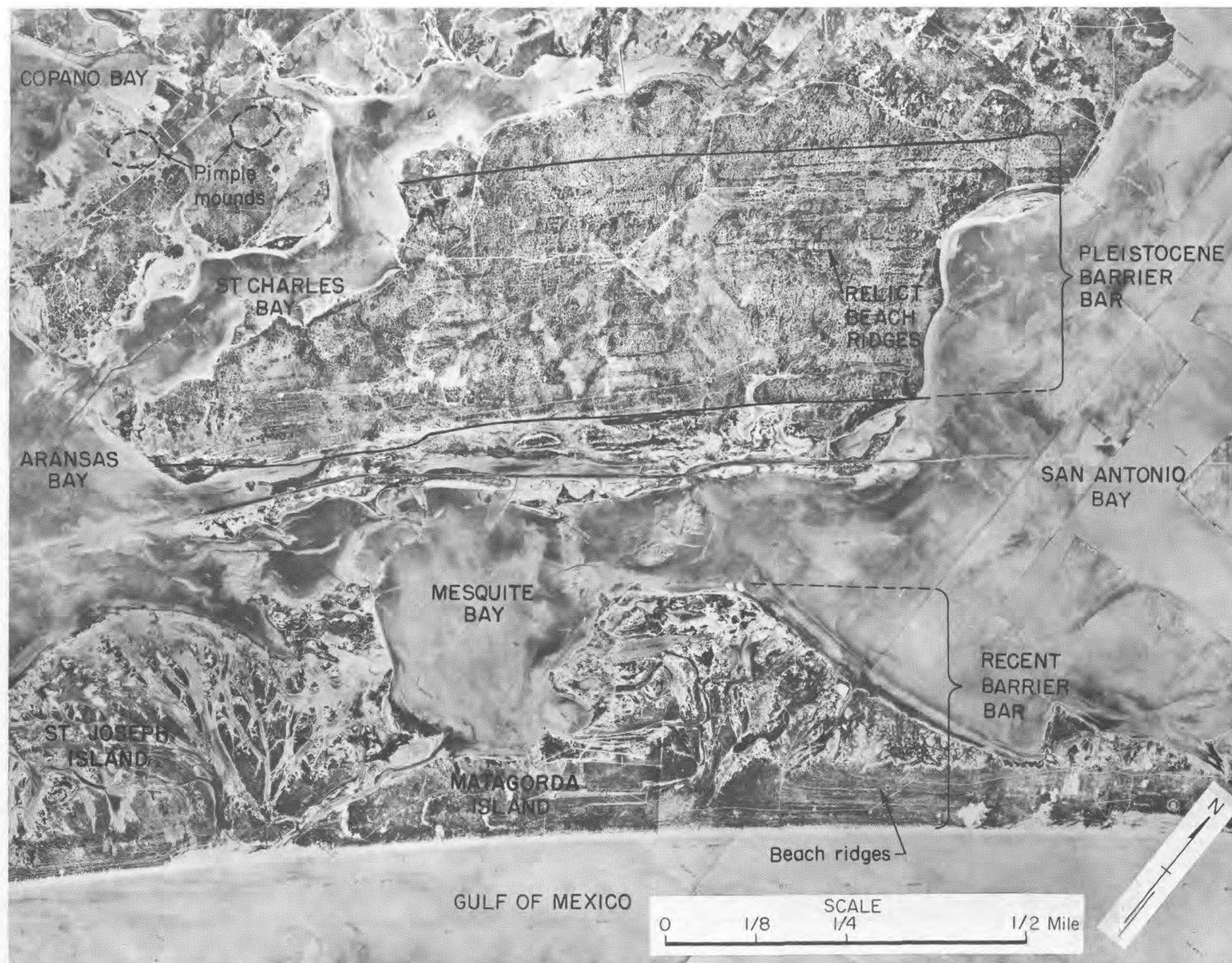
The thickness of the Lissie Formation ranges from approximately 30 feet in upstream deposits to an estimated 1,000 feet in the subsurface along the present coastline (Doering, 1935, p. 669).

Lissie deposits are generally composed of light-colored, fine to medium sands, clayey sands, and sandy clays. Mineral composition of sands is predominantly quartz with minor amounts of chert, heavy minerals, and disseminated clay. Basal gravels are exposed locally. Gravel is predominantly light-colored quartz and chert and possibly was derived from the underlying Willis Formation (Doering, 1935, p. 670).

Soils developed on the Lissie Formation are



Geomorphic features (abandoned channels, point bars, pockmarks, and pimple mounds) on Beaumont Formation and Recent sediments, Fort Bend and Wharton counties, Texas



Pleistocene and Recent barrier bars, Matagorda County, Texas

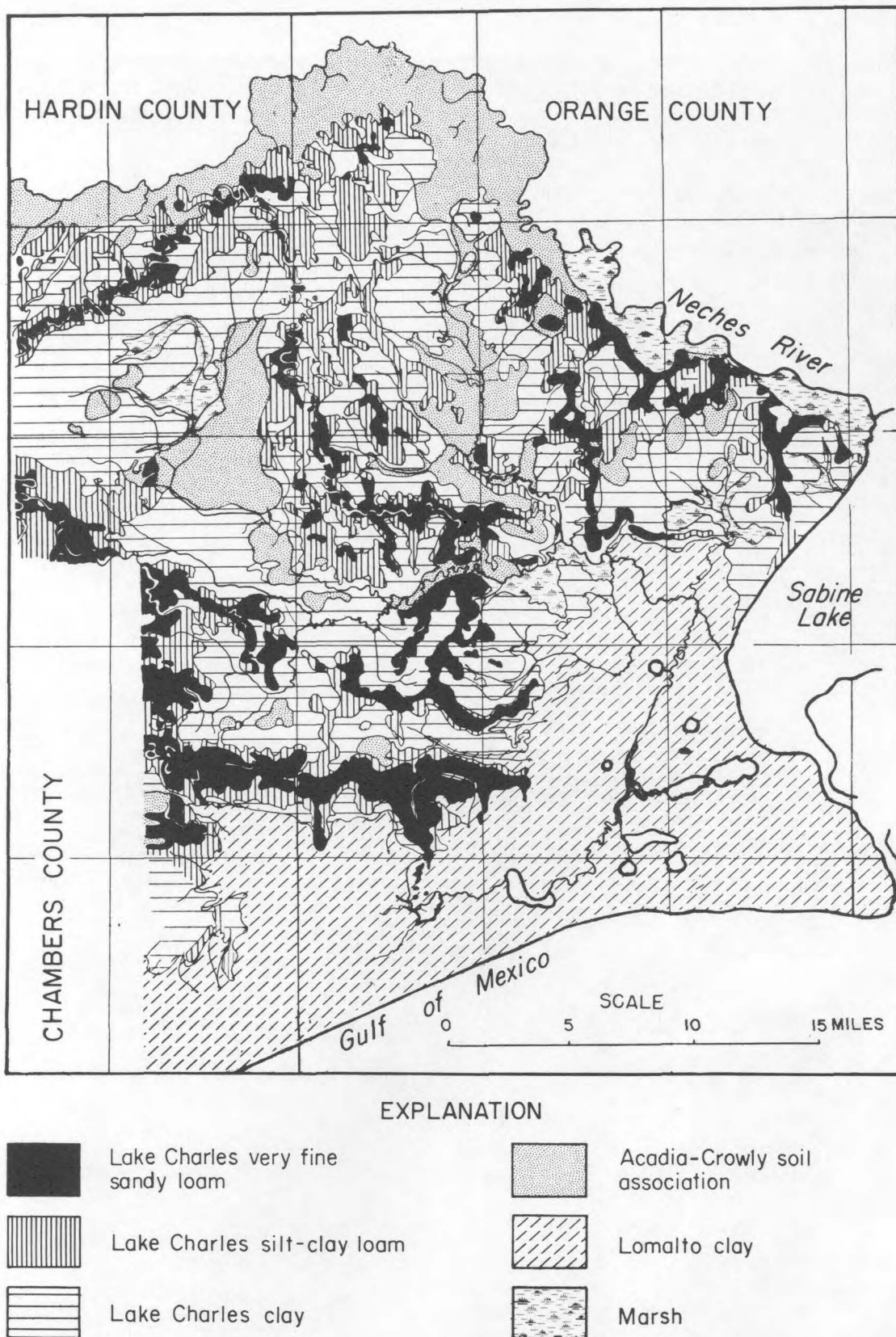


Fig. 2. Soil map of Jefferson County, Texas (modified after U. S. Department of Agriculture, Soil Conservation Service, Jefferson County soil map, 1913). Lake Charles soils are developed entirely on Beaumont Formation; other soils developed mostly on younger sediments.

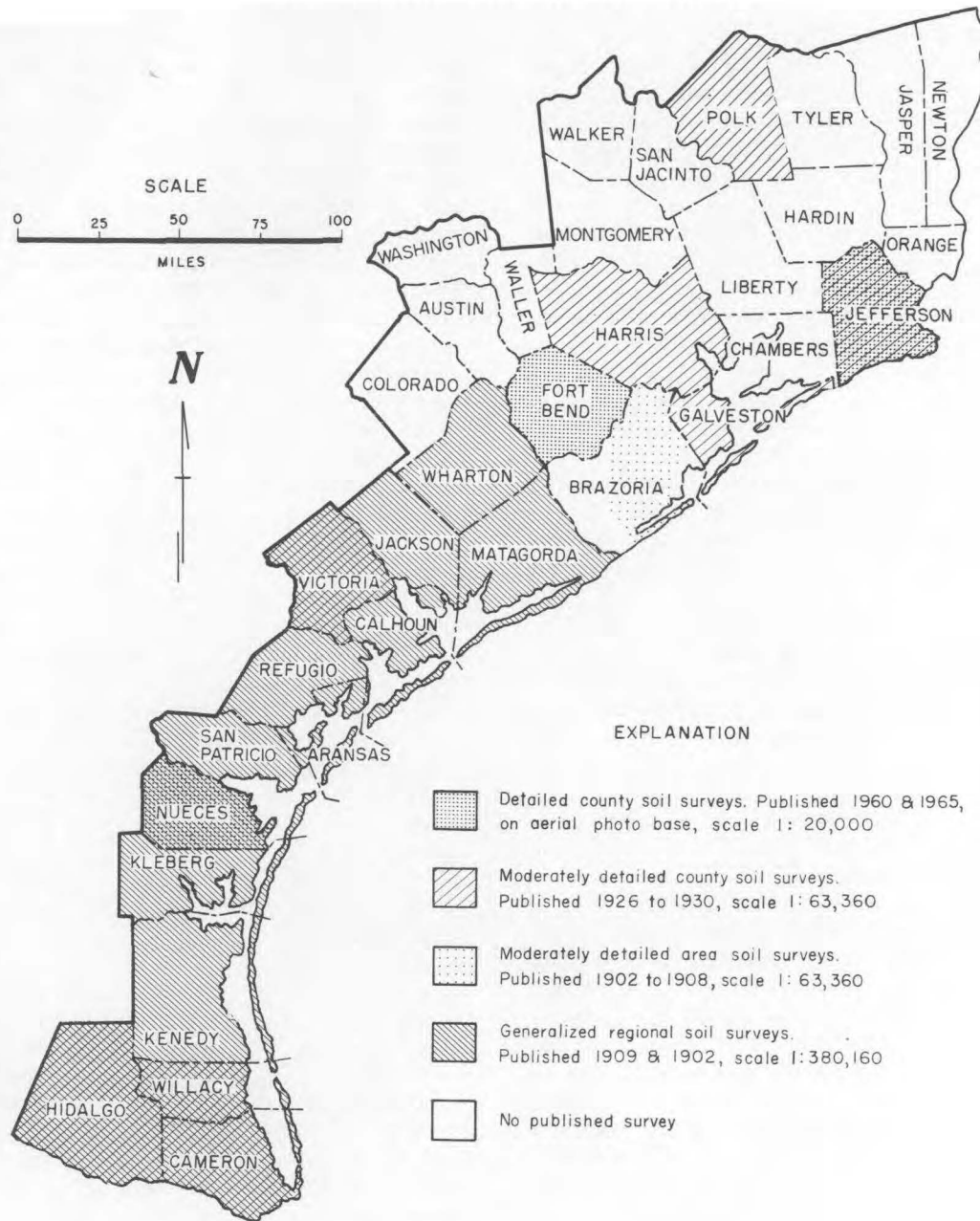


Fig. 3. Index of U. S. Department of Agriculture soil surveys in study area.

light tan and gray, fine sandy loams. The principal types developed in Harris County are the Katy soils, but the Victoria County soil map (fig. 3) shows Hockley soils predominantly developed on the Lissie in that area. Katy soils are yellow-brown to gray-brown, fine sandy loams, 10 to 30 inches thick, with light brown to yellow-brown sandy loam subsoils locally containing iron concretions and quartz gravel. Correlation of the Lissie Formation with a soil type or types is difficult in South Texas because there is less lithic contrast between the Pleistocene units or because the soils are masked by overlying wind-blown sand; however, the Willacy soils appear to

be mostly derived from the Lissie Formation.

Montgomery Formation. —Deposits related to this terrace were originally mapped as parts of the Lissie and Beaumont Formations. The terrace has not been given a formal name in Texas but has been mapped as unnamed 2nd terrace by Bernard et al. (1962) in the area northwest of Houston and along the Brazos River. Bernard and LeBlanc (1965, pp. 146 and 148) applied the names unnamed 2nd terrace, Upper Lissie, and the Louisiana term Montgomery to this unit; for purposes of this report the name Montgomery is used. The Montgomery terrace extends in a narrow belt, 5 to 10 miles wide, sub-parallel to and gulfward from outcrop

of the Lissie Formation (Pl. I). The Montgomery unconformably overlies the Lissie Formation. Average seaward slope of this terrace is approximately 2.5 feet/mile and elevations range from about 70 to 100 feet. The surface is not extensively dissected and has little topographic relief.

Sediments underlying the Montgomery terrace are similar to those of the Lissie Formation. They consist predominantly of light-colored, medium to fine sands, clayey sands, and silts. Mineral composition of the sands is mainly quartz with minor amounts of heavy minerals, chert, and disseminated clay. Exposures of this unit are seen along the Brazos River near San Felipe. Total thickness of the deposits is not known but in some outcrops where basal contact is exposed, a thickness of approximately 20 feet is present. The divergence of the surface slopes of this terrace and of the underlying Lissie terrace suggests that the rate of thickening is about 1 foot/mile toward the coast.

Soils developed on Montgomery deposits are not as distinctive as soils developed on the other Pleistocene units. Soils of the Acadia series are commonly developed on this surface in the vicinity of Harris County. The Edna and Brennan soil series are developed in the central and southern parts of the Coastal Plain, respectively. Acadia soils are light gray to brown, very fine sandy loam to fine sand, 6 to 18 inches thick. Subsoil is light brown to yellow-brown fine sand with iron concretions in the lower part. Edna soils consist of light to dark gray, fine sandy loam, 8 to 12 inches thick, with a dark gray clay subsoil grading downward to a fine sandy clay locally mottled with yellow and red yellow, containing iron and lime concretions below 2 to 3 feet. Brennan soils are gray brown to brown, fine sandy loams, 12 to 20 inches thick. Subsoil is light brown to yellow-brown, fine sandy clay loam with white caliche occurring below a depth of 5 to 10 feet. In some areas soils developed on the Montgomery Formation are similar to slope phases of other soils developed on the Lissie Formation.

Beaumont Formation.—In Texas, the Beaumont Formation extends in an arcuate belt, 30 to 40 miles wide, from the Rio Grande to the Sabine River (Pl. I); it overlies the Montgomery terrace unconformably and upstream deposits overlap Lissie, Willis, and Tertiary Formations (Doering, 1935, p. 672). Average seaward slope of the Beaumont surface is approximately 2 feet/mile and surface elevations range from about 10 to 70 feet. The surface has very little topographic relief and is only slightly dissected, resulting in relatively few natural exposures.

In contrast to the older Pleistocene coastwise terraces, physiographic features developed during the deposition of the Beaumont, such as meander belts, distributary systems, and barrier bars, are preserved and easily recognized. One

of the most prominent features is the Live Oak Barrier, originally named Live Oak mature offshore bar by Price (1933, p. 919). It is a Late Pleistocene counterpart of the modern barrier islands (e.g., Padre and Mustang Islands). The ancient Live Oak Barrier is a prominent feature from Baffin Bay to south of the Colorado-Brazos deltaic plain; remnants are also found near Chocolate Bay, east of Trinity Bay, and near Beaumont (Price, 1947, p. 1620) (see Pls. I, III, and IV). It is readily recognized on the ground and on aerial photographs by vegetation (predominantly oak trees contrasted with surrounding grasslands), abundant pimple mounds, topographic relief, and, in some places, beach ridges (Pls. III and V). It is also easily recognized in wells by its characteristic medium to fine sand lithology, in contrast to the adjacent silts and clays (fig. 4). Parts of the Live Oak Barrier are well exposed in Aransas and San Patricio counties. Sediments of the Beaumont deposits are predominantly quartz sands, silts, and clays, generally finer grained than those of the Lissie. Distribution of sand bodies within the Beaumont is irregular (figs. 2 and 5), but generally basal sands grade upward to silts and clays. Sand units are composed predominantly of quartz with minor amounts of chert and heavy minerals. Sands of the Live Oak Barrier are similar in color and mineral composition to the Recent barrier island sands.

Soils of the Lake Charles series are developed on the Beaumont Formation in the northern and central parts of the area. They consist of light gray to dark gray-brown clay, clay loams, and very fine sandy loams which vary from 8 to 30 inches thick. The subsoil is light gray to yellow-brown clay or clay loam. In South Texas, Victoria and Hidalgo soils are predominant on Beaumont deposits. Victoria soils are dark brown to black, fine sandy loams, ranging in thickness from 8 to 15 inches. Victoria subsoil is a calcareous light brown to brown, fine sandy clay or clay loam. Hidalgo soils are light brown to brown, fine sandy loams, 8 to 12 inches thick, with light brown, calcareous, sandy clay loam subsoil. Hidalgo and Victoria soils are commonly very similar and are differentiated arbitrarily. Barton (1930b, p. 1303) pointed out the value of soil maps in delineating sand units within the Beaumont, especially in the northern part of the Texas Gulf Coastal Plain. Sand bodies form irregular sand ridges flanked by slopes of clay and silt loams (figs. 2 and 5). Most of the irregular sand bodies are delineated on aerial photographs by ancient channel scars or abundant pimple mounds (Pls. II and V).

Recent Series

Alluvial deposits.—Rivers which cross the Coastal Plain have deposited large amounts of alluvial sediment. The Colorado, Brazos, Guad-



Pleistocene and Recent barrier bars, Chambers County, Texas



Geomorphic features (Pleistocene barrier bar, relict beach ridges, abandoned channels, point bars, and pimple mounds) on Beaumont Formation, Jefferson County, Texas

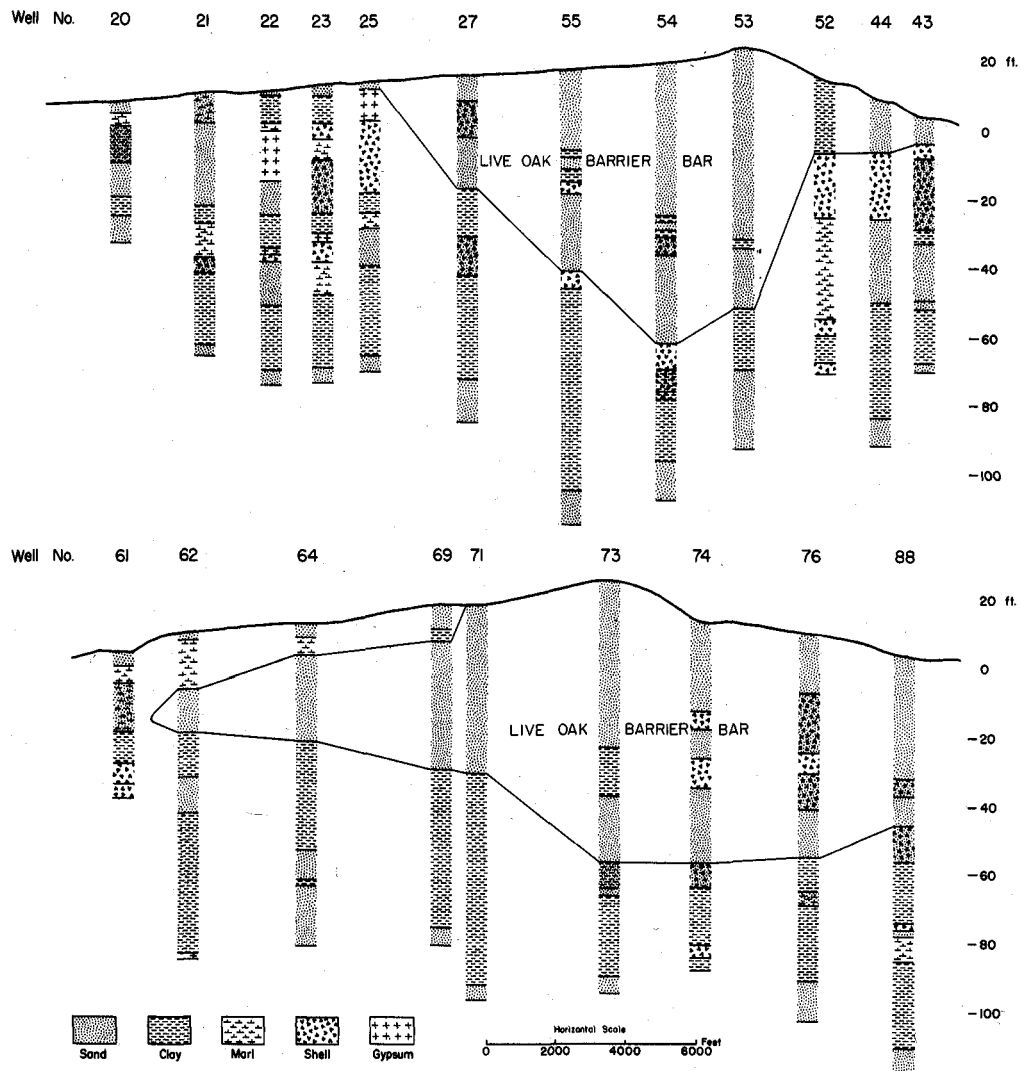


Fig. 4. (a) Sections across Live Oak Barrier Bar, Aransas County, Texas (modified after Johnson, 1940, p. 46).

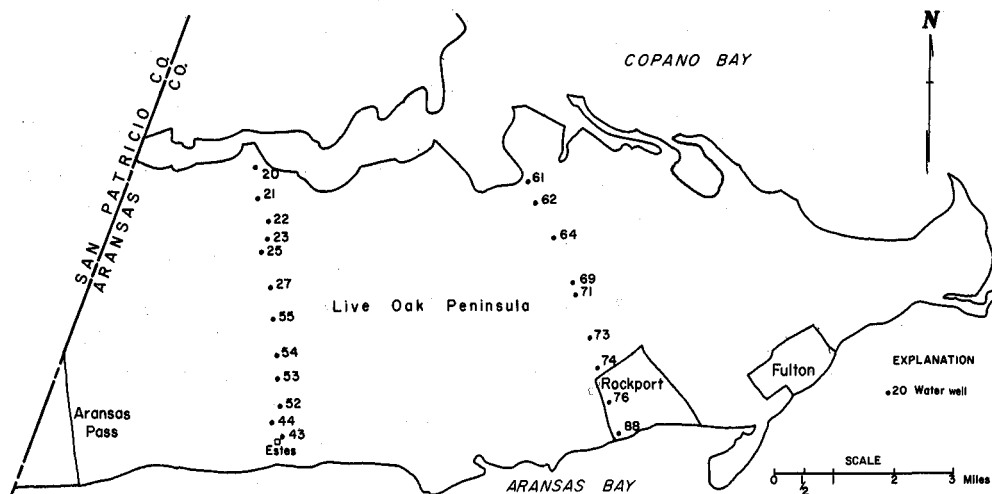


Fig. 4. (b) Locality map of wells used in figure 4(a).

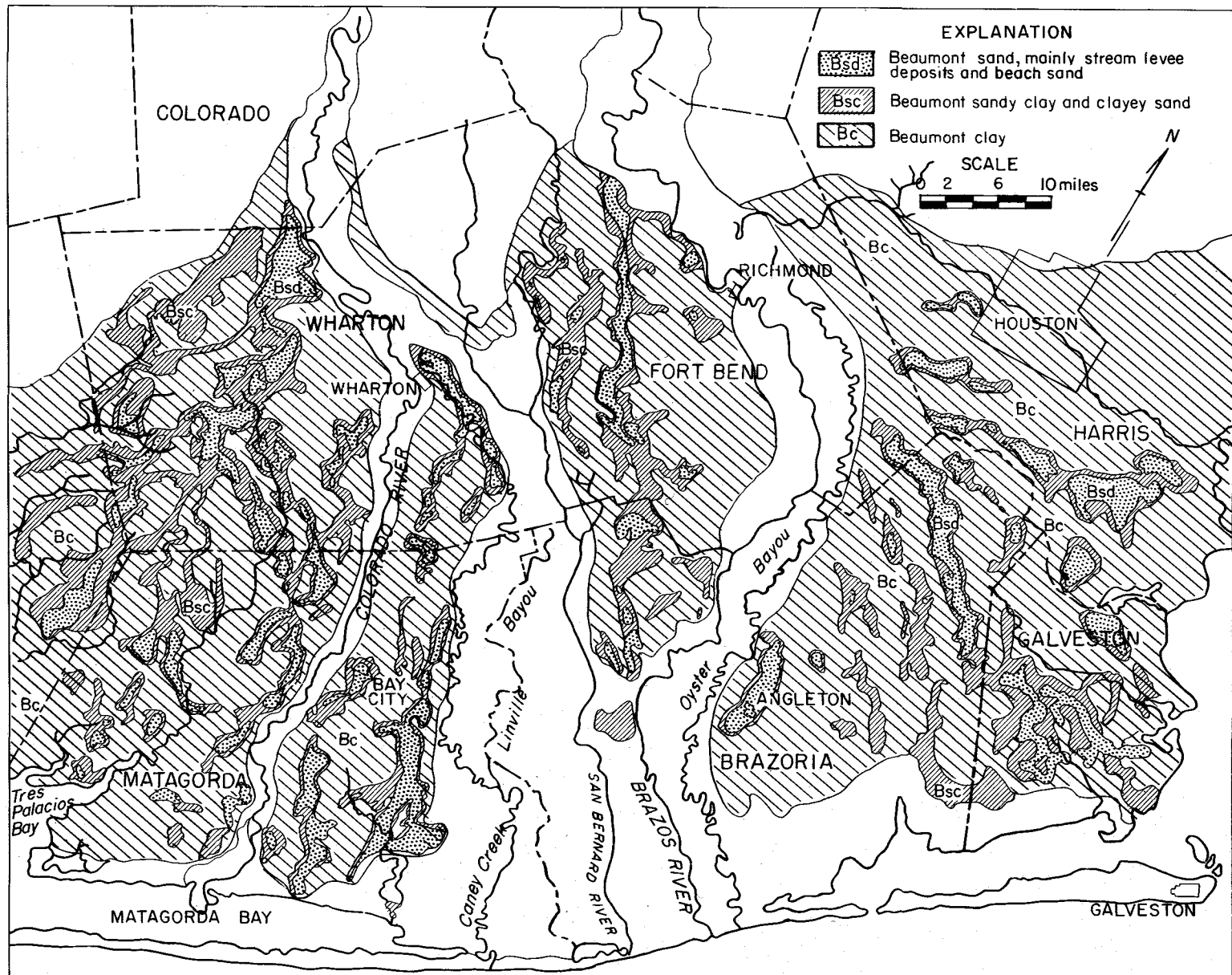


Fig. 5. Distribution of Beaumont sediments, central Gulf Coast, Texas (modified after Metcalf, 1940, p. 698).

alupe, Neches, and San Jacinto Rivers and the Rio Grande deposited the largest amounts of material but several smaller stream valleys contain significant deposits. These include bars and abandoned stream channel, flood-plain, natural levee, terrace, and deltaic deposits.

Bedding and grain size distribution in the alluvial deposits are irregular. Individual sand and gravel deposits vary in thickness from 10 to 30 feet and ratio of sand to gravel ranges from 30/70 to 50/50. Units display graded bedding locally. Beds are not persistent. Most deposits are composed of quartz and chert with minor amounts of igneous or sedimentary rock fragments, heavy minerals, and clay. Chert is commonly more abundant in the gravel fraction than in the sand fraction. Dark varieties of chert are more common in the central part of the area because streams drain the Edwards Plateau where relatively more dark chert is available. Heavy mineral and grain size analyses of Texas river sands are summarized in tables 1 and 2 and figure 6.

Coastal dune deposits.—Sand dunes are extensive along the Texas coastline; development is

most extensive on the barrier islands—Galveston, Mustang, and Padre. Deposits range in thickness from about 3 feet along Bolivar Peninsula to 40 feet in some dunes on Padre Island. Vegetation has stabilized some dune slopes.

Source of the dune sands is beach sand. Long-shore currents and tidal and wave action move sand from river mouths and deposit it along beaches (Bullard, 1942; Lohse, 1952 and 1955). Prevailing winds move the sand inland and deposit it behind the beaches as dune ridges. Sands are generally well sorted and very fine to medium grained; they consist of quartz, chert, heavy minerals, and volcanic and plutonic rock fragments. Percent of heavy minerals and rock fragments is variable (table 3 and fig. 7). The most notable change is along Padre Island. Sands on the northern part of the island contain plutonic and volcanic rock fragments; on the southern part of the island they contain relatively more volcanic rock fragments and relatively fewer plutonic rock fragments (table 4). Percentage of heavy minerals is relatively higher on the southern part of Padre Island (table 5). Also, grain size distribution varies along the

Table 1. Heavy mineral analyses of Texas river sands (percent by number of grains)
(after Bullard, 1942, p. 1026).

	Rio Grande	Nueces River		San Antonio River	Colorado River					Brazos River			Trinity River	Neches River	
Sample number	-	65	68	15	1	2	3	10	13	4	5	6	82	79	80
Number of counts	2	1	1	2	2	2	2	3	2	2	2	2	1	1	1
Apatite	1	-	-	1	1	-	1	2	1	1	1	2	-	-	-
Basaltic hornblende	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Opaque minerals	56	57	66	54	39	26	45	62	21	46	64	45	66	50	55
Epidote	4	4	2	2	1	7	5	2	3	1	1	1	-	1	2
Garnet	3	1	4	2	2	3	4	3	5	14	7	12	3	1	1
Hornblende	5	3	1	1	13	35	20	15	50	1	-	-	-	-	-
Iron oxides	3	3	2	4	2	7	1	2	4	2	1	2	6	10	4
Kyanite	2	-	-	2	-	2	-	-	1	2	-	2	1	2	1
Leucoxene	10	18	12	16	10	10	7	2	4	12	6	12	1	9	14
Monazite	-	-	-	2	-	-	1	-	-	1	2	1	-	3	-
Rutile	-	4	2	2	2	1	-	1	2	-	2	2	-	3	1
Staurolite	1	-	1	3	1	2	1	-	-	5	1	2	5	6	-
Tourmaline	1	1	2	5	1	3	1	1	2	2	1	2	1	1	-
Zircon	2	8	6	10	27	2	14	10	6	13	14	14	17	11	21
Others	11A	1E	2A	-	1B	2A	-	-	1H	1E	-	1H	-	2E	1E
	2E	-	-	-	-	-	-	-	-	-	-	1B	-	1B	-

A, Augite; E, Enstatite; H, Hypersthene; B, Brookite.

Table 2. Average heavy mineral and light mineral composition of sediment supplied to the northern Gulf of Mexico by Texas rivers (modified from Van Andel, 1960, p. 36),

River	Number of samples											Light Minerals			
		Hornblende	Tourmaline	Epidote	Zircon	Garnet	Staurolite	Kyanite	Basaltic hornblende	Pyroxenes	Others	Number of samples	Quartz and chert	Metamorphic	Feldspar
Rio Grande	7	20	2	22	5	6	1	3	10	26	4	5	73	13	14
Nueces	3	4	15	14	20	15	5	3	2	11	11	-	-	-	-
Rivers between Nueces and Colorado	10	1	14	15	44	13	4	4	-	-	5	-	-	-	-
Colorado	5	77	1	4	7	6	1	-	-	-	4	-	-	-	-
Brazos	3	1	21	7	22	36	6	1	-	-	6	-	95	-	5
Trinity, Neches, and Sabine	5	1	17	10	37	4	11	12	-	-	8	-	-	-	-

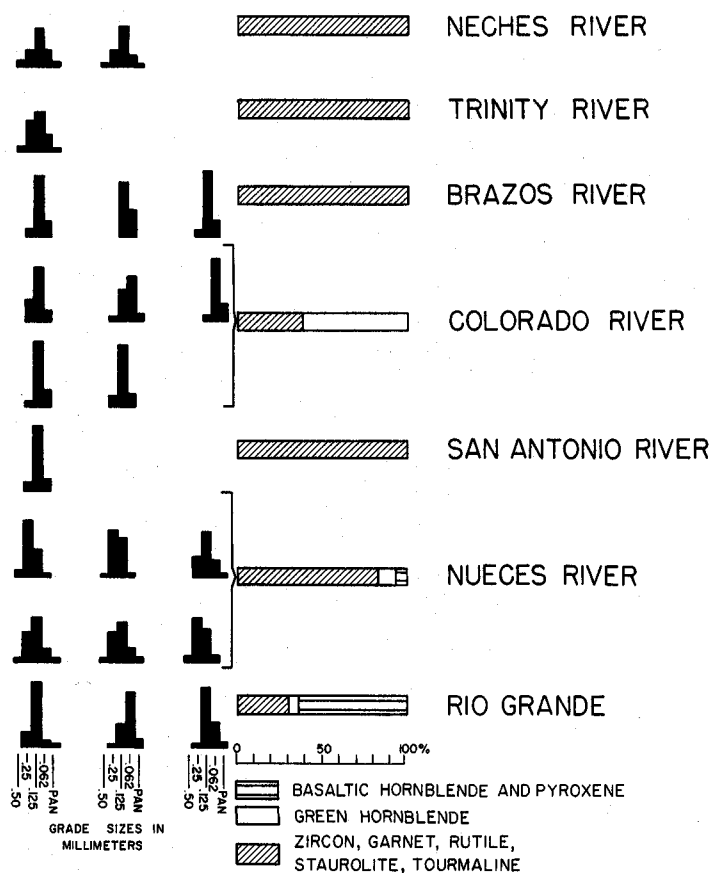


Fig. 6. Mechanical and heavy mineral analyses of Texas river sands (after Bullard, 1942, p. 1030).

Table 3. Heavy mineral analyses of Texas Gulf Coast beach sands (after Bullard, 1942, p. 1028).
(Percent by number of grains; for each sample, three counts of 100 each were made.)

Sample Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Augite	12	17	9	5	8	5	4	7	6	-	1	1	1	1	2	2	1	2	1	1	-	1	1	-	-	1	1	-	-	-	-	1	1	2	1	1	1	2
Basaltic horn- blende	6	8	10	4	9	10	9	12	8	2	1	-	1	1	-	1	-	1	1	-	-	1	1	-	-	-	-	-	-	-	-	1	2	1	1	-	1	1
Enstatite	1	-	-	1	1	-	-	1	1	-	-	-	-	1	1	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	1	1	2	1	1	-	1
Epidote	6	6	7	6	6	6	8	5	4	4	3	5	3	3	4	3	8	4	5	9	3	5	3	1	4	2	3	4	2	-	6	9	7	7	5	3	3	5
Garnet	5	3	7	6	5	2	5	3	1	3	2	1	-	2	2	5	3	7	5	6	7	5	10	9	10	7	8	7	10	7	12	8	5	6	4	2	1	7
Hornblende	8	15	8	6	16	21	15	27	24	14	11	9	7	15	23	24	25	24	30	35	3	22	9	4	13	12	8	10	-	-	9	22	22	16	15	11	7	17
Hypersthene	2	2	2	1	2	2	1	-	1	-	-	1	-	-	-	1	-	1	-	1	-	-	-	-	-	1	-	-	-	-	-	-	1	1	-	-	1	-
Kyanite	1	1	3	1	-	2	1	1	-	-	1	2	1	-	2	2	1	1	1	1	-	2	1	-	1	1	-	1	1	-	1	2	1	-	2	3	2	-
Leucoxene	4	8	8	4	7	12	5	9	13	15	23	9	12	16	22	24	18	19	18	17	7	23	11	4	11	11	10	9	7	3	12	10	11	14	15	20	21	13
Limonite	1	2	-	2	2	3	2	1	1	1	1	1	2	1	1	2	-	-	-	-	-	2	1	1	2	-	2	3	2	1	1	1	1	5	4	9	12	1
Monazite	3	2	3	3	1	1	1	1	1	-	-	1	1	1	-	1	-	1	-	-	-	-	-	1	-	-	1	-	-	2	2	2	3	1	3	-	-	1
Opaque minerals	41	31	34	53	40	29	40	23	28	35	40	46	54	35	22	17	24	23	16	15	48	21	43	45	37	41	45	44	47	58	36	28	26	27	35	34	24	33
Rutile	1	-	1	-	-	-	1	1	-	3	2	1	1	2	2	3	1	1	2	1	1	1	1	1	2	1	-	2	1	1	1	3	-	2	1	2	3	-
Staurolite	2	1	1	2	1	1	1	1	3	1	3	3	4	3	4	5	-	1	3	2	-	2	2	1	1	1	1	4	1	1	2	3	3	1	2	3	4	2
Tourmaline	2	1	4	1	1	2	3	5	6	9	6	11	5	11	13	7	10	5	9	8	3	8	5	1	3	4	5	3	-	1	3	5	8	4	5	5	8	4
Zircon	4	2	3	5	1	2	3	2	3	13	6	9	8	8	1	2	8	9	7	3	28	6	12	32	15	18	16	12	29	26	15	3	7	11	5	7	10	6
Others	1A	1A	-	-	-	2A	1A	1A	-	-	-	-	-	-	1A	1A	1Ac	1A	-	-	-	-	-	-	-	-	-	1A	-	-	1A	1A	-	-	1A	-	2P	6P

A, Apatite; Ac, Actinolite; P, Pyrite.

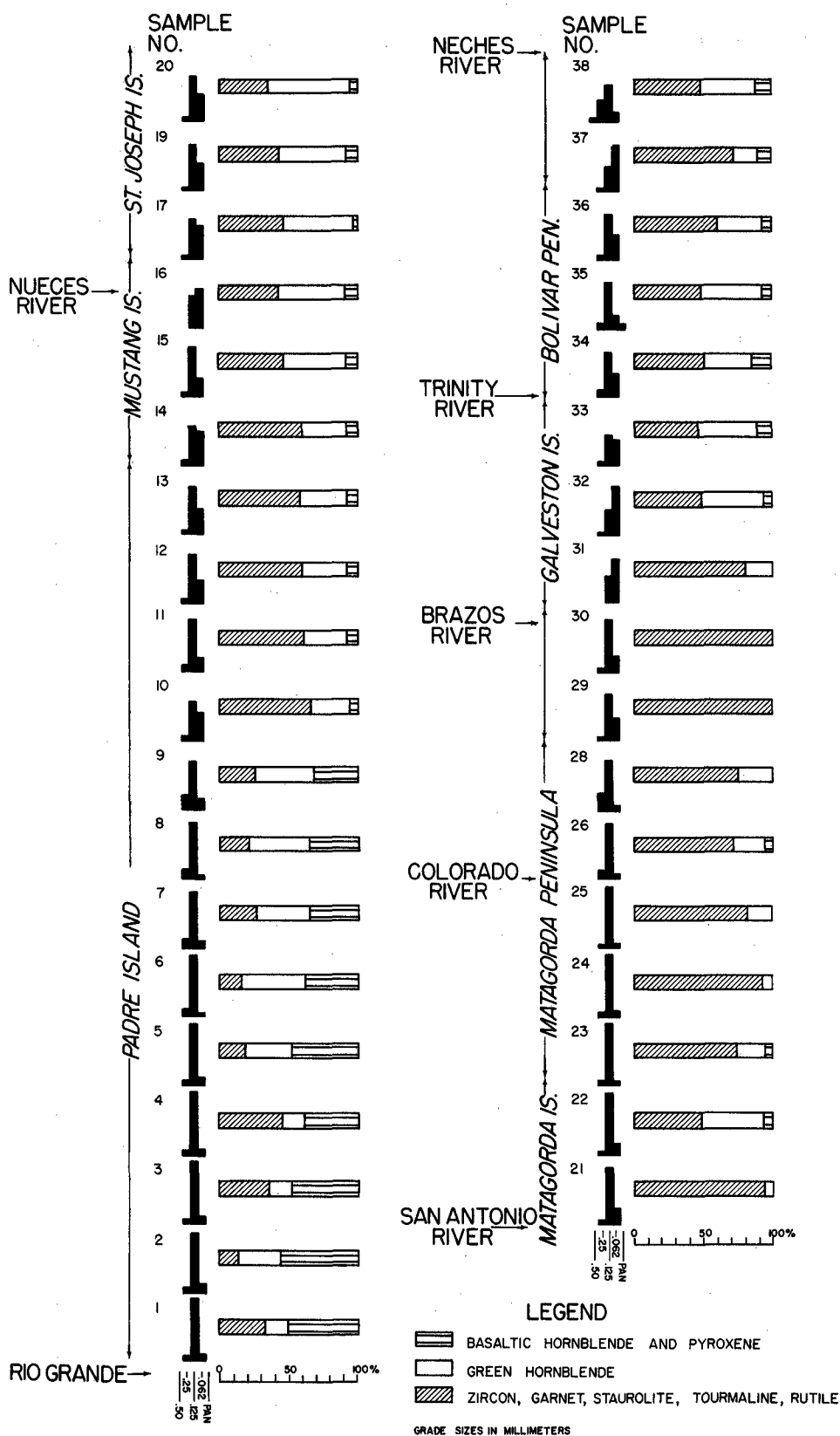


Fig. 7. Mechanical and heavy mineral analyses of Texas beach sands (after Bullard, 1942, p. 1036). Sample numbers correspond to numbers in table 7.

Table 4. Mineral distribution in sands along Padre Island (modified after Hayes, 1965, p. 323).

Petrographic Province	Sample Number	Quartz	Chert	Rock Fragments			Feldspar	
				Volcanic	Metamorphic	Plutonic	Sanidine	Other
Northern Province	G-40	90	2	-	4	-	1	3
	PIQ-1	79	1	3	3	3	2	9
	PIP-12	88	6	4	-	-	-	2
Transition Zone	PID-1	83	-	9	1	-	2	5
	PIF-4 (3.0 ϕ)	91	1	2	1	-	1	4
	PIF-4 (2.25 ϕ)	73	2	11	1	1	2	10
Southern Province	PIG-4	89	1	6	1	1	2	-
	PIJ-2A	82	-	2	-	-	5	11
	PIL-6	77	-	10	2	1	5	5
	MCh-B	71	4	4	3	-	2	16
	Pla-2d	83	1	4	2	-	3	7

island (Appendix C). In the mid-part of the island, grain size distribution is bimodal; northern and southern samples have only one grain size mode (Hayes, 1965, p. 234).

Dune plain deposits. —The South Texas dune plain is an area of sand dunes, extending from Baffin Bay southward to the northern part of Willacy County and about 75 miles inland from the coast. Most of the dunes are stabilized by sparse vegetation. In the north and east parts of Kenedy County, there are live dune fields.

Dune plain sands are derived from coastal deposits. Large amounts of sand are deposited by opposing longshore currents near the mid-part of

Padre Island. These loose sands are carried inland by prevailing winds (Lohse, 1955, p. 101). The process has almost filled a 25-mile stretch of Laguna Madre in recent years (Cook, 1958, p. 49). Thickness of the sands making up the dune plain is irregular. Southeast of Sarita, lagoonal clays underlie the sands at 6 to 8 feet and in Humble Oil & Refining Company C. M. Armstrong No. 8 (central Kenedy County), 200 feet of dunelike sands overlie the clays (Cook, 1958, p. 50). Sands of the inland dune plain are similar in grain size distribution, mineral content, and general appearance to the sands of the coastal dunes.

Table 5. Results of beneficiation tests.

Iron oxide (Fe ₂ O ₃)							
Sample Number	Laboratory Number	Percent in washed sample	Light fraction		Light fraction--attrition scrubbed		Percent heavy minerals removed from washed sample
			Percent	Percent reduction from washed sample	Percent	Percent reduction from washed sample	
Aransas 1	64534	0.102	0.078	23.5	0.074	24.7	0.12
Austin 2	65001	0.088	0.069	21.6	0.060	24.4	0.16
Austin 3	65002	0.289	0.196	32.3	0.139	41.3	0.20
Cameron 2B	64526	0.480	0.223	53.5	0.216	55.1	0.75
Cameron 3B	64529	0.408	0.202	50.4	0.193	52.9	1.12
Galveston 3C	64511	0.495	0.218	55.2	0.205	58.5	0.24
Hardin 1	64459	0.092	0.091	1.0	0.075	1.2	0.07
Hardin 2	64460	0.082	0.053	35.4	0.048	38.6	0.26
Hardin 3	65052	0.097	0.069	28.8	0.061	32.3	0.20
Harris 4A	65007	0.062	0.054	12.9	0.051	13.7	0.13
Harris 7	65012	0.069	0.060	13.2	0.058	13.6	0.11
Harris 8	65013	0.080	0.065	18.8	0.061	19.9	0.12
Harris 9	65054	0.080	0.060	25.0	0.055	27.0	0.06
Kenedy 2	64538	0.271	0.175	35.4	0.172	36.1	0.18
Kenedy 3	64539	0.213	0.136	36.2	0.126	38.7	0.04
Kleberg 1A	64561	0.136	0.098	27.9	0.095	28.7	0.98
Kleberg 3	64610	0.140	0.129	7.8	0.125	8.0	0.05
Matagorda 3B	64501	0.182	0.141	22.5	0.139	22.7	1.51
Matagorda 4	64503	0.180	0.132	26.7	0.132	26.7	1.22
Nueces 4C	64549	0.178	0.138	22.5	0.136	22.7	1.75
Nueces 5C	64552	0.193	0.151	21.8	0.151	21.8	0.08
Nueces 6A	64553	0.116	0.092	20.7	0.091	20.9	0.32
Orange 1	65051	0.071	0.051	28.1	0.042	33.2	0.20
Orange 2	65053	0.071	0.055	22.5	0.054	23.0	0.16

PHYSICAL AND CHEMICAL PROPERTIES

Grain Size Distribution

Sample analyses show similarities between Pleistocene and Recent sediments. Grain size limits of upstream Pleistocene terrace deposits and Recent channel and terrace deposits range from gravels to fine sand; deposits are poorly to moderately sorted. Pleistocene coastwise terrace deposits and Recent flood-plain and coastal deposits range from medium to fine sand and are well sorted to moderately well sorted.

Average grain size of sands in the Lissie, Montgomery, and Beaumont coastwise terrace deposits is about 0.20 mm, and in upstream equivalents, sand grain size averages about 0.50 mm. Coastal dune and dune plain deposits have average grain sizes of about 0.15 mm. Samples generally have less than 5 percent silt-clay size particles. Amount of material retained on the 100-mesh screen ranges from about 95 percent in channel and terrace deposits to about 40 percent in some dune deposits; in the same deposits, material coarser than 60 mesh ranges from about 90 percent to less than 1 percent. A summary of grain size distribution of Texas river and beach sands is given in figures 6 and 7. Detailed grain size analyses are in Appendix C.

Mineral Composition

Deposits in the area of study are chiefly composed of quartz and chert with minor amounts of heavy minerals, igneous fragments, feldspar, and clay minerals. Fine-grained alluvial deposits and windblown deposits are predominantly quartz and locally contain only 1 or 2 percent chert. Coarse-grained terrace deposits contain larger percentages of chert, especially in the gravel fraction. Lissie, Montgomery, and Beaumont sands are similar in mineral composition to Recent barrier island and alluvial sands. White chert is present in most sands but red, black, and brown varieties are generally more abundant. Deposits (Recent and Pleistocene) in the central part of the Texas Coastal Plain contain a larger percent chert than deposits of the northern part. Rivers supplying sediment to the central Coastal Plain have drainage areas in the Edwards Plateau where relatively more chert is available. Source area for sediments in the northern part of the Texas Coastal Plain is composed of a wider variety of rocks (ranging from Precambrian granites to Tertiary sands) which dilute the chert. Sands inspected in the northern part of the Texas Gulf Coastal Plain reflect these multiple sources in the feldspar and granitic rock fragments which accompany the dominant quartz. Sands deposited by smaller rivers whose drainages are restricted to Tertiary rocks

contain up to 99 percent quartz. Sediments deposited by the Rio Grande contain about the same percent chert as deposits in the northern part of the area; in addition, they contain a large amount of volcanic rock fragments (up to 20 percent in the sand fraction and even higher in gravel fractions). Volcanic provinces of Southwest Texas and Mexico are the primary sources of Rio Grande deposits.

Selected sand samples from the Texas Gulf Coastal Plain have a range in heavy mineral content from 0.05 to .175 percent of the total sand sample (table 5). Samples analyzed by Hahn et al. (1961, pp. 40 and 43) show that Texas Gulf Coast beach sands contain from 0.13 to 2.57 percent heavy minerals. Heavy minerals in beach and river deposits are apatite, green hornblende, basaltic hornblende, pyroxene, epidote, garnet, magnetite and ilmenite, leucoxene, kyanite, monazite, rutile, staurolite, tourmaline, zircon, and others. Magnetite and ilmenite (opaque heavy minerals) are the predominant minerals in the heavy fraction; relative abundance ranges from 17 to 58 percent in beach sands and from 21 to 66 percent in river sands (tables 1 and 3). Percentages of these heavy minerals in beach and river sands are summarized in tables 1 and 3 and figures 6 and 7. Heavy minerals are more abundant in Recent alluvium of the Rio Grande and beach sands of southern Padre Island. Basaltic hornblende and pyroxene contributed by the Rio Grande compose 15 to 25 percent of the heavy fraction in sands of southern Padre Island; farther northward the amount of these minerals is reduced to 1 or 2 percent. The characteristic suite of heavy minerals contributed to beach sands by the Rio Grande changes abruptly to the Colorado River suite, rich in green hornblende, near the mid-part of Padre Island (fig. 7 and Bullard, 1942). In beach sands the relative abundance of the more durable heavy minerals (garnet, tourmaline, rutile, zircon, and staurolite) increases near the mouths of the Nueces, San Antonio, and Brazos Rivers (fig. 6).

Chemical Composition

Principal chemical constituent of the Lissie, Montgomery, Beaumont, and Recent sands is silica. Percentage of other elements ranges from about 20 percent to less than 1 percent. Alluvial deposits in South Texas contain the smallest amount of silica, and deposits in the northern part of the Texas Gulf Coastal Plain contain the largest amounts. Amount of silica also decreases southward in coastal dune deposits, though the decrease is not as apparent as in alluvial deposits. Non-siliceous constituents are in heavy minerals, impure chert, grain inclusions, grain coatings, and rock fragments. Volcanic rock fragments are the

primary source in Rio Grande deposits and heavy minerals contribute most of the nonsiliceous elements in windblown and alluvial sands. Impure chert also adds a considerable amount in some deposits. The main contaminating element in silica sands is iron; this is contributed chiefly by opaque heavy minerals (magnetite, ilmenite, and hematite) and iron-bearing chert.

Iron oxide content (Fe_2O_3) in the Beaumont, Montgomery, and Lissie sands (see p. 32) ranges from 0.07 to 0.17 percent. Alluvial deposits generally are too high in iron (Fe_2O_3 content generally

greater than 0.2 percent) to be considered for use other than constructional or blast sand; however, a few samples from the northern part of the area contained as little as 0.08 percent Fe_2O_3 . In coastal dune and dune plain sands, iron (Fe_2O_3) content ranges from 0.10 to almost 1 percent. Variation in the percent of heavy minerals and chert causes high variation in iron content. Iron content can be lowered considerably by removal of heavy minerals (table 5); scrubbing and chert removal also lower iron content (see p. 22).

RESOURCES

Definition and Utilization

Material referred to as sand in this report is an unconsolidated aggregate of mineral grains which range in size from 2 mm to 0.074 mm (-10 to +200 mesh U. S. Standard sieve sizes). From a commercial standpoint, sand is segregated into two groups according to use: (1) industrial and (2) constructional. Industrial sand includes abrasive sand (blast, cutting, grinding, and polishing), glass and chemical sand, molding sand, filter sand, fire or furnace sand, hydraulic fracturing sand, and ground silica. Constructional sand is sand used in concrete, mortar, paving, and as fill.

Specifications

Abrasive sand.—Size distribution is the main specification for abrasive sand, though the sand also must be free of clay and grain coatings of iron oxide. Grains must be durable and resistant to dusting and fracturing. Specifications vary according to use. In blast sands coarse grades range from 4 mesh to 12 mesh, medium grades from 12 mesh to 30 mesh, and fine grades from 20 to 100 mesh or finer. Angular grains are preferred by some consumers because they cut faster, but rounded grains are more commonly used because of their more durable nature and lower loss in fines. A desirable property of any grade class is that most of the sand be retained in two sieve intervals and be relatively low in nonsiliceous impurities. Sands used for cutting, grinding, or polishing must meet about the same requirements as blast sand. Grain size for grinding and polishing sand is commonly required to be between fine and medium sand. The main requirement for cutting sand is that it be free of flat and fine grains.

Glass and chemical sand.—High-purity silica sand is required for glass making and chemical

uses. Frequency distribution is commonly specified as between 20-mesh and 100-mesh sieves with approximately 80 percent of the sand retained above the 80-mesh sieve. Some consumers extend the lower limits to 200 mesh. Specifications call for an almost pure silica sand (table 6). Impurities which color the product, such as iron, manganese, and aluminum oxides, are limited to a few hundredths of a percent.

Chemical uses of high-silica sands include manufacture of sodium silicates and silicon carbide. Requirements for chemical uses and glass making are similar. Discoloration due to excessive amounts of iron is important to sodium silicate producers but is not critical in silicon carbide. A coarse sand is generally preferred by manufacturers of silicon carbide.

Molding and furnace sand.—Requirements placed on sand used for metal-casting molds vary with individual foundries. Generally, the sand should be highly refractory and permeable enough to permit escape of gases. Grain size specifications depend on the type and size of casting. Grade requirements are based on the American Foundrymen's Association (1952) specifications. Particle size is generally specified - 30 mesh and +140 mesh. Foundry sands may be either naturally bonded or artificially bonded. Naturally bonded sand contains enough clay to give desired mold strength. Artificially bonded foundry sands may be bonded with synthetic materials or with clay; these are generally blended at the foundries.

Furnace or fire sand is used as bottom lining and patching in acid-type furnaces. Sand used for this purpose should contain enough natural or added clay bond to give the material cohesiveness and enough silt-size material and iron oxide impurities to promote rapid fusion. A wide range of size distribution is desirable. An ideal size distribution ranges from pebble to clay-size particles.

Table 6. Specifications for glass sand.

	<u>Minimum</u>	<u>Maximum</u>		
	<u>SiO₂</u>	<u>Al₂O₃</u>	<u>Fe₂O₃</u>	<u>CaO + MgO</u>
First quality, optical glass	99.8	0.1	0.02	0.1
Second quality, flint glass containers and tableware	98.5	0.5	0.035	0.2
Third quality, flint glass	95.0	4.0	0.035	0.5
Fourth quality, sheet glass rolled, polished plate and window glass	98.5	0.5	0.06	0.5
Fifth quality, sheet glass rolled, polished plate and window glass	95.0	4.0	0.06	0.5
Sixth quality, green glass containers	98.0	0.5	0.3	0.5
Seventh quality, green glass	95.0	4.0	0.3	0.5
Eighth quality, amber glass containers	98.0	0.5	1.0	0.5
Ninth quality, amber glass	95.0	4.0	1.0	0.5

Refractory and common brick.—Quartz sand is used in making refractory brick for acid-type metallurgical furnaces. The raw material should contain between 96 and 98 percent silica with combined iron and alumina content less than 1.5 percent. A suitable grain size distribution usually has about 55 percent retained between the 4 and 28 mesh, 20 percent retained between the 28 and 65 mesh, and 25 percent under 65 mesh. High-silica sand is desirable as a refractory material because it has a high load-bearing capacity even at temperatures approaching its melting point (1729°C). Quartz sand is also used in the manufacture of sand-lime brick and as an additive in common brick to increase refractoriness.

Filter sand.—Grain size uniformity and chemical inertness are primary considerations for a filter sand. A well-sorted, highly quartzose sand with no silt or clay is required. The sand should not contain enough iron or manganese to contaminate the solution being filtered. Permissible solubility of the sand is dictated by the pH of the water to be filtered (commonly, less than 5.0 percent soluble). Particle shape is not critical except for the exclusion of flat or elongate grains. The three major grades of filter sands are fine sand (0.35 to 0.45 mm), medium sand (0.45 to 0.55 mm), and coarse sand (0.55 mm or larger).

Hydraulic fracturing sand.—Size distribution and structural soundness are the chief specifications for hydraulic fracturing sand. The grade most used is the 20-40 U. S. Standard mesh grade—100 percent between 16 and 60 mesh is specified with a minimum of 80 percent between 20 and 40 mesh. Desired physical requirements of the grains are a minimum compressive strength of 2500 psi, Krumbein roundness factor 0.7, and a maximum particle density of 2.7. In addition, the sand should be clean, sound, and inert and contain no clay, silt, or organic matter.

Ground sand.—Ground silica sand or silica flour is used in paint filler, scouring powders, insecticides and fertilizer fillers, ceramic glazes, enamels, abrasives, autoclave cement, pipelining, and building products. Chemically, it should contain 0.05 percent or less iron oxide (Fe_2O_3). Size distribution of the raw material is not important, but 98 percent of the finished product must be smaller than 200 mesh.

Mining and Processing

The poorly consolidated or unconsolidated sands and gravels along the Texas coast are mined in open pits by dragline or suction dredges. Main production along the Texas Gulf Coast is for construction uses, and processing of raw materials involves only simple washing and classifying. Sands are classified by screens and hydroclassifiers (fig. 8). In deposits worked for aggregate

some producers remove the gravel and return sand and clay to the pit as spoil or waste. Producers of sand remove gravel-size material or crush it to a sand size.

Industrial sands produced in this area chiefly for use as foundry and blast sand require only washing and classifying (fig. 9). For use in the manufacture of glass or other products, where a very low iron (Fe_2O_3) content is required, more extensive beneficiation is necessary.

Beneficiation

High iron content of sand deposits along the Texas Gulf Coast is due to heavy minerals, grain coatings of iron oxide, inclusions of iron-bearing minerals within quartz and chert grains, and rock fragments which contain iron. Beneficiation processes for upgrading these sands include removal of heavy minerals, iron-bearing chert, and rock fragments by heavy media, magnetic and electrostatic separation techniques, flotation, and removal of grain coatings by attrition scrubbing or acid washing. Some producers have found that they can upgrade their product simply by removing from the raw material certain grain size intervals which contain most of the undesirable fractions (chert, heavy minerals, and quartz grains with inclusions).

In this study iron oxide content was determined before and after removal of heavy minerals and iron oxide grain coatings. Results of these tests are shown in table 5. Method of treatment is described in Appendix A.

The average total reduction in percent iron oxide (Fe_2O_3) after both treatments was 28.5 percent. Removal of heavy minerals alone accounted for 26.8 percent of the total and the additional 1.7 percent was due to removal of grain coatings. The amount of heavy minerals removed did not have a direct relationship to the decrease in percent of iron oxide; this is due to the varying proportions of iron-bearing heavy minerals. Samples which initially contained higher percentages of iron oxide were generally reduced proportionately more by the beneficiation treatment; however, most of these could not be reduced sufficiently for use in high quality silica products. Beneficiation by the methods used in this study can be effective on sands which initially contain less than 0.1 percent Fe_2O_3 .

Production, Consumption, and Value

Production of constructional and industrial sand in Texas in 1964 was 14,151,000 short tons. The area covered by this report produced 4,282,000 short tons, approximately 30 percent of total State production. Industrial sands (i.e., foundry, engine, abrasive, and chemical) compose only a

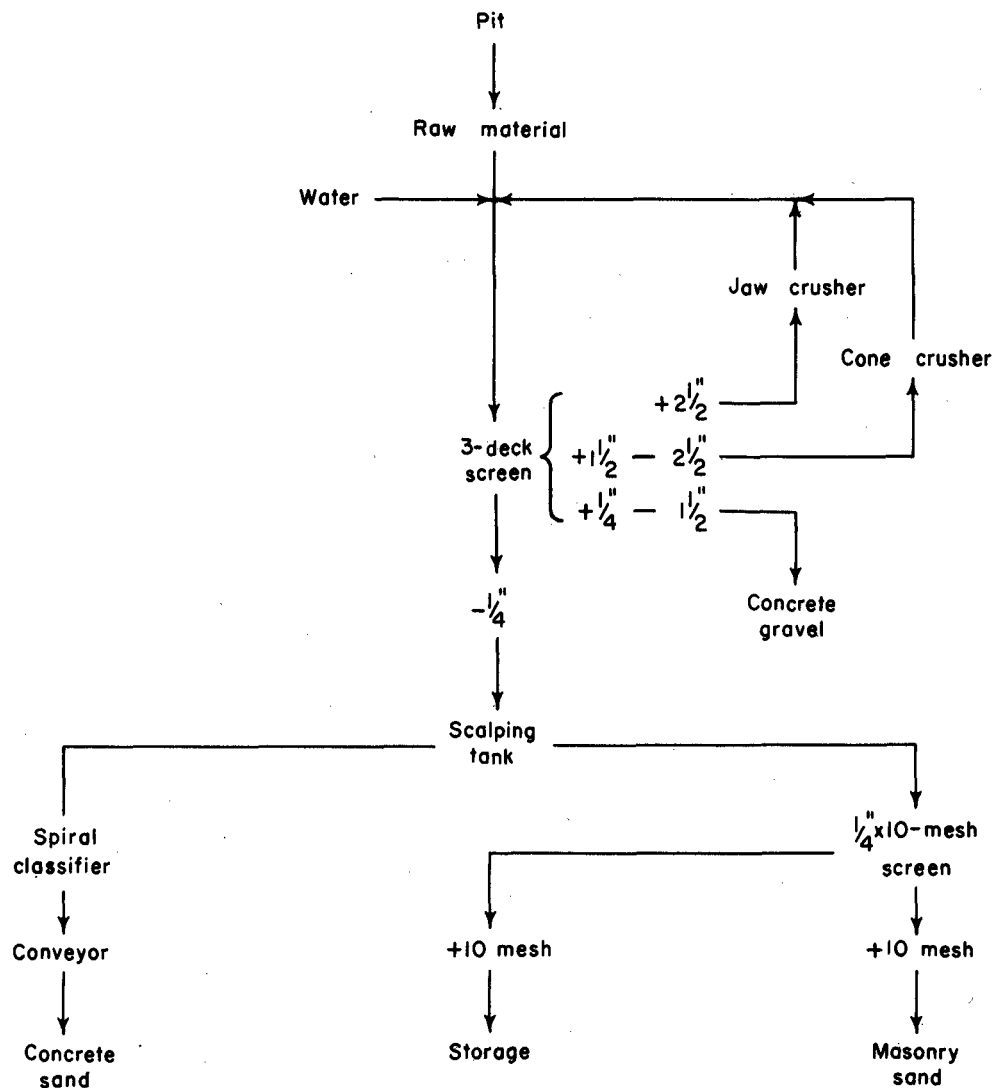


Fig. 8. Flowsheet of a typical sand and gravel operation (modified after Chelf, in Fisher, 1965, p. 324).

small part of this total. Annual production of industrial sand in Texas is approximately 1/2 million tons, about 3 percent of total United States production of 18 million tons. Industrial sands account for about 7 percent of total United States sand production and about 4.5 percent of total sand produced in Texas, based on quantity of sand produced (table 7). Along the Gulf Coast, sands produced for industrial and constructional uses are mined primarily from Recent alluvial and Pleistocene river terrace deposits (the only exception being local fill and bank sand production). Currently, industrial sand is produced in Hardin, Colorado, and Liberty counties. Constructional sands are produced in Hidalgo, Nueces, San Patricio, Victoria, Colorado, Harris, Liberty, Beaumont, Hardin, Austin, Brazoria, Jefferson, Orange, and Willacy counties (fig. 10).

Industrial sand consumption in Texas consists mostly of glass sand, blast and abrasive sand, hydraulic fracturing sand, ground silica, and foundry sand. Main markets for glass sand are in Houston, Waco, Palestine, and Corsicana. Abrasive and blast sand consumption is not as localized as glass sand consumption but consumption is higher in industrial and metropolitan areas than in other areas. Hydraulic fracturing sand is used by oil producers and has a State-wide market. Ground silica markets are mainly in industrial areas. Largest consumption of foundry sand is in East Texas and the northern part of the Texas Gulf Coast. Total consumption of industrial sands in Texas is approximately 700,000 tons (Fisher, 1965). Almost 30 percent of the total consumption is imported from nearby States, primarily Oklahoma.

Value of industrial sands, ground and un-

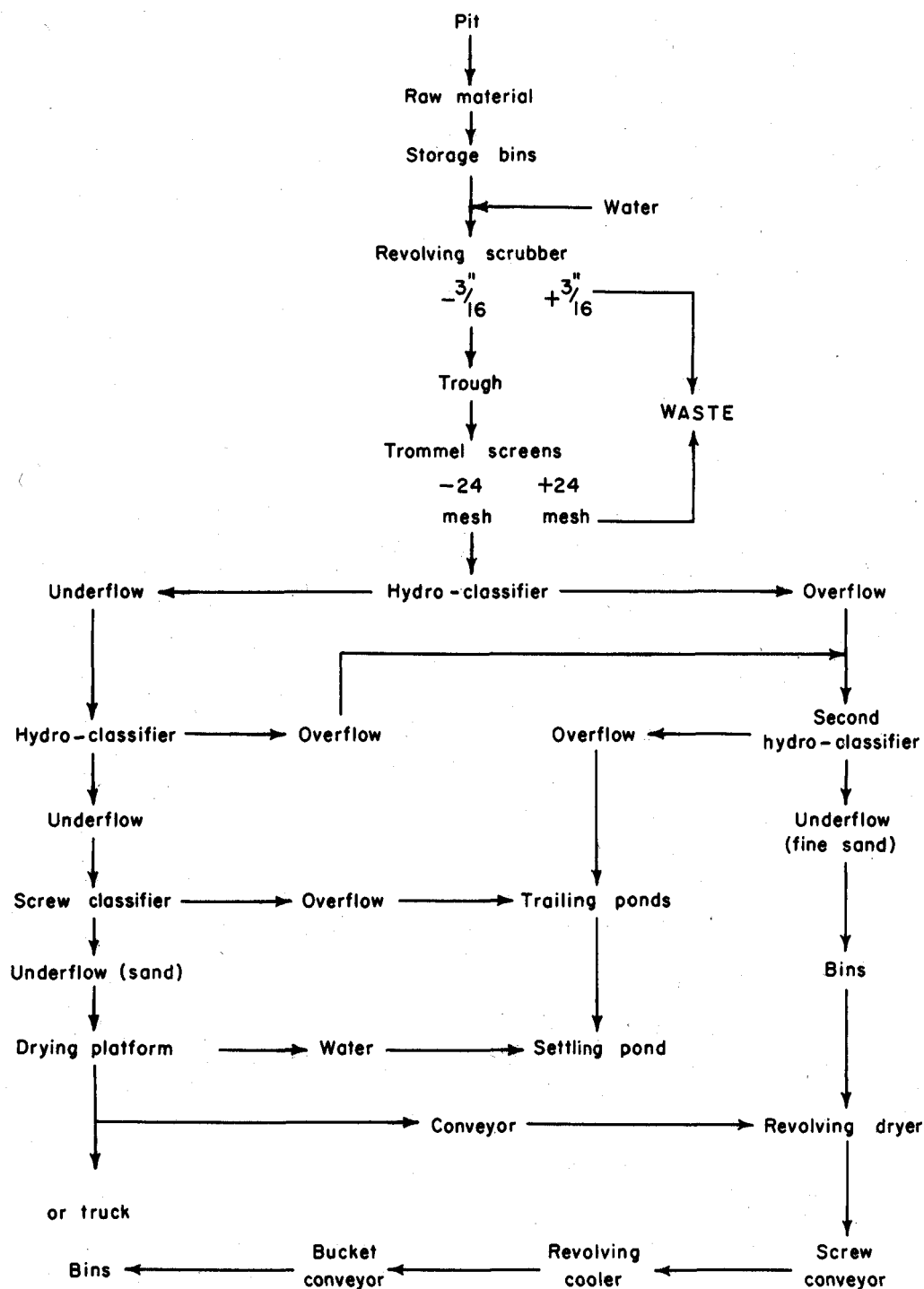


Fig. 9. Flowsheet for scrubbing and classifying unconsolidated sand.

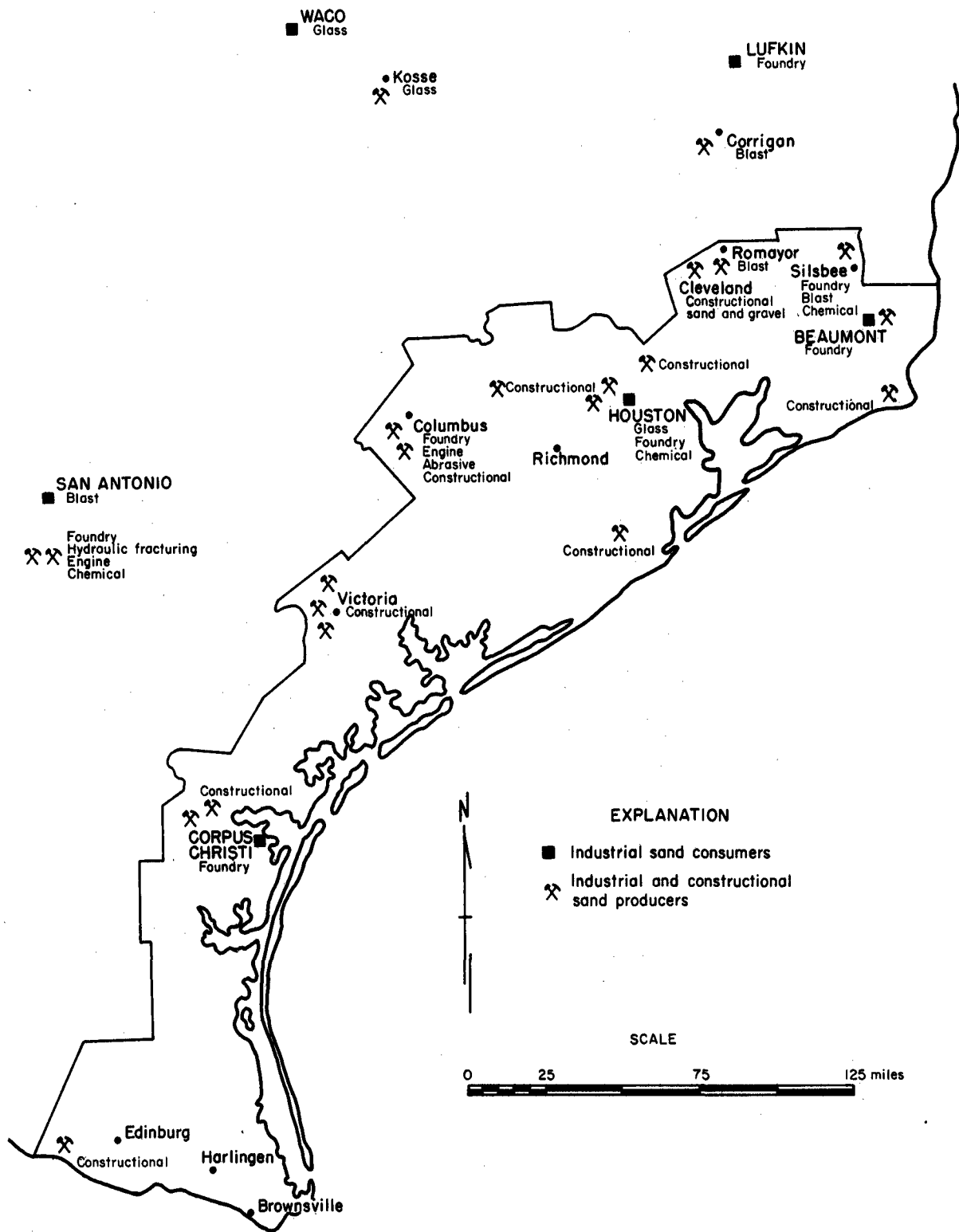


Fig. 10. Distribution of sand and gravel producers and consumers, Texas Gulf Coast.

Table 7. Production and value of industrial and constructional sands in the United States and Texas for year 1964 (data in part from U. S. Bureau of Mines Minerals Yearbook).

	<u>United States</u>	<u>Texas commercial</u>
Constructional sand		
Quantity (thousand short tons)	303,358	11,885
Value (thousand dollars)	283,794	11,673
Unit value (dollars per ton)	0.93	0.98
Industrial sands (ground and unground)		
Quantity (thousand short tons)	23,283	580
Value (thousand dollars)	74,335	2,478
Unit value (dollars per ton)	3.20	4.27

ground, produced in the United States in 1964 ranged in value from \$2.03 per ton to \$11.38 per ton (table 8). Average value in the United States was about \$3.20 per ton, compared to the Texas average of \$4.27 per ton (table 7). Constructional sand value averaged \$0.93 per ton in the United States and \$0.98 per ton in Texas (table 7). Glass sand, blast sand, hydraulic fracturing sand, and ground silica have the highest market values (table 8) because of the relative scarcity of deposits which meet specifications.

Economic Considerations

The primary consideration involved in determining value of a sand deposit is the quality of the product derived from the deposit and the location of the deposit with relation to transportation facilities (railroads, highways, and canals), power,

water, and market. By-products, such as heavy minerals, may make an otherwise marginal venture profitable.

Generally, all parts of the study area (except some parts of South Texas) (Pl. I) are accessible. Principal markets are in the more heavily populated and industrial northern and central parts of the area (fig. 10). Present production of industrial sand, exclusive of blast sand, in the study area is small and therefore a favorably located deposit of high quality industrial sand would find a ready market. Samples examined indicate that no deposit available within this area is satisfactory for high quality uses without beneficiation in addition to simple washing. Appendix C presents data on some physical and chemical properties of sands at specific locations.

Table 8. Average value of industrial sands produced in the United States in year 1964 (derived from data in U. S. Bureau of Mines Minerals Yearbook).

<u>Industrial sand (unground)</u>	<u>Average value per ton</u>	<u>Industrial sand (ground)</u>	<u>Average value per ton</u>
Glass	\$3.19	Abrasives	\$10.01
Molding	2.69	Chemicals	9.11
Grinding and polishing	1.81	Enamels	11.38
Blast sand	4.15	Fillers	5.29
Fire or furnace	2.03	Foundry uses	8.22
Engine	2.04	Glass	5.09
Filtration	2.68	Pottery, porcelain, and tile	10.72
Oil (hydrofrac)	5.77	Unspecified	10.12
Other	2.56	Total average	8.56
Total average	2.90		

Iron content and grain size distribution are irregular in the Lissie, Montgomery, and Beaumont Formations, but generally sands in the coastwise terrace deposits have a lower iron percent and better sorting characteristics than sands in upstream equivalents. Most samples from coastwise terrace deposits are well sorted with 75 to 95 percent retained on the 100-mesh screen and 10 to 60 percent retained on the 60-mesh screen. Samples from the coastwise units in the northern part of the area and the Pleistocene barrier (Beaumont) in the central part average about 0.15 percent Fe_2O_3 . Lowest value determined was 0.06 percent Fe_2O_3 . The relatively low percent of Fe_2O_3 in samples from the northern part of the area is due to the smaller amounts of iron-bearing chert and heavy minerals in those deposits. Recent stream deposits sampled in the northern part of the area also have relatively low percentages of iron (lowest value determined, 0.06 percent Fe_2O_3) and contain less gravel-size material than other streams along the Texas Gulf Coast. Pleistocene stream terraces, equivalent to coastwise terraces, and Recent channel deposits generally contain high percentages of gravel (up to 50 percent) and are best suited for constructional purposes and are currently so used (e.g., Columbus and Victoria areas).

Recent coastal dune samples display a fairly uniform grain-size distribution (generally, 5 to 20 percent coarser than 80-mesh, 30 to 50 percent coarser than 100-mesh, and 90 to 95 percent coarser than 140-mesh screens). Samples from northern Padre and Mustang Islands have lower iron content (about 0.15 percent Fe_2O_3) than other coastal dune deposit samples. The abundance of iron-contributing heavy minerals and volcanic rock fragments increases abruptly near the central part of Padre Island and is relatively high along southern Padre Island (fig. 7 and table 3). No samples examined contain sufficient quantities of potentially valuable heavy minerals (ilmenite, rutile, and zircon) for commercial extraction (table 5 and Hahn et al., 1961, pp. 40 and 43); however, heavy minerals should be considered as a possible by-product if these deposits are used for production of high quality silica sands. Sands of the dune plain are similar in grain size distribution and mineral composition to coastal dune sands along Padre Island.

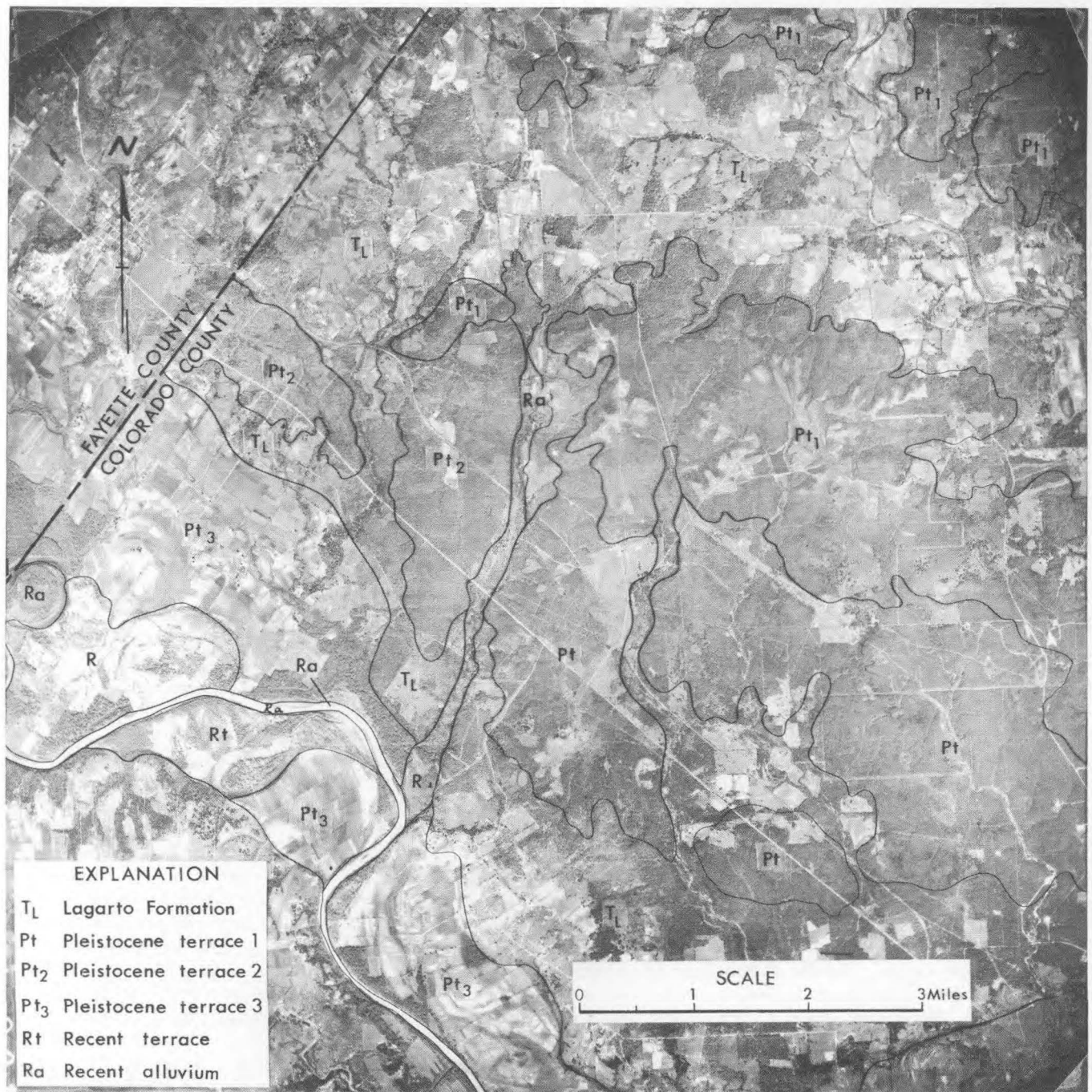
Prospecting

Certain features on aerial photographs indicate areas where sand bodies are likely to occur. These are abandoned channels, natural levees, point bars, pock marks, alluvial terraces, barrier

bars, coastal and inland dunes, and pimple mounds. Boundaries between contrasting soil types can be drawn on aerial photographs, although field checks are necessary to determine the type of soil. Vegetation contrasts are easily recognized on aerial photographs.

Land forms are recognized on aerial photographs by characteristic shape, tone, texture, and vegetation. Abandoned channels are low arcuate or sinuous features which are the result of filled or partially filled cutoff stream meanders. Natural levees are low ridges parallel to a river course; they slope gradually away from the channel. Point bars are developed on the inside of meander bends and are characterized by a system of ridges and swales. Pock marks are small circular depressions or intermittent lakes that are incompletely filled parts of abandoned river channels. Alluvial terraces are defined by topographic surfaces which mark former valley floor levels. Barrier bars are elongate bodies parallel to the mainland shore; characteristic features are parallel ridges, swales, washover fans, spits, and sand dunes. Sand dunes commonly occur in groups forming arcuate or elongate ridges (active dune fields are not vegetated). Pimple mounds are circular mounds which occur only on silty or sandy terrain having gentle slopes. Generally, pimple mounds are thought to be erosional features but their origin is controversial. A more detailed treatment of the above features is given by Bernard and LeBlanc (1965, pp. 152-176). Examples of abandoned channels and related features, barrier bars (Pleistocene and Recent), alluvial terraces, pimple mounds, and pock marks are illustrated on Plates II, III, IV, V, and VI.

Vegetation contrasts that can be observed on aerial photographs are commonly related to soils and bedrock composition. Areas in which quartz sand is the most common constituent are characterized by relatively dense growths of trees, commonly oak and pine. Grasslands are more commonly developed in areas where clays and silts are most abundant. Climate also affects vegetation so that soil and bedrock are not the only variables. Examples of vegetation controlled by lithology are illustrated on Plates V and VI. Contrast between Pleistocene barrier bar (sand) and other Beaumont sediments (clay and sandy clay) is shown on Plate V, between T_1 (clay) and P_{H1} (sand and gravel) on Plate VI, and between P_{13} (sand) and R_t (clay and sandy clay) on Plate VI. However, vegetation differences between Recent and Beaumont sediments shown on Plates II and V are due primarily to increased availability of water along streams and not to contrasting lithology.



Pleistocene river terraces along Colorado River, Colorado County, Texas

BIBLIOGRAPHY

- American Foundrymen's Society, Inc. (1952) Foundry sand handbook, 6th ed., Chicago, Illinois, 265 pp.
- Bailey, T. L. (1923) The geology and natural resources of Colorado County [Texas]: Univ. Texas Bull. 2333, 159 pp.
- Barton, D. C. (1930a) Deltaic coastal plain of southeastern Texas: Bull. Geol. Soc. Amer., vol. 41, pp. 359-382.
- _____. (1930b) Surface geology of coastal Southeast Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 14, pp. 1301-1320.
- Beckelhymer, R. L. (1946) Stratigraphy of Waller and Harris counties, Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 30, pp. 52-62.
- Bernard, H. A. (1950) Quaternary geology of Southeast Texas: Louisiana State Univ., Ph. D. dissertation, 164 pp.
- _____, and LeBlanc, R. J. (1965) Resume of the Quaternary geology of the northwest Gulf of Mexico Province, in *The Quaternary of the United States*, H. E. Wright and D. A. Frey, editors: Princeton Univ. Press, Princeton, New Jersey, pp. 137-185.
- _____, _____, and Major, C. F. (1962) Recent and Pleistocene geology of Southeast Texas, in *Geology of the Gulf Coast and Central Texas and Guidebook of Excursions*, Annual Meeting of The Geological Society of America and Associated Societies, Houston, Texas, edited by E. H. Rainwater and R. P. Zingula, pp. 175-224, Excursion No. 3.
- _____, Major, C. F., Jr., and Parrott, B. S. (1959) The Galveston barrier island and environs: A model for predicting reservoir occurrence and trend: Gulf Coast Assoc. Geol. Socs. Trans., vol. 9, pp. 221-224.
- Bullard, F. M. (1942) Source of beach and river sands on Gulf Coast of Texas: Bull. Geol. Soc. Amer., vol. 53, pp. 1021-1044.
- Carter, G. J., Harris, H. M., Strandberg, K. G. (1964) Beneficiation studies of the Oregon coastal dune sands for use as glass sand: U. S. Bur. Mines Rept. Inv. 6484, 21 pp.
- Cook, T. D. (1958) The sand sheet of South Texas, in *Sedimentology of South Texas: Gulf Coast Assoc. Geol. Socs., Field Trip Guidebook*, Oct. 30-Nov. 1, 1958, pp. 49-50.
- Cox, C. L., Jr. (1950) Pleistocene terraces of the lower Brazos River, Texas: Louisiana State Univ., master's thesis, 53 pp.
- Curry, J. R. (1960) Sediments and history of Holocene transgression, continental shelf, northwest Gulf of Mexico, in *Recent sediments, northwest Gulf of Mexico*, F. P. Shepard et al., editors: Amer. Assoc. Petrol. Geol., pp. 221-226.
- Deussen, Alexander (1914) Geology and underground water resources of southeastern part of Texas Coastal Plain: U. S. Geol. Survey Water-Supply Paper 335, 365 pp.
- _____. (1924) Geology of the Coastal Plain of Texas west of Brazos River: U. S. Geol. Survey Prof. Paper 126, 139 pp.
- Doering, J. A. (1935) Post-Fleming surface formations of coastal Southeast Texas and South Louisiana: Bull. Amer. Assoc. Petrol. Geol., vol. 19, pp. 651-688.
- _____. (1956) Review of Quaternary surface formations of Gulf Coast region: Bull. Amer. Assoc. Petrol. Geol., vol. 40, pp. 1816-1862.
- Fisher, W. L. (1965) Rock and mineral resources of East Texas: Univ. Texas, Bureau Econ. Geol. Rept. Inv. No. 54, 438 pp.
- Fisk, H. N. (1938) Geology of Grant and LaSalle parishes: Louisiana Geol. Survey Bull. 10, 246 pp.
- _____. (1939) Depositional terrace slopes in Louisiana: Jour. Geomorphology, vol. 2, pp. 181-200.
- _____. (1940) Geology of Avoyelles and Rapides parishes: Louisiana Geol. Survey Bull. 18, 240 pp.
- _____. (1944) Geological investigation of the alluvial valley of the lower Mississippi River: U. S. Army Corps Engrs., Mississippi River Comm., Vicksburg, Miss., 78 pp.
- _____. (1947) Fine-grained alluvial deposits and their effects on Mississippi River activity: U. S. Army Corps Engrs., Mississippi River Comm., Vicksburg, Miss., 82 pp.
- _____. (1952) Geological investigation of the Atchafalaya basin and the problem of Mississippi River diversion, vol. 1: U. S. Army Corps Engrs., Mississippi River Comm., Vicksburg, Miss., 145 pp.
- _____, and McFarlan, E., Jr. (1955) Late Quaternary deltaic deposits of the Mississippi River, in *Crust of the earth*, A. Poldervaart, editor: Geol. Soc. Amer. Spec. Paper 62, pp. 279-302.
- Folk, R. L. (1961) Petrology of sedimentary rocks: Hemphill Book Store, Austin, Texas, 154 pp.
- Forney, L. B. (1950) The Willis Formation of the Texas Gulf Coast: Univ. Houston, master's thesis, Houston, Texas, 39 pp.
- Gulf Coast Association of Geological Societies (1958) Sedimentology of South Texas: Field Trip Guidebook, annual meeting, Oct. 27-Nov. 1, 1958, Corpus Christi, Texas, 114 pp.
- _____. (1959) Recent sediments of the north-central Gulf Coastal Plain: Field Trip Guidebook, joint annual meeting with Soc. Econ.

- Pal. Min. and Amer. Assoc. Petrol. Geol., Nov. 11–15, 1959, Houston, Texas, 84 pp.
- _____. (1964) Depositional environments south-central Texas Coast: Field Trip Guidebook, annual meeting, Oct. 28–31, 1964, Corpus Christi, Texas, 170 pp.
- _____. (1965) The deltaic coastal plain: Field Trip Guidebook, annual meeting with Amer. Assoc. Petrol. Geol., Oct. 27–30, 1965, Houston, Texas, 71 pp.
- Gould, H. R., and McFarlan, E., Jr. (1959) Geologic history of the chenier plain, southwestern Louisiana: Gulf Coast Assoc. Geol. Socs. Trans., vol. 9, pp. 261–270.
- Hahn, A. D., Miller, W. C., and Fine, M. M. (1961) Titanium-bearing deposits in South Texas: U. S. Bur. Mines Rept. Inv. 5712, 84 pp.
- Hayes, M. O. (1965) Sedimentation on a semiarid wave-dominated coast (South Texas); With emphasis on hurricane effects: Univ. Texas, Ph. D. dissertation, 350 pp.
- Johnson, C. E. (1940) Records of wells, drillers' logs, water analyses, cross sections, and map showing locations of wells, Aransas County, Texas: Texas State Bd. Water Engrs., 45 pp.
- Lang, J. W., Winslow, A. G., and White, W. N. (1950) Geology and ground-water resources of the Houston district, Texas: Texas State Bd. Water Engrs. Bull. 5001, 55 pp.
- LeBlanc, R. J. (1955) Quaternary geology of the central Gulf coastal plain (abst.): Bull. Geol. Soc. Amer., vol. 66, p. 1589.
- _____, and Bernard, H. A. (1954) Resume of late Recent geological history of the Gulf Coast: *Geologie en Mijnbouw*, vol. 16, pp. 185–194.
- _____, and Hodgson, W. D. (1959) Origin and development of the Texas shoreline: 2nd Coastal Geog. Conf., Coastal Studies Inst., Louisiana State Univ., Baton Rouge, Louisiana, pp. 57–101.
- Lenhart, W. B. (1960) Sand and gravel, in *Industrial minerals and rocks*: Amer. Inst. Min. Met. Petrol. Engrs., 3d ed., pp. 733–758.
- Lohse, E. A. (1952) Shallow-marine sediments of Rio Grande Delta: Univ. Texas, Ph. D. dissertation, 113 pp.
- _____. (1955) Dynamic geology of the modern coastal region, northwest Gulf of Mexico: Soc. Econ. Pal. Min., Spec. Pub. No. 3, pp. 99–103.
- McFarlan, E., Jr. (1961) Radiocarbon dating of Late Quaternary deposits, South Louisiana: Bull. Geol. Soc. Amer., vol. 72, pp. 129–158.
- Metcalf, R. J. (1940) Deposition of Lissie and Beaumont Formations of Gulf Coast of Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 24, pp. 693–700.
- Meyer, W. G. (1939) Stratigraphy and historical geology of Gulf Coastal Plain in vicinity of Harris County, Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 23, pp. 145–211.
- Murphy, T. D. (1960) Silica sand and pebbles, in *Industrial minerals and rocks*: Amer. Inst. Min. Met. Petrol. Engrs., 3d ed., pp. 763–772.
- Murray, G. E. (1960) Geology of the Atlantic and Gulf Coastal Province of North America: Harper Brothers, New York, 692 pp.
- Petitt, B. M., Jr., and Winslow, A. G. (1957) Geology and ground-water resources of Galveston County, Texas: U. S. Geol. Survey Water-Supply Paper 1416, 157 pp.
- Plummer, F. B. (1933) Cenozoic systems in Texas, in Sellards, E. H., Adkins, W. S., and Plummer, F. B., *The geology of Texas*, Vol. I, Univ. Texas Bull. 3232 (Aug. 22, 1932), pp. 519–818.
- Price, W. A. (1933) Role of diastrophism in topography of Corpus Christi area, South Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 17, pp. 907–962.
- _____. (1947) Equilibrium of form and forces in tidal basins of coast of Texas and Louisiana: Bull. Amer. Assoc. Petrol. Geol., vol. 31, pp. 1619–1663.
- _____. (1958) Sedimentology and Quaternary geomorphology of South Texas: Gulf Coast Assoc. Geol. Socs. Trans., vol. 8, pp. 41–75.
- Quinn, J. H. (1955) Miocene Equidae of the Texas Gulf Coastal Plain: Univ. Texas Pub. 5516, 102 pp.
- _____. (1957a) Paired river terraces and Pleistocene glaciation: *Jour. Geology*, vol. 65, pp. 149–166.
- _____. (1957b) Pleistocene Equidae of Texas: Univ. Texas, Bur. Econ. Geology Rept. Inv. No. 33, 51 pp.
- Rose, N. A. (1943) Ground water and relation of geology to its occurrence in Houston district, Texas: Bull. Amer. Assoc. Petrol. Geol., vol. 27, pp. 1081–1101.
- Shepard, F. P. (1960) Rise of sea level along northwest Gulf of Mexico, in *Recent sediments, northwest Gulf of Mexico*, F. P. Shepard et al., editors: Amer. Assoc. Petrol. Geol., pp. 338–344.
- _____, and Moore, D. G. (1955) Central Texas coast sedimentation: Characteristics of sedimentary environment, recent history, and diagenesis: Bull. Amer. Assoc. Petrol. Geol., vol. 39, pp. 1463–1600.
- Trowbridge, A. C. (1954) Mississippi River and Gulf Coast terraces and sediments as related to Pleistocene history—A problem: Bull. Geol. Soc. Amer., vol. 65, pp. 793–812.
- _____. (1932) Tertiary and Quaternary geology of the lower Rio Grande region, Texas: U. S. Geol. Survey Bull. 837, 260 pp.
- United States Bureau of Mines Minerals Yearbook,

three volumes, annual issues.

- Van Andel, T. H. (1960) Sources and dispersion of Holocene sediments, northern Gulf of Mexico, in Recent sediments, northwest Gulf of Mexico, F. P. Shepard et al., editors: Amer. Assoc. Petrol. Geol., pp. 34–55.
- Wadsworth, A. H., Jr. (1941) Lower Colorado River, Texas: Univ. Texas, master's thesis, 61 pp.
- Weeks, A. W. (1941) Late Cenozoic deposits of Texas Coastal Plain between Brazos River and Rio Grande: Univ. Texas, Ph. D. dissertation, 267 pp.
- _____(1945) Quaternary deposits of Texas Coastal Plain between Brazos River and Rio Grande: Bull. Amer. Assoc. Petrol. Geol., vol. 29, pp. 1693–1720.

APPENDIX A — TECHNIQUES

Investigation of sand deposits included sampling commercial sand and gravel deposits, alluvial deposits, sand dunes (coastal and inland), and natural outcrops of the Beaumont, Montgomery, and Lissie Formations, and of Recent deposits. Channel samples were collected from natural exposures and in pits; sampling was by hand auger in areas where no exposures were available; grab samples were taken at dredging operations. Auger samples and channel samples were collected in vertical 5-foot intervals except when bed thickness was less than 5 feet. Commercial operators in the area were interviewed to determine methods of mining and processing, market areas, and commodities produced.

Samples were washed to remove clay, and grain size distribution of sands was determined by sieve analysis (analysis made only on material passing a U. S. Standard #10-mesh screen for samples containing a gravel fraction). Sand fraction was ground to pass a U. S. Standard #200-mesh screen for X-ray spectroscopic analysis on a General Electric XRD6 X-ray machine. X-ray analysis was used to determine percent of iron (expressed as Fe_2O_3) in the samples. Radiation intensity of the iron in each sample was measured and compared to intensities of known standard samples to determine Fe_2O_3 content.

A few selected samples were treated to reduce the Fe_2O_3 content to determine whether or not sands in this area could be satisfactorily beneficiated. Samples were suspended in a bromoform solution to separate heavy minerals and then washed and attrition-scrubbed to remove iron oxide coatings. Attrition-scrubbing was performed by shaking samples in a Pica grinder with plastic balls rather than with tungsten carbide grinding balls; material was then rewashed to remove loosened grain coatings. Treated samples were then ground and tested for Fe_2O_3 content in the same manner as described above (fig. 11).

Statistical parameters are used to show the mean grain size and sorting of the samples. Values were determined from cumulative percent curves of the +200-mesh sand fraction. Curves were plotted with percent retained above sieve intervals against grain size in phi units (ϕ). Grain size readings were taken from the 5, 16, 50, 84, and 95 percent levels and used in the following equations (after Folk, 1961, pp. 44–45) to determine mean grain size (M_z) and Inclusive Graphic

Standard Deviation (σ).

$$M_z = \frac{16 + 50 + 8}{3}$$

$$\phi = \frac{85 - 16}{4} = \frac{95 - 5}{6.6}$$

Inclusive Graphic Standard Deviation (σ) is used as a sorting index classified as follows:

Values of σ	Verbal description
less than 0.35	very well sorted
0.35 to 0.50	well sorted
0.50 to 0.71	moderately well sorted
0.71 to 1.0	moderately sorted
1.0 to 2.0	poorly sorted
2.0 to 4.0	very poorly sorted
more than 4.0	extremely poorly sorted

Equivalence of values used in statistical analyses and grain size descriptions are according to the following tabulation:

U. S. Standard Sieve No.	Millimeters	Phi (ϕ)	Wentworth Size Class
10	2.00	-1.0	Gravel
12	1.68	-0.75	
14	1.41	-0.5	Very coarse sand
16	1.19	-0.25	
18	1.00	0.0	
20	0.84	0.25	
25	0.71	0.5	Coarse sand
30	0.59	0.75	
35	0.50	1.0	
40	0.42	1.25	
45	0.35	1.50	Medium sand
50	0.30	1.75	
60	0.25	2.0	
70	0.210	2.25	
80	0.177	2.50	Fine sand
100	0.149	2.75	
120	0.125	3.0	
140	0.105	3.25	
170	0.088	3.50	Very fine sand
200	0.074	3.75	
230	0.062	4.0	
270	0.053	4.25	Silt
325	0.044	4.50	

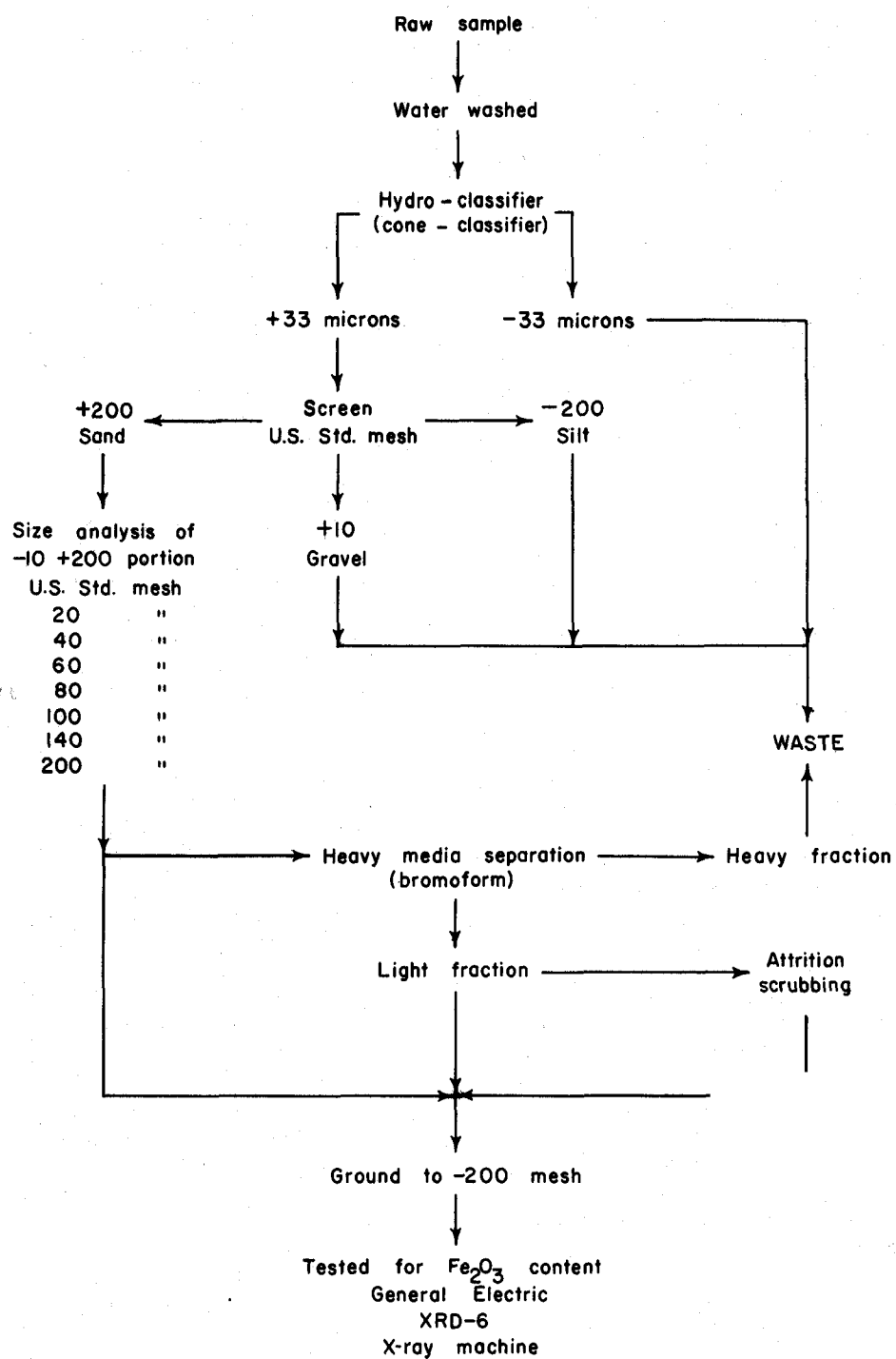


Fig. 11. Sample flowsheet (size analysis, heavy mineral separation, and iron analysis).

APPENDIX B — LOCALITIES

The following register lists the specific localities examined for this report. Localities are plotted on Plate I; results of grain size analyses and Fe_2O_3 tests are given in Appendix C. Localities are entered by county in the following manner: (1) County locality number (e.g., Harris 1); (2) Bureau of Economic Geology Mineral Studies Laboratory number for samples tested (e.g., 64549); (3) locality description; (4) unit (e.g., Beaumont); (5) rock type (e.g., sand).

- Aransas 1. (64534) Sand pit, north side of Park Road 13 at Goose Island State Park. Beaumont Formation, sand.
- Aransas 2. (64535) Road cut, northwest side of State Highway 35, $\frac{1}{2}$ mile southwest of causeway across Copano Bay. Beaumont Formation, sand.
- Aransas 3. Auger hole, approximately 3 miles south of Rockport along State Highway 35. Beaumont Formation, sand.
- Austin 1. (64474) Turn east onto private road at junction of Park Road 38 and Spur 99, northeast of Sealy; follow road to river. Recent, sand and gravel.
- Austin 2. (65001) Road cut, east side of State Highway 36, $5\frac{1}{2}$ miles south of Bellville; 150 yards south of Clear Creek crossing. Recent, sand.
- Austin 3. (65002) Road cut, 6.8 miles east of Bellville along Farm Road 331, cut on south side of road. Montgomery Formation, sand.
- Austin 4. (65003) Road cut, west side of Farm Road 331, 2.1 miles north of junction of Farm Road 331 and State Highway 36; cut is where small stream crosses road. Recent, sand.
- Austin 5. (65004) Auger hole, 0.7 mile west of Brazos River on south side of U. S. Highway 90. Beaumont Formation, sand.
- Austin 6. Abandoned pit, $1\frac{1}{2}$ miles northeast of Bellville along State Highway 159. Willis Formation, sand and gravel.
- Brazoria 1. (64475, 64476, 64477) Sand dune, on end of peninsula adjacent to San Luis Pass, 13.4 miles northeast of end of State Highway 332 at Surfside. Recent, sand.
- Brazoria 2. (64478, 64479, 64480) Sand dune, 8.4 miles northeast of end of State Highway 332 at Surfside. Recent, sand.
- Brazoria 3. (64481, 64482, 64483) Sand dune, 3.4 miles northeast of end of State Highway 332 at Surfside. Recent, sand.
- Brazoria 4. (64484, 64485, 64486) Sand dune, 3.1 miles northeast of mouth of Brazos River. Recent, sand.
- Brazoria 5. (64487, 64488, 64489) Sand dune, on beach at mouth of Brazos River. Recent, sand.
- Brazoria 6. (64490, 64491, 64492) Sand dune, 2.4 miles northeast of mouth of Brazos River. Recent, sand.
- Brazoria 7. (64493, 64494, 64495) Sand dune, 0.2 mile northeast of Surfside jetty. Recent, sand.
- Brazoria 8. Pit, 2 miles east of Lake Jackson, west side of Oyster Creek. Recent, sand.
- Brazoria 9. Auger hole, 2 miles east of Hoskins Mound along dirt road. Beaumont Formation, sand.
- Calhoun 1. Auger hole, 12 miles southeast of Seadrift along State Highway 185. Beaumont Formation, sand.
- Cameron 1. (64522, 64523, 64524) Sand dune, north end of Brazos Island. Recent, sand.
- Cameron 2. (64525, 64526, 64527) Sand dune, 100 yards north of termination of State Highway 4 on Brazos Island. Recent, sand.
- Cameron 3. (64528, 64529, 64530) Sand dune, 10 miles north of south end of Padre Island. Recent, sand.
- Cameron 4. (64531, 64532, 64533) Sand dune, 5 miles north of south end of Padre Island. Recent, sand.
- Chambers 1. Auger hole, 6 miles northeast of Smith Point, along State Highway 562. Beaumont Formation, sand.
- Colorado 1. (64467) Pit of Texas Construction Material Company; turn off State Highway 71, $2\frac{1}{2}$ miles south of Columbus, and follow paved road to plant. Beaumont Formation, sand and gravel.
- Colorado 2. (64468) Pit of Texas Construction Material Company; turn southwest off U. S. Highway 90A onto paved road at southwest edge of Eagle Lake city limits and follow approximately 2 miles to plant site. Beaumont Formation, sand and gravel.
- Colorado 3. (64469, 64470) Pit of Horton & Horton; turn north off State Highway 75, 1.9 miles southeast of Columbus, and follow dirt road to plant. Beaumont Formation, sand and gravel.
- Colorado 4. (64471) Pit of Parker Bros. & Company; turn south off Farm Road 102, $1\frac{3}{4}$ miles southeast of Alleyton, and follow gravel road to plant. Beaumont Formation, sand and gravel.
- Colorado 5. (64472) Pit of Thorstenberg Materials Company; turn south off Farm Road 102, $\frac{4}{5}$ miles southeast of Alleyton. Beaumont Formation, sand and gravel.
- Colorado 6. (64473) Pit of Thorstenberg Materials Company; turn south off Farm Road 102, $5\frac{3}{4}$ miles southeast of Alleyton. Beaumont Formation, sand and gravel.
- Colorado 7. (64543) Channel deposit in Skull Creek, at crossing of State Highway 71 and Skull Creek, $\frac{1}{2}$ miles south of Altair. Recent, sand and gravel.
- Fort Bend 1. Auger hole, 8 miles west of Rosen-

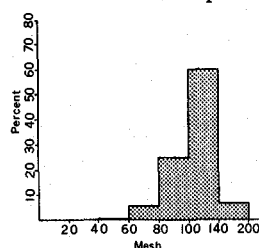
- berg along U. S. Highway 90A. Beaumont Formation, sand.
- Galveston 1. (64504, 64505) Auger holes on windward side and crest of dune at end of county road $\frac{1}{2}$ mile south of State Highway 87. County road intersects Highway 87, 5 miles northeast of Port Bolivar. Recent, sand.
- Galveston 2. (64506, 64507, 64508) Sand dune, first dune ridge on southwest end of Galveston Island. Recent, sand.
- Galveston 3. (64509, 64510, 64511) Sand dune, 6.7 miles northeast of southern end of Galveston Island. Recent, sand.
- Galveston 4. (64512, 64513, 64514) Sand dune, 12 miles northeast of southern end of Galveston Island. Recent, sand.
- Hardin 1. (64459) Road cut on State Highway 327, 1.9 miles west of Silsbee on east side of Village Creek. Montgomery Formation, sand.
- Hardin 2. (64460) Dredge pit of Barry & Barry Sand Company, 6 miles south of Silsbee. Recent, sand.
- Hardin 3. (65052) Outcrop, $\frac{1}{2}$ mile east of Farm Road 92, $\frac{1}{2}$ mile south of Hardin-Tyler County line. Lissie Formation, sand.
- Hardin 4. Outcrop, $2\frac{1}{2}$ miles east of Farm Road 943 along dirt road which intersects Farm Road 943, 4 miles southeast of Polk-Hardin County line. Lissie Formation, sand.
- Harris 1. (64465) Sand bank of San Jacinto River on State Highway 59, Harris-Montgomery County line. Recent, sand.
- Harris 2. (64466) Pit, 5 miles north of U. S. Highway 290, on Farm Road 1960; sold as bank sand, top soil, fill sand. Montgomery Formation, sand.
- Harris 3. (65005, 65006) Pit; turn west off Farm Road 2100, $1\frac{1}{2}$ miles south of junction of Farm Roads 2100 and 1942, and follow dirt road $1\frac{1}{2}$ miles to pit. Recent, sand.
- Harris 4. (64007, 64008) Pit; south side of U. S. Highway 90, 1 mile west of junction of U. S. Highway 90 and Farm Road 2100. Recent, sand.
- Harris 5. (64009) Auger hole, 4.3 miles east of Humble city limits on north side of Farm Road 1960. Beaumont Formation, sand.
- Harris 6. (64010, 64011) Pit; turn south off Farm Road 529, 2.3 miles west of junction of U. S. Highway 290 and Farm Road 529, follow paved county road 0.9 mile and turn west onto dirt road, follow dirt road to pit. Montgomery Formation, sand.
- Harris 7. (64012) Pit, 2 miles due south of Jersey Village on Tanner Road, 0.3 mile east of intersection of Tanner and Brittmore Streets. Montgomery Formation, sand.
- Harris 8. (64013) Sand pit, northeast corner of Clara Street and Tanner Road, 2.3 miles east of Harris 7. Montgomery Formation, sand.
- Harris 9. (65054) Expressway excavation, approximately 0.4 mile southeast of junction of U. S. Highway 290 and Interstate Highway 10 (expressway interchange). Excavation is between T. & N. O. Railroad and Washington Street. Beaumont Formation, sand.
- Harris 10. (64011) Stream bank, 1.8 miles southeast of Cypress Community along U. S. Highway 290. Lissie Formation, sand.
- Hidalgo 1. (64540) Pit, 1.3 miles west of La Joya, north side of U. S. Highway 83. Lissie Formation, sand and gravel.
- Hidalgo 2. (64541) Pit, $\frac{3}{4}$ mile south of Sullivan City on gravel road. Lissie Formation, sand and gravel.
- Hidalgo 3. (64542) Road cut, $\frac{1}{2}$ mile west of La Joya along U. S. Highway 83. Lissie Formation, sand and gravel.
- Jackson 1. (64469) Sand bar, 100 yards downstream from junction of Sandy Creek and Navasota River, southwest of Ganado. Recent, sand.
- Jackson 2. Abandoned pit, adjacent to Highway 59, 2 miles southwest of Edna. Recent, sand.
- Jefferson 1. (64464) Auger hole, approximately 10 miles west of Sabine Pass along State Highway 87. Recent, sand.
- Jefferson 2. (65055) Sandpit, west of Sabine Pass; turn south off State Highway 87 (3 miles northwest of Sabine Pass) and follow road approximately 3 miles to pits. Recent, sand.
- Jefferson 3. Auger hole, $2\frac{1}{2}$ miles west of State Highway 124 at Fannett. Beaumont Formation, sand.
- Kenedy 1. (64537) Road cut, 25.5 miles north of Raymondville along U. S. Highway 77. Recent, sand.
- Kenedy 2. (64538) Road cut, 34 miles north of Raymondville along U. S. Highway 77. Recent, sand.
- Kenedy 3. (64539) Road cut, 47 miles north of Raymondville along U. S. Highway 77. Recent, sand.
- Kleberg 1. (64561, 64562, 64563) Sand dune, 5 miles southwest of Kleberg-Nueces County line along Padre Island beach. Recent, sand.
- Kleberg 2. (64564, 64565, 64566) Sand dune, 10 miles southwest of Kleberg-Nueces County line along Padre Island beach. Recent, sand.
- Kleberg 3. (64610) Sand dune, 28 miles south of Kleberg-Nueces County line via King Ranch road; Stop No. 2 on 1964 field trip of the Gulf Coast Association of Geological Societies. Beaumont Formation, sand.
- Kleberg 4. Auger hole, 9 miles south of Kingsville, along U. S. Highway 77. Montgomery Formation, sand.
- Liberty 1. (64461) Pits of Texas Construction Material Company, Romayor, 24 miles east of Cleveland. Recent, sand and gravel.
- Liberty 2. (64462) River bank, west side of Trinity River between Dayton and Liberty, 1.5 miles

- west of junction of U. S. Highway 90 and Farm Road 146. Recent, sand.
- Liberty 3. (64463) Pit, turn east off Farm Road 1725 (approximately 3 miles northwest of Cleveland) and follow road approximately 1 mile to pit on south side of road. Recent, sand.
- Liberty 4. Auger hole, 10 miles southeast of Cleveland along State Highway 90A. Montgomery Formation, sand.
- Matagorda 1. (64497) Sand dune, 12 miles northeast along beach from end of Farm Road 2030. Recent, sand.
- Matagorda 2. (64498, 64499) Sand dune, 7.4 miles northeast along beach from end of Farm Road 2030. Recent, sand.
- Matagorda 3. (64500, 64501, 64502) Sand dune, 2.4 miles northeast along beach from end of Farm Road 2030. Recent, sand.
- Matagorda 4. (64503) Sand dune, first ridge northeast of mouth of Colorado River. Recent, sand.
- Nueces 1. (64544) Pit of Heldenfels Bros., 1-3/4 miles north of La Rosa community, 4.2 miles west of Calallen on Farm Road 624. Beaumont Formation, sand and gravel.
- Nueces 2. (64545) Pit of M. P. Wright Sand and Gravel Company, east side of Farm Road 666, 1 mile north of junction of Farm Roads 666 and 624. Recent, sand and gravel.
- Nueces 3. (64546) Sand dune, northwest side of Nueces County Park No. 1, Padre Island, 1/2 mile inland from beach. Recent, sand.
- Nueces 4. (64547, 64548, 64549) Sand dune, on beach of Padre Island, 1/2 mile northeast of Nueces County Park No. 1. Recent, sand.
- Nueces 5. (64550, 64551, 64552) Sand dune, 2 miles southwest of beach access road No. 2 on Mustang Island. Recent, sand.
- Nueces 6. (64553, 64554, 64555) Sand dune, 3 miles northeast of beach access road No. 2 along Mustang Island beach. Recent, sand.
- Nueces 7. (64556, 64557, 64558) Sand dune, 1 mile northeast of beach access road No. 1 along Mustang Island beach. Recent, sand.
- Nueces 8. Auger hole, approximately 1 mile west of Flour Bluff. Beaumont Formation, sand.
- Orange 1. (65051) Pit, west side of State Highway 105, 1-3/4 miles north of junction with Interstate Highway 10 at Vidor. Recent, sand.
- Orange 2. (64053) Pit, north side of Interstate Highway 10, 1.5 miles east of Neches River (near Rose City exit). Recent, sand.
- Orange 3. Auger hole, 4 miles west of State Highway 62 at Texla. Beaumont Formation, sand.
- Refugio 1. (64536) Road cut, exposed on both sides of U. S. Highway 77, 0.6 mile southwest of Refugio city limits, 0.3 mile southwest of Mission River. Samples taken on south side of road. Beaumont Formation, sand.
- Refugio 2. Auger hole, 10 miles north of Refugio along U. S. Highway 77. Beaumont Formation, sand.
- San Patricio 1. (64559) Pit of Fordyce Company, southwest edge of San Patricio community. Beaumont Formation, sand and gravel.
- San Patricio 2. (64560) Pit of M. P. Wright Sand and Gravel Company, 3/4 mile north of San Patricio community on west side of Farm Road 666. Beaumont Formation, sand and gravel.
- Victoria 1. (64515) Pit of Fordyce Company, north side of U. S. Highway 59, west edge of Victoria. Recent, sand and gravel.
- Victoria 2. (64516) Pit of Heldenfels Bros., west side of U. S. Highway 87, north edge of Victoria. Recent, sand and gravel.
- Victoria 3. (64517) Pit of Gulf Concrete Company, 4 miles north of Victoria city limits on west side of U. S. Highway 87. Recent, sand and gravel.
- Victoria 4. Pit, approximately 2 miles east of Mission Valley along dirt road. Willis Formation, gravel.
- Victoria 5. Abandoned pit, approximately 3 miles north of Nursery along U. S. Highway 87; pit is east of highway. Lissie Formation, sand and gravel.
- Wharton 1. Auger hole, 8 miles west of El Campo on north side of U. S. Highway 59. Montgomery Formation, sand.
- Wharton 2. Auger hole, 2 1/2 miles north of Lissie, along dirt road. Lissie Formation, sand.

APPENDIX C — LABORATORY DATA

Physical and chemical analyses of silica sands from study area. For sampling and testing procedure, see Appendix A; for locality description, see Appendix B. Asterisk (*) indicates that the sample contained greater than 0.5 percent iron

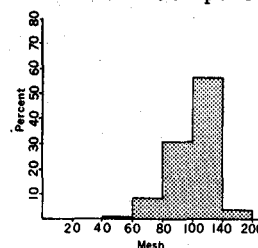
Locality number, --Aransas 1
Mineral Studies Laboratory Number, --64534
Stratigraphic unit, --Beaumont Formation
Type of exposure, --Barrow pit
Thickness of sampled unit, --4-1/2 feet
Coherence, --Loose
Overburden, --None
Yield after coning, --95.00 percent
Graphic mean, --0.14 mm fine sand
Sorting index, --0.290 very well sorted
Iron expressed as oxide, --0.10 percent



U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.51	0.51	0.56	0.58
-60 +80	5.45	5.96	6.00	6.58
-80 +100	23.08	29.04	25.45	32.03
-100 +140	54.79	83.83	60.40	92.43
-140 +200	6.98	90.81	7.72	100.15
-200 +pan	8.95	99.78		

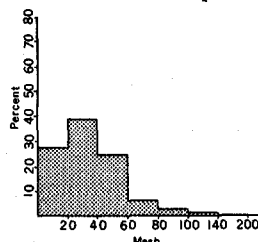
oxide (Fe_2O_3); accuracy for values greater than 0.5 percent is questionable in the method of analysis used (Appendix A) and therefore such values are not reported.

Locality number, --Aransas 2
Mineral Studies Laboratory Number, --64535
Stratigraphic unit, --Beaumont Formation
Type of exposure, --Road cut
Thickness of sampled unit, --5 feet
Coherence, --Loose
Overburden, --None
Yield after coning, --98.20 percent
Graphic mean, --0.15 mm fine sand
Sorting index, --0.320 very well sorted
Iron expressed as oxide, --0.08 percent



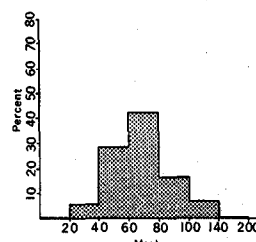
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.92	0.94	1.03	1.05
-60 +80	7.53	8.47	8.38	9.43
-80 +100	27.72	36.19	30.90	40.33
-100 +140	50.85	87.04	56.60	96.93
-140 +200	2.77	89.81	3.09	100.02
-200 +pan	10.72	100.53		

Locality number. --Austin 1
 Mineral Studies Laboratory Number. --64474
 Stratigraphic unit. --River alluvium
 Type of exposure. --Sand and gravel bar in Brazos River
 Thickness of sampled unit. --Unknown
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.95 percent
 Graphic mean. --0.61 mm coarse sand
 Sorting index. --0.70 moderately well sorted
 Iron expressed as oxide. -->0.5 percent



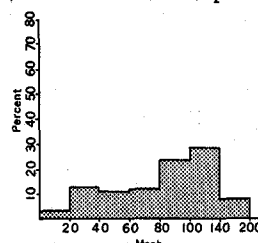
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	27.16	27.16	27.41	27.41
-20 +40	37.92	65.08	38.40	65.81
-40 +60	23.89	88.97	24.20	90.01
-60 +80	6.33	95.30	6.41	96.42
-80 +100	2.13	97.43	2.16	98.58
-100 +140	1.30	98.73	1.32	99.90
-140 +200	0.04	98.77	0.50	100.40
-200 +pan	1.07	99.84		

Locality number. --Austin 2
 Mineral Studies Laboratory Number. --65001
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Road cut
 Thickness of sampled unit. --4 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --90.60 percent
 Graphic mean. --0.25 mm fine sand
 Sorting index. --0.480 well sorted
 Iron expressed as oxide. --0.09 percent



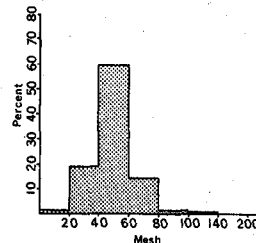
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.13	0.13	0.14	0.14
-20 +40	4.66	4.79	5.20	5.34
-40 +60	25.05	29.84	28.00	33.34
-60 +80	37.77	67.61	42.00	75.34
-80 +100	16.04	83.65	17.90	93.24
-100 +140	5.94	89.59	6.12	99.36
-140 +200	0.60	90.19	0.67	100.03
-200 +pan	9.62	99.81		

Sample number. --Austin 3
 Mineral Studies Laboratory Number. --65002
 Stratigraphic unit. --Montgomery Formation
 Type of exposure. --Road cut
 Thickness of sampled unit. --4 feet
 Coherence. --Slightly compact
 Overburden. --4-1/2 feet
 Yield after coning. --75.32 percent
 Graphic mean. --0.26 mm medium sand
 Sorting index. --0.960 poorly sorted
 Iron expressed as oxide. --0.29 percent



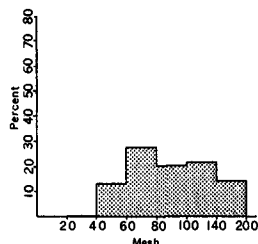
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	2.33	2.33	3.25	3.25
-20 +40	9.28	11.61	12.91	16.16
-40 +60	8.19	19.80	11.40	27.56
-60 +80	8.25	28.05	11.51	39.07
-80 +100	17.17	45.22	23.87	62.94
-100 +140	20.49	65.71	28.62	91.56
-140 +200	6.05	71.76	8.41	99.97
-200 +pan	28.20	99.96		

Sample number. --Austin 4
 Mineral Studies Laboratory Number. --65003
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Stream cut
 Thickness of sampled unit. --3 feet (no base exposed)
 Coherence. --Loose
 Overburden. --6 feet
 Yield after coning. --98.50 percent
 Graphic mean. --0.38 mm medium sand
 Sorting index. --0.650 moderately well sorted
 Iron expressed as oxide. --0.14 percent



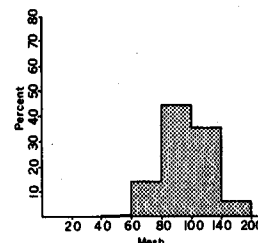
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	1.43	1.43	1.45	1.45
-20 +40	19.49	20.92	19.87	21.32
-40 +60	58.95	79.87	59.84	81.16
-60 +80	14.53	94.40	14.78	95.94
-80 +100	2.80	97.20	2.84	98.78
-100 +140	1.00	98.20	1.02	99.80
-140 +200	0.16	98.36	0.16	99.96
-200 +pan	1.60	99.96		

Locality number. --Austin 5
 Mineral Studies Laboratory Number. --65004
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Auger hole
 Thickness of sampled unit. --6 feet (base of unit not reached)
 Coherence. --Slightly compact
 Overburden. --None
 Yield after coning. --87.67 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.64 moderately well sorted
 Iron expressed as oxide. --*



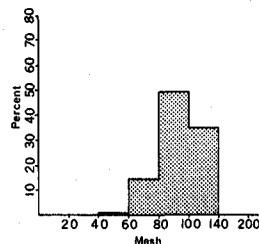
		Entire sample		Sand fraction	
U. S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.02	0.02	0.03	0.03	
-20 +40	0.25	0.27	0.33	0.36	
-40 +60	9.97	10.24	13.10	13.46	
-60 +80	21.93	32.17	28.80	42.26	
-80 +100	16.28	48.45	21.40	63.66	
-100 +140	16.78	65.23	22.00	85.66	
-140 +200	10.88	76.11	14.20	99.86	
-200 +pan	23.31	99.42			

Locality number. --Brazoria 1A
 Mineral Studies Laboratory Number. --64475
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.73 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.33 very well sorted
 Iron expressed as oxide. --*



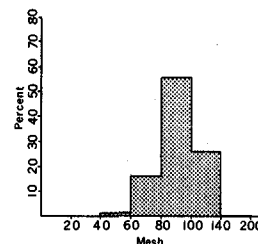
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.01	0.01	0.01	0.01	
-20 +40	0.06	0.07	0.06	0.07	
-40 +60	0.54	0.61	0.54	0.61	
-60 +80	14.33	14.94	14.50	15.11	
-80 +100	43.32	58.26	44.00	59.11	
-100 +140	34.46	92.72	35.00	94.11	
-140 +200	5.96	98.68	6.50	100.61	
-200 +pan	0.78	99.46			

Locality number. --Brazoria 1B
 Mineral Studies Laboratory Number. --64476
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3-1/2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.53 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.28 very well sorted
 Iron expressed as oxide. --*



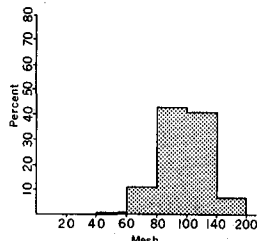
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.05	0.05	0.05	0.05	
-40 +60	0.92	0.97	0.99	1.04	
-60 +80	13.32	14.29	14.51	15.55	
-80 +100	45.41	59.70	49.00	64.55	
-100 +140	32.72	92.42	35.30	99.85	
-140 +200	0.20	92.62	0.22	100.07	
-200 +pan	5.87	98.49			

Locality number. --Brazoria 1C
 Mineral Studies Laboratory Number. --64477
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.67 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.32 very well sorted
 Iron expressed as oxide. --*



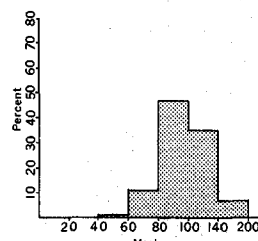
		Entire sample		Sand fraction	
U. S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.12	0.12	0.13	0.13	
-40 +60	1.31	1.43	1.38	1.51	
-60 +80	15.89	17.32	16.80	18.31	
-80 +100	52.31	69.63	55.02	73.33	
-100 +140	24.51	94.14	25.80	99.13	
-140 +200	0.74	94.88	0.78	99.91	
-200 +pan	5.27	100.15			

Locality number. --Brazoria 2A
 Mineral Studies Laboratory Number. --64478
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --89.85 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --*



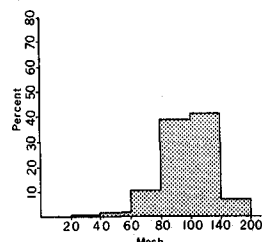
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.01	0.01	0.01	0.01	
-20 +40	0.04	0.05	0.05	0.06	
-40 +60	0.44	0.49	0.50	0.56	
-60 +80	8.81	9.30	10.50	11.06	
-80 +100	36.86	46.16	42.00	53.06	
-100 +140	36.21	82.37	41.20	94.26	
-140 +200	5.55	87.92	6.30	100.56	
-200 +pan	11.45	99.37			

Locality number. --Brazoria 2B
 Mineral Studies Laboratory Number. --64479
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3-1/2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.71 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.33 ϕ very well sorted
 Iron expressed as oxide. --*



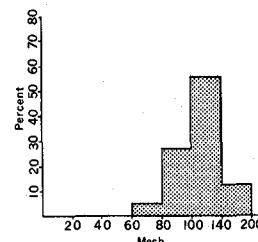
		Entire sample		Sand fraction	
U. S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.02	0.02	0.02	0.02	
-40 +60	0.88	0.90	0.90	0.92	
-60 +80	10.74	11.64	10.90	11.82	
-80 +100	47.29	58.93	47.99	59.81	
-100 +140	33.59	92.52	34.00	93.81	
-140 +200	6.26	98.78	6.35	100.16	
-200 +pan	1.69	100.47			

Locality number. --Brazoria 2C
 Mineral Studies Laboratory Number. --64480
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.63 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.33 ϕ very well sorted
 Iron expressed as oxide. --*



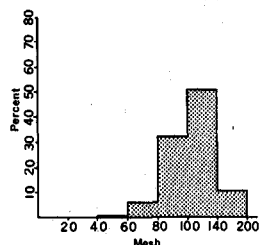
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.03	0.03	0.03	0.03	
-20 +40	0.55	0.58	0.57	0.60	
-40 +60	1.28	1.86	1.33	1.93	
-60 +80	10.03	11.89	10.45	12.38	
-80 +100	37.94	49.83	39.50	51.88	
-100 +140	39.27	89.10	40.90	92.78	
-140 +200	6.97	96.07	7.26	100.04	
-200 +pan	3.70	99.77			

Locality number. --Brazoria 3A
 Mineral Studies Laboratory Number. --64481
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.73 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.33 ϕ very well sorted
 Iron expressed as oxide. --*



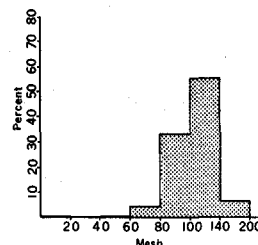
		Entire sample		Sand fraction	
U. S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.20	0.20	0.21	0.21	
-20 +40	0.12	0.32	0.13	0.34	
-40 +60	0.37	0.69	0.39	0.73	
-60 +80	4.56	5.25	4.82	5.55	
-80 +100	24.61	29.86	26.10	31.65	
-100 +140	52.98	82.84	56.10	87.75	
-140 +200	11.63	94.47	12.34	100.09	
-200 +pan	5.06	99.53			

Locality number. --Brazoria 3B
 Mineral Studies Laboratory Number. --64482
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --7 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.73 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.280 very well sorted
 Iron expressed as oxide. --*



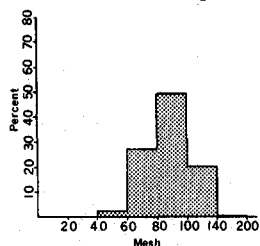
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.07	0.07	0.07	0.07
-40 +60	0.79	0.86	0.81	0.88
-60 +80	6.36	7.22	6.54	7.42
-80 +100	30.70	37.92	31.50	38.92
-100 +140	49.32	87.24	50.70	89.62
-140 +200	10.15	97.39	10.45	100.07
-200 +pan	2.02	99.41		

Locality number. --Brazoria 3C
 Mineral Studies Laboratory Number. --64483
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.79 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.250 very well sorted
 Iron expressed as oxide. --*



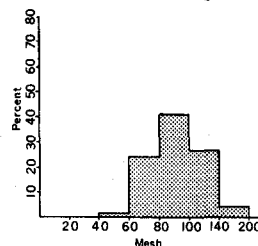
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.20	0.20	0.22	0.22
-20 +40	0.14	0.34	0.15	0.37
-40 +60	0.26	0.60	0.28	0.65
-60 +80	3.86	4.46	4.21	4.86
-80 +100	30.67	35.13	33.36	38.22
-100 +140	50.60	85.73	55.20	93.42
-140 +200	5.98	91.71	6.53	99.95
-200 +pan	7.54	99.25		

Locality number. --Brazoria 4A
 Mineral Studies Laboratory Number. --64484
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.64 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.280 very well sorted
 Iron expressed as oxide. --0.20 percent



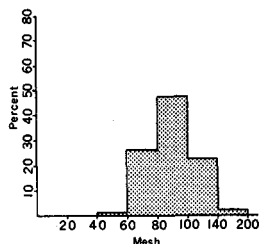
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	2.72	2.73	2.84	2.85
-60 +80	26.33	29.06	27.50	30.35
-80 +100	47.31	76.37	49.40	79.75
-100 +140	19.17	95.54	20.10	99.85
-140 +200	0.19	95.73	0.20	100.05
-200 +pan	4.81	100.54		

Locality number. --Brazoria 4B
 Mineral Studies Laboratory Number. --64485
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3-1/2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.48 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.360 well sorted
 Iron expressed as oxide. --0.19 percent



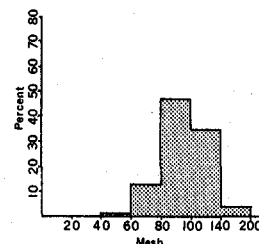
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	1.88	1.89	1.96	1.97
-60 +80	23.63	25.52	24.50	26.47
-80 +100	39.89	65.41	41.65	68.12
-100 +140	26.36	91.77	27.63	95.75
-140 +200	3.97	95.74	4.25	100.00
-200 +pan	3.56	99.30		

Locality number, --Brazoria 4C
 Mineral Studies Laboratory Number, --64486
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --2 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.27 percent
 Graphic mean, --0.17 mm fine sand
 Sorting index, --0.36 ϕ well sorted
 Iron expressed as oxide, --0.19 percent



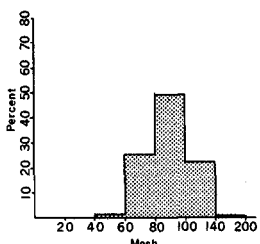
		Entire sample		Sand fraction	
U.S. Standard		Weight	Cumulative	Weight	Cumulative
Mesh Number		Percent	Percent	Percent	Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.01	0.01	0.01	0.01
-40 +60		1.62	1.63	1.71	1.72
-60 +80		25.29	27.92	26.60	28.32
-80 +100		44.67	72.59	47.00	75.32
-100 +140		21.78	94.37	22.90	98.22
-140 +200		1.77	96.14	1.87	100.09
-200 +pan		3.81	99.95		

Locality number, --Brazoria 5A
 Mineral Studies Laboratory Number, --64488
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --2 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.28 percent
 Graphic mean, --0.15 mm fine sand
 Sorting index, --0.33 ϕ very well sorted
 Iron expressed as oxide, --*



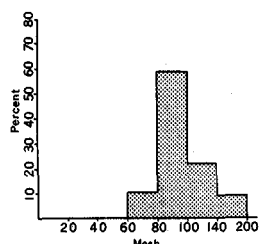
		Entire sample		Sand fraction	
U.S. Standard		Weight	Cumulative	Weight	Cumulative
Mesh Number		Percent	Percent	Percent	Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.01	0.01	0.01	0.01
-40 +60		1.65	1.66	1.89	1.90
-60 +80		11.96	13.62	13.65	15.55
-80 +100		40.57	54.19	46.40	61.95
-100 +140		30.45	84.64	34.80	96.75
-140 +200		2.88	87.52	3.29	100.04
-200 +pan		12.98	100.50		

Locality number, --Brazoria 5B
 Mineral Studies Laboratory Number, --64487
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --3-1/2 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.45 percent
 Graphic mean, --0.17 mm fine sand
 Sorting index, --0.36 ϕ well sorted
 Iron expressed as oxide, --*



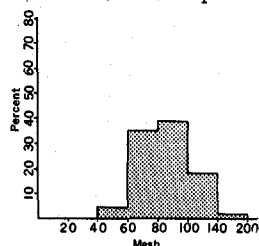
		Entire sample		Sand fraction	
U.S. Standard		Weight	Cumulative	Weight	Cumulative
Mesh Number		Percent	Percent	Percent	Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.02	0.02	0.02	0.02
-40 +60		1.57	1.59	1.71	1.73
-60 +80		23.11	24.70	25.20	26.93
-80 +100		45.66	70.36	49.80	76.73
-100 +140		20.26	90.62	22.10	98.83
-140 +200		1.12	91.74	1.22	100.05
-200 +pan		8.96	100.70		

Locality number, --Brazoria 5C
 Mineral Studies Laboratory Number, --64489
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --2 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.54 percent
 Graphic mean, --0.16 mm fine sand
 Sorting index, --0.28 ϕ very well sorted
 Iron expressed as oxide, --*



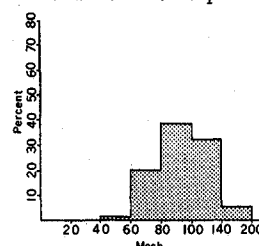
		Entire sample		Sand fraction	
U.S. Standard		Weight	Cumulative	Weight	Cumulative
Mesh Number		Percent	Percent	Percent	Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.00	0.00	0.00	0.00
-40 +60		0.05	0.05	0.05	0.05
-60 +80		9.68	9.73	10.02	10.07
-80 +100		57.09	66.82	59.20	69.27
-100 +140		20.34	87.16	21.08	90.35
-140 +200		9.38	96.54	9.72	100.07
-200 +pan		3.00	99.54		

Locality number. --Brazoria 6A
 Mineral Studies Laboratory Number. --64490
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.85 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.350 very well sorted
 Iron expressed as oxide. --0.15 percent



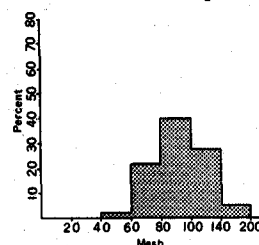
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.01	0.01	0.00	0.00	
-20 +40	0.01	0.02	0.01	0.01	
-40 +60	4.18	4.20	4.25	4.26	
-60 +80	34.49	38.69	35.10	39.36	
-80 +100	38.85	77.54	39.50	78.86	
-100 +140	18.69	96.23	19.00	97.86	
-140 +200	2.22	98.45	2.29	100.15	
-200 +pan	1.74	100.19			

Locality number. --Brazoria 6B
 Mineral Studies Laboratory Number. --64491
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --4 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.66 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.370 well sorted
 Iron expressed as oxide. --0.17 percent



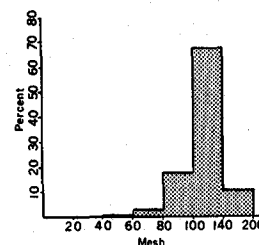
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.01	0.01	0.01	0.01	
-40 +60	1.81	1.82	1.90	1.91	
-60 +80	19.38	21.20	20.35	22.26	
-80 +100	37.62	58.82	39.50	61.76	
-100 +140	31.29	90.11	32.90	94.66	
-140 +200	5.14	95.25	5.39	100.05	
-200 +pan	4.07	99.32			

Locality number. --Brazoria 6C
 Mineral Studies Laboratory Number. --64492
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.67 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.340 very well sorted
 Iron expressed as oxide. --0.16 percent



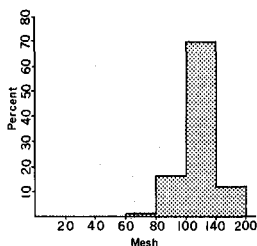
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.02	0.02	0.02	0.02	
-20 +40	0.01	0.03	0.01	0.03	
-40 +60	2.33	2.36	2.41	2.44	
-60 +80	22.81	25.17	23.60	26.04	
-80 +100	38.92	64.09	40.25	66.29	
-100 +140	27.79	91.88	28.80	95.09	
-140 +200	4.71	96.59	4.88	99.97	
-200 +pan	2.74	99.33			

Locality number. --Brazoria 7A
 Mineral Studies Laboratory Number. --64493
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet (fore dune)
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.78 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.220 very well sorted
 Iron expressed as oxide. --*



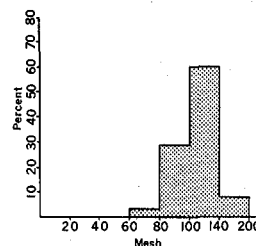
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.03	0.03	0.03	0.03	
-40 +60	0.17	0.20	0.18	0.21	
-60 +80	2.33	2.53	2.42	2.63	
-80 +100	18.04	20.57	18.70	21.33	
-100 +140	65.35	85.92	67.80	89.13	
-140 +200	10.55	96.47	10.95	100.08	
-200 +pan	3.61	100.08			

Locality number. --Brazoria 7B
 Mineral Studies Laboratory Number. --64494
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet (dune crest)
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.80 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.24 ϕ very well sorted
 Iron expressed as oxide. --*



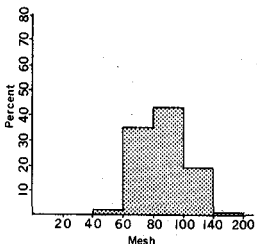
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.08	0.09	0.08	0.09
-60 +80	1.44	1.53	1.50	1.59
-80 +100	15.28	16.81	15.88	17.47
-100 +140	67.35	84.16	70.00	87.47
-140 +200	12.01	96.17	12.50	99.97
-200 +pan	3.63	99.80	*	

Locality number. --Brazoria 7C
 Mineral Studies Laboratory Number. --64495
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.89 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.21 ϕ very well sorted
 Iron expressed as oxide. --*



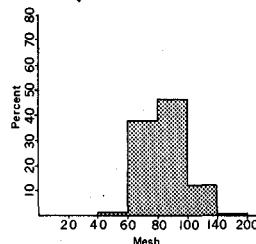
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.02	0.03	0.02	0.03
-60 +80	2.90	2.93	3.02	3.05
-80 +100	28.04	30.97	29.10	32.15
-100 +140	58.22	89.19	60.60	92.75
-140 +200	7.04	96.23	7.33	100.08
-200 +pan	3.82	100.05		

Locality number. --Cameron 1A
 Mineral Studies Laboratory Number. --64522
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.80 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --*



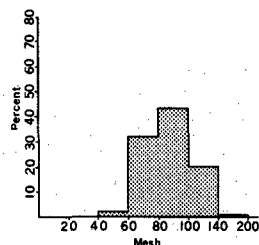
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.10	0.10	0.10	0.10
-40 +60	2.55	2.65	2.61	2.71
-60 +80	33.30	35.95	34.00	36.71
-80 +100	42.30	78.25	43.30	80.01
-100 +140	18.77	97.02	19.20	99.21
-140 +200	0.93	97.95	0.95	100.16
-200 +pan	1.00	98.95		

Locality number. --Cameron 1B
 Mineral Studies Laboratory Number. --64523
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --25 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.81 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --*



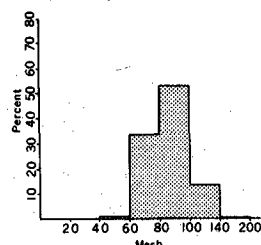
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.16	0.16	0.16	0.16
-40 +60	1.25	1.41	1.28	1.44
-60 +80	38.00	39.41	38.81	40.25
-80 +100	46.59	86.00	47.70	87.95
-100 +140	11.08	97.08	11.30	99.25
-140 +200	0.74	97.82	0.75	100.00
-200 +pan	1.84	99.66		

Locality number, --Cameron 1C
 Mineral Studies Laboratory Number, --64524
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --3 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.83 percent
 Graphic mean, --0.18 mm fine sand
 Sorting index, --0.32 ϕ very well sorted
 Iron expressed as oxide, --*



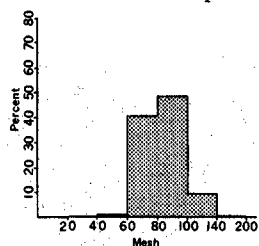
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.07	0.07	0.07	0.07
-40 +60	2.76	2.83	2.82	2.89
-60 +80	31.61	34.44	32.39	35.28
-80 +100	42.12	76.56	43.10	78.38
-100 +140	20.34	96.90	20.79	99.17
-140 +200	1.07	87.97	1.09	100.26
-200 +pan	2.00	99.97		

Locality number, --Cameron 2A
 Mineral Studies Laboratory Number, --64525
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --2 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.46 percent
 Graphic mean, --0.18 mm fine sand
 Sorting index, --0.27 ϕ very well sorted
 Iron expressed as oxide, --*



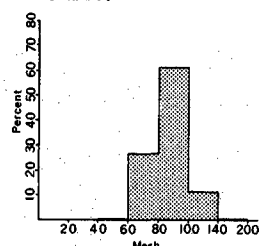
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.03	0.03	0.03	0.03
-40 +60	0.75	0.78	0.78	0.81
-60 +80	31.88	32.66	33.10	33.91
-80 +100	50.09	82.75	52.00	85.91
-100 +140	13.19	95.94	13.70	99.61
-140 +200	0.41	96.35	0.43	100.04
-200 +pan	2.11	98.46		

Locality number, --Cameron 2B
 Mineral Studies Laboratory Number, --64526
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --17 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.69 percent
 Graphic mean, --0.18 mm fine sand
 Sorting index, --0.27 ϕ very well sorted
 Iron expressed as oxide, --0.48 percent



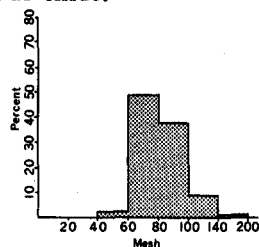
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.84	0.86	0.83	0.85
-60 +80	40.78	41.64	40.40	41.25
-80 +100	49.27	90.91	48.80	90.05
-100 +140	9.27	100.18	9.19	99.24
-140 +200	0.57	100.75	0.57	99.81
-200 +pan	0.74	101.49		

Locality number, --Cameron 2C
 Mineral Studies Laboratory Number, --64527
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --3 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.56 percent
 Graphic mean, --0.18 mm fine sand
 Sorting index, --0.27 ϕ very well sorted
 Iron expressed as oxide, --*



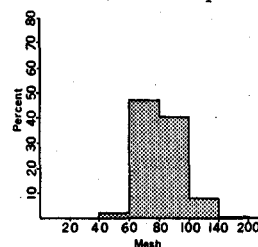
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.27	0.28	0.27	0.28
-60 +80	26.19	26.47	26.54	26.82
-80 +100	60.15	86.62	60.90	87.72
-100 +140	11.60	98.22	11.75	99.47
-140 +200	0.46	98.68	0.47	99.94
-200 +pan	0.75	99.43		

Locality number. --Cameron 3A
 Mineral Studies Laboratory Number. --64528
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.45 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --*



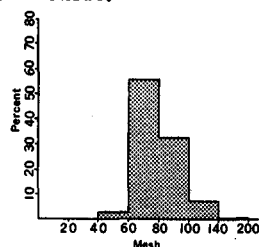
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.04	0.04	0.04	0.04
-40 +60	2.22	2.26	2.25	2.29
-60 +80	48.16	50.42	48.90	51.19
-80 +100	38.09	88.51	38.70	89.89
-100 +140	8.94	97.45	9.08	98.97
-140 +200	1.06	98.51	1.08	100.50
-200 +pan	1.55	100.06		

Locality number. --Cameron 3B
 Mineral Studies Laboratory Number. --64529
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --25 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.62 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --0.41 percent



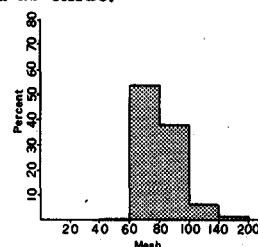
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	2.11	2.12	2.15	2.16
-60 +80	46.69	48.81	47.60	49.76
-80 +100	40.10	88.91	40.90	90.66
-100 +140	8.75	97.66	8.93	99.59
-140 +200	0.34	98.00	0.35	99.94
-200 +pan	1.64	99.64		

Locality number. --Cameron 3C
 Mineral Studies Laboratory Number. --64530
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --98.17 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --*



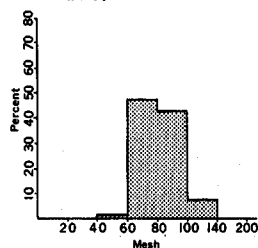
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.02	0.02	0.02	0.02
-20 +40	0.08	0.10	0.08	0.10
-40 +60	2.37	2.47	2.45	2.55
-60 +80	54.73	57.20	56.60	59.15
-80 +100	31.84	89.04	32.90	92.05
-100 +140	7.16	96.20	7.41	99.46
-140 +200	0.52	96.72	0.54	100.00
-200 +pan	3.39	100.11		

Locality number. --Cameron 4A
 Mineral Studies Laboratory Number. --64531
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.00 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.25 ϕ very well sorted
 Iron expressed as oxide. --*



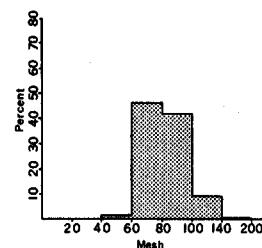
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.48	0.49	0.48	0.49
-60 +80	53.04	53.53	53.04	53.53
-80 +100	38.19	91.72	38.19	91.72
-100 +140	6.07	97.79	6.07	97.79
-140 +200	0.58	98.37	1.58	99.37
-200 +pan	1.61	99.98		

Locality number, --Cameron 4B
 Mineral Studies Laboratory Number, --64532
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --30 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.56 percent
 Graphic mean, --0.19 mm fine sand
 Sorting index, --0.27 ϕ very well sorted
 Iron expressed as oxide, --*



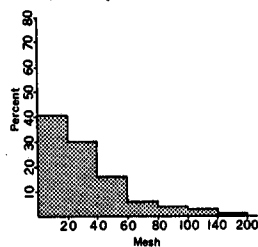
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	U.S. Standard Mesh Number	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	-10 +20	0.00	0.00
-20 +40	0.01	0.01	-20 +40	0.01	0.01
-40 +60	1.23	1.24	-40 +60	1.26	1.27
-60 +80	46.49	47.73	-60 +80	47.60	48.87
-80 +100	42.00	89.73	-80 +100	43.15	92.02
-100 +140	7.81	97.54	-100 +140	7.98	100.00
-140 +200	0.18	97.62	-140 +200	0.18	100.18
-200 +pan	1.97	99.69	-200 +pan		

Locality number, --Cameron 4C
 Mineral Studies Laboratory Number, --64533
 Stratigraphic unit, --Recent
 Type of exposure, --Sand dune
 Thickness of sampled unit, --3 feet
 Coherence, --Loose
 Overburden, --None
 Yield after coning, --99.47 percent
 Graphic mean, --0.19 mm fine sand
 Sorting index, --0.32 ϕ very well sorted
 Iron expressed as oxide, --*



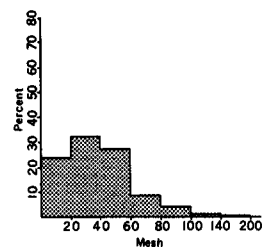
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	U.S. Standard Mesh Number	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	-10 +20	0.00	0.00
-20 +40	0.01	0.01	-20 +40	0.01	0.01
-40 +60	1.48	1.49	-40 +60	1.49	1.50
-60 +80	44.18	45.67	-60 +80	46.80	48.30
-80 +100	40.12	85.79	-80 +100	42.50	90.80
-100 +140	8.51	94.30	-100 +140	9.02	99.82
-140 +200	0.13	94.43	-140 +200	0.14	99.96
-200 +pan	5.54	99.97	-200 +pan		

Locality number, --Colorado 1
 Mineral Studies Laboratory Number, --64467
 Stratigraphic unit, --Beaumont Formation
 Type of exposure, --Dredge pit
 Thickness of sampled unit, --Unknown
 Coherence, --Unknown
 Overburden, --Unknown
 Yield after coning, --97.18 percent
 Graphic mean, --0.84 mm coarse sand
 Sorting index, --1.10 ϕ poorly sorted
 Iron expressed as oxide, --*



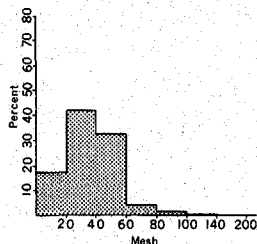
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	U.S. Standard Mesh Number	Weight Percent	Cumulative Percent
-10 +20	37.71	37.71	-10 +20	40.35	40.35
-20 +40	28.65	66.36	-20 +40	30.72	71.07
-40 +60	14.54	80.90	-40 +60	15.54	86.61
-60 +80	5.27	86.17	-60 +80	5.64	92.25
-80 +100	3.31	89.48	-80 +100	3.55	95.80
-100 +140	2.66	92.14	-100 +140	2.85	98.65
-140 +200	1.23	93.37	-140 +200	1.32	99.97
-200 +pan	6.59	99.96	-200 +pan		

Locality number, --Colorado 2
 Mineral Studies Laboratory Number, --64468
 Stratigraphic unit, --Beaumont Formation
 Type of exposure, --Dredge pit
 Thickness of sampled unit, --Unknown
 Coherence, --Unknown
 Overburden, --Unknown
 Yield after coning, --98.50 percent
 Graphic mean, --0.64 mm coarse sand
 Sorting index, --1.03 ϕ poorly sorted
 Iron expressed as oxide, --*



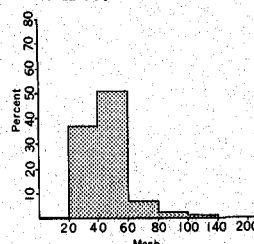
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	U.S. Standard Mesh Number	Weight Percent	Cumulative Percent
-10 +20	23.90	23.90	-10 +20	24.63	24.63
-20 +40	31.26	55.16	-20 +40	32.16	56.79
-40 +60	27.11	82.27	-40 +60	27.88	84.67
-60 +80	9.25	91.52	-60 +80	9.48	94.15
-80 +100	3.32	94.84	-80 +100	3.42	97.57
-100 +140	1.67	96.51	-100 +140	1.74	99.31
-140 +200	0.34	96.85	-140 +200	0.35	99.66
-200 +pan	3.11	99.96	-200 +pan		

Locality number. --Colorado 3A
 Mineral Studies Laboratory Number. --64469
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Dredge pit (tailings from mined material)
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --98.95 percent
 Graphic mean. --0.59 mm coarse sand
 Sorting index. --0.86 ϕ moderately sorted
 Iron expressed as oxide. --*



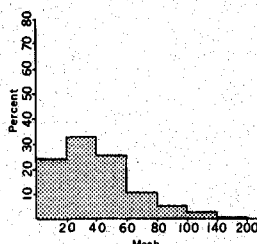
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	17.52	17.52	17.79	17.79
-20 +40	40.53	58.05	41.17	58.96
-40 +60	32.01	90.06	32.53	91.49
-60 +80	5.54	95.60	5.62	97.11
-80 +100	1.86	97.46	1.89	99.00
-100 +140	0.88	98.34	0.89	99.89
-140 +200	0.08	98.42	0.08	99.97
-200 +pan	1.54	99.96		

Locality number. --Colorado 3B
 Mineral Studies Laboratory Number. --64470
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --98.37 percent
 Graphic mean. --0.44 mm medium sand
 Sorting index. --0.57 ϕ moderately sorted
 Iron expressed as oxide. --*



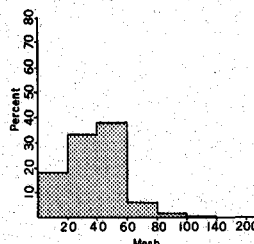
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.65	0.65	0.67	0.67
-20 +40	37.15	37.80	37.92	38.59
-40 +60	49.40	87.20	50.53	89.12
-60 +80	7.45	94.65	7.62	96.74
-80 +100	1.89	96.54	1.95	98.69
-100 +140	1.03	97.57	1.05	99.74
-140 +200	0.23	97.80	0.24	99.98
-200 +pan	2.17	99.97		

Locality number. --Colorado 4
 Mineral Studies Laboratory Number. --64471
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --99.11 percent
 Graphic mean. --0.68 mm coarse sand
 Sorting index. --1.03 ϕ poorly sorted
 Iron expressed as oxide. --*



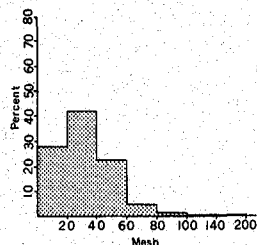
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	24.07	24.07	24.65	24.65
-20 +40	32.14	56.21	32.86	57.51
-40 +60	24.63	80.84	25.35	82.86
-60 +80	10.06	90.90	10.18	93.04
-80 +100	4.04	94.94	4.14	97.18
-100 +140	2.25	97.19	2.30	99.48
-140 +200	0.48	97.67	0.49	99.97
-200 +pan	2.31	99.98		

Locality number. --Colorado 5
 Mineral Studies Laboratory Number. --64472
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --99.55 percent
 Graphic mean. --0.57 mm coarse sand
 Sorting index. --0.91 ϕ moderately sorted
 Iron expressed as oxide. --*



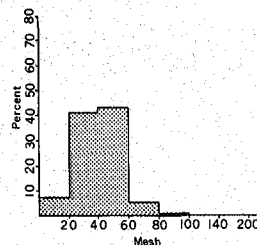
U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	18.22	18.22	18.36	18.36
-20 +40	33.19	51.41	33.37	51.73
-40 +60	38.35	89.76	38.64	90.37
-60 +80	6.85	96.61	6.91	97.28
-80 +100	1.84	98.45	1.85	99.13
-100 +140	0.76	99.21	0.77	99.90
-140 +200	0.06	99.27	0.06	99.96
-200 +pan	0.68	99.95		

Locality number. --Colorado 6
 Mineral Studies Laboratory Number. --64473
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --99.71 percent
 Graphic mean. --0.76 mm coarse sand
 Sorting index. --1.01 moderately sorted
 Iron expressed as oxide. --*



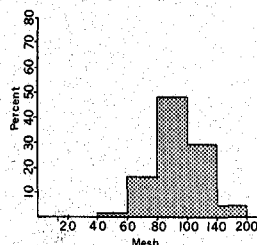
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	28.04	28.04	28.19	28.19
-20 +40	41.28	69.32	41.52	69.71
-40 +60	27.76	92.08	22.98	92.69
-60 +80	4.90	96.98	4.93	97.62
-80 +100	1.57	98.55	1.58	99.20
-100 +140	0.65	99.20	0.65	99.85
-140 +200	0.13	99.33	0.13	99.98
-200 +pan	0.64	99.97		

Locality number. --Colorado 7
 Mineral Studies Laboratory Number. --64543
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Sand and gravel bar
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.51 percent
 Graphic mean. --0.49 mm medium sand
 Sorting index. --0.70 moderately well sorted
 Iron expressed as oxide. --*



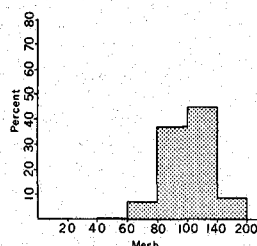
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	7.88	7.88	7.94	7.94
-20 +40	40.87	48.75	41.10	49.04
-40 +60	43.64	92.39	43.84	92.88
-60 +80	5.92	98.31	5.94	98.82
-80 +100	0.90	92.21	0.91	99.73
-100 +140	0.22	99.43	0.22	99.95
-140 +200	0.02	99.45	0.02	99.97
-200 +pan	0.51	99.96		

Locality number. --Galveston 1A
 Mineral Studies Laboratory Number. --64504
 Stratigraphic unit. --Recent
 Type of exposure. --Auger hole, fore dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.77 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.32 very well sorted
 Iron expressed as oxide. --*



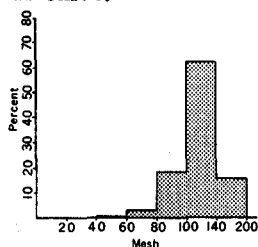
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.05	0.05	0.05	0.05
-40 +60	1.57	1.62	1.59	1.64
-60 +80	15.87	17.49	16.10	17.74
-80 +100	47.63	65.12	48.25	65.99
-100 +140	29.56	94.68	29.90	95.89
-140 +200	4.18	98.86	4.23	100.12
-200 +pan	1.14	100.00		

Locality number. --Galveston 1B
 Mineral Studies Laboratory Number. --64505
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.76 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.32 very well sorted
 Iron expressed as oxide. --*



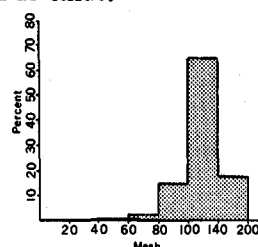
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.34	0.35	0.35	0.36
-60 +80	7.44	7.79	7.53	7.89
-80 +100	37.15	44.94	37.80	45.69
-100 +140	45.27	90.21	45.90	91.59
-140 +200	8.35	98.56	8.47	100.06
-200 +pan	1.33	99.89		

Locality number. --Galveston 2A
 Mineral Studies Laboratory Number. --64506
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.92 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --*



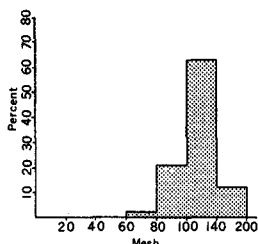
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.07	0.07	0.07	0.07	
-20 +40	0.04	0.11	0.04	0.11	
-40 +60	0.41	0.52	0.42	0.53	
-60 +80	3.85	4.37	3.93	4.46	
-80 +100	18.10	22.47	18.46	22.92	
-100 +140	60.39	82.86	61.60	84.52	
-140 +200	15.11	97.97	15.52	100.04	
-200 +pan	1.95	99.92			

Locality number. --Galveston 2B
 Mineral Studies Laboratory Number. --64507
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.92 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --*



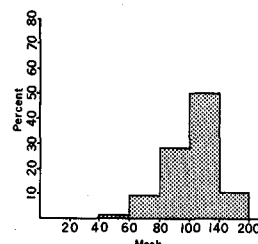
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.01	0.01	0.01	0.01	
-40 +60	0.07	0.08	0.07	0.08	
-60 +80	2.50	2.58	2.59	2.67	
-80 +100	15.60	18.18	15.87	18.54	
-100 +140	63.33	81.51	64.30	82.84	
-140 +200	16.90	98.41	17.26	100.10	
-200 +pan	1.58	99.99			

Locality number. --Galveston 2C
 Mineral Studies Laboratory Number. --64508
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.76 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --*



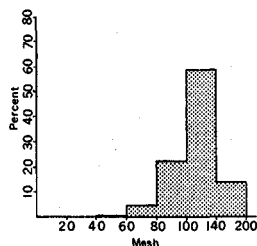
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.01	0.01	0.01	0.01	
-40 +60	0.09	0.10	0.09	0.10	
-60 +80	2.65	2.75	2.71	2.81	
-80 +100	20.75	23.50	21.22	24.03	
-100 +140	61.88	85.38	63.30	87.33	
-140 +200	12.36	97.74	12.70	100.03	
-200 +pan	2.26	100.00			

Locality number. --Galveston 3A
 Mineral Studies Laboratory Number. --64509
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.72 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --*



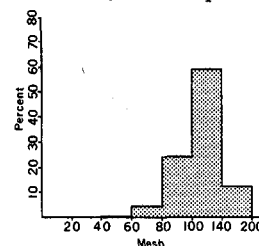
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.01	0.01	0.01	0.01	
-20 +40	0.07	0.08	0.07	0.08	
-40 +60	1.45	1.53	1.49	1.57	
-60 +80	9.00	10.53	9.23	10.80	
-80 +100	28.09	38.62	28.80	39.60	
-100 +140	49.21	87.83	50.05	89.65	
-140 +200	9.81	97.64	10.05	99.70	
-200 +pan	2.44	100.08			

Locality number. --Galveston 3B
 Mineral Studies Laboratory Number. --64510
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --4 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.54 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --*



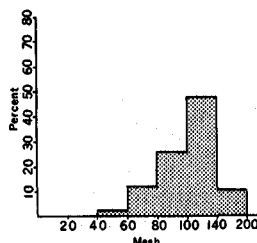
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.02	0.02	0.02	0.02	
-40 +60	0.40	0.42	0.42	0.44	
-60 +80	4.48	4.90	4.65	5.09	
-80 +100	20.70	25.60	21.40	26.49	
-100 +140	57.52	83.12	59.70	86.19	
-140 +200	13.38	96.50	13.89	100.08	
-200 +pan	3.12	99.62			

Locality number. --Galveston 3C
 Mineral Studies Laboratory Number. --64511
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.79 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --0.50 percent



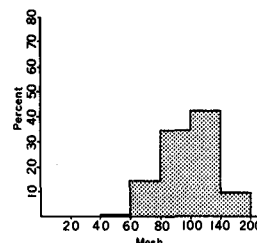
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.08	0.08	0.08	0.08	
-40 +60	0.31	0.39	0.32	0.40	
-60 +80	4.13	4.52	4.25	4.65	
-80 +100	22.82	27.34	23.60	28.25	
-100 +140	58.02	85.36	59.90	88.15	
-140 +200	11.68	97.04	12.02	100.17	
-200 +pan	2.97	100.01			

Locality number. --Galveston 4A
 Mineral Studies Laboratory Number. --64512
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.87 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.33 ϕ very well sorted
 Iron expressed as oxide. --*



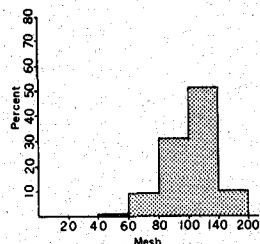
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.01	0.01	0.01	0.01	
-20 +40	0.08	0.09	0.08	0.09	
-40 +60	2.33	2.42	2.38	2.47	
-60 +80	11.75	14.17	12.00	14.47	
-80 +100	26.98	41.15	27.60	42.07	
-100 +140	46.28	87.43	47.40	89.47	
-140 +200	10.50	97.93	10.71	100.18	
-200 +pan	1.93	99.86			

Locality number. --Galveston 4B
 Mineral Studies Laboratory Number. --64513
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.56 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.33 ϕ very well sorted
 Iron expressed as oxide. --*



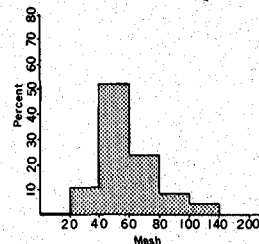
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.02	0.02	0.02	0.02	
-40 +60	0.83	0.85	0.85	0.87	
-60 +80	14.41	15.26	14.71	15.58	
-80 +100	33.36	48.62	34.09	49.67	
-100 +140	40.23	88.85	41.10	90.77	
-140 +200	8.99	97.84	9.19	99.96	
-200 +pan	1.95	99.79			

Locality number. --Galveston 4C
 Mineral Studies Laboratory Number. --64514
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.87 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --*



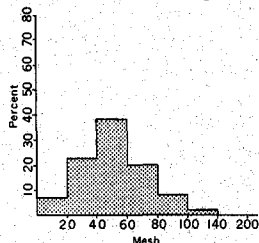
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.93	0.95	0.96	0.98
-60 +80	9.19	10.14	9.35	10.33
-80 +100	29.22	39.36	30.79	41.12
-100 +140	48.68	88.04	50.10	91.22
-140 +200	9.32	97.36	9.58	100.80
-200 +pan	2.09	99.45		

Locality number. --Hardin 1
 Mineral Studies Laboratory Number. --64459
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --7 feet
 Coherence. --Very slightly compact
 Overburden. --1 foot
 Yield after coning. --97.83 percent
 Graphic mean. --0.29 mm medium sand
 Sorting index. --0.48 ϕ well sorted
 Iron expressed as oxide. --0.09 percent



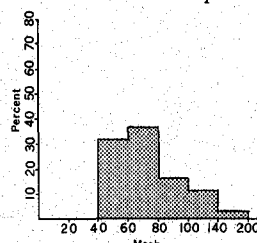
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.22	0.22	0.23	0.23
-20 +40	10.36	10.58	10.84	11.07
-40 +60	49.59	60.17	51.90	62.97
-60 +80	22.61	82.78	23.61	86.58
-80 +100	8.52	91.30	8.90	95.48
-100 +140	3.94	95.24	4.12	99.60
-140 +200	0.35	95.59	0.37	99.97
-200 +pan	4.31	99.90		

Locality number. --Hardin 2
 Mineral Studies Laboratory Number. --64460
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit (dredged)
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --99.33 percent
 Graphic mean. --0.41 mm medium sand
 Sorting index. --0.85 ϕ moderately sorted
 Iron expressed as oxide. --0.08 percent



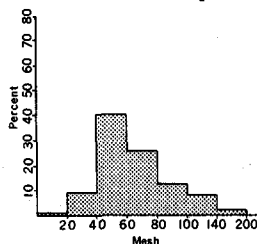
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	6.30	6.30	6.40	6.40
-20 +40	23.18	29.48	23.58	29.98
-40 +60	37.93	67.41	38.57	68.55
-60 +80	20.23	87.64	20.58	89.13
-80 +100	7.78	95.42	7.89	97.02
-100 +140	2.87	98.29	2.90	99.92
-140 +200	0.08	98.37	0.08	100.00
-200 +pan	1.55	99.92		

Locality number. --Hardin 3
 Mineral Studies Laboratory Number. --65052
 Stratigraphic unit. --Lissie Formation
 Type of exposure. --Stream bank
 Thickness of sampled unit. --4 feet
 Coherence. --Slightly compact
 Overburden. --3 feet
 Yield after coning. --97.28 percent
 Graphic mean. --0.23 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.10 percent



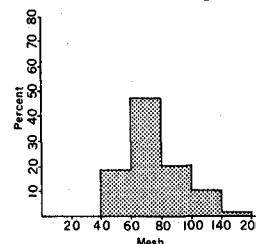
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.22	0.22	0.23	0.23
-40 +60	30.76	30.98	31.90	32.13
-60 +80	35.36	66.34	36.70	68.83
-80 +100	15.50	81.84	16.10	84.93
-100 +140	10.77	92.61	11.19	96.12
-140 +200	3.58	96.19	3.72	99.84
-200 +pan	3.48	99.67		

Locality number. --Harris 1
 Mineral Studies Laboratory Number. --64465
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Sand bank
 Thickness of sampled unit. --10 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --97.89 percent
 Graphic mean. --0.27 mm medium sand
 Sorting index. --0.70 moderately well sorted
 Iron expressed as oxide. --0.08 percent



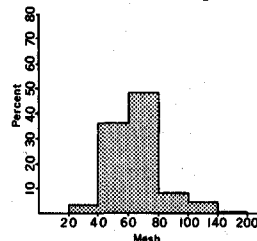
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.89	0.89	0.95	0.95
-20 +40		8.87	9.76	9.44	10.39
-40 +60		37.73	47.49	40.15	50.54
-60 +80		25.33	72.82	26.98	77.52
-80 +100		11.89	84.71	12.65	90.17
-100 +140		7.55	92.26	8.04	98.21
-140 +200		1.69	93.95	1.81	100.02
-200 +pan		6.02	99.97		

Locality number. --Harris 2
 Mineral Studies Laboratory Number. --64466
 Stratigraphic unit. --Montgomery Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --25 feet
 Coherence. --Slightly compact
 Overburden. --2 feet
 Yield after coning. --96.04 percent
 Graphic mean. --0.21 mm fine sand
 Sorting index. --0.46 moderately well sorted
 Iron expressed as oxide. --0.13 percent



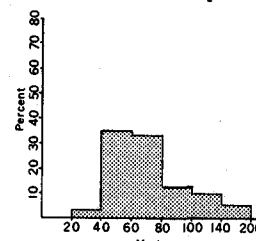
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.03	0.03	0.03	0.03
-40 +60		17.67	17.70	19.25	19.28
-60 +80		44.12	61.82	48.23	67.51
-80 +100		18.87	80.69	20.60	88.11
-100 +140		9.73	90.42	10.60	98.71
-140 +200		1.23	91.65	1.35	100.06
-200 +pan		7.32	98.97		

Locality number. --Harris 3A
 Mineral Studies Laboratory Number. --64005
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --4 feet
 Coherence. --Very slightly compact
 Overburden. --2 feet
 Yield after coning. --98.24 percent
 Graphic mean. --0.26 mm medium sand
 Sorting index. --0.54 moderately well sorted
 Iron expressed as oxide. --0.12 percent



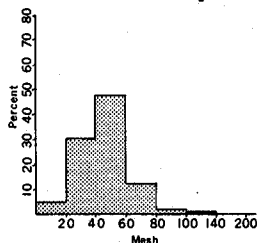
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.08	0.08	0.08	0.08
-20 +40		2.19	2.27	2.23	2.31
-40 +60		36.38	38.65	37.10	39.41
-60 +80		47.62	86.27	48.53	87.94
-80 +100		8.64	94.91	8.81	96.75
-100 +140		2.77	97.68	2.83	99.58
-140 +200		0.38	98.06	0.39	99.97
-200 +pan		1.91	99.87		

Locality number. --Harris 3B
 Mineral Studies Laboratory Number. --65006
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --7 feet
 Coherence. --Very slightly compact
 Overburden. --2 feet
 Yield after coning. --93.73 percent
 Graphic mean. --0.25 mm medium sand
 Sorting index. --0.60 moderately well sorted
 Iron expressed as oxide. --0.13 percent



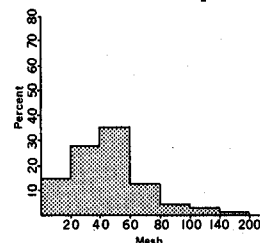
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.05	0.05	0.05	0.05
-20 +40		3.17	3.22	3.52	3.57
-40 +60		31.38	34.60	34.88	38.55
-60 +80		30.39	64.99	33.90	72.45
-80 +100		11.06	76.05	12.31	84.76
-100 +140		8.93	84.98	10.00	94.76
-140 +200		4.85	89.83	5.35	100.11
-200 +pan		10.23	100.06		

Locality number. --Harris 4A
 Mineral Studies Laboratory Number. --64007
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --99.61 percent
 Graphic mean. --0.57 mm coarse sand
 Sorting index. --0.54 moderately well sorted
 Iron expressed as oxide. --0.06 percent



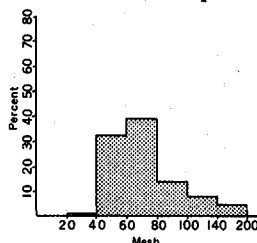
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	5.77	5.77	5.82	5.82	
-20 +40	30.09	35.86	30.17	35.99	
-40 +60	47.48	83.34	47.71	47.71	
-60 +80	12.42	95.76	12.50	96.20	
-80 +100	2.68	98.44	2.71	98.91	
-100 +140	0.88	99.32	0.88	99.79	
-140 +200	0.17	99.49	0.17	99.96	
-200 +pan	0.48	99.97			

Locality number. --Harris 4B
 Mineral Studies Laboratory Number. --64008
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --Unknown
 Yield after coning. --97.67 percent
 Graphic mean. --0.48 mm medium sand
 Sorting index. --1.01 poorly sorted
 Iron expressed as oxide. --0.08 percent



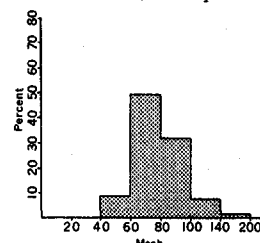
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	14.64	14.64	15.19	15.19	
-20 +40	27.44	42.08	28.54	43.73	
-40 +60	34.51	76.59	35.79	79.52	
-60 +80	11.61	88.20	12.19	91.71	
-80 +100	3.87	92.07	4.03	95.74	
-100 +140	2.87	94.94	2.99	98.73	
-140 +200	1.23	96.17	1.23	99.96	
-200 +pan	3.79	99.91			

Locality number. --Harris 5
 Mineral Studies Laboratory Number. --64009
 Stratigraphic unit. --Beaumont Formation (soil zone)
 Type of exposure. --Auger hole
 Thickness of sampled unit. --4 feet
 Coherence. --Slightly compact
 Overburden. --1 foot (soil)
 Yield after coning. --90.07 percent
 Graphic mean. --0.25 mm medium sand
 Sorting index. --0.57 moderately well sorted
 Iron expressed as oxide. --0.17 percent



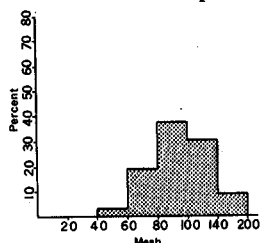
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.08	0.08	0.09	0.09	
-20 +40	1.31	1.39	1.57	1.66	
-40 +60	27.19	28.58	32.40	34.06	
-60 +80	32.89	61.42	39.09	73.15	
-80 +100	11.44	72.86	13.59	86.74	
-100 +140	7.48	80.34	8.90	95.64	
-140 +200	3.69	84.03	4.40	100.04	
-200 +pan	15.94	99.97			

Locality number. --Harris 6A
 Mineral Studies Laboratory Number. --64010
 Stratigraphic unit. --Montgomery Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --18 feet
 Coherence. --Slightly compact
 Overburden. --15 feet
 Yield after coning. --96.51 percent
 Graphic mean. --0.20 mm fine sand
 Sorting index. --0.34 very well sorted
 Iron expressed as oxide. --0.07 percent



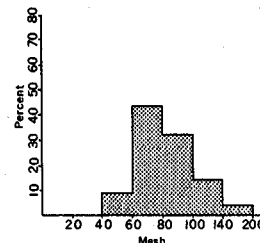
Entire sample			Sand fraction		
U.S. Standard Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.03	0.03	0.03	0.03	
-40 +60	8.15	8.18	8.53	8.56	
-60 +80	47.53	55.71	49.80	58.36	
-80 +100	30.40	86.11	31.87	90.23	
-100 +140	8.03	94.14	8.42	98.65	
-140 +200	1.41	95.55	1.47	100.12	
-200 +pan	4.24	99.79			

Locality number. --Harris 7
 Mineral Studies Laboratory Number. --64012
 Stratigraphic unit. --Montgomery Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --4 feet
 Coherence. --Slightly compact
 Overburden. --7 feet
 Yield after coning. --91.52 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.38 ϕ well sorted
 Iron expressed as oxide. --0.07 percent



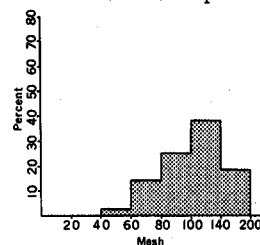
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Weight	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.04	0.04	0.04	0.04
-40 +60	3.09	3.13	3.48	3.52
-60 +80	17.49	20.62	19.70	23.22
-80 +100	32.77	53.39	37.00	60.22
-100 +140	27.11	80.50	30.06	90.28
-140 +200	8.09	88.59	9.11	99.39
-200 +pan	11.01	99.60		

Locality number. --Harris 8
 Mineral Studies Laboratory Number. --64013
 Stratigraphic unit. --Montgomery Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --6 feet
 Coherence. --Slightly compact
 Overburden. --7 feet
 Yield after coning. --96.44 percent
 Graphic mean. --0.20 mm fine sand
 Sorting index. --0.36 ϕ well sorted
 Iron expressed as oxide. --0.08 percent



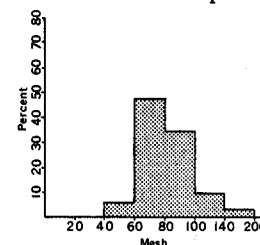
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.15	0.15	0.16	0.16
-40 +60	8.46	8.61	9.00	9.16
-60 +80	40.60	49.21	43.00	52.16
-80 +100	29.25	78.46	31.10	83.26
-100 +140	12.88	91.34	13.64	96.90
-140 +200	2.95	94.29	3.13	100.03
-200 +pan	5.14	99.43		

Locality number. --Harris 9
 Mineral Studies Laboratory Number. --65054
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Excavation
 Thickness of sampled unit. --6 feet
 Coherence. --Very slightly compact
 Overburden. --3 feet
 Yield after coning. --88.20 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.22 ϕ very well sorted
 Iron expressed as oxide. --0.08 percent



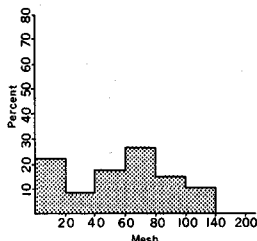
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.03	0.03	0.04	0.04
-40 +60	2.12	2.15	2.56	2.60
-60 +80	12.05	14.20	14.51	17.11
-80 +100	20.20	34.40	24.40	41.51
-100 +140	31.95	66.35	38.60	80.11
-140 +200	16.38	82.73	19.75	99.86
-200 +pan	17.53	100.26		

Locality number. --Harris 10
 Mineral Studies Laboratory Number. --64011
 Stratigraphic unit. --Lissie Formation
 Type of exposure. --Stream bank
 Thickness of sampled unit. --6 feet
 Coherence. --Slightly compact
 Overburden. --None
 Yield after coning. --95.45 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.33 ϕ very well sorted
 Iron expressed as oxide. --0.07 percent



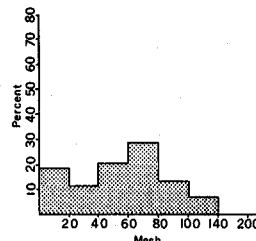
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	5.28	5.29	5.75	5.76
-60 +80	43.54	48.83	47.41	53.17
-80 +100	31.03	79.86	34.00	87.17
-100 +140	8.83	88.69	9.60	96.77
-140 +200	3.35	92.04	3.65	100.42
-200 +pan	7.66	99.70		

Locality number. --Hidalgo 1
 Mineral Studies Laboratory Number. --64540
 Stratigraphic unit. --Lissie Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --5 feet
 Yield after coning. --98.59 percent
 Graphic mean. --0.51 mm coarse sand
 Sorting index. --1.350 poorly sorted
 Iron expressed as oxide. --*



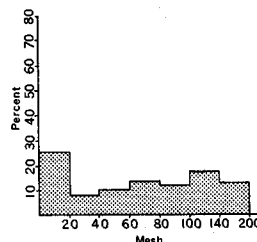
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	19.74	19.74	21.36	21.36	
-20 +40	7.94	27.68	8.57	29.93	
-40 +60	15.81	43.49	17.12	47.05	
-60 +80	24.80	68.29	26.84	73.89	
-80 +100	14.24	82.53	15.40	89.29	
-100 +140	9.77	92.30	10.57	99.86	
-140 +200	0.10	92.40	0.11	99.97	
-200 +pan	7.54	99.94			

Locality number. --Hidalgo 2
 Mineral Studies Laboratory Number. --64541
 Stratigraphic unit. --Lissie Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --5 feet
 Yield after coning. --98.58 percent
 Graphic mean. --0.53 mm coarse sand
 Sorting index. --1.200 poorly sorted
 Iron expressed as oxide. --*



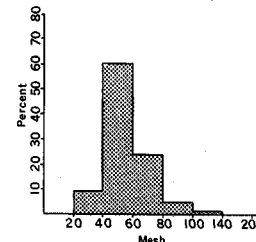
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	18.50	18.50	19.34	19.34	
-20 +40	10.96	29.46	11.81	31.15	
-40 +60	19.18	48.64	20.08	51.23	
-60 +80	27.06	75.70	28.32	79.55	
-80 +100	13.15	88.85	13.77	92.32	
-100 +140	6.77	95.62	7.09	99.41	
-140 +200	0.18	95.80	0.19	99.60	
-200 +pan	4.44	100.24			

Locality number. --Hidalgo 3
 Mineral Studies Laboratory Number. --64542
 Stratigraphic unit. --Lissie Formation
 Type of exposure. --Road cut
 Thickness of sampled unit. --5 feet
 Coherence. --Compact
 Overburden. --None
 Yield after coning. --90.22 percent
 Graphic mean. --0.54 mm coarse sand
 Sorting index. --4.660 extremely poorly sorted
 Iron expressed as oxide. --*



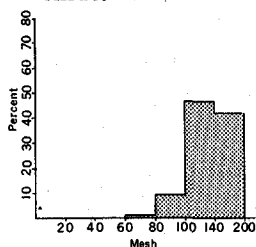
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	18.26	18.26	25.84	25.84	
-20 +40	5.79	24.05	8.19	34.03	
-40 +60	7.32	31.37	10.35	44.38	
-60 +80	9.21	40.58	13.02	57.40	
-80 +100	8.74	49.32	12.40	69.80	
-100 +140	12.48	61.80	17.64	87.44	
-140 +200	8.86	70.66	12.52	99.96	
-200 +pan	29.31	99.97			

Locality number. --Jackson 1
 Mineral Studies Laboratory Number. --64496
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Sand bar
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --89.22 percent
 Graphic mean. --0.31 mm medium sand
 Sorting index. --0.540 moderately well sorted
 Iron expressed as oxide. --0.10 percent



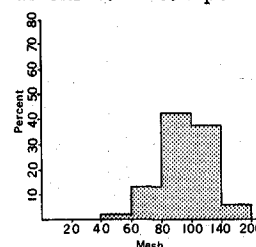
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.06	0.06	0.07	0.07	
-20 +40	8.76	8.82	9.86	9.93	
-40 +60	53.78	62.60	60.40	70.33	
-60 +80	20.92	83.52	23.60	93.93	
-80 +100	4.22	87.74	4.68	98.61	
-100 +140	1.26	89.00	1.42	100.03	
-140 +200	0.04	89.04	0.05	100.08	
-200 +pan	0.30	89.34			

Locality number. --Jefferson 1
 Mineral Studies Laboratory Number. --64464
 Stratigraphic unit. --Recent
 Type of exposure. --Beach sand (auger hole)
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --98.93 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.320 very well sorted
 Iron expressed as oxide. --*



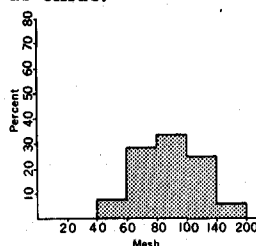
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.18	0.23	0.19	0.24
-20 +40	0.35	0.58	0.37	0.61
-40 +60	0.30	0.88	0.32	0.93
-60 +80	1.66	2.54	1.74	2.67
-80 +100	8.60	11.14	9.03	11.70
-100 +140	44.61	55.75	46.80	58.50
-140 +200	39.50	95.25	41.50	100.00
-200 +pan	4.66	99.91		

Locality number. --Jefferson 2
 Mineral Studies Laboratory Number. --65055
 Stratigraphic unit. --Recent
 Type of exposure. --Pit
 Thickness of sampled unit. --5 feet
 Coherence. --Very slightly compact
 Overburden. --2 feet
 Yield after coning. --96.53 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.620 moderately well sorted
 Iron expressed as oxide. -->0.2 percent



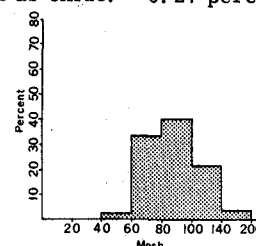
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	1.64	1.66	1.72	1.74
-60 +80	12.08	13.74	12.65	14.39
-80 +100	40.82	54.56	42.31	56.70
-100 +140	35.55	90.11	37.19	93.89
-140 +200	5.45	95.56	5.70	99.59
-200 +pan	4.23	99.79		

Locality number. --Kenedy 1
 Mineral Studies Laboratory Number. --64537
 Stratigraphic unit. --Recent
 Type of exposure. --Road cut through stabilized sand dune
 Thickness of sampled unit. --3-1/2 feet
 Coherence. --Very slightly compact
 Overburden. --None
 Yield after coning. --98.70 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.490 well sorted
 Iron expressed as oxide. --*



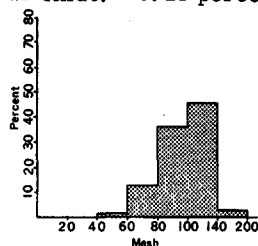
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.05	0.05	0.05	0.05
-40 +60	6.88	6.93	7.18	7.23
-60 +80	26.87	33.80	28.10	35.33
-80 +100	31.69	65.49	33.00	68.33
-100 +140	24.50	89.99	25.60	93.93
-140 +200	5.91	95.90	6.17	100.10
-200 +pan	3.89	99.79		

Locality number. --Kenedy 2
 Mineral Studies Laboratory Number. --64538
 Stratigraphic unit. --Recent
 Type of exposure. --Road cut through stabilized sand dune
 Thickness of sampled unit. --9 feet
 Coherence. --Very slightly compact
 Overburden. --None
 Yield after coning. --99.06 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.320 very well sorted
 Iron expressed as oxide. --0.27 percent



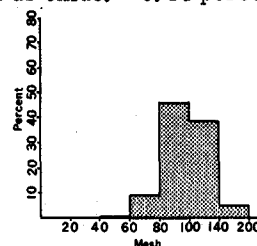
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.03	0.03	0.03	0.03
-20 +40	0.02	0.05	0.02	0.05
-40 +60	2.84	2.89	2.89	2.94
-60 +80	31.68	34.57	32.30	35.24
-80 +100	39.37	73.94	40.15	75.39
-100 +140	20.71	94.65	21.10	96.49
-140 +200	3.45	98.10	3.51	100.00
-200 +pan	1.79	99.89		

Locality number. --Kenedy 3
 Mineral Studies Laboratory Number. --64539
 Stratigraphic unit. --Recent
 Type of exposure. --Road cut through stabilized sand dune
 Thickness of sampled unit. --13 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.56 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.21 percent



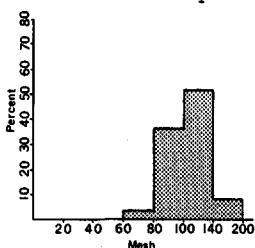
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.03	0.03	0.03	0.03
-20 +40	0.02	0.05	0.02	0.05
-40 +60	1.56	1.61	1.65	1.70
-60 +80	12.56	14.17	13.33	15.03
-80 +100	34.72	48.89	36.80	51.83
-100 +140	42.44	91.33	45.00	96.83
-140 +200	2.81	94.14	2.98	99.81
-200 +pan	5.94	100.08		

Locality number. --Kleberg 1A
 Mineral Studies Laboratory Number. --64561
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.77 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.14 percent



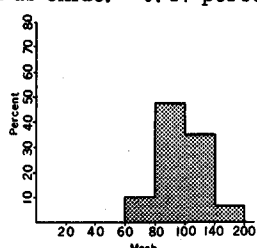
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.04	0.04	0.04	0.04
-40 +60	0.26	0.30	0.28	0.32
-60 +80	9.15	9.45	9.35	9.67
-80 +100	46.73	56.18	46.80	56.47
-100 +140	37.26	93.44	38.10	94.57
-140 +200	4.42	97.86	4.51	99.08
-200 +pan	1.54	99.40		

Locality number. --Kleberg 1B
 Mineral Studies Laboratory Number. --64562
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --15 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.87 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.26 ϕ very well sorted
 Iron expressed as oxide. --0.15 percent



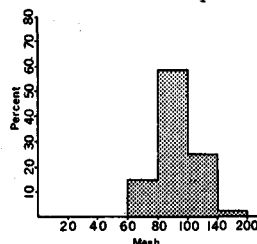
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.03	0.03	0.03	0.03
-40 +60	0.03	0.06	0.03	0.06
-60 +80	3.70	3.76	3.75	3.81
-80 +100	36.95	40.71	37.40	41.21
-100 +140	50.69	91.40	51.40	92.61
-140 +200	7.45	98.85	7.53	100.14
-200 +pan	0.84	99.69		

Locality number. --Kleberg 1C
 Mineral Studies Laboratory Number. --64563
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.21 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --0.17 percent



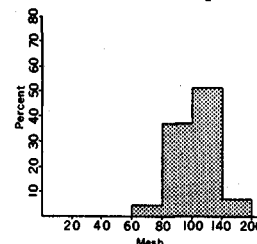
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.18	0.20	0.18	0.20
-60 +80	10.05	10.25	10.07	10.27
-80 +100	46.99	57.24	47.90	58.17
-100 +140	34.31	91.55	35.10	93.27
-140 +200	6.52	98.07	6.65	99.92
-200 +pan	1.26	99.33		

Locality number. --Kleberg 2A
 Mineral Studies Laboratory Number. --64564
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.89 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --0.10 percent



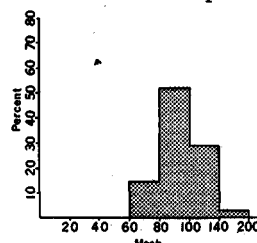
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.13	0.14	0.13	0.14
-60 +80	13.93	14.07	14.00	14.14
-80 +100	57.94	72.01	58.10	72.24
-100 +140	25.25	97.26	25.40	97.64
-140 +200	2.26	99.52	2.27	99.91
-200 +pan	0.30	99.82		

Locality number. --Kleberg 2B
 Mineral Studies Laboratory Number. --64565
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --20 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.96 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.26 ϕ very well sorted
 Iron expressed as oxide. --0.15 percent



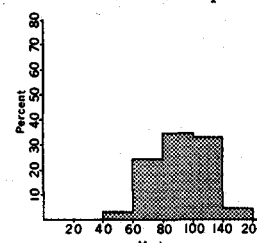
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.03	0.04	0.03	0.04
-60 +80	4.70	4.74	4.84	4.88
-80 +100	36.27	41.01	37.30	42.18
-100 +140	49.78	90.79	51.10	93.28
-140 +200	6.56	97.35	6.75	100.03
-200 +pan	2.82	100.17		

Locality number. --Kleberg 2C
 Mineral Studies Laboratory Number. --64566
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.85 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.10 percent



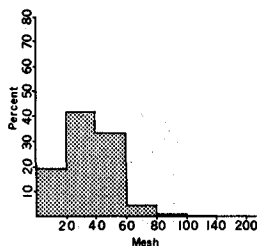
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.19	0.20	0.19	0.20
-60 +80	13.89	14.09	14.10	14.30
-80 +100	51.33	65.42	52.00	66.30
-100 +140	29.55	94.97	29.99	96.29
-140 +200	3.62	98.59	3.68	99.97
-200 +pan	1.02	99.61		

Locality number. --Kleberg 3
 Mineral Studies Laboratory Number. --64610
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Sand dune
 Thickness of sampled unit. --25 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --97.10 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.37 ϕ very well sorted
 Iron expressed as oxide. --0.14 percent



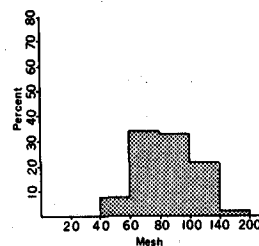
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	3.06	3.07	3.17	3.18
-60 +80	23.19	26.26	24.00	27.18
-80 +100	33.37	59.63	34.50	61.68
-100 +140	32.76	92.39	33.90	95.58
-140 +200	4.25	96.64	4.40	99.98
-200 +pan	3.25	99.89		

Locality number. --Liberty 1
 Mineral Studies Laboratory Number. --64461
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.68 percent
 Graphic mean. --0.68 mm coarse sand
 Sorting index. --0.84 ϕ moderately sorted
 Iron expressed as oxide. --*



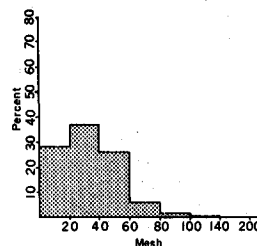
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	18.88	18.88	19.01	19.01
-20 +40	41.10	59.98	41.43	60.44
-40 +60	33.34	93.32	33.65	94.09
-60 +80	4.49	97.81	4.49	98.58
-80 +100	0.80	98.61	0.85	99.43
-100 +140	0.47	99.08	0.48	99.91
-140 +200	0.06	99.14	0.06	99.97
-200 +pan	0.82	99.96		

Locality number. --Liberty 2
 Mineral Studies Laboratory Number. --64462
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --River bank
 Thickness of sampled unit. --10 feet
 Coherence. --Very slightly compact
 Overburden. --None
 Yield after coning. --92.15 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.36 ϕ well sorted
 Iron expressed as oxide. --*



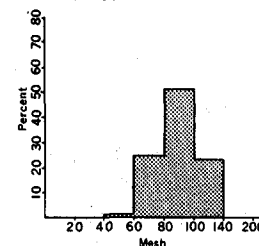
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.17	0.17	0.20	0.20
-40 +60	7.68	7.85	8.90	9.10
-60 +80	28.85	36.70	33.70	42.80
-80 +100	28.20	64.90	33.00	75.80
-100 +140	18.59	83.49	21.75	97.55
-140 +200	2.11	85.60	2.47	100.02
-200 +pan	14.36	99.96		

Locality number. --Liberty 3
 Mineral Studies Laboratory Number. --64463
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Dredge pit
 Thickness of sampled unit. --Unknown
 Coherence. --Unknown
 Overburden. --6-12 feet
 Yield after coning. --99.68 percent
 Graphic mean. --0.73 mm coarse sand
 Sorting index. --0.97 ϕ moderately sorted
 Iron expressed as oxide. --0.10 percent



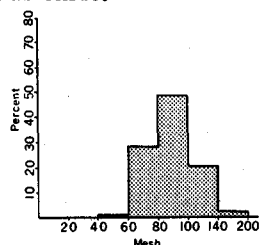
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	27.93	27.93	28.06	28.06
-20 +40	36.57	64.50	36.79	64.85
-40 +60	25.99	90.49	26.12	90.97
-60 +80	6.63	97.12	6.67	97.64
-80 +100	1.75	98.87	1.76	99.40
-100 +140	0.51	99.38	0.51	99.91
-140 +200	0.05	99.43	0.05	99.96
-200 +pan	0.53	99.96		

Locality number. --Matagorda 1
 Mineral Studies Laboratory Number. --64497
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --89.84 percent
 Graphic mean. --0.16 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --*



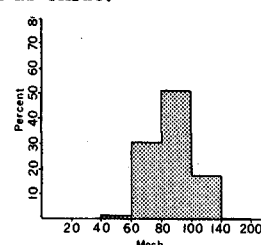
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.04	0.04	0.05	0.05
-40 +60	1.04	1.08	1.20	1.25
-60 +80	21.61	22.69	24.40	25.65
-80 +100	44.36	67.05	51.10	76.75
-100 +140	19.56	86.61	23.44	100.19
-140 +200	0.08	86.69	0.09	100.28
-200 +pan	2.65	89.34		

Locality number. --Matagorda 2A
 Mineral Studies Laboratory Number. --64499
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --6 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.63 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --*



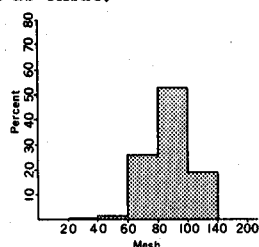
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.11	0.11	0.11	0.11
-40 +60	1.65	1.76	1.70	1.81
-60 +80	28.14	29.90	28.65	30.46
-80 +100	47.12	77.02	48.00	78.46
-100 +140	20.04	97.06	20.43	98.89
-140 +200	1.10	98.16	1.12	100.01
-200 +pan	1.44	99.60		

Locality number. --Matagorda 2B
 Mineral Studies Laboratory Number. --64498
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --89.83 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --*



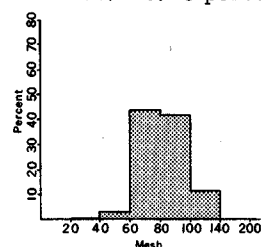
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.03	0.03	0.03	0.03
-40 +60	0.94	0.97	1.05	1.08
-60 +80	26.78	27.75	30.50	31.58
-80 +100	44.17	71.92	50.50	82.08
-100 +140	15.52	87.44	17.50	99.58
-140 +200	0.44	87.88	0.49	100.07
-200 +pan	1.94	89.82		

Locality number. --Matagorda 3A
 Mineral Studies Laboratory Number. --64500
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.78 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --*



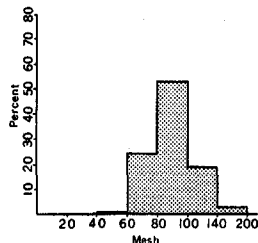
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.42	0.42	0.43	0.43
-40 +60	1.18	1.60	1.21	1.64
-60 +80	25.49	27.09	26.23	27.87
-80 +100	51.16	78.25	52.70	80.57
-100 +140	18.89	97.14	19.35	99.92
-140 +200	0.09	97.23	0.09	100.01
-200 +pan	2.57	99.80		

Locality number. --Matagorda 3B
 Mineral Studies Laboratory Number. --64501
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --6 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.72 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --0.18 percent



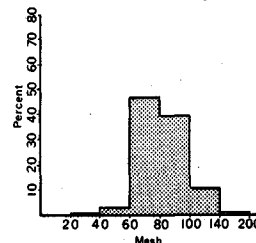
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.24	0.24	0.25	0.25
-40 +60	2.66	2.90	2.72	2.97
-60 +80	42.40	45.30	43.35	46.32
-80 +100	41.00	86.30	41.90	88.22
-100 +140	11.47	97.77	11.72	99.94
-140 +200	0.09	97.86	0.09	100.03
-200 +pan	1.84	99.70		

Locality number. --Matagorda 3C
 Mineral Studies Laboratory Number. --64502
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.59 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --*



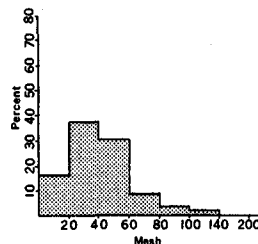
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.04	0.04	0.04	0.04	
-40 +60	1.20	1.24	1.22	1.26	
-60 +80	23.94	25.18	24.40	25.66	
-80 +100	51.12	76.30	52.10	77.76	
-100 +140	18.97	95.27	19.33	97.09	
-140 +200	2.85	98.12	2.91	100.00	
-200 +pan	1.54	99.66			

Locality number. --Matagorda 4
 Mineral Studies Laboratory Number. --64503
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.80 percent
 Graphic mean. --0.18 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.18 percent



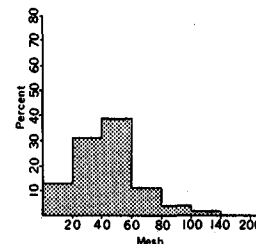
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.13	0.13	0.13	0.13	
-40 +60	3.25	3.38	3.27	3.40	
-60 +80	46.13	49.51	46.50	49.90	
-80 +100	38.87	88.38	39.10	89.00	
-100 +140	10.22	98.60	10.29	99.29	
-140 +200	0.80	99.42	0.80	100.09	
-200 +pan	0.42	99.82			

Locality number. --Nueces 1
 Mineral Studies Laboratory Number. --64544
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --20 feet
 Coherence. --Unknown
 Overburden. --10-25 feet
 Yield after coning. --99.29 percent
 Graphic mean. --0.54 mm coarse sand
 Sorting index. --1.04 ϕ poorly sorted
 Iron expressed as oxide. --*



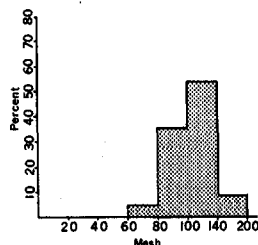
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	16.37	16.37	16.60	16.60	
-20 +40	37.19	53.56	37.74	54.34	
-40 +60	30.81	84.37	31.27	85.61	
-60 +80	8.68	93.05	8.82	94.43	
-80 +100	3.31	96.36	3.36	97.79	
-100 +140	2.13	98.49	2.16	99.95	
-140 +200	0.01	98.50	0.01	99.96	
-200 +pan	1.47	99.97			

Locality number. --Nueces 2
 Mineral Studies Laboratory Number. --64545
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --20 feet
 Coherence. --Unknown
 Overburden. --10-25 feet
 Yield after coning. --99.48 percent
 Graphic mean. --0.47 mm medium sand
 Sorting index. --0.94 ϕ moderately sorted
 Iron expressed as oxide. --*



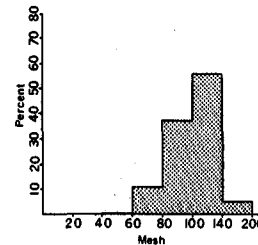
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	12.23	12.23	12.35	12.35	
-20 +40	30.80	43.03	31.18	43.53	
-40 +60	38.15	81.18	38.55	82.08	
-60 +80	10.81	91.99	10.91	92.99	
-80 +100	4.00	95.99	4.04	97.03	
-100 +140	2.47	98.46	2.49	99.52	
-140 +200	0.43	98.89	0.44	99.96	
-200 +pan	1.08	99.97			

Locality number. --Nueces 3
 Mineral Studies Laboratory Number. --64546
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --14 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.66 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --*



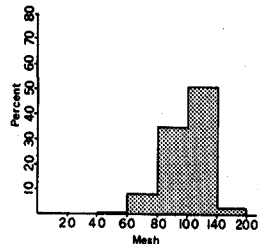
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.07	0.07	0.07	0.07
-40 +60	0.08	0.15	0.08	0.15
-60 +80	4.21	4.36	4.40	4.55
-80 +100	33.70	38.06	35.20	39.75
-100 +140	50.78	88.84	53.10	92.85
-140 +200	7.77	96.61	8.13	100.98
-200 +pan	3.03	99.64		

Locality number. --Nueces 4A
 Mineral Studies Laboratory Number. --64547
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.78 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --*



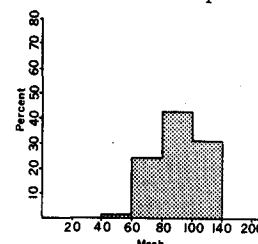
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.05	0.05	0.05	0.05
-40 +60	0.45	0.50	0.47	0.52
-60 +80	10.21	10.71	10.78	11.30
-80 +100	35.92	46.63	37.90	49.20
-100 +140	43.26	89.89	45.70	94.90
-140 +200	4.84	94.73	5.11	100.01
-200 +pan	4.66	99.39		

Locality number. --Nueces 4B
 Mineral Studies Laboratory Number. --64548
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --15 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.91 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.32 ϕ very well sorted
 Iron expressed as oxide. --*



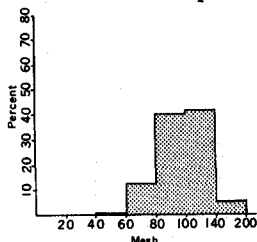
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.29	0.31	0.37	0.39
-60 +80	8.40	8.71	8.90	9.29
-80 +100	33.93	42.64	35.90	45.19
-100 +140	48.18	90.82	51.00	96.19
-140 +200	3.71	94.53	3.92	100.11
-200 +pan	5.40	99.93		

Locality number. --Nueces 4C
 Mineral Studies Laboratory Number. --64549
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --2 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.82 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.34 ϕ very well sorted
 Iron expressed as oxide. --0.18 percent



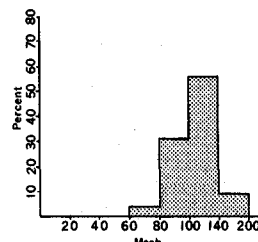
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.03	0.03	0.03	0.03
-40 +60	1.79	1.82	1.89	1.92
-60 +80	23.16	24.98	24.40	26.32
-80 +100	39.82	64.80	42.20	68.52
-100 +140	29.73	94.53	31.40	99.92
-140 +200	0.06	94.59	0.06	99.98
-200 +pan	5.14	99.73		

Locality number. --Nueces 5A
 Mineral Studies Laboratory Number. --64550
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.77 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --0.20 percent



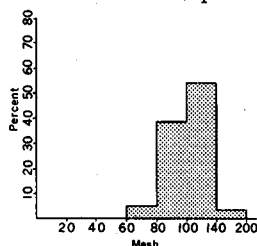
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.03	0.03	0.03	0.03
-40 +60		0.81	0.84	0.82	0.85
-60 +80		11.91	12.75	12.25	13.10
-80 +100		39.15	51.90	40.20	53.30
-100 +140		40.11	92.01	41.30	94.60
-140 +200		5.37	97.38	5.53	100.13
-200 +pan		2.27	99.65		

Locality number. --Nueces 5B
 Mineral Studies Laboratory Number. --64551
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --25 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.79 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.28 ϕ very well sorted
 Iron expressed as oxide. --*



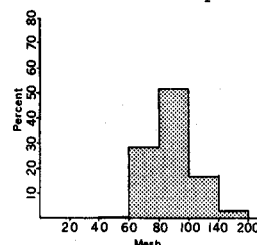
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.01	0.01	0.01	0.01
-40 +60		0.04	0.05	0.04	0.05
-60 +80		3.48	3.53	3.60	3.65
-80 +100		30.57	34.10	31.49	35.14
-100 +140		53.86	87.96	55.50	90.64
-140 +200		9.08	97.04	9.37	100.01
-200 +pan		2.15	99.19		

Locality number. --Nueces 5C
 Mineral Studies Laboratory Number. --64552
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --5 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.92 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.29 ϕ very well sorted
 Iron expressed as oxide. --0.19 percent



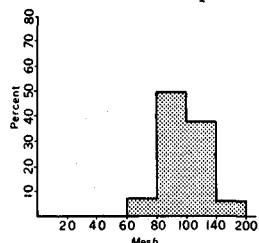
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.01	0.01	0.01	0.01
-40 +60		0.03	0.04	0.03	0.04
-60 +80		3.24	3.28	3.36	3.40
-80 +100		37.10	40.38	38.10	41.50
-100 +140		52.90	93.28	54.70	96.20
-140 +200		3.22	96.50	3.34	99.54
-200 +pan		3.36	99.86		

Locality number. --Nueces 6A
 Mineral Studies Laboratory Number. --64553
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --4 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.83 percent
 Graphic mean. --0.17 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.12 percent



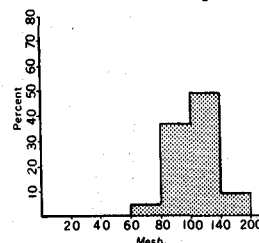
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20		0.00	0.00	0.00	0.00
-20 +40		0.01	0.01	0.01	0.01
-40 +60		0.42	0.43	0.42	0.43
-60 +80		28.58	29.01	28.79	29.22
-80 +100		50.80	79.81	51.30	80.52
-100 +140		17.57	97.38	17.70	98.22
-140 +200		2.00	99.38	2.02	100.24
-200 +pan		0.28	99.66		

Locality number. --Nueces 6B
 Mineral Studies Laboratory Number. --64554
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --17 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.80 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.300 very well sorted
 Iron expressed as oxide. --0.15 percent



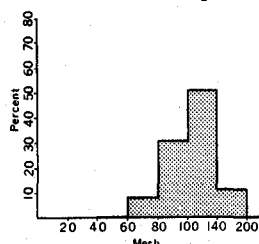
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.02	0.02	0.02	0.02
-40 +60	0.04	0.06	0.04	0.06
-60 +80	6.80	6.86	6.80	6.86
-80 +100	49.26	56.12	49.26	56.12
-100 +140	37.97	94.09	37.96	94.08
-140 +200	6.00	100.09	6.00	100.08
-200 +pan	0.38	100.47		

Locality number. --Nueces 6C
 Mineral Studies Laboratory Number. --64555
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --4 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.72 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.270 very well sorted
 Iron expressed as oxide. --0.15 percent



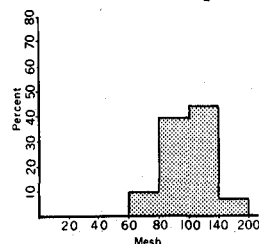
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.02	0.02	0.02	0.02
-20 +40	0.02	0.04	0.02	0.04
-40 +60	0.15	0.19	0.15	0.19
-60 +80	5.73	5.92	5.77	5.96
-80 +100	35.33	41.25	35.60	41.56
-100 +140	47.87	89.12	48.30	89.86
-140 +200	9.80	98.92	9.90	99.76
-200 +pan	1.00	99.92		

Locality number. --Nueces 7A
 Mineral Studies Laboratory Number. --64556
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.70 percent
 Graphic mean. --0.14 mm fine sand
 Sorting index. --0.300 very well sorted
 Iron expressed as oxide. --0.20 percent



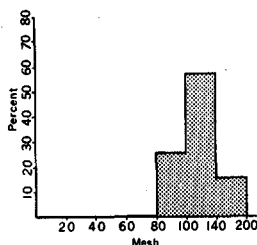
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.01	0.01	0.01	0.01
-20 +40	0.03	0.04	0.03	0.04
-40 +60	0.34	0.38	0.35	0.39
-60 +80	7.25	7.63	7.38	7.77
-80 +100	29.77	37.40	30.30	38.07
-100 +140	49.36	86.76	50.20	88.27
-140 +200	11.50	98.26	11.71	99.98
-200 +pan	1.72	99.98		

Locality number. --Nueces 7B
 Mineral Studies Laboratory Number. --64557
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --12 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.75 percent
 Graphic mean. --0.15 mm fine sand
 Sorting index. --0.320 very well sorted
 Iron expressed as oxide. --0.16 percent



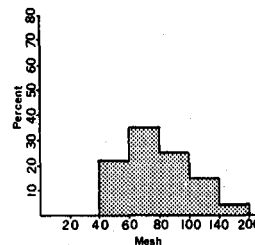
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	0.00	0.00	0.00	0.00
-20 +40	0.01	0.01	0.01	0.01
-40 +60	0.15	0.16	0.15	0.16
-60 +80	9.03	9.19	9.25	9.41
-80 +100	38.45	47.64	39.60	49.01
-100 +140	42.44	90.08	43.40	92.41
-140 +200	7.51	97.59	7.69	100.10
-200 +pan	2.10	99.69		

Locality number. --Nueces 7C
 Mineral Studies Laboratory Number. --64558
 Stratigraphic unit. --Recent
 Type of exposure. --Sand dune
 Thickness of sampled unit. --3 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --99.57 percent
 Graphic mean. --0.13 mm fine sand
 Sorting index. --0.27 ϕ very well sorted
 Iron expressed as oxide. --*



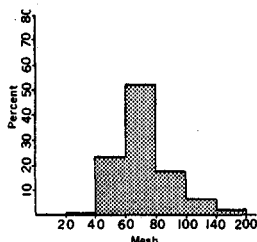
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.00	0.00	0.00	0.00	
-20 +40	0.03	0.03	0.03	0.03	
-40 +60	0.19	0.22	0.20	0.23	
-60 +80	0.67	0.89	0.72	0.95	
-80 +100	24.21	25.10	26.00	26.95	
-100 +140	54.11	79.21	58.00	84.95	
-140 +200	14.09	93.30	15.10	100.05	
-200 +pan	1.92	95.22			

Locality number. --Orange 1
 Mineral Studies Laboratory Number. --65051
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --8 feet
 Coherence. --Very slightly compact
 Overburden. --6 feet
 Yield after coning. --97.80 percent
 Graphic mean. --0.19 mm fine sand
 Sorting index. --0.30 ϕ very well sorted
 Iron expressed as oxide. --0.07 percent



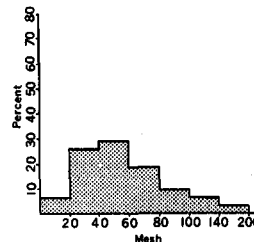
		Entire sample		Sand fraction	
U. S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.01	0.01	0.02	0.02	
-20 +40	0.17	0.18	0.18	0.20	
-40 +60	20.86	21.04	21.80	22.00	
-60 +80	33.28	54.32	34.80	56.80	
-80 +100	23.36	77.68	24.40	81.20	
-100 +140	13.60	91.28	14.20	95.40	
-140 +200	4.50	95.78	4.69	100.09	
-200 +pan	3.56	99.34			

Locality number. --Orange 2
 Mineral Studies Laboratory Number. --65053
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --4 feet
 Coherence. --Very slightly compact
 Overburden. --2 feet
 Yield after coning. --98.42 percent
 Graphic mean. --0.22 mm fine sand
 Sorting index. --0.24 ϕ very well sorted
 Iron expressed as oxide. --0.07 percent



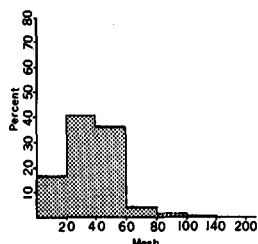
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	0.04	0.04	0.04	0.04	
-20 +40	0.99	1.03	1.01	1.05	
-40 +60	22.77	23.80	23.22	24.27	
-60 +80	49.69	73.49	51.00	75.27	
-80 +100	16.67	90.16	17.04	92.31	
-100 +140	5.83	95.99	5.69	98.00	
-140 +200	1.67	97.66	1.71	99.71	
-200 +pan	2.18	99.84			

Locality number. --Refugio 1
 Mineral Studies Laboratory Number. --64536
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Road cut
 Thickness of sampled unit. --7 feet
 Coherence. --Loose
 Overburden. --None
 Yield after coning. --98.92 percent
 Graphic mean. --0.40 mm medium sand
 Sorting index. --0.86 ϕ moderately sorted
 Iron expressed as oxide. --0.09 percent



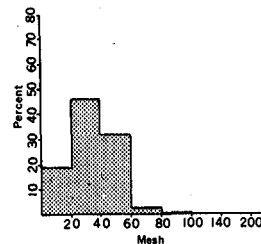
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-10 +20	6.55	6.55	6.75	6.75	
-20 +40	24.60	31.15	25.35	32.10	
-40 +60	28.72	59.87	29.90	62.00	
-60 +80	18.68	78.55	19.24	81.24	
-80 +100	9.68	88.23	9.90	91.14	
-100 +140	6.63	94.86	6.84	97.98	
-140 +200	2.12	96.98	2.19	100.17	
-200 +pan	3.08	100.06			

Locality number. --San Patricio 1
 Mineral Studies Laboratory Number. --64559
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --20 feet
 Coherence. --Unknown
 Overburden. --10-25 feet
 Yield after coning. --99.74 percent
 Graphic mean. --0.56 mm coarse sand
 Sorting index. --0.84 ϕ moderately sorted
 Iron expressed as oxide. --*



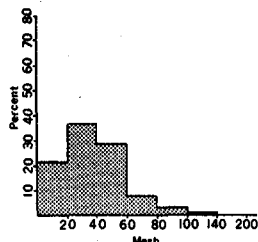
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	16.47	16.47	16.46	16.46
-20 +40	40.70	57.17	40.69	57.15
-40 +60	36.91	94.08	36.91	94.06
-60 +80	4.03	98.11	4.02	98.08
-80 +100	0.95	99.06	0.96	99.04
-100 +140	0.49	99.55	0.49	99.53
-140 +200	0.10	99.65	0.10	99.63
-200 +pan	0.31	99.96		

Locality number. --San Patricio 2
 Mineral Studies Laboratory Number. --64560
 Stratigraphic unit. --Beaumont Formation
 Type of exposure. --Pit
 Thickness of sampled unit. --20 feet
 Coherence. --Unknown
 Overburden. --10-20 feet
 Yield after coning. --99.27 percent
 Graphic mean. --0.65 mm coarse sand
 Sorting index. --0.79 ϕ moderately sorted
 Iron expressed as oxide. --*



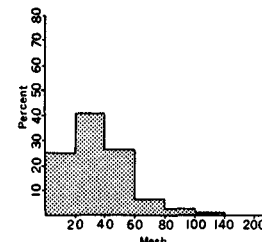
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	19.55	19.55	19.72	19.72
-20 +40	44.62	64.17	45.00	64.72
-40 +60	31.37	95.54	31.61	96.33
-60 +80	2.62	98.16	2.64	98.97
-80 +100	0.55	98.71	0.60	99.57
-100 +140	0.34	99.05	0.34	99.91
-140 +200	0.07	99.12	0.07	99.98
-200 +pan	0.84	99.96		

Locality number. --Victoria 1
 Mineral Studies Laboratory Number. --64515
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --15-20 feet
 Coherence. --Unknown
 Overburden. --15-20 feet
 Yield after coning. --98.88 percent
 Graphic mean. --0.63 mm coarse sand
 Sorting index. --0.94 ϕ moderately sorted
 Iron expressed as oxide. --*



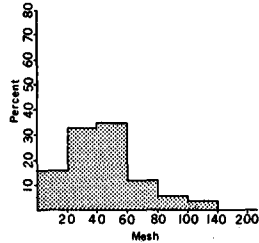
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	20.81	20.81	21.03	21.03
-20 +40	35.48	56.29	35.72	56.75
-40 +60	29.35	85.64	29.54	86.29
-60 +80	8.85	94.49	8.95	95.24
-80 +100	2.96	97.45	2.99	98.23
-100 +140	1.54	98.99	1.54	99.77
-140 +200	0.18	99.17	0.18	99.85
-200 +pan	0.79	99.96		

Locality number. --Victoria 2
 Mineral Studies Laboratory Number. --64516
 Stratigraphic unit. --Recent alluvium
 Type of exposure. --Pit
 Thickness of sampled unit. --15-20 feet
 Coherence. --Unknown
 Overburden. --10-15 feet
 Yield after coning. --98.88 percent
 Graphic mean. --0.70 mm coarse sand
 Sorting index. --0.78 ϕ moderately sorted
 Iron expressed as oxide. --*



U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	23.97	23.97	24.38	24.38
-20 +40	39.13	63.10	40.06	64.44
-40 +60	25.23	88.33	25.92	90.36
-60 +80	6.28	94.61	6.37	96.73
-80 +100	1.92	96.53	1.94	98.67
-100 +140	1.06	97.59	1.07	99.74
-140 +200	0.22	97.81	0.23	99.97
-200 +pan	2.16	99.97		

Locality number, --Victoria 3
 Mineral Studies Laboratory Number, --64517
 Stratigraphic unit, --Recent alluvium
 Type of exposure, --Pit
 Thickness of sampled unit, --18 feet
 Coherence, --Unknown
 Overburden, --12 feet
 Yield after coning, --99.05 percent
 Graphic mean, --0.49 mm medium sand
 Sorting index, --0.96 moderately sorted
 Iron expressed as oxide, --*



U. S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-10 +20	14.76	14.76	15.03	15.03
-20 +40	31.68	46.44	32.24	47.27
-40 +60	33.47	79.91	34.15	81.42
-60 +80	11.61	91.52	11.81	93.23
-80 +100	4.21	95.73	4.29	97.52
-100 +140	2.16	97.89	2.20	99.72
-140 +200	0.24	98.13	0.24	99.96
-200 +pan	1.84	99.97		

APPENDIX D — SUPPLEMENTARY DATA

Samples for the following analyses were collected by M. O. Hayes as a part of his Ph. D. dissertation, "Sedimentation on a Semiarid Wave-Dominated Coast (South Texas); With Emphasis on Hurricane Effects." Hayes' original grain size

analyses have been revised for inclusion in this report. No iron analyses were performed on these samples. Their locations are shown in figure 12.

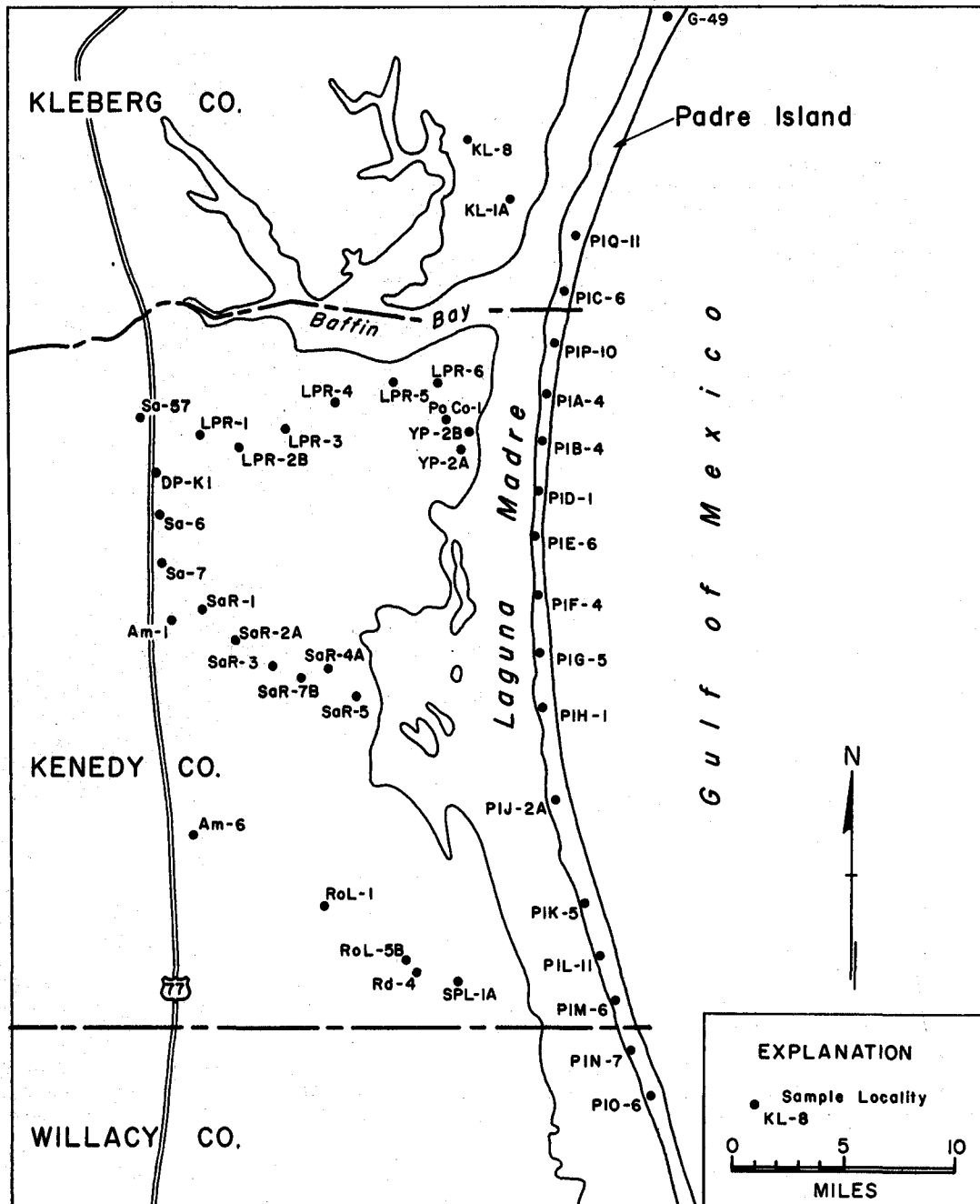


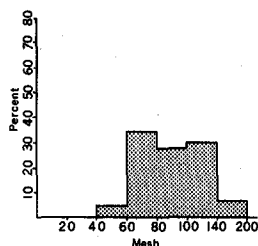
Fig. 12. Locality map for samples contributed by M. O. Hayes.

Sample number. --Am-1

Yield after coning. --95.91 percent

Graphic mean. --0.15 mm

Sorting index. --0.570



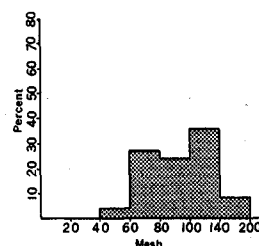
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		3.62	3.62	3.93	3.93
-60 +80		31.62	35.24	34.34	38.27
-80 +100		24.68	59.92	26.81	65.08
-100 +140		27.66	87.58	30.05	95.13
-140 +200		4.48	92.06	4.87	100.00
-200 +pan		7.09	99.15		

Sample number. --Am-6

Yield after coning. --98.31 percent

Graphic mean. --0.14 mm

Sorting index. --0.490



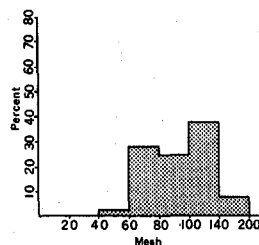
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		3.93	3.93	4.13	4.13
-60 +80		26.19	30.12	27.56	31.69
-80 +100		22.83	52.95	24.03	55.72
-100 +140		33.96	86.91	35.74	91.46
-140 +200		8.11	95.02	8.54	100.00
-200 +pan		4.96	99.98		

Sample number. --DP-K1

Yield after coning. --97.63 percent

Graphic mean. --0.14 mm

Sorting index. --0.400



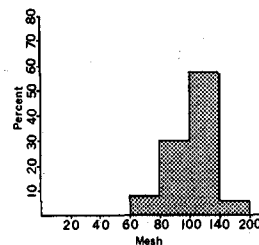
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		2.92	2.92	3.08	3.08
-60 +80		26.80	29.72	28.34	31.42
-80 +100		23.21	52.93	24.54	55.96
-100 +140		34.88	87.81	36.88	92.84
-140 +200		6.77	94.58	7.16	100.00
-200 +pan		5.42	100.00		

Sample number. --G-49

Yield after coning. --99.64 percent

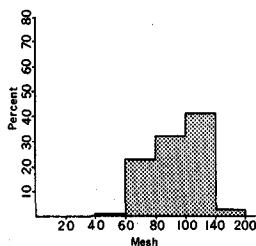
Graphic mean. --0.13 mm

Sorting index. --0.260



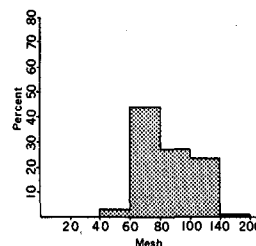
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		0.09	0.09	0.09	0.09
-60 +80		7.72	7.61	7.55	7.64
-80 +100		30.19	37.80	30.30	37.94
-100 +140		56.80	94.60	57.00	94.94
-140 +200		5.04	99.64	5.06	100.00
-200 +pan		0.36	100.00		

Sample number, --KL-1A
Yield after coning, --99.82 percent
Graphic mean, --0.14 mm
Sorting index, --0.32 ϕ



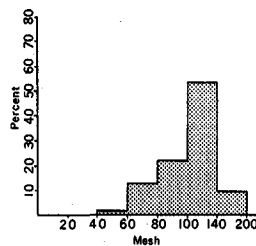
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	0.68	0.68	0.69	0.69
-60 +80	22.33	23.01	22.61	23.30
-80 +100	32.01	55.03	32.35	55.65
-100 +140	40.36	95.39	40.95	96.60
-140 +200	3.56	98.95	3.40	100.00
-200 +pan	1.05	100.00		

Sample number, --KL-8
Yield after coning, --99.82 percent
Graphic mean, --0.17 mm
Sorting index, --0.34 ϕ



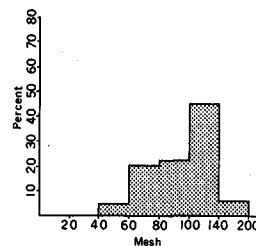
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	3.42	3.42	3.42	3.42
-60 +80	43.68	47.10	43.76	47.18
-80 +100	26.96	74.06	27.01	74.19
-100 +140	24.35	98.41	24.39	98.58
-140 +200	1.41	99.82	1.42	100.00
-200 +pan	0.18	100.00		

Sample number, --LPR-1
Yield after coning, --99.68 percent
Graphic mean, --0.13 mm
Sorting index, --0.36 ϕ



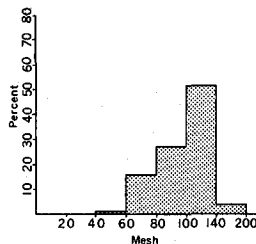
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.72	1.72	1.74	1.74
-60 +80	13.00	14.72	13.18	14.92
-80 +100	20.32	35.04	22.33	35.51
-100 +140	54.13	89.17	54.88	90.39
-140 +200	9.48	98.65	9.61	100.00
-200 +pan	1.36	100.01		

Sample number, --LPR-2B
Yield after coning, --99.90 percent
Graphic mean, --0.14 mm
Sorting index, --0.41 ϕ



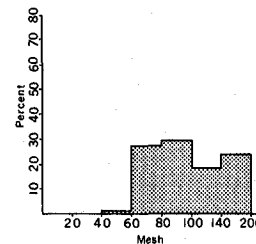
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	4.89	4.89	4.92	4.92
-60 +80	20.82	25.71	20.59	25.87
-80 +100	22.67	48.38	22.81	48.68
-100 +140	45.04	93.42	45.33	94.01
-140 +200	5.95	99.37	5.99	100.00
-200 +pan	0.62	99.99		

Sample number. --LPR-3
Yield after coning. --99.65 percent
Graphic mean. --0.14 mm
Sorting index. --0.330



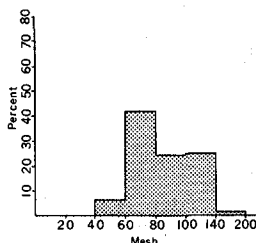
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		1.28	1.28	1.29	1.29
-60 +80		15.82	17.10	15.96	17.25
-80 +100		26.98	44.08	27.23	44.48
-100 +140		50.31	94.39	50.76	95.24
-140 +200		4.71	99.10	4.76	100.00
-200 +pan		0.87	99.97		

Sample number. --LPR-4
Yield after coning. --99.43 percent
Graphic mean. --0.14 mm
Sorting index. --0.420



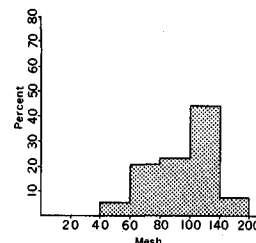
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		4.92	4.92	5.00	5.00
-60 +80		20.70	25.62	21.08	26.08
-80 +100		22.89	48.51	23.30	49.38
-100 +140		42.99	91.50	43.76	93.14
-140 +200		6.73	98.23	6.86	100.00
-200 +pan		1.76	99.99		

Sample number. --LPR-5
Yield after coning. --99.89 percent
Graphic mean. --0.17 mm
Sorting index. --0.380



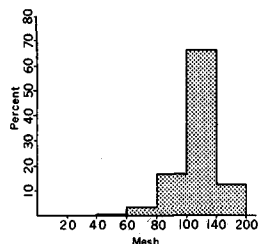
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		5.96	5.96	6.04	6.04
-60 +80		41.13	47.09	41.73	47.77
-80 +100		25.39	72.48	25.76	73.53
-100 +140		24.89	97.37	25.25	98.78
-140 +200		1.20	98.57	1.22	100.00
-200 +pan		1.45	100.02		

Sample number. --LPR-6
Yield after coning. --99.92 percent
Graphic mean. --0.15 mm
Sorting index. --0.350



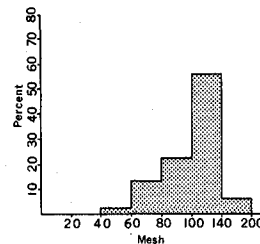
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		1.38	1.38	1.40	1.40
-60 +80		26.78	28.16	27.24	28.64
-80 +100		28.64	56.80	29.13	57.77
-100 +140		18.10	74.90	18.40	76.17
-140 +200		23.42	98.32	23.83	100.00
-200 +pan		1.69	100.01		

Sample number. --PARD-A
Yield after coning. --99.40 percent
Graphic mean. --0.12 mm
Sorting index. --0.270



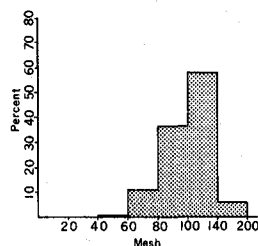
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	0.05	0.05	0.05	0.05
-60 +80	3.77	3.82	3.79	3.84
-80 +100	16.63	20.45	16.73	20.57
-100 +140	66.27	86.72	66.67	87.24
-140 +200	12.68	99.40	12.76	100.00
-200 +pan	0.60	100.00		

Sample number. --PIA-4
Yield after coning. --99.94 percent
Graphic mean. --0.14 mm
Sorting index. --0.330



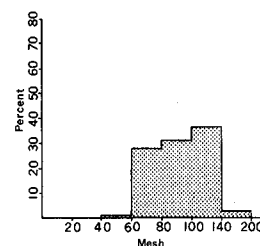
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	2.95	2.95	2.95	2.95
-60 +80	13.58	16.53	13.59	16.54
-80 +100	22.09	39.62	22.10	39.64
-100 +140	55.85	95.47	55.89	95.53
-140 +200	5.47	99.94	5.47	100.00
-200 +pan	0.06	100.00		

Sample number. --PIB-4
Yield after coning. --99.96 percent
Graphic mean. --0.14 mm
Sorting index. --0.300



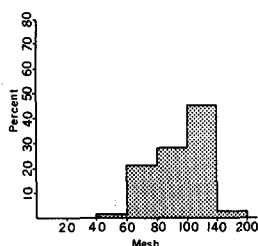
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.01	1.01	1.01	1.01
-60 +80	11.48	12.49	11.48	12.49
-80 +100	24.42	36.91	36.43	36.92
-100 +140	57.25	94.16	57.28	94.20
-140 +200	5.80	99.96	5.80	100.00
-200 +pan	0.04	100.00		

Sample number. --PIC-6
Yield after coning. --99.95 percent
Graphic mean. --0.15 mm
Sorting index. --0.320



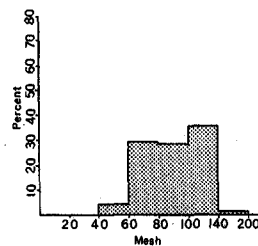
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.21	1.21	1.21	1.21
-60 +80	28.91	30.12	28.92	30.13
-80 +100	30.98	61.10	31.00	61.13
-100 +140	36.26	97.36	36.28	97.41
-140 +200	2.59	99.95	2.59	100.00
-200 +pan	0.05	100.00		

Sample number. --PID-1
 Yield after coning. --99.96 percent
 Graphic mean. --0.15 mm
 Sorting index. --0.33ø



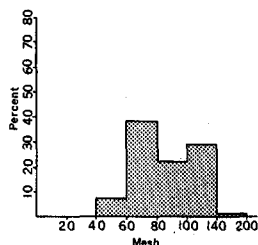
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		2.09	2.09	2.09	2.09
-60 +80		21.54	23.63	21.55	23.64
-80 +100		28.56	52.19	28.57	52.21
-100 +140		45.12	97.31	45.14	97.35
-140 +200		2.65	99.96	2.65	100.00
-200 +pan		0.04	100.00		

Sample number. --PIE-6
 Yield after coning. --99.98 percent
 Graphic mean. --0.16 mm
 Sorting index. --0.34ø



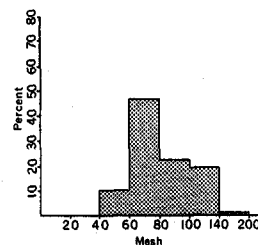
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		4.33	4.33	4.33	4.33
-60 +80		29.74	34.07	29.75	34.08
-80 +100		29.52	63.59	29.52	63.60
-100 +140		35.03	98.62	35.04	98.64
-140 +200		1.36	99.98	1.36	100.00
-200 +pan		0.02	100.00		

Sample number. --PIF-4
 Yield after coning. --99.92 percent
 Graphic mean. --0.17 mm
 Sorting index. --0.40ø



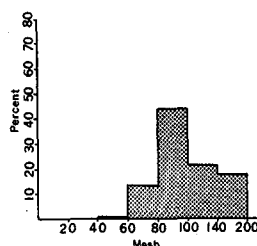
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		7.44	7.44	7.45	7.45
-60 +80		38.26	45.70	38.29	45.74
-80 +100		22.88	68.58	22.89	68.63
-100 +140		29.60	98.18	29.63	98.26
-140 +200		1.74	99.92	1.74	100.00
-200 +pan		0.08	100.00		

Sample number. --PIG-5
 Yield after coning. --99.94 percent
 Graphic mean. --0.18 mm
 Sorting index. --0.39ø



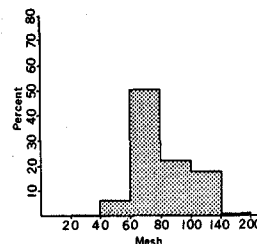
		Entire sample		Sand fraction	
U.S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		10.30	10.30	10.31	10.31
-60 +80		46.07	56.37	46.09	56.40
-80 +100		22.66	79.03	22.68	79.08
-100 +140		19.59	98.62	19.60	98.68
-140 +200		1.32	99.94	1.32	100.00
-200 +pan		0.06	100.00		

Sample number. --PIH-1
Yield after coning. --99.80 percent
Graphic mean. --0.18 mm
Sorting index. --0.410



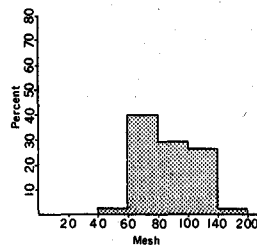
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-20 +40	0.98	0.98	0.98	0.98	
-40 +60	13.47	14.45	13.50	14.48	
-60 +80	44.15	58.60	44.24	58.72	
-80 +100	21.14	79.74	21.18	79.90	
-100 +140	18.49	98.23	18.53	98.43	
-140 +200	1.57	99.80	1.57	100.00	
-200 +pan	0.20	100.00			

Sample number. --PIJ-2A
Yield after coning. --99.84 percent
Graphic mean. --0.18 mm
Sorting index. --0.370



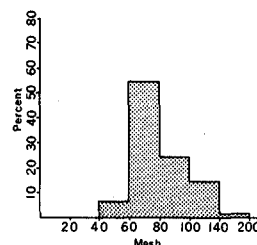
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-20 +40	0.05	0.05	0.05	0.05	
-40 +60	6.96	7.01	6.97	7.02	
-60 +80	50.35	57.36	50.43	57.45	
-80 +100	22.15	79.51	22.19	79.64	
-100 +140	18.78	98.29	18.81	98.45	
-140 +200	1.55	99.84	1.55	100.00	
-200 +pan	0.16	100.00			

Sample number. --PIK-5
Yield after coning. --99.77 percent
Graphic mean. --0.17 mm
Sorting index. --0.340



		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-20 +40	0.04	0.04	0.04	0.04	
-40 +60	2.50	2.54	2.51	2.55	
-60 +80	39.18	41.72	39.27	41.82	
-80 +100	29.47	71.19	29.53	71.35	
-100 +140	26.08	97.27	26.14	97.49	
-140 +200	2.50	99.77	2.51	100.00	
-200 +pan	0.23	100.00			

Sample number. --PIL-11
Yield after coning. --99.85 percent
Graphic mean. --0.18 mm
Sorting index. --0.330



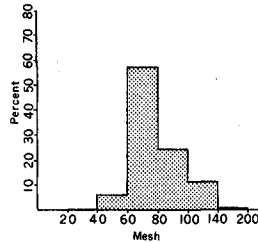
		Entire sample		Sand fraction	
U.S. Standard	Weight	Cumulative	Weight	Cumulative	
Mesh Number	Percent	Percent	Percent	Percent	
-20 +40	0.00	0.00	0.00	0.00	
-40 +60	6.58	6.58	6.59	6.59	
-60 +80	53.96	60.54	54.04	60.63	
-80 +100	23.96	84.50	24.00	84.63	
-100 +140	14.29	98.79	14.31	98.94	
-140 +200	1.06	99.85	1.06	100.00	
-200 +pan	0.15	100.00			

Sample number. --PIM-6

Yield after coning. --99.88 percent

Graphic mean. --0.19 mm

Sorting index. --0.310



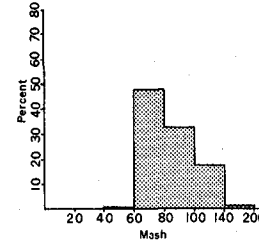
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.14	0.14	0.14	0.14
-40 +60	6.37	6.51	6.38	6.52
-60 +80	57.35	63.86	57.42	63.94
-80 +100	24.07	87.93	24.10	88.04
-100 +140	11.24	99.17	11.25	99.29
-140 +200	0.71	99.88	0.71	100.00
-200 +pan	0.12	100.00		

Sample number. --PIN-7

Yield after coning. --99.89 percent

Graphic mean. --0.17 mm

Sorting index. --0.280



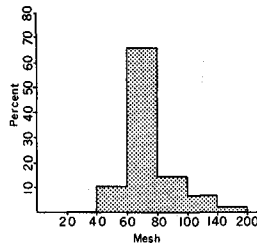
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.33	1.33	1.33	1.33
-60 +80	47.74	49.17	47.89	49.22
-80 +100	32.03	81.20	32.07	81.29
-100 +140	17.50	98.70	17.51	98.80
-140 +200	1.19	99.89	1.20	100.00
-200 +pan	0.11	100.00		

Sample number. --PIO-6

Yield after coning. --99.39 percent

Graphic mean. --0.20 mm

Sorting index. --0.320



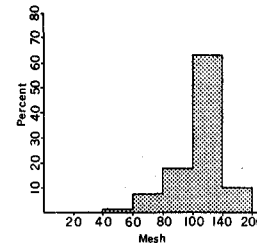
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.82	0.82	0.83	0.83
-40 +60	10.24	11.06	10.30	11.13
-60 +80	65.13	76.19	65.52	76.65
-80 +100	14.78	90.97	14.88	91.53
-100 +140	6.00	96.97	6.04	97.57
-140 +200	2.42	99.39	2.43	100.00
-200 +pan	0.61	100.00		

Sample number. --PIP-10

Yield after coning. --99.89 percent

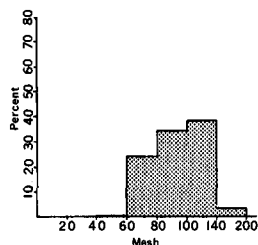
Graphic mean. --0.12 mm

Sorting index. --0.310



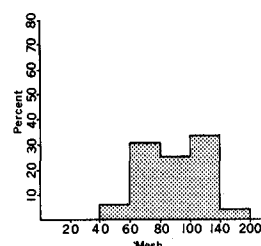
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.12	0.12	0.12	0.12
-40 +60	1.79	1.91	1.79	1.91
-60 +80	7.97	9.88	7.98	9.89
-80 +100	16.79	26.67	16.81	26.70
-100 +140	63.25	89.92	63.32	90.02
-140 +200	9.97	99.89	9.98	100.00
-200 +pan	0.11	100.00		

Sample number. --PIQ-11
Yield after coning. --99.95 percent
Graphic mean. --0.15 mm
Sorting index. --0.30 ϕ



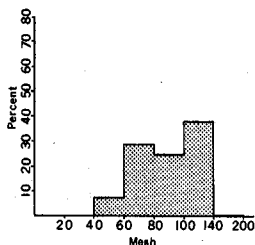
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.09	0.09	0.09	0.09
-40 +60	0.31	0.40	0.31	0.40
-60 +80	24.23	24.63	24.24	24.64
-80 +100	33.67	58.30	33.69	58.33
-100 +140	38.43	96.73	38.45	96.78
-140 +200	3.22	99.95	3.22	100.00
-200 +pan	0.05	100.00		

Sample number. --PoCo-1A
Yield after coning. --99.95 percent
Graphic mean. --0.15 mm
Sorting index. --0.42 ϕ



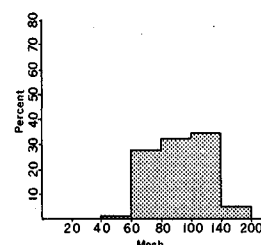
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	6.57	6.57	6.67	6.60
-60 +80	30.38	36.95	30.57	37.17
-80 +100	25.20	62.15	25.35	62.52
-100 +140	32.80	94.95	33.00	95.52
-140 +200	4.45	99.40	4.48	100.00
-200 +pan	0.55	99.95		

Sample number. --PoCo-1B
Yield after coning. --99.92 percent
Graphic mean. --0.15 mm
Sorting index. --0.43 ϕ



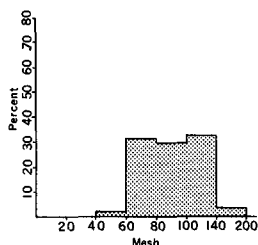
U.S. Standard Mesh Standard	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.09	0.09	0.09	0.09
-40 +60	7.30	7.39	7.30	7.39
-60 +80	29.09	36.48	29.11	36.50
-80 +100	24.20	60.68	24.22	60.72
-100 +140	38.81	99.49	38.84	99.56
-140 +200	0.43	99.92	0.44	100.00
-200 +pan	0.08	100.00		

Sample number. --RoL-1
Yield after coning. --98.87 percent
Graphic mean. --0.15 mm
Sorting index. --0.35 ϕ



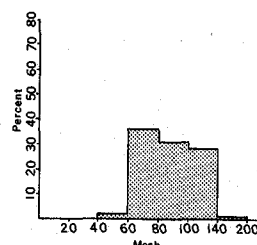
U.S. Standard Mesh Standard	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.27	1.27	1.30	1.30
-60 +80	26.65	27.92	27.38	28.68
-80 +100	31.98	59.90	32.85	61.53
-100 +140	33.50	93.40	34.42	95.95
-140 +200	3.94	97.34	4.05	100.00
-200 +pan	2.65	99.99		

Sample number, --RoL-4
Yield after coning, --98.88 percent
Graphic mean, --0.16 mm
Sorting index, --0.380



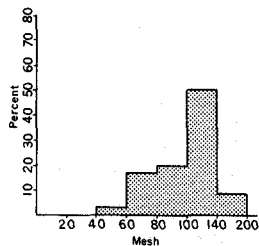
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	2.84	2.84	2.91	2.91
-60 +80	30.37	33.21	31.16	34.07
-80 +100	29.51	62.72	30.29	64.36
-100 +140	31.08	93.80	31.89	96.25
-140 +200	3.65	97.45	3.75	100.00
-200 +pan	2.50	99.95		

Sample number, --RoL-5B
Yield after coning, --99.92 percent
Graphic mean, --0.16 mm
Sorting index, --0.350



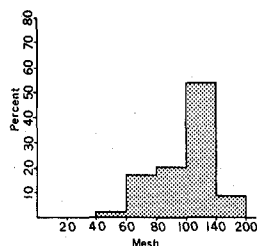
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	2.92	2.92	2.93	2.93
-60 +80	35.72	38.64	35.90	38.83
-80 +100	30.26	68.90	30.40	69.23
-100 +140	28.13	97.03	28.27	97.50
-140 +200	2.48	99.51	2.50	100.00
-200 +pan	0.48	99.99		

Sample number, --Sa-6
Yield after coning, --96.76 percent
Graphic mean, --0.13 mm
Sorting index, --0.490



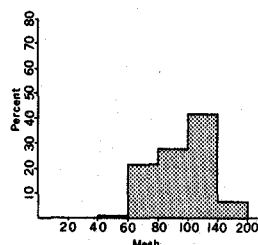
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	3.33	3.33	3.54	3.54
-60 +80	16.19	19.52	17.26	20.80
-80 +100	18.92	38.44	20.17	40.97
-100 +140	47.19	85.63	50.31	91.28
-140 +200	8.18	93.81	8.72	100.00
-200 +pan	5.84	99.65		

Sample number, --Sa-7
Yield after coning, --99.82 percent
Graphic mean, --0.13 mm
Sorting index, --0.380



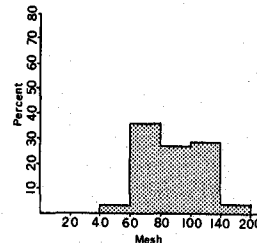
U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	2.49	2.49	2.51	2.51
-60 +80	16.00	18.49	16.16	18.67
-80 +100	20.07	38.56	20.18	38.95
-100 +140	52.74	91.30	53.28	92.23
-140 +200	7.69	98.99	8.77	100.00
-200 +pan	1.00	99.99		

Sample number. --SaR-1
Yield after coning. --99.23 percent
Graphic mean. --0.13 mm
Sorting index. --0.370



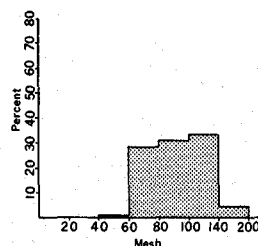
Entire sample					Sand fraction				
U.S. Standard	Weight	Cumulative	Weight	Cumulative	U.S. Standard	Weight	Cumulative	Weight	Cumulative
Mesh Number	Percent	Percent	Percent	Percent	Mesh Number	Percent	Percent	Percent	Percent
-20 +40	0.00	0.00	0.00	0.00	-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.48	1.48	1.50	1.50	-40 +60	3.01	3.01	3.02	3.02
-60 +80	22.42	23.90	22.87	24.37	-60 +80	36.84	39.85	36.96	39.98
-80 +100	27.51	51.41	28.05	52.42	-80 +100	27.59	67.44	27.69	67.67
-100 +140	40.60	92.01	41.40	93.82	-100 +140	28.41	95.85	28.50	96.17
-140 +200	6.06	98.07	6.18	100.00	-140 +200	3.81	99.66	3.83	100.00
-200 +pan	1.91	99.98			-200 +pan	0.35	100.01		

Sample number. --SaR-2A
Yield after coning. --99.96 percent
Graphic mean. --0.16 mm
Sorting index. --0.380



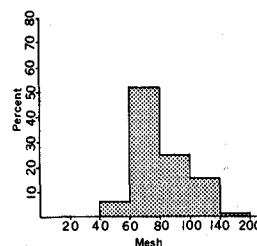
Entire sample					Sand fraction				
U.S. Standard	Weight	Cumulative	Weight	Cumulative	U.S. Standard	Weight	Cumulative	Weight	Cumulative
Mesh Number	Percent	Percent	Percent	Percent	Mesh Number	Percent	Percent	Percent	Percent
-20 +40	0.00	0.00	0.00	0.00	-20 +40	0.00	0.00	0.00	0.00
-40 +60	3.01	3.01	3.02	3.02	-40 +60	5.91	5.91	5.92	5.92
-60 +80	36.84	39.85	36.96	39.98	-60 +80	51.39	57.30	51.52	57.44
-80 +100	27.59	67.44	27.69	67.67	-80 +100	24.48	81.78	24.54	81.98
-100 +140	28.41	95.85	28.50	96.17	-100 +140	16.30	98.08	16.34	98.32
-140 +200	3.81	99.66	3.83	100.00	-140 +200	1.67	99.75	1.68	100.00
-200 +pan	0.35	100.01			-200 +pan	0.28	100.03		

Sample number. --SaR-3
Yield after coning. --99.69 percent
Graphic mean. --0.15 mm
Sorting index. --0.340



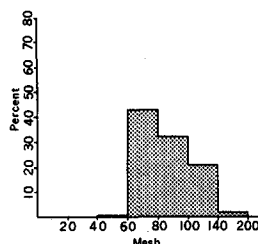
Entire sample					Sand fraction				
U.S. Standard	Weight	Cumulative	Weight	Cumulative	U.S. Standard	Weight	Cumulative	Weight	Cumulative
Mesh Number	Percent	Percent	Percent	Percent	Mesh Number	Percent	Percent	Percent	Percent
-20 +40	0.00	0.00	0.00	0.00	-20 +40	0.00	0.00	0.00	0.00
-40 +60	1.07	1.07	1.08	1.08	-40 +60	5.91	5.91	5.92	5.92
-60 +80	29.65	30.72	29.92	31.00	-60 +80	51.39	57.30	51.52	57.44
-80 +100	30.92	61.64	31.21	62.21	-80 +100	24.48	81.78	24.54	81.98
-100 +140	33.21	94.85	33.53	95.74	-100 +140	16.30	98.08	16.34	98.32
-140 +200	4.22	99.07	4.26	100.00	-140 +200	1.67	99.75	1.68	100.00
-200 +pan	0.97	100.04			-200 +pan	0.28	100.03		

Sample number. --SaR-4A
Yield after coning. --99.98 percent
Graphic mean. --0.18 mm
Sorting index. --0.340



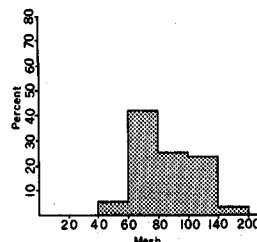
Entire sample					Sand fraction				
U.S. Standard	Weight	Cumulative	Weight	Cumulative	U.S. Standard	Weight	Cumulative	Weight	Cumulative
Mesh Number	Percent	Percent	Percent	Percent	Mesh Number	Percent	Percent	Percent	Percent
-20 +40	0.00	0.00	0.00	0.00	-20 +40	0.00	0.00	0.00	0.00
-40 +60	5.91	5.91	5.92	5.92	-40 +60	5.91	5.91	5.92	5.92
-60 +80	51.39	57.30	51.52	57.44	-60 +80	51.39	57.30	51.52	57.44
-80 +100	24.48	81.78	24.54	81.98	-80 +100	24.48	81.78	24.54	81.98
-100 +140	16.30	98.08	16.34	98.32	-100 +140	16.30	98.08	16.34	98.32
-140 +200	1.67	99.75	1.68	100.00	-140 +200	1.67	99.75	1.68	100.00
-200 +pan	0.28	100.03			-200 +pan	0.28	100.03		

Sample number. --SaR-5
Yield after coning. --99.40 percent
Graphic mean. --0.17 mm
Sorting index. --0.310



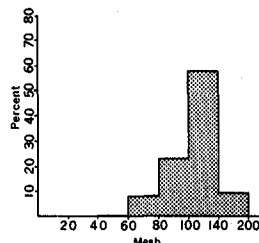
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		1.17	1.17	1.18	1.18
-60 +80		42.40	43.57	42.88	44.06
-80 +100		32.33	75.90	32.69	76.75
-100 +140		21.25	97.15	21.50	98.25
-140 +200		1.73	98.88	1.75	100.00
-200 +pan		0.99	99.87		

Sample number. --SaR-7B
Yield after coning. --99.92 percent
Graphic mean. --0.17 mm
Sorting index. --0.390



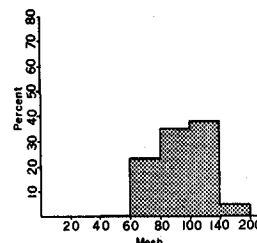
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		5.50	5.50	5.52	5.52
-60 +80		41.57	47.06	41.73	47.25
-80 +100		25.09	72.16	25.19	72.44
-100 +140		24.24	96.40	24.34	96.78
-140 +200		3.20	99.60	3.22	100.00
-200 +pan		0.38	99.98		

Sample number. --Sa-57A
Yield after coning. --99.94 percent
Graphic mean. --0.12 mm
Sorting index. --0.300



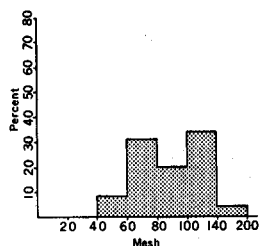
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		0.14	0.14	0.14	0.14
-60 +80		8.67	8.81	8.71	8.85
-80 +100		23.70	32.51	23.80	32.67
-100 +140		58.06	90.57	58.34	91.01
-140 +200		9.06	99.51	8.99	100.00
-200 +pan		0.49	100.00		

Sample number. --SPL-1A
Yield after coning. --99.93 percent
Graphic mean. --0.15 mm
Sorting index. --0.320



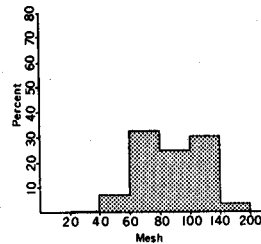
		Entire sample		Sand fraction	
U. S. Standard	Mesh Number	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40		0.00	0.00	0.00	0.00
-40 +60		0.83	0.83	0.84	0.84
-60 +80		22.99	23.82	23.28	24.12
-80 +100		33.89	57.71	34.32	58.44
-100 +140		36.71	94.42	37.17	95.61
-140 +200		4.33	98.75	4.39	100.00
-200 +pan		1.25	100.00		

Sample number, --YP-2A
 Yield after coning, --99.74 percent
 Graphic mean, --0.15 mm
 Sorting index, --0.450



U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.00	0.00	0.00	0.00
-40 +60	8.88	8.88	8.96	8.96
-60 +80	31.33	40.21	31.64	40.60
-80 +100	20.22	60.43	20.42	61.02
-100 +140	34.28	94.71	34.61	95.63
-140 +200	4.32	99.03	4.37	100.00
-200 +pan	0.96	99.99		

Sample number, --YP-2B
 Yield after coning, --99.88 percent
 Graphic mean, --0.15 mm
 Sorting index, --0.420



U.S. Standard Mesh Number	Entire sample		Sand fraction	
	Weight Percent	Cumulative Percent	Weight Percent	Cumulative Percent
-20 +40	0.14	0.14	0.14	0.14
-40 +60	7.85	7.99	7.89	8.03
-60 +80	32.69	40.68	32.88	40.91
-80 +100	25.06	65.74	25.21	66.12
-100 +140	30.38	96.12	30.56	96.68
-140 +200	3.30	99.42	3.32	100.00
-200 +pan	0.58	100.00		

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