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GEOLOGICAL SURVEY

HEAVY MINERALS IN THE PLEISTOCENE TERRACE DEPOSITS OF SOUTH CAROLINA AND GEORGIA

By

John B. Mertie, Jr.

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HEAVY MINERALS IN THE PLEISTOCENE TERRACE DEPOSITS OF SOUTH CAROLINA AND GEORGIA

By

John B. Mertie, Jr.

ABSTRACT

The Pleistocene terrace deposits of southeastern South Carolina and southeastern Georgia contain minor amounts of heavy minerals. A preliminary examination, which was made of these terraces in October 1948, indicates that if economic concentration of heavy minerals exist in the Pleistocene terrace deposits of South Carolina and Georgia, they most likely occur in the Wicomico, Okefenokee, and Sunderland terraces and to the east and southeast of Trail Ridge, Georgia. Exploration for these terrace deposits could be done by deep drilling with casing, although shallow exploration down to the water table could be done by drilling without casing or by trenching.

The mean percentage of heavy minerals in samples from terrace deposits in southeastern Georgia is 0.37, whereas the mean percentage of heavy minerals in samples from terrace deposits in southeastern South Carolina is 0.15. Sands containing relatively large amounts of heavy minerals contain small percentages of monazite; sands containing relatively small amounts of heavy minerals contain large percentages of monazite.

INTRODUCTION

Interest was shown, by the Atomic Energy Commission, in the possibility of the existence of large, even though low-grade, deposits of heavy minerals in the Pleistocene terraces of North Carolina, South Carolina, and Georgia. Particular interest was shown in the Pleistocene terraces that are adjacent to streams that drain the western monazite belt of North Carolina and South Carolina. Accordingly, a preliminary examination of the southeastern Coastal Plain was made in October 1948, during which 56 samples were taken of the Pleistocene terrace deposits and concentrated by panning in the field. The mineralogic work on these samples was done by the Trace Elements laboratory in Washington, D. C.

GENERAL GEOLOGY

The Broad and Saluda Rivers, which drain most of the western monazite belt of North and South Carolina, join to form the Congaree River; and the Congaree joins the Waterlee to form the Santee River, which flows 100 miles to the Atlantic Ocean. This drainage system has persisted with minor modifications throughout Pleistocene and Recent times. All of the Pleistocene terraces that were directly controlled by Atlantic base-levels occur within or close to the valley of the Santee River; therefore a preliminary examination was made of the terraces of this part of southeastern South Carolina. Additional work was done on the Pleistocene terraces of southeastern Georgia.

Eight Pleistocene terraces have been described by Cooke_/,

_/ Cooke, C. W., Seven coastal terraces in the southeastern states: Washington Acad. Sci. Jour., vol. 21, no. 21, pp. 503-513, 1931.

_____, Geology of the Coastal Plain of Georgia: U. S. Geol. Survey Bull. 941, 1944.

Stephenson_/, and other geologists who have worked in the Atlantic

_/ Stephenson, L. W., Major features in the geology of the Atlantic and Gulf Coastal Plain: Washington Acad. Sci., Jour., vol. 16, no. 17, pp. 460-480, 1926.

Coastal Plain. Terraces, from the highest to the lowest, are: the Brandywine, Coharie, Sunderland, Okefenokee, Wicomico, Penholoway, Talbot, and Pamlico. The maximum altitudes of these terraces are respectively 300, 215, 170, 140, 100, 70, 42, and 25 feet. The upper limit of each of these formations has been determined in some measure by scarps and other physiographic features; but where such significant data are lacking, it has been defined by hypsometry. Neither lithologic nor paleontologic definitions of these formations have been presented.

Most of the terrace deposits in and near the Santee Valley contain differing amounts of silt and clay. The master streams that debouched during the Pleistocene epoch onto the swampy forelands bordering the ocean were muddy, though probably not to the degree that they now are. The resulting deposits were therefore originally

clayey, and most have remained so. Some of these deposits were reworked by the ocean in the course of numerous advances and regressions of the strand-line, but most of them are not true marine sands and are considered to be undisturbed deltaic and estuarine deposits. Littoral reconcentration of the heavy minerals in these deposits did not occur.

Conditions of similar Pleistocene sedimentation probably prevailed throughout North Carolina and South Carolina, and most of Georgia, where large rivers heading in the Piedmont belt reach the ocean.

South of the Altamaha River in southeastern Georgia, many of the terrace deposits were reworked by oceanic waves and currents, and therefore could be classified as marine deposits. Former shorelines have been recognized in the Wicomico, Okefenokee, and Sunderland formations along the eastern flank of Trail Ridge. Prospecting of these formations in this area, and to the east and southeast, is more likely to be rewarding than searching for concentrations of heavy minerals in the area to the northeast. A large deposit of heavy minerals was discovered in Florida, near the south end of Trail Ridge, and has been mined on a large scale by the Humphrey's Gold Corporation since 1949.

SAMPLES

Southeastern South Carolina

Thirty-nine samples of the Pleistocene formations in and near the Santee Valley of South Carolina, were panned (fig. 1). Four other samples from the same area were taken of the McBean and Black Mingo formations of middle and lower Eocene age, respectively. The localities, altitudes, terrace assignments, lithology, and content of heavy minerals for all these samples are given in the tables 1 and 2.

Owing to the interest of the Atomic Energy Commission in the discovery of deposits of heavy minerals containing significant amounts of monazite, more field work was done in the Santee River valley of South Carolina than in southeastern Georgia. Though the headwater tributaries of this river drain much of the western Carolina monazite belt, the results of the examination indicate that heavy minerals make up an average of only 0.15 percent of the terrace sands and that only 2.7 percent of the heavy minerals consist of monazite. Monazite then makes up about 0.004 percent of the terrace deposits, a grade no higher than that of the monazite-bearing granite of Shelby, North Carolina.

On the basis of the few samples taken during this examination, the Eocene formations of the area appear to contain twice as high a percentage of monazite as the terraces, but the total content of heavy minerals appears to be even smaller than that of the terraces.

FIG. 1

HEAVY MINERAL SAMPLES
SOUTHEASTERN SOUTH CAROLINA

JOHN B. MERTIE, JR.

SCALE

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Table 1.--Localities and descriptions of samples from southeastern South Carolina.

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 46	1/4 mile northeast of Snake Swamp on State road 33, Orangeburg County.	Coharie terrace and formation.	185'	Mottled white to reddish-brown, fine-grained, clayey, sandy material.	Lower 3 feet	20	3.8
48 Mt 47	" "	"	185'	Clayey, reddish-brown limonitic material.	Upper 4 feet of section.	25	4.4
48 Mt 48	Quarry 1/8 mile southwest of Snake Swamp on State road 33, Orangeburg County.	Coharie terrace and formation.	170'	Mottled light tan to brown to red, quartzose grit with pebbles up to 1/2" in size.	6 feet of 6 exposed feet.	25	18.8
48 Mt 49	" "	"	170'	"	8 feet; 40 feet to north of 48 Mt 48	35	89.2
48 Mt 50	Sideroad running northwest from State road 33 and 0.2 mile southeast of Cooper Swamp. Also 8.9 miles S 54° W from center of Orangeburg, Orangeburg County.	Brandywine terrace and formation.	230'	Sandy material.	Lower 3 feet of 6-foot section	25	9.6
48 Mt 51	On Bennecker Bridge road, 7.1 miles S 62°W from center of Orangeburg, Orangeburg County.	Brandywine terrace and formation.	250'	Mottled white, brown, to red, pebbly material; quartz pebbles up to 1/2 inch in diameter.	Lower 3 feet	25	2.7

Table 1.--(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 52	Southside of State road 36 about 0.45 mile west of Cooper Swamp and 10.6 miles S 20° W. from center of Orangeburg, Orangeburg County.	Sunderland terrace and formation.	155'	Slightly clayey, quartzose grit, quartz grains from very small size up to 3/8 inch in diameter.	3 feet	25	8.0
48 Mt 53	North side of State road 36, about 0.1 mile west of North Fork of Edisto River; and 9.65 miles S 11½° W from center of Orangeburg, Orangeburg County.	Sunderland terrace	150'	Reddish-brown to yellowish, clayey sand.	Lower 6-feet of 9-foot section	25	3.2
48 Mt 54	West side of U. S. road 21, about 1¼ miles south of St. Matthews, Calhoun County.	McBean (middle Eocene) formation	?	Coarse-grained, quartzose grit containing marine fossils.	Upper 5 feet of 15 feet	25	2.2
48 Mt 55	" "	"	?	"	Lower 5 feet of 15 feet	25	3.7
48 Mt 56	Southwest side of State road 47, 1.3 miles west-northwest of junction of State roads 47 and 33, Calhoun County.	Dune behind Coharie terrace and formation.	230'	Unconsolidated yellow sand with darker irregular-shaped masses.	Lower 6 feet of 8-foot bluff	25	35.3
48 Mt 57	East side of State road 47, about 3 3/4 miles S 23° E of Lone Star, Calhoun County.	Sunderland terrace and formation.	110'	Reddish-brown consolidated sandstone, about 2/3 quartz grains and 1/3 clay.	4-foot section	25	8.8

Table 1.—(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 58	State road 6, 7/8 mile west of intersection of State road 6 with U. S. road 15, Orangeburg County.	Okefenokee terrace and formation.	120'	Brown, unconsolidated to little consolidated, sandy material.	4-foot section	25	1.9
48 Mt 59	State road 45, 1/2 mile west of Eutaw Springs, 75 yards east of junction of State roads 45 and 6, Orangeburg County.	Wicomico terrace and formation.	100'	Yellowish-brown unconsolidated sand.	6-foot section	25	5.6
48 Mt 60	State road 45, about 2¼ miles west of Eutawville, Orangeburg County.	Dune on Okefenokee terrace and formation.	140'	Yellow sand.	2-foot section	25	2.7
48 Mt 61	Old open cut on north side of State road 4, 1/4 mile west of Four Hole Swamp, Orangeburg County.	Okefenokee terrace and formation.	140'	White mottled, reddish sandstone; coherent, but disintegrates in water.	4-foot section	25	14.9
48 Mt 62	Utsey Bluff on northeast side of Edisto River, 0.7 mile southeast of Beulah Church, and about 5 miles S 45° W of Reevesville, Dorchester County.	Wicomico terrace and formation.	87'-95'	Partially consolidated gritty sandstone, that disintegrates in water.	8 feet, section starting 5 feet below surface.	25	21.4
48 Mt 63	North side of U. S. road 78, about 2½ miles east, and a little north of Dorchester, and about 30 yards west of Four Hole Swamp, Dorchester County.	Penholoway terrace and formation.	70'	Cooper marl (Eocene) at base overlain by 3 feet of carbonaceous sand, overlain by 2½ feet of very carbonaceous sand, overlain by 15 feet of yellow sand.	Lower 12 feet of 15-foot section of yellow sand	25	15.5

Table 1.—(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 64	Same as preceeding location (48 Mt 63)	Penholoway terrace and formation.	70'	Same as preceeding (48 Mt 63)	2½ feet of 2½ feet of very carbonaceous sand	25	6.4
48 Mt 65	Southwest side of U. S. road 78 (State road 2), about 2 7/8 miles S 87° E of Ridgeville on north side of Ashley River, Dorchester County.	Either Penholoway terrace and formation or a dune along the Pamlico terrace.	40'	Clayey material.	Upper 4 feet of 8-foot section	25	5.3
48 Mt 66	" "	"	40'	Somewhat consolidated.	Lower 4 feet of 8-foot section	25	7.8
48 Mt 67	Northeast side of U. S. road 78 (State road 2), about 3.3 miles S 72° E of Ridgeville, and on southeast side of Ashley River, Dorchester County.	Penholoway terrace formation	40'	Clayey material.	4-foot section	25	4.3
48 Mt 68	North side of U. S. road 78 (State road 2), about 1.05 miles N 35° W of Otranto, Berkeley County.	Talbot terrace and formation.	30'	Semi-consolidated brown sand.	4-foot section	25	13.9
48 Mt 69	Northeast side of State road 31, about 0.85 mile N 80° W of Wassamassaw Church and on west side of Wassamassaw Swamp, Berkeley County.	Penholoway terrace and formation	50'-60'	Mottled red, yellow, and white, clayey sandstone.	4-foot section	25	12.0

Table 1.--(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 70	Southeast side of U. S. road 15, about 250 yards northeast of Lake Marione (Santee River Dam) and 100 yards southeast of the road, Clarendon County.	Either Wicomico terrace or a dune on the Penholoway terrace and formation.	100'	Clayey, cream-colored unconsolidated, very fine sand, with disseminated black specks of ilmenite.	Upper 4 feet of section	25	26.8
48 Mt 71	Road-metal pit on southeast side of secondary road, about 1.62 miles N 35° W from bend in U. S. road 521 west of Georgetown; also 100 yards southwest of junction of secondary road with Johnson road, Georgetown County.	Bar atop the Pamlico terrace and formation.	25'	Fine yellow sand.	4-foot section	25	20.9
48 Mt 72	South bank of Black River, about 8 miles N 13° W from Georgetown and 700 feet west of the Pumping Station, Georgetown County.	Pamlico terrace and formation.	18'	Yellowish-brown sandy clay.	4-foot section	25	14.0
48 Mt 73	East side of Browns Ferry road, about 1.3 miles southeast of Browns Ferry, Georgetown County.	Shoreline of Pamlico terrace or possibly a beach ridge on the Talbot terrace and formation.	25'-30'	Yellow sand.	6½-foot section	25	16.5
48 Mt 74	Southwest side of Browns Ferry road, about 0.35 miles west-northwest of Browns Ferry, Georgetown County.	Dune on shoreline of Pamlico terrace and formation.	20'	Fine yellow sand.	4-foot section	25	12.9

Table 1.--(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 75	Northeast side of Browns Ferry road, about 0.1 mile southeast of road junction at Red Hill, Georgetown County.	Black Mingo (lower Eocene) formation.	20'-30'	Brownish-red to dark red, well consolidated sandstone and grit, that disintegrates when panned.	12-foot section	25	31.3
48 Mt 76	Northeast side of U. S. road 521, about 1.63 miles northwest of Oak Grove and 0.2 miles northwest of junction with Bethel Road, Georgetown County.	Talbot terrace and formation.	28'	Mottled red and orange clayey sand; sandier at base.	4-foot section	25	2.7
48 Mt 77	Northeast side of U. S. road 521, about 0.57 miles N 10° E, of West Andrews, Williamsburg County.	Talbot terrace and formation.	35'	Upper 2 feet, leached white sand; lower 4 feet, yellow clay.	6-foot section	25	4.5
48 Mt 78	Northeast side of U. S. Road 521, about 4.8 miles west of Warsaw and 200 yards east of Spring Gully Church, Williamsburg County.	Talbot terrace and formation.	40'	Upper 3 feet, dune material; lower 3 feet, yellowish-brown clayey sandstone.	Lower 3 feet sampled	25	12.4
48 Mt 79	Northeast side of U. S. road 521, about 6.85 miles N 77° W. from Warsaw, and 0.4 miles southeast of Spring Gulley, Williamsburg County.	Talbot terrace and formation, close to Talbot shoreline.	40'	Reddish-brown slightly sandy clay.	4-foot section	25	3.8

Table 1.--(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 80	Southwest side of State road 179, about 1½ miles southeast of Honey Hill, and just southeast of Honey Hill Fire Tower, Berkeley County.	Shore line of Pamlico terrace and formation.	25'	Light yellow unconsolidated sand.	3-foot section	25	38.2
48 Mt 81	West side of State road 179, about 0.6 mile southeast of Honey Hill, and 0.83 mile northwest of Honey Hill Fire Tower, Berkeley County.	Dune on Talbot terrace and formation.	40'	White sand, stained yellow irregularly.	6-foot section	25	70.3
48 Mt 82	East side of State road 179, about 1.7 mile southeast of Jamestown and about 100 feet northeast of junction with Pipkin road, Berkeley County.	Talbot terrace and formation.	36'	Brown sandy clay.	3-foot section	25	3.8
48 Mt 83	Northwest side of State road 511, about 1½ miles southwest of Jamestown, and just southwest of Tiger Corner road, Williamsburg County.	Talbot terrace and formation (?)	40'-45'	Consolidated red clay containing mica but no large grains of quartz.	6-foot section	25	3.0
48 Mt 84	East side of State road 511, about 15 3/4 miles southwest of Jamestown, Georgetown County.	Talbot terrace and formation.	35'	Red to orange clay.	10-foot section	25	5.7

Table 1.—(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 85	North side of U. S. road 17, about 3 miles east of Awendaw, at Buck Hall Fire Tower, Charleston County.	Offshore bar on Pamlico terrace and formation.	20'	White to yellow unconsolidated sand.	4-foot pit section	25	50.1
48 Mt 86	West side of State road 64, about 7½ miles northeast of Summerville and ¼ mile north of Poplar Branch, Berkeley County.	Bar or dune on Penholoway spit; Penholoway terrace and formation.	70'	3 foot light yellow unconsolidated sand, underlain by yellow, clayey sand.	3 feet	25	8.5
48 Mt 87	North side of a side road leading from U. S. road 52 west to the Santee-Cooper Hydroelectric Power Plant, and 0.7 mile from U. S. road 52, Berkeley County.	Black Mingo formation.	50'	Yellow-brown to orange consolidated coarse sandstone and grit mottled with white spots and stringers.	8-foot section	25	9.2
48 Mt 88	Northeast side of U. S. road 52, about 4 miles northwest of St. Stephens at a point where a secondary road leads off to west; about 4 miles southwest of Santee River.	Dune near Penholoway shore line possibly atop Wicomico terrace and formation.	77'	6 foot white unconsolidated sand underlain by yellow clayey sand.	6-foot section	25	76.7

Table 2.—Heavy-mineral content of samples from Pleistocene terrace deposits and Eocene formations in southeastern South Carolina.

Sample No.	Terraces	Total heavy minerals (percent)	Distribution of total heavy-mineral content					
			Ilmenite (percent)	Leucoxene (percent)	Rutile (percent)	Zircon (percent)	Monazite (percent)	Others (percent)
48 Mt 71	Pamlico	0.18	68		4	21	1	6
48 Mt 72	Pamlico	.12	73	2	4	11	2	8
48 Mt 73	Pamlico	.15	63		5	28	1	3
48 Mt 74	Pamlico	.14	74		3	19	2	2
48 Mt 80	Pamlico	.34	58		3	25	1	13
48 Mt 85	Pamlico	.44	27	Tr	Tr	4	Tr	68
48 Mt 68	Talbot	.12	50	3	5	35	5	2
48 Mt 76	Talbot	.02	40	2	2	14	1	41
48 Mt 77	Talbot	.04	65	3	5	11	1	15
48 Mt 78	Talbot	.11	66	2	6	16	2	8
48 Mt 79	Talbot	.03	54	3	3	24	3	13
48 Mt 81	Talbot	.62	62	3	6	11		18
48 Mt 82	Talbot	.03	50		5	22		23
48 Mt 83	Talbot	.03	71	1	2	14	2	10
48 Mt 84	Talbot	.05	67	Tr	3	16	3	11
48 Mt 63	Penholoway	.14	64	3	6	16	2	9
48 Mt 64	Penholoway	.06	45	Tr	8	24	Tr	23
48 Mt 65	Penholoway	.05	61	Tr	3	21	5	10
48 Mt 66	Penholoway	.07	62	Tr	6	17	2	13
48 Mt 67	Penholoway	.04	67		4	18	1	10
48 Mt 69	Penholoway	.11	66	Tr	3	15	2	17
48 Mt 86	Penholoway	.07	61		5	30	3	1
48 Mt 88	Penholoway	.68	71		3	11	2	13
48 Mt 59	Wicomico	.05	39		9	17	4	31

Table 2.--Heavy-mineral content of samples from Pleistocene terrace deposits and Eocene formations in southeastern South Carolina (Continued)

Sample No.	Terraces	Total heavy minerals (percent)	Distribution of total heavy-mineral content					
			Ilmenite (percent)	Leucoxene (percent)	Rutile (percent)	Zircon (percent)	Monazite (percent)	Others (percent)
48 Mt 62	Wicomico	0.19	46	Tr	7	16	3	28
48 Mt 70	Wicomico	.24	30		1	6	14	49
48 Mt 57	Okefenokee	.08	54		3	13	4	26
48 Mt 58	Okefenokee	.02	31		12	35	Tr	22
48 Mt 60	Okefenokee	.02	29		10	43	2	16
48 Mt 61	Okefenokee	.13	47	Tr	7	7	1	38
48 Mt 52	Sunderland	.07	73		2	14	5	6
48 Mt 53	Sunderland	.03	37		9	26	5	23
48 Mt 46	Coharie	.04	34	3	3	6	1	53
48 Mt 47	Coharie	.04	25	3	9	26	7	30
48 Mt 48	Coharie	.17	30	3	7	10	4	46
48 Mt 49	Coharie	.56	14	15	6	6	3	56
48 Mt 56	Coharie	.31	46		7	41	3	3
48 Mt 50	Brandywine	.08	47		3	6	7	37
48 Mt 51	Brandywine	.02	42		10	7	2	39
Mean	Pleistocene terraces	0.15	51.5	1.2	5.1	18.0	2.7	21.5
48 Mt 54	McBean(middle Eocene)	.02	39		4	8	9	40
48 Mt 55	" "	.03	58		5	15	8	14
48 Mt 75	Black Mingo (lower Eocene)	.28	56	Tr	3	20	1	20
48 Mt 87	" "	.08	70		3	24	2	1
Mean	Eocene formations	0.10	55.7		3.8	16.8	5.0	18.7

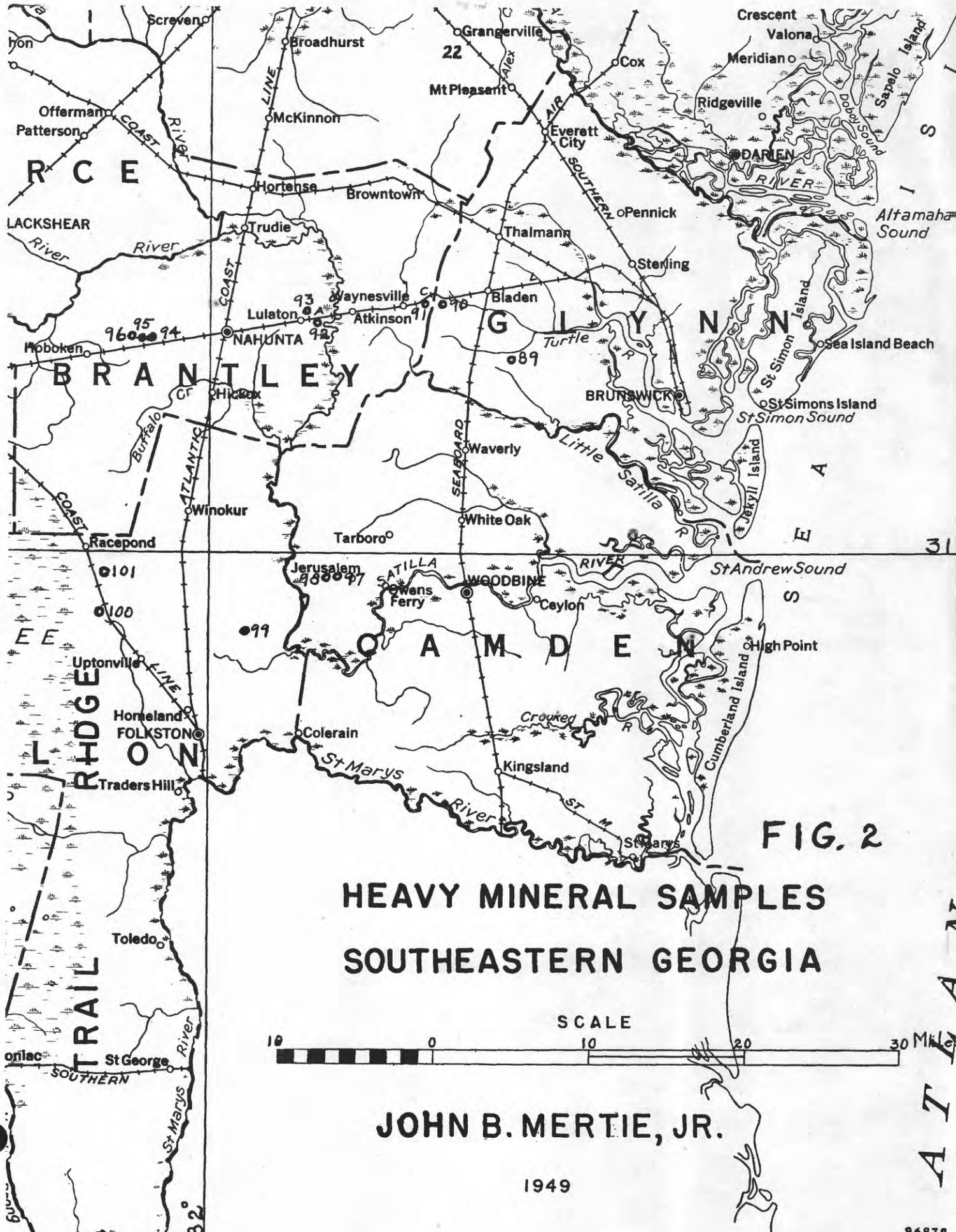
The amount of monazite in the heavy-mineral fraction of the Santee Valley terrace deposits, however, is greater than elsewhere to the southwest along the Atlantic coast. Thus, the mineralogic analyses from southeastern Georgia (table 4) show an average tenor in monazite of only 1.2 percent. This diminution in the content of monazite continues southward, as the tenor at the plant of the Titanium Alloy Manufacturing Co., southeast of Jacksonville, Fla., is 0.5 percent; and the tenor in monazite of the heavy minerals at the south end of Trail Ridge, Fla., is from 0.1 to 0.05 percent.

Southeastern Georgia

Twelve samples of the Pleistocene terrace deposits in the country between Brunswick and Trail Ridge were panned (fig. 2). One other sample from this area of the Miocene Hawthorn formation was also taken. The localities, altitudes, terrace assignments, lithology, and contents of heavy minerals for all these samples are given in tables 3 and 4.

The average content of heavy minerals in the terrace deposits of this area is more than twice that in the terrace deposits in and near the Santee Valley of South Carolina. Five of the samples taken from the east side of Trail Ridge have an average content of 0.6 percent of heavy minerals, about 1/7 of the lowest commercial grade, and two of the five samples have a content of nearly 1.0 percent of heavy minerals, or approximately 1/4 the lowest commercial grade.

These higher tenors of heavy minerals along the east side of Trail Ridge may have some significance. It is true that no ores of commercial grade have been located, but if dependence had been placed entirely upon surficial sampling, the large deposit at the south end of Trail Ridge would not have been discovered, as the surficial tenor of heavy minerals is likewise about one percent. The commercial ore of this deposit, which has an average content of 3.9 percent of heavy minerals, lies from 10 to 40 feet below the surface.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SCALE
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FIG. 2
HEAVY MINERAL SAMPLES
SOUTHEASTERN GEORGIA
JOHN B. MERTIE, JR.
1949
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Table 3.—Localities and descriptions of samples from southeastern Georgia.

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 89	North side of U. S. road 84, about 2.3 miles east of College Creek, and 2.7 miles east of junction with State road 99, Glynn County.	Probably bar on Pamlico terrace and formation	?	Gray sand	4½-foot section	25	27.7
48 Mt 90	North side of U. S. road 84 about 2.6 miles east of Waynesville, and 2.8 miles west of Seaboard RR crossing, Glynn County.	Pamlico terrace and formation near Pamlico shoreline.	21'	Upper half of section, light gray, carbonaceous sand; lower half, clayey yellow sand.	3½-foot section	25	10.3
48 Mt 91	North side of U. S. road 84, about 1½ miles east of Waynesville, Brantley County.	Outside bar on Penholoway terrace and formation	60'	Light to dark yellow, non-clayey, unconsolidated sand exposed in sand pit at crest of hill.	5-foot section	25	14.2
48 Mt 92	North side of U. S. road 84, on crest of hill; about 1/2 mile west of Satlla River, Brantley County.	Bar or beach on Penholoway terrace and formation	70'	White sand and exposed in sand pit	7-foot section	25	8.9
48 Mt 93	North side of U. S. road 84, about 0.7 mile east of Lulaton, and about 5.6 miles west of railroad crossing in Nahunta, Brantley County.	Hawthorn formation (Miocene) overlain by 3 feet of Penholoway sand	80'		7-foot section of Hawthorn formation	25	8.7
48 Mt 94	South side of U. S. road 84, about 1.2 miles east of Hoboken Five Tower, Brantley County.	Penholoway shoreline on east side of Trail Ridge.	75'	Carbonaceous non-clayey fairly coarse sand; uniform grain size.	5-foot section	25	23.2

Table 3.—(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 95	South side of U. S. road 84, about 0.5 mile east of Hoboken Five Tower, Brantley County.	Shore line of Wicomico terrace and formation on east side of Trail Ridge	100'	Coarse, carbonaceous sand containing many black minerals.	4-foot section	25	105.2
48 Mt 96	Northside of U. S. road 84, about 200 yards east of Hoboken Five Tower, Brantley County.	Shore line of Okefenokee terrace and formation on east side of Trail Ridge.	140'	4 feet of unconsolidated gray, carbonaceous sand; lower 4 feet is consolidated brown sandstone that disintegrates in water.	8-foot section	25	108.6
48 Mt 97	South side of unpaved road, about 1¼ miles west-southwest of Jerusalem, Camden County.	Above the level of the Talbot terrace and formation.	45'	Hard packed white sand at base, overlain by carbonaceous sand, overlain by 12 inches of windblown sand.	6-foot section	25	28.0
48 Mt 98	Northside of unpaved road, about 1 1/3 miles west-southwest of Jerusalem, Camden County.	Penholoway terrace and formation	65'	Light yellow sand overlain by 1 foot of wind blown sand.	6-foot section	25	22.8
48 Mt 99	West side of Burnt Fork-Folkston (unpaved) road about 2/5 miles S 71° W from Burnt Fork (crossing of Satella River) Charlton County.	Penholoway terrace and formation	60'	White sand, resting on Hawthorn formation.	5-foot section	25	35.4
48 Mt 100	West side of U. S. road 1, 3 2/5 miles N 38° W from Uptonville, and on the west side of the Atlantic Coast Line, railroad cut.	Wicomico terrace and formation on east side of Trail Ridge.	100'	Gray sand.	Upper 6 feet of cut	25	62.0

Table 3.—(Continued)

Sample No.	Location	Formation	Altitude (above sea level)	Description	Part of formation sampled	Sample weight (pounds)	Heavy mineral weight (grams)
48 Mt 101	East side of U. S. road 1, 6 1/4 miles N. 29° W from Uptonville at entrance of a side road leading to Sand Hill Church, Charlton County.	Okefenokee (Lower Sunderland terrace and formation along east side of Trail Ridge).	145'	Yellow sand overlain by thin bed of wind blown sand.	4-foot section	25	38.5

Table 4.—Heavy-mineral content of samples from Pleistocene terrace deposits of southeastern Georgia

Sample No.	Terraces	Total heavy minerals (percent)	Distribution of total heavy-mineral content					
			Ilmenite (percent)	Leucoxene (percent)	Rutile (percent)	Zircon (percent)	Monazite (percent)	Others (percent)
48 Mt 89	Pamlico	0.24	47		7	38	6	2
48 Mt 90	Pamlico	.09	47		8	40		5
48 Mt 97	Talbot	.25	50		5	38	1	6
48 Mt 91	Penholoway	.13	63		7	27	1	2
48 Mt 92	Penholoway	.08	49		6	38	5	2
48 Mt 94	Penholoway	.20	39		6	28	Tr	27
48 Mt 98	Penholoway	.20	47	2	9	27	1	14
48 Mt 99	Penholoway	.31	51	3	8	27	Tr	11
48 Mt 95	Wicomico	.93	31	Tr	4	24	Tr	41
48 Mt 100	Wicomico	.55	42	Tr	7	29		22
48 Mt 96	Okefenokee	.96	43		4	27		26
48 Mt 101	Okefenokee	.34	39		7	50	Tr	4
Mean	Pleistocene terraces	.37	45.7	0.4	6.5	32.7	1.2	13.5
48 Mt 93	Hawthorn (Miocene)	0.08	67		5	18	8	2

CONCLUSIONS

If economic concentrations of heavy minerals exist in the Pleistocene terraces of South Carolina and Georgia, they most likely occur in the Wicomico, Okefenokee, and Sunderland terraces and formations, and to the east or southeast of Trail Ridge. Analyses of samples show that sands containing relatively large amounts of heavy minerals are percentagewise low in monazite, and that sands containing small amounts of heavy minerals are percentagewise high in monazite.

It does not seem likely that further surface sampling will be of value in searching for such deposits. The formations in which heavy minerals occur are not indicated by the topography, and the sites of particular Pleistocene shore lines are no index of the occurrence of ore sands. Spots of black sand along the present beaches are perhaps the least significant indices. Physiographic and general geologic studies are therefore poor exploratory tools, though geologic and mineralogic work are needed in genetic studies of the ore sand.

Exploration by drilling and trenching is the only means of locating new deposits. Auger drilling and trenching might suffice for shallow prospecting but, owing to the water tables' proximity to the surface, deeper exploration would be done best by drilling with casing. Exploration by drilling requires equipment, skilled personnel, and laboratory facilities for the study of samples; therefore, any program of drilling would have to provide for these items.