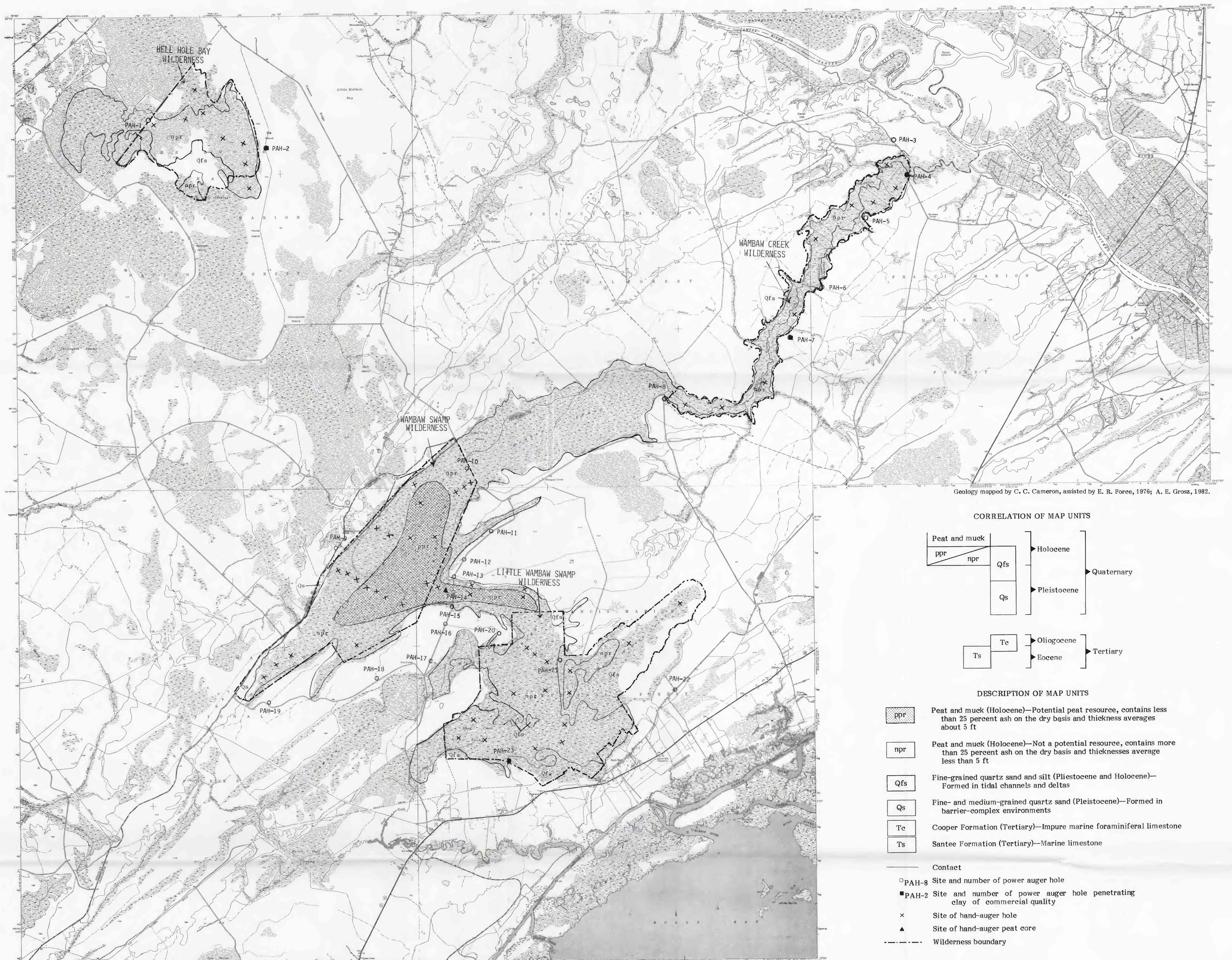
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1556-B
PAMPHLET ACCOMPANIES MAP



Geology mapped by C. C. Cameron, assisted by E. R. Force, 1978; A. E. Grosz, 1982.

Base from U.S. Geological Survey 1:24,000
Awendaw, Ocean Bay, Santee, and Shulerville, 1943
(photorevised 1973); and Honey Hill, 1942
(Photorevised 1973)

SCALE 1:48 000

CORRELATION OF MAP UNITS

Peat and muck (ppr, npr)	Qfs	Holocene	Quaternary
	Qs	Pleistocene	
Ts	Tc	Oligocene	Tertiary
		Eocene	

DESCRIPTION OF MAP UNITS

ppr — Peat and muck (Holocene)—Potential peat resource, contains less than 25 percent ash on the dry basis and thickness averages about 5 ft

npr — Peat and muck (Holocene)—Not a potential resource, contains more than 25 percent ash on the dry basis and thicknesses average less than 5 ft

Qfs — Fine-grained quartz sand and silt (Pleistocene and Holocene)—Formed in tidal channels and deltas

Qs — Fine- and medium-grained quartz sand (Pleistocene)—Formed in barrier-complex environments

Tc — Cooper Formation (Tertiary)—Impure marine foraminiferal limestone

Ts — Santee Formation (Tertiary)—Marine limestone

Contact

PAH-8 Site and number of power auger hole

PAH-2 Site and number of power auger hole penetrating clay of commercial quality

× Site of hand-auger hole

▲ Site of peat core

Wilderness boundary

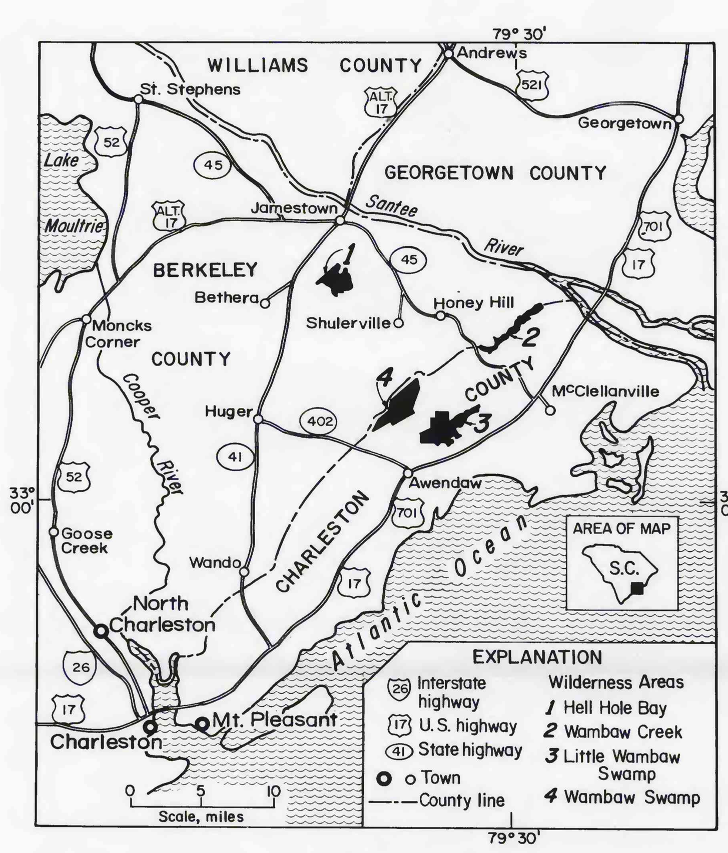


Figure 1.—Index map of the Hell Hole Bay, Wambaw Swamp, Little Wambaw Swamp and Wambaw Creek Wildernesses

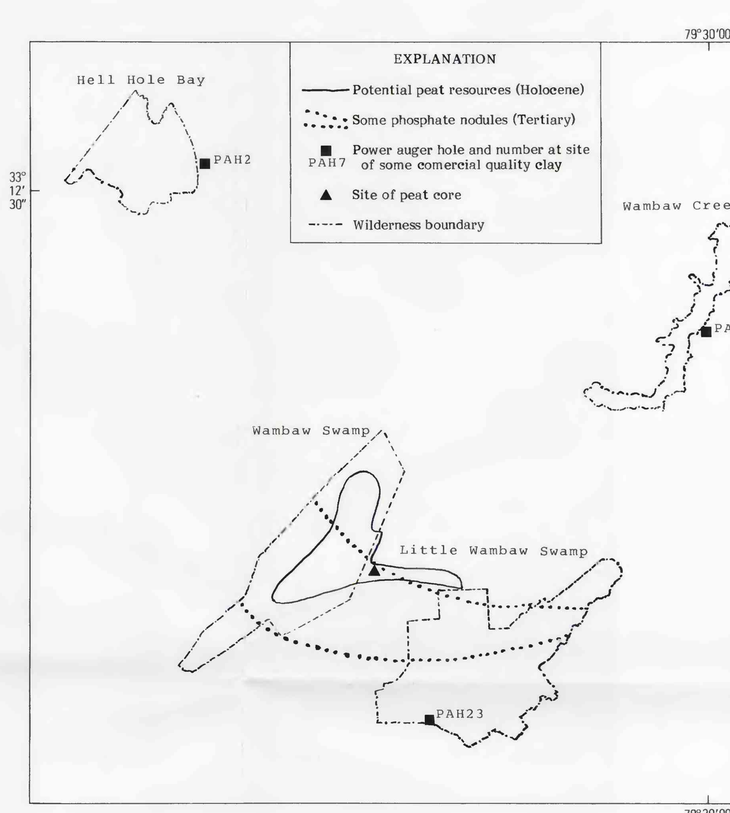


Figure 2.—Map of Hell Hole Bay, Wambaw Creek, Wambaw Swamp and Little Wambaw Swamp Wildernesses showing areas of potential peat resources, site of peat core, area of some phosphate nodules and sites of power-auger holes penetrating small amounts of clay.

MINERAL RESOURCE POTENTIAL MAP OF THE HELL HOLE BAY, WAMBAW SWAMP, LITTLE WAMBAW SWAMP, AND WAMBAW CREEK WILDERNESSES, BERKELEY AND CHARLESTON COUNTIES, SOUTH CAROLINA

By

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STUDIES RELATED TO WILDERNESS

The Wilderness Act (Public Law 88-577, September 3, 1964) and related acts require the U.S. Geological Survey and the U.S. Bureau of Mines to survey certain areas on Federal lands to determine their mineral resource potential. Results must be made available to the public and be submitted to the President and the Congress. This report presents the results of a mineral resource potential survey of the Hell Hole Bay, Little Wambaw Swamp, Wambaw Swamp, and Wambaw Creek Wildernesses in the Francis Marion National Forest, Berkeley and Charleston Counties, S.C. These four wildernesses were established by Public Law 96-560, December 22, 1980.

SUMMARY

Hell Hole Bay, Little Wambaw Swamp, Wambaw Creek, and Wambaw Swamp Wildernesses are coastal plain swamplands in the Francis Marion National Forest, Berkeley and Charleston Counties, S.C. Unconsolidated Quaternary-age sediments, ranging in thickness from 10 to more than 60 ft, overlie bedrock, consisting of the Santee Limestone in the Hell Hole Bay and Wambaw Creek Wildernesses and the Cooper Formation in the Wambaw Swamp and Little Wambaw Swamp Wildernesses.

Peat is a potential resource only in Wambaw Swamp, where approximately 810,000 tons on the dry basis occurs. A small amount of clay, suitable for structural-clay products and expanded lightweight aggregate, is of potential importance in the Hell Hole Bay and Wambaw Creek Wildernesses. Although phosphate concentrations occur in Little Wambaw Swamp and Wambaw Swamp, they are low grade. Uranium and heavy minerals occurring in the wildernesses are in amounts too small to be economically important. Sand, suitable for the ceramics industry, and limestone, suitable for agricultural lime, crushed stone, and cement, are more easily obtainable in greater amounts elsewhere on the coastal plain and at this time are economically unimportant. Oil and gas are not known to occur in the South Carolina Coastal Plain. Recent speculation suggests the possibility of hydrocarbon accumulation at great depth in the region. This possibility has not been tested.

INTRODUCTION

The Hell Hole Bay, Wambaw Creek, Little Wambaw Swamp, and Wambaw Swamp Wildernesses together comprise 13,720 acres in the Francis Marion National Forest, Berkeley and Charleston Counties, S.C. Hell Hole Bay comprises 1,980 acres, Wambaw Creek 1,640 acres, Little Wambaw Swamp 5,000 acres, and Wambaw Swamp 5,100 acres. All four Wildernesses are swamps located about 30 mi northeast of Charleston, S.C., and are easily accessible by a good road network on the lower Coastal Plain province (fig. 1).

SURFACE- AND MINERAL-RIGHTS OWNERSHIP

All surface and mineral rights for the wilderness areas are owned by the Federal Government. There are no outstanding mining or prospecting permits or applications in the Francis Marion National Forest, nor is there any record of applications in the past.

GEOLOGY

Unconsolidated deposits of Quaternary age conceal the somewhat more indurated rocks of the Santee Limestone and Cooper Formation of Tertiary age in and near the four wildernesses. These Tertiary sedimentary rocks probably overlie 2,100 to 2,400 ft of Upper Cretaceous and Paleocene sedimentary rocks. No deep drilling has been done in the wildernesses, but reasonable projections can be made from test holes located 25 or 30 mi to the west (Bureau of Land Management, 1978; Siple, 1958; and Gohn and others, 1977).

The oldest formation penetrated by power-auger drill holes in the wildernesses is the Santee Limestone, to which Hazel (1975) assigns a late Eocene age. It lies closest to the surface in the Hell Hole Bay and Wambaw Creek Wildernesses and is deepest in southern parts of the Wambaw and Little Wambaw Swamp Wildernesses.

The Cooper Formation, described by Stephenson (1914), Cooke and MacNeil (1952), Malde (1959), and Hazel (1975), consists of carbonate sand, clay, and phosphate. It lies unconformably on the Santee. Some phosphate nodules, representing an old erosional surface at the base of the Cooper, extend across Wambaw and Little Wambaw Swamps.

Deposits of clay, silt, sand, and gravel of Quaternary age unconformably overlie the Santee Limestone and Cooper Formation in and near the four wildernesses to a thickness greater than 60 ft at the southern borders of Wambaw Swamp and Little Wambaw Swamp. The oldest deposits are beds of granular to shelly, coarse- to medium-grained feldspathic sand, locally grading upward into silty clay. These deposits reflect fluvial (at the base) to upper estuary (at the top) depositional environments. The estuary deposits are in turn overlain by calcareous sandy muds and muddy fine sands typical of nearshore shelf, lagoon, and inlet environments. Next in the transgressive sequence are well-sorted sands that form the gentle rises of former barrier islands and sand-spit deposits. Fine-grained sand, silt, and organic clay fills channels that were cut into the older sediments by the regressing sea. Peat and muck of Holocene age represent the present stage of sedimentation in the fresh water swamps now covering the wildernesses.

MINERAL RESOURCE POTENTIAL

Peat, used by the agriculture, horticulture, and fuel industries, is the only potential mineral resource in the area. Clay, suitable for structural clay products and expanded lightweight aggregate, is present in very small amounts and is a potential resource only in the Wambaw Creek and Hell Hole Bay Wildernesses. Uranium and heavy minerals occurring in the wildernesses are also in amounts too small to be a potential resource. Although phosphate concentrations occur in Little Wambaw Swamp and Wambaw Swamp, they are low grade. Sand, suitable for the ceramics industry, and limestone, used for agricultural lime, crushed stone, and cement, are more easily obtainable in greater amounts elsewhere on the coastal plain. Oil and gas are not known to occur in the South Carolina Coastal Plain. Recent speculation suggests the possibility of hydrocarbon accumulation at great depth in the region, but as yet this possibility has not been tested.

Peat

Hand augering shows that peat and muck of Holocene age is prevalent in all four wildernesses; however, only in Wambaw Swamp does peat occur as a potential resource (defined as containing not more than 25 percent ash on the dry-weight basis and in a minimum thickness of 5 ft).

A core sample collected near the eastern margin of Wambaw Swamp is typical of the unit mapped as potential peat resource (ppr). It showed 5 ft of commercial-quality peat and 1 ft of organic material having more than 25 percent ash resting on Pleistocene and Holocene fine-grained quartz sand and silt. Analyses of two samples are shown in table 1. Sample CC82-1 was taken at a depth of 1 ft and Sample CC82-2 was taken at a depth of 2 to 3 ft. Approximately 810 acres of the Wambaw Swamp Wilderness contains 810,000 tons of peat on the dry basis, computed as 200 tons per acre-foot at an average thickness of 5 ft. The peat is of comparatively low acidity and has an ash content well below the minimum permitted for commerical-quality peat. Fuel value was not determined for these samples, but for similar samples of North Carolina and Florida peat, values range from 9,500 to 10,646 BTU per pound (Cameron, 1980).

Peat has been mined commercially for agricultural and horticultural use from only one locality in South Carolina—near Green Pond, Colleton County, about 50 mi southwest of the wildernesses. According to USBM records, mining there has been continuous since 1958. A $250 million peat-to-methanol conversion plant at Cresswell, N.C. is under construction at a lower coastal plain peat deposit (Davis, 1982).

Phosphate

More than 13 million long tons of phosphate rock were mined in the Charleston area from 1867 until 1938, when richer deposits in Florida and Tennessee were developed (Malde, 1959). Little information is available regarding the grade of phosphate mined, but drill-hole samples by Malde (1959) give values of 5.6 to 9.6 percent P_2O_5 as the higher range of values for analyses of Cooper "marl" samples from the Charleston phosphate area.

The higher phosphate values are in zones of secondary enrichment which occur locally in the weathered upper part of the Cooper Formation and in the overlying sediments. Enrichment has occurred where erosion has removed phosphatic Cooper Formation from some areas, then leached, reworked, and redeposited it in others. The resulting 2- to 3-foot thick, unconsolidated conglomerate that lies unconformably on the weathered surface of the Cooper contains a concentration of phosphate nodules that commonly range from sand to pebble size. Recent studies of the Cooper by Force and others (1978) show P_2O_5 values in these zones of secondary phosphate enrichment to have an average of 5.4 percent, with some values as high as 13.9 percent.

Previous augering by the USGS (Force, 1978) and power-auger holes (PAH) located on the map of this report indicate that the Cooper Formation is present only in parts of Little Wambaw Swamp and Wambaw Swamp (fig. 2 inset). Based on this information, it is estimated that approximately 200 acres of Little Wambaw Swamp and 600 acres of Wambaw Swamp are underlain by the Cooper. Subsurface information gathered by Cameron and others (1979) at Little Wambaw Swamp from PAH-20 and PAH-21 shows that the enriched-phosphate zone averages 3 ft thick, has a P_2O_5 content of about 8 percent, and overburden 40 to 60 ft thick. These deposits do not compare favorably with similar deposits currently being mined in Florida, which are generally 20 or more ft thick, more than 25 percent P_2O_5, and have overburden thicknesses which vary, but are frequently in the 15- to 40-foot range.

Clay

Clay beds of varying quality and size occur in unconsolidated Quaternary-age sediments above the Santee Limestone and the Cooper Formation. These beds are normally associated with lagoonal environments, behind barrier-dune scarp structures, or with river estuaries. The only clay deposit near the wildernesses that has been commercially recovered is a river-terrace deposit along the Santee River near St. Stephens, S.C., about 20 mi northwest of Hell Hole Bay (Heron and others, 1965). The clay, used in the manufacture of bricks, is not currently being mined.

A possible source of commercial clay in the Little Wambaw Swamp Wilderness was noted in PAH-23 at a depth of 34 ft. It is a noncalcareous, homogenous, sticky, blue-gray clay approximately 24 ft thick, containing detrital wood and a few foraminifera tests. X-ray diffraction indicated the primary clay mineral to be kaolinite.

Clay beds in the other 22 auger holes are thin; only one exceeds 9 ft in thickness. This clay, from PAH-2 near Hell Hole Bay, is within 2 ft of the surface and is 18 ft thick. In slow-firing tests, the upper 14 ft of clay (Sample 13-14 from PAH-2) showed good firing qualities with a firing range of 1,100-1,250 °C, indicating suitability for structural-clay products (table 2). Samples 2 (PAH-4), 10 (PAH-7), and 16 (PAH-2) also fired successfully (table 2), but none of these clay beds exceeded 6 ft in thickness at the sample site. In testing the clays for use in expanded lightweight aggregate, only sample 16 (PAH-2) showed good bloating qualities (table 2).

These clay beds were laid down in fluvial, esturine, and tidal environments, which tend to form irregular deposits that vary in thickness over short distances and are often limited in extent. Additional augering would be necessary to define the size and determine thickness variations of the clay deposits.

Uranium

Uranium is present in the phosphatic material of the Charleston-area deposits. Its percentage is directly related to the phosphate content of the sediments. Force and others (1978) calculated that zones of secondary phosphate enrichment associated with the Cooper Formation average 60 parts per million (ppm) uranium.

Five auger-hole samples from two sites adjacent to Little Wambaw Swamp (PAH-20 and PAH-21) yielded from 33 to 123 ppm uranium, well below the 200 ppm currently considered to be the lowest grade economically feasible to mine from easily leached deposits (Cameron and others, 1979). Deposits in Little Wambaw Swamp, besides being low grade, average only 3 ft thick and are overlain by 40 to 60 ft of overburden.

Limestone

Both the Santee Limestone and Cooper Formation have been quarried in South Carolina for various uses. At present, the Santee is being quarried for agricultural lime and crushed stone near Jamestown, S.C., and for cement near Harleyville, S.C., both about 50 mi west of the wilderness areas. In the past, the Cooper has been used in the manufacture of cement and, in places, its magnesium content may make it valuable as a source of agricultural lime.

Neither the Santee nor the Cooper is exposed in or near the wilderness areas. The Santee is within 10 to 25 ft below the surface in the Hell Hole Bay and Wambaw Creek Wildernesses. Overburden in Wambaw Swamp and Little Wambaw Swamp is at least 50 ft thick. Both the Santee and the Cooper are more accessible elsewhere in the region.

Sand

Large deposits of well-sorted sand of marine origin occur at the surface in the barrier bars adjacent to the wildernesses, but within the boundaries the sands are interbedded with lagoonal and swamp-deposited clays and organic material. Some of the sand beds underlying the swamps are of fluvial origin (Colquhoun and others, 1972) and contain from 10 to 50 percent potassium feldspar (Cameron and others, 1979), which is of possible interest to the ceramics industry. However, since well-sorted, high-quality, easily assessible sand occurs throughout the coastal plain in both beach and fluvial deposits, the sands under the wildernesses are of little economic importance at this time.

Heavy Minerals

Heavy-mineral concentrations in beach sands are a major source of titanium and zircon and a variety of other industrial minerals are produced as byproducts. Both the USBM and private companies have drilled the South Carolina Coastal Plain in search of heavy-mineral concentrations, but mining ventures have not been successful.

Available drilling information from the vicinity of the wildernesses indicate that heavy minerals are concentrated to less than 3 percent, and many of the concentrated heavy minerals are not of economic value. As a comparison, Florida deposits presently being mined have heavy-mineral concentrations of 3.5 to 4.5 percent with about 45 percent of the concentrate being titanium minerals (ilmenite and rutile), plus large percentages of zircon and varying amounts of other economically valuable minerals (Calver, 1957).

The drilling of eight holes by the USBM near the Wambaw Creek Wilderness in the 1950's indicated that the average heavy-mineral content was 2.9 percent (Williams, 1967). The amount of ilmenite in the heavy-mineral concentrate from one hole was reported as 41 percent. This high value for ilmenite has not been substantiated by more recent drilling in the area (Arthur H. Maybin, South Carolina Division of Geology, oral commun., 1982), and exact locations for the original eight holes are not available.

Results of mineral determinations for three power-auger holes (PAH-14, PAH-20, and PAH-23) near the Little Wambaw Swamp Wilderness show the concentration of heavy minerals less than 3 percent (table 3). Titanium minerals make up 14 percent of the heavy mineral concentrate (12 percent ilmenite and 2 percent rutile); the major minerals, hornblende and epidote, are not of economic value. Analyses of samples from power-auger sites at Wambaw Swamp, Wambaw Creek, and Hell Hole Bay confirmed the absence of heavy-mineral concentrations (Table 4).

Oil and Gas

Oil and gas have never been produced in South Carolina. Rodehamel (1979) assessed the probability of discovering commercial quantities of hydrocarbons as low. He stated, in part, that sedimentary layers on the coastal plain are thin, that the area lacks adequate source beds, and that suitable traps are unknown.

Seismic studies suggest that sedimentary rocks may underlie crystalline rock in the core of the southern Appalachians west of the wildernesses. The crystalline rock, formerly considered to be in-place basement rock, has recently been theorized to have been overthrust from the east. It has also been suggested that the concealed sedimentary strata are likely hydrocarbon traps and that they exist at great depth as far east as the present coastal plain (Cooke and others, 1980). This possibility has not yet been tested by deep drilling in the area.

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Table 1.—*Analyses of peat samples from hand-augered core.*

Sample No.	Ash (Percent dry weight basis)	pH	Moisture (Percent as received)	Peat type
CC82-1	8.28	4.25	86.09	Humus
CC82-2	9.24	3.95	88.64	Humus

[1]Analyst - R. Moore, USGS Laboratories, Reston, Va.

Table 3.—*Heavy minerals in Pleistocene sands of the Little Wambaw Swamp Wilderness.*

APPROXIMATE WEIGHT PERCENT OF HEAVY MINERALS (P .5%)

Drill site	Depth (feet)	Heavy minerals (p 2.85) in weight percent	"Ilmenite"*	Magnetite	Amphibole +Pyroxene	Epidote	Garnet	Staurolite	Sulfides	Phosphate	Zircon	Sillimanite	Rutile
PAH-14	25.0-27.5	0.7	8	1	20	30	3	8	4	P	-	3	P
PAH-14	38.0-40.0	0.9	6	1	20	30	5	9	7	P	P	4	2
PAH-20	0-17	0.8	5	1	20	30	P	12	-	1	2	4	2
PAH-23	5.0-9.0	2.7	10	P	30	15	2	4	-	P	P	5	1
PAH-23	25.5-26.0	1.7	12	P	25	20	2	7	1	1	2	2	2
PAH-23	55.0-60.0	1.1	9	P	30	25	5	7	3	3	P	2	2
PAH-23	64.0-69.0	2.0	5	P	30	25	3	5	2	4	2	2	2

*"Ilmenite" is defined by magnetism, density, color, and opacity, but consists mostly of alteration products.

Table 4.—*Heavy minerals in Pleistocene sands of the Wambaw Creek, Wambaw Swamp, and Hell Hole Bay Wildernesses.*

Drill site*	Depth (feet)	Heavy minerals (S.G. 2.85) in weight percent	Mineralogy[1] (shown in order of decreasing abundance)
PAH-1	12-19	0.14	Amphibole, epidote, sillimanite, ilmenite, staurolite, garnet, rutile, zircon
PAH-3	0-3	2.54	Amphibole[2], epidote, ilmenite[3], staurolite, sillimanite[4], zircon, rutile
PAH-3	19-22	0.10	Limonite, amphibole, ilmenite, sillimanite, epidote, zircon, rutile
PAH-5	3-5	0.03	Sillimanite, ilmenite, epidote, amphibole, staurolite, rutile, zircon
PAH-7	11-20	0.92	Amphibole, epidote, sillimanite, ilmenite, staurolite, rutile, zircon, sulfides
PAH-9	0-5	1.27	Ilmenite, epidote, sillimanite, staurolite, amphibole, tourmaline, zircon, rutile
PAH-9	11-21	0.30	Amphibole, epidote, ilmenite, sillimanite, staurolite, rutile, zircon, mica
PAH-9	28-41	0.05	Amphibole, epidote, sillimanite, staurolite, ilmenite, zircon, rutile
PAH-18	0-15.5	0.23	Amphibole, sillimanite, epidote, ilmenite, staurolite, tourmaline, zircon, rutile, mica
PAH-19	0-10	0.13	Amphibole, ilmenite, sillimanite, staurolite, epidote, rutile, zircon
PAH-19	10-14	0.38	Amphibole, sillimanite, ilmenite, epidote, staurolite, rutile, zircon
PAH-19	27-35	0.61	Amphibole, epidote, sillimanite, ilmenite, tourmaline, rutile, zircon, phosphate
PAH-19	35-40	1.04	Amphibole, epidote, sillimanite, tourmaline, ilmenite, staurolite, garnet, zircon, rutile
PAH-19	48-55	0.39	Amphibole, epidote, sillimanite, ilmenite, staurolite, garnet, zircon, rutile
PAH-22	0-7	1.20	Amphibole, epidote, sillimanite, staurolite, ilmenite, tourmaline, garnet, zircon, rutile
PAH-22	9-14	0.47	Epidote, amphibole, sillimanite, ilmenite, staurolite, tourmaline, zircon, mica, rutile
PAH-22	14.5-18	0.90	Amphibole, epidote, ilmenite, sillimanite, tourmaline, staurolite, mica, sulfides, zircon, rutile
PAH-23	0-13	0.60	Amphibole, epidote, sillimanite, ilmenite, staurolite, rutile, zircon
PAH-24	13-18	0.19	Amphibole, epidote, sillimanite, staurolite, ilmenite, mica, tourmaline, rutile, zircon
PAH-24	22-25	0.30	Amphibole, epidote, sillimanite, staurolite, mica, ilmenite, phosphate, tourmaline, zircon, rutile

*Power-auger holes drilled by Earl M. Lemon, Jr., USGS
Mineral separations by Cynthia M. Sears, USGS
1 All samples contain trace magnetite
2 Includes pyroxene
3 Ilmenite is defined by magnetism, density, color, and opacity, but consists mostly of alteration products
4 Includes kyanite

Table 2.—*Evaluation of clay samples, Hell Hole Bay and Wambaw Creek Wildernesses.*

[Testing performed by the U.S. Bureau of Mines Tuscaloosa Research Center, Tuscaloosa, Ala.]

Sample number	Power-auger hole number	Sample depth (feet)	Raw properties	Slow-fire tests: Temp. °C	Munsell color	Moh's hardness	Linear shrinkage (percent)	Absorption (percent)	Apparent porosity (percent)	Bulk density gm/cc	Potential use
13-14	PAH-2	2-16	Water of plasticity: 26.7%	1000	5 YR 7/8	3	5.0	22.5	37.3	1.66	Structural clay
			Working properties: plastic	1050	5 YR 7/6	3	7.5	19.5	3.9	1.73	products (e.g.,
			Drying shrinkage: 5.0%	1100	5 YR 6/8	4	7.5	17.0	30.9	1.81	building brick at
			Dry strength: good	1150	5 YR 6/8	4	7.5	16.1	29.6	1.84	1100°-1250°C).
			pH: 4.9	1200	2.5 YR 4/6	5	10.0	14.3	26.9	1.88	Good firing range.
			HCl effervescence: none	1250	2.5 YR 4/4	5	10.0	11.1	22.1	1.99	
16	PAH-2	29-33	Water of plasticity: 31.1%	1000	5 YR 6/8	3	5.0	27.8	42.1	1.52	Structural clay
			Working properties: plastic	1050	5 YR 6/8	3	7.5	23.9	38.4	1.61	products (e.g.,
			Drying shrinkage: 5.0%	1100	5 YR 5/8	3	7.5	22.3	6.0	1.65	building brick at
			Dry strength: good	1150	2.5 YR 5/8	3	7.5	21.7	36.3	1.67	1200°-1250°C).
			pH: 4.6	1200	2.5 YR 4/8	4	10.0	17.7	31.4	1.78	
			HCl effervescence: none	1250	2.5 YR 4/4	5	12.5	12.6	24.8	1.97	
2	PAH-4	9-13	Water of plasticity: 31.2%	1000	7.5 YR 7/8	3	5.0	28.6	42.9	1.50	Structural clay
			Working properties: plastic	1050	7.5 YR 7/8	3	7.5	25.1	39.6	1.58	products (e.g.,
			Drying shrinkage: 5.0%	1100	7.5 YR 7/8	3	10.0	22.7	37.4	1.65	building brick at
			Dry strength: good	1150	7.5 YR 8/10	3	10.0	22.1	36.6	1.66	1200°-1250°C).
			pH: 6.6	1200	7.5 YR 6/8	4	10.0	18.2	31.9	1.76	
			HCl effervescence: none	1250	7.5 YR 6/6	4	10.0	14.6	27.0	1.85	
10	PAH-7	5-11	Water of plasticity: 19.9%	1000	7.5 YR 8/6	3	5.0	18.5	33.2	1.79	Structural clay
			Working properties: short	1050	7.5 YR 8/6	3	5.0	18.2	32.6	1.79	products (e.g.,
			Drying shrinkage: 5.0%	1100	5 YR 8/6	3	5.0	17.1	31.4	1.83	building brick at
			Dry strength: fair	1150	5 YR 8/10	3	5.0	17.1	31.3	1.83	1250°C).
			pH: 6.9	1200	2.5 YR 5/8	3	5.0	14.5	27.3	1.89	
			HCl effervescence: none	1250	2.5 YR 4/4	4	7.5	12.7	24.6	1.94	

Sample number	Power-auger hole number	Sample depth (feet)	Preliminary bloating test: Temp. °C	Absorption (percent)	Bulk density (gm/cc)	Bulk density (lb/ft)	Remarks	Potential use
16	PAH-2	29-33	1050	15.5	1.48	92.4	No expansion	Lightweight aggregate at 1150°C.
			1100	14.0	1.32	82.4	Slight expansion	
			1150	14.2	.91	56.8	Good pore structure	

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1983

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