DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

TO ACCOMPANY MAP MF-1470

MINERAL RESOURCE POTENTIAL OF THE SAVANNAH ROADLESS AREA, LIBERTY COUNTY, FLORIDA

By

Sam H. Patterson[1], Walter Schmidt[2], and Thomas M. Crandall[3]

STUDIES RELATED TO WILDERNESS

Under the provisions of the Wilderness Act (Public Law 88-577, September 3, 1964) and the Joint Conference Report on Senate Bill 4, 88th Congress, the U.S. Geological Survey and the U.S. Bureau of Mines have been conducting mineral surveys of wilderness and primitive areas. Areas officially designated as "wilderness," "wild," or "canoe" when the act was passed were incorporated into the National Wilderness Preservation System, and some of them are presently being studied. The act provided that areas under consideration for wilderness designation should be studied for suitability for incorporation into the Wilderness System. The mineral surveys constitute one aspect of the suitability studies. The act directs that the results of such surveys are to be made available to the public and be submitted to the President and the Congress. This report discusses the results of a mineral survey of the Savannah Roadless Area in the Apalachicola National Forest, Liberty County, Florida. The Savannah Roadless Area was classified as a further planning area (Forest Service number (08009) during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The Savannah Roadless Area is underlain by sedimentary rocks having low potential for oil and gas and minerals. The low potential for oil or gas notwithstanding, the possibilities for discovery cannot be ruled out because the area and nearby lands have not been thoroughly explored. No minerals have been mined within the Savannah Roadless Area, and the only production nearby has been the digging of clayey sand used in stabilizing U.S. Forest Service roads. Fuller's earth, quartz sand and gravel, clayey sand, and common clay presently are produced elsewhere in the region, and limestone and peat have been produced in the past. No clay suitable for structural clay products or fuller's earth is present in the roadless area; however, a bed of quartz sand and gravel of excellent quality was penetrated at a depth interval of 37-50 ft by one drill hole. Although this bed is coarser grained—and therefore is more suitable for many uses—than the sand deposits worked elsewhere in the Big Bend region, its mineral resource potential is reduced by the thickness of overburden above it and by its distance from markets in population centers. The Apalachicola National Forest has been explored for phosphate and reconnoitered for heavy minerals, but no valuable deposits of either have been found.

INTRODUCTION

The Savannah Roadless Area lies in the Big Bend region of the Florida panhandle (fig. 1). The area can be reached by traveling about 6 mi northwest from the village of Sumatra on County Highway 379. Sumatra, in southern Liberty County, is located at the junction of County Highway 379 and Florida Highway 65. The Savannah Roadless Area is a three-sided tract of 1,944 acres bounded by County Highway 379 on the southwest and by Forest Service roads 115 on the northwest and 123 on the southeast. The area is very gently undulating; altitudes range from a maximum of 43 ft at the northern corner of the area to a low of about 25 ft where small intermittent streams cross the southwestern boundary. Compared to much of the land in the surrounding region the area is well drained. None of the swamps in the roadless area that are shown on the map (fig. 2, mineral resource potential map) contain standing water in the dry season. About half of the area is open grassland, which is the basis for the name Savannah. The other half is irregularly covered by open pine-palmetto forest.

Previous Investigations

No detailed geologic studies had been made in Liberty County prior to thorough investigations by the Florida Bureau of Geology that were begun with a drilling program in the summer of 1981. Crystalline rocks at depth in the region are discussed by Milton (1972) and outlined by Puri and Vernon (1964, plate 1). Schmidt and Clark (1980) presented the results of a thorough study of the geology of Bay County, Fla., which is about 20 mi west of the Savannah Roadless Area, and Hendry and Sproul (1966) outlined the geology of Leon County to the northeast of the area. Some information on the stratigraphy of the region is contained in publications covering the entire state by Puri and Vernon (1964) and Chen (1965). A report by Applegate, Pontigo, and Rooke (1978) summarizes information on the oil and gas potential of the Big Bend region.

[1]U.S. Geological Survey
[2]Florida Bureau of Geology
[3]U.S. Bureau of Mines

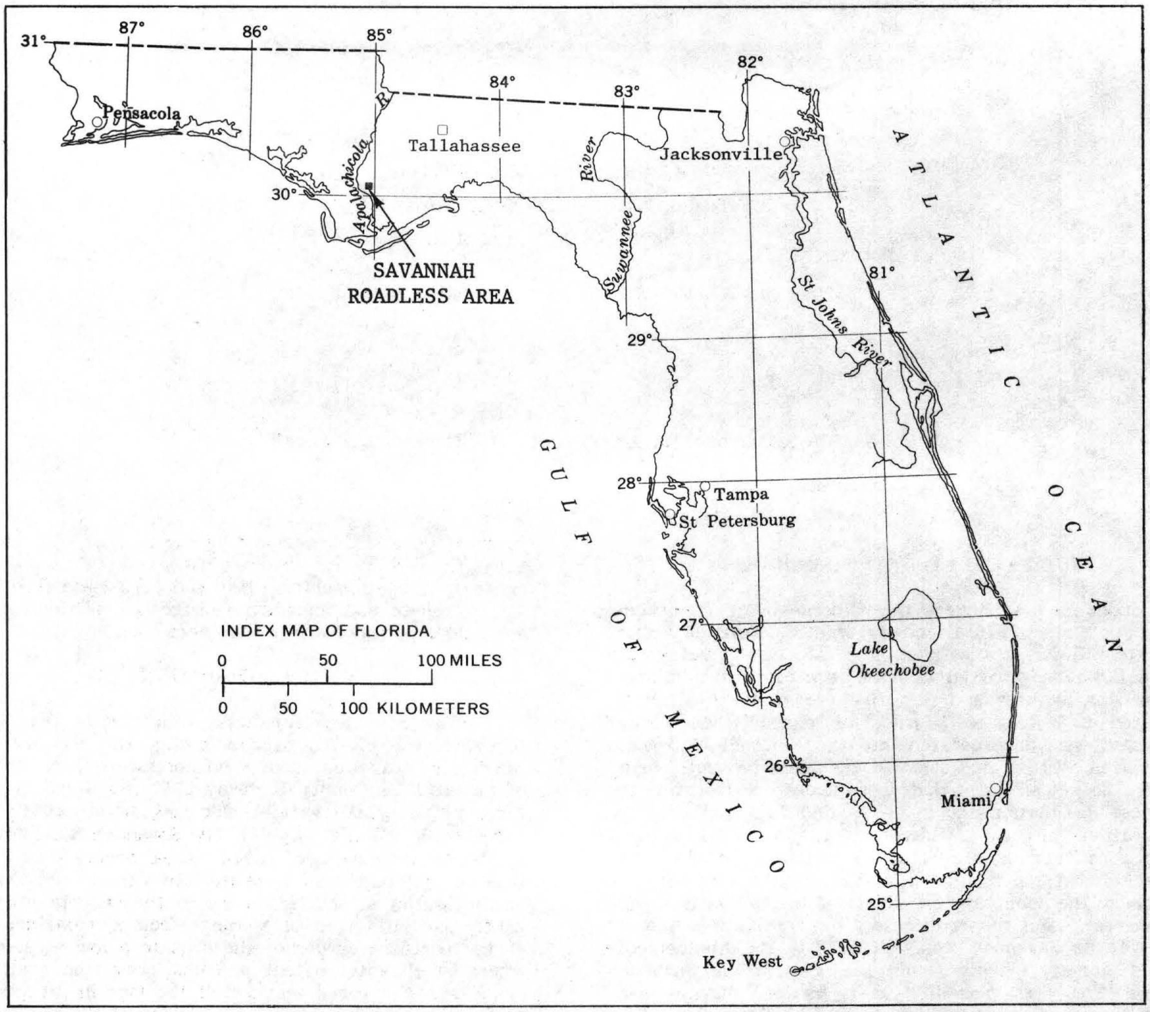

Figure 1.—Location of the Savannah Roadless Area, Liberty County, Fla.

Present Investigation

Patterson reviewed the published information on the geology of the Apalachicola National Forest, reconnoitered the region, and searched reports and records of the Florida Bureau of Geology for information on oil and gas in the spring of 1980. Crandall, assisted by Frederick W. Miller of the U.S. Bureau of Mines, investigated the area in February 1981. During this work soils were probed with an auger at several places to make certain that no peat deposits are present. Crandall also obtained information on surface- and mineral-rights ownership from the records of the U.S. Forest Service and the U.S. Bureau of Land Management. In a joint program of the U.S. Geological Survey and the U.S. Bureau of Mines, one hole was drilled in the Savannah Roadless Area and one in the Mud Swamp-New River Roadless Area in October 1980. Cores and cuttings were logged at the drill hole sites and samples were collected and later investigated in the laboratory. Schmidt supervised the drilling program of the Florida Bureau of Geology and correlated the rocks penetrated, providing much of the information on which figure 3 and discussion in the text are based.

Information on dry holes given in this report is based primarily on published reports and records on file in the Florida Bureau of Geology. The term "dry hole" is used according to the definition meaning no significant amounts of oil or gas were found.

No geochemical survey was necessary during the work leading to this report because: 1) stream-sediment and soil sampling would have yielded no information of value in appraising the nonmetallic mineral potential of the area; and 2) the metallic and other heavy minerals occurring in strata near the surface are not in sufficient concentrations to form valuable mineral deposits.

Acknowledgments

The authors are grateful for the cooperation of the Florida Bureau of Geology, the U.S. Forest Service, and the U.S. Bureau of Land Management. David Curry and Felipe A. Pontigo, Jr. of the Florida Bureau of Geology aided in gathering information on oil and gas. Tim Smith and Larry Thornton of the Apalachicola Ranger District, Apalachicola National Forest, provided maps and storage facilities for drilling equipment and samples. U.S. Forest Service personnel—William R. Waite, soil scientist, Forest Supervisors Office, Tallahassee, Fla.; James Hart, soil scientist, Wakulla Ranger District, Crawfordville, Fla.; and Edward W. Read, geologist, Region 8 Office, Atlanta, Ga.—provided soils and boundary maps and other information during the investigation. Personnel of the U.S. Bureau of Land Management supplied records of leasing and prospecting activity.

SURFACE- AND MINERAL-RIGHTS OWNERSHIP

The Federal Government owns all surface and mineral rights in the Savannah Roadless Area. These rights were acquired under the authority of the Weeks Act in the early 1930s by the U.S. Department of Agriculture, Forest Service.

In the 1960s, phosphate-prospecting permits were issued on the entire Apalachicola National Forest. There were no subsequent applications for phosphate leases. The entire Savannah Roadless Area has been under oil and gas leases in the past. In 1981 about 51 percent of the study area was under an oil and gas lease and an application for an oil and gas lease was on file on about 6 percent of the area (fig. 2).

GEOLOGY

The Savannah Roadless Area is entirely blanketed by a veneer of unconsolidated sediments that overlie a thick sequence of sedimentary rocks deposited in the Apalachicola embayment. The A-horizon soil covering the roadless area is rarely more than a foot thick. It consists chiefly of slightly clayey sand containing minor amounts of organic matter and root remains. Surficial soil is underlain by a blanket of Pleistocene and Holocene unconsolidated sand, gravel, and clay about 60 ft thick. The underlying Pliocene Jackson Bluff Formation, which is the uppermost bedrock unit, also extends over the entire area. It, in turn, is underlain by a thick sequence of older rocks described in the following sections.

Stratigraphy

Igneous, metamorphic, and sedimentary rocks ranging in age from Precambrian to early Mesozoic are almost certainly present at depth in the Savannah Roadless Area. A well drilled offshore about 43 mi southeast of the area intersected 10 ft of diabase at a depth of 10,460 ft (Milton, 1972, p. 31). This diabase is overlain by pinkish quartzitic sandstone and underlain by diabase fragments admixed with sandstone. Sills or dikes of mafic igneous rock have been found in Triassic sedimentary rocks penetrated by a few dry holes in the region (Applegate, Pontigo, and Rooke, 1978, p. 81). One dry hole 20 mi west of the Savannah Roadless Area passed into an arkose (F. A. Pontigo, oral commun., 1981). Another dry hole about 15 mi northwest of the area penetrated quartzite and metamorphosed shale of probable Paleozoic age. The Hunt Oil Co. dry hole 20 mi south of the roadless area penetrated a Precambrian granite (F. A. Pontigo, oral commun., 1981).

Mesozoic Era

Mesozoic strata in the Apalachicola embayment have a total thickness of about 10,000 ft. They generally extend from 3,000 ft to about 13,000 ft below sea level, and include rocks of Triassic, Jurassic, and Cretaceous age.

Triassic rocks consist of indurated micaceous sandstone and shale that are commonly red. Triassic beds exceed 1,950 ft in thickness in southeastern Leon County, about 50 mi east-northeast of the Savannah Roadless Area.

Five major stratigraphic units of Jurassic age occur in the region. The lowermost, the Louann Formation, is irregularly distributed and consists of salt and anhydrite. One dry hole located 6 mi east-northeast of the Savannah Roadless Area bottomed in salt after penetrating 34 ft (Applegate, Pontigo, and Rooke, 1978, p. 82), but the formation is known to be much thicker farther east. The overlying Norphlet Formation is mainly red sandstone, siltstone, and shale that has a total thickness ranging from 0-300 ft. The third unit, the Smackover Formation, consists of limestone, dolomitic limestone, siltstone, and sandstone. The carbonate rocks in this formation were found to be 186 ft thick where intersected by a dry hole located 15 mi southeast of the Savannah Roadless Area. The area is underlain by the Smackover Formation as shown by Applegate, Pontigo and Rooke (1978, fig. 1), and, therefore, this formation should be present at depth. The fourth Jurassic unit, the Haynesville Formation, which is present locally above the Smackover, consists of red siltstone, shale, and sandstone. The uppermost major Jurassic unit, the Cotton Valley Group, undifferentiated, is a sequence of varicolored mudstone and coarse sandstone, having a total thickness of as much as 2,600 ft.

Several stratigraphic units of Cretaceous age have been recognized in the Apalachicola embayment. The Lower Cretaceous rocks consist of an undifferentiated sequence of sandstone and shale having a total thickness of 5,000-6,000 ft (Schmidt and Clark, 1980, p. 28). The overlying Upper Cretaceous Tuscaloosa Formation is made up of three members: a lower nonmarine sand and variegated shale member, a middle member of glauconitic hard shale, and an upper member of calcareous sandstone. The Tuscaloosa is variable in thickness but locally is more than 700 ft thick. Beds of Eutaw age, above the Tuscaloosa, consist of gray to cream-colored sandstone that changes downdip to soft, pasty, sandy chalk. Above the Eutaw-age rocks are beds of Austin age. They consist of soft glauconitic, micaceous, fine to

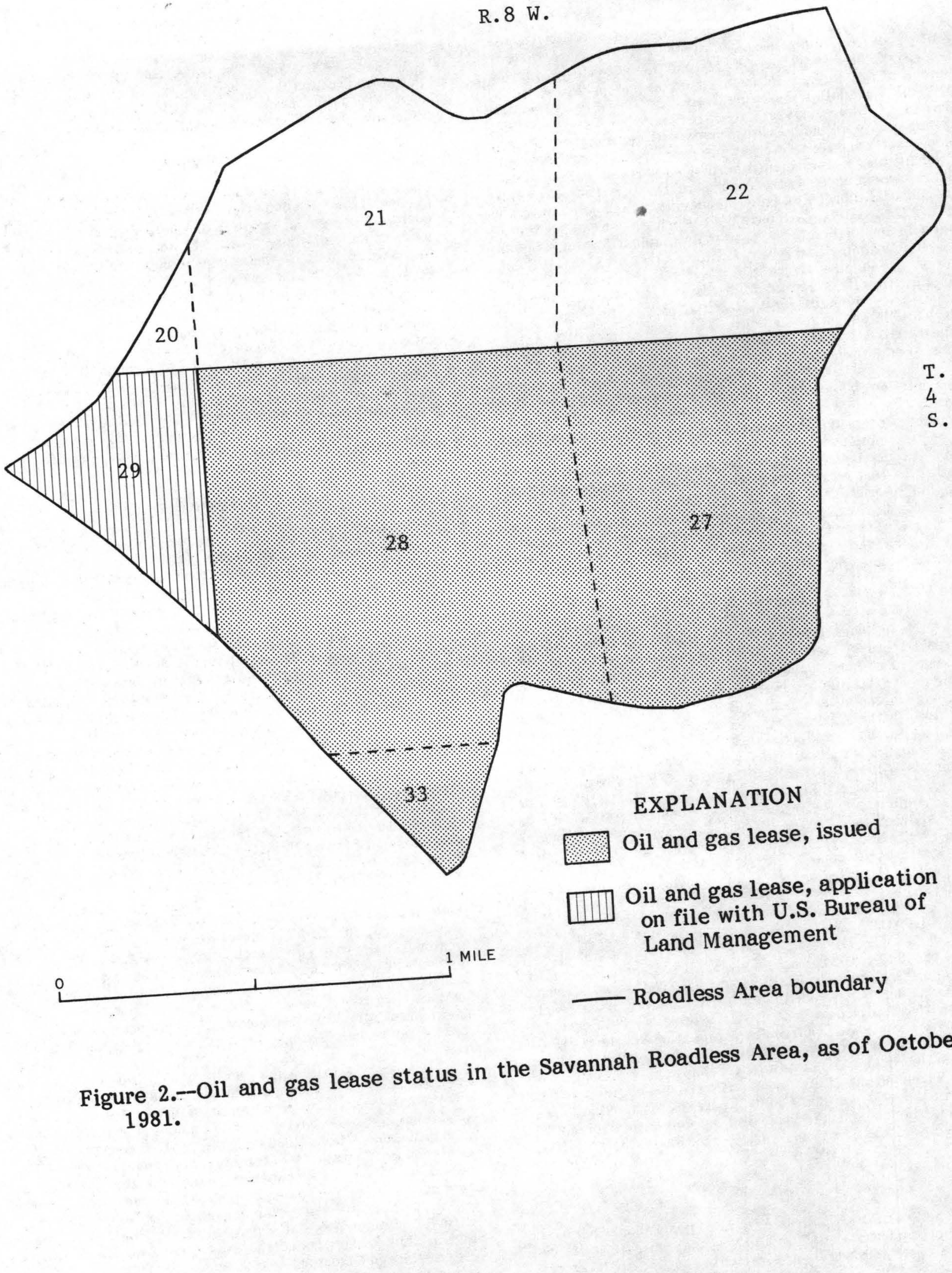

Figure 2.--Oil and gas lease status in the Savannah Roadless Area, as of October 1981.

coarse quartz sand interbedded with calcareous, thin-bedded clay. Beds of Taylor age overlie the Austin-age rocks. The Taylor-age strata consist of clayey, pasty chalk containing thin beds of calcareous clay and marl. The total thickness of the Upper Cretaceous beds is 1,800-2,000 ft.

Cenozoic Era

Paleocene rocks, which rest unconformably on the Cretaceous formations, consist mainly of glauconitic, sandy shale and sandstone in the Savannah Roadless Area. According to an isopach-lithofacies map by Chen (1965, fig. 26), Paleocene beds in the region are about 200 ft thick.

Eocene rocks, which consist of marine clastic sediments and limestones, have an aggregate thickness of 1,500 1,700 ft. The lower Eocene is represented by a sequence of glauconitic, calcareous sandstone and greenish-gray, micaceous, calcareous, glauconitic, silty shale. Chen's (1965, fig. 30) isopach-lithofacies map shows the thickness of the lower Eocene beds in the vicinity of the Savannah Roadless Area to be 400-600 ft. Middle Eocene beds in the Apalachicola embayment are assigned to two unnamed formations. The lower formation is composed of glauconitic, calcareous sandstone and greenish-gray, glauconitic, sandy, clayey limestone (Schmidt and Clark, 1980, p. 31). The upper formation is fossiliferous limestone containing some shale beds. The total thickness of the middle Eocene beds in the region is about 800 ft. Upper Eocene rocks consist of a group of limestone beds containing abundant large foraminifers and a few megafossils. The upper Eocene beds underlying the Savannah Roadless Area are probably about 300 ft thick.

Oligocene rocks in the region are assigned to two formations characterized by distinctive foraminifers. The lower unnamed formation is a light-gray chalky limestone. The upper one, the Suwannee Limestone, is generally buff-colored, dolomitic limestone, but locally it is chiefly dolomite.

Four major Miocene stratigraphic units are present in the Apalachicola embayment region. The lowermost, an unnamed unit, generally consists of light-gray limestone containing biogenic and very finely crystalline as well as coarsely crystalline carbonate grains and minor amounts of sand (Schmidt and Clark, 1980, p. 35). This unit is 50-100 ft thick. The second unit, the Chipola Formation, typically consists of very light orange limestone containing clear crystals, finely crystalline, and pellet grains of carbonate. Foraminifers, corals, and mollusks are commonly present. The Chipola is generally about 50 ft thick. The third unit, the "Bruce Creek Limestone", was named by Huddlestun (1976) and described by Schmidt and Clark (1980, p. 38-40). "Bruce Creek" beds penetrated by drill holes F1 and F2 (fig. 3) consist of light-gray indurated limestone containing minor amounts of dolomite, clay, and sand, and traces of phosphate pellets, mollusks, foraminifers, echinoids, and bryozoa fossils. Beds penetrated by drill hole F3 were more dolomitic than the limestone found in core from the other two holes, and therefore are more like the St. Marks Formation, which, farther east, is in the approximate stratigraphic position of the "Bruce Creek". All three drill holes (F1, F2, and F3) passed through algal beds in the upper part of the "Bruce Creek". The fourth unit, the "Intracoastal Formation", penetrated by the drill holes (fig. 3), consists mainly of fine to very coarse sand-sized foraminifers, and shell and echinoid fragments. It also contains minor amounts of calcareous clay, and quartz sand, traces of phosphate pellets, glauconite, and miscellaneous heavy minerals.

The Pliocene Jackson Bluff Formation, which overlies the "Intracoastal Formation", consists mainly of unconsolidated light-gray coarse sand- to gravel-sized mollusk fragments, forming a shell hash, and some clay. A dark-gray very sandy clay as much as 4 ft thick occurs locally in the upper part of the Jackson Bluff Formation. The shell hash contains minor amounts of quartz sand and traces of phosphate pellets, glauconite, and miscellaneous heavy minerals.

Sixty feet of Pleistocene and Holocene unconsolidated sand, clay, and gravel beds blanket the Savannah Roadless Area and surrounding region. The upper beds are mostly medium- and fine-grained quartz sand and contain minor amounts of clay. These beds also contain traces of phosphate pellets and variable minor amounts of heavy minerals. A stratum that is generally more than 50 percent very coarse sand and gravel is in the middle part of the Pleistocene and Holocene beds.

Structure

The Savannah Roadless Area is located in the central part of the Apalachicola embayment, a deep structural basin that was formed by the depression of crustal rocks. The embayment was filled with Triassic to Quaternary sediments having a total thickness of more than 14,000 ft. Deep rocks along the axis of the embayment plunge about 65 ft per mile to the west-southwest (Applegate, Pontigo, and Rooke, 1978, p. 80). Shallow rocks, which were deposited after the embayment was mostly filled, dip only a few feet per mile toward the Gulf of Mexico.

No faults have been recognized in the Savannah Roadless Area. However, minor disturbances of strata by slumping into solution cavities have no doubt occurred in a few places. Rock displacements of this type involve breakage and differential movement, but are not ordinarily considered to be structural features.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Fuller's earth, common clay, sand and gravel, and clayey sand are produced in the Big Bend region, and limestone was quarried and peat dug in the past. The region also has been explored for phosphate and reconnoitered for heavy minerals, but no commercial deposits have been found. There has been no mining activity within the Savannah Roadless Area, and the only production nearby has been the digging of clayey sand, used in stabilizing Forest Service roads, from borrow pits located 2 mi south of the area.

Fuller's Earth and Other Clays

A large district leading the world in the production of palygorskite- (attupulgite-) type fuller's earth straddles the boundary of Florida and Georgia northeast of the Savannah Roadless Area (Patterson, 1974). The closest active processing plants are at Quincy, Fla., 42 mi northeast of the roadless area, and Hinson, Fla., east of Quincy. The fuller's earth occurs in the Miocene Hawthorn Formation, which is not present in the roadless area, and no fuller's earth was found in the core from five drill holes; therefore, we conclude the roadless area has no potential for fuller's earth.

The only current mining of common clay in the Big Bend region is at the Apalachee Correctional Institution plant south of Chattahoochee. This plant, which is operated by the State of Florida, uses clayey and silty alluvium from the floodplain of the Apalachicola River to make common construction brick.

Although very sandy plastic clay beds were penetrated by the drill hole in the roadless area (fig. 2, mineral resource potential map) at depth intervals of 59-64 ft and 72-76 ft, nevertheless they are too thin and too deeply buried to be of value. In addition to much quartz, the upper bed consists of kaolinite, illite, and organic matter. The clay minerals in the lower bed are kaolinite and montmorillonite (smectite). The sand is mainly quartz, but small amounts of fine-grained mica flakes and phosphate pellets are also present.

No commercial common-clay deposits and no extensive alluvial deposits are present in the Savannah Roadless Area.

Heavy Minerals

Several reconnaissance studies of the heavy minerals in sands in the Big Bend region have been made, but no

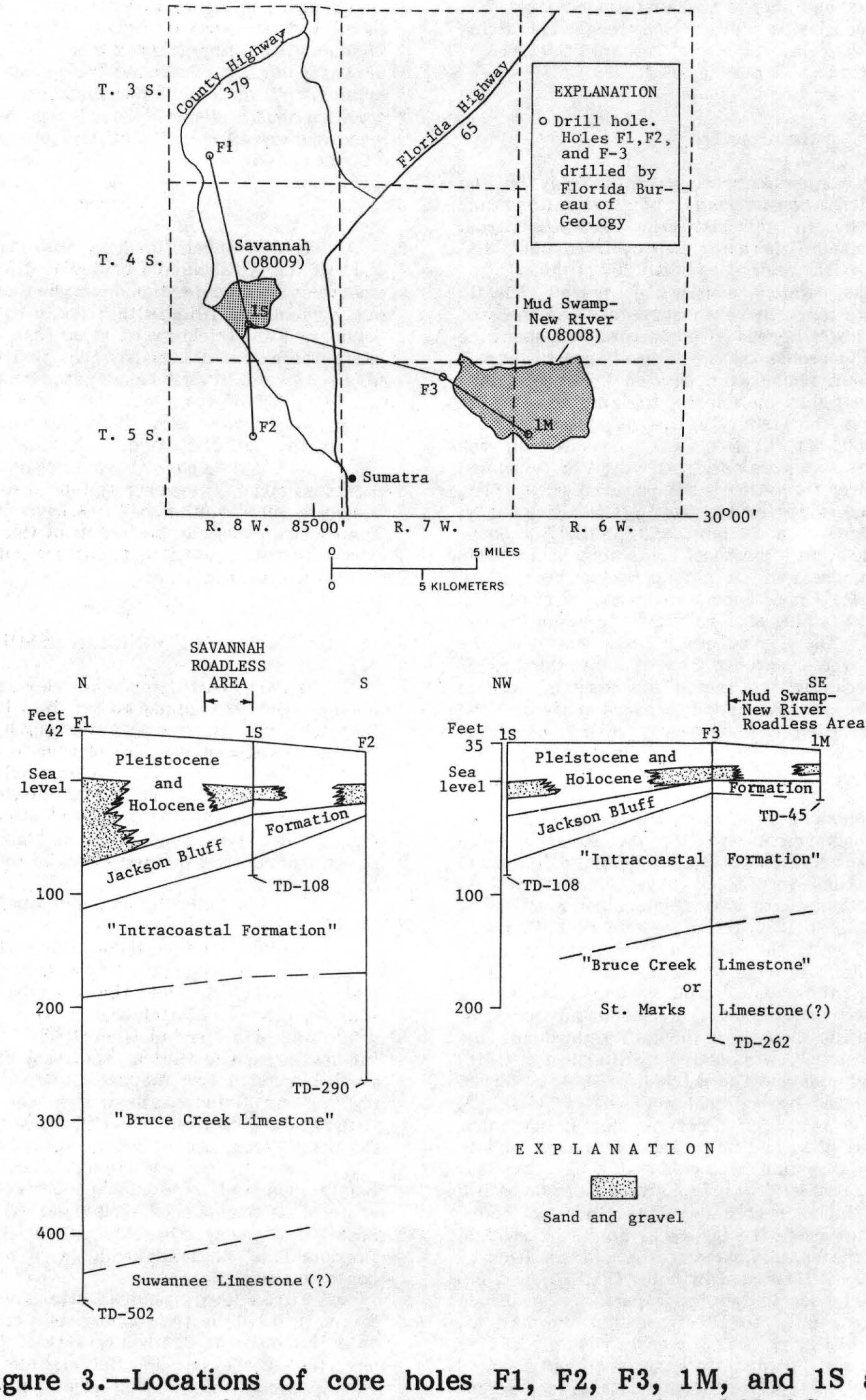

Figure 3.—Locations of core holes F1, F2, F3, 1M, and 1S and correlations of rock units penetrated, Savannah and Mud Swamp-New River Roadless Areas. Each roadless area's RARE II number is shown in parentheses on the map.

valuable concentrations have been found. The studies include M.S. theses on heavy minerals in Leon and Wakulla Counties, cited by Schmidt and Clark (1980, p. 72). In the work leading to the present report, (table 1, mineral resource potential map), among the heavy-mineral determinations made were those of a sample from the depth interval at 37-50 ft in the drill hole in the roadless area, and a sample from a borrow pit located 2 mi south of the area. The sample from the drill hole contained 1.8 percent and the sample from the borrow pit 2.3 percent heavy minerals; these concentrations are too low for profitable recovery. Heavy minerals identified include biotite, muscovite, ilmenite, tourmaline, staurolite, sillimanite, rutile, leucoxene, kyanite, chlorite, garnet, and phosphate. The wide range of mineral species present, rather than concentrations of valuable minerals such as ilmenite, rutile, and zircon, further detracts from the heavy-mineral potential of the sand.

Limestone

Several inactive quarries, where limestone was obtained for stabilizing secondary roads, are scattered throughout the Big Bend region. The largest one is in sec. 4, T. 3 S., R. 1 W. about 40 mi east of the Savannah Roadless Area. The workings of this quarry, which has not been operated for many years, extend over more than 40 acres. Another old quarry is located in sec. 12, T. 4 S., R 2 W., 2.3 mi south of Crawfordville. The limestone at both quarries is in the Miocene St. Marks Formation. Marl, a soft impure calcareous rock, was also dug for road-surfacing material in western Leon County and east-central Franklin County.

Very large quantities of limestone are present below the surface of the Savannah Roadless Area, but they have no value. The limestone is under excessive thicknesses of overburden, whereas unlimited quantities are present at sites more favorable for quarrying and closer to markets in other parts of the Big Bend region.

Peat

Peat has been produced on a minor scale in the Big Bend region, and small deposits occur in several swamps (Davis, 1946). No large peat swamps are present in the Savannah Roadless Area. The production closest to the roadless area in recent years has been near Carrabelle, about 27 mi to the southeast, where both bulk and packaged peat have been prepared (Cameron and Mory, 1977, p. 29).

Phosphate

Very minor amounts of phosphate are present in the Pleistocene to Holocene sand, the Pliocene Jackson Bluff Formation, and the "Intracoastal Formation" underlying the Savannah Roadless Area. The phosphate occurs as scattered black, gray, tan, and white pellets of very fine to medium grain size, and rarely as fragments of fish or other fossil remains. Some of the phosphatic materials are thought to have been reworked from deposits in the Miocene Hawthorn Formation farther north.

Although minor amounts of phosphate are present in the strata underlying the roadless area, there is very little possibility that commercial deposits are present. A selected drill-core sample of a phosphatic shell-hash bed 13 ft thick (85-102-ft depth) from the drill hole in the area (fig. 2, mineral resource potential map) contained less than 0.5 percent P_2O_5, which is far too low to be of value. Furthermore, no commercial phosphate was found during exploration programs carried out by two companies in and near the Apalachicola National Forest in the 1960s. These two firms drilled 124 holes (some are shown in figure 4, mineral resource potential map) including a few close to the Savannah Roadless Area. One company apparently decided to do no analytical testing after examining core samples. The other company found that 37 of 52 holes penetrated phosphatic material worth sampling. The sample richest in P_2O_5 (5.45 percent) was from a 3-ft-thick interval (81-84-ft depth) penetrated by a single hole. Two other samples from thin, deep intervals each contained 4.16 percent P_2O_5. The remaining 49 samples contained less than 4 percent P_2O_5 and about half of them had less than 2 percent P_2O_5.

Sand

Sand for construction and miscellaneous uses is produced at several places in the Big Bend region. Sand requirements of the Tallahassee market area are satisfied by the Roberts Sand Co. at Norfleet and by two other companies operating nearby (Scott and others, 1980). A pit near Panacea, 38 mi east of the Savannah Roadless Area, is the source of sand for the market along the Gulf Coast. Sand also is dredged from the Apalachicola River near Chattahoochee.

A sand and gravel bed 13 ft thick (depth interval 37-50 ft) was penetrated by the drill hole in the roadless area. A sample of this bed was found to be remarkably pure, consisting almost entirely of angular quartz, with 1.8 percent heavy minerals and a trace of clay. Only 17 percent of this sand was finer than coarse sand, and 28.6 percent was gravel (sample 1 in table 1, mineral resource potential map). Not only does the sand and gravel bed contain large quantities under the roadless area, but the bed is known also to extend for several miles outside of the area. The same bed was penetrated by the hole drilled in the Mud Swamp-New River Roadless Area about 11 mi east-southeast of the Savannah Roadless Area (fig. 3, hole 1M). The bed also was penetrated by hole F3, 7 mi east of the Savannah Roadless Area, by hole F2, 0.6 mi south of the area, and by hole F1, about 5 mi north of the area.

Although the sand and gravel deposits underlying the roadless area are of better quality than the deposits found in active pits in the Big Bend region, the mineral resource potential of the former is reduced by several factors. A considerable thickness of overburden would have to be stripped if the sand and gravel were to be produced. Moreover, the deposits are much farther from markets in population centers than are the sand and gravel currently produced.

Clayey sand of the type found in the borrow pits 2 mi south of the Savannah Roadless Area is widespread in the region. Large tonnages of this type of material occur in the roadless area but they have no particular value because unlimited quantities exist elsewhere.

ASSESSMENT OF OIL AND GAS POTENTIAL

According to the reports and records of the Florida Bureau of Geology, many exploratory wells have been drilled in search of oil and gas in the Big Bend region (figure 5 and table 2, mineral resource potential map). To date, only a few shows of oil have been found, and all of the holes have been dry. Of the selected holes shown in table 2, 30 were deeper than 5,000 ft and 15 were deeper than 10,000 ft. The deepest hole bottomed at 14,570 ft. Surprisingly, two of the shallow dry holes (mineral resource potential map, table 2, holes 5 and 8) were reported to have good shows of oil (Hendry and Sproul, 1966, p. 105) These two wells are located about 50 mi east of the Savannah Roadless Area. Oil stains also were found in the Smackover Formation and in a conglomeratic calcareous sandstone of the Norphlet Formation in a Hunt Oil Co. dry hole (Schmidt and Clark, 1980, p. 73), located 20 mi west-northwest of the roadless area.

Although there are no reasons for optimism about the discovery of oil and gas in and near the roadless area, the possibilities cannot be completely ruled out. Oil and gas may occur in the Jurassic Smackover Formation, which is present at depth in the Savannah Roadless Area (Applegate, Pontigo, and Rooke, 1978). Oil and gas are produced from this formation in the Jay field in the westernmost Florida panhandle and in a nearby field in Alabama (Babcock, 1972). Therefore, geologists think that this formation has potential for oil in the Big Bend region. However, the several holes that have been drilled into the Smackover in parts of the Big Bend region east, south, and west of the roadless area have all been dry (Applegate, Pontigo, and Rooke, 1978). Other reasons for not ruling out the potential for oil and gas discovery in the Savannah Roadless Area include: 1) the shows of oil in dry holes in the region, noted in the foregoing paragraph; 2) uncertainty as to whether or not formations older than the Smackover may contain oil and gas; and 3) the geology of the region, which is favorable for the occurrence of both structural and sedimentary traps (Applegate, Pontigo, and Rooke, 1978, p. 84).

REFERENCES CITED

Applegate, A. V., Pontigo, F. A., Jr., and Rooke, J. H., 1978, Jurassic Smackover oil and gas prospects in the Apalachicola embayment: The Oil and Gas Journal, January 23, p. 80-84.

Babcock, Clarence, 1972, Oil and gas activities in Florida, 1970: Florida Bureau of Geology Information Circular No. 80, 82 p.

Cameron, C. C., and Mory, P. C., 1977, Mineral resources of the Bradwell Bay Wilderness and the Sopchoppy River Study Area, Wakulla County, Florida: U.S. Geological Survey Bulletin 1431, 37 p.

Chen, Chih Shan, 1965, The regional lithostratigraphic analysis of Paleocene and Eocene rocks of Florida: Florida Bureau of Geology Bulletin No. 45, 105 p.

Davis, J. H., Jr., 1946, The peat deposits of Florida, their occurrence, development, and uses: Florida Bureau of Geology Bulletin No. 30, 247 p.

Hendry, C. W., Jr., and Sproul, C. R., 1966, Geology and ground-water resources of Leon County, Florida: Florida Bureau of Geology Bulletin No. 47, 178 p.

Huddlestun, P. F., 1976, The Neogene stratigraphy of the central Florida panhandle: Geological Society of America Abstracts with Programs, v. 8, no. 2, p. 203.

Milton, Charles, 1972, Igneous and metamorphic basement rocks of Florida: Florida Bureau of Geology Bulletin No. 55, 125 p.

Patterson, S. H., 1974, Fuller's earth and other industrial mineral resources of the Meigs-Attapulgus-Quincy district, Georgia and Florida: U.S. Geological Survey Professional Paper 828, 45 p.

Puri, H. S., and Vernon, R. O., 1964, Summary of the geology of Florida and a guidebook to the classic exposures: Florida Bureau of Geology Special Publication No. 5 (revised), 312 p.

Schmidt, Walter, and Clark, M. W., 1980, Geology of Bay County, Florida: Florida Bureau of Geology Bulletin No. 57, 96 p.

Scott, T. M., and others, 1980, The sand and gravel resources of Florida: Florida Bureau of Geology Report of Investigation No. 90, 41 p.