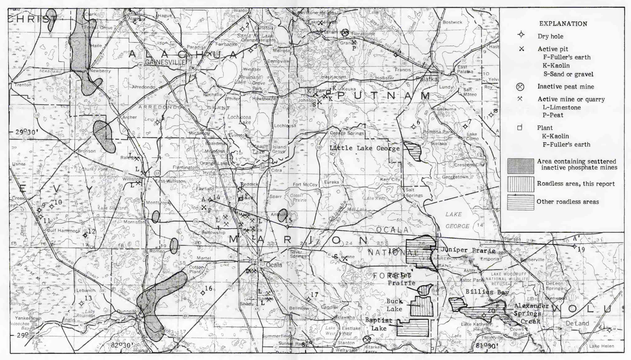
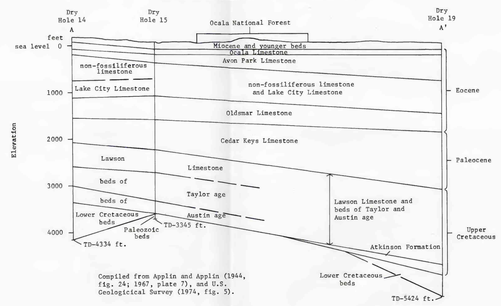
Figure 1.—Index map showing the location of Farles Prairie and Buck Lake Roadless Areas.





Compiled from Applin and Applin (1944, fig. 24; 1967, plate 7), and U.S. Geological Survey (1974, fig. 5).

Figure 2.—Location of Farles Prairie and Buck Lake Roadless Areas and other roadless areas, dry holes, pits, mines, and quarries in the region of the Ocala National Forest.

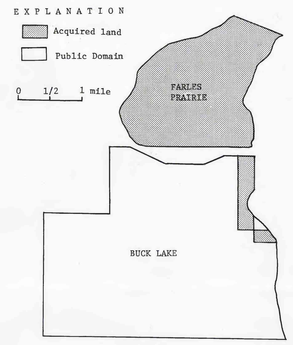


Figure 4.—Land-status map.

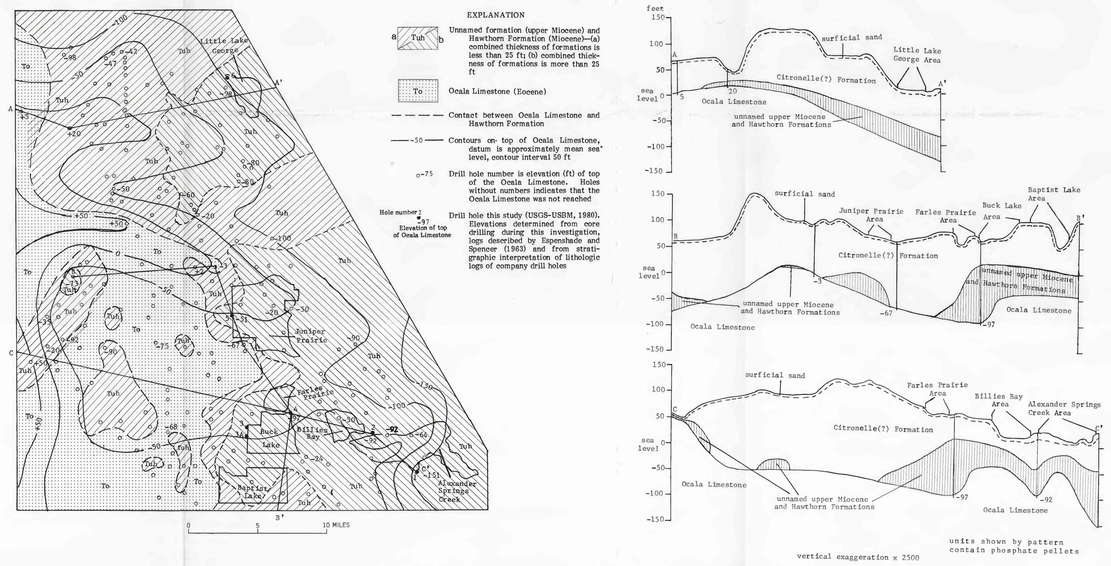
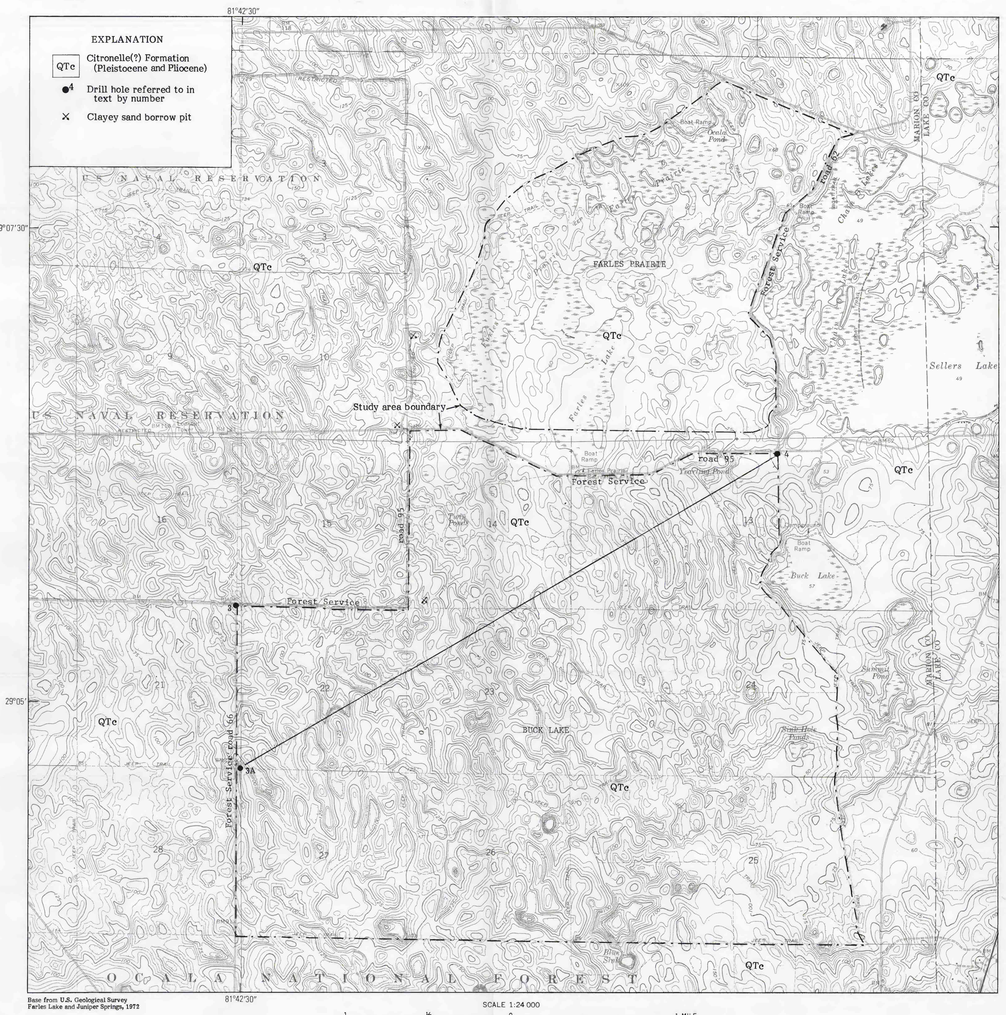


Figure 5.—The extent of the phosphate-bearing unnamed upper miocene formation and Hawthorn Formation, the Ocala Limestone, locations of drill holes, and structure-contour map of part of the Ocala National Forest.



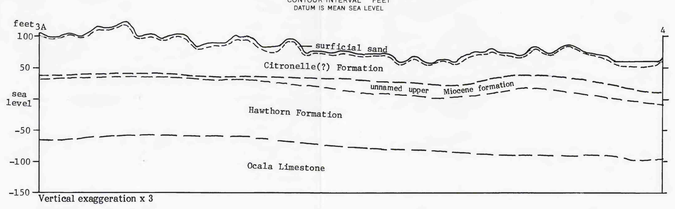


Figure 3.—Geology, drill holes, and clay pits in and near the Farles Prairie and Buck Lake Roadless Areas.

Table 1.—*Summary of uranium content of samples of phosphate rock, Ocala National Forest*
[Analyses in ppm uranium. Analysts: L. J. Sherlock and N. J. Nelson, Branch of Exploratory Research, USGS]

Unit	Number of samples	Uranium ppm Range	Average
Head (Total rock samples)			
Unnamed Upper Miocene Formation	2	7–29	18
Hawthorn Formation	5	4–120	31
Pebble (+20 mesh = +1mm)			
Unnamed Upper Miocene Formation	2	43–160	102 (101.5)
Hawthorn Formation	7	38–150	96
Concentrate (+20 + 150 mesh = -1mm + 0.1mm)			
Unnamed Upper Miocene Formation	2	74–90	82
Hawthorn Formation	11	33–130	75
Slime (-150 mesh = -0.1mm)			
Unnamed Upper Miocene Formation	2	4–27	16 (15.5)
Hawthorn Formation	6	3–110	28

Table 2.—*Selected exploratory oil and gas data for the Ocala National Forest and surrounding region*
[Source: Florida Bureau of Geology, oil and gas reports and records]

Florida Bureau of Geology Number	Dry hole Number (fig. 2)	Company or owner name	Dry hole or farm name	County	Sec	T.	R.	Year of Completion	Elevation of Derrick floor	Total depth of hole (ft)
49	1	Tidewater Associated Oil Co.	R.H. Cato #1	Alachua	23	8S	18E	1947	112	3150
709	2	Chevron Oil Co.	#1 Fred S. Donaldson et al. and Container Corp. of America	Alachua	34	8S	21E	1974	150	3340
52	3	Tidewater Associated Oil Co.	#1 J.A. Phifer	Alachua	24	9S	21E	1947	132	3288[1]
58	4	Sun Oil Co.—Seaboard Oil Co.	O.I. Roberts	Putnam	19	9S	25E	1947	206	3327[1]
238	5	The Texas Co.	#1 Albert M. Creighton	Alachua	16	11S	19E	1955	77	3527
96	6	Sun Oil Co.	#1 R.E. Westburg et al	Putnam	27	11S	26E	1949	32	3892[1]
607	7	Gilbert E. Thayer and Sam Davis	Johnson-Malphure, Inc. #1	Putnam	27	11S	27E	1972	34	5572
44	8	Humble Oil and Refining Company	J.W. Campbell et ux	Flagler	8	11S	28E	1947	31	4631[1]
199	9	Sphinx Syndicate	Prudential Timber Co.	Levy	31	13S	16E	1954	26	3857
110	10	J. A. Abbott, Trustee	Prudential Timber Co.	Levy	34	13S	16E	1950	18	2013
69	11	Carl M. Brunkenfeld Syndicate	Levy-Lennon	Levy	5	14S	16E	1949	17	2173
13	12	Sun Oil Co.	J. T. Goethe #1	Levy	31	14S	17E	1946	44	3997[1]
105	13	Humble Oil and Refining Company	#1 C.E. Robinson et ux	Levy	19	16S	17E	1949	46	4609
W901	14	J.S. Cosden	W.L. Lawson #1	Marion	25	13S	20E	1928	195	4334[1]
101	15	Sun Oil Co.	H.T. Parker	Marion	24	14S	22E	1949	79	3845[1]
W18	16	Ocala Oil Co.	Clark-Ray Johnson (Tork)	Marion	10	16S	20E	1928	80	6180[1]
53	17	Sun Oil Co.	#1 Henry N. Camp	Marion	16	16S	23E	1947	74	4637[1]
785	18	Amoco Production Company	#1 U.S.A. (6-4)	Marion	6	15S	25E	1975	76	4102
78	19	Grace Drilling Co.	Retail Lumber Co.	Volusia	2	15S	30E	1949	44	5424[1]
795	20	Amoco Production Company	#1 U.S.A. 44 (29-13)	Lake	Irreg. tract 44			1975	56	5893
19	21	Sun Oil Co.	#1 Powell Land Co.	Volusia		17S	31E	1946	48	5958[1]

[1] hole penetrated Paleozoic strata (Puri and Vernon, 1964, plate 1)

MINERAL RESOURCE POTENTIAL MAP OF THE FARLES PARIRIE AND BUCK LAKE ROADLESS AREAS, MARION COUNTY, FLORIDA

By
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and
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1983

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 survey of the Farles Prairie and Buck Lake Roadless Areas, Ocala National Forest, Marion County, Fla. The two roadless areas were classified as further planning areas during the Second Roadless Area Review and Evaluation (RARE II) by the U.S. Forest Service, January 1979.

SUMMARY

The Farles Prairie-Buck Lake Roadless Areas in the Ocala National Forest, Marion County, Fla., are underlain by phosphate-bearing sedimentary rocks. The deposits are below the present economic standard for P_2O_5 contents (28 percent P_2O_5) and tonnage, and are slightly high in the deleterious elements—magnesium, calcium, iron, and aluminum. In addition, the ratio of thickness-of-overburden to thickness-of-phosphate rock is slightly above economic standards and therefore, the deposits of phosphate are subeconomic at the present time. The area has a low potential for oil and gas, indicated by numerous holes drilled in the vicinity that were abandoned as dry, and by the absence of the formations that produce hydrocarbons in south Florida and in the western panhandle of Florida. Nearly pure limestone deposits underlie the study areas, but they are deeply buried. Sand has been mined from a pit in the Buck Lake Roadless Area, but virtually unlimited deposits of sand are present in areas closer to markets. No peat is present in the area—the Holocene and Pleistocene sands that blanket the area are very low in total organic matter.

Kaolinitic and smectitic clays are present in the area but have little value. The kaolinite in the Citronelle(?) Formation is only about 15 percent by weight of the total rock, which is far too impure to be of value. Lenticular beds of smectitic clay in the Hawthorn Formation are too deeply buried to be minable.

No commercial heavy-mineral deposits are known to be present in the areas and none are likely to be found. Heavy-mineral concentrations in the surficial sand average only about one-tenth as much as in minable deposits.

The only mining in the area was of surficial clayey sand that was used as road metal, but these deposits are not considered useful, because virtually unlimited quantities of clayey sand are present at the surface outside of the Farles Prairie-Buck Lake areas.

INTRODUCTION

The Farles Prairie and Buck Lake Roadless Areas are in the southeast part of the Ocala National Forest in Marion County, Fla., about 30 mi. east of the town of Ocala, Fla. (figs. 1 and 2). Farles Prairie Roadless Area is an irregular area of about 2,175 acres in parts of secs. 1, 2, 11, and 12, T. 16 S., R. 26 E. (fig. 3). Buck Lake Roadless Area contains about 5,680 acres in parts or all of secs. 13, 14, 22, 23, 24, 25, 26, and 27, T. 16 S., R. 26 E.

The Federal Government owns all surface and mineral rights in the study area. Public domain and acquired lands are shown in figure 4.

No geochemical survey was made during the field work because it would provide no information of value in assessing the mineral potential of the area; heavy minerals in the rocks exposed at the surface are in concentrations far too low to form potential deposits.

Previous Investigations

The general geology of central Florida is discussed by Cooke (1945), Espenshade and Spencer (1963), and Puri and Vernon (1964). The geologic maps and descriptions by these writers have been used in the discussion of the geology in this report.

Subsurface geology of northern peninsular Florida is discussed in reports by Applin (1951), Applin and Applin (1944, 1965, and 1967), and Rainwater (1971).

Although there are no detailed surveys of the mineral resources of the Ocala Forest, general information is included in the following references: Limestone (Schmidt and others, 1979); phosphate (Cathcart, 1968; Espenshade and Spencer, 1963, Mansfield, 1942, Sever, Cathcart, and Patterson, 1967); clay (Calver, 1949); peat, (Davis, 1946); heavy minerals (Garner, 1972, 1981).

GEOLOGY

The surface of the Farles Prairie and Buck Lake Roadless Areas is blanketed by unconsolidated soil, sand, muck, and humus. These surficial materials are no more than about 5 ft thick in most places, but are as much as 100 ft thick in sink-hole fillings. These surficial materials are underlain by a second unconsolidated layer consisting of white, red, and orange sand and clayey sand that is 40 to about 60 ft thick in the two roadless areas and as much as 100 ft thick elsewhere in the Ocala National Forest. The age of this unconsolidated layer is uncertain, but it is probably of Pliocene and Pleistocene age and tentatively is correlated with the Citronelle Formation because it is lithologically similar to that formation. These unconsolidated beds rest unconformably on Miocene strata (fig. 3) which consist of an unnamed upper Miocene Formation and the Hawthorn Formation of early and middle Miocene age. The unnamed formation, which is 0-70 ft thick in the two areas, is chiefly sandy clay and clayey sand containing shell fragments and minor quantities of phosphate grains. The Hawthorn Formation is 0-130 ft thick; its upper part is sandy clay and clayey sand containing dolomite grains and considerable quantities of phosphate grains. The lower part is chiefly dolomite containing some phosphate grains. The Ocala Limestone of Eocene age unconformably underlies the Miocene formations. The Ocala, which is approximately 100 ft thick, consists of hard limestone and chalk. The Ocala is underlain by four more Eocene and one Paleocene formations that consist mainly of limestone and have a total thickness of as much as 1,685 ft. The Paleocene formation is underlain by about 1,600 ft of Upper Cretaceous formations consisting mainly of limestone and chalk. Lower Cretaceous rocks occur as three units having a total thickness of 630 ft. These rocks consist of two groups of limestone and shaly sandstone separated by a dolomite unit. Cretaceous formations are separated by a major unconformity from the underlying Paleozoic rocks consisting of basalt, rhyolite, diorite, tuff, quartzite, sandstone, and shale.

The Mesozoic and Cenozoic sedimentary rocks underlying the Farles Prairie and Buck Lake Roadless Areas dip gently and thicken in an easterly direction (fig. 2). The area is on the eastern flank of the Peninsular Arch, a broad anticline. The top of the Ocala Limestone is 50 ft above sea level at the western edge of the Ocala National Forest and 100 ft below sea level at the eastern edge, confirming the dip to the east. However, the surface is not uniform and the most prominent irregularity is a ridge in the Ocala Limestone that trends southeast across the Ocala National Forest.

ASSESSMENT OF MINERAL RESOURCE POTENTIAL

Limestone, clay, sand, and peat are produced in the region in which the Farles Prairie and Buck Lake areas are located (fig. 2). Hard-rock phosphate was produced many years ago from small mines located along and near the crest of the Peninsular Arch, some 40 mi to the west, and phosphate is being produced from mines in Hamilton County, about 100 mi to the north, and from Polk and Hillsborough Counties, about 90 mi to the south. Inferred subeconomic phosphate deposits underlie much of the Farles Prairie and Buck Lake Roadless Areas, but total tonnage and grade cannot be estimated with existing prospect data. Extensive deposits of limestone underlie the areas, but are deeply buried. No heavy-mineral concentration rich enough for mining is known in the area. Although beds of clay are known to be present, they are probably lenticular, and are too deeply buried to be minable. No peat deposits are known in the area. Clayey sand has been dug in the area for use in construction of Forest Service roads but none is being mined at the present. The area has a low resource potential for oil and gas.

PHOSPHATE

The phosphate deposits of central peninsular Florida are in the southernmost part of the north Florida-south Georgia district. Phosphate is present in the Hawthorn Formation and in younger rocks in which most of the phosphate has been reworked from the Hawthorn Formation (Cathcart, 1968).

In the late 1960's, several phosphate companies drilled about 200 holes in the Ocala National Forest (fig. 5). Most drill cores contained so little phosphate that samples were not analyzed, and no commercial deposits were found.

The Hawthorn Formation has been removed by erosion on the higher parts of the Peninsular Arch and is present only as erosional remnants in the westernmost part of the Ocala National Forest (fig. 5). The formation is present throughout the eastern part of the forest where drill hole data show that it ranges from 20 to about 90 ft in thickness. Moderate concentrations of phosphate are present in the upper part of the Hawthorn Formation and in rocks of probable late Miocene age that overlie the Hawthorn Formation.

Characteristics of Minable Phosphate Deposits

The economic limits, both maxima and minima, are estimates of industry standards. The criteria are for the separated phosphate particles, except for thicknesses. Details are given in the pamphlet, page 15.

1. Phosphorus content—Must be greater than 28 percent P_2O_5 or about 60 percent bone phosphate of lime (BPL).
2. Iron and alumina content—Must be less than 5 percent Fe_2O_3 plus Al_2O_3.
3. MgO content—Must be less than 1 percent.
4. CaO content—CaO occurs in the apatite mineral where the ratio of percent CaO to percent P_2O_5 ranges from 1.4 to 1.55. Ratios higher than 1.60 indicate unacceptable amounts of either calcite or dolomite.
5. Minable tonnage—Minimum is 400 tons per acre-foot, equal to about 2 percent by weight of recoverable phosphate particles.
6. Minimum minable thickness for a phosphate bed is 3 ft.
7. The maximum ratio of overburden thickness to ore thickness is about 5 to 1.
8. The maximum total thickness of overburden plus ore that can be profitably mined is 150 ft.

The phosphorite in the Farles Prairie-Buck Lake Roadless Areas is a subeconomic resource by today's standards. Although much of the concentrate fraction contains more than 28 percent P_2O_5, the pebble fraction averages only about 13 percent. Although iron and alumina contents are below the maximum, tonnages of acceptable material are too low and contents of MgO and CaO are slightly high. The phosphorite in the area is a subeconomic resource that will increase in value as the reserves presently being mined elsewhere are exhausted. Data from the scattered drilling indicate that the best phosphate is in the eastern parts of the study areas.

Uranium—Uranium is present in all marine phosphorites in amounts that typically range from 1 to 300 ppm (Cathcart, 1978). The uranium is syngenetic in origin and substitutes for calcium in the apatite structure.

Analyses of uranium contents of samples from the core drilling of this study (table 1) show that the pebble fraction contains more uranium than the concentrate fractures. Samples of phosphorite from the unnamed upper Miocene formation are slightly higher in uranium than samples from the Hawthorn. Slime (-150 mesh) samples contain much less uranium than either the pebble or the concentrate samples and contain very nearly the same amount of phosphate as the head (total rock) samples.

Uranium has been recovered as a byproduct of the manufacture of phosphoric acid at several plants in the Florida land-pebble phosphate district.

CLAY

Clay is mined from several localities both to the north and the west of the Ocala National Forest. Kaolinite is mined in the area near Edgar in T. 10 S., R. 23 E., about 40 mi to the north; the kaolinite is from sandy clay of the Citronelle(?) Formation. Fuller's earth clay is mined from the Hawthorn Formation near Emathla in T. 13 S., R. 20 E., 38 mi to the west.

Although kaolinite is present in samples from the Citronelle(?) Formation in the holes drilled, the amount of the slime (-200 mesh) fraction is low, ranging from four to about 30 percent, and averaging about 15 percent. The slime fraction contains abundant quartz as well as montmorillonite and some dolomite and attapulgite. The material, therefore, is such a mixture of minerals that it is very doubtful that there could be any deposits of kaolinite that are even remotely considered a potential resource.

Smectite is a common clay mineral in the Hawthorn Formation, but examination of the core during the drilling showed that almost all samples were very sandy. Only one sample of clay was taken for tests by the U.S. Bureau of Mines. According to Crandall (1981) the sample showed excellent ceramic properties and bloating characteristics. The sample, taken from the interval 86-90 ft below the surface at drill hole 4 (fig. 3), was chiefly a high-iron smectite, but x-rays showed that the sample also contained some attapulgite, quartz, dolomite and a trace amount of apatite.

The clays in the Farles Prairie-Buck Lake Roadless Areas have no value as they are too impure or too deeply buried.

HEAVY MINERALS

Heavy minerals have been mined for many years from deposits about 60 air miles to the north of the study areas. Ilmenite, the ore of titanium oxide, is the principal mineral produced, but staurolite, monazite, zircon, garnet and kyanite are also recovered (Garner, 1972, 1981). The heavy-mineral deposits in the Trail Ridge mineral district are thought to have been concentrated by the winnowing action of ocean waves and currents (Pirkle and Yoho, 1970; Garner, 1972, 1981). The deposits are reported to contain about three percent heavy minerals (Pirkle, Pirkle, and Yoho, 1977).

No commercial heavy-mineral deposits are known to be present in the study areas and none are likely to be found. Surficial sand and the sands of the Citronelle(?) Formation are low in heavy minerals—nine samples of cuttings from the drill holes contained from 0.2 to 0.8 percent and averaged only about 0.4 percent of heavy minerals, only about one-tenth of the concentraton of commercial deposits. Mineral species found include ilmenite, garnet, zircon, staurolite, rutile, sillimanite, tourmaline, and kyanite, but no monazite has been identified.

LIMESTONE

The Ocala Limestone is quarried at several localities about 30 mi west of the Farles Prairie Roadless Area, both north and south of the town of Ocala (fig. 2). The limestone underlies all of the Ocala National Forest and is very pure (Schmidt and others, 1979) and, according to Mossom (1925), contains from 96 to 98 percent $CaCO_3$. The amount of limestone present must be enormous, but the top of the Ocala Limestone in the Farles Prairie-Buck Lake Roadless Areas is about 100 ft below surface. Abundant resources of limestone at or close to the surface are available in the area around the town of Ocala.

Sandy, phosphatic dolomite of the lower unit of the Hawthorn Formation is present under all of the area, but is impure and deeply buried.

PEAT

Although organic muck and humus deposits are known to occur in low, swampy areas in the Ocala National Forest, the Farles Prairie-Buck Lake Roadless Areas consist mainly of low sand hills and the surficial sands in the area are very low in organic content (Aydelott and others, 1975). There is no likelihood that any peat deposits are present in the two study areas.

SAND

Slightly clayey sand of the Citronelle(?) Formation, mined from a pit in the Buck Lake Roadless Area, was used for road metal on Forest Service roads. At the present time, the Forest Service obtains clayey sand from pits outside of the two areas. The nearest commercial sand operation is near Lynne, about 10 mi to the northwest. Very large resources of sand, close to market areas, are available throughout the region adjacent to the Ocala National Forest.

OIL AND GAS

Oil and natural gas are produced from Lower Cretaceous Sunniland Limestone in southern Florida and from the Jurassic Smackover Formation in western panhandle Florida. Jurassic beds are not present in the area of the Ocala National Forest, and beds of Early Cretaceous age, present both to the east and west, are also missing. Beds of Late Cretaceous age overlie Paleozoic rocks (Applin and Applin, 1944; U.S. Geological Survey, 1974).

Several exploratory holes for oil and gas have been drilled in and around the Ocala National Forest (fig. 2 and table 2); All holes were dry and abandoned. Two holes were drilled by Amoco Production Co. in the Ocala National Forest (No. 18 and 20, table 2). According to Crandall (1981), Amoco personnel stated that the primary production target was the Upper Cretaceous Atkinson Formation (fig. 2). The Atkinson Formation is correlated with the Tuscaloosa Formation, from which oil is produced in Alabama and Mississippi (Applin and Applin, 1965).

In summary, there is a low potential for oil and gas resources in the Farles Prairie-Buck Lake Roadless Areas because of the number of dry holes in the surrounding areas and because rocks that contain oil and gas elsewhere in Florida are not present here.

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