MAP SERIES NO. 135

FLORIDA GEOLOGICAL SURVEY
DEPARTMENT OF NATURAL RESOURCES

R 10 E | R 11 E | R 12 E | R 13 E | R 14 E | R 15 E | R 16 E | R 17 E

83°20' | 83°10' | 83°00' | 82°50' | 82°40'

T 3 N | T 2 N | T 1 N | T 1 S | T 2 S

30°30' | 30°20'

STATE OF GEORGIA

W-15121 | W-12773 | W-12601 | W-1039 | W-12600

JENNINGS | JASPER | WHITE SPRINGS

Lake Octahatchee | Cypress Creek Swamp | Bird Bay | Buzzard Bay | Bee Haven Bay

WITHLACOOCHEE RIVER | MADISON COUNTY | ALAPAHA RIVER | SUWANNEE RIVER | SUWANNEE COUNTY | COLUMBIA COUNTY

Adams Spring | Morgans Spring | Stephens Spring | Charlton Spring

HM-1 | HM-2

PH

N

0 0.5 1 2 3 4 MILES
0 0.5 1 2 3 4 5 6 KILOMETERS

SCALE

EXPLANATION

- CLAY
- LIMESTONE
- PEAT
- PHOSPHATE
- UNDIFFERENTIATED RESOURCES
- MINE SITE (ACTIVE)
- PH PHOSPHATE
- CONCENTRATION OF MINING ACTIVITY
- WELL CUTTINGS LOCATION
- CORE LOCATION
- STATE PARK
- HM-1 SAND SAMPLE LOCATION

MINERAL RESOURCES OF HAMILTON COUNTY

FLORIDA

BY
STEVEN M. SPENCER, PG#319, FRANK RUPERT,
RONALD W. HOENSTINE, AND ED LANE

1993

FLORIDA GEOLOGICAL SURVEY EST. 1907

WALTER SCHMIDT
STATE GEOLOGIST AND CHIEF

CARTOGRAPHY BY JIM JONES & TED KIPER

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Steven M. Spencer, P.G. #319, Frank Rupert,
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FLORIDA GEOLOGICAL SURVEY
WALTER SCHMIDT, STATE GEOLOGIST AND CHIEF
DIVISION OF RESOURCE MANAGEMENT
DEPARTMENT OF NATURAL RESOURCES

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HAMILTON COUNTY

INTRODUCTION

In recent years, considerable attention has been focused on Florida's rapid development, the accompanying population increase, and their effect on the state's important mineral resources. Frequently, this development occurred in areas underlain by known mineral deposits, precluding extraction of the minerals. The economics associated with these mineral resources represent substantial employment and income to the private sector as well as taxes to county and state governments. One response to this conflict between rapid population and urban growth, and Florida's mineral resource development was in the form of legislation enacted by the Florida Legislature in 1985 requiring each county to establish a comprehensive land use plan. Additional guidelines and due dates were established by the 1986 Florida Legislature.

In response to this legislation, and at the request of the North Central Florida Regional Planning Council, the Florida Geological Survey initiated this investigation of Hamilton County's mineral resources. Our objectives were to identify potential mineral resource areas and to present the results in a format appropriate for use by city and county planners. This mineral resource assessment is general and is intended as a land-use planning tool. A site-specific evaluation would require detailed research beyond the scope of this investigation.

A knowledge of Hamilton County's mineral resources is basic and integral to the process of initiating, developing, and implementing an effective comprehensive land use plan. This information is essential to planners and officials in their analyses of urban and rural development in such areas as zoning, road construction and the establishment of waste disposal sites.

Resource evaluation for this report is based on a number of sources including Florida Geological Survey reports and unpublished data, core and well cutting descriptions, geological logs, field reconnaissance, state and federal statistical data, company reports, questionnaires, and discussions with mining company personnel and state and federal officials. Although detailed information on company statistics is confidential, information of a more general nature is readily available or can be reasonably extrapolated from existing data. The diversity of sources as well as their close association with the various aspects of resource evaluation lends substantial confidence to the general assessments and inferences of this report.

Metric Conversion Factors

For readers who prefer metric units to the U. S. units in this report, the following conversion factors are provided.

MULTIPLY	BY	TO OBTAIN
feet	0.3048	meters
miles	1.609	kilometers
acres	0.4046	hectares
tons	907.18	kilograms

GEOMORPHOLOGY

Hamilton County is situated in the Northern (Proximal) Zone of White (1970). This zone extends across the northern Florida peninsula and westward into the Western Highlands of Florida's panhandle. Two major geomorphic subdivisions of the Northern Zone occur in Hamilton County: the Northern Highlands and the Gulf Coastal Lowlands (Figure 1).

The Northern Highlands incorporates the majority of Hamilton County, being present in all but the extreme southwestern portion of the county. Elevations generally range between 125 and 150 feet above mean sea level (MSL). The topography here is characterized by gently sloping hills and lowlands in the western half of the county and extensive swampy lowlands in the eastern half. Lowland areas include: Cypress Creek Swamp, Bee Haven Bay, Buzzard Bay and Bird Bay. The majority of lakes and large ponds are located in the Northern Highlands in northwestern Hamilton County.

The southern boundary of the Northern Highlands is marked by a relict marine escarpment named the Cody Scarp. This feature separates the Northern Highlands from the topographically lower Gulf Coastal Lowlands subzone. The Cody Scarp, which trends northwest-southeast in Hamilton County, has been described by Puri and Vernon (1964) as the most persistent topographic break in Florida (Figure 1). The toe of this escarpment approximates an elevation of 100 feet above MSL in Hamilton County.

The Gulf Coastal Lowlands geomorphic subzone is a broad, flat-lying marine erosional plain lying south of the Cody Scarp. It occupies less than 20 percent of Hamilton County. This is an area of little relief with elevations ranging from 100 feet above MSL at the toe of the Cody Scarp to approximately 50 feet above MSL along the Withlacoochee and Suwannee Rivers. The Gulf Coastal Lowlands of Hamilton County incorporate portions of the Suwannee River State Park and several springs including Morgans Spring and Adams Spring.

In addition to the above geomorphic features, two relict terraces formed by ancient seas are present in the county. Healy (1975) identified two terraces based on land surface elevations (Figure 2). In order of descending elevation, they are: the Sunderland/Okefenokee Terrace (100-170 feet above MSL), and the Wicomico Terrace (70-100 feet above MSL).

GEOLOGY

Hamilton County is underlain by siliciclastic sediments (quartz sand, silt, clayey sand and clay). In turn, these sediments are underlain by thick sequences of Cenozoic carbonates (limestone and dolomite) and Mesozoic siliciclastics and carbonates measuring thousands of feet in thickness.

The near-surface geologic units include the Ocala Limestone which was deposited during the Late Eocene (approximately 41 to 38 million years before the present, BP) (Figures 3a-c). The lithology of this marine limestone grades upward from alternating soft and hard, white to tan fossiliferous and dolomitic limestone into white to pale orange, fossiliferous limestone. The occurrence of the distinctive foraminifera genus *Lepidocyclina* is common to abundant and is often used as an aid in distinguishing this formation from the overlying Suwannee Limestone.

The Ocala Limestone, which occurs at depths ranging from 45 feet to nearly 270 feet below land surface, forms an integral part of the Floridan aquifer system in Hamilton County. Thickness of these carbonate sediments averages 200 to 300 feet.

The Oligocene age (38 to 33 million years BP) Suwannee Limestone, which represents the oldest geologic unit cropping out in Hamilton County, unconformably overlies the Ocala Limestone. Outcrops of this formation can be observed along the Suwannee River between White Springs and Ellaville. Colton (1978) states that the Suwannee Limestone was deposited in water between low tide level and a maximum depth of approximately 100 feet. This unit comprises the upper portion of the Floridan aquifer system in parts of western Hamilton County and in all of the central and eastern portions of the county. The lithology of the Suwannee Limestone in Hamilton County consists of a very pale orange, finely crystalline, moderately to well indurated, fossiliferous, partially recrystallized limestone (calcarenite) with moderate to good porosity. Fossils include foraminifera, mollusks and echinoids. The top of this formation is extremely variable and ranges from 20 to more than 150 feet below land surface. Observed thicknesses range from approximately 10 feet to 150 feet (Figures 3a, 3b and 3c).

In northwestern Hamilton County, the Suwannee Limestone is unconformably overlain by the St. Marks Formation. Deposited during the Early Miocene (25 to 20 million years BP), the St. Marks Formation averages 40 feet in thickness (Figure 3c) and is discontinuous in distribution. The lithology of this formation is typically a white to very pale orange, sandy, silty, clayey, calcilutitic, marine limestone. Fossils are few and generally consist of mollusks and foraminifera. Where present, the St. Marks Formation is the uppermost unit of the Floridan aquifer system.

The Hawthorn Group, which was deposited during the Early and Middle Miocene (23 to 15 million years BP), unconformably overlies the Suwannee Limestone or, where it is present, the St. Marks Formation. It is an important economic resource in Hamilton County, containing abundant phosphate ore. It has a variable lithology ranging from phosphatic dolomites and clayey sands to dolomitic silty clays. In general, these sediments consist of pale olive to moderate yellow sandy, phosphatic clays and sands.

The Hawthorn Group sediments can be observed intermittently along the banks of the Suwannee River from State Highway 6 to the confluence of the Alapaha River. The thickness of the Hawthorn Group ranges from approximately 30 feet south of the Cody Scarp to as much as 150 feet in the northern and eastern portions of the county.

A veneer of Pleistocene to Holocene age (1.8 million years BP and younger) sediments overlie the Hawthorn Group throughout Hamilton County. The sediments, referred to as "Undifferentiated Sand and Clay," represent relict Pleistocene marine sands and Holocene aeolian and alluvial deposits. Extremely variable in thickness, they range from a minimum value of less than a foot to a maximum observed value of approximately 50 feet.

MINERAL RESOURCES

Introduction

The following discussion of the economic geology of Hamilton County is not intended to be a comprehensive investigation leading to immediate industrial development because, in many cases, the data represents information on a single outcrop, pit or mine. However, where the data are favorable, they may indicate that certain areas warrant further investigation. The Mineral Resources Map is designed to present an overview of the major mineral commodities in an area. Factors such as thickness of overburden as well as the quality and volume of the deposit will affect the mining of the mineral commodity at any specific site. In contrast, geologic cross sections are extrapolated from cores and well cuttings to show the distribution and thickness of surface and near-surface stratigraphic units (Figures 3b and 3c). Occasional variations between the geologic cross sections and the Mineral Resources Map may occur. The following is a discussion of the clay, peat, phosphate, and sand resources of the Hamilton County.

Clay

Most of the economic clay deposits in Florida are from the Miocene age Hawthorn Group. Scott (1988) shows the Hawthorn Group as present in northern and eastern Hamilton County. The clays are often dolomitic, phosphatic, and very sandy. The clay minerals present in this region are characteristically smectite, palygorskite, and illite (Scott, 1988).

Bell (1924) tested clay deposits from the White Springs region of Hamilton County. Although results of these tests showed the clay to have excellent plasticity and working qualities, samples had high air and fire shrinkage, and a tendency to warp in firing. These clays were determined to be unsuitable for fired products (Bell, 1924).

Alluvial clay deposits, belonging to the Bivans soil series, are present along various portions of the Suwannee River (David Howell, U.S. Soil Conversation Service (SCS), personal communication, 1991). The SCS reports the alluvial clays contain up to 60 percent montmorillonite (smectite) and extend to a depth of at least 81 inches.

A sandy clay to clayey sand, from scattered borrow pits located throughout the county, is used as fill material by the county road department. There is little potential for a structural clay products industry in Hamilton County.

Peat

Peat is a product of partially decomposed organic materials which accumulate when the depositional rate exceeds decomposition (Davis, 1946; Bond et al., 1986). In perennially wet areas organisms which normally metabolize plant matter are inhibited, thereby allowing peat to form.

The United States Soil Conservation Service located two areas containing the highly organic Dorovan Muck soil type in Hamilton County (David Howell, SCS, personal communication, 1991). Dorovan Muck, the most peat-like soil found in Hamilton County, is within the mining limits of Occidental Chemical Corporation, Suwannee River Phosphate mine.

Phosphate

Florida produces approximately 80 percent of the nation's supply of phosphate and roughly 25 percent of the world's supply (Florida Phosphate Council, 1990). Phosphate is mined from two regions in Florida: central peninsular Florida, primarily the Polk-Hillsborough County region, and in Hamilton County in northern Florida. The phosphate mined in eastern Hamilton County lies within the Georgia-Florida Phosphate District (Sever et al., 1967). It is in this area that Occidental Chemical Corporation operates two mines, the Swift Creek mine (multiple sections, Township 1 S, Range 15 E), and the Suwannee River Phosphate mine (multiple sections, Township 1 S, Ranges 15 and 16 E). Occidental began processing land-pebble phosphate here in 1965.

Land-pebble phosphate (carbonate-fluorapatite) is present in the Miocene age Hawthorn Group sediments. The phosphate is rounded to subrounded, and varies from silt to pebble size. Its color ranges from white, to tan, brown, or black with varying degrees of polish. Weathered grains have a dull finish and are usually white or tan in color (Sever et al., 1967). Phosphate at the Swift Creek mine averages 20 feet thick. It is overlain by approximately 20 feet of sand and clayey sediments (Larry Miller, Occidental Chemical Corporation, personal communication, 1991). The economic deposit overlies a layer of phosphatic dolomitic clays, sandy dolomite, sand or limestone.

FGS well data suggest that portions of north-central and northeastern Hamilton County may contain phosphate deposits of economic value (Mineral Resource Map). These wells (W-15121, W-12600, W-12601, W-12773, and W-1039) contain up to 40 percent phosphate (visual estimate) within 40 feet of land surface.

Phosphate mining in Florida is the open pit type and uses draglines with capacities up to 70 cubic yards. Overburden is removed to mined out areas or cuts. The draglines then remove the ore material to pits where it is slurried using high water pressure and pumped to a beneficiation plant (Campbell, 1986). The beneficiation process uses froth flotation to separate the ore from the matrix material. This is usually a two step flotation process where a reagent floats the phosphate, then in the next stage, floats the waste material (Campbell, 1986). The two stage flotation process recovers about 80 percent of the phosphate from the feed material (Zellers-Williams, 1978). About 90 percent of the phosphate produced in Florida goes into making agricultural fertilizer. The remainder is used in the production of livestock feed supplements, light bulb filaments, cleaning supplies, bone china, soft drinks, vitamins and other goods (Florida Phosphate Council, 1990). The primary finished products of Occidental's beneficiation process are diammonium phosphate and phosphoric acid. A significant portion of Occidental's products are transported to Jacksonville where they are shipped to foreign markets in India, Italy, France, and China. However, the majority of their products are transported via trucks, rail, and barge to the agricultural midwestern U.S. In Hamilton County the Occidental Chemical Corporation employs over 1300 people and accounts for about 50 percent of all income earned (Ray Kirkland, Occidental Chemical Corporation, personal communication, 1991). Occidental has substantial phosphate reserves and expects to continue mining and processing through the year 2010.

Sand

Quartz sand is common in the near-surface and surface sediments of Hamilton County. However, its occurrence with clays along with the presence of other impurities, diminish its value as an economic commodity. Surface grab samples from eastern Hamilton County were examined for this investigation. The sediments were typically unconsolidated quartz sands, yellowish gray to moderate yellowish brown in color, very fine to coarse range, and subangular to subrounded (section 8, Township 2 S, Range 16 E, and section 18, Township 1 S, Range 15 E). Accessory constituents included variable amounts of clay, traces of heavy minerals and iron staining, and minor amounts of organics.

Undifferentiated Resources

Much of Hamilton County has surface and near-surface sediments made up of clayey sand, and organic muck. These undifferentiated resources have extensive occurrences throughout the county. Although the potential for large scale mining is minimal due to the heterogeneous nature of these sediments, they may be valuable locally as fill material.

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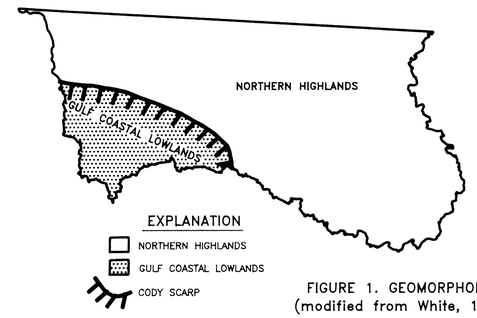


FIGURE 1. GEOMORPHOLOGY (modified from White, 1970)

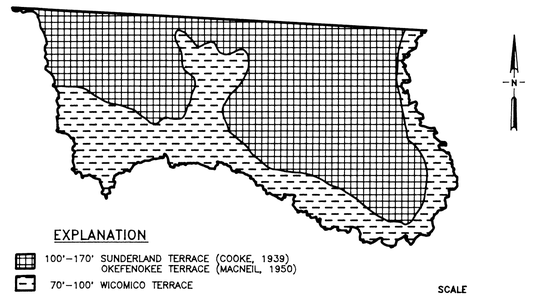


FIGURE 2. TERRACES AND SHORELINES (modified from Healy, 1975)

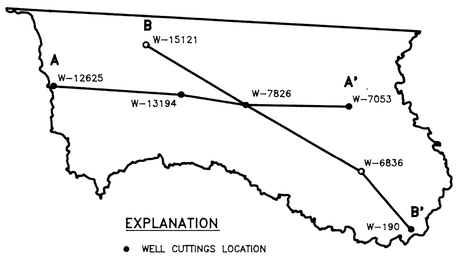
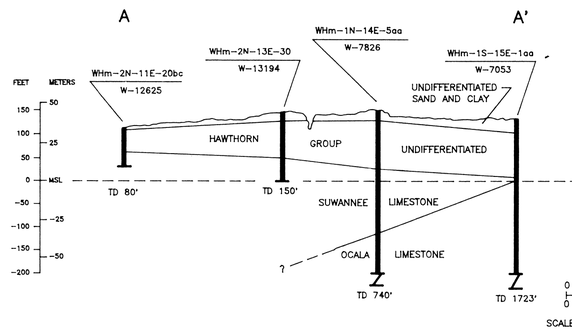


FIGURE 3a. GEOLOGIC CROSS SECTION LOCATIONS

Two well systems are used in this report. One uses the rectangular system of section, township and range for identification. The well number consists of six parts: W for well, county abbreviations, the Township, Range, and Section, and the quarter/quarter location within the section. The other system uses the Florida Geological Survey sample repository accession number.



VERTICAL EXAGGERATION FOR FIGURES 3b AND 3c IS APPROXIMATELY 160 TIMES HORIZONTAL

FIGURE 3b. GEOLOGIC CROSS SECTION A–A'

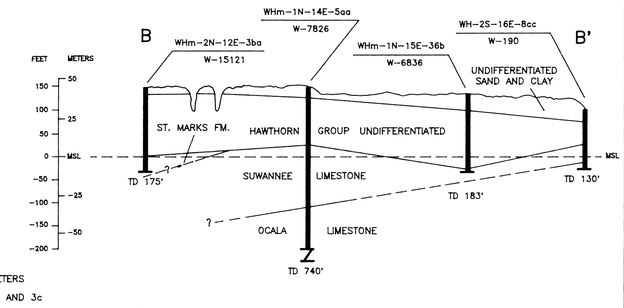


FIGURE 3c. GEOLOGIC CROSS SECTION B–B'