State of Florida
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Open File Report 8

St. Vincent Island
(St. Vincent National Wildlife Refuge)

by

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Florida Geological Survey
Tallahassee, Florida
1984

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Location

St. Vincent Island is a Holocene barrier island located in Franklin County, Florida, west-southwest of Apalachicola, Florida (figure 1). The island is located on the Apalachicola Sheet topographic quadrangle (U.S G.S., 1:250,000) and on the Indian Pass and West Pass 7.5 minute quadrangle maps (U.S.G.S., 1:24,000).

Access

St. Vincent Island is accessible only by boat. To obtain current access information, contact the Refuge Manager:

St. Vincent National Wildlife Refuge
Post Office Box 347
Apalachicola, Florida 32320
(904) 653-8808

Significance of site

St. Vincent Island consists of an extensive, virtually undisturbed beach ridge plain of late Holocene age. The system of 12 beach ridge sets (approximately 180 individual ridges) provides a detailed window into late Holocene coastal and sea level history.

Site Information

Regional Geology

Structure

The dominant structure in the St. Vincent Island area is most commonly called the Apalachicola Embayment. The embayment is narrowest to the northeast, and opens to the south and southwest along an axis which plunges to the south-southwest (Schmidt, 1984). The embayment is bounded by the Chattahoochee Anticline to the northwest and the Ocala Arch to the southeast. The adjacent highs bring Eocene and Oligocene sediments to the surface. Neogene and Quaternary sediments pinch out or are truncated against the flanks of the high (Schmidt, 1984).

Neogene Stratigraphy

St. Marks Formation

The St. Marks Formation was named by Puri and Vernon (1964). Lithologically, the St. Marks is a dolomitic, calcarenitic limestone, ranging to a packed biomicrite to wackestone, very pale orange to light gray to white in color, moderately to well indurated and fossiliferous. The St. Marks is often quartz sandy and may contain occasional greenish clay blebs (Schmidt, 1984).

The St. Marks dips to the southwest and ranges in thickness from zero at the east edge of the Apalachicola Embayment to over 200 feet near the embayment axis just west of St. Vincent Island (Cameron and Mory, 1977). In the St. Vincent Island area, the St. Marks Formation becomes indistinguishable from the overlying Bruce Creek Limestone (figures 2 and 3) (Schmidt, 1984).

Bruce Creek Limestone

The Bruce Creek Limestone was named by Huddlestun (1976a) for Alum Bluff equivalent carbonate rocks in the coastal portion of Walton County and vicinity. More recently other authors have mapped this unit to both the east and west of Walton County. Schmidt et al (1982) and Bolling (1982) have shown that the eastern extent of the Bruce Creek coincides with the eastern boundary of the Neogene Apalachicola Embayment where the Bruce Creek and the underlying St. marks Formation are indistinguishable (Schmidt, 1984).

Lithologically, the Bruce Creek in the St. Vincent Island area is a white to light yellowish-gray, moderately indurated, macro-moldic, calcarenitic limestone with some dolomite (Schmidt, 1984). Common accessary minerals include quartz sand (up to 20%), with pyrite, phosphorite, mica, clay and glauconite in trace amounts. Common microfossils include planktonic and benthic foraminifera, ostracods, bryozoans and calcareous nannofossils (Schmidt, 1984).

The Bruce Creek dips gently to the south-southwest at approximately 12 feet per mile (Schmidt, 1984). Several workers (Huddlestun, 1976a; Schmidt and Clark, 1980; Clark and Schmidt, 1982; Bolling, 1982) have dated the Bruce Creek as Middle Miocene based on planktonic foraminifera.

Intracoastal Formation

The Intracoastal was named by Huddlestun (1976a,b) in the Walton County, Florida area. Schmidt and Clark (1980) and Schmidt (1982) extended the formation eastward to eastern-most Franklin County (east of St. Vincent Island).

Schmidt and Clark (1980) describe the Intracoastal as a "very sandy, highly micro-fossiliferous, poorly consolidated, argillaceous, calcarenitic limestone." The dominant lithologic components include quartz sand, clay, calcilutite, phosphorite and abundant microfossils. Accessory minerals include mica, glauconite, pyrite and heavy minerals, generally in trace amounts (Schmidt, 1984).

The Intracoastal dips very gently to the west and west-southwest in the vicinity of St. Vincent Island. The dip in this area is less than three feet per mile (Schmidt, 1984). The formation thickens from the eastward margin of the Apalachicola Embayment and ranges from 100 to 200 feet thick in the vincinity of St. Vincent Island (Schmidt, 1984). The top of the Intracoastal has been dated as Late Pliocene in Bay County, to the west of St. Vincent Island (Schmidt and Clark, 1980).

Chipola and Jackson Bluff Formations

The Chipola Formation and the overlying Jackson Bluff Formation are undifferentiated in the vicinity of St. Vincent Island. Both formations are predominantly molluscan rich, argillaceous, quartz sandy shell beds (Schmidt, 1984). The Jackson Bluff, where it is differentiated from the Chipola, generally contains more quartz sand and clay, is more poorly indurated, with pelecypods dominant over gastropods. Where the Chipola is not identified, the entire shell bed thickness is considered to be Jackson Bluff (Schmidt, 1984). In the St. Vincent Island area, the base of the undifferentiated Chipola - Jackson Bluff contains a shell barren clayey sand unit (Schmidt, 1984).

The dip of the Jackson Bluff in the St. Vincent Island area is variable however the regional dip is to the south-southwest at about three feet per mile (Schmidt, 1984). The Jackson Bluff in the vicinity of St. Vincent Island has been dated as Late Pliocene to possibly Early Pleistocene (Schmidt, 1984).

Quaternary Stratigraphy

Undifferentiated Pleistocene

Schnable and Goodell (1968) discussed the Pleistocene and Holocene geology of the coastal area of the Apalachicola coast, including St. Vincent Island. Pleistocene sediments vary in thickness from approximately 120 feet at Cape San Blas (west of St. Vincent Island) to less than 10 feet to the east (Schnable and Goodell, 1968). Two of Schnable and Goodell's borings are located along the western portion of the lagoon side of St. Vincent Island. These borings show 22-25 feet of Holocene sediment, but do not reach the base of Pleistocene sediment. Limestone is encountered in local water wells at 100-110 feet below mean sea level (Schnable and Goodell, 1968). This would indicate approximately 75 to 90 feet of Pleistocene sediment at St. Vincent Island.

Schnable and Goodell (1968) utilize a two part breakdown of Pleistocene sediments and suggest that two depositional cycles are represented. Each depositional cycle is represented by a fining upward sediment package separated from overlying and underlying units by unconformities.

The lower Pleistocene unit of Schnable and Goodell (1968) at St. Vincent Island consists of a coarse sand, overlain by silty clay and clay, in turn overlain by very clean fine quartz sand. The uppermost portion of the lower unit consists of gray silty, clayey quartz sand or dark gray, quartz sandy, silty clay. Clays within the lower Pleistocene unit consist primarily of kaolinite with smaller quantities of montmorillonite (Schnable and Goodell, 1968).

The upper Pleistocene sequence (Schnable and Goodell, 1968) consists of a silty, fine to coarse quartz sand which grades upward to fine grained sands and silty sands. The fine sands and silty sands are overlain by clayey sand and sandy clay.

Schmidt (1984) breaks Quarternary sediments into two lithologic packages, but did not attempt to differentiate between Pleistocene and Holocene sediments. The lower unit of Schmidt, onshore in the vicinity of St. Vincent Island consists of massive clays with interspersed quartz sands which grade and thin northward into graded sands with some massive clays. Schmidt's upper unit consists of clean sands and clayey sands (Schmidt, 1984).

Holocene

Holocene sediments in the vicinity of St. Vincent Island consist primarily of the present day barrier islands, spits and shoals and sediments filling the old entrenched Apalachicola River Valley. Holocene sediments attain their greatest thickness (74 feet) in the entrenched river valley. Outside the old Apalachicola River Valley, Holocene sediments range from approximately 10-25 feet thick (Schnable and Goodell, 1968).

St. Vincent Island rests on basal Holocene sediments which consist of clayey, fine grained quartz sands, quartz sandy muds and poorly sorted quartz sands. These Holocene sediments are deposited on an oxidized Pleistocene surface (Otvos, 1984). The island itself is constructed of well to very well sorted quartz sands, deposited under littoral or supratidal conditions. Many of the beach ridge swales and some of the ridges are blanketed with silts and clays. The first two ridges behind the present beach, and those immediately adjacent to Indian Pass are dune decorated (Stapor, 1973).

Beach Ridge Development

Beach ridges are linear sand ridges which were deposited along the beach face in areas with a gentle offshore slope, low wave energy, and an abundant sand supply. Beach ridges form only on accreting beaches. Because they form on the beach face they indicate the location and orientation of the coastline at the time they were formed.

Beach ridges are constructed by wave run-up in the swash zone by waves which fall in the long term "maximum wave energy" category (Tanner and Stapor, 1972). The internal structure of beach ridges indicates that all or almost all of the ridge is constructed by wave run-up, with very little washover (Tanner and Stapor, 1972). Internal bedding is almost exclusively composed of planar, seaward dipping cross beds. The ridge grows upward and seaward as material is deposited. Smaller ridges may be constructed by "fair weather waves" but will be destroyed when wave energy increases.

Beach Ridge Plain Development

Stapor (1973), describes several basic types of beach ridge patterns, each of which is indicative of specific depositional environments. Stapor's categories are: (1) Ridges convex seaward, occuring at the distal prograding tip of spits; (2) Ridges concave seaward which are being actively eroded perpendicular to their ridge and swale orientation; (3) Ridges concave seaward deposited in embayed sections of the coast; and (4) Ridges convex seaward which represent net seaward growth, not lateral extention.

Beach ridges of category (3) are predominant on St. Vincent Island (sets A-G and set K) (figure 4). Category (3) ridges which are essentially parallel indicate that sediment was transported from offshore without significant longshore transport. On St. Vincent, beach ridge sets A, B, C, F, G, H, J and K are indicative of these conditions. Sets D and E are splayed to the east (increasing ridge crest spacing), a condition which indicates that westward longshore drift supplied the sand for their construction (Stapor, 1973). Beach ridges of set I, although indistinct, appear to splay to the west, indicating a temporary reversal of drift direction (to the east).

Beach ridge sets H, I, J & L were deposited in large part due to the migration of the West Pass lunate bar across the inlet (Stapor, 1973). The youngest ridge set (L) is of category (4). The sediment source for these ridges was sand delivered by easterly (primary) and southerly (secondary) transporting drift systems (Stapor, 1973).

Holocene Sea Level History

Stapor and Tanner (1977) present a Holocene sea level history developed from evidence preserved on St. Vincent Island and the adjacent mainland. The evidence utilized includes: 1) "average elevations of erosional scarps and beach ridge sets" 2) "elevation and distribution of cultural components of archeological sites" 3) "elevation of silt and clay beds containing marine shells" and 4) carbon 14 dating. Stapor and Tanner find evidence for 4 sea level reversals.

Following a long period of sea level rise beginning approximately 20,000 years before present (BP), and continuing thru the early Holocene, sea level reached the highest Holocene sea level stand approximately 5,000 BP (Stapor and Tanner, 1977). This sea level stand is at approximately 5.0 feet above present sea level. The evidence for this high Holocene sea level stand consists of a wave cut scarp cut into unconsolidated pre-Holocene sands on the mainland shoreward of the present location of St. Vincent Island (figure 5).

This appears to be the Silver Bluff position (Stapor and Tanner, 1977).

The first sea level reversal documented by Stapor and Tanner (1977) occurred approximately 6000-4000 BP when sea level rise changed to fall. The evidence consists of the topographically low silt and clay covered beach ridges on St. Vincent Island (figure 4 sets A - D, figure 5) located offshore of the topographically high (+ 5.0 feet) scarp found on the mainland. St. Vincent Island beach ridge sets A - D were deposited at sea levels approximately 5.0 feet lower than present, a sea level fall of approximately 10 feet. Archeological information provides the only present information regarding the time of formation of the mainland scarp, the St. Vincent beach ridges and the sea level reversal. Norwood occupation sites are present on both the mainland scarp and at sites 60 & 64 on St. Vincent Island (figure 2). This indicates that they were formed prior to 4000-3000 BP (Stapor and Tanner, 1977).

The second reversal (from fall to rise) occurred after the deposition of beach ridge sets A-D and prior to deposition of the marine shell bed which overlies the silts and clays which blanket set D. The marine shells are C-14 dated at 2100 $\pm$ 130 BP (figure 4). The marine shells are exposed approximately 1.6 feet above present sea level, indicating a rise of about 6.5 feet (Stapor and Tanner, 1977).

The third reversal (from rise to fall) occurred after deposition of the dated marine shells (2110 $\pm$ 130 BP), but prior to the early Swift Creek (1800-1500 BP) occupation of archeological site 71 (figure 2). This site is a midden which rests on silt and clay material. The contact is located in the middle of the present day intertidal zone (Stapor & Tanner, 1977). The magnitude of sea level fall is 6.5 - 8.2 feet (Stapor and Tanner, 1977).

The last sea level reversal documented by Stapor and Tanner (1977) occurred after the Weeden Island (1500-800 BP) occupation of site 72 (figure 4). The base of the shell midden at site 72 rests on silt and clay substrate 3.9 feet below present sea level. Sea level rise to the present position is 3.9 feet.

Based on elevation, there are two major groups of beach ridge sets on St. Vincent Island. Sets A - D (figure 2) have crest elevations of about 1m. Sets E - L (figure 4) have crest elevations of approximately 8.2 feet (excluding dune ridges and dune decorated beach ridges which have elevations up to 16.4 feet). Tanner and Stapor (1972) related beach ridge height to wave height and concluded that fair weather waves are not responsible for beach ridge formation. Stapor and Tanner (1977) state that most of the beach ridges on St. Vincent Island could be constructed by modern day storm waves (3.3 - 4.9 feet). The 3.3 foot crest ridges (sets A - D) would require either less wave energy, or lower sea level. As these ridges are blanketed with silt and clay, the lower sea level accounts for the difference in elevation.

Secondary deposits of alluvial silt and clay, marsh deposits and shell beds have filled or partially filled many of the beach ridge swales. If these secondary deposits were removed, St. Vincent would be several islands as the original surfaces of the swales are often below present day sea level. This supports Stapor and Tanner's (1977) conclusion that mean sea level has for the past approximately 4,000 years fluctuated around a mean value which is less than 4.9 feet below present mean sea level position.

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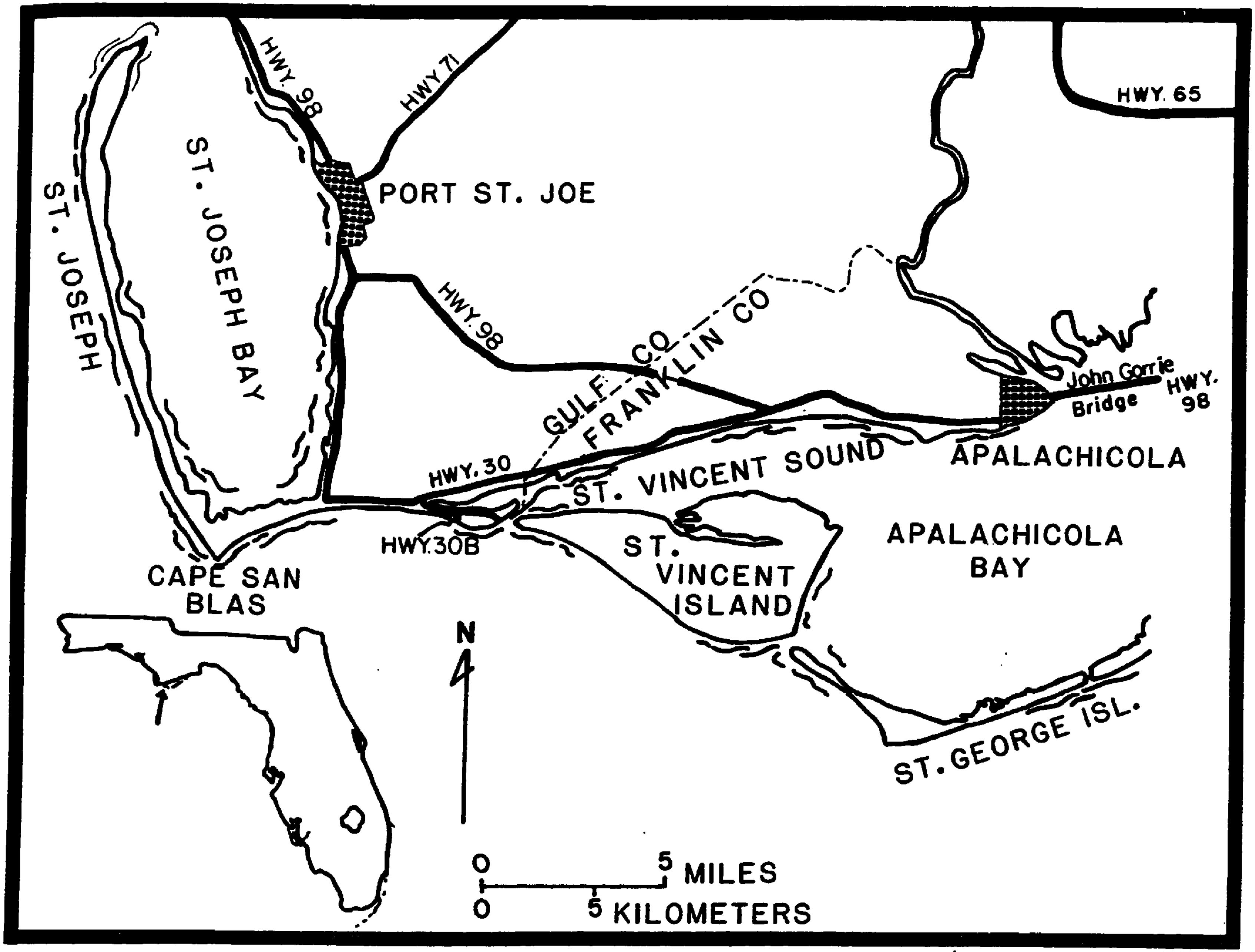
Figure 1: Location Map

Figure 2: North-South Geologic Cross-Section, modified from Schmidt, 1984.

Figure 3: East-West Geologic Cross Section, modified from Schmidt, 1984.

Figure 4: Diagrammatic sketch map of St. Vincent Island, Franklin County, Florida showing the different sets of beach ridges (A, B, C,..., L) which comprise this Holocene island. The number 60, 64, 71 and 72 locate critical Indian middens; these sit number should begin with 8Fr to correspond with the site survey files of the Department of Anthropology, Florida State University. The C-14 data of 2110 BP locates the marine shell bed exposure; this shell bed stratigraphically overlies the clay/silt deposits which blanket beach ridge set D. The open arrows indicate directions of present-day net long shore transport. Modified from Stapor and Tanner, 1977.

Figure 5: A detailed interpretation of the Holocene history of St. Vincent Island Florida. Modified from Stapor, 1973.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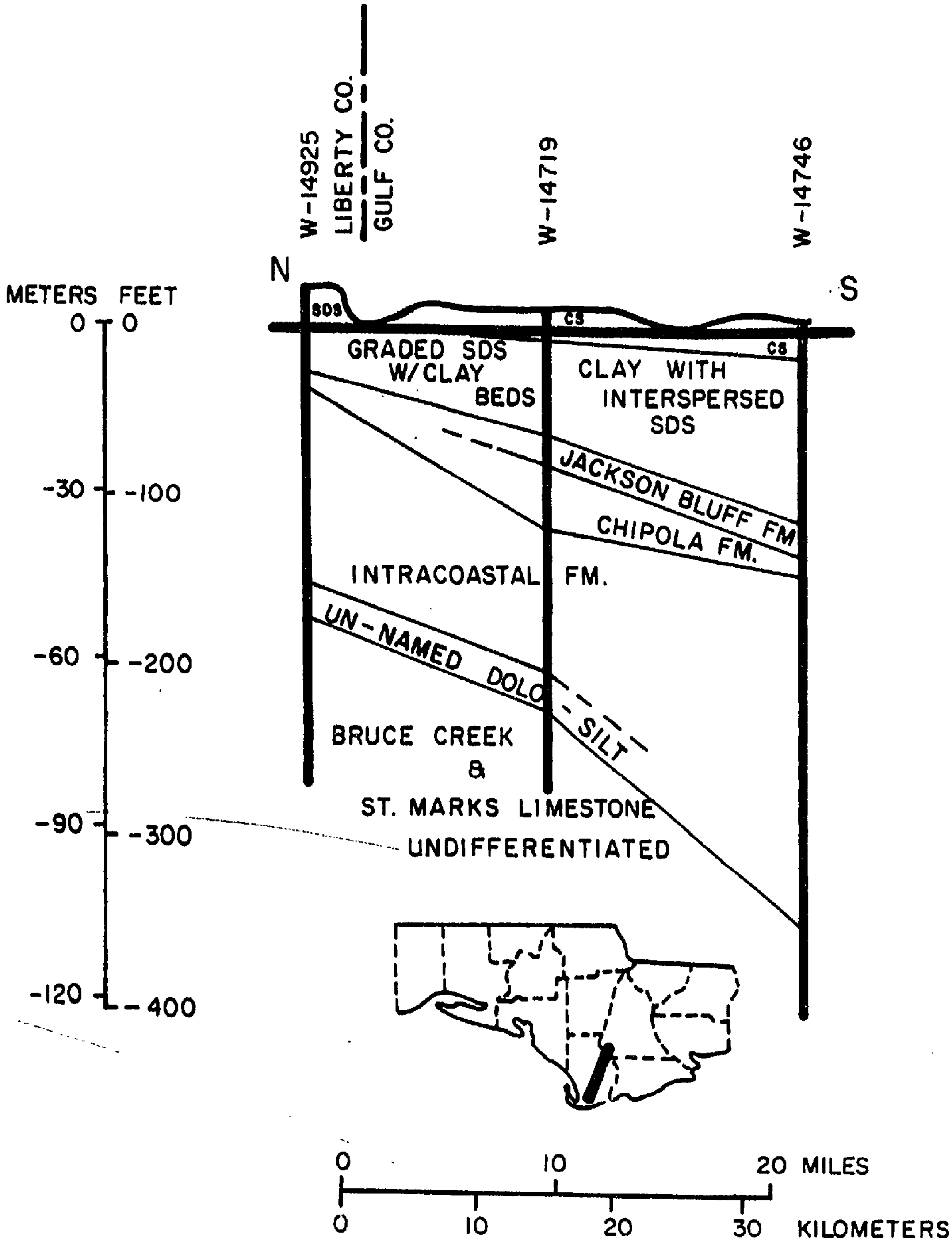
HWY 71
HWY. 65
PORT ST. JOE
ST. JOSEPH BAY
ST. JOSEPH
HWY. 98
GULF CO
FRANKLIN CO
John Gorrie Bridge
HWY. 98
HWY. 30
APALACHICOLA
ST. VINCENT SOUND
HWY. 30B
ST. VINCENT ISLAND
APALACHICOLA BAY
CAPE SAN BLAS
N
ST. GEORGE ISL.
0 5 MILES
0 5 KILOMETERS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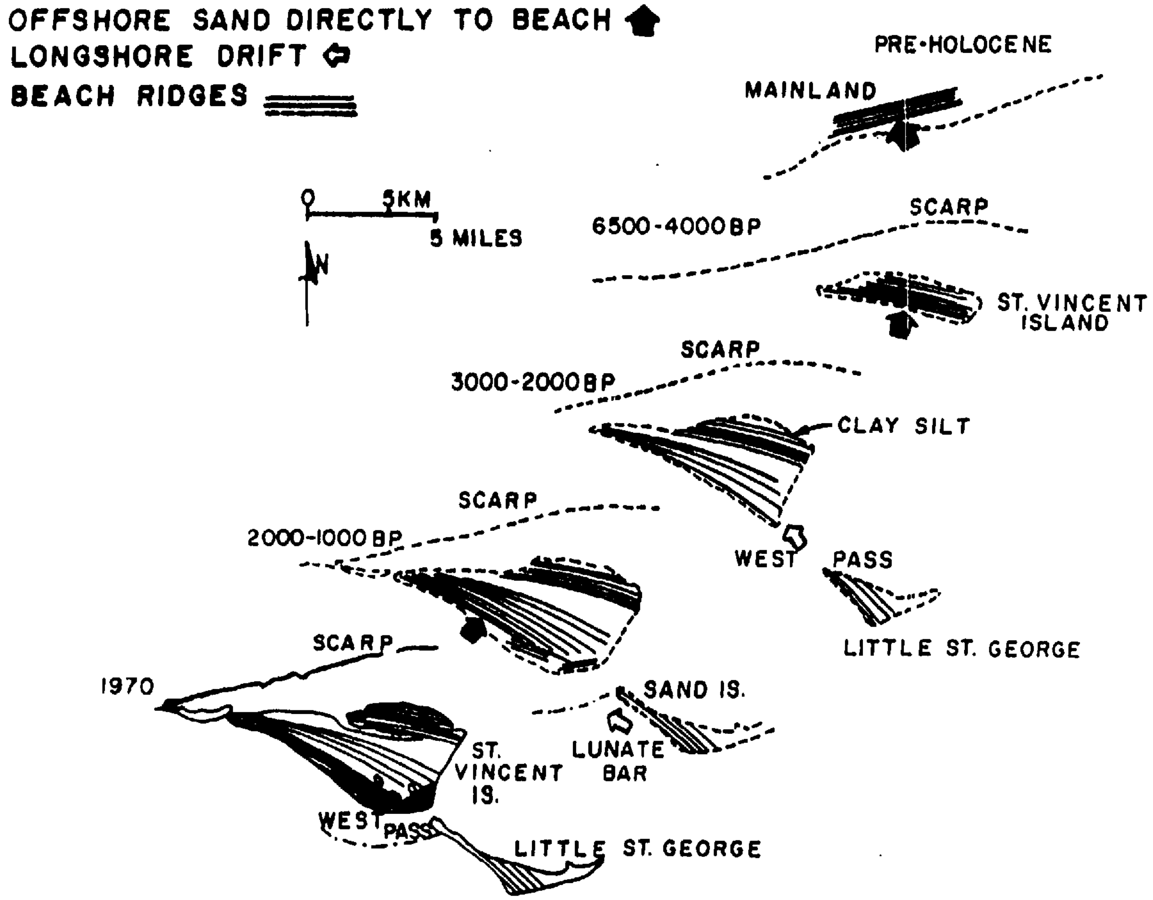
LIBERTY CO.
GULF CO.
W-14719
W-14746
N
S
METERS FEET
0 0
-30 -100
-60 -200
-90 -300
-120 -400
SDS
CS
CS
GRADED SDS W/CLAY BEDS
CLAY WITH INTERSPERSED SDS
JACKSON BLUFF FM
CHIPOLA FM.
INTRACOASTAL FM.
UN-NAMED DOLO - SILT
BRUCE CREEK & ST. MARKS LIMESTONE UNDIFFERENTIATED
0 10 20 MILES
0 10 20 30 KILOMETERS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LONGSHORE DRIFT
BEACH RIDGES
PRE-HOLOCENE
MAINLAND
0 5KM
5 MILES
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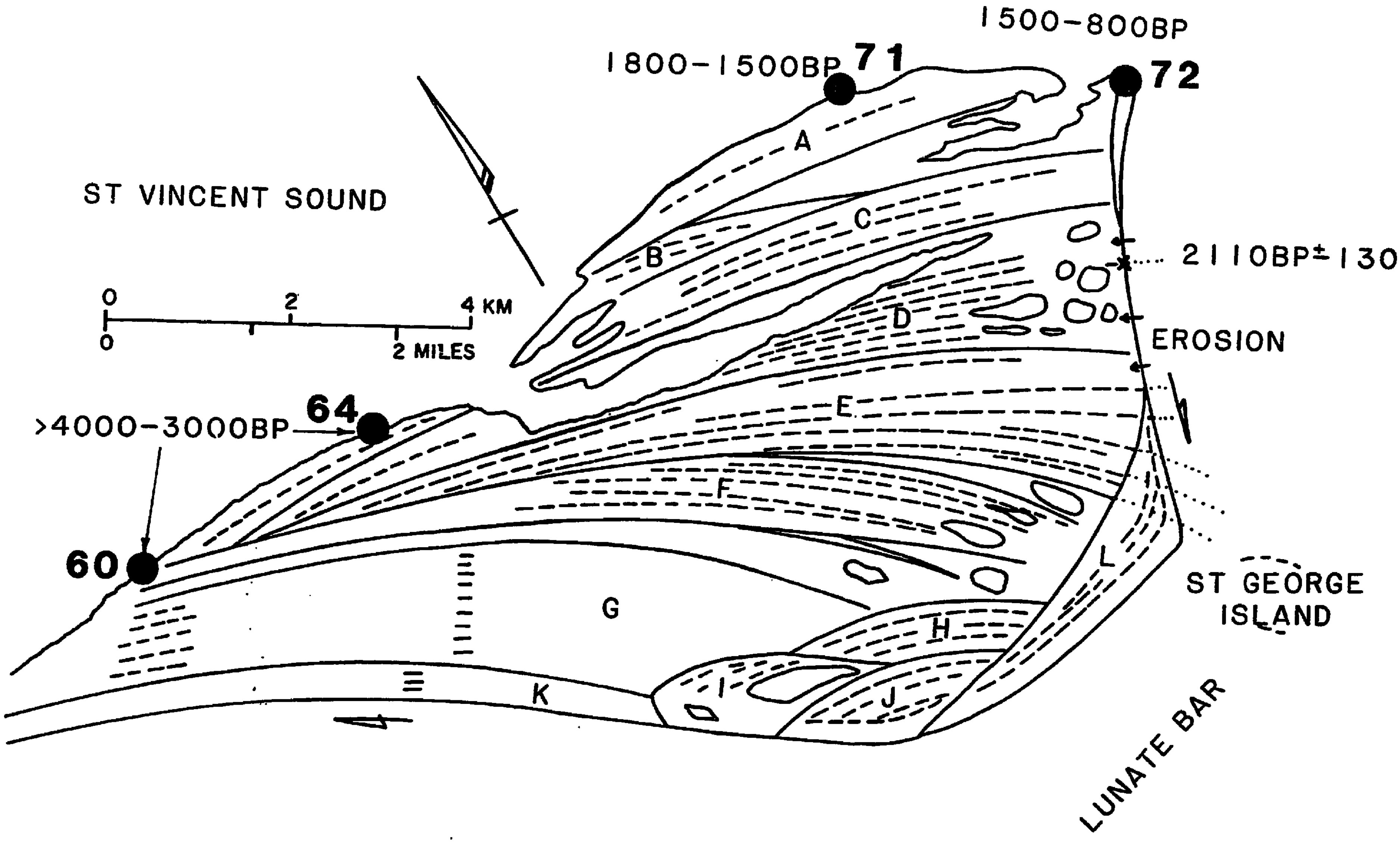
6500-4000BP
SCARP
ST. VINCENT ISLAND
SCARP
3000-2000BP
CLAY SILT
SCARP
2000-1000BP
WEST PASS
LITTLE ST. GEORGE
SCARP
1970
SAND IS.
LUNATE BAR
ST. VINCENT IS.
WEST PASS
LITTLE ST. GEORGE



1500-800BP
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ST VINCENT SOUND
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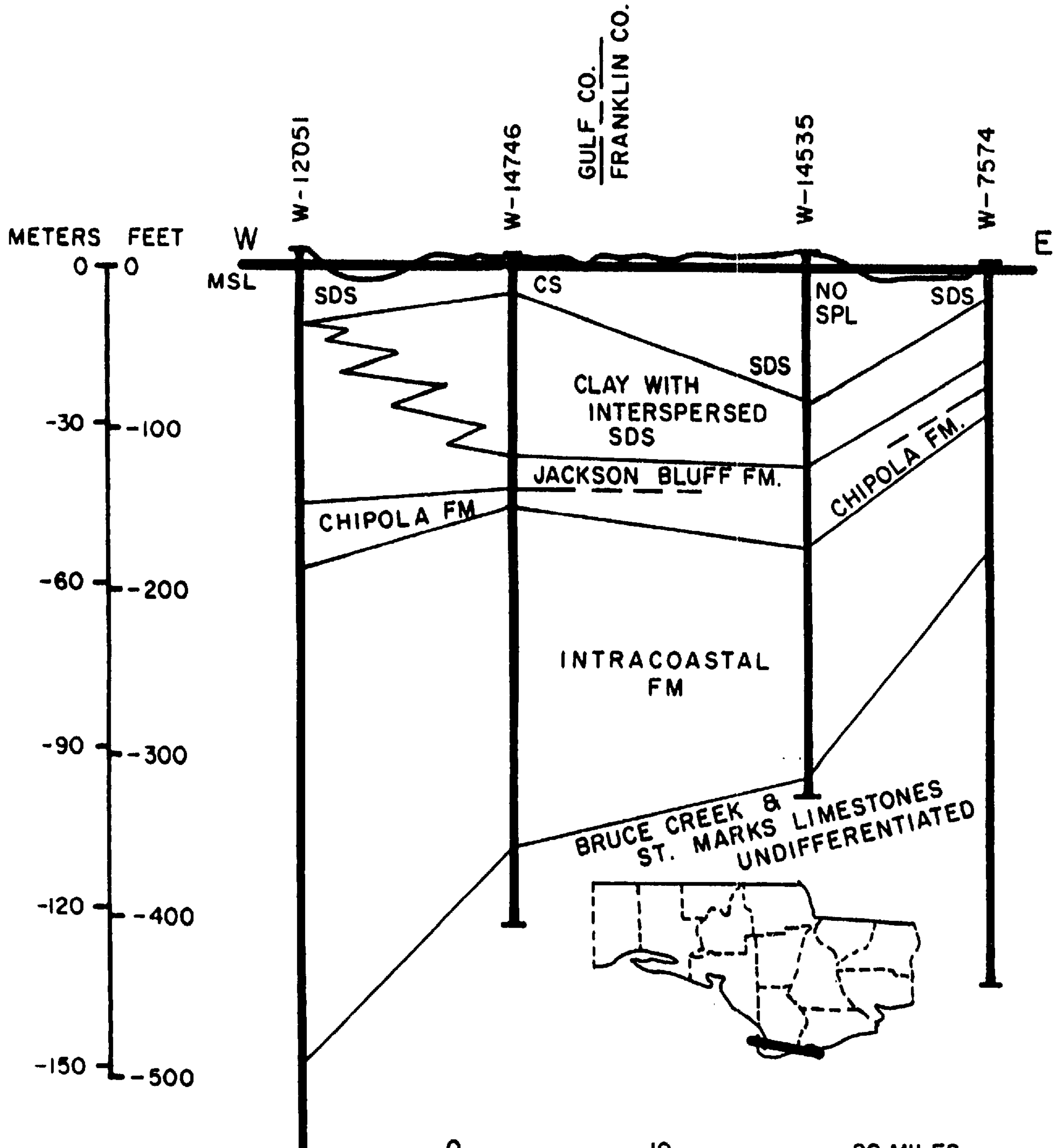
ST GEORGE
ISLAND
LUNATE BAR



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CLAY WITH INTERSPERSED SDS
-30 -100
JACKSON BLUFF FM.
CHIPOLA FM
CHIPOLA FM.
-60 -200
INTRACOASTAL FM
-90 -300
BRUCE CREEK & ST. MARKS LIMESTONES UNDIFFERENTIATED
-120 -400
-150 -500
0 10 20 MILES
0 10 20 30 KILOMETERS