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PART I: 1988 AND 1989 FLORIDA PETROLEUM PRODUCTION AND EXPLORATION

By
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INCLUDING FLORIDA PETROLEUM RESERVE ESTIMATES

By
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PART II: PETROLEUM EXPLORATION AND DEVELOPMENT POLICIES IN FLORIDA: RESPONSE TO PUBLIC CONCERN FOR SENSITIVE ENVIRONMENTS

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PART III: PETROLOGY AND PROVENANCE OF THE NORPHLET FORMATION, PANHANDLE, FLORIDA

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TABLE OF CONTENTS

	Page
Abstract	x
Acknowledgements	x
Introduction	1
1988 and 1989 Production	1
1988 and 1989 Onshore Drilling Activity	8
Offshore Drilling Activity	8
Exploratory Drilling in State Waters	8
1988 and 1989 Exploratory Drilling in Federal Waters,Offshore Florida	11
Geophysical Exploration Activity	12
Florida Oil Field Descriptions	12
North Florida Oil Field Summaries	15
Introduction	15
Bluff Springs Field	15
McDavid Field	17
Jay Field	19
Coldwater Creek Field	19
Blackjack Creek Field	22
Mt. Carmel Field	22
McLellan Field	25
Sweetwater Creek Field	25
South Florida Oil Field Summaries	28
Introduction	28
Lehigh Park Field	28
Townsend Canal Field	28
West Felda Field	30
Mid-Felda Field	30
Sunoco Felda Field	30
Corkscrew Field	32
Lake Trafford Field	32
Sunniland Field	34
Seminole Field	34
Bear Island Field	34
Pepper Hammock Field	37
Baxter Island Field	37
Raccoon Point Field	37
Forty Mile Bend Field	37
Summary	39
References	40

ILLUSTRATIONS

Figure	Page
1. South Florida oil field location map	2
2. Stratigraphic nomenclature, Upper Jurassic to Lower Cretaceous, south Florida	3

3. Northwest Florida oil field location map 4

4. Stratigraphic nomenclature, Middle Jurassic to Lower Cretaceous, northwest Florida 5

5. Oil production, 1970 through 1989 6

6. 1987, 1988, and 1989 oil production comparison 7

7. Oil exploration wells, Florida state waters 9

8. Mesozoic structural features in Florida and offshore 10

9. 1988 and 1989 oil exploration wells and active leases, federal waters, offshore Florida 13

10. 1988 and 1989 geophysical exploration activity 14

11. Bluff Springs and McDavid fields structure map, top of Smackover Formation 16

12. Geophysical log correlation, Bluff Springs and McDavid fields 18

13. McDavid field production curve 20

14. Jay field structure map, top of Smackover Formation 21

15. Blackjack Creek structure map, top of Smackover Formation 23

16. Mt. Carmel field structure map, top of Norphlet Sandstone 24

17. McLellan and Sweetwater Creek fields well location map 26

18. Geophysical log correlation, McLellan field 27

19. Lehigh Park field structure map, top of Sunniland Formation 29

20. Sunoco Felda, West Felda, and Mid-Felda fields structure map, top of Sunniland Formation 31

21. Corkscrew and Lake Trafford fields structure map, top of Sunniland Formation 33

22. Sunniland field structure map, top of Sunniland Formation 35

23. Bear Island field structure map, base of anhydrite in Upper Sunniland Formation 36

24. Raccoon Point field preliminary structure map, top of Sunniland Formation 38

ABSTRACT

Florida oil production began to decline in 1979 and continued to do so during 1988 and 1989. Jay field, as the leading producing field for Florida, controls the rate of decline.

Onshore exploratory drilling during 1988 and 1989 resulted in the discovery of McDavid field in Escambia County and Coldwater Creek field in Santa Rosa County. Offshore exploratory drilling included six wells which were completed in federal waters off Florida during 1988 and 1989; one of these was the second Norphlet discovery in the Destin Dome area and was classified by the federal government as a producible field.

Geophysical exploration during 1988 and 1989 concentrated in the Florida panhandle and the south Florida peninsula. The panhandle exploration included the known oil-producing Santa Rosa and Escambia Counties, an area offshore from Santa Rosa and Escambia Counties, and the Apalachicola Embayment area. South Florida seismic activity was east of the known Sunniland-producing trend in Broward, Dade, Hendry and Palm Beach Counties.

In addition to 1988 and 1989 data, a summary of offshore exploratory drilling in state waters, from 1947 through 1983, is included in this report. This information may be useful in evaluating future offshore and onshore development and exploration. Of similar value are descriptions of each of Florida's 22 oil fields. Descriptions include discovery data, geologic information, and production totals.

ACKNOWLEDGEMENTS

Several Florida Geological Survey staff members contributed to this report. Charles Tootle compiled oil field data and production statistics. The Oil and Gas Section maintains files on permitted exploratory and development drilling. Joan Ragland and Charles Tootle provided comments and assistance in using these files. Joan Ragland tabulated and assisted with the interpretation of the geophysical exploration permit data. Joel Duncan assisted with the interpretation of geophysical logs from the recently-discovered McDavid field. Jim Jones and Ted Kiper drafted and photographed the figures. Walt Schmidt, Tom Scott, Ed Lane, Joan Ragland, and Joel Duncan edited the manuscript and suggested improvements.

1988 AND 1989 FLORIDA PETROLEUM PRODUCTION AND EXPLORATION

By
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INTRODUCTION

There are two major oil producing areas in Florida. One is the Sunniland trend in South Florida, the other is in the western panhandle area. The Sunniland trend includes 14 oil fields; the western panhandle includes eight. Appendix 1 lists the discovery well data for these fields.

The Sunniland trend production began with Florida's first oil discovery at Sunniland field in September, 1943. Of the 14 Sunniland trend oil fields, 10 are active, one is temporarily shut-in, and three are plugged and abandoned. These fields are oriented along a northwest-southeast trend through Lee, Hendry, Collier, and Dade Counties (Figure 1). Production is principally from rudistid reefs found in the upper one hundred feet of the Lower Cretaceous Sunniland Formation (Figure 2).

Production in the western panhandle began with the discovery of Jay field in June, 1970. The eight panhandle oil fields are located in Escambia and Santa Rosa Counties, Florida (Figure 3). Seven fields are active and one is plugged and abandoned. Production is from Upper Jurassic Smackover Formation carbonates and Norphlet Sandstone sands (Figure 4).

1988 AND 1989 PRODUCTION

Florida oil production began to decline in 1979 and has continued to do so since then (Figure 5). Total oil production for 1988 was 7,746,048 barrels, down 6% from 1987. Production dropped another 6% during 1989 for a 1989 total of 7,289,390 barrels. Appendix 2 lists 1988, 1989, and cumulative production statistics for each of Florida's oil fields including oil, gas, and water production data. Appendix 3 lists 1988 and 1989 field well statistics including the number of production, injection, shut-in, and temporarily abandoned wells for each field.

Jay field dominates Florida production. The field was discovered in 1970 and reached peak production in 1978. It accounts for about 61 percent of the 1988 oil production total, about 66 percent of the 1989 total, and about 70 percent of the cumulative total. Figure 5 graphically illustrates both state wide annual oil production and Jay field annual oil production for 1970 through 1989, clearly showing Jay field's dominance in Florida oil production trends. The Jay field production curve is typical of oil fields produced with tertiary recovery methods (David Curry, Oil and Gas Section Administrator, Florida Geological Survey, personal communication, 1990). Production has leveled off during the last three years (1987, 1988, and 1989, Figure 5). This generally agrees with the projections made by Christian, et al. (1981) in their discussion of tertiary recovery estimates for Jay field. They predicted a production plateau of about 10,000 barrels/day for about 12 years (1984 through 1996). They estimated that tertiary recovery would be terminated in 1996, followed by rapid decline to depletion in about 2004. Total production will be about 84.7 million barrels; 37.5 million would have been produced through waterflood alone (Christian, et al., 1981).

Figure 6 is a histogram comparing 1987, 1988, and 1989 oil production for all Florida oil fields except Jay field. Jay field data would obscure the information for all other fields since its production for 1987 was five times greater than that of West Felda field, the next most productive field in Florida during 1987. Northwest Florida production increased by one percent from 1987 to 1988 and by two percent from 1988 to 1989. South Florida production decreased by 18 percent from 1987 to 1988 and by 24 percent from 1988 to 1989.

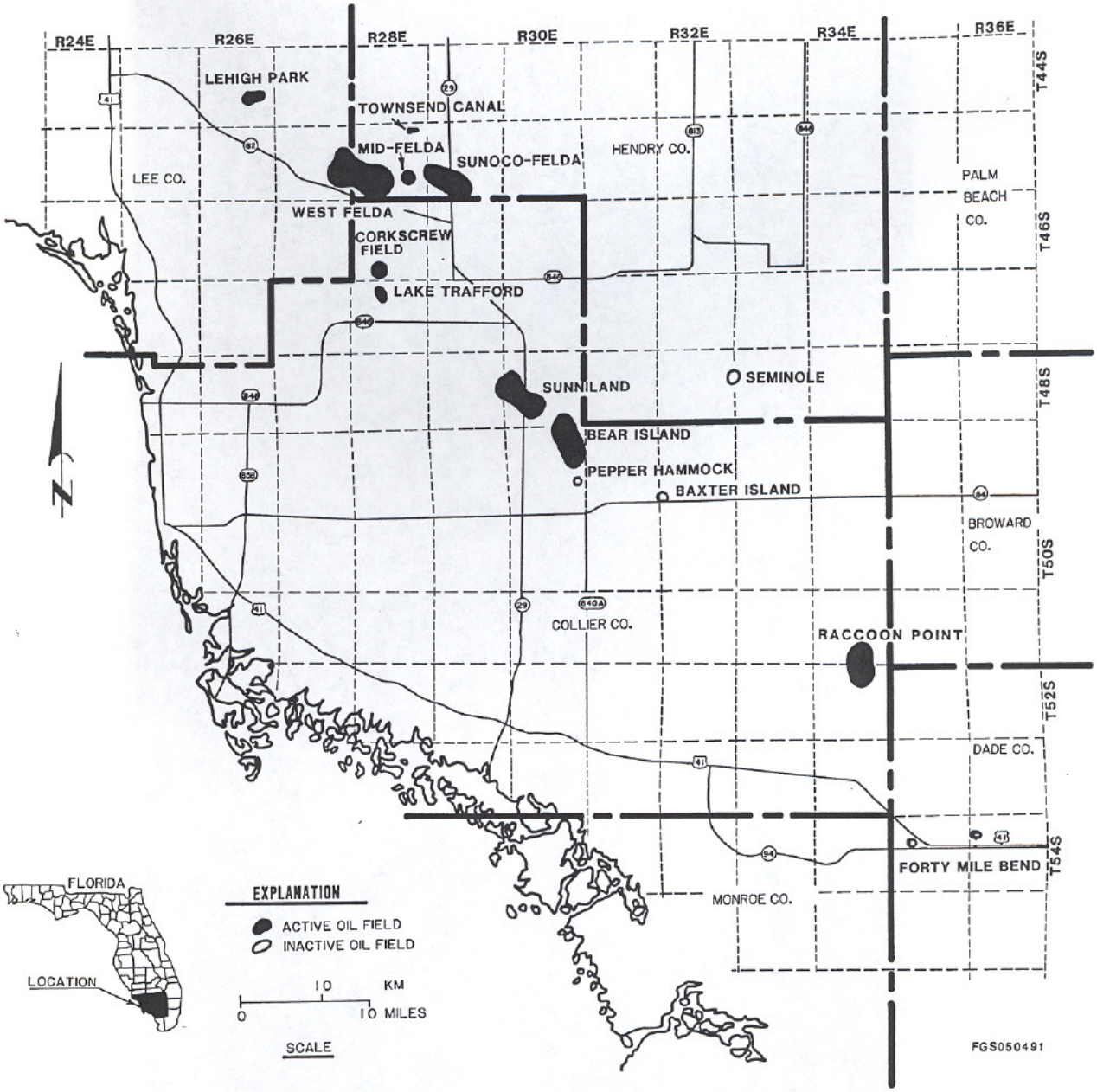


Figure 1. South Florida oil field location map.

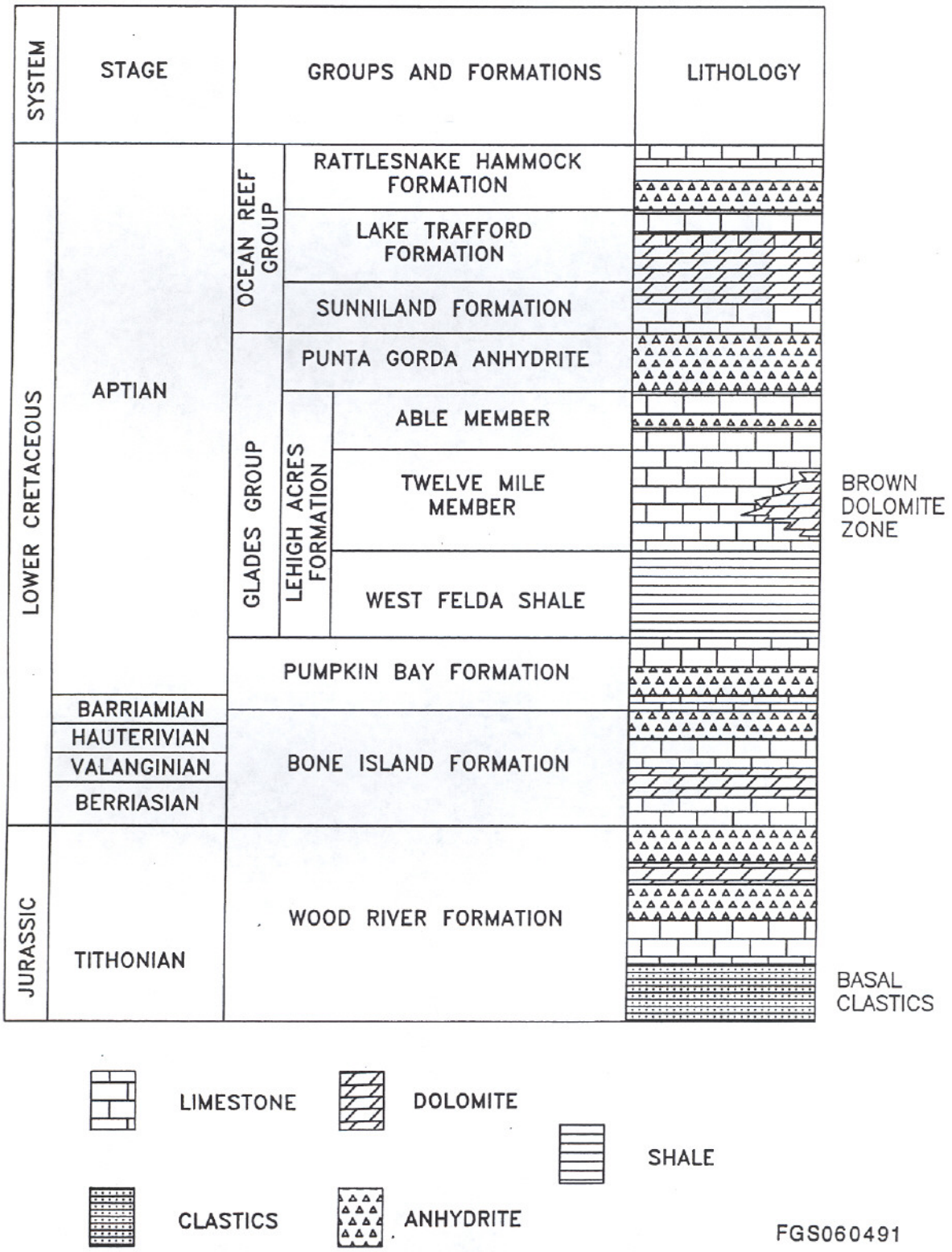


Figure 2. Stratigraphic nomenclature, Upper Jurassic to Lower Cretaceous, south Florida.

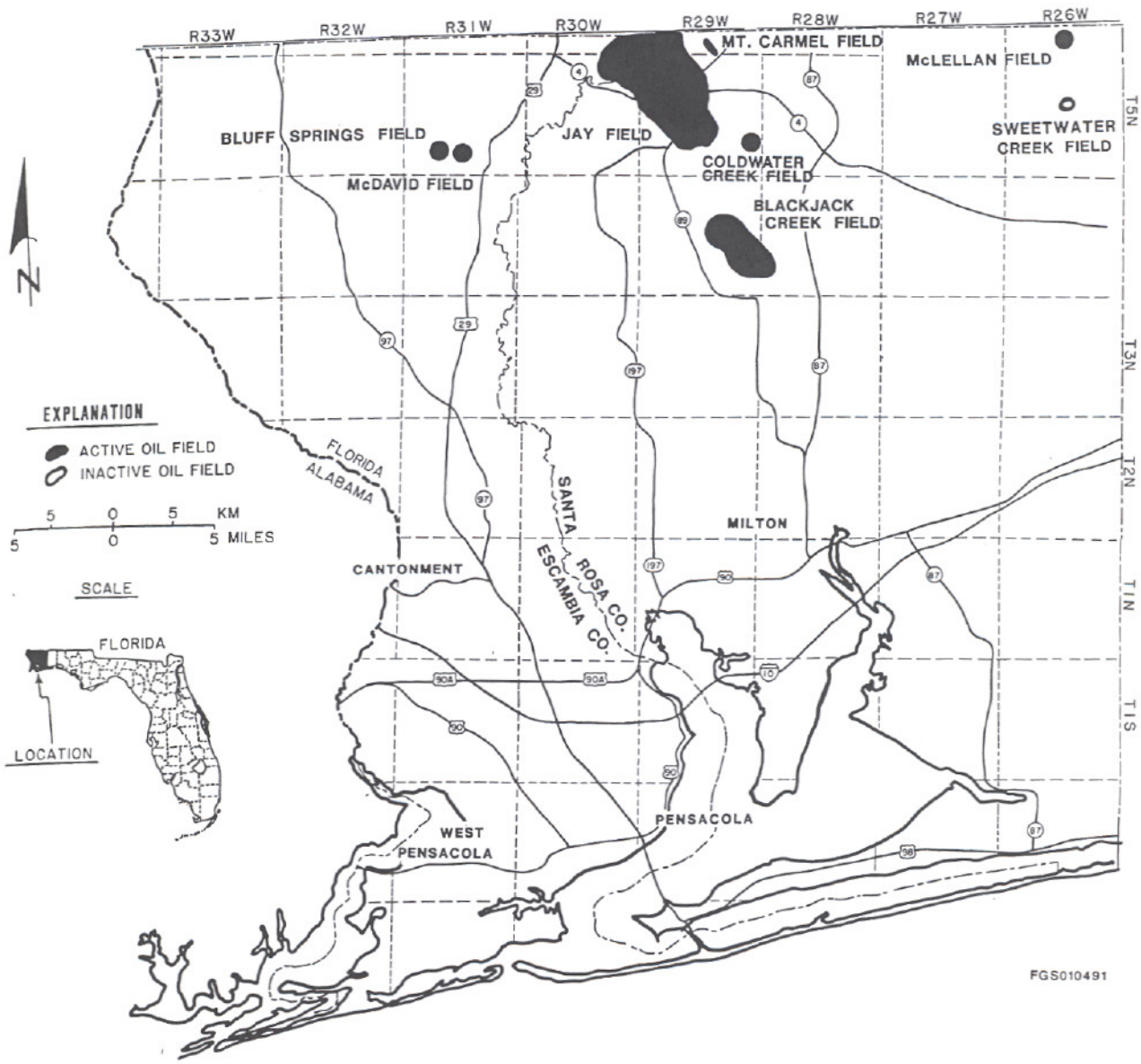


Figure 3. Northwest Florida oil field location map.

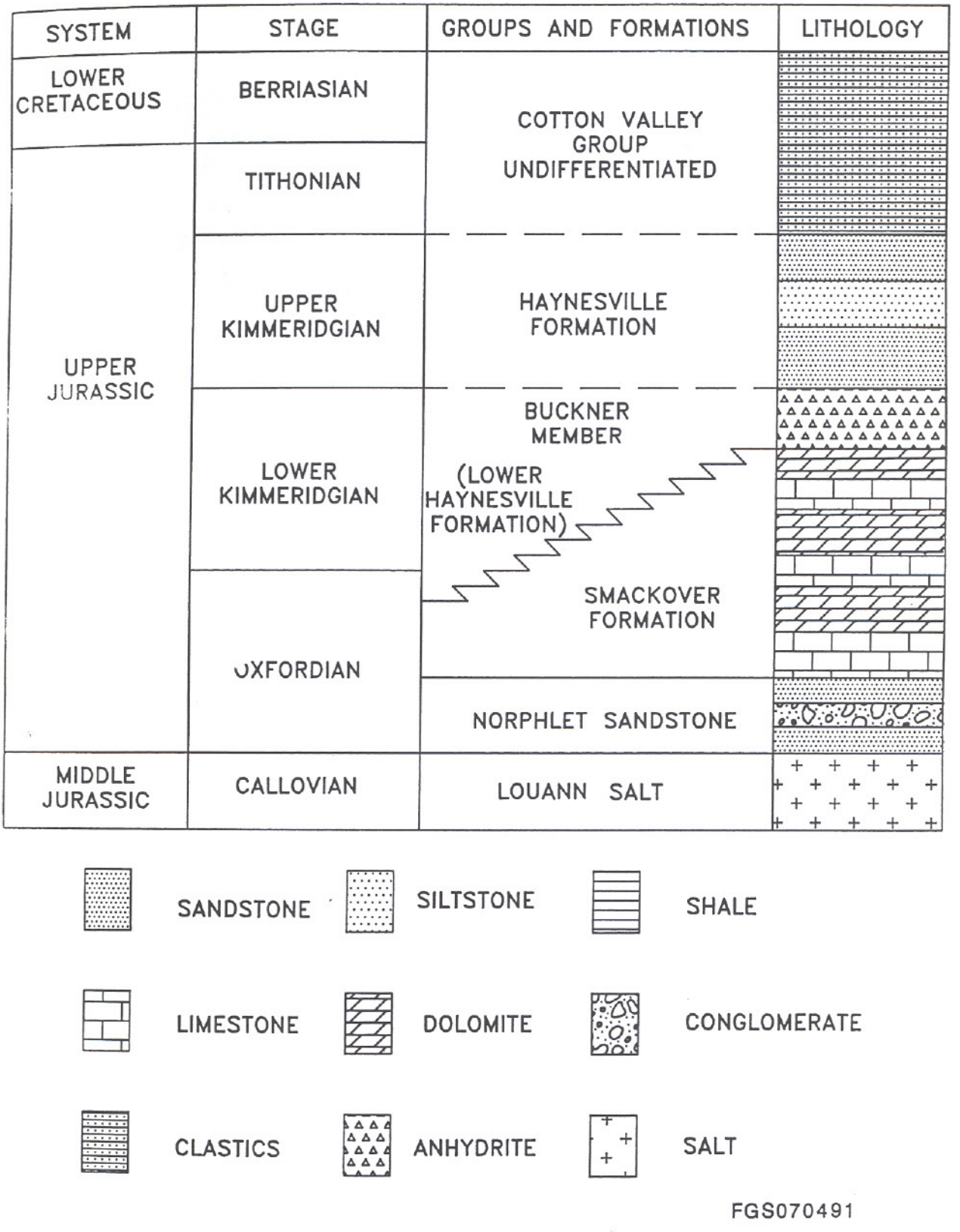


Figure 4. Stratigraphic nomenclature, Middle Jurassic to Lower Cretaceous, northwest Florida.

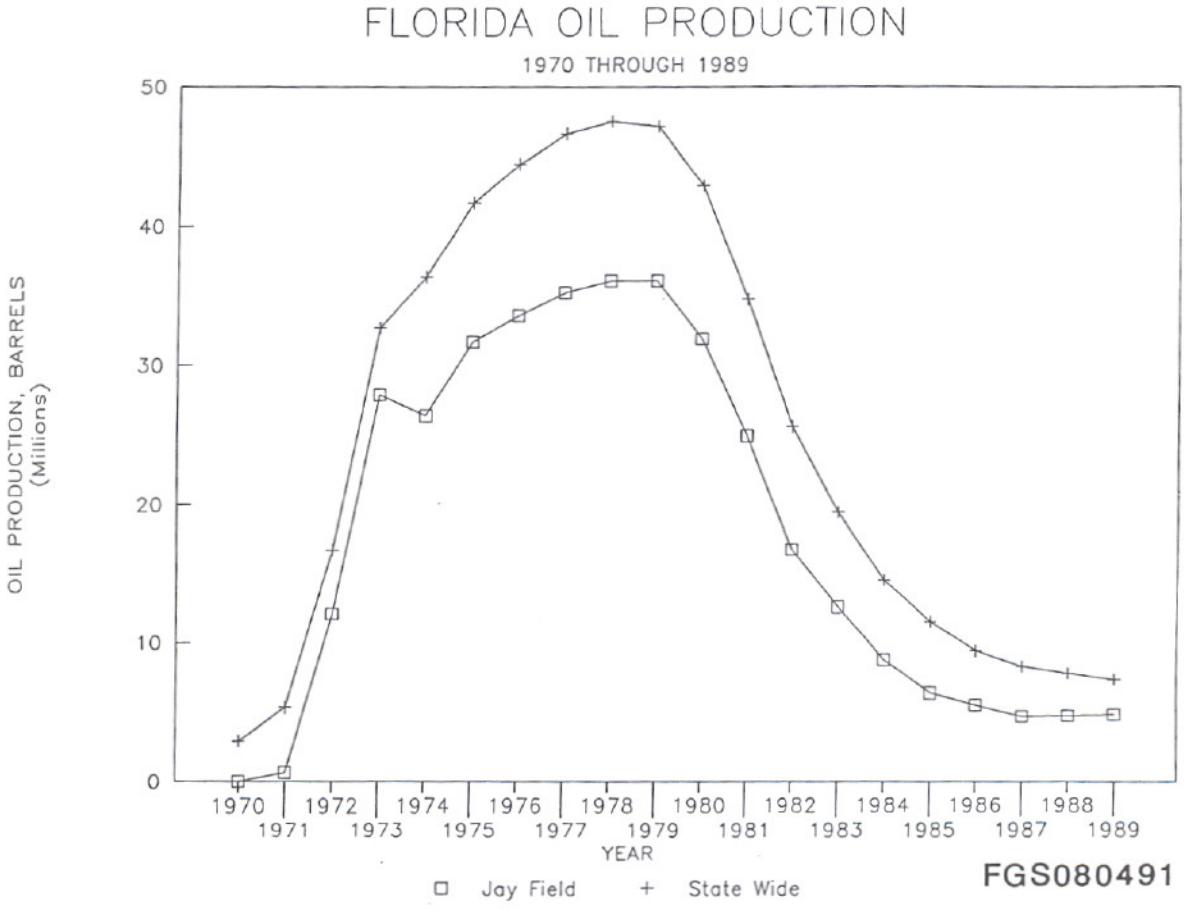
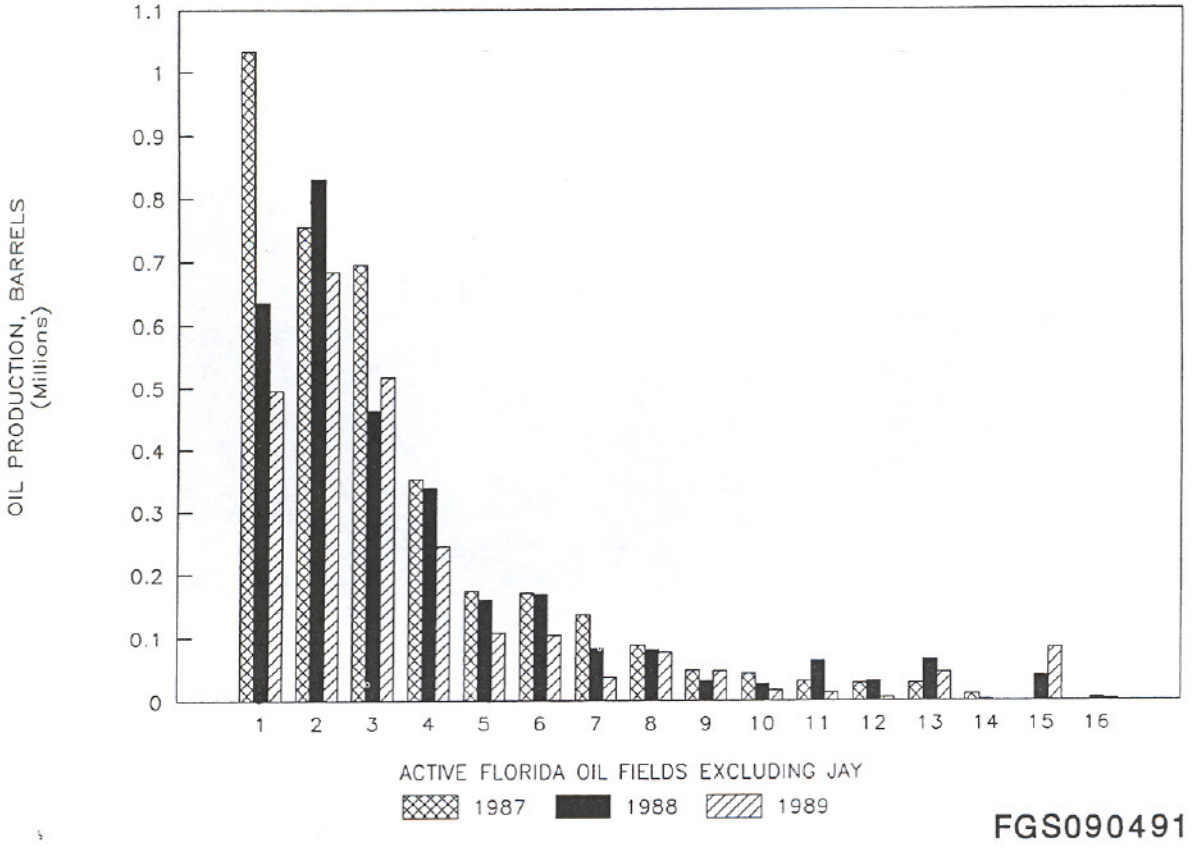


Figure 5. Oil production, 1970 through 1989.



FIELD	PLOT CODE
West Felda	1
Raccoon Point	2
Blackjack Creek	3
Bear Island	4
Corkscrew	5
Lehigh Park	6
Sunoco Felda	7
Mid-Felda	8
Townsend Canal	9
Bluff Springs	10
Mt. Carmel	11
Sunniland	12
McLellan	13
Lake Trafford	14
McDavid	15
Coldwater Creek	16

Figure 6. 1987, 1988, and 1989 oil production comparison.

1988 and 1989 ONSHORE DRILLING ACTIVITY

Only three development wells were drilled during 1988 and 1989. A description of these wells is given in Appendix 4. One of these was an injection well drilled at Jay field in Santa Rosa County. One was the first offset to the McDavid field discovery well in Escambia County and was plugged and abandoned as a dry hole. The McDavid field discovery and this offset are discussed under the "Florida oil fields descriptions" section of this report. The third development well was completed as a potential producer at Raccoon Point field in Collier County.

Sixteen exploratory wells were drilled during 1988 and 1989 (Appendix 5). Eleven of these were drilled in northwest Florida; the remaining five were drilled in south Florida. Only one well was completed as a potential producer. This was the discovery well for McDavid field (Escambia County).

Coldwater Creek field was also discovered in 1988 with the first production test of the Red Rock Oil and Minerals Corporation - Pittman Estate No. 26-2A in Santa Rosa County. Further discussion of this field is in the "Florida oil field descriptions" section of this report.

OFFSHORE DRILLING ACTIVITY

State ownership of the continental shelf off Florida extends three miles into the Atlantic Ocean and about 10.5 miles (three marine leagues) into the Gulf of Mexico. The federal government controls resources beyond these state boundaries out to 200 miles. The Outer Continental Shelf (OCS) is a jurisdictional term that describes the offshore area which is under control of the federal government. "Federal waters," in this context, does not refer to ownership, but rather to responsibility (Johnson and Tucker, 1987).

Exploratory Drilling in State Waters

A total of 19 wells have been drilled in Florida state waters from 1947 through 1983 (Appendix 6 and Figure 7). Effective July, 1990, all drilling activity was prohibited in Florida state waters (details are discussed in Part II of this publication); however, the information obtained from the wells that were drilled in state waters may be useful in future decisions concerning offshore exploration and development in federal waters.

The 19 offshore wells tested three different potential oil horizons. Ten of the wells are within the South Florida Basin (off Charlotte and Lee Counties and off the Florida Keys, Monroe County, Figure 8) and targeted the Lower Cretaceous. The six wells drilled off the Florida panhandle sought to extend the onshore (and offshore Alabama) Jurassic production (Figure 4). The remaining three wells drilled off the northern portion of the Gulf coast (Permits 304, 382 and 383) were Cretaceous or possibly Paleozoic tests (Applegate and Lloyd, 1985).

As shown in Appendix 6, only one of the wells drilled in state waters had a significant oil show. A drill stem test of the Gulf Oil-Florida State Lease 826-Y (permit 275), located near the Marquesas Keys off Monroe County, recovered 15 barrels of 22° A.P.I. gravity oil and 14.1 barrels of saltwater from the Lake Trafford (?) Formation. Another well, which was drilled in federal waters near the Marquesas, tested black saltwater in the Lake Trafford and Sunniland Formations and in the Brown Dolomite interval (Applegate and Lloyd, 1985). Charles Tootle (1985, Florida Geological Survey, personal communication, in Applegate and Lloyd, 1985) believed this well could be a low volume oil producer from the Lake Trafford and Sunniland Formations.

Applegate (1987) conducted an extensive study of the Brown Dolomite Zone of the Lehigh Acres Formation in the South Florida Basin. He concluded that this zone could be a potentially prolific producing horizon offshore. He found that

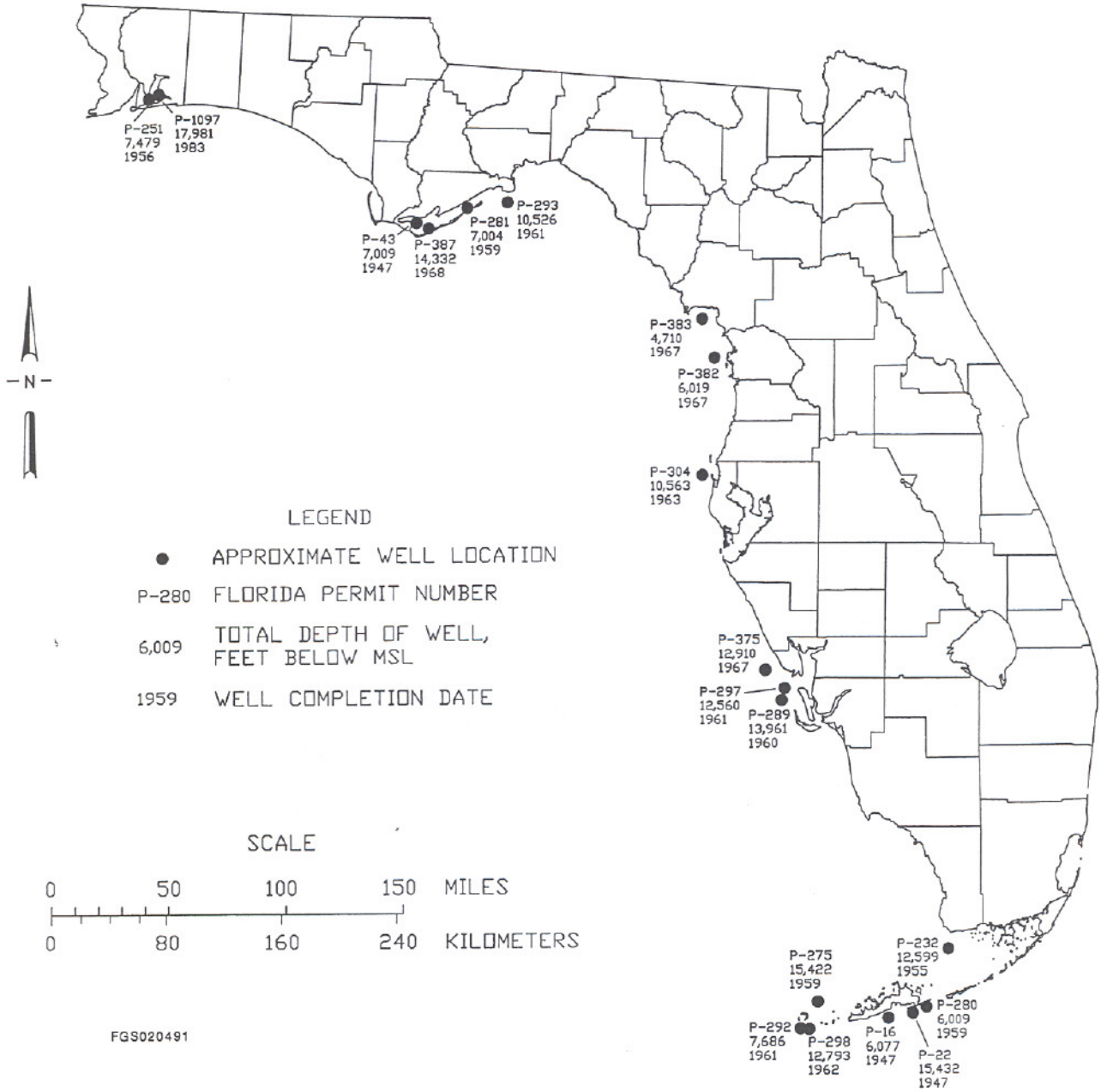


Figure 7. Oil exploration wells, Florida state waters.

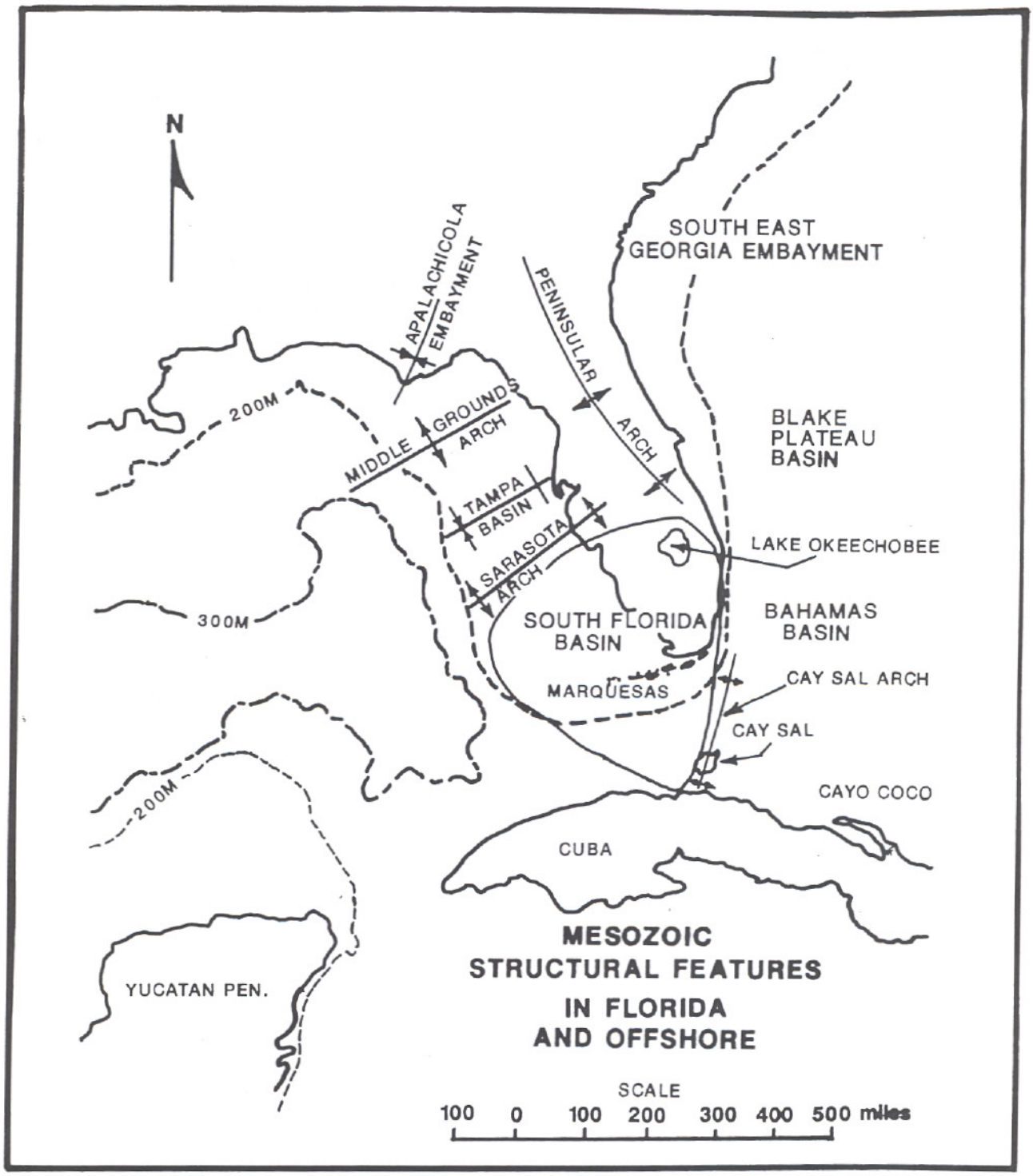


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Figure 8. Mesozoic structural features in Florida and offshore (after Applegate, 1987).

the best development of the Brown Dolomite onshore is in Charlotte and surrounding counties in the northern part of the South Florida Basin at a depth of about 12,000 feet. Here, the Brown Dolomite Zone attains a maximum thickness of 100 feet, of which about one-half is porous and capable of high volume fluid production. Offshore, the maximum thickness occurs near the Marquesas Keys, where about 400 feet of mostly porous dolostone has been found. Very little oil staining has been found in the Charlotte County area, but staining has been observed in the Marquesas area, as discussed above.

Applegate (1987) concluded that the best possibility for finding oil in the Brown Dolomite Zone appears to be in the offshore portion of the South Florida Basin. Brown Dolomite is present in at least three wells on the Sarasota Arch (Figure 8) and probably continues around the rim of the basin southeast to the Marquesas, where thick porous dolostone is present. Applegate (1987) believed that stratigraphic and structural traps associated with this dolostone, which is capped by dense limestone and anhydrite, may have led to the formation of giant oil fields.

In addition to this South Florida Basin potential, there has been interest in extending Jurassic production in the Florida panhandle area. Jurassic production occurs onshore in the Jay trend area (Figure 3) from the Smackover Formation and Norphlet Sandstone (Figure 4). There is also Jurassic production twenty miles to the west of the Florida - Alabama boundary where several natural gas fields produce from the Norphlet Sandstone in Alabama state waters in Mobile Bay. The Mary Ann gas field was the first of these to be discovered in 1979. An additional six natural gas fields have been established in Alabama state waters since then (Masingill, 1989). Recoverable reserves have been estimated at 4.93 to 8.12 trillion cubic feet of natural gas (Mink, et al., 1987).

A Jurassic test, the Getty Oil-Florida State Lease 2338, Well No. 1 (permit 1097), was drilled in 1983 to a total depth of 18,011 feet (-17,981 feet MSL) in East Bay, Santa Rosa County, Florida (Appendix 6, Figure 7). Two tests in the Smackover Formation produced only saltwater. The Norphlet Sandstone and underlying Louann Salt, which together are responsible for production in the Mobile Bay fields, were very thin in this well (Applegate and Lloyd, 1985).

The three wells drilled off Levy, Citrus, and Pinellas Counties do not fall within the obvious target areas discussed above. None of these wells had significant oil shows or porous zones. Two of the three penetrated Paleozoic rocks; the third bottomed in the Lower Cretaceous (Appendix 6). These may have been drilled with interest in both the Lower Cretaceous and the Paleozoic potential. Amoco drilled five Paleozoic wildcat wells to the north of this area (Taylor, Madison, Lafayette, and Dixie Counties) in the early 1980's (Applegate and Lloyd, 1985). All were dry holes and none had any shows of oil. Paleozoics in Florida range from Devonian to Ordovician or Cambrian in age, and are faunally related to African rocks (Cramer, 1971, 1973). Production from the West African rocks spurred interest in Florida; however, the Florida Paleozoic sandstones are extremely indurated and have very little porosity or permeability (Applegate and Lloyd, 1985).

1988 and 1989 Exploratory Drilling in Federal Waters, Offshore Florida

The first federal oil and gas lease sale off Florida was conducted in May, 1959 off the Florida Keys in what is now the Straits of Florida Planning Area. Ten additional OCS lease sales have occurred since then; seven in the Eastern Gulf of Mexico Planning Area and three in the South Atlantic Planning Area. There have been no sales in the Straits of Florida Planning Area off Florida since the 1959 sale. The last lease sale in the South Atlantic Planning Area off Florida was Sale 78 in July, 1983.

The two most recent lease sales off Florida were in the Eastern Planning Area. They were

Sales 79 and 94, held in January, 1984 and January, 1985, respectively. Eastern Planning Area Sale 116, held in November 1988, excluded all areas originally proposed off the Florida coast (see Part II of this publication for more details). Lease sales 79 and 94 are discussed in Applegate and Lloyd (1985) and Lloyd and Applegate (1987). Historic leases in the Eastern Planning Area are shown on Figure 9.

Six wells were completed off the Florida panhandle during 1988 and 1989 (Figure 9). Appendix 7 includes data on these wells (Gould, 1989). Three of the wells were in the Pensacola area; three were in the Destin Dome area. The principal drilling targets in these areas are the Smackover Formation and the Norphlet Sandstone (Figure 4); however, three of the wells were drilled to less than 3,000 feet, which is too shallow to have penetrated these potential targets. One of the Destin Dome area wells (Chevron-6406, block 56, Figure 9) was a Norphlet discovery and is described as a producible field by Gould (1989). The Amoco-8338 well, which was completed in Destin Dome block 111 in 1987, was also a Norphlet discovery described by Gould (1989) as a producible field. This was the first commercial discovery in the Eastern Gulf of Mexico Planning Area (Gould, 1989). The Oil and Gas Journal (1989) discusses the Chevron-6406 well and quotes Chevron USA Inc. as stating that "the well was not tested due to safety and cost considerations. However, analysis of cores and wireline logs indicates the presence of gas in the Norphlet sandstone." These two discoveries extend the offshore Norphlet gas trend seaward and eastward from the Mobile map area of the Central Gulf of Mexico Planning Area, offshore Alabama, into the Florida offshore.

GEOPHYSICAL EXPLORATION ACTIVITY

Twenty-two geophysical permits applications were received by the Florida Geological Survey during 1988; 15 were received during 1989. Of these 37 applications, 31 have been permitted, five were withdrawn or canceled by the applicants, and four were placed on hold by the applicants. Appendix 8 summarizes the data for these applications, including total survey mileage by area (panhandle onshore, panhandle offshore, and south Florida) and by survey method (vibrator, airgun, and seismic gel).

Geophysical exploration was concentrated in the Florida panhandle and the south Florida peninsula (Figure 10). The panhandle exploration included the known oil-producing Santa Rosa and Escambia Counties, an area offshore from Santa Rosa and Escambia Counties, and an area east of the known production covering Okaloosa, Bay, Gadsden, Holmes, Jackson, Leon, Wakulla and Washington Counties. This activity indicates interest in potential east of the known production including the Apalachicola Embayment area. The Apalachicola Embayment area was discussed by Applegate, et al. (1978) as an area with significant Smackover oil potential. South Florida seismic activity was east of the known Sunniland-producing trend in Broward, Dade, Hendry and Palm Beach Counties.

FLORIDA OIL FIELD DESCRIPTIONS

Applegate and Lloyd (1985) provided a brief history of each of Florida's oil fields including discovery data, geologic information, and production totals. Structure maps were presented whenever possible. This publication is now out-of-print; therefore, this information is summarized again and presented in this report. Somewhat more detailed information is presented for the five oil fields discovered since 1985. These are Bluff Springs, McDavid, Coldwater Creek, and McLellan fields in north Florida and Corkscrew field in south Florida. Fields are discussed in approximate geographic order from north to south and west to east (Figures 1 and 3).

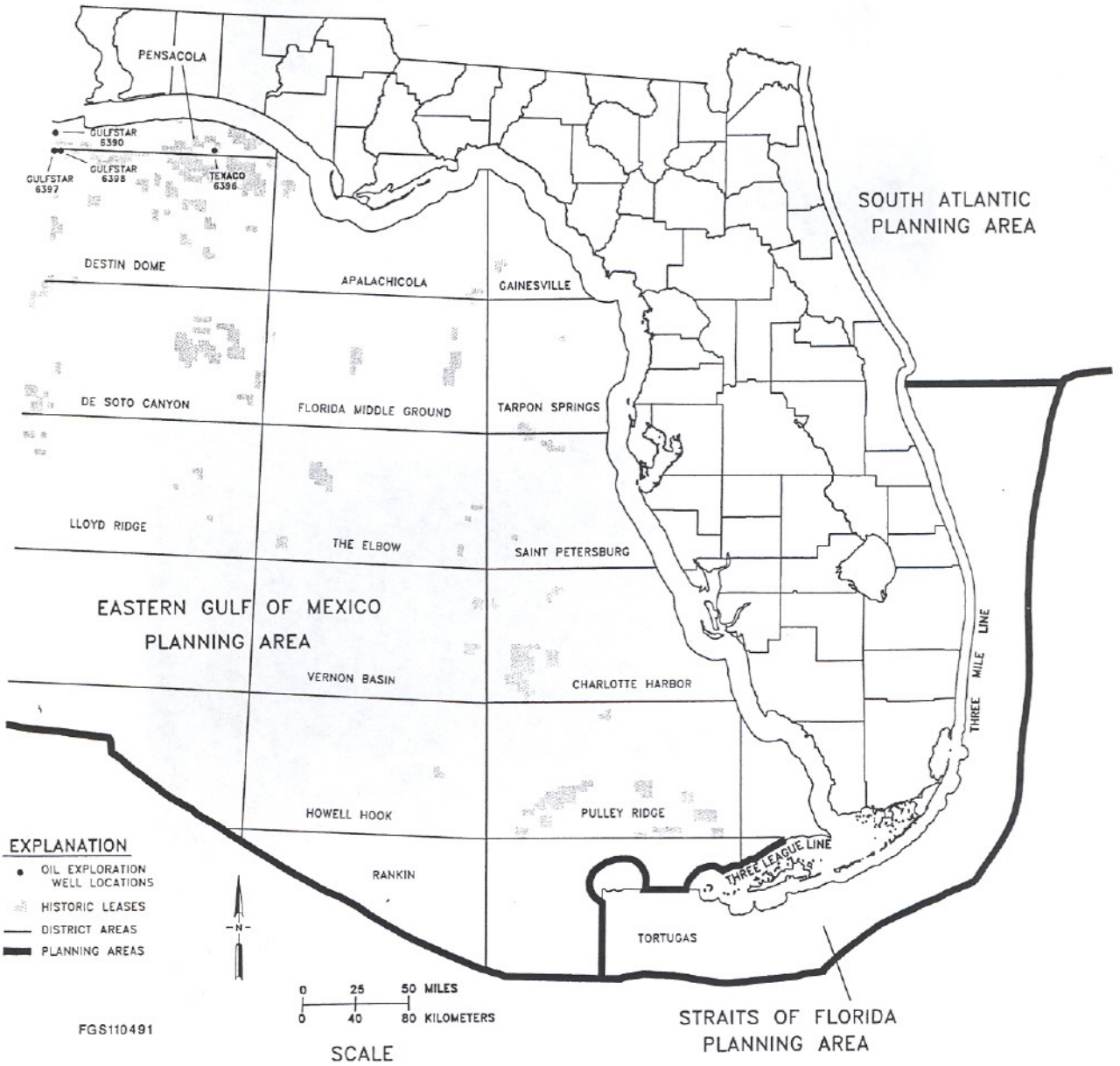

Figure 9. 1988 and 1989 oil exploration wells and historic leases, federal waters, offshore Florida (Gould, 1989).

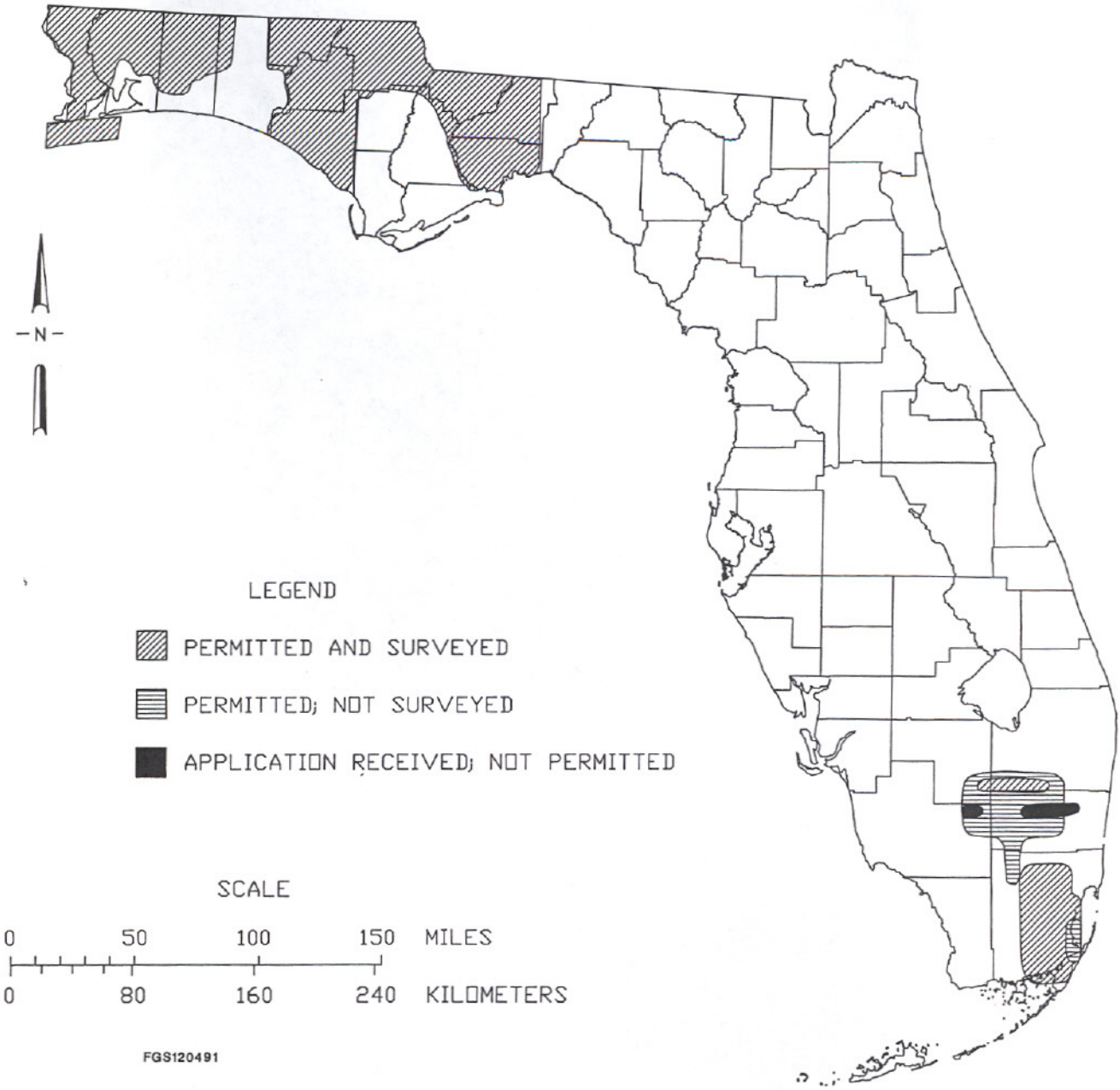

Figure 10. 1988 and 1989 geophysical exploration activity.

North Florida Oil Field Summaries

INTRODUCTION

Production in north Florida began with the discovery of Jay field in June, 1970. There are now eight panhandle oil fields located in Escambia and Santa Rosa Counties, Florida (Figure 3). Seven fields are active and one is plugged and abandoned. Production is from Upper Jurassic' Smackover Formation carbonates and Norphlet Sandstone sands (Figure 4).

Jay field is located within a trend which extends through Escambia and Santa Rosa Counties in Florida, and Escambia County, Alabama. Other fields within the trend include Mt. Carmel, Coldwater Creek, and Blackjack Creek fields in Florida and Fanny Church, Flomaton, and Big Escambia Creek fields in Alabama. The fields are located along a normal fault complex which rims the Gulf Coast through Alabama, Mississippi, Louisiana, Arkansas, and Texas (Moore, 1984).

Bluff Springs and McDavid fields are located west and southwest of the Jay trend in an area known to be underlain by Louann Salt, with seismic studies indicating salt-induced fault structures in the overlying formations (Lloyd and Applegate, 1987). The remaining two north Florida oil fields, McLellan and Sweetwater Creek, are located east of the Jay trend, near the approximate updip limits of the Smackover Formation (Lloyd, 1989; Applegate et al., 1978; Ottman et al., 1973 and 1976) and could be the result of stratigraphic pinchouts. They are also located within the area known to be underlain by the Louann Salt and may have salt-related trap structures. Current data does not reveal which trapping mechanism produced the Smackover reservoirs for these fields.

BLUFF SPRINGS FIELD

Bluff Springs field was discovered on March 25, 1984. The discovery well, the Stone Petroleum Corp. St Regis Paper Co. number 29-4 (permit 1125), was a rank wildcat located in Section 29, Township 5 North, Range 31 West, Escambia County (Appendix 1). It is approximately 10 miles west-southwest of Jay field and approximately four miles southeast of the nearest previously drilled wildcat, permit 1177 (Figures 3 and 11). This area, west and southwest of Jay, is known to be underlain by Louann Salt, with seismic studies indicating salt-induced fault structures in the overlying formations (Lloyd and Applegate, 1987). Seismic data has been interpreted by Hughes Eastern Corporation (1988) (Figure 11) to indicate several small structures in a northwest-to-southeast trend in this specific area.

The discovery well produced 477 barrels of oil and 170 barrels of saltwater per day. Oil gravity was 57.0° A.P.I.. Production is from Jurassic-age Smackover Formation dolostones from -16,154 to -16,161 feet MSL. These dolostones are dark brownish-gray to brownish-black, fine grained, microcrystalline, and show evidence of recrystallization from originally oolitic and possibly pelletal facies (Lloyd, 1986; Lloyd and Applegate, 1987).

The first offset, permit 1136 (Stone Petroleum Corporation - St. Regis Paper Company number 29-3) is located about one-half mile northwest of the discovery well (Figure 11). The Smackover Formation was encountered at -16,171 feet MSL, structurally 17 feet lower than in the discovery well (Figure 12). The well produced only saltwater from two thin zones (-16,182 to -16,185 feet MSL and -16,192 to -16,195 feet MSL; Figure 12) within the upper Smackover. Core analysis by Location Sample Service, Inc. (LSS), Jackson, Mississippi, yielded mean porosity estimates for these zones of 11.4 and 8.4 percent, respectively. LSS found a trace of oil in one sample at -16,185 feet MSL. This well may be located too low on the structure. Alternatively, as shown on the structure map (Figure 11) drawn by Hughes Eastern Corporation (1988; based on geophysical and well data), Hughes believes there may be a permeability barrier between the discovery well and this well.

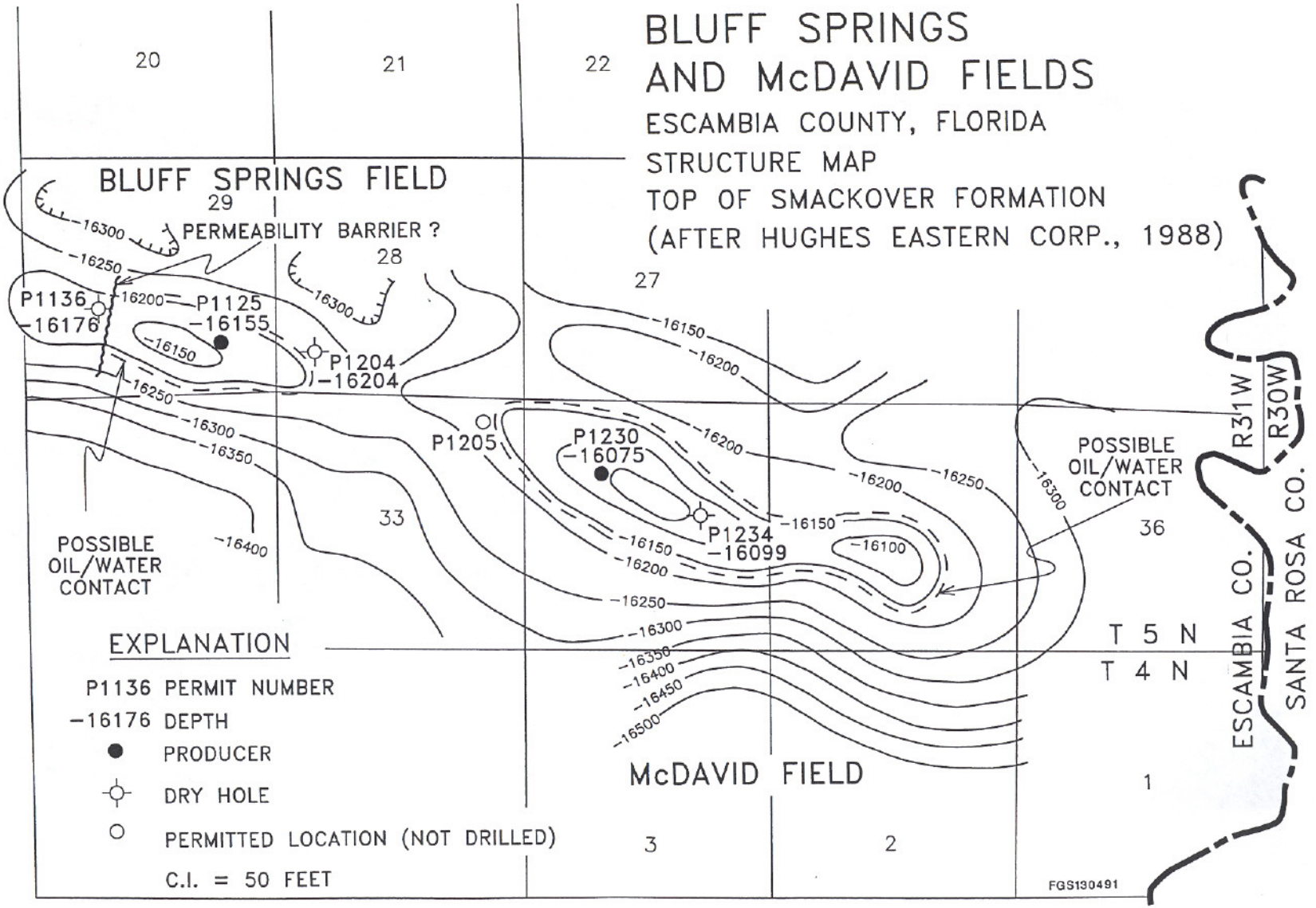

Figure 11. Bluff Springs and McDavid fields structure map, top of Smackover Formation (after Hughes Eastern Corporation, 1988).

Ownership of the discovery well transferred to Hughes Eastern Corporation in 1985. Permits were issued to Hughes Eastern to drill two additional offsets, one east and one southeast of the discovery well (permits 1204 and 1205, Figure 11). Permit 1204 was completed in August 1986. The Smackover was again found at a structurally lower position (Figure 12), this time 44 feet lower. Two zones of saltwater production were also encountered (-16,208 to -16,211 feet MSL and -16,215 to -16,233 feet MSL; Figure 12). LSS core analysis yielded mean porosity estimates of 23.9 and 13.6 percent, respectively, and no indications of oil. As interpreted by Hughes Eastern Corporation (1988) (Figure 11), the Smackover in this well is below the probable oil-water contact. The third offset, permit 1205, has not been drilled. This well is now actually closer to the more recently discovered McDavid field (discussed below) and is outside the potential productive limits drawn by Hughes Eastern Corporation (1988) (Figure 11).

Production to date at Bluff Springs is solely from the discovery well. Total production for Bluff Springs field, as of the end of 1989, was 220,000 barrels of oil (Appendix 2).

MCDAVID FIELD

McDavid field was discovered on June 14, 1988 with the first production test of the discovery well, the Hughes Eastern Corp. Walker-Baley number 34-2 (permit 1230). The well is located in Section 34, Township 5 North, Range 31 West, Escambia County (Appendix 1). It is about one and one-half miles southeast of the Bluff Springs discovery well (Figures 3 and 11). As discussed above for Bluff Springs field, this area, west and southwest of Jay, is known to be underlain by Louann Salt, with seismic studies indicating salt-induced fault structures in the overlying formations (Lloyd and Applegate, 1987). Seismic data has been interpreted by Hughes Petroleum Corp (1988) (Figure 11) to indicate several small structures in a northwest to southeast trend in this specific area.

The discovery well produced 235 barrels of oil per day and no saltwater. Oil gravity was 53.8° A.P.I.. Production is (as it is for Bluff Springs field) from Jurassic-age Smackover Formation dolostones from -16,075 to -16,089 feet MSL. These dolostones were described by LSS as gray to dark gray, sucrosic to granular, with poor to fair porosity and permeability. Examination of core chips with a binocular microscope concurs with this description. Core analysis by LSS yielded a mean porosity estimate of 15.9 percent for this zone. Geophysical log analyses by Charles Tootle (Appendix 9) yielded a mean porosity estimate of 12.8 percent, an original oil in place estimate of 4,987,347 barrels, and a recoverable oil estimate of 498,736 barrels.

The first offset, permit 1234 (Hughes Eastern Corporation - Jones Estate number 34-1) is located about one-half mile southeast of the discovery well (Figure 11, Appendix 4). The offset was completed in June 1989. The Smackover Formation was encountered at -16,099 feet MSL, structurally 24 feet lower than in the discovery well (Figure 12). The structure map (Figure 11) was drawn prior to the time this well was drilled. In fact, the map was submitted to the Florida Geological Survey in support of a request for an non-regular location for this well. As shown on the map, Hughes Eastern Corporation expected to encounter the Smackover at about -16,050 feet MSL in this well. Based on the actual depth (-16,099 feet MSL), the McDavid structure is probably smaller than that shown. The productive limit expected by Hughes is still below this depth (at about -16,200 feet, Figure 11); however, analysis of geophysical logs from this well indicate that the oil-water contact may actually be at about -16,102 feet MSL (Joel Duncan, Florida Geological Survey, personal communication, 1991). In addition, production from the discovery well appears to have peaked around December 1988 and may have depleted this small structure enough to move the potential productive limits above the level of the Smackover in the offset

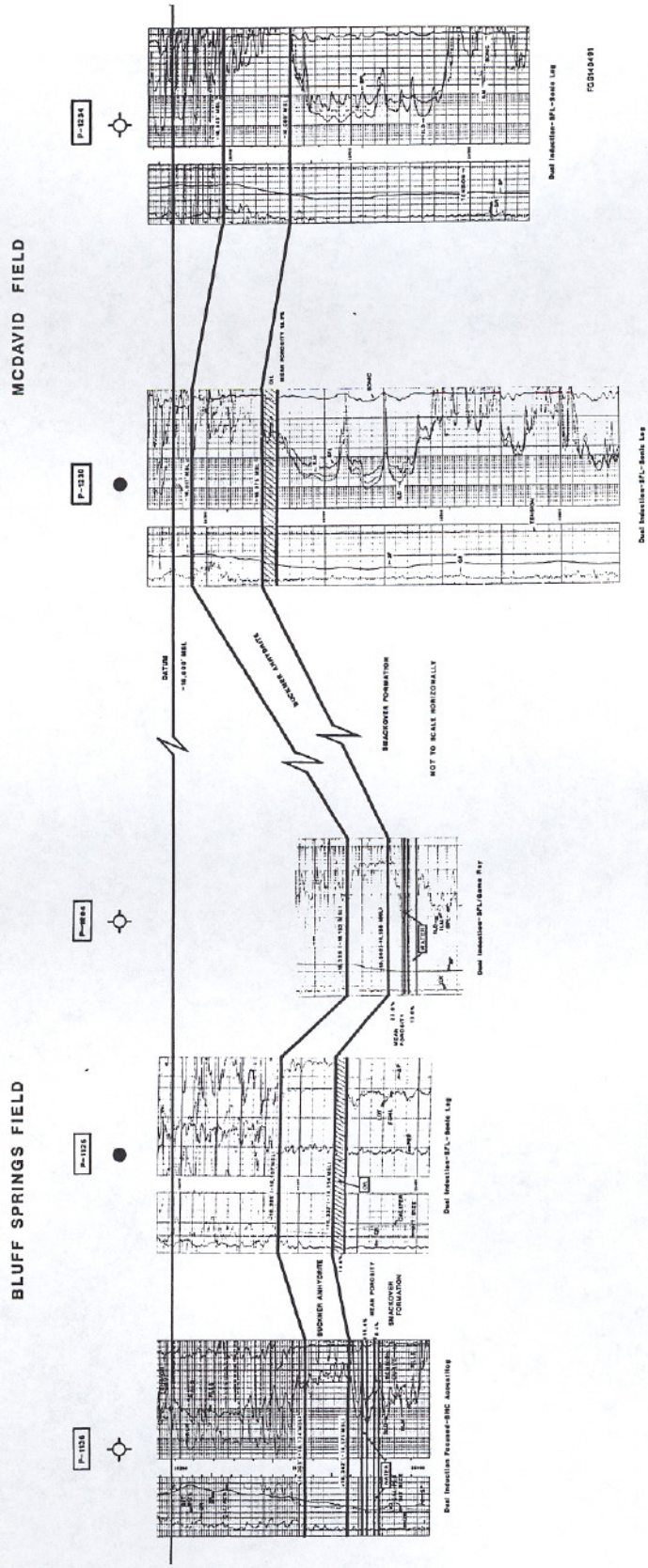

Figure 12. Geophysical log correlation, Bluff Springs and McDavid fields.

(Figure 13) (Joel Duncan, Florida Geological Survey, personal communication, 1991).

As with Bluff Springs field, production from McDavid field is solely from the discovery well. Production from this one-well field, as of December 1989, totaled about 121,000 barrels of oil (Appendix 2).

JAY FIELD

Jay field was discovered in June, 1970, by the drilling of the Humble St. Regis number 1 (permit 417) in Section 43, Township 5 North, Range 29 West, Santa Rosa County (Figures 3 and 14 and Appendix 1). The well produced from the Smackover Formation from -15,264 to -15,318 feet MSL. The initial production test yielded 1712 barrels of 50.7° A.P.I. gravity oil and 23 barrels of saltwater per day.

Jay field is located within the "Jay trend" of Escambia and Santa Rosa Counties, Florida and Escambia County, Alabama (discussed in north Florida oil fields introduction above). The northern extension of Jay, in Escambia County, Alabama, is the Little Escambia Creek (LEC) field. Oil accumulation at Jay is within an asymmetric anticline with the fault complex forming the eastern barrier to oil migration (Figure 14) (Applegate and Lloyd, 1985).

The northern limit of Jay field is a porosity barrier in Alabama where the lithology changes from porous dolostone to dense, micritic limestone. The porosity at Jay field is due to dolomitization of the pelletal grainstones in the upper, regressive section of the Smackover Formation. Dolomitization, fresh water leaching, and an anhydrite cap rock (Buckner Member of the Haynesville Formation, Figure 4) have formed a complex, extensive reservoir. Numerous analyses of the Jay area Smackover Formation, including comparisons with modern carbonate environments, have been made in attempts to understand this complex reservoir (Ottman et al., 1973 and 1976; Sigsby, 1976; Mancini and Benson, 1980; Lomando et al., 1981; Vinet, 1984; Moore, 1984; Bradford, 1984; Lloyd et al., 1986).

Despite the complexity of the Jay field Smackover Formation reservoir, exploration and development of the field have been extremely successful. Core analyses were combined with bottom hole pressure data, porosity log information, and other geologic data to arrive at a highly successful reservoir management program (Shirer et al., 1978; Langston et al., 1981; Langston and Shirer, 1985).

As of December 1989, Jay field was producing from a total of 44 wells, 43 wells were temporarily shut-in, and there were 27 injection wells. One of these injection wells was completed in 1989 (Appendix 4). Total production for Jay field, as of the end of 1989, was 365,479,000 barrels of oil (Appendix 2).

COLDWATER CREEK FIELD

Coldwater Creek field was discovered on June 4, 1988. The discovery well was a reentry of a Smackover wildcat. The original permit was issued to Inexco Oil Company (permit 1173). The location is about two miles east of the southern portion of Jay field in Section 26, Township 5 North, Range 29 West, Santa Rosa County (Figure 3). Inexco began drilling in November, 1985. They drilled the well to a total depth of -15,407 feet MSL, logged the well, and recommended plugging and abandonment.

The top of the Smackover Formation had been encountered at -14,969 feet MSL; the Norphlet Sandstone at -15,331 feet MSL. Side wall core analyses by Location Sample Service, Inc. (Jackson, Mississippi) indicated a potential oil productive zone from -14,985 to -15,016 feet MSL. Mean porosity of the zone was about 14.8 percent. Analysis of the same interval by Charles Tootle yielded a mean porosity of about 12 percent, an original oil in place estimate of 2,080,107 barrels, and a recoverable oil estimate of 312,016 barrels (Appendix 9).

Louisiana Land and Exploration Company

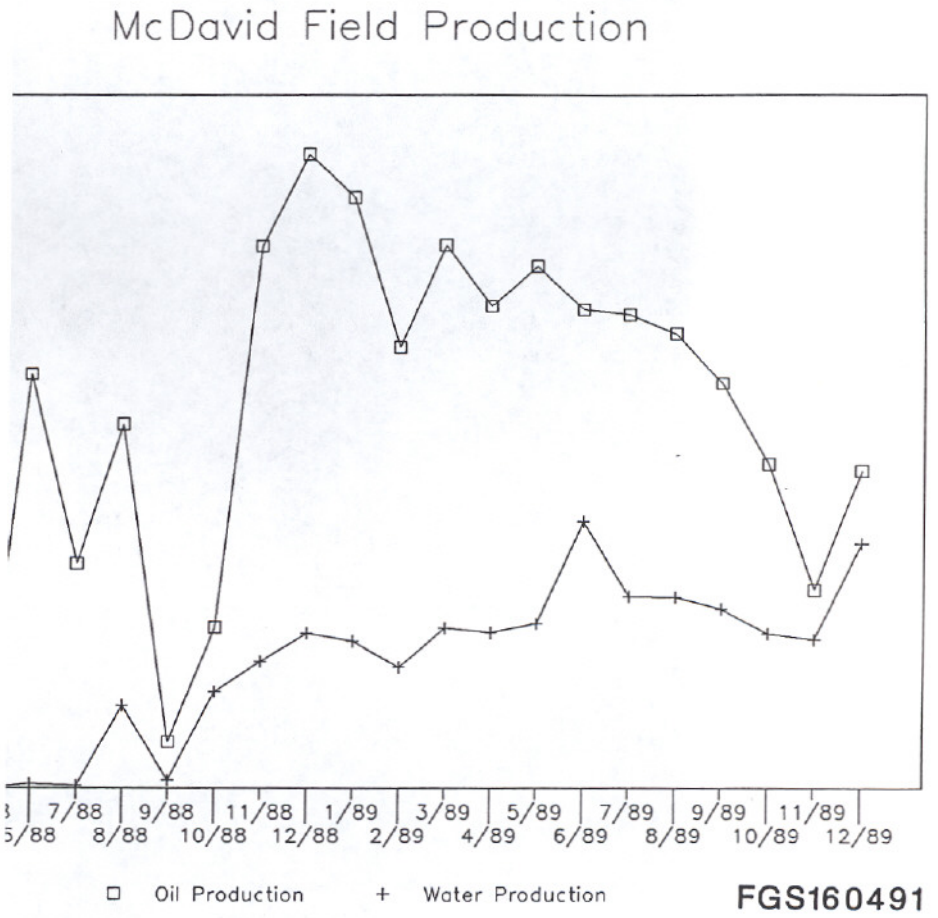

Figure 13. McDavid field production curve.

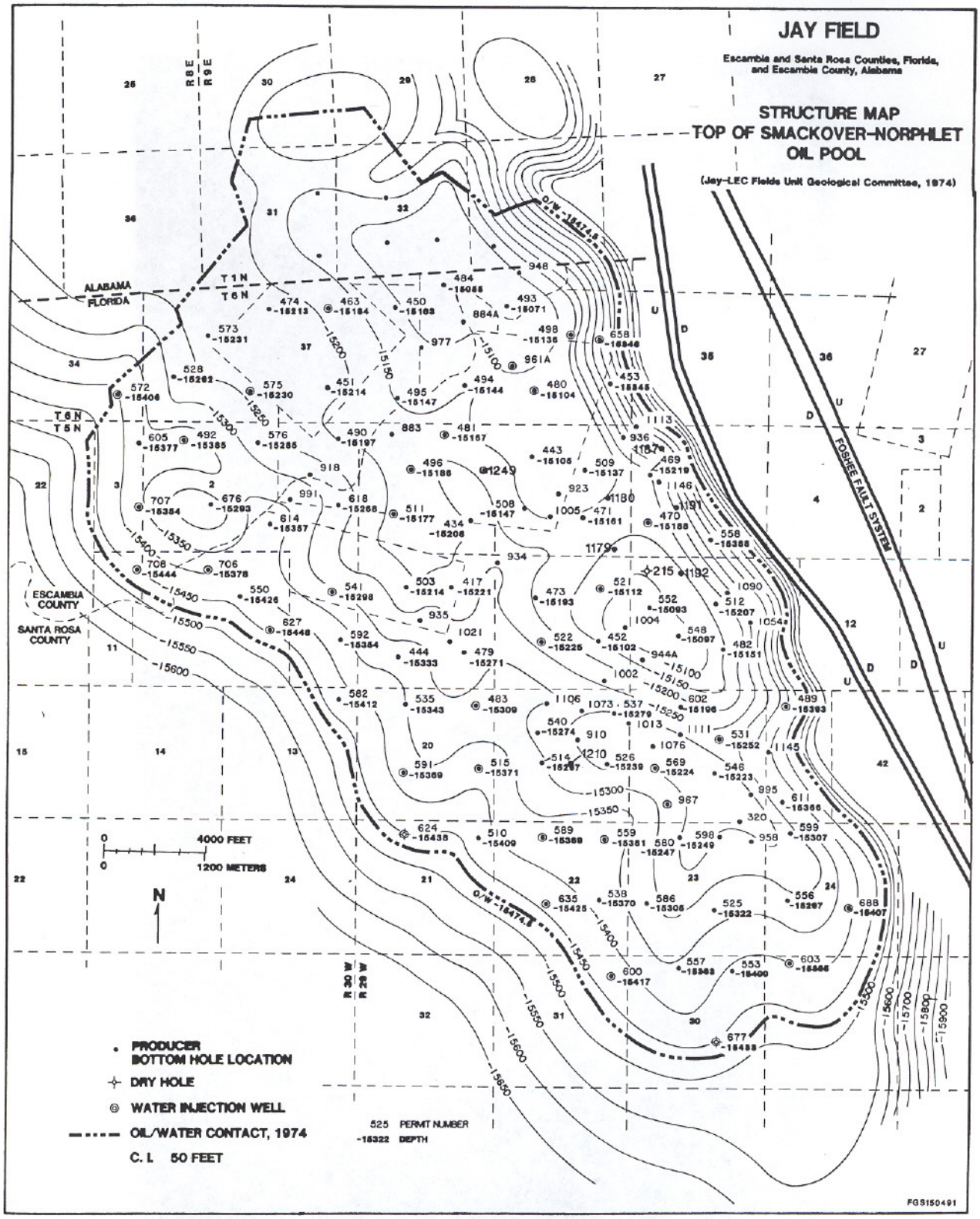

Figure 14. Jay field structure map, top of Smackover Formation (after Jay-LEC Fields Unit Geological Committee, 1974).

(LL&E) took over operations on January 10, 1986 and plugged and abandoned the well. Bruxoil, Inc. then took over responsibility for the well. They conducted a geophysical survey across the area (geophysical permit G-70-86; see Lloyd, 1989). The stated purpose was to determine whether to reenter the existing well or drill at a new location. They decided not to reenter the well and have not submitted any permit applications to drill in the vicinity.

In 1987, Red Rock Oil and Minerals Corporation, received permit 1220 (Appendix 1) to reenter the well. They completed redrilling on May 24, 1987 and ran the first production test on June 4, 1988. This test yielded 152 barrels per day of 46.5° A.P.I. gravity oil and 280 barrels per day of saltwater. In a retest on December 27, 1988, the well flowed 259 barrels per day of 46.5° A.P.I. gravity oil with no saltwater production. Production is from the zone discussed above, from -14,984 to -15,006 feet MSL in the Smackover Formation. Judging from the field's location within the Jay trend, it appears that reservoir formation may have been structurally related to the Foshee Fault System; however, a single well does not yield sufficient information to test this hypothesis.

No additional wells have been drilled at Coldwater Creek field. Total production, as of December 1989, from Coldwater Creek field was 9,000 barrels of oil from this single well (Appendix 2).

BLACKJACK CREEK FIELD

The Blackjack Creek field discovery well was the Humble Oil and Refining Company - St. Regis Paper Company number 13-3 well (permit 523) drilled in Section 13, Township 4 North, Range 29 West, Santa Rosa County, about eight miles southeast of Jay field. The well was completed February 14, 1972, as a producer in the Norphlet Sandstone from -15,965 to -15,975 feet MSL. Initial production was 371 barrels of 51.3° A.P.I. gravity oil and 4.5 barrels of saltwater per day. Due to limited productivity and water production from the Norphlet Sandstone, the well was recompleted as a Smackover Formation producer from -15,633 to -15,743 feet MSL. The initial production test from the Smackover, on January 22, 1975, yielded 1,428 barrels of 51.2° A.P.I. gravity oil and no saltwater.

Blackjack Creek field now produces primarily from oolitic dolostones of the Smackover Formation (Applegate and Lloyd, 1985). The trapping structure is an anticline located on the downthrown, southwest side of the regional Foshee Fault System (Figure 15). Similar to Jay field, Blackjack Creek has been carefully cored and analyzed to achieve a successful reservoir management and development program.

About 160,000 barrels of oil have been produced from the Norphlet Sandstone at Blackjack Creek field. The remaining production, 54,322,000 barrels through December 1989 (Appendix 2), is from the Smackover. Through January 1990, 20 producing wells had been drilled at Blackjack Creek; only five dry holes had been drilled. Nine wells were actively being produced as of December 1989 (Appendix 3).

MT. CARMEL FIELD

Mt. Carmel field was discovered in December 1971 by LL&E. The discovery well was the LL&E - Finley Heirs number 39-3 (permit 504), located about one mile east of Jay field in Section 39, Township 5 North, Range 29 West, Santa Rosa County (Figures 3 and 16). Initial production was 1,440 barrels of 47° A.P.I. gravity oil per day with no saltwater.

Mt. Carmel field is separated from Jay field by the Foshee Fault System (Figure 16). Mt. Carmel field produces both oil and gas from the Smackover Formation and the Norphlet Sandstone. Complex reservoir geometry has apparently made development of this field more difficult. As of January 1990, three producing wells and 10 dry holes had been drilled at Mt. Carmel field.

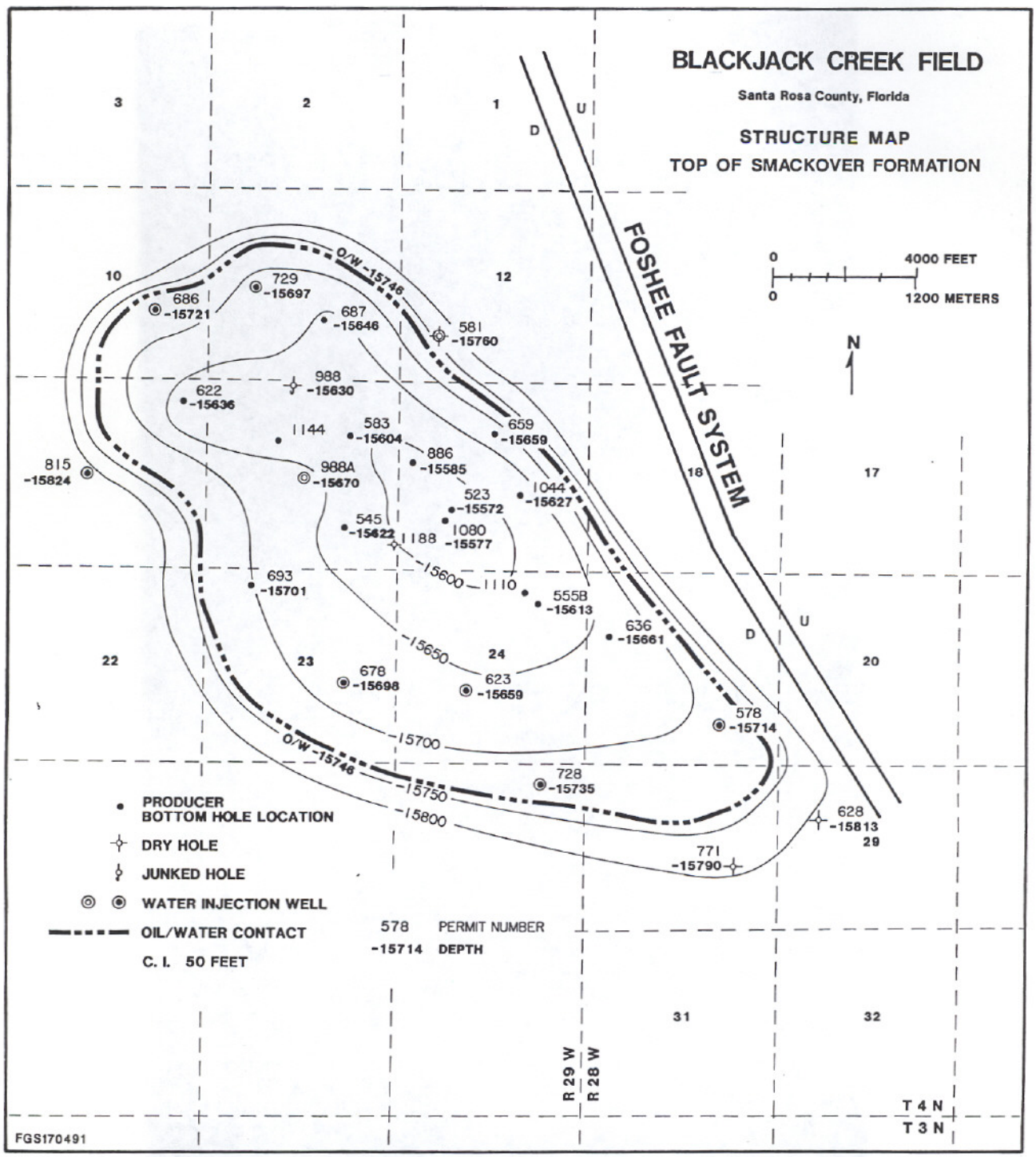

Figure 15. Blackjack Creek structure map, top of Smackover Formation (after Blackjack Creek Geological Committee, 1974).

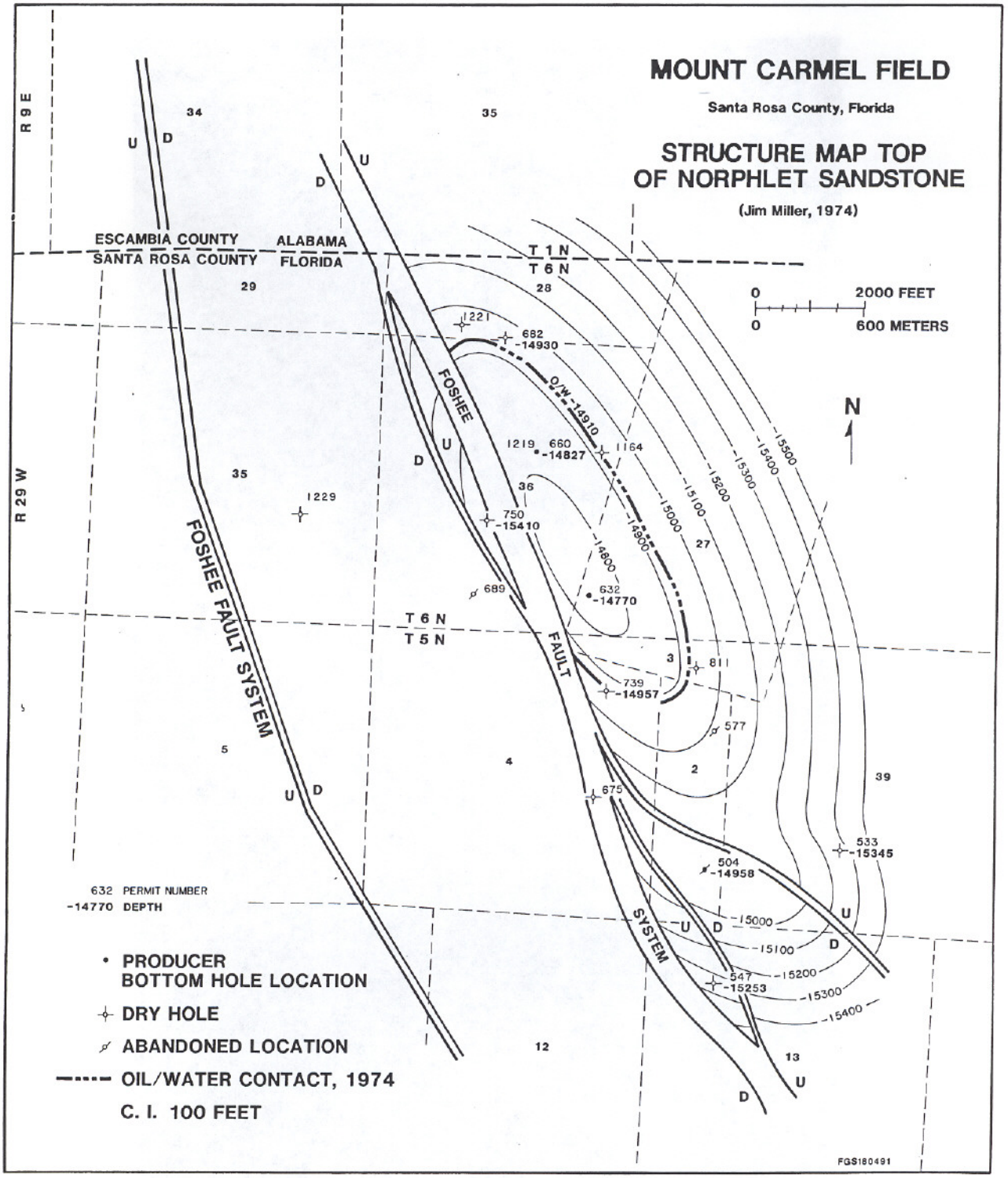

Figure 16. Mt. Carmel field structure map, top of Norphlet Sandstone (after Miller, 1974).

There is currently one producing well in the Mt. Carmel field. As of the end of 1989, the field had produced 4,666,000 barrels of oil (Appendix 2).

MCLELLAN FIELD

McLellan field was discovered on February 15, 1986, with the initial testing of the Exxon Corporation - State of Florida number 33-1 (permit 1194, Appendix 1, Figures 3 and 17). The well is located about 3.25 miles north of the abandoned Sweetwater Creek field in Section 33, Township 6 North, Range 26 West, Santa Rosa County.

An initial flowing test of the discovery well produced 152 barrels of 41° A.P.I. gravity oil per day and no saltwater. Production is from Smackover Formation dolostones from -13,827 to -13,845 feet MSL (Figure 18). Core analysis of a potential oil and gas productive zone from -13,819 to -13,845 feet MSL by Core Laboratories, Inc. (Dallas, Texas) indicated a mean porosity of 12.3 percent. The analysis showed additional oil and gas production potential between -13,854 and -13,863 feet MSL. Mean porosity is about 15 percent for this zone. Both of the analyzed zones contained dark, fine grained, microcrystalline dolostones with vuggy porosity.

McLellan field is located within the area known to be underlain by the Louann Salt and may have a salt-related trap structure. It is also located within a few miles of the approximate updip limits of the Smackover Formation (Lloyd, 1989; Applegate et al., 1978; Ottman et al., 1973, 1976); thus, the trap could be a stratigraphic pinchout. Current data does not reveal which trap mechanism produced the Smackover reservoir for this field.

The first offset and confirmation well for the field was the Exxon Corporation - State of Florida number 34-2 (permit 1206). It is located about one-half mile east of the discovery well (Figure 17). It was tested on March 9, 1987 and flowed 641 barrels of 43.4° A.P.I. gravity oil and 24 barrels of saltwater per day. The Smackover Formation was encountered at -13,788 feet MSL, 27 feet higher than in the discovery well (Figure 18). Production is from the Smackover Formation from -13,797 to -13,847 feet MSL. Core analysis by All Points, Inc. (Houston, Texas) yielded a mean porosity of 11.5 percent for the productive zone.

A second offset to the discovery well, Exxon Corporation - State of Florida number 28-4 (permit 1226) was drilled about one-half mile north of the discovery well (Figure 17). During initial production tests, in February 1988, the well flowed 154 barrels of oil (gravity not reported) and 171 barrels of saltwater per day. The Smackover was encountered 42 feet higher in this well than in the discovery well (Figure 17), indicating a fairly steep gradient between these wells.

Operations at the second offset well were suspended in March 1988 and the well has since been temporarily abandoned. As of December 1989, production for McLellan field was from the two remaining wells and totaled 174,000 barrels of oil (Appendix 2).

SWEETWATER CREEK FIELD

Sweetwater Creek field was discovered on April 22, 1977, with the successful flow test of the Houston Oil and Minerals Corporation - W. M. Stokes number 15-2 well (permit 881, Appendix 1, Figures 3 and 17). The well is located in Section 15, Township 5 North, Range 26 West, Santa Rosa County. In the initial test the well produced 624 barrels of 43.5° A.P.I. gravity oil and only a trace of saltwater from a Smackover limestone interval from -14,044 to -14,085 feet MSL. This test data spurred rumors that a "new Jay" field had been discovered. Rumors proved to be false and an offset drilled in 1978 to the south of the discovery well was dry (permit 890, Figure 17). Core analyses of the Smackover Formation in the offset well by Core Laboratories, Inc. (Dallas, Texas) indicated very fine

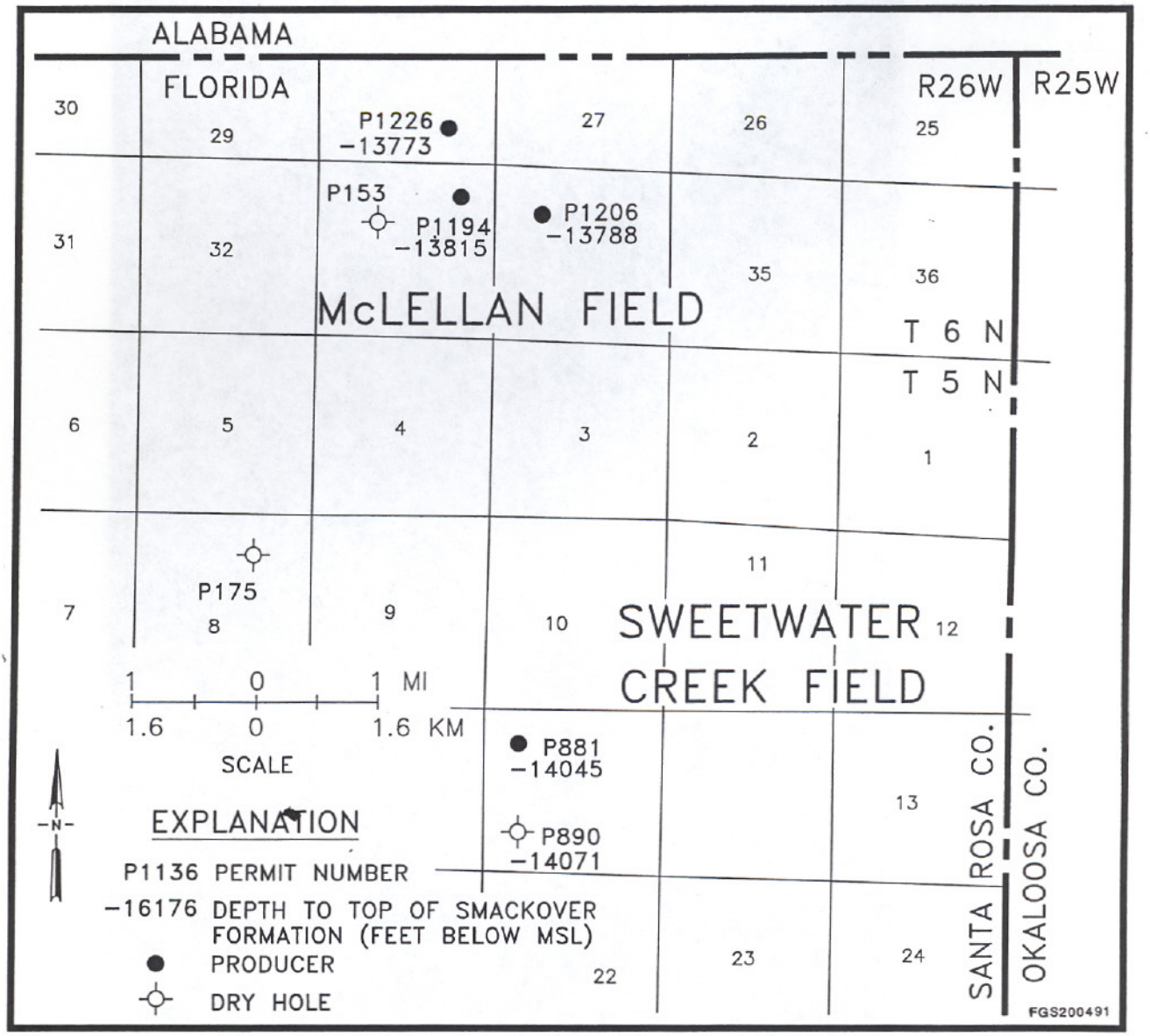

Figure 17. McLellan and Sweetwater Creek fields well location map.

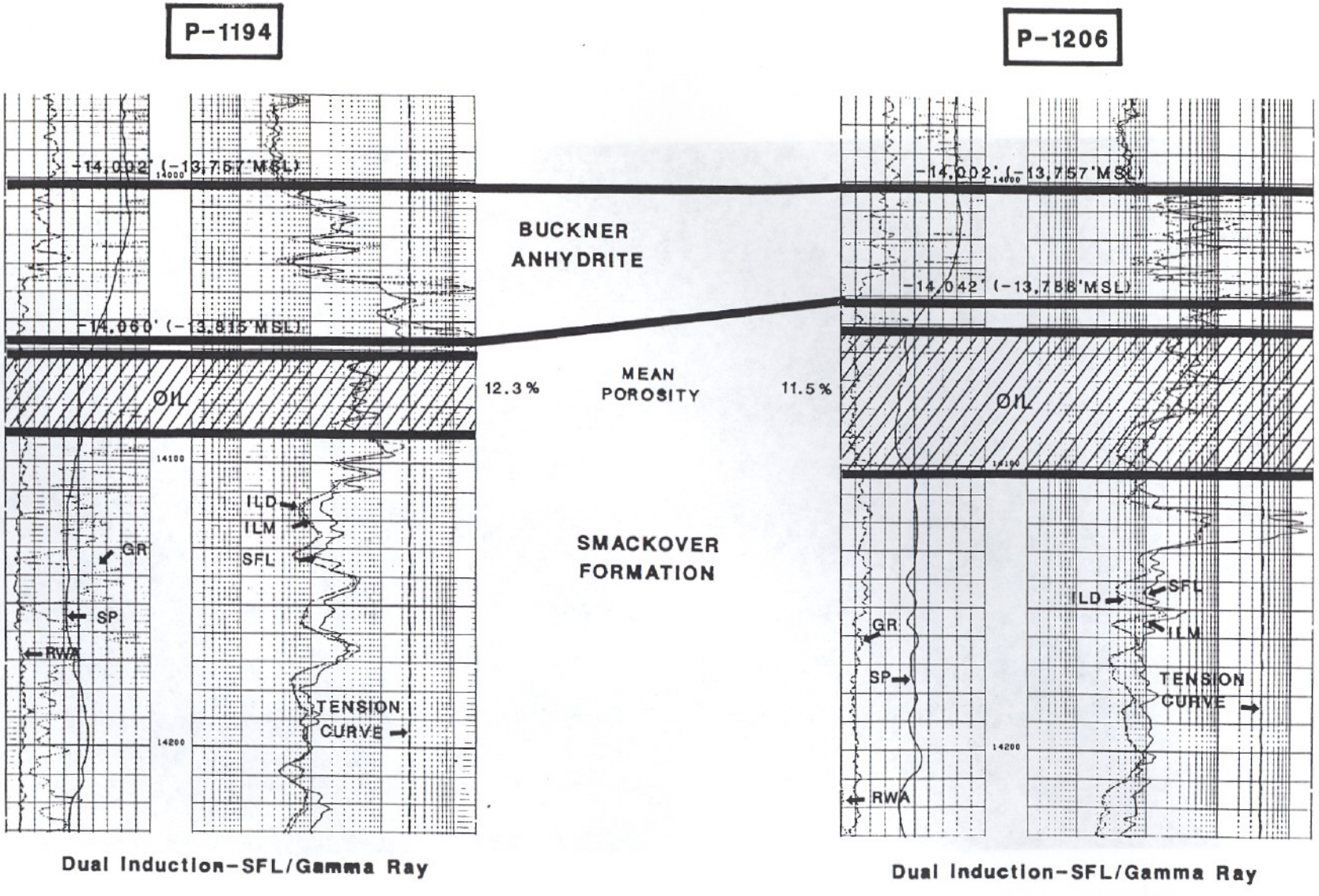

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Figure 18. Geophysical log correlation, McLellan field.

crystalline, gray brown limestone and dolostone, with low porosity and permeability, and potential for only saltwater production. The field produced a total of 13,695 barrels of oil during its entire lifetime (Appendix 2). The discovery well was the only producer at Sweetwater Creek field and was plugged and abandoned in December 1980, after it began producing 100 percent saltwater.

South Florida Oil Field Summaries

INTRODUCTION

South Florida oil production began with Florida's first oil discovery at Sunniland field in September, 1943. There are now a total of 14 oil fields in South Florida, oriented in a northwest-southeast trend through Lee, Hendry, Collier and Dade Counties (Figure 1). Of these 14 Sunniland trend oil fields, 10 are active, one is temporarily shut-in, and three are plugged and abandoned.

Reservoirs found along the Sunniland trend are composed of localized buildups of organic debris into mounds or pods which formed porous grainstones within the upper Sunniland Formation (Figure 2). The fauna which make up these bioherms include rudistids, algal plates, gastropods, and foraminifera. Dolomitization has enhanced the porosity of these grainstones. The grainstones grade laterally into nonporous, miliolid-rich mudstones (Means, 1977, Mitchell-Tapping, 1984, 1985, and 1986). These miliolid mudstones often provide the trapping mechanism for these reservoirs.

The exception to the above general description of south Florida oil fields is Lake Trafford field. Lake Trafford produces oil from a fractured limestone in the lower Sunniland Formation (Means, 1977).

LEHIGH PARK FIELD

The discovery well for the Lehigh Park field was the Exxon Consolidated - Tomoka number 22-4 (permit 712) drilled in Section 22, Township 44 South, Range 26 East, Lee County. This is the most northwesterly field in the Sunniland trend (Figure 1). The discovery well was completed on July 30, 1974, in the -11,349 to -11,354 foot MSL interval of the Sunniland Formation. Initial production was 490 barrels of 27.6° A.P.I. gravity oil and 48 barrels of saltwater per day. This well was later abandoned and a deviated well (permit 712A) was drilled at the same surface location to produce higher on the structure. A total of nine dry holes were drilled to delineate this field. All of the producing wells were directionally drilled because bottom hole locations are beneath the town of Lehigh Acres.

Figure 19 is a structure map on the top of the Sunniland Formation (Ferber, 1985) at Lehigh Park field. The reservoir appears to be typical of the south Florida Sunniland trend fields -a leached limestone bioherm. Core analysis by R. E. Laboratories, Inc. (Dallas, Texas) yielded an average porosity of 19.7 percent for the Sunniland Formation from -11,337 to -11,364 feet MSL. They described this interval as a tan to brown, fossiliferous, partially dolomitized limestone.

Two wells were actively producing and production totaled 5,165,000 barrels of oil at the end of December 1989 for this field (Appendices 2 and 3).

TOWNSEND CANAL FIELD

Townsend Canal field is located in Section 2, Township 45 South, Range 28 East, Hendry County, approximately three miles north of Mid-Felda field, within the Sunniland trend (Figure 3). It was discovered on June 27, 1982, with the first production test of the Natural Resources Management Corporation - A. Duda & Sons number 2-3 well (permit 1070). The test produced 160 barrels of 28.4° A.P.I. gravity oil and 42 barrels of saltwater per day. Production is from the Sunniland Formation between -11,363 and -11,368 feet MSL (Appendix 1).

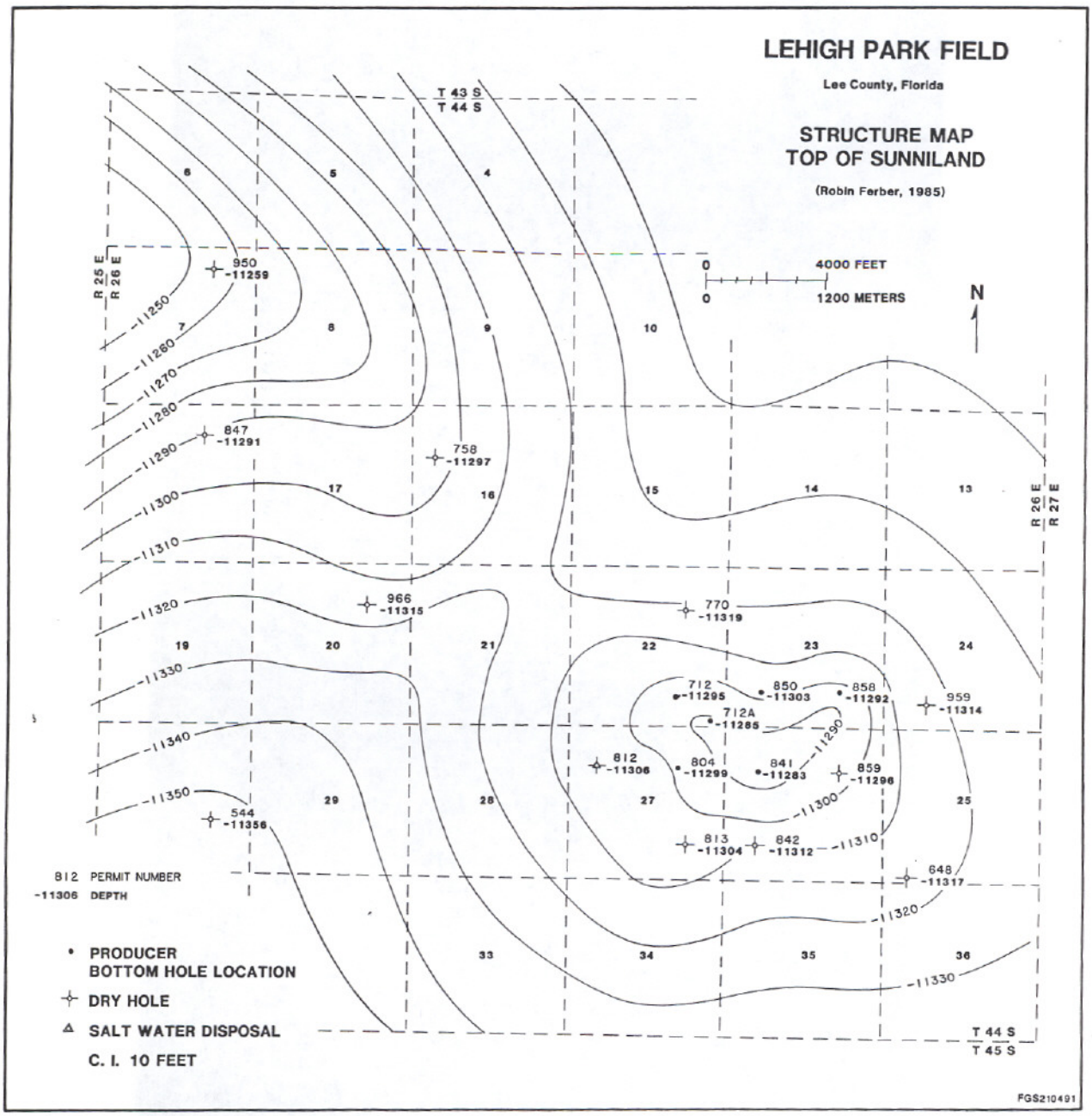

Figure 19. Lehigh Park field structure map, top of Sunniland Formation (after Ferber, 1985).

Two wells were producing at Townsend Canal field at the end of 1989 (Appendix 3). Production totaled 406,000 barrels of oil at the end of 1989 (Appendix 2).

WEST FELDA FIELD

West Felda field was discovered on August 2, 1966, with the drilling of the Sun - Red Cattle number 21-3 well (permit 371) in Section 21, Township 45 South, Range 28 East, Hendry County (Appendix 1, Figures 1 and 20). The first production test yielded 56 barrels of 24.6° A.P.I. gravity oil and 148 barrels of saltwater per day from the -11,437 to -11,440 foot MSL interval of the Sunniland Formation.

The field is mainly a stratigraphic trap; however, structural closure is more evident than at Sunoco Felda field (Figure 20). The main producing unit has a composition typical of the south Florida Sunniland trend fields (Means, 1977, Mitchell-Tapping, 1986). Means (1977) summarized the reservoir characteristics for West Felda field as follows: average pay thickness of 17 feet, average porosity of 20 percent, average water saturation of 35 percent, A.P.I. oil gravity of 26°, and average daily oil production of 4,600 barrels. Values indicate improved reservoir quality over Sunoco Felda field.

Means (1977) believed that the reservoir quality was improved because West Felda field "experienced higher energy and more-normal marine conditions" than did Sunoco Felda field. Alternatively, Mitchell-Tapping (1986) considered the energy levels about the same for both fields and believed that the improved quality is "due to greater sub-aerial exposure as the mound structure is larger and topographically higher" at West Felda field.

At the end of December 1989, eleven wells were producing at West Felda field and cumulative production totaled 41,226 barrels of oil (Appendices 2 and 3).

MID-FELDA FIELD

The Mid-Felda field discovery well was the R. L. Burns - Red Cattle number 27-4 (permit 904) in Section 27, Township 45 South, Range 28 East in Hendry County, Florida. The well was completed in the -11,433 to -11,437 foot MSL interval of the Sunniland Formation on October 13, 1977. An initial production test on October 24, 1977 yielded 281 barrels of 26° A.P.I. gravity oil and 53.6 barrels of saltwater per day (Appendix 1).

The well is located on a small subsurface feature between West Felda field and Sunoco Felda field (Figure 20). Samples from the producing zone show a partially dolomitized fossil hash with about ten feet of oil staining. Geophysical log analysis indicated approximately 20 percent porosity for an eight-foot interval (Applegate and Lloyd, 1985).

At the end of 1989, two wells were actively producing (Appendix 3). Cumulative production, as of the end of December, 1989 was 1,239,000 barrels of oil (Appendix 2).

SUNOCO FELDA FIELD

The Sunoco Felda field, located in Hendry and Collier Counties, was discovered in July 1964 by Sunoco, when they drilled the discovery well (Appendix 1). The well (the Sun - Red Cattle number 32-1; permit 315) is located in Section 32, Township 45 South, Range 29 East. Sunoco Felda was the second commercial oil field discovered in Florida and was discovered 21 years after the first commercial discovery (Sunniland field). Forty Mile Bend field was discovered in 1954 but turned out to be non-commercial and was abandoned in 1956. The Sunoco Felda discovery well location was based on a combination of subsurface and seismic data (Tyler and Erwin, 1976).

In an initial pumping test in November 1964, the discovery well produced 427 barrels of 25.4° A.P.I. gravity oil and 11 barrels of saltwater per

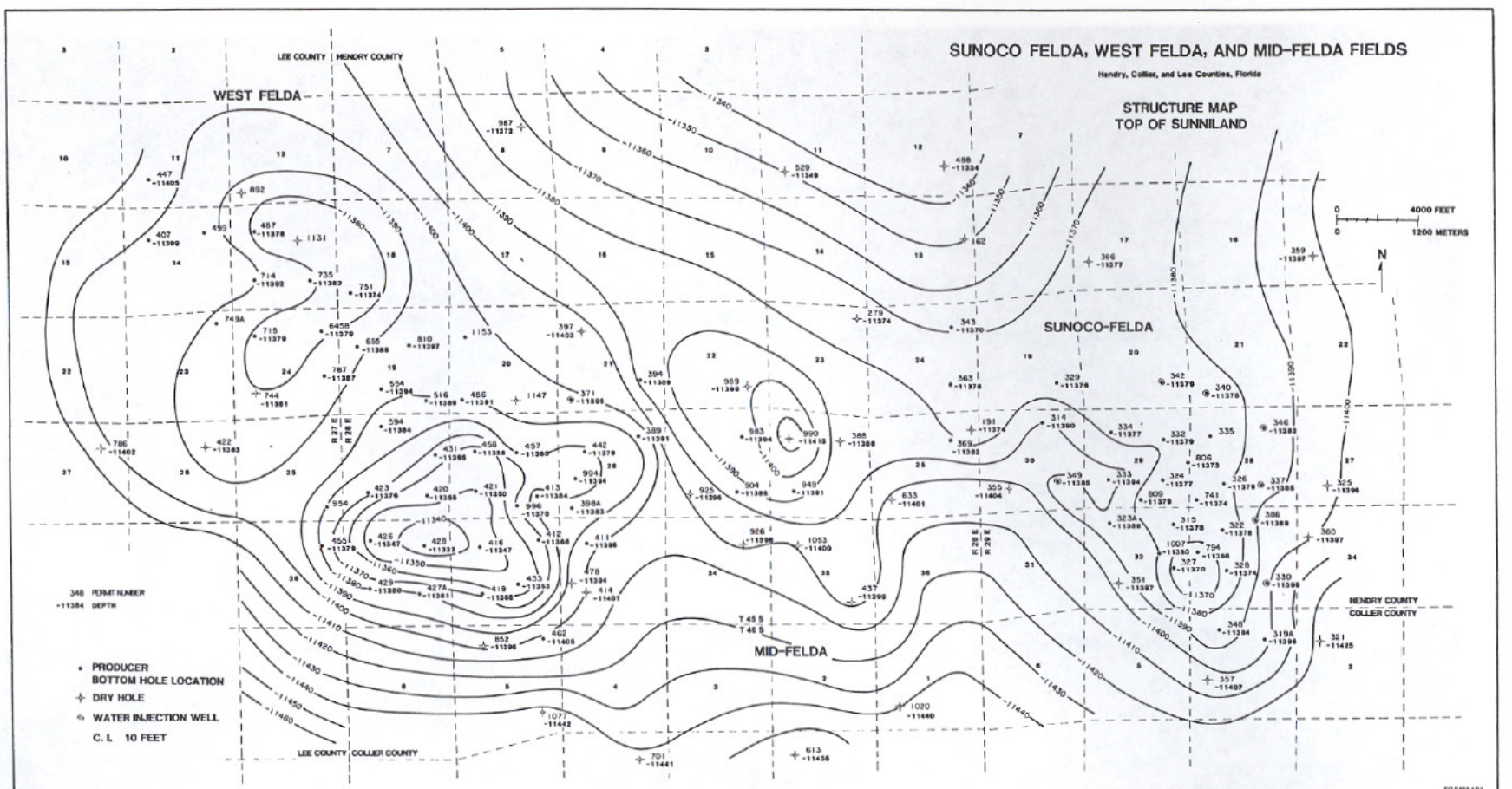

Figure 20. Sunoco Felda, West Felda, and Mid-Felda fields structure map, top of Sunniland Formation.

day. Production is from the Sunniland Formation from -11,417 to -11,430 feet MSL from a leached limestone bioherm. The faunal composition of the bioherm is somewhat typical of the Sunniland reservoirs (as described in the south Florida oil fields introduction above) (Means, 1977, Mitchell-Tapping, 1986). Mitchell-Tapping (1986) observed faunal differences at Sunoco Felda field which indicated formation in "the shallow lagoonal zone of the back-reef environment." The reservoir has a permeability barrier to the northeast which prevents migration of the oil up-dip (Tyler and Erwin, 1977).

Means (1977) summarized the reservoir characteristics of Sunoco Felda field. These include an average pay zone thickness of 11 feet, average porosity of 18 percent, average water saturation of 50 percent, A.P.I. oil gravity of 25°, and average daily oil production of 1,700 barrels.

As of December 1989, Sunoco Felda field was producing from 18 wells (Appendix 3). Total production was 11,529,000 barrels of oil (Appendix 2).

CORKSCREW FIELD

Corkscrew field was discovered on November 10, 1985 with an initial swab test of the R. K. Petroleum - Rex Properties number 33-2 (permit 1170). Corkscrew field is located about two and one-half miles north and slightly west of the one-well Lake Trafford field in Collier County, Florida (Figures 1 and 21). In its initial test, the discovery well produced 435 barrels of 25° A.P.I. gravity oil per day with no saltwater. Production was from open hole in the Sunniland at -11,502 to -11,520 feet MSL.

Core analysis by Analytical Logging, Inc. (Ft. Myers, Florida) indicated an oil producing zone from -11,506 to -11,515 feet MSL. The zone was described as a "fossil-hash" of dolomitic limestone with an average porosity of 15.25 percent. This description, and the small closed structure drawn by Cheeseman (1988) (Figure 21), are again consistent with a bioherm formation for the reservoir.

Two successful offsets have been drilled at Corkscrew field (Figure 21, permits 1199 and 1201A) (Lloyd, 1989). These two wells and the discovery well were all producing at the end of 1989 (Appendix 3). Total oil production as of January 1, 1990 was 524,000 barrels (Appendix 2).

LAKE TRAFFORD FIELD

Lake Trafford field was discovered by Mobil Oil Corporation on the Baron Collier Jr. lease in Section 9, Township 47 South, Range 28 East in Collier County (Figures 1 and 21). The discovery well (permit 401) was completed on March 30, 1969 (Appendix 1). During initial production tests the well pumped 118 barrels of 25.6° A.P.I. gravity oil and 78 barrels of saltwater per day. Production was from the Sunniland Formation from -11,830 to -11,892 feet MSL. The well was later squeeze cemented to shut off water from above the perforations. The well is unique in south Florida in that it has not produced water since that time.

Lake Trafford field is also unique in south Florida as the only field which produces oil from a fractured limestone in the lower Sunniland Formation (Means, 1977). Core material from the discovery well has been described as an argillaceous, burrowed, limestone "rubble." The combination of burrowing and fracturing was believed to be responsible for the development of producible permeability and porosity (Jim Richter, Mobil Oil Corporation, personal communication, in Applegate and Lloyd, 1985).

Offsets drilled northwest and south of the discovery well were dry holes. The discovery well remains the single producing well for Lake Trafford field. The well was shut-in in March 1988 and remained shut-in for the rest of 1988 and all of 1989. Total oil production for this field, as of the end of 1989 was 278,000 barrels (Appendix 2).

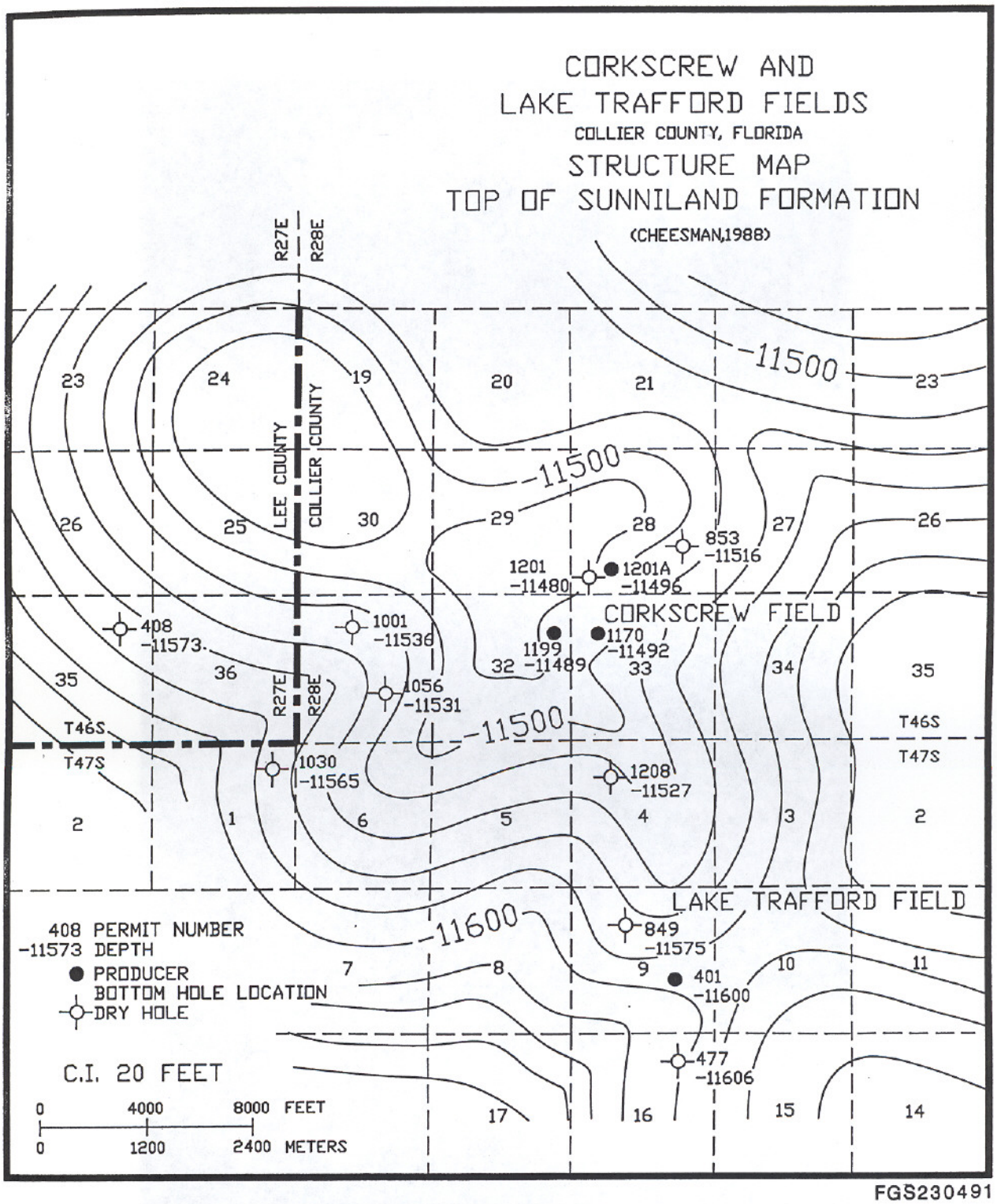

Figure 21. Corkscrew and Lake Trafford fields structure map, top of Sunniland Formation (after M. Cheeseman, independent petroleum geologist, Pensacola, Florida, 1988, personal communication).

SUNNILAND FIELD

In September 1943, Humble Oil and Refining Company discovered Sunniland field in Collier County, Florida (Figure 1); this was the first commercial oil discovered in Florida. The discovery well was the Humble Oil and Refining Company - Gulf Coast Realties number 1 (permit 42) located in Section 29, Township 48 South, Range 30 East. The well was completed in an open hole interval between -11,568 and -11,592 feet MSL. Initial production was 97 barrels of 26° A.P.I. gravity oil and 425 barrels of saltwater per day by pumping.

The well was drilled on a prospect outlined by magnetic, gravity, seismic, and core data. Production in the field is from various porous zones in rudistid mounds in the upper 60 feet of the formation. Mitchell-Tapping (1985) described the producing horizon as consisting of leached rudist and algal particles together with pellets and foraminifers. Mitchell-Tapping's (1985) study of Sunniland, Bear Island, and Forty Mile Bend fields concluded that the depositional environment of these fields was that of a tidal shoal with a landward (east-northeast) mud-flat area and a seaward (west-southwest) shallow-water back-reef area. The structure map (Figure 22) for the Sunniland field shows a northwest-southeast trending dome that formed as these rudistid beds grew with slowly-rising sea level during the Lower Cretaceous. The dome is about four miles long and two miles wide with closure of about 40 feet.

Twenty-six producing wells and ten dry holes have been drilled at Sunniland field. Sunniland field has been producing oil for almost 50 years; increased saltwater production has forced abandonment of many of the old Sunniland wells. Eighteen of the producers had been abandoned by the end of 1989. Of the remaining eight producers, five were shut-in during 1988 and 1989. The other three produced intermittently during 1988 and 1989 and were all also shut-in as of December 1989 (Appendix 3). Oil production totaled 18,445,000 barrels at the end of December 1989 (Appendix 2).

SEMINOLE FIELD

The discovery well for the Seminole field was the Weiner-Oleum Corporation well number 12-1 (permit 662) in Section 12, Township 48 South, Range 32 East, Hendry County (Figure 1). The well was completed in the -11,379 to -11,384 foot MSL interval of the Sunniland Formation on November 14, 1973. Initial production was 26 barrels of 25.4° A.P.I. gravity oil and eight barrels of saltwater per day. This three-well oil field was abandoned in 1978 after producing a total of 85,000 barrels of oil (Appendix 2).

BEAR ISLAND FIELD

Bear Island field was discovered on December 5, 1972, with the completion of the Exxon - Gulf Coast Realties number 2-4 well (permit 563) in Section 2, Township 49 South, Range 30 East (Figure 23). The field is located about two miles southeast of Sunniland field (Figure 1). The discovery well pumped 132 barrels of 26° A.P.I. gravity oil and 545 barrels of saltwater per day from perforations between -11,558 and -11,564 feet MSL in Sunniland carbonates.

The structure map of Bear Island field (Figure 23) indicates a northwest-southeast trending dome about 4.5 miles long and 2.5 miles wide with a closure of about 55 feet. Mitchell-Tapping (1985) found this field to have the same faunal assemblage as Sunniland field; his conclusion concerning the general depositional environment is listed above in the description of Sunniland field. Despite the generally similar origin, Mitchell-Tapping (1985) found Bear Island field to be lithologically different than Sunniland field. Most of the Sunniland Formation at Bear Island field is dolomitized and is more leached than at Sunniland field. Anhydrite and some secondary dolomitization has reduced the effective

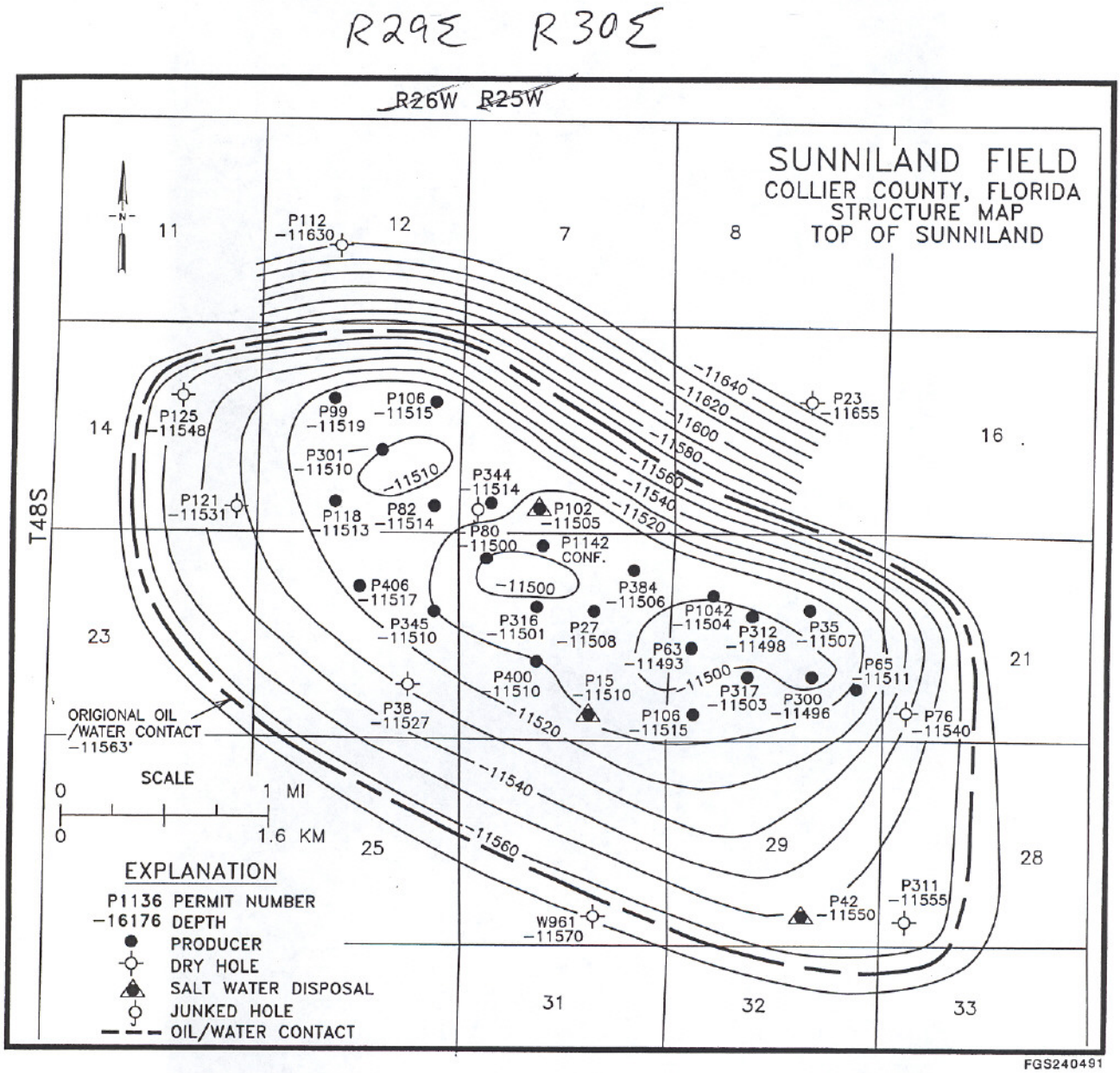

Figure 22. Sunniland field structure map, top of Sunniland Formation.

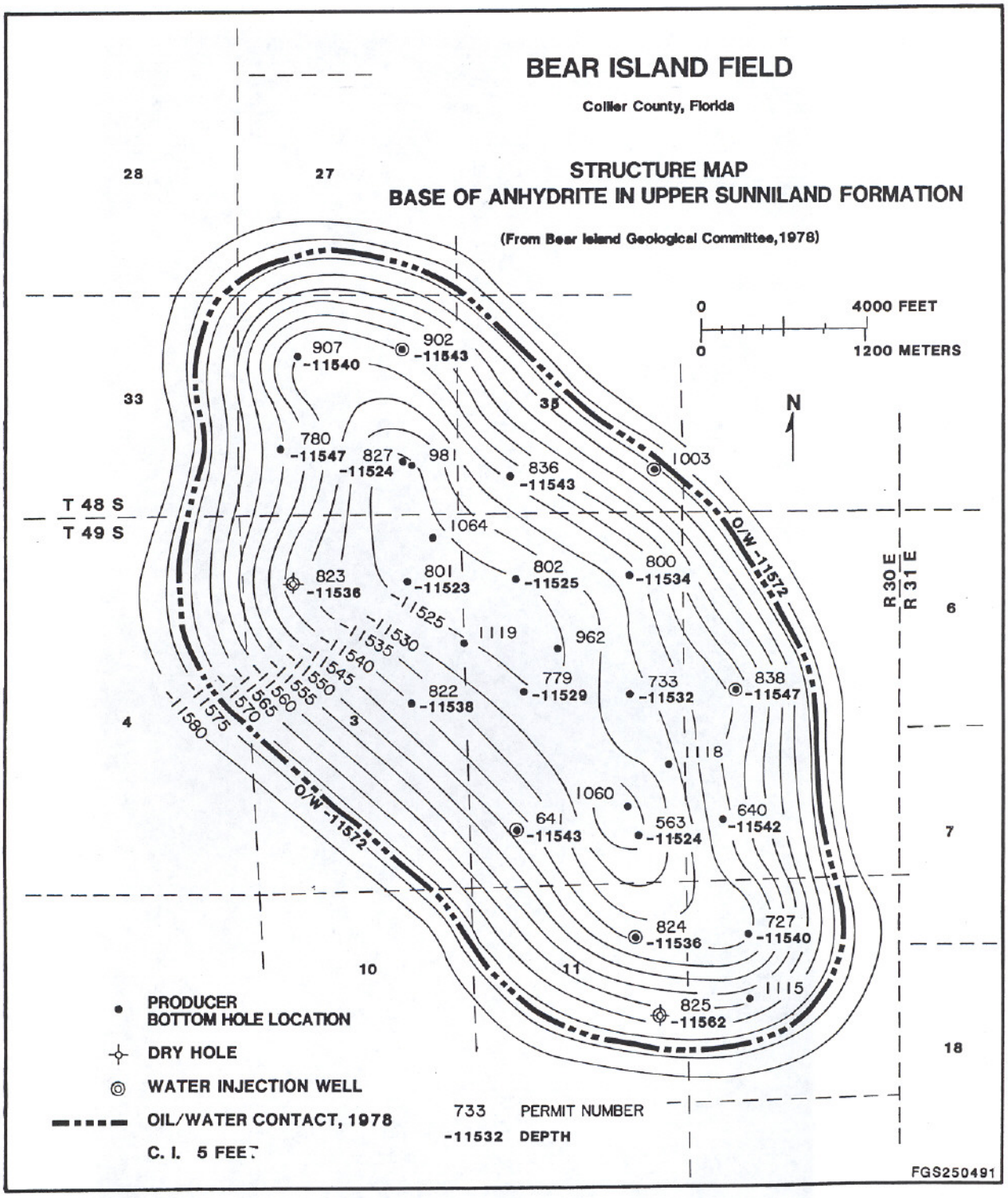

Figure 23. Bear Island field structure map, base of anhydrite in Upper Sunniland Formation (after Bear Island Geological Committee, 1978).

permeability in some sections. Dolomitization in the lower units of the upper Sunniland, however, enhanced both porosity and permeability (Mitchell-Tapping, 1985).

A total of 25 producing wells have been drilled at Bear Island field; seven of these were active at the end of 1989 (Appendix 3). Total oil production, through December 1989, was 10,575,000 barrels (Appendix 2).

PEPPER HAMMOCK FIELD

Pepper Hammock field was discovered on September 28, 1978. The discovery well, the Exxon Corporation - Collier Company number 23-1 well (permit 897) is located in Section 23, Township 29 South, Range 30 East, approximately one and one-half miles south of Bear Island field (Figure 1). The initial production test yielded 20 barrels of 27° A.P.I. gravity oil and 206 barrels of saltwater per day. Production was from Sunniland limestones between -11,586 and -11,590 feet MSL. The discovery well is the only well at Pepper Hammock and is shut-in. A total of 323 barrels of oil were produced before the well was shut-in in October 1978 (Appendix 2).

BAXTER ISLAND FIELD

Baxter Island field is a one-well, abandoned field located approximately eight miles southeast of Bear Island field (Figure 1). The single producer and discovery well was the Diamond Shamrock - Gerry Brothers Ltd. number 31-3 well (permit 865) located in Section 31, Township 49 South, Range 32 East, Collier County. In its initial production test on August 11, 1977, the well pumped 35 barrels of 22.4° A.P.I. gravity oil and 220 barrels of saltwater per day. Production was from the Sunniland Formation from -11,482 to -11,485 feet MSL. The field produced a total of 1,859 barrels of oil before the well was shut-in in 1978 (Appendix 2). The well was plugged and abandoned on January 12, 1980.

RACCOON POINT FIELD

Raccoon Point field is the southeastern-most active field in the Sunniland trend (Figure 1). Its discovery well was the Exxon -Oleum Corporation number 33-4 (permit 829) drilled in Section 33, Township 51 South, Range 43 East, Collier County (Figure 24). Initial production was from the -11,371 to -11,375 foot MSL interval of the Sunniland Formation. In a production test on June 20, 1978, the well pumped 57 barrels of 23.3° A.P.I. gravity oil and 845 barrels of saltwater per day.

Figure 24 is a preliminary structure map for Raccoon Point field. The map indicates an elongated series of small highs trending north-south. The limits of the field are still not completely defined since no dry holes have been drilled at Raccoon Point to date. A total of 15 producing wells have been drilled, one during 1989 (Appendix 4).

At the end of 1989, 12 of the 15 wells were active (Appendix 3). Oil production totaled 4,444,000 barrels at the end of December 1989 (Appendix 2).

FORTY MILE BEND FIELD

Commonwealth Oil Company drilled the Wiseheart - State Board of Education number 1 wildcat (permit 167) in Section 16, Township 45 South, Range 35 East, Dade County. It was located 50 miles southeast of Sunniland field (Figure 1). The well was completed in the -11,298 to -11,315 foot MSL interval of the Sunniland Formation and was initially tested on February 5, 1954. In this initial test, the well pumped an estimated 76 barrels of 21.3° A.P.I. gravity oil and 96 barrels of saltwater per day. Core examination (Applegate and Lloyd, 1985) in the open interval showed a partially to fully oil-saturated, finely crystalline dolostone and limestone with pin-point porosity, which did not appear to be commercial.

The second well in the Forty Mile Bend field,

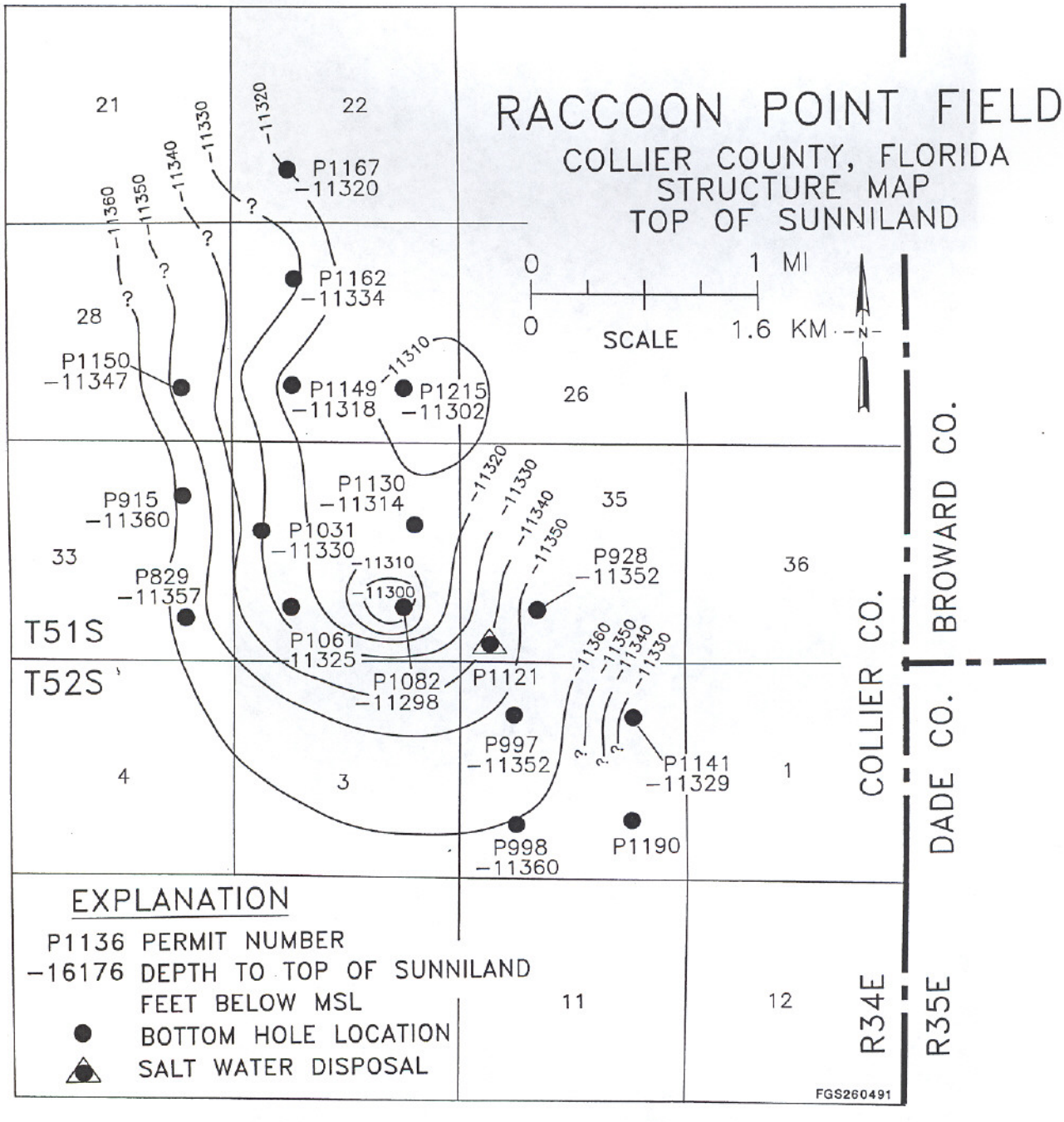

Figure 24. Raccoon Point field preliminary structure map, top of Sunniland Formation.

the Gulf Oil - State of Florida number 1 well (permit 182), was completed in 1954. The well is located about three and one-quarter miles east of the discovery well (Figure 1). It was completed as a pumping well in the -11,309 to -11,316 foot MSL interval of the Sunniland Formation. Initial production was 112 barrels of 21.7° A.P.I. gravity oil per day. Water production was not tabulated.

The distance between the two wells comprising Forty Mile Bend field indicate that they probably did not produce from the same reservoir. Mitchell-Tapping (1985) studied the fauna and lithology of Sunniland, Bear Island, and Forty Mile Bend fields. His description of the depositional environment for these fields is discussed above in the Sunniland field description. He found the lithology and fauna at Forty Mile Bend to be similar to that of Sunniland field, except for the presence of anhydrite in the pore space and an increase in the dolomite content.

Low oil gravity and low porosity and permeability in the Sunniland at both well locations made this field non-commercial. In addition, a half-inch hole was found in the casing of the Gulf well (permit 182) at -10,027 feet MSL. This could have caused excessive water flow, and thus shortened the productive life of this well. Both of the Forty Mile Bend wells were abandoned in 1956, after producing only 32,888 barrels of oil in about 17 months in 1954 and 1955 (Appendix 2) (Gunter, 1955 and 1956).

SUMMARY

Florida oil production continued to decline during 1988 and 1989. Jay field, as the leading producing field for Florida, controls the rate of decline. The field appears to be following the production curve predicted by Christian, et al. (1981) in their discussion of tertiary recovery estimates for Jay field.

Three development wells and sixteen exploratory wells were drilled during 1988 and 1989. One exploratory well was completed as a producer and was the discovery well for McDavid field (Escambia County). Coldwater Creek field was also discovered in 1988 with the first production test of the Red Rock Oil and Minerals Corporation - Pittman Estate No. 26-2A in Santa Rosa County.

Six wells were completed in federal waters off Florida during 1988 and 1989. Three of the wells were in the Pensacola area; three were in the Destin Dome area. The principal drilling targets in these areas are the Smackover Formation and the Norphlet Sandstone (Figure 4). One of the Destin Dome area wells (Chevron-6406) is the second offshore Norphlet discovery in this area.

Geophysical exploration during 1988 and 1989 concentrated in the Florida panhandle and the south Florida peninsula. The panhandle exploration included the known oil-producing Santa Rosa and Escambia Counties, an area offshore from Santa Rosa and Escambia Counties, and the Apalachicola Embayment area. South Florida seismic activity was east of the known Sunniland producing trend in Broward, Dade, Hendry and Palm Beach Counties.

REFERENCES

Applegate, A. V., 1987, The Brown Dolomite Zone of the Lehigh Acres Formation (Aptian) in the South Florida Basin - A potentially prolific producing horizon offshore: Florida Geological Survey Information Circular no. 104, Part II, p. 46-66.

_____, and Lloyd, J. M., 1985, Summary of Florida petroleum production and exploration,onshore and offshore, through 1984: Florida Geological Survey Information Circular no. 101, 69 p.

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

Bear Island Geological Committee, 1978, Bear Island field structure map, Exxon Corporation Sunniland oil pool report: Florida Department of Natural Resources Hearing no. 40.

Blackjack Creek Geological Committee, 1974, Blackjack Creek field unit, Exhibit M-1: Florida Department of Natural Resources Hearing no. 38.

Bradford, C. A., 1984, Transgressive-regressive carbonate of the Smackover Formation, Escambia County, Alabama: in Ventress, W. P. S., Bebout, D. G., Perkins, B. F., and Moore, C. H. (editors), The Jurassic of the Gulf Rim: Proceedings of the third annual research conference, Gulf Coast Section, Society of Economic Paleontologists and Mineralogists Foundation, p. 27-39.

Christian, L. D., Shirer, J. A., Kimbel, E. L., and Blackwell, R. J., 1981, Planning a tertiary oil-recovery project for Jay/LEC fields unit: Journal of Petroleum Technology, v. 33, p. 1535-1544.

Cramer, F. H., 1971, Position of the north Florida Lower Paleozoic block in Silurian time; phytoplankton evidence: Journal of Geophysical Research, v. 76, no. 20, p. 4754-4757.

_____, 1973, Middle and Upper Silurian chitinozoan succession in Florida subsurface: Journal of Paleontology, v. 47, no. 2, p. 279-288.

Ferber, R., 1985, Depositional and diagenetic history of the Sunniland Formation, Lower Cretaceous, Lehigh Park field, Lee County, Florida: Master's thesis, University of Southwestern Louisiana, Lafayette, Louisiana.

Gould, G. J., 1989, Gulf of Mexico Update: May 1988 - July 1989, U. S. Department of the Interior Minerals Management Service: OCS Information Report, MMS 89-0079, 51 p.

Gunter, H., 1955, Exploration for oil and gas in Florida, Florida Geological Survey, 1954 Supplement to Information Circular no. 1, 35 p.

_____, 1956, Exploration for oil and gas in Florida, Florida Geological Survey, 1955 Supplement to Information Circular no. 1, 31 p.

Hughes Eastern Corporation, 1988, McDavid Prospect, Escambia County, Florida, top Smackover, Geophysical Map: Florida Department of Natural Resources Hearing no. 42.

Jay-LEC Fields Unit Geological Committee, 1974, Structure map-top of Smackover-Norphlet oil pool, Exhibit no. G-1: Florida Department of Natural Resources Hearing no. 36.

Johnson, P. G. and Tucker, D. L., 1987, The federal Outer Continental Shelf oil and gas leasing program; a Florida perspective, February, 1987: Office of the Governor, Office of Planning and Budgeting, Intergovernmental Unit, 16 p.

Langston, E. P., and Shirer, J. A., 1985, Performance of the Jay-LEC field unit under mature waterflood and early tertiary operations: Journal of Petroleum Technology, v. 37, p. 261-268.

_____, Shirer, J. A., and Nelson, D. E., 1981, Innovative reservoir management - key to highly successful Jay-LEC waterflood: Journal of Petroleum Technology, v. 33, p. 783-791.

Lloyd, J. M., 1986, Bluff Springs field discovery renews interest in Florida's western panhandle: Oil and Gas Journal, June 30, 1986, p. 105-108.

_____, 1989, 1986 and 1987 Florida petroleum production and exploration: Florida Geological Survey Information Circular no. 106, 39 p.

_____, and Applegate, A. V., 1987, 1985 Florida petroleum production and exploration: Florida Geological Survey Information Circular no. 104, Part I, p. 1-42.

_____, Ragland, P. C., Ragland, J. M., and Parker, W. C., 1986, Diagenesis of the Jurassic Smackover Formation, Jay field, Florida: Gulf Coast Association of Geological Societies Transactions, v. 36, p. 201-211.

Lomando, A. J., Jr., Schreiber, C., and Nurmi, R. D., 1981, Sedimentation and diagenesis of Upper Smackover grainstone, Jay-field area, west Florida (abstract): American Association of Petroleum Geologists Bulletin, v. 65, no. 5, p. 950.

Mancini, E. A., and Benson, D. J., 1980, Regional stratigraphy of Upper Jurassic Smackover carbonates of southwest Alabama: Gulf Coast Association of Geological Societies Transactions, v. 30, p. 151-165.

Masingill, J. H., 1989, The petroleum industry in Alabama, 1988: Alabama State Oil and Gas Board, Oil and Gas Report 3-L, 100 p.

Means, J. A., 1977, Southern Florida needs another look: The Oil and Gas Journal, v. 75, no. 5, p. 212-225.

Miller, J., 1974, Mount Carmel field structure map: Florida Department of Natural Resources Hearing no. 27.

Mink, R. M., Hamilton, R. P., Bearden, B. L., and Mancini, E. A., 1987, Determination of recoverable natural gas reserves for the Alabama coastal waters area: Alabama State Oil and Gas Board, Oil and Gas Report 13, 74 p.

Mitchell-Tapping, H., 1984, Petrology and depositional environment of the Sunniland producing fields of south Florida: Gulf Coast Association of Geological Societies Transactions, v. 34, p. 157-173.

_____, 1985, Petrology of the Sunniland, Forty Mile Bend, and Bear Island fields of south Florida: Gulf Coast Association of Geological Societies Transactions, v. 35, p. 233-242.

_____, 1986, Exploration petrology of the Sunoco Felda trend of south Florida: Gulf Coast Association of Geological Societies Transactions, v. 36, p. 241-256.

Moore, C. H., 1984, The Upper Smackover of the Gulf Rim: depositional systems, diagenesis, porosity evolution and hydrocarbon development: in Ventress, W. P. S., Bebout, D. G., Perkins, B. F., and Moore, C. H. (editors), The Jurassic of the Gulf Rim: Proceedings of the third annual research conference, Gulf Coast Section, Society of Economic Paleontologists and Mineralogists Foundation, p. 283-307.

Ottman, R. D., Keyes, P. L., and Ziegler, M. A., 1973, Jay field - a Jurassic stratigraphic trap: Gulf Coast Association of Geological Societies Transactions, v. 23, p. 146-157.

_____, 1976, Jay field - a Jurassic stratigraphic trap: in Braunstein, J. (editor), North American oil and gas fields: American Association of Petroleum Geologists Memoir 24, p. 276-286.

Shirer, J. A., Langston, E. P., and Strong, R. B., 1978, Application of field-wide conventional coring in the Jay-Little Escambia Creek Unit: Journal of Petroleum Technology, v. 30, p. 1774-1780.

Sigsby, R. J., 1976, Paleoenvironmental analysis of the Big Escambia Creek-Jay-Blackjack Creek field area: Gulf Coast Association of Geological Societies Transactions, v. 26, p. 258-278.

Tyler, A. N. and Erwin, W. L., 1976, Sunoco-Felda field, Hendry and Collier Counties, Florida: in Braunstein, J. (editor), North American oil and gas fields: American Association of Petroleum Geologists Memoir 24, p. 287-299.

Vinet, M. J., 1984, Geochemistry and origin of Smackover and Buckner dolomites (Upper Jurassic), Jay field area, Alabama-Florida: in Ventress, W. P. S., Bebout, D. G., Perkins, B. F., and Moore, C. H. (editors), The Jurassic of the Gulf Rim: Proceedings of the third annual research conference, Gulf Coast Section, Society of Economic Paleontologists and Mineralogists Foundation, p. 365-374.