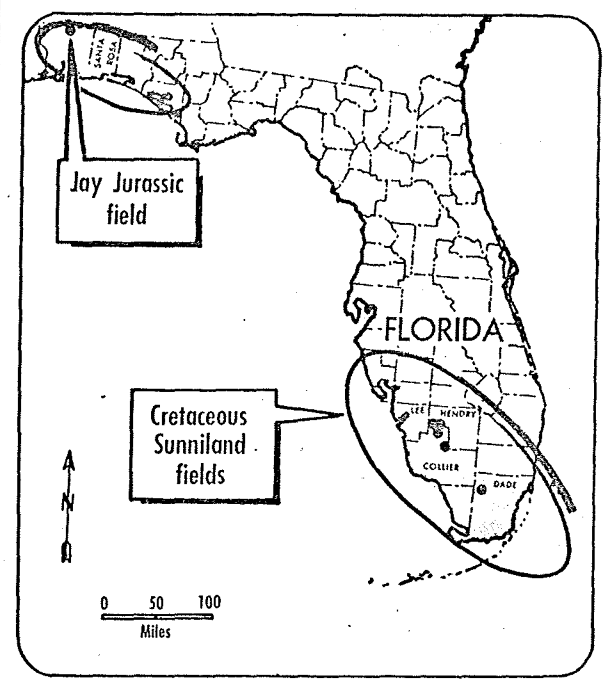
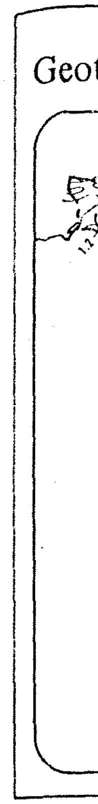
Fig. 1

Florida's oil scene





Why most of the Florida Peninsulema

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OVER 300 oil tests have been drilled in Florida, but most of these have been dry. In South Florida, several small fields have been found in the Lower Cretaceous Sunniland limestone and increased exploration is under way, Fig. 1. The 1970 discovery in the Jurassic Smackover formation at Jay in Santa Rose County is the only field in northern Florida and has led to a rash of wildcatting and leasing. But most of the state still remains oil-barren.

The reason most of Florida has failed to produce has not been explained fully. Explanations include the difficulty of seismic exploration, lack of effective porosity and permeability, and lack of source beds. This study suggests that if the subsurface transformation of a random assemblage of organic molecules into petroleum-like molecules is temperature dependent, then the apparent oil and gas barrenness of most of the state may result from the lack of sufficient subsurface temperature for the requisite organic transformation.

That is, over much of Florida, the sedimentary section overlying the basement is too cool for the thermal maturation of hydrocarbons.

Geothermal gradient variations. Fig. 2 is a contour map of average township geothermal gradients.

On the whole, average geothermal gradients are higher in northern Florida than in the south. An area of interest is the northwest-southeast Sunniland oil field trend in southern Florida. A local geothermal gradient high is indicated in the Sunniland and Felda field area and also in the now-dry Forty-Mile Bend field. Sunniland is located on an anticlinal structure and has individual wells with gradients as high as 1.5° F./100 ft. The cause of the anomaly may be related to the Sunniland structure, but, more likely, the high gradients are produced by the presence of the petroleum itself. Slow spontaneous oxidation of oil may create a local heat source of small but sufficient magnitude to increase the geothermal gradient in the field area.

Petroliferous trends - geothermal gradient relationships. Burst (1969) suggested that thermally induced clay mineral dehydration is related directly to the flushing of hydrocarbons from source beds and their transport into reservoirs.

He showed that it is possible to relate the minimum depth of liquid petroleum production to the depth at which the second stage of dehydration and water release occurs in montmorillonite. He indicates clay diagenesis is essentially a temperature controlled process and can be interpreted best in terms of burial temperature rather than burial depth. He tabulated the minimum temperatures for petroleum production in 5,368 oil reservoirs in the Gulf Coast region. The temperatures range from about 221° F. to 260° F. and are considered to be closely related to the temperature of oil maturation in that area.

The 221° F. isotherm depth varies considerably over the state. In north-

This is a condensed version of a paper presented at the Gulf Coast Association of Geological Societies meeting in New Orleans, October 1971. Full paper appears in the Transactions of that meeting.

Fig. 2

Geothermal gradients

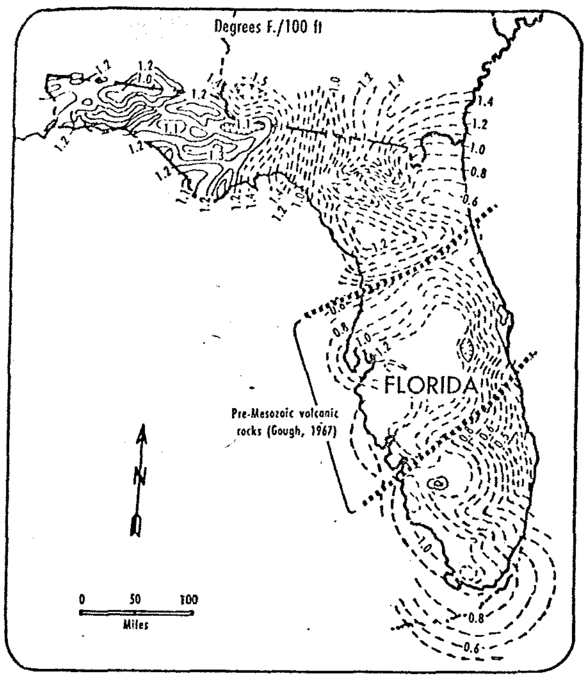
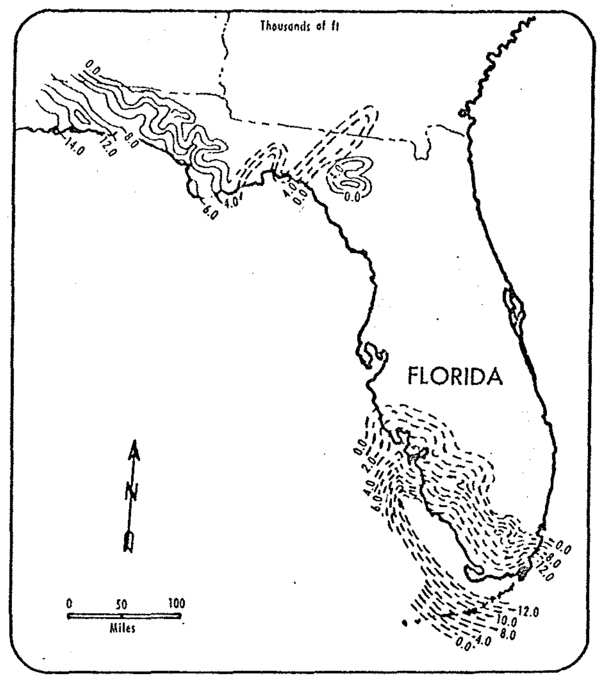


Fig. 3

Potential section



ul...mains dry is not fully explained

western Florida the 221° F. isotherm generally occurs between 8,000 and 16,000 ft; on the Peninsula between 10,000 to 24,000 ft; and in the Keys it may increase to over 30,000 ft.

By subtracting the depth of the 221° F. isotherm (representing the shallowest expected depth of in situ liquid hydrocarbon occurrence) from the depth of the "basement" complex (the deepest expected producing depth), the thickness of section in which liquid hydrocarbons will most likely occur can be derived. These values are contoured in Fig. 3.

The basement surface plunges toward the southwest, resulting in Mesozoic and Cenozoic sediment thickness greater than 25,000 ft and implies great thickness of potentially hydrocarbon-bearing section. Fig. 3, however, suggests that for much of this area, especially in the southern Keys, the requisite temperature for liquid hydrocarbons may not be reached before penetrating the basement. Therefore, potential oil-bearing section may not exist in these areas.

The prospects. Most of Central Florida as well as South Georgia-North Florida look unfavorable for liquid hydrocarbon formation above the basement.

In these areas, the sediment section is too thin for the requisite 221° F. temperature to be found above basement. Areas on Fig. 3 which contain thick sediments of the proper temperature for oil occurrence contain all of the known oil areas in Florida as of now.

Three areas of most promising potential are shown in Fig. 3. The first is the western part of the Panhandle where the thickness of the potential section reaches nearly 14,000 ft and probably increases offshore toward the southwest. Jay field is in the northern part of this area. Fig. 3 predicts 7,000 ft of potential section at Jay. Based on the apparent local gradient of 1.15° F./100 ft, a temperature of 246° F. exists at pay depth, well in the Burst range of 221°-260° F. Fig. 3 also suggests that a large area of the panhandle east of Apalachicola Bay is relatively favorable.

A potential second area so far has no oil. It extends northeast from Franklin, Wakulla, and Taylor counties, through parts of Leon, Madison, Lafayette, Suwannee, and Hamilton counties, into Echols County, Georgia. Oil shows have been reported here. Sparse drilling leaves this area poorly defined.

A third area of potential is in the South Florida structure basin which includes Sunniland, Felda, West Feld, Lake Trafford, and Forty Mile Bend fields. Geothermal relationships suggest that the potentially best parts of the basin have not been tested enough here. Best areas are Monroe, Dade, Collier, Hendry, Lee, and Charlotte counties. The favorable band may extend offshore to the southwest or east.

The area with the highest exploration potential, containing more than 12,000 ft of sediment in the acceptable temperature range, lies in a northwest-southeast band offshore from Collier and Monroe counties.

The authors stress that the usual factors controlling oil accumulation, such as favorable traps, migration paths, and source beds, need to be satisfied. Nevertheless, good correlation between presently known geothermal relationships and known oil occurrences strongly suggest that earth temperatures should definitely be considered in petroleum exploration programs in sparsely drilled areas such as Florida. END