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SEISMIC STRATIGRAPHY OF THE JACKSON DOME

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INTRODUCTION

In a search for seismic lines in the Jackson, Mississippi, area, seven lines were identified that impinged on the truncated surface of a Late Cretaceous-age, volcanic island buried beneath the Late Cretaceous Jackson Gas Rock. A confidentiality agreement was granted (January 9, 1997) by the Commission on Environmental Quality to obtain six of these lines, five of which were shot in 1969 (one of which is not shown here) and one in 1976.

Five seismic lines are identified as lines A, B, C, E, and F on the stick map in Figure 1 and are interpreted in figures 2-4 and 6-8. Line D of Figure 5 is a stratigraphic cross section using the top of the Jackson Gas Rock as a datum. Mike Blackwell of MOCO Inc., who has done extensive seismic work in west-central Mississippi, and others helped with the seismic interpretation. These interpretations were modified somewhat with the advantage of additional geophysical data. One such source of data came from Steve Walkinshaw, Exploration Manager for Hughes-Rawls, L.L.C., who allowed us to view 3-D seismic lines of the Brownsville Salt Dome for comparison with seismic line B, which passes just southwest of Brownsville Dome. Walkinshaw's interpretations of the Hughes-Rawls seismic lines were supported by velocity survey and well-control data and provided an important tie-in with the seismic lines presented here. In addition to this help, 15 oil exploration wells (listed in the Appendix and plotted on Figure 1) were used to tie the well tops and stratigraphy with the seismic reflectors.

The seismic lines studied were printed from microfilm with variable horizontal scales. Vertical scales of lines A, C, E, and F were the same at 1 second = 3.75 inches, while the vertical scale of line B was 1 second = 2.8 inches. Accompanying the time scale on lines A, C, E, and another line not show here, were depth markers at 2,000-foot intervals to 20,000 feet below sea level. These depths were extrapolated to lines B and F as a reference for tying seismic reflectors to contacts picked on geophysical logs from exploratory wells.

The five seismic lines presented here clearly show the truncation of inclined reflectors at the angular unconformity beneath the Jackson Gas Rock. They also show the lenticular thickening of geologic section between the top of the Jackson Gas Rock and the first Eutaw sand called the Perry Sand (an oil-productive sand in Tinsley Field) on the west and north sides of the Jackson Dome. The Perry Sand is a regional marker,

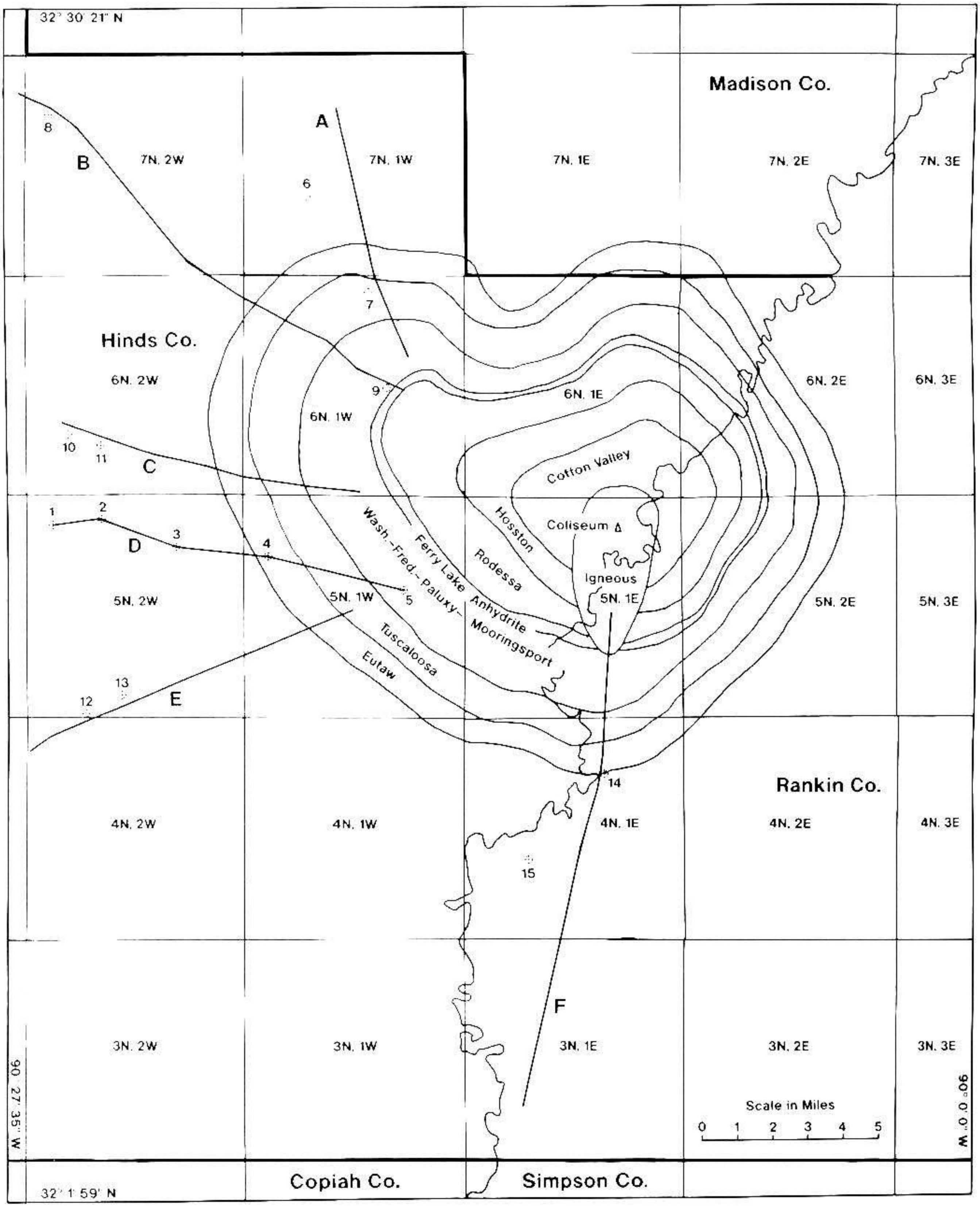

Figure 1. Stick map showing the location of seismic lines A-C and E-F, cross section D, and exploration wells 1-15 used in seismic interpretations. See Appendix for identification of the wells.

which seems to have been deposited on a rather level surface before the uplift of the Jackson Dome and its associated volcanic activity.

STRATIGRAPHY OF PROMINENT SEISMIC REFLECTORS

Prominent seismic reflectors identified on the interpretation of the seismic lines in west-central Mississippi include, in ascending order, the base of the Louann Salt, the top of the salt, top of the lower Haynesville Formation, top of the Cotton Valley Group, top of the Ferry Lake Anhydrite, top of the Eutaw Group, top of the Jackson Gas Rock, base of the Wilcox Group, and top of the Winona/Tallahatta Formation.

Louann Salt. Reflectors above and below the Louann Salt are evident in all the seismic lines. In lines A, B, C, and F, the Louann Salt pinches out on the flanks of the Jackson Dome. The reflector at the base of the salt on line C continues updip of the salt pinchout, where it is labeled as the "pre-salt surface." The Louann pinchout is most prominent in line A, where the salt forms a thick lens at the foot of the uplift.

Haynesville Formation. The "top of the lower Haynesville" reflector is produced by the limestones and shales of the upper Haynesville sequence. This reflector shows deformation from salt movement in lines B and E, but is rather smooth above salt structures in lines A, C, and F.

Cotton Valley Group. The "top of the Cotton Valley Group" was recognized by Mike Blackwell only on line A.

Ferry Lake Anhydrite. The "top of the Ferry Lake Anhydrite" reflector was prominent on all seismic lines, often characterized by a strong peak/trough.

Eutaw Group. The "top of the Eutaw Group" reflector is shown on sections C, E, and F, and is equivalent to the "base of the Gas Rock" on section B. On section C, this surface is shown by a peak/trough, which looks very similar to the first Eutaw sand reflector (or Perry Sand) in the Brownsville Salt Dome area as shown to us on 3-D seismic by Steve Walkinshaw.

Jackson Gas Rock. It would seem that the "top of the Jackson Gas Rock" reflector would be easy to pick as it is the first rock contact below the Porters Creek Clay. However, it was picked with confidence only in lines B and E where the Gas Rock can be seen as a lenticular deposit on the Jackson Dome's western flank. Multiple strong reflectors above the angular unconformity in lines A, C, and F make it difficult to know which reflector is the top of the Gas Rock. Here the top of the Gas Rock is picked based on its elevation in projected exploration wells.

Wilcox Group. The base of the Wilcox Group (top of the Porters Creek Clay) is shown in lines A, B, and F. Here the Porters Creek Clay, which separates the Wilcox Group and Jackson Gas Rock can be seen to dramatically thin over the Jackson Dome. Section B indicates that the Porters Creek thins over thick Gas Rock deposits on the dome's flank, while, in section F, it thins near the edge of the dome's angular unconformity below the Gas Rock. The top of the Wilcox Group is the first reflector below the "top of the Winona/Tallahatta Formation" reflector (see enlargement of line E, Figure 8).

Winona/Tallahatta Formation. The first rather continuous prominent reflector below the surface as shown in lines B, E, and F is the top of the Winona/Tallahatta Formation. This was determined by correlation with well logs and by personal communication with local seismic stratigraphers.

Unlabeled Reflectors. Those reflectors not correlated to specific formational boundaries but which can be traced for some distance are shown with dashed lines.

THE ANGULAR UNCONFORMITY BENEATH THE JACKSON GAS ROCK

The angular unconformity below the Jackson Gas Rock was drawn by Frederic Mellen (1958, fig. 4) in his west-east cross section of the Jackson Dome from Vicksburg to Bolton to Jackson. This unconformity is evident by the presence of rocks as old as the Cotton Valley Group subcropping beneath the Gas Rock and by the projection of contacts between wells. However, the angular unconformity that represents the ancient surface of the Jackson volcanic island can be "seen" where inclined reflectors are truncated on the seismic lines shown here. Of particular interest is line E, which seems to show buried relief at the unconformity, with possible hogbacks or cuestas developed by the ancient outcropping of resistant layers. This relief suggests a rugged, steeply-dipping sedimentary terrain surrounding a volcano or volcanoes on a Cretaceous tropical island, a setting similar to many Caribbean islands today.

THE JACKSON GAS ROCK

The Jackson Gas Rock was an important exploration objective in the 1930s and produced Mississippi's first significant oil/gas boom. According to Hughes (1993, p. 85), commerce from the Jackson Gas Field helped the city and the state to survive the economic downturn of the Great Depression. According to Monroe (1954), the Jackson Gas Field included just five wells in 1930, increased to 114 in 1935, and by 1941 included 152 gas wells and 44 dry holes. This production declined to just 12 wells in 1950. The ultimate production of the field was predicted to be 120 billion cubic feet of gas (revised production to date is 150 bcf). About 25,000 barrels of heavy crude with an API gravity of 13.6° were produced from wells on the south side of the field. The #5 State of Mississippi Fee, which was connected to the pipeline on January 21, 1937, and later abandoned, is located behind the clubhouse at LeFleur's Bluff State Park. After sitting idle for decades, this well was reopened by Gulf South Resources, Inc., in April of 1994 and found to have enough pressure for commercial production. From 1994 to date (1-1-98), the #5 State Fee has produced 113,578,000 cubic feet of gas.

The Jackson Gas Rock is a chalky white limestone with algal fossils comprising the most common reefal component

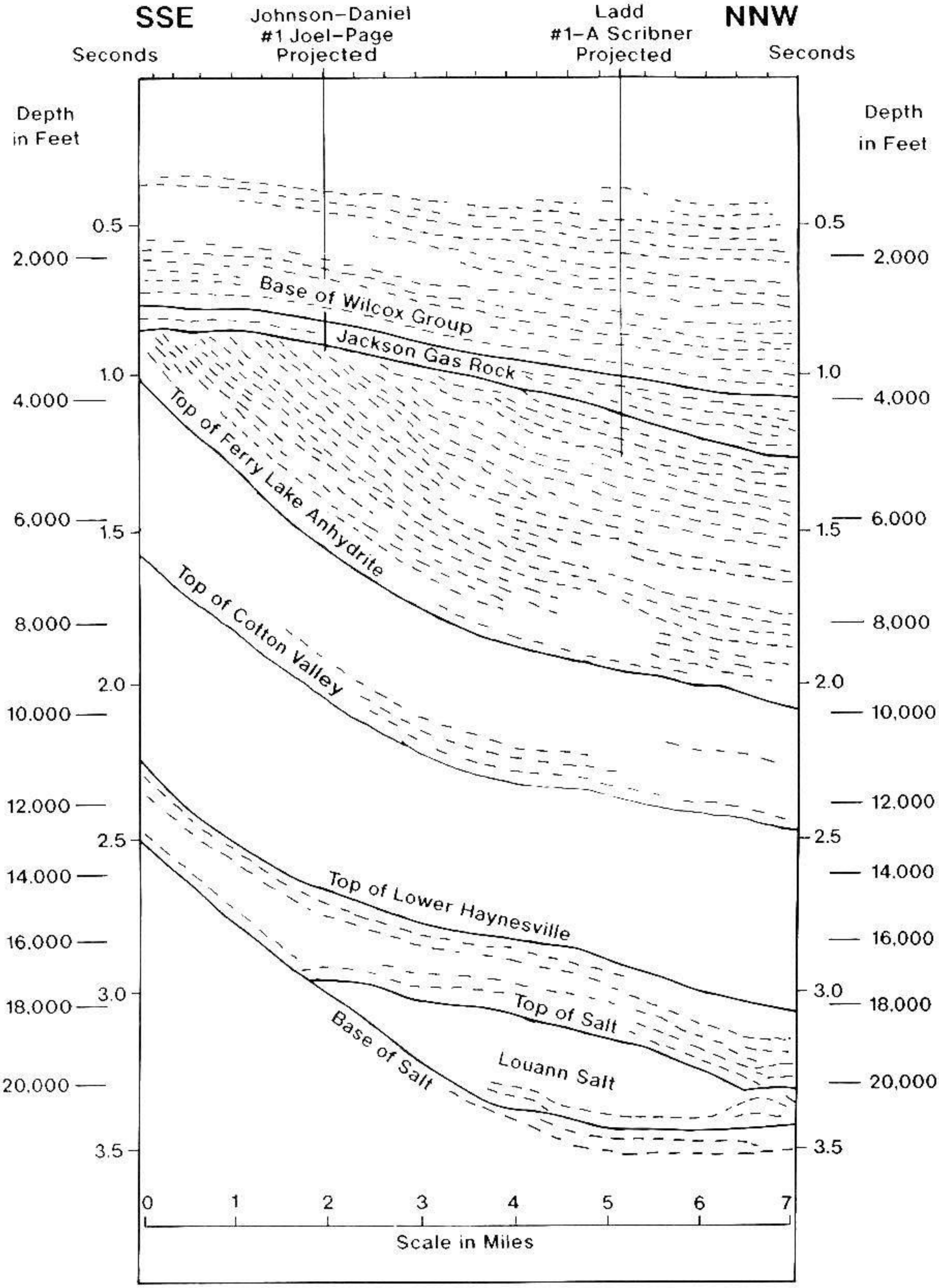

Figure 2. Seismic line A. Reflectors in the Jackson Gas Rock show convergent thinning on the dome's northern flank. Depth is shown in feet below sea level.

(see Dockery et al., 1997, fig. 6). Most of the Gas Rock is of Cretaceous (Selma) age. However, unconformably overlying Cretaceous carbonates of the Gas Rock is a veneer of the Clayton Formation of early Paleocene age. McKibben (1988, p. 9) recognized the average thickness of the Clayton Formation in west-central Mississippi to be between 30 and 50 feet, but stated that the formation was missing on the crest of the Jackson Dome.

Monroe and Toler (1937, p. 28) reported the Clayton present on the dome at the top ("cap rock") of the Gas Rock in the State Fee #2 based on the identification of *Tubulostium*, a planispiral annelid (worm) tube, in a 3-foot section of dark-gray, fossiliferous limestone. This fossil was identified by Julia Gardner of the U.S. Geological Survey, who recognized it as similar to the *Tubulostium* species common at the base of the Midway Group in Alabama. According to Toulmin (1977), the common Midway *Tubulostium* species of Alabama is now recognized as *Rotularia mcglameryae* (Gardner, 1939) and occurs in the upper Clayton and lower Porters Creek formations. In the Gulf #1 Hartfield in Rankin County, Monroe (1954) reported that a core of Clayton Formation from 2,396 to 2,398 feet contained fragments of nullipores, which are calcareous algae related to *Lithothamnium*, and the foraminiferan *Robulus* (=*Lenticulina*) *midwayensis* (Plummer).

In the Lion Oil Refining Co. #1 Misterfeldt well in Rankin County, the top of the Clayton was encountered at 3,064 feet and the top of the Cretaceous Gas Rock was determined to be at some depth between 3,069 and 3,081 feet. The few fossils found in a core from 3,480 to 3,491 feet, including the foraminiferan *Lepidorbitoides* (*Asterorbis*) *rooki* Vaughan and Cole and *Orbitocyclina nortoni* Vaughan and the annelid (worm tube) *Hamulus* sp., suggested a Navarro or Prairie Bluff age (Monroe, 1954). These fossils were known to occur in the Monroe Gas Rock in Louisiana, which was also believed to be of Navarro age. The Late Cretaceous coral *Heliopora* sp. was found in a core of the Gas Rock from 2,865 to 2,878 feet in the Gulf Refining Co. #1 Hamilton well in Rankin County (Monroe, 1954).

Wedell et al. (1941) correlated the Taylor/Navarro stage boundary of Texas into the Selma sequence of central Mississippi and also recognized the Jackson Gas Rock as Navarro in age. In the "normal Selma facies," they recognized the Navarro foraminiferan *Siphogenerina plummeri* as an index fossil in a thin zone near the top of normal Selma Chalk facies (Gas Rock equivalent) north of Township 7 North. The foraminiferan *Lituola taylorensis* occurred in Navarro-age sediments below. Below the *L. taylorensis* zone, the Selma Chalk showed a lower self-potential and resistivity on electric logs and contained the Taylor-age foraminiferan *Planulina taylorensis* as an index fossil. The Navarro/Taylor contact was correlated at the base of a high self-potential, limestone interval overlying chalky beds of lower self-potential. Taylor-age sediments of the lower Selma Chalk were found to be absent on the higher parts of the Jackson uplift and to contain water-lain volcanics in wells in Scott and southern Madison counties.

Seismic lines B and E, as shown together in Figure 8, depict a thick lens of the Jackson Gas Rock developed on the northwest and west flank of the Jackson Dome peripheral to the truncation of Eutaw strata. Reflectors between the top of the Eutaw Group and the top of the Gas Rock include a lower sequence of downlap beds largely of Taylor age and an upper sequence of onlap beds of Navarro age. The culmination of the Gas Rock onlap was when the Jackson volcanic island was eroded below sea level in late Navarro (late Maastrichtian) time and the Gas Rock covered the crest.

Downlap reflectors in the Jackson Gas Rock peripheral to the truncation of Eutaw strata show the development of a crescent-shaped, carbonate and clastic, sedimentary trough around the northern and western flanks of the Jackson Dome. This is also shown on Oxley's isopach map of the Gas Rock as published in Dockery et al., 1997, fig. 2, and is shown here in the cross section of line D in Figure 5, a line connecting five exploratory wells. This line shows rapid westward thickening of the Jackson Gas Rock and underlying Selma carbonates and clastics between well 4 near the edge of the Eutaw subcrop and well 2 near the axis of the trough.

According to Walkinshaw (personal communication), much of what is mapped as Gas Rock is actually sand, the Gas Rock northwest of Jackson containing up to 500 feet of sand. Wedell et al. (1941) believed the Woodruff Sand in Tinsley Field to be equivalent to the Jackson Gas Rock as it was more like the Gas Rock "faunally, lithologically, and electrically" than like the "normal Selma" chalk facies. Though some of the Gas-Rock sand may have come from the uplift and erosion on the Sharkey Platform, cross section D of Figure 5 and seismic lines B and E of Figure 8 suggest that the erosion of uplifted sedimentary strata on the Jackson volcanic island supplied most of the sediment.

TIMING OF THE JACKSON DOME UPLIFT

The history of the Jackson Dome's uplift can be found in the post-Eutaw sedimentary trough on the dome's northern and western flanks. The early post-Eutaw history of an emergent island and fringing reef can be seen in the downlap beds of the trough. The island's history of erosion and subsidence below sea level can be seen in the onlap beds (Figure 8). These beds eventually covered the island, leaving it perhaps as an atoll in a tropical Cretaceous seaway. Downlap beds in the trough may date as old as the basal Selma Group at about 84 million years ago (Ma), while the onlap beds covering the dome's crest may be as young as the end of the Cretaceous at 65 Ma. Thus, the Jackson volcanic island may have existed for some 20 million years or less before sinking below sea level.

Seismic line B is the longest and most useful line in unraveling the uplift history of the Jackson Dome. This line shows no thinning of pre-Selma Cretaceous or Jurassic units

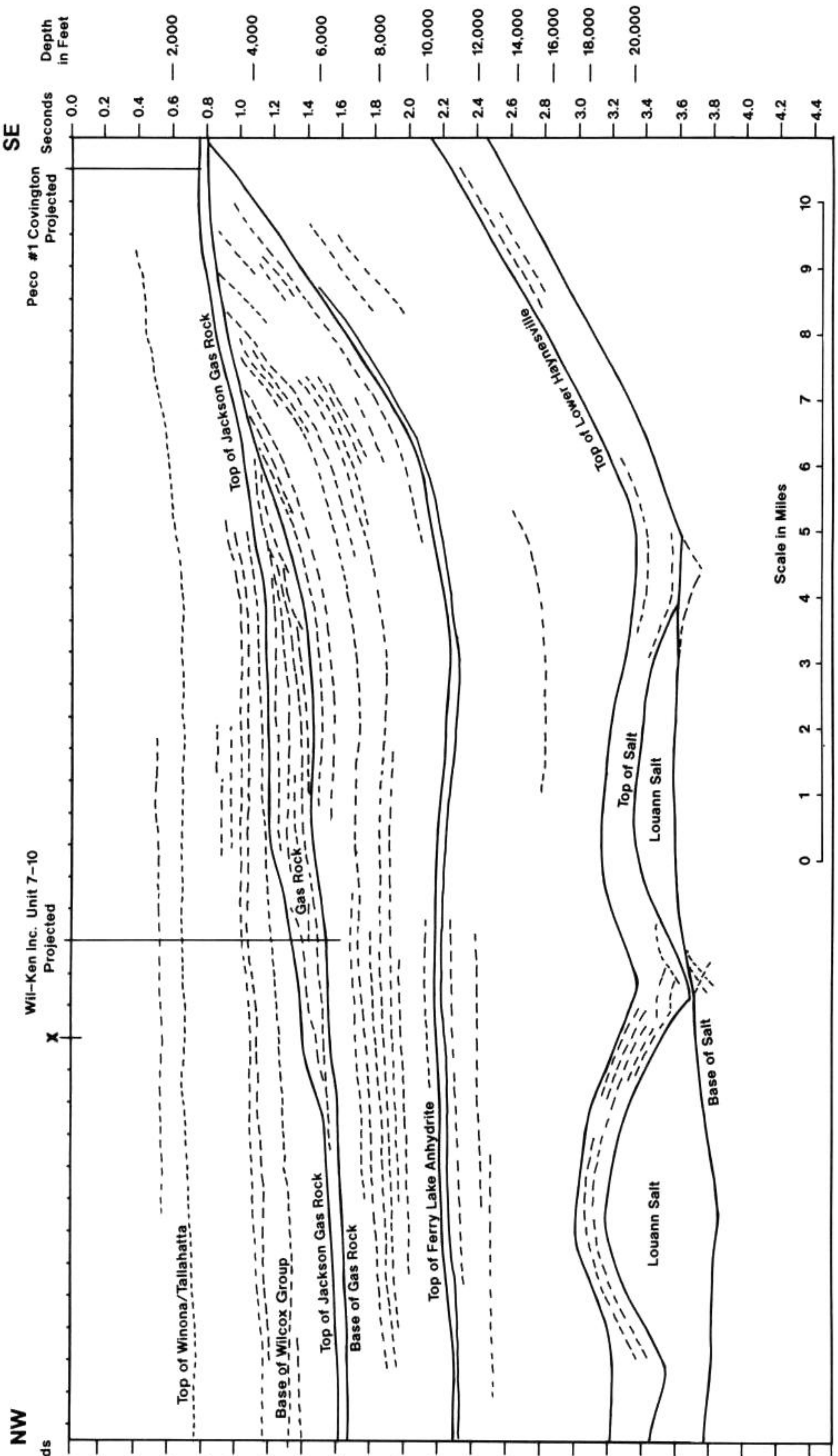

Figure 3. Seismic line B, showing the thick lens of Jackson Gas Rock on the dome's northwestern flank. X marks the northwestern end of the section as shown on the stick map in Figure 1. Depth at right is shown in feet below sea level.

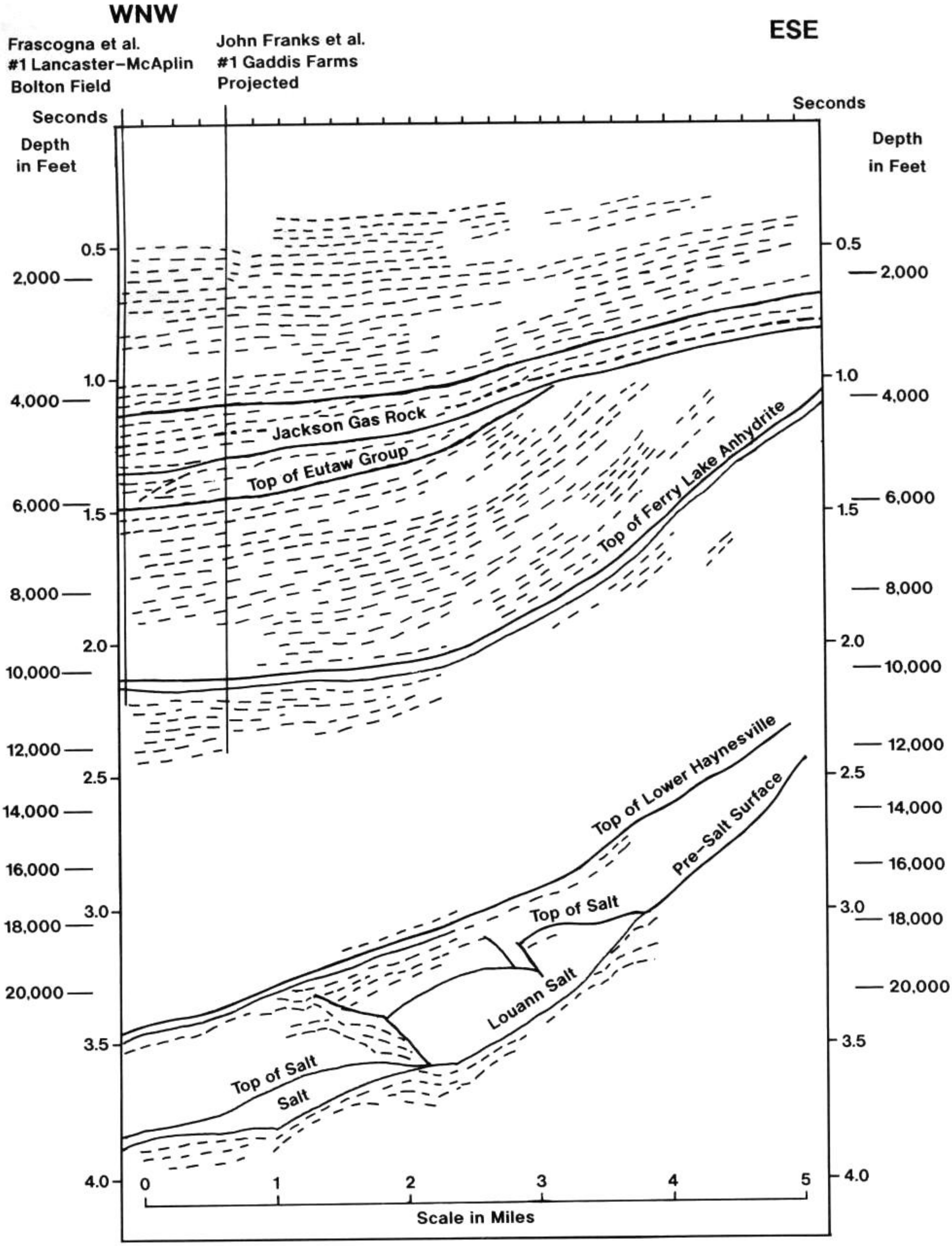

Figure 4. Seismic line C. The top of the Jackson Gas Rock was projected from the wells shown into a set of strong reflectors, but seems to be high in comparison to lines B and E where the top is more certain. Depth is shown in feet below sea level.

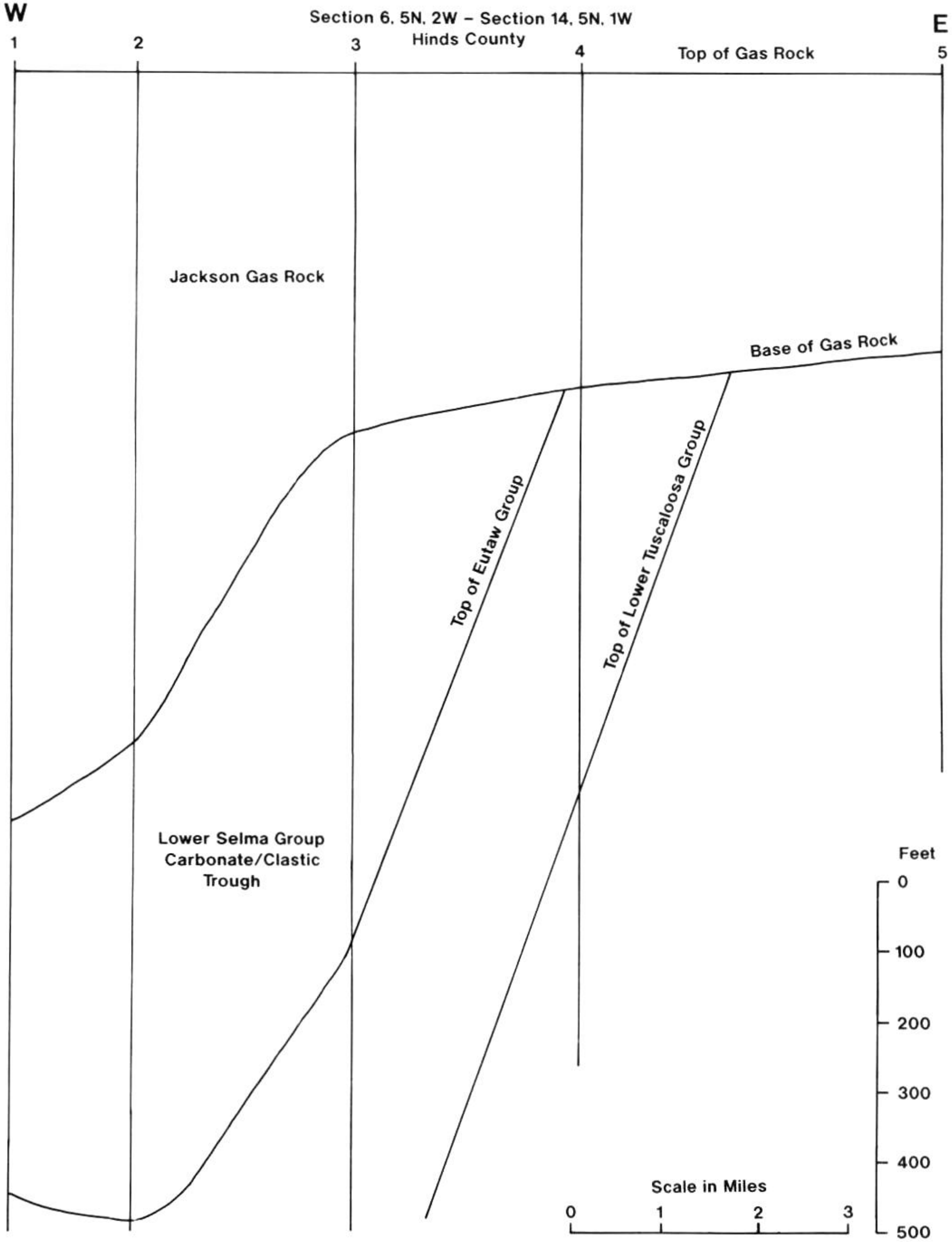

Figure 5. Cross Section D, showing the thickness of the Selma Group within the sedimentary trough west of the Jackson Dome as determined by geophysical well logs. Datum at top of cross section is the top of the Jackson Gas Rock.

over the dome with the exception that the Louann Salt is absent. One explanation for the absence of salt over the Jackson Dome is a possible uplift in the Jurassic before or during salt deposition. This explanation would agree with Harrelson (1981), who stated that "The geologic history of the dome began in Jurassic time with crustal upwarping as the result of emplacement of an undersaturated plutonic mass." However, no igneous rocks of Jurassic age have been documented from the Jackson Dome, and the most reasonable explanation for the absence of the Louann seems to be the dissolution of salt by hydrothermal fluids associated with volcanism in the Late Cretaceous. The apparent thinning of section between the top of the lower Haynesville and the top of the Ferry Lake Anhydrite in lines C and E, as shown in figures 4 and 6, is partly a product of the exaggerated vertical scale, which below 2.0 seconds is greater than 2 to 1. This exaggeration makes flat-lying beds appear more than twice as thick as the same beds when turned on end in a vertical position.

After Louann deposition, the sedimentary record shows no evidence of an uplift at Jackson until the middle of the Selma Group. The absence of Early Cretaceous (Hosston Formation) to Late Cretaceous (early Selma Group) strata over the crest of the Jackson Dome is not the result of sedimentary units pinching out against a structural high but, as seen in the seismic records, is clearly the result of post-Eutaw uplift and erosional truncation. The last relatively flat-lying sedimentary unit deposited at Jackson before the uplift may have been the "sandstone" bed in the lower Selma Chalk sequence, which McKibben (1988) mapped as the Taylor-Navarro boundary. A truncation of basal reflectors in the Selma Group, which may include the "Taylor-Navarro sand," can be seen in Figure 8.

McKibben's (1988) Taylor/Navarro boundary pick at the top of a regional "sand" bed is a little higher than that correlated in the cross sections of Wedell et al. (1941). Still, she was able to map this bed across west-central Mississippi (1988, fig. 6) and drew the line where it was missing on the Jackson Dome. Noting that the area in which this sand bed was missing was greater than the area in which the Eutaw was missing, she concluded that "the island was still building during the early part of Selma times." However, for a breached dome, the area of "missing formation" grows for successively younger formations, which are truncated closer to the edge. This explains the increase in the area of absence for rocks between Eutaw and lower Selma age and ties the uplift to a time in the middle Selma at about 75 million years ago, a time indicated by the radiometric ages of intrusive and extrusive igneous rock within the Jackson Dome (Dockery et al., 1997).

The Jackson Volcano rose from the sea floor at a time when volcanic islands were popping up worldwide and especially in the western Pacific, where atolls, such as the Marshall Islands, and their flat-topped sunken remnants called guyots are widely scattered. In the Marshall Islands, Anewetak is the only atoll where deep drilling has penetrated the carbonate platform and encountered the underlying volcanic edifice. Here, igneous cores gave a radiometric age of 75±0.6 million years old (Wilson et al., 1998), the same age as found at Jackson.

The timing of the uplift at Jackson can also be determined by the age of erosional debris stripped from the dome's crest. Much of this debris can be found in thick Jackson Gas Rock and other Selma-age deposits in northern Hinds, southwestern Madison, and southeastern Yazoo counties. These sediments lie in a trough between two prominent structures, the Sharkey Platform and the Jackson Dome. Both of these structures were emergent from the sea in Late Cretaceous time and contributed clastic sediments to the marine environment. However, while Tuscaloosa and Eutaw strata were involved in the uplift at Jackson, the initial uplift of the Sharkey Platform occurred before Tuscaloosa time as is shown by radiometric ages (Merrill, 1983) and commercial cross sections in the area.

Geomap Company Cross Section 15-770 A-A' shows the lower Tuscaloosa Group to onlap truncated Washita/Fredericksburg strata on the Sharkey Platform in northern Holmes County and Paluxy-age strata in Leflore County, Mississippi. Their Cross Section 15-320 A-A' shows the Tuscaloosa Group to onlap truncated Washita/Fredericksburg to Ferry Lake-age strata in Sharkey County, the Eutaw Group to onlap truncated Rodessa to Sligo-age strata in Sharkey County, and the Selma Group to onlap truncated Hosston strata in Sharkey and Issaquena counties, Mississippi. Both geological cross sections are marked with a revision date of March 1981. From these sections, it could be argued that the Sharkey Platform had been largely eroded by Selma time and only the portion spared from the Eutaw onlap was a possible source of clastic sediments. For this reason, the source of sand in the Jackson Gas Rock is attributed here largely to the truncated pre-Selma strata of the Jackson Dome.

Not all of the sediments eroded from the Jackson volcanic island were washed out to sea. Some sediments remained within the island's interior depressions and lakes. Monroe (1954, p. 15) recognized a 100-foot, sedimentary section of probable Late Cretaceous age beneath the Gas Rock and conformably overlying igneous agglomerate and ash in the Louisiana Gas & Fuel Co. #1 Harris and Jackson Oil & Gas Co. #1 Taylor in Hinds County and the Gulf #1 Rainey in Rankin County. This interval contained beds of sandstone and dark-brown and gray carbonaceous clay and was interpreted as lacustrine deposits preserved within the remnants of crater lakes. Monroe (1954, p. 45-46) described cores from the Gulf #1 Rainey well where pre-Gas Rock "lake" deposits extended from 2,837 to 2,988 feet and contained sloping sedimentary beds with bedding dips of 20° to 30° between 2,912 to 2,936 feet above a coarsely crystalline igneous rock at 2,936 to 2,940. Below the igneous rock and above altered igneous rock at 2,988 feet, the bedding was almost horizontal.

The Jackson Dome continued to rise in relation to its surroundings in Tertiary time. This uplift is most profoundly seen in the early Tertiary strata of the Porters Creek Clay and overlying Wilcox Group. Seismic lines B and F (figures 3 and

7) show the Porters Creek, the section between the top of the Jackson Gas Rock and the base of the Wilcox Group, to thin over the Jackson Dome. Lower Paleocene reflectors in seismic line E of figures 6 and 8 onlap the Gas Rock on the dome's southwestern flank. In line F of Figure 7, a wedge of several lower Wilcox reflectors merge on the dome's southern flank. Prather et al. (1998) describe similar seismic features in the intraslope basins of the Gulf of Mexico as convergent-thinning facies. They note that convergence usually occurs on the flanks of basins (or at Jackson, the flank of a dome).

The uplift of the Jackson Dome continued even into late Tertiary times, as is evident by the present-day outcrop of Tertiary units at Jackson and by cross sections at Jackson of Eocene to Miocene (Catahoula Formation) units by Moore (1965, plates 2 and 3). Uplift of the dome during a sea-level highstand in the Late Eocene may have sent sea-floor sediments, comprised of Yazoo Clay, on a slow slide downslope. Mass flows within the Yazoo are evidenced by the rotated, en echelon faults exposed in the Miss Lite clay pit north of Jackson (see Priddy, 1960, p. 40, fig. 9, and Dockery and Siesser, 1984, fig. 1-3). Such flows can be seen today in the deep waters of the Gulf of Mexico (Prather et al., 1998, fig. 13). The Jackson Dome may even be on the rise today. An earthquake attributed to the Jackson area (Bograd, 1981) occurred in 1927 and shook houses as far as Meridian.

FAULTS AND PLUTONIC STRUCTURES

It is unlikely that the uplift and removal of some 10,000 feet of Cretaceous (and perhaps some Jurassic) strata over the crest of the Jackson Dome was accomplished without major faulting. In general, the seismic lines show a regular flexure of pre-Selma strata, bending upward on the dome's flanks. Though many small fault-related structures were seen on these lines, only one significant fault was seen to cut Cretaceous rocks.

A possible fault seen on seismic line F of Figure 7 cuts prominent reflectors, including base of the salt, lower Haynesville, and the top of Ferry Lake. These reflectors show a slight roll on the south side of the fault and disappear on the north side. This fault ties at depth into a structure interpreted as an igneous stock. The stock is capped by a strong reflector and is largely absent of internal reflectors, a feature in strong contrast to the layered reflectors found in the sedimentary sequences to the south. Also, reflectors of the sedimentary sequence adjacent to the stock's southern edge are strongly inclined. The igneous stock in line F was interpreted as such by both Blackwell and others. This interpretation is the basis for modifying the areal subcrop of the igneous plug in Figure 1 as opposed to its shape as published in Dockery et al. (1997, fig. 5).

A Skelly Oil Company top-of-the-Eutaw contour map provided by Charles Barton and dated as "11/62" claims to be based on both well and seismic data and shows the central and eastern part of the Jackson Dome, including several faults in the Jackson area. One unlabeled, east-west fault on the map cuts the Jackson Dome's southern flank south of Florence, Mississippi, intersecting the top of the Eutaw about 3 miles south of the Harris & Karges well shown in Figure 7. It is tempting to correlate this fault with the one shown on seismic line F, as both faults are down to the north. However, the fault on the Skelly map is a couple of miles to the south of the one shown on line F. The Skelly map shows six additional faults extending from the Eutaw subcrop on the dome's eastern flank and trending northwest to southeast away from the dome; the northernmost fault also extends northwest from the subcrop near the center of the dome's northern flank. These faults do not appear on the more recent Geological Consulting Services' Top of Eutaw map M304 as shown in Dockery et al., 1997, figure 5; however, the GCS map has a contour interval of 500 feet as opposed to the 100-foot interval of the Skelly map and may not have enough resolution to pick up faulting on the dome's flanks.

GEOTHERMAL RESOURCES

Geothermal gradients show the Jackson Dome to be more than a cold, dead structure. Welex Training Program's (© 1962) manual for electric log interpretation includes a contour map of geothermal gradients in the southwestern Gulf states (fig. 25, p. 33) based on bottom-hole temperatures of petroleum exploration wells. This map shows a high geothermal gradient of between 1.8° and 2.0°F per 100 feet along an area connecting Monroe, Louisiana, and Jackson, Mississippi. This gradient was calculated based on a mean surface temperature of 74°F, which is 9°F higher than that of the Jackson area.

Smith (1981, p. 41) recognized a general geothermal gradient of 25°C/km for water wells in northern Louisiana with anomalous gradients associated with the Monroe Uplift of 35-44°C/km and heat flow values up to 2.1 heat flow units (hfu), units measured as 10^{-6}cal/cm^{2}sec. A general gradient of 25°C/km equals 45°F/3,280.8 feet, or about a 1°F increase for each additional 73 feet in depth. To extrapolate this gradient to ground-water temperatures in Jackson area water wells, 1°F/73 feet should be added to the region's long-term, average, annual temperature of 65°F.

Bill Oakley of the U.S. Geological Survey, Water Resources Division, in Jackson provided data for the newly drilled Town of Raymond test well on the Hinds Community College campus in Section 21, T. 5 N., R. 2 W., Hinds County (located on the southwestern flank of the Jackson Dome). Water pumped for three days at 113 gallons/minute from a screened interval at 1,684-1,754 feet (1,719 feet mean depth) in the Sparta Aquifer (Kosciusko Formation) was measured at 37°C or 98.6°F. The model temperature for this depth is 88.5°F; thus, the aquifer is 10°F hotter than expected. This well could be used for water supply and, if tied to a heat pump at the well head, could heat a building along the way.

Gulf South Resources (originally drilled by Strahan in 1965) #2 Love Petroleum Fee in Section 36, T. 6 N., R. 1 E., Rankin

County, is on the crest of the Jackson Dome. A recent temperature measurement of a Wilcox aquifer from this well provided by Jay Cottingham was 90°F at 1,100 feet. This again is 10°F hotter than Smith's general gradient of 25°C/km would predict at this depth.

A recently drilled hot water well west of Jackson is the Cal Maine Foods well at Edwards, located in Section 13, T. 5 N., R. 4 W., Hinds County. This well has a 50-foot-long 6-inch screen set at 1,822 to 1,874 feet below the surface in the Sparta Aquifer and has a water temperature measured (by Oakley on October 12, 1998) at 99°F, or 9°F above the regional geothermal gradient.

Robert L. Steffey's Special Oil Scout Service report (v. 8, no. 193, April 14, 1930) of the Gulf #1 Rainey well in Section 13, T. 5 N., R. 1 E., Rankin County, reported the well at 2,500 to 2,520 feet to have flowed 10,000 barrels of "very hot salt water." A later report (v. 17, no. 467, August 5, 1932) gave the temperature of salt water from this well and heavy oil from the Love Petroleum Co. #1 Maley (two sections to the west) in Section 15, T. 5 N., R. 1 E., Hinds County, as 127°F. For both wells, this is 28°F higher than the model temperature of 99°F predicts for mean production depths of 2,510 and 2,494 feet, respectively. The August 5, 1932, Steffey report went on to note "phenomena of differences in temperatures of fluids out of the chalk" in that fluids from two dry holes in the Jackson Gas Rock to the north in the southeastern quarter of Section 35, T. 6 N., R. 1 E., Hinds County (the Louisiana Gas & Fuel Co. #1 Harris and the Jackson Oil & Gas Co. #1 Taylor) were cold in comparison.

The following are a sampling of relatively hot wells in the Jackson area as recorded in the U.S. Geological Survey well schedule reports; as the screened intervals in these wells are in sands somewhere above TD, the hotter-than-gradient figures are minimum values:

(1) USGS #N15, the King Edwards Hotel well on 235 W. Capitol Street in downtown Jackson, Section 3, T. 5 N., R. 1 E, Hinds County, which was recorded in 1945 as 32°C or 90°F at or above 1,446 feet TD (5°F hotter than gradient).

(2) USGS #H187, the Jackson Zoo well in Section 32, T. 6 N., R. 1 E., Hinds County, which was recorded in 1987 as 28.5°C or 82.5°F at or above 815 feet TD (6.7°F hotter than gradient).

(3) USGS #N84, the Filtrol Corp. Well #1 in Section 21, T. 5 N., R. 1 E., Hinds County, which was recorded in 1978 as 94°F at or above 1,604 feet TD (7°F hotter than gradient).

(4) USGS #H46, the Colonial Country Club well in Section 7, T. 6 N., R. 2 E., Hinds County, which was recorded in 1956 as 27.7° C or 82.5°F at or above 780 feet TD (7°F hotter than gradient).

(5) USGS #G64, a Clinton well in Section 21, T. 6 N., R. 1 W., Hinds County, which was recorded in 1963 as 29.3°C or 84.5°F at or above 903 feet TD (7°F hotter than gradient).

(6) USGS #L5, a Raymond well in Section 20, T. 5 N., R. 2 W., Hinds County, which was recorded in 1956 as 33.2°C or 89.7°F at or above 1,185 feet TD (8.7°F hotter than gradient).

(7) USGS #N56, a Jackson well in Section 10, T. 5 N., R. 1 E., Hinds County, which was measured by E. N. Lowe, once the State Geologist, in 1902 as 35.5°C or 96°F at or above 1,168 feet TD (15°F hotter than gradient).

In comparison to the "hot" wells above, the Cleve Love #1 Ridgway and McGehee (USGS #N25) in Section 2, T. 5 N., R. 1 E., Hinds County, which was measured in 1956 as 92.5°F at 1,800 feet and was featured as a "hot well" in Dockery et al. (1997), is only 3° hotter than the regional gradient.

CONCLUSIONS

The five seismic lines illustrated here, in interpreted form, show structural features of the Jackson Dome, which before could only be assumed by connecting stratigraphic tops of adjacent wells. These lines provide useful information concerning the dome's geologic history, including the following: (1) there is no evidence of thinning or truncation in the sedimentary sequence until middle Selma time in the Late Cretaceous, (2) pre-Selma formations do not pinch out on the dome's flank but are uplifted and truncated below the Jackson Gas Rock, (3) a thick lens of Selma-age clastic and carbonate sediments is deposited in a crescent-shaped trough along the dome's northern and western flanks, (4) seismic reflectors in the dome's peripheral trough show downlap surfaces indicating subaerial erosion of the dome in early Selma time and onlap surfaces indicating subsidence of the dome and marine transgression in late Selma time, and (5) uplift of the dome continued into Tertiary time.

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APPENDIX

Wells plotted on Figure 1. Tops not adjusted to sea level.

1. Jett Drilling Company & Dakamont Exploration Corp. #1 J. L. Gaddis, Jr., Section 6, T. 5 N., R. 2 W., Hinds County. Elevation: D.F. 240', G.L. 231'. Total Depth: 10,812'. Logged: 11-28-1955. Tops: Winona/Tallahatta 2,500', Wilcox 2,758', Porters Creek 4,950', Jackson Gas Rock 5,135', Base of Jackson Gas Rock 6,195', Eutaw 6,720'.

2. Texas Crude Oil Company #1 Hinds County, Section 4, T. 5 N., R. 2 W., Hinds County. Elevation: D.F. 268'. Total Depth: 11,004'. Logged: 2-21-1955. Tops: Winona/Tallahatta 2,385', Wilcox 2,674', Porters Creek 4,670', Jackson Gas Rock 4,798', Base of Jackson Gas Rock 5,750', Eutaw 6,430', Lower Tuscaloosa

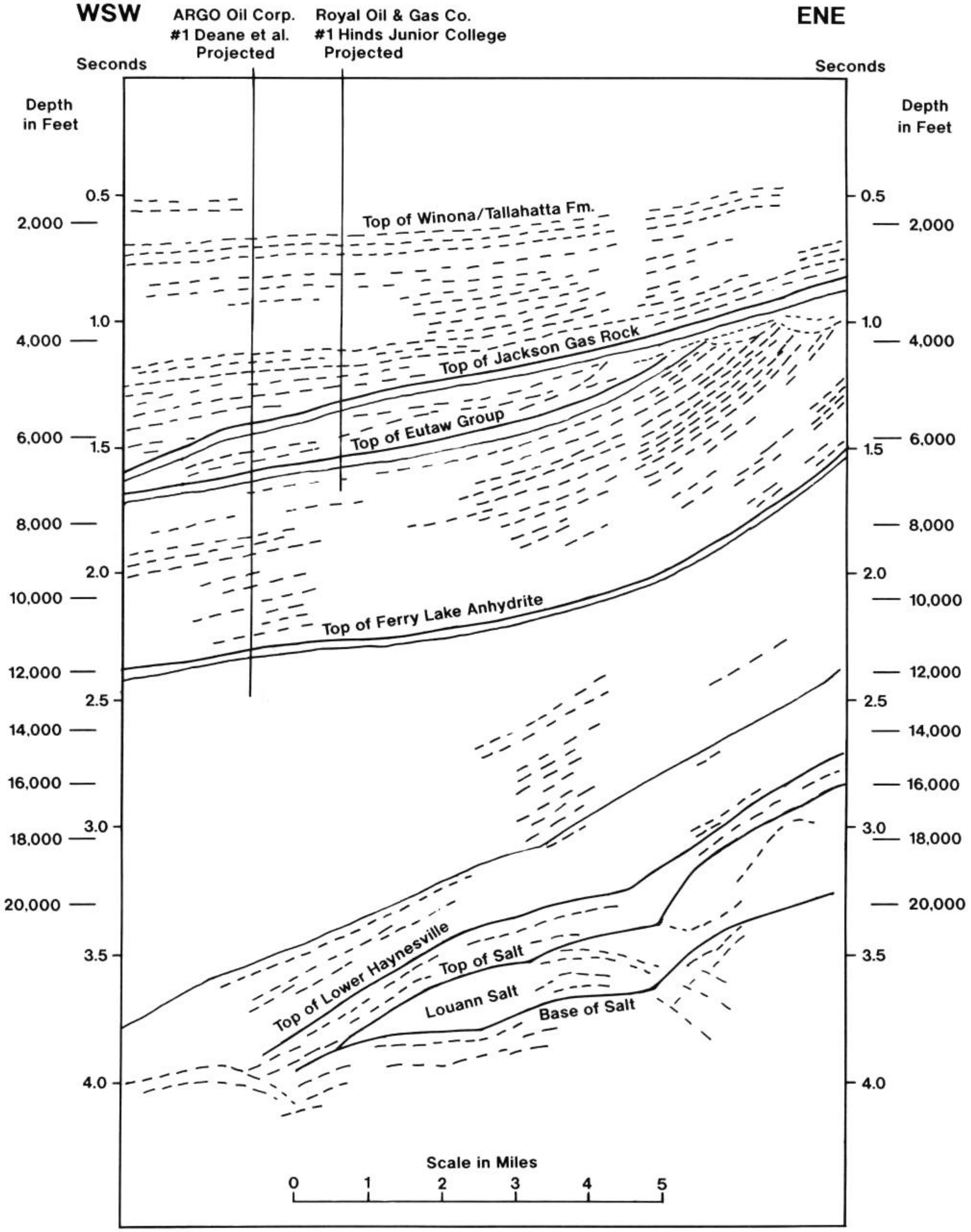

Figure 6. Seismic line E, showing the lenticular thickening of the Jackson Gas Rock adjacent to the Eutaw Formation's truncated subcrop at an angular unconformity with considerable relief. Depth is shown in feet below sea level.

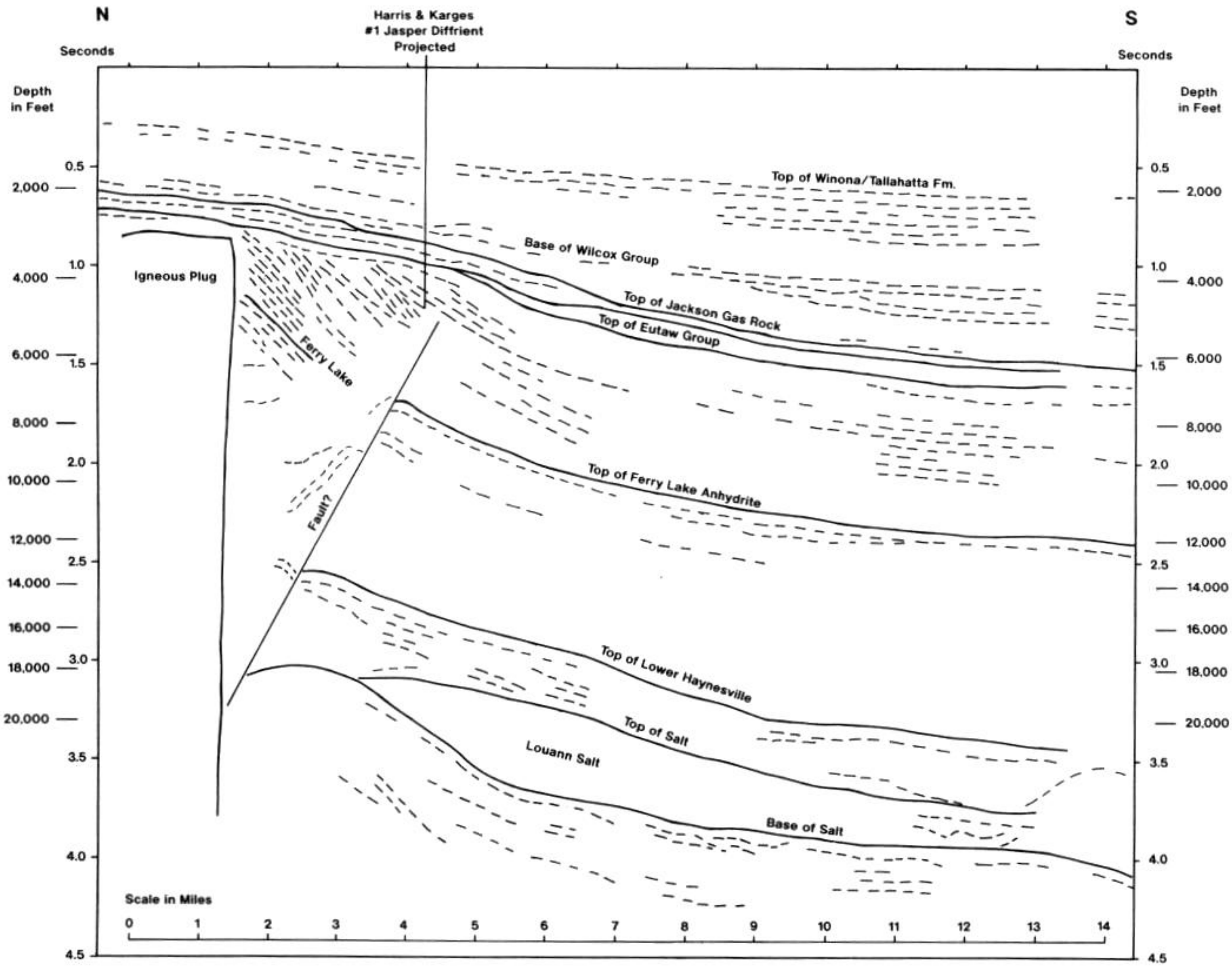

Figure 7. Seismic line F, showing an igneous plug and fault beneath the south Jackson area. Depth is shown in feet below sea level.

7,100'.

3. Getty Oil Company #1 Audrey W. Brand 11-5, Section 11, T. 5 N., R. 2 W., Hinds County. Elevation: K.B. 279.6', D.F. 278.6', G.L. 247.6'. Total Depth: 16,840'. Logged: 6-4-1980. Tops: Winona/Tallahatta 2,255', Wilcox 2,500', Porters Creek 4,190', Jackson Gas Rock 4,330', Base of Jackson Gas Rock 4,840', Eutaw 5,580', Lower Tuscaloosa 6,270'.

4. J. V. Canterberry #1 J. R. Ball, Section 7, T. 5 N., R. 1 W., Hinds County. Elevation: D.F. 365'. Total Depth 6,147'. Logged: 11-1-1944. Tops: Winona/Tallahatta 1,195', Wilcox 2,146', Porters Creek 3,585', Jackson Gas Rock 3,735', Base of Jackson Gas Rock 4,180', Lower Tuscaloosa 4,760'.

5. Kingwood Oil Company & Geo. E. Shaw #1 Lewis, Section 14, T. 5 N., R. 1 W., Hinds County. Elevation: D.F. 401'. Total Depth: 3,714'. Logged: 1-13-1947. Tops: Winona/Tallahatta 1,445', Wilcox 1,555', Porters Creek 2,820', Jackson Gas Rock 3,000', Base of Jackson Gas Rock 3,395'.

6. Ladd Petroleum Corp. #1-A Scribner, Section 20, T. 7 N., R. 1 W., Hinds County. Elevation: K.B. 233.8', D.F. 232.8', G.L. 223.8'. Total Depth: 5,025'. Logged: 6-7-1976. Tops: Winona/ Tallahatta 1,805', Wilcox 2,020', Porters Creek 3,510', Jackson Gas Rock 3,625', Base of Jackson Gas Rock 4,070'.

7. Johnson - Daniel Drilling Co., Inc. #1 Joel - Page, Section 3, T. 6 N., R. 1 W., Hinds County. Elevation: D.F. 251'. Total Depth: 3,442'. Logged: 6-28-1969. Tops: Winona/Tallahatta 1,377', Wilcox 1,500, Potters Creek 2,730', Jackson Gas Rock 2,660', Base of Jackson Rock 3,270'.

8. Wil-Ken Inc. Transco Exploration Co. #1 Gaddis McLaurin Inc. Unit 7-10, Section 7, T. 7 N., R. 2 W., Hinds County. Elevation: K.B. 281.8', D.F. 280.0', G.L. 275.0'. Total Depth: 6,898'. Logged: 9-6-1978. Tops: Winona/Tallahatta 2,295', Wilcox 2,595', Porters Creek 4,775', Jackson Gas Rock 5,175',

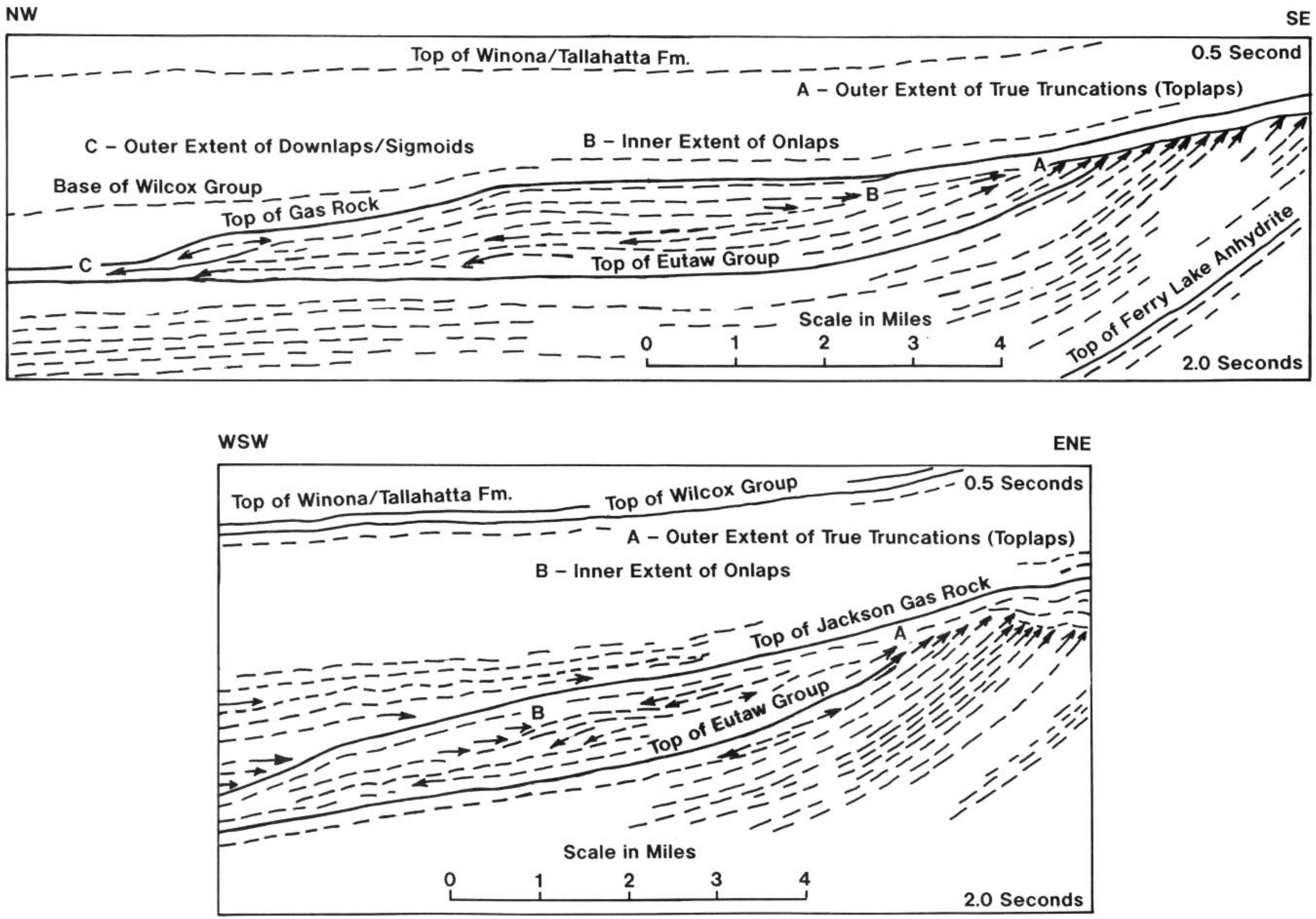

Figure 8. The Gas-Rock sections of seismic lines B (top) and E (bottom) showing downlap reflectors (surfaces indicating erosion and prograding deposition) and onlap reflectors (surfaces indicating marine transgression) associated with the sedimentary trough peripheral to the Eutaw Formation subcrop. Datum at top and bottom of each line is 0.5 and 2.0 seconds, respectively.

Base of Jackson Gas Rock 6,250', Eutaw 6,755'.

9. PECO of Mississippi, Inc. #1 Covington, Section 22, T. 6 N., R. 1 W., Hinds County. Elevation: not listed Total Depth: 2,716'. Logged: 3-24-1970. Tops: Winona/Tallahatta 1,265', Wilcox 1,560', Porters Creek 2,610', Jackson Gas Rock 2,780'.

10. X. M. Frascogna, Collins, Wohner, et al. #1 Lancaster-McAlpin Unit, Section 29, T. 6 N., R. 2 W., Hinds County. Elevation: D.F. 275'. Total Depth: 10,819'. Logged: 9-6-1965. Tops: Winona/Tallahatta 2,320', Wilcox 2,595', Porters Creek 4,585', Jackson Gas Rock 4,676', Base of Jackson Gas Rock 5,720', Eutaw 6,400', Ferry Lake Anhydrite 10,550'.

11. John Franks, Meyre & Lanius, et al. #1 Gaddis Farms, Section 28, T. 6 N., R. 2 W., Hinds County. Elevation: D.F. 265'. Total Depth: 12,017'. Logged: 12-8-1958. Tops: Jackson Gas Rock 4,560', Base of Jackson Gas Rock 5,405', Eutaw 6,200'.

12. ARGO Oil Corp. - K. S. Briggs & O. D. Brame #1 A. N. Deane et al., Section 32, T. 5 N., R. 2 W., Hinds County. Elevation: D.F. 291'. Total Depth: 13,110'. Logged: 5-6-1960. Tops: Winona/Tallahatta 2,540', Wilcox 2,840', Porters Creek 5,400', Jackson Gas Rock 5,770', Base of Jackson Gas Rock 6,490', Eutaw 7,050'.

13. Royal Oil & Gas Co. #1 Hinds Junior College, Section 33, T. 5 N., R. 2 W., Hinds County. Elevation: D.F. 361.3'. Total Depth: 7,648'. Logged: 5-18-1940. Tops: Winona/Tallahatta 2,600', Wilcox 2,870', Porters Creek 5,120', Jackson Gas Rock 5,318', Base of Jackson Gas Rock 6,065', Eutaw 6,920'.

14. James W. Harris & H. E. Karges #1 Jasper Diffrient, Section 10, T. 4 N., R. 1 E., Rankin County. Elevation: K.B. 279', D.F. 278', G.L. 274'. Total Depth: 5,030'. Logged: 3-1-1965. Tops: Winona/Tallahatta 1,675', Wilcox 1,830', Porters Creek 3,320', Jackson Gas Rock 3,450', Base of Jackson Gas Rock 3,898', truncated (upper 90' missing) Eutaw 3,898'.

15. Larco Drilling Co., Toler, & Bryant - #1 W. C. Hemphill, Section 20, T. 4 N., R. 1 E., Rankin County. Elevation: D.F. 285', G.L. 275'. Total Depth: 10,755'. Logged: 8-4-1956. Tops: Winona/Tallahatta 2,010', Wilcox 2,220', Porters Creek 4,270', Jackson Gas Rock 4,590', Base of Jackson Gas Rock 4,825', Eutaw 5,610', Ferry Lake Anhydrite 10,440'.

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