THE DEPARTMENT OF ENVIRONMENTAL QUALITY

mississippi geology

Office of Geology
P. O. Box 20307
Jackson, Mississippi 39289-1307

Volume 18, Number 3
September 1997

THE JACKSON VOLCANO

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INTRODUCTION

One of the most interesting geologic features of Mississippi is the Jackson Volcano, which rests only 2900 feet beneath the state's capital city. The volcano's dense core forms one of the most prominent structural anomalies found on gravity and magnetic surveys of the state, showing tightly wrapped contours of increasing gravity and magnetic deflection like a crowded bull's-eye (Figure 1). This igneous complex and the uplifted formations around it comprise a structure known as the Jackson Dome. Northwest of the Jackson Volcano in southern Humphreys County is the Midnight Volcano and the associated volcanic terrain of the Sharkey Platform. Dense igneous rock below Jackson and Midnight increase the force of gravity slightly as shown in Figure 1. A person tipping the scales at Jackson or Midnight would be slightly heavier than elsewhere in the state (if anyone would like to use that for an excuse).

No other capital city or major population center is situated above an extinct volcano, even though the recent movie "Volcano" fictitiously placed Los Angeles, California, above one. Monroe, Louisiana, is Jackson's sister city in being a close second, as it rests above a volcanic terrain known as the Monroe Uplift. However, the position of Jackson's downtown district above the throat of an extinct Cretaceous volcano seems to be unique. If the Jackson Volcano were to ever vent itself in the future, the Coliseum would be near ground zero. The Coliseum is a landmark for those traveling Interstate 55 through Jackson and should serve as a geologic reminder of the buried volcanic peak below.

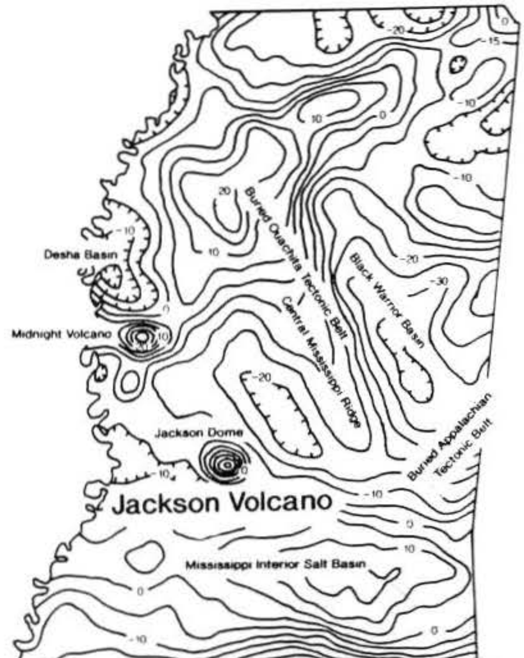

Figure 1. Gravity map: simple Bouguer anomaly map of Mississippi modified from Jurick (1989, p. 88). Contour interval is 5 mgal.

Movies such as "Volcano" and "Dante's Peak" have renewed public interest in the volcano under Jackson. The Jackson Volcano was front-page news in a report by Bruce Reid for the January 17, 1997, edition of the *Clarion-Ledger* (Jackson, Mississippi) and was the substance of a political cartoon by Marshall Ramsey the following day. Reid's article was reprinted in several other Mississippi papers. Before the premier of "Dante's Peak," Biloxi's WLOX featured a report by Josh Wilson on the Jackson Volcano in its February 7, 1997, evening news, which was aired in Biloxi, Columbus, Meridian, and Greenville. The opening of the movie "Volcano" prompted a report by Ken South on WJTV's evening news, aired in the Jackson metropolitan area on April 26, 1997. Both reports were staged along Interstate 55 at the Pearl Street exit with the Coliseum and Jackson skyline in the background. These footages were ominously mixed with movie clips of exploding volcanoes, lava, and public panic.

This paper is an up-to-date summary of an ongoing project that will incorporate seismic data in an attempt to unravel the geologic history of the Jackson Dome. Hughes (1993) chronicled the early exploration of this structure in the late 1920s and the 1930s, including a photograph of a blowing gas well at the present location of Jackson Mall. Exploration fever was so great in those days that even the State of Mississippi got into the action with State Fee wells 1 through 9. The target of this exploration was the Jackson Gas Rock, a largely Maastrichtian algal reef, which is structurally high over the Jackson Dome but is thickest on the dome's north and northwest flank as shown by Marvin Oxley's (first published here) isopach map of the gas rock in Figure 2.

The asymmetry of the gas rock is probably due to ancient currents flowing northwestward from the Gulf and into the Western Interior as far north as Alaska. Such currents may have eroded uplifted Cretaceous and Jurassic units on the Jackson Dome in Maastrichtian time producing the sands deposited as the Woodruff Sand in Tinsley Oil Field, the field's first producing sand.

The structural-dip (south-southwest to north-northeast) cross section A-A' of Figure 3 was inspired by an earlier unpublished cross section by Millsaps College students, which contained 12 unnamed wells in a nearly straight line that extended 76 miles from Crystal Springs in Copiah County, through Jackson in Hinds County, to Pickens in Madison County. A discussion of this cross section and associated block diagram is found in McAtee (1960). Figure 3 contains 15 wells that extend some 58 miles from Terry (Hinds County) to Pickens. These wells and their stratigraphic contacts (tops) are given in Appendix 1. The Ferry Lake Anhydrite, which is not recognized north of Gluckstadt in Madison County, is not shown on the northeastern flank of the Jackson Dome.

The west-east (approximate structural strike) cross section B-B' of Figure 4 is a modification of an unpublished cross section entitled "Cross Section: Hinds-Rankin County, Mississippi," which was prepared by Charles Barton for Skelly Oil Company (dated as November 1957). This section includes 11 wells, given in Appendix 2, which extend some 45 miles across Hinds and Rankin counties, passing just north of the volcanic neck. Well 8 of cross section B-B' is the same as well 6 of cross section A-A'.

Figure 5 is a subcrop map of stratigraphic units truncated below the Jackson Gas Rock as modified (with permission) from Geological Consulting Services' map: "Top of Eutaw M304." This subcrop pattern seems reliable though there are others which differ in the details. Cross section B-B' of Barton in Figure 4 would extend the subcrop farther to the east within the area of Township 5 North and Range 2 East of Rankin County.

The Cotton Valley Group is some 10,000 feet high above regional dip at Jackson with an equal thickness of Cretaceous strata eroded from above it (see Figure 3). If the missing Cretaceous section had been domed above sea level intact, the Jackson Island would have been 10,000 feet above sea level plus the height of the volcanic vent. This is not likely but suggests that Jackson was once an island with as much relief as any in the Caribbean today. The Jackson and Midnight volcanoes were part of a broader group of volcanoes that sprang up in Cretaceous times.

CRETACEOUS RIM OF FIRE IN THE NORTHERN GULF

The Cretaceous Period between 144 and 65 million years ago was a time of widespread volcanic activity, including many of the explosive, diamond-bearing, kimberlite pipes such as those in West Africa and one at Murfreesboro, Arkansas. This episode of volcanism was responsible for many of the plateaus and sea mount chains of the western Pacific, Indian, South Atlantic, and Caribbean oceans (Larson, 1995). Close to home was a Cretaceous rim of fire in the northern Gulf. Radiometric analyses of volcanic rocks from Arkansas and Mississippi show an episode of volcanism within the Mississippi Embayment from 106 to 69 million years ago, the latest of which was at Jackson, Mississippi.

The anomalous volume of volcanic rock extruded worldwide during the mid-Cretaceous has been attributed to the release of vast amounts of heat from deep within the planet in the form of "superplumes" (Larson, 1995). Such "overheated" plumes have an episodic record in Earth history and are responsible for massive outpourings of basalt (i.e. the Paraná Basalts of Brazil, the Deccan Traps of western India, and the Siberian Traps of northern Russia).

During the mid-Cretaceous volcanic episode, an equatorial seaway, the Tethys Sea, covered southern North America, North Africa, Europe, and central Asia. This seaway was split by the growing North Atlantic, leaving two remnants, the Gulf of Mexico in the west and the Mediterranean in the east. However, volcanoes in the northern Gulf fell silent 69 million years ago, while tectonic deformation continued in the Mediterranean with the thrusting of the Alps, Himalayas, and other

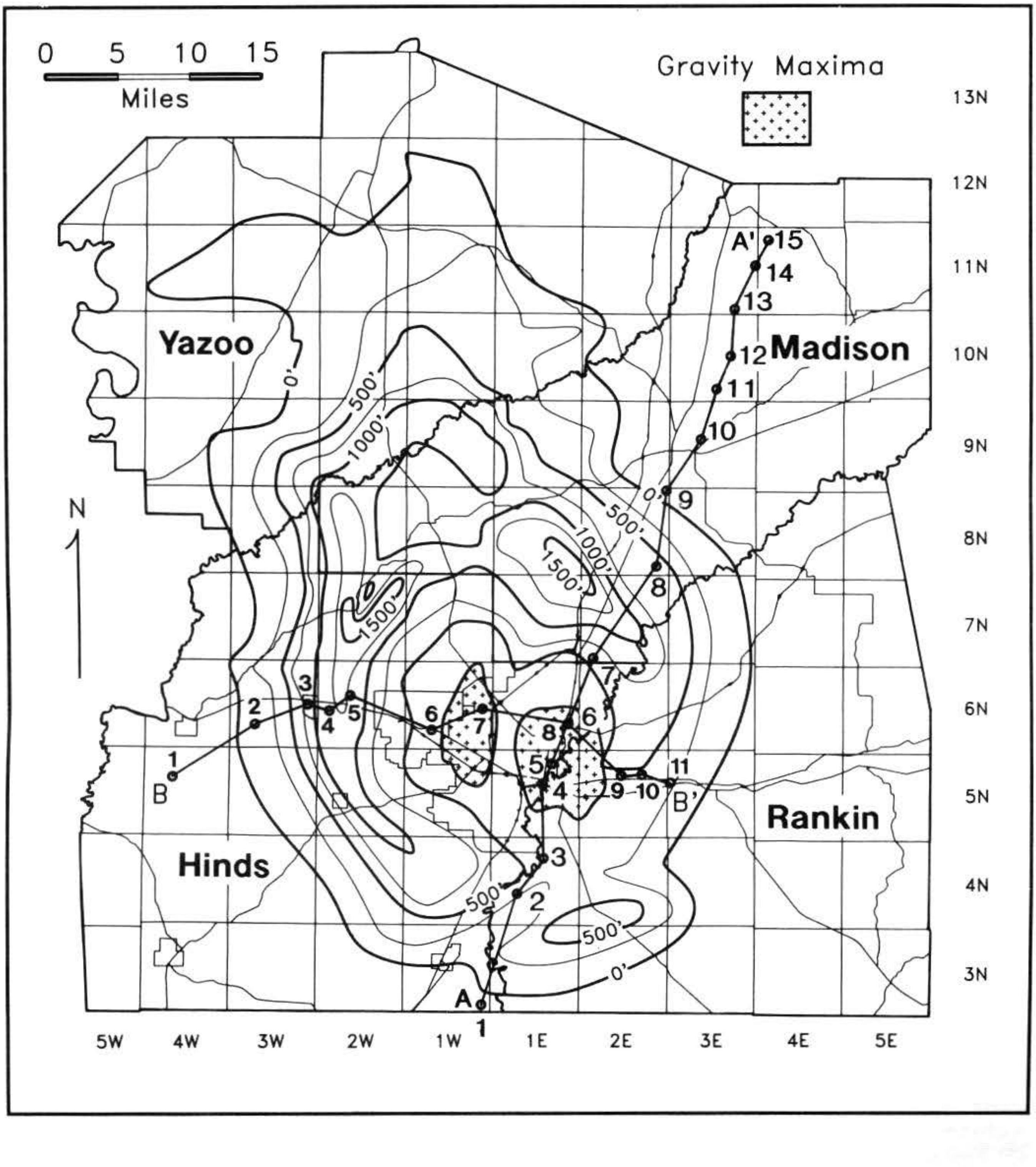

Figure 2. Isopach of the Jackson Gas Rock modified from Marvin Oxley (unpublished) showing cross sections A-A' and B-B'. Shaded areas show local gravity maxima.

mountain ranges of Europe and Asia and with active volcanoes such as the today's Vesuvius and Stromboli of Italy. This volcanic activity is attributed to the collision of the African and Indian plates with Europe and Asia.

The Cretaceous Gulf margin resembled its present-day Mediterranean sister in having a rim of volcanic islands and sea mounts that extended from Mexico to Mississippi. In the northwestern Gulf, the Balcones Volcanic Province was 80 km wide and 400 km long, extending from the Rio Grande Embayment to central Texas (Byerly, 1989). Here, submarine volcanism formed over 200 tuff mounds, sometimes called "serpentine plugs," and related intrusive bodies (Hunter and Davies, 1979). This activity peaked during deposition of the upper Austin and lower Taylor Groups about 80 million years ago (Ewing and Caran, 1982; Hutchinson, 1994).

Volcanism in the north-central Gulf occurred in a vast seaway that occupied the Mississippi Embayment. Here, volcanoes rose above the ocean surface and formed volcanic terrains to the north in southern Arkansas and as far south as Door Point off the mouth of the Mississippi River in southeastern Louisiana (Braunstein and McMichael, 1976). Late Early to early Late Cretaceous igneous rocks exposed in southern Arkansas include the 97 to 106 million-year-old, Murfreesboro lamprophyre, the 95 to 103 million-year-old Magnet Cove carbonatite, and the 86 to 91 million-year-old Little Rock syenite (Byerly, 1989). The Murfreesboro lamprophyre includes explosive volcanic pipes containing diamonds, and the carbonatite complex of Magnet Cove contains an exotic array of rare minerals. Saunders and Harrelson (1992) suggested a similar carbonatite complex may underlie the Jackson Dome.

A triangular array of volcanic terrains sprang up in the central region of the Mississippi Embayment during the Late Cretaceous. These include the Monroe Uplift, the Sharkey Platform, and the Jackson Dome. Igneous rocks were discovered at the core of the Jackson Dome in the early 1930s when the structure was drilled for oil and gas (Monroe and Toler, 1937). At Jackson, these rocks occur 2900 feet below the surface and have reported ages ranging from 69 to 79 million years old (Saunders and Harrelson, 1991).

JACKSON DOME VOLCANICS

Early volcanic activity at Jackson may have been a source for detrital volcanic rock fragments, which were diagenetically altered to form the "ash" beds in the lower Tuscaloosa of southwestern Mississippi (Hersch, 1987; Saunders, 1993, p. 72). However, the volcano certainly came to life in early Selma time as rising magmas beneath Jackson lifted the sea floor above sea level. The Jackson area remained above sea level until truncated in the late Maastrichtian during a sea level highstand. Figure 5 shows subcropping units beneath an erosional surface of late Selma age. Capping this surface is the Jackson Gas Rock, an algal limestone (Figure 6) of Maastrichtian age (McKibben, 1988).

Judging from the limits of the Eutaw subcrop, the Jackson island included a 184-square-mile area from Tougaloo in the north to Elton Road in the south and from Clinton in the west to Pearl in the east. The igneous core of the volcano underlies downtown Jackson and is centered about the Mississippi Coliseum. The beginning of the Jackson uplift roughly correlates with the age of commercial upper Eutaw bentonites mined at Aberdeen, Mississippi. However, these bentonites may have been derived from ash falls coming from eruptive events on the Sharkey Platform as noted by Merrill (1983).

Saunders and Harrelson (1992) reported the K-Ar geochronology of igneous rocks in the Gulf #1 Rainey and Gulf #1 Hamilton on the Jackson Dome in Rankin County as ranging in age from 79.0±2.9 to 69.2±2.9 million years old. One of the best records of igneous activity at Jackson is found in the State #2 Fee exploratory well. As shown in well #6 of Figure 3, the State #2 Fee encountered extrusive igneous rock at 3068-3205 feet, having a radiometric age of 75±2 million years old, intrusive igneous rock at 4770-4839 feet with an age of 73.0±1.9 m.y., intrusive igneous rock at 5040-5073 feet with an age of 75±1.9 m.y., and intrusive igneous rock at 5468-5482 feet with a different chemistry than those above and an age of 101±3 m.y. (Jack Henderson, unpublished well log; data from Geochron Laboratories, Cambridge, Massachusetts).

Igneous intrusives of the Jackson Dome are not known to breach the Jackson Gas Rock, suggesting the buried volcano has been extinct since the Late Cretaceous. However, the Paleocene Porters Creek Formation thins dramatically over the dome and other Tertiary formations through the Oligocene Vicksburg Group are uplifted. Some have cited differential compaction and the draping of sedimentary formations over an incompressible igneous plug to explain the relative uplift of Tertiary rocks at Jackson. However, continued deep-seated igneous activity in the late Tertiary would explain both the uplift and the source of heat required to generate the oil found in uplifted Wilcox and Sparta beds of Eocene age.

HEAT FLOW NEAR THE JACKSON VOLCANO

In a survey of wells from Florida to Louisiana, Smith (1981), Smith et al. (1981), and Smith and Dees (1982) found the highest heat flow values (up to 2.1) associated with the igneous intrusives of the Monroe Uplift in northern Louisiana. In these studies, no wells at Jackson, Mississippi, were measured. Jarrett (1982) would later find the highest measured heat-flow value (3.24) in the Gulf Coastal Plain on the southeastern flank of the Jackson Dome in a Rankin County water well near Star (Central Rankin Water Association, U82, Section 14, T. 3 N., R. 2 E.).

Another interesting water well was originally drilled as a gas test near the location of well #5 in Figure 3. The Cleve Love #1 Ridgway and McGehee, which is near the center of the Jackson Dome, is located on the northeast corner of Larson and

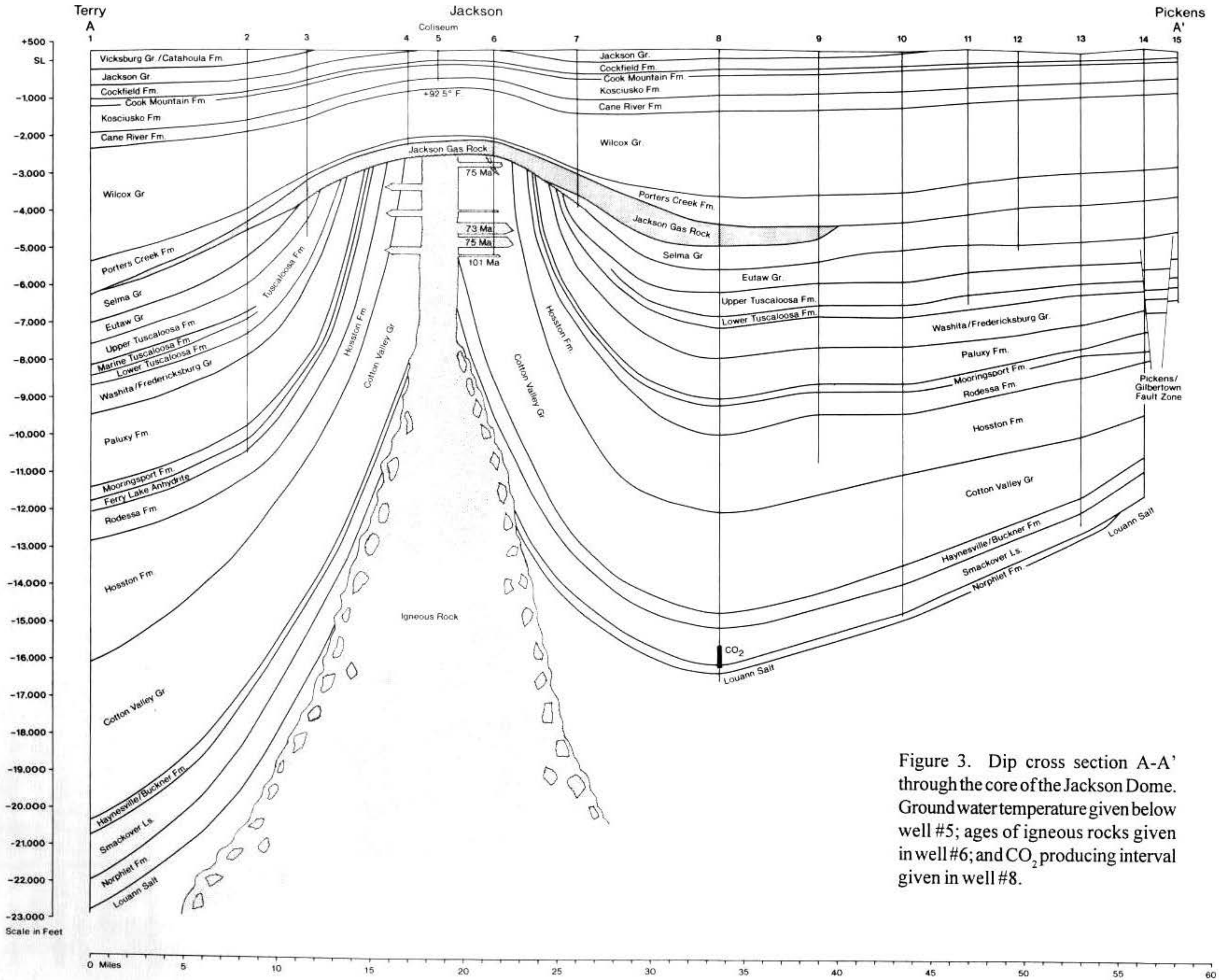

Figure 3. Dip cross section A-A' through the core of the Jackson Dome. Ground water temperature given below well #5; ages of igneous rocks given in well #6; and CO_2 producing interval given in well #8.

High Street in the SW/4, NW/4, NW/4, SE/4, SE/4, Section 2, T. 5 N., R. 1 W., Hinds County. It was drilled to a total depth of 2367 feet in the Jackson Gas Rock on August 23, 1930. With the gas test unsuccessful, the driller lowered several sticks of dynamite to a depth of 1800 feet and blew the 8-inch casing open opposite the Meridian Sand Aquifer. The resulting, flowing artesian well was used as a water supply for an above-ground swimming pool, which operated as Crystal Pools (owned by Taylor Parson) from 1935 to 1937.

Tom Spengler of Jackson (personal communication, February 20, 1997) swam in this pool as a child along with other neighborhood kids. Admission for those not having season passes was 15 cents. The water had a sulfur taste, and the pool was closed before World War II.

When the well was tested by Ernie Boswell of the U.S. Geological Survey on November 30, 1956, its static water level was 19.8 feet above ground level, and the water temperature was 92.5 degrees. John Marble and Wilbur Baughman of the Mississippi Geological Survey opened the well's valve during construction of a sewer line in the summer of 1975. It flowed gassy water that burned when lit. The well is now plugged and under the parking lot of Shoney's Restaurant.

MAGMATIC GAS HALO AROUND JACKSON

Thermal energy and gases released from Cretaceous magmas at the core of the Jackson Dome produced a broad halo effect (skewed updip to the northeast) around the structure, charging reservoir rocks in the Smackover Limestone, Norphlet Sandstone, and Cotton Valley Group with H_2S and CO_2. Heating of anhydrite in the Buckner Formation charged the Smackover Limestone on the Jackson Dome's southeastern flank with H_2S. A mixture of H_2S and natural gas is produced in the Thomasville, Piney Woods, Southwest Piney Woods, Harrisville, and Johns fields. This gas was once piped to Shell's Thomasville and Pursue Energy's Piney Woods plants, where it was used to produce sulfur and natural gas. Now the Thomasville Plant, bought from Shell by Pursue, handles all the gas.

Over-pressured gas has made exploration risky in the sour-gas fields on the Jackson Dome's southeastern flank. Here a wildcat well near Piney Woods, the Shell #1 Cox, surprised geologists with high-pressured, sour gas in the Jurassic at 21,122 feet. The well was spudded on July 21, 1969, and blew out on March 25, 1970. High-pressured gas invaded the shallow aquifers and blew the pump out for the water well that supplied water for drilling activities. A worker died of an apparent heart attack during the event.

Monitor wells were drilled to bleed gas from the local aquifers, and Shell bought the forty-acre tract around the burned-out well. The well eventually bridged itself, and the flow of gas stopped. However, it would be a full year before another drilling rig intercepted the well and sealed it with cement (Monty White, Pursue Energy, personal communication). The Piney Woods Field discovery well, the #2 Cox, was spudded on May 3, 1970, and completed on June 4, 1973. It produced sour gas and methane from the Smackover at 18,795-18,810 feet and had a bottom hole temperature of 320 degrees Fahrenheit.

The volume of gas that invaded local aquifers from the # 1 Cox blowout was impressive. The Shell #2 Shell-Cockfield monitor well in Section 28, T. 3 N., R. 3 E., Rankin County, was completed May 26, 1970, and produced one million cubic feet of gas per day from a two-foot interval at 1317-1319 feet with a tubing pressure of 350 pounds per square inch on a 27/64ths-inch choke. The Shell #5 Shell-Sparta in the same section was completed on July 4, 1973, and produced 583,000 cubic feet of gas per day from 1495 feet with a tubing pressure of 285 pounds on a 25/64ths-inch choke.

Several other monitor wells also produced respectable volumes of gas from shallow aquifers. There were probably many anxious moments for the monitor-well drillers. John Marble remembers arriving to log one monitor well as the drill crew was fleeing the rig expecting it to blow. They had panicked at the smell of H_2S bubbling from their drilling mud. Fortunately, most of the gas produced from the shallow aquifers was methane. The sour gas probably reacted with iron in the ground water and sediments to form pyrite.

The discovery well for the Johns Field, the Caley T. Jones 33-10 #1, was spudded on January 11, 1980, and completed October 17, 1980. Later this well would blow out during a work over, driving the owner to bankruptcy.

East-northeast of Jackson, CO_2 is produced from Smackover Limestone in the Pisgah and Holly Bush fields. This gas may be of magmatic origin. Hern and Lundy (1991) measured delta ^{13}C for CO_2 from the Goshen Springs Field as -7.4 and the delta ^{13}C for the Smackover Limestone as +4.4 and determined the source of CO_2 to be something other than heating of the limestone. CO_2 from the Pisgah and Holly Bush fields was once piped as far south as McComb to re-pressurize the old McComb, Mallalieu, and Little Creek oil fields. Now it's primarily used in the making of dry ice to quick freeze processed chickens. Other fields northeast of Jackson include Loring Field southeast of Pickens and the Texas Pacific #1 Yandell (well #8 of Figure 3), which produced two and a half million cubic feet of gas (98.2% CO_2) per day with 2100 pounds of flowing pressure on a 9/16ths-inch choke.

Northwest of the Jackson Dome, CO_2 in the Smackover Limestone increases toward Jackson from the Tchula Field (Larry Baria, personal communication). Tchula Field contains a trace of H_2S and 28% CO_2. Two miles closer to Jackson, the South Tchula Field contains 2% H_2S and 30% CO_2. Six miles closer to Jackson, the Thornton Field contains 19% H_2S and CO_2. Even closer to Jackson in the Cotton Valley Group, the Shell #1 White in Section 33, T. 8 N., R. 3 W., Hinds County, tested eight million cubic feet of CO_2 a day.

The Jackson Dome continued to produce gas long after

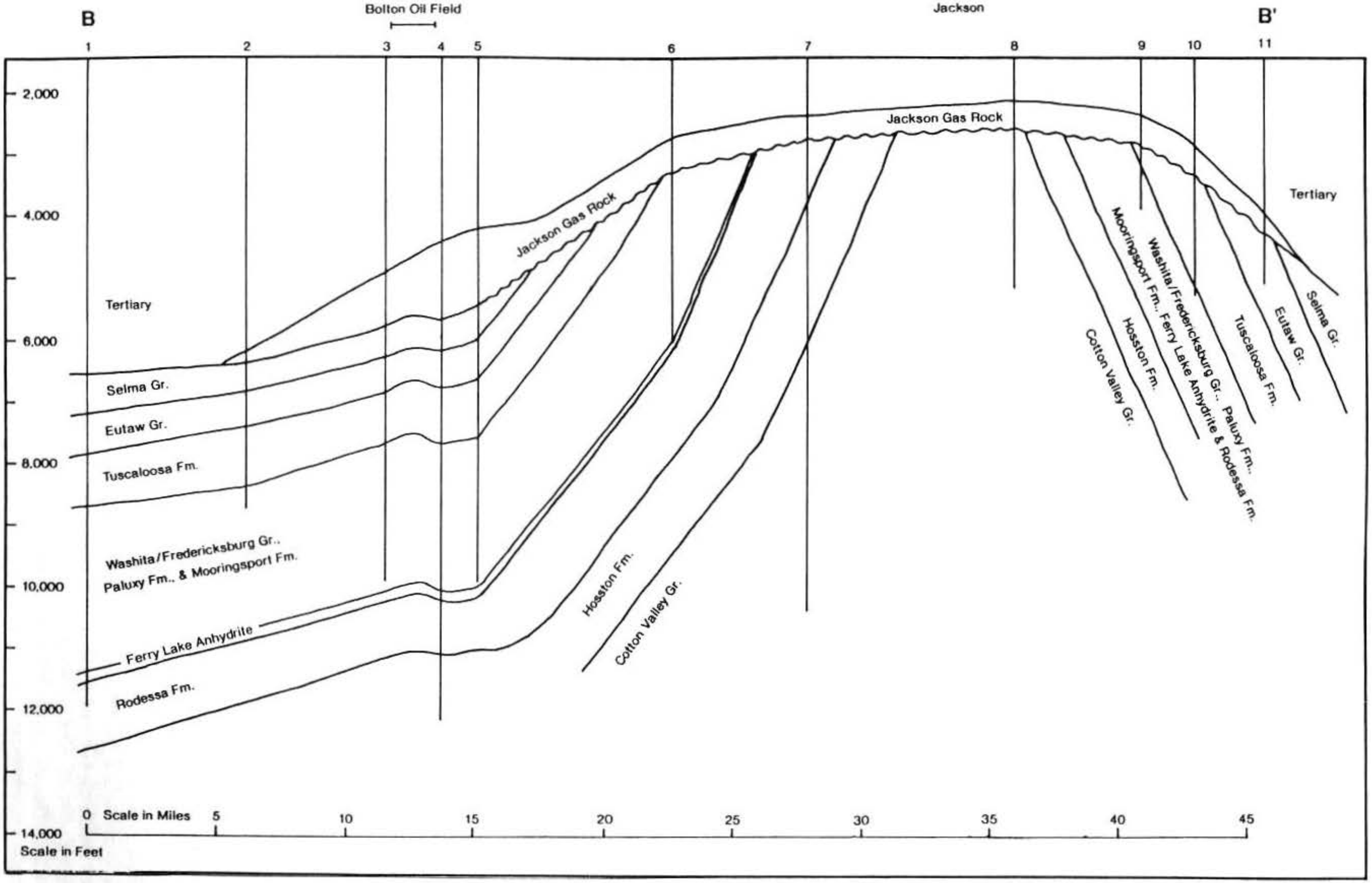

Figure 4. West-east (about strike) cross section B-B' across Hinds and Rankin counties; modified from an unpublished section prepared by Charles Barton for Skelly Oil Company (dated November 1957).

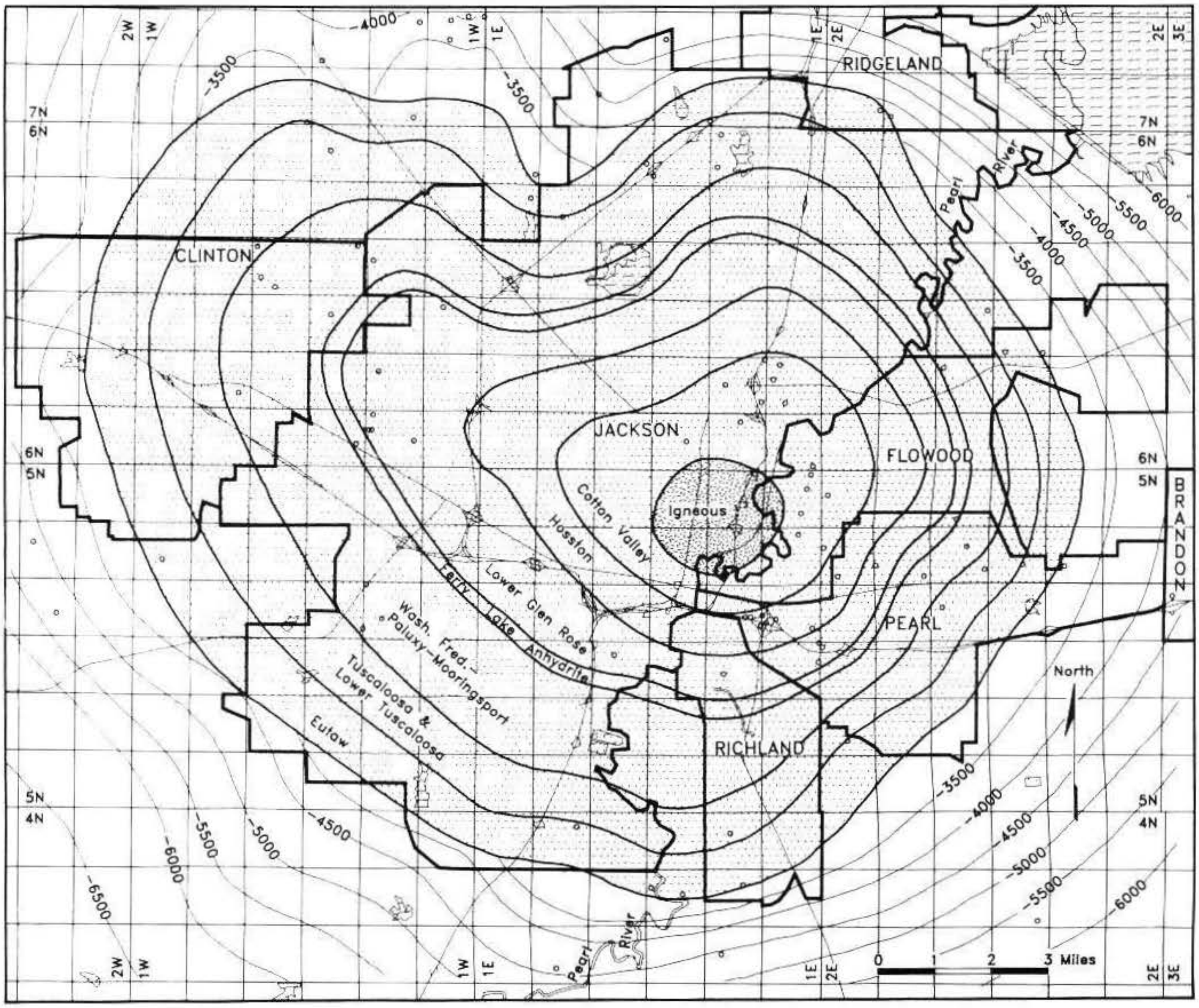

Figure 5. Subcropping units below the Jackson Gas Rock; modified from Geological Consulting Services' Top of Eutaw map M304.

active volcanism ended in the late Cretaceous. In early Tertiary times after deposition of the Porters Creek Clay, residual heat in the Jackson Dome cooked hydrocarbons, probably from Jurassic source rocks, to produce the gas trapped in the Jackson Gas Rock. Zimmerman and Sassen (1993) attributed the source of gas in the Monroe Gas Rock of similar age to the lower Smackover Limestone.

ACME OF MAJOR UPLIFT AND VOLCANISM AT JACKSON

Figure 5 shows the subcrop of the Jackson Dome at the angular unconformity below the Jackson Gas Rock. If the maximum relief of the dome above the surrounding sea floor

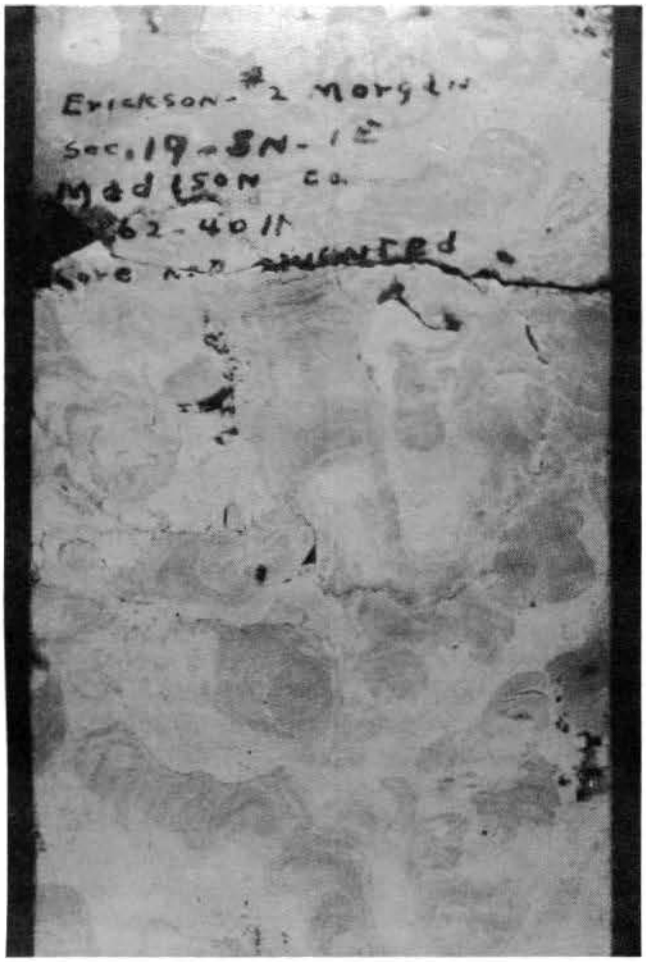

Figure 6. Core of the Cretaceous Jackson Gas Rock (algal reef facies) from the Erickson #2 Morgan in Section 19, T. 8 N., R. 1 E., Madison County, Mississippi, from core section in Mississippi Office of Geology core box C-26.0. The 3.5-inch diameter core runs from 3963 to 4011 feet with core sections not in order ("not oriented").

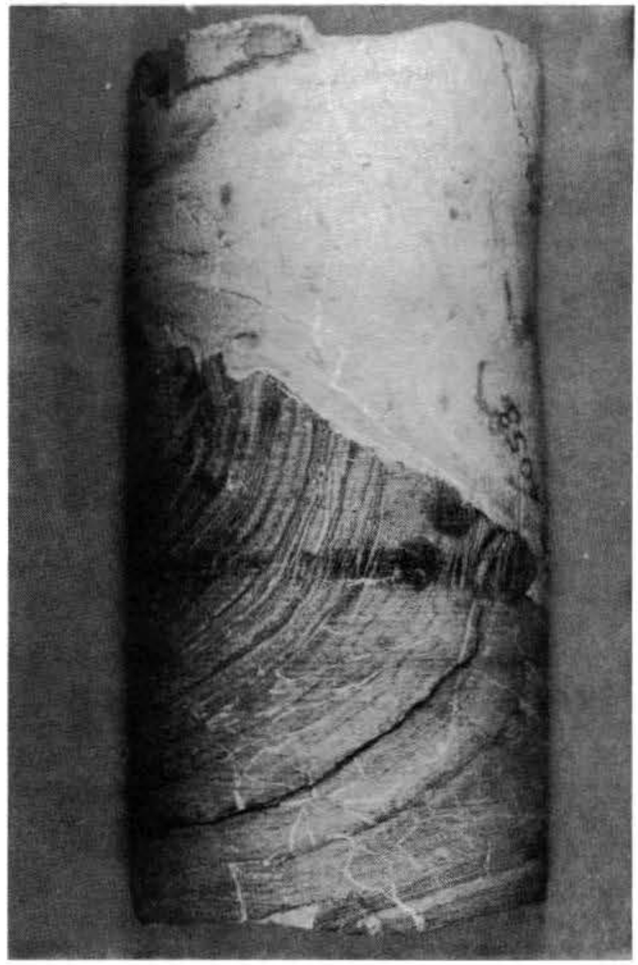

Figure 7. Cretaceous intrusive igneous rock, an intrusive phonolite, at lower contact with deformed, thinly-bedded Smackover Limestone from the Mississippi Valley Gas #1 Terry-Bell Unit in Section 18, T. 17 N., R. 9 W., Washington County, Mississippi, at 4053 feet. The 3.5-inch diameter core interval is from the bottom of Mississippi Office of Geology core box C-49.6.

correlates with the pulse of igneous activity at 75 million years ago as indicated by the age of igneous rocks in the State #2 Fee well, it occurred at a time of rising sea level and the deposition of the "middle chalk member" of the Demopolis Formation. Sanidine from a biotite bed in the "middle chalk member" at the Holnam Inc. Quarry south of Artesia, Mississippi, was determined by John Obradovich of the U.S. Geological Survey to be 75.4 million years old (Dockery, 1996). This bed seems to confirm 75 million years ago as the major time for explosive volcanic activity at Jackson.

An island of some 184 square miles composed of uplifted strata from the Late Cretaceous Eutaw Formation to the Jurassic Cotton Valley Group was eroded away before deposition of the late Maastrichtian Jackson Gas Rock. Where did all of this sediment go? Some of it occurs as sand units within the Selma Chalk north of Jackson. Currents transported eroded sands from Jackson northward to Yazoo County. It was here at Tinsley where the Union Producing #1 G. C. Woodruff discovered oil (a gusher) from a Selma Chalk sand on August 29, 1939. This sand interval was named the Woodruff Sand and is the discovery horizon for the Tinsley Oil Field. The Woodruff Sand thickens eastward across Tinsley from 0 to 100 feet thick on the dome's eastern flank as is shown in a Pennzoil United cross section illustrated in Moore (1974, plate 3).

THE MIDNIGHT VOLCANO AND THE SHARKEY PLATFORM

Another buried Cretaceous volcano of interest is the Midnight Volcano in southern Humphreys County. This "volcano" was discovered in 1939 when Union Producing Company drilled their C. B. Box #1 wildcat well on a structure at Midnight and encountered igneous rock at 3634 feet. The company continued drilling in igneous rock and quartzitic sandstone until it gave up hopes of finding oil at a TD of 5652 feet. Mellen (1958, p. 23-24) named this structure the Midnight Volcano even though the Box #1 did not encounter a volcanic pipe. The igneous cores of both the Midnight Volcano and Jackson Dome show as profound maxima in the gravity map of Figure 1.

Union Producing was not the only oil company surprised to find volcanic rock beneath the Mississippi Delta (= Mississippi River Alluvial Plain of northwestern Mississippi). David Love, made famous in John McPhee's book on the Rockies of Wyoming (*Rising from the Plains*, 1986), worked for Shell Oil Company in 23 states from 1938-1942. The one fascination of those years, years he described as "an exciting time -- really five golden years," that he related to writer Mary Fritz (1987) was the unexpected discovery of volcanic rocks in Mississippi where they were not supposed to be. Love submitted a paper on the find to Shell management, which, as far as he knew, was lost in the black hole of proprietary information.

Yet another company was surprised by igneous rock in the Delta. In November of 1995, Lewis Oil Company completed their #1 Graham 21-16 over a promising structure between Yazoo City and Midnight in Section 16, T. 13 N., R. 3 W., Humphreys County, only to reach total depth at 6913 feet in an igneous plug. According to Larry Baria (personal communication), igneous rock was first encountered at 5130 feet just below the top of the Eutaw (at 4720 feet). Cuttings from the top of the igneous plug were unweathered, suggesting an intrusion into the Eutaw. From 5130-6913 feet, drilling continued in a continuous section of "trachyte."

The Mississippi Valley Gas #1 Terry-Bell Unit along Highway 82 south of Greenville in the S/2, NW/4, SW/4, Section 18, T. 17 N., R. 9 W., Washington County, encountered igneous rock on the northern flank of the Sharkey Platform where it merges with the Desha Basin. Cores 01-07 of the #1 Terry-Bell Unit recovered Cretaceous igneous intrusives in Jurassic Smackover shale and limestone from 3963-4611 feet. Figure 7 shows the lower contact of a 25-foot-thick igneous intrusive of Cretaceous age with deformed beds of the underlying Jurassic Smackover Limestone at 4053 feet. Thin-section analyses of this intrusion at 4024 feet showed it to be the chemical and textural equivalent of a phonolite (Harrelson and Bicker, 1979, p. 245, 248-249).

WHAT IF?

When Jackson schoolchildren learn that their city overlies an ancient volcano, their eyes widen as they ask, "Will it erupt?" They often receive an answer something like this: "Don't worry. It's not an active volcano, or even a dormant one. It's an extinct volcano." The volcanoes of the northern Gulf Province have been silent for some 65 million years or more. There is no reason to believe that any of them will ever erupt again. However, there is no more reason to believe they will not

Today, the Gulf Coastal Plain is a quiet, passive, continental margin, with the exception of the New Madrid Seismic Zone. This is one reason geologists suspect that buried Cretaceous volcanoes within the province have vented themselves for the last time. However, igneous provinces are known to have rested for almost 100 million years before returning to life. Radiometric dates in the State #2 Fee well show a 26-million-year gap in activity between 101- and 75-million-year-old igneous rocks. These rocks show even later evidence of hydrothermal alteration (Saunders, 1993). Also, the Jackson Dome has risen in respect to its surroundings in post-Oligocene time less than 30 million years ago. Outcrops of the Oligocene Vicksburg Group, including the Glendon Limestone, are preserved on the dome's northwestern flank.

Bercovici and Mahoney (1994) showed that several of the world's flood basalt provinces display two distinct times of major eruptions. These eruptive episodes were separated by 20 to 90 million years. Bercovici and Mahoney explained this separation as due to the division of magmatic plumes within the mantle at the 660-kilometer discontinuity. Here the plumes divide as half the volume breaks through to rise toward the surface, while the other half stalls at the discontinuity, only to follow some tens of millions of years later. Could this be a model for the future of the Gulf Coastal Plain? Even if it were, there's little chance of a 65-million-year-old volcano awakening in the short 70- to 80-year lifespan of the average person. So the chances of any of us seeing an erupting volcano on the Gulf Coastal Plain are very small.

Fortunately, volcanoes give certain warnings before major eruptions. These include such things as harmonic tremors, rising ground elevations, elevated ground water temperatures, and tree kills due to the out-gassing of carbon dioxide into the soil. In the interview with Ken South of WJTV, Dockery discussed ancient volcanic activity at Jackson and was asked, "What if it were to happen again?" He answered, "Hopefully we'd have some warning" (i.e. harmonic tremors or earthquakes). In the final scene as aired, Ken South had his ear toward the ground in the Coliseum parking lot. There he cautioned, "So the next time you're at the Coliseum and you feel the ground rumble beneath your feet, it may not be the eighteen-wheeler passing nearby. It could be *the warning*."

ACKNOWLEDGMENTS

The writers would like to thank Marvin Oxley for the use of his Jackson Gas Rock isopach map, Charles Barton for his cross section across Hinds and Rankin counties, Carl Dillistone for use of the Geological Consulting Services, Inc., top-of-Eutaw map, Larry Baria for information on gas production north of Jackson and on the Lewis Oil Co. #1 Graham 21-16, Bobbie Woolsey of the State Oil and Gas Board for data on gas production in the Thornton Field, Monty White of Pursue Energy for information on the Piney Woods Field, Nancy Bounds of the Mississippi Department of Archives and History and Tom Spengler, a long-time Jackson resident, for information on Crystal Swimming Pool, and Steve Ingram for help with logs and cross sections.

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APPENDIX 1

CROSS SECTION A-A' WELLS WITH TOPS

1. Exxon Co., U.S.A. #1 D. B. McDonald
Section 36, T. 3 N., R. 1 W., Hinds County
Tops: Moodys Branch 936', Cockfield 968', Cook Mountain 1362', Cook Mountain Ls. 1440', Kosciusko 1528', Zilpha (Cane River) 2230', Winona-Tallahatta 2470', Wilcox 2710', Porters Creek 5690', Clayton 6475', Selma 6580', Eutaw 7342', Tuscaloosa 7864', Marine Tuscaloosa 8432', Lower Tuscaloosa 8750', Lower Cretaceous 9006', Washita-Fred. 9480', Paluxy 9800'?, Mooringsport 11,727', Ferry Lake 12,113', F. L. base 12,351', Rodessa sand 12,418', Hosston 13,196', Cotton Valley 16,410', Haynesville 20,655', Buckner 20,884', Smackover 21,050', Norphlet 22,254'?, Salt 23,105', T.D. 23,154'.

Distance between wells 1 & 2 = 8.44 miles

2. Larco Drilling Co. - Toler - Bryant #1 W. C. Hemphill
Section 20, T. 4 N., R. 1 E., Rankin County
Tops: Winona-Tallahatta 2020', Wilcox 2220', Porters Creek 4270', Clayton 4560', Gas Rock 4590', Gas Rock base 4823', Eutaw 5610', Tuscaloosa 6267', Marine Tuscaloosa 7070', Lower Tuscaloosa 7197', Lower Cretaceous 7605', Washita-Fred. 7925', Paluxy 8047', Mooringsport 10,035', Ferry Lake 10,390', Ferry Lake 10,620', Rodessa sd. 10,697', T.D. 10,755'.

Distance between wells 2 & 3 = 3.16 miles

3. James W. Harris & H. E. Karges #1 Jasper Diffrient
Section 10, T. 4 N., R. 1 E., Rankin County
Tops: Moodys Branch 445', Cockfield 470', Cook Mountain 800', Cook Mountain Ls. 845', Kosciusko 940', Zilpha (Cane River) 1520', Winona-Tallahatta 1675', Wilcox 1830', Porters Creek 3320', Clayton 3450', Gas Rock 3470', truncated Eutaw 3898', Tuscaloosa 4505', T.D. 5030'.

Distance between wells 3 & 4 = 5.38 miles

4. Leonard Jones #1 Larue
Section 15, T. 5 N., R. 1 E., Hinds County
Tops: Cook Mountain 330', Cook Mountain Ls. 380', Kosciusko 450', Zilpha (Cane River) 830', Winona-Tallahatta 1052', Wilcox 1132', Porters Creek 2330', Gas Rock 2491', Clayton 2491', Selma 2521', T.D. 2518'.

Distance between wells 4 & 5 = 1.6 miles

5. Mississippi Geological Survey #1 Mississippi State Fair Grounds
Section 2, T. 5 N., R. 1 E., Hinds County
Tops: Cook Mountain 270', Cook Mountain Ls. 325', Kosciusko 393', Zilpha (Cane River) 766', T.D. 840'.

Distance between wells 5 & 6 = 3.0 miles

6. State of Mississippi #2 Fee
Section 25, T. 6 N., R. 1 E., Hinds County
Tops: Cockfield 50', Est. Cook Mountain 350', Est. Kosciusko 470', Zilpha (Cane River) 805', Est. Winona-Tallahatta 942', Wilcox 1130', Porters Creek 2360', Gas Rock 2469', Cotton Valley 2843', T.D. 5529'.

Distance between wells 6 & 7 = 4.52 miles

7. D. C. Latimer and H. E. Richardson #1 Rogers-Raymond
Section 31, T. 7 N., R. 2 E., Madison County
Tops: Cook Mountain 678', Kosciusko 830', Zilpha (Cane River) 1378', Winona-Tallahatta 1580', Wilcox 1768', Porters Creek 3270', Gas Rock 3405, Gas Rock base 3924', Eutaw 4240', T.D. 4264'.

Distance between wells 7 & 8 = 7.6 miles

8. Texas Pacific Oil Co. #1 D. R. Yandell
Section 36, T. 8 N., R. 2 E., Madison County
Tops: Moodys Branch 240', Cockfield 300', Cook Mountain 543', Kosciusko 760', Zilpha (Cane River) 1282', Winona-Tallahatta 1494', Wilcox 1720', Porters Creek 3976', Gas Rock 4703', Gas Rock base 5275', Eutaw 5924', Tuscaloosa 6528', Marine Tuscaloosa 7054', Lower Tuscaloosa 7170', Lower Cretaceous 7500', Washita-Fred. 7870', Paluxy 8300', Mooringsport 9360', Rodessa 9565', Hosston 10,334', Cotton Valley? 12,420', Haynesville 15,130', Buckner 15,300', Smackover 15,460', Brown Dense 15,760', Norphlet 16,460', Salt 16,680', T.D. 16,886'.

Distance between wells 8 & 9 = 5.34 miles

9. The California Co. and Colorado Oil and Gas Co. #1 F. C. Larson et al.
Section 1, T. 8 N., R. 2 E., Madison County
Tops: Wilcox 1590', Porters Creek 3832', Clayton 4605', Selma 4680', Gas Rock base 5046', Eutaw 5690', Tuscaloosa 6200', Marine Tuscaloosa 6707', Lower Tuscaloosa 6774', Lower Cretaceous 7093', Washita-Fred. 7540', Paluxy -7946',

Mooringsport 8900', Ferry Lake? "8990", Rodessa 9120', Hosston 9719', T.D. 11,008'.

Distance between wells 9 & 10 = 4.46 miles

10. Pan American Petroleum Corp. #1 Madison County Board of Supervisors
Section 16, T. 9 N., R. 3 E. Madison County
Tops: Cook Mountain 420', Kosciusko 550', Zilpha (Cane River) 1100', Winona-Tallahatta 1250', Wilcox 1550', Porters Creek 3830', Clayton 4560', Selma 4589', Eutaw 5650', Tuscaloosa 6190', Lower Tuscaloosa 6800', Marine Tuscaloosa 6711', Lower Cretaceous 7130', Washita-Fred. 7556', Paluxy 7908', Mooringsport 8910', Rodessa 9090', Hosston 9700', Cotton Valley 11,328', Haynesville 13,753', Buckner 13,870', Smackover 14,245', Brown Dense 14,484', Norphlet 15,020', T.D. 15,060'.

Distance between wells 10 & 11 = 3.54 miles

11. McColloch Oil Co. of California and State Exploration Co. #1 Ragsdale
Section 34, T. 10 N., R. 3 E., Madison County
Tops: Kosciusko? 500', Zilpha (Cane River) 1027', Winona-Tallahatta 1163', Wilcox 1450', Porters Creek 3608', Clayton 4405', Selma 4437', Eutaw 5413', Tuscaloosa 5950', T.D. 6816'.

Distance between wells 11 & 12 = 2.68 miles

12. Ralph A. Johnston #1 Dinkins-Ray-Reid
Section 14, T. 10 N., R. 3 E., Madison County
Tops: Zilpha (Cane River) 945', Winona-Tallahatta 1055', Wilcox 1358', Porters Creek 3490', Selma 4217', Eutaw 5210', T.D. 5315'.

Distance between wells 12 & 13 = 3.32 miles

13. The Carter Oil Co. S.L. Brown #1-B
Section 35, T. 11 N., R. 3 E., Madison County
Tops: Winona-Tallahatta 928', Wilcox 1120', Porters Creek 3218', Clayton 4030', Selma 4080', Eutaw 5050', Tuscaloosa 5650', Lower Tuscaloosa 6185', Lower Cretaceous 6485', Washita-Fred. 6915', Paluxy 7272', Mooringsport 7925', Rodessa 8110', Hosston 8718', Cotton Valley 10,290', Haynesville 11,925', Buckner 12,020', Smackover 12,320, T.D 12,622'.

Distance between wells 13 & 14 = 3.32 miles

14. Pruet and Hughes - Aquitane #1 Maude Castens 13-9
Section 13, T. 11 N., R. 3 E., Madison County
Tops: Selma 4055', Eutaw 5065', Tuscaloosa 5900', lower Tuscaloosa 6355', Fault with 400' of throw at -6227', Washita-Fred. 6573', Paluxy 6994', Mooringsport 7615', Rodessa 7780', Hosston 8350', Cotton Valley 9785', Haynesville 10,929', Buckner 11,005', Smackover 11,267', Brown Dense 11,532', Salt 11,963', T.D. 11,996.

Distance between wells 14 & 15 = 1.84 miles

15. Pruet #1 Dendy
Section 6, T. 11 N., R. 4 E., Madison County
Tops: Winona-Tallahatta 808', Wilcox 1138', Porters Creek 3070', Clayton 3835', Selma 3880', Eutaw 4825', Tuscaloosa 5500', Lower Tuscaloosa 6055', Lower Cretaceous 6280', Washita-Fred. 6660', T.D. 6689'.

APPENDIX 2

CROSS SECTION B-B' WELLS

1. Crow (Continental) #1 Bryant, Section 9, T. 5 N., R. 4 W., Hinds County, T.D. 12,174 feet, Completion Date: June 5, 1955.

2. Pure #1 Gaddis, Section 29, T. 6 N., R. 3 W., Hinds County, T.D. 9002 feet, Completion Date: October 2, 1943.

3. Jett #1 Sedlack Unit, Section 24, T. 6 N., R. 3 W., Hinds County, T.D. 10,133 feet, Completion Date: April 5, 1955.

4. Larco #1 McAlpin (Discovery well for Bolton Oil Field), Section 19, T. 6 N., R. 2 W., Hinds County, T.D. 9951 feet, Completion Date: August 2, 1954.

5. Quin (Sanford) #1 Board of Supervisors, Section 16, T. 6 N., R. 2 W., Hinds County, T.D. 10,212 feet, Completion Date: February 21, 1955.

6. Love #1 Johnson, Section 29, T. 6 N., R. 1 W., Hinds County, T.D. 6484 feet, Completion Date: June 16, 1939.

7. Stanolind #1 Cox, Section 24, T. 6 N., R. 1 W., Hinds County, T.D. 10,730 feet, Completion Date: December 9, 1952.

8. State #2 Fee, Section 25, T. 6 N., R. 1 E., Hinds County, T.D. 5514 feet, Completion Date: April 6, 1937.

9. Shell # 1 Lulu Muse, Section 9, T. 5 N., R. 2 E., Rankin County, T.D. 4500 feet, Completion Date: March 28, 1949.

10. Shell #1 Elliott, Section 11, T. 5 N., R. 2 E., Rankin County, T.D. 5665 feet, Completion Date: December 27, 1948.

11. Jones #1 Stone, Section 18, T. 5 N., R. 3 E., Rankin County, T.D. 5511 feet, Completion Date: January 27, 1934.

A HISTORY OF THE MISSISSIPPI GEOLOGIC REGISTRATION LAW

Rick L. Ericksen, President
Mississippi State Board of Registered Professional Geologists

INTRODUCTION

Effective July 1, 1997, the Geologic Practice Act of 1997 became law. Briefly, the law affects all those who publicly practice geology in the State of Mississippi, with only two exceptions. Those who desire to become registered must have a baccalaureate degree in geology from an accredited college or university and a minimum of four years of qualifying geologic experience. Qualifying geologic experience includes one year of credit for a master's degree in geology and two years for a doctorate in geology, with the total number of years credit not to exceed two years. Additionally, each applicant must obtain references from three geologists who are familiar with the registrant. As noted, the only two exceptions which are allowed under the Act are for petroleum geologists and those whose practice is limited solely to teaching. Those who are exempt from geologic registration may register if they desire to do so, provided they meet the requirements of the Act as previously discussed. Importantly, as required by this law, any non-resident geologist performing geological work in Mississippi which may impact the public's health, safety, or welfare as defined by this Act or by Board rule, must first notify the Board of who they are, when and where they will be working in-state, the scope of their work, and the duration of the work.

During the period from the first availability of application forms, which should be in late October, through December 1998, those who qualify may be "grandfathered." During this grandfathering phase, registration applicants will not be required to take the National Association of State Boards of Geology (ASBOG) examination(s), provided they meet the degree and experience requirements mentioned. All geologists who do not meet the experience requirements may become a Geologist In Training (GIT) and after attaining the requisite four years of geologic experience may apply for registration after their successful passage of an ASBOG examination if required by the Rules of the Board.

Mississippi joins 22 other states which now have registration laws for the public practice of geology. As used in this writing, registration and licensing will be considered as being equivalent terms. Table 1 is a listing of the states which have registration, certification, and definition laws, the date of the passage of their legislation, and the type of legislation passed. Figure 1 is a graphical representation of the time frame of state registration from 1956, when Arizona became the first state with registration, through 1997, when three states passed geologic registration acts (Wyoming, Kansas, and Mississippi). There are four states with geologic certification laws (Alaska, Indiana, Iowa, and Virginia) and four states which have definition laws (Colorado, Michigan, Nevada, and Oklahoma). Certification laws generally require that a geologist must be certified by the state or other appropriate governing entity to perform specific types of geological work, e.g. underground storage tank studies/closures. Definition laws by in large only define who may be considered a geologist; this is generally by recognition of a college degree in geology. Further, these definition acts usually define what constitutes geologic practice. Definition laws are considered to be very weak in regard to safeguarding the public's health, safety, and welfare. Currently there are six states which have ongoing legislative registration efforts. These states are Nebraska, New Mexico, New York, Texas, Oklahoma, and Utah.

GEOLOGIC REGISTRATION EFFORTS IN MISSISSIPPI - A SYNOPSIS

There have been at least two attempts to have geologic registration in Mississippi. An attempt at registration occurred 20 years ago in 1977-78. At that time, several prominent Jackson-area geologists, including Mr. Joseph Fritz, presented their views on geologic registration during a meeting of the Mississippi Geological Society. Unfortunately their views were not shared by many of the geologists present, who by geologic professional specialty were petroleum geologists. After that fateful and tension-filled meeting, discussions concerning geologic registration were few and far between. It wasn't until the summer of 1992 before several geologists in the state began meeting concerning the possibility of introducing geologic registration legislation at the then upcoming 1993 legislative session. After several meetings, the work on the proposed legislation had progressed but perhaps not as quickly as anticipated. A bill was rather hastily submitted to the state legislature for the 1993 session but was not heard in committee and hence the bill died a silent death.

Roughly three years later late in the summer of 1995, at the urging of the then President of the Mississippi Geological Society, Mr. Les Aultman, an ad hoc committee was formed. The committee, which adopted the title of the "Mississippi Geologic Task Force/Advisory Committee," began studying

TABLE 1. States with Registration/Certification/Definition Laws

ARIZONA	1956	Registration
CALIFORNIA	1968	Registration
IDAHO	1971	Registration
DELAWARE	1972	Registration
MAINE	1973	Registration
COLORADO	1973	Definition
GEORGIA	1975	Registration
OREGON	1977	Registration
ALASKA	1980	Certification
INDIANA	1980	Certification
VIRGINIA	1980	Certification
NORTH CAROLINA	1983	Registration
KANSAS	1984	Registration
SOUTH CAROLINA	1986	Registration
ARKANSAS	1988	Registration
FLORIDA	1988	Registration
MICHIGAN	1988	Definition
TENNESSEE	1988	Registration
IOWA	1991	Certification (UST's only)
KENTUCKY	1992	Registration
PENNSYLVANIA	1993	Registration
OKLAHOMA	1993	Definition
MISSOURI	1994	Registration
WISCONSIN	1994	Registration
ALABAMA	1995	Registration
ILLINOIS	1995	Registration
MINNESOTA	1995	Registration
NEVADA	1997	Definition
WYOMING	1997	Registration
KANSAS	1997	Registration
MISSISSIPPI	**1997**	**Registration**

the issues related to geologic registration. The members of the Geologic Task Force elected Mr. Rick L. Ericksen as its Chairman and Mr. Stephen L. Ingram, Sr., as its Vice Chairman/ Recording Secretary. The members of the Task Force represented a cross section of geologists from a diverse set of backgrounds, practices, and geographic locations from across the state.

The Geologic Task Force's leadership recognized that the previous attempts concerning geologic registration in the state had failed for several reasons. The more critical reasons recognized were as follows: 1) the lack of adequate information concerning the need for registration and a lack of knowledge of the registration laws of other states; 2) the lack of a consensus within the state's geologic community concerning the need for a professional registration law; 3) adequate time to draft a "consensus" bill to be submitted to the state legislature for its consideration; 4) the lack of endorsements for registration from professional geologic organizations; and 5) simply that during previous attempts the conditions were just not conducive to expect passage of such legislation.

With these factors in mind, three subcommittees were formed within the Geologic Task Force, which were a "Registration Need Subcommittee," a "Registration Law Assessment Subcommittee," and a "Geologist Census Subcommittee." The following were the key tasks assigned to each of the three subcommittees.

Registration Assessment Subcommittee. This subcommittee compiled all of the pertinent geologic registration laws, with emphasis on those in the southeastern U.S. This compilation noted the common components of these registration laws. This assessment included factors such as grandfathering requirements, code of ethics, makeup of board memberships, comity or reciprocity clauses, testing, fee structures, etc. and also included, for comparison, the legislative act which created the Mississippi State Board for Registration of Professional Engineers and Land Surveyors. This subcommittee determined the common and/or key points to the existing and proposed geological registration laws in each of the states in the southeastern U.S., as well as the "Suggested Geological Practices Act" developed by the American Association of Petroleum Geologists (AAPG), American Institute of Professional Geologists (AIPG), Association of Engineering Geologists (AEG), and other organizations, and the structure and content of Mississippi's engineering law.

Geological Census Subcommittee. This subcommittee identified and compiled a database containing the names and mailing addresses for all of the geologists residing in Mississippi, which subsequently totaled approximately 550 geologists.

Geological Registration Need Subcommittee. This subcommittee identified and compiled the reasons for needed legislated geologic registration in Mississippi. The subcommittee specifically compiled cases where geologic input was either not provided or provided for by (an) unqualified person(s). Another task of this subcommittee was to determine whether or not any particular segment of the geologic profession should not be required to be registered should a registration bill be drafted.

After the presentation of these formal, subcommittee reports to the Geologic Task Force, the Task Force, on April 23, 1996, by unanimous agreement voted to proceed with registration bill writing efforts. Subsequently a "Registration Bill Subcommittee" was formed and over the next seven months this subcommittee wrote, rewrote, modified, and discussed the form and content of the draft bill. During this time frame, presentations of the draft legislation were held at several locations across the state including the University of Mississippi at Oxford, Mississippi State University at Starkville, the University of Southern Mississippi at Hattiesburg and also at its Long Beach campus, at the Army Corps of Engineers at Vicksburg, at the Natchez Geological Society in Natchez, and the Mississippi Geological Society in Jackson. These meetings provided additional input by the state's geologic community in developing the content and scope of the proposed legislation. Additional input was also solicited during meetings with an allied group, the Mississippi State Board for Registration of Professional Engineers and Land Surveyors.

After making many of the suggested revisions to the bill, the draft was tendered to the state legislature after first being submitted for legislative rewrite. This process of legislative rewrite put the draft bill in the form most familiar to the state's legislators. The bill's sponsors in the Mississippi State Senate were Senator Robert Dearing and Senator Vincent Scoper. In the Mississippi House of Representatives, the bill was sponsored by State Representative James Ellington and co-sponsored by Representative Keith Montgomery. The companion appropriation bill funding the proposed geologic practice act was sponsored by Senator Dick Hall.

Initially the bill was submitted to the House of Representatives and assigned to the Committee on Conservation and Water Resources, chaired by Representative James Ellington. The bill, House Bill 953, then went to a subcommittee chaired by Representative Keith Montgomery for a hearing. After the hearing and favorable recommendation from Representative Montgomery, the bill was heard during a full committee hearing. During this hearing the bill was voted on favorably and it was then sent to the full House of Representatives for its vote. After multiple votes on the bill, it was finally successfully passed in an amended form and sent to the State Senate. An identical bill in the Senate, Senate Bill 2530, had been referred to the Committee on Business and Financial Institutions, chaired by Senator Clyde Woodfield. SB 2530 was not acted on by this Senate committee and it subsequently died in Senator Woodfield's committee.

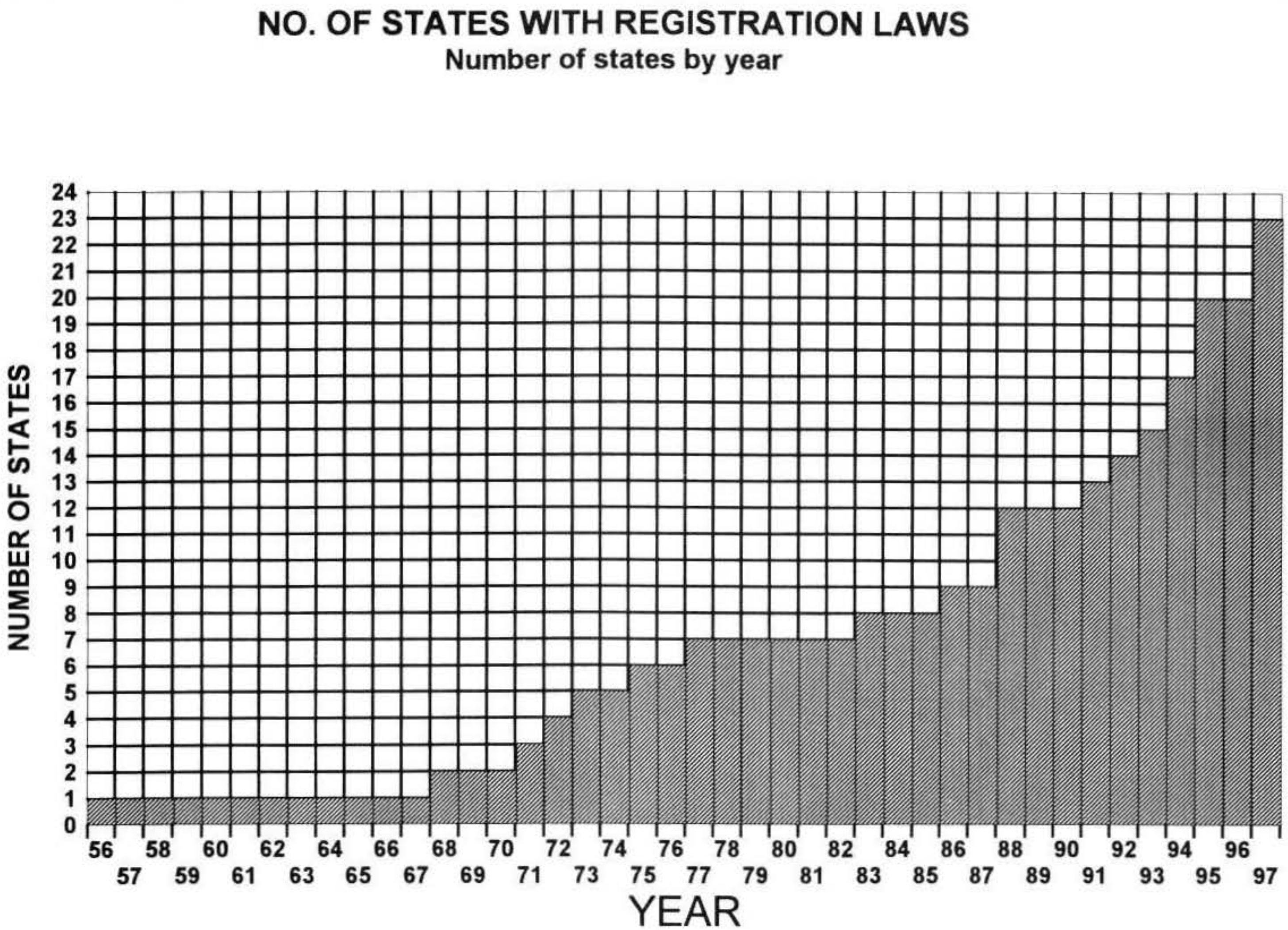

Figure 1. Graph of states with registration versus year.

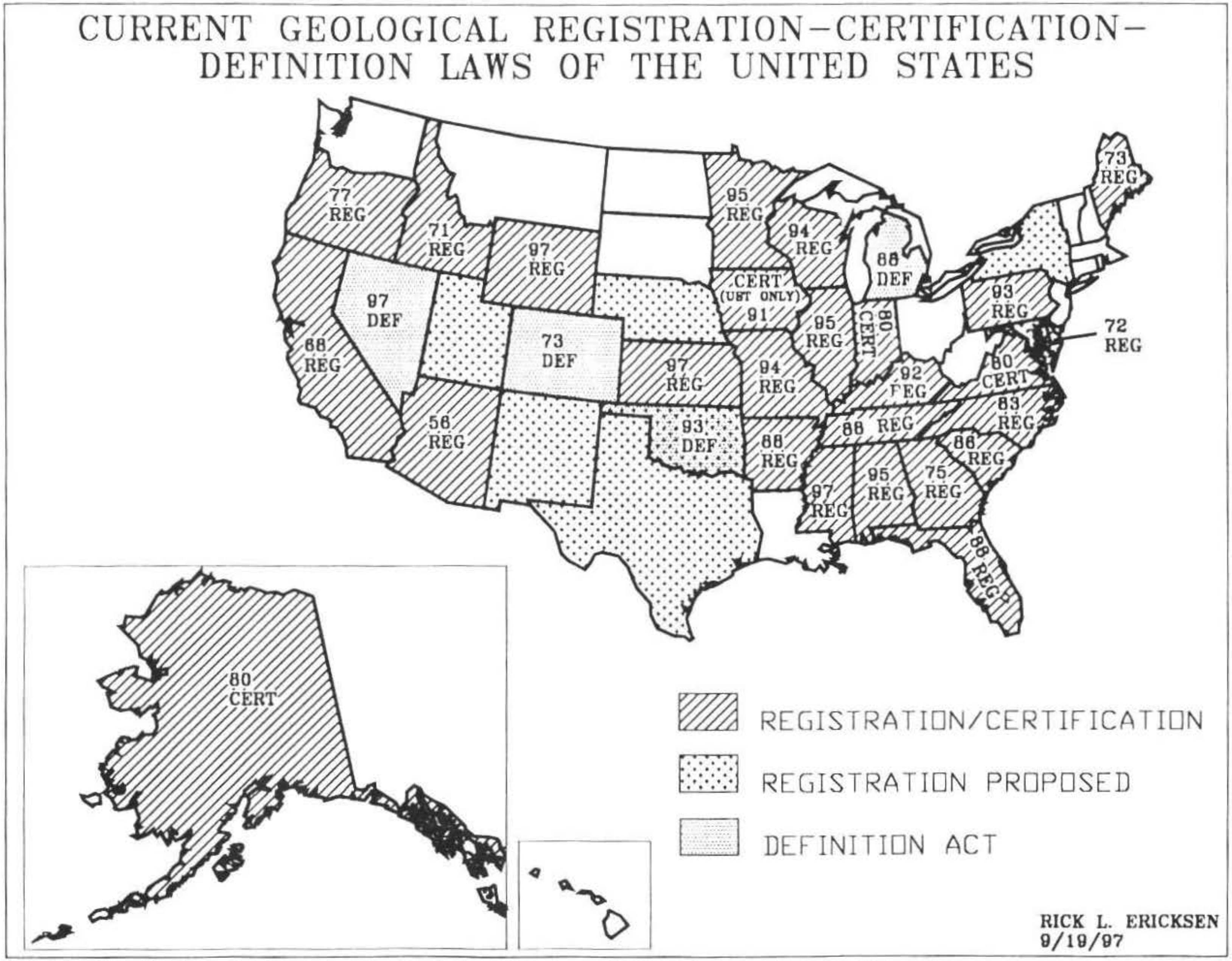

Figure 2. States with geologic registration, certification, and definition laws.

The bill as passed by the House of Representatives contained some last minute modifications which were not acceptable to the Geologic Task Force nor the sponsors of the bill. So during hearings before a joint meeting of the Senate Committee on Environmental Protection, Conservation and Water Resources, chaired by Senator Robert Dearing, and the Committee on Oil, Gas and Other Minerals, chaired by Senator Vincent Scoper, the bill was essentially restored to its original submitted form. After these restorations, the bill was passed by unanimous vote by both committees and then proceeded to the floor of the Senate where on April 1, 1997, it passed on unanimous vote. The next day the House of Representatives passed the Senate version of the bill by a 116 to 2 vote, and on April 10, Governor Kirk Fordice signed the bill, effectuating "The Registered Professional Geologists Practice Act of 1997."

As previously mentioned, sponsors and co-sponsors of the legislation were Representative James Ellington, Representative Keith Montgomery, Senator Robert Dearing, and Senator Vincent Scoper. Companion appropriation authority was sponsored by Senator Dick Hall. The law became effective on July 1, 1997, and a five member board was selected by the Governor. The board members chosen by Governor Kirk Fordice are W. Lester Aultman (Clinton), an independent oil and gas geologist; Rick L. Ericksen (Ridgeland), the Geologic Task Force Chairman and a geologist with the Mississippi Office of Geology; John W. Green (Terry), with GeoScience Engineers; Darrel W. Schmitz (Starkville), professor of Geology at Mississippi State University; and Charles T. Swann (Oxford), with the Mississippi Mineral Resources Institute.

The passage of this legislation is the culmination of efforts over nearly a two year period by the ad hoc committee, the Mississippi Geologic Task Force. The Geologic Task Force was comprised of the following geologists, several of whom went far beyond the call of duty and unselfishly gave of their time, spending untold hours compiling, studying, writing, meeting, calling, etc. — all to benefit their chosen profession. Special thanks go to each and every one of those members who are Maureen Corcoran, Sandra Dowty, John Green, Danny Harrelson, Ed Hollingsworth, Stephen Ingram, Steve Jennings, Harold Karges, Jeff Lundy, Charles Morrison, David Patrick, Shaire Rahaim, Darrel Schmitz, Lindsey Stewart, Tony Stuart, Charles Swann, and George Vockroth.

In addition to these individuals, the Geologic Task Force received financial and professional support from several geologists across the state, the American Association of Petroleum Geologists (AAPG Division of Professional Affairs), the American Institute of Professional Geologists (AIPG), the Society of Independent Professional Earth Scientists (SIPES), the Mississippi Geological Society (MGS), the Natchez Geological Society (NGS), the Association of Engineering Geologists (AEG), the Association of State Boards of Geology (ASBOG), academia, the Mid-Continent Oil and Gas Association, and the Mississippi Board of Registration for Professional Engineers and Land Surveyors.

THE REGISTRATION LAW - A BRIEF OVERVIEW

The geologic registration law governs all who practice geology where the work may affect the public's health, safety, or welfare. Under the guidelines of this legislation all geologists, with the exception of petroleum geologists and those whose practice is limited to the teaching of geology, are required to become registered in order to practice in the state. It requires that geologic work or studies which may affect the public must be signed and sealed by a registered geologist. These studies, for example, include the geologic portions of environmental site assessments, solid waste sites, ground-water studies, and so on. Further, geologic cross sections, geologic maps of all types, correlation studies of geologic units, including but not limited to ground-water aquifers, must be performed by or under the supervision of a qualified, registered professional geologist. These examples are only a few of the multitude of studies which require professional registration. Those geologists who are exempted may register if they desire to do so, provided they meet the requirements as provided for under the "grandfathering" provision or later take a written examination(s) to be administered by the Board of Registered Professional Geologists as determined by the Rules of the Board.

The newly appointed Board has had several meetings and has elected Rick Ericksen as its President and John Green as its Vice President. As noted, the Board is anticipating that applications for registration will be available in late October. Information may be obtained by writing to the Board, by downloading the application forms and other pertinent information from an Internet Web site, or by calling the Board at 601/961-5507. The Board's mailing address is as follows:

Mississippi State Board of Registered Professional Geologists
P.O. Box 22742
Jackson, Mississippi 39225-2742

At least two Internet addresses will be available for those who desire to download the necessary application forms and information concerning registration in Mississippi. Currently the following Web site address may accessed for preliminary information concerning this data - http://www.olemiss.edu/depts/mmri. Another Web site which will have the registration information available will be at the following address - http://www.deq.state.ms.us/geoweb.nsf. Other Web sites will be forthcoming and the availability of the applications will be profusely advertised so no one will have the opportunity to miss the "grandfathering" period. The "grandfathering" period shall begin when forms become available and continue until December 1998. The costs associated with registration have not yet been formally accepted by the Board pending public comment and the Board's formal action but have been tentatively proposed to consist of the following schedule.

Registered Professional Geologist Application (Non-refundable) $95.00

Geologist In Training Application (Non-refundable) $50.00

Registered Professional Geologist Registration fee - biennially $130.00

Geologist In Training Enrollment fee - biennially $100.00

CONCLUSION

With the passage of the Geologic Practice Act of 1997, Mississippi joins the growing number of states which legislatively recognize the significance of professional geologic registration for those whose job or practice may impact the public's health, safety, and welfare (Figure 2). The real winners who will ultimately benefit from this Act are the citizens of the State of Mississippi.

The newly appointed Mississippi State Board of Registered Professional Geologists after their swearing-in ceremony held July 10, 1997. From left to right are Les Aultman, Charles Swann, Rick Ericksen (President), John Green (Vice President), and Darrel Schmitz.

THE SCIENCE OF *EXTINCT* AND *MEG*: TWO BOOKS, TWO SOUTHERN WRITERS, ONE IDEA

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Charles Wilson of Brandon, Mississippi, and Steve Alten of southern Florida have published successful novels *Extinct* and *Meg* in the same year (May and July, respectively, of 1997) and on the same idea. Giant sharks, of a species thought to be extinct, *Carcharodon megalodon*, rise from deep ocean trenches to terrify people like us. The sharks of Alten's *Meg* wreak havoc in the Pacific realm, while those of Wilson's *Extinct* terrify residents along Mississippi's own gulf coast (not that this will prejudice my review).

The occurrence of *Carcharodon megalodon* teeth in the Miocene and Pliocene sediments of the Atlantic and Gulf coastal plains inspired Alten to write and may have influenced Wilson as well. Sam McGahey, an archeologist with the Mississippi Department of Archives and History, and I recently examined a large, about 3,000-year-old, Indian effigy stone of a *C. megalodon* tooth, showing that even Mississippi's aboriginal population was awed by such teeth. These large teeth also held the attention of seventeenth-century Europe, where they were called glossopetra, or stone tongues (*glossa*, Latin from Greek for tongue; *petra*, Latin from Greek for rock) for their tongue-like shape.

Both Wilson and Alten may also have been encouraged by the success of Michael Crichton's *Jurassic Park*, which brought dinosaurs into human contact. The back cover of Alten's *Meg* reads: "Two Words: Jurassic Shark" (Jurassic *Jaws* is more like it).

The following review of *Extinct* and *Meg* was inspired by another review in which a science class, after reading "Bakker's Field Guide to *Jurassic Park* Dinosaurs" (Bakker, 1993), watched a video of *Jurassic Park* and made notes of those things they believed to be less than scientifically accurate (Vitale et al., 1996). For comparison with the students' observations, professional comments concerning the movie's inaccuracies were solicited over the Internet. The professionals' list of flaws, as published in the *American Paleontologist* (Bennington, 1996), was both educational and entertaining; some flaws were hilarious. It should be noted here that a critique of science in a science-fiction novel is more like a roast than a review.

"A book may be very amusing with numerous errors, or it may be very dull without a single absurdity."

—Oliver Goldsmith

So, the following are areas in which *Extinct* and *Meg* fail to pass muster with me, a paleontologist. A successful novelist should create a believable universe, or, for the science-fiction writer, believable science. Both *Extinct* and *Meg* deal with scientific problems in their openings. In *Extinct*, a dog senses danger in the shallow bay waters of the Pascagoula River, an embayment along the Mississippi coastline, just before two young boys are swallowed alive by a 30-foot *Carcharodon megalodon* (a small one), which we'll refer to simply as *megalodon*. The shark, of course, leaves one hand behind for evidence. So, how does a 30-foot shark sneak up on kids in a shallow bay? Wilson sees the problem here but notes the low visibility of the muddy bay waters.

Wilson's second problem is how to get an ocean-going shark to find the Pascagoula River an interesting place. He handles this by noting that modern bull sharks inhabit brackish river environments and then utilizes what we don't know about the extinct *megalodon* as license for his novel. A shark expert may not buy this explanation, but Wilson gets an A for acknowledging and trying to address these difficulties. I also give him an A for having his manuscript's scientific content reviewed by paleontologist and oceanographer Dean Dunn of the University of Southern Mississippi (as acknowledged in the book).

The opening of *Meg* takes us 70 million years back in time where we find a *megalodon* attacking, of all things, a *Tyrannosaurus rex*! Eating the titan of *Jurassic Park* would be one up on Michael Crichton's novel, but could it happen? I don't doubt that a *megalodon* could bring down a *T. rex* in coastal waters, but the two species were separated by at least 50 million years of geologic time. The tyrannosaurs became extinct an the end of the Cretaceous Period 65 million years ago, and the first *megalodons* didn't appear until the Middle Miocene Epoch 15 million years ago.

Tyrannosaur and *megalodon* fossils are separated by a thick stratigraphic section, including all of the Oligocene, Eocene, and Paleocene series. Mississippi Office of Geology Circular 4 (Manning and Dockery, 1992) is a publication on Cretaceous shark teeth, and nothing close to a *megalodon* is there. The fact that *Meg*'s plot works is a testimony to our lack of scientific literacy. No one with scientific credentials is listed as a reviewer in the book's acknowledgments. Wilson's *Extinct* also stumbles over the *megalodon*'s geologic range, but it does so in less spectacular manner with only a short note citing the range as Triassic to Pleistocene. In both books, this mistake amounts to geologic misinformation.

I would like to know the sources for the authors' misinformation on the *megalodon*'s range. For the most up-to-date information on the correct range, I called fossil *megalodon* expert Bob Purdy with the U.S. National Museum (at which time I was embarrassed to find that I was mispronouncing the creature's name: it's me-gal'-o-don, not meg'-a-lo-don). The *megalodon*'s range is from the Middle Miocene 15 million years ago to the Early Pleistocene 1 million years ago. Some teeth on the abyssal ocean floor have been cited as Late Pleistocene, but this is debated.

The *megalodons* of *Extinct* and *Meg* have their own personalities. In *Extinct*, these sharks are dangerous to people but nurturing to their own kind and show considerable intelligence. The reader gets a warm and fuzzy feeling for these endangered creatures and may tend to overlook their dastardly deeds, even to the point of pulling for the sharks when they are in distress. In *Meg*, the *megalodons* are cold-blooded (no pun meant, as sharks are, of course, cold blooded) killers who devour their own mates and offspring (pups) if given the chance. Alten is closer to reality on this one.

There is one problem which both writers have dealt with in the same way. How have such large sharks escaped notice if they are not extinct? Both writers have them tucked away in deep oceanic trenches. In *Extinct*, pollution and depletion of food supply are suggested as reasons for the shark's return to shallow water. Once out of the trenches, the *megalodons* visit their "supposed" ancestral stomping grounds in the Gulf of Mexico somewhat like salmons returning to the place of their birth to spawn. Of course for the *megalodon*, the recovered memory is one genetically suppressed over millions of years and many generations.

In *Meg*, the sharks live in a "tropical" layer on the trench floor, which is warmed by hydrothermal vents. The sharks are trapped in this layer by six miles of freezing cold water above them. A female escapes the "tropical" layer through the warm blood stream of its mate, which is towed to the surface by a boat cable. Alten's "tropical" layer does not exist in reality, and it is quite a stretch to get us to believe the slightly-warmer-than-sea-water blood of a 40-foot, 30,000-pound shark is sufficient to make a six-mile-long corridor to safety for its even larger 55-foot-long, 40,000-pound mate. The way we know of this escape is that the main character witnesses it from his submersible! No one sees that far in the dark abyss, even if "meg" is luminescent.

In *Extinct*, the *megalodon* invades not only the freshwater of the Pascagoula River but, in hot pursuit of terrified kids, flops into the shallows, wallowing out its own channel much as an alligator in the Florida everglades! Is no place safe? I can remember a comedy routine on *Saturday Night Live* concerning "land sharks." New York residents were cautioned to check before answering their door. Sharks must keep moving to bring oxygenated water across their gills or they will suffocate. I doubt a large shark would purposely moor itself in the shallows in pursuit of prey. Also the body mass of a stranded 30-foot shark would behave differently than that of Florida's walking catfish, which can flop from pond to pond.

This last thought brings me to an obvious problem in both books—how many times can a shark bang its head against a boat at full speed without hurting itself. Or, for that matter, how many collisions can it survive with the steel hull of a nuclear submarine? In *Meg*, it was the submarine that sank!

The female *megalodon* in *Meg* eats too much, even if carrying unborn triplets. Devouring fourteen whales in seventy-two hours and topping them off with a few surfers would be some kind of record. Alten prepares us for this by warning that the shark will have a higher metabolism in warm surface waters. But what about that hot "tropical" layer in the trench? The *megalodons* in *Extinct* eat in moderation, but their kin grow with the story from 30-footers, to 50-footers, and then to a pair of 200-footers! The latter pair eat nothing that we are told of. They must really be hungry.

The mystique of the extinct shark is treated differently by the writers. In *Extinct*, the mystique lives on as we encounter the beasts but are left without hard, specimen evidence. In *Meg*, specimens are obtained; the mystique is broken. *Meg* ends like a King Kong movie gone berserk, or as Snoopy (the *Peanuts* character) wrote in his one-line novel: "Suddenly, it all happened."

Among the science of *Extinct* and *Meg* are miracles of Biblical proportion. *Extinct* includes a Lazarus shark, and *Meg* has a Jonah for its main character. The science of *Meg* also errs, of all things, in its geology! There has been no subduction at Monterey Bay, California. And, even if there had been, the North American plate would not have subducted to form the Monterey Bay Canyon "gorge." Submarine canyons are formed by turbidity currents flowing downhill from the continental shelf, not by subduction as are oceanic trenches.

Both novels are good reads, especially for those of us interested in extinct creatures. They also provide a service in exposing the reading public to paleontology and the Earth's geologic past. The foul-mouthed wife of the main character in *Meg* made the reading less pleasant for me—not a book to read to children. Of course the language is probably setting her up for shark bait (a note I made while halfway through the book). You'll have to read it to see if I'm right. If Alten snuffs out all his cussing characters, maybe he's giving a moral here. My congratulations go to Wilson for faring better in the language department.

In conclusion, I would like to say a word on behalf of all the slaughtered whales in *Meg*. Large *megalodon* sharks and our modern whales battled each other throughout the world's oceans for a period of some 14 million years. The final score is: whales 1,000,000 plus; *megalodons* 0.

Extinct, by Charles Wilson: published by St. Martin's Paperbacks, May 1997, 310 p., $6.50.

Meg, by Steve Alten: published by Doubleday, July 1997, 278 p., hardback, $22.95.

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