1988

Data Base for Mineral Resources Exploration in the Falkner, Mississippi 7.5' Quadrangle

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The Mississippi Mineral Resources Institute
University, Mississippi 38677

DATA BASE FOR MINERAL RESOURCES EXPLORATION IN THE FALKNER, MISSISSIPPI, 7.5' QUADRANGLE

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August 1988

ABSTRACT

The oldest geologic unit cropping out in the Falkner. Mississippi.,7.5' Quadrangle is the McNairy Sand Member of the Ripley Formation. The Owl Creek Formation uncomformably overlies the McNairy Sand and is the youngest Cretaceous unit; its upper contact marking the Cretaceous - Tertiary boundary. Both of these units are included in the Selma Group. The Clayton and Porters Creek formations (Midway Group) have been mapped as separate formations. Isolated bauxite and bauxitic clay deposits, present at the top of the Porters Creek Formation, were not mapped separately and were included in the Porters Creek map unit. McNeil (1951) suggested that these deposits were an equivalent to the Naheola Formation, also of the Midway Group. The Wilcox Group was not subdivided in the study area. The youngest Tertiary unit is the Meridian Sand, basal unit of the Claiborne Group. The Meridian Sand overlaps the Wilcox Group and may lie unconformably on the Porters Creek Formation.

The predominant structural feature is the Muddy Creek Fault Zone. The fault zone consists of a series of normal faults trending along the present course of Muddy Creek. Due to sparse subsurface control, other components of the fault zone may be present which were not identified during surface mapping.

Notable mineral resources identified during field operations were bauxite and bauxitic clay, ball clays, glauconite, and construction sand. The upper section of the Porters Creek Formation is presently mined near Ripley. The presence of faulting in the study area and hydrocarbons in the Paleozoic outcrop belt make the subsurface Paleozoic section an attractive hydrocarbon target. The eastern (upthrown) side of the Muddy Creek Fault Zone is untested.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Ms. Michele Morphis and Ms. Nancy Roberts. Mississippi Mineral Resources Institute, for their help in preparing the manuscript. Mr. Paul Mitchell, also of the Mineral Resources Institute, prepared the illustrations included in the text.

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Introduction

The Falkner, Mississippi, 7.5' Quadrangle adjoins the southern boundary of the Walnut, Mississippi - Tennessee Quadrangle. The mineral resources of the Walnut Quadrangle were reported earlier by Swann and Johnson (1986). This report is a continuation of this series of data bases for mineral resource exploration. Its purpose is to provide basic geologic information which may be of use to exploration geologists, well drillers, and others involved in the earth sciences.

As in the earlier data base, this report is not intended to represent the final interpretation of the geology. Problems remain in some areas of the quadrangle regarding surface stratigraphy and local structure. Interpretations were made on the basis of available time and data, but the brief descriptions herein are hoped to stimulate further investigations in this interesting area of the state.

General Geology

The Falkner Quadrangle is within the Mississippi Embayment, a large structural syncline (Stearns, 1975). Units of Tertiary and Cretaceous age overlie the indurated rocks of the Paleozoic basement. The structural and stratigraphic relationships are not well known in the subsurface Paleozoic section of northern Mississippi. In the Falkner Quadrangle unconsolidated units of Cretaceous and Tertiary age crop out at the surface.

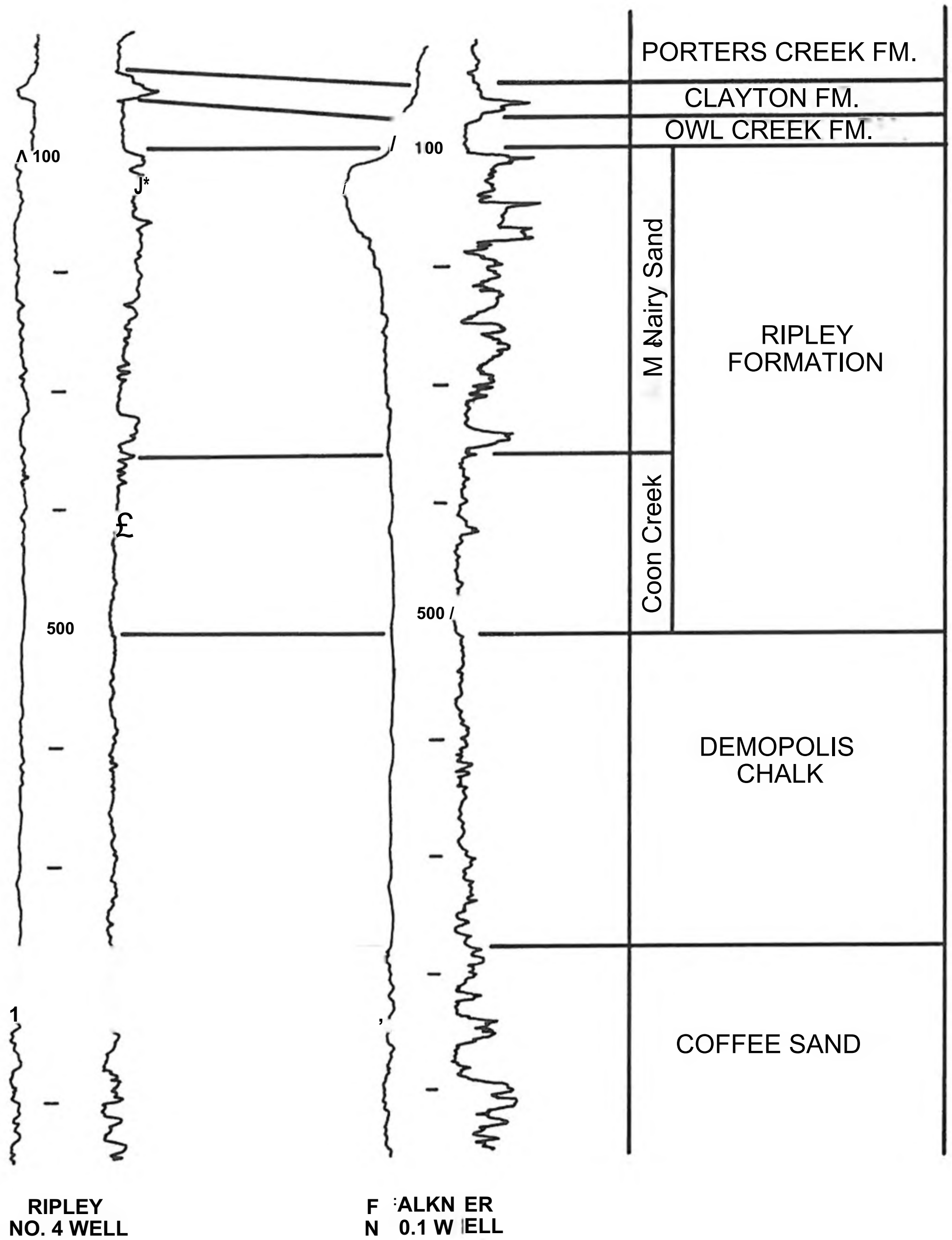
Surface Stratigraphy

The geologic map (Figure 1) was constructed from surface exposures and limited subsurface data. The U.S. Geological Survey's 7.5 minute Falkner Quadrangle map, with a 20-foot contour interval, was used as a base map. High altitude photography was used as a supplement.

The oldest unit within the study area is the McNairy Sand (Selma Group), a member of the Ripley Formation (Keroher, 1966: Dockery, 1981). The McNairy Sand typically consists of medium- to coarse-grained, micaceous, cross-bedded sands. Weathered outcrops of this unit commonly have abundant crusts of iron oxides and/or thin beds of iron oxide cemented sandstone. A total of 246 feet of sediments was assigned to the McNairy Sand in the Falkner No. 1 well (Figure 2). The McNairy Sand is considered to be in unconformable contact with the younger Owl Creek Formation.

The youngest Cretaceous unit is the Owl Creek Formation. The Owl Creek Formation (Selma Group) is differentiated from the McNairy Sand by its finer grain size. The Owl Creek typically consists of sparsely glauconitic, fossiliferous, sandy silts and clays. It is 28 feet thick in the Falkner No. 1 well and thickens to 47 feet in the Ripley No. 4 well (Figure 2, also see Appendix A). The Owl Creek saprolite often consists of light-gray, sandy clays. The contact between the Owl Creek and the Lower Tertiary Clayton Formation is unconformable.

The Clayton Formation (Midway Group) consists of a basal, coarse- to fine-grained, argillaceous sand unit containing clay clasts and rare *Ophiomorphia* sp. burrows. This basal unit is present only in the northeast corner of



ELECTRIC LOG RESPONSES TO SUBSURFACE UNITS

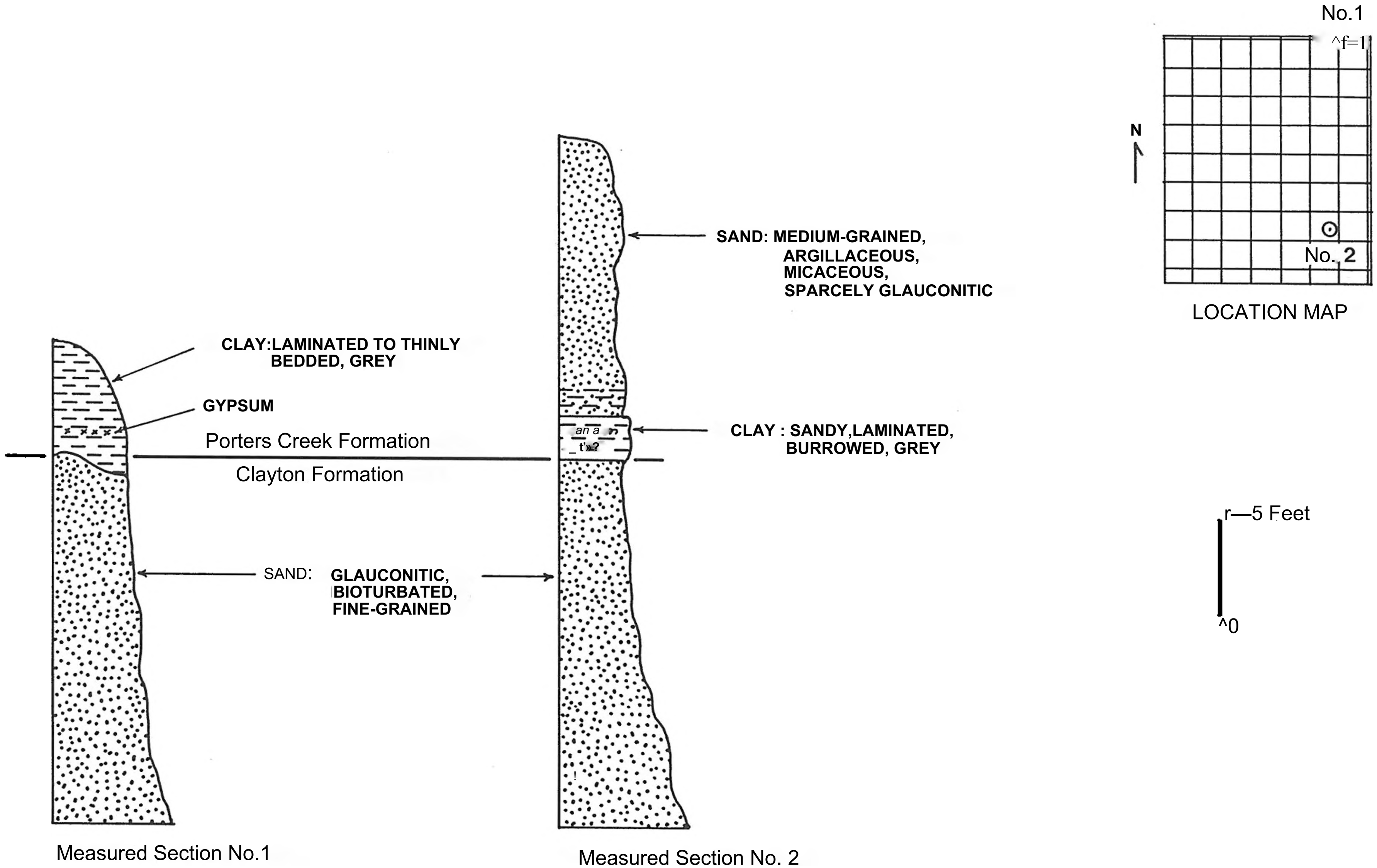
FIGURE 2

the study area and corresponds to a thickening of the Clayton. Overlying the basal sand facies is a glauconitic sand facies. The glauconitic sand facies is present throughout the Clayton outcrop belt. No limestone beds are noted within the study area, although they are present in Walnut Quadrangle (Swann and Johnson, 1986) and in the Owl Creek type section (in the Ripley Quadrangle (Connant and McCutcheon, 1941)).

The contact between the Clayton and the younger Porters Creek Formation (Midway Group) is gradational and conformable. The lower section of the Porters Creek Formation contains more sand in the northern quarter of the study area, making the contact difficult to recognize in weathered surface outcrops. The sand content decreases southward, however, and the contact is easily distinguishable. Figure 3 compares measured sections containing the Clayton-Porters Creek contacts in the northern and southern portions of the study area. The Clayton thickens eastward as the nearshore facies thicken.

The Porters Creek Formation consists of a basal unit of interbedded sand and montmorillonite clays. The sand content decreases southward. The Tippah Sand Lentil, a member of the Porters Creek Formation, is not present in the study area. A majority of the formation consists of medium- to dark-gray, blocky clays. East of Muddy Creek, the formation is present only as outliers, but some are of considerable size. The majority of the outcrop belt lies west of Muddy Creek. The clay is mined northwest of Ripley by the Oil Dri Corporation and is used primarily as an absorbent.

The upper contact of the Porters Creek is unconformable and sharp. An ideal stratigraphic section would place the Naheola Formation above the Porters Creek Formation. MacNeil (1951) assigned the zone of bauxite and kaolinitic sediments overlying the Porters Creek to the Naheola Formation. This interpretation is questioned by



MEASURED SECTIONS - FALKNER QUADRANGLE

FIGURE 3

some geologists working in the section. In this investigation the in situ bauxite and kaolin deposits are included in the Porters Creek map unit due to the difficulty of mapping relatively small discontinous units. Reworked bauxite and kaolin are assigned to the younger Wilcox Group.

The Wilcox Group was not formally divided into formations. It typically consists of a basal sand unit and an upper unit of clay and/or silts. Channels filled with well rounded to very angular clay boulders are present (Figure 4) in the basal unit. These features could also be interpreted as slumps associated with growth faulting or the landward end of turbidity flows which developed shortly after deposition. These features may thus indicate faulting in the general proximity. Just above the Wilcox - Midway contact, the basal sand is medium- to fine-grained and contains lenses of reworked sandy, pisolitic, bauxite and clay. This unit is best exposed in the Tippah Lake - Wicker Mountain area.

Above the basal Wilcox unit is a section of silty, thinly bedded to laminated clays. The clay laminae are separated by fine- to very fine-grained sand with the sand partings containing sparse, fine-grained glauconite. The clay section changes facies in the northern quarter of the study area to bedded clays and silts. The West Prong drainage basin appears to mark the approximate location of this facies change. The northern facies is best exposed in the Walnut Quadrangle and the southern facies is typically exposed in road cuts in Section 21, T3S, R3E.

The overlying Meridian Sand consists of a coarse- to fine-grained, crossbedded, gravely sand. In weathered outcrops, the sands are argillaceous and typically light red in color. The lower section of the Meridian Sand contains sediments reworked from the older units. For example, an exposure near Pine Hill Church (Sec. 29, T.3 S., R.4 E.) contains bauxitic pisolites reworked into a medium- to

Figure 4 - Photograph of clay boulder filled channel in the lower Wilcox section

coarse-grained sand matrix. The pisolites were probably derived from the basal Wilcox/upper Midway section.

The Meridian Sand, basal unit of the Claiborne Group, extends eastward beyond the outcrop belt to the older Wilcox and Midway groups. The basal Meridian contact is very irregular, with channels cutting into the underlying units. Apparently, such a channel has led to an unusual stratigraphic relationship west of Lindsey Mountain, with the Meridian lithology cropping out at lower elevations than the older Wilcox Group. This stratigraphic relationship may also have resulted from downslope movement of the sands and gravels into alluvial deposits at the base of steep slopes. These deposits occur in a restricted area, however, which tends to support the channel hypothesis.

Structure

Structural interpretations are based on surface exposures and very limited subsurface data. The surface units are reasonably easy to distinguish in the field making detection of displacement reasonably reliable. The largest uncertainty is the orientation of structures. Large areas without surface exposures or subsurface data make determination of structural orientations somewhat conjectural.

The most obvious structural component is the north - south trending Muddy Creek Fault Zone extending from the Walnut Quadrangle. The fault zone is interpreted as a series of normal faults oriented along Muddy Creek. These faults are upthrown on the eastern side, resulting in truncation of the Porters Creek outcrop belt. Only dissected ridges and outliers of the lower section of the Porters Creek are present east of the fault zone. The steep, eastern boundary of the Muddy Creek floodplain may represent a composite faultline scarp.

A minor fault was noted in the sand pit north of Tippah Lake (Sec. 26. T3S, R3E) . The fault has a strike of north 38 degrees east and a dip of 75 degrees to the south. Displacement along the fault is only a few feet, but it does crosscut beds within the Meridian Sand, indicating post early Eocene movement.

East of Muddy Creek is a normal fault subparallel to the Muddy Creek Fault Zone. The fault is upthrown on the East, suggesting that it is a component of the Muddy Creek Fault Zone. The lower section of the Porters Creek is preserved between the Muddy Creek Zone and this fault. The fault also appears to limit the eastern edge of the Porters Creek outcrop.

The entire section dips to the West on a regional scale, but Connant and McCutcheon (1941) have suggested that the area north of Falkner dips to the north. This investigation supports their conclusion. The Clayton - Owl Creek contact, for example, is exposed at elevations of approximately 530 feet in the southern half of the quadrangle, but the elevation is only approximately 490 feet in the northeast quarter of the quadrangle. The geologic map (Figure 1) and a series of cross sections (Figure 5) illustrate the structural and stratigraphic attitude of the quadrangle.

Mapping Problems

Most of the mapping problems were encountered in the eastern third of the quadrangle. The Clayton Formation was especially problematic in the northeastern corner of the quadrangle. The Clayton becomes considerably thicker here than in the southern half of the quadrangle and contains a coarse-grained, basal, nearshore, sand facies not present elsewhere. The nearshore facies is coarser grained than the typical glauconitic, marine facies. The Clayton also contains a thin clay unit that weathers to a saprolite very similar to the Owl Creek saprolite. Detailed mapping determined that the clay unit was within the upper section of the Clayton rather than within the Owl Creek, as initial mapping indicated.

As noted earlier, the Clayton - Porters Creek contact is conformable and gradational. Some of the sediments in the northeastern corner may therefore be the time equivalent of the Porters Creek. The lithologies were more consistent with the Clayton lithology and were mapped as such.

Structure also complicates the geology in the northeastern quarter of the quadrangle. Reliable Porters Creek - Clayton contacts were identified along Muddy Creek, and reliable Clayton - Owl Creek contacts were identified on the eastern edge of the Falkner Quadrangle and the western edge of the adjoining Peoples Quadrangle. The westward projection of the older units at reasonable dips resulted in the juxtaposition of the Clayton and Owl Creek formations with the Porters Creek Formation. The problem is compounded if a northerly dip is assumed. Faulting appears to be the most reasonable solution to this problem.

Displacement of formational contacts was noted in other places in the southeastern corner of the quadrangle. Data were insufficient to determine if structure was present in these areas. The structural/stratigraphic relationships in the eastern third of the quadrangle are complex. Additional detailed mapping and subsurface data in this region would further aid the existing interpretation.

Mineral Resources

The mineral resources and mining activities in the Falkner Quadrangle are illustrated in Figure 2. The mineral resources were noted by examination of surface exposures.

Careful economic and geologic analysis is recommended prior to utilization.

Ball Clay - Exposures which may contain useful ball clay deposits are present in the northwest corner of the study area. These clays are associated with the Wilcox Group and consist of silty to sandy clays with some organic material. The Wilcox clays in the southern half of the map area appear to possess less plasticity. Clay lenses within the Meridian Sand may also be useful for ball clays. but they are typically lenticular and quite small.

Bauxite - Bauxite is composed of a number of minerals which are useful for the manufacture of high temperature refractories and as an ore of aluminum. A sandy. pisolitic clay is commonly present at the base of the Wilcox. These bauxitic sediments are reworked and seldom have sufficient lateral extent or purity to be of economic value. Other bauxite and kaolin deposits, however, are associated with the Wilcox - Midway contact with greater potential for economic utilization. These bauxitic materials have been interpreted as a weathering zone by Mellen and McCutcheon (1939) and assigned to the Betheden Formation. MacNeil (1951) reinterpreted these deposits as sedimentary and suggested that they may be equivalent to the Naheola Formation (Midway Group). He also formally abandoned the Betheden name.

Regardless of the stratigraphic nomenclature, the most promising bauxite prospect in the study area is in the northeast corner of Section 4. T4S. R3E. The basal unit is a red. indurated, pisolitic bauxite. Above the bauxite are massive pisolitic clays. Should the entire hilltop be composed of these bauxitic materials, as much as 30 feet of section could be present.

Glauconite - Glauconite is occasionally used as a soil conditioner and as a water softener. The beds of the Clayton Formation contain the largest amounts of glauconite.

Some Clayton exposures may contain as much as 30 percent glauconite grains.

Heavy Minerals - Heavy minerals are present in small amounts in sand units of Tertiary and Cretaceous age. A thin bed of concentrated, dark, heavy minerals was noted in the Meridian Sand of the Walnut Quadrangle (Swann and Johnson, 1986). Similar beds of concentrated heavy minerals were not noted in the Falkner Quadrangle. The Meridian, as well as the McNairy sand, contains heavy minerals in quantities of less than one percent.

Limestone - Limestone was not noted in the Falkner Quadrangle, but is present in the lower section of the Clayton Formation in the Walnut Quadrangle (Swann and Johnson, 1986).

Phosphate - Conant and McCutcheon (1941) report that phosphate was mined for local use approximately one mile east of Falkner. This phosphatic bed was confirmed by test well A257 (well number six of this report). The phosphatic bed was not identified during field operations, however, the location is included in Figure two.

Sand - The most commonly utilized mineral resource in the area is construction sand. Sand has been mined from numerous locations in the outcrop belts of the Meridian Sand, Clayton Formation, and McNairy Sand. The sands are most suitable for road and foundation construction. No glass sands were encountered during the investigation.

Oil and Gas - No hydrocarbon production exists in Tippah County or any of the adjoining counties. This lack of production can be attributed in part to the lack of exploration. There are two hydrocarbon test wells in the Falkner Quadrangle. Houston Oil and Mineral Company's No. 1 Harrell well was drilled in 1975 in Section 34, Township 2S, Range 3E. This well has a total depth of 4216 feet, encountering the Paleozoic basement 1215 feet below the surface. Falkner Oil Company's No. 1 Jackson well was spudded in 1966 in Section 2, Township 3S, Range 3E. The well has a total depth of 1220 feet, encountering the Paleozoic basement at a depth of 1200 feet. Surface mapping revealed no structure which may have dictated the location of these wells. All of the wells were plugged and abandoned without production.

The lack of hydrocarbon production from these wells should not be considered sufficient evidence to discount potential production. Hydrocarbons in the Paleozoic section have been noted within the region. Russell (1968) has noted oil shows in Memphis Equipment Company’s John Curtis No. 1 well in Hardin County, Tennessee. These oil showings were assigned to the Knox section of Cambrian age. Bramlette (1925) notes oil and gas showings in the Mississippi Oil and Refining Co., Southward No. 1 well and Iuka Development Corporation’s Jordan No. 1 well, both in Tishomingo County, Mississippi. Morse (1933) also discusses the presence of oil residues in the Paleozoic outcrop of Tishomingo County.

Very little is known about the production potential of the Muddy Creek Fault Zone. The upthrown (eastern) side of the Muddy Creek Zone is untested, but it provides the needed trapping mechanism and fracture porosity for hydrocarbon accumulation and production.

Remote Sensing Analysis

Satellite photography using the near infrared portion of the spectrum can be used to identify lineaments which may represent faults and/or fracture zones. These zones are often associated with increased fracture porosity which is reflected in the plant cover. The photography can detect these changes in reflectivity of the plants.

Tonal circular anomalies also reflect changes in the reflectivity of an area’s plant cover, but these changes are thought to reflect migration of hydrocarbons to the surface in very small amounts. The plants are affected by the hydrocarbons, and their response is detectable on the satellite photography.

Geological interpretations of satellite photography must be used with caution. Lineaments are occasionally a product of chance with no relationship to the geology. They also may reflect cultural features which should be excluded from consideration. Tonal circular anomalies can reflect topography, or they can reflect migration of fluids other than hydrocarbons. A thorough understanding of the area's geology should be used to evaluate the relevence of all interpretations from satellite photography.

Figure 6 illustrates the major lineaments and tonal circular anomalies in the Falkner Quadrangle. Two tonal circular anomalies are centered north and northwest of Falkner, Mississippi. The northern anomaly is centered in the northwest quarter of Section 36. T2S. R3E, and the northwestern anomaly is centered on the intersection of Sections 34 and 35 of T2S. R3E and Sections 2 and 3 of T3S. R3E. These two anomalies appear to be separated by a secondary lineament. The Houston Oil and Mineral Company’s No. 1 Harrell hydrocarbon test well lies within the northwestern anomaly, but the No. 1 Harrell does not coincide with a lineament.

Two major trends of the lineaments of the map area exist: a northeast-southwest trend and a northwest-southeast trend. No lineaments trend north-south or east-west within the quadrangle. The highest concentration of lineaments is between Falkner and Ripley. If these lineaments represent fractures or fault zones, they may provide zones of fracture porosity which would be advantageous for hydrocarbon production.

Groundwater Resources

The municipal water supplies in Tippah County are from the Cretaceous Coffee Sand and the McNairy Sand. Gandi (1982) lists 16 large wells in Tippah County utilizing the Coffee Sand., three wells utilizing the Ripley (probably McNairy)., and two wells utilizing the Eutaw-McShan aquifer. The Ripley Aquifer wells produce 120 to 300 gallons per minute. The Coffee Sand and the Eutaw-McShan wells produce 100 to 560 and 90 to 150 gallons per minute, respectively. Boswell (1963) indicates that the Clayton Formation and sand units in the Wilcox Group are used for private water supply. The thick sand sections of the Meridian Sand would also be suitable for residential use. Aquifer data for these Tertiary units are not available.

Water quality in the outcropping Meridian Sand may not be as good as underlying units. Furthermore, the utilization of the unconfined Meridian aquifer is more susceptible to contamination from the surface, and is subject to greater fluctuations in the potentiometric surface. No problems exist with water supply or quality because of a relatively small population and few high water-use industries.

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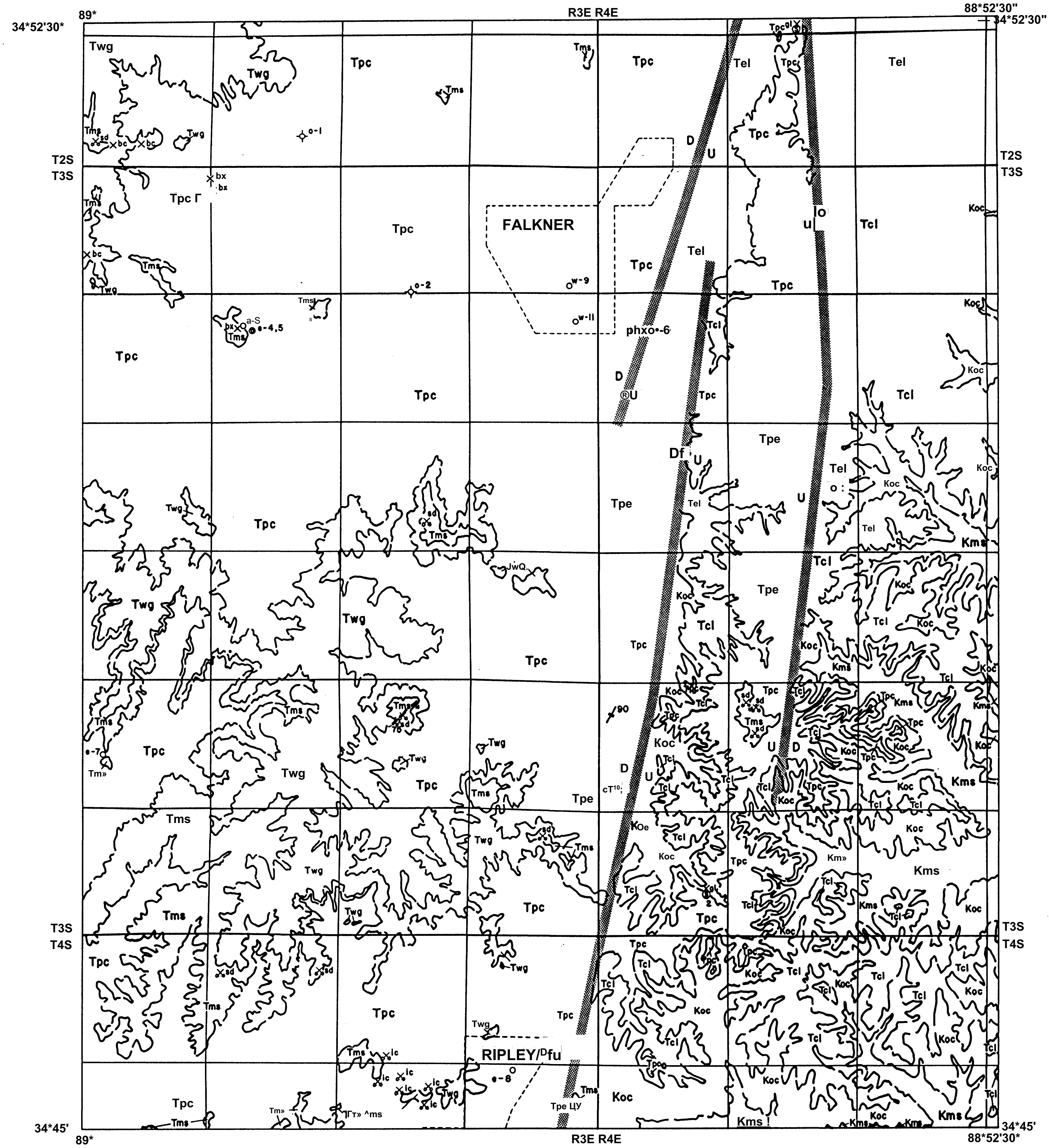
APPENDIX A

Map #	Well Name	Use of Well	Location	Source of Data
1	Houston Oil & Mineral Corporation, No. 1 C.T.Harrell	oil test well	Sec. 34, 2S, 3E, 1386' FSL, 1518' FEL	Petroleum Information Corporation Oil and Gas Board files and logs
2	Falkner Oil Company, No. 1 John T. Jackson	oil test well	Sec. 2, 3S, 3E, 1' FSL, 271' FWL, SE 1/4	Petroleum Information Corporation Oil and Gas Board files and logs
3	J.C.McElwain Property, Test Hole A188	mineral exploration well	Sec. 10, 3S, 3E, near center of NW 1/4	Conant and McCutcheon, 1941, p.96
4	J.C.McElwain Property, Test Hole A171	mineral exploration well	Sec. 10, 3S, 3E, SE 1/4 of NW 1/4	Conant and McCutcheon, 1941, p.91
5	J.C.McElwain Property, Test Hole A203	mineral exploration well	Sec. 10, 3S, 3E, SW 1/4 of NW 1/4	Conant and McCutcheon, 1941, p.100
6	J.L.Reed Property, Test Hole A257	mineral exploration well	Sec. 7, 3S, 4E, NE 1/4	Conant and McCutcheon, 1941, p.104
7	H.E.Finger, Attorney-in-fact, Property, Test Hole A212	mineral exploration well	Sec. 28, 3S, 3E, NW 1/4 of SW 1/4	Conant and McCutcheon, 1941, p.100
8	L.A.Mogan Property, Test Hole A165	mineral exploration • well	Sec. 12, 4S, 3E, NE 1/4 of NW 1/4	Conant and McCutcheon, 1941, p.89
9	City of Falkner, No. 1 well	public water supply	Sec. 1, 3S, 3E, SW 1/4, SE 1/4, SE 1/4	MS Bureau of Geology files
10	City of Ripley, No. 4 well	public water supply	Sec. 30, 3S, 4E, NE, NIÍ, SW	MS Bureau of Geology files
11	City of Falkner No. 2 well	public water supply	Sec. 12, 3S, 3E, SW 1/4, NE 1/4, NE 1/4	MS Bureau of Geology files



LEGEND

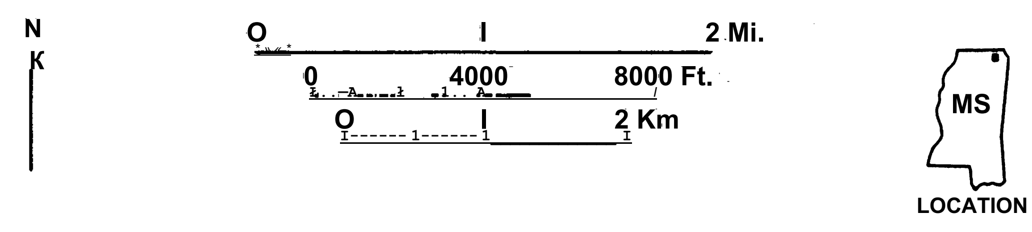
GEOLOGY

Tm» - Meridian Sand
Twg - Wilcox Group
Tpc - Porter» Creek Fm.
Tel - Clayton Formation
Koc - Owl Creek Formation
Km» - MCNairy Sand (member-Ripley Fm.)

MMMM- Inferred fault
75 - Fault» showing dip
90 - Vertical Joint

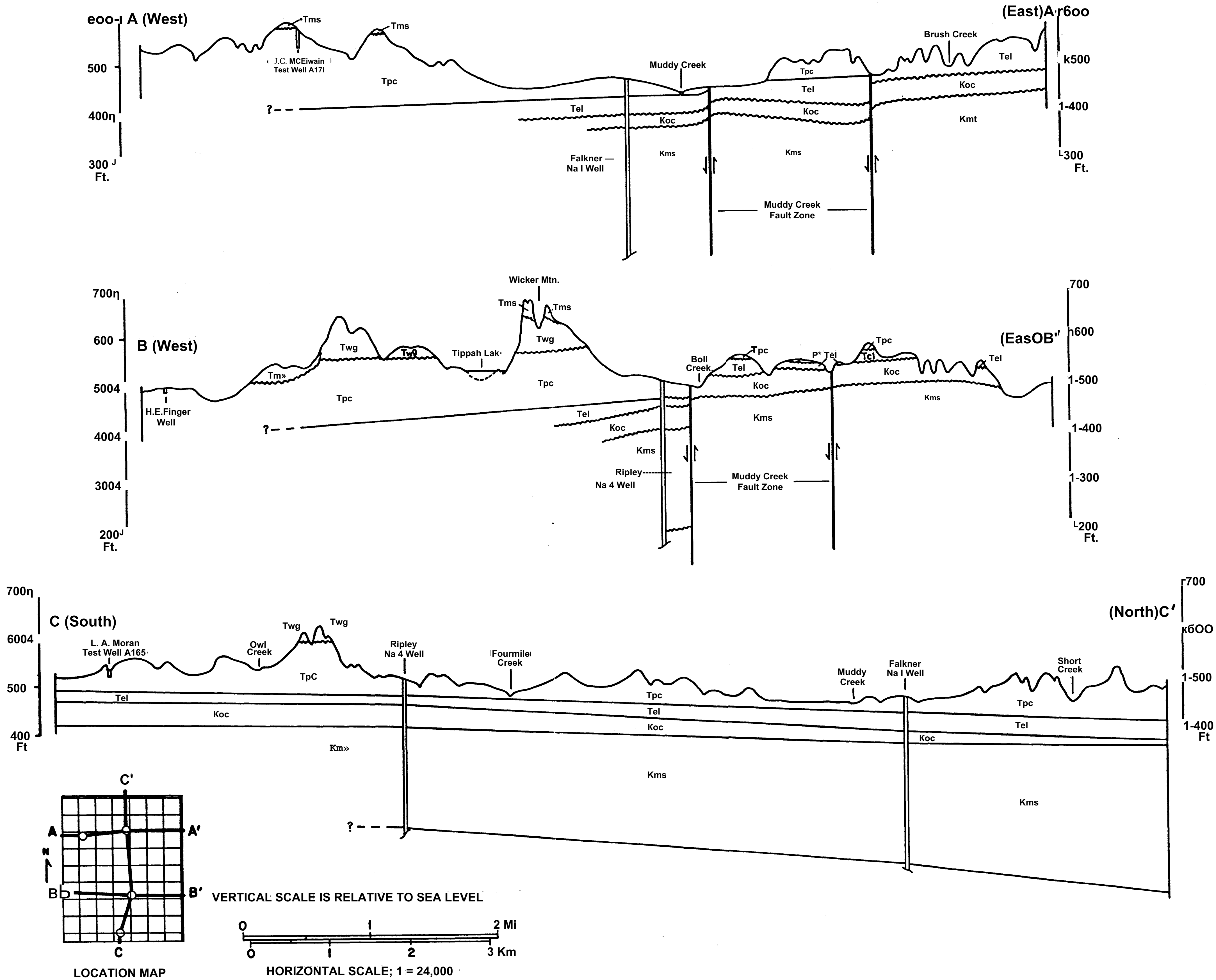
MINERALS

»d - »and
bx - bauxite
be - ball clay
le - Industrial elay
gl - glouconite o ·"# " mineral exploration well
ph - phosphate
X - prospeet . O w-# - water wall & number
K - pit
фo-# - oil tost well β number
Φ» • location a number of measured section



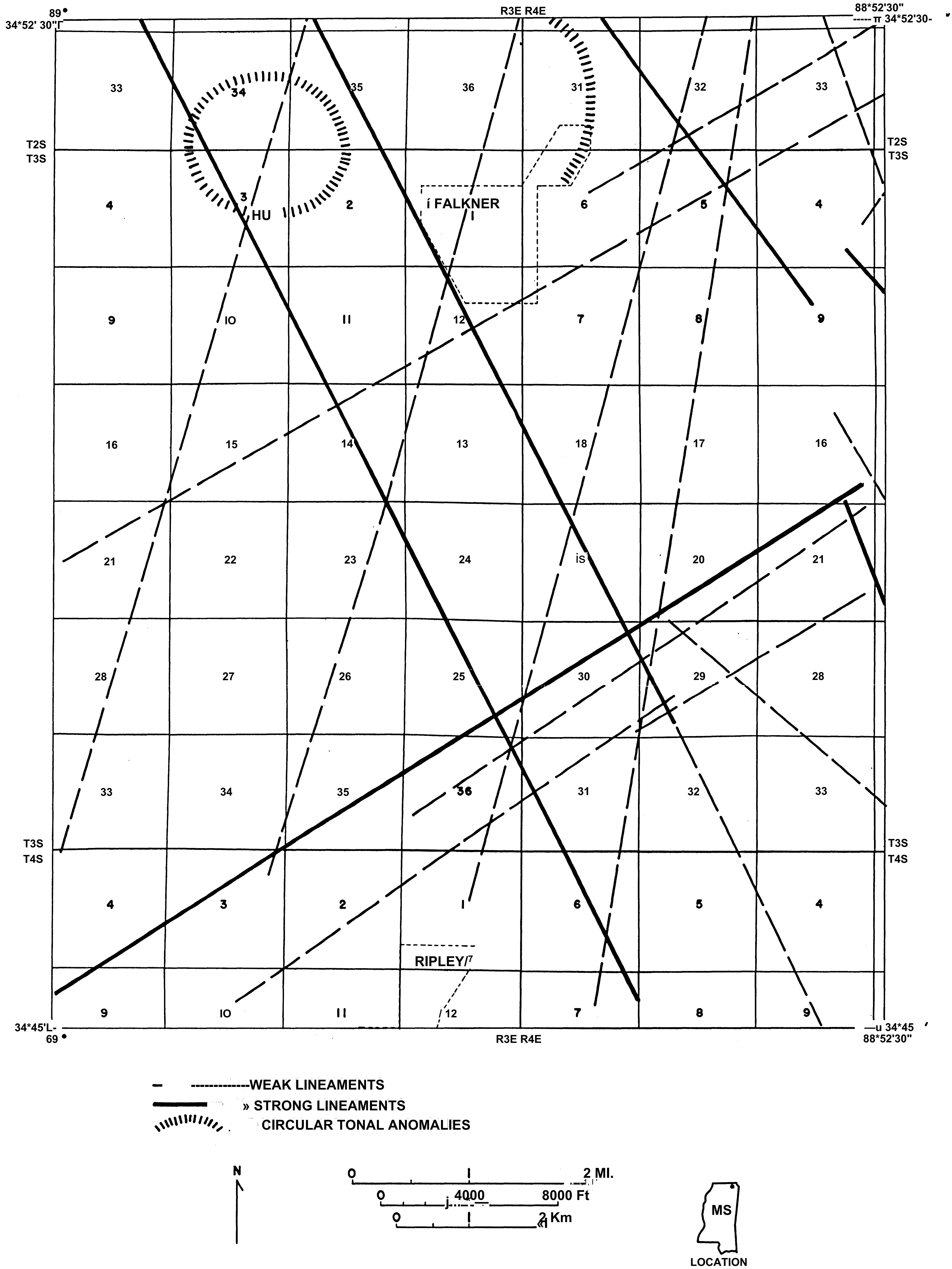
GEOLOGIC MAP OF FALKNER QUADRANGLE

FIGURE 1



GEOLOGIC CROSS SECTIONS - FALKNER QUADRANGLE

FIGURE 5



LANDSAT INTERPRETATION OF FALKNER QUADRANGLE

FIGURE 6