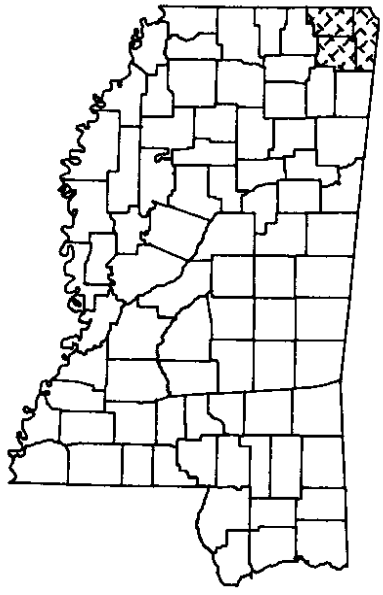
POTENTIOMETRIC MAP OF THE PALEOZOIC AQUIFER IN NORTHEASTERN MISSISSIPPI FALL AND WINTER, 1992

by

Stephen P. Jennings and Patricia A. Phillips

OLWR HYDROLOGIC MAP 93-6



MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

OFFICE OF LAND AND WATER RESOURCES

Charles T. Branch

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STATE OF MISSISSIPPI
DEPARTMENT OF ENVIRONMENTAL QUALITY
JAMES I. PALMER, JR.
EXECUTIVE DIRECTOR

LETTER OF TRANSMITTAL

Commission on Environmental Quality
of the State of Mississippi

To the Citizens of the State of Mississippi:

The Department of Environmental Quality, Office of Land and Water Resources, is pleased to transmit to you OLWR Map 93-6, entitled "Potentiometric Map of the Paleozoic Aquifer in Northeastern Mississippi, Fall and Winter, 1992" by Stephen P. Jennings and Patricia A. Phillips.

The wise use of the ground-water resources of Mississippi is dependent upon the collection of water-level data. This report presents data and interpretations pertinent to that effort.

It is hoped that water-management agencies, municipalities, water associations, and the water development industry can utilize data from this report to the benefit of the citizens of the State of Mississippi.

Respectfully submitted,

R. B. Flowers

R. B. (Dick) Flowers
Chairman

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POTENTIOMETRIC MAP OF THE PALEOZOIC AQUIFER IN NORTHEASTERN MISSISSIPPI, FALL AND WINTER, 1992

INTRODUCTION

Paleozoic rocks form a significant aquifer in northeastern Mississippi, providing the principal source of freshwater for Corinth, Iuka, and water associations in Alcorn and Tishomingo Counties. The Mississippi Department of Environmental Quality, Office of Land and Water Resources, monitors ground-water levels in the Paleozoic aquifer as part of the on-going efforts of the agency to study and report on the water resources of the state. This map is one of a series of potentiometric maps published by the Mississippi Office of Land and Water Resources that present water-level data and interpretations of the major fresh-water aquifers of the state. The maps depict the potentiometric surfaces of the aquifers at five year intervals in order to document changes in water levels. It should be noted that water levels may be highly variable from season to season or even daily, and therefore only long-term and regional trends should be interpreted from the data presented here. This publication augments and updates water-level information previously published by the U.S. Geological Survey Water Resources Division in cooperation with the Mississippi Office of Land and Water Resources (Darden, 1984; Goldsmith, 1992; Wasson, 1979; Wasson and Tharpe, 1975).

Water-level measurements reported here (Table 1 and Plate 1) were made in Paleozoic wells from October, 1992 through January, 1993. Water levels were measured with a steel tape and corrected for height of the measuring point above land surface datum. The well location and land surface elevation for each well were estimated from a U.S. Geological Survey 7.5 Minute Series Topographic Map. Base maps were computer-generated by using digitized well locations plotted on topographic maps and a Geographic Information System (GIS) database. Subsurface hydrogeologic maps, utilizing data from geophysical well logs, well cuttings, and drillers' logs, were used to determine that the wells used in this study were screened in the Paleozoic rocks.

ACKNOWLEDGEMENTS

In the course of the field investigations, J.F. Everett, P.E. Grantham, D.L. Hardin, L. Stewart, and A.J. Warner were of great assistance in the collection of water-level data used in this study. Water-level data for wells in Corinth were enthusiastically provided by R. Lilly of the Corinth Gas and Water Department. E.H. Boswell and J.H. Hoffmann made many helpful suggestions and reviewed the report. A.J. Warner was most helpful in providing information concerning water use from the Paleozoic aquifer.

HYDROGEOLOGY

Sedimentary rocks of Paleozoic age subcrop beneath Upper Cretaceous sediments in northeastern Mississippi and are exposed in limited outcrop areas in Tishomingo County, principally along the shores of Pickwick Lake (Merrill et al, 1988). Although the Paleozoic-Cretaceous topographic surface generally slopes westward at rates of 25 to 35 feet per mile, the

Paleozoic formations generally dip to the south-southwest at 25 to 50 feet per mile. Progressively younger Paleozoic rocks subcrop from northwest to southeast across the area. Wells are screened in chert of probable Devonian age in the Corinth area, but the overlying Mississippian Iowa chert and cherty limestone is the principal ground- water source in southeastern Alcorn County and in northern Tishomingo County. The aquifer intervals are composed primarily of white to light gray, weathered and fractured chert beds. The degree of hydraulic interconnection between aquifer intervals in the Mississippian and Devonian rocks is unknown, but they are generally considered to constitute a single aquifer system. Data from aquifer tests in Alcorn and northern Tishomingo counties show that the average hydraulic conductivity of the Paleozoic aquifer is about 60 feet/day, and the mean transmissivity is about 4,200 feet squared/day (Slack and Darden, 1991). The water storage and transmissive properties of the Paleozoic rocks are the products of a complex geologic history; important factors resulting from that history that influence the aquifer properties include depositional facies, structure, diagenetic events, weathering, fracturing, and hydraulic interconnection with the overlying Cretaceous aquifers.

AQUIFER DEVELOPMENT AND GROUND-WATER USE

The Paleozoic aquifer is a source of freshwater for public and industrial water supplies in Alcorn and Tishomingo Counties, Mississippi. Total water use from the Paleozoic aquifer is estimated to be about 5.5 million gallons per day (MGD) (Figure 1). Municipalities and water associations that use the aquifer in Alcorn County include Corinth, Alcorn Water Association, Farmington Water Association, and Kossuth Water Association. In Tishomingo County the cities of Iuka and Burnsville and the Short-Coleman Water Association utilize freshwater from Paleozoic aquifer wells.

Corinth is the principal pumping center with average daily use estimated at about 3.5 MGD. Average daily pumpage at Corinth has exceeded 2 MGD since the early 1960's and began to exceed 3 MGD in the late 1960's. Individual well yields range from 500 to 1,000 gallons per minute (gpm). References to public water-supply wells developed in the Paleozoic chert at Corinth date from the early part of this century (Crider and Johnson, 1906). Prior to 1960 the city also pumped from wells completed in the Coffee Sand (one Coffee Sand well was retained on a standby basis until the late 1960's). Corinth's exclusive use of the Paleozoic chert aquifer after 1960 has been mainly due to the presence of higher quality water than found in the Cretaceous aquifers. The city currently has eleven wells completed in the chert aquifer.

Elsewhere in Alcorn County, wells have been completed in the Paleozoic rocks since the 1970's at Glens and Biggersville (Alcorn Water Association), Farmington, and Kossuth. In 1942 a Paleozoic test well (K11), located west of Rienzi, yielded good quality water at sufficient rates to be a significant supply, but the well was never completed. Recent additional Paleozoic wells have been drilled and completed near Jacinto in the southeastern part of Alcorn County and near the Roscoe Turner Airport southwest of Corinth.

In the early 1960's the city of Iuka began developing wells screened in the Mississippian Iowa chert. The city currently pumps from four Paleozoic wells with well yields ranging from 175 to 1,000 gallons per minute. Iuka withdraws an estimated 0.72 MGD, the second largest Paleozoic pumping center in Mississippi.

WATER LEVELS

Recharge to the Paleozoic aquifer occurs in the Paleozoic outcrop areas from precipitation. Freshwater also probably enters the aquifer from connection with overlying Cretaceous aquifers. Hydrographs illustrating historical water-level changes for selected wells are shown in Figures 2, 3, and 4. Paleozoic aquifer water levels at Iuka (well E19) and elsewhere in northeastern Tishomingo County have shown relatively minor changes since significant pumping began in the early 1960's. This is the result of being near the Mississippian Iowa outcrop areas and the presence of overlying Tuscaloosa sand and gravel deposits that are probably hydraulically interconnected with the Paleozoic aquifer.

Current water levels at Corinth are generally 100 feet lower than they were in 1919 (Stephenson et al, 1928) when Paleozoic water levels more nearly represented pre-development conditions (Boswell et al, 1963). A general water-level decline of over 120 feet from 1962 to 1974 in observation well G57 resulted from the significant increase in the rate of pumpage that began in the 1960's, concentration of pumpage in a relatively small area, the total reliance on the Paleozoic aquifer that began in 1960, and relatively low aquifer transmissivities of the Paleozoic rocks in the southern part of the city (Newcome and Callahan, 1964). By the early 1970's Corinth had nine Paleozoic wells, all located within a radius of less than two miles from observation well G57. A general recovery of over 30 feet in water levels in G57 from 1974 to 1989 was a response to a greater spread in the distribution of Corinth's wells. Well G18 in Corinth shows a similar pattern of decline of water levels as G57 during the 1960's and early 1970's. In recent years, potentiometric levels in Corinth's wells have shown some recovery, probably the result of the wider distribution of pumping wells and close monitoring of pumpage and water levels by the Corinth Gas and Water Department.

At Kossuth, approximately 8 miles southwest of Corinth, Paleozoic water levels in well F69 have declined approximately 115 feet since 1979. The significant decline is probably the result of relatively low transmissivity of the chert at this locality. The recently completed additional well northeast of Kossuth at the airport should help alleviate the problem of rapidly declining water levels at Kossuth. Observation well K11, located approximately 3.5 miles south of Paleozoic wells at Biggersville and about 8.5 miles from the pumpage at Kossuth, has shown an overall water-level drop of approximately 45 feet since 1942 and has declined an average of 1.36 feet per year since 1961.

In summary, the steep cone of depression at Corinth mapped by Wasson and Tharpe (1975) and Wasson (1979) has changed into a larger but flatter depression on the potentiometric surface. Most of the wells in Corinth have shown significant water-level recoveries in recent years. The cone of depression at Kossuth, however, has grown larger and steeper. Water levels in Tishomingo County and eastern Alcorn County have shown modest or no appreciable decline.

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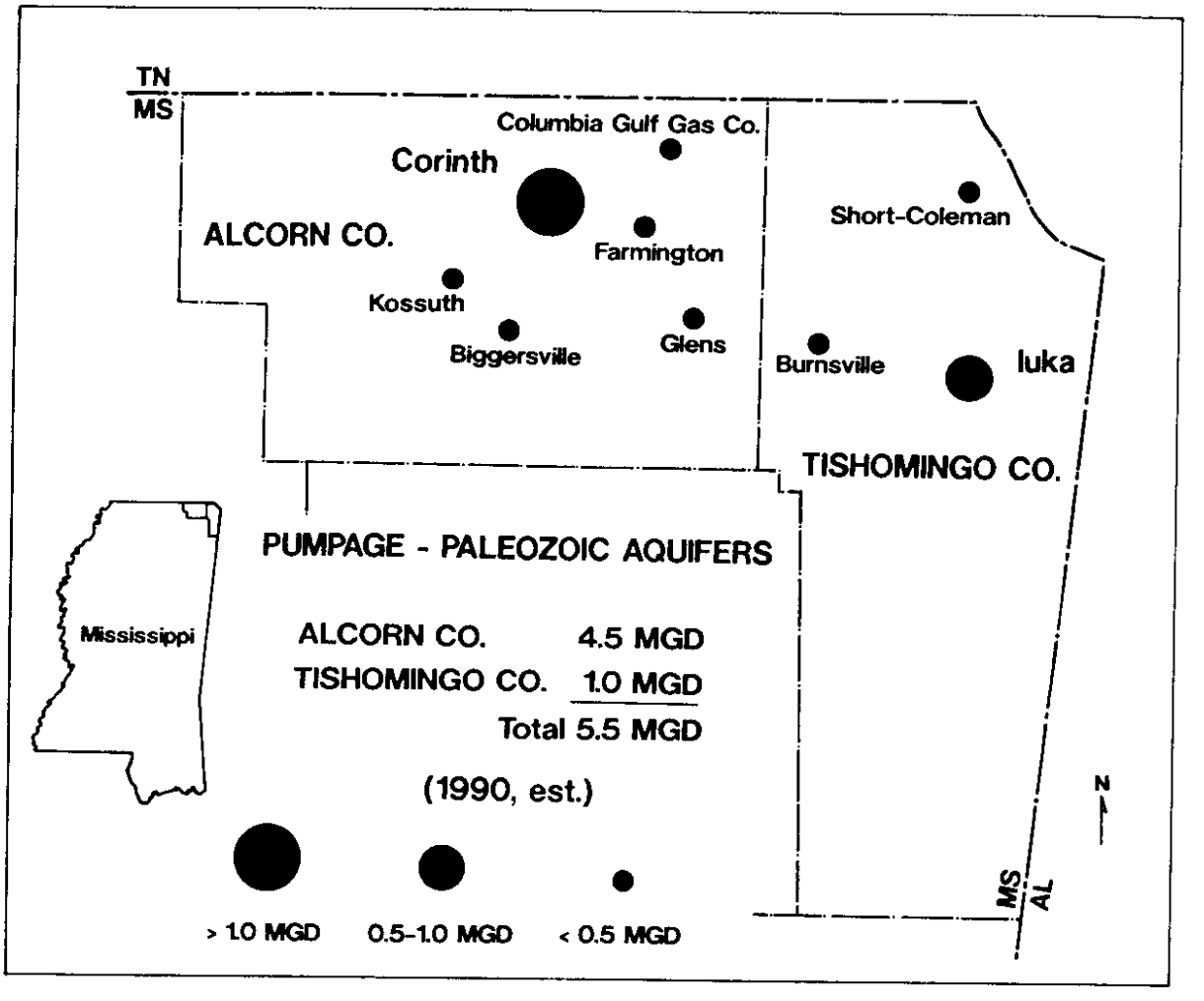


Figure 1: Pumpage from Paleozoic rocks in Mississippi.

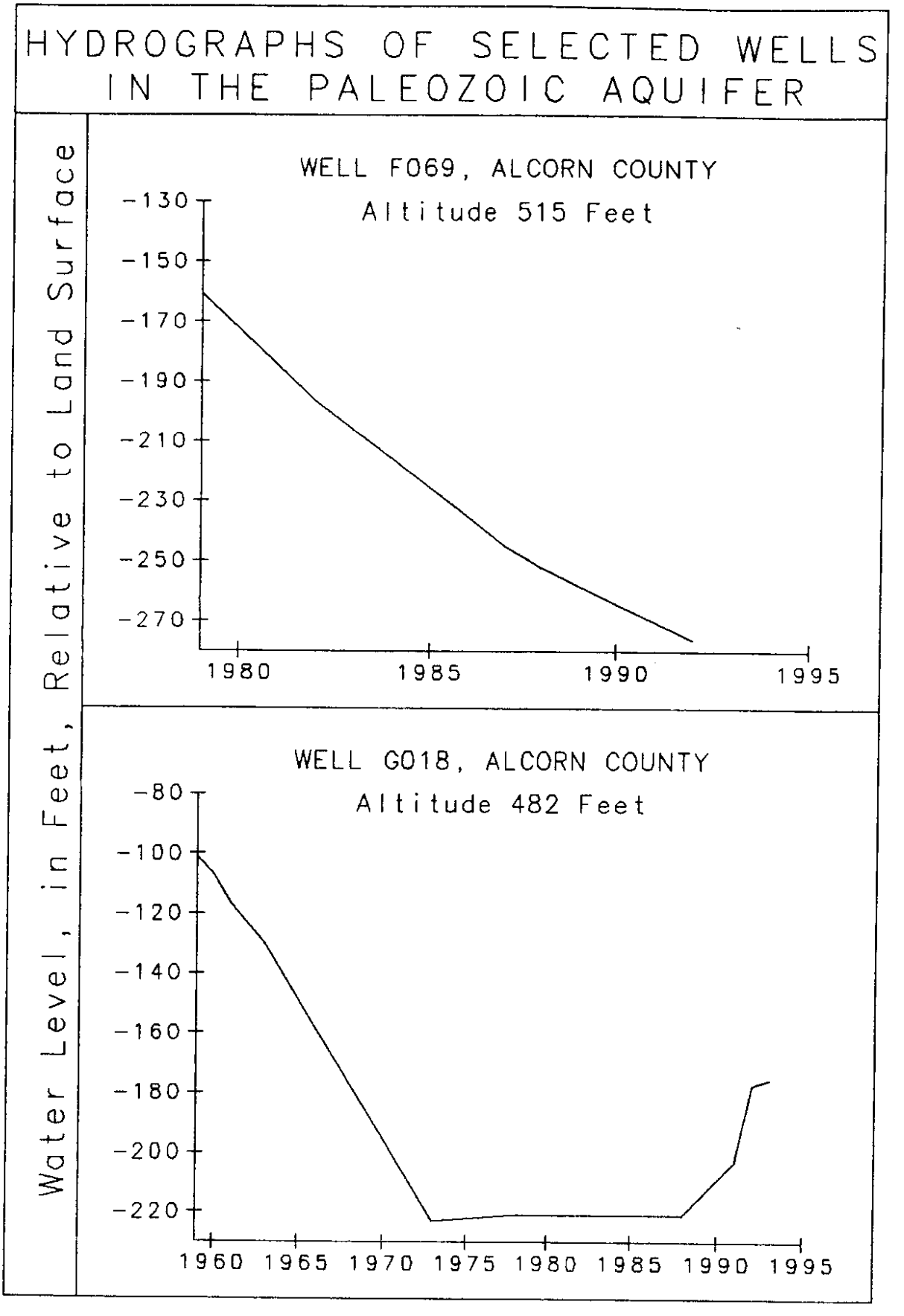

HYDROGRAPHS OF SELECTED WELLS IN THE PALEOZOIC AQUIFER
Water Level, in Feet, Relative to Land Surface
WELL F069, ALCORN COUNTY
Altitude 515 Feet
-130
-150
-170
-190
-210
-230
-250
-270
1980
1985
1990
1995
WELL G018, ALCORN COUNTY
Altitude 482 Feet
-80
-100
-120
-140
-160
-180
-200
-220
1960 1965 1970 1975 1980 1985 1990 1995

FIGURE 2

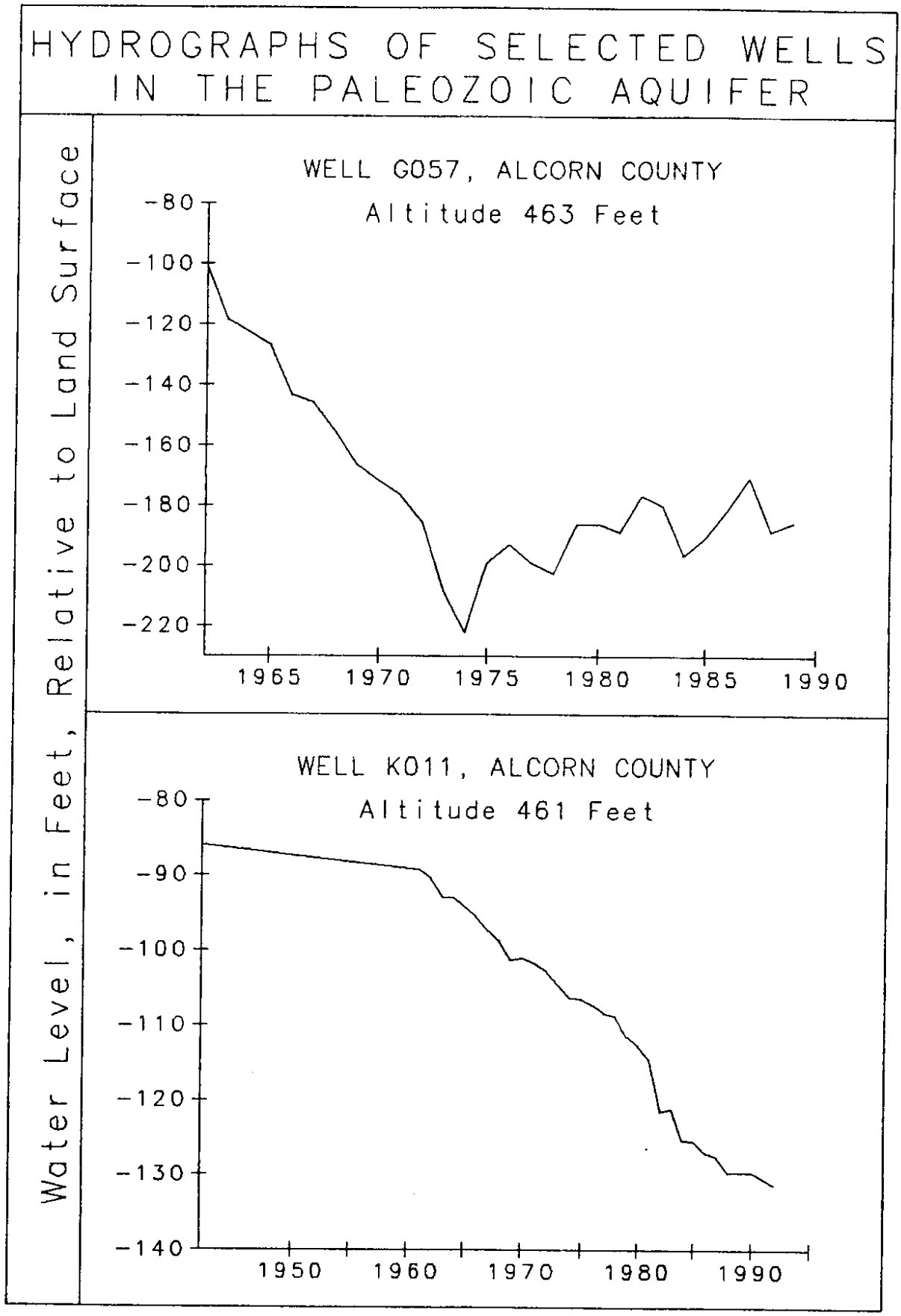

HYDROGRAPHS OF SELECTED WELLS IN THE PALEOZOIC AQUIFER
Water Level, in Feet, Relative to Land Surface
WELL G057, ALCORN COUNTY
Altitude 463 Feet
-80
-100
-120
-140
-160
-180
-200
-220
1965
1970
1975
1980
1985
1990
WELL K011, ALCORN COUNTY
Altitude 461 Feet
-80
-90
-100
-110
-120
-130
-140
1950
1960
1970
1980
1990

FIGURE 3

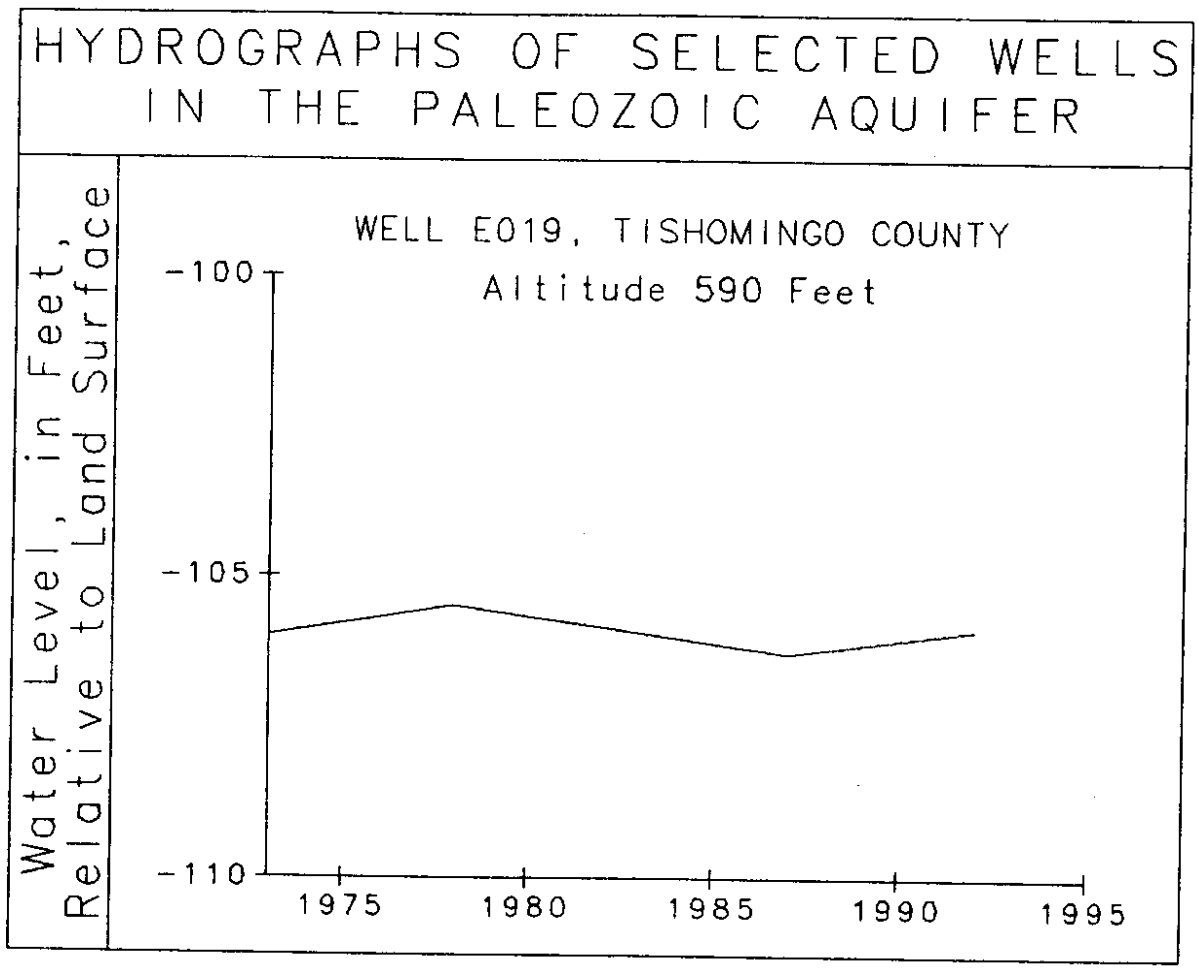
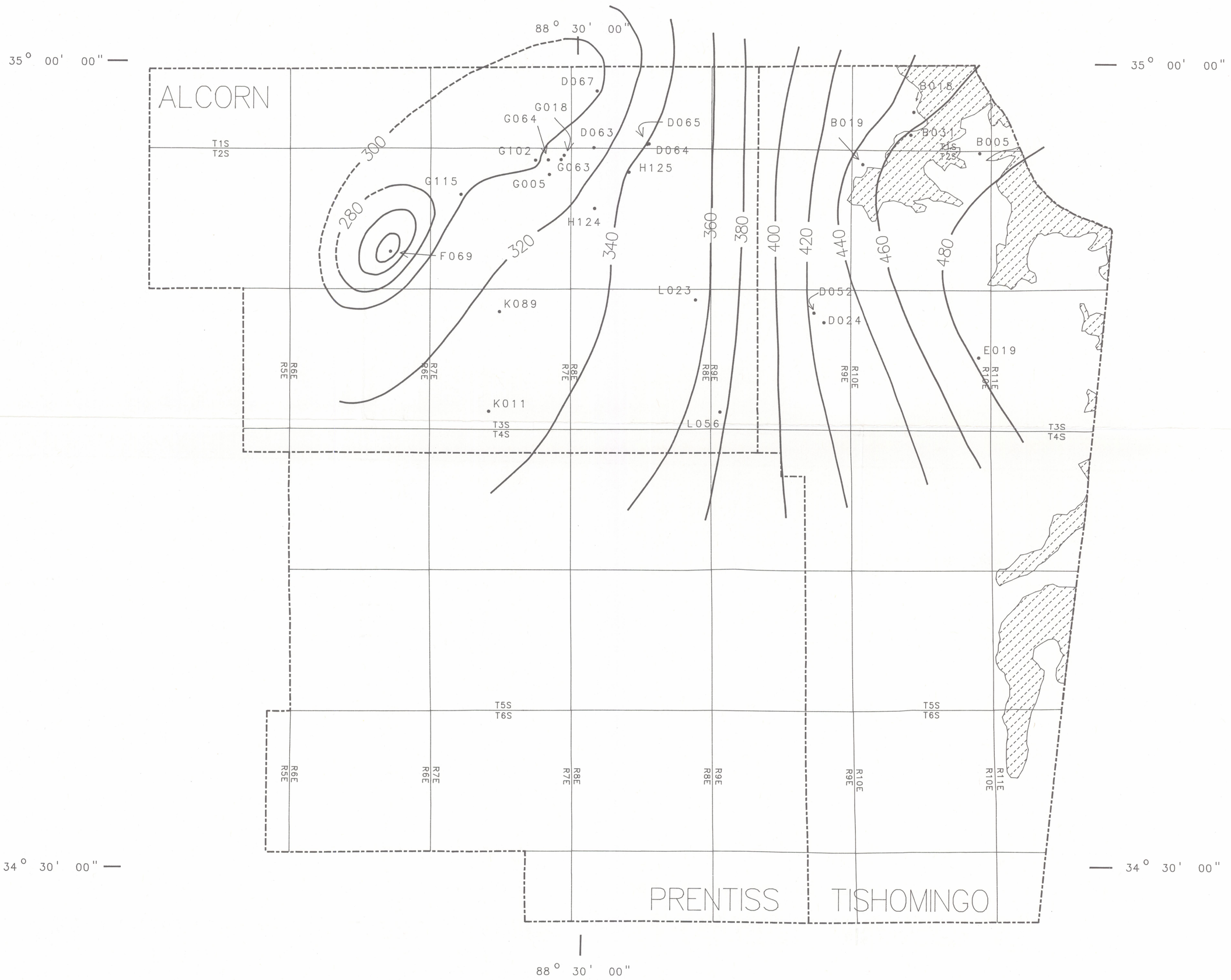

HYDROGRAPHS OF SELECTED WELLS IN THE PALEOZOIC AQUIFER
Water Level, in Feet, Relative to Land Surface
WELL E019, TISHOMINGO COUNTY
Altitude 590 Feet
-100
-105
-110
1975
1980
1985
1990
1995

FIGURE 4

TABLE 1: WATER LEVEL RECORDS OF WELLS SCREENED IN THE PALEOZOIC AQUIFER

COUNTY	U.S.G.S. WELL NUMBER	ALTITUDE IN FEET RELATIVE TO MSL	1992 HEAD VALUES IN FEET RELATIVE TO MSL	1992 WATER LEVELS IN FEET RELATIVE TO LAND SURFACE	PREVIOUS WATER LEVELS IN FEET RELATIVE TO LAND SURFACE	AVERAGE CHANGE IN WATER LEVEL RISE (+) OR DECLINE (-) IN FEET PER YEAR
ALCORN	D063	443	309.83	133.17	131.00 (1981)	- 0.20
	D064	490	340.30	149.70	131.00 (1981)	- 1.70
	D065	495	342.50	152.50	134.00 (1982)	- 1.85
	D067	482	299.00	183.00	159.00 (1984)	- 3.00
	F069	515	238.60	276.40	161.00 (1979)	- 8.88
	G005	435	302.20	132.80	26.00 (1954)	- 2.81
	G018	482	311.13	170.87	101.00 (1959)	- 2.12
	G063	480	304.30	175.70	145.00 (1967)	- 1.23
	G064	445	308.40	136.60	123.00 (1967)	- 0.54
	G102	455	281.93	173.07	172.00 (1972)	- 0.05
	G115	395	298.50	96.50	65.00 (1982)	- 3.15
	H124	510	335.60	174.40	154.00 (1973)	- 1.07
	H125	510	342.90	167.10	151.00 (1973)	- 0.85
	K011	461	330.00	131.00	89.30 (1961)	- 1.35
	K089	484	330.80	153.20	123.00 (1971)	- 1.44
	L023	623	352.57	270.43	227.00 (1973)	- 2.29
	L056	650	375.45	274.55	----.------	----.----
TISHOMINGO	B005	626	470.89	155.11	155.85 (1968)	+ 0.03
	B018	550	447.35	102.65	99.00 (1973)	- 0.19
	B019	467	450.70	16.30	15.00 (1973)	- 0.07
	B031	483	467.00	53.00	12.00 (1979)	- 3.15
	D024	465	427.33	37.67	20.00 (1966)	- 0.68
	D052	520	426.75	93.25	81.00 (1977)	- 0.82
	E019	590	484.10	105.90	106.00 (1973)	+ 0.01



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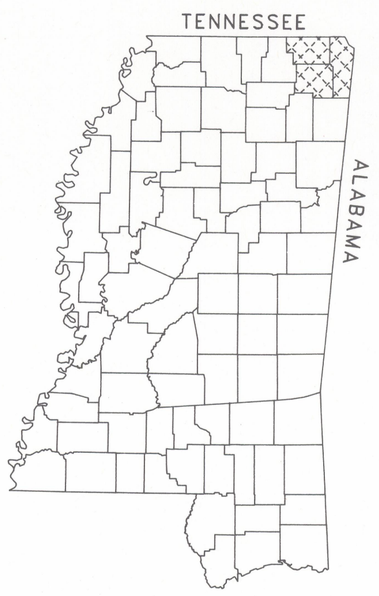

Location of Study Area

EXPLANATION

260 — POTENTIOMETRIC CONTOUR : Contour interval 20 feet. Datum is sea level.

OUTCROP AREA OF THE PALEOZOIC ROCKS IN MISSISSIPPI

A046 OBSERVATION WELL AND NUMBER

SCALE 1:175000

5 0 5 10

MILES