THE PETROGRAPHY, DIAGENESIS AND DEPOSITIONAL SETTING OF THE GLENN (BARTLESVILLE) SANDSTONE, WILLIAM BERRYHILL UNIT, GLENN POOL OIL FIELD, CREEK COUNTY, OKLAHOMA

By

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ABSTRACT

Cores and logs of the Glenn (Bartlesville) Sandstone from the Gulf Oil Exploration and Production Company, William Berryhill Unit, Glenn Pool Field, Creek County, Oklahoma have been studied. Investigation of the petrology and petrography, diagenesis, physical stratigraphy, depositional setting, pore and pore throat system, and log-response characteristics of the Glenn (Bartlesville) Sandstone has been carried out utilizing information from 10 cores and more than 70 modern logs within the 160-acre unit.

The sandstone is sublitharenite to litharenite; lithic constituents chiefly are fragments of metamorphic rock, argillaceous rock, and shale rip-up clasts. Principle diagenetic minerals are kaolinite, chlorite, illite, and minor siderite. Intervals of calcium-carbonate cemented sandstone are thin and discontinuous. Porosity mostly is secondary, owing to dissolution of rock fragments, feldspar grains, and minor detrital matrix.

Moderately complex, short-distance changes in the geometry of the sandstone and attendant reservoir heterogeneity have been shown. Various log responses are indicative of distinct sedimentary facies and respective rock properties. Correlation of individual lithofacies on the basis of well-log signatures alone is complicated by suspected changes in

the depositional strike of the rock units. The regional and local depostional history and stratigraphy indicate that sands were upper delta-plain deposits. Within the study area the specific depositional setting of the Glenn (Bartlesville) Sandstone is that of distributary channel-fill containing at least three genetic sandstones units (Lower, Middle, and Upper Glenn).

CHAPTER I

INTRODUCTION

Location

In the giant Glenn Pool oil field, in parts of Township 17 and 18 North, Ranges 11 and 12 East, Creek and Tulsa Counties, Oklahoma, the Glenn Sandstone serves as the reservoir. The Glenn Sandstone is the local subsurface name. The rock unit is equivalent to the outcropping Bluejacket Sandstone Member, Boggy Formation, Krebs Group, Desmoinesian Series, Pennsylvainan System. The Glenn also is equivalent to the Bartlesville Sandstone of the subsurface of central Oklahoma. The subject of the investigation is the Glenn (Bartlesville) Sandstone within the Gulf Oil Exploration and Production Company, William Berryhill Unit, NE 1/4, Sec. 17, T.17N., R.12E., Creek County, Oklahoma (Figure 2). This small area was selected for detailed study of the Glenn (Bartlesville) Sandstone and its corresponding log-response characteristics. Density of wells and cores and abundance of modern logs provide a special opportunity to study closely the lithofacies and logs of a portion of a giant oil field.

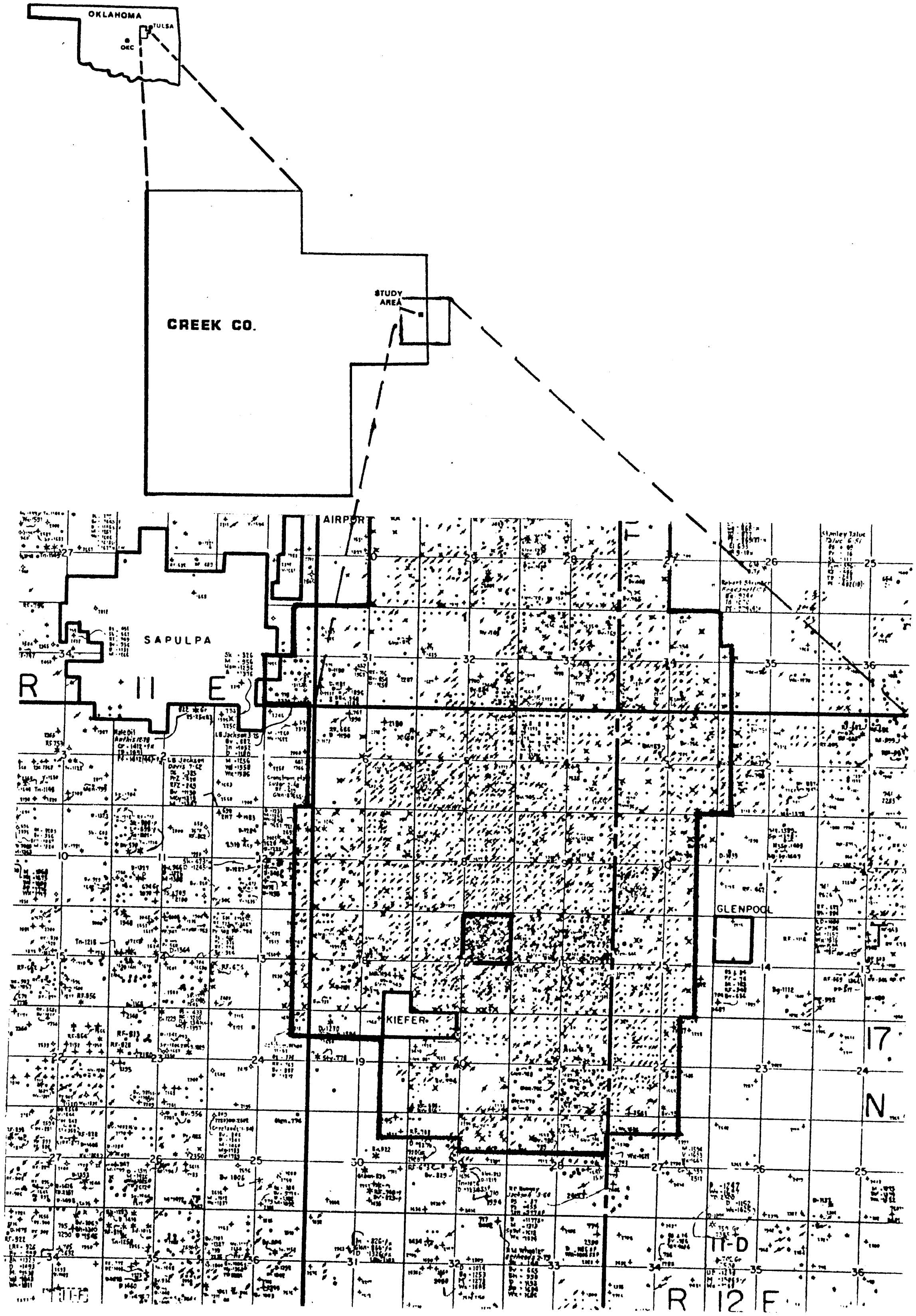


Figure 1. General Location of Study Area in the Glenn Pool Oil Field

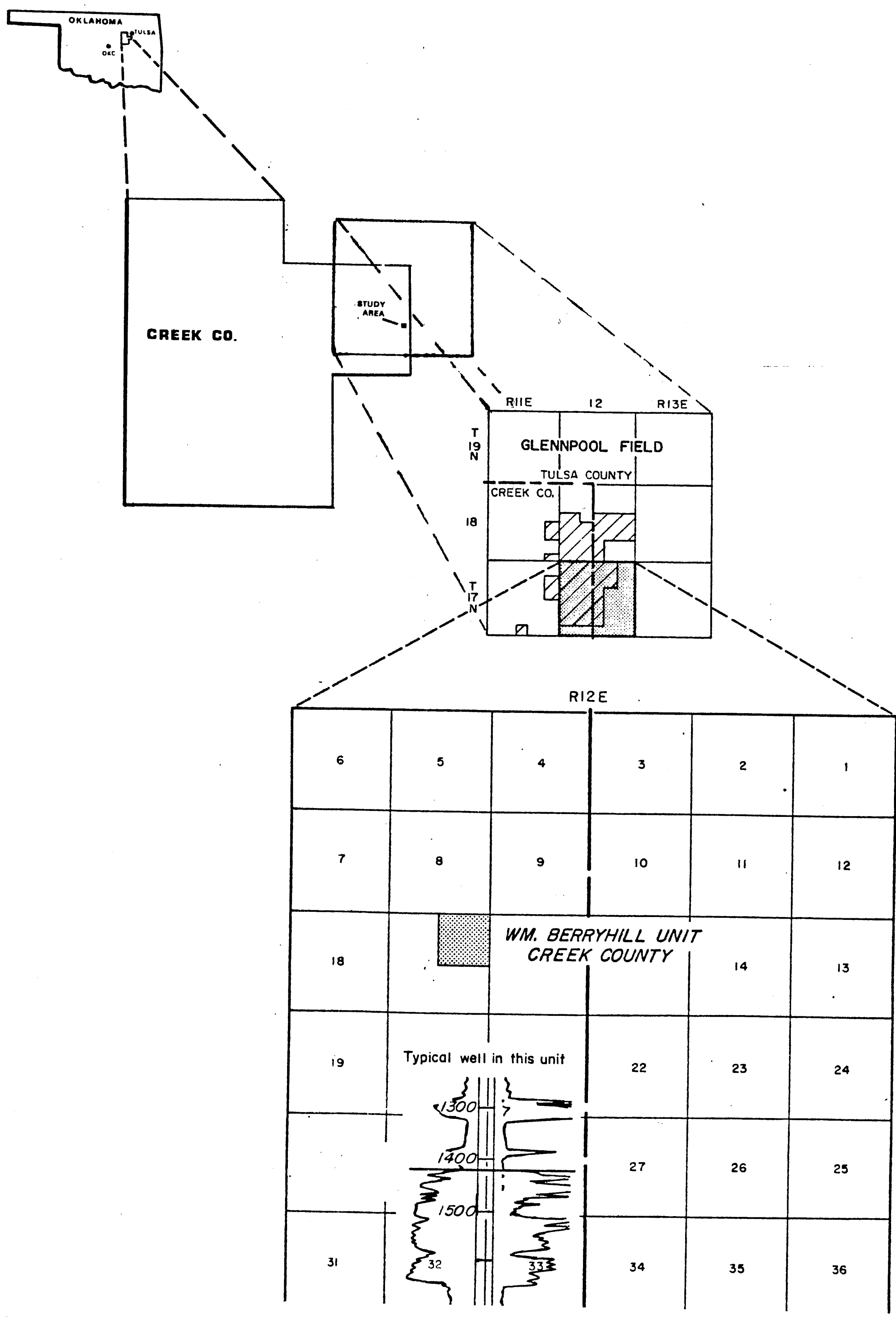


Figure 2. Location of the Gulf Oil Exploration and Production Company, William Berryhill Unit, Glenn Pool Oil Field, Creek and Tulsa Counties, Oklahoma

William Berryhill Unit

The Gulf Oil Exploration and Production Company William Berryhill Unit is a 160-acre tract currently undergoing special methods of enhanced oil recovery (EOR). More than 140 wells have been drilled in the unit since the discovery of the field in 1906. Gulf has drilled at least 70 EOR wells since 1974 (Figure 3). Eighteen full-diameter (4 1/2 in.) cores of the Glenn (Bartlesville) Sandstone have been drilled and utilized in characterizing the reservoir (Figure 3). In this study ten of these cores were available for study, and information from each was utilized. in some manner.

Before 1974 the unit had previously undergone other methods of secondary and tertiary oil recovery (Figure 4). These started in 1941 with a very successful gas-repressuring operation. A waterflood pilot was conducted in the unit in 1955 and later expanded field-wide. After waterflood operations ceased, a steam flood was begun. It was in operation until a pilot micellar-polymer project was initiated. Currently the entire William Berryhill unit is involved in an enhanced recovery operation (Gulf Oil and Exploration and Production Company Reports).

Purpose

The purpose of the study was to document the stratigraphic, petrographic, diagenetic, and related reservoir and log-response characteristics of the Glenn (Bartlesville)

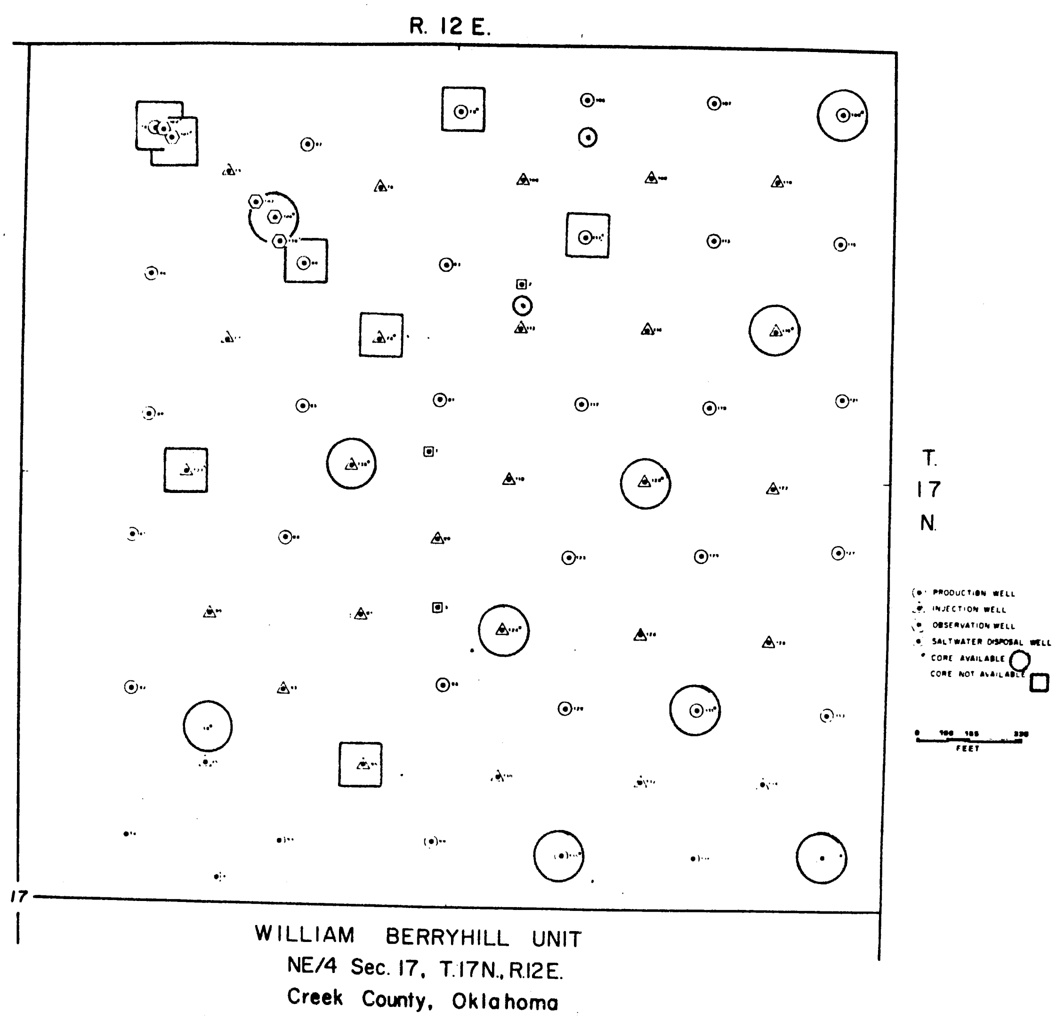
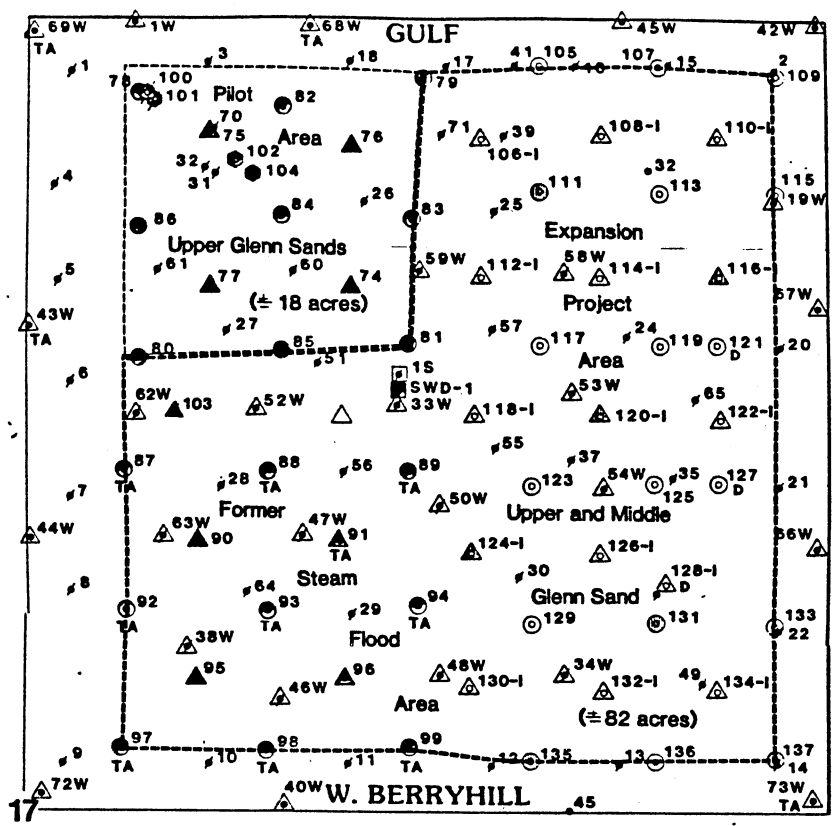


Figure 3. Gulf Oil Exploration and Production Company, William Berryhill Unit, Creek County, Oklahoma. Well and Core Locations Shown. (Cores Available, Shown by Circles; Cores Not Available Shown by Squares)



PREVIOUS AND CURRENT PROJECT AREAS

WILLIAM BERRYHILL MICRO-EMULSION PROJECT
NE/4 SEC. 17, T17N-R12E
CREEK COUNTY, OKLAHOMA

LEGEND

- △ Proposed Injection
- Converted Producer To Injection
- ⊙ Producing Well
- TA Temporarily Abandoned
- Converted TA To Producer
- Cored Well
- Converted TA To Injection
- ○ Observation Well
- Plugged And Abandoned
- D Directionally Drilled
- ■ Drilled & Logged During Steamflood & Micellar-Polymer Pilot Phase (1978-80)
- □ Drilled & Logged Expansion Phase (1981)

Figure 4. Locations of Previous and Current Enhanced Recovery Project Areas, William Berryhill Unit (Modified from Gulf Oil Exploration and Production Company)

Sandstone in the Gulf Oil Exploration and Production Company, William Berryhill Unit (Figure 2). Integration of information about sedimentary petrography with information from wireline geophysical logs should aid in the design of stimulation and completion techniques within the William Berryhill Unit, as well as provide information useful for research on the enhancement of well-log data via signal processing techniques.

Objectives

The principle objectives of this study involved: (1) interpreting the environments of deposition of the Glenn [1] Sandstone, (2) developing a basis for recognition and correlation of distinct lithofacies; (3) characterizing the petrography of the sandstone, (4) assessing the porosity (genesis, types, geometry, and trends), (5) developing a detailed understanding of the diagenetic processes and diagenetic evolution of the sandstone, and (6) evaluating the log-response characteristics of the sandstone.

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[1] Hereafter, the name "Glenn Sandstone" may be used alone, or it may be used interchangeably with "Bartlesville Sandstone" or "Bluejacket Sandstone". The term "Glenn" has a long history of local usage and certain utilitarian value. Equivalence of the three rock-unit names can be assumed.

Method of Investigation

In order to understand the Glenn Sandstone's depositional setting, literature was reviewed. Detailed methods of study included: (1) examination and study of modern logs (Dual-Induction/Laterolog and Spherically Focused Log, Formation Density, Compensated Neutron-Compensated Density, Borehole Compensated Sonic, and various computer-processed logs) from more than 70 EOR wells in the unit, (2) foot-by-foot lithologic descriptions and careful selection of samples from 10 cores in the unit, (3) complete documentation of the cores by black-and-white and/or color photographs, (4) close correlation of the cores and respective well logs, (5) routine thin-section examination, x-ray diffraction and scanning electron microscopy (SEM), (6) evaluation of porosity and permeability using data from standard and special core analyses, (7) documentation of sand thicknesses, trends, and structural configuration using several subsurface maps. (8) construction of several stratigraphic and structural cross sections, and (9) construction of a log-signature map which was utilized in correlation with a three-dimensional panel diagram. These methods have provided convergent lines of evidence for the formation and testing of working hypotheses concerning the evaluation of the Glenn Sandstone and its log-response characteristics within the William Berryhill Unit.

Historical Background

The Glenn Sandstone was the name given to an oil productive sandstone that was encountered at 1,475 feet in a well drilled by Galbreath and Chessley in December, 1906 on the Ida Glenn farm, SE 1/4, Sec. 10, T.17N., R.12E., Creek County, Oklahoma (Wilson, 1927) (Figure 5). Although initial production was only 75 barrels of oil per day, it marked the discovery of the first giant oil field in Oklahoma.

The Glenn Pool Oil Field has had a long history of secondary and tertiary efforts at recovering additional volumes of hydrocarbons. The following discussion includes information provided by Gulf Oil Exploration and Production Company. It is a brief summary of the history of the Glenn Pool.

Figure 5 shows the Glenn Pool Oil Field and Units within. The Glenn Pool is divided into the "North Glenn Pool", and the "South Glenn Pool", and each general area has had a distinct history of development.

As shown in Figure 6, primary recovery continued fieldwide from 1907 until after 1913. Cooperative, low-pressure gas injection began in 1941 to early 1942 but was applied only in "South Glenn Pool". Development continued and included new producing wells, in addition to new gas input. The response was rapid and within a year oil production increased generally in the range of 100% to 300%. The great increase in production resulted in the recovery of a large volume of light fraction as gas liquids -- so much so that

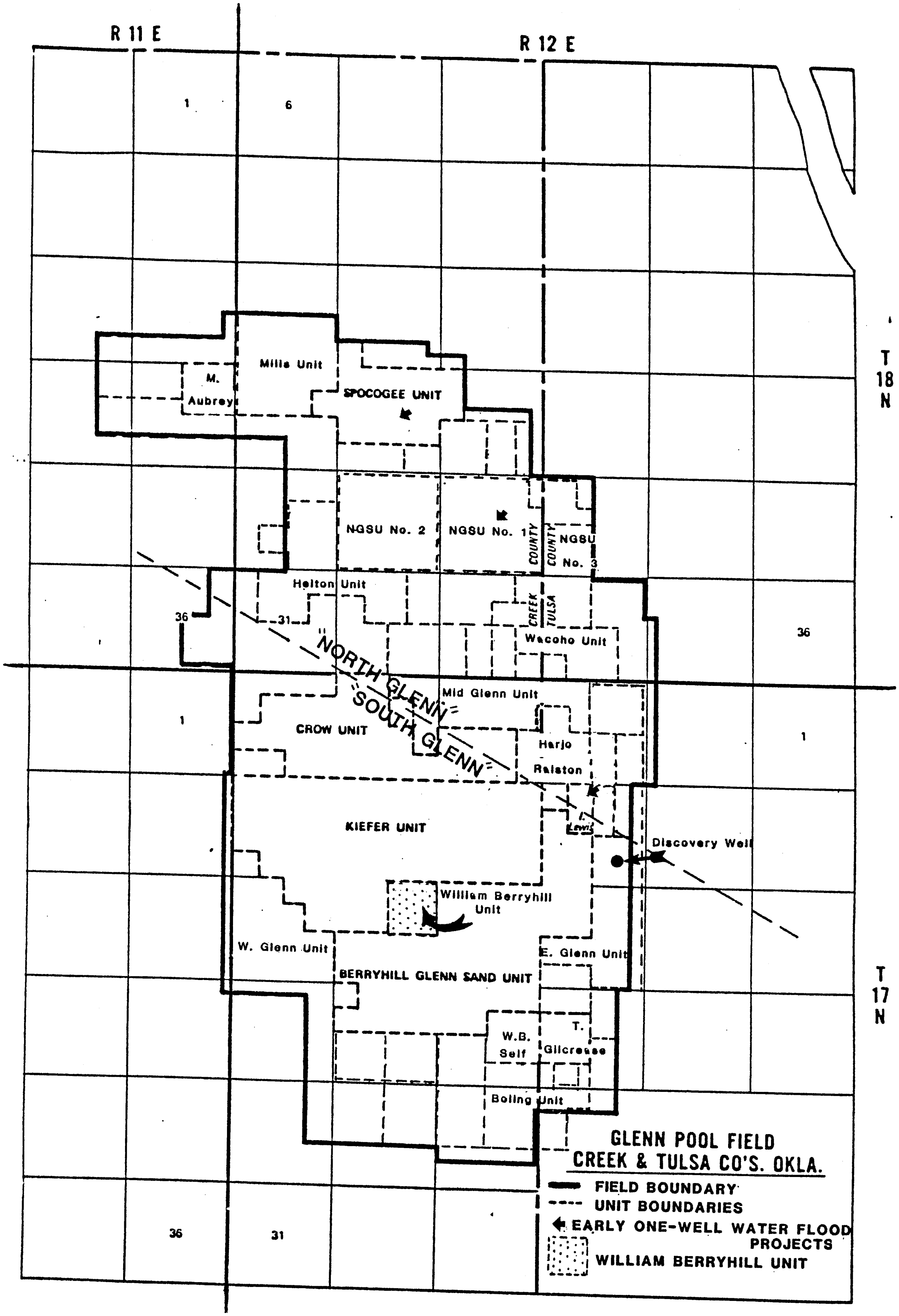


Figure 5. Locations of Units Within the Glenn Pool Oil Field

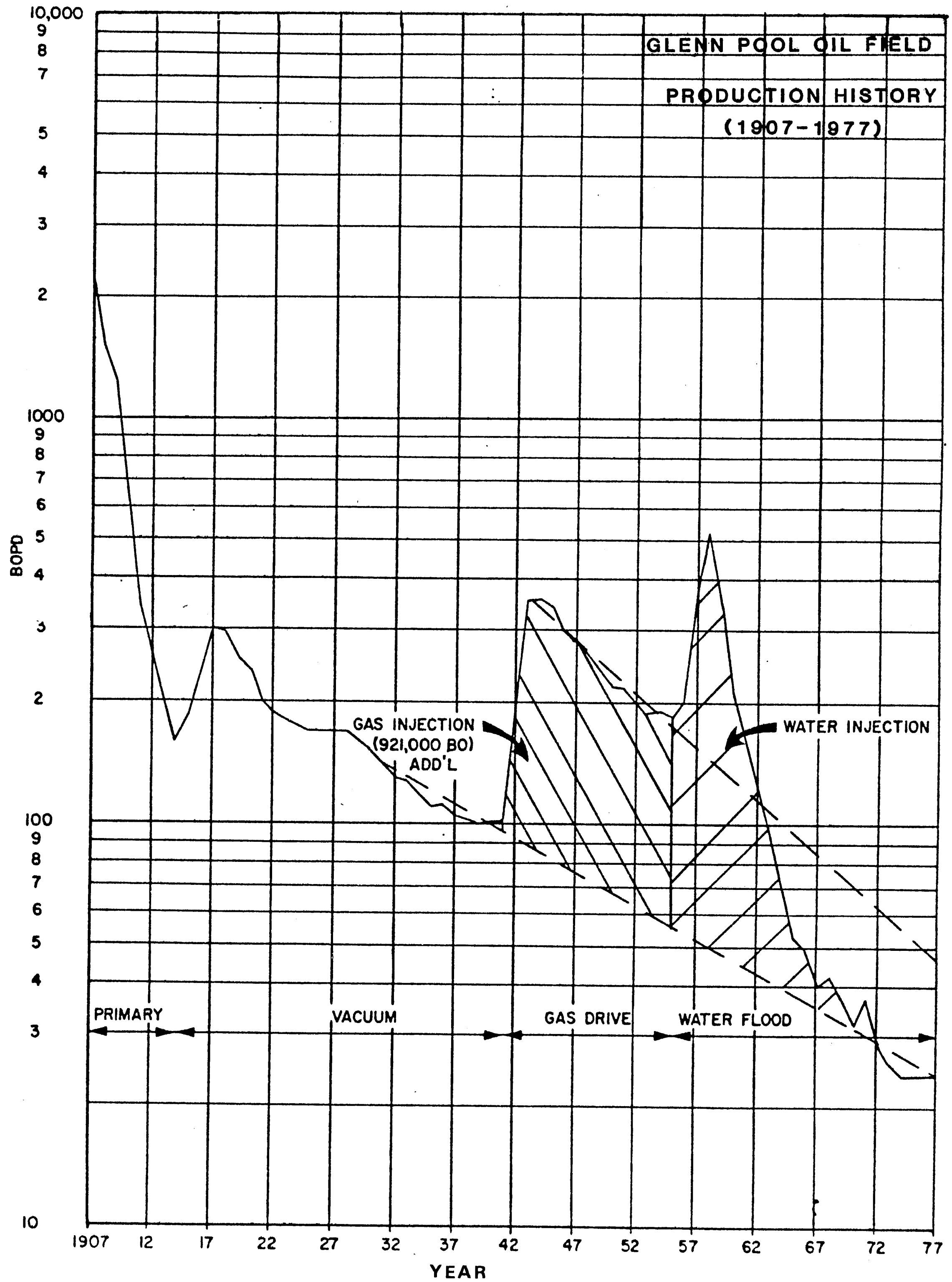


Figure 6. Production History (1907 - 1977), Glenn Pool Oil Field (Modified from Gulf Oil Exploration and Production Company)

gravity of oil in "South Glenn Pool" is about 1° API unit less than in "North Glenn Pool".

Several single-well, unconfined waterflood pilots were conducted from 1944 to 1951 in "North Glenn Pool", most were unsuccessful. The first successful waterflood was operated by Fair Oil Company in North Glenn Sand Unit No. 1, Sec., 28, T.17N., R.12E. (Figure 5). It was unitized in October, 1953 and required almost two years for significant response, but its success caused very rapid development of other waterfloods in "North Glenn Pool". The William Berryhill Unit, NE/4, Sec., 17, T.17N., R.12E., was the first multi-pattern pilot in "South Glenn Pool". It was initiated in 1955 and proved to be successful; it caused rapid development of "South Glenn Pool" waterfloods, including the largest, the Kiefer Unit (Figure 5), in 1959. The W. B. Self Unit, S/2, NE, and N/2, SE, Sec. 21, T.17N., R.12E., was another multi-pattern waterflood conducted in 1957 by Sinclair Oil Company (Figure 5). The flood was not as successful as the William Berryhill pilot, but furnished valuable data about problems to be expected concerning waterflood operations in the Glenn Pool. Waterflood eventually was conducted field-wide.

The Glenn Pool is now near depletion under waterflood operations. Core tests in the William Berryhill Unit reveal residual oil saturation to be about 30% (for example, Figure 161, Appendix E); however, actual residual oil saturation in the field may be somewhat greater. In the William

Berryhill Unit a steam flood was conducted from 1974 to 1979. It proved unsuccessful and was replaced by a micellar-polymer operation. In 1977 a micellar-polymer minitest was performed in the Middle Glenn Sandstone, and in 1979 an 18-acre surfactant pilot test was initiated in the Upper Glenn Sandstone. Bae and Petrick (1984) reported on the comparison of field performance of the process as observed in the observation wells with data obtained from laboratory tests. In 1981 a 90-acre expansion, including the Upper and Middle Glenn Sandstone, was initiated and is presently in operation.

Previous Work

Oil had been discovered in the Bartlesville Sandstone nine years prior (1897) to the discovery of the Glenn Pool by the Cudahy Oil Company, in the No. 1 Nellie Johnstone, near Bartlesville, Oklahoma (Weirich, 1968). According to Weirich (1968) oil was also discovered in the formation in Wilson County, Kansas as early as 1892. In the same year Haworth and Crane (1892) first gave the sandstone the name "Columbus Sandstone" in a report on the geology of Cherokee County, Kansas (Berg, 1963). Ohern (1914) named the sandstone "Bluejacket" in reference to an outcrop west of the town of Bluejacket, in Craig County Oklahoma.

As exploration and development continued, many new fields were discovered in several counties of eastern Kansas and Oklahoma (Weirich, 1968). Extreme lenticularity and abrupt lateral gradations of the sandstone as well as thickening of the Cherokee section south from Kansas into Oklahoma made correlations a difficult task. It was not until 1937 that correlation between the outcrops of Columbus Sandstone in Kansas and Bluejacket Sandstone in Oklahoma was observed (Pierce and Courtier, 1937). The sandstone was renamed "Bluejacket" due to ambiguity of the name "Columbus" (Pierce and Courtier, 1937). However, names for sandstone of the subsurface varied greatly, due to local descriptive terms given by early drillers. The name "Bartlesville Sand" first appeared in the literature in Bulletin II, Oklahoma Geological Society Survey, dated 1911, in an article by Hutchison (Jordan, 1957). The name "Glenn Sand" first appeared in an article by Snider, dated 1913, in Petroleum and Natural Gas in Oklahoma, 1913 (Jordan, 1957).

Smith (1914) described briefly the stratigraphy of the Glenn Pool and published a generalized subsurface structural geologic map of the pool and vicinity (Wilson, 1927). In 1927, W. B. Wilson presented a paper at a meeting of the American Association of Petroleum Geologists in Tulsa, Oklahoma on the "Geology of Glenn Pool of Oklahoma". Wilson set forth a proposed trapping mechanism (combination trap) of oil in the Glenn Pool (Figures 7 and 8).

Since 1927 there have been many surface and subsurface investigations on the Bartlesville Sandstone, most of which dealt with correlation, depositional environments, and regional framework of the sandstone. Increased study of the Bartlesville Sandstone began in the mid-1930's with regional

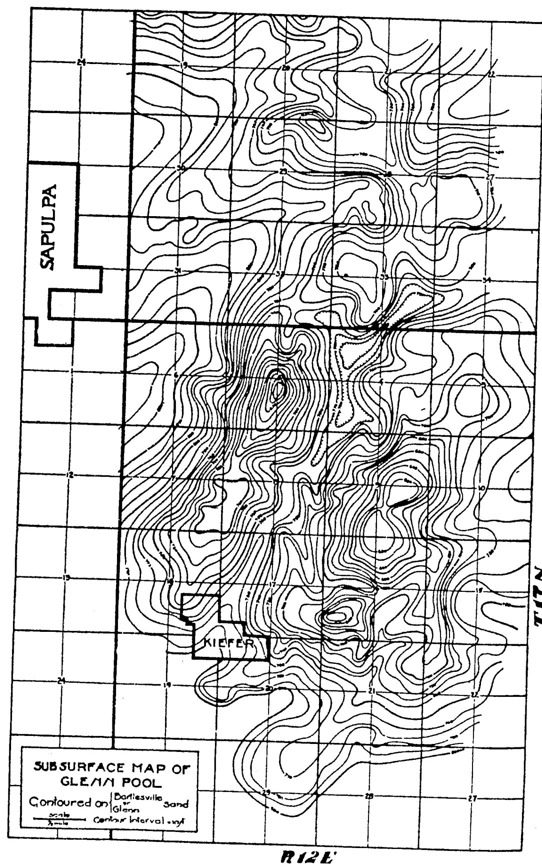


Figure 7. Wilson's (1927) Subsurface Map (Structural Configuration of Top of the Glenn Sandstone) (After Wilson, 1927)

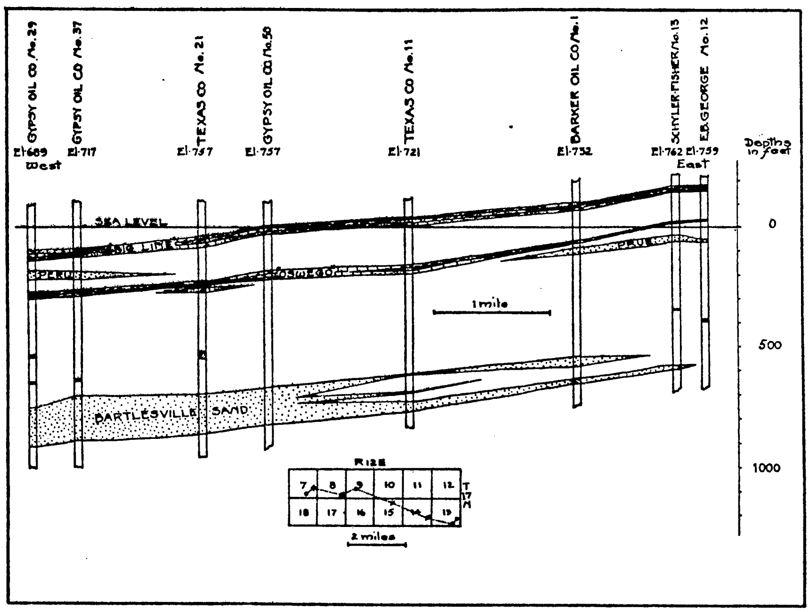


Figure 8. Wilson's (1927) Cross-section Through the Glenn Pool Showing the Trapping Mechanism (After Wilson, 1927)

surface and subsurface work by Wilson (1935), Bass (1936), Dane and Hendricks (1936), Pierce and Courtier (1937), and more detailed qualitative petrographic work by Leatherock and Bass, 1937). Progress decreased in the 1940's but increased in the 1950's with studies by Howe (1951), Oakes (1953), Searight et al. (1953), Weirich (1953), Branson (1954), and Kirk (1957). Much of the work during this time primarily was descriptive and little was known about the origin of the sandstone. Previous interpretations seemed to suggest that the sand was deposited as parallel "shoe-string sands" as the shoreline of the Cherokee sea migrated across northern Oklahoma and southern Kansas (Bass, 1936). Others considered the sandstone as linear belts greater than 150 feet thick and persistent over an area 200 miles long and 50 miles wide (Weirich, 1953; Branson, 1954). Models of three sand bodies having different origins were hypothesized by Berg (1963); these included the following: (1) a deltaic or bar-finger sand, (2) an offshore sand bar, and (3) a channel-fill sand. Berry (1963) showed that the sand was deposited essentially during one time interval as a complex of channel-fill sands in a system that built in a regressive manner.

Several other workers supported the ideas of Berg (1963) and Berry (1963). Hawissa (1965) and Shulman (1965) concluded that channel patterns were evident and possibly even influenced by pre-Pennsylvanian topography. Visher (1968) determined that the Bartlesville Sandstone was deposited in a large deltaic complex and also proposed a general geologic framework for the sandstone. The geologic framework and depositional environment were studied further by Saitta and Visher (1968), Phares (1969), and Visher, Saitta, and Phares (1971).

In addition to these specific studies of the sandstone many surface and subsurface studies that discuss the Cherokee Group have been completed at various localities in northeastern Oklahoma and southern Kansas. Nearly all of these studies include a written description of Bartlesville/Bluejacket Sandstone and/or a description of its general depositional environment, which is included in the generally accepted interpretation of a deltaic depositional system. Some of these studies are: Howe (1956), Sartin (1958), Huffman (1959), McElroy (1961), Baker (1962), Branson (1962), Clayton (1965), Shulman (1965), Hanke (1967), Cole (1969), Dogan (1969), Shelton (1973), Astarita (1975), Chenoweth (1979), Brown (1979), Bennison (1979), Ebanks (1979), Hulse (1979), Moore (1979), Pulling (1979), Rascoe and Adler (1983), and Woody (1983).

Tight (1981) completed a study on the Bartlesville Sandstone in the North Avant Field of eastern Osage County, Oklahoma; Mason (1982), made a detailed study of the Bartlesville in the Cushing Field of Creek County, Oklahoma. Recent investigations of the Glenn Sandstone within the confines of the Glenn Pool Field are not known to the author, and none are believed to have been published. Nevertheless, the regional geologic framework and depositional environment of the Bartlesville Sandstone as set forth by previous authors provides sufficent geologic background for the purpose of investigation of the Glenn Sandstone within the William Berryhill Unit, Glenn Pool.

CHAPTER II

GEOLOGIC FRAMEWORK

Stratigraphy

The general stratigraphy of the Pennsylvanian System in north-central Oklahoma and southeastern Kansas is well documented in the literature and thus will not be discussed. However, a brief discussion concerning the stratigraphic relationships and general character of the Bartlesville Sandstone follows.

Figure 9 shows the stratigraphy and type electric-log of the Pennsylvanian System in the study area. The Bartlesville is included in what is known commonly as the "Cherokee Group" (Figure 9) (rocks within the Krebs and Cabaniss Groups of the Desmoinesian Series), which is characterized by lenticular sandstones, by shales, coal beds, and thin but persistent limestones (Shelton, 1973). The discontinuous nature of the strata was not recognized when the original stratigraphic order was developed. Difficulties of correlation of the Cherokee Group have been emphasized only recently (Ebanks, 1979). However, as early as 1953, Oakes had divided the Cherokee Group into the Krebs and Cabaniss Groups. Branson (1954) dropped the Cherokee Group from the standard terminology and replaced it with the new terms proposed by Oakes. The Krebs and Cabaniss Groups and the overlying Marmaton Group compose the Desmoinesian Series (Figure 9).

Recently the term "Cherokee Group" has been used again in the literature due to discrepancies in an agreed-upon boundary between the Krebs and Cabaniss Groups (Saitta, 1968). Hawissa (1965) divided the "Cherokee Group" into four "time-rock units", which are from youngest to oldest, the Prue, Skinner, Red Fork, and Bartlesville intervals.

In more recent work the term "time-rock unit" has been replaced by a new term, "chronozone". In the International Stratigraphic Guide (H. Hedberg, editor, 1976), the term "chronozone" was introduced as the lowest-ranking division in the hierarchy of chronostratigraphic terms. A "chronozone" is "a zonal unit embracing all rocks formed anywhere during the time range of some geologic feature or some specified interval of rock strata" (Hedberg, 1976, p.67). Tight (1981) used the above definition to classify the Bartlesville Sandstone in the North Avant Field, as a member of the Bartlesville Chronozone, composed of rocks from the top of the post-Mississippian, pre-Pennsylvanian unconformity to the Inola Limestone. The Bartlesville sand is generally accepted as having been deposited during progradation of an early Desmoinesian delta in eastern Oklahoma. Considering the definition of "chronozone", the "geologic feature" can be related to progradation and abandonment of the Bartlesville delta. Therefore, the Glenn (Bartlesville) Sandstone in Glenn Pool also may be considered to be a

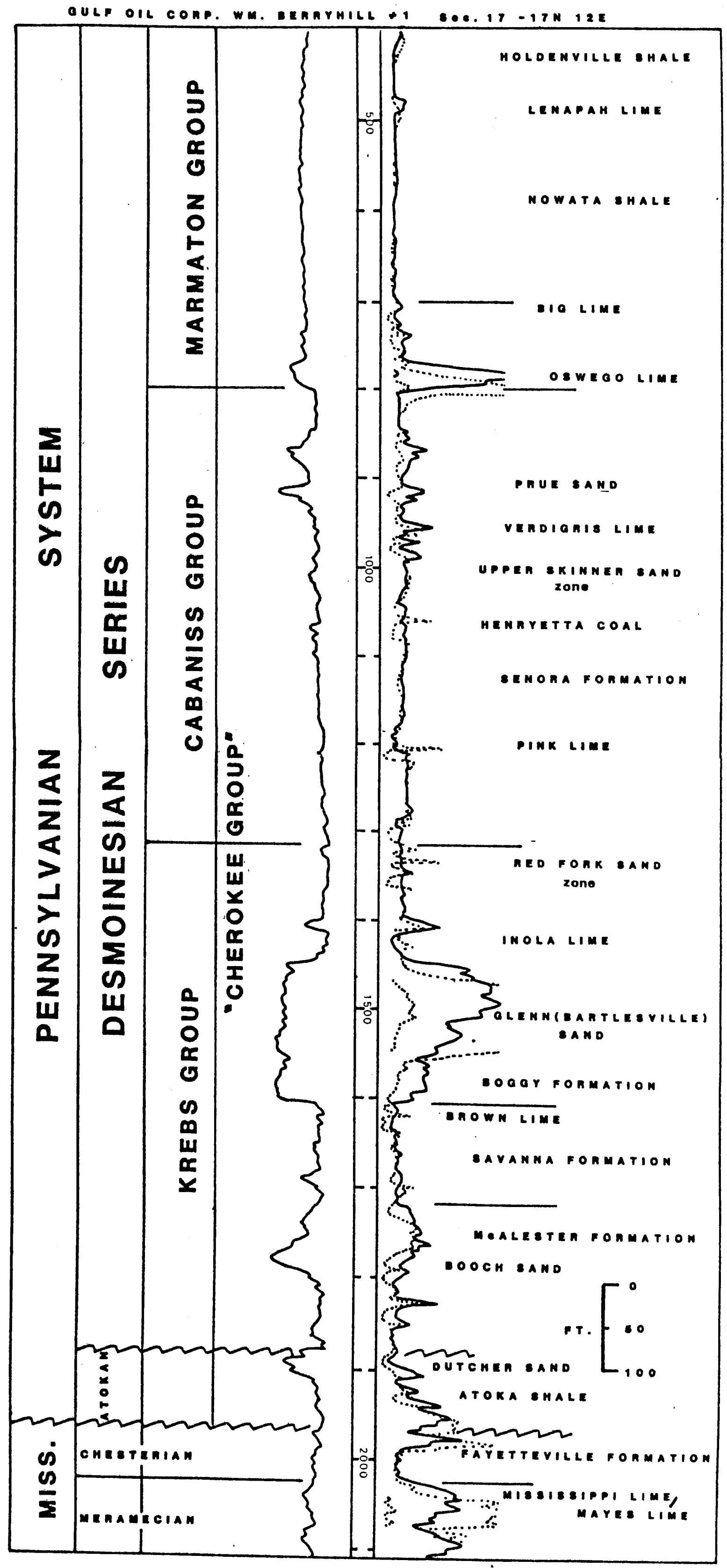


Figure 9. Stratigraphy and Type Log Within Study Area

member of the Bartlesville Chronozone.

Oakes (1953) divided the Krebs Group into the following formations, listed in ascending order: McAlester Formation, Savanna Formation and Boggy Formation (Figure 9). The McAlester Formation consists of the time-equivalent Booch, Tucker, and Taneha sandstones (Branson, 1954). The Savanna Formation contains a series of thin limestones known as the Brown Limestones (Branson, 1954). Regionally the Boggy Formation consists of the Bartlesville sandstone interval and the lower part of the Red Fork sandstone interval, in which lenticular sandstone bodies are set within a predominantly shale section. The Bartlesville is underlain by the Brown Limestone and overlain by the Inola Limestone. The Red Fork overlies the Inola Limestone and is bounded above by the Pink Limestone (Tiawah Limestone) which is in the lower part of the Cabaniss Group (Weirich, 1953). (Saitta (1968) explained that the boundary between the Krebs and Cabaniss Groups has not been defined consistently.) These thin limestones are transgressive regionally, and enable one to define genetic increments of strata, useful for regional and local mapping.

The general character of the Bartlesville Sandstone may change greatly within a relatively short distance. Numerous authors describe the Bartlesville Sandstone as an erratic and lenticular sandstone, which passes laterally within short distances into shales (Saitta and Visher, 1968). In the area described by Saitta and Visher (1968), the Bartlesville Sandstone is distributed in lenses with an average thickness of 100 feet. According to them the sandstone grades laterally into shales to the west, east and south of their study area. Between 50 and 100 feet of marine mud and silt were deposited above the Brown Limestone before the Bartlesville delta prograded across the shale and before its distributaries cut major channels (Saitta and Visher, 1968).

In the present study area the general character of the Glenn Sandstone is more-or-less consistent. However, the more detailed stratigraphic changes that occur internally are great among closely spaced wells. Thickness may be quite varied, or certain sedimentary features present in one core may not be in an nearby core, although the distance between the two wells may be as little as 150 feet. Thus internal stratigraphic correlation over relatively short distances may be quite difficult in some instances.

Figure 10 is a type log (Dual-Induction) of the Glenn Sandstone in the William Berryhill Unit. A distinctive and persistent gamma-ray log signature, corresponding to a thin carbonaceous shale above a thin (1 foot) shaly limestone (suspected of being the Inola Limestone), was chosen as an upper marker bed (Figure 10). The Brown Limestone rarely was penetrated in the study area; thus a distinctive and persistent gamma-ray log signature corresponding to a thin coal or dark carbonaceous shale was chosen as the lower marker bed (Figure 10). These two distinctive log signatures and rock types were used to create a genetic-increment of strata useful for correlation and for construction of var-

CORE ANALYSIS DATA

Ø (%)	K(md)	So(%)	Sw(%)
24	169	24	41
22	140	30	32
22	181	29	44
12	.03	14	61
23	381	20	27
21	188	26	41
18	27	8	54
17	18	3	66

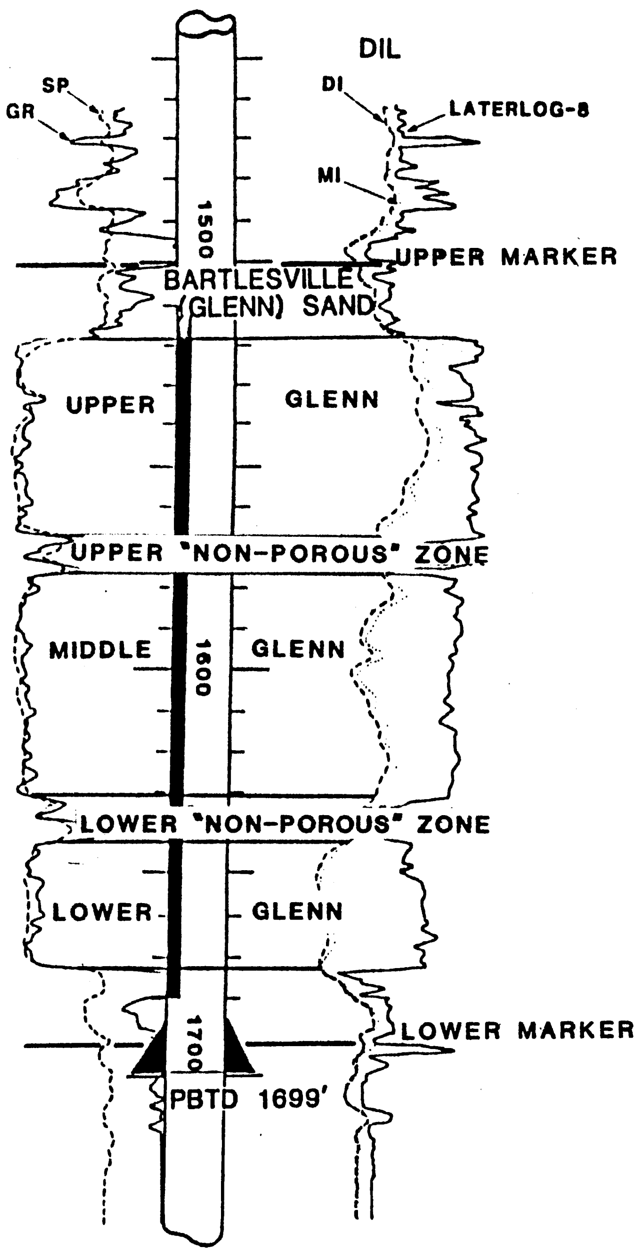


Figure 10. Type Log of Glenn (Bartlesville) Sandstone in Study Area With Average Core-analysis Data for Respective Sand Bodies

ious maps and cross-sections within the William Berryhill Unit.

In the study area the Glenn is approximately 1500 feet deep and ranges from 130 to 175 feet thick. It can be divided into three genetic sandstone bodies (Lower, Middle, Upper) separated by thin, laterally discontinuous units of interbedded sandstone and shale, and/or shale rip-up clasts, known as the Upper and Lower "Non-Porous" Zones (Figure 10). The Upper and Middle Glenn are the productive intervals in the unit, whereas beds of the Lower Glenn are below the oil/water contact. Thus, the Upper and Middle Glenn were dealt with in more detail than the Lower Glenn. Average core-analysis data in Figure 10 indicate the general reservoir quality of each of the genetic sandstone bodies.

Depositional Setting

The Glenn Pool oil field is located on the Northeastern Oklahoma Platform, which is bounded on the east-northeast by the Ozark Uplift, on the south by the Arkoma Basin, and on the west by the Nemaha Ridge (Figure 11). Visher et al. (1971), and others have shown considerable evidence indicating that lower Desmoinesian sediments were deposited during overall transgression onto the shelf, interrupted by episodes of regression that were marked by progradation of deltas. Figure 11 shows the locations of major and minor channel axes, as well as the geometry of the delta and its basic components as interpretated by Visher and others.

Major deltaic systems of the Cherokee Group prograded from a northerly source area and deposited thick sequences of sand and clay. These sediments were deposited in a cyclic manner in sedimentary environments that ranged from marine to nonmarine (Berry, 1963; Hawissa, 1965; Shulman, 1965; Dogan, 1969; and Visher, Saitta and Phares, 1971). Weirich (1953) demonstrated that during Atokan and Desmoinesian time a hinge-line (Boggy Hinge Line) developed that defined the northerly limit of the subsiding Arkoma Basin (Figure 11). Basinward from the hinge-line strata thicken southward at a rate approximately six times greater than the rate at which sediments on the shelf thicken toward the hinge-line (Rascoe and Adler, 1983).

Rascoe and Adler (1983) summarized the work of many, and interpreted paleogeography of the region during early Desmoinesian time (Figure 12).

Regionally, the Bartlesville Sandstone is composed of several genetic sandstone units formed in several specific depositional environments, within the extensive early Desmoinesian deltaic complex (Berry, 1963; Hawissa, 1965; Shulman, 1965; Dogan, 1969; and Visher, Saitta and Phares, 1971; and others). According to Visher et. al. (1971) six environmental units evolved during progradation: (1) lower alluvial valley, (2) upper deltaic plain, (3) lower deltaic plain, (4) distributary-mouth bar, (5) marginal basin, and (6) marginal depositional plain (Figure 13). Glenn Pool is within the postulated upper deltaic plain (Figure 13).

The sequence of sedimentary units within the deltaic

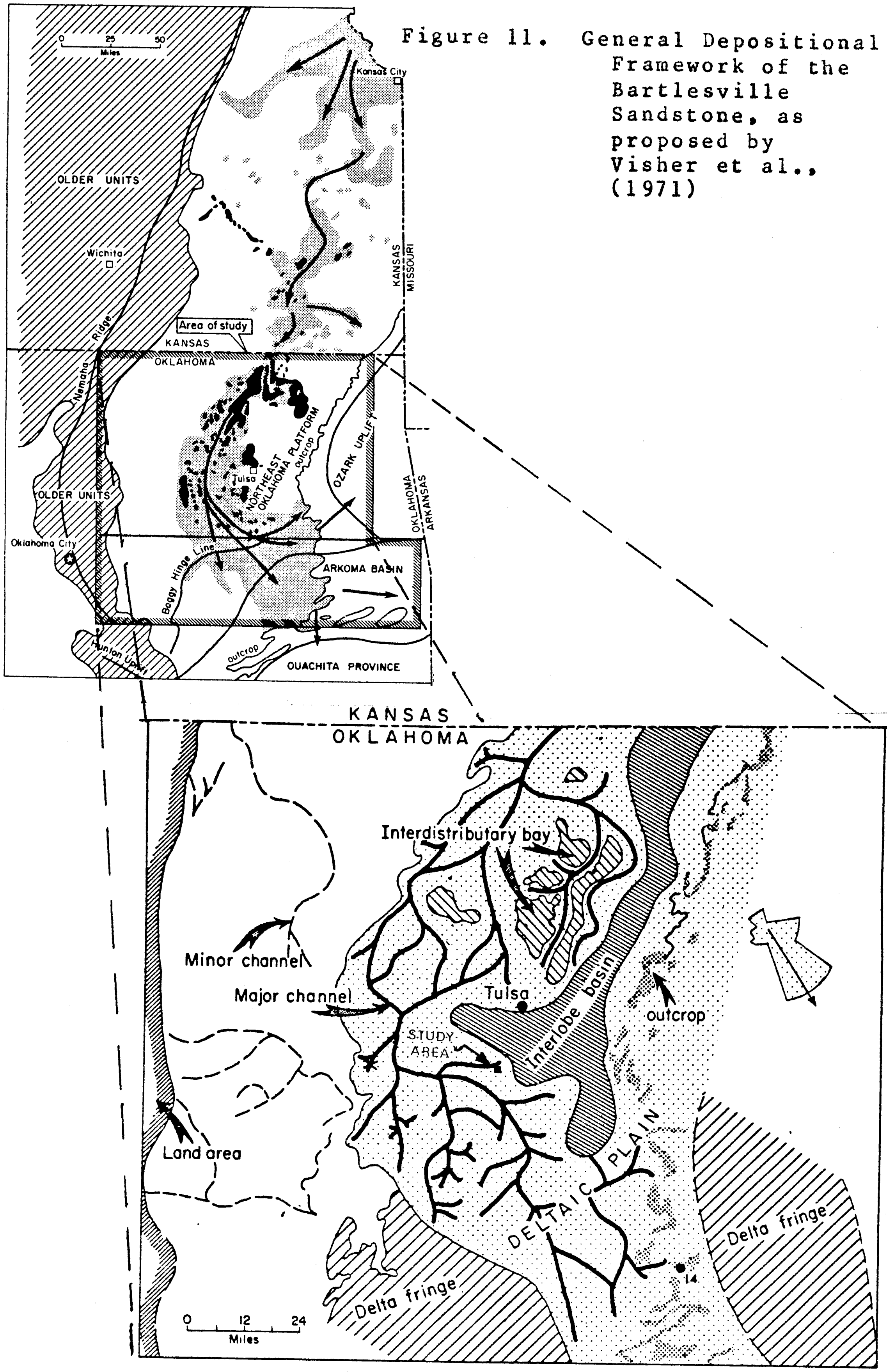


Figure 11. General Depositional Framework of the Bartlesville Sandstone, as proposed by Visher et al., (1971)

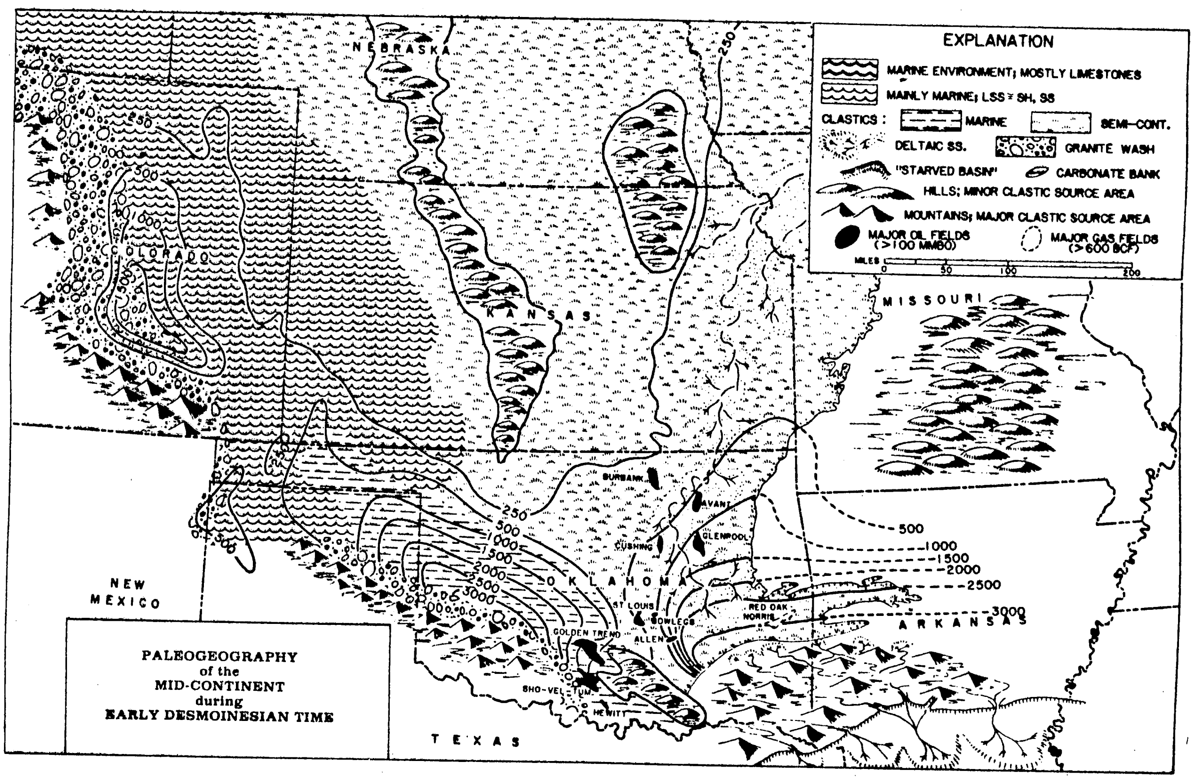


Figure 12. Paleogeography of the Midcontinent During Early Desmoinesian (After Rascoe and Adler, 1983). Note: Giant Oil Fields (Glenn Pool, Cushing, Avant, and Burbank) In Northeastern Oklahoma

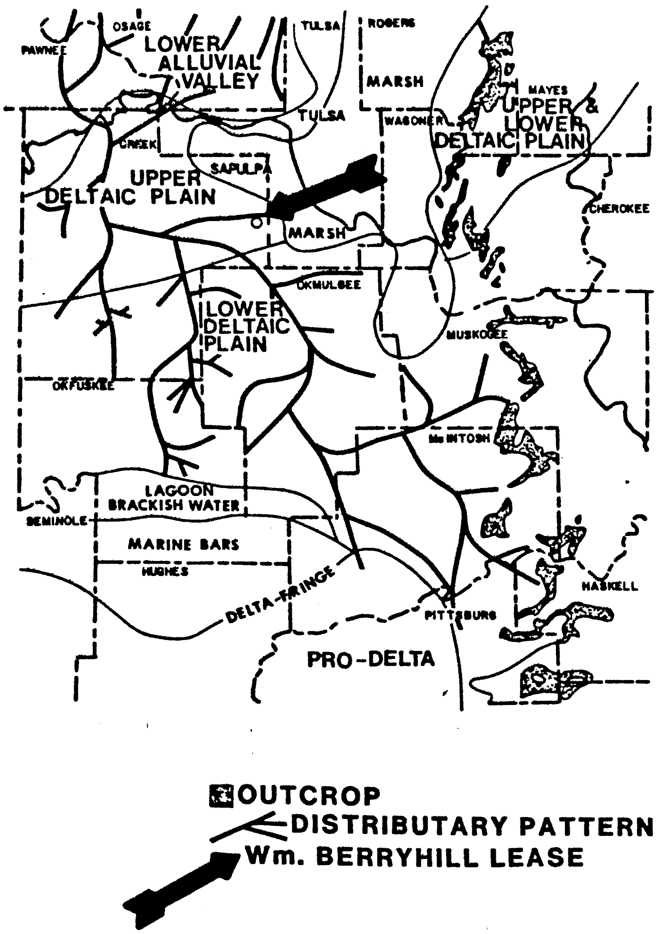


Figure 13. Depositional Environment of the Glenn (Bartlesville) Sandstone, Northeastern Oklahoma (After Visher, 1968)

framework is dependent on the nature of the fluvial processes (Visher, 1965). According to Coleman and Prior (1981) the upper delta plain lies above the level of effective saltwater intrusion and is generally unaffected by marine processes. Sediments that compose the upper delta plain are created by processes such as migrating distributary channels, overbank flooding, local breaks in the river banks and crevassing, and many other processes dependent upon physical, chemical and biological factors (Coleman and Prior, 1981; Scruton, 1969). Evidence from cores and logs of the Glenn Sandstone from the study area supports the proposed interpretation of upper-delta-plain environment. Such evidence is well shown in the study area and has been described in the surrounding region by Visher et al. (1971), Weirich (1953), Rascoe and Adler (1983), Tight (1981), Mason (1982), and many others. Figure 14 shows the components of the deltaic system as described by Coleman and Prior (1981) and the hypothetical location of the study area. The model that comes closest to accounting for the facts of lithology and stratigraphic sequence in the study area is an upper-delta-plain model. This setting or a variant thereof is reguarded as being highly probable as the basic depositional framework of the Glenn Sandstone in the study area.

Assuming that the depositional framework described above is correct for all practical purposes, then certain lithic and sedimentary features characteristic of upper-delta-plain deposition should be observed within cores from the study

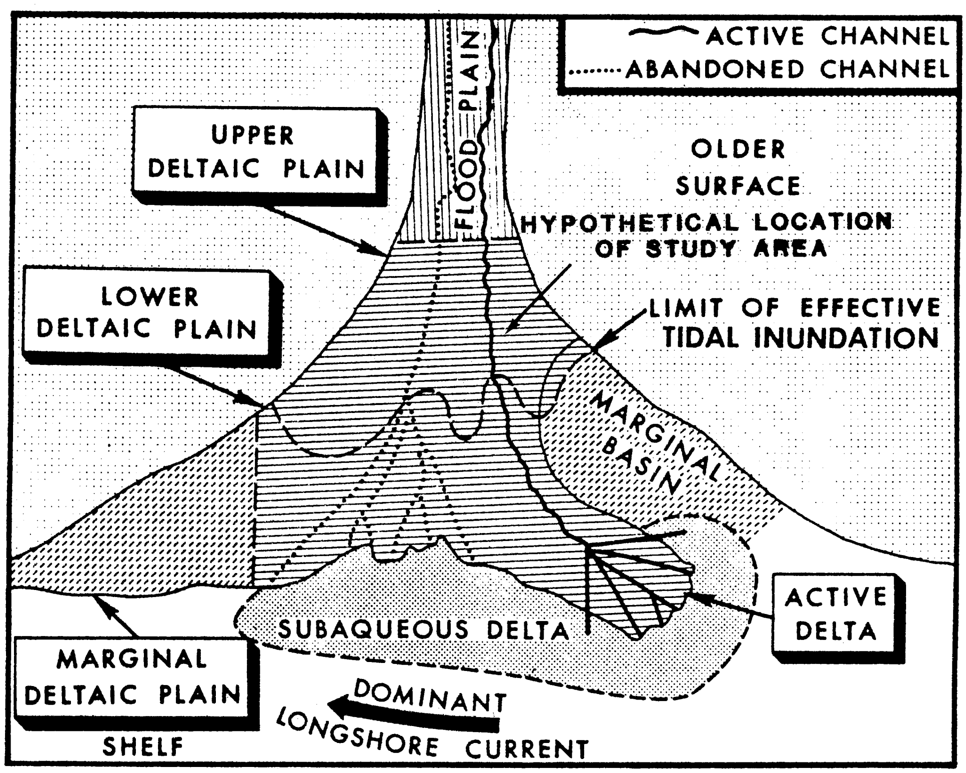


Figure 14. Components of the Deltaic System and Hypothetical Location of the Study Area (After Coleman and Prior, 1981)

area. Brown (1979) described Pennsylvanian deltaic sandstone facies of the Midcontinent and characterized their vertical sequences. Figure 15 shows the idealized log pattern and lithology of a Pennsylvanian deltaic sandstone that serves as an example of the types of environments and facies characteristic of the Glenn Sandstone. Figure 16 is a model of a deltaic distributary channel-fill sequence showing spacial relationships of lithofacies and a typical vertical sequence of sedimentary structures and textures. Evidence in cores of the Glenn Sandstone from the study area indicates features associated with the depositional model described here.

ENVIRONMENTS/FACIES				DEPOSITIONAL PHASES		DESCRIPTION
DELTA SYSTEM	SUBAERIAL	UPPER DELTA PLAIN; MID- AND LOWER DELTA PLAIN	POINT BAR; DISTRIBUTARY CHANNEL-FILL; CREVASSE SPLAYS; FLOODBASIN/ INTERDISTRIBUTARY BAY; MARSH/ SWAMP PEAT	DELTA CONSTRUCTION	SUBAERIAL AGGRADATION	Point-bar sandstone: fining upward from conglomerate lag to silty levees, upward change from large trough-filled crossbeds to tabular crossbeds and uppermost ripple crossbeds. Distributary channel-fill sandstone: fine- to medium-grained, trough-filled crossbeds, local clay, clast conglomerate, abundant fossil wood. Crevasse splay sandstone: coarsening upward, trough and ripple crossbeds, commonly burrowed at top. Floodbasin/interdistributary mudstone: burrowed, marine fossils, grade updip to non-marine, silty near splays. Coal/peat: rooted, overlie underclay (soil).
	SUBMARINE	DELTA FRONT	BAR CREST		PROGRADATION	Well-sorted, fine- to medium-grained sandstone, plane beds (high flow regime) common, channel erosion increases updip, distal channel fill plane-bedded, some contemporaneous tensional faults.
			CHANNEL-MOUTH BAR			Fine- to medium-grained sandstone, trough-filled crossbeds common, commonly contorted bedding, local shale or sand diapirs in elongate deltas.
			DELTA FRINGE			Fine-grained sandstone and interbedded siltstone and shale, well-bedded, transport ripples, oscillation ripples at top of beds, growth faults in lobate deltas, some sole marks and contorted beds at base.
		PRODELTA	PROXIMAL			Silty shale and sandstone, graded beds, flow rolls, slump structures common, concentrated plant debris.
			DISTAL			Laminated shale and siltstone, plant debris, ferruginous nodules, generally unfossiliferous near channel mouth, grades downdip into marine shale/limestone, grades along strike into embayment mudstones

IDEALIZED LOG PATTERN AND LITHOLOGY

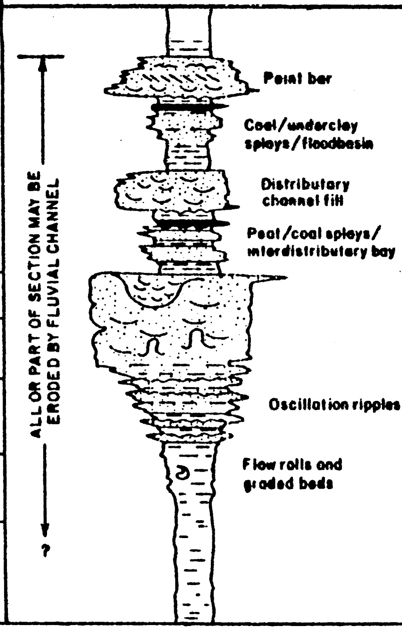


Figure 15. Idealized Log Patterns, Lithology, and Environment/Facies of Pennsylvanian Deltaic Sandstone Facies of the Midcontinent (After Brown, 1979, Figure 12)

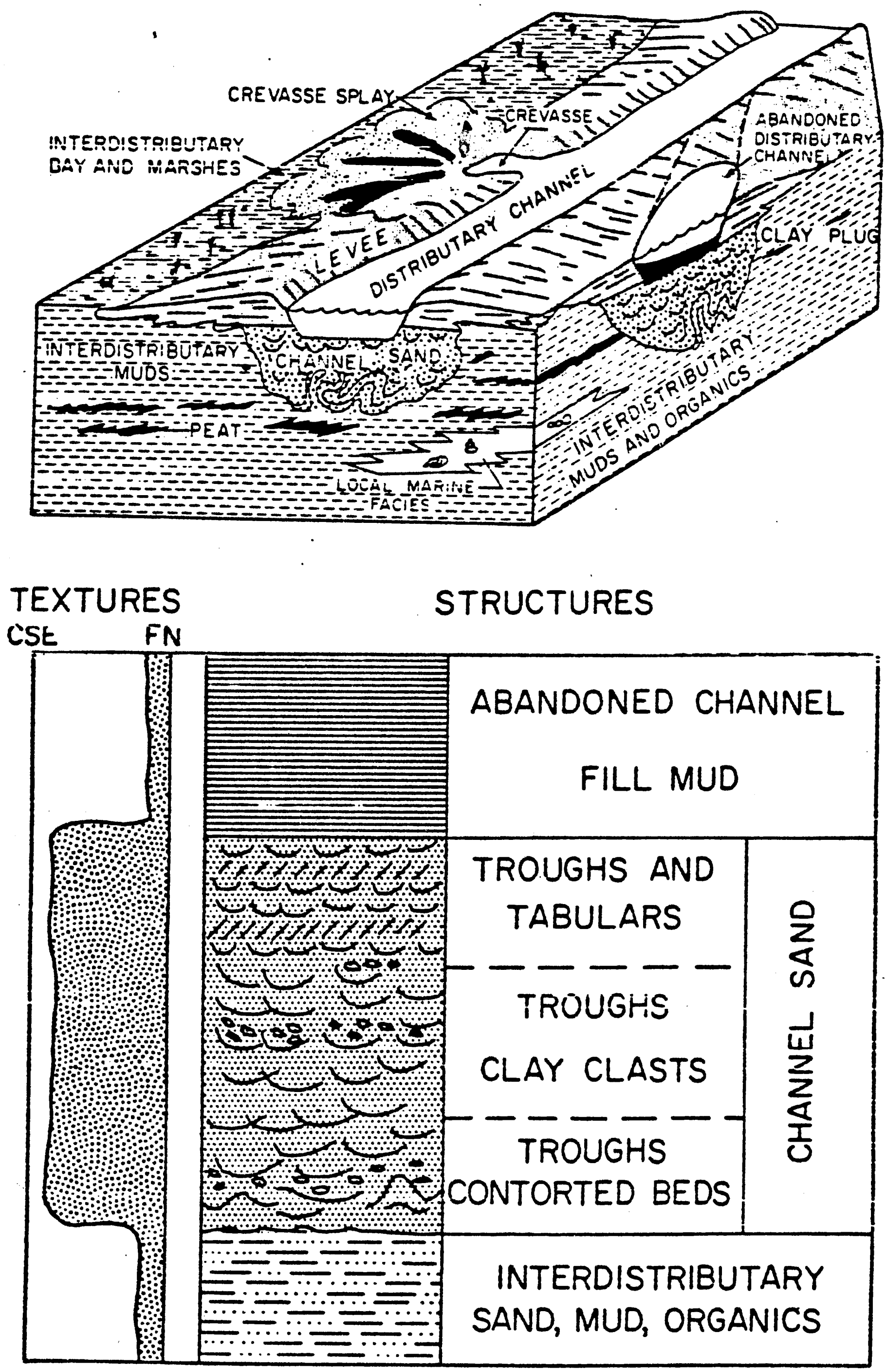


Figure 16. Deltaic Distributary Channel Model and Idealized Vertical Sequence (After Brown, 1979, Figure 16)

CHAPTER III

LITHOFACIES

Introduction

Ten cores of the Glenn Sandstone were available for examination and sampling; their locations are plotted in Figure 3. They were examined for gross lithology, constituents, grain size, and sedimentary structures. Corresponding detailed petrologic logs (Plates II through XIII) can be keyed with respective descriptions and photographs of cores. Locations where samples were taken are marked on Plates II through XIII with numbers that can be cross-referenced on various diagrams and logs in the Appendixes.

Detailed examination of individual lithofacies and corresponding log signatures from sets of cores and matching well logs aided in recognition and correlation of distinctive lithofacies. Analysis of bed contacts and vertical sequences of sedimentary structures also provided evidence that supported interpretation of deposition within an upper-delta-plain setting.

A brief discussion of the basis and method of approach for identification of lithofacies follows. Also included is a review of the lithology and various lithofacies of the Glenn Sandstone in the William Berryhill Unit, based on several selected core-and-log suites (Appendix B).

Basis for Identification of Lithofacies

The term "facies" was introduced by Gressly in 1838 (Dunbar and Rodgers, 1957) and since that time much controversy has arisen over its usage. Gressly defined facies as a body of rock with specific characteristics, such as color, bedding, composition, texture and sedimentary structures. "Facies" has been used by many scientists in a strictly observational sense, as well as in a genetic, environmental, and tectonic sense. Selley (1970) described a sedimentary facies as a mass of sedimentary rock that can be defined and distinguished from others by its geometry, lithology, sedimentary structures, current patterns and fossils. Reading (1981) summarized that a facies ideally should be a distinctive rock that forms under certain conditions of sedimentation, reflecting a particular process or environment. He further stated "a facies may be subdivided into subfacies or grouped into facies associations or assemblages". According to Almon (1980) sedimentary facies are the genetic-unit building blocks of depositional environments. However, a knowledge of the "context" of a facies is essential before proposing an environmental interpretation.

Walther's (1894) Law of Facies has been taken by many geologists to indicate that facies occurring in a conformable vertical sequence were formed in laterally adjacent environments and that facies in vertical contact must be the product of geographically neighboring environments (Reading, 1981). However, Middleton (1973) pointed out that the law applies only to successions without major unconformities. Perhaps erosive contacts bounding and/or within the succession represent an unknown number of environments whose products were removed. Because facies are deposited under a relatively restricted and consistent set of conditions, each facies can be expected to possess a relatively consistent mineralogy and depositional fabric. According to Almon (1980) these two factors control the rock properties sensed by wireline logging tools. In addition, in many petrologic-log-response studies, diagenesis has been determined to be responsible for part of various log-response "anomalies" (Almon and Shultz, 1979).

The physical and biological sedimentary aspects of individual facies of the Glenn Sandstone in northeastern Oklahoma can be explained on the basis of specific sedimentary processes. The environment of deposition of the Glenn Sandstone within the relatively small present study area was one in which no major changes in facies occurred, inasmuch as evidence from cores suggests deposition predominantly in distributary channels. However, evidence of localized scouring and avulsion, and abrupt to gradational changes in grain size, sedimentary structures, and geometry of individual rock units suggests that even within the small study area the Glenn Sandstone is relatively heterogeneous.

In the context of this discussion, the term "lithofacies" is more appropriate than "facies", because identification of specific rock units within the Glenn Sandstone is an objective task based on data available from cores and from wireline log-response. "Lithofacies" refers to a described rock unit by which wireline log responses can be distinguished, documented, and classified. Pickett (1971) listed several rock properties and relationships that can be used to specify rock characteristics. They include

1) lithology,
2) relationship between permeability and porosity,
3) relationship between actual porosities and various porosities recorded on well-logs,
4) relationship between inital and residual saturation of hydrocarbons,
5) relationship between water saturation and porosity,
6) pore-size distribution or shape of capillary-pressure curves, and
7) cementation and saturation exponents ("m", and "n").

Well-log quality control for the Glenn (Bartlesville) Sandstone in the William Berryhill Unit is good; irregularites in the boreholes are minimal, most suites of log-surveys are similar (Table XXIII, Appendix C), and logging was done by one service company. Thus, dependable identification of specific rock types, or "lithofacies", and mapping of the Glenn Sandstone within the William Berryhill Unit should be possible from information from cores and well-log signatures.

General Description of Lithofacies

In discussion of general lithology of the Glenn Sandstone that follows, reference is made to examples of lithofacies from cores shown in Appendix B. Examples illustrate sedimentologic features characteristic of the Glenn Sandstone in the study area.

Sandstone of the Glenn is light gray to gray, or light brown to brown, very fine to fine grained and shaly. In the cores are small-to medium-scale cross-bedding, current-ripple laminations, horizontal to massive bedding, planar bedding, flaser bedding, water-escape structures, scour surfaces, channel-base conglomerate (shale rip-up clasts), "randomly" distributed carbonized filaments, clay galls, small rounded siderite pebbles, burrows, chaotic zones of mixing, calcite-cemented intervals, and abrupt to gradational bed contacts. Figures 99, 108, 114, and 120 (Appendix B) show log-signatures of selected wells coupled with evidence of lithologic and sedimentary features included within the gamma-ray signature. Petrologic logs (Plates II through XIII) of the cores studied show more detail; they can be keyed to redescriptions of cores, in Appendix B.

Thickness of the Glenn Sandstone in the study area ranges from 130 feet in the southeast part to approximately 175 feet in the northern portions of the unit (Figures 149, 151, and 153, Appendix D). As mentioned, the Glenn is divided into three sandstone bodies with slightly different reservoir characteristics.

Lower Glenn Sandstone

The Lower Glenn Sandstone (c.f. core: 1557.0-85.6 ft., Figure 100, Appendix B) is generally light gray to gray, very fine to fine grained (medium grained near the base), poorly sorted, and silty, with many thin beds of shale, siltstone, and siderite. Thickness ranges from approximately 20 to 50 feet. The general fining-upward sequence of grain size, and the various sedimentary structures ("massive" sandstone, medium-to large scale cross-bedding, inclined bedding, planar bedding in the uppermost part, thin beds of black shale and sideritic shale, scour surfaces, and bedded sideritic shale pebbles) provide evidence that suggests that the Lower Glenn Sandstone may be a distributary channel-fill sandstone; finer grained overbank sediments seem to overlie the more "massive" channel-fill facies. Channel-lag pebble conglomerate and/or an abrupt contact of carbonate-cemented sandstone with underlying black shale marks the base of the Glenn Sandstone (c.f. core: 1584.8-85.6 ft., Figure 100; core: 1563.2 ft., Figure 121, Appendix B).

Lower "Non-Porous" Zone

The Lower Glenn grades upward into what is called the Lower "Non-Porous" Zone. Interpretation of cross-sections, cores, and core analyses of the Glenn Sandstone across the unit suggests that this interval may be a vertical permeability barrier, and thus seemingly separates the Lower Glenn reservoir from the Middle Glenn reservoir. However, in several wells this rock unit may be relatively thin and may not actually be an effective vertical permeability barrier across the entire unit. The Lower "Non-Porous" Zone typically is interbedded and interlaminated silty sandstone and shales; at some places it contains thin beds of shale rip-up clasts and siderite pebbles within a fine grained sandstone matrix (c.f. core: 1549-57 ft., Figure 100, Appendix B). Its top marks the base of the Middle Glenn and it is generally identifiable by an abrupt increase in gamma-ray deflection (See well-log signatures, Appendix B). Lithic interpretation of the gamma-ray signature alone may be misleading in some instances; the rocks may be interbedded sandstone and shale or an interval of large shale rip-up clasts within fine grained sandstone (c.f. Figure 109, core: 1547.4-49.4 ft., and Figure 115, core: 1539.5-43.7 ft., Appendix B). The former suggests the preserved sediments of a thalweg, where underlying fine grained sediments of the Lower "Non-Porous" Zone were scoured, as shown in the William Berryhill No. 138-I core (Figure 142, Appendix B). In such a case it is doubtful that this interval could be an effective vertical permeablity barrier between the Lower and Middle Glenn Sandstone (c.f. log: 1572.0-75.0 ft., Figure 140; and coregraph: 1560-73 ft., Figure 141, c.f. core: 1559.5-72.8 ft., Figure 142, Appendix B).

Middle Glenn Sandstone

The Middle Glenn Sandstone generally is light brown to brown (due to oil stain), very fine to fine grained, well sorted, and apparently "massively" bedded, with abundant "randomly" oriented carbonized filaments, clay galls, and small, rounded siderite pebbles. Its thickness ranges from approximately 50 to 90 feet; the Middle Glenn is the bulk of the Glenn (Bartlesville) Sandstone reservoir. Medium-scale cross-bedding, finely laminated organic material, and a few thin intervals of flattened, elongated shale rip-up clasts are common (c.f. core: 1482.1-1549 ft., Figure 100, Appendix B). Abrupt contacts of calcite-cemented sandstone with non-calcite cemented rock are also present (c.f. core: 1499.9-1500.5 ft., Figure 109; core: 1506.5 ft., Figure 132, Appendix B). Sedimentological features and bed contacts within the Middle Glenn provide evidence that supports its interpretation as a distributary-channel sand.

Upper "Non-Porous" Zone

Overlying the Middle Glenn is the Upper "Non-Porous" Zone, which separates the Middle and Upper Glenn (c.f. core: 1476.8-82.1 ft., Figure 100, Appendix B). This rock unit is a thin, silty shale, or interbedded and interlaminated silty sandstones and shales that may constitute a relatively thick interval. Discernment of the Upper "Non-Porous" Zone by log signatures alone is difficult. Lateral discontinuity of thin sandstone and shale beds, and their related geometric changes make correlation difficult even with abundant data from cores. Figure 17 shows a few examples of the thin, interbedded shales and siltstones that are characteristic of

Figure 17. Examples of Thin-Bedded, Interbedded and Interlaminated Siltstones/Shales Characteristic of Portions of the Upper and Lower "Non-Porous" Zones

the Upper "Non-Porous" Zone. They are characterized by abrupt contacts with the bounding sandstone, and they may not be detected by standard logging tools because they are thin-bedded.

The Upper "Non-Porous" Zone probable is not be a permeability barrier across the unit. Evidence from pulse-testing in an 18-acre pilot test in the unit suggests significant communication of fluid between the Middle and Upper Glenn (Bae and Petrick, 1984). Difficultly in correlating the zone across the William Berryhill Unit, and its apparent insufficiency as a vertical permeability barrier most likely is due to discontinuity of sandstone and shale interbeds, and perhaps physical contact of the Upper and Middle.

Upper Glenn Sandstone

The Upper Glenn Sandstone generally is gray (near the top), light brown to brown (where it is oil stained), very fine to fine grained, with medium grained, relatively poorly sorted sandstone in the upper part. This medium grained interval shows small to medium scale cross-bedding (c.f. core: 1426.5-1434.0 ft., Figure 109, Appendix B) and has relatively high porosities (25-28%) and permeabilities (300-700 md). It can be identified easily from well logs by its lower resistivity, higher log porosities, and relative increase in interval transit time as compared to rocks above and below (c.f. log: 1433-40 ft., Figure 108, Appendix B). The Upper Glenn may contain more sedimentary features than the Lower and Middle Glenn, but is also in part "massive" in appearance (c.f. core: 1428-1476.8 ft., Figure 100, Appendix B).

In some instances, the uppermost part of the Upper Glenn is gradational into gray siltstone and shales; in other instances it is abruptly transitional into finely interbedded, sideritic, limy sandstone and shale (c.f. core: 1410-1422.5 ft., Figure 109; 1406.4-1424.3 ft., Figure 137, Appendix B). There is significant organic material in the shales that overlie the Glenn; bioturbated rock suggests that the overlying shales and silty shales are interdistributary bay deposits.

Based on the general fining-upward sequence of sedimentary features, the Upper Glenn is interpreted as a distributary-channel sand. Tabular cross-beds, small scale trough cross-beds, horizontal beds, and ripple-lamination suggest preservation of incomplete point-bar sets in the upper portion of the interval. Based on several north-south and east-west cross-sections, at some localities the Upper Glenn appears to have channeled into the underlying Middle Glenn; at such places discrimination between them can be difficult.

In summary, the Glenn (Bartlesville) Sandstone in the William Berryhill Unit is divisible into three genetic sandstone bodies. They are interpreted as "stacked" channel-fill sandstones, separated, or seemingly separated by beds of finer grained rock that could be vertical permeability barriers at some localities.

Several distinct lithofacies within the Glenn Sandstone were recognized from observation of the cores. A summary of the distinguishing characteristics of each lithofacies in presented in Table I. Correlation of individual lithofacies across the area by logs alone is uncertain because of short-distance physical and textural variations. Better correlations can be made by detailed examination of cores and calibration of well-logs.

TABLE I

SUMMARY DESCRIPTION OF LITHOFACIES OF THE GLENN SANDSTONE
WILLIAM BERRYHILL UNIT, GLENN POOL OIL FIELD

Lithofacies	Thickness (Ft.)	Distinguishing Characteristics	
"Massive" Sandstone	.5 - 25	Upper Glenn:	Oil stained in part, gray to light brown, fine to medium grained, moderately-well sorted, angular to sub-angular, visible porosity in coarser intervals, carbonaceous filaments, few sand-sized rock fragments, flowage features, scour surfaces.
	25 - 80	Middle Glenn:	Oil stained in part, light to dark brown, fine grained, well-moderately sorted, sub-angular to angular, abundant carbonaceous filaments, small rounded siderite pebbles and clay galls, scour surfaces.
	.5 - 20	Lower Glenn:	Gray to light gray, fine to medium grained, moderately to poorly sorted, abundant small siderite pebbles in part, abundant sand-sized rock fragments, slightly micaceous, clayey, scour surfaces.
Cross-bedded Sandstone	.2 - 5	Small scale:	(Apparently trough cross-bedding). Characteristics of upper portion of Upper Glenn, very fine to medium grained, poorly sorted, visible porosity, silty interlaminations, mottled appearance, in part due to carbonate cementation.
	.5 - 15	Medium scale:	(Trough and/or planar?). Characteristic of portions of each sand (Upper, Middle, and Lower Glenn), abundant authigenic siderite in portions of Middle Glenn, asphaltic material fills pores in relatively thin intervals in portions of Upper and Middle Glenn.
	?	Large scale:	Probably recorded, but not well defined in cores, (low angle cross-bedding?, massive appearance?).

TABLE I (Continued)

Interbedded and Interlaminated Sandstone/Shale	.2 - 15	Interbedded sandstone/shale:	Characteristic of portions of the Upper and Lower "Non-Porous" Zone, alternating thin (2 - 3 in.) beds of sandstone and shale, near-parallel bedding to flaser bedding, flowage features in part.
	.1 - 10	Interlaminated sandstone/shale:	Characteristic of portions of the Upper and Lower "Non-Porous" Zone, finely bedded, silty, carbonaceous laminations, current-ripple laminations to planar bedding, convolute bedding, flowage features and burrowed in part.
Calcium-carbonate-cemented Sandstone	.5 - 1.5	Thin intervals:	Apparent massive bedding, (inclined bedding at base of Glenn Sandstone) abrupt contacts with non-carbonate-cemented sandstone or black shale at base of Glenn.
	1.5 - 8	Thick intervals:	Usually above and below a bed of shale or contains large clasts of shale and increased carbonaceous material; mottled appearance near top contact.
		"Spherical" contacts:	Near-circular or semi-circular abrupt contacts with non-carbonate-cemented sandstone; observed only as isolated contacts in a few cores.

TABLE I (Continued)

	.2 - 1	Thin basal conglomerate:	Characteristic of base of Glenn Sandstone in several cores; rounded to well-rounded pebbles of black to gray shale, sideritic shale, and siltstone in addition to carbonized plant debris are common at numerous places in a very fine to fine grained carbonate-cemented sandstone matrix; abrupt contact with shale below.
Conglomeratic Sandstone	.1 - 2	Thin "chaotic" intervals:	Characteristic of portions of the Lower and Middle Glenn and Lower "Non-Porous" Zone, flat-elongate, rounded to sub rounded, black shale and sideritic shale pebbles in a very fine to fine grained sandstone matrix, abrupt contacts above and below may or may not exist.
	2 - 8	Thick "chaotic" intervals:	Characteristic of portions of the Lower "Non-Porous" Zone. Large (2 to more than 4.5 in.), angular to subangular, clasts of black shale in very fine to fine grained sandstone matrix, in some cores this interval may be partially carbonate-cemented.

CHAPTER IV

PETROLOGY

Introduction

Few subsurface stratigraphic studies of the Cherokee Group in northeastern Oklahoma include a detailed description of the petrography, diagenetic features, or types of porosity of the Bartlesville Sandstone. In previous investigations by many geologists, the Bartlesville has been described as being composed largely of white to light gray - buff, very fine to medium grained, angular to subangular quartz with smaller percentages of feldspars, chert, mica, hornblende, rutile, zircon, and other minor minerals. Two of the most detailed petrographic studies of the Bartlesville Sandstone were done by Leatherock and Bass (1937), and Visher et al. (1971); however, both of the studies were qualitative. Leatherock and Bass (1937) noted a large proportion (10 to 20 percent) of rock fragments and regionally "uniform" composition and texture of the sandstone, whereas Visher et al. (1971) described the Bartlesville in northeastern Oklahoma as subgraywacke, and identified the clay minerals as kaolinite, iron chlorite, and illite.

Recent studies by Tight (1981) and Mason (1982) give more detailed descriptions of the composition and diagenetic features of the Bartlesville in the Avant and Cushing oil fields, respectively.

The purpose of this chapter is to describe the methods used to identify detrital and authigenic minerals in the Glenn Sandstone within the William Berryhill Unit, to list and describe those constituents, and to classify the rock accordingly.

Methods

Petrographic analysis of the Glenn in the William Berryhill Unit included examination of more than 125 thin sections from ten cores. Thin-section samples were selected primarily from "reservoir" lithofacies, selected by megascopic examination of the cores. Locations of samples from each core are marked on corresponding logs, diagrams, core analyses, and core photographs included in the Appendixes. More than 300 points were counted from several randomly selected thin sections, in order to provide reliable estimates of percentages of detrital and diagenetic constituents, and of porosity. Percentages of framework grains (quartz, feldspar, rock fragments) were plotted on Folk's (1968) ternary diagram and rock was classified accordingly. Classification of each sample is shown on ternary diagrams for each core in Appendix B.

Routine thin-section examination was agumented by anal ysis of selected samples using scanning electron microscopy (SEM). X-ray diffraction of several "clay-extracted" samples gave semi-quantitative values of the amount of each clay mineral present (Kiltrick and Hope, 1963).

Glenn Sandstone

Major detrital constituents of the Glenn Sandstone are quartz and subordinate amounts of feldspar and sand-sized fragments of metamorphic and sedimentary rock. Minor detrital constituents, ranging from trace amounts to one to two percent, include: mica (muscovite and/or biotite), pyrite, hematite, hornblende, magnetite, rutile, zircon, tourmaline, collophane, and leucoxene. Glauconite, in the form of small (.05 - .1 mm) rounded pellets or compacted pellets that compose a green pseudomatrix, was observed in only a few samples from near the top and/or base of the sandstone. A trace to five percent of finely particulate plant debris and fine carbonaceous filaments also occurred throughout the sandstone, as thin (.5 - 3 mm) partings and dispersed filaments.

In addition to the framework grains and minor detrital constituents, detrital matrix, cements, clay minerals and other authigenic constituents contribute to the subtle compositional differences observed in the Glenn Sandstone.

Constituents of the sandstone basically are similar in kind but moderately variable in amount. These subtle differences influence the reservoir quality and log-response characteristics of each genetic sandstone body (Upper, Middle, and Lower). However, the major differences in reservoir quality and log-response characteristics are due primarily to changes in texture, grain size, pore geometry, volume and distribution of clay minerals, and fluid content. Table II lists the average mineralogic composition of each of the genetic sandstone bodies.

Classification

In the study area the Glenn Sandstone primarily is sublitharenite to litharenite. Originally the rock probably was more feldspathic; a significant percentage of the feldspar grains appear to have been dissolved or altered to clay. Compositional differences among the Upper, Middle and Lower Glenn, in terms of major detrital constituents seems to be related primarily to relative abundances of rock fragments and detritial matrix. This association is shown in Figures 18, 19, and 20.

Lower Glenn Sandstone

The Lower Glenn ranges from sublitharenite to litharenite, to a feldspathic litharenite (Figure 18). Grain size ranges from very fine to fine grained near the top, to medium grained near the base.

Middle Glenn Sandstone

The Middle Glenn is not as varied in composition as the Upper Glenn. It is sublitharenite (Figure 19), primarily very fine to fine grained.

TABLE II

AVERAGE MINEROLOGIC COMPOSITION OF THE GLENN SANDSTONE
WILLIAM BERRYHILL UNIT, GLENN POOL OIL FIELD,
CREEK COUNTY, OKLAHOMA

	PERCENTAGE		
	UPPER GLENN	MIDDLE GLENN	LOWER GLENN
QUARTZ			
MONOCRYSTALLINE	70	68	61
POLYCRYSTALLINE	5	2	3
FELDSPAR			
UNDIFFERENTIATED	1	1	2
PLAGIOCLASE	2	3	3
MICROCLINE	1	1	1
ROCK FRAGMENTS			
LOW RANK METAMORPHIC	4	3	5
SEDIMENTARY	3	2	4
CHERT	1	<1	1+
OTHER DETRITAL CONSTITUENTS			
MICA	1	1	1+
GLAUCONITE	TR-1	TR	TR-1
ZIRCON	TR	TR	TR
TOURMALINE	TR	TR	TR
HORNBLENDE	TR	TR	TR
OPAQUE MINERALS	TR	TR	TR
DETRITAL MATRIX	2	1	4+
DIAGENETIC CONSTITUENTS			
CEMENT			
QUARTZ OVERGROWTHS	3	2	1
CALCITE	1	3+	2+
DOLOMITE	TR	1	<1
SIDERITE	<1	3+	2
AUTHIGENIC CLAY			
KAOLINITE	3	3	2
ILLITE	<1	1	3
CHLORITE	1+	1	2
OTHER			
IRON OXIDES	<1	<1	1
PYRITE	<1	1	1
PSEUDOMATRIX	1+	1	3+

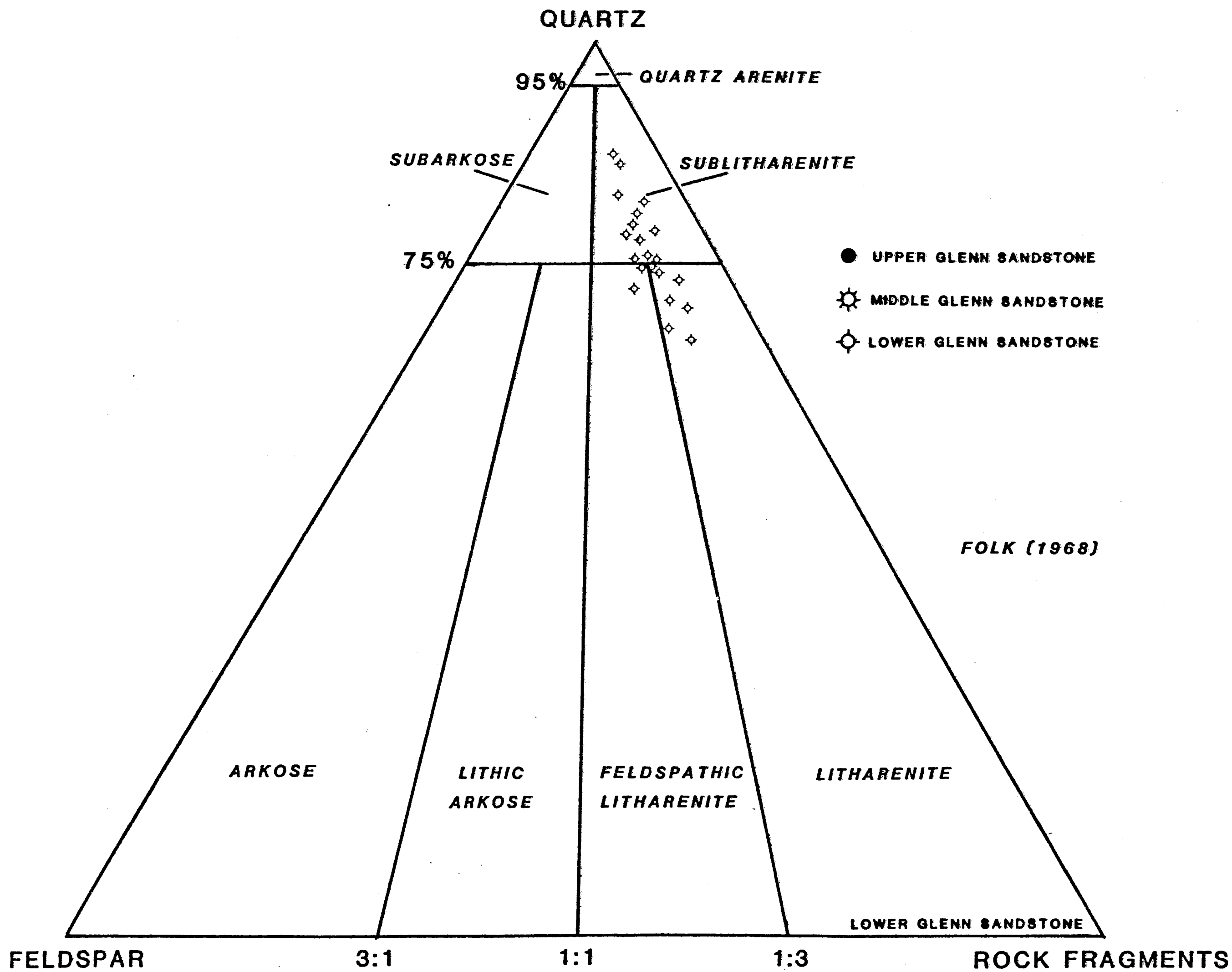


Figure 18. Ternary Diagram Depicting Composition and Classification of the Lower Glenn Sandstone, William Berryhill Unit

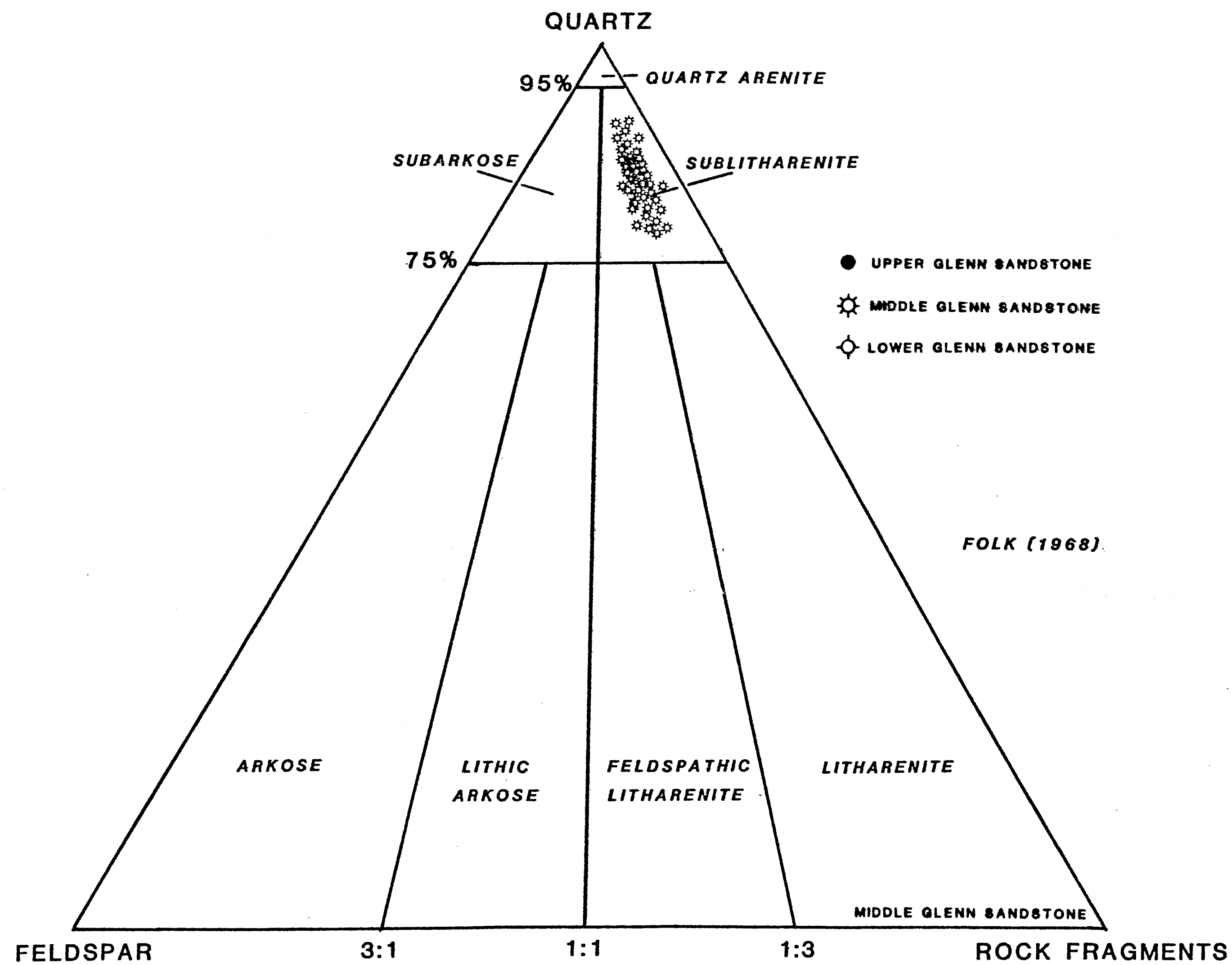


Figure 19. Ternary Diagram Depicting Composition and Classification of the Middle Glenn Sandstone, William Berryhill Unit

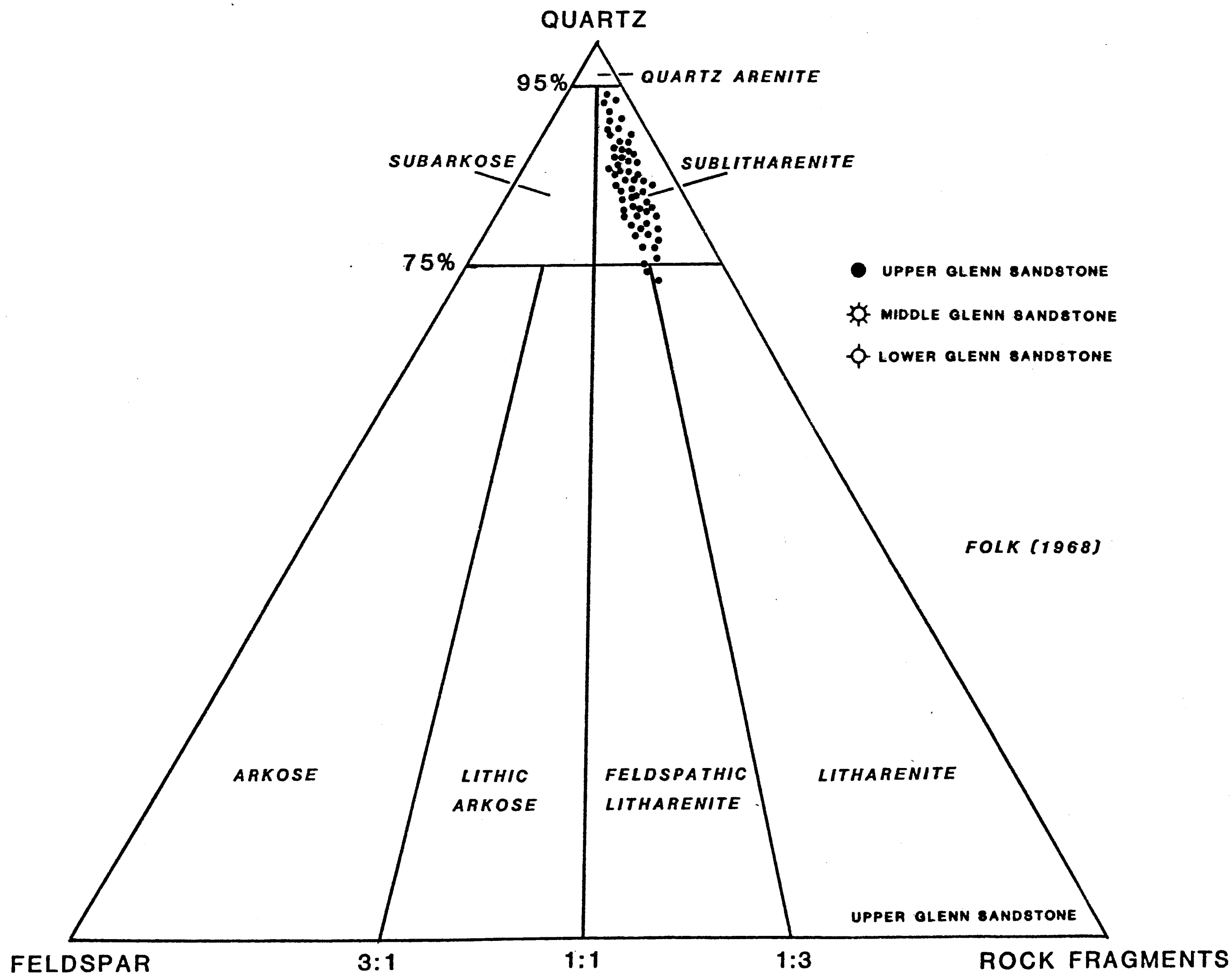


Figure 20. Ternary Diagram Depicting Composition and Classification of the Upper Glenn Sandstone, William Berryhill Unit

Upper Glenn Sandstone

The Upper Glenn ranges from nearly quartz arenite, to predominantly sublitharenite, approaching feldspathic litharenite to litharenite (Figure 20). Grain size ranges from medium in thin subunits near the top, to fine to very fine in the remainder of the the sandstone.

Detrital Constituents

Quartz

Quartz is the most abundant grain type in the Glenn Sandstone (Figure 21). Content of quartz ranges from 60 to 80 percent and averages 70 percent of the framework grains. Generally, grain size ranges from very fine to fine grained and shapes range from angular to subangular, but beds of medium grained, subrounded-subangular grains are near the top and base of the Glenn. Most quartz grains are monocrystalline with undulose to slightly undulose extinction, but several grains show straight extinction (Figure 22). Inclusions of rutile, tourmaline, and zircon are common in many of the monocrystalline quartz grains. In addition, many of the grains contain irregular fluid inclusions often in the form of bubble trains.

Polycrystalline quartz averages two to three percent of the total rock sample (Figure 23). The composite nature of the polycrystalline quartz shows a interlocking mosaic char acteristic of recrystallized metamorphic quartz. Crenulated borders of some polycrystalline quartz grains show characteristics of stretched metamorphic quartz, whereas a few

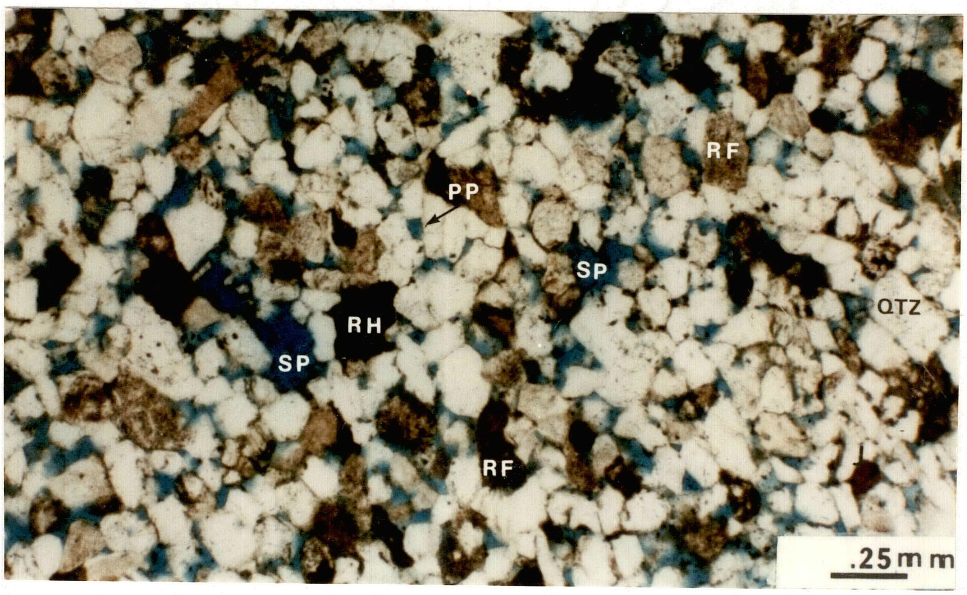
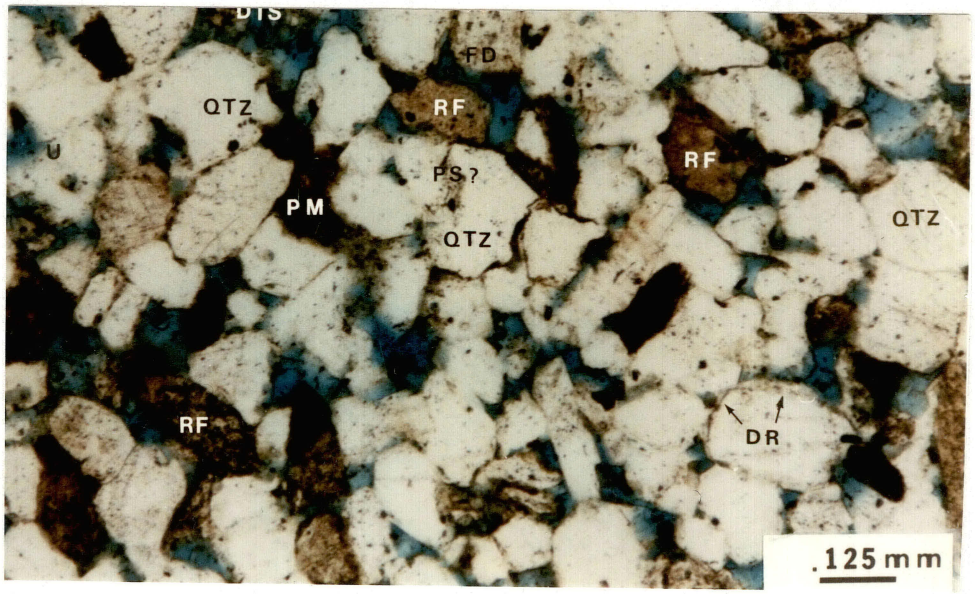


Figure 21. Thin Section Photomicrograph, Plane Polarized Light. Sandstone, Very Fine Grained, Angular to Subrounded. Characteristic Sample of Glenn Sandstone. Quartz (QTZ), Rock Fragments (RF), Primary Pore (PP); Residual Hydrocarbons (RH) Fill Some Pore Spaces (SP)



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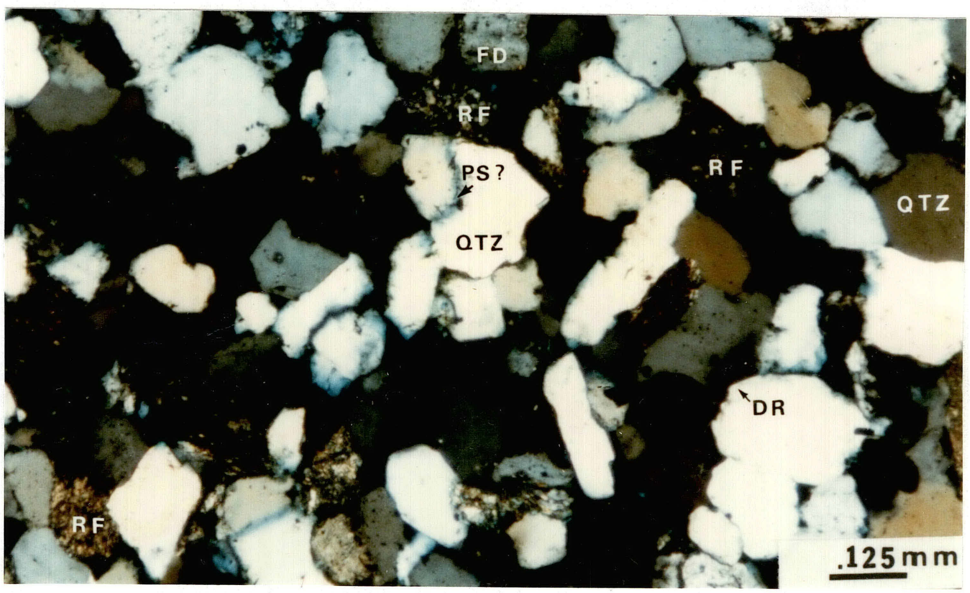


B

Figure 22. Thin Section Photomicrograph, (A) Plane Polarized Light, (B) Crossed Nicols. Sandstone Showing Various Framework Grains, Quartz (Qtz), Feldspar (FD), and Rock Fragments (RF). Evidence of Dissolution (DIS), Pressure Solution (PS), Pseudomatrix (PM), and Thin Clay "Dust Rims" (DR). (Porosity shown in Blue)

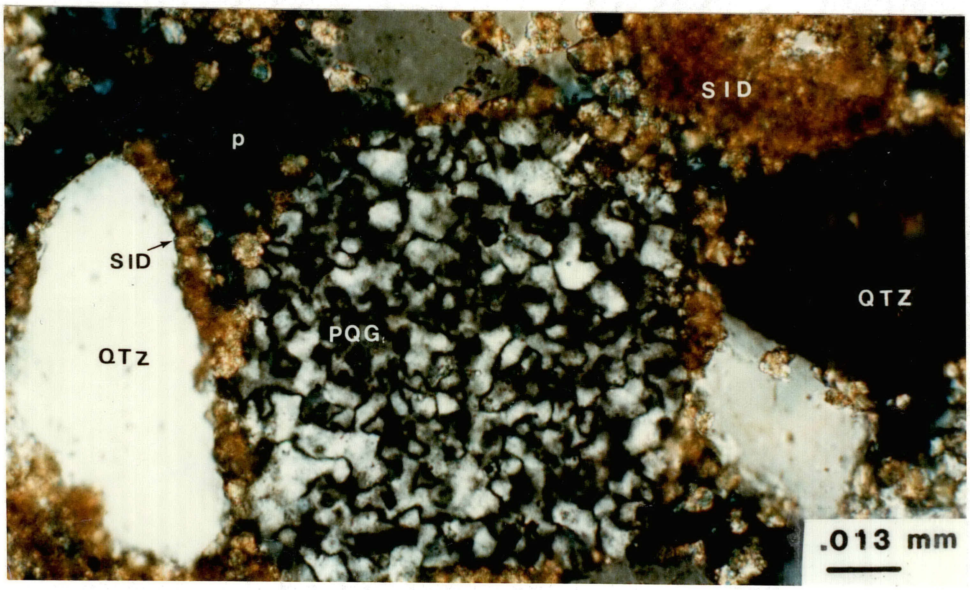


Figure 23. Thin Section Photomicrograph, Crossed Nicols, Well-Rounded Polycrystalline Quartz Grain (PQG). Siderite (SID) Aggregates Line Grains. Pore (P)

elongate, straight-border polycrystalline quartz grains with inclusions of parallel mica show characteristics of schistose metamorphic quartz. The types of quartz suggest that the source area of sand was terrain of granitic-metamorphic rock.

Rock Fragments

Rock fragments are the second most abundant framework grain in sandstone of the Glenn (Figure 22). They constitute four to sixteen percent, and average six to ten percent of the total rock. Most rock fragments are metamorphic or sedimentary. Metamorphic-rock fragments (Figure 24) are foliated quartz-mica gneiss, quartzite, or phyllite. Most grains are subrounded to rounded, subequant to equant, behave rigidly, and therefore show very little effects of compaction. They constitute four to eight percent and average six percent of the total rock.

Sedimentary-rock fragments (Figure 25) range from two to four percent, and average three percent of the total rock. They include laminated and non-laminated argillaceous rock, and fragments of chert. The argillaceous fragments tend to show more effects of compaction, as made evident by clayey "pseudomatrix," seemingly formed by squeezing of soft fragments into pore spaces and around harder grains (Figures 26 and 27).

Fragments of chert are relatively few (one to two percent) and in some instances are difficult to distinguish

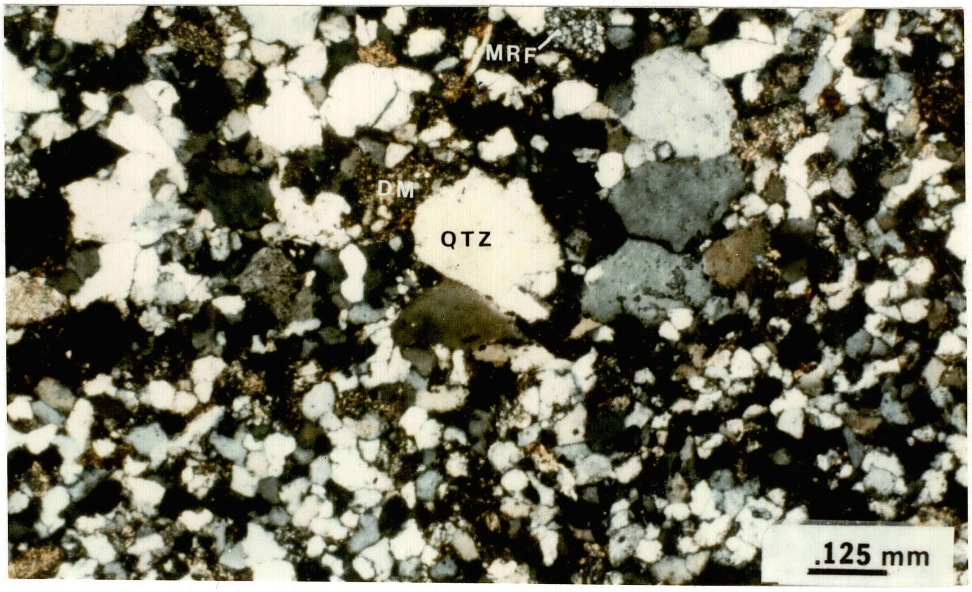


Figure 24. Thin Section Photomicrograph, Cross Nicols. Sandstone Shows Abrupt Change in Grain Size (Very Fine to Silt-sized Below, Fine to Medium Grained Above) Characteristic of the Top Portion of the Lower Glenn. Metamorphic Rock Fragment (MRF), Detrital Matrix (DM)

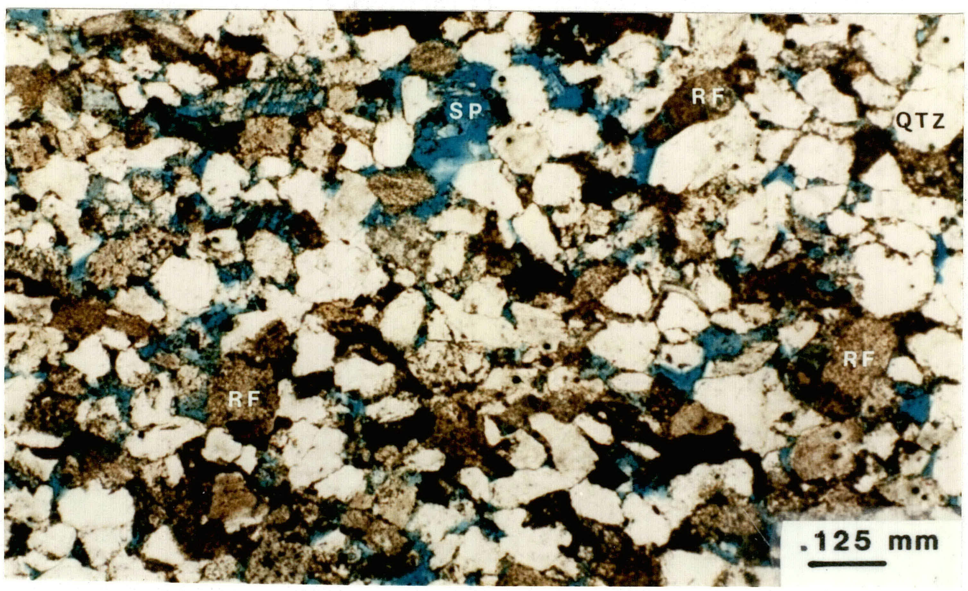


Figure 25. Thin Section Photomicrograph, Plane Polarized Light. Sandstone Characteristic of the Lower Glenn. Note the Abundance of Rock Fragments (RF) and Apparently Isolated Secondary Pore Spaces (SP)

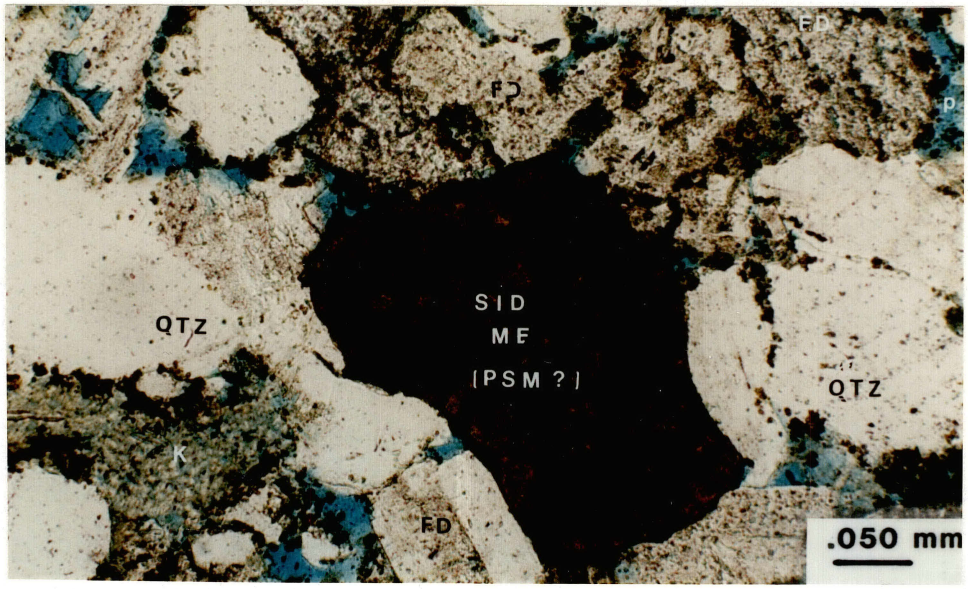


Figure 26. Thin Section Photomicrograph, Plane Polarized Light. Sideritic (SID), Argillaceous Rock Fragment (Mud Fragment) (MF) That Has Undergone Some Ductile Deformation and Can Be Classified Possibly As Pseudomatrix (PSM ?). Kaolinite (K), probably altered clay fragment.

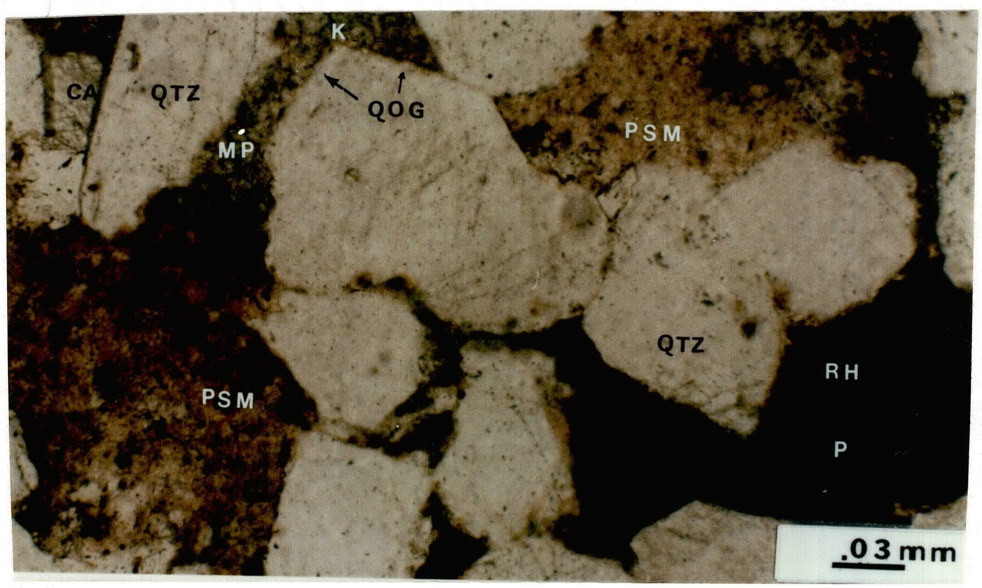


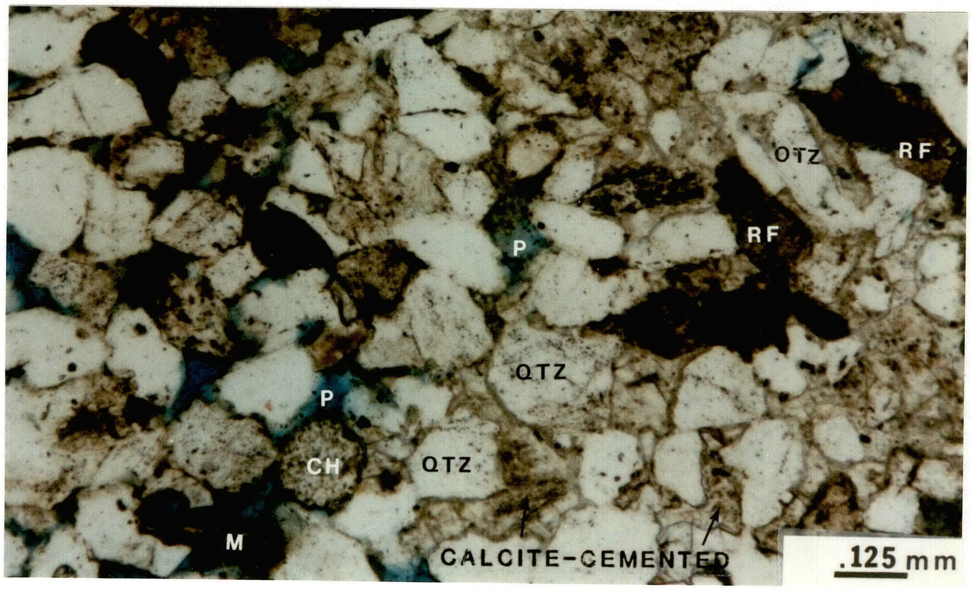
Figure 27. Thin Section Photomicrograph, Plane Polarized Light. Sandstone Showing Straight Crystalline Outlines of Syntaxial Quartz Overgrowth (QOG), and Clayey Pseudomatrix (PSM). Kaolinite (K) Creates Microporosity (MP). Calcite (CA), Residual Hydrocarbons (RH), Quartz (QTZ), and Pore Space (P)

from fragments of low-grade metamorphic rock. However, characteristic pin-point extinction of the chert aids in differentiation of the two (Figure 28).

Larger rock fragments, such as clay galls and shale rip-up clasts, are characteristic of portions of the Glenn, especially in lithofacies near the bases of channel-fill sequences (e.g., base of the Middle Glenn, and base of the Lower Glenn (Figures 99, and 108, Appendix B). The more "massive" sand bodies (i.e., Middle Glenn) contain scattered, small, rounded to subrounded, sideritic, argillaceous pebbles and clasts. The Lower Glenn contains relatively more argillaceous fragments of rock (and detrital matrix) than the Upper and Middle Glenn sandstones (cf. Figures 18, 19, 20, and 25). This difference is believed to be the major factor in the decreased porosity and permeability in the Lower Glenn (cf. Figure 10). In most instances, the relative increase in gamma-ray API units of the Lower Glenn sandstone is related directly to increase of argillaceous rock fragments and of detrital matrix of illitic composition (cf. Log-signature diagrams, Figures 99, 108, 114, and 120, Appendix B)

Feldspars

Feldspars constitute four to six percent of the total rock and average five percent. Most twinned feldspars are easily identified as plagioclase by their distinctive albite twinning (Figure 29). Untwinned feldspars were more difficult to distinguish but commonly were recognized in plane



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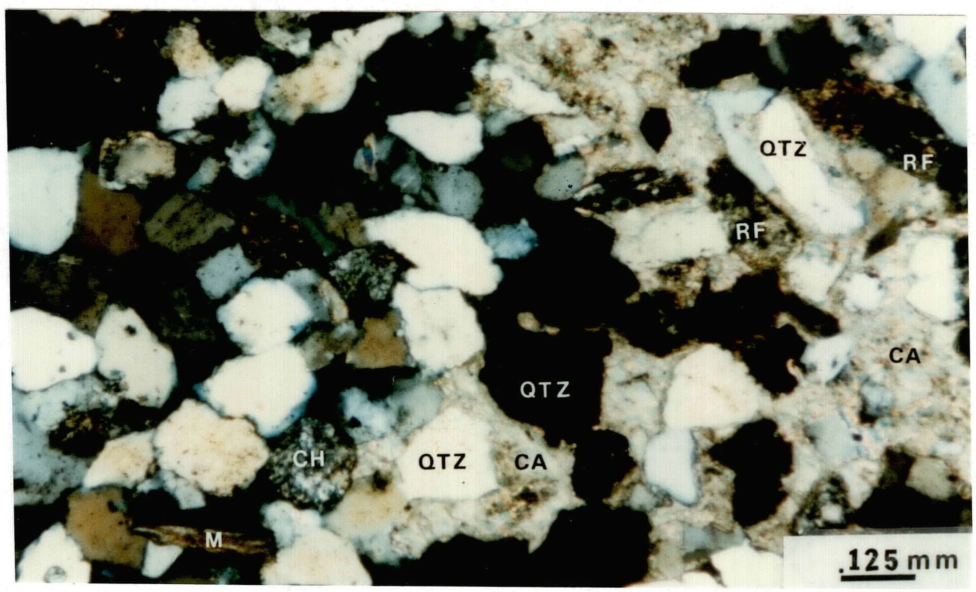


B

Figure 28. Thin Section Photomicrograph, (A) Plane Polarized Light, (B) Crossed Nicols. Boundary of Calcite-cemented Sandstone (Right) with Non Calcite-cemented Sandstone (Left). Calcite (CA), Quartz (QTZ), Chert (CH), Mica (M), Rock Fragment (RF), and Pore Space (P)

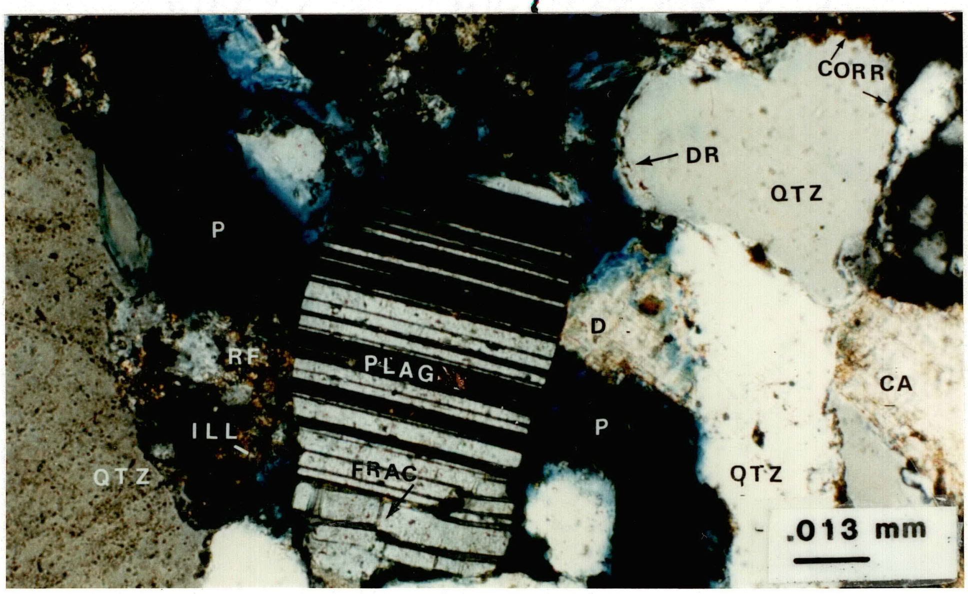


Figure 29. Thin Section Photomicrograph, Crossed Nicols. Plagioclase Feldspar Grain (PLAG), Subrounded-Rounded, With Characteristic Albite Twinning; Portion of Grain is Fractured (FRAC). Corroded (CORR) Quartz Grain (QTZ) With Thin Partially Dissolved Overgrowth Remnant, as Indicated by "Dust-Rim" (DR). Patchy Calcite Cement (CA), Illitic Rock Fragment (RF, ILL), Dolomite (D), and Porosity (P).

polarized light by their "cloudy", or "dirty" appearances, which are caused by alteration to clays (Figure 30). During thin-section examination it was assumed that most of the untwinned feldspars and those unidentifiable as plagioclase were orthoclase. Most feldspar grains observed with cross-hatched twinning, and some with uneven twinning lamellae, were identified as microcline (Figure 30). However, possible diagenetic albitization of some potassic feldspar may have occurred (Figure 30).

Accessory Minerals

Accessory heavy minerals such as zircon, tourmaline, rutile, collophane, hornblende, and magnetite were common in trace amounts in nearly all the samples. Mica (muscovite and/or biotite) constitutes at least one percent of the sandstone and is easily identified by its high birefringence and elongate grain morphology (.02 - .5 mm) (Figure 28). Bent and broken mica suggest deformation by compaction, a commonly inferred feature in most sandstones of the Cherokee Group. The largest percentage of mica in the Glenn is in the interbedded sandstone and shale lithofacies, where decreasing energy allowed deposition of the platy, slowly settling grains. Some mica shows partial alteration to kaolinite or extensive oxidization, as indicated by a brownish color.

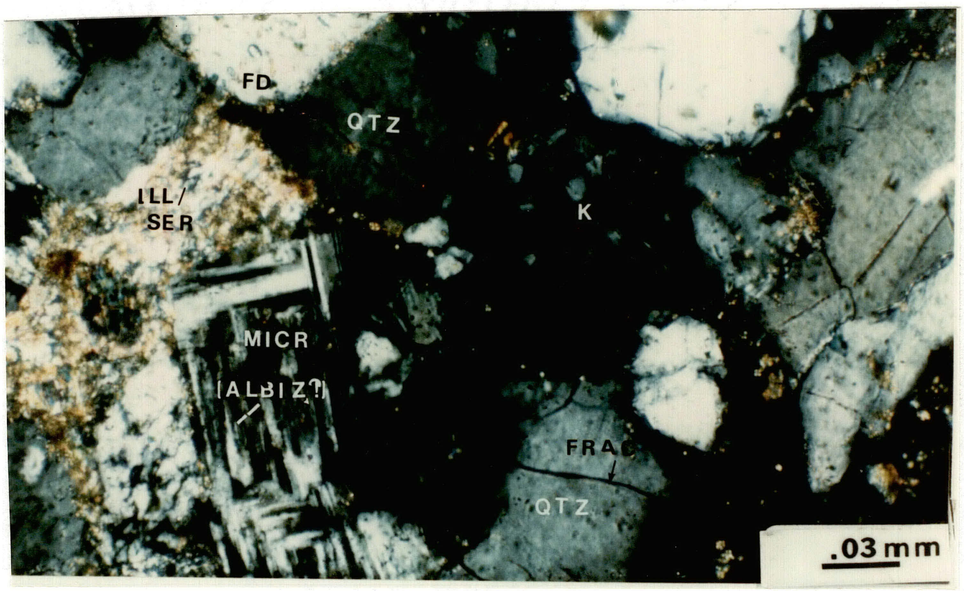


Figure 30. Thin Section Photomicrograph, Crossed Nicols. Microcline (MICR)? Shows Characteristic "Cross-hatched" Twinning (Albitization Feature (ALBIZ ?). Feldspar (FD) Shows a Faint Rim of Highly Birefringent Clay. Illitic/Sericitic (ILL/SER) alteration product of a detrial constituent (Feldspar ?) Fractured (FRAC) ? Quartz (QTZ), Kaolinite (K).

Detrital Matrix

Detrital matrix is a syndepositional material, commonly illitic or chloritic. It is composed primarily of silt-sized quartz grains and illitic clay with small amounts of chlorite (Figure 31). The Upper and Middle Glenn contain one to three percent of detrital matrix, and average two percent, whereas the Lower Glenn contains as much as twelve percent and averages four percent.

Authigenic Constituents

Authigenic constituents include cements and clay minerals. Major authigenic constituents documented in this study are syntaxial quartz overgrowths, few feldspar overgrowths, carbonate cements (calcite/dolomite), siderite aggregates, kaolinite, chlorite, illite, and mixed layered clays.

Authigenic Cements

Silica cements, in the form of syntaxial quartz overgrowths (Figure 32), are common in each genetic sandstone body and constitute about two percent of the total rock. They are well developed, subhedral to euhedral, and can be identified in thin section by sharp straight-line crystalline outline. Many of the overgrowths contain a very thin "dust rim" of clay that surrounds the original grain. Feldspar overgrowths are very rare in the Glenn; they were observed in only a few thin sections, primarily from the

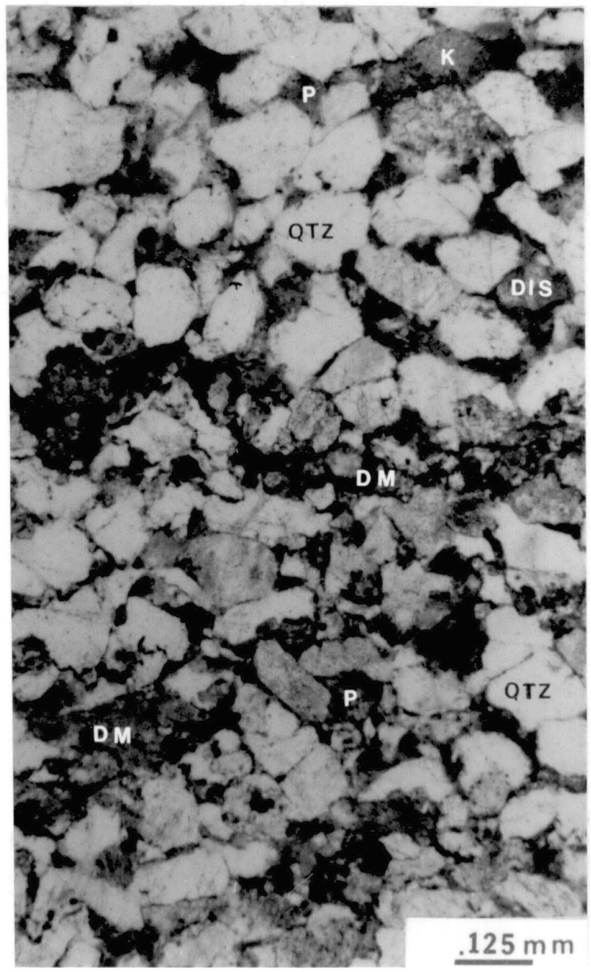


Figure 31. Thin Section Photomicrograph, Plane Polarized Light. Sandstone Showing Abrupt Increase in Amount of Detrital Matrix (DM) (Lower Half). Note Occlusion of Porosity (P) as Compared to Upper Half of Photograph. Quartz (QTZ), Kaolinite (K), Dissolution (DIS).

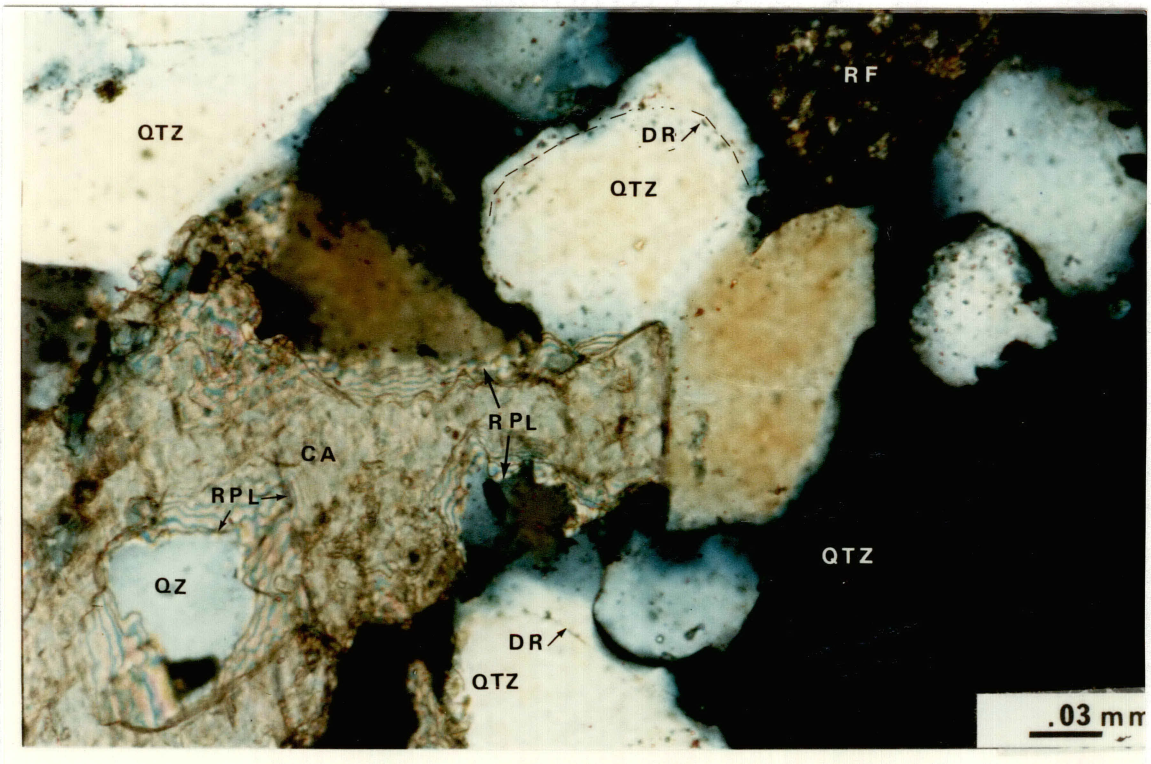


Figure 32. Thin Section Photomicrograph, Crossed Nicols. Sandstone Showing Syntaxial Quartz Overgrowth as Inferred by Dashed Line Representing Original Quartz Grain (QTZ). Calcite (CA) Displacement and Replacement (RPL) of Quartz. At Least Two Stages of Calcite Replacement can be Inferred by the Presence of an Outline or "Ghost" of Quartz Grain (Lower Left). Rock Fragment (RF) and "Dust-Rim" (DR) Also Shown

Lower Glenn.

Calcium-carbonate cements in the Glenn include: 1) calcite as an early, pore-filling cement that normally replaced and displaced the original framework grains, 2) dolomite as a late replacement of calcite, and 3) siderite as an early pore-filling aggregate, which may be a major cementing agent. Intervals with calcite cementation are common in the Upper, Middle, and Lower Glenn; less than one percent or as much as 35 percent of the total rock is cemented by calcite. Poikilotic calcite cement surrounds grains and has effectively destroyed almost all porosity and permeability (Figures 28, 32, and 33). Evidence from cores and well logs suggests that the extensively calcite-cemented strata are discontinous laterally and that they may compartmentalize or isolate portions of the reservoir. These zones of calcite cementation normally are associated with shales and/or abundant carbonaceous matter, most commonly near the bases of the Lower and Middle Glenn, and the top of the Upper Glenn. However, other zones within each sandstone body appear to be isolated intervals (most commonly showing "spherical" contacts) of calcite-cemented sandstone. Figure 34 shows several examples of the occurrences of calcite cementation in the Glenn (Bartlesville) Sandstone.

Dolomite cementation was recognized in association with the calcite-cemented intervals. Evidence of calcite replacement by discrete rhombohedra of ferroan dolomite suggests secondary formation of dolomite cement (Figure 29). Dolomite cement may also fill pores in small isolated areas

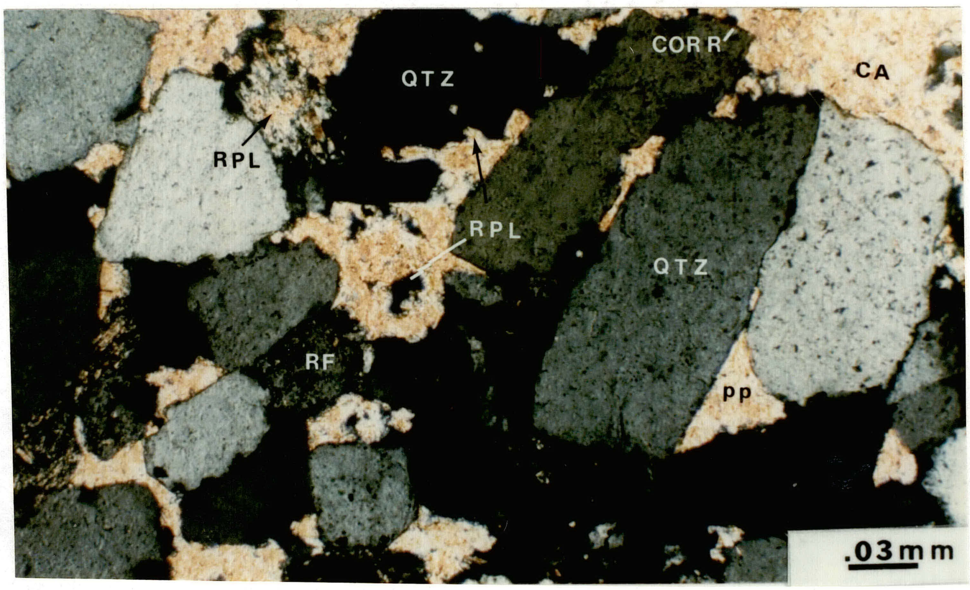


Figure 33. Thin Section Photomicrograph, Crossed Nicols. Calcite-cemented (CA) Sandstone Possibly Owing to Replacement (RPL) of Quartz (QTZ) and/or Feldspar (FD) by Calcium-carbonate. Note Partial Corrosion (CORR) of Quartz Grains. A Possible Primary Pore (PP) Has Been Filled By Calcite

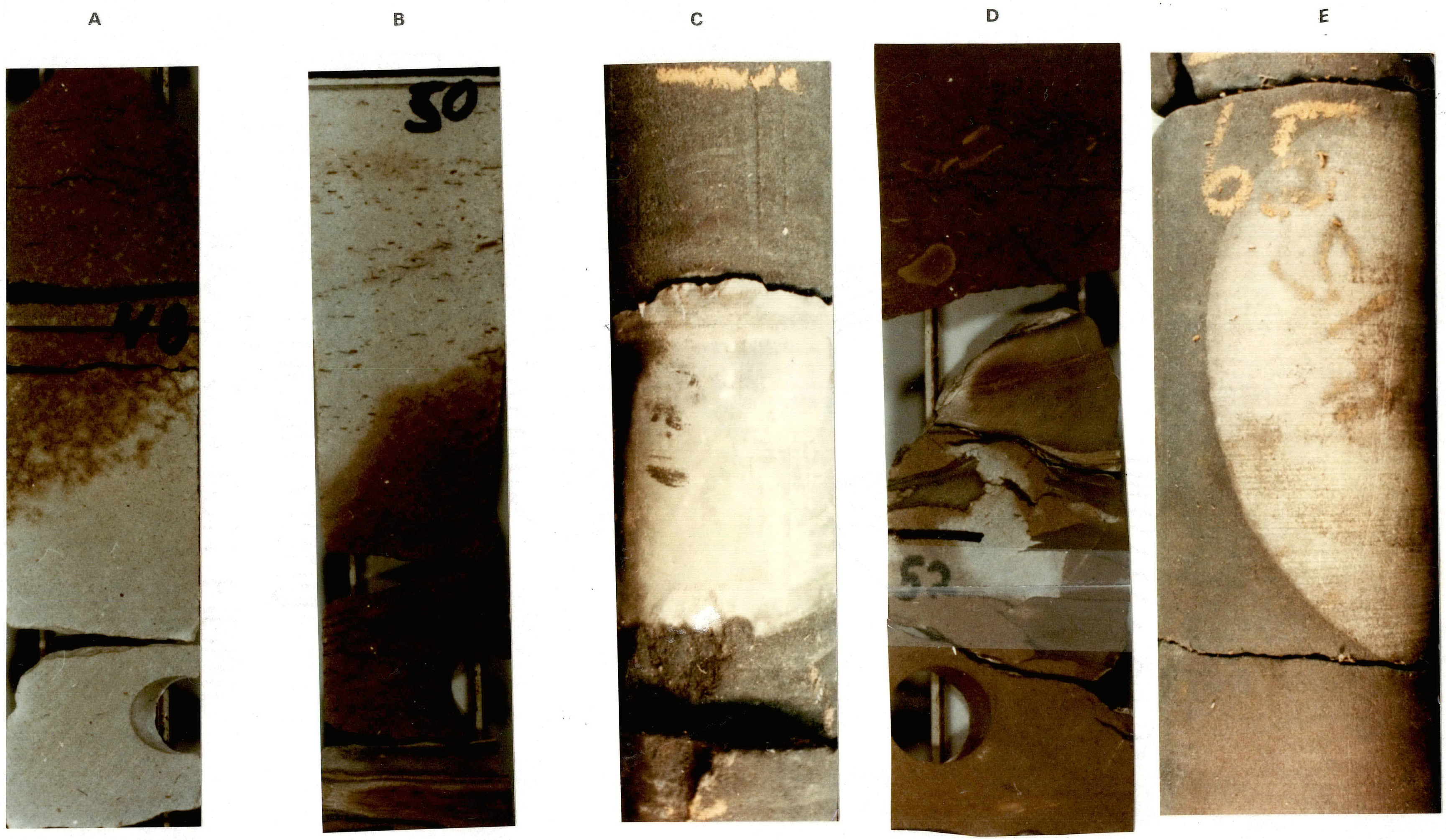


Figure 34. Calcium-carbonate Cement in the Glenn Sandstone. (A) Upper Contact and (B) Lower Contact of Cemented Interval Approximately Two Feet Thick; (C) Thin-bedded, Abrupt Contact ; (D) "Diapiric" Feature; (E) Semi-circular Contact ("Spherical" Growth)

within the calcite-cemented intervals. It may range from less than one percent to as much as three percent of the total rock. In parts of the Glenn that are not cemented by calcite, dolomite occurs only in trace amounts.

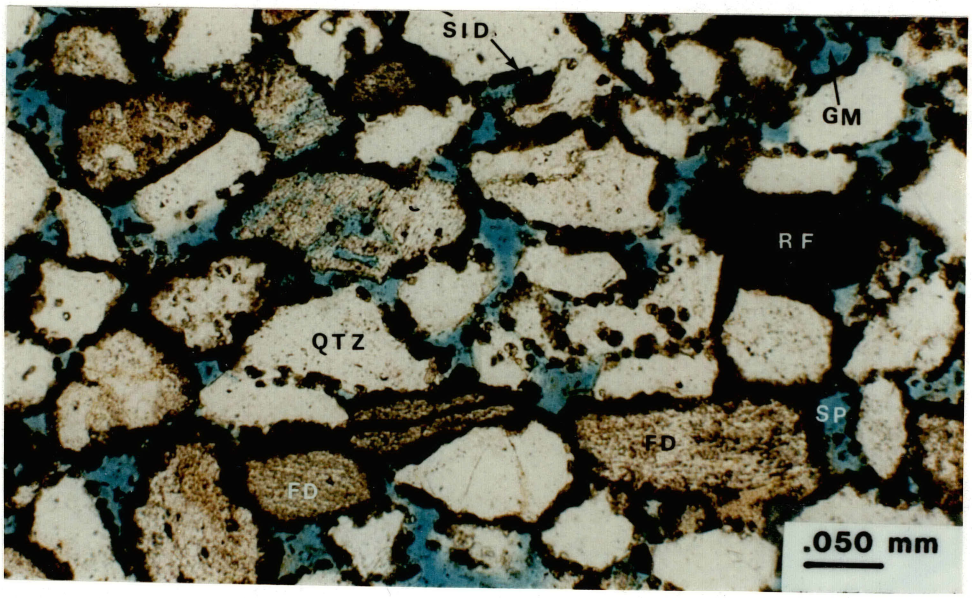
Discrete, rhombic crystals of siderite were observed as pore-filling and grain-lining aggregates in several samples from the upper portion of the Middle Glenn (Figures 23 and 35). Abundant siderite (as much as five percent) seems to be confined to this general interval, although smaller amounts are in samples in other portions of the sandstone. Siderite primarily is developed in conjunction with "massive", fine grained sandstones that have relatively large porosities (20 - 24 %) and permeabilites (100 - 450 md). Small aggregates of siderite are believed to be early diagenetic features; however, siderite appears to cement only these local portions of the Middle Glenn.

Other Minor Cements

Hematite and limonite cements make up from a trace to one percent of the total rock. They are detected easily by their opaqueness and reddish brown to yellowish brown colors in reflected light.

Authigenic Clay Minerals

Authigenic clays minerals documented in this study are kaolinite, illite, and chlorite. X-ray diffraction and SEM analyses confirmed the presence of clays seen poorly in thin



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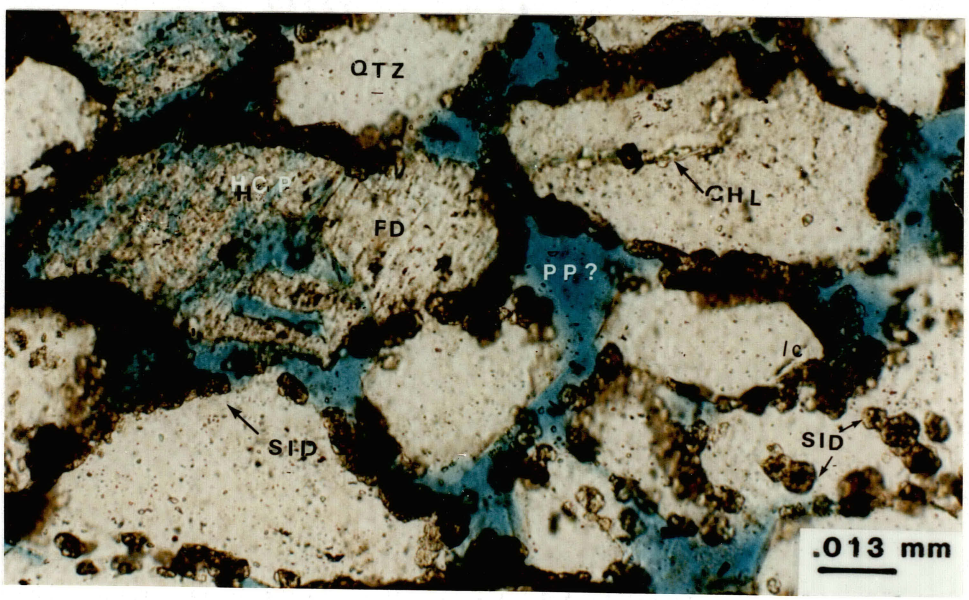


B

Figure 35. Thin Section Photomicrograph, (A) Plane Polarized Light, (B) Larger Magnification. Sandstone Containing Abundant Siderite (SID) Aggregates Filling Pore Throats. Dissolution of Some Detrital Grains Gave Rise to Secondary Porosity (SP) in the Form of Grain Molds (GM). Rock Fragment (RF), Feldspar (FD), "Honeycomb" Porosity (H), Primary Pore ? (PP ?), Chlorite (CHL)

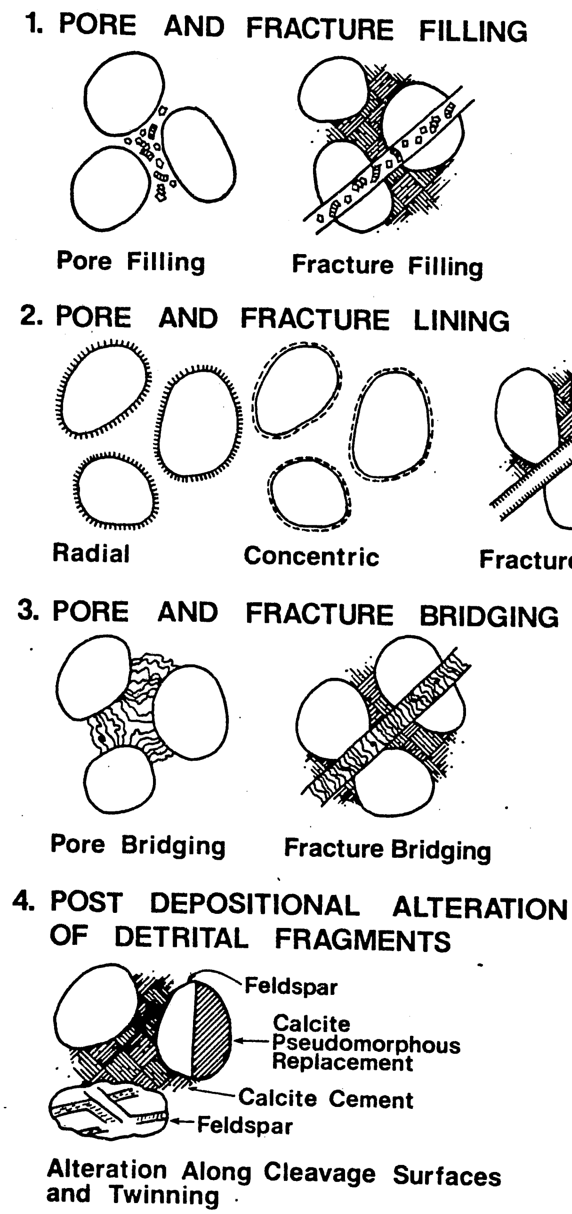


Figure 36. Types of Occurrences, Authigenic Clay Minerals in Clastic Rocks (Courtesy of Z. Al-Shaieb)

sections. Authigenic clay minerals in clastic rocks may occur as pore and fracture fillings, pore and fracture linings, pore and fracture bridgings, and post-depositional alterations of detrital fragments (Figure 36). Authigenic clays in the Glenn predominantly are pore fillings, pore linings, pore bridges, and post-depositional alteration products of detrital fragments. Authigenic clays in association with fractures were not documented. Figure 37 shows a comparison of the characteristic x-ray diffraction peaks of natural, glycolated, and heated "clay-extracted" samples of the Glenn.

Kaolinite is distributed irregularly as pore-filling clay (Figures 26 and 38). SEM photomicrographs reveal the stacked, pseudo-hexagonal plate morphology of kaolinite (Figure 38). Kaolinite averages two to three percent of the total rock, and constitutes approximately 55 percent of the total clay. Kaolinite may also occur as an alteration product of feldspar and may completely replace grains.

Illite is in the sandstone as lath-like projections bridging the pore throats and lining some grains (Figure 39). It ranges from less than one to three percent of the total rock and constitutes approximately 20 percent of the total clay. It is most common in the Lower Glenn and in many cases is difficult to distinguish from some detrital matrix because of its fine size; but it can be recognized by its high biregfringence under cross nicols (Figure 29), and characteristic morphology as seem in SEM photomicrgraphs (Figure 39).

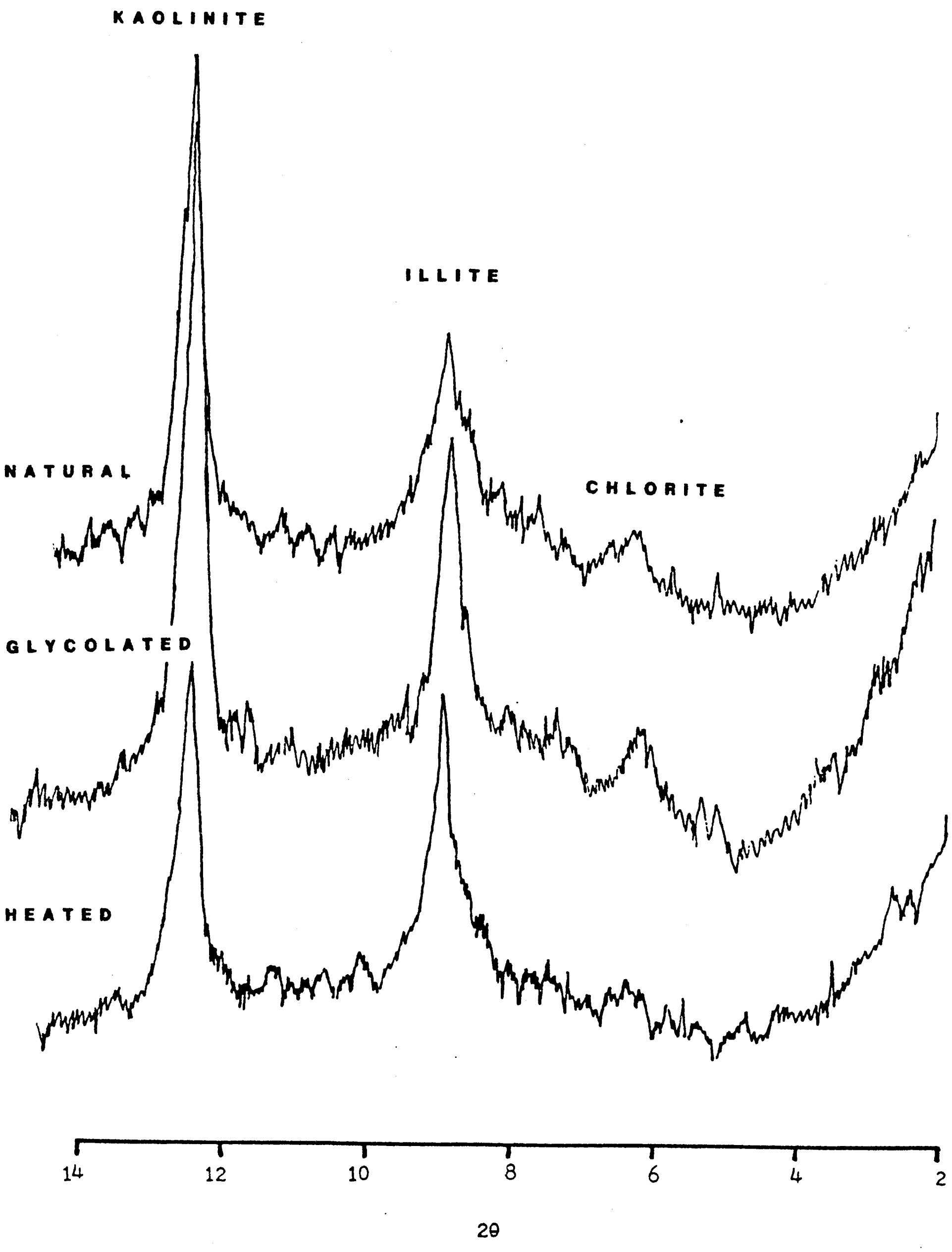
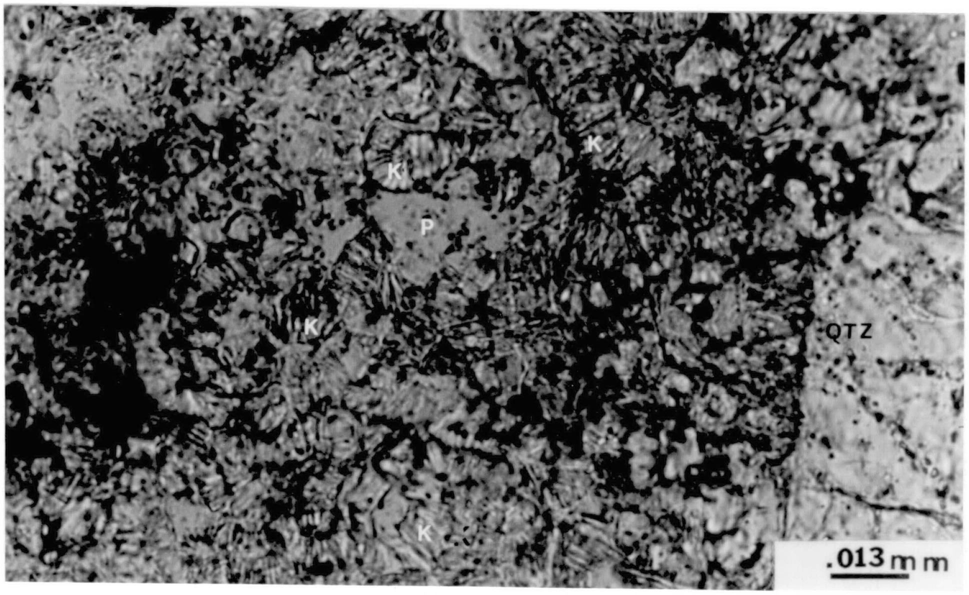


Figure 37. Characteristic X-ray Diffraction Peaks of "Clay-extracted" Samples of the Glenn Sandstone



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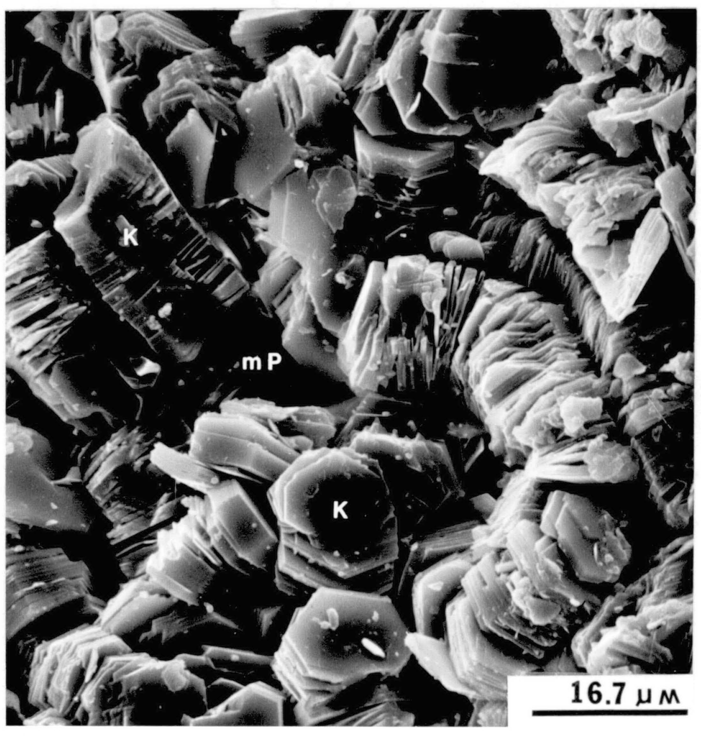


B

Figure 38. Thin Section Photomicrograph, Plane Polarized Light (A). Sandstone With Abundant Kaolinite (K) That Occupies Pore (P) (Light Blue). Note The Vermicular Morphology and Pseudohexagonal Geometry of Kaolinite Crystals as shown in (B), SEM (x1200)

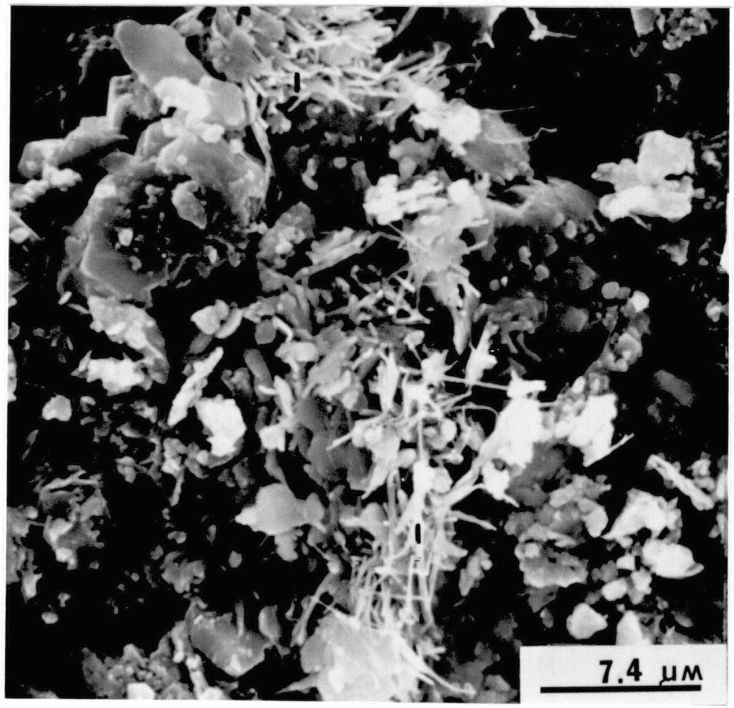


Figure 39. SEM Photomicrograph, x2700. Authigenic Illite (I) Showing Extension of Delicate "Hair-like" Crystals

Chlorite occurs as pore-lining clay (Figure 40) and may partially replace micas, feldspars, and even kaolinite (Figure 41). It ranges from less than one to three percent of the total rock and constitutes approximately 30 percent of the total clay. It can be identified by its characteristic olive-green color under plane-polarized light, ultra-blue color under crossed nicols, and bladed morphology in SEM photomicrographs (Figure 40).

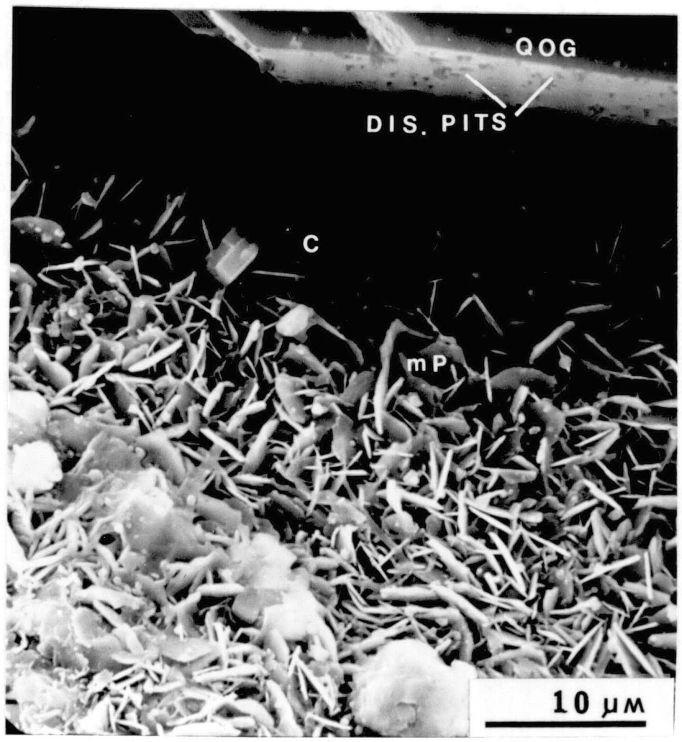


Figure 40. SEM Photomicrograph, x2000. Authigenic Chlorite (C) Shows Characteristic "Face-to-edge" Morphology and Microporosity Between and Among the Clay Crystals. Straight Crystalline Outline at Upper Part of Photo is a Quartz Overgrowth. Note Dissolution Pits (DIS. PITS) on Surface of Overgrowth

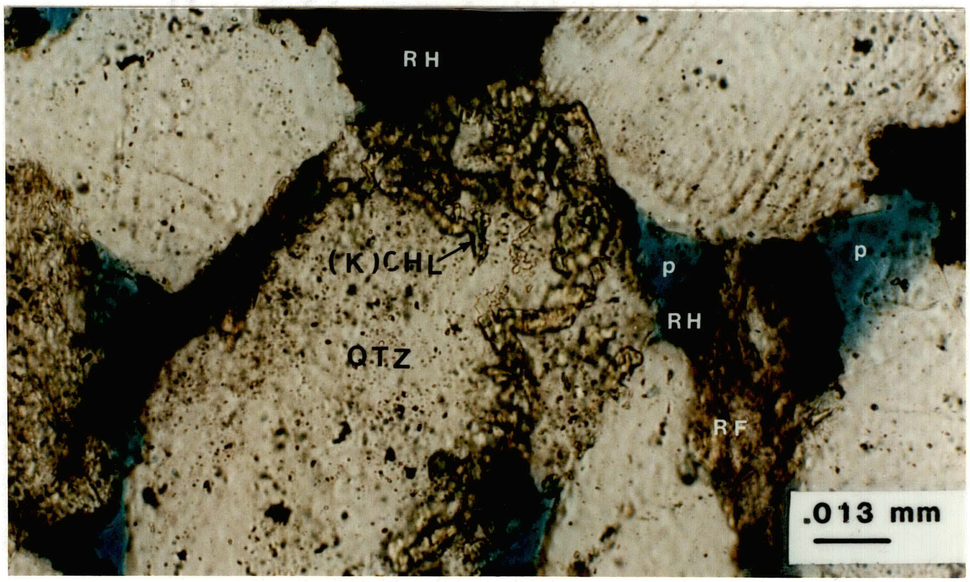


Figure 41. Thin Section Photomicrograph, Plane Polarized Light. Quartz Grain (QTZ) Has Undergone Partial Alteration to Kaolinite and Later Chloritization of the Kaolinite [(K) CHL]. Pores (P) Are Partially Filled with Residual Hydrocarbons (RH). Rock Fragment (RF)

CHAPTER V

DIAGENESIS

Introduction

The present morphology and composition of the Glenn Sandstone appear to have resulted from several diagenetic processes. These processes are inferred from mineralogic and textural features identified by thin-section analysis, SEM examination of rock samples and relief pore casts, and x-ray diffraction analysis.

Diagenetic features recognized and documented in the Glenn Sandstone in the study area may have involved the following processes: 1) partial to complete dissolution of some detrital fragments (i.e., quartz, feldspars, rock fragments), 2) precipitation of authigenic kaolinite, chlorite, and illite, of syntaxial quartz overgrowths, calcite and siderite cements, and trace minerals, 3) alteration of various constituents (kaolinization and illitization of feldspars, etc.), and replacement of detrital constituents (quartz by calcite, in the calcite-cemented zones, and possible albitization of potassic feldspars), and 4) mechanical compaction of components with ductile deformation of soft detrital constituents.

Dissolution Features

Partial to complete dissolution of detrital grains was common in all of the samples examined, and was responsible for most of the observed porosity (Figure 42). Detrital quartz, feldspar, and rock fragments (metamorphic and sedimentary) all show some degree of dissolution. Feldspar and argillaceous rock fragments are the most commonly dissolved framework grains, and they account for a large percentage of the secondary porosity. Some quartz grains show evidence of dissolution at contacts of the grains with partially dissolved (hydrolized) feldspar (Figure 43).

Partially corroded syntaxial quartz overgrowths were a common feature in the samples examined. SEM photomicrographs of overgrowths reveal pitted surfaces and corroded edges showing some effects of dissolution (Figures 40 and 44).

Al-Shaieb and Shelton (1981), Heald and Larese (1973), Land and Milliham (1981), and many others recognized dissolution of feldspar and alteration as contributors in development of secondary porosity. Dissolution of feldspar commonly occurs along cleavage planes where bonding is weakest and the mineral is most susceptible to ionic substitution. In the Glenn Sandstone, the partial dissolution of feldspar most commonly results in "honeycomb" porosity (Figure 43).

Rock fragments are also susceptible to dissolution, which may leave oversized pores or apparently isolated grain

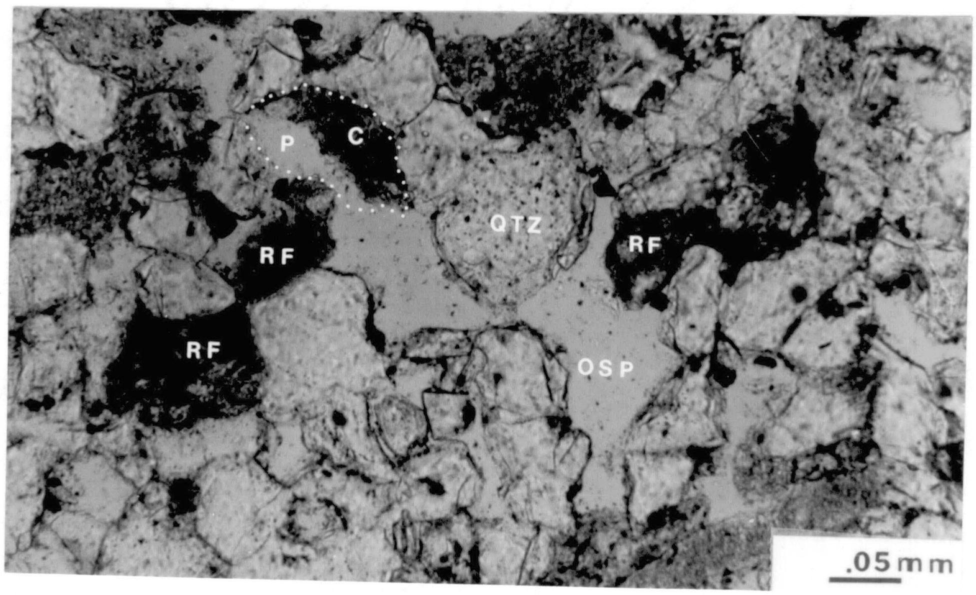


Figure 42. Thin Section Photomicrograph, Plane Polarized Light. Sandstone Showing Partly and/or Completely Dissolved Clasts (Altered Rock Fragments (RF), Resultant Oversized Secondary Porosity (OSP), and Remnants of Clay (C))

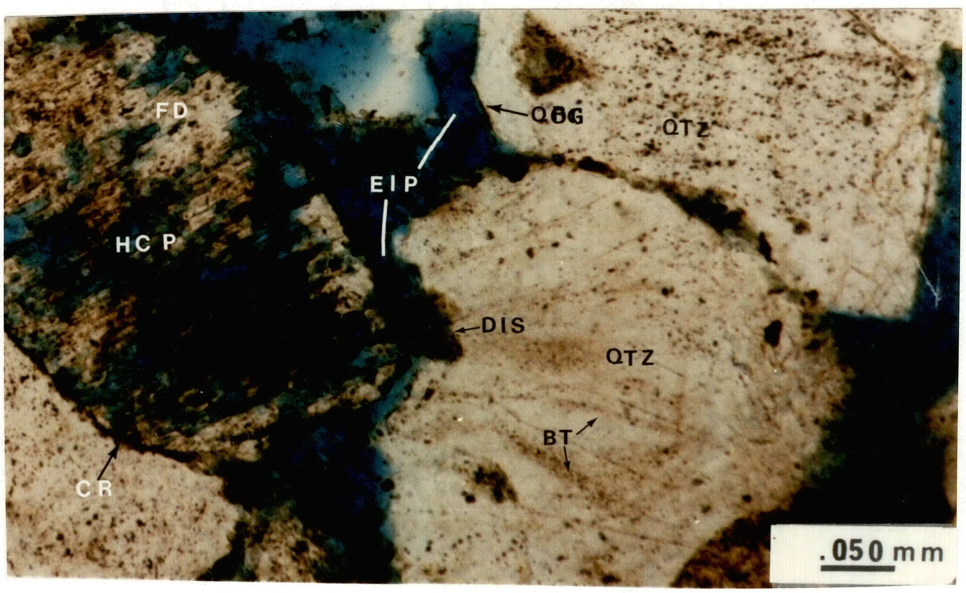


Figure 43. Thin Section Photomicrograph, Plane Polarized Light. Partially Dissolved Feldspar Grain (FD) Creating Secondary Porosity "Honeycomb" (HCP). Enlarged Intergranular Porosity is Created Around the Feldspar Grain by Dissolution (DIS) of Quartz (QTZ) During Feldspar-hydrolysis. Note Clay Rim (CR) Surrounding Feldspar (FD) and Inclusions ("Bubble Trains" (BT)) in Quartz (QTZ)

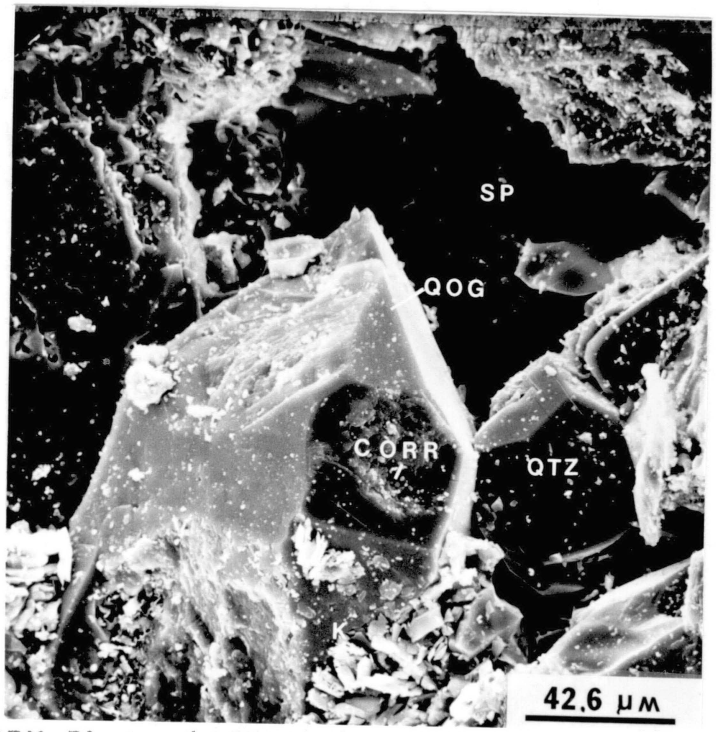


Figure 44. SEM Photomicrograph, x470. Euhedral Surface of Quartz Overgrowth (QOG), and Abundant Clay as Pore Linings and Coatings on Grains. Note the Small Area of Corrosion (CORR) on the Quartz Grain. Secondary Pore (SP)

molds (Figure 45). Most rock fragments that were dissolved were argillaceous, but a small percentage of fragments of metamorphic rock also show evidence of dissolution and alteration. Evidence of dissolution of calcite cement has been observed along the boundaries of the calcite-cemented rock (Figures 28 and 46). Oversized pores have resulted from the partial to complete dissolution of the calcite cement (Figure 46). To estimate to what extent porosity has been enhanced by calcite dissolution is difficult. Many detrital grains associated with calcite cementation and subsequent dissolution apparently either have been dissolved or partly replaced by calcite (Figures 32 and 33). In the case of the extensively calcite-cemented rock the latter explanation is the more probable.

In several samples detrital matrix and psuedomatrix also show evidence of partial to complete dissolution (Figure 47).

Precipitates

Several diagenetic precipitates are common in most samples of the Glenn. Principally they are syntaxial quartz overgrowths, calcite, dolomite, siderite, kaolinite, chlorite, and illite.

Syntaxial quartz overgrowths are abundant. They show sharp crystal outlines or develop near quartz grains and other overgrowths to form a "cluster" with irregular boundaries between overgrowths (Figures 22, 27, 32, 44, and 45). Overgrowths may be difficult to distinguish from pressure-

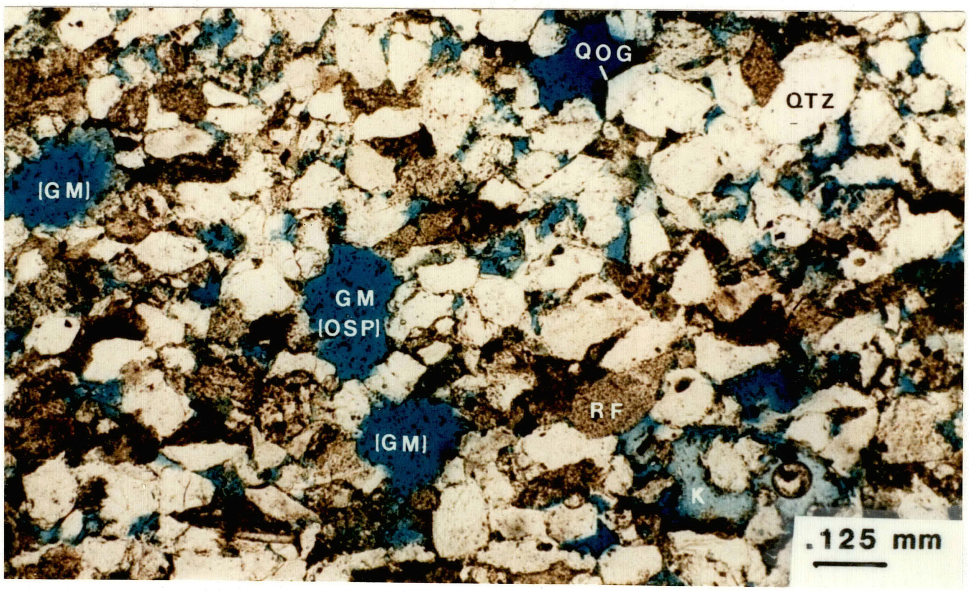


Figure 45. Thin Section Photomicrograph, Plane Polarized Light. Sandstone Showing Abundant Grain Molds (GM). Note the Relatively Small Sizes of Pore Throats, as Compared to the Pores. Also Note Kaolinite (K) in the Lower Right, and Quartz Overgrowth (QOG) That Has Formed in a Large Pore

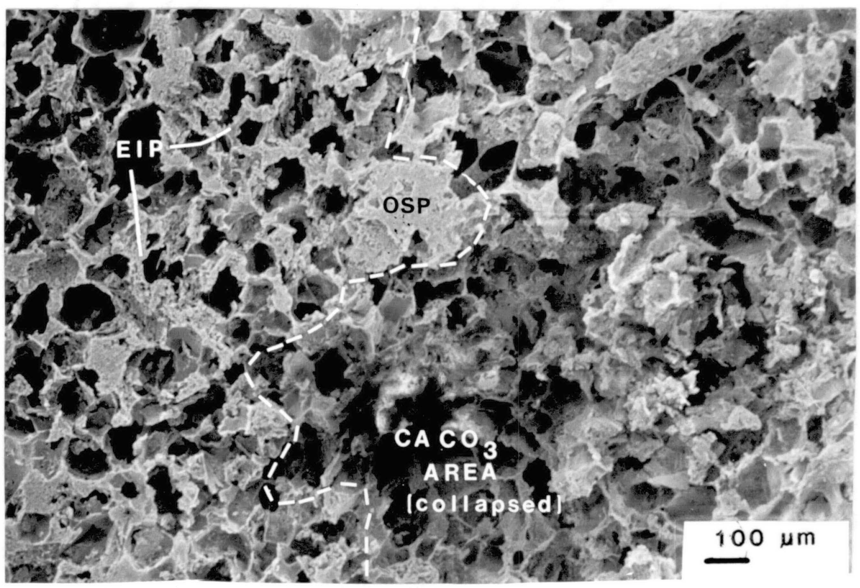


Figure 46. SEM Photomicrograph x100. Relief Pore Cast of Sandstone Showing the Boundary Between a Calcite-cemented (Right) and Non-calcite-cemented (Left) Interval. The Calcite-cemented Side of the Pore Cast "Collapsed" but the Non-calcite-cemented Side Shows Enlarged Intergranular Porosity (EIP) and Oversized Secondary Porosity (OSP), Most Likely Due to Partial Calcite Replacement of Constituents and Subsequent Calcite Dissolution

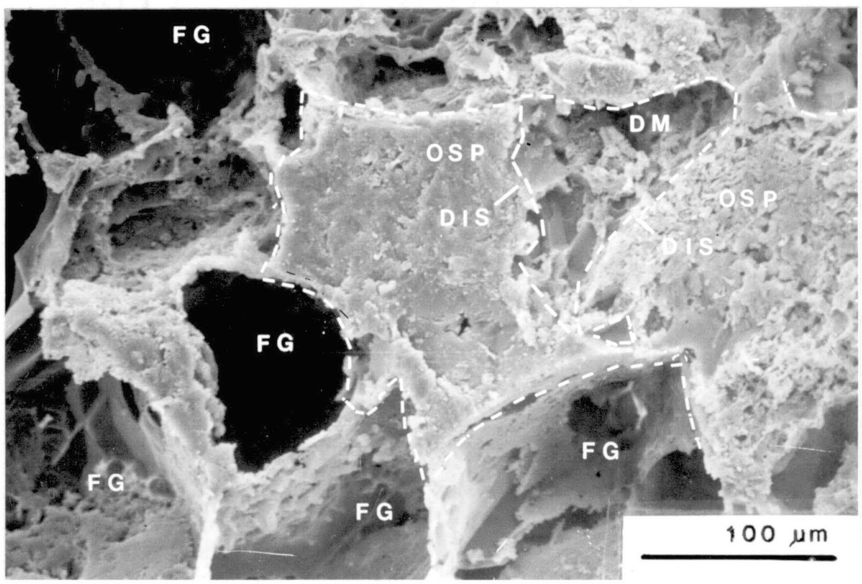


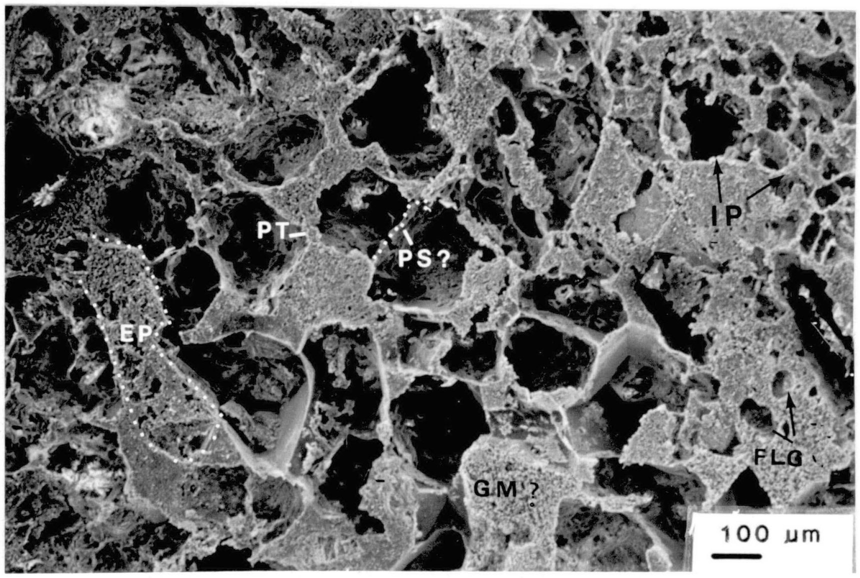
Figure 47. SEM Photomicrograph, x260. Relief Pore Cast of Sandstone Showing Evidence of Dissolution (DIS) of Detrital Matrix (DM) or Pseudomatrix Creating Oversized Secondary Pore Space (OSP). Note the Smooth, Yet Abrupt Contacts with the Surrounding Framework Grains (FG)

solution features, which also are common in the sandstone. Pressure-solution may be inferred from sutured grain contacts, as shown in Figure 22 and can be inferred in relief pore casts as shown in Figure 48. Pressure-solution is believed to have been a minor source of silica for cementation by quartz.

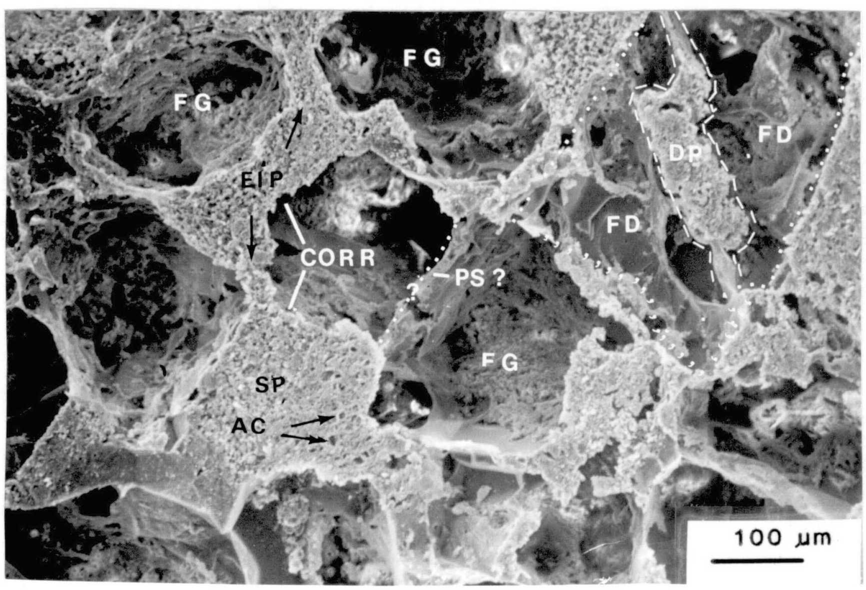
Advanced stages of development of overgrowths were observed in the more porous and permeable lithofacies, which are relatively clean and contain a larger percentage of detrital quartz (e.g., upper portions of the Upper Glenn). Some the quartz overgrowths are not in optical continuity with original grains. However, both the original grains and overgrowths generally show slightly undulose to undulose extinction, possibly due to stress applied to the grains. This may have caused rotation and undulosity of the overgrowths. Many overgrowths contain very thin "dust rims" of clay that surround the original grains and make identification of overgrowths somewhat easier (Figure 32).

Cementation by silica in the finer grained lithofacies, notably the upper part of the Lower Glenn, decreased porosity and permeability greatly. In the medium grained lithofacies of the upper part of the Upper Glenn, silica cementation decreased overall porosity, but portions of the sandstone still are quite porous and permeable.

Other minor silica cements include microquartz, chalcedony and authigenic chert. Microquartz was a minor precipitate; it occurred as small euhedral crystals that protruded



A



B

Figure 48. SEM Photomicrograph, x50 (A), x250 (B). (A) Relief Pore Cast of Sandstone Showing Elongate Pore (EP), "Floating" Grains (FLG), and Possible Evidence of Pressure-solution (PS ?) Between Preserved Molds of Two Framework Grains (FG) (Quartz ?). (B) Larger Magnification Shows Preserved Molds of Authigenic Clay (AC) Minerals in a Secondary Pore (SP), Corrosion (CORR) Along a Grain Boundary Creating Elarged Intergranular Porosity (EIP), and Dissolution Porosity (DP) within a Feldspar (FD) Grain

from a quartz grain substrate into pore spaces and was identified only by using SEM. Chalcedony is very rare; it was identified only in a few thin sections. Authigenic chert also is very rare; it was recorded only in one thin section.

As mentioned previously, the Glenn Sandstone contains calcite cement that varies from "patchy and spotty" to a major cement in some beds associated with large amounts of carbonaceous material or bounded by shale. In several cores are semicircular contacts of calcite-cemented, non-calcite-cemented sandstone; this relationship is suggestive of "spherical" growth of calcite nuclei (Figure 34). Other calcite-cemented intervals appear to be bedded, with thickness ranging from 6-8 cm to 0.6-1.5 m. In such strata, sandstone may show no apparent changes in texture; contacts of calcite-cemented and noncemented rock may be almost horizontal or slightly irregular.

Ferroan dolomite also was observed primarily in association with calcite cement. It is believed to have been a late stage of carbonate precipitation, or possibly to have replaced calcite (Figure 29).

Very fine grained masses of equant-rhombic crystals of siderite fill pores and line grains (Figures 23 and 35). In sandstone that contains more than three percent siderite, framework grains are moderately sorted to well sorted and relatively unaltered by dissolution or cementation. Aggregates of siderite give the rock a reddish brown to yellowish brown spotty appearance, as a result of partial alteration of siderite to limonite. Thin coatings of clay minerals on many of the subrounded grains may have isolated the grains from the pore fluids and inhibited alteration or cementation. Clay films may have formed during or soon after deposition. Formation of siderite is believed to have been an early diagenetic processes, indicating moderate to strongly reducing conditions. Evidence of a later stage of siderite precipitation is that siderite aggregates line some syntaxial quartz overgrowths.

Hematite and limonite are minor cements; these minerals normally are associated with laminae of organic material and with pyrite.

Pyrite and leucoxene are trace constituents in the Glenn Sandstone; they are associated with carbonaceous filaments and organic matter. Pyrite typically occurs as small groups of framboidal crystals, characterized by opaqueness and brassy yellow color under reflected light, and spheroidal morphology in SEM (Figure 49). Pyrite suggests reducing conditions at the time of formation. Leucoxene was recorded in trace amounts; it is also characterized by opaqueness and white color under reflected light.

Authigenic clays are abundant in all samples of the Glenn Sandstone examined. Variation of clays among the three genetic sandstone bodies of the Glenn is believed to be a function of texture, composition, and porosity, which in turn are related to the environments of deposition and the changes in pore-fluid composition during the various

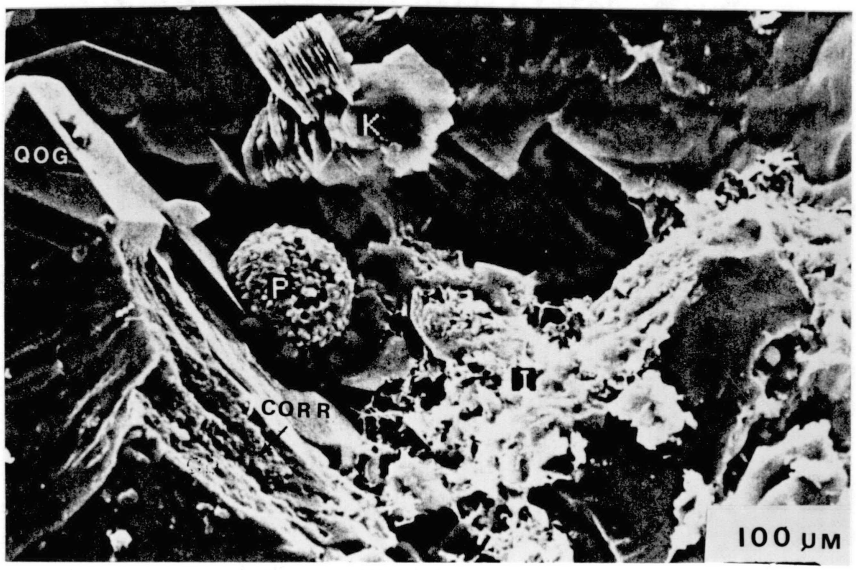


Figure 49. SEM Photomicrograph, x1200. Sandstone Showing Framboidal Pyrite (P), Kaolinite (K), Illite (I), Quartz Overgrowth (QOG), and Apparent Corrosion (CORR) of Quartz Grain

stages of diagenesis.

As described previously, authigenic clay minerals identified are kaolinite, chlorite, and illite. Mixed-layered clays are presumed to exist in the sandstone but were not identified.

Kaolinite is distributed irregularly; discrete particles and/or clusters fill pores (Figure 50), particularly in the more porous and permeable lithofacies. Morphologically, kalinite occurs as well crystallized psuedohexagonal clay platelets, stacked along C-axes to form vermicular booklets (Figure 38). Kaolinite also developed as an alteration product of detrital grains, predominantly feldspar and argillaceous rock fragments (Figures 26, and 41). Authigenic chlorite is mainly pore-lining, fine, thin-bladed crystals with face-to-edge morphology (Figure 40). Figure 41 shows vermicular kaolinite booklets that have been chloritized. Authigenic illite occurs as lath-like, "hair-like" projections that may bridge pore throats (Figure 39).

Illite and chlorite are present essentially throughout the sandstone. Illite is more abundant in the Lower Glenn, which has larger percentages of rock fragments and detrital matrix. Chlorite occurs with kaolinite in the more porous and permeable lithofacies in all three of the genetic sandstone bodies. However, chlorite is more abundant in the upper portions of the Upper Glenn, and the lower portions of the Lower Glenn. The Middle Glenn predominantly contains kaolinite with smaller amounts of chlorite and illite.

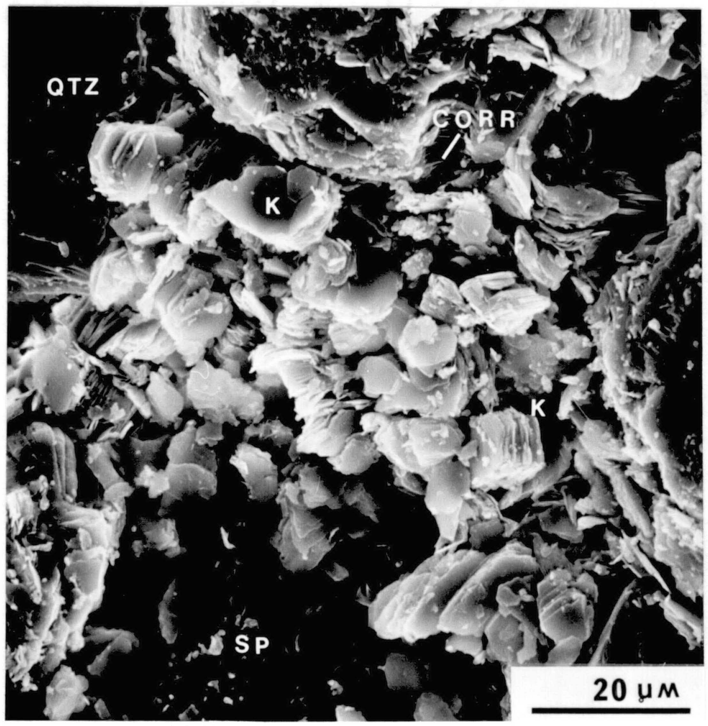


Figure 50. SEM Photomicrograph, x1000. Authigenic Kaolinite (K) Occludes a Pore. Note Evidence of Corrosion (CORR) on Framework Grain in Upper Portion of Photomicrograph

Alteration Products

Alteration processes such as kaolinization and illitization of feldspars and rock fragments, chloritization of various clay minerals, and alteration of siderite and pyrite to limonite and hematite were inferred from evidence observed in thin section and SEM analyses. Alteration of feldspars and rock fragments to clay minerals (predominantly kaolinite) was the most common alteration inferred from all of the samples. The degree of alteration appears to be a function of the microenvironments that surrounded the grains. Alteration and subsequent dissolution of feldspars results from hydrolytic reactions that are pH-sensitive (Al-Shaieb and Shelton, 1981). In turn, quartz grains (which are soluble at high pH values) adjacent to the hydrolyzed grains of feldspar should show some evidence of corrosion or dissolution, as in Figure 43.

Some fragments of metamorphosed rock show evidence of alteration to clay minerals and later sericitization (Figures 30 and 51). The parallel arrangement of illitic and chloritic clay suggest alteration of micaceous constituents within gneissic to schistose fragments.

Chloritization and illitization of various constituents were difficult to document in detail, although there is some evidence that shows various stages of alteration (Figure 41).

Alteration of siderite and pyrite to limonite and hematite is believed to have been a common process. Pyrite

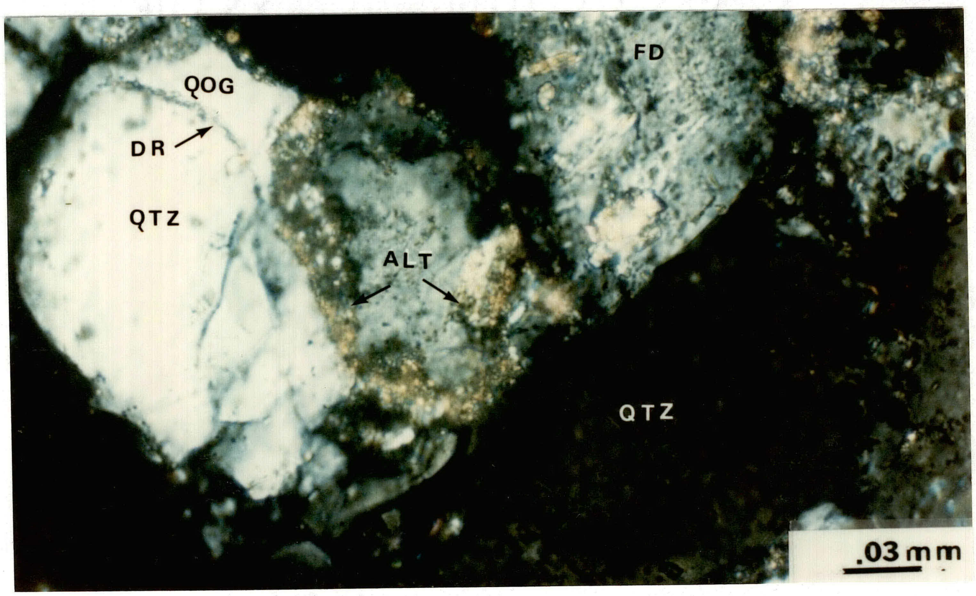


Figure 51. Thin Section Photomicrograph, Crossed Nicols. Sandstone Showing Altered (ALT) Grain With "Rim" of Highly Birefringent Clay Minerals. Note Quartz Overgrowth (QOG) With Characteristic "Dust-Rim" of Clay Minerals (DR), and Slightly Altered Feldspar Grain (FD)

generally shows some evidence of alteration to limonite and oxidation to hematite. Leucoxene is rare, but is believed to have formed as an alteration product of titanium-bearing minerals, such as rutile, which constitute only a trace amount in the sandstone.

Replacement Features

Predominantly, detrital constituents were replaced or displaced by calcite and ferroan dolomite. In the extensively cemented intervals, poikilotic calcite cement completely surrounds grains and drastically has reduced or almost completely destroyed the porosity. In some samples from these intervals calcite seems to have replaced selectively feldspar and quartz, leaving a faint "ghost" or "outline" of the original grain (Figure 32). There may have been at least two stages of calcite cementation: 1) initial cementation, and 2) a later stage of replacement of detrital constituents (Figures 32 and 33).

Pyrite is believed to have formed by replacement of organic material, and some potassium feldspar grains may have been replaced by albite (Figure 30). According to Walker (1984) the latter type of alteration ultimately produces grains of pure or nearly pure albite that are pseudomorphs of the parent grain, typically either untwinned or displaying "chessboard" twinning. If successive stages of the albitization are not recorded in the samples, diagenetically albitized grains might be interpreted as detrital grains of plagioclase, perthite or antiperthite (Walker, 1984). Of course, in order to determine the extent to which albitization has taken place, one must have knowledge of the amount and composition of feldspar in the original sediment; unfortunately, this is not possible to do with any appreciable level of certainty in the case at hand.

Mechanical Deformation

As described previously, mechanical compaction of the sandstone during burial can be inferred by apparent squeezing of softer detrital constituents into pores and around grains (Figures 26 and 27). Fractured grains also may have resulted from compaction (Figures 29 and 30).

CHAPTER VI

PARAGENETIC SEQUENCE

Introduction

The presence and duration of each diagenetic process is a direct response to the changing composition of the pore fluid, to the detritial constituents, and to the temperature and pressure regimes during burial (Schmidt and McDonald, 1979). Thus the rock-fluid system is dynamic and quite complex and should not be considered to have been in equilibrium over geologic time. Major and minor tectonic changes, fracturing, faulting and folding could influence the paths, speeds, and compositions of pore fluids. Also, the nature of the depositional environment and lithofacies developed therein are very important factors in migration of fluids and release of ions into solution (Pittman, 1979).

Development of Secondary Porosity

Choquette and Pray (1970) formulated a system of diagenetic regimes for study of porosity in carbonate rocks; this has been adopted by many geologists to investigate secondary porosity in sandstones (Figure 52). Mesodia genesis is the subsurface regime during the effective burial process and is judged to have been responsible for the

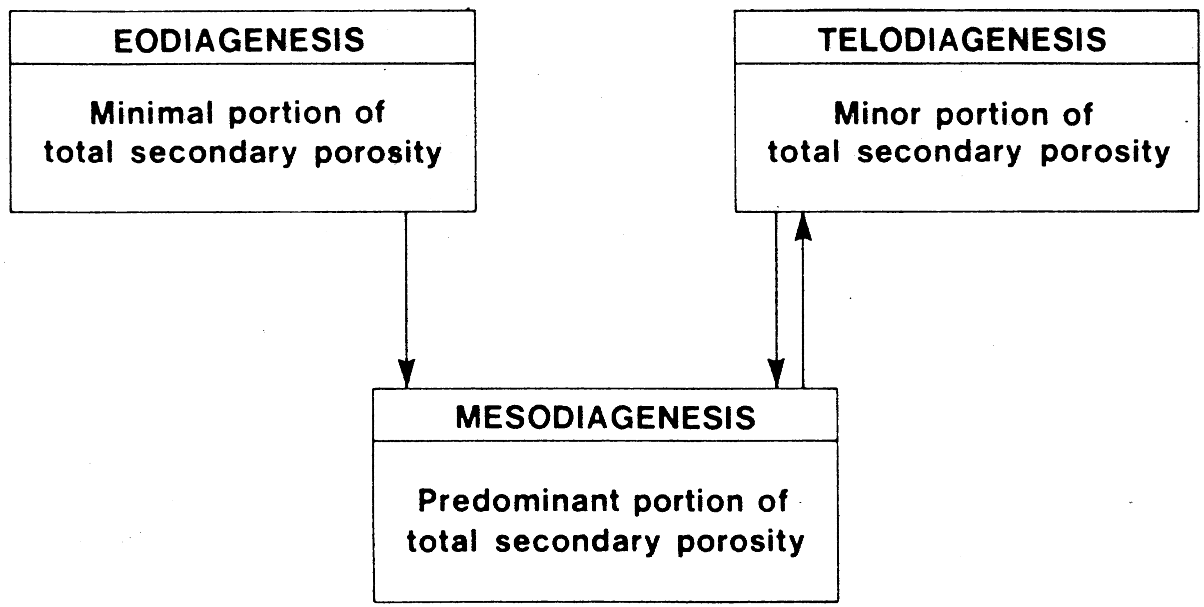


Figure 52. Diagenetic Regimes of Development of Secondary Sandstone Porosity (After Schmidt and McDonald, 1979, Figure 33)

majority of the secondary porosity observed in the Glenn Sandstone.

Al-Shaieb and Shelton (1981) discussed the generation and migration of hydrocarbons and the relationship and development of secondary porosity in sandstones. They pointed out that the degree to which reservoir quality is enhanced by development of secondary porosity may be proportional to the amount of constituents unstable during diagenesis.

Carbonic acid is considered to be the primary reagent responsible for dissolution of the unstable constituents in sandstone (McBride, 1977; Hayes, 1979; Schmidt and McDonald, 1979). Carbonic acid is released in conjunction with the production of CO_2 during generation and migration of hydrocarbons from source rocks to reservoir rocks (Momper, 1978, 1980; Schmidt and McDonald, 1979). In the Glenn Sandstone of the study area unstable constituents that have partly or completely dissolved mostly are feldspar and various rock fragments. According to Al-Shaieb and Shelton (1981), dissolution of feldspar is enhanced by increasing concentrations of CO_2 in pore fluid. The main constituents released into solution are, K^+, Na^+, Ca^{++}, Mg^{++}, and dissolved silica (H_4SiO_4). These ions may be precipitated as authigenic clays and/or silica cements.

Sequence of Diagenetic Events

The general order and relative timing of the diagenetic events was estimated empirically by examination of cross-cutting relationships in thin sections and SEM photomicrographs. The general sequence, in which some diagenetic events may have occurred simultaneously and/or independent of one another is as follows:

1. Mechanical compaction.
2. Formation of aggregates of siderite, clay rims, and pyrite.
3. Precipitation of quartz overgrowths and minor feldspar overgrowths.
4. Formation of localized, concretionary (spherulitic), poikilotopic calcite cement.
5. Second stage of calcite cementation.
6. Generation and migration of hydrocarbons (hypothesized).
7. Initial dissolution and replacement of plagioclase, then potassium feldspars, and the more unstable rock fragments. Alteration of unstable grains to clays. Development of secondary porosity.
8. Precipitation of patchy kaolinite, illite, chlorite, mixed-layer clays, and second stage of siderite.
9. Albitization of potassium feldspars (hypothesized).
10. Dissolution of calcite cement and replacement by ferroan dolomite.
11. Migration of hydrocarbons.
12. Alteration of pyrite and siderite to limonite and hematite.

Figure 53 shows the estimated sequence of events that led to present morphology and composition of the Glenn Sandstone. Diagenetic events are depicted either by a solid line (process believed to have been active continuously) or by a dashed line (process believed to have been intermittent). Lengths represent relative times during which diagenetic processes are believed to have been active.

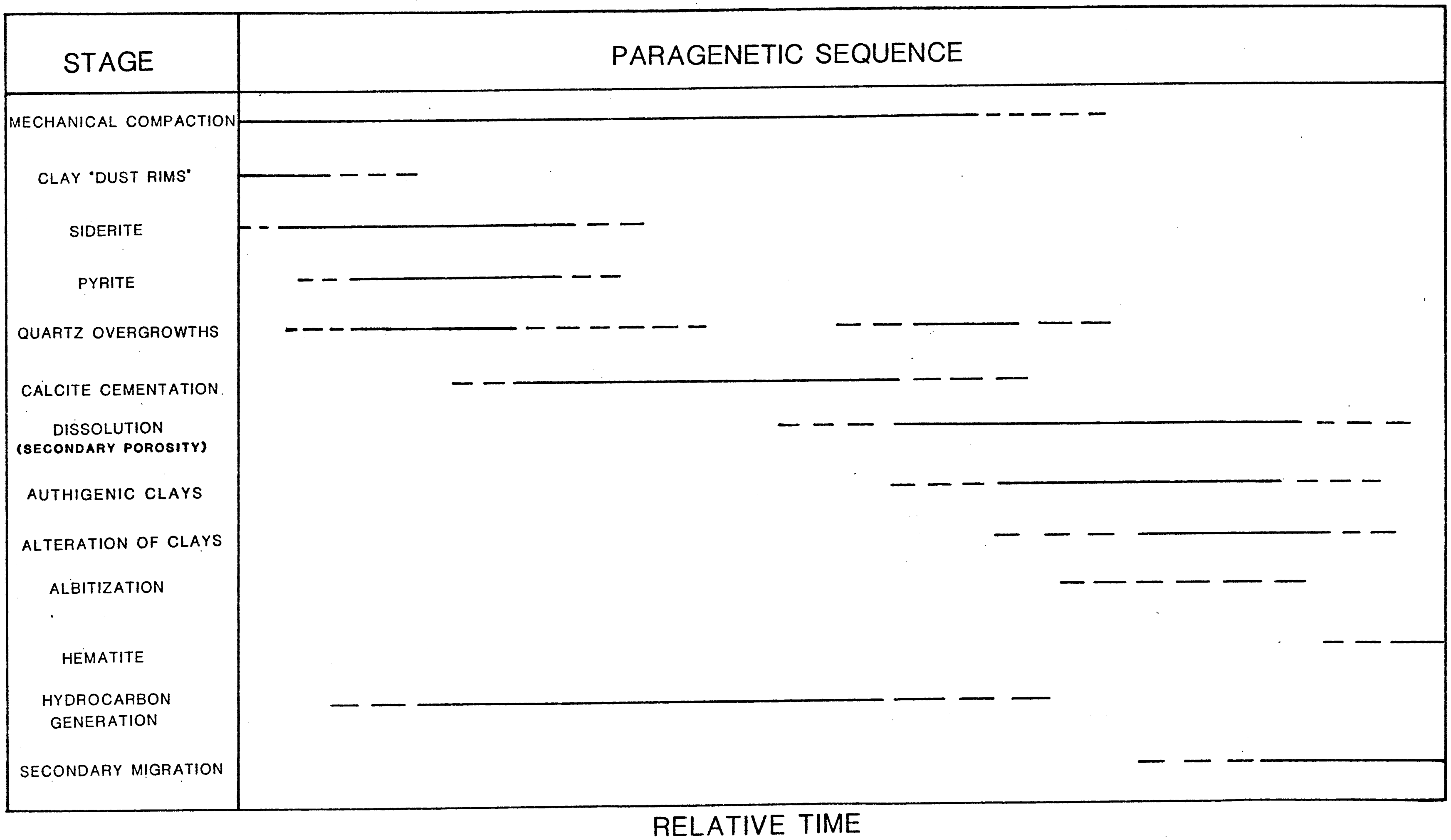


Figure 53. Paragenetic Sequence, Glenn Sandstone William Berryhill Unit, Glenn Pool Oil Field, Creek County, Oklahoma (Solid Lines Indicate that the Process was Continuous Without Interruption; Dashed Lines Indicate Intermittent Activity.)

CHAPTER VII

POROSITY

Introduction

The purpose of this chapter is to document the amounts and types of porosity in the Glenn Sandstone, within the study area. Identification of porosity was based upon examination of thin sections impregnated with blue epoxy, and upon SEM analysis of selected samples and several relief pore casts.

Pittman (1979) listed three primary types of porosity in sandstones: 1) intergranular porosity, 2) dissolution porosity, 3) and microporosity. Fracture porosity is considered a secondary feature that may enhance the porosity listed above.

Intergranular porosity in the Glenn includes both primary and secondary porosity. Primary intergranular porosity is approximately two to four percent of the total porosity observed in the samples. Secondary porosity averages 8 to 15 percent in the Lower Glenn, 14 to 20 percent in the Middle Glenn and Upper Glenn, and as much as 22 percent in parts of the Upper Glenn. Dissolution generated most of the secondary porosity.

Microporosity is defined by pores with aperture-radii less than 0.5 microns (Pittman, 1979). Commonly it is well developed among kaolinite, chlorite, and illite (Figures 38, 39, 40, and 54), and occurs in association with partly dissolved feldspar grains (Figure 43). Microporosity inhibits flow of fluid, due to the small sizes of pores. Thus, it reduces effective porosity.

Fracture porosity in significant amounts was not observed in the samples. However, several grains of plagioclase and quartz appeared to be broken, creating insignificant amounts of microporosity (Figures 29 and 30).

Classification and Petrographic Critera

As mentioned above, secondary porosity is the predominant porosity in the Glenn. Schmidt and McDonald (1979) classified secondary porosity in sandstone according to origin and pore texture (Figure 55). Hybrid pores, characterized by coexistence of primary and secondary porosity, and/or other genetic classes of porosity, are also present (Figure 56).

Table III lists the five major groups of pore textures of secondary porosity: 1) intergranular pores, 2) oversized pores, 3) moldic pores, 4) intraconstituent pores, and 5) open fractures (Schmidt and McDonald, 1979). The Glenn shows all these pore textures except open fractures. Distinct types of pore textures exist for each major group, and many of these textures exist in the Glenn. Intergranular textures of secondary porosity range from regular

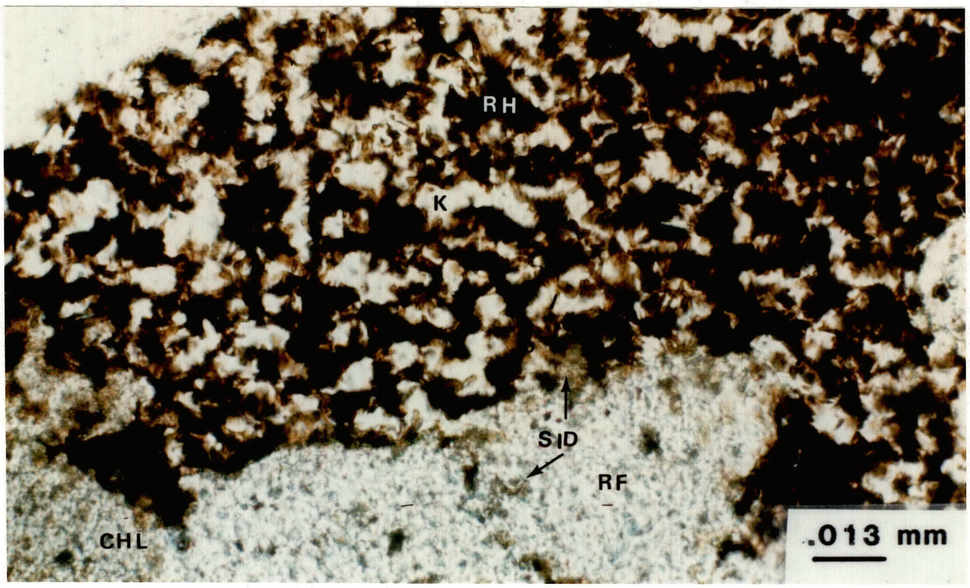


Figure 54. Thin Section Photomicrograph, Plane Polarized Light. Kaolinite (K) Fills a Pore and Creates Microporosity. Residual Hydrocarbons (RH) Stain the Kaolinite (K), Indicating That Hydrocarbons Migrated Into the Reservoir After Formation of Kaolinite. Note Slightly Altered Rock Fragments (RF) and Patchy Clay (Sideritic ?) (SID)

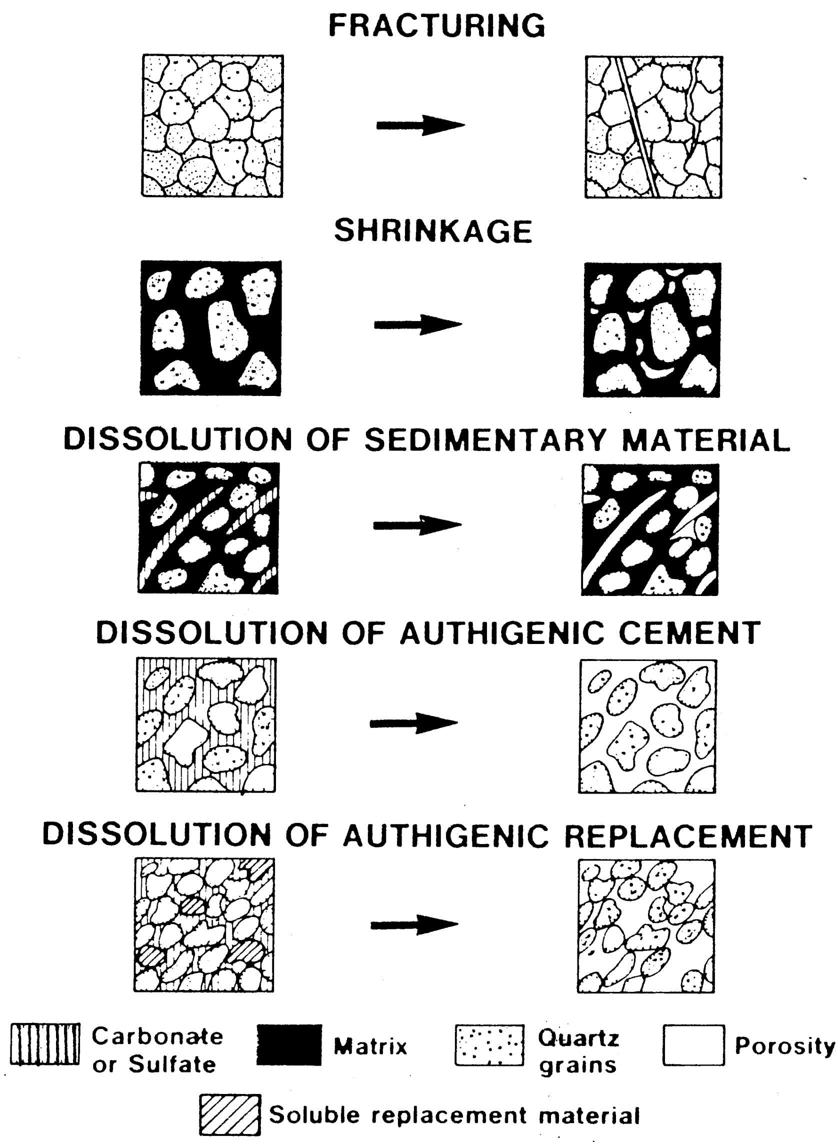


Figure 55. Genetic Classes of Secondary Sandstone Porosity (After Schmidt and McDonald, 1979, Figure 2)

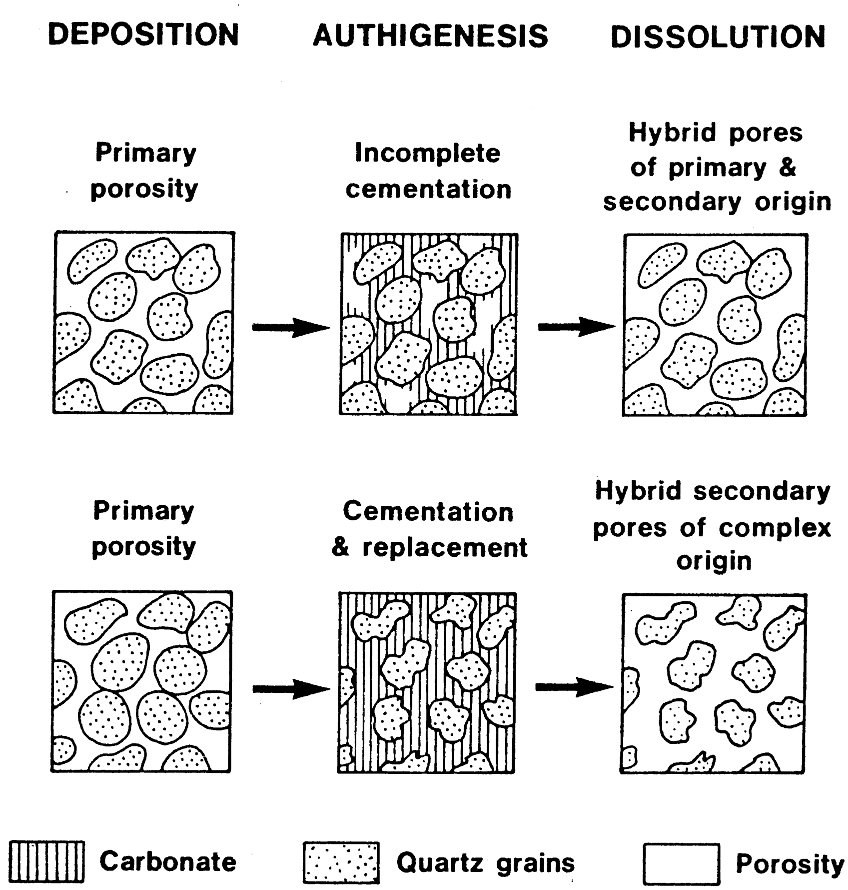


Figure 56. Textural Development of Hybrid Pores (After Schmidt and McDonald, 1979, Figure 9)

TABLE III

TEXTURAL SPECTRUM OF SECONDARY SANDSTONE POROSITY

POROSITY TEXTURES	GENETIC CLASSES OF SECONDARY POROSITY				
	RESULT OF FRACT- URING	RESULT OF SHRINK- AGE	RESULT OF DIS- SOLUT- ION OF SEDIM- ENT	RESULT OF DIS- SOLUT- ION OF CEMENT	RESULT OF DIS- SOLUT- ION OF REPLACE- MENT
INTERGRANULAR TEXTURES:					
REGULAR INTERGRANULAR		X P	X P&C	X P&C	X P&C
REDUCED INTERGRANULAR		X P	X P&C	X P&C	X P&C
ENLARGED INTERGRANULAR		X P	X P&C	X P&C	X P&C
OVERSIZED TEXTURES:					
OVERSIZED FABRIC SELECTIVE		X	X	X	X
OVERSIZED CROSSCUTTING				X	X
MOLDIC TEXTURES:					
GRAIN MOLD		X P	X P&C	X P&C	X P&C
CEMENT MOLD		X P		X P&C	X P&C
REPLACEMENT MOLD		X P		X P&C	X P&C
INTRA-CONSTITUENT TEXT.:					
INTRAGRANULAR		X	X	X	X
INTRA-MATRIX		X	X	X	X
INTRA-CEMENT		X		X	X
INTRA-REPLACEMENT		X	X	X	X
FRACTURE TEXTURES:					
ROCK FRACTURES	X		X P&C	X P&C	X P&C
GRAIN FRACTURES	X			X P&C	X P&C
INTERGRANULAR FRACTURES	X			X P&C	X P&C

P&C indicates open void may extend over part of the textural precursor or over the complete textural precursor.

P indicates open void may extend only over part of textural precursor.

(After Schmidt and McDonald, 1979, Table I) intergranular pore texture to reduced or enlarged intergranular pore texture (Figure 57).

Schmidt and McDonald (1979) also listed several petrographic critera useful for identification of secondary porosity: 1) partial dissolution, 2) molds, 3) inhomogeneity of packing ("floating grains"), 4) oversized pores, 5) elongate pores, 6) corroded grains, 7) intra-constituent pores ("honeycomb grains"), and 8) fractured grains (Figure 58).

All three of the genetic sandstone bodies in the Glenn Sandstone show evidence of extensive secondary porosity. However, secondary porosity is best developed in the fine to medium grained lithofacies that are relatively free of detrital matrix (i.e., most portions of the Upper and Middle Glenn, and the lower portions of the Lower Glenn).

Partial to complete dissolution of detrital grains and small amounts of clayey matrix is the most common feature related to the development of secondary porosity in the sandstone (Figures 42 and 47). Dissolution of feldspar along crystallographic lines of weakness created the distinctive intergranular "honeycomb" porosity (Figure 43). Partial dissolution of clayey matrix and laminae give the patches of matrix a "floating" appearance in the pore space (Figure 59). Complete dissolution of feldspar grains and other detrital constituents produced grain molds that enhanced total and effective porosity (Figure 60). Most grain molds are in fine to medium grained lithofacies.

Inhomogeneity of packing and "floating" grains are

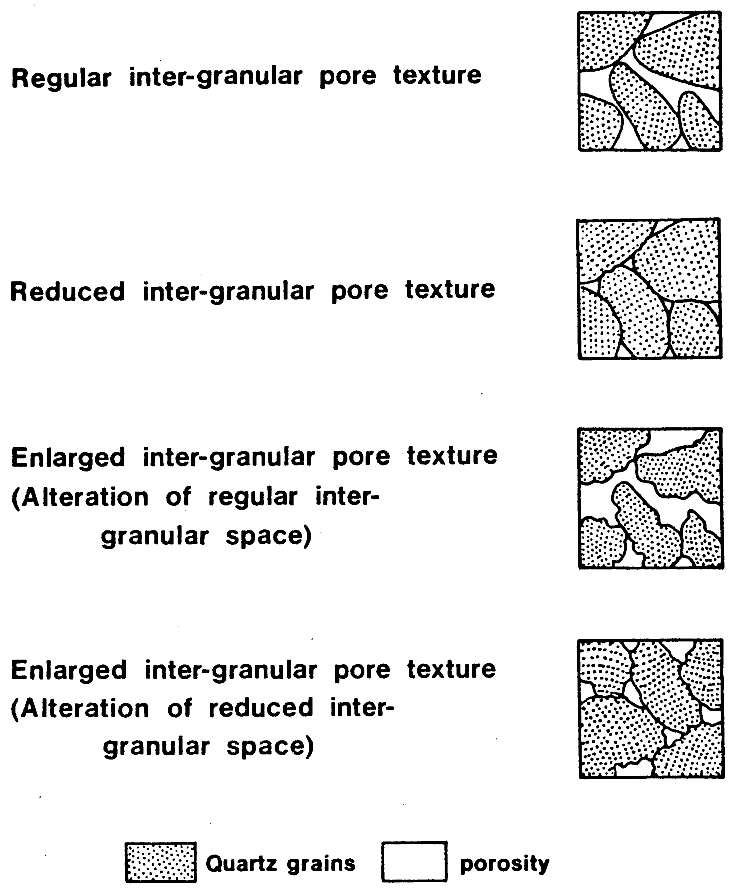


Figure 57. Intergranular Textures of Secondary Porosity (After Schmidt and McDonald, 1979, Figure 10)

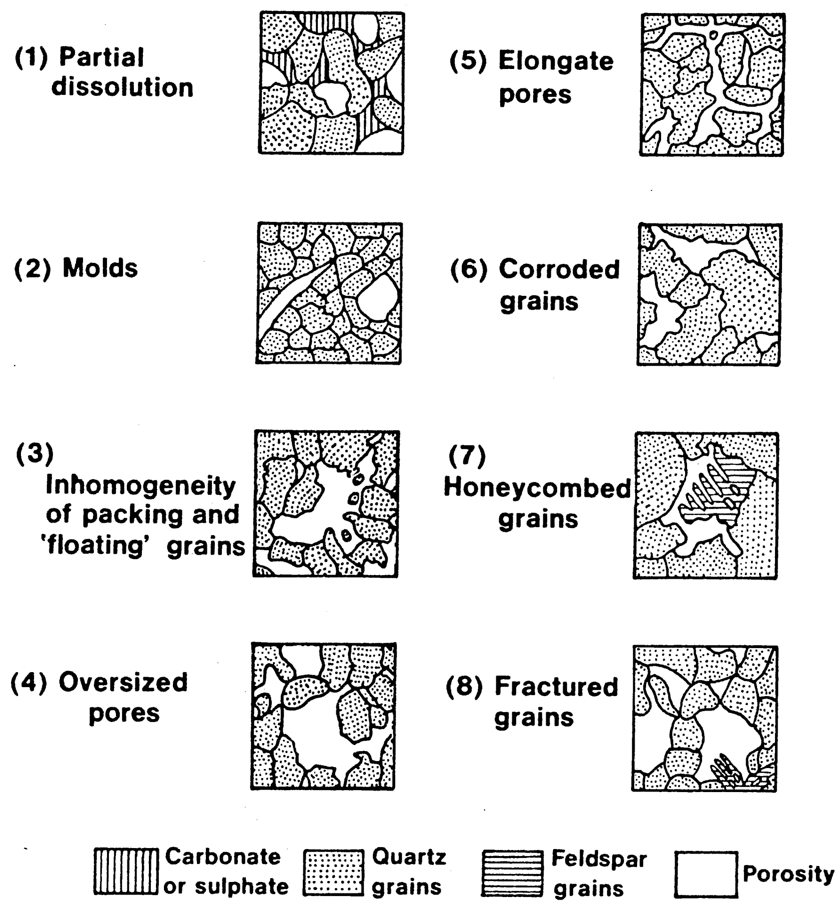


Figure 58. Petrographic Critera for Recognition of Secondary Sandstone Porosity (After Schmidt and McDonald, 1979, Figure 18)

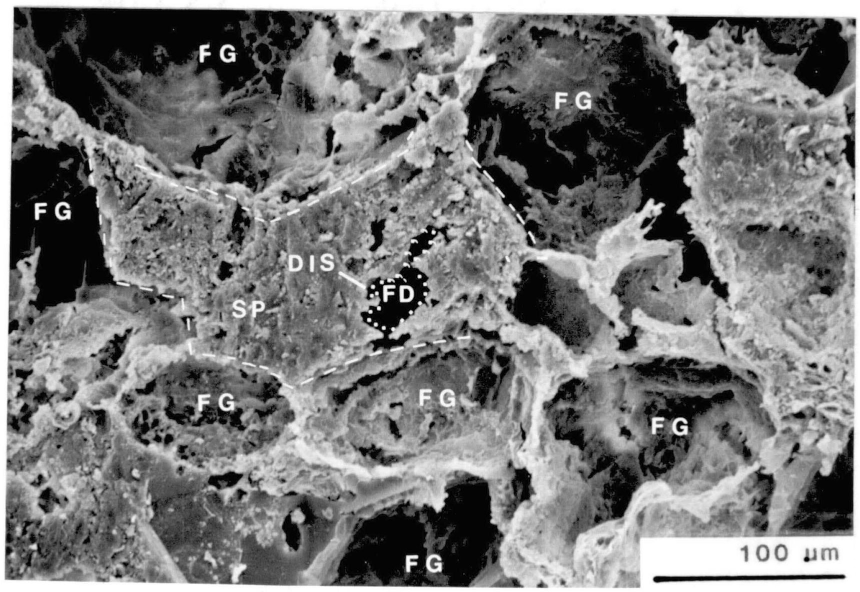


Figure 59. SEM Photomicrograph, x100. Relief Pore Cast of Sandstone Showing Evidence of Partial Dissolution (DIS) of a Suspected Feldspar Grain (FD) Creating Secondary Porosity (SP). Note Isolated Pores and Relatively Small Pore Throats. Sample is Characteristic of Portions of the Lower Glenn. Molds of Framework Grains (FG)

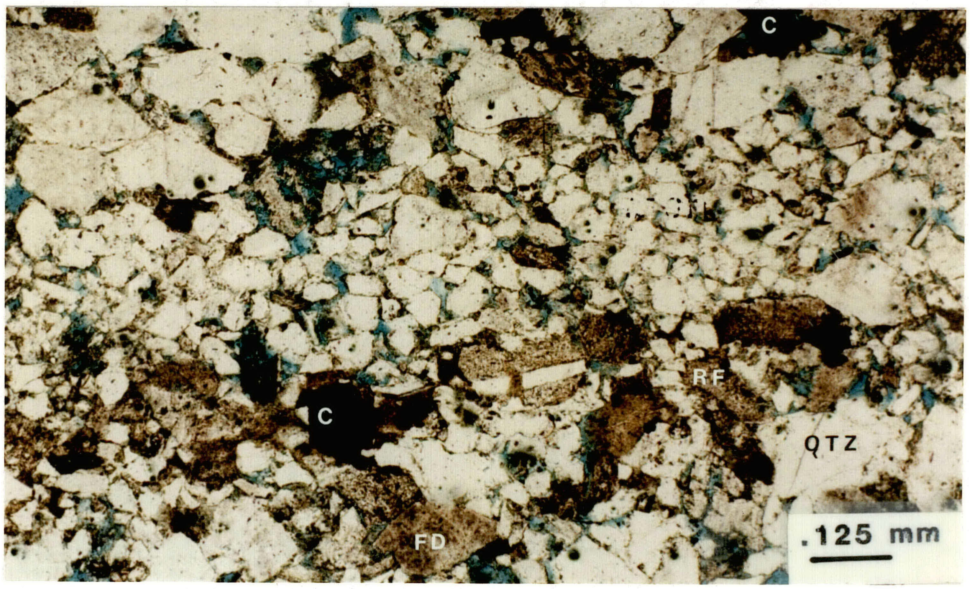


Figure 60. Thin Section Photomicrograph, Plane Polarized Light. Sandstone, Poorly Sorted (Silt-sized to Medium Grained); Abundant Quartz (QTZ) and Rock Fragments (RF), Altered Feldspars (FD). This Sample is characteristic of Upper Portions of the Upper Glenn. Carbonaceous Material (C)

common in lithofacies that are very fine to medium grained, poorly sorted, and that contain irregularly distributed clayey matrix (detrital and/or psuedomatrix) (Figures 61 and 62).

Oversized pores result from connection of adjacent grain molds and/or dissolution of detrital matrix or cement. Oversized pores occur with inhomogeneous packing and form "channels" that may increase permeability significantly (Figure 61).

Elongate pores also are common; generally they are associated with inhomogeneous packing. They tend to be along the boundaries of calcite-cemented rock, where calcite has been dissolved (Figures 28, 46, and 48).

Corroded grain boundaries are commonly associated with intergranular porosity and they generally occur in conjunction with enlarged intergranular pores (Figure 48).

As mentioned earlier, intraconstituent pores or "honeycomb" grains are very common and are associated with the partial dissolution of feldspar grains along cleavage planes or planes of twinning (Figures 43 and 48).

Fractured grains are rare and considered insignificant relative to effective porosity.

Relationship Between Porosity and Permeability

Semi-logarithmic plots of porosity and permeability from conventional core analyses are shown with well data in Appendix B. Foot-by-foot values of porosity and permeability are plotted with corresponding symbols and sample num-

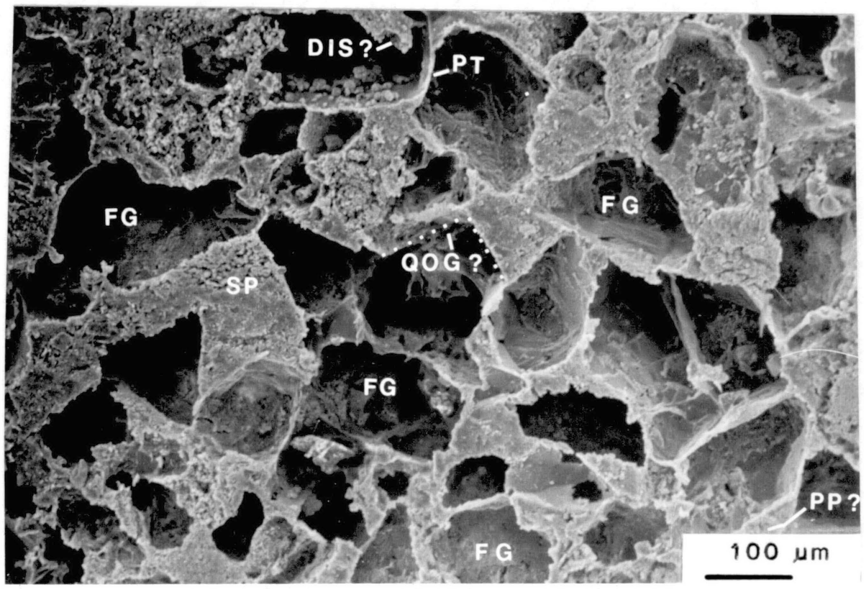


Figure 61. SEM Photomicrograph, x250. Relief Pore Cast of Sandstone Showing Angularity of Secondary Pores (SP). Note Small Pore Throats (PT) and Possible Straight-line Outline of Quartz Overgrowth (QOG). Partial Dissolution Feature (DIS)

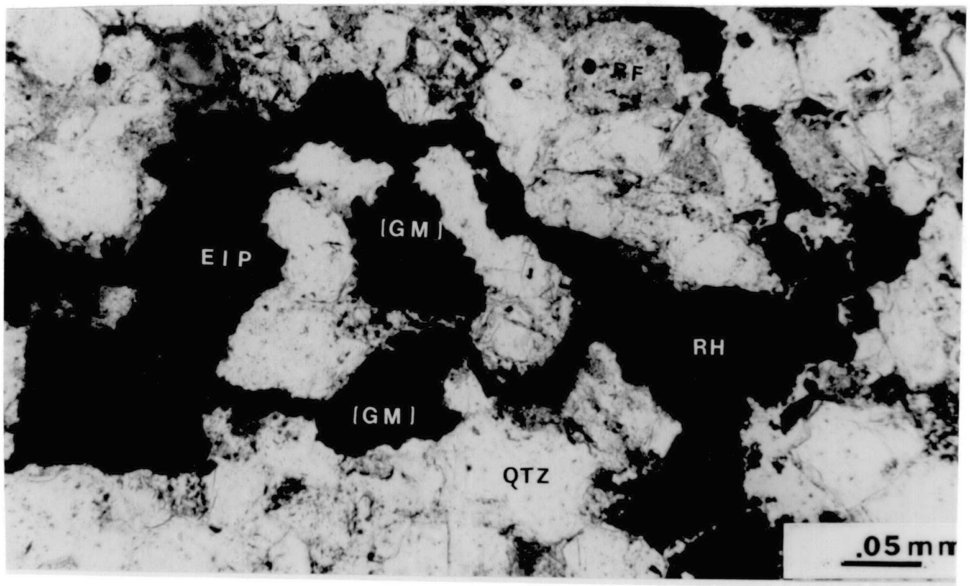


Figure 62. Thin Section Photomicrograph, Plane Polarized Light. Sandstone Showing Residual Hydrocarbons (RH) (Black) Filling Apparent Secondary Pores Created by Dissolution of Grains and/or Detrital Matrix. Enlarged Intergranular Pores (EIP), Grain Molds (GM)

bers for each distinct sandstone body or specified lithofacies. Figures 63, 64, and 65 show amounts of porosity as compared to amounts of permeability of each of the three genetic sandstone bodies. Summary statistics were estimated from sets of 50 random samples. The Upper and Middle sandstones are somewhat similar, in that they both tend to show clustering and general straight-line relationship (c.f. Figures 64 and 65). However, there is notable difference in the amount of scatter of the data points (c.f. correlation coefficients) (Figure 65). Larger scattering of data of the Upper Glenn may be due to the more varied grain sizes and textures associated with particular lithofacies, in addition to the relative abundance and influence of pore-filling clays. Significantly larger porosities and permeabilities are associated with the medium grained lithofacies of the Upper Glenn sandstone, whereas the finer grained lithofacies tends to have somewhat less porosity and permeability (c.f. Plates II through XIII). Possibly the smaller scatter of points in the Middle Glenn is due to its "massive" nature and less varied grain size.

In the Middle and Upper Glenn, data points that indicate relatively large porosities (18 - 22 percent) and relatively small permeabilities (10 - 50 md) are indicative of lithofacies that contain abundant clay minerals and/or shale rip-up clasts (c.f. Plates II through XIII). However, a few samples showing secondary pores and extensive silica cementation may also have relatively high porosities and low

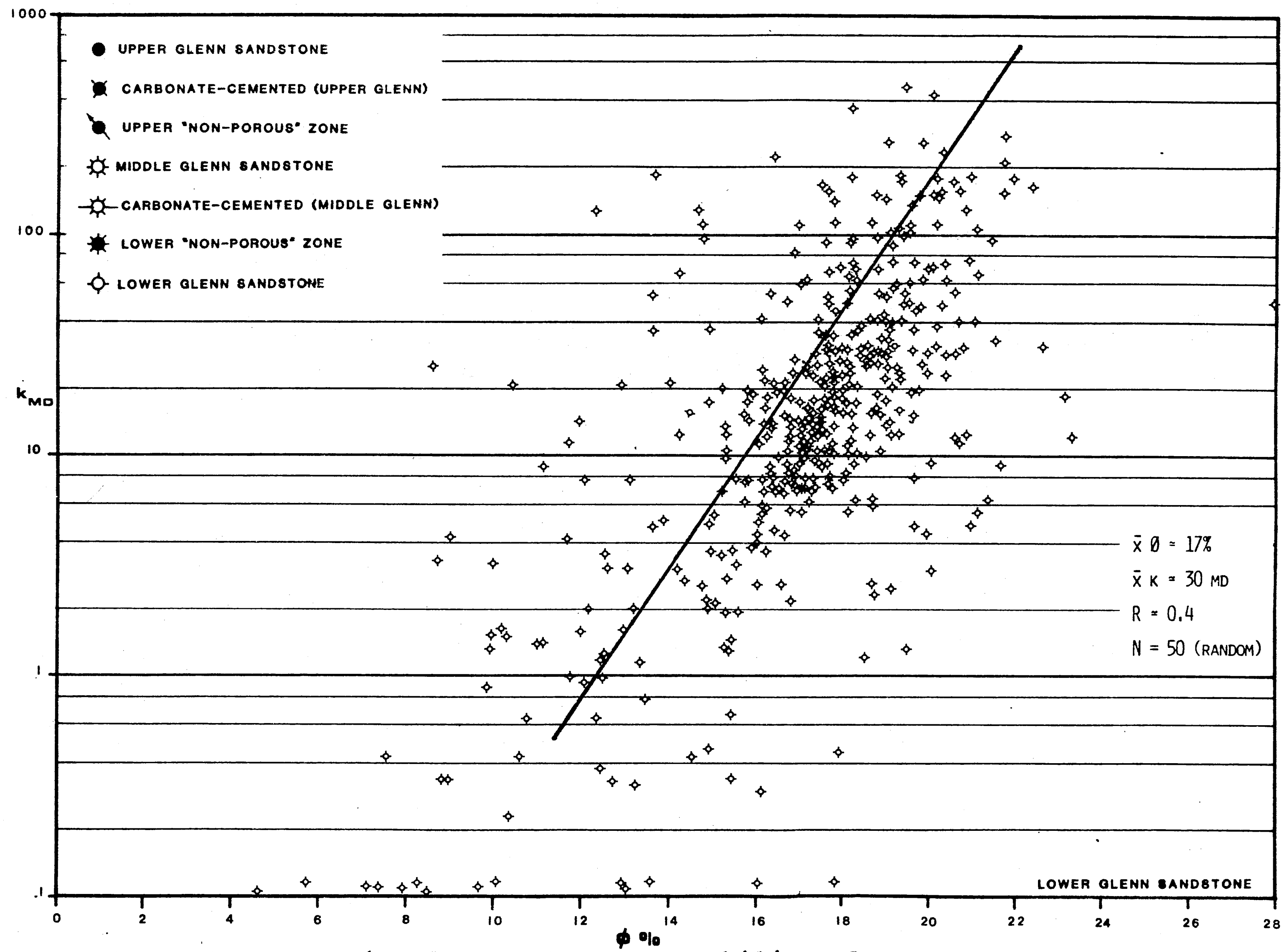


Figure 63. Porosity Compared to Permeability, Lower Glenn Sandstone, William Berryhill Unit

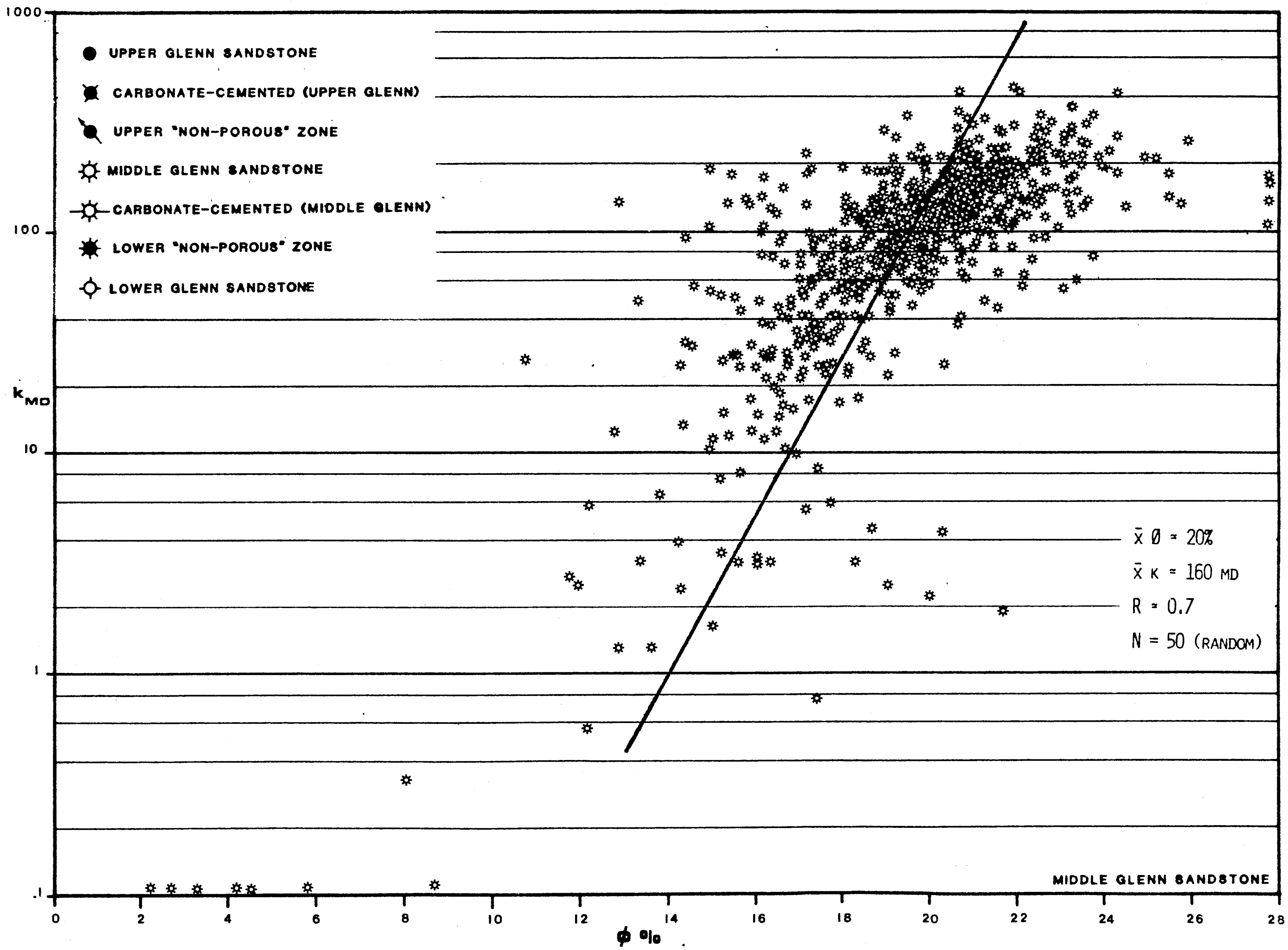


Figure 64. Porosity Compared to Permeability, Middle Glenn Sandstone, William Berryhill Unit

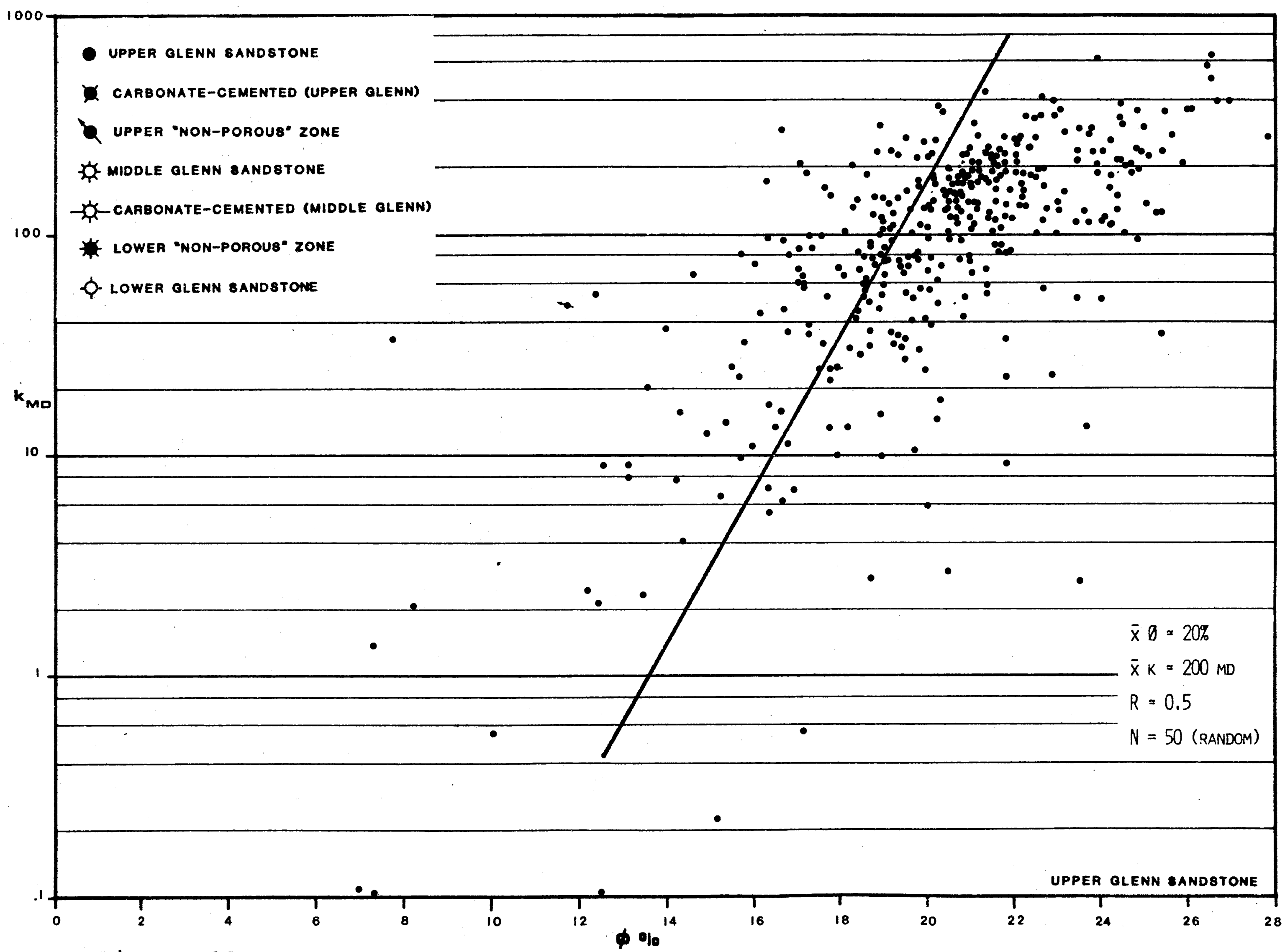


Figure 65. Porosity Compared to Permeability, Upper Glenn Sandstone, William Berryhill Unit

permeabilities. Figure 160, Appendix E, shows examples of mercury-injection capillary pressure tests of three selected samples, two of which have similar porosities, but different permeabilities. Relative displacement of the curves for samples with similar porosity suggests differences such as matrix and/or clay content, pore size, or pore-throat radii. A plot of pore throat radius compared to cumulative percent of pore space of one sample is shown in Figure 158, Appendix E. Porosity of this sample is 19.4 percent and permeability is 64.5 millidarcies. Fifty percent of the cumulative pore space has pore throat radii that are 3.5 microns or smaller.

Comparison of porosity and permeability of the Lower Glenn with those of the Middle and Upper Glenn shows a distinct difference in the relationship (Figures 64 and 65, c.f. to Figure 63). Average porosity and permeability of the Lower Glenn are less, and variation in porosity is greater. Increase in slope (Figure 63) indicates that in the Lower Glenn, for increasing amounts of porosity, permeability increases at a rate greater than in the Upper and Middle Glenn. One hypothesis generated to explain this relationship concerns the type and distribution of secondary porosity in the sandstones. The Lower Glenn contains more detrital matrix, rock fragments, and feldspar than the Upper or Middle Glenn. Dissolution of unstable constituents and detrital matrix could create more interconnected pores, and these could be enlarged to some degree.

A plot of permeability compared to water saturation of a core (Figure 159, Appendix E) shows that as amounts of water saturation increase, permeability decreases.

Plots of porosity compared to permeability of the Upper and Lower "Non-Porous" Zones and calcite-cemented intervals are shown in Figures 66, 67, and 68. The Upper and Lower "Non-Porous" Zones are similar; the Lower "Non-Porous" Zone shows slightly larger porosities but approximately the same permeabilities. This may be due to more sand than in the interbedded, interlaminated sandstone and shale of the Upper "Non-Porous" Zone (c.f. Plates II through XIII). The plot of porosity compared to permeability of the calcite-cemented intervals shows very low to almost nonexistent porosities and permeabilities. In these intervals some dissolution of calcite or replacement by dolomite, or dissolution of feldspar led to small amounts of porosity and permeablity. Overall, these intervals are effectively vertical permeability barriers with limited lateral extent.

Factors That Affect Porosity

Mineralogy, grain size, sorting, angularity, packing and compaction, pore-throat size, dissolution and cementation are important depositional and diagenetic factors influencing porosity and permeability in sandstones (Pettijohn, et al., 1972). The detrital mineralogy of the Glenn Sandstone is relatively consistent with only a few slight differences among the three sandstone bodies. Figure 69 shows data from seive analysis showing the grain-size distribution of the "Main Pay" (Upper and Middle Glenn) rela-

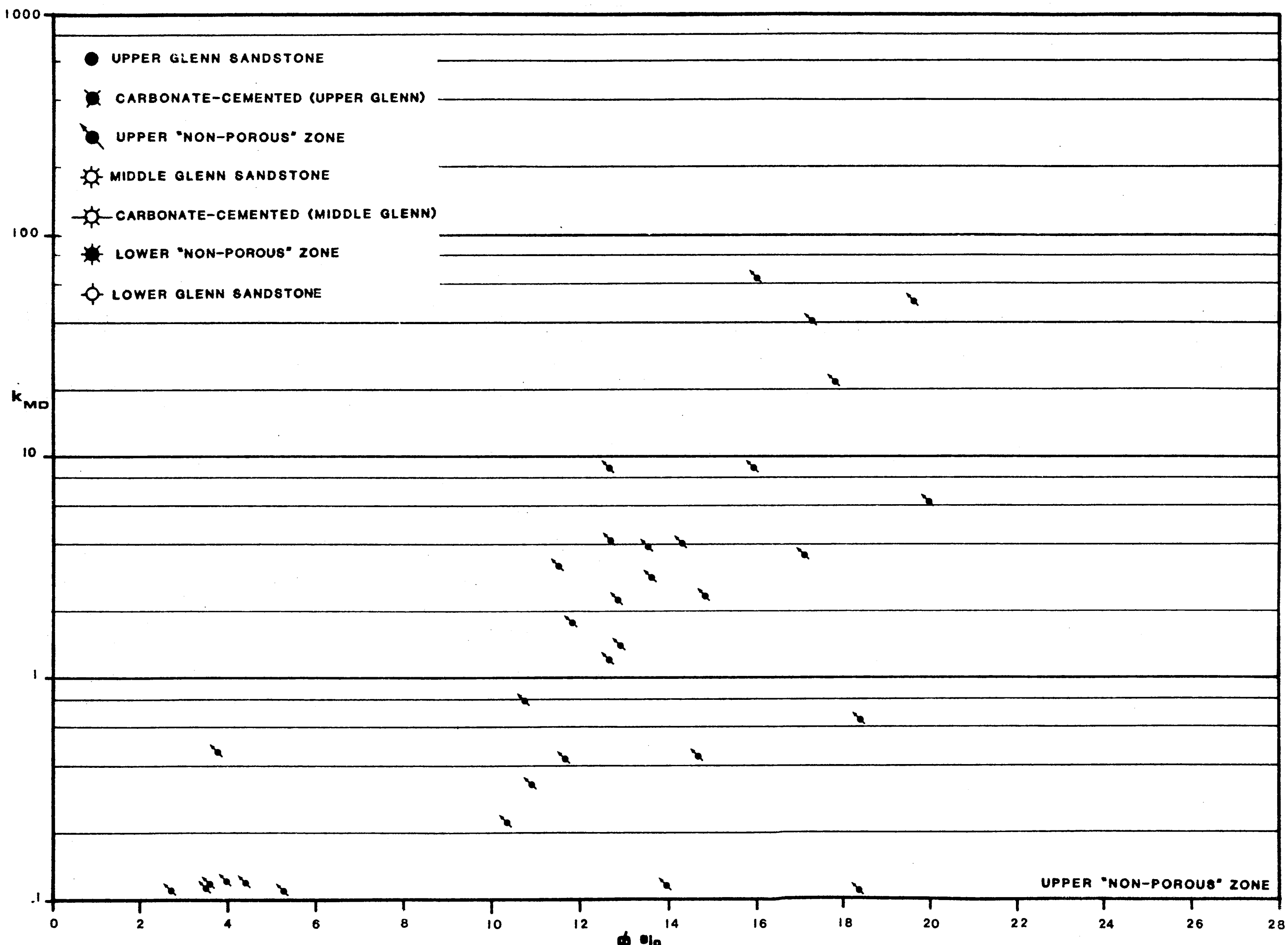


Figure 66. Porosity Compared to Permeability, Upper "Non-Porous" Zone, William Berryhill Unit

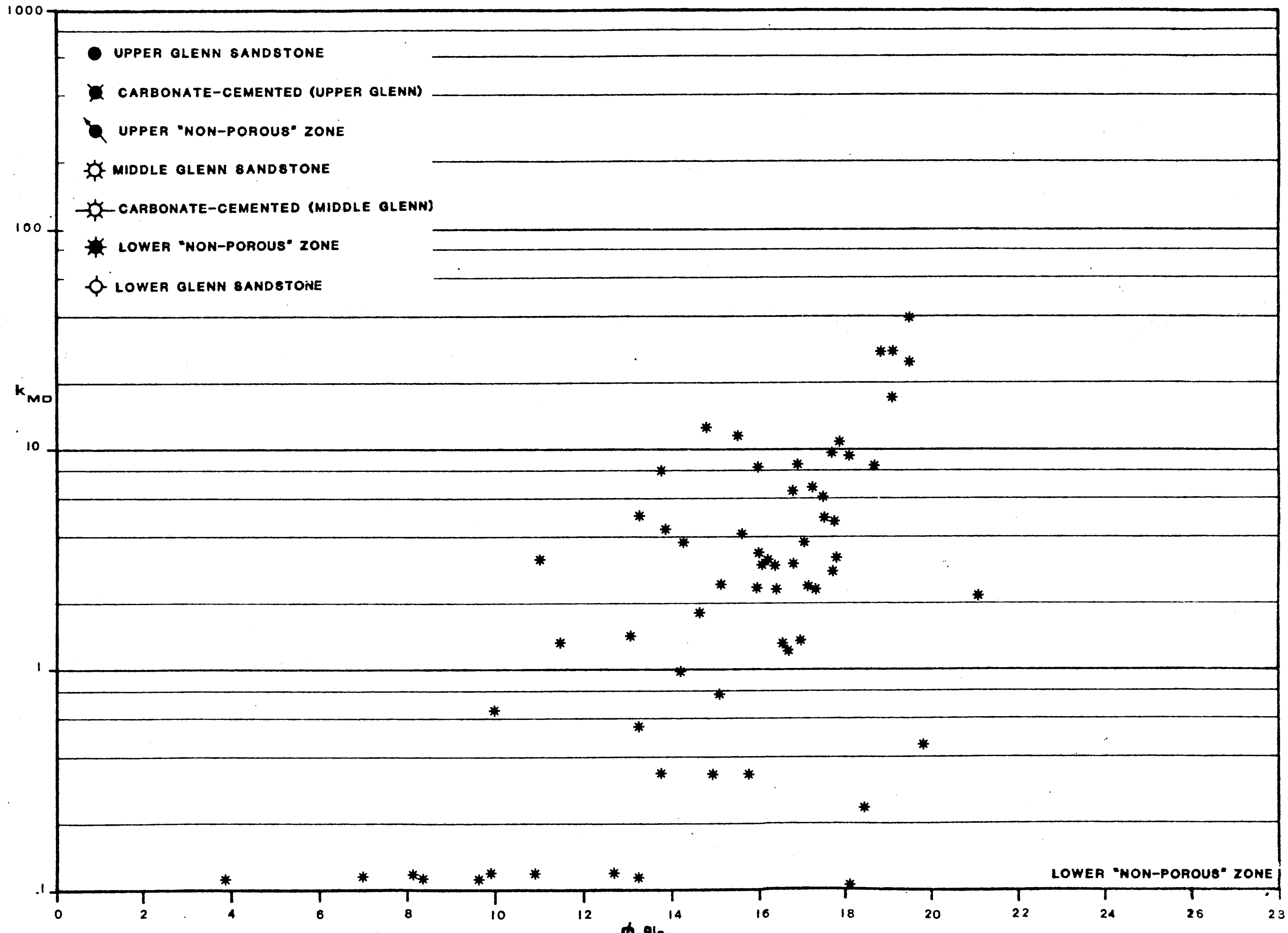


Figure 67. Porosity Compared to Permeability, Lower "Non-Porous" Zone, William Berryhill Unit

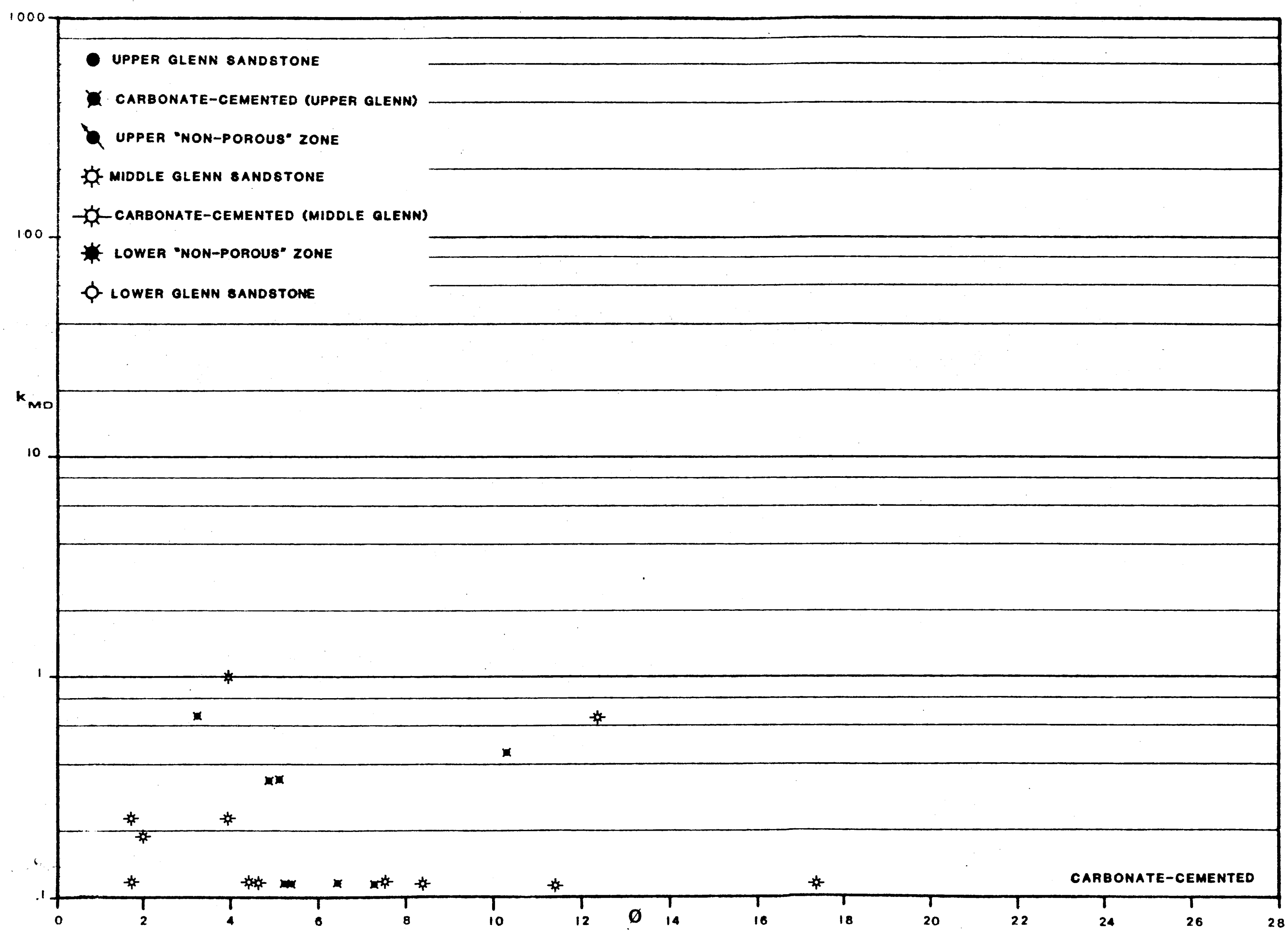


Figure 68. Porosity Compared to Permeability, Calcium-carbonate Cemented Sandstone Intervals, William Berryhill Unit

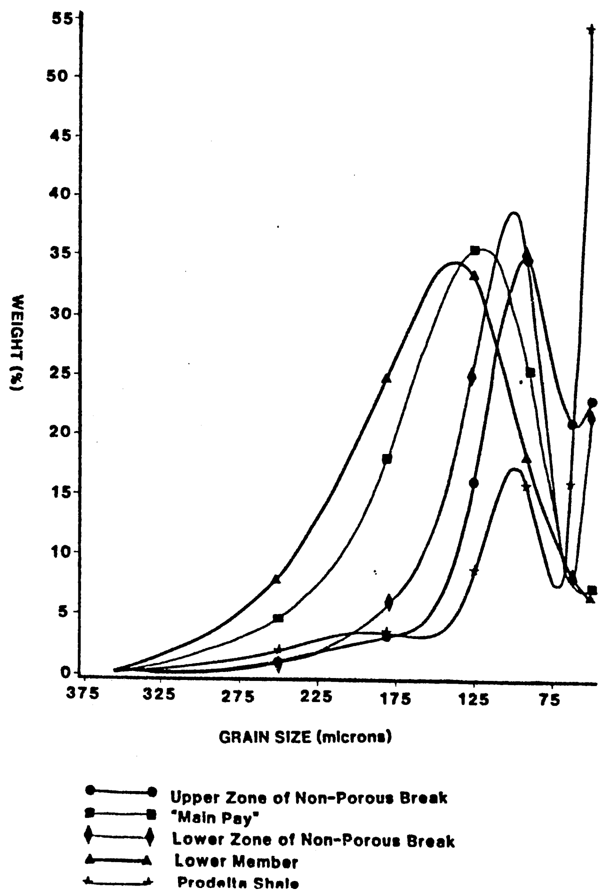


Figure 69. Sieve Analysis of William Berryhill No. 104-0 Showing Grain Size Distribution of and "Main Pay" (Upper and Middle Glenn) Relative to "Lower Member" (Lower Glenn), "Non-Porous" Intervals, and Prodelta Shale Below the Glenn (From Gulf Oil Exploration and Production Company)

tive to the "Lower Member" (Lower Glenn), "Non-Porous" intervals, and prodelta shale. Variation from fine to medium grain seems to be characteristic of the upper parts of the Upper Glenn and parts of the Lower Glenn sandstone (c.f. Plates II through XIII). Grain size of the Middle Glenn (very fine to fine) is relatively consistent. The medium grained sandstone is less sorted than the very fine to fine grained sandstone (c.f. Plates II through XIII).

Distribution of porosity has great influence on recovery (Wardlaw and Cassan, 1979). Pryor (1973) demonstrated variation in pore-system properties (grain size, bedding, etc.) among various types of sandstone. Clark et al. (1965) showed that injection flow followed coarser-grain rocks with large scale cross-bedding and parallel laminations. Also, in this instance fluid movement generally followed the overall isopach trends of the Robinson Sandstone.

Depositional strike, axial trends of channel sandstones, and thin interbedded shales of the Glenn sandstone in the study area may influence the directional permeability and preferential flow of fluids injected and recovered at well bores.

Diagenetic processes almost certainly have influenced the pore system and amounts and directions of permeability. As demonstrated, secondary porosity is controlled by the size, shape and distribution of relatively unstable or soluble rock components. Selected SEM photomicrographs of the Glenn Sandstone show characteristic pore geometry (Fig-

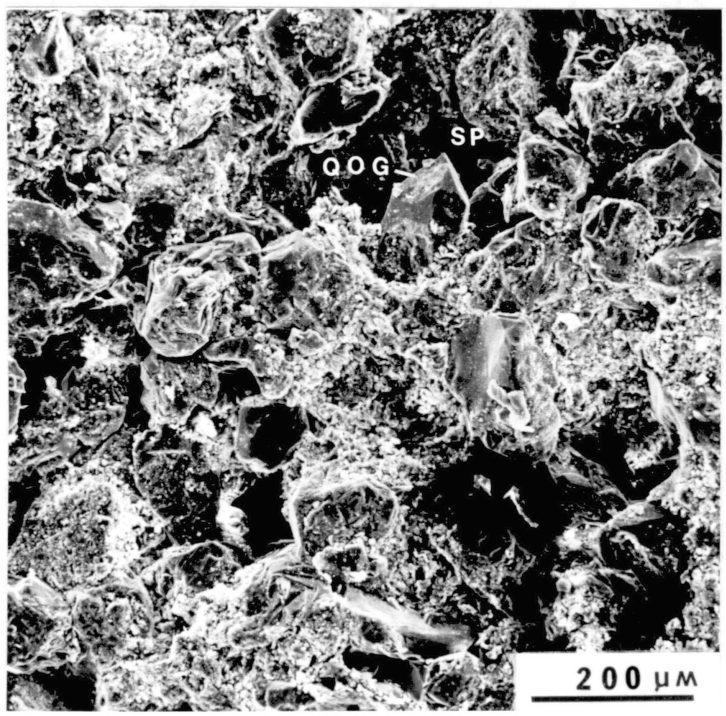


Figure 70. SEM Photomicrograph, x100. Sandstone Characteristic of Upper Glenn, Showing Framework Grains and Abundant Authigenic Clays (Light-toned). Note Interconnected Pores (SP) (Dark Areas), and Quartz Overgrowth (QOG)

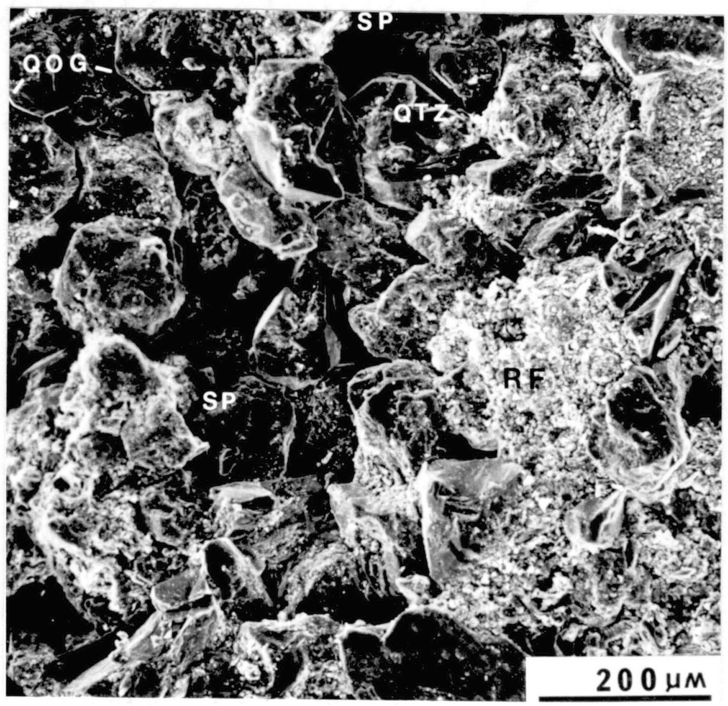


Figure 71. SEM Photomicrograph, x100. Sandstone Characteristic of Middle Glenn. Note Interconnected Pore Spaces (SP) Between Framework Grains, and Abundant Pore-filling Clay. Argillaceous Rock Fragment (RF) on Right Side of Photomicrograph, and Straight-line Outline of Quartz Overgrowth (QOG) in Upper Left

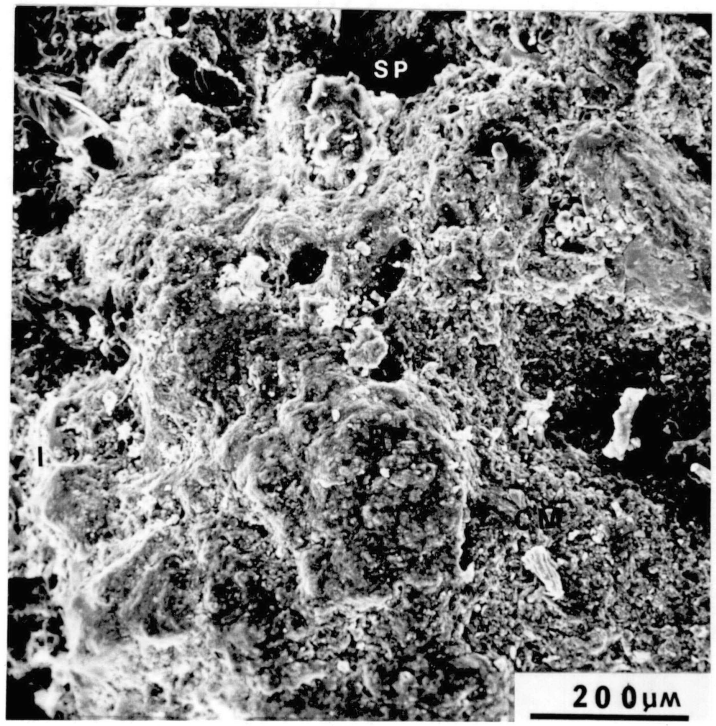


Figure 72. SEM Photomicrograph, x100. Sandstone Characteristic of Some Portions of Lower Glenn. Note Small Amount of Porosity and That Texture of Sandstone Generally is Obscured by Clay. Note Isolated Secondary Pore Spaces (SP)

ures 70, 71, and 72). Also, SEM examination of several relief pore casts allowed further study of the pore geometry and porosity types (Figures 46 through 48, 59 and 61). Irregularity and inhomogeneity of porosity is evident in several pore casts (Figures 48 and 59). However, good interconnected porosity in some samples is apparent from continuity of the solid parts of casts, which represent pore space (Figure 73). Small voids within the solid material show evidence of clays (Figure 48).

Variations in efficiency of recovery among sandstones can be explained in terms of the geometric aspects of the pore system. According to Wardlaw and Cassan (1979), increased heterogeneity and the common increase in ratio of pore size to aperture size associated with secondary porosity are likely to decrease recovery efficiency. Obviously, spatial arrangement of secondary pores can affect recovery efficiency, because connected secondary pores can increase permeability. In the Glenn Sandstone secondary pores tend to be connected well, particularly in the Upper and Middle Glenn. The Lower Glenn has less interconnected secondary porosity.

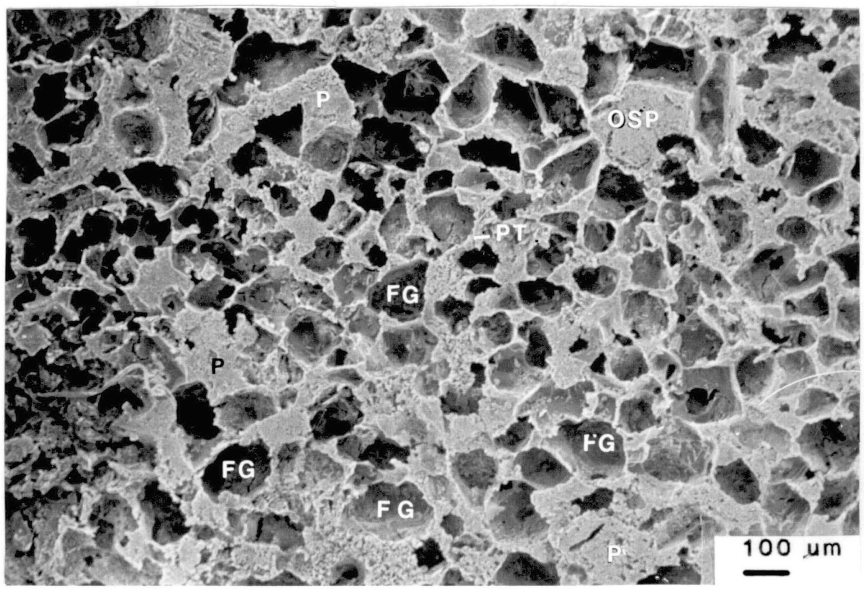


Figure 73. SEM Photomicrograph, x50. Relief Pore Cast of Glenn Sandstone. Solid (Lighter Areas) are Pores (P), Whereas Voids (Darker Areas) are Preserved Molds of Framework Grains (FG) and Various Other Constituents. Note Relatively Large Sizes of Pores, Oversized Pore Spaces, (OSP) and Interconnection of Pore Throats (PT)

CHAPTER VIII

CORRELATION

Introduction

Terminology of the International Subcommittee on Stratigraphy (1972, 1976) indicates that to "correlate" is to show correspondence in character and stratigraphic position. The fact is recognized that in many instances well-log signatures alone are not reliable for accurate correlation of stratigraphic sequences and distinct lithofacies therein. According to Almon (1980), there is no adequate way to determine the specific sedimentary facies present in a well bore by using wireline logs alone. Application of well-log data to interpretation of ancient depositional environments seems to be limited, highly empirical, and closely dependent upon calibration with cores.

Methods

Several methods of correlation of well-logs have been addressed in the recent literature (Jagelar and Matuszak, 1970; Shaw and Cubitt, 1979; Mann, 1979; Srivastava, et al., 1981). Most have dealt with an automated approach to recognition, definition, and correlation of discrete intervals within an undifferentiated sequence, whereas others employ different techniques of visual examination (Srivastava, et al., 1981). Difficulties arise due to the complex or obscure lithostratigraphic relationships within the formation of interest. The probability that a "homogeneous" rock unit will maintain constant thickness through any appreciable distance is small. Dissimilar rates of sedimentation, compaction, and truncation by erosion and/or faulting all may create unequal thicknesses of stratigraphic units. In characterization and correlation of "reservoir facies" it is important first to approximate the environment of deposition represented by each rock type. This enables one to make predictions or to develop working hypotheses concerning reservoir geometry and continuity, directions of permeability, and extents of possible fluid-flow barriers.

Careful study and calibration of cores and well logs have provided data sufficient for formation and testing of working hypotheses that deal with correlation of general lithofacies of the Glenn Sandstone within the study area. Several procedures have been involved: (1) detailed petrographic work on selected cores, (2) correlation of information about lithology, sedimentary features, petrology, and porosity with log-response characteristics of available cores, (3) sampling from cores and examination of well-logs from offset wells, and (4) extension of correlations to uncored wells using only well logs. This method of approach enabled various log-responses to be classified according to sedimentary facies and petrographic properties, which led to better correlation of the Glenn using well-log information.

Quality Control

Quality control of the well logs used in this study was very good. Suites of "modern" log-surveys are similar, and the types of logging tools used were basically the same. Most wells were logged by Schlumberger, but a few were logged by Gearhart Industries Inc. Surveys included Dual Induction-Laterolog or Spherically Focused Log, Compensated Neutron-Compensated Density, Borehole Compensated Sonic, and various computer-processed logs. Several new wells have Electromagnetic Propagation surveys. Table XXIII in Appendix C lists all wells in the unit and their respective log-suites. Appendix B includes log-signature diagrams of cored wells, in addition to diagrams of log-signatures and corresponding lithic features.

General Considerations

Within the study area, recognition of laterally continuous, distinct units in the Glenn Sandstone based on well-log signatures alone is difficult. The upper-delta-plain depositional setting of the Glenn was such that short-distance changes in facies were significant, and a rock unit in a core may not have the same composition, sedimentary features, and thickness elsewhere, even though the two samples are stratigraphically equivalent. In addition, important lateral changes may go undetected by visual inspection of well logs. Thus, recognition of a rock-stratigraphic or time-stratigraphic marker in a sequence and its identification throughout the area is vital to correlation purposes.

Figure 74 shows a conceptual block diagram of a meander point bar depositional environment, similar to what might be expected in an upper-delta-plain setting. Idealized log-signatures also are shown; they represent log-responses at certain locations through the point bar. This diagram illustrates the difficultly in correlation of individual lithofacies in such an environment with well-log signatures alone.

Consideration of the Glenn Sandstone's environment of deposition (distributary channel-fill and associated point bar(s)), general reservoir geometry, and uncertainty of correlation of indiviual lithofacies, led to the adoption of a method suggested by Alpay (1972). Instead of attempting to identify individual thin beds between wells, a "band of genetic similarity" is identified; texturally similar lithofacies are correlated from well to well within the confines of this "band" (i.e., from the base of the Upper "Non-Porous" Zone to the top of the Lower "Non-Porous" Zone). This method seemed to work well and aided in construction of the correlation network (panel diagram) (Plate I).

Correlation of the three genetic sandstone bodies of the Glenn was done with the aid of several cross sections and a log-signature map showing gamma-ray and/or spontaneous potential curves (Figure 75). The log-signature map aided in visualizing general changes in gross thickness of the Glenn across the unit. It was modified into a panel diagram (Plate I, in pocket).

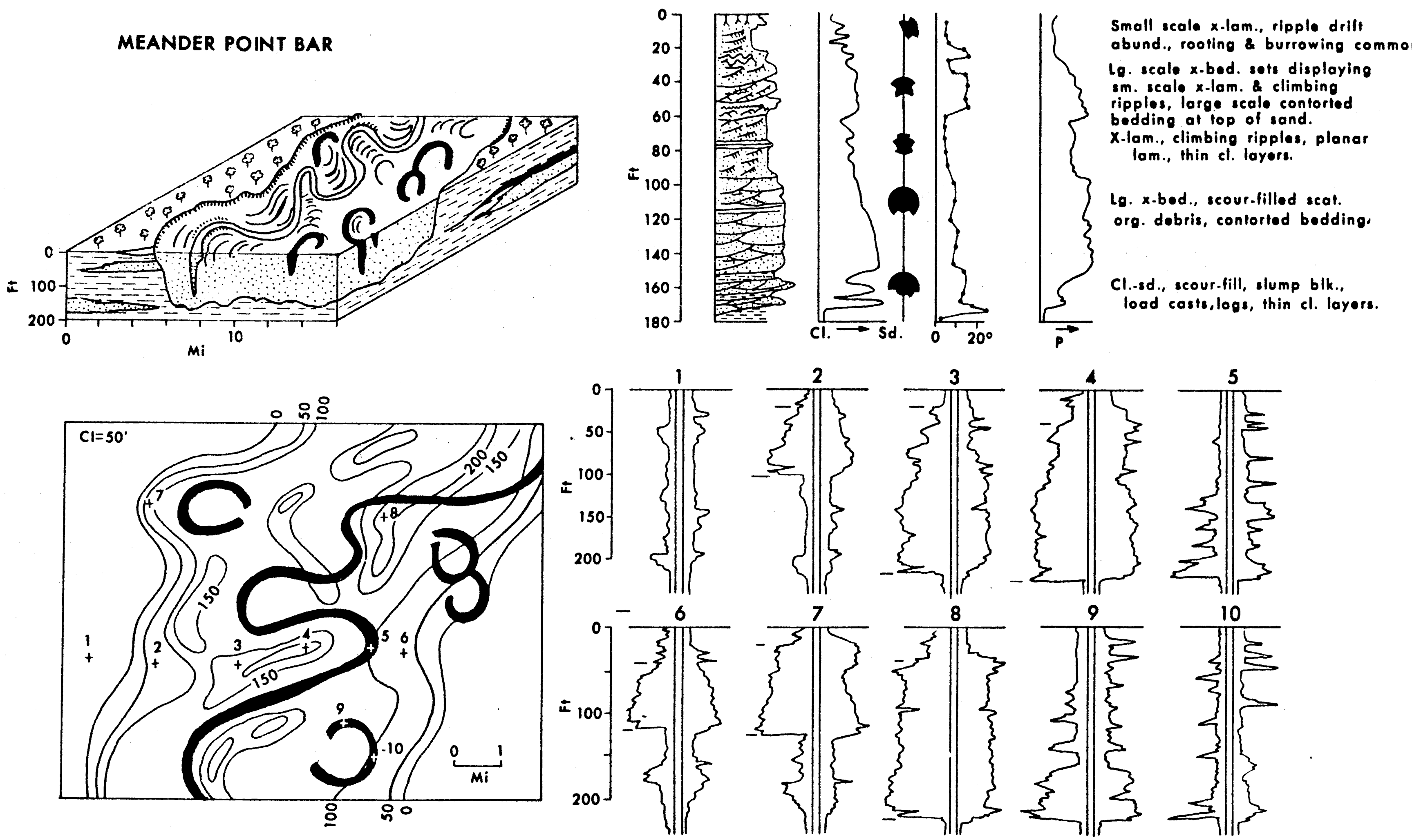


Figure 74. Summary Diagram Illustrating the Major Characteristics of Meandering Point-bar Deposits. (After Coleman and Prior, 1981)

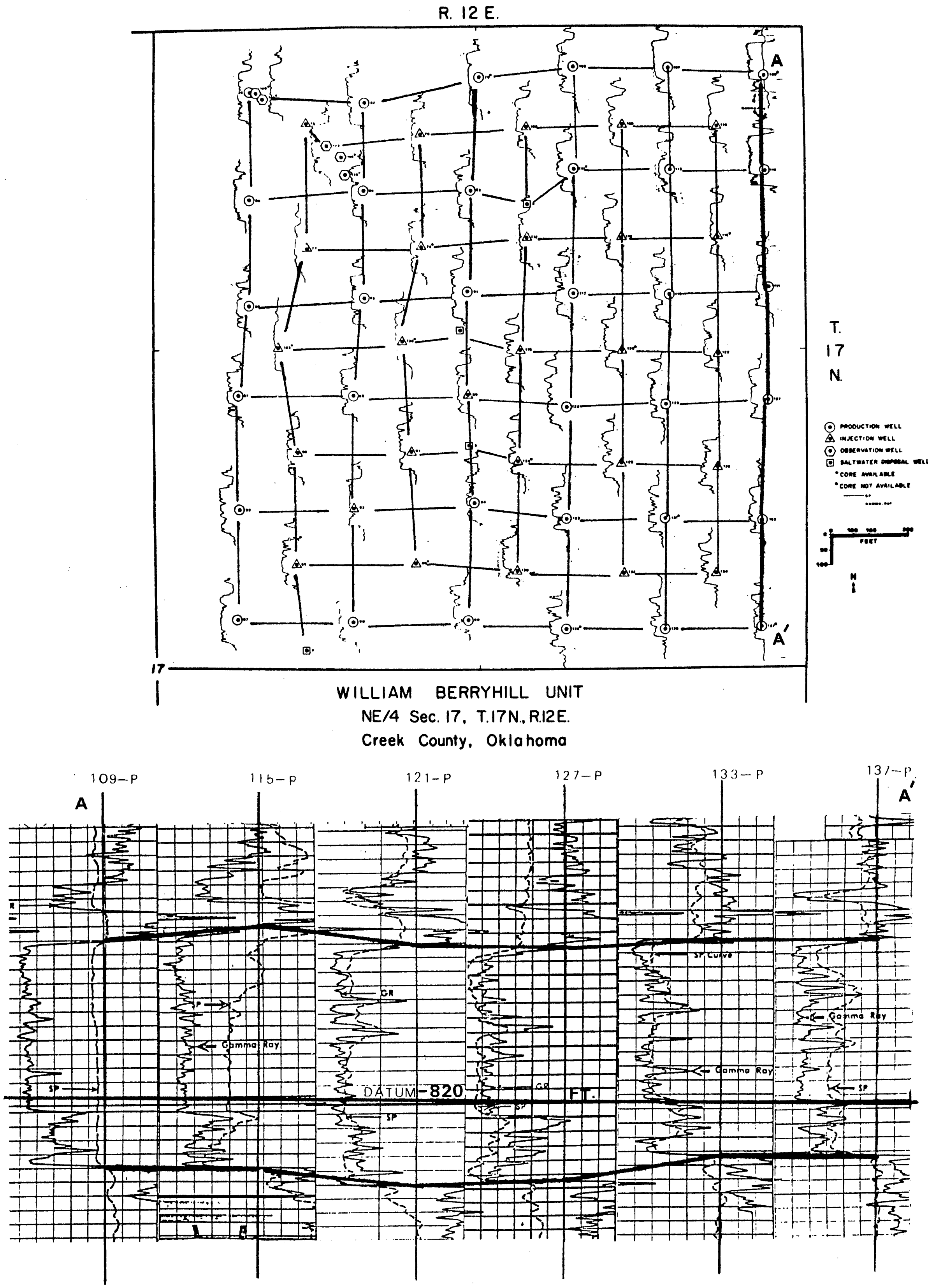


Figure 75. Log-signature (Spontaneous Potential and/or Gamma-ray) Map (Top) Showing Network of Cross-section Lines. Example Structural Cross-section (A - A') (Bottom)

Figures 155, 156, and 157 (Appendix D) each show a stratigraphic cross-section that was constructed by "stacking" interval transit time log-signatures. As mentioned previously, good correlation can be established by using the top and bottom of the Glenn, but there is difficulty in correlating log-responses within the interval. The discontinuous calcite-cemented units can be inferred from these cross-sections. Abrupt decrease (deflection of the log-signature to the right) of interval transit time generally denotes the cemented rock.

Variations of the sedimentary features in cores from well to well are rather clearly documented in the log-signature, general lithology, and sedimentary feature diagrams (Appendix B). Log-signatures of the Glenn show appreciable subtle variations from well to well although relatively good correlation can be made of the top and bottom of the formation. Difficulty arises when one tries to correlate accurately and precisely the individual lithofacies within the formation. However, matching of certain lithofacies can be done at levels useful for prediction in adjacent wells. Moderately complex, short-distance changes in the geometry of the Glenn Sandstone and attendant reservoir heterogeneity make extensive correlation of individual lithofacies difficult. Correlation on the basis of well-log signatures alone is complicated by changes in depositional strike of the rock units, as well as by lithic variation. Figure 76 illustrates the increase in uncertainity of correlation as

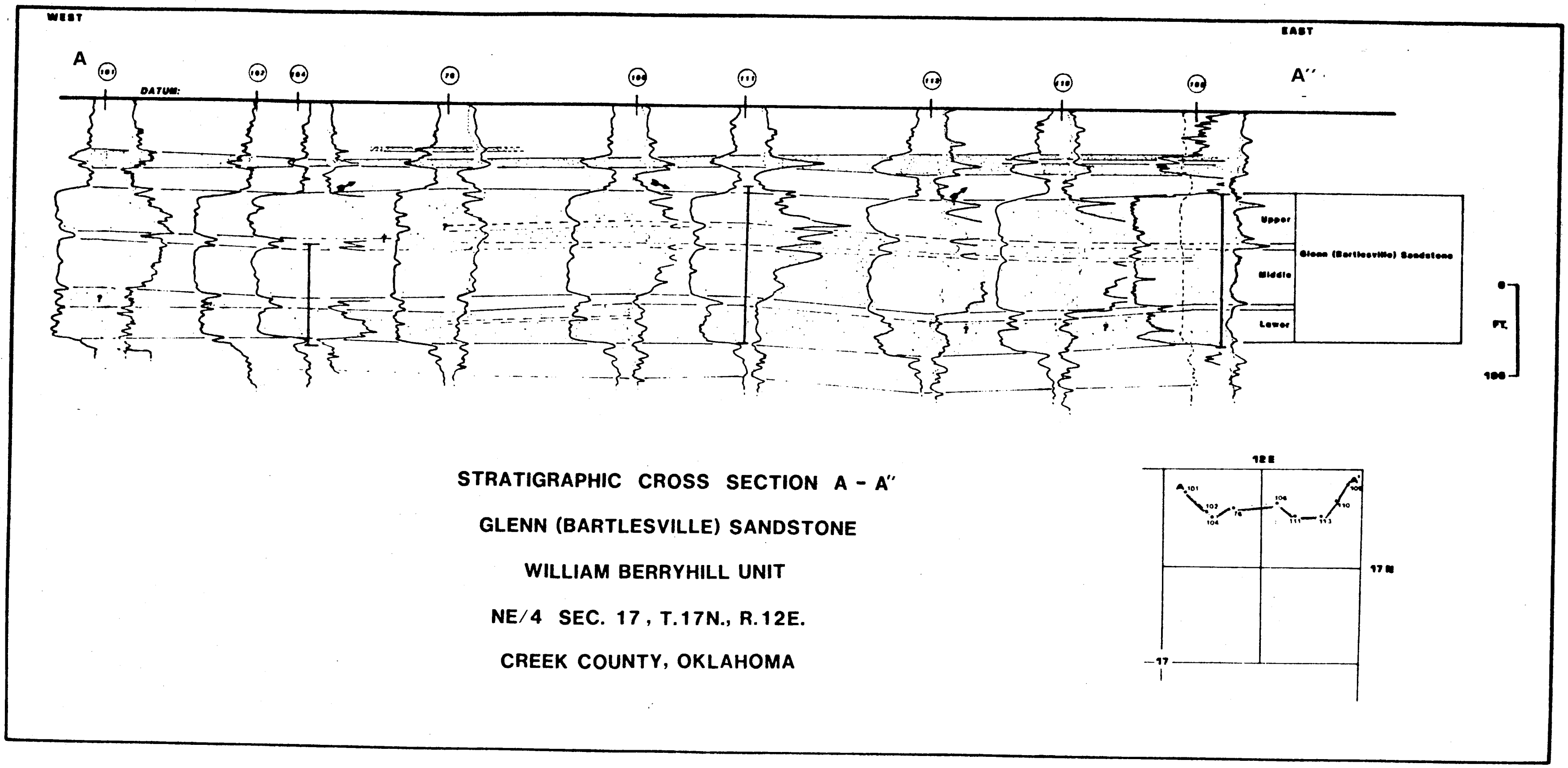


Figure 76. Stratigraphic Cross-section A - A'': Glenn (Bartlesville) Sandstone, William Berryhill Unit. (Depositional Strike Apparently Was Southeastward, as Inferred from the Directness of Correlation of the Three Leftmost Logs)

strike of the cross-section or depositional strikes of rock units change abruptly. Consequently, inferences about depositional strike of the rock units of the Glenn can be made using core-log correlation techniques. Thus, prediction of porosity trends, fluid flow barriers, and continuity of reservoir and nonreservoir lithofacies is possible.

Most reservoir rocks are not homogeneous or isotropic or even simply layered. Complex variation in reservoir continuity, pore-system properties, and thickness generally is present but probably is not adequately defined by most reservoir studies (Pickett, 1971). If reservoir rocks were considered as being homogeneous and isotropic in reservoir engineering, serious deficiencies in performance of reservoirs would be highly likely to occur. The moderate complexity of the Glenn Sandstone within the 160-acre William Berryhill Unit illustrates this point well. However, as Alpay (1972) points out, "dealing effectively with the characterization of the physical and textural variations in a reservoir has always been an elusive problem, because the reservoir portion that can be investigated through boreholes is usually insignificant in comparison with the bulk of the reservoir". Nevertheless, the density of information (cores and well-logs) in the William Berryhill Unit allows an unqiue opportunity to characterize a reservoir and investigate internal features that normally are undetected.

CHAPTER IX

SUMMARY AND CONCLUSIONS

Stratigraphic, petrographic, diagenetic, and related reservoir and log-response characteristics of the Glenn (Bartlesville) Sandstone within the 160-acre, Gulf Oil Exploration and Production Company, William Berryhill Unit, Glenn Pool Oil Field, were documented using information from 18 cores and more than 70 suites of modern logs. A summary of conclusions reached is listed below.

1. Within the William Berryhill Unit, the Glenn Sandstone is divided into three distinct genetic sandstone bodies (Upper, Middle, and Lower), of which the Upper and Middle Glenn are considered the "main pay"; the Lower Glenn is below the oil/water contact and in non-productive in the unit. Separation of the three genetic sandstones is based on differences in lithologic characteristics, sedimentologic features, porosity, permeability, log-response characteristics, and the apparent separation by thin intervals of interbedded sandstone and shale, and/or shale rip-up clasts (Upper and Lower "Non-porous" Zones). At some locations the Upper "Non-porous" Zone may not be an effective vertical permeability barrier, due to lateral discontinuity of the interbedded sandstone and shale.

2. Evidence shown in cores indicates features associated with deposition in an upper deltaic plain, specifically, distributary channel-fill and point-bar deposition. This interpretation is consistent with the regional geologic framework of the sandstone, as established by other geologists.

3. The sandstone predominantly is sublitharenite - litharenite. In terms of major detrital constituents compositional differences among the Upper, Middle, and Lower Glenn, seem to be related to relative abundances of rock fragments (metamorphic and argillaceous), feldspar, and detrital matrix.

4. Morphology and composition of the sandstone have been influenced strongly by diagenetic processes, such as partial to complete dissolution of some detrital constituents, precipitation of authigenic clays and cements, alteration of various constituents, replacement of detrital constituents, and mechanical compaction.

5. Porosity mostly is secondary, owing to dissolution of unstable framework grains (i.e., feldspars and rock fragments) during mesodiagenesis. Average porosities and permeabilities of genetic sandstone units range from 22 % porosity and 175 md permeability in the Upper Glenn, through 21 % porosity and 120 md permeability in the Middle Glenn, to 17 % porosity and 30 md permeability in the Lower Glenn. Porosities as great as 26 % and permeabilities as large as 950 md are common in portions of the Upper and Middle Glenn.

6. Calcite-cemented beds are in all three genetic sandstone bodies. Commonly they are associated with nearby shales, but some are isolated in apparently "massive" sandstone.

7. Evidence from cross-sections suggests that the calcite-cemented intervals are discontinuous laterally, and that they may compartmentalize portions of the reservoir.

8. Pore textures of secondary porosity in the sandstone include 1) intergranular pores, 2) oversized pores, 3) moldic pores, and 4) intraconstituent pores.

9. As compared with permeability from core analyses of each genetic sandstone, porosity shows general straight-line association. However, the data suggest subtle differences in reservoir characterisitics.

10. Distribution and general trends of porosity almost certainly are affected by changes in composition in a particular lithofacies, and by changes in depositional strikes of rock units. Fluid movement probably is greatest along the depositional strike of the rock units.

11. Variations of the sedimentary features in cores can be documented clearly from well to well, using log-signatures, general lithology, and sedimentary-feature diagrams.

12. Moderately complex, short-distance changes in geometry of the sandstone and attendant reservoir heterogeneity make precise correlation of individual lithofacies difficult. Inferences about detailed physical continuity of rock units were made guardedly, in spite of the small size of the study area.

13. A log-signature map aided in visualizing general changes in the gross thickness of the Glenn.

14. "Bands of genetic similarity" were identified within the Glenn; similar lithofacies can be correlated from well to well.

15. Petrographic information and calibration of logs led to improved interpretation of logs, and improved correlation. This information should contribute to improved prediction of results of enhanced recovery.

16. Documentation of porosity and permeability, with input of information about petrography, diagenesis, petrophysics and depositional environments should aid in modeling of reservoirs and prediction of recovery from place to place and time to time. Moreover, calibration of logs by cores and petrographic data described herein could lead to enhancement of data from wells documented by wireline logs alone.

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APPENDIXES

APPENDIX A

ABBREVIATIONS AND SYMBOLS

TABLE IV

CORE DESCRIPTION ABBREVIATIONS

Word	*Suggested Abbreviation**	*Word*	*Suggested Abbreviation**
About	abt	Conchoidal	conch
Above	abv	Concretion, concretionary	conc
Abundant	abnt	Conglomerate	cgl
Acicular	acic	Conodont	Cono
Agglomerate	aglm	Contact	ctc
Aggregate	agg	Contorted	cntrt
Algae, algal	Alg	Coquina	coq
Altered, altering	alt	Covered	cov
Amorphous	amor	Crenulated	cren
Amount	amt	Crevice	crev
Angular	ang	Crinkled	crnk
Anhedral	anhed	Crinoid, crinoidal	Crin
Anhydrite, anhydritic	anhy	Cross-bedded, cross-bedding	xbd, xbdg
Apparent	apr	Cross-laminated	xlam
Appears	aprs	Cross-stratified	xstrat
Approximate, approximately	aprox	Cryptocrystalline	crpxl
Aragonite	arag	Cryptograined	crpgr
Arenaceous	aren	Crystal, crystalline	xl
Argillaceous	arg	Cuttings	ctgs
Arkose, arkosic	ark	Dark	dk
Asphalt, asphaltic	asph	Dead	dd
*At	@	Debris	deb
Average	av	Decrease, decreasing	decr
Band, banded	bnd	Dendritic	dend
Barite, baritic	bar	Dense	dns
Basalt	bas	Determine	dtrm
Bed	bd	Detrital, detritus	dtrl
Bedded	bdd	Diameter	dia
Bedding	bdg	Difference	dif
Bentonite, bentonitic	bent	Disseminated	dism
Biotite	biot	Dolocast, dolocastic	dolc
Bitumen, bituminous	bit	Dolomite, dolomitic	dol
Black	blk	Dolomold, dolomoldic	dolmd
Block, blocky	blky	Druse, drusy	drsy
Blue, bluish	bl	Earthy	rthy
Botryoidal	btry	Echinoid	Ech
Boulder	bldr	Elliptical	elip
Brachiopod	Brac	Elongate	elg
Breccia, brecciated	brec	Embedded	embd
Bright	bri	Enlarged	enl
Brittle	brit	Equivalent	equiv
Brown	brn	Euhedral	euhed
Bryozoa	Bry	Evaporitic	evap
Calcite, calcareous	calc	Expose, exposed, exposure	exp
Carbonaceous	carb	Extrusion, extrusive	extr
Cavernous	cav	Faceted	fac
Caving	cvg	Faint	fnt
Cement, cemented	cmt	Fair	fr
Center, centered	cntr	Fault	flt
Cephalopod	Ceph	Fauna	fau
Chalcedony	chal	Feldspar, feldspathic	fld
Chalk, chalky	chk	Ferruginous	Fe
Chert	cht	Fibrous	fib
Cherty	chty	Figured	fig
Chitin, chitinous	chit	Fine, finely	f
Clastic	clas	Fissile	fis
Clay, clayey	cly	Flaggy	flgy
Claystone	clyst	Flake	flk
Clean	cln	Flaky	flky
Clear	clr	Flat, flattened	flat
Cluster	cls	Floating	fltg
Coarse, coarsely	c	Fluorescence	flor
Cobble	cbl	Foliated	fol
Color, colored	col	Foraminifera	Foram
Common	com	Formation	fm
Compact	cpct	Fossil, fossiliferous	fos
Concentric	cncn	Fracture, fractured	frac

* Denoted by "◊" in Core Descriptions

TABLE IV (Continued)

Word	*Suggested Abbreviation*[a]	*Word*	*Suggested Abbreviation*[a]
Fragment, fragmental	frag	Light, lighter	lt
Fresh	frs	Lignite, lignitic	lig
Friable	fri	Limestone	ls
Frosted	fros	Limonite, limonitic	lmn
Fusulinid	Fus	Limy	lmy
Gabbro	gab	Lithic, lithology, lithographic	lith
Gastropod	Gast	Little	ltl
Glassy	gl	Long	lg
Glauconite, glauconitic	glau	Loose	lse
Gloss, glossy	glos	Lower	low
Gneiss	gns	Lumpy	lmpy
Good	g	Luster	lstr
Grade, grades, graded	grd	Magnetic	magn
Grading	grdg	Marlstone	mrlst
Grain, grained	gr	Maroon	mar
Granite	grnt	Massive	mas
Granular	gran	Material, matter	mat
Granule	grnl	Matrix	mtx
Graptolite	Grap	Maximum	max
Gravel	gvl	Median	mdn
Gray	gy	Medium	m
Graywacke	gywke	Member	mbr
Greasy	gsy	Metamorphic	meta
Green	gn	Mica, micaceous	mica
Gritty	grty	Microcrystalline	micxl
Gypsum, gypsiferous	gyp	Microfossil, microfossiliferous	micfos
Hackly	hky	Micrograined	micgr
Hard	hd	Micro-micaceous	mic-mica
Heavy	hvy	Middle	mid
Hematite, hematitic	hem	Mineral, mineralized	mnrl
Hexagonal	hex	Minimum	min
High	hi	Minor	mnr
Horizontal	hztl	Minute	mnut
Hydrocarbon	hydc	Moderate	mod
Igneous	ig	Mollusca	Mol
Imbedded	imbd	Mottled, mottling	mot
Impression	imp	Mudstone	mdst
Intrusion, intrusive	incl	Muscovite	musc
Increase, increasing	incr	Nacreous	nac
Indistinct	indst	No, non-	n.
Indurated	ind	Nodule	nod
Interbedded	intbd	Numerous	num
Intercalated	intcl	Object	obj
Intercrystalline	intxl	Ochre	och
Interfingered	intfr	Odor	od
Intergranular	intgran	Oil	o
Intergrown	intgwn	Oil sand	o. sd
Interlaminated	intlam	Oil stain	o. stn
Interstitial	intstl	Olive	olv
Interval	intv	Oölicast, oölicastic	ooc
Intraformational	intfm	Oölite, oölitic	ool
Intrusion, intrusive	intr	Oömold, oömoldic	oom
Invertebrate	invrtb	Opaque	op
Iron	Fe	Orange	orng
Ironstone	Fe-st	Organic	org
Irregular	ireg	Orthoclase	orth
Irridescent	irid	Ostracode	Ost
Jasper, jasperoid	jasp	Oxidized	ox
Jointed	jtd	Part, partly	pt
Joints	jts	Parting	ptg
Kaolin	kao	Pearl, pearly	prly
Laminated	lam	Pebble	pbl
Large, larger	lrg	Pebbly	pbly
Lavender	lav	Pelecypod	Plcy
Leached	lchd	Pellet	pel
Ledge	ldg	Permeability	perm
Lentil, lenticular	len	Petroleum, petroliferous	pet

TABLE IV (Continued)

Word	*Suggested Abbreviation*[1]	*Word*	*Suggested Abbreviation*[1]
Phosphate, phosphatic	phos	Small	s
Pink	pk	Smooth	sm
Pin-point	p-p	Soft	sft
Pisolite, pisolitic	piso	Solution	sol
Pitted	pit	Sort	srt
Plagioclase	plag	Sorted	srtd
Plant fossils	pl fos	Sorting	srtg
Plastic	plas	Speck, speckled	spec
Platy	plty	Sphalerite	sphal
Polish, polished	pol	Spherules	sph
Poor, poorly	p	Spicule, spicular	spic
Porcelaneous	porc	Splintery	splty
Porosity, porous	por	Sponge	Spg
Possible, possibility	pos	Spore	Spr
Predominate, predominantly	pred	Spot, spotted, spotty	sp
Preserved, preservation	pres	Stain, stained, staining	stn
Primary	prim	Stippled	stip
Prism, prismatic	pris	Stone	st
Probable, probably	prob	Strata, stratified, stratification	strat
Prominent, prominently	prom	Streak	str
Pseudo-	psdo	Striated	stri
Purple	purp	Stringer	strg
Pyrite, pyritized	pyr	Stromatoporoid	Strom
Pyrobitumen	pyrbit	Structure	struc
Pyroclastic	pyrclas	Stylolite	styl
Quartz	qtz	Subangular	sbang
Quartzite	qtzt	Subhedral	sbhed
Quartzitic	qtzc	Subrounded	sbrd
Quartzose	qtzs	Sucrose	suc
Radiate, radiating	rad	Sulphur	S
Range, ranging	rng	Surface	surf
Rare	rr	Tabular	tab
Regular	reg	Texture	tex
Remains, remnant	rmn	Thick	thk
Replaced, replacing, replacement	repl	Thin	thn
Residue, residual	resd	Throughout	thru
Resinous	rsns	Tight, tightly	tt
Rhomb, rhombic	rhmb	Trace	tr
Rock	rk	Translucent	trnsl
Round, rounded	rd	Transparent	trnsp
Rubbly	rbly	Trilobite	Trilo
Sample	spl	Tripoli, tripolitic	trip
Sand	sd	Tubular	tub
Sandstone	ss	Tuffaceous	tuf
Sandy	sdy	Unconformity	unconf
Saturated, saturation	sat	Unconsolidated	uncons
Scales	sc	Upper	up
Scarce	scs	Variable	var
Scattered	scat	Varicolored	vcol
Schist	sch	Variegated	vgt
Scolecodonts	Scol	Varved	vrvd
Secondary	sec	Vein	vn
Sediment, sedimentary	sed	Vertebrate	vrtb
Selenite	sel	Very	v
Shadow	shad	Vesicular	ves
Shale	sh	Vitreous	vit
Shaly	shy	Volcanics	volc
Siderite, sideritic	sid	Vug, vuggy, vugular	vug
Silica, siliceous	sil	Water	wtr
Silky	slky	Wavy	wvy
Silt	slt	Waxy	wxy
Siltstone	sltst	Weather, weathered	wthr, wthrd
Silty	slty	Well	w
Size	sz	White	wh
Slabby	slab	With	/
Slickensided	sks	Yellow	yel
Slight, slightly	sl	Zone	zn

[1]Compiled by the A. A. P. G. Committee on **Stratigraphic Correlations.**
[2]Plural of noun may be indicated **by adding "s" to abbreviation.**

(Maher, 1964)

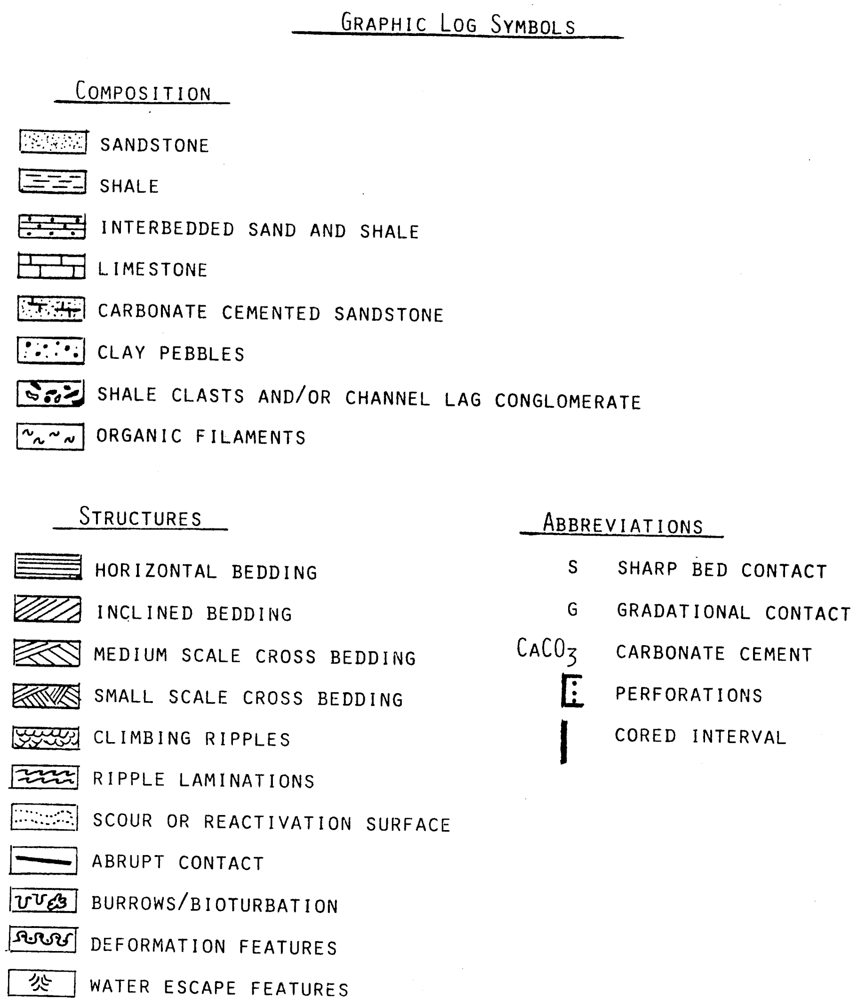


Figure 77. Graphic Log Symbols For Log-signature, General Lithology, and Sedimentary-feature Diagrams

APPENDIX B

WELL AND SAMPLE INFORMATION

HUMBLE OIL CORPORATION NO. 38-W

(545 FWL, 533 FSL) NE/4, SEC. 17, T.17N, R.12E

Humble Oil Corp. No. 38-W
(545 FWL, 533 FSL, NE/4, Sec. 17)

Cored Interval: 1436.0 - 1592.0 ft.
Correlation: Core only, log not available, (old Humble Oil Corp. core); (core broken and poorly marked)

Core Depth (Ft.)	Core Description
	Upper Glenn
1436.0 - 40.0	sh; blk, dns
40.0 - 42.0	ss/sltst; lt gy - gy, th sh ptg ◇ 41.1 ft., abrupt ctc blw
42.0 - 43.0	sltst/sh; dk gy - blk, slty, sl ripple-lam, grdg downw into blk sh, abrupt ctc blw
43.0 - 45.0	ss; brn, vf gr, carb fil, o. stn (Sample 38-26, 44.3 ft.)
45.0 - 46.7	core missing
46.7 - 47.0	sh; blk - gy, f intlam w/ vf ss, hztl bdd to ripple-lam
47.0 - 48.0	ss; brn, vf - f gr, apr mas bdg, slty, abrupt trans, w/ underlying sl calc cmt ss
48.0 - 50.1	ss; gy - lt gy, vf - f gr, sl calc cmt, patchy, apr mas bdg
50.1 - 57.0	ss; brn - lt brn, f gr, apr mas bdg, apr rd coloring?, sev apr reactivation surfs or scour surfs, carb fils, th sh (3 cm) ◇ 55.0 ft., sl incr gr sz up, (Sample 38-23, 56.0 ft.)
57.0 - 58.0	ss; dk gy - blk, vf - f gr, aph mat (dd o. stn?) filling intstl
58.0 - 61.0	intbdd/intlam ss/sh; blk - gy, slty, f lams, flaser struc, current ripples, abrupt ctc w/ ss blw ("Upper Non-Porous Zone"?)

Middle Glenn

61.0 - 62.8	ss; brn - gy, vf - f gr, apr mas bdg, carb fil, sev reactivation surfs or scour surfs, abrupt ctc blw
62.8 - 63.5	sltst; by - blk, carb mat (asph mat ?), s sid clasts, abrupt ctcs abv & blw
63.5 - 71.8	ss; lt brn - gy, vf - f gr, apr mas bdg, scat s sid pbls s rd clay galls, carb fils
71.8 - 72.3	ss/sh; lt brn - gy, blk, vf - f gr, abnt sh rip-up clasts in ss mtx, apr mas bdg
72.3 - 76.0	ss; brn, vf - f gr, abnt carb fils, apr mas bdg, abrupt ctc blw (Sample 38-18, 75.0 ft.)
76.0 - 81.5	intbd ss/sh; gy - blk, v th bdd - lam, hztl bdg, sl convolute bdg, abrupt ctc abv & blw
81.5 - 1537.0	ss; lt brn - gy, vf - f gr, apr mad bdg, scat carb fils, few scat s sid pbls, few bdd flat-elg sid clasts ◇ 91.0 ft., & 92.0 - 92.5 ft., incr carb mat ◇ 98.0 ft., decr carb ◇ 1513.0 ft., abrupt ctc w/ ss/sh blw (Sample 38-12, 1531.5 ft.)
1537.0 - 40.0	intlam ss/sh; gy - blk, ripple-lam, flaser bdg, few apr climbing ripples, abrupt ctc w/ ss blw
40.0 - 41.5	ss; lt gy - gy, vf - f gr, apr mas, abnt carb, grdg downw into chaotic zone of sh rip-up clasts
41.5 - 47.3	ss/sh; lt gy - blk, vf - f gr, abnt sh rip-up clasts, flat-elg to sub rd, th interbd sltst (3 cm) ◇ 43.6 - 44.0 ft., sl apr climbing ripples, abrupt ctc abv & blw
47.3 - 48.0	ss; lt gy, vf - f gr, apr mas, carb fil, grdg downw into chaotic zn of sh rip-up clast w/ iner carb mat
48.0 - 49.5	ss/sh; lt gy, blk, vf - f gr, abnt sh rip-up clasts & few sid clasts, incr carb mat, grdg downw into ss

Lower Glenn

49.5 - 66.0	ss; lt gy - dk gy, vf - f gr, apr mas bdg, abnt carb fils & f lam of carb mat, abrupt ctc blw (Sample 38-7, 55.0 ft.)
66.0 - 70.0	ss/sh; lt gy - blk, chaotic zn of lg (4 - 5 cm) sh rip-up clasts in ss mtx
70.0 - 71.0	ss; lt gy, f - m gr, apr mad bdg, carb fils
71.0 - 74.0	core missing
74.0 - 83.0	ss; lt brn - gy, f - m gr, apr mas bdg, abnt carb, s clay galls, s flat-elg sh clasts, sl hem stn (Sample 38-5, 79.0 ft.)
83.0 - 86.0	ss; lt gy, vf - f gr, w calc cmt, apr mas bdg, carb fils, abrupt trans abv & blw
86.0 - 88.0	congl; gy - blk - brn - rd - yellow, brk, crumbly, highly weathered apr, p strd, coaly frags, v abrupt ctc blw w/ sh (Base of Glenn)
88.0 - 88.8	sh; blk, dns, grdg downw into sh/sltst
88.8 - 91.0	sh/sltst; dk gy - blk, flaser struc, bur near base

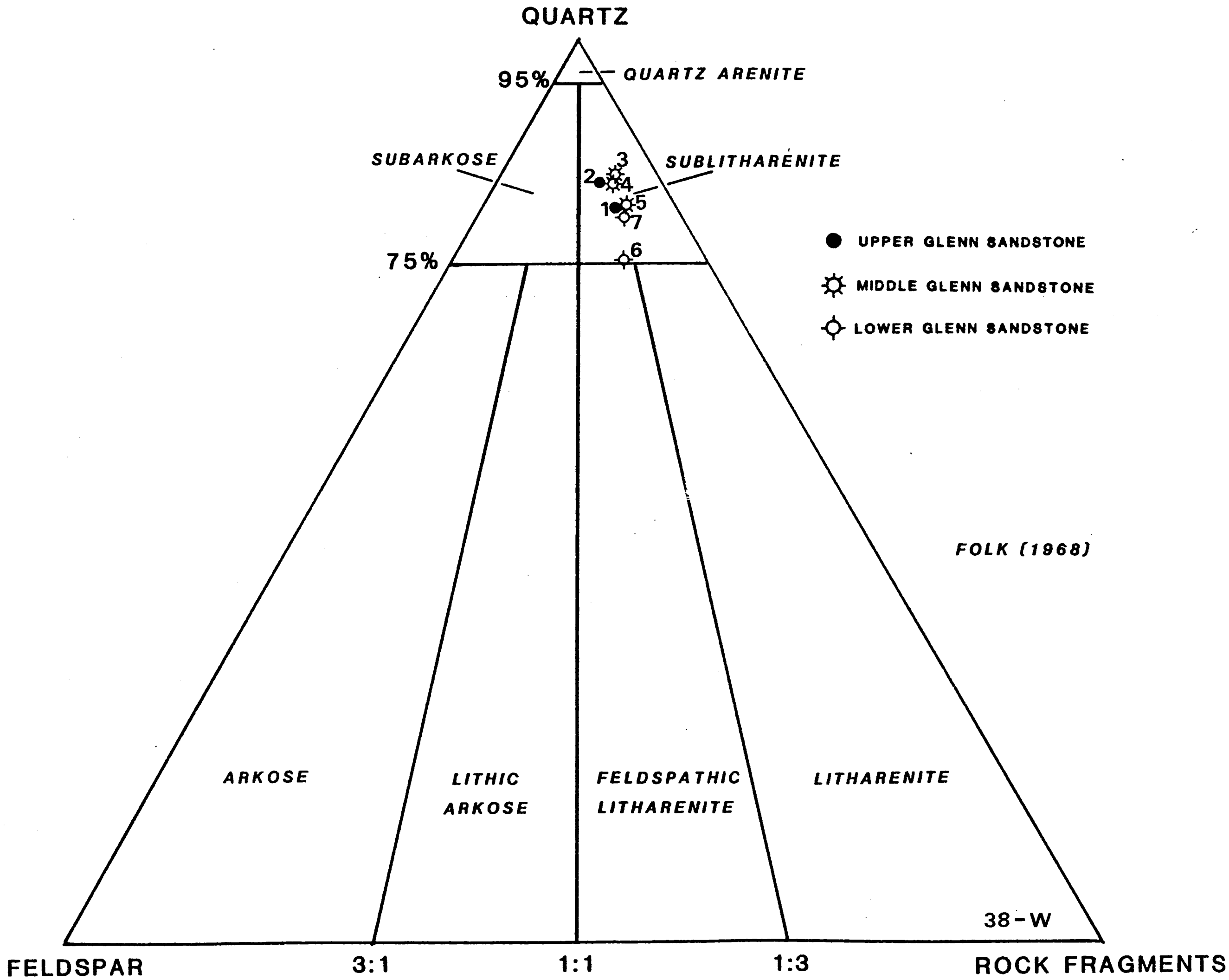


Figure 78. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, Humble Oil Corporation No. 38-W

WILLIAM BERRYHILL NO. 74-I

(1000 FWL, 1780 FSL) NE/4, SEC. 17, T.17N, R.12E

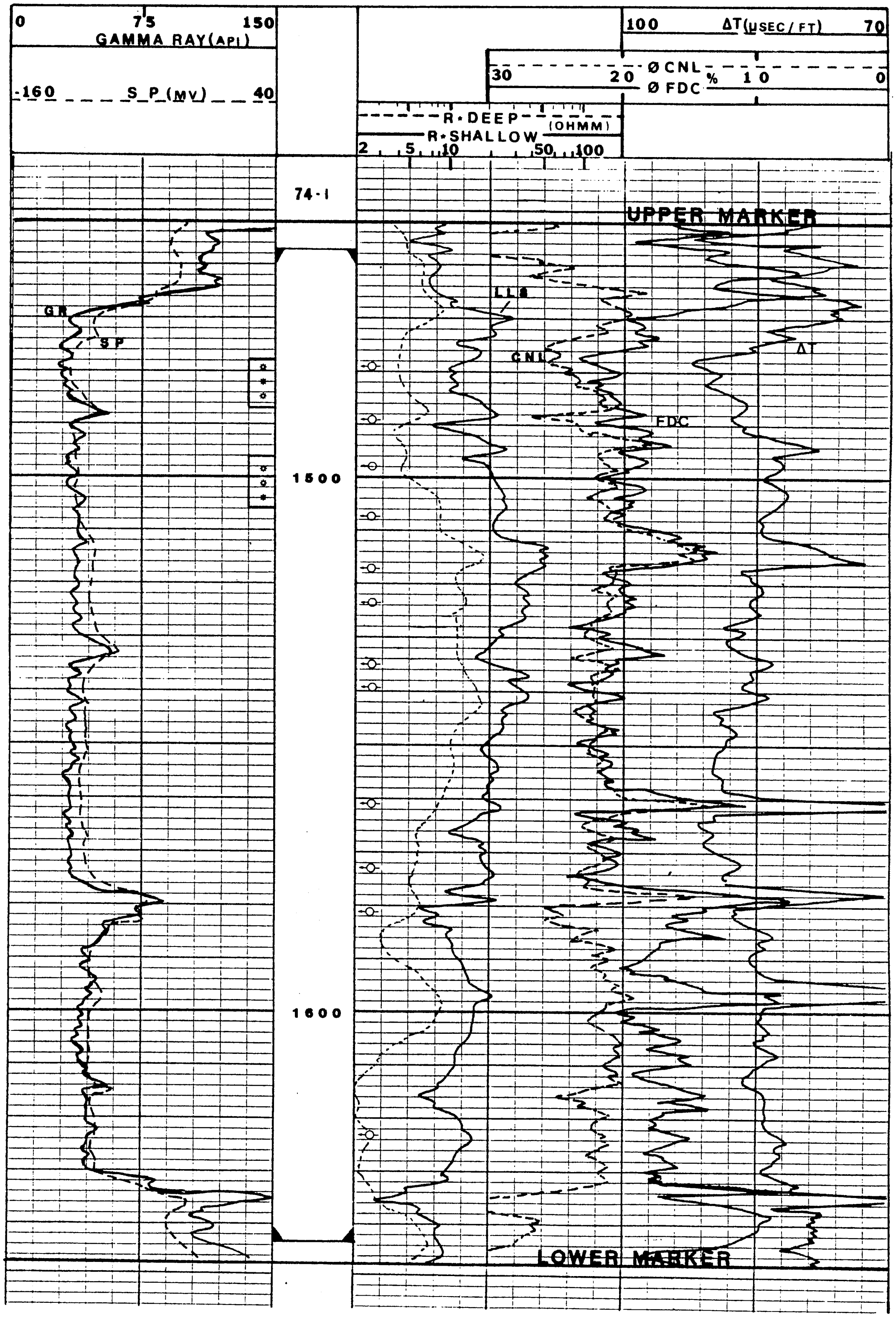


Figure 79. Well-log Signatures, Glenn Sandstone, William Berryhill No. 74-I

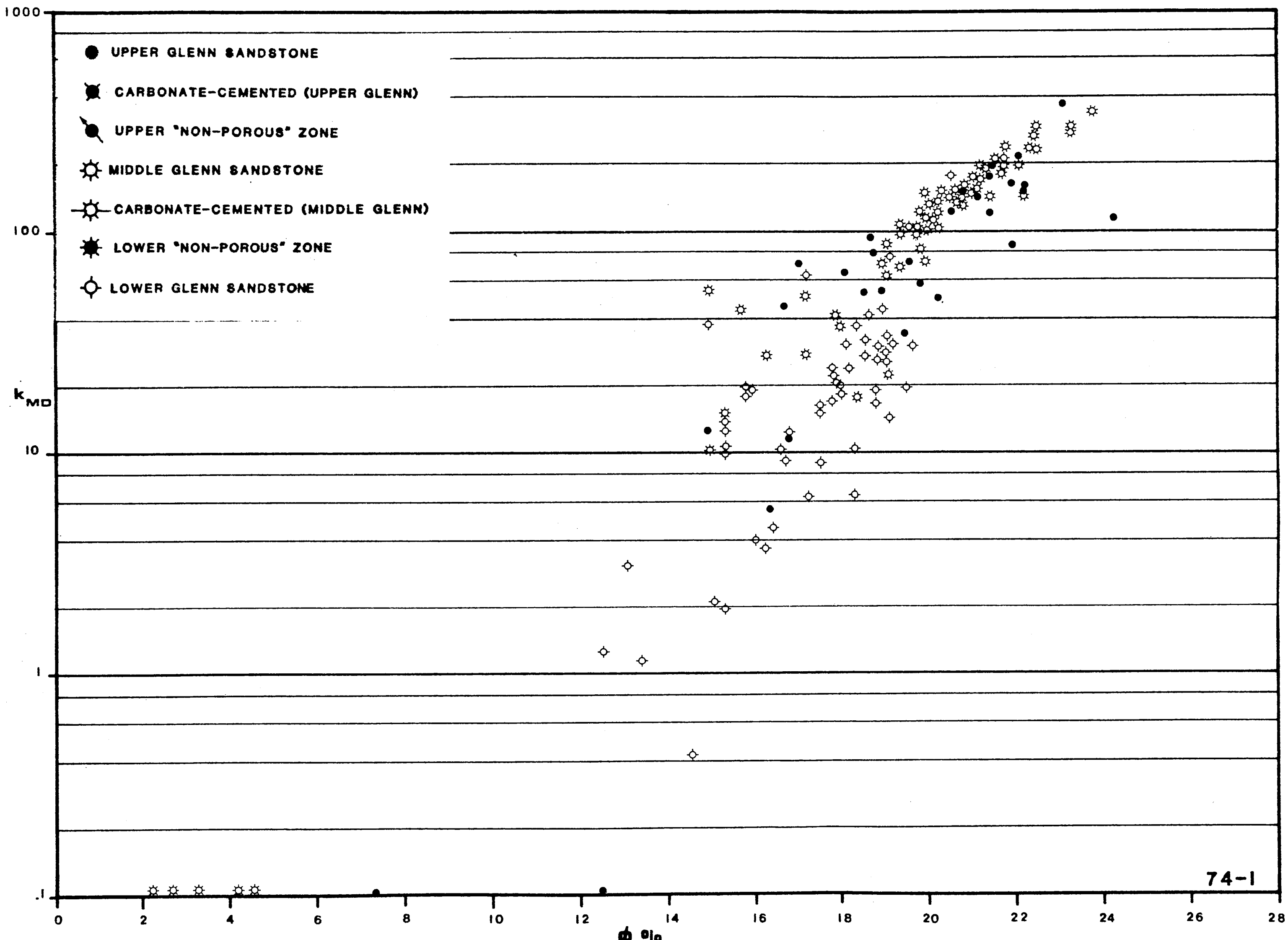


Figure 80. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 74-I

TABLE V

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 74-I
CORE ANALYSIS

Sample Number	Depth, Feet	Air Permeability, Md. Horizontal	Vertical	Porosity, Per Cent	Grain Density	Sodium Chloride PPM
1	1466-67	<0.1	<0.1	6.3	2.94	53,000
2	1467-68	0.3	0.2	9.9	2.66	92,000
3	1468-69	1.0	3.5	13.6	2.82	98,000
4	1469-70	18	12	17.5	2.71	78,000
5	1470-71	54	22	18.1	2.68	76,000
6	1471-72	43	97	20.1	2.67	65,000
7	1472-73	132	39	19.9	2.66	60,000
8	1473-74	45	66	19.9	2.66	93,000
9	1474-75	22	20	16.6	2.66	85,000
10	1475-76	144	5.9	22.6	2.69	75,000
11	1476-77	72	88	23.8	2.83	71,000
12	1477-78	41	34	19.4	2.67	76,500
13	1478-79	194	28	22.9	2.67	41,000
14	1479-80	197	108	22.5	2.67	39,000
15	1480-81	174	147	21.8	2.68	51,000
16	1481-82	223	129	19.6	2.77	54,000
17	1482-83	216	14	22.4	2.66	37,500
18	1483-84	315	140	22.7	2.64	36,000
19	1484-85	37	46	19.1	2.62	42,000
20	1485-86	122	64	21.0	2.65	50,000
21	1486-87	263	159	21.2	2.64	41,000
22	1487-88	55	32	20.6	2.65	29,000
23	1488-89	0.8	0.2	13.1	2.64	34,500
24	1489-90	273	312	21.8	2.65	26,500
25	1490-91	329	207	23.2	2.66	29,500
26	1491-92	339	315	22.7	2.66	29,000
27	1492-93	46	51	16.9	2.67	38,500
28	1493-94	157	110	19.6	2.66	36,500
29	1494-95	60	16	15.0	2.67	38,500
30	1495-96	281	296	22.8	2.66	34,000
31	1496-97	64	108	18.6	2.69	41,000
32	1497-98	69	48	19.4	2.67	31,000
33	1498-99	106	11	20.1	2.66	37,500
34	1499-00	139	80	20.4	2.66	24,500
35	1500-01	115	69	19.3	2.72	30,000
36	1501-02	141	112	20.0	2.66	30,000
37	1502-03	139	92	20.2	2.67	28,000
38	1503-04	135	0.1	20.2	2.66	47,000
39	1504-05	29	12	15.8	2.70	32,000
40	1505-06	139	69	20.3	2.68	22,500
41	1506-07	125	83	19.9	2.68	21,000
42	1507-08	171	92	21.1	2.68	13,000
43	1508-09	101	112	18.5	2.68	21,000
44	1509-10	202	161	21.4	2.67	23,500
45	1510-11	185	4.3	21.6	2.67	43,000
46	1511-12	42	5.2	16.8	2.65	31,000
47	1512-13	67	53	17.8	2.67	44,000
48	1513-14	28	15	15.8	2.65	38,000
49	1514-15	20	30	13.1	2.68	52,000
50	1515-16	32	105	16.6	2.67	39,000
51	1516-17	<0.1	<0.1	5.4	2.69	65,000
52	1517-18	98	108	19.1	2.66	47,000
53	1518-19	162	115	20.8	2.66	41,000
54	1519-20	36	25	17.6	2.65	37,500
55	1520-21	58	42	18.7	2.65	42,000
56	1521-22	37	92	17.5	2.64	30,000
57	1522-23	42	9.2	18.1	2.65	53,000
58	1523-24	82	25	19.7	2.65	43,000
59	1524-25	144	73	20.9	2.66	37,500
60	1525-26	124	71	20.1	2.65	36,000
61	1526-27	104	66	19.6	2.66	33,000
62	1527-28	83	73	19.3	2.66	27,000
63	1528-29	203	163	21.6	2.66	26,000
64	1529-30	58	3.0	21.6	2.63	30,000
65	1530-31	148	117	20.6	2.65	22,500
66	1531-32	245	175	21.8	2.66	15,000
67	1532-33	79	32	19.8	2.66	14,000
68	1533-34	17	0.2	17.5	2.66	42,000
69	1534-35	1.0	0.1	14.4	2.70	84,000
70	1535-36	30	65	18.9	2.65	56,000
71	1536-37	74	76	20.5	2.66	39,000
72	1537-38	87	83	20.1	2.66	30,000
73	1538-39	34	35	17.9	2.64	68,000
74	1539-40	149	73	20.9	2.66	45,000
75	1540-41	113	57	20.8	2.67	20,000
76	1541-42	159	133	21.2	2.67	22,000
77	1542-43	150	117	20.7	2.67	20,000
78	1543-44	157	220	21.3	2.65	18,000
79	1544-45	282	262	23.5	2.67	19,000
80	1545-46	283	246	23.4	2.66	23,500
81	1546-47	150	133	21.0	2.66	23,500

TABLE V (Continued)

Sample Number	Depth, Feet	Air Permeability, Md. Horizontal	Vertical	Porosity, Per Cent	Grain Density	Sodium Chloride PPM
82	1547-48	104	124	20.0	2.67	29,000
83	1548-49	138	97	20.9	2.67	25,000
84	1549-50	179	147	21.6	2.66	22,000
85	1550-51	175	131	21.7	2.67	16,000
86	1551-52	200	159	21.9	2.66	17,000
87	1552-53	221	142	22.1	2.66	22,500
88	1553-54	145	149	21.0	2.67	21,000
89	1554-55	127	133	20.0	2.67	22,500
90	1555-56	137	83	19.9	2.67	21,000
91	1556-57	111	64	19.9	2.67	27,000
92	1557-58	163	122	20.9	2.68	21,000
93	1558-59	154	55	20.7	2.67	19,000
94	1559-60	166	124	21.3	2.66	21,000
95	1560-61	206	168	21.6	2.66	19,000
96	1561-62	64	57	18.5	2.67	17,000
97	1562-63	131	108	20.6	2.67	11,000
98	1563-64	191	115	21.6	2.66	16,000
99	1564-65	175	115	21.0	2.66	12,000
100	1565-66	201	266	21.7	2.67	16,000
101	1566-67	346	368	24.0	2.66	15,000
102	1567-68	12	47	15.9	2.66	60,000
103	1568-69	164	46	20.8	2.66	29,000
104	1569-70	220	246	22.0	2.66	29,000
105	1570-71	216	147	21.8	2.66	13,000
106	1571-72	178	131	20.8	2.66	16,000
107	1572-73	187	129	20.9	2.67	22,500
108	1573-74	55	51	17.9	2.68	41,500
109*	1576-77					
110	1577-78	269	216	23.2	2.66	29,000
111*	1578-79					
112*	1579-80					
113	1580-81	20	4.0	13.4	2.67	46,000
114	1581-82	0.4	0.1	13.0	2.70	86,000
115	1582-83	5.0	0.1	14.8	2.71	91,000
116	1583-84	17	42	20.1	2.67	83,000
117	1584-85	1.9	1.4	13.0	2.98	132,000
118	1585-86	10	2.6	17.7	2.68	116,000
119	1586-87	5.3	<0.1	17.6	2.67	83,000
120	1587-88	25	16	20.4	2.67	66,000
121	1588-89	7.8	3.9	18.3	2.67	93,000
122	1589-90	10	5.2	18.6	2.68	103,000
123	1590-91	8.7	2.7	18.1	2.68	97,000
124	1591-92	11	4.5	17.7	2.67	93,000
125	1592-93	22	11	19.4	2.68	30,000
126	1593-94	31	16	19.5	2.68	23,500
127	1594-95	23	12	18.8	2.68	20,000
128	1595-96	30	16	18.9	2.67	22,000
129	1596-97	42	28	19.6	2.67	19,000
130	1597-98	30	16	18.8	2.67	20,000
131	1598-99	5.0	0.7	15.3	2.67	40,000
132	1599-00	25	9.2	18.8	2.67	25,000
133	1600-01	15	11	18.4	2.67	43,000
134	1601-02	9.1	3.9	16.2	2.67	37,000
135	1602-03	22	11	18.1	2.68	28,000
136	1603-04	30	21	18.9	2.68	20,000
137	1604-05	27	18	18.2	2.67	12,000
138	1605-06	11	5.4	16.3	2.67	32,000
139	1606-07	13	8.9	16.8	2.67	37,500
140	1607-08	17	9.1	17.2	2.67	57,000
141	1608-09	29	6.8	18.0	2.66	72,000
142	1609-10	25	14	18.1	2.67	54,000
143	1610-11	33	18	18.8	2.68	46,000
144	1611-12	27	34	18.3	2.70	54,000
145	1612-13	54	23	19.4	2.67	59,000
146	1613-14	37	22	18.8	2.68	70,000
147	1614-15	43	30	18.7	2.66	88,000
148	1615-16	71	48	19.8	2.66	92,000
149	1616-17	77	53	20.0	2.66	97,000
150	1617-18	23	4.3	15.6	2.82	118,000
151	1618-19	102	94	20.3	2.66	110,000
152*	1619-20					
153	1620-21	37	30	19.6	2.66	96,000
154	1621-22	29	19	19.1	2.67	100,000
155	1622-23	27	18	18.6	2.67	98,000
156	1623-24	23	13	18.4	2.67	100,000
157	1624-25	14	6.6	17.5	2.67	105,000
158	1625-26	16	8.9	17.7	2.68	100,000
159	1626-27	11	6.1	17.7	2.68	96,000
160	1627-28	24	19	18.8	2.67	97,000
161	1628-29	8.2	2.5	18.2	2.68	97,000
162	1629-30	16	18	19.1	2.67	90,000
163	1630-31	27	24	19.7	2.69	87,000
164	1631-32	14	10	18.2	2.68	102,000
165*	1632-33					
166	1633-34	29	24	19.0	2.66	90,000
167	1634-35	0.6	0.2	15.9	2.68	94,000
168	1635-36	<0.1	<0.1	10.0	2.72	56,000
169*	1636-37					

WILLIAM BERRYHILL NO. 79-P

(1310 FWL, 2440 FSL) NE/4, SEC. 17, T.17N, R.12E

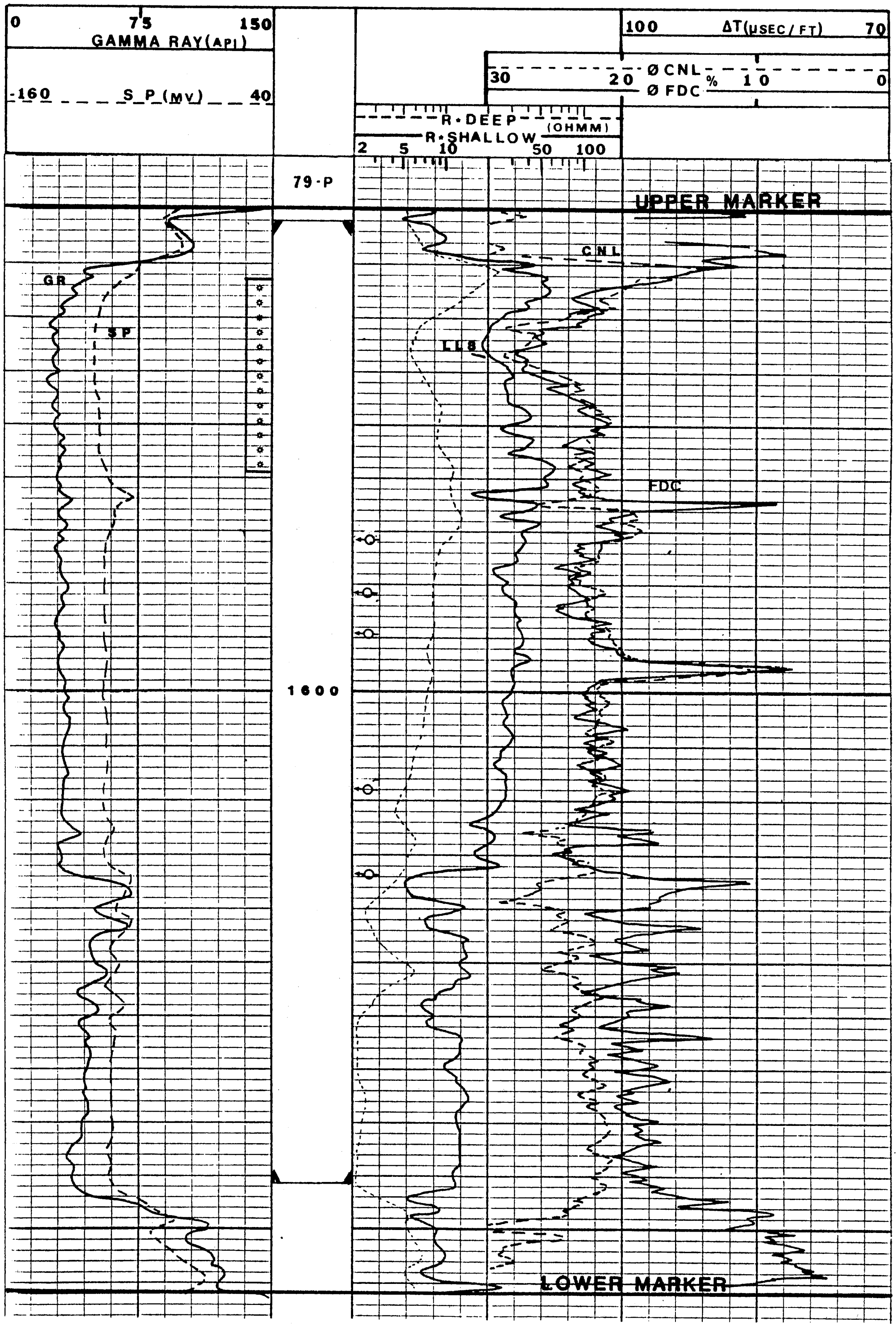


Figure 81. Well-log Signatures, Glenn Sandstone, William Berryhill No. 79-P

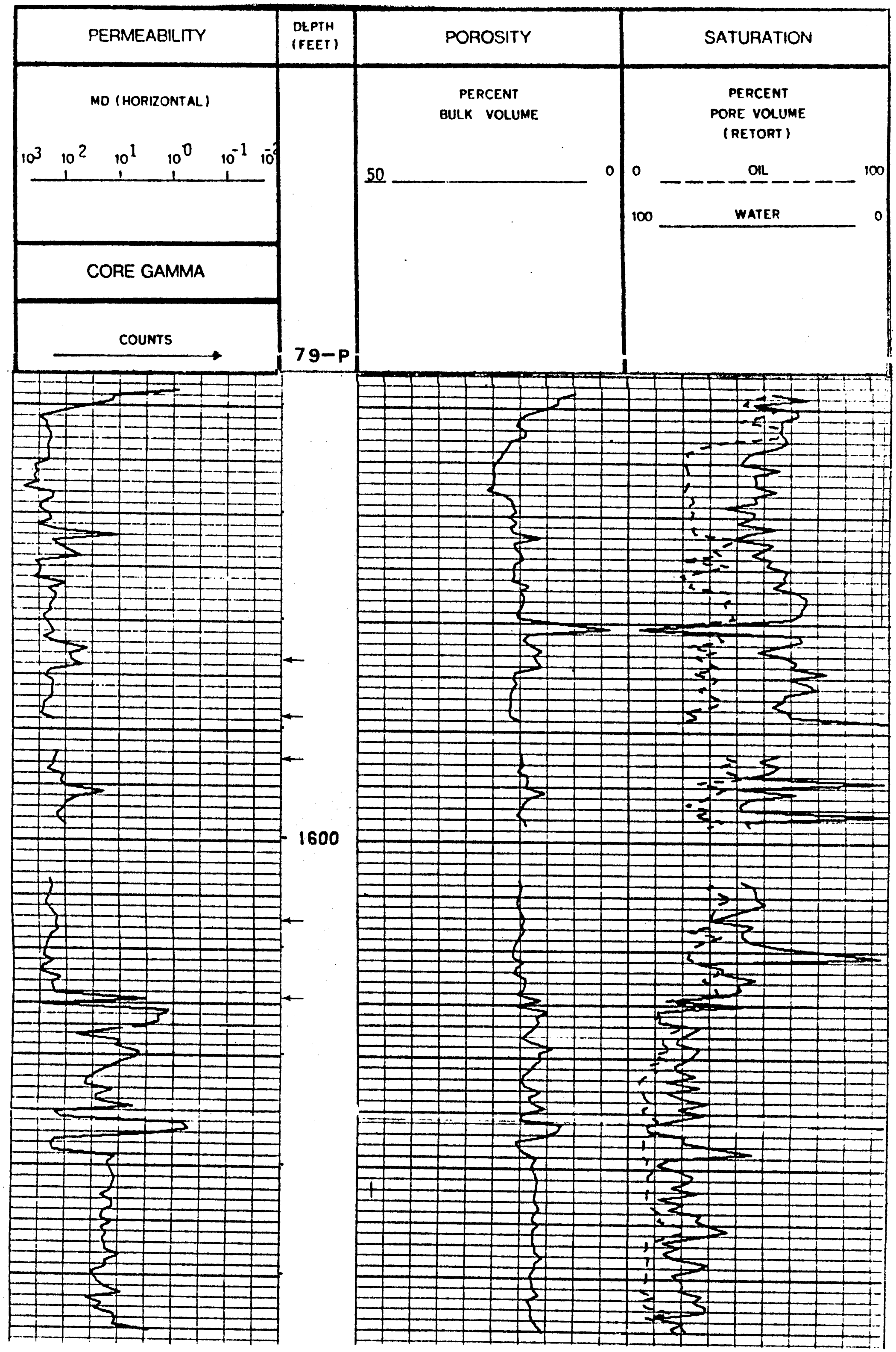


Figure 82. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 79-P

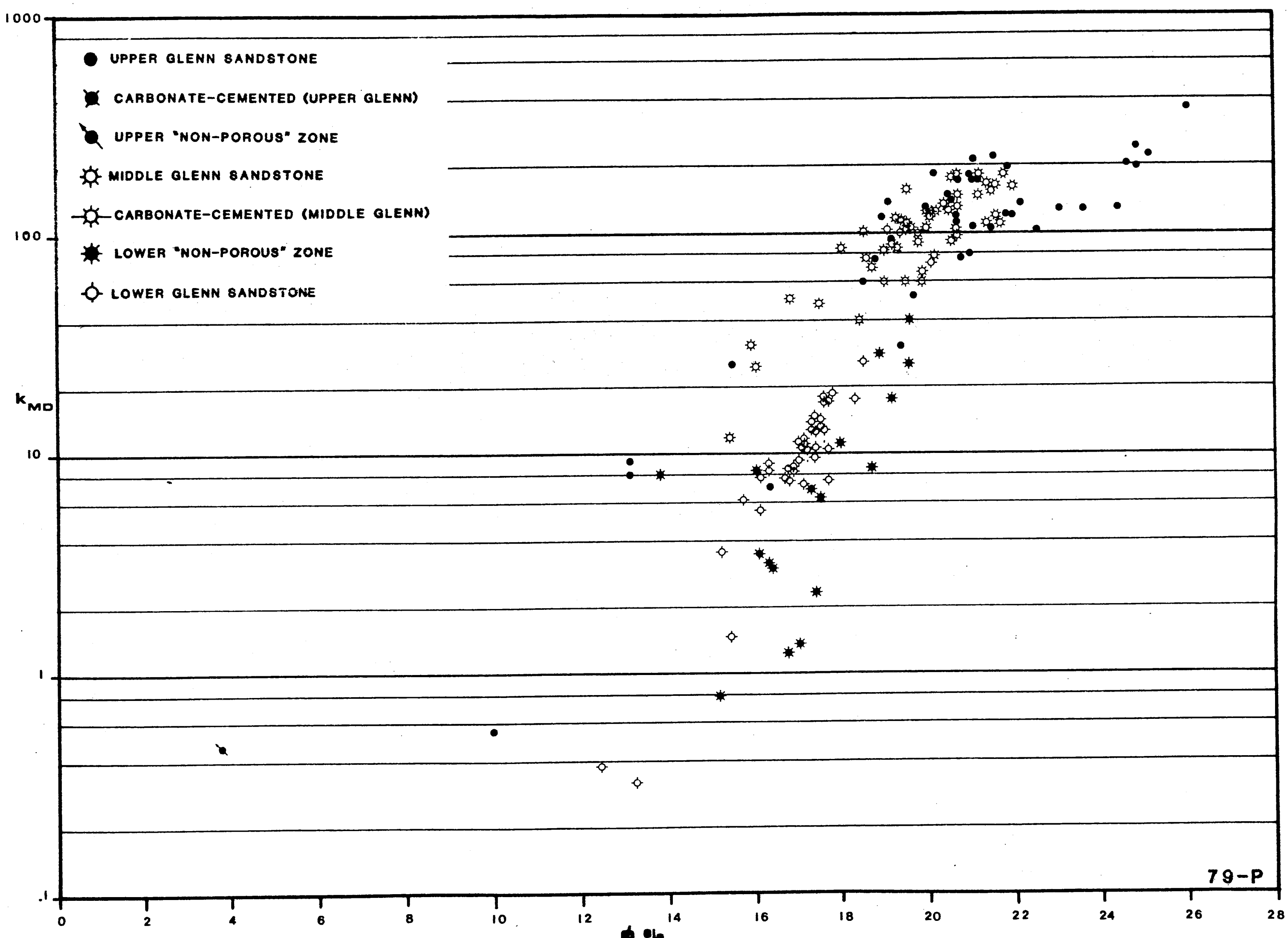


Figure 83. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 79-P

TABLE VI

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 79-P
CORE ANALYSIS

SAMPLE DEPTH	PERMEABILITY-MD. HORZNTL	HOR @SWI	VERTICAL	GRAIN DENS.	POR. %	CON. WTR-%	IMB. FLOOD GAS%	OIL%	PC	KR	RETORT % OIL	WTR.
1512.0 to 1517.0	SHALE											
1517.5	.52	.36	.27	2.66	9.8	42.9	38.5				54.0	46.0
1518.5	7.9		3.7	2.69	13.0						45.3	33.3
1519.5	9.0	8.1	2.6	2.66	13.0	39.8	31.5				42.6	53.0
1520.5	26.2	25.9	16.6	2.74	15.5	26.9	39.6				55.3	36.9
1521.5	76.5	75.4	47.1	2.71	18.8	19.0	37.8				50.1	36.6
1522.5	194.1	192.7	182.4	2.66	20.2	14.8	35.0				41.5	42.7
1523.5	146.4	145.3	113.8	2.67	20.6	16.5	34.6				55.7	42.5
1524.5	145.0	143.8	53.5	2.66	19.1	17.7	35.8				56.8	43.2
1525.5	123.0	117.4	64.5	2.67	19.0	18.6	36.6				54.8	41.4
1526.5	124.1		24.7	2.67	21.9						33.1	40.5
1527.5	140.6	135.5	64.1	2.68	22.2	32.5	27.4				25.7	45.3
1528.5	131.5		82.3	2.68	23.1						21.5	54.4
1529.5	132.0	113.9	77.6	2.67	23.7	36.7	25.7				22.6	56.3
1530.5	131.0		75.9	2.68	24.5						21.0	58.1
1531.5	241.1	215.6	91.5	2.68	25.2	34.4	26.2				22.0	43.0
1532.5	215.2	180.6	139.1	2.67	24.7	34.3	24.5				22.4	52.7
1533.5	252.8	219.2	116.3	2.70	24.9	30.1	26.2				22.2	52.1
1534.5	209.8		91.5	2.69	24.9						22.0	52.6
1535.5	389.3	344.3	219.1	2.68	26.1	27.6	25.7				20.7	44.5
1536.5	104.1	82.4	29.3	2.66	22.6	32.0	27.4				23.3	52.4
1537.5	110.0		84.7	2.66	21.5						24.1	51.2
1538.5	122.7	165.1	80.0	2.66	21.1	24.0	30.5				21.5	63.3
1539.5	184.0		83.4	2.66	20.7						24.4	52.1
1540.5	124.6	105.6	102.2	2.73	22.0	26.9	29.8				23.0	53.3
1541.5	117.8		45.6	2.66	20.7						25.2	58.3
1542.5	209.0	188.2	156.9	2.67	21.9	23.3	30.8				23.8	44.5
1543.5	82.1	70.3	34.6	2.67	21.0	29.2	30.0				24.8	54.8
1544.5	7.0	4.6	1.6	2.67	16.3	43.2	28.1				39.7	60.3
1545.5	112.1	100.7	78.7	2.66	21.1	27.1	30.4				36.3	45.1
1546.5	79.7	67.7	111.3	2.67	20.8	29.2	29.9				31.4	48.3
1547.5	54.0	48.1	46.7	2.67	19.7	30.3	30.3				34.4	53.3
1548.5	32.4	25.7	18.0	2.67	19.4	34.2	29.6				19.9	46.1
1549.5	228.1	213.6	148.7	2.67	21.1	19.4	34.4				37.0	47.8
1550.5	184.1		140.9	2.67	21.2						28.9	39.8
1551.5	191.7	172.3	140.1	2.67	21.0	23.0	31.6				19.4	41.3
1552.5	239.8	214.3	232.6	2.67	21.6	20.4	32.9				23.6	41.0
1553.5	62.6	51.5	38.3	2.67	18.5	29.2	35.0				22.5	45.3
1554.5	133.3	114.0	97.9	2.67	20.0	24.2	32.9				38.0	36.0
1555.5	98.1	86.7	83.4	2.67	19.2	25.9	32.2				38.4	32.8
1556.5	107.1	105.4	90.8	2.67	19.4	25.0	32.4				35.7	32.6
1557.5	125.6		99.3	2.66	19.8						36.2	34.2
1558.5	121.4	121.0	137.1	2.66	20.7	22.5	33.3				37.8	34.7
1559.5	164.8	155.9	108.1	2.66	20.5	23.2	32.5				39.5	38.5
1560.5	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1561.5	TR		.46	3.25	3.5						4.9	95.1
1562.5	105.2	103.4	75.0	2.66	18.5	20.1	39.0				32.8	35.8
1563.5	166.6	159.8	197.9	2.66	19.5	18.8	37.5				35.3	34.5
1564.5	87.3	80.5	40.2	2.66	18.0	23.9	38.4				22.3	42.6
1565.5	25.0	18.8	7.2	2.66	16.0	32.7	36.7				32.7	51.0
1566.5	53.2	48.6	17.5	2.66	17.5	27.4	37.7				25.3	40.5
1567.5	51.0		16.5	2.66	16.8						30.2	36.3
1568.5	32.1	25.7	.21	2.65	15.9	30.8	37.7				33.8	38.9
1569.5	129.2	124.1	135.6	2.66	20.8	22.1	35.1				24.8	25.3
1570.5	162.7	154.8	49.9	2.66	21.5	21.2	34.5				33.7	39.0
1571.5	108.8	97.4	91.5	2.66	20.7	23.8	36.3				31.6	32.0
1572.5	116.9		118.9	2.68	21.4						26.7	29.3
1573.5	113.5	75.6	82.0	2.65	21.9	27.0	36.5				30.6	40.9
1574.5	122.5	91.5	87.8	2.66	21.8	25.8	36.6				35.5	41.7
1575.5	171.0		122.0	2.69	21.8						32.1	45.6
1576.5	170.8	169.2	136.3	2.67	22.0	21.9	32.6				21.6	40.2
1577.5	190.7	190.0	34.3	2.67	21.8	21.2	33.4				27.1	38.8
1578.5	108.0		101.7	2.67	20.0						18.5	2.1
1579.0 to 1584.0	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1584.5	91.0	90.6	74.2	2.67	19.8	26.3	31.5				33.9	43.5
1585.5	105.9	104.0	85.0	2.67	19.5	24.8	32.5				40.5	50.0
1586.5	108.9		82.9	2.67	19.5						34.2	42.7
1587.5	139.9	134.8	141.5	2.67	20.4	24.1	32.0				37.2	46.2
1588.5	70.6	70.4	46.2	2.68	18.7	28.0	31.4				45.9	54.1
1589.5	79.7		56.5	2.67	18.6						26.3	3.5
1590.5	62.4	53.7	38.9	2.67	19.0	27.6	32.1				26.2	58.6
1591.5	11.8	9.9	1.6	2.68	15.4	38.4	30.0				32.4	36.3
1592.5	40.2	38.0	29.7	2.67	18.4	29.6	32.3				28.2	54.0
1593.5	61.9		68.6	2.67	19.5						21.8	57.2

TABLE VI (Continued)

SAMPLE DEPTH	PERMEABILITY-MD. HORZNTL	HOR 90	VERTICAL	GRAIN DENS.	POR. %	CON. WTR-%	IMB. FLOOD GAS%	OIL%	PC	KR	RETORT % OIL	WTR.
1594.5	68.4	65.9	61.9	2.67	19.9	27.4	31.6				30.9	57.0
1595.5	91.5	91.0	88.3	2.67	20.6	25.5	31.9				24.8	2.1
1596.5	82.0		41.0	2.66	19.2						35.4	54.9
1597.5	61.8	60.5	49.2	2.66	18.9	27.1	32.3				29.7	53.3
1598.0 to 1607.0	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1607.5	127.9	127.3	86.7	2.67	20.2	24.1	32.5				34.8	56.6
1608.5	109.9	109.4	49.7	2.67	19.6	24.5	32.9				29.3	51.6
1609.5	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1610.5	131.6		116.4	2.67	20.5						28.6	50.9
1611.5	154.2	153.4	134.9	2.66	20.7	23.1	32.2				33.2	47.6
1612.0 to 1614.0	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1614.5	91.9	91.4	74.3	2.68	19.2	27.4	31.4				30.7	67.3
1615.5	100.3	99.6	82.2	2.67	19.8	26.6	31.3				30.6	51.8
1616.5	86.9		67.6	2.67	19.3						22.9	55.5
1617.5	121.7	120.8	104.6	2.67	20.1	25.7	31.4				34.9	55.8
1618.5	137.9	136.9	137.3	2.67	20.7	24.7	31.3				28.1	52.7
1619.5	156.5	155.4	175.2	2.67	21.2	24.3	31.2				24.7	42.1
1620.5	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1621.5	175.4		195.8	2.66	21.4						22.4	4.0
1622.5	118.7	115.2	49.5	2.66	19.4	25.4	31.5				28.2	71.8
1623.5	187.5		166.3	2.66	20.7						33.2	62.7
1624.5	194.0	192.5	170.5	2.66	21.2	22.3	30.3				33.9	63.0
1625.5	85.7	85.0	34.5	2.66	19.0	27.6	31.1				27.7	50.7
1626.5	120.7		68.5	2.66	19.3						31.9	56.7
1627.5	115.5	114.6	20.5	2.64	19.5	26.1	29.5				33.2	55.7
1628.5	100.4	99.6	32.7	2.66	20.7	28.0	32.1				33.7	60.4
1629.5	2.1	1.3	NF	2.68	16.3	52.3	28.3				14.6	80.0
1630.5	183.3	180.8	.02	2.66	20.6	21.1	34.8				28.0	54.9
1631.5	.77	.29	NF	2.68	15.1	64.4	22.8				14.3	85.7
1632.5	1.3		.59	2.68	17.0						10.0	84.6
1633.5	1.2	.52	.59	2.68	16.7	57.8	26.1				14.7	85.3
1634.5	2.3	1.3	1.8	2.68	17.4	51.0	27.6				20.2	70.1
1635.5	8.5	8.2	1.4	2.68	18.7	40.8	30.8				15.5	73.7
1636.5	41.9	41.1	35.9	2.67	19.6	31.0	32.5				13.2	78.1
1637.5	6.2	5.4	.62	2.68	17.5	44.0	29.6				13.3	78.7
1638.5	8.1		.24	2.71	13.8						16.7	70.1
1639.5	2.8	2.1	.45	2.67	16.4	49.6	28.3				10.3	72.2
1640.5	3.3	2.8	.19	2.68	16.1	50.5	28.6				14.9	74.4
1641.5	6.8	5.9	2.6	2.69	17.3	41.7	30.7				7.5	79.1
1642.5	11.1	10.0	4.0	2.68	18.0	38.8	31.6				11.2	78.0
1643.5	18.5	17.3	12.5	2.68	19.2	36.5	30.4				6.7	71.3
1644.5	26.9		17.7	2.68	19.6						4.5	81.9
1645.5	29.1	28.1	14.0	2.67	18.9	33.3	31.2				4.6	69.9
1646.5	8.5	7.5	.72	2.68	16.0	43.4	27.4				5.8	81.2
1647.5	17.8		5.2	2.67	18.3						7.0	76.3
1648.5	17.4	15.9	2.3	2.67	17.7	40.6	29.3				9.2	67.1
1649.5	3.5	2.8	1.4	2.67	15.2	54.6	23.9				5.9	77.4
1650.5	102.8	102.7	35.0	2.64	19.4	27.3	31.3				6.4	68.2
1651.5	75.2	73.2	26.5	2.67	20.1	29.5	31.0				11.3	78.7
1652.5	.42	.13	.04	2.62	12.3	74.7	15.9				11.4	88.6
1653.5	.32	.08	.03	2.69	13.1	76.0	15.2				11.8	88.2
1654.5	1.9	1.1	.03	2.66	15.0	61.0	22.9				6.3	74.6
1655.5	103.3	102.6	13.8	2.66	20.7	29.2	31.2				6.1	75.2
1656.5	122.3	121.8	32.5	2.66	20.1	27.3	31.8				6.2	62.8
1657.5	107.7		2.7	2.63	19.1						4.5	49.1
1658.5	7.5	5.9	3.7	2.68	16.8	42.8	30.0				7.6	80.1
1659.5	10.4	9.7	4.2	2.68	17.7	40.4	30.8				7.3	84.5
1660.5	9.5	8.6	4.5	2.67	17.4	40.8	30.4				9.6	77.0
1661.5	8.5	7.8	2.8	2.68	16.7	42.0	29.6				7.7	71.2
1662.5	7.6	6.2	3.3	2.68	16.7	42.5	29.5				7.7	73.0
1663.5	8.7		4.5	2.68	16.9						7.7	79.6
1664.5	9.1	8.5	3.7	2.68	17.0	40.8	30.4				7.5	69.7
1665.5	14.0	13.5	8.9	2.67	17.3	37.4	32.0				7.5	84.2
1666.5	8.3		5.2	2.68	16.9						7.6	74.8
1667.5	8.5	7.5	3.0	2.68	16.3	41.6	30.1				10.2	80.5
1668.5	12.7	12.0	4.1	2.68	17.3	38.5	31.2				13.7	68.3
1669.5	14.1	13.3	8.7	2.68	17.5	38.5	31.0				11.4	70.4
1670.5	8.8	8.0	3.7	2.68	16.3	41.2	30.6				20.0	65.1
1671.5	13.4		10.2	2.68	17.5						21.4	58.3
1672.5	10.7	9.8	7.9	2.70	17.4	41.5	29.2				15.4	70.5
1673.5	12.5		5.5	2.68	17.4						7.5	82.5
1674.5	11.0	9.9	5.1	2.68	17.1	38.5	30.6				7.6	76.8
1675.5	11.0		6.1	2.68	17.1						5.3	81.7
1676.5	6.1	5.3	3.9	2.72	15.7	45.6	27.8				8.3	78.3

TABLE VI (Continued)

SAMPLE DEPTH	PERMEABILITY-MD. HORZNTL	HOR KSWI	VERTICAL	GRAIN DENS.	POR. %	CON. WTR-%	IPE. GAS%	FLOOD OIL%	FC KW	RETORT % OIL	WTR.
1077.5	11.1	8.2	5.2	2.67	17.0	38.3	31.3			7.6	65.7
1078.5	10.4	7.4	4.3	2.68	17.1	39.2	30.0			7.6	69.3
1079.5	19.0	13.8	11.3	2.68	17.8	35.4	31.5			7.2	78.5
1080.5	17.2	12.5	11.8	2.67	17.6	36.2	30.7			7.2	75.9
1081.5	14.5	10.6	8.8	2.67	17.4	36.9	30.3			5.1	74.5
1082.5	10.4	9.7	8.8	2.67	17.2	37.4	30.3			5.2	76.3
1083.5	5.5	4.4	2.4	2.68	16.1	43.0	29.0			10.4	67.2
1084.5	25.3	21.2	13.6	2.67	18.5	33.9	31.2			4.8	70.0
1085.5	12.6	11.3	8.1	2.67	17.6	38.5	29.6			7.2	65.2
1086.5	17.6	16.2	14.2	2.67	17.6	35.8	30.8			16.7	66.0
1087.5	7.5		12.2	2.67	17.7					7.3	84.7
1088.5	7.3	1.7	5.2	2.65	17.1	53.0	29.9			20.3	74.5
1089.5	7.9	1.2	1.8	2.63	16.1	57.5	26.1			20.8	79.2
1090.5	1.6	.03	1.6	2.66	15.4	69.2	26.9			23.2	76.8

WILLIAM BERRYHILL NO. 96-I

(425 FWL, 1050 FSL) NE/4, SEC. 17, T.17N, R.12E

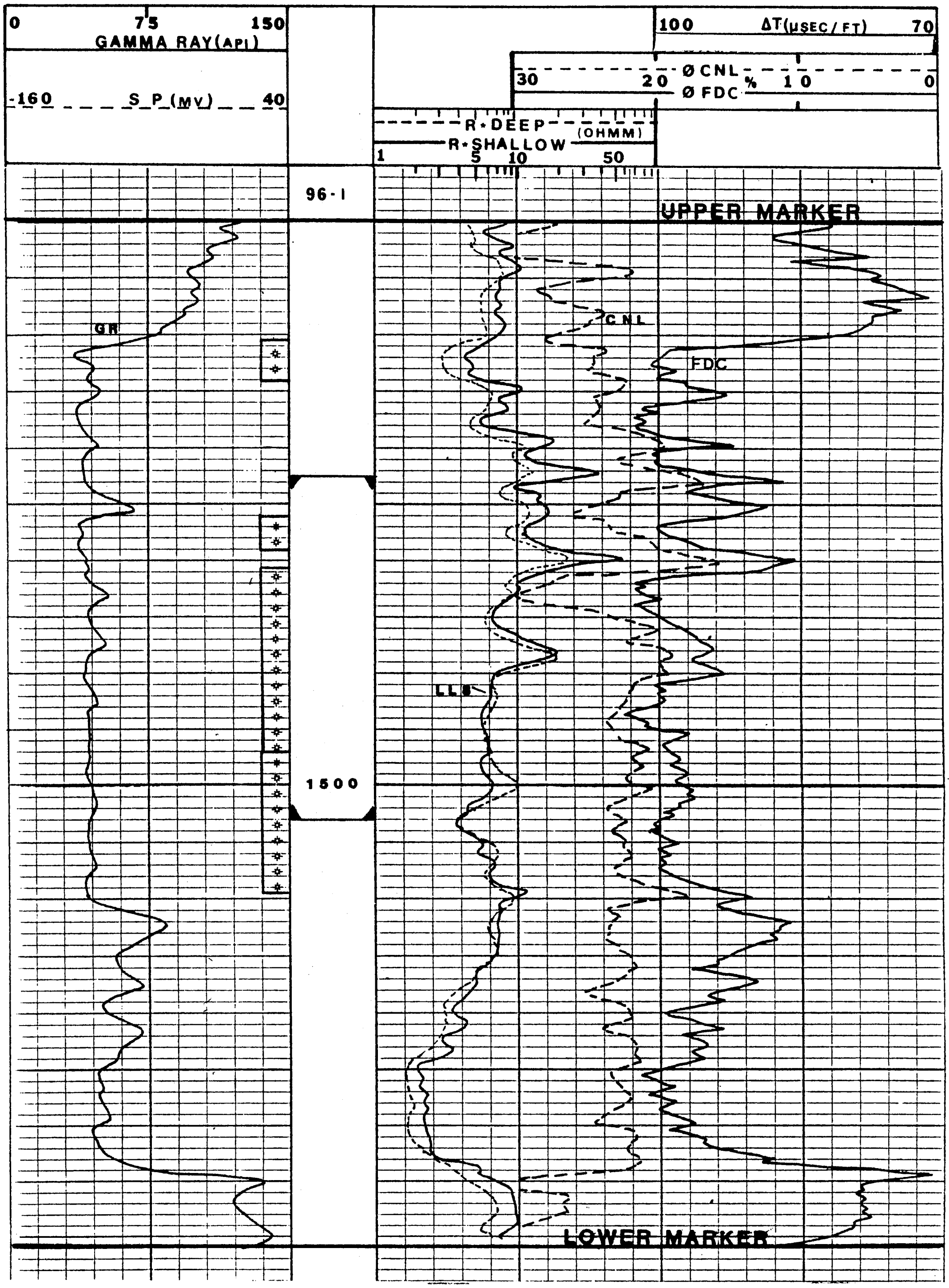


Figure 84. Well-log Signatures, Glenn Sandstone, William Berryhill No. 96-I

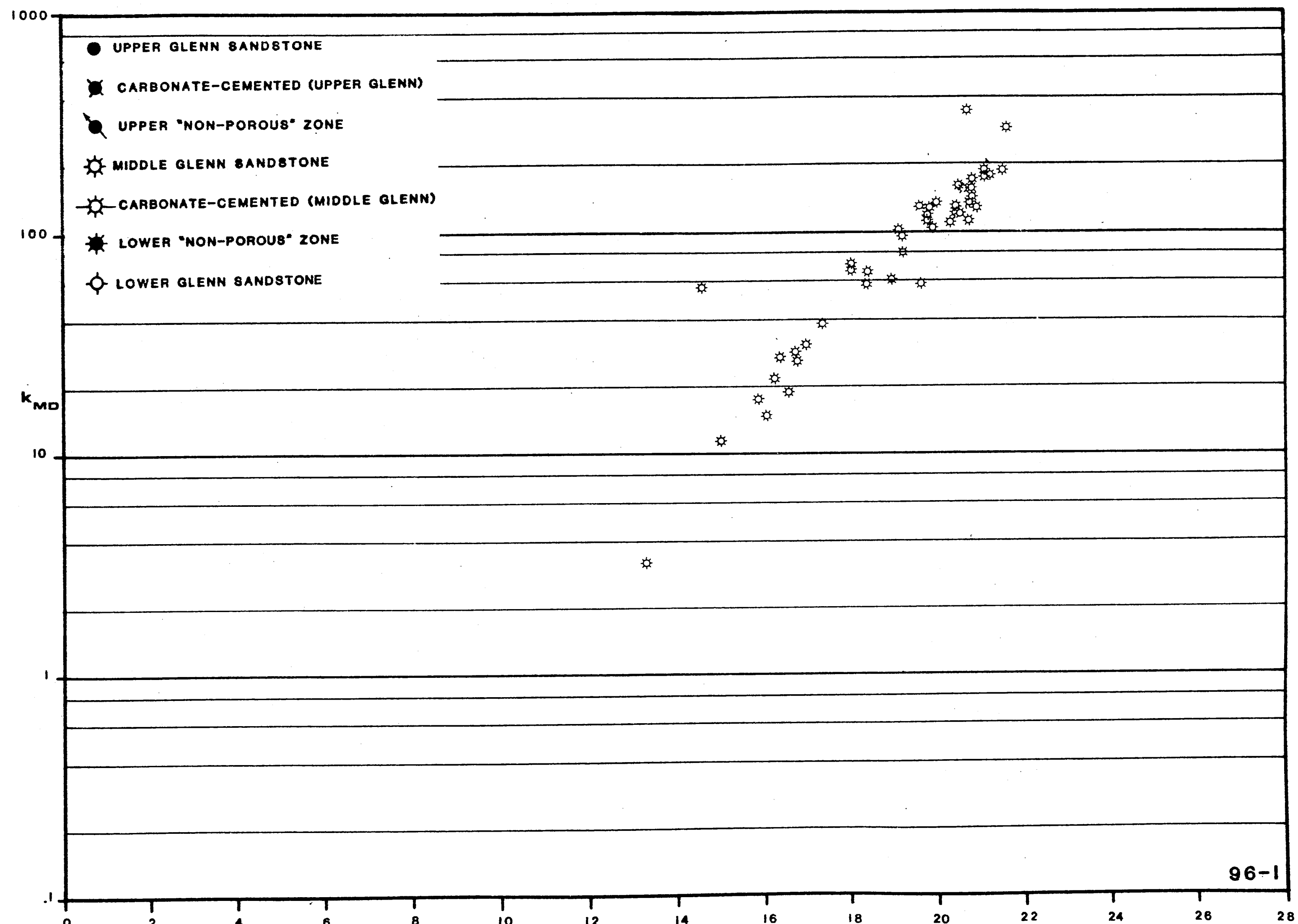


Figure 85. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 96-I

TABLE VII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 96-I
CORE ANALYSIS

SAMPLE DEPTH	PERMEABILITY-MD. HORZNTL	HOR @SWI	VERTICAL	GRAIN DENS.	POR. %	CON. WTR-%	IMB. GAS%	FLOOD OIL%	PC	KR	RETORT % OIL	WTR.
1445.5	61.4	58.0	17.0	2.69	17.1	27.3	33.4				26.0	52.3
1446.5	70.6	60.2	34.9	2.67	18.2	29.4	32.2				31.9	42.5
1447.5	51.2	48.1	3.0	2.69	18.1	28.2	32.1				32.3	41.7
1448.5	58.4	40.7	42.3	2.69	18.6	32.2	32.4				38.1	43.5
1449.5	14.6	10.1	TR	2.67	15.5	37.7	34.4				47.5	26.9
1450.5	TR		TR	2.69	2.7						14.2	85.8
1451.5	136.4	131.6	125.8	2.69	20.4	23.0	31.6				36.3	44.3
1452.5	124.5	114.4	73.8	2.68	20.5	26.4	31.4				36.0	43.9
1453.5	192.2	187.9	160.3	2.67	21.1	22.6	31.1				33.0	49.5
1454.5	194.4	187.1	190.5	2.69	21.5	22.4	30.5				35.7	55.0
1455.5	61.0	57.1	.20	2.66	18.9	25.2	36.9				39.5	36.1
1456.5	306.6	290.4	2.0	2.66	21.6	21.6	32.8				2.1	82.3
1457.5	113.0	108.2	96.6	2.68	19.8	26.8	31.9				28.9	54.3
1458.5	108.0	103.1	90.4	2.66	19.9	25.5	32.4				31.8	56.5
1459.5	164.2	155.7	119.3	2.66	20.6	22.6	34.4				26.9	50.4
1460.5	58.8	54.9	16.3	2.69	19.6	30.5	32.8				27.7	40.7
1461.5	18.6	15.4	9.4	2.64	16.5	36.1	34.0				34.8	40.2
1462.5	72.4	64.5	44.7	2.66	19.0	29.4	34.8				29.6	61.5
1463.5	32.4	28.4	18.8	2.67	16.9	33.6	34.4				30.0	53.0
1464.5	14.6	12.2	6.3	2.67	16.0	38.4	33.7				30.5	59.8
1465.5	3.2	1.6	.76	2.57	13.2	52.7	31.1				32.2	33.4
1466.5	25.7	23.0	2.3	2.65	16.3	31.7	38.9				36.3	31.2
1467.5	38.3	35.0	24.3	2.65	17.3	30.5	36.8				39.4	43.8
1468.5	68.2	62.2	9.4	2.67	18.0	29.1	35.2				31.1	58.3
1469.5	101.3	94.5	35.3	2.65	19.1	25.8	35.5				26.6	59.1
1470.5	98.0	92.6	55.1	2.67	19.2	27.1	34.8				22.4	46.2
1471.5	187.6	177.9	134.9	2.66	21.2	22.7	33.5				29.3	50.9
1472.5	133.4	128.3	115.4	2.67	20.9	24.9	33.4				33.5	58.9
1473.5	137.0	129.4	114.2	2.66	20.8	24.5	33.6				26.2	44.8
1474.5	59.0	54.6	2.2	2.66	18.3	29.0	34.2				26.5	37.0
1475.5	163.1	155.3	130.5	2.65	20.8	22.5	34.2				23.7	57.5
1476.5	140.6	133.1	142.0	2.65	20.8	23.7	33.3				25.4	48.6
1477.5	126.3	115.3	95.8	2.66	20.4	24.2	34.0				21.5	55.5
	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1468.5	26.4	24.3	15.9	2.67	16.7	33.9	31.7				22.5	55.7
1489.5	23.3	22.7	13.6	2.67	16.2	34.2	32.6				24.8	57.4
1490.5	17.4	16.3	9.6	2.68	15.8	35.2	32.6				22.2	56.1
1491.5	167.2	162.7	143.6	2.66	20.5	22.1	33.2				24.7	74.7
1492.5	185.3	176.3	142.2	2.66	21.1	22.2	32.4				26.7	73.3
1493.5	132.5	127.1	88.9	2.66	19.8	24.3	32.6				22.1	68.3
1494.5	122.5	119.2	82.2	2.66	19.8	25.2	32.6				22.4	63.4
1495.5	170.9	160.6	128.9	2.66	20.8	23.0	32.6				25.8	68.2
1496.5	113.0	110.9	97.2	2.66	20.3	26.0	32.1				18.1	61.6
1497.5	11.0	9.8	6.0	2.67	14.9	36.6	32.2				26.4	73.6
1498.5	133.9	128.5	100.4	2.65	19.6	24.3	32.3				21.5	60.9
1499.5	28.7	26.8	22.7	2.66	16.7	34.2	30.4				24.5	63.8
	NOT RECEIVED IN SHIPMENT FROM HARMARVILLE											
1501.5	84.8	81.8	53.7	2.66	19.2	33.1	33.1				21.6	57.7
1502.5	57.0		.50	2.58	14.5						25.6	74.4
1503.5	374.8	355.2	211.0	2.67	20.7	14.1	34.8				25.4	51.8
1504.5	116.6	113.3	102.4	2.66	20.7	25.4	32.4				28.2	60.7
1505.5	139.7	136.9	125.2	2.69	20.0	24.2	31.4				26.8	66.1

NF=NO FLOW TR=TRACE A=AVAILABLE

WILLIAM BERRYHILL NO. 100-O

(400 FWL, 2415 FSL) NE/4, SEC. 17, T.17N, R.12E

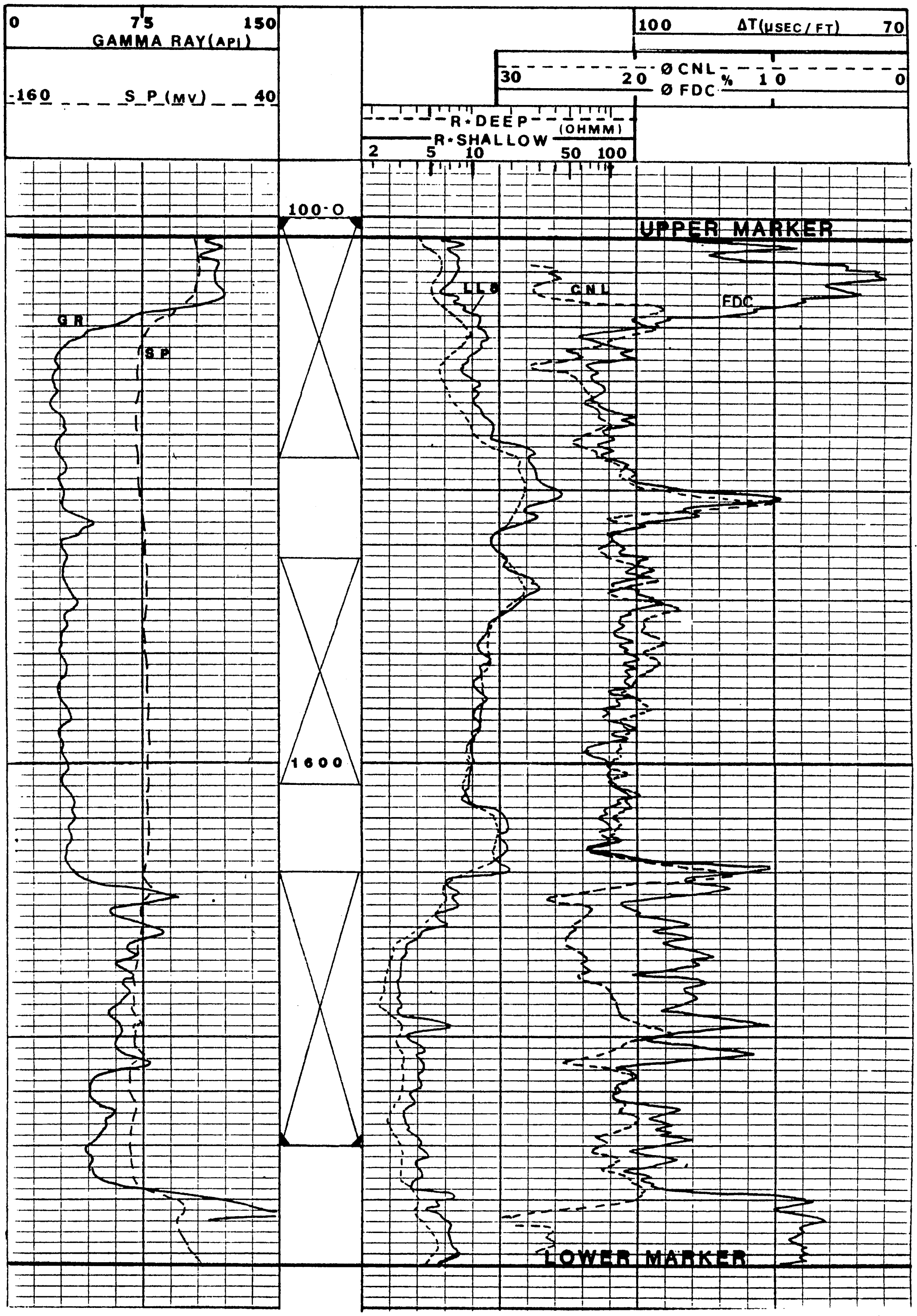


Figure 86. Well-log Signatures, Glenn Sandstone, William Berryhill No. 100-O

William Berryhill No. 100-0
(400 FWL, 2415 FSL, NE/4, Sec. 17)

Cored Interval: 1496.0 - 1670.0 ft. (Described: 1539.5 - 1561.0 ft., 1599.8 - 1615 ft.)
Correlation: Core depth estimated four feet shallow to log depth

Core Depth (Ft.)	Core Description
	Upper Glenn
1496.0 - 1539.5	core missing
1539.5 - 48.0	ss; dk gy, f - m gr, apr mas bdg to sl incld bdg, carb fils, o. stn, asph? lams ◇ 40.1 ft., 42.4 ft., & 45.0 ft., grdg downw into calc cmt ss, abrupt trans ◇ 48.1 ft.
48.0 - 50.5	ss; lt gy - gy, f gr, apr mas bdg, patchy calc cmt near top, abrupt trans ◇ 48.1 ft. into w calc cmt ss, carb fil, few scat sid pbls ◇ 48.8 ft., abrupt ctc blw
50.5 - 52.5	ss; lt gy - gy - lt brn, vf - f gr, apr mas bdg, f lam of sh, few s sid pbls, ang sh rip-up clasts (4 cm) ◇ 51.8 ft.
52.5 - 54.0	core missing
54.0 - 56.0	ss; lt gy, vf - f gr, f lams, carb fils, hztl lam near top, th sh ptg ◇ 55.0 ft., grdg downw into apr mas ss
56.0 - 60.8	ss; lt gy - dk gy, vf - f gr, apr mas bdg in part, apr incld bdg (poss m sc xbdg?), hztl bdg ◇ 59.0 - 60.8 ft.
60.8 - 99.8	core missing
	Middle Glenn
99.8 - 1601.0	ss; gy - lt gy, vf - f gr, hztl bdg, f lam of carb mat
1601.0 - 01.5	ss; as abv, except apr low ang bdg (apr m sc xbdg?)

01.5 - 15.0	ss; lt gy - gy, vf - f gr, apr mas bdg, v few carb fils, parll align sh clasts & sid pbls ◇ 10.2 ft., sl hztl bdg ◇ 11.5 ft abnt carb, coalymat ◇ 12.0 ft.
15.0 - 70.0	core missing

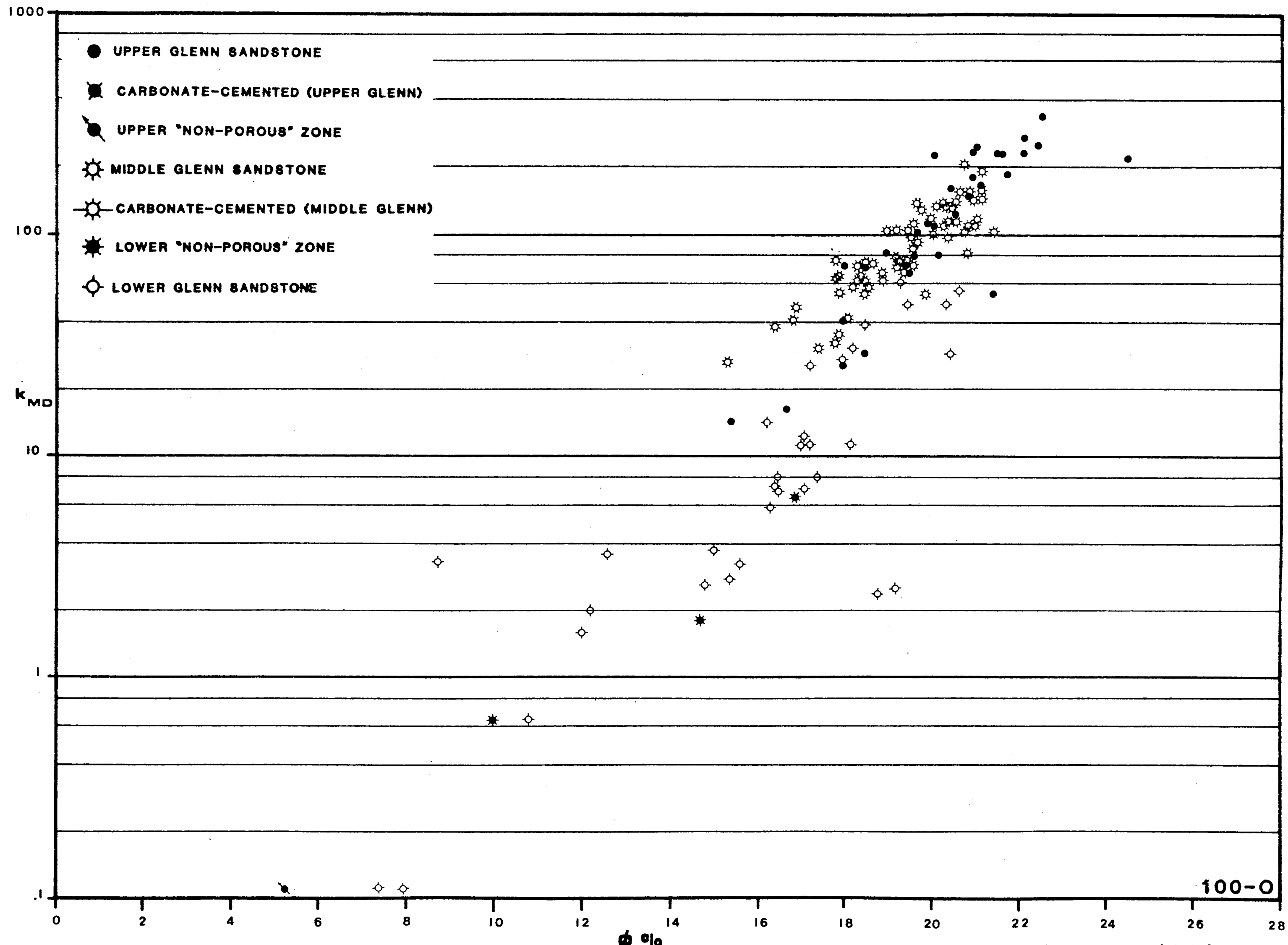


Figure 87. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 100-O

TABLE VIII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 100-0
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY* PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.*	DESCRIPTION
			CONVENTIONAL ANALYSIS				
	1496.0-12.5						SH
1	1512.5-13.0	<0.1	4.1	0.0	83.5	2.71	SD,LMY,PYR
2	1513.0-14.0	0.2	10.6	0.0	78.9	2.66	SD,SL/LMY
3	1514.0-15.0	0.1	9.3	33.0	54.2	2.65	SD,SL/LMY
4	1515.0-16.0	6.1	14.3	27.2	43.8	2.66	SD,SL/LMY
5	1516.0-17.0	14.0	15.3	28.1	44.4	2.66	SD,SL/LMY
6	1517.0-18.0	16.0	13.6	37.7	36.0	2.65	SD
7	1518.0-19.0	42.0	17.9	38.4	40.9	2.66	SD
8	1519.0-20.0	167.0	21.6	41.3	34.0	2.65	SD,SL/LMY
9	1520.0-21.0	356.0	22.5	44.1	32.6	2.65	SD,SL/LMY
10	1521.0-22.0	247.0	20.9	39.7	32.7	2.65	SD,SL/LMY
11	1522.0-23.0	244.0	20.0	36.9	32.6	2.65	SD,SL/LMY
12	1523.0-24.0	285.0	22.1	36.6	36.6	2.77	SD,SL/LMY
13	1524.0-25.0	234.0	24.5	44.3	33.7	2.86	SD,SL/LMY
14	1525.0-26.0	81.0	20.1	39.2	39.2	2.68	SD,SL/LMY
15	1526.0-27.0	187.0	20.9	36.6	40.8	2.66	SD,SL/LMY
16	1527.0-28.0	118.0	19.9	34.0	45.0	2.66	SD,SL/LMY
17	1528.0-29.0	85.0	18.9	38.6	43.2	2.66	SD,SL/LMY
18	1529.0-30.0	29.0	18.4	32.8	49.2	2.68	SD,SL/LMY
19	1530.0-31.0	168.0	20.4	37.7	45.5	2.66	SD,SL/LMY
20	1531.0-32.0	104.0	19.6	34.7	48.6	2.68	SD,SL/LMY
21	1532.0-33.0	69.0	19.4	34.7	43.6	2.67	SD,SL/LMY
22	1533.0-34.0	158.0	20.8	34.5	47.7	2.65	SD,LIG
23	1534.0-35.0	26.0	17.9	32.0	46.3	2.65	SD
24	1535.0-36.0	240.0	21.5	40.7	33.9	2.66	SD
25	1536.0-37.0	240.0	21.6	40.4	36.0	2.64	SD,LIG
26	1537.0-38.0	55.0	21.4	31.0	41.7	2.67	SD,VF
27	1538.0-39.0	198.0	21.7	30.3	42.0	2.66	SD,SL/LMY
28	1539.0-40.0	260.0	21.0	45.3	33.0	2.65	SD,LIG
29	1540.0-41.0	243.0	22.1	38.1	38.1	2.66	SD
30	1541.0-42.0	129.0	20.5	36.5	43.4	2.66	SD,LIG
31	1542.0-43.0	269.0	22.4	33.0	43.4	2.65	SD,LIG
32	1543.0-44.0	73.0	19.1	30.9	48.8	2.67	SD,LIG
33	1544.0-45.0	82.0	19.5	34.5	47.2	2.67	SD,LIG
34	1545.0-46.0	110.0	20.0	32.4	43.6	2.67	SD,SL/LMY,LIG
35	1546.0-47.0	73.0	18.4	31.0	48.3	2.67	SD,SL/LMY,LIG
36	1547.0-48.0	73.0	17.9	28.3	47.2	2.66	SD,SL/LMY,LIG,PYR
37	1548.0-49.0	<0.1	5.1	0.0	64.0	2.68	SD,LMY,LIG
38	1549.0-50.0	<0.1	5.1	0.0	67.4	2.68	SD,LMY,LIG
39	1550.0-51.0	26.0	15.2	34.6	43.3	2.66	SD,SHY,LIG,MICA,PY
40	1551.0-52.0	77.0	17.7	15.4	56.5	2.65	SD,LIG
41	1552.0-52.5	65.0	18.3	4.6	79.1	2.66	SD,SL/SHY,LIG
	1552.5-1554.0	LOST CORE					
42	1554.0-55.0	38.0	16.3	25.9	57.6	2.66	SD,LIG
43	1555.0-56.0	35.0	17.8	4.4	87.0	2.64	SD,LIG
44	1556.0-57.0	105.0	21.4	0.0	92.3	2.65	SD,LIG
45	1557.0-58.0	84.0	20.8	2.7	88.9	2.66	SD,LIG
46	1558.0-59.0	112.0	20.8	1.2	91.1	2.66	SD,LIG
47	1559.0-60.0	79.0	19.1	3.6	89.5	2.66	SD,LIG
48	1560.0-61.0	75.0	19.2	2.9	91.6	2.67	SD,LIG
49	1561.0-62.0	94.0	19.6	3.0	91.2	2.67	SD,LIG
50	1562.0-63.0	54.0	18.4	3.1	90.1	2.66	SD,LIG
51	1563.0-64.0	70.0	19.3	2.9	90.4	2.65	SD,LIG,MICA
52	1564.0-65.0	73.0	19.5	3.0	91.0	2.66	SD,LIG,MICA
53	1565.0-66.0	33.0	17.7	8.0	78.0	2.65	SD,LIG,MICA
54	1566.0-67.0	105.0	18.9	4.2	88.0	2.65	SD
55	1567.0-68.0	58.0	18.1	3.3	88.5	2.65	SD,LIG
56	1568.0-69.0	42.0	16.7	8.5	79.1	2.64	SD,LIG
57	1569.0-70.0	44.0	18.0	4.5	91.0	2.65	SD,LIG
58	1570.0-71.0	30.0	17.3	7.7	86.5	2.65	SD,LIG,MICA
59	1571.0-72.0	64.0	18.8	4.3	85.8	2.66	SD,LIG,MICA
60	1572.0-73.0	68.0	18.8	4.0	91.3	2.66	SD,LIG,MICA
61	1573.0-74.0	89.0	19.5	2.9	91.1	2.65	SD,LIG
62	1574.0-75.0	54.0	17.8	3.1	91.5	2.66	SD,LIG
63	1575.0-76.0	62.0	18.2	2.9	89.7	2.66	SD,LIG,MICA
64	1576.0-77.0	75.0	19.2	2.8	39.4	2.65	SD,LIG,MICA
65	1577.0-78.0	79.0	19.4	4.1	89.6	2.65	SD,LIG,MICA
66	1578.0-79.0	98.0	20.3	2.7	89.7	2.65	SD,LIG,MICA
67	1579.0-80.0	56.0	17.8	3.1	84.1	2.65	SD,LIG
68	1580.0-81.0	63.0	18.2	4.2	89.6	2.66	SD,LIG,MICA
69	1581.0-82.0	98.0	19.5	2.4	76.4	2.67	SD,LIG
70	1582.0-83.0	112.0	20.2	2.8	91.9	2.65	SD,LIG
71	1583.0-84.0	73.0	18.6	2.8	89.7	2.65	SD,LIG,MICA

TABLE VIII (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
72	1584.0-85.0	148.0	20.9	1.2	93.6	2.66	SD,LIG,MICA
73	1585.0-86.0	114.0	20.9	1.1	92.4	2.66	SD,LIG,MICA
74	1586.0-87.0	105.0	19.1	1.3	85.9	2.66	SD,LIG,MICA
75	1587.0-88.0	63.0	18.4	1.2	82.0	2.65	SD,LIG,MICA
76	1588.0-89.0	82.0	19.0	3.3	91.6	2.65	SD,LIG,MICA
77	1589.0-90.0	149.0	21.1	1.1	92.6	2.65	SD,LIG,MICA
78	1590.0-91.0	115.0	20.5	3.8	91.3	2.66	SD,LIG,MICA
79	1591.0-92.0	75.0	19.2	3.9	91.1	2.67	SD,LIG,MICA
80	1592.0-93.0	59.0	18.5	1.3	89.9	2.67	SD,LIG,MICA
81	1593.0-94.0	120.0	21.0	3.9	89.5	2.66	SD,LIG,MICA
82	1594.0-95.0	119.0	20.3	0.0	93.7	2.66	SD,LIG,MICA
83	1595.0-96.0	106.0	19.4	1.1	93.6	2.65	SD,LIG,MICA
84	1596.0-97.0	144.0	20.2	0.0	92.6	2.65	SD,LIG,MICA
85	1597.0-98.0	121.0	19.9	0.0	93.6	2.66	SD,LIG,MICA
86	1598.0-99.0	147.0	20.5	1.0	89.4	2.65	SD,LIG,MICA
87	1599.0-00.0	76.0	18.4	1.2	94.3	2.68	SD,LIG,MICA
88	1600.0-01.0	160.0	20.8	1.1	93.1	2.67	SD,LIG,MICA
89	1601.0-02.0	104.0	20.7	1.1	92.8	2.66	SD,LIG,MICA
90	1602.0-03.0	137.0	20.3	1.2	91.7	2.67	SD,LIG,MICA
91	1603.0-04.0	85.0	19.0	7.6	81.5	2.67	SD,LIG,MICA
92	1604.0-05.0	47.0	16.8	9.6	79.3	2.65	SD,LIG,MICA
93	1605.0-06.0	118.0	20.3	4.1	85.0	2.67	SD,LIG,MICA
94	1606.0-07.0	111.0	20.2	13.1	72.2	2.67	SD,LIG,MICA
95	1607.0-08.0	133.0	19.7	33.5	53.6	2.66	SD,LIG,MICA
96	1608.0-09.0	161.0	20.6	36.8	50.5	2.67	SD,LIG,MICA
97	1609.0-10.0	102.0	20.0	36.2	37.2	2.66	SD,LIG,MICA
98	1610.0-11.0	116.0	19.5	30.2	47.9	2.64	SD,LIG STKS,MICA
99	1611.0-12.0	64.0	17.7	32.9	46.5	2.67	SD,LIG STKS,MICA
100	1612.0-13.0	164.0	21.1	33.4	47.4	2.66	SD,LIG,MICA
101	1613.0-14.0	134.0	20.4	37.9	45.7	2.66	SD,LIG,MICA
102	1614.0-15.0	220.0	20.7	33.7	43.9	2.65	SD,LIG,MICA
103	1615.0-16.0	203.0	21.1	33.2	53.2	2.64	SD,LIG,MICA
104	1616.0-17.0	93.0	19.6	33.8	46.6	2.78	SD,SL/LMY,LIG,MICA
105	1617.0-18.0	138.0	20.1	22.5	54.4	2.67	SD,SL/LMY,LIG,MICA
106	1618.0-19.0	142.0	19.8	18.5	53.4	2.66	SD,SL/LMY,LIG,MICA
107	1619.0-20.0	6.1	16.8	14.3	73.0	2.68	SD,SL/LMY,LIG,MICA
108	1620.0-21.0	0.6	9.9	8.9	60.7	2.73	SD,SHY,LMY,LIG,MICA
109	1621.0-22.0	1.7	14.6	4.7	81.7	2.69	SD,LIG,MICA
110	1622.0-23.0	28.0	20.4	10.2	73.4	2.67	SD,LIG,MICA
111	1623.0-24.0	49.0	20.3	9.6	65.3	2.67	SD,SL/SHY,LIG,MICA
112	1624.0-25.0	56.0	20.6	8.3	74.4	2.66	SD,LIG,MICA
113	1625.0-26.0	27.0	17.9	8.1	72.0	2.67	SD,SL/SHY,LIG,MICA
114	1626.0-27.0	3.4	12.5	6.9	79.8	2.73	SD,SHY,MICA
115	1627.0-28.0	0.6	10.7	7.5	71.9	2.65	SD,SH STKS,LIG,MICA
116	1628.0-29.0	24.0	19.1	8.6	75.9	2.67	SD,LIG,MICA
117	1629.0-30.0	23.0	18.7	9.5	76.1	2.67	SD,LIG,MICA
118	1630.0-31.0	2.5	14.7	12.7	67.5	2.69	SD,SH STKS,LIG,MICA
119	1631.0-32.0	3.6	14.9	11.4	68.1	2.68	SD,SH STKS,LIG,MICA
120	1632.0-33.0	14.0	16.1	9.3	59.3	2.61	SD,LIG,MICA
121	1633.0-34.0	3.2	15.5	8.7	68.0	2.67	SD,LIG,MICA
122	1634.0-35.0	2.7	15.3	11.5	64.8	2.68	SD,LIG,MICA
123	1635.0-36.0	11.0	18.1	12.4	57.8	2.67	SD,LIG,MICA
124	1636.0-37.0	6.8	17.0	8.8	66.4	2.67	SD,LIG,MICA
125	1637.0-38.0	5.6	16.2	9.9	64.3	2.68	SD,LIG,MICA
126	1638.0-39.0	7.0	16.3	9.2	68.6	2.67	SD,LIG,MICA
127	1639.0-40.0	7.9	17.3	8.8	70.5	2.67	SD,LIG,MICA
128	1640.0-41.0	12.0	17.3	8.7	72.5	2.67	SD,LIG,MICA
129	1641.0-42.0	11.0	17.1	7.5	71.4	2.66	SD,LIG,MICA
130	1642.0-43.0	0.1	7.3	8.9	71.4	2.68	SD,LMY,LIG,MICA
131	1643.0-44.0	6.8	16.4	12.9	58.2	2.67	SD,LIG,MICA
132	1644.0-45.0	7.8	16.4	0.0	87.8	2.66	SD,LIG,MICA
133	1645.0-46.0	0.1	7.9	0.0	91.2	2.68	SD,LMY,LIG,MICA
134	1646.0-47.0	1.5	11.9	12.7	52.8	2.67	SD,LMY,LIG,MICA
135	1647.0-48.0	11.0	16.9	7.6	75.9	2.66	SD,LIG,MICA
136	1648.0-49.0	12.0	17.0	10.4	66.1	2.67	SD,LIG,MICA
137	1649.0-50.0	3.2	8.6	6.6	78.8	3.21	SD,SLTY,LIG,MICA
138	1650.0-51.0	1.9	12.1	9.1	83.3	2.69	SD,SHY,LIG,MICA
139	1651.0-52.0	62.0	19.2	8.5	56.1	2.65	SD,LIG,MICA
140	1652.0-53.0	48.0	19.4	9.6	72.5	2.65	SD,LIG,MICA
141	1653.0-54.0	30.0	18.1	11.7	62.4	2.66	SD,LIG,MICA
142	1654.0-55.0	25.0	17.2	7.6	64.5	2.66	SD,LIG,MICA
143	1655.0-56.0	39.0	18.4	9.5	74.4	2.66	SD,LIG,MICA
	1656.0-1658.0	TOO BROKEN FOR ANALYSIS					
	1658.0-1670.0	LOST CORE					

* MEASURED BY BOYLE'S LAW

WILLIAM BERRYHILL NO. 101-0

(425 FWL, 2360 FSL) NE/4, SEC. 17, T.17N, R.12E

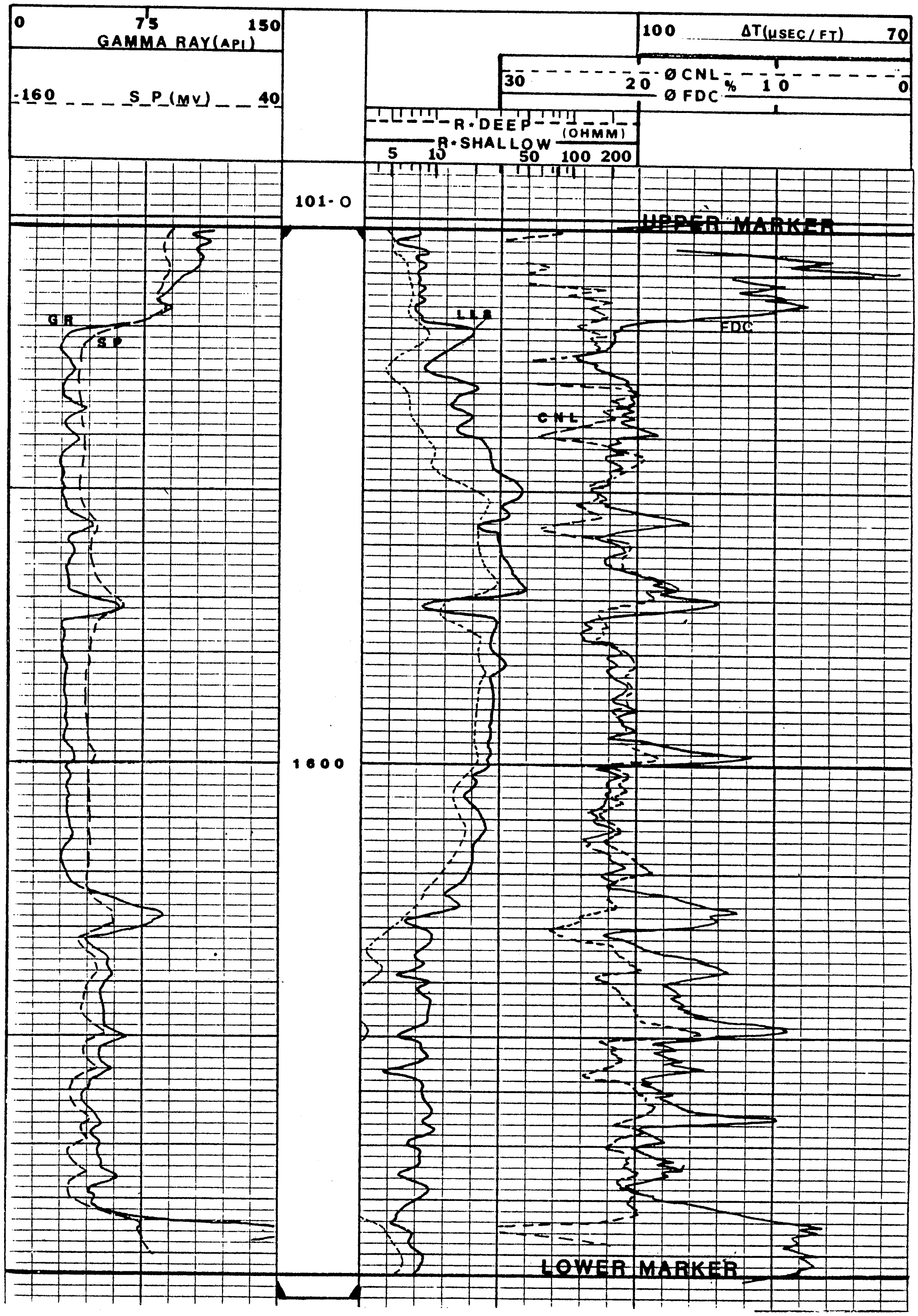


Figure 88. Well-log Signatures, Glenn Sandstone, William Berryhill No. 101-O

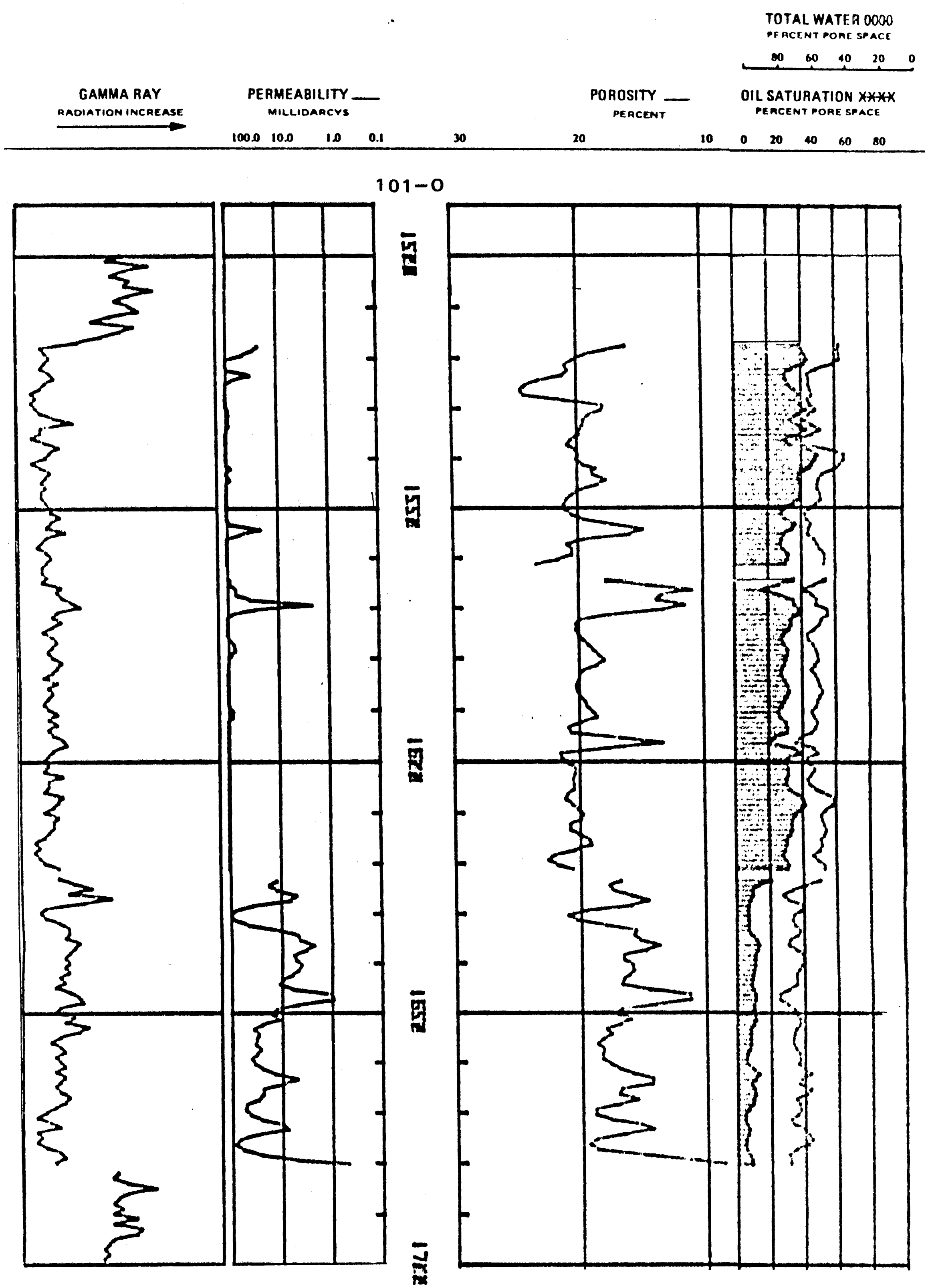


Figure 89. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 101-O

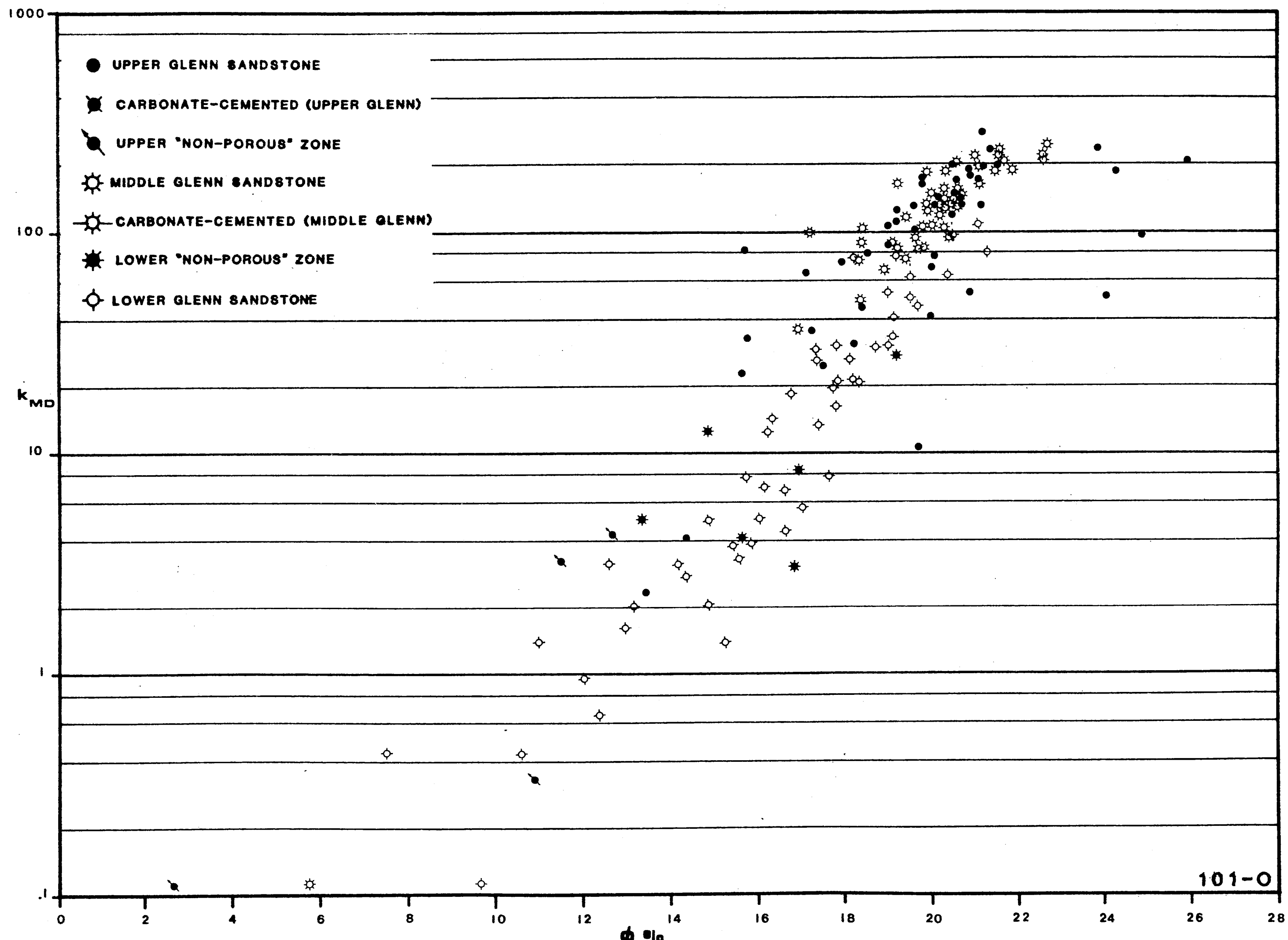


Figure 90. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 101-O

TABLE IX

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 101-0
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY* PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.*	DESCRIPTION
		CONVENTIONAL ANALYSIS					
	1500.0-10.0						SH
	1510.0-12.0						SLT
	1512.0-13.0						SH
	1513.0-14.0						SD,SL/DOL,SH LAMS
	1514.0-14.6						SH
	1514.6-15.0						SD,SH LAMS,SLTY
	1515.0-17.4						SH,SD STKS
1	1517.4-18.0	22.0	15.6	38.0	36.7	2.65	SD,SL/LMY,MICA
2	1518.0-19.0	24.0	17.5	40.6	40.6	2.65	SD,SL/LMY,MICA
3	1519.0-20.0	42.0	20.1	42.2	35.0	2.65	SD,SL/LMY,MICA
4	1520.0-21.0	69.0	20.0	42.4	39.4	2.65	SD,SL/LMY,MICA
5	1521.0-22.0	247.0	21.4	46.2	35.8	2.65	SD,SL/LMY
6	1522.0-23.0	53.0	20.9	30.1	54.5	2.75	SD,SL/LMY
7	1523.0-24.0	10.0	19.7	28.6	60.0	2.87	SD,SL/LMY
8	1524.0-25.0	51.0	24.1	32.6	52.3	2.65	SD,SL/LMY
9	1525.0-26.0	195.0	24.3	30.3	57.5	2.64	SD
10	1526.0-27.0	249.0	23.9	36.1	55.5	2.65	SD
11	1527.0-28.0	219.0	26.0	41.5	51.0	2.82	SD
12	1528.0-29.0	171.0	21.1	35.0	57.3	2.66	SD,SL/LMY
13	1529.0-30.0	81.0	15.7	35.6	59.7	2.67	SD,LMY
14	1530.0-31.0	108.0	19.0	50.3	43.3	2.66	SD,LMY
15	1531.0-32.0	46.0	18.4	35.2	59.5	2.70	SD,SL/LMY,MICA
16	1532.0-33.0	134.0	20.7	30.9	60.6	2.66	SD,SL/LMY,MICA
17	1533.0-34.0	32.0	18.2	35.2	56.6	2.65	SD,MICA,LIG
18	1534.0-35.0	134.0	21.2	48.6	41.5	2.65	SD,LIG
19	1535.0-36.0	81.0	18.5	38.4	54.8	2.66	SD,LIG
20	1536.0-37.0	203.0	21.2	28.5	64.2	2.66	SD,LIG
21	1537.0-38.0	292.0	21.2	25.8	68.1	2.65	SD,LIG
22	1538.0-39.0	102.0	19.6	53.4	34.2	2.65	SD,LIG
23	1539.0-40.0	78.0	20.1	46.5	36.2	2.65	SD,LIG,MICA
24	1540.0-41.0	168.0	19.8	51.5	31.8	2.65	SD,LIG
25	1541.0-42.0	154.0	20.6	41.8	40.6	2.65	SD,LIG,MICA
26	1542.0-42.5	35.0	17.2	48.5	36.9	2.65	SD,LIG,MICA
27	1542.5-43.0	88.0	19.0	40.2	42.4	2.65	SD,MICA
28	1543.0-44.0	145.0	20.2	37.6	49.7	2.65	SD,LIG,MICA,PYR
29	1544.0-45.0	33.0	15.7	37.1	49.4	2.65	SD,LIG,MICA
30	1545.0-46.0	113.0	19.2	40.0	51.4	2.66	SD,LIG,MICA
31	1546.0-47.0	136.0	19.6	40.0	51.4	2.66	SD,LIG,MICA
32	1547.0-48.0	175.0	20.6	37.8	48.3	2.66	SD,LIG,MICA
33	1548.0-49.0	194.0	20.9	40.5	46.3	2.66	SD,LIG,MICA
34	1549.0-50.0	247.0	21.2	34.3	52.4	2.65	SD,LIG,MICA
35	1550.0-51.0	134.0	21.2	29.7	55.4	2.66	SD,LIG,MICA
36	1551.0-52.0	208.0	20.5	25.9	59.1	2.65	SD,LIG,MICA,PYR
37	1552.0-53.0	180.0	19.8	27.5	58.2	2.69	SD,LIG,MICA,PYR
38	1553.0-54.0	74.0	17.9	41.3	52.6	2.66	SD,LIG,MICA,PYR
39	1554.0-55.0	2.2	13.4	35.4	54.0	2.78	SD,SH STKS,LIG,MICA
40	1555.0-56.0	3.8	14.3	26.0	62.4	2.74	SD,SH STKS,LIG,MI
41	1556.0-57.0	208.0	21.6	30.4	48.0	2.66	SD,LIG,MICA
42	1557.0-58.0	184.0	20.9	25.9	51.8	2.66	SD,MICA
43	1558.0-59.0	145.0	20.2	27.4	51.6	2.66	SD,LIG,MICA
44	1559.0-60.0	147.0	20.7	35.2	42.5	2.66	SD,LIG,MICA
45	1560.0-61.0	121.0	20.5	30.9	49.1	2.73	SD,LIG,MICA
46	1561.0-62.0	97.0	24.9	29.8	46.3	2.85	SD,MICA
	1562.0-1564.0	DRILLED					
47	1564.0-65.0	65.0	17.1	34.8	45.9	2.64	SD,LIG,MICA
48	1565.0-66.0	135.0	19.1	35.2	47.0	2.65	SD,LIG,MICA
49	1566.0-67.0	<0.1	2.5	0.0	70.7	2.67	SD,LMY,LIG,MICA
50	1567.0-68.0	128.0	19.2	32.0	50.3	2.64	SD,LIG,MICA
51	1568.0-69.0	4.2	12.6	41.2	44.6	2.63	SD,LIG STKS,MICA,PYR
52	1569.0-70.0	0.3	10.8	25.5	64.7	2.65	SD,SH STKS,LIG,MICA
53	1570.0-71.0	3.1	11.4	49.9	33.8	2.57	SD,SH STKS,LIG,MI
54	1571.0-72.0	107.0	19.4	34.4	48.1	2.64	SD,LIG,MICA
55	1572.0-73.0	109.0	20.0	32.6	47.8	2.65	SD,LIG,MICA
56	1573.0-74.0	97.0	20.4	34.0	50.4	2.66	SD,LIG,MICA
57	1574.0-75.0	133.0	20.2	32.9	49.9	2.64	SD,LIG,MICA
58	1575.0-76.0	130.0	20.3	28.6	61.5	2.65	SD,LIG,MICA
59	1576.0-77.0	77.0	19.4	26.6	55.3	2.66	SD,LIG,MICA
60	1577.0-78.0	86.0	19.7	28.6	53.8	2.65	SD,LIG,MICA
61	1578.0-79.0	49.0	18.3	33.7	50.5	2.68	SD,LIG,MICA
62	1579.0-80.0	90.0	19.1	30.1	51.7	2.66	SD,LIG,MICA
63	1580.0-81.0	100.0	17.2	30.4	49.5	2.59	SD,LIG,MICA
64	1581.0-82.0	90.0	18.4	30.3	50.2	2.62	SD,LIG,MICA
65	1582.0-83.0	107.0	20.3	26.5	60.8	2.66	SD,LIG,MICA

TABLE IX (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
66	1583.0-84.0	109.0	19.8	27.2	47.7	2.66	SD,LIG,MICA
67	1584.0-85.0	128.0	19.9	30.6	51.8	2.64	SD,LIG,MICA
68	1585.0-86.0	132.0	20.6	30.4	51.1	2.67	SD,LIG,MICA
69	1586.0-87.0	151.0	20.0	33.2	45.4	2.65	SD,LIG,MICA
70	1587.0-88.0	140.0	20.1	31.8	49.4	2.65	SD,LIG,MICA
71	1588.0-89.0	119.0	19.4	27.3	54.6	2.64	SD,LIG,MICA
72	1589.0-90.0	86.0	19.2	29.6	46.9	2.67	SD,LIG,MICA
73	1590.0-91.0	95.0	19.8	24.3	60.2	2.67	SD,LIG,MICA
74	1591.0-92.0	37.0	16.9	24.9	51.0	2.66	SD,LIG,MICA
75	1592.0-93.0	151.0	20.6	32.4	50.8	2.66	SD,LIG,MICA
76	1593.0-94.0	169.0	21.1	30.6	52.4	2.66	SD,LIG,MICA
77	1594.0-95.0	155.0	20.7	30.1	54.6	2.66	SD,LIG,MICA
78	1595.0-96.0	161.0	20.3	31.2	57.2	2.66	SD,LIG,MICA
79	1596.0-97.0	<0.1	5.6	0.0	78.4	2.69	SD,LMY,SHY,LIG,MICA
80	1597.0-98.0	242.0	21.6	48.7	43.5	2.63	SD,LIG,MICA
81	1598.0-99.0	230.0	21.6	40.9	48.4	2.66	SD,LIG,MICA
82	1599.0-00.0	198.0	21.5	26.1	62.8	2.64	SD,LIG,MICA
83	1600.0-01.0	202.0	21.1	32.5	55.7	2.65	SD,LIG,MICA
84	1601.0-02.0	191.0	19.8	30.2	50.7	2.61	SD,LIG,MICA
85	1602.0-03.0	214.0	20.6	33.1	53.4	2.61	SD,LIG,MICA
86	1603.0-04.0	158.0	20.6	29.5	60.9	2.65	SD,LIG,MICA
87	1604.0-05.0	147.0	20.5	30.6	52.8	2.66	SD,LIG,MICA
88	1605.0-06.0	142.0	20.3	30.1	56.7	2.66	SD,MICA
89	1606.0-07.0	233.0	21.0	39.6	41.7	2.65	SD,LIG,MICA
90	1607.0-08.0	219.0	21.7	39.0	41.0	2.65	SD,LIG,MICA
91	1608.0-09.0	191.0	20.3	43.7	39.4	2.63	SD,LIG,MICA
92	1609.0-10.0	121.0	20.2	39.1	48.4	2.66	SD,LIG,MICA
93	1610.0-11.0	137.0	19.9	34.4	49.8	2.64	SD,LIG,MICA
94	1611.0-12.0	68.0	18.9	34.8	48.0	2.64	SD,LIG,MICA
95	1612.0-13.0	195.0	21.9	31.4	48.2	2.66	SD,LIG,MICA
96	1613.0-14.0	154.0	20.6	35.3	44.9	2.66	SD,LIG,MICA
97	1614.0-15.0	147.0	20.3	32.4	46.0	2.65	SD,LIG,MICA
98	1615.0-16.0	167.0	19.2	29.3	52.2	2.61	SD,LIG,MICA
99	1616.0-17.0	75.0	18.3	30.0	47.6	2.66	SD,LIG,MICA
100	1617.0-18.0	135.0	20.5	31.2	47.3	2.66	SD,LIG,MICA
101	1618.0-19.0	263.0	22.7	24.7	59.2	2.66	SD,LIG,MICA
102	1619.0-20.0	223.0	22.6	30.5	51.2	2.68	SD,LIG,MICA
103	1620.0-21.0	235.0	22.6	32.8	44.4	2.66	SD,LIG,MICA
104	1621.0-21.5	95.0	19.6	29.2	49.0	2.72	SD,LIG,MICA
	1621.5-1623.0	LOST CORE					
105	1623.0-24.0	3.9	15.6	27.0	43.5	2.66	SD,LIG,MICA
106	1624.0-25.0	27.0	19.2	7.4	64.2	2.67	SD,LIG,MICA
107	1625.0-26.0	8.0	16.9	10.2	63.5	2.67	SD,LIG,MICA
108	1626.0-27.0	2.8	16.8	10.0	76.8	2.68	SD,LIG,MICA
109	1627.0-28.0	4.9	13.3	8.0	72.6	2.69	SD,SH STKS,LIG,MICA
110	1628.0-29.0	12.0	14.8	6.8	54.7	2.69	SD,SH STKS,LIG,MICA
111	1629.0-30.0	111.0	21.1	7.1	61.5	2.68	SD,SL/SHY,LIG,MICA
112	1630.0-31.0	82.0	21.3	6.6	69.2	2.66	SD,LIG,MICA
113	1631.0-32.0	97.0	20.5	7.8	64.7	2.65	SD,LIG,MICA
114	1632.0-33.0	33.0	19.1	7.4	70.2	2.67	SD,LIG,MICA
115	1633.0-34.0	1.9	13.1	5.8	57.2	2.69	SD,SLT STKS,LIG
116	1634.0-35.0	5.4	17.0	10.0	64.8	2.67	SD,LIG,MICA
117	1635.0-36.0	4.9	16.0	11.4	68.2	2.67	SD,LIG,MICA
118	1636.0-37.0	0.9	12.0	14.6	73.2	2.64	SD,LIG STKS,MICA
119	1637.0-38.0	1.9	14.8	12.4	63.7	2.67	SD,LIG,MICA
120	1638.0-39.0	7.8	17.6	10.1	59.2	2.68	SD,LIG,MICA
121	1639.0-40.0	4.3	16.6	11.4	61.1	2.68	SD,LIG,MICA
122	1640.0-41.0	3.7	15.8	10.5	61.3	2.67	SD,LIG STKS,MICA
123	1641.0-42.0	3.7	15.4	10.4	62.4	2.67	SD,LIG,MICA
124	1642.0-43.0	6.5	16.6	9.2	67.3	2.67	SD,LIG,MICA
125	1643.0-44.0	6.7	16.1	9.6	63.0	2.67	SD,LIG,MICA
126	1644.0-45.0	16.0	17.8	7.8	64.9	2.67	SD,LIG,MICA
127	1645.0-46.0	3.2	15.5	9.3	66.9	2.68	SD,LIG,MICA
128	1646.0-47.0	0.1	9.6	12.2	78.5	2.69	SD,LMY,LIG,MICA
129	1647.0-48.0	0.4	10.5	11.0	75.5	2.69	SD,LMY,LIG,MICA
130	1648.0-49.0	2.6	14.3	9.4	70.3	2.68	SD,SH STKS,LIG,
131	1649.0-50.0	13.0	17.4	10.3	64.2	2.67	SD,LIG STKS,MICA
132	1650.0-51.0	21.0	18.3	10.0	66.1	2.67	SD,LIG,MICA
133	1651.0-52.0	4.7	14.8	11.9	62.2	2.67	SD,LIG,MICA
134	1652.0-53.0	14.0	16.3	10.1	60.7	2.65	SD,LIG,MICA
135	1653.0-54.0	63.0	20.4	6.8	67.8	2.66	SD,LIG,MICA
136	1654.0-55.0	1.3	15.2	8.9	65.2	2.68	SD,SH STKS,LIG,MICA
137	1655.0-56.0	47.0	19.7	7.7	68.4	2.66	SD,LIG,MICA
138	1656.0-57.0	30.0	18.7	8.9	66.4	2.67	SD,LIG,MICA
139	1657.0-58.0	26.0	18.1	7.9	65.9	2.67	SD,LIG,MICA
140	1658.0-59.0	21.0	18.2	5.2	62.9	2.67	SD,LIG,MICA
141	1659.0-60.0	54.0	19.0	5.4	61.2	2.61	SD,LIG,MICA
142	1660.0-61.0	26.0	17.3	5.7	66.2	2.66	SD,LIG,MICA
143	1661.0-62.0	28.0	17.3	7.9	63.0	2.66	SD,LIG,MICA
144	1662.0-63.0	12.0	16.2	16.8	47.5	2.65	SD,LIG,MICA
145	1663.0-64.0	2.8	14.1	10.1	67.6	2.67	SD,LIG,MICA
146	1664.0-65.0	1.5	12.9	6.1	66.2	2.66	SD,LIG,MICA
147	1665.0-66.0	30.0	17.8	11.5	53.6	2.66	SD,LIG,MICA

TABLE IX (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
148	1666.0-67.0	30.0	19.0	11.3	52.5	2.66	SD,LIG,MICA
149	1667.0-68.0	3.0	12.5	8.1	78.7	2.67	SD,SH STKS,LIG,MICA
150	1668.0-69.0	77.0	18.2	10.9	51.8	2.64	SD,LIG STKS,MICA,PYR
151	1669.0-70.0	42.0	19.1	5.7	70.5	2.66	SD,LIG,MICA
152	1670.0-71.0	51.0	19.5	4.1	57.8	2.67	SD,LIG,MICA
153	1671.0-72.0	21.0	17.8	4.3	71.7	2.67	SD,LIG,MICA
154	1672.0-73.0	7.5	15.7	4.8	71.9	2.68	SD,LIG,MICA
155	1673.0-74.0	1.3	11.9	8.5	52.8	2.68	SD,LIG,MICA
156	1674.0-75.0	19.0	17.7	5.9	64.3	2.66	SD,LIG,MICA
157	1675.0-76.0	79.0	19.2	5.0	50.9	2.66	SD,LIG,MICA
158	1676.0-77.0	90.0	19.6	4.6	57.5	2.66	SD,LIG,MICA,PYR
159	1677.0-78.0	63.0	19.5	4.1	67.5	2.68	SD,LIG,MICA,PYR
160	1678.0-79.0	18.0	16.7	7.8	69.9	2.68	SD,LIG,MICA
161	1679.0-80.0	0.4	7.4	8.2	72.1	2.68	SD,LMY,LIG STKS,MICA
162	1680.0-80.5	0.6	12.3	10.3	59.9	2.65	SD,LMY,LIG,MICA,PY
	1680.5-1682.0	LOST CORE					
	1682.0-90.0						SLT,SL/SDY
	1690.0-99.0						SH
	1699.0-1702.0	LOST CORE					

WILLIAM BERRYHILL NO. 103-I

(475 FWL, 1350 FSL) NE/4, SEC. 17, T.17N, R.12E

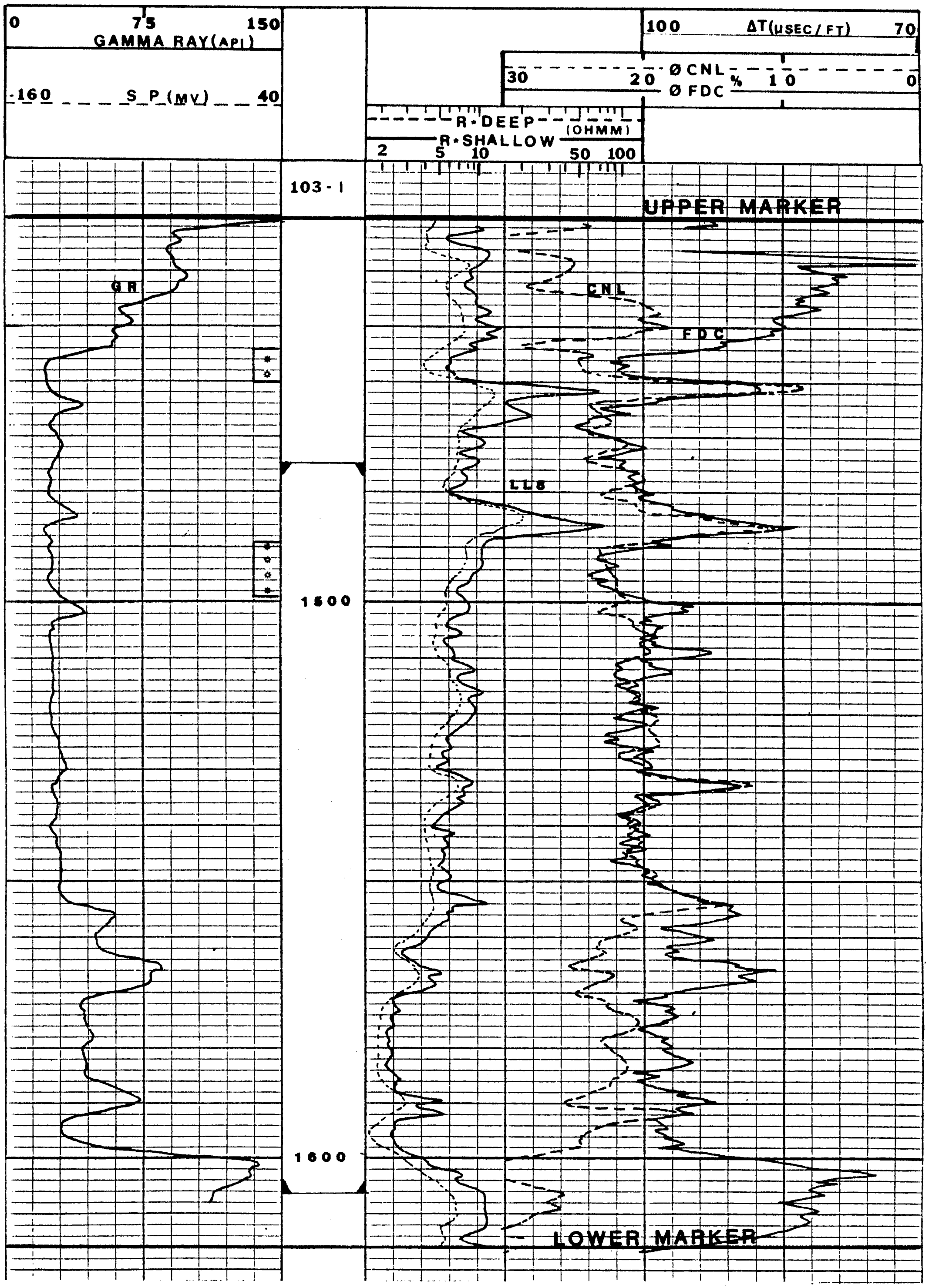


Figure 91. Well-log Signatures, Glenn Sandstone, William Berryhill No. 103-I

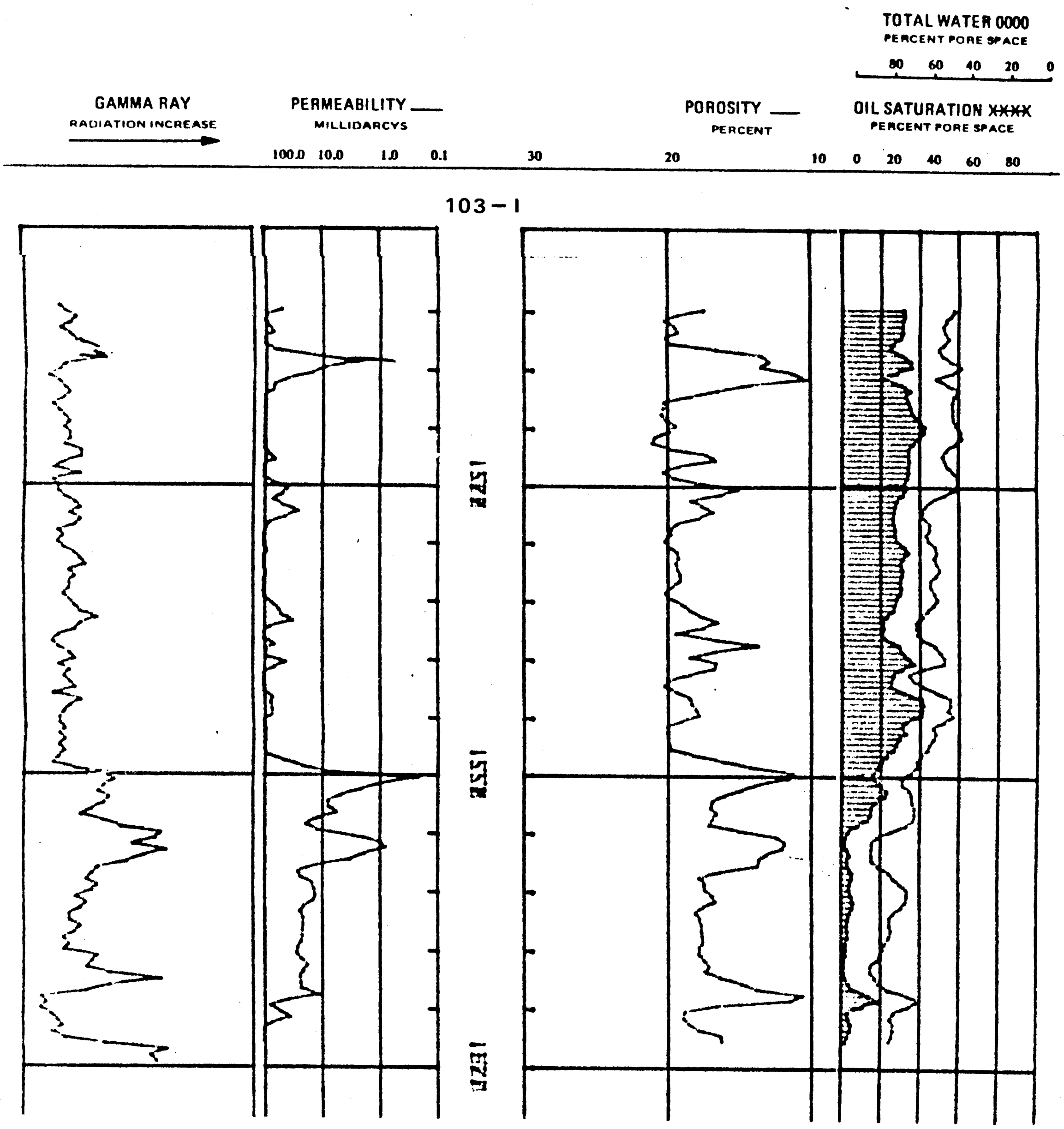


Figure 92. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 103-I

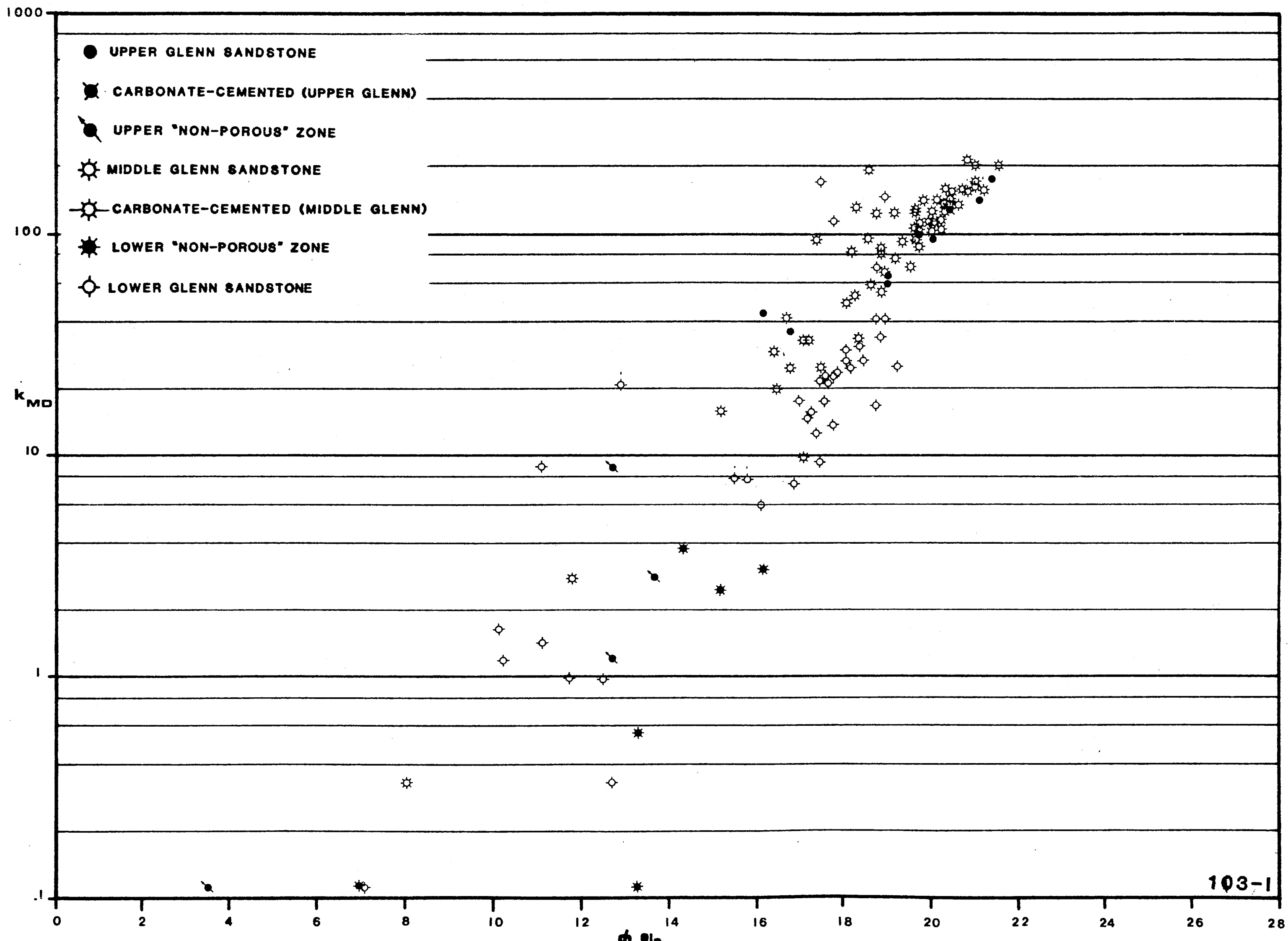


Figure 93. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 103-I

TABLE X

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 103-I
CORE ANALYSIS

DEAN STARK PLUG ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
1	1469.0-70.0	35.0	16.7	31.1	42.4	2.63	SD,LIG,MICA
2	1470.0-71.0	97.0	19.7	33.5	42.7	2.68	SD,LIG,MICA
3	1471.0-72.0	146.0	21.0	30.5	47.5	2.68	SD,LIG,MICA
4	1472.0-73.0	59.0	19.0	31.0	48.1	2.69	SD,LIG,MICA
5	1473.0-74.0	63.0	19.0	32.3	48.1	2.68	SD,LIG,MICA
6	1474.0-75.0	92.0	20.0	30.2	43.4	2.68	SD,LIG,MICA
7	1475.0-76.0	175.0	21.4	29.2	44.4	2.68	SD,MICA
8	1476.0-77.0	43.0	16.1	18.0	55.0	2.65	SD,LIG,MICA
9	1477.0-78.0	3.9	12.6	34.4	46.8	2.64	SD,LIG,MICA
10	1478.0-79.0	1.1	12.6	37.6	45.0	2.66	SD,LIG,MICA
11	1479.0-80.0	2.7	13.6	32.8	38.4	2.65	SD,LIG,MICA
12	1480.0-81.0	28.0	14.1	40.6	30.6	2.66	SD,LMY,LIG,MICA
13	1481.0-82.0	<0.1	3.3	0.0	70.6	2.69	SD,LMY,LIG
14	1482.0-83.0	129.0	20.4	45.4	35.7	2.66	SD,SL/LMY,LIG,MICA
15	1483.0-84.0	8.7	12.6	31.3	40.9	2.67	SD,LMY,LIG,MICA
16	1484.0-85.0	137.0	20.4	32.7	42.4	2.65	SD,LIG,MICA
17	1485.0-86.0	143.0	20.1	34.3	44.0	2.66	SD,LIG,MICA
18	1486.0-87.0	138.0	20.6	35.0	43.5	2.66	SD,LIG,MICA
19	1487.0-88.0	112.0	20.0	37.5	41.5	2.68	SD,LIG,MICA
20	1488.0-89.0	159.0	21.2	36.2	44.5	2.70	SD,LIG,MICA
21	1489.0-90.0	132.0	18.2	47.7	40.8	2.61	SD,LIG,MICA
22	1490.0-91.0	98.0	20.1	39.3	38.5	2.68	SD,LIG,MICA
23	1491.0-92.0	172.0	21.0	42.2	35.8	2.66	SD,LIG,MICA
24	1492.0-93.0	203.0	21.5	36.6	41.7	2.66	SD,LIG,MICA
25	1493.0-94.0	136.0	20.3	32.7	45.8	2.66	SD,LIG,MICA
26	1494.0-95.0	91.0	17.3	35.0	50.6	2.63	SD,LIG,MICA
27	1495.0-96.0	3.5	14.2	34.3	46.1	2.67	SD,SHY,LIG,MICA
28	1496.0-97.0	158.0	20.8	35.3	45.8	2.65	SD,LIG,MICA
29	1497.0-98.0	205.0	21.0	31.8	44.9	2.67	SD,LIG,MICA
30	1498.0-99.0	58.0	18.6	38.2	35.8	2.68	SD,LIG,MICA
31	1499.0-00.0	106.0	20.2	26.3	44.2	2.67	SD,SL/LMY,LIG,MICA
32	1500.0-01.0	2.6	11.7	37.8	37.5	2.69	SD,LMY,LIG,MICA
33	1501.0-02.0	40.0	16.6	29.4	47.7	2.67	SD,LIG,MICA
34	1502.0-03.0	100.0	20.0	28.7	55.4	2.67	SD,LIG,MICA
35	1503.0-04.0	33.0	17.0	26.5	57.4	2.69	SD,LIG,MICA
36	1504.0-05.0	19.0	16.4	27.5	58.6	2.69	SD,LIG,MICA
37	1505.0-06.0	24.0	17.4	25.2	60.7	2.69	SD,LIG,MICA
38	1506.0-07.0	101.0	20.0	27.1	52.1	2.66	SD,LIG,MICA
39	1507.0-08.0	90.0	20.0	27.2	54.9	2.68	SD,LIG,MICA
40	1508.0-09.0	77.0	19.1	29.1	57.9	2.67	SD,LIG,MICA
41	1509.0-10.0	162.0	21.0	24.5	56.6	2.67	SD,LIG,MICA
42	1510.0-11.0	87.0	19.7	35.2	51.2	2.67	SD,SL/LMY,LIG,MICA
43	1511.0-12.0	70.0	19.5	34.5	49.0	2.66	SD,LIG STKS,MICA
44	1512.0-13.0	121.0	18.7	32.3	55.9	2.62	SD,LIG,MICA
45	1513.0-14.0	140.0	20.1	27.4	50.7	2.66	SD,LIG,MICA
46	1514.0-15.0	82.0	18.8	33.2	49.4	2.67	SD,LIG,MICA
47	1515.0-16.0	95.0	19.6	31.2	49.1	2.66	SD,LIG,MICA
48	1516.0-17.0	95.0	18.5	28.0	59.2	2.63	SD,LIG,MICA
49	1517.0-18.0	127.0	20.0	32.8	51.0	2.67	SD,LIG,MICA
50	1518.0-19.0	116.0	20.2	28.9	57.0	2.68	SD,LIG,MICA
51	1519.0-20.0	127.0	20.3	29.1	45.8	2.67	SD,LIG,MICA
52	1520.0-21.0	53.0	18.8	25.2	55.0	2.67	SD,LIG,MICA
53	1521.0-22.0	48.0	18.0	28.8	56.3	2.68	SD,LMY,SHY,LIG,MICA
54	1522.0-23.0	67.0	18.9	22.1	56.6	2.67	SD,LMY,SHY,LIG,MICA
55	1523.0-24.0	9.2	15.0	20.0	65.3	2.69	SD,SH INCL,LIG,MICA
56	1524.0-25.0	33.0	17.1	22.8	60.9	2.68	SD,LIG,MICA
57	1525.0-26.0	229.0	20.8	20.8	60.9	2.66	SD,SL/LMY,LIG,MICA
58	1526.0-27.0	125.0	19.1	18.8	62.3	2.66	SD,LMY,LIG,MICA
59	1527.0-28.0	0.3	7.9	34.0	48.7	2.67	SD,LMY,LIG,MICA
60	1528.0-29.0	130.0	19.6	30.7	50.0	2.67	SD,LMY,LIG,MICA
61	1529.0-30.0	106.0	19.6	27.8	50.6	2.67	SD,SL/LMY,LIG,MICA
62	1530.0-31.0	15.0	15.1	49.4	38.3	2.75	SD,LMY,LIG,MICA
63	1531.0-32.0	24.0	16.7	21.1	64.4	2.66	SD,LIG,MICA
64	1532.0-33.0	196.0	18.5	31.0	66.2	2.57	SD,LIG,MICA
65	1533.0-34.0	163.0	20.3	22.7	66.4	2.66	SD,LIG,MICA
66	1534.0-35.0	159.0	20.7	24.8	54.2	2.66	SD,LIG,MICA
67	1535.0-36.0	92.0	19.3	27.1	56.9	2.69	SD,LMY,LIG,MICA
68	1536.0-37.0	52.0	18.2	47.9	37.5	2.65	SD,LIG,MICA
69	1537.0-38.0	81.0	18.1	41.0	45.3	2.66	SD,LIG,MICA
70	1538.0-39.0	86.0	18.8	36.9	50.4	2.68	SD,SL/LMY,LIG,MICA
71	1539.0-40.0	28.0	16.3	48.4	37.2	2.82	SD,LMY,LIG,MICA
72	1540.0-41.0	143.0	19.8	28.0	47.7	2.66	SD,LIG,MICA
73	1541.0-42.0	155.0	20.4	27.1	59.6	2.67	SD,LIG,MICA
74	1542.0-43.0	128.0	19.6	40.3	47.0	2.68	SD,LIG,MICA
75	1543.0-44.0	153.0	20.4	23.9	54.8	2.67	SD,LIG,MICA
76	1544.0-45.0	105.0	19.7	30.8	55.7	2.67	SD,SL/LMY,LIG,MICA
77	1545.0-46.0	114.0	19.9	25.5	55.2	2.67	SD,SL/LMY,LIG,MICA

TABLE X (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
78	1546.0-47.0	112.0	19.7	23.9	59.9	2.67	SD,SL/LMY,LIG,MICA
79	1547.0-48.0	19.0	13.4	18.8	62.6	2.67	SD,LMY,LIG,MICA
80	1548.0-49.0	33.0	18.3	20.7	61.4	2.65	SD,LMY,LIG STKS,MICA
81	1549.0-50.0	0.1	6.8	13.4	63.2	2.68	SD,LMY,SHY,LIG,MICA
82	1550.0-51.0	0.1	13.2	18.6	70.7	2.69	SD,LIG,MICA
83	1551.0-52.0	0.5	13.2	14.8	72.2	2.67	SD,LIG STKS,MICA
84	1552.0-53.0	2.3	15.1	27.8	61.7	2.65	SD,LIG STKS,MICA
85	1553.0-54.0	2.8	16.1	22.3	65.4	2.66	SD,LIG,MICA
86	1554.0-55.0	9.3	17.1	16.0	63.5	2.66	SD,LIG,MICA
87	1555.0-56.0	8.8	17.4	14.8	62.4	2.66	SD,SH INCL,LIG,MICA
88	1556.0-57.0	2.8	16.3	14.5	62.2	2.66	SD,LIG,MICA
89	1557.0-58.0	7.0	16.6	15.7	63.0	2.67	SD,SHY,LIG,MICA,PYR
90	1558.0-59.0	30.0	18.3	8.2	65.8	2.66	SD,LIG,MICA
91	1559.0-60.0	7.5	15.4	1.4	73.1	2.66	SD,SHY,LIG,MICA
92	1560.0-61.0	1.3	11.0	2.8	85.7	2.67	SD,SHY,LIG,MICA
93	1561.0-62.0	0.9	12.4	0.7	83.4	2.68	SD,SHY,LIG,MICA
94	1562.0-63.0	0.9	11.6	1.8	85.7	2.70	SD,SHY,LIG,MICA
95	1563.0-64.0	0.3	12.6	6.7	84.3	2.69	SD,SHY,LIG,MICA
96	1564.0-65.0	5.6	16.0	1.3	83.9	2.67	SD,SHY,LIG,MICA
97	1565.0-66.0	1.1	10.1	2.1	85.8	2.71	SD,SHY,LIG,MICA
98	1566.0-67.0	40.0	18.9	7.4	69.9	2.66	SD,LIG,MICA
99	1567.0-68.0	20.0	17.6	4.9	77.1	2.66	SD,LIG,MICA
100	1568.0-69.0	12.0	17.3	3.8	69.3	2.66	SD,LIG,MICA
101	1569.0-70.0	13.0	17.7	3.7	64.6	2.69	SD,LIG,MICA
102	1570.0-71.0	15.0	17.2	4.5	67.7	2.67	SD,LIG,MICA
103	1571.0-72.0	7.4	15.7	6.8	67.0	2.67	SD,LIG,MICA
104	1572.0-73.0	24.0	18.1	6.0	67.7	2.67	SD,LIG,MICA
105	1573.0-74.0	26.0	18.4	3.1	75.9	2.67	SD,LIG,MICA
106	1574.0-75.0	17.0	17.5	4.0	74.9	2.67	SD,LIG,MICA
107	1575.0-76.0	23.0	17.8	1.5	76.7	2.67	SD,LIG,MICA
108	1576.0-77.0	20.0	17.6	4.0	73.4	2.66	SD,LIG,MICA
109	1577.0-78.0	22.0	17.7	3.4	74.6	2.66	SD,LIG,MICA
110	1578.0-79.0	21.0	17.4	1.0	79.5	2.66	SD,LIG,MICA
111	1579.0-80.0	26.0	18.0	2.7	77.4	2.66	SD,LIG,MICA
112	1580.0-81.0	29.0	18.0	1.9	82.1	2.66	SD,LIG,MICA
113	1581.0-82.0	23.0	17.5	1.5	79.3	2.65	SD,LIG,MICA
114	1582.0-83.0	14.0	17.1	0.3	87.6	2.65	SD,SH INCL,LIG,MICA
115	1583.0-84.0	17.0	16.9	2.0	86.5	2.67	SD,SH STKS,LIG,MICA
116	1584.0-85.0	34.0	18.8	0.9	80.8	2.65	SD,LIG,MICA
117	1585.0-86.0	8.4	11.0	4.3	84.0	2.70	SD,SH INCL,SH STKS
118	1586.0-87.0	40.0	18.7	5.6	75.8	2.65	SD,LIG,MICA
119	1587.0-88.0	0.1	6.9	9.8	69.8	2.67	SD,LMY,SHY,LIG,MICA
120	1588.0-89.0	1.5	10.0	30.7	48.8	2.66	SD,LMY,LIG,MICA
121	1589.0-90.0	145.0	18.9	4.8	70.7	2.66	SD,SL/LMY,LIG,MICA
122	1590.0-91.0	16.0	18.7	2.0	72.5	2.66	SD,SL/LMY,LIG,MICA
123	1591.0-92.0	24.0	19.2	3.3	78.4	2.65	SD,LMY,LIG,MICA,PYR
124	1592.0-93.0	70.0	18.7	5.5	71.6	2.67	SD,SL/LMY,LIG,MICA
125	1593.0-94.0	117.0	17.7	5.1	73.0	2.65	SD,LMY,LIG STKS,MICA
126	1594.0-95.0	173.0	17.4	1.2	78.2	2.67	SD,SL/LMY,LIG,MICA
127	1595.0-96.0	20.0	12.8	3.5	68.2	2.67	SD,LMY,LIG,MICA,PYR
	1596.0-98.5						SH
	1598.5-1600.0	LOST CORE					

WILLIAM BERRYHILL NO. 104-O

(750 FWL, 2116 FSL) NE/4, SEC. 17, T.17N, R.12E

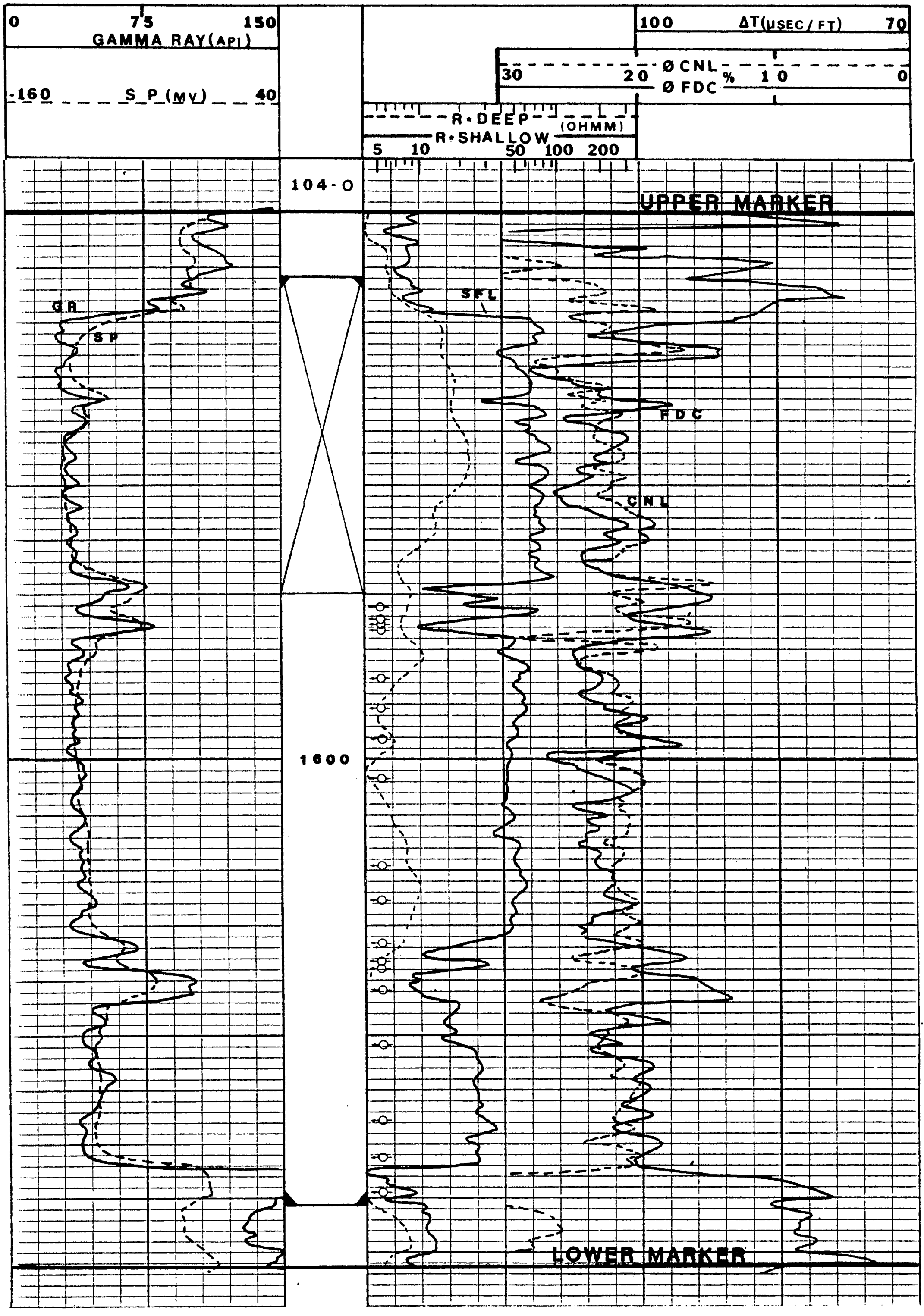


Figure 94. Well-log Signatures, Glenn Sandstone, William Berryhill No. 104-O

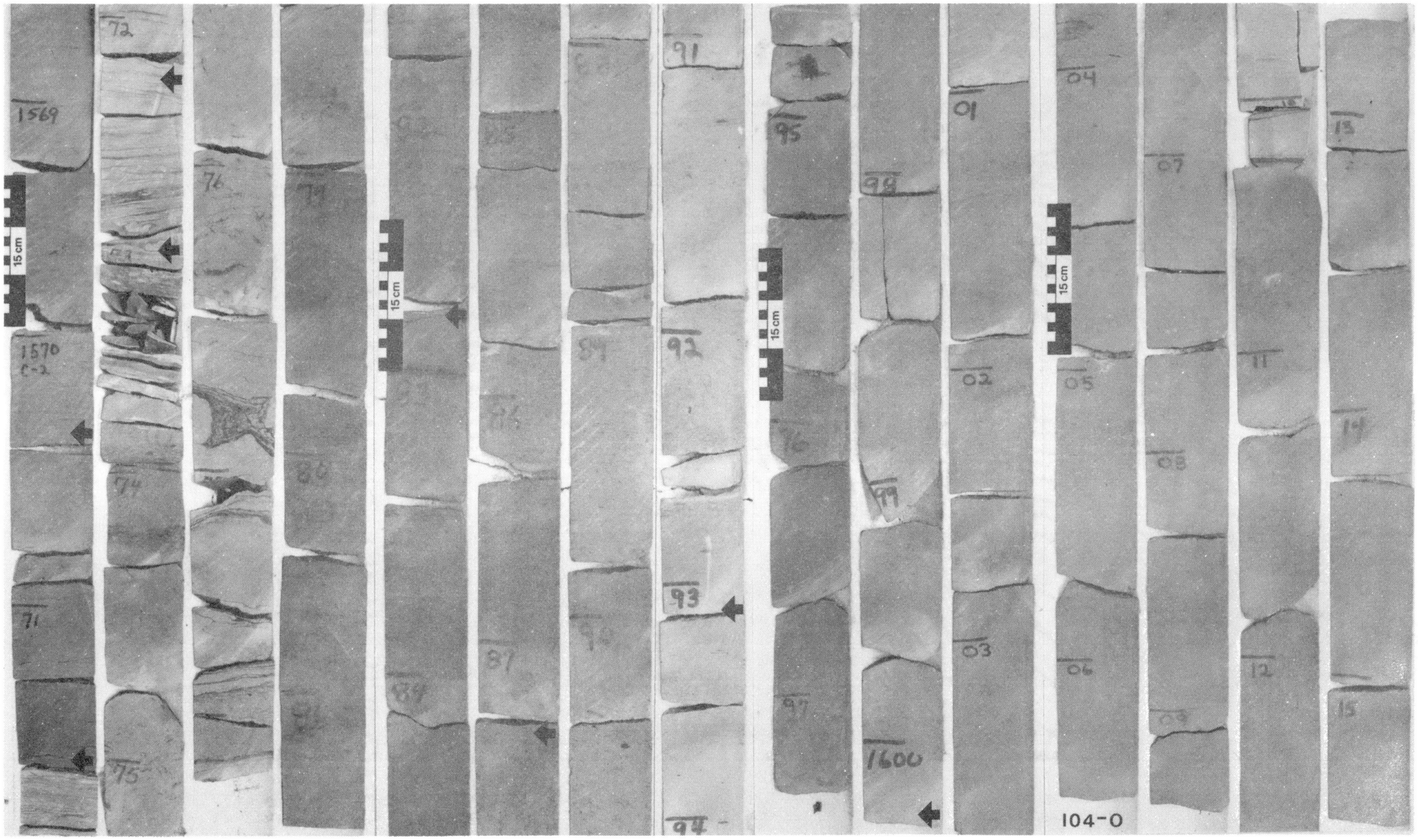
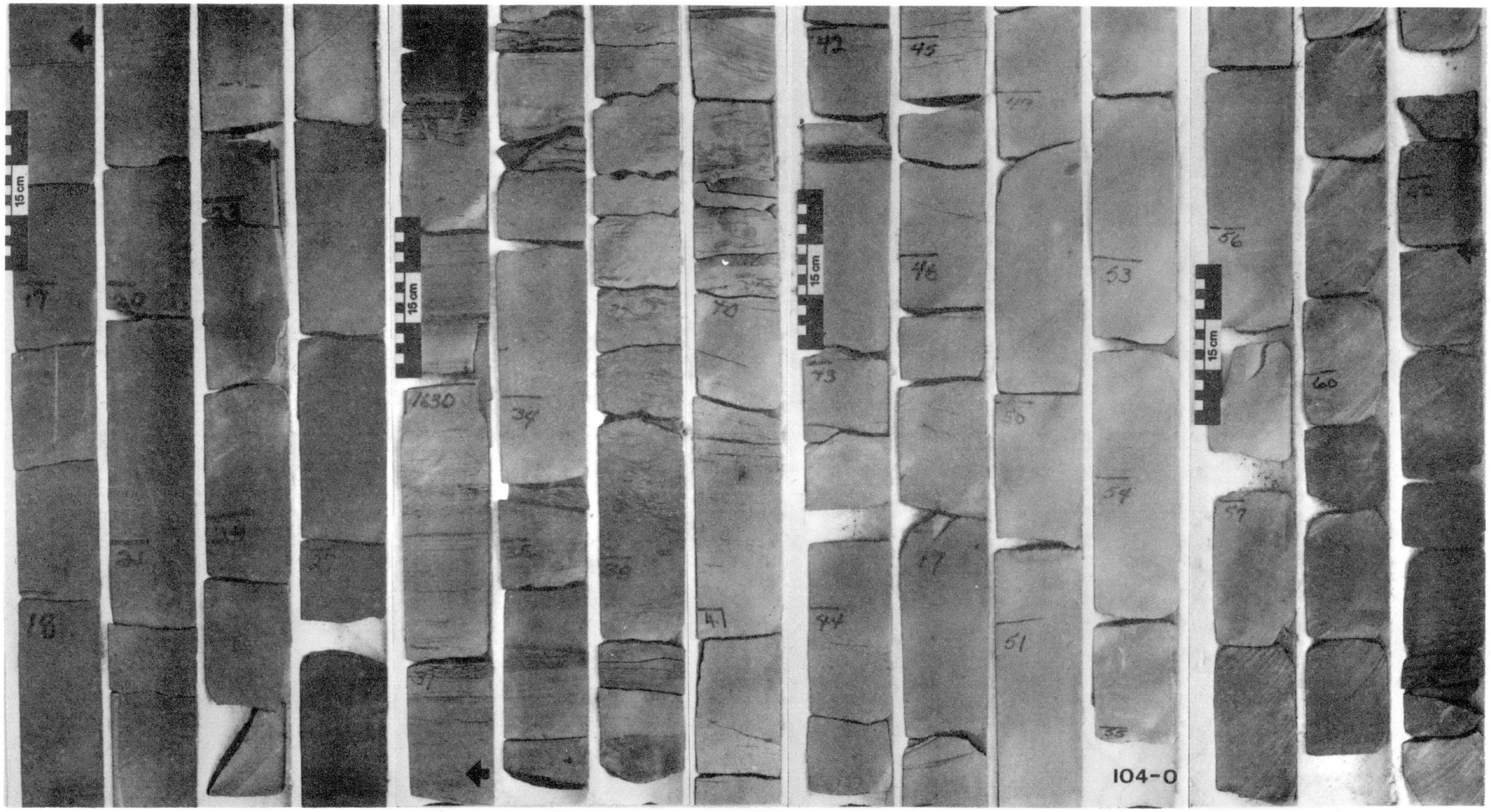
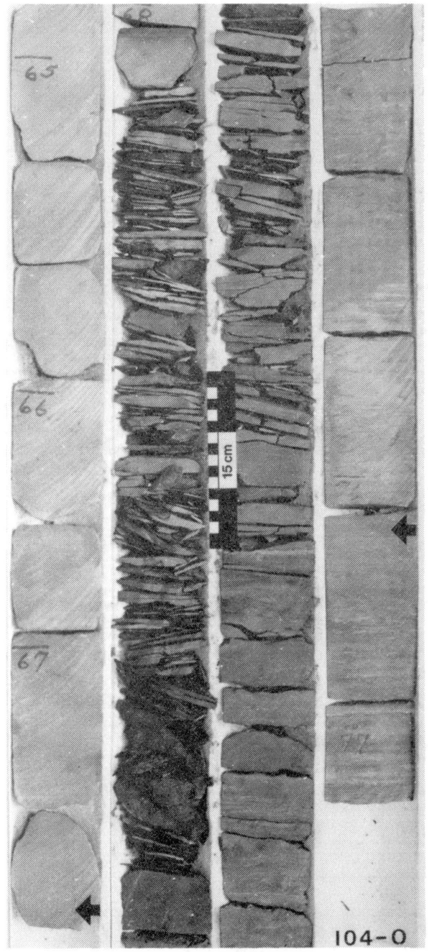


Figure 95. Glenn Sandstone, William Berryhill No. 104-0, 1568.5 - 1615.5 ft., Showing a Portion of the Middle Glenn.



Note: Glenn Sandstone, William Berryhill No. 104-0, 1615.8 - 64.5 ft., Showing a Portion of the Middle Glenn (1615.8 - 34.8 ft.), with a Distinct Oil/Water Contact at 1628.9 ft. Lower "Non-Porous" Zone (1634.8 - 42.3 ft.) and a Portion of the Lower Glenn

Figure 95 (Continued)



Note: Glenn Sandstone, William Berryhill No. 104-O, 1664.8 - 77.2 ft., Showing a Portion of the Lower Glenn and the Abrupt Basal Contact with the Underlying Black Shale

Figure 95 (Continued)

William Berryhill No. 104-0
(750 FWL, 2116 FSL, NE/4, Sec. 17)

Cored Interval: 1510.0-1677.3 ft., (Described 1568.6-1677.3 ft.)
Correlation: Core depth three feet shallow to log depth

<u>Core Depth (Ft.)</u>	<u>Core Description</u>
	<u>Upper Glenn</u>
1510.0 - 1568.6	Cored, but not available for visual description. Description from Gulf Oil Corp. core report. ss; f - m gr, m gr near top, abrupt ctc w/ over- lying sh, carb ptgs & sh rip-up clast bds, impermeable bds (sh?) ◇ 1530.9 - 31.8ft., 1540.9 - 42.5 ft., sed struc ?, (see Petrologic Log)
	<u>Middle Glenn</u>
1568.6 - 71.9	ss; lt brn - gy, vf - f gr, carb, apr ripple lams, o. stn
71.9 - 73.5	sltst/sh/ss; lt brn - gy - blk, intbd & intlam, flaser bdg
73.5 - 78.0	ss; lt brn - dk gy, vf - f gr, abnt carb debris, apr mas bdg, o. stn, grading downw into flow features, carb mat & carb lam abrupt hi ang ctc ◇ 78.0 ft.
78.0 - 92.6	ss; lt brn - brn, vf - f gr, apr mas bdg, scat s sid pbls, abnt carb fil, o. stn
92.6 - 94.1	sltst/ss; lt gy, vf ss, s sid pbls (1 cm) align hztl, abnt cly, poss vert perm barrier ?, abrupt ctc abv & blw
94.1 - 1610.4	ss; lt brn - brn, vf - f gr, apr mas bdg, flow features ◇ 97.0 ft., carb fils, sl incld ◇ 1604.0 ft., few scat s sid pbls
1610.4 - 10.6	ss; lt gy, vf gr, hzlt carb/slty lams, sl incld, scour surf

10.6 - 29.0	ss: lt brn - brn, vf - f gr, apr mas bdg, carb fil, few v s scat sid pbls, flat-elg clasts ◊ 22.8 ft., flow struc (sand pipe?) ◊ 21.0 ft., grdg into hzlt bdd ss, poss o/w ctc ◊ 29.0 ft.
29.0 - 31.8	ss; dk gy - gy, vf - f gr, f hztl lam, carb/slt, mot apr, sl incld bdg ◊ 31.5 ft.
31.8 - 32.3	ss; as abv, abnt carb lam, scour surf ◊ 32.3 ft., coal ptg
32.3 - 35.0	ss; gy - dk gy, vf - f gr, apr mas bdg, abnt carb fil, few sh clast/sid pbls, incrg near base, scour surf b/w
35.0 - 36.0	ss; dk gy - gy, blk, vf - f gr, apr mas bdg, abnt carb lam, abrupt ctc w/ th sh ◊ 36.0 ft.
36.0 - 38.5	ss/sh; dk gy - gy, blk, abnt lg (3 - 4 cm), flat-elg sh rip-up clasts in a vf - f gr ss matrix, few sid pbls, abnt carb fils, abrupt ctc w/th sh ptg ◊ 38.5 ft.
38.5 - 40.5	shy ss; dk gy - gy, blk, sh ptg ◊ 38.5 ft., lg (6 cm) sh clast ◊ 38.9 ft., sev scour surfs, abnt sh rip-up clast & sid pbls, sl xbdg - hztl bdg
40.5 - 42.5	ss; gy - lt gy, vf - fg, sl incld bdg, abnt carb fils, few s sid pbls, sh rip-up clasts ◊ 42.0 ft., th sh ptg (3 cm) ◊ 42.45 ft., abrupt ctc w/ underlying ss
	<u>Lower Glenn</u>
42.5 - 48.6	ss; lt gy, f - m gr, m sc xbdg, abnt carb fil, few clasts, hi ang carb ptgs & th lam of slt/cly (sideritic)
48.6 - 60.3	ss; lt gy, f - m gr, apr mas bdg, abnt carb fil, v few s sid pbls
60.3 - 63.2	ss; dk gy, f - m gr, apr mas bdg, abnt carb fils, few s sid pbls, sev s clasts of slty sh, sl incld ctc ◊ 63.2 ft.
63.2 - 64.5	ss; gy - lt brn - blk, f - m gr, sl incld bdg, abnt carb mat, carb lams (styolitic ?) (Base of Glenn)

64.5 - 68.1	ss; lt gy, apr mas bdg, sl not spr, sl calc cmt, carb fils
68.1 - 71.1	sh; blk, fis, brittle, bur
71.1 - 71.15	sh; blk, hd, dns, fos (Plcy), (3 - 4 cm)
71.15 - 72.9	sh; blk - dk gy, th slty lam, convolute bdg, bur?
72.9 - 77.2	slty sh; blk - gy, slty, flow structures, convolute bdg, flaser struc, microfaults, bur, becoming homog downw

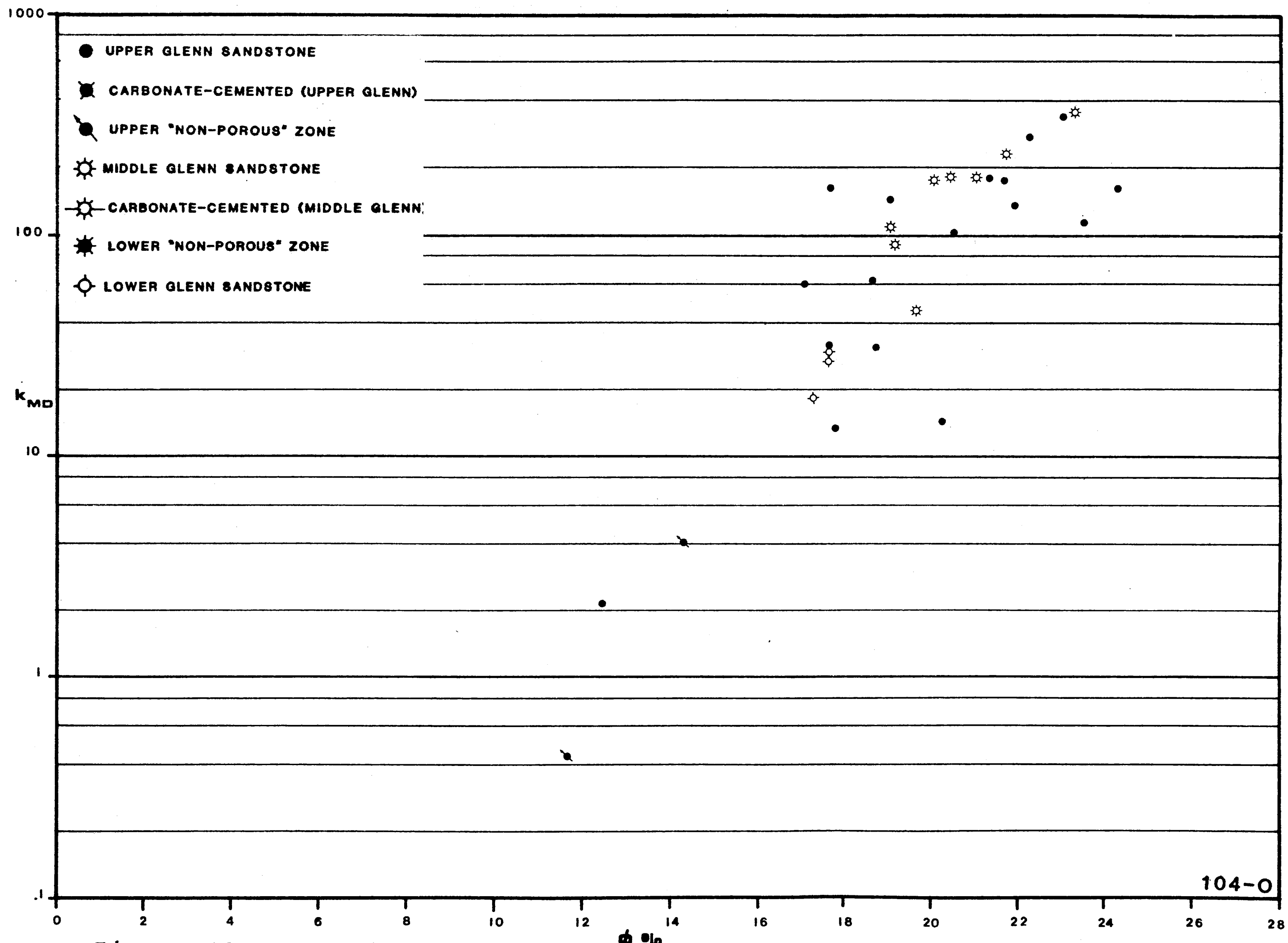


Figure 96. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 104-O

TABLE XI

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 104-0
CORE ANALYSIS

Sample Number	Depth, Feet	Permeability, Millidarcies Perm. Max.	Perm. 90°	Perm. Vert.	Porosity, Per Cent	Residual Saturation Per Cent Pore Oil	Total Water	Grain Density	Sample Description And Remarks
1	1517.6	*	13		17.8	29.9	41.3	2.75	Sd,slty
2	1519.5	*	355		23.1	26.3	36.6	2.70	Sd,slty
3	1523.3	*	14		20.3	28.7	41.8	2.68	Sd,slty
4	1524.5	*	169	76	24.4	23.7	40.8	2.69	Sd,slty
5	1526.4	*	115		23.6	28.3	37.7	2.72	Sd,slty
6	1530.5	*	31		18.8	30.1	42.7	2.69	Sd,slty
+7	1531-32	2.0	1.5	<0.1	12.4	16.9	60.1	2.78	Sd,slty
8	1533.4	*	289		22.3	27.0	31.3	2.65	Sd,slty
9	1535.9	*	140		22.0	29.9	32.2	2.66	Sd,slty
10	1539.5	*	63		18.7	32.0	33.7	2.66	Sd,slty
+11	1541-42	33	31	<0.1	17.7	17.8	45.1	2.65	Sd,slty
12	1541.8	*	149		19.1	27.1	38.0	2.65	Sd,slty
13	1545.7	*	181		21.7	29.2	43.9	2.66	Sd,slty
14	1551.4	*	185		21.4	24.1	37.3	2.66	Sd,slty
15	1556.3	*	60		17.1	27.5	32.5	2.66	Sd,slty
16	1557.8	*	170		16.7	29.1	31.7	2.66	Sd,slty
17	1561.5	*	106		20.6	39.4	39.4	2.68	Sd,slty
18	1564-65	<0.1	<0.1	<0.1	5.2	0.0	76.7	2.72	Sd,slty
19	1565.5	*	3.9		14.3	46.1	37.2	2.65	Sd,slty
20	1566-67	0.4	0.3	<0.1	11.6	13.9	60.8	2.65	Sd,slty
21	1580-81	*	93		19.2	33.5	29.9	2.66	Sd,slty
22	1586-87	*	183		20.1	35.3	29.0	2.66	Sd,slty
23	1594-95	*	381		23.4	19.9	27.0	2.66	Sd,slty
24	1600-01	*	112		19.1	20.5	44.8	2.67	Sd,slty
25	1609-10	*	188		21.1	25.6	41.5	2.66	Sd,slty
26	1615-16	*	190		20.5	30.4	45.1	2.67	Sd,slty
27	1627-28	*	247		21.8	31.1	49.7	2.65	Sd,slty
28	1633-34	*	46		19.7	5.9	53.0	2.65	Sd,slty
29	1645-46	*	187		20.1	4.8	56.7	2.65	Sd,slty
30	1653-54	*	30		17.7	5.7	61.8	2.66	Sd,slty
31	1658-59	*	27		17.7	7.9	53.7	2.66	Sd,slty
32	1666-67	*	18		17.3	3.1	65.9	2.67	Sd,slty

+ Denotes Horizontal Cracks

* Denotes Dean Stark Plug Analysis

WILLIAM BERRYHILL NO. 109-P

(2475 FWL, 2454 FSL) NE/4, SEC. 17, T.17N, R.12E

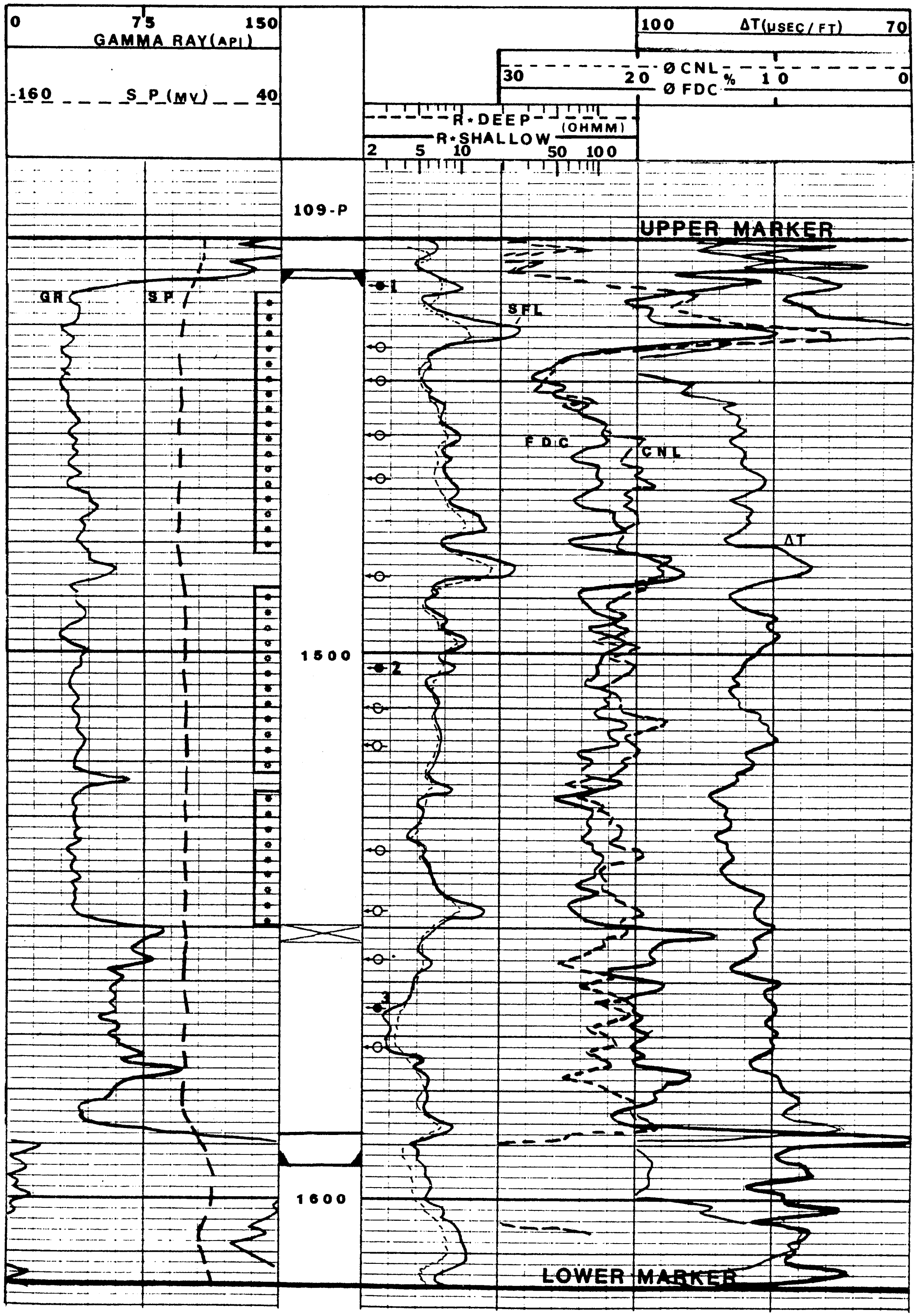


Figure 97. Well-log Signatures, Glenn Sandstone, William Berryhill No. 109-P

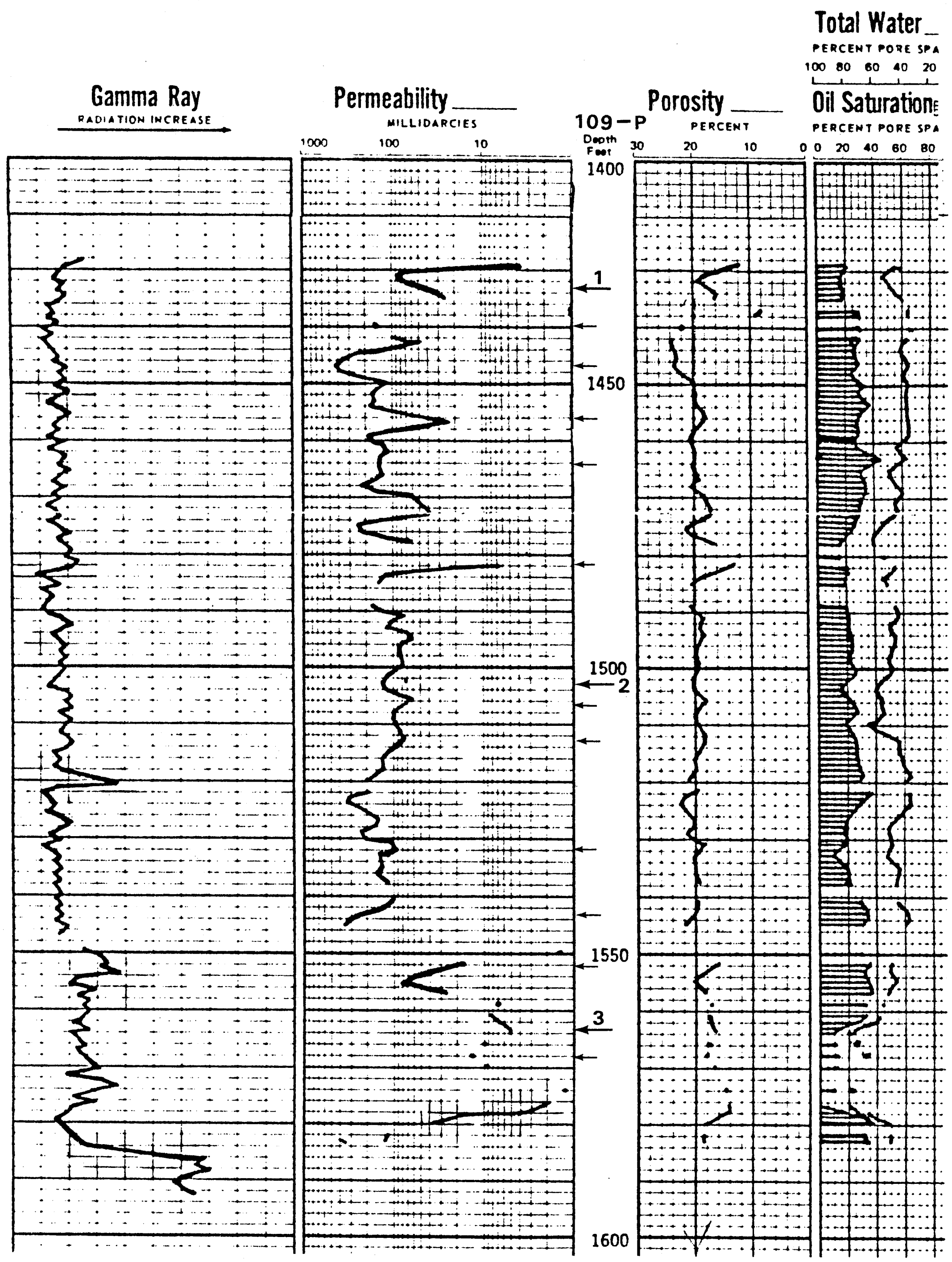


Figure 98. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 109-P

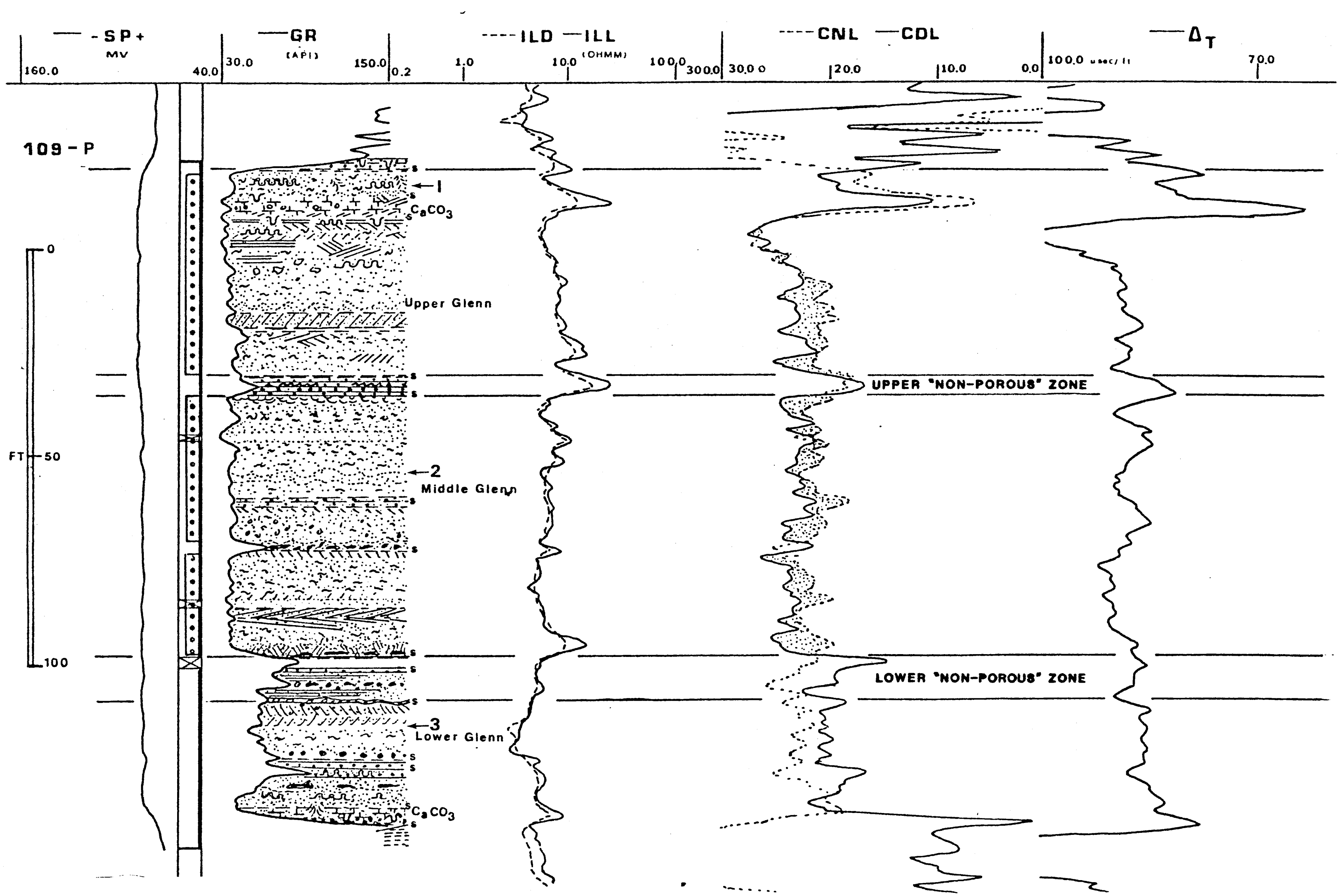


Figure 99. Log-signatures, General Lithology, and Sedimentary-features, Glenn Sandstone, William Berryhill No. 109-P

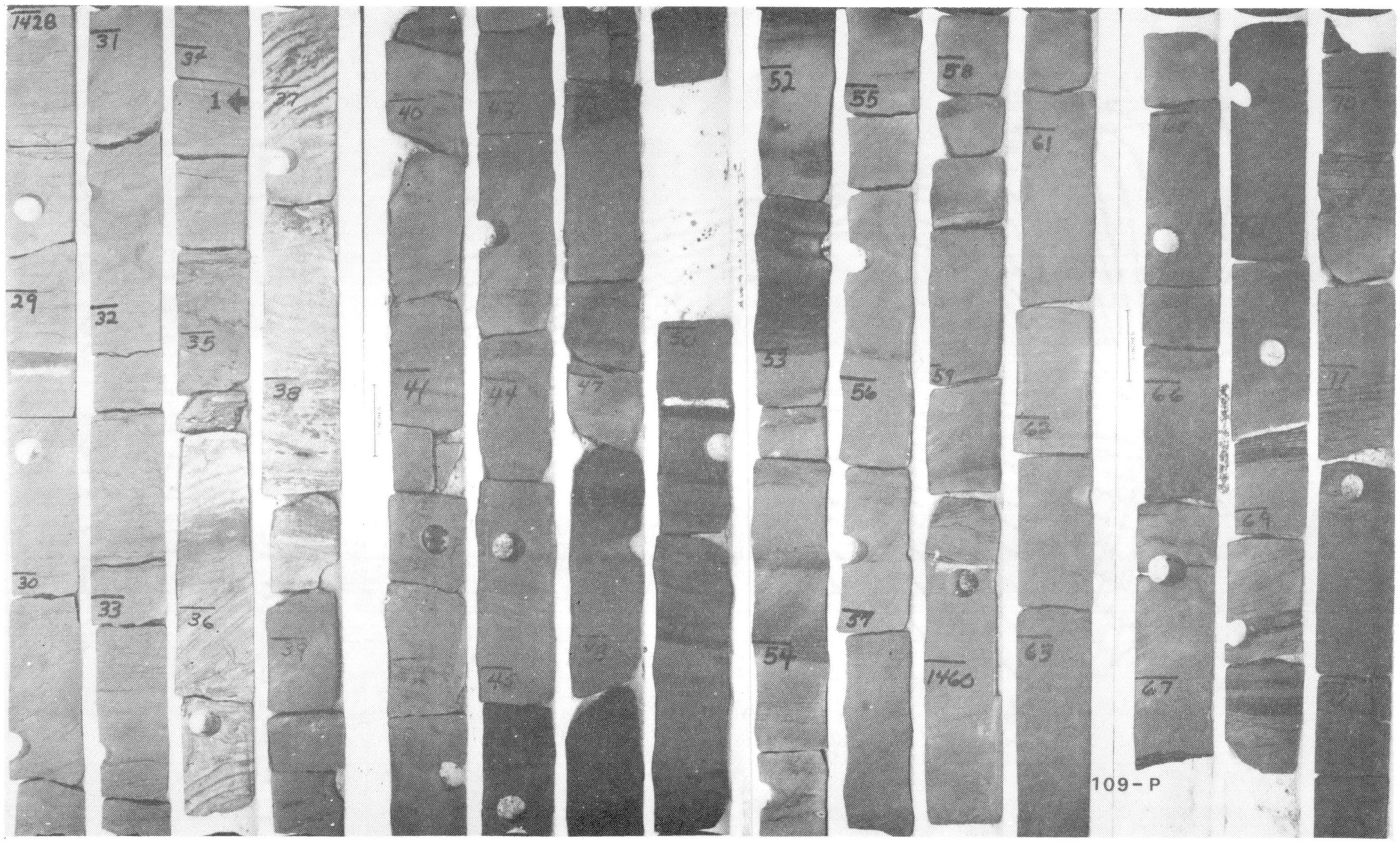
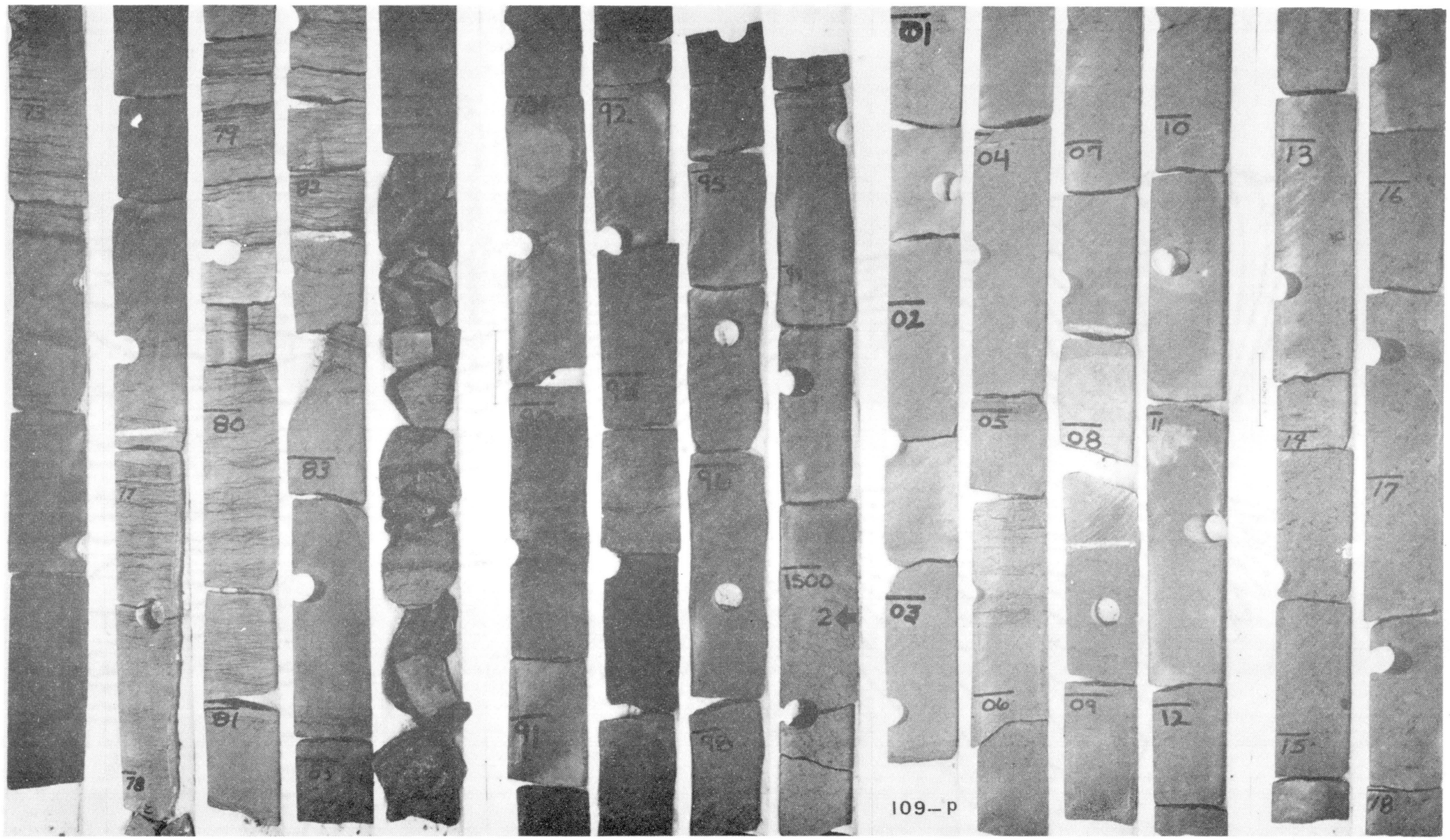
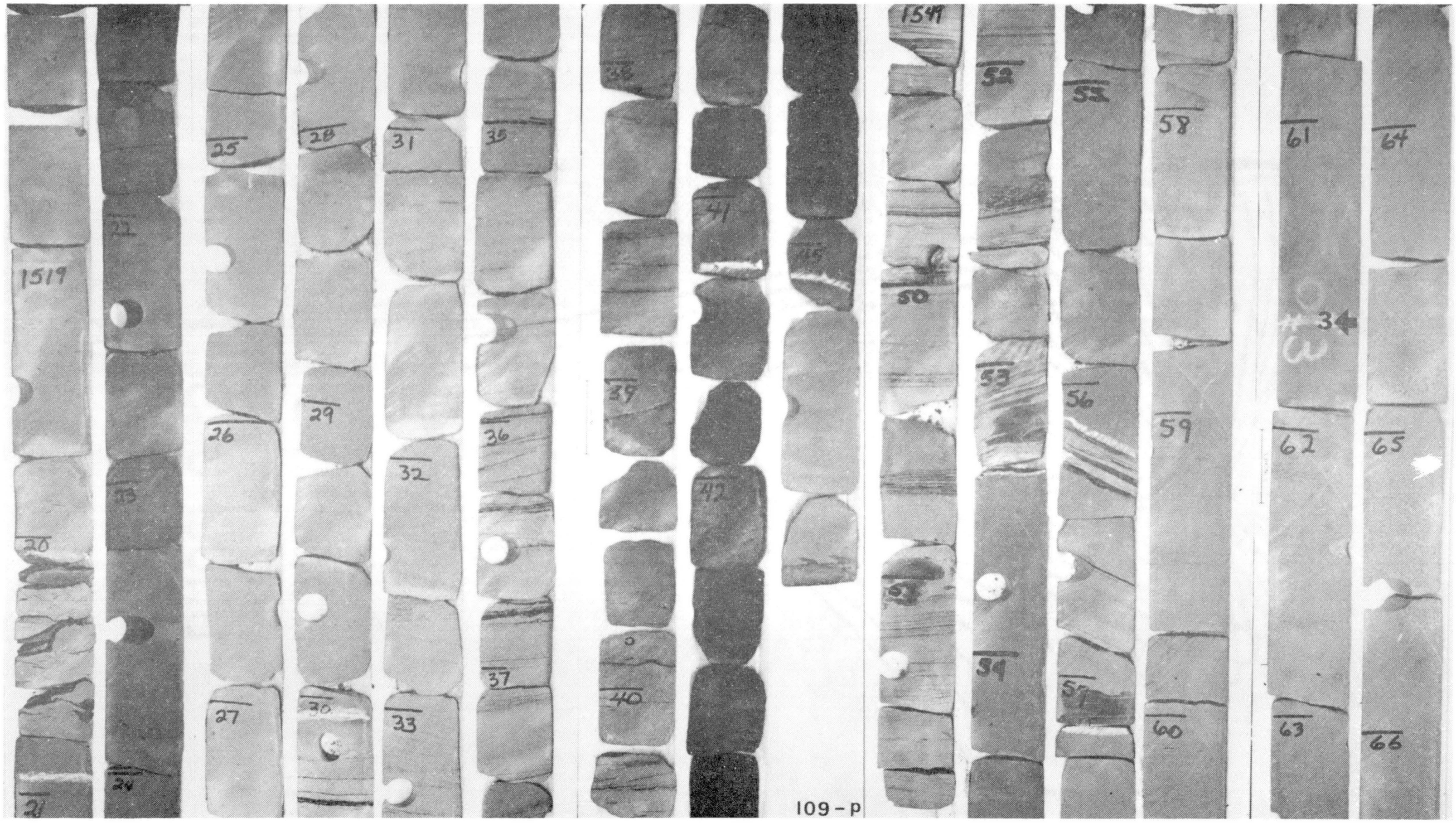


Figure 100. Glenn Sandstone, William Berryhill No. 109-P, 1428.0 - 72.5 ft., Showing a Portion of the Upper Glenn



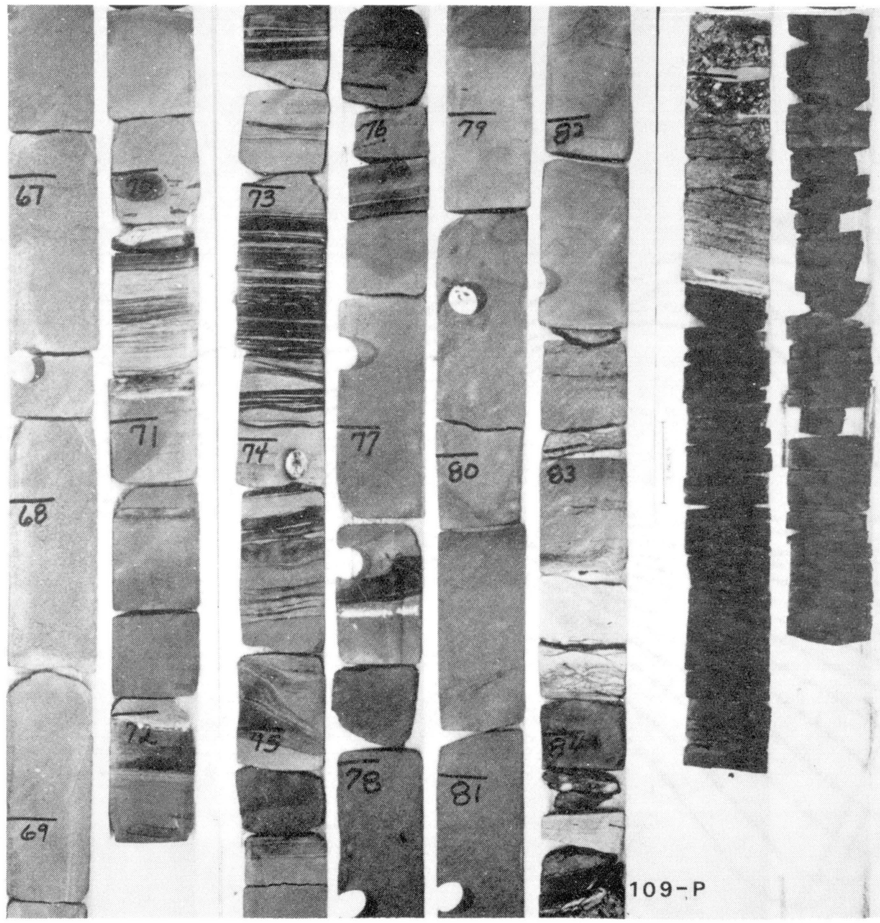
Note: Glenn Sandstone, William Berryhill No. 109-P, 1472.5 - 1518.1 ft., Showing the Upper "Non-Porous" Zone (1476.8 - 82.1 ft.) and a Portion of the Middle Glenn (1482.1 - 1518.1 ft.)

Figure 100 (Continued)



Note: Glenn Sandstone, William Berryhill No. 109-P, 1518.1 - 66.5 ft., Showing a Portion of the Middle Glenn (1518.1 - 49.9 ft.), Lower "Non-Porous" Zone (1549.0 - 57.1 ft.), and a Portion of the Lower Glenn (1557.1 - 66.5 ft.)

Figure 100 Continued



Note: Glenn Sandstone, William Berryhill No. 109-P, 1566.5 - 90.5 ft., Showing a Portion of the Lower Glenn (1566.5 - 85.6 ft.), and Underlying Black Shale (1585.6 - 90.5 ft.)

Figure 100 Continued

William Berryhill No. 109-P
(2475 FWL, 2454 FSL) NE/4, Sec. 17

Cored Interval: 1428.0 - 1592.0 ft.
Correlation: Core depth three feet shallow to log depth

Core Depth (Ft.)	Core Description
	Upper Glenn
1428.0 - 29.3	ss; lt gy, vf gr, slty, alternating lams of ss/sltst, brk by disc carb lams, bur?, flow?, no o. stn, abrupt ctc blw
29.3 - 35.3	ss; lt gy - gy, vf - f gr, (m - c gr near base), vis por, flow, slump?, carb lams, th slty lam, scat sideritic zns, (Sample 109-1, 34.1 ft.)
35.3 - 38.8	ss; lt gy -gy, buff, f gr, similar struc as abv, calc cmt, hem stn, mot apr, s sc - m sc xbdg, few sid clasts abrupt ctc blw
38.8 - 49.0	ss; brn - dk brn, vf - m gr, vis por, uneven o. stn, m sc xbdg, carb fils, poss flow struc, few sid pbls, sid lams
49.0 - 50.0	core missing
50.0 - 68.8	ss; brn - dk brn, f - m gr, vis por, incld bdg, alternating bns of blk asph stng, carb fils, few sid pbls, flow?
68.8 - 76.9	ss; brn - dk brn, f - m gr, blk carb ptgs, th intlam sh ptgs, abnt carb fils & ptgs, wvy ireg bdg, sl incld, grdg downw into a finely-lam slty ss
76.9 - 82.1	sltst; gy - lt brn, finely lam carb mat & slt, carb/slty ptgs, f ripple-lam slty ss (Upper "Non-Porous" Zone)
	Middle Glenn
82.1 - 97.0	ss; brn - gy, vf - f gr, apr mas bdg, f lam carb debris, s sid pbls, sev scour surfs, o. stn, decrg downw aprox 1500.0 ft.
97.0 - 98.0	core missing

98.0 - 1507.8	ss; as abv, less carb mat from 1501.0 - 07.8 ft.
1507.8 - 08.5	sltst; lt gy - lt brn, apr mas bdg, scat carb fils, sl calc cem, th (1 cm) incld sid ptg
08.5 - 20.0	ss; brn - gy, vf - f gr, apr mas bdg, incr carb fil & s sid pbls downw, clay gall ◇ 13.5 ft., abrupt ctc w/ sh ptg (sh rip-up clast?) ◇ 20.0 ft.
20.0 - 20.8	sh/ss; brn - gy - blk, sh rip-up clasts in a vf - f gr ss mtx
20.8 - 30.0	ss; brn - lt gy, vf - f gr, apr mas bdg, m sc xbdg near top, o. stn near top decrg downw, abnt carb fils, scour surf ◇ 30.0 ft.
30.0 - 33.8	ss; lt gy - lt brn, vf - f gr, sl incld bdg, abnt carb lam & ptgs, slty, carb fils
33.8 - 34.6	core missing
34.6 - 40.5	ss; lt gy - lt brn, brn, vf - f gr, sl incld bdg, abnt carb lam & ptgs, slty, incrg carb downw, poss m sc xbdg, dk o. stn near base
40.5 - 44.1	ss; brn, vf - f gr, dk o. stn, apr mas bdg, carb fils, s sid pbl ◇ 43.9 ft.
44.1 - 44.9	core missing
44.9 - 46.0	ss; lt brn - gy, vf - f gr, slty, apr mas bdg, carb fils, ireg ctc w/ sh ◇ 45.9 ft.
46.0 - 49.0	core missing
49.0 - 53.3	sltst/ss; lt brn - gy - blk, f intbds & intlams of carb mat, hztl bdg, sh rip-up clasts ◇ 51.0 ft. & 53.2 ft. (Lower "Non-Porous" Zone)
	<u>Lower Glenn</u>
53.3 - 57.6	ss; lt brn - gy, vf - f gr, apr mas bdg near top, apr incld bdg near middle, hi ang bd of intlam ss/sh ◇ 56.1 ft., abrupt ctc w/ th sh ◇ 57.0 ft., few flat-elg sh rip-up clasts ◇ 57.5 ft.

57.6 - 70.1	ss; lt brn - lt gy, vf - f gr, apr m sc xbdg near top, apr mas bdg to 70.0 - 70.1 ft., carb fils, sl o. stn, aprox o/w ctc ◇ 61.6 ft., w rd sid pbl (3 cm) & few s rip-up clasts ◇ 70.0 - 70.1 ft., abrupt ctc w/ sh ptg ◇ 70.1 ft. (Sample 109-3, 61.6 ft.)
70.1 - 72.0	intlam/intbdd ss/sh; lt brn - gy, th (2 cm) intbd sh near top, grdg downw into intlam ss/sh, th (1 cm) sh ptg ◇ 71.3 ft., abrupt ctc w/ sh/ss ◇72.0 ft.
72.0 - 76.2	intlam ss/sh; lt brn - gy -blk, hztl lam slty sh ◇ 73.1 - 73.5 ft., apr convolute bdg, pos bur, flaser struc blw, flow struc ◇ 75.0 ft., abrupt ctc w/ underlying ss ◇ 76.2 ft.
76.2 - 83.5	ss; lt brn - gy, f - m gr, apr mas bdg, slty, carb fils, carb ptgs near base, sid ptg (3 cm) ◇ 77.5 ft., scour surf? ◇ 78.8 ft., abrupt color change & incr slt & mtx, flow strucs. diapir ◇ 81.8 ft., abrupt trans ◇ 83.5 ft.
83.5 - 83.9	ss; lt gy - buff, f - m gr, calc cmt, carb ptg (1 cm) grdg downw into mot ss sl calc cmt, & calc cmt sltst
83.9 - 84.6	sltst/sh; brn - lt gy, carb fil, calc cmt, abrupt ctc w/ underlying congl
84.6 - 85.2	congl; brn, by, blk, flat-elg, sub rd - r pbls of sid, sh rip-up clasts, carb debris, pyr, hem stn, fining downw, scour surf ◇ 85.2 ft.
85.2 - 85.6	shy ss; brn, gy - blk, abnt fos, brk, sl calc cmt, hi ang ctc w/ blk, carb sh (Base of Glenn)
85.6 - 92.0	sh; blk, carb, fis, slty downw, sl convolute bdg, bur

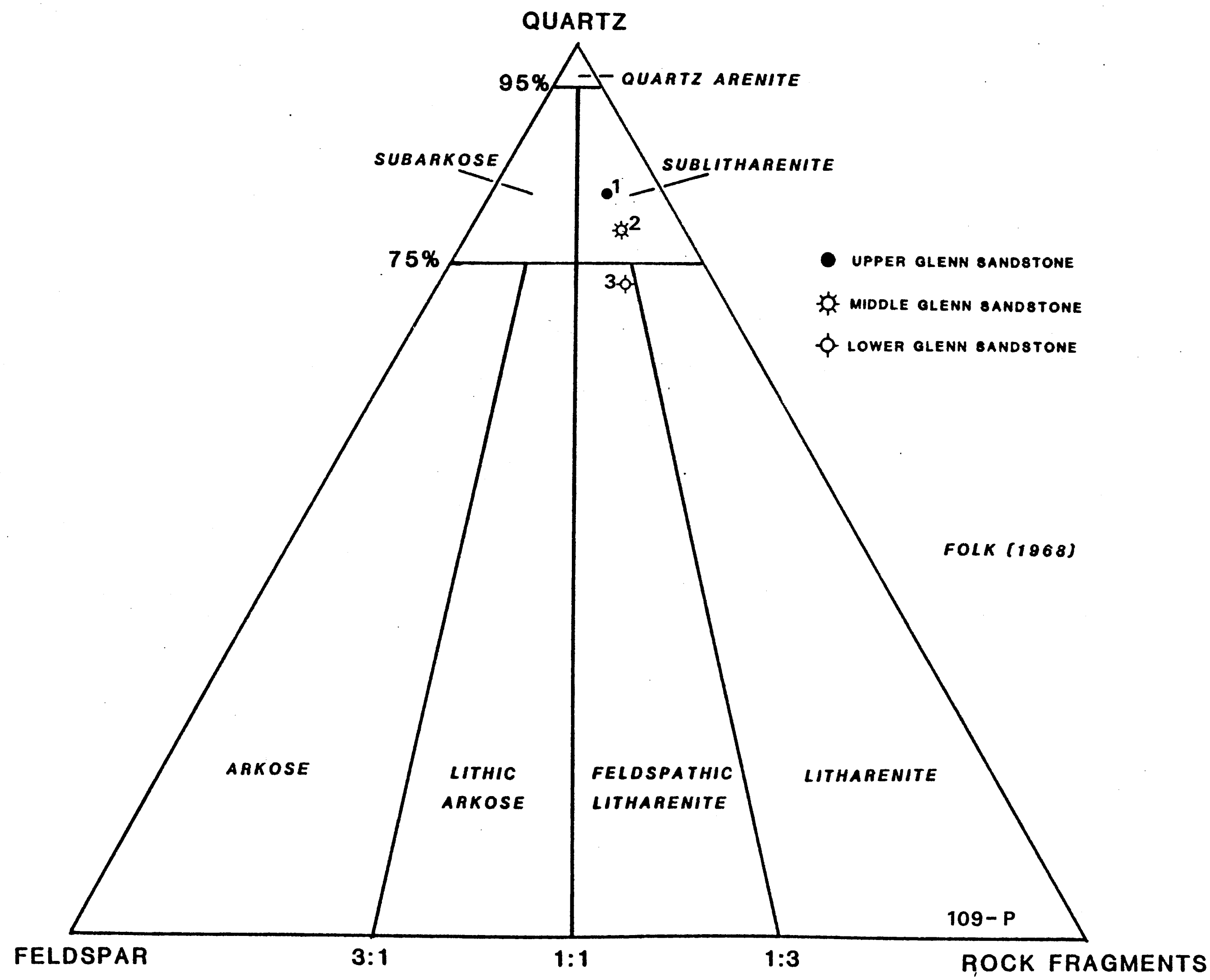


Figure 101. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 109-P

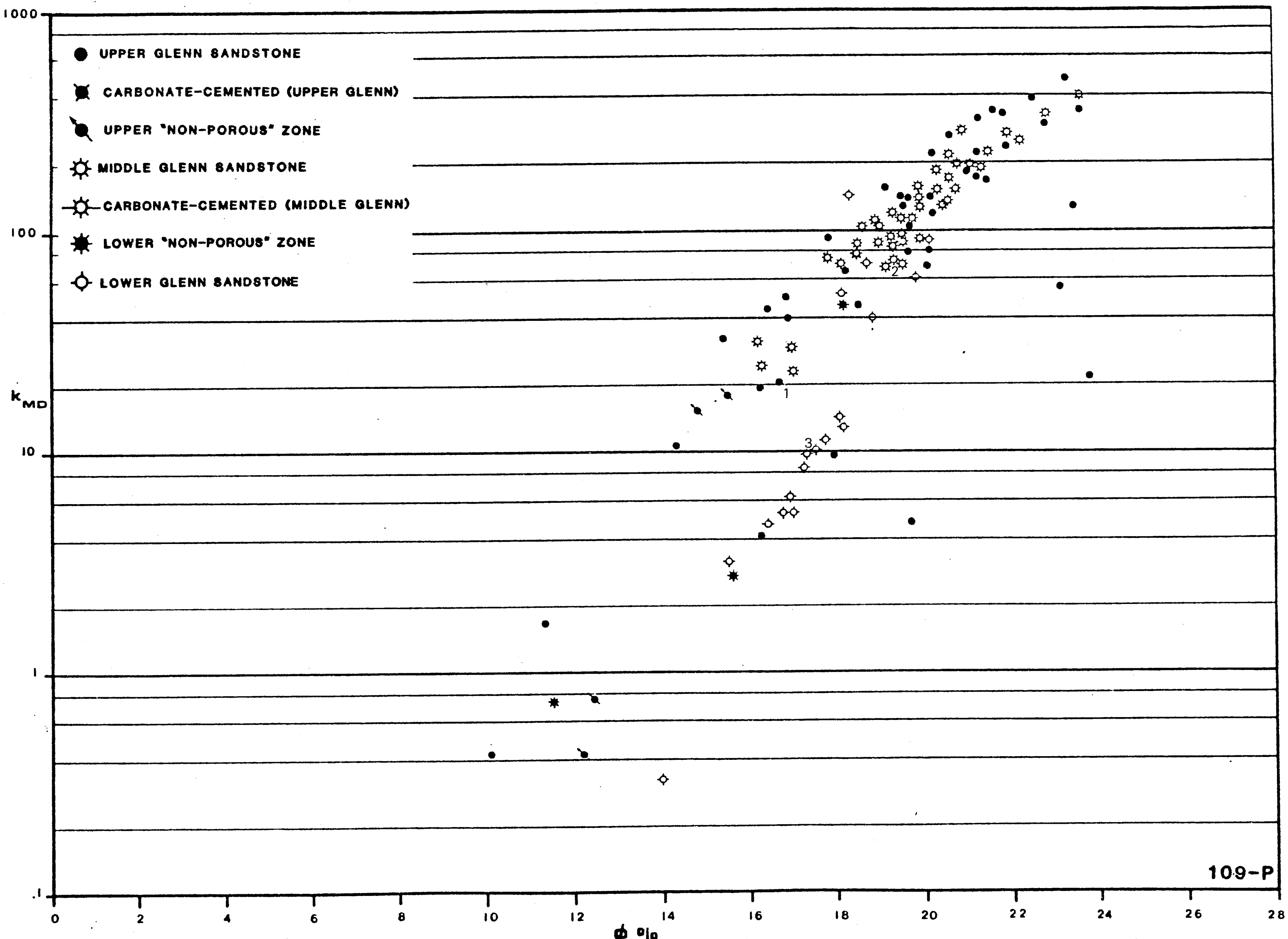


Figure 102. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 109-P

TABLE XII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 109-P
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. HORZ.	VERT.	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.
			DEAN STARK PLUG ANALYSIS				
1	1428.0-29.0	1.6		11.4	21.3	38.5	2.67
2	1429.0-30.0	10.0		14.4	21.4	54.4	2.66
3	1430.0-31.0	130.0		19.6	14.9	56.6	2.65
4	1431.0-32.0	83.0		20.2	16.1	45.4	2.66
5	1432.0-33.0	50.0		17.0	19.4	50.3	2.65
6	1433.0-34.0	33.0		15.5	18.6	43.9	2.65
7	1434.0-35.0 ← 1	21.0		16.8	17.4	36.4	2.69
	1435.0-36.0						
8	1436.0-37.0	0.2	<0.1	7.3	28.8	35.5	2.68
9	1437.0-38.0	0.4		10.1	30.6	34.9	2.66
	1438.0-39.0						
10	1439.0-40.0	172.0		21.5	30.5	32.2	2.71
	1440.0-41.0						
11	1441.0-42.0	128.0		23.5	30.4	34.8	2.65
12	1442.0-43.0	22.0		24.0	27.5	40.3	2.66
13	1443.0-44.0	53.0		23.2	24.8	42.1	2.66
14	1444.0-45.0	314.0		22.9	26.1	39.3	2.65
15	1445.0-46.0	351.0		23.7	30.7	35.0	2.65
16	1446.0-47.0	491.0		23.3	28.2	36.0	2.66
17	1447.0-48.0	404.0		22.6	23.1	38.3	2.65
18	1448.0-49.0	248.0		22.0	23.6	40.4	2.66
19	1449.0-50.0	6.7		18.1	38.2	33.8	2.66
20	1450.0-51.0	186.0		21.0	27.7	34.4	2.65
21	1451.0-52.0	228.0		20.3	24.9	40.6	2.65
22	1452.0-53.0	47.0		18.6	48.3	30.5	2.91
23	1453.0-54.0	332.0		21.3	24.1	41.4	2.65
24	1454.0-55.0	4.0		16.3	37.7	31.4	2.71
25	1455.0-56.0	81.0		19.7	25.5	37.7	2.65
26	1456.0-57.0	9.4		18.0	28.1	33.3	2.67
27	1457.0-58.0	4.6		19.7	27.5	34.7	2.66
28	1458.0-59.0	272.0		20.7	30.4	35.3	2.66
29	1459.0-60.0	184.0		21.3	24.0	38.9	2.66
30	1460.0-61.0	120.0		20.3	30.0	42.5	2.66
31	1461.0-62.0	105.0		19.8	33.4	44.5	2.66
32	1462.0-63.0	145.0		20.2	57.1	27.4	2.68
33	1463.0-64.0	140.0		19.7	32.2	49.0	2.67
34	1464.0-65.0	140.0		19.6	30.9	48.8	2.66
35	1465.0-66.0	140.0		19.7	29.6	50.3	2.65
36	1466.0-67.0	96.0		17.9	34.9	44.2	2.66
37	1467.0-68.0	349.0		21.7	33.7	46.3	2.66
38	1468.0-69.0	119.0		19.6	32.2	33.8	2.65
39	1469.0-70.0	41.0		17.0	32.9	41.3	2.88
40	1470.0-71.0	65.0		18.3	28.1	48.4	2.71
41	1471.0-72.0	44.0		16.5	30.5	40.1	2.65
42	1472.0-73.0	19.0		16.4	28.1	46.2	2.74
43	1473.0-74.0	68.0		20.1	27.5	52.3	2.66
44	1474.0-75.0	349.0		21.9	24.4	56.0	2.65
45	1475.0-76.0	224.0		21.3	22.0	58.7	2.65
46	1476.0-77.0	157.0		19.2	19.3	62.2	2.67
47	1477.0-78.0	15.0		14.9	14.5	58.6	2.66
	1478.0-79.0						
48	1479.0-80.0	0.4	0.3	12.2	14.7	55.3	2.64
	1480.0-81.0						
49	1481.0-82.0	0.7	0.1	12.5	18.1	46.6	2.65
50	1482.0-83.0	18.0		15.8	28.2	42.6	2.60
51	1483.0-84.0	192.0		20.4	15.0	60.3	2.66
52	1484.0-85.0	122.0		20.3	20.2	46.8	2.66
	1485.0-1488.0	TOO BROKEN FOR ANALYSIS					
53	1488.0-89.0	178.0		20.7	19.4	47.2	2.66
54	1489.0-90.0	157.0		20.8	20.6	41.4	2.66
55	1490.0-91.0	23.0		17.1	25.1	42.1	2.69
56	1491.0-92.0	124.0		19.5	20.0	50.4	2.67
57	1492.0-93.0	158.0		20.0	22.3	51.3	2.67
58	1493.0-94.0	29.0		17.1	24.2	44.5	2.67
59	1494.0-95.0	67.0		19.2	23.8	45.5	2.66
60	1495.0-96.0	87.0		19.4	22.8	43.4	2.66
61	1496.0-97.0	95.0		19.5	23.4	48.7	2.66
62	1497.0-98.0	72.0		19.6	25.4	50.1	2.66
63	1498.0-99.0	87.0		19.1	17.9	54.3	2.65
64	1499.0-00.0	73.0		19.4	28.5	44.8	2.66
65	1500.0-01.0 ← 2	91.0		19.7	26.5	48.9	2.65
66	1501.0-02.0	131.0		20.6	21.6	53.3	2.66

TABLE XII (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. HORZ.	VERT.	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.
67	1502.0-03.0	128.0		20.5	18.5	56.0	2.66
68	1503.0-04.0	146.0		20.0	9.7	63.2	2.66
69	1504.0-05.0	96.0		20.0	23.6	56.5	2.66
70	1505.0-06.0	29.0		16.4	23.9	55.0	2.65
71	1506.0-07.0	96.0		19.7	26.4	57.8	2.66
72	1507.0-08.0	98.0		19.7	28.3	52.0	2.66
73	1508.0-09.0	102.0		19.7	26.7	51.0	2.66
74	1509.0-10.0	95.0		19.4	5.7	74.2	2.70
75	1510.0-11.0	84.0		18.6	28.7	60.5	2.66
76	1511.0-12.0	81.0		18.6	20.3	48.8	2.66
77	1512.0-13.0	70.0		18.3	27.2	40.5	2.66
78	1513.0-14.0	87.0		18.6	25.9	42.7	2.66
79	1514.0-15.0	110.0		19.6	26.3	44.1	2.66
80	1515.0-16.0	140.0		20.2	26.2	41.6	2.66
81	1516.0-17.0	136.0		20.0	28.8	37.7	2.66
82	1517.0-18.0	115.0		19.6	24.6	42.6	2.66
83	1518.0-19.0	142.0		20.3	38.8	26.9	2.66
84	1519.0-20.0	227.0		21.5	21.4	43.6	2.67
	1520.0-21.0						
85	1521.0-22.0	75.0		17.9	40.6	35.1	2.66
86	1522.0-23.0	435.0		23.7	30.9	36.2	2.66
87	1523.0-24.0	342.0		22.9	30.9	33.9	2.66
88	1524.0-25.0	201.0		21.1	27.3	38.6	2.66
89	1525.0-26.0	190.0		21.3	20.2	44.7	2.66
90	1526.0-27.0	156.0		20.4	21.0	45.0	2.66
91	1527.0-28.0	105.0		19.1	19.0	49.2	2.66
92	1528.0-29.0	284.0		22.0	13.3	54.0	2.66
93	1529.0-30.5	265.0		22.3	20.7	46.7	2.67
94	1530.0-31.0	31.0		16.3	18.7	49.4	2.66
95	1531.0-32.0	91.0		19.7	15.6	48.2	2.66
96	1532.0-33.0	169.0		20.8	3.7	56.7	2.66
97	1533.0-34.0	145.0		19.9	16.4	44.3	2.66
98	1534.0-35.0	108.0		19.7	17.7	43.6	2.66
99	1535.0-36.0	204.0		20.9	23.6	40.1	2.65
100	1536.0-37.0	108.0		19.0	21.5	46.3	2.66
101	1537.0-38.0	122.0		19.4	20.9	43.8	2.64
	1538.0-40.0						
102	1540.0-41.0	111.0		19.9	27.2	44.4	2.65
103	1541.0-42.0	102.0		18.7	30.3	40.5	2.64
104	1542.0-43.0	227.0		20.7	34.8	35.3	2.66
105	1543.0-44.0	297.0		21.0	34.8	35.7	2.65
106	1544.0-45.0	350.0		21.6	28.9	38.7	2.66
	1545.0-46.0						
	1546.0-1549.0	LOST CORE					
107	1549.0-50.0	0.7	<0.1	11.6	23.9	63.8	2.83
	1550.0-51.0						
108	1551.0-52.0	2.7		15.7	40.7	48.0	2.67
109	1552.0-53.0	47.0	15.0	18.3	25.4	52.7	2.66
110	1553.0-54.0	40.0	<0.1	18.9	31.9	45.4	2.66
111	1554.0-55.0	90.0		20.2	37.5	44.6	2.66
112	1555.0-56.0	62.0		19.9	32.6	49.6	2.67
113	1556.0-57.0	11.0		17.8	38.7	51.9	2.67
	1557.0-58.0						
114	1558.0-59.0	5.2		16.9	33.2	54.6	2.67
	1559.0-60.0						
115	1560.0-61.0	10.0		17.6	31.6	57.7	2.67
116	1561.0-62.0 ←3	5.2		17.0	32.5	55.6	2.68
117	1562.0-63.0	5.9		17.0	8.9	77.1	2.67
118	1563.0-64.0	4.5		16.5	10.1	81.6	2.68
	1564.0-65.0						
119	1565.0-66.0	8.2		17.3	9.8	77.8	2.68
	1566.0-67.0						
120	1567.0-68.0	13.0		18.2	12.4	63.9	2.67
	1568.0-69.0						
121	1569.0-70.0	14.0		18.1	11.6	74.2	2.67
	1570.0-73.0						
122	1573.0-74.0	0.3	<0.1	14.0	14.1	77.5	2.68
	1574.0-76.0						
123	1576.0-77.0	3.1		15.6	0.0	78.1	2.67
124	1577.0-78.0	<0.1	<0.1	11.2	14.9	82.1	2.93
125	1578.0-79.0	9.7		17.4	36.9	56.9	2.67
126	1579.0-80.0	52.0		18.2	36.8	47.3	2.67
	1580.0-81.0						
127	1581.0-82.0	147.0		18.4	32.4	48.3	2.66
128	1582.0-83.0	72.0		18.8	29.7	52.6	2.66
	1583.0-92.0						

WILLIAM BERRYHILL NO. 111-P

(1698 FWL, 2064 FSL) NE/4, SEC. 17, T.17N, R.12E

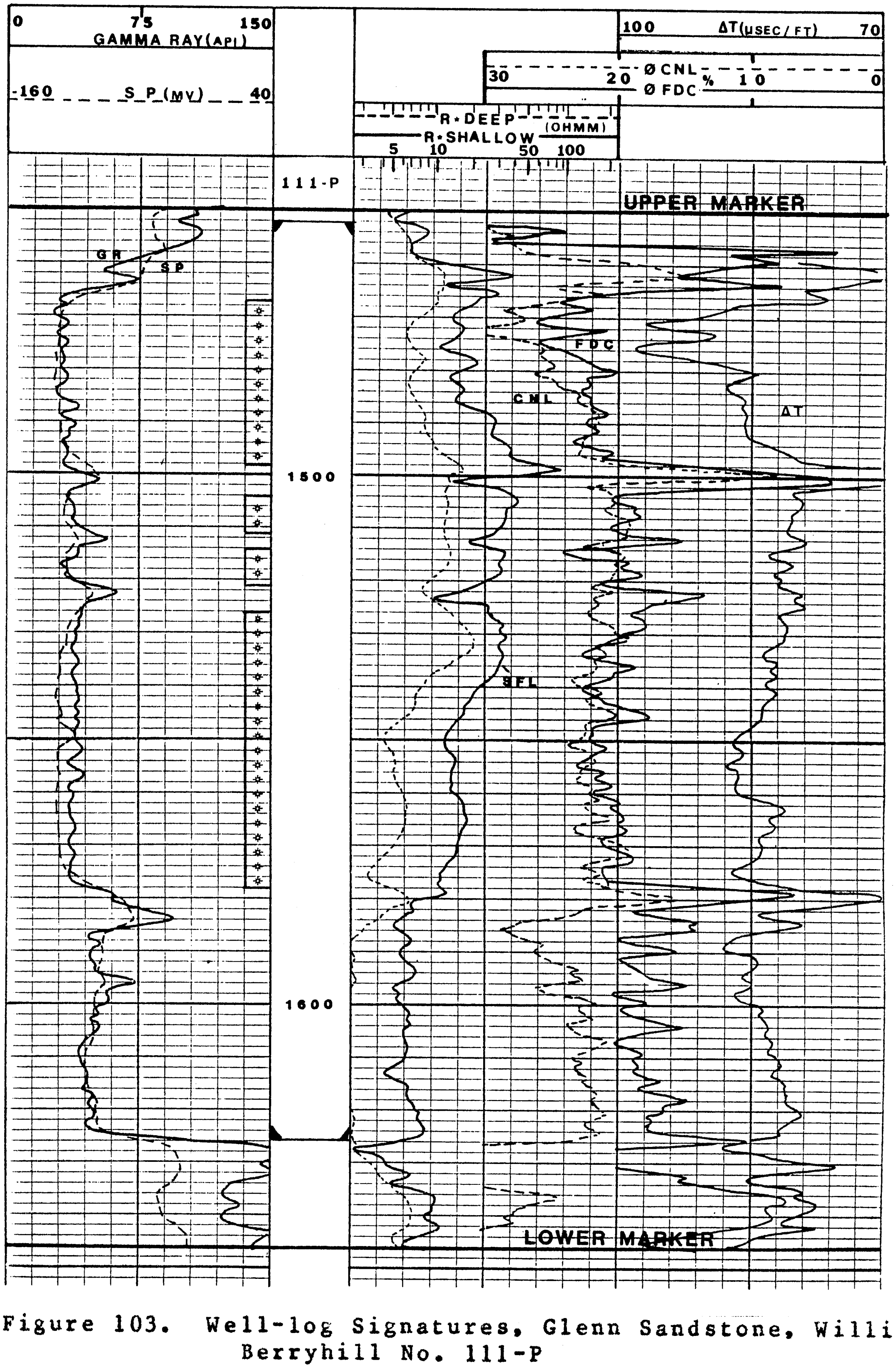


Figure 103. Well-log Signatures, Glenn Sandstone, William Berryhill No. 111-P

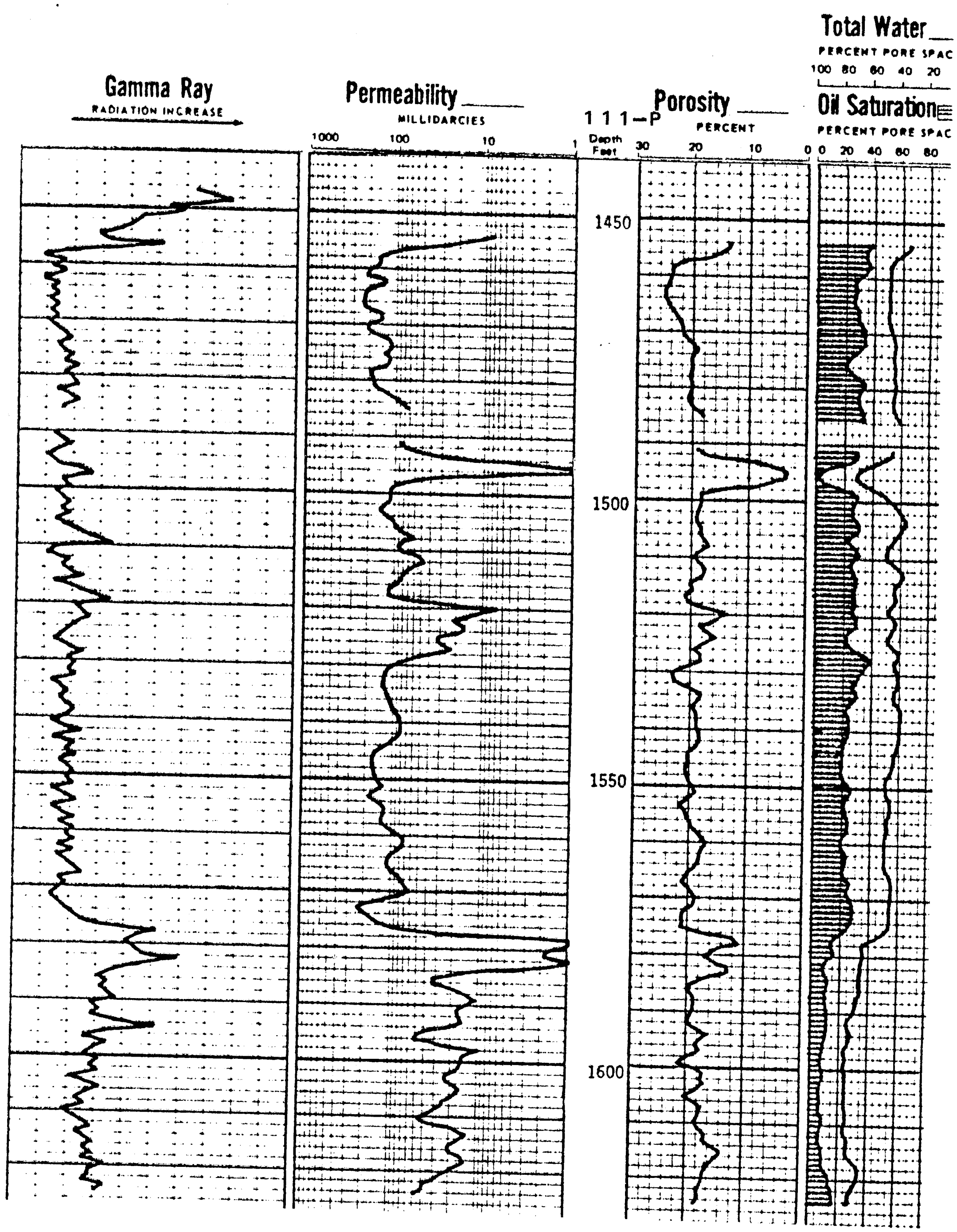


Figure 104. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 111-P

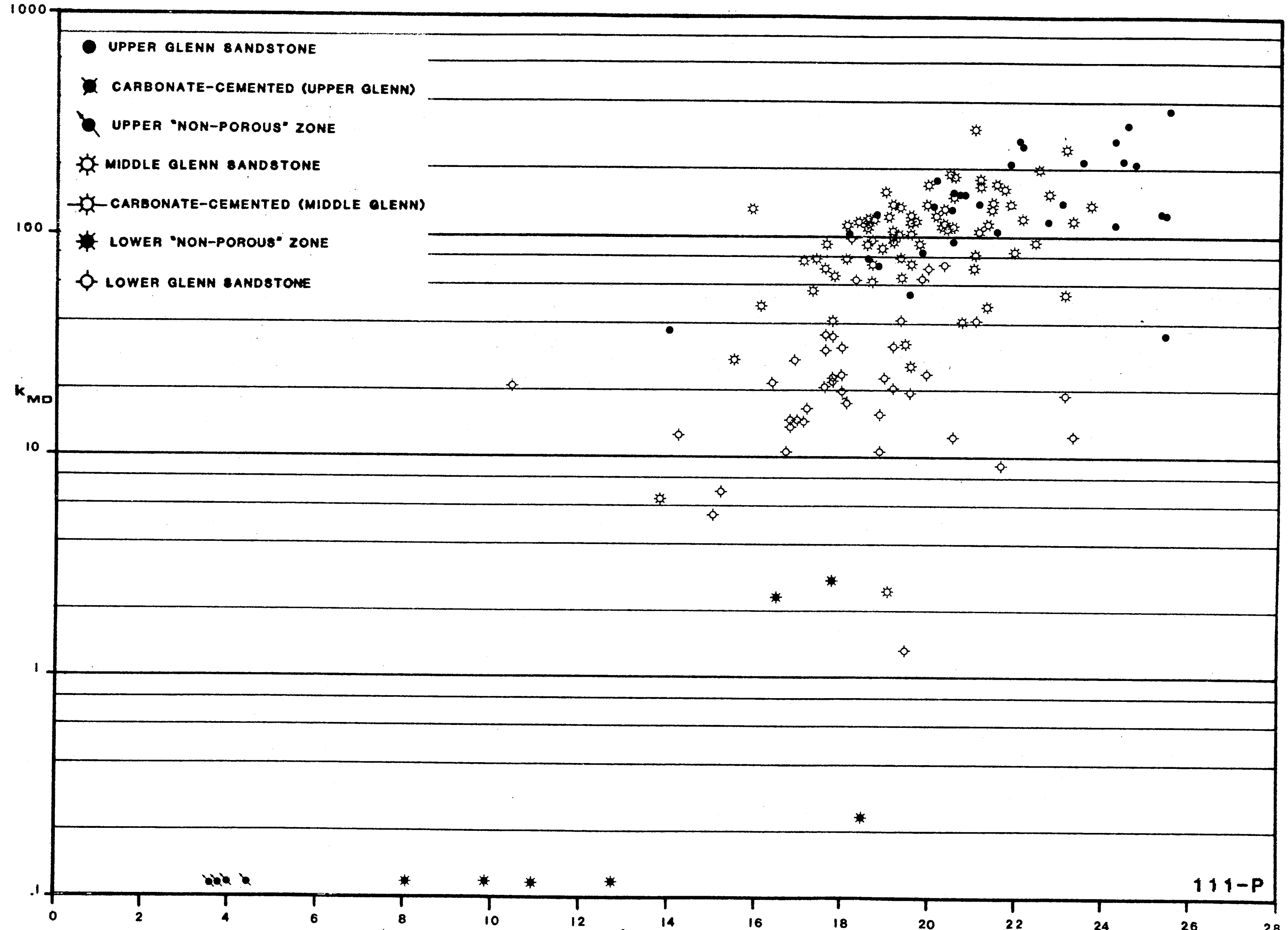


Figure 105. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 111-P

TABLE XIII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 111-P
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
		CONVENTIONAL PLUG ANALYSIS					
	1446.0-53.0						SH W/SD STKS
1	1453.0-54.0	1.3	14.0	37.9	36.2		SD,SLTY
2	1454.0-55.0	32.0	14.6	32.4	33.5		SD
3	1455.0-56.0	5.9	13.9	29.5	48.2		SD,SLTY
4	1456.0-57.0	139.0	20.1	35.1	49.5		SD
5	1457.0-58.0	213.0	24.8	36.6	50.9		SD
6	1458.0-59.0	113.0	24.3	32.7	50.0		SD
7	1459.0-60.0	222.0	24.5	25.3	51.9		SD
8	1460.0-61.0	278.0	24.3	23.1	49.7		SD
9	1461.0-62.0	127.0	25.5	26.6	51.1		SD
10	1462.0-63.0	35.0	25.4	24.1	52.1		SD
11	1463.0-64.0	388.0	25.6	19.7	51.0		SD
12	1464.0-65.0	127.0	25.4	27.3	51.4		SD
13	1465.0-66.0	332.0	24.6	27.4	51.4		SD
14	1466.0-67.0	225.0	23.6	24.6	52.3		SD
15	1467.0-68.0	142.0	23.1	27.9	51.9		SD
16	1468.0-69.0	117.0	22.8	32.2	48.9		SD
17	1469.0-70.0	264.0	22.2	31.1	49.7		SD
18	1470.0-71.0	218.0	22.6	28.9	47.2		SD
19	1471.0-72.0	159.0	20.7	34.5	46.7		SD
20	1472.0-73.0	125.0	18.8	26.6	46.2		SD
21	1473.0-74.0	96.0	20.6	21.3	49.8		SD
22	1474.0-75.0	159.0	20.6	17.7	46.1		SD
23	1475.0-76.0	142.0	21.2	18.2	47.2		SD
24	1476.0-77.0	54.0	19.6	20.0	45.0		SD
25	1477.0-78.0	278.0	22.1	33.3	48.5		SD
26	1478.0-79.0	156.0	20.8	33.5	46.4		SD
27	1479.0-80.0	182.0	20.2	25.5	43.8		SD
28	1480.0-81.0	216.0	21.9	31.8	48.8		SD
29	1481.0-82.0	134.0	20.5	24.2	45.5		SD
30	1482.0-83.0	108.0	21.8	30.9	47.9		SD
31	1483.0-84.0	74.0	18.8	29.4	45.6		SD
32	1484.0-85.0	79.0	18.6	30.9	43.1		SD
	1485.0-1490.0	LOST CORE					
33	1490.0-91.0	85.0	19.9	25.1	45.9		SD
34	1491.0-92.0	100.0	18.2	26.9	48.3		SD
35	1492.0-93.0	36.0	14.0	31.4	51.8		SD
36	1493.0-94.0	0.1	3.9	0.0	73.5		SD,SLTY
37	1494.0-95.0	<0.1	3.5	0.0	71.9		SD,SLTY
38	1495.0-96.0	0.1	4.3	0.0	75.4		SD,SLTY
39	1496.0-97.0	<0.1	3.7	0.0	73.6		SD,SLTY
40	1497.0-98.0	119.0	18.6	26.9	54.7		SD
41	1498.0-99.0	113.0	18.6	28.3	54.7		SD
42	1499.0-00.0	125.0	19.1	27.3	48.4		SD
43	1500.0-01.0	110.0	18.6	22.1	42.3		SD
44	1501.0-02.0	125.0	19.6	24.5	42.2		SD
45	1502.0-03.0	176.0	20.0	23.7	36.5		SD
46	1503.0-04.0	117.0	19.6	30.7	35.7		SD
47	1504.0-05.0	113.0	18.1	29.4	39.4		SD
48	1505.0-06.0	102.0	19.6	25.3	44.4		SD
49	1506.0-07.0	88.0	18.9	10.2	45.5		SD
50	1507.0-08.0	27.0	15.5	34.3	51.8		SD
51	1508.0-09.0	113.0	20.3	26.7	50.7		SD
52	1509.0-10.0	113.0	20.3	26.7	55.7		SD
53	1510.0-11.0	25.0	19.6	20.9	45.5		SD,SL/SHY
54	1511.0-12.0	56.0	17.3	18.0	39.0		SD
55	1512.0-13.0	66.0	17.8	29.9	36.2		SD
56	1513.0-14.0	103.0	20.3	19.5	43.0		SD
57	1514.0-15.0	48.0	21.4	32.5	46.2		SD
58	1515.0-16.0	142.0	19.2	18.4	45.0		SD
59	1516.0-17.0	71.0	21.8	28.7	44.3		SD
60	1517.0-18.0	193.0	22.5	26.2	41.0		SD
61	1518.0-19.0	11.0	16.9	23.1	58.5		SD,SLTY
62	1519.0-20.0	4.4	12.4	24.4	44.0		SD,SLTY
63	1520.0-21.0	11.0	16.0	25.5	42.7		SD,SLTY
64	1521.0-22.0	32.0	19.5	29.9	46.9		SD
65	1522.0-23.0	15.0	19.5	16.0	47.9		SD
66	1523.0-24.0	6.6	13.8	23.2	53.2		SD,SLTY,SHY
67	1524.0-25.0	42.0	17.8	18.6	47.6		SD
68	1525.0-26.0	41.0	20.8	24.5	39.3		SD
69	1526.0-27.0	2.3	19.1	34.3	40.9		SD,SLTY,SHY
70	1527.0-28.0	48.0	16.1	44.9	46.8		SD
71	1528.0-29.0	54.0	23.2	26.4	42.6		SD

TABLE XIII (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.	DESCRIPTION
72	1529.0-30.0	118.0	23.4	33.4	41.5		SD
73	1530.0-31.0	142.0	23.8	28.9	42.2		SD
74	1531.0-32.0	122.0	22.2	22.2	40.8		SD
75	1532.0-33.0	144.0	21.9	23.6	42.9		SD
76	1533.0-34.0	134.0	15.9	33.1	49.9		SD
77	1534.0-35.0	110.0	20.6	18.5	40.3		SD
78	1535.0-36.0	119.0	19.7	22.3	41.1		SD
79	1536.0-37.0	105.0	19.2	20.4	41.4		SD
80	1537.0-38.0	91.0	19.8	24.6	40.1		SD
81	1538.0-39.0	96.0	19.0	21.7	41.0		SD
82	1539.0-40.0	79.0	19.4	21.4	43.5		SD
83	1540.0-41.0	85.0	18.7	22.3	41.1		SD
84	1541.0-42.0	91.0	18.6	17.5	40.8		SD
85	1542.0-43.0	96.0	19.2	20.4	41.8		SD
86	1543.0-44.0	117.0	21.4	16.9	46.0		SD
87	1544.0-45.0	196.0	20.5	18.9	42.6		SD
88	1545.0-46.0	156.0	20.6	19.7	44.5		SD
89	1546.0-47.0	173.0	21.2	16.0	47.0		SD
90	1547.0-48.0	168.0	21.8	17.5	48.5		SD
91	1548.0-49.0	142.0	20.0	22.8	53.5		SD
92	1549.0-50.0	190.0	20.6	24.8	49.1		SD
93	1550.0-51.0	79.0	17.4	26.0	52.1		SD
94	1551.0-52.0	182.0	21.2	17.0	45.0		SD
95	1552.0-53.0	235.0	23.2	18.0	47.2		SD
96	1553.0-54.0	110.0	20.4	23.3	46.4		SD
97	1554.0-55.0	144.0	21.5	19.7	48.9		SD
98	1555.0-56.0	127.0	20.2	24.2	50.7		SD
99	1556.0-57.0	136.0	20.4	22.3	48.8		SD
100	1557.0-58.0	162.0	19.0	22.8	48.7		SD
101	1558.0-59.0	91.0	17.6	17.5	50.0		SD
102	1559.0-60.0	77.0	17.1	16.2	53.0		SD
103	1560.0-61.0	79.0	18.1	17.0	50.9		SD
104	1561.0-62.0	62.0	18.7	26.0	50.9		SD
105	1562.0-63.0	117.0	18.4	16.5	51.8		SD
106	1563.0-64.0	100.0	19.2	24.2	50.8		SD
107	1564.0-65.0	139.0	19.3	16.9	49.6		SD
108	1565.0-66.0	105.0	21.2	17.2	46.1		SD
109	1566.0-67.0	85.0	22.0	30.7	46.9		SD
110	1567.0-68.0	82.0	21.1	20.8	45.4		SD
111	1568.0-69.0	77.0	19.6	20.1	46.2		SD
112	1569.0-70.0	65.0	19.4	26.3	48.3		SD
113	1570.0-71.0	71.0	17.6	26.8	46.5		SD
114	1571.0-72.0	208.0	22.6	25.5	45.4		SD
115	1572.0-73.0	315.0	21.1	27.7	49.2		SD
116	1573.0-74.0	136.0	21.5	27.4	45.1		SD
117	1574.0-75.0	179.0	21.6	21.9	48.0		SD
118	1575.0-76.0	159.0	22.8	16.9	49.4		SD
119	1576.0-77.0	<0.1	8.0	13.5	60.6		SD,SHY
120	1577.0-78.0	0.1	9.8	6.4	69.3		SD,SLTY
121	1578.0-79.0	0.2	18.5	15.6	66.1		SD,SLTY
122	1579.0-80.0	2.1	16.5	12.6	63.3		SD,SLTY
123	1580.0-81.0	2.6	17.8	11.6	66.1		SD,SLTY
124	1581.0-82.0	<0.1	12.7	0.0	67.8		SD,SLTY,SHY
125	1582.0-83.0	<0.1	10.9	10.1	69.6		SD,SLTY,SHY
126	1583.0-84.0	10.0	18.9	10.7	67.4		SD,SLTY
127	1584.0-85.0	41.0	19.4	9.2	69.4		SD
128	1585.0-86.0	42.0	21.1	8.3	68.1		SD
129	1586.0-87.0	9.6	18.7	7.2	67.7		SD,SLTY
130	1587.0-88.0	22.0	19.0	8.3	72.2		SD
131	1588.0-89.0	1.2	19.5	9.2	70.3		SD,SLTY
132	1589.0-90.0	20.0	19.2	9.4	71.7		SD
133	1590.0-91.0	19.0	19.6	10.5	76.8		SD
134	1591.0-92.0	12.0	20.6	9.8	76.0		SD,SLTY
135	1592.0-93.0	23.0	20.0	7.8	76.8		SD
136	1593.0-94.0	5.1	15.0	9.4	72.0		SD,SLTY
137	1594.0-95.0	63.0	18.3	7.6	72.7		SD
138	1595.0-96.0	74.0	20.4	6.4	79.7		SD
139	1596.0-97.0	6.6	15.2	5.4	78.5		SD,SLTY
140	1597.0-98.0	8.8	21.8	4.8	77.2		SD,SLTY
141	1598.0-99.0	18.0	23.2	5.9	77.7		SD
142	1599.0-00.0	17.0	18.1	5.5	79.6		SD
143	1600.0-01.0	10.0	16.7	8.1	78.9		SD,SLTY
144	1601.0-02.0	31.0	19.2	5.2	75.6		SD
145	1602.0-03.0	21.0	16.4	6.2	78.4		SD
146	1603.0-04.0	23.0	18.0	5.0	77.3		SD
147	1604.0-05.0	12.0	23.4	4.5	77.7		SD,SLTY
148	1605.0-06.0	23.0	17.8	7.5	76.3		SD
149	1606.0-07.0	22.0	17.8	3.2	79.1		SD
150	1607.0-08.0	31.0	18.0	5.6	74.9		SD
151	1608.0-09.0	19.0	18.0	7.6	75.5		SD
152	1609.0-10.0	71.0	20.0	6.4	78.8		SD
153	1610.0-11.0	34.0	17.8	4.3	78.5		SD
154	1611.0-12.0	13.0	16.8	4.7	74.8		SD,SLTY
155	1612.0-13.0	14.0	16.8	6.0	72.8		SD,SLTY

TABLE XIII (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
156	1613.0-14.0	15.0	18.9	5.2	76.4		SD,SLTY
157	1614.0-15.0	20.0	10.4	8.4	77.5		SD
158	1615.0-16.0	27.0	16.8	8.0	72.7		SD
159	1616.0-17.0	12.0	14.2	5.6	68.0		SD,SLTY
160	1617.0-18.0	14.0	17.1	9.2	65.6		SD,SLTY
161	1618.0-19.0	16.0	17.2	12.2	65.7		SD
162	1619.0-20.0	24.0	17.0	12.0	68.7		SD
163	1620.0-21.0	30.0	17.6	12.7	69.1		SD
164	1621.0-22.0	35.0	17.6	13.4	70.4		SD
165	1622.0-23.0	64.0	19.9	16.9	72.8		SD
166	1623.0-24.0	0.1	14.2	11.6	77.8		SD,SLTY

WILLIAM BERRYHILL NO. 116-I

(2281 FWL, 1782 FSL) NE/4, SEC. 17, T.17N, R.12E

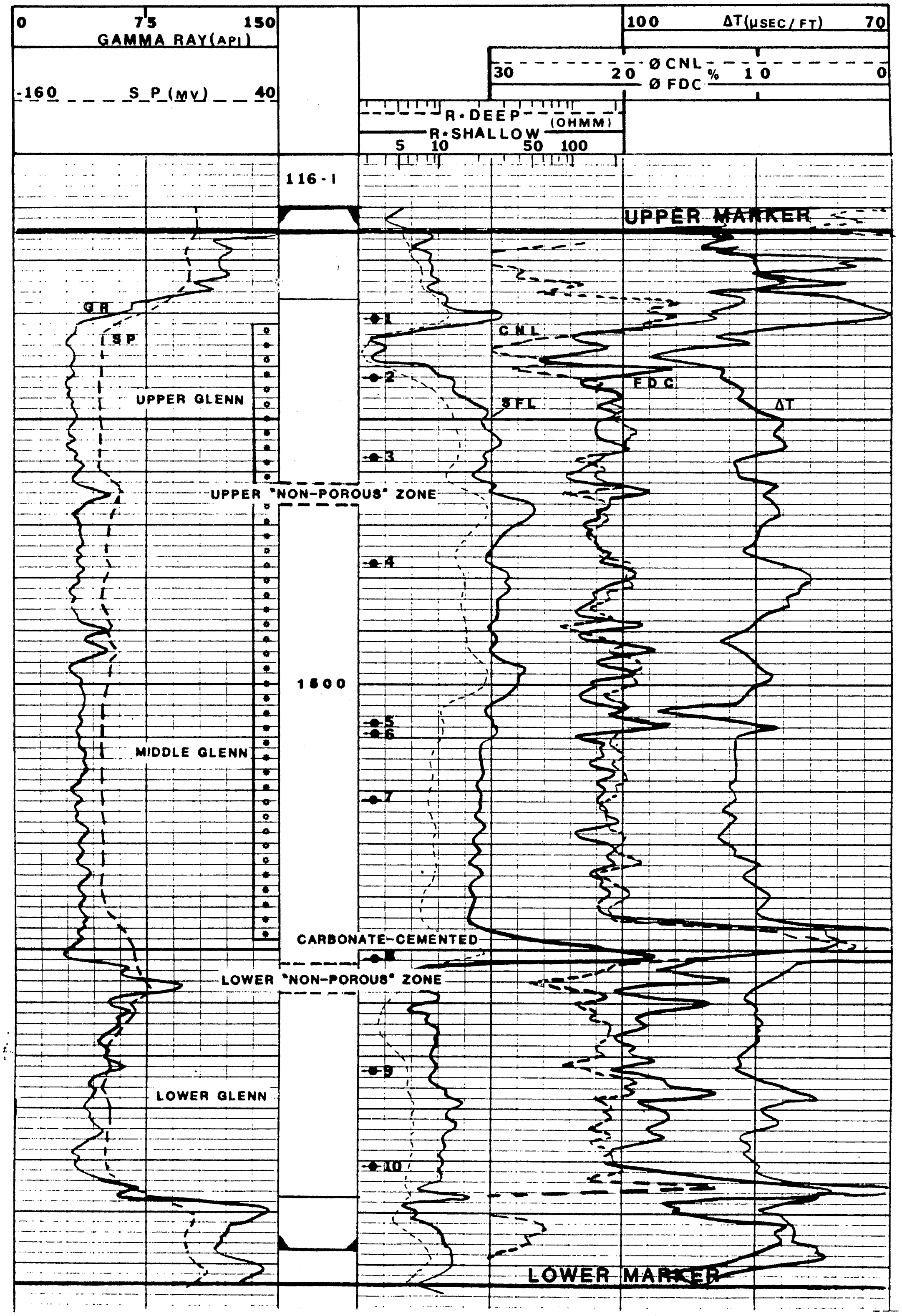


Figure 106. Well-log Signatures, Glenn Sandstone, William Berryhill No. 116-I

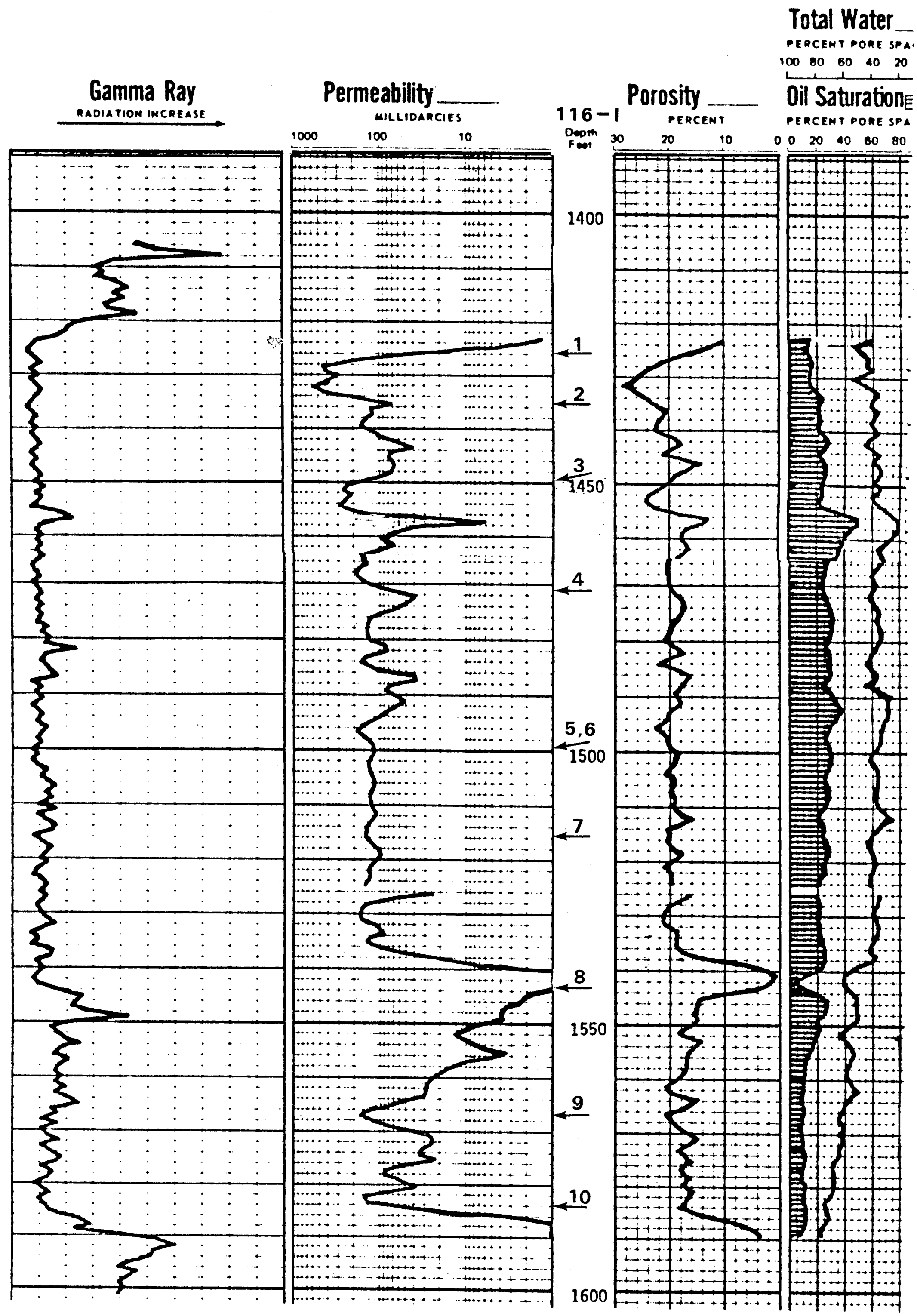


Figure 107. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 116-I

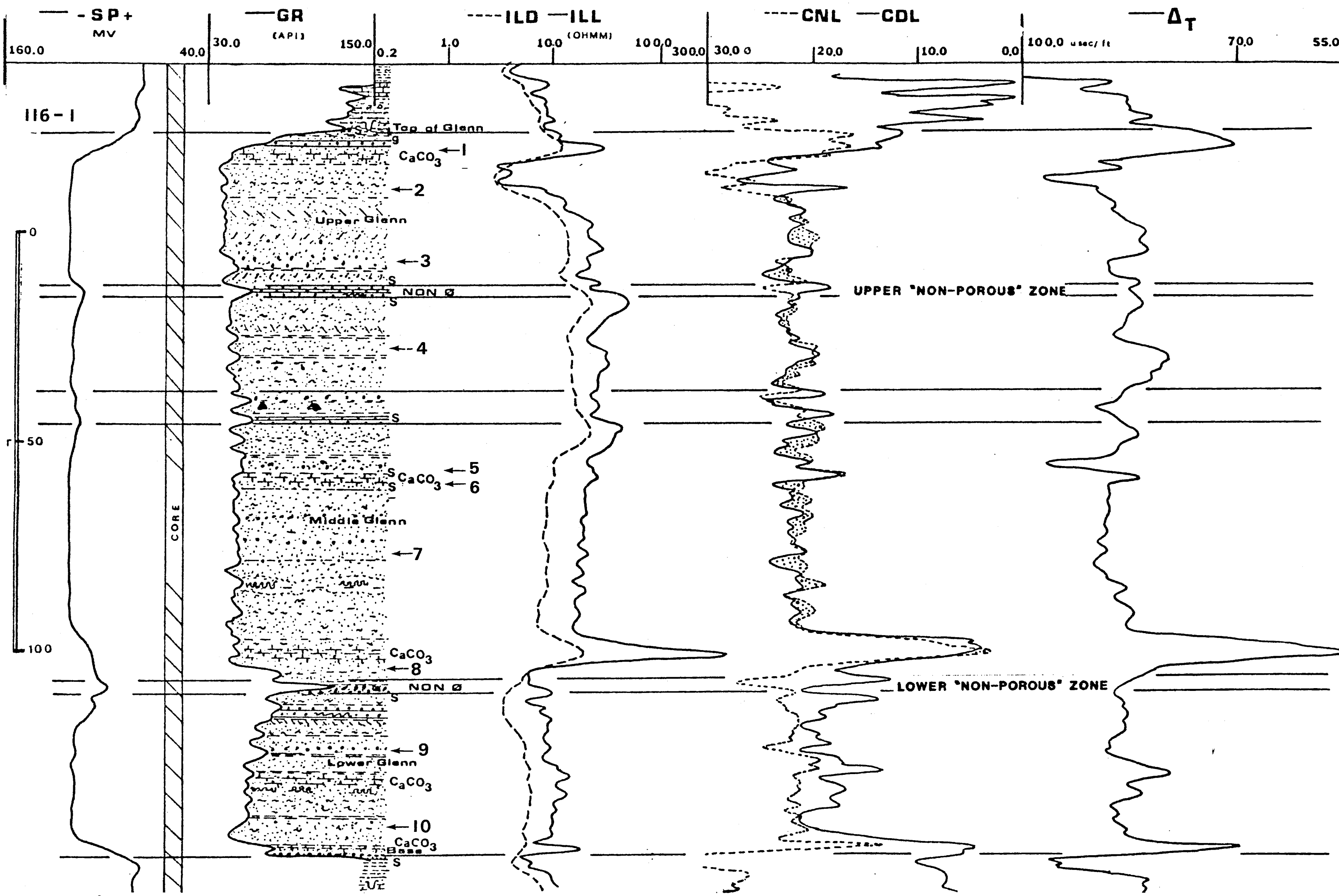


Figure 108. Log-signature, General Lithology, and Sedimentary-features, Glenn Sandstone, William Berryhill No. 116-I

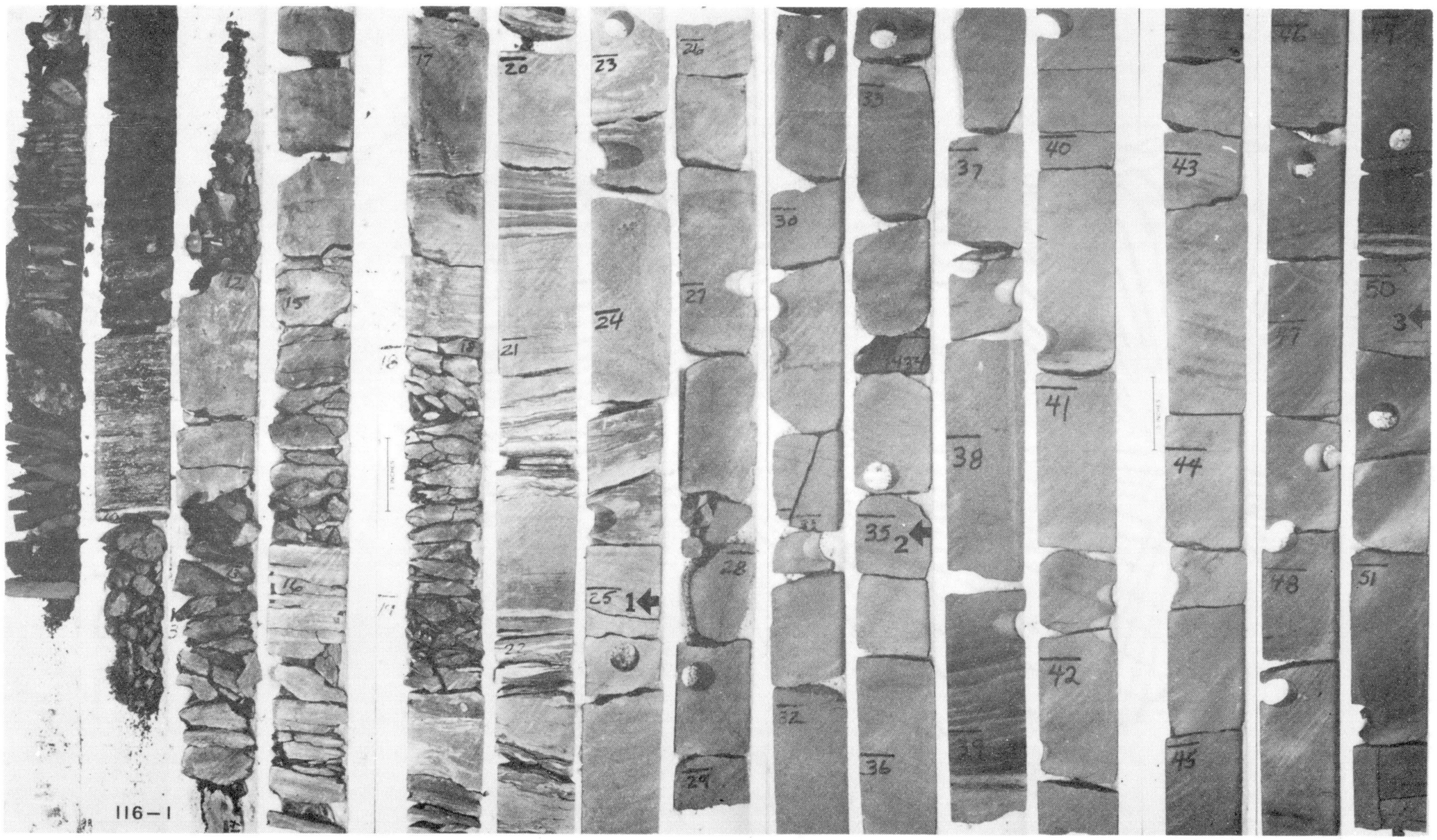
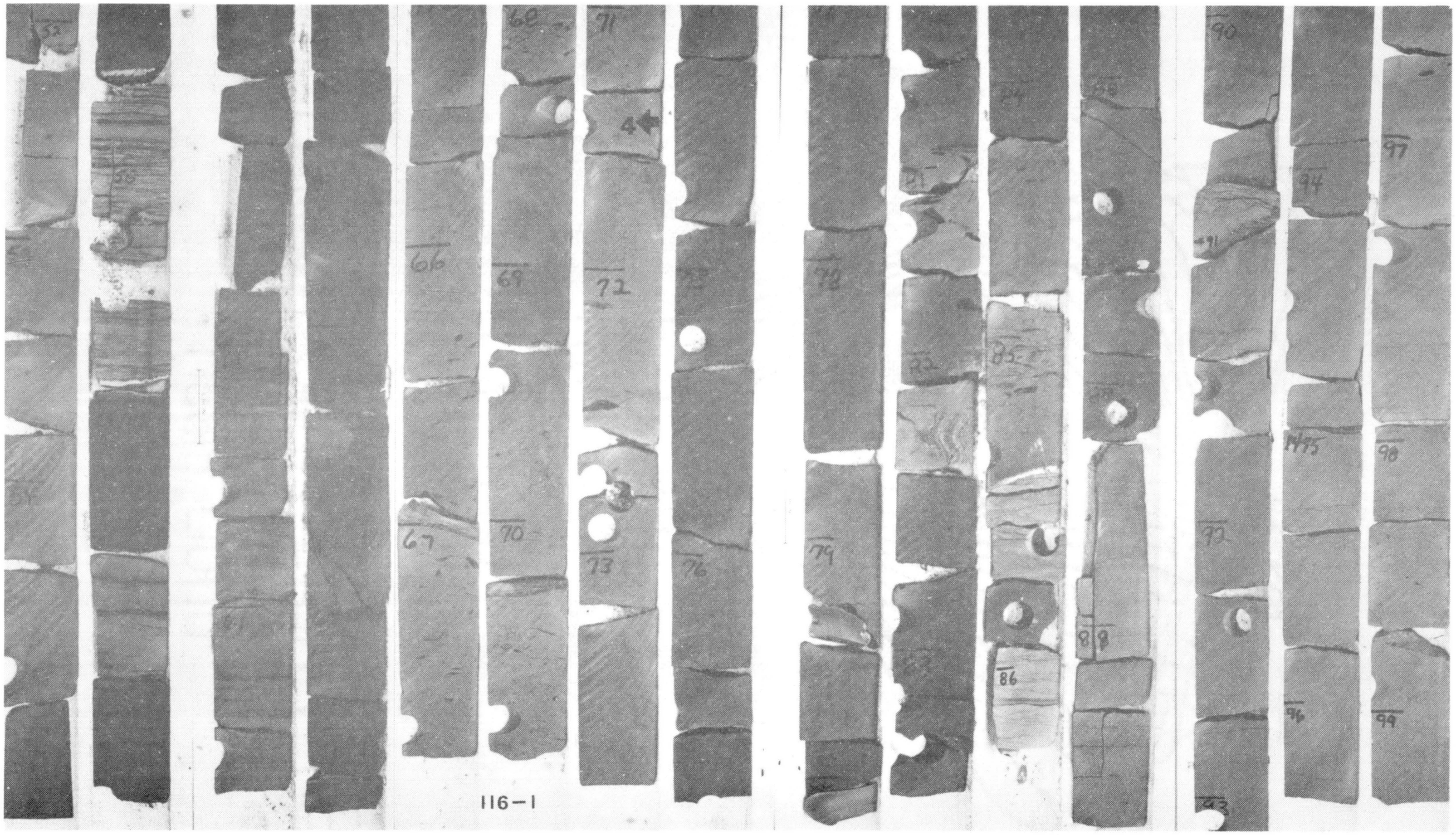
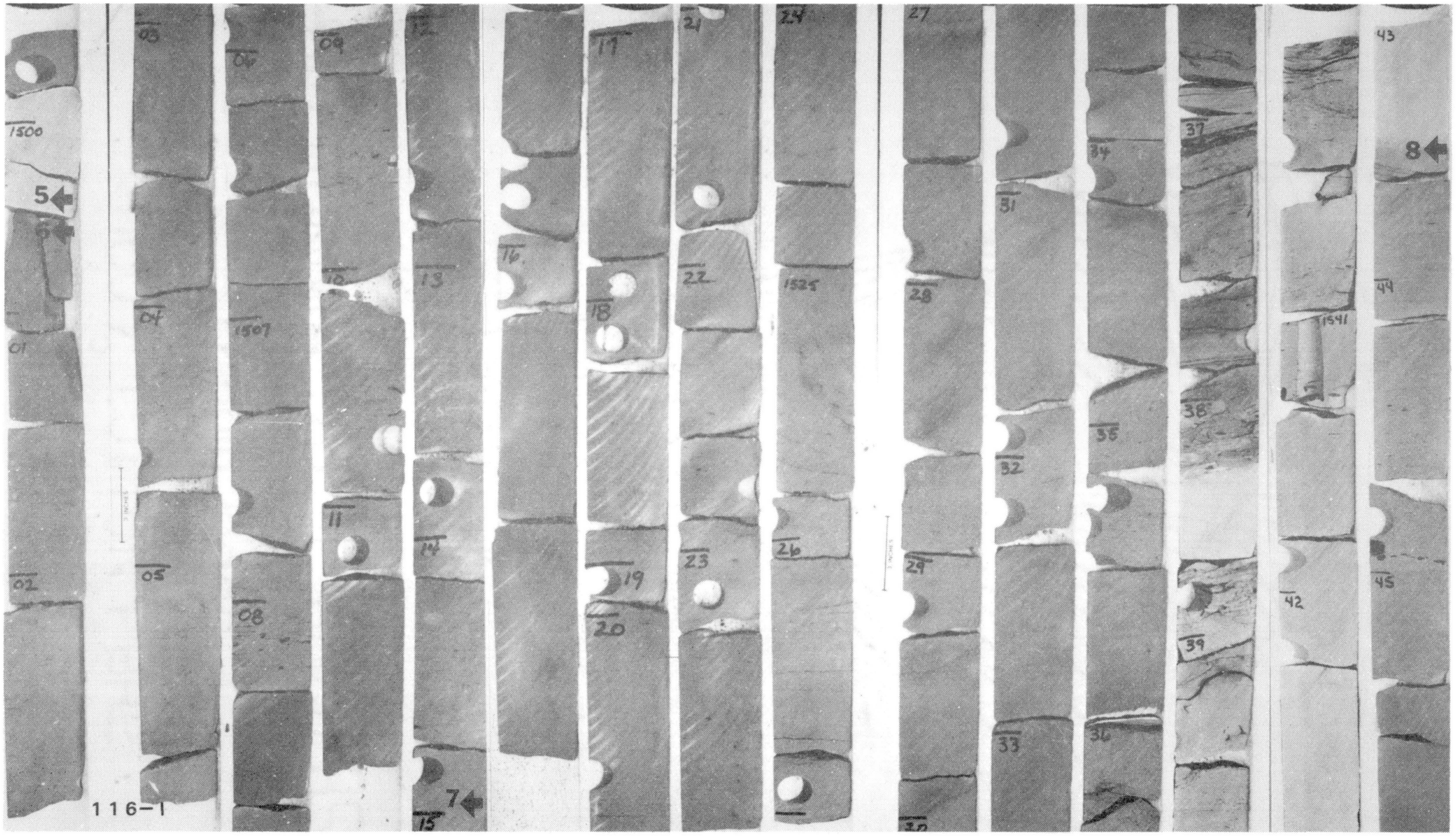


Figure 109. Glenn Sandstone, William Berryhill No. 116-I, 1405.0 - 51.9 ft., Showing Upper Marker at 1409.0 - 10.0 ft., and a Portion of Upper Glenn



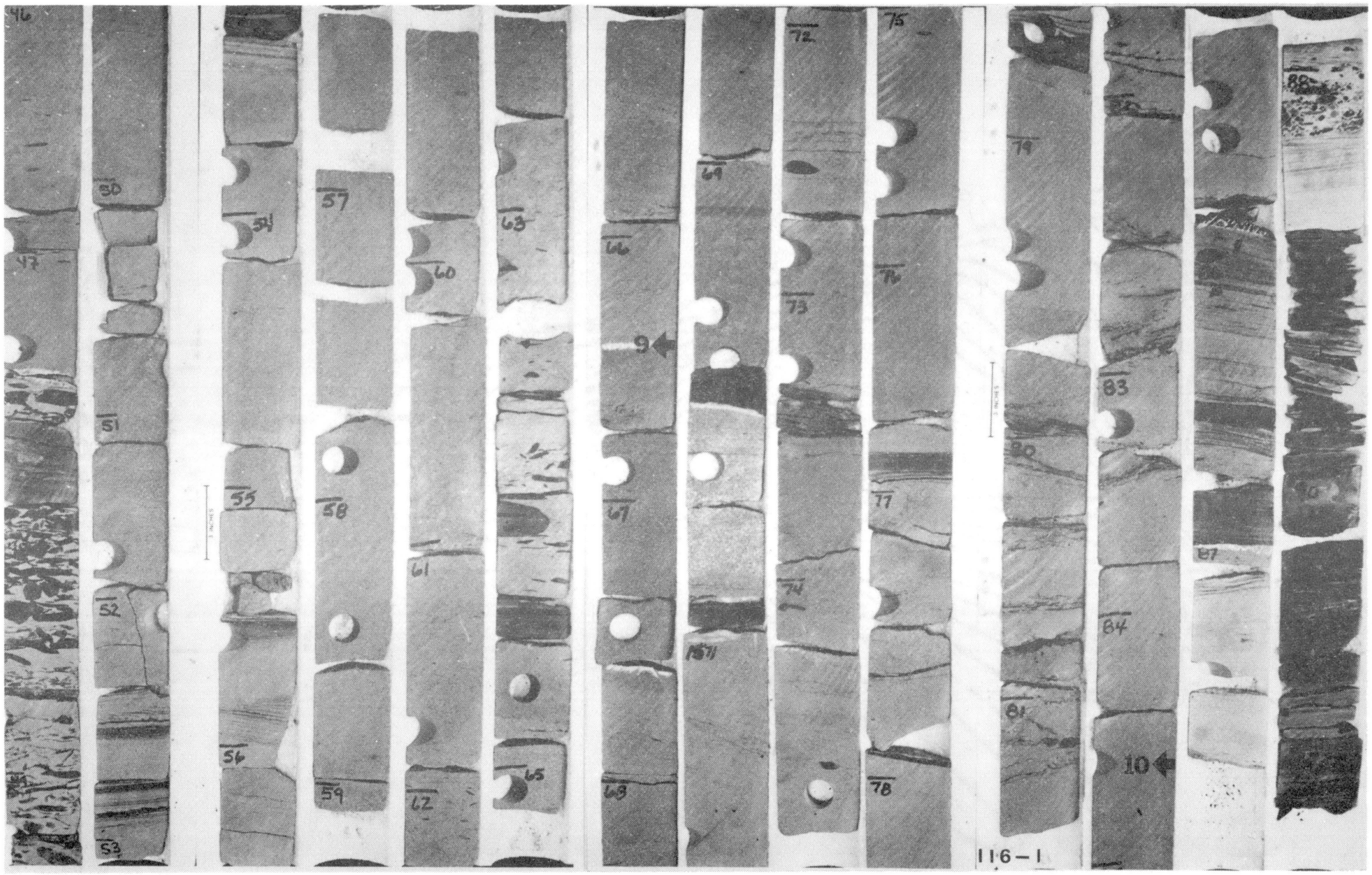
Note: Glenn Sandstone, William Berryhill No. 116-I, 1451.9 - 99.5 ft., Showing Upper "Non-Porous" Zone (1455.5 - 57.0 ft.), and a Portion of the Middle Glenn

Figure 109 (Continued)



Note: Glenn Sandstone, William Berryhill No. 116-I, 1499.8 - 1546.0 ft., Showing a Portion of the Middle Glenn, and Calcite-cemented Intervals (1499.9 - 1500.5 ft., and 1538.4 - 43.4 ft.)

Figure 109 (Continued)



Note: Glenn Sandstone, William Berryhill No. 116-I, 1546.0 - 91.5 ft., Showing the Lower "Non-Porous" Zone (1547.4 - 49.4 ft.), and Lower Glenn.

Figure 109 (Continued)

William Berryhill No. 116-I
(2281 FWL, 1782 FSL, NE/4, Sec. 17)

Cored Interval: 1405.0 - 1601.0 ft.
Correlation: Core depth six to eight feet shallow to log depth

Core Depth (Ft.)	Core Description
1405.0 - 09.0	sh; blk, carb, fis, bit str
09.0 - 10.0	lst; dk gy - blk, shy, bur fos (Plcy)
10.0 - 17.0	sh; gy, slty, lam, f calc vn, sid nod, brit
17.0 - 18.0	sltst; gy - lt gy, f lam, bur, flow, sl hem stn
18.0 - 19.5	as abv, brit - broken
19.5 - 22.5	intbd ss & sh; gy - dk gy, bur, fn lam, flow
	Upper Glenn
22.5 - 24.5	ss; gy - lt gy, vf gr, sl calc, mot, flow struc
24.5 - 24.9	sltst; gy - dk gy, fn intlam sh, flow, bur, hem stn
24.9 - 26.5	ss; (abrupt ctc w/ overlying sltst) gy - tan, vf - m gr, p srtd, c gr sbmem in apr ripple-lam, or s sc trough xbdg (Sample 116-1, 1425.0 ft.)
26.5 - 30.3	ss; gy, f - m gr, w rd, g - mod srt, vis por, fri, apr mas bdg
30.3 - 33.0	ss; gy, f - m gr, sevral scour surf, m sc xbdg
33.0 - 34.0	ss; dk gy, f - m gr, abnt carb fil, flow
34.0 - 34.1	sh; blk - dk gy, abrupt ctc w/ ss abv & blw
34.1 - 37.0	ss; gy, f-m gr, m sc xbdg (Sample 116-2, 1435.1 ft.)

37.0 - 39.4	ss; gy, f - m gr, apr mas bdg, carb fil, grdg downw into a dk gy - blk, dd o. stn ss w/ slt inclined bdg (low ang xbg?), scour surf ◇ 39.4 ft.
39.4 - 43.0	ss; gy, f - m gr, apr mas bdg, sev scour surfs, s (1 x 1.5 cm) sid pbl ◇ 42.6 ft.
43.0 - 47.0	ss; gy, f - m gr, low ang xbdg, abnt carb fil
47.0 - 49.9	ss; dk gy, vf - f gr, apr mas bdg, near hztl bdg, carb fil, few s (<.5 cm) sid pbls
49.9 - 50.0	sltst; lt gy, fn intbd carb mat (blk)
50.0 - 54.5	ss; gy - dk gy, vf - f gr, low & incld bdg, grdg downw into a dk gy - blk, dd o. stn ss (Sample 116-3, 50.1 ft.)
54.5 - 55.5	ss; brn - dk brn, apr mas bdg, resd - dd o. stn
55.5 - 57.0	sltst/ss; gy - blk, fn intbd, current-ripple lam, abrupt ctc w/ss abv & blw (Upper "Non-Porous" Zone)

<u>Middle Glenn</u>

57.0 - 57.5	ss; brn, vf - f gr, apr mas bdg, o. stn.
57.5 - 58.0	sltst; gy - dk gy, intlam carb sh, abnt carb fils
58.0 - 59.8	ss; brn, vf - f gr, sl incld bdg, carb lam, o. stn, decr o. stn, downw
59.8 - 61.8	ss; dk gy - gy, vf - f gr, wvy, near hztl carb lams, sl o. stn grdg downw into a apr mas bdd ss
61.8 - 74.0	ss; gy - lt gy, vf - f gr, apr mas bdd, scat sid pbls, flat elg sh rip-up clast, sh ptgs ◇ 67.0 ft., and 70.0 ft. (Sample 116-4, 71.4 ft.)
74.0 - 81.0	ss; gy, vf - f gr, apr mass bdg, v few pbls or clasts as abv, sh ptgs ◇ 79.3 ft., and 80.0 ft.
81.0 - 82.0	ss; lt gy - gy, vf - f gr, 5 to 7 flat-elg sh rip-up clasts, scat

82.0 - 82.4	ss; lt gy, vf - f gr, nearly equant clast (4 x 6 cm) of ireg, wvy - bdd, carb sltst
82.4 - 84.1	ss; brn, vf - f gr, apr mas bdg, few flat-elg sh rip-up clasts, sl o. stn
84.1 - 85.5	ss; gy, vf - f gr, abnt sh rip-up clasts, abrupt basal ctc w/ underlying sltst
85.5 - 86.2	sltst; lt gy - buff, f ripple-lam w/ 1.5 cm sh ptg
86.2 - 90.9	ss; gy, vf - f gr, more-or-less hztl bdd, mas apr, sl o. stn carb fils.
90.9 - 91.0	ss; as abv, incr carb mat, some flow & relatively hi ang bdg plane
91.0 - 99.9	ss; gy, vf - f gy, apr mass bdg, few scat s sid pbl, sl o. stn
99.9 - 1500.5	ss; buff - lt tan, vf - f gr, calc cmt, abrupt trans w/ non calc cmt ss abv & blw (Sample 116-5 & 116-6, 1500.5 ft. & 1500.51 ft.)
1500.5 - 36.0	ss; gy, vf - f gr, apr mas bdg, few scat sid pbls, poss slump or flow feature ◇ 25.2 ft. to 26.0 ft., scour ◇ 27.2 ft., carb ptg (1 cm) ◇ 36.0 ft., (Sample 116-7, 1515.0 ft.)
36.0 - 38.2	ss; gy - dk gy, vf - f gr, relatively abnt carb lam & s sid pbls, incrg carb downw, abrupt trans w/ calc cmt ss ◇ 38.2 ft.
38.2 - 43.4	ss; buff - dk gy, vf - f gr, calc cmt, abnt carb mat, few re sid pbls, apr mas bdg inpart, abrupt basal trans w/ non-calc cmt ss blw (Sample 116-8, 43.4 ft.)
43.4 - 47.4	ss; gy, vf - f gr, sl incld bdg, few bdd sid pbls ◇ 44.9 ft., flat-elg sh rip-up clasts ◇ 46.5 ft. & 47.0 ft., abrupt basal ctc. ◇ 47.4 ft.
47.4 - 49.4	ss/sh; lt gr - blk, vf - f gr, abnt sh rip-up clasts, (varying sizes and shapes, (<.1 x .5 cm to 1 x 3 cm) (Lower "Non-Porous" Zone)
	<u>Lower Glenn</u>
49.4 - 52.5	ss; gy, vf - f gr, apr mas bdg, carb fil, few s sid pbls (< .5 x .5 cm)

52.5 - 53.4	ss/sh; dk gy - blk, vf - f gr, apr planar bdg, sh/sltst ptg ◇ 53.2 ft.
53.4 - 63.0	ss; gy - lt gy, vf - f gr, apr mas bdg, faint apr of planar bdg near top (53.4 - 53.45 ft.)
63.0 - 64.5	ss; lt gy, vf - f gr, abnt flat-elg sh rip-up clasts (<.5 x 1 cm), portion of a larger (2 x 4 cm), rd sh clast ◇ 64.0 ft., sh bd (4 cm) ◇ 64.5 ft., abrupt basal ctc ◇ 64.5 ft.
64.5 - 66.5	ss; gy, f - m gr, apr faint incld bdg (m sc xbdg ?), abrupt trans (scour surf ?) ◇ 64.9 ft. & 66.5 ft. (Note abrupt grain size change and relatively amount of matrix ◇ 66.5 ft., (cf Sample 116-9, 66.5 ft.)
66.5 - 67.5	ss; gy, vf - f gr, apr mas bdg, cly, carb
67.5 - 70.0	ss; gy, vf - f gr, apr mas bdg, poss flow, carb, abrupt corasening ◇ 68.3 ft., slty ◇ 69.0 - 69.4 ft.
70.0	sh; blk, dns (4 cm)
70.0 - 70.9	ss; lt gy, vf - f gr, pt calc cmt, aprs mot
70.9 - 71.0	sh; blk, dns, abrupt basal ctc
71.0 - 80.0	ss; gy, f - m gr, mas in pt, abnt carb fil along hztl bdg (72.5 ft.), one oblate sid pbl (1 x 2 cm) ◇ 75.5 ft., slty - carb intbd ◇ 73.4 ft., sh ptg ◇ 76.9 ft., incld carb ptg ◇ 77.9 ft., intbd sh/ss ◇ 78.6 ft.
80.0 - 85.9	ss; gy - dk gy, f - m gr, abnt carb lam, s rd sid pbls, v thin (2 cm) coaly ptg ◇ 85.9 ft. ((Sample 116-10, 84.5 ft.)
85.9 - 87.0	ss/sh; gy - dk gy, sl incld bdg, f lam in assoc w/ thin bds of sh, abrupt basal ctc
87.0 - 87.9	ss; buff - lt gy, f - m gr, low ang bdg, carb lam
87.9 - 88.2	pbl cgl; lt gy - blk - gy, flat-elg to w rd pbls of sh, sid, sltst, & carb mat
88.2 - 88.6	ss; buff - gy, f - m gr, sl incld bdg, slty lams, abrupt basal ctc w/ sh blw (Base of Glenn)

88.6 - 92.0	sh; blk, carb, fis, scat sid nods
92.0 - 92.4	sh; blk - dk gy, slty, sft sed deform, flow ?
92.4 - 1601.0	slty sh; lt gy - dy gy - blk, f lam, conv bdg, bur

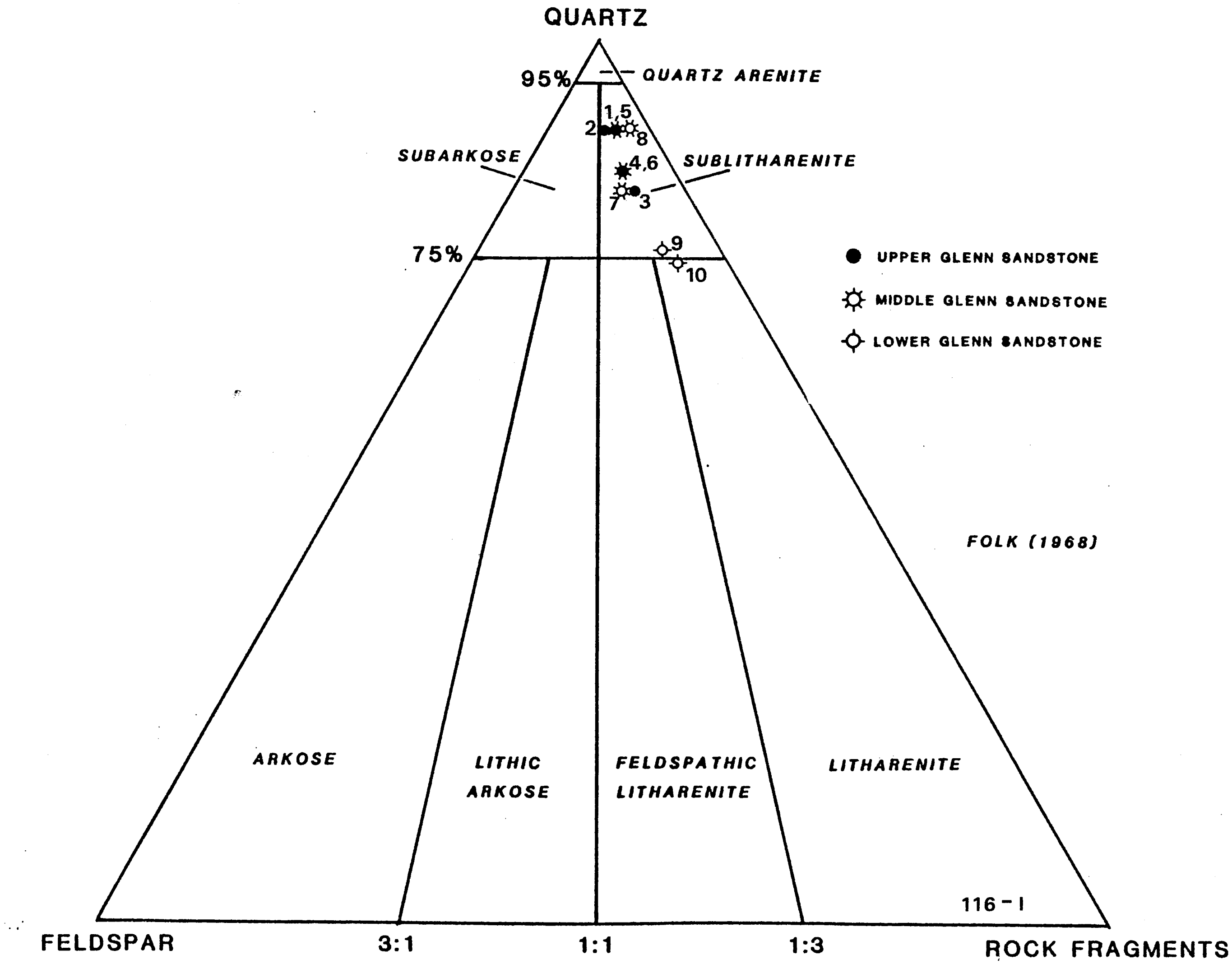


Figure 110. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 116-I

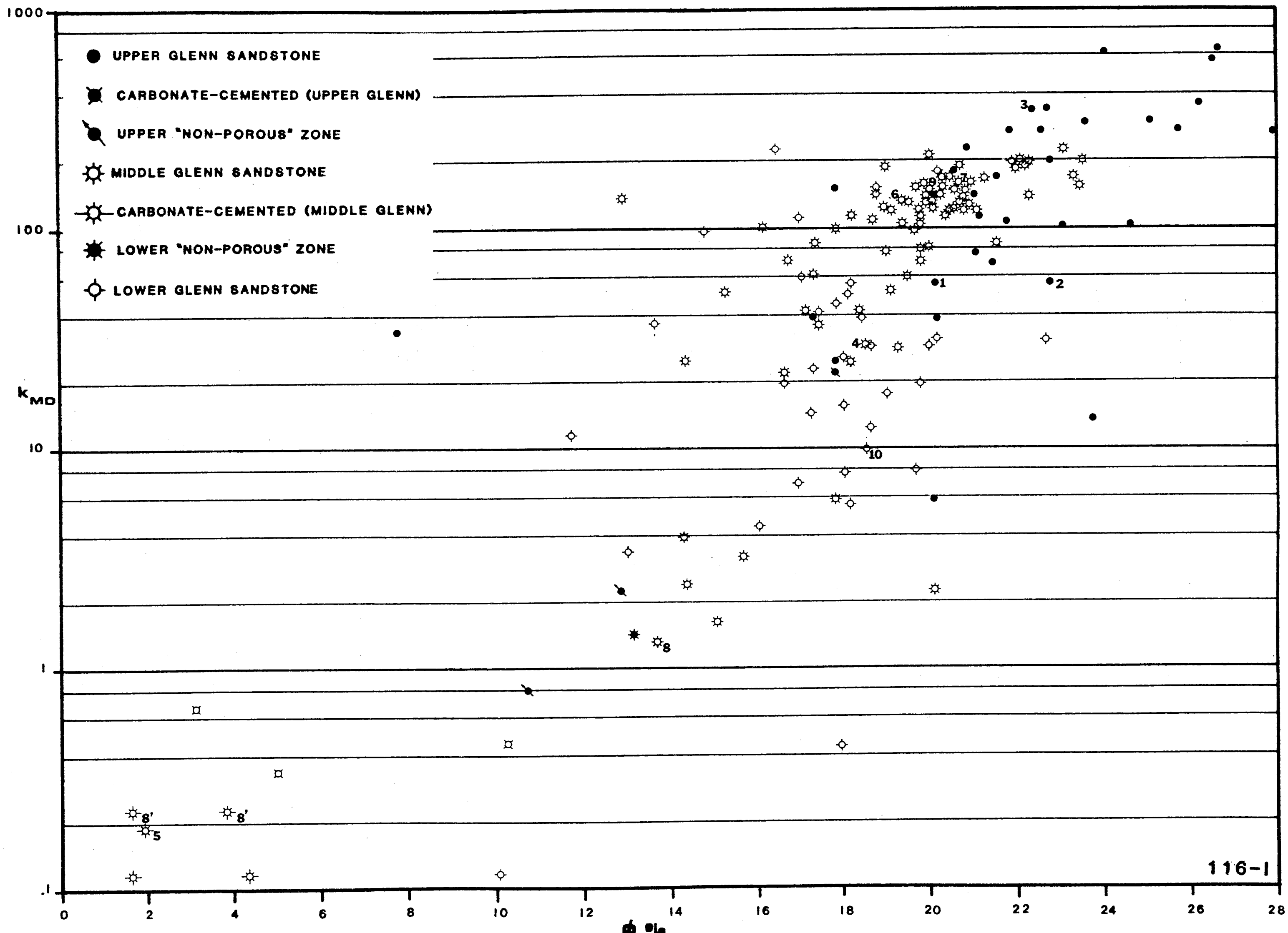


Figure 111. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 116-I

TABLE XIV

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 116-I
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
		CONVENTIONAL ANALYSIS					
	1405.0-22.0						SH W/SD STKS
1	1422.0-23.0	0.1	9.8	14.8	36.9		SD,SLTY,SL/CALC
2	1423.0-24.0	5.2	12.3	9.1	60.3		SD,SLTY
3	1424.0-25.0	0.9	16.3	10.3	48.5		SD,SLTY
4	1425.0-26.0 ←1	56.0	20.1	12.7	40.9		SD
5	1426.0-27.0	147.0	21.1	17.8	48.3		SD
6	1427.0-28.0	655.0	24.1	12.9	40.4		SD
7	1428.0-29.0	385.0	26.3	13.5	38.0		SD
8	1429.0-30.0	294.0	25.8	9.4	69.0		SD
9	1430.0-31.0	271.0	28.3	15.9	37.6		SD
10	1431.0-32.0	689.0	26.7	13.1	38.6		SD
11	1432.0-33.0	603.0	26.6	19.9	38.2		SD
12	1433.0-34.0	13.0	23.8	27.0	38.2		SD,SLTY
13	1434.0-35.0 ←2	57.0	22.8	19.1	50.2		SD,SLTY,CL/INCL
14	1435.0-36.0	188.0	20.6	17.9	30.5		SD
15	1436.0-37.0	69.0	21.5	21.7	42.3		SD
16	1437.0-38.0	177.0	21.6	20.6	42.2		SD
17	1438.0-39.0	201.0	22.8	19.4	40.6		SD
18	1439.0-40.0	102.0	23.1	16.9	32.9		SD
19	1440.0-41.0	153.0	17.8	28.0	46.6		SD
20	1441.0-42.0	38.0	17.3	26.4	45.8		SD,SLTY
21	1442.0-43.0	36.0	20.2	27.3	39.8		SD,SLTY
22	1443.0-44.0	78.0	21.1	18.9	32.6		SD
23	1444.0-45.0	107.0	21.8	19.4	40.9		SD
24	1445.0-46.0	33.0	7.6	28.8	39.3		SD,SLTY
25	1446.0-47.0	117.0	21.2	25.2	31.4		SD
26	1447.0-48.0	24.0	17.8	25.7	33.4		SD,SLTY
27	1448.0-49.0	142.0	20.1	25.0	43.2		SD
28	1449.0-50.0	240.0	20.9	23.5	32.0		SD
29	1450.0-51.0 ←3	359.0	22.4	22.2	31.1		SD
30	1451.0-52.0	105.0	24.7	23.7	45.6		SD
31	1452.0-53.0	319.0	25.1	19.6	33.3		SD
32	1453.0-54.0	298.0	22.6	21.2	35.6		SD
33	1454.0-55.0	286.0	21.9	27.7	27.7		SD
34	1455.0-56.0	0.7	10.5	52.7	18.3		SD,SLTY,SL/CALC
35	1456.0-57.0	2.1	12.7	54.0	22.3		SD,SLTY,SHY
36	1457.0-58.0	21.0	20.1	34.3	22.1		SD,SLTY,SL/SHY,M
37	1458.0-59.0	90.0	16.1	43.9	26.9		SD,SL/SHY,MIC
38	1459.0-60.0	103.0	19.8	34.8	25.8		SD
39	1460.0-61.0	71.0	16.7	32.9	34.2		SD
40	1461.0-62.0	51.0	15.2	33.7	38.3		SD,SL/SHY
41	1462.0-63.0	181.0	20.5	34.5	32.3		SD,MIC
42	1463.0-64.0	193.0	19.0	23.2	34.8		SD,MIC
43	1464.0-65.0	153.0	20.9	26.2	30.4		SD,MIC
44	1465.0-66.0	126.0	19.8	27.2	36.2		SD,MIC
45	1466.0-67.0	188.0	22.0	23.9	35.8		SD,MIC
46	1467.0-68.0	224.0	20.0	25.6	42.3		SD,MIC
47	1468.0-69.0	153.0	20.4	24.0	40.3		SD,CL/INCL
48	1469.0-70.0	166.0	21.0	20.9	36.6		SD,MIC
49	1470.0-71.0	52.0	19.1	26.3	41.8		SD,SL/CALC
50	1471.0-72.0 ←4	29.0	18.5	23.5	40.8		SD,SLTY
51	1472.0-73.0	62.0	17.3	29.4	41.5		SD,MIC
52	1473.0-74.0	43.0	18.4	27.2	35.8		SD,MIC
53	1474.0-75.0	102.0	17.8	29.3	35.7		SD
54	1475.0-76.0	147.0	20.3	29.7	35.2		SD
55	1476.0-77.0	146.0	20.0	30.5	37.3		SD,MIC
56	1477.0-78.0	138.0	20.0	29.1	33.5		SD,MIC
57	1478.0-79.0	162.0	20.7	28.7	33.1		SD
58	1479.0-80.0	124.0	20.8	28.7	35.0		SD,MIC
59	1480.0-81.0	117.0	20.4	21.4	36.3		SD
60	1481.0-82.0	3.7	14.2	26.7	43.4		SD,SLTY,SHY
61	1482.0-83.0	236.0	23.1	28.5	39.0		SD,MIC
62	1483.0-84.0	159.0	23.5	28.5	47.5		SD,MIC
63	1484.0-85.0	135.0	19.5	25.2	36.2		SD,MIC
64	1485.0-86.0	2.4	14.3	28.1	43.0		SD,SLTY,SH LAMS
65	1486.0-87.0	28.0	19.3	31.2	27.7		SD,SLTY
66	1487.0-88.0	102.0	16.1	11.2	54.6		SD
67	1488.0-89.0	100.0	19.7	36.3	31.8		SD
68	1489.0-90.0	60.0	19.5	29.5	27.3		SD
69	1490.0-91.0	43.0	17.1	33.3	29.3		SD,SL/SLTY
70	1491.0-92.0	72.0	19.8	42.1	30.7		SD,SL/SLTY
71	1492.0-93.0	87.0	21.6	30.5	25.4		SD
72	1493.0-94.0	102.0	19.8	36.0	30.4		SD,MIC
73	1494.0-95.0	177.0	23.4	27.9	32.6		SD,MIC
74	1495.0-96.0	196.0	22.2	24.6	33.5		SD

TABLE XIV (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
75	1496.0-97.0	193.0	20.7	25.6	36.3		SD
76	1497.0-98.0	124.0	20.5	24.8	32.4		SD
77	1498.0-99.0	131.0	20.9	27.5	35.9		SD
78	1499.0-00.0	114.0	18.2	29.6	40.7		SD
79	1500.0-01.0 ←5	131.0	19.4	27.9	44.2		SD,MIC
80	1501.0-02.0 ←6	159.0	20.3	28.5	40.6		SD,MIC
81	1502.0-03.0	124.0	19.1	27.0	36.4		SD,MIC
82	1503.0-04.0	141.0	22.3	22.5	35.2		SD,MIC
83	1504.0-05.0	110.0	18.7	25.1	37.0		SD
84	1505.0-06.0	131.0	20.1	24.2	37.5		SD,MIC
85	1506.0-07.0	124.0	20.6	26.2	39.2		SD,MIC
86	1507.0-08.0	159.0	19.7	27.1	37.3		SD
87	1508.0-09.0	103.0	19.4	26.6	37.0		SD
88	1509.0-10.0	165.0	19.9	24.5	36.8		SD
89	1510.0-11.0	79.0	19.8	21.5	30.6		SD
90	1511.0-12.0	139.0	12.8	13.8	22.4		SD
91	1512.0-13.0	138.0	20.0	24.4	37.7		SD,MIC
92	1513.0-14.0	153.0	20.9	24.2	39.0		SD,MIC
93	1514.0-15.0 ←7	167.0	20.7	22.5	40.7		SD
94	1515.0-16.0	143.0	20.8	21.2	41.3		SD
95	1516.0-17.0	126.0	20.1	25.6	47.8		SD
96	1517.0-18.0	112.0	19.8	25.9	36.1		SD
97	1518.0-19.0	86.0	17.3	26.4	44.9		SD
98	1519.0-20.0	126.0	21.1	21.7	35.2		SD,MIC
99	1520.0-21.0	134.0	20.7	22.4	39.5		SD
100	1521.0-22.0	155.0	20.9	23.1	43.0		SD,MIC
101	1522.0-23.0	122.0	19.0	22.4	42.4		SD,MIC
102	1523.0-24.0	165.0	21.0	17.7	41.7		SD,MIC
	1524.0-1525.0	TOO BROKEN FOR ANALYSIS					
103	1525.0-26.0	21.0	16.6	17.1	34.2		SD,SL/SLTY
104	1526.0-27.0	36.0	17.4	20.8	36.4		SD,SL/SLTY
105	1527.0-28.0	208.0	22.1	22.4	37.0		SD
106	1528.0-29.0	153.0	20.6	20.5	41.1		SD,MIC
107	1529.0-30.0	172.0	21.3	20.6	39.2		SD,MIC
108	1530.0-31.0	208.0	22.3	20.5	37.1		SD
109	1531.0-32.0	84.0	20.0	21.1	34.4		SD,SL/SLTY
110	1532.0-33.0	79.0	19.0	21.2	36.5		SD,SL/SLTY
111	1533.0-34.0	147.0	18.8	21.5	39.3		SD
112	1534.0-35.0	174.0	20.3	24.1	39.4		SD
113	1535.0-36.0	81.0	18.3	23.4	45.6		SD,SL/SLTY
114	1536.0-37.0	24.0	18.1	25.2	36.5		SD,SHY,LIG
115	1537.0-38.0	24.0	14.3	24.6	34.4		SD,SHY,LIG
116	1538.0-39.0	0.1	4.1	22.1	56.8		LM,SDY,SHY,LIG
117	1539.0-40.0	0.1	1.4	19.6	59.3		LM,SDY,SHY
118	1540.0-41.0	0.1	1.2	0.0	61.4		LM,SDY
119	1541.0-42.0	0.2	1.4	0.0	62.9		LM,SDY
120	1542.0-43.0	0.2	2.6	0.0	60.2		LM,SDY
121	1543.0-44.0 ←8	1.2	13.5	25.0	53.6		SD,SLTY
122	1544.0-45.0	3.0	15.6	25.8	51.6		SD,SLTY,MIC
123	1545.0-46.0	1.5	15.0	26.8	52.1		SD,SLTY,MIC
124	1546.0-47.0	3.7	14.3	23.0	54.2		SD,SLTY,MIC
125	1547.0-48.0	5.7	17.8	27.2	49.2		SD,SLTY,MIC
126	1548.0-49.0	1.3	13.0	12.8	53.1		SD,SLTY
127	1549.0-50.0	6.5	17.7	22.2	54.9		SD,SLTY,MIC,CL/
128	1550.0-51.0	17.0	19.0	18.2	66.7		SD,SLTY,MIC
129	1551.0-52.0	12.0	18.6	18.6	64.6		SD,SLTY,MIC
130	1552.0-53.0	11.0	11.6	14.0	59.9		SD,SLTY,MIC
131	1553.0-54.0	7.3	18.0	16.0	57.7		SD,SLTY
132	1554.0-55.0	4.1	16.0	11.6	50.9		SD,SLTY
133	1555.0-56.0	0.4	17.9	10.3	57.9		SD,SLTY,SHY
134	1556.0-57.0	14.0	17.2	9.4	59.2		SD,SLTY
135	1557.0-58.0	15.0	18.0	8.9	60.1		SD,SLTY
136	1558.0-59.0	25.0	18.0	8.9	59.7		SD,SLTY,MIC
137	1559.0-60.0	27.0	18.6	8.6	61.6		SD,SLTY,SL/SHY
138	1560.0-61.0	31.0	22.7	6.9	49.3		SD,SLTY
139	1561.0-62.0	32.0	20.2	7.3	54.7		SD,SLTY
140	1562.0-63.0	29.0	20.0	7.9	55.5		SD,SLTY,SL/SHY
141	1563.0-64.0	36.0	13.5	4.2	57.8		SD,SLTY
142	1564.0-65.0	112.0	16.9	8.3	64.8		SD
143	1565.0-66.0	205.0	21.9	8.2	61.3		SD
144	1566.0-67.0 ←9	150.0	20.0	7.8	67.3		SD,MIC
145	1567.0-68.0	186.0	20.2	5.0	67.2		SD
146	1568.0-69.0	5.2	18.1	5.6	56.4		SD,SLTY
147	1569.0-70.0	57.0	18.2	7.6	73.1		SD,SL/SLTY
148	1570.0-71.0	3.2	12.9	8.3	55.0		SD,SLTY,LIG
149	1571.0-72.0	40.0	18.4	7.5	68.6		SD,MIC
150	1572.0-73.0	19.0	19.8	6.8	65.2		SD,SL/SLTY
151	1573.0-74.0	60.0	17.0	10.9	63.2		SD,LIG
152	1574.0-75.0	6.5	16.9	8.3	69.1		SD,SLTY
153	1575.0-76.0	23.0	17.3	8.2	72.1		SD,SL/SLTY
154	1576.0-77.0	124.0	19.8	6.8	68.5		SD
155	1577.0-78.0	98.0	15.7	3.7	71.9		SD,LIG
156	1578.0-79.0	50.0	18.1	11.3	68.8		SD

TABLE XIV (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
157	1579.0-80.0	45.0	17.8	7.7	69.0		SD,LIG
158	1580.0-81.0	19.0	16.6	7.2	71.1		SD,LIG
159	1581.0-82.0	235.0	16.4	9.8	72.9		SD
160	1582.0-83.0	157.0	18.8	7.3	78.1		SD
161	1583.0-84.0	41.0	17.4	8.5	75.4		SD
162	1584.0-85.0 ← 10	9.5	18.5	8.7	73.1		SD,SLTY
163	1585.0-86.0	0.1	9.7	9.0	74.6		SD,SLTY,SHY
164	1586.0-87.0	0.4	10.1	8.7	76.1		LM,SDY
165	1587.0-88.0	0.3	4.8	6.1	79.5		LM,SDY
166	1588.0-89.0	0.6	2.9	3.5	76.1		SD,SLTY,PYR
	1589.0-00.0						SH

WILLIAM BERRYHILL NO. 120-I

(1893 FWL, 1320 FSL) NE/4, SEC. 17, T.17N, R.12E

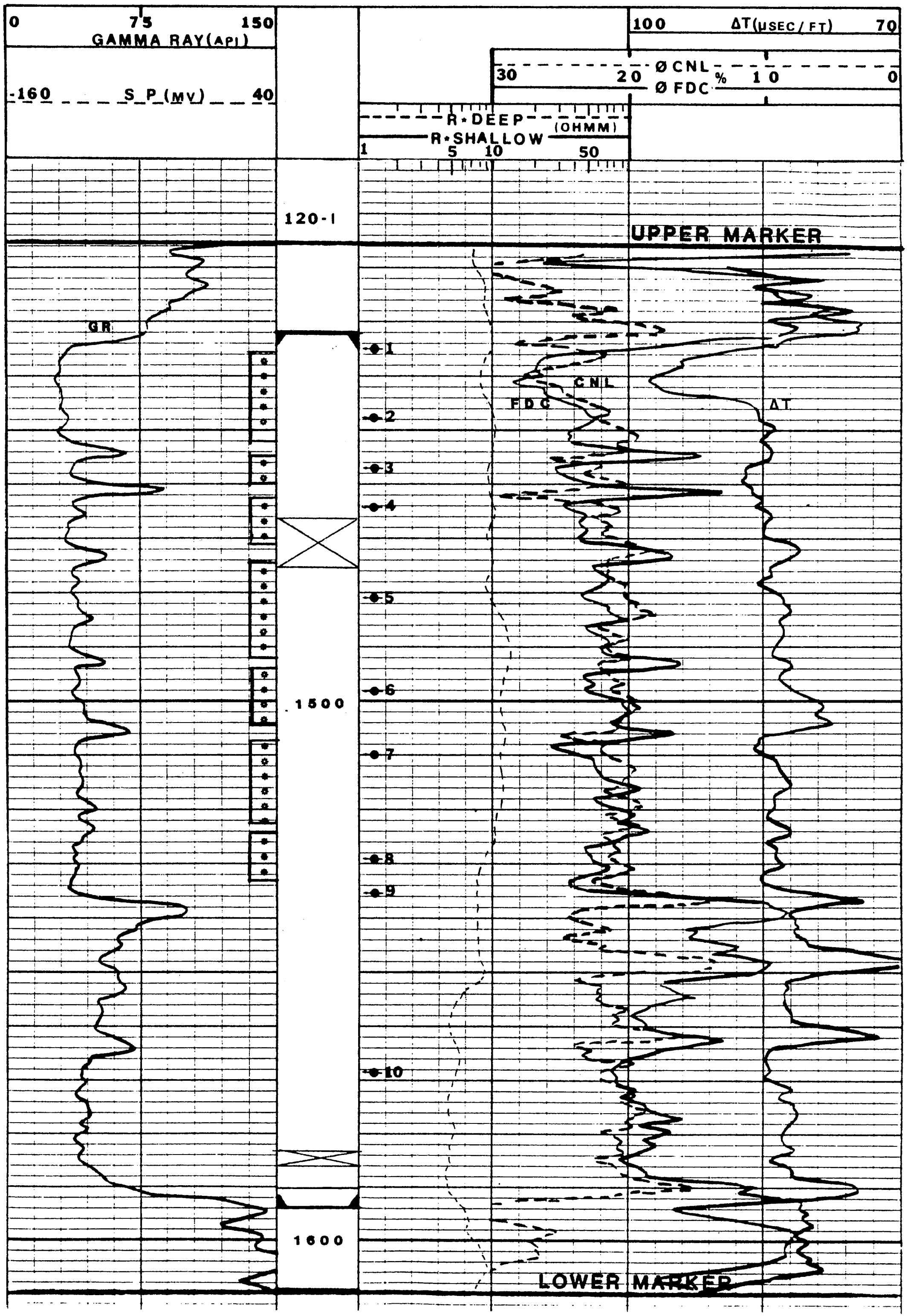


Figure 112. Well-log Signatures, Glenn Sandstone, William Berryhill No. 120-I

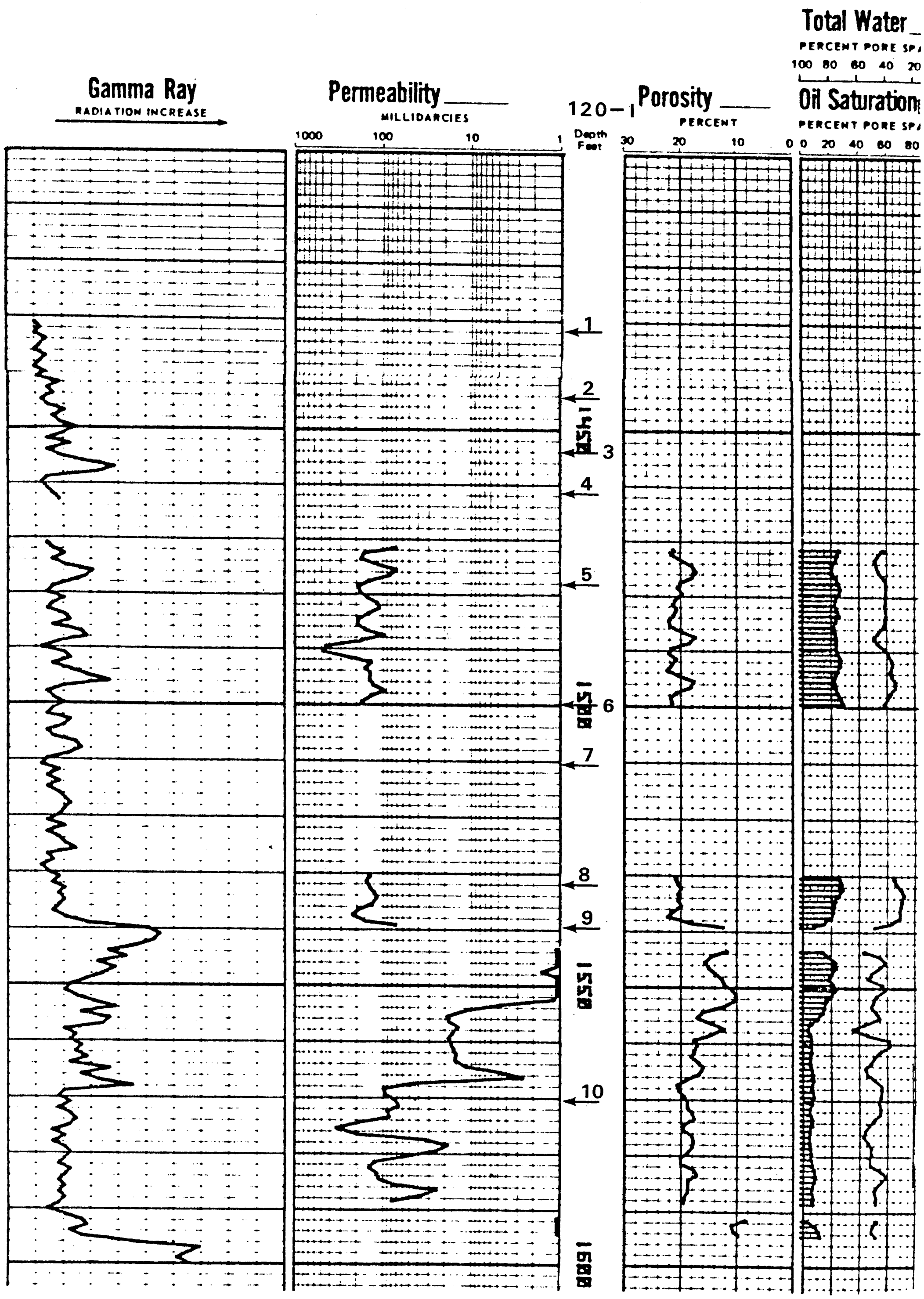


Figure 113. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 120-I

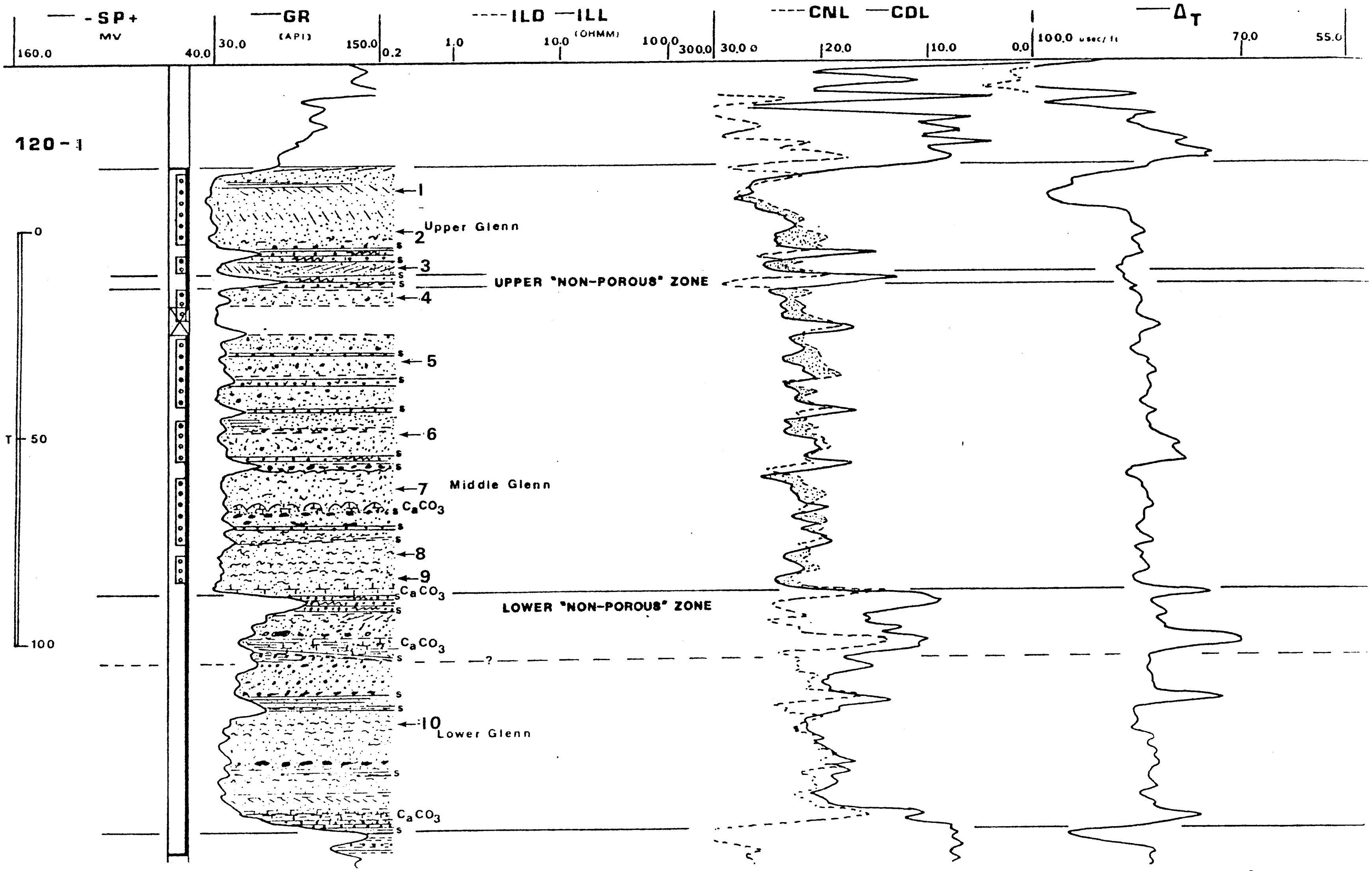


Figure 114. Log-signatures, General Lithology, and Sedimentary-features, Glenn Sandstone, William Berryhill No. 120-I

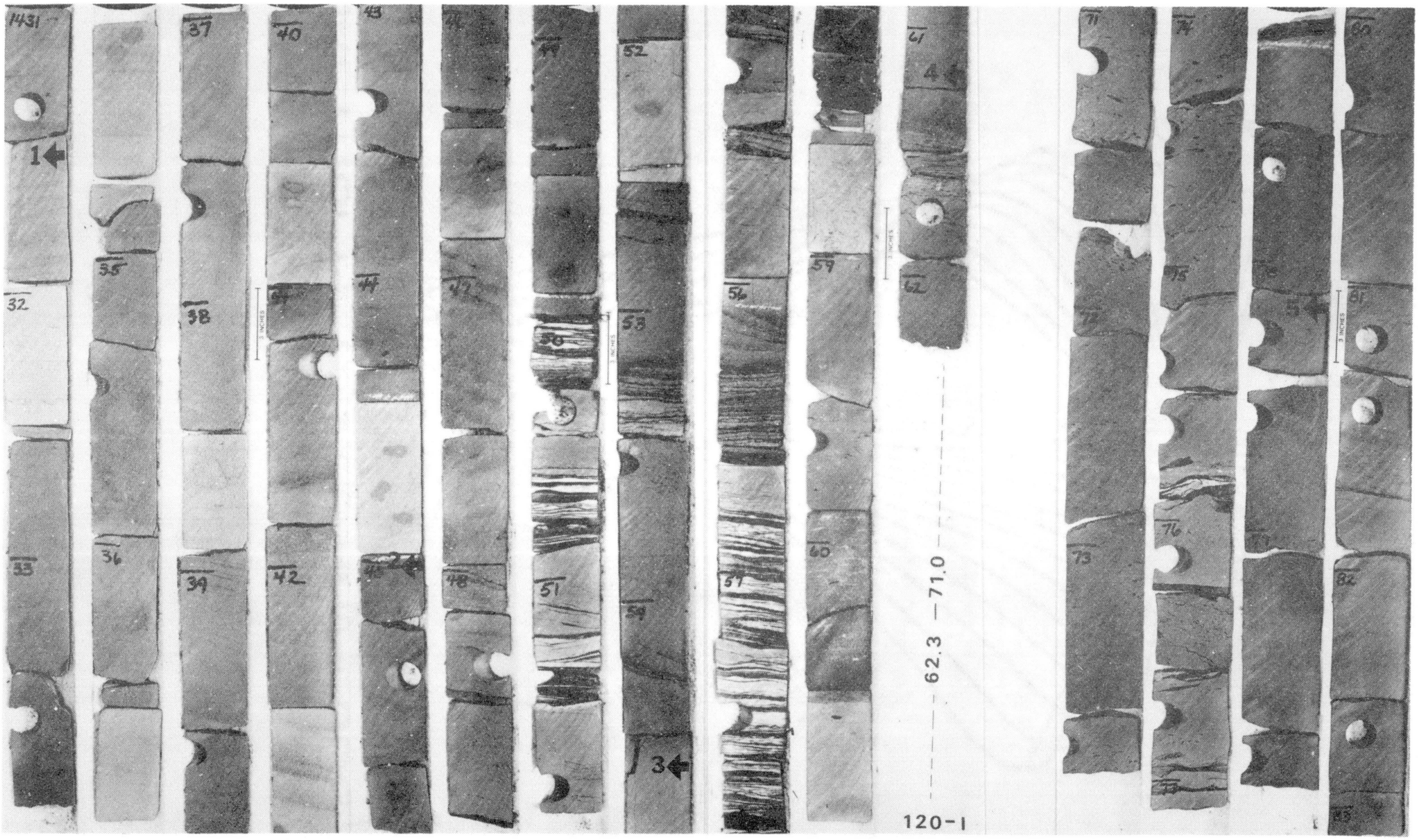
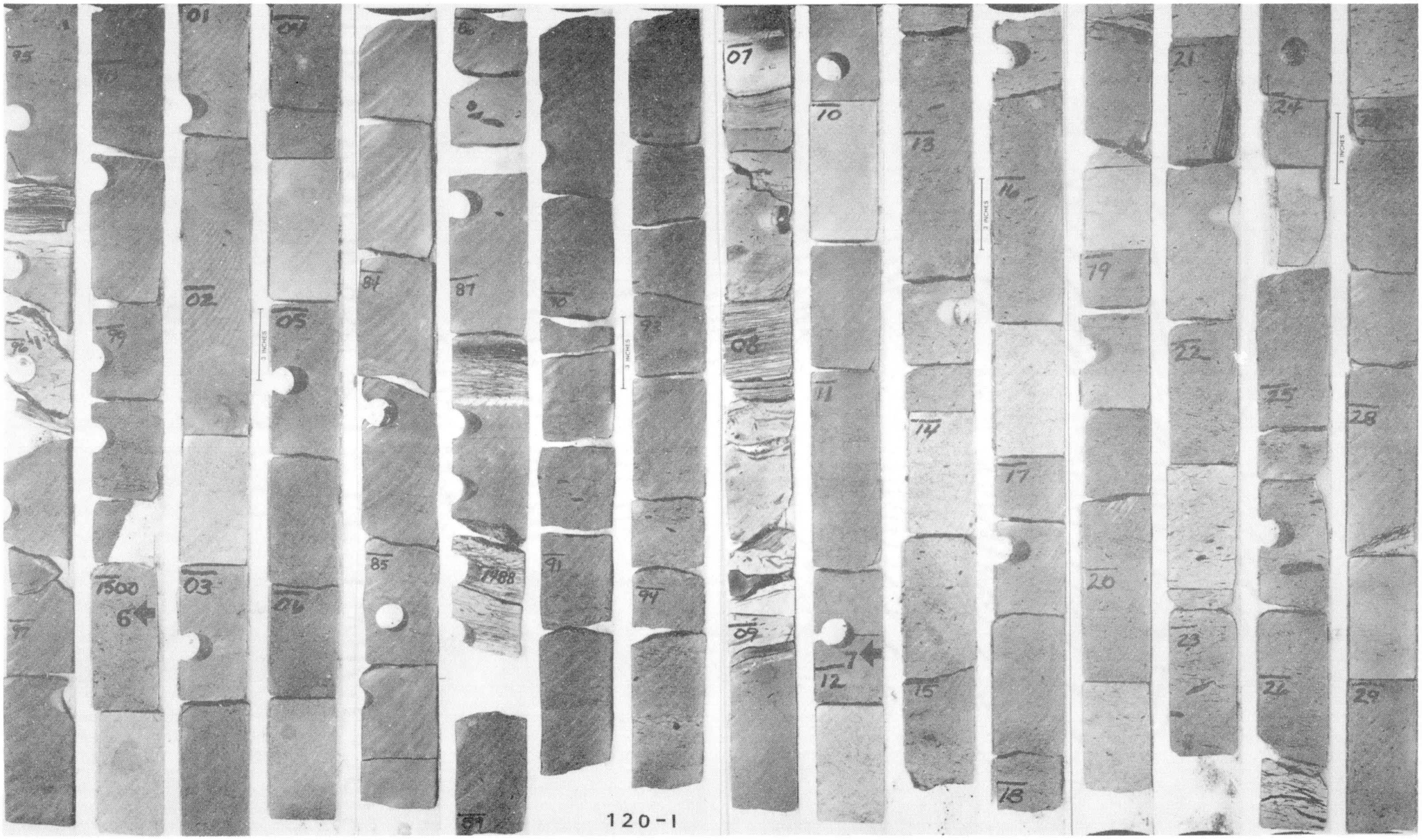
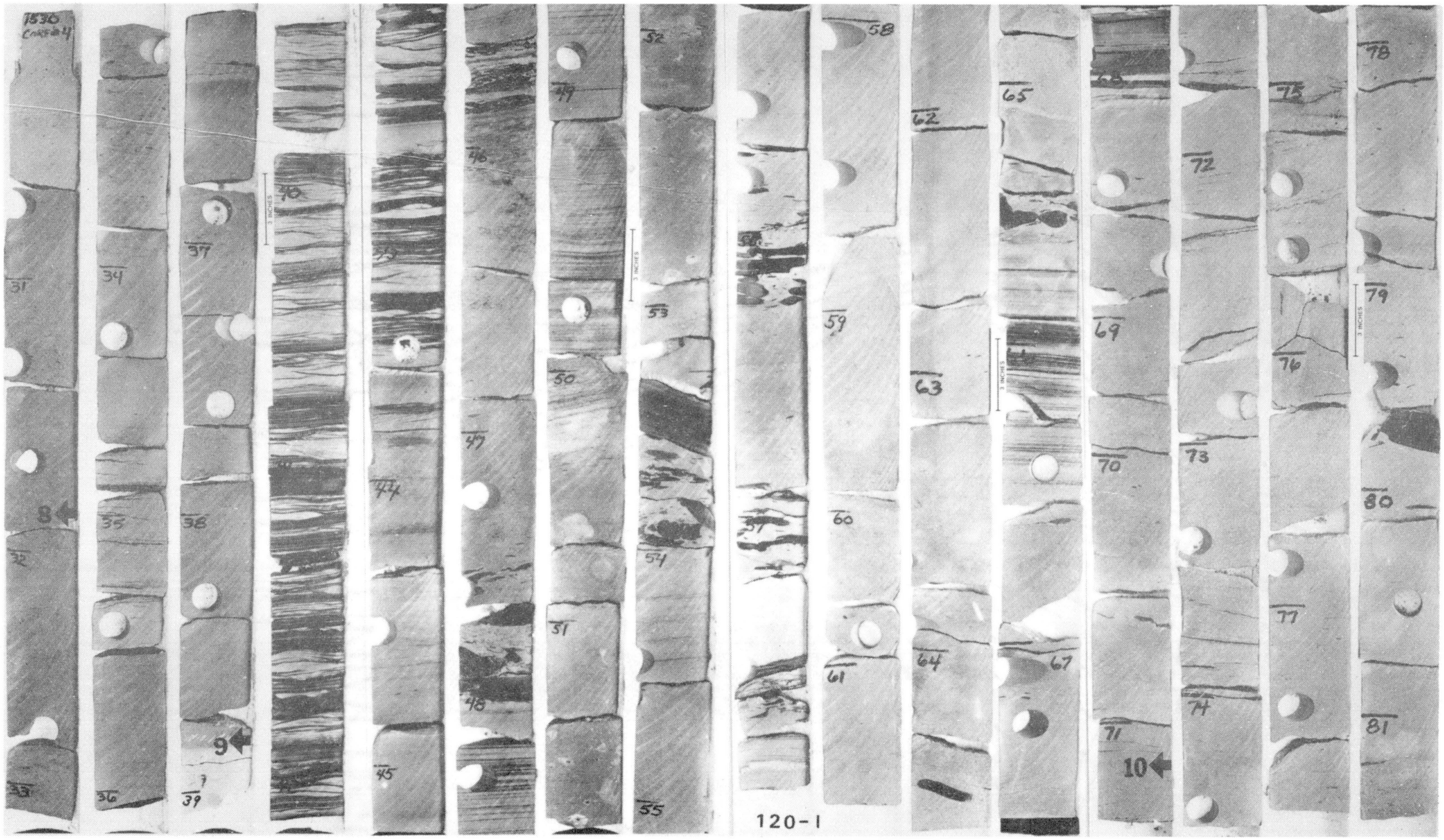


Figure 115. Glenn Sandstone, William Berryhill No. 120-I, 1431.0 - 83.2 ft., Showing the Upper Glenn and Upper "Non-Porous" Zone (1456.3 - 57.9 ft.), and a Portion of the Middle Glenn



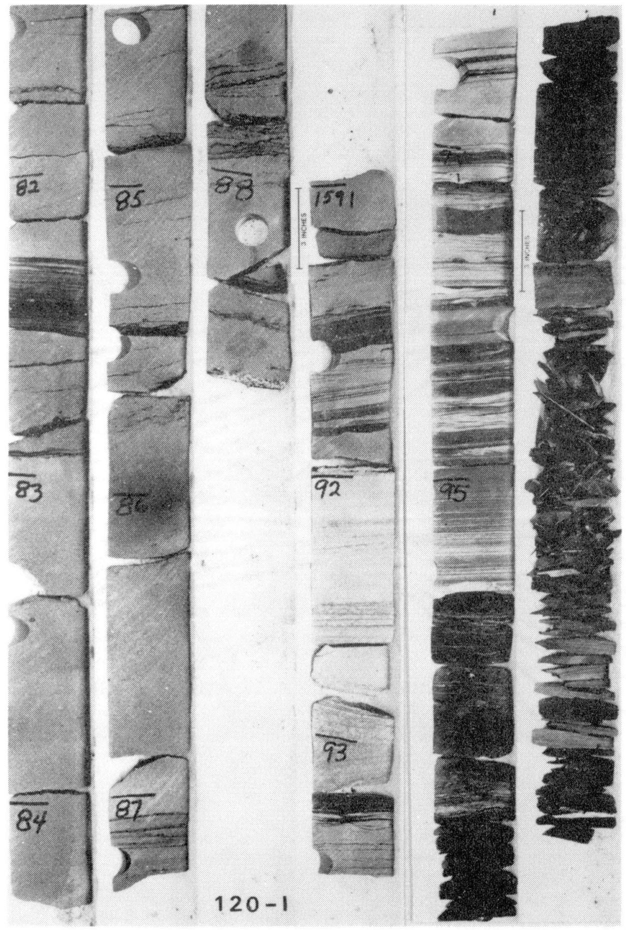
Note: Glenn Sandstone, William Berryhill No. 120-I, 1494.8 - 1529.8 ft., Showing a Portion of the Middle Glenn

Figure 115 (Continued)



Note: Glenn Sandstone, William Berryhill No. 120-I, 1530.0 - 1581.4 ft., Showing a Portion of the Middle Glenn, the Lower "Non-Porous" Zone (1539.5 - 43.7 ft.), Portion of the Lower Glenn (1543.7 - 81.4 ft.)

Figure 115 (Continued)



Note: Glenn Sandstone, William Berryhill No. 120-I, 1581.4 - 1600.0 ft., Showing a Portion of the Lower Glenn (1581.4 - 95.5 ft.), and Underlying Black Shale

Figure 115 (Continued)

William Berryhill No. 120-I
(1893 FWL, 1320 FSL, NE/4, Sec. 17)

Cored Interval: 1431.0 - 1605.0 ft.
Correlation: Core depth three and one-half to four feet deep to log depth

Core Depth (Ft.)	Core Description
	Upper Glenn
1431.0 - 40.0	ss; lt gy - lt brn, vf - m gr, mod w strd, apr mas bdg, m sc xbg in part, few s sid pbls, vis por, carb fil align along apr xbdg, sl o. stn (Sample 120-1, 31.5 ft.)
40.0 - 50.0	ss; lt gy - lt brn, vf - f gr, apr mas bdg, faint m sc xbg, few s sid pbls apr bdd, sl incld, fn carb lam incr downw, poss res o or asph mat w/ in intsls, few s sid pbls abv abrupt ctc ◇ 50.0 (Sample 120-2, 45.1 ft.)
50.0 - 51.5	intbd ss/sh/sltst; lt gy - gy - bld, fn intlam of sltst, ripple-lam, flaser bdg, abrupt ctc of carb sltst ◇ 51.4 w/ underlying ss
51.5 - 56.3	ss; gy - lt brn, vf - f gr, fn carb intlam, sl incld, abnt dism carb mat (Sample 120-3, 54.6 ft.)
56.3 - 57.9	intlam ss/sh; gy - blk, vf gr, ripple-lam, flaser bdg, grdg downw into blk sh (Upper "Non-Porous" Zone)
57.9 - 58.5	sh; blk - dk gy, dns, abrupt ctc w/ underlying ss
	Middle Glenn
58.5 - 60.5	ss; lt gy - lt brn, vf - f gr abnt carb fil, few rd sid pbls, flat-elg sh rip-up clasts ◇ 60.0 ft., abrupt trans w/ lt gy ss ◇ 60.5 ft.

60.5 - 62.1	ss; gy - lt brn, vf - f gr, scat carb fil, s rd sid pbls ◇ 61.5 ft. (Sample 120-4, 61.1 ft.)
62.1 - 71.0	core missing
71.0 - 75.9	ss; lt brn - lt gy, vf - f gr, scat s sid pbls (.1 - 1 cm) & sh rip-up clasts
75.9 - 75.95	sltst; lt by - blk, fn intlam w/ blk sh, current ripple-lam, ireg ctc
75.95 - 77.1	ss; lt brn - dk gy, vf - f gr, fn intbd sh & carb lam, apr s sc xbdg, abrupt ctc of thn sh ◇ 77.1 w/ underlying ss
77.1 - 87.2	ss; lt brn, vf - f gr, apr mas bdg, abnt carb fil, sl incld bdg or m sc xbdg, few subrd sid pbls (1 x 2 cm) ◇ 86.5 ft., abrupt ctc w/ underlying sltst (Sample 120-5, 78.2 ft.)
87.2 - 88.2	sltst/ss/sltst; lt brn - blk - gy, th (6 cm) sltst, carb intlam, flaser struc, bur, abrupt ctc w/ ss; vf - f gr, apr mas bdd, carb fil, abrubt ctc w/ sltst, lt gy - blk, carb intlam, flaser struc, bur, sl incld ctc w/ underlying ss
88.2 - 95.5	ss; lt brn, vf - f gr, apr mas bdg, abnt carb fils, few scat s sid pbls (.5 - 1.5 cm), abrupt ctc w/ underlying sh
95.5 - 95.55	sh; blk - lt gy, f intlam slt, sl bur, abrupt ctc w/ sltst - ss
95.55 - 96.4	sltst - ss; lt gy - buff, carb fils, s sh rip-up clasts, abrupt ireg hi ang ctc w/ chaotic zn of vf ss & s sh rip-up clasts, abrupt ireg ctc w/ ss blw
96.4 - 1507.0	ss; lt brn, vf - f gr, apr mas bdg, abnt carb fils, s sid pbls (Sample 120-6, 1500.1 ft.)
1507.0 - 07.2	ss; lt gy - lt buff, vf - f gr, apr mas bdg, calc cmt, apr sph ctc w/ ss, abrupt ctc w/ underlying chaotic zn
07.2 - 09.1	ss/sh; lt brn - gy - blk, vf - f gr, chaotic zn of sh rip-up clasts, sltst clasts (07.9 ft., 08.8 ft.) w/ th intbd

	sltst ◇ 07.95 - 08.1 ft., blk - lt gy, flaser struc, bur, abrupt incld ctc ◇ base of zn (th sh ptg ◇ 09.1 ft.)
09.1 - 26.5	ss; lt brn, vf - f gr, apr mas bdg, v abnt carb fil, s sid pbls, th sltst/sh intbd ◇ 18.2 ft., abnt sh rip-up clasts, w rd sid pbls & flat elg sh clasts ◇ 22.8 - 23.5 ft. & 25.1 - 25.6 ft. (Sample 120-7, 11.8 ft.)
26.5 - 26.6	ss/sh; gy - blk, vf - f gr, flat elg sh rip-up clasts
26.6 - 38.9	ss; lt brn, vf - f gr, apr mas bdg, abnt carb fils, th incld bed of sh rip-up clasts in carb, slty mtx ◇ 28.5 ft., few s sid pbls, v th lam of carb mat, coaly ptgs ◇ 34.8 - 35.5 ft. abrupt trans w/ calc cmt ss ◇ 38.9 ft. (Sample 120-8, 31.9 ft.)
38.9 - 39.1	ss; lt gy - lt buff, vf - f gr, calc cmt, apr mas bdg. (Sample 120-9, 38.9 ft.)
39.1 - 39.5	core missing
39.5 - 43.7	intbd ss/sh; gy - blk, intlam, flaser struc, current ripple-lam, bur, grdg downw in a hztl bd ss (planar bdg?) (Lower "Non-Porous" Zone)

<u>Lower Glenn</u>

43.7 - 45.5	ss; lt brn - gy, vf - m gr, hzlt bdg, f parall slty lams abrubt ctc (scour surf?) w/ underlying shy zn
45.5 - 46.3	ss/sh; dk gy - blk, cpct cls of blk sh rip-up clasts, grdg downw into a v slty, cly ss w/ mat apr
46.3 - 47.5	ss; gy - lt brn, vf - f gr, apr mas bdg, abnt carb fil, slty
47.5 - 48.1	ss/sh; dk gy - blk, sl incld bdd sh rip-up clasts abv irg clasts, brk & disrupted
48.1 - 50.7	ss; lt gy - lt brn, vf gr, planar bdg
50.7 - 53.3	ss; lt gy - lt brn, vf - f gr, apr mas bdg, sp calc cem hi ang abrupt ctc w/ blk sh bd
53.3 - 53.5	sh; blk, dns, steeply dipping, abrupt ctc w/ underlying sh rip-up clasts

53.5 - 54.0	ss/sh; lt brn - blk, sh rip-up clast in a vf - f gr ss mat
54.0 - 55.8	ss; lt brn - gy, vf - f gr, planar bdg near top grdg to mas apr bdg, grgd into sh rip-up clasts ◇ 55.8 ft.
55.8 - 56.2	ss/sh; by - blk, sh rip-up clasts, flat-elg to w rd clasts apr bdd nature
56.2 - 56.9	ss; lt brn, vf - f gr, slty, cly, abnt carb fils, few s sid pbls
56.9 - 57.2	ss/sh; lt gy - blk, sh rip-up clast, flat-elg
57.2 - 57.6	sltst; buff, apr mas bdg, f carb fil, abrupt ctc w/ carb lam & sh rip-up clasts
57.6 - 57.7	ss/sh; gy - blk, vf - f gr, sh rip-up clasts, flat-elg ang, carb
57.7 - 65.5	ss; lt gy - gy, vf - f gr, apr mas bdg, v s scat sid pbls, oblate sid clast ◇ 64.5 ft., abnt lg (3 - 4 cm) subrd sid clasts ◇ 65.5 ft., scour surf blw
65.5 - 66.5	ss; gy - dk gy, vf gr, hztl bdg (planar?), paral slty lams incr ◇ 66.0 ft. grdg downw, grd trans
66.5 - 67.7	ss; by, vf - f gr, apr mas bdg, few flat-elg sid clasts & pbls
67.7 - 68.0	sh; blk, dns, f lam of slty mat, abrupt ctc blw
68.0 - 79.6	ss; gy - lt gy, vf - f gr, apr mas bdg in pt, sl incld carb lam, abnt carb fils, s sid pbls & flat-elg clasts (Sample 120-10, 71.1 ft.)
79.6 - 79.7	sh clast, lg (6 cm), subrd, s flat-elg clast b/w
79.7 - 81.1	ss; gy; vf - f gr, apr mas bdg, carb lam & fils, abrupt ctc w/ m gr ss ◇ 81.1 ft.
81.1 - 82.4	ss; gy - lt gy, f - m gr, apr mas bdg w/ thin carb lam, abrupt ctc ◇ 82.4 ft.
82.4 - 82.5	sh; blk, dns, sl f intlam of slty mat, incld ctc w/ ss blw

82.5 - 88.8	ss; gy - dk gy, f - m gr, apr mas bdg, incr carb downw, carb ptg ◇ 85.5 ft., abnt carb fils, f intlam carb ◇ 87.1 - 88.0 ft., incld coaly ptg ◇ 88.8 ft.
88.8 - 91.0	core missing
91.0 - 92.0	ss/sh; dk gy - blk, intbd, abrupt ctc w/ calc cmt ss
92.0 - 92.8	ss; lt buff, vf - m gr, hztl bdg (planar?), f lam of carb mat, ang ctc, carb ptg ◇ 92.8 ft. (poss s - m sc xbdg)
92.8 - 93.2	ss; lt gy - vf - m gr, sp calc cem, (poss s - m xbd) abrupt ctc w/ thin (3 cm) sh
93.2 - 95.5	intlam ss/sh; lt gy - dk gy - blk, f carb lam, flaser bdg, convolute, apr calc cmt, hztl lam at base, abrupt ctc w/ underlying sh
95.5 - 97.0	sh; blk, carb, slty, bur, sid nod, hem stn
97.0 - 97.1	sh; blk, carb, fos (Plcy)
97.1 - 1605.0	sh; blk, carb, sid nod, slty, convolute bdg, brk, fis

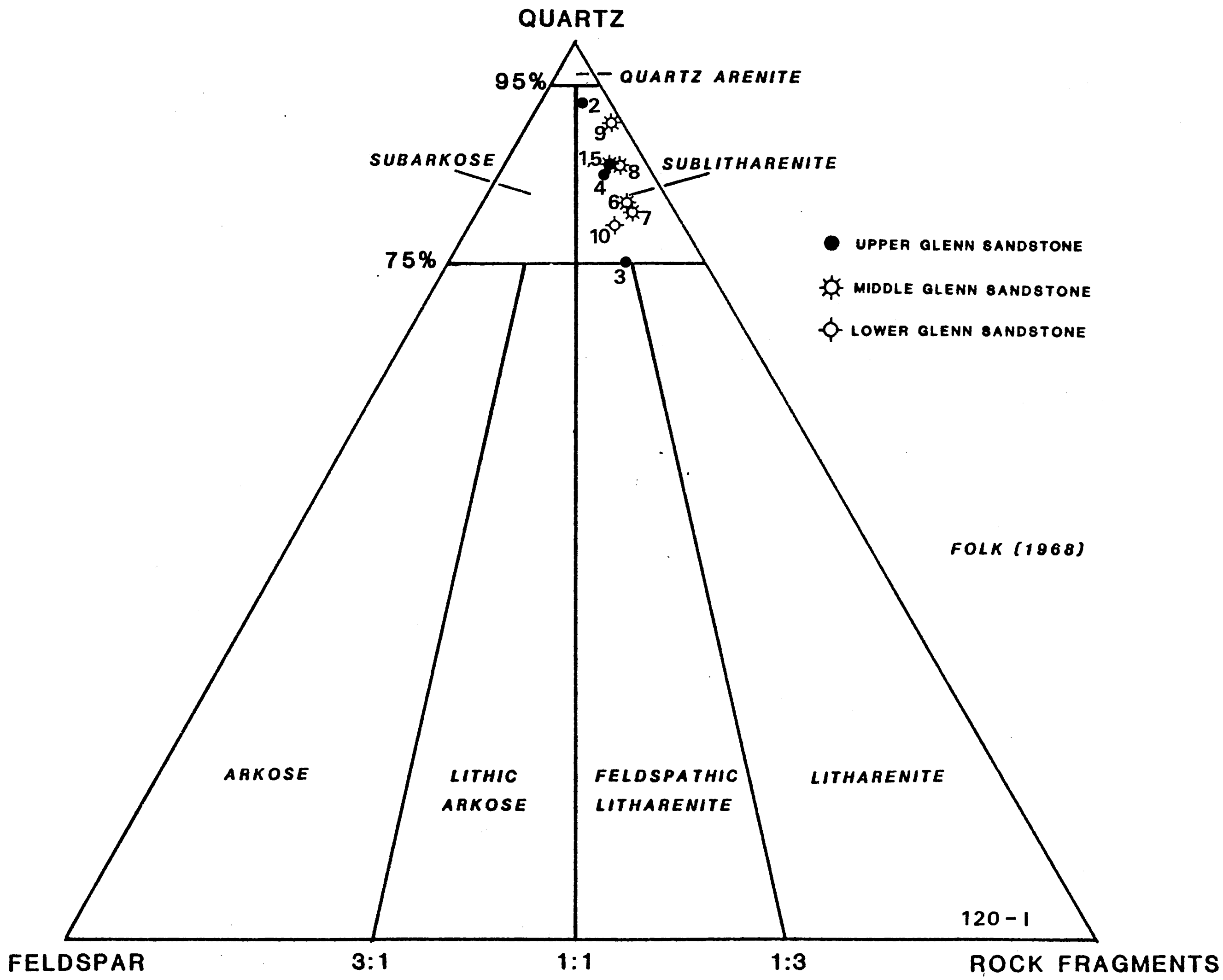


Figure 116. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 120-I

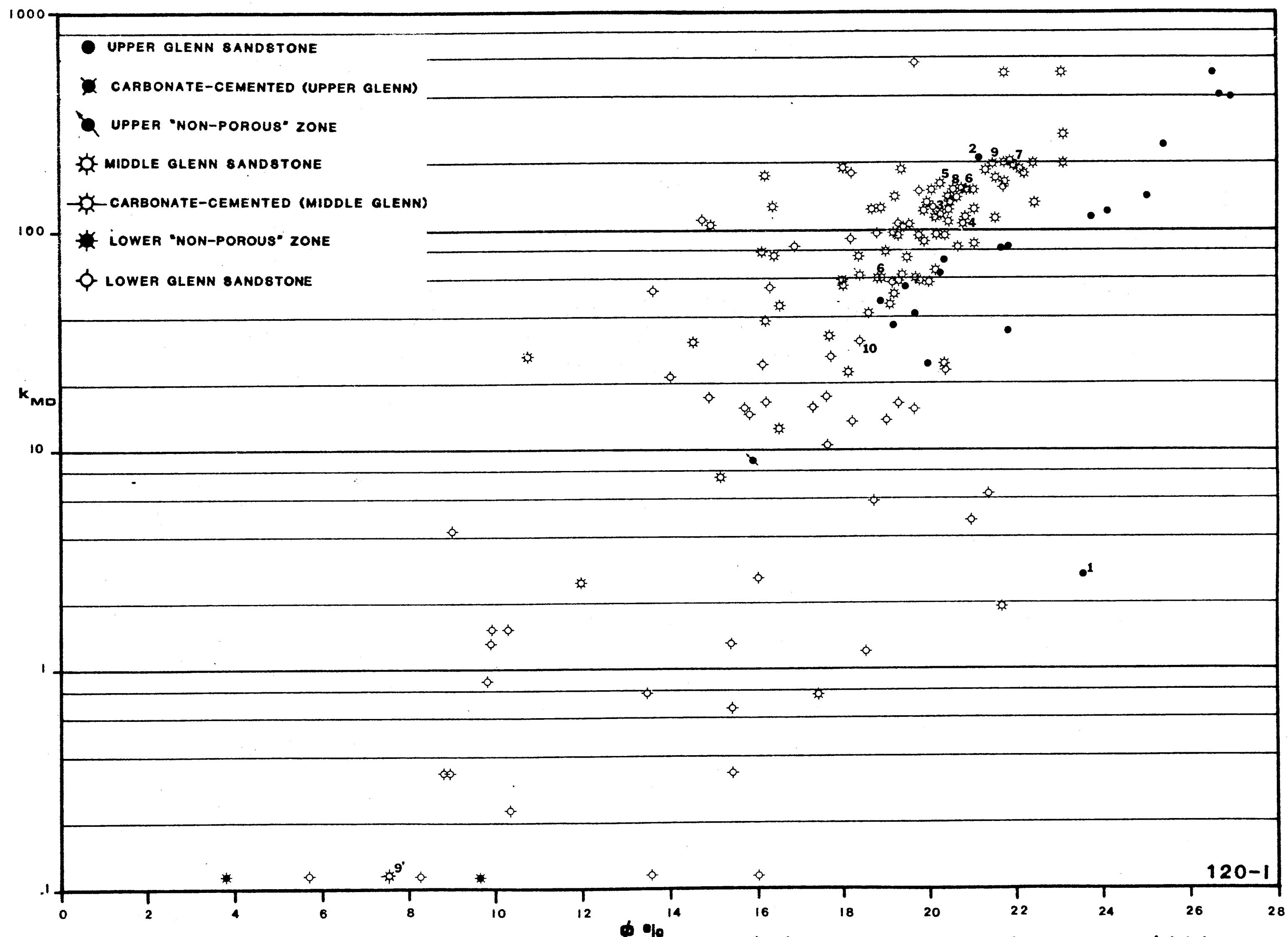


Figure 117. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 120-I

TABLE XV

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 120-I
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
		CONVENTIONAL PLUG ANALYSIS					
	1431.0-56.5						SD
	1456.5-58.5						SD,SLTY,SHY
	1458.5-63.0						SD
	1463.0-1471.0	DRILLED					
1	1471.0-72.0	24.0	20.4	28.2	39.1		SD,SHY
2	1472.0-73.0	196.0	22.2	25.7	44.4		SD
3	1473.0-74.0	194.0	19.4	26.4	48.2		SD
4	1474.0-75.0	79.0	16.1	21.2	43.9		SD
5	1475.0-76.0	77.0	18.4	20.9	45.4		SD
6	1476.0-77.0	30.0	14.5	25.8	40.3		SD
7	1477.0-78.0	170.0	21.8	27.3	36.4		SD
8	1478.0-79.0 ←5	168.0	20.3	28.4	39.3		SD
9	1479.0-80.0	197.0	18.0	29.4	37.1		SD
10	1480.1-81.0	127.0	21.1	24.2	38.9		SD
11	1481.0-82.0	117.0	21.6	23.3	39.5		SD
12	1482.0-83.0	76.0	19.5	26.1	37.5		SD
13	1483.0-84.0	143.0	20.7	30.0	38.5		SD
14	1484.0-85.0	188.0	22.3	24.7	37.5		SD
15	1485.0-86.0	195.0	21.4	22.8	40.4		SD
16	1486.0-87.0	154.0	20.9	24.8	41.1		SD
17	1487.0-88.0	105.0	14.9	26.2	50.8		SD
18	1488.0-89.0	0.7	17.4	25.1	44.9		SD,SLTY,SHY
19	1489.0-90.0	552.0	21.8	27.2	38.3		SD
20	1490.0-91.0	559.0	23.1	23.7	37.0		SD
21	1491.0-92.0	129.0	18.7	32.9	34.1		SD
22	1492.0-93.0	87.0	21.1	27.0	32.2		SD
23	1493.0-94.0	208.0	23.2	28.5	35.1		SD
24	1494.0-95.0	94.0	20.4	24.0	36.0		SD
25	1495.0-96.0	129.0	16.4	23.6	30.5		SD
26	1496.0-97.0	181.0	16.2	25.4	28.2		SD,SHY
27	1497.0-98.0	1.8	21.7	26.6	38.9		SD,SLTY
28	1498.0-99.0	176.0	21.6	28.4	32.4		SD
29	1499.0-00.0 ←6	157.0	20.8	32.2	42.9		SD
	1500.0-30.0						SD,SHY
30	1530.0-31.0	124.0	20.5	25.8	34.4		SD
31	1531.0-32.0 ←8	157.0	20.6	31.1	30.0		SD
32	1532.0-33.0	145.0	19.2	29.4	30.6		SD
33	1533.0-34.0	99.0	19.2	30.1	18.5		SD
34	1534.0-35.0	136.0	22.5	21.5	33.2		SD
35	1535.0-36.0	76.0	16.4	26.1	22.0		SD
36	1536.0-37.0	207.0	22.5	22.2	31.9		SD
37	1537.0-38.0	213.0	21.8	22.9	25.9		SD
	1538.0-39.0	206.0	21.5	20.4	27.5		SD
39	1539.0-39.5 ←9	0.1	7.4	3.7	56.0		SD,LMY,SHY
	1539.5-43.0						SH
40	1543.0-44.0	<0.1	9.5	11.8	62.8		SD,SLTY,SHY
41	1544.0-45.0	0.6	15.4	21.3	38.0		SD,SLTY
42	1545.0-46.0	<0.1	16.0	27.4	33.2		SD,SLTY,SHY
43	1546.0-47.0	0.7	13.4	22.7	50.8		SD,SLTY
44	1547.0-48.0	2.4	16.0	27.6	37.7		SD,SLTY,SHY
45	1548.0-49.0	0.3	8.8	13.0	69.3		SD,SLTY,SHY
46	1549.0-50.0	0.3	15.4	28.8	27.3		SD,SLTY,SHY
47	1550.0-51.0	<0.1	8.1	21.8	40.4		SD,SLTY,SL/LMY
48	1551.0-52.0	0.2	10.2	26.0	49.5		SD,SLTY,SL/LMY
49	1552.0-53.0	1.4	10.2	14.6	41.2		SD,SLTY,SL/LMY
50	1553.0-54.0	1.2	9.8	18.0	56.7		SD,SLTY
51	1554.0-55.0	13.0	18.2	17.5	41.3		SD
52	1555.0-56.0	16.0	16.2	11.3	43.7		SD,SHY
53	1556.0-57.0	24.0	16.1	10.1	43.4		SD
54	1557.0-58.0	4.0	8.9	0.0	79.8		SD,SHY
55	1558.0-59.0	21.0	14.0	10.1	47.2		SD
56	1559.0-60.0	15.0	19.7	6.8	34.0		SD
57	1560.0-61.0	17.0	14.9	6.8	30.0		SD
58	1561.0-62.0	15.0	17.3	9.3	48.0		SD
59	1562.0-63.0	13.0	19.0	5.4	45.5		SD
60	1563.0-64.0	15.0	15.7	7.2	48.2		SD
61	1564.0-65.0	14.0	15.8	6.7	55.2		SD
62	1565.0-66.0	1.2	15.4	9.2	55.3		SD,SHY
63	1566.0-67.0	1.2	18.5	9.9	44.4		SD,SHY
64	1567.0-68.0	6.1	21.4	7.2	42.2		SD
65	1568.0-69.0	155.0	19.8	7.9	40.7		SD
66	1569.0-70.0	58.0	19.2	10.5	43.3		SD

TABLE XV (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.	DESCRIPTION
67	1570.0-71.0	94.0	18.2	7.4	42.9		SD
68	1571.0-72.0 ←10	31.0	18.4	7.3	46.3		SD,SHY
69	1572.0-73.0	98.0	18.8	4.1	35.9		SD
70	1573.0-74.0	112.0	14.7	9.6	53.1		SD
71	1574.0-75.0	4.5	21.0	8.4	47.2		SD
72	1575.0-76.0	603.0	19.7	5.1	55.8		SD
73	1576.0-77.0	86.0	16.9	6.1	55.9		SD
74	1577.0-78.0	10.0	17.6	5.9	53.5		SD
75	1578.0-79.0	17.0	17.6	5.8	46.7		SD
76	1579.0-80.0	26.0	17.7	7.8	53.1		SD
77	1580.0-81.0	23.0	20.4	6.6	45.9		SD
78	1581.0-82.0	132.0	20.1	6.7	57.8		SD
79	1582.0-83.0	184.0	18.2	10.0	42.3		SD
80	1583.0-84.0	53.0	13.6	10.3	32.7		SD
81	1584.0-85.0	164.0	21.8	9.2	45.8		SD
82	1585.0-86.0	55.0	16.3	8.4	43.2		SD
83	1586.0-87.0	16.0	19.3	5.3	51.8		SD
84	1587.0-88.0	5.6	18.7	10.9	42.4		SD
85	1588.0-89.0	110.0	19.3	7.0	48.1		SD
	1589.0-1591.0	TOO BROKEN FOR ANALYSIS					
86	1591.0-92.0	<0.1	5.5	0.0	41.5		SD,SLTY,SHY
87	1592.0-93.0	<0.1	13.5	11.4	54.9		SD,SLTY,SHY
88	1593.0-94.0	0.8	9.7	15.0	42.6		SD,SLTY,SHY
89	1594.0-95.0	0.3	8.7	7.1	59.6		SD,SLTY,LMY
	1595.0-00.0						SH
	1600.0-1605.0	LOST CORE					

WILLIAM BERRYHILL NO. 124-I

(1470 FWL, 862 FSL) NE/4, SEC.17, T.17N, R.12E

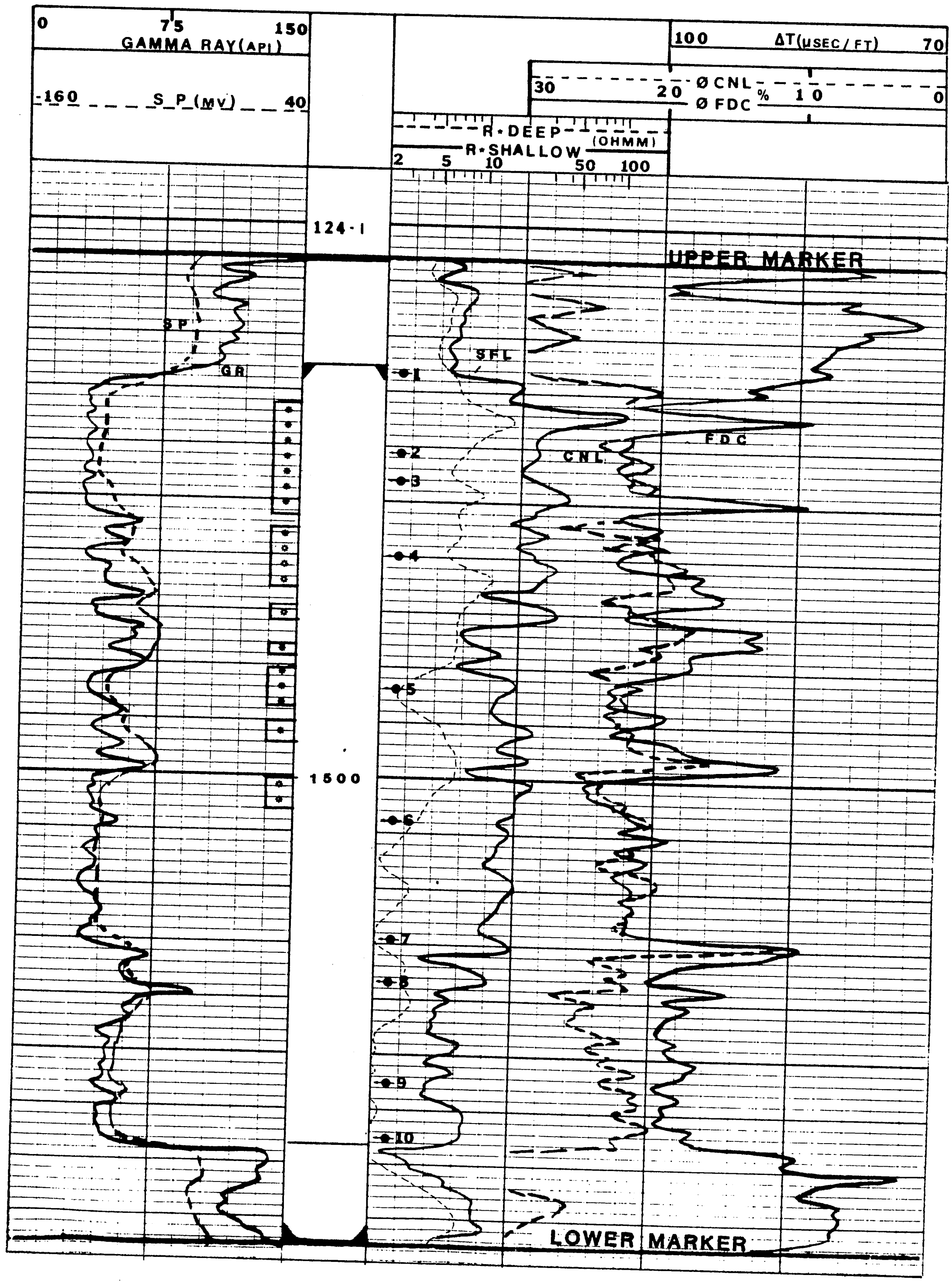


Figure 118. Well-log Signatures, Glenn Sandstone, William Berryhill No. 124-I

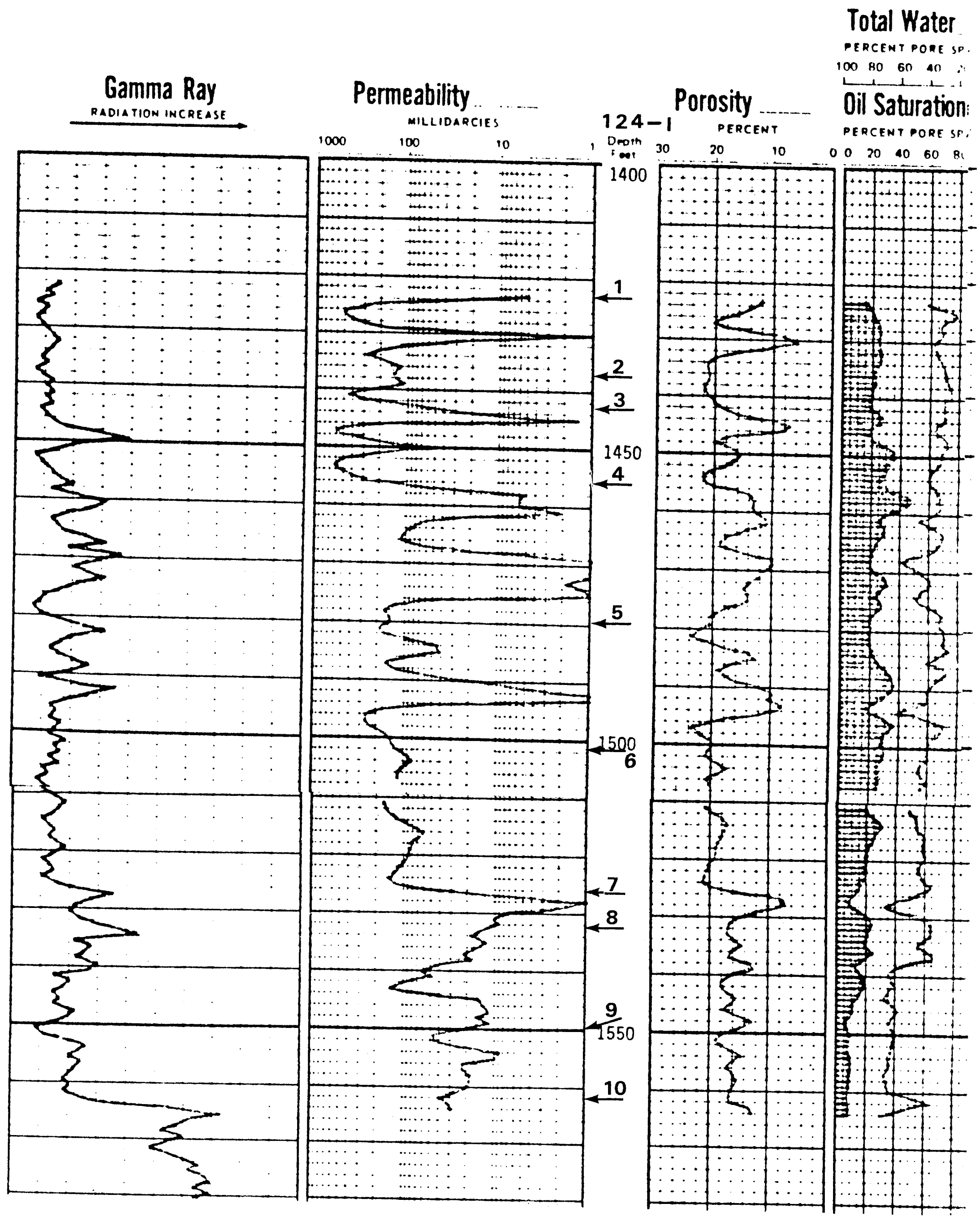


Figure 119. Correlation Coregraph, Glenn Sandstone, William Berryhill NO. 124-I

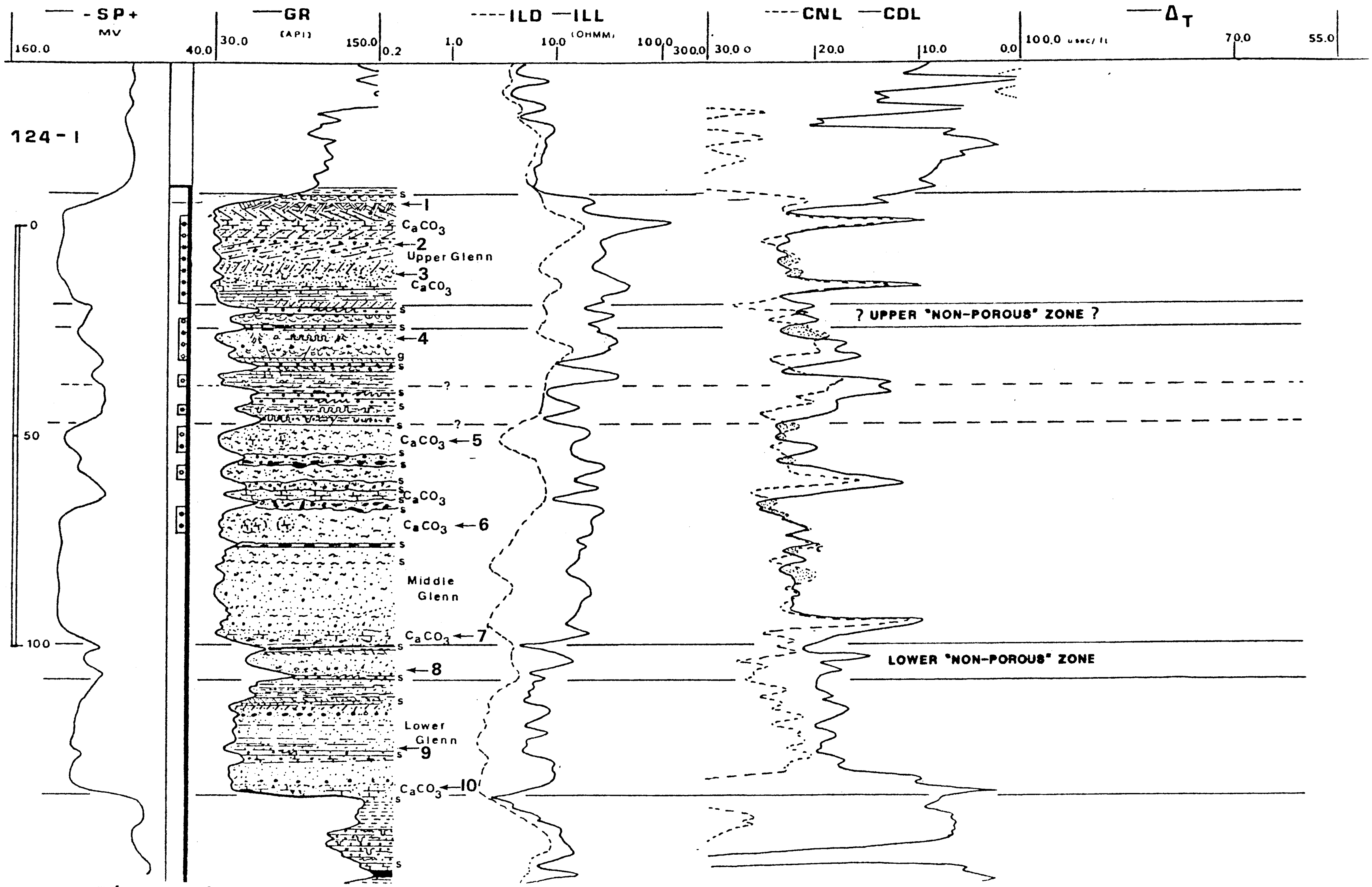


Figure 120. Log-signatures, General Lithology, and Sedimentary-features, Glenn Sandstone, William Berryhill No. 124-I

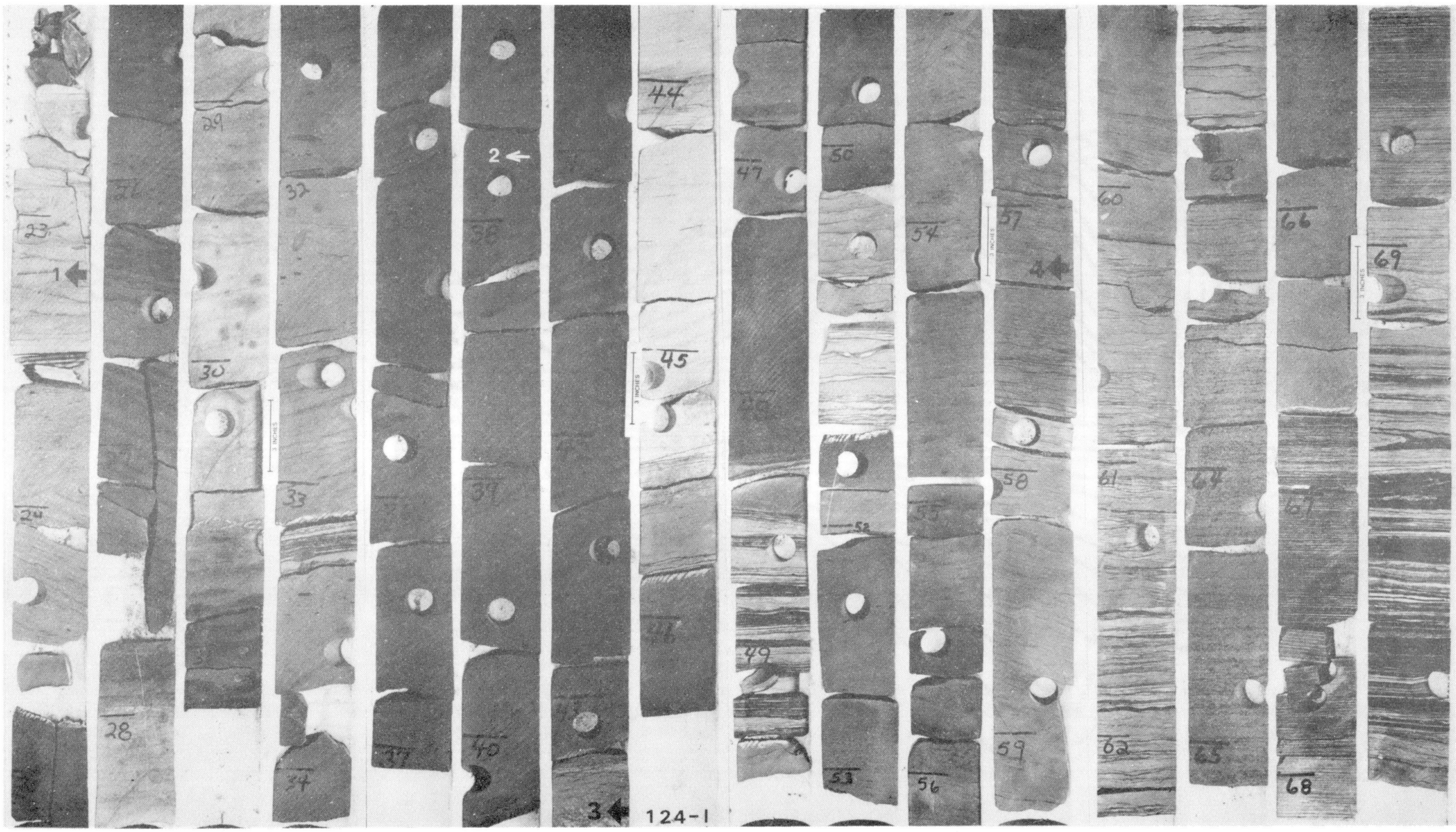
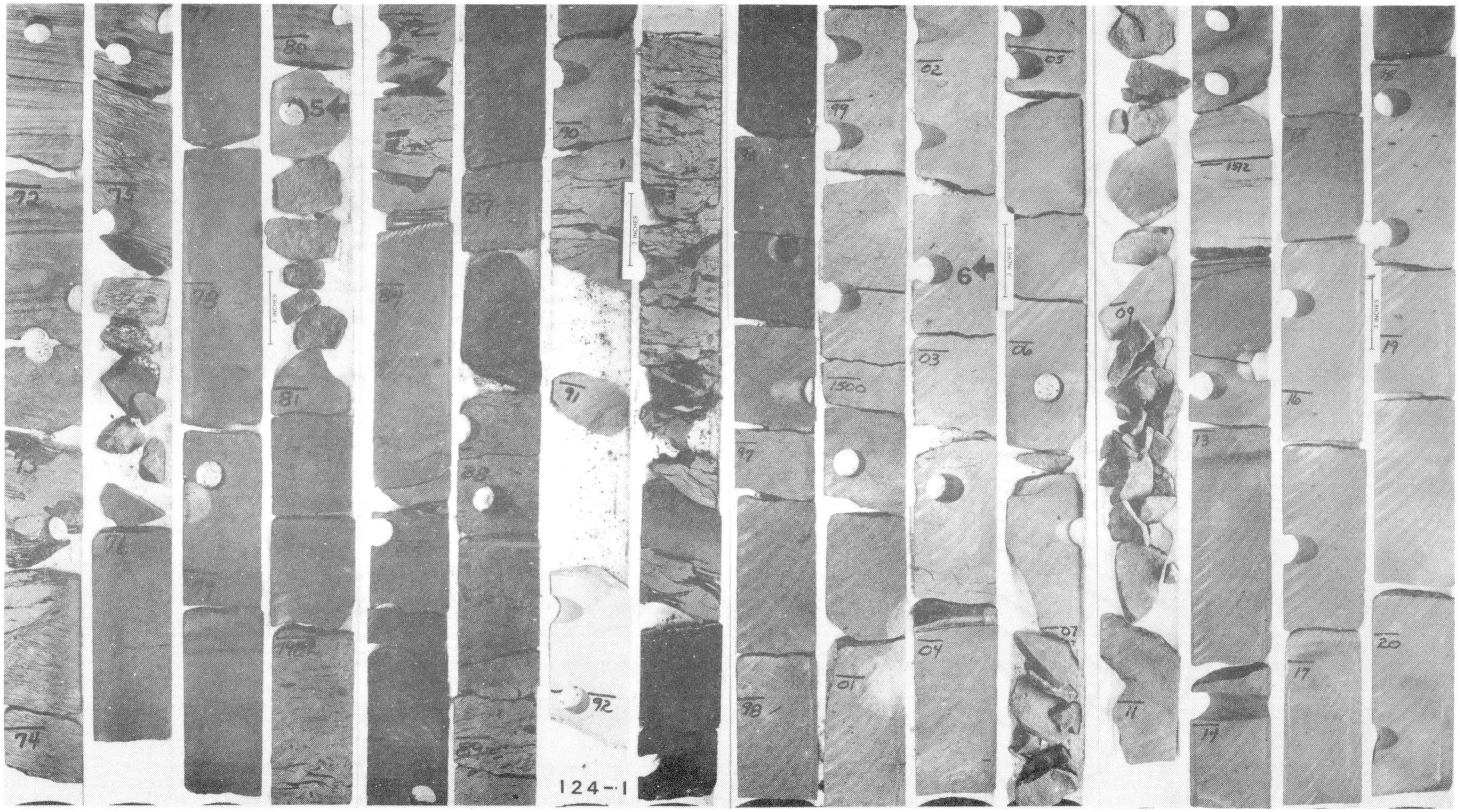
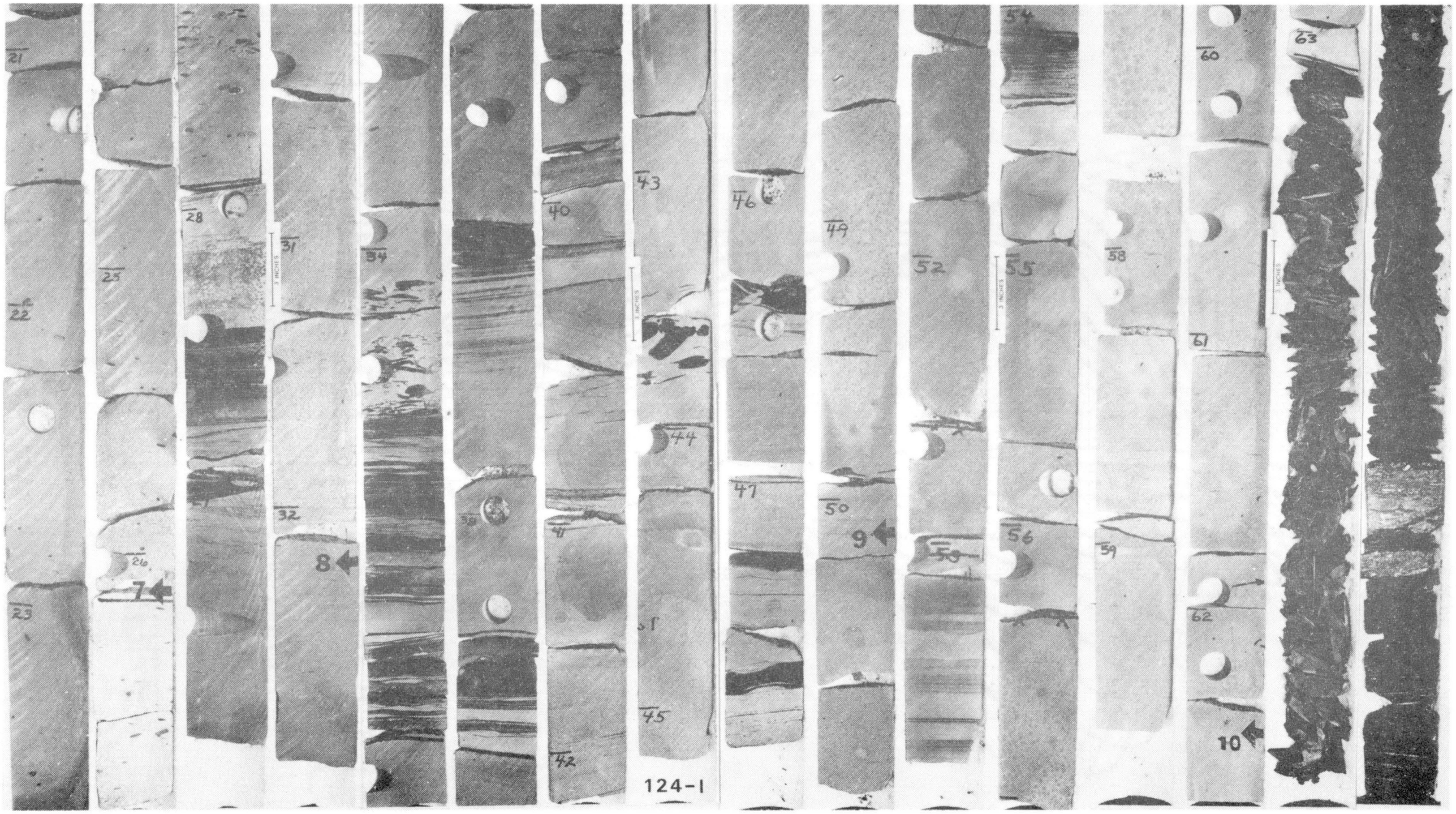


Figure 121. Glenn Sandstone, William Berryhill No. 124-I, 1422.0 - 70.9 ft., Showing the Upper Glenn and a Portion of the Upper "Non-Porous" Zone ? (1448.2 - 70.9 ft.)



Note: Glenn Sandstone, William Berryhill No. 124-I, 1470.9 - 1520.8 ft., Showing a Portion of the Upper "Non-Porous" Zone? (1470.9 - 94.5 ft.), and a Portion of the Middle Glenn

Figure 121 (Continued)



Note: Glenn Sandstone, William Berryhill No. 124-I, 1520.8 - 82.3 ft., Showing a Portion of the Middle Glenn, the Lower "Non-Porous" Zone (1534.8 - 35.8 ft.), and the Lower Glenn

Figure 121 (Continued)

William Berryhill No. 124-I
(1470 FWL, 862 FSL, NE/4, Sec. 17)

Cored Interval: 1422.0 - 1582.3 ft.
Correlation: Core depth three feet shallow to log depth

Core Depth (Ft.)	Core Descriptions
1422.0 - 22.5	sh; gy - dk, brk
	Upper Glenn
22.5 - 24.8	ss; lt gy - gy, vf - m gr, p strd, s sc xbdg or ripple-lams, altng vf - m gr lams, th carb slty ptg ◇ 23.5 ft., sl calc cmt, (Sample 124-1, 23.1 ft.)
24.8 - 28.0	ss; brn, f - m gr, m sc xbdg, th slty, carb lam (poss asph mat) o. stn, vis por
28.0 - 30.5	ss; lt gy - gy, vf - f gr, apr m sc xbdg, calc cmt, grdg downw into brn o. stn ss
30.5 - 33.1	ss; lt brn - brn, f gr, sl m sc xbdg, few sid pbls, carb mat, abrupt ctc w/ intlam sh ptg blw
33.1 - 33.2	sh; dk gy - blk, f intlam of slt & carb mat, abrupt ctc blw
33.2 - 43.1	ss; lt brn - brn, f - m gr, m sc xbdg, few s sid pbls, carb fils, sev scour surfs, vis por (Sample 124-2, 37.8 ft.)
43.1 - 45.5	ss; lt gy - buff, vf - f gr, mot calc cmt top 6 cm, (Sample 124-3, 43.2 ft.) w calc cmt, carb fils, sl incld bdg (low ang m sc xbdg?) grdg trans to non-calc cmt ss, incr carb lam
45.5 - 48.2	ss; brn, f - m gr, apr mas bdg, o. stn, few v s sid pbls, carb fils, vis por, low ang abrupt ctc blw
48.2 - 49.3	intlam ss/sh; gy - blk, f intlam of ss/sltst w/ blk carb sh, flaser struc, current-ripple lam, abrupt ctc blw (Upper "Non-Porous" Zone ?)

49.3 - 50.1	ss; brn, vf - f gr, apr mas bdg, carb mat, abrupt ctc w/ underlying sltst
50.1 - 51.0	sltst; lt gy - blk, intlam w/ thn sh ptgs (2 - 3 cm), abrupt ctc
51.0 - 51.8	core missing
51.8 - 53.1	ss; brn, vf - f gr, apr mas bdg, grdg downw into slty ss, f sed strucs
53.1 - 60.1	ss; lt brn - gy, vf - f gr, slty, cly, abnt carb mat, f ripple lam sl incld, flow feature ◇ 53.1 - 53.8 ft., (Sample 124-4, 57.4 ft.)
60.1 - 63.1	intlam shy ss; gy - dk gy, vf gr, slty f lam of slt & carb mat, ripple lams, th (1 cm) sh & carb ptgs, abrupt ctc blw
63.1 - 66.8	ss; dk gray - blk, vf gr, hztl bdg, abnt carb mat, grdg to mas apr ss, abrupt ctc ◇ 66.8 ft. w/ planar bdd ss/sh
66.8 - 69.2	shy ss; dk gy - blk, f lams, hztl bdg (planar bdg?), 67.3 - 67.8 ft. is calc cmt, zn grds into intlam/intbd ss/sh
69.2 - 70.8	intlam/intbd ss/sh; dk gy - blk, incrg sh downw, grdg downw into hztl lam shy ss
70.8 - 72.1	shy ss; gy - dk gy, f hzlt bdg (planar bdg?) carb, slty
72.1 - 76.0	shy ss; gy - dk gy - blk, flow, disrpt bdg, wvy ireg lams, carb, slty carb ptgs, slump feature?
76.0 - 82.0	ss; brn, vf - f gr, apr mas bdg in pt, faint hzlt bdg obsvd, abnt, carb fils, sph zn (4 cm) of calc cmt ss ◇ 78.8 ft., (Sample 124-5, 80.1 ft.)
82.0 - 83.8	ss/sh; brn - blk, vf - f gr, abnt sh rip-up clasts, incrg in sz cownw, th (2 cm) sh ptgs create abrupt low ang ctc w/ underlying ss
83.8 - 90.5	ss; brn, vf - f gr, apr mas bdg, abnt carb fils & ptgs, bdd sh rip-up clasts ◇ 84.9 ft., incrg sh rip-up clast downw
90.5 - 91.0	core missing

91.0 - 91.1	ss; brn, vf - f gr, apr mas bdg, abnt carb fils
91.1 - 91.7	core missing
91.7 - 92.4	ss; lt gy - buff, vf - f gr, apr mas bdg, calc cmt, carb fils, abrupt ctc ◇ 92.4 ft. w/ underlying sh rip-up clast zn
92.4 - 94.5	ss/sh; brn - blk, abnt sh rip-up clasts, sh ptgs, abnt carb, flow, low ang abrupt ctc ◇ 94.5 ft. w/ underlying o. stn ss
	Middle Glenn
94.5 - 1526.1	ss; brn, vf - f gr, o. stn, apr mas bdg, abnt carb fils, s sid pbls, abrupt decr in o. stn ◇ 96.6 ft., decrg o. stn, lt brn - brn, mas apr calc cmt front ◇ 1500.9 - 01.1 ft., (Sample 124-6, 1502.6 ft.), sh ptg (2 - 3 cm) ◇ 03.9 ft., brk ss from 07.0 - 10.9 ft., f slty/ carb lams & ptgs ◇ 11.9 - 12.5 ft., few scat s sid pbls ◇ 18.0 - 19.0 ft., lt gy - gy ss, scat s sid pbls incr downw, abrupt trans ◇ 26.1 ft.
1526.1 - 27.0	ss; lt gy - buff, ss as abv, calc cmt, s sid pbls (flat-elg) (Sample 124-7, 26.1 ft.)
27.0 - 27.9	ss; gy - brn, vf - f gr, abnt sh rip-up clasts & sid pbls, abrupt low ang ctc ◇ 27.9 ft.
27.9 - 28.5	ss; lt gy - gy, vf - f gr, mot apr, low ang parll bdg, v abrupt ctc ◇ 28.5 ft.
28.5 - 29.0	sh; blk - dk gy, f intlam of slt, decrg sh to 29.0 ft., abrupt ctc w/ sh ptg (3 cm), low ang ctc
29.0 - 34.1	ss; dk gy - gy, vf - f gr, sl low ang parll bdg near top, grdg to apr mas bdg, abnt carb fil, (Sample 124-8, 32.1 ft.)
34.1 - 34.8	ss/sh; gy - blk, vf - f gr, sh rip-up clasts, flat-elg, sub rd, abrupt ctc w/ underlying intlam ss/sh
34.8 - 35.8	intlam/intbd ss/sh; dk gy - blk, f intlam, flaser, current-ripple lams, thin bdd ss/sh, abrupt ctc blw ("Lower Non-Porous Zone")

Lower Glenn

35.8 - 36.9	ss; lt brn - gy, vf - f gr, apr mas bdg, isolated sid pbls, carb fils, abrupt ctc blw
36.9 - 37.0	sh; blk, dns, slty, (4 cm)
37.0 - 38.5	ss; lt brn - gy, vf - f gr, low ang parll bdg, carb/slty lams decrg downw, abrupt ctc blw
38.5 - 39.3	sh; blk, dns, th intbdd ss abv abrupt low ang ctc ◇ 39.3 ft.
39.3 - 39.9	ss; lt brn - gy, vf - f gr, mas in part, low ang fabric, carb fils, few s flat-elg sid pbls, abrupt ctc blw
39.9 - 40.2	ss/sh; lt brn - gy - dk gy, intbd sh & ss, low ang bdg plane, abrupt ctc w/ ss blw
40.2 - 43.8	ss; lt brn - gy, vf - f gr, s - m sc xbdg near top, few flat-elg sh rip-up clasts, carb ptgs ◇ 41.0 ft., low ang bdg - mas
43.8 - 43.9	sh/ss; gy - blk; lg (3 - 4 cm) sub rd sid clasts
43.9 - 46.4	ss; gy, vf - f gr, apr mad bdg, carb fils
46.4 - 46.45	sh; blk, brk sh ptg or sh rip-up clast
46.45 - 47.8	ss; gy, vf - f gr, faint parll bdg & ptg, th (2 cm) sh ptgs ◇ 47.2 ft., & 47.6 ft., vis por
47.8 - 53.0	ss; gy - lt gy, vf - f gr, apr mas bdg, faint parll bdg of slty lam, flat-elg sid clast ◇ 49.5 ft., & 49.95 ft., (Sample 124-9, 50.1 ft.)
53.0 - 54.4	sltst/sh; gy - dk gy - blk, parll lams & th bds of slt, incrg sh lams downw, sl calc cmt, abrupt ctc ◇ 54.4 ft.
54.4 - 63.0	ss; lt gy, vf - f gr, mas apr, coaly ptg ◇ 56.2 ft., v few s sid pbls, carb fils, (Sample 124 -10, 62.4 ft.)
63.0 - 63.1	ss; lt gy - buff, mas apr, calc cmt, low ang abrupt ctc w/ underlying sh

63.1 - 69.0	sh; blk, fis, brk, carb sid nods, sl hem stn, dns, hard, sid sh str ◊ 68.0 ft.
69.0 - 78.1	slty sh; lt gy - dk gy - blk, intlam slt, sid near top, bur, convolute bdg, flow
78.1 - 81.1	sh; blk, fis, brk, carb
81.1 - 81.4	ls; gy - dk gy, fos (Plcy), carb, th intbd carb sh, abrupt ctcs abv & blw
81.4 - 82.3	coal; blk, bit, carb

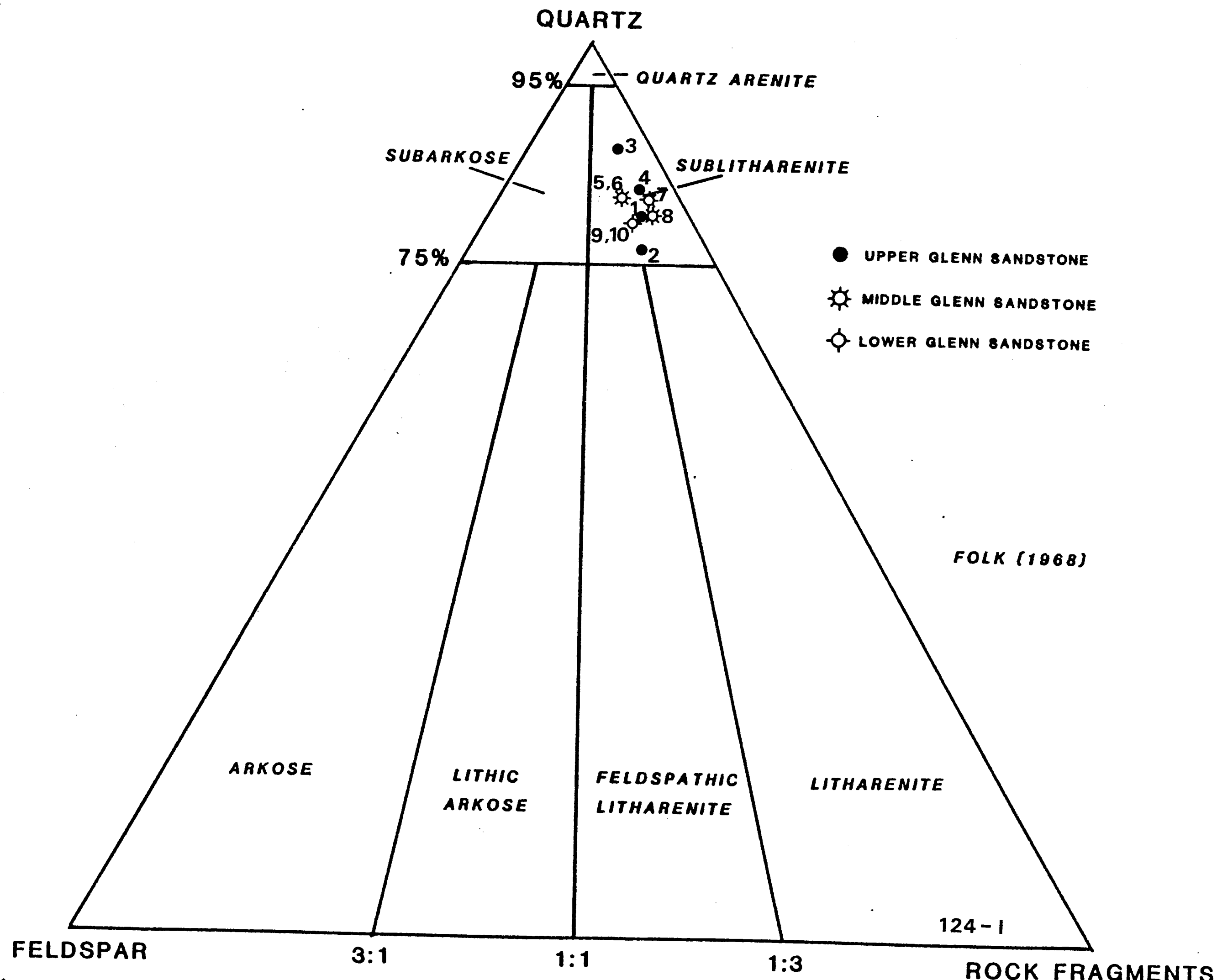


Figure 122. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 124-I

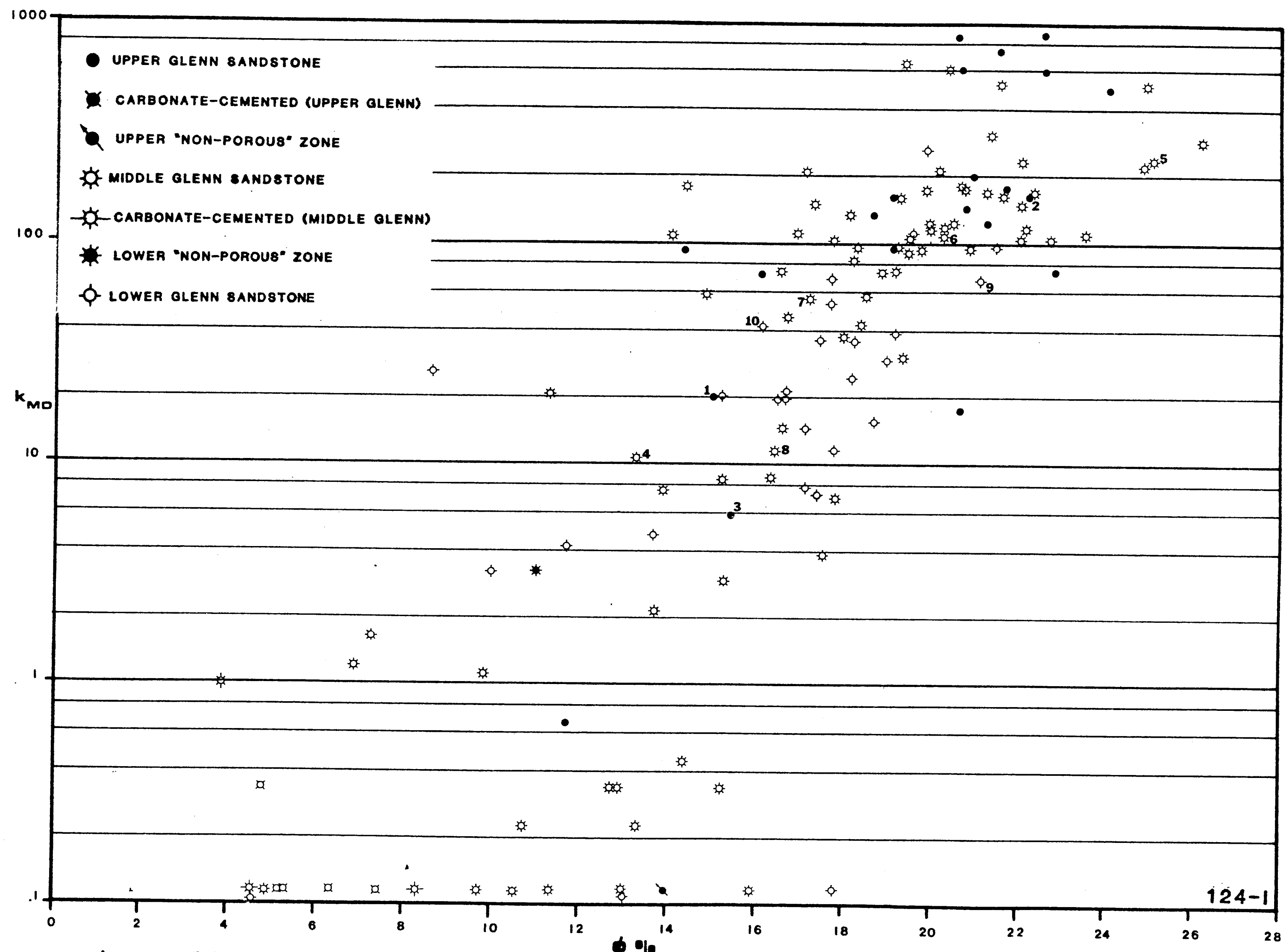


Figure 123. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 124-I

TABLE XVI

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 124-I
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT.	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
		CONVENTIONAL PLUG ANALYSIS					
1	1422.0-23.0	0.6	11.6	12.7	52.8		SD,CALC
2	1423.0-24.0 ◄1	19.0	15.0	21.5	15.4		SD
3	1424.0-25.0	93.0	14.3	14.4	20.8		SD
4	1425.0-26.0	916.0	20.6	26.9	29.0		SD,CALC
5	1426.0-27.0	202.0	21.0	17.9	40.0		SD
6	1427.0-28.0	672.0	20.7	29.3	28.2		SD
7	1428.0-29.0	0.3	4.6	19.5	32.8		LM,SDY
8	1429.0-30.0	<0.1	6.2	24.6	41.1		LM
9	1430.0-31.0	<0.1	7.3	23.6	37.9		LM
10	1431.0-32.0	97.0	19.1	24.5	35.0		SD,CALC
11	1432.0-33.0	137.0	18.7	27.6	32.4		SD
12	1433.0-34.0	524.0	24.1	18.6	31.0		SD
13	1434.0-35.0	17.0	20.7	22.3	31.9		SD,CALC
14	1435.0-36.0	180.0	21.7	20.2	28.3		SD
15	1436.0-37.0	127.0	21.3	22.6	28.7		SD
16	1437.0-38.0 ◄2	166.0	22.3	17.4	25.1		SD
17	1438.0-39.0	76.0	22.9	18.9	28.3		SD
18	1439.0-40.0	145.0	20.8	17.9	31.6		SD
19	1440.0-41.0	791.0	21.6	16.0	27.0		SD
20	1441.0-42.0	165.0	19.1	19.8	32.6		SD
21	1442.0-43.0	71.0	16.1	25.4	28.2		SD
22	1443.0-44.0 ◄3	5.5	15.4	31.7	30.2		SD,CALC
23	1444.0-45.0	<0.1	5.0	12.8	40.9		LM
24	1445.0-46.0	<0.1	5.1	17.2	39.5		LM
25	1446.0-47.0	938.0	22.6	18.8	23.1		SD
26	1447.0-48.0	628.0	22.6	22.0	27.7		SD
27	1448.0-49.0	0.1	13.9	41.2	34.4		SD,SHY
28	1449.0-50.0	101.0	17.7	33.4	29.5		SD
29	1450.0-51.0	28.0	15.2	30.5	32.0		SD
30	1451.0-52.0	701.0	19.4	28.9	41.6		SD
31	1452.0-53.0	672.0	20.4	28.0	34.5		SD
32	1453.0-54.0	554.0	21.6	23.6	48.3		SD
33	1454.0-55.0	540.0	25.1	27.0	34.0		SD
34	1455.0-56.0	218.0	17.1	28.7	37.8		SD
35	1456.0-57.0 ◄4	10.0	13.2	52.2	28.8		SD,CARB
36	1457.0-58.0	2.0	13.6	44.5	35.9		SD,CARB
37	1458.0-59.0	7.2	12.8	40.6	32.5		SD,CARB
38	1459.0-60.0	8.0	15.2	28.9	27.4		SD,CARB
39	1460.0-61.0	0.1	9.6	20.5	64.1		SD,CARB,SHY
40	1461.0-62.0	<0.1	11.2	32.2	32.2		SD,CARB,SHY
41	1462.0-63.0	109.0	14.0	28.5	33.5		SD,CARB,SHY
42	1463.0-64.0	75.0	18.9	26.0	29.5		SD,CARB
43	1464.0-65.0	97.0	19.2	24.2	34.6		SD
44	1465.0-66.0	166.0	19.3	19.6	34.6		SD
45	1466.0-67.0	58.0	18.5	22.2	43.1		SD
46	1467.0-68.0	<0.1	4.7	19.3	71.8		LM
47	1468.0-69.0	0.1	12.9	16.5	49.5		SD,CARB,SHY
48	1469.0-70.0	0.2	10.6	20.7	48.3		SD,CARB,SHY
49	1470.0-71.0	0.2	13.2	32.3	35.9		SD,CARB,SHY
50	1471.0-72.0	0.3	12.8	33.5	39.1		SD,CARB,SHY
51	1472.0-73.0	3.6	17.5	25.9	41.5		SD,CARB
52	1473.0-74.0	0.3	12.6	17.6	58.7		SD,CARB,SHY
53	1474.0-75.0	0.3	15.2	29.0	39.7		SD,CARB,SHY
54	1475.0-76.0	0.4	14.3	28.0	41.2		SD,CARB,SHY
55	1476.0-77.0	171.0	21.7	17.8	23.7		SD
56	1477.0-78.0	177.0	21.3	18.6	36.1		SD
57	1478.0-79.0	171.0	19.7	20.4	35.2		SD
58	1479.0-80.0	110.0	22.6	17.1	25.7		SD,CARB
59	1480.0-81.0 ◄5	232.0	24.5	19.2	30.6		SD
60	1481.0-82.0	222.0	24.3	18.2	30.4		SD
61	1482.0-83.0	75.0	16.5	19.4	30.4		SD,SHY
62	1483.0-84.0	46.0	16.7	24.1	17.4		SD,SHY
63	1484.0-85.0	15.0	7.1	18.8	66.9		SD,SHY
64	1485.0-86.0	96.0	20.9	32.4	20.9		SD,CARB
65	1486.0-87.0	220.0	20.2	32.7	27.2		SD
66	1487.0-88.0	151.0	17.3	27.6	39.4		SD
67	1488.0-89.0	37.0	18.0	42.3	33.6		SD
68	1489.0-90.0	20.0	11.2	30.2	43.2		SD
69	1490.0-91.0	1.1	6.7	31.5	47.5		SD,SHY
70	1491.0-92.0	<0.1	15.9	23.1	31.8		LM
71	1492.0-93.0	<0.1	4.4	14.6	58.5		LM
72	1493.0-94.0	1.0	9.7	15.5	77.4		SD,SHY
73	1494.0-95.0	188.0	14.3	30.8	37.3		SD,CARB
74	1495.0-96.0	318.0	21.4	39.4	25.2		SD,CARB
75	1496.0-97.0	294.0	26.3	31.3	34.1		SD,CARB

TABLE XVI (CONTINUED)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
76	1497.0-98.0	240.0	22.1	27.1	35.8		SD,CARB
77	1498.0-99.0	188.0	20.7	25.6	40.5		SD,CARB
78	1499.0-00.0	107.0	19.5	29.9	41.4		SD,CARB
79	1500.0-01.0	176.0	20.8	27.5	42.3		SD,CARB
80	1501.0-02.0	105.0	22.8	29.9	38.5		SD,CARB
81	1502.0-03.0 ←6	110.0	20.3	22.0	48.4		SD,CARB
82	1503.0-04.0	58.0	14.8	23.9	51.0		SD,CARB
83	1504.0-05.0	125.0	20.5	27.0	42.2		SD,CARB
84	1505.0-06.0	119.0	22.2	23.9	40.8		SD,CARB
85	1506.0-07.0	119.0	20.0	23.8	47.7		SD
	1507.0-1510.0	TOO BROKEN FOR ANALYSIS					
86	1510.0-11.0	169.0	21.6	20.6	52.7		SD
87	1511.0-12.0	180.0	19.9	15.9	48.0		SD
88	1512.0-13.0	138.0	18.1	30.0	43.7		SD
89	1513.0-14.0	110.0	16.9	31.0	49.9		SD
90	1514.0-15.0	98.0	18.3	25.9	41.9		SD
91	1515.0-16.0	44.0	18.4	24.1	41.0		SD
92	1516.0-17.0	75.0	19.2	22.2	40.9		SD
93	1517.0-18.0	90.0	19.5	19.4	45.8		SD
94	1518.0-19.0	93.0	19.8	18.9	35.6		SD
95	1519.0-20.0	81.0	18.2	21.0	46.9		SD
96	1520.0-21.0	105.0	22.1	15.3	43.7		SD
97	1521.0-22.0	120.0	20.0	17.7	45.3		SD
98	1522.0-23.0	116.0	21.3	15.6	45.9		SD
99	1523.0-24.0	174.0	22.4	14.4	35.6		SD
100	1524.0-25.0	151.0	21.2	12.8	35.8		SD
101	1525.0-26.0 ←7	55.0	17.2	13.8	40.8		SD,LMY
102	1526.0-27.0	0.9	3.7	0.0	60.1		SD,LMY
103	1527.0-28.0	0.1	8.2	10.6	75.9		SD,LMY
104	1528.0-29.0	<0.1	10.4	10.6	59.0		SD,SHY
105	1529.0-30.0	8.2	16.3	25.2	39.3		SD,SHY
106	1530.0-31.0	14.0	16.6	22.0	35.8		SD
107	1531.0-32.0	6.7	17.8	20.4	37.1		SD
108	1532.0-33.0 ←8	11.0	16.4	21.0	36.4		SD
109	1533.0-34.0	30.0	19.4	19.6	35.7		SD
110	1534.0-35.0	3.0	10.9	13.7	59.4		SD,SHY
111	1535.0-36.0	15.0	18.7	26.5	28.9		SD
112	1536.0-37.0	35.0	18.2	23.1	26.7		SD
113	1537.0-38.0	4.5	13.6	0.0	58.5		SD,SHY
114	1538.0-39.0	31.0	9.9	17.1	66.0		SD
115	1539.0-40.0	111.0	19.6	16.9	60.3		SD
116	1540.0-41.0	11.0	17.8	15.7	64.0		SD,SHY
117	1541.0-42.0	69.0	17.7	16.4	64.1		SD
118	1542.0-43.0	269.0	19.9	16.8	60.4		SD
119	1543.0-44.0	<0.1	12.9	8.3	77.9		SH,SDY
120	1544.0-45.0	24.0	18.2	10.1	57.0		SD
121	1545.0-46.0	14.0	17.1	9.5	59.5		SD
122	1546.0-47.0	3.8	19.2	7.0	62.4		SD,SHY
123	1547.0-48.0	26.0	8.5	2.6	65.2		SD,CARB
124	1548.0-49.0	6.9	17.4	6.0	63.2		SD
125	1549.0-50.0	7.5	17.1	8.1	61.6		SD,CARB
126	1550.0-51.0 ←9	69.0	21.2	6.3	60.3		SD
127	1551.0-52.0	52.0	17.7	4.5	63.0		SD,CARB
128	1552.0-53.0	29.0	19.0	5.3	64.5		SD
129	1553.0-54.0	4.0	11.6	7.3	64.9		SD
130	1554.0-55.0	<0.1	17.8	8.8	62.9		LM,SDY
131	1555.0-56.0	36.0	17.5	7.9	67.8		SD
132	1556.0-57.0	19.0	16.5	6.3	69.9		SD
133	1557.0-58.0	20.0	15.2	9.2	64.6		SD
134	1558.0-59.0	19.0	16.6	6.2	69.8		SD
135	1559.0-60.0	21.0	16.7	6.2	63.7		SD
136	1560.0-61.0	21.0	16.7	4.9	62.9		SD
137	1561.0-62.0	52.0	17.7	5.8	7.9		SD
138	1562.0-63.0 ←10	41.0	16.1	6.5	68.8		SD
139	1563.0-64.3	<0.1	4.4	6.8	70.3		LM,SDY
	1564.3-69.0						SH
	1569.0-78.0						SH,SLTY W/FN
	1578.0-83.0						SH,SLTY
	1583.0-1589.0	LOST CORE					

WILLIAM BERRYHILL NO. 131-P

(2073 FWL, 627 FSL) NE/4, SEC. 17, T.17N, R.12E

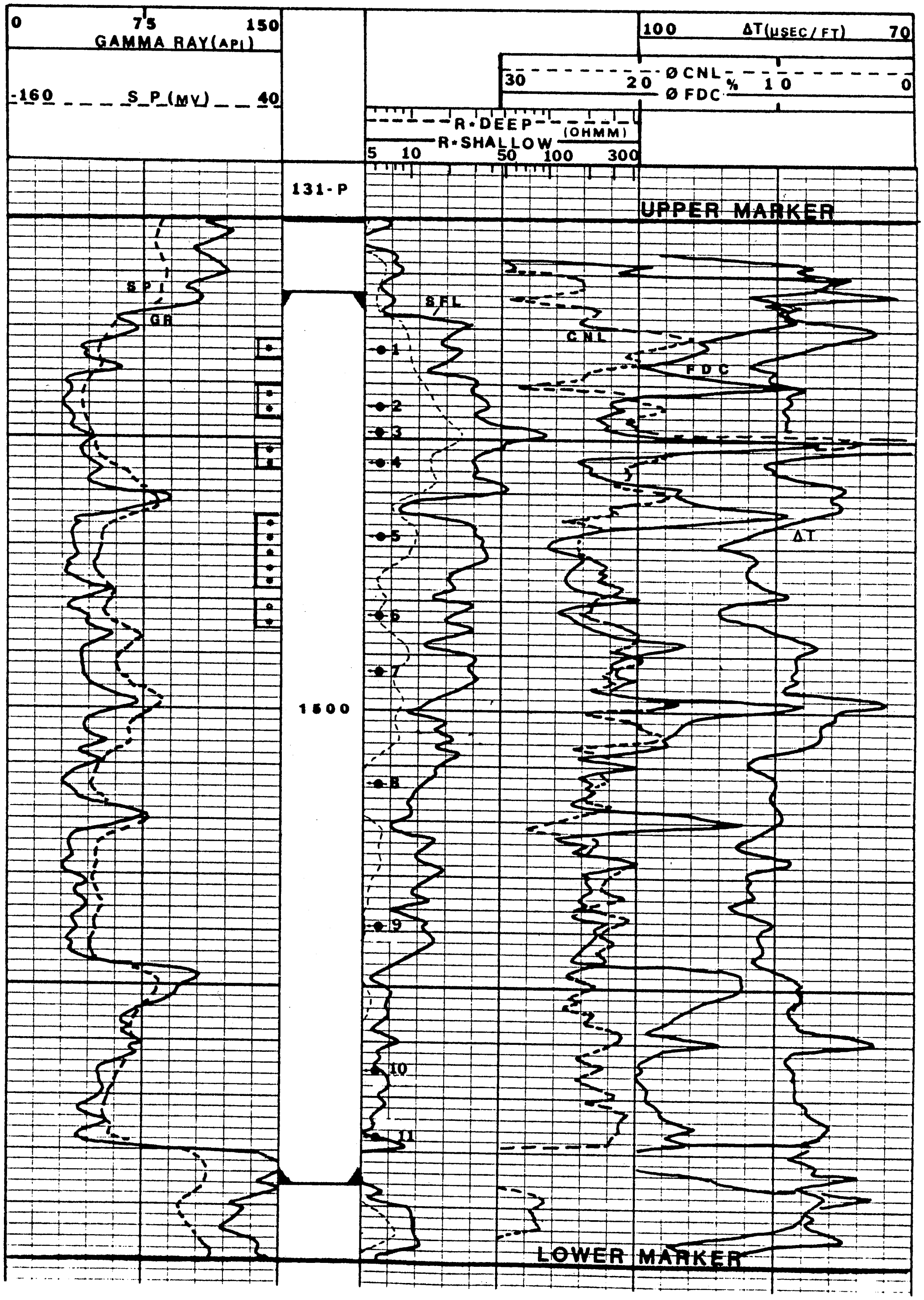


Figure 124. Well-log Signatures, Glenn Sandstone, William Berryhill No. 131-P

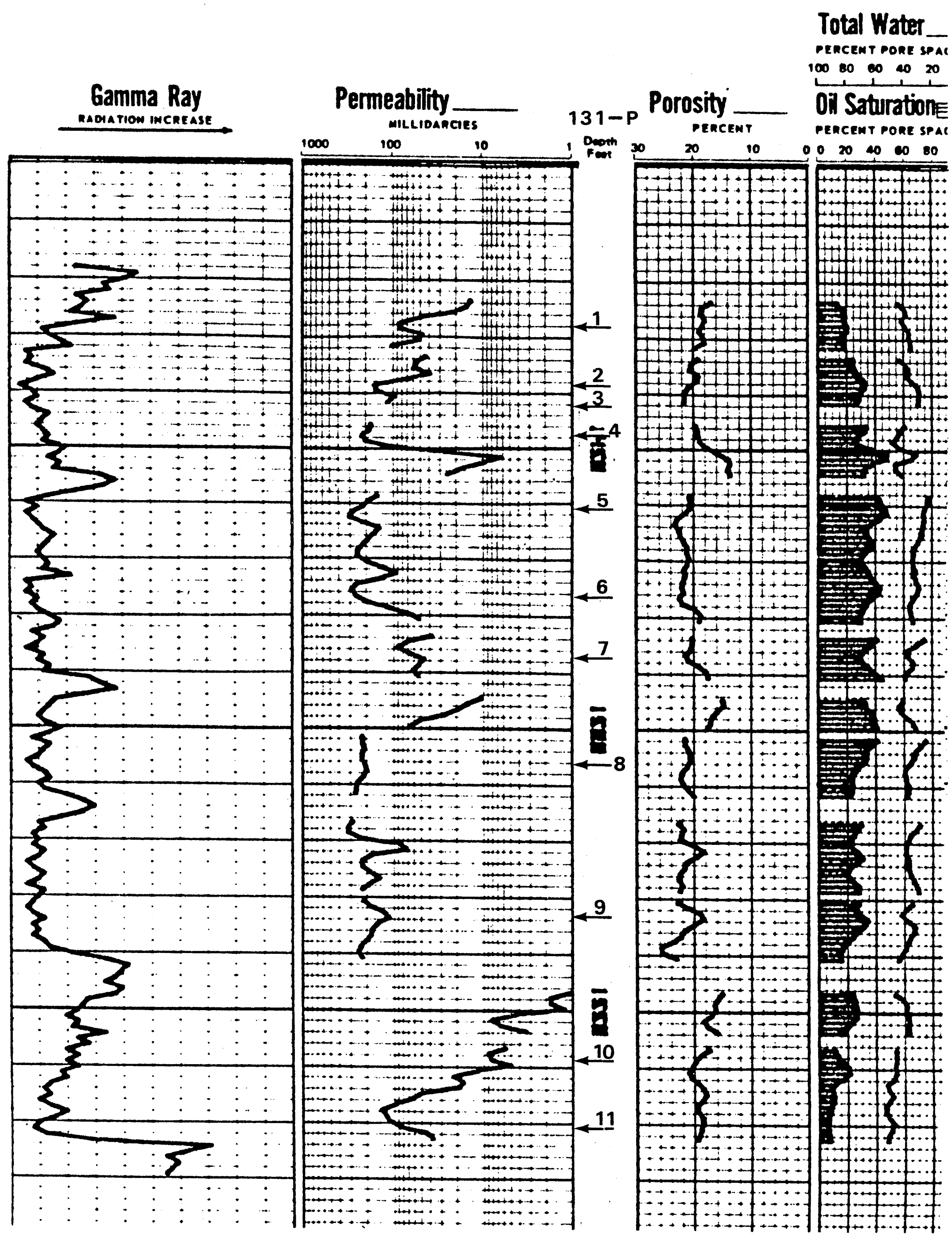


Figure 125. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 131-P

William Berryhill No. 131-P
(2073 FWL, 627 FSL, NE/4, Sec. 17)

Cored Interval: 1418.0 - 1577.3 ft. (Not photographed)
Correlation: Core depth six feet shallow to log depth

<u>Core Depth (Ft.)</u>	<u>Core Description</u>
1418.0 - 22.8	sh; blk - dk gy, fis, becoming slty downw, sl conv bdg abrupt ctc w/ ss blw
	<u>Upper Glenn</u>
22.8 - 30.1	ss; lt brn - brn, f - m gr, vf gr near top, abnt carb fils, thin (2 - 3 cm) sh ptgs, carb lams, o. stn, apr mas bdg in part, sl incld bdg, sev th sh ptgs ◊ 26.5 - 27.1 ft., calc cmt ss ◊ 28.9 - 29.1 ft., carb, abrupt ctc w/ sl calc cmt ss w/ sh rip-up clasts (Sample 131-1, 28.0 ft.)
30.1 - 32.4	intbdd ss/sh; lt brn - gy, lt gy, sl, calc cmt ss w/ abnt sh rip-up clasts (30.1 - 30.8 ft.), th ss bd, abrupt ctc w/ similar intv as abv, intbd ss, abrupt ctc w/ sh bd (32.0 - 32.3 ft.) abrupt ctc w/ ss blw
32.4 - 36.9	ss; lt brn - gy, f - m gr, apr mas bdg, carb fils grdg downw into slty ss, abrupt ctc w/ sh rip-up clasts
36.9 - 37.1	ss/sh; lt brn - gy, blk, abnt sh rip-up clasts, flowage
37.1 - 42.1	ss; lt brn, f - m gr, apr m sc xbdg in part, abnt carb fils, th sh ptg ◊ 41.0 ft., abrupt ctc w/ calc cmt ss ◊ 42.1 ft. (Sample 131-2, 38.5 ft.)
42.1 - 44.9	ss; lt gy - buff, f - m gr, w calc cmt, apr mas bdg, carb fils, th (2 - 3 cm) incld sh ptg ◊ 44.5 ft. (Sample 131-3, 42.5 ft.)
44.9 - 50.4	ss; lt brn, f - m gr, apr mas bdg, carb fils, (Sample 131-4, 48.0 ft.)
50.4 - 51.1	intlam ss/sh; lt gy - blk, slty, f lams (current-ripple lam), abrupt ctc abv & blw

51.1 - 54.4	ss; lt brn - gy, vf - f gr, slty, apr mas bdg, carb fils
54.4 - 58.0	intlam/intbdd ss/sh; lt gy - gy, blk flaser bdg, f current-ripple lams, abrupt ctc abv & blw (Upper "Non-Porous" Zone)
	<u>Middle Glenn</u>
58.0 - 72.5	ss; lt brn, vf - f gr, apr mas bdg, carb fils, few sid pbls, slty & finer gr ◇ 64.0 - 64.5 ft. (Sample 131-5, 61.5 ft.)
72.5 - 73.5	intlam ss/sh; lt gy - blk, f intlams, current-ripple lams, slty
73.5 - 80.6	ss; lt brn, vf - f gr, apr mas bdg, carb fils, few s sid pbls, (Sample 131-6, 76.0 ft.)
80.6 - 81.4	sltst; lt gy - dk gy, f lams of carb sh, grdg downw into slty, parll bdd ss
81.4 - 92.3	ss; lt brn - gy, vf - f gr, apr mas bdg, o. stn, abnt carb fils, few th (2 - 3 cm) sh ptgs, color change ◇ 87.6 ft., incrg f sh ptgs near base (Sample 131-7, 86.5 ft.)
92.3 - 93.4	intbd ss/sh; lt gy - blk, slty, few flat-elg sh rip-up clasts in ss matrix, flowage, abrupt ctc abv & blw
93.4 - 1512.0	ss; lt brn - gy, vf - f gr, apr mas bdg, abnt carb fils, few scat s sid pbls, slty near top, abrupt ctc w/ sh rip-up clast ◇ 1512.0 ft. (Sample 131-8, 1506.8 ft.)
1512.0 - 15.2	ss/sh; lt gy - blk, abnt lg sh rip-up clasts, brkn, flat-elg, slty parll lams, flowage, abrupt ctc abv & blw
15.2 - 20.4	ss; gy, vf - f gr, apr mas bdg, abnt carb fils, grdg downw into slty parll lam ss
20.4 - 22.0	ss; lt gy - gy, vf - f gr, slty, th sh ptgs ◇ 20.4 - 20.8 ft.
22.0 - 26.1	ss; lt gy, vf - f gr, apr mas bdg, abnt carb fils, abrupt ctc w/ intlam ss/sh blw
26.1 - 27.0	intlam ss/sh; lt gy - dk gy; blk, v f intlams of slty ss/sh, current-ripple lams, abrupt ctc abv & blw

27.0 - 29.0	ss; gy - lt brn, vf - f gr, apr mas bdg, carb fils, slty, abrupt ctc blw
29.0 - 30.0	intlam ss/sh; lt gy - gy, blk, f lams, current-ripple lams, th coaly ptg ◊ 29.5 ft., pyr, abrupt ctc blw
30.0 - 40.5	ss; lt gy - gy, vf - f gr, apr mas bdg, abnt carb fils, s sid pbls, slty in part ◊ 32.5 - 34.0 ft. (Sample 131-9, 33.5 ft.)
40.5 - 51.0	intlam/intbdd ss/sh; lt gy - dk gy, blk, flaser, current-ripple lam, carb, sl calc cmt ◊ 47.3 ft., abrupt ctc abv & blw (Lower "Non-Porous" Zone)
	<u>Lower Glenn</u>
51.0 - 53.0	ss; lt gy - gy, vf - f gr, apr mas bdg, carb fils, incrg slt downw, th sh ptgs ◊ 54.6 ft., abrupt ctc w/ sh rip-up clasts blw
53.0 - 53.1	ss/sh; gy - blk, abnt flat-elg sh rip-up clasts in vf gr ss matrix, abrupt ctc blw
53.1 - 56.5	ss; lt gy - gy, vf - f gr, apr mas bdg, carb fils, abrupt ctc w/ sh ◊ 56.5 ft.
56.5 - 56.6	sh; blk - dk gy, carb, hd, dns, abrupt ctc blw
56.6 - 62.3	ss; lt gy, vf - f gr, apr mas bdg, carb fils, s scat sid pbls, abrupt incld ctc w/ intlam ss/sh (Sample 131-10, 59.0 ft.)
62.3 - 62.5	intlam/intbdd ss/sh; lt gy - blk, f intlam, sl incld bdg, abrupt ctc blw
62.5 - 65.0	ss; lt gy, vf - f gr, apr mas bdg, carb fils abrupt ctc blw
65.0 - 66.0	ss/sh; lt gy - gy, blk, abnt lg sh rip-up clasts in a vf - f gr ss matrix, flowage, abrupt ctc w/ ss blw
66.0 - 68.9	ss; lt gy - gy, f - m gr, apr mas bdg, carb fils, few scat s sid pbls, th sh ptgs ◊ 67.0 ft., abrupt ctc w/ sh bd ◊ 68.9 ft.
68.9 - 69.1	sh; blk - dk gy, carb hd, dns, abrupt ctc blw

69.1 - 73.3	ss; lt gy - gy, f - m gr, apr mas bdg, carb fils, few scat s sid pbls, slty, abrupt trans w/ calc cmt ss ◇ 73.3 ft. (Sample 131-11, 71.0 ft.)
73.3 - 73.7	ss; lt gy - buff, f - m gr, w calc cmt, s flat-elg sid clasts at base, v abrupt basel ctc w/ sh (Base of Glenn)
73.7 - 77.3	sh; blk, carb, fis, sl incr slt near base

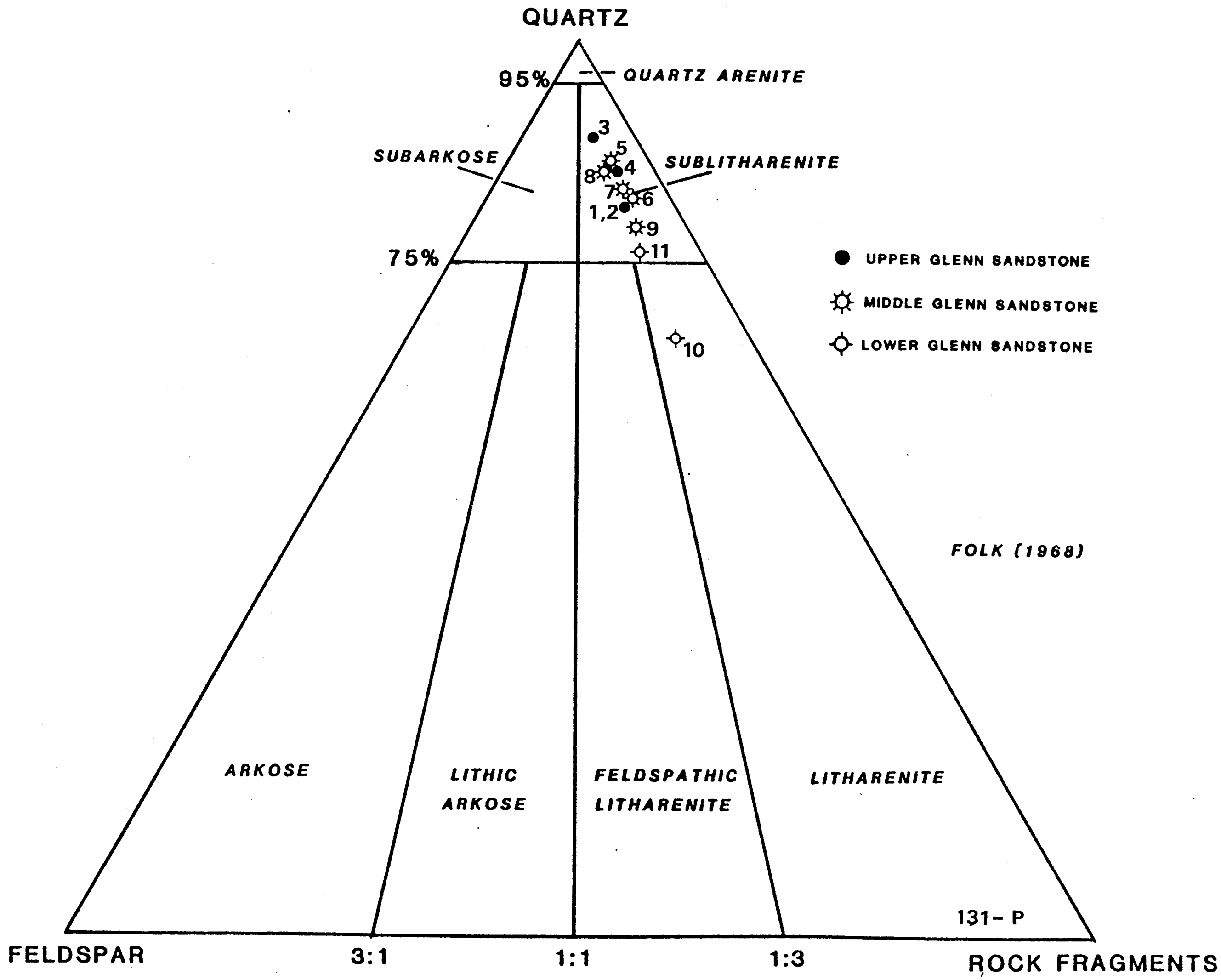


Figure 126. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 131-P

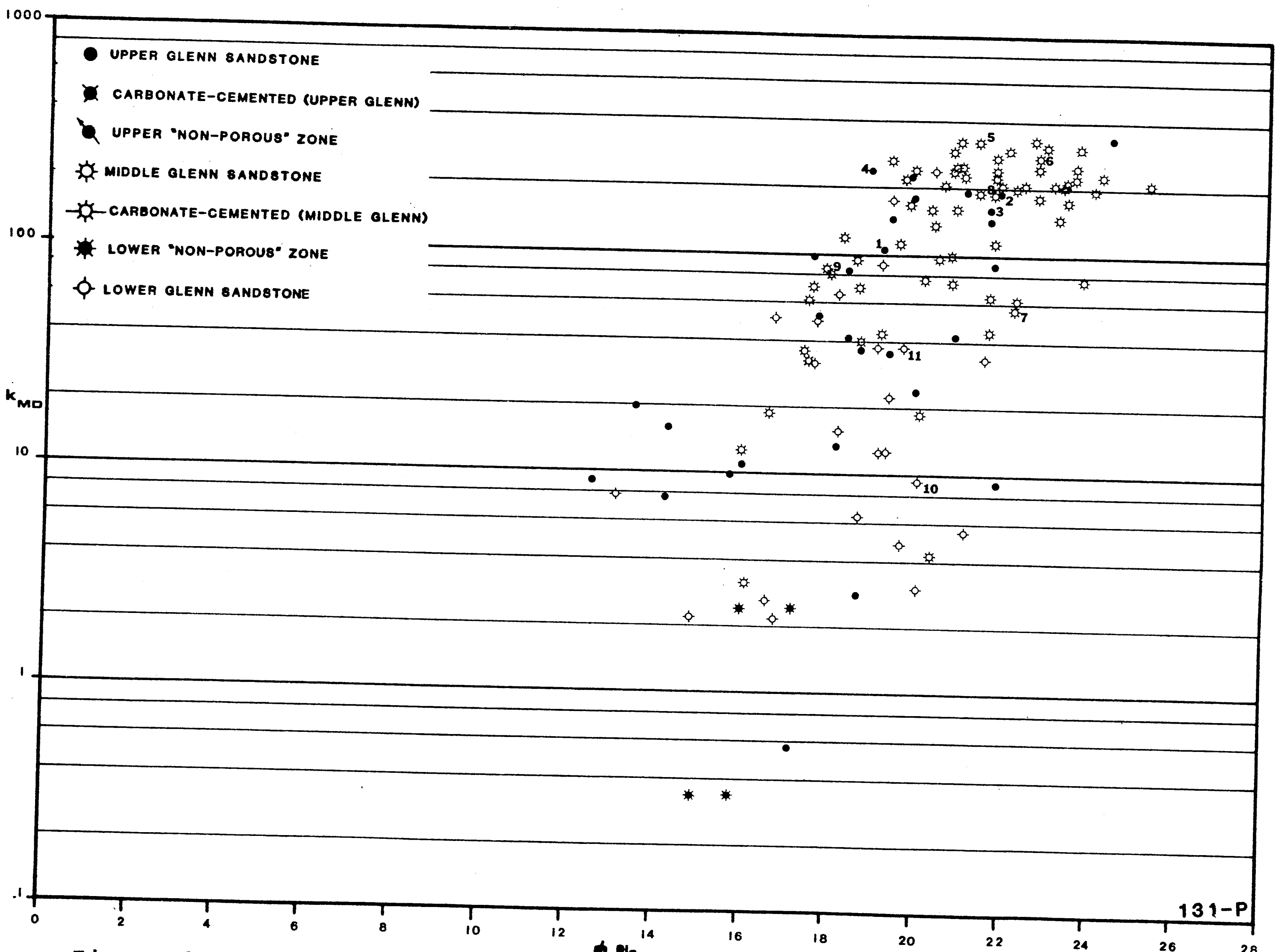


Figure 127. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 131-P

TABLE XVII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 131-P
CORE ANALYSIS

CONVENTIONAL PLUG ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
	1418.0-23.0						SH,SLTY
1	1423.0-24.0	10.0	16.0	9.9	45.1		SD,SLTY
2	1424.0-25.0	23.0	20.0	19.5	40.2		SD
3	1425.0-26.0	2.6	18.7	18.1	32.6		SD,SLTY
4	1426.0-27.0	52.0	17.7	16.4	48.4		SD
5	1427.0-28.0	81.0	18.4	20.9	36.9		SD
6	1428.0-29.0 ←1	105.0	19.2	20.9	34.8		SD
7	1429.0-30.0	35.0	19.4	16.5	38.9		SD
8	1430.0-31.0	9.3	15.7	15.8	33.0		SD,SLTY
9	1431.0-32.0	144.0	21.7	19.5	36.0		SD
	1432.0-33.0						SH
10	1433.0-34.0	42.0	18.4	24.9	46.1		SD
11	1434.0-35.0	43.0	20.9	22.3	37.1		SD
12	1435.0-36.0	88.0	21.8	25.5	33.6		SD
13	1436.0-37.0	13.0	18.2	27.8	42.9		SD,SLTY
14	1437.0-38.0	36.0	18.7	33.5	32.2		SD
15	1438.0-39.0 ←2	195.0	21.9	34.2	29.2		SD
16	1439.0-40.0	198.0	21.1	26.0	29.1		SD
17	1440.0-41.0	8.8	21.9	32.3	29.3		SD,SLTY
18	1441.0-42.0 ←3	162.0	21.7	23.2	30.3		SD
	1442.0-45.0						LM,SDY
19	1445.0-46.0	182.0	19.9	32.2	36.6		SD
20	1446.0-47.0	148.0	19.4	34.8	45.2		SD
21	1447.0-48.0 ←4	241.0	18.9	24.6	45.7		SD
22	1448.0-49.0	230.0	19.8	24.6	43.7		SD
23	1449.0-50.0	96.0	17.6	24.7	57.3		SD
24	1450.0-51.0	0.5	17.2	60.1	16.0		SD,SLTY
25	1451.0-52.0	8.0	12.5	47.5	36.1		SD,SLTY
26	1452.0-53.0	7.3	14.2	35.1	50.2		SD,SLTY
27	1453.0-54.0	15.0	14.3	31.0	47.3		SD
28	1454.0-55.0	28.0	13.5	31.4	38.4		SD
	1455.0-58.0						LM,SDY
29	1458.0-59.0	99.0	20.8	41.4	22.3		SD
30	1459.0-60.0	249.0	20.9	42.0	21.0		SD
31	1460.0-61.0	138.0	20.4	48.1	27.3		SD
32	1461.0-62.0 ←5	336.0	21.4	47.9	25.5		SD
33	1462.0-63.0	320.0	23.0	44.6	26.6		SD
34	1463.0-64.0	230.0	24.3	30.9	24.7		SD
35	1464.0-65.0	65.0	21.7	35.3	29.2		SD
36	1465.0-66.0	213.0	23.2	30.9	26.2		SD
37	1466.0-67.0	150.0	21.7	40.5	29.4		SD
38	1467.0-68.0	244.0	20.8	37.0	34.9		SD
39	1468.0-69.0	215.0	21.8	32.0	32.0		SD
40	1469.0-70.0	306.0	20.8	27.1	34.4		SD
41	1470.0-71.0	165.0	20.3	31.4	34.7		SD
42	1471.0-72.0	150.0	23.3	35.7	30.0		SD
43	1472.0-73.0	77.0	20.2	33.6	34.7		SD
44	1473.0-74.0	62.0	22.3	40.8	31.9		SD
45	1474.0-75.0	347.0	22.7	42.9	26.7		SD
46	1475.0-76.0	253.0	21.0	45.1	31.5		SD
47	1476.0-77.0 ←6	289.0	22.8	33.9	32.0		SD
48	1477.0-78.0	212.0	23.4	33.5	38.2		SD
49	1478.0-79.0	93.0	18.6	31.6	34.0		SD
50	1479.0-80.0	70.0	18.7	27.7	36.2		SD,SL/SHY
51	1480.0-81.0	43.0	19.2	30.2	32.5		SD
	1481.0-83.0						SD,SHY
52	1483.0-84.0	18.0	20.1	39.9	24.4		SD,SL/SHY
53	1484.0-85.0	74.0	20.8	41.1	28.1		SD
54	1485.0-86.0	112.0	19.6	29.3	42.2		SD,SLTY,SL/SHY
55	1486.0-87.0 ←7	56.0	22.3	29.2	36.3		SD
56	1487.0-88.0	44.0	21.7	27.6	34.7		SD
57	1488.0-89.0	38.0	18.7	37.6	29.1		SD,SL/SHY
58	1489.0-90.0	85.0	17.9	35.7	43.4		SD
59	1490.0-91.0	35.0	17.4	48.5	37.1		SD,SL/SHY
	1491.0-94.0						SH,SD STKS
60	1494.0-95.0	12.0	16.0	33.4	36.3		SD,SLTY
61	1495.0-96.0	7.3	13.1	27.7	49.9		SD,SLTY,SL/SHY
62	1496.0-97.0	33.0	17.5	40.6	39.3		SD
63	1497.0-98.0	2.9	16.1	37.7	40.6		SD,SLTY,SL/SHY
64	1498.0-99.0	70.0	17.6	38.9	31.1		SD
65	1499.0-00.0	61.0	17.5	41.3	32.3		SD
	1500.0-01.0						SH,SD STKS
66	1501.0-02.0	203.0	21.0	43.9	24.1		SD
67	1502.0-03.0	252.0	22.8	34.3	25.7		SD
68	1503.0-04.0	170.0	19.8	32.5	35.9		SD
69	1504.0-05.0	243.0	21.8	33.7	29.7		SD
70	1505.0-06.0	229.0	19.7	33.5	35.8		SD

TABLE XVII (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
71	1506.0-07.0 ←8	190.0	21.8	26.2	40.3		SD
72	1507.0-08.0	207.0	22.0	24.0	[illegible]		SD
73	1508.0-09.0	186.0	22.8	22.1	36.5		SD
74	1509.0-10.0	285.0	21.8	24.1	38.1		SD,SL/SHY
75	1510.0-11.0	233.0	21.8	24.0	34.9		SD
76	1511.0-12.0	276.0	19.4	20.3	39.4		SD
	1512.0-16.0						SH,SD STKS
77	1516.0-17.0	260.0	23.7	31.7	29.9		SD
78	1517.0-18.0	338.0	21.0	24.8	27.9		SD
79	1518.0-19.0	307.0	22.1	25.7	40.5		SD
80	1519.0-20.0	315.0	23.8	20.7	34.1		SD
81	1520.0-21.0	4.0	20.4	22.4	41.5		SD,SLTY
82	1521.0-22.0	18.0	16.6	25.1	39.0		SD,SLTY
83	1522.0-23.0	243.0	19.9	35.3	37.6		SD
84	1523.0-24.0	204.0	22.3	25.5	36.3		SD
85	1524.0-25.0	232.0	21.1	19.8	37.5		SD
86	1525.0-26.0	214.0	22.5	18.7	35.5		SD
87	1526.0-27.0	77.0	23.9	21.8	33.7		SD,SL/SHY
88	1527.0-28.0	208.0	20.6	30.9	30.9		SD
89	1528.0-29.0	227.0	23.5	25.8	29.5		SD
	1529.0-30.0						SH,SD STKS
90	1530.0-31.0	227.0	23.7	31.2	31.2		SD
91	1531.0-32.0	193.0	21.4	20.9	40.7		SD
92	1532.0-33.0	119.0	18.3	28.4	43.2		SD
93	1533.0-34.0 ←9	81.0	18.0	36.9	40.7		SD
94	1534.0-35.0	170.0	19.4	31.5	29.3		SD
95	1535.0-36.0	176.0	23.5	25.7	32.4		SD
96	1536.0-37.0	165.0	20.9	24.7	36.6		SD
97	1537.0-38.0	202.0	24.1	19.7	37.7		SD
98	1538.0-39.0	216.0	25.4	15.2	38.8		SD
99	1539.0-40.0	283.0	28.5	14.0	41.4		SD
100	1540.0-41.0	196.0	20.5	15.2	45.7		SD
	1541.0-46.0						SD,SHY
101	1546.0-47.0	0.3	14.9	22.3	51.0		SD,SLTY
102	1547.0-48.0	2.2	16.0	24.6	37.6		SD,SLTY
103	1548.0-49.0	2.2	17.2	26.3	37.4		SD,SLTY
104	1549.0-50.0	0.3	15.8	23.7	41.4		SD,SLTY
105	1550.0-51.0	2.0	16.8	30.1	35.6		SD,SLTY
106	1551.0-52.0	12.0	19.2	20.3	35.8		SD,SLTY
107	1552.0-53.0	5.9	18.7	21.8	38.8		SD,SLTY
108	1553.0-54.0	2.0	14.8	12.6	36.1		SD,SLTY
	1554.0-56.0						SD,SHY
109	1556.0-57.0	2.4	16.6	9.7	45.7		SD,SLTY
110	1557.0-58.0	12.0	19.3	12.3	47.0		SD,SLTY
111	1558.0-59.0 ←10	8.8	20.1	15.7	44.9		SD,SLTY
112	1559.0-60.0	2.8	20.1	21.7	48.0		SD,SLTY
113	1560.0-61.0	5.1	21.2	20.5	46.4		SD,SLTY
114	1561.0-62.0	33.0	21.6	20.0	44.3		SD
115	1562.0-63.0	15.0	18.2	7.5	56.3		SD
116	1563.0-64.0	4.4	19.7	6.8	53.0		SD,SLTY
117	1564.0-65.0	51.0	16.7	11.2	45.0		SD
118	1565.0-66.0	90.0	19.2	9.4	52.8		SD,LIG
119	1566.0-67.0	22.0	19.4	8.3	54.5		SD,LIG
120	1567.0-68.0	247.0	20.4	6.7	52.5		SD
121	1568.0-69.0	32.0	17.6	5.8	54.4		SD
122	1569.0-70.0	179.0	19.4	5.2	44.2		SD
123	1570.0-71.0	65.0	18.2	5.7	50.3		SD
124	1571.0-72.0 ←11	37.0	19.7	6.9	54.1		SD
125	1572.0-73.0	37.0	19.1	5.5	48.5		SD
	1573.0-79.0						SH

WILLIAM BERRYHILL NO. 134-I

(2281 FWL, 396 FSL) NE/4, SEC. 17, T.17N, R.12E

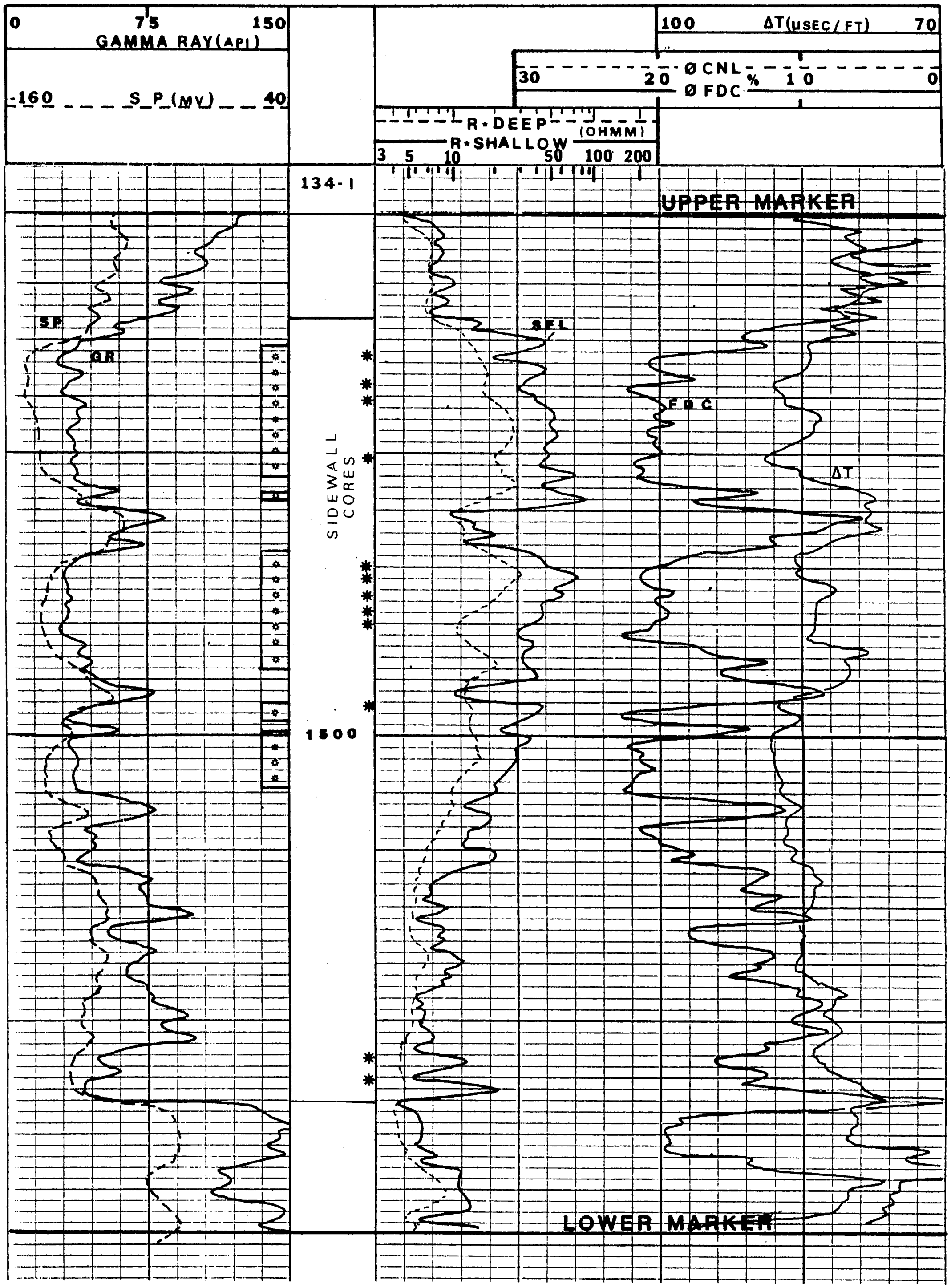


Figure 128. Well-log Signatures, Glenn Sandstone, William Berryhill No. 134-I

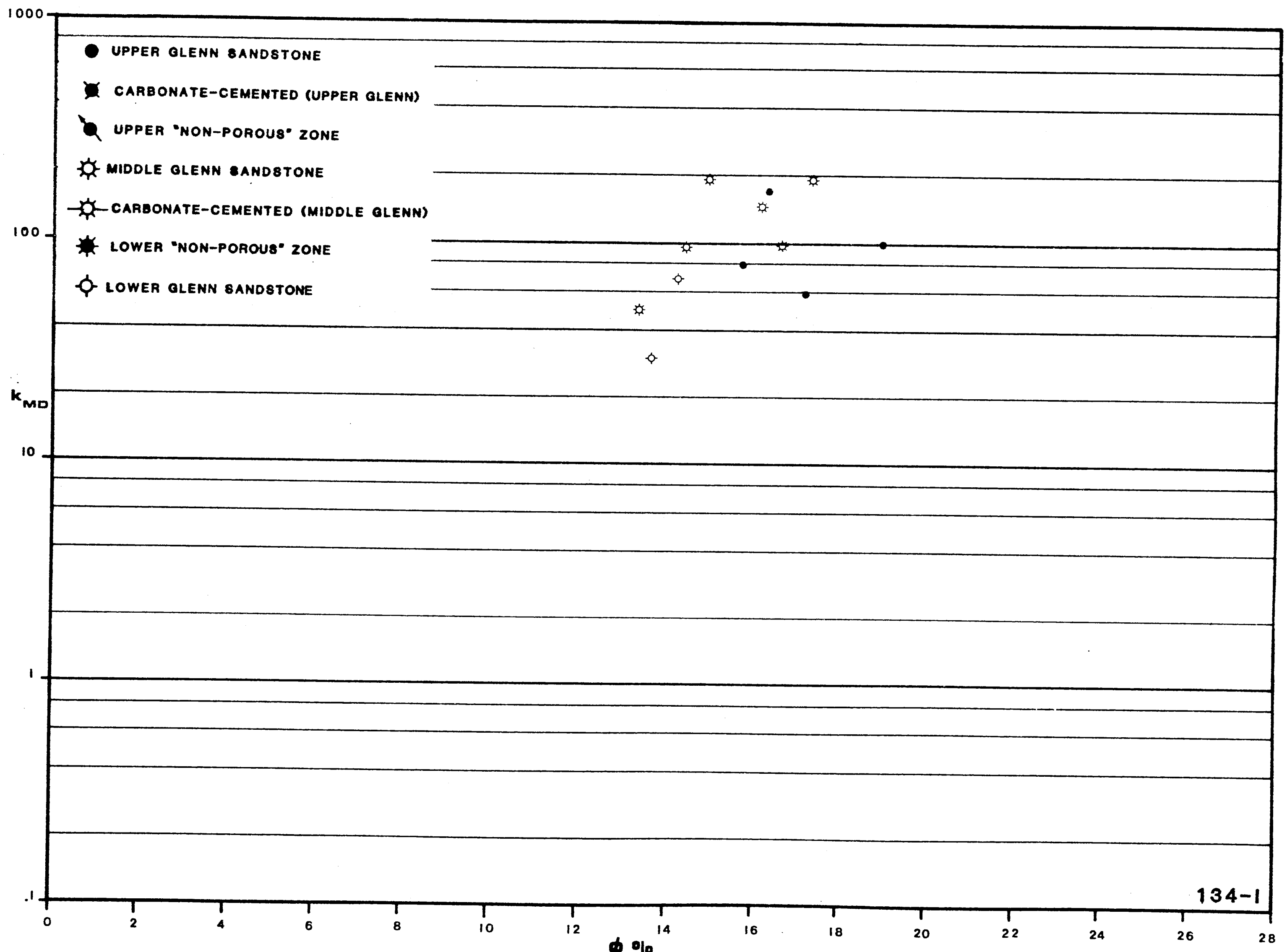


Figure 129. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 134-I

TABLE XVIII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 134-I
CORE ANALYSIS

Lithological Abbreviations

SAND-SD SHALE-SH LIME-LM DOLOMITE-DOL CHERT-CH GYPSUM-GYP ANHYDRITE-ANHY CONGLOMERATE-CONG FOSSILIFEROUS-FOSS SANDY-SDY SHALY-SHY LIMY-LMY FINE-FN MEDIUM-MED COARSE-CSE CRYSTALLINE-XLN GRAIN-GRN GRANULAR-GRNL BROWN-BRN GRAY-GY VUGGY-VGY FRACTURED-FRAC LAMINATION-LAM STYLOLITIC-STY SLIGHTLY-SL VERY-V/ WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE		SAMPLE DESCRIPTION AND REMARKS
				OIL	TOTAL WATER	
SIDEWALL ANALYSIS						
1	81	3	16.7	14.4	59.3	Sd,fn-slt grn,fair odor,fair flu
2	169	0.9	13.8	21.0	51.4	Sd,fn-slt grn,fair odor,fair flu
3	175	Unsuitable for analysis				Sh,no odor,no flu
4	182	0.6	13.6	9.6	67.6	Sd,med-slt grn,calc,fair odor,fair flu
5	1334	50	16.0	28.0	46.8	Sd,fn-slt grn,fair odor,fair flu
6	1336	100	17.7	15.8	72.8	Sd,fn-slt grn,lig,good odor,good flu
7	1402	150	21.7	18.4	60.3	Sd,fn-slt grn,good odor,good flu
8	1433	100	19.0	31.5	54.7	Sd,fn-slt grn,good odor,good flu
9	1438	60	17.2	32.4	51.6	Sd,fn-slt grn,fair odor,fair flu
10	1441	175	16.3	33.7	46.6	Sd,fn-slt grn,good odor,good flu
11	1451	80	15.7	24.8	49.0	Sd,fn-slt grn,good odor,good flu
12	1470	100	16.6	23.5	59.6	Sd,fn-slt grn,good odor,good flu
13	1472	50	13.3	22.6	37.5	Sd,fn-slt grn,good odor,good flu
14	1475	200	17.3	28.3	47.9	Sd,fn-slt grn,good odor,good flu
15	1478	200	14.9	25.5	52.3	Sd,fn-slt grn,good odor,good flu
16	1480	150	16.1	8.6	65.2	Sd,fn-slt grn,lig,good odor,good flu
17	1495	100	14.4	0.0	72.9	Sd,fn-slt grn,no odor,no flu
18	1556	70	14.2	13.3	61.8	Sd,fn-slt grn,sl/shy,fair odor,fair flu
19	1560	30	13.6	13.2	61.7	Sd,fn-slt grn,fair odor,fair flu

WILLIAM BERRYHILL NO. 135-P

(1671 FWL, 165 FSL) NE/4, SEC. 17, T.17N, R.12E

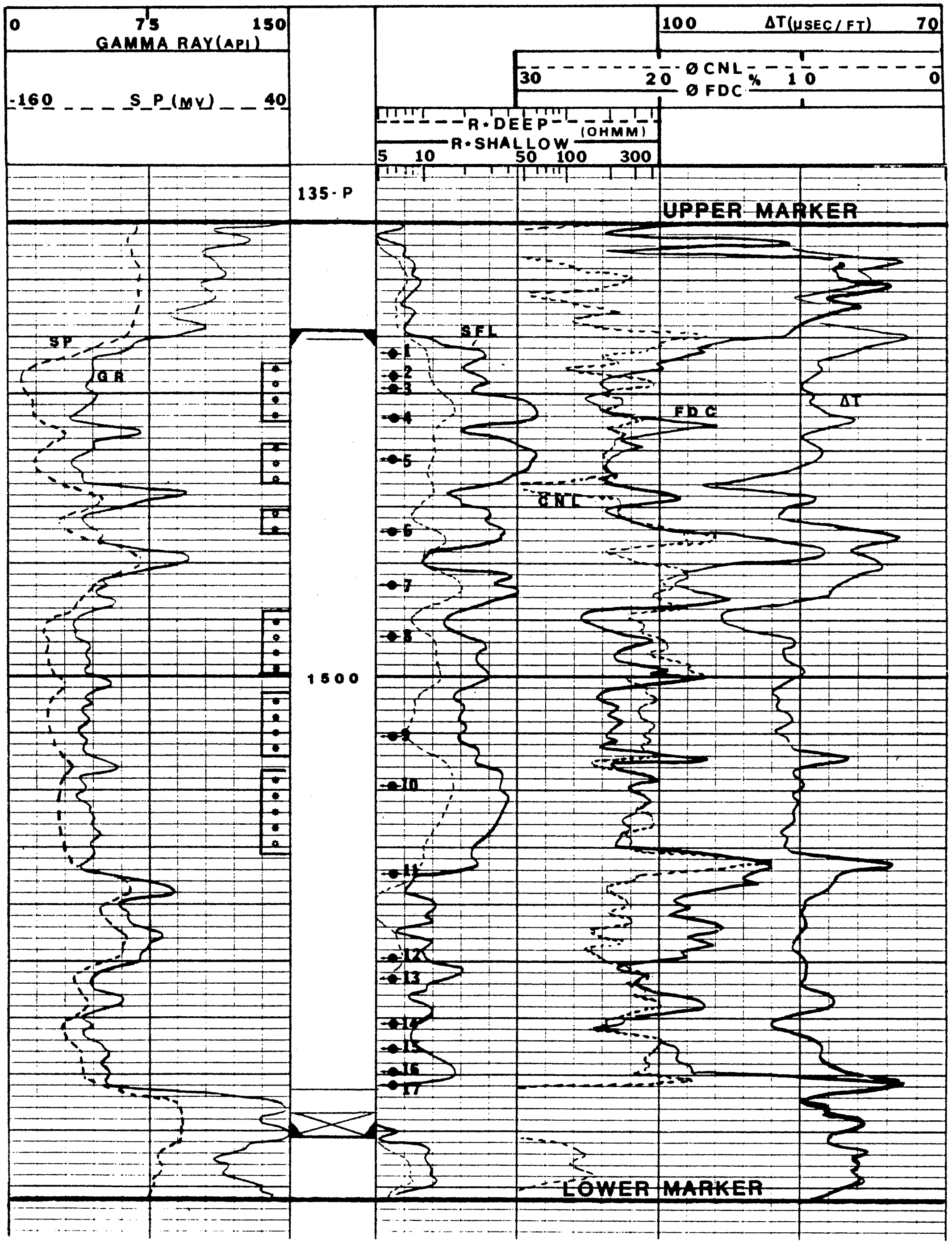


Figure 130. Well-log Signatures, Glenn Sandstone, William Berryhill No. 135-P

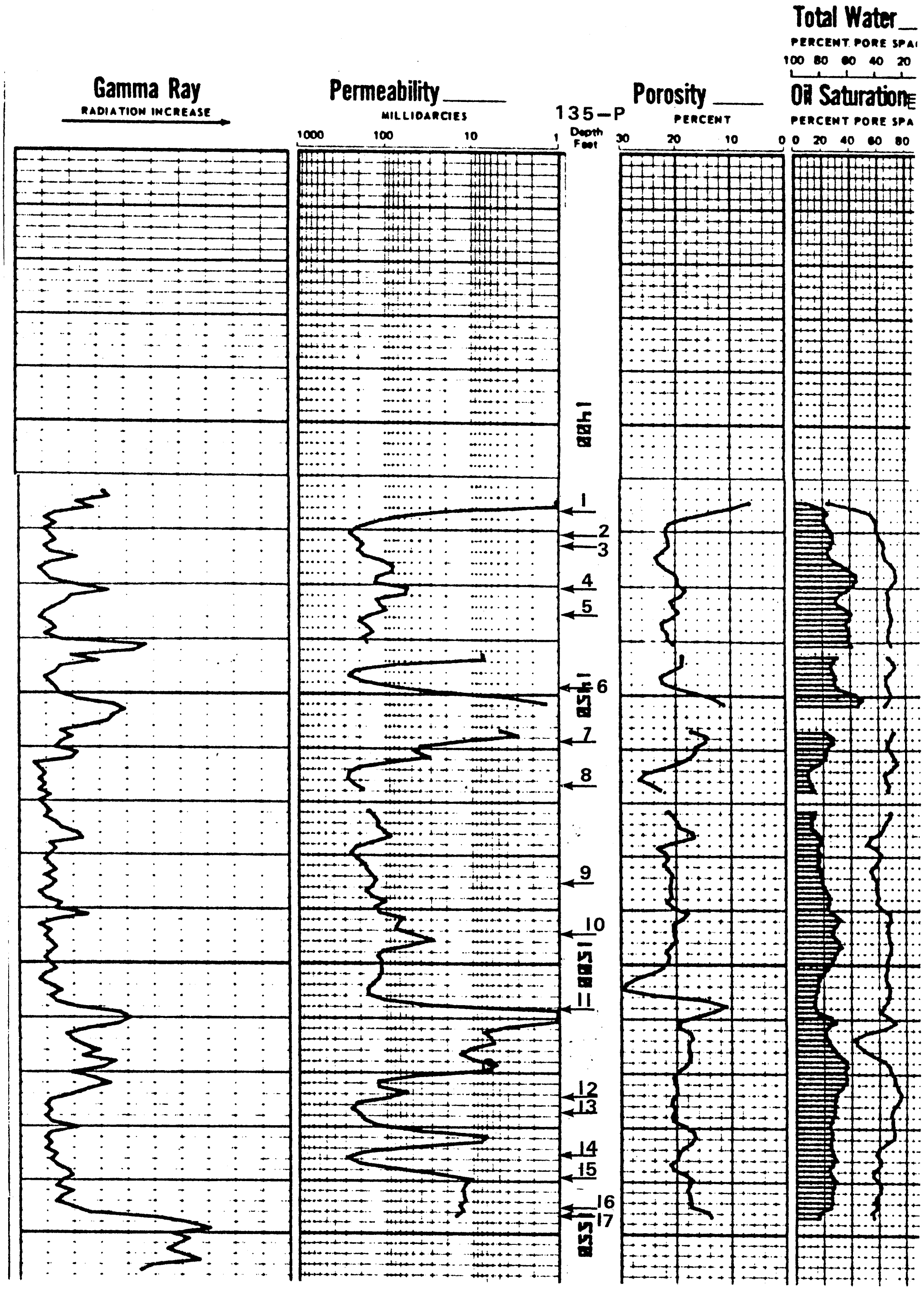


Figure 131. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 135-P

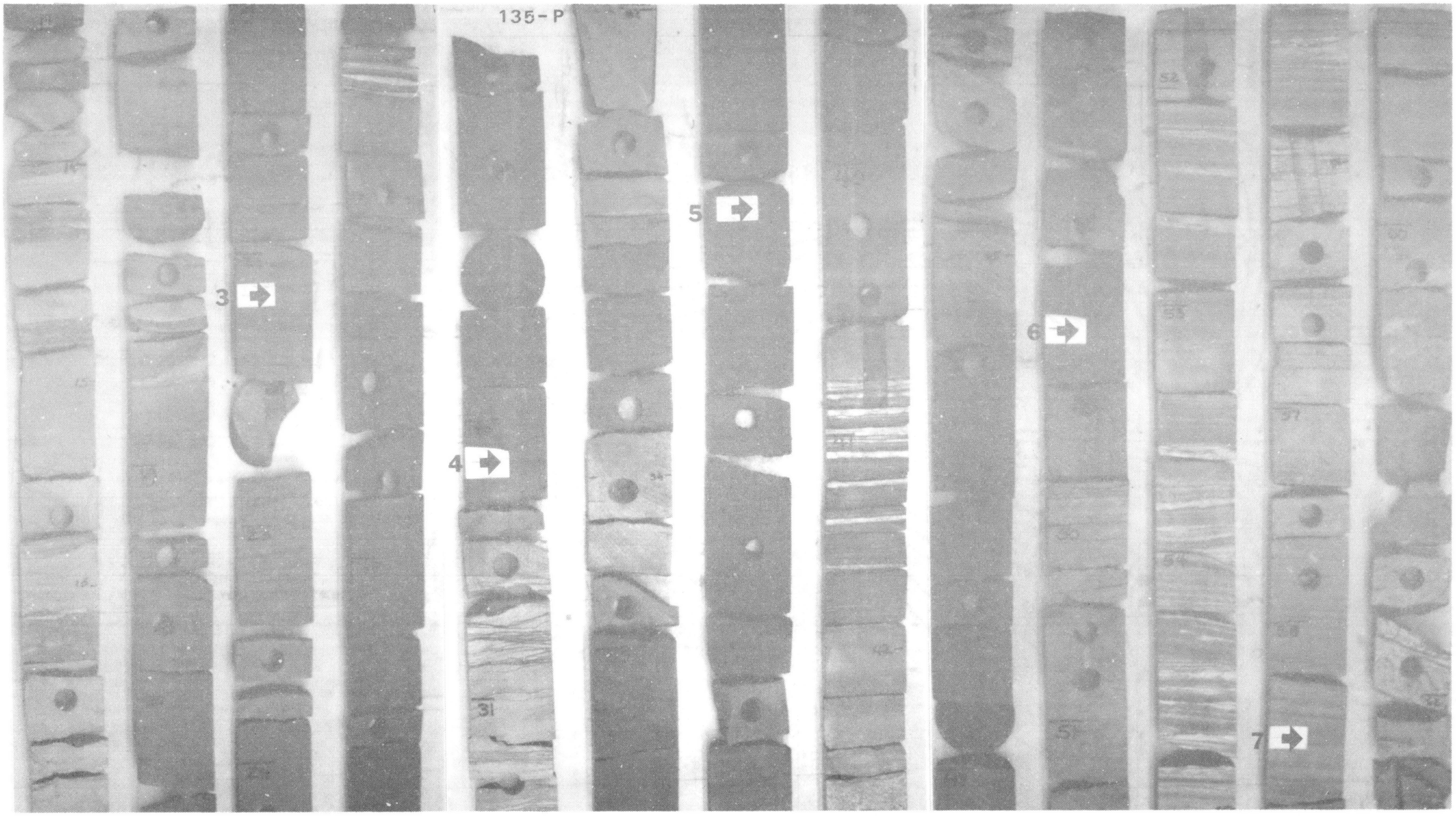
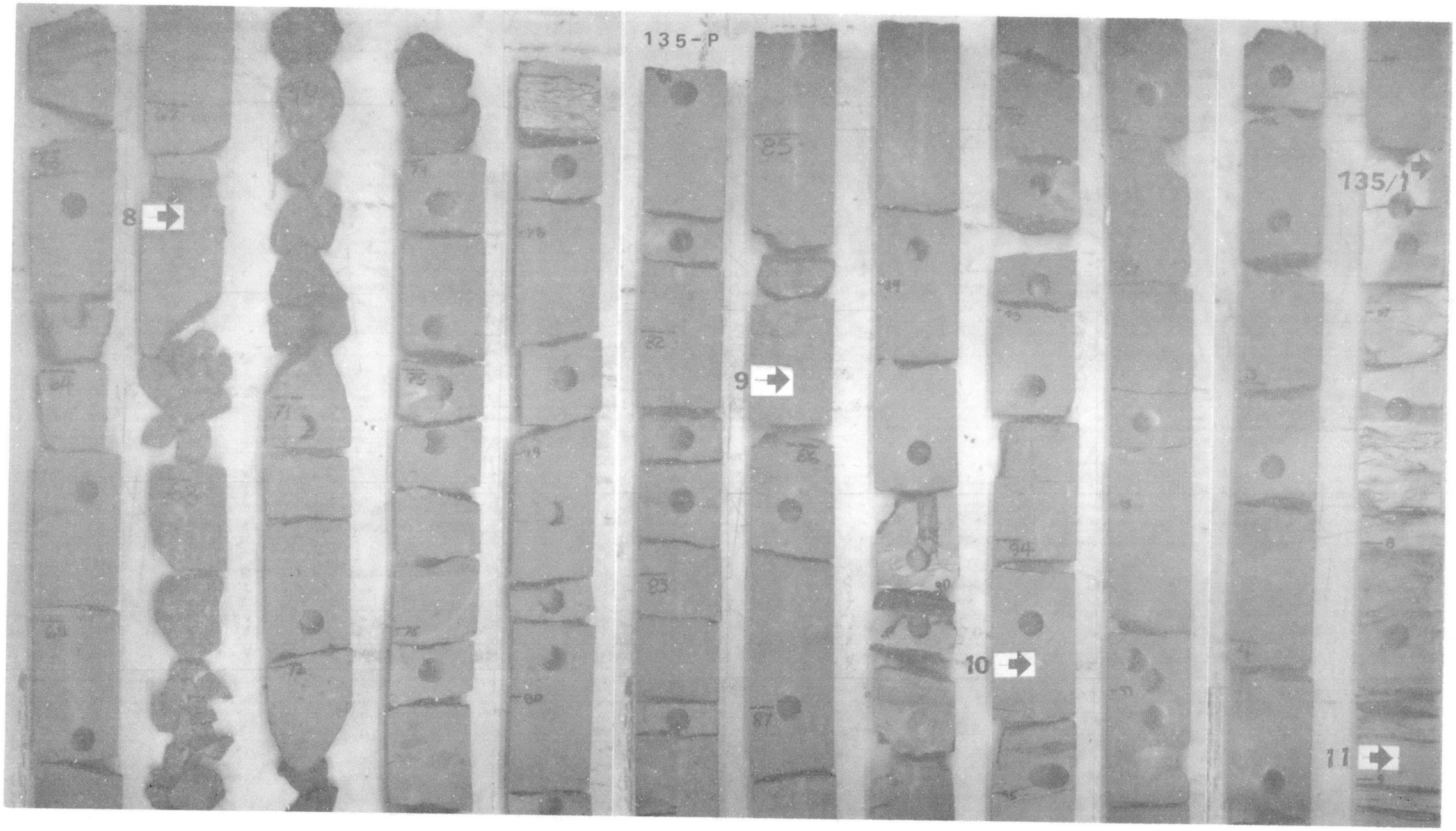
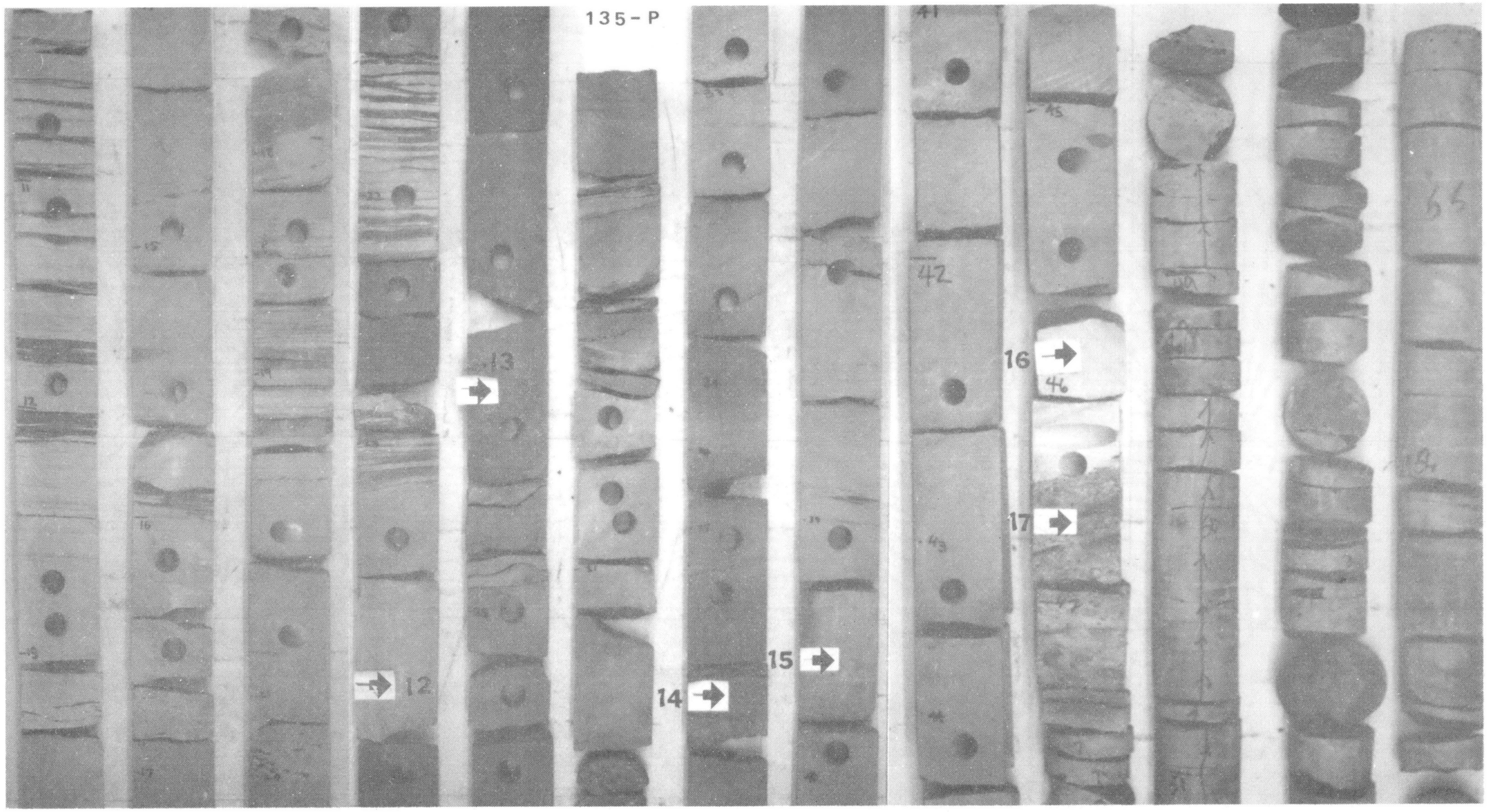


Figure 132. Glenn Sandstone, William Berryhill No. 135-P, 1412.8 - 62.5 ft., Showing the Upper Glenn and Upper "Non-Porous" Zone (1440.5 - 45.2 ft., and/or 1452.0 - 56.0 ft.), and a Portion of the Middle Glenn



Note: Glenn Sandstone, William Berryhill No. 135-P, 1462.5 - 1510.0 ft., Showing a Portion of the Middle Glenn and a Portion of the Lower "Non-Porous" Zone (1508.0 - 10.0 ft.)

Figure 132 (Continued)



Note: Glenn Sandstone, William Berryhill No. 135-P, 1510.4 - 57.0 ft., Showing a Portion of the Lower "Non-Porous" Zone (1510.4 - 24.2 ft.), and the Lower Glenn

Figure 132 (Continued)

William Berryhill No. 135-P
(1671 FWL, 165 FSL, NE/4, Sec. 17)

Cored Interval: 1412.8 - 1557.0 ft.
Correlation: Core depth four feet shallow to log depth

Core Depth (Ft.)	Core Description
1412.8 - 16.9	sh/sltst; lt gy - gy - blk, th intbds of sh, conv bdg, bur, grdg downw into v f - f gr ss
	Upper Glenn
16.9 - 18.6	ss; gy - lt brn, v f - f gr, slty, th (4 cm) sh intbd ◇ 18.3 ft., abrupt ctc w/ underlying ss (Sample 135-1, 16.8 ft.)
18.6 - 29.9	ss; brn, f - m gr, m sc xbdg, flowage? grdg downw into dk gy - blk ss (Sample 135-2, 20.6 ft., Sample 135-3, 22.2 ft.)
29.9 - 32.0	ss/sh, dk gy - gy - blk, v f - f gr, ss w/ blk aph mat filling intstls, grdg into f lam sh & sltst, sideritic, conv bdg, sl bur? (Sample 135-4, 30.1 ft.)
32.0 - 40.5	ss; lt brn - brn - dk by, v f - f gr, apr s ripple lam (32.0-35.0 ft.), carb mat & flow? ◇ 35.2 ft., o. stn, apr mas bdg, grdg into dk gy ss ◇ 38.0 ft., apr asph mat in intstls, f parll slty lams grdg downw into intlam ss/sh, (Sample 135-5, 35.5 ft.)
40.5 - 45.2	ss/sh; lt gy - blk - dk gy, f intlam near top, interbdd sh ◇ 41.8 ft., abrupt ctc ◇ 42.5 ft., w/ m gr, mot apr ss, incrg carb mat, poss s sc xbdg ◇ 44.5 ft., incld ctc w/ sh ptg ◇ 44.9 ft., few sh rip-up clasts ◇ 45.0 ft. (Upper "Non-Porous" Zone)
45.2 - 48.0	ss; brn, v f - f gr, apr mas bdg, abnt carb fils, f carb lams, grdg downw into dk gy ss
48.0 - 49.9	ss; dk gy, v f - f gr, apr mas bdg, asph mat filling intstls, few s sid pbls, hem stn, abrupt ctc w/ ripple-lam sltst blw

49.9 - 52.0	sltst; gy, f ripple lam, sl incld bdg, grdg downw (Sample 135-6, 49.0 ft.)
52.0 - 56.0	intbd/intlam sltst/sh; gy - dk gy - blk, sid nods, hem stn, sl conv bdg, bur? grdg downw (Upper "Non-Porous" Zone ?)
	<u>Middle Glenn</u>
56.0 - 60.0	ss; gy - dk gy, v f gr, slty, f parll bdg, (Sample 135-7, 58.5 ft.)
60.0 - 63.0	ss/sh; gy - lt brn, blk, v f gr, incrg s flat-elg sh rip-up clasts, abnt sh rip-up clast ◇ 61.9 - 62.1 ft., core brkn, sh ptg (4 cm) w/ ireg basal ctc ◇ 62.8 ft., hi ang ctc w/ ss blw
63.0 - 67.8	ss; lt brn, v f - f gr, faint apr hztl bdg, incrg slty lams (Sample 135-8, 67.3)
67.8 - 71.0	ss; lt brn, v f - f gr, as abv, brkn
71.0 - 77.6	ss; lt brn, v f - f gr, apr mas bdg, abnt s sid pbls incrg downw, sh ptg (or portion of lg sh clast?) ◇ 76.8 ft., abrupt ctc ◇ 77.6 ft.
77.6 - 77.8	ss/sh; lt gy - blk abnt flat-elg sh rip-up clasts, carb ptg at base, sl incld ctc
77.8 - 89.8	ss; lt brn, b f - f gr, apr mas bdg, abnt s sid pbls incrg carb fils ◇ 81.0 - 82.5 ft., scour surf? ◇ 83.5 ft., incr carb mat ◇ 83.5 - 86.0 ft., scour surf? ◇ 86.8 ft., incrg carb lams ◇ 87.0 - 88.0 ft., apr mas bdg to abrupt basal ctc ◇ 89.8 ft. (Sample 135-9, 85.8 ft.)
89.8 - 90.5	ss/sh; lt gy - blk, lg sh rip-up clasts, partially exposed? th (2 cm) carb sh ptg ◇ 90.0 ft., w rd sh clast ◇ 90.45 ft., ireg ctc blw
90.5 - 1506.5	ss; gy - lt brn, v f - f gr, apr mas bdg, abnt carb fil, incr shly/slty lam ◇ 94.8 - 95.0 ft., sl incld, heavy o. stn ◇ 96.0 - 97.0 ft., abrupt trans into calc cmt ss (Sample 135-10, 1494.5 ft.)
1506.5 - 07.0	ss; lt gy - buff, lt brn, apr mas bdg, ss as abv, more-or-less vert ctc b/ calc cmt ss & non-calc cmt ss, carb pl fos (pyr) a ctc abv (Sample 135-1, 1506.5 ft.)

07.0 - 08.0	ss; lt gy - blk, ss as abv, w/ calc cmt, abnt carb debris, f carb ripple lam, th (1 cm) carb ptg ◇ 07.9 ft., grdg downw into non calc cmt ss w/ abnt carb debris
08.0 - 12.1	intlam/intbdd ss/sh; lt brn - gy, blk, abnt carb debris near top, carb slty ptg ◇ 08.8 ft., grdg downw into intlam ss/sh, [th parll lams (1 - 2cm)], incrg thickness of lams & ss bds, abrupt ctc ◇ 12.1 ft. (Sample 135-11, 08.9 ft.) (Lower "Non-Porous" Zone)
12.1 - 17.6	ss; lt gy - lt brn, v f - f gr, slty, parll, hztl bdg near top, few flat-elg sh rip-up clasts ◇ 13.2 ft., f carb lam ◇ 13.5 ft., sl incld bdd flat-elg, rd sh rip-up clasts ◇ 14.8 ft., portion of a sh clast (flat-elg) ◇ 15.5 ft., th (3 - 4 cm) sh ptg (f current lam) ◇ 15.95 - 16.0 ft. apr mas bdg to abrupt ctc ◇ 17.6 ft.
17.6 - 19.2	ss/sh; dk gy - blk, lt brn, abnt s flat-elg sh rip-up clasts at top, sh (dk gy) ◇ 17.7 - 18.0 ft., few brk sh clasts blw, grdg into hztl lam ss/sh, abrupt ctc w/ ss blw
19.2 - 21.3	ss; lt brn, v f - f gr, apr mas bdg, few bdd sid pbls ◇ 19.9 ft., abrupt ctc w/ intlam ss/sh blw
21.3 - 22.3	intlam ss/sh; dk gy - blk, lt brn, sl hem stn, lams (1 - 2 cm) of ss/sh, current-ripple, flaser, abrupt ctc blw
22.3 - 22.8	ss; brn, v f - f gr, sl incld bdg, o. stn, abrupt ctc blw
22.8 - 23.2	sh/sltst; dk gy - blk, lt brn, conv bdg near top, f parll lam grdg into ss blw
23.2 - 24.2	ss; lt gy - gy, v f gr, slty, apr mas bdg, v s sid pbls
	<u>Lower Glenn</u>
24.2 - 45.8	ss; brn - lt brn, gy, f - m gr, carb fils, apr mas bdg in part, poss m sc xbdg (25.0 - 27.5 ft.), two th (3 cm) sh ptgs ◇ 27.5 - 27.9 ft., incr carb lams, sl incld carb sh ptgs from 29.5 - 30.3 ft., sl color change (from brn to gy), poss flow or m sc xbdg, th bdd carb sh rip-up clasts blw, carb ptg ◇ 35.5 ft., sev flat-elg sh rip-up clasts blw, carb ptg ◇ 36.95 ft., color change (lt

	brn to gy), apr mas bdg, few flat bdd sid pbls, carb lams decrg to 45.8 ft. (Sample 135-12, 24.0 ft.,Sample 135-13, 27.0 ft., Sample 135-14, 35.5 ft., and Sample 135-15, 39.5 ft.)
45.8 - 46.5	ss; lt gy, f - m gr, apr mas bdg, w calc cmt, v abrupt ctc blw w/ pbl congl (Sample 135-16, 45.9 ft.)
46.5 - 47.5	pbl congl; gy - dk gy, brn, flat-elg to w rd pbls of sh, sid pbls, sltst, carb debris; v abrupt sl incld ctc w/ sh blw (Base of Glenn) (Sample 135-17, 46.5 ft.)
47.5 - 57.0	sh; blk, hd, dns, sl slty downw, poss conv bdg,

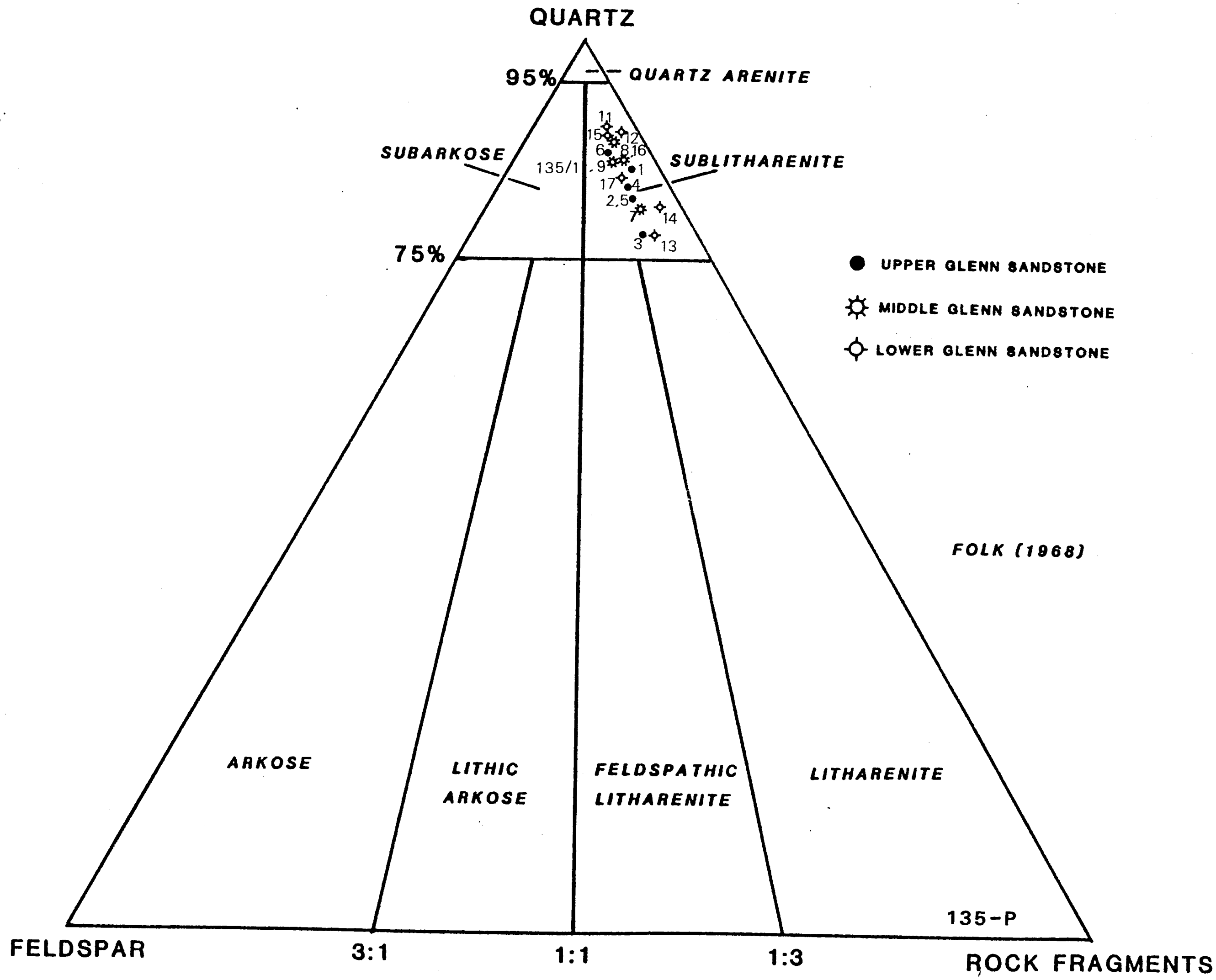


Figure 133. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 135-P

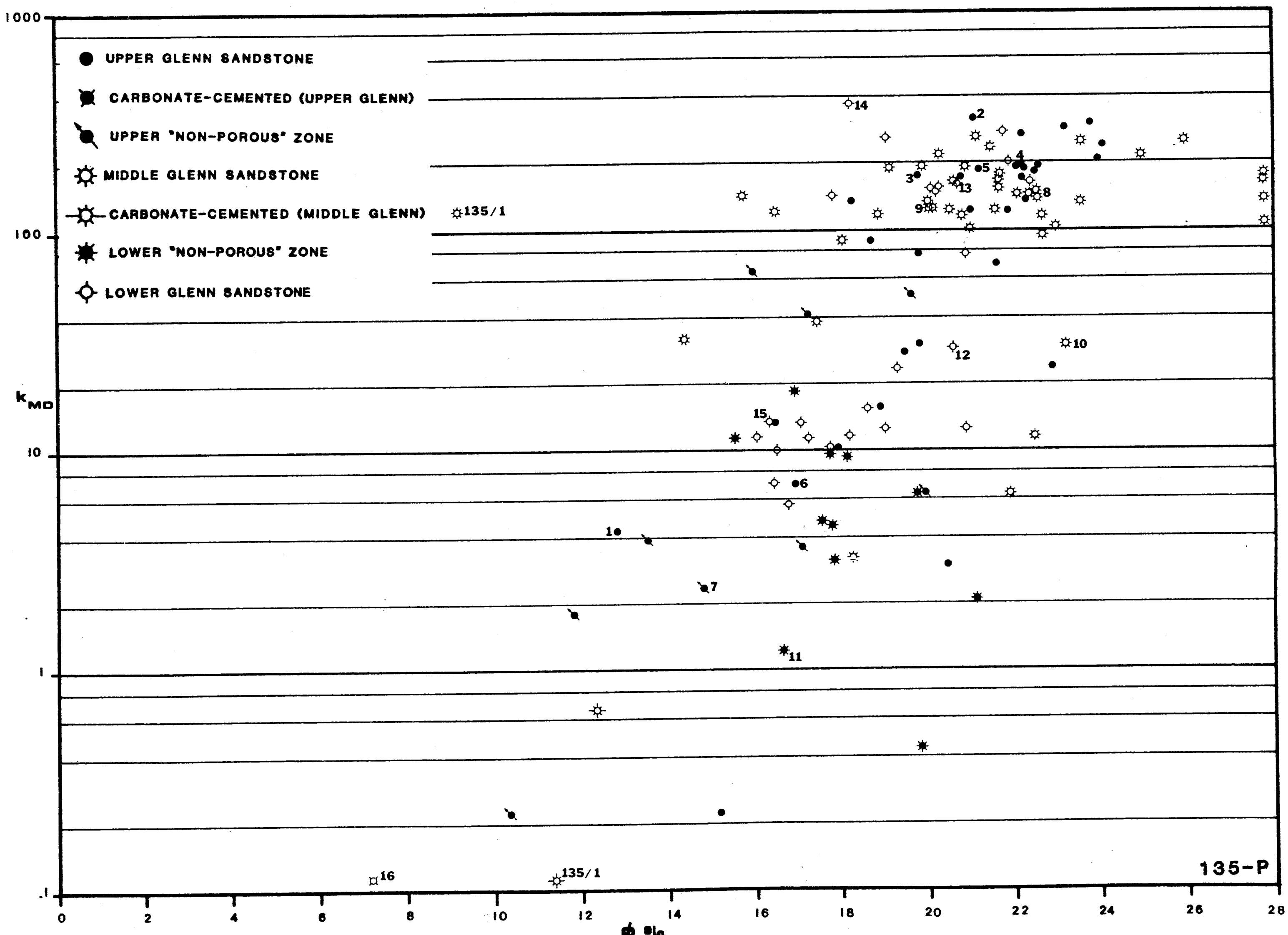


Figure 134. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 135-P

TABLE XIX

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 135-P
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
			CONVENTIONAL PLUG ANALYSIS				
	1413.0-14.0						SH
1	1414.0-15.0	<0.1	5.4	0.0	85.2		SD,SHY
2	1415.0-16.0	<0.1	10.3	28.2	51.7		SD,SHY
3	1416.0-17.0 ←1	4.1	12.8	23.1	42.6		SD,SHY
4	1417.0-18.0	78.0	19.9	17.1	45.5		SD
5	1418.0-19.0	124.0	21.1	24.0	37.3		SD
6	1419.0-20.0	187.0	22.4	22.5	45.0		SD
7	1420.0-21.0 ←	329.0	21.2	29.8	38.3		SD
8	1421.0-22.0	170.0	22.3	25.9	37.9		SD
9	1422.0-23.0 ←2	175.0	19.9	27.8	33.3		SD
10	1423.0-24.0	191.0	22.7	19.8	35.9		SD
11	1424.0-25.0	246.0	24.2	23.9	37.6		SD
12	1425.0-26.0	23.0	23.0	32.5	29.1		SD,SHY
13	1426.0-27.0	133.0	22.4	37.6	26.0		SD
14	1427.0-28.0	29.0	19.9	45.7	27.3		SD,CARB
15	1428.0-29.0	135.0	18.3	45.3	25.7		SD
16	1429.0-30.0 ←3	187.0	22.2	41.0	27.0		SD
17	1430.0-31.0 ←4	0.2	15.5	39.6	38.1		SD,SHY
18	1431.0-32.0	27.0	19.6	26.9	26.9		SD,CARB
19	1432.0-33.0	172.0	20.9	28.4	35.8		SD
20	1433.0-34.0	122.0	22.0	32.7	29.7		SD
21	1434.0-35.0	35.0	17.3	45.6	32.2		SD,CARB
22	1435.0-36.0 ←5	186.0	21.3	37.1	28.7		SD
23	1436.0-37.0	196.0	22.3	37.4	28.5		SD
24	1437.0-38.0	212.0	24.1	33.5	34.5		SD
25	1438.0-39.0	15.0	19.0	47.4	29.3		SD,CARB
26	1439.0-40.0	303.0	23.9	29.8	35.3		SD
27	1440.0-41.0	87.0	18.8	45.9	27.6		SD
	1441.0-42.0						SH
28	1442.0-43.0	9.7	18.0	31.5	35.3		SD,CARB
29	1443.0-44.0	2.8	20.5	27.0	27.0		SD,CARB
30	1444.0-45.0	13.0	16.5	23.7	26.5		SD,CARB
31	1445.0-46.0	273.0	22.1	27.7	29.7		SD
32	1446.0-47.0	295.0	23.1	30.5	37.2		SD
33	1447.0-48.0	184.0	22.6	28.7	32.5		SD
34	1448.0-49.0 ←6	69.0	21.7	24.0	33.9		SD,CARB
35	1449.0-50.0	6.7	15.0	48.5	29.7		SD,CARB
36	1450.0-51.0	3.7	13.5	50.9	29.8		SD,CARB,SHY
37	1451.0-52.0	0.2	10.3	42.2	37.5		SD,CARB,SHY
	1452.0-56.0						SH W/SD STKS
38	1456.0-57.0	6.0	20.0	17.4	27.4		SD
39	1457.0-58.0	1.7	11.8	29.7	31.7		SD,CARB,SHY
40	1458.0-59.0 ←7	2.2	14.8	29.7	31.3		SD,CARB,SHY
41	1459.0-60.0	41.0	17.3	19.5	36.5		SD,CARB,SHY
42	1460.0-61.0	66.0	16.0	22.9	28.3		SD
43	1461.0-62.0	3.4	17.1	22.5	28.9		SD,SHY
44	1462.0-63.0	50.0	19.7	17.1	25.1		SD,CARB,SHY
45	1463.0-64.0	242.0	21.6	8.8	27.5		SD
46	1464.0-65.0	257.0	26.1	7.3	40.4		SD
47	1465.0-66.0	280.0	28.3	9.3	33.4		SD
48	1466.0-67.0	254.0	23.7	11.1	31.0		SD
49	1467.0-68.0 ←8	142.0	22.5	13.5	33.7		SD
	1468.0-1471.0	TOO BROKEN FOR ANALYSIS					
50	1471.0-72.0	170.0	21.8	12.2	31.3		SD
51	1472.0-73.0	123.0	20.6	14.8	31.8		SD
52	1473.0-74.0	117.0	18.9	8.1	32.5		SD,CARB
53	1474.0-75.0	121.0	21.1	13.0	40.7		SD
54	1475.0-76.0	124.0	16.5	10.8	31.0		SD,CARB
55	1476.0-77.0	32.0	14.4	23.8	50.9		SD,CARB
56	1477.0-78.0	154.0	21.8	16.1	49.5		SD,CARB
57	1478.0-79.0	220.0	25.1	12.1	41.5		SD
58	1479.0-80.0	271.0	21.2	21.4	34.6		SD
59	1480.0-81.0	225.0	20.4	14.6	41.7		SD
60	1481.0-82.0	135.0	23.7	15.8	39.0		SD,CARB
61	1482.0-83.0	195.0	21.0	17.2	49.5		SD,CARB
62	1483.0-84.0	131.0	20.1	18.6	43.8		SD,CARB
63	1484.0-85.0	124.0	21.7	17.4	39.7		SD,CARB
64	1485.0-86.0 ←9	128.0	20.1	22.0	41.7		SD,CARB
65	1486.0-87.0	168.0	22.4	20.0	43.1		SD
66	1487.0-88.0	195.0	19.2	26.4	36.8		SD
67	1488.0-89.0	11.0	22.6	24.7	43.4		SD,CARB,SHY
68	1489.0-90.0	178.0	21.8	21.0	41.0		SD,CARB
69	1490.0-91.0	146.0	15.8	23.7	26.5		SD

TABLE XIX (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.	DESCRIPTION
70	1491.0-92.0	3.0	18.3	40.3	32.5		SD,CARB,SHY
71	1492.0-93.0	93.0	22.8	23.9	32.5		SD
72	1493.0-94.0	90.0	18.1	29.5	33.1		SD
73	1494.0-95.0 ←10	29.0	23.0	22.8	32.3		SD
74	1495.0-96.0	38.0	17.5	31.9	31.9		SD
75	1496.0-97.0	6.0	22.0	35.8	30.7		SD
76	1497.0-98.0	149.0	22.2	26.5	30.4		SD
77	1498.0-99.0	117.0	20.9	28.5	32.7		SD
78	1499.0-00.0	103.0	21.1	27.2	34.6		SD
79	1500.0-01.0	117.0	22.8	22.7	31.2		SD
80	1501.0-02.0	106.0	23.1	19.9	35.9		SD
81	1502.0-03.0	114.0	28.2	15.3	35.1		SD
82	1503.0-04.0	135.0	29.0	15.5	32.4		SD
83	1504.0-05.0	164.0	30.0	15.4	31.6		SD
84	1505.0-06.0	170.0	28.7	14.5	32.0		SD
85	1506.0-07.0 ←135/1	128.0	9.2	11.5	33.1		SD,LMY
86	1507.0-08.0	<0.1	11.3	17.0	33.9		LM,SDY
87	1508.0-09.0	0.6	12.3	6.7	44.3		SD,CARB
88	1509.0-10.0 ←11	1.1	16.7	29.2	30.6		SD,SHY
89	1510.0-11.0	0.4	19.9	33.1	24.0		SD,SHY
90	1511.0-12.0	1.9	21.2	16.0	31.9		SD,SHY
91	1512.0-13.0	11.0	15.6	22.5	54.0		SD,SHY
92	1513.0-14.0	4.5	17.6	22.3	59.0		SD,SHY
93	1514.0-15.0	4.3	17.8	22.1	59.7		SD,SHY
94	1515.0-16.0	9.1	18.2	31.6	47.4		SD,SHY
95	1516.0-17.0	18.0	17.0	25.7	50.0		SD,CARB
96	1517.0-18.0	9.1	17.8	40.1	32.3		SD,SHY
97	1518.0-19.0	2.9	17.9	37.0	30.7		SD,CARB,SHY
98	1519.0-20.0	6.0	19.9	31.7	36.2		SD,SHY
99	1520.0-21.0	12.0	21.0	37.8	24.1		SD,SHY
100	1521.0-22.0	155.0	20.3	36.1	30.7		SD
101	1522.0-23.0	155.0	20.2	33.4	26.7		SD
102	1523.0-24.0	23.0	19.4	26.6	22.0		SD
103	1524.0-25.0 ←12	29.0	20.7	27.5	25.4		SD
104	1525.0-26.0	280.0	21.9	29.2	26.2		SD
105	1526.0-27.0	268.0	19.1	24.9	30.9		SD
106	1527.0-28.0 ←13	163.0	20.8	30.3	31.4		SD
107	1528.0-29.0	202.0	22.0	24.9	29.9		SD
108	1529.0-30.0	149.0	17.9	21.7	29.3		SD
109	1530.0-31.0	9.8	16.6	27.7	30.5		SD
110	1531.0-32.0	5.3	16.8	24.6	24.6		SD
111	1532.0-33.0	6.8	16.5	25.1	36.3		SD
112	1533.0-34.0	12.0	19.1	23.4	39.8		SD
113	1534.0-35.0	155.0	20.4	27.4	43.9		SD,CARB
114	1535.0-36.0 ←14	398.0	18.3	27.3	39.8		SD,CARB
115	1536.0-37.0	167.0	22.5	30.5	33.4		SD,CARB
116	1537.0-38.0	79.0	21.0	16.9	47.5		SD,CARB
117	1538.0-39.0	4.0	18.0	28.0	44.5		SD,SHY
118	1539.0-40.0 ←15	13.0	16.4	28.5	41.3		SD
119	1540.0-41.0	9.8	17.8	27.3	37.6		SD
120	1541.0-42.0	15.0	18.7	25.8	36.8		SD
121	1542.0-43.0	11.0	17.3	24.3	43.3		SD
122	1543.0-44.0	13.0	17.1	26.1	43.9		SD
123	1544.0-45.0	11.0	18.3	25.5	42.1		SD
124	1545.0-46.0	20.0	16.1	21.4	37.2		SD
125	1546.0-47.0 ←16	<0.1	7.1	0.0	64.1		LM
	1547.0-57.0						SH
	1557.0-1562.0	LOST CORE					

WILLIAM BERRYHILL NO. 137-P

(2425 FWL, 171 FSL) NE/4, SEC. 17, T.17N, R.12E

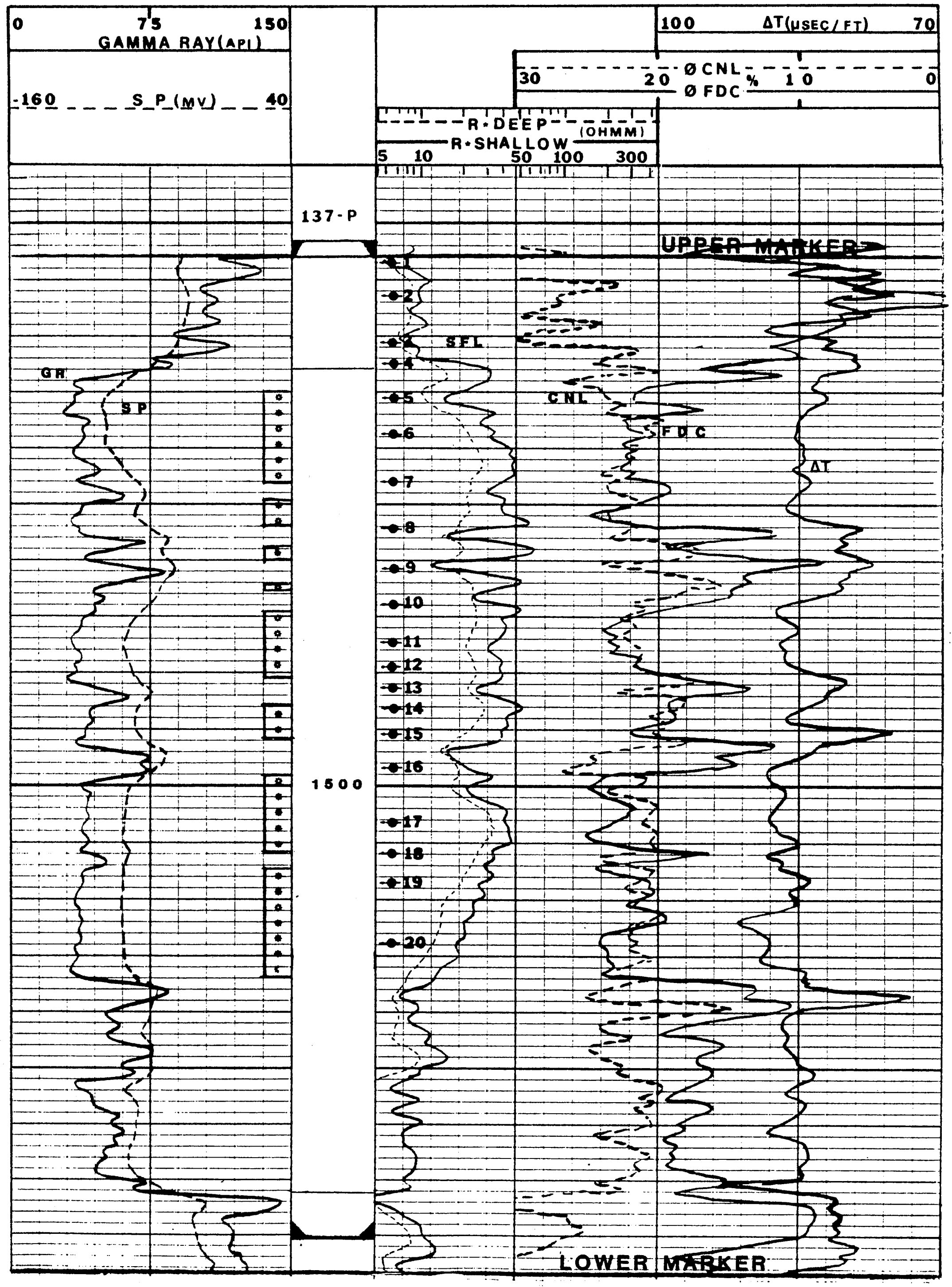


Figure 135. Well-log Signatures, Glenn Sandstone, William Berryhill No. 137-P

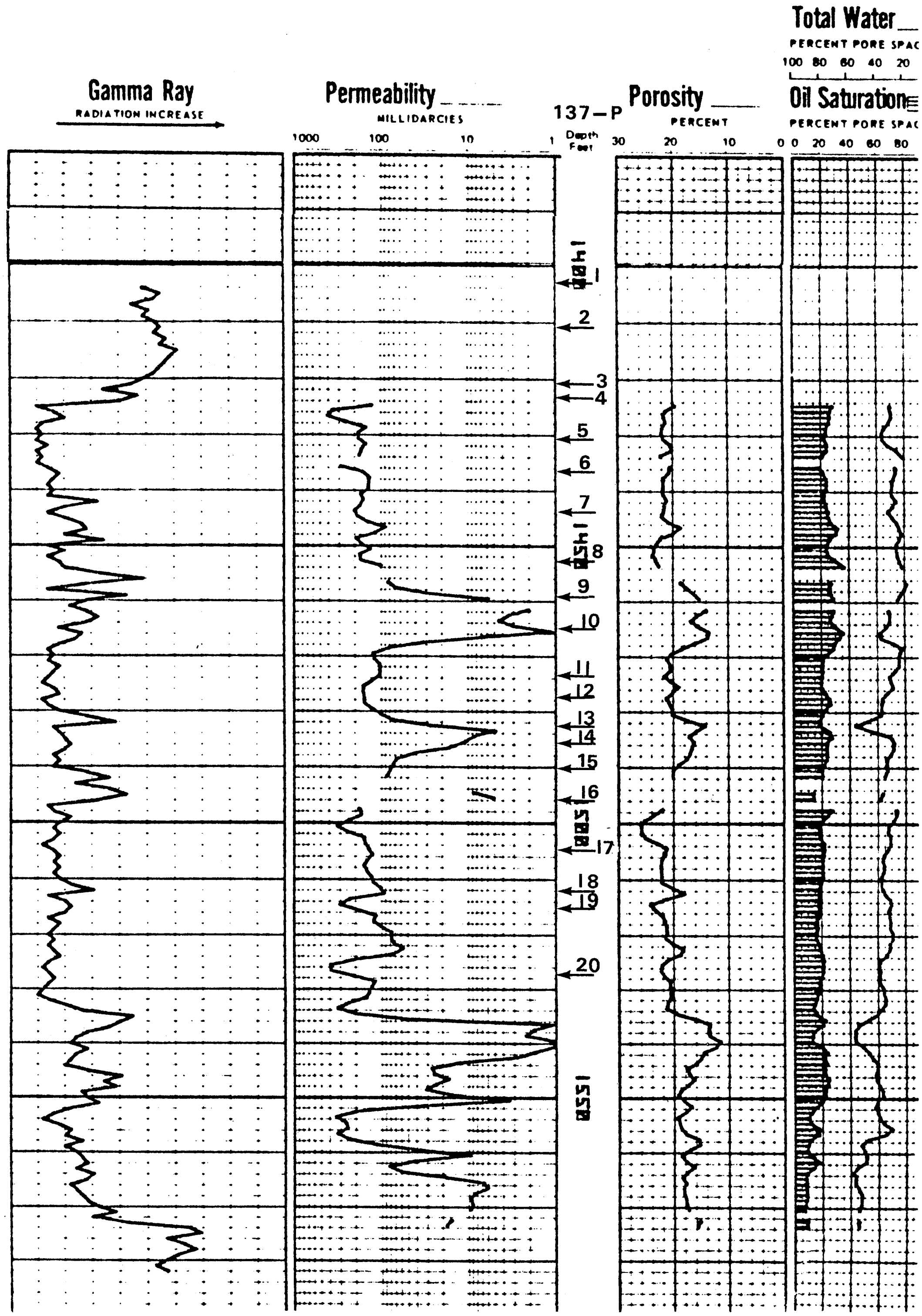


Figure 136. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 137-P

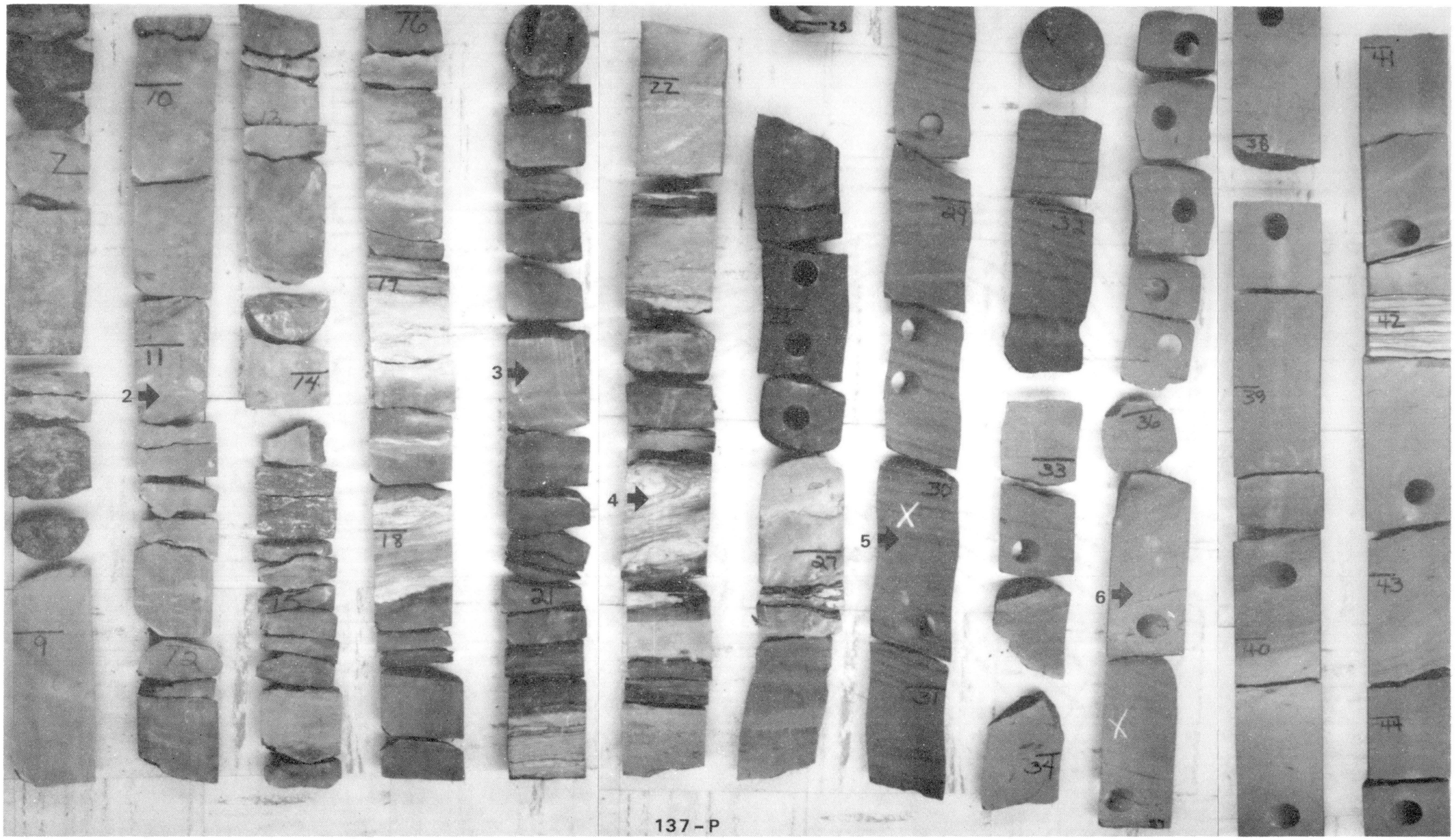
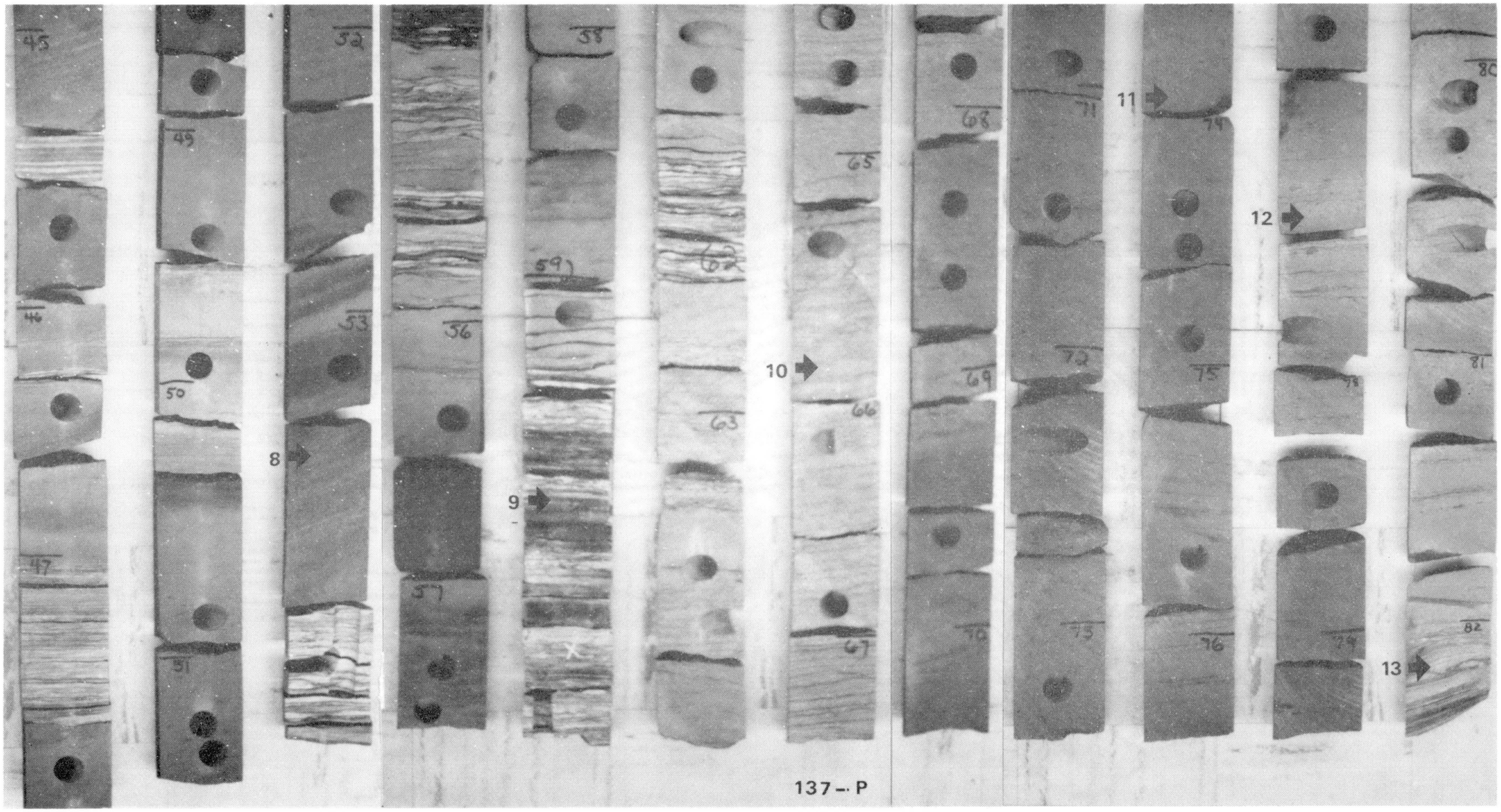
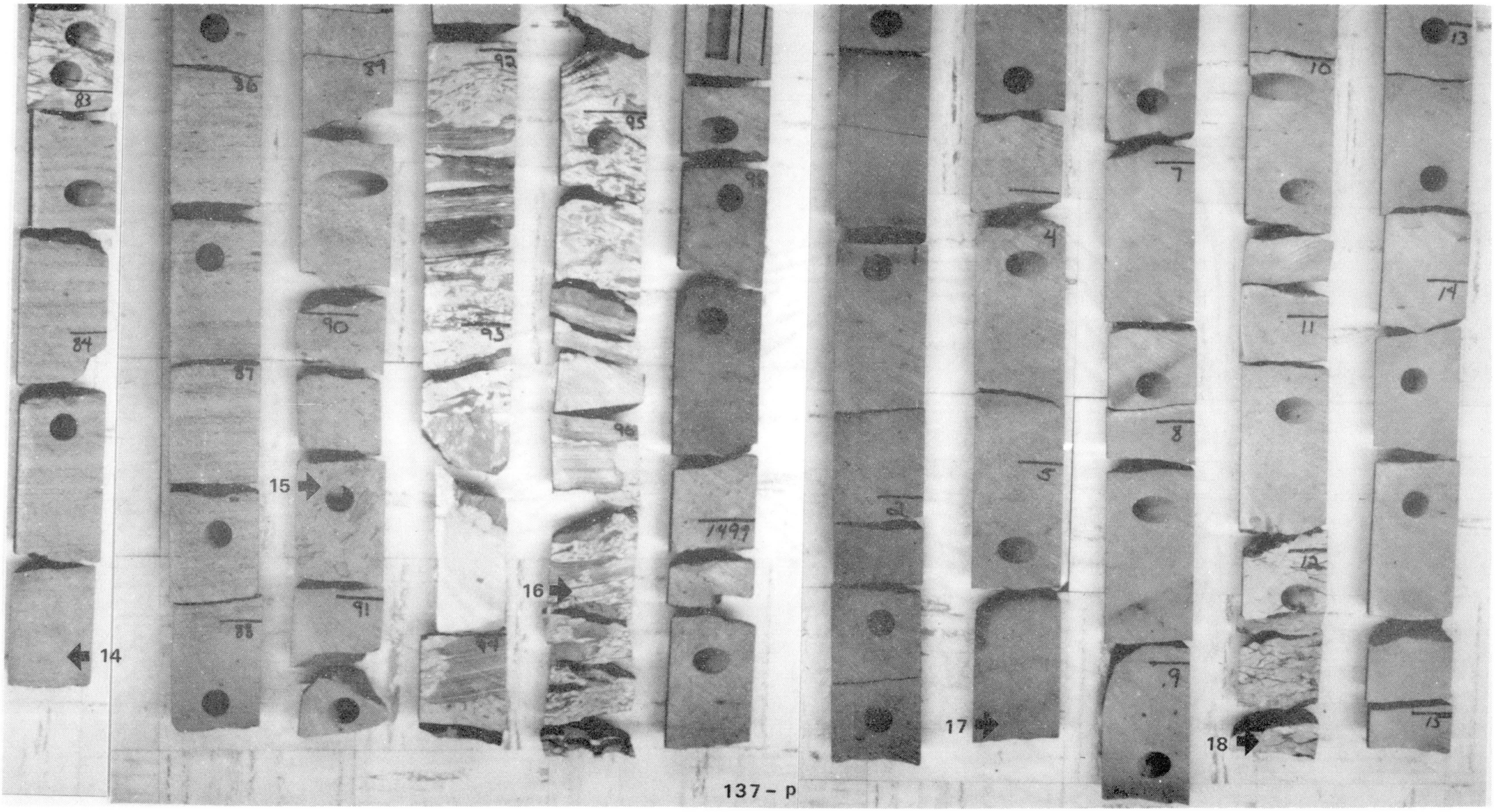


Figure 137. Glenn Sandstone, William Berryhill No. 137-P, 1406.5 - 44.5 ft., Showing a Portion of the Overlying Shale and Siltstone (1406.5 - 1424.3 ft.)



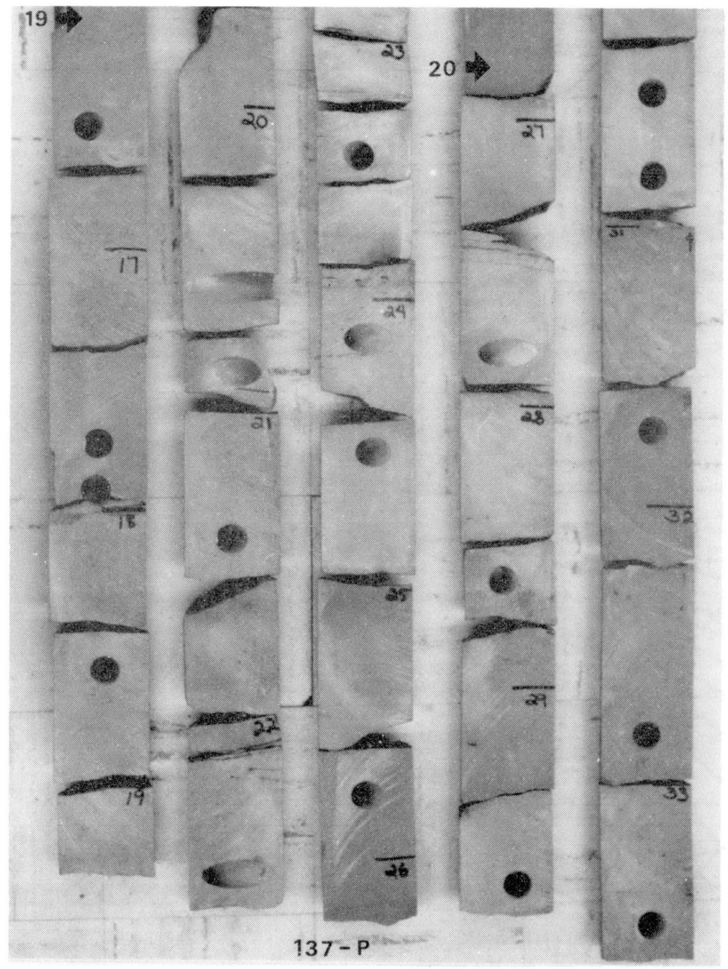
Note: Glenn Sandstone, William Berryhill No. 137-P, 1444.5 - 1482.4 ft., Showing a Portion of the Upper Glenn, and the Upper "Non-Porous" Zone? (1454.0 - 62.1 ft.)

Figure 137 (Continued)



Note: Glenn Sandstone, William Berryhill No. 137-P, 1482.4 - 1515.1 ft., Showing a Portion of the Upper "Non-Porous" Zone and/or Upper Glenn ? (1482.4 - 98.0 ft.), Portion of the Middle Glenn (1498.0 - 1515.1 ft.)

Figure 137 (Continued)



Note: Glenn Sandstone, William Berryhill No. 137-P, 1516.0 - 1533.6 ft., Showing a Portion of the Middle Glenn

Figure 137 (Continued)

William Berryhill No. 137-P
(2425 FWL, 171 FSL, NE/4, Sec. 17)

Cored Interval: 1404.0 - 1581.6 ft. (Sampled and photographed: 1404.0 - 1533.6 ft.)
Correlation: Core depth one foot deep to log depth

Core Depth (Ft.)	Core Description
1404.0 - 06.4	lst; dk gy - gy, abnt fos (Brac, Plcy, Crin), carb stly slty, cly (Sample 137-1, 04.0 ft.)
06.4 - 16.1	sh; dk gy - gy, slty, bur (Sample 137-2, 11.2 ft.)
16.1 - 18.2	sh/sltst; gy - lt gy, flowage, soft sed deform, bur? sl incld abrupt ctc blw
18.2 - 21.4	sh; blk - dk gy, dns, sideritic str, nod & conc, abrupt ctc blw (Sample 137-3, 20.2 ft.)
21.4 - 24.3	sh; sltst; gy - lt gy, blk, intlam/intbdd, bur, flow abrupt ctc w/ sltst blw (Sample 137-4, 23.5 ft.)
	Upper Glenn
24.3 - 26.5	ss; brn, f - m gr, apr mas bdg, carb fils, o. stn, abrupt ctc blw w/ sh/sltst as abv
26.5 - 27.2	sh/sltst; gy - lt gy, blk intlam/intbdd, th (2 cm) carb sh ptg near base, abrupt ctc w/ ss blw
27.2 - 42.0	ss; brn - lt brn, gy, f - m gr, apr m sc xbdg, alternat parll layers of dk brn matl (siderite), creates a banded apr, decrg o. stn, sev intvs w/ asph matl filling intstls (33.6 ft., 39.6 - 40.0 ft., 41.0 - 42.0 ft.) carb fils, v few sid pbls, abrupt ctc w/ th sltst blw (Sample 135-5, 30.2 ft.; Sample 135-6, 36.5 ft.)
42.0 - 42.1	intlam sltst; lt gy - blk, f intlam of carb sh, flaser? current-ripple lams, abrupt ctc abv & blw

42.1 - 45.5	ss; brn, dk brn - blk, f - m gr, apr incld bdg (m sc xbdg?), abrupt trans at base into ss w/ blk, asph matl fills intstls, abrupt ctc blw w/ th intlam sltst as abv (Sample 135-7, 44.8 ft.)
45.5 - 45.6	intlam sltst; lt gy - blk, f intlam of carb sh, flaser?, current-ripple lams, abrupt ctc abv & blw
45.6 - 46.0	ss; brn, vf - f gr, apr mas bdg, carb fils
46.0 - 46.1	ss; dk gy, vf - f gr, f slty lam, blk asph matl fills intstls, th carb ptg at base
46.1 - 47.0	ss; brn - dk gy, vf - f gr, slty, apr m sc xbdg, grdg downw into a f intlam sltst
47.0 - 47.6	sltst; dk gy - gy, blk, f intlam of carb sh, current-ripple lams? sl bur?, abrupt ctc blw
47.6 - 49.5	ss; brn, vf - f gy, apr current-ripple lam? or climbing-ripple lams?, carb fils, o. stn (48.0 - 48.8 ft.) abrupt ctc w/ sltst ◇ 49.5 ft.
49.5 - 50.4	sltst; lt gy - gy, hztl bdg. abnt carb mat in lams, abrupt ctc w/ ss blw
50.4 - 54.0	ss; brn, dk gy - blk, apr m sc xbdg, alternat parll layers of dk brn matl (siderite), grdg downw into ss as abv but w/ abnt asph matl filling intstls, abrupt ctc w/ intlam sltst (Sample 137-8, 53.4 ft.)
54.0 - 62.1	intlam/intbdd sltst/sh; lt gy - gy, blk, f intlams, flaser? current-ripple lams, grdg into thin o. stn ss ◇ 56.1 - 57.0 ft., asph matl (57.0 - 57.5 ft.), slty ss to 59.0 ft., incr th sh lams & sh content, apr bur & conv bdg (59.5 - 61.0 ft.), apr mas slty ss to 61.8 ft., intlam sltst/sh ◇ 61.8 - 62.1 ft. abrupt ctc w/ slty ss blw (Sample 135-9, 59.9 ft.) (Upper "Non-Porous" Zone)
62.1 - 67.5	ss; lt gy - gy. vf gr, slty, f lam of carb sh, th sh ptg ◇ 63.9 - 64.0 ft., abnt carb lams (current-ripple?), abnt carb fils, grdg downw in o. stn ss (Sample 137-10, 65.9 ft.)

Middle Glenn

67.5 - 81.9	ss; brn, vf - f gr, slty near top, abnt sid lams & abnt carb fils, apr xbdg ◊ 75.0 - 76.0 ft., hztl bdg in part, incr carb matl, incr slt, decr o. stn (Sample 137-11, 73.9ft.; Sample 137-12, 77.4 ft.)
81.9 - 83.1	ss/sh; lt gy - blk, parll lams of sh, sl incld bdg, flowage, abnt sh rip-up clasts (82.3 - 83.1 ft.), lg, flat-elg clasts, some brkn, flowage (Sample 137-13, 82.2 ft.)
83.1 - 91.0	ss; gy - dk gy, vf - f gr, abnt f parll carb lams, incr s sid pbls downw, lg sid clasts ◊ 90.5 - 91.0 ft., (Sample 137-14, 85.2 ft.; Sample 137-15, 90.5 ft.)
91.0 - 92.0	ss; gy - lt brn, vf - f gy, apr mas bdg, few sid pbls & carb lams as c.f. w/ abv ss, abrupt ctc w/ sh rip-up clasts
92.0 - 97.0	ss/sh; lt gy - gy, blk, abnt sh rip-up clasts, varying sizes & shapes, brkn, etc, sl calc cmt (92.9 - 93.6 ft.) w calc cmt (93.6 - 94.0 ft.), sh ptg (5 cm) (or lg sh clast?) ◊ 94.0 ft., sl incld ctc ◊ 97.0 ft. (Sample 135-16, 96.5 ft.)
97.0 - 1512.0	ss; brn - lt brn, vf - f gr, apr mas bdg, abnt carb fils, s. sid pbls, siderite, decrg o. stn downw, lt gy from 09.8 - 12.0 ft. (Sample 137-17, 05.9 ft.)
1512.0 - 12.6	ss/sh; lt gy, abnt sh rip-up clasts, flat-elg (Sample 135-18, 12.4 ft.)
12.6 - 33.6	ss; lt gy - gy, vf - f gr, lt brn, apr mas bdg, v few scat sid pbls, few carb fils, sev th carb ptgs (18.0 ft., 22.1 ft., 23.0 ft.) incr carb lam ◊ 28.9 - 29.1 ft., 27.5 ft., (Sample 135-19, 15.9 ft.; Sample 137-20, 26.7 ft.)
(33.6 - 81.6)	Described but not sampled or photographed
33.6 - 34.8	ss; lt gy - gy, lt brn, vf - f gr, apr mas bdg, ss as abv, few bdd sh clasts ◊ 34.5 ft.

34.8 - 38.8	intlam/intbdd ss/sh; gy - dk gy, blk, v f lams, ripple-current, abnt carb mat'l, few s rip-up clasts 37.0-38.0 ft., th coaly ptgs (1 - 2 mm), pl fos, abrupt trans into calc cmt ss ◇ 38.8 ft.
	<u>Lower Glenn</u>
38.8 - 41.6	ss; lt gy - buff, vf - f gr, w calc cmt, abnt carb debris
41.6 - 46.0	ss; lt gy - lt brn, vf - f gr, abnt carb fils, th sh ptgs (42.9 ft., 45.8 ft.) few bdd sh rip-up clasts & pbls
46.0 - 48.5	intlam/intbdd ss/sh; lt gy - gy, blk, current-ripple lams, th sh ptg at base
48.5 - 50.9	ss; lt gy - lt brn, vf - f gr, apr mas bdg, th sh ptg ◇ 49.9 ft., abrupt ctc w/ th sh ptg ◇ 50.9 ft.
50.9 - 52.0	intlam/intbdd ss/sh; lt gy - gy, blk, f current ripple lams, flaser, carb, abrupt ctc w/ ss blw
50.2 - 54.0	ss; lt gy - lt brn, vf - f gr, apr mas bdg, th sh bd ◇ 53.5 ft., v f lam
54.0 - 69.5	ss; lt gy - brn, f - m gr, apr mas bdg, abnt carb fils, near top, th sl calc sh ptgs (55.1 ft., 56.0 ft., 58.0 ft., 59.8 ft., 64.8 ft.), th coaly ptg ◇ 58.05 ft., th sid lams & ripples, th bdd sh rip-up clasts ◇ 61.9 ft., decrg lt o. stn
69.5 - 70.0	ss/sh; gy - blk, lg sh rip-up clasts in f gr ss matrix, abrupt ctc abv & blw
70.0 - 71.0	ss; lt gy - lt brn, f - m gr, apr mas bdg, abnt carb fils, abrupt ctc w/ sh rip-up clasts blw
71.0 - 71.8	ss/sh; gy - blk, lg sh rip-up clasts in f gr ss matrix, abrupt ctc abv & blw
71.8 - 73.3	ss; lt gy - lt brn, f - m gr, apr mas bdg, th bdd sh rip-up clasts ◇ 72.5 ft.
73.3 - 74.0	ss/sh; gy - blk, lg sh rip-up clasts, few w rd clasts, abrupt ctc w/ blk sh blw (Base of Glenn)

74.0 - 76.0 sh; blk, carb, fis

76.0 - 81.6 sh; blk - dk gy, carb, slty, sl bur, conv bdg

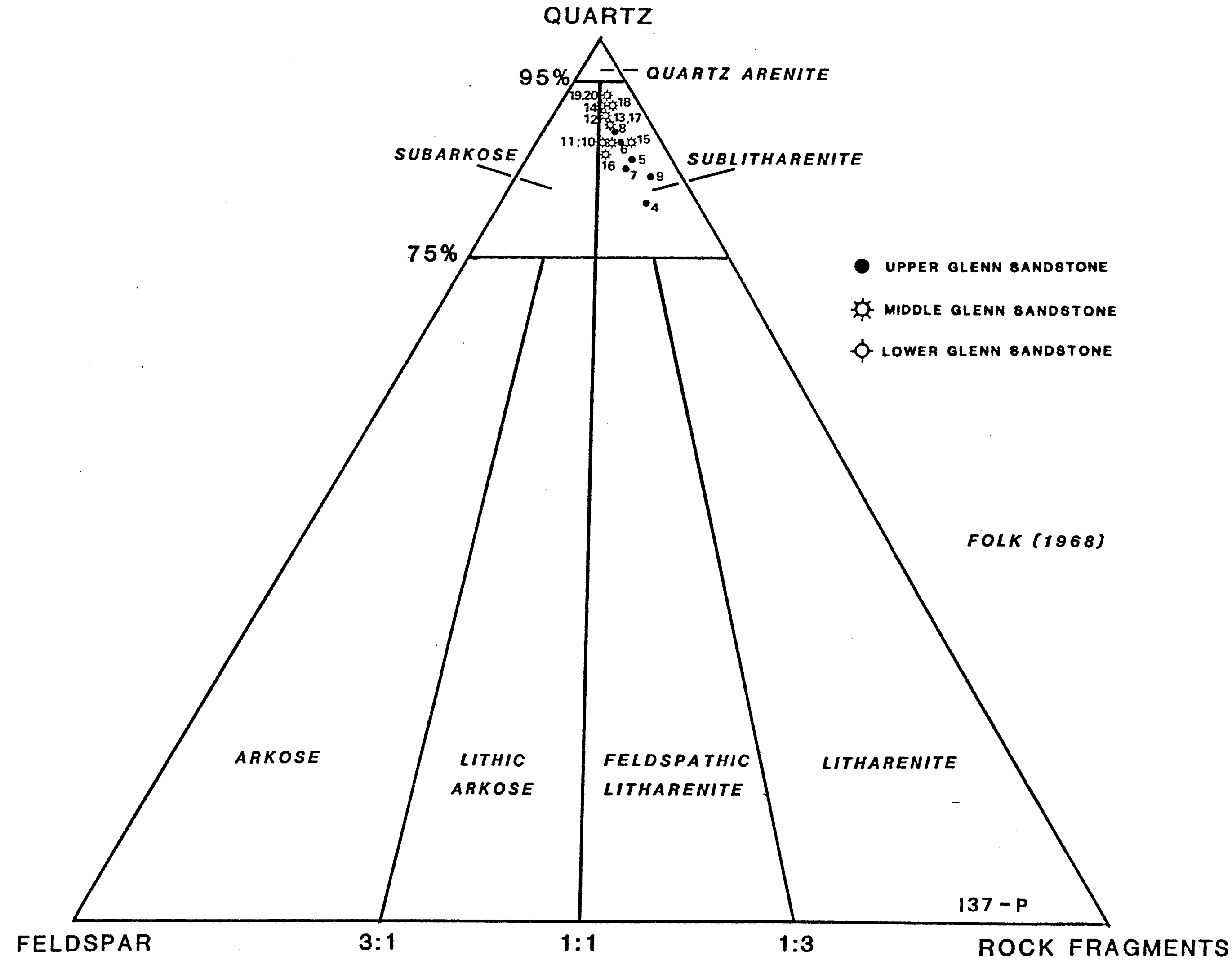


Figure 138. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 137-P

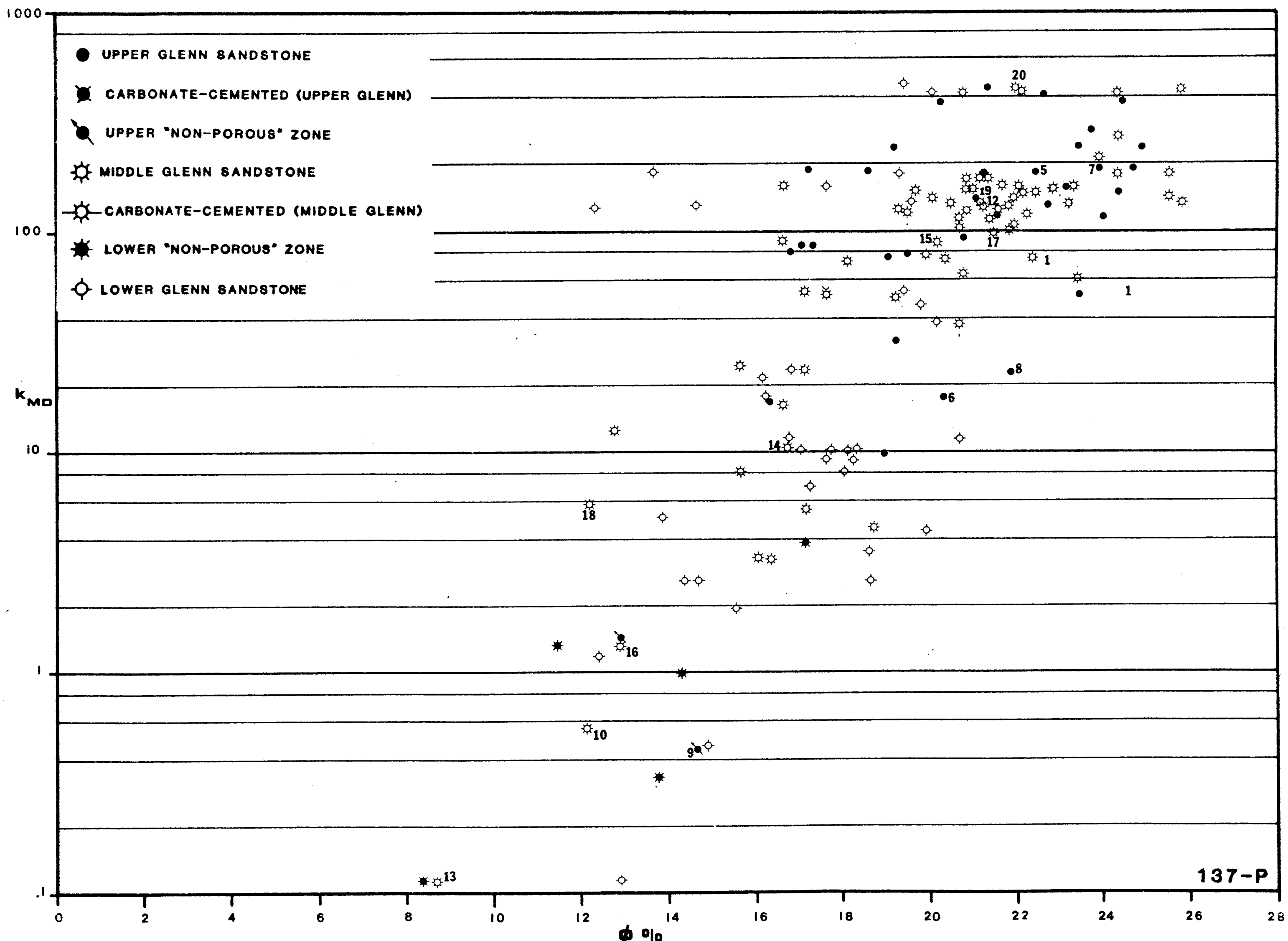


Figure 139. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 137-P

TABLE XX

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 137-P
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
		CONVENTIONAL PLUG ANALYSIS					
	1414.0-24.0						SH,SL/SDY
1	1424.0-25.0	9.1	19.0	29.0	30.2		SD,SLTY
2	1425.0-26.0	458.0	21.5	25.4	29.5		SD
3	1426.0-27.0	437.0	22.8	26.7	28.6		SD
4	1427.0-28.0	244.0	19.3	27.0	29.4		SD
5	1428.0-29.0	50.0	23.6	21.8	36.1		SD
6	1429.0-30.0	227.0	20.9	25.8	35.4		SD
7	1430.0-31.0 ←5	189.0	22.6	19.5	36.1		SD
8	1431.0-32.0	94.0	20.9	25.4	34.9		SD
9	1432.0-33.0	197.0	17.3	27.1	21.9		SD
10	1433.0-34.0	156.0	24.5	18.0	21.4		SD
	1434.0-1435.0	TOO BROKEN FOR ANALYSIS					
11	1435.0-36.0	403.0	20.4	18.1	26.6		SD
12	1436.0-37.0 ←6	17.0	20.4	21.3	25.5		SD,SHY
13	1437.0-38.0	188.0	21.4	25.5	26.5		SD
14	1438.0-39.0	132.0	22.9	21.9	30.4		SD
15	1439.0-40.0	79.0	19.6	27.4	26.5		SD
16	1440.0-41.0	246.0	25.1	19.7	32.6		SD
17	1441.0-42.0	87.0	17.1	23.9	23.0		SD
18	1442.0-43.0	195.0	24.9	21.5	24.9		SD
19	1443.0-44.0	190.0	18.7	27.8	36.6		SD
20	1444.0-45.0 ←7	196.0	24.1	23.1	27.6		SD
21	1445.0-46.0	143.0	21.2	26.0	24.0		SD
22	1446.0-47.0	82.0	16.9	33.7	25.6		SD
23	1447.0-48.0	33.0	19.3	33.3	18.4		SD
24	1448.0-49.0	299.0	23.9	23.5	23.5		SD
25	1449.0-50.0	119.0	21.7	26.1	27.1		SD
26	1450.0-51.0	116.0	24.2	23.8	22.9		SD
27	1451.0-52.0	157.0	23.3	23.1	26.5		SD
28	1452.0-53.0	245.0	23.6	30.1	22.9		SD
29	1453.0-54.0 ←8	22.0	22.0	39.7	20.8		SD
	1454.0-56.0						SD,SLTY,V/SHY
30	1456.0-57.0	76.0	19.1	29.0	18.6		SD
31	1457.0-58.0	87.0	17.4	24.7	18.2		SD
32	1458.0-59.0	16.0	16.4	26.3	22.1		SD
33	1459.0-60.0 ←9	0.4	14.7	30.4	25.6		SD,SLTY,SHY
	1460.0-61.0						SD,SLTY,V/SHY
34	1461.0-62.0	1.3	12.9	29.4	31.2		SD,SLTY,SHY
35	1462.0-63.0	3.2	16.1	27.4	31.8		SD,SLTY,SHY
36	1463.0-64.0	5.2	17.2	26.7	26.7		SD,SLTY
37	1464.0-65.0	3.0	16.4	25.2	36.4		SD,SLTY,SHY
38	1465.0-66.0 ←10	0.5	12.1	43.3	31.5		SD,SLTY,SHY
39	1466.0-67.0	0.2	13.4	30.3	48.1		SD,SLTY,SHY
40	1467.0-68.0	24.0	15.7	27.7	20.4		SD,SHY
41	1468.0-69.0	74.0	18.2	33.2	20.9		SD,SHY
42	1469.0-70.0	136.0	20.6	20.9	24.0		SD
43	1470.0-71.0	127.0	21.7	21.9	24.9		SD
44	1471.0-72.0	75.0	20.5	19.9	22.0		SD
45	1472.0-73.0	125.0	19.4	21.8	26.4		SD
46	1473.0-74.0 ←11	75.0	22.5	19.5	32.1		SD
47	1474.0-75.0	129.0	21.4	21.5	31.8		SD
48	1475.0-76.0	166.0	16.7	18.2	23.4		SD
49	1476.0-77.0	160.0	21.0	23.0	34.6		SD
50	1477.0-78.0 ←12	139.0	21.3	25.9	35.2		SD
51	1478.0-79.0	173.0	21.0	27.4	37.9		SD
52	1479.0-80.0	122.0	19.6	24.9	35.1		SD
53	1480.0-81.0	81.0	20.1	16.5	38.6		SD,SHY
54	1481.0-82.0	104.0	20.8	25.3	33.8		SD
55	1482.0-83.0 ←13	0.1	8.6	10.0	77.3		SD,SLTY,SHY
56	1483.0-84.0	4.2	18.8	31.7	32.9		SD,SLTY,SHY
57	1484.0-85.0 ←14	10.0	16.8	28.3	31.0		SD,SLTY,SHY
58	1485.0-86.0	7.8	15.7	21.7	26.0		SD,SLTY,SHY
59	1486.0-87.0	16.0	16.7	24.6	28.7		SD,SHY
60	1487.0-88.0	23.0	17.2	22.4	27.6		SD,SHY
61	1488.0-89.0	90.0	16.7	25.9	35.4		SD
62	1489.0-90.0	50.0	19.3	21.0	33.8		SD
63	1490.0-91.0 ←15	89.0	20.3	19.5	29.2		SD
64	1491.0-92.0	78.0	20.0	20.9	37.4		SD
	1492.0-94.0						SD,V/SHY,CALC
65	1494.0-95.0	12.0	12.8	13.4	34.7		SD
66	1495.0-96.0 ←16	1.2	12.9	14.8	38.9		SD,SLTY,SHY
	1496.0-97.0						SD,V/SHY

TABLE XX (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG	POROSITY PERCENT	FLUID SATS. OIL	FLUID SATS. WTR.	GR. DEN.	DESCRIPTION
67	1497.0-98.0						
68	1498.0-99.0	179.0	21.3	28.5	26.4		SD
69	1499.0-00.0	166.0	23.5	24.9	26.8		SD
70	1500.0-01.0	146.0	25.7	19.0	25.6		SD
71	1501.0-02.0	463.0	26.0	18.0	34.4		SD
72	1502.0-03.0	185.0	25.7	18.3	32.4		SD
73	1503.0-04.0	136.0	26.0	17.4	30.6		SD
74	1504.0-05.0	162.0	23.0	23.4	29.0		SD
75	1505.0-06.0 ←17	146.0	20.2	21.5	32.3		SD
76	1506.0-07.0	98.0	21.6	21.2	34.3		SD
77	1507.0-08.0	150.0	22.3	20.4	38.9		SD
78	1508.0-09.0	163.0	22.2	20.3	32.9		SD
79	1509.0-10.0	144.0	22.1	20.8	35.7		SD
80	1510.0-11.0	124.0	22.4	21.4	36.9		SD
81	1511.0-12.0	116.0	21.5	19.2	38.4		SD
82	1512.0-13.0 ←18	137.0	23.4	18.3	34.8		SD
83	1513.0-14.0	5.5	12.2	18.0	38.0		SD
84	1514.0-15.0	218.0	24.1	17.6	28.1		SD
85	1515.0-16.0	449.0	24.5	15.5	29.4		SD
86	1516.0-17.0 ←19	61.0	23.6	20.6	32.7		SD
87	1517.0-18.0	143.0	21.2	17.6	32.4		SD
88	1518.0-19.0	106.0	22.1	14.7	28.3		SD
89	1519.0-20.0	126.0	21.0	17.9	32.6		SD
90	1520.0-21.0	37.0	20.8	16.1	28.9		SD
91	1521.0-22.0	102.0	22.0	14.7	26.5		SD
92	1522.0-23.0	63.0	20.9	17.6	33.0		SD
93	1523.0-24.0	53.0	17.2	20.9	31.4		SD
94	1524.0-25.0	50.0	17.7	17.6	28.9		SD
95	1525.0-26.0	131.0	22.0	24.6	42.4		SD
96	1526.0-27.0 ←20	470.0	22.1	18.5	37.1		SD
97	1527.0-28.0	440.0	22.3	22.3	38.7		SD
98	1528.0-29.0	154.0	22.6	20.0	36.3		SD
99	1529.0-30.0	78.0	19.5	19.3	41.9		SD
100	1530.0-31.0	156.0	21.1	16.5	34.0		SD
101	1531.0-32.0	116.0	20.8	18.9	35.7		SD
102	1532.0-33.0	154.0	19.8	15.5	36.5		SD
103	1533.0-34.0	166.0	21.9	14.7	29.3		SD
104	1534.0-35.0	449.0	20.9	14.4	42.2		SD
105	1535.0-36.0	179.0	21.5	12.5	33.0		SD
106	1536.0-37.0	0.3	13.8	24.3	52.0		SD,SLTY,SHY
107	1537.0-38.0	0.9	14.3	26.5	49.7		SD,SLTY
108	1538.0-39.0	1.2	11.4	5.2	62.3		SD,SLTY
109	1539.0-40.0	3.6	17.2	23.0	50.1		SD,SLTY
110	1540.0-41.0	<0.1	8.3	0.0	65.0		LM
111	1541.0-42.0	0.1	12.9	27.1	44.6		SD,SLTY,SHY
112	1542.0-43.0	2.4	14.7	25.5	49.4		SD,SLTY,SHY
113	1543.0-44.0	1.8	15.6	15.4	44.0		SD,SLTY,SHY
114	1544.0-45.0	4.8	13.9	28.4	40.1		SD,SLTY,SHY
115	1545.0-46.0	38.0	20.3	18.6	38.3		SD
116	1546.0-47.0	21.0	16.2	21.2	45.3		SD
117	1547.0-48.0	17.0	16.3	25.5	38.3		SD
118	1548.0-49.0	11.0	16.8	25.2	43.4		SD
119	1549.0-50.0	53.0	19.5	19.8	33.7		SD
120	1550.0-51.0	2.4	18.7	23.0	36.3		SD,SLTY,SHY
121	1551.0-52.0	4.2	20.0	21.6	39.7		SD,SLTY
122	1552.0-53.0	2.4	14.4	14.7	45.8		SD,SLTY
123	1553.0-54.0	139.0	18.7	12.5	38.1		SD
124	1554.0-55.0	497.0	19.5	9.2	40.3		SD
125	1555.0-56.0	186.0	19.4	8.0	38.7		SD
126	1556.0-57.0	169.0	17.7	20.0	27.5		SD
127	1557.0-58.0	455.0	20.2	19.8	27.5		SD
128	1558.0-59.0	189.0	13.7	7.9	54.3		SD
129	1559.0-60.0	134.0	14.7	11.0	53.3		SD
130	1560.0-61.0	8.8	18.3	7.4	48.0		SD,SLTY,SHY
131	1561.0-62.0	8.8	17.7	9.1	51.9		SD,SLTY,SHY
132	1562.0-63.0	11.0	20.8	23.0	41.8		SD,SLTY
133	1563.0-64.0	131.0	12.4	11.7	60.2		SD
134	1564.0-65.0	46.0	19.9	8.0	58.0		SD
135	1565.0-66.0	9.9	18.4	7.4	55.8		SD,SLTY
136	1566.0-67.0	6.6	17.3	8.0	58.3		SD,SLTY
137	1567.0-68.0	3.3	18.7	7.4	54.0		SD,SLTY
138	1568.0-69.0	9.8	18.2	8.8	51.3		SD,SLTY
139	1569.0-70.0	9.9	17.8	7.7	53.6		SD,SLTY
140	1570.0-71.0	7.7	18.1	7.6	51.6		SD,SLTY
	1571.0-72.0	9.9	17.1	6.0	54.5		SD,SLTY,SHY
141	1572.0-73.0						SH
142	1573.0-74.0	23.0	16.9	8.2	53.3		SD,SLTY
	1574.0-82.0	1.1	12.4	8.8	58.5		SD,SLTY,SHY
							SH

WILLIAM BERRYHILL NO. 138-I

(1052 FWL, 1358 FSL) NE/4, SEC. 17, T.17N, R.12E

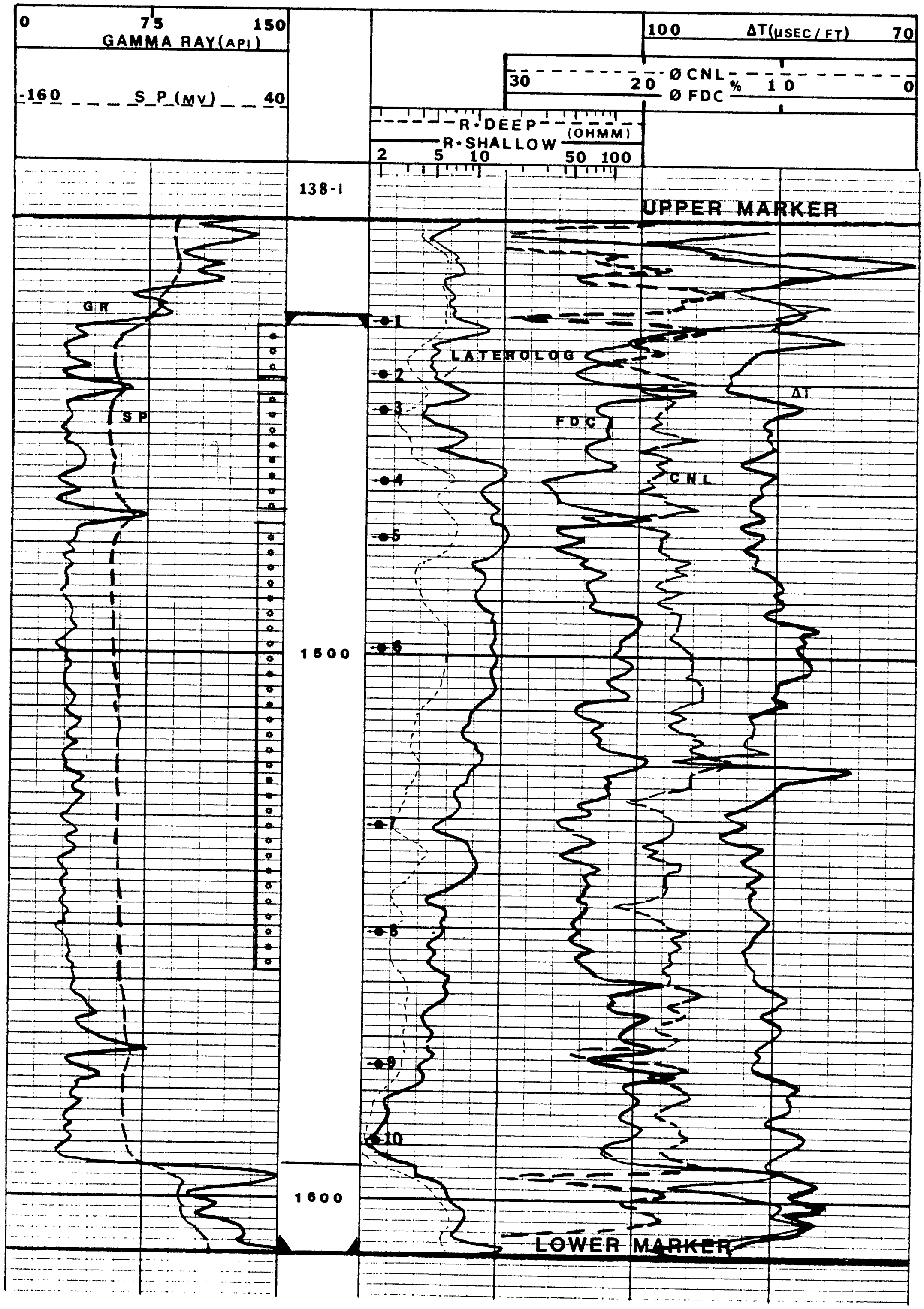


Figure 140. Well-log Signatures, Glenn Sandstone, William Berryhill No. 138-I

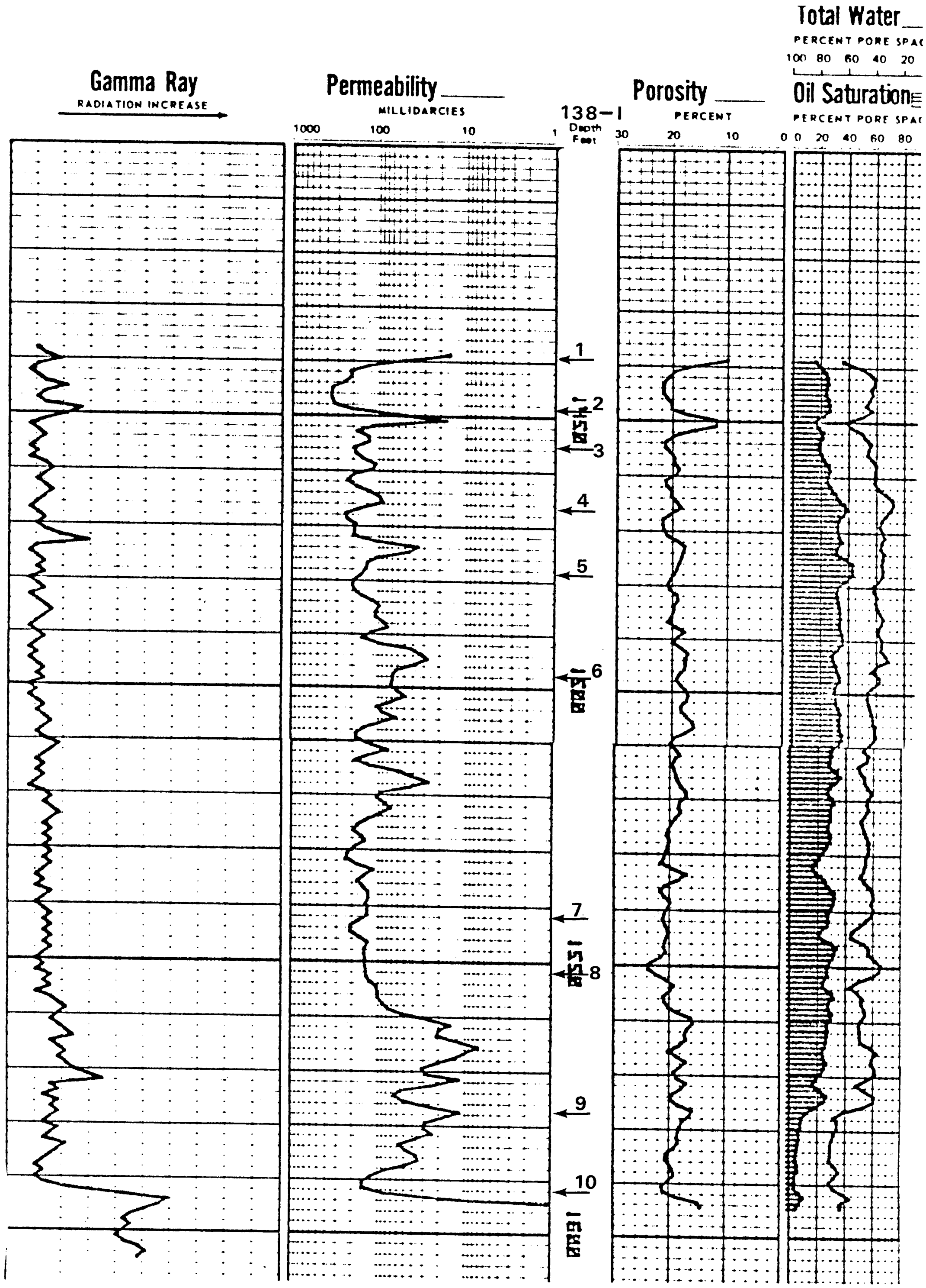


Figure 141. Correlation Coregraph, Glenn Sandstone, William Berryhill No. 138-I

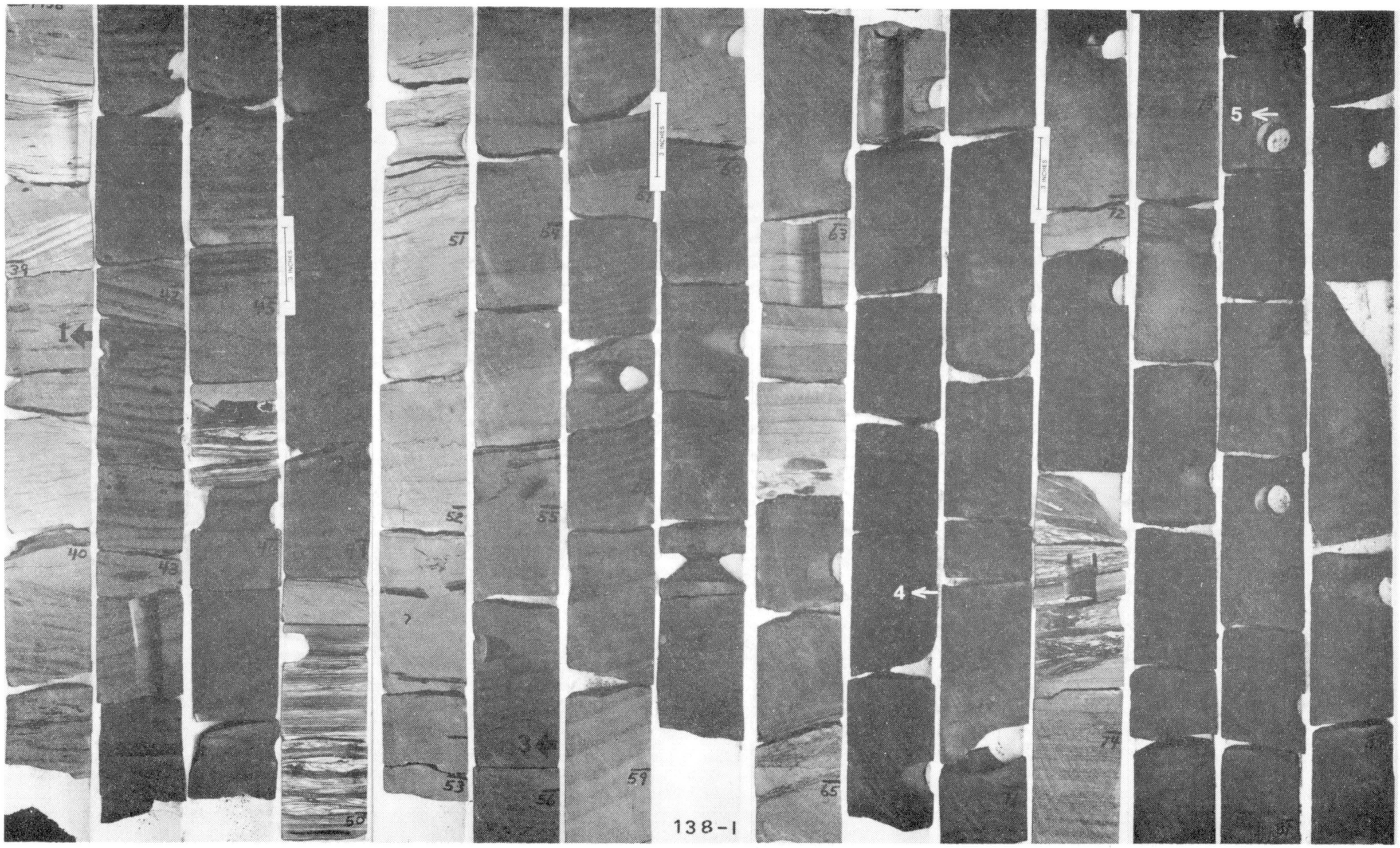
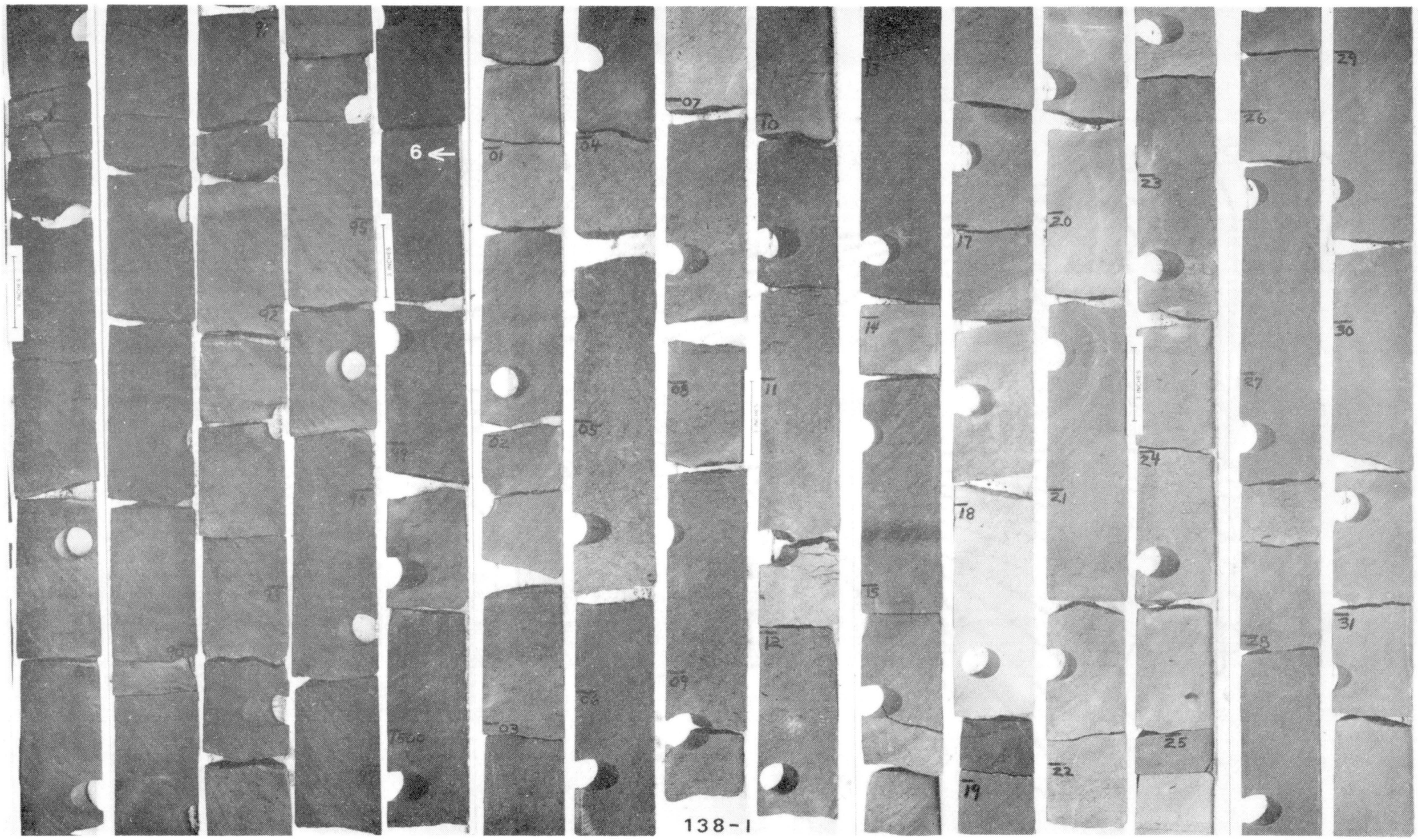
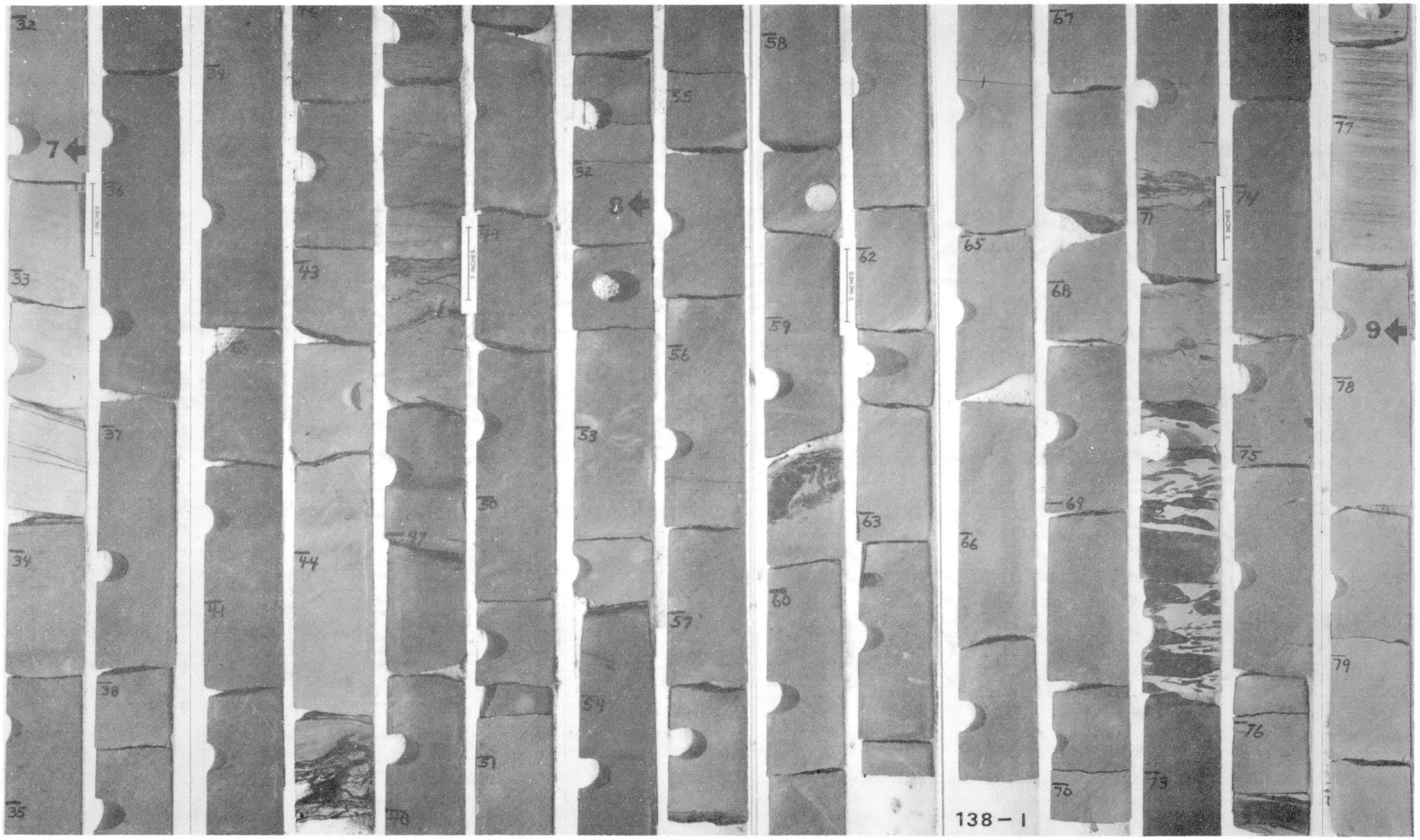


Figure 142. Glenn Sandstone, William Berryhill No. 138-I, 1438.0 - 84.5 ft., Showing the Upper Glenn (1438.0 - 73.0 ft.), Upper "Non-Porous" Zone (1473.0 - 73.6 ft.), and a Portion of the Middle Glenn



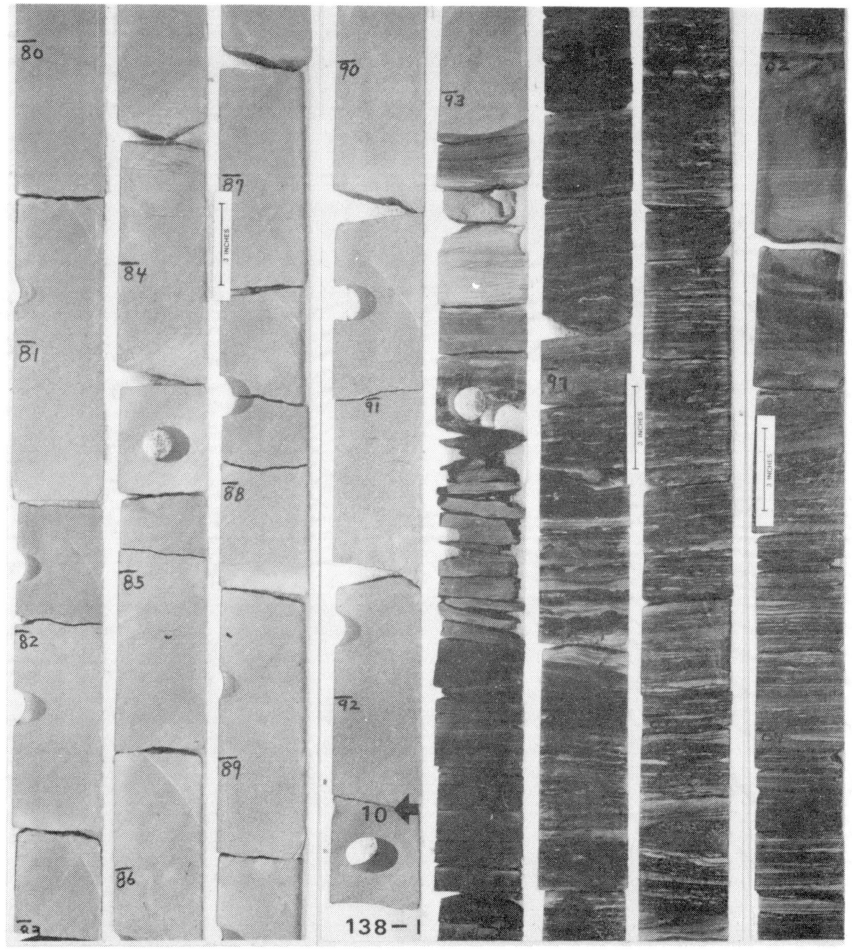
Note: Glenn Sandstone, William Berryhill No. 138-I, 1484.5 - 1531.9 ft., Showing a Portion of the Middle Glenn

Figure 142 (Continued)



Note: Glenn Sandstone, William Berryhill No. 138-I, 1531.9 - 79.8 ft., Showing a Portion of the Middle Glenn, Lower "Non-Porous" Zone (1571.6 - 72.8 ft.), and a Portion of the Lower Glenn

Figure 142 (Continued)



Note: Glenn Sandstone, William Berryhill No. 138-I, 1579.8 - 1605.0 ft., Showing a Portion of the Lower Glenn (1579.8 - 94.3 ft.)

Figure 142 (Continued)

William Berryhill No. 138-I
(1052 FWL, 1358 FSL, NE/4, Sec. 17)

Cored Interval: 1438.0 - 1610.0 ft.
Correlation: Core depth one foot shallow to log depth

Core Depth (Ft.)	Core Description
	Upper Glenn
1438.0 - 40.0	ss; gy - lt gy, vf - m gr, slty, p srt, sc xbdg (s sc through x bdg?) abnt carb lam, sh ptg ◇ 40.0 ft., grdg down to o. stn ss (Sample 138-1, 39.1 ft.)
40.0 - 45.5	ss; brn - dk brn, f - m gr, m sc xbdg, abnt slty-carb lam, vis por, o. stn, few scat s sid pbls ◇ 44.4 - 44.8 ft., abrupt ctc ◇ 45.5 ft.
45.5 - 45.6	intlam ss/sh; gy - blk, convolute bdg, abrupt basal ctc w/ underlying ss
45.6 - 49.1	ss; brn - dk brn, f - m gr, m sc xbdg, few scat sid pbls ◇ 47.8 ft., fis por, o. stn, abrupt hztl ctc ◇ 49.1 ft. (Sample 138-2, 48.8 ft.)
49.1 - 50.1	intlam ss/sh; gy - lt gy, f lam, convolute bdg, abrupt trans into slty ss
50.1 - 64.0	ss; lt gy - brn, vf - f gr, slty near top, abnt carb lam & th ptgs, grdg downw into f gr ss, abnt carb fils, brk elg sh clast ◇ 52.3 ft., flat-elg sh clast ?, ptg ◇ 52.6 ft., flow struc ◇ 55.8 ft., sl incld bdg w/ intlam of slty mat, incr s sid pbls (Sample 138-3, 55.8 ft.) 59.8 ft., abrupt basal ctc ◇ 63.9 ft., sub rd sh rip-up clasts
64.0 - 73.0	ss; brn - gy, vf - f gr, abnt carb fil & lam to 65.5 ft., apr mas bdg & abnt carb fil, o. stn, abrupt ctc ◇ 75.0 ft.
73.0 - 73.6	intlam ss/sh; lt gy - blk, f intlam, bur, convolute bdg, v abrupt ctc abv & blw (Upper "Non-Porous" Zone)

Middle Glenn

73.6 - 75.5	ss; gy - dk gy, vf - f gr, hzlt bdg (planar bdg?), carb lam, abrupt ctc ◇ 75.5 ft., scour surf?
75.5 - 1518.0	ss; brn, vf - f gr, apr mas bdg, abnt carb fil, o. stn, scat s sid pbls, flowage features ◇ 78.3 ft., (Sample 138-5, 78.3 ft.), sub rd elg, sh clasts ◇ 79.0 ft., flowage features & carb mat ◇ 83.0 - 83.3 ft., carb ptgs ◇ 90.0 ft., abnt, s sid pbls randomly dispersed 94.8 - 95.8 ft., (Sample 138-6, 98.1 ft.), sev scour surfs, few flat-elg sh rip-up clasts & s sid pbls 1509.8 - 12.4 ft., hztl bdg ◇ 13.0 - 14.0 ft., bnd carb mat ◇ 14.8 ft., abrupt trans w/ calc cmt ss
1518.0 - 18.8	ss; lt gy - gy, vf - f gr, calc cmt, few carb fil
18.8 - 25.1	ss; brn - lt brn, vf - f gr, apr mas bdg, scat s sid pbls & carb fils
25.1 - 25.2	sltst; lt gy - buff, apr mas bdg, faint carb lams
25.2 - 32.5	ss; lt brn - gy, vf - f gr, apr mas bdg, fewer carb fil, scat sid pbls ◇ 27.5 ft. (Sample 138-7, 32.5 ft.)
32.5 - 33.9	sltst; lt gy - buff, hi ang bdg (m sc xbdg?), carb lams & ptgs, abrupt ang ctc ◇ 33.9 ft.
33.9 - 44.8	ss; lt brn - gy, vf - f gr, apr mas bdg, carb fils, fes scat s sid pbls, lt gy - gy ss ◇ 43.2 - 44.8 ft., abrupt ctc w/ slty ss & coaly mat ◇ 44.8 ft.
44.8 - 45.0	sltst/coaly mat; lt brn - blk, (4 cm) of sltst, sl flow struc of s ripple-lams, ireg ctc w/ coaly mat in vf gr ss mtx, few carb pl fos, poss scour surf blw
45.0 - 47.1	ss; brn, vf - m gr, por srtd, sev scour surfs, flat-elg sh rip-up clasts, sl incd bdg, carb fils & ptgs, abrupt ctc w/ incld carb ptg ◇ 47.1 ft.

47.1 - 59.5	ss; brn - lt brn, vf - f gr, apr mas bdg, sl incld bdg ?, abnt carb fils, few scat sid pbls, th coaly ptg ◇ 59.5 ft., (Sample 138-8, 52.4 ft.)
59.5 - 59.6	sh/ss; lt brn - gy - blk, bd sub rd sh rip-up clast (1 - 4 cm), sl incld bdg, apr abrupt trans w/ underlying ss
59.6 - 71.6	ss; lt brn - gy, vf - f gr, apr mad bdg, few carb fils, w rd sid pbl ◇ 63.2 ft., apr mixing of f - m gr sz ◇ 69.0 - 70.0 ft., th bdd sh rip-up clasts (7 cm) ◇ 70.9 - 71.0 ft., scat sid pbls & sh rip-up clasts to 71.6 ft., abrupt ctc w/ underlying sh rip-up clast zn
71.6 - 72.8	sh/ss; lt gy - blk, lg (4 - 7 cm), flat-elg, sh rip-up clasts in a vf gr ss mtx, bdd sh (lg sh clast?) ◇ 72.1 - 72.2 ft., abrupt sl ang ctc w/ underlying ss ◇ 72.8 ft. (Lower "Non-Porous" Zone)
	<u>Lower Glenn</u>
72.8 - 76.3	ss; brn - lt brn, apr mas bdg, o. stn near top, few rd-flat sid pbls ◇ 75.0 ft., scat flat-elg sh clasts to 76.3 ft., abrupt ctc w/ th sh
76.3 - 76.4	sh; blk, sideritic, (4 cm), s sh rip-up blw, abrupt sl incld ctc w/ hztl lam (planar bdd?) ss ◇ 76.4 ft.
76.4 - 77.8	ss; lt gy - dk gy, vf gr, hztl bdg (planar bdg?), carb lam grdg downw into lt gy apr mas ss
77.8 - 93.1	ss; lt gy, f gr, apr mas bdg, cly, few carb fils, v th sid ptg ◇ 83.5 ft., incr gr sz aprox. 88.5 ft., intsls filled w blk asph mat (dd o. stn?) near base, 91.8 - 93.1 ft., abrupt "curved" ctc w/ slty sh ◇ 93.1 ft. (Sample 138-9, 77.9 ft.; Sample 138-10, 92.5 ft.)
93.1 - 94.3	sh/sltst; blk - lt gy, th sh bd (4 cm), sl rippled, grdg into lt gy sltst, f ripple-lams, carb; abrupt ctc w/ slty sh which grds into sltst, pyr, fos, hd, dns, abrupt ctc w/ th (2 cm) carb sh (Base of Glenn)
94.3 - 96.1	sh; blk - dk gy, slty near top, hd, dns, carb, few fos

96.1 - 1602.0	sh; dk gy - blk, slty, flaser struc, convolute bdg, abnt bur
1602.0 - 02.5	sltst; dk gy - gy, f parll lam, convolute bdg, f ripple-lam
02.5 - 04.0	sh; dk gy - blk, slty, flaser struc, convolute bdg, bur

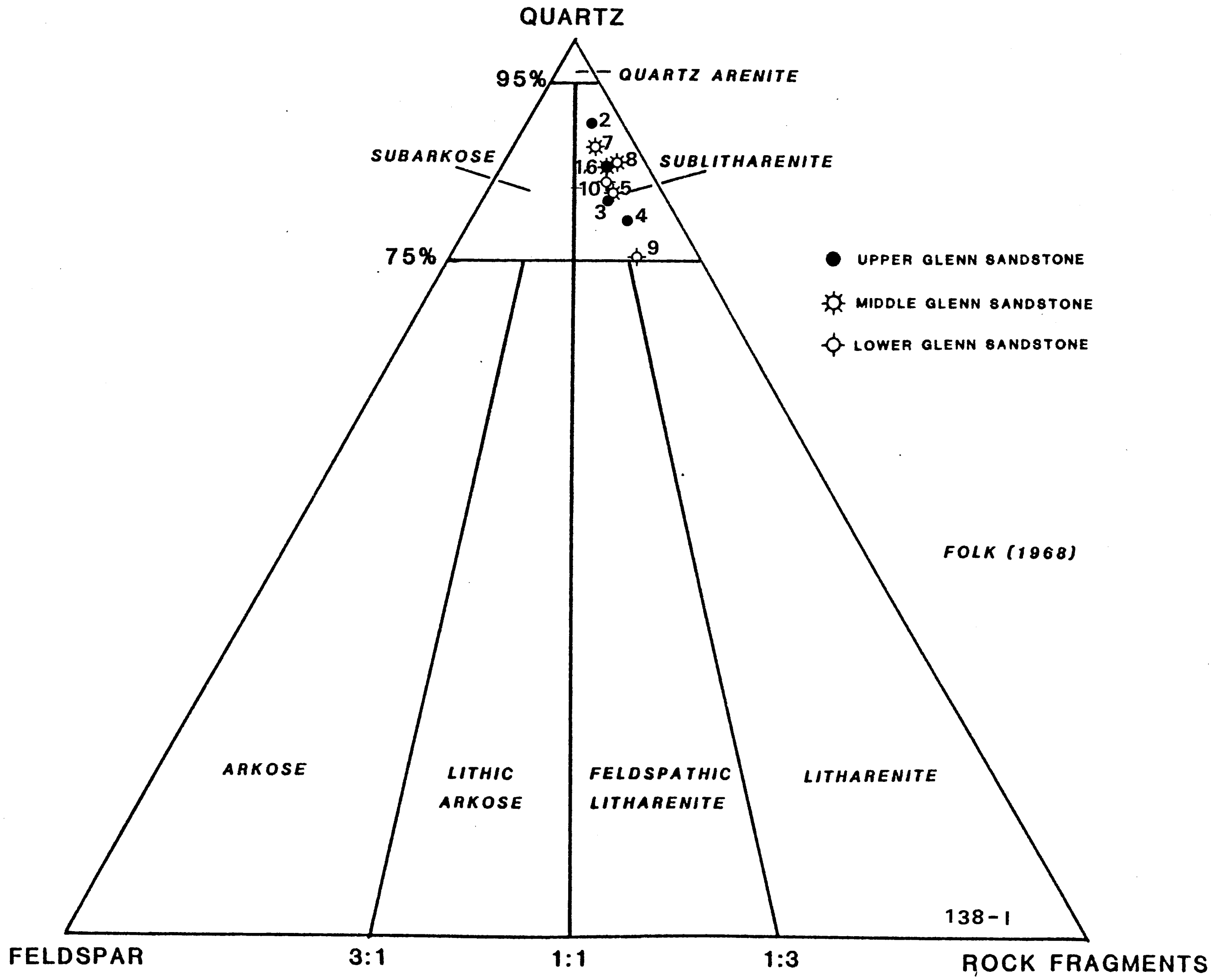


Figure 143. Ternary Diagram Depicting Composition and Classification of Samples of Glenn Sandstone, William Berryhill No. 138-I

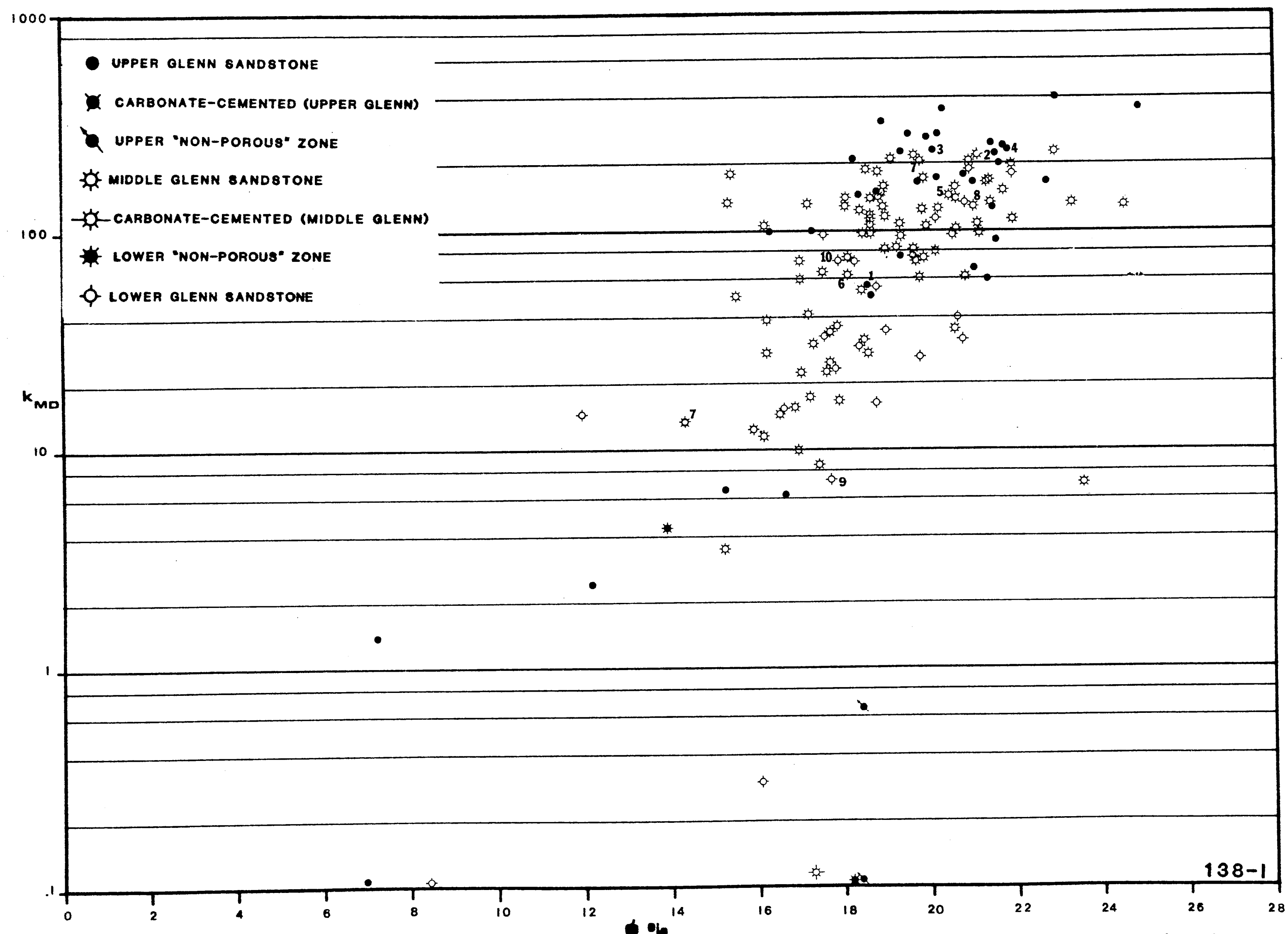


Figure 144. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 138-I

TABLE XXI

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 138-I
CORE ANALYSIS

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG H	PLUG V	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.	DESCRIPTION
				CONVENTIONAL ANALYSIS				
1	1438.0-39.0	1.3	0.04	7.1	14.3	69.9		SD,SLTY,SL/DOL
2	1439.0-40.0 ←1	56.0	22	18.6	22.5	43.8		SD,SL/DOL
3	1440.0-41.0	76.0		19.4	25.7	47.8		SD,SL/DOL
4	1441.0-42.0	284.0		19.6	25.0	37.5		SD,SL/DOL
5	1442.0-43.0	171.0		22.8	26.7	38.2		SD,SL/DOL
6	1443.0-44.0	172.0	108	19.8	25.6	46.7		SD,SL/DOL
7	1444.0-45.0	430.0		23.0	21.4	39.0		SD,SL/DOL
8	1445.0-46.0	275.0	274	20.0	28.8	43.2		SD,SL/DOL
9	1446.0-47.0	373.0		20.4	25.9	50.7		SD,SL/DOL
10	1447.0-48.0	331.0		19.0	27.9	41.8		SD,SL/DOL
11	1448.0-49.0 ←2	232.0		21.6	26.9	35.9		SD,SL/DOL
12	1449.0-50.0	0,01	0.01	6.8	9.4	79.3		SD,SLTY,SL/DOL,S
13	1450.0-51.0	2.3		12.1	20.4	50.4		SD,SLTY,DOL,SH L
14	1451.0-52.0	59.0		16.6	23.4	49.6		SD,SL/DOL,SH LAM
15	1452.0-53.0	282.0		20.3	21.8	50.1		SD,SL/DOL
16	1453.0-54.0	67.0		21.3	19.5	38.9		SD,SL/DOL
17	1454.0-55.0	90.0		21.6	18.0	44.9		SD,SL/DOL
18	1455.0-56.0 ←3	244.0		20.1	22.7	48.5		SD,SL/DOL
19	1456.0-57.0	149.0	46	18.4	20.7	40.3		SD,SL/DOL
20	1457.0-58.0	172.0	140	21.1	27.1	38.5		SD,SL/DOL
21	1458.0-59.0	100.0		17.3	28.6	39.0		SD,SL/DOL
22	1459.0-60.0	50.0		18.7	23.9	40.7		SD,SL/DOL
23	1460.0-61.0	250.0		21.8	26.3	40.4		SD,SL/DOL
24	1461.0-62.0	209.0	130	21.7	24.3	40.5		SD,SL/DOL
25	1462.0-63.0	217.0		18.3	35.4	31.7		SD,SL/DOL
26	1463.0-64.0	60.0	1.2	21.4	28.6	26.5		SD,SL/DOL
27	1464.0-65.0	153.0		18.8	38.6	25.7		SD,SL/DOL
28	1465.0-66.0	6.2	6.2	17.1	42.3	27.8		SD,SLTY,SL/DOL
29	1466.0-67.0	177.0		20.2	36.9	32.5		SD,SL/DOL
30	1467.0-68.0 ←4	241.0		21.9	31.9	33.9		SD,SL/DOL
31	1468.0-69.0	263.0		21.5	33.8	38.9		SD,SL/DOL
32	1469.0-70.0	130.0		21.5	31.9	32.9		SD,SL/DOL
33	1470.0-71.0	181.0	97	20.9	34.3	32.3		SD,SL/DOL
34	1471.0-72.0	234.0		19.4	37.8	33.2		SD,SL/DOL
35	1472.0-73.0	100.0		16.3	35.1	40.7		SD,SL/DOL
36	1473.0-74.0	0.06	0.01	18.4	23.9	27.9		SD,SLTY,SL/DOL,SH
37	1474.0-75.0	34.0		17.7	43.8	36.1		SD,SL/DOL,SH LAMS
38	1475.0-76.0	97.0		18.5	43.8	35.3		SD,SL/DOL,SH LAMS
39	1476.0-77.0	149.0		18.9	43.7	32.3		SD,SL/DOL
40	1477.0-78.0	116.0		19.0	44.9	35.4		SD,SL/DOL
41	1478.0-79.0 ←5	149.0		20.5	41.1	32.4		SD,SL/DOL
42	1479.0-80.0	173.0		19.9	32.6	45.0		SD,SL/DOL
43	1480.0-81.0	201.0		22.0	32.5	41.3		SD,SL/DOL
44	1481.0-82.0	189.0		17.4	32.6	34.9		SD,SL/DOL
45	1482.0-83.0	154.0		19.0	34.2	41.2		SD,SL/DOL
46	1483.0-84.0	109.0		19.4	34.5	37.9		SD,SL/DOL
47	1484.0-85.0	76.0		19.9	35.2	36.3		SD,SL/DOL
48	1485.0-86.0	109.0	44	18.7	36.0	32.4		SD,SL/DOL
49	1486.0-87.0	112.0		22.0	34.6	33.7		SD,SL/DOL
50	1487.0-88.0	81.0		19.7	33.9	38.4		SD,SL/DOL
51	1488.0-89.0	60.0		15.5	38.0	36.7		SD,SL/DOL
52	1489.0-90.0	94.0		19.4	35.8	34.7		SD,SL/DOL
53	1490.0-91.0	215.0		21.0	37.6	33.4		SD,SL/DOL
54	1491.0-92.0	66.0		17.5	34.9	36.2		SD,SL/DOL
55	1492.0-93.0	27.0	3.3	16.2	25.3	35.2		SD,SL/DOL
56	1493.0-94.0	37.0		17.9	31.3	21.3		SD,SL/DOL
57	1494.0-95.0	22.0		17.0	33.0	42.6		SD,SL/DOL
58	1495.0-96.0	22.0		17.6	30.9	45.1		SD,SL/DOL
59	1496.0-97.0	75.0		18.1	34.4	34.4		SD,SL/DOL
60	1497.0-98.0	60.0		19.8	40.0	33.1		SD,SL/DOL
61	1498.0-99.0 ←6	63.0		18.1	26.3	43.9		SD,SL/DOL
62	1499.0-00.0	74.0		17.0	33.5	44.2		SD,SL/DOL
63	1500.0-01.0	59.0		17.0	32.2	45.6		SD,SL/DOL
64	1501.0-02.0	38.0		16.2	30.6	44.6		SD,SL/DOL
65	1502.0-03.0	50.0	48	18.7	34.2	42.7		SD,SL/DOL
66	1503.0-04.0	118.0		18.7	36.1	43.3		SD,SL/DOL
67	1504.0-05.0	104.0		16.2	34.7	39.0		SD,SL/DOL
68	1505.0-06.0	17.0		17.2	34.0	43.1		SD,SL/DOL
69	1506.0-07.0	102.0		13.7	34.3	37.7		SD,SL/DOL
70	1507.0-08.0	132.0		18.1	37.3	39.8		SD,SL/DOL
71	1508.0-09.0	189.0		18.9	36.0	39.6		SD,SL/DOL
72	1509.0-10.0	170.0		21.4	35.2	42.9		SD,SL/DOL
73	1510.0-11.0	146.0		18.1	28.8	50.0		SD,SL/DOL
74	1511.0-12.0	8.2	5.7	17.4	30.1	40.5		SD,SLTY,SL/DOL,SH
75	1512.0-13.0	134.0		19.0	34.2	37.7		SD,SL/DOL
76	1513.0-14.0	231.0		19.7	20.1	56.9		SD,SL/DOL

TABLE XXI (Continued)

SMP. NO.	DEPTH	PERM. TO AIR MD. PLUG H	PLUG V	POROSITY PERCENT	FLUID SATS. OIL	WTR.	GR. DEN.	DESCRIPTION
77	1514.0-15.0	114.0		18.7	40.3	46.4		SD,SL/DOL
78	1515.0-16.0	27.0	16	18.6	36.6	43.9		SD,SL/DOL
79	1516.0-17.0	53.0		18.5	34.5	45.6		SD,SL/DOL
80	1517.0-18.0	24.0		17.7	31.0	45.2		SD,SL/DOL
81	1518.0-19.0	0.07		17.2	22.3	34.8		SD,SLTY,SL/LMY
82	1519.0-20.0	138.0		15.3	35.1	44.2		SD,SL/DOL
83	1520.0-21.0	81.0		19.0	32.3	44.2		SD,SL/DOL
84	1521.0-22.0	98.0		18.1	29.9	39.8		SD,SL/DOL
85	1522.0-23.0	42.0		17.2	29.3	43.9		SD,SL/DOL
86	1523.0-24.0	98.0		18.7	32.5	49.3		SD,SL/DOL
87	1524.0-25.0	127.0		19.9	26.9	44.9		SD,SL/DOL
88	1525.0-26.0	159.0	1.4	19.0	28.4	46.2		SD,SL/DOL
89	1526.0-27.0	217.0		21.6	30.6	43.8		SD,SL/DOL
90	1527.0-28.0	143.0		18.7	31.3	40.9		SD,SL/DOL
91	1528.0-29.0	105.0		20.0	25.9	41.6		SD,SL/DOL
92	1529.0-30.0	192.0		21.0	26.2	41.9		SD,SL/DOL
93	1530.0-31.0	216.0		19.2	22.1	43.2		SD,SL/DOL
94	1531.0-32.0	231.0		23.0	18.2	46.9		SD,SL/DOL
95	1532.0-33.0	218.0		19.8	14.2	38.7		SD,SL/DOL
96	1533.0-34.0 ←7	13.0	5.0	14.3	24.3	55.2		SD,SL/DOL
97	1534.0-35.0	188.0		18.5	28.4	41.0		SD,SL/DOL
98	1535.0-36.0	160.0		20.7	24.4	43.5		SD,SL/DOL
99	1536.0-37.0	153.0		21.8	38.0	36.0		SD,SL/DOL
100	1537.0-38.0	109.0		21.2	30.5	37.9		SD,SL/DOL
101	1538.0-39.0	126.0		18.4	33.1	40.4		SD,SL/DOL
102	1539.0-40.0	127.0		20.3	32.0	38.6		SD,SL/DOL
103	1540.0-41.0	143.0		20.7	26.5	35.0		SD,SL/DOL
104	1541.0-42.0	95.0		20.6	30.2	47.1		SD,SL/DOL
105	1542.0-43.0	167.0		21.5	28.9	46.4		SD,SL/DOL
106	1543.0-44.0	192.0		18.6	25.0	53.5		SD,SL/DOL
107	1544.0-45.0	230.0		21.2	13.3	62.5		SD,SL/DOL
108	1545.0-46.0	146.0	60	19.1	37.4	41.0		SD,SL/DOL,SHY
109	1546.0-47.0	104.0		22.4	33.8	38.7		SD,SL/DOL
110	1547.0-48.0	148.0		19.0	32.0	47.4		SD,SL/DOL
111	1548.0-49.0	134.0		21.2	33.3	34.4		SD,SL/DOL
112	1549.0-50.0	135.0		23.4	28.2	32.0		SD,SL/DOL
113	1550.0-51.0	133.0		24.6	26.9	32.2		SD,SL/DOL
114	1551.0-52.0	131.0		21.5	30.9	37.1		SD,SL/DOL
115	1552.0-53.0 ←8	129.0	116	21.1	25.3	47.5		SD,SL/DOL
116	1553.0-54.0	133.0		17.2	20.0	65.3		SD,SL/DOL
117	1554.0-55.0	80.0		20.2	34.7	44.8		SD,SL/DOL
118	1555.0-56.0	102.0		20.7	33.6	44.4		SD,SL/DOL
119	1556.0-57.0	97.0		21.2	27.8	50.3		SD,SL/DOL
120	1557.0-58.0	84.0	55	19.3	26.9	43.2		SD,SL/DOL
121	1558.0-59.0	74.0		19.7	33.5	43.9		SD,SL/DOL
122	1559.0-60.0	58.0		13.7	31.3	45.2		SD.SL/DOL
123	1560.0-61.0	12.0		15.9	26.3	51.2		SD,SL/DOL
124	1561.0-62.0	14.0		16.5	29.8	46.9		SD,SL/DOL
125	1562.0-63.0	15.0	8.2	16.9	28.6	47.7		SD,SL/DOL
126	1563.0-64.0	30.0		17.3	24.9	51.1		SD,SL/DOL
127	1564.0-65.0	3.3		15.2	30.4	41.0		SD,SLTY,SL/DOL
128	1565.0-66.0	6.7		23.6	20.3	29.0		SD,SLTY,SL/DOL
129	1566.0-67.0	9.4		16.9	26.0	42.5		SD,SLTY,SL/DOL
130	1567.0-68.0	11.0	4.4	16.1	29.0	40.6		SD,SL/DOL
131	1568.0-69.0	16.0		17.9	25.3	35.5		SD,SL/DOL
132	1569.0-70.0	32.0		18.5	23.2	36.6		SD,SL/DOL
133	1570.0-71.0	35.0		20.6	22.6	37.6		SD,SL/DOL
134	1571.0-72.0	4.3	0.85	13.9	10.3	62.1		SD,SLTY,SL/DOL,SHY
135	1572.0-73.0	0.09		18.1	25.3	41.7		SD,SLTY,SL/DOL,SHY
136	1573.0-74.0	74.0		19.7	28.1	34.8		SD,SL/DOL
137	1574.0-75.0	55.0		18.8	27.3	39.2		SD,SL/DOL
138	1575.0-76.0	62.0		20.9	21.1	36.9		SD,SL/DOL
139	1576.0-77.0	14.0	3.0	11.9	14.4	69.9		SD,SL/DOL
140	1577.0-78.0 ←9	6.9		17.7	7.9	67.2		SD,SL/DOL
141	1578.0-79.0	15.0		16.6	9.9	63.5		SD,SL/DOL
142	1579.0-80.0	29.0		18.4	8.8	64.1		SD,SL/DOL
143	1580.0-81.0	33.0		17.6	7.9	67.0		SD,SL/DOL
144	1581.0-82.0	16.0		18.8	7.3	69.8		SD,SL/DOL
145	1582.0-83.0	23.0		17.8	7.8	66.3		SD,SL/DOL
146	1583.0-84.0	74.0		18.3	4.4	74.0		SD,SL/DOL
147	1584.0-85.0	39.0	30	20.7	7.5	62.5		SD,SL/DOL
148	1585.0-86.0	31.0		20.8	3.9	77.6		SD,SL/DOL
149	1586.0-87.0	35.0		19.0	7.2	63.3		SD,SL/DOL
150	1587.0-88.0	26.0		19.8	8.0	62.1		SD,SL/DOL
151	1588.0-89.0	96.0		17.6	3.2	66.0		SD,SL/DOL
152	1589.0-90.0	115.0		20.2	5.1	72.3		SD,SL/DOL
153	1590.0-91.0	135.0		20.9	4.8	70.0		SD,SL/DOL
154	1591.0-92.0	183.0		22.0	4.5	60.4		SD,SL/DOL
155	1592.0-93.0 ←10	73	64	17.9	16.0	53.7		SD,SL/DOL
156	1593.0-94.0	0.27	0.03	16.0	6.6	53.2		SD,SL/DOL
157	1594.0-95.0	0.05		8.3	3.0	87.7		SD,SLTY,DOL,SH LAM
	1595.0-05.0							SH,SD STKS,SLTY SH
	1605.0-1610.0	LOST CORE						

WILLIAM BERRYHILL NO. 139-P

(797 FWL, 2058 FSL) NE/4, SEC. 17, T.17N, R.12E

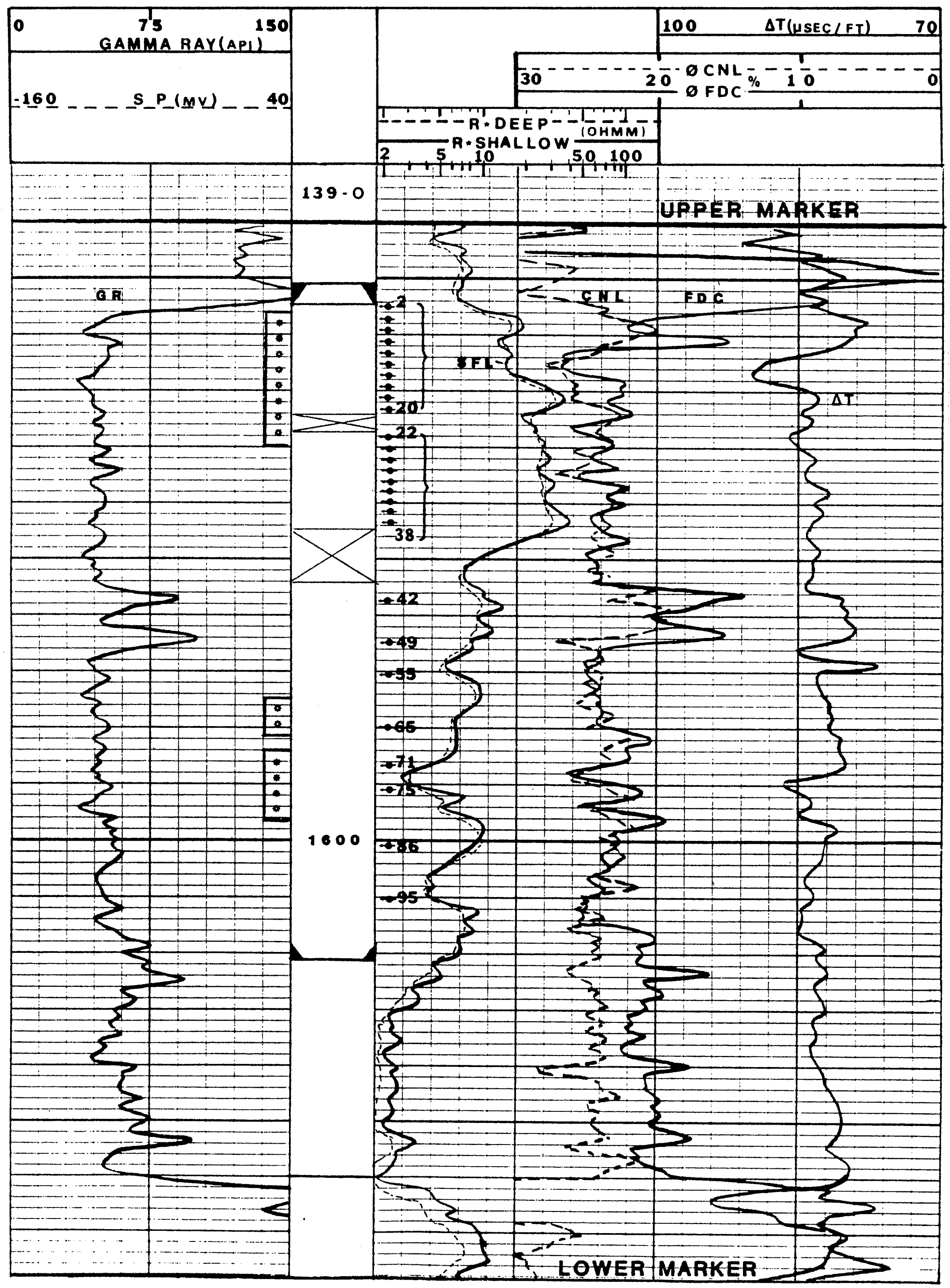


Figure 145. Well-log Signatures, Glenn Sandstone, William Berryhill No. 139-P

William Berryhill No. 139-P
(797 FWL, 2058 FSL, NE/4, Sec. 17)

Cored Interval: 1501.0 - 1616.0 ft. (Upper and Middle Glenn)
Correlation: Core less than one foot shallow to log, approx. three to four feet shallow near base of cored interval.
Note: Core not available, general description made from color photographs of whole core (Core Laboratories).

Core Depth (Ft.)	Core Description
1501.0 - 04.0	intbd/intlam ss/sh; dk gy - lt gy, abrupt ctc ◇ 03.6 ft. (5 cm sh, slty, v f lam) incrg carb mat to 04.0 ft.
	Upper Glenn
1504.0 - 09.3	ss; brn, few sh rip-up clasts ◇ 05.5 ft., flow strucs, general mot apr, incrg slt near base w/ s sc sed strucs, abrupt trans w/ calc cmt ss ◇ 09.3 ft.
09.3 - 09.6	ss; lt gy - buff, apr mas bdg, w calc cmt (aprox 12 cm thick), abrupt trans abv & blw
09.6 - 24.0	ss; brn - dk by, apr mas bdg, abnt carb fils, v f carb lam near base, brd in part, friable
24.0 - 27.0	core missing
27.0 - 28.0	ss; brn - dk gy - lt gy, v f carb sh ptgs, th (3 cm) intlam sltst/sh (lt gy - gy) ◇ 27.8 ft., abrupt ctc abv & blw, incrg carb mat to 28.0 ft., apr scour surf
28.0 - 30.0	ss; brn - dk gy, apr mas bdg near top, apr incld bdg near base, incrg carb lam & slt near basal ctc w/ th (5 cm) lt gy sh, abrupt ctc w/ ss blw
30.0 - 44.0	ss; brn - gy, apr mas bdg, sev th carb ptgs & sltst ptgs (ie. 35.8 ft., 37.3 ft.), brk near base
44.0 - 54.0	core missing

54.0 - 55.2	intlam ss/sh; lt gy - dk gy, g ireg hztl lam, conv bdg, bur?, v abrupt ctc w/ ss ◇ 55.2 ft.
55.2 - 56.95	ss; dk brn, heavy o. stn, abnt carb lams (ripple lams?), abrupt ctc w/ intlam ss/sh as abv.
56.95 - 57.4	intlam ss/sh; lt gy - dk gy - blk, f irreg hztl lam, incr carb mat, sl flaser struc, abruptly grdg into ss blw
57.4 - 60.5	ss; brn, apr mas bdg, incr v f slty ptgs ◇ 59.5 - 60.0 ft., abrupt ctc ◇ 60.5 ft.
60.5 - 60.8	sltst/sh; lt gy-gy, th (9 cm) apr bur, conv bdg, abrupt ctc w/ ss blw
60.8 - 62.5	ss/sh; brn - gy - blk, abnt carb & slty lams, apr flow, soft sed deform, grdg downw into sh (blk - dk gy) f intlam of slt, abrupt ctc blw w/ ss; carb lam, mot
	<u>Middle Glenn</u>
62.5 - 64.0	ss; brn - blk, f, th carb shly lams ◇ 63.5 ft., grdg downw to an apr mas ss
64.0 - 1614.5	ss; brn - lt brn, apr mas bdg, abnt carb fils, v few th carb ptgs (ie. 1609.8 - 10.1 ft.), one elg sh clast ◇ 1603.5 ft., incrg carb mat ◇ 1614.0 ft., abrupt ireg ctc ◇ 1614.5 ft.
1614.5 - 15.1	ss/sh; lt brn - blk, abnt sh rip-up clasts, apr zone of mixing, abnt carb mat incrg downw to 15.1 ft.
15.1 - 16.1	ss; brn, apr mas bdg, sl incld carb ptg ◇ 15.5 ft.

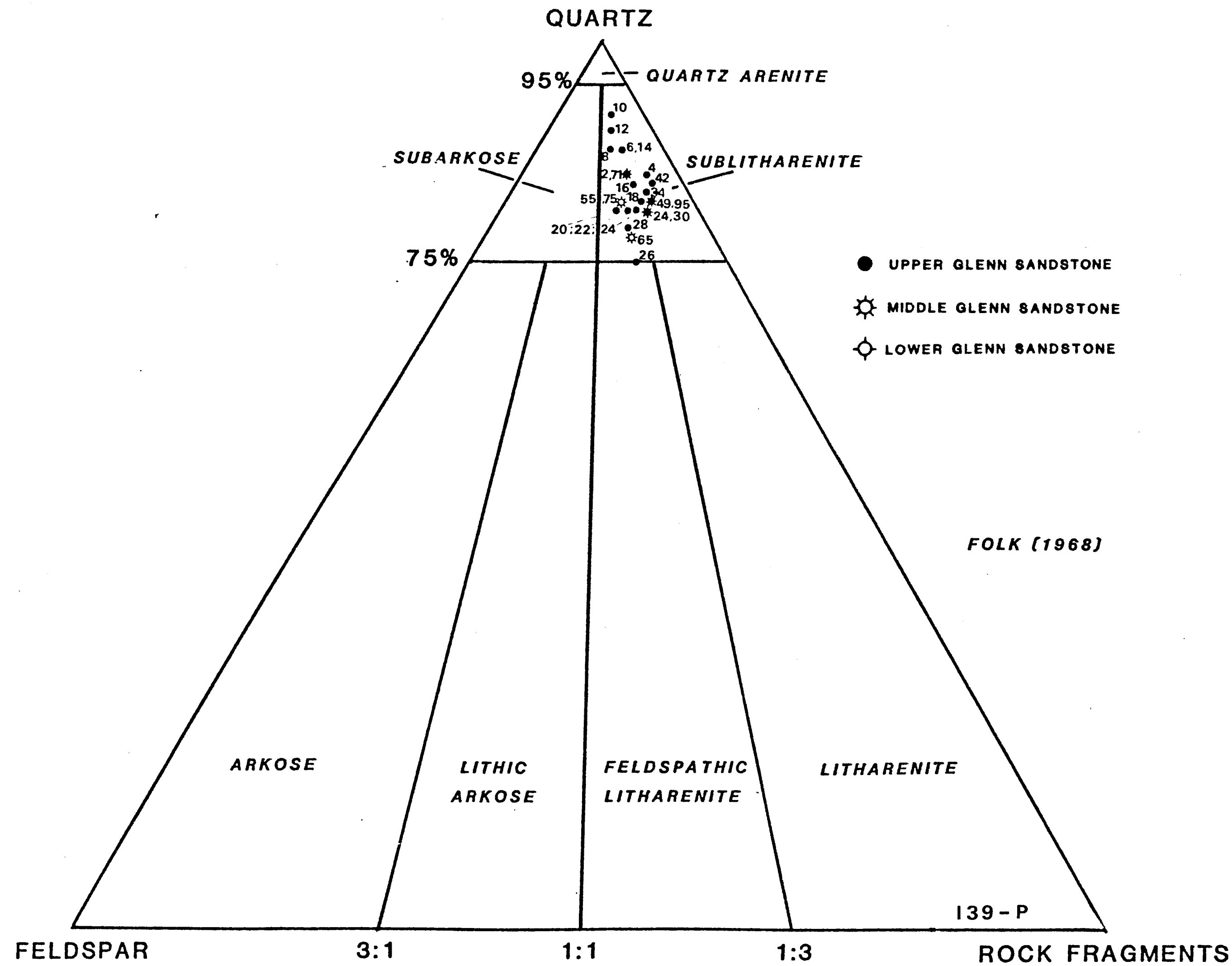


Figure 146. Ternary Diagram Depicting Composition and Classification of Sample of Glenn Sandstone, William Berryhill No. 139-P

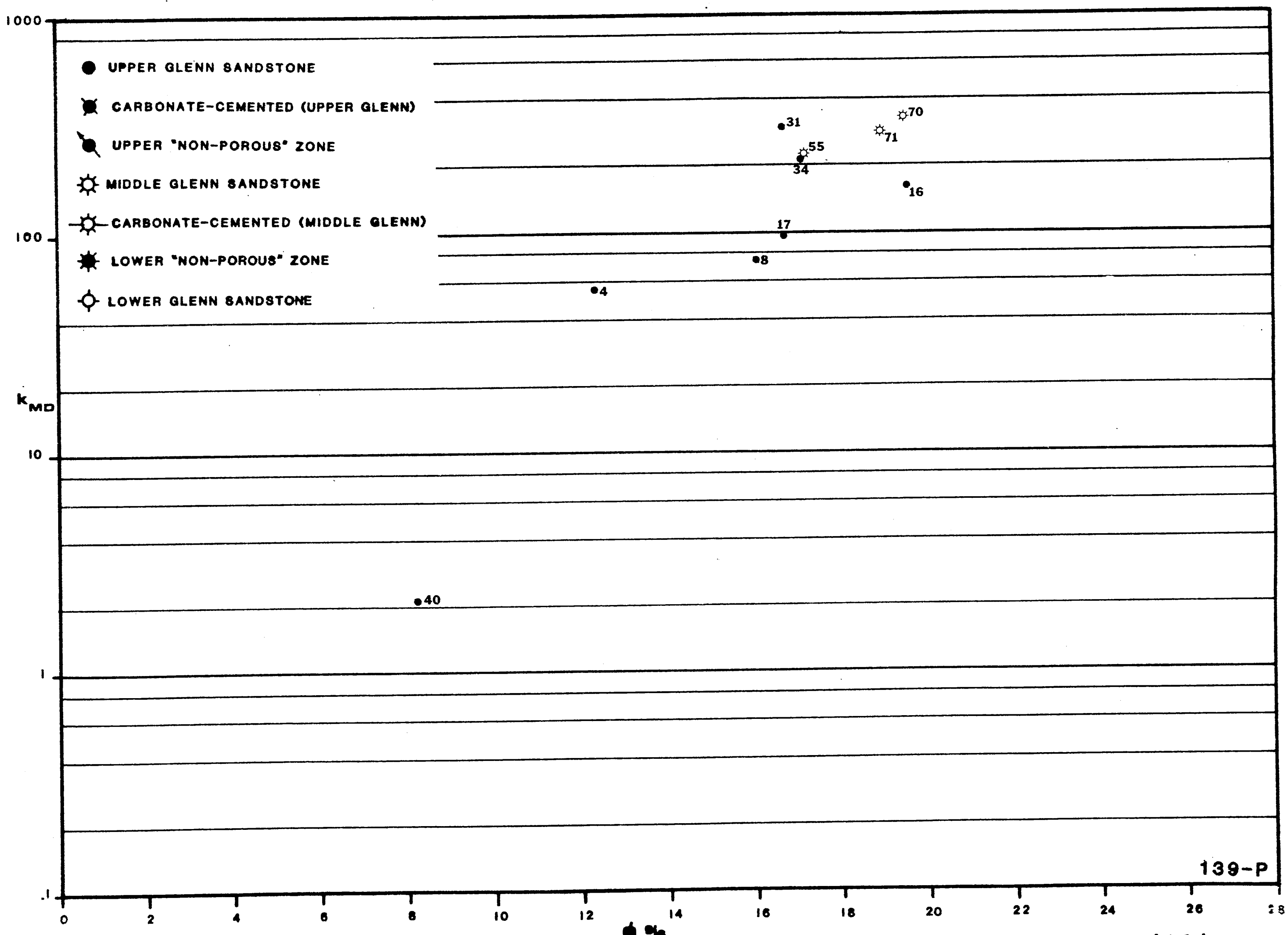


Figure 147. Porosity Compared to Permeability, Glenn Sandstone, William Berryhill No. 139-P

TABLE XXII

GULF OIL EXPLORATION AND PRODUCTION COMPANY
WILLIAM BERRYHILL NO. 139-P
CORE ANALYSIS

IDENTIFICATION AND LITHOLOGICAL DESCRIPTION OF SAMPLES

GULF OIL EXPL. AND PROD. CO.
BARTLESVILLE SAND FORMATION
CREEK COUNTY, OKLAHOMA

BERRYHILL NO. 139 WELL
GLENPOOL FIELD

Sample Identification	Depth, feet	Lithological Description
4	1506-07	Ss: lt gry, w ind, f gr, w srtd
8	1510-11	Ss: lt gry, w ind, m gr, w srtd, sl lmy
16	1518-19	Ss: lt gry, w ind m to crs gr, w srtd, sl lmy
17	1519-20	Ss: lt gry, w ind, m to crs gr, w srtd, sl lmy
31	1536-37	Ss: lt gry, w ind, m gr, w srtd
34	1539-40	Ss: lt gry, w ind, m gr, w srtd
40	1555-56	Ss: lt gry, w ind, f gr, mod srtd, mica, lig strks
55	1570-71	Ss: lt gry, w ind, m gr, w srtd
70	1585-86	Ss: lt gry, w ind, m gr, w srtd
71	1586-87	Ss: lt gry, w ind, m to f gr, w srtd

Sample Identification:	4	8	16	17	31
Depth, feet:	1506.0	1510.0	1518.0	1519.0	1536.0
Permeability to Air, md:	56	77	169	97	313
Porosity, percent:	16.4	20.2	23.7	20.8	20.8

Sample Identification:	34	40	55	70	71
Depth, feet:	1539.0	1555.0	1570.0	1585.0	1586.0
Permeability to Air, md:	219	2.0	235	361	302
Porosity, percent:	21.2	12.2	21.3	23.7	23.1

APPENDIX C

CUMULATIVE WELL AND SAMPLE INFORMATION

TABLE XXIII

GULF OIL EXPLORATION AND PRODUCTION COMPANY, WILLIAM BERRYHILL UNIT, LOCATIONS OF WELLS AND RESPECTIVE LOG SURVEYS

Well No.	Location		Log Surveys				
	FWL	FSL	DIL	CNL-CDL	FDC	BCS	OTHER
74-I	1100	1780	X	X		X	X
75-P	640	2290	X	X		X	X
76-I	1076	2207	X				X
77-I	690	1740	X	X			X
78-P	376	2390	X	X			X
79-P	1310	2440	X	X			X
80-P	376	1506	X	X			X
81-P	1260	1556	X	X			X
82-P	830	2400	X	X	X		X
83-P	1222	1973	X	X			X
84-P	843	1973	X				X
85-P	865	1565	X	X			X
86-P	376	1943		X			X
87-P	336	1134	X	X			X
88-P	803	1134	X	X			X
89-P	1270	1134	X	X			X
90-I	570	900	X	X			X
91-I	1037	900	X	X			X
92-P	336	667	X	X			X
93-P	803	667	X	X			X
94-P	1270	667	X	X			X
95-I	570	433	X	X			X
96-I	425	1050	X	X			X
97-P	336	200	X	X			X
98-P	802	200	X	X			X
99-P	1270	200	X	X			X
100-O	400	2415	X	X			
101-O	425	2360	X	X			X
102-P	725	2190	X	X			
103-I	475	1350	X	X			
104-O	750	2116	X	X			
105-P	1698	2475	X		X	X	X
106-I	1504	2233	X	X	X	X	
107-P	2087	2475	X		X	X	
108-I	1893	2244	X	X		X	
109-P	2475	2454	X	X		X	
110-I	2281	2244	X		X	X	X
111-P	1698	2064	X	X		X	X
112-I	1505	1778	X		X	X	X
113-P	2087	2059	X		X	X	
114-I	1885	1782	X		X	X	
115-P	2475	2059	X		X	X	
116-I	2281	1782	X	X			X
117-P	1698	1551	X		X	X	X

TABLE XXIII (Continued)

Well No.	Location		Log Surveys				
	FWL	FSL	DIL	CNL-CDL	FDC	BCS	OTHER
118-I	1484	1323	X		X	X	
119-P	2087	1551	X		X	X	X
120-I	1893	1320	X	X			
121-P	2275	1551	X		X	X	X
122-I	2281	1304	X		X	X	X
123-P	1671	1099	X		X	X	X
124-I	1470	862	X	X		X	
125-P	2073	1099	X		X	X	X
126-I	1893	858	X		X	X	X
127-P	2275	1099	X		X	X	X
128-I	2108	755	X		X	X	X
129-P	1671	627	X		X	X	X
130-I	1470	407	X		X	X	X
131-P	2073	627	X	X			
132-I	1893	396	X		X	X	X
133-P	2475	627	X		X	X	
134-I	2281	396	X		X	X	
135-P	1671	165	X	X		X	X
136-P	2073	165	X		X	X	
137-P	2425	171	X	X		X	X
138-I	1052	1358	X	X		X	
139-P	797	2058	X	X		X	
140-O	1555	2186	X	X			Cyberlook, EPT
141-O	1538	1840	X	X			Cyberlook, EPT
38-W	545	533					E-Log

TABLE XXIV

GULF OIL EXPLORATION AND PRODUCTION COMPANY, WILLIAM BERRYHILL UNIT, WELL-LOG INFORMATION FOR CORED WELLS

WELL No.	BIT in.	FLUID	DEN gm/cc	VIS sec/qt	PH	Q ml/30min	Rm	Rmf	Rmc	BHT o F	Rm @ BHT
							-----(OHMM)-----				
74	8 3/4	chem	10	42	9.0	9.6	2.33 @ 72	1.83 @ 77	2.95 @ 78	95	1.77
79	8 3/4	fgm	9.1	41	7.0	14.2	2.80 @ 58	1.70 @ 64	2.95 @ 59	82	1.98
96	8 3/4	chem	10	55	9.0	10.4	.28 @ 67	.12 @ 71	- -	93	.20
100	8 3/4	chem	12	45	12.0	12.2	.68 @ 51	.39 @ 62	.69 @ 67	90	.39
101	7 7/8	chem	9.7	46	10.5	6.8	1.46 @ 68	1.18 @ 68	1.46 @ 71	92	1.08
103	8 3/4	chem	9.5	60	9.0	9.6	.24 @ 76	.20 @ 76	.35 @ 76	91	.18
104	7 7/8	chem	9.5	43	9.5	10.4	3.72 @ 66	2.83 @ 64	- -	99	2.59
109	8 3/4	disp	9.1	37	9.5	30.0	.32 @ 70	.25 @ 70	.33 @ 70	87	.26
111	8 3/4	fgm	9.2	61	11.0	4.8	1.08 @ 86	.92 @ 86	.97 @ 86	88	1.06
116	7 7/8	fgm	9.2	62	11.0	8.8	1.60 @ 85	1.41 @ 85	2.40 @ 85	102	1.35
120	7 7/8	disp	9.4	65	9.5	8.2	1.55 @ 96	1.34 @ 96	1.35 @ 96	103	1.45
124	7 7/8	fgm	9.2	37	11.0	10.1	1.40 @ 87	1.22 @ 87	1.21 @ 87	90	1.35
131	8 3/4	fgm	9.3	85	9.4	9.4	1.66 @ 90	1.46 @ 90	1.42 @ 90	88	1.69

TABLE XXIV (Continued)

WELL No.	BIT in.	FLUID	DEN gm/cc	VIS sec/qt	PH	Q ml/30min	Rm	Rmf	Rmc	BHT o F	Rm @ BHT
							------(OHMM)----				
134	7 7/8	fgm	9.1	70	10.0	14.8	1.88 @ 84	1.67 @ 84	1.58 @ 84	95	1.68
135	8 3/4	fgm	9.4	60	10.0	8.1	2.33 @ 95	2.10 @ 95	1.91 @ 95	109	2.05
137	8 3/4	fgm	9.2	85	9.8	6.5	1.17 @ 82	1.01 @ 82	1.04 @ 82	91	1.06
138	7 7/8	chem	9.0	50	10.0	11.8	.86 @ 70	.67 @ 68	1.20 @ 70	86	.70
139	7 7/8	kcl	9.1	49	9.5	4.8	.17 @ 60	.13 @ 60	.310 @ 60	99	.11

APPENDIX D

MAPS AND CROSS-SECTIONS

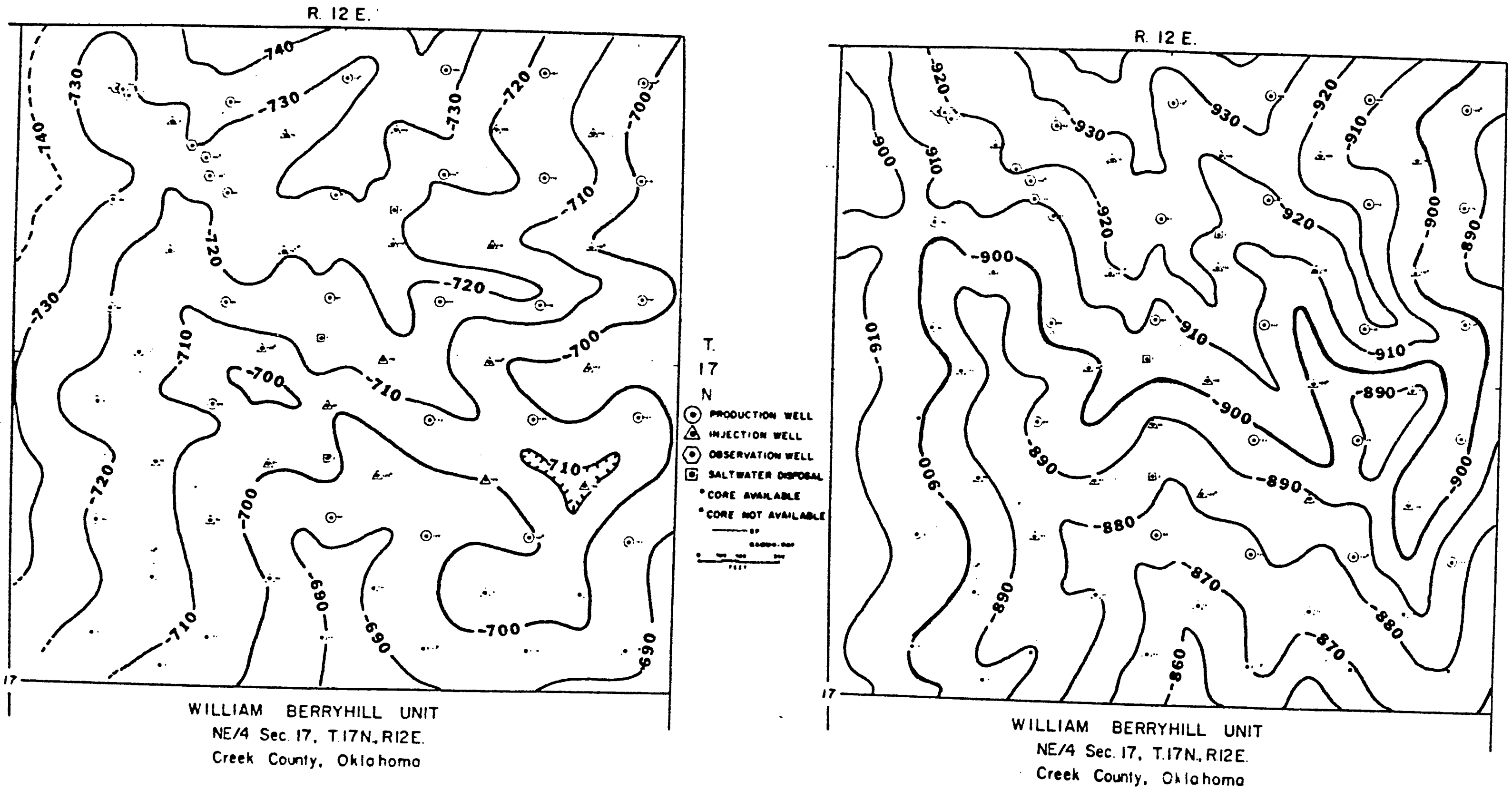


Figure 148. Structural Contour Maps: (A) Upper Marker, C.I. = 10 Ft., (B) Lower Marker, C.I. = 10 Ft., William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

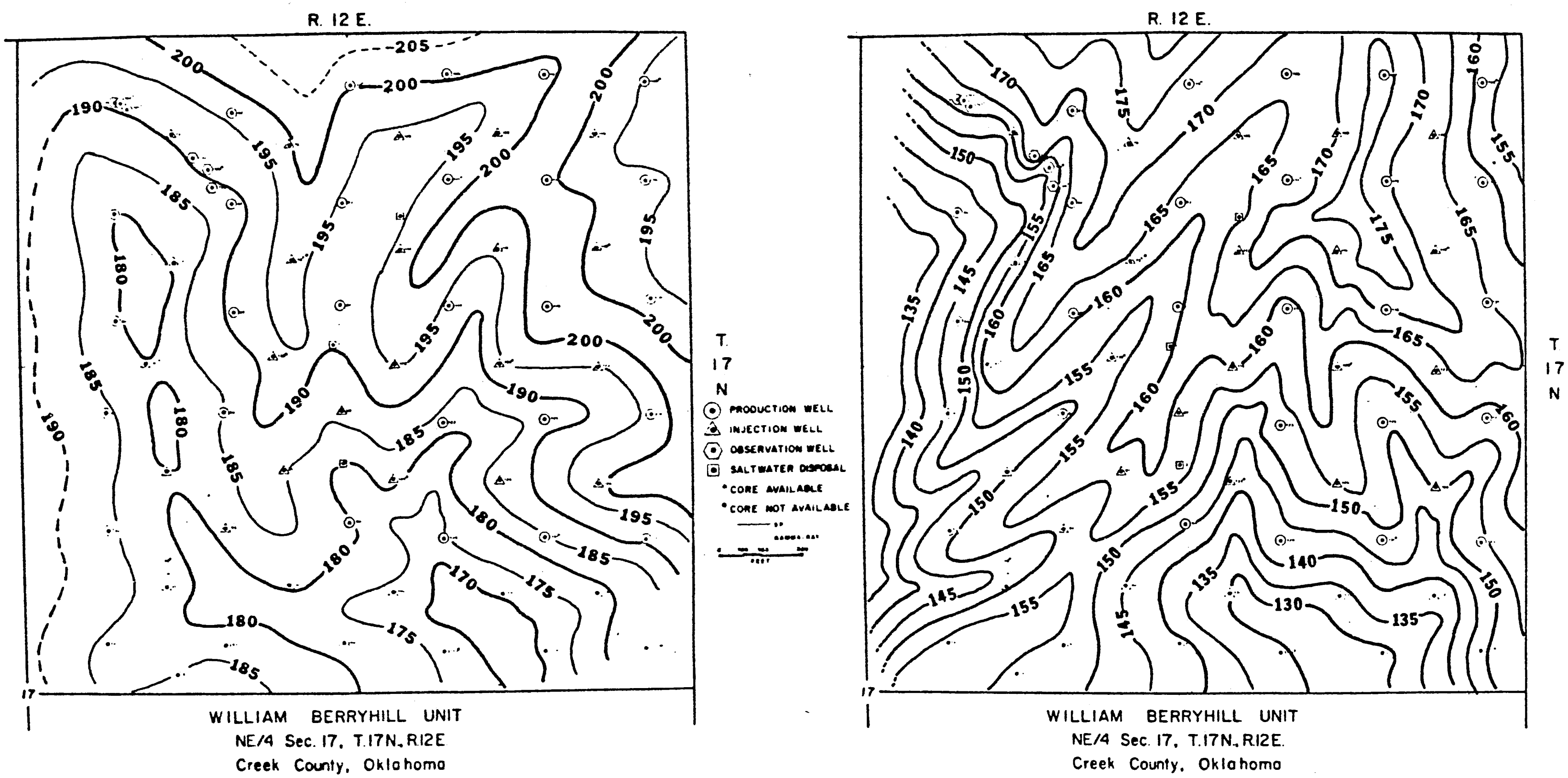


Figure 149. Isopach Maps: (A) Base of Upper Marker to Top of Lower Marker, C.I. = 5 Ft., (B) Glenn Sandstone, C.I. = 5 Ft., William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

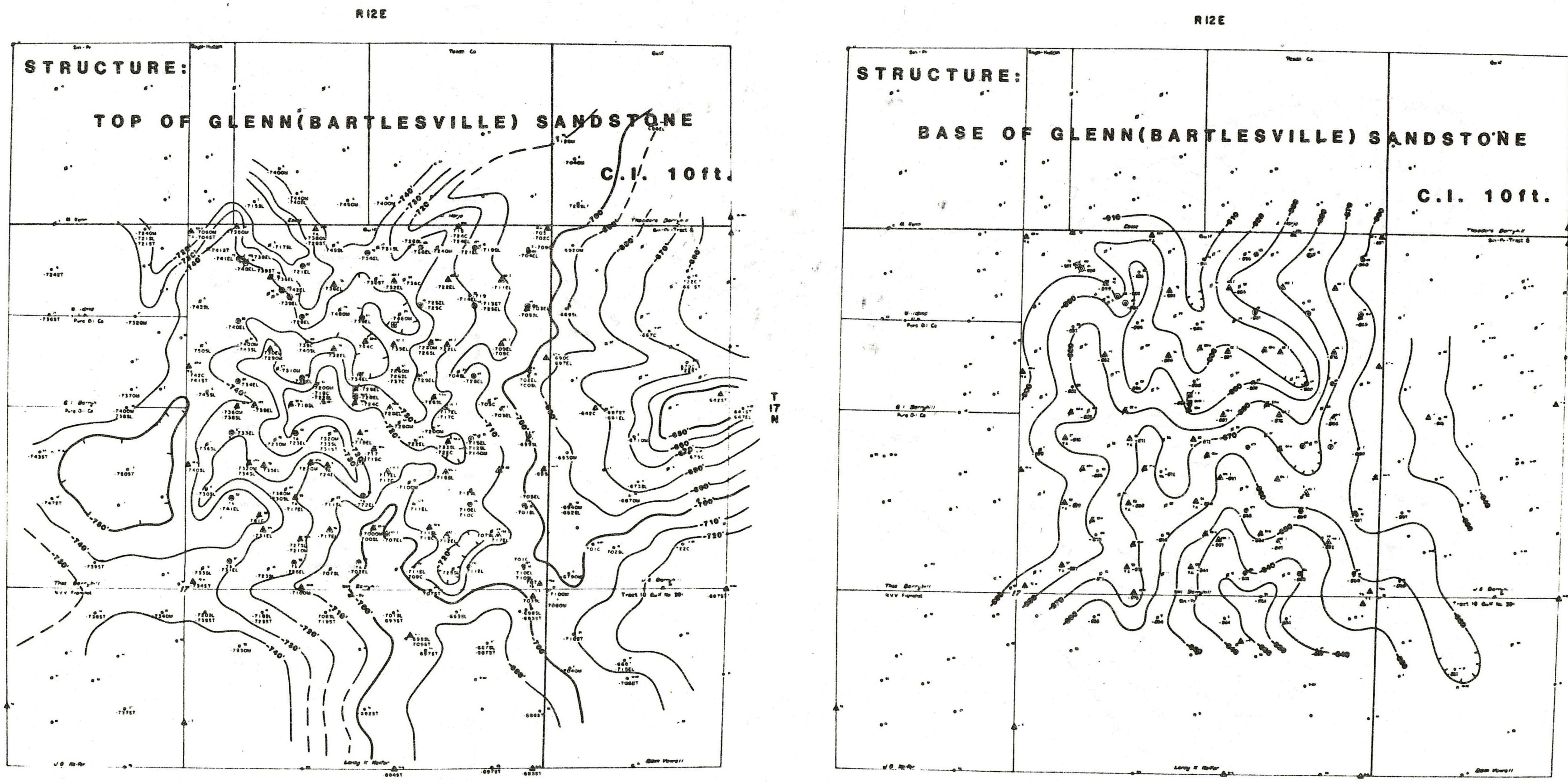


Figure 150. Structural Contour Maps: (A) Top of Glenn Sandstone, C.I. = 10 Ft., (B) Base of Glenn Sandstone, C.I. = 10 Ft., William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma (from Gulf Exploration and Production Company)

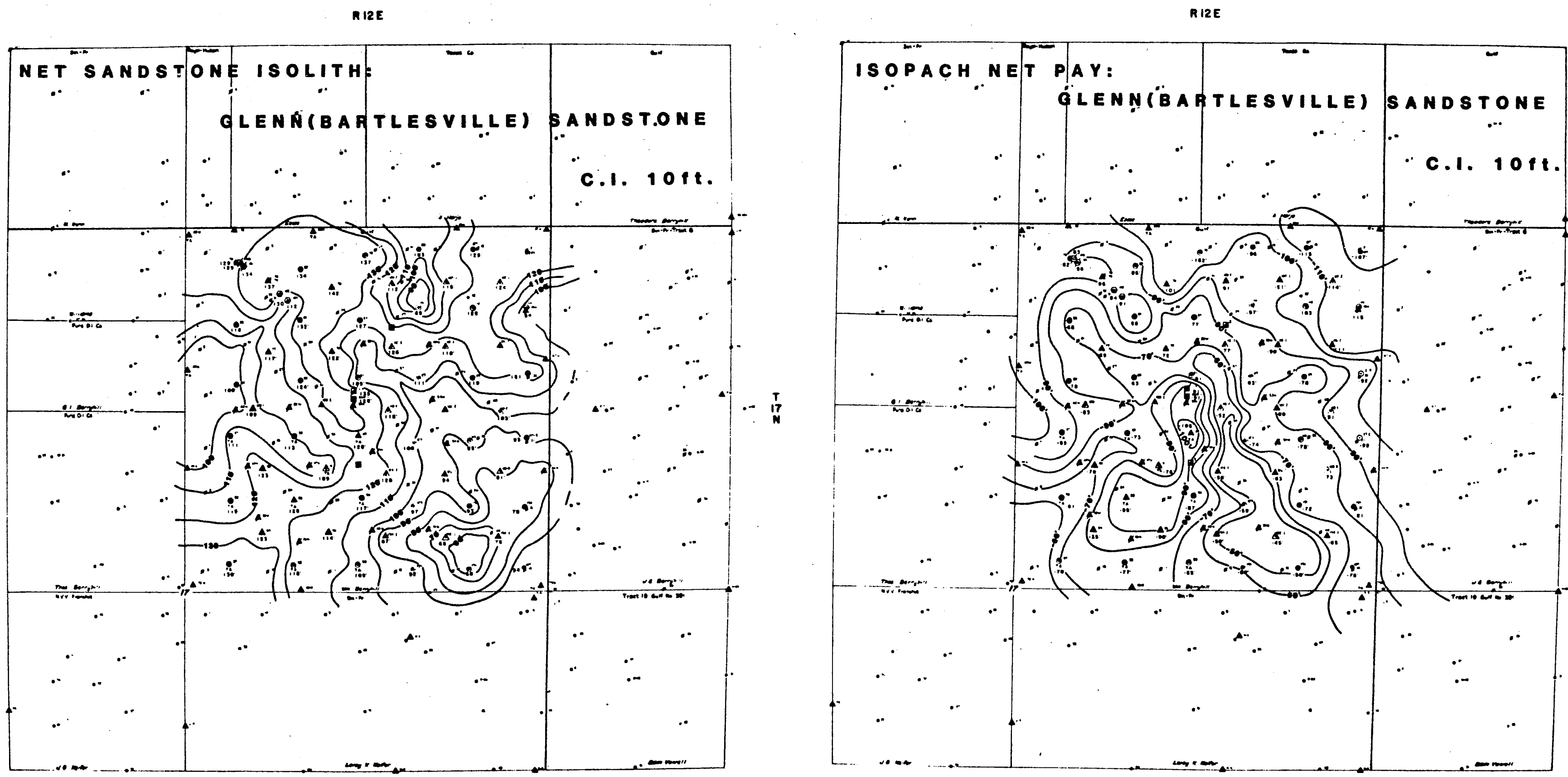


Figure 151. Isopach Maps: (A) Net Sandstone Isolith - Glenn Sandstone, C.I. = 10 Ft., (B) Net Pay Isopach - Glenn Sandstone, C.I. = 10 Ft., William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma, (from Gulf Exploration and Production Company)

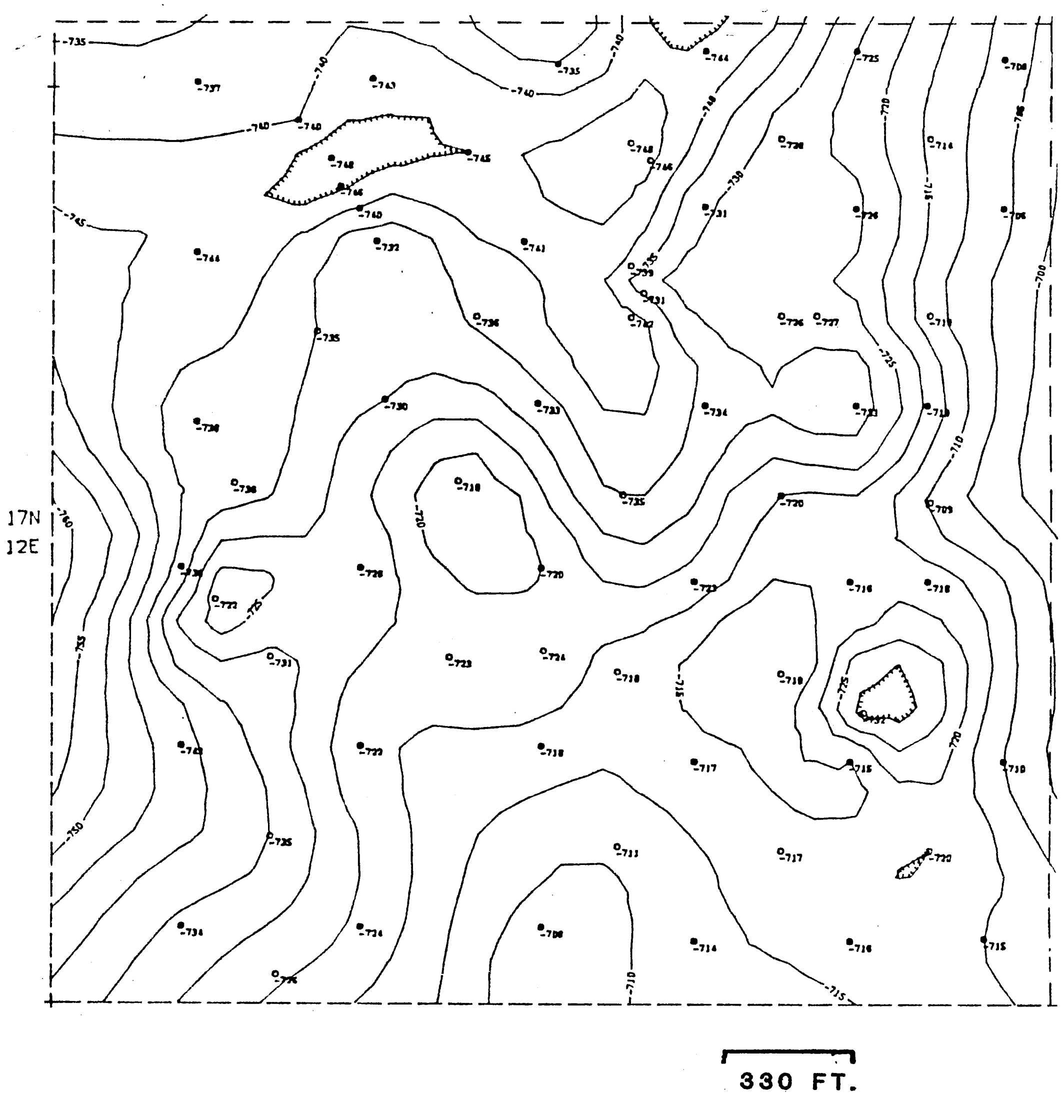


Figure 152. Computer-generated Structural Contour Map: Top of Glenn Sandstone, C.I. = 5 Ft., William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

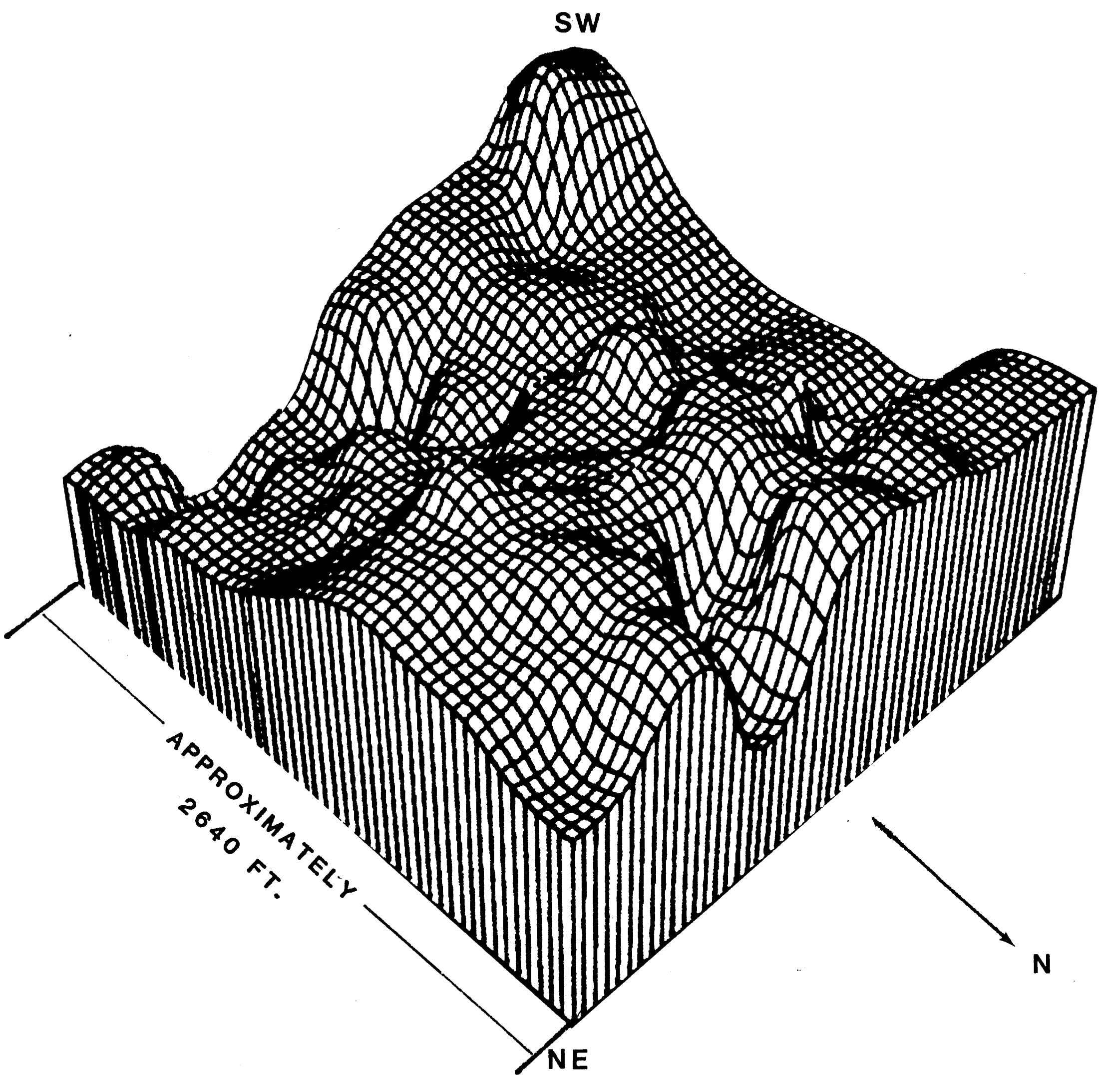


Figure 153. Computer-generated 3-D Isopach Map: Glenn Sandstone, William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma (Note: Perspective is from NE to SW)

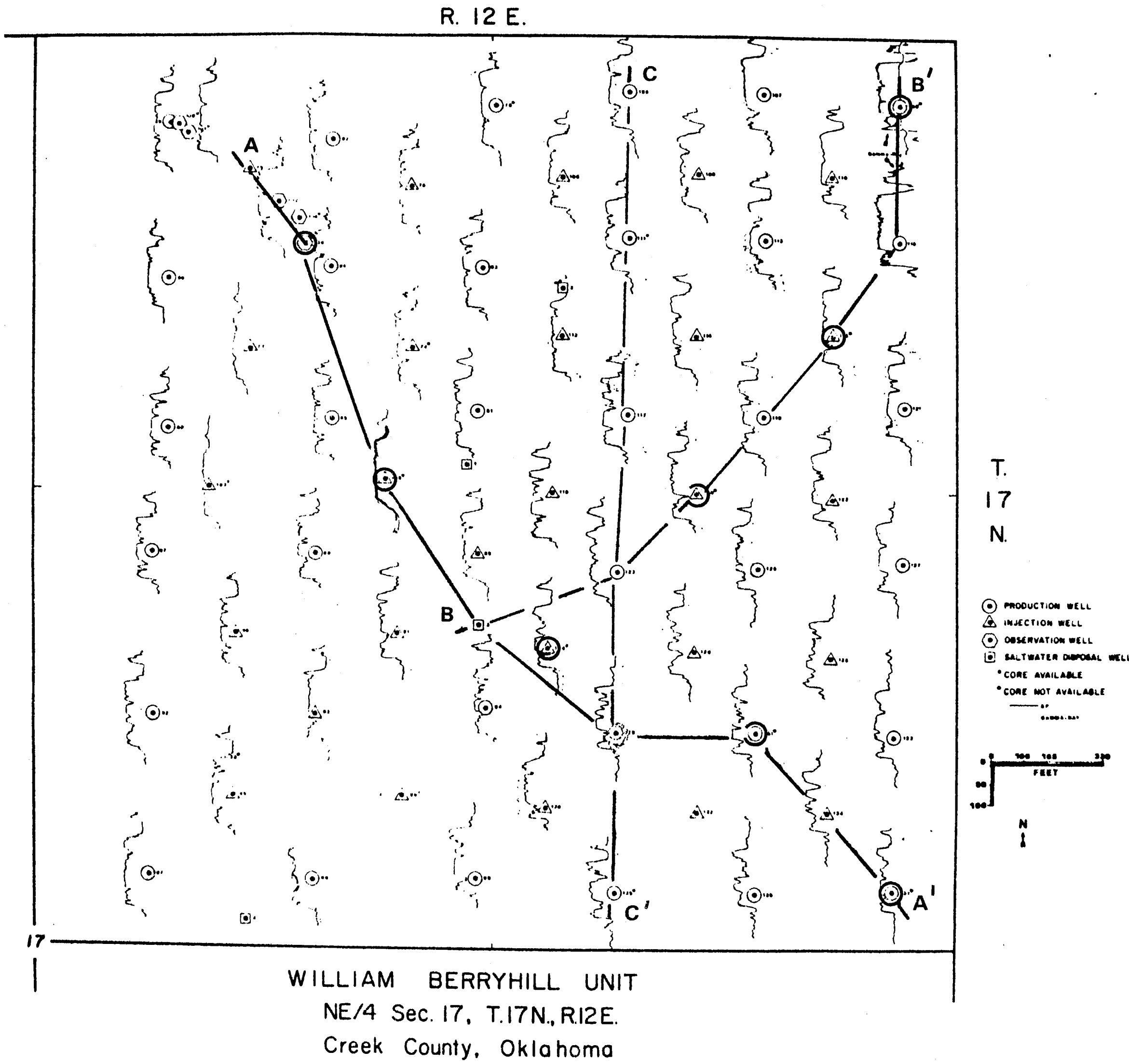


Figure 154. Locations of Interval Transit Time Cross-sections (A-A', B-B', and C-C'), William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

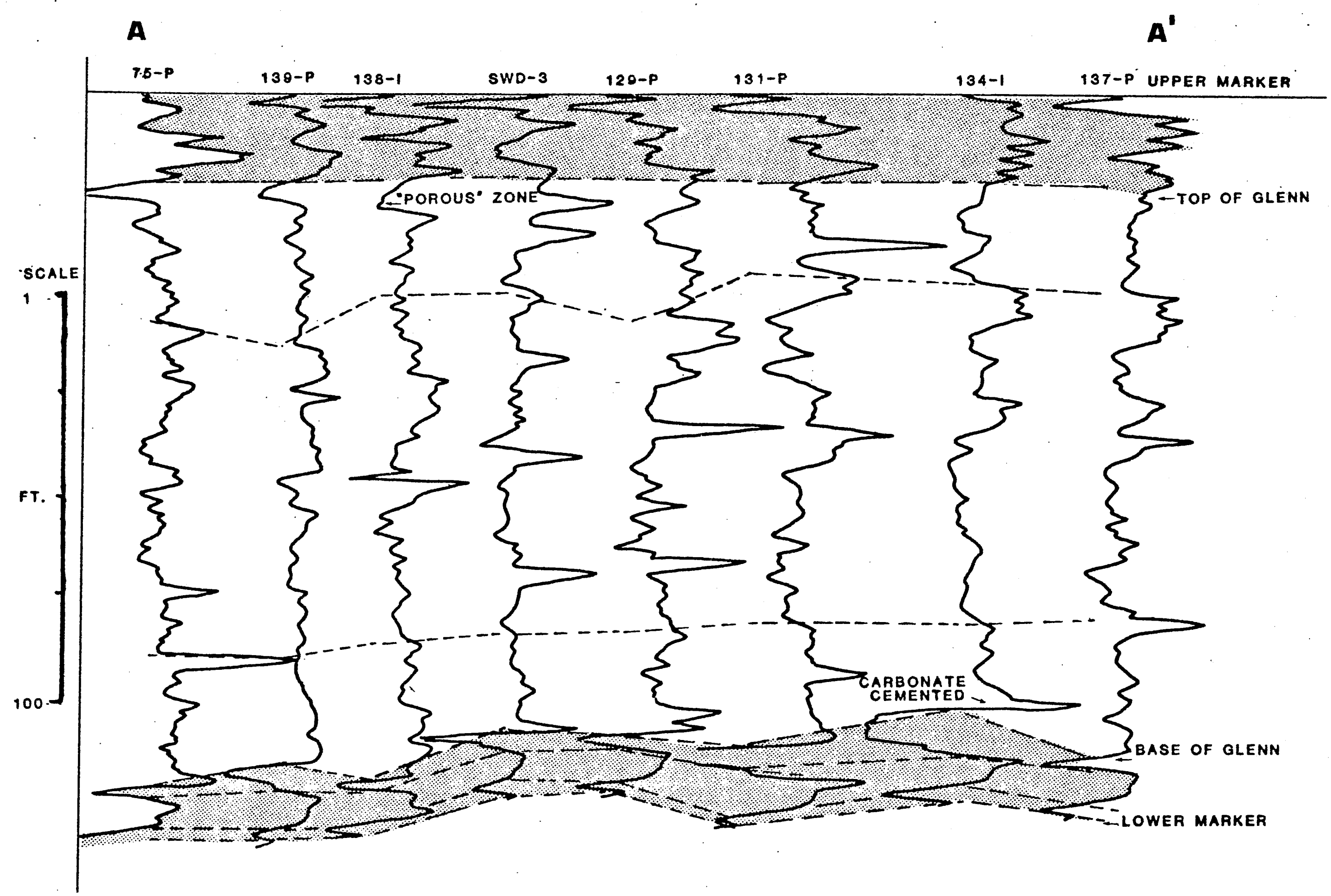


Figure 155. Interval Transit Time "Stacked" Cross-section: (A-A'), Glenn Sandstone, William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

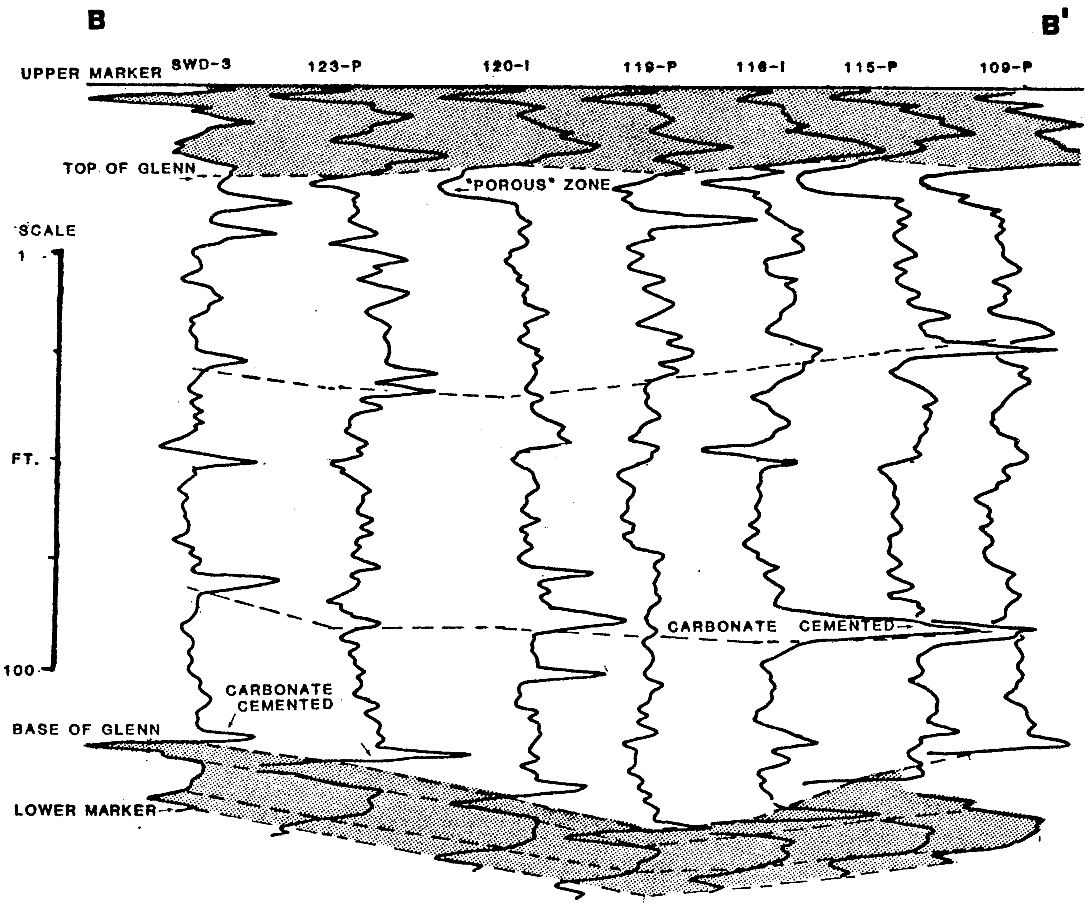


Figure 156. Interval Transit Time "Stacked" Cross-section: (B-B'). Glenn Sandstone, William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

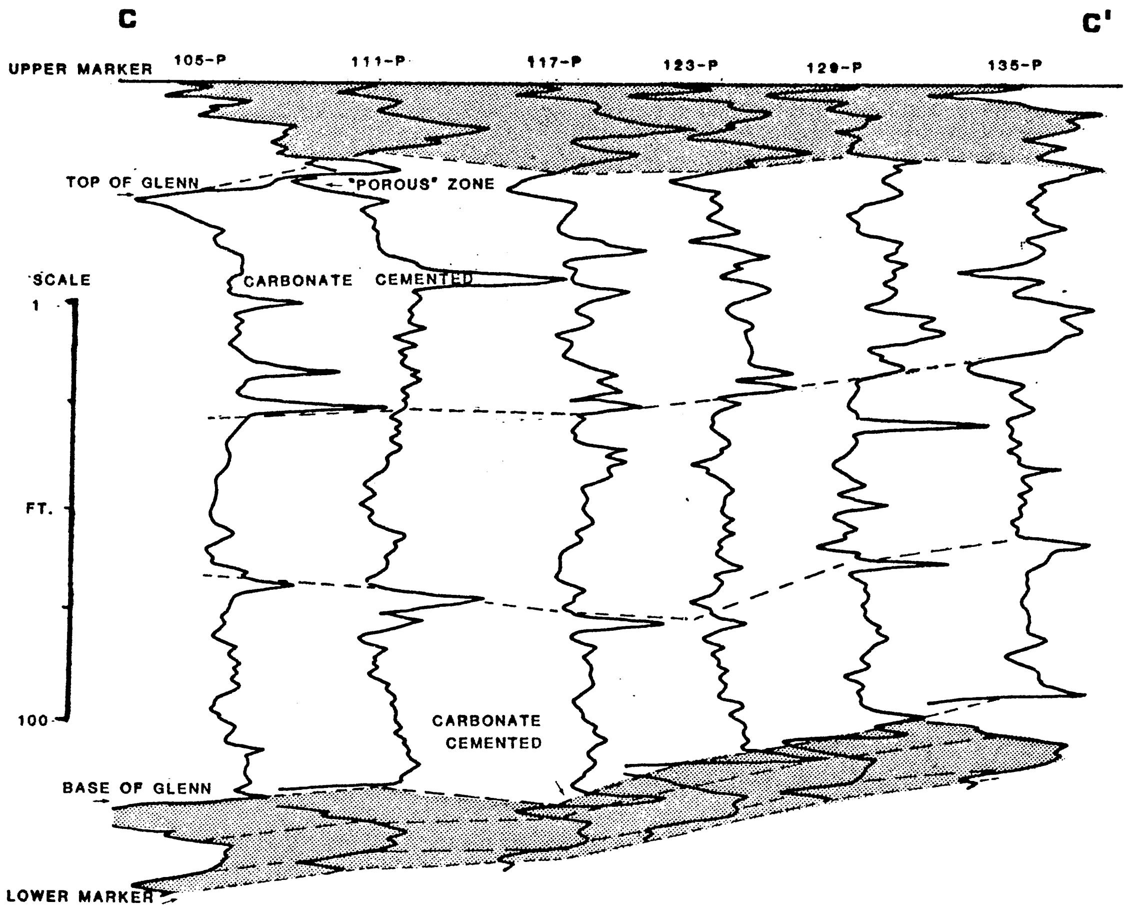


Figure 157. Interval Transit Time "Stacked" Cross-section: (C-C'), Glenn Sandstone, William Berryhill Unit, NE/4, Sec. 17, T.17N, R.12E, Creek Co., Oklahoma

APPENDIX E

RESERVOIR CHARACTERISTICS

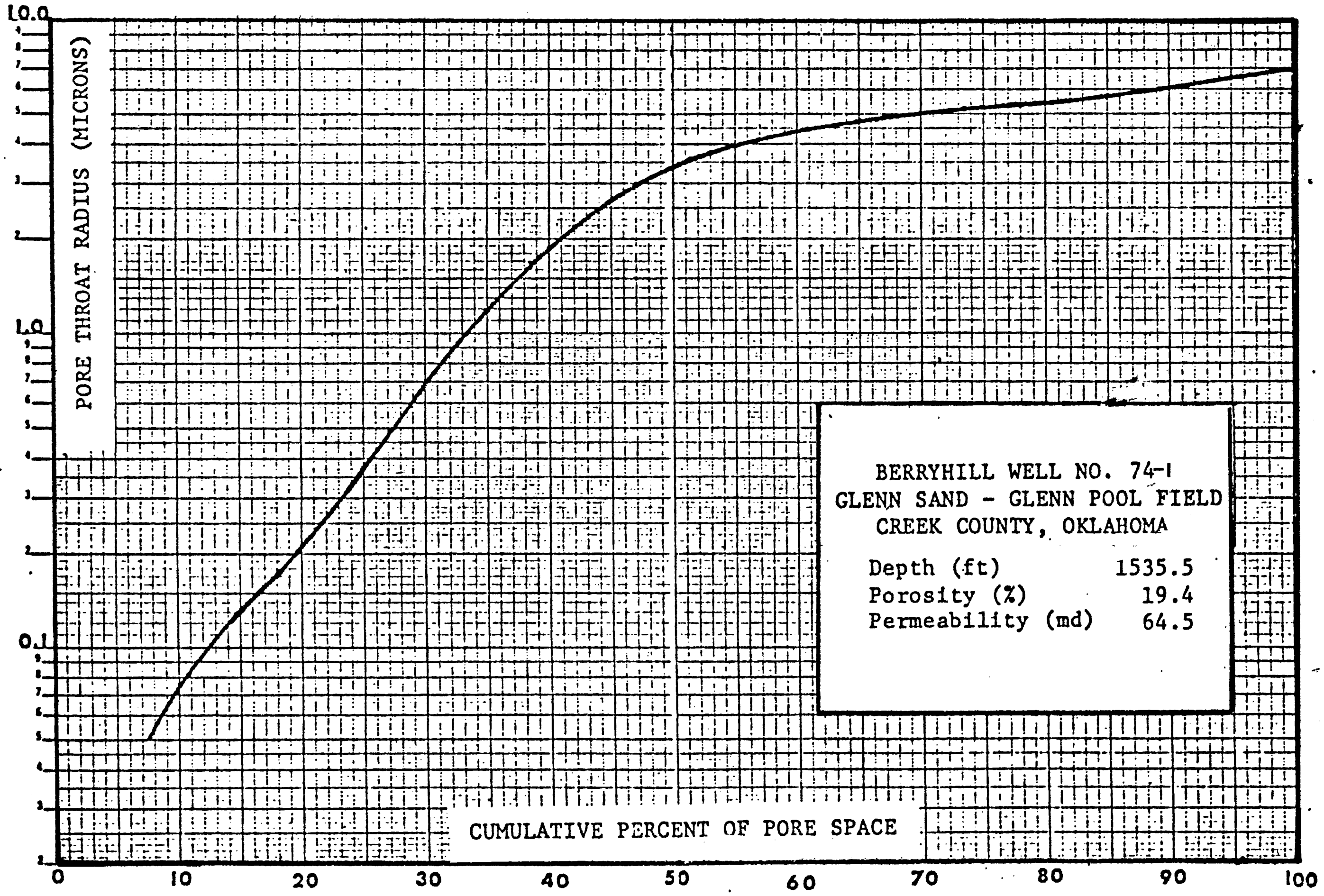


Figure 158. Pore-throat Radius Compared to Cumulative Percent of Pore Space, Glenn Sandstone, William Berryhill No. 74-I, (Courtesy of Gulf Oil Exploration and Production Company)

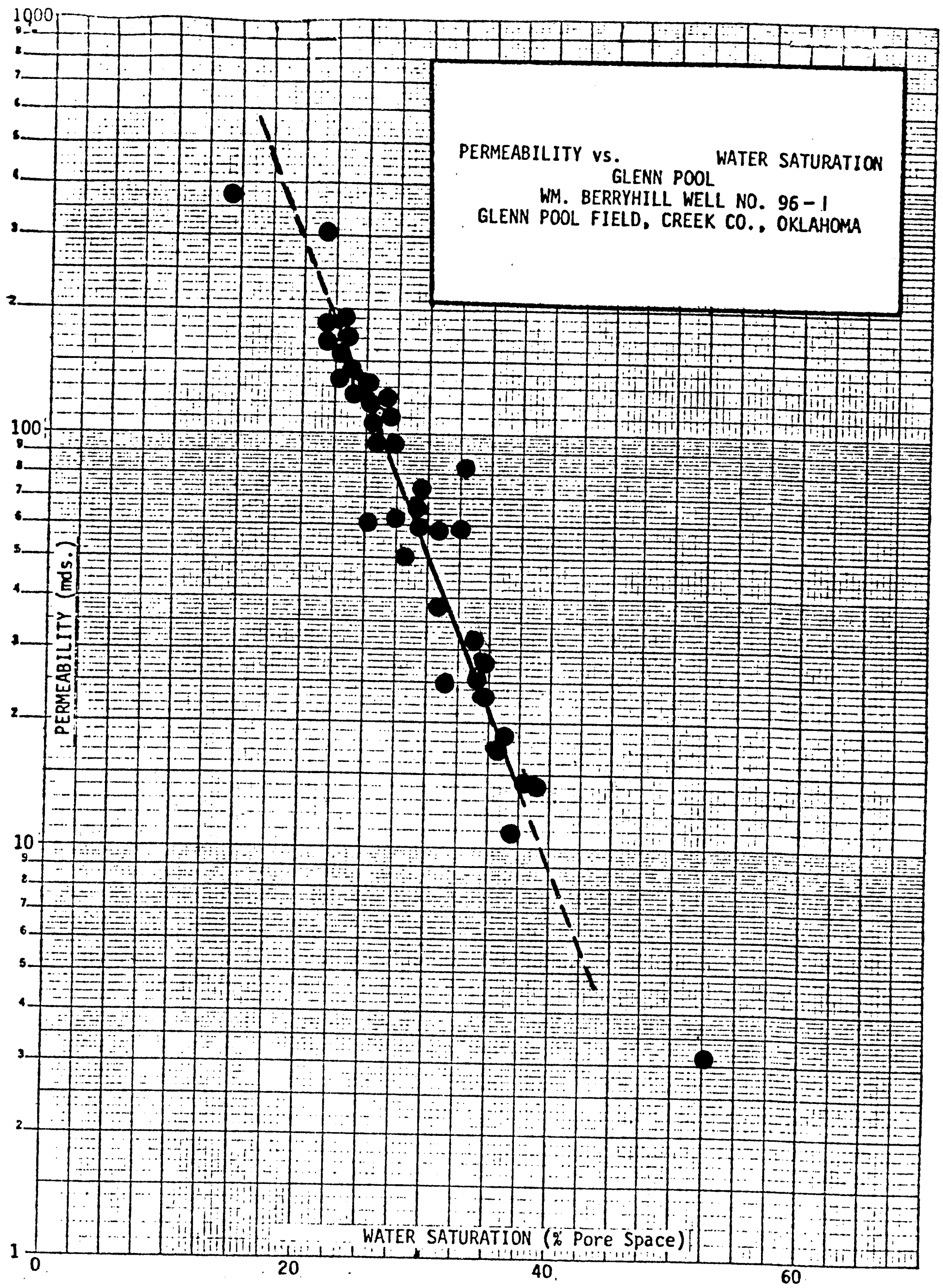


Figure 159. Permeability Compared to Water Saturation, Glenn Sandstone, William Berryhill No. 96-I, (Courtesy of Gulf Oil Exporation and Production Company)

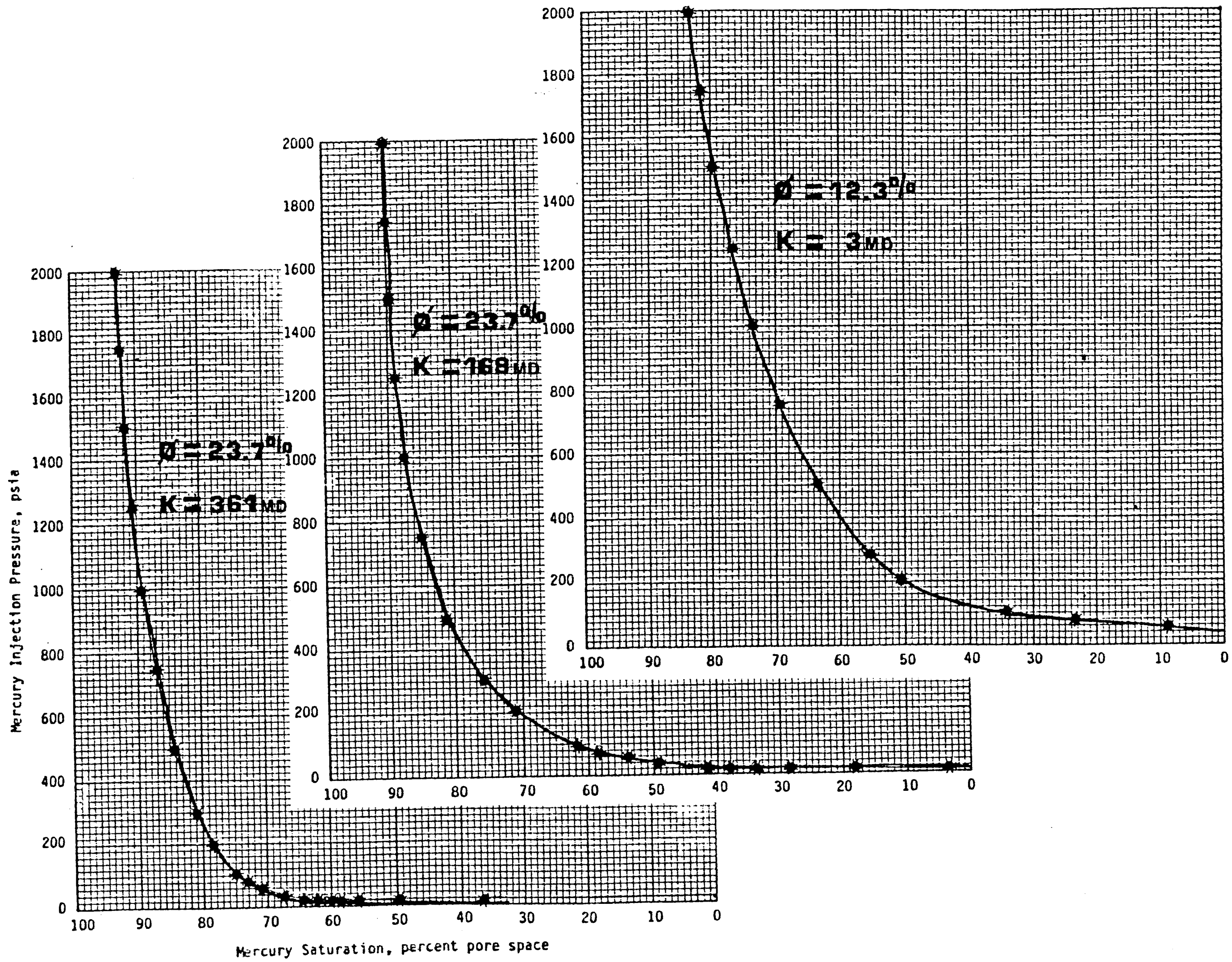


Figure 160. Mercury-injection Capillary-pressure Curves, Glenn Sandstone, William Berryhill Unit, (Courtesy of Gulf Oil Exploration and Production Company)

COMPUTED
RELATIVE PERMEABILITY — SATURATION RELATIONSHIP

Company	:	GULF OIL COMPANY-U.S.
Well	:	BERRYHILL WELL NO. 74-I
Formation	:	GLENN SAND
Field	:	GLENN POOL
Depth	:	1535.5
Permeability-(Klinkenberg) (md)	:	64.5
Porosity (%)	:	19.4
Irreducible Brine Saturation (%)	:	26.3
Waterflood Residual Oil Saturation (%)	:	32.1

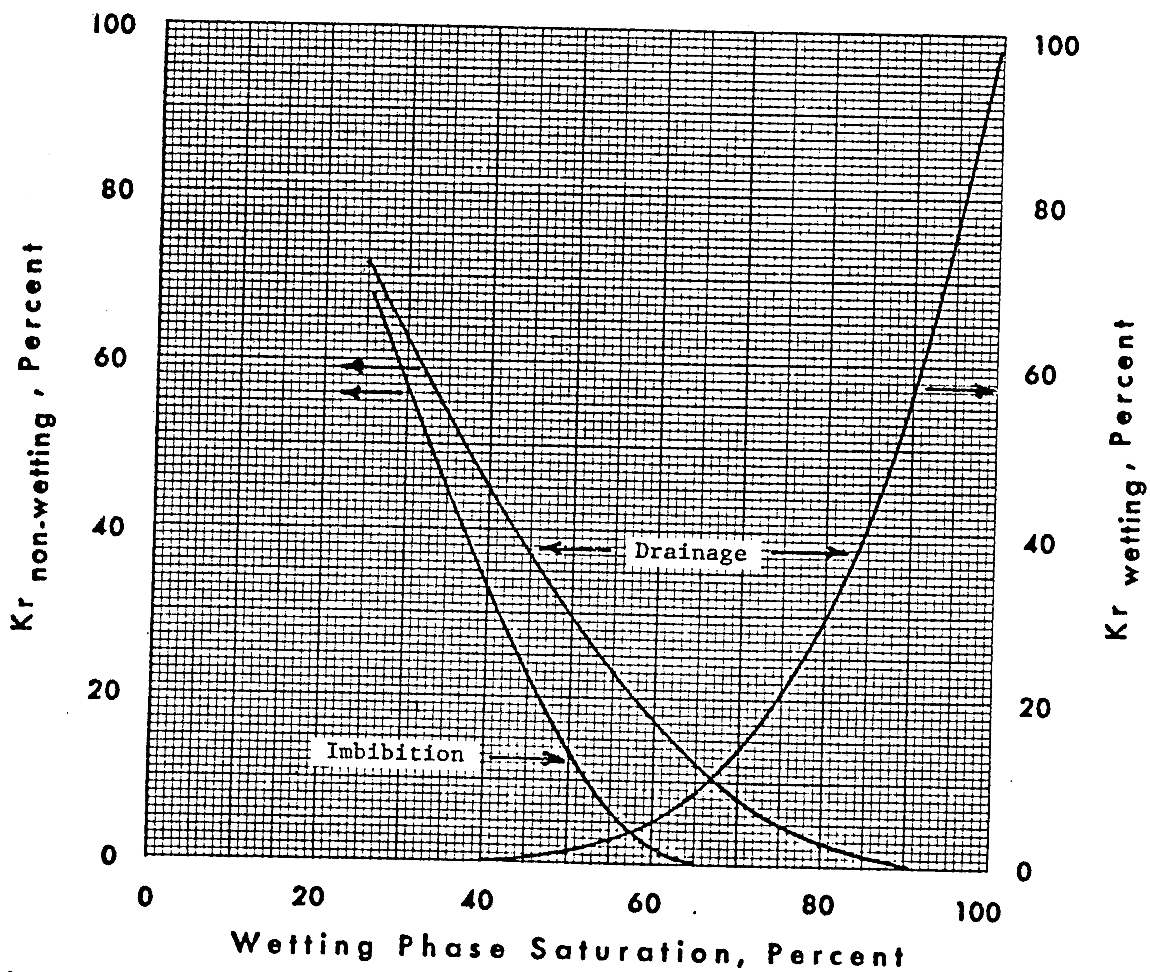


Figure 161. Relative Permeability - Saturation Relationship, Glenn Sandstone, William Berryhill No. 74-I, (Courtesy of Gulf Oil Exploration and Production Company)

VITA

Michael Douglas Kuykendall

Candidate for the Degree of

Master of Science

Thesis: THE PETROGRAPHY, DIAGENESIS AND DEPOSITIONAL SETTING OF THE GLENN (BARTLESVILLE) SANDSTONE, WILLIAM BERRYHILL UNIT, GLENN POOL OIL FIELD, CREEK COUNTY, OKLAHOMA

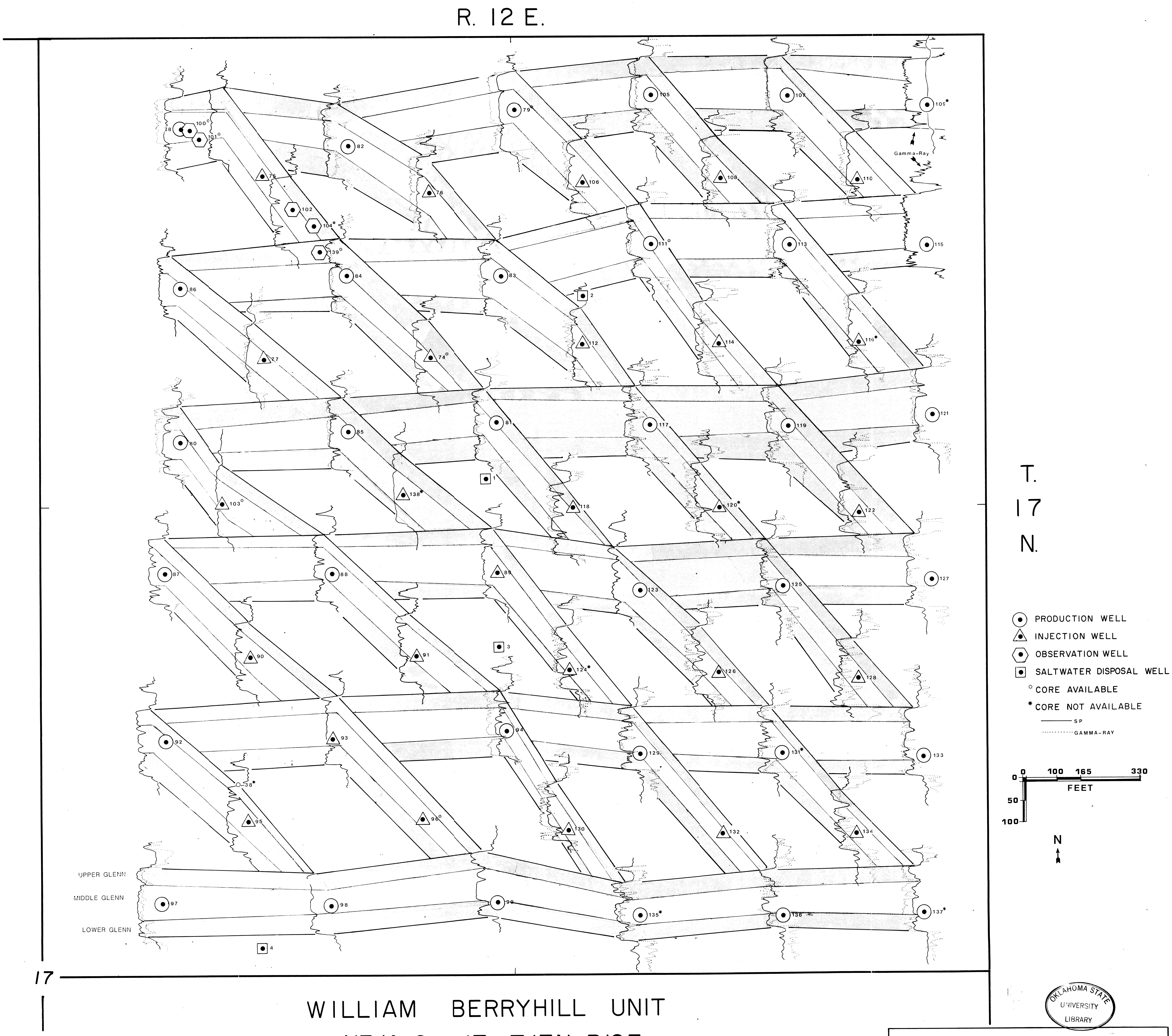
Major Field: Geology

Biographical:

Personal: Born in Paris, Arkansas, the son of C. L. and Neva Kuykendall. Married to Danette Lynn Stoops on June 2, 1981.

Education: Graduated from Nathan Hale High School, Tulsa, Oklahoma, in May 1976: Received Bachelor of Arts and Science in Geology, May, 1982, from Oklahoma State University, Stillwater, Oklahoma; completed requirements of the Master of Science degree at Oklahoma State University in December, 1985.

Professional Experience: Staff Geologist for Earth Energy Resources Inc., Stillwater, Oklahoma, 1981-82. Geological Consultant, 1982-85, subsurface mapping, well-site, prospect generation (north-central Oklahoma). Research Assistant, Oklahoma State University, Stillwater, Oklahoma, Enchancement of Well Log Data Via Signal Processing, 1981-84. Teaching Assistant, Oklahoma State University, 1982-83. Speaker, AAPG National Convention, Dallas, Texas, April 1983, "Correlation of Wireline Logs with a Shaly Sandstone Sequence, Red Fork Sandstone, Payne County, Oklahoma". Speaker, AAPG National Convention, San Antonio, Texas, 1984, "The Petrography, Diagenesis, and Depositional Setting of the Glenn (Bartlesville) Sandstone William Berryhill Unit, Glenn Pool Oil Field, Creek County, Oklahoma". Member of: AAPG, SPE, SPWLA, OCGS, TGS.



WILLIAM BERRYHILL UNIT
NE/4 Sec. 17, T.17N., R.12E.
Creek County, Oklahoma

PLATE I
LOG SIGNATURE-PANEL DIAGRAM
GLENN SANDSTONE

MICHAEL D. KUYKENDALL
1985


PLATE II
Petrologic Log
Company Humble Oil Corp.
Well Location No. 38-W
Lithology
Bedding(B)-Laminae(L)
Surface-Features
Organic
Deformed Features
Chemical
Contacts of Strata
Cores
Miscellaneous
Rock Classification
AGE STRATIGRAPHIC UNIT
ENVIRONMENT
S.P./GAMMA RAY
DEPTH THICKNESS
LITHOLOGY
SEDIMENTARY STRUCTURES
COLOR
GRAIN SIZE
POROSITY
SORTING
CONSTITUENTS
ROCK CLASSIFICATION
SAMPLE
REMARKS
DESMOINESIAN SERIES/ KREBS GROUP/ BOGGY FORMATION/ GLENN (BARTLESVILLE) SANDSTONE
UPPER GLENN
UPPER "NON-POROUS" ZONE
MIDDLE GLENN
LOWER "NON-POROUS" ZONE
LOWER GLENN
40
1450
60
70
80
90
1500
10
20
30
40
1550
60
70
80
90

PLATE III

Petrologic Log

Company: Gulf Oil Explor./Prod. Co.

Well Location: William Berryhill No. 100-0

PLATE IV

Petrologic Log

Company Gulf Oil Explor./Prod. Co.

Well Location William Berryhill No. 104-0


PLATE V
Petrologic Log
Company Gulf Oil Explor./Prod. Co.
Well Location William Berryhill No. 109-P
Lithology
CLAY/CLAYSTONE
SILTY CLAYSTONE/MUDSTONE
SILT/SILTSTONE
SAND/SANDSTONE
INTERBEDDED SANDSTONE/MUDSTONE
MUDDY SANDSTONE
CONGLOMERATE
LIMESTONE
MARL
DOLOMITE
DOLOMITIC ROCKS
GYPSUM/ANHYDRITE
GYPSIFEROUS ROCKS
HALITE
CHERT
CHERTY ROCKS
COAL/LIGNITE
VOLCANIC ROCKS
INTRUSIVE ROCKS
METAMORPHIC ROCKS
Bedding(B)-Laminae(L)
MASSIVE
HORIZONTAL
INITIAL SLOPE/DIP
GRADED
CROSS BEDDING (DUNES-WAVES) T-TROUGH, P-PLANAR
*Surface-Features
RIPPLE LAMINAE C-CURRENT D-RIPPLE DRIFT, W-WAVE, F-FLASER, L-LENTICULAR
CURRENT SOLEMARKS F-FLUTES, T-TOOL, Fa-FLAME
*Surface-Related
Deformed Features
FLOWAGE(F), FAULTED(Fa), LOAD(L)
WATER ESCAPE D-DISH, P-PIPE
DISRUPED M-MUD CRACK, D-DIKES, S-SYNERESIS CRACK
Organic
BURROW TRACE FOSSIL
BIOTURBATED
ROOT TRACES
Chemical
CONCRETIONS
STYLOLITES
GRAIN SIZE AVG | MAX
POROSITY P PRIMARY S SECONDARY M MICROPOROSITY
CONSTITUENTS
QUARTZ M Monocrystalline P Polycrystalline C Chert O Other
FELDSPAR K K-Feldspar P Plagioclase O Other
ROCK FRAGMENTS M Metamorphic I Intrusive V Volcanic
CLAY & CARBONATE C Clay CA Carbonate
FOSSILS Plant C Carbonaceous Material W Carbonized Wood
INVERBRATES & ALGAE A Algae Ar Arthropods B Brachiopods C Cephalopods Co Corals E Echinoderm F Forams G Gastropod P Pelecypod S Sponge
CLAY MINERIALS C Chlorite H Halloysite I Illite K Kaolinite S Smectite ML Mixed Layered O Other
CARBONATE C Calcite FC Ferroan Calcite D Dolomite Fd Ferroan Dolomite S Siderite O Other
SILICA O Quartz Overgrowth M Micro Quartz Cd Chalcedony
SULFIDES P Pyrite O Other
SULFATES G Gypsum A Anhydrite B Barite O Other
MICA M Muscovite B Biotite O Other
Contacts of Strata
ABRUPT
TRANSITIONAL
EROSIONAL
BORED
DEFORMED
Cores
CORED INTERVAL AND CORE NUMBER
RECOVERY
NO RECOVERY
Miscellaneous
THIN SECTION
P & P ANALYSIS
SEM
Rock Classification
QUARTZ
FELDSPAR
ROCK FRAGMENTS
AGE/STRATIGRAPHIC UNIT
ENVIRONMENT
S.P./GAMMA RAY
DEPTH/THICKNESS
LITHOLOGY
SEDIMENTARY STRUCTURES
COLOR
GRAIN SIZE
SORTING
POROSITY %
PERM. md
TYPE
CONSTITUENTS
DETRITAL ALLOGENIC
FOSSILS
PENE-CONTEMPORANEOUS AUTHIGENIC
ROCK CLASSIFICATION
SAMPLE
REMARKS
DESMOINESIAN SERIES/
KREBS GROUP/
BOGGY FORMATION/
GLENN (BARTLESVILLE) SANDSTONE
UPPER GLENN
UPPER "NON-POROUS" ZONE
MIDDLE GLENN
LOWER "NON-POROUS" ZONE
LOWER GLENN
1450
1500
1550

PLATE VI

Petrologic Log

Company Gulf Oil Explor./Prod. Co.

Well Location William Berryhill No. 116-I

PLATE VII

Petrologic Log

Company Gulf Oil Explor./Prod. Co.
Well Location William Berryhill No. 120-I

PLATE VIII

Petrologic Log

Company Gulf Oil Explor./Prod. Co.

Well Location William Berryhill No. 124-I

PLATE IX

Petrologic Log

Company Gulf Oil Explor./Prod. Co.

Well Location William Berryhill No. 131-P

PLATE X

Petrologic Log

Company Gulf Oil Explor./Prod. Co.
Well Location William Berryhill No. 135-P

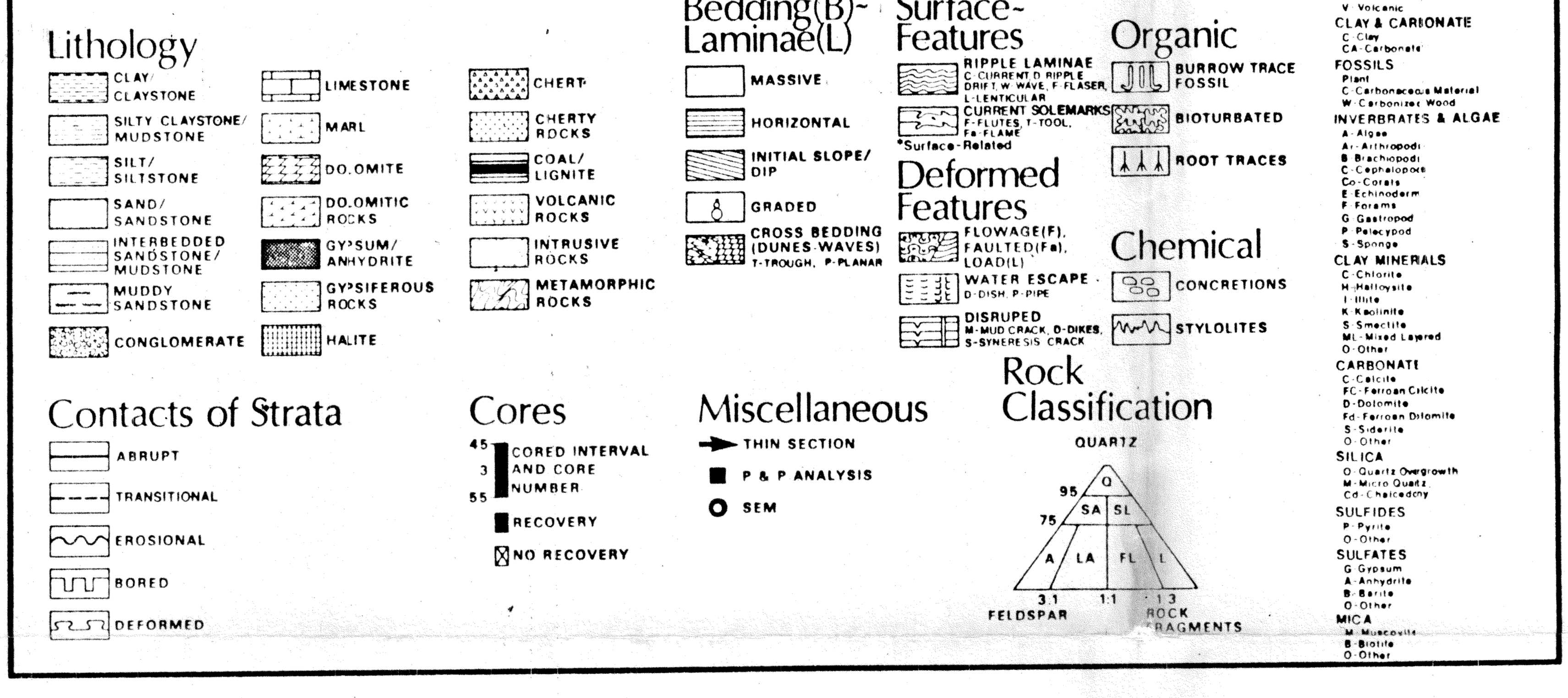


PLATE XI

Petrologic Log

Company Gulf Oil Explor./Prod. Co.
Well Location William Berryhill No. 137-P

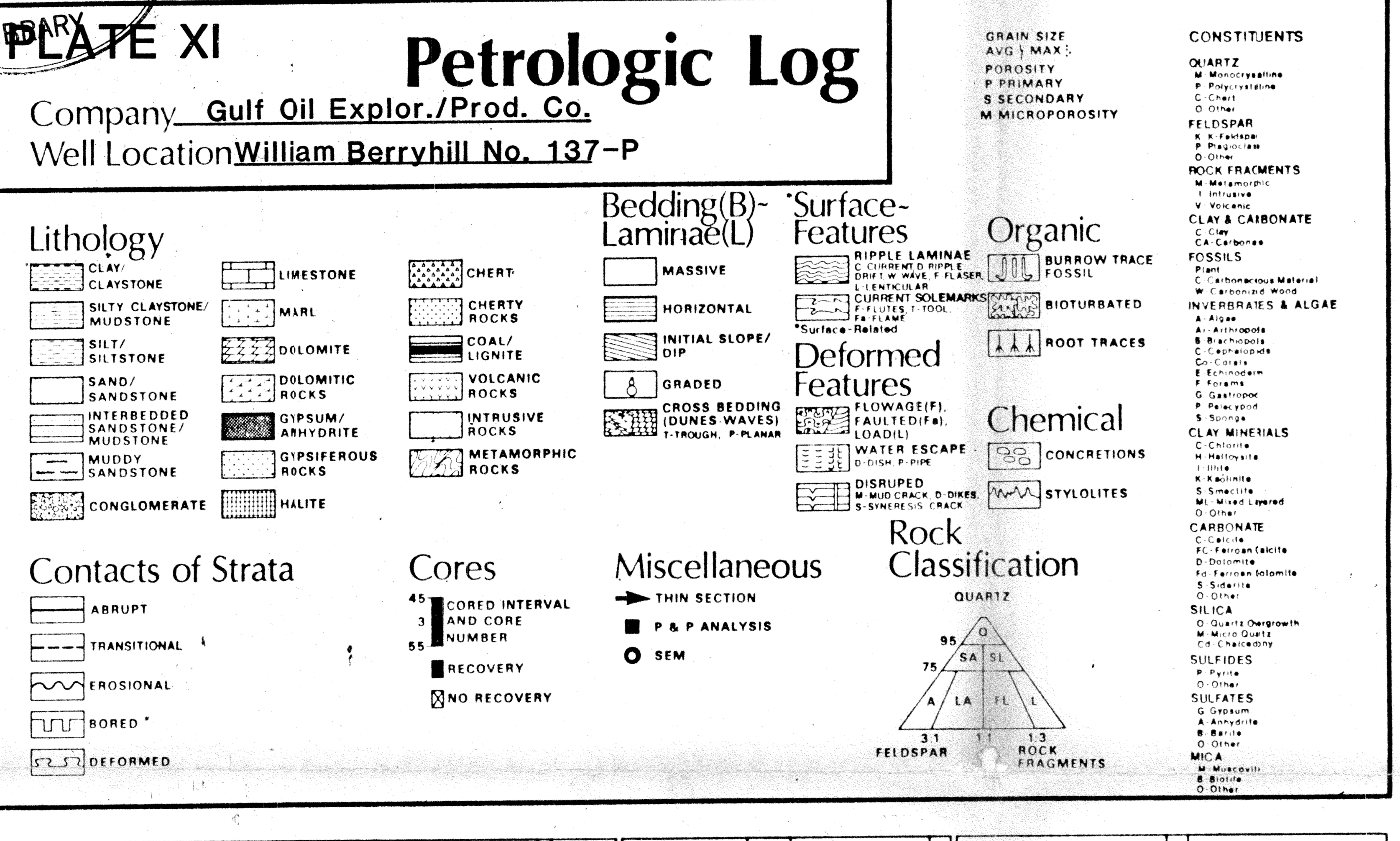


PLATE XII

Petrologic Log

Company Gulf Oil Explor./Prod. Co.

Well Location William Berryhill No. 138-I

PLATE XIII

Petrologic Log

Company Gulf Oil Explor./Prod. Co.

Well Location William Berryhill No. 139-P