SUPPLEMENTARY
MATERIAL
IN BACK OF BOOK

Lithologic Study of the Upper Cambrian of Foster Number 1 Well, Ogemaw County, Michigan

By

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INTRODUCTION

General

The study herein is a part of a general program of study on the Upper Cambrian and Ordovician of the Michigan Basin. Recent successful petroleum exploration in the Ordovician of Southern Michigan and the Upper Cambrian of Northern Ohio has placed emphasis on the need for additional information on the subsurface stratigraphy of these areas.

The Upper Cambrian stratigraphy of the Northern Michigan outcrop is not clearly understood in regard to the typical Upper Cambrian of Wisconsin. One exception is a well core from Delta County (Dixon, 1961) which apparently shows the principal units of the Wisconsin section and therefore serves as a helpful reference well for Southern Michigan Cambrian.

Cambrian wells are scarce and widely spaced geographically in the Basin. Special significance is placed therefore on any well penetrating all or even part of the Cambrian. Distance to other Cambrian wells or the Wisconsin outcrop makes correlation difficult and most criteria of correlation are cought in these studies.

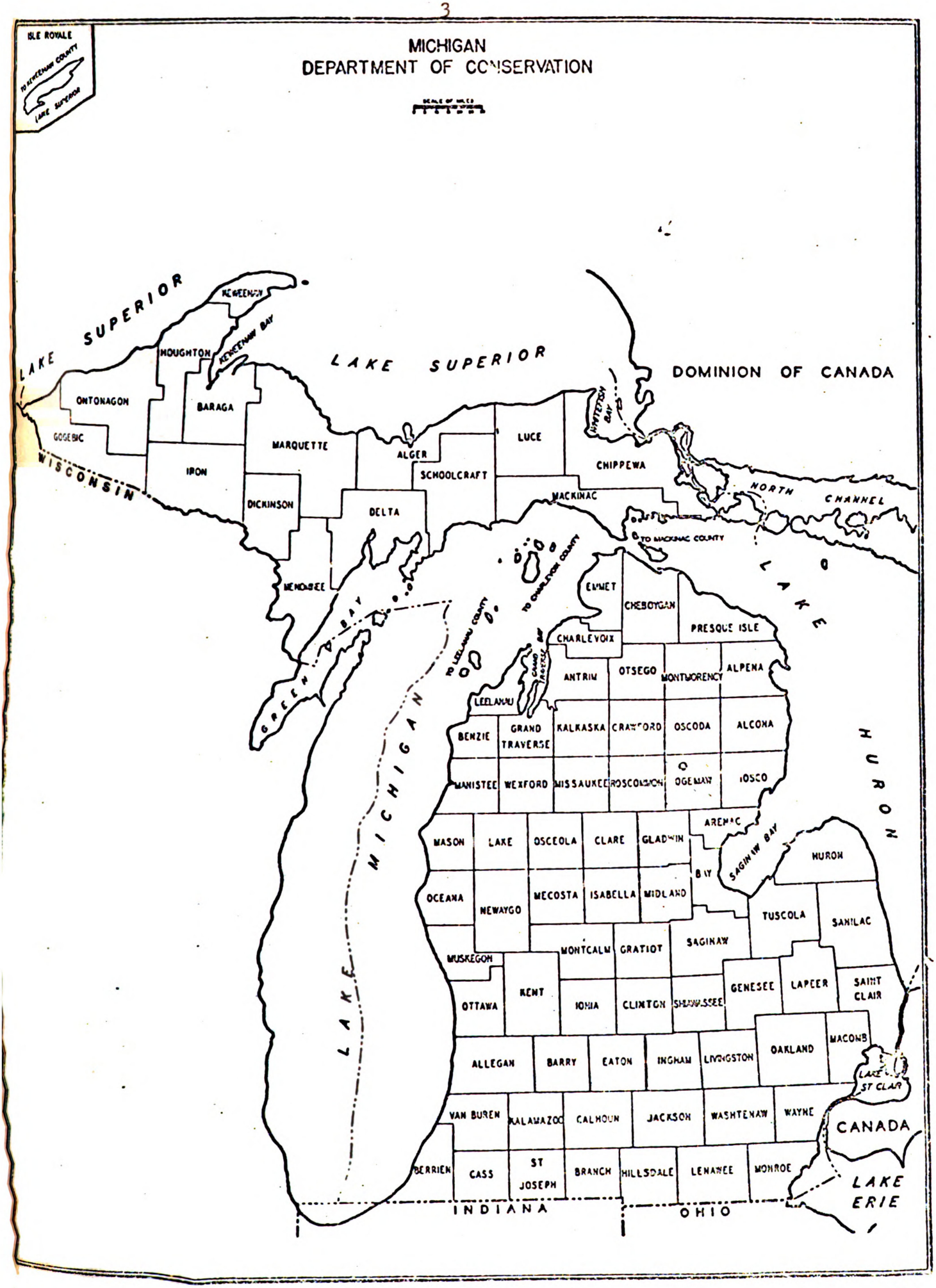
Purpose and Scope

The problem involves the study of Upper Cambrian cores and cuttings available from the Foster No. 1 Well, Ogemaw County, Michigan, the deepest well drilled to date in Michigan.

The purpose of this work is to make detailed study of the lithologic composition and to compare it to available reference samples, and to any primary information offered through possible fossil content in the samples studied. It is hoped that the tops of formations can be selected, that the identification of the particular formations present can be made, and possible correlations within Southern Michigan and demonstrate lateral relations with Northern Michigan, Wisconsin, Northern Ohio, and Indiana.

Location of Area

The State-Foster No. 1 Well was drilled in SW ¼, SE ¼, SE¼, Section 28-T24N-R2E, Ogemaw County. It is located 330 feet from south line and 990 feet from east line of the quarter section.



7. Location of Baxter No. 1 Well

HISTORY OF PREVIOUS WORK

The Michigan structural basin was recognized after the work of Douglas Houghton in 1814. James Hall (1843) published a map indicating the circular pattern of the rocks beneath the glacial drift in Michigan.

Most of the reports on Lake Superior geology mention the "Lake Superior Sandstone" primarily because of the problem of its age and stratigraphic relationships to the Keweenawan rocks. The question whether the "Lake Superior Sandstone" is more closely related to the copper bearing rocks of the Michigan Basin has been debated for over a century. Houghton (1837-1845) first applied the term "Lake Superior Sandstones" to the lowest Paleozoic rocks in Northern Michigan which rest upon the Precambrian complex.

Foster and Whitney (1851) published the results of their extensive studies of the geology and physiography of the Lake Superior area and presented the first detailed descriptions of the "Lake Superior Sandstones". They considered the sandstone on both sides of the Keweenaw Peninsula to be the same age and to be equivalent to the Potsdam of New York. Rominger (1873) believed that the "Lake Superior Sandstones" were equivalent to the Potsdam of New York.

Van Hise and Bayley (1900) from their studies of the rocks in the Menominee district, proposed the term "Hermansville" for the strata which overlie the "Lake Superior Sandstone".

Prior to 1944 the Hurst Well No. 1, drilled in St. Clair County, Michigan, was the only well in the Southern Peninsula of Michigan to penetrate the full sedimentary section overlying Precambrian rocks. The depth to Precambrian rocks increases considerably northwestward from Washtenaw County toward the center of the Michigan Basin in southeastern Clare County and southwestern Gladwin County, where it is estimated that approximately 14,000 feet of sediments overlie Precambrian rocks.

As the result of subsurface stratigraphic work in the Michigan Basin, Cohee (1945) considered the Hermansville to be equivalent to Jordan, Trempealeau and Prairie du Chien, and the Munising Formation equivalent to Eau Claire, Dresbach and Franconia.

Several unpublished theses have been written on various parts of the Munising or Jacobsville Formations. The earliest of these was by Roberts (1940), who studied the geology of the Alston district in Houghton and Baraga Counties. Roberts recognized the unconformity between the Jacobsville and Middle Keweenawan flows and concluded that the Jacobsville was Cambrian in age.

Denning (1949) studied the petrology of the Jacobsville Sandstone and made detailed heavy mineral analyses of a number of samples collected in the Keweenaw Bay area. His work shows that the heavy mineral assemblage of the Jacobsville Formation remains relatively constant over a large area and throughout the stratigraphic section.

Oetking (1951) studied the Lower Paleozoic rocks in the Munising area in an effort to determine their origin and stratigraphic relationships. He recognized an unconformity between the Jacobsville and Munising and on the basis of similarities in lithology and heavy mineral suites correlated the Jacobsville with the Bayfield of Wisconsin. Although he recognizes no lithologic break within the Munising Formation, Oetking (1951) reports a break in heavy mineral suites and correlates the Munising with Dresbach and Franconia. On the basis of fossils collected in the "Au Train" Formation Oetking established its age as Middle Ordovician which is indicated on his map to overlap the Hermansville Formation.

Driscoll (1956) studied the heavy minerals from samples collected from the Munising and Jacobsville between Marquette and Grand Marais. His heavy mineral work was much more detailed than Oetking's and it shows that the change in the heavy mineral suite is at the contact between the "Pictured Rocks" and "Miner's Castle" members. Driscoll believes that the upper Munising represents a transgressive-regressive cycle of the Upper Cambrian seas. The lower units of the Upper Munising, or transgressive phase, represent the Franconia and the upper units, the regressive phase, represent the Jordan of southern Wisconsin. He bases these conclusions on the "upwardly increasing garnet percentages" in the Munising Formation.

Many of the early workers based their correlation on

the lithologic similarity between the Jacobsville and various red sandstones of Late Paleozoic age. The more recent correlations, however, are based primarily on stratigraphic position with most of the disagreements resulting because the authors were unable to examine enough outcrops to establish a regional picture for the problem.

GENERAL STRUCTURE

The Michigan Basin is a roughly circular structural basin. It includes the Southern Peninsula and eastern Wisconsin, northeastern Illinois, northern Indiana, northwestern Ohio, and western Ontario. The Basin is bordered on the west by the Wisconsin Arch, on the south by the Kankakee Arch, and on the east by the Findlay-Algonquin Arch. The Basin includes an area of 122,000 square miles, part of which is covered by Lakes Michigan, Huron, and St. Clair.

Only a few wells have been drilled to the Precambrian basement rocks around the margin of the basin, and none of the wells drilled in the deeper part of the Basin reached the basement. The basement was reached in two wells drilled on Beaver Island at the northern end of Lake Michigan. In one well, the basement was reached at a depth of 4,705 feet below sea level, and another well drilled about 3 miles to the southwest, someshat down the dip, reached weathered granite about 700 feet higher. The amount of physiographic relief on the old weathered basement surface is of the order of hundreds of feet. A well at the southern end of Lake Michigan reached basement at a depth of 3,628 feet below sea level. A few wells were drilled to the basement along the Kankakee Arch in Indiana, the Findlay Arch in northwestern Ohio, southeastern Michigan, and southwestern Ontario. Here basement was reached at depths of from 2,000 to 3,000 feet below sea level. Many wells in southern Michigan

have been drilled into the Cambrian sequence, but not entirely through it.

In the Northern Peninsula at the northern edge of the Michigan Basin, the Precambrian rocks trend in an east-west direction, with the pattern dominated by a series of high-angle faults. Gravity data show that these trends probably connect with other trends in the Southern Peninsula (Gamas, et al., 1961; Case and Gair, 1965).

The Bouguer gravity anomaly map of mid-western United States, published by Rudman, Summerson and Hinze (1965), shows a gravity high, which is labeled trend B, extending northwest-southeast through the Michigan Basin. This "high" extends northward into Lake Superior and from there westward through the lake area to the western end, where it is a part of the prominent gravity feature known as the Mid-Continent gravity "high". Thiel (1956) showed that the positive part of the "Mid-Continent High" originated from dense basalt flows of Keweenawan age and that parallel negative anomalies result from a contrast with low-density Keweenawan sediments. Rudman and others show another linear positive anomaly, trend C, extending from eastern Kentucky across the Cincinnati Arch into southwestern Michigan.

Zietz (1967) and others have pointed out the strong possibility that the Michigan trend may tie up with the area of east-west-trending gravity and magnetic anomalies in the iron district in the Northern Peninsula. They state that the magnetic data indicates that anomaly C is not a

continuing lithologic unit.

The tectonic map of Canada reveals numerous folded areas and major faults at the northern edge of the Michigan Basin, and similar features occur in northern Michigan and Wisconsin bordering the Basin. We can assume that the basement under the Michigan Basin is characterized by such features.

We know that the Howell Anticline, which is at the southeast end of the strong northwest-southeast anomaly through central Michigan, has been elevated at different times during the Paleozoic age and that some faulting has taken place along the fold (Cohee, 1965a). It is believed that other structural features such as faults and folds in the basement of the Michigan Basin, were likewise reactivated at different times.

According to Ekblaw (1948) the major movement of the Wisconsin Arch occurred in post-Cambrian time with less movement possibly occurring during Cambrian time. The first major movement of the Kankakee Arch was after Shakopee time, but before St. Peter time.

The Wisconsin Arch was apparently elevated at various times in Upper Cambrian and possibly Lower Ordovician time, as suggested by the predominance of sandstone in deposits of these ages in eastern Wisconsin. The dolomite/sand ration in these rocks increases southward and eastward from Wisconsin. The Eau Claire, Trempealeau, and Prairie du Chien rocks contain much sandstone on the west side of Michigan but are less

sandy on the east.

The Findlay Arch was apparently elevated during Upper Cambrian time as suggested by the thinning of the Mount Simon sandstone eastward from Illinois and over the arch (Cohee, 1948). Major uplift at the close of Lower Ordovician time is indicated by the erosion of Lower Ordovician and Upper Cambrian rocks along parts of the arch in northwestern Ohio and by the absence of all Cambrian and Lower Ordovician rocks on the arch in parts of Ontario. A drop by faulting of more than 200 feet in the top of the Trenton limestone is indicated between well locations in the vicinity of Findlay, Cygnet, and Bowling Green, Ohio. The fault, which is downthrown on the west, extends northward and connects with the Lucas County (Ohio)-Monroe County (Michigan) monocline.

A structurally low area in Kent County, Ontario, referred to by Kay (1948) as the Chatham Sag was depressed at frequent times during the Paleozoic era as indicated by the increased thickness of certain Paleozoic rocks in that area. The sag probably served as a connection between the Michigan and Appalachian Basins at various times. Likewise, the Logansport Sag on the Kankakee Arch near Logansport, Cass County, Indiana, was probably a structurally low area connecting the Michigan and Illinois Basins at times. The structure of the rocks in the area of the Loganspost Sag has been discussed by Phinney, Logan, Cummings and Shrock (1948).

The Michigan Basin may have originated in Precambrian time, but important deformation in the Basin is believed to have occurred in Salina (Silurian) time (Cohee 1948) and in late Mississippian time (Kilbourne, 1947). The top of the Precambrian is estimated to lie at a depth of approximately 14,000 feet in the center of the Michigan Basin in southeastern Clare and southwestern Gladwin Counties.

Little is known about the northern extension of the Michigan Basin. A well at Grand Marais in northeastern Alger County penetrated 7,700 feet of sandstone, which suggests that the Basin continues as a narrow trough into Lake Superior and is bordered by Precambrian crystalline and metamorphic rocks. It is possible, however, that a Precambrian range, built by folding and continuous with the metamorphic rocks in the western part of the Northern Peninsula, extends eastward under the Paleozoic sedimentary rocks.

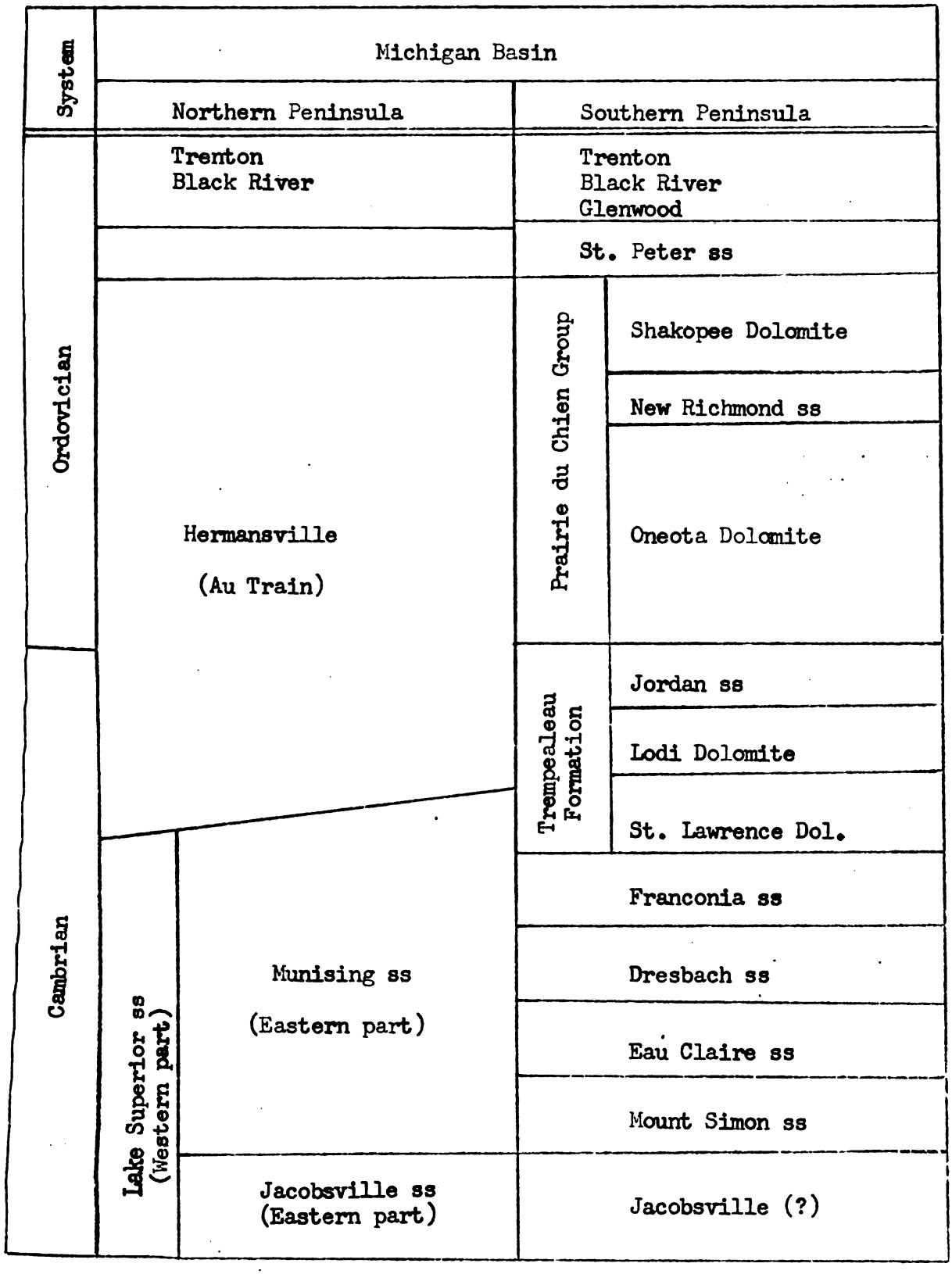


Figure 2—Correlation of Ordovician and Cambrian Formations of the Michigan Basin.

(in part after Cohee and Bridge, 1948)

STRATIGRAPHY

General Section:

Southward from Northern Michigan into Wisconsin and Illinois, eastward across the Northern Peninsula, Middle Ordovician rocks overlap progressively older rocks, and on Manitoulin and adjacent islands, Black River rocks of Middle Ordovician age rest on Precambrian. This same stratigraphic relationship is observed in other outcrop areas in Ontario and in deep wells that have penetrated the full section of sedimentary rocks. Pre-Black River erosion removed most of the older Paleozoic rocks from the underlying Precambrian in southwestern Ontario and in some places only a thin remnant of Upper Cambrian sandstone and some dolomite occurs between Middle Ordovician and Precambrian rocks.

The aggregate thickness of these rocks increases southwestward from Michigan toward Illinois and thins southeastward over the Findlay Arch in southeastern Michigan and northwestern Ohio. The rocks increase in thickness eastward into the Appalachian Basin from the Findlay Arch.

Upper Cambrian sandstones, which may be more than 2500 feet thick in places, are the oldest deposits on the Precambrian surface.

Granite and metamorphic rocks have been found at the top of the Precambrian in most of the wells that have been drilled through the sedimentary rocks in the Michigan Basin. The greatest thickness of Precambrian rocks penetrated in

the Southern Peninsula of Michigan is the well studied by Yettaw (1967), where more than 800 feet of granite has been drilled.

Rocks of Upper Cambrian age underlie Middle Ordovician rocks and rest on Precambrian rocks in a large part of southeastern Michigan. The thickness of Cambrian rocks varies from 1160 feet in Washtenaw County to 140 feet in St. Clair County. This variation in thickness is due to the unconformity at the base of Middle Ordovician rocks which was brought about by uplift and erosion at the close of Lower Ordovician time. Cambrian rocks are missing in parts of Kent, Lambston, and other counties in southwestern Ontario, and in these places Middle Ordovician rocks overlie Precambrian rocks.

Overlying the Precambrian rocks in the Northern Peninsula of Michigan the following section is recognized:

Jacobsville Sandstone

The Jacobsville Formation was named by Lane and Seaman (1907) after the little town of Jacobsville. This red sandstone is considered of Cambrian age by Hamblin (1958) and felt to be of Precambrian age by Thwaites (1934) and Trow (1967). Jacobsville thickens greatly to the north where it may be several thousand feet thick.

Mount Simon Sandstone

The Upper Cambrian Mount Simon sandstone rests on Precambrian rock, in the same places where Jacobsville is absent. The Mt. Simon reaches its maximum thickness in

northeastern Illinois, where it is 2500 feet thick. The sandstone thins eastward from Illinois. It is only 300 feet thick in southeastern Michigan, and is absent in parts of southwestern Ontario. It is a medium-to-coarse-grained sandstone with subangular to rounded grains, a few thin beds of dolomite and sandy dolomite occurring in the upper part of the sandstone.

Eau Claire Sandstone

This sandstone consists of sand, shale, and dolomite which is shaly and sandy. The dolomite beds in the Eau Claire may be gray to dark gray, pink, purple and red to brown in color, and the shale also is variously colored. Glauconite is locally abundant in the formation west of the Findlay Arch. The Eau Claire is much more sandy in western Michigan, northwestern Indiana, Illinois, and eastern Wisconsin than it is in eastern Michigan, Ohio, and northeastern Indiana. It is also much more sandy northward in Michigan, and is mostly sandstone in the Northern Peninsula. It is approximately 600 feet thick in northeastern Illinois but thins to 250 feet in southeastern Michigan.

Dresbach Sandstone

This unit is recognized in Wisconsin, Illinois, Michigan, and northwestern Indiana. It is absent in northeastern Indiana but is present in northwestern Ohio and continues eastward across the Findlay Arch. In southeastern Michigan it is approximately 100 feet thick and is coarse sandstone with well rounded grains. Thin beds of dolomite

are found in parts of the sandstone.

Franconia Sandstone

This unit overlies the Dresbach Sandstone, which consists of fine, angular grains of quartz and thin beds of sandy dolomite. The sandstone in places is generally very glauconitic. In southeastern Michigan it is 10 to 20 feet thick, but in northeastern Illinois, where it is sandstone and sandy dolomite, it attains a thickness of 70 feet in places; in eastern Wisconsin the sandstone is red and pink in some areas and as much as 140 feet thick, the basal part of the Franconia sandstone at many places in Wisconsin consisting mainly of reworked sand grains of the Dresbach.

Trempealeau Formation

The Trempealeau is a distinct lithologic unit consisting predominantly of dolomite, somewhat sandy in parts, but also including some shaly dolomite and dolomitic shale at the base. It is 700 feet thick in northern Indiana but thins westwardly into northeastern Illinois to 400 feet; and to 500 feet in southeastern Michigan. The formation is generally sandy at the top and may be sandy at the base in places. Small amounts of chert are found in the Trempealeau. A considerable thickness of pink dolomite is found locally, but may disappear rapidly laterally.

The Trempealeau in the typical area (Ulrich, 1924) is divided into the St. Lawrence, Lodi, and Jordan sandstone members in ascending order.

St. Lawrence Member

Winchell, N.H. (1874) described the St. Lawrence limestone, named by Alexander Winchell (1872), as the 14.5 feet of glauconitic and sandy dolomite occurring in quarries at the village of St. Lawrence, Scott County, Minnesota. The basal part consists of gray, sandy, very glauconitic dolomite overlain by dark gray to black dolomitic shale and dolomite.

Lodi Member

The Lodi was named by Ulrich (1924). It is generally white to buff dolomite, slightly sandy. Pink dolomite occurs locally in southeastern Michigan.

Jordan Sandstone Member

The Jordan sandstone was named by Winchell (1874) for the exposures at Sand Creek near the town of Jordan, Scott County, Minnesota.

This member is not present in southeastern Michigan and northwestern Ohio, but is represented by sandy dolomite in northern Indiana. The sandstone is present in the Northern Peninsula where it is 5 to 30 feet thick and consists of well rounded, frosted and pitted quartz grains (Cohee, 1948).

Standard Section		Ozark Region Missouri	Wisconsin Minnesota		Great Valley Appalachians	Central Pennsylvania		Great Valley Southern Pa. Northern Va.
Series	Stage	Ordovician	Ordovician		Ordovician	Ordovician		Ordovician
Upper Cambrian	Trempealeau	Eminence dolomite	Trempealeau	Madison Fm.	Copper Ridge dolomite (?)	Gatesburg Formation	Mines Member or Ore Hill Member (?)	Conococheague Limestone
				Jordan Member				
				Lodi Member				
		Potosi dolomite		St. Lawrence				
	Franconian	Elvins Group: Doe Run dolomite	Franconia	Bad Axem				
		Elvins Group: Derby dolomite		Hudson Member				
		Elvins Group: Davis Formation		Good-enough Member				
				Ironton Member				
	Dresbachian	Bonneterre dolomite	Dresbach	Galesville Member	Maynardsville Limestone	Warrior Formation		
				Eau Claire Member	Nolichucky Shale			
		Lamotte ss		Mt. Simon ss				

Figure 3—General Section
Correlation Table Showing Upper Cambrian
Nomenclature in Several Areas
Modified after the G.S.A. Bulletin (1944)

CAMBRIAN SECTION IN THE FOSTER WELL

General Statement

The Foster No. 1 Well, the subject of this study, is the deepest well drilled in the Michigan Basin. The well was completed as a dry hole at a depth of 13,000 feet, in Upper Cambrian sandstone.

Well cuttings were studied under a binocular microscope in order to observe lithologic differences and to examine the relation between the lithology and gamma ray-neutron log characteristics. Stratigraphic position, lithologic and heavy mineral similarities are used as the bases for determining the correlations. A number of figures, cross sections, structure contour maps and isopach maps are constructed to help the interpretation of stratigraphy, regional structure and correlations. These will be fully discussed in later sections.

The following description covers the section from the Black River, Ordovician to the bottom of the well in low Upper Cambrian. Well cuttings taken at five-foot intervals in the well were compared to core chips from 11,640 feet to 12,345 feet. From 12,345 feet to the bottom of the well at 12,995, only core chips were studied.

The Cambrian section, indicating the formation elevations and thickness, can be observed from Figure 11, and Appendix B, and from the detailed descriptions of the Upper Cambrian, Appendix A. Allmajor units of the Upper Cambrian

standard of the Upper Mississippi Valley, the Mount Simon, Eau Claire, Dresbach, Franconia and Trempealeau, are represented in the Foster Well. Subdivisions of the Trempealeau, the St.Lawrence, Lodi, and Jordan are not recognized in the well.

Overlying Beds

Lower Ordovician sections are discussed in detail in Appendix A.

Trempealeau---985 feet

This formation, as indicated in Figure 11, consists of intermixed carbonates and clastic rocks. The proportion of them are shown in Appendix B.

Dolomite: gray to brownish gray, buff, occasionally dark gray to black, some fine crystalline texture. Almost all dolomite particles have some hairline fractures, most of which are covered by fine crystalline gypsum; proportion of dolomite in this section is slightly greater than sandstone, mostly occurs in upper part, becomes sandy dolomite in lower part; some oil stains.

Sandstone: consists highly of clear quartz grains, fine to coarse grained, predominately medium size, rounded to subangular, fine grained usually are better rounded in middle part; white, colorless, sometimes orange to reddish; inclusions in some quartz grains; major part of sandstone in the middle part of this section, approximately 110 feet; becomes sandy dolomite associated with some salt toward lower part.

Limestone: rather white in color, intermixed with other rocks,

especially in lower part of section.

Salt: some small proportion of salt associated with sandy dolomite in lower part. Between 10,820 to 10,840 feet, salt comprises 80 percent of whole rock.

Heavy minerals: small pieces of muscovite in upper part, tend to occur with sandstone; iron oxide (mostly limonite), pyrite, glauconite are scattered throughout the section. Zircon, tourmaline and an opaque mineral (possibly garnet) are observed in this unit.

Fossils: Brachiopod fragments are observed mostly in carbonate part of this unit.

Franconia---195 feet

This formation is readily recognized on the gamma ray-neutron log (Fig. 11).

Sandy dolomite: major portion of this unit dolomite, gray to brown, dark brown, with some hairline fractures; dolomite occurs mostly in lower part; oil stains.

Sandstone: fine grained, rounded, frosted, some orange to pink quartz crystals; sandstone found mostly in upper part; some small proportion of limestone and quartz-siltstone intermixed through this section, average 2 per cent of salt, slight increase toward lower part; bottom 25 feet is associated with almost 10 percent of salt.

Heavy minerals: glauconite is found in middle part in sandy dolomite, muscovite in upper part, some limonite is scattered through this section; opaque mineral, probably garnet.

Fossils: brachiopod shells in upper part, disappear in middle, and reappear in lower part.

Dresbach---515 feet

This formation has high evaporite content (Table 5).

Dolomite: light gray to dark brown, crystalline, very small seams of calcite intermixed with dolomite particles, sandy upper part, extend to middle section of this unit, from middle part toward the bottom, of this formation shaley dolomite have highest proportion in Dresbach.

Sandstone: grayish brown, fine to coarse grained, angular to rounded, occasional frosting; sandstones are mostly found in upper part, decrease toward middle part, rare towards base; proportion of sandstone is less than dolomite.

Shale: dark to black; some thin flakes of green shale, increases toward bottom of section.

Limestone: occurs in small proportions in power part; high vugular porosity.

Quartz-siltstone: white, colorless, very finely crystalline, alternating with other rock types through the whole unit.

Salt: white to buff, 25 feet of rock in the upper part contains approximately 30 percent salt; the middle part shows a small proportion of salt, locally with anhydrite, in the middle and lower parts of this unit.

Heavy minerals: iron oxide, limonite, hematite with good proportion of muscovite in upper part occur with sandy dolomite, pyrite, glauconite.

Fossils: brachiopod fragments; a fragmented gastropod shell.

Eau Claire---655 feet

The EauClair characteristically shows a high glauconite content which is helpful in making correlations. The top of the formation shows clearly on the gamma ray-neutron log (Figure 11).

Dolomite: gray to brownish buff, intermixed with some shale, shaley dolomite, locally dolomitic shale; some fractures in dolomite particles show secondary calcite, gypsum; dolomite intermixed with sandstone throughout the formation; increasing shaley dolomite toward top; some oil stains.

Sandstone: fine grained, white, rounded, intermixed with dolomite, highest portion of sandstone occurs in middle part.

Limestone: occurs with high porocity due to solution (vugs), intermixed with other rocks scattered in whole section, proportion of limestone is less than dolomite and sandstone.

Quartz-siltstone: white, soft, occurring as minor constituent.

Anhydrite: rather good proportion found in middle, increasing towards upper part; frace of salt in upper part; a few crystals of calcite.

Heavy minerals: iron oxide mixed with oil stains, high content of glauconite; a few flakes of muscovite.

Fossils: some brachiopod shells scattered in upper part of the unit.

Mount Simon---150 feet

The Mount Simon varies only slightly from top to the bottom of that portion drilled at total depth of well.

Dolomite: intermixed with dolomitic shale, brown to gray, most dolomite particles covered by gypsum crystals; thin beds of green shale; occurrence of dolomite is greater in upper portion of this unit; proportion of dolomite and dolomitic shale is higher than other rock types; color of dolomite is darker in lower portion.

Shale: rather dark, some micaceous, and containing heavy minerals, mostly in upper portion of this unit, some scattered in middle and lower part; shale proportion is less than dolomite.

Sandstone: white, colorless, some orange to red, well rounded fine to coarse grained, some big crystals of quartz, a few of which are the smoky variety; some sandstone with calcareous cement, mostly in middle part; occurrence of sandstone in Mount Simon is high in middle part decreasing towards the base, proportion of sandstone is less than dolomite and shale.

Limestone: partially frosted, some with high porosity (vugy), intermixed with other rocks, scattered in whole section, limestone has least proportion of the Mount Simon units.

Anhydrite: intermixed with dolomite, some gypsum, amount of anhydrite increases towards upper part; proportion of anhydrite is less than dolomite, shale, sandstone, limestone.

Quartz-siltstone: white, very fine crystals of quartz,

very small proportion intermixed with other major rock types; micaceous shale, very small amount of chert intermixed with calcareous part in lower part of Mt. Simon drilled.

Heavy minerals: iron oxide, limonite, hematite, ferrous iron form major part of heavy minerals, occurring throughout the whole section; pyrite increases toward lower part.

IMPLICATIONS OF FOSTER WELL

A broad look at the structural maps of Precambrian, Cambrian and isopach maps of the Michigan Basin, reveals different lines of evidence to interpret the Michigan Basin environment through Cambrian time.

At the beginning of Cambrian time, perhaps what is now the center of the Michigan Basin was relatively lower than surrounding structures and received more sediment. At this time northern Wisconsin (Figure 4) was a positive area, which stood above the sea, and was the source of the sediments for the Michigan "Basin" area, which was negative area and covered by the early Cambrian sea. The movement of the center of the Michigan "Basin" appears eastward from Precambrian time to Cambrian time, as is shown by structure contour maps (Figures 5 and 6). It must be pointed out, however, that these maps are based on a minimum of control and therefore are not realistic.

The general paleogeography of the Michigan "Basin" area in Cambrian time is basically dependant on the position of the dividing line between areas of erosion and sedimentation. It is generally thought that the west shore line was somewhere in Wisconsin. The eastern shore line of the basin was located a short distance east of the Foster Well area. Quick back and forth motions of the shore line in Cambrian time is understood and rapid change in lithologic facies as shown in Figure 11 is in harmony with the transgression and regression of the shore lines. Thinning iso-

pachs toward the east side of the basin is another criterion for locating this shore line. But it should be mentioned that the isopach map of the Michigan Basin likely locates the greatest depth of sinking but not necessarily the greatest depth of water in the original basin. The Foster Well area is characterized for the most part by rather shallow water environment. There is some evidence through the siltstones and shales of quiet water deposition in the Foster Well area. These fine grained clastics are found predominately in the lower Cambrian section which suggests the source area was still not high enough to provide coarse elastic materials to this region or perhaps the Foster Well area was too removed from the source area.

Erosive power and current velocity apparently increased into Upper Cambrian time. The occurrence of coarse sandstone in various parts of the Upper Cambrian section in the Foster Well might indicate that high land of Wisconsin was reaching its Cambrian climax in providing sediment for the Michigan "Basin". In general, the coarse clastic material suggests a turbulant or rough water environment which was restricted to shallow depth.

By constructing a number of sections based on deep wells in Michigan and surrounding states, the comparative structural position of the Foster Well was demonstrated. Figures 8 and 9 are sub-Trenton sections using the top of Trenton limestone as the datum plane. These sections in effect restore the picture to the approximate conditions at the time of Trenton sedimentation. It would appear

the Foster Well area was very close to the center of sinking basin area or a low (pocket) in the Precambrian surface. A structure section (Figure 11) from southeast of the basin to the Foster Well indicates the position of the Foster Well compared to sea level. This section also shows the low structural position of the Foster Well area.

Evaporites occur in the Foster Well in thicknesses considered unusually great for Cambrian rocks in the general Michigan Basin area. Gypsum and anhydrite infer normal salinity, and greater salinity leads to precipitation of halite. Existance of sodium chloride crystals in this well indicate at least a temporary salinity greater than normal. There is no reason to indicate that in Cambrian time, an arid condition prevailed in the Michigan "Basin" area, a condition often assigned to evaporite sedimentation. If arid conditions are necessary, it is then difficult to account for the apparently local concentration of high evaporites in the Cambrian of the Foster Well. The occurrence of the abundant evaporites in the structurally low Foster Well may prove more than coincidence when comparisons are made to the studies of Pennington (1967) and Yettaw (1967). The Wooden No. 1 Well studied by the former is lower structurally and has a higher evaporite content than the Security-Thalmann No. 1 Well studied by the latter, which is structurally higher and has a lower evaporite content. Should additional studies show similar correlations, speculation would be strengthened indicating lower areas (pock-

ets) in the Cambrian sea floors being areas of poorer circulation and higher saline waters.

Observation of the above mentioned maps, also indicate a thickening of certain units into the Foster Well area, which is compatable with the lower structural (basinal) position of this area. Questions arise as to the time of major settling of the true Michigan Basin, generally believed to be in the Salina (Silurian) time. It is more reasonable to assume that the "highs" and "lows" of the Cambrian floor more likely reflect the basement erosional surface and possibly structural elements such as has been noted by Lockett (1947) and Asseez (1967) that may have been inherited from the Precambrian. Thus the exceptionally low structural position of the Foster Well Cambrian could reflect one of the extreme lows in the Precambrian topography as opposed to the alternate consideration that it represents the center and therefore the lowest part of a true basinal structure. Thus until additional deep well data are available, it may be difficult to say whether the conditions as inferred from Figures 5, 6, and 7 more closely represent the picture than that inferred from Figures 8, 9, 10 and 11.

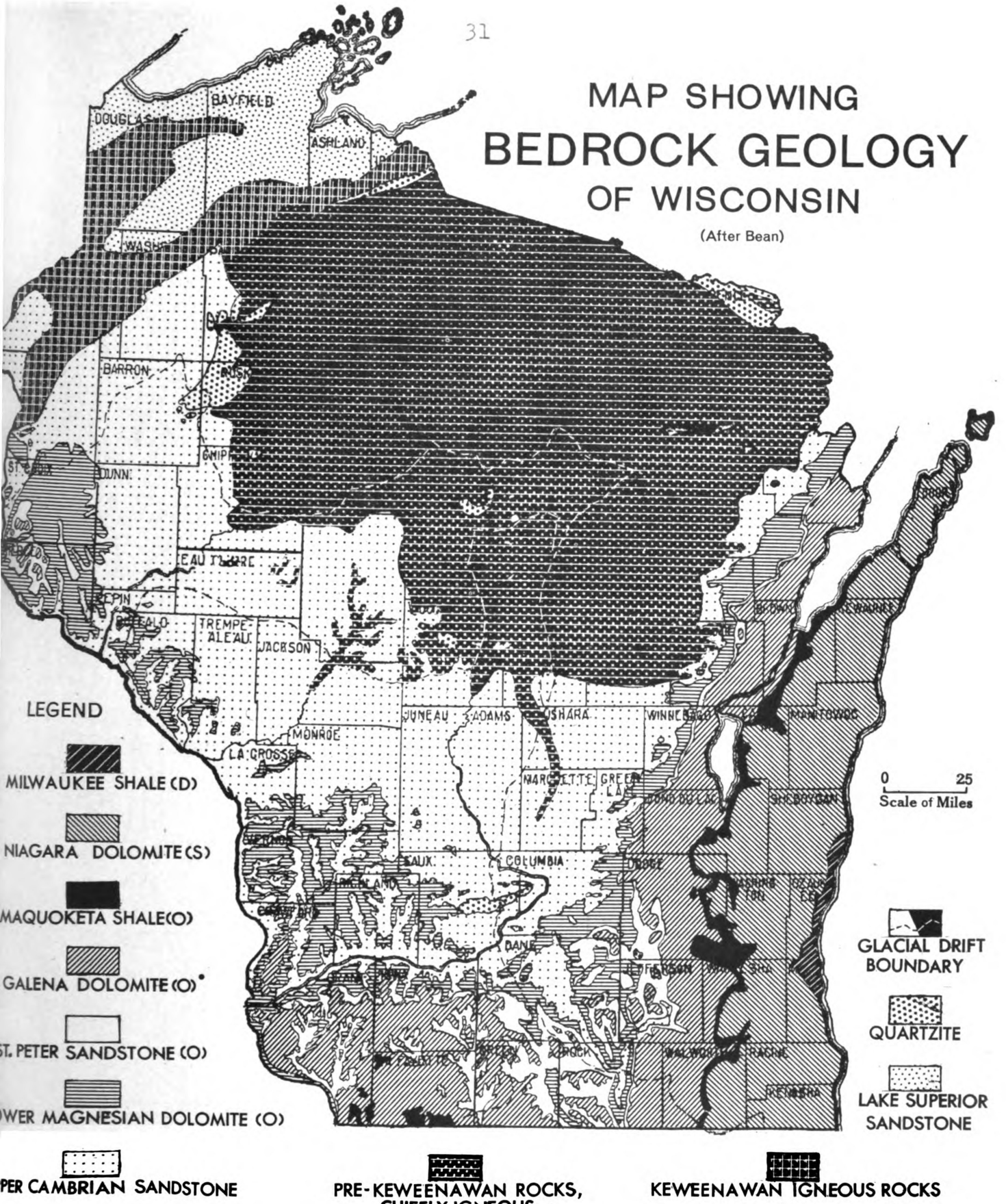

MAP SHOWING
BEDROCK GEOLOGY
OF WISCONSIN
(After Bean)
DOUGLAS
BAYFIELD
ASHLAND
BARRON
DUNN
EAU CLAIRE
PEPIN
BUFFALO
TREMPE-ALEAU
JACKSON
MONROE
LA CROSSE
JUNEAU
ADAMS
WAUSHARA
WINNEBAGO
MANITOWOC
MARQUETTE
GREEN LAKE
FOND DU LAC
SHEBOYGAN
SAUK
COLUMBIA
DODGE
DANE
JEFFERSON
ROCK
WALWORTH
RACINE
KENOSHA
LEGEND
MILWAUKEE SHALE (D)
NIAGARA DOLOMITE (S)
MAQUOKETA SHALE (O)
GALENA DOLOMITE (O)*
ST. PETER SANDSTONE (O)
LOWER MAGNESIAN DOLOMITE (O)
UPPER CAMBRIAN SANDSTONE
PRE-KEWEENAWAN ROCKS, CHIEFLY IGNEOUS
KEWEENAWAN IGNEOUS ROCKS
0 25
Scale of Miles
GLACIAL DRIFT BOUNDARY
QUARTZITE
LAKE SUPERIOR SANDSTONE
SOILS DIV., WISC. GEOL. AND NAT. HIST. SURV.
* and Platteville.
Note: In legend, left, formations are in order of age, youngest at top.
F.D.H., 1950

Figure 4

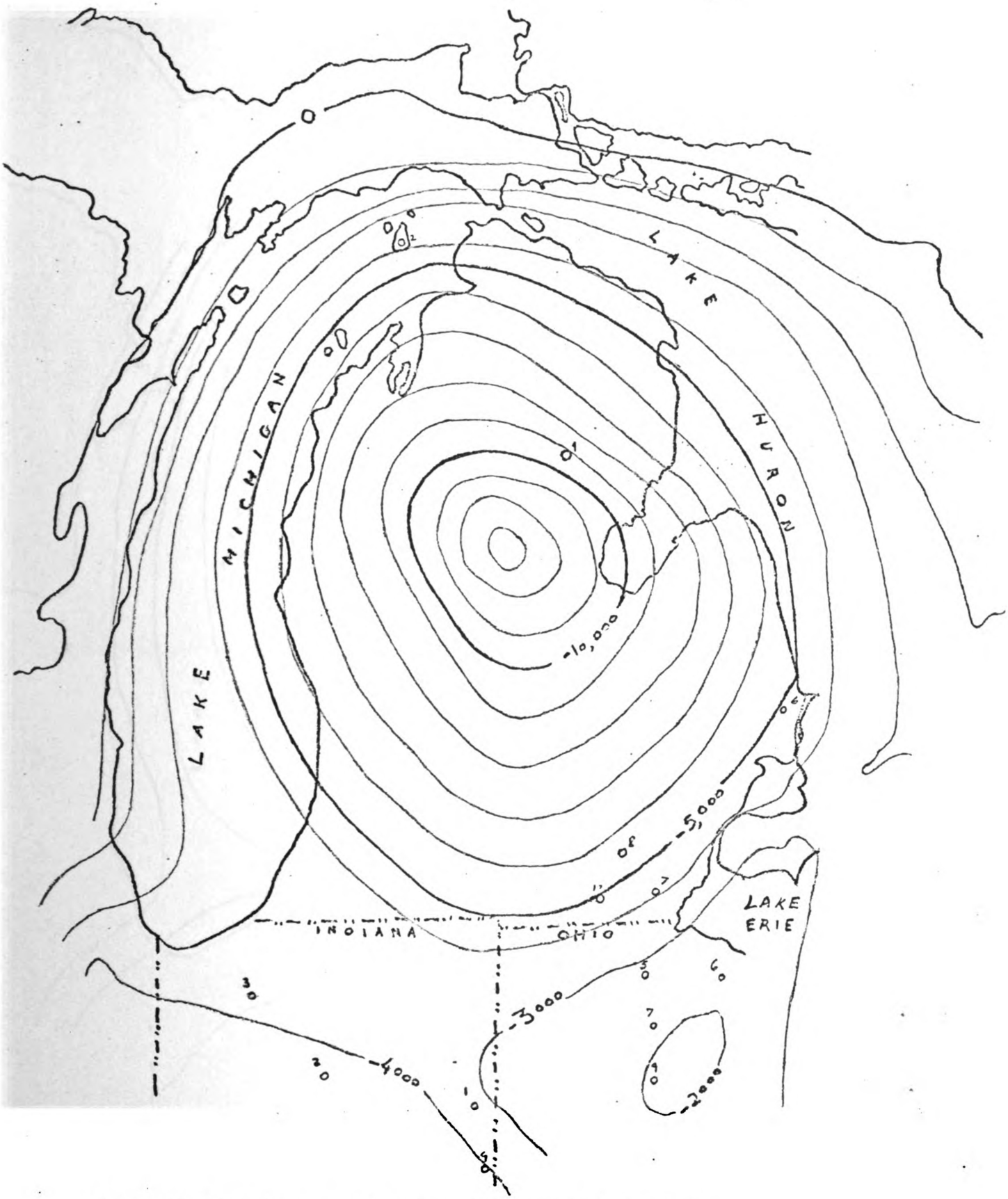


Figure 5--Structure contour map of Precambrian surface
(after Cohee 1948)

Figure 6—Structure contour map of Upper Cambrian surface

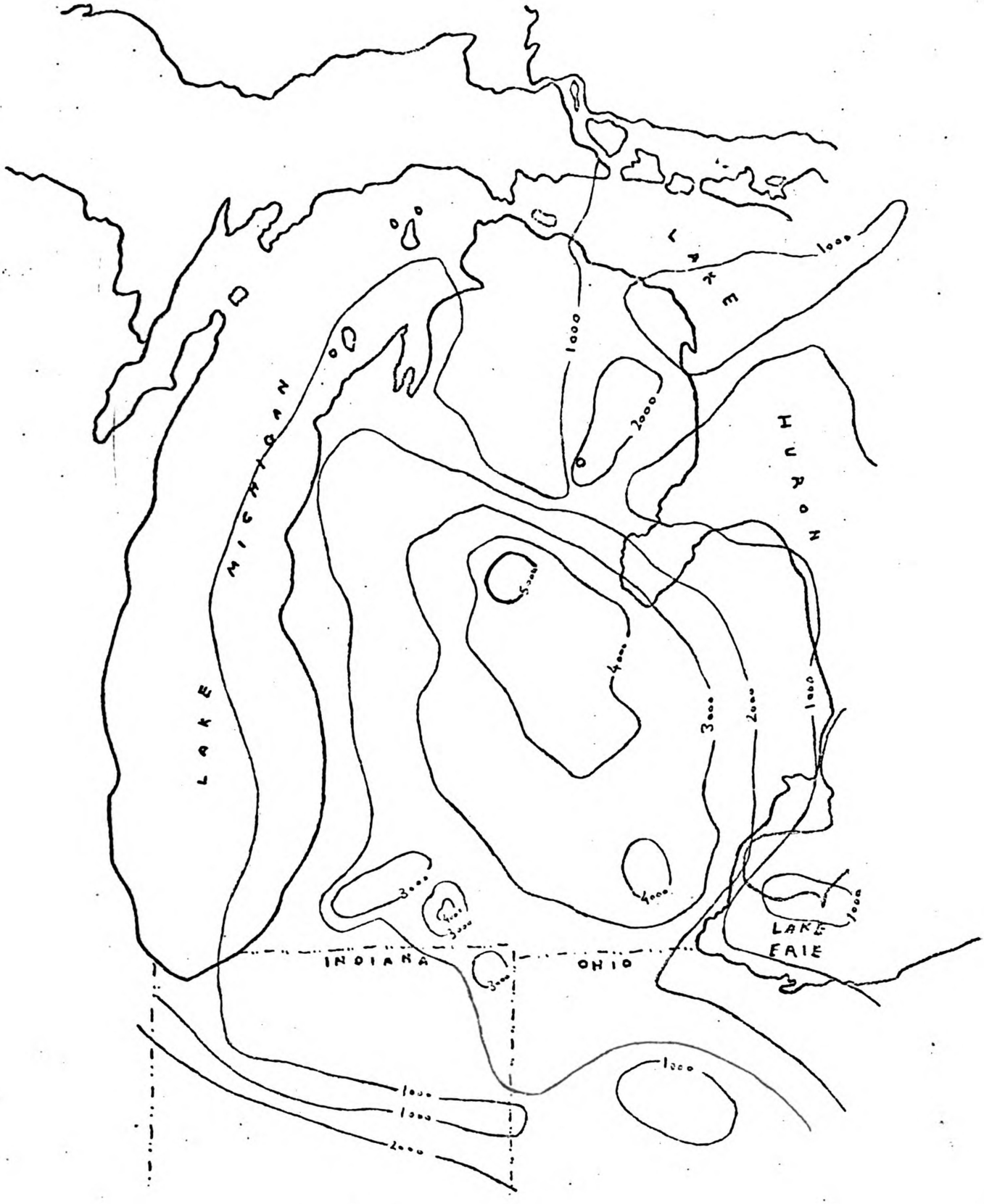


Figure 7--Isopach Map--Upper Cambrian

CONCLUSION

A comprehensive lithologic study of cuttings and core from rotary drilling in Ogemaw County, Michigan, using petrographic, mineralogic and sedimentary techniques was attempted. A paleontologic study was not undertaken in this work other than to note occurrences of megascopic fossiliferous zones.

Cambrian system starts at 10,480 feet in depth in this well. The tentative correlations are based primarily on the gamma ray-neutron log, general stratigraphic position, lithologic and heavy mineral similarities.

The proposed classification of the stratigraphic units of the Upper Cambrian Foster Well tend to be in harmony with those which are found in different literature. The five formations are not sharply separated vertically by abrupt changes in lithology. The members of Trempealeau recognized in Wisconsin and western Northern Michigan are not recognized in this well. The five major units are also recognized in gamma ray-neutron logs and are compared with logs of southern Michigan Basin. Trempealeau is thickest and Franconia is thinnest of the units in this well. Total thickness of these five units is 2520 feet, with only 150 feet of Upper Mount Simon. Trempealeau, Franconia, Dresbach and Eau Claire become thinner as they are traced toward the southeast and southwest of Michigan Basin. But Mount Simon is thicker in these areas. In general, every unit is predominately dolomitic except Franconia which is

mostly sandstone with minor dolomite. Eau Claire is characterized by high glauconite content.

The stratigraphic position of the rock at total depth has been a matter of debate. Based on reasonably close comparison of the lithology and gamma ray-neutron logs of the Foster Well with other deep wells, the writer believes that the upper 150 feet of the Mount Simon formation was penetrated.

Mount Simon, which represents quick vertical changes in facies, indicates regressive and transgressive shallow seas over a very short time. These transitions are observed in almost all of the Upper Cambrian section of Foster Well. A high amount of carbonate rocks intermixed with sandstone indicate oscillation of a broad shallow sea. The quick transgressions and regressions of the sea, may be the result of small scale uplifts and downwarps in this area or simply eustatic movements.

Great thickness of several units in the Foster Well indicate low structure in this area, especially Trempealeau and Eau Claire, which were reported thinner in the southwestern portion of the Michigan Basin in a study by Pennington (1967). Clear lithologic and gamma ray-neutron log correlations were made between these two localities (Figure 8).

A trace of salt is noticed first in the upper part of the Eau Claire, increasing into the Dresbach. Wherever salt exists, it associates with other evaporite facies like anhydrite. Halite or rock salt was not observed definitely

as individual rock units in any of the formations except possibly the Trempealeau. This maximum concentration of salt was 80 percent for 20 feet, almost in the middle of Trempealeau. The higher ratio of rock to salt was 50 feet with 30 percent salt, in the upper part of Dresbach and the lower part of Franconia. The increase of salt and its occurrence with anhydrite towards the upper part of the Cambrian section is an indication of more precipitation of salt due to decrease of volume of water and possibly shallowing of the seas and increase in the rate of evaporation, which is characteristic of shallow shelf water.

Three major assumptions are proposed in this report for the environmental depositions of Upper Cambrian in Foster Well.

The first approach is directed toward the structural basin. Thickening formations toward Foster Well area, may indicate that the whole basin area started to sink at this time; but as mentioned earlier there is no other reason to support this approach until Salina (Silurian) time.

The second approach is indication of near-shore evaporite conditions. The processes of this type sedimentation can be completed in lagoon type environment or areally restricted bay which is characterized by shallow water, poor circulation and proximity to the shoreline. In this type environment, high evaporation causes high concentration of salt water. The marginal position of the Foster

Well in the Cambrian could then account for the higher saline content.

The third interpretation which is also in harmony with low structure of the Foster Well region is that there was probably a pocket form location, which may be the result of topography of Precambrian floor in the edge of the basin with relatively deeper water, which was characterized by having submarine restriction, may be below the reach of wave base, with no or very weak circulation to dilute the salines which built up to supersaturation and subsequently salt precipitation.

In conclusion, it is generally agreed that the increase in carbonate components and existance of salt and anhydrite in the upper units of Foster Well, indicates an isolated evaporite environment for at least the east side of the Michigan "Basin", in which dolomite was deposited in both transgressive and regressive seas. Increasing sand toward the Wisconsin sections indicates that the source area for these sediments was toward the northwestern portion of the Michigan "Basin" in the Upper Cambrian time. Additional studies need to be done, in order to understand fully the environmental deposition in this area.

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APPENDIX A

Lithologic Description of Samples

DETAILED DESCRIPTION OF THE SAMPLES

The following description covers the section from the Black River, Ordovician, to the bottom of the well in low Upper Cambrian. Well cuttings taken at five-foot intervals in the well were compared to core chips from 11,640 feet to 12,345 feet. From 12,345 feet to the bottom of the well at 12,995 feet, only core chips were studied.

ORDOVICIAN

Mohawkian Series:

Black River Group

10,000-10,030. Limestone, chalky, finegrained, dark brown to buff; considerable dolomite; some shale and crystalline calcite; brachiopod fragment, hematite, siderite; little oil stain.

10,030-10,050. Limestone, as above, except, light brown in color; little increase in dolomite.

10,050-10,065. Limestone, as above, except, brown to dark brown, increase in crystalline calcite; shale dolomitic, minor amount; a few chips of white quartz-siltstone; large amounts of brachiopod fragments; limonite, some hematite.

10,065-10,105. Limestone, light in color, cement of calcite; good percentage of dolomite; decrease in shale; couple crystals of quartz; a few crystals of calcite; one crystal of gypsum; some very small lines in big dolomite particles, may be stylolite; brachiopod fragment, iron oxide.

10,105-10,150. Limestone, brown, gray to buff, fine grain, a little chalky; good percentage of dolomite; increase in gypsum; little shale; small fragments of brachiopod, iron oxide, siderite.

10,150-10,165. Halite, 85% white crystalline salt; minor percentage is dolomite; limestone; a little gypsum; no fossil, oil stains on some dolomite grains.

10,165-10,190. Limestone, brown, brownish gray, chalky in part; couple grains of halite; minor shale and dolomite; brachiopod fragments; iron oxide.

10,190-10,240. Limestone, as above, except lighter in color; no halite; slight decrease in shale.

10,240-10,265. Limestone, brownish to dark gray, fine grained, chalky, dolomitic; a little shale; brachiopod fragments; very small pieces of gypsum.

10,265-10,310. Limestone, brownish gray to brown, fine grained; dolomite, high percentage; shale, minor; many brachiopod fragments; carbonaceous grain mixed with gypsum.

10,310-10,325. Limestone, as above, except, a few fragments of calcite crystals.

10,325-10,350. Limestone, brown, brownish gray to buff, fine grained, dolomitic; a few crystals of calcite; brachiopod fragments and oil stains on a few dolomite grains.

10,350-10,375. Limestone, color a little lighter than unit above, fine grained; brachiopod fragments; small percentage of dolomite; very few salt grains.

10,375-10,395. Limestone, darker, fine grained; increase in dolomite; couple grains of amorphous quartz; a brachiopod fragment; few grains of hematite.

10,395-10,415. Limestone, dark gray, fine grained, some high porosity limestone due to vugs; good percentage of dolomite; brachiopod fragments; oil stain on some dolomitic grains.

10,415-10,440. Dolomite, gray, very dark to black; predominantly limestone; gypsum crystals covered some dolomite grains; minor shale; brachiopod fragments, iron oxide.

Glenwood Sandstone:

10,440-10,460. Dolomite, very dense; high percentage of limestone; some shale; hairline fractures on some dolomitic grains are covered by gypsum; trace of sandstone, frosted, fine to medium, angular to subangular, white; brachiopod fragments, iron oxide, pyrite.

Chazyan Series

St. Peter Sandstone:

10,460-10,480. Dolomite, intermixed with shale, very dense, gray to black, unfossiliferous, some medium size, white, highly rounded sandstone, iron oxide, oil stains on some dolomite grains.

CAMBRIAN

St. Croixan Series

Lake Superior Group

Trempealeau Formation:

10,480-85. Dolomite, brownish gray to black, with some crystalline texture, hairline fractures on some dolomite are filled by gypsum; some limestone; little shale; increase in sandstone component; white, fine grained, rounded to subrounded quartz; brachiopod fragments, oil stain on some dolomite grains.
(dolomite 65%, limestone 20%, shale 5%, sandstone 5%)

10,485-90. Is missing.

10,490-95. Dolomite, gray brownish to black; fine grained limestone; calcareous shale; a little increase in sandstone (quartz), fine to medium, subangular to subrounded, white, some frosted; brachiopod fragments, iron oxide.
(dolomite 65%, limestone 15%, shale 5%, sandstone 8%)

10,495-10,500. Dolomite, entirely dark to black, increase in dolomite; decrease in sandstone; limestone; shale; a few pieces gypsum; no fossil, oil stain.
(dolomite 70%, limestone 20%, shale 5%, sandstone 2%)

10,500-05. Dolomite, as above, except, increase in sandstone; a few brachiopod fragments, iron oxide, a piece of muscovite.

10,505-10. Dolomite, brownish to light buff; much more increase in sandstone, white, frosted, fine grained; decrease in limestone and shale; brachiopod fragments, iron oxide, muscovite.
(dolomite 60%, limestone 10%, shale 5%, sandstone 15%)

10,510-15. Dolomite, gray to dark gray, black; fine grained limestone; shale; less sand than unit above; brachiopod fragments, limonite, green ferrous iron, muscovite.
(dolomite 65%, limestone 10%, shale 5%, sandstone 10%)

10,515-20. Dolomite, gray to light gray, buff; limestone; calcareous shale; hairline fracture on dolomite filled with gypsum; increase in sandstone, white, very strong frosted, fine grained to medium grained; couple white quartz-siltstone; limonite, oil stain.
(dolomite 55%, limestone 5%, shale 5%, sandstone 20%)

10,520-25. Dolomite, as above, except, amount of sand highly increased; can be called sandy dolomite. (dolomite 50%, limestone 5%, shale 5%, sandstone 30%)

10,525-30. Dolomite, as above, except, some ferrous iron with blue color.

10,530-35. Dolomite; minor limestone, is fine grained; shale; sandstone, white, fine grained to medium grained, most fine grain are rounded and some frosted; white quartz-siltstone; brachiopod fragments, iron oxide, glauconite.

10,535-40. Dolomite, as above, except, minor increase in sandstone.

10,540-45. Dolomite, gray to buff; sandstone, white, fine to medium grained, rounded, frosted, interlocked with some dolomite and some calcareous shale grains; brachiopod fragments, iron oxide; can be called sandy dolomite. (dolomite 50%, limestone 5%, shale 3%, sandstone 35%)

10,545-50. Dolomite, as above, except, slight increase in sandstone; some white quartz-siltstone; oil stain on some sand grains.

10,550-55. Sandy dolomite, increase in sandstone, white, highly frosted, angular and subangular; dolomite, mixed with some gypsum; iron oxide, limonite; very fine, soft, green glauconite chips; a few white quartz-siltstone grains. (dolomite 48%, limestone 5%, shale 2%, sandstone 40%)

10,555-60. Sandstone, white, fine to medium, mostly medium, a few coarse grains; very good percentage dolomite; some limestone; a few shale components; limonite, glauconite. (sandstone 50%, dolomite 40%, limestone 5%, shale 1%)

10,560-65. Sandstone, as above, except, quartz grains are entirely frosted; brachiopod fragments.

10,565-70. Sandstone, as above, except more increase in amount of sandstone; no fossil.

10,570-75. Sandstone, predominantly quartz, white, to light buff, frosted, fine to coarse, mostly medium grained; good percentage dolomite; some fine grained limestone, high porosity due to vugs; a few white quartz-siltstone grains; iron oxide, mostly limonite, oil stain. (sandstone 60%, dolomite 30%, limestone 5%, quartz-siltstone 2%)

10,575-80. Sandy dolomite; increase in dolomite, some hairline fractures filled out by gypsum; fine grained limestone; sandstone retain the same general characteristic; a few white quartz-siltstone; iron oxide, green, fine chips of glauconite. (dolomite 45%, limestone 10%, sandstone 40%)

10,580-85. Sandstone, as above, except, increase in amount of sandstone; brachiopod fragments, muscovite, small yellow mineral may be zercon.

10,585-90. Sandstone, as above, except, may be garnet, pyrite.

10,590-95. Sandy dolomite; carbonate component increase; sandstone retain the same general characteristic, some orange in color; a few white quartz-siltstone; oil stain, iron oxide, muscovite.
(dolomite 45%, limestone 5%, sandstone 40%, quartz-siltstone 2%)

10,595-10,600. Sandstone, highly increased in sandstone; quartz grains, yellow fine to medium grained, white coarse grained, fine grain well rounded, coarse grains subrounded, inclusion in some quartz grains; good percentage dolomite; some white quartz-siltstone; brachiopod fragments, pyrite, muscovite.
(sandstone 50%, dolomite 35%, limestone 5%, quartz-siltstone 2%)

10,600-05. Sandstone, as above, except, more increase in sandstone, quartz grains appear clear, colorless, yellow to orange.

10,605-10. Sandstone as above, except, red micaceous siltstone; brachiopod fragments.

10,610-15. Sandstone, not too much different from unit above, except, gypsum coated dolomite grains; limonite, may be garnet mineral, may be magnetite.

10,615-20. Sandstone, different colors of quartz, white to yellow, fine to coarse, predominantly medium size, rounded to subrounded; red micaceous siltstone; a little white quartz-siltstone; dolomite, come coated by fine, soft gypsum of anhydrite chips; iron oxide, glauconite, pyrite.
(sandstone 55%, dolomite 35%, limestone 5%, quartz-siltstone 3%)

10,620-25. Sandstone, as above, except, more increase in amount of sandstone; couple coarse crystals of quartz.

10,625-30. Sandstone, as above, except, increase in amount of white quartz-siltstone.

10,630-35. Sandstone, as above, except, inclusions in some quartz grains; one small brachiopod fragment, couple big pieces of limonite.

10,635-40. Sandstone, quartz grains retain the same general characteristic; dolomite decrease; a red clay particle; amount of white quartz-siltstone decrease; brachiopod fragments, glauconite, iron oxide mixed with oil stain.
(sandstone 55%, dolomite 30%, limestone 5%, quartz-siltstone 5%)

10,640-45. Sandstone, as above, except, increase in amount of iron oxide.

10,645-50. Sandstone, as above, except, couple big crystals of calcite; hairline fracture on some dolomite particles.

10,650-55. Sandstone, as above, except, no crystal of calcite.

10,655-60. Sandstone, as above, except, light increase in amount of dolomite; brachiopod fragments.

10,660-65. Sandy dolomite; increase in amount of dolomite; limestone; sandstone is minor component; one shale particle with good fissility; sand grains retain the same general appearance, size, shape; a little white quartz-siltstone; brachiopod fragments.
(dolomite 50%, limestone 8%, sandstone 35%, quartz-siltstone 5%)

10,665-70. Sandy dolomite; as above, except, a little decrease in dolomite.

10,670-75. Sandy dolomite; not much change, predominantly dolomite, some hairline on dolomite grains; sandstone minor component, mostly frosted; limonite, hematite.

10,675-80. Dolomite, brown, brownish gray to buff; some limestone particles; some quartz grains, fine grained, some medium size, rounded, some subrounded, different colors of quartz; some white quartz-siltstone; iron oxide, pyrite.
(dolomite 50%, limestone 5%, sandstone 35%, quartz-siltstone 5%)

10,680-85. Dolomite, some coated by soft gypsum; quartz grains retain the same characteristic; brachiopod fragments, glauconite.

10,685-90. Dolomite, as above, except no fossil.

10,690-95. Dolomite, as above, except a little increase in sandstone; a piece of red micaceous siltstone.

10,695-10,700. Dolomite, as above, except much decrease in amount of white, quartz-siltstone; hairline fracture in some dolomite.

10,700-05. Dolomite, increase in dolomite again; quartz grains with orange color, almost poor sorted; couple pieces of red micaceous ciltstone.
(dolomite 55%, limestone 5%, sandstone 30%, quartz-siltstone 5%)

10,705-10. Is missing.

10,710-15. Dolomite, more increase in dolomite, tend to be dark; couple pieces of shale; few pieces of limonite, oil stain on some dolomite grains.

10,715-20. Dolomite, predominantly dolomite, hairline fractures filled with gypsum; good sorted sandstone, orange to yellow, fine grained, some inclusion in quartz; some white quartz-siltstone; muscovite, iron oxide, can be called sandy dolomite.
(dolomite 55%, limestone 5%, sandstone 30%, quartz-siltstone 4%, shale 2%)

10,720-25. Sandy dolomite, increase in sandstone; other components retain the same as unit above, except no muscovite.

10,725-30. Sandstone, predominantly sandstone (quartz grains), mostly fine grained, some medium size, white, some smoky quartz, some frosted; limonite, hematite, pyrite.
(sandstone 50%, dolomite 30%, limestone 5%, quartz-siltstone 5%)

10,730-35. Sandstone, quartz grains predominantly orange, pink couple limestone particles with crystalline texture; iron oxide.

10,735-40. Sandstone, increase in sandstone, quartz grains with different colors; dolomite, gray to buff; couple red micaceous siltstones, some white quartz-siltstone.
(sandstone 52%, dolomite 25%, limestone 5%, quartz-siltstone 5%)

10,740-45. Sandstone, as above, except no red micaceous siltstone.

10,745-50. Sandstone, as above.

10,750-55. Sandstone, increase in white, colorless quartz, decrease in white quartz-siltstone.

10,755-60. Sandstone, as above, except some may be garnet, pyrite.

10,760-65. Sandstone, light increase in dolomite, brownish to buff; couple big crystals of calcite; can be called dolomitic sandstone.
(sandstone 50%, dolomite 35%, limestone 8%, quartz-siltstone 3%)

10,765-70. Sandstone, quartz increase, characteristic retain the same size, shape, color; most dolomite particles coated by gypsum, soft white; a few pieces of shale.
(sandstone 50%, dolomite 35%, limestone 8%, quartz-siltstone 3%, shale 2%)

10,770-75. Sandstone, as above, except, a few crystals of calcite look like quartz grains; no shale; brachiopod fragments, a few pieces of iron oxide.

10,775-80. Sandstone, as above, except couple white gray calcareous particles which could be marl; muscovite.

10,780-85. Sandstone, increase in dolomite again, very thin hairline on some dolomite grains; decrease in white quartz-siltstone; brachiopod fragments, iron oxide, oil stain on a few dolomite particles, can be called dolomitic sandstone.
(sandstone 40%, dolomite 40%, limestone 5%, quartz-siltstone 3%)

10,785-90. Sandstone; decrease in dolomite; sandstone, different colors predominantly fine grained, rounded to angular, white quartz grains are more angular; a few crystals of calcite, fine grain, white; limonite, a piece of fine, soft, green mineral, may be ferrous iron or glauconite, may be tourmaline.
(sandstone 50%, dolomite 30%, limestone 10%, quartz-siltstone 5%)

10,790-95. Sandstone, as above, except a little increase in sandstone; no glauconite.

10,795-10,800. Sandstone, much increase in sandstone; oil stain on some quartz grains.
(sandstone 55%, dolomite 28%, limestone 6%, quartz-siltstone 8%)

10,800-05. Sandstone, most white, colorless quartz grains, some orange to pick, fine grained, subangular to rounded, couple smokey quartz; characteristic of dolomite retain the same as above; a few fine crystals of calcite; decrease in white quartz-siltstone; oil stain on quartz and dolomite grains, iron oxide, trace of salt.
(sandstone 50%, dolomite 28%, limestone 10%, quartz-siltstone 5%)

10,805-10. Sandstone, white, pink, fine to coarse grained, rounded and frosted, intermixed with some dolomite, brown to buff, very fine crystalline; a few limestone particles, brownish gray; some white or colorless quartz-siltstone; some salt.
(sandstone 40%, dolomite 25%, salt 10%, limestone 10%, quart-siltstone 5%)

10,810-15. Dolomite; much increase in salt, light brown to buff, some perfect cube crystalline; one very large piece of calcareous particle.

10,815-20. Dolomite, as above, except more increase in salt.
(salt 35%, dolomite 25%, sandstone 15%, limestone 10%, quartz-siltstone 5%)

10,820-25. Halite, as above, except more increase in salt, with large particles.
(salt 65%, dolomite 20%, limestone 5%, quartz-siltstone 5%, sandstone 5%)

10,825-30. Halite, much more increase in salt, buff, white, colorless, a few orange, pink, some oil stain on salt grains; high decrease in dolomite.
(salt 80%, dolomite 10%, quartz-siltstone 5%, sandstone 3%, limestone 2%)

10,830-35. Halite, as above, except light increase in dolomite; couple very large crystals of salt.

10,835-40. Halite, increase of salt again.

10,840-45. Halite, as above.

10,845-50. Dolomite; much decrease of salt; predominantly dolomite, frosted, some hairline fractures; some white sandstone, fine to medium; white quartz-siltstone; a few fine crystals of calcite.
(dolomite 60%, sandstone 15%, calcareous shale 5%, quartz-siltstone 5%, salt 3%)

10,850-55. Halite, again, increase in salt; dolomite minor component; a little green micaceous shale.
(salt 60%, dolomite 20%, sandstone 5%, quartz-siltstone 5%, shale 5%)

10,855-60. Dolomite, predominantly dolomite, gray to dark brown; some salt; a few sandstone particles; green, smooth shale; white quartz-siltstone.
(dolomite 80%, salt 10%, shale 5%, sandstone 3%, quartz-siltstone 2%)

10,860-65. Dolomite, as above, except a little increase in dolomite.

10,865-70. Dolomite; some crystalline calcite; brachiopod fragments; no salt.
(dolomite 85%, shale 8%, sandstone 3%, quartz-siltstone 2%)

10,870-75. Dolomite, as above, except a little increase in green shale; some hairline fractures on dolomite; much decrease in white quartz-siltstone; limonite.

10,875-80. Dolomite, as above, except a little increase in sandstone; one big crystal of gypsum; some green shale; oil stain on dolomite.
(dolomite 80%, shale 5%, sandstone 5%, quartz-siltstone 2%)

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10,880-85. Dolomite, as above, except a light increase in sandstone.

10,885-90. Dolomite, predominantly dolomite, most show hairline fractures, dark; some green shale; some minor sandstone (quartz) frosted, fine grain, subrounded; couple white quartz-siltstone, muscovite.
(dolomite 77%, shale 6%, sandstone 10%, quartz-siltstone 2%)

10,890-95. Dolomite; increase in sandstone; carbonate rock with crystalline texture; more green shale; may be garnet, magnetite.

10,895-10,900. Dolomite, as above, except brachiopod fragments, no opaque mineral.

10,900-05. Dolomite, predominantly dolomite, gray to buff, some hairline fracture filled by gypsum; increase in sandstone, general characteristic retain the same before, size, shape, color; decrease in green shale; white quartz-siltstone; limonite, oil stain.
(dolomite 70%, sandstone 15%, shale 6%, quartz-siltstone 2%)

10,905-10. Dolomite, as above, except quartz grains tend to show orange to pink in color rather than white; dolomite is still major component; a few fine grains of limestone.

10,910-15. Dolomite; salt appears again, light brown to buff; green shale; some quartz grains.
(dolomite 60%, salt 20%, shale 10%, sandstone 7%, limestone 3%)

10,915-20. Dolomite; salt disappear; much increase in sandstone; green shale; a couple white quartz-siltstone; some limestone; iron oxide, oil stain.
(dolomite 70%, shale 10%, sandstone 15%, limestone 5%)

10,920-25. Dolomite, some coated by gypsum; a little increase in limestone; increase in white quartz-siltstone; characteristic of sandstone, retain the same as before; one grain of salt; oil stain.

10,925-30. Dolomite, as above, except light increase in sandstone; no green shale; high porosity limestone particle due to vugs; limonite.

10,930-35. Sandy dolomite, increase in sandstone, fine grained, some medium grained, white to orange, pink, rounded, a few angular; dolomite is still major component; green shale; white quartz-siltstone; brachiopod fragments, iron oxide, muscovite.
(dolomite 65%, sandstone 20%, shale 5%, limestone 7%, quartz-siltstone 3%)

10,935-40. Sandy dolomite, as above, except some limestone with crystalline texture, no muscovite.

10,940-45. Dolomite, predominantly dolomite, fine crystalline; sandstone, fine grained, mostly orange to red; green shale; some white quartz-siltstone; brachiopod fragments. (dolomite 65%, sandstone 20%, shale 5%, limestone 7%, quartz-siltstone 3%)

10,945-50. Dolomite, as above, except no fossil, oil stain on dolomite and quartz grains.

10,950-55. Dolomite, as above, except a little increase in sandstone, orange to pink.

10,955-60. Dolomite, dolomite is still major component, gray to dark gray, most grains have hairline fractures; a little increase in white quartz-siltstone; quartz grains, fine, mostly orange in color, rounded to subangular; green shale; oil stain, limonite, muscovite.
(dolomite 60%, sandstone 20%, shale 4%, limestone 5%, quartz-siltstone 5%)

10,960-65. Sandy dolomite, much increase in sandstone, one big crystal of quartz; small seam of calcite in dolomite.

10,965-70. Sandy dolomite, as above, except increase in dolomite again.

10,970-75. Dolomite, predominantly dolomite; amount of sandstone goes up again, characteristic of quartz retain the same; green shale; white quartz-siltstone; trace of salt; can be called sandy dolomite.
(dolomite 55%, sandstone 25%, shale 5%, limestone 8%, quartz-siltstone 6%)

10,975-80. Dolomite, as above, except no salt; brachiopod fragments.

10,980-85. Dolomite, as above, except a little increase in sandstone; limonite.

10,985-90. Sandy dolomite; increase in quartz grains; green shale; white quartz-siltstone; a piece of micaceous siltstone; limonite, muscovite.
(dolomite 50%, sandstone 30%, limestone 5%, shale 3%, quartz-siltstone 6%)

10,990-95. Sandy dolomite, as above, except couple big crystals of quartz; a small crystal of gypsum.

10,995-11,000. Dolomite, dolomite increase again; brachiopod fragments, iron oxide.
(dolomite 65%, sandstone 20%, limestone 4%, shale 2%, quartz-siltstone 4%)

11,000-05. Dolomite, brownish to dark gray, some hairline fractures; quartz grains, white to orange in color, fine to coarse grained, mostly rounded; very few white quartz-siltstone; limestone; crystalline calcite, oil stain, limonite, pyrite.
(dolomite 70%, sandstone 20%, limestone 4%, shale 2%, quartz-siltstone 2%)

11,005-10. Dolomite, as above, except, light increase in sandstone; green shale; crystalline gypsum.

11,010-15. Dolomite, as above, except couple pieces of yellow to pink crystalline calcite.

11,015-20. Dolomite; halite, very good percentage of salt; brachiopod fragments.
(dolomite 65%, sandstone 10%, salt 8%, limestone 3%, shale 3%, quartz-siltstone 5%)

11,020-25. Dolomite, a little decrease in dolomite; amount of salt retain the same; calcite seam in dolomite; iron oxide, pyrite.

11,025-30. Dolomite; increase in quartz grains; salt still the same; a little increase of green shale; a heavy, yellow mineral, may be zircon, limonite.
(dolomite 60%, sandstone 15%, salt 10%, shale 5%, quartz-siltstone 3%)

11,030-35. Dolomite, as above, except a little decrease in salt; couple crystalline calcite.

11,035-40. Dolomite, as above, except a little increase in sandstone; a few salt particles; mollusc (cornularia).

11,040-45. Dolomite, much increase in dolomite, dark; a few limestone particles intermixed with salt; sandstone, white, fine grained, rounded; white quartz-siltstone; crystalline calcite; red micaceous siltstone, iron oxide.
(dolomite 70%, sandstone 10%, salt 5%, shale 2%, limestone 3%, quartz-siltstone 2%)

11,045-50. Dolomite, as above, except a little increase in sandstone; still some salt; brachiopod fragments; mollusc (tentaculitco).

11,050-55. Dolomite, as above, except red micaceous siltstone; no fossil.

11,055-60. Dolomite, as above, except light increase in sandstone; disappearance of salt; fine, soft, green mineral, tourmaline, glauconite.
(dolomite 85%, sandstone 15%, limestone 5%, shale 3%, quartz-siltstone 5%)

11,060-65. Dolomite, as above, except a little increase in sandstone; some crystalline calcite.

11,065-70. Dolomite, as above.

11,070-75. Dolomite, increase in dolomite, brownish buff to dark gray; quartz grains retain the same, size, shape, color; some white quartz-siltstone; a little crystalline calcite; some hairline fractures on dolomite grains; iron oxide, oil stain.
(dolomite 70%, sandstone 12%, limestone 8%, shale 2%, quartz-siltstone 5%)

11,075-80. Dolomite, as above, except a little increase in crystalline calcite; brachiopod fragments.

11,080-85. Dolomite; halite, very good percentage of salt, colorless to buff; dolomite, dark; quartz grains the same as above; some crystalline calcite; white quartz-siltstone; couple green shale.
(dolomite 55%, salt 15%, sandstone 5%, limestone 10%, shale 3%, quartz-siltstone 5%)

11,085-90. Dolomite, as above, except salt disappears; sandstone increased.

11,090-95. Dolomite, as above, except very good percentage of salt again.
(dolomite 45%, salt 35%, sandstone 5%, limestone 5%, shale 2%, quartz-siltstone 3%)

11,095-11,100. Dolomite, as above, except decrease in salt; a few green shale.

11,100-05. Sandy dolomite; more decrease in salt; a little increase in white quartz-siltstone; quartz grains, white, colorless, fine grained, rounded to subrounded; some crystalline calcite; dolomite still major component, gray to brownish gray; couple green shale; limonite.
(dolomite 50%, salt 15%, sandstone 20%, limestone 5%, quartz-siltstone 10%)

11,105-10. Sandy dolomite, as above, except disappearance of salt; a little increase in sandstone; green shale.

11,110-15. Sandy dolomite, as above.

11,115-20. Sandy dolomite, as above, except brachiopod fragments, iron oxide, some oil stain.

11,120-25. Dolomite, increase in dolomite; increase in amount of iron oxide, no fossil; red micaceous siltstone.

11,125-30. Dolomite, as above, except more increase in iron oxide.

11,130-35. Dolomite, as above, except a little gypsum intermixed with calcite; no green shale.

11,135-40. Dolomite, as above, except a little increase in dolomite.

11,140-45. Dolomite, dark; decrease in sandstone; other components retain the same.

11,145-50. Dolomite, as above, except decrease in iron oxide; couple white quartz-siltstone; may be garnet, pyrite.

11,150-55. Dolomite, predominantly dolomite, some frosted, gray to dark brown, some with hairline fractures; decrease in sandstone, fine grained, some coarse grained, white, colorless, frosted, rounded; crystalline calcite; white quartz-siltstone; iron oxide.
(dolomite 70%, sandstone 15%, limestone 5%, quartz-siltstone 5%)

11,155-60. Dolomite; halite, good percentage of salt; some pink to red quartz grains; oil stain; a little increase in iron oxide.
(dolomite 65%, sandstone 12%, salt 8%, limestone 5%, quartz-siltstone 3%)

11,160-65. Dolomite; increase in salt.
(dolomite 60%, sandstone 5%, salt 20%, limestone 3%, quartz-siltstone 2%)

11,165-70. Dolomite, as above.

11,170-75. Halite, salty dolomite, very fine, white grain to yellow, coarse grained salt; good percentage of iron oxide.
(salt 50%, dolomite 25%, sandstone 3%, limestone 3%, iron oxide 9%)

11,175-80. Halite, as above, except some green shale.

11,180-85. Sandy dolomite; the amount of salt decreases, very fine grained, dusty, salt; quartz grains, with a little calcite mixed together; dolomite retain the same general characteristic.

11,185-90. Sandy dolomite, as above, except disappearance of salt.

11,190-95. Sandy dolomite, as above, except some grains of salt again.
(dolomite 65%, sandstone 15%, salt 4%, limestone 6%, quartz-siltstone 4%)

11,195-11,200. Dolomite; disappearance of salt; increase in dolomite, some iron oxide.

11,200-05. Dolomite, as above, except change in percentages.
(dolomite 80%, sandstone 8%, limestone 3%, quartz-siltstone 5%)

11,205-10. Dolomite, as above, except a small piece of brown mica.

11,210-15. Is missing.

11,215-20. Dolomite; salt again, all particles of components are broken to very fine pieces, like dust, muscovite.
(dolomite 65%, sandstone 10%, limestone 5%, salt 5%, quartz-siltstone 5%)

11,220-25. Sandy dolomite, disappearance of salt; a little increase in sandstone; limonite, muscovite.

11,225-30. Sandy dolomite, as above, except a big piece of muscovite.

11,230-35. Sandy dolomite, as above, except green shale; brachiopod fragments.

11,235-40. Sandy dolomite; quartz grains; crystalline calcite; white quartz-siltstone are broken similar to dust; dolomite retain the same general characteristic.

11,240-45. Sandy dolomite, all components are very fine, similar to dust.

11,245-50. Sandy dolomite, dark; with high percentage sandstone, fine grained, rounded, frosted; some crystalline calcite intermixed with sandstone; some white quartz-siltstone; oil stain, some iron oxide.
(dolomite 60%, sandstone 20%, limestone 5%, shale 2%, quartz-siltstone 5%)

11,250-55. Sandy dolomite, as above, except pyrite.

11,255-60. Sandy dolomite, as above, except a little increase in sandstone; brachiopod fragments.

11,260-65. Sandy dolomite, as above, except some pink to orange quartz; no fossil.

11,265-70. Sandy dolomite, as above, except green shale. (dolomite 55%, sandstone 25%, limestone 5%, shale 3%, quartz-siltstone 5%)

11,270-75. Sandy dolomite, as above, except no green shale; predominantly orange grains of quartz; a little increase in sandstone.

11,275-80. Sandy dolomite, as above, except more increase in sandstone; may be garnet, pyrite.
(dolomite 53%, sandstone 30%, limestone 3%, shale 2%, quartz-siltstone 3%)

11,280-85. Sandy dolomite, as above, except some dolomite particles are coated by crystalline gypsum; glauconite.

11,285-90. Sandy dolomite, as above, except increase in white quartz-siltstone; most particles have oil stain.

11,290-95. Sandy dolomite, as above, except a little increase in sandstone.

11,295-11,300. Sandy dolomite; appearance of salt again; green shale; glauconite.
(dolomite 55%, sandstone 30%, limestone 4%, shale 2%, salt 2%, quartz-siltstone 3%)

11,300-05. Sandy dolomite, as above, except no salt.

11,305-10. Sandy dolomite, as above, except a little increase in sandstone; some iron oxide, pyrite.

11,310-15. Sandy dolomite, as above, except brachiopod fragments.

11,315-20. Sandy dolomite, all components are broken to very fine grains, similar to dust, except some dolomite particles.

11,320-25. Dolomite, predominantly dolomite, gray to brown, dark brown, some hairline fractures; sandstone retain the same general characteristic, size, shape, color; some white quartz-siltstone; some crystalline calcite; some iron oxide.
(dolomite 60%, sandstone 25%, limestone 5%, shale 2%, quartz-siltstone 5%)

11,325-30. Dolomite, as above, except some quartz with orange to pink color.

11,330-35. Dolomite, as above, except light increase in iron oxide.

11,335-40. Dolomite, as above, except a little increase in sandstone; and a brachiopod fragment.
(dolomite 57%, sandstone 30%, limestone 5%, shale 1%, quartz-siltstone 6%)

11,340-45. Dolomite, as above, except no fossil.

11,345-50. Dolomite, as above, except some salt; green shale.
(dolomite 55%, sandstone 25%, limestone 5%, salt 4%, quartz-siltstone 5%)

11,350-55. Dolomite; increase in green shale; couple big red to pink calcite crystals, dolomite retain the same; brachiopod fragments.

11,355-60. Sandy dolomite; halite, good percentage of salt; decrease in green shale.
(dolomite 55%, sandstone 20%, limestone 4%, salt 7%, quartz-siltstone 4%)

11,360-65. Sandy dolomite, as above, except very small seams of calcite inside the dolomite grains.

11,365-70. Sandy dolomite, as above, except a little increase in salt.

11,370-75. Dolomite, as above, except more increase in salt.
(dolomite 56%, salt 12%, sandstone 10%, limestone 5%, shale 2%, quartz-siltstone 5%)

11,375-80. Dolomite, as above.

11,380-85. Dolomite, as above, except brachiopod fragments.

11,385-90. Dolomite, much more increase in salt.
(dolomite 50%, salt 28%, sandstone 5%, limestone 5%, shale 1%, quartz-siltstone 4%)

11,390-95. Dolomite, as above, except a little decrease in salt.

11,395-11,400. Dolomite, as above, except amount of salt is made of large particles; a few green shale.

11,400-05. Dolomite, as above, except no salt.
(dolomite 60%, sandstone 20%, limestone 5%, shale 2%, quartz-siltstone 7%)

11,405-10. Dolomite, as above, except increase in sandstone; pyrite.

11,410-15. Sandy dolomite, very dark, some fractures; sandstone, fine grained, a few nedium; some colorful crystalline calcite; some white quartz-siltstone; chips hematite, limonite.
(dolomite 58%, sandstone 23%, limestone 6%, shale 2%, quartz-siltstone 8%)

11,415-20. Sandy dolomite, as above, except green shale.

11,420-25. Sandy dolomite, as above, except increase in sandstone.
(dolomite 48%, sandstone 30%, limestone 3%, shale 2%, quartz-siltstone 7%)

11,425-30. Sandy dolomite, as above, except more green shale; limonite, pyrite.

11,430-35. Sandy dolomite, as above, except no opaque mineral.

11,435-40. Sandstone, as above, except increase in sandstone; brachiopod fragments, muscovite, oil stain mixed with limonite.
(sandstone 50%, dolomite 30%, limestone 5%, shale 2%, quartz-siltstone 5%)

11,440-45. Salty dolomite, good percentage of salt, with large particles, light brown in color; sandstone is broken to very fine grains, similar to dust; dolomite retain the same general characteristic.
(salt 40%, dolomite 30%, sandstone 15%, limestone 3%, quartz-siltstone 3%)

11,445-50. Sandy dolomite; only one small particle of salt; dolomite, dark to gray; quartz grains mostly broken down; some white quartz-siltstone; a little crystalline calcite; big fractures on dolomites; oil stain, limonite.
(dolomite 48%, sandstone 25%, shale 1%, limestone 10%, quartz-siltstone 8%)

11,450-55. Sandy dolomite, increase in sandstone; a clay particle.
(dolomite 35%, sandstone 35%, limestone 10%, shale 1%, Quartz-siltstone 10%)

11,455-60. Sandy dolomite, as above, except a little increase in white quartz-siltstone.

11,460-65. Sandy dolomite, as above.

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11,465-70. Shale, dolomitic shale, brown to brownish gray, hairline fractures filled by gypsum; sandstone, the same general characteristic, size, shape, color; a white siltstone particle; green shale; limonite. (dolomitic shale 30%, dolomite 15%, sandstone 30%, limestone 10%, green shale 2%, quartz-siltstone 5%)

11,470-75. Dolomitic shale, as above, except, a little increase in sandstone; a big particle of salt; pyrite.

11,475-80. Shale, dolomitic shale, dark gray to black; some limestone; good percentage sandstone with the same characteristic; limonite, pyrite.

11,480-85. Shale, as above, except some white quartz-siltstone.

11,485-90. Halite, salt with other components are broken to very fine particles similar to dust. (salt 70%, dolomitic shale 16%, sandstone 5%, limestone 3%, quartz-siltstone 5%)

11,490-95. Halite, as above.

11,495-11,500. Halite, as above.

11,500-05. Dolomitic shale; much decrease in salt; still all components are powdered similar to dust; except some dolomite grains.

11,505-10. Dolomitic shale, as above.

11,510-15. Dolomitic shale, as above, except very little salt; increase in dolomitic shale.

11,515-20. Dolomitic shale, as above.

11,520-25. Dolomitic shale, as above, except no salt; some green shale.

11,525-30. Dolomitic shale, as above.

11,530-35. Halite, very good percentage of halite, big particles; other components are powdered similar to dust.

11,535-40. Halite, as above.

11,540-45. Halite, increase in salt. (salt 80%, dolomitic shale 15%, sandstone 3%, limestone 2%)

11,545-50. Dolomitic shale, as above, except decrease in amount of salt; other components are powdered; limonite, hematite.
(salt 40%, dolomitic shale 40%, sandstone 15%, limestone 3%, quartz-siltstone 2%)

11,550-55. Shale, dolomitic shale, dark brown to very black; some limestone; some sandstone, fine grained, white and rounded, oil stain, limonite.
(shale, dolomitic shale 90%, limestone 5%, sandstone 5%)

11,555-60. Shale, dark gray, brownish to black; some dolomitic shale; limestone; quartz-siltstone, some quartz, white, fine grained, rounded.
(shale, dolomitic shale 92%, limestone 3%, sandstone 3%, quartz-siltstone 2%)

11,560-65. Shale, as above, except iron oxide.

11,565-70. Shale; big pieces of salt; shale, dark gray to black; some sandstone; a little white quartz-siltstone.
(shale 50%, salt 30%, sandstone 8%, limestone 5%, quartz-siltstone 5%)

11,570-75. Dolomitic shale; no salt; black shale, dolomite; a little limestone; a few sandstone particles; some hairline fractures on dolomitic shale.
(shale, dolomitic shale 90%, limestone 5%, sandstone 3%, quartz-siltstone 1%)

11,575-80. Dolomitic shale, predominantly dolomite, gray to brown, not too dark; some gypsum on dolomite; some shale; a few quartz grains; a few white quartz-siltstone; some limestone; very small pieces of hematite, glauconite, oil stain.
(dolomite 60%, dolomitic shale 30%, limestone 5%, sandstone 3%, quartz-siltstone 2%)

11,580-85. Dolomitic shale, as above, except a little increase in shale.

11,585-90. Dolomitic shale, predominantly shale, dark gray to black; sandstone; a little limestone; a few white quartz-siltstone; limonite, oil stain.
(shale, dolomitic shale 88%, limestone 6%, sandstone 2%, quartz-siltstone 2%)

11,590-95. Dolomitic shale, as above, except a little increase in sandstone; a high porosity particle of limestone, due to vugs.

11,595-11,600. Dolomitic shale; predominantly dolomite with fine crystals of gypsum on them, brown to buff; some shale; some limestone; a few sandstone; a few white quartz-siltstone; limonite, some oil stain.
(dolomite 80%, shale 10%, limestone 5%, sandstone 3%, quartz-siltstone 2%)

11,600-05. Dolomite, as above, except increase in quartz grains.

11,605-10. Dolomite, as above, except more iron oxide.

11,610-15. Dolomite, predominantly dolomite, gray to brownish buff; some dolomitic shale; some limestone; crystalline calcite; a few quartz grains; couple white quartz-siltstone; oil stain.
(dolomite 80%, dolomitic shale 8%, limestone 7%, sandstone 2%, quartz-siltstone 7%)

11,615-20. Dolomite, as above, except limonite.

11,620-25. Dolomite, as above, except a little increase in sandstone, and quartz-siltstone.

11,625-30. Dolomite, as above, except a yellow clay particle; oil stain.

11,630-35. Dolomite, as above, except most particles have oil stain.

11,635-40. Dolomite, as above, except most particles have oil stain.

11,640-45. Dolomitic shale, as above, except a little increase in shale; one high porosity limestone particle, due to vugs.
(dolomite 70%, shale 20%, limestone 5%, sandstone 1%, quartz-siltstone 1%)

11,645-50. Shaley dolomite; some sandstone, frosted with oil stain; some quartz-siltstone; some limestone with crystalline calcite; oil stain; core chips perfectly dolomitic shale.

Dresbach:

11,650-55. Shaley dolomite, predominantly dolomite, brown to buff; hairline fractures; some shale; increase in limestone, some high poro sity due to vugs; a little increase in sandstone; a few white quartz-siltstone; limonite, oil stain.
(dolomite 75%, shale 12%, limestone 7%, sandstone 5%, quartz-siltstone 1%)

11,655-60. Shaley dolomite; increase in shale; a little increase in sandstone; high porosity limestone due to vugs; a few white quartz-siltstone; limonite, oil stain.
(dolomitic shale 90%, sandstone 5%, limestone 4%, quartz-siltstone 1%)

11,660-65. Dolomitic shale, as above, except a piece of green shale.

11,665-70. Dolomitic shale, as above, except a little increase in dolomite; a red clay particle; some orange quartz.

11,670-75. Dolomitic shale, as above, except a few limestone particles with high porosity due to vugs.

11,675-80. Dolomitic shale, as above, except a lot of crystalline calcite; some gypsum coated dolomitic particles.

11,680-85. Dolomitic shale, as above, except more contamination of quartz.

11,685-90. Dolomitic shale; some of dolomite particles are coated by gypsum; a little increase in limestone; green shale; a few crystalline calcite; some sandstone; hematite, oil stain.
(dolomitic shale 80%, limestone 15%, sandstone 3%)

11,690-95. Dolomitic shale, as above.

11,695-11,700. Dolomitic shale, as above, except a little lighter in color.

11,700-05. Dolomitic shale; increase in calcareous amount, a few white quartz-siltstone; some sandstone; hematite, oil stain.
(dolomitic shale 75%, limestone 20%, sandstone 3%, quartz-siltstone 2%)

11,705-10. Dolomitic shale, as above, except a piece of limestone with high porosity due to vugs; a small piece of brachiopod fragment.

11,710-15. Dolomitic shale, as above, except more brachiopod fragments.

11,715-20. Dolomite, as above, except more increase in calcareous amount; very light in color.
(dolomite 60%, shale 10%, limestone 25%, sandstone 3%, quartz-siltstone 1%)

11,720-25. Dolomite, as above, except a little increase in shale; darker in color.

11,725-30. Dolomite, as above, except more iron oxide, (limonite).

11,730-35. Dolomite, as above, except a little increase in sandstone; some green shale.

11,735-40. Dolomite; intermixed with some gypsum; other components retain the same general characteristic.

11,740-45. Dolomitic sand, good percentage of sandstone, a few particles of salt.
(sandstone 45%, dolomite 45%, salt 2%)

11,745-50. Is missing.

11,750-55. Dolomitic shale; hairline fractures on dolomite; limestone particle with high porosity due to vugs; limonite, oil stain.
(dolomitic shale 86%, limestone 10%, sandstone 3%, quartz-siltstone 1%)

11,755-60. Dolomitic shale, as above, except a little increase in shale.

11,760-65. Dolomite, gray to brownish buff, intermixed with some shale; some limestone; a few red clay particles; some sandstone; hematite, limonite, oil stain.
(dolomite 80%, shale 8%, limestone 8%, sandstone 2%)

11,765-70. Dolomite, as above, except more sandstone.

11,770-75. Dolomite; a little increase in limestone, with high porosity due to vugs; some sandstone; some crystalline calcite; some shale; brachiopod fragments.
(dolomite 70%, limestone 20%, shale 8%, sandstone 2%)

11,775-80. Dolomite, as above, except increase in limestone with high porosity; hematite.

11,780-85. Dolomite, as above, except a few big crystals of calcite.
(dolomite 65%, limestone 25%, shale 5%, sandstone 4%)

11,785-90. Dolomite, as above, except green shale; a few white quartz-siltstone.

11,790-95. Dolomitic shale, increase in shale; darker in color; brachiopod fragments, limonite, oil stain.

11,795-11,800. Dolomite, gray to dark gray; shale; limestone, some high porosity; some sandstone, fine grained, white, rounded; a few white quartz-siltstone; limonite, oil stain.
(dolomite 70%, shale 10%, limestone 10%, sandstone 10%)

11,800-05. Dolomite, as above, except a little increase in sandstone.

11,805-10. Dolomite, as above, except couple red siltstone particles.

11,810-15. Dolomite, as above, except a little increase in limestone, lighter in color; brachiopod fragments.

11,815-20. Dolomite, as above.

11,820-25. Dolomitic shale, increase in shale, darker in color; other components retain the same general characteristic.
(dolomitic shale 85%, limestone 10%, sandstone 3%)

11,825-30. Dolomite, as above, except decrease in shale; green shale; high increase in sandstone; brachiopod fragments.
(dolomite 60%, shale 15%, limestone 10%, sandstone 15%)

11,830-35. Dolomite, high porosity limestone due to vugs; increase in green shale; some white quartz-siltstone.

11,835-40. Dolomite, as above.

11,840-45. Dolomite; increase in sandstone, most quartz grains intermixed with dolomitic particles; red clay particle; some limestone; a little white quartz-siltstone; limonite, pyrite, oil stain.
(dolomite 60%, shale 8%, limestone 12%, sandstone 20%)

11,845-50. Dolomite, as above, except some green shale; some high porosity limestone due to vugs.

11,850-55. Dolomite, as above, except hairline fractures on some dolomite grains.

11,855-60. Dolomite, as above, except increase in limestone; brachiopod fragments.

11,860-65. Dolomite, as above, except no fossil, increase in amount of iron oxide.

11,865-70. Dolomite, as above.

11,870-75. Dolomite, as above, except high decrease in sandstone; some gypsum crystals coated dolomite particles.
(dolomite 70%, shale 10%, limestone 15%, sandstone 5%)

11,875-80. Dolomitic sand, good percentage of sandstone (quartz); some high porosity limestone due to vugs; green shale; white quartz-siltstone, a big fragment of arkose; some iron oxide.
(dolomite 54%, shale 5%, limestone 20%, sandstone 20%, quartz-siltstone 1%)

11,880-85. Dolomite, intermixed with some anhydrite; quartz; shale; limestone; white quartz-siltstone; limonite, oil stain.

11,885-90. Dolomite, as above, except no anhydrite; increase in sandstone; a few green shale.

Eau Clair:

11,890-95. Dolomite, as above, plus a big piece of limonite.

11,895-11,900. Sandy dolomite, as above, except increase in sandstone.
(dolomite 54%, shale 3%, limestone 22%, sandstone 21%)

11,900-05. Dolomite; some orange quartz grains; some green shale; a little white quartz-siltstone; other characteristic retain as above.

11,905-10. Dolomite, as above, except a little increase in limestone.

11,910-15. Dolomite, as above.

11,915-20. Dolomite; some shale; hairline fractures on dolomite which are filled by crystalline gypsum; very good rounded, white, fine grained quartz; some high porosity limestone; a few green shale; almost all particles have oil stain.
(dolomite 65%, shale 15%, limestone 10%, sandstone 10%)

11,920-25. Dolomite, as above, except some big white, fine grained siltstone particles.

11,925-30. Dolomite, as above, except a little increase in sandstone.

11,930-35. Dolomite, as above, except some anhydrite.

11,935-40. Dolomite, as above, except no anhydrite.

11,940-45. Dolomite, predominantly dolomite, gray to buff; decrease in other components, a perfect medium size crystal of anhydrite; good percentage of iron oxide mixed with oil stain.
(dolomite 80%, shale 5%, limestone 5%, sandstone 8%)

11,945-50. Dolomite, as above, except alittle increase in sandstone, no anhydrite.

11,950-55. Is missing.

11,955-60. Dolomite, with large amount of iron oxide, some very fine grained quartz.

11,960-65. Dolomite; increase in shale, green shale; red fine grained siltstone; decrease in sandstone; limonite, hematite.
(dolomite 70%, shale 15%, limestone 10%, sandstone 5%)

11,965-70. Dolomite, as above, except some fine grained gypsum crystals; glauconite.

11,970-75. Dolomite, as above, except no glauconite.

11,975-80. Dolomite, as above, except a little increase in sandstone.

11,980-85. Dolomite, as above, except more increase in sandstone; some very small crystals of gypsum and anhydrite.

11,985-90. Dolomite, as above, except no gypsum and anhydrite.

11,990-95. Dolomite, gray to brownish dark; high increase in limestone, some with high porosity due to vugs; some sandstone, fine grained, rounded to subrounded, white to orange in color; some gypsum intermixed with dolomite; a few green shale; oil stain, limonite.
(dolomite 60%, shale 10%, limestone 25%, sandstone 5%)

11,995-12,000. Dolomite, as above, except entire dolomite particles are coated by fine gypsum crystals.

12,000-05. Dolomite, as above, except anhydrite; trace of salt.
(dolomite 70%, shale 5%, limestone 10%, anhydrite 8%)

12,005-10. Dolomite, predominantly dolomite; a little quartz grains; glauconite, iron oxide.

12,010-15. Dolomite, as above, except no glauconite.

12,015-20. Dolomite, as above.

12,020-25. Dolomite; increase in shale; predominantly iron oxide, oil stain.

12,025-30. Dolomitic shale, more increase in shale, black in color.
(dolomitic shale 90%, limestone 5%)

12,030-35. Dolomite, increase in carbonate components.

12,035-40. Is missing.

12,040-45. Dolomite, gray to buff; some dark shale; trace of anhydrite; a little quartz grains; fine grained limestone; limonite, oil stain.
(dolomite 75%, shale 15%, limestone 5%, anhydrite 2%, sandstone 2%)

12,045-50. Dolomite, as above.

12,050-55. Dolomite, predominantly coated by fine gypsum crystals and anhydrite.

12,055-60. Dolomite; salt.
(dolomite 70%, salt 25%, limestone 5%)

12,060-65. Dolomite, as above, high decrease in salt.

12,065-70. Dolomitic shale; some fine grained gypsum crystals; iron oxide, pyrite.

12,070-75. Dolomitic shale, as above, except no pyrite.

12,075-80. Dolomitic shale, as above, predominantly oil stain.
(dolomitic shale 90%, limestone 8%)

12,080-85. Dolomite, light in color; some high porosity limestone due to vugs, trace of anhydrite.

12,085-90. Dolomite, as above, except increase in limestone; limonite, oil stain.
(dolomite 80%, limestone 15%, shale 5%)

12,090-95. Dolomite, as above, except a few fine to medium quartz crystals; white, rounded, quartz siltstone.

12,095-12,100. Dolomite; fine grained gypsum coated some dolomite grains; a few chips of green shale; predominantly oil stain, iron oxide.

12,100-05. Dolomite, as above.

12,105-10. Dolomite, as above, except increase in gypsum.

12,110-15. Is missing.

12,115-20. Dolomite; trace of salt; anhydrite; limonite, oil stain.

12,120-25. Dolomite, gray to buff; seam of anhydrite in dolomite grains; high porosity limestone; a few quartz grains; pyrite.
(dolomite 75%, limestone 10%, anhydrite 2%, sandstone 2%)

12,125-30. Dolomite, as above, except a little shale; brachiopod fragments, limonite, oil stain.

12,130-35. Dolomite, gray to light brown; some shale; some gypsum crystals on dolomite particles; limestone; trace of anhydrite; limonite.
(dolomite 70%, limestone 18%, shale 5%)

12,135-40. Dolomite, as above, except more increase in gypsum crystals.

12,140-45. Dolomite, as above, except some green shale; a few fine crystals of quartz.

12,145-50. Dolomite; increase in shale; iron oxide, oil stain.
(dolomite 85%, shale 10%, limestone 5%)

12,150-55. Dolomite, as above, except increase in shale; dolomitic shale; brachiopod fragments.

12,155-60. Dolomite, as above, except no fossil.

12,160-65. Dolomite, dark brown, crystalline, anhydritic.

12,165-70. Anhydrite; intermixed with dolomite; a few quartz grains, fine, white, rounded; trace of salt.
(anhydrite 50%, dolomite 40%, quartz 3%)

12,170-75. Dolomite; decrease in anhydrite; increase in salt.

12,175-80. Dolomite, as above; high increase in salt.
(dolomite 50%, salt 40%, quartz 5%)

12,180-85. Shale; intermixed with dolomite, dark to black; limonite, oil stain.
(shale 50%, dolomite 45%, limestone 5%)

12,185-90. Dolomite, gray to brown, buff, gypsum on dolomite particles; some shale; some vuggy limestone.

12,190-95. Dolomite, as above, except no vuggy limestone.

12,195-12,200. Dolomite, as above, except some quartz grains, fine to medium, white to orange, rounded; a few quartz-siltstone.
(dolomite 75%, shale 10%, limestone 5%, quartz 3%, quartz-siltstone 1%)

12,200-05. Dolomite; salt.
(dolomite 50%, salt 50%)

12,205-10. Dolomitic shale, increase in shale; quartz grains; a big crystal of calcite.
(dolomitic shale 85%, limestone 10%, quartz 4%)

12,210-15. Dolomitic shale; gypsum crystals on dolomitic particles; a red, fine grained clay particle.

12,215-20. Dolomite, most dolomite particles are coated by fine gypsum crystals; some quartz grains, frosted; limestone.
(dolomite 85%, limestone 10%, shale 3%, quartz 2%)

12,220-25. Dolomite, as above, except increase in limestone; quartz, red to orange; limonite.

12,225-30. Dolomite, as above, except more increase in quartz grains.
(dolomite 70%, quartz 20%, limestone 5%, shale 2%)

12,230-35. Dolomite; salt; iron oxide.
(dolomite 65%, salt 30%)

12,235-40. Dolomite, as above, except red fine grained clay particles.

12,240-45. Dolomite, as above, except some quartz grains.
(dolomite 65%, salt 25%, quartz 5%)

12,245-50. Dolomite, as above.

12,250-55. Dolomitic shale, dark to black; a few quartz grains.
(dolomitic shale 90%, quartz 2%, limestone 2%)

12,255-60. Dolomitic shale, as above, except increase in quartz grains; fine crystals of gypsum on dolomite particles, muscovite.

12,260-65. Shale, dark to very black; fine grain limestone; increase in sandstone; chert; some dolomite; oil stain.
(shale 70%, dolomite 10%, sandstone 15%, limestone 5%)

12,265-70. Dolomite, gray to brown; anhydrite; quartz grains.
(dolomite 75%, shale 10%, quartz 5%, limestone 5%)

12,270-75. Dolomitic shale, gray to dark; a few crystals of calcite.

12,275-80. Dolomite; some shale; limestone, fine to medium, white, orange, angular to subangular quartz grains.
(dolomite 75%, shale 8%, limestone 10%, quartz 7%)

12,280-85. Dolomite, as above.

12,285-90. Dolomitic shale, gray to dark brown; trace of anhydrite; vuggy limestone.
(dolomitic shale 85%, limestone 8%, quartz 7%)

12,290-95. Dolomite, increase in dolomite; limestone; quartz grains; limonite.
(dolomite 70%, limestone 15%, shale 5%, quartz 10%)

12,295-12,300. Dolomite, as above, except dolomite particles coated by fine gypsum crystals.

12,300-05. Dolomite, as above, except more increase in sand.
(dolomite 65%, sandstone 20%, limestone 5%, shale 5%)

12,305-10. Dolomite, as above, except quartz-siltstone.

12,310-15. Dolomite, gray to buff, coated by gypsum crystals, anhydritic.
(dolomite 65%, sandstone 15%, limestone 5%, shale 5%, anhydrite 5%)

12,315-20. Dolomite, as above, except oil stain.

12,320-25. Dolomite, much increase in sandstone.
(dolomite 60%, sandstone 22%, limestone 8%, shale 5%)

12,325-30. Dolomite, almost all particles are coated by o il stain; increase in limestone.

12,330-35. Dolomite, as above.

12,335-40. Dolomite, as above, except increase in quartz grains.

12,340-45. Dolomite, as above.

From this depth to the bottom of the well, laboratory work was done only with core chips.

12,345-50. Dolomite, brownish gray, microcrystalline; anhydrite; micaceous; shaley.

12,350-55. Dolomite, as above, except sandstone with medium size quartz grains.

12,355-60. Dolomitic shale, increase in shale; pyrite.

12,360-65. Dolomite, brown to light gray, microcrystalline, micaceous; trace of anhydrite.

12,365-70. Dolomite, as above.

12,370-75. Dolomite, brownish gray, fine grained, shaley, anhydritic.

12,375-80. Dolomite, as above, except carbonaceous.

12,380-85. Anhydrite, gray to dark gray, intermixed with dolomite, microcrystalline.

12,385-90. Dolomite, brown to gray, microcrystalline, micaceous.

12,390-95. Dolomite, brown to dark gray, shaley, trace of anhydrite.

12,395-12,400. Shale, gray to dark gray, micaceous; anhydrite; dolomitic.

12,400-05. Shale, as above, except darker in color.

12,405-10. Dolomite, intermixed with shale, some anhydrite.

12,410-15. Shale, micaceous; a little dolomite; very pyritic.

12,415-20. Shale, as above.

12,420-25. Shale, as above, except increase in dolomite, no pyrite.

12,425-30. Dolomite, brownish gray, microcrystalline, shaley, anhydritic.

12,430-35. Dolomite, good percentage of sandstone, smoky quartz grains, carboneous cement.

12,435-40. Dolomitic sand, some quartz grains intermixed with dolomite.

12,440-45. Dolomite, gray to brown, no sand, trace of anhydrite.

12,445-50. Shale, gray to dark gray, micaceous, pyrite.

12,450-55. Dolomite, brownish gray, crystalline, shaley.

12,455-60. Sandstone, medium to fine grained, smoky quartz, calcareous cement, dolomitic.

12,460-65. Dolomite, brownish gray, shaley in part, anhydritic, a little carbonaceous, pyrite.

12,465-70. Sandstone, smoky quartz grains, carbonaceous cement, dolomitic in part, anhydritic.

12,470-75. Shale, dark gray, micaceous.

12,475-80. Shale, as above, only darker in color.

12,480-85. Dolomite, brownish gray, anhydritic, calcareous, fine grained.

12,485-90. Sandstone, dark to black, fine to medium quartz grains, subrounded to angular, calcareous cement.

12,490-95. Sandstone, white in color, calcareous cement, trace of anhydrite.

12,495-12,500. Dolomite, light gray to white, highly calcareous, fine grained to microcrystalline.

12,500-05. Dolomite, as above, except some quartz grains.

12,505-10. Sandstone, white, milky; a little chert.

12,510-15. Shale, brownish black to black, micaceous.

12,515-20. Shale, as above.

12,520-25. Shale, brownish gray, dolomitic; pyrite.

12,525-30. Shale, as above, except, darker in color; no pyrite.

12,530-35. Dolomite, brownish to white, microcrystalline, anhydritic.

12,535-40. Shale, gray dark to black, banded with dolomite; pyrite.

12,540-45. Dolomite, brownish to dark gray, intermixed with anhydrite.

12,545-50. Sandy shale; black shale micaceous; quartz grains, rounded to subrounded, some smoky, medium size; calcareous cement.

12,550-55. Shale, gray to dark gray, micaceous in part.

12,555-60. Shale, as above, except lighter in color.

12,560-65. Sandstone, gray to black, rounded to subangular, medium grained, carbonaceous cement.

12,565-70. Shale, brownish gray, partly dolomitic, partly micaceous.

12,570-75. Shale, as above.

12,575-80. Shale, as above, except darker in color.

12,580-85. Sandstone, white to gray, medium to coarse, rounded, carbonaceous cement.

12,585-90. Shale, gray to black, micaceous in part, banded with dome dolomite.

12,590-95. Dolomite, brownish black, micaceous in part.

12,595-12,600. Dolomite, gray black, calcareous in part, anhydritic in part.

12,600-05. Dolomite, light gray to white, mostly calcareous.

12,605-10. Dolomitic shale, gray to brownish gray, anhydritic, micaceous in part.

12,610-15. Dolomite, gray to dark gray, shaley, micaceous, anhydritic.

12,615-20. Dolomite, as above, except intermixed with anhydrite.

12,620-25. Sandy dolomite; coarse to medium quartz grains, white, some frosted; gray to black dolomite, microcrystalline partly, calcareous.

12,625-30. Shale, dark gray to black, micaceous.

12,630-35. Shaley dolomite, dark to black in color, micaceous in part.

12,635-40. Shale, black, pyritic.

12,640-45. Dolomite, gray to dark brown, microcrystalline, anhydritic, shaley.

12,645-50. Dolomite, as above, except darker in color, more shaley.

12,650-55. Sandy dolomite, dark gray to black; fine to medium quartz grains, rounded, calcareous cement.

12,655-60. Shale, gray to light gray, anhydritic.

12,660-65. Shale, as above, except very dark in color.

12,665-70. Shale, very dark to black, micaceous, pyritic.

12,670-75. Dolomitic shale, gray to brown, anhydritic, very pyritic.

12,675-80. Shale, brownish to gray, dolomitic in part, micaceous in part.

12,680-85. Shale, as above, except lighter in color.

12,685-90. Dolomitic shale, gray to white, anhydritic; pyrite.

12,690-95. Shale, dark gray to black.

12,695-12,700. Dolomite, gray to light brown, microcrystalline, shaley, anhydritic.

12,700-05. Shale, black, micaceous, anhydritic in part; pyritic.

12,705-10. Shale, as above, except light in color, very pyritic.

12,710-15. Shale, as above, except very black, no pyrite.

12,715-20. Shale, as above.

12,720-25. Shaley dolomite, gray to brown, microcrystalline, dolomite, trace of anhydrite.

12,725-30. Shale, very black.

12,730-35. Dolomite, brownish gray, shaley in part, microcrystalline.

12,735-40. Limey dolomite, black, highly calcareous, anhydritic.

12,740-45. Dolomite, as above, except decrease in calcareous part.

12,745-50. Dolomite, as above, except not too black, calcareous again.

12,750-55. Shale, gray to light brown.

12,755-60. Anhydrite, brownish to dark gray, shaley in part, calcareous in part.

12,760-65. Sandstone, dark gray to black, fine to medium quartz grains, rounded, some smoky quartz, calcareous cement, shaley in part.

12,765-70. Shale, dark gray to black, partly dolomitic, some micaceous.

12,770-75. Shale, as above, except lighter in color; pyrite.

12,775-80. Dolomite, gray to black, banded with shale.

12,780-85. Dolomite, as above, except no shale.

12,785-90. Shale, gray to black, intermixed with dolomite, calcareous, anhydritic, micaceous.

12,790-95. Shale, black, partly micaceous.

12,795-12,800. Dolomite, gray, white, anhydritic, microcrystalline.

12,800-05. Dolomite, as above, except highly anhydritic.

12,805-10. Dolomite, as above, except darker in color.

12,810-15. Sandstone, white to gray, rounded to subrounded, fine to medium, calcareous.

12,815-20. Dolomitic shale, dark gray to black, calcareous, anhydritic.

12,820-25. Dolomitic shale, as above, except darker in color.

12,825-830. Sandstone, dark gray to black, shaley in part, calcareous cement.

Mount Simon:

12,830-35. Dolomite, brownish gray, anhydritic, sandy in part.

12,835-40. Shale, dark gray, dolomitic.

12,840-45. Dolomite, dark gray to black, anhydritic, shaley.

12,845-50. Shale, brownish gray, concloidal chert, intermixed with quartz grains, dolomitic.

12,850-55. Sandstone, gray to buff, rounded to subrounded, mostly medium.

12,855-60. Sandy dolomite, as above, except more dolomitic.

12,860-65. Dolomite, gray to dark brown, shaley in part, calcareous, microcrystalline, anhydritic.

12,865-70. Dolomite, as above, except darker in color.

12,870-75. Sandstone, white to gray, rounded to subrounded, medium, calcareous cement.

12,875-80. Dolomite, white to gray, highly anhydritic.

12,880-85. Sandstone, dark gray, some smoky quartz grains, calcareous cement, dolomitic in part.

12,885-90. Sandstone, as above, except light in color.

12,890-95. Dolomite, dark brown to black, sandy in part, shaley, anhydritic.

12,895-12,900. Dolomite, as above, except darker in color.

12,900-05. Dolomite, gray to light brown, highly calcareous.

12,905-10. Dolomite, as above, except lighter in color.

12,910-15. Dolomite, dark gray to black, microcrystalline, highly anhydritic.

12,915-20. Dolomite, light gray to white, highly calcareous, anhydritic.

12,920-25. Shaley dolomite, brownish gray to dark gray, sandy in part, shaley.

12,925-30. Dolomite, dark gray to black, calcareous, sandy in part.

12,930-35. Shale, black, micaceous, dolomitic in part, calcareous.

12,935-40. Sandstone, white, fine to coarse, rounded and frosted, calcareous cement.

12,940-45. Dolomite, gray to brownish gray, microcrystalline, shaley, calcareous.

12,945-50. Sandstone, dark gray to black, fine to medium, subrounded, calcareous cement, calcareous in part, anhydritic.

12,950-55. Dolomite, brown to dark brown, highly anhydritic, shaley in part, calcareous.

12,955-60. Dolomite, brown to light gray, sandy in part, calcareous, intermixed with anhydrite.

12,960-65. Sandstone, brown to white, fine to coarse, rounded to subrounded, dolomitic, very pyritic.

12,965-70. Sandstone, as above, except very dark in color, no pyrite, calcareous.

12,970-75. is missing

12,975-80. Dolomite, gray to white, microcrystalline, sandy in part, anhydritic in part.

12,980-85. Shale, dark gray to black, micaceous.

12,985-90. Shaley dolomite, gray to dark gray, anhydritic in part.

12,990-95. Dolomite, gray, calcareous, sandy in part, anhydritic in part.

APPENDIX B

Analyses showing relative
abundance of rock types at
50-foot intervals, based on visual estimates.

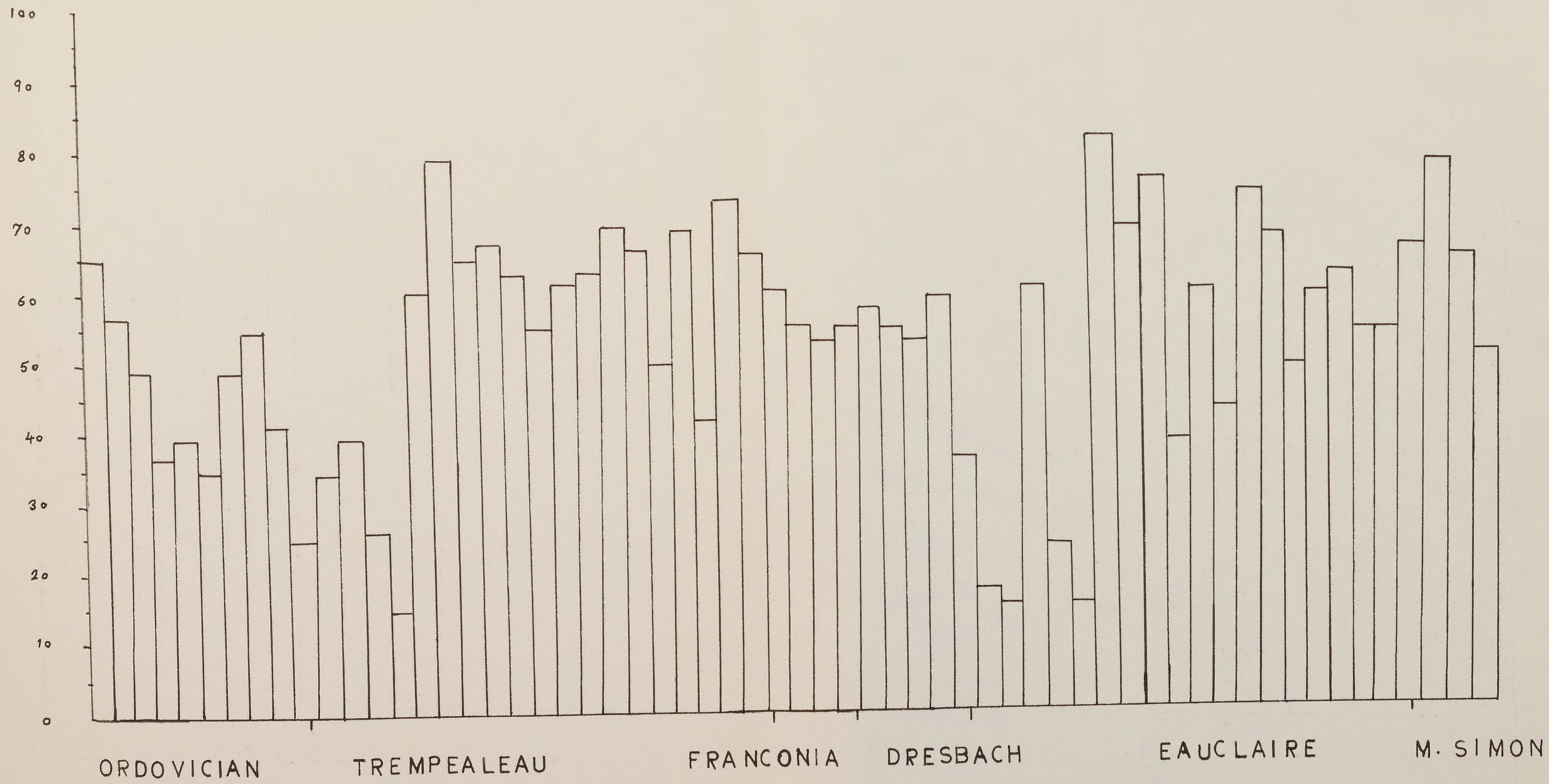

TABLE I PERCENTAGE OF DOLOMITE

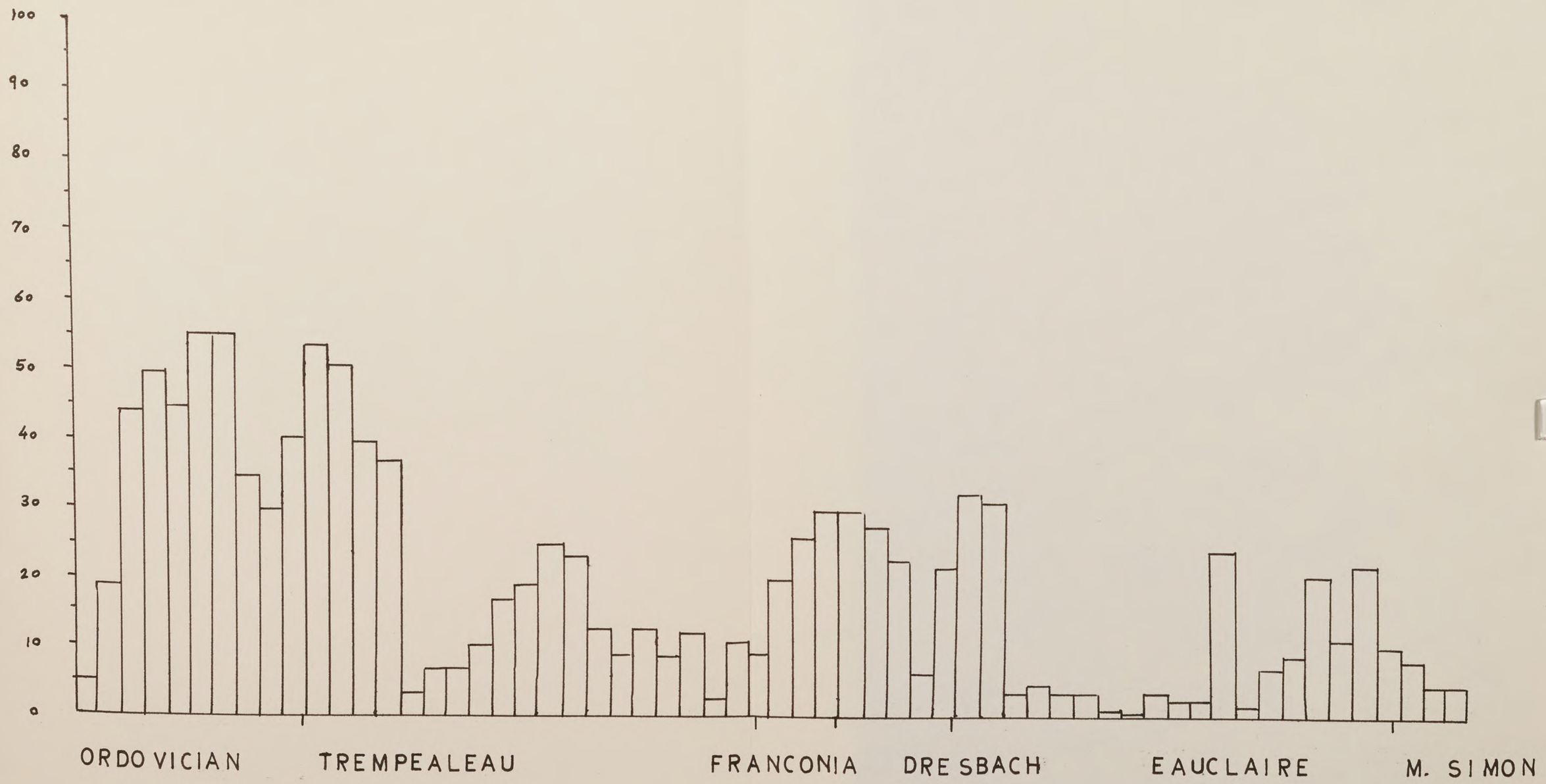

TABLE 2 PERCENTAGE OF SANDSTONE

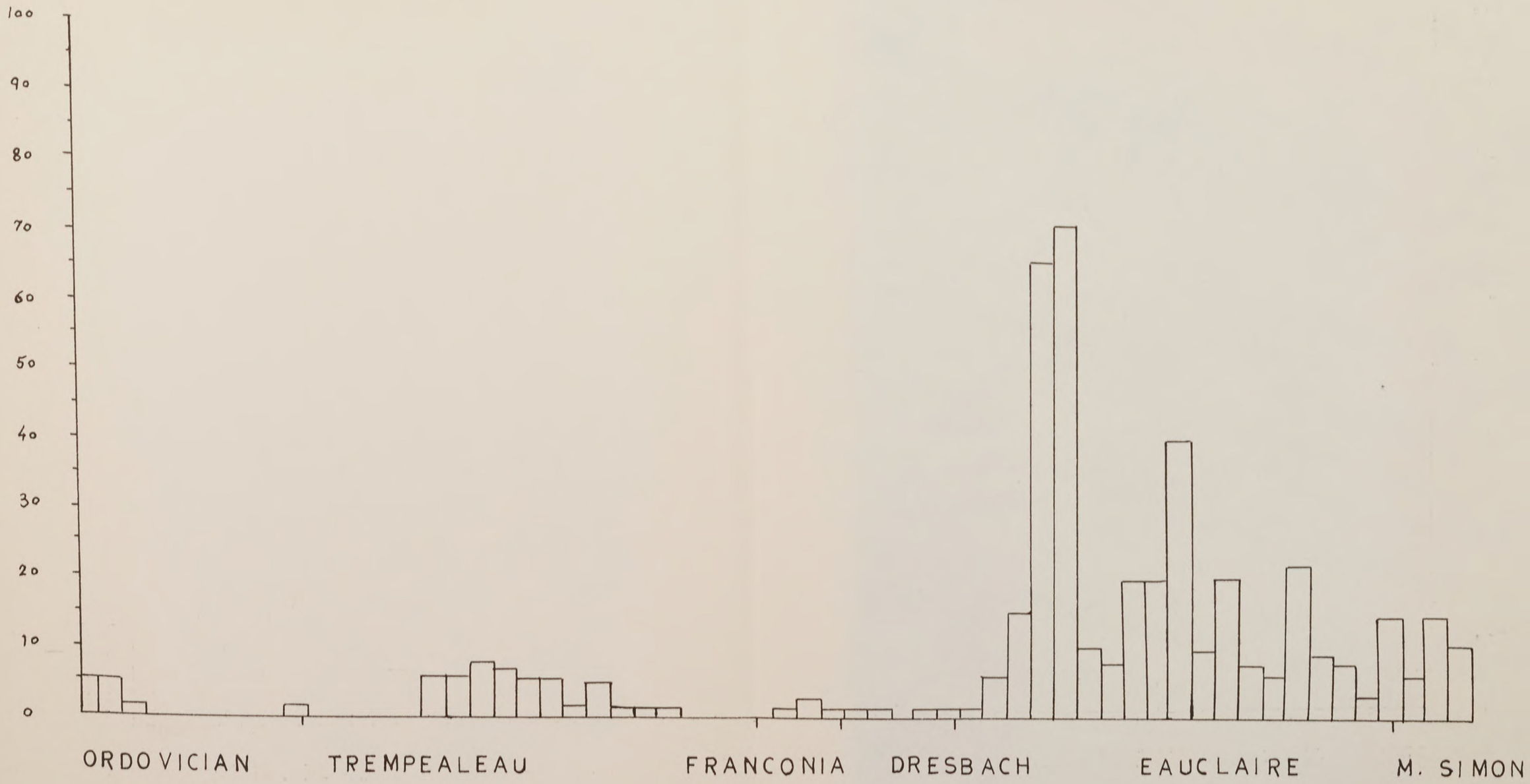

TABLE 3 PERCENTAGE OF SHALE

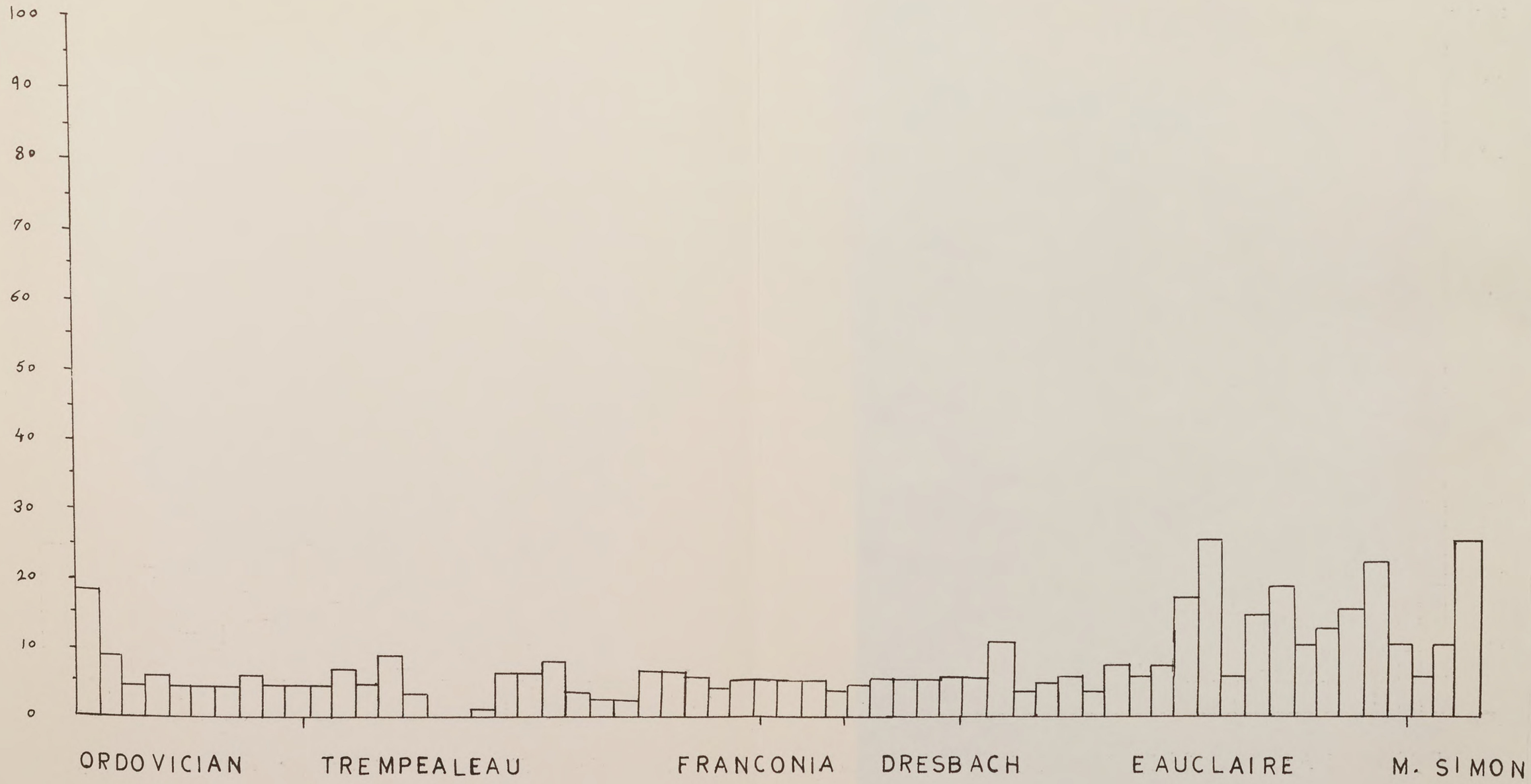

TABLE 4 PERCENTAGE OF LIMESTONE

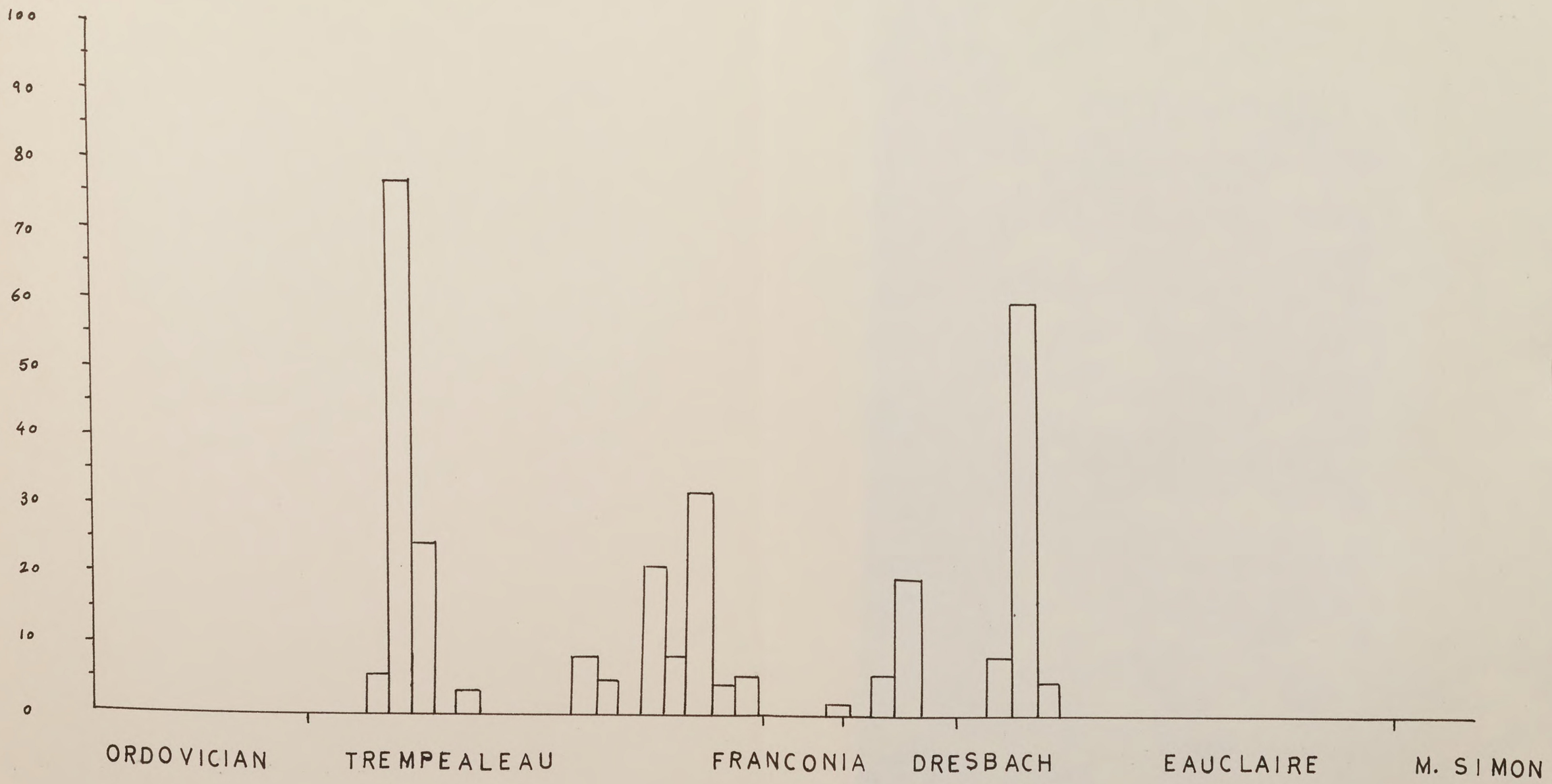

TABLE 5 PERCENTAGE OF EVAPORITE

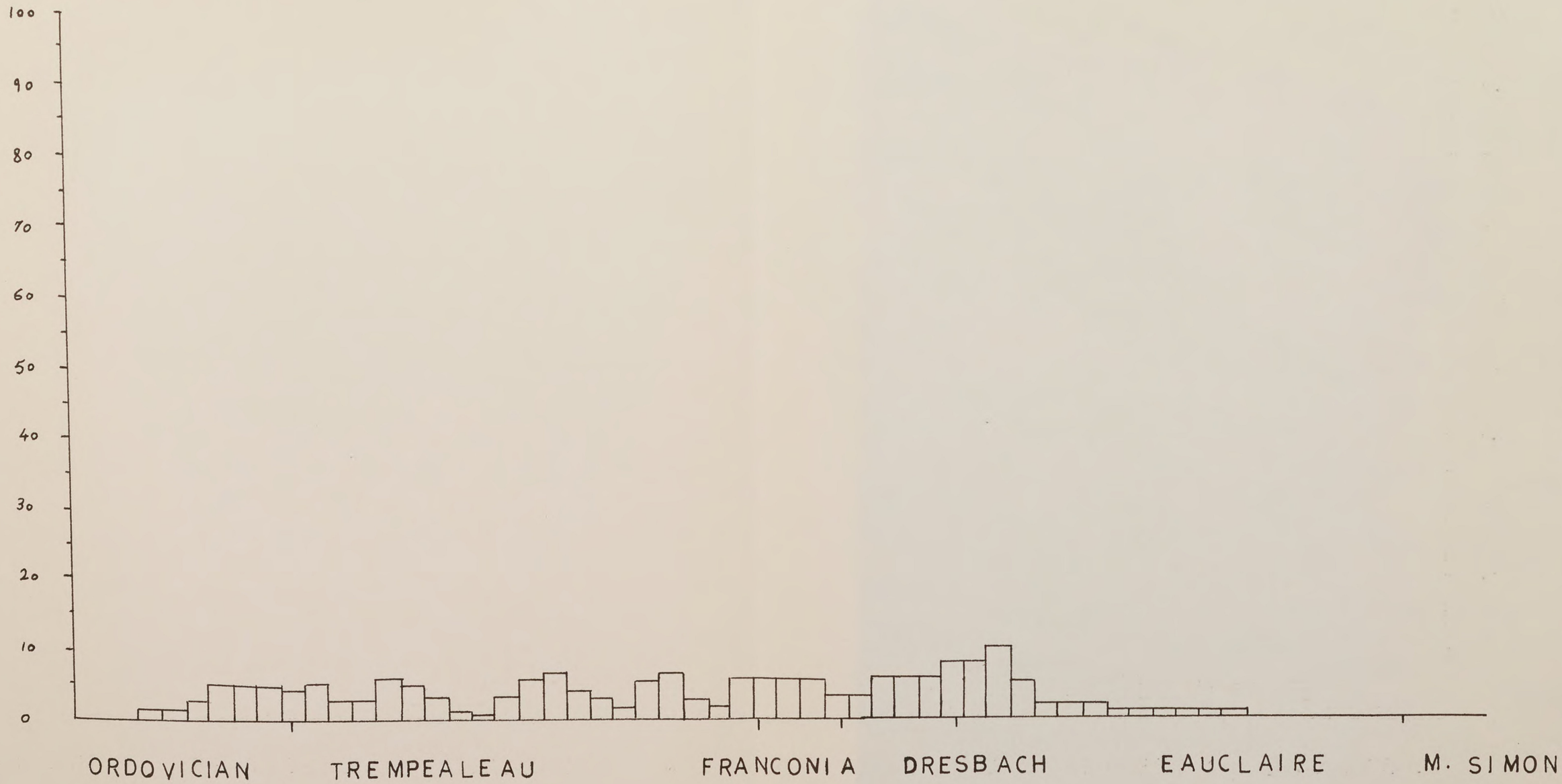

TABLE 6 PERCENTAGE OF QUARTZ-SILTSTONE

APPENDIX C

Michigan Wells

Map No.	Location	Name	Top of Camb.	Top of Precamb.
1	Ogemaw County	Foster #1	10480'	———
2	Charlevoix (wildcat)	Beaver Island #2	3830'	4739'
3	Berrien (wildcat) T.6S, R.17W, Sec. 10	Thalmann #1	2860'	———
4	Cass (wildcat)	Wooden #1	2890'	———
5	Ottawa T.5N, R.15W, Sec. 30	Holland Twp.	4470'	———
6	St. Clair T.4N, R.15E, Sec. 31	BD-1	4486'	4770'
7	Monroe T.2S, R.7E, Sec. 12	Merlin Shimp #1	2770'	3637'

Michigan Wells

Map No.	Location	Name	Top of Camb.	Top of Precamb.
8	Washtenaw T.2S, R.7E, Sec. 12	Viola Neinringer #1	4730'	5692'
9	Wayne T.4S, R.9E, Sec. 16	Theisen Est #1	3390'	———
10	Lenawee T.8S, R.5E, Sec. 32	Harry Taylor #1	3012'	3902'

Chio Wells

Map No.	Location	Top of Camb.	Top of Precamb.
1	DeFiance County	1704'	____
2	Fulton County	2032'	____
3	Henry County	1411'	____
4	Williams County	1987'	____
5	Wood County	1556'	2884'
6	Sandusky County	1415'	2701'
7	Hancock County	1060'	2770'
8	Mercer County	857'	____
9	Logan County	890'	3255'
10	Fair Field County	2452'	____

Indiana Wells

Map. No.	Location	Name	Top of C	Top of Precamb.
1	Jay County T.24N, R.13E, Sec. 29	Jacob Bineger #1	2942'	3351'
2	Howard County T.24N, R.5E, Sec. 33	Green Town #1	2350'	3945'
3	Porter County	Bethlehem Steel#WD-1	1301'	4263'
4	Wayne County T.15N, R.13E, Sec. 23	Well #1	2600'	3960'