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The Spearfish Formation in the Williston Basin of western North Dakota

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THE SPEARFISH FORMATION IN THE WILLISTON BASIN OF WESTERN NORTH DAKOTA

by

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Chairman

John R. Reid

Dean of the Graduate School

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THE SPEARFISH FORMATION IN THE WILLISTON BASIN OF WESTERN NORTH DAKOTA

Wallace G. Dow

INTRODUCTION

General

The Spearfish Formation was named by Darton (1899, p. 387) who later described it (1901, p. 516) as a conspicuous series of gypsiferous red beds cropping out in the vicinity of the Black Hills, South Dakota. The Spearfish Formation, as originally defined, included all rocks between the Minnekahta Limestone of Permian age and the Sundance Formation of Jurassic age. In the absence of fossil evidence, Darton (1901, p. 519) tentatively assigned a Triassic age to the Spearfish although he believed the lower portion may be Permian in age.

More recently, a unit of gypsum interbedded with maroon and gray shales originally included at the top of Darton's Spearfish have been redesignated as the Gypsum Spring Formation of Middle Jurassic age (Imlay, 1947, p. 237). Maple and Bergendahl (1956, p. 84) supported this correlation and placed an unconformity, representing

most of Lower Jurassic time, between the Spearfish and the Gypsum Spring Formations. The Spearfish Formation of the Black Hills, as restricted, contains red beds and gypsums of Permian and Triassic age.

The Spearfish Formation crops out in a red valley of variable width that encircles the Black Hills. It also crops out along the Belle Fourche River in the vicinity of Devil's Tower, Wyoming (Plate 14). Thicknesses of the formation in the Black Hills vary from 400 to 700 feet. Darton (1909, p. 28-30) gave several measured sections of the limited exposures present.

Figure 1 shows the upper part of the Spearfish Formation on the west flank of the Black Hills near Four Corners, Weston County, Wyoming. In this area, the Spearfish is capped by 30 feet of white gypsum of the Gypsum Spring Formation. In the vicinity of Devil's Tower, Crook County, Wyoming, the Gypsum Spring Formation is only about 10 feet thick. Detail of the upper part of the Spearfish in this area is provided by Rea and Paape (1958, p. 305). This section, shown in figure 2, consists in general of a predominance of orange-red siltstone with maroon shale and fine sandstone interbeds.

The discovery of oil in the Williston Basin of North Dakota in 1951 spurred an extensive drilling program which revealed a series of red siltstones and shales with thick salt interbeds in the subsurface of western North Dakota and eastern Montana. The stratigraphic position of these beds suggested that they might be equivalent to the Spearfish Formation of the Black Hills. Poor well control between the central part of the basin and the outcrop sections, however, precluded definite correlation with the type Spearfish and the term "Spearfish" was used

Figure 1 — Upper part of the Spearfish Formation capped by 30 feet of Gypsum Spring Formation. Red Butte, 5 miles south of Four Corners, Weston County, Wyoming.

Figure 2 — Upper part of the Spearfish Formation, the Gypsum Spring Formation, and the Stockade Beaver Member of the Sundance Formation. East side of Devil's Tower, Crook County, Wyoming.

with some reservation. Subsequently numerous and varied correlations appeared, all of which were based on limited well control. Due to a considerable expansion of available data in recent years, a new look at these strata seemed justified. The main purpose of this study is to produce a detailed discussion of these rocks in the western part of North Dakota and to establish, if possible, a correlation with the type Spearfish north of the Black Hills.

Methods of Study

The combined use of mechanical and sample logs provided the data on which this report is based. Mechanical logs of 288 wells in western North Dakota were chosen so as to provide the best coverage possible. In areas where wells are closely spaced, approximately one well per township was used while in other areas, all available well control was employed. Detailed mapping of the Spearfish Formation was restricted to North Dakota west of 101° longitude (Figure 3). In addition, two cross sections were prepared to trace the Spearfish Formation from the subsurface of the Williston Basin to a bore hole six miles north of the outcrop area near the South Dakota - Wyoming border. Plates 1 and 14 show the well control used in the preparation of this report.

Gamma ray and lateroresistivity curves were used whenever possible because they are the most abundant and provide the best definition of the strata involved. Tops were taken from gamma ray logs, when they were available, to provide uniformity in correlation. Microlatero, section gage, and neutron curves proved useful in

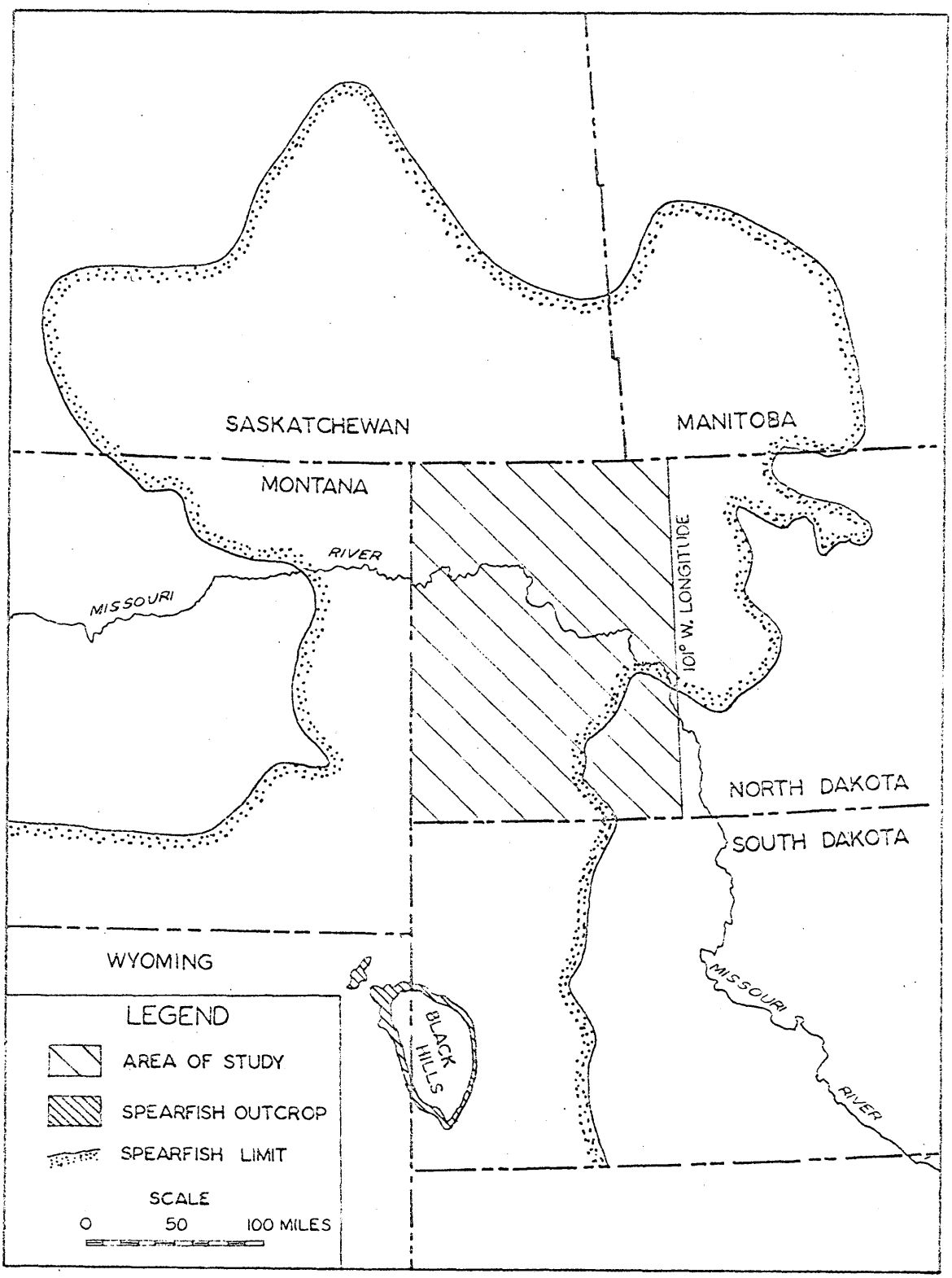

Figure 3 — Index map showing approximate limits of the Spearfish Formation and equivalents in the Williston Basin. Modified slightly after Ziegler, 1955 p.171.

distinguishing salt from anhydrite. Lithologic descriptions were taken from sample logs in the form of North Dakota Geological Survey Circulars. In addition, some detailed sample logging was done by the writer.

The isopachous maps included in this report are actually isochore maps because thicknesses have not been corrected for dip or well deviation. However, since dips in the basin generally do not exceed one degree, differences in real and apparent thickness is so small that they can, for all practical purposes, be ignored.

Acknowledgments

The writer wishes to express his appreciation to Dr. Walter L. Moore, Associate Professor of Geology at the University of North Dakota for suggesting the problem and for his interest and advice during the course of study.

The writer is indebted to Dr. Wilson M. Laird, State Geologist of North Dakota, for affording summer employment and the use of the facilities of the North Dakota Geological Survey. Thanks are expressed to Sidney B. Anderson, Clarence G. Carlson, Dan E. Hansen, and other members of the North Dakota Geological Survey who offered assistance.

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STRATIGRAPHY

Units underlying the Spearfish Formation

Throughout much of western North Dakota and South Dakota, in the area between the southern end of the Nesson Anticline and the Black Hills, the Spearfish Formation rests on and is conformable with the Minnekahta Limestone of Permian (possibly Leonard) age. To the north and east of the Minnekahta Limestone (Plate 8), the Spearfish Formation rests with angular discordance on rocks of progressively older Paleozoic age. In the area covered by this study the oldest rocks encountered, underlying the Spearfish Formation, are the Frobisher-Alida interval of the Madison Group (Mississippian). The pre-Spearfish unconformity truncates the Minnekahta and extends about 10 miles inside the latters present limit. Plate 8 shows the subcrop pattern of the units underlying the Spearfish Formation in western North Dakota.

In some areas where the Spearfish Formation rests directly on redbeds of the Opeche Formation and the Big Snowy Group (Heath and Otter Formations), its lower boundary is difficult to determine. In these areas erosional lows are commonly developed in the underlying shales and the lower beds of the Spearfish vary in thickness in response to this relief. As a result, an added section of Spearfish is generally found above underlying shale units which cannot be traced to areas where the Spearfish rests on resistant strata.

Consequently a margin of error in selecting the base of the Spearfish of a few feet or even a few tens of feet can be expected in these areas.

Spearfish Formation

GENERAL

In the subsurface of the Williston Basin in western North Dakota, the Spearfish Formation can be divided into three lithologic units, which, in ascending order are: (1) a lower red siltstone and gray shale unit, (2) a middle salt unit, and (3) an upper red siltstone, shale, and fine-grained sandstone unit. These units correspond, respectively, to the Spearfish Formation (restricted), Pine Salt, and the Saude Formation of Zieglar (1955) and are herein redesignated the Belfield Member, Pine Member, and Saude Member of the Spearfish Formation. Typical radiation and electric logs of these units are shown in figure 4.

In North Dakota, the Spearfish Formation reaches a thickness of 715 feet just north of the Cedar Creek Anticline in the extreme southwestern corner of the state. From this point, it thins gradually northward to an average thickness of 300 feet along the Canadian border. Figure 3 shows the approximate lateral extent of the Spearfish Formation and equivalents in the Williston Basin and adjoining areas. Plate 3 shows its areal extent and thickness trends in western North Dakota.

It has been 9 years since Zieglar introduced the terms Pine and Saude. Although these terms were never established in accordance

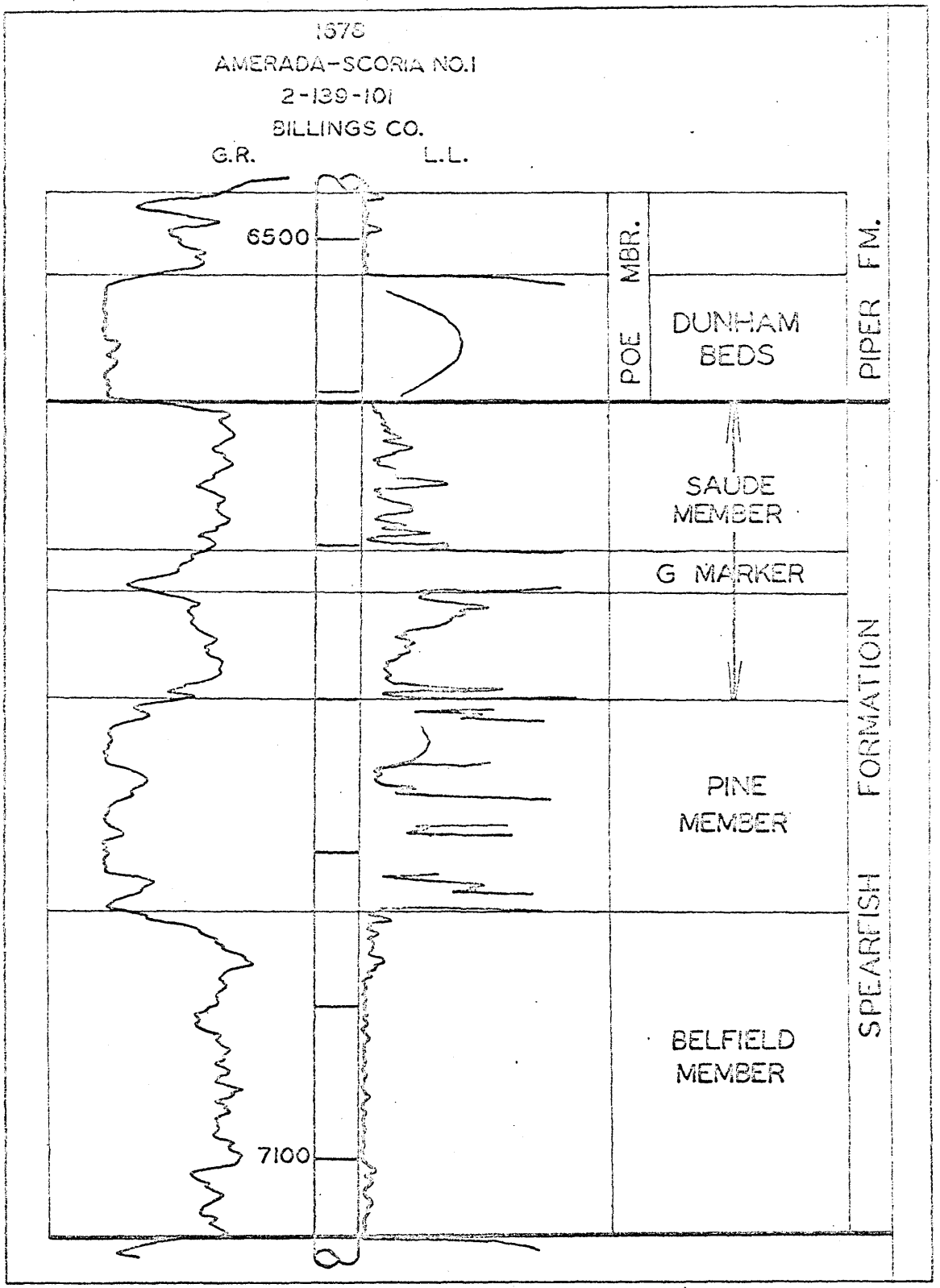

Figure 4 – Typical radiation and electric logs showing the members of the Spearfish Formation and the Poe Member of the Piper Formation.

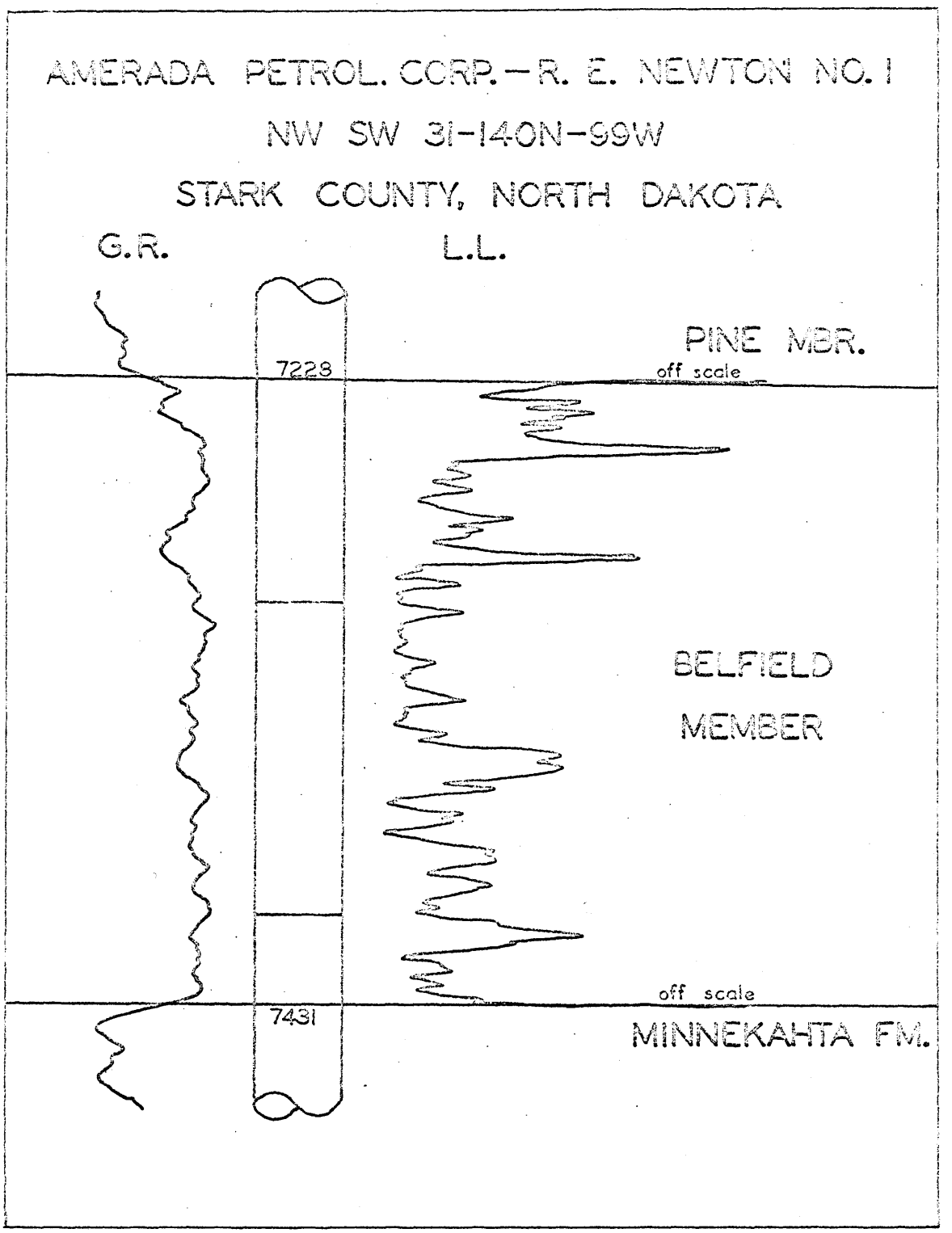

Figure 5 — Electric and radiation logs of the type section, Belfield Member, Spearfish Formation.

7310 - 30 Missing

7330 - 40 Shale, gray, N3, fissile, some reddish orange siltstone, 10R 6/6, trace of white anhydrite, considerable salt from collapse.

7340 - 50 Siltstone, reddish orange, shale, gray, N3.

7350 - 60 Missing

7360 - 70 Shale, gray, N3 and siltstone, light brown, 5YR 5/6, trace of anhydrite.

7370 - 90 Shale, gray, trace of light brown siltstone, trace of anhydrite.

7390 - 00 Shale, gray, trace of light brown siltstone, trace of pyrite.

7400 - 10 Shale, as above, trace of dolomite, finely crystalline, grayish pink, 5R 8/2.

7410 - 20 Shale as above, trace of selenite?, trace of dolomite as above.

7420 - 31 Shale, as above, trace of anhydrite, moderate pink and white.

The Belfield Member varies in thickness from an erosional edge to 232 feet in northwestern Dunn County, North Dakota. Its distribution and thickness in North Dakota are shown on plate 7.

Lithologically, this unit consists of fissile gray shale interbedded with reddish orange siltstone and mudstone, especially in the upper portion. Thin beds of whitish and pinkish anhydrite are present locally. Traces of pyrite and grayish pink dolomite are present in some areas.

The Belfield Member is conformable with the underlying Minnekahta Limestone except along a narrow belt just inside the limits of the Minnekahta where it rests on an erosional surface. The Belfield does not extend beyond the Minnekahta limit and is itself terminated along

an erosional belt 10 - 30 miles in width. Except along this erosional belt, the Belfield is conformably overlain by either the Pine Salt Member or the Saude Member of the Spearfish Formation.

PINE SALT MEMBER

Overlying the Belfield Member throughout much of western North Dakota is the Pine Salt Member which ranges in thickness from 215 feet in Bowman County to a feather edge along the margins of its basin of deposition. This unit thickens somewhat south of the Cedar Creek Anticline, reaching a maximum thickness of about 300 feet 35 miles north of the Spearfish outcrop area in the Black Hills.

The Pine was named by Zieglar (1955) who included a persistent sandy siltstone unit and an equally persistent anhydrite and salt unit in its upper part. The anhydrite and salt unit is referred to in this report as the G marker bed. The top of the Pine is herein revised to exclude these two units. In his original description of the Pine, Zieglar suggested that additional well control might warrant such a revision. The thickness and areal extent of the Pine Salt Member are shown in plate 6.

The type section of the Pine Member is herein designated as the interval between 5237 and 5432 feet, mechanical log depth, in the Carter Oil Co., L. L. Johnson No. 1 well, NW, SW, Sec. 9, T. 129 N., R. 106 W., Bowman County, North Dakota. The well was spudded on October 27, 1957 and completed on January 6, 1958 having reached a total depth of 8980 feet. The mechanical log depths were measured from the rotary drill bushing which was 15 feet higher than the ground

level of 2938 feet above sea level. The name Pine is considered to have become established through popular use.

The type log of the Pine Salt Member is shown on figure 6. The following lithologic description is based on samples on file at the North Dakota Geological Survey. Sample depths have been adjusted to mechanical log depths.

Samples:

5237 - 70 Salt, some moderate reddish orange siltstone, minor dark gray shale.

5270 - 00 Salt

5300 - 20 Salt, some medium dark gray shale and minor reddish orange siltstone.

5320 - 70 Salt

5370 - 32 Salt, minor dark gray shale and moderate reddish orange siltstone.

The Pine Salt Member consists of clear halite with thin interbeds of reddish orange siltstone and white anhydrite. Anhydrite occurs frequently in the lower part of the unit and is especially common in northern Billings County. In this area the base of the Pine is difficult to determine accurately due to the apparent gradational character of these basal anhydrite beds with the red siltstones of the underlying Belfield Member. Descriptions of two cores taken from this unit in Amerada's Dena Svor well, Sec. 9, T. 156N., R. 95 W., Williams County, North Dakota are given by Anderson and Hansen (1957). These cores reveal that the Pine in this area consists of large crystals of halite interbedded with hard red shale containing variable amounts of salt inclusions.

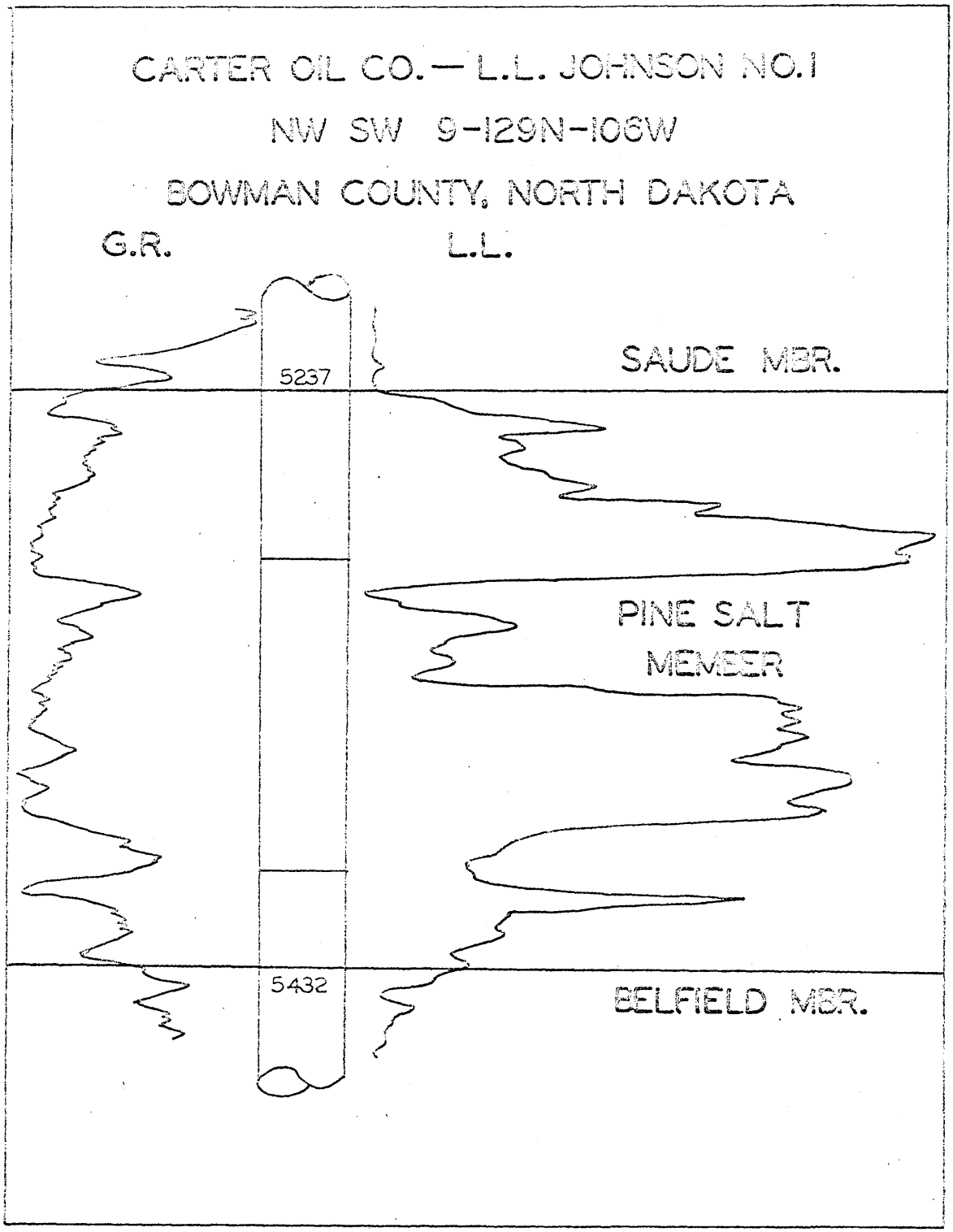

Figure 6 — Electric and radiation logs of the type section, Pine Salt Member, Spearfish Formation.

The Pine Salt Member is conformable with the underlying Belfield Member except along a narrow belt where it rests on eroded Belfield shale. The Pine extends somewhat beyond the Belfield in northwestern North Dakota where it rests with angular discordance on rocks as old as Mississippian. The Pine thickens in areas where it rests on the soft shales of the Opeche Formation and the Big Snowy Group, suggesting erosional lows which were filled with salt. There is also a commensurate thinning over the Amsden Formation which is more resistant and which, therefore, probably formed an erosional high on the pre-Pine surface.

The Pine represents a period of restricted marine conditions. Since the Pine Salt rests on the pre-Spearfish unconformity to the east and north of its basin of deposition, the barrier doubtlessly lay to the west or south. Perhaps the Belt Island and Sheridan Arch which restricted the Jurassic seas of the Williston Basin (Peterson, 1957, p. 406) played a part in the formation of these late Permian evaporites. Very little sedimentation occurred on the eastern and northern margins of the Pine basin because nowhere in North Dakota is the Pine seen to grade laterally into shales. In the area north of the Black Hills, however, a red siltstone and gypsum section of limited thickness is probably correlative with the Pine Salt of the deeper part of the basin. The Pine Salt Member is conformably overlain by the red mudstones of the Saude Member of the Spearfish Formation.

SAUDE MEMBER

The upper red mudstone unit of the Spearfish Formation, termed the Saude Formation by Zieglar (1955) is herein reduced to

member status and placed in the Spearfish Formation. The base of the Saude is extended to include a persistent anhydrite and salt unit and an equally persistent sandy siltstone unit formerly included by Zieglar in the underlying Pine Salt.

The Saude Member ranges in thickness from a feather edge along its periphery to over 350 feet in western North Dakota and to nearly 500 feet in South Dakota just north of the Black Hills. Its distribution and thickness in western North Dakota are shown on plate 4.

The type section of the Saude Member is herein designated as the interval between 6290 and 6610 feet, mechanical log depth, in the Amerada Petroleum Corporation, Pederson, Cater No. 1 well, NE, SW, Sec. 21, T. 158 N., R. 95 W., Williams County, North Dakota. The well was spudded on February 16, 1959 and completed on April 6, 1959 having reached a total depth of 10,441 feet. The mechanical log depths were measured from the rotary drill bushing which was 14 feet higher than the ground level of 2458 feet above sea level. The name Saude is derived through popular usage.

The following lithologic description is based on samples on file at the North Dakota Geological Survey. Sample depths are adjusted to mechanical log depths. The type log is shown on figure 7.

Samples:

6290 - 50 Shale, moderate reddish brown, 10 R 4/6, to pale reddish brown, 10 R 5/4, lumpy, slightly calcareous, silty, some white anhydrite.

6350 - 30 Siltstone, moderate reddish orange, very slightly calcareous, sandy in part, with very fine to fine, rounded, frosted quartz grains, a little white anhydrite.

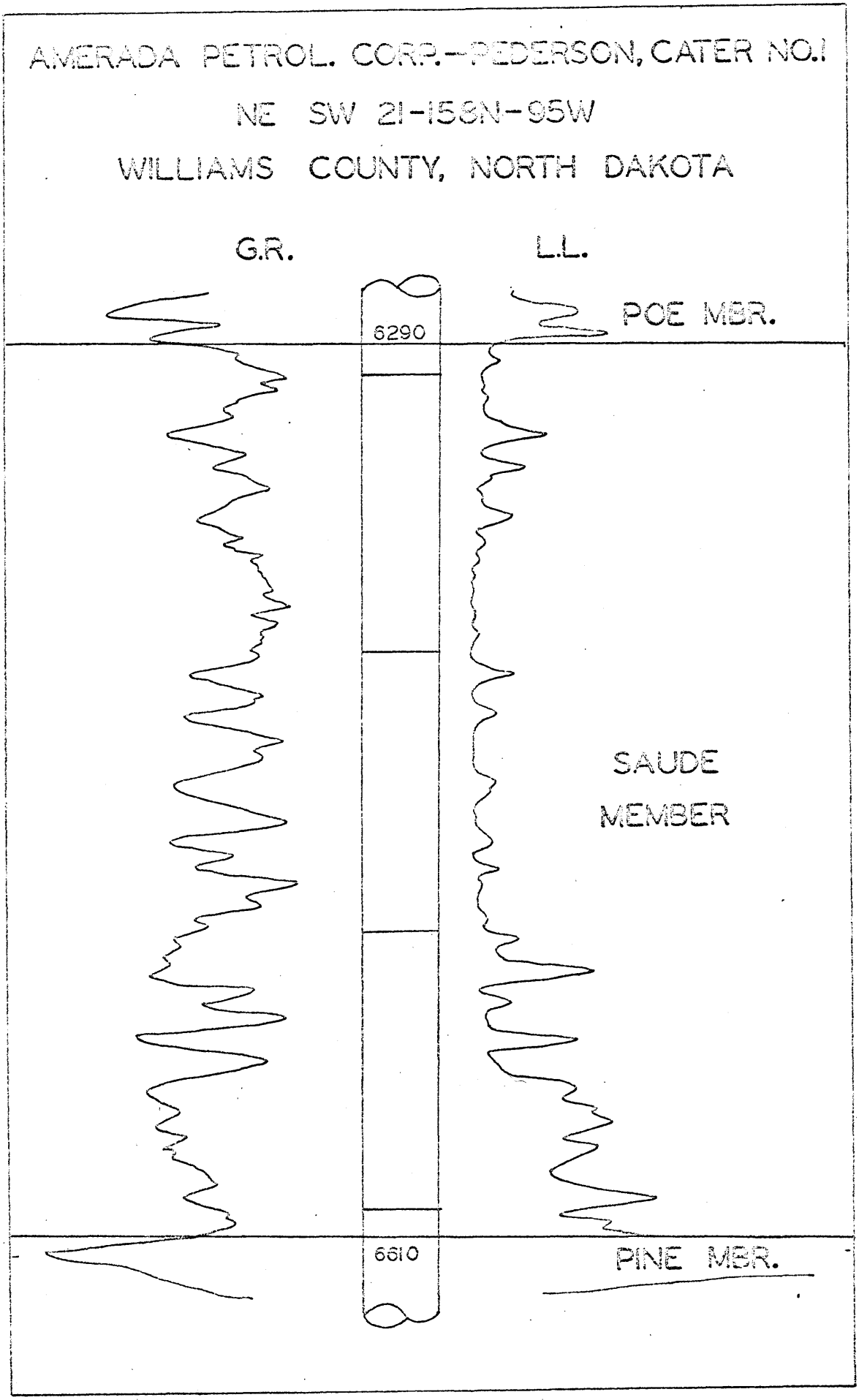

Figure 7—Electric and radiation logs of the type section, Saude Member.

6530 - 10 Siltstone, as above, traces of colorless anhydrite, traces of sandstone, moderate reddish orange, very fine to medium grained, silty, slightly calcareous.

The Saude Member is predominantly made up of reddish orange siltstone and fine-grained sandstone with frequent anhydrite interbeds. Reddish brown and gray siltstone and shale lenses occur locally. In some areas, frosted sand grains occur scattered through the siltstone.

Near the base of the Saude Member in the southwestern corner of North Dakota is a persistent anhydrite bed which locally contains salt. Where salt is present the unit thickens, reaching as much as 50 feet in southwestern Billings County. An isopachous map of this unit, herein referred to informally as the G marker bed, is shown on plate 5. The G marker bed is generally separated from the underlying rocks by a persistent sandy siltstone unit but east of the edge of the Pine Salt Member it rests directly on the shales of the Belfield Member.

The Saude Member extends well beyond the limits of the Pine Salt and rests unconformably on progressively older Paleozoic rocks to the east and north. The character and distribution of the Saude suggest that it is an onlapping transgressive sand and siltstone unit that was deposited in a growing basin. Lithofacies studies by Goldsmith (1959, p. 11) based on sand-silt ratios indicate a source area lying generally to the west and north.

Comparison of the pre-Spearfish subcrop map (plate 8) and the Saude isopachous map (plate 4) reveals a marked thinning over resistant rocks such as the Amsden Formation and the Kibbey Formation and a thickening over erosional lows underlain by the Opeche Formation

and the Heath and Otter Formations of the Big Snowy Group. The relative relief of the pre-Spearfish surface at the time of basal Saude deposition had a great effect on controlling the thickness and lithology of the lower part of the unit. In areas where topographic lows were present the Saude thickens and in areas underlain by topographic highs, thinning is observed. This feature is well developed in Divide and Williams Counties, North Dakota.

In some areas, especially in Bottineau County, North Dakota, and southern Saskatchewan and Manitoba, the Saude contains a basal sand unit. In Bottineau County, the sand varies from 10 to 40 feet in thickness and consists of a very fine grained quartzose sandstone with some interbedded reddish and greenish siltstone and shaly sandstone (Harrison and Larson, 1958, p. 29). The topographic relief on the pre-Spearfish surface at the time of deposition had the greatest effect on the distribution and thickness of the basal sand, causing it to be concentrated in the low areas. However, minor structural activity appears to have played a part as well, since the sand is seen to overlap onto resistant strata at some points.

In Canada a basal sandstone unit is distinctive and is called the frosted-grain unit of the Watrous Formation. This unit is made up of sandstone, conglomerate, and locally contains fragments of chert and limestone derived from the pre-Spearfish surface. In southern Saskatchewan, the basal Watrous contains an orange-red frosted grain unit of possible aeolian origin (Milner and Thomas, 1954, p. 256). Well rounded, frosted sand grains occur scattered through the silty beds of the Saude in North Dakota (Zieglar, 1956, p. 196).

Smith (1956, p. 105) believed these to be windblown deposits and that these and the thin anhydrite beds of the Saude were associated with playa lakes. Goldsmith (1959, p. 11) suggested that a large alluvial plain may have existed in the basin during much of Saude time. Lithofacies studies based on sand-silt ratios indicate the apices of sandstone tongues to be in northwestern North Dakota and southeastern Saskatchewan, thereby indicating source areas near these localities. These data, together with the irregularity of bedding in the Saude and the apparent absence of strand line deposits, imply that much of the Saude is continental in origin. Regularity of bedding south of the Cedar Creek Anticline and in the lower portions of the Saude in southwestern North Dakota, however, suggests that these beds may be marine.

The Saude is overlain by a lower evaporite member of the Piper Formation. The contact is probably conformable throughout much of northwestern North Dakota and Canada. To the west and south, however, a considerable portion of the Saude has been removed by erosion and the lower boundary of the Piper is marked by a distinct angular unconformity.

Units Overlying The Spearfish Formation

Throughout western North Dakota, the Spearfish Formation is overlain by a series of anhydrite and salt beds designated as the Poe Member of the Nesson Formation by Nordquist (1955, p. 104). Geologists at the North Dakota Geological Survey, however, believe the term Nesson Formation should be abandoned and the term Piper

Formation used in its place. Since the term Poe Member is useful in describing the lower evaporite unit it will be referred to as the Poe Member of the Piper Formation in this report. This usage is not formally proposed and is employed solely for the sake of continuity. The cross sections in North Dakota (plates 9-12) have as a datum a persistent anhydrite bed near the top of the Poe Member which probably closely approximates a time line. The Poe Member, as defined by Nordquist, locally includes an additional evaporite bed which occurs above this datum plane.

The Poe Member consists of white to pink anhydrite, interbedded with dark red shale and a little limestone near the top (Nordquist, 1955, p. 104). Included also in the lower part of the type Poe is a basal salt unit which lies almost entirely within the boundaries of North Dakota. This unit was named the Dunham Salt by Zieglar (1955) who regarded it as part of the Spearfish Formation. The Dunham is considered to be a facies of the Poe by most other workers (Goldsmith, 1959, Nordquist, 1955) and the present writer. The Dunham locally attains a thickness of 130 feet and is found only in the central part of the basin (plate 2). The Dunham is believed to be conformable with the underlying Saude Member of the Spearfish Formation although some small local unconformities may exist.

The Poe Member is reasonably uniform in thickness where it overlies the Saude, but exhibits considerable variation to the east of the Saude limit where it rests on the pre-Spearfish erosional surface (Nordquist, 1955, p. 104-105). This uniformity in thickness over the Saude suggests the lack of an erosional surface.

STRATIGRAPHIC RELATIONSHIPS AND CORRELATIONS

Several divergent opinions as to the proper stratigraphic position of the post-Minnekahta, pre-Piper red beds of the Williston Basin have appeared since these beds were first observed in the subsurface. Figure 8 shows the best known correlations.

The term Spearfish, when first extended into the Williston Basin of western North Dakota, was applied to rocks between the Minnekahta Limestone of Permian age and the Piper Formation of Jurassic age. The term "Spearfish" was used because of its lithologic resemblance and similar stratigraphic position to the Spearfish Formation of the Black Hills. These red beds were considered to be essentially Triassic in age and the term "Spearfish" was applied with some reservation by most geologists.

In 1955, Zieglar subdivided these red beds into four units which, in ascending order, were: (1) Spearfish Formation (restricted), (2) Pine Salt, (3) Saude Formation, and (4) Dunham Salt. Zieglar (1956, p. 176) postulated a major unconformity at the base of the Pine Salt which "can be mapped with varying degrees of certainty across North Dakota and with a little imagination across northwestern South Dakota back to the Black Hills." Zieglar correlated this unconformity with the regional erosion surface at the base of the Jurassic in central Montana. Thus, the Pine, Saude, and Dunham were, according to him, Jurassic in age. Although he believed the Spearfish

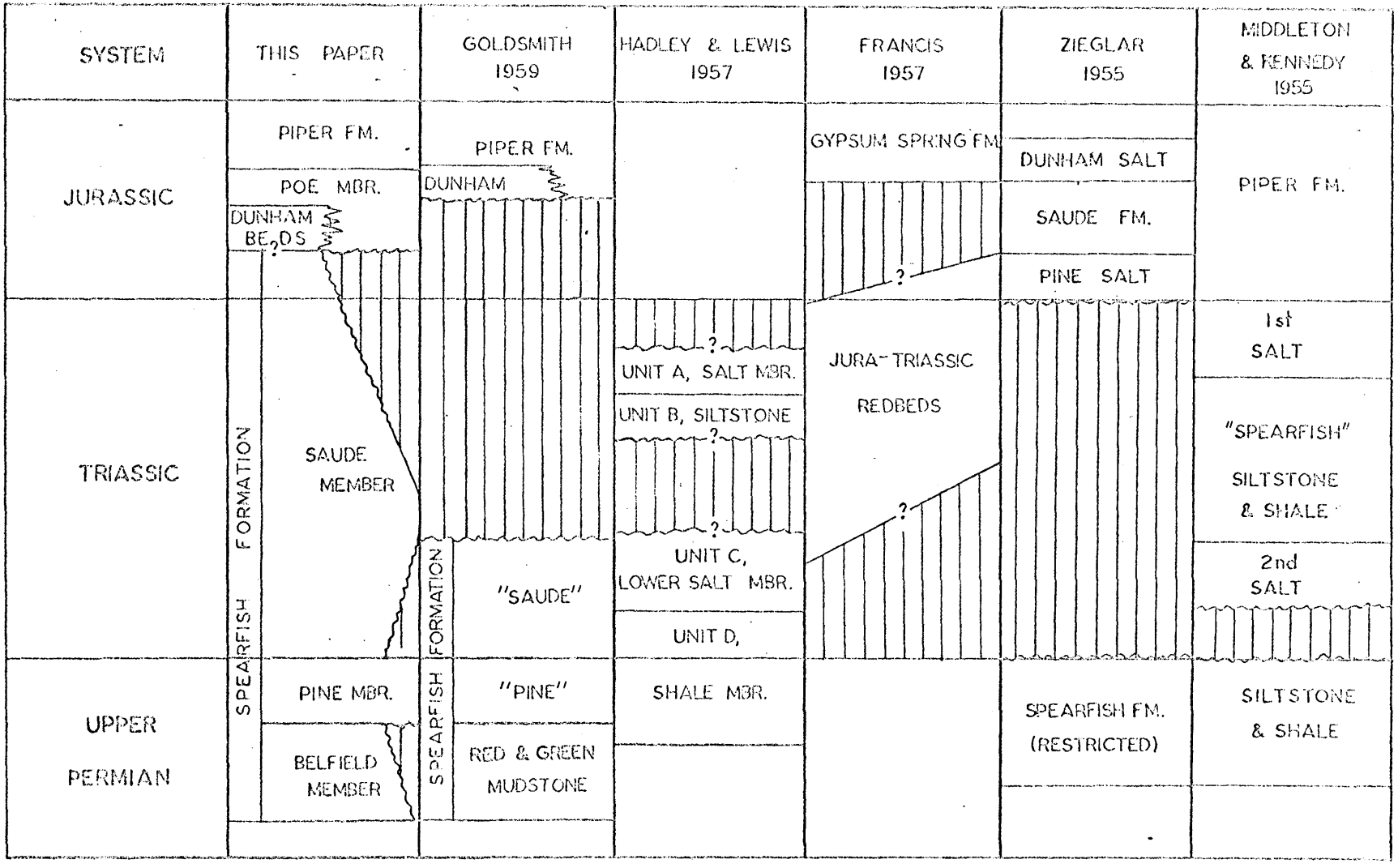

Figure 8 — Previous and present stratigraphic nomenclature of the post-Minnekhata, pre-Piper rocks of the Williston Basin.

in the Black Hills to be in part Triassic, it was beveled northward so that no Triassic sediments were present in the Williston Basin.

In contrast to Zieglar's ideas, Hadley and Lewis (1957, p. 1484-1486) assigned most of the red bed sequence, except for the lower portion of Zieglar's Spearfish (restricted), to the Triassic system. They believed that the Saude conformably underlies and overlies adjacent rock units in the central and northern part of the basin but lies with marked unconformity along the margins on rocks as old as Mississippian. They believed this to be the only major unconformity associated with the Spearfish Formation in the Williston Basin.

Francis (1957, p. 376) referred to the "Spearfish" only as the Jura-Triassic red beds and dispensed with any further classification as implying more than is known.

Goldsmith (1959, p. 11) correlated the lower shale unit (Spearfish (restricted) of Zieglar) with a red and green shale unit of inferred Permian age in the Black Hills. Likewise, the Pine salt was believed to be a lateral equivalent of interbedded red mudstone and gypsum units of Permian age in the Spearfish surface sections. The Saude Formation was tentatively considered by Goldsmith to be of Lower Triassic age and correlative with Lower Triassic units in the Black Hills. Goldsmith also maintained that a major unconformity representing much of Middle and Late Triassic and Early Jurassic time separates the Saude from overlying formations. A basal conglomerate in the overlying Poe evaporite Member of the Piper Formation (Nesson Formation of Nordquist) locally marks the unconformity.

The stratigraphic relationships and correlations set forth in this paper are essentially a modification and extension of Goldsmith's conclusions. The lower shale unit (Belfield Member) of the Spearfish Formation is considered to be Permian in age for the following reasons: (1) its conformable relationship with the underlying Minnekahta Limestone of Permian age, (2) its concordant limits with the Minnekahta indicate deposition in a basin of similar configuration, and (3) its correlation with the lower portion of the type Spearfish of inferred Permian age north of the Black Hills. The relatively large amount of gray (marine?) shale suggests environmental conditions not unlike those that probably existed in Minnekahta time.

The Pine Salt Member is considered Permian in age because of its correlation with Permian gypsums and shales in the Black Hills surface sections. As stated by Goldsmith (1959, p. 11) "evaporites are more common in the Permian than in the Triassic System." The Pine Salt may also be correlative with the Ervay tongue of the Phosphoria Formation of central Wyoming because of its similar stratigraphic position.

The oldest rocks of the Saude Member consist of red siltstones which overly the Pine Salt in extreme southwestern North Dakota. They are probably marine in origin because of their conformable relationship with the underlying salt beds. Following deposition of these beds, the seas again were restricted and a thin bed of anhydrite was deposited. This bed is herein informally called the G marker bed and is correlated with the top of the Goose Egg Formation of eastern Wyoming and Montana (Figure 9; Plate 15). Since the base of the Triassic System is placed

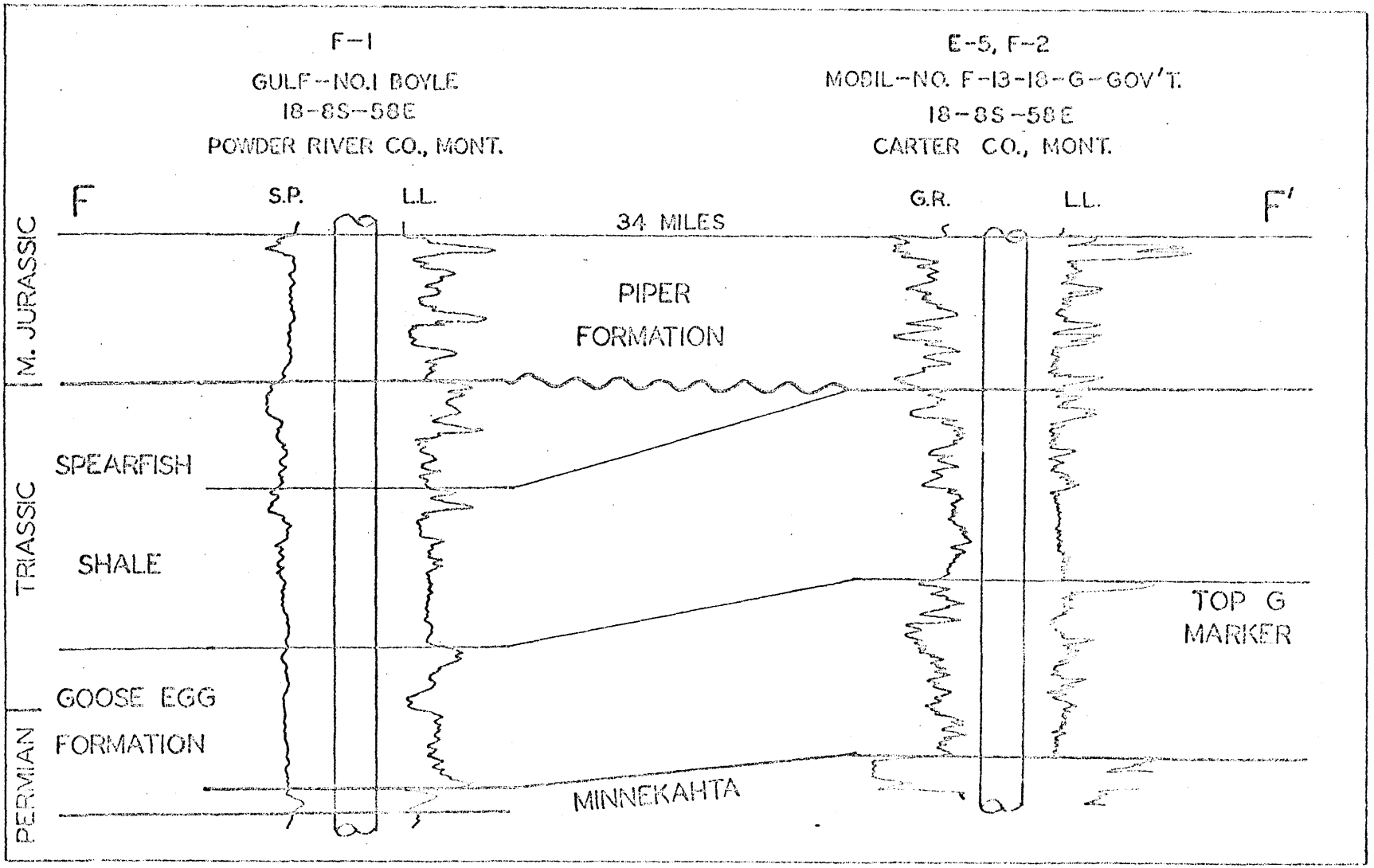

Figure 9 — Cross section showing correlation of the G marker bed with the top of the Goose Egg Formation. Tops in the Gulf No.1 Boyle are as picked by the Nomenclature Committee, Wyoming Geological Association, in Wyoming Stratigraphy, Part I, 1956.

slightly below the top of the Goose Egg Formation by Wyoming geologists, and is separated from the G marker bed by a thin siltstone unit, the top of the Pine Salt is at about the same stratigraphic position and therefore marks the top of the Permian System. The combined thinness and wide areal extent of the G marker bed suggests that it is probably marine in origin. Its greater thickness and localized salt content in southwestern North Dakota is probably due to basin subsidence and restriction of this part of the basin by the Cedar Creek Anticline.

Beds of the Saude Member above the G marker bed can be separated into two areas by a line extending from southeastern Montana to northwestern South Dakota, just south of and roughly parallel to the Cedar Creek Anticline. South of this line, individual beds in the Saude can be traced for some distance indicating uniformity of deposition and probable marine conditions. Such uniformity of bedding is also present in the Red Peak Member of the Chugwater Formation of central Wyoming which is a lateral equivalent of the Saude.

The Saude in this area has an angular relationship with the overlying Poe Member of the Piper Formation which can be traced across most of the area between the North Dakota - South Dakota border and the Black Hills, and into eastern Montana and Wyoming (Plates 15 & 16, Figure 9). Evidence of angular discordance is lost about 30 miles north of the outcrop area and it appears questionable whether the angular unconformity extends as far south as the surface sections. The Saude thins markedly over the Cedar Creek Anticline but thickens again in the main part of the basin. The unconformity cannot be traced with any degree of accuracy north of the anticline and its

extent in North Dakota is not known. Goldsmith (1959, p. 11) extended this erosional surface about 50 miles into North Dakota and cited indirect evidence such as the presence of a local conglomerate at the base of the overlying Poe evaporite Member (Nordquist, 1955, p. 104) for its presence in the southwestern part of North Dakota.

The Saude Member is stratigraphically equivalent to the Watrous Formation in Saskatchewan (Zieglar, 1956, p. 175). The Watrous Formation is divided into three units, a basal frosted grain unit, a middle shale unit, and an upper evaporite unit. The lower two units are equivalent to the Saude Member in North Dakota while the evaporite unit is correlative with the Poe Member of the Piper Formation. A Jurassic age is commonly assigned to the Watrous although its basal portion may be Triassic (Cumming, 1956, p. 169). No unconformity is recognized within the Watrous Formation in Saskatchewan.

It is apparent, then, that the Saude is conformable with overlying Jurassic strata in Canada and separated from the Jurassic in South Dakota and southeastern Montana by a sharp unconformity. The following hypothesis is submitted to account for this apparent discrepancy. The depositional history of the Saude in North Dakota and Canada was probably somewhat different than in areas to the south. In the main part of the Williston Basin, north of the Cedar Creek Anticline, the Saude is considered to be an onlapping transgressive unit, becoming younger to the east and north. It is probable that the Triassic - Jurassic time boundary lies within the upper part of the Saude. Geologic time is a very difficult factor to deal with in an unfossiliferous sequence of beds and location of time boundaries

must depend on other criteria. Recognizable unconformities serve this purpose best where they are present but in their absence, the position of time boundaries can only be estimated. The relationship of the Saude in North Dakota with its laterally equivalent rocks indicates that it is probably Triassic in age, becoming younger to the east and north along the margins of its basin of deposition. The upper part of the Saude in extreme northwestern North Dakota and southern Saskatchewan may be Jurassic in age. The major unconformity on top of the Saude south of the Cedar Creek Anticline limits its age in this area to the Triassic, probably Lower and Middle Triassic. This is in agreement with the supposed Lower Triassic age of the Red Peak Member of the Chugwater Formation in Wyoming which is a lateral equivalent of the Saude in that area. Figure 10 shows the laterally equivalent rocks of the Saude and other members of the Spearfish Formation in Canada, South Dakota, and Wyoming.

The Piper Formation as defined in this report is equivalent to the Gypsum Spring Formation of the Black Hills (Francis, 1957, p. 375). Plates 15 and 16 show this correlation. The Poe Member of the Piper Formation is correlative with the upper unit of the Watrous Formation of Saskatchewan (Milner and Thomas, 1954, p. 257).

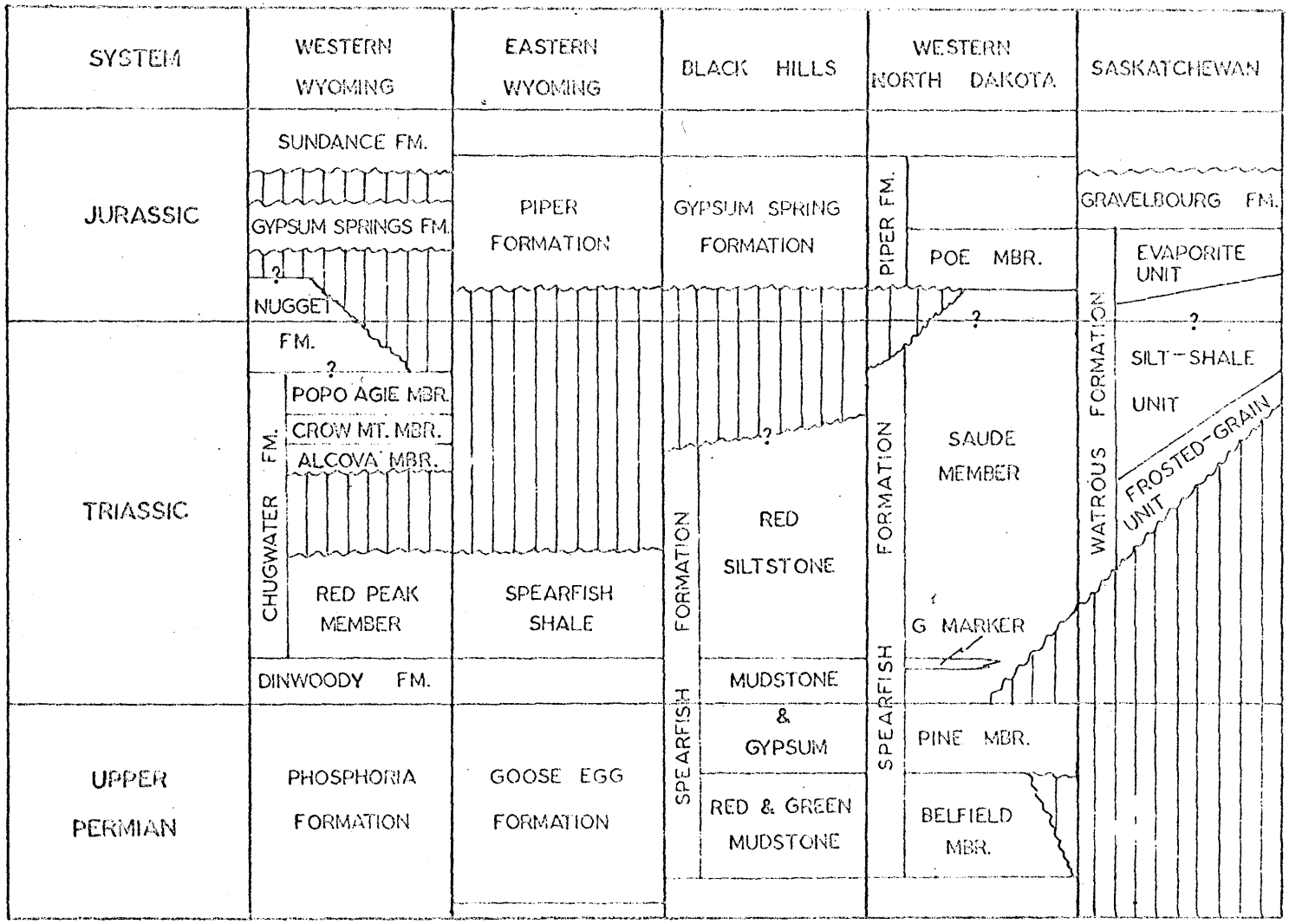

Figure 10 -- Correlation of the Spearfish Formation of western North Dakota with laterally equivalent rocks in Canada, South Dakota, and Wyoming.

STRUCTURAL ELEMENTS

General

The western part of North Dakota lies entirely within the Williston Basin. The Williston Basin can be described as a stable shield basin, formed by a broad gentle downwarp on the cratonic platform and characterized by relatively slow undisturbed sedimentation. Several positive and negative structural elements which affected deposition of the Spearfish Formation are present in western North Dakota. The major positive elements are the Nesson and Cedar Creek Anticlines. In addition to these, several minor structures are defined by thickness variations on the isopachous maps (Figure 11).

Nesson Anticline

Although the Nesson Anticline is a major structural feature in the Williston Basin, it was apparently relatively inactive during Spearfish time. A marked thickening of the Belfield Member on the southwestern end of the anticline is balanced by a thinning of the overlying Pine Member in the same area. These thickness trends are interpreted as being due to differential erosion of the Belfield before deposition of the Pine Salt rather than to structural activity. The isopachous map of the total Spearfish shows little variation in thickness over the Nesson Anticline.

Activity of the Nesson Anticline was apparently renewed during Late Jurassic time. The Dunham salt beds of the Piper Formation are

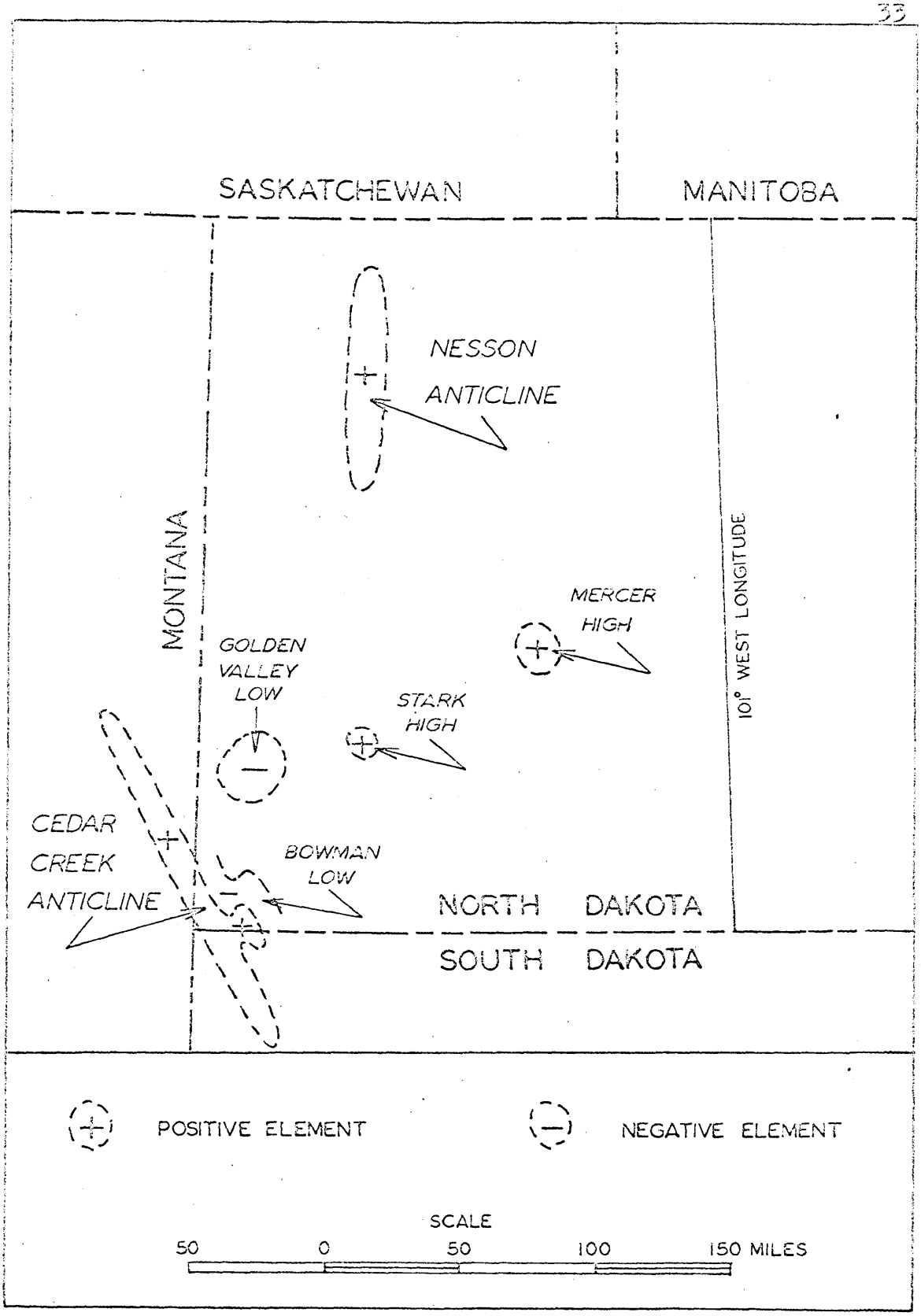

Figure 11 — Location map showing positive and negative structural elements that affected Spearfish sedimentation in western North Dakota.

absent along the axis of the anticline (plate 2) and a thickening of the "Morrison" over these areas indicates solution during Late Jurassic time. Apparently a gentle uplift fractured the overlying rocks allowing percolating water to reach the Dunham salt 800 feet below the surface. An unusual system of "solution channels" in the Dunham (Figure 12) is interpreted as being due to solution along fractures or faults of minor displacement. These channels are very narrow and elongated normal to the anticlinal axis. Such an orientation suggests that they may be cross faults of the type commonly found on anticlinal structures. The presence of faulting in this area is further suggested by progressively higher oil-water contacts in pools from south to north along the axis of the Nesson Anticline (C. B. Folsom, North Dakota Geological Survey, oral communication, May, 1964).

Cedar Creek Anticline

The Cedar Creek Anticline (Figure 11) had a somewhat greater effect on Spearfish sedimentation than did the Nesson Anticline. During deposition of the Minnekahta Limestone and the Belfield Member, however, the anticline was inactive as these units continue over it with little change in thickness. During Pine time the anticline became active. This activity is reflected by a marked thinning of the Pine Salt over the anticlinal axis in South Dakota (Plate 15). The relatively high position of the anticline during this period may have contributed to the development of restricted conditions in the North Dakota part of the basin. The presence of salt in the G marker bed in the southwestern part of North Dakota and its sudden change to

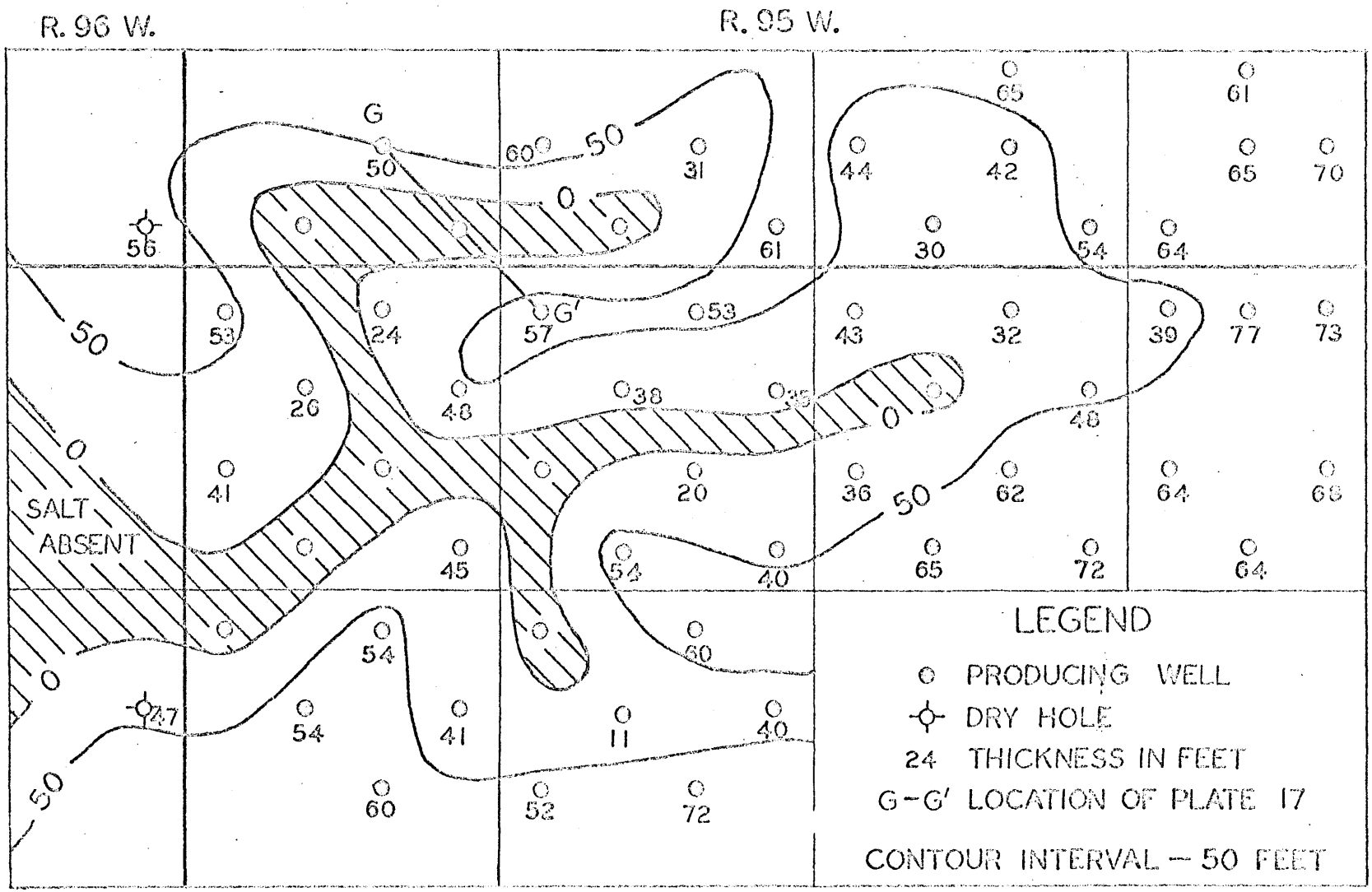

Figure 12 — Isopachous map of the Dunham beds showing solution channels in the northwestern part of the Charlson Field, Mckenzie County, North Dakota.

a thin anhydrite over the Cedar Creek Anticline indicates restriction by this structure.

Near the end of Saude deposition (Late Triassic?) the Cedar Creek Anticline rose considerably causing the Saude to be eroded and forming the angular unconformity which separates the Spearfish from younger rocks in the area. The uniformity in thickness of the overlying Piper Formation indicates development of near peneplain conditions prior to Piper time.

Bowman Low

The Spearfish Formation reaches its greatest thickness in North Dakota in a small area in extreme southwestern Bowman County. This low takes the form of a narrow trough, the axis of which is just north of and parallel to the Cedar Creek Anticline (Fig. 11). Apparently the crest of the anticline was farther south during Spearfish time as areas of thick Spearfish accumulation are penetrated by wells lying on and producing from that structure as it is known today. The tectonics of the Bowman Low are vague but its position suggests that it is probably intimately connected with the activity of the adjacent Cedar Creek Anticline.

The continuity of the Bowman Low is interrupted by what appears to be a northern extension or high axis off of the Cedar Creek Anticline (Figure 11). The structure is defined by a marked thinning of all three members of the Spearfish Formation. However, since the presence of this high is defined by a single well, future drilling is necessary before its precise relationship with the Cedar Creek Anticline can be established.

Golden Valley Low

About 50 miles north of the Bowman Low in an area centering in the southwestern corner of Golden Valley County is a broad structural depression that marks the depococenter of the Spearfish Formation in the Williston Basin. All the units of the Spearfish thicken toward this area where a maximum of 670 feet is reached. Although this is 45 feet less than the total Spearfish preserved in the Bowman Low, the Golden Valley Low is considered the depocenter due to its larger size and persistence throughout Spearfish time.

Stark High

The Stark High is located a few miles northwest of Dickinson in the western portion of Stark County, North Dakota. It is defined by an abrupt thinning of the Belfield and Saude Members of the Spearfish Formation but no effect on the intermediate Pine Salt has been observed. Although the Stark High is very limited in size, its significance is enhanced by the presence of two producing oil wells associated with it.

Mercer High

A positive area of unknown size is defined by the presence of a "fenster" in the Minnekahta Limestone in western Mercer County, North Dakota (plate 8). Here, a single well shows the Belfield Member resting on the Minnelusa Formation. Since the Belfield is considered to be conformable with the Minnekahta and the latter is present in wells completely surrounding the area, the apparent anomaly can be

explained in either of two ways. First, it is possible that the structure was high in Permian time and the Opeche and Minnekahta Formations were never deposited in the area, and second that the structure became active immediately prior to Spearfish time, subjecting the Opeche and Minnekahta Formations to erosion. Inadequate well control in the area at the present time makes a choice difficult, although the writer favors the first because of the time necessary for the erosion of post-Minnelusa, pre-Spearfish strata. The structure was inactive during Spearfish time as neither the Belfield nor the Saude were affected by it.

ECONOMIC GEOLOGY

Known Oil Fields

The Saude Member of the Spearfish Formation produces oil in the Newburg and South Westhope Fields, Bottineau County, North Dakota. The Spearfish pay section is a very fine grained, quartzose sandstone interbedded with red and green siltstone and shale. It varies in thickness from 0 to 40 feet and occurs at the base of the Saude where it lies directly on the pre-Spearfish unconformity. The sands are considered to be an onlapping transgressive unit that were deposited in a topographic low. They wedge out up dip and laterally, forming a stratigraphic trap. The oil apparently migrated from the underlying Madison, across the unconformity, and into the porous basal sands of the Saude. Detailed consideration of these fields was given by Folsom, Hansen, and Anderson (1958) and by Harrison and Larson (1958).

Petroleum Possibilities

Unfavorable porosities in much of the Spearfish Formation make it an unlikely prospect as a source rock for petroleum. Oil bearing sand lenses of limited extent such as those that occur in the Newburg and South Westhope Fields may be discovered by future drilling, but their location is difficult or impossible to predict. Since close proximity to a source rock appears to be a necessary prerequisite, new drilling in areas where the Spearfish overlies such petroliferous rocks as the Madison Limestone may reveal new pools in Spearfish sands.

The most important role of the Spearfish in the development of petroleum traps is where it forms a seal over porous strata. This condition is met at numerous localities but rocks at none of these have produced oil to date. Some possibilities include areas where the Saude Member overlies the Tyler Sand, Kibbey Sand, or the sands of the Minnelusa Formation.

Stratigraphic traps may occur where Paleozoic formations pinch out against the Stark or Mercer Highs. Two wells are currently producing from stratigraphic traps in Typer sands on the flanks of the Stark High. A closer look at the Mercer High may reveal similar traps.

Another possibility for the formation of petroleum traps occurs in areas where the Pine or Dunham salts have been removed by solution. Porous beds on the down dip side of collapse structures might become sealed by lowering of overlying impervious strata. Solution of the Dunham on the crest of the southern half of the Nesson Anticline and of the Pine in eastern Slope and western Stark Counties has been observed. Oil bearing horizons, if present, would be located in Jurassic rocks and since the Jurassic is productive in parts of Montana, the possibility should not be overlooked in North Dakota. Careful drill stem testing of porous Jurassic strata in the above mentioned areas might prove fruitful.

Salt

The Dunham beds of the Piper Formation and the Pine Salt Member of the Spearfish Formation are potential sources of halite in North Dakota. Due to their depth, however, the only economic way in which

they could be used would be to employ a solution mining method. Fresh water could be introduced into the formation to dissolve the salt, and the resulting brine would be pumped to the surface and evaporated. Cost could be reduced by employing abandoned exploratory wells. The resulting cavities could then be used for the storage of liquid petroleum products. This procedure is currently being used by the Dakota Salt and Chemical Company in four wells a few miles east of Williston, Williams County, North Dakota. In this area Mississippian salts are being mined. Texaco Inc. has developed one well in Devonian salts for L.P.G. storage in Burke County but the salt produced in the formation of the cavity was pumped back into the Dakota Sandstone rather than being used for commercial purposes.

Groundwater and Gypsum

The Spearfish Formation yields limited amounts of groundwater from shallow wells near the outcrop area in Wyoming and South Dakota. A high content of calcium sulfate in the water, however, generally makes it unacceptable as drinking water and its use is limited to agricultural and industrial purposes (Whitcomb et al., 1958, p. 254). Due to unfavorable porosities and depths in North Dakota, the production of groundwater from the Spearfish Formation is nonexistent.

The gypsum of the lower Spearfish in the outcrop area could conceivably become of local importance if a favorable market is developed. The general impurity and limited extent of these deposits, however, render large scale development improbable.

SUMMARY

The Spearfish Formation of the Black Hills has been traced into the Williston Basin of western North Dakota. In the basin, the formation can be divided into three members. In ascending order these are: (1) a lower gray shale and red siltstone unit herein named the Belfield Member, (2) a middle salt unit, the Pine Salt Member, and (3) an upper red siltstone and fine grained sandstone unit, the Saude Member. Type sections for all three members are herein established. Isopachous maps and stratigraphic cross sections have been prepared to delineate the thickness and distribution of each of the units in western North Dakota.

The Belfield Member and the Pine Salt Member are considered to be Permian in age and are correlated with the Permian part of the type Spearfish Formation in the outcrop sections north of the Black Hills. The Saude Member is predominantly Triassic in age although its upper part in extreme northern North Dakota and Canada may contain the Triassic-Jurassic boundary. The Saude in North Dakota is probably non-marine in origin and was deposited in a different depositional environment than its equivalent south of the Cedar Creek Anticline. South of the anticline the upper part of the Saude has been removed by erosion and a sharp angular unconformity separates the Saude from overlying Jurassic sediments. A persistent anhydrite bed in the lower part of the Saude in southwestern North Dakota is correlated with the top of the Goose Egg Formation in eastern Wyoming and Montana.

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APPENDIX

Well locations and formation tops the North Dakota wells used in this study are listed by counties and then by North Dakota Geological Survey well numbers as shown on the location map (Plate 1). The wells outside of North Dakota are listed by state, county, and then by cross section number as shown on the index map (Plate 14). Formation tops are given as the depth in feet from the Kelly bushing (K.B.). The top of the lowermost formation listed is also the depth to the pre-Spearfish surface (Plate 8).

Billings County

291. Amerada Petrol. Corp. - H. May # 1
NE NE 9 - 139 - 100
K.B. 2774

Piper Fm.	
Poe Mbr.	6650
Dunham beds	6684
Spearfish Fm.	
Saude Mbr.	6785
G marker top	6908
G marker base	6930
Pine Mbr.	6996
Belfield Mbr.	7152
Minnekahta Fm.	7365

555. Stanolind Oil & Gas Co. - N.W. 1. (N.P.) # 1
SE SE 17 - 143 - 100
K.B. 2815

Piper Fm.	
Poe Mbr.	6968
Dunham beds	7010
Spearfish Fm.	
Saude Mbr.	7060
Pine Mbr.	7265
Belfield Mbr.	7374
Minnekahta Fm.	7580

840. Stanolind Oil & Gas Co. - Schwartz # 1
SE SE 34 - 138 - 100
K.B. 2828

Piper Fm.	
Poe Mbr.	6775
Spearfish Fm.	
Saude Mbr.	6820
G marker top	6912
G marker base	6944
Pine Mbr.	7000
Belfield Mbr.	7150

859. Texaco - Gov't.-M. S. Pace # 1
SW NE 31 - 144 - 100
K.B. 2463

Piper Fm.	
Poe Mbr.	6586
Dunham beds	6630
Spearfish Fm.	
Saude Mbr.	6764
Pine Mbr.	6966
Belfield Mbr.	7078
Minnekahta Fm.	7276

1304. Northern Pump Co. - L. Fritz # 1
SE SE 15 - 137 - 100
K.B. 2854

Piper Fm.	
Poe Mbr.	6685
Spearfish Fm.	
Saude Mbr.	6739
G marker top	6868
G marker base	6913
Pine Mbr.	6928
Belfield Mbr.	7045
Minnekahta Fm.	7254

1508. Amerada Petrol. Corp. - Scoria # 1
NE NE 10 - 139 - 101
K.B. 2626

Piper Fm.	
Poe Mbr.	6560
Spearfish Fm.	
Saude Mbr.	6620
G marker top	6710
G marker base	6722
Pine Mbr.	6778
Belfield Mbr.	6928
Minnekahta Fm.	7142

1678. Amerada Petrol Corp. - Scoria # 2
SW SW 2 - 139 - 101
K.B. 2634

Piper Fm.	
Poe Mbr.	6470
Dunham beds	6525
Spearfish Fm.	
Saude Mbr.	6606
G marker top	6706
G marker base	6730
Pine Mbr.	6800
Belfield Mbr.	6938
Minnekahta Fm.	7151

2294. Shell Oil Co. - N.P. # 42-21
SE NE 21 - 141 - 100
K.B. 2668

Piper Fm.	
Poe Mbr.	6720
Spearfish Fm.	
Saude Mbr.	6800
Pine Mbr.	6913
Belfield Mbr.	7094
Minnekahta Fm.	7310

2357. The Calif. Co. - Gov't. # 1
NE NW 20 - 137 - 102
K.B. 2719

Piper Fm.	
Poe Mbr.	6520
Spearfish Fm.	
Saude Mbr.	6580
G marker top	6700
G marker base	6750
Pine Mbr.	6840
Belfield Mbr.	7048
Minnekahta Fm.	7250

2689. Hunt Oil Co. - N. Haag # 1
NE NE 21 - 144 - 99
K.B. 2721

Piper Fm.	
Poe Mbr.	6950
Dunham beds	7000
Spearfish Fm.	
Saude Mbr.	7112
Pine Mbr.	7280
Belfield Mbr.	7400
Minnekahta Fm.	7620

2745. Hunt Oil Co. - W. Palanuk # 1
NE sw 15 - 144 - 99
K.B. 2727

Piper Fm.	
Poe Mbr.	6950
Dunham beds	6990
Spearfish Fm.	
Saude Mbr.	7134
Pine Mbr.	7298
Belfield Mbr.	7415
Minnekahta Fm.	7636

2768. H. L. Hunt - U. S. A. # 1
SE SE 4 - 140 - 100
K.B. 2736

Piper Fm.	
Poe Mbr.	6910
Spearfish Fm.	
Saude Mbr.	6956
Pine Mbr.	7091
Belfield Mbr.	7204
Minnekahta Fm.	7409

2788. Hunt Oil Co. - A. T. Thompson # 1
NE NE 33 - 144 - 99
K.B. 2716

Piper Fm.	
Poe Mbr.	6974
Dunham beds	7008
Spearfish Fm.	
Saude Mbr.	7130
Pine Mbr.	7290
Belfield Mbr.	7430
Minnekahta Fm.	7649

2798. Lamar Hunt - N. P. # 1
SW NW 9 - 144 - 100
K.B. 2592

Piper Fm.	
Poe Mbr.	6992
Spearfish Fm.	
Saude Mbr.	7038
Pine Mbr.	7194
Belfield Mbr.	7320
Minnekahta Fm.	7533

2853. Shell Oil Co. - Gov't. # 41X - 5 - 1
NE NE 5 - 143 - 100
K.B. 2572

Piper Fm.	
Poe Mbr.	6662
Dunham beds	6702
Spearfish Fm.	
Saude Mbr.	6807
Pine Mbr.	7020
Belfield Mbr.	7146
Minnekahta Fm.	7350

3211. H. L. Hunt - N. P. # 1
NE SE 1 - 141 - 100
K.B. 2741

Piper Fm.	
Poe Mbr.	6993
Spearfish Fm.	
Saude Mbr.	7041
Pine Mbr.	7196
Belfield Mbr.	7302
Minnekahta Fm.	7514

Bottineau County

38. The California Co. - B. Thompson # 1
SW SE 31 - 160 - 81
K.B. 1526

Piper Fm.	
Poe Mbr.	3462
Spearfish Fm.	
Saude Mbr.	3610
Madison Grp.	
Ratcliffe Interval	3852

200. Ward-Williston Oil Co. - Gorder # 1
C NW 35 - 164 - 80
K.B. 1503

Piper Fm.	
Poe Mbr.	2990
Spearfish Fm.	
Saude Mbr.	3100
Madison Grp.	
Ratcliffe Interval	3239

201. Ward-Williston Drlg. Co. - Klackstead # 3
NE NW 36 - 164 - 79
K.B. 1525

Piper Fm.	
Poe Mbr.	2850
Spearfish Fm.	
Saude Mbr.	2958
Madison Grp.	
Ratcliffe Interval	3083

206. Zach Brooks Drlg. Co. - Berenson # 1
SW SE 21 - 163 - 80
K.B. 1503

Piper Fm.	
Poe Mbr.	3130
Spearfish Fm.	
Saude Mbr.	3177
Madison Grp.	
Ratcliffe Interval	3346

338. Sohro Petrol. Co. - A. J. Artz # 1
NW SW 14 - 163 - 82
K.B. 1530

Piper Fm.	
Poe Mbr.	3300
Spearfish Fm.	
Saude Mbr.	3434
Madison Grp.	
Frobisher-Alida Interval	3573

524. Dakota Drlg. - O. Anderson # 1
SE NW 19 - 161 - 81
K.B. 1522

Piper Fm.	
Poe Mbr.	3475
Spearfish Fm.	
Saude Mbr.	3600
Madison Grp.	
Ratcliffe Interval	3855

893. Amerada Petrol. Corp. - Beauchamp # 1
SE SW 21 - 161 - 79
K.B. 1473

Piper Fm.	
Poe Mbr.	3131
Spearfish Fm.	
Saude Mbr.	3220
Madison Grp.	
Ratcliffe Interval	3440

911. H. M. Cox - Feland-State # 1
NE NE 31 - 163 - 82
K.B. 1565

Piper Fm.	
Poe Mbr.	3458
Spearfish Fm.	
Saude Mbr.	3590
Madison Grp.	
Ratcliffe Interval	3728

949. Cardinal Drlg. - A. J. Gunning # 1
NE NE 15 - 159 - 82
K.B. 1563

Piper Fm.	
Poe Mbr.	3665
Spearfish Fm.	
Saude Mbr.	3770
Madison Grp.	
Poplar Interval	4017

962. Amerada Petrol. Corp. - Luddington # 1
SW NE 5 - 160 - 80
K.B. 1503

Piper Fm.	
Poe Mbr.	3290
Spearfish Fm.	
Saude Mbr.	3408
Madison Grp.	
Ratcliffe Interval	3632

1159. Monsanto Oil Co. - Halvorson # 1
NW SE 2 - 162 - 79
K.B. 1499

Piper Fm.	
Poe Mbr.	2930
Spearfish Fm.	
Saude Mbr.	3028
Madison Grp.	
Ratcliffe Interval	3160

1206. Anschutz Drlg. Co. - Heath # 1
SE NE 31 - 159 - 83
K.B. 1661

Piper Fm.	
Poe Mbr.	4100
Spearfish Fm.	
Saude Mbr.	4186
Madison Grp.	
Poplar Interval	4450

1324. Leach Oil Corp. - R. R. Smith # 1
SW SW 14 - 162 - 80
K.B. 1507

Piper Fm.	
Poe Mbr.	3150
Spearfish Fm.	
Saude Mbr.	3250
Madison Grp.	
Ratcliffe Interval	3430

1431. Carter Oil Co. & Phillips Petrol. Co.
O. Fossum # 1
NE NE 31 - 162 - 81
K.B. 1523

Piper Fm.	
Poe Mbr.	3404
Spearfish Fm.	
Saude Mbr.	3500
Madison Grp.	
Ratcliffe Interval	3728

1427. Carter Oil Co. & Phillips Petrol. Co.
G. Blowers # 1
SE SW 20 - 160 - 83
K.B. 1634

Piper Fm.	
Poe Mbr.	3928
Spearfish Fm.	
Saude Mbr.	4022
Madison Grp.	
Poplar Interval	4251

3017. Simcox Oil Co. - J. E. Reed # 1
SE SE 13 - 161 - 83
K.B. 1566

Piper Fm.	
Poe Mbr.	3706
Spearfish Fm.	
Saude Mbr.	3783
Madison Grp.	
Ratcliffe Interval	4023

3250. Amerada Petrol. Corp. - T. Feland # 1
SE SW 31 - 163 - 81
K.B. 1522

Piper Fm.	
Poe Mbr.	3302
Spearfish Fm.	
Saude Mbr.	3427
Madison Grp.	
Ratcliffe Interval	3588

Bowman County

485. Hunt & Brooks - State # 1
NW NW 16 - 129 - 104
K.B. 3212

Piper Fm.	
Poe Mbr.	5833
Spearfish Fm.	
Saude Mbr.	5894
G marker top	6000
G marker base	6030
Pine Mbr.	6076
Belfield Mbr.	6190
Minnekahta Fm.	6336

516. Western Natural Gas Co. - Traut-Trager # 1FEE
NW SW 13 - 132 - 102
K.B. 3074

Piper Fm.	
Poe Mbr.	6226
Spearfish Fm.	
Saude Mbr.	6228
G marker top	6385
G marker base	6419
Pine Mbr.	6470
Belfield Mbr.	6685
Minnekahta Fm.	6858

1446. J. H. Snowden - M. A. Morrison # 1
SE SW 34 - 130 - 103
K.B. 3028

Piper Fm.	
Poe Mbr.	5588
Spearfish Fm.	
Saude Mbr.	5650
G marker top	5900
G marker base	5920
Pine Mbr.	5975
Belfield Mbr.	6191
Minnekahta Fm.	6364

1575. Carter Oil Co. - L. L Johnson # 1
NW SW 9 - 129 - 106
K.B. 2953

Piper Fm.	
Poe Mbr.	4810
Spearfish Fm.	
Saude Mbr.	4890
G marker top	5179
G marker base	5184
Pine Mbr.	5237
Belfield Mbr.	5432
Minnekahta Fm.	6505

2942. Shell Oil Co. - # 32X - 3A - 7
SW NE 3 - 130 - 107
K.B. 3000

Piper Fm.	
Poe Mbr.	4778
Spearfish Fm.	
Saude Mbr.	4855
G marker top	5035
G marker base	5058
Pine Mbr.	5116
Belfield Mbr.	5320
Minnekahta Fm.	5484

3338. Shell Oil Co. - # 41 - 24A - 36
NE NE 24 - 130 - 107
K.B. 2970

Piper Fm.	
Poe Mbr.	4900
Spearfish Fm.	
Saude Mbr.	4980
G marker top	5194
G marker base	5224
Pine Mbr.	5290
Belfield Mbr.	5477
Minnekahta Fm.	5655

Burke County

836. Carter Oil Co. - Morrissey # 1
SE SE 6 - 161 - 92
K.B. 2153

Piper Fm.	
Poe Mbr.	5613
Spearfish Fm.	
Saude Mbr.	5742
Kibbey Fm.	6053

898. Texota Oil Co. - Ely # 1
SE SE 32 - 163 - 93
K.B. 1936

Piper Fm.	
Poe Mbr.	5254
Spearfish Fm.	
Saude Mbr.	5353
Kibbey Fm.	5705

1006. Calvert Drlg. Inc. - A. C. Lawson # 1
NE NW 1872
K.B. 1872

Piper Fm.	
Poe Mbr.	4745
Spearfish Fm.	
Saude Mbr.	4833
Madison Grp.	
Poplar Interval	5163

1082. Calvert Drlg. Inc. - Jepsen # 1
NE NE 30 - 161 - 90
K.B. 2075

Piper Fm.	
Poe Mbr.	5430
Spearfish Fm.	
Saude Mbr.	5550
Kibbey Fm.	5880

1153. Northwest Drlg. Co. - Durick # 1
SW SE 31 - 164 - 93
K.B. 1911

Piper Fm.	
Poe Mbr.	5080
Spearfish Fm.	
Saude Mbr.	5192
Kibbey Fm.	5550

1368. Calvert-Williamson - R. Bryant # 1
NW NW 29 - 159 - 90
K.B. 2367

Piper Fm.	
Poe Mbr.	6606
Spearfish Fm.	
Saude Mbr.	6130
Heath-Otter Fms.	6470

1428. Calvert Drlg. Inc. - Davis # 1
NE SE 15 - 163 - 89
K.B. 1895

Piper Fm.	
Poe Mbr.	4640
Spearfish Fm.	
Saude Mbr.	4749
Madison Grp.	
Poplar Interval	5028

1430. Hunt Oil Co. - F. H. Cooksley # 1
NE SE 22 - 161 - 94
K.B. 2419

Piper Fm.	
Poe Mbr.	6061
Spearfish Fm.	
Saude Mbr.	6174
Heath-Otter Fms.	6525

1490. Northern Pump Co. - Bauer # 1
SE SE 31 - 163 - 88
K.B. 1895

Piper Fm.	
Poe Mbr.	4750
Spearfish Fm.	
Saude Mbr.	4830
Madison Grp.	
Poplar Interva.	5139

1493. Petroleum Corp. of America - B. Wilson # 1
NE SE 32 - 164 - 90
K.B. 1920

Piper Fm.	
Poe Mbr.	4770
Spearfish Fm.	
Saude Mbr.	4890
Madison Grp.	
Poplar Interval	5170

1531. Northwestern Oil Drlg. Co. - T. Olson # 1
NW NE 18 - 162 - 90
K.B. 1945

Piper Fm.	
Poe Mbr.	4970
Spearfish Fm.	
Saude Mbr.	5085
Madison Grp.	
Poplar Interval	5440

1540. Arrowhead Exploration Co. - Probst # 1
SE SE 17 - 163 - 92
K.B. 1930

Piper Fm.	
Poe Mbr.	5105
Spearfish Fm.	
Saude Mbr.	5208
Kibbey Fm.	5540

1766. Pan American Petrol. Corp. - R. Owings # 1
SE SW 13 - 161 - 92
K.B. 2171

Piper Fm.	
Poe Mbr.	5613
Spearfish Fm.	
Saude Mbr.	5738
Kibbey Fm.	6072

1807. Northern Pump Co. - Jacobsen # 1
NE NW 21 - 161 - 89
K.B. 1984

Piper Fm.	
Poe Mbr.	5147
Spearfish Fm.	
Saude Mbr.	5280
Kibbey Fm.	5590

1966. Hunt Oil Co. - E. K. Olson # 1
SW SW 18 - 160 - 94
K.B. 2346

Piper Fm.	
Poe Mbr.	6054
Spearfish Fm.	
Saude Mbr.	6150
Amsden Fm.	6450

2132. Lion Oil Co. - Bly # 1
NE NW 36 - 163 - 92
K.B. 1947

Piper Fm.	
Poe Mbr.	5126
Spearfish Fm.	
Saude Mbr.	5235
Kibbey Fm.	5587

2304. Stewart Petrol. Co. - Huff # 1
SW SW 31 - 161 - 93
K.B. 2477

Piper Fm.	
Poe Mbr.	6161
Spearfish Fm.	
Saude Mbr.	6270
Amsden Fm.	6500

2323. Calvert Drlg. Inc., Sun Oil Co. -
J. Maruskie # 1
NE NE 23 - 160 - 94
K.B. 2417

Piper Fm.	
Poe Mbr.	6120
Spearfish Fm.	
Saude Mbr.	6230
Amsden Fm.	6493

2406. Carter Oil Co. - State-Moberg # 2
SW SW 17 - 159 - 94
K.B. 2231

Piper Fm.	
Poe Mbr.	5994
Spearfish Fm.	
Saude Mbr.	6230
Amsden Fm.	6400

2430. Ohio Oil Co. - J. Rolie # 1
NW SW 4 - 162 - 94
K.B. 1948

Piper Fm.	
Poe Mbr.	5413
Spearfish Fm.	
Saude Mbr.	5532
Kibbey Fm.	5862

2829. Great Plains Royalty et. al. -
M. K. & M. B. Fetherston # 1
SE SE 18 - 160 - 92
K.B. 2348

Piper Fm.	
Poe Mbr.	5949
Spearfish Fm.	
Saude Mbr.	6063
Heath-Otter Fms.	6354

3290. Mar-Win Deuel. Co. - A. Peterson # 1
SE SW 28 - 162 - 94
K.B. 2302

Piper Fm.	
Poe Mbr.	5845
Spearfish Fm.	
Saude Mbr.	5945
Heath-Otter Fms.	6287

Divide County

321. Argyle Royalte Co. - Baukol-Noonan # 1
SW NE 11 - 162 - 95
K.B. 2031

Piper Fm.	
Poe Mbr.	5547
Spearfish Fm.	
Saude Mbr.	5664
Kibbey Fm.	5993

548. Pure Oil Co. - O. Gunderson # 1
SW NW 11 - 160 - 98
K.B. 2242

Piper Fm.	
Poe Mbr.	6085
Spearfish Fm.	
Saude Mbr.	6172
Amsden Fm.	6421

1024. Phillips Petrol. Co. - Braathen # 1
NE NW 29 - 162 - 95
K.B. 2233

Piper Fm.	
Poe Mbr.	5697
Spearfish Fm.	
Saude Mbr.	5794
Heath-Otter Fms.	6128

1286. Skelly Oil Co. - O. M. Olsen # 1
SE NE 33 - 162 - 100
K.B. 2275

Piper Fm.	
Poe Mbr.	5993
Spearfish Fm.	
Saude Mbr.	6070
Kibbey Fm.	6430

1443. Dakamont Explor. Corp. - H. E. Jacobson # 1
SW NE 6 - 162 - 96
K.B. 1945

Piper Fm.	
Poe Mbr.	5446
Spearfish Fm.	
Saude Mbr.	5564
Kibbey Fm.	5900

1532. Spartan Drlg. Co. - K. J. Ecklund # 1
SW NW 9 - 162 - 95
K.B. 2016

Piper Fm.	
Poe Mbr.	5491
Spearfish Fm.	
Saude Mbr.	5606
Kibbey Fm.	5940

1546. Kerr-McGee Oil Industries Inc. - Johnson # 1
NE NW 34 - 162 - 101
K.B. 2261

Piper Fm.	
Poe Mbr.	6000
Spearfish Fm.	
Saude Mbr.	6090
Kibbey Fm.	6440

1900. Signal Drlg. Inc. - K. Unhjem # 1
NW SW 5 - 162 - 98
K.B. 2121

Piper Fm.	
Poe Mbr.	5836
Spearfish Fm.	
Saude Mbr.	5930
Kibbey Fm.	6270

2010. Carter Oil Co. - D. Moore # 1
NW NE 7 - 163 - 102
K.B. 2206

Piper Fm.	
Poe Mbr.	5522
Spearfish Fm.	
Saude Mbr.	5607
Kibbey Fm.	5941

2121. Pan American Petrol. Corp. - M. Bakken # 1
NE SE 29 - 161 - 95
K.B. 2327

Piper Fm.	
Poe Mbr.	5880
Spearfish Fm.	
Saude Mbr.	5980
Amsden Fm.	6226

2143. Kerr McGee Oil Industries Inc. - Wifstad # 1
SE NW 13 - 163 - 95
K.B. 1912

Piper Fm.	
Poe Mbr.	5206
Spearfish Fm.	
Saude Mbr.	5304
Kibbey Fm.	5644

2688. Signal Drlg. Inc. - Hagen # 1A
SE NW 10 - 163 - 98
K.B. 1966

Piper Fm.	
Poe Mbr.	5400
Spearfish Fm.	
Saude Mbr.	5510
Kibbey Fm.	5830

2702. Signal Drlg. et. al. - State-Brady # 1
SW SW 8 - 163 - 96
K.B. 1924

Piper Fm.	
Poe Mbr.	5271
Spearfish Fm.	
Saude Mbr.	5380
Kibbey Fm.	5700

2714. Signal Drlg. Inc. - Elmar # 1
SE SE 11 - 162 - 96
K.B. 2037

Piper Fm.	
Poe Mbr.	5491
Spearfish Fm.	
Saude Mbr.	5600
Kibbey Fm.	5940

2720. Signal Drlg. Inc. - Carlson # 1
NW NW 27 - 163 - 100
K.B. 2170

Piper Fm.	
Poe Mbr.	5667
Spearfish Fm.	
Saude Mbr.	5760
Kibbey Fm.	6104

2721. Signal Drlg. Co. - Lund # 1
SW SW 15 - 161 - 100
K.B. 2242.

Piper Fm.	
Poe Mbr.	6010
Spearfish Fm.	
Saude Mbr.	6095
Heath-Otter Fms.	6430

2722. Signal Drlg. Co. - Joyce # 1
SE SW 13 - 161 - 98
K.B. 2060

Piper Fm.	
Poe Mbr.	5837
Spearfish Fm.	
Saude Mbr.	5926
Heath-Otter Fms.	6172

2716. L. Hunt - J. Brodal # 1
NW SW 11 - 161 - 95
K.B. 2396

Piper Fm.	
Poe Mbr.	5995
Spearfish Fm.	
Saude Mbr.	6095
Heath-Otter Fms.	6356

2759. Signal Drlg. & Exploration Co. - Sullivan # 1
SE NW 23 - 160 - 96
K.B. 2320

Piper Fm.	
Poe Mbr.	5992
Spearfish Fm.	
Saude Mbr.	6090
Amsden Fm.	6405

2970. Mar-Win Deuel. Co. - J. Raaum # 1
NE NE 20 - 162 - 101
K.B. 2244

Piper Fm.	
Poe Mbr.	5921
Spearfish Fm.	
Saude Mbr.	6010
Kibbey Fm.	6366

2996. Hunt Petrol. Corp. - C. Roestel # 1
SE SW 25 - 161 - 96
K.B. 2364

Piper Fm.	
Poe Mbr.	5980
Spearfish Fm.	
Saude Mbr.	6073
Amsden Fm.	6315

3098. Amerada Petrol. Corp. - S. Grout # 1
NE SE 11 - 160 - 97
K.B. 2273

Piper Fm.	
Poe Mbr.	6137
Spearfish Fm.	
Saude Mbr.	6227
Amsden Fm.	6473

3177. Hunt Petrol. Corp. - L. Rosten # 1 - B
NW SE 30 - 160 - 97
K.B. 2315

Piper Fm.	
Poe Mbr.	6218
Spearfish Fm.	
Saude Mbr.	6306
Amsden Fm.	6597

3196. Hunt Petrol. Corp. - E. Salveson et al. # 1
NW SE 25 - 160 - 98
K.B. 2309

Piper Fm.	
Poe Mbr.	6230
Spearfish Fm.	
Saude Mbr.	6317
Amsden Fm.	6588

3260. Amerada Petrol. Corp. & Sun Oil Co. -
G. Anderson # 1
NW SW 30 - 161 - 102
K.B. 2104

Piper Fm.	
Poe Mbr.	5860
Spearfish Fm.	
Saude Mbr.	5923
Kibbey Fm.	6250

3374. Hunt Petrol Corp. - I. Olson # 1
SE SW 32 - 160 - 101
K.B. 2257

Piper Fm.	
Poe Mbr.	6243
Spearfish Fm.	
Saude Mbr.	6318
Amsden Fm.	6492

3456. Cardinal Petrol. Co. - Nat'l. Bulk Carriers -
Kittelson # 1
SW SW 35 - 163 - 103
K.B. 2118

Piper Fm.	
Poe Mbr.	5553
Spearfish Fm.	
Saude Mbr.	5633
Kibbey Fm.	5980

Dunn County

505. Socony Vacuum - Dvorak F - 32 - 6P
SE NE 6 - 141 - 94
K.B. 2296

Piper Fm.	
Poe Mbr.	6187
Dunham beds	6227
Spearfish Fm.	
Saude Mbr.	6344
Belfield Mbr.	6480
Minnekahta Fm.	6684

607. Mobile Producing Co. - Kennedy 7 - 32 - 24P
SW NE 24 - 149 - 93
K.B. 2145

Piper Fm.	
Poe Mbr.	6330
Dunham beds	6380
Spearfish Fm.	
Saude Mbr.	6430
Pine Mbr.	6670
Minnekahta Fm.	6735

734. Cities Service Oil Co. - Clarke # 1
NE NW 17 - 145 - 91
K.B. 2235

Piper Fm.	
Poe Mbr.	6080
Dunham beds	6127
Spearfish Fm.	
Saude Mbr.	6200
Minnekahta Fm.	6410

793. Mobil Producing Co. - S. Birdbear et. al. # 1
SE NW 22 - 149 - 91
K.B. 2092

Piper Fm.	
Poe Mbr.	6240
Spearfish Fm.	
Saude Mbr.	6275
Minnekahta Fm.	6527

824. Northwest Oil Drlg. Co. - W. Hamann# 1
SE SE 8 - 141 - 91
K.B. 2113

Piper Fm.	
Poe Mbr.	5780
Spearfish Fm.	
Saude Mbr.	5818
Belfield Mbr.	5912
Minnekahta Fm.	6073

826. Stanolind Oil & Gas Co. - H. Creek # 1
NW SW 11 - 146 - 91
K.B. 2291

Piper Fm.	
Poe Mbr.	6190
Dunham beds	6232
Spearfish Fm.	
Saude Mbr.	6330
Minnekahta Fm.	6540

892. Argo Oil Co. - Larsen # 1
NE NW 19 - 144 - 94
K.B. 2410

Piper Fm.	
Poe Mbr.	6549
Dunham beds	6600
Spearfish Fm.	
Saude Mbr.	6678
Pine Mbr.	6831
Belfield Mbr.	6943
Minnekahta Fm.	7020

897. W. H. Hunt - T. W. Darwin # 1
SW SW 35 - 145 - 96.
K.B. 2519

Piper Fm.	
Poe Mbr.	6823
Dunham beds	6866
Spearfish Fm.	
Saude Mbr.	6975
Pine Mbr.	7136
Belfield Mbr.	7180
Minnekahta Fm.	7402

1219. Mayfair Minerals Inc. - E. Lockwood Jr. # 1
SW NW 5 - 147 - 93
K.B. 2172

Piper Fm.	
Poe Mbr.	6340
Dunham beds	6390
Spearfish Fm.	
Saude Mbr.	6400
Pine Mbr.	6608
Belfield Mbr.	6689
Minnekahta Fm.	6753

1408. The Calif. Co. - C. Danielson & Bank of N. D. # 1
NW SW 20 - 148 - 97
K.B. 2162

Piper Fm.	
Poe Mbr.	6584
Dunham beds	6628
Spearfish Fm.	
Saude Mbr.	6737
Pine Mbr.	6950
Belfield Mbr.	6992
Minnekahta Fm.	7224

1787. Sinclair Oil & Gas Co. - B. Heidecker # 1
NW NE 23 - 143 - 93
K.B. 2248

Piper Fm.	
Poe Mbr.	6211
Dunham beds	6248
Spearfish Fm.	
Saude Mbr.	6305
Belfield Mbr.	6450
Minnekahta Fm.	6520

2230. Continental Oil Co. - State # 1
SW SW 36 - 147 - 96
K.B. 2647

Piper Fm.	
Poe Mbr.	7082
Spearfish Fm.	
Saude Mbr.	7153
Pine Mbr.	7320
Belfield Mbr.	7387
Minnekahta Fm.	7546

2352. Amerada Petrol. Corp. - U.S.A. Reed
Tract 1, # 1
SE NW 18 - 148 - 95
K.B. 2441

Piper Fm.	
Poe Mbr.	6768
Dunham beds	6816
Spearfish Fm.	
Saude Mbr.	6835
Pine Mbr.	7053
Belfield Mbr.	7068
Minnekahta Fm.	7219

2615. Stewart Petrol. Corp. - J. Dvirnak # 1
NE NE 20 - 146 - 96
K.B. 3039

Piper Fm.	
Poe Mbr.	7450
Dunham beds	7492
Spearfish Fm.	
Saude Mbr.	7550
Pine Mbr.	7723
Belfield Mbr.	7788
Minnekahta Fm.	7964

2618. Pan American Petrol. Corp. - J. Huber # 1
SW SE 15 - 145 - 91
K.B. 2212

Piper Fm.	
Poe Mbr.	6373
Spearfish Fm.	
Saude Mbr.	6420
Minnekahta Fm.	6571

2848. Lyda Hunt - Herbert Trusts' et. al.
H. B. Gun # 1
Sw SE 8 - 147 - 93
K.B. 2297

Piper Fm.	
Poe Mbr.	6504
Spearfish Fm.	
Saude Mbr.	6554
Pine Mbr.	6730
Belfield Mbr.	6808
Minnekahta Fm.	6828

3044. Amerada Petrol. Corp. - M. Selle Tract 1 # 1
NE NE 27 - 143 - 92
K.B. 2200

Piper Fm.	
Poe Mbr.	6158
Spearfish Fm.	
Saude Mbr.	6219
Belfield Mbr.	6354
Minnekahta Fm.	6410

3199. Amerada Petrol. Corp. - J. Steffen # 1
NW NE 16 - 144 - 92
K.B. 2198

Piper Fm.	
Poe Mbr.	6121
Spearfish Fm.	
Saude Mbr.	6170
Minnekahta Fm.	6324

Golden Valley County

410. Gulf Oil Corp. - N. Dorough - Federal # 1
NE SW 24 - 143 - 103
K.B. 2515

Piper Fm.	
Poe Mbr.	6695
Dunham beds	6755
Spearfish Fm.	
Saude Mbr.	6780
Pine Mbr.	6920
Belfield Mbr.	7084
Minnekahta Fm.	7280

470. Blackwood & Nichols - Gilman # 1
NE SE 15 - 140 - 105
K.B. 2867

Piper Fm.	
Poe Mbr.	6780
Spearfish Fm.	
Saude Mbr.	6828
G marker top	6950
G marker base	6977
Pine Mbr.	7012
Belfield Mbr.	7130
Minnekahta Fm.	7343

586. Gulf Oil Corp. - Bundy-Federal # 1
NW NE 3 - 143 - 103
K.B. 2365

Piper Fm.	
Poe Mbr.	6582
Dunham beds	6626
Spearfish Fm.	
Saude Mbr.	6650
Pine Mbr.	6820
Belfield Mbr.	6977
Minnekahta Fm.	7177

1705. N. American Royalties - Badlands # 1
SE SE 22 - 143 - 103
K.B. 2479

Piper Fm.	
Poe Mbr.	6689
Spearfish Fm.	
Saude Mbr.	6750
Pine Mbr.	6920
Belfield Mbr.	7055
Minnekahta Fm.	7255

1907. Shell Oil Co. - N.P.R.R. # 41-35
NE NE 35 - 139 - 103
K.B. 2503

Piper Fm.	
Poe Mbr.	6305
Dunham beds	6340
Spearfish Fm.	
Saude Mbr.	6387
G marker top	6511
G marker base	6554
Pine Mbr.	6618
Belfield Mbr.	6824
Minnekahta Fm.	7043

2894. Shell Oil Co. - N. Brown et. al. - 41-24-1
NE NE 24 - 142 - 103
K.B. 2688

Piper Fm.	
Poe Mbr.	6870
Spearfish Fm.	
Saude Mbr.	6915
Pine Mbr.	7080
Belfield Mbr.	7200
Minnekahta Fm.	7408

Grant County

232. Yooungblood & Youngblood - Kelstrom # 1
SW SW 26 - 133 - 83
K.B. 1997

Piper Fm.	
Poe Mbr.	3712
Minnelusa Fm.	3740

Hettinger County

511. Socony Vacuum Co. - F - 14 - 24P Jacobs # 1
SW SW 24 - 134 - 96
K.B. 2616

Piper Fm.	
Poe Mbr.	5970
Spearfish Fm.	
Saude Mbr.	6020
G marker top	6080
G marker base	6087
Belfield Mbr.	6100
Minnekahta Fm.	6274

1926. Amerada Petrol. Corp. - R. Grosz # 1
NW NE 35 - 135 - 93
K.B. 2549

Piper Fm.	
Poe Mbr.	5735
Spearfish Fm.	
Saude Mbr.	5820
G marker top	5861
G marker base	5870
Belfield Mbr.	5870
Minnekahta Fm.	6050

McHenry County

1622. Triton Oil Co. - Switzer # 1
SW SW 24 - 158 - 80
K.B. 1503

Piper Fm.	
Poe Mbr.	3410
Spearfish Fm.	
Saude Mbr.	3495
Madison Grp.	
Poplar Interval	3723

1632. Triton Oil Co. - Fredrickson # 1
SW NE 24 - 157 - 80
K.B. 1509

Piper Fm.	
Poe Mbr.	3460
Spearfish Fm.	
Saude Mbr.	3540
Madison Grp.	
Poplar Interval	3790

1651. Hunt Oil Co. - B. Rosenau # 1
SE SE 17 - 159 - 79
K.B. 1473

Piper Fm.	
Poe Mbr.	3200
Spearfish Fm.	
Saude Mbr.	3310
Madison Grp.	
Ratcliffe Interval	3504

2670. Cardinal Petrol. Co. - Herdt-Bank of N. D. # 1
NE NE 6 - 158 - 80
K.B. 1505

Piper Fm.	
Poe Mbr.	3460
Spearfish Fm.	
Saude Mbr.	3568
Madison Grp.	
Poplar Interval	3833

McKenzie County

33. Mallard Petrol. Ltd. & C. W. Jones - B. Risser # 1
SW SE 12 - 149 - 96
K.B. 2434

Piper Fm.	
Poe Mbr.	6580
Dunham beds	6625
Spearfish Fm.	
Saude Mbr.	6690
Pine Mbr.	6935
Belfield Mbr.	6968
Minnekahta Fm.	7129

78. Amerada Petrol. Corp. - N. D. # "D" - 1
NE NW 16 - 153 - 95
K.B. 2474

Piper Fm.	
Poe Mbr.	6055
Dunham beds	6116
Spearfish Fm.	
Saude Mbr.	6200
Pine Mbr.	6485
Belfield Mbr.	6565
Minnekahta Fm.	6645

147. Amerada Petrol. Corp. - G. Wollon # 1
NW NW 15 - 152 - 96
K.B. 2480

Piper Fm.	
Poe Mbr.	6340
Spearfish Fm.	
Saude Mbr.	6395
Pine Mbr.	6634
Belfield Mbr.	6676
Minnekahta Fm.	6782

277. Amerada Petrol. Corp. - N. D. "B"
Tract 2, # 1
NE NE 16 - 149 - 95
K.B. 2364

Piper Fm.	
Poe Mbr.	6559
Dunham beds	6606
Spearfish Fm.	
Saude Mbr.	6648
Pine Mbr.	6890
Belfield Mbr.	6970
Minnekahta Fm.	7093

303. Amerada Petrol. Corp. - N. D. "B"
Tract 3, # 1
SW SW 16 - 150 - 95
K.B. 2263

Piper Fm.	
Poe Mbr.	6218
Dunham beds	6335
Spearfish Fm.	
Saude Mbr.	6383
Pine Mbr.	6613
Belfield Mbr.	6700
Minnekahta Fm.	6771

306. Amerada Petrol. Corp. - E. H. Pittsley # 1
SE SE 15 - 151 - 96
K.B. 2395

Piper Fm.	
Poe Mbr.	6334
Dunham beds	6380
Spearfish Fm.	
Saude Mbr.	6445
Pine Mbr.	6656
Belfield Mbr.	6790
Minnekahta Fm.	6950

341. Stanolind Oil & Gas Co. - W Starr # 1
SW SE 21 - 152 - 94
K.B. 2140

Piper Fm.	
Poe Mbr.	6197
Dunham beds	6238
Spearfish Fm.	
Saude Mbr.	6300
Pine Mbr.	6550
Belfield Mbr.	6628
Minnekahta Fm.	6694

527. The Calif. Co. - Rough Creek # 1
NW NE 13 - 148 - 98
K.B. 2472

Piper Fm.	
Poe Mbr.	7015
Spearfish Fm.	
Saude Mbr.	7071
Pine Mbr.	7272
Belfield Mbr.	7330
Minnekahta Fm.	7510

545. Phillips Petrol. Co. - Hoehn "A" # 1
NE SE 13 - 152 - 102
K.B. 2278

Piper Fm.	
Poe Mbr.	6947
Dunham beds	7010
Spearfish Fm.	
Saude Mbr.	7068
Pine Mbr.	7378
Belfield Mbr.	7432
Minnekahta Fm.	7505

882. The Texas Co. - A. Helle # 1
NW NE 8 - 151 - 95
K.B. 2447

Piper Fm.	
Poe Mbr.	6382
Spearfish Fm.	
Saude Mbr.	6438
Pine Mbr.	6671
Belfield Mbr.	6788
Minnekahta Fm.	6878

956. Gulf Oil Corp. - B. Pierre-Federal # 1
NW SW 28 - 148 - 104
K.B. 2339

Piper Fm.	
Poe Mbr.	6879
Dunham beds	6908
Spearfish Fm.	
Saude Mbr.	6959
Pine Mbr.	7133
Belfield Mbr.	7250
Minnekahta Fm.	7405

967. Stanolind Oil & Gas Co. - K. D. Wolf Inc. # 1
SE NE 10 - 151 - 94
K.B. 1957

Piper Fm.	
Poe Mbr.	6136
Spearfish Fm.	
Saude Mbr.	6190
Pine Mbr.	6438
Belfield Mbr.	6490
Minnekahta Fm.	6565

1111. Amerada Petrol. Corp. - L. Norby # 1
SE NE 1 - 152 - 95
K.B. 2148

Piper Fm.	
Poe Mbr.	6150
Spearfish Fm.	
Saude Mbr.	6210
Pine Mbr.	6450
Belfield Mbr.	6502
Minnekahta Fm.	6535

1152. Amerada Petrol. Corp. - H. Felland
Tract 1, # 1
SE SW 30 - 153 - 95
K.B. 2280

Piper Fm.	
Poe Mbr.	5910
Dunham beds	5958
Spearfish Fm.	
Saude Mbr.	6040
Pine Mbr.	6315
Belfield Mbr.	6390
Minnekahta Fm.	6481

1309. Anschulz Drlg. Co. - Matthews # 1
SE SW 20 - 150 - 94
K.B. 2077

Piper Fm.	
Poe Mbr.	6250
Dunham beds	6300
Spearfish Fm.	
Saude Mbr.	6310
Pine Mbr.	6540
Belfield Mbr.	6670
Minnekahta Fm.	6727

1422. Amerada Petrol. Corp. - R. Sorenson # 1
NW SW 16 - 152 - 95
K.B. 2383

Piper Fm.	
Poe Mbr.	6282
Spearfish Fm.	
Saude Mbr.	6356
Pine Mbr.	6598
Belfield Mbr.	6705
Minnekahta Fm.	6809

1451. Juniper Oil & Mining - A. Elton # 1
NW NW 2 - 151 - 95
K.B. 2312

Piper Fm.	
Poe Mbr.	6245
Dunham beds	6300
Spearfish Fm.	
Saude Mbr.	6350
Pine Mbr.	6600
Belfield Mbr.	6710
Minnekahta Fm.	6802

1469. Amerada Petrol. Corp. - Bear Den # 1
NE SE 25 - 149 - 96
K.B. 2408

Piper Fm.	
Poe Mbr.	6559
Dunham beds	6600
Spearfish Fm.	
Saude Mbr.	6725
Pine Mbr.	6960
Belfield Mbr.	6981
Minnekahta Fm.	7154

1606. Amerada Petrol. Corp. - H. H. Sheluik
Tract 1, # 1
NE SW 35 - 150 - 97
K.B. 2334

Piper Fm.	
Poe Mbr.	6710
Spearfish Fm.	
Saude Mbr.	6760
Pine Mbr.	6982
Belfield Mbr.	7060
Minnekahta Fm.	7132

1619. Amerada Petrol. Corp. - A. Kennedy # 1
NW NE 29 - 151 - 96
K.B. 2270

Piper Fm.	
Poe Mbr.	6266
Dunham beds	6315
Spearfish Fm.	
Saude Mbr.	6380
Pine Mbr.	6640
Belfield Mbr.	6695
Minnekahta Fm.	6865

1624. Investors Oil Inc. - I. & E. Shaide # 1
SW NE 8 - 151 - 103
K.B. 2200

Piper Fm.	
Poe Mbr.	6976
Spearfish Fm.	
Saude Mbr.	7033
Pine Mbr.	7270
Belfield Mbr.	7320
Minnekahta Fm.	7385

1679. Amerada Petrol. Corp. - C. C. Mogen
Tract 1, # 1
SW SE 10 - 153 - 96
K.B. 2017

Piper Fm.	
Poe Mbr.	5820
Spearfish Fm.	
Saude Mbr.	5884
Pine Mbr.	6129
Belfield Mbr.	6158
Minnekahta Fm.	6239

1740. Amerada Petrol. Corp. - J. Ljaadal
Tract 1, # 1
NE NW 29 - 150 - 96
K.B. 2243

Piper Fm.	
Poe Mbr.	6490
Spearfish Fm.	
Saude Mbr.	6540
Pine Mbr.	6772
Belfield Mbr.	6798
Minnekahta Fm.	6930

1816. Calvert, King, Stevenson, et. al. -
M. Signalness # 1
SW NW 2 - 150 - 96
K.B. 2382

Piper Fm.	
Poe Mbr.	6390
Dunham beds	6440
Spearfish Fm.	
Saude Mbr.	6500
Pine Mbr.	6754
Belfield Mbr.	6805
Minnekahta Fm.	6984

2226. Amerada Petrol. Corp. - U.S.A. Thomas # 1
SW NW 18 - 153 - 94
K.B. 2134

Piper Fm.	
Poe Mbr.	6130
Dunham beds	6186
Spearfish Fm.	
Saude Mbr.	6278
Pine Mbr.	6560
Belfield Mbr.	6683
Minnekahta Fm.	6733

2382. Gulf Oil Corp. - Lawrence Birds' Bell # 1
NW NE 30 - 150 - 94
K.B. 2167

Piper Fm.	
Poe Mbr.	6315
Dunham beds	6365
Spearfish Fm.	
Saude Mbr.	6376
Pine Mbr.	6621
Belfield Mbr.	6750
Minnekahta Fm.	6834

2469. Shell Oil Co. - N. P. R. R. # 32-15
SW NE 15 - 145 - 101
K.B. 2294

Piper Fm.	
Poe Mbr.	6618
Dunham beds	6668
Spearfish Fm.	
Saude Mbr.	6723
Pine Mbr.	6906
Belfield Mbr.	7043
Minnekahta Fm.	7237

2494. Carter Oil Co. - Y ellow Face # 1
SW SE 19 - 151 - 94
K.B. 2206

Piper Fm.	
Poe Mbr.	6286
Spearfish Fm.	
Saude Mbr.	6340
Pine Mbr.	6575
Belfield Mbr.	6688
Minnekahta Fm.	6751

2667. Texaco Inc. - Gov't.-M. Pace # 1
SW NW 14 - 146 - 101
K.B. 2392

Piper Fm.	
Poe Mbr.	6782
Dunham beds	6816
Spearfish Fm.	
Saude Mbr.	6936
Pine Mbr.	7121
Belfield Mbr.	7258
Minnekahta Fm.	7427

2707. Shell Oil Co. - N. P. R. R. -14-35-1
SW SW 35 - 145 - 101
K.B. 2218

Piper Fm.	
Poe Mbr.	6550
Spearfish Fm.	
Saude Mbr.	6603
Pine Mbr.	6770
Belfield Mbr.	6920
Minnekahta Fm.	7122

2746. W. H. Hunt - A. M. Holt # 1
NE SE 8 - 153 - 97
K.B. 2110

Piper Fm.	
Poe Mbr.	6850
Spearfish Fm.	
Saude Mbr.	6900
Pine Mbr.	7154
Belfield Mbr.	7210
Minnekahta Fm.	7295

2786. W. H. Hunt - U.S.A. "A" # 1
NW SW 15 - 148 - 102
K.B. 2383

Piper Fm.	
Poe Mbr.	6973
Dunham beds	7010
Spearfish Fm.	
Saude Mbr.	7059
Pine Mbr.	7226
Belfield Mbr.	7359
Minnekahta Fm.	7550

2821. W. H. Hunt - E. Glovatsky # 1
NW NE 3 - 145 - 99
K.B. 2681

Piper Fm.	
Poe Mbr.	7162
Dunham beds	7201
Spearfish Fm.	
Saude Mbr.	7220
Pine Mbr.	7416
Belfield Mbr.	7525
Minneka hta Fm.	7724

2849. L. H. Hunt-Herbert Trusts', et. al. -
H. C. Hystad # 1
NE SW 31 - 152 - 99
K.B. 2316

Piper Fm.	
Poe Mbr.	7043
Dunham beds	
Spearfish Fm.	
Saude Mbr.	7180
Pine Mbr.	7460
Belfield Mbr.	7556
Minnekahta Fm.	7622

3020. Sinclair Oil & Gas Co. - Federal - 7009 -
McKenzie # 1
NE NW 33 - 146 - 104
K.B. 2516

Piper Fm.	
Poe Mbr.	6995
Spearfish Fm.	
Saude Mbr.	7044
Pine Mbr.	7230
Belfield Mbr.	7258
Minnekahta Fm.	7430

3084. Sinclair Oil & Gas Co. - Federal - 7020 -
McKenzie # 1
NW SE 11 - 147 - 103
K.B. 2345

Piper Fm.	
Poe Mbr.	6854
Dunham beds	6888
Spearfish Fm.	
Saude Mbr.	6972
Pine Mbr.	7130
Belfield Mbr.	7266
Minnekahta Fm.	7447

3157. Caroline Hunt Trust Estate - M. Nelson # 1-A
NW SE 11 - 149 - 98
K.B. 2232

Piper Fm.	
Poe Mbr.	6886
Dunham beds	6928
Spearfish Fm.	
Saude Mbr.	6993
Pine Mbr.	7240
Belfield Mbr.	7320
Minnekahta Fm.	7470

McLean County

49. Stanolind Oil Co. - McLean County # 1
SW SW 28 - 150 - 80
K.B. 2100

Piper Fm.	
Poe Mbr.	4393
Spearfish Fm.	
Saude Mbr.	4424
Heath-Otter Fms.	4652

432. H. Hanson Oil Syndicate - N. E. Hanson # 1
SW SE 2 - 146 - 81
K.B. 1957

Piper Fm.	
Poe Mbr.	4366
Spearfish Fm.	
Saude Mbr.	4390
Amsden Fm.	4523

1194. Calvert Drlg. Co. - G. Wolf # 1
NW NE 5 - 149 - 90
K.B. 1989

Piper Fm.	
Poe Mbr.	6027
Dunham beds	6073
Spearfish Fm.	
Saude Mbr.	6125
Opeche Fm.	6300

1516. H. Hanson Oil Syndicate - Samuelson # 1
SE SW 32 - 146 - 82
K.B. 2022

Piper Fm.	
Poe Mbr.	4674
Spearfish Fm.	
Saude Mbr.	4703
Minnelusa Fm.	4800

Mercer County

21. F. F. Kelly - F. Leutz # 1
NW NE 28 - 142 - 89
K.B. 2284

Piper Fm.	
Poe Mbr.	5889
Spearfish Fm.	
Saude Mbr.	5918
Belfield Mbr.	5960
Minnekahta Fm.	6040

377. Williston Oil & Gas Co. - Boeckel et. al. # 1
SW SW 10 - 144 - 88
K.B. 2059

Piper Fm.	
Poe Mbr.	5556
Spearfish Fm.	
Saude Mbr.	5580
Belfield Mbr.	5675
Minnekahta Fm.	5722

2826. Sinclair Oil & Gas Co. - A. Hauck # 1
SE SW 1 - 143 - 90
K.B. 2200

Piper Fm.	
Poe Mbr.	6041
Spearfish Fm.	
Saude Mbr.	6096
Belfield Mbr.	6234
Opeche Fm.	6290

Morton County

133. Deep Rock Oil Co. - H. Johnson "A" # 1
SW SW 30 - 139 - 86
K.B. 2204

Piper Fm.	
Poe Mbr.	4982
Opeche Fm.	5050

464. Deep Rock Corp. - Gangl # A-1
NW NW 11 - 135 - 82
K.B. 2134

Piper Fm.	
Poe Mbr.	3887
Minnelusa Fm.	3910

1620. Pan American Petrol. Corp. - R. Vetter # 1
NE SW 27 - 139 - 90
K.B. 2426

Piper Fm.	
Poe Mbr.	5660
Spearfish Fm.	
Saude Mbr.	5716
G marker top	5739
G marker base	5748
Belfield Mbr.	5748
Minnekahta Fm.	5897

2185. Fletcher Oil & Gas Co. & Singal Drlg. Co. -
Boehm # 1
SW NE 11 - 139 - 82
K.B. 1861

Piper Fm.	
Poe Mbr.	3950
Minnelusa Fm.	3980

Mountrail County

237. Amerada Petrol. Corp. - C. Rice # 1
NE NW 23 - 158 - 94
K.B. 2425

Piper Fm.	
Poe Mbr.	6250
Dunham beds	6326
Spearfish Fm.	
Saude Mbr.	6380
Pine Mbr.	6705
Opeche Fm.	6758

355. Amerada Petrol. Corp. - C. Hanson # 3
SW NW 18 - 158 - 94
K.B. 2339

Piper Fm.	
Poe Mbr.	6075
Spearfish Fm.	
Saude Mbr.	6170
Pine Mbr.	6478
Opeche Fm.	6508

416. C.W.R. Oil co. & Whitson Inc. -
N. Johnsberg # 1
SW NW 15 - 158 - 93
K.B. 2413

Piper Fm.	
Poe Mbr.	6402
Spearfish Fm.	
Saude Mbr.	6498
Pine Mbr.	6808
Opeche Fm.	6890

474. W.H. Hunt - W. D. Dunham # 1
NW NW 24 - 155 - 90
K.B. 2161

Piper Fm.	
Poe Mbr.	5800
Dunham beds	5878
Spearfish Fm.	
Saude Mbr.	6016
Pine Mbr.	6310
Amsden Fm.	6348

528. W. H. Hunt - Anderson # 1
NW NW 25 - 157 - 89
K.B. 2271

Piper Fm.	
Poe Mbr.	5810
Spearfish Fm.	
Saude Mbr.	5891
Heath-Otter Fms.	6212

534. Amerada Petrol. Corp. - B. Lokken # 1
NE SW 2 - 157 - 94
K.B. 2399

Piper Fm.	
Poe Mbr.	6215
Dunham beds	6294
Spearfish Fm.	
Saude Mbr.	6344
Pine Mbr.	6660
Opeche Fm.	6696

592. W. H. Hunt - E. G. Horne # 1
SE NW 14 - 156 - 92
K.B. 2322

Piper Fm.	
Poe Mbr.	6233
Dunham beds	6314
Spearfish Fm.	
Saude Mbr.	6401
Pine Mbr.	6724
Opeche Fm.	6755

1223. Texata Oil Co. - W. F. Bauer # 1
SW SE 27 - 156 - 99
K.B. 2180

Piper Fm.	
Poe Mbr.	5670
Spearfish Fm.	
Saude Mbr.	5746
Pine Mbr.	6040
Heath-Otter Fms.	6100

1307. L. H. Cron - M. C. Jorstad # 6
SW SE 9 - 157 - 94
K.B. 2319

Piper Fm.	
Poe Mbr.	6098
Spearfish Fm.	
Saude Mbr.	6183
Pine Mbr.	6436
Opeche Fm.	6532

1315. Calvert Drlg. Inc. - Bratlien # 1
NE NE 9 - 158 - 92
K.B. 2288

Piper Fm.	
Poe Mbr.	6174
Spearfish Fm.	
Saude Mbr.	6290
Amsden Fm.	6600

1406. Calvert Drlg. Co. & L. J. Williamson Inc. -
Salo # 1
NE SW 19 - 157 - 90
K.B. 2384

Piper Fm.	
Poe Mbr.	6153
Dunham beds	6240
Spearfish Fm.	
Saude Mbr.	6254
Pine Mbr.	6560
Amsden Fm.	6584

1813. Anschutz Drlg. Co. & Sun Oil Co. - State # 1
NE NE 16 - 157 - 88
K.B. 2301

Piper Fm.	
Poe Mbr.	5720
Spearfish Fm.	
Saude Mbr.	5810
Heath-Otter Fms.	6130

1844. Anschutz Drlg. Co. - A. Lehman # 1
SW SW 10 - 158 - 91
K.B. 2402

Piper Fm.	
Poe Mbr.	6162
Spearfish Fm.	
Saude Mbr.	6247
Pine Mbr.	6590
Amsden Fm.	6610

2273. Stewart Petrol. Co. - Cvancava # 1
NW SW 15 - 155 - 93
K.B. 2360

Piper Fm.	
Poe Mbr.	6638
Spearfish Fm.	
Saude Mbr.	6720
Pine Mbr.	7006
Opeche Fm.	7050

2695. Hunt Petrol. Co. - J. Dancing Bull # 1
NE NW 9 - 150 - 92
K.B. 2115

Piper Fm.	
Poe Mbr.	6232
Dunham beds	6277
Spearfish Fm.	
Saude Mbr.	6390
Pine Mbr.	6625
Minnekahta Fm.	6714

2779. N. W. Edmund - W. A. Spletstroser # 1
SW NW 19 - 152 - 88
K.B. 2086

Piper Fm.	
Poe Mbr.	5786
Spearfish Fm.	
Saude Mbr.	5830
Opeche Fm.	6100

2816. Davis Oil Co. - L. Carkuff # 1
SW SE 12 - 154 - 92
K.B. 2389

Piper Fm.	
Poe Mbr.	6540
Dunham beds	6606
Spearfish Fm.	
Saude Mbr.	6647
Pine Mbr.	6930
Opeche Fm.	6953

3005. I. J. Wilhite - Krueger # 1
SW SW 9 - 158 - 89
K.B. 2342

Piper Fm.	
Poe Mbr.	5840
Spearfish Fm.	
Saude Mbr.	5938
Heath-Otter Fms.	6280

3134. Shell Oil Co. - Prochaska # 12 - 8 - 1
SW NW 8 - 155 - 93
K.B. 2297

Piper Fm.	
Poe Mbr.	6447
Dunham beds	6510
Spearfish Fm.	
Saude Mbr.	6568
Pine Mbr.	6862
Opeche Fm.	6904

3227. Amerada Petrol. Corp. - N. D. - "N" # 1
SE SE 16 - 155 - 94
K.B. 2030

Piper Fm.	
Poe Mbr.	6066
Dunham beds	6129
Spearfish Fm.	
Saude Mbr.	6208
Pine Mbr.	6500
Belfield Mbr.	6546
Minnekahta Fm.	6567

3228. Calif. Oil Co. - L Elefson & Federal Land
Bank # 1
NE NE 6 - 157 - 91
K.B. 2429

Piper Fm.	
Poe Mbr.	6288
Dunham beds	6378
Spearfish Fm.	
Saude Mbr.	6390
Amsden Fm.	6711

3317. Jack Grynberg - Johnsonberg # 1
NW NE 25 - 153 - 92
K.B. 2308

Piper Fm.	
Poe Mbr.	6550
Spearfish Fm.	
Saude Mbr.	6616
Pine Mbr.	6872
Belfield Mbr.	6915
Minnekahta Fm.	6945

3353. Monsanta Chem. Co. - Jackson # 1
NW NW 28 - 158 - 91
K.B. 2344

Piper Fm.	
Poe Mbr.	6150
Dunham beds	6237
Spearfish Fm.	
Saude Mbr.	6256
Amsden Fm.	6576

Oliver County

95. Youngblood & Youngblood - Wachter # 1
SE SW 3 - 141 - 81
K.B. 1924

Piper Fm.	
Poe Mbr.	4178
Minnelusa Fm.	4210

2183. Fletcher Oil & Gas Co. & Signal Drlg. Co. -
Bucligen # 1
NW NW 34 - 141 - 85
K.B. 2173

Piper Fm.	
Poe Mbr.	4987
Opeche Fm.	5050

3277. Sunray Dx. Oil Co. - Henke # 1
NE SE 14 - 142 - 85
K.B. 2193

Piper Fm.	
Poe Mbr.	5035
Opeche Fm.	5591

Renville County

369. Sohio Petrol. Co. - J. Nelson # 1
SE SW 34 - 158 - 81
K.B 1541

Piper Fm.	
Poe Mbr.	3658
Spearfish Fm.	
Saude Mbr.	3755
Madison Grp.	
Poplar Interval	3986

814. Sohio Petrol Co. - Marcil # 1
NW NW 13 - 163 - 84
K.B. 1623

Piper Fm.	
Poe Mbr.	3636
Spearfish Fm.	
Saude Mbr.	3769
Madison Grp.	
Ratcliffe Interval	3923

867. Calvert Drlg. Inc. - Stangeland # 1
NE SW 29 - 162 - 86
K.B. 1768

Piper Fm.	
Poe Mbr.	4370
Spearfish Fm.	
Saude Mbr.	4461
Madison Grp.	
Poplar Interval	4732

960. Sohio Petrol. Co. - Magnuson # 2
SE NE 30 - 163 - 84
K.B. 1642

Piper Fm.	
Poe Mbr.	3840
Spearfish Fm.	
Saude Mbr.	3950
Madison Grp.	
Ratcliffe Interval	4140

1098. Sohio Petrol. Corp. - Burns # 1
SW SW 17 - 163 - 85
K.B. 1727

Piper Fm.	
Poe Mbr.	3998
Spearfish Fm.	
Saude Mbr.	4095
Madison Grp.	
Ratcliffe Interval	4286

1178. Sohio Petrol. Co. - Hanson # 1A
SW SW 9 - 163 - 87
K.B. 1814

Piper Fm.	
Poe Mbr.	4381
Spearfish Fm.	
Saude Mbr.	4462
Madison Grp.	
Poplar Interval	4690

1602. Petrol. Corp. of America - L. Krueger # 1
NW NE 26 - 161 - 87
K.B. 1858

Piper Fm.	
Poe Mbr.	4678
Spearfish Fm.	
Saude Mbr.	4774
Madison Grp.	
Poplar Interval	5110

1726. Gulf Oil Corp. - Rusch # 1
SE NW 3 - 163 - 85
K.B. 1677

Piper Fm.	
Poe Mbr.	3830
Spearfish Fm.	
Saude Mbr.	3927
Madison Grp.	
Ratcliffe Interval	4089

1727. Gulf Oil Co. & Signal Drlg. Co. - R. Hoke # 1
SE SW 32 - 161 - 84
K.B. 1705

Piper Fm.	
Poe Mbr.	4190
Spearfish Fm.	
Saude Mbr.	4276
Madison Grp.	
Poplar Interval	4518

1815. Davis Oil Co. - Jensen # 1
NW NW 21 - 162 - 87
K.B. 1856

Piper Fm.	
Poe Mbr.	4630
Spearfish Fm.	
Saude Mbr.	4723
Madison Grp.	
Poplar Interval	5022

1822. T. Jordan et. al. - J. Routledge # 1
NE NW 29 - 163 - 86
K.B. 1802

Piper Fm.	
Poe Mbr.	4307
Spearfish Fm.	
Saude Mbr.	4406
Madison Grp.	
Poplar Interval	4606

3280. Texata Oil Co. - Raaf # 1
SE SE 15 - 162 - 84
K.B. 1624

Piper Fm.	
Poe Mbr.	3856
Spearfish Fm.	
Saude Mbr.	3970
Madison Grp.	
Ratcliffe Interval	4193

3335. C. W. Jones, Shell Oil Co., Sun Oil Co. -
Larson # 1
NW SE 31 - 160 - 85
K.B. 1782

Piper Fm.	
Poe Mbr.	4534
Spearfish Fm.	
Saude Mbr.	4641
Madison Grp.	
Poplar Interval	4960

3368. Cardinal Petrol. et. al. - M. Ness # 1
NW NW 6 - 161 - 85
K.B. 1770

Piper Fm.	
Poe Mbr.	4348
Spearfish Fm.	
Saude Mbr.	4440
Madison Grp.	
Poplar Interval	4724

3422. Farmers Union Inc. - Rhoads # 1
NE SW 16 - 158 - 82
K.B. 1599

Piper Fm.	
Poe Mbr.	?
Spearfish Fm.	
Saude Mbr.	3954
Madison Grp.	
Poplar Interval	4186

Slope County

91. Stanolind Oil & Gas Co. - J. Brusich # 1
SE SE 8 - 135 - 98
K.B. 2803

Piper Fm.	
Poe Mbr.	6304
Spearfish Fm.	
Saude Mbr.	6364
G marker top	6416
G marker base	6430
Pine Mbr.	6474
Belfield Mbr.	6660
Minnekahta Fm.	6864

378. D.D. Feldman Oil & Gas Co. - J. Benz # 1
SW NE 20 - 135 - 98
K.B. 2974

Piper Fm.	
Poe Mbr.	6690
Spearfish Fm.	
Saude Mbr.	6748
G marker top	6801
G marker base	6805
Belfield Mbr.	6864
Minnekahta Fm.	7022

1464. Skelly Oil Co. - Bismarck "A" # 1
SW SW 16 - 135 - 100
K.B. 2807

Piper Fm.	
Poe Mbr.	6470
Spearfish Fm.	
Saude Mbr.	6527
G marker top	6590
G marker base	6614
Pine Mbr.	6644
Belfield Mbr.	6783
Minnekahta Fm.	6989

2895. N. American Royalities et. al. - Hamann Estate # 1
SE SE 9 - 135 - 101
K.B. 2795

Piper Fm.	
Poe Mbr.	6506
Spearfish Fm.	
Saude Mbr.	6595
G marker top	6650
G marker base	6680
Pine Mbr.	6710
Belfield Mbr.	6828
Minnekahta Fm.	6980

3383. Pan Am. Petrol. Corp. - L. Foreman # 1
SW SE 23 - 133 - 106
K.B. 2787

Piper Fm.	
Poe Mbr.	5487
Spearfish Fm.	
Saude Mbr.	5597
G marker top	5689
G marker base	5721
Pine Mbr.	5800
Belfield Mbr.	5979
Minnekahta Fm.	6156

Stark County

344. Plymouth Oil Co. - F. Fischer # 1
SW NE 11 - 137 - 98
K.B. 2784

Piper Fm.	
Poe Mbr.	6709
Spearfish Fm.	
Saude Mbr.	6760
G marker top	6860
G marker base	6875
Pine Mbr.	6905
Belfield Mbr.	7035
Minnekahta Fm.	7180

539. W. H. Hunt - V. H. Kudrna # 1
SW NW 20 - 139 - 97
K.B. 2590

Piper Fm.	
Poe Mbr.	6462
Spearfish Fm.	
Saude Mbr.	6520
G marker top	6590
G marker base	6600
Pine Mbr.	6660
Belfield Mbr.	6830
Minnekahta Fm.	7010

613. Amerada Petrol. Corp. - R. E. Newton # 1
NW SW 31 - 140 - 99
K.B. 2697

Piper Fm.	
Poe Mbr.	6685
Dunham beds	6740
Spearfish Fm.	
Saude Mbr.	6869
G marker top	6972
G marker base	6998
Pine Mbr.	7054
Belfield Mbr.	7228
Minnekahta Fm.	7431

657. Sun Oil Co. - Beaudoin # 1
NW SW 9 - 138 - 99
K.B. 2640

Piper Fm.	
Poe Mbr.	6694
Spearfish Fm.	
Saude Mbr.	6748
G marker top	6822
G marker base	6837
Pine Mbr.	6890
Belfield Mbr.	7080
Minnekahta Fm.	7265

810. Southern Prod. Co. & Texata Oil Co. -
F. J. Wanner # 1
NW NW 9 - 137 - 97
K.B. 2690

Piper Fm.	
Poe Mbr.	6556
Spearfish Fm.	
Saude Mbr.	6606
G marker top	6680
G marker base	6705
Pine Mbr.	6728
Belfield Mbr.	6877
Minnekahta Fm.	7056

850. W. H. Hunt - A. A. Privatsky # 1
NW NW 15 - 138 - 98
K.B. 2652

Piper Fm.	
Poe Mbr.	6624
Spearfish Fm.	
Saude Mbr.	6677
G marker top	6751
G marker base	6760
Pine Mbr.	6810
Belfield Mbr.	7010
Minnekahta Fm.	7200

1466. Leach Oil Corp. - W. Kalanek # 1
SW NW 32 - 140 - 96
K.B. 2516

Piper Fm.	
Poe Mbr.	6650
Spearfish Fm.	
Saude Mbr.	6690
G marker top	6829
G marker base	6836
Pine Mbr.	6916
Belfield Mbr.	6975
Minnekahta Fm.	7101

1536. Skelly Oil Co. - Weigum # 1
SE NW 25 - 138 - 99
K.B. 2644

Piper Fm.	
Poe Mbr.	6644
Spearfish Fm.	
Saude Mbr.	6700
G marker top	6700
G marker base	6784
Pine Mbr.	6834
Belfield Mbr.	7000
Minnekahta Fm.	7193

1641. Texata Oil Co. - J. Kubishta # 1
SE SE 6 - 138 - 95
K.B. 2511

Piper Fm.	
Poe Mbr.	6499
Spearfish Fm.	
Saude Mbr.	6540
G marker top	6627
G marker base	6634
Belfield Mbr.	6634
Minnekahta Fm.	6788

1574. Northern Pump Co. - C. Braun # 1
NW NW 15 - 137 - 99
K.B. 2733

Piper Fm.	
Poe Mbr.	6680
Spearfish Fm.	
Saude Mbr.	6730
G marker top	6811
G marker base	6831
Pine Mbr.	6900
Belfield Mbr.	7044
Minnekahta Fm.	7261

1646. Atlantic Refining Co. - J. J. Kadrmas, Jr. # 1
NE SE 31 - 140 - 96
K.B. 2498

Piper Fm.	
Poe Mbr.	6716
Spearfish	
Saude Mbr.	6766
G marker top	6905
G marker base	6913
Pine Mbr.	6931
Belfield Mbr.	6983
Minnekahta Fm.	7070

1935. Sinclair Oil Co. - J. Muecke # 1
SE NE 29 - 140 - 94
K.B. 2427

Piper Fm.	
Poe Mbr.	6473
Spearfish Fm.	
Saude Mbr.	6528
Belfield Mbr.	6600
Minnekahta Fm.	6731

2004. Skelly Oil Co. - P. Stieg # 1.
NW SW 9 - 138 - 92
K.B. 2416

Piper Fm.	
Poe Mbr.	5786
Spearfish Fm.	
Saude Mbr.	5841
G marker top	5869
G marker base	5878
Belfield Mbr.	5878
Minnekahta Fm.	6062

2075. Skelly Oil Co. - S. Merrill # 1
SE NW 33 - 140 - 98
K.B. 2526

Piper Fm.	
Poe Mbr.	6697
Spearfish Fm.	
Saude Mbr.	6744
G marker top	6892
G marker base	6901
Pine Mbr.	6970
Belfield Mbr.	7126
Minnekahta Fm.	7296

2117. Tenn. Gas Transmission Co. -
Casimer-Duletski # 1
NW NW 16 - 139 - 99
K.B. 2644

Piper Fm.	
Poe Mbr.	6690
Dunham beds	6732
Spearfish Fm.	
Saude Mbr.	6784
G marker top	6886
G marker base	6897
Pine Mbr.	6955
Belfield Mbr.	7120
Minnekahta Fm.	7311

2496. Atlantic Refining Co. - A. Eberts # 1
SE SE 18 - 138 - 97
K.B. 2726

Piper Fm.	
Poe Mbr.	6882
Spearfish Fm.	
Saude Mbr.	6934
G marker top	6994
G marker base	7004
Belfield Mbr.	7050
Minnekahta Fm.	7238

3160. Amerada Petrol. Corp. - L. Koppinger # 1
SE NW 20 - 137 - 95
K.B. 2695

Piper Fm.	
Poe Mbr.	6447
Spearfish Fm.	
Saude Mbr.	6495
G marker top	6555
G marker base	6558
Belfield Mbr.	6584
Minnekahta Fm.	6737

Ward County

47. H. Hunt Trust - Wald # 1
SE SW 23 - 155 --81
K.B. 1595

Piper Fm.	
Poe Mbr.	3815
Spearfish Fm.	
Saude Mbr.	3887
Madison Grp.	
Poplar Interval	4185

52. Wanete Oil Co. - M. O. Lee # 1
NE NE 24 - 156 - 85
K.B. 1839

Piper Fm.	
Poe Mbr.	4612
Spearfish Fm.	
Saude Mbr.	4708
Kibbey Fm.	5000

105. Stanolind Oil & Gas Co. - W. Waswick # 1
SW NE 2 - 153 - 85
K.B. 2175

Piper Fm.	
Poe Mbr.	5150
Dunham beds	5212
Spearfish Fm.	
Saude Mbr.	5240
Pine Mbr.	5486
Heath-Otter Fms.	5517

126. Quintana Prod. Co. - C. W. Linnertz # 1
SW SE 33 - 156 - 83
K.B. 1772

Piper Fm.	
Poe Mbr.	4384
Spearfish Fm.	
Saude Mbr.	4467
Madison Grp.	
Poplar Interval	4755

392. Sam G. Harrison - J. E. Anderson # 1
SW SW 21 - 157 - 85
K.B. 1875

Piper Fm.	
Poe Mbr.	4790
Spearfish Fm.	
Saude Mbr.	4894
Kibbey Fm.	5186

588. W. H. Hunt - F. C. Neumann # 1
SW SE 33 - 152 - 82
K.B. 2087

Piper Fm.	
Poe Mbr.	4734
Spearfish Fm.	
Saude Mbr.	4787
Kibbey Fm.	5060

656. W. H. Hunt - G. Almy # 1
NW NE 13 - 155 - 82
K.B. 1632

Piper Fm.	
Poe Mbr.	3985
Spearfish Fm.	
Saude Mbr.	4066
Kibbey Fm.	4348

1061. Calvert Drlg. Inc. - G. Jacobson # 1
SW SW 30 - 153 - 84
K.B. 2112

Piper Fm.	
Poe Mbr.	5170
Spearfish Fm.	
Saude Mbr.	5267
Pine Mbr.	5497
Heath-Otter Fms.	5525

1138. H. Mack. Cox - Kotosek # 1
NW SW 19 - 156 - 82
K.B. 1636

Piper Fm.	
Poe Mbr.	4136
Spearfish Fm.	
Saude Mbr.	4214
Madison Grp.	
Poplar Interval	4504

1438. L. J. Williamson Inc. - Pederson # 1
NW SW 6 - 156 - 86
K.B. 2104

Piper Fm.	
Poe Mbr.	5370
Spearfish Fm.	
Saude Mbr.	5404
Kibbey Fm.	5759

1801. Anschutz Drlg. Co. & Sun Oil Co. -
O. Nielson # 1
SW NE 21 - 159 - 87
K.B. 1954

Piper Fm.	
Poe Mbr.	5047
Spearfish Fm.	
Saude Mbr.	5143
Kibbey Fm.	5460

1808. Northern Pump Co. - Schoemer # 1
NW NE 11 - 160 - 89
K.B. 1956

Piper Fm.	
Poe Mbr.	5070
Spearfish Fm.	
Saude Mbr.	5176
Kibbey Fm.	5515

1843. Anschutz Drlg. Co. & M. B. Rudman -H. Sinclair
State # 1
NW NW 32 - 159 - 88
K.B. 2141

Piper Fm.	
Poe Mbr.	5507
Spearfish Fm.	
Saude Mbr.	5608
Kibbey Fm.	5953

1876. Exploration Drlg. Co. - M. Crider # 1
SE NE 22 - 158 - 87
K.B. 2006

Piper Fm.	
Poe Mbr.	5217
Spearfish Fm.	
Saude Mbr.	5312
Kibbey Fm.	5627

1885. Juniper Oil & Mining - Huber # 1
SW NW 18 - 160 - 87
K.B. 1919

Piper Fm.	
Poe Mbr.	4961
Spearfish Fm.	
Saude Mbr.	5070
Madison Grp.	
Poplar Interval	5392

2017. British American Oil Co. - Anderson "C" # 1
NW NW 2 - 157 - 82
K.B. 1598

Piper Fm.	
Poe Mbr.	3880
Spearfish Fm.	
Saude Mbr.	3960
Madison Grp.	
Poplar Interval	4208

2051. Davis Oil Co. - A. Peterson # 1
SE NE 28 - 153 - 86
K.B. 2117

Piper Fm.	
Poe Mbr.	5446
Spearfish Fm.	
Saude Mbr.	5530
Amsden Fm.	5760

2134. The Texas Co. - B. T. James # 1
NE NW 3 - 159 - 87
K.B. 1921

Piper Fm.	
Poe Mbr.	4977
Spearfish Fm.	
Saude Mbr.	5085
Madison Grp.	
Poplar Interval	5390

2930. I. J. Wilhite, & C. W. Jones -
A. W. Benno # 1
NW NW 8 - 154 - 83
K.B. 1845

Piper Fm.	
Poe Mbr.	4582
Spearfish Fm.	
Saude Mbr.	4682
Kibbey Fm.	4940

2931. I. J. Wilhite & C. W. Jones -
SE SE 32 - 155 - 85
K.B. 2170

Piper Fm.	
Poe Mbr.	5280
Spearfish Fm.	
Saude Mbr.	5362
Pine Mbr.	5643
Heath-Otter Fms.	5660

3039. I. J. Wilhite - R. D. Becker # 1
NW NW 11 - 155 - 85
K.B. 1944

Piper Fm.	
Poe Mbr.	4890
Spearfish Fm.	
Saude Mbr.	4973
Kibbey Fm.	5267

3080. Cardinal Petrol. Co., & Nat'l Bulk Carriers - E. Mathis # 1
SE SE 13 - 152 - 83
K.B. 2110

Piper Fm.	
Poe Mbr.	4830
Spearfish Fm.	
Saude Mbr.	4886
Kibbey Fm.	5178

3124. Signal et. al. - Helseth # 1
NW SW 3 - 156 - 81
K.B. 1566

Piper Fm.	
Poe Mbr.	3732
Spearfish Fm.	
Saude Mbr.	3823
Madison Grp.	
Poplar Interval	4138

3125. Calvert et. al. - Troxel # 1
SW NE 11 - 156 - 86
K.B. 1990

Piper Fm.	
Poe Mbr.	5008
Spearfish Fm.	
Saude Mbr.	5100
Kibbey Fm.	5390

3314. I. J. Wilhite - Pietsch # 1
SW SE 7 - 153 - 83
K.B. 2067

Piper Fm.	
Poe Mbr.	4924
Spearfish Fm.	
Saude Mbr.	5020
Kibbey Fm.	5290

Williams County

32. Amerada Petrol. Corp. - H. O. Bakken # 1
SW NW 12 - 156 - 95
K.B. 2458

Piper Fm.	
Poe Mbr.	6110
Spearfish Fm.	
Saude Mbr.	6230
Pine Mbr.	6520
Opeche Fm.	6550

128. Amerada Petrol. Corp. - N. D. "E" # 1
NW NW 16 - 154 - 95
K.B. 2305

Piper Fm.	
Poe Mbr.	5928
Dunham beds	5980
Spearfish Fm.	
Saude Mbr.	6034
Pine Mbr.	6318
Belfield Mbr.	6380
Minnekahta Fm.	6453

313. Kenneth A. Ellison - Ellison N. D. # 1
NE NE 16 - 159 - 96
K.B. 2266

Piper Fm.	
Poe Mbr.	6164
Dunham beds	6240
Spearfish Fm.	
Saude Mbr.	6276
Opeche Fm.	6605

547. W. H. Hunt - B. H. Weypauck # 1
NE NW 27 - 156 - 97
K.B. 2272

Piper Fm.	
Poe Mbr.	6450
Spearfish Fm.	
Saude Mbr.	6524
Pine Mbr.	6830
Belfield Mbr.	6870
Minnekahta Fm.	6945

984. Pure Oil Co. - Esterby # 1
SW SW 11 - 159 - 100
K.B. 2056

Piper Fm.	
Poe Mbr.	6116
Spearfish Fm.	
Saude Mbr.	6190
Amsden Fm.	6417

999. Texaco Inc. - J. Donahue # 1
SW NE 23 - 154 - 100
K.B. 2253

Piper Fm.	
Poe Mbr.	7033
Spearfish Fm.	
Saude Mbr.	7092
Pine Mbr.	7385
Belfield Mbr.	7457
Minnekahta Fm.	7515

1033. Amerada Petrol. Corp. - L. Nelson Tract 3, # 2
NE NE 35 - 157 - 95
K.B. 2250

Piper Fm.	
Poe Mbr.	5974
Spearfish Fm.	
Saude Mbr.	6060
Pine Mbr.	6337
Opeche Fm.	6390

1231. Amerada Petrol. Corp. - Iverson-Nelson # 1
C NE 2 - 155 - 96
K.B. 2316

Piper Fm.	
Poe Mbr.	5822
Dunham beds	5880
Spearfish Fm.	
Saude Mbr.	5930
Pine Mbr.	6220
Belfield Mbr.	6266
Minnekahta Fm.	6294

1290. Amerada Petrol. Corp. - N. D. "F" # 5
SE NW 36 - 155 - 96
K.B. 2038

Piper Fm.	
Poe Mbr.	5668
Spearfish Fm.	
Saude Mbr.	5735
Pine Mbr.	6010
Belfield Mbr.	6043
Minnekahta Fm.	6098

1374. Investors Oil Inc. - U. S. A. # 1
SE NE 28 - 154 - 95
K.B. 1903

Piper Fm.	
Poe Mbr.	5460
Spearfish Fm.	
Saude Mbr.	5536
Pine Mbr.	5815
Belfield Mbr.	5890
Minnekahta Fm.	5960

1447. Amerada Petrol. Corp. - W. Ferguson # 1
NE NE 9 - 154 - 96
K.B. 1865

Piper Fm.	
Poe Mbr.	5502
Spearfish Fm.	
Saude Mbr.	5564
Pine Mbr.	5846
Belfield Mbr.	5910
Minnekahta Fm.	5972

1477. Amerada Petrol. Corp. - C. Hemsing # 1
NE NE 9 - 157 - 95
K.B. 2445

Piper Fm.	
Poe Mbr.	6140
Spearfish Fm.	
Saude Mbr.	6221
Pine Mbr.	6532
Opeche Fm.	6568

1745. Hunt Oil Co. - W. Odegaard # 1
C NW 21 - 157 - 95
K.B. 2361

Piper Fm.	
Poe Mbr.	6010
Spearfish Fm.	
Saude Mbr.	6097
Pine Mbr.	6404
Opeche Fm.	6460

2122. Calvert Drlg. Inc. & N. Am. Royalties -
H. Hermanson # 1
NW NE 18 - 159 - 95
K.B. 2313

Piper Fm.	
Poe Mbr.	6116
Spearfish Fm.	
Saude Mbr.	6210
Amsden Fm.	6540

2182. Amerada Petrol. Corp. - Pederson-Cater # 1
NE SW 21 - 158 - 95
K.B. 2473

Piper Fm.	
Poe Mbr.	6200
Spearfish Fm.	
Saude Mbr.	6290
Pine Mbr.	6610
Opeche Fm.	6628

2501. Hunt Oil Co. & Amerada Petrol Corp. -
H. Iverson # 1
SE SW 30 - 156 - 95
K.B. 2392

Piper Fm.	
Poe Mbr.	5957
Spearfish Fm.	
Saude Mbr.	6032
Pine Mbr.	6332
Belfield Mbr.	6370
Minnekahta Fm.	6385

2824. Hunt Oil Co. - C. Price # 1
SW NE 29 - 159 - 103
K.B. 2042

Piper Fm.	
Poe Mbr.	6050
Spearfish Fm.	
Saude Mbr.	6113
Amsden Fm.	6294

2828. Texaco Inc. - L. J. Hovde # 1
NW NW 16 - 154 - 98
K.B. 2233

Piper Fm.	
Poe Mbr.	6996
Spearfish Fm.	
Saude Mbr.	7058
Pine Mbr.	7337
Belfield Mbr.	7348
Minnekahta Fm.	7401

2846. Hunt Oil Co. & Skelly Oil Co. - State of N. Dak. # 1
NW NE 16 - 158 - 103
K.B. 2165

Piper Fm.	
Poe Mbr.	6360
Spearfish Fm.	
Saude Mbr.	6410
Amsden Fm.	6591

2861. Dakota Salt & Chemical Co. - Fee # 1
SE SW 17 - 154 - 100
K.B. 1883

Piper Fm.	
Poe Mbr.	6712
Spearfish Fm.	
Saude Mbr.	6767
Pine Mbr.	7030
Belfield Mbr.	7049
Minnekahta Fm.	7087

2933. Hunt Petrol. Corp. & Skelly Oil Co. -
H. A. Garaas # 1
NW SW 33 - 159 - 102
K.B. 2209

Piper Fm.	
Poe Mbr.	6324
Spearfish Fm.	
Saude Mbr.	6380
Amsden Fm.	6583

2959. W. H. Hunt - A. Strand # 1
SE SE 22 - 157 - 103
K.B. 2461

Piper Fm.	
Poe Mbr.	6860
Spearfish Fm.	
Saude Mbr.	6919
Amsden Fm.	7250

3043. James S. Wise - G. Emerson # 1
SE SE 27 - 159 - 102
K.B. 2277

Piper Fm.	
Poe Mbr.	6396
Spearfish Fm.	
Saude Mbr.	6450
Amsden Fm.	6663

3106. Hunt Petrol. Co. - Larson Estate # 1
SW SE 20 - 159 - 102
K.B. 2224

Piper Fm.	
Poe Mbr.	6310
Spearfish Fm.	
Saude Mbr.	6378
Amsden Fm.	6565

3230. Hunt, Texaco & Skelly Oil Cos. - E. Beaver # 1
SW SE 10 - 159 - 102
K.B. 2272

Piper Fm.	
Poe Mbr.	6294
Spearfish Fm.	
Saude Mbr.	6360
Amsden Fm.	6526

3235. Sun Oil Co. - State # 1
NW NW 16 - 156 - 101
K.B. 2168

Piper Fm.	
Poe Mbr.	6822
Spearfish Fm.	
Saude Mbr.	6885
Pine Mbr.	7212
Opeche Fm.	7308

3252. Hunt Oil Co. - A. S. Hoover et. al. # 1
NE NW 3 - 158 - 99
K.B. 2150

Piper Fm.	
Poe Mbr.	6375
Spearfish Fm.	
Saude Mbr.	6454
Amsden Fm.	6766

3274. H. L. Hunt - C. T. Solem # 1
NW SE 2 - 159 - 98
K.B. 2306

Piper Fm.	
Poe Mbr.	6320
Spearfish Fm.	
Saude Mbr.	6410
Amsden Fm.	6696

3363. Texaco Inc. - C. Pederson # 1
NW SE 19 - 157 - 96
K.B. 2332

Piper Fm.	
Poe Mbr.	6346
Spearfish Fm.	
Saude Mbr.	6427
Pine Mbr.	6750
Minnekahta Fm.	6742

3373. Hunt Petrol. Co. - Larson-Sabine et. al. # 1
SW SW 4 - 159 - 102
K.B. 2218

Piper Fm.	
Poe Mbr.	6186
Spearfish Fm.	
Saude Mbr.	6259
Amsden Fm.	6407

3385. Continental Oil Co. - Bakken-State 2, # 1
SW SE 2 - 156 - 95
K.B. 2249

Piper Fm.	
Poe Mbr.	5930
Spearfish Fm.	
Saude Mbr.	6017
Pine Mbr.	6301
Belfield Mbr.	6332
Minnekahta Fm.	6355

3406. Hunt Petrol. Corp. - E. Erickson et. al # 1
NE NE 10 - 156 - 99
K.B. 2281

Piper Fm.	
Poe Mbr.	6843
Spearfish Fm.	
Saude Mbr.	6950
Pine Mbr.	7270
Belfield Mbr.	7301
Minnekahta Fm.	7322

3449. Hunt Petrol. Corp. - C. J. Hammers # 1
SE NW 20 - 157 - 98
K.B. 2213

Piper Fm.	
Poe Mbr.	6700
Dunham beds	6758
Spearfish Fm.	
Saude Mbr.	6807
Pine Mbr.	7133
Opeche Fm.	7170

Carter County, Montana

E-3 Continental Oil Co. - Gov't # 1
NW SE 17 - 95 - 61E
K.B. 3562

Spearfish Fm.	2335
G marker top	2771
Minnekahta Fm.	2998

E-4. Union Oil of Calif. - Gov't.-Newton # 1
NW SW 23 - 95 - 59E
K.B. 3444

Spearfish Fm.	1587
G marker top	1885
Minnekahta Fm.	2112

E-5. Mobil Producing Co. - Gov't. #F - 13 - 18 - G
NW SW 18 - 85 - 58E
K.B. 3527

Spearfish Fm.	2335
G marker top	2580
Minnekahta Fm.	2812

E-6. Union Oil Co. - Gov't.-Hamilton # 1
NE SW 21 - 65 - 57E
K.B. 3708

Spearfish Fm.	3692
G marker top	3907
Minnekahta Fm.	4113

E-7. Amerada Petrol. Corp. - Corral Creek # 1
NE NE 15 - 45 - 57E
K.B. 3447

Spearfish Fm.	4391
G marker top	4517
Minnekahta Fm.	4707

E-8. Warren Petrol. - Curry # 1
NW SE 20 - 15 - 60E
K.B. 3153

Spearfish Fm.	5317
G marker top	5354
Minnekahta Fm.	5560

E-9. The Ohio Oil Co. - Gov't. # 1
SE NW 4 - 15 - 62E
K.B. Unknown

Spearfish Fm.	5840
G marker top	5880
Minnekahta Fm.	6130

Butte County, South Dakota

D-2. Shell Oil Co. - W. Johnson # 23 - 23
NE SW 23 - 10N - 1E
K.B. 3293

Spearfish Fm.	1968
G marker top	2397
Minnekahta Fm.	2633

D-3. Superior Oil Co. - Indian Creek # 1 - 33
SE SW 33 - 13N - 2E
K.B. 3239

Spearfish Fm.	
Saude Mbr.	3708
G marker top	3995
Pine Mbr.	4053
Belfield Mbr.	4363
Minnekahta Fm.	4478

D-4. Amerada Petrol. Corp. - State # 1
NW NW 4 - 14N - 4E
K.B. 3028

Spearfish Fm.	
Saude Mbr.	4278
G marker top	4458
Pine Mbr.	4503
Belfield Mbr.	4836
Minnekahta Fm.	4956

Harding County, South Dakota

D-5. Richfield Oil Corp. - State # A - 1
SE NW 16 - 17N - 4E
K.B. 3141

Piper Fm.	
Poe Mbr.	4787
Spearfish Fm.	
Saude Mbr.	4833
G marker top	4939
Pine Mbr.	4996
Belfield Mbr.	5209
Minnekahta Fm.	5408

D-6. Shell Oil Co. - Gov't. # 32 - 27
SW NE 27 - 20N - 5E
K.B. 2996

Piper Fm.	
Poe Mbr.	5367
Spearfish Fm.	
Saude Mbr.	5426
G marker top	5497
Pine Mbr.	5531
Belfield Mbr.	5576
Minnekahta Fm.	5763

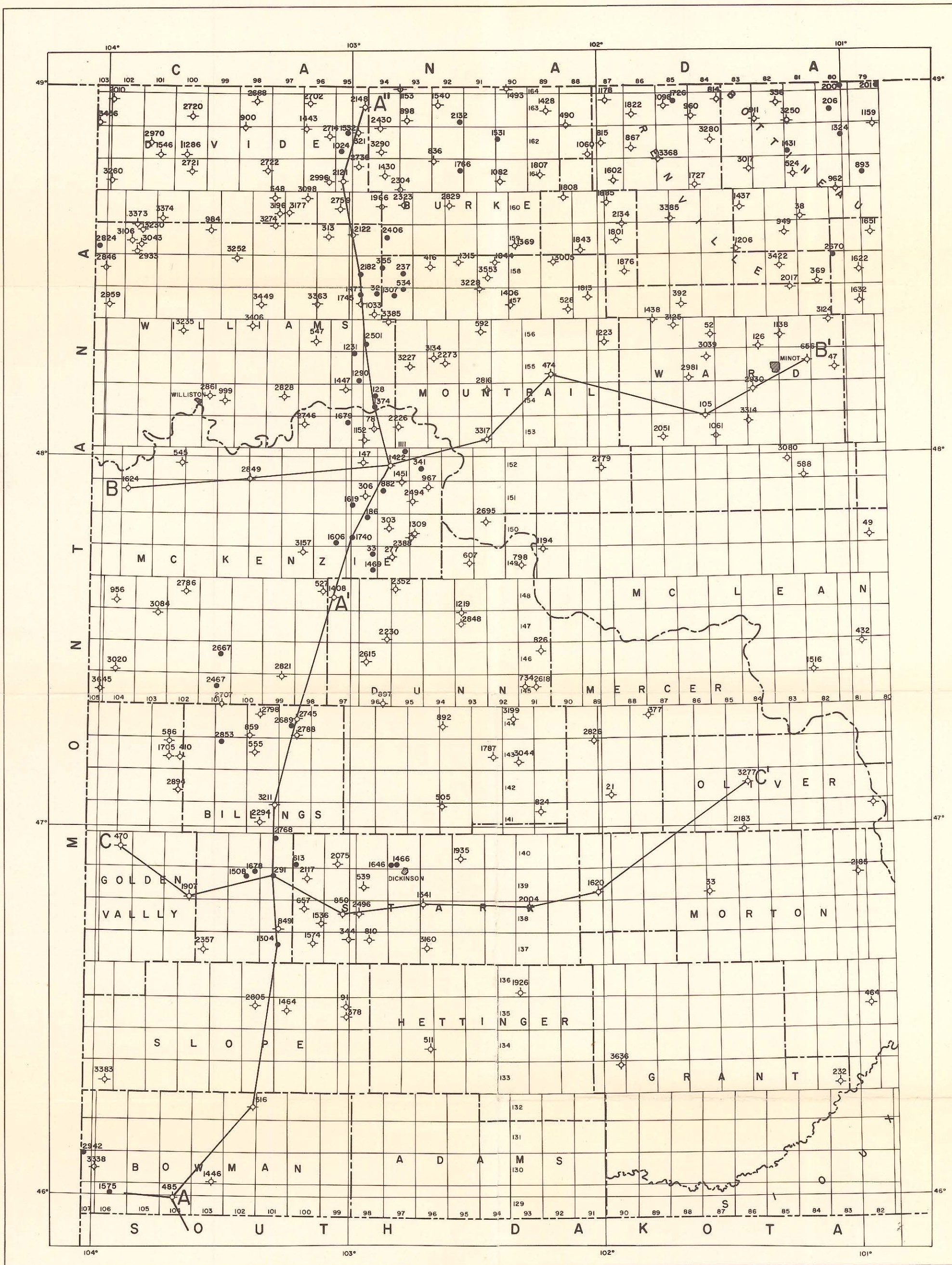
Crook County, Wyoming

DE-1. Mobile Producing Co. - P. Helmer
F - 13 - 21
NW SW 21 - 54N - 60W
K.B. 3575

Spearfish Fm.	536
G marker top	966
Minnekahta Fm.	1209

E-2. Hunt Oil Co. - Gov't.-Miller # 1
NE NW 14 - 56N - 61W
K.B. 3387

Spearfish Fm.	1087
G marker top	1553
Minnekahta Fm.	1772



LEGEND

- ● PRODUCING WELL
- ⊹ DRY HOLE

657 NORTH DAKOTA GEOLOGICAL SURVEY WELL NUMBER

LOCATION OF SECTIONS:

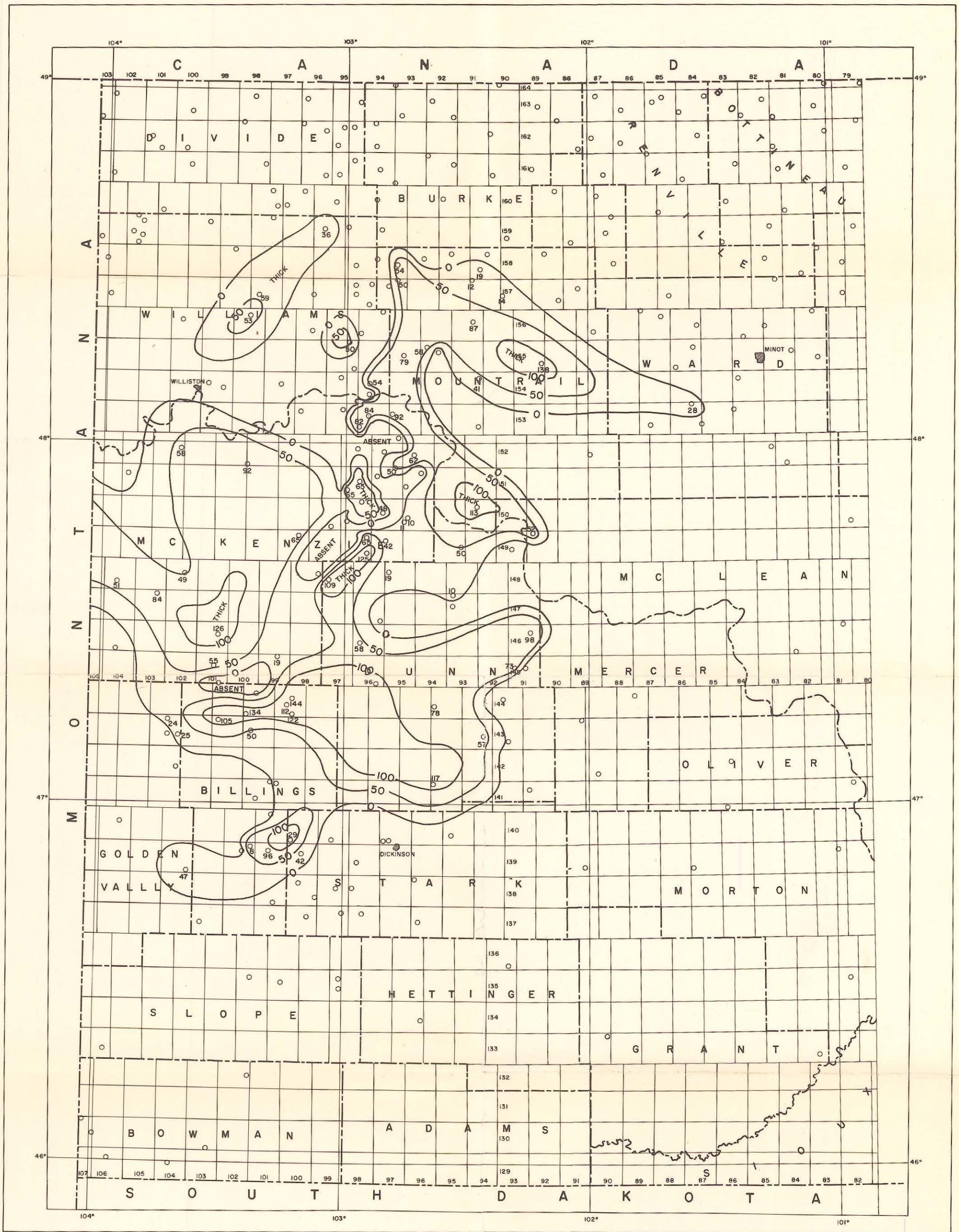
A-A'– PLATE 9 B-B'–PLATE 11

A'-A''–PLATE 10 C-C'–PLATE 12

SCALE 10 0 10 20 30 40 MILES

LOCATION MAP SHOWING WELL CONTROL USED

PLATE 1



LEGEND

○ CONTROL WELL

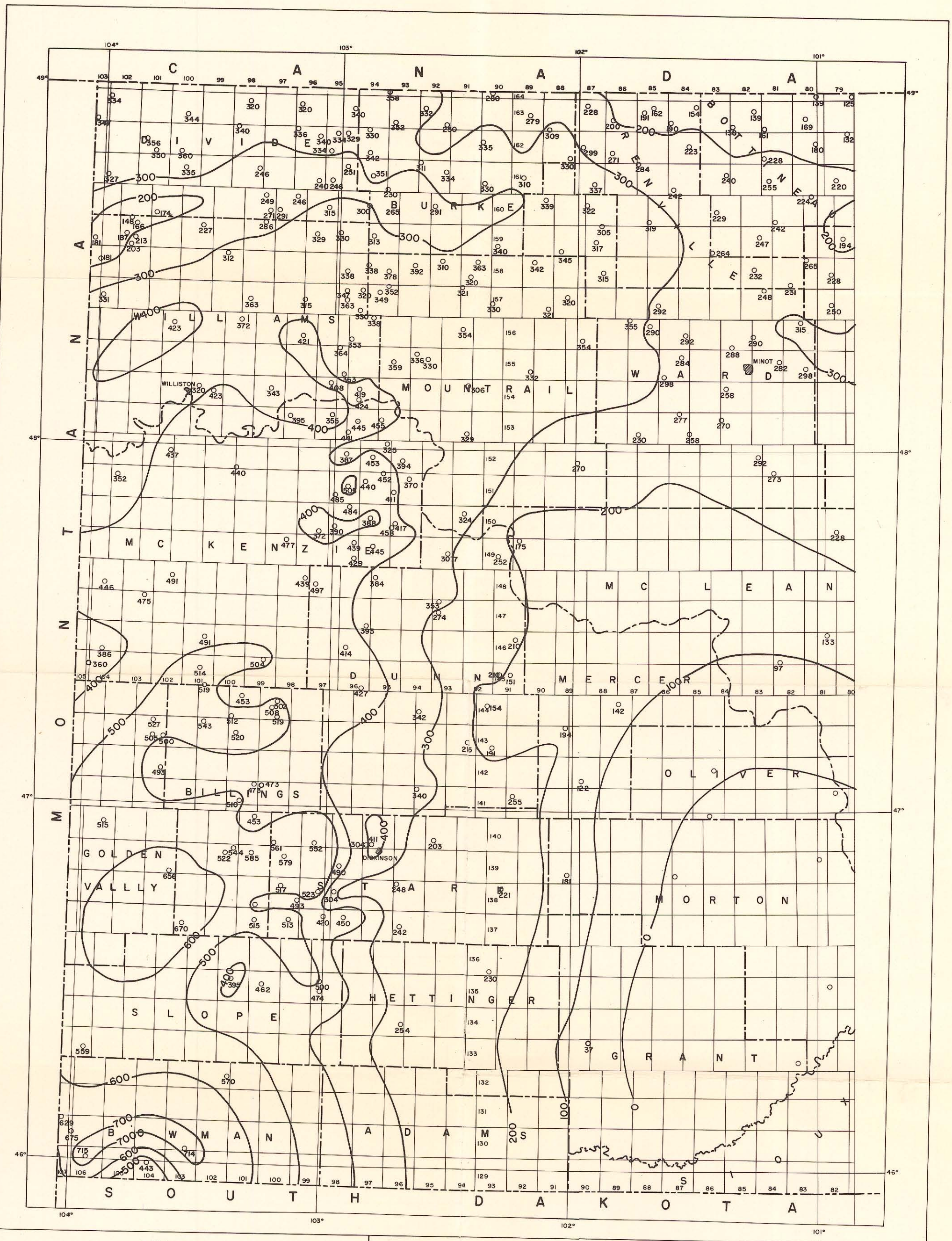
152 THICKNESS IN FEET

CONTOUR INTERVAL – 50 FEET

SCALE 10 0 10 20 30 40 MILES

ISOPACHOUS MAP OF THE DUNHAM SALT BEDS, POE MEMBER, PIPER FORMATION

PLATE 2



LEGEND

○ CONTROL WELL

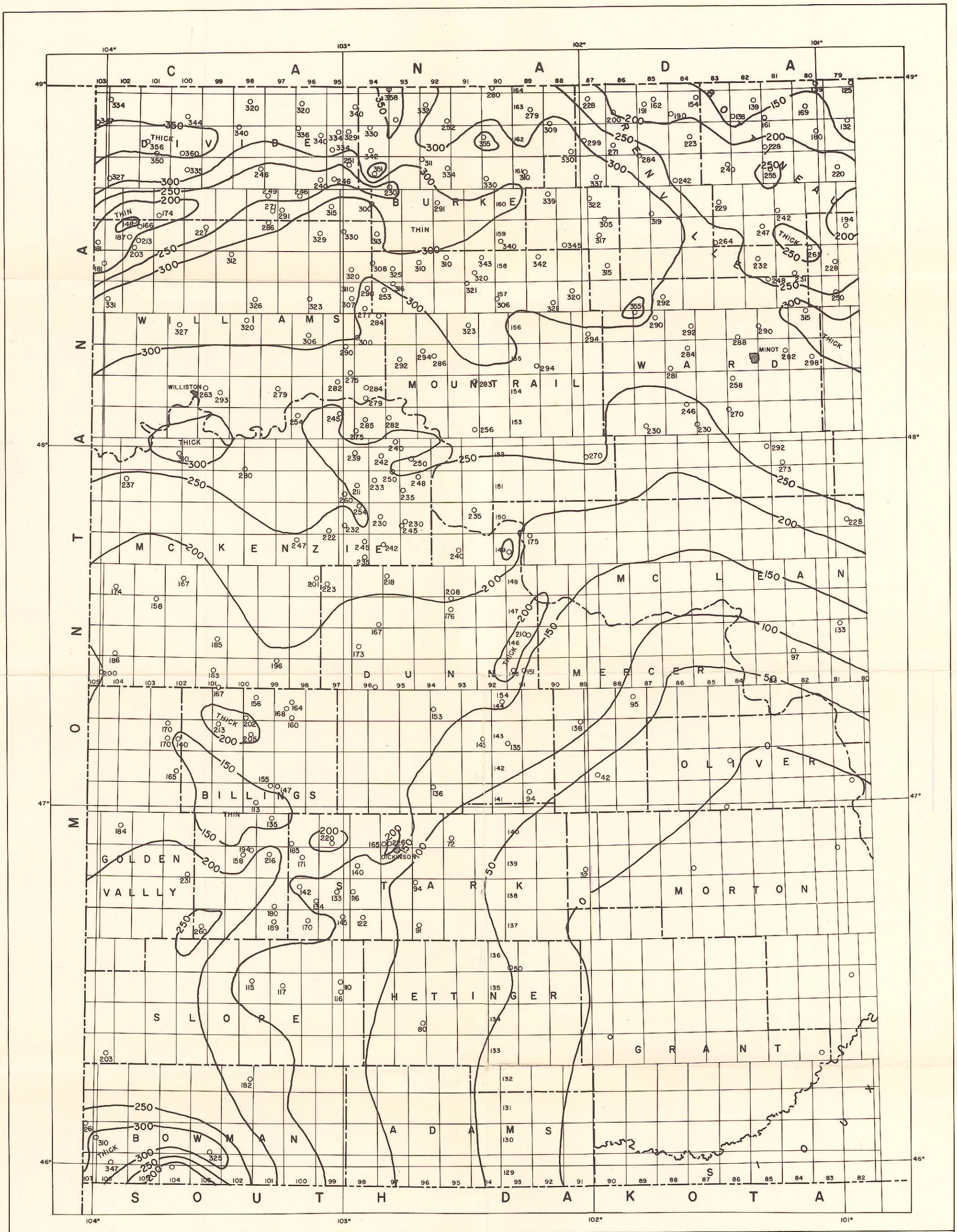
408 THICKNESS IN FEET

CONTOUR INTERVAL — 100 FEET

SCALE 10 0 10 20 30 40 MILES

ISOPACHOUS MAP OF THE SPEARFISH FORMATION

PLATE 3



LEGEND

○ CONTROL WELL

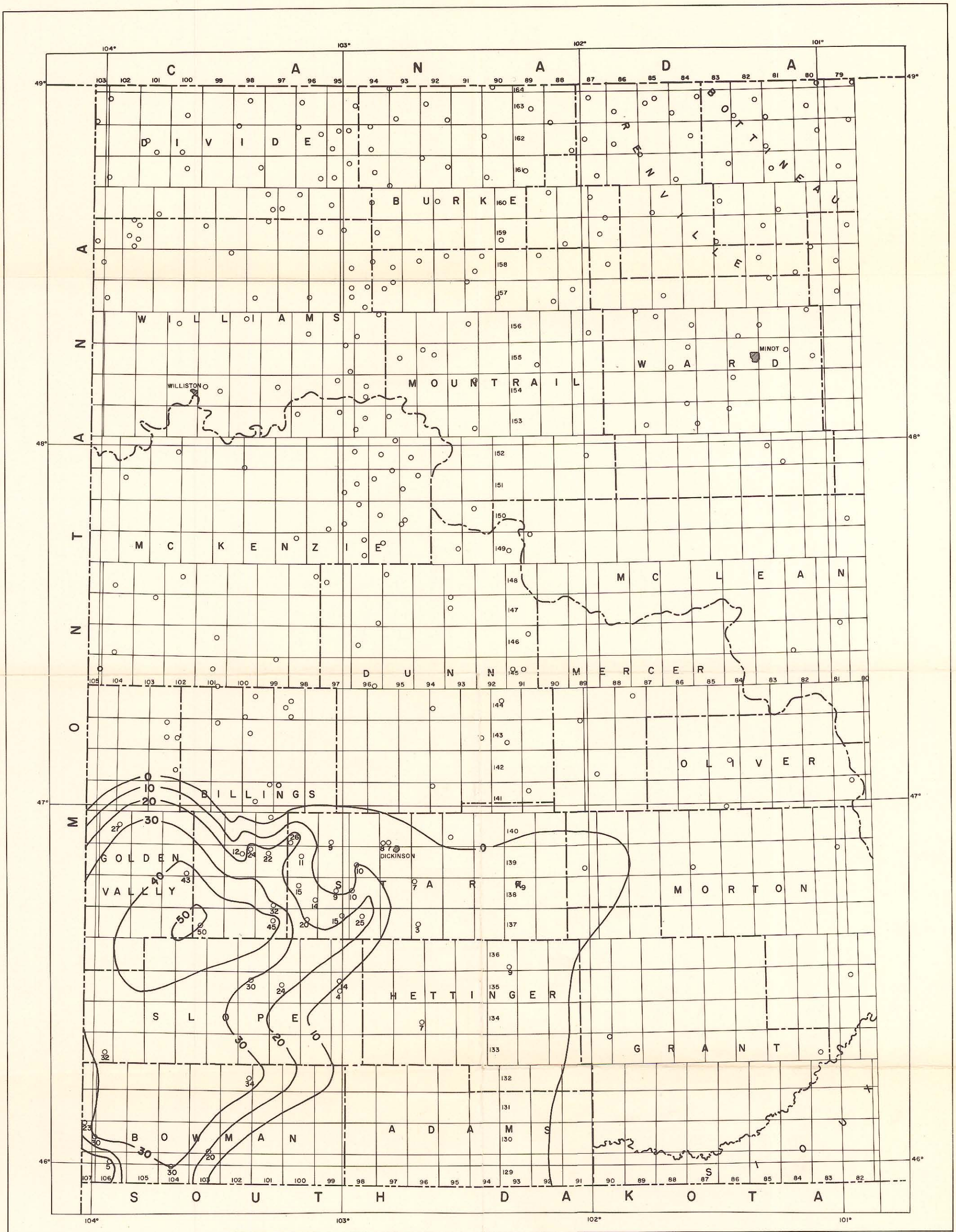
205 THICKNESS IN FEET

CONTOUR INTERVAL — 50 FEET

SCALE 10 0 10 20 30 40 MILES

ISOPACHOUS MAP OF THE SAUDE MEMBER, SPEARFISH FORMATION

PLATE 4



LEGEND

o CONTROL WELL

37 THICKNESS IN FEET

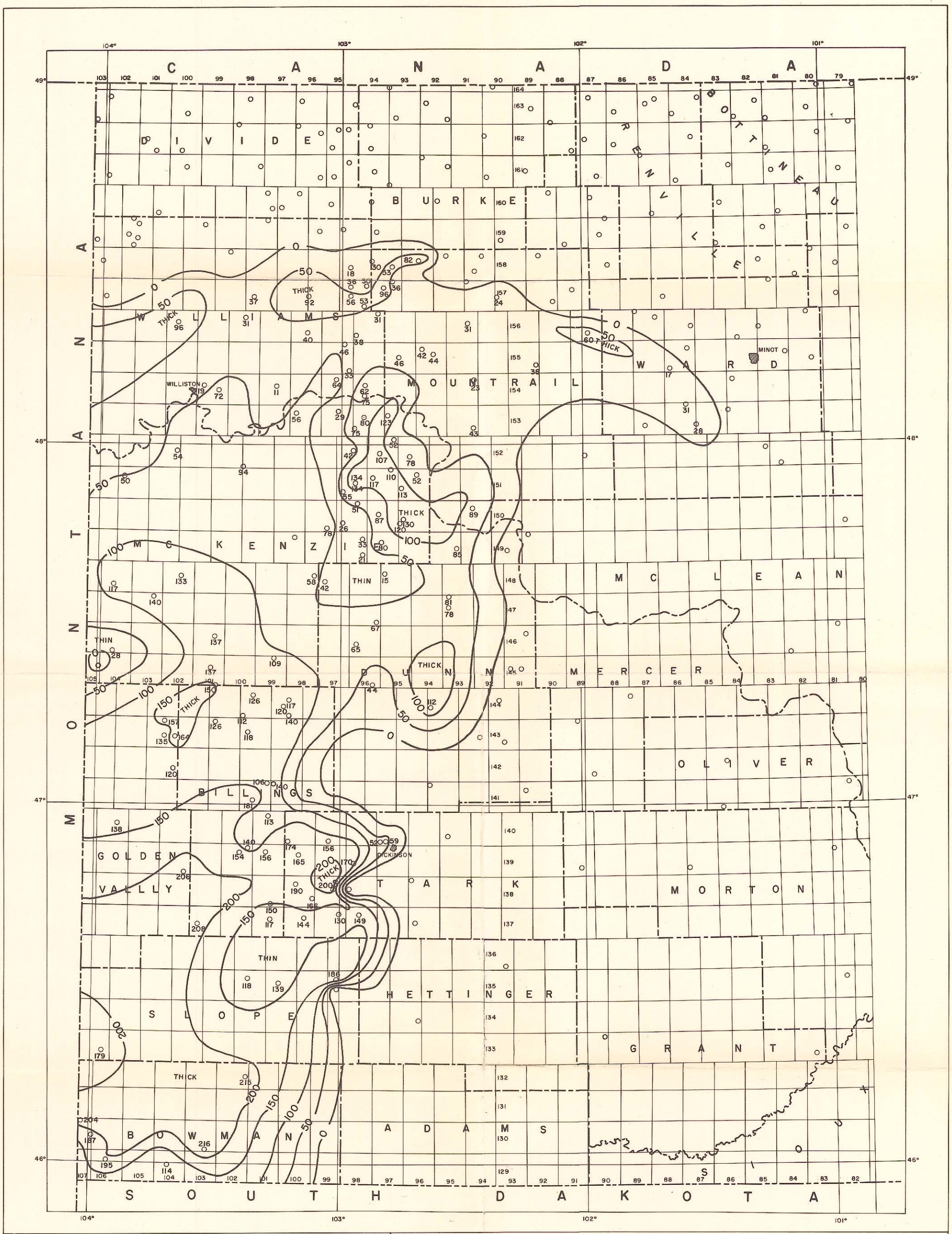
CONTOUR INTERVAL — 10 FEET

SCALE

10 0 10 20 30 40 MILES

ISOPACHOUS MAP OF THE G MARKER SALT BED, SAUDE MEMBER, SPEARFISH FORMATION

PLATE 5



LEGEND

o CONTROL WELL

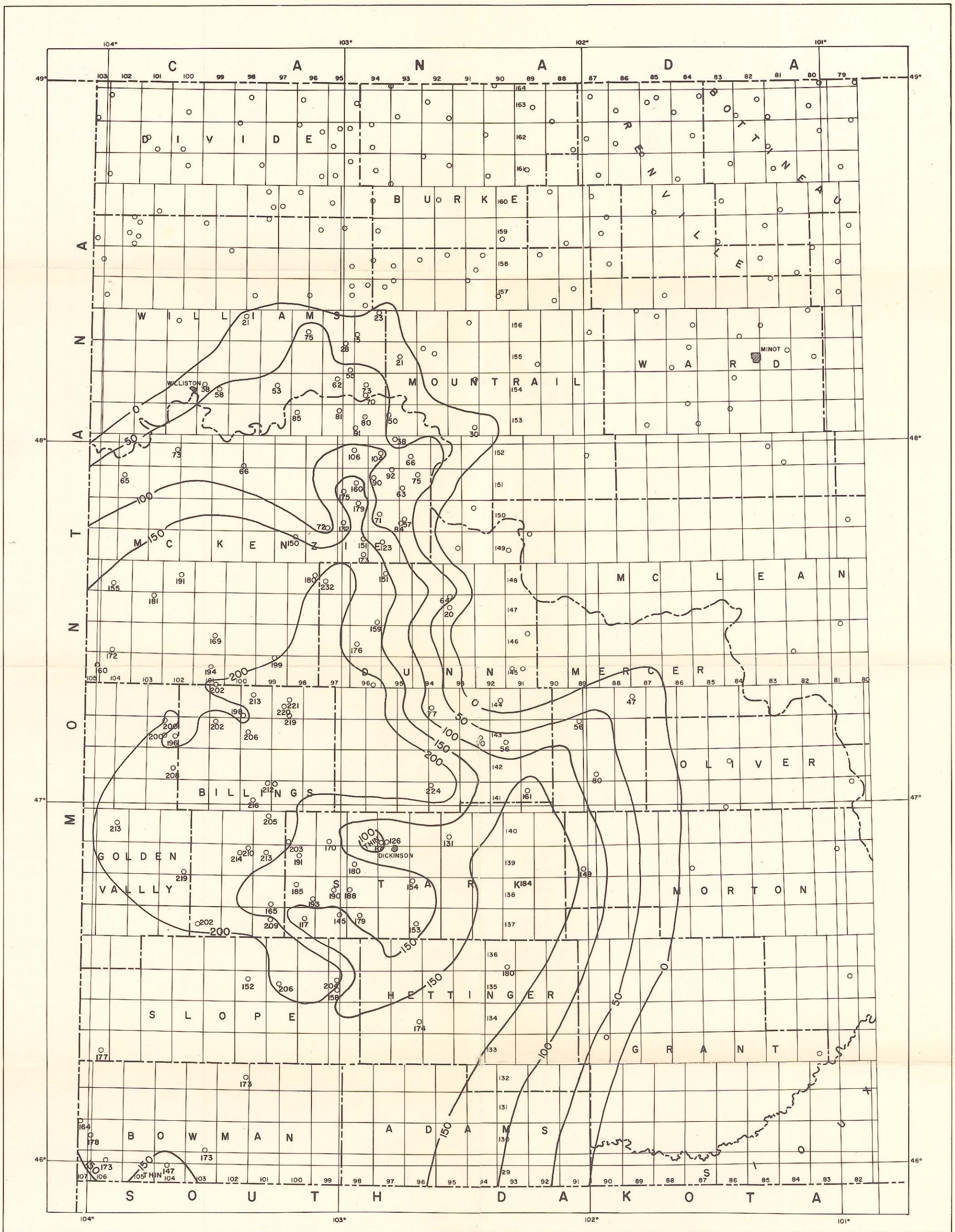
215 THICKNESS IN FEET

CONTOUR INTERVAL — 50 FEET

SCALE 10 0 10 20 30 40 MILES

ISOPACHOUS MAP OF THE PINE SALT MEMBER, SPEARFISH FORMATION

PLATE 6



LEGEND

CONTROL WELL

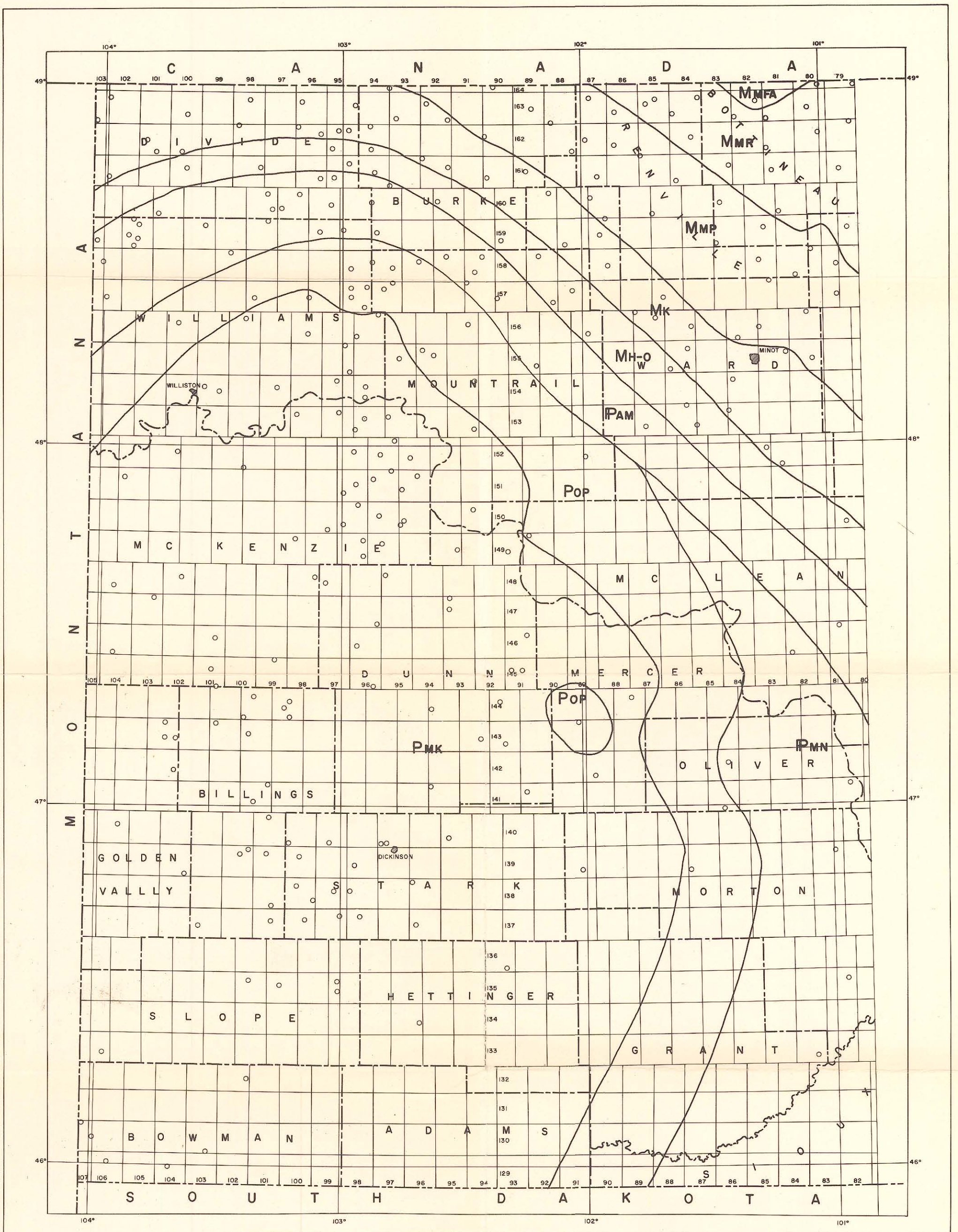
173 THICKNESS IN FEET

CONTOUR INTERVAL – 50 FEET

SCALE 10 0 10 20 30 40 MILES

ISOPACHOUS MAP OF THE BELFIELD MEMBER, SPEARFISH FORMATION

PLATE 7



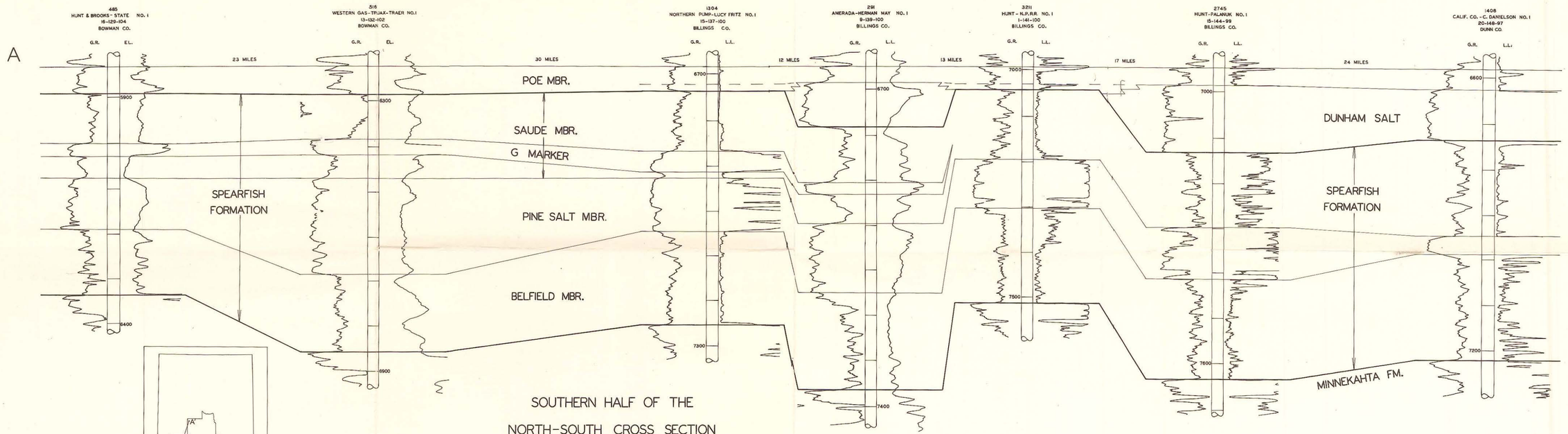
LEGEND

- o CONTROL WELL
- PMK MINNEKHATA FM.
- POP OPECHE FM.
- PMN MINNELUSA FM.
- PAM AMSDEN FM.
- MH-O HEATH & OTTER FMS.
- MK KIBBEY FM.
- MMP MADISON FM-POPLAR INTERVAL
- MMR MADISON FM.-RATCLIFFE INTERVAL
- MMFR MADISON FM.-FROBISH-ALIDA INTERVAL

SCALE 10 0 10 20 30 40 MILES

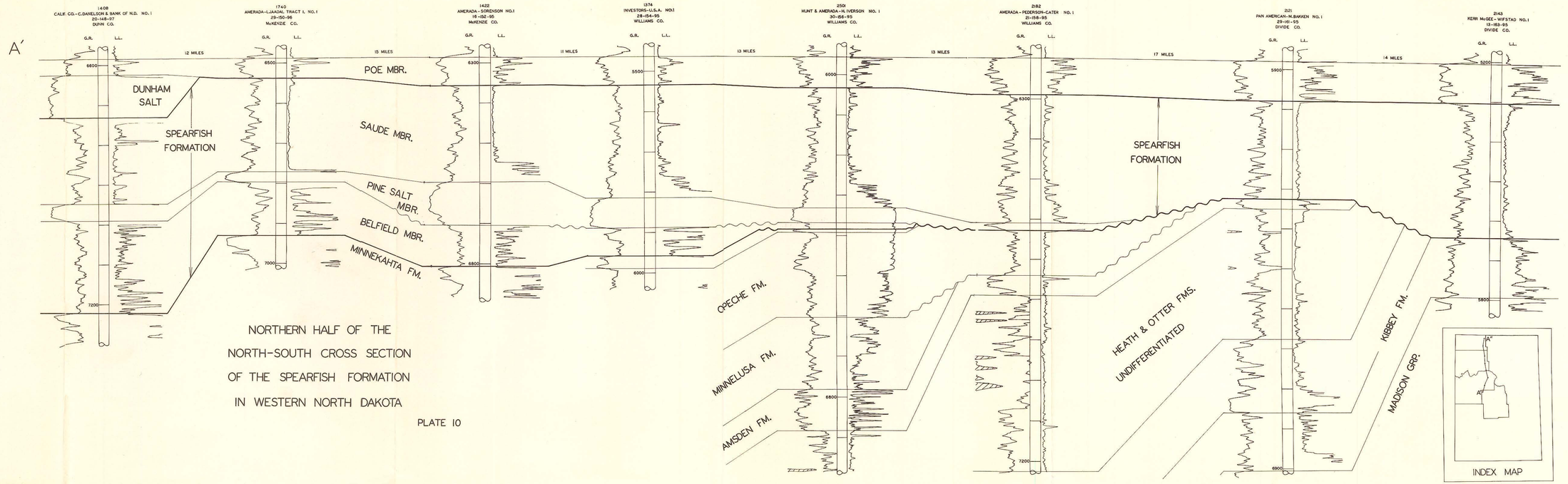
PRE-SPEARFISH SUBCROP MAP

PLATE 8



SOUTHERN HALF OF THE
NORTH-SOUTH CROSS SECTION
OF THE SPEARFISH FORMATION
IN WESTERN NORTH DAKOTA

PLATE 9



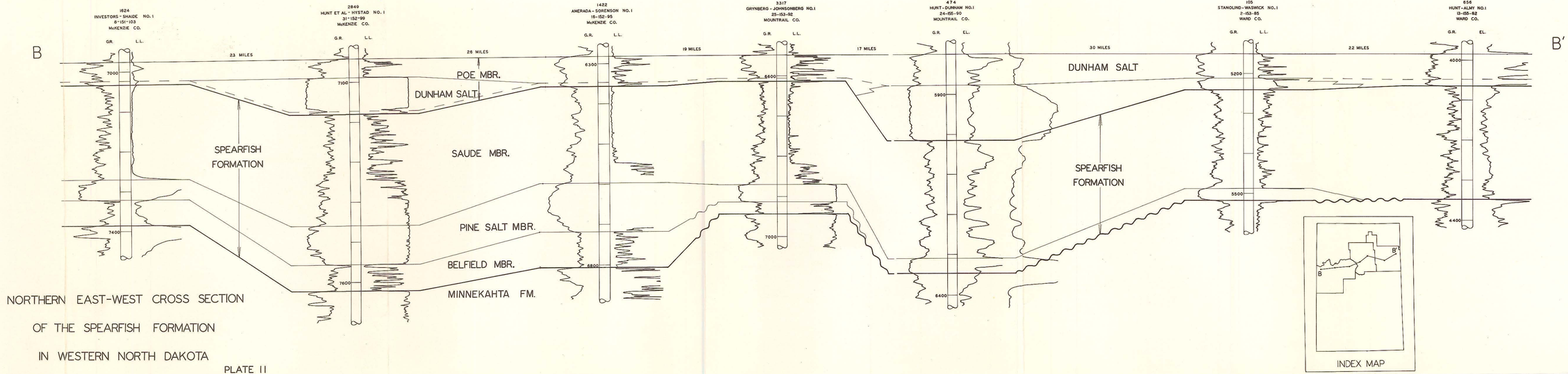
NORTHERN HALF OF THE
NORTH-SOUTH CROSS SECTION
OF THE SPEARFISH FORMATION
IN WESTERN NORTH DAKOTA

PLATE 10

Wilson M. Laird, *State Geologist*

NORTH DAKOTA GEOLOGICAL SURVEY

Bulletin 32

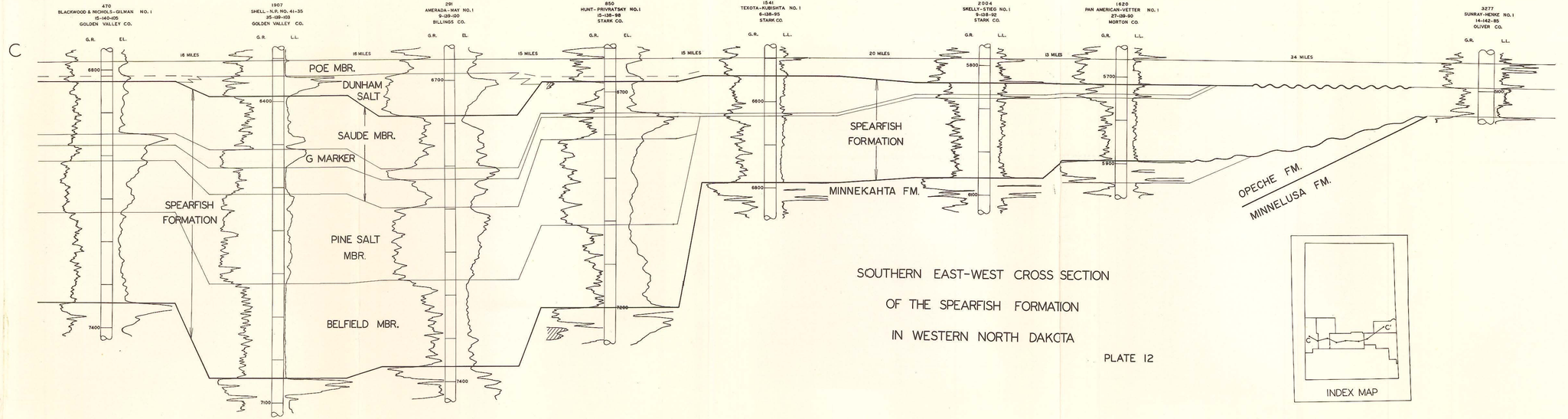


NORTHERN EAST-WEST CROSS SECTION

OF THE SPEARFISH FORMATION

IN WESTERN NORTH DAKOTA

PLATE II



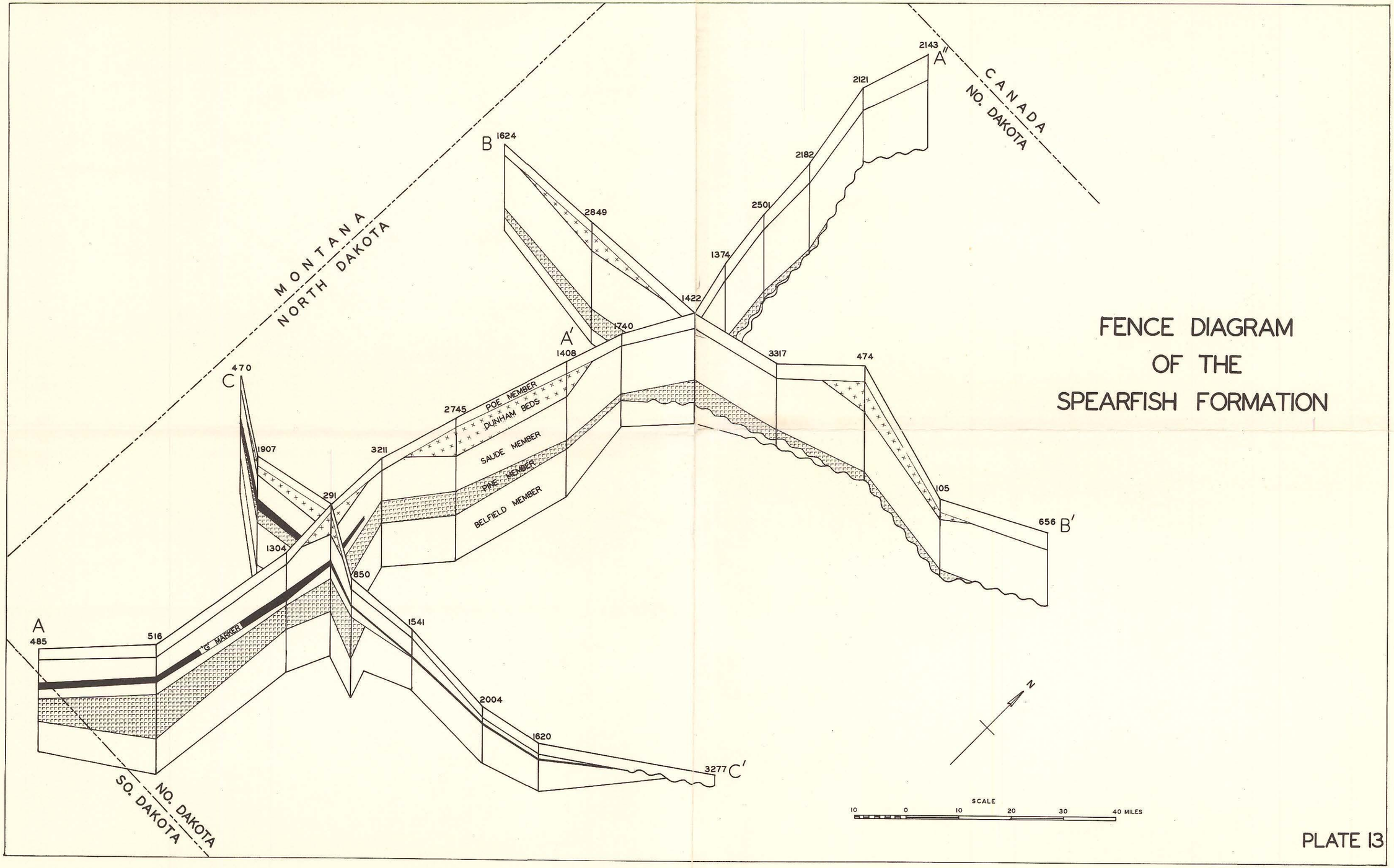
SOUTHERN EAST-WEST CROSS SECTION

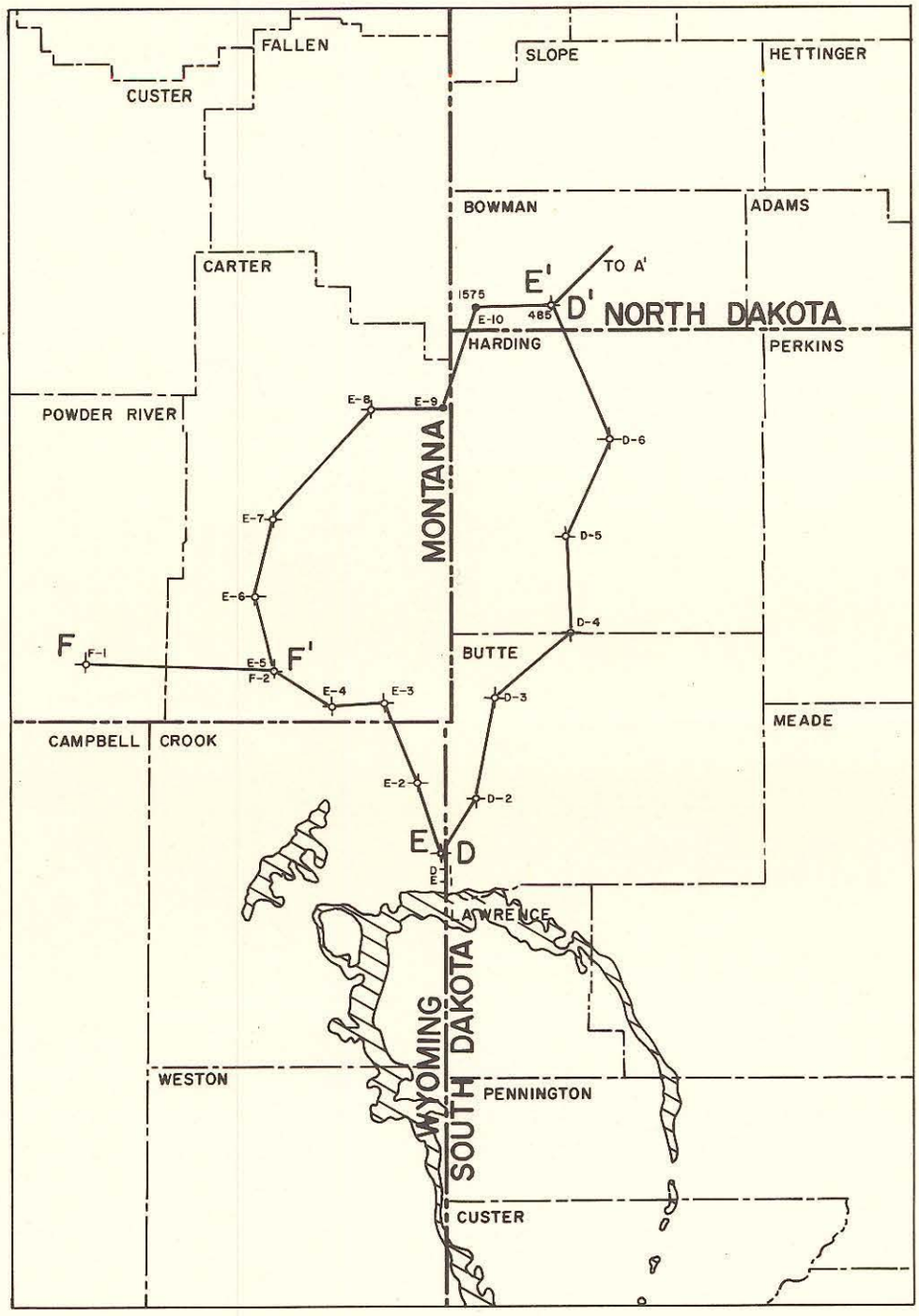
OF THE SPEARFISH FORMATION

IN WESTERN NORTH DAKOTA

PLATE 12

INDEX MAP


MONTANA
NORTH DAKOTA
CANADA
NO. DAKOTA
SO. DAKOTA
NO. DAKOTA
A
A'
A''
B
B'
C
C'
470
1907
1304
485
516
"G" MARKER
1408
2745
3211
291
850
1740
1541
2004
1620
3277
1624
2849
1422
1374
2501
2182
2121
2143
3317
474
105
656
POE MEMBER
DUNHAM BEDS
SAUDE MEMBER
PINE MEMBER
BELFIELD MEMBER
FENCE DIAGRAM
OF THE
SPEARFISH FORMATION
N
SCALE
10 0 10 20 30 40 MILES
PLATE 13



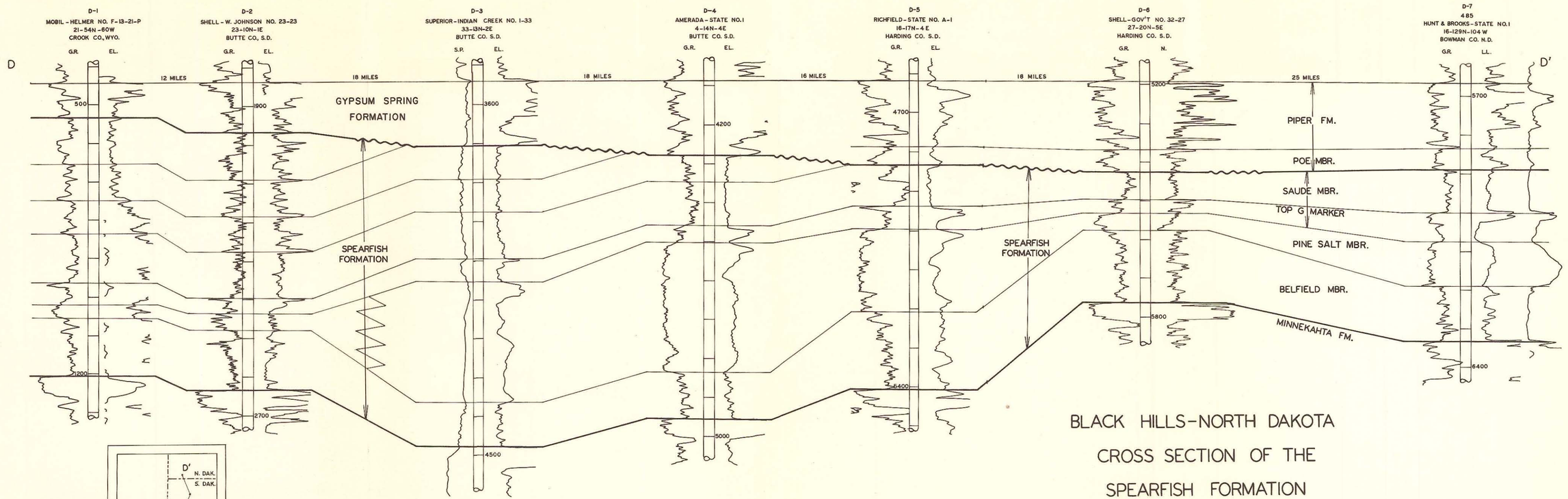
LEGEND

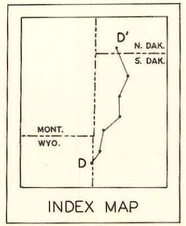
- o PRODUCING WELL
- DRY HOLE
- D-D' LOCATION OF PLATE 15
- E-E' LOCATION OF PLATE 16
- F-F' LOCATION OF FIGURE 9
- SPEARFISH OUTCROP AREA

SCALE
6 0 6 12 18 24 Miles

INDEX MAP SHOWING LOCATION OF THE BLACK HILLS-NORTH DAKOTA CROSS SECTIONS

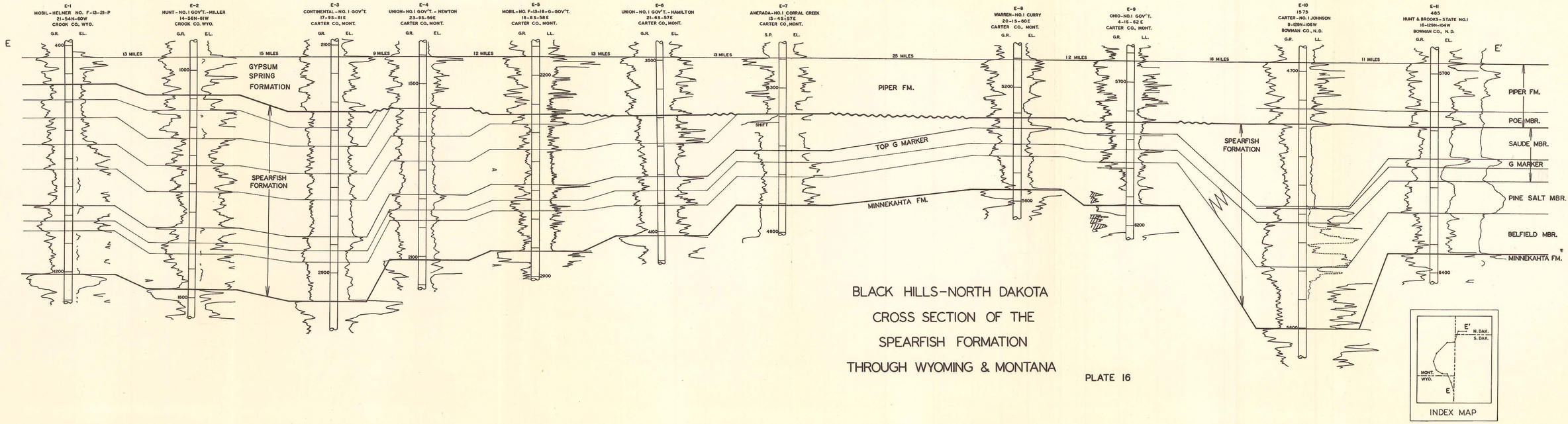
PLATE 14





BLACK HILLS-NORTH DAKOTA CROSS SECTION OF THE SPEARFISH FORMATION THROUGH SOUTH DAKOTA

PLATE 15



BLACK HILLS-NORTH DAKOTA
CROSS SECTION OF THE
SPEARFISH FORMATION
THROUGH WYOMING & MONTANA

PLATE 16

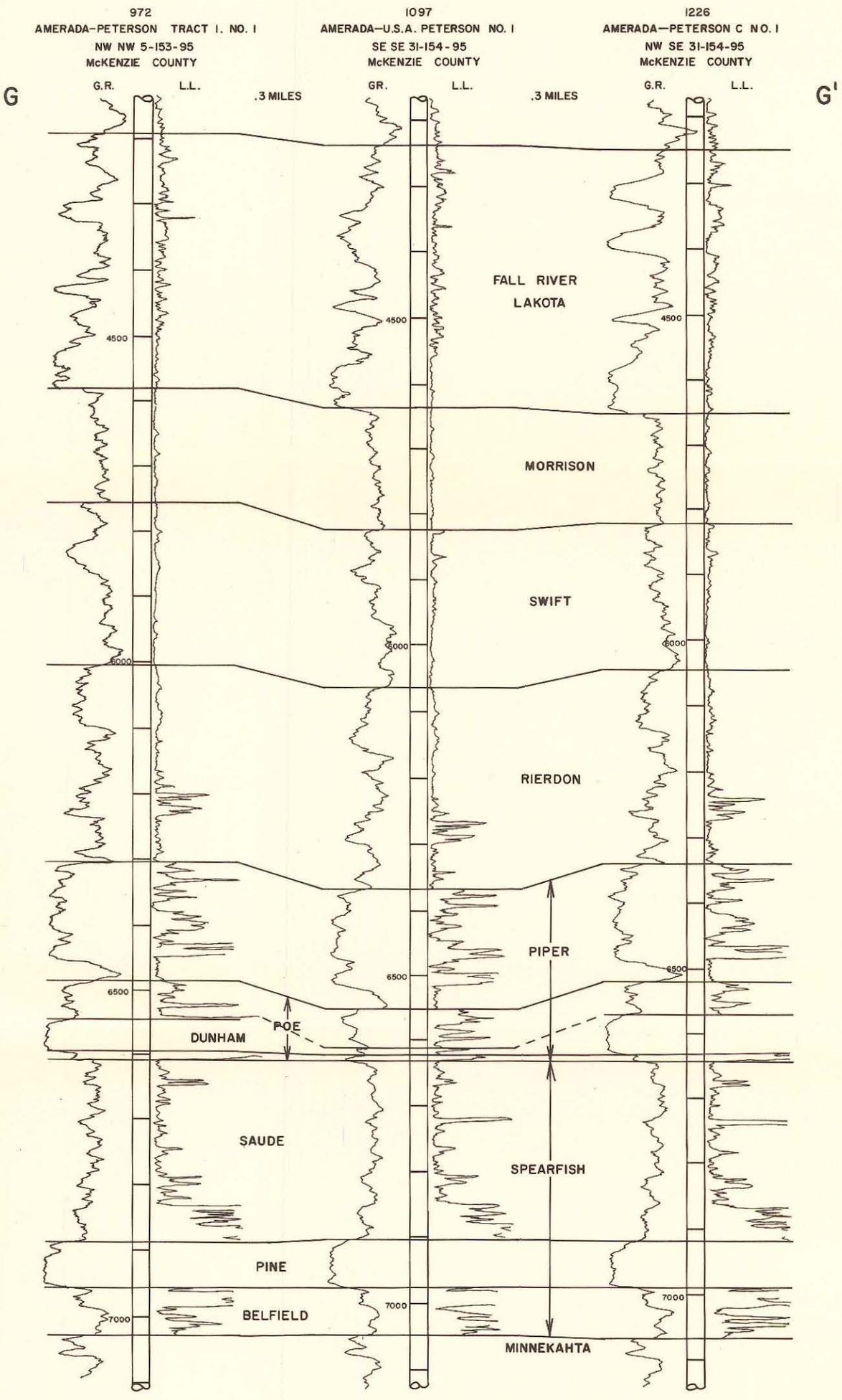


PLATE 17—CROSS SECTION SHOWING EFFECT OF DUNHAM SALT SOLUTION ON OVERLYING ROCKS. FOR LOCATION SEE FIGURE 10.