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OIL AND GAS POSSIBILTIES OF HUDSON BAY JUNCTION AREA SASKATCHEWAN

BY

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INTRODUCTION

During the past few years considerable interest has been shown in the possible occurrence of oil or gas in the vicinity of Hudson Bay Junction and nine wells have been drilled in different parts of the area. Because of this interest an investigation was undertaken by the Geological Survey in the summer of 1935.

A field party under the direction of F. H. McLearn made a careful study of the exposures along Etomami and Red Deer rivers, south and southeast of Hudson Bay Junction. Important horizon markers, that is typical and persistent beds, were traced from one exposure to another. The identification of these beds was checked by their fossil contents. Numerous samples were taken for micro-palaeontological analysis. A plane table survey, with stadia alidade, was made of parts of Etomami and Red Deer rivers, in order to locate exposures and determine the rise and fall of the beds and so determine the structure.

R.T.D. Wickenden spent two days in the field near the end of the season. He has examined, in the office, the foraminifera and other microfossils in the samples obtained both from the exposures and the wells. He has also worked out the succession of beds in the wells. These studies by Wickenden have made possible a comparison of the beds in the wells with those exposed on the surface.

Acknowledgment is made to the Petroleum Engineering Company for permission to publish the results of examination

of samples obtained from the Trail Blazer well and the wells at Kakwa.

GEOGRAPHY

Hudson Bay Junction is situated in east-central Saskatchewan, on the Prince Alberta and Swan River branch of the Canadian National railways, and is a junction point for The Pas and other northern settlements. The surrounding country is nearly flat or gently sloping and is part of a very broad valley that lies between the Pasquia and Porcupine hills. The surface of this valley is covered by a mantle of Pleistocene boulder clay, gravel, sand and clay.

Red Deer river and its tributaries, including Etomami river, drain this old, broad valley and have excavated steep-walled, narrow, trench-like valleys below its floor. Most of them have not yet cut deeply enough through the drift mantle to expose the underlying Cretaceous beds. At places, however, along Etomami river between Kakwa and locality 12 and along Red Deer river between locality 10 and Erwood (See Figure 1), the Cretaceous is uncovered.

This post-glacial drainage system began on the surface of the drift mantle and was determined by its slope, irregularities, and other features. As this youthful drainage is only now beginning to penetrate through to the Cretaceous, the relatively hard and soft layers and the structure of the Cretaceous have not determined its pattern. Obviously, therefore, the structure of the Cretaceous cannot be inferred from the courses of the streams.

STRATIGRAPHY

The section in the Hudson Bay Junction area, based on a study of surface exposures and on a study of samples from the Trail Blazer and No. 5 Kakwa wells, is as follows:

Era	Period	Formation	Thickness, feet	Lithology
Mesozoic	Cretaceous	Riding Mountain	400 +	Grey shales with clay-ironstone concretions
		Pembina	30 to 40	Dark carbonaceous shales, many bentonite beds
		Boyne-Morden	70 ±	Calcareous speckled and dark shales
		Keld-Assiniboine	80 to 90	Calcareous speckled shales, silt zone at base
		Ashville	200 ±	Dark carbonaceous shales
		Swan River	335 ±	Shales, silts, and sands
Palaeozoic	Devonian	Not named	300 ±	Dolomite, etc.

Compared with the Cretaceous of Alberta, a part or all of the Ashville, the Keld-Assiniboine, the Morden-Boyne, and perhaps a part of the Pembina are equivalent to the Alberta shale, and a part or all of the Pembina and the Riding Mountain beds are equivalent to the Lea Park and perhaps later formations.

Devonian Beds

No strata of Palaeozoic age outcrop in the area. They are known only from samples obtained from the bottom of the Trail Blazer well, where the drill penetrated:

Dolomite
Sand
Dolomite and limestone.

All except the sand is probably of Devonian age. The sand resembled that in the overlying Swan River beds and may be the filling of a cavern or hollow in the dolomite.

There is a considerable break between the dolomite and the Swan River beds, representing Carboniferous, Permian, Triassic, and, perhaps, Jurassic time. No Jurassic beds have yet been identified in northern Saskatchewan.

Swan River

Like the underlying Devonian the Swan River beds in this area are known only from the Trail Blazer well. They consist mostly of sand, with a little shale and coal, and are about 335 feet thick. The lithology and thickness probably vary from place to place, depending on the relief of the surface of the Palaeozoic and the conditions that prevailed during deposition. No microfauna was found in the samples from the well.

Ashville

The Ashville follows the Swan River formation. Only the upper part of the formation is exposed in this area; the beds outcrop from about locality 4 to Erwood (See Figures 1 and 3), where dark, partly carbonaceous and almost fissile shales are present. The following section of the formation is based on studies of samples from the Trail Blazer and Kakwa No.5 wells:

	Feet
Dark grey to black shale	100 ±
Coarse sand	20 ±
Dark grey to black shale	80 ±

The total thickness is thus about 200 feet. The bed of coarse sand is represented in Swan River area by a bed of silt or silty shale.

The microfauna includes the following foraminifera: Miliammina manitobensis Wickenden, Tritaxia manitobensis Wickenden, Ammobaculites sp?, Haplophragmoides sp?, Gaudryina sp?.

Keld-Assiniboine

Overlying the beds assigned to the Ashville in this area is a zone of calcareous siltstone, silt, and dark shale, tentatively included in the Keld-Assiniboine. It is exposed at localities 9 and 10 and reached by auger drill at localities 7 and 8 (See Figures 1, 3) on Red Deer river. It can also be recognized in all Kakwa wells. This silt zone has not been found anywhere in Manitoba and appears to be peculiar to Saskatchewan.

Above the silt zone is one of non-calcareous dark shale with poorly preserved Inoceramus, a small ammonite, and the foraminifera Trochammina sp? and Gaudryina sp?. These dark shales are exposed at localities 7, 8, and 10 along Red Deer river and in all the wells at Kakwa, where Trochammina sp? is also present. The Trochammina occurs in diamond drill cores from a well at Thunderhill, Manitoba, in a zone between typical Ashville and Keld.

Yet higher, on Red Deer river, at localities 6 and 8 (See Figures 1 and 3), is a bed of calcareous speckled shale typical of the Keld-Assiniboine. The exposed section is about 8 feet, but the total thickness is undoubtedly much more. Belemnites, fragments of Inoceramus, and the foraminifera Globigerina cretacea d'Orbigny and Gumbelina globulosa Reuss are present.

The total thickness of the Keld-Assiniboine in the Kakwa wells, including the silt zone, is from 80 to 90 feet. This is much less than the combined thickness on Vermilion

river in Manitoba. It is not known whether the Keld-Assiniboine merely thins to the northwest in Saskatchewan or whether some part of it is missing there.

The Keld and Assiniboine can be recognized as separate units at many localities in Manitoba. The Keld on Vermilion river consists mostly of calcareous speckled shale with common Inoceramus labiatus Schlotheim. At the top and separating it from the Assiniboine above is a 4 to 8-inch limestone band with Prionotropis and Inoceramus cf. corpulentus (Kirk, 1930). The Assiniboine also consists mostly of calcareous speckled shale and is surmounted by the 4-foot limestone. The Keld-Assiniboine can be correlated with the Lower Alberta shale of western Alberta.

Morden-Boyne

In the Kakwa wells the calcareous shales of the Keld-Assiniboine are followed above by about 30 feet of dark grey shales like those of the Morden in Manitoba. Very little if any of these dark shales are exposed on the surface. Some of the shales at locality 12 and neighbouring localities on Etomami river may belong to these Morden-like beds, as well as dark grey to black, almost fissile shales obtaining in excavating for the piers of a railway bridge across Red Deer river, southwest of Hudson Bay Junction.

Overlying these dark shales, but without any definite boundary, are calcareous speckled shales with interbedded, non-calcareous, dark shales. These beds are like those of the Boyne. They have a thickness of about 40 feet in the Kakwa wells, although there is some variation there. On the surface they are exposed at intervals along Etomami river between localities 15 and 24 (See Figures 1 and 2). Inoceramus cf. lundbreckensis was found near the top of the speckled shale

and Scaphites ventricosus and varieties, Buculites, Inoceramus pontoni, and other species at a lower horizon in the speckled shales. The presence of S. ventricosus and I. pontoni permits a correlation with a part of the upper Alberta shale in western Alberta. The microfauna includes about ten species of foraminifera, among the most easily recognized being Globigerinella aspera (Ehrenberg), Planulina cf. leptospira (Ehrenberg), Neobulimina canadensis Cushman and Wickenden, Heterohelix americana (Ehrenberg), Gumbelina globulosa (Reuss.), and Globigerina cretacea d'Orbigny.

Pembina

The Pembina overlies the Boyne, the contact in the Hudson Bay Junction area being drawn between a calcareous speckled shale below and a bed of non-calcareous, dark, carbonaceous, almost fissile shale above. It consists of dark, carbonaceous, friable and almost fissile shales, with numerous seams of bentonite, particularly near the top and bottom. It is exposed at intervals along Etomami river from locality 18 to locality 25, and has a tendency to slump in the river banks. In the Kakwa wells it is from 30 to 40 feet thick. No macrofossils were found in this area. The foraminifera obtained are nearly all arenaceous species, which are easily crushed and, therefore, indeterminate.

Riding Mountain

The Riding Mountain is the youngest of the Cretaceous formations in the Hudson Bay Junction area where it is exposed at places along Etomami river between Kakwa and locality 25 (See Figures 1 and 2). It consists of grey, plastic, bentonitic, non-calcareous shales with numerous concretions of clay-ironstone. There is considerable slumping at almost all exposures. Only the lower part of this formation, not more than

about 100 feet, is present in the area. In Manitoba it attains in places a thickness of from 400 to 900 feet, where the topography permits.

No macrofauna was found in this area, but in Manitoba a "Pierre" fauna is present. The microfauna includes the foraminifera Reophax cf. texana Cushman and Waters, Ammodiscus cretacea (Reuss.), Haplophragmoides sp.?, and Bigenerina hastata Cushman and numerous specimens of a somewhat globular radiolarian.

Structure

It is difficult to determine the structure in an area where exposures are so few. However, there are sufficient along parts of Etomami and Red Deer rivers to do so. As the structure is only known in one plane, however, that is in a plane parallel to the course of the river, the closure cannot be worked out.

It must be remembered, in examining Figures 2 and 3 that the vertical scale is twenty times the horizontal. The structure shown, therefore, is greatly exaggerated. It is not a pronounced, but a very gentle, structure and would hardly be noticeable were the vertical scale equal to that of the horizontal.

Care must be taken in the study of the river banks not to confuse slumping with true structure. The soft shales, particularly those of the Riding Mountain and Pembina formations, have a tendency to slip down on the valley sides and assume dips that bear no relation to the structure of the underlying strata.

Etomami River (See Figures 1 and 2). The contact between the Riding Mountain and Pembina formations drops at a

rate of about 6½ feet a mile in a southwest direction between locality 25 and the Kakwa well No.5. There is an estimated drop at the rate of about 45 feet a mile in a southwest direction between localities 24 and 25, in less than a mile. Of course it has not been proved that there is an even slope of the strata between 24 and 25, as shown in Figure 2. There may be one or more faults present, with downthrow to the southwest. The contact between the Boyne and Pembina slopes at the rate of about 6.5 feet a mile in a northeasterly direction between localities 24 and 20. There is a slight rise in the same contact in a northeasterly direction between localities 20 and 19, and a drop at the rate of about 20 feet a mile in an easterly direction between 19 and 18. Beyond this in a northeasterly direction there is a rise at the estimated rate of about 6 feet a mile to locality 15. At locality 15 there is a normal fault with a drop of about 10 feet on the north side. From localities 15 to 12 the structure is difficult to interpret, but is not likely pronounced.

Red Deer River (See Figures 1 and 3). In Figure 3 the lines indicate the top and bottom of the Cretaceous silt beds described above under Keld-Assiniboine. Where the line is unbroken it indicates where the contact actually is, as determined by observation. Where the line is broken it indicates where the contact probably is, although concealed by the drift mantle, or where the contact would probably be had the silt beds not been removed by erosion.

From locality 10 to locality 7 there is a variable slope of the strata in a direction a little south of east. From 10 to 8 the silt beds drop at a rate of about 70 feet a mile. It is not known whether this can be explained by an even dip of the beds or by faulting. From 8 to 7 the same

silt beds rise a little and from 7 to 6 these beds are estimated to drop a little again in the same direction. There is only a small exposure of dark shale with silt partings at locality 5. The lithology suggests a reference of the beds to the silt zone, but the microfauna is more like that of the shale beds above the silt zone at locality 8. If the evidence of the lithology be accepted, it follows that the structure is almost flat between localities 6 and 5. If the evidence of the microfauna is accepted, and the beds at locality 5 are considered to be above the silt zone, it follows that there is a slight drop or dip to the north between localities 6 and 5, as recorded in Figure 3.

As the lithology and microfauna of the beds at locality 4 indicate that they are of the Ashville formation and below the silt zone there must be a rise in the structure from 5 to 4 in an approximately northern direction, as shown in Figure 3. As a part of the silt zone can be recognized in the Trail Blazer well and at a lower level than that inferred for the silt zone at locality 4 there is a drop in a northerly direction from locality 4 to locality 3, that is to the Trail Blazer well. The beds exposed at locality 2 are of the Ashville and there may be a slight rise from 3 to 2 in an easterly direction. Downstream, east of locality 2, the structure is difficult to interpret, but there may be a low easterly or northeasterly dip there.

Comparison of the elevation of the silt zone in the Kakwa well No. 5, on Etomami river, with the elevation of the silt zone at locality 10 along Red Deer river indicates an average regional slope to the southwest of about 3 feet a mile. On this regional slope is superimposed the minor structures

described above on Etomami and Red Deer rivers. This is an irregular and not a very pronounced structure. Slopes of 6 or 7 feet a mile are not uncommon, and some of the apparent steeper dips may really be best interpreted by faulting. It is not likely an orogenic structure and possibly is not continuous to depth. A probable cause of the minor structures is the uneven settling of the Cretaceous sediments on the eroded surface of the Palaeozoic limestone and dolomite.

OIL AND GAS POSSIBILITIES

The Cretaceous formations of Hudson Bay Junction area contain beds that might be source beds and others that might well serve for the storage of oil and gas. No structure large and pronounced enough for the accumulation of oil or gas in commercial quantities, however, has yet been found.

A moderate flow of gas has been reported from some of the Kakwa wells, at the horizons of the silt zone and the calcareous beds of the Keld-Assiniboine. Although this may have some local use, the quantity apparently is not sufficient for large commercial exploitation. Possibly similar small flows may be found on minor structures in the vicinity of Etomami river.

Some viscous asphaltic material was found in the Trail Blazer well. It is in a sand bed that in the foregoing section on stratigraphy is assumed to be the filling of a cavern near the top of the Palaeozoic dolomite. No other showings of petroliferous material have been reported.

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