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POTASH OCCURRENCE IN THE VERMILION AREA OF THE PROVINCE OF ALBERTA

Prepared by

Albert Golden, B. Sc.

Petroleum Geologist

October 1, 1965.

[redacted]

Albert Golden, B. Sc.,
Petroleum Geologist

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I N D E X

POTASH OCCURRENCE IN THE VERMILION AREA OF THE PROVINCE OF ALBERTA

1. GENERAL

The economical production of potash over a large area of the Province of Saskatchewan has recently widened the search of this mineral into the Province of Manitoba and the State of North Dakota. The identical geological stratigraphic sequence and depositional environment that resulted in potash formation in the Province of Saskatchewan is also present in the portion of the Province of Alberta under study in this report.

A detailed study of this portion of Alberta showed the presence of small irregular veinlets of potassium minerals in the Lesser Slave Lake area of North Alberta and a substantial quantity of carnallite ($KCl.MgCl_2.6H_2O$.) and likely sylvite (KCl) in the Vermilion area in the East Central Plains of Alberta. Literature made available from the Alberta Oil and Gas Conservation Board, the Government of Canada Department of Mines and Technical Surveys, and personal communication with the well site geologist on the initial discovery well, corroborates this potash occurrence in Alberta. The cores from the well with the carnallite have been lost and dispersed since the well was drilled in 1945.

2. GEOLOGY

The potash minerals in the VCO #15 well in Lsd 6, Sec 12, Tp 49, Rge 6, W4, the only deep well in the area, are found in the Prairie Evaporite section of the Middle Devonian Elk Point Basin. The carnallite and the pinkish potash mineral mentioned in the enclosed literature, lies on top of a thick 400 foot section of common salt (halite). Twelve feet of carnallite was reported to be present in this well and the pinkish and grayish mineral (in

all probability sylvite) occurs throughout the first 50 feet of the Prairie Evaporite. The cores from the VCO #15 well were exposed for weeks to the atmosphere and transported long distances before being spot analyzed. Because of these two conditions and the very high solubility of sylvite, a true and accurate analysis was probably not ascertained, but the core description indicates the presence of sylvite in substantial quantities.

The potash minerals in the VCO #15 well are of the same composition and depositional sequence and depth as the potash at Unity and Saskatoon, Saskatchewan. These potash deposits are now in the formational stages of economic mining and development. It is feasibly possible that the potash in VCO #15 and Unity are one large continuous deposit. Northwards from the VCO #15 well, towards Fort McMurray the overburden and geological strata overlying the potash deposits become less. This thinning has allowed subsurface waters to percolate throughout the highly soluble potassium salts and removing them by solution and leaching. This solution by waters also caused areas of salt collapse in this vicinity. To the northwest the salt section becomes more anhydritic and potash was not deposited. Further to the northwest the anhydritic section becomes carbonate in the Rainbow Area of Alberta. South of VCO #15, in the deeper portion of the Elk Point Basin and beyond its maximum depth to its southern synclinal edge, deep wells reveal no trace of potash.

3. RECOMMENDATIONS

1. Land

Land for potash production and development has been acquired over an area encircling the VCO #15 well.

2. Development Program

An active development program should be initiated on the acquired

land. Wells to probe for potash should be drilled to approximately 3700 feet in specific areas. These suggested locations are:

a) Initial Well:
Sec 32, Tp 48, Rge 5, W4

b) Second Well:
Sec 10, Tp 48, Rge 5, W4

c) A possible third well:
Sec 22, Tp 49, Rge 6, W4
Northwest of the VCO #15 well to further prove up the acreage.

3. Oil and Gas Possibilities in Various Formations Above the Potash

All upper formations in the Cretaceous should be closely studied and checked during drilling operations. This area is an ideal prospect for gas and oil accumulation in the many sands present in this area.

Note: Oil and Gas Possibilities in the various formation above the potash.

Westwards from the area selected for drilling for potash, lies a large Paleozoic (Devonian) remnant of Limestone. This remnant is overlain by a series of sands and shales in the lower Cretaceous. On the flanks of this remnant, where the selected acreage lies the lower Cretaceous is thicker with the resulting pinch out of the various sands against the Paleozoic remnant. It is in similar sands that the various fields such as: Wainwright, Wildmere, Baxter Lake and Borradaile produce oil and gas. Other such fields will no doubt be found in the area. Stratigraphic sand pinch outs are difficult to uncover by seismic or other prospecting means, but this area is a potential first class prospect for oil and gas accumulation. The Colony sand which is the uppermost sand in the Blairmore (Lower Cretaceous) gave gas blows of over 4 MMCF in the VCO #15 well. The Viking sand named after the large Viking gas field just west of this acreage is another upper sand that may prove productive. Even some of the Devonian has shown gas and oil in a test just to the south of the prospect area.

4. Drilling and Testing

Tests of the various sands should be made during drilling. Electric and radioactive logs on potash, petroleum, and natural gas horizons should be run and evaluated. A core of 50 feet of the upper Prairie Evaporite should be sufficient to evaluate the potash potential, however coring may reveal a thicker potash bearing section that should be evaluated.

4. CONCLUSIONS

1. The first group filing for land under potash regulations has the first choice with no other competitive leasing in this area and will receive full co-operation from the Alberta Government for this initial venture.

2. The geological strata and basinal effects of the Vermilion area are closely related to the Saskatchewan potash rich areas at Esterhazy, Saskatoon and Unity now being successfully developed and mined. This is shown in the enclosed cross section.

3. Oil and gas reservoirs in the area could provide economical energy sources for developing potash by solution mining. The Battle River which flows through the prospect would provide adequate water supplies for solution mining. The Blairmore sands that are so heavily water laden and proved so costly to penetrate in Saskatchewan potash mines, are not present in the Vermilion area, so that shaft mining is also feasible and should be less hazardous and more economical in this area.

4. The economics for the production of potash appear equally favorable in this area to those in existing potash mines in Saskatchewan. The depth is such that either solution mining or shaft mining could be carried out. It's geographical location to developing markets in Japan and Asia will make the area very competitive with potash now being produced in Saskatchewan. The cost of a well fully tested and logged would be approximately $40,000.00.

5. The area is probably of the same potential as other existing

developed potash areas in Saskatchewan.

6. More potash than was originally recorded will be present, as much leaching and solution loss took place by the inadequate potash coring techniques used in taking the cores cut in 1945. In the Saskatchewan potash areas sylvite in commercial quantities is always associated with carnallite. The pinkish mineral mentioned throughout the core description is primarily sylvite as shown by cores taken in other areas in Saskatchewan now producing potash.

ENCLOSURES

Exhibit No. 1 - Map of Elkpoint showing thickness and lithology.

Exhibit No. 2 - Cross section of potash producing areas.

Exhibit No. 3 - Literature from Alberta Oil and Gas Conservation Board.

Exhibit No. 4 - Copy of Alberta Potash Regulations.

Exhibit No. 5 - Stratographic sequence of Potash Beds (idealized).

Exhibit No. 6 - Land Plat.

REFERENCES

a) Potash in Saskatchewan (1965).

b) Reference literature from Alberta Oil and Gas Conservation Board.

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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

Ottawa, June 8, 1946.

D. P. Goodall, Esq.,
Board Member,
The Petroleum and Natural Gas Conservation Board,
Province of Alberta,
514 Eleventh Ave., West,
Calgary, Alta.

Dear Sir:

Your letter of June 3rd addressed to Mr. L.H. Cole and accompanying sample of the salt core from Vermilion Consolidated Oils No. 15 well have been received. Mr. Cole is at present out of town and will not return until the first week in July.

We have examined the pink mineral in this core and find it to be a potash mineral. The core is now in the hands of our mineralogist for further study and we will advise you just as soon as we receive a further report.

Have you any core sections that contain appreciable quantities of this pink mineral? As you will note it is highly soluble and it would be advisable to carefully examine the cores for evidence of some soluble mineral having been dissolved therefrom by the drilling water. Any section of core that shows numerous solution cavities would be of interest. Some of the potash minerals are of the same colour as rock salt and they would be hard to detect. If you would care to forward us some sections of core containing many cavities we would be glad to examine them for you.

Yours truly,

M. F. Goudge,
Acting Chief,
Division of Mineral Resources.

MFG:VJ

EXHIBIT No 3

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Division of
Mineral Resources

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

Ottawa, June 22, 1946.

D. P. Goodall, Esq.,
Board Member,
The Petroleum and Natural Gas Conservation Board,
Province of Alberta,
514 Eleventh Ave., West,
Calgary, Alta.

Dear Sir:

I have just returned to Ottawa after a brief field trip and have a report from Dr. Poitevin, our mineralogist, on the potash mineral that we sent to him for examination. He reports it to be Carnallite, a mixture of potassium chloride and magnesium chloride. The mineral generally has the formula $KCL.MgCl + 6 H_2O$ and thus contains, when pure, 26.8 per cent potassium chloride, 34.2 per cent magnesium chloride and 39.0 per cent water.

This is a very interesting occurrence and the matter should be followed up in the hope of finding a potash-bearing horizon having economic possibilities. Have you other sections of core showing this mineral or containing many solution cavities?

Yours sincerely,

M. F. Goudge,
Acting Chief,
Division of Mineral Resources.

MFG:VJ

6-12-49-6W4

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XEROX COPY

PHONE M7941

THE PETROLEUM AND NATURAL GAS CONSERVATION BOARD

PROVINCE OF ALBERTA

TELEPHONE BUILDING,
CALGARY, ALBERTA

February 16th, 1945.

REPORT

Analysis of Salt Cores.

VERMILION CONSOLIDATED OILS WELL #15.

I have selected sixteen samples representing the salt section 3480' 9" - 3903' 4" (422') of V. C. O. #15 well, for chemical analysis. The samples were not taken at regular intervals but rather selected to represent sections of similar character. Following is a summary of each sample under the headings -

(1) Description of sample selected.
(2) Depth from which same was taken.
(3) Remarks regarding the section represented by the sample. The sample numbers are these used by Mr. Gilbart in his record.

Sample #8 - 45

Sample - 2" of reddish-brown stained salt of salt cored.
Depth - 3483' (Of Core #32)
Remarks: - Representative sample of section 3480' 9" - 3486'; section is for most part reddish-brown coloured with approximately one foot of relatively crystal clear salt containing splotches of pink mineral believed to be pink anhydrite

Sample #9 - 45

Sample - 2" of crystal clear, pink stained, throughout with splotches of pink mineral.
Depth - 3490' (Of Core #33)
Remarks: - Representative sample of section 3486 - 3493'; section is crystal clear, pink stained throughout with scattered splotches of pink mineral.

Sample #10 - 45

Sample - 2" of pinkish - brown coloured salt core with ¼" of maroon shale containing veinlets of pink, crystalline mineral.

Sample #10 - 45 (Continued)

Depth - 3502' - (Of Core #34)
Remarks: - Representative sample of section 3493 - 3511'; section is in general pinkish-brown containing much of pink mineral and appreciable amount of maroon and green intermixed and interbedded shale.

Sample #11 - 45

Sample - 1½" of crystal clear salt with slight pinkish stain throughout and one narrow (¼") grey band of impurities.
Depth - 3519 (Of Core #35)
Remarks: - Representative sample of section 3511' - 3521'; section is for most part crystal clear with slight pinkish stain throughout and few hroizontial, grey coloured bands.

Sample #12 - 45

Sample - 2" of crystal clear salt containing splotches of pink mineral.
Depth - 3522 (Of Core #36)
Remarks: - Representative sample of section 3521' - 3531'; section is for most part crystal clear salt containing scattered splotches of pink mineral and few grey coloured bands.

Section 3531' - 3541' (Core #37, Recovery 9' 9")

This section was not sampled for the present due to its alternating and gradational character - crystal clear - pinkish stained and grey coloured salt with few narrow partings of green shale. The proportion of above is approximately 50 - 50 and no practical sized sample was noted to be of this proportion.

Sample #13 - 45

Sample - 1½" of crystal clear salt with slight pinkish stain throughout.
Depth - 3543 (Of Core #38)
Remarks: - Representative sample of section 3541' - 3551'; section is relatively crystal clear with slight pinkish stain throughout with occasional splotches of pink mineral and few grey coloured bands.

Sample #14 - 45

Sample - 1 3/4" salt core consisting of 1½" of relatively crystal clear grading into ¼" of grey coloured less pure salt.
Depth - 3572 - (Of Core #41)
Remarks: - Representative sample of section 3551' - 3611'; section consists of alternating, clear pink stained and grey coloured salt which appears to be due to intermixed shale.

Sample #15 - 45

Sample - 1½" crystal clear salt with one, narrow , grey coloured band and trace of pink mineral.
Depth - 3618 (Of Core #45)
Remarks: - Representative sample of section 3611' - 3621'; section consists of 6" or less clear and grey coloured salt alternating.

Section 3621 - 3731 - Not cored.

Sample #16 - 45

Sample - 2" of clear salt with faint grey stain.
Depth - 3734 (Of Core #46)
Remarks: - Representative sample of section 3731' - 3761'; section is for most part slightly grey stained salt with few sections of crystal clear and dark grey coloured; occasional splotch of pink mineral.

Sample #17 - 45

Sample - 2" of slightly pinkish and grey stained salt core.
Depth - 3780 (Of Core #51)
Remarks: - Representative sample of section 3761' - 3781'; section consists of crystal clear salt with slight pinkish stain (contains more pink mineral than sample #16 - 45) and scattered sections of grey stained salt.

Sample #18 - 45

Sample - 2" of crystal clear salt with slightly grey stain throughtou and scattered spots of grey.
Depth - 3797 (Of Core #52)
Remarks: - Representative sample of section 3781' & 3806'; section is for most part crystal clear with slight grey stain throughout and scattered narrow bands dark grey in colour; small trace of pink mineral near top.

Sample #19 - 45

Sample - 2" of crystal clear salt with slight grey stain throughout and containing few, small irregular stringers of argillaceous dolomite.
Depth - 3825 - (Of Core #55)
Remarks: - Representative sample of section 3806' - 3831'; section is for most part crystal clear with slight grey stain and few sections fairly dark in colour; the depth 3806' marks the top of scattered partings and streaks of buff, dolomite. (See Core Repot, page 4, Core 53)

Sample #20 - 45

Sample -2" of crystal clear salt containing specks and spots of reddish-brown mineral and one irregular, horizontal, narrow streak of interbedded dolomite.
Depth - 3850' - (Of Core #58)
Remarks: - Representative sample of section 3831' - 3851'; section for most part clear with slight greyish stain becoming somewhat darker towards base.

Sample #21 - 45

Sample - 2" of crystal clear with slight greyish stain and few streaks of dolomite.
Depth - 3867 (Of Core 59)
Remarks: - Representative sample of section 3851' - 3871'; section for most part clear with slight greyish stain throughout and few darker coloured sections between 3851'-3861'.

Sample #22 - 45

Sample - 2" of clear salt with slight greyish stain throughout and few irregular stringers of dolomite.
Depth - 3887' (Of Core #61)
Remarks: - Representative sample of section 3871' - 3897'; section for most part clear with slight grey stain and numerous irregular streaks of dolomite.

Section - 3897' - 3901.5'.

The depth 3897' is the base of 4' 9" of salt core of #62. The remainder of Core #62 i.e. 3897' - 3901' is for most part dolomite with intermixed and interbedded salt, estimate of proportion being 4/5 dolomite and 1/5 salt. No sample was taken of this interval.

Sample #23 - 45

Sample - 2½" of clear salt with slight greyish colour.
Depth - 3902 (Of Core #63)
Remarks: - Representative sample of section 3901.5' - 3903.3' (1.8'); section is relatively clear salt with slight greyish colour throughout.

Section 3903.3' - 3906' (2' 7")

This section was not sampled due to its low percentage of salt in form of inclusions in dolomite and shale.

"D. G. Penner",

Geologist.

DGP/MFV.

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CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

Ottawa, May 29, 1946.

Dr. A.G. Bailey,
Deputy Chairman,
Petroleum Natural Gas Conservation Board,
Calgary, Alta.

Dear Sir:

Dr. Hume of the Geology and Topography Branch, Department of Mines and Resources, has shown me your letter to him and the results obtained on the chemical analyses of the salt samples from the Vermilion Consolidated Oils No. 15 well. I have read this with great interest. In it there is mention of a pink mineral which is believed to be pink anhydrite. I was wondering if it would be possible for you to furnish me with a small sample of one of the cores in which this mineral occurs, as I would like to examine the mineral in more detail. I would be pleased to give you any results we obtain from either spectrographic or other means of identification after we have examined it.

Yours very truly,

L. H. Cole,
Mining Engineer,
Industrial Minerals Section.

LHC:VJ

Bottom
Core #36
3521 - 3531
2 1/2"

EXHIBIT No 3

June 3rd, 1946.

0153

L.H. Cole, Esquire,
Mining Engineer,
Industrial Minerals Section,
Department of Mines and Resources,
OTTAWA, Ontario.

Dear Sir:

I have for acknowledgment your letter of May 29th and am replying in the absence of Mr. A.G. Bailey.

I am forwarding under separate cover a sample of the salt core from Vermilion Consolidated Oils #15 well. This core contains some of the pink mineral which appears to fill the solution cavities in the salt. Some sections of the core apparently have the pink mineral finely interspersed through the salt giving it a faint pinkish color. The sample I am sending, however, has considerable amount of the pink mineral which will give you a large sample for analysis. We would be very pleased to have a report from you on your analysis.

Yours very truly,

D.P. Goodall,
Board Member.

DPG/IGR

June 27th, 1946.

J.K. Swanson, Esquire,
Vermilion Consolidated Oils, Ltd.,
Vermilion, Alberta.

Dear Mr. Swanson: Re: V.C.O. #15.

The chief of Mineral Resources has recently made an analysis of the red mineral obtained in salt cores from the above well. I am enclosing herewith a copy of a letter from Mr. M.P. Goudge for your information.

Yours very truly,

D.P. Goodall,
Board Member.

DPG/IGR
Encl.

June 28th, 1946.

Director,
Bureau of Mines,
Austin, Texas,
U.S.A.

Dear Sir:

An extensive salt deposit has been drilled through at several points in the province of Alberta.

The salt occurs in almost continuous bed of about 400 feet in thickness. This deposit in two wells recently drilled at locations about approximately 60 miles apart have shown a striking similarity. The upper part of the bed contains a red salt enclosed in vugs and in some sections finely interspersed through the salt. The Chief of Mineral Resources at Ottawa, reports that this mineral is Carnallite (KCl.MgCl + 6 H2O).

I understand you have some production of potassium bearing salts in Texas and I would be very pleased if you could forward any pamphlets which you have for distribution describing the method of extraction of the potassium salts and the separation from the sodium chloride.

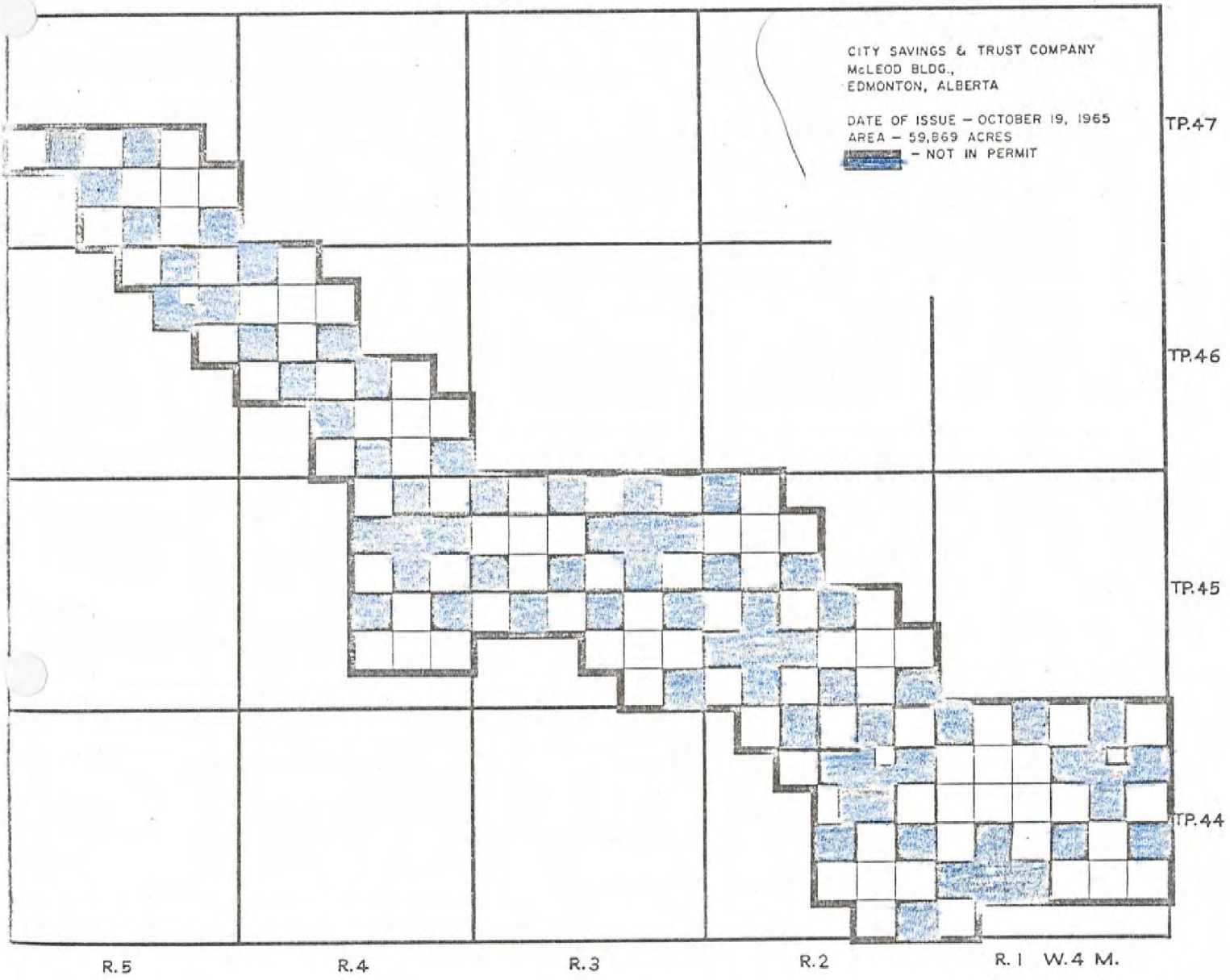
Yours very truly,

D.P.Goodall,
Board Member.

DPG/IGR

73D/15+16
73E/2

POTASH PROSPECTING PERMIT No. 4

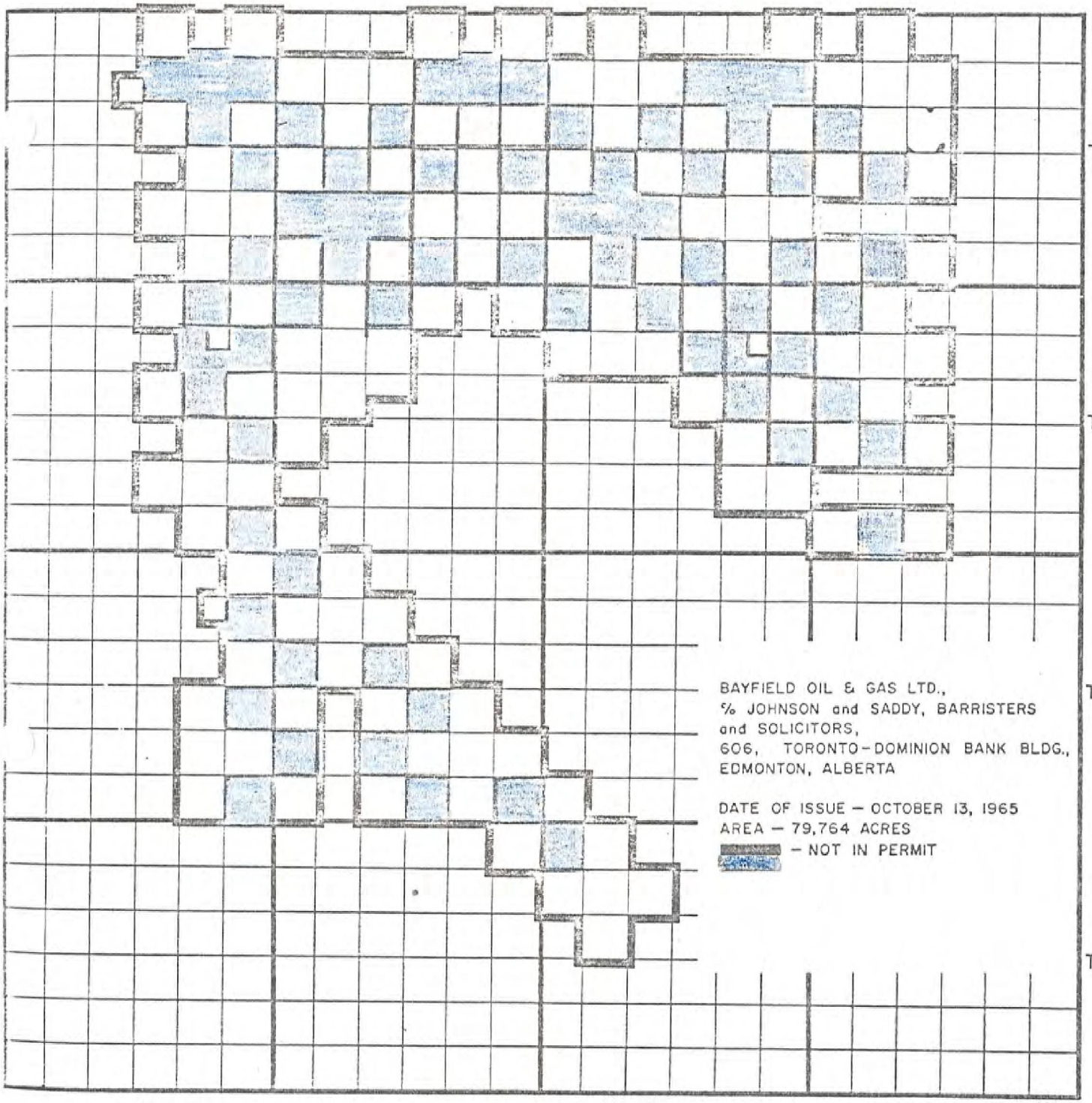


19650002

SCALE 0 1 2 3 MILES

POTASH PROSPECTING PERMIT No. 3

73E/247



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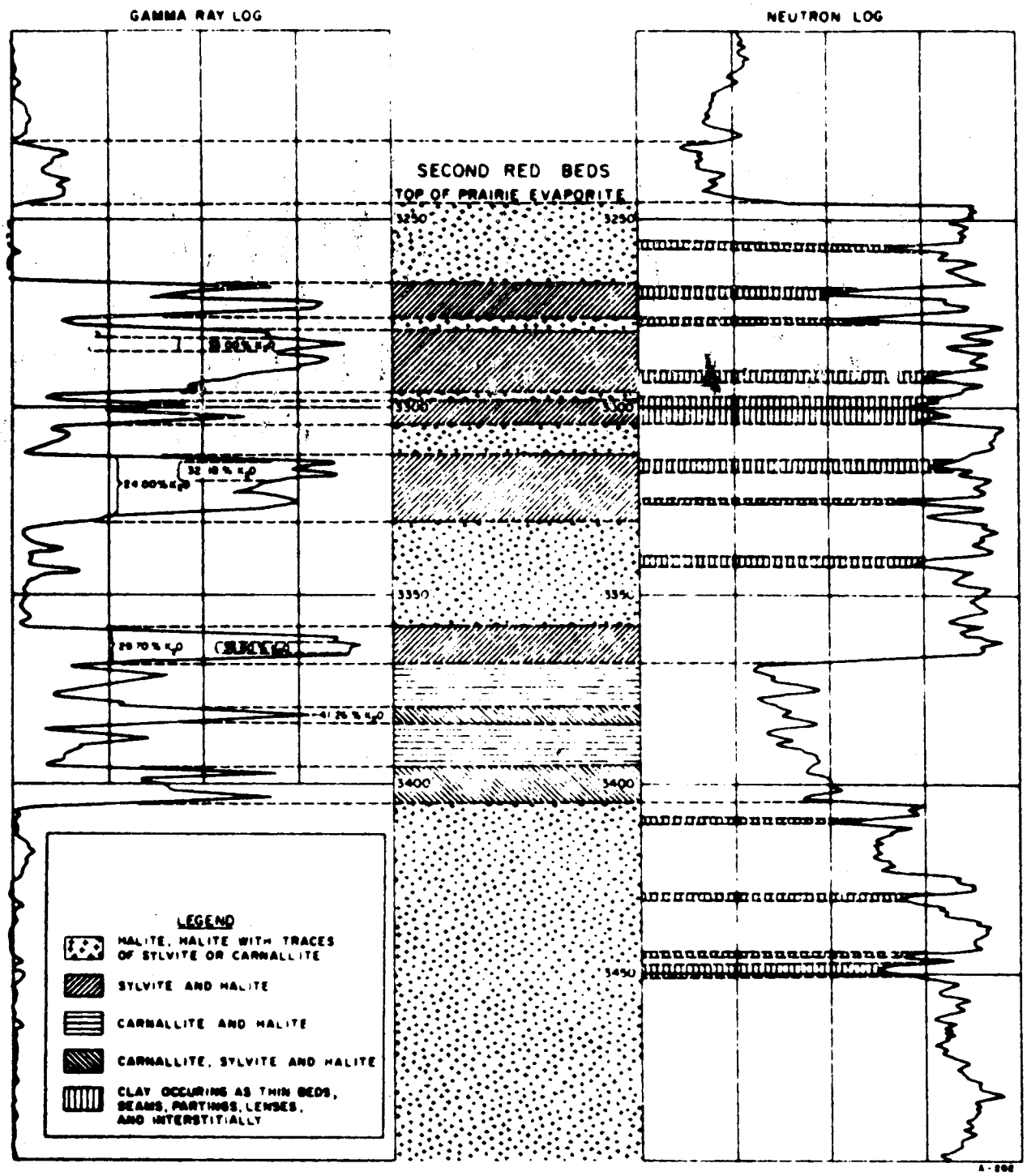

FIGURE

CORRELATION OF GAMMA RAY AND NEUTRON LOGS
WITH THE MINERALOGY AND LITHOLOGY OF THE UPPER PART OF THE PRAIRIE EVAPORITE
AND OVERLYING SECOND RED BEDS

EXHIBIT No. 5