HELIUM AND HYDROCARBON POSSIBILITIES,

LAKE MANITOBA AREA,

MANITOBA

BY

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INTRODUCTION

The object of the present study was to make a preliminary investigation of the possibilities of the presence of commercial accumulations of helium and hydrocarbons underlying lands held by Hemisphere Helium Corporation Ltd , N P L , in south-central Manitoba, particularly in the Lake Manitoba area, (Fig 1) The study was limited to a review of pertinent geological literature and examination of electric logs and drill stem test data from bore holes

GEOLOGICAL CONDITIONS FAVORABLE FOR HELIUM ACCUMULATION

As pointed out by Bateman (1960), Jodry and Henneman (1960) and Sawatzky, Agarwal and Wilson (1960), helium is one of the end products of disintegration of radioactive minerals and most helium deposits are believed to have been derived from this source Minor amounts of radioactive minerals occur in all shales and sandstones, but the most prolific source rocks for generation of helium are widespread granitic rocks which invariably contain a relatively high content of radioactive minerals Indeed, the geological occurrence of many of the known commercial helium deposits supports the concept of helium derivation from widespread granitic basement rocks For example, Rogers (1921) as quoted by Jodry and Henneman (1960) states "Helium in the Kansas - Oklahoma area is associated with a buried granite ridge which directly underlies the Pennsylvanian producing formations along the

western boundary of the helium producing area" In addition, Wheeler (1956) also quoted from Jodry and Henneman (1960) states "Usually the gas of higher helium content is found in fields that lie over buried granite ridges such as the deeply buried Amarillo Mountains of the Texas Panhandle and the Nemaha Ridge of Kansas, and in fields closely associated with igneous intrusions, such as the Rattlesnake field of San Juan county, New Mexico"

Helium occurs as a minor constituent of natural gas and the world's greatest known helium production (Texas and Oklahoma Panhandles of the United States) is recovered from natural gases produced as fuel Much of the processed gas contains 1 8 per cent helium, but recently discovered helium bearing gas accumulations including Pinta Dome in northwestern Arizona and Harley Dome, Grand County, Utah are reported to contain 7-8 per cent helium (Jodry and Henneman, 1960) In Alberta, helium has been reported from many natural gases, but the greatest known reserve is in the Medicine Hat field where the helium content is approximately 0 2 per cent

Helium also occurs associated with various non-combustible gases, particularly nitrogen and more rarely carbon dioxide For example, gas from the Devonian Dawson Bay formation at United Canso et al, Battle Creek 4-31 (4-31-3-26-W3) in southwestern Saskatchewan drilled in 1952, contains 95 16 per cent nitrogen, 0 47 per cent helium and 4 47 per cent other gases Gas from stratigraphically higher Devonian beds (Duperow formation) in the same well contains 81 7 per cent

carbon dioxide, 13 5 per cent nitrogen, 0 14 per cent helium and 5 66 per cent other gases Substantial gas blows were obtained on drill stem test from both of these horizons and the calculated open flow potential from the Duperow was 16 MMcf/day (Sawatzky, Agarwal and Wilson, 1960) More recently, helium bearing inert gas has been discovered in Cambrian beds (Deadwood formation) at B A Wilhelm (1-9-17-14-W3) and Texaco Wood Mountain (12-10-5-8-W3) also in southwestern Saskatchewan (Bateman, 1960)

Like hydrocarbons, the occurrence of commercial quantities of helium requires suitable source rocks, reservoir and trap The presently known helium occurrences in the Williston Basin are limited to southwestern Saskatchewan, but there is no reason to believe that the occurrence of helium will be limited to this part of the basin In fact, since Precambrian basement rocks consisting largely of granitic types underlie the entire Williston Basin, any untested traps, particularly those lying directly above the basement, should be considered to be potentially helium bearing

STRATIGRAPHY

Figure 2 shows various formations encountered in bore holes and in outcrop areas near Lake Manitoba The Palaeozoic section, comprising strata of Ordovician, Silurian and Devonian age, consists largely of carbonate rocks with relatively thin interbeds of shale Many excellent reservoir horizons occur within the carbonate sequence and it is

possible that local structural or stratigraphic conditions may be present for accumulation of hydrocarbons and/or helium However, the most prospective horizon for helium appears to be the Winnipeg formation The Winnipeg formation, which lies at the base of the Palaeozoic sequence consists largely of greenish shales with interbedded permeable quartz sands As pointed out by Andrichuk (1959) these sands are highly lenticular and offer possibilities of stratigraphic traps Of particular interest for helium possibilities is the basal sand which is 25 to 35 feet thick at Gridoil Minnedosa 2-21 and B A Bernie 16-11 (Fig 2) This basal sand appears to pinch out by onlap to the east as the basal sand in the outcrop area is interpreted by Andrichuk (1959) to be younger than that in subsurface sections The actual presence and position of this interpreted pinchout can only be determined by further stratigraphic drilling Furthermore, the Lundar diamond drill hole, which would have provided valuable information on this problem, did not penetrate the lower part of the Winnipeg formation (Fig 2)

Besides the basal sand, possibilities exist in lenticular sands that occur in the middle and upper parts of the Winnipeg formation For example, two sands, 5 and 11 feet thick in the central part of the Winnipeg formation at Gridoil Minnedosa 2-21 are not present at B A Bernie 16-11 (Fig 2) Similar lenticularity has been noted in other areas and is considered important as a possible trapping mechanism

In the western portion of the area of study, thin sands within the Jurassic shale section are considered to have hydrocarbon possi-

bilities Correlation of electric logs suggests that some of these sands are lenticular and it is possible that traps are present in this section despite the shallow depth

STRUCTURE

As shown by a contour map published by Andrichuk (1959) the strike and dip of the Precambrian basement surface in the Lake Manitoba area is approximately north 30 degrees west and 20 feet per mile to the southwest respectively Because of the sparse well control, very little irregularity is noticed on the subsurface contours, but as pointed out by Baillie (1952) the erosional Precambrian surface which underlies the Winnipeg formation in the outcrop area exhibits considerable topographic relief Such relief, although not in the true sense structural, may have an important bearing on the distribution of the basal Winnipeg sand

FLUID CONTENT OF WINNIPEG SANDS

As shown by drill stem test data plotted on Figure 1, very few basement wells have been drilled within the reservation areas and in most of these no drill stem tests were taken An examination of electric logs suggests that the sands at the localities tested are largely salt water bearing However, resistive streaks coinciding with some of the thinner sands, and in one or two of the wells in the upper few feet of thicker sands, suggests the possibility of untested gas or oil shows

Some of these resistive streaks are probably due to calcite cement within the sand, but further microscopic study is required to evaluate these possibilities

CONCLUSIONS AND RECOMMENDATIONS

Good possibilities for the occurrence of helium and/or hydrocarbon accumulations appear to be present in the reservation areas, particularly in the Winnipeg formation In view of the shallow depths to the objective horizons, it is believed that the most effective and economical method of exploration is to drill a series of stratigraphic tests to the Precambrian basement Such a program should be carefully supervised in order to test all prospective reservoir units

It is also recommended that microscopic study of samples and cores be undertaken of the entire Palaeozoic section in the area of interest The main purpose of this work would be to determine possibilities of facies changes which might be important as a trapping mechanism Such a study should include both presently drilled wells and tests drilled during the course of the stratigraphic testing program

Respectfully submitted,

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