

GEOLOGICAL PROGRESS REPORT
D. TODD BRIGGS PROJECT, N.W.T.
AS OF JUNE 30, 1955

Evaluation of Structure Test Results in
Relation to Geophysical and Deep Drilling Results

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GEOLOGICAL & EXPLORATION CONSULTANTS

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Numbers not with Report

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INTRODUCTION

The present report presents a summary evaluation of the exploration work done to date on the D. Todd Briggs project, N.W.T. This work has been carried out in three stages.

The first stage included work done prior to acquisition of the project acreage by the D. Todd Briggs group. During that time an aeromagnetic survey was carried out by Gravimeter Exploration Company, of Houston, Texas.

The second stage of the operation was carried out during the past summer field season when a surface geological exploration of the entire holdings was carried out by J. C. Sproule & Associates. The report on this work was entitled "Geological Report, D. Todd Briggs Project, N.W.T." and was dated March 4th, 1955. The area involved included the Hay River-Trout Lake holdings under present review, as well as the Liard River holdings, which are not referred to in this report.

The third stage was entered into during the past winter, when a two-fold seismic operation and a structure test program were carried out, supplemented by the drilling of two deep test holes, Briggs Rabbit Lake No. 1 and No. 2 wells, drilled near the top and on the flank, respectively, of a structure known as the Rabbit Lake structure, delineated by surface geological work. The two-fold seismic program consisted of a conventional reflection survey by Seismograph Service Corporation and a High Resolution seismic survey over a restricted portion of the area, by Geophysical Services Inc. The S.S.C. work was conducted as blanket coverage over as much of the southwestern and southern portion of the area as could be covered. The area was selected in part because it had no usable rock outcrops and could, therefore, not be satisfactorily evaluated by any other means and in part because of the existence of considerable limestone at or near the surface in the northern and northeastern portions of the area, which it was suspected would have interfered with the seismic records. The G.S. I. party worked on and around structures that were known only from the surface data from limestone outcrop information. This work was done largely on an experimental basis in order to evaluate a tool that, it was hoped, might refine

the structure in areas of limestone outcrop that it was believed could not be satisfactorily evaluated by the conventional seismic method, and which should be evaluated by the structure drill only as a last resort, because of the high cost of obtaining equivalent station density by Structure Test drilling and the limited depth control.

The Structure Test program was designed to test surface geological structures that were revealed during the past season's surface geological survey and to provide information on facies changes in the Upper Hay River group, with particular reference to reefoid and related facies. During the course of the G.S.I. seismic experimental work the Structure Test data also turned out to be of use in checking such results.

The details of the physical operation of the Structure Test program have been incorporated in a separate memorandum prepared by the geologist-in-charge, D. L. Campbell. This memorandum is attached hereto as Appendix I. A summary of structure test lithologic results has been presented in another memorandum prepared by D. L. Campbell and G. K. Williams. Mr. Williams was the wellsite geologist for the Briggs Rabbit Lake wells, and senior geologist in local charge of the geological aspects of the D. Todd Briggs winter operation in the Northwest Territories, conducted under the general supervision of White and Lloyd, Operators, of Dallas, Texas. This structure test memorandum is supplemented by two structure test cross-sections (Figures IV and V) and by a composite section of the stratigraphic intervals penetrated collectively by the structure tests drilled during the 1955 Structure Test program.

Our summary evaluation of the different sources of Exploration data referred to above is illustrated by regional structure isopach maps, based on deep drill holes in the general area (Figures I to III), by two maps showing the seismic results in relation to the photogeological features (Figures VII and VIII), by four maps showing aeromagnetic data in relation to surface geological, structure test and indicated photogeological trends (Figures IX to XII) and by a cross-section between the Rabbit Lake No. 1 and No. 2 wells, showing certain significant changes in facies between the two wells at and near the horizon of the principal zone of interest (Figure XIII).

A discussion of the data now available to us, with particular reference to the probable relationship between geophysical and geological results, is presented below, followed by our conclusions and recommendations.

REGIONAL SUBSURFACE AND PHOTOGEOLOGICAL DATA

A regional subsurface map of the Territories formation was presented as Figure VIII, of our report on the D. Todd Briggs project, dated March 4, 1955. This map is herein revised from information obtained in the drilling of the Briggs Rabbit Lake Nos. 1 and 2 wells and Imperial Island River No. 1 well to the south of Trout Lake (just outside the map area). A contour map covering the same area, referred to the top of the Precambrian, comprises Figure II; whereas an isopach of the interval between the Territories formation and the top of the Precambrian forms Figure III.

Interpretation and Results

The results of all structure tests are good with overall correlation beyond doubt in all tests.

It is of particular interest that, when we study three of these upper horizons in the Structure Test section, Markers E to D, Markers D to F and Markers F to B, they all show a thickening from east to west. As between Test Holes Nos. 1 and 30 the interval from E to D thickens 50 feet in about 28 miles, D to F thickens 35 feet, whereas F to B thickens about 20 to 25 feet in the same distance, although we do not have full control for this last figure, as the test holes toward the west did not penetrate the F to B section. Although the interval between F and B increases from east to west it is significant that reefoid development decreases.

Structures in the area previously mentioned in our Geological Report of February, 1955, have been verified by the present Structure Test program. The Rabbit Lake structure is closed to the north, as confirmed by Structure Test No. 21, indicating an approximate minimum of 282 feet of closure to the north.

The suggested fault adjoining the Rabbit Lake structure to the east, while still not proven, is further substantiated by Structure Test No. 5 indicating Marker "M" to be 328 feet below the same marker in Briggs Rabbit Lake No. 1.

The area immediately to the east of the Rabbit Lake structure is synclinal. The Foetus Lake structure lies to the east of this sharp syncline. The Foetus Lake structure is higher and appears to be several times larger than the Rabbit Lake structure with indicated closure to the north and east.

The Two Island Lake and Kakisa Lake structures are not proven as to closure. Further confirmation on this could be obtained by the drilling of additional structure tests.

A chart showing the significant structure test horizon markers and their depths and elevations accompanies this memorandum.

G. K. Williams
G.K. Williams,
Senior Geologist. *W*

D. L. Campbell
D.L. Campbell,
Geologist-in-charge of
Structure Drill Operation *DS*

(c) Second Vertical Derivative Map (See Figure XI)

So far as we can see, the second vertical derivative map shows all the features exhibited by the observed data map, except that such anomalies are accentuated and considerably refined. Many of these refinements have all the ear-marks of being surface glacial features, which would appear to be strongly indicative of the possibility that many at least of the anomalies concerned are glacial. We believe that this is definitely so in some cases, whereas in other cases it is structure that (also) shows and in still other cases basement magnetic variations.

(d) Residual Magnetic Anomaly Map (See Figure XII)

There is nothing about this map that is particularly different from the observed map, except that in the process of removing the regional the individual anomalies stand out "differently" rather than "better." The remarks made previously regarding the observed data map in general apply here also.

DEEP DRILLING RESULTS, BRIGGS RABBIT LAKE NOS. 1 AND 2 WELLS

The detailed results from the drilling of Briggs Rabbit Lake Nos. 1 and 2 wells have been discussed in the two well-site reports previously submitted, and general comments relative to their regional and local stratigraphic and structural significance made above, under the heading of Regional Subsurface Results, etc. No further comments should be called for here other than to point out the significance of the rapid lateral changes in lithology between the original Rabbit Lake well, drilled on the structural high, and the second well, drilled down flank. For example, the Presqu'ile formation on the structure in the No. 1 well is well developed and reefoid, whereas the Presqu'ile in the No. 2 well, on the flank, is considerably thinner. By contrast the Territories Detrital limestone zone in the off-flank No. 2 well is much better developed than in the No. 1 well where it was shaly with large blocks of limestone, indicating the probable close proximity to nearby higher structural reefoid conditions.

The rapid lateral change in lithology as between these two deep tests, combined with what is otherwise known about the structures in the area and also with our knowledge of the shows of oil in both wells and the presence of indicated commercial gas in the No. 1 well, speaks well for the future of the area.

CONCLUSIONS AND RECOMMENDATIONS

In summary of the significance of the data presented by the various exploration methods applied to the D. Todd Briggs N.W.T. project to date, the main conclusions we would draw are as follows:

1. The area of principal present interest is a broad, structurally high platform occupying the northeastern portion of the map-area. It appears to

strike in an easterly to southeasterly direction and may extend all the way from Pine Point, on the south shore of Great Slave Lake, through the northeastern part of the map-area. The basis for identification of this area is both Regional Subsurface data and local Surface Geological and Structure Test data.

2. The platform referred to above appears to be one in which biostromal and biohermal reefoid and related conditions conducive to the propagation and reservoiring of petroleum and natural gas are favourable.

3. Structurally this same area appears to be an area of high incidence of small structures that bear local reefoid features.

4. Immediately to the west of the above platform area the reefoid limestone facies in the Upper Hay River group are replaced by sandy facies. An outstanding example of this is an occurrence of reefoid ledges at Jean Marie Lake, grading to sand off-reef on the outcrop. Such off-reef sand conditions are promising for the future of any structural traps that may be involved in the area. The extent to which off-reef sand conditions exist to the south of the above reefoid platform is not known at this time, but it is believed that such conditions do exist there. Evidence of the facies changes on, and on the flanks of these features, such as the Rabbit Lake and Foetus Lake structures, is provided by Surface Geological, Structure Test and the results from Rabbit Lake Nos. 1 and 2 wells.

5. Several of the smaller structures referred to as being present on the above platform, identified on surface outcrop, were checked satisfactorily by Structure Test work during the past winter operation. Additional similar features could become further known and refined by additional Structure Test work.

6. A series of structural trends in the area that must be given an important place in our thinking are the several strong northeast-southwest trending fault features, such as the Trout Lake, Redknife and Rabbit Lake-Providence faults. The fact that they parallel the well-known Pine Point fault, a Precambrian basement feature that bears an important relationship to reef conditions along the southeast shore of Great Slave Lake, forces us to regard them as of potential importance. They could reflect important deep-seated structural features without showing much in the way of structural displacement at the surface. A possible fault, or pair of faults, belonging to this series, occurs between the Heart Lake and Kakisa Lake areas. This fault (or faults) is currently being evaluated by a geological party working in the field. The problem is to determine whether the Heart Lake reef horizon of the Heart Lake area is faulted up to become the Kakisa reef horizon of the Kakisa Lake area, as is indicated by one of two regional subsurface correlations made (See our letter and cross-section re: Stratigraphic Correlation N.W.T. Providence No. 2, Rabbit-Desmarais-Heart-Escarpment Lake Wells, dated April 28, 1955).

7. The value of the aeromagnetic work conducted in this area is conjectural at this time. It is believed that most of the magnetic features recorded are either glacial or basement and in either case are probably only related to structure in a second-hand fashion.

8. The Reflection Seismic survey has not identified any structures that can be recommended for drilling, but it has outlined two areas for future attention, inasmuch as they appear to be connected to known geological structures and are favourably located from the standpoint of Devonian reef and off-reef facies.

9. The High Resolution Seismic survey results that we have seen are as yet of doubtful value. The use of this tool in future evaluation of the area should depend upon the results obtained from the current G.S.I. seismic program in the Kakisa Lake area.

10. The presence of indicated commercial gas in the Rabbit Lake No. 1 well (over 17 million cubic feet open flow potential) and the presence of numerous oil shows in both the Rabbit Lake wells, combined with the regional and local Devonian structural and facies conditions, indicates a high promise for the future of the Petroleum and Natural gas prospects of the area.

Our recommendations for further work in the project area, based on results obtained to date, are as follows:

1. Complete the current G.S.I. seismic experimental work. If it proves satisfactory the method could be given wide use in the area. If the current experimental work is not satisfactory the method should be discarded forthwith.

2. Complete the current surface geological program planned. It may be possible to cut this work short if the problem as described above can be solved before the full program is carried out.

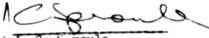
3. Further reflection seismic work to be carried out next winter should be confined to the several areas of indicated present interest. Two of these are the two areas partly covered by seismic work last year, as shown on Figure VII and as described under "Seismic Results" above, and two others along the Trout Lake fault and along the Redknife fault. The extent to which Reflection Seismic work is done along the Rabbit Lake-Kakisa platform trend should depend upon the adaptability of the method to obtain good records in that area.

4. Further structure test work should be done next winter only if the reflection seismic or High Resolution seismic work cannot be depended upon for reliable records. If they cannot be relied upon it is recommended that two Structure Test crews be put in the area for the full winter season.

5. In consideration of the possible long-range nature of the project and the possible limitation on available funds, it is believed that, as drillable structures are already available and more satisfactory drill-sites (Foetus Lake structure, etc.) can be made with little further effort, the bulk of future

expenditure should be made in the area of principal interest, the northern and northeastern portion of the map-area.

6. It is further recommended that, in view of the above, the bulk of the future expenditure should be made in the drilling of deep wells, which is the only way in which the several known and partly known structures can be evaluated.


J. C. Sproule,
P. Eng., Alberta.

901 - 8th Ave. West,
Calgary, Alberta,
July 7, 1955.

MEMORANDUM RE: OPERATION OF STRUCTURE TEST PROGRAM,
D. TODD BRIGGS PROJECT, N.W.T.

Equipment

The contract for road building for the program was given to Grue and Rosdal of Edmonton, Alberta, who subcontracted to Linton Construction, Hay River. One D-7 Caterpillar and one D-6 Caterpillar tractor were used for the making of roads and clearing locations.

The drilling and logging of all structure test holes was contracted to Brett Exploration of Calgary. Two Failing 1500 slim hole rigs were used. All tests were electro-logged with a Schlumberger correlation logger under rental to Brett Exploration. One D-4 Caterpillar was supplied to the drilling contractor for general use and emergencies.

Operation

Brett Exploration left Manning the morning of January 10 and spudded their first two holes on January 13.

Twenty tests were drilled during the season.

On March 3 the D-6 bulldozer became unserviceable and was taken into Hay River shortly after breakdown. On March 13 the one remaining bulldozer, making road into Structure Test No. 13, became unserviceable. Structure Test No. 12 was logged the same day and for want of location Rig #1 was set up on Structure Test No. 32. This location was a widening of the road, approximately 4 miles south of Structure Test No. 9. It was impossible to hold water in the top hole and water pits. The rig was skidded with the same results. The estimated time to get the caterpillar serviceable was seven days and the time to make road into Structure Test No. 13 another five days. Rather than have the rig waiting on location and, as no further location had been approved, this rig was moved out of the area on March 16 to Calgary.

On March 15 word was received to drill Structure Tests Numbers 33 and 34. G.S.I.'s D-7 caterpillar, with the help of the D-4 attached to Brett Exploration, were used to bulldoze locations for Test Numbers 33 and 34. Rig #2 was used to drill them and had to wait on location for both holes.

On March 18 Mr. A. M. Lloyd stated that Brett Exploration would be released with the completion of Test Numbers 33 and 34. He said he felt any additional holes would be too expensive and that G.S.I. could add any additional information needed. Structure Test Number 34 was logged on March 20 and Brett Exploration began moving out the camp the following day.

Drilling was slow and great care had to be taken when surface cover above bedrock was encountered. As the drilling was mainly in limestone, cuttings

and surface cavings were liable to lodge above bit, resulting in greater danger of being stuck in the hole. This happened with Structure Tests Numbers 2 and 3. Rigs were skidded in each case and casing was set for Structure Test Number 2. Loss of circulation in muskeg and surface gravels also proved a problem in Structure Tests Numbers 4 and 6. Rigs were skidded and surface casing set. A total of 446 feet of hole was lost in the skidding of rigs.

The following table gives the drilling footages and average footage per rig-day for each week. The low average of 90 feet per rig-day represents a period when both rigs were stuck in the hole and skidded locations. The high average footage is 125 feet per rig-day. The overall average for the season is 107 feet per rig-day.

Weekly Drilling Progress:

<u>Date</u>	<u>Drilled Footage</u>	<u>Aver. Footage / rig-day</u>	<u>Footage lost by skidding locations</u>
Jan. 13 - 22	2240	112	160
Jan. 23 - 29	1436	103	106
Jan. 30 - Feb. 5	1215	90	180
Feb. 6 - 12	1527	109	
Feb. 12 - 19	1558	111	
Feb. 20 - 26	1745	125	
Feb. 29 - March 5	1518	108	
March 6 - 12	1575	113	
March 13 - 20	1122	102	
Total -	<u>13,936</u>		<u>446</u>

Total Footage logged - 13,501

Progress of the program would have been speeded up considerably and more holes drilled if the operation had had any luck in making of roads and clearing locations. For much of the season one bulldozer was usually unserviceable and quite often both. Often rigs were kept drilling beyond depths otherwise necessary until other locations were cleared by the bulldozer. Such was the case with Structure Tests Nos. 8, 9, 12, 27 and 30, which were drilled 133 feet, 164 feet, 100 feet, 250 feet and 90 feet, respectively, deeper while awaiting the clearing of locations.

Road building in general was not too difficult. Jack pine and poplar-forested land made good road beds, while muskeg slowed up progress and a poor road was the result. The personnel operating the bulldozers estimated that five miles of good road could be built through pine and poplar in the same amount of time it would take to make two miles of passable road over muskeg. With this in mind, the main access road was put behind schedule by the "short-cuts" made through muskeg.

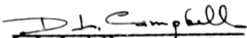
The D-7 tractor was of sufficient size for the task. The D-6 tractor also did the job, but it was too light. Two D-7 tractors or their equivalent

would meet the need in any program such as this. Considering the large amount of breakdown time of the D-7 and D-6 it was fortunate that a D-4 tractor was attached to Brett Exploration, as it did considerable work making and improving roads.

A suggestion that might result in a smoother operation would be to have the "bulldozers" directly subject to the drilling contractors involved. Such was the case with G.S.I. and S.S.C. This would eliminate any friction about the condition of the roads for travel. When "bulldozers" are not responsible to the drilling operation a proper effort is not always made to make roads suitable for travel. Brett Exploration should be commended for putting their equipment over some roads which caused them needless wear and tear on drills, water and shift trucks.

It is of utmost importance in an operation such as this to take utmost care in making certain that all equipment going into the field is in good shape, as distances for repairs causes excessive delay to the progress of such a program.

Brett Exploration had a relatively small amount of breakdown time. Good equipment, camp and food, with an excellent crew ready to co-operate to their best advantage at all times, added much to the success of their program.


D. L. Campbell
Geologist-in-charge of
Structure Drill Operation