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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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 Gravitymeter 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.

In the preparation of the above three maps we have not only taken into consideration wells drilled within the area, but also several drilled outside the area, where it was necessary to get outside control for a reasonable presentation within the map-area. For example, the structure control in the northeastern extremity of the map-area was taken from Imperial Windy Point No. 1 well and other wells in the area. Imperial Windy Point No. 1 is the only one in that area that penetrated the Precambrian and it was possible, by using this well in conjunction with others in the area to obtain reasonable control for use within the map-area. We also used data on other wells, immediately outside the southeastern corner and beyond the southern boundary of the map-area; more specifically, Imperial Yates No. 1, Imperial Rat Lake No. 1 and Imperial Bitscho Lake No. 1 wells.

With reference to the above regional map, there are possibly two features that are, at this time, worth particular mention. One of them has to do with the contour map on the top of the Territories formation, which shows a very strong regional nosing in the vicinity of the Briggs Rabbit Lake and Foetus Lake structures, and the strong contour widening in the immediate vicinity of and to the west of Kakisa Lake. This, of course, is only our interpretation of the structure on the top of the Territories formation, but we believe that it is a reasonable one, when we consider the information that has been provided by the surface work and structure test results.

The second feature of principal interest has to do with the isopach of the interval between the Territories formation and the top of the Precambrian (Figure III). Here again we have taken a certain amount of license by using the geological information available on and around the surface geological and structure test high, and information obtained in the drilling of the Briggs Rabbit Lake wells, and have come up with an interpretation that highlights an area extending from the Pine Point area, south of the west end of Great Slave Lake, through the Heart Lake area to the west of the Rabbit Lake structure. This terrace shows to best advantage on Figure III, in the Kakisa-Rabbit Lake area, and shows best regionally by a widening of the contours on Figure II.

Our views on the significance of this terrace have been expressed previously in correspondence, verbally, and in our geological report on the D. Todd Briggs project of March, 1955. Very briefly, it is our opinion that this terrace is of paramount importance from the standpoint of both the sourcing and reservoiring of petroleum and natural gas. It appears to be an area of widespread biostrom reefs with biohermal conditions developed on and around local highs. The nature of this terrace and its position with respect to sea-level was such that it was an area of high lime concentration and an area of very prolific marine life. Such marine life is probably responsible for the high incidence of oil and gas shows in this area. The suitable porosity and permeability conditions in the reefoid and related lime rocks render this a high priority area from the standpoint of potential oil and gas accumulations.

Whether or not the limestone and reef condition continues northward and northwestward across the Mackenzie River is conjectural, but we strongly suspect that such is the case. If so, it would explain why west of the Rabbit

Lake structure we gradually run into a sandy facies that becomes still more sandy farther west to the Nahanni Mountain area, where lime facies are again encountered.

The above situation can readily be reconciled with an interpretation that could allow a correlation with the Woodbend and related Devonian type reef trend of central Alberta. This reef trend is known to pass northward past the east end of Lesser Slave Lake, and is known still farther north. It is believed to pass west of Lake Athabasca to the Pine Point area. From there it swings northwest to the present map-area. From here it is believed that this reefal trend extends northward and northwestward, possibly down to the Lower Mackenzie area. This reefoid trend then probably turns southward along the west flank of the old Devonian basin. Such an interpretation fits very closely with the regional facts as we know them.

The above interpretation of a lime facies terrace on a structurally high platform, shaling out to the south and southwest, with consequent loss of lime content, fits in very well with the facts whereby in the Imperial Island River well and other deep tests to the southwest of the map-area the limestone and reefoid facies of the Territories-Pine Point, etc., group have been replaced by shale. This same condition exists also on and around the Kakisa Lake reef, exposed at the surface, as witness the reefal development on the tops of the structural features with consequent shaling out and sanding out of the off-reef facies, particularly to the west and south. (See Appendix II).

STRUCTURE TEST RESULTS

The stratigraphic and lithologic aspects of the Structure Test results are reported on in the accompanying Appendices I and II. In general, it may be said that the results confirmed the surface geological features found during the surface geological program carried out last summer. The Structure Tests also refined such surface geological features satisfactorily at all points drilled.

The Structure Test results are presented in a structure test map comprising Figure XIV, and these results are further illustrated in two cross-sections, Figures IV and V, as well as in a composite stratigraphic section, Figure VI, prepared from the data obtained from Test Holes Nos. 2 and 20.

In our opinion, the Structure Test results have confirmed our high regard for the value of any small local structural changes that can be recognized along the limestone "bank" all the way from the vicinity of the Briggs Rabbit Lake structure to at least the southeastern margin of Great Slave Lake, through the Heart Lake and Escarpment Lake areas and possibly also northward from the Rabbit Lake area. As a result, we believe that additional work done by the D. Todd Briggs group in the Northwest Territories should give almost exclusive attention to this trend, with the exceptions that are noted throughout the text of this report and in the Conclusions and Recommendations.

SEISMIC RESULTS

For comparison of the Reflection Seismic with the Geological picture, we have selected only one of the reflection horizons used, the tentative top of the Precambrian. That horizon has been used as being probably the most revealing in an evaluation of our problem. The "Tentative Precambrian" top was not identifiable on records for the western part of the area, in view of which, as will be observed by reference to Figure VII, the contours on a Devonian horizon were substituted. We have added to this an isochron (Figure VIII) of the interval between a Devonian horizon and the Precambrian.

Our comments on the general S.S.C. seismic results, in relation to known and suspected geological features, are as presented below, by reference to the reflection contour map selected and an isochron representing the interval between the tentative top of the Territories formation and the Precambrian. Thus:

(a) Seismic Map, Contours on Tentative Basement (See Figure VII)

No strong closed features have been revealed by the last winter's seismograph program. In our opinion, the most significant feature of interest is the long southwest-trending nose that passes through Latitude 60° 30' and Longitude 119° 30'. This seismic nose appears to be on the southwest extension of the Rabbit Lake (Providence) fault. This southwest extension of the Rabbit Lake fault shows very well on air photographs which fact, in our opinion, gives strong evidence that the seismic feature as shown is actually a structure. The isochron Figure VIII shows thinning over the feature, which adds to its value. In the same area on the photographs we see evidence of a fault that trends north 10 degrees east. It is along this line that it was found that the seismograph interpretation necessitated that a dividing line be drawn between variable drift velocities.

The strong seismic nose passing northwest-southeast through about Latitude 60° 40' and Longitude 120° 15' does not appear to show on the photogeological map, although this is such a strongly glaciated area that it may have covered photogeological features that would otherwise show through. In this area there are obviously several periods of glaciation and it appears likely that earlier periods of glaciation were responsible for excessive glacial gouging and dumping that may have obscured either or both the photogeological and the seismic picture.

Another seismic nose with a small closure near Latitude 60° 50' and Longitude 120° 30' is on the line of the southwestern extension of the Trout River fault as indicated on the photographs, and there may be a connection between the two. The isochron shows thinning over the top of this feature also.

(b) High Resolution Seismic Results by G.S.I.

The final results of the G.S.I. Program in the Rabbit Lake and Heart Lake areas have not been made available to us, in view of which we cannot comment on them here, other than to say that the preliminary results observed by us were inconclusive as to ultimate value. Experimental work is continuing in the Kakisa Lake area during the current summer season and the results of that should decide the fate of the High Resolution method as an exploration tool in this area.

AEROMAGNETIC RESULTS

(a) Observed Magnetic Map (See Figure IX)

In general, the observed magnetic anomalies appear to reflect basement features and glacial features. It conforms closely to the pattern of the glacial terminal moraines with a few exceptions, some of which may be due to structural features and others to basement features. Some of the anomalies do appear to have a close relationship to known structural features. In these cases it may be a question of a direct relationship, and on the other hand it may be the result of a secondary relationship that comes as a result of the structural control of deposition of glacial debris.

One of the best possible examples of the above is the Rabbit Lake fault which passes immediately to the southeast of the Rabbit Lake structure and continues for some distance to the southwest of it. This structural feature has been strongly gouged on the down-thrown side by glaciation. It shows very well on both the structure test picture and the airborne magnetometer maps.

The Rabbit Lake high and other closely related anomalies are shown on the observed data map, but it is not clear to what extent they reflect structure. For example, the Structure Test results show the Rabbit Lake structure dropping off a short distance to the west of the well locations, whereas the airborne magnetometer picture shows a large high region that is not too closely related to the Rabbit Lake high as it is known to us. Furthermore, structure test results show a very strong re-entry of the Cretaceous over the western half of the magnetic feature. This re-entry fits the Structure Test map, but not the observed magnetic map.

The northwest-trending Kakisa River valley, where it crosses Longitude 119°, shows very well on the observed aeromagnetic map. This may be a glacial feature related to the terminal moraine, but on the other hand it may be structural. It is possible that it is both, but its relationship to other drainage features and glacial kettle systems in the vicinity would appear to make it likely due to glacial causes.

There are two reasonably strong features that show on the observed magnetic map and also appear to be reflected on the photogeological picture. One may be described as the "Jean Marie Northeast Fault Trend." This feature extends in a northeast-southwest direction in the vicinity of the headwaters of Jean Marie River. The true nature of this feature is confused to some extent as it is in the exact direction of the glacial striae which, of course, may have followed structure to some extent. In any event, this strong anomalous feature on the airborne magnetometer map does conform to an equally strong feature on the air photographs. The second Jean Marie area possible fault line extends in a southeasterly direction, the same direction as the general course of the Jean Marie River. Evidence that this feature is structural rather than glacial may be provided by the fact of the lineation of this feature with a lineation following the lower part of the Kakisa valley, referred to on Figure IX, etc., as the Kakisa Valley trend.

The Trout River fault trend appears to be a proven structural feature. It parallels the "Jean Marie Northeast Fault Trend" to the southeast of it. The lithologic situation that exists on the Trout River near the crossing of Longitude 120° 50', as described visually in our report of March, 1955 (See Figure VII), is very strong evidence that this trend is a structural feature. Evidence of its structural nature can also be observed by reference to Figure II of the same report, which shows a strong structural nose paralleling the Trout River at the stream bend.

The Redknife fault trend is another feature that parallels the Trout River fault, to the southeast of it. It also shows only faintly on the airborne magnetometer map. On the airphoto picture this trend parallels the Redknife River for some distance and passes off to the northeast where it is apparently related to a strong deflection in the Mackenzie River, in the vicinity of Mills Lake.

There is a strong magnetic anomaly north of Tathlina Lake at Latitude 60° 40' and Longitude 117° 45'. It may be reflected on the air photographs, although one would not suspect this structural feature from the air photos alone. Drainage passes around the anomaly and there are evidences of crustal fracture common to an area of high relief. We believe this feature should definitely be checked if it should fall within the D. Todd Briggs land holdings. This feature was recommended last year for Structure Test control, but as it lay outside the D. Todd Briggs holdings it was not checked.

The area of strong observed data anomalies in the vicinity of and to the west of Kakisa Lake could be structural, but in our opinion is almost certainly due to the influence of the surface and near-surface limestone masses. In general, these anomalies conform to the outcropping limestone surface. On the other hand, the projection of the prominent anomaly west of Kakisa Lake to the southeast passes through the very strong feature referred to in the previous paragraph. Reefoid limestones of the type with which we are concerned and presently unknown basement features could both be reflected by this trend.

(b) Contour Map Projected Basement Surface (See Figure X)

The exact meaning of this map is not clear at this time, although it does seem to be of some significance that the general area of our strong terracing on which the Rabbit Lake, etc., structures are located, are also on an indicated irregular basement platform. Whether this is of real basement structure significance we do not know. It could be. With reference, for example, to the vicinity of the Rabbit Lake structure, that feature is located on a regional basement terrace, according to the magnetic data. There is a low area to the north and considerably lower low to the southeast of the Rabbit Lake fault. The large indicated low area between the Rabbit Lake Fault and Kakisa Lake does make sense, as does the drop-off to the southeast and south of the general Kakisa-Rabbit Lake area.

(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 bulldose 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:

Date	Drilled Footage	Aver. Footage / rig-day	Footage lost by skidding locations
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. 28 - March 5	1518	108	
March 6 - 12	1575	113	
March 13 - 20	1122	102	
Total -	13,936		446

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 C.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

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

MEMORANDUM RE: LITHOLOGY ENCOUNTERED IN STRUCTURE TEST HOLES

Pleistocene and Recent

The mantle of unconsolidated material above bedrock in the area is very thin; from 0 to 25 or 30 feet is the average. This covering material appears to be of glacial origin, composed of locally derived limestone and sandstone boulders, with a few igneous rocks, in a brown clay matrix. Some of the wells, however, encountered fine gravel which is probably of stream deposition.

Cretaceous

Some of the wells drilled in the southwest part of the area encountered a dark grey, soft, fissile shale which is believed to be Cretaceous. It overlies the eroded surface of the Devonian unconformably.

Devonian

The highest section of the Devonian penetrated in the southwesterly structure tests consists of light grey, fine to crypto-crystalline, for the most part clean limestone. From the nature of the electric logs, which can be correlated point for point over long distances with little change in character or thickness, this section appears to have thin, regular bedding. This limestone member becomes slightly silty and sandy about 100 to 150 feet above Marker D; the clastic content increases downward and the limestone grades into a calcareous sandstone in most wells, which immediately overlies the uppermost reef. The thickness of this sand varies between 10 and 40 feet.

By comparison with the Devonian section in Alberta it appears that the Wabamun/Winterburn contact is approximately at Marker D.

From Marker F to Marker B is a variable zone, averaging about 165 feet thick, which contains blanket-type limestone reefoid zones separated by sandy limestone and calcareous sandstone. Two main reefoid members are present: from F to A, and above B. In general the lower reef is best developed in the east and north, where it is responsible for the escarpment along the southwest shore of Kakisa Lake, and the upper reef is best developed in the southwest where the lower reef is replaced by a sandy section. The overall thickness of this reefoid zone thickens southwestward.

This reef-bearing zone, together with the sandstone and sandy limestone above, is similar in its clastic nature, as well as in the development of biostroms, to the Winterburn formation of Alberta.

Below Marker B the lithology consists of interbedded sandy limestone and calcareous sandstone which becomes increasingly argillaceous with depth, being replaced just below Marker C by green shale with sandy and silty layers.

The sand and silt content gradually decreases with depth until the rock consists predominantly green, slightly calcareous shale which overlies the Lady Evelyn Falls member. The thickness of the section from Marker C to the top of the Lady Evelyn Falls member in S.T. No. 2 is 470 feet, however it is subject to marked changes in thickness in short distances, as is seen from S.T. No. 1 and Briggs Rabbit Lake No. 1.

The Lady Evelyn Falls member consists of dull grey argillaceous limestone, gradational into, and interbedded with, grey calcareous shale, all interbedded with a variable amount of green, slightly calcareous shale as is found above the member. The entire member was not penetrated by any of the structure test holes. Its drilled thickness in Briggs Rabbit Lake No. 1 was 840 feet. It seems probable that this member is extremely variable both in development of the constituent limestone members and in thickness.

The section below Marker B appears to correlate with part or all of the Woodbend-Beaverhill Lake Group of Alberta.

The thick sandy section from B to below Marker C is seen in outcrop below the crest of the escarpment on Kakisa Lake. It is not exposed, however, in the Hay River section. It has its equivalent in the silty section of the upper Woodbend in Imperial-Bistcho Lake No. 1 in northern Alberta. This silty section in Bistcho Lake is not present in deep wells drilled to the east and south in Alberta. It appears that this sandy and silty section forms a wedge which thins out completely to the east.

Formations Penetrated, Depths and Electric Log Markers Used in Correlation

The test holes were drilled entirely in the Upper Devonian sequence, with the exception of Structure Tests Nos. 12, 19, 20 and 30. Lower Cretaceous marine shale was encountered near the top of each of these holes.

Structure Tests Nos. 1 and 2 were drilled first and fairly deep with the purpose of finding reliable markers. Upon drilling Tests Nos. 3 and 7 it was seen that shift changes of the base of the resistivity curve such as Markers "A", "B" and "C" would make good markers. Marker "F" was picked as the top of a reef zone with the bottom at or close to Marker "A". Marker "F" was picked on a correlative point in the more argillaceous part of the section. During the latter part of the program, upon drilling down dip tests, it was observed that correlation of the limestone section above Marker "F" was good and Markers "D" and "E" were picked in the stratigraphically higher sections.

Electric Log Marker Used in Structural Interpretation

Intervals between markers are not constant and no marker was common in all structure tests. This can be seen in Figures IV and V. Consequently, one of the lower markers, "F", was selected for structural interpretation. It was felt that interpolation to "F" would give a more accurate picture of the structure at depth than would a marker higher in the section.

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 "F" 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 horison markers and their depths and elevations accompanies this memorandum.

G.K. Williams

G.K. Williams,
Senior Geologist.

D.L. Campbell

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

STRUCTURE TEST DATA - KAKISA LAKE AREA 1955

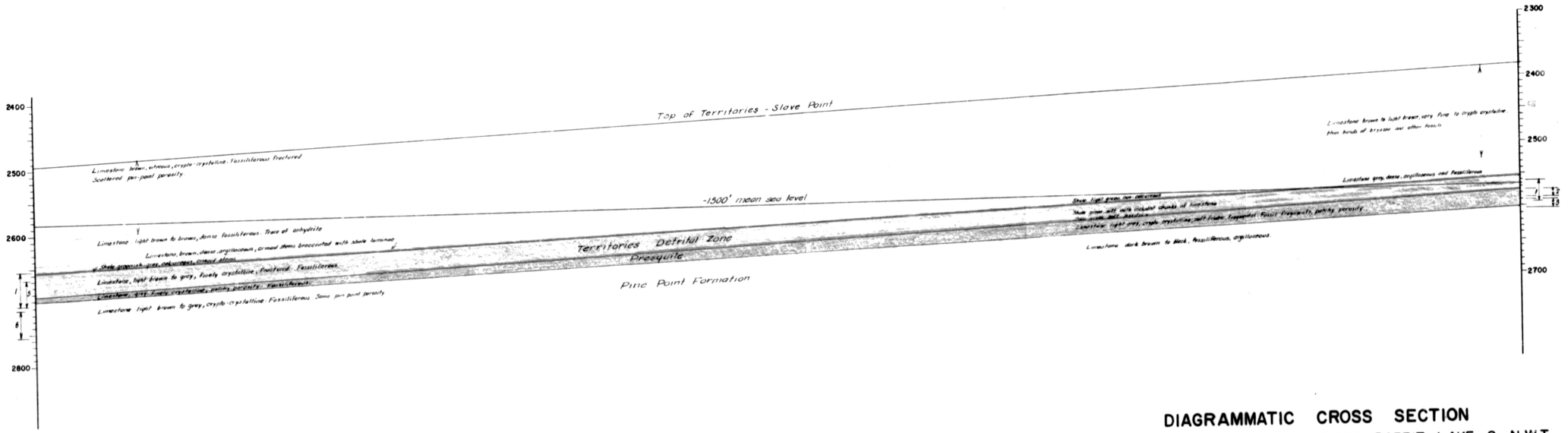
D. TODD BRIGGS PROJECT, N.W.T.

S.T. No.	Ground Elev.	Cover Above Devonian	Depth & Elev. Marker E	Thick. E-D	Depth & Elev. D	Thick. D-F	Depth & Elev. F.	Thick. F-A	Depth & Elev. A	Thick. A-B	Depth & Elev. B	Thick. B-C	Depth & Elev. C	Thick. C-M	Depth & Elev. M	Logged Depth
Rabbit Lake 1	1068(K.B.)	3			66 +1002	76	142 +926	50	192 +876	128	320 +748	210	530 +538	66	596 +472	235
1	1067.1	0						49*	38 +1030	113	151 +916	198	349 +718	69	418 +649	1270
2	1035.2	15			100	45	145 +890	27	172 +863	108	280 +755	198	478 +557	62	540 +495	1419
3	1042	5			6* +1036*	50*	56 +986	44	100 +942	113	213 +829	202	415 +627	68	483 +559	510
4	1102	39	171 +931	280	451 +651	59	510 +592	60	570 +532	119*	689* +413*	205*	894* +208*	66*	960* +142*	680
5	1044	29	87 +957	285	372 +672	72	444 +600	52	496 +548	126	622 +422	211	833 +211	67	900 +144	1018
6	970	30			288 +682	53	341 +629	58	399 +571	119	518 +452	203*	721* +249*	64*	785* +185*	651
7	1049	8			212 +837	50	262 +787	46	308 +741	112	420 +629	200	620 +429	65	685 +364	690
8	872	3			85 +787	75	160 +712	45	205 +667	142	347 +525	212*	559* +313*	65*	624* +248*	533
9	931	15	44 +887	299	343 +588	85	428 +503	52	480 +451	137	617 +314	212*	829* +102*	65*	894* + 37*	644
12	996	25**	327 +669	299	626 +370	100	726 +270	60*	786* +210	135*	921* + 75*	212*	1133* -137*	65*	1198* -202*	750
19	1059	97**	435 +624	294*	729* +330*	87*	816* +243	66*	882* +177	120*	1002* + 57*	210*	1212* -153	65*	1277* -218*	999
20	1083	89**	510 +573	291	801 +282	88	889 +194	66	955 +128	120*	1075* + 8*	210*	1285* -202*	65*	1350* -267*	955
21	953	3			256 +697	63	319 +634	51	370 +583	126	496 +457	203*	699* +254*	64*	763* +190*	613

* Interpolated Marker
** Includes Cretaceous

S.T. No.	Ground Elev.	Cover Above Devonian	Depth & Elev. Marker X	Thick. X-E	Depth & Elev. E	Thick. E-F	Depth & Elev. F	Thick. F-A	Depth & Elev. A	Thick. A-B	Depth & Elev. B	Thick. B-C	Depth & Elev. C	Thick. C-D	Depth & Elev. D	Logged Depth
27	1028	2									26* +1002*	183*	209 +819	64	273 +755	668
28	792	20											53 +739	70	123 +669	690
29	916	30			90 +826	47	137 +779	19	156 +760	124	280 +636	195	475 +441	62	537 +379	616
30	912	37**	52 +860	311	363 +549	101	464 +448		500* +412*	139*	639* +273*	230*	869* + 43*	65*	934* - 22	940
31	969	7							17* +952	113*	130 +839	195*	325* +644*	65*	390* +579*	274
33	994										89 +905	191*	270* +724	65*	345* +649*	267
34	993	40									159 +834	191*	350* +643*	66*	416* +577*	200

* Interpolated Marker
** Includes Cretaceous



DIAGRAMMATIC CROSS SECTION

BRIGGS RABBIT LAKE-1 TO BRIGGS RABBIT LAKE-2 N.W.T.

SHOWING

LITHOLOGIC CHANGES IN ZONE OF PRINCIPAL INTEREST BETWEEN TOP OF TERRITORIES AND TOP OF PINE POINT FORMATIONS

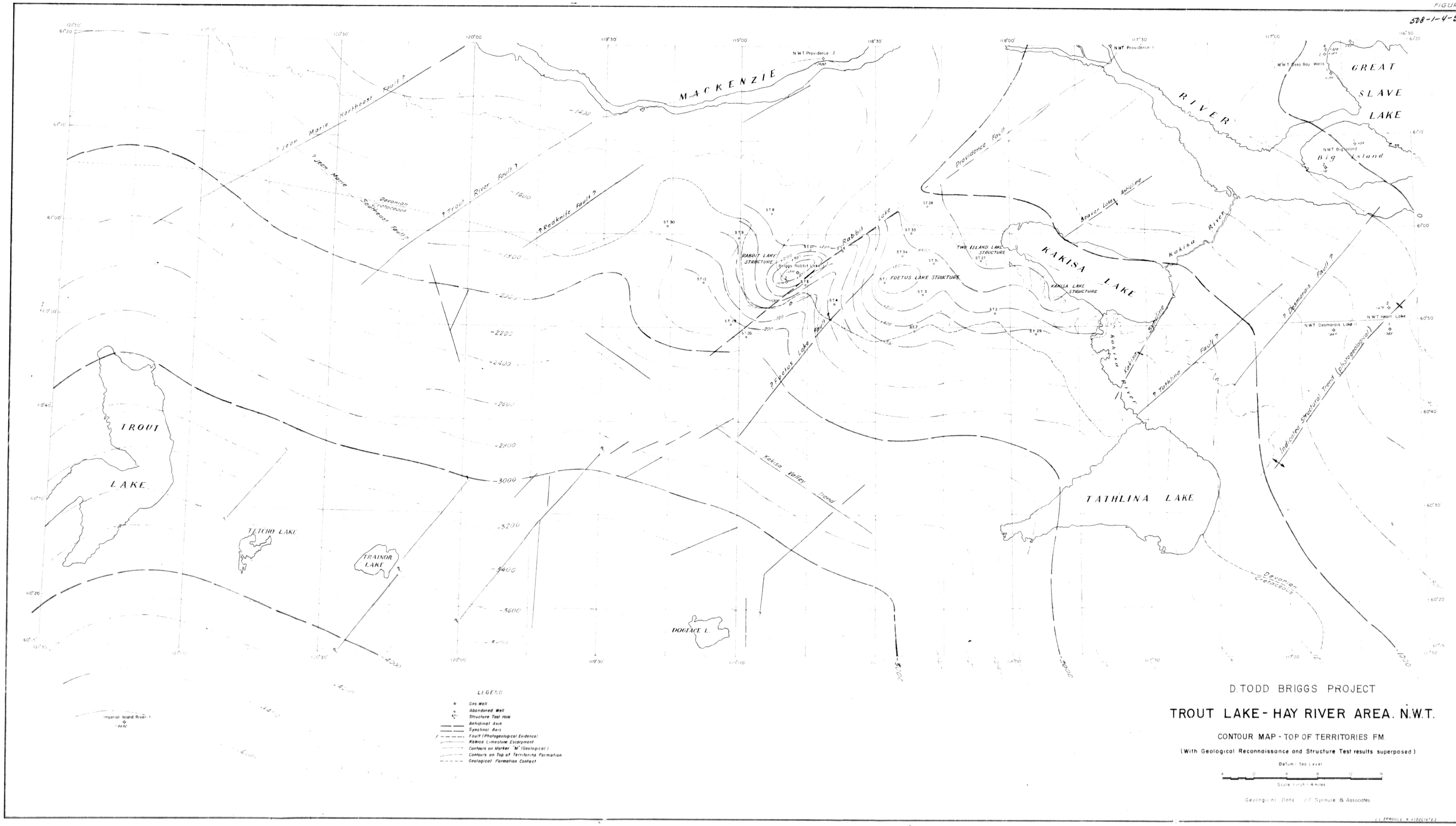
Horizontal Scale - 1" = 400 ft.

Vertical Scale - 1" = 100 ft.

To accompany Geological Report on D.Todd Briggs Project, July 1955

FIGURE 1

508-1-4-5



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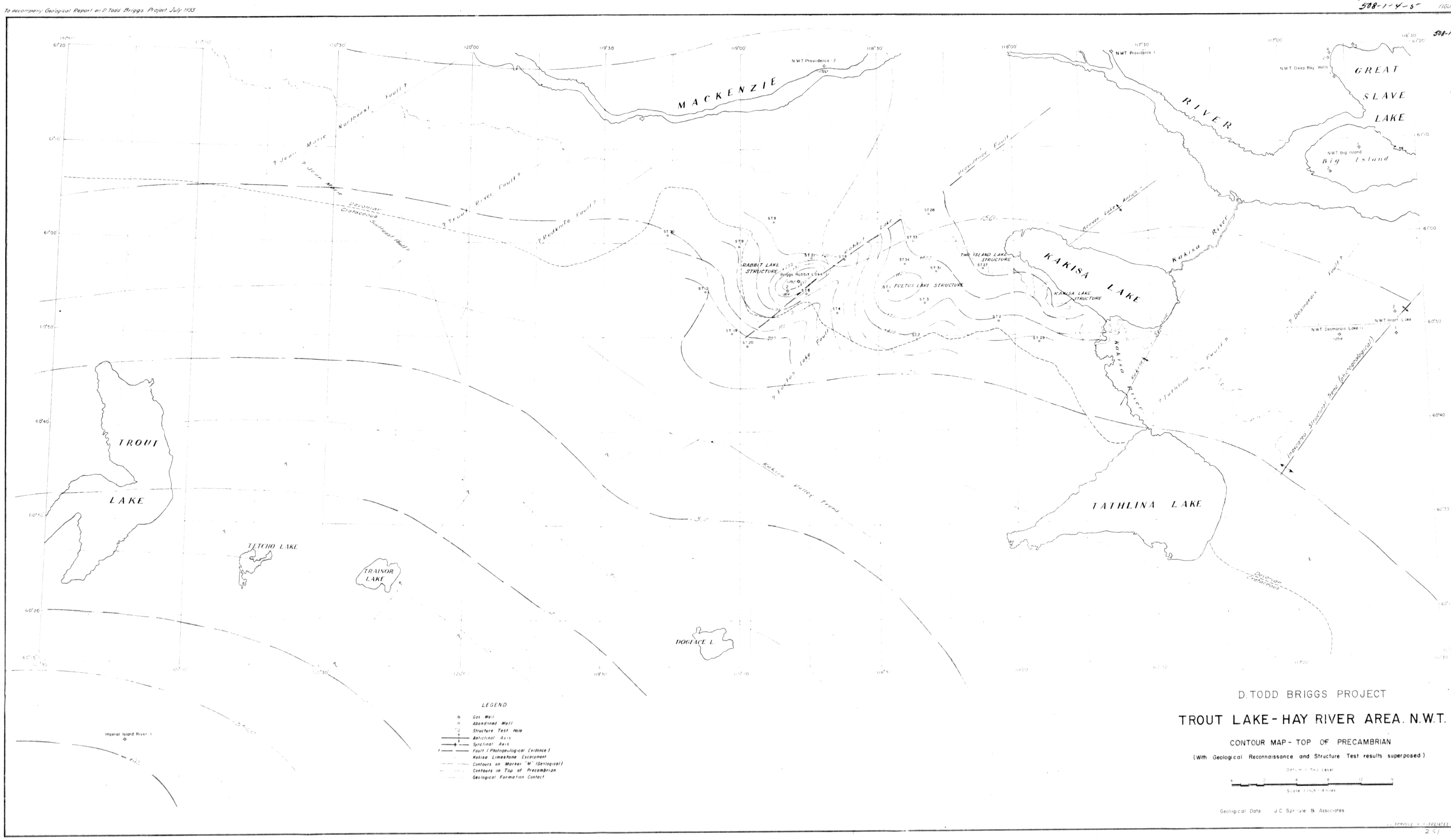
To accompany Geological Report on D Todd Briggs Project. July 1955

508-1-4-5 FIGURE II



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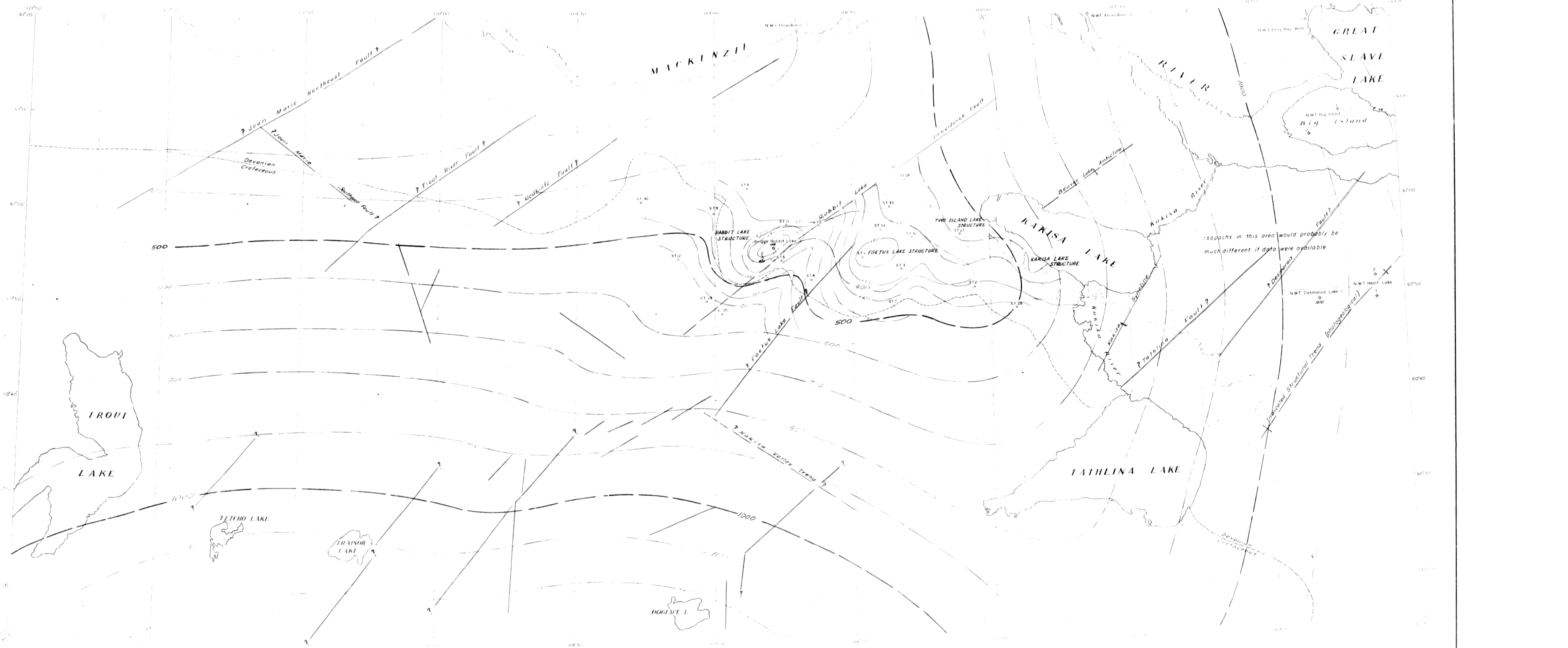

LEGEND

- Gas Well
- Abandoned Well
- Structure Test Hole
- Anticlinal Axis
- Synclinal Axis
- Fault (Photogeological Evidence)
- Kakisa Limestone Escarpment
- Contours on Marker "M" (Geological)
- Isopach Top of Territories Fm to Precambrian
- Geological Formation Contact

D. TODD BRIGGS PROJECT

TROUT LAKE - HAY RIVER AREA. N.W.T.

ISOPACH MAP - TOP OF TERRITORIES TO PRECAMBRIAN

(With Geological Reconnaissance and Structure Test results superposed)

Geological Data: J.C. Sproule & Associates

S08-1-4-5

D. TODD BRIGGS NOMINEE ACCOUNT, N. W. T.
J. B. WHITE AND A. M. LLOYD OPERATOR
S U M M A R Y of: "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 Drlg. Results"
--J. C. Sproule

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

J. C. SPROULE & ASSOCIATES
GEOLOGICAL & EXPLORATION CONSULTANTS

901 EIGHTH AVENUE WEST
CALGARY, ALBERTA

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D. TODD BRIGGS PROJECT, N.W.T.

AS OF JUNE 30, 1955

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 Gravitymeter 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.

(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 conditons 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:

Date	Drilled Footage	Aver. Footage / rig-day	Footage lost by skidding locations
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. 20 - March 5	1518	108	
March 6 - 12	1575	113	
March 13 - 20	1122	102	
Total -	13,936		446

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

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

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.

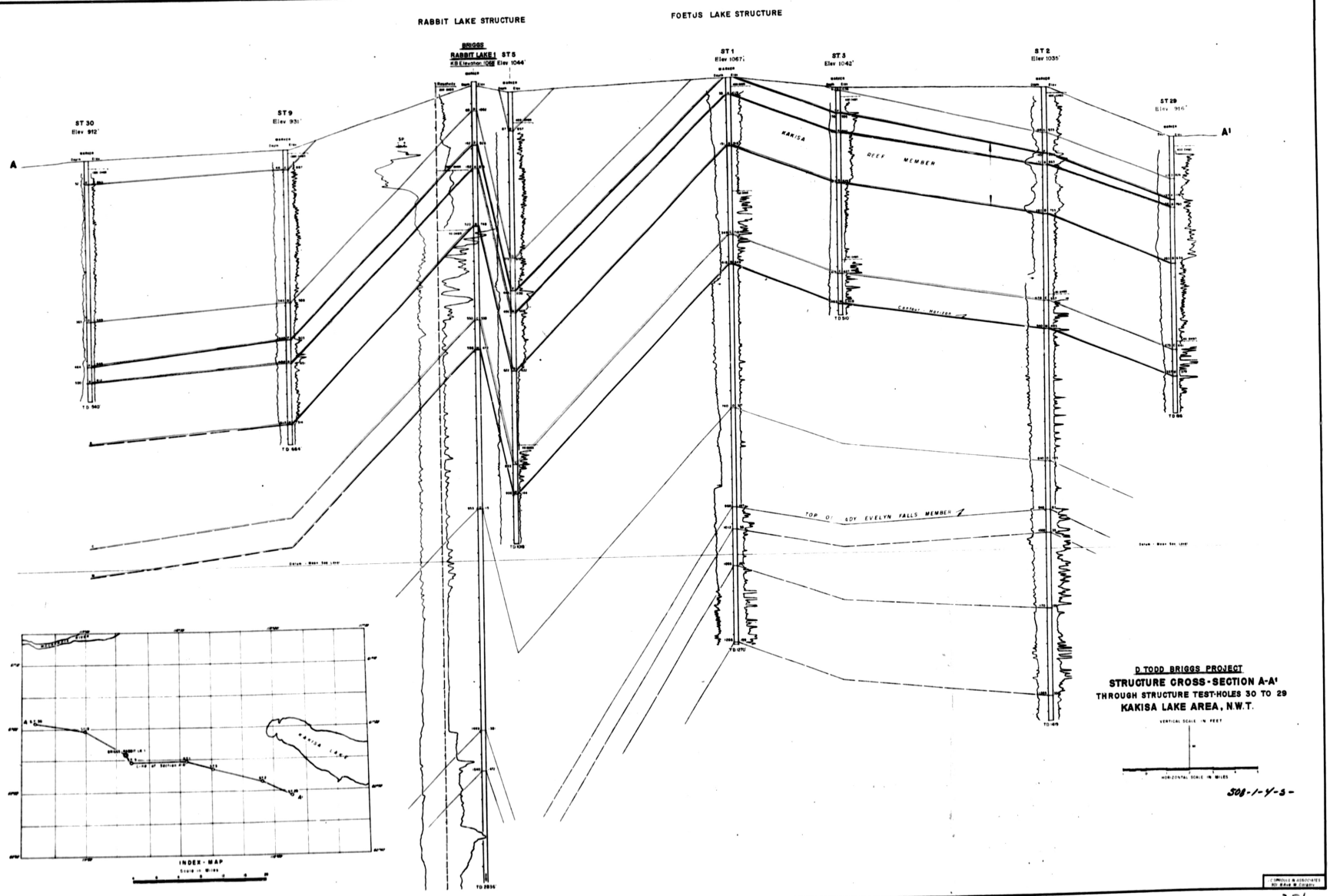
The Two Island Lake and Kakisa Lake structures are not proven as to closure. Further confirmation on this could be obtained by the drilling of additional structure tests.

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

G.K. Williams,
Senior Geologist.

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

To accompany Geological Report on D. Todd Briggs Project, July 1955



D TODD BRIGGS PROJECT

STRUCTURE CROSS-SECTION A-A'

THROUGH STRUCTURE TEST-HOLES 30 TO 29

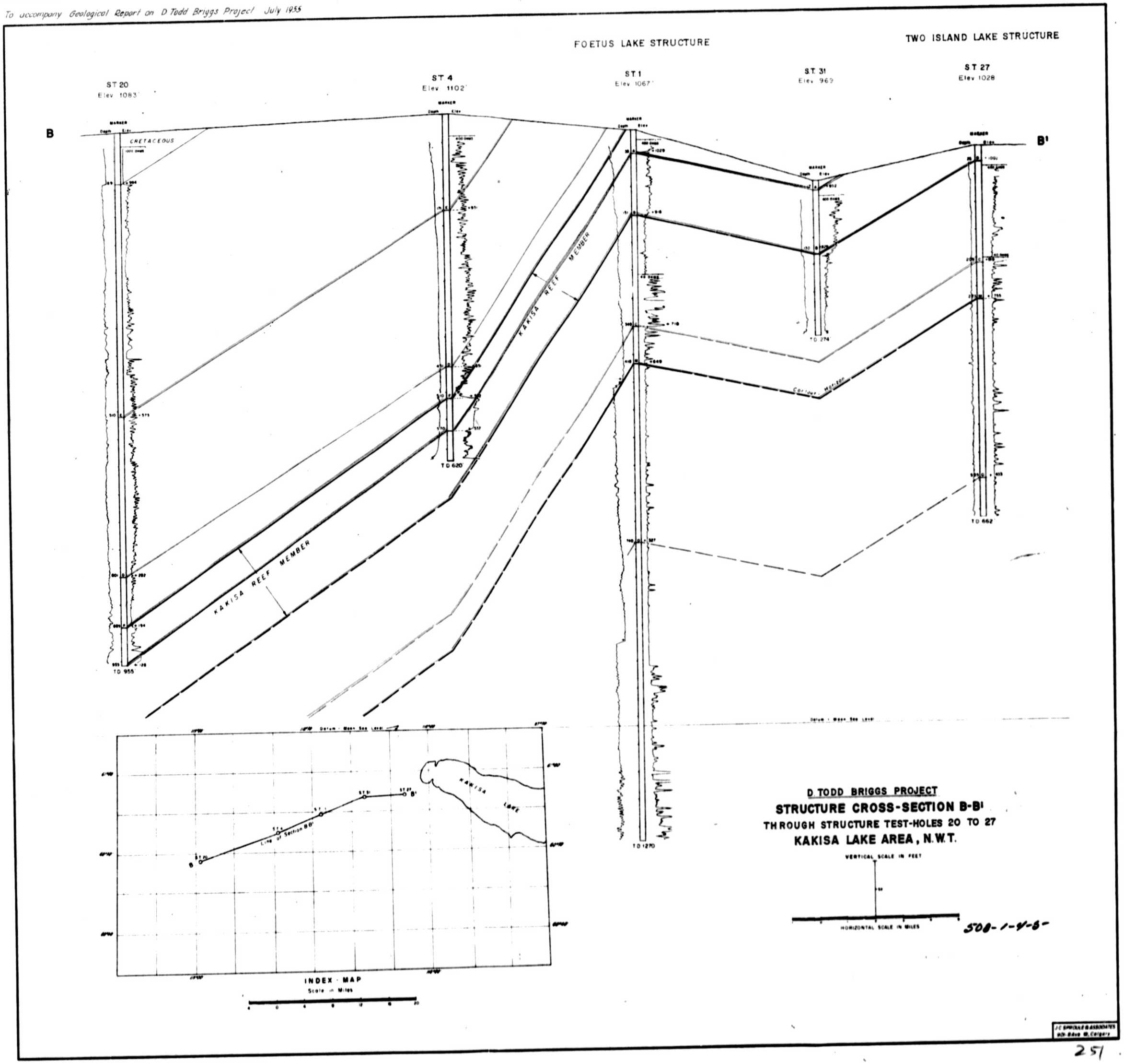
KAKISA LAKE AREA, N.W.T.

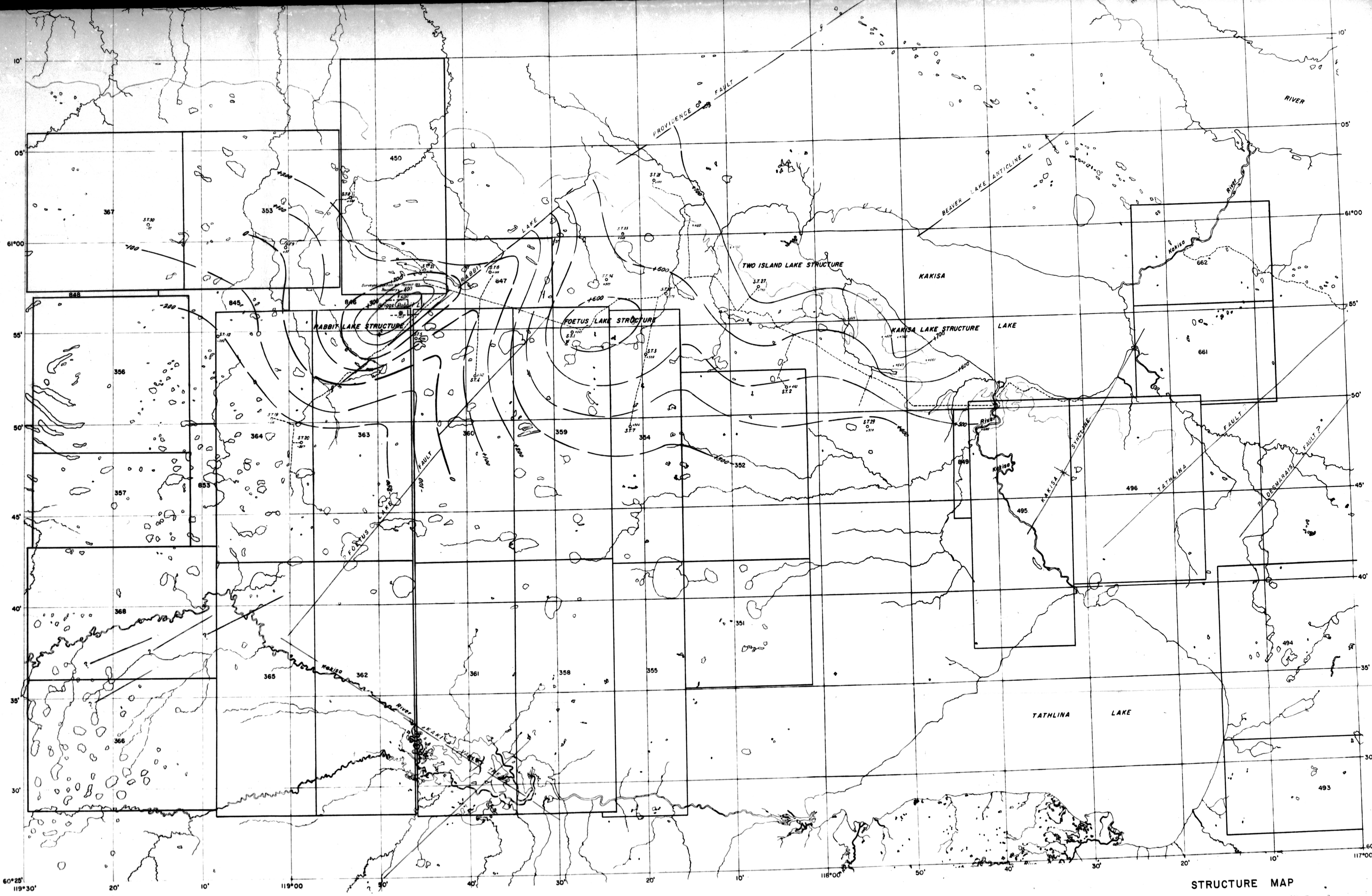
VERTICAL SCALE IN FEET

HORIZONTAL SCALE IN MILES

308-1-4-5-

To accompany Geological Report on D Todd Briggs Project July 1955





ST.5 Structure Test Hole

Elevation on Top of "M" Marker (E-Log)

Elevation on Top of "M" Marker (calculated from outcrop)

Kakisa Limestone Escarpment

STRUCTURE MAP

D. TODD BRIGGS PROJECT

KAKISA LAKE AREA, N.W.T.

CONTOURS ON MARKER "M"

Interval 100 ft. Datum Sea Level

2 1 0 2 4 6 8

Scale 1" = 2 miles

508-1-4-5

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FIGURE XIV