NORTHERN FOOTHILLS AGREEMENT

TEXACO EXPLORATION COMPANY (OPERATOR)

CALGARY, ALBERTA

EVALUATION

OF THE

BOVIE LAKE STRUCTURAL COMPLEX

NORTHWEST TERRITORIES

by

K.D. HUTCHINSON AND R.W. CRAIG

CALGARY, ALBERTA

JANUARY, 1959.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

INTRODUCTION

General Statement

During the summer of 1958 Texaco Exploration Company, on behalf of the Northern Foothills Agreement, carried out a detailed geological mapping program in the Bovie Lake area of the Northwest Territories. The 1958 program was to be compiled into a final geological evaluation of the Bovie Lake structural complex prior to the selection of a drilling location.

The north and south topographic segments of the complex were mapped in detail.

Location

The Bovie Lake structural complex lies within the boundaries of the permit blocks Bovie Lake North and Bovie Lake South. (Ref. Loc. Map, fig. 1)

Topography

The Bovie Lake structural complex exists as a north-trending segmented ridge and is the prominent topographic feature in an area of generally low, flat relief. It comprises two segments, designated north, and south topographic segments. The north segment is offset to the west with respect to the south segment. The surface expression ranges from one-half to one mile in width, and has a maximum relief in the order of 600 feet. A typical end view of any one segment shows a relatively gentle west slope that flattens out near the top of the ridge and terminates in a steep slope on the east.

The southernmost part of the map area is drained by

125°30' 125°00' 124°30' 124°00' 123°30' 123°00' 122°30' 122°00' 121°30' 121°00'

Bovie Lake North

Bovie Lake South

Fort Liard

Nelson Forks

Fort Nelson

Muskwa

YUKON TERRITORY
BRITISH COLUMBIA

NORTHWEST TERRITORIES
BRITISH COLUMBIA

LIARD PLATEAU

ROCKY MOUNTAIN FOOTHILLS BELT

ROCKY MOUNTAIN TRENCH

LIARD RIVER

FORT NELSON RIVER

PETITOT RIVER

BEAVER RIVER

KECHIKA RIVER

TROUT LAKE

KOTCHO LAKE

SIKANNI CHIEF RIVER

PROPHET RIVER

FONTAS RIVER

LOCATION MAP
showing
Permit Blocks Where Work Was Conducted
SCALE - 1 INCH = 20 MILES

Figure No. 1
(1a)

the northwesterly flowing Petitot River system of which Petitot River itself is the main stream. This river is entrenched 200 to 500 feet below the general surface of the surrounding terrain and transects the ridge south of the south topographic segment. The Muskeg River system drains the northern portion of the map-area. Bovie Creek and Bovie Lake, into which Bovie Creek flows, belong to this drainage system.

The area supports an extensive forest cover and with the exception of the higher portions of the topographic segments is generally swampy. Numerous small lakes and streams exist on the relatively flat low lands surrounding Bovie Lake ridge.

There is a well-developed system of glacial lineations possessing very low relief and trending east-northeast across the area.

Operations

The field party worked out of a single base camp located on the north-central shore of Bovie Lake. Personnel and equipment were transported to base camp by a company leasedBeaver aircraft from Fort Nelson, British Columbia. Regular supply trips were made by Beaver aircraft during the field season. A model 47-D-1 Bell helicopter (later replaced by a model 47-G-2 Bell) leased from Associated Helicopters Limited, Edmonton, Alberta served as a means of transportation between base camp and the ridge.

Work commenced on the south topographic segment on June 1st. An unfortunate accident the same day rendered the

helicopter unserviceable for one week and it was found convenient to recommence operations on foot on the north topographic segment.

Surveying was greatly facilitated by the use of existing seismic trails in the area. During the previous winter a caterpillar had cleared helicopter landing spots at intervals along the ridge. These "heliports" were of necessity enlarged with axe and power-saw during the summer.

Forty-eight days were spent in the field. Of these, seven days were lost due to weather, two days due to moving and one day due to the helicopter crash.

Mapping Methods

Mapping was carried out by two teams equipped with telescopic alidades and plane tables. A team generally consisted of an instrumentman, a geologist, and a line-cutter. Survey data was plotted in the field using a scale of one inch equals five hundred feet. A foresight-backsight method was employed wherever possible as a check for surveying errors.

The segments were thoroughly scouted for rock exposures. Certain outcrops considered impractical to survey were located by pace and compass traverses from instrument stations. Topographic features important in the structural interpretation were mapped either by plane table or pace and compass methods.

The scale and orientation of the pertinent air photos were established in the field to facilitate the transfer of point locations from photos to base map. Air photos were used to

advantage in positioning the limestone-sandstone boundary and the transverse faults on the north topographic segment.

Survey control is referred to Triangulation Station Mayday, established by the British Columbia Government on the south topographic segment. It is believed that the survey is within a maximum horizontal error of 150 feet.

Representative rock samples were collected from outcrops which yielded reliable attitudes. Any fossils observed in situ were also collected.

History of Exploration

A reconnaissance geological investigation of the Bovie Lake structural complex was conducted by W. I. Wright and R. L.Slavin in 1950.

Seismic work has been carried out intermittently on the permits since January, 1956, with special equipment being utilized to enable operations to be conducted throughout the summer. The most recent seismic project was completed in November, 1958.

The only well drilled to date, Texaco N.F.A. Bovie Lake No. 1, was spudded on the south topographic segment on January 23, 1957, and was abandoned March 1, 1957 at a total depth of 1,403 feet in Mississippian and/or Pennsylvanian sandstone.

STRATIGRAPHY

General Statement

Bedrock exposed in the vicinity of the subject permit blocks ranges in age from Mississippian to recent. Devonian strata outcrop to the northwest, north and east of the area. Only Mississippian and Mississippian and/or Pennsylvanian rocks were observed on the ridges. Lower and Upper Cretaceous strata outcrop along Petitot River on the west limb of the anticline and as far west as Fort Liard. Lower Cretaceous beds are also exposed on Muskeg River at the north end of the feature. Outcrop on the permits is restricted to the topographic ridges and Petitot River valley. Figure 2 is a table of exposed formations from Wright and Slavin (1951).

Mississippian

Mississippian limestones are the oldest rocks exposed on the structural complex. They underly the major portion of the north topographic segment. Wright and Slavin suggest a total Mississippian exposure of about 250 feet, made up of a 160 foot section on Petitot River plus some 100 feet exposed elsewhere, stratigraphically higher, on the escarpments. Surface conditions indicate only about 50 feet of limestone observable at a higher stratigraphic position than the Petitot River outcrop.

The thickness of the Mississippian limestone, as determined from regional geology, ranges from 1,000 feet on the south segment to 900 feet on the north segment. Correlation

between separate outcrops is indefinite due to the relatively small exposures and absence of marker beds.

Outcrops consist of both well-bedded and poorly bedded limestones of two basic types. The predominant type is generally light olive grey to pale yellowish brown. It has a distinctive crinoidal fragmental testure which reflects its composition of partial crinoid stems and ossicles, fragmentary bryozoans and other fossil fragments. A lesser amount of light and medium grey to brownish grey, dense to finely crystalline limestones were observed, usually in thicker, more irregular beds. Both types are commonly associated with irregular lenses and nodules of black to grey chert, No porosity was observed in the limestones. Horn corals and colonial corals predominate in the limestone beds. The fossil collection was identified by Mr. P. S. Warren and Dr. C. R. Stelck of the University of Alberta, and placed in an "Upper Rundle" age bracket.

<u>Mississippian and/or Pennsylvanian</u>

This sandstone sequence was observed on most of the south topographic segment and at isolated points along the outer margins of the north segment. It overlies the Mississippian limestones and is believed by Wright and Slavin to correlate in age to Mississippian and/or Pennsylvanian beds exposed on Pointed Mountain, about 20 miles west of Fort Liard. No lithological or paleontological evidence was found by the writers to assign a more accurate age to the sequence.

The majority of the sandstone observed is poorly exposed due to its ready susceptibility to weathering and soil-formation. The rock is pale yellowish brown to light brown, fine-grained, quartz, clean, well-sorted and friable, with occasional shaly and carbonaceous streaks. Beds exhibiting good porosity are not uncommon. No faunal remains were observed, but casts of stems and rootlets and numerous cylindrical cavities are noted throughout the sandstone. Iron staining produces a reddish brown weathering colour.

Included with the sandstones are some badly fractured, ferruginous chert beds observed on both segments. Wright and Slavin (1951, p. 17)state that

> "No accurate estimate of the thickness of the Pennsylvanian and/or Mississippian beds can be made on the Bovie Lake structure because of the scarcity of outcrops. However, there is a stratigraphic interval of 1,385 feet, although largely drift covered, between the Mississippian limestone and the Lower Cretaceous shale, the greater part of which may be made up largely of these sandstones and chert beds."

Individual outcrops can not be related to each other stratigraphically and the largest continuous single outcrop exposes less than 100 feet of section. The stratigraphic thickness of the Mississippian and/or Pennsylvanian sequence is estimated to vary from 1,100 feet in the south to 800 feet in the north.

STRUCTURE

General Statement

The Bovie Lake structural complex is essentially a continuous, faulted, anticlinal feature possessing pronounced north plunge and east-west turnover. The surface expression of the feature comprises two north-trending en echelon segments. Refer to the accompanying map No. 1.

North Topographic Segment

This segment is a faulted asymmetric anticline cut by two transverse faults in the southern portion and exhibiting pronounced north plunge. The surface expression of the anticline is four miles in length, from one-quarter to three-quarters of a mile in width, and has a maximum relief of 400 feet. Its southern end merges with the surrounding terrain one-half mile west of Bovie Lake.

Essentially the segment is completely underlain by Mississippian limestone but the overlying Mississippian and/or Pennsylvanian sandstone is occasionally present in small, isolated outcrops on the extreme west and north perimeters of the feature. The west limb has an average dip of 65 degrees at the limestone-sandstone contact, but flattens rapidly towards the crest. The east limb attains an average dip of 50 degrees near the contact and is less than one-half the width of the west limb. A longitudinal fault has upthrown the west limb with respect to the east. Two transverse faults are present on the southern portion of the segment.

Northern Portion

A gentle limestone dip slope constitutes the surface expression of the west limb, terminating to the south in a near-vertical east-facing cliff immediately west of the axial trace. A sandstone outcrop at the northern extremity of the feature represents the only visible expression of the east limb. Dips on the west limb vary from 10 degrees to horizontal near the crest and steepen sharly at the limestone-sandstone contact to a maximum of 58 degrees.

The near-vertical limestone cliff marking most of the eastern boundary of this portion of the segment is some 75 feet in height. No further expression of the anticline is visible east of the cliff-face. The nature of the sheer straight cliff-face suggests a fault cutting the anticline in the axial position. No estimate of relative displacement on this portion of the segment is possible. Definite existence of the fault has not been postulated north of where the main cliff loses its identity in a series of minor scarps and slump-blocks.

Southern Portion

The highest and widest portion of the north topographic segment lies south of the northernmost transverse fault. The anticline maintains its asymmetric profile.

Both east and west limbs are expressed at surface. The west limb constitutes the major portion of the feature; the east limb is present as the most easterly limestone outcrops. The anticlinal axis swings to the south-southeast and the

longitudinal fault, represented by the cliff, cuts the west limb of the fold.

Two minor transverse faults cut this portion of the segment. Evidence for the north fault is found in the pronounced disruption in the alignment of the north-trending cliff, in the presence of a limestone-chert breccia, and in the distinct alignment seen on aerial photographs. Attitudes of the beds near the breccia are suggestive of a drag at the fault. There is little to attest to the existence of the south fault other than an alignment on aerial photographs and a displacement along the inferred position of the limestone-sandstone contact. Absence of correlative beds in the limestone prevents any accurate measurement of the relative movement at the faults.

South Topographic Segment

This segment is the most pronounced of the two topographic segments, having a surface expression some eight and one-half miles in length, from one-half to one mile in width, and possessing 600 feet of maximum relief. The surface expression loses its identity immediately south of Bovie Creek in the north and near Petitot River in the south. Mississippian and/or Pennsylvanian sandstone underlies the entire segment except for the north and south ends.

The segment is essentially an expression of the west limb of an asymmetric anticline, with minor transverse faulting at the northern end. The east limb is well defined in the southernmost portion of the segment.

Northern Portion

This portion of the south segment lies north of seismic line No. 4, Bovie Lake South permit. It narrows rapidly to the north, losing its identity at Bovie Creek. Although it is topographically a part of the middle segment it is included with the north segment with respect to structure. Westerly dips predominate, ranging from a maximum of 46 degrees on the west flank to four degrees near the ridge crest. One major and two minor transverse faults are associated with a straight, sheer limestone cliff immediately west of a small lake.

Southern Portion

South of seismic line No. 4 the south segment comprises a slightly asymmetric anticline. The axial trace meanders only slightly from a general north-south trend.

Limestone-Sandstone Contact

The actual limestone-sandstone contact was not observed in the field. Its position on the west side of the north topographic segment is easily located through the use of air photos and topography. The contact is placed at the eastern edge of a slight topographic rise marking the base of a gentle limestone dip-slope. This topographic rise is made up of Mississippian and/or Pennsylvanian sandstone present as small isolated outcrops or sandy, rust-weathering soil. Ground adjoining the rise on the east is commonly swampy indicating that it is underlain by limestone, rather than by porous sandstone. The contact is not easily located on the east side of

the segment except at the extreme north end where it falls between closely spaced limestone and sandstone outcrops.

The trace of the contact is U-shaped at either end of the south segment. On the north end the contact is again placed at the base of a gentle limestone dip-slope and immediately west of a narrow swampy area. The contact is not recognizable on air photos.

CONCLUSIONS

1. The two topographic segments of the Bovie Lake structural complex constitutes a continuous anticlinal feature possessing pronounced north plunge.
2. Refraction-reflection profiles indicate some decrease in structure at depth accompanied by crestal thickening and complementary thinning on the flanks in the thick Mississippian and Upper Devonian shale section. It is suggested that thickening resulted from either shale flowage or faulting.
3. Structure is disrupted by transverse and longitudinal faults.

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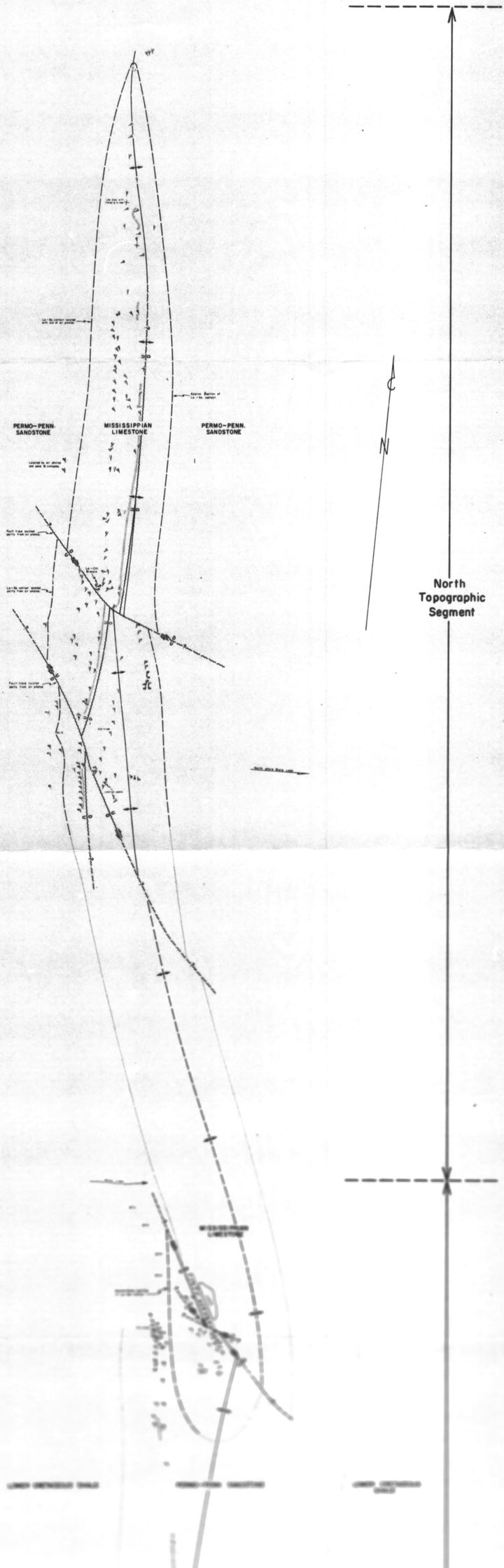
PERMO–PENN.
SANDSTONE
MISSISSIPPIAN
LIMESTONE
PERMO–PENN.
SANDSTONE
N
North
Topographic
Segment

November, 1958.

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PALEOZOIC	PENNSYLVANIAN AND/OR MISSISSIPPIAN	? 1100?	Sandstone, and bedded dark grey chert. The sandstone is medium grey, medium grained, quartzitic; contains stem concretions, casts of trails (?).
	MISSISSIPPIAN (?)	? 250+	Limestone, with minor shale bands. The limestone is mostly massive, but in places sandy, silty, well-bedded; many nodules and elongated masses of black chert. Fossils include corals, cephalopods, fusilinids, brachiopods.

(5a) Figure 2

South Topographic Segment

LOWER CRETACEOUS SHALE

PENNO-PENN SANDSTONE

LOWER CRETACEOUS SHALE

MISSISSIPPIAN LIMESTONE

PENNO-PENN. SANDSTONE

LOWER CRETACEOUS SHALE

FORT NELSON FORMATION

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