STRUCTURAL RECONNAISSANCE
OF THE
COLVILLE LAKE REGION

Prepared for

Union Oil Company of Canada Limited

by
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P. Geol.

September, 1975

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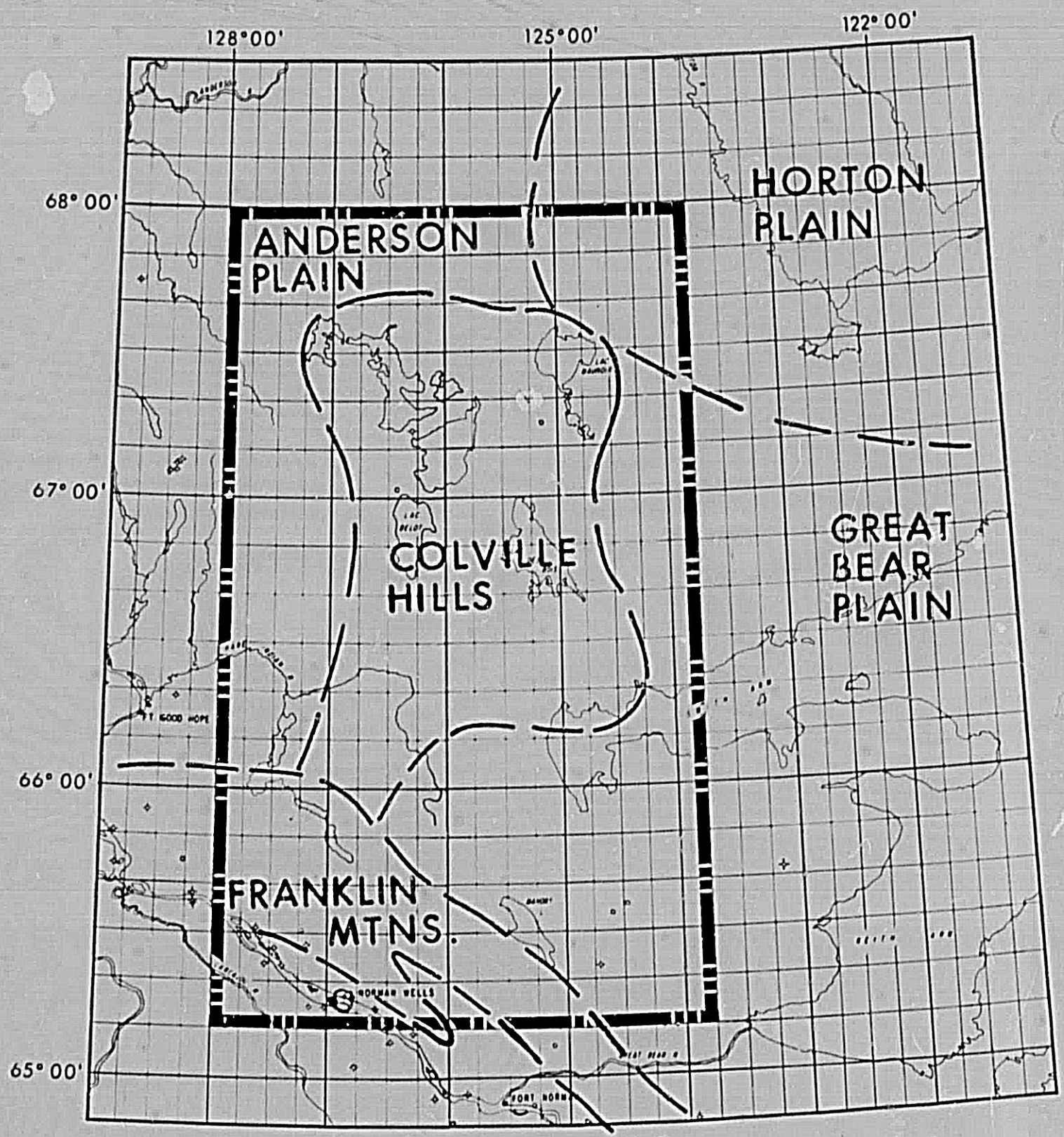

FIGURE 1

REGION LOCATION MAP

SCALE 1:2,000,000

Z-1535

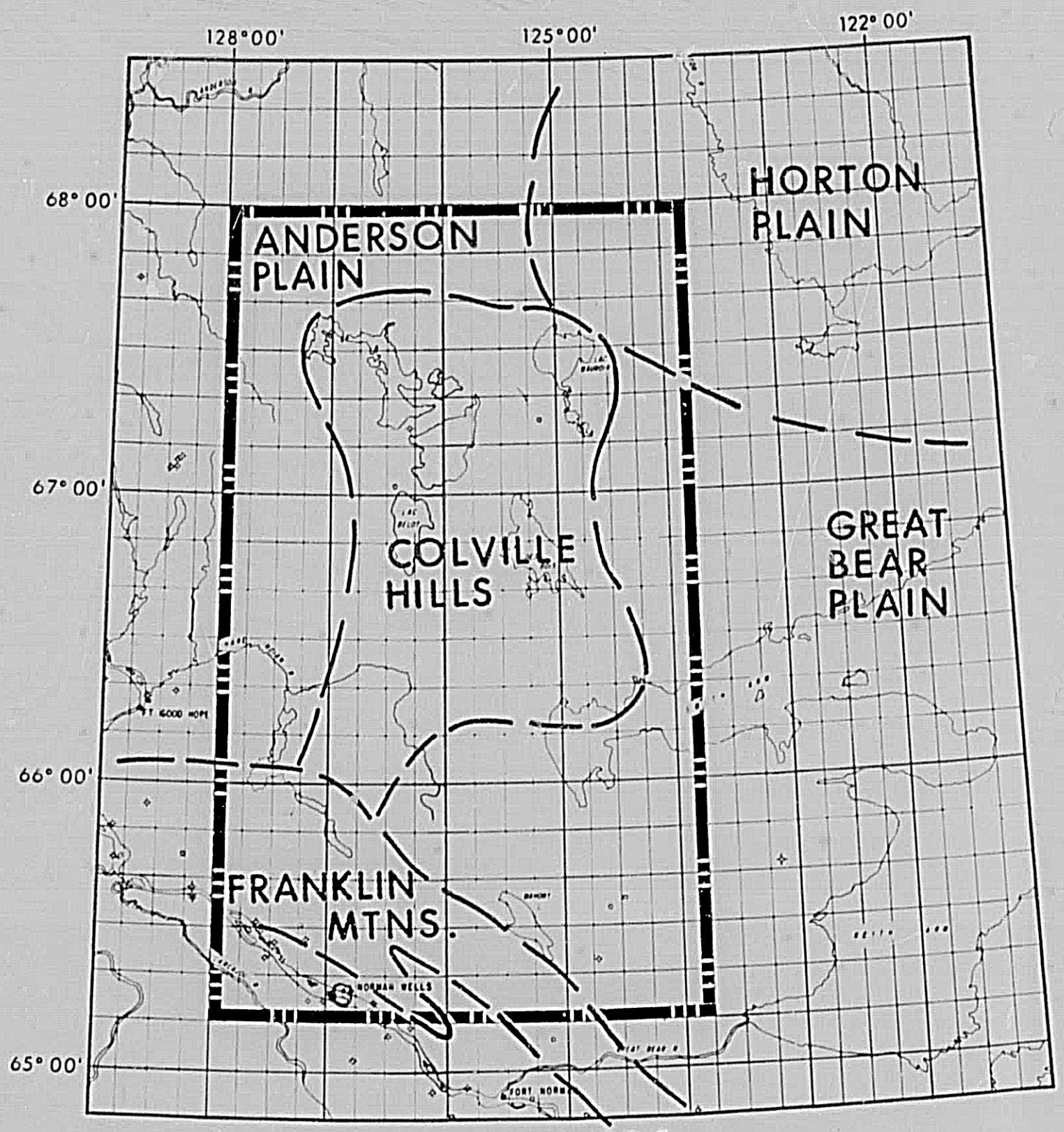

FIGURE 1

REGION LOCATION MAP

PROJECT AREA

PHYSIOGRAPHIC PROVINCE BOUNDRY

SCALE 1:2,000,000

Z-1535

INTRODUCTION

During July and August, 1974, a helicopter-borne structural geological reconnaissance was carried out over a broad area of the Northern Franklin Mountains, Colville Hills and adjacent areas of the Great Bear and Anderson Plains. The area investigated is illustrated in Figure 1. This reconnaissance was carried out for Union Oil Company of Canada Limited by Dr. J. Keith Rigby and Mr. James W. Davis, using a Bell 47-J piloted by Mr. Keith Knowles. The objectives of this program were to field check a geomorphic interpretation of the structures of this region, look for additional structures and gain some appreciation of the structural evolution of the area.

Field observations plus information gathered from a geomorphic and photogeologic interpretation of the area were incorporated in the production of this report. Although Dr. Rigby's data is included within this report, final responsibility for the interpretation of the structures presented herein is assumed by the author. The author is most grateful for the insight and observations made by Dr. Rigby during the course of this field investigation.

The structural data gathered during this investigation was obtained primarily by observing and measuring bedrock attitudes while overflying the area at low altitude in a helicopter. Landings were made to check the structure and/or stratigraphy at specific points. Structural control gained in this fashion, along with the photogeologic interpretation completed following the field investigation proved adequate to evaluate the structural configuration of the region. Additional control used to compile the maps accompanying this report was obtained from a photogeologic map of the Franklin Mountains produced by V. Zay Smith and Associates, various Geological Survey of Canada maps and publications and a comprehensive geomorphic interpretation map completed prior to the field investigation.

Regional Structural Geology

The area under consideration includes parts of four physiographic provinces (Fig. 1); the Franklin Mountains, the Colville Hills, the Great Bear Plain and the Anderson Plain. Each of the physiographic provinces is also a separate and distinct structural province.

Franklin Mountains

The Franklin Mountains form a series of linear fault controlled ranges and ridges composed largely of resistant Lower Paleozoic carbonates which reach elevations in excess of 3,000 feet (914 m). The structure of the Franklin Mountains appears to be controlled by a system of basement faults orientated predominantly in an east-west and northwest-

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southeast direction. This fault system divides the basement of this area into a series of orthogonal blocks or tessera. These blocks, when subject to horizontal compression, have responded by rotating in a clockwise fashion accompanied by tilting and uplift. The rotation of these blocks took place along a series of right-lateral wrench faults within, and at the margins of, the Franklin Mountains.

Faults along these ranges are characterized by rapid reversals in throw along strike. This produces the so-called "flip-flop" structures of these mountains. Adjacent to these faults the rocks are deformed into steeply dipping homoclines and sharply assymetric, anticlinal, drag folds.

Colville Hills

The Colville Hills consist of a series of ridges of Lower Paleozoic strata which stand above the adjacent lowlands. These ridges, which reach elevations of up to 2,200 feet (670 m), form a net-like pattern which encloses several large lakes, namely Lac Belot, Lac des Bois and Colville Lake. The structure of the Colville Hills is similar in style, but not in scale, to that of the Franklin Mountains. The Tunago Ridge structure actually forms a physical link between the two areas. Within the Colville Hills, three prominent structural orientations exist, northwest-southeast, northeast-southwest and north-south.

The structure of the various ridges in the Colville Hills is similar to that of the Franklin Mountains in that the ridges are faulted anticlines or homoclines. These narrow, fault-controlled ridges mark the edges of intracratonic blocks or tessera, which control the structure of this region. The structural response to horizontal compression of these blocks was the same as that for the Franklin Mountains with the exception that much more secondary folding related to the strike-slip movements took place within, and adjacent to, the bounding faults. This resulted in the development of a number of broadly folded anticlines within these blocks which are highly attractive as potential petroleum traps.

This structural model can also be used to interpret the rapid change in orientation of structures which occurs in this area. In some cases adjacent anticlines are oriented perpendicular to each other. This is caused by one set of structures being drag folds associated with a fault along the plate boundary, while the adjacent structures are formed by secondary compressive stress generated within the block by differential horizontal movement along faults bounding the plate.

The other structural model suggested for these structures involves using the Cambrian Saline River shale and evaporites as decollement surface and appealing to flowage of evaporites into the cores of anticlinal

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structures. The model was proposed by R. D. Hughes (1969) and D. G. Cook and J. D. Aitken (1971). There are several lines of evidence which indicate that their structural model should be abandoned. Drilling of structures in this region has revealed no apparent thickening of evaporites in cores of anticlines. Saline River thicknesses encountered in the subsurface in these anticlines never equal structural relief, thus, it is difficult to imagine flowage accounting for the deformation. It is also difficult to envision this type of ductile flowage deforming the 2,000 - 3,000 foot (610-914 m) thick carbonate packet which overlies the Saline River Formation in this area. Gravity data over several structures shows no gravity negatives associated with the anticlines as one would expect if flowage occurred. Finally magnetic data shows a series of linear anomalies associated with many of the faults and folds suggesting basement involvement in these structures.

Great Bear Plain

The Great Bear Plain, which is underlain mostly by Mesozoic strata, is a gently rolling plain with moderate relief ranging from 512 feet (156 m) along Great Bear Lake itself, to about 2150 feet (655 m) in the Scented Grass Hills. Structures in the Great Bear Plain have a distinctly different structural style than those encountered in the other three areas.

Anderson Plain

The Anderson Plain is essentially a westward dipping homocline on which most structural development has taken place adjacent to the Franklin Mountains and the Colville Hills. Anticlines present in this region tend to be broad and low amplitude and, as in the Great Bear Plain, faulting plays only a minor roll in the structure of this region.

Regional Stratigraphy

Precambrian: The composition of the crystalline basement underlying this region is unknown, but is thought to be a gneissic granite similar to that exposed in the adjacent portion of the Canadian Shield, which has been dated at 1,765 million years. Overlying these basement rocks are the Hornby Bay Group sediments. The Hornby Bay Group consists of quartzite, conglomerate and dolomite with a total stratigraphic thickness of up to 8,000 feet (2,400 m). The age of this group is Helikian or late Aphebian. The Hornby Bay Group was intruded by the basic and ultrabasic rocks related to the Muskox intrusion, which have been dated at 1,155 million years.

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Overlying the Hornby Bay Group is the Coppermine River Series. This series consists of up to 11,000 feet (3,300 m) of amygdoloidal basaltic flows which may be genetically related to the Muskox intrusion. The most probable age for the Coppermine Basalts is 1,065-1,200 million years. Following the implacement of these flood basalts, the region was uplifted and eroded before the overlying sedimentary units were layed down. The original Coppermine River Series included an upper succession composed of interlayered sandstone, shale, dolomites and minor limestones and gypsum. It appears most likely that these unaltered sedimentary rocks belong to the late Proterozoic Shaler Group. The age of the Shaler Group is Hadrynian or Neohalikian. Based on seismic evidence, the thickness of this group ranges up to 30,000 feet (9,000 m) in the report area.

The Shaler Group was intruded by diabase dikes and sills which have been dated at 635 to 640 million years. Following this intrusion, the region was broadly folded and eroded to a peneplain before the Paleozoic succession covered the region.

Paleozoic: The Lower Cambrian Old Fort Island Formation is the basal Paleozoic unit in this region. This mature, medium to coarse grained, quartz sandstone ranges up to 300 feet (90 m) thick in this area. Sedimentary structures within this formation are indicative of a shallow water marine depositional environment.

The Old Fort Island Formation is overlain conformably by the Cambrian Mount Cap Formation. The Mount Cap Formation is a succession of glauconitic sandstone interbedded with siltstone and shale with several orange-weathering dolomite units present near the top of the formation. This formation ranges from 200 to 600 feet (60 to 180 m) thick. The Mount Cap Formation has been dated as middle Cambrian and like the Old Fort Island Formation is of shallow water marine origin.

The overlying Saline River Formation is also middle Cambrian in age and is made up of a lower evaporite unit and an upper shale unit. The lower unit consists of interbedded salt, anhydrite, shale and minor dolomite up to 300 feet (90 m) thick. The upper unit is composed of interbedded green and red shale with thin flaggy interbeds of siltstone and silty dolomite with a composite thickness of up to 500 feet (150 m). The composition and sedimentary structures of this formation are interpreted as indicative of shallow water marine and restricted marine environments.

The Cambrian and Ordovician Franklin Mountain Formation conformably overlies the Saline River. The Franklin Mountain Formation has been subdivided into three rock stratigraphic units; the "Cyclic", "Rhythmic", and "Cherty" units. The basal "Cyclic" unit is a transition unit between the underlying clastics and evaporites and the overlying carbonate sequence. This unit is characterized by cyclic repetitions of dolomite with green dolomitic shale up to 150 feet (50 m) thick.

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The middle "Rhythmic" unit is composed of dolomite which exhibits a subtle banded appearance due to the alternating colors and resistance of the strata. The "Rhythmic" unit is readily distinguishable from the underlying unit due to its relative resistance to erosion as compared to the "Cyclic". The "Rhythmic" unit ranges from 500 to 1,400 feet (150 to 420 m) thick in this region.

The upper "Cherty" unit of the Franklin Mountain Formation is a dolomite unit distinguished by vugs lined with varicolored druzy quartz and beds of light grey to white chert. This resistant unit is up to 1,500 feet (457 m) thick. The differentiation of the "Cherty" unit from the "Cyclic" unit is much easier in surface exposures than in the subsurface of this region.

The ages of the three units of the Franklin Mountain Formation are still somewhat in doubt. An Upper Cambrian age has been tentatively assigned to the "Cyclic" unit. The Cambrian-Ordovician boundary is placed somewhere within the upper part of the "Rhythmic" unit and the "Cherty" unit is presently considered Ordovician in age. All three units appear to be of shallow water marine origin.

The Ordovician-Silurian Mount Kindle Formation disconformably overlies the Franklin Mountain over most of this area and is unconformably overlain by either Devonian or Cretaceous strata. This formation, which reaches a maximum thickness of 425 feet (130 m), is a dolomite unit which is characterized by beds of abundant nodules of chert and a silicified fauna of late Ordovician and early Silurian age. The Mount Kindle and the Franklin Mountain Formations were once included together as the Ronning Group, but recognition of the disconformity between the Mount Kindle and the underlying unit necessitated the change in nomenclature. Like the Franklin Mountain Formation, this formation was deposited in a shallow water marine environment.

The Middle Devonian Bear Rock Formation is composed of dolomite, limestone and rarely exposed white gypsum and ranges up to 1,800 feet (550 m) thick. Thick units of solution brecciated dolomite and limestone occur widely over this region. The Bear Rock Formation is widely distributed and is thickest to the west and southwest. The composition of this formation indicates a shallow water and restricted marine depositional environments.

The relatively resistant Middle Devonian Hume Formation conformably overlies the Bear Rock Formation and consists of interbedded units of fossiliferous limestone and shale. The variable resistance of these two lithologies produces three or more persistent scarps which are excellent photogeologic markers over this region. The thickness of this formation ranges from 400 to 550 feet (120 to 170 m) and its distribution is confined to the west and southwest parts of the area. This Hume Formation is the youngest shelf carbonate unit in the thick sequence of carbonates which begins with the Franklin Mountain Formation.

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Conformably overlying the Hume Formation is the shale of the Middle Devonian Hare Indian Formation. Maximum thickness measured for this recessive sequence is about 600 feet (183 m). Exposures are confined to the southwest part of the map area and along the Carnwath River near the northwest margin of the area.

Mesozoic: The basal Cretaceous unit, which unconformably overlies the Lower Paleozoic succession in this region, is the Sans Sault Formation. This mature sandstone is found in sporatic outcrops over most of the area and provides an extensive cover in the east and northwest. Excellent exposures are present along the west flank of Belot Ridge and along the northwest shore of Lac des Bois. The thickness of this formation was never over 150 feet (50 m). It was deposited on a surface with relief of up to 200 feet (61 m) and has been dated as early Cretaceous.

The youngest Mesozoic unit exposed in this region is an unnamed Cretaceous shale unit. This unit consists of soft, brownish grey shale and minor siltstone with local ironstone concretions. This unit has similar distributions to the Sans Sault Formation, but slightly more restricted. The best exposures were noted along the northwest shore of Lac des Bois and have been dated as early Cretaceous.

An unnamed Tertiary unit is present at the extreme southwest margin of the area, south of Brackett Lake. This unit is made up of continental sediments including shale, sandstone and lignite. Exposures of this unit were not observed within the area, but are known further south. The thickness of this Tertiary outlier is unknown within the area, but reaches a thickness of 6,000 feet (1,829 m) in the vicinity of Fort Norman. The Tertiary exposed near Fort Norman has been dated as Eocene.

TURTON LAKE (TEXACO) BLOCK

The Turton Lake Block is situated between 65°25' and 66°00' north latitude and 126°15' and 127°30' west longitude. The permit block is roughly triangular in outline and extends over the northeastern third of map NTS 96. The center of the area is approximately 50 miles north of Norman Wells. Physiographically, the area is entirely within the Franklin Mountains.

Stratigraphy: Strata in this permit block range in age from Cambrian to the Middle Devonian. The sedimentary succession within this area consists predominantly of carbonate rock with minor shale. The oldest unit exposed is the Cambrian and Ordovician Franklin Mountain Formation. This sequence of carbonates is in excess of 2,500 feet (760 m) thick in this region. The "Cherty", "Rhythmic" and "Cyclic" units have all been recognized within the area.

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Overlying the Franklin Mountain Formation is the Ordovician and Silurian Mount Kindle Formation. This formation thins from about 200 feet (60 m) toward the southwest across this permit and may be entirely absent in the southwest extremity of the area. Because of the relatively resistant nature of this siliceous dolomite unit, it can be readily distinguished from overlying rubbly exposures of the Bear Rock Formation.

The Middle Devonian Bear Rock Formation is composed of solution brecciated dolomite, which is the product of differential solution of interbedded evaporites and resultant collapse. This rock unit is approximately 1,100 feet (335 m) thick in this area. Despite the generally poor, rubbly exposures characteristic of the Bear Rock Formation, several relatively resistant units can be recognized in the upper part of this formation. This formation is the most widely distributed unit within the Turton Lake Permit area.

The Hume Formation, which is about 500 feet (150 m) thick, is a moderately resistant Middle Devonian limestone and shale unit. Within the Turton Lake area, this formation forms a series of mesas and plateaus over the southwest part of the area due to its resistant nature relative to the adjacent strata above and below.

The Hare Indian Formation is a recessive Middle Devonian, shale unit which is about 500 feet (150 m) thick in this region. This formation is exposed only at the southwestern margin of the Turton Lake Block.

Structure: Structures within this area are typical of the Franklin Mountains. Two prominent orientations are noted for the structures present, east-west and northwest-southeast. The easternmost range of the Franklin Mountains is present along the eastern margin of this permit block and the east-west trending northern edge of the Franklins is located just to the north of the block. The structure of these ranges is dominated by a series of assymetric, fault flextures. These flextures are essentially very large drag folds along a regional fault system. Sudden reversals of throw along these fault zones result in associate folds being alternately located on either side of the fault with opposite assymetry. The overall effect has been characterized by offliers of the Geologic Survey of Canada as "flip-flop" structures. In the northeastern part of the Texaco lands there is an excellent example of this type of structure. Here a faulted-fold structure passes northward from a faulted, assymetric, north-south trending fold with a steep east flank to a northwest trending structure with the fault and steeper flank on the southwest side. The accompanying geologic map of the Turton Lake Block (Fig. 2) illustrates this structural configuration.

One possible explanation for this type of structural configuration is that it represents the surface expression of a strike-slip fault system located along the outer margins of the Franklin Mountains. This would

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Plate 1

South part of "Kelly" Anticline illustrating the assymetry of the structure and the south plunge of the anticline toward Kelly Lake.

Plate 2

North end of "Kelly" Anticline showing the north plunge of the structure.

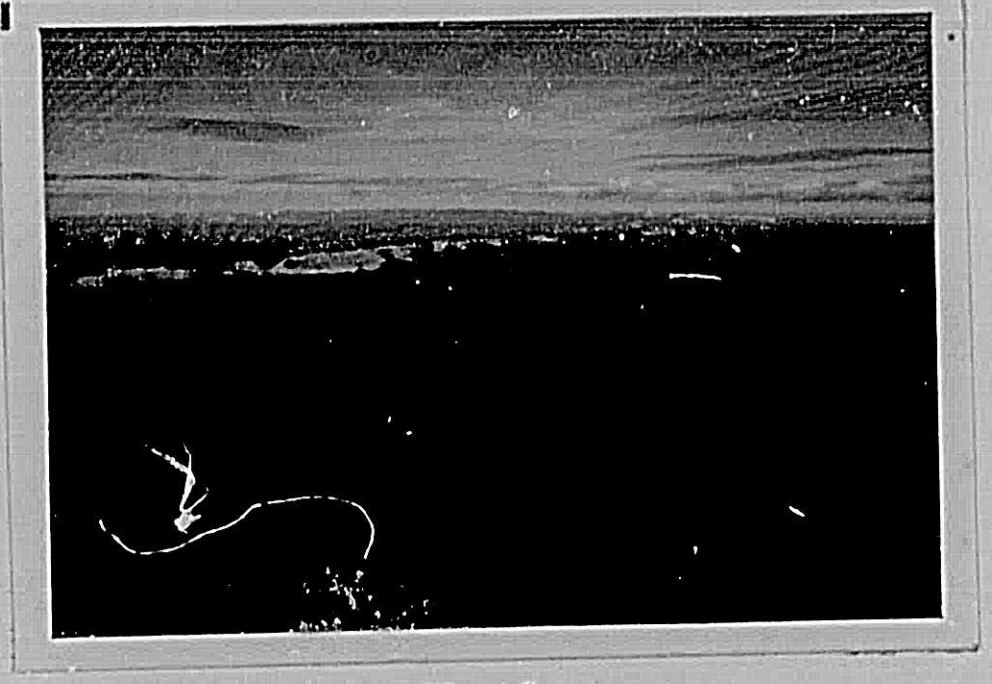

Plate 1

South part of "Kelly" Anticline illustrating the assymetry of the structure and the south plunge of the anticline toward Kelly Lake.

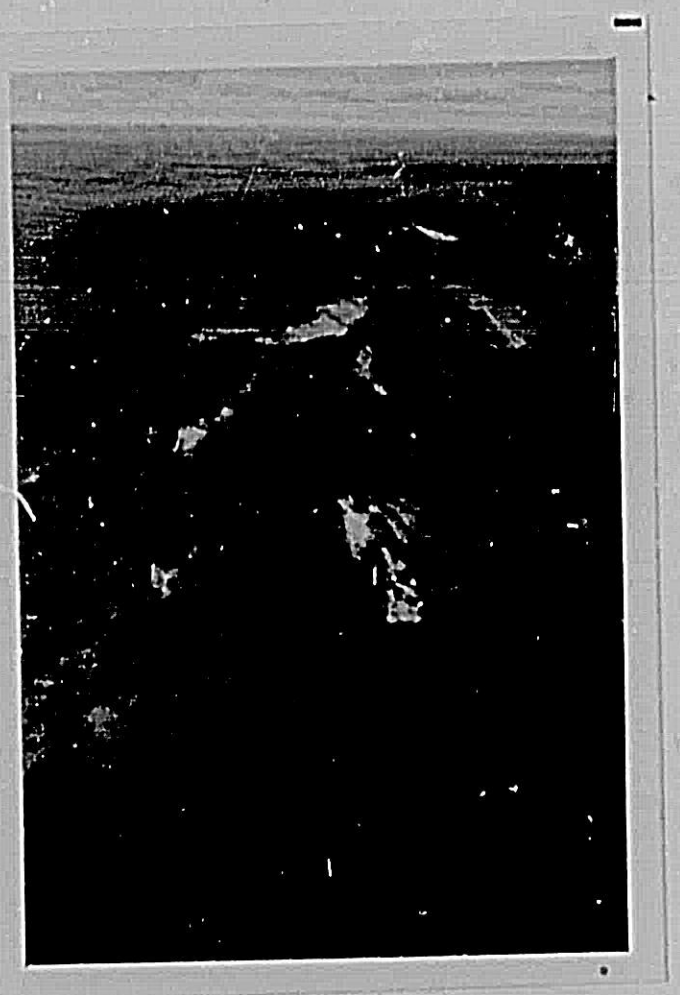

Plate 2

North end of "Kelly" Anticline showing the north plunge of the structure.

account for the sudden reversal of throw along the fault zone since the phenomenon is characteristic of this type of fault. This model would also account for the regional nature of this fault system. A system of right lateral fault movement at the margin, with a basement plate underlying the Franklin Mountains, could produce the observed structures by a clockwise rotation of the underlying intercratonic blocks.

From an economic standpoint, one structure referred to informally herein as the "Kelly" Anticline, is the most prospective structure delineated within the area. This name is used since the anticline parallels the elongated part of Kelly Lake, for some distance. The fold is oriented toward the north-northwest and is approximately 20 miles (32 km) long and 5 miles (8 km) wide.

There exists a minimum closure of 400 feet (122 m) on this assymetric anticline. The apex of the structure is located at approximately 65°30' north latitude and 126°17' west longitude. Seismic survey lines were observed along the structure so that the existence of the structure is already well documented by Texaco. The Franklin Mountain Formation is exposed in the core of this anticline and the Mount Kindle and Bear Rock Formations are found on the flanks. Dips range from 5° to 6° on the gentle east flank of the anticline and from 10° to 15° on the steeper west flank. The assymetry suggests that the structure may be faulted in the subsurface, although no faulting could be observed at the surface. Plates 1 and 2 illustrate the surface expression of the "Kelly" Anticline.

Other structures are present within the area, however, these fall into two categories, small low amplitude folds and large complexly faulted homoclines. The first category is typified by the series of fault related en echelon folds west of Turton Lake. The other group of structures would be exemplified by the faulted mountain ranges on the eastern periphery of the Franklin Mountians. The first group of structures were downgraded because of their small size and the second group because of their highly fractured nature.

BRACKETT LAKE PERMITS

The Brackett Lake permits are jointly held by Union Oil Company of Canada Limited and Canadian Reserve Oil and Gas Ltd. and are located in the area between Brackett and Mahony Lakes, 65°20' to 65°30' north latitude and 125°07'30" to 125°30' west longitude. Geologically, the permits are located along the eastern margin of the Franklin Mountains, with the northeast part of the area actually straddling the boundary of the Franklin Mountains and the Great Bear Plain. Local relief exceeds 800 feet (240 m) associated with structural highs, but the area adjacent to Brackett Lake itself is part of a broad lake-studded lowland.

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Plate 3

The faulted assymetric "South Mahony" Anticline southwest of Mahony Lake.

Plate 4

View toward the northwest across the Brackett Lake Permits showing the lake filled graben in the central part of the area and the faulted half dome beyond.

Plate 3

The faulted assymetric "South Mahony" Anticline southwest of Mahony Lake.

Plate 4

View toward the northwest across the Brackett Lake Permits showing the lake filled graben in the central part of the area and the faulted half dome beyond.

Stratigraphy: The oldest formation recognized in the area is the cherty unit of the Ordovocian-Cambrian Franklin Mountain Formation. This rock unit is exposed immediately southwest of Mahony Lake and adjacent to an unnamed lake in the center of this permit group. In both cases, the exposures are due to the erosion of younger strata over structural highs. The cherty unit of the Franklin Mountain Formation consists of a resistant, buff microcrystalline dolomite with local chert interbeds. The Brackett Lake geologic map (Fig. 3) illustrates the distribution of this rock unit within the area.

The overlying Ordovician-Silurian Mount Kindle Formation forms the poorly exposed bedrock for the remainder of the permit block. This formation is relatively resistant and forms a strip surface over much of this area, i.e. the topographic surface is essentially the same as Mount Kindle bedrock surface. Lithologically, the Mount Kindle is a fossiliferous, siliceous, buff weathering dolomite. The uppermost rock unit is particularly resistant and much of the topography of this area conforms to this stratigraphic interval.

Structure: There are two prominent structures within this area which can be considered potential hydrocarbon traps (Fig. 3). The first is a faulted, assymetric anticline southwest of Mahony Lake which is referred to as "South Mahony" Anticline, while the second is a faulted half dome southwest of the unnamed lake in the central part of the area. "South Mahony" Anticline has structural relief of at least 800 feet (240 m) and is shown in Plate 3. This anticline is oriented northwest-southeast and is faulted on the northeast flank producing the more steeply dipping east limb of this assymetric structure. The anticline is closed in both directions producing an excellent structural trap.

The half dome structure is also oriented northwest-southeast and broken by a fault to the northeast (Plate 4). The structural relief appears to be in the order of 200 feet (60 m). No reversal of dip could be observed on the structure, however, closure against the fault provides a viable structural trap. This half dome is broken by several normal faults, none of which appear to have appreciable vertical displacements.

Separating these two structures, and immediately adjacent to the half dome, is a lake filled graben. This structure, as are others in this area, is oriented northwest-southeast and is the structural low between the two prominent structural highs previously discussed.

Given the existence of two untested structures within this permit block, it is recommended that Union retain our interest and possibly drill ("South Mahony" Anticline) at some future date in order to test the hydrocarbon potential of the area.

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Plate 5

View north across the Hare Indian River showing the resistant benches in the upper part of the Bear Rock Formation and the lower part of the Hume Formation.

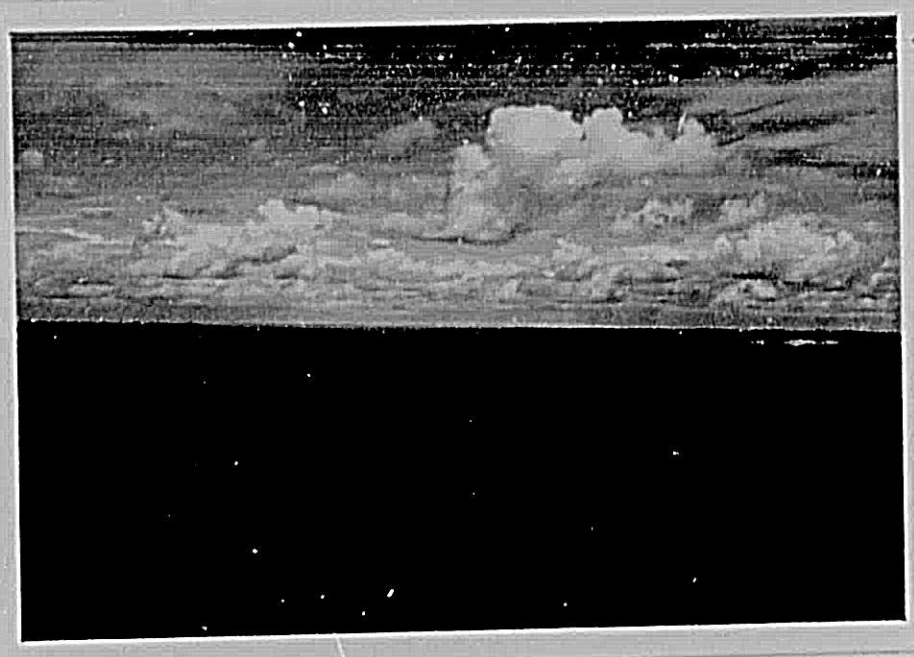

Plate 6

Looking north from Lac 'a Jacques illustrating the general westward regional dip.

Plate 5

View north across the Hare Indian River showing the resistant benches in the upper part of the Bear Rock Formation and the lower part of the Hume Formation.

Plate 6

Looking north from Lac 'a Jacques illustrating the general westward regional dip.

LAC 'A JACQUES PERMITS

The Lac 'a Jacques permits, which are jointly held by Union Oil Company of Canada Limited and Aquitaine Company of Canada Ltd., are located north and east of Lac 'a Jacques between 66°10' and 66°30' north latitude and 127°00' and 127°30' west longitude. The topography of this region has a moderate relief of about 500 feet (150 m) and consists of a flat topped upland dissected by the broad valley of the Hare Indian River and its tributaries. This valley and the topographic low extending north of, and occupied by, Lac 'a Jacques appear to be glacial meltwater channels. The Hare Indian River is an underfit stream flowing in an incised valley that was the principle discharge channel for Great Bear Lake during the later stages of glaciation (Craig, 1960) while the present discharge course down the Great Bear River was presumably still ice-bound.

Stratigraphy: The oldest rocks exposed within this permit block belong to the Middle Devonian Bear Rock Formation. Strata of the Bear Rock Formation cover the entire southeast part of the area and are well exposed in the bluffs along sections of the Hare Indian River Valley. The overlying Middle Devonian Hume Formation is fairly well exposed as a sequence of resistant flat topped benches which cap the Bear Rock and dip gently toward the west (Plate 5). These resistant beds persisted over most of the area and it was possible to do quantitative structural mapping by measuring elevations of key beds with a helicopter altimeter while traversing the area. In the extreme southwest part of the area, separated by a regional unconformity, are the poorly exposed sandstone units belonging to the Lower Cretaceous Sans Sault Formation. The friable nature of this sandstone is responsible for the poor exposures, but a distinct marker horizon can be followed on the air photos of the area. With minor exception the G.S.C. mapping of the distribution of rock units within this area was found to be correct.

Structure: The dominant structure on this permit block is a west dipping homocline. This homocline dips at a rate of 50 to 100 feet per mile (15 m to 30 m) or generally less than a degree (Plate 6). Elevations taken on a key bed in the lower part of the Hume Formation allowed construction of a structural contour map (Fig. 4) over much of this area. This map illustrates a general westward regional dip with a slight steepening at the western margin of the area.

Only two structures interrupt this regional pattern within the permit block, a fault in the northeast corner and a rather poorly defined anticline in the southeast part of the block. The fault trends northwest-southeast and has a throw of 50 feet to 100 feet (15 m to 30 m) as determined by correlating elevations of a key bed across the fault. This fault is a simple vertical separation of the regional homocline and no flexure

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was observed associated with it. The anticline in the southeast section of the area, south of the Hare Indian River, is expressed as a geomorphic anomaly and as a series of poorly expressed dip slopes in the Bear Rock Formation. This northwest-southeast trending structure plunges toward the northwest with no apparent culmination within the permit block. The structure is moderately well expressed on air photos and as a geomorphic anomaly, but field observations could not conclusively confirm its existence.

PANCANADIAN PERMITS

The PanCanadian Petroleum Limited permits that were mapped during this field program are located between Mahony Lake and the Hare Indian River, from 65°40' to 66°10' north latitude and from 124°45' to 126°45' west longitude. The area extends westward from Bydand Bay on Great Bear Lake to the plain immediately west of Tunago Ridge and is crossed from east to west by the incised valley of the Hare Indian River. Much of the area is poorly drained and swampy with numerous sinkholes. These sinkholes divert much of the surface drainage underground and many of the lakes in this area are in fact, plugged sinkholes. The glacially modified karst topography in this region is undergoing rapid rejuvenation as evidenced by numerous solution collapse features and sinking streams.

Stratigraphy: Within these permits only three formations were observed to outcrop. They are the Cambrian-Ordovician Franklin Mountain Formation, the Ordovician-Silurian Mount Kindle Formation and the Devonian Bear Rock Formation. With the exception of the Tunago Ridge structure, which exposes the Franklin Mountain Formation in its core, the plain west of Tunago Ridge, which is underlain by the Bear Rock Formation, and one erosional outlier of Bear Rock in the southeast part of the area, the permits are underlain entirely by the Mount Kindle Formation. The resistant upper unit of the Mount Kindle forms a strip surface over most of the area, which means that the topographic contours can be treated essentially as structure contours.

Structure: There are three structures within this PanCanadian Permit Group which are of interest as potential hydrocarbon traps. They are "Mahony Dome", "Hare Indian" Anticline, and the Tunago Ridge structure. These structures are illustrated by the accompanying geologic map (Fig. 5). Although other structures are present within this area, none are considered of sufficient size to be viable entrapment mechanisms.

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Plate 7

Mahony Dome is the dry upland surrounded by lakes in the center of this photograph. View toward the southeast, note north end of Mahony Lake on background with the "South Mahony" Anticline to the left.

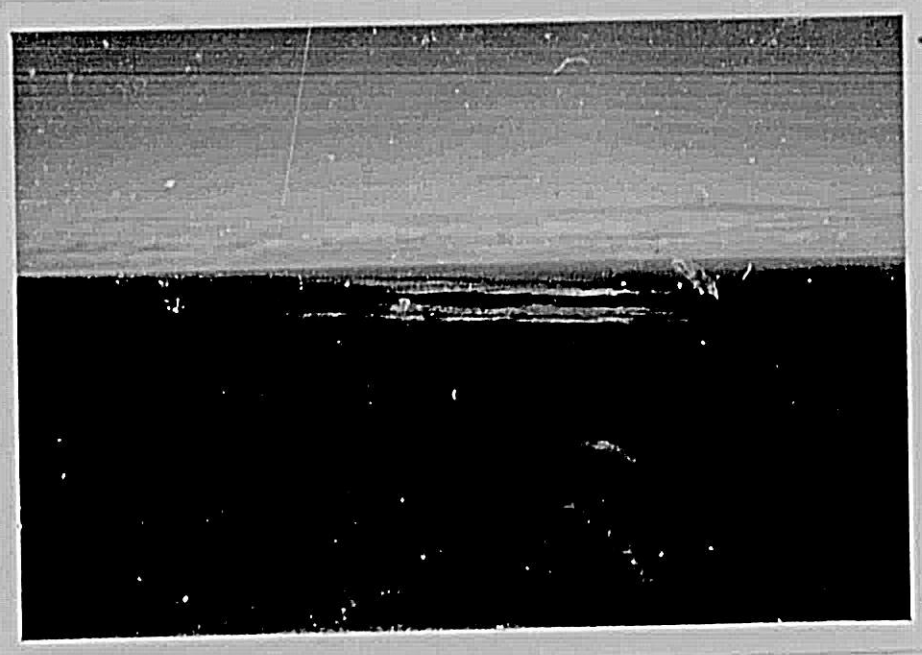

Plate 8

Looking Northeast toward Smith Arm of Great Bear across the axis of "Hare Indian" Anticline showing the east dip beds of the Mount Kindle Formation.

Plate 7

Mahony Dome is the dry upland surrounded by lakes in the center of this photograph. View toward the southeast, note north end of Mahony Lake on background with the "South Mahony" Anticline to the left.

Plate 8

Looking Northeast toward Smith Arm of Great Bear across the axis of "Hare Indian" Anticline showing the east dip beds of the Mount Kindle Formation.

The most significant structure present in this permit group is "Mahony Dome" (Plate 7). This broad north-south trending dome measures 11 miles by 17 miles (18 km by 27 km) with a minimum closure in excess of 200 feet (60 m). The dome is broadly assymetric with a slightly steeper east flank. The apex of the structure occurs at approximately 65°46' north latitude and 125°27' west longitude. The structure is completely expressed, at the surface, by the Ordovician-Silurian Mount Kindle Formation. Toward the northeast, this structure is separated from the "Hare Indian" Anticline by a northwest trending syncline.

The "Hare Indian" Anticline (Plate 8) extends for approximately 33 miles (53 km) in a general north-south direction. The width of the structure varies from 2 miles to 3 miles (3 km to 5 km) with at least two culminations located along its axial trend. One of these culminations occurs within the PanCanadian land at approximately 65°59' north latitude and 125°15' west longitude. The structure trends northwest-southeast through the PanCanadian block, then swings to a north-south orientation toward the crown land to the north. The anticline is essentially unfaulted and has local closure of about 200 feet (60 m). Like "Mahony Dome", the surface exposures all consist of Mount Kindle Formation.

The third structure of interest in this area is Tunago Ridge. This is a narrow north-south trending faulted homocline with considerable structural relief. This ridge forms a direct structural link between the Franklin Mountains and the structures of the Colville Hills as noted by D. G. Cook and J. D. Aitken (1971). The structure has the Cambrian and Ordovician Franklin Mountain Formation exposed against the fault and, as noted previously, it is the only structure to do so in this permit group.

The petroleum potential of this structure is rated as low due to its faulted nature, lack of identifiable closure and the fact that a similar structure has been drilled to the north by Mobil Oil, the Belot Hills M-63 well, with negative results.

SOUTHWEST BELOT HILLS (CROWN LAND)

The crown land west of Belot Ridge and north of the Hare Indian River was investigated in order to identify and evaluate possible structures. The existence of one large structure was suspected based on a pre-field geomorphic interpretation of this area. For purposes of the present discussion, the area concerned is between 66°20' and 66°45' north latitude and 126° and 127° west longitude.

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Plate 9

North end of the Lost Lake Anticline. Note karst development along axis of structure possibly due to tension fracturing.

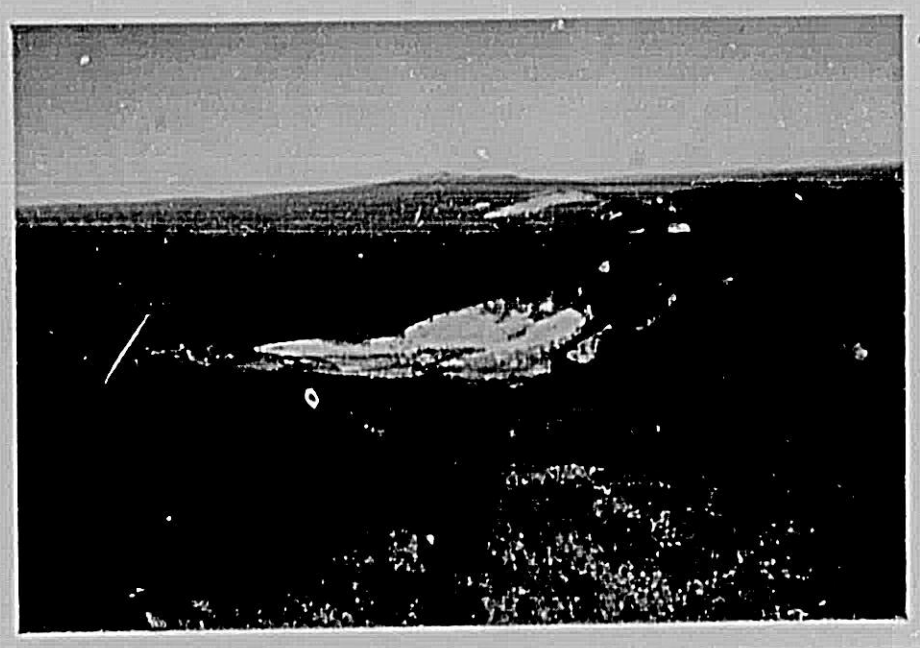

Plate 10

Look north along the Belot Ridge Anticline. The peak along the horizon was the apex of the structure drilled by Mobil Oil (Mobil Belot Hills M-63).

Plate 9

North end of the Lost Lake Anticline. Note karst development along axis of structure possibly due to tension fracturing.

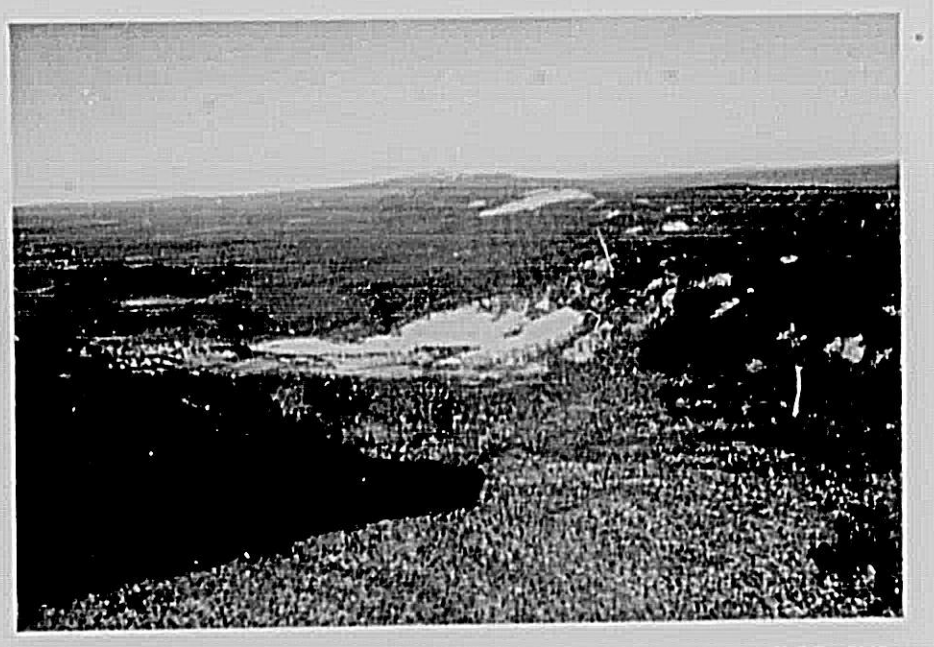

Plate 10

Look north along the Belot Ridge Anticline. The peak along the horizon was the apex of the structure drilled by Mobil Oil (Mobil Belot Hills M-63).

Stratigraphy: Two formations are exposed at the surface within this permit group. They are the Ordovician-Silurian Mount Kindle Formation and the Middle Devonian Bear Rock Formation. Dolomite of the Mount Kindle Formation is exposed along the eastern margin of the map area, with the remaining exposures found in the central part of the area adjacent to the incised valley of the Hare Indian River and its tributaries.

The carbonate and interbedded evaporite of the Bear Rock Formation are present over the remainder of the area. An extensive karst terrain is developed in the area underlain by the Bear Rock. Steep walled collapsed sinkholes are common (Plate 9) and several springs were observed issuing from this formation along the incised tributaries north of the Hare Indian River. Exposures of the Bear Rock Formation are typically poor, although several resistant units are found locally which can be used to determine the structural attitude of the formation.

Structure: Only one broad simple low amplitude anticline was mapped in this area which could be considered of any significance as a structural trap for hydrocarbons. This north-south trending structure has been given the informal name "Lost Lake" Anticline on the geologic map (Fig. 6) of the area accompanying this report. Although the surface definition of this structure is poor, enough dip information was collected to fix the axial trend of this anticline with reasonable accuracy. The maximum structural relief on this fold would appear to be about 150 feet (45 m), but a seismic survey would be necessary to define its exact geometry.

Two other structures are evident along the eastern margin of the area. They are the Belot Ridge Anticline (Plate 10) and a part of the Tunago Ridge structure. Both structures have similar geometry, i.e. long, narrow, faulted, sharply assymetric, anticlines. Further north, on an apex of Belot Ridge Anticline, Mobil Oil drilled a 4200 foot (1,280 m) test (Mobil Belot Hills M-63) with negative results. Thus it can be inferred that this type of structure does not form a suitable hydrocarbon trap. Further investigation of these two structures would not seem warranted.

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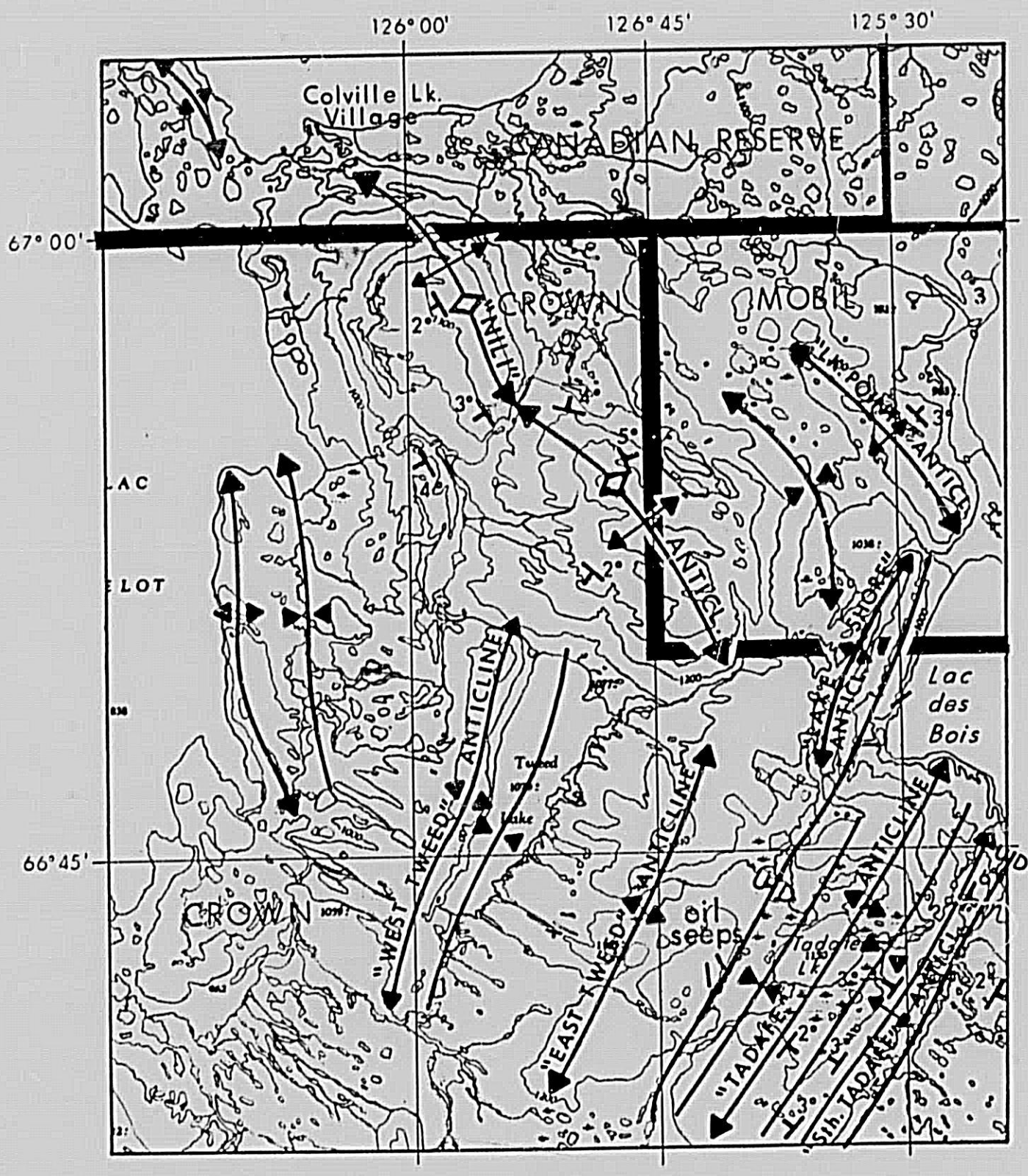

Figure 7

SOUTH COLVILLE AREA

SCALE 1:250,000
CONTOUR INT. 100'

Z-1539

SOUTH COLVILLE AREA (MOBIL & CROWN LAND)

This area is located between Lac Belot and Lac des Bois and south of Colville Lake. Figure 7 illustrates the exact location and extent of the structures in the area under discussion. There is moderate relief within the area with the most prominent topographic features being the twin hills which comprise the surface expression of "Nili" Anticline. Glacial drift thicknesses are minimal over most of the area, however, glacial fluting is well developed.

Stratigraphy: Three formations are exposed within this area, the Ordovician-Silurian Mount Kindle Formation, the Middle Devonian Bear Rock Formation and the Cretaceous Sans Sault Formation. The Mount Kindle Formation is extensively exposed throughout this region. Most of the southeast part of the area and nearly all the remaining upland areas are underlain by this formation. The remaining lowlands are occupied by the Bear Rock Formation and the Sans Sault Formation. A strip surface is developed on the upper resistant unit of the Mount Kindle Formation and several resistant units within the Bear Rock Formation. Thus, as elsewhere in this region, the topographic map can be read essentially as a structure contour map. This approximation is valid over this entire area.

A minor outcrop of the Cretaceous sandstone occurs immediately adjacent to Lac des Bois. This outcrop of the Sans Sault Formation is a tar sand at this location and several minor tar seeps can be observed.

Structure: Numerous flextures have been identified within the region, but with the exception of "Nili" Anticline, none are considered large enough to be of economic interest (Fig. 8). Two perpendicular structural orientations exist in this area. In the south-central and southeast parts of the area, a strong northeast-southwest preferred structural orientation is exhibited by all the faults and folds present. However, to the north and northwest the structural grain is northwest-southeast. This suggests that either we are looking at two generations of structural deformation with markedly different orientations of the principle horizontal stress or a local intercratonic plate margin exists within the area and, therefor, the structures present are the result of a different structural response to the same stress system. Lacking any evidence of two different ages of deformation, the intercratonic plate hypothesis appears to have more merit.

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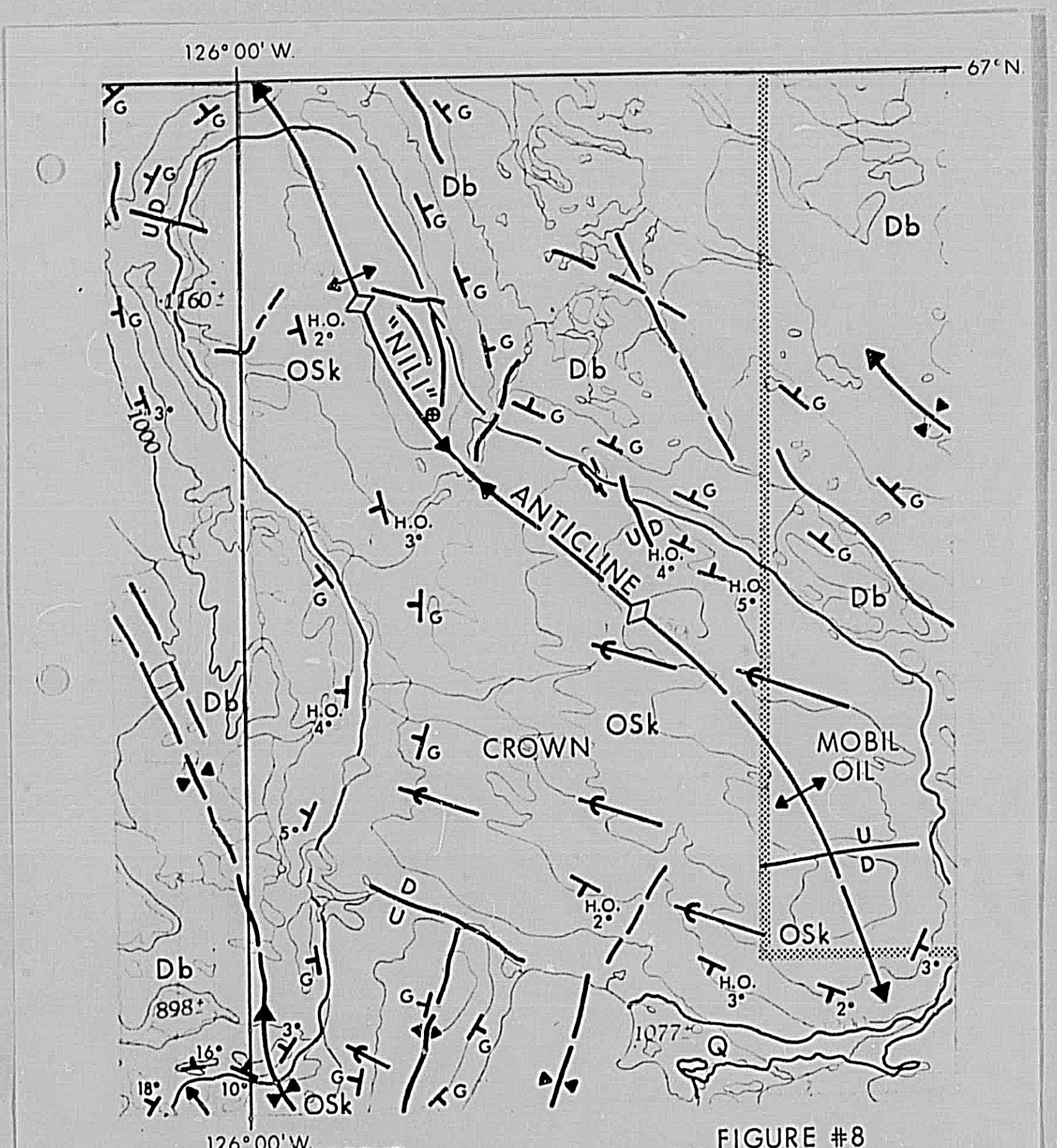

FIGURE #8
MOBIL OIL & CROWN LAND GEOLOGIC MAP of the NILI ANTICLINE

SCALE 1:100,000 CONTOUR INT. 100 FT.

OCT. /1975 File No. Z-1534

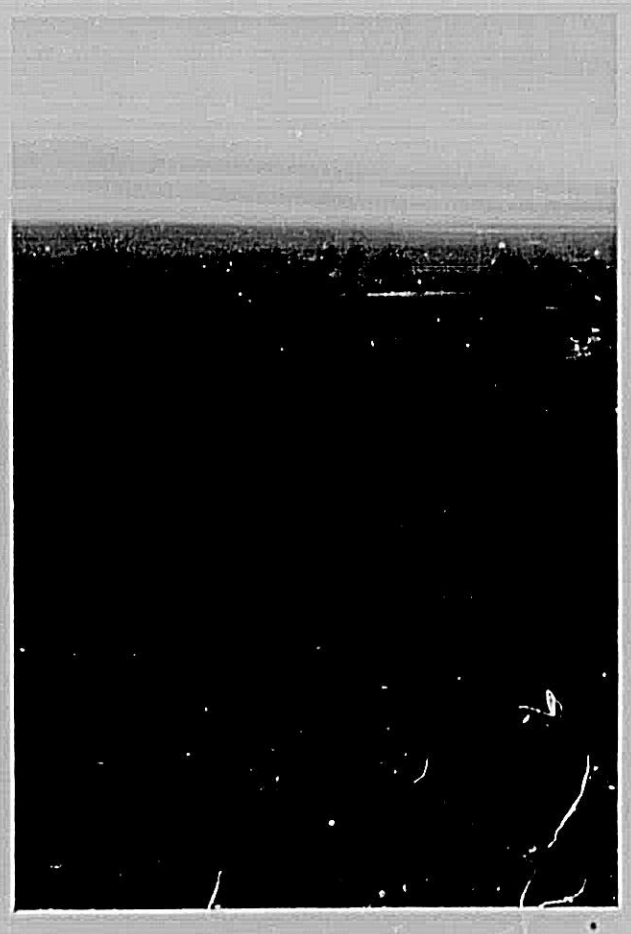

Plate 11

Looking south along the contact between the Bear Rock and Mount Kindle on the northeast flank of "Nili" Anticline.

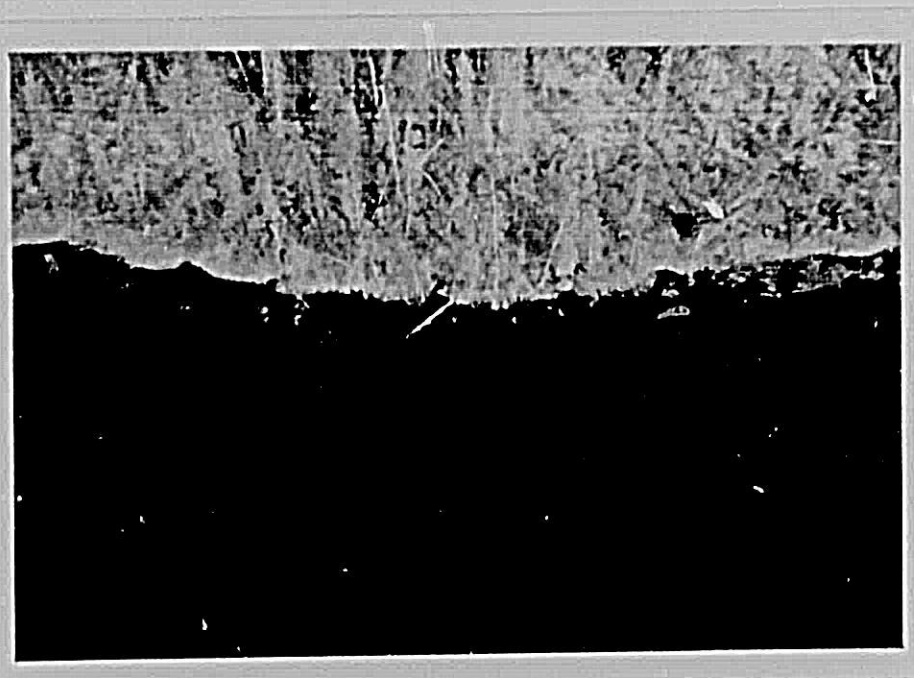

Plate 12

Oil seep producing a minor oil slick on a lake filled depression located along a fault zone west of Tadafe Lake.

Plate 11

Looking south along the contact between the Bear Rock and Mount Kindle on the northeast flank of "Nili" Anticline.

Plate 12

Oil seep producing a minor oil slick on a lake filled depression located along a fault zone west of Tadafe Lake.

"Nili" Anticline is located southeast of the village of Colville Lake between Colville Lake and Lac des Bois. The anticline is approximately 17 miles (27 km) long and 6 miles (9.6 km) wide. The structure is broadly assymetric with the northeast flank of the structure slightly steeper (Plate 11). Two separate closures appear to exist along the axial trend of the anticline with a minimum closure of 400 feet (120 m) separated by a saddle midway along the axis. Only minor flank faults were noted when mapping the structure. The accompanying geologic map (Fig. 8) shows the details of this anticline. Because of its relative simplicity and the large amount of closure on this anticline, this structure should be one of the prime exploration targets in this region.

No other flextures parallel to "Nili" Anticline, or belonging to the other set of structures with a northeast trend, appear to be of sufficient size to warrant further evaluation. Other structures in the area are typically small low amplitude folds expressed as low hills held up by the upper resistant unit of the Mount Kindle Formation.

Three oil seeps were noted in the area, only one of which was previously noted. The one known seep occurs in the Cretaceous sandstone exposed at the extreme western end of Lac des Bois. The two new seeps (Plate 12) which were detected during the course of this field work are located about 1.5 miles (2 km) west-southwest of Tadafe Lake. These seeps appear in lakes aligned along a northeast trending fault, which displaces the Mount Kindle Formation at the surface. The amount of vertical displacement is, at most, about 50 feet (15 m), therefore, the seeps are probably the result of fracturing along the fault rather than stratigraphically controlled. It should be noted that the original oil seep at Lac des Bois is on strike with these seeps and could represent dispersion of the oil from this fracture system through the porous, basal Cretaceous sandstone.

CANADIAN RESERVE (TEDJI) BLOCK

This Canadian Reserve block of land is bounded by 67°30' to 67°50' north latitude and 126°30' to 127°00' west longitude. The topography of the area consists of a series of low rolling hills with numerous lakes. Figure 9 illustrates the location of the area and the various structures present.

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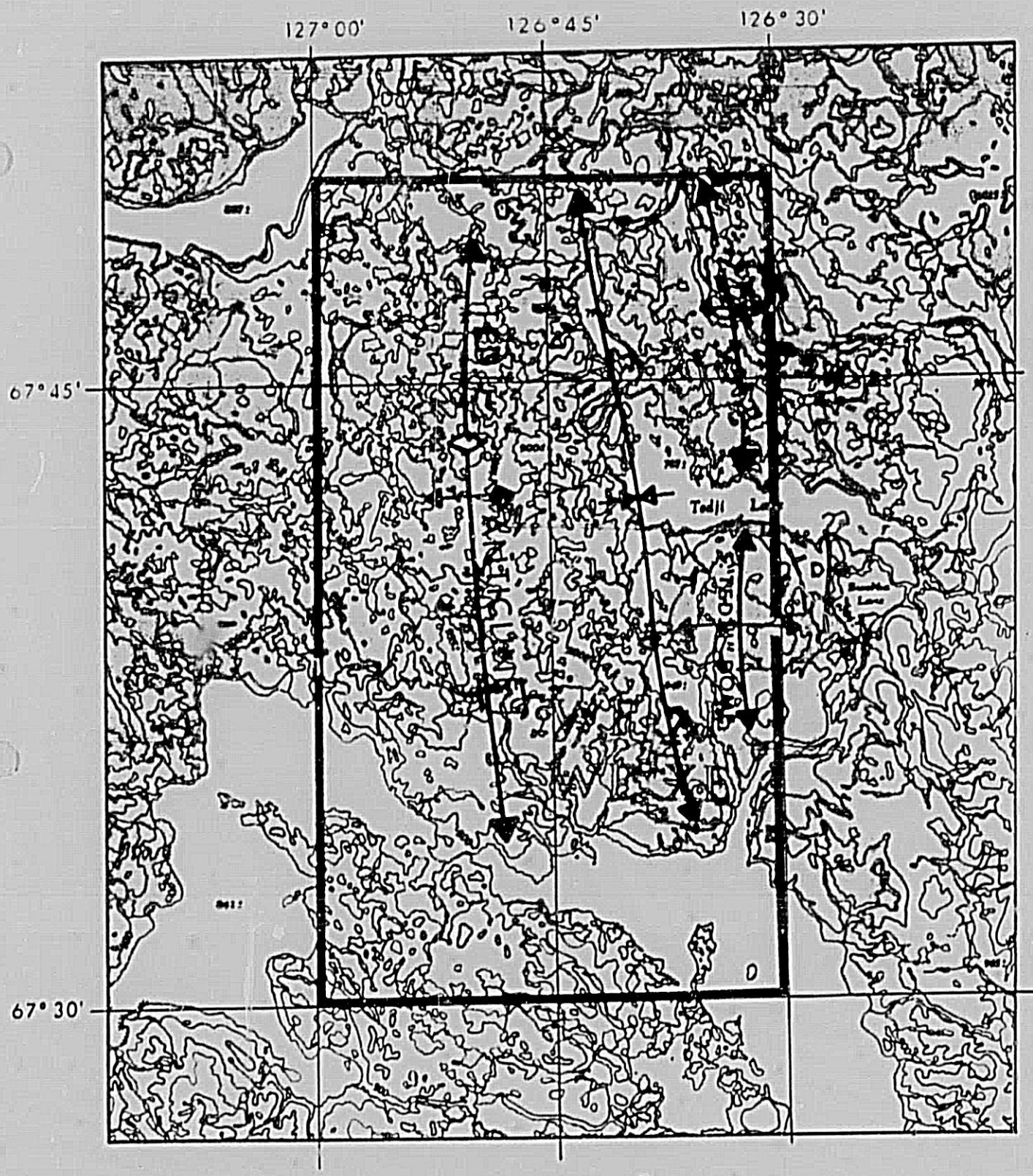

Figure 9

CANADIAN RESERVE (TEDJI) BLOCK

SCALE 1:250,000
CONTOUR INT. 100'

Z-1540

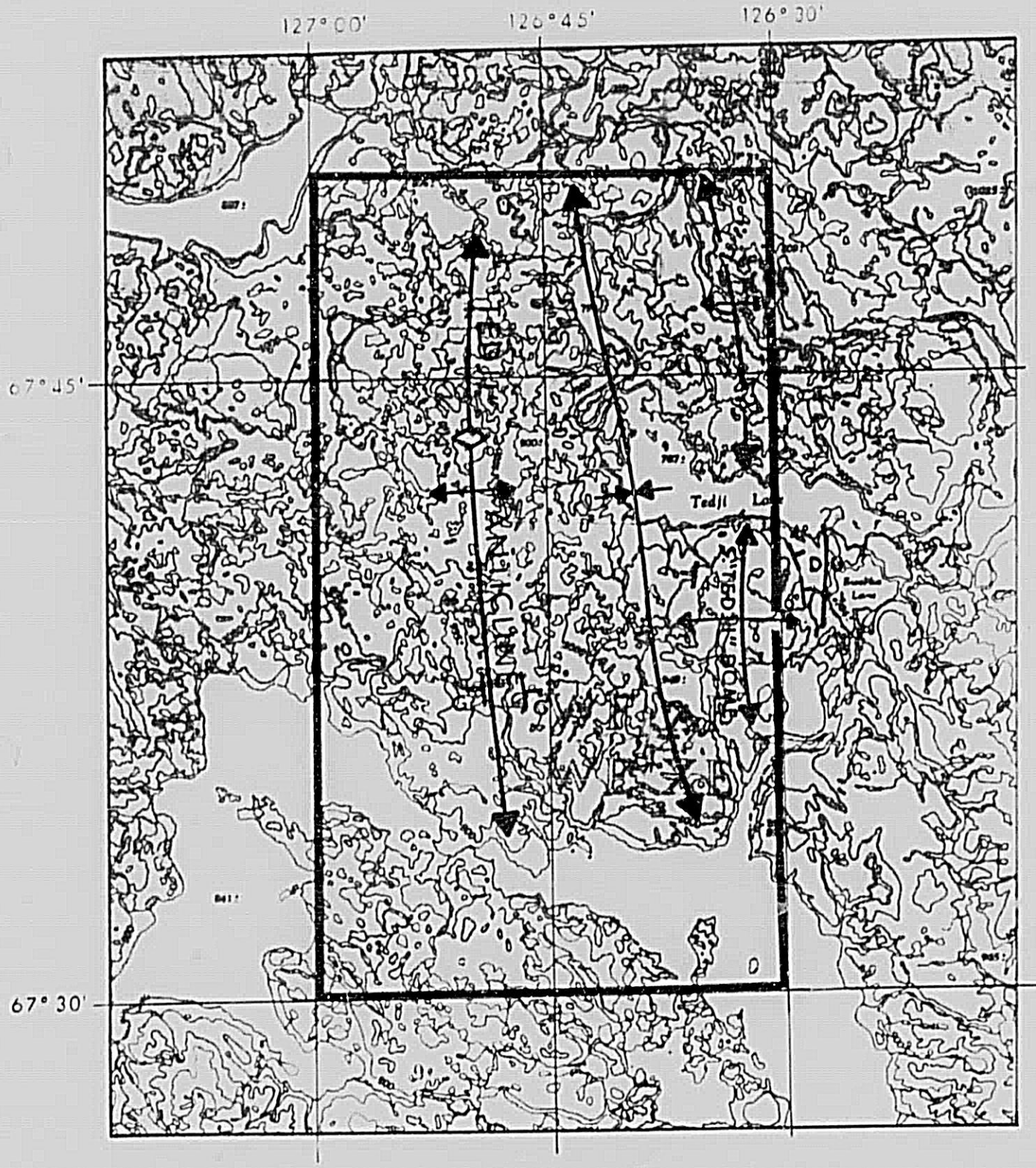

Figure 9

CANADIAN RESERVE (TEDJI) BLOCK

SCALE 1:250,000
CONTOUR INT. 100'

Z-1540

Plate 13

The Ashland et al Tedji Lake K-24 wellsite along the crest of Tedji Anticline.

Plate 14

View looking north at "South Tedji" Dome. The light toned negative patch in the distance marks the crest of the structure.

Plate 13

The Ashland et al Tedji Lake K-24 wellsite along the crest of Tedji Anticline.

Plate 14

View looking north at "South Tedji" Dome. The light toned negative patch in the distance marks the crest of the structure.

Stratigraphy: Exposures of the Middle Devonian Bear Rock Formation occur just south of Tedji Lake associated with the north end of the elongate "South Tedji" Dome. No other exposures occur within the area, but on the basis of the irregular topographic surface over the remainder of the area, it can be reasonably assumed that the Bear Rock Formation also underlies the entire permit block.

Structure: Three promising structures occur within the Tedji Block, ie. the Tedji Anticline, the "South Tedji" Dome and a third possible, unnamed structure located north of Tedji Lake.

The Tedji Anticline trends north from the northwest end of Aubry Lake. This structure has been well defined by seismic, but is relatively poorly expressed as a topography anomaly. The dimensions of this structure are roughly 16 miles by 4 miles (26 km by 6 km) with a minimum closure of 100 feet (30 m). This structure was tested by the Ashland et al Tedji Lake K-24 well and produced gas on drillstem tests. The well was located along the crest of the structure at 67°43'38" north latitude and 126°49' 56" west longitude (Plate 13). This well, in which Union has a small interest was the first significant hydrocarbon discovery in the Colville Hills. Any adjacent structures within this block thus take on increased importance.

Field observations revealed the existance of a structure just south of Tedji Lake, which has been given the informal name "South Tedji" Dome (Plate 14). This dome is elongate in a north-south direction and has a faulted northeast flank. The dome has moderately high structural relief and is about 6 miles (10 km) long by 4 miles (6 km) wide. Minimum closure on this structure, based on its topographic expression, is 150 feet (45 m) with dips measuring 4° to 7° along the north end of the structure. Although this structure is smaller than the Tedji Anticline, its proximity makes it the next logical structure to be tested in this area after a step-out well has been drilled on the Tedji Anticline.

A third possible structure is located north of Tedji Lake. This subtile topographic high could be the expression of a north-south trending anticline. The dimensions of this feature would be 8 miles by 3 miles (13 km by 5 km). The validity of this structure would require seismic confirmation. Estimated minimum structural relief would be about 100 feet (30 m). Although it is very difficult to make a positive identification of this structure, it should be pointed out that the Tedji Anticline also has poor topographic expression.

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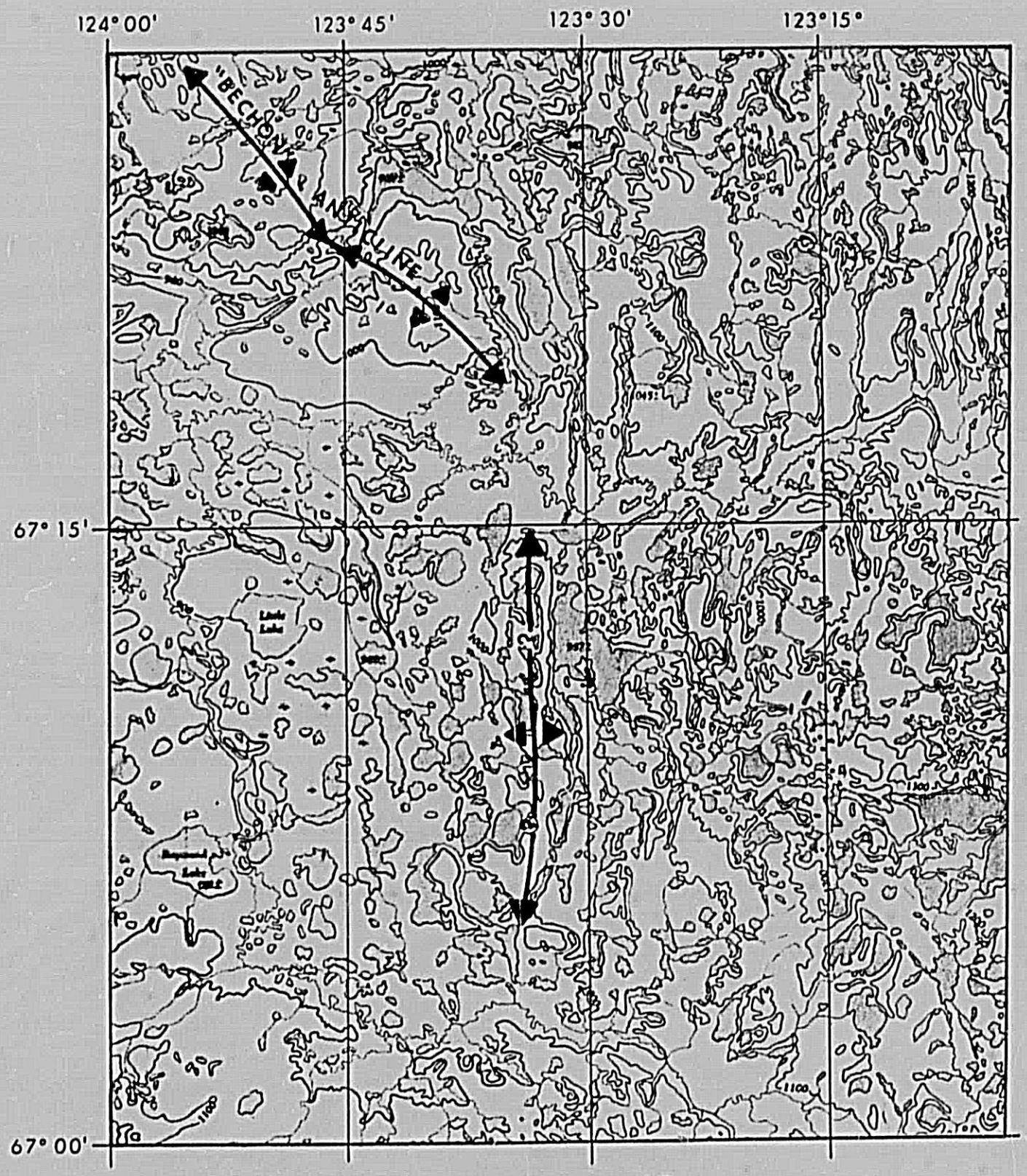

Figure 10

IMPERIAL OIL ANDERSON RIVER BLOCK

SCALE 1:250,000
CONTOUR INT. 100'

Z-1537

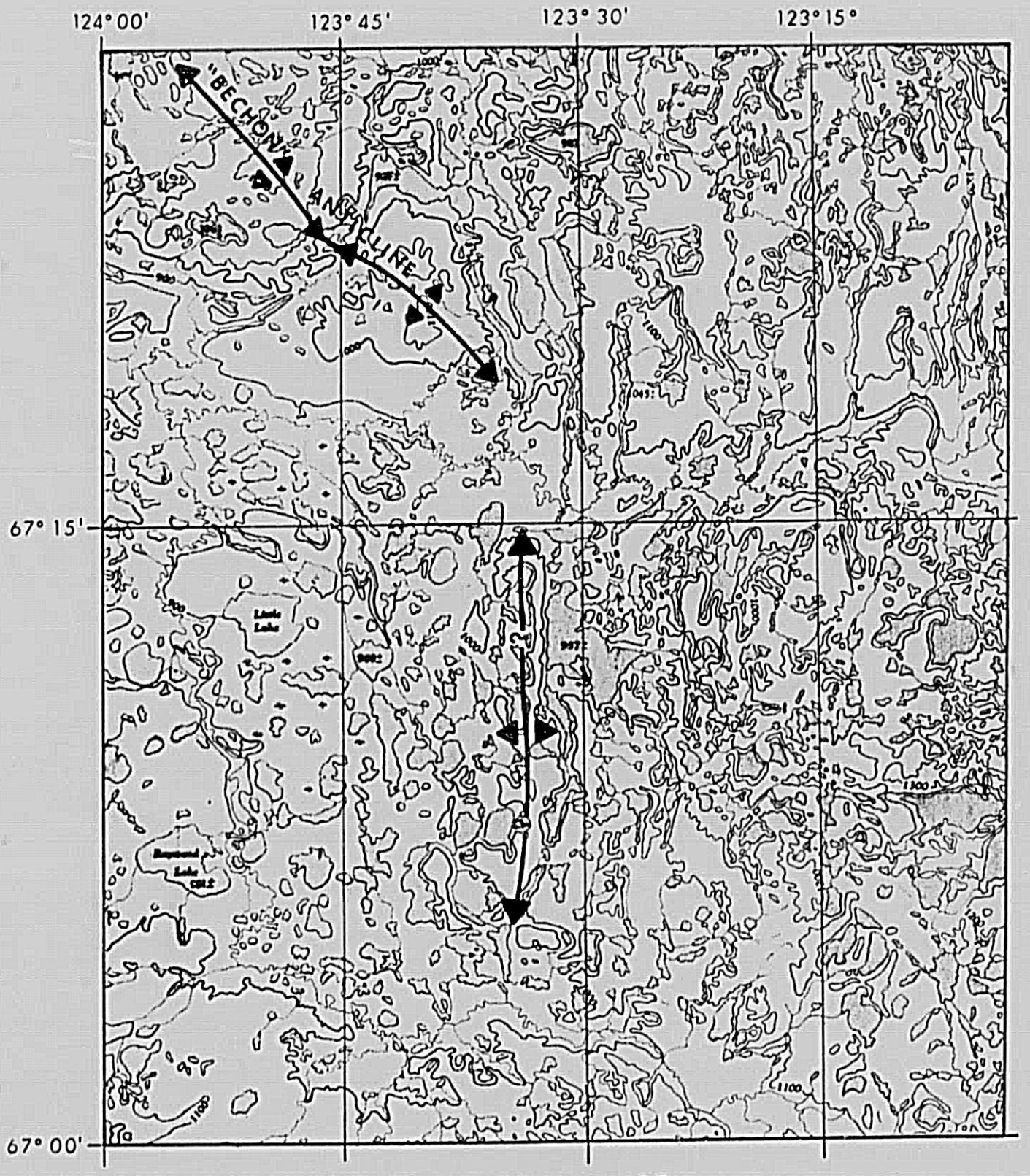

Figure 10

IMPERIAL OIL ANDERSON RIVER BLOCK

SCALE 1:250,000
CONTOUR INT. 100'

Z-1537

IMPERIAL OIL ANDERSON RIVER BLOCK

The Imperial Oil Anderson River Block is located southeast of Lac Maunoir and east of the Anderson River. Several geomorphic anomalies were investigated in order to confirm or deny the existance of structures. Figure 10 illustrates the area investigated and the structures thought to be present.

The area was found to be heavily mantled by glacial and glacial-fluvial deposits which made positive confirmation of structures extremely difficult. However, one of the geomorphic anomalies within this block had considerable topographic relief and based on experience gained with regard to the topographic expression of structures in this region, it is almost certainly a valid structure. The feature is elongate northwest-southeast and is centered at 67°22' north latitude and 123°46' west longitude. This structure is informally referred to as "Bechon" Anticline. The topographic form would suggest that the structure has two separated closures along its axial trend and that the overall structure is approximately 9 miles (14 km) long by 5 miles (8 km) wide. Closure on the north end of the anticline would appear to be at least 75 feet (23 m) while the south culmination has a minimum closure of 125 feet (38 m). Seismic evaluation will be required to accurately define the geometry of this structure.

The second possible structure has a north-south orientation and is centered at 67°11' north latitude and 123°33' west longitude. At the surface only glacial-fluvial deposits could be observed and the amount of topographic relief was minimal. Thus, either there is no structure present or the structure has very low structural relief and is hidden by glacial deposits. In either case, no further investigation is recommended.

UNION OIL BLOCK (COLVILLE PROSPECT)

This permit block is located northwest of Lac Maunoir and centered at approximately 57°35' north latitude and 125°20' west longitude. The topography of the permit is relatively low relief and lake studded, rising abruptly toward Colville Ridge. This ridge has a northeast-southwest orientation, and is located along the southeast part of Union's land. Figure 11 shows the location and extent of the area under discussion.

Stratigraphy: Based on minor exposures mapped by D. G. Cook and J. D. Aitken (1971), along Colville Ridge and the topographic expression of bedrock in the lowland portion of this block, the Middle Devonian Bear Rock Formation is thought to underlie the entire Union Block. The amount of glacial drift mantling bedrock in this area appears minimal, since there is present, the well developed irregular karst topography which is so characteristic of the Bear Rock Formation.

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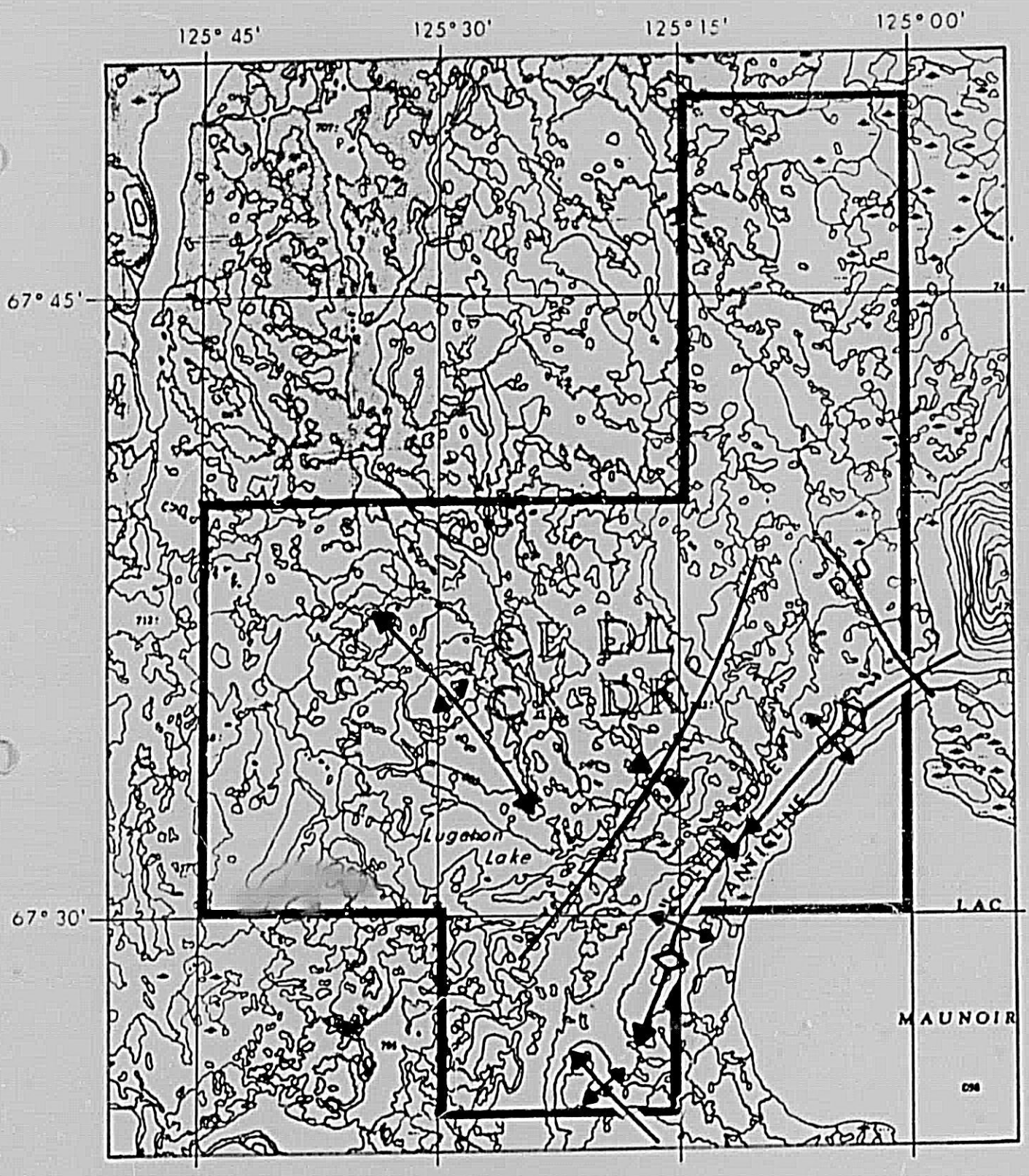

Figure 11

UNION OIL BLOCK
(COLVILLE PROSPECT)

SCALE 1:250,000
CONTOUR INT. 100'

Z-1538

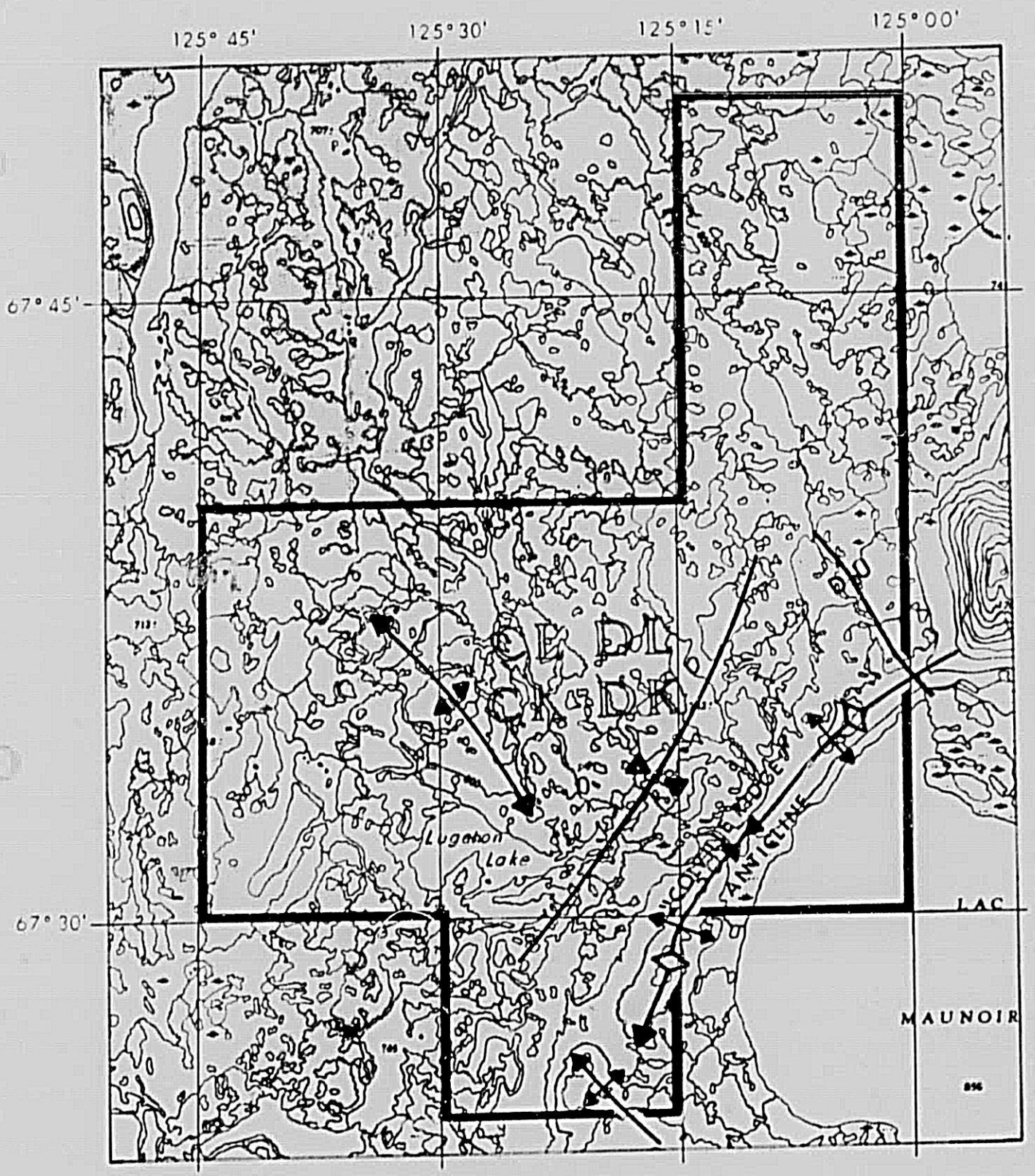

Figure 11

UNION OIL BLOCK
(COLVILLE PROSPECT)

SCALE 1:250,000
CONTOUR INT. 100'

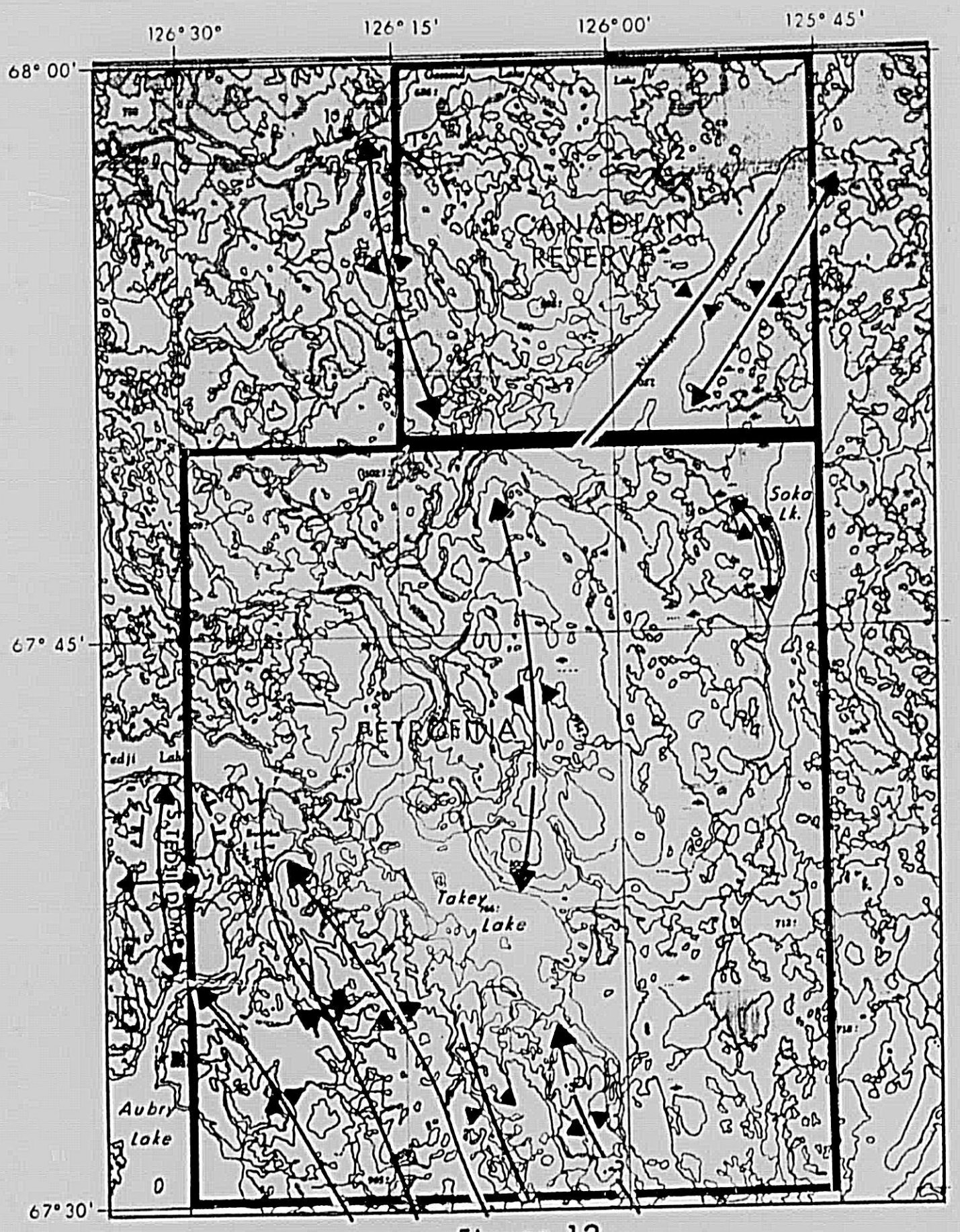

Figure 12

PETROFINA and CANADIAN RESERVE (Niwelin) BLOCKS

SCALE 1:250,000

CONTOUR INT.:100'

Z-1536

Structure: Due to a lack of exposure, the interpretation of structures within this block is dependent on geomorphic criteria and field experience gained in this region. Based on these judgements, there appears to be three structures or parts of structures within the area. They are the Colville Ridge Anticline, "Lugeton" Anticline and the north plunging section of the Maunoir Ridge Anticline.

Colville Ridge Anticline extends along the northwest shore of Lac Maunoir and is oriented northeast-southwest. From the topographic expression of the structure, two areas of closure appear to be present along its axial trend. The anticline appears closed at about 67°28' north latitude and 125°12' west longitude, just northeast of the intersection of Maunoir Ridge with Colville Ridge and a second, smaller closure, may be present at 67°35' north latitude and 125°04' west longitude. Seismic confirmation of these closures would be required to fully assess this structure. The Colville Ridge Anticline varies from 2 to 3 miles (3 km to 5 km) in width through the permit block. This anticline eventually extends to the southwest where it merges with the Belot Ridge structure. Both structures have a similar geometry which suggests a similar mode of origin. It can also be inferred, by analogy, that the Colville Anticline is extensively faulted. It has been tested, previously, by the Mobil Colville E-15 well with negative results and thus the potential of this structure must be downgraded.

The extreme north end of Maunoir Ridge Anticline plunges into the southern part of this permit block. This structure is not closed within the area and thus is of little interest.

"Lugeton" Anticline extends in a northwest-southeast direction from about 4 miles (7 km) northwest of Colville Ridge. This anticline, which may be closed at about 67°34' north latitude and 125°25' west longitude, is a small low amplitude fold with perhaps 125 feet (38 m) of relief. "Lugeton" Anticline is about 6 miles (10 km) long and 2 miles (3 km) wide. Because of the poorly exposed nature of the structure, seismic confirmation would be required to evaluate its potential as a hydrocarbon trap.

PETROFINA BLOCK

The Petrofina Block is located between Niwelin Lake and Aubry Lake and is confined between 67°30' to 67°50' north latitude and 125°45' to 126°30' west longitude (Fig. 12). Topography varies from relatively low relief in the eastern third of the block to a series of gently rolling hills toward the west and southwest. Numerous seismic lines have been shot in the area so that a surface reconnaissance of the block could only give some appreciation of structures already detailed by seismic.

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Stratigraphy: The only bedrock exposures observed within the Petrofina Permits were located in the west central part of the area just west of Ewekka Lake. The outcrops are composed of the lower part of the Middle Devonian Bear Rock Formation. Because of the characteristic irregular karst terrain developed in areas underlain by the Bear Rock Formation, it is possible to infer that this formation underlies the entire permit block. In general, glacial drift is thin and discontinuous with only minor glacio-fluvial deposits such as the partially submerged esker which occurs between Ewekka Lake and Aubry Lake.

Structure: Due to the limited exposures of bedrock within the area, all structural inferrences are based on geomorphic criteria. The topographic expression of folds in this area is generally good. In all, five structures were tentatively identified on the basis of topography.

Two large open folds with a northwest-southeast orientation appear to be present between Aubry Lake and Takey Lake. Both of these structures are about 13 miles (16 km) long and 3 miles (5 km) wide and both appear to be structurally simple with a minimum closure of 200 feet (60 m). Some structural complications such as cross-faulting may be present, but remain undetected by geomorphic means. Seismic evaluation would be necessary to fully define the geometry of these anticlines.

A smaller unnamed anticline appears to be present southeast of Takey Lake with the same orientation as the two larger structures to the west. This anticline would measure 7 miles (11 km) by perhaps, 2 miles (3 km) and have a minimum closure of about 75 feet (23 m). Given the dimensions of this structure it would be of only secondary interest as a potential hydrocarbon trap.

A fourth anticline may extend north-south between Takey Lake and Niwelin Lake. This anticline would be relatively a large, 12 miles by 4 miles (19 km by 6 km), broad open fold with perhaps 150 feet (45 m) of closure. This anticline, along with the two southwest of Takey Lake, appear to be the most suitable structures for further evaluation by Union if an agreement could be reached with Petrofina on these lands.

A fifth, unnamed structure, occurs in the northeast corner of the block just west of a north-south trending lake known to the local Indians as Soka Lake. This structure would be small, 4 miles (6 km) long by 1 mile (1.6 km) wide, with high structural relief and have about 125 feet (40 m) of closure. The small size of this anticline would remove it from further consideration.

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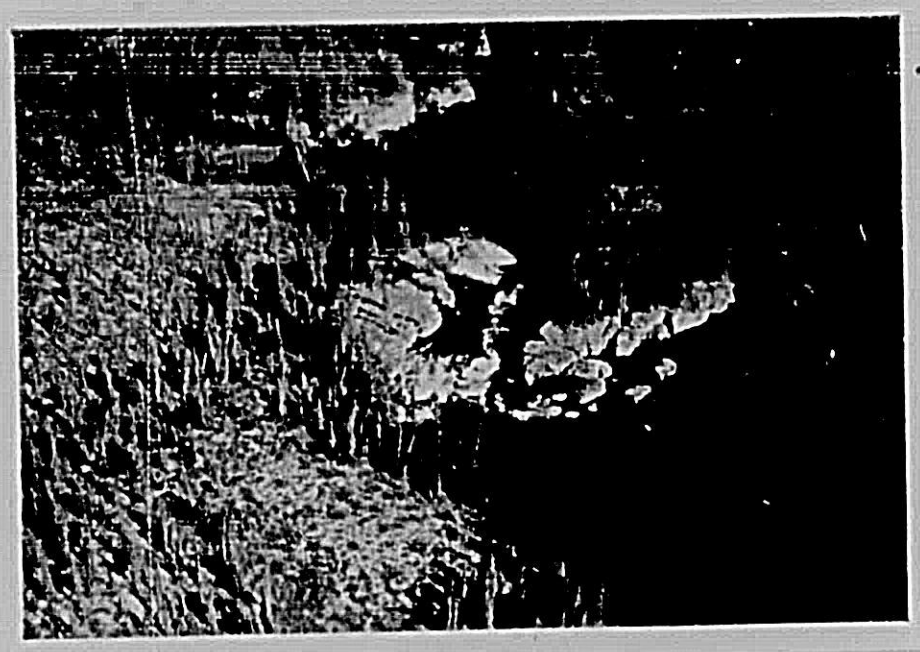

Plate 15

Outcrops of the Devonian Bear Rock Formation along the stream between Niwelin Lake and Gassend Lake.

Plate 16

A second exposure of the Bear Rock Formation along the stream mentioned above. Note hummocky, mottled topography which is characteristic of the area underlain by this formation.

Plate 15

Outcrops of the Devonian Bear Rock Formation along the stream between Niwelin Lake and Gassend Lake.

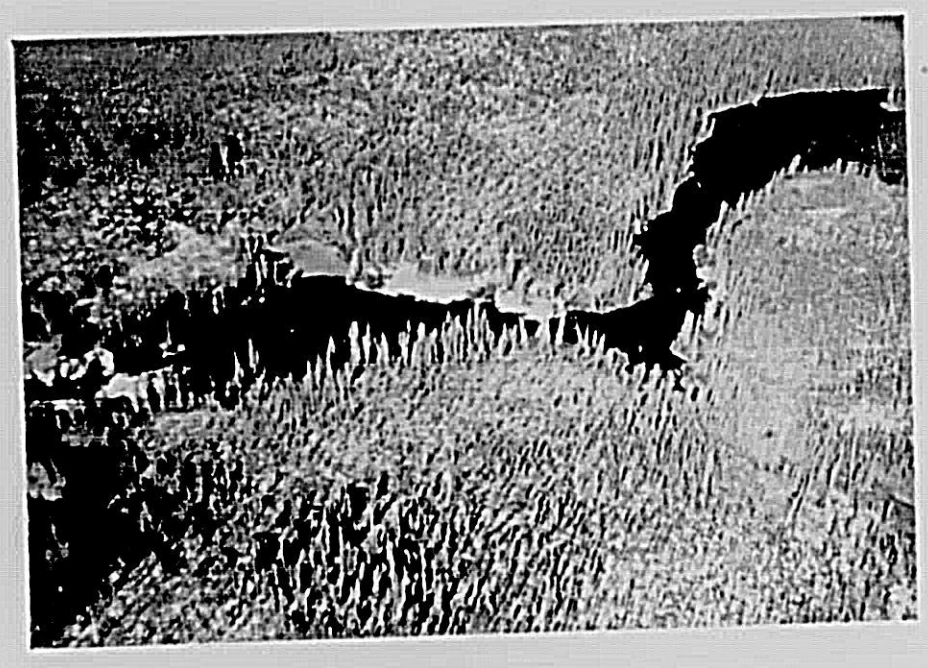

Plate 16

A second exposure of the Bear Rock Formation along the stream mentioned above. Note hummocky, mottled topography which is characteristic of the area underlain by this formation.

CANADIAN RESERVE (NIWELIN) BLOCK

This permit block is located around Niwelin Lake and is bounded by latitudes 67°50' and 68°00' north and longitudes 125°45' and 126°15' west. The topography of this area is low relief, rising gradually to the west-southwest where gently rolling hills are present.

Stratigraphy: Exposures observed in the area were confined to an area southwest of Gassend Lake and adjacent to a stream connecting Gassend and Niwelin Lak s (Plates 15 and 16). In both cases the formation exposed is the Middle Devonian Bear Rock. These outcrops were good enough to give local structural control to an area which would have otherwise been evaluated solely on the basis of geomorphic criteria.

Structure: The presence of two anticlines are indicated based on the morphology and dip control observed in this block. Neither are considered prospective. The first anticline is oriented essentially north-south and is located in the southwest part of the block (Figure 12). North plunge can be inferred from helicopter observed dips near the southwest end of Gassend Lake. The topographic expression of the remainder of this structure is relatively poor so that seismic confirmation would be required to properly define the dimensions and structural relief of the feature. However, based on the lack of topographic expression of this structure and the magnitude of observed dips, which were in the 1° to 2° range, this anticline appears to have little structural relief. Further evaluation of this flexture is, therefore, not considered warranted.

A second possible structure is located immediately southeast of Niwelin Lake and has the same orientation as the lake itself, i.e. northeast-southwest. No surface outcrops were found to substantiate this anticline, however, the geomorphic expression of the structure is excellent. It can be inferred from the topographic expression, that the structure is relatively broad and has low structural relief of less than 50 feet (15 m). As such, this anticline is probably of no further interest as a viable hydrocarbon trap.

ALMINEX BLOCK

This permit block is located about 2 miles (3 km) east of Niwelin Lake and 25 miles (40 km) northwest of Lac Maunoir and is between 67°40' and 68°00' north latitude and 125°15' and 125°45' west longitude (Fig. 13). The topography is hummocky with numerous lakes. Glacial and glacial-fluvial deposits mantle most of the area. A prominent north-south trending esker complex occurs in the southwest part of the area. Bedrock exposures were encountered at only two locations within the permit block.

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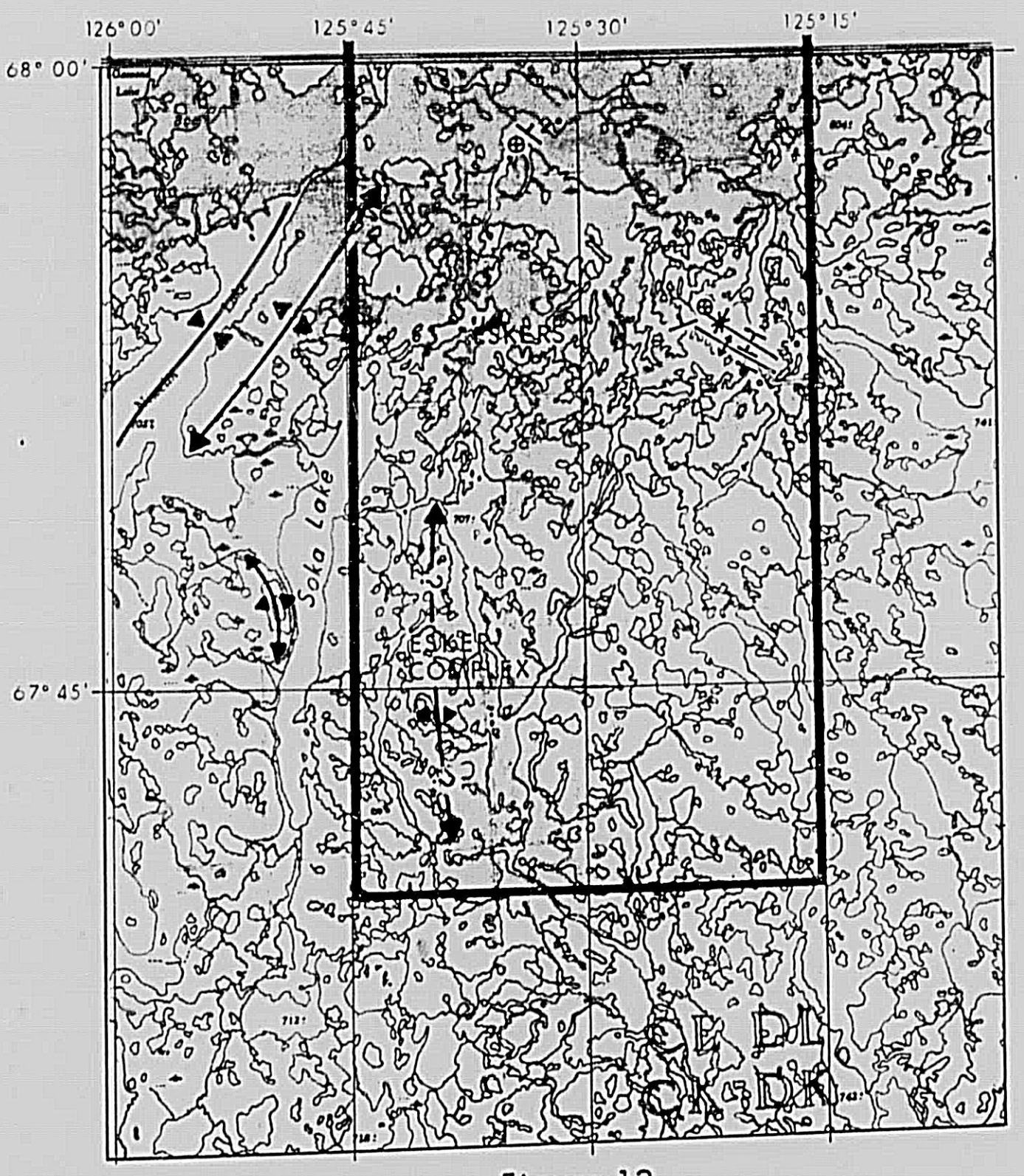

Figure 13

ALMINEX BLOCK

SCALE 1:250,000
CONTOUR INT. 100'

Z-1541

Stratigraphy: The two exposures which were observed within this area were both of the Middle Devonian Bear Rock Formation. Much of the remaining area, where a thick glacial cover is not present, also appears to be underlain by Bear Rock Formation. This inference is made on the basis of the unique topographic expression which characterizes a terrain underlain by this particular unit.

Structure: Due to the limited exposures, structures were difficult to identify. One conclusion which can be made, however, is that no major structures are present. This conclusion is based on the fact that, if a major structure were present, the resistant Ordovician and Silurian Mount Kindle Formation would be exposed at the surface as a prominent topographic high. No such topographic features were observed.

A structure with less than 100 feet (30 m) of structural relief may be present beneath the esker complex in the southwest part of the area, but positive identification of this structure would require a seismic survey. Several minor structures were detected where observation of bedrock was possible. One minor anticline-syncline pair can be seen, with dips of from 3 to 5 degrees, in the east central part of the permit block at 67°53' north latitude and 125°19' west longitude.

In general, this area lacked the type of structure which could provide an economically viable hydrocarbon trap. Seismic exploration of the block would not seem warranted, with the possible exception of a line in the southwest section of the block to test for a possible structure masked by glacial drift.

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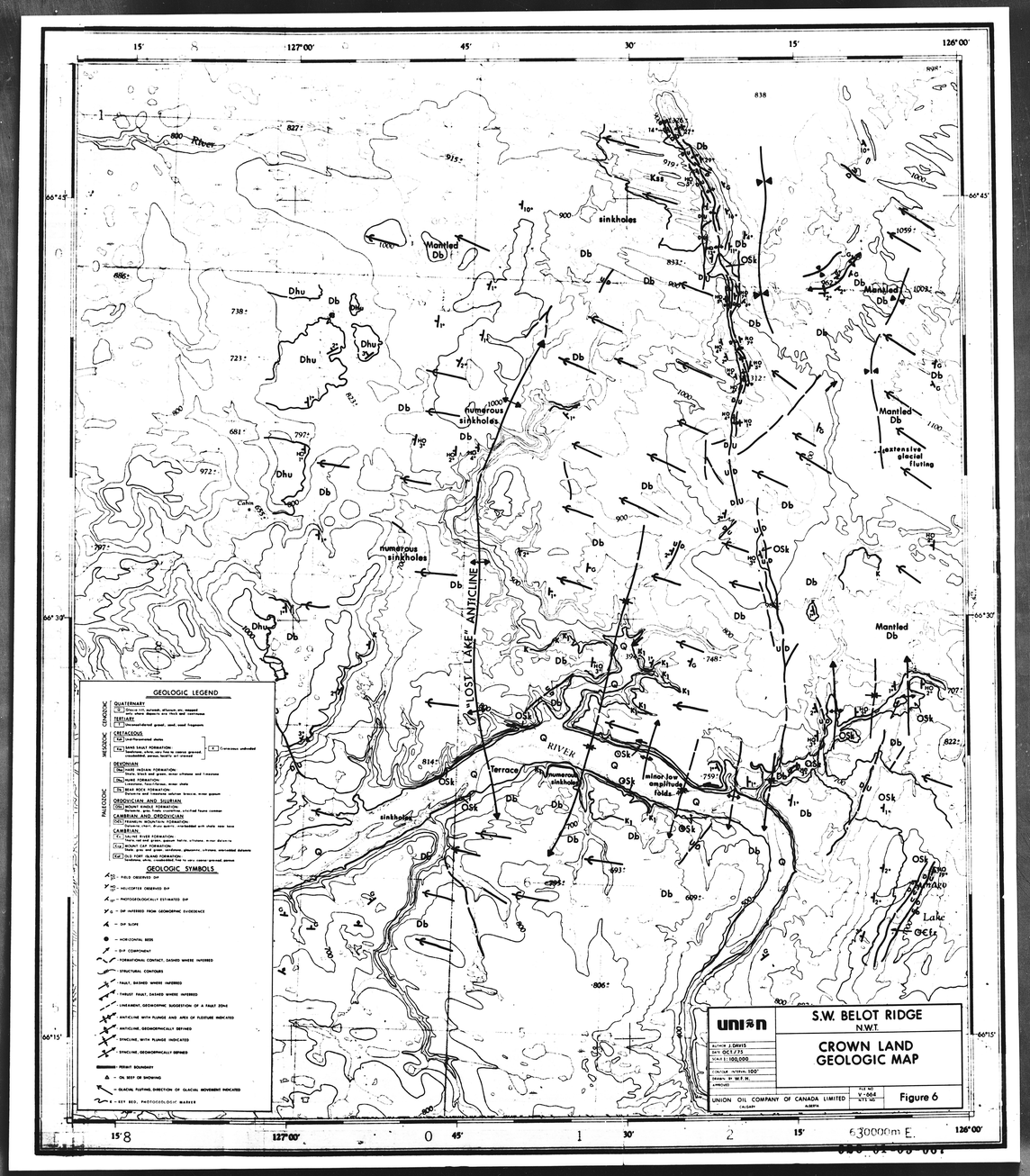
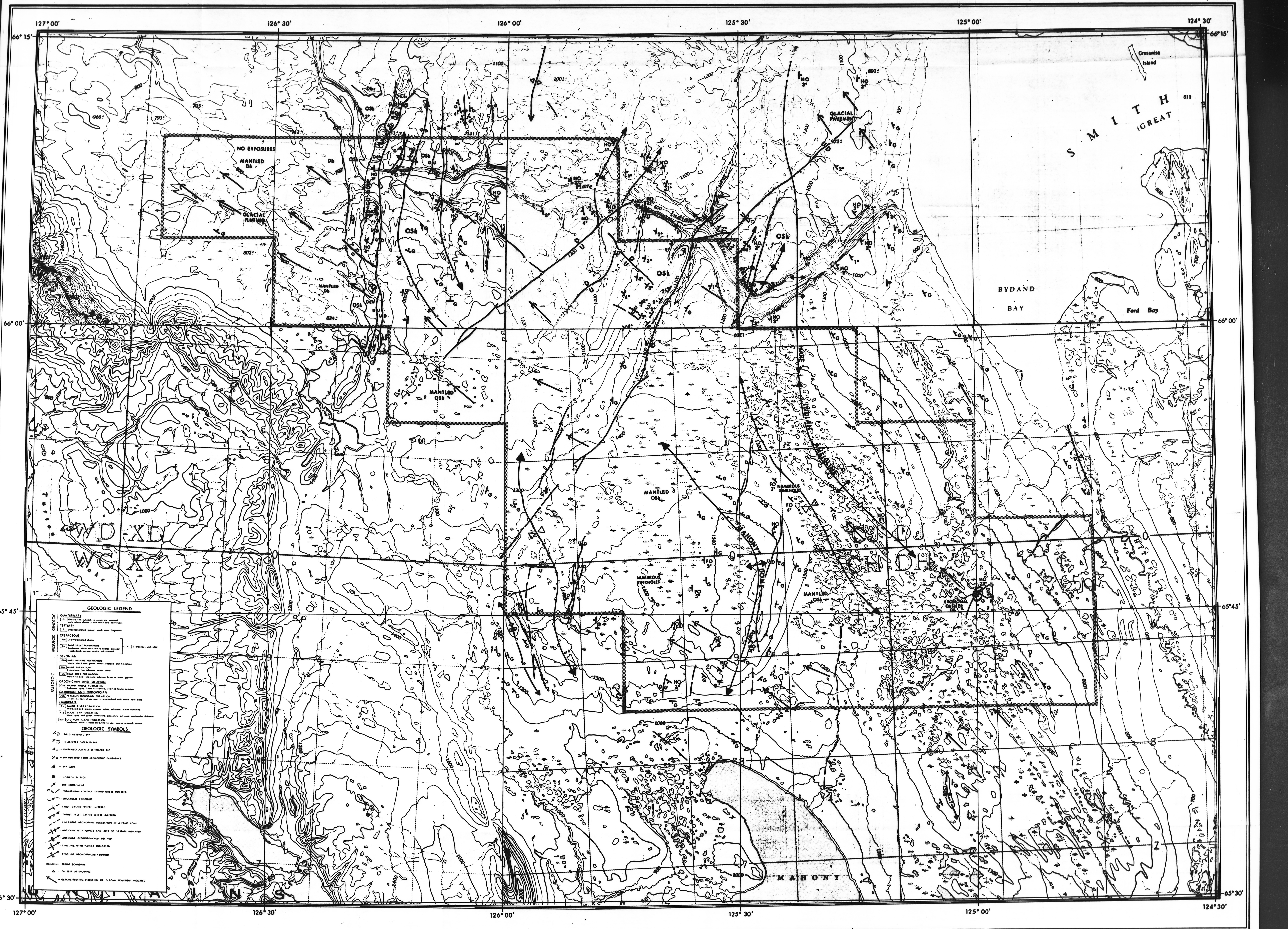
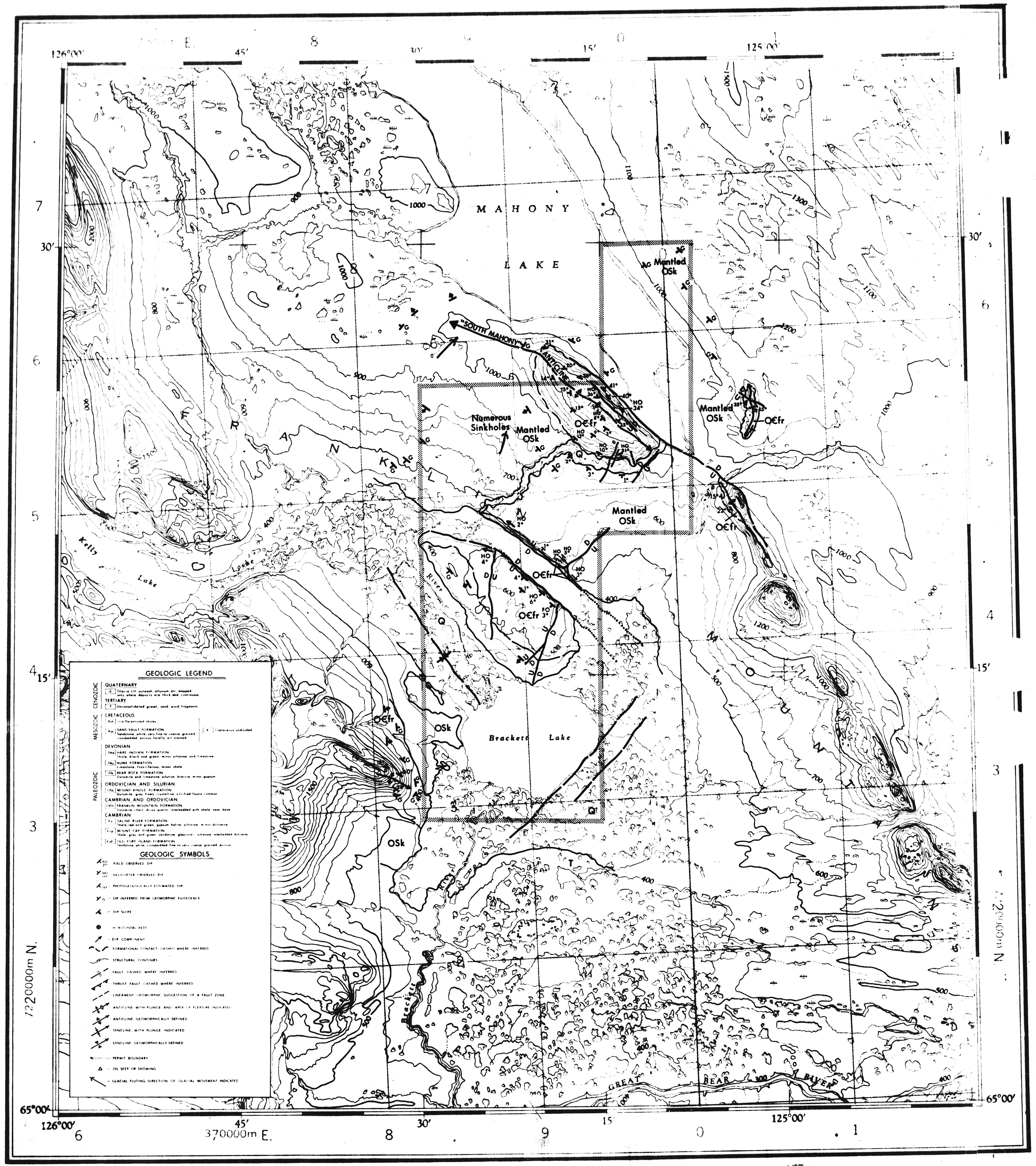




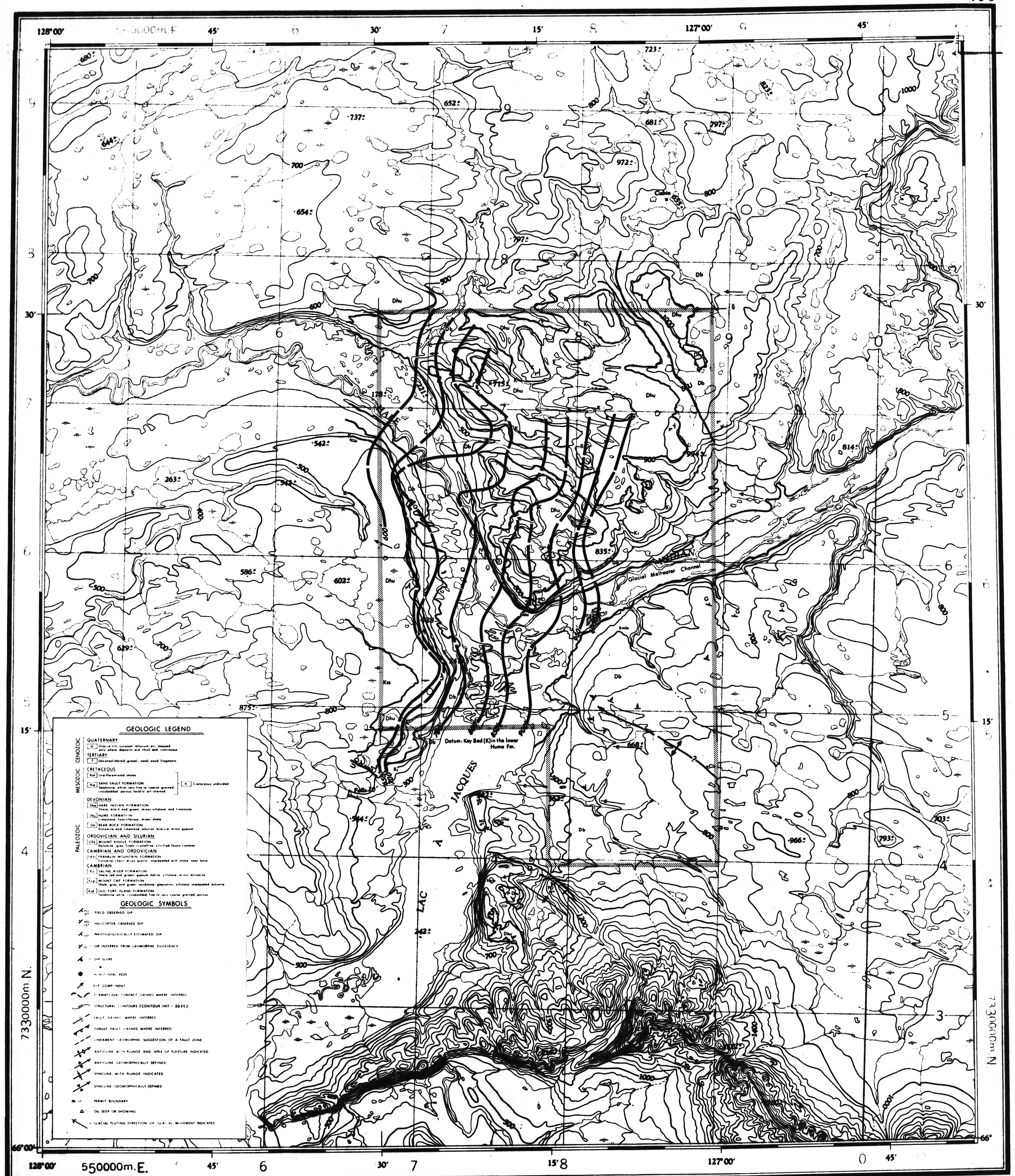
UNION	PANCANADIAN PERMIT N.W.T.
AUTHOR J. DAVIS DATE JULY /'75 SCALE 1:100,000 CONTOUR INTERVAL 100' DRAWN BY W.P.H. APPROVED	GEOLOGIC MAP of MAHONY DOME
UNION OIL COMPANY OF CANADA LIMITED CALGARY ALBERTA	FILE NO. Q-681 NTS NO. Figure 5

028-01-05-007



UNION	**BRACKETT LAKE** **N.W.T.**		
AUTHOR J. DAVIS DATE APRIL/1975 SCALE 1:100,000 CONTOUR INTERVAL 100' DRAWN BY W.F.H APPROVED	**GEOLOGIC MAP** **of the** **BRACKETT LAKE PERMITS**		
UNION OIL COMPANY OF CANADA LIMITED CALGARY ALBERTA	FILE NO V-644 NTS NO	**Figure 3**	

028-01-05-067


GEOLOGIC LEGEND
CENOZOIC
QUATERNARY
Q Glacial till, outwash, alluvium, etc. mapped only where deposits are thick and continuous
TERTIARY
T Unconsolidated gravel, sand, wood fragments
MESOZOIC
CRETACEOUS
Ksh Undifferentiated shales
Kss SANS SAULT FORMATION: Sandstone, white, very fine to coarse grained, crossbedded, porous, locally oil-stained
K Cretaceous undivided
PALEOZOIC
DEVONIAN
Dha HARE INDIAN FORMATION: Shale, black and green, minor siltstone and limestone
Dhu HUME FORMATION: Limestone, fossiliferous, minor shale
Db BEAR ROCK FORMATION: Dolomite and limestone solution breccia, minor gypsum
ORDOVICIAN AND SILURIAN
OSk MOUNT KINDLE FORMATION: Dolomite, grey, finely crystalline, silicified fauna common
CAMBRIAN AND ORDOVICIAN
OЄfr FRANKLIN MOUNTAIN FORMATION: Dolomite, chert, drusy quartz, interbedded with shale near base
CAMBRIAN
Єs SALINE RIVER FORMATION: Shale, red and green, gypsum, halite, siltstone, minor dolomite
Єcp MOUNT CAP FORMATION: Shale, grey and green, sandstone, glauconitic, siltstone, interbedded dolomite
Єof OLD FORT ISLAND FORMATION: Sandstone, white, crossbedded, fine to very coarse grained, porous
GEOLOGIC SYMBOLS
FIELD OBSERVED DIP
HELICOPTER OBSERVED DIP
PHOTOGEOLOGICALLY ESTIMATED DIP
DIP INFERRED FROM GEOMORPHIC EVIDEDENCE
DIP SLOPE
HORIZONTAL BEDS
DIP COMPONENT
FORMATIONAL CONTACT, DASHED WHERE INFERRED
STRUCTURAL CONTOURS (CONTOUR INT = 50 FT.)
FAULT, DASHED WHERE INFERRED
THRUST FAULT, DASHED WHERE INFERRED
LINEAMENT GEOMORPHIC SUGGESTION OF A FAULT ZONE
ANTICLINE WITH PLUNGE AND APEX OF FLEXTURE INDICATED
ANTICLINE, GEOMORPHICALLY DEFINED
SYNCLINE, WITH PLUNGE INDICATED
SYNCLINE, GEOMORPHICALLY DEFINED
PERMIT BOUNDARY
OIL SEEP OR SHOWING
GLACIAL FLUTING, DIRECTION OF GLACIAL MOVEMENT INDICATED
LAC A JACQUES
Glacial Meltwater Channel
Datum: Key Bed (K) in the lower Hume Fm.
128°00'
550000m.E.
45'
30'
15'
127°00'
66°00'
7330000m.N.
1:100,000
MILES
FEET

union

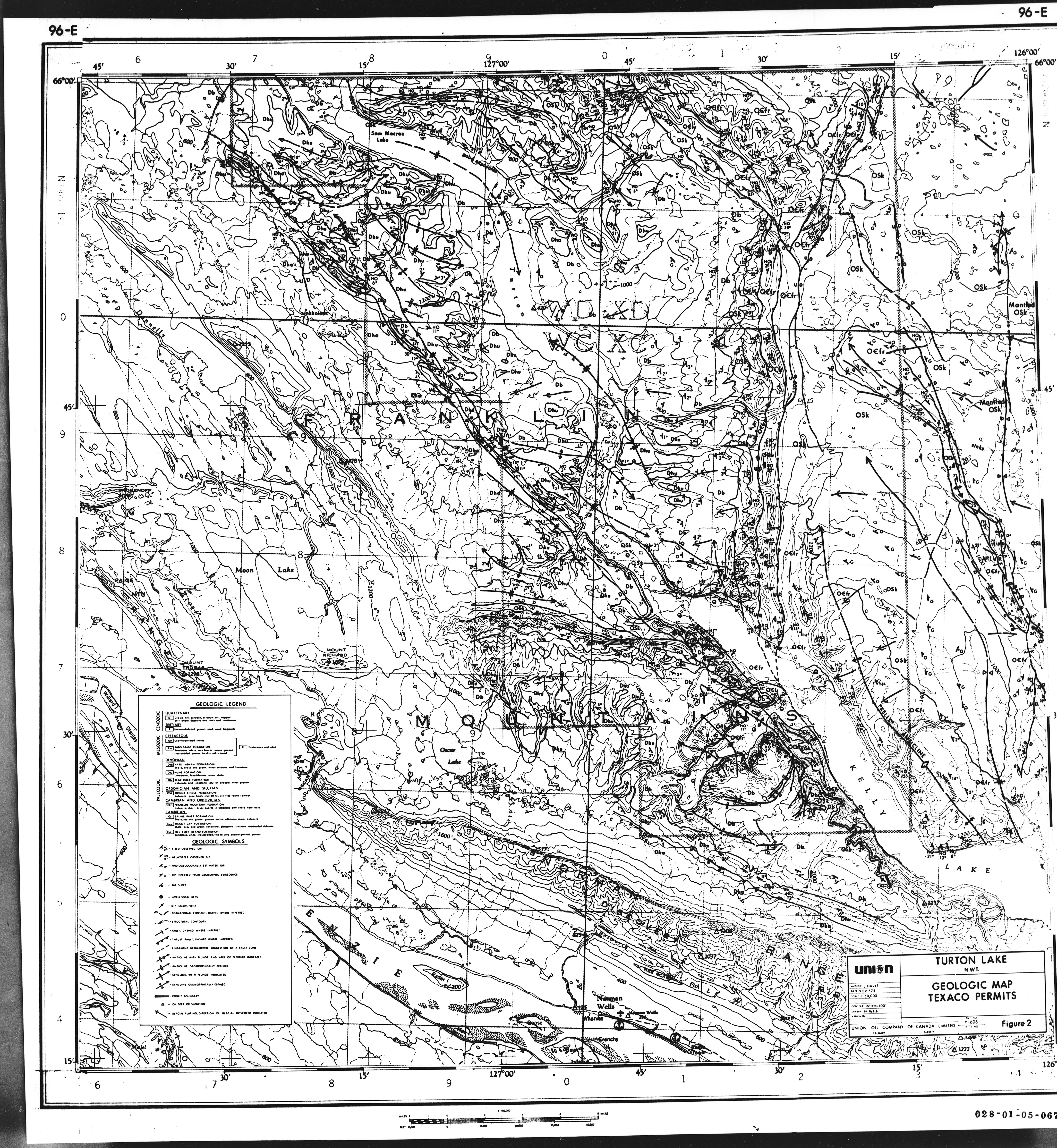
LAC 'A JACQUES PERMITS
N.W.T.

GEOLOGIC MAP of the LAC 'A JACQUES PERMITS

AUTHOR J. DAVIS
DATE OCT. / 74
SCALE 1: 100,000.
DATUM 40' above base of Hume
CONTOUR INTERVAL 100'
DRAWN BY D.N.W., W.F.H.
APPROVED
FILE NO V-645

Figure 4

028-01-05-067


96-E
96-E
FRANKLIN
MOUNTAINS
Sam Macrae Lake
Moon Lake
Oscar Lake
MOUNT RICHARD
KELLY LAKE
Norman Wells
GEOLOGIC LEGEND
QUATERNARY
CRETACEOUS
DEVONIAN
ORDOVICIAN AND SILURIAN
CAMBRIAN AND ORDOVICIAN
CAMBRIAN
GEOLOGIC SYMBOLS
TURTON LAKE
N.W.T.
GEOLOGIC MAP
TEXACO PERMITS
AUTHOR J DAVIS
DATE NOV /75
SCALE 1: 50,000
CONTOUR INTERVAL 100'
DRAWN BY W.F.H
APPROVED
FILE NO Y-608
NTS NO
UNION OIL COMPANY OF CANADA LIMITED
CALGARY ALBERTA
Figure 2

028-01-05-067