TEXACO EXPLORATION COMPANY
CALGARY, ALBERTA

STRUCTURAL AND STRATIGRAPHIC INVESTIGATIONS OF PORTIONS OF THE PORCUPINE-PEEL PLATEAUX AND MACKENZIE PLAIN YUKON AND NORTHWEST TERRITORIES

by

D. R. YONT

March, 1961

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ABSTRACT

Texaco Exploration Company geologists carried out structural and stratigraphic investigations on and near Texaco acreage in the Ogilvie and Mackenzie Mountain regions of the Yukon and Northwest Territories during the summer field season of 1960. The areas investigated are as follows:

Sid Lake-Hungry Lake Area, Yukon
Arctic Red River-Hume River Area, Northwest Territories
Johnson River-Iverson Lake Area, Northwest Territories

The Sid Lake-Hungry Lake area contains a maximum of 18,000 feet of sediments. The older sediments, represented throughout most of the area by a complete Paleozoic sequence, are overlain disconformably by Cretaceous rocks. Erosional unconformities have caused marked variations in thickness and distribution of the younger Paleozoic formations. Numerous closed anticlinal structures are present in the area, five of which were mapped by Brunton compass methods.

The Arctic Red River-Hume River area contains over 16,000 feet of sediments. A major unconformity is present in this area, the Upper Devonian sediments being overlain disconformably by a thick Cretaceous sequence. The structure of the area is characterized by broad east-west trending, east plunging folds truncated by transverse faults.

The Johnson River-Iverson Lake area contains from 10,000 to 17,000 feet of sediments representing all systems from Cambrian to Upper Devonian. Stratigraphic work in the Iverson Lake area indicates that numerous facies variations occur in the early Middle Devonian sequence. The Johnson River area contains several north-south trending folds most of which appear to plunge northward.

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INTRODUCTION

General

During the 1960 field season, geologists of Texaco Exploration Company carried out structural and stratigraphic studies in selected areas of the Yukon and Northwest Territories.

The main purpose of the work was to enlarge on previous reconnaissance studies in the region and to more fully evaluate specific permit blocks held by Texaco.

The field operations commenced at Sid Lake on June 3 and ended at Iverson Lake on August 11. During this period a total of four base camps were established, including Hungry Lake and Red Lake in addition to those mentioned above. Sixteen days were lost due to inclement weather during the course of the operations.

Location of Area

The areas investigated during the past field season lie south of the Arctic Circle along a broad area extending from the north central Yukon to the southwestern part of the Northwest Territories. For the purpose of this discussion they have been grouped into three general areas as follows:

(1) Sid Lake-Hungry Lake Area

(2) Arctic Red River-Hume River Area

(3) Johnson River-Iverson Lake Area

The locations of these areas and the main base camp used for the operations are shown in Fig. 1.

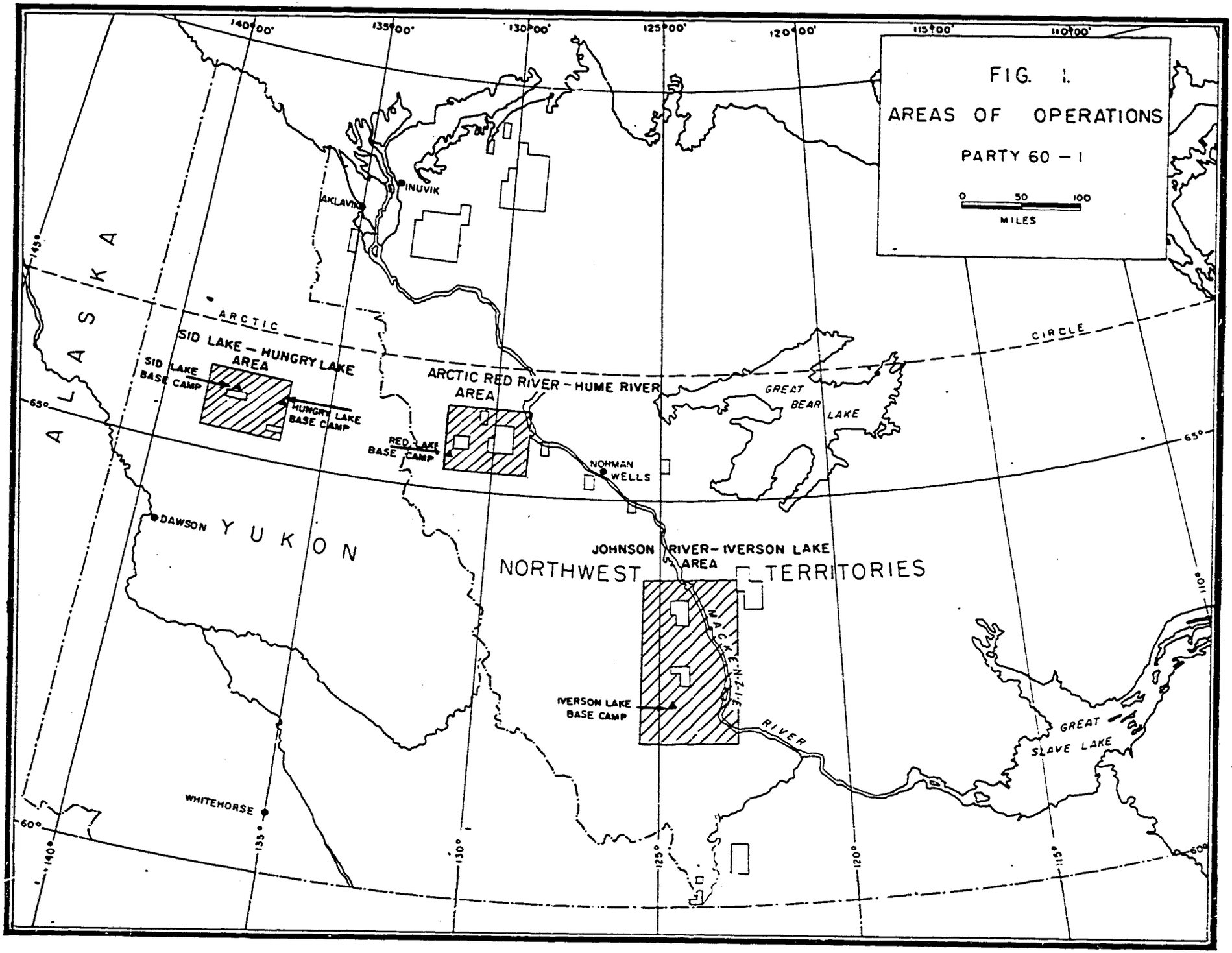
FIG. 1.
AREAS OF OPERATIONS
PARTY 60 – 1
0 50 100
MILES
140°00'
135°00'
130°00'
125°00'
120°00'
115°00'
110°00'
INUVIK
AKLAVIK
ALASKA
ARCTIC CIRCLE
SID LAKE – HUNGRY LAKE AREA
SID LAKE BASE CAMP
HUNGRY LAKE BASE CAMP
ARCTIC RED RIVER – HUME RIVER AREA
RED LAKE BASE CAMP
GREAT BEAR LAKE
NORMAN WELLS
DAWSON
YUKON
JOHNSON RIVER – IVERSON LAKE AREA
NORTHWEST TERRITORIES
IVERSON LAKE BASE CAMP
MACKENZIE RIVER
GREAT SLAVE LAKE
WHITEHORSE
65°
60°
140°
135°
130°
125°
120°
115°
110°

Transportation, Communication and Supply

Transportation for the summer's operations was provided by several types of aircraft. A Bell model 47-G-2 helicopter was used while doing the actual field work. A Beaver, and on one occasion an Otter float plane were chartered for camp moves and hauling fuel.

Communications with aircraft and Department of Transport radio stations were maintained by use of a Spilsbury and Tyndall MRT-600 radio telephone.

The fuel supply for the Sid Lake and Hungry Lake operations was cached during the preceding winter by ski-equipped Beaver. The fuel for the remainder of the operations was obtained at Norman Wells and flown to the base camps by Beaver float plane as required during the course of the work.

The initial food supply was obtained in Dawson City, Yukon. The food for the latter half of the summer was purchased in Fort Nelson, British Columbia and shipped by barge to Norman Wells, N. W. T. Weekly fresh food shipments were purchased in Edmonton and shipped via commercial airlines to Norman Wells.

Scope of Work

The main scope of the summer's operations was to carry out detailed structural mapping of selected features on Texaco's exploration permits. Several standard field methods were used to accomplish this.

Structures in the Sid Lake-Hungry Lake area were outlined by obtaining dips on the outcrops by means of a Brunton compass. In

the Arctic Red River-Hume River area data for compiling structure contour maps was obtained by means of a plane table survey and the helicopter altimeter. In the Johnson River area the structure was mapped by observing apparent dips in stream exposures from a helicopter and where possible by direct measurement using a Brunton compass.

Some stratigraphic work was done in all areas in conjunction with the structural investigations, but at Iverson Lake obtaining stratigraphic information was the sole objective. In all instances, standard field procedures were used to measure and describe the stratigraphic sections.

Previous Work

Stratigraphic studies were carried out in the Yukon and Northwest Territories by Texaco geologists in the years 1957 to 1959. The reader is referred to Company reports by Lowther (1957), McGuire (1958), Murray and Teitz (1959), Leslie (1959), Murray and Yont (1960), Edwards (1960) and the references contained therein for the background material used in the present study.

Acknowledgements

This report was prepared under the direction of H.M. Kroon, Texaco Exploration Company, to whom the writer is indebted for valuable suggestions and assistance.

Field personnel, besides the author, included geologists O.S. McGuire and R.J. Leslie, and assistant geologists M.E. Holter and W.L. Wiggins. E. Forman performed the duties of cook and J. Pearson as cook's helper. All are to be commended for their efforts.

The aircraft personnel of Associated Helicopters, Connelly-Dawson Airways, and Pacific Western Airlines all gave outstanding service in the interest of a successful field season.

SID LAKE-HUNGRY LAKE AREA

General

The Sid Lake-Hungry Lake area (Fig. 2) is located in the north central Yukon about 100 miles north of Dawson City. It includes portions of the two main physiographic subdivisions; the Porcupine Plateau and the Ogilvie Mountains. The structures investigated in the Sid Lake area lie adjacent to the mountains in the southern portion of the Porcupine Plateau. Those studied at Hungry Lake have much greater relief and are included in the front ranges of the Ogilvie Mountains.

Texaco holds two permit blocks within the area; namely the Sid Lake Permits and the Hungry Lake Permits (see Fig. 2).

Stratigraphy

The region contains a maximum of 18,000 feet of sediments representing every major system from Cambrian to Cretaceous with the exception of the Triassic and Jurassic. A brief description of the lithology, thickness and distribution of the major stratigraphic units within the area of study follows.

Cambrian-Ordovician ± 2500 Feet

This unit consists of rough weathering algal dolomites which rest with profound angular unconformity on older rocks where observed in outcrops behind the front range of the Ogilvie Mountains.

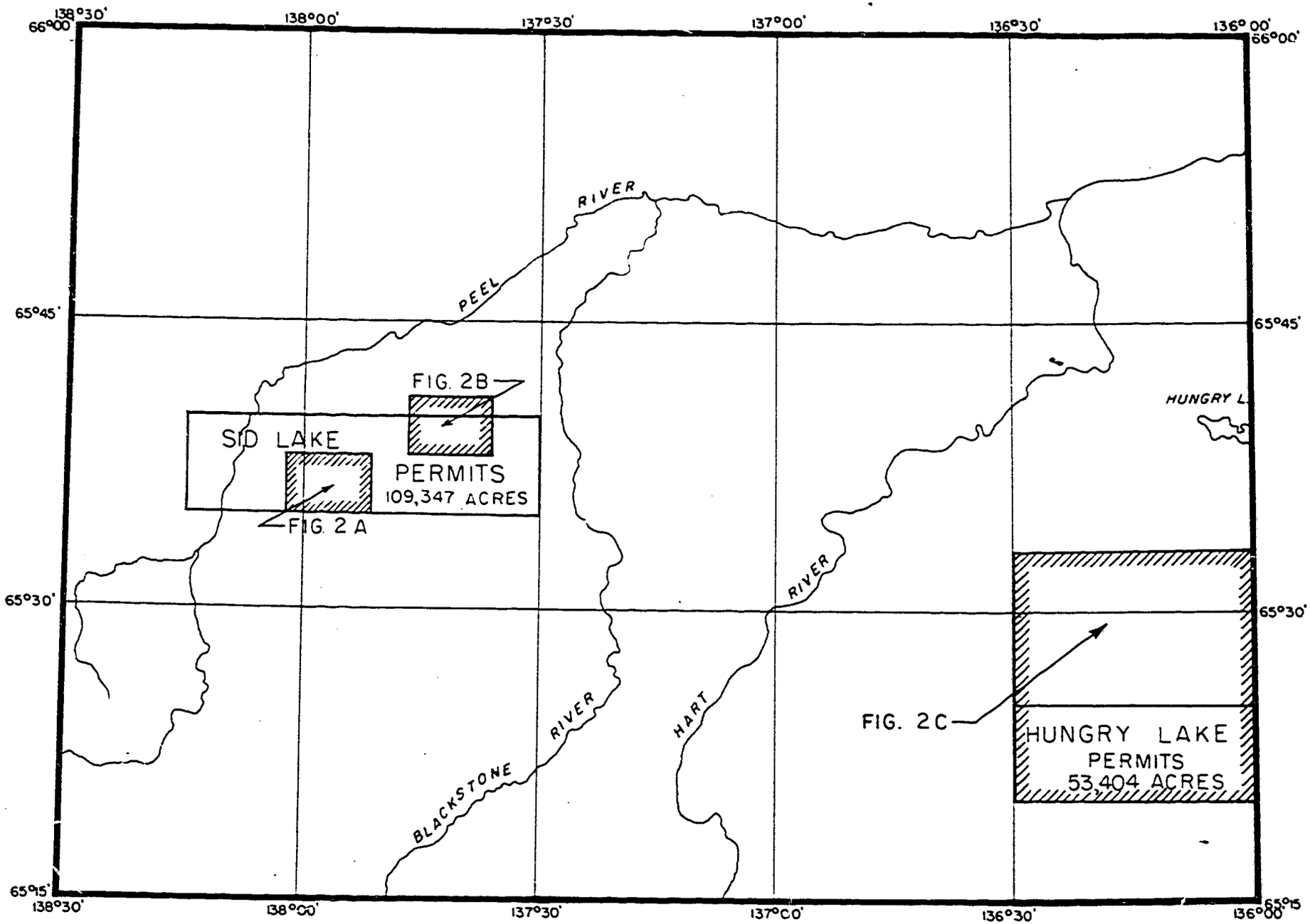

FIG. 2

SID LAKE – HUNGRY LAKE AREA

Ordo-Silurian ± 4500 Feet

This unit consists mainly of a grey weathering limestone and dolomite sequence which occasionally has a red weathering conglomeratic sandstone unit at its base.

Silurian ± 1200 Feet

This unit consists of black calcareous shale with interbeds of thin bedded argillaceous limestones. Silurian graptolites occur in this sequence.

Lower and Middle Devonian 700 to 2500 Feet

This unit shows marked lateral change from medium to thick bedded fossiliferous limestones 2500 feet thick in the Sid Lake area to thin bedded argillaceous and cherty limestones 700 feet thick in the Hungry Lake area.

Middle Devonian - Fort Creek ± 500 Feet

This unit consists of hard, black bituminous shale which occasionally is burnt a brick red color.

Upper Devonian 500 to 3000 Feet

This unit consists of a sequence of silty shales and sandstones. It is less than 500 feet thick in the Sid Lake area but thickens to over 3000 feet in the Hungry Lake area.

Mississippian 0 - 1000 Feet

This Mississippian is represented in the southern part of the region by dark grey, non-calcareous concretionary shales. This unit is absent on Texaco's permit blocks due to pre-Permo-Pennsylvanian erosion.

Permo-Pennsylvanian ± 2000 Feet

This unit consists of a sequence of silty shales and sandstones with a resistant weathering cherty limestone at the base.

Cretaceous + 4000 Feet

The Cretaceous consists of a sequence of shales and sandstones best developed in the Eagle Plains north of the area of study.

Structure

Detailed structural mapping using Brunton compass methods was carried out in both the Sid Lake and Hungry Lake areas. A discussion of the structures mapped in each of these areas by this method follows.

Sid Lake Area:

Two closed surface anticlines, namely Sid West and Sid East, were mapped in the Sid Lake area.

Sid West (Fig. 2A) is a symmetrical anticlinal fold which exposes Middle Devonian limestones in its core. Dips on the Middle Devonian limestones and shales show evidence of a definite reversal in plunge resulting in a significant amount of closure.

Sid East (Fig. 2B) is an asymmetrical anticlinal fold with the axial plane dipping north at 80°. Middle Devonian limestones are exposed in the core. Dips on the Middle Devonian beds indicate a definite plunge reversal exists on the structure resulting in a significant amount of closure.

Hungry Lake Area:

The Hungry Lake area is characterized by the occurrence

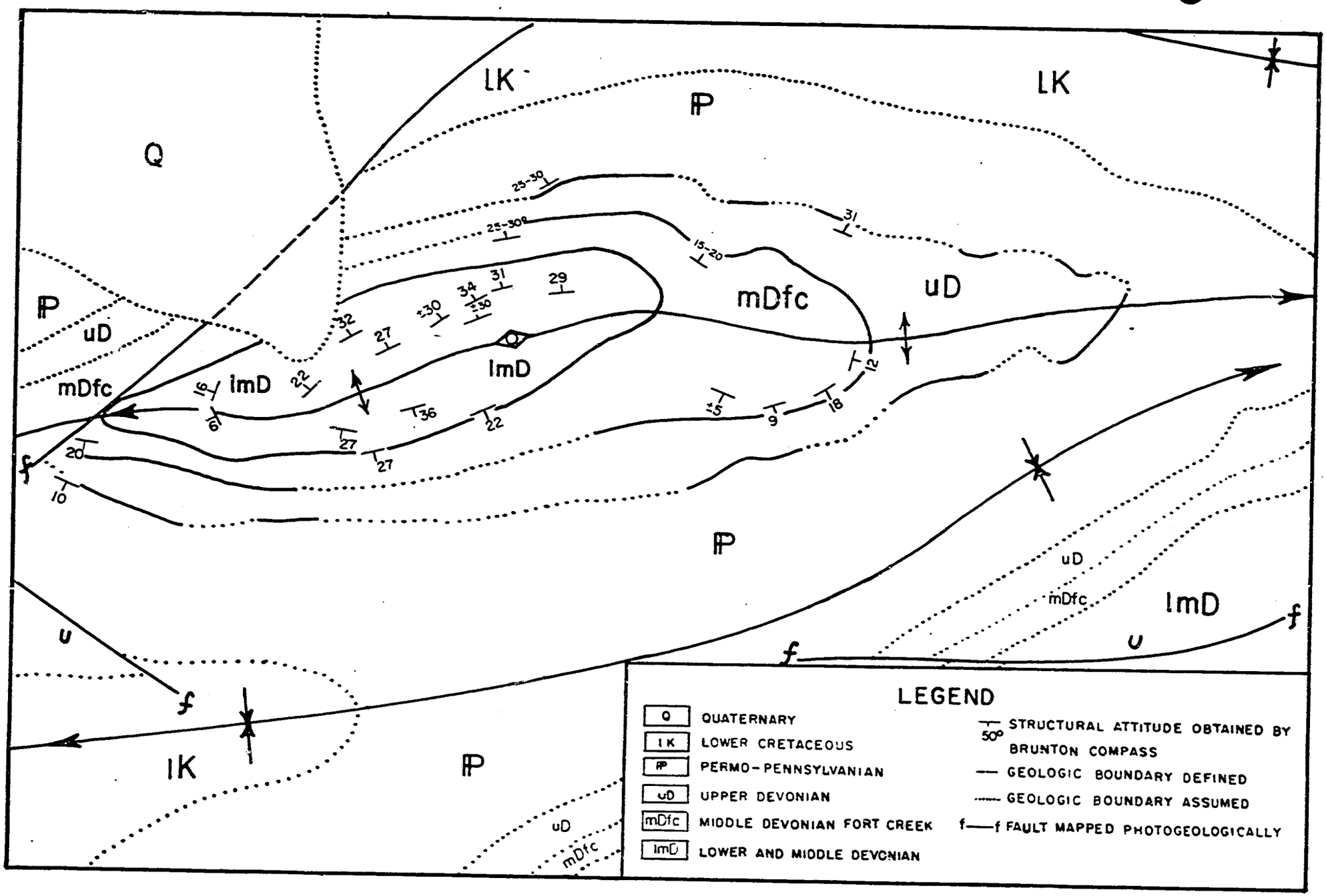

FIG. 2 A SID WEST ANTICLINE

SCALE: 2 INCHES = 1 MILE

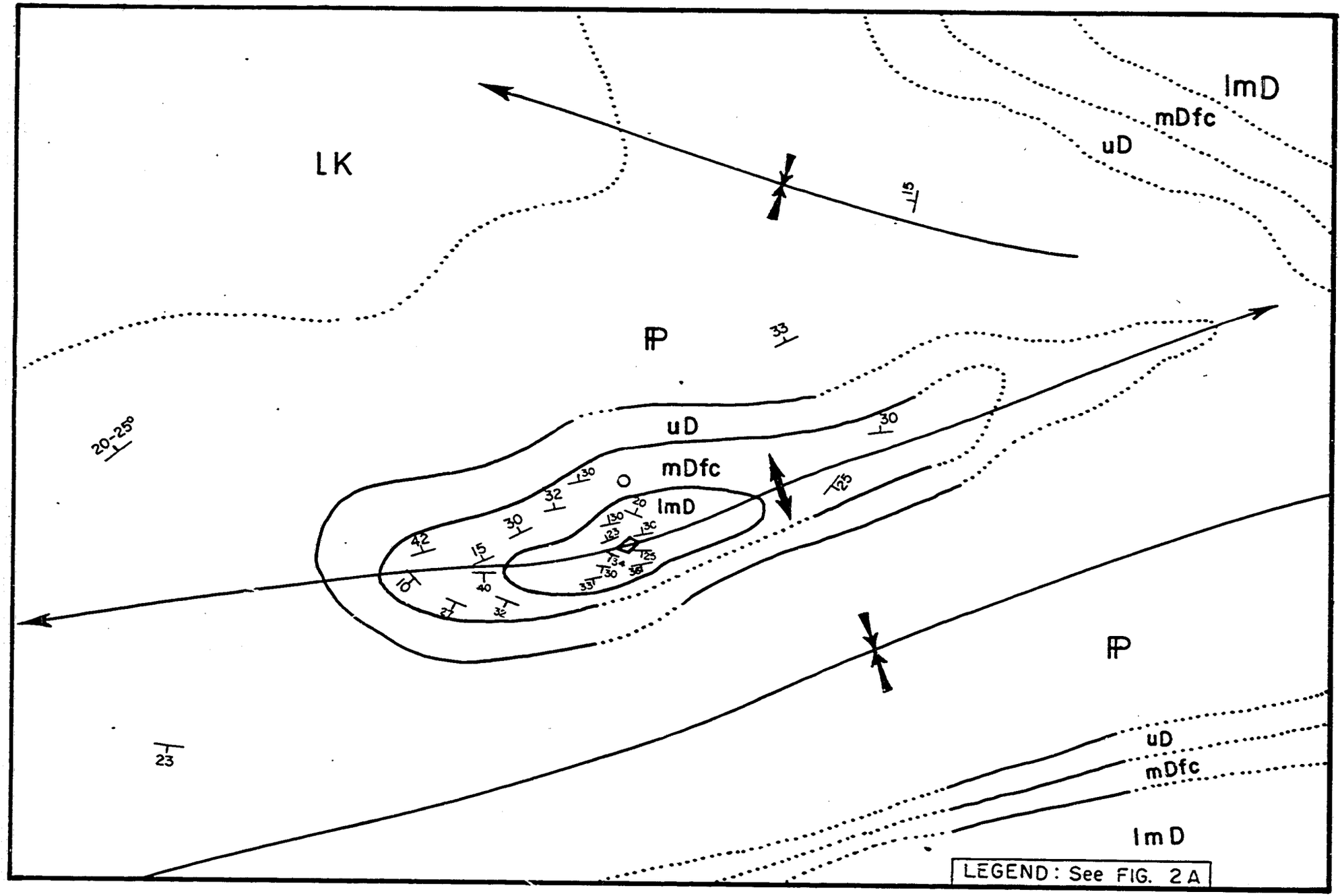

FIG. 2B SID EAST ANTICLINE

SCALE 2 INCHES = 1 MILE

of numerous, large, closed anticlinal structures which have rocks ranging in age from Ordo-Silurian to Upper Devonian exposed in their cores. A brief discussion of four of these structures (see Fig. 2C) follows.

Hungry South Anticline is a large closed anticline which exposes Ordo-Silurian carbonates in its core.

Hungry West Anticline is a large closed symmetrical anticline faulted along its northern limb. It has Lower-Middle Devonian limestones exposed in the core. Brunton dips on the Upper and Middle Devonian beds indicate a definite reversal in plunge on the structure resulting in a significant amount of closure.

Hungry East Anticline is a closed surface anticline, faulted along its southern limb. Minor folds associated with the faulting have decreased the amount of west plunge on this structure. Measured dips on the Upper Devonian indicate a definite plunge reversal exists, resulting in a significant amount of closure on the anticline. The oldest beds exposed are Upper Devonian in age.

Hungry Creek Dome is a well defined domal feature which exposes Middle Devonian limestones in the core. Although only one Brunton attitude was obtained on the structure, field observations support the photogeologic structure interpretation shown in Fig. 2C. This dome apparently has a relatively large amount of closure.

ARCTIC RED RIVER-HUME RIVER AREA

General

The Arctic Red River-Hume River area (Fig. 3) is located

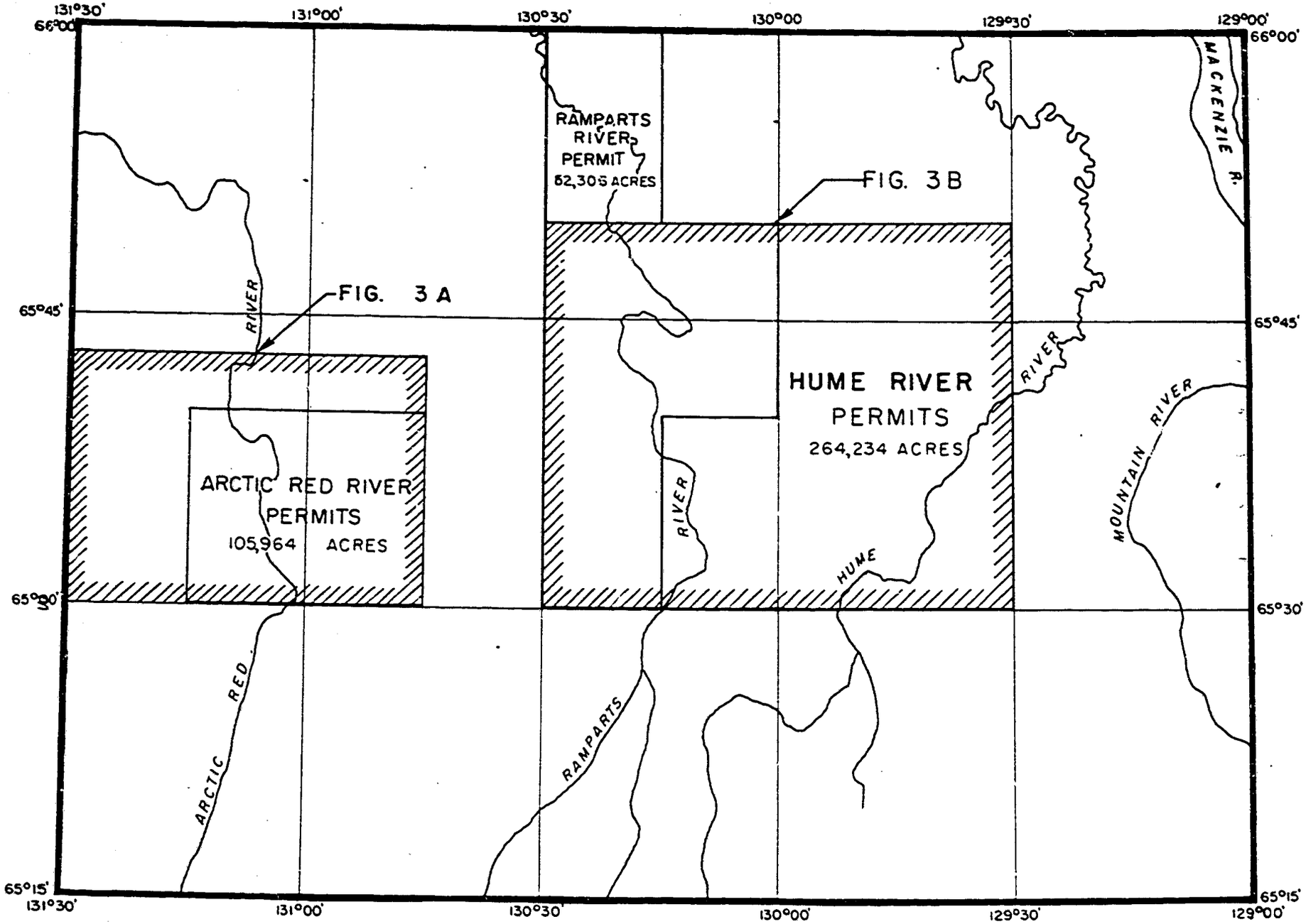

FIG. 3
ARCTIC RED RIVER-HUME RIVER AREA

in the southeastern portion of the Peel Plateau, which is a great triangular area of gently folded sedimentary rocks occupying the angle between the north front of the Mackenzie Mountains and the east front of the Richardson Mountains. Texaco holds three permit blocks within the area, namely the Arctic Red River, Ramparts River, and Hume River Blocks (see Fig. 3).

Stratigraphy

The Paleozoic - Mesozoic sequence in this region contains over 16,000 feet of sediments. A brief description of the lithology and thickness of the major stratigraphic units follows.

Cambrian ± 3300 Feet

The Cambrian sequence is represented mainly by rusty brown weathering quartzites with some varicolored argillites and minor dolomites near the base. Diabase sills are present in the basal Cambrian in the Arctic Red River area.

Ordo-Silurian - Ronning Group ± 2500 Feet

The Ronning group is generally divisible into two formations, the Franklin Mountain and the Mt. Kindle. The Franklin Mountain, of Ordovician age, is represented by 2000 feet of light grey weathering dolomites. The Mt. Kindle is both Ordovician and Silurian in age and consists of about 500 feet of greyish brown weathering dolomites.

Lower Devonian - Bear Rock Fm. 600 to 1200 Feet

The Bear Rock consists of grey and orange weathering brecciated and non-brecciated carbonates. To the west the unit thickens and the brecciation is absent.

Middle Devonian - Hume Fm. ± 1200 Feet

The Hume formation consists of a limestone sequence generally divisible into two units. The lower is a grey weathering, massive bedded limestone 800 feet thick and the upper is an abundantly fossiliferous argillaceous limestone about 400 feet thick.

Middle Devonian - Fort Creek Group 500 to 1000 Feet

The Fort Creek group consists of black, calcareous and non-calcareous shales. Reef limestones up to 500 feet thick (Kee Scarp formation) are developed in the upper part of the unit in the Norman Wells area.

Upper Devonian - Imperial Formation ± 2000 Feet

The Imperial formation consists of greenish grey weathering, silty sandstones and shales. The middle part of the unit is quite shaly and weathers recessively.

Upper and Lower Cretaceous - Shale Unit ± 3000 Feet

This shale unit consisting of dark grey shales and siltstones, represents the oldest Cretaceous rocks in the area. Several thick sandstone beds are developed in the upper part of the unit in the Arctic Red River area. The unit rests disconformably on the Upper Devonian, the contact usually being marked by a basal conglomerate.

Upper Cretaceous - Bald Hills Sandstone 500 to 2000 Feet

The Bald Hills sandstone is about 500 feet thick in the Arctic Red River area and caps many of the higher hills in that region.

The sandstones become poorly developed in the Hume River area where the unit is represented by 2000 feet of interbedded sandstones and shales.

Upper Cretaceous - Yadek Lake Sandstone ± 500 Feet

The Yadek Lake sandstone is best developed in the Hume River area and caps the higher hills in that vicinity.

Structure

The Arctic Red River-Hume River area is characterized by the presence of broad east-west trending, eastward plunging folds broken by a series of transverse faults. A discussion on the structures in this region, investigated during this past summer, is given below.

Arctic Red River Structures: (Fig. 3A)

The plane table survey carried out along the Arctic Red River and one of its western tributaries revealed the presence of several east-west trending anticlinal features. A broad eastward plunging anticline occurs in the central portion of the Block and is flanked to the north and south by similar but smaller folds. The behavior of these folds to the west could not be observed in the field but from photogeologic evidence it appears that they are truncated by northwesterly trending, transverse faults.

Faulting was observed on Arctic Red River in the southern portion of the Permit Block but the paucity of outcrops at this locality makes the structural relationships uncertain.

Hume River Structures: (Fig. 3B)

A helicopter altimeter-controlled structural traverse along the Ramparts River indicated the presence of an east-plunging anticline situated in the southeastern corner of the Hume River Block. The nature of the westward continuation of this structure is not known but it may be truncated by transverse faults similar to the Arctic

Red River structures. The northwesterly trending folds shown in the northern portion of the Block were mapped from aerial photos. The lack of suitable exposures prevented verification of these structures in the field.

JOHNSON RIVER-IVERSON LAKE AREA

General

The Johnson River-Iverson Lake area is located in the southern part of the Mackenzie Mountains and Mackenzie Plain. The Mackenzie Plain is an area of relatively low elevation along the Mackenzie River between the Franklin and Mackenzie Mountain systems. Texaco holds two permit blocks in this area, namely the Johnson River Block and the Root River Block (see Fig. 4).

Stratigraphy

The Paleozoic succession in the Johnson River-Iverson Lake area ranges in thickness from 10,000 feet in the east to over 17,000 feet in the west. The thickening appears to be regional, affecting all the major stratigraphic units. Stratigraphic work on the Middle Devonian was carried out in the Iverson Lake area, during the latter part of the 1960 field season. Based on information gained in the Johnson River area during the summer of 1959, the stratigraphic succession in that region is known to be similar to that at Iverson Lake. The following discussion of stratigraphy is based mainly on information gained this past summer at Iverson Lake but applies to the area as a whole. Few formation names have been established in this region so only a broad stratigraphic breakdown is considered.

125°30' 125°00' 124°30' 124°00' 123°30' 123°00'

64°00' 64°00'

REDSTONE RIVER

DAHADINNI RIVER

BLACKWATER RIVER

BLACKWATER LAKE

JOHNSON RIVER PERMITS
199,527 ACRES

MACKENZIE RIVER

FIG. 4A

63°30' 63°30'

JOHNSON RIVER

WRIGLEY

1 of

63°00' 63°00'

ROOT RIVER

ROOT RIVER PERMITS
87,727 ACRES

MC-1

NI-1

ML-1

EC-1

IL-3

MEASURED SECTIONS IVERSON LAKE AREA

62°30' 62°30'

IVERSON LAKE

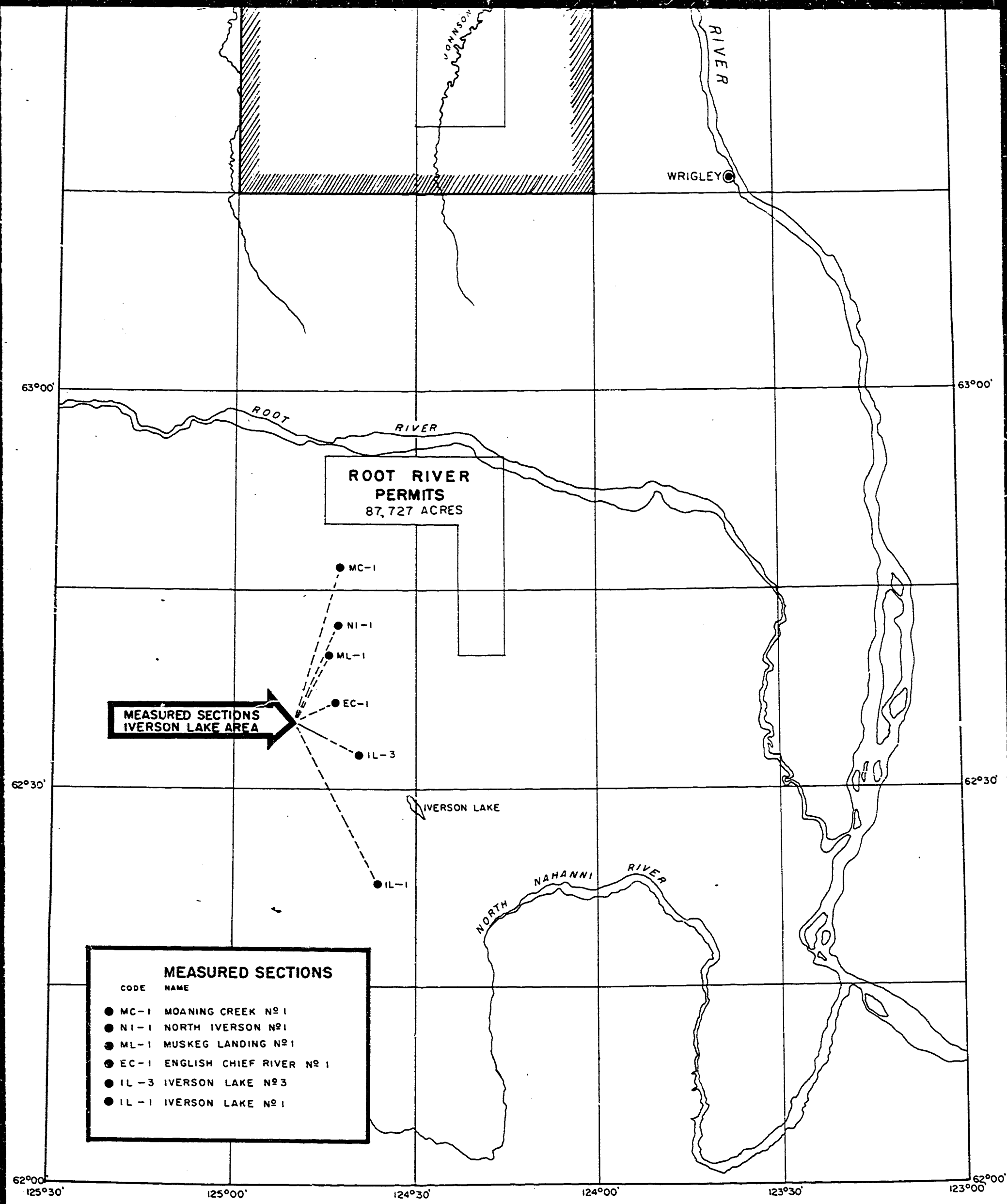

FIG. 4 JOHNSON RIVER–IVERSON LAKE AREA

2 of 2

Cambrian 2000 to 5000 Feet

The Cambrian sequence consists of rusty weathering quartzites overlain by varicolored argillites with some evaporites. From previous investigations in the area north of Johnson River, it is known that the Cambrian thickens in a westward direction.

Ordovician to Middle Devonian - Lone Mountain 4000 to 6000 Feet

The term Lone Mountain is applied to a thick, predominantly carbonate sequence including beds from Ordovician to Middle Devonian in age. The numerous facies changes which occur, particularly in the upper part of the unit, coupled with the scarcity of fossils, make a complete understanding of this unit very difficult. As a result of this summer's work, a tentative two-fold division of the unit has been made as described below.

The lower part of the Lone Mountain consists mainly of grey weathering banded dolomites ranging in age from Ordovician to Lower Devonian. The upper part of this dolomite sequence is locally brecciated and probably represents an equivalent of the Lower Devonian Bear Rock formation of the Norman Wells area. No complete sections were measured in this part of the Lone Mountain.

The upper 300 to 600 feet of the Lone Mountain is considered to be Middle Devonian in age. It is represented by grey weathering limestones grading laterally to dolomites in the Johnson River area and the northern part of the Iverson Lake area. This unit in the Iverson Lake region is also represented by coarsely crystalline dolomites, and dark grey, argillaceous limestones or calcareous shales (see stratigraphic sections in pocket). The contact with the overlying

Nahanni formation appears conformable.

Middle Devonian - Nahanni Formation 800 to 900 Feet

The Nahanni formation consists of a basal recessive weathering, abundantly fossiliferous limestone overlain by massive cliff forming limestones. The argillaceous content in the limestones varies, throughout the region so that the upper cliff-forming unit is not always well-developed. For a more detailed lithologic description of the Nahanni limestones refer to Muskeg Landing - 1 (ML-1) stratigraphic section in the pocket.

Upper Devonian 3000 to 5000 Feet

Upper Devonian rocks form the surface exposures over most of the plains regions in the Johnson River-Iverson Lake area. The Upper Devonian is predominantly a shale-siltstone sequence but occasional limestone interbeds and organic limestones are present. The basal 200 to 300 feet generally consists of black, fissile shale which may be equivalent to the Fort Creek shale of the Norman Wells area. The Upper Devonian appears to thicken towards the southern part of the area. No stratigraphic sections were measured in the Upper Devonian during the past field season.

Structure

A structural traverse was carried out by helicopter on the Johnson River Block during July 1960. Most of the structural information was gained by observing apparent dips in stream exposures while flying at low altitude, because thick tree growth prevented landings to obtain actual Brunton measurements.

The operations at Iverson Lake this summer were concerned

mainly with stratigraphic work so only the structure of the Johnson River area will be considered here.

Johnson River Structures: (See Fig. 4A)

The Johnson River area is characterized by a series of sub-parallel north to northwest trending folds. The structural evidence is widely scattered so the details of these folds are not well known. Most of the folds appear to plunge northward, but plunge reversals may exist on the axial trends shown in Fig. 4A. Additional structural evidence is necessary for a more complete understanding of the area.

CONCLUSIONS

The field methods employed in the structural mapping were all considered satisfactory when used under the proper conditions. The choice of method depends on various factors and in some instances one method can be substituted for another. The helicopter altimeter controlled structural mapping could prove to be an adequate substitute for a plane table survey. It is much less accurate, but the time and money saved in using the helicopter altimeter warrant its consideration.

The structures in the Sid Lake-Hungry Lake region appear the most favorable for hydrocarbon accumulation of those investigated. They all show significant amounts of closure and the Paleozoic sequence appears to have several potential reservoir horizons.

All of the areas investigated show evidence of favorable structural and reservoir conditions for hydrocarbon accumulations. Further exploration and development of these regions will depend largely on economic considerations in the future.

Respectfully submitted,

D. R. Yont

D. R. Yont, Party Chief.

R. R. Baker

R. R. Baker,
Chief Geologist, P. Eng.

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GEOLOGIC SECTIONS FROM YUKON AND NORTHWEST TERRITORIES

DETAILED STRATIGRAPHIC SECTION

Section Name: IVERSON LAKE-3 Code: IL-3

Location: 9 miles north of Iverson Lake

SYSTEM: DEVONIAN

SERIES: MIDDLE

FORMATION: MOUNTAIN

MEMBER:

TYPE SECTION EQUIVALENT:

SCALE: 100, 200, 300, 400, 500, 600, 700

LITHOLOGY

LITHOLOGIC DESCRIPTION

fos zone, num Brach, s/ corals & cri

UNIT #2

Ls sl arg, m dk gy w ths lt gy, f gr microtex- rexld calcarenite, thk to mass bdd., forms steep cliff., fracs infilled w/ sec calc. Ls becomes v mass bdd towards top w beds 10' to 20' thk. To the south the ls becomes less resis presumably due to facies change to sh. Overlain directly by Nahanni fm. on next mtn.

UNIT #1

Ls, arg, dk gy, w ths lt yel bn, f gr, thn bdd. w ths recess forming talus slope, fos w/ Brachs, corals, plcy, Cri

TEXACO EXPLORATION COMPANY

GEOLOGIC SECTIONS FROM YUKON AND NORTHWEST TERRITORIES

DETAILED STRATIGRAPHIC SECTION

Section Name: NORTH IVERSON-1 Code: NI-1

Location: 8½ miles north of English Chief River, just east of prominent north-south trending trench valley.

SYSTEM: DEVONIAN

SERIES: MIDDLE

FORMATION: MOUNTAIN / NAHANNI

MEMBER:

TYPE SECTION EQUIVALENT:

SCALE: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000

LITHOLOGY

LITHOLOGIC DESCRIPTION

UNIT #1

Ls. sl arg, m dk gy w ths m gy w/ brnsh tinge, thn to m irreg bdd. f gr, rubbly w thg, fos w/ num colonial corals. Strom, & occasional brachs.

UNIT #2

Ls. m dk. gy, w ths lt gy to m gy f gr., thk to mass bdd., sparsely fos.

UNIT #3

Dol lt to m gy w thg, mott lt and dk gy frs. col, calc i pt, m to crs xln, mass to thk bdd., abnt sec calc & qtz.

TEXACO EXPLORATION COMPANY

GEOLOGIC SECTIONS FROM YUKON AND NORTHWEST TERRITORIES

DETAILED STRATIGRAPHIC SECTION

Section Name MUSKEG LANDING-1 Code ML-1

Location On east side of a prominent north-south trending valley, 5 miles north of the English Chief River and 19 miles northwest of Iverson Lake

SYSTEM	SERIES	FORMATION	MEMBER	TYPE SECTION EQUIVALENT	SCALE	LITHOLOGY	LITHOLOGIC DESCRIPTION
DEVONIAN	MIDDLE	NAHANNI		FORT CREEK ?	100		Sh rd bn wthg, bk frs col, n. calc, extremely fiss ¼" to ½" plates, blky wthd surface. Observed 60 yds down river from last ls outcrop
					200		
					300		Ls as below
					400		
					500		Covered interval, prob sh.
					600		
					700		Ls m to lt gy wthg, f gr, fos.
					800		Ls as below
					900		Sh lt bn gy wthg, m gy frs col, calc, sl sty, fis ¼" to ⅛" plates
					1000		Ls purp gy to bn gy wthg, m gy frs col, vf to m gr, thn to m bdd, nodular appearance i pt, fos.
					1100		Ls lt to m bf wthg, m to dk gy frs col, vf gr to micxl, thn to med bdd, extremely foss (lower 10')
							Ls lt brn gy to m bn gy wthg, m gy frs col, f gr to crpxl, thk bdd, contains num calc blebs

TEXACO EXPLORATION COMPANY

GEOLOGIC SECTIONS FROM YUKON AND NORTHWEST TERRITORIES

DETAILED STRATIGRAPHIC SECTION

Section Name MOANING CREEK-1 Code MC-1

Location On front range north of Iverson Lake, a few miles south of the Rooit River

SYSTEM	SERIES	FORMATION	MEMBER	TYPE SECTION EQUIVALENT	SCALE	LITHOLOGY	LITHOLOGIC DESCRIPTION
DEVONIAN	MIDDLE	NAHANNI			100		UNIT #10
					200		Ls lt bn gy to bf wthg, m gy frs col, f gr to crpxl, f bdd 1', somewhat nodular, forms distinctive bnish tsnd on mtn., extremely fos w/ num corals, f brachs.
					300		UNIT #9
					400		Ls lt gy wthg, dk gy to bk frs col, vf gr to microln, contains w/ calc infilled vugs, m bdd, foss., bcm f gr, thn to med bdd towards top.
					500		UNIT #8
					600		Ls lt gy wthg f frs col, v c gr'n, mass bdd, num vugs, shot thru w/ calc., bndd, appearance, v rbly, por, sits w/ marked discontinuity on unit below, bcms calc dol towards top.
					700		UNIT #7
					800		Dol, calc, similar to UNIT #5
					900		UNIT #6
					1000		Ls, m gy wthg, bk frs col, f gr, mass bdd, contains occasional Cri stems, dolt at base.
					1100		UNIT #5
							foss zone, 80% Cri frags in rock.
							Dol, calc, slty, f to m gr, saccharoidal bk wthg f frs col
							UNIT #4

DEVONIAN

MIDDLE

LOWER

MOUNTAIN

LONE

Ls m to lt gy wthg, f gr, fos.

Ls as below

Sh lt bn gy wthg, m gy frs col, calc, sl sty, fis ¼" to ⅛" plates

Ls purp gy to bn gy wthg, m gy frs col, v f to m gr, thn to m bdd, nodular appearance i pt, fos.

Ls lt to m bf wthg, m to dk gy frs col, v f gr to mical, thn to med bdd, extremely foss (lower 10')

Ls lt brn gy to m bn gy wthg, m gy frs col, f gr to crpsl, thk bdd, contains num calc blebs

Dol lt gy to m gy wthg, lt gy to buf frs col, m to vc gr, numerous vugs up to 2" sec ca gives bnd appearance, por. sl inbds of ls, lt gy wthg, m gy frs col, f gr to crpsl, m to thk bdd, ca infilled vugs.

Ls lt gy wthg, m gy col, f gr to crpsl, w/ numerous ca infilled vugs, v foss m to thk bdd

Ls lt gy wthg, m to dk gy frs col, f gr., m bdd, blky frac, fos frags in pt, cliff forming thk bdd to mass, m to crs gr, abnt Amphipora

Ls yel gy to bk wthg, bk frs col, f gr. v. foss w/ Plcys & Brachs, rbly, m bdd. sl blky ca infilled fracs, wths resis, w/ sl sh

Ls m purp gy to med gy to dk gy wthg, dk gy to bk frs col., f grn, sl sty, m bdd occasional tr of org deb, rbly

Sh m purp gy to dk gy wthg, blk to dk gy frs col, fis ¼" plates, calc.

Ls m purp gy to dk gy wthg, dk gy to bk f.s. v f gr to microxln, arg, sl sty, thn bdd rbly, n. foss.

Sh m purp gy to bn wthg, dk gy to blk f.s., extremely calc, fis in ⅛" to ¼" plates, contains numerous Conularia, sl sty, outcrop is rbly & p exp

Dol lt to m bl gy wthg, m gy col, c gr, fos w/ up to 40% Cri, m to thk bdd, somewhat rubbly wthg, fr to p int xl por occasional cht blebs 20' below top mnr qtz. xls to 1"

DEVONIAN

LOWER

LONE

MOUNTAIN

UNIT #5

foss zone, 80% Cri frags in rock.

Dol, calc, silty, f to m gr, saccharoidal bk wthg & frs col

UNIT #4

dol now only sl ca.

dol. bcms less calc.

Dol, calc, f gr, mass bdd, n. foss, contains ⅟ (1/16" to ⅛") calc vugs.

UNIT #3

Ls bk wthg & frs col, f gr, dolc, sl sty, thn bdd, contains ca veinlets, fos w/ Tent, bcm mass to thk bdd 10' above base

UNIT #2

Dol. (Dol ls.) dk gy to bk wthg & frs col, f gr, subsaccharoidal, thk bdd. to mas, highly frac, num ca strgs, blky wthg, rest w/ sharp discontinuity upon unit below, num cri stems near top.

UNIT #1

Dol, f gr, dk gy wthg, dk gy to ycl bn frs col, v. calc, m to thk bdd, blky frac, num calc veins, dns, sl sty, n. foss, calc blebs apr. aligned on outcrop face. Forms prom. cliff face

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TEXACO EXPLORATION COMPANY
GEOLOGIC SECTIONS FROM YUKON AND NORTHWEST TERRITORIES
DETAILED STRATIGRAPHIC SECTION

Section Name: IVERSON LAKE - 1 Code: I.L - 1

Location: This section is located 9 miles southwest of Iverson Lake in the Iverson Range

SYSTEM: DEVONIAN | SERIES: MIDDLE | FORMATION: NAHANNI | MEMBER: LONE MOUNTAIN | TYPE SECTION EQUIVALENT: LOWER

SCALE: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100

LITHOLOGIC DESCRIPTION

UNIT #4
Ls m to lt gy wths lt gy, f. grnd, thin bdd. w/ sl. med. bdd., foss'l w bry, brachs.

UNIT #3
Ls. med. gy to dk. gy, f. grnd, poorly exposed. Foss'l w/ cri, brachs, corals, strom

UNIT #2
Dol. mott lt gy to wh wths med lt. gy, crs xln, mass. irreg. bdd., numerous vugs w/ qtz & ca mineralization. Highly frac'd. near top giving hackly wthg appearance.

UNIT #1
Dol m. gy wths m gy, m to crs xln. Scattered qtz. mineralization in masses up to 6" across, indistinctly mass bdd. Secy wh. ca. veinlets

TEXACO EXPLORATION COMPANY
GEOLOGIC SECTIONS FROM YUKON AND NORTHWEST TERRITORIES
DETAILED STRATIGRAPHIC SECTION

Section Name: ENGLISH CHIEF RIVER-1 Code: EC-1

Location: 1 mile north of English Chief River, just east of where it enters the long north-south trending trench valley, 14 miles north northwest of Iverson Lake

SYSTEM: DEVONIAN | SERIES: MIDDLE | FORMATION: NAHANNI | MEMBER: LONE MOUNTAIN | TYPE SECTION EQUIVALENT:

SCALE: 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1100

LITHOLOGIC DESCRIPTION

UNIT #6
Ls sl arg., m. dk. gy, wthr m. gy w/ bn tinge, thn to m. irreg bdd., f. gr, rbly wthg, sl res, 1.85 up to 2' thk. in low ft. of unit. Fos w/ num colonial corals, stroms & occassional brachs, The 70' of Nahanni ls is an erosional remnant on this pt. of the mtn.

UNIT #5
Ls. sl. arg., m dk gy, wths m gy to lt gy, f gr, m to mass bdd., v resistant wthg forming steep cliff. Microtex indicates ls is frag'l. Lower 35' of unit wths recessive, is m. bdd w/ pnk stain. Unit is sparsely fos w/ corals, stroms, brachs. Towards top of unit is becomes lithographic

UNIT #4
Ls m to dk gy, wths m gy to pnk & yel/sh gy, f. gr, m to thk irreg bdd., rbly wthg, sl arg. forms rbly zone between cliffs above and talus slope below

Ls similar to base of unit

from 190' to 425' abv base of unit there is lit exp. due to talus

Ls resist bnd 10' thk., foss w/ brach, crin, trilo, corals, & gast.

UNIT #3
Ls. arg, dk gy, wthrs m gy to yel gy, f gr, lam to thn bdd., banded in appearance w/ occassional bds 6" to 1 ft thk., foss w/ brachs & corals. Unit becomes reg med bdd towards

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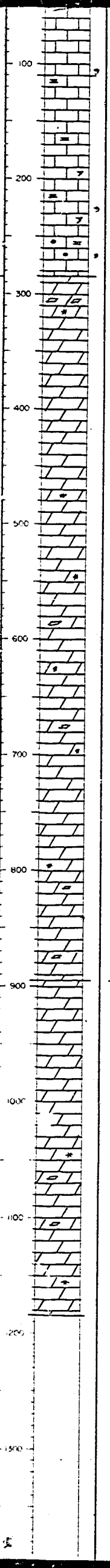
DEVONIAN
MIDDLE
NAHANNI
MOUNTAIN

LOWER
LONE MOUNTAIN



UNIT #4

LS. m to lt gy, wths lt gy, f. grnd, thin bdd. w/ sl. med. bdd., foss!! w bry, brachs.

UNIT #3

LS. med. gy to dk. gy, f. grnd, poorly exposed. Foss!! w/ cri, brachs, corals, strom

UNIT #2

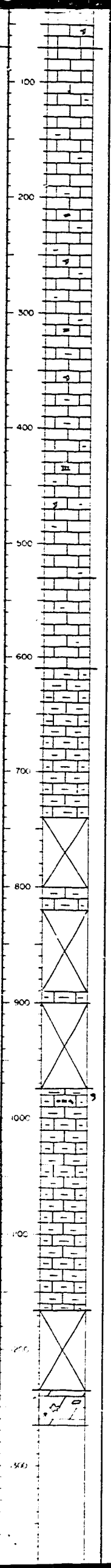
Dol. mott lt gy to wh wths med lt. gy, crs xln, mass. irreg. bdd., numerous vugs w/ qtz & ca mineralization. Highly frac'd. near top giving hackly wthg appearance.

UNIT #1

Dol m. gy wths m gy, m to crs xln. Scattered qtz. mineralization in masses up to 6" across, indistinctly mass bdd. Secy wh. ca. veinlets

DEVONIAN
MIDDLE
MOUNTAIN

LOWER
LONE



...low pt of unit. Fos w/ num colonial corals, stroms & occasional brachs. The 70' of Nahanni is is an erosional remnant on this pt. of the mtn.

UNIT #5

Ls. sl. arg., m dk gy. wths m gy to lt gy, f gr, m to mass bdd, v resistant wthg forming steep cliff. Micrites indicates ls is frag!!. Lower 35' of unit wths recessive, ls is m bdd w pink fe stain. Unit is sparsely fos w corals, stroms, brachs. Towards top of unit ls becomes lithographic

UNIT #4

Ls m to dk gy, wths m gy to pink & yellsh gy, f gr, m to thk irreg bdd., rbly wthg sl arg. forms rbly zone between cliffs above and talus slope below

Ls similar to base of unit

from 190' to 425' abv base of unit there is lttl exp due to talus

Ls resist bnd 10' thk., foss w/ brach, crin, trilo, corals & gast.

UNIT #3

Ls. arg, dk gy, wthrs m gy to yel gy, f gr, lam to thn bdd., banded in appearance w/ occassional bds 6" to 1 ft thk., foss w/ brachs & corals. Unit becomes reg med. bdd towards top & wths more resist.

UNIT #2

Covered interval wths. recess.

UNIT #1

Dol dk. gy wths m gy to yel gy f. gr, mass bdd, frac & bneec. w/ abnt secy ca & qtz mnrl.

2 of 2

136°30'

136°15'

136° 00'

65° 30'

65° 25'

HUNGRY CREEK DOME

HUNGRY EAST ANTICLINE

HUNGRY WEST ANTICLINE

HUNGRY SOUTH ANTICLINE

Minor Faults

Minor Folds

Minor Folds

Minor Folds

LEGEND

Q	QUATERNARY	30°	STRUCTURAL ATTITUDE OBTAINED BY BRUNTON COMPASS
PP	PERMO–PENNSYLVANIAN		PHOTOGEOLOGICAL SYMBOL (SEE BELOW)
uD	UPPER DEVONIAN		
mDfc	MIDDLE DEVONIAN FORT CREEK	lmD	LOWER & MIDDLE DEVONIAN UNDIVIDED
lmD	LOWER AND MIDDLE DEVONIAN		
S	SILURIAN		
OS	ORDO – SILURIAN		

PHOTOGEOLOGIC SYMBOLS

- Bedding horizontal
- Dip less than 1°
- Dip 1° to 3°
- Dip 2° to 15°
- Dip 10° to 30°
- Dip 25° to 45°
- Dip 40° to 89°
- Bedding vertical
- Bedding overturned
- Strike and dip, amount unknown
- Dip component
- Strike, dip unknown
- Escarpment or ridge in gently dipping to horizontal beds; generally structure controlled by stream valley
- Fracture or joint
- Fault, showing throw (dotted through Quarternary)
- Fault, strike-slip
- Fault, thrust (prongs on thrust sheet)
- Fault, indefinite
- Fault, inferred
- Anticline, arrow denotes plunge, diamond denotes apex
- Syncline, arrow denotes plunge, cross bars denotes high point
- Anticline and Syncline, position indefinite
- Anticline and Syncline, inferred

Q	QUATERNARY
PP	PERMO–PENNSYLVANIAN
uD	UPPER DEVONIAN
mDfc	MIDDLE DEVONIAN FORT CREEK
lmD	LOWER AND MIDDLE DEVONIAN
S	SILURIAN
OS	ORDO – SILURIAN

STRUCTURAL ATTITUDE OBTAINED BY BRUNTON COMPASS (30°)

PHOTOGEOLOGICAL SYMBOL (SEE BELOW) lmD LOWER & MIDDLE DEVONIAN UNDIVIDED

HUNGRY EAST ANTICLINE

HUNGRY WEST ANTICLINE

HUNGRY SOUTH ANTICLINE

Minor Folds

PHOTOGEOLOGIC SYMBOLS

- Bedding horizontal
- Dip less than 1°
- Dip 1° to 3°
- Dip 2° to 15°
- Dip 10° to 30°
- Dip 25° to 45°
- Dip 40° to 89°
- Bedding vertical
- Bedding overturned
- Strike and dip, amount unknown
- Dip component
- Strike, dip unknown
- Fracture or joint
- Fault, showing throw (dotted through Quarternary)
- Fault, strike-slip
- Fault, thrust (prongs on thrust sheet)
- Fault, indefinite
- Fault, inferred
- Anticline, arrow denotes plunge, diamond denotes apex
- Syncline, arrow denotes plunge, cross bars denotes high point
- Anticline and Syncline, position indefinite
- Anticline and Syncline, inferred
- Anticline and Syncline, overturned (arrows on side of normal dip)
- K — Key bed (any mappable marker)
- SB — Stratigraphic break, contact between different lithologies
- Dyke
- Contact
- Contact, indefinite
- Contact, inferred
- DA — Distinct alignment, usually a fault trace
- EB — Exposed bedrock in a heavily mantled area
- PEB — Possible exposed bedrock
- FO — Field observation by Texaco personnel
- FOP — Field observed data, published by an outside source
- PDS — Possible dip slope

65°30'

65°25'

136°30'

136°15'

136°00'20

FIG. 2C HUNGRY LAKE STRUCTURE 1 INCH = 1 MILE

2 of 2

131°30'
131°15'
131°00'
130°45'
65°43'
65°40'

uKb
Ksh
uKb
Ksh
uKb
uKb
Ksh
uKb

ARCTIC RED RIVER
PERMIT BLOCK
105,964 Acres

CORRELATION UNPROVED

PHOTOGEOLOGIC SYMBOLS

- Bedding horizontal
- Dip less than 1°
- Dip 1° to 3°
- Dip 2° to 15°
- Dip 10° to 30°
- Dip 25° to 45°
- Dip 40° to 89°
- Bedding vertical
- Bedding overturned
- Strike and dip, amount unknown
- Dip component
- Strike, dip unknown
- Fracture or joint
- Fault, showing throw (dotted through Quarternary)
- Fault, strike-slip
- Fault, thrust (prongs on thrust sheet)
- Fault, indefinite
- Fault, inferred
- Anticline, arrow denotes plunge, diamond denotes apex
- Syncline, arrow denotes plunge, cross bars denotes high point
- Anticline and Syncline, position indefinite
- Anticline and Syncline, inferred

LEGEND

uKb	939	UPPER CRETACEOUS BALD HILLS SANDSTONE
Ksh	907	UPPER and LOWER CRETACEOUS SHALE
o 1449		ELEVATION OBTAINED BY PLANE TABLE SURVEY
⊗ 1260		ELEVATION OBTAINED BY HELICOPTER ALTIMETER
1500		STRUCTURE CONTOURS ON CRETACEOUS SAND "FOX"

107

65°40'

uKb

Ksh

ARCTIC RED RIVER
PERMIT BLOCK
105,964 Acres

65°30'

131°30'

131°15'

131°00'

65°30'

130°45'

PHOTOGEOLOGIC SYMBOLS

- Bedding horizontal
- Dip less than 1°
- Dip 1° to 3°
- Dip 2° to 15°
- Dip 10° to 30°
- Dip 25° to 45°
- Dip 40° to 89°
- Bedding vertical
- Bedding overturned
- Strike and dip, amount unknown
- Dip component
- Strike, dip unknown
- Fracture or joint
- Fault, showing throw (dotted through Quarternary)
- Fault, strike-slip
- Fault, thrust (prongs on thrust sheet)
- Fault, indefinite
- Fault, inferred
- Anticline, arrow denotes plunge, diamond denotes apex
- Syncline, arrow denotes plunge, cross bars denotes high point
- Anticline and Syncline, position indefinite
- Anticline and Syncline, inferred
- Anticline and Syncline, overturned (arrows on side of normal dip)
- K — Key bed (any mappable marker)
- SB — Stratigraphic break, contact between different lithologies
- d — d — Dyke
- Contact
- Contact, indefinite
- Contact, inferred
- OA — Distinct alignment, usually a fault trace
- EB — Exposed bedrock in a heavily mantled area
- PEB — Possible exposed bedrock
- FO — Field observation by Texaco personnel
- FOP — Field observed data, published by an outside source
- PDS — Possible dip slope

LEGEND

- uKb — 939 UPPER CRETACEOUS BALD HILLS SANDSTONE
- Ksh — 907 UPPER and LOWER CRETACEOUS SHALE
- ○ 1449 — ELEVATION OBTAINED BY PLANE TABLE SURVEY
- ⊗ 1260 — ELEVATION OBTAINED BY HELICOPTER ALTIMETER
- 1500 / 1450 — STRUCTURE CONTOURS ON CRETACEOUS SAND "FOX"
- BOUNDARY TEXACO ACREAGE

CORRELATION UNPROVED

1/2 0 1 2
MILES

FIG. 3 A
ARCTIC RED RIVER STRUCTURE

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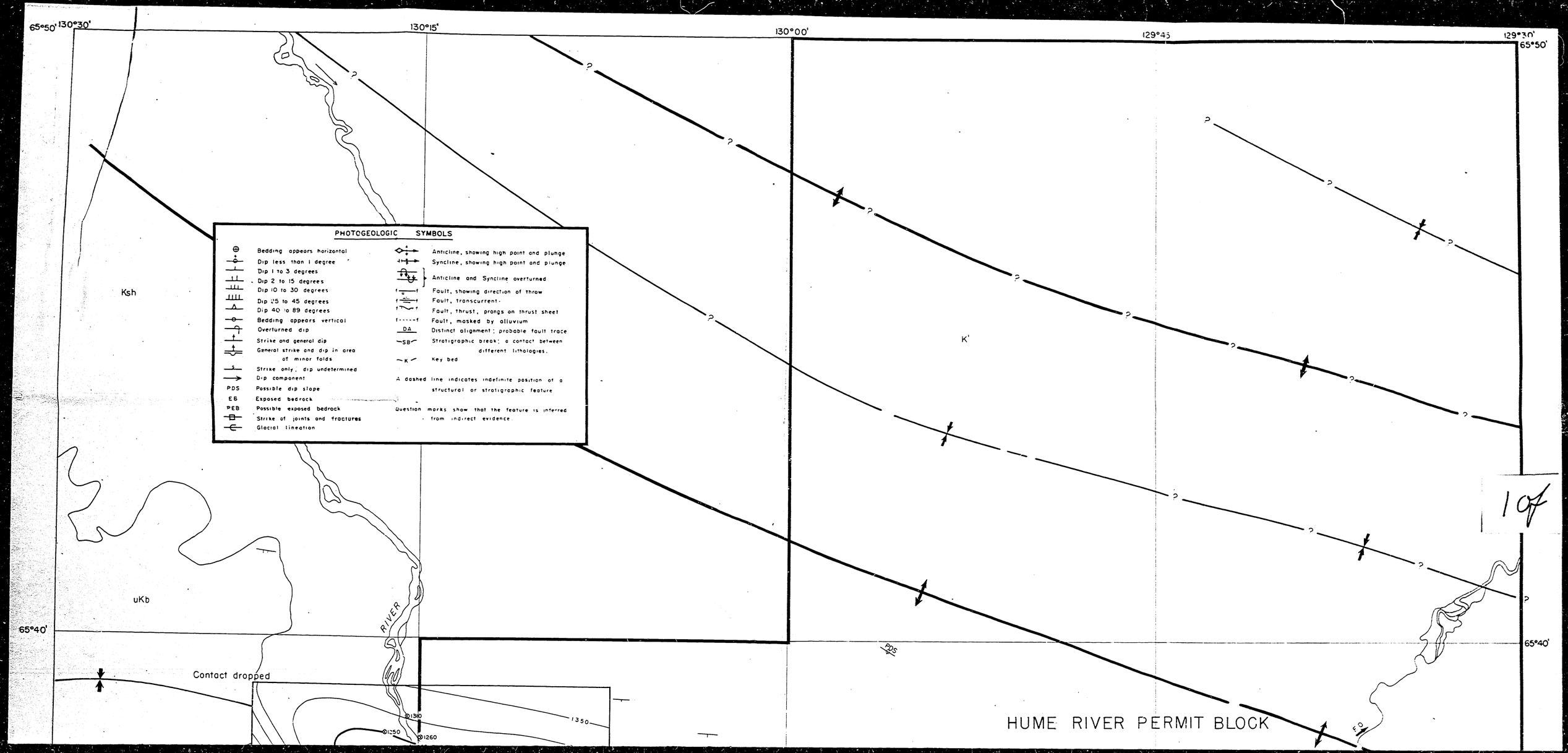
65°50'
130°30'
130°15'
130°00'
129°45'
129°30'
65°50'
65°40'
65°40'
Ksh
K'
uKb
RIVER
Contact dropped
PDS
1350
1340
1250
1260
HUME RIVER PERMIT BLOCK
PHOTOGEOLOGIC SYMBOLS
Bedding appears horizontal
Dip less than 1 degree
Dip 1 to 3 degrees
Dip 2 to 15 degrees
Dip 10 to 30 degrees
Dip 25 to 45 degrees
Dip 40 to 89 degrees
Bedding appears vertical
Overturned dip
Strike and general dip
General strike and dip in area of minor folds
Strike only, dip undetermined
Dip component
PDS Possible dip slope
EB Exposed bedrock
PEB Possible exposed bedrock
Strike of joints and fractures
Glacial lineation
Anticline, showing high point and plunge
Syncline, showing high point and plunge
Anticline and Syncline overturned
Fault, showing direction of throw
Fault, transcurrent
Fault, thrust, prongs on thrust sheet
Fault, masked by alluvium
DA Distinct alignment; probable fault trace
SB Stratigraphic break; a contact between different lithologies.
K Key bed
A dashed line indicates indefinite position of a structural or stratigraphic feature
Question marks show that the feature is inferred from indirect evidence.

10f

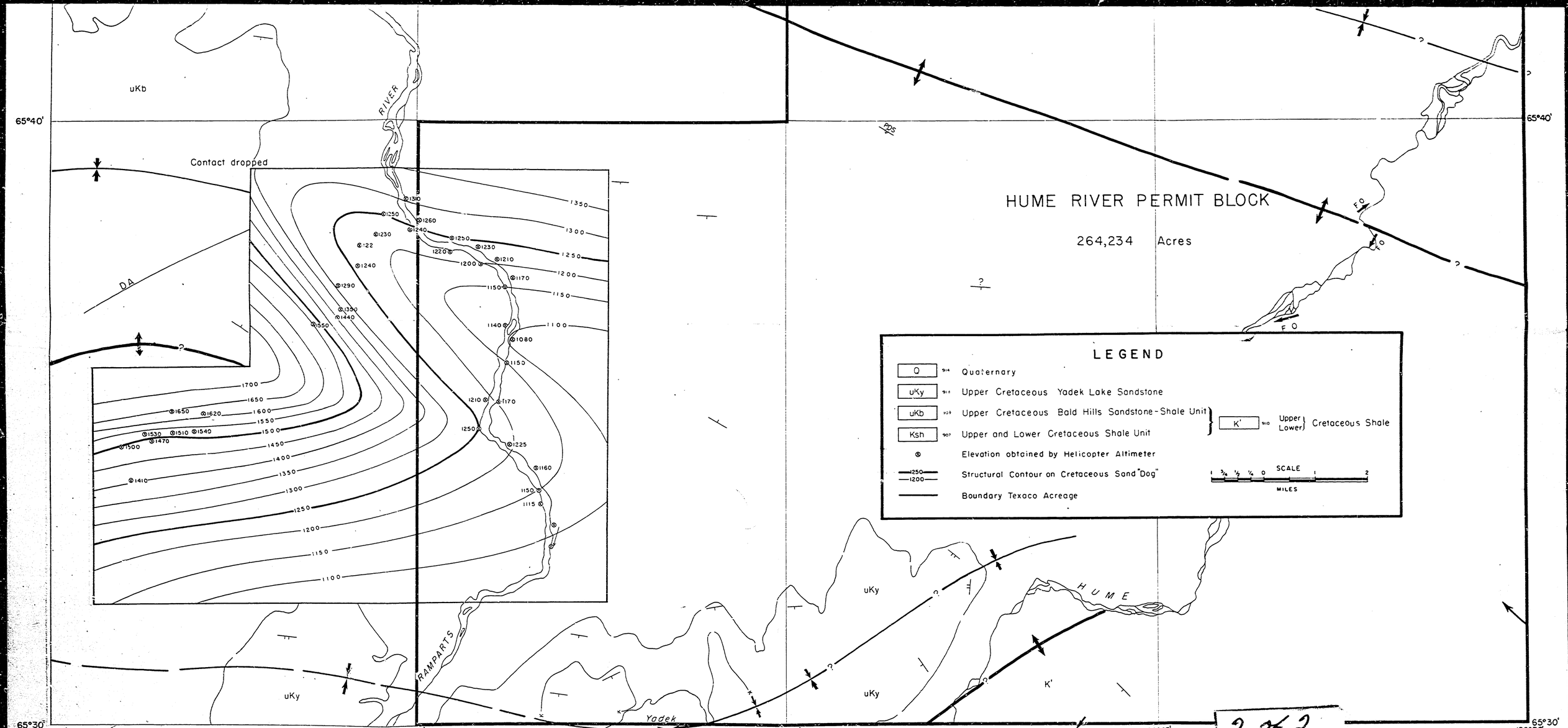

FIG. 3B HUME RIVER STRUCTURE

2 of 2

125°00'
63°45'

124°30'

123°00'
63°45'

JOHNSON RIVER PERMITS

199,527 ACRES

D A H A D I N N I R A N G E

JOHNSON RIVER

F.O.

5°-8° F.O.

10° F.O.

15° F.O.

18° F.O.

63°30'

63°30'

HADINNI RANGE

JOHNSON RIVER

63°30'

63°00'

125°00'

124°30'

124°00'

F.O.

F.O. F.O.

F.O.

F.O. 10°

F.O.

F.O.

10° F.O.

F.O.

18° F.O.

F.O.

15° F.O.

F.O.

F.O.

F.O.

F.O.

5°-8° F.O.

5°-8° F.O.

LEGEND

F.O. — STRUCTURAL ATTITUDE OBSERVED FROM HELICOPTER

10° / F.O. — STRUCTURAL ATTITUDE OBTAINED BY BRUNTON COMPASS

BOUNDARY TEXACO ACREAGE

2 1 0 2 4 6

MILES

FIG. 4A JOHNSON RIVER STRUCTURE