

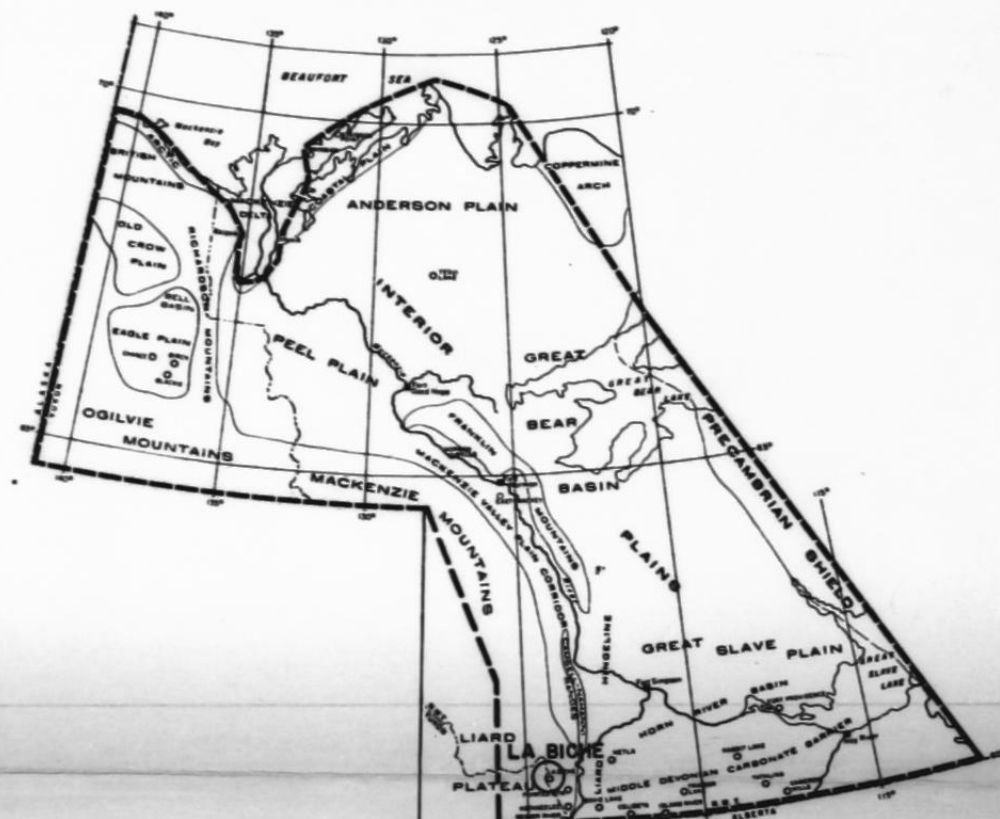
**GEOLOGY
OF THE
LA BICHE F-08
GAS DISCOVERY**

NORTHWEST TERRITORIES

DISCOVERY DATE: 1971

PREPARED BY
VEEZAY GEODATA (1977) LIMITED PARTNERSHIP
CALGARY, ALBERTA
1982

REGIONAL LOCATION MAP



1982 MACKENZIE BASIN CANADA LANDS EXPLORATION PROGRAM

STRUCTURAL GEOLOGY
of the
LIARD PLATEAU
and the
BEAVER RIVER GAS FIELD

The Liard Plateau is a subprovince of the Cordillera Structural Province. It occupies the southern part of the province and encompasses about 20,000 square kilometers. It is bounded on the north by the Rocky Mountains and foothills of northeastern British Columbia and on the east by the Interior Plains. The northern limit of the Liard Plateau is arbitrarily defined by the southeasterly flowing South Nahanni River.

Carboniferous and Permian sediments form bedrock over much of the Liard Plateau, but Cretaceous rocks typically occupy structural lows. Early Paleozoic sediments form bedrock in the western part of the plateau where much trending reverse faults are the dominant structural features. The boundary with the Interior Plains on the east is marked by the Liard fault. This high angle reverse fault brings Carboniferous strata to the surface and since folds have been developed on the overthrust plate.

The Liard Plateau is situated in a part of the Cordillera where a marked change in the structural style and trend occurs. This change has created diverse structural features and trends. The general north-westerly trend of the Rocky Mountains to the south in British Columbia is deflected to the northeast north of latitude 60° N. The Mackenzie Mountains, situated north of the Liard Plateau, appear as an eastern extension of the Rocky Mountains front. This extension results in an east-west offsetting of the mountain blocks, and places the Liard Plateau as a transitional zone between these two areas of differential structural shortening. Thus, the variation in structural style and the nature of structural trends within the Liard Plateau result from orogenic forces acting in opposition to each other in adjacent structural sub-provinces. The easterly displacement of the Mackenzie Mountains north of the Liard Plateau has been referred to as the "Mackenzie deflection".

Structure within the Liard Plateau is characterized by northwesterly, northerly and northeasterly trending elongate folds, high angle reverse faults and thrust faults which dip both easterly and westerly. Many of these faults and folds, which are primarily of Tertiary origin, are offset by northwesterly trending normal faults. These latter faults are thought to be of Paleozoic and post-Tertiary rejuvenation along structural zones which date back to early Paleozoic and Precambrian time.

Rates of dip of strata in the Liard Plateau range from about 10° to nearly vertical, but are typically on the order of 15° to 45°. Structural relief is locally more than 2,000 meters and structural closure on many of the best folds is indicated to be up to 1,000 meters. Some examples of large closed folds in the Liard Plateau are the La Biche Anticline, the Pointed Mountain Anticline and the Beaver River Anticline.

Another major structural feature found mainly in the western and northern part of the Liard Plateau is the presence of east-dipping high angle thrust faults. These faults display significant stratigraphic throw, as exemplified by the fault which borders the Caribou Range on the west. It is uncertain where these faults root but they are thought to be related to the thick Precambrian succession that underlies the Liard Plateau.

The La Biche gas field is reinterpreted in a structure which is a northwest trending, doubly plunging anticline. The degree of symmetry of the limbs is not determinable because of complex faulting occurring in the southwest limb. Southwest dipping thrust faults give rise to the anticline. A second phase of deformation gave rise to high-angle northeast dipping reverse faults. The relative time of emplacement of these two phases of deformation is not clear. At the Liard Plateau carbonate level the structure is 14.4 km (11.4 miles) in length and 2.3 km (1.4 miles) wide. The Middle Devonian carbonate is extensively fractured with vertical and horizontal open-filled fractures and some vertical open fractures. In the La Biche field, as in other Liard Plateau fields, deformation by folding, faulting and fracturing occurred in response to regional stresses. The maximum gross pay is 135 m (443 feet) and the closure at the water line is 4,150 hectares (10,250 acres).

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RESERVOIR DATA

HYDROCARBON BEARING SECTION: Gas is pooled in the Nahanni Fm. of Middle Devonian age and the underlying Headless Fm. also of Middle Devonian age.

RESERVOIR ROCK: The reservoir rock is very fine grained, light grey limestone with some intergranular porosity, very porous and fracture porosity. There is abundant calcite veining. Fractured dark grey siltstones may also produce gas but since the drillstem test stratified the limestone-siltstone contact, it is not known if the siltstones host any hydrocarbons.

TRAP TYPE: Structural. Gas is trapped in an anticline which may be structurally complicated by high-angle faulting.

POTENTIAL PRODUCTIVE INTERVAL: 4382'-7030' (1945.2m-2139.7m)

NET GAS PAY THICKNESS: 184' (56.3m) (28 porosity cut off)

PORESDITY AND PERMEABILITY: Average porosity 3.1% (maximum porosity 24.9%) Average permeability 11.2md (maximum permeability 98.2md)

DRILLSTEM TEST MAXIMUM FLOW RATE: 3.3 mcmf/d (.09 x 10⁶ m³/d)

ESTIMATED RESERVES: 0.26 tcf (7.4 x 10¹⁰ m³)

GAS CHARACTERISTICS: (4 by volume)	
Methane	0.11
Hydrogen Sulfide	0.22
Carbon Dioxide	10.23
Nitrogen	2.60
Ethane	86.15
Propane	0.19
trace	
total	100%

GROSS HEATING VALUE: 872.7 BTU ft⁻³ (at 14.65 psia and 60° F.)

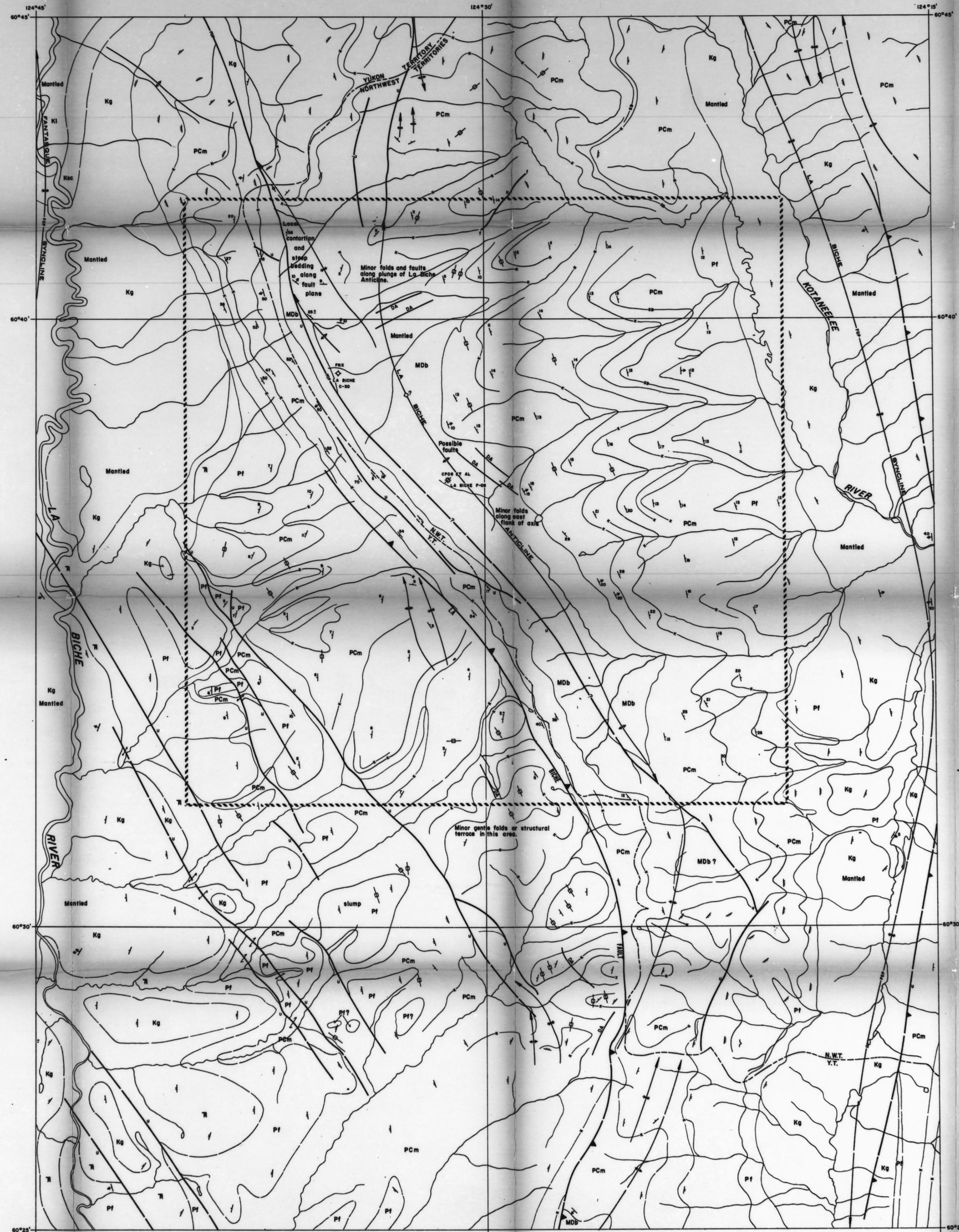
32516.8 Btu/m³ (at 101.0 kPa and 15.5° C.)

SPECIFIC GRAVITY: 0.668 (calculated)

0.667 (by weight)

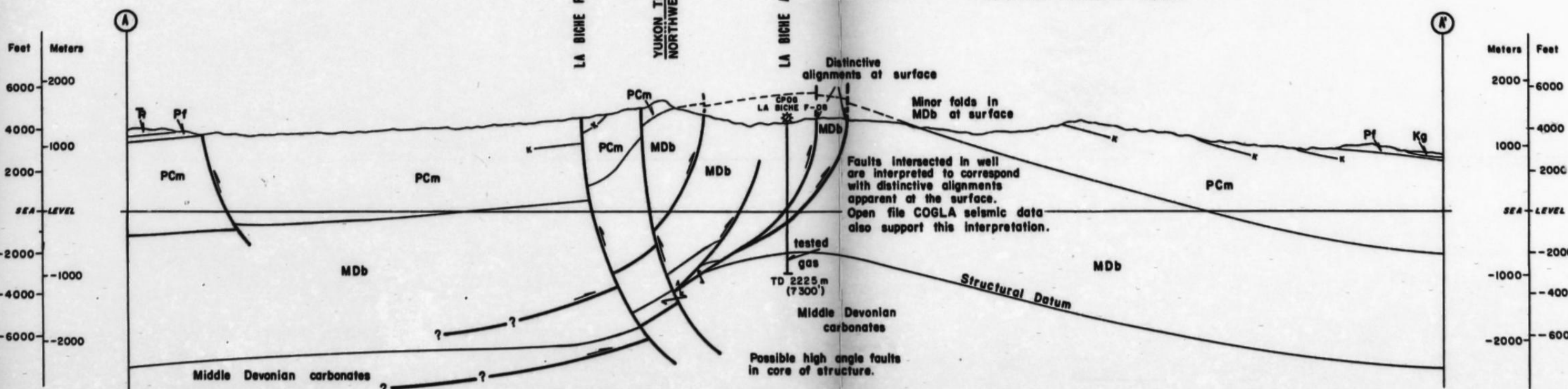
**SURFACE AREAL GEOLOGY AND STRUCTURAL INTERPRETATION MAP
OF THE
LA BICHE GAS DISCOVERY
LIARD PLATEAU**

SCALE 1:50,000



**STRUCTURAL CROSS SECTION
DRAWN ACROSS LA BICHE ANTICLINE**

HORIZONTAL SCALE 1:50,000
VERTICAL SCALE 1:50,000



LEGEND

- CRETACEOUS**
- Kq Lias Formation, 5s
 - Ks Saurer Formation, 5s, 4s
 - Kd Gorbett Formation, 5s
- TRIASSIC**
- T Triassic undivided, 5s
- PERMIAN**
- Pf Fortescue Formation, 5s, 4s
- PERMIAN AND CARBONIFEROUS**
- PcM Mackenzie Formation, 5s, 4s, 3s
- MISSISSIPPIAN AND UPPER DEVONIAN**
- MDb Beaver River Formation, 5s

GEOLOGIC SYMBOLS

- Faults, fold axes and contacts are dashed where their position is indefinite, solid where inferred, and dotted where concealed by post-terrestrial strata.
- Bedding appears horizontal on air photograph
 - Trace of bedding in stream cut appears horizontal
 - Mezogeoclinal dip 1° or less
 - Dip group 1, 1° to 3°
 - Dip group 2, 3° to 10°
 - Dip group 3, 10° to 25°
 - Dip group 4, 25° to 45°
 - Dip group 5, 45° to nearly vertical
 - Bedding appears nearly vertical on air photograph
 - Overturned bedding
 - General dip of beds having subordinate folds
 - Dip strike, amount of dip cannot be determined
 - Dip constant
 - Strike and dip interpreted from geomorphic evidence
 - Possible dip slope
 - Strike line of prominent ridge or saddle
 - Direction of dip cannot be determined on air photograph
 - Field observed information
 - Field observed published or open file information
 - Field observed dip from published or open file source
 - Dip measured photographically
 - Contours (isolated, vertical)
 - Control
 - Apparent unconformable contact
 - Key bed
 - Stratigraphic break
 - Equivalent formations
 - Correlative key beds
 - Outcrop area
 - Fracture or joint
 - Distinctive alignment, possible structural significance
 - High-angle fault: U denotes upthrown side
 - Strike-slip fault showing direction of relative movement
 - High-angle normal fault: Solid circles on downthrown side
 - Thrust fault, triangles on upthrown side
 - Anticline, arrow denotes plunge. Diamond denotes approximate position of apex
 - Syncline, arrow denotes plunge. Diamond and cross bars denote approximate position of high point
 - Anticline and syncline centered. Arrows denote direction of dip of limbs and are on side of normal dip
 - Axis of anticline appears to coincide with fault trace
 - Axis of syncline appears to coincide with fault trace
 - Structural terrace
 - Monocline
 - Proximate slope, steep slope or marginal ridge
 - Dip 10° or steeper
 - Quaternary standing direction of ice movement
 - Facies and/or temperature change
 - Location of Veezay field-measured stratigraphic section

STRUCTURAL CONTOUR SYMBOLS

- Outline of detailed structural contour area
 - Datum elevation in meters from base line information
 - Stratigraphic thickness in meters measured photographically
 - Structure datum elevation calculated in meters and derived from structural elevation measured with a Kern PG 2 stereoreducer
 - Control points on beds lying above or below datum have been projected to datum with quantitative information derived photographically
 - Structure contour in meters dashed where inferred
 - Dip measured photographically
 - Fault, anticline and syncline at datum level based on published or open file information
 - Fault based on published or open file information
 - Surface trace of thrust fault
 - Thrust fault at datum level
- GEOMORPHIC SYMBOLS**
- Linear stream segment, interpreted as strike control
 - Continental stream segment, interpreted as structural control
 - Strike and dip interpreted from geomorphic evidence
 - Anticline and syncline based on geomorphic evidence
 - Arrow indicates direction of plunge
- WELL SYMBOLS**
- Location of drilling
 - Dry and abandoned
 - Oil well
 - Gas well
 - Oil and gas well
 - Capped gas well
 - Completed well
 - Suspended well

STRUCTURAL CONTOUR MAP OF THE LA BICHE ANTICLINE

CONTOUR INTERVAL: 250 METERS
STRUCTURAL DATUM: TOP OF MIDDLE DEVONIAN CARBONATE
SCALE 1:50,000

