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LOWER AND MIDDLE DEVONIAN
STRATIGRAPHY
OF THE
SNAKE RIVER AREA
YUKON AND NORTHWEST TERRITORIES

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ABSTRACT

The Lower and Middle Devonian sequence of the Snake River area displays a major facies change from carbonates in the east to shales in the west. Structural complications and insufficient paleontological evidence makes a thorough understanding of the stratigraphic relationships involved very difficult.

The Devonian stratigraphic nomenclature of the Norman Wells region is applicable only in the eastern part of the area and a revised nomenclature for the western part is recommended.

TABLE OF CONTENTS

	<u>Page</u>
<u>ABSTRACT</u>	
<u>INTRODUCTION</u>	
General	1
Scope of Operations	2
Transportation, Communication and Supply	3
Personnel and Acknowledgements	3
Previous Geological Work	4
Physiography	4
<u>STRATIGRAPHY</u>	
General	5
Lower Devonian - Bear Rock Formation	6
Middle Devonian - Hume Formation	7
Middle Devonian - Hare Indian Formation	8
Middle Devonian - Canol Formation	9
<u>CONCLUSIONS</u>	9
<u>REFERENCES</u>	10
<u>APPENDIX</u>	
	<u>ILLUSTRATIONS</u>
<u>Figure</u>	<u>Follows Page</u>
1 Location map Snake River Area and Texaco Acreage	1
2 Location of Stratigraphic sections and inspected locations, in the Snake River Area, Yukon and Northwest Territories.	In Pocket. ✓
3 Lower and Middle Devonian Stratigraphic Relationships in the Snake River Region	5

INTRODUCTION

General

In the latter three weeks of June, 1961, geologists of Texaco Exploration Company carried out geological investigations in the Snake River area of the Yukon and Northwest Territories. The Snake River area (Fig. 1) is located along the Yukon Northwest Territories border approximately 175 miles west of Norman Wells.

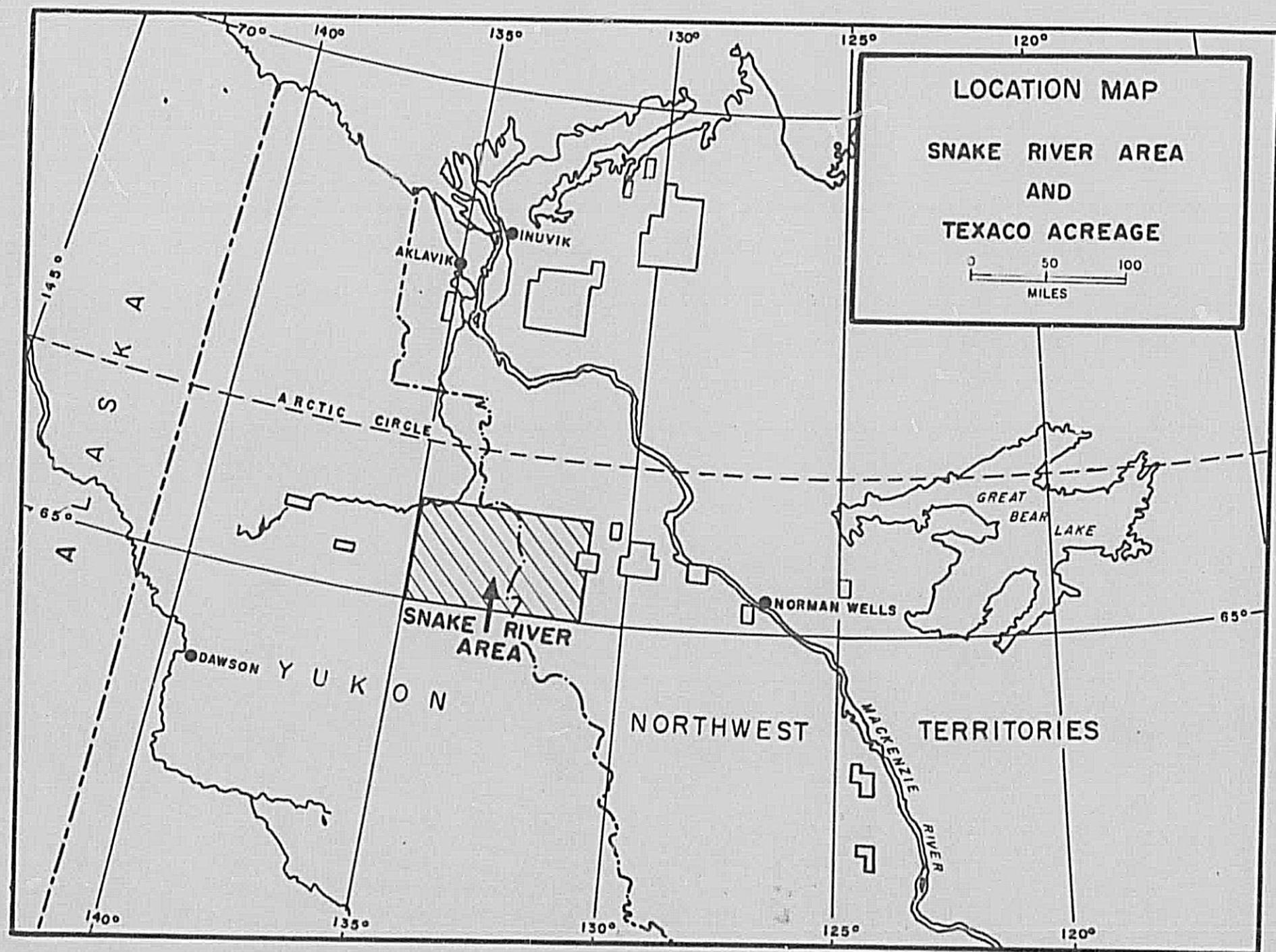
The purpose of this study was to gain more detailed stratigraphic information on the Lower and Middle Devonian formations of this area investigated previously in reconnaissance studies during 1958.

The stratigraphic data was obtained mainly by measuring sections along the frontal ranges of the Mackenzie Mountains. In addition, several outcrop localities were visited and all pertinent lithologic data recorded. The locations of the measured stratigraphic sections and the inspected localities are shown in Fig. 2.

The base camp for this operation was located on the east shore of Taylor Lake (Fig. 2). A fly camp was established on Battleship Creek to better facilitate the investigations in that region.

The weather in the vicinity of Taylor Lake was generally favourable throughout the entire operation but rain squalls were quite common along the Mackenzie Mountain front. These storms hampered operations on several occasions during the course of the work.

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Scope of Operations

This operation consisted of a detailed stratigraphic investigation of the Lower and Middle Devonian formations using field methods widely accepted as standard procedures in this type of work.

Stratigraphic sections were measured and described in as much detail as possible and samples collected at every major lithologic break. Fossils were collected in several localities and their position in the lithologic succession carefully recorded. A five-foot "Jacobs staff" was used in measuring all sections.

Section names were derived from nearby topographic features and coded with an appropriate name and number. Inspected localities were recorded similarly except that a letter was substituted for the number to differentiate between locations with the same letter code.

In order to facilitate correlation, detailed strip logs were constructed showing all pertinent data. A copy of these logs along with description of inspected locations is included with this report.

As further aid to correlation, microfossil samples were collected at ten-foot intervals from two stratigraphic sections located at the eastern and western extremities of the area of study. The work on the microfossil is not yet completed but it is hoped that useful results will be obtained.

Transportation, Communication and Supply

A considerable amount of time was spent prior to the field season investigating the logistics of transportation, communication and supply.

A Bell model 47-G-2 helicopter and a Beaver float plane were used as a means of transportation while conducting the actual field investigations. Food supplies were purchased in Fort Nelson and along with the camp equipment were transported down the Mackenzie River system by boat and barge to Sans Sault rapids. The aviation fuel was obtained at Norman Wells and barged down the Mackenzie River to the Sans Sault rapids on the same trip. The camp equipment, fuel and supplies were then flown into Taylor Lake by Beaver.

Communications with aircraft and PWA at Norman Wells were maintained by a Marconi single side band model CH16A radio transceiver. It was intended to be in direct contact by single side band with the Company office in Edmonton but on only two occasions was direct communication possible over this vast distance.

Personnel and Acknowledgements

The party consisted of the following technical personnel:

Geologists: D. R. Yont and P. W. Hay

Assistant Geologists: R. Brown and D. Ferrie.

Aircraft Personnel were: P. Peterson and A. Boles pilots and H. Eskelson, Engineer.

The boat and barge were owned and operated by D. Turner of South Nahanni.

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The kitchen duties were handled by E. Forman.

All concerned co-operated loyally in the interest of a successful operation.

Previous Geological Work

The earliest geological work in this region was conducted during the Canol Project in 1942. The results of this investigation are summarized by Hume (1954).

Perry (1953) in an unpublished report described the southern Richardson Mountains and adjacent areas.

Wheeler (1954) explored the Selwyn Mountains to the south.

Bullock (1957) studied the Middle Devonian rocks in the Margery Creek - Peel River Area.

Martin (1957) made a comprehensive study of the northern Yukon - Lower Mackenzie River region.

Texaco Exploration Company geologists carried out stratigraphic reconnaissance of this region during the summer of 1958.

Basset (1960) revised the Devonian Stratigraphy in the Norman Wells area to the east.

Physiography

The Snake River region is situated in the southwestern portion of the Peel Plateau. It includes the Mackenzie and Wernecke Mountains to the south and the Bonnet Plume Basin to the west. The Peel Plateau is a great triangular terrace occupying the angle between the Mackenzie and Richardson Mountains. Its surface is of gently rolling terrain and its north-

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east boundary is marked by a steep scarp facing the Mackenzie Delta. The greater portion of the Peel Plateau is muskeg covered but in the Snake River area rounded hills capped by Cretaceous sandstones are present. The main streams, including the Snake and Arctic Red Rivers are deeply incised into the Plateau with broad flat valleys and steep banks.

The Bonnet Plume Basin is a broad flat region underlain by Tertiary sediments which rest unconformably on folded lower Palaeozoics. The Bonnet Plume Basin represents the peneplaned southern extension of the early Richardson Mountains.

The Mackenzie and Wernecke Mountains are formed mainly of folded sedimentary rocks and rise to elevations of over 6000 feet. The Wernecke Mountains contain small intrusions and are separated from the Mackenzies on this basis.

STRATIGRAPHY

General

The Lower and Middle Devonian sequence in the Snake River area differs markedly from the Devonian succession of the Norman Wells region to the east. The lower part of the Devonian succession represented by carbonates in the Norman Wells region undergoes a major facies change westward to shales in the Snake River region. Structural complications along the Mackenzie Mountain front in the vicinity of this facies change make stratigraphic correlations across the area uncertain. It is hoped that the micropaleontological studies may solve some of the problems involved.

FIG. 3. LOWER AND MIDDLE DEVONIAN STRATIGRAPHIC RELATIONSHIPS
IN THE SNAKE RIVER REGION

SYSTEM	ARCTIC RED RIVER	SNAKE RIVER
UPPER DEVONIAN	IMPERIAL	IMPERIAL
	CANOL	CANOL
MIDDLE DEVONIAN	HARE INDIAN	HARE INDIAN
	HUME	BATTLESHIP
		GREEK
LOWER DEVONIAN	BEAR ROCK	BEAR ROCK
	UPPER ORANGE	UPPER ORANGE
SILURIAN	RONNING	RONNING

Basset's (1960) terminology for the Devonian succession can be applied readily in the eastern part of the Snake River area. To the west, however, these stratigraphic units cannot be recognized and new terminology is necessary. Because of incomplete faunal evidence a new division of the Devonian sequence in the Snake River region will not be proposed here. For purposes of discussion, the shale facies in the western part of the region will be termed the Battleship Creek Unit, after the locality where it is best exposed.

Battleship Creek is a small western tributary of the Snake River which has its mouth close to the Mackenzie Mountain front.

The stratigraphic units of the Lower and Middle Devonian of the Arctic Red and Snake River area are tabulated in Fig. 3. A discussion of these units with reference to their lithology, thickness and facies variations follows:-

Lower Devonian - Bear Rock Formation

The Bear Rock formation is the oldest stratigraphic unit of the Devonian succession. Its base is marked by an orange weathering dolomite 50 to 100 feet thick, referred to as the Upper Orange Member. This Upper Orange Member rests conformably on light grey Silurian dolomite and serves as a very useful marker bed throughout the Snake River region. The Upper contact of the Bear Rock with the overlying Hume formation is gradational and is placed at the first appearance of a continuous succession of the characteristic medium grey limestones of the Hume formation.

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The Bear Rock varies from 900 to 1000 feet in thickness in the eastern part of the Snake River area. Its equivalent thickness in the western part of the area is unknown due to the facies variations.

In the eastern part of the area the Bear Rock consists of an interbedded sequence of light and grey dolomites and medium grey limestones. Crinoidal debris is quite abundant in some zones and scattered corals, brachiopods and stromatoporoids are also present. The brecciated dolomite characteristic of the Bear Rock formation at Norman Wells is not developed in this region. The orange weathering dolomite at the base of the formation is cryptocrystalline and highly pyritic. The upper boundary of the Upper Orange dolomite is gradational with overlying carbonates. The Bear Rock formation weathers into a series of ridges and saddles. The distinctive basal orange dolomite characteristically weathers recessively.

The Bear Rock carbonates thin rapidly westward and are represented by 300 to 400 feet of limestones resting on the upper orange member. This rapid thinning is probably a result of a westward facies change to shales.

Middle Devonian - Hume Formation

The Hume formation rests conformably on the Lower Devonian Bear Rock Formation. Its upper contact with the overlying Hare Indian formation is gradational.

The Hume formation is 500 to 600 feet thick in the eastern part of the Snake River area. Its equivalent thickness in the western part of the area is unknown due to the facies change.

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The Hume formation in the Arctic Red River region is similar in lithology to its type section consisting of medium to light grey weathering, thick bedded lithographic limestone. It is generally unfossiliferous except near the top and weathers resitantly. The Hume formation change facies westward to black calcareous shales in the Snake River region where it is represented as part of the Battleship Creek Unit.

Middle Devonian - Hare Indian Formation

The Hare Indian formation rests with gradational contact on the Hume River limestones. Its upper boundary is marked by an abrupt lithologic break to the argillitic shales of the Canol formation.

The Hare Indian formation is 300 to 400 feet thick in the eastern part of the Snake River area. Its thickness in the western part is unknown due to the Middle Devonian facies variations.

In the eastern part of the Snake River area, in the vicinity of the Arctic Red River, the Hare Indian is represented by a highly fossiliferous sequence of rubbly weathering argillaceous limestones and calcareous shales. It contains much more limestone than the type section but carries the characteristic colonial coral and brachiopod fauna of other exposures along the Mackenzie Mountain front. The highly fossiliferous nature and recessive weathering distinguish it from the underlying Hume formation. The lime content of the Hare Indian formation appears to persist westward for some distance past the facies change in the underlying Hume formation.

In the extreme western part of the Snake River area however, the Hare Indian limestones become more argillaceous and gradually shale out.

Middle Devonian - Canol Formation

The Canol formation rests with sharp contact on the Hare Indian formation. It is overlain by the silty shales and sandstones of the Upper Devonian Imperial formation.

The thickness of this unit was not measured in the Snake River area but is estimated at 500 feet.

The Canol formation is characterized by resistant weathering highly indurated black shales or argillites containing abundant pyrite. It weathers a characteristic yellowish to reddish colour and splits into $\frac{1}{4}$ " to $\frac{1}{2}$ " thick plates. The Canol is unfossiliferous and noncalcareous which distinguishes from the underlying Hare Indian.

The characteristic lithologic nature of the Canol, persists over an extremely large area.

CONCLUSIONS

The geological investigations of the Snake River area have contributed valuable stratigraphic information on this little known region. Correlation problems still remain to be solved and a revision of the Devonian stratigraphic nomenclature appears necessary. Detailed Micropaleontological studies may be of valuable assistance in determining the age relationships involved in the facies change.

The presence of Middle Devonian organic carbonates along the Mackenzie Mountain front may enhance the petroleum

possibilities of the Peel Plateau area considerably. However, the equivalent beds in the subsurface would have to be much thicker and more widespread than those observed in outcrop if commercial production is to be realized. Further evaluation of this area will be dependant largely on the effectiveness of subsurface geophysical methods in outlining favourable reservoir areas and improved economic conditions.

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APPENDIX

Lithologic Descriptions of Inspected Localities:

MARG -A

The following stratigraphic succession in ascending order was observed at this locality.

Silurian:

Limestone, argillaceous, dark grey to black, micro-crystalline, thin bedded. Interbeds of black calcareous shale containing large ovoid limestone concretionary layers are present. Occasional interbeds of light grey weathering limestone one to two feet thick were observed. A dwarf brachiopod fauna is present.

Devonian:

(1) Limestone conglomerate:

- consists of pebbles and cobbles of medium grey lithographic limestone in a matrix of dark grey argillaceous limestone. The rock is well cemented.

(2) Black Shales - 250 feet est.

- shale, black, calcareous, with thin limestone interbeds.

(3) Grey Shales - 750 feet est.

- shale, medium grey, weathering, calcareous.

(4) Canol Formation

- shale, hard, argillitic, platy, weathers resistanstly.

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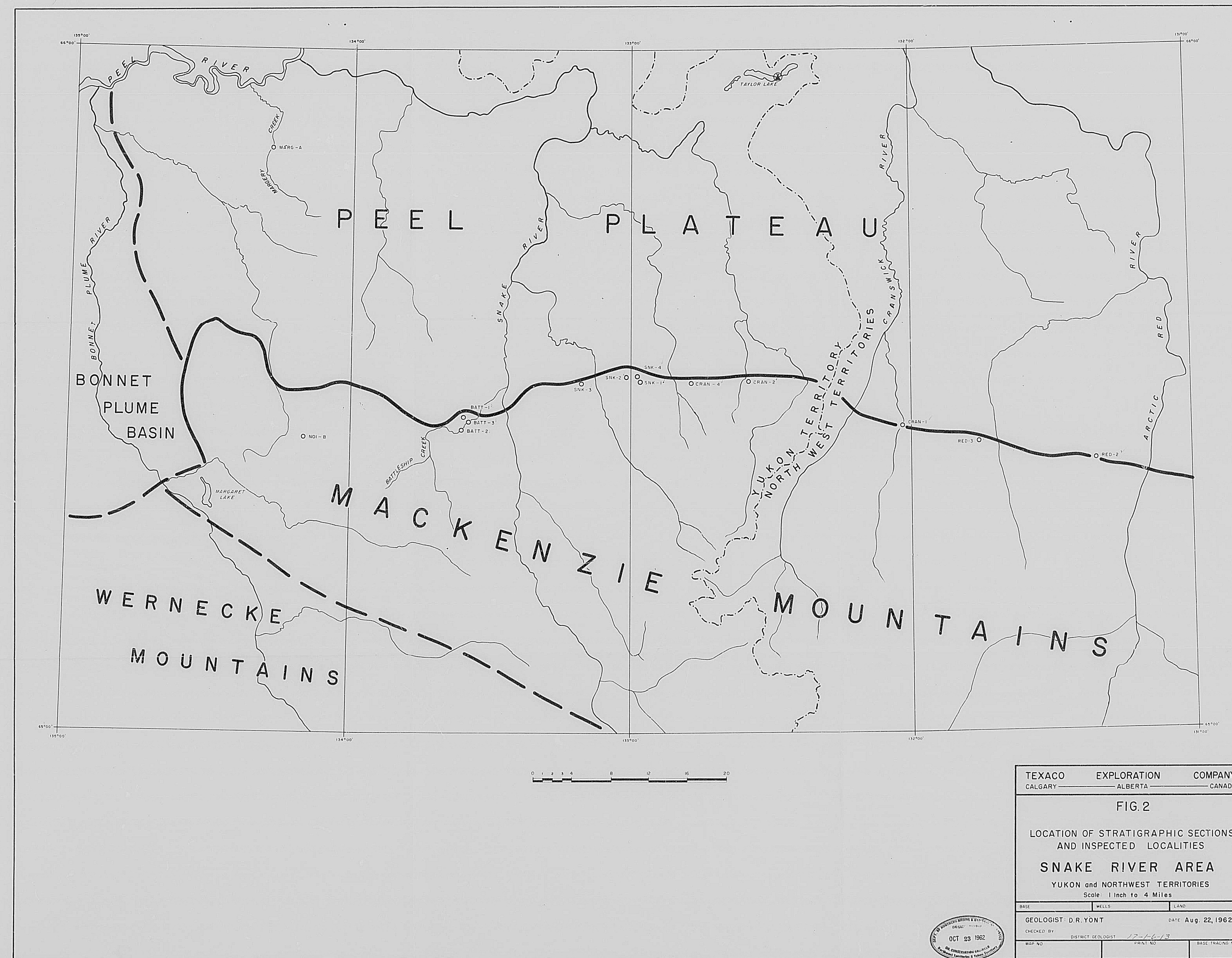
The contact of the Battleship Creek unit and the Canol formation is exposed at this locality.

Battleship Creek Unit:

Limestone and shale interbedded, dark grey to black. Penecontemporaneous slump structures observed. Contact with overlying Canol formation very sharp and appears disconformable.

Canol Formation:

Shale, dark grey to black, argillitic, weathers resistantly.



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