THUNDERCLOUD COAL PROJECT

1981 SUMMER PROGRAM

Itemized Cost Statement

of Work Performed, on

Coal Licences 4552, 4554, 4555, 4557 and 4558

Geological Mapping:	
Other - Helicoptor	$ 2,037
Salaries	1,360
Logging, Sampling and Testing:	
Other - Grab Samples (analysis)	497
Off-Property Costs:	
Room and Board	220
Transport to and from property:	
Helicoptor	7,338
Airline	650
Fixed wing	1,400
TOTAL AMOUNT SUBMITTED	$13,502

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TY-Thundercloud 81(1)A

PETRO-CANADA

COAL DIVISION

THUNDERCLOUD COAL PROJECT

1981 field work

NTS 104 J/2 AND 104 J/7

58°16' 130°51'

COAL LICENCES 4552, 4554, 4555, 4557 AND 4558

Submitted June 30, 1983

OPEN
CONFIDENTIAL

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Senior Geologist

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SUMMARY

The Thundercloud property, located in the Cassiar Mining District near Dease Lake, B.C., was acquired by Petro-Canada from Pacific Petroleums Ltd. in 1978. Mapping and diamond drilling programs were carried out on the property in 1979 and 1980. On August 16 and 17, 1981 a visit to the property resulted in a re-interpretation of its geology and resource potential. The current estimate suggests a resource of over 200 million tonnes of thermal coal. It is recommended that additional drilling and mapping be carried out to better define the coal bearing section.

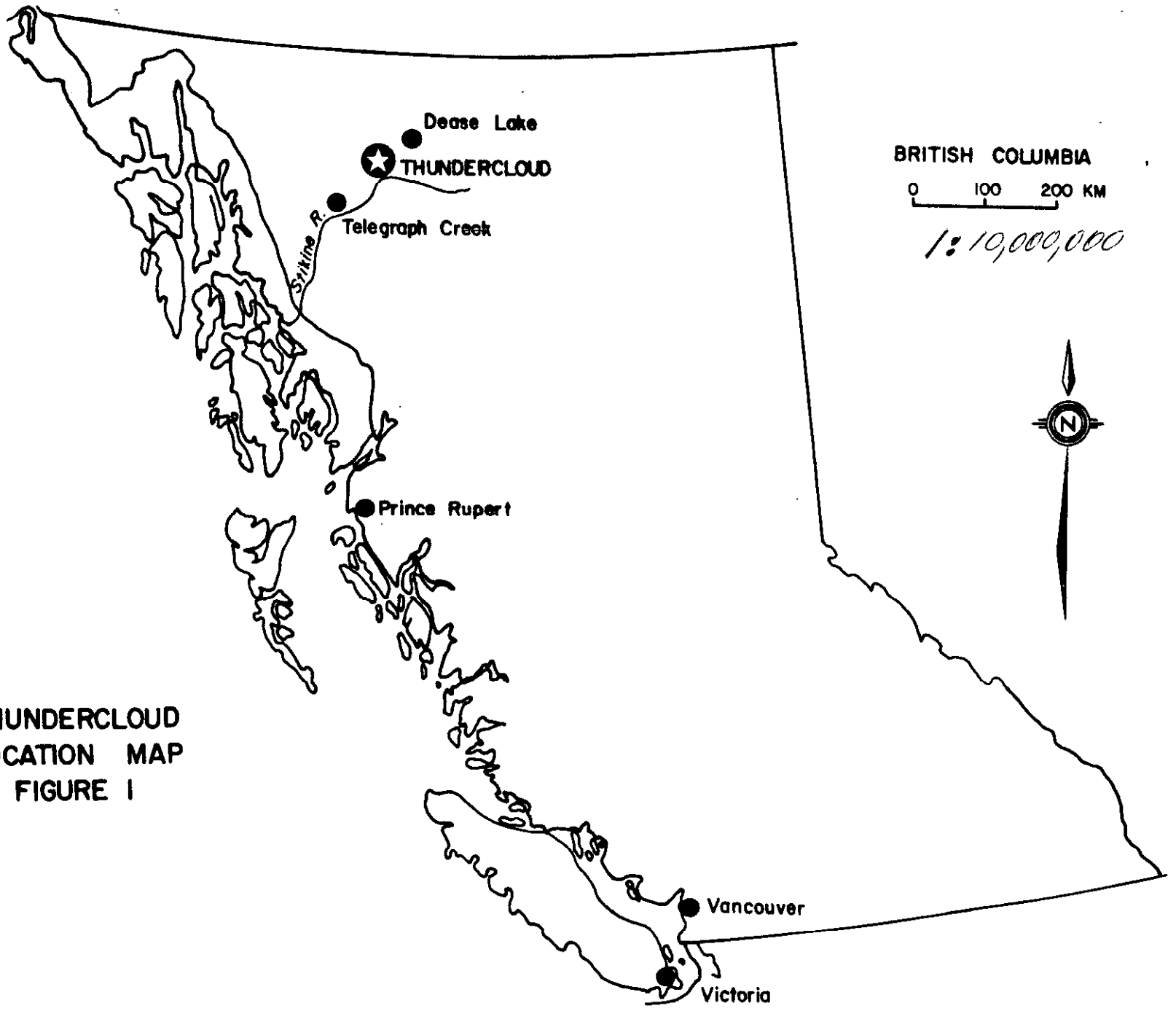
1.0 INTRODUCTION

1.1 Location and Access

The Thundercloud property is located in the Cassiar Mining District of B.C., 50 km southwest of Dease Lake at 130°45' W Longitude and 58°15' N Latitude (Figure 1). Dease Lake is approximately 1,100 km north of Vancouver. Petro-Canada's coal licences are situated on the Little Tuya River at its confluence with Mansfield Creek (Figure 2). A gravel road, which connects Telegraph Creek with Dease Lake, passes within 10 km of the property. Airstrips are located at both Dease Lake and Telegraph Creek.

1.2 Physiography

The Thundercloud property is situated within the Stikine Plateau, an area of low relief between the Cassiar Mountains to the east and the Coast Mountains to the west. The plateau is about 800 m above sea level and is dissected by rivers and streams which flow in gorges 150 m below the plateau surface. Drainage of the plateau is poor and swampy areas are interspersed with forested areas.



THUNDERCLOUD
LOCATION MAP
FIGURE 1

104 J 7/2

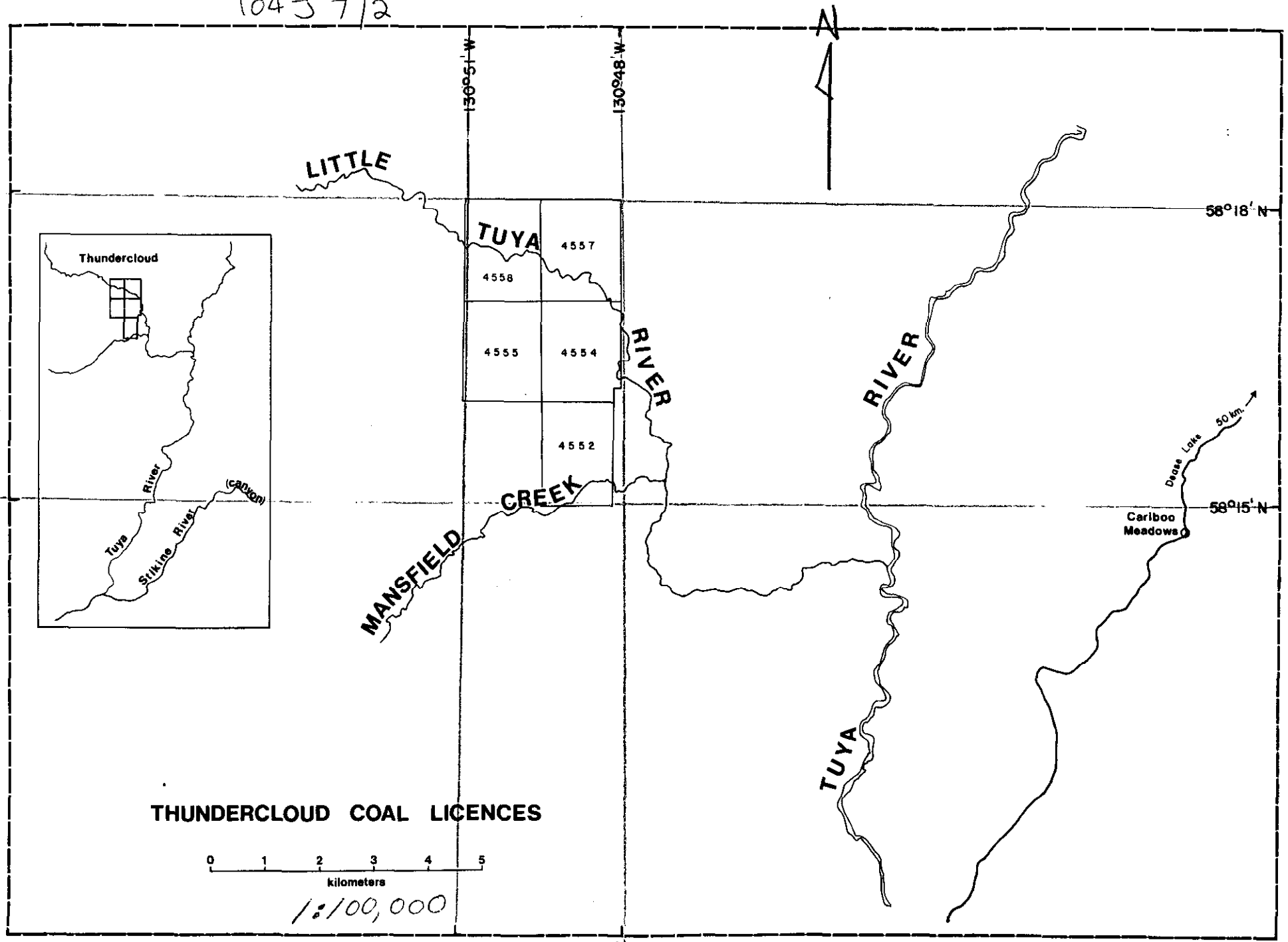


FIGURE 2: LICENCE LOCATION MAP

2.0 GEOLOGY

2.1 Regional Geology

The Stikine Plateau is part of the Intermontane Belt of the Cordillera flanked on the east by the Omineca Crystalline Complex and on the west by the Coast Crystalline Complex. The map area is underlain by Paleozoic and Mesozoic sedimentary and volcanic rocks (Figure 3). The Thundercloud coal measures are an erosional remnant of late Cretaceous to Early Tertiary rocks which were deposited on the deformed Paleozoic and Mesozoic strata. From late Tertiary to recent time, igneous rocks were extruded in the area forming plateau basalts and volcanoes. A diabase sill has intruded the lower portion of the coal bearing strata on the Thundercloud property (Figure 5).

2.2 Structural Geology

The Paleozoic and Mesozoic rocks are folded and in some cases have undergone multiple deformation. The overlying Tertiary clastics are faulted and locally folded. Some of the folding is thought to be associated with faulting. In the Telegraph Creek area the major fault zones are oriented north-south. The faults are thought to predate the Tertiary sedimentation and some remained active into the Quaternary as evidenced by faulting in the Pleistocene and younger flows. Normal displacement of seams within the property is small, probably in the order of a few meters or tens of meters. Air photo lineations and sheared outcrops in the western part of the property indicate a major normal fault which places down-dropped younger volcanics and volcaniclastics alongside the

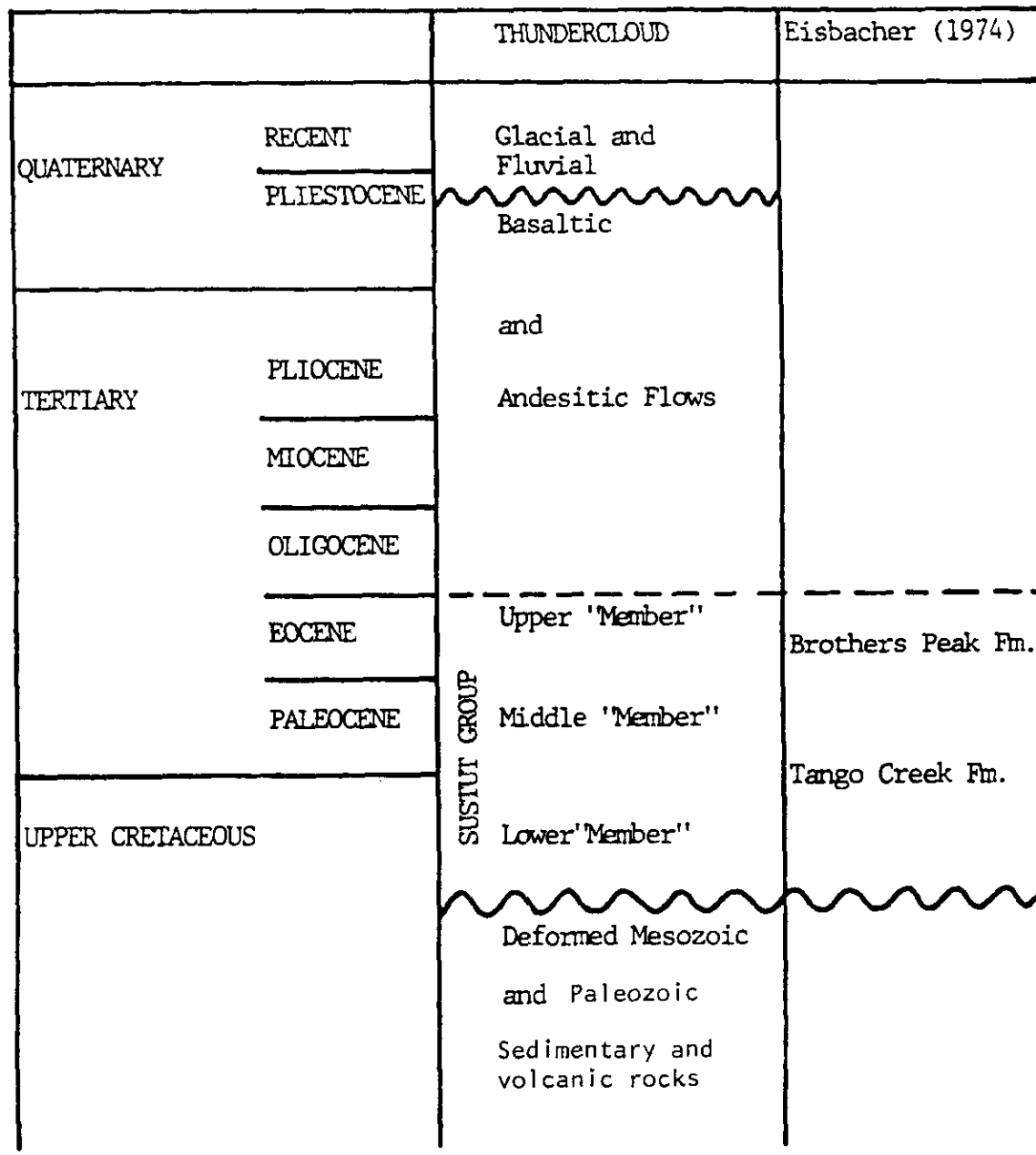


FIGURE 3 STRATIGRAPHIC COLUMN

Tertiary coal bearing rocks (refer to Geologic Map, Figure 4 (in pocket) and to Cross-Sections in Appendix A). The coal bearing strata strike north-south and dip 10 to 20 degrees to the east. Folds mapped on Mansfield Creek may be related to the normal faulting previously described. Late stage thrust faults, possibly related to glaciation, have been observed in some coal outcrops on the Thundercloud property. These faults tend to increase seam thicknesses.

2.3 Sedimentary History

The coal bearing strata of the Thundercloud property are thought to belong to the Upper Cretaceous to Eocene Sustut Group. These rocks represent clastic wedges which were deposited into non-marine successor basins following the westward retreat of the sea late in the Cretaceous. The slowly uplifting Omineca Crystalline Belt to the east (Columbian Orogeny) became a continental source of sediments approximately 120 million years ago. Deformation during the Late Cretaceous to Paleogene Pacific Orogen to the west, provided a source area in the Coast Crystalline Complex for upper Sustut Group sediments (Eisbacher, 1974).

2.4 Stratigraphy

2.4.1 Regional Stratigraphy

The Sustut Group has been divided into two Formations (Eisbacher, 1974). The lowest is the Tango Creek Formation which consists of claystone, sandstone, some conglomerate and local, thin lignite seams (Figure 3). It varies from 500 to 1400 m in thickness.

The Tango Creek Formation is overlain by the Brothers Peak Formation. Their contact is generally conformable but some angular unconformities exist. The Brothers Peak Formation is characterized by thick conglomerates interbedded with claystone and numerous acidic, ash fall tuffs.

2.4.2 Local Stratigraphy

The Sustut Group is undivided within Petro-Canada's licences but three informal units have been described (Figure 3). The lower member is over 200 m thick and consists of sandstone, siltstone, claystone and coal. The thickest coal seams are present in this member with an aggregate coal thickness of 15 to 20 m. The middle member varies in thickness from approximately 200 m on Mansfield Creek to about 100 m in the northern part of the property. It consists of chert pebble conglomerate, sandstone, siltstone, claystone and some coal. Conglomerate is prominent in beds from one to 7 m in thickness. The upper member, which is at least 300 m thick, is also conglomeratic but pebbles and cobbles are composed predominantly of basalt. Vesicular flow basalts (up to 10 m thick) and sandstones are interbedded with the conglomerate. This member's upper contact is not exposed on Petro-Canada's licences.

The entire succession is unconformably overlain by a cover of recent, unconsolidated glacial and fluvial sediments. This overburden varies in thickness from a few meters over much of the property to 90 m or more south of the property. Overburden slumping is common and large scale rotational slump blocks and scars can be seen in all stream valleys.

2.5 Coal Zone Stratigraphy

Three of the holes drilled in 1979 and 1980 (TDD 7901, TDD 7903 and TDD 8004) intersected the coal measures. Correlations between drill holes proved difficult and coal outcrops are scarce and often slumped so that correlations between drilled intersections and outcrops are only tentative. The following discussions are based on a re-interpretation of geologic data reported in the 1980 Assessment Report (F. J. G. De Nys, 1980).

The coal bearing horizons extend north-south through the licence blocks. Coal intersected in drill holes has been grouped into three zones (Figure 5). The oldest, Zone 1, has an aggregate coal thickness of 5 to 10 m. Zone 2 is 130 m stratigraphically above Zone one and consists of two seams with an aggregate thickness of 2.6 m in the central portion of the property and three seams with an aggregate thickness of 7.0 m in the northern portion of the property. Zone 3 is approximately 20 m above Zone 2, varies from 24 to 30 m in thickness and contains numerous rock partings. In the northern portion of the property it is comprised of three seams with an aggregate coal thickness of 9 m.

Interseam and interzone sediments consist of claystone, siltstone, sandstone and minor chert pebble conglomerate.

COAL ZONE CORRELATION

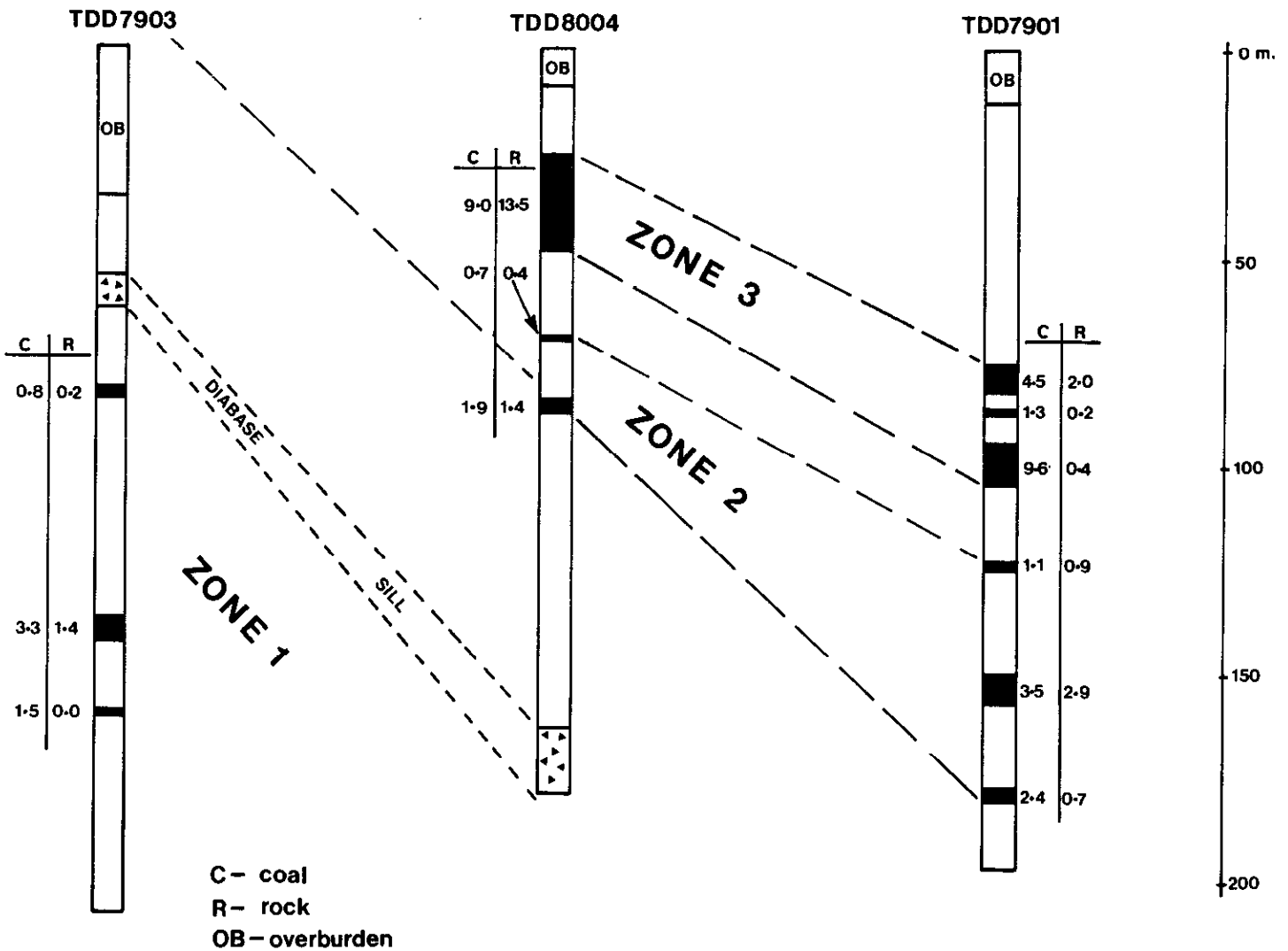


FIGURE 5: CORRELATION CHART

The coal zones are not well exposed on the Thundercloud property but two outcrops provided measurable sections of thick coal seams. The Mansfield Creek section (Figure 6 and location S-1 on the Geologic Map) has a true coal thickness of about 10 m and is thought to be the lowermost seam in the succession. The seam has been somewhat thickened by small scale thrust faults. The top of the seam is not exposed. The other outcrop is on Tuya River in the northern part of the property (Figure 7 and location S-2 on the Geologic Map). The top of the seam is covered but a 5.4 m section is exposed, 4.8 m of which is coal. This seam is thought to represent the basal portion of Zone 3 (Figure 5).

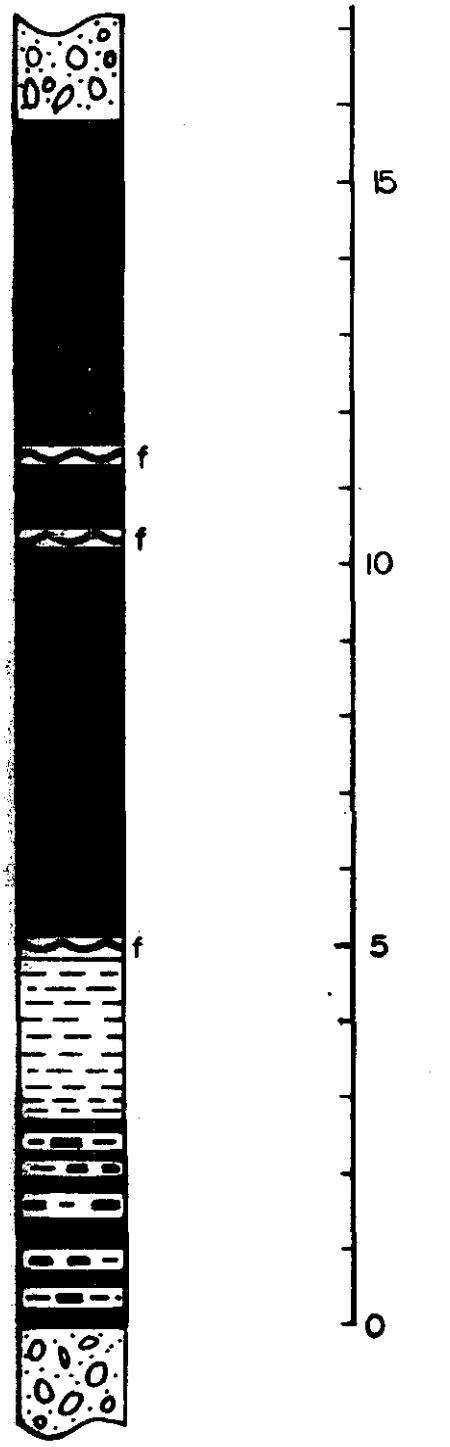


FIGURE 6 ZONE 1 COAL OUTCROP, MANSFIELD CREEK

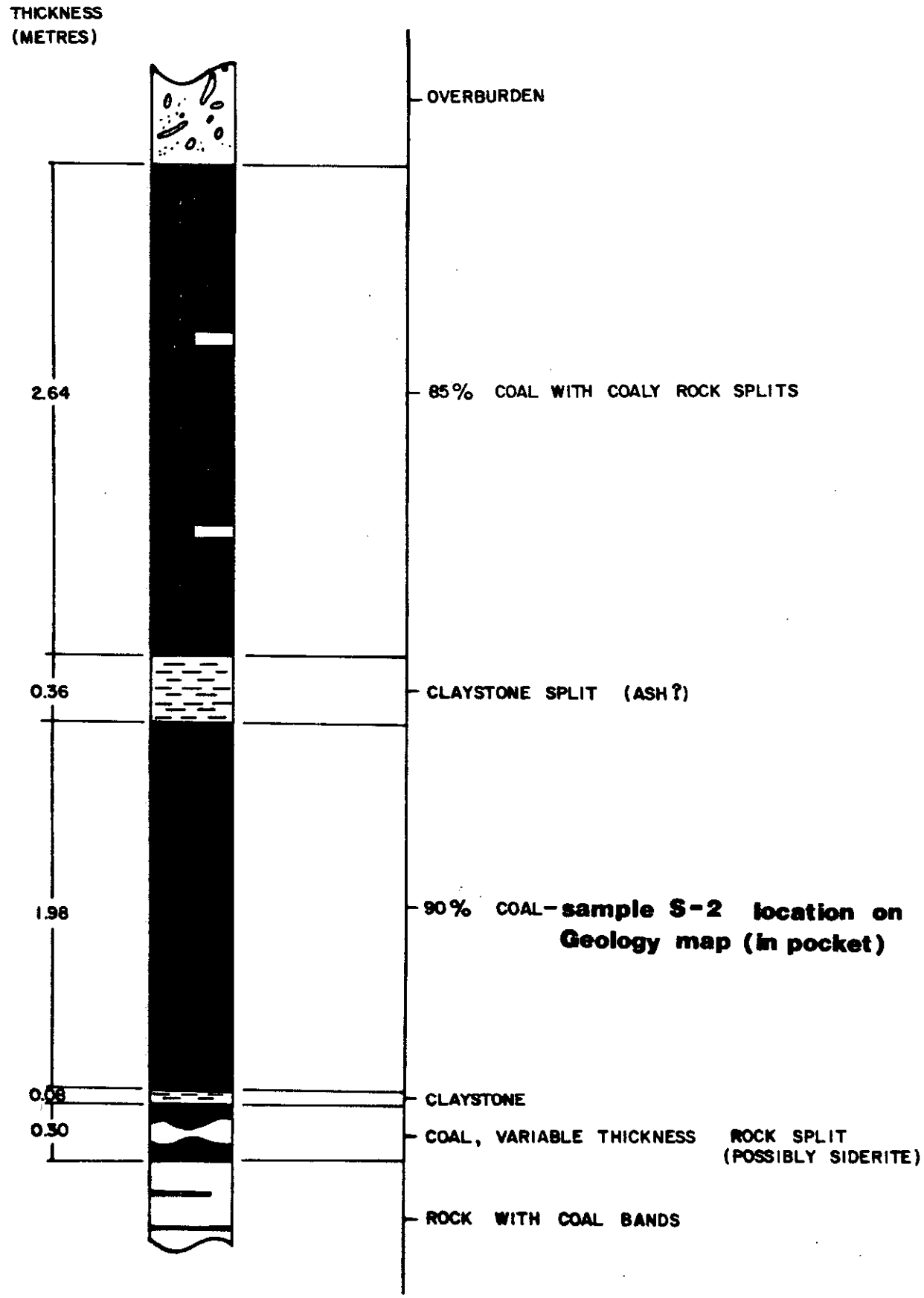


FIGURE 7 : ZONE 3 COAL OUTCROP, LITTLE TUYA RIVER

3.0 QUALITY

The following is a compilation of the analyses of samples from drillhole TDD8004. The results are stated on a raw, as-received basis:

Moisture	11.14%
Ash	24.25%
V.M.	29.09%
F.C.	34.30%
S.	0.46%
C.V.	4,299 cal/g

Table 1 lists the results of analyses done on coal sampled from the Mansfield Creek and Little Tuya River outcrops. The coal is considered to be ranked as sub-bituminous A to high volatile C bituminous based on its calorific value (moisture and ash free).

TABLE 1

GRAB SAMPLE (OUTCROP) COAL QUALITY

PROXIMATE, Sulphur, Calorific Value and Grindability.		MANSFIELD CREEK		LITTLE TUYA	
		Air Dry Basis	Dry Basis	Air Dry Basis	Dry Ba
Residual Moisture	%	7.83	---	8.87	---
Ash	%	7.33	7.95	4.96	5.44
Volatile Matter	%	35.32	38.32	39.31	43.14
Fixed Carbon	%	49.52	53.73	46.86	51.42
Free Swelling Index	FSI	0	---	0	---
Sulphur	%	0.83	0.90	0.38	0.41
Calorific Value	cal/g	5,798	6,290	5,723	6,280
Grindability	HGI	49	---	36	---
ANALYSIS OF ASH					
Silica (SiO_2)	%		62.16		44.98
Alumina (Al_2O_3)	%		25.44		30.78
Iron (Fe_2O_3)	%		3.41		3.40
Titanium (TiO_2)	%		0.54		0.75
Phosphorus (P_2O_5)	%		0.56		0.43
Calcium (CaO)	%		1.45		7.87
Magnesium (MgO)	%		0.90		2.24
Sodium (Na_2O)	%		0.24		0.48
Potassium (K_2O)	%		1.92		0.55
Sulphate (SO_3)	%		0.89		5.95

4.0 RESOURCES

4.1 Resource Potential

The inferred coal resource potential of the Thundercloud property is 214 million tonnes.

4.2 Resource Calculation

Thicknesses were assigned to the coal zones based on drilled intersections (Figure 5) and volume of coal was calculated for the property based on the strike length influence of three cross-sections (Appendix A). A value of 1.49 g/cc was used as the specific gravity of the coal. The total resource includes in-situ coal within the property boundary to a vertical depth of 500 m. The following calculation was used to determine resource potential:

$$\text{Total Resource} = \sum_{j=A}^{C} \left(\sum_{i=1}^{3} (\text{Seam Length} \times \text{Seam Thickness} \times \text{Section Influence Length} \times \text{Specific Gravity}) \right)$$

where i = coal zones 1 to 3

j = cross-sections A-A' to C-C'

5.0 RECOMMENDATIONS

A program of mapping and drilling is recommended to more accurately measure the resource potential of the Thundercloud area.

5.1 Mapping

Two to three weeks of mapping with at least one crew is recommended. The mapping program would define the positions of the igneous rocks which limit the extent of the coal measures in the northern and western parts of the property and would determine whether or not the coal zones extend south of the property boundary.

5.2 Drilling

Three to five diamond holes each with a total depth of 200 - 300 m should be drilled. These holes would be evenly spaced on a north-south section and each would intersect all three coal zones. All holes would be lithologically and geophysically logged.

5.3 Field Program

The entire program, including drilling, would be helicopter supported and a heli-portable drill which could produce NQ core would be required. A Hughes 500 D helicoper is recommended for best access to the property. Petro-Canada personnel would include a project geologist, a senior assistant and two junior assistants. Drilling and mapping would commence simultaneously and begin during spring runoff to ensure adequate water for drilling on higher ground. The program would probably commence in early June.

6.0 CONCLUSION

The Thundercloud property is underlain by over 200 million tonnes of high quality thermal coal. The gentle dip of the coal measures (10-20 degrees over most of the property) suggests surface mining potential for Thundercloud. Additional drilling and mapping has been recommended to better define the coal bearing horizons and to determine whether or not they extend south of the current property boundary.

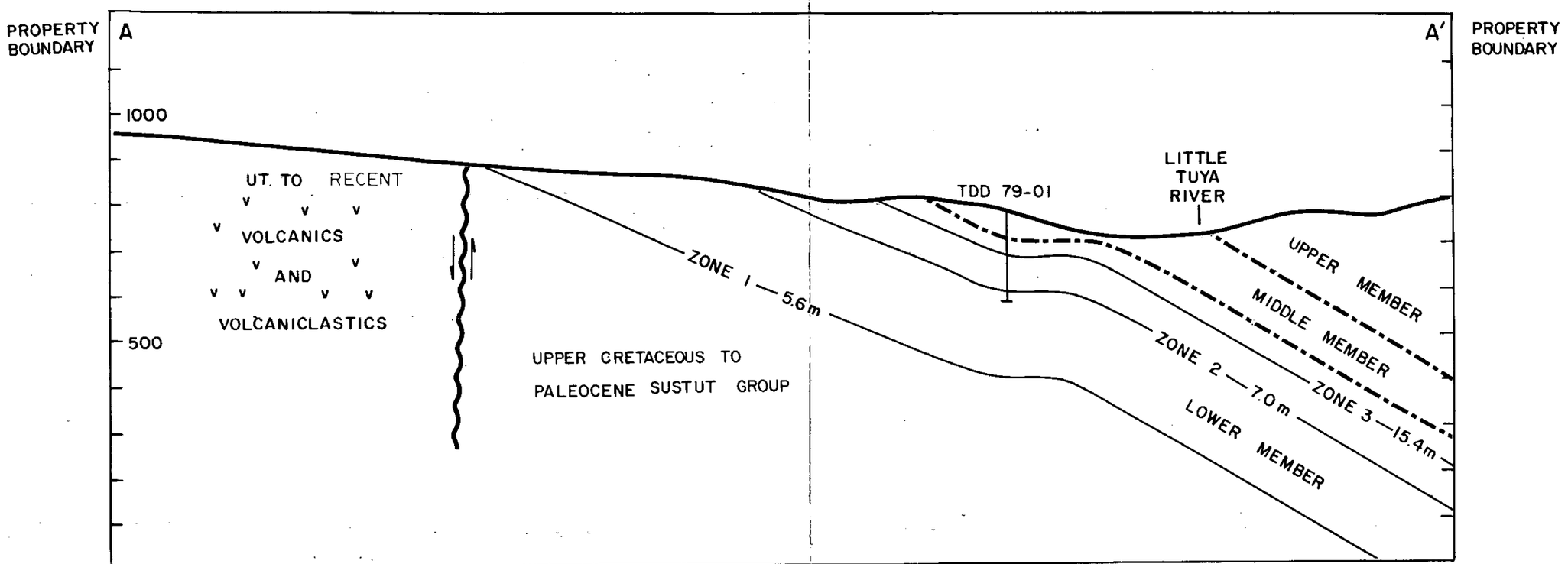
7.0 REFERENCES

De Nys, F.J.G., 1980 Thundercloud Coal Project, Petro-Canada Exploration Inc., Assessment Report for the B.C. Ministry of Energy, Mines and Petroleum Resources.

Eisbacher, G.H., 1974, Sedimentary History and Tectonic Evolution of the Sustut and Sifton Basins, North-Central British Columbia, Geologic Survey of Canada, Paper 73-31

APPENDIX A

CROSS-SECTIONS (A-A', B-B', C-C')



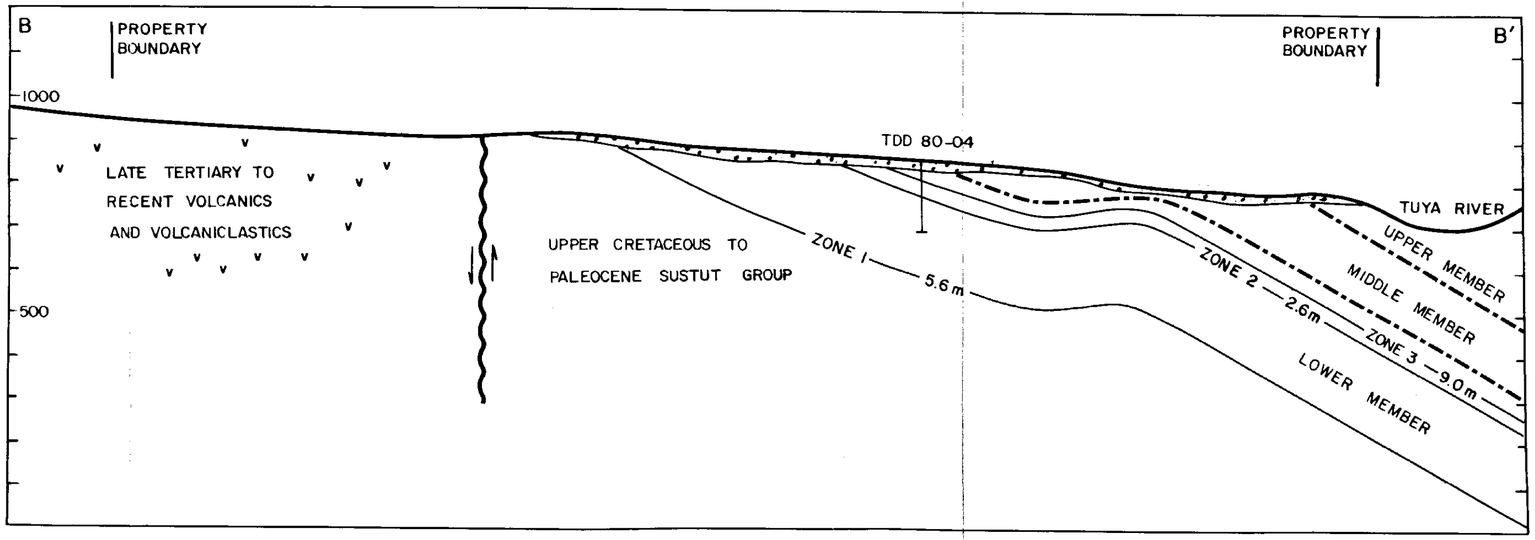
PETRO-CANADA
COAL DIVISION

DATE	JUNE, 1983
REVISED	
AUTHOR	F.B.G.
DRAFTED	S.K.
SCALE	1:10,000

THUNDERCLOUD PROJECT

CROSS-SECTION A-A'

(44)



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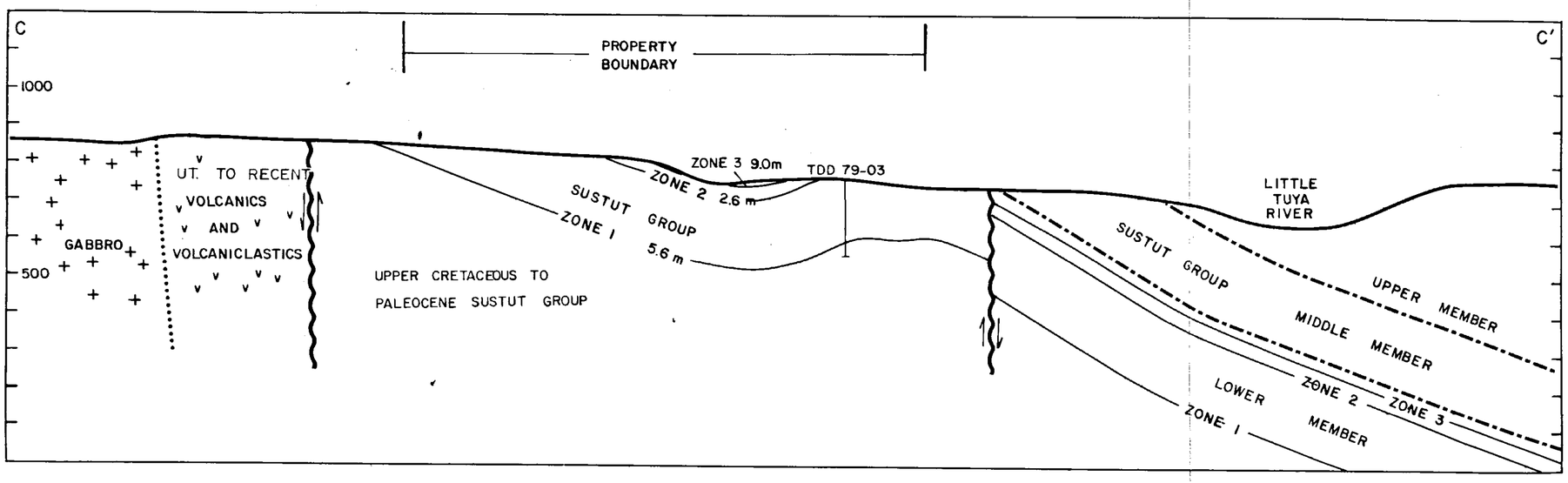
DRAFTED	S.K.
SCALE	1:10,000

THUNDERCLOUD PROJECT

CROSS-SECTION B-B'

(M2)



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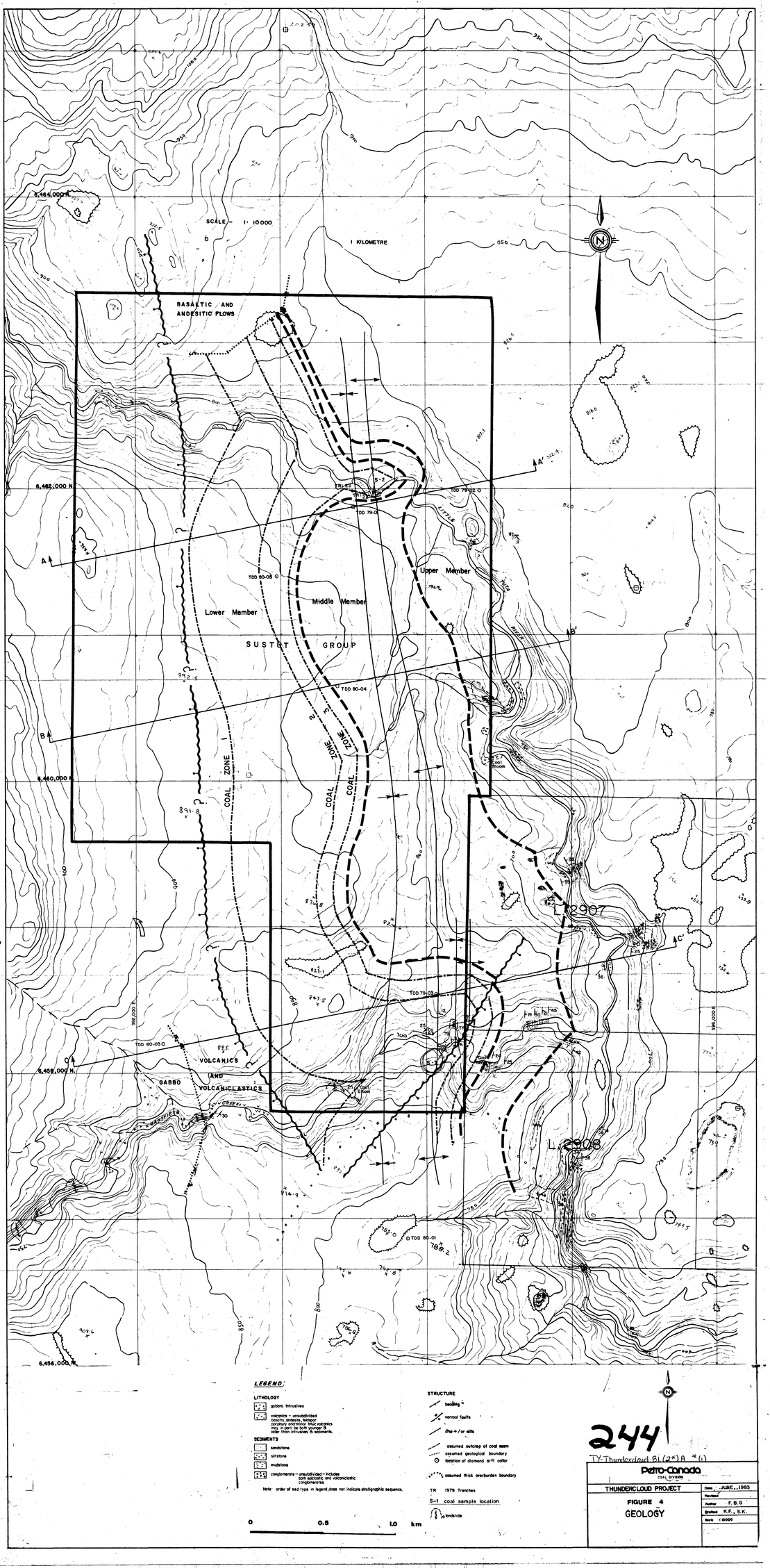
DRAFTED	S.K.
SCALE	1:10,000

THUNDERCLOUD PROJECT

CROSS-SECTION C-C'


SCALE 1: 10000
1 KILOMETRE
6,464,000 N
6,462,000 N
6,460,000 N
6,458,000 N
6,456,000 N
392,000 E
396,000 E
BASALTIC AND ANDESITIC FLOWS
SUSTUT GROUP
Upper Member
Middle Member
Lower Member
ZONE 1
ZONE 2
ZONE 3
COAL
COAL
COAL
VOLCANICS AND VOLCANICLASTICS
GABBRO
TDD 80-03
TDD 80-04
TDD 80-08
TDD 79-02
TDD 79-03
TDD 80-01
S-1
S-2
A
A'
B
B'
C
C'
L 2907
L 2908
LEGEND:
LITHOLOGY
gabbro intrusives
volcanics - unsubdivided
basalts, andesites, felsic volcanics
may in part be both younger & older than intrusives & sediments.
SEDIMENTS
sandstone
siltstone
mudstone
conglomerate - unsubdivided - includes both epiclastic and volcaniclastic conglomerates
Note: order of sed type in legend, does not indicate stratigraphic sequence.
STRUCTURE
bedding
normal faults
dike +/or sills
assumed outcrop of coal seam
assumed geological boundary
location of diamond drill collar
assumed thick overburden boundary
TR 1979 Trenches
S-1 coal sample location
landslide
0
0.5
1.0
km
244
TY-Thundercloud 81 (2") B 4 (1)
Petro-Canada
COAL DIVISION
THUNDERCLOUD PROJECT
Date JUNE, 1983
Plotted
Author F. B. G.
Drafted K.F., S.K.
Scale 1:10000
FIGURE 4
GEOLOGY