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GEOLOGICAL EVALUATION
OF THE SUSTUT AND SUSTUT S.E. COAL PROPERTIES
(NTS 94D)
A REPORT OF THE 1982 FIELD
EXPLORATION ACTIVITIES
BY

JOHN DAVIES M. Sc., P. Geol.
COAL PROJECT GEOLOGIST
NCOR INC. RESOURCES GROUP
500 - 4th Avenue S.W.
Calgary, Alberta

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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GEOLOGICAL EVALUATION OF THE SUSTUT AND SUSTUT S.E. COAL PROPERTIES

(NTS 94D)

C.A. 7244 – 7259 (INCL)
7322 – 7337 (INCL)

A Report of the 1982 field exploration activities

10 - I - 83

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~~Pat~~ OFile. 00116.

Trench locations not given or mapped
- refer to Coal Act p. 8
Section 14, #6
- survey pts used as trench ID - can locate most on traverse survey map.
Change to Sustut southeast to avoid confusion
✓ with Gulf-Sustut

47.48

76-79

SUMMARY

Suncor Inc.'s Sustut and Sustut S.E. coal properties are located 170 km N.N.E. of Smithers, British Columbia and comprise 32 coal licences totalling 9,207 hectares.

Between June and September, 1982 reconnaissance and detailed field mapping was carried out on these properties. A base camp was established at Bear Lake and the crews transported to the site daily by helicopter.

The properties are underlain primarily by strata of Mesozoic and Palaeocene (Sustut) age, although parts are covered by late Tertiary basalts. The coal bearing strata are found within the Juro-Cretaceous Upper Bowser Lake Group and the Palaeocene Tango Creek Formation.

Severe tectonic activity has disrupted the pre-Eocene rocks resulting in thrusts, faults and tight folding. The principal structural axes are aligned in a northwest to southeast direction.

Several coal seams up to 8.5 metres thick were discovered during the 1982 field season. Their ranks range from sub-bituminous to medium/low volatile bituminous, with the majority being high volatile A and medium volatile bituminous. They are generally high in ash but low in sulphur.

A rank gradient of 0.6% Ro max. per 1,000 metres has been assumed for the properties which indicates a total stratigraphic thickness of over 1,000 metres for the U. Bowser Lake Group and 1,400 metres for the Sustut Group. Discrepencies between these latter values and measured sections have been interpreted as the result of faulting.

Preliminary coal reserve calculations for the Main Creek Valley indicate that inferred resources may be of the order of 200 million tonnes (raw coal). Over 3/4 of this tonnage would be of medium volatile bituminous rank.

Problems in correlating strata and coal seams need to be resolved in 1983. The use of both palynology and coal petrology should unravel many of these difficulties.

The 1983 field season should also include trenching and core drilling as a major component of its program along with additional geological mapping, sampling and testing.

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1. INTRODUCTION

1.1 Location

Suncor's Sustut coal property is situated 170 km N.N.E. of Smithers, 360 km north west of Prince George and 16 km north east of Bear Lake. The area is contained within N.T.S. Sheet 94D (McConnell Creek).

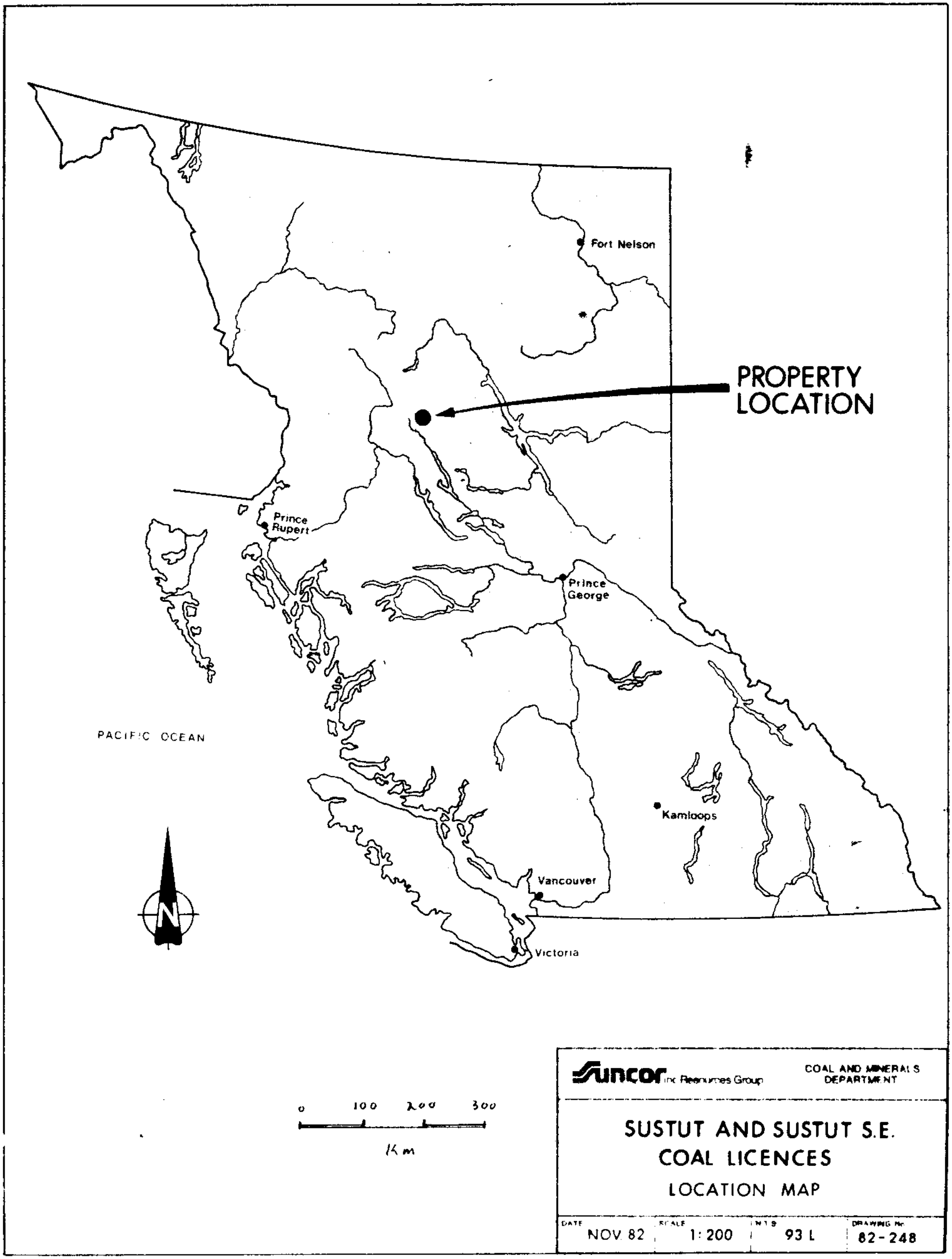
The only feasible means of access to the Sustut licences is by helicopter. Bear Lake, however, is also accessible by fixed wing aircraft, either using floats on the lake or at the gravel strip immediately north of the lake. Furthermore, the British Columbia Railway line from Prince George to Dease Lake runs along the eastern shore of Bear Lake. Unfortunately, although the track has been laid up to and northward of Bear Lake, scheduled train services terminate at Driftwood, some 60 km to the south east.

Two pack trails used by the Geological Survey party in 1945 enter the property. One crosses the central part from south west to north east whilst the other enters from the south east. Neither trail is in good condition, but they are still passable on foot with care.

1.2 Land Status

On 19th June, 1981 Suncor filed an application for 16 coal licences covering 4591 hectares to the south east of the confluence of the Sustut and Asitka rivers. These licences (7244 to 7259) were issued by the B.C. Government on 14th October 1982, having an adjusted area of 4599 hectares.

As a result of additional information becoming available on the area towards the end of the summer of 1981, a


PROPERTY
LOCATION
Fort Nelson
Prince Rupert
Prince George
PACIFIC OCEAN
Kamloops
Vancouver
Victoria
N
0 100 200 300
Km
Suncor Inc Resources Group
COAL AND MINERALS DEPARTMENT
SUSTUT AND SUSTUT S.E.
COAL LICENCES
LOCATION MAP
DATE NOV. 82
SCALE 1:200
N.T.S. 93 L
DRAWING No 82-248

82-248

further application was filed on 7th October, 1982. This second application for 16 additional coal licences extended Suncor's land holdings to the south east of the original licences. This group of licences (7322 to 7337) termed Sustut S.E., was issued by the B.C. Government on 7th November and incorporates 4608 hectares. A complete list of licences together with areas and their dates of issue is given in Table 1.

1.3 Previous Work

The earliest reported geological reconnaissance of the area was in 1914 by G.S. Malloch who briefly visited the Sustut Valley in conjunction with his work in the Groundhog Coalfield to the north. In 1948, the Geological Survey of Canada published Memoir 251 on the McConnell Creek Map area. The field work for this report was directed by C.S. Lord during 1941 and again in 1944/45.

Lord discovered coal bearing strata in the area around Red Creek, to the east of Saiya Creek and to the north of the Omineca River. He assigned the majority of these showings to the Jurassic with minor occurrances in the U Cretaceous and Paleocene. Two reported analyses show the coals to be of high to medium volatile bituminous in rank.

General overviews of the Jurassic-Paleocene sedimentation and tectonic activity were provided by Souther and Armstrong in 1966, G.H. Eisbacher in 1973 and Tipper and Richards in 1976.

The 1976 geological map of the McConnell Creek area (G.S.C. O.F. 342) compiled by T.A. Richards generally shows the same geological distribution as Lord's original map although nomenclature and structure have been substantially altered.

FIGURE 2

SUSTUT AND SUSTUT S.E. COAL LICENCES

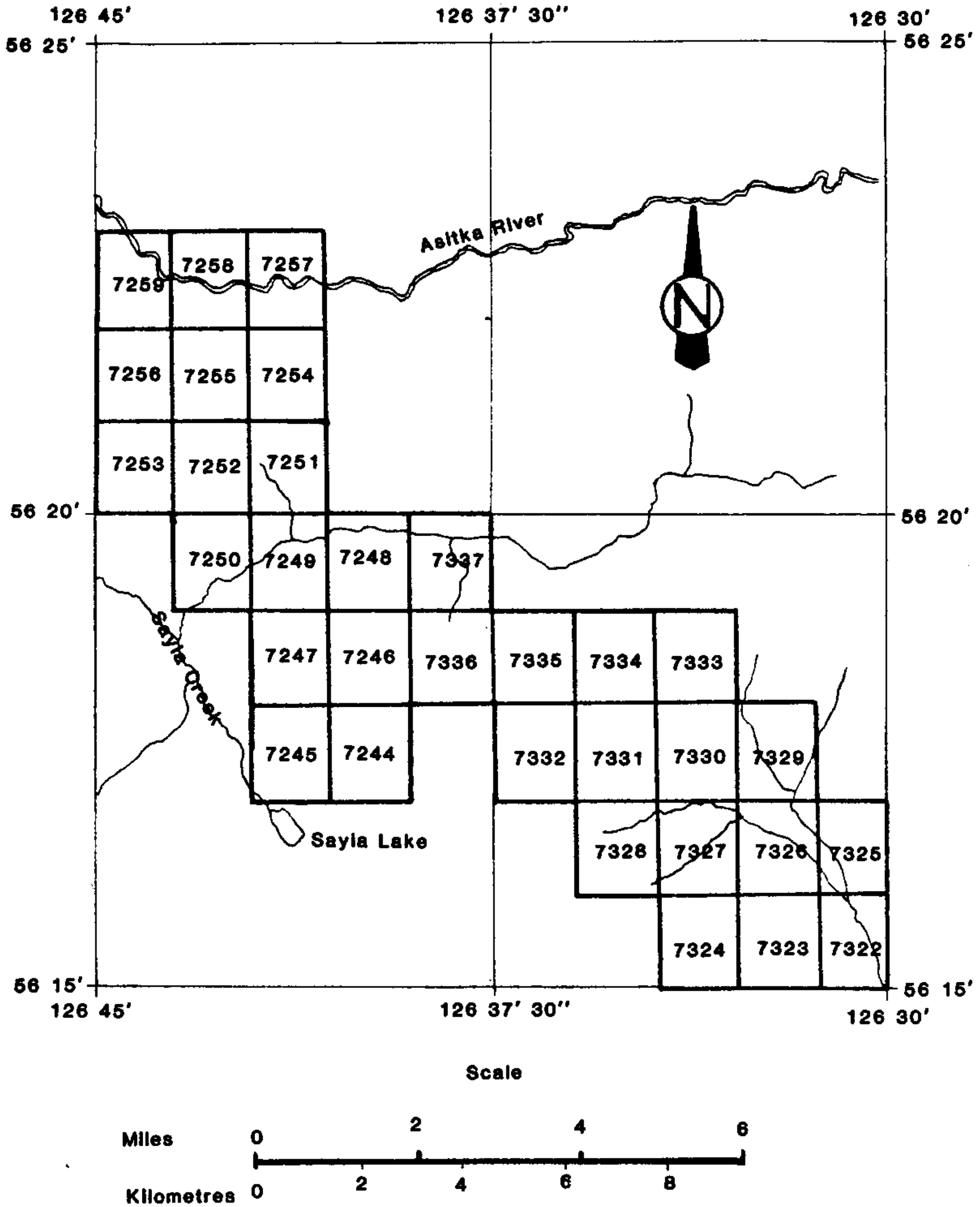


TABLE 1

SUSTUT AND SUSTUT S.E. COAL LICENCES

Licence No.	Date Issued	Map Area	Units	Hectares
		SUSTUT		
7244	Oct. 14, 1981	94-D-7, Blk B	43,44,53,54	288
7245	Oct. 14, 1981	94-D-7, Blk B	45,46,55,56	288
7246	Oct. 14, 1981	94-D-7, Blk B	63,64,73,74	288
7247	Oct. 14, 1981	94-D-7, Blk B	65,66,75,76	288
7248	Oct. 14, 1981	94-D-7, Blk B	83,84,93,94	288
7249	Oct. 14, 1981	94-D-7, Blk B	85,86,95,96	288
7250	Oct. 14, 1981	94-D-7, Blk B	87,88,97,98	288
7251	Oct. 14, 1981	94-D-7, Blk G	5,6,15,16	287
7252	Oct. 14, 1981	94-D-7, Blk G	7,8,17,18	287
7253	Oct. 14, 1981	94-D-7, Blk G	9,10,19,20	287
7254	Oct. 14, 1981	94-D-7, Blk G	25,26,35,36	287
7255	Oct. 14, 1981	94-D-7, Blk G	27,28,37,38	287
7256	Oct. 14, 1981	94-D-7, Blk G	29,30,39,40	287
7257	Oct. 14, 1981	94-D-7, Blk G	45,46,55,56	287
7258	Oct. 14, 1981	94-D-7, Blk G	47,48,57,58	287
7259	Oct. 14, 1981	94-D-7, Blk G	49,50,59,60	287
	16 Licences		TOTAL	4599

TABLE 1 - (Continued

SUSTUT AND SUSTUT S.E. COAL LICENCES

Licence No.	Date Issued	Map Area	Units	Hectares
		SUSTUT S.E.		
7322	November 7/81	94-D-7, Blk A	1,2,11,12	288
7323	November 7/81	94-D-7, Blk A	3,4,13,14	288
7324	November 7/81	94-D-7, Blk A	5,6,15,16	288
7325	November 7/81	94-D-7, Blk A	21,22,31,32	288
7326	November 7/81	94-D-7, Blk A	23,24,33,34	288
7327	November 7/81	94-D-7, Blk A	25,26,35,36	288
7328	November 7/81	94-D-7, Blk A	27,28,37,38	288
7329	November 7/81	94-D-7, Blk A	43,44,53,54	288
7330	November 7/81	94-D-7, Blk A	45,46,55,56	288
7331	November 7/81	94-D-7, Blk A	47,48,57,58	288
7332	November 7/81	94-D-7, Blk A	49,50,59,60	288
7333	November 7/81	94-D-7, Blk A	65,66,75,76	288
7334	November 7/81	94-D-7, Blk A	67,68,77,78	288
7335	November 7/81	94-D-7, Blk A	69,70,79,80	288
7336	November 7/81	94-D-7, Blk B	61,62,71,72	288
7337	November 7/81	94-D-7, Blk B	81,82,91,92	288
	16 Licences		TOTAL	4608

The most recent work, other than that herein presented, was undertaken at Suncor's request by D. Pearson in 1981. This entailed a brief reconnaissance of the licence area primarily to establish coal seam thicknesses and quality.

1.4 Physiography

The Sustut coal licences lie within the Hogem Ranges of the Stikine Mountain belt. Ridge tops are of the order of 1,900 metres and valley floors at elevations of 1,100 metres.

Within the licence configuration itself, a north west-south east trending ridge dominates the topography. The ground falls steeply towards Saiya Creek and the headwaters of the Omineca River to the west and towards Main Creek and the Asitka River in the east and north east.

The principal rivers, into which all creeks draining the property flow, are the Sustut and Omineca. The former flows to the west where it enters the Skeena whilst the latter flows in a south easterly direction to Williston Lake.

The 1982 season proved better than average as far as weather conditions were concerned. June was exceptionally hot and dry with daily highs in the 25°C to 30°C range and lows around 20°C. No precipitation was noted during June. July was still regarded as a good month with highs in the low 20's°C and lows around 5°C. On 4 days, rain fell continously and on a further 8, showers were recorded. During August conditions deteriorated markedly with highs in the upper teens and lows around 2°C. Rain fell continuously on 1 day whilst on a further 19 days showers were recorded. Snow fell on 2 days, with light accummulations on high ground and 4 days of frost were recorded. The above observations were made at the base camp and temperatures were generally a few degrees lower on the property.

The valleys and slopes up to 1,600 metres are densely covered by alpine fir, spruce and lodgepole pine. Willow and ground birch are common whilst alpine meadows and tundra occur above the treeline. On the steeper slopes and ridge tops vegetation is scarce with considerable rock outcrop and scree.

Wildlife was not seen to be particularly abundant during the field season. Isolated sightings of caribou, mountain goat and marmot were reported from the licences whilst the camp had a resident porcupine. The Bear and Sustut rivers contain large numbers of salmon, particularly in late August, as well as steelhead and rainbow trout.

1.5 1982 Field Work

Geological mapping of the Sustut licences was undertaken between June and September. To support these activities a base camp was constructed adjacent to the airstrip immediately north of Bear Lake. The camp site had previously been used by construction crews working on the British Columbia Railway in the mid 1970's and no clearing of vegetation was required. The location was a level, gravel terrace above the Bear River which provided a suitable water supply. A previously excavated gravel pit was utilized for garbage disposal once it had been incinerated.

All camp equipment, fuel and initial food supplies were air lifted from smithers by a Trans Provincial Airlines D.C.3. Additional supply flights were provided throughout the season by Central Mountain Air Services of Smithers, all supplying and expediting being done through this town. At the end of the season the camp equipment and remaining fuel were air lifted back to Smithers by Kelowna Flightcraft. After removal of the camp, the site was tidied and garbage and latrine pits filled.

The physical task of carrying out the geological mapping was borne by a crew of 6 geological assistants under the writer's supervision and supported by a cook, helicopter pilot and engineer. The following personnel were involved throughout the summer:

John Davies	-	Coal Project Geologist
Rob Booker	-	Party Chief
Rick Sereda	-	Senior Geological Assistant
Mark Steacy	-	Senior Geological Assistant
John Alguire	-	Junior Geological Assistant
Norm Hopkins	-	Junior Geological Assistant
Bruno Wiskel	-	Junior Geological Assistant
Suzanne Pereault	-	Cook
Dave Hocking	-	Pilot - Highland Helicopter
Mike Nagel	-	Pilot - Highland Helicopter
Roland and Rolf	-	Engineers - Highland Helicopter

The field crews were transported daily (weather permitting) from the camp to the licences by Bell 206B Jetranger III helicopter, a journey of approximately 10 minutes.

The objectives of the 1982 field program were three-fold:

a) to more fully examine the known coal seams and prospect for additional seams

b) to map the geology and obtain a better understanding of the structure

c) to sample coal outcrops and other strategic lithologies

It is estimated that the program was 80 to 90% successful, which considering the short time interval, accessibility to outcrop and the personnel available, is regarded as an exceptionally good performance.

2. REGIONAL GEOLOGY

2.1 Stratigraphy

The Sustut licences lie within the intermontane belt of north central B.C. and are underlain primarily by rocks of Mesozoic and Paleocene age.

The basement rocks of the area are of U Proterozoic age and outcrop some 30 miles to the N.E. of the property. The overlying strata are of Carbo-permian age belonging to the Cache Creek Group and are comprised of marble, chert and slate. It is postulated that these sediments were deposited in an extensive shallow sea with a shore line to the east in the neighbourhood of the present day Omineca Mountains.

The overlying Asitka Group is presumed to be of Permian age comprising rhyolite, tuff, andesite and minor limestone. It outcrops in the extreme southeastern corner of the property and was probably a precursor to the mid-Triassic orogeny.

The intense tectonic activity in the early to mid-Triassic resulted in the folding and metamorphism of the Cache Creek and Asitka sediments. The majority of these folds, however, have since been masked by subsequent tectonism.

In the late Triassic a broad basin developed accompanied by an extensive marine transgression. The earliest deposits of this basin belong to the Takla Group, resulting from

TABLE 2

Stratigraphic Column

FORMATION	AGE	LITHOLOGY
ALLUVIUM	HOLOCENE	
GLACIAL DEPOSITS	PLEISTOCENE	Till, Gravel and Sand
POPLAR BUTTE VOLCANICS	MIOCENE to PLIOCENE	Olivine Basalt
ENDAKO GROUP	LATE EOCENE to EARLY MIOCENE	
a) China Nose Breccia	Oligocene to Early Miocene	Basaltic Breccia
b) Buck Creek Volcanics	Late Eocene and Oligocene	Andesite and Dacite
GOOSLY LAKE INTRUSIVES	EOCENE	Syenomonzonite and Gabbro
BABINE INTRUSIVES	EOCENE	Diorite and Granodiorite
KASTBERG/NANIKA INSTRUSIVES	EOCENE	Felsite, Quartz Monzonite and Quartz Eye Porphyry
OOTSA LAKE GROUP	LATE CRETACEOUS to EOCENE	
a) Goosly Lake Volcanics		Trachyte and Rhyolite
b) Tiptophill Volcanics	Maestrichtian	Andesite and Dacite
SUSTUT GROUP	LATE CRETACEOUS to EOCENE	
a) Brothers Peak Formation	Paleocene	Conglomerate, Sandstone, Tuff and Minor Coal
b) Tango Creek Formation	Cenomanian	Conglomerate, Sandstone and Minor Coal
BULKLEY INTRUSIVES	LATE CRETACEOUS	Granodiorite, Quartz Monzonite, (Amelgold Gabbro)
SKEENA GROUP	EARLY to LATE CRETACEOUS	
a) Brian Boru Formation	Cenomanian	Porphyritic Tuff and Andesitic Breccia
b) Red Rose Formation	Middle to Upper Albian	Greywacke, Sandstone, Shale and Coal
c) Rocky Ridge Volcanics	Albian	Augite Porphyry, Andesite and Breccia
d) Kitsun Creek Sediments	Hauterivian to Albian	Conglomerate, Greywacke, Shale and Coal
OMINECA INTRUSIVES	EARLY CRETACEOUS	Granitic and Dioritic Intrusives
BOWSER LAKE GROUP	MIDDLE to LATE JURASSIC	
a) Upper	Oxfordian to Kimmeridgian	Sandstone, Shale, Conglomerate and Coal
b) Lower (Ashman Formation) (Trout Creek Bajs/Netalzul Volcanics)	Callovian and L. Oxfordian	Shale and Sandstone with Minor Conglomerate and Greywacke
HAZELTON GROUP	EARLY to MIDDLE JURASSIC	
a) Smithers Formation	Bajocian and Bathonian	Sandstone, Greywacke, Shale Conglomerate, Minor Tuff
b) Nilkitkwa Formation	Pleinsbachian to Bajocian	Basalt Breccia and Tuff Grading up to Shale and Sandstone
(i) Red Tuff Member		Tuff, Basalt, Andesite, Dacite and Rhyolite
	Toarcian and Bajocian	
(ii) Ankwell Member		Andesite, Breccia, Tuff, Minor Greywacke and Limestone
c) Telkwa Formation	Sinemurian	Basaltic to Rhyolitic Lavas, Minor Greywacke and Shale
TOPLEY INTRUSIVES	EARLY JURASSIC	Quartz Monzonite, Quartz Diorite and Granodiorite
TAKLA GROUP	LATE TRIASSIC	Andesite, Basalt, Minor Greywacke and Argillite
ASITKA GROUP	PERMIAN	Rhyolite, Tuff, Andesite, Agglomerate, Minor Limestone
ULTRAMAFICS	CARBO-PERMIAN	Serpentinite
CACHE CREEK GROUP	CARBO-PERMIAN	Argillite, Marble, Chert, Basalt.

widespread, mainly submarine volcanism. Associated clastic sediments were derived primarily from a reworking of these volcanics. Takla lithologies are mainly andesites, basalts and argillites, with an approximate total thickness of 10,000 metres in the McConnell Creek map area.

Uplift along the Pinchi Fault, which trends NW-SE through the central part of the McConnell Creek map area, in the early Jurassic, split the Triassic marine basin into an eastern sedimentary trough and a western, dominantly volcanic area. Prior to the deposition of the Hazelton Group, the diorites, monzonites and granodiorites forming the Hogem Batholith were intruded.

The earliest deposits of the Hazelton Group in the Sustut area belong to the Telkwa Formation, being basaltic to rhyolitic lavas with subordinate greywackes and shales. The overlying Nilkitkwa Formation was laid down in a NW-SE trending, subsiding depression within the broader expanse of the Hazelton Trough, in which marine sedimentation was relatively continuous throughout the Lower and Middle Jurassic. The Nilkitkwa deposits comprise up to 1,000 metres of interbedded shale, greywacke, andesitic to rhyolitic tuff and minor limestone, with frequent basaltic flows in the lower members.

In Bajocian times, uplift resulted in the formation of the Skeena Arch to the south and the development of the Bowser Basin, the eastern extent of which was marked by the Pinchi and Ingenika faults. The first deposits of the basin were a continuation of the Hazelton Group, being assigned to the Smithers formation and comprising sandstones, shales and greywackes with minor volcanics.

The lower member of the Bowser Lake Group, the Ashman Formation, rests conformably upon the Smithers Formation.

It has a thickness up to 760 metres and comprises shales, sandstone, greywackes and conglomerates derived from erosion of the land mass immediately to the east.

The upper Bowser Lake Group rests conformably upon the lower member showing a continuation of similar lithologies with the important exception of coal deposition. The Bowser Lake Group is characterized by a phase of regressive deltaic sedimentation continuing until the Kimmeridgian when deposition ceased.

The major hiatus that occurred between the Kimmeridgian and U. Cretaceous culminated with the uplift of the Coast Range and induced deformation into the sediments of the Bowser Basin. It was during this interval that the majority of the Omineca granitic and dioritic intrusives were emplaced. Sedimentation did not recommence in the area until the U. Cretaceous, with the formation of the Sustut Basin.

The Sustut Basin occupied a narrow belt between the Skeena and Omineca Mountains in which was deposited a non-marine clastic sequence of Cenomanian to Paleocene age. The lower member, the Tango Creek Formation rests unconformably upon the Bowser Assemblage. It commences with a basal conglomerate, passing up into a sandstone/mudstone succession with occasional discontinuous coals. The maximum thickness in the Bear Lake area is thought to be about 700 metres. During the deposition of the Tango Creek Formation, the Axelgold Gabbro was emplaced.

The overlying Brothers Peak Formation rests conformably on the Tango Creek sediments. It commences with acidic tuffs and conglomerate units and fines upwards into sandstones, mudstones and the occasional thin coal.

The deposition of the Tango Creek Formation can be attributed to a meandering river system with an easterly and northeasterly provenance, whilst the Brothers Peak Formation appears to have been deposited as an alluvial fan with a west to north provenance.

The Brothers Peak Formation represents the final phase of sedimentation in the area. From the Eocene until the present day erosion has been the dominant process, punctuated by periods of intrusive and volcanic activity. The Kastberg Granodiorite was intruded during the Eocene along with associated dykes and sills. In the late Tertiary and Quaternary the final phase of tectonic activity produced plateau and valley basalts.

The Pleistocene glaciation resulted in the erosion of material from the peaks and ridges and depsoition of ground moraine and gravels on the lower slopes and valley bottoms. More recently the post-glacial drainage pattern has produced gravel terraces and alluvial fans.

2.2 Structure

The area has been subjected to three discernable orogenic events since the end of the Paleozoic era. The first of these occurred in the mid-Triassic and resulted in the folding and regional metamorphism of the Cache Creek and Asitka formations. These folds have since been masked by later tectonic activity, but generally folds in these older rocks appear much tighter.

The second orogenic event signalled the end of Bowser deposition and reached its peak in the mid to late Cretaceous. These movements correspond to the Columbian and Pacific Orogenies. The structural trend is NW to SE with movement in a northeasterly direction affecting the pre-Sustut strata. On a local scale the fold-systems conform to the margins of fault bounded blocks, with the folds in the Bowser Basin conforming to the outlines of the basin itself. The region appears broken into many separate crustal blocks bounded by deep faults which influenced the pattern of deformation. The locus of most of the faulting is the Pinchi-Ingenica system, itself a major thrust zone.

The final phase of tectonic activity took place in the early Eocene. The Sustut basin was a late orogenic basin in which molasse deposits of the Columbian and Pacific Orogens accummulated. This deposition was terminated by the Eocene movements which thrust the Sustut strata from the southwest and developed a series of open folds. Associated with the major thrusting are numerous small scale imbricate thrust faults directed to the northeast which affect both Sustut and Bowser assemblages and die out rapidly to the south of the Sustut River.

3. PROPERTY GEOLOGY

3.1 General

The geological mapping of the Sustut and Sustut S.E. properties was carried out using the Forest Cover Series 1:15,840 base maps and air photographs at the same scale. In addition, the Coal Bowl area has been mapped at a more detailed scale of 1:5,000.

One of the principal problems encountered during the mapping was the differentiation between the Lower to Middle Jurassic Ashman Formation and the Upper Jurassic/Lower Cretaceous Upper Bowser Lake Group. The contact between these two formations appears gradational and only the absence of coal from the former distinguishes it from the overlying coal bearing group.

Another hindrance to the field work was the presence of extensive tracts of drift, particularly on lower slopes and valley bottoms. Main Creek valley in particular exhibits a very low percentage of rock outcrop.

Maps have been prepared which show the traverses and sample locations and geological interpretations, together with trench descriptions and schematic sections. These are contained in the Appendix section at the end of the report.

3.2 Stratigraphy

During the 1982 field season, no strata older than the Lower Jurassic were encountered within the property, whilst the youngest rocks recognized were basalt flows of late Tertiary age. However, immediately to the east of the Sustut S.E. block, rocks belonging to the Upper Triassic Takla Group outcrop and may possibly extend beneath the Tertiary basalts and Pleistocene drift deposits to sub-crop within the property.

3.2.1 Takla Group

As mentioned above the Takla Group is not seen to outcrop within the property, but its proximity to the eastern boundary of the S.E. block justifies a brief description. Traverse RAB 16 passed through rocks of Takla age and encountered an entirely volcanic assemblage, comprising predominantly of green-grey, aphanitic andesite containing numerous amphibole phenocrysts. Quartz breccia was also seen to be present but only as a relatively minor constituent.

3.2.2 Hazelton Group

Strata of Sinemurian to Bathonian age, belonging to the Telkwa and Smithers Formations of the Hazelton Group, outcrop at the northeast corners of the S.E. block.

The Telkwa Formation in the poorly exposed section examined, comprised grey, fine grained sandstones exhibiting loadcasts, siltstones and black, slickensided, pyritic shales. The more characteristic volcanic assemblages were not seen in this particular section, although they do occur elsewhere in the area.

The Smithers Formation was examined both in the northeast corner of the S.E. block and also approximately 3.5 km to the north. The principal lithology in a sequence of some several hundred metres is a fine grained sandstone associated with siltstones and shales. A marine influence is indicated by the presence of minor limestones and an abundant fauna of belemnites, pelecypods and ammonites.

3.2.3 Bowser Lake Group

The most important group of sedimentary rocks present within the property belongs to the Bowser Lake Group. Three units have been distinguished within this group. The lowermost is the Ashman Formation which is Callovian and Oxfordian in age, whilst the Upper Bowser Lake Group extends from the late Oxfordian to the earliest Cretaceous. Within this latter group is the third unit, the Upper Jurassic Netalzul, Volcanics.

3.2.4 Ashman Formation

The Ashman strata present the most extensive outcrop of the three Bowser Lake members within the Sustut and Sustut S.E. properties.

Where examined, the Ashman Formation comprises essentially a clastic sequence of deposits, primarily sandstones, siltstones and shales with sub-ordinate conglomerates and rare limestones. The sandstone units predominate, being generally massive and light brown to grey in colour. Occasionally they are seen to be grey-green, probably indicating the presence of glauconite, a mineral indicative of marine deposition. In many instances the sandstones show a calcareous cementation and in general exhibit an abundant marine fauna of ammonites, belemnites and pelecypods. A brief list of genera and species recognized during the field work is given in Appendix VIII.

The siltstones are generally gradational units between the sandstones and shales. They vary in colour from dark grey to light brown and can be massive or thinly bedded. A distinctive feature of the more shaly members is the presence of large numbers of ironstone concretions. These spherical bodies range in diameter from 1 or 2 cm to 30 - 40 cm being usually light brown or rust coloured and invariably structureless when broken. Such concretions have not been noted from any other formations within the property and have been used to indicate the presence of Ashman strata where differentiation between it and the overlying Upper Bowser Group has been indistinct.

The shale and mudstone strata frequently occur in cyclothemic relationships with the sandstones and siltstones. They are almost always thinly bedded to laminated and individual units rarely exceed 30 - 50 cm in thickness. They are generally dark coloured, from grey to black and on occasion are carbonaceous, although plant fossils have not been found.

Isolated conglomerate units have been noted from several localities. They are poorly sorted with well rounded clasts of sandstone, quartz and andesitic and basaltic volcanics. Thicknesses are variable and most sections measured were incomplete.

Limestone units are almost always thin, less than 60 cm and usually dark grey in colour. They are not common, but where seen, they are interbedded with alternating sandstone/shale sequences.

3.2.5 Upper Bowser Lake Group

Strata ostensibly belonging to the U. Bowser Lake Group outcrop in a discontinuous belt extending from just south of the southwest corner of the Sustut S.E. block, through Marmot Ridge, Coal Bowl and Willow Creek, to the confluence of Hate and Saiya Creeks. The sediments comprise an entirely clastic succession of sandstone, siltstone, mudstone, shales and coal which, in part at least, is non-marine.

The sandstone units attain thicknesses up to 50 metres and are predominantly deltaic in origin as indicated by the presence of cross-bedding and their association with coarsening upwards cycles and coal deposits. In general they are medium grained with sub-angular to sub-rounded grains which are usually well sorted. In the majority of cases cementation is non-calcareous. Fossils are sparse and when found are primarily pelecypods and disseminated plant debris.

Siltstones are gradational, being part of a fining upwards cycle and tend not to form thick units. They are generally light brown to buff coloured, in which respect they are similar to the sandstones, with argillaceous and carbonaceous inclusions.

The mudstone and shale units are less well exposed than the more resistant sandstone strata. Where seen, they comprise dark grey to black, thinly bedded, carbonaceous horizons, frequently containing thin stringers of coal. They do not appear to form thick units, although many of the low lying swampy areas could be underlain by more extensive argillaceous strata.

Coal seams occur throughout the U. Bowser Lake Group and will be mentioned in detail in a later section.

The aforementioned sedimentary sequence exhibits a marked lateral variation. Only in the case of one or two of the thicker and more resistant sandstone units can any continuation be traced along strike. A major problem in this respect is the restriction of outcrop to the headwaters of relatively minor creeks. Where more than 100 - 200 metres of cover separates creek sections, correlation becomes extremely tenuous. This is particularly marked below the tree line where large areas can be traversed without a single outcrop being encountered. A further complication is the high degree of structural disturbance which affects all the strata. The structure of the area will be discussed in the next section.

3.2.6 U. Jurassic (Netalzul) Volcanics

Penecontemporaneous with the U. Bowser Lake Group are a suite of volcanics which have a thickness somewhat in excess of 100 metres. They have a northwest to south east trend along the western edge of the Sustut properties and range from basaltic to andesitic in composition. They are invariably porphyritic with phenocrysts of plagioclase and pyroxine. The basaltic members tend to exhibit a reddish-browsn colouration whilst the andesites are typically green-grey.

Important constituents of this volcanic assemblage are tuffs and agglomerates. The former are water lain and show sedimentary features such as crossbedding and fining upwards cycles. The latter are generally interlayered with the tuffs and form thicker, ill-sorted units. Associated with these rocks is a volcanic mudflow or Lahar, remnants of which are encountered several times along the strike of the volcanics.

3.2.7 Sustut Group

The Sustut Group provides the youngest assemblage of sedimentary rocks found on the properties. It is subdivided into two members, of which only the lowermost Tango Creek Formation has been recognized within the licence blocks. The upper division, the Brothers Peak Formation, occurs to the west along the Connolly Range and was only briefly examined.

3.2.8 Tango Creek Formation

The Tango Creek Formation rests unconformably upon the U. Bowser Lake Group, although this relationship was not seen during the 1982 field work. Eisbacher (1973) has subdivided the Tango Creek into a lower Niven member and an upper Tatlatui member. The former is primarily arenaceous with minor mudstones whilst the latter comprises essentially mudstones with subordinate arenaceous rocks and thin coals.

The sections of Tango Creek strata examined within the properties comprised conglomerates, sandstones, mudstones and coals, belonging to both Niven and Tatlatui members.

The conglomerate units are generally interbedded with more dominant sandstones. Thicknesses are usually less than 10 metres and it is thought therefore that the thick basal conglomerate is either absent within the properties or lies at a lower elevation than that exposed. Many of the conglomerates recorded were channel fill deposits. The numerous sandstones showed a preponderance of fining upwards cycles, commencing with a thin conglomerate and terminating with either a siltstone or mudstone. They confirm a fluviatile mode of deposition and probably belong to the Niven member. It is thought that strata of this member outcrop predominantly within the central and southeastern parts of the properties.

Associated with these Niven arenites are mudstones and carbonaceous layers which include thin coals. These latter are generally confined to the southeast area.

Evidence supporting the presence of the Tatlatui member comes from the northern part of the Sustut block at Courage Ridge. Here a section measured over 150 metres recorded a predominantly argillaceous assemblage of black, grey and olive green shales and mudstones with subordinate fine grained silty sandstones. Towards the top of the section, two coal seams, Saiya A and B, occur, which have been proved to be younger than those to the southeast.

The strata encountered confirms a depositional environment in which the high energy fluvial conditions of Niven times gave way gradually to a lower river gradient during the Tatlatui culminating in flood basin swamps.

3.2.9 Tertiary Basalts

The volcanism that gave rise to the lavas, dykes and necks assigned to this group, probably commenced during the Miocene and continued into the Quaternary.

The basaltic lavas generally form caps on ridge tops, particularly along the western boundary of the Sustut S.E. property. However, the single most extensive flow is a valley fill deposit which extends from west to east across the Main Creek valley for a distance of 5.5 km and at its widest is 2.5 km across. The basalt is generally massive, fine grained, dark grey to black and very strong. The upper parts of many of the flows exhibit a vesicular texture and appear brown in colour. Columnar jointing can be seen near the base of the flow immediately above Coal Bowl and again where the Main Creek cuts the basalt.

Only one dyke worthy of note was recorded during the summer. It cuts through the Tango Creek Formation some 1.5 km to the southeast of the Sustut S.E. block. Erosion has removed much of the surrounding sediment so that the vertical, 2 metre wide dyke, is left protruding 6 metres above the ground. It is composed of vesicular basalt with occasional inclusions of obsidian.

3.2.10 Pleistocene and Recent

Glacial deposits are generally found below the tree line and become progressively thicker towards the valley bottoms. The majority of these deposits are ground moraine comprising a silty sand and gravel matrix with only minor clay, in which are embedded larger cobbles and boulders. Outwash sands and gravels of glacial origin occur at isolated localities throughout the more open valleys and almost all the larger creeks contain some alluvium.

Talus slopes are frequent, extending from the frost shattered ridges to beyond the tree line. Weathering and oxidation, particularly of the less resistant coals and shales, has been especially severe on slopes not steep enough for gravity to continually provide a fresh surface. A deep regolith of slumped and solifluction material often occurs in basin or cirque-like areas at the headwaters of many of the creeks, e.g., Coal Bowl. Gravity has also been responsible for the creep and cambering of rock outcrop down slope and is particularly noticeable in vertical or near vertical strata.

A final minor depositional phase has been that of calcareous tufa primarily to the south of the property. It is a creamy grey colour forming in thin layers and resulting from the emanation of cold springs. The largest deposit occurs at Fumar Creek where a cone over 2 metres high has resulted, being known as Big Kettle fumerole.

3.3 Structure

The Sustut and Sustut S.E. properties exhibit an extremely complex structure. Three separate orogenic events have contributed to this complexity resulting in faults, thrusts and tight folding affecting all the strata except for the Tertiary basalts. The final phase of tectonic activity must therefore have been completed by the Miocene and it is probable that the outpouring of the late Tertiary basalts represented the last event of this orogeny.

3.3.1 Faulting

The prinicipal faults and thrusts which affect the properties trend from northwest to southeast. Minor east-west oriented faults also occur but generally have a small throw, dying out rapidly and being of only local significance. Evidence for the presence of the larger dislocations comes from several sources, e.g., brecciation, mineralization and slickensiding, juxtaposition of stratigraphic members, topographic expression and air photo interpretations. The magnitude and to a lesser degree, the direction of these displacements is open to conjecture. However, reflectance data has indicated broad ranges for several of these movements and this work will be discussed in a following section.

Saiya Fault - It extends for a distance of approximately 25 km, forming the western boundary of the properties.

Its position is marked by the break of slope along the eastern side of the Saiya valley. It diverges from the Saiya valley immediately south of Saiya Lake and follows the headwaters of the Omineca in a south easterly direction before heading south. At its northern end it probably merges with the Sustut and Asitka faults at the confluence of these two rivers. The downthrow side appears to be to the southwest where strata of the Sustut Group dip to the northeast and strike parallel to the fault. Across the fault older strata of Upper Bowser Lake age have been thrown up against the Sustut Group. The throw of the fault would seem to be of the order of 200 to 500 metres, as the Tango Creek member of the Sustut Group rests alongside strata belonging to the middle part of the U. Bowser Lake Group.

Carruthers Fault - Another northwest trending dislocation, this time running along the eastern boundary of the S.E. block. It extends from just south of the Asitka river in the north to the Omineca river in the south, a distance of 32 km. It is probably a high angle thrust fault, responsible for pushing the lower and middle Jurassic strata to the west overtop of the Permian and Triassic rocks. Displacement seems considerable as a great deal of the Hazelton Group and some Takla are missing.

Asitka Fault - This is perhaps the principal east-west fault in the proximity of the Sustut properties. Its trace lies immediately north of the Asitka river, extending from the Sustut fault in the west to the Pinchi fault some 20 km to the east. It downthrows to the south where Ashman strata dip to the east and north east. To the north of the fault south dipping Telkwa and uppermost Takla strata are exposed. The fault has been recorded as a high angle reverse fault and displacement would seem to be at least 1,000 metres and perhaps as much as 2,000 metres.

Main Creek Fault - It is inferred that a significant fault must run along Main Creek, probably being a splay from the Carruthers Fault. The exact location of the fault plane is unknown due to the extensive cover of drift. It is probably a high angle reverse fault which has thrown up Ashman strata next to the Tango Creek. This implies that the U. Bowser Lake Group is missing which would suggest a displacement of approximately 1,000 metres. However, as there is no direct evidence for the presence of Ashman strata immediately west of the fault, the throw could be much smaller.

Coal Bowl Faults - A series of thrust faults has been assumed to occur in the Coal Bowl area to explain the repetition of coal seams. It is felt that at least two significant thrusts occur with displacements of between 100 and 200 metres. Additional minor faults would also seem to be present imparting an imbricate structure to the area. It is possible that these thrusts unite at depth and may originate in the Saiya Fault. This would assume that the Coal Bowl area and much of Marmot Ridge is composed of a series of thrust wedges.

Watney and Bass Faults - These two faults have a common origin at the northern end of Courage Ridge. They diverge from one another to the southeast, running either side of the ridge. The Watney fault separates the Tango Creek Formation from the Ashman and may link with the thrusts of Coal Bowl. It would seem to be a high angle reverse fault and if it has resulted in the omission of the U. Bowser Lake Group, then its throw must be in the order of 1,000 metres. The Bass Fault appears to be less significant, separating the U. Jurassic Volcanics from the Tango Creek Formation. The amount of throw is probably only a few hundred metres, resulting in the loss of the Niven member of the Tango Creek Formation.

The majority of thrusting and faulting would seem to be the result of the early Tertiary orogeny.

Undoubtedly the older orogenic events produced dislocations, but there is no conclusive evidence to assign specific faults to these events. Furthermore, it is most likely that older faults were reactivated by the younger tectonic movements.

3.3.2 Folding

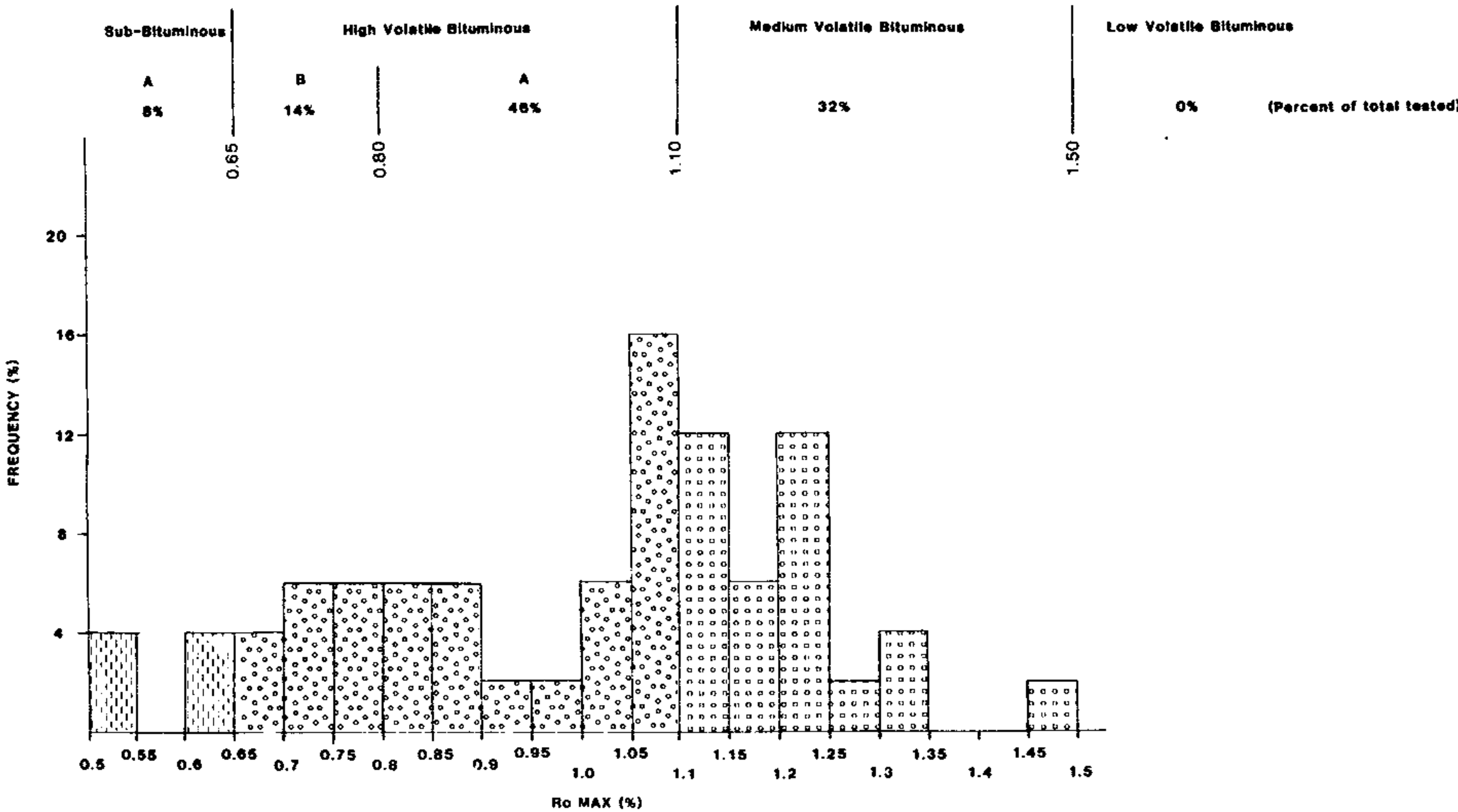
The principal fold axes are oriented northwest to southeast, paralleling the fault trends. The earliest folding resulted from movements in the mid-Triassic and affected only pre-Takla rocks. However no evidence of these folds was recognized during the field work.

The second orogenic phase which affected the pre-Sustut strata manifests itself far more obviously. These folds are particularly well marked in the Ashman and U. Bowser Lake Groups which are more highly disturbed with tighter folds than the overlying Sustut Group.

The three principal fold axes within the properties are the Worthington and Vaux synclines and the Harp anticline. The Worthington syncline trends northwest to southeast down Main Creek valley, the axis lying somewhere to the west of the creek. Evidence for the syncline comes from dip measurements in the Ashman Formation to the west, particularly along Lo Coal Creek. The general dip is to the east becoming less steep towards Main Creek and the synclinal axis. Minor variations to this trend are apparent, so that the structure probably resembles a synclinorium. The synclinal axis presumably continues beneath the Tertiary Basalts as indicated by an area of Ashman strata to the north of the S.E. block where dips are consistant with the presence of a syncline. Dip readings tend to suggest that the syncline has a plunge to the northwest, confirming Lord's findings.

FIGURE 3

REFLECTOGRAM FOR SUSTUT AND SUSTUT S.E. COALS



Approximately 2 km to the west of the Worthington syncline is the Harp anticline which parallels the former and probably runs along the eastern edge of Coal Bowl. It is certainly assymetrical in form, particularly near Coal Bowl and immediately north of the Tertiary Basalts where the western limb is much steeper. Again, as for the Worthington syncline, it is more an anticlinorium than a simple anticline. Generally, dips become steeper and structure more complex as the Coal Bowl area is approached, reflecting both the presence of thrusting and also the less competent coal measure strata. Both coals and shales exhibit a high degree of contortion and shearing whenever they are found within the area.

The Vaux syncline has been recognized within the Sustut Group rocks and is therefore of post-Paleocene age. It may be present within the older rocks to the south of Willow Creek but cannot be defined with any certainty. It is cut out by the Watney fault to the east of Courage Ridge in the north and disappears into the Tertiary Basalts in the south. It is a broader and more gentle structure than the older folds with dips rarely exceeding 40° and very few subsidiary flank folds. The more competent and brittle nature of the Sustut strata undoubtedly affected the style of folding within this group, particularly within the lower Niven member.

Only three of the many folds have been mentioned above. The same principals, however, apply to all the other folds recorded, that is, folds within the Sustut Group are less complex and more open than those in the Ashman and U. Bowser Lake groups. Also, the less competent coal, shale and mudstone horizons exhibit the greatest deformation.

4. COAL

4.1 Distribution

Two separate periods of coal deposition occurred within the strata of the properties. The oldest coals belong to the Upper Bowser Lake Group ranging through some 800 metres of strata. The oldest coal (Mackeson seam) occurs just over 0.5 km south of the Sustut S.E. property on a tributary of Stout Creek. It is of medium to low volatile rank which is the highest rank of all the Sustut coals.

The greatest number of seams occurs in the Coal Bowl area where 9 seams of high to medium volatile rank have been recognized. These seams can be split, according to their reflectances, into three ages of deposition. The youngest, Main numbers 1 and 2 are high volatile bituminous A in rank, whilst the remainder, Main 3, 4, 5, 6, 7 and Main 8 and 9 (the oldest group) are medium volatile coals. These 9 coals are obviously younger than the Mackeson seam although they still belong to the Upper Bowser Lake Group.

The final series of coals belongs to the Sustut Group and occurs in the southeast corner of the Sustut S.E. block and in the central and northern parts of the Sustut block. These coals can be subdivided into three groups according to the A.S.T.M. classification. The oldest coals are probably of lower Tango Creek age and are of high volatile bituminous A rank. The second group is a continuation of these latter coals in an unbroken series, but are classified as high volatile bituminous B rank. The coals of these two groups are confined to the south eastern area and in scattered localities in the central area where strata lower down in the succession are exposed. They are probably of Lower to lowest Upper Tango Creek age. The last group of coals comprises three seams, Saiya A, B and C. The first two appear older than the last, but all are classified as sub-bituminous A rank. They all probably belong to the upper Tango Creek, but Saiya C appears to lie some 100 to 200 metres higher in the succession.

4.2 Description

Throughout the property, coals have been described from float, slough, outcrop and trenches. In many cases, particularly the Coal Bowl area, weathering has been so severe as to substantially disrupt seam profiles, even where hand trenched. Correlation using the seam profiles described herein cannot be undertaken with any degree of certainty, particularly where distance of 50 to 100 metres or more separate exposures. It has become obvious from this initial phase of exploration that further detailed work is required on the coal seams something which will be discussed in the section on Recommendations.

4.2.1 Mackeson Seam

This is the oldest seam found and occurs to the south of the property, some 75 metres along a southwest flowing tributary of Stout Creek. The seam is exposed in a slumped bank of the creek where it has been assymetrically folded with the nose of the fold exposed. The strike is 302° with the northern limb dipping at 70° to the northeast whilst the southern limb is vertical. The hanging wall comprises black mudstone and carbonaceous mudstone whilst the footwall is a poorly exposed mudstone. The seam thickness has been recorded as 4.5 metres, however because of severe slumping, it was not possible to locate the actual nose of the fold and the true thickness may be considerably less than this. The seam has been sheared and contains several thin bands of carbonaceous mudstone. The strike of the seam takes it across the creek, but a large slide has covered all traces of outcrop. To the south, the seam turns into the hillside and could not be traced.

4.2.2 Main No. 1

The Main No. 1 seam has been trenched in two localities, as shown in Appendix IV. In trench 11A the upper 1 metre could not be uncovered, leaving only 0.5 metre of coal bearing strata visible. The seam is very dirty and probably less than 1.0 metre thick with only about 0.3 metre of coal. In trench 1C it is only represented by coal stringers probably indicating a shaling out in this direction.

4.2.3 Main No. 2

This was trenched in 6 localities and as with all the Main coals exhibits considerable variation in thickness and coal content. Its maximum thickness is recorded in trench 2AA where the overall seam thickness is 3.90 metres. It comprises an upper ply of 1.45 m, interseam shale and carbonaceous mudstone of 0.6 m and a lower ply which is 1.85 m thick. Roof and floor are of carbonaceous shale. Nearby at trench 2AC, it is reduced in thickness to 3.05 m, with 3 coal plys of 0.25, 0.25 and 0.6 m with carbonaceous shale interseams of 0.55 m and 1.4 m respectively. Elsewhere the seam thins to between 0.5 m and 1.1 metres.

4.2.4 Main No. 3

It basically consists of two plys although these coals are split frequently by thin shale and mudstone partings. The thickest development is seen in trench 11C where the seam reaches 6.2 metres. The upper ply is 4.0 metres thick although it contains 4 partings of shale and mudstone, the thickest of which is 0.25 metres. 1.65 metres of mudstone separates the latter from the bottom ply which does not contain any splits and is 0.55 metres thick. On the other side of the creek, ostensibly in the same seam, trench 11D proved a thickness of only 1.85 metres. Unfortunately, no reflectance data is yet available for this trench and it seems likely that a lateral displacement has occurred and that some seam other than No. 3 has been measured.

In trenches 12F and 12H further north, the seam has thinned to 4.5 and 4.4 metres respectively. In 12H, the upper ply is 1.45 m thick and includes a 0.2 m split. The interseam mudstone is 1.45 metres thick being reasonably consistant with 11C. The bottom ply is 1.5 metres thick with a very thin split some 0.2 m from its top. Trench 12F close by has a similar overall thickness but shows three plys, the original lower ply now being split some 0.2 m from the top by 0.9 m of carbonaceous mudstone. The upper ply is slightly thinner at 1.10 m, but contains no splits. The interseam mudstone is 1.5 m thick, almost identicle to 12H. The middle ply as described above is 0.2 m thick and the bottom ply is 0.8 m. It seems that the very thin split in the lower ply of 12H has thickened substantially to 0.9 m in 12F.

4.2.5 Main No. 4

This seam has been measured in two trenches, 11E, where it comprises 1.40 m of coal with no splits and 12E where it is 0.6 metres of solid coal. It is possible that it is this seam that was measured in trench 11D. It appears to show a thinning trend to the north.

4.2.6 Main No. 5

It was trenched at locality 12D where it comprised some 5.0 metres of carbonaceous shale with coal stringers. It is possible that No. 5 is not a seam at all but just a very carbonaceous horizon.

4.2.7 Main No. 6

As in the case of No. 5, this seam is a carbonaceous mudstone, this time only 1.25 metres thick.

4.2.8 Main No. 7

In trench 12B it comprises two plys, an upper of 0.35 metres and a lower of 0.15 m with 0.65 m of inter-seam siltstone.

4.2.9 Main No. 8

This seam has not been completely exposed. Trench 14 showed a 1.3 metre seam with 3 mudstone splits, the total coal being 0.95 m. It is possible that the upper coal horizon of trench 36D could be seam No. 8. The seam thickness would be 3.55 metres consisting of an upper ply of 0.5 m, 1.10 m of interseam carbonaceous shale and a lower ply of 1.95 m.

4.2.10 Main No. 9

In trench 36D it comprises a 4.10 metre seam with an upper and lower ply separated by 0.8 m of mudstone. The top coal is 1.2 m thick whilst the bottom is 2.10 metres, although some 0.4 metres of this was covered. In trench 14, a coal of 1.3 m thickness has been assigned to seam No. 9, although 3 metres above is a further 3.85 m of interbedded coal and mudstone, the stratigraphic position of which is uncertain.

4.2.11 McEwan No. 1

This was trenched at locality MS11-X where it was 0.5 metre thick. To the north, at MS6V what appears to be the same seam is 0.8 metre thick. The McEwan No. 1 is the only one of the McEwan seams to be worthy of note because of its supposed continuation and low elevation.

4.2.12 Stone Seam

Located in the central part of the property, it is one of the Sustut Group coals and in common with these seams, appears to be of limited extent. It has a thickness of 0.4 m at locality 30D, being overlain by a carbonaceous shale and underlain by mudstone.

4.2.13 New Seam

A coal seam at least 2 metres in thickness was discovered on the south slope of New Creek Valley, approximately 3 km from its confluence with Saiya Creek. The coal strikes at 100° and dips at 45° to the north and there is a possibility that it is the same as the Stone seam to the east. It is interbedded with carbonaceous shales and siltstones and contains a high percentage of vitrinite. The total section measures some 25 metres. Due to thick cover and the nature of the topography it was not possible to trace the seam along strike.

4.2.14 Saiya A and B

These seams are exposed on an extremely steep slope on the west side of Courage Ridge. They are contained in a sequence of olive green and grey mudstone carbonaceous mudstones and fine grained, buff-coloured sandstones. The strata strike at 0° and dip 35° to the east. The section is described in detail in Appendix V.

Saiya A occurs some 150 metres above the base of the section. It is 2.8 metres thick and contains three discernable coal plys. The upper ply is 1.3 metres thick and contains several minor mudstone partings. This is underlain by 0.35 m of carbonaceous shale with coal partings. The middle ply is 0.35 m thick with two 0.01 m partings of shale and mudstone. This is separated from the bottom ply by a 0.1 m thick shale band. The bottom ply is 0.6 metres thick and appears to be all coal.

Saiya B lies 47.5 metres above Saiya A and is 8.55 metres thick. It is split into an upper and a lower ply by 3.60 metres of mudstones, siltstones and carbonaceous bands. The upper coal ply is 2.55 metres thick with several minor partings of carbonaceous mudstone and siltstone, the thickest of which is just over 0.2 m. The lower ply is 2.40 m thick, again with several thin carbonaceous mudstone interbeds. The total thickness of coal in the Saiya B seam is approximately 2.6 metres.

4.2.15 Saiya C

Saiya C, located just over 1 km along the ridge overlooking Whitbread Creek, is the youngest coal encountered within the properties. It has a thickness of 3.6 metres of which upper and lower coal plys account for 1.5 m. The intervening 2.1 metres is composed of dark grey mudstone and carbonaceous mudstone. The hanging wall is a light brown sandstone and the footwall a brown mudstone (seat earth). The strata dip at 70° to the north east and strike at 103°.

4.3 Rank and Reflectance

The ranks of 50 coals from the Sustut and Sustut S.E. properties and their immediate vicinity were determined by reflectance measurements on vitrinite particles (Romax). This method was chosen as the high degree of oxidation of the coals rendered chemical determinations inaccurate.

The reflectance results ranged from 1.47 for the Mackeson seam to 0.51 for Saiya C. A full list of reflectance results is contained in Appendix VI. A reflectogram (Fig. 3) for the Sustut and Sustut S.E. coals has been produced which shows the distribution of ranks throughout the samples tested. The rank range is from sub-bituminous A to medium volatile, with the majority of results falling within the medium and high volatile A bituminous range.

The highest rank coal, the Mackeson seam is classified as medium volatile but is so close to the boundary with the low volatile coals that it could possibly fall within the latter range. The majority of the Main coals also fall within the medium volatile range, the exceptions being Main 1 and 2 which are high volatile bituminous coals and therefore somewhat younger.

The McEwan coals of the southeast, lying between McEwan Ridge and Main Creek, are generally of high volatile A bituminous rank, although higher up in the succession, towards the ridge top, high volatile B bituminous coals occur.

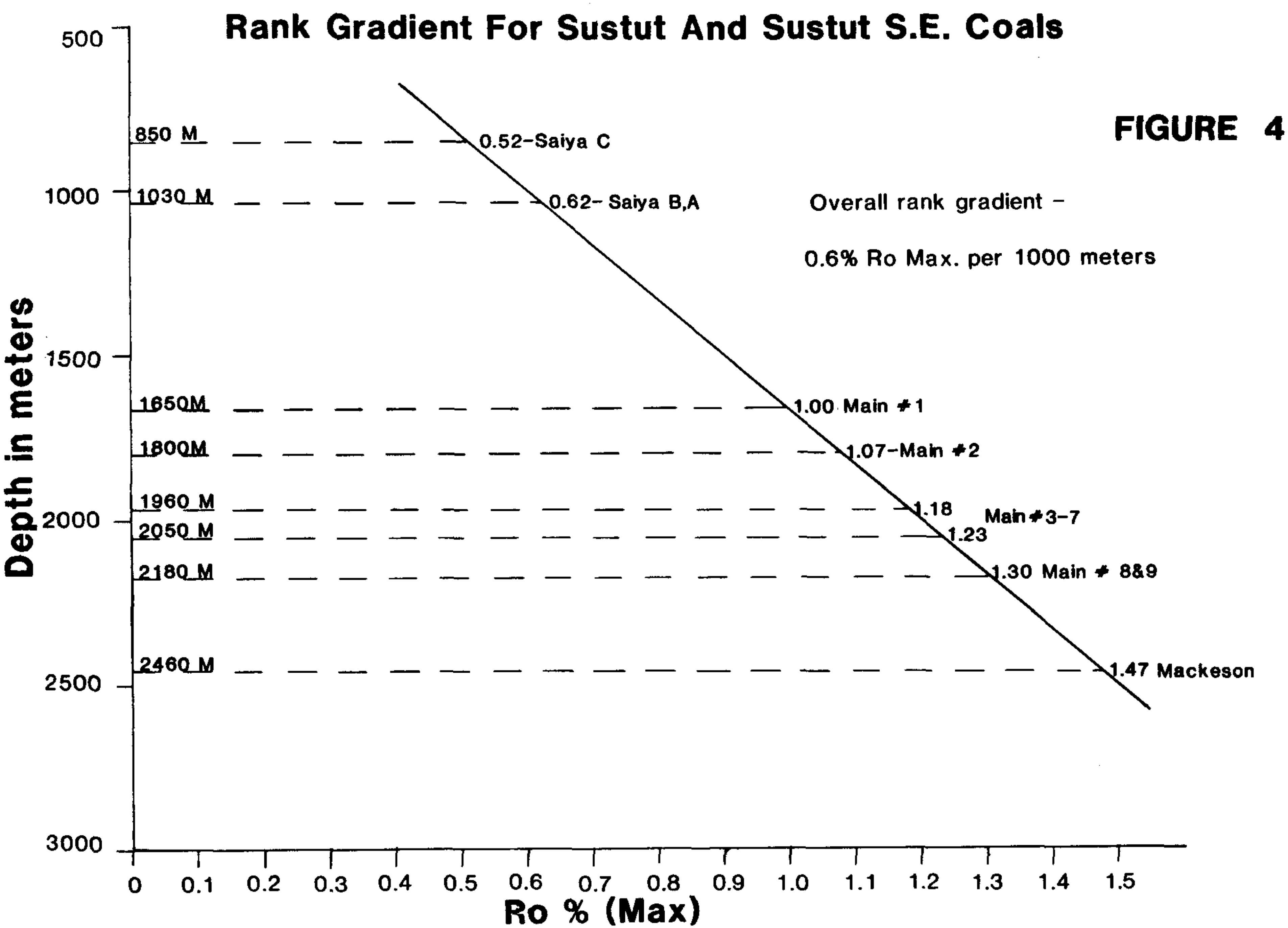
The central area coals, including New Seam are predominantly high volatile B bituminous coals. The three Saiya coals are of sub-bituminous A rank, although Saiya A and B may just be high volatile bituminous C. A discrepancy exists between reflectance results from 1981 and those recently obtained for the Saiya A and B seams. 1981 results (0.86 and 0.81) suggest the coals are high volatile A bituminous, whilst 1982 results (0.61 and 0.63) indicate a sub-bituminous rank. The most likely explanation for these differences is that the 1981 samples were taken from portions of the seams which had been heat affected. The section on Courage Ridge shows volcanics lying immediately on top of Saiya B for two thirds of its length, whilst the northern one third has been down faulted and lies some 10 metres below the volcanics. The 1982 samples were obtained from the northern one third of the Saiya B outcrop and should not, therefore, be heat affected.

Saiya A is cross-cut by a small dyke and affected by several small faults. It is possible therefore that the 1981 sample was taken from a close proximity to the dyke or to one of the faults where heat transfer may have been high enough to alter the reflectance readings.

4.3.1 Rank Gradient

By measuring the reflectance of vitrinite in coals at intervals along a measured section, it has been possible to arrive at a rank gradient for the Sustut and Sustut S.E. coals. This graph is shown in Fig. 4 and indicates an overall gradient of 0.6% Romax per 1,000 metres. This gradient compares well with results from the Peace River coalfield by Hacquebard and Donaldson (1974) who proved a rank gradient of 0.71% Ro for similar rank coals. Recent work by Pearson and Grieve indicated a similar gradient for high volatile bituminous coals. It must be stressed that Fig. 4 shows an average rank gradient for sub-bituminous to medium/low volatile coals. The actual gradient would in fact be expected to be lower for the lower rank coals and higher towards the medium and low volatile end. This would resemble a curve, steeper at the low rank end and flattening out towards the anthracites.

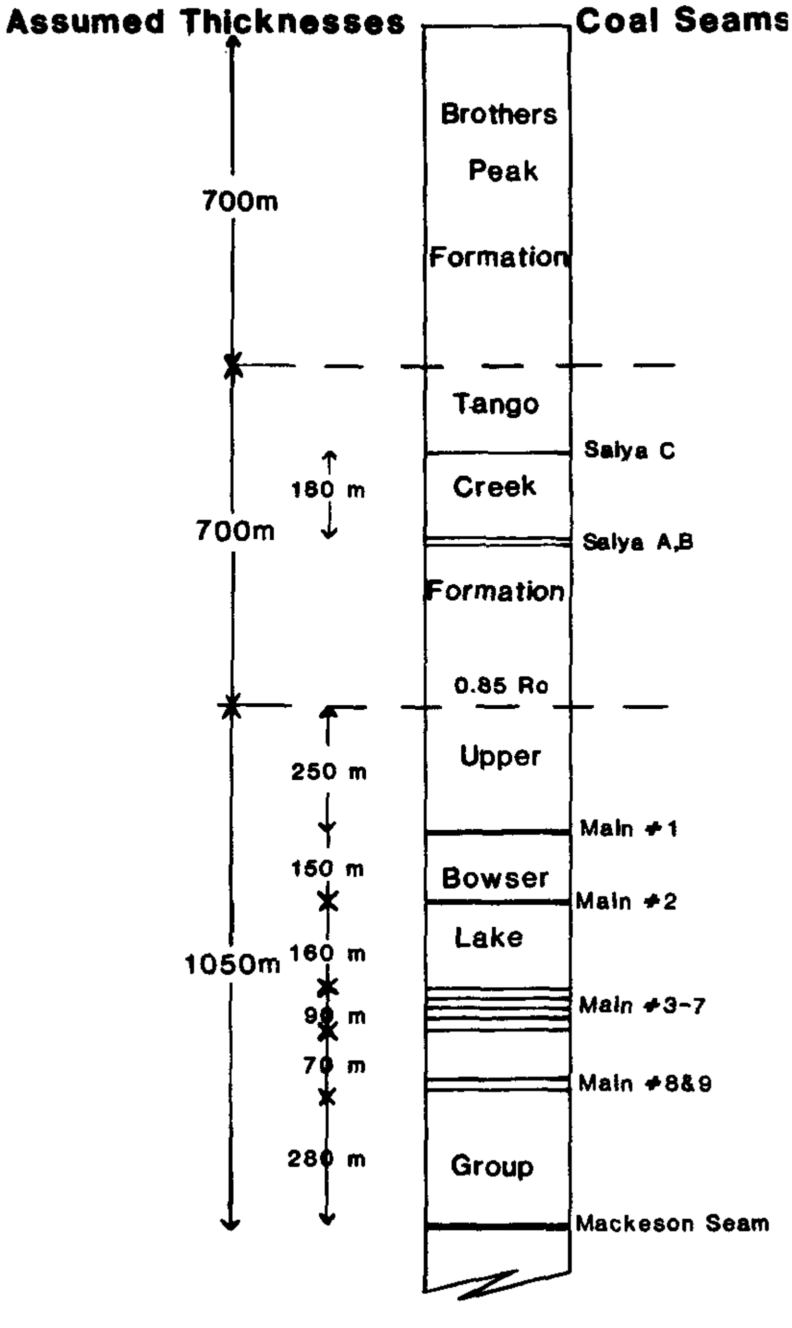
Using this assumed rank gradient, it has been possible to estimate the thicknesses of various stratigraphic members from the lower parts of the U. Bowser Lake Group to the Recent. Fig. 5 shows a possible stratigraphic column for the above range. It shows a total thickness of coal bearing strata from the Mackeson Seam to the Main No. 1 seam of about 800 metres. There is then a barren interval of some 250 metres before deposition of the first Sustut (McEwan) coals. The base of the Tango Creek Formation is still conjectural but has been



Rank Gradient For Sustut And Sustut S.E. Coals
FIGURE 4
Overall rank gradient -
0.6% Ro Max. per 1000 meters
Depth in meters
500
1000
1500
2000
2500
3000
850 M
1030 M
1650M
1800M
1960 M
2050 M
2180 M
2460 M
0.52-Saiya C
0.62- Saiya B,A
1.00 Main #1
1.07-Main #2
1.18
1.23
Main #3-7
1.30 Main # 8&9
1.47 Mackeson
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
Ro % (Max)

FIGURE 5

Stratigraphic Column For The Upper Bowser Lake And Sustut Groups



narrowed to within 250 metres of the Main No. 1 seam. After the deposition of the last recorded coal, Saiya C, there would appear to have been about 900 metres of strata deposited, most of which belongs to the Brothers Peak Formation.

The U. Bowser Lake Group coal measures show five separate periods of coal formation. The first, resulting in the Mackeson Seam, followed after a substantial gap, by the Main Nos. 8 and 9 seams. A further interval occurred represented by 70 metres of strata, before Main Nos. 3, 4, 5, 6 and 7 were deposited, covering approximately 100 metres of strata. Main No. 2 is some 160 metres above these latter and is followed by a similar interval before Main No. 1, which appears to be the youngest U. Bowser Lake Group coal, was deposited.

An interesting anomaly within the reflectance results is a value of 1.25 in Lo Coal Creek, an area thought to be of Ashman age. If this result is correct, it would mean that these strata are similar in age to the Main No. 7 seam and could represent the stratigraphic interval between the No. 7 and Mackeson seams. As the No. 8 and 9 seams were not encountered, one would have to envisage these being faulted out or presume a lateral facies variation resulting in their non-deposition.

It is quite possible therefore, that the Lo Coal Creek area contains strata of U. Bowser Lake Group age. Although no coal was found at the surface, it may be present at not too great a depth and may also occur to the south beneath the drift.

It must be stressed that reflectance values are subject to minor variations which could have an affect upon the assumed rank gradient. The lithology of roof strata can have a signifcant effect upon the rank of the underlying coal resulting in reflectance variations of up to 0.1% Ro. Similarly, in-seam variations can also produce anomalous readings. Therefore, the rank gradient produced for the Sustut properties is only intended as a tentative guide to the likely stratigraphic thicknesses of the units previously mentioned.

4.3.2 Structural Implications

Reflectance values are important tools in the correlation of coal seams bearing in mind the aforementioned variations. Only one area within the properties has sufficient reflectance data to permit attempts at seam correlation. This is the Coal Bowl area, which initially was thought to contain only 4 seams. The reflectance data, however, has changed the picture substantially, indicating the presence of 9 seams with thrusting resulting in both repetition and omission of strata.

The detailed geological map and cross sections of the Coal Bowl area, in Appendix III, attempt to portray the complicated scenario. The reflectance results, together with the assumed rank gradient suggest that two substantial thrust faults and at least two high angle faults affect the area. This would result in seams 1 and 2 being thrust over seams 2 and 7 which in turn had been thrust on top of seams 8 and 9. Intense folding must have occurred both before and during the thrusting.

A fault must be inferred between seam 1 and 2 to account for an 80% reduction in stratigraphic thickness. The sequence of strata including seams 3 to 7 has a relatively small range of reflectance (0.5% Ro) which could be explained by natural variation. It is assumed therefore, that rather than invoke a series of faults or very tight folds, the whole sequence is inverted with seam 7 now at the top.

Initially it was thought that seam 2 lay beneath seam 3 in stratigraphic order and the whole unit had, as previously stated, been inverted. However, when the rank gradient was examined, it was obvious that some 70 metres of strata were missing, which could be explained by inserting a fault downthrowing to the east. Seam 1 would have been removed by the underlying thrust.

Seams 8 and 9 should lie some 300 metres below seam 2, but in the section there is only room to insert 150 metres of strata. Furthermore, seams 8 and 9 must be folded as shown in section A-A' or faulted to prevent seams 3 to 7 outcropping. The thrust just east of seam 2 would explain the present situation.

The structural picture presented above is thought to be the most feasible given the current information on the area. Obviously when additional data is obtained this picture can be ammended, but at least it provides a starting point for future work.

4.4 Coal Quality

In addition to the vitrinite reflectance, proximate analyses, sulphur content and calorific value determinations were carried out on selected coal samples. The results of the proximate analyses and calorific values as determined in the laboratory are substantially affected by oxidation of the coal and cannot be used to classify the coals by A.S.T.M. rank. The percent of mineral matter, volatile matter and fixed carbon on a dry mineral matter free basis have been computed using the Parr Formula. This was done because the ash content in many of the samples was extremely high, something which can be attributed both to sampling methods and the high inherent ash content of the seams.

The only reliable rank parameter for the Sustut and Sustut S.E. coal samples is the reflectance of vitrinite, as mentioned in section 4.3. A reflectance - calorific value diagram is contained in Fig. 6 on which the principal coal seams have been plotted. Their calorific values correspond to the unoxidised, ash-free positions and can be compared to the actual values obtained in the laboratory. In every case, the laboratory determined calorific values are substantially reduced, halved in the case of Main No. 1, compared with the chart values.

Sulphur values are generally less than 0.5%, with a maximum value of 0.7% from Main No. 6 and a minimum of 0.18% from Main No. 1. The average sulphur content for the Sustut Group coals is slightly higher than that for the U. Bowser Lake Group. The overall range of sulphur values (0.18% to 0.7%) may indicate that certain seams within both the Sustut Group and the U. Bowser Lake Group were deposited in a more or less brackish environment. It may be possible, with more data, to correlate individual seams or certain areas on their sulphur content and perhaps obtain a better insight into the depositional environments appertaining.

The quality analyses indicate the presence of coal ranging in rank from sub-bituminous to medium/low volatile bituminous. There is potential for a high calorific value product, however considerable washing may be required as ash contents are generally high. The next phase of exploration should endeavour to uncover the seams to allow more accurate and better quality samples to be obtained. Testing should then include, in addition to those tests already carried out, ultimate analyses, washabilities and coking property evaluations.

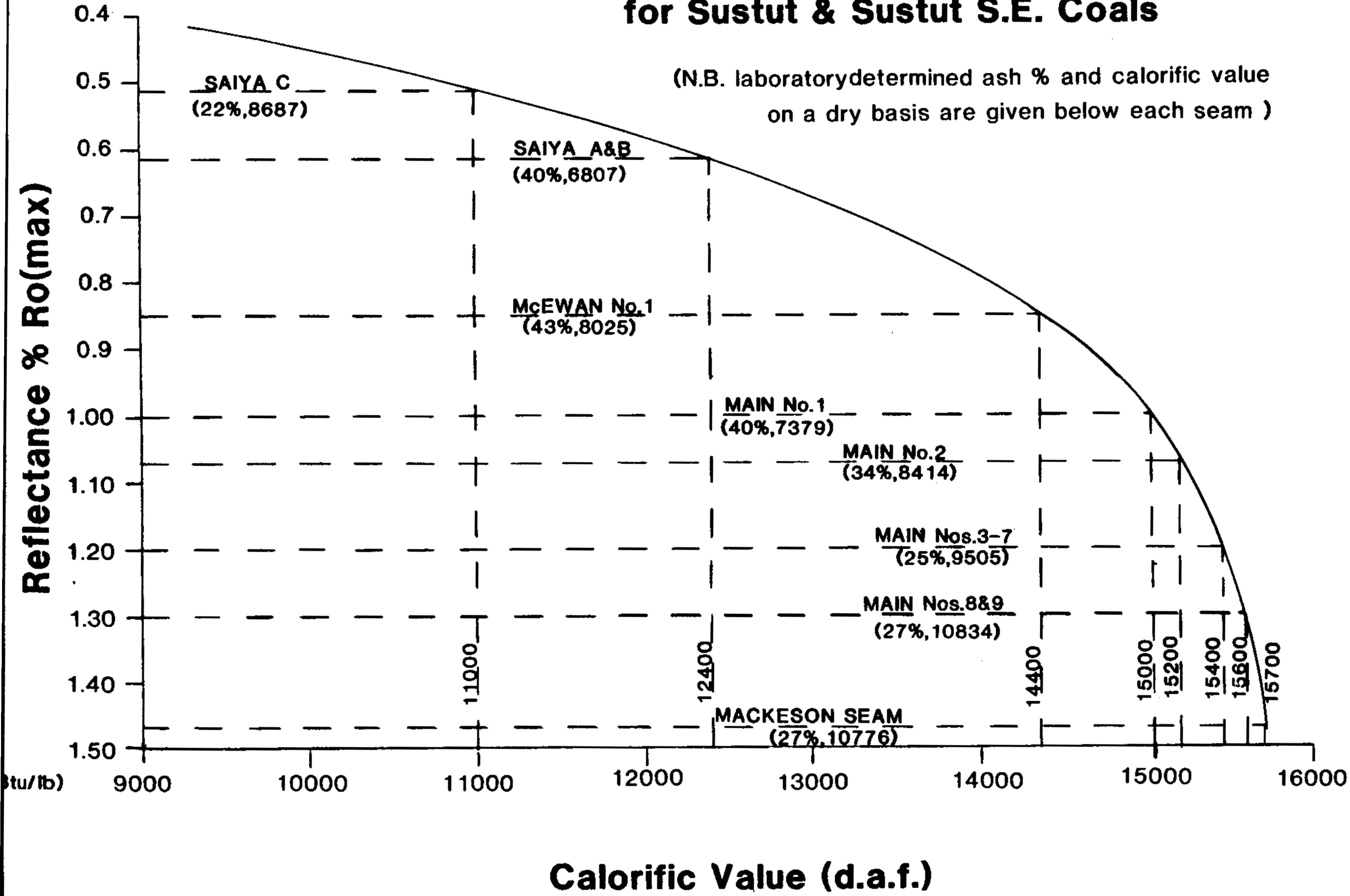
4.5 Coal Reserves

The areas where coal has been proven with some certainty from outcrops and where some idea of its quality has been ascertained, are the Coal Bowl and Courage Ridge areas. Unfortunately neither lends itself to economic exploitation,

FIGURE 6

Calorific Value-Reflectance Diagram

for Sustut & Sustut S.E. Coals



unless accompanied by a much larger and less complex deposit. Computing reserves for these areas would therefore prove meaningless. Instead, so that some idea of possible quantities of raw coal may be obtained, it has been assumed that the Main No. 1 to 9 seams extend beneath the Main Creek Valley to the Main Fault. This is feasible given the presence of a synclinal structure (Worthington Syncline) in this region. Consequently, the term inferred resources, as defined by the U.S. Bureau of Mines, will be used for the following figures.

The area used in these calculations extends from the western edge of Coal Bowl to Main Creek and for a north-south distance of 4 km parallel to the strike of the seams. The large area of Ashman strata to the southeast of Coal Bowl has been omitted from calculations. The total area is 11.5 km^2, much of which occupies the lower slopes and valley bottom.

The average coal thicknesses and corresponding raw coal tonnages for each of the 9 seams are given in Figure 7. The total of just over 200 million tonnes of raw coal includes 33 million tonnes of high volatile bituminous A and 169 million tonnes of medium volatile bituminous coal.

No detailed calculations have been done for the southeast coals as continuity has yet to be proven. However, the lower most McEwan coals are of high volatile A bituminous rank and on the lower slopes to the east of the Main Creek Fault may provide additional tonnages of the order of 20 million tonnes of raw coal.

5. CONCLUSION AND RECOMMENDATIONS

The 1982 field mapping program has proved the existence of several coal seams of economic potential. However it has also uncovered a great number of problems which must be solved before a comprehensive understanding of the properties can be achieved.

5.1 Palynology

Perhaps the foremost problem is that of stratigraphic correlation, particularly within the Ashman Formation and U. Bowser Lake Group. An attempt must be made to establish the top and bottom of the coal bearing sequence and delineate its extension along strike. The base of the Sustut Group also requires to be established along with the stratigraphic position of the associated coal seams.

The most accurate method of correlation which would simplify the above difficulties is the use of palynology. A palynostratigraphic study could be undertaken immediately, using samples collected this year and areas of sparse information filled-in with further sampling during 1983. The advantage of commencing the study prior to the 1983 field season is obvious, in that a considerable amount of time will be saved and confused areas removed before the field crews actually arrive at the properties. We would therefore be maximising the fairly short field season. As the palynology work should be on-going throughout 1983, field crews must be instructed to collect mudstones, shales and siltstones in addition to coals so that repeat visits to the properties will not be required in the fall.

5.2 Trenching

The most important on-site work in 1983 must be the trenching of as many of the principal coal seams as possible. It is felt that hand trenching alone will not provide the requisite depth or extent of exposure necessary. Therefore, a helicopter portable, hydraulic trenching machine with the capability of

Figure 7

INFERRED COAL RESOURCES OF THE SUSTUT S.E. PROPERTY

Seam Number	A.S.T.M. Rank	Thickness (Metres)	Raw Coal (Tonnes x 10^6)
Main No. 1	H.V.B. - A	0.3	4.49
Main No. 2	H.V.B. - A	1.9	28.41
Main No. 3	M.V.B.	2.8	41.86
Main No. 4	M.V.B.	1.1	16.45
Main No. 5	M.V.B.	0.4	5.98
Main No. 6	M.V.B.	0.3	4.49
Main No. 7	M.V.B.	0.5	7.48
Main No. 8	M.V.B.	2.6	38.87
Main No. 9	M.V.B.	3.6	53.82
	TOTALS	13.5	201.85
Total H.V.B. - A			32.90
Total M.V.B.			168.95

N.B. Area Used = 11.5 km^2
S.G. Assumed = 1.3 g/cc

excavating trenches approximately 1.0 metre wide and at least 3.0 metres deep is recommended. Such a machine must be capable of moving between trench locations under its own power and to be brokendown, lifted and reassembled quickly.

The majority of trenching will be done in the Coal Bowl area where both cross-cut and along strike trenches should be excavated through the coal seams. The trenches must be deep enough to avoid the worst of the weathered and slumped material and logged in detail by a qualified coal geologist.

Safety of personnel must be of prime importance when entering trenches. Under no circumstance should personnel work in an unshuttered trench which is deeper than 1.5 metres. The best method of examining deep trenches is by using a steel cage lowered into the trench by the backhoe.

5.3 Drilling

The only method considered sufficiently reliable to determine the nature of the strata beneath the glacial cover is drilling. The feasibility of the property as an economic coal producing area hinges upon their being a continuation of coal bearing strata beneath the Main Creek valley. It is important, therefore, that drilling be carried out in this area in 1983.

It is considered that five holes, to depths of between 150 m and 300 m should provide the requisite information. The holes should be cored with a minimum core diameter of 47.6 mm (N.Q.) and geophysically logged. Because of the high angle of dip, particularly close to the Coal Bowl area, at least two of the holes must be drilled at an angle. As it has been assumed that the general dip of the strata is towards the Worthington Syncline, then the drill holes should be angled at about 45° to the west. It is most unlikely that the true thickness of the strata will be represented in the core and one must not become too enthusiastic over thick coal seam intersections until the true thickness has been calculated. An additional problem with angle hole drilling in the effect upon geophysical logging tools. Certain functions normally available will not be feasible and the logging contractor should be contacted before programs are finalized.

A further hole should be drilled to prove the extent of the McEwan No. 1 seam in the southeast area, where licences have recently been acquired. One hole, angled at approximately 45° to the west and with a depth of 150-200 metres, should prove adequate. The actual position of the hole will depend upon surface conditions, but should obviously be drilled down-dip from the existing outcrop.

If funds are available, it would be worthwhile to drill a hole to the east of Courage Ridge and east of the Watney Fault. This area has very little outcrop and may possibly be underlain by coal bearing strata. A vertical hole some 200 metres deep is recommended.

The drilling and trenching operations will require a certain amount of clearing work. Once operations have been completed reclamation must be undertaken and must conform with provincial regulations and recommendations.

5.4 Geological Mapping

Field mapping should continue from the work done in 1982, preferrably at a scale of 1:10,000 with detailed areas mapped at 1:500. As the results of the palynology study become available certain areas may require re-examination. The assumed location of the principal faults and thrusts must be checked for surface indications. Additional sections must be measured in the southeast, Coal Bowl area, central area and Courage Ridge so that as complete a stratigraphic sequence as possible is recorded. As trenching progresses and new data becomes available the area must be continually reassessed and further detailed mapping undertaken where required.

5.5 Sampling and Testing

Samples will be required for several different purposes. The palynostratigraphic study calls for not only coal but shales, mudstones and siltstones to be collected. Petrographic work needs coal samples for both maceral analyses and reflectance measurement. Samples for the latter should contain a relatively high proportion of vitrinite.

Both proximate and ultimate analyses should be carried out on selected coals. Additionally, the coking properties of the medium volatile coals should be examined, initially by F.S.I., ash composition and petrographic analyses. Finally, bulk samples will be required for washability tests.

The samples will be collected from outcrops, trenches and drill cores but irrespective of origin, all must be carefully taken to be as representative as possible. The largest samples will be available from trenches and it is only from these that washability tests will be carried out. The drill core, depending upon depth, should provide relatively unoxidized samples and once the seams have been correlated with outcrop and trench localities, a measure of the degree of oxiditation can be obtained.

The testing schedule must be drawn up prior to the field work so that samples can be shipped back to laboratories during the season and results obtained whilst exploration is continuing. This will permit the exploration work to be redirected to a certain degree, where indicated, thereby maximising its effectiveness.

5.6 Air Photography and Maps

The air photos used during the 1982 field season were adequate but had a number of drawbacks. The principal of these was the presence of snow cover on higher ground and partial cloud effects when the photos were flown. In several cases this has obscured important areas of the properties. It would be desirable to re-fly the area in colour at a scale of about 1:15,000. The 1:15,840 Forest Cover base maps used in 1982 are not adequate for the detailed work required. They do not possess contours and many of the creeks are not accurately positioned. New maps must be compiled from the air photos at a scale of 1:10,000 for general mapping and 1:500 for detailed areas.

5.7 Land Holding

It is recommended that in the Sustut block, licence numbers 7256, 7257, 7258 and 7259 be dropped. The area covered by these licences has been shown to contain marine strata of Ashman age. No coal is thus expected to occur within the above licences. It is not recommended that any additional licences be acquired to adjoin the Sustut property at this time.

In the Sustut S.E. property, it is recommended that licence numbers 7333, 7334 and 7337 be dropped. The latter contains non-coal bearing strata of Ashman age, whilst the former two are covered by a considerable thickness of Tertiary basalt. Furthermore, it is probable that the strata beneath the basalt are of Ashman and Hazelton age.

It would be advisable, to acquire four additional licences within the Sustut S.E. area. The northern most of these lies west of licence Number 7332 and would include the Stone Seam and an area of U. Bowser Lake Group strata. The remaining three adjoin licence number 7322 at the south east corner of the existing property. These licences would incorporate several McEwan seams, including McEwan No. 1 and their strike extensions.

5.8 Summary of Recommendations

1. Palynostratigraphic Study - commencing December 1982 and continuing through 1983.

2. Trenching - using a helicopter portable excavating machine to dig both cross-cut and along strike trenches.

3. Drilling - 5 or 6 core holes in the Main Creek valley to depths of 150 to 300 metres, accompanied by geophysical logging.

4. Geological Mapping - to accommodate new data and at more detailed scales.

5. Sampling and Testing - for palynology, petrography, chemical analysis, washability and coking properties.

6. Air Photography and Maps - re-fly at 1:15,000 in colour and produce base maps at scales of 1:10,000 and 1:500.

7. Land Holding - drop 4 licences from Sustut and 3 from Sustut S.E. and acquire 4 new blocks adjoining Sustut S.E.

ACKNOWLEDGEMENTS

The 1982 summer field work on the Sustut and Sustut S.E. properties would not have been possible without the help of the geological assistants, cook and helicopter personnell, whose contributions are gratefully acknowledged. Particular thanks must go to Rob Booker who kept the field activities running smoothly and assisted in the preparation of this report.

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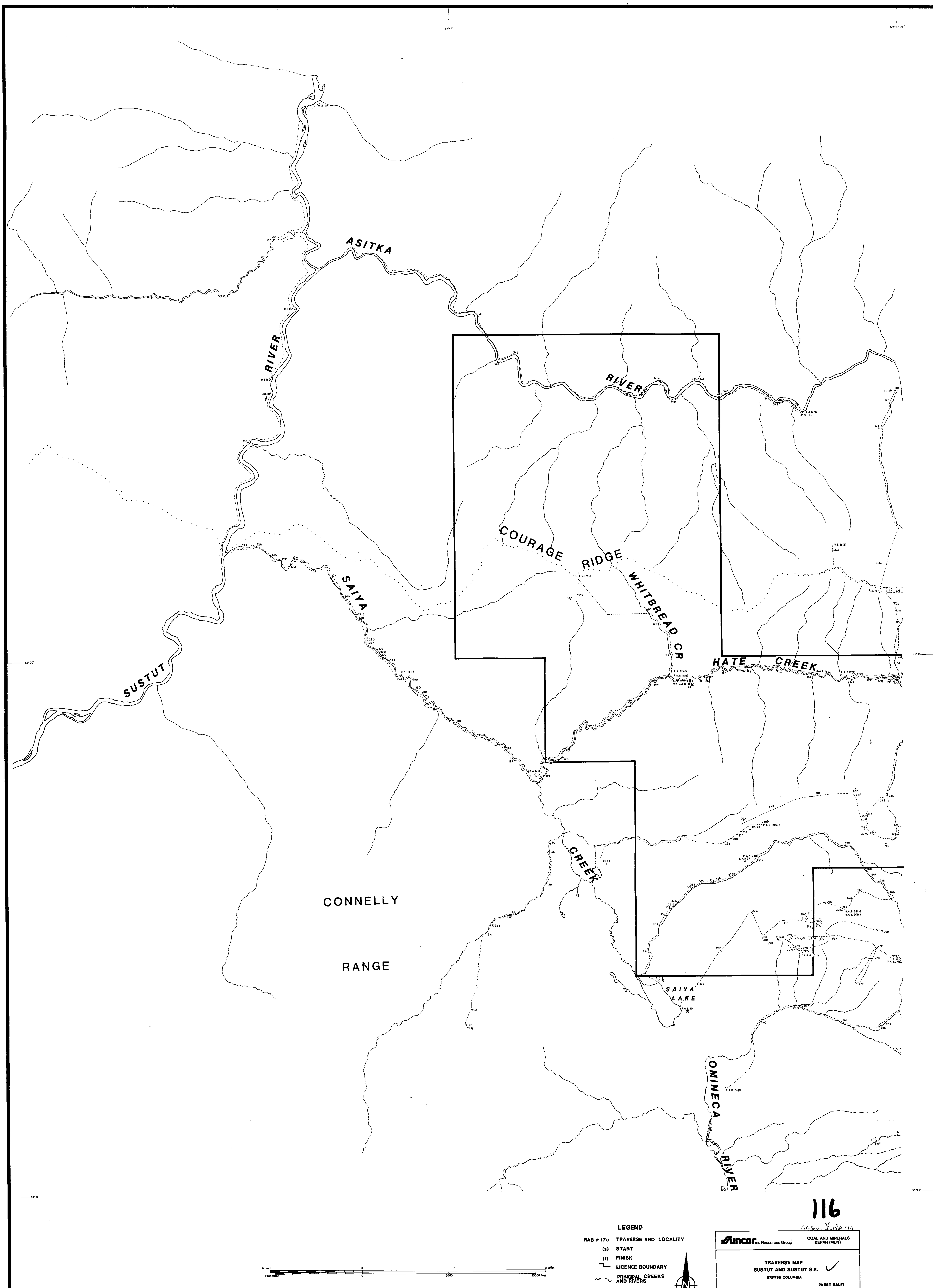
APPENDIX I

Traverse Maps of the Sustut and

Sustut S.E. Coal Properties



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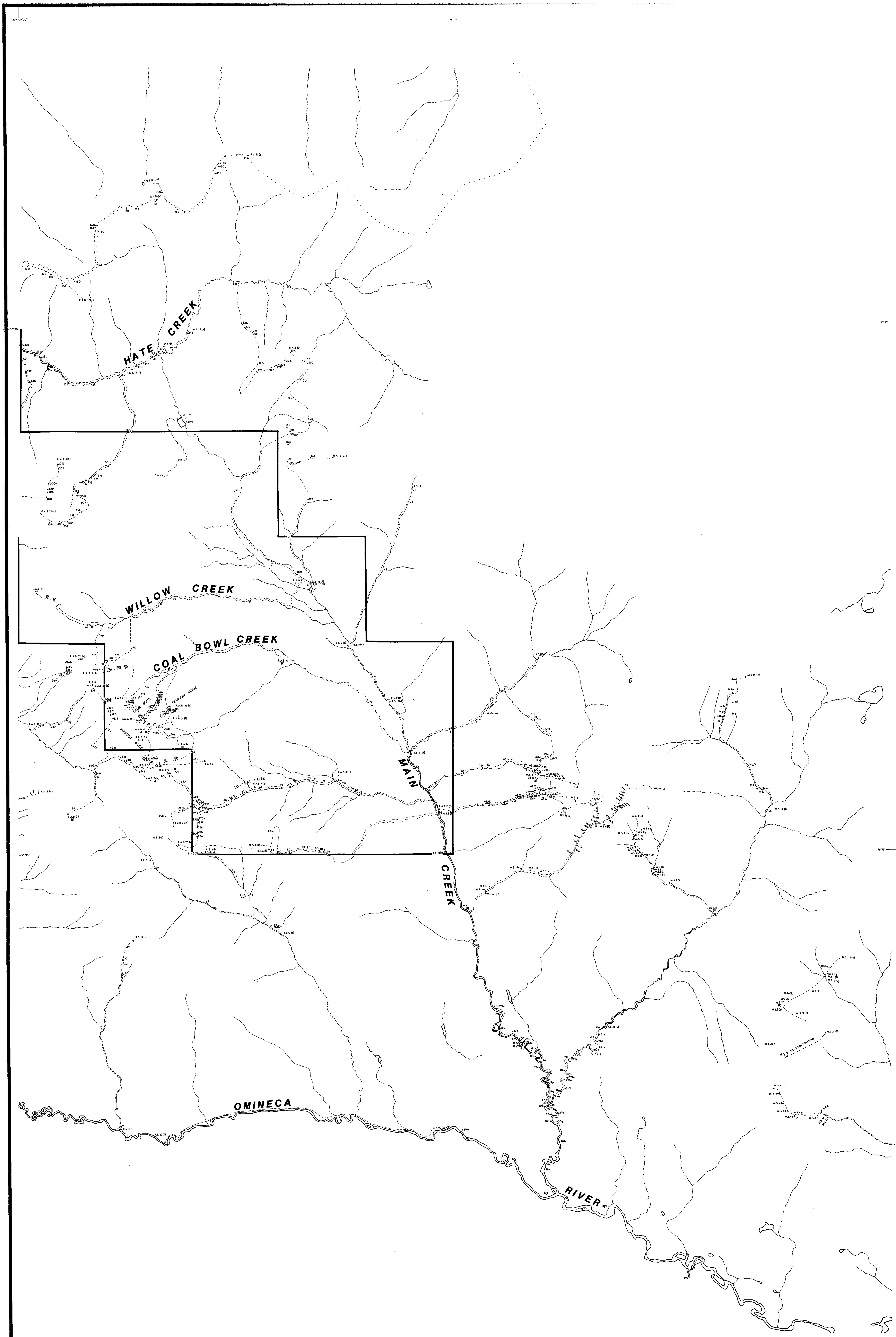
GR-Sustut S.E. 82(2)A *(1)

Suncor inc. Resources Group — COAL AND MINERALS DEPARTMENT

TRAVERSE MAP
SUSTUT AND SUSTUT S.E.
BRITISH COLUMBIA

(WEST HALF)

DATE	SCALE	N.T.S.	DRAWING No.
83-03-14	SEE SCALE BAR	94-D	82-250-A



GR-Sustut SE 82 (2)A *(1)

Suncor inc. Resources Group — COAL AND MINERALS DEPARTMENT

TRAVERSE MAP
SUSTUT AND SUSTUT S.E.
BRITISH COLUMBIA
(EAST HALF)

DATE	SCALE	N.T.S.	DRAWING No.
83-03-14	SEE SCALE BAR	94-D	82-250-B

116

APPENDIX II

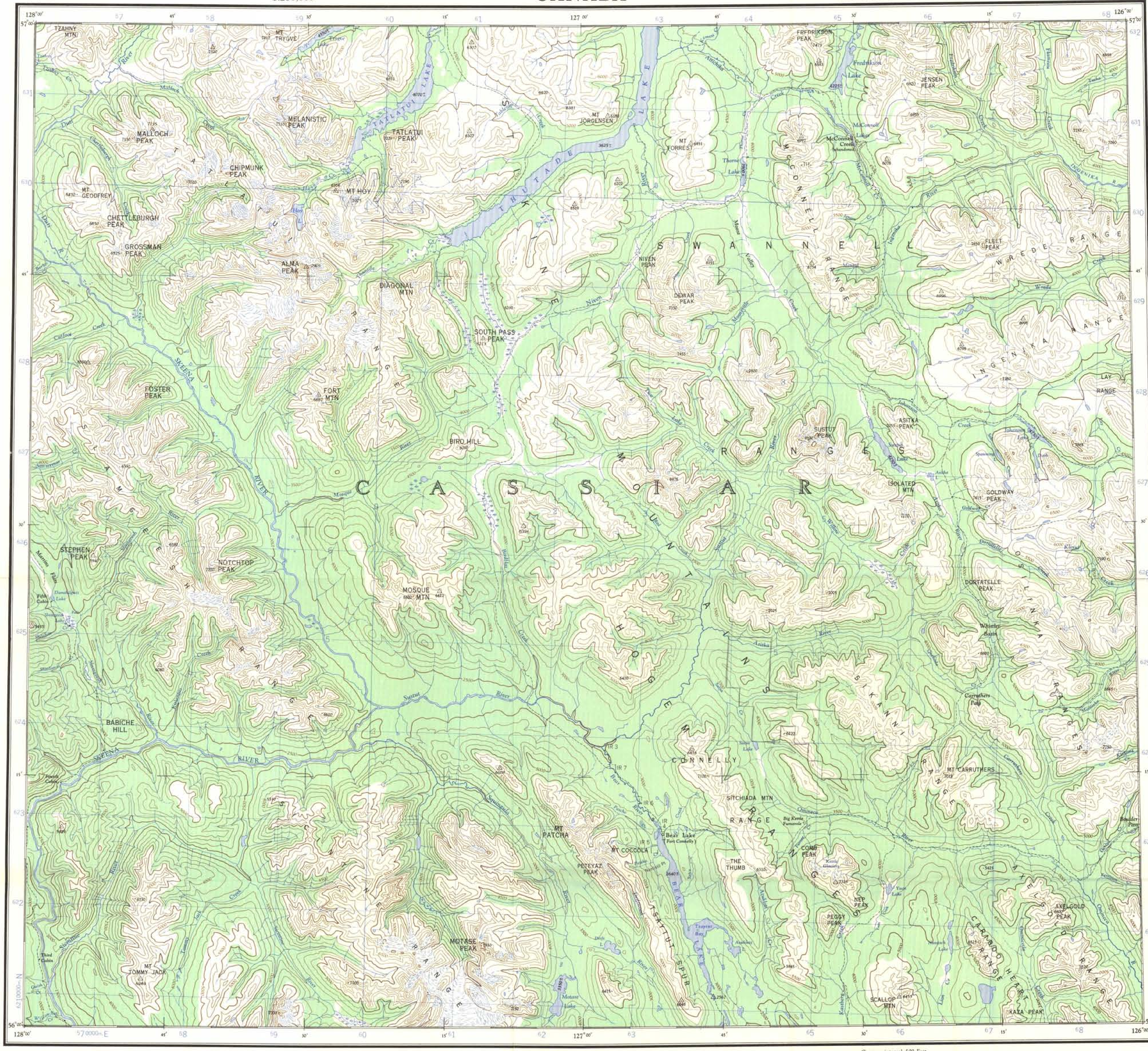
Geological Maps of the Sustut and

Sustut S.E. Coal Properties

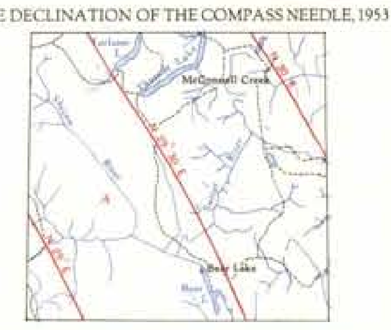
94 D | 1:250,000 | EDITION 3 | 94 D

CANADA

Military users, refer to this map as: Référence de la carte pour usage militaire:	SERIES	A 502	SÉRIE
	MAP	94 D	CARTE
	EDITION	3 MCE	ÉDITION



THE DECLINATION OF THE COMPASS NEEDLE, 1953



The declination of the compass needle at any place along a red line is the declination given on that red line. At other places the declination is between those given on the neighbouring red lines; thus at the place marked A, the declination is between N. 29° E. and N. 29° 30′ E. The easterly declinations of the compass needle are decreasing 4.5 minutes annually.

Base map by the Topographical Survey Dept. of Mines and Technical Surveys, 1941 Revised, drawn and printed by the Army Survey Establishment, R.C.E. 1952-53

Transverse Mercator Projection
North American Datum 1927
Preliminary 1952

McCONNELL CREEK
BRITISH COLUMBIA

Scale 1 : 250,000
1 Inch to 4 Miles Approximately

Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilometres

Contour interval 500 Feet
All Elevations in Feet above Mean Sea Level.

REFERENCE

- Road, Hard Surface, All Weather — More than 2 Lanes — Route No. 26 — 2 Lanes
- Loose Surface, All Weather — More than 2 Lanes — 2 Lanes
- Less than 2 Lanes — All Weather — Dry Weather
- Cart Track, Trail — Cart Track — Trail
- Railway, Multiple Track
- Single Track
- Boundary, International
- Province or State
- County or District
- Reservations, Indian, Military, etc.

REFERENCE

- Horizontal Control Point
- Spot Elevation, in feet .124
- Contours, Elevation 500 1000
- Depression 1000 500
- Approximate
- Glacier or Snowfield
- Forest, unclassified
- Swamp or Marsh
- Stream, Intermittent
- W.L.125
- Ferry
- Lighthouse
- Dam
- Falls
- Mud
- Sand
- Airfield, on Land — Water — Landing Ground — Anchorage
- Power Transmission Line

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GRID ZONE DESIGNATION	100,000 M. SQUARE IDENTIFICATION
9V	WP XP / WN XN (63, 6)

TO GIVE A REFERENCE TO NEAREST 1000 METRES

EXAMPLE: CABIN

SQUARE: Read letters of 100,000 m. square	XN
EASTING: Read number on grid line immediately to left of point. Estimate tenths of a square from this line eastward to point.	6 / 5 / 65
NORTHING: Read number on grid line immediately below point. Estimate tenths of a square from this line northward to point.	4 / 7 / 47
MILITARY GRID REFERENCE (to nearest 1,000 metres)	XN6547
If reporting beyond 18° in any direction, prefix Grid Zone Designation as	9VXN6547

TEN THOUSAND METRE
UNIVERSAL TRANSVERSE MERCATOR GRID
ZONE 9

GR- Sustut S.E. 82(1)A

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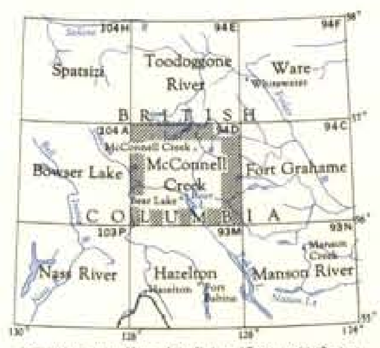

Index to adjoining Maps of the National Topographic System
Tableau d'assemblage du Système national de référence cartographique

McCONNELL CREEK
94 D
EDITION 3

82-251

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CANADIAN PATENT 1065729 1979
(RD) 1977

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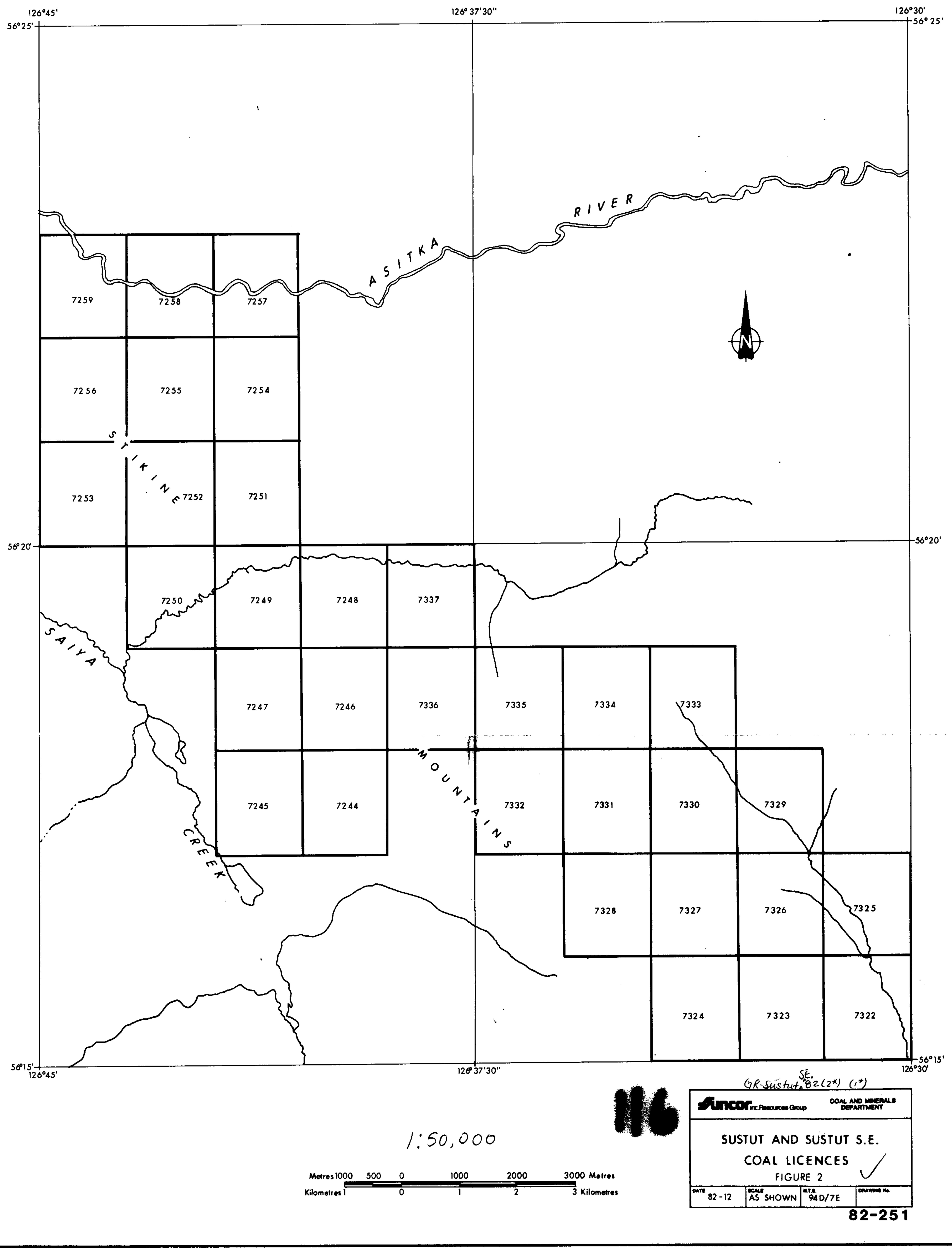

GR-Sustut SE. 82(2*) (1*)

Suncor Inc. Resources Group — COAL AND MINERALS DEPARTMENT

SUSTUT AND SUSTUT S.E.
COAL LICENCES
FIGURE 2

DATE	SCALE	N.T.S.	DRAWING No.
82-12	AS SHOWN	94D/7E	

82-251

10 PRINTS


GEOLOGICAL MAP OF THE
SUSTUT AND S.E. SUSTUT COAL
LICENCES
(EAST HALF)
LEGEND
RECENT AND QUATERNARY
GLACIAL AND FLUVIAL DEPOSITS
UPPER TERTIARY AND QUATERNARY
BASALT,LAHAR,BRECCIA,PLUGS,DYKES
UPPER CRETACEOUS TO EOCENE
SUSTUT GROUP
TANGO CREEK FORMATION : CONGLOMERATE,SANDSTONE
SHALES,MINOR COAL
UPPER JURASSIC / LOWER CRETACEOUS
UPPER BOWSER LAKE GROUP
VOLCANICS : BRECCIA,ANDESITE
COAL BEARING,SANDSTONE,
SILTSTONE,MUDSTONE
MIDDLE JURASSIC
LOWER BOWSER LAKE GROUP
ASHMAN FORMATION : SILTSTONE
LOWER AND MIDDLE JURASSIC
HAZELTON GROUP
SMITHERS FORMATION : SILTSTONE,SANDSTONE,LIMESTONE
TELKWA FORMATION :
CALCALKALINE BASALT,ANDESITE,DACITE
UPPER TRIASSIC
TELKWA GROUP
DEWAR FORMATION : BASALTS,BRECCIA,ANDESITE
MAP SYMBOLS
THRUST FAULT
FAULT
FORMATION BOUNDARY DEFINED
FORMATION BOUNDARY ASSUMED
ANTICLINE,SYNCLINE
BEDDING :
STRIKE AND DEGREE
OF DIP
DYKE
N
HATE CREEK
WILLOW CREEK
COAL BOWL CREEK
HARP SYNCLINE
MAIN CREEK FAULT
MAIN CREEK
CARUTHERS FAULT
OMINECA RIVER
1:19230
116
GR. Sustut SE 82 (2*)A *(1)
Suncor inc. Resources Group
COAL AND MINERALS
DEPARTMENT
GEOLOGICAL MAP OF THE SUSTUT
AND SUSTUT S.E. COAL LICENCES
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82-246


ASTIKA
ASITKA FAULT
RIVER
RIVER
SAIYA
SUSTUT
WATNEY FAULT
COURAGE RIDGE
BASS FAULT
WHITBREAD CR
HATE CREEK
VAUX SYNCLINE
CREEK
CONNELY
RANGE
SAIYA LAKE
SAIYA FAULT
OMINECA RIVER
GEOLOGICAL MAP OF THE SUSTUT AND S.E. SUSTUT COAL LICENCES
(WEST HALF)
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GLACIAL AND FLUVIAL DEPOSITS
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UPPER TRIASSIC
TELKWA GROUP
DEWAR FORMATION : BASALTS,BRECCIA,ANDESITE
MAP SYMBOLS
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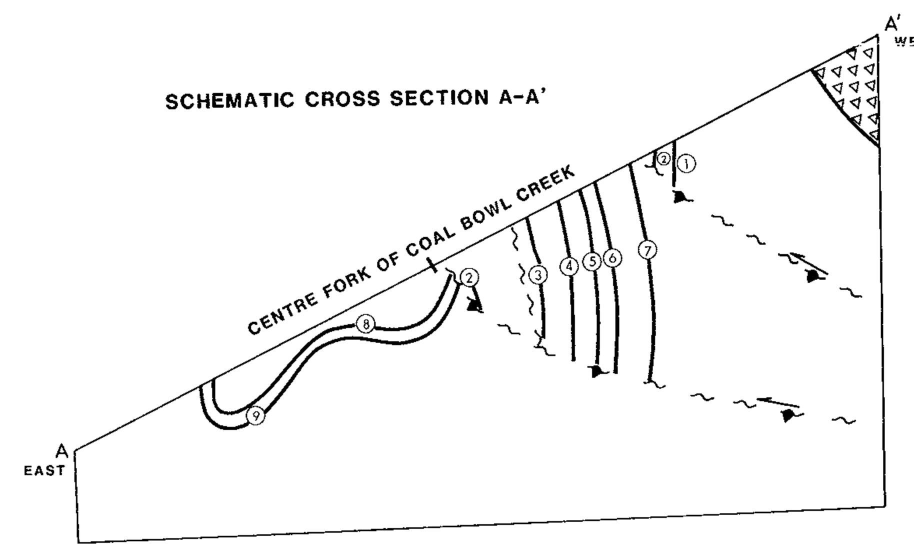
FAULT
FORMATION BOUNDARY DEFINED
FORMATION BOUNDARY ASSUMED
ANTICLINE,SYNCLINE
BEDDING
STRIKE AND DEGREE OF DIP
DYKE
1:19230
Miles 1
Feet 5000
10000 Feet
Meters 1000
1000
2000
3000 Meters
116
GR-Sustut S.E. 82(2*)A *(1)
Suncor inc Resources Group
COAL AND MINERALS DEPARTMENT
GEOLOGICAL MAP OF THE SUSTUT AND SUSTUT S.E. COAL LICENCES
WEST HALF
DATE
NOV. 82
SCALE
SEE SCALE BAR
N.T.S.
94 D
DRAWING No.
94 D 82-247
94 D 82-247

APPENDIX III

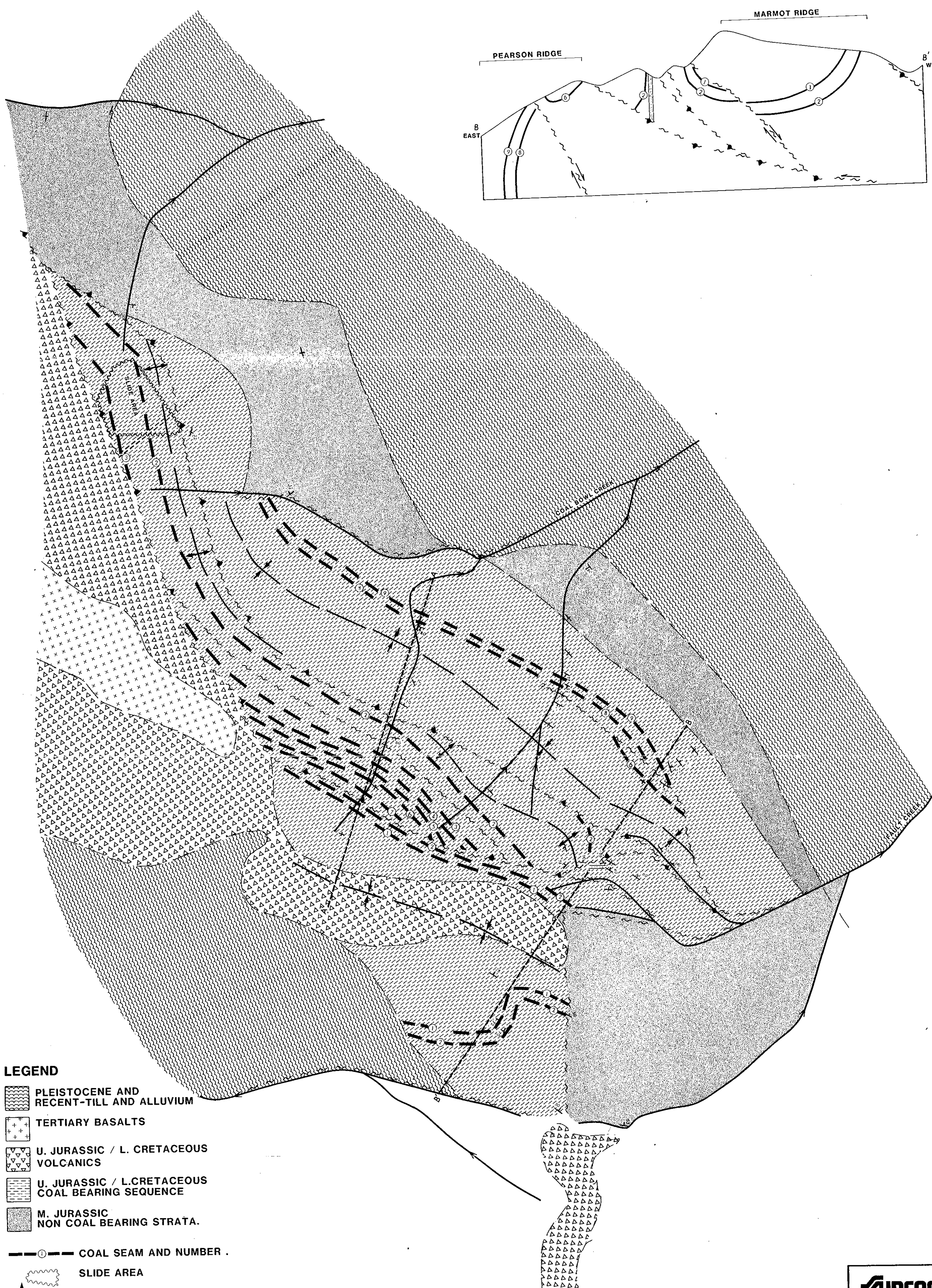
Detailed Geological Map and Cross Sections

of the Coal Bowl Area

SCHEMATIC CROSS SECTION A-A′



SCHEMATIC CROSS SECTION B-B′



LEGEND

- PLEISTOCENE AND RECENT-TILL AND ALLUVIUM
- TERTIARY BASALTS
- U. JURASSIC / L. CRETACEOUS VOLCANICS
- U. JURASSIC / L.CRETACEOUS COAL BEARING SEQUENCE
- M. JURASSIC NON COAL BEARING STRATA.
- COAL SEAM AND NUMBER .
- SLIDE AREA
- ANTICLINAL AXIS
- SYNCLINAL AXIS
- THRUST FAULT
- FAULT
- GEOLOGICAL BOUNDARY
- DYKE
- DIP AND STRIKE
- CREEK

1:5000

0 500
METRES
SCALE 1:5,000

116

Suncor Inc. Resources Group
COAL AND MINERALS DEPARTMENT

GEOLOGICAL MAP OF THE COAL BOWL AREA SUSTUT S.E.

DATE	SCALE	N.T.S.	DRAWING No.

82-249

APPENDIX IV

Trench Descriptions

TRENCH DESCRIPTIONS
Sustut and Sustut S.E.
Coal Licences

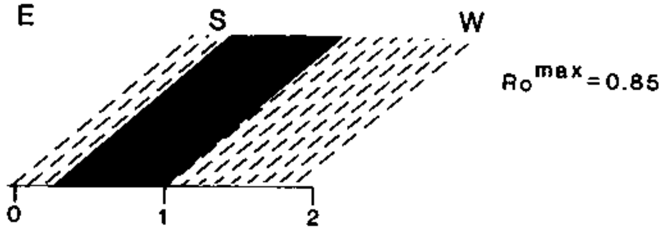
SCALE
1:50
(Metres)

0 1 2 3 4 5

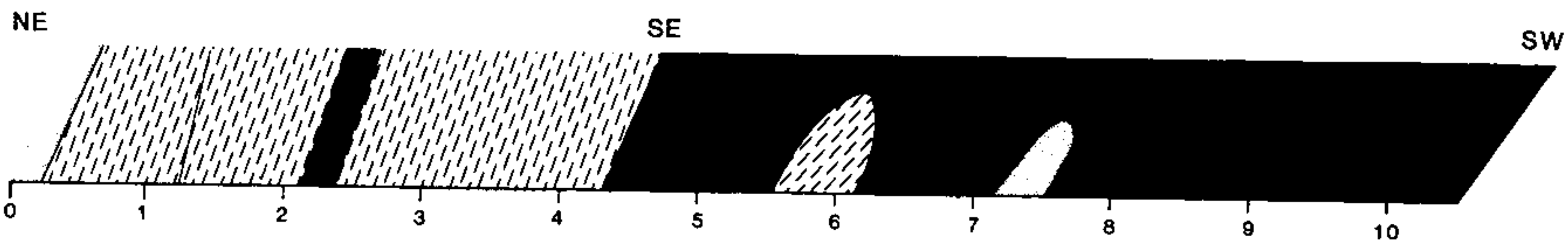
LEGEND

- COVER
- COAL
- CLAY
- SHALE
- MUDSTONE
- SHALE WITH COAL STRINGERS
- MUDSTONE WITH COAL STRINGERS
- SILTSTONE
- SANDSTONE

McEWAN #1
TRENCH MSX-11

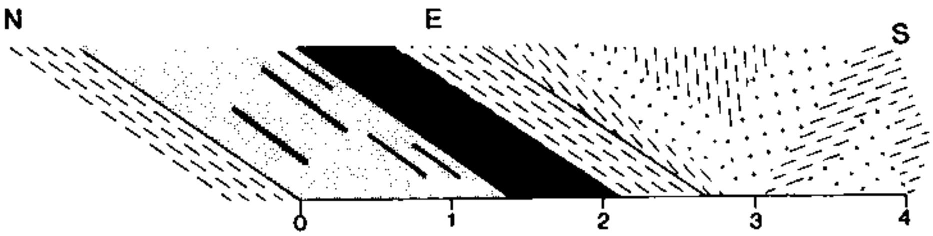


MacKESON SEAM
TRENCH#4,RS#5



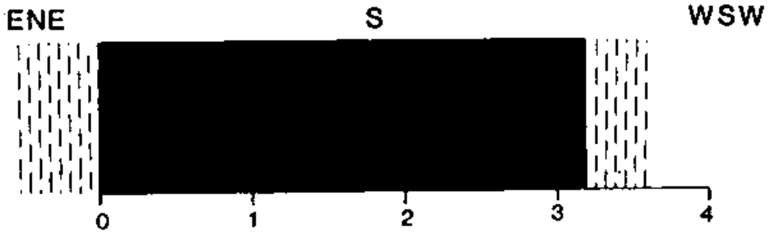
TRENCH #3OD
Stone Seam

Ro^{max} = 0.72

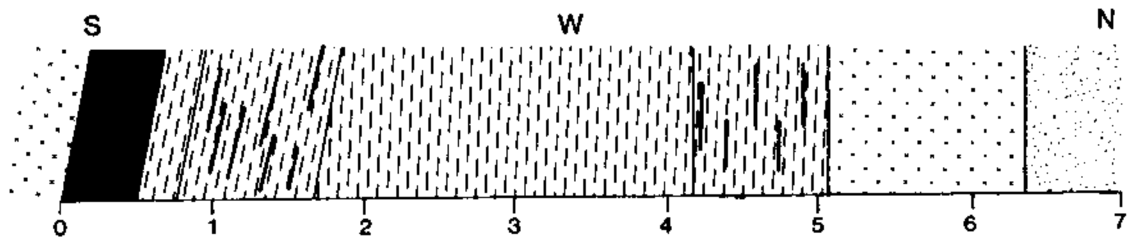


TRENCH #36F
Main #6

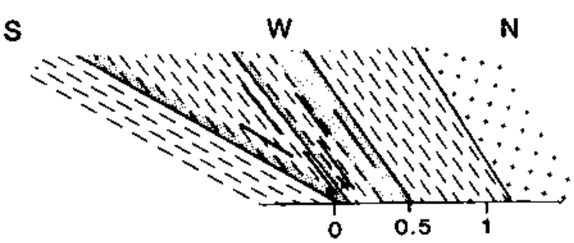
Ro^{max} = 1.18



TRENCH #1D
Main #2

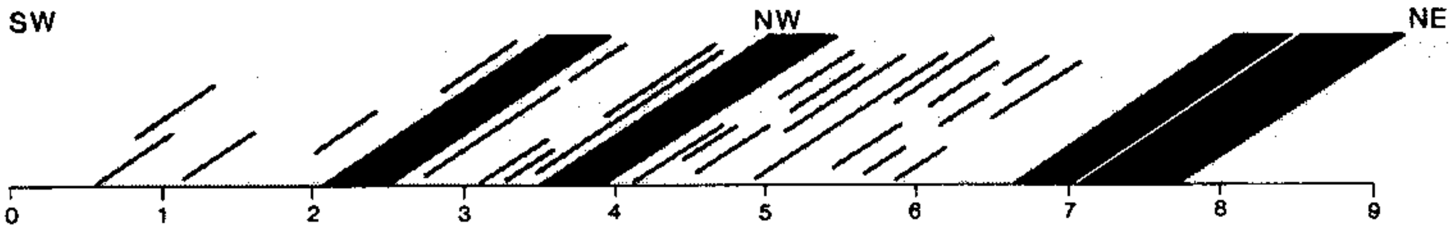


TRENCH #1C
Main #1

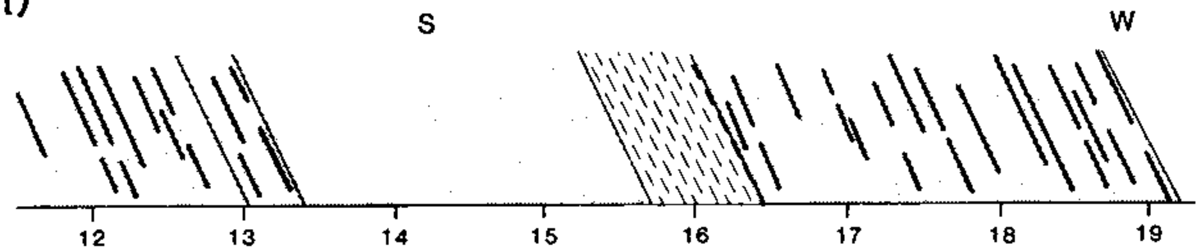


Ro^{max}=1.02

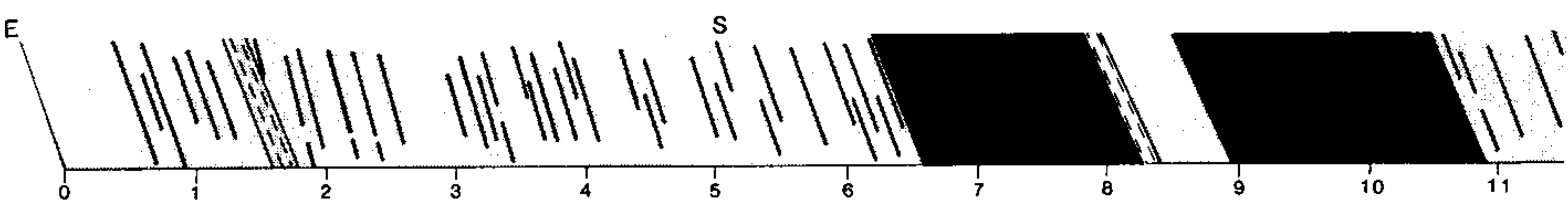
TRENCH #2AC
Main #2



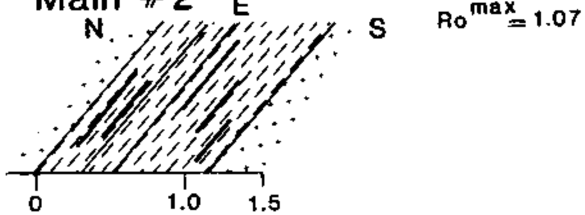
TRENCH #2AA
(con't)



TRENCH #2AA
Main #2

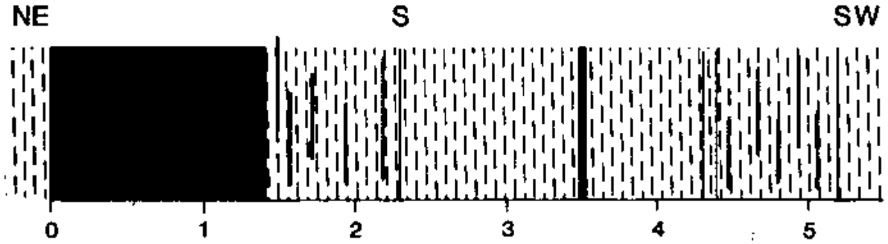


TRENCH #2Ab
Main #2

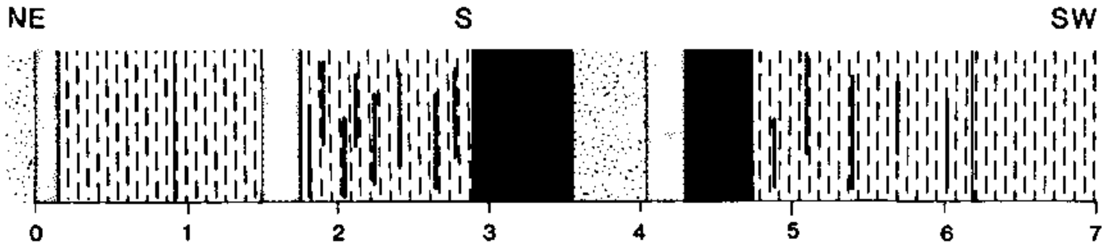


TRENCH #11E
Main #4

$Ro^{max}=1.18$

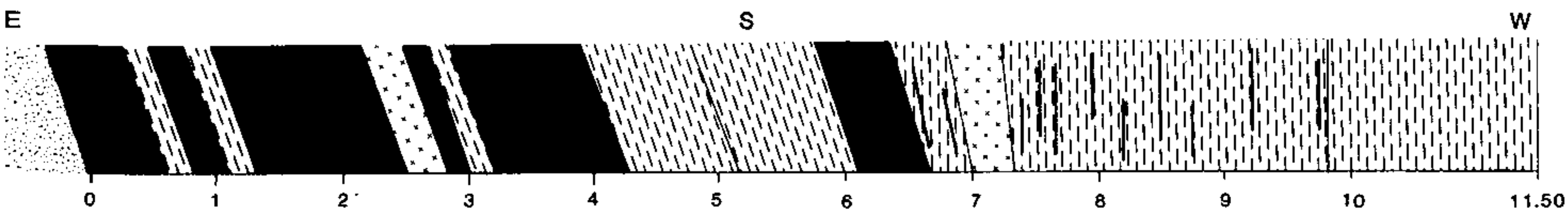


TRENCH #11D
Main #3



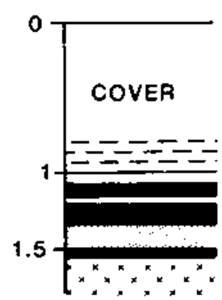
TRENCH #11C
Main #3

$Ro^{max}=1.20$



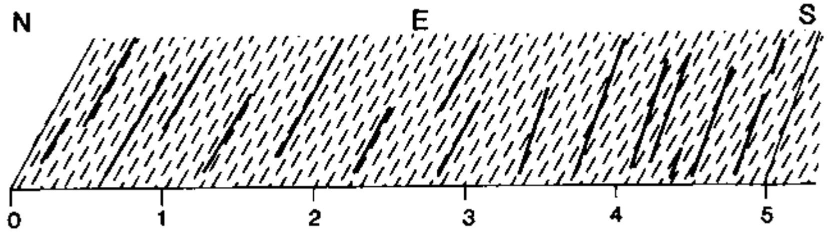
TRENCH #11A
Main #1

$Ro^{max}=1.01$



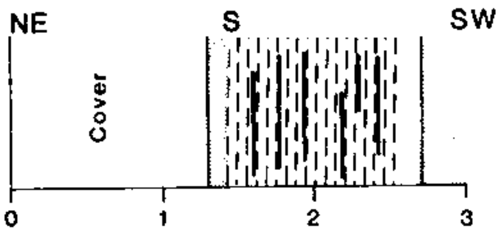
TRENCH #12D
Main #5

$Ro^{max} = 1.21$



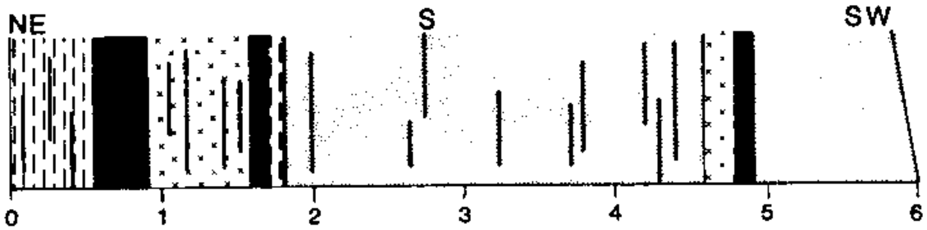
TRENCH #12C
Main #6

$Ro^{max} = 1.18$



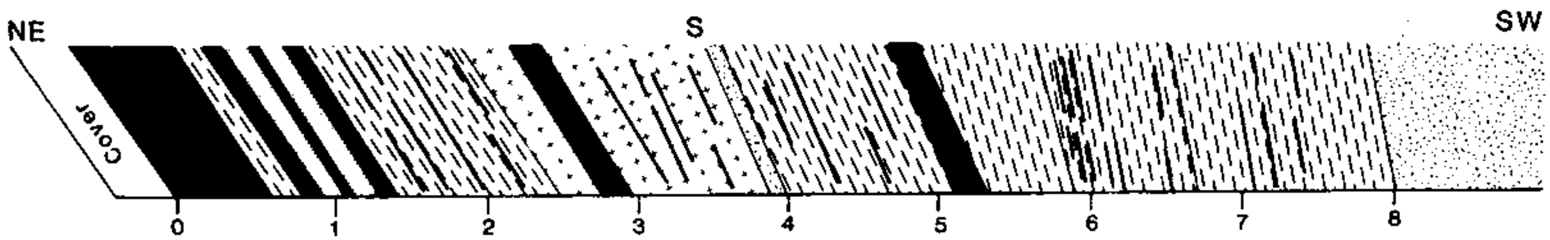
TRENCH #12B
Main #7

$Ro^{max} = 1.23$



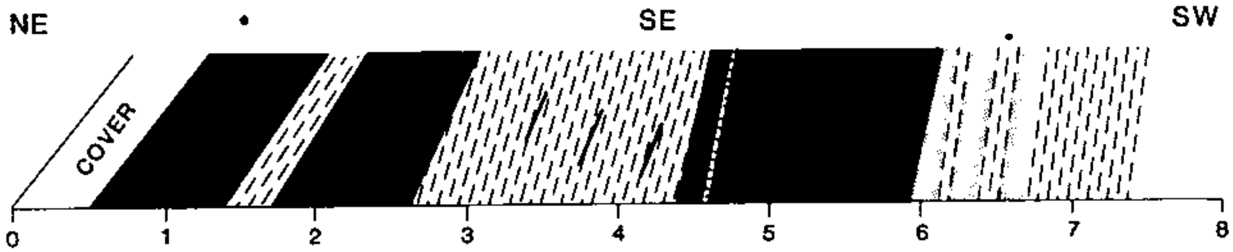
TRENCH #12A
Main #2

$Ro^{max} = 1.05$



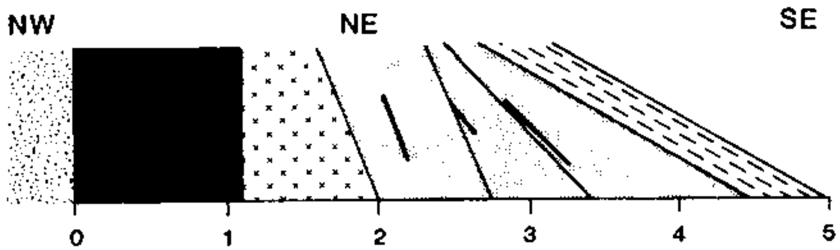
TRENCH #12H
Main #3

$Ro^{max}=1.23$



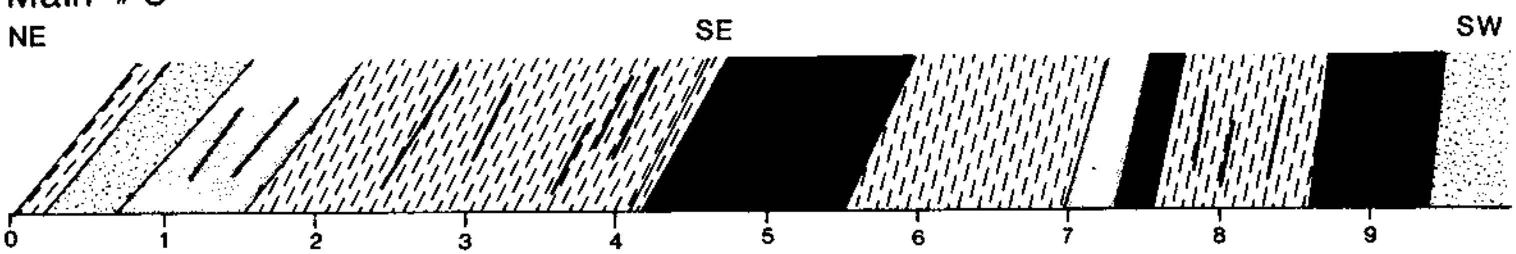
TRENCH #12G
Main #2

$Ro^{max}=1.07$



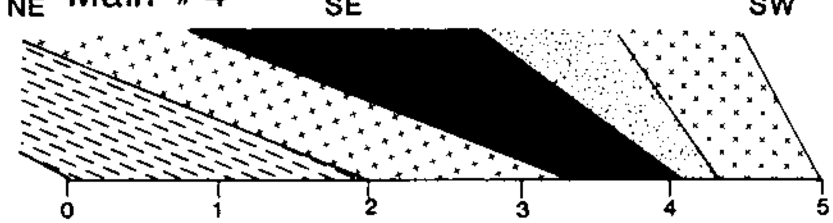
TRENCH #12F
Main #3

$Ro^{max}=1.19$

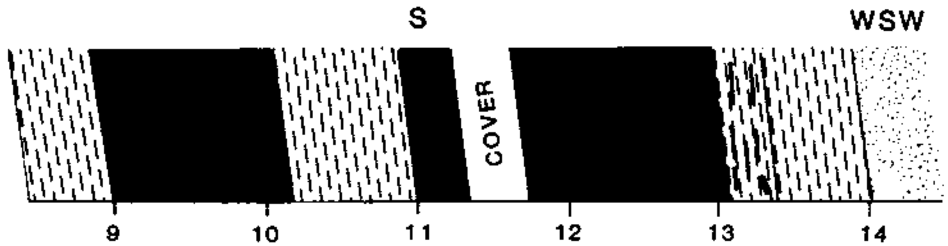


TRENCH #12E
Main #4

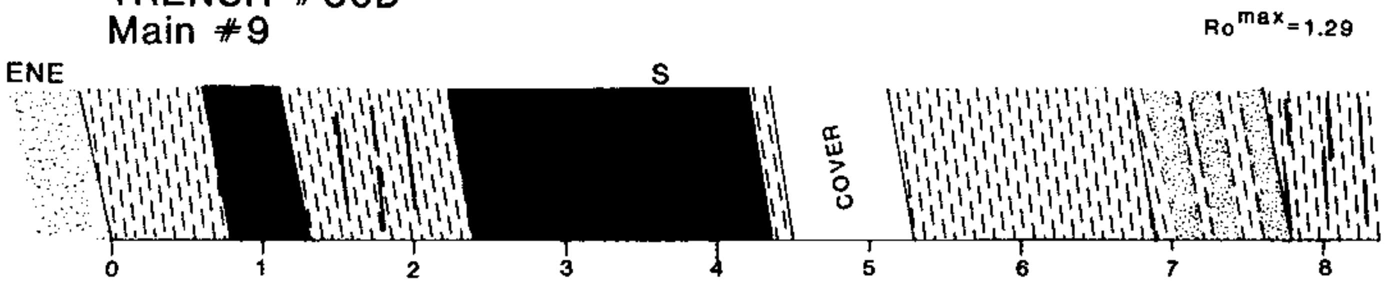
$Ro^{max}= 1.23$



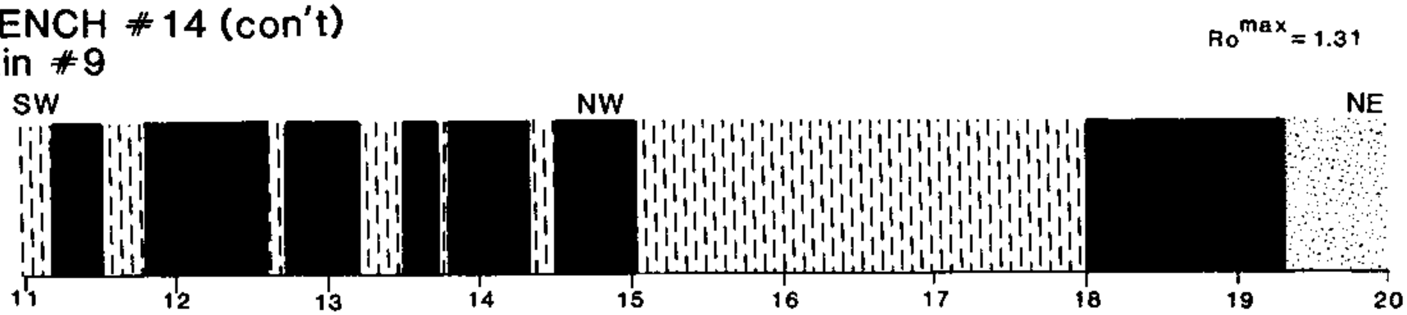
TRENCH #36D
(con't)



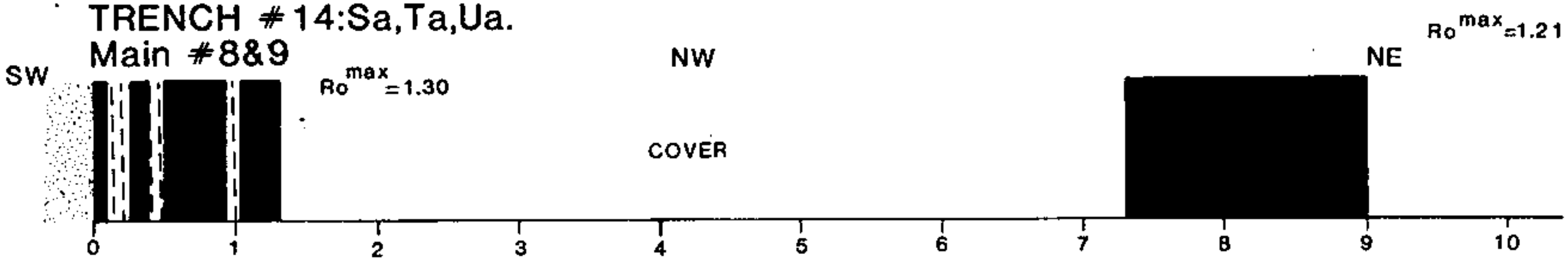
TRENCH #36D
Main #9



TRENCH #14 (con't)
Main #9



TRENCH #14:Sa,Ta,Ua.
Main #8&9

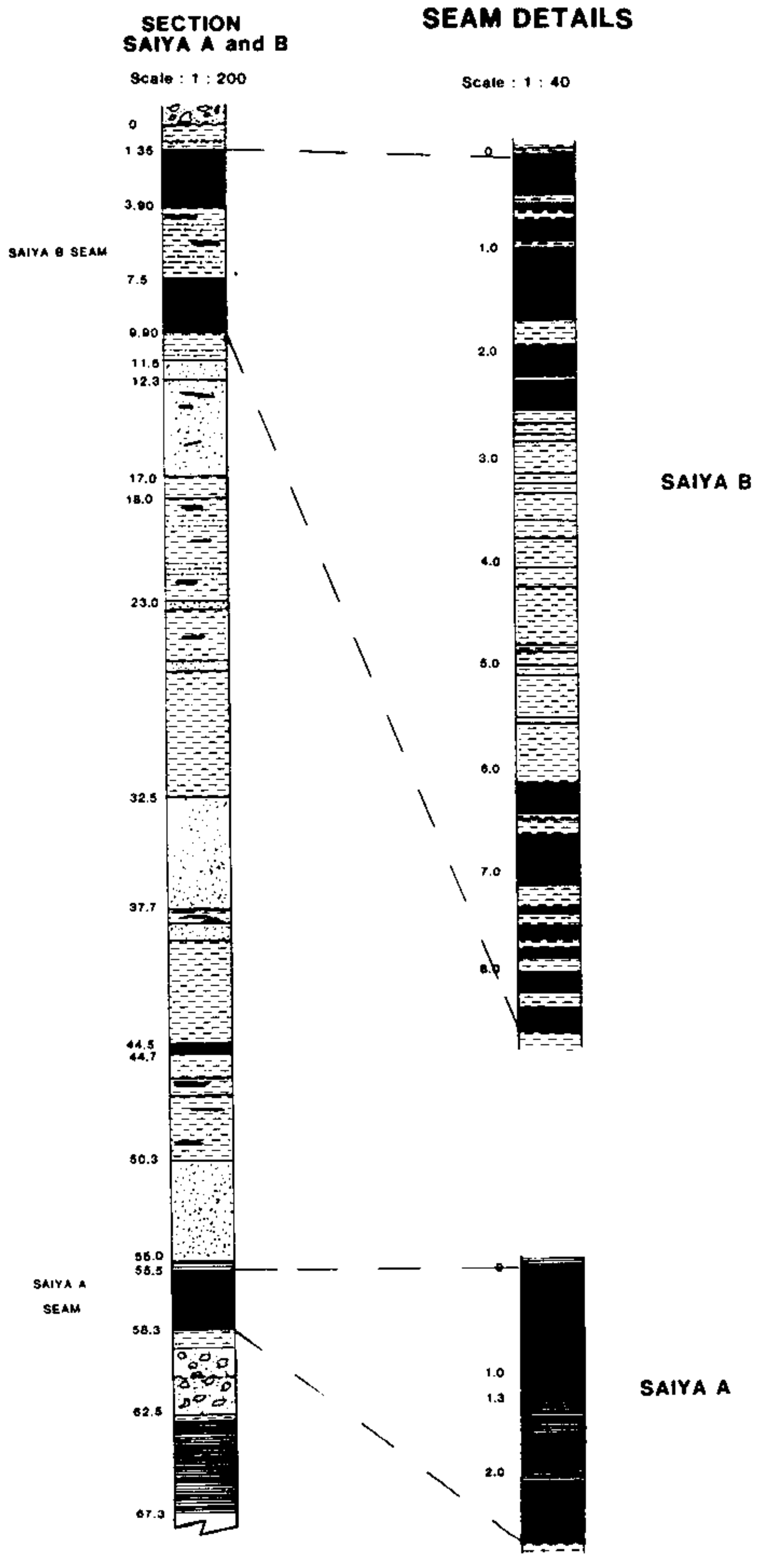


APPENDIX V

Stratigraphic Section through Saiya A and B

Coal Seams

DETAILED SECTION OF SAIYA A and B COAL SEAMS



APPENDIX VII

Proximate Analysis Results

SUNCOR INC.

ATTN: J Davies

LORING LABORATORIES LTD

P.O.# 40-82-170

Page # 7

CERTIFICATE of COAL TESTING

FILE NO. 24017

DATE October 20, 1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	FLOAT		REC'D % H_2O	% H_2O	% VOL MATTER	% ASH	% FIXED CARBON	% S	BTU /LB	%RO	%MM D.B.	%DMMF V.M.	%DMMF F.C.	RANK
S 5	Main No. 3	Raw Coal			As Received	5.65	----	14.57	48.48	31.30	.27	5849	1.20	56.45	35.48	76.17	M.V.
					Air Dried	-----	1.79	15.17	50.46	32.58	.28	6088					
					Dry Basis	-----	----	15.45	51.38	33.17	.29	6199					
S 6	Main No. 1	Raw Coal			As Received	11.84	----	18.93	34.98	34.25	.34	6505	1.01	43.06	37.67	68.18	H.V.A.
					Air Dried	-----	2.33	20.97	38.75	37.95	.38	7207					
					Dry Basis	-----	----	21.47	39.67	38.86	.39	7379					
S 7	Main No. 4	Raw Coal			As Received	19.16	----	20.21	19.24	41.39	.37	7785	1.18	25.96	33.78	69.19	M.V.
					Air Dried	-----	3.36	24.16	23.00	49.48	.44	9307					
					Dry Basis	-----	----	25.00	23.80	51.20	.46	9630					
S 9	Main No. 6	Raw Coal			As Received	3.50	----	16.81	35.98	43.71	.68	8456	1.18	40.65	29.53	77.46	M.V.
					Air Dried	-----	1.54	17.15	36.71	44.60	.69	8628					
					Dry Basis	-----	----	17.42	37.28	45.30	.70	8763					
S 10	Main No. 3	Raw Coal			As Received	19.79	----	18.17	26.68	35.36	.27	6968	1.23	36.11	35.39	68.89	M.V.
					Air Dried	-----	2.60	22.06	32.40	42.94	.33	8461					
					Dry Basis	-----	----	22.65	33.26	44.09	.34	8686					
S 11	Main No. 2	Raw Coal			As Received	7.16	----	18.66	29.79	44.39	.34	8307	1.09	34.85	30.92	73.57	H.V.A.
					Air Dried	-----	2.04	19.69	31.43	46.84	.36	8765					
					Dry Basis	-----	----	20.10	32.08	47.82	.37	8948					
S 12	Main No. 2	Raw Coal			As Received	14.12	----	19.73	22.20	43.95	.34	8259	1.11	28.14	31.92	71.06	MV/HVA
					Air Dried	-----	2.65	22.37	25.17	49.81	.38	9362					
					Dry Basis	-----	----	22.98	25.86	51.16	.39	9617					

SUNCOR INC.

ATTN: J Davies

LORING LABORATORIES LTD

P.O. # 40-82-170

Page # 8

CERTIFICATE of COAL TESTING

FILE NO.: 24017

DATE: October 20, 1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU /LB.	ZRO	%MM D.B.	%DMMF V.M.	%DMMF F.C.	RANK
S 13	Main No. 8	Raw Coal			As Received	12.08	----	15.86	33.17	38.89	.35	7786	1.30	40.96	30.58	75.00	M.V.
					Air Dried	-----	1.04	17.85	37.34	43.77	.39	8764					
					Dry Basis	-----	----	18.04	37.73	44.23	.39	8856					
S 14	Unknown Main Seam	Raw Coal			As Received	2.21	----	20.30	34.52	42.97	.42	8977	1.21	38.36	33.48	70.87	M.V.
					Air Dried	-----	0.67	20.62	35.06	43.65	.43	9118					
					Dry Basis	-----	----	20.76	35.30	43.94	.43	9179					
S 15	Main No. 9	Raw Coal			As Received	3.19	----	18.85	26.06	51.90	.42	10489	1.21	29.31	27.42	75.51	M.V.
					Air Dried	-----	.66	19.34	26.74	53.26	.43	10763					
					Dry Basis	-----	----	19.47	26.92	53.61	.43	10834					
S 16	Mackeson Seam	Raw Coal			As Received	2.21	----	15.43	25.89	56.47	.43	10538	1.47	28.84	22.23	81.32	L.V.
					Air Dried	-----	.83	15.65	26.26	57.26	.44	10687					
					Dry Basis	-----	----	15.78	26.48	57.74	.44	10776					
S 18	Sustut Coal	Raw Coal			As Received	6.11	----	34.31	11.08	48.50	.49	11618	0.75	13.03	42.00	59.38	H.V.B.
					Air Dried	-----	1.83	35.87	11.58	50.72	.51	12148					
					Dry Basis	-----	----	36.54	11.80	51.66	.52	12374					
S 19	McEwan Coal	Raw Coal			As Received	7.76	----	22.55	36.74	32.95	.55	7244	0.83	43.34	42.90	62.67	H.V.A.
					Air Dried	-----	2.17	23.92	38.97	34.94	.58	7683					
					Dry Basis	-----	----	24.45	39.83	35.72	.59	7854					
S 20	McEwan Coal	Raw Coal			As Received	7.13	----	20.10	33.54	39.23	.61	8072	0.73	39.37	35.48	69.25	H.V.B.
					Air Dried	-----	1.80	21.25	35.47	41.48	.65	8535					
					Dry Basis	-----	----	21.64	36.12	42.24	.66	8691					

SUNCOR INC.

ATTN: J Davies

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P.O. # 40-82-170

CERTIFICATE of COAL TESTING

Page # 9

FILE NO. 24017

DATE: October 20, 1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU / LB.	%RO	%MM D.B.	%DMMF V.M.	%DMMF F.C.	RANK
S 21	McEwan Coal	Raw Coal			As Received	3.60	----	23.29	37.07	36.04	.43	8090	0.80	41.78	40.95	63.36	HVA/B
					Air Dried	-----	1.74	23.74	37.79	36.73	.44	8246					
					Dry Basis	-----	----	24.16	38.46	37.38	.45	8392					
S 22	McEwan Coal	Raw Coal			As Received	3.10	----	19.16	50.09	27.65	.51	6060	0.82	56.13	44.93	64.84	H.V.A
					Air Dried	-----	1.31	19.51	51.02	28.16	.52	6172					
					Dry Basis	-----	----	19.77	51.70	28.53	.53	6254					
S 23	McEwan Coal	Raw Coal			As Received	3.17	----	25.14	24.12	47.57	.29	10504	0.85	27.07	35.56	67.30	H.V.A
					Air Dried	-----	1.38	25.60	24.57	48.45	.30	10698					
					Dry Basis	-----	----	25.96	24.91	49.13	.30	10847					
S 24	McEwan Coal	Raw Coal			As Received	6.67	----	19.75	43.33	30.25	.30	6729	0.91	50.32	42.32	64.84	H.V.A
					Air Dried	-----	1.86	20.77	45.56	31.81	.32	7076					
					Dry Basis	-----	----	21.16	46.42	32.42	.33	7210					
S 25	McEwan No. 1	Raw Coal			As Received	3.28	----	22.20	41.58	32.94	.42	7762	0.85	46.67	43.32	64.25	H.V.A
					Air Dried	-----	1.21	22.68	42.47	33.64	.43	7928					
					Dry Basis	-----	----	22.96	42.99	34.05	.44	8025					
S 26	Main No. 7	Raw Coal			As Received	14.77	----	14.99	46.30	23.94	.21	4596	1.23	58.80	42.90	68.51	M.V.
					Air Dried	-----	5.07	16.70	51.57	26.66	.23	5119					
					Dry Basis	-----	----	17.59	54.32	28.09	.24	5393					
S 27	Main No. 5	Raw Coal			As Received	18.15	----	16.29	39.75	25.81	.21	5027	1.21	52.60	42.34	67.09	M.V.
					Air Dried	-----	3.62	19.18	46.81	30.39	.25	5919					
					Dry Basis	-----	----	19.90	48.57	31.53	.26	6141					

SUNCOR INC.

ATTN: J Davies

LORING LABORATORIES LTD

P.O. # 40-82-170

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CERTIFICATE of COAL TESTING

FILE NO. 24017

DATE October 20, 1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU /LB.	%RO	%MM D.B.	%DMMF V.M.	%DMMF F.C.	RANK
S 28	Main No. 4	Raw Coal			As Received	21.09	----	20.46	19.66	38.79	.31	7500	1.23	27.12	35.52	67.34	M.V.
					Air Dried	-----	4.69	24.71	23.74	46.86	.38	9059					
					Dry Basis	-----	----	25.93	24.91	49.16	.40	9505					
S 29	Main No. 3	Raw Coal			As Received	15.39	----	15.30	45.95	23.36	.22	4476	1.19	58.79	44.10	67.34	M.V.
					Air Dried	-----	5.72	17.05	51.20	26.03	.24	4988					
					Dry Basis	-----	----	18.08	54.31	27.61	.25	5291					
S 30	Main No. 2	Raw Coal			As Received	14.80	----	15.01	41.68	28.51	.19	5272	1.07	52.96	37.49	71.19	H.V.A
					Air Dried	-----	3.06	17.08	47.42	32.44	.22	5998					
					Dry Basis	-----	----	17.62	48.92	33.46	.23	6187					
S 32	Main No. 1	Raw Coal			As Received	14.96	----	19.04	39.64	26.36	.15	5031	0.99	50.44	45.06	62.43	H.V.A
					Air Dried	-----	4.98	21.27	44.29	29.46	.17	5621					
					Dry Basis	-----	----	22.38	46.61	31.01	.18	5916					
S 33	Main No. 2(?)	Raw Coal			As Received	17.70	----	17.83	38.63	25.84	.24	4792	1.08	50.86	44.24	64.08	H.V.A
					Air Dried	-----	5.46	20.48	44.38	29.68	.28	5505					
					Dry Basis	-----	----	21.66	46.94	31.40	.30	5823					
S 34	Main No. 2 (?)	Raw Coal			As Received	12.31	----	17.74	49.29	20.66	.17	3906	1.11	60.82	51.87	60.41	H.V.A
					Air Dried	-----	3.76	19.47	54.10	22.67	.19	4287					
					Dry Basis	-----	----	20.23	56.21	23.56	.20	4454					
S 37	Saiya B	Raw Coal			As Received	9.70	----	23.20	24.76	42.34	.47	8515	0.86	29.90	36.70	66.99	H.V.A
					Air Dried	-----	3.11	24.89	26.57	45.43	.50	9136					
					Dry Basis	-----	----	25.69	27.42	46.89	.52	9429					

SUNCOR INC.

ATTN: J. Davies

LORING LABORATORIES LTD

CERTIFICATE of COAL TESTING

P.O. # 40-82-170

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FILE NO. 23017

DATE: October 20, 1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU /LB.	Ro%	%mm db	dmmf V.M.	dmmf F.C.	Rank
S 38	Saiya B	Raw Coal			As Received	18.30	----	21.34	34.95	25.41	.29	5308					
					Air Dried	-----	4.64	24.91	40.79	29.66	.34	6195					
					Dry Basis	-----	----	26.12	42.77	31.11	.36	6497	0.61	46.39	48.37	57.61	Sub Bit
S 39	Saiya B	Raw Coal			As Received	18.87	----	22.56	30.51	28.06	.36	5773					
					Air Dried	-----	6.39	26.03	35.20	32.38	.41	6661					
					Dry Basis	-----	----	27.81	37.60	34.59	.44	7116	0.63	40.85	47.14	58.63	Sub Bit
S 40	McEwan Coal	Raw Coal			As Received	10.68	----	27.21	17.96	44.15	.43	10007					
					Air Dried	-----	2.00	29.85	19.70	48.45	.47	10980					
					Dry Basis	-----	----	30.46	20.10	49.44	.48	11204	0.67	21.97	39.05	63.39	HVB
S 41	Main No 2	Raw Coal			As Received	5.57	----	18.21	26.30	49.92	.37	9354					
					Air Dried	-----	1.83	18.93	27.34	51.90	.38	9724					
					Dry Basis	-----	----	19.28	27.85	52.87	.39	9906	1.07	30.29	27.54	75.53	HVA
S 42	Main No 2	Raw Coal			As Received	12.64	----	21.38	22.37	43.61	.38	8489					
					Air Dried	-----	3.22	23.68	24.78	48.32	.42	9404					
					Dry Basis	-----	----	24.47	25.60	49.93	.43	9717	1.13	27.89	33.99	69.35	MV
S 43	Main No 1	Raw Coal			As Received	14.19	----	19.27	28.15	38.39	.27	7274					
					Air Dried	-----	3.52	21.67	31.65	43.16	.30	8178					
					Dry Basis	-----	----	22.46	32.80	44.74	.31	8476	1.02	35.80	35.09	69.91	HVA
S 46	Stone Seam	Raw Coal			As Received	9.46	----	25.55	14.59	50.40	.37	10019					
					Air Dried	-----	3.59	27.21	15.54	53.66	.38	10669					
					Dry Basis	-----	----	28.22	16.12	55.66	.39	11066	0.77	17.62	34.42	67.88	HVB

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CERTIFICATE of COAL TESTING

FILE NO. 24017

DATE October 20, 1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU / LB.	% Ro	%mm db	dmmf V.M.	dmmf F.C.	Rank
S 47	New Seam	Raw Coal			As Received	4.27	----	18.21	54.19	23.33	.22	5766					
					Air Dried	-----	1.87	18.67	55.55	23.91	.23	5911					
					Dry Basis	-----	----	19.03	56.61	24.36	.23	6023	0.74	61.27	48.80	62.46	HVB
S 49	Main No 2	Raw Coal			As Received	13.02	----	16.99	36.40	33.59	.27	6349					
					Air Dried	-----	3.16	18.92	40.53	37.39	.30	7069					
					Dry Basis	-----	----	19.54	41.85	38.61	.31	7300	1.13	45.37	35.53	70.20	Mv/HVA
S 50	Main No 2	Raw Coal			As Received	12.21	----	19.43	29.92	38.44	.30	7387					
					Air Dried	-----	3.07	21.45	33.03	42.45	.33	8156					
					Dry Basis	-----	----	22.13	34.08	43.79	.34	8414	1.10	36.99	35.13	69.51	HVA
S 51	Saiya 'A'	Raw Coal			As Received	9.20	----	24.72	17.61	48.47	.50	9988					
					Air Dried	-----	2.85	26.45	18.84	51.86	.53	10687					
					Dry Basis	-----	----	27.23	19.39	53.38	.55	11000		21.24	34.47	62.71	
S 52	Main Coal	Raw Coal			As Received	8.68	----	18.93	27.15	45.24	.38	8595					
					Air Dried	-----	2.40	20.23	29.02	48.35	.41	9186					
					Dry Basis	-----	----	20.73	29.73	49.54	.42	9412		32.34	30.49	72.85	
S 53	Main No 3	Raw Coal			As Received	12.12	----	16.22	41.18	30.48	.28	5879					
					Air Dried	-----	2.44	18.01	45.72	33.83	.31	6527					
					Dry Basis	-----	----	18.46	46.86	34.68	.32	6690		50.79	37.67	70.78	
S 54	Main Coal	Raw Coal			As Received	6.37	----	16.04	35.66	41.93	.49	8177					
					Air Dried	-----	1.30	16.91	37.59	44.20	.52	8620					
					Dry Basis	-----	----	17.13	38.09	44.78	.53	87.34		41.43	29.25	76.46	

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FILE NO.: 24017

CERTIFICATE of COAL TESTING

DATE: October 20,1982

SAMPLE NO.	IDENTIFICATION	SAMPLE TYPE	% RECOVERY SINK	% RECOVERY FLOAT		REC'D % H_2O	% H_2O	% VCL MATTER	% ASH	% FIXED CARBON	% S	BTU /LB.	% Ro	% mm db	dmmf V.M.	dmmf F.C.	Rank
S 55	Main Coal	Raw Coal			As Received	7.36	----	15.62	39.35	37.67	.26	7635					
					Air Dried	-----	1.32	16.64	41.92	40.12	.28	8133					
					Dry Basis	-----	----	16.86	42.48	40.66	.28	8242		46.03	36.86	75.30	
S 56	Main Coal	Raw Coal			As Received	18.48	----	18.08	29.53	33.91	.30	6715					
					Air Dried	-----	3.44	21.41	34.98	40.17	.36	7954					
					Dry Basis	-----	----	22.17	36.23	41.60	.37	8237		39.33	36.34	68.20	
S 57	Main Coal	Raw Coal			As Received	10.39	----	19.29	24.09	46.23	.37	9042					
					Air Dried	-----	2.30	21.03	26.27	50.40	.40	9858					
					Dry Basis	-----	----	21.53	26.89	51.58	.41	10090		29.27	30.32	72.65	
S 58	Main Coal	Raw Coal			As Received	14.47	----	18.81	23.08	43.64	.34	8500					
					Air Dried	-----	2.63	21.41	26.27	49.69	.39	9677					
					Dry Basis	-----	----	21.99	26.98	51.03	.40	9939		29.36	30.97	71.87	

APPENDIX VIII

List of Fossils

PARTIAL FOSSIL LIST

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GENERA	AGE	LOCALITY
Ammonite (Probably Grammoceras)	Jurassic to Cretaceous	RAB17k;RAB32J
Belemnites	Jurassic (Upper)	RAB17k;RAB31B RAB32J
Buchia	Upper Jurassic	RAB1I
Dielasma	Jurassic	RAB32J
Plant Debris (Unknown)	Jurassic	RAB31B
Spiriferid	Lower to Middle Jurassic	RAB32J
Trigonia	Jurassic	RAB31B

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GR SUSTUT SE 82A

CONFIDENTIAL

REFLECTANCE RESULTS

APPENDIX VI

Reflectance Results

Reflectance Results for Sustut and Sustut S.E. Coals

Sample No.	Location	Age	Seam	Ro Max. %	
S1	RB 2Ab	U. Bowser	Main 2	0.87*	re-tested
S2	RB 1Ca	U. Boswer	Main 1	1.02	see S49
S3	RG 3C	** Ashman	shale	1.12	
S4	RB 3J	** Ashman	shale	1.25	
S5	RB 11Ca	U. Bowser	Main 3	1.20	
S6	RB 11Aa	U. Bowser	Main 1	1.01	
S7	RB 11Ei	U. Bowser	Main 4	1.18	
S8	RB 12A	U. Bowser	Main 1 or 2(?)	1.05	
S9	RB 12Ca	U. Bowser	Main 6	1.18	
S10	RB 12Hc	U. Bowser	Main 3	1.23	
S11	RB 14A-Da	U. Bowser	Main 2	1.09	
S12	RB 14A-Ha	U. Bowser	Main 2	1.11	
S13	RB 14Sa	U. Bowser	Main 8	1.30	
S14	RB 14Ta	U. Bowser	Main (?)	1.21	
S15	RB 14Ua	U. Bowser	Main 9	1.31	
S16	RS 4#S	U. Bowser	Mackeson	1.47	
S17	RS 17b	Sustut	Saiya C	0.51	
S18	RS 17c	Sustut	Unknown	0.75	
S19	MS 6f	Sustut	McEwan (?)	0.83	
S20	MS 6k	Sustut	McEwan (?)	0.73	
S21	MS 6m	Sustut	McEwan (?)	0.80	
S22	MS 6t	Sustut	McEwan (?)	0.82	
S23	MS 6Va	Sustut	McEwan (?)	0.85	
S24	MS 11w	Sustut	McEwan (?)	0.91	
S25	MS 11x	Sustut	McEwan (?)	0.85	
S26	RB 12B	U. Bowser	Main 7	1.23	
S27	RB 12D	U. Bowser	Main 5	1.21	
S28	RB 12E	U. Bowser	Main 4	1.23	
S29	RB 12F	U. Bowser	Main 3	1.19	
S30	RB 12G	U. Bowser	Main 2	1.07	
S31	RB 9J	U. Bowser	Main 2 (?)	1.05	
S32	RB 9J2	U. Bowser	Main 1	0.99	
S33	RB 9J3	U. Bowser	Main 2 (?)	1.08	
S34	RB 9J5	U. Bowser	Main 2 (?)	1.11	
S35	RB 27N	U. Boswer	Main 2 (?)	1.09	

Reflectance Results for Sustut and Sustut S.E. Coals

Sample No.	Location	Age	Seam	Ro Max. %
S36	RB 28A	Sustut	Unknown	0.79
S37	Saiya -B1	Sustut	Saiya B	0.86
S38	Saiya - B2 (0 - 530)	Sustut	Saiya B	0.61
S39	Saiya - B2 (1440-1890)	Sustut	Saiya B	0.63
S40	JD 1C	Sustut	McEwan Coal	0.67
S41	RB 36 H1	U. Bowser	Main 2 (?)	1.07
S42	RB 36 H2	U. Bowser	Main 2 (?)	1.13
S43	RB 36 G1	U. Bowser	Main 1 (?)	1.02
S44	RB 18Db	Sustut	Unknown	0.77
S45	RB 18Fa	Sustut	Unknown	0.69
S46	30D (JB1)	Sustut	Stone Seam	0.72
S47	RS 23E	Sustut	New Seam	0.74
S48	RAB2Ab	U. Bowser	Main 2	1.07
S49	RAB2Aa	U. Bowser	Main 2	1.13
S50	RAB2Ac	U. Bowser	Main 2	1.10

** Age uncertain