MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT - NASS - SKEENA AREA

GEOLOGICAL REPORT

1987

GEOLOGICAL REPORT

GULF CANADA RES

COAL DIV

GULF CANADA RESOURCES LIMITED

Mount Klappan Anthracite Project Geological Report

Summit-Nass-Skeena Area

1987

Coal Project Licence Number

7118 to 7177

7381 to 7392

7416 to 7432

7487 to 7539

7559 to 7561

7714 to 7757

Cassiar Land District

NTS Map Number 104 H

Latitude Between 57° 06' and 57° 23'

Longitude Between 128° 37' and 129° 15'

Gulf Canada Resources Limited

April, 1988

PREFACE

The Mount Klappan Anthracite Project is located in northwest British Columbia and is wholly owned and operated by Gulf Canada Resources Limited.

The 1987 Summit-Nass-Skeena Geological Report combines current and previous exploration work to provide an assessment of the geology, coal quality and resource potential of the Summit-Nass-Skeena Area.

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Coal Trench Data and Coal Quality Data

Measured Section Data

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Summit Area	
1:5 000 Maps	
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J-11	KPN87SA-02
J-12	KPN87SA-03
K-9	KPN87SA-04
K-10	KPN87SA-05
K-11	KPN87SA-06
K-12	KPN87SA-07
L-10	KPN87SA-08
L-11	KPN87SA-09
L-12	KPN87SA-10
M-11	KPN87SA-11
M-12	KPN87SA-12
1:10 000 Maps	
104 H/6 A, 104 H/7 D	KPN87SA-13
104 H/6 B	KPN87SA-14
104 H/6 H	KPN87SA-15

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	Drawing No.
Summit Area	
1:5 000 Cross-Sections	
13 500 NE + W	KPN87SA-16
13 000 NE + W	KPN87SA-17
12 500 NE + W	KPN87SA-18
12 000 NE + W	KPN87SA-19
11 500 NE + W	KPN87SA-20
11 000 NE + W	KPN87SA-21
10 500 NE + W	KPN87SA-22
10 000 NE + W	KPN87SA-23
9 500 NE + W	KPN87SA-24
9 000 NE + W	KPN87SA-25
7 000 NE + W	KPN87SA-26
6 000 NE + W	KPN87SA-27
5 500 NE + W	KPN87SA-28
1:10 000 Cross-Sections	
17 000 NE + W	KPN87SA-29
15 000 NE + W	KPN87SA-30
13 000 NE + W	KPN87SA-31
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cont'd

	Drawing No.
Nass Area	
1:5 000 Maps	
F12	KPN87NA-01
F13	KPN87NA-02
F14	KPN87NA-03
G10	KPN87NA-04
G11	KPN87NA-05
G12	KPN87NA-06
G13	KPN87NA-07
G14	KPN87NA-08
G15	KPN87NA-09
H10	KPN87NA-10
H11	KPN87NA-11
H12	KPN87NA-12
H13	KPN87NA-13
H14	KPN87NA-14
H15	KPN87NA-15
I11	KPN87NA-16
I12	KPN87NA-17
I13	KPN87NA-18
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	Drawing No.
Nass Area	
I15	KPN87NA-20
J13	KPN87NA-21
J14	KPN87NA-22
1:10 000 Maps	
104 H/3 G	KPN87NA-23
104 H/3 J	KPN87NA-24
1:5 000 Cross-Sections	
11 000 NW	KPN87NA-25
9 000 NW	KPN87NA-26
7 000 NW	KPN87NA-27
5 000 NW	KPN87NA-28
3 000 NW	KPN87NA-29
1 000 NW	KPN87NA-30
1 000 SW	KPN87NA-31
1:10 000 Cross-Sections	
17 000 NW	KPN87NA-32

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	Drawing No.
Nass Area	
15 000 NW	KPN87NA-33
13 000 NW	KPN87NA-34
11 000 NW	KPN87NA-35
9 000 NW	KPN87NA-36

1.0 SUMMARY

Gulf Canada Resources Limited's Mount Klappan Anthracite Property is located in the Bowser Basin of northwest British Columbia, 290 km north of Smithers, and 150 km northeast of Stewart, British Columbia. The property is composed of 152 crown coal licences, totalling 40 186 hectares of land.

The Mount Klappan property has been a focus of Gulf's coal exploration activities since 1981. Several areas with economic coal potential have been highlighted or further defined during each of the exploration programs undertaken since the acquisition of the property. Three areas of concentration have emerged over time: the Lost-Fox Area, the Hobbit-Broatch Area and the Summit-Nass-Skeena Area. This report pertains to the Summit-Nass-Skeena Area. A 1987 report covering exploration activities in the Lost-Fox Area has been completed as well.

Since 1981, exploration in the peripheral Summit, Nass and Skeena areas of the Mount Klappan property has prompted periodic acquisition, investigation and sometimes relinquishment of additional coal licences. The object of this continuous review of the frontier areas bounding the Mount Klappan property is to ensure that the limits of the established resource are well defined, and that no further resource has been overlooked. This is accomplished largely through lateral tracking of the coal-bearing Klappan Sequence.

The exploration of the Summit, Nass and Skeena area has relied on fundamental mapping, trenching and seam tracing. These exploration methods have led the way to a clearer understanding of all geologic aspects of the peripheral areas of the property. Extensive seam

tracing has allowed a more concise view of the structure and stratigraphy of the Nass and Summit Areas.

The Upper Jurassic to Lower Cretaceous sedimentary strata underlying the Mount Klappan property have been subdivided into four sequences: the Spatsizi, Klappan, Malloch and Devils Claw, in ascending order. An interpretation of the cumulative data to 1987 determines that the Summit Area is predominantly underlain by strata of the coal-bearing Klappan Sequence. The three lower sequences are represented in the Nass Area, with the Klappan Sequence encountered most often and the Spatsizi and Malloch sequences occupying much more restricted areas. The Skeena Area is dominated by the Malloch Sequence with local exposures of both the Klappan and the Devils Claw.

All strata appear to have been subjected to two phases of structural deformation resulting in dominant northwest-southeast trending folds with associated thrust, normal and reverse faulting, and subordinate overprinting northeast-southwest trending folds with much less associated faulting.

The Summit-Nass-Skeena Area contains 3 407.2 million tonnes of largely speculative resources (Table 1.1). These resource estimates do not imply mineability or economic viability. They represent estimated in-place anthracite resources only.

Table 1.1

COAL RESOURCE SUMMARY

(million tonnes)

	Summit-Nass-Skeena Area
Measured	-
Indicated	-
Inferred	32.6
Speculative	3 374.7
Total	3 407.2

2.0 RECOMMENDATIONS

Based on the exploration activities conducted during the 1987 field season, the following recommendations are proposed for the Summit-Nass-Skeena Area.

1. With the acquisition of 1:5 000 orthophotos of the Summit Area, all previous trench and outcrop data should be checked for location accuracy.

2. Initiate a mechanical trenching program in the Summit South Area to facilitate seam correlation in the flats north and south of Marshall Ridge, in the covered area surrounding Porky's Peak and in the area northeast of Little Repeater Ridge.

3. Implement a limited diamond drilling program in the Summit South Area to obtain accurate coal quality data on known coal occurrences and to gain further geologic understanding of the Lower Klappan Sequence.

4. Further evaluation of current peripheral licence areas.

5. Continue seam tracing in the Summit and Nass Areas.

3.0 INTRODUCTION

3.1 Mount Klappan Anthracite Project

3.1.1 Location

The Mount Klappan coal licences are situated in northwest British Columbia approximately 930 km north of Vancouver, 150 km northeast of Stewart and 530 km northwest of Prince George (Figure 3.1).

Geographically the coal licences are at the northern extremity of the Skeena Mountains between 57° 06' and 57° 23' N Lat., and 128° 37' and 129° 15' W Long., and cover the headwaters of the Klappan, Little Klappan, Spatsizi, Skeena and Nass Rivers.

The nearest community to the property is the community of Iskut (population 500) located 100 km to the northwest on the Stewart-Cassiar Highway (Hwy 37).

3.1.2 Access

The Mount Klappan property straddles the partially completed British Columbia Railway line between Prince George and Dease Lake (Figure 3.2). Prior to cessation of work on the construction of the line, steel was laid to within 80 km south of the property. With the exception of a 24 km stretch north of the Kluatantan River, the railway subgrade

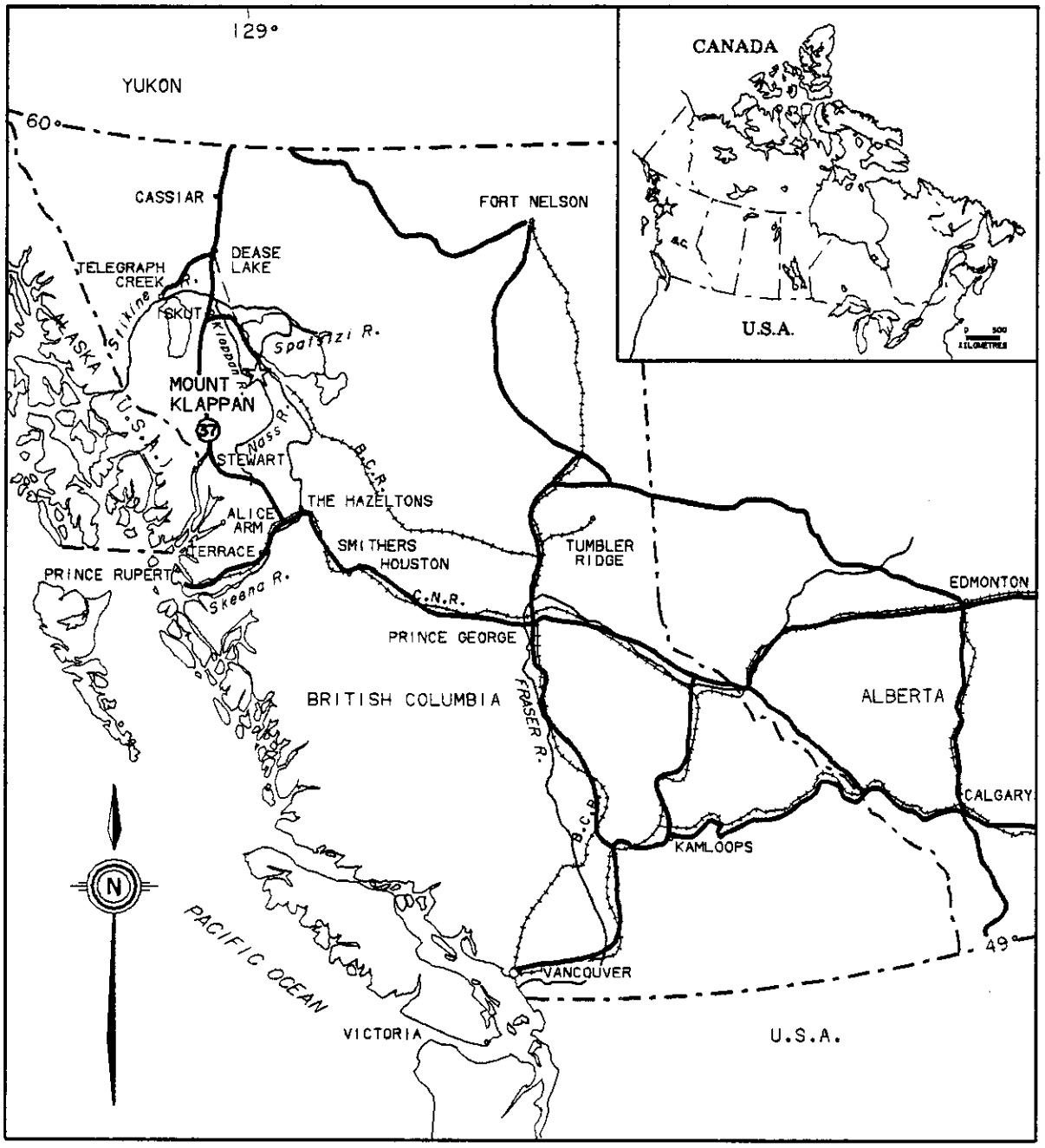


FIGURE 3-1

MOUNT KLAPPAN ANTHRACITE PROJECT

LOCATION MAP

GULF CANADA RESOURCES LTD.

GULF CANADA RESOURCES LTD.
26/01/87
KLAP:[205057]840564005.LOC

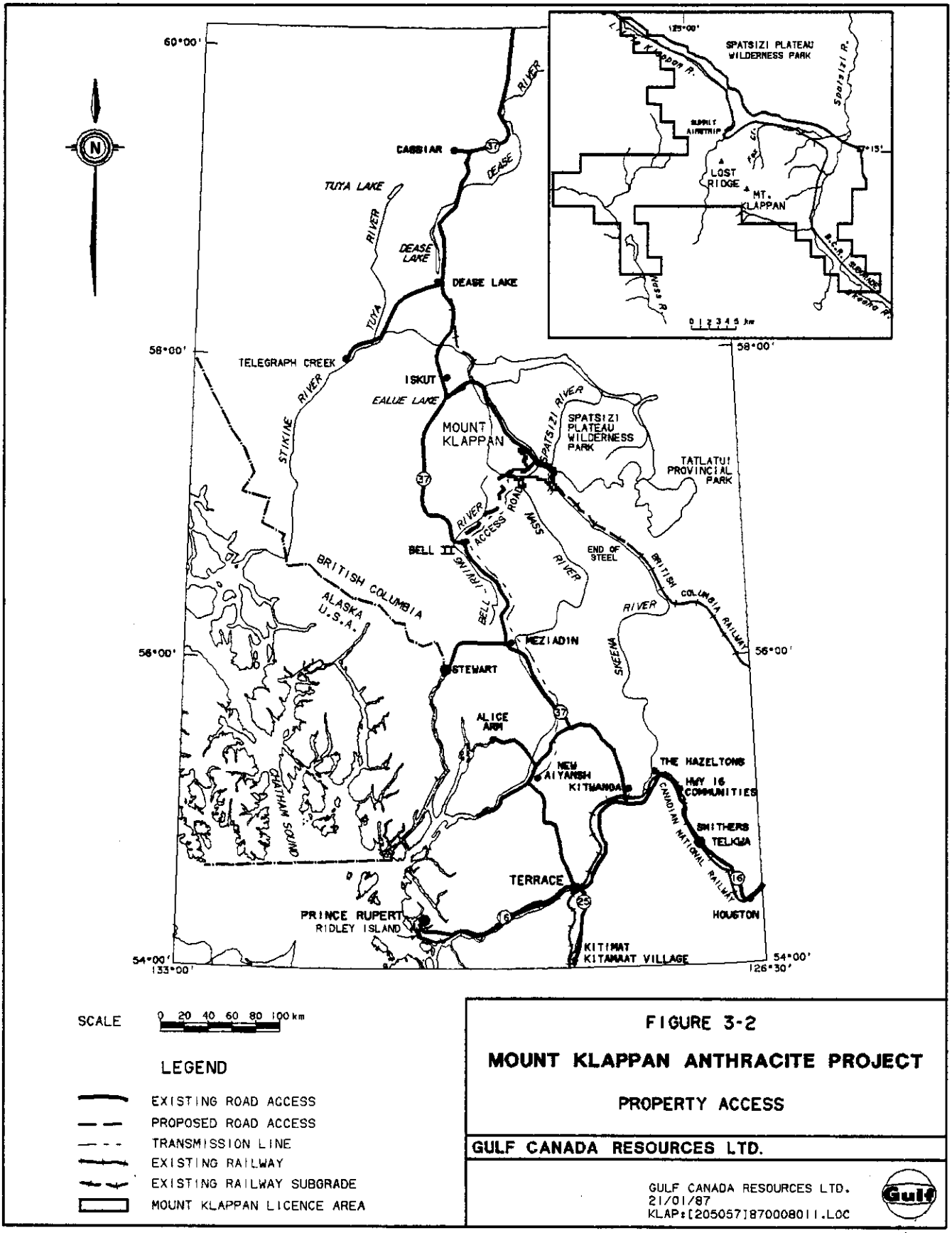


FIGURE 3-2

MOUNT KLAPPAN ANTHRACITE PROJECT

PROPERTY ACCESS

GULF CANADA RESOURCES LTD.

GULF CANADA RESOURCES LTD.
21/01/87
KLAP:[205057]87000801I.LOC

was constructed through and beyond the property to the Stikine River just south of Dease Lake.

Road access to the property from Highway 37 via Ealue Lake Road, is provided along the British Columbia Railway subgrade. Three bridges were constructed along the subgrade early in 1984 to permit surface access to the property. Road distances from Terrace and Stewart to the property are 575 km and 426 km respectively.

Fixed wing aircraft provide access by air and use the 1 000 m Summit Airstrip located along the railway subgrade in the central region of the property.

3.1.3 Property Description

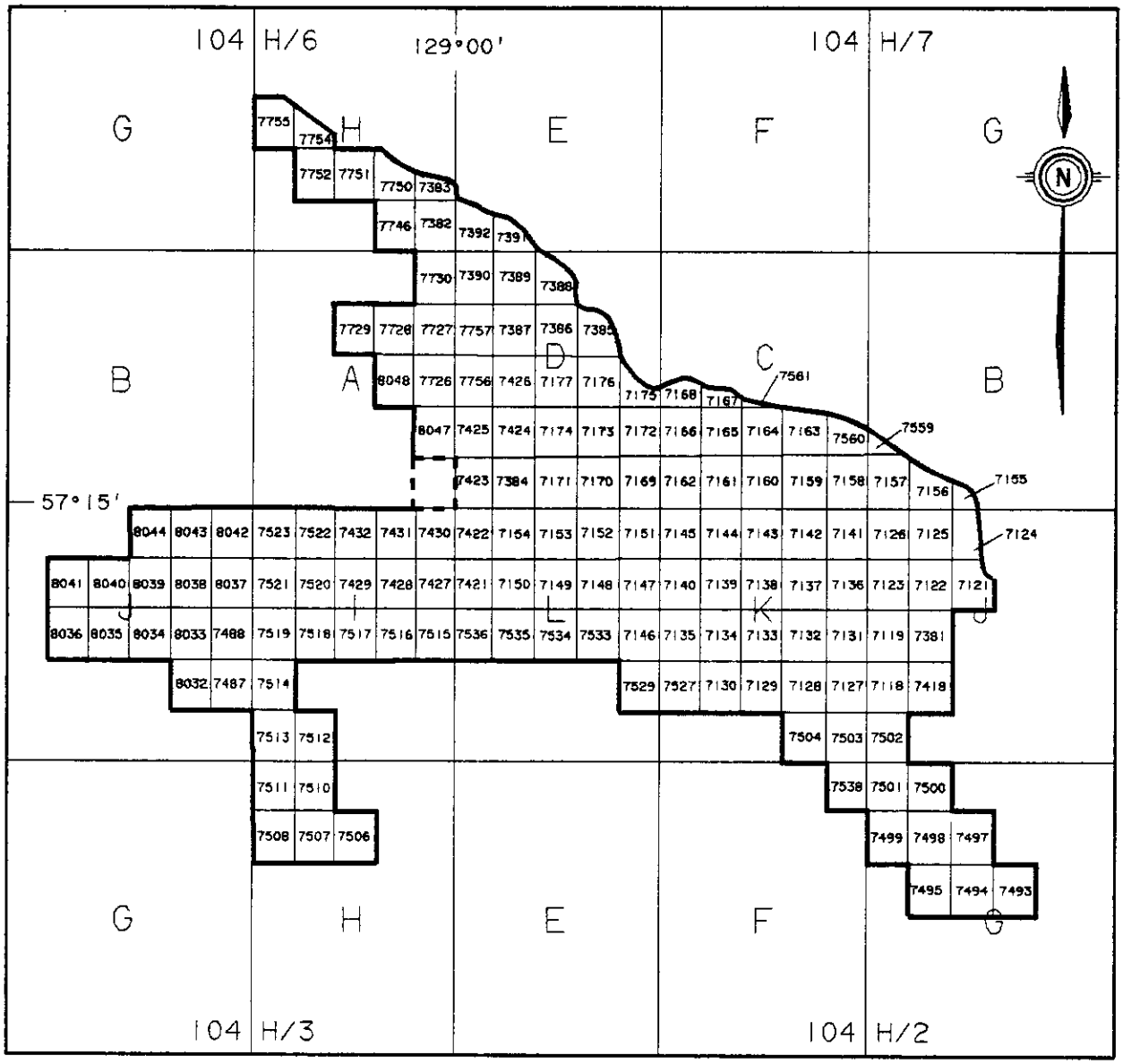
The Mount Klappan property comprises 152 coal licences totalling 40 186 ha of land (Figure 3.3) as of October 31, 1987. The property was acquired in five separate applications from 1981 to 1985.

3.1.4 Ownership

Gulf wholly owns the coal licences comprising the Mount Klappan property.

3.1.5 Property Geography and Biophysical Environment

The Mount Klappan property is located at the headwaters of the Little Klappan, Klappan, Nass, Skeena, and



SCALE

0 1 2 3 4 5 km

LEGEND

LICENCE AREA

7386 LICENCE NUMBER

UNDER APPLICATION

FIGURE 3-3

MOUNT KLAPPAN ANTHRACITE PROJECT

LICENCES

GULF CANADA RESOURCES LTD.

GULF CANADA RESOURCES LTD.
10/30/86
KLAP:[205057]83:024020.LOC

Spatsizi Rivers (Figure 3.1). This area is within the northern extremity of the Skeena Mountains physiographic region. The regional physiography is of mountainous terrain with broad northwest to southeast trending valleys of the aforementioned rivers.

Elevations on the property range from 991 m in the Klappan River Valley to over 2 000 m on Mount Klappan and the adjacent ridge tops.

The climatic regime of the area is in the Northern and Central Plateau and Mountain Zone. Precipitation values average 300 to 400 mm per year with the mean daily temperatures comparable to Fort Nelson and Prince George. This information is derived from the weather station located on the northeastern edge of the property which have been monitored monthly since their installation in 1983.

Tree line in the area is at approximately 1 500 m. Valley bottoms are partially covered with scattered coniferous forests, grasses, shrubs, meadows, and bogs. The higher elevations are characterized by alpine tundra.

3.2 Summit-Nass-Skeena Area

3.2.1 Location

The Mount Klappan property has been divided into project blocks to facilitate exploration expansion and subsequent logistics. The Summit-Nass-Skeena Area

encompasses the northwestern, southwestern and southeastern extensions of the Mount Klappan property (Figure 3.4).

The Summit Area is cut by the Little Klappan River in the northeast and extends to the southwest into a series of mountainous ridges.

The Nass Area has a common northeast boundary with Summit while its western and southern borders are bounded by several small ice fields and elevated terrain. Drainage valleys of the Klappan and Nass Rivers occupy a large portion of the Nass Area.

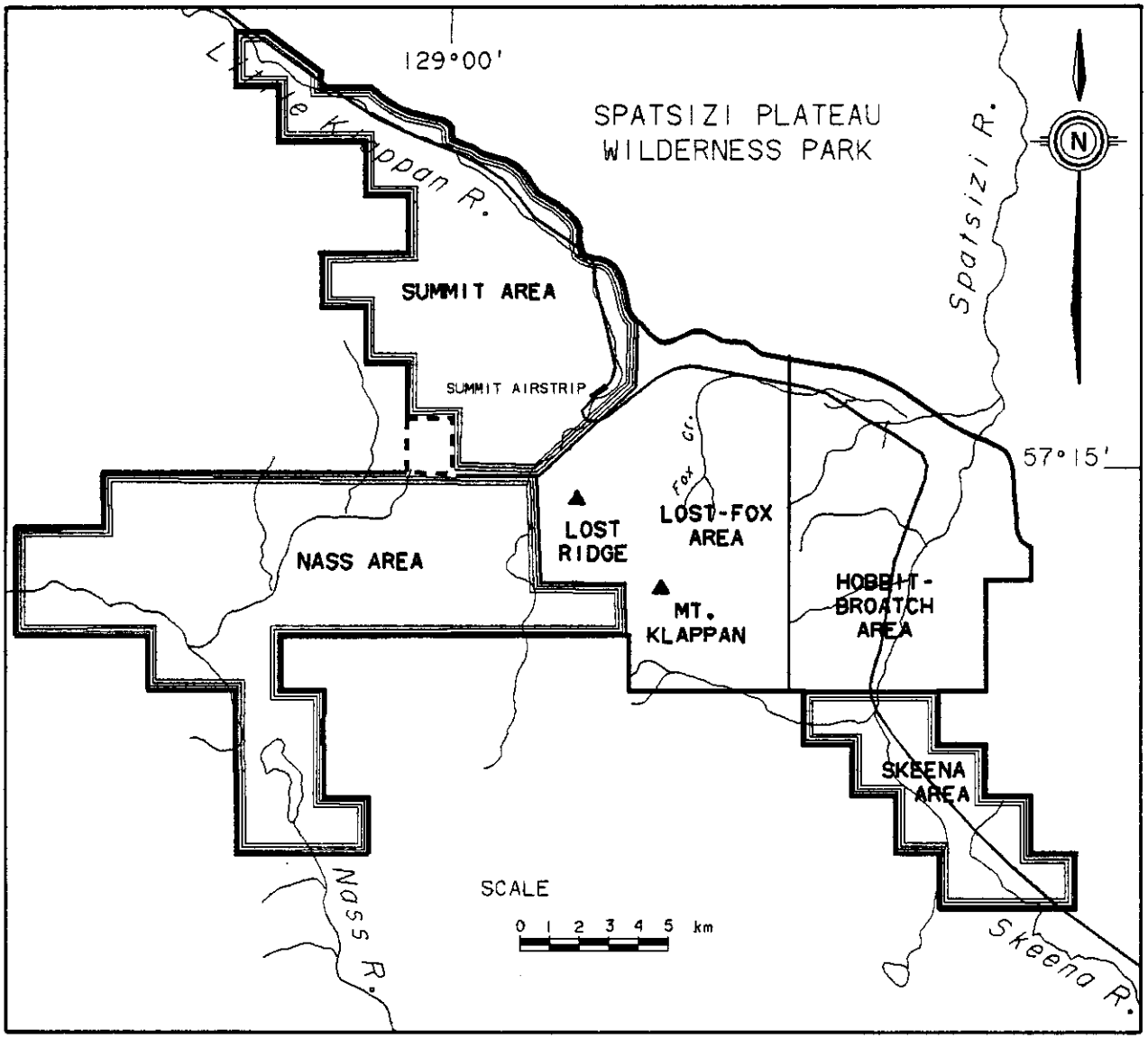
The Skeena Area has a common northern boundary with the Lost-Fox and Hobbit Broatch areas and it is cut by Tahtsedle Creek and the Skeena River.

3.2.2 Access

The low lying portions of the Summit and Skeena areas are accessible by truck along the British Columbia Railway subgrade. Exploration at higher elevations in Summit and Skeena and everywhere in the Nass Area requires helicopter support from the Didene Creek base camp.

3.2.3 Area Description

The Summit-Nass-Skeena Area covers 27 376.5 ha and includes 93 of the 152 licences comprising the Mount Klappan Coal Project (Appendix A). Of the 35 licences (totaling



SCALE

0 1 2 3 4 5 km

LEGEND

- BRITISH COLUMBIA RAILWAY SUBGRADE
- LICENCE AREA
- LICENCE UNDER APPLICATION

FIGURE 3-4

MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT-NASS-SKEENA 1987 EXPLORATION AREAS

GULF CANADA RESOURCES LTD.

GULF CANADA RESOURCES LTD.
20/01/87
KLAP:[205057]84||65015.LOC

8 822.5 ha) in the Summit block, two licences, 7171 and 7173, are divided between the Summit-Nass Area and the Lost-Fox Area. The Nass block contains 46 coal licences comprising 12 926.0 ha and the Skeena Area is made up of 12 licences totalling 3 375.0 ha.

3.2.4 Biophysical Environment

The regional physiography of the Summit-Nass-Skeena Area is one of mountainous terrain and broad northwest to southeast and east-west trending valleys.

Vegetation is variable with alpine tundra characterizing higher elevations above treeline and thick coniferous forests, shrubs, meadows and bogs occupying valley floors. Elevations range from approximately 1 050 m in the Nass and Skeena Valleys to over 2 100 m in the Summit Area.

The headwaters of the Little Klappan, Klappan, Nass and Skeena rivers and Tahtsedle Creek all occur within the Summit-Nass-Skeena licence boundary. These rivers are generally broad and meandering forming deep gorges only when cutting through steep terrain.

Heavy precipitation and ground fog occurred on approximately 10 percent of the field days. Higher elevations of the Summit, Skeena and northern Nass areas, depending on weather conditions, may remain snow covered year around. Several small ice fields are located just beyond the western property boundary in Summit and the northern property boundary in Nass.

4.0 EXPLORATION HISTORY

4.1 Mount Klappan Property

Gulf Canada Resources Limited has been actively involved in the exploration of the Bowser Basin in northeastern British Columbia since 1981. The vast majority of this work has been in the northern end of the Groundhog Coalfield delineating the anthracite potential of the area using the various techniques summarized in Table 4.1

A total of 10 separate reports have been submitted detailing the results of our exploration activities:

Mount Klappan Coal Project - Geological Report	1981
Mount Klappan Coal Project - Geological Report	1982
Mount Klappan Coal Project - Geological Report	1983
Mount Klappan Coal Project - Lost-Fox Area	1984
Mount Klappan Coal Project - Hobbit-Broatch Area	1984
Mount Klappan Coal Project - Summit-Nass-Skeena Area	1984
Mount Klappan Coal Project - Lost-Fox Area	1985
Mount Klappan Coal Project - Summit-Nass Area	1985
Mount Klappan Anthracite Project - Lost-Fox Area	1986
Mount Klappan Anthracite Project - Summit-Nass-Skeena Area	1986

4.2 Summit-Nass-Skeena Area

4.2.1 Summary of Exploration 1981-1986

Exploration work in the Summit-Nass-Skeena Area

Table 4.1

MOUNT KLAPPAN ANTHRACITE PROJECT
EXPLORATION SUMMARY 1981 TO 1986

	1981	1982	1983	1984	1985	1986	Total
Adits							
Number	--	--	1	--	--	1	2
Tonnes	--	--	39.2	--	--	30	69.2
Diamond Drill Holes							
Number (HQ)	--	7	3	8	34	38	90
Total Metres	--	1 223	603	1 507	6 146	5 550	15 029
Number (AIX)	--	--	6	--	--	--	6
Total Metres	--	--	126	--	--	--	126
Rotary Drill Holes							
Number	--	--	--	17	6	--	23
Total Metres	--	--	--	897	620	--	1 517
Hand Trenching							
Number	24	51	93	95	45	36	344
Total Metres	89	289	527	416	178	95	1 594
Mechanical Trenches							
Number	--	--	--	128	--	--	128
Total Metres	--	--	--	1 041	--	--	1 041
Measured Sections							
Number	--	--	--	13	19	6	37
Total Metres	--	--	--	2 736	3 347	745	6 828
Geological Mapping Scales	1:10 000	1:10 000	1: 5 000 1:10 000	1: 2 500 1: 5 000 1:10 000	1: 2 500 1: 5 000 1:10 000	1: 2 000 1: 5 000 1:10 000	

commenced in 1981 and has continued annually, during summer field seasons. The programs consisted of air photo interpretation, geologic mapping, hand trenching, seam tracing and diamond drilling (Table 4.2).

Table 4.2

SUMMIT-NASS-SKEENA AREA EXPLORATION SUMMARY 1981-1986

Summit Area

	1981	1982	1983	1984	1985	1986	Total
Hand Trenches							
Number	2	2	26	18	10	7	65
Length (m)	12.90	25.40	188.70	90.10	38.64	15.94	371.14
Diamond Dril Holes							
Number	--	1	1	--	--	--	2
Length (m)	--	192.60	130.20	--	--	--	322.80

Nass Area

Hand Trenches							
Number	--	2	16	13	2	10	43
Length (m)	--	8.50	56.00	45.50	8.78	20.84	139.62

Skeena Area

Hand Trenches							
Number	--	--	--	1	--	1	2
Length (m)	--	--	--	4.00	--	2.12	6.12

5.0 1987 EXPLORATION PROGRAM

5.1 Summit-Nass-Skeena Area Program Objectives

The Summit, Nass and Skeena exploration programs of the past concentrated on mapping general structure, locating and trenching coal occurrences, and gaining a better understanding of the overall stratigraphy in the Mount Klappan area. Our goals throughout the 1987 program became more specific in that more emphasis was placed on detailed structure and accurate tracing of seams in the Summit South and the northwestern Nass Areas. This led to a better understanding of the extent of the Lower Klappan Sequence and the seams contained therein.

Program objectives of 1987:

1. To continue detailed geologic mapping at 1:5 000 scale.

2. To better define the extent of the anthracite bearing strata through detailed seam tracing.

3. To understand more fully where the stratigraphy fits in with respect to the anthracite package on Lost-Ridge.

4. To delineate the Klappan/Spatsizi Sequence contact Zone between the Nass and Summit Areas.

5. To find a suitable route to get a backhoe into the Caribou Cirque and Summit South Areas to initiate a mechanical trenching program.

6. To accurately define the Malloch/Devils Claw Sequence contact in the southwestern portion of the Skeena Area.

5.2 Summary of Exploration

5.2.1 Mount Klappan Anthracite Project

In seven years of exploration on the Mount Klappan property, Gulf has advanced through regional investigations to seam tracing, drilling, adit driveage and trial cargos (Table 5.1). While new areas are constantly being investigated, exploration is being focussed on those areas which have immediate economic interest.

The 1987 summer exploration program resulted in the completion of 34 diamond drill holes, 53 mechanical trenches and 13 hand trenches. The program also included detailed geological mapping of the Lost-Fox, Summit, Nass, and Skeena areas.

The Didene Creek Camp provided lodging and working space for up to 50 Gulf and support personnel during the program. Geological, drilling and support crews were transported daily from camp either by four-wheel-drive vehicles or by a Bell 206B helicopter.

The British Columbia Railway subgrade provided good access through the property, and joins with Highway 37 via the Ealue Lake Road (Figure 3.2). A four-wheel-drive Emergency Transportation Vehicle was on standby at all times for use in a medical emergency.

Table 5.1

MOUNT KLAPPAN ANTHRACITE PROJECT
EXPLORATION SUMMARY 1981 TO 1987

	1981	1982	1983	1984	1985	1986	1987	Total
Adits								
Number	--	--	1	--	--	1	--	2
Tonnes	--	--	39.2	--	--	30	--	69.2
Diamond Drill Holes								
Number (HQ)	--	7	3	8	34	38	34	124
Total Metres	--	1223	603	1507	6164	5500	4931	19978
Number (AXI)	--	--	6	--	--	--	--	6
Total Metres	--	--	126	--	--	--	--	126
Rotary Drill Holes								
Number	--	--	--	17	6	--	--	23
Total Metres	--	--	--	897	620	--	--	1517
Mechanical Trenches (Seam Tracing)								
Number	--	--	--	128	--	--	53	181
Total Metres	--	--	--	1041	--	--	700	1741
Hand Trenches								
Number	24	51	93	95	45	36	13	387
Total Metres	89	289	527	416	178	95	58	1652
Measured Sections								
Number	--	--	--	13	19	6	25	62
Total Metres	--	--	--	2736	3347	745	1951	8779
Geological Mapping Scales	1:10 000	1:10 000	1:5 000 1:10 000	1:2 500 1:5 000 1:10 000	1:2 500 1:5 000 1:10 000	1:2 000 1:5 000 1:10 000	1:2 000 1:5 000 1:10 000	

Commercial as well as charter fixed wing aircraft linked the Summit Airstrip on the property to major centres and provided convenient air transportation for personnel and cargo throughout the exploration program.

5.2.2 Summit-Nass-Skeena

Exploration of the Summit-Nass-Skeena Area began on July 1, 1987 and was completed August 24, 1987. A summary of the Summit-Nass-Skeena exploration activities is outlined in Table 5.2.

The 1987 Summit-Nass-Skeena report contains geologic interpretations based on all exploration information collected to date.

5.3 Cartography

Topographic maps used in this exploration program are at 1:5 000 and 1:10 000 scales. The 1:5 000 metric maps were prepared from 1:30 000 British Columbia Government air photos flown prior to subgrade construction. For the areas of northwestern Summit and western Nass where 1:5 000 map coverage did not exist 1:50 000 imperial Government topographic maps were blown up to 1:10 000 scale.

5.4 Geologic Mapping

Reconnaissance and detailed geological mapping were carried out at scales of 1:5 000 and 1:10 000 for the Summit and

Table 5.2

SUMMIT-NASS-SKEENA AREA EXPLORATION SUMMARY

1987

	1987	1981-1987 Total
Diamond Drill Holes (HQ)		
Number	--	2
Total Metres	--	322.8
Hand Trenches		
*Number	8	118
Total Metres	28.50	542.0
Measured Sections		
Number	10	27
Total Metres	965.59	4278.89

*Includes trenches that have been relogged.

Nass areas. Mapping in the Skeena Area was completed at a scale of 1:50 000 where detailed map coverage is non existent. Emphasis was placed on completing a comprehensive seam tracing program in the Summit and Nass Areas.

Two crews of geologists were responsible for the Summit and Nass Areas. A separate crew was responsible for the Malloch/Devils Claw contact and formation study in the Skeena Area. Transportation of all crews to the field was provided by a Bell 206B helicopter.

5.5 Trenching

Eight trenches intersecting coal seams with an aggregate thickness of 28.5 m were excavated in the Summit Area. Coal exposures in excess of 0.5 m were logged at true thickness and sampled during daily traverses.

Tables 6.6 and 6.9 summarize 1981-1987 trench information. A more detailed description of coal trench data is contained in Appendix I.

5.6 Data Management

Throughout the 1987 exploration program, an IBM AT computer was utilized for cost accounting and budget control. During the field season it also served as an on-site data storage system which facilitated the uploading of outcrop, trench, drill hole coal quality and washability data onto Gulf's mainframe Coal Data Base, set up on an AMDAHL V8 computer, in Calgary. A Hayes 1200

modem was utilized for test transmission of data through a satellite telephone to Calgary. System 2000 data base management and Act 1 software provided data entry retrieval and manipulation of stored data on the mainframe computer.

5.7 Reclamation

The Summit-Nass exploration program produced very minor environmental disturbances. Most hand excavated trenches were backfilled.

5.8 Additional Geological Studies

Studies undertaken in previous years have ranged from being very regional in scope, to concentrating on small and very localized features. Studies conducted this year involved a re-examination of several areas. By incorporating a detailed understanding of the geology gained from previous years' work, an extention of the main coal-bearing area was discovered into the West Lost Ridge Area. Also, a detailed investigation of Knooph Hill was made to establish a connection from Lost Ridge to the Hobbit-Broatch Area.

An undergraduate thesis is presently underway to determine a possible correlation between the lower package of seams in the Lost Ridge Area and the known anthracite seams found in the Summit South Area. This data will be incorporated into a subsequent report.

The marker horizon study initiated in 1985 has proven to be invaluable in correlating drilled stratigraphies. There are now seven key beds that have demonstrated a reliable consistency and occurrence across the Lost-Fox Area. A description of these correlative horizons and their relative stratigraphic positions is outlined in Table 5.3.

Results from a bentonite study completed in 1986 suggest that the Mount Klappan area bentonites were deposited in brackish waters as they are generally composed of illite-smectite mixed layer swelling clays. Most of the samples collected are from above I seam, above K seam and above N seam in the Lost-Fox Area. Initial results indicate that elemental analyses and ratios can be used to determine stratigraphic positions by using discriminant function statistics. In future drill programs, bentonites will continue to be sampled and analyzed to expand the data base and improve on statistical reliability.

During the 1986 field season, an undergraduate study was also completed on the two phases of folding on the Mount Klappan property. Analysis of cleavage and lineation data re-confirmed the presence of two phases of folding, the first trending at 135°, verging to the northeast and plunging to the southeast on the northern side of the Beirnes Synclinorium, the second trending 045° and possibly verging to the southeast.

Work continued for a fourth year on the collection of flora and fauna samples and locations. The results of this work are discussed in section 6.3.3 of this report and shown in table form in Appendix D.

TABLE 5.3

LOST-FOX AREA
KEY STRATIGRAPHIC HORIZONS

Seam	Marker Horizon	Description
P		
O		Thick white ash layer (>20 cm); in
	Crest Zone ---------->	distinct contrast with dark mudstone above
N		and below; marks a point 10-15m above
M/N		N seam.
?		
M	------->	Hard tuffaceous zone with extremely fine
L/M	|	grained uniform texture and conchoidal
L	|	fracture; becomes thinner and more mixed
?	|	in with the surrounding sediment westward;
K/L	|	occurs at a variable stratigraphic level
?	|	above K seam.
?	|	
	Porcelaneous Tuffite	
	Zone ------->	Rhythmitic, extremely fissile dark grey
K	|	mudstone; marks occurrence of J seam zone
?	|	which always lies immediately beneath
?	|	the Coaster Zone.
	Coaster Zone ---|	
J		
	Tuffite Zone ---------->	Variable thickness containing a mixture
I		of tuffaceous material and siltstone;
?		normally has a sharp base and gradational
H/I		top; occurs always in association with I
H/I2		seam but at a variable stratigraphic
H		level above it.
	Recrystallized Zone -|	
?	------>	Diagenetic recrystallization of carbonate
H(lower)		in mudstone; sensitive to facies but
H-1		occurs widely within 10 m below H seam.
PH		
G		
G(lower)	------->	Mudstone speckled with dispersed angular
F/G	|	white quartz clasts; variable in thickness
	Milky Way Zone -|	and abundance of quartz clasts; marks a
F		point 12 m above F seam.
E		
D	------->	Gastropods occur only in a very restricted
	Gastropod Zone -|	portion of the coal sequence; several thin
C		bands densely packed with gastropods can
B		occur above and below D seam (mostly
B(lower)		below); bivalves are found in association.
A		

As a culmination of work done to date on the sedimentology of the Mount Klappan property, a paper has been prepared by J.W. Innis, S. MacLeod and E. Swanbergson entitled "The Stratigraphy of the Klappan Coalfield, Northern Bowser Basin, Northwestern British Columbia.

5.9 Exploration and Camp Permits

Approval for the 1987 exploration program on the Mount Klappan property was received following submission of Coal Exploration Forms 6 and 7 to the Government of British Columbia. Subsequently, the following permits/approvals were issued to Gulf with respect to the Mount Klappan Anthracite Project 1987 exploration program:

Name	B.C. Ministry
Reclamation Permit C-160	E.M.P.R.
Free Use Permit 14097	Forests
Waste Management PR-78332 + PA-7717	Environment
Water Management A61-20	Environment
Class B Burning Permit B130734	Forests
Inspection Report C-160	E.M.P.R.

5.10 Project Management and Contractors

The 1987 exploration program was co-ordinated by E. Swanbergson of Gulf Canada Resources Limited. Field operations in the Summit-Nass-Skeena Area were supervised by L. Savoie and K. Hunter. Coal quality analyses were performed by Loring Laborator-

ies Ltd. and interpreted by L. Savoie. D.E. Pearson and Associates Limited conducted coal petrology studies. The report was written by L. Savoie and A. Penman, with supervision and editing done by E. Swanbergson and J. Innis. The Skeena section was prepared and written by A. Ledda.

The following personnel contributed to the Summit-Nass-Skeena exploration program.

J. Innis	Senior Geologist
G. Seve	Senior Geologist
L. Savoie	Geologist
K. Hunter	Geologist
M. Woofter	Geologist
A. Penman	Geological Technologist
S. Lee	Geologist
J. Wallace	Geologist
G. Parry	Geologist
A. Ledda	Geologist
B. Van Den Bussche	Geologist
M. Barker, P.Geol.	Geologist
D. Willis	Geological Assistant
L. Kende	Geological Assistant
V. Srivastava	Geological Assistant
G. Murray	Geological Assistant
A. Sali	Administrator

R. Aftergood	Administrative Analyst
W. Osborne	Bookkeeper
T. Sampietro	Camp Manager
R. Quock	Computer Operator
C. Ireland	Secretary
R. Bonang	Cook

The following companies provided the majority of services and/or supplies to the Summit-Nass-Skeena exploration program.

Canadian Freightways Ltd.	Calgary, Alberta
Central Mountain Air Services Ltd.	Smithers, B.C.
D.E. Pearson & Associates Ltd.	Calgary, Alberta
Loring Laboratories Ltd.	Calgary, Alberta
Neville Crosby Inc.	Vancouver, B.C.
Northern Mountain Helicopters Inc.	Prince George, B.C.
Northmount Camp Services (1974) Ltd.	Vancouver, B.C.
Starr Industries Ltd.	Fort St. John, B.C.
Westcan Electronic Services Ltd.	Calgary, Alberta

6.0 GEOLOGY

6.1 Introduction

Geological mapping, mechanical trenching and hand trenching activities were undertaken over the majority of the Mount Klappan property during the 1987 exploration program. In addition, diamond drilling continued in the Lost-Fox area. The results of this exploration program combined with previous years' work provided the basis for geological interpretations presented in this report.

The Mount Klappan property is underlain by uppermost Jurassic to Lower Cretaceous strata which consist of marine to non-marine sediments deposited in the Bowser Basin of northcentral British Columbia. The strata have been subjected regionally to two successive non-coaxial phases of deformation, F1 and F2, which resulted in folding and faulting trending in NW-SE (F1) and E-W (F2) directions generally. (See 1:50 000 Regional Geology Map; Appendix I).

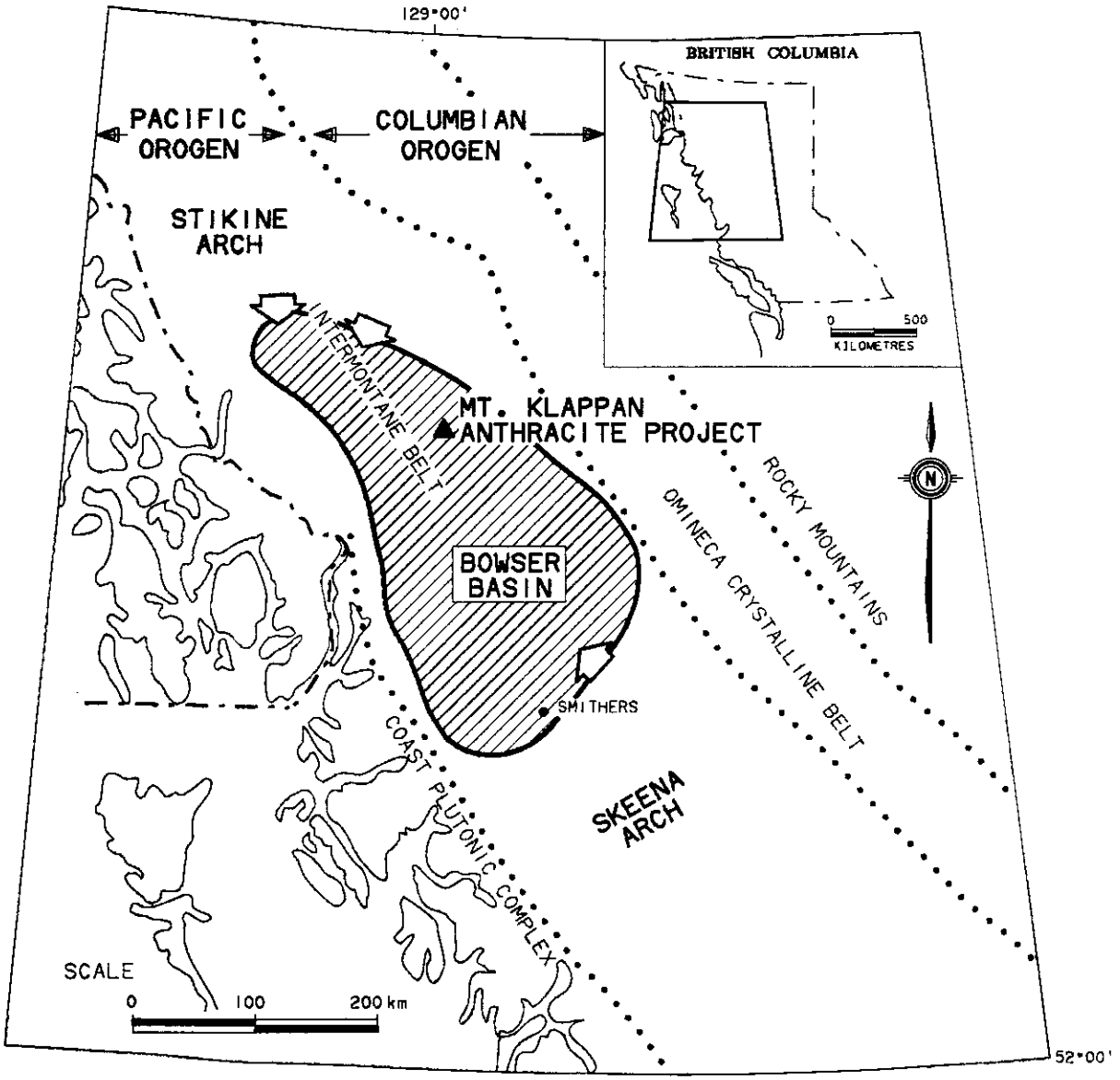
The coal seams of the Mount Klappan property occur primarily in the Klappan Sequence; in addition, some minor seams have been trenched in the Malloch Sequence. Coal seams range up to 9.23 metres in maximum true thickness in the Lost-Fox Area and are usually found to be laterally continuous over broad areas although some seams thin locally.

6.2 Regional Geologic Setting

The coal measures of the Mount Klappan property are contained within a series of sediments ranging in age from uppermost Jurassic to Lower Cretaceous. These sediments were deposited in the Bowser Basin, a successor basin to the volcanogenic Hazelton Trough (Tipper and Richards 1976). The Bowser Basin is bounded to the north and south by the Stikine and Skeena Arches respectively, and to the east by the Columbia Orogen (Omineca Crystalline Belt). The western margin is thought to have been open to the sea at the time of Bowser sediment deposition (Figure 6.1).

The formation and development of the Bowser Basin was controlled by the "collision and subsequent isostatic uplift of several crustal blocks in the Cordilleron Orogen of western Canada" (Eisbacher, 1981). These crustal blocks include the Stikine Terrane (volcanic arc complex) which directly underlies the Bowser sediments, the Atlin Terrane (remnant oceanic crust) and the Omineca Crystalline Belt (western margin of the North American Craton).

During the Middle Jurassic, the Skeena Arch was uplifted and the subsidence of the Stikine Terrane divided the Hazelton Trough into the Bowser Basin to the north and the Nechako Basin to the south. Uplift of the Atlin Terrane to the north and northeast of the Bowser Basin, coupled with continued subsidence of the Stikine Terrane and collision and suturing of both these terranes with the Omineca Crystalline Belt (Eisbacher, 1981) resulted in a progradation of non-marine over marine sediments within the basin.



LEGEND

DIRECTION OF DEPOSITION

FIGURE 6-1

MOUNT KLAPPAN ANTHRACITE PROJECT

JURASSIC-CRETACEOUS BOWSER BASIN

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88/04/06
KLAP:[205057]87023800].LOC

Paleocurrent measurements indicate a centripetal flow into the Bowser Basin from highlands to the north, northeast, and south.

Bowser sediment source rocks originate within the Atlin Terrane (high chert; low volcanic content) for the north and northeastern margins of the Basin, and from the remnant volcanic arc assemblage of the Stikine Terrane, (high volcanic; low chert content) for the southern portion of the Basin. Sediments from the Lower Cretaceous (youngest marine succession of the Bowser Basin) through to the Paleocene are found only on the eastern, and in part, the southern margins of the Basin.

Geologic studies in the southern and northern Bowser Basin sediments have resulted in several reports and descriptions of the sedimentary package associated with the Mount Klappan Area. These studies are summarized in Table 6.1.

Structural deformation of Bowser Basin sediments resulted from intermittent tectonic stresses at the western cratonic margin from Cretaceous to recent time. The deformation caused an extensive, shallow decollement, recumbent folds, and local thrust faults extending a few km along strike (Eisbacher, 1981).

The large scale forces resulting from collision of a remnant volcanic arc and cratonic margin subjected the area to northeast-southwest compression (F_1) creating the general structural trend of northwest-southeast.

Later positioning of the former volcanic arc terrain

		MALLOCH, 1914	BUCKHAM & LATOUR, 1950		SOUTHER & ARMSTRONG, 1966	EISBACHER, 1974c		TIPPER & RICHARDS, 1976	RICHARDS & GILCHRIST, 1979	BUSTIN & MOFFAT, 1983	KOO, 1986	INNIS, et al. in press
		SOUTHERN GROUNDHOG COALFIELD	GROUNDHOG COALFIELD		NORTHERN BRITISH COLUMBIA	NORTHERN BOWSER BASIN		SOUTHERN BOWSER	SOUTHERN GROUNDHOG COALFIELD	GROUNDHOG COALFIELD	KLAPPAN COALFIELD	KLAPPAN COALFIELD
CRETACEOUS	UPPER				SUSTUT-SIFTON ASSEMBLAGE	SUSTUT-SIFTON ASSEMBLAGE		SUSTUT GROUP				
	LOWER	SKEENA SERIES	HAZELTON GROUP	UPPER PART	BOWSER ASSEMBLAGE	BOWSER ASSEMBLAGE	?	SKEENA GROUP	GUNANOOT ASSEMBLAGE	DEVILS CLAW UNIT	UNIT 5	DEVILS CLAW SEQUENCE
							JENKINS CREEK FACIES			McEVOY UNIT	UNIT 4	MALLOCH SEQUENCE
											UNIT 3	
							GUNANOOT-GROUNDHOG FACIES	UNCONFORMITY			UNIT 2U	KLAPPAN SEQUENCE
JURASSIC	UPPER	HAZELTON GROUP		LOWER PART				BOWSER LAKE GROUP		CURRIER / PRUDENTIAL	UNIT 2L	
							DUTI RIVER SLAMGEESH FACIES				UNIT 1	SPATSIZI SEQUENCE
	MIDDLE				TAKLA-HAZELTON ASSEMBLAGE	TAKLA-HAZELTON ASSEMBLAGE		HAZELTON GROUP		JACKSON UNIT		
	LOWER							UNCONFORMITY				
TRIASSIC	UPPER							TAKLA GROUP				
	MIDDLE											

TABLE 6.1

MOUNT KLAPPAN ANTHRACITE PROJECT

REGIONAL STRATIGRAPHY TABLE OF FORMATIONS

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northwards along interlaced right lateral high angle faults (Eisbacher, 1981) may account for the later north-south compressional (F_2) event. This deformational event resulted in generally broad, open NE to SW trending folds with relatively rare, flat lying thrusts expressed in several klippen fault structures.

The final deformational event which produced strike-slip and some dip-slip faulting may have resulted from a change in the rotational component of the western crustal block.

6.3 Mount Klappan Anthracite Project Geology

6.3.1 Stratigraphy

Based on age-dating of collected species of plant macrofossils and fauna, the sediments underlying the Mount Klappan property range from uppermost Jurassic to Lower Cretaceous in age (Section 6.3.3). This sedimentary package has been subdivided into four gradational sequences which in ascending order are the Spatsizi, Klappan, Malloch and Devils Claw sequences (Figure 6.2). These conformable sequences occur within approximately 3 000 m of section and represent a gradual marine regression. Table 6.2 briefly outlines the sedimentological characteristics observed within each sequence.

Kdc **DEVILS CLAW SEQUENCE**

SEQUENCE OF THICK CHERT PEBBLE CONGOLMERATES AND MINOR GRITTY SANDSTONES INTERBEDDED WITH AN INCREASING NUMBER OF SILTSONES AND MUDSTONES TOWARDS THE BASAL CONTACT. LARGE SCALE TROUGH AND TABULAR CROSS BEDS ARE COMMON. TEN SPECIES OF PLANT FOSSILS OCCUR WITHIN THE SEQUENCE, A FEW OF WHICH OCCUR PREDOMINANTLY NEAR ITS BASE.

Km **MALLOCH SEQUENCE**

THICK INTERBEDS OF MUDSTONES, ARGILLACEOUS SILTSTONES, FINE GRAINED SANDSTONES AND THIN INTERBEDS OF ORANGE WEATHERING NODULAR SILTSTONES. MANY CONGLOMERATE BEDS DISPLAY LARGE SCALE CROSS BEDDING AND TEND TO BE LATERALLY DISCONTINUOUS. THICK CLEAN SANDSTONE BEDS AND THIN COAL SEAMS INCREASE IN ABUNDANCE TOWARDS THE BASAL GRADATIONAL CONTACT. TWENTY-THREE SPECIES OF PLANT FOSSILS OCCUR WITHIN THE SEQUENCE.

JKk **KLAPPAN SEQUENCE (MAIN COAL-BEARING UNIT)**

FINE TO COARSE GRAINED SANDSTONES INTERBEDDED WITH MUDSTONES, SILTSTONES, OCCASIONAL THIN BANDS OF ORANGE WEATHERING CALCAREOUS SILTSTONES, CONGLOMERATES AND ABUNDANT COAL SEAMS. CONGLOMERATE BEDS GRADE LATERALLY INTO SANDSTONE. SANDSTONES OFTEN DISPLAY TABULAR OR TROUGH CROSS BEDDING. RHYTHMITES OCCUR IN THE MIDDLE OF THE SEQUENCE. TWENTY-THREE SPECIES OF BIVALVES AND UP TO TWENTY-FIVE SPECIES OF PLANTS OCCUR THROUGHOUT. PETRIFIED WOOD AND RARE COQUINA MAY BE PRESENT TOWARDS THE UPPER CONTACT.

Js **SPATSIZI SEQUENCE**

PREDOMINANTLY A MARINE SEQUENCE OF INTERBEDDED MUDSTONES, SILTSTONES, SANDSTONES AND CONGLOMERATES. CARBONACEOUS MUDSTONES, COARSENING UPWARDS SEQUENCES AND CHERT PEBBLE CONGLOMERATES ARE MORE ABUNDANT IN THE UPPER PART OF THE SEQUENCE. NINETEEN SPECIES OF BIVALVES ARE PRESENT. BELEMNITES ARE RARE. PLANT DEBRIS MAY OCCUR NEAR THE UPPER GRADATIONAL CONTACT.

TABLE 6-2

MOUNT KLAPPAN ANTHRACITE PROJECT

TABLE OF FORMATIONS

GULF CANADA RESOURCES LTD.

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88/04/12
KLAP:[2050571880072011.PLT SAM

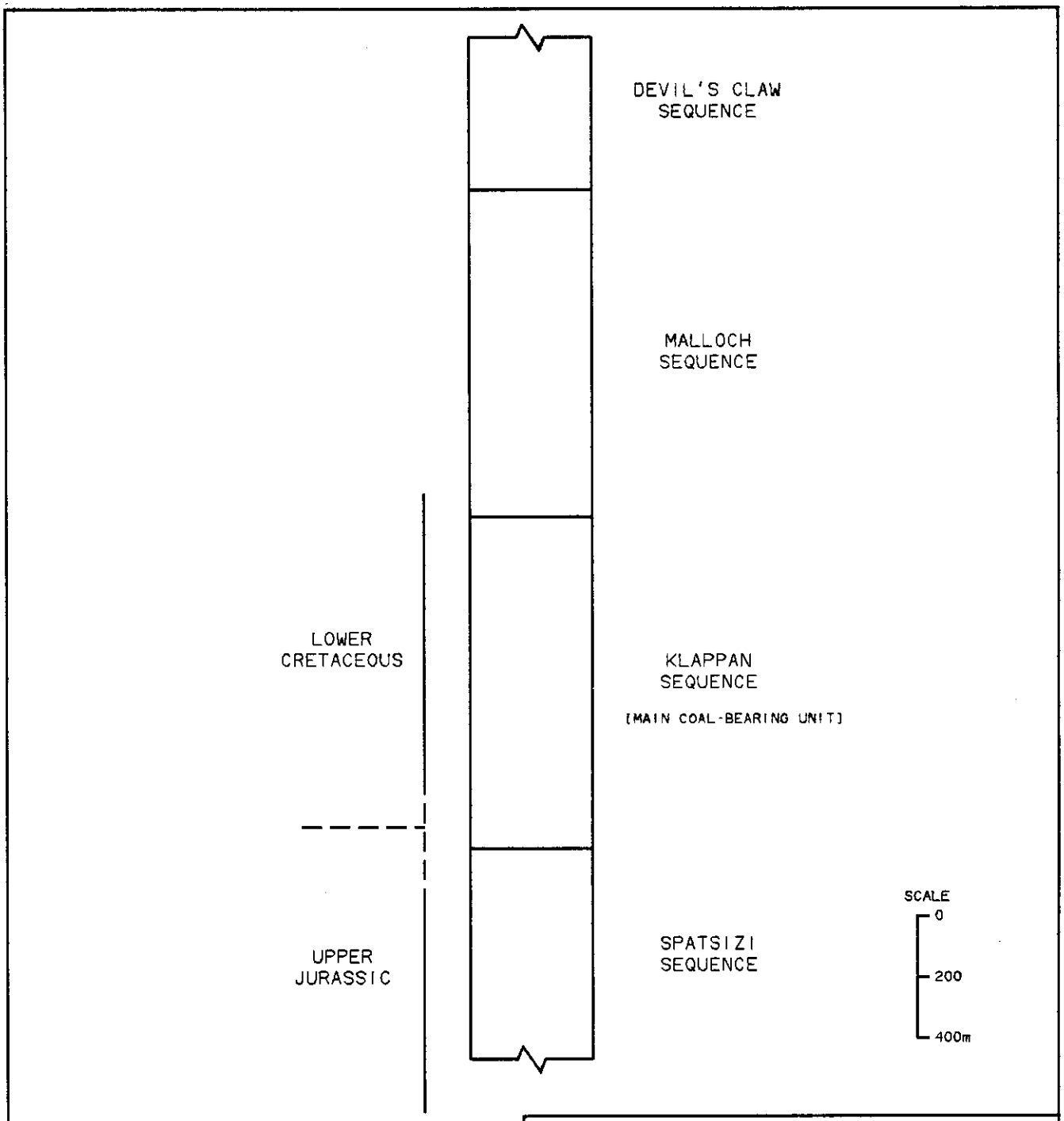


FIGURE 6-2

MOUNT KLAPPAN ANTHRACITE PROJECT

SCHEMATIC STRATIGRAPHIC COLUMN

GULF CANADA RESOURCES LTD.

GULF CANADA RESOURCES LTD.
88/04/06
KLAP:[2050571841165010.CHT SAM

6.3.1.1 Spatsizi Sequence

The Spatsizi Sequence is the lowest stratigraphic unit within the Mount Klappan property. Approximately 600 m of this section has been measured and although the base has not been observed the stratigraphic thickness is estimated to be in excess of 1 200 m. Interbedded mudstones, siltstones and sandstones are found throughout the sequence while thin coal seams and massive conglomerates exist within the upper portion. The overall trend is a coarsening upward sequence with marine conditions throughout and increasing coastal environment influences toward the upper transitional contact with the Klappan Sequence.

Exposures of the Spatsizi Sequence are located in the western and northern Summit Area and in the northern Nass Area of the Mount Klappan property.

6.3.1.2 Klappan Sequence

The Klappan Sequence, the main coal-bearing unit, conformably overlies the Spatsizi Sequence and occurs over the majority of the property. It represents a transition from marine conditions, at the base of the unit, to more coastal influenced sediments toward the top. The stratigraphy consists of cyclic packages of interbedded fine to coarse-grained

sandstones, siltstones, mudstones, laterally discontinuous conglomerates and abundant coal seams. Up to 36 coal horizons with seam true thicknesses of as much as 9.23 m occur within the Klappan Sequence. The sequence is interpreted to attain a thickness of up to 1 100 m though both the upper and lower contacts are transitional.

6.3.1.3 Malloch Sequence

The Malloch Sequence conformably overlies the Klappan Sequence and outcrops in the central, western and southeastern areas of the property. The strata consist of interbedded argillaceous sandstone, siltstone and mudstone with the development of thin coal seams towards the base of the sequence. The Malloch is characterized by its abundance of active channel deposits including laterally discontinuous sandstone and chert pebble conglomerate units. Approximately 900 m of Malloch Sequence are exposed within the Klappan property.

6.3.1.4 Devils Claw Sequence

The Devils Claw Sequence is the youngest stratigraphic package on the Mount Klappan property and has a gradational and conformable contact with the underlying Malloch Sequence. Outcroppings of the Devils Claw are restricted to the southeast of the

property in the Skeena Area where approximately 500 m of the lowermost portion of the sequence is exposed. The top of the sequence has not been observed to date. Lithologically the Devils Claw is dominated by thick, laterally extensive conglomerate units separated by sandstones, siltstones and minor mudstones. The sequence has been interpreted to represent an overall prograding, completely terrestrial, alluvial fan system probably resulting from increased uplift generated further west.

6.3.2 Structure

Deformation of sediments within the Mount Klappan property is the result of two regimes of non-coaxial stress which differ in the intensity of their effect on the stratigraphic package. The dominant structural features in the region are the Beirnes Synclinorium and the parallel Nass River Anticlinorium which trend northwest to southeast. These major folds and all associated structures result from the dominant deformational phase (F1). On the Mount Klappan property the synclinorium axis can be observed in the competent Devils Claw strata as bisecting a broad, open, upright feature and plunging gently to the southeast. Smaller folds on both sides of the synclinorium have axes that dip toward the synclinorium axis. The adjacent major anticlinorium is not so clearly discerned as it is defined solely by the alignment of subordinate folds in the less competent Malloch strata.

Across the Mount Klappan property both outcrop and drilling indicate a structure comprised of south-westerly dipping fold axes and thrust faults that are all part of the F1 regime. The secondary deformation (F2) produces primarily low amplitude, long wavelength folds trending northeast-southwest. These are superimposed on the F1 folding, producing a series of plunge reversals averaging 8° to 10° to the northwest and southeast.

Cleavage is associated with both fold patterns. The F1 cleavage is pervasive and well developed in all fine grained lithologies. It has also been observed in different areas either as axial plane divergent or convergent, trending generally at 135°. Similarly, cleavage related to the F2 folding can be convergent or divergent and trend anywhere from 030° to 110°.

Non-compressional structures are also a feature of the Mount Klappan area. High angle normal faults trending north-south and large scale fracture zones trending east-west have been recorded regionally. These may have resulted from re-activation by F2 stresses of zones of weakness formed during F1 deformation; they may be relaxation features dating from before or after the F2 event; or they may be related to an entirely separate deformational event.

6.3.3 Plant Macrofossils and Fossil Fauna

During the 1984 to 1987 field seasons 1 420 specimens of fossil flora and fauna were collected from 803 sites on

the Mount Klappan property during routine traverses and the drill core logging program. The 27 species of fossil fauna and up to 27 species of plant macrofossils collected have aided in age determination, paleoenvironmental interpretations, stratigraphic delineation and, to a lesser extent, detailed stratigraphic correlation. The 1984 to 1987 Fossil Location Map in Appendix I documents all collection sites and a complete listing of fossils with stratigraphic and geographic positions is given in Appendix D.

6.3.3.1 Fossils Evidence for Stratigraphic Age

Twenty three species of plant macrofossils previously identified within the Klappan and Malloch Sequences on the Mount Klappan property were dated as Lower Cretaceous on the basis of floristic comparisons with other western Canadian Lower Cretaceous formations with similar collections (Table 6.3).

An age ambiguity is present at the Klappan-Spatsizi contact zone where limited Lower Cretaceous plant species and abundant Jurassic-Cretaceous marine fauna co-exist. Age dating confidence increases, however, towards the middle and upper Klappan Sequence where there is a marked increase in plant species diversity and numbers (Table 6.4). For this reason, the Jurassic-Cretaceous contact, previously placed at or near the Spatsizi-Klappan contact zone, remains unchanged.

KLAPPAN - MALLOCH - DEVILS CLAW FORMATION
PLANT MACROFOSSILS

		FORMATIONS	CLADOPHLEBIS WHITBIENSIS	SPHENOPTERIS SOLENSIS	EQUISETITES LYELLI	BAIERA FURCATA	BAIERA GRACILIS	GINKGO LEPTOPHYLLA	GINKGO SIBIRICA	GINKGO PLURIFURCATA	CZEKANOWSKIA RIGIDA	PHOENICOPSIS ANGUSTIFOLIA	PHOENICOPSIS SPECTABILIS	PHOENICOPSIS PLICATUM	NILSSONIA ORIENTALIS	NILSSONIA CHALOKENSIS	NILSSONIA TENUINERVIS	NILSSONIA SCHAUMBURGENSIS	OTOZAMITES BEANEI	NILSSONIA ORIENTALIS	PSEUDOCTENIS EATONI	PSEUDOCTENIS ACUTIFOLIUS	PSEUDOCTENIS LANCEOLATUS	SAGENOPTERIS NILLIANSII	PHLEBOPTERIS KNOWLTONI	ELATIDES CURVIFOLIA	CONIOPTERIS HYMENOPHYLLOIDES
LOWER CRETACEOUS	ALBIAN	BLAIRMORE FM (UPPER FLORA)	●	•																		7 •					
		PASAYTEN GP	●															7 •									
		KINGSVALE GP												•													
		CROWSNEST FM																									
		COMMOTION FM																									
	APTIAN	BLAIRMORE GP (LOWER FLORA)	●	•	•				•	●					•						●	•	●	●	●		•
		LUSCAR FM	●	•	●					●		●	•		•						●	●	●	●	●		•
		BULLHEAD GP (GETHING FM)	●				•	•		•		●	•		●						●	●	•	•	•		•
		USLIKA FM	●																								
		HAZELTON GP (SKEENA BEDS)					•		•	•		•			•						•			●	•		
		JACKASS MOUNTAIN GP	●									•													•	•	
		SPENCE BRIDGE GP																								•	
	NEOCOMIAN - BARREMIAN	KOOTENAY FM	●		●	•	•	●	●	•	●				•		●	●	•		●	●	•				
		NIKANASSIN FM			•	?			•	•	•								●		•	•					
		HAZELTON GP (HAZELTON AREA)	●		●	•			●		●			•			•		•		●	•	•				
		HAZELTON GP (GROUNDHOG AREA)	●						•	•					•	•		●				•					
		TANTALUS FM	•											•		•					•						•

* PARTIAL SPECIES LISTS ARE GIVEN FOR ALL FORMATIONS. ONLY THOSE SPECIES COMMON TO BOTH MT. KLAPPAN AND OTHER FORMATIONS ARE INCLUDED.

TABLES INDICATES A LOWER CRETACEOUS AGE FOR COAL-BEARING STRATA OF MT. KLAPPAN BY FLORISTIC COMPARISONS WITH OTHER WESTERN CANADIAN LOWER CRETACEOUS FORMATIONS WITH SIMILAR COLLECTIONS.

● 1 - 2 DOCUMENTED OCCURENCES

● 3 - 4 DOCUMENTED OCCURENCES

● 5 OR MORE DOCUMENTED OCCURENCES

(BASED ON DATA FROM BELL, 1956)

TABLE 6-3

MOUNT KLAPPAN ANTHRACITE PROJECT

AGES OF MOUNT KLAPPAN PLANT MACROFOSSILS IN OTHER WESTERN CANADIAN FORMATIONS

GULF CANADA RESOURCES LTD.
12/11/86
KLAP:[205057]851022001.CHT

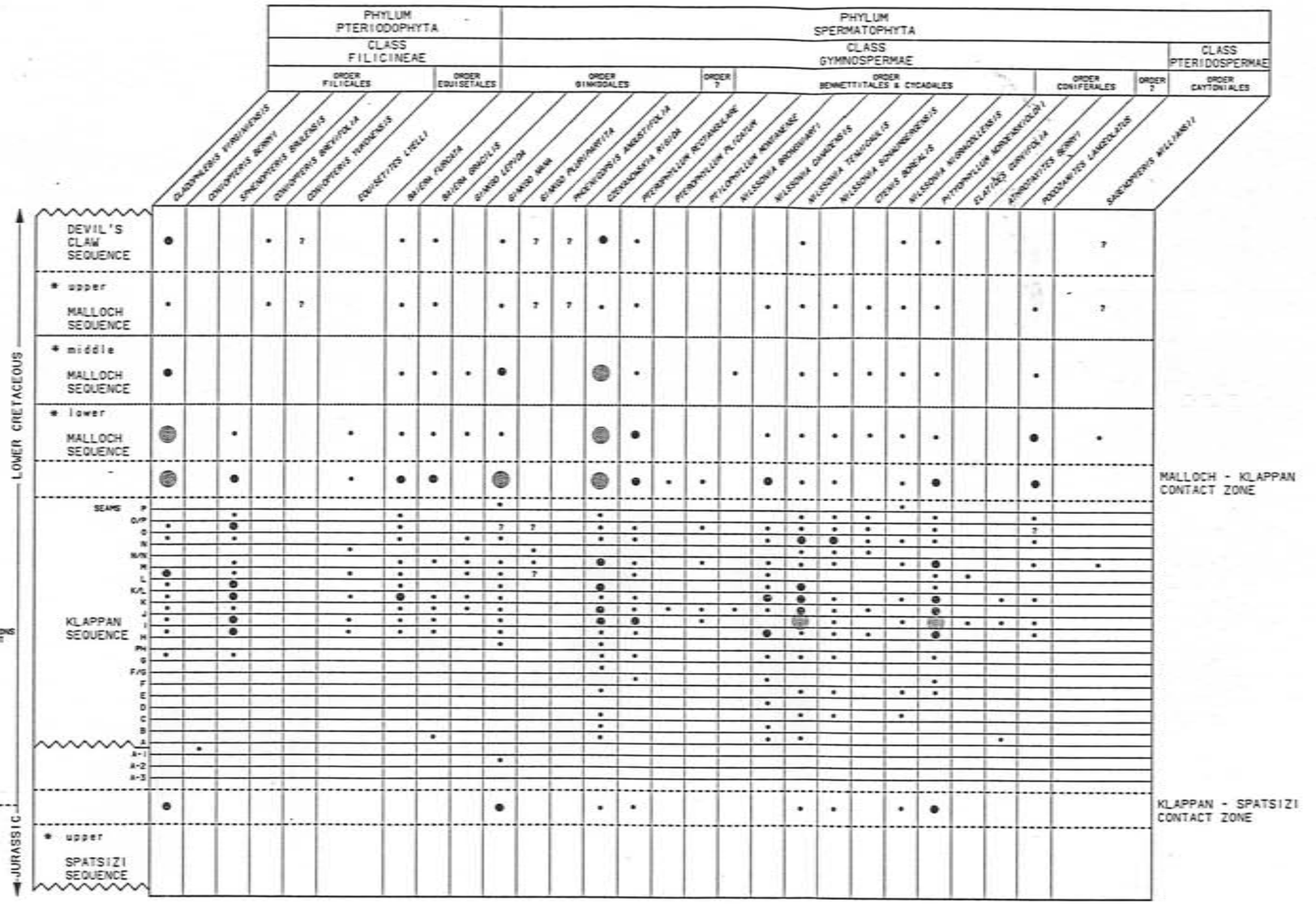


TABLE 6-4

MOUNT KLAPPAN ANTHRACITE PROJECT

STRATIGRAPHIC POSITION
OF PLANT MACROFOSSILS

GULF CANADA CORPORATION
19/01/87
KLAP:[205057185]005001.CHT

6.3.3.2 Fossil Distribution and Limitations as Index Fossils

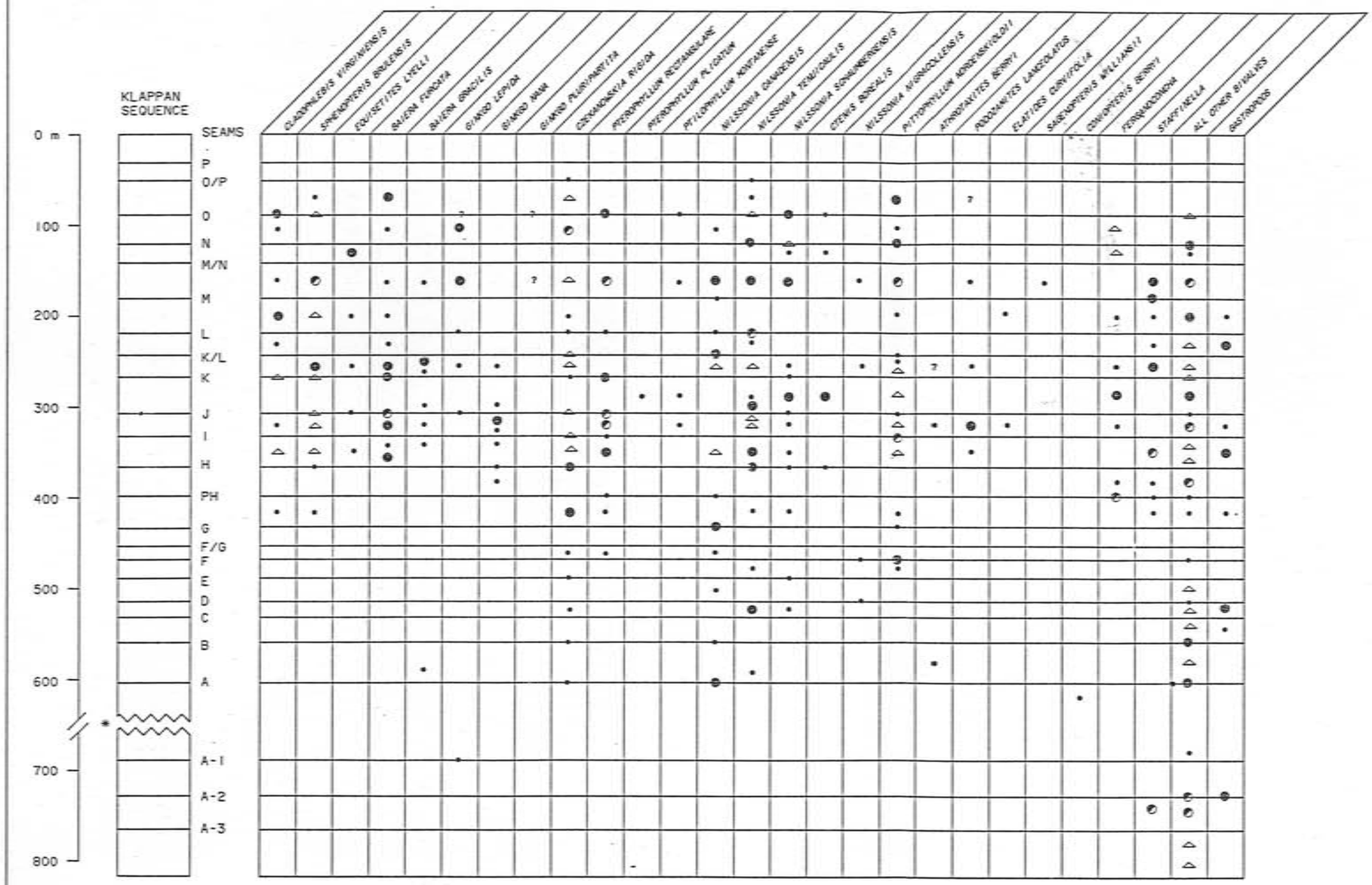
During the 1987 field season an additional 320 specimens were collected at 213 sites, including drill hole intersections, bringing the total specimen and collection site totals to 1 420 and 903 respectively. Despite the increasing data and stratigraphic control, few individual species are believed to be true index fossils, except on a localized basis.

Numerous marine bivalves, along with gastropods, belemnites and ammonites have been found in the Spatsizi Sequence which confirms previously known trends. Until this year, the Spatsizi Sequence was the only Mount Klappan strata to be characterized by the presence of lytoceratid ammonites and to lack in-situ plant fossils. In 1987, one ammonite was found above K seam in drill core. An attempt to identify the species and determine the age of the fossil was unsuccessful. Belemnites, previously thought to be relatively abundant only within the Spatsizi Sequence, have been recently documented in the Klappan Sequence at one location above K seam in drill core (DDH87030), below A seam on Lost Ridge and on Repeater Ridge in the Summit Area.

The Klappan Sequence contains the only brackish water bivalves (the oyster, Ostrea, and Modiolus),

both of which have been found only in the lower Klappan Sequence. Ferganoconcha, a large fresh water bivalve, has proven to be more widespread in occurrence than previous documentation indicated. This fossil occurs within the upper Klappan Sequence in the Lost-Fox N - O interseam, in drill core and in outcrop. It has more recently been noted between seams G and M in drill core only. Gastropods, known to be abundant in the lower Klappan, have also been found this year in the middle Klappan below seam I and near seam L.

The flora of the Klappan Sequence is apparently more widespread than originally thought as can be expected with a greater number of sites. Athrotaxites berryi is a new addition to the Klappan Sequence assemblage. This conifer was found in abundance at one outcrop site below J seam and in drill core above K seam. The Malloch Sequence continues to be characterized by abundant flora, with 24 of the 27 species represented, and a lack of marine fauna. A few more species were added to the Malloch assemblage in 1987 including Coniopteris brevifolia. The Devils Claw Sequence typically has no marine fauna and rare flora. Tables 6.4 and 6.5 illustrate the statigraphic position of all species documented on the Mount Klappan property. Given the continuing increase in distribution of flora and fauna throughout the Klappan and Malloch sequences, property wide



* LOWER SECTION, REPRESENTED BY DDH86026, TENTATIVELY INTERPRETTED TO BE BELOW SEAM A
NO SPECIFIC A/A-1 INTERSEAM IS IMPLIED (MAY BE AS MUCH AS 150-200m)

** INTERSECTIONS/OCCURENCES BASED ON 1986 AND 1987 DRILLING AND INTERPRETATION OF TRENCH SEAMS

? 1 QUESTIONABLE INTERSECTION

• 1 INTERSECTION/OCCURENCES

● 2 INTERSECTION/OCCURENCES

◐ 3 INTERSECTION/OCCURENCES

△ 4 - 6 INTERSECTION/OCCURENCES

VERTICAL SCALE 0 100 200 300 m

TABLE 6-5

MOUNT KLAPPAN ANTHRACITE PROJECT

KLAPPAN SEQUENCE
STRATIGRAPHIC POSITION OF
FOSSIL FLORA AND FAUNA

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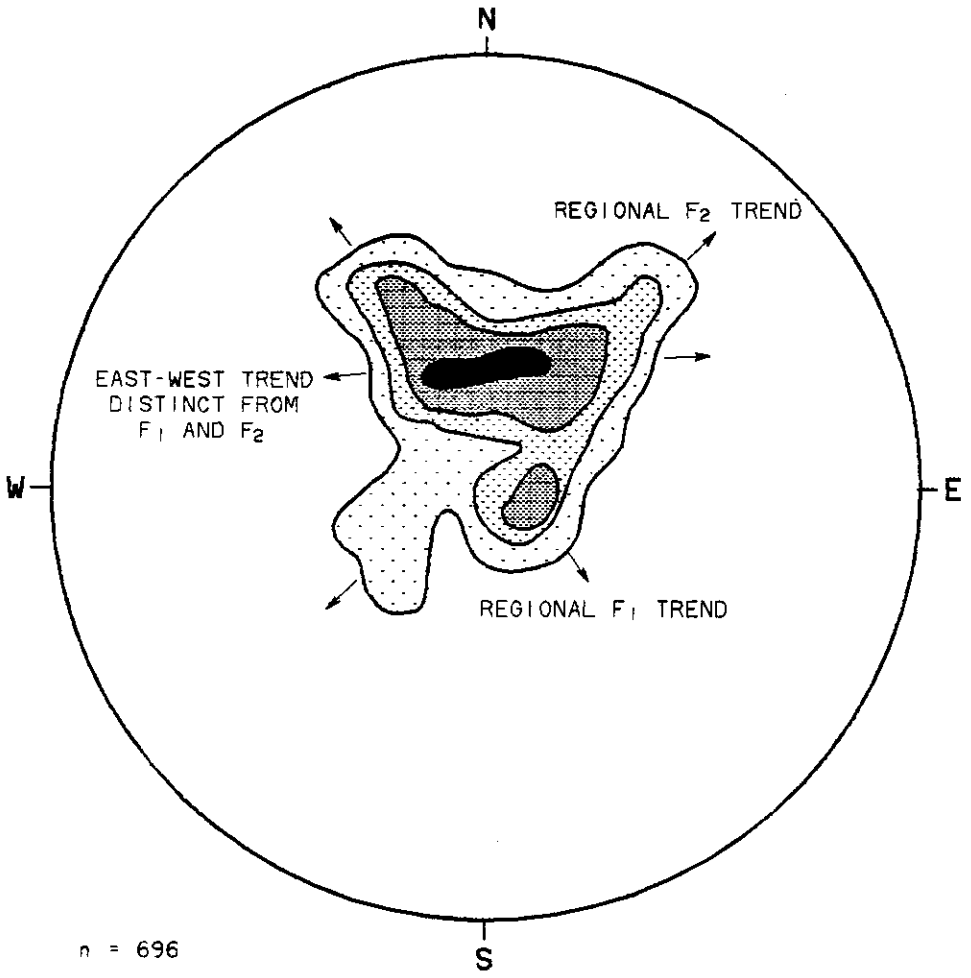
correlations on the basis of individual species are not advisable. Although increased data has confirmed a few previously noted fossil group trends, it has also proven that a number of seemingly rare species have a wider stratigraphic and geographic distribution than previously thought.

6.4 Summit-Nass-Skeena Area Geology

6.4.1 Introduction

The entire stratigraphic section represents a sequence of environments from marine deltaic in the Spatsizi Sequence, to delta plain, fluvial environments, and finally alluvial fan environments in the Devils Claw Sequence. Overall this represents a coarsening upward megacycle deposit that was the result of a large scale progradation during the Late Jurassic to Early Cretaceous. The Spatsizi, Malloch and Devils Claw (formerly Rhondda) sequences are well represented in excellent outcrop exposures while the Klappan Sequence is best represented by the diamond drill hole information from the Lost-Fox (Lost Ridge) area.

The regional structure is characterized by two phases of non-coaxial stress which have generated a northwest-southeast folding trend (F_1) and a generally less prominent northeast-southwest folding trend (F_2) (Figure 6.3). The first phase of deformation (D1), resulted in the formation of the Beirnes Synclinorium with an axial surface and cleavage trend of approximately 135°. F_1 folds to the northeast of



5 - 6% (34 - 41 MEASUREMENTS)
4 - 5% (26 - 34)
3 - 4% (20 - 26)
2 - 3% (14 - 20)
0 - 2% (0 - 14)

FIGURE 6-3

MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT AREA
KLAPPAN SEQUENCE
EQUAL AREA PLOT OF POLES TO BEDDING PLANES

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this major structure also trend 135° and generally have long, upright southwest limbs with shorter upright to overturned northeast limbs. Axial planes for these folds typically dip towards the southwest. The second deformational event (D2), has resulted in low amplitude folds (F_2) which are generally perpendicular to the F1. Cleavage trends for this second set of folds vary from 30° to 110°. The results of the D2 on the first set of folding is portrayed as a series of plunge reversals. Post D2 structural events include normal, reverse and some minor thrust faulting.

The Summit Area continues to be of the greatest interest with reference to coal seam development. The stratigraphy appears to represent the Lower Klappan Sequence and may contain as many as seventeen seams with true thickness ranging from <0.50 m to 3.20 m. Much of this data is based solely on outcrop and trench data. The Nass Area theoretically contains the entire Klappan Sequence. Unfortunately, the majority of the Klappan Sequence lies in the Nass and Klappan Valleys which retain a large amount of water in the form of lakes and swampy terrain. Coal seam tracing is restricted to areas above tree line and to river cut exposures.

This report will deal with each sequence as it occurs in the Summit, Nass and Skeena Areas and will cover any changes made in the contacts between successive sequences. A short section of reinterpretation of some structure and a summary of coal seam development is also included for the Nass and Summit Areas.

6.4.2 Summit Area

6.4.2.1 Spatsizi Sequence

This predominantly marine sequence of the Upper Jurassic underlies the anthracite bearing Klappan Sequence. It is approximately 1 200 m in thickness although only 600 m outcrop on the property. The upper Spatsizi is characterized by repetitive coarsening upward cycles on the order of 15 to 45 m in thickness each (Plate 6-1). A typical cycle would exhibit interlaminated to thinly interbedded dark grey mudstone (slightly carbonaceous in some locations) and rippled siltstone at the base. This is overlain by progressively coarser sediments with a fine to medium grained sandstone capping the sequence. Conglomerates are found throughout the sequence and tend to be laterally continuous over only a few hundred metres. They vary in thickness from a few cm of pebble lag, which is common higher in the section, to tens of m (generally lower in the section).

Common sedimentological features include low angle planar cross-bedding and wave ripples. Minor rip-up clasts, and bivalves have also been observed. Another common feature is randomly oriented tree fragments in coarse grained sands and conglomerates. Marine bivalves such as Acesta, Hypoxytoma, Buchia concentrica, and the brackish water oyster Ostrea have been documented in the Spatsizi Sequence of the Summit

Plate 6-1 Photograph of several coarsening upward sequences near the top of the Spatsizi Sequence, west face of Caribou Cirque. Light colored bands represent coarse grained lithologies. The Spatsizi/Klappan Sequence contact occurs near the top of this outcrop. View looking east.

Area. Very thin, discontinuous carbonaceous mudstone occurs near the top of the Spatsizi Sequence.

The Spatsizi/Klappan contact is a gradational zone through which the environment alters from marine to a more terrestrial setting. Interfingering of marine and lower delta plain sediments is observed on either side of the contact. The contact is placed where in-situ plant fossils become abundant, where there is a marked decrease in marine fauna, and where the first laterally continuous coal zone occurs. It coincides approximately with the transition from Jurassic to Cretaceous.

Seam tracing has allowed a more exact placement of the contact zone to the north and west of Caribou Cirque.

6.4.2.2 Klappan Sequence

The Summit Area includes approximately 600 to 1 000 m of documented Klappan Sequence. This strata represents a marginal marine environment which was subjected to periodic sea level fluctuations and episodic periods of hinterland uplift. Minor coarsening upward sequences are still prominent at the base of the Lower Klappan and are typically capped by thin coal seams, which may thicken locally. Oriented tree fragments (Plate 6-2), trough cross-bedding or high angle planer cross-bedding is common. Numerous

Plate 6-2 Oriented tree or plant material within a sandstone. Lens cap for scale.

bivalve death assemblages have been noted, typically near the top of the coarsening upward sequences (Plate 6-3), and are interpreted to represent a more seaward facies penecontemporaneous with the development of the coal at the same stratigraphic level. Belemnites, turritellid gastropods and marine bivalves found in the lower package of the Klappan Sequence on the southern edge of Repeater Ridge and in outcrops KPNSSOTC84004, 84005 and 87005 may be indicators of brief shallow marine incursions.

The basal 200 m of the Klappan Sequence is best exposed in the Caribou Cirque/Little Repeater Ridge areas (Map J12). Marginal marine sediments and an increase in the amount of plant debris and recognizable plant fossils marks the transition to a more terrestrial environment. A laterally continuous coal seam passes through TRC87305 (C/C+R = 0.59/0.59 M) and is designated the lowermost Klappan Seam A'. It is overlain by Seams B' and C' which have been trenched near the apex of Little Repeater Ridge as TRC87304 (C/C+R = 0.90/1.45 M) and TRC86031 (C/C+R = 1.46/1.59 M) respectively. Seam D' occurs between Little Repeater Ridge and Caribou Cirque but it disappears into the scree and is difficult to trace. Although there is a marked increase in terrestrial influence, marine incursions are still relatively common. An example of this would be the oyster horizon situated in the main saddle of Layton Ridge (Map K12).

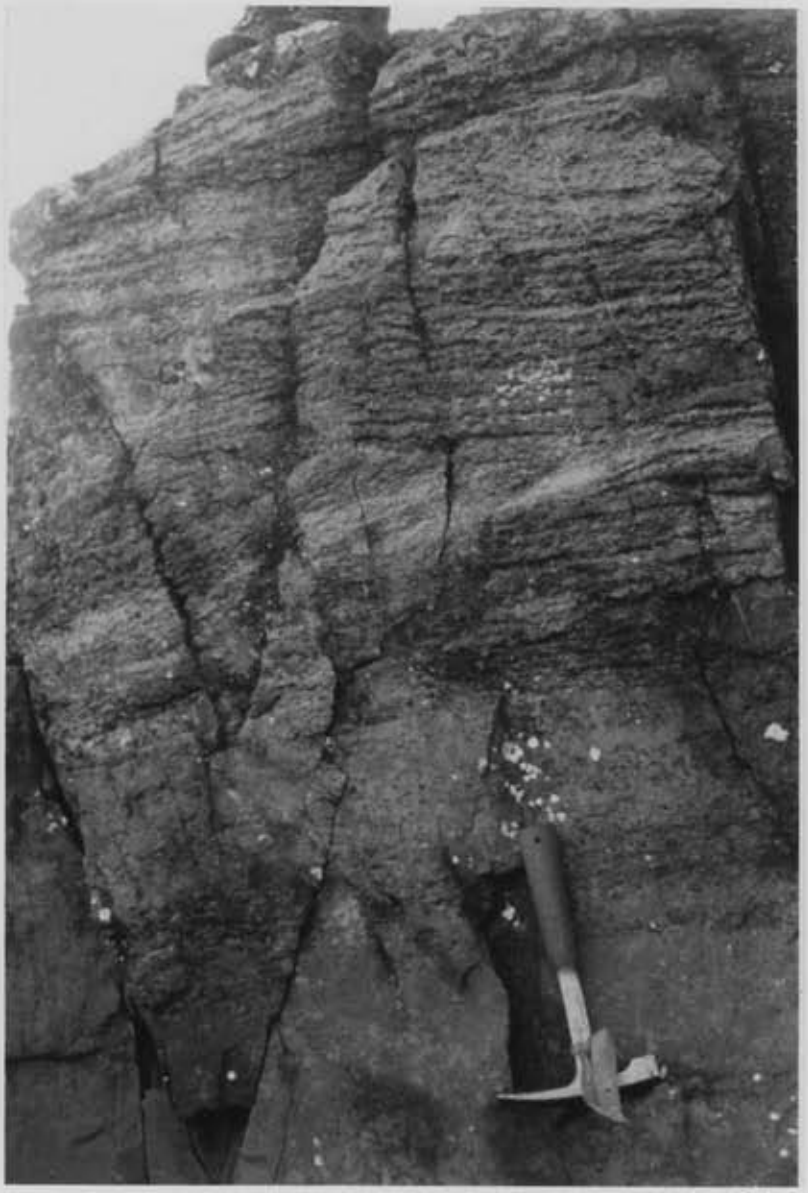


Plate 6-3 Two meter thick bivalve death assemblage at the top of a small coarsening upward sequence. Note the trough cross bedding. North face of Porky's Peak.

The strata between Seams D' and J' contain greater than 40% sandstone. The coal seams become better defined and are easier to trace as they typically overlie thick laterally continuous sandstones. Of particular interest in this zone is a 1.5 cm bentonite horizon stratigraphically above TRC83057. Unfortunately it is within a recessive unit which typically weathers into a scree slope and is therefore difficult to trace on surface. Between Seams H' and I' there is a 2 m zone of sandstone at the west end of Marshall Ridge which contains abundant trace fossils identified as Diplocraterion (Plate 6-4). These long vertical burrows are associated with a high energy environment causing physical reworking of sediment by currents or waves. This sand has been interpreted as a marine foreshore facies and supports the theory of an interfingering of marine and terrestrial sediment in this transitional zone.

The seams and stratigraphy above J' are thought to be stratigraphic equivalents of the lower seams found on Lost Ridge. An undergraduate thesis by Derrick Willis, presently in preparation, will discuss whether a direct correlation is possible. The environment associated with the strata above Seam J' changes progressively into a more terrestrial upper deltaic facies during the Cretaceous. This environment was strongly influenced by two processes. Periodic uplift of the surrounding terrain resulted in

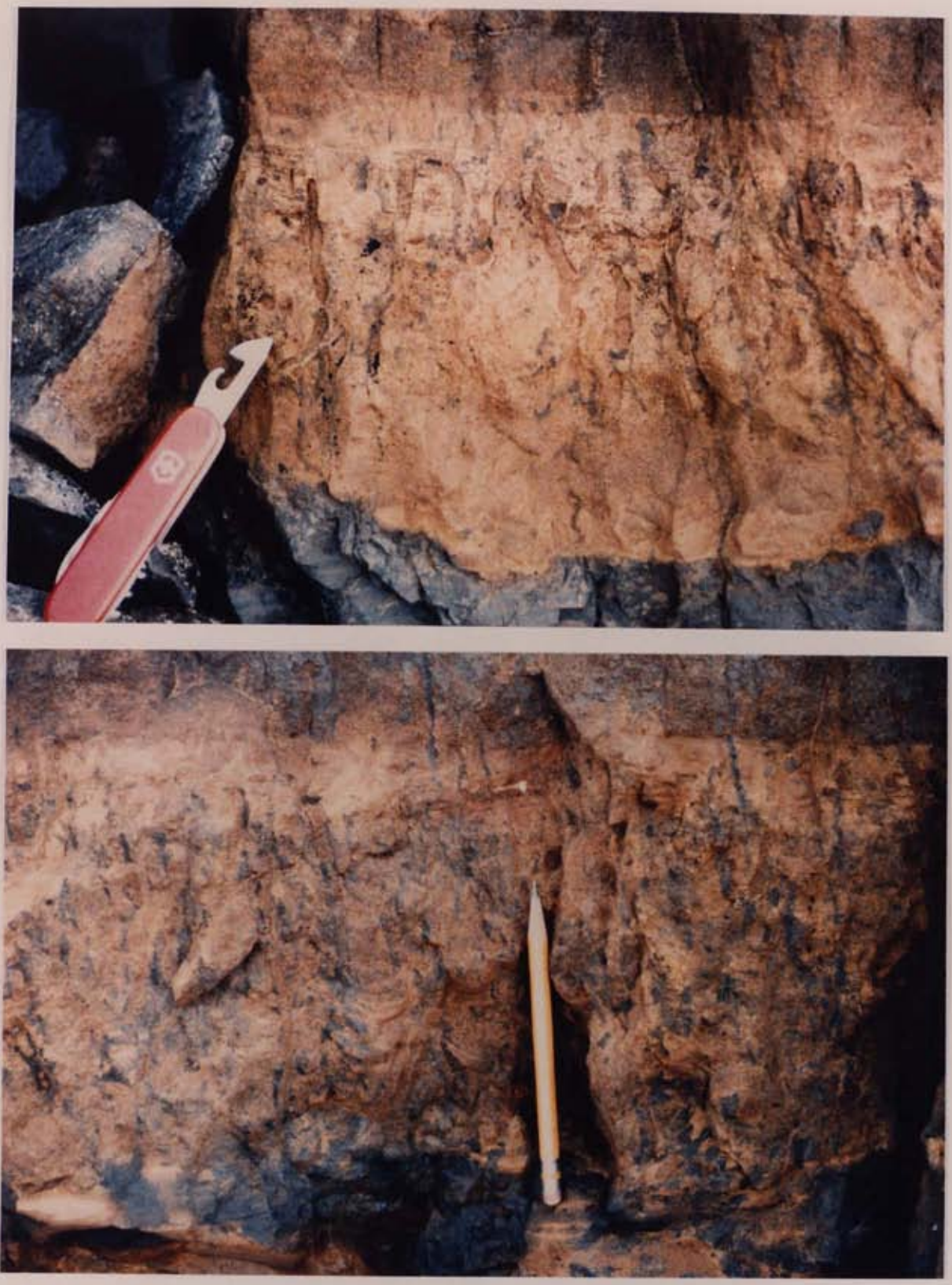


Plate 6-4 Diplocraterion trace fossils. Vertical worm burrows associated with a high energy environment and interpreted to indicate a marine foreshore facies. (Photographs courtesy of J. Innis).

an increase of sediment from the hinterland which slowly buried developing coal swamps. Fluctuations in sea level had the affect of promoting coal swamp development. These two processes resulted in a more gradual fining upward sequence below the coal seams and a gradual coarsening upward sequence above.

The strata above J' seam tends to contain less prominent sandstone and a more diverse mixture of silt, mud and coal. One highly visible unit is an orange and grey banded ("tiger stripe") outcrop that occurs in several locations (Plate 6-5). It is approximately 10 to 15 m in thickness and closely resembles the outcrop 200 m north of the Hobbit-Broatch test pit along the B.C.R. subgrade. Alternating, thin bands of siltstone and sandstone and the presence of Helminthopsis indicate a bay fill environment. The ratio of coarse sediment to fine grained sediment decreases upward. Higher in the stratigraphy sandstone beds tend to be thinner and less numerous.

The middle and upper Klappan Sequence, which contains the majority of thick and laterally extensive anthracite seams, is best represented in diamond drill core from Lost Ridge. A complete description can be found in the Lost-Fox 1987 Geological Report.

Plate 6-5 Interbedded siltstone and fine grained sandstone ("tiger stripe"), along with the presence of helminthopsis, indicates a bay fill environment. Approximately 1 Km east of Fiction ridge. View looking northwest.

Table 6.6

SUMMIT AREA TRENCH SUMMARY

Year	Trench	C/C + R (m)	Sequence
1981	81007	3.98/4.97	Klappan
	81008	3.07/4.45	Klappan
1982	82035	3.29/3.48	Klappan
	82039	6.36/7.72	Klappan
1983	83048*	6.60/7.00	Klappan
	83049	0.87/1.37	Klappan
	83051	1.36/1.47	Klappan
	83052	3.50/3.50; 4.83/5.20	Klappan
	83054	1.71/1.91	Klappan
	83055	2.32/2.74	Klappan
	83056	1.92/2.32	Klappan
	83057	1.93/2.54	Klappan
	83058	5.33/5.68	Klappan
	83059	0.91/1.13; 1.89/2.27	Klappan
	83060	7.68/9.24; 0.90/0.90	Klappan
	83061	1.40/1.90	Klappan
	83062	1.79/1.89	Klappan
	83063	0.00/4.20	Klappan
	83064	0.50/0.70	Klappan
	83065	0.08/0.08	Klappan
	83066	6.18/7.02	Klappan
	83067	1.10/1.81	Klappan
	83074	1.53/2.95	Klappan

*retrenched (85003) therefore not included in average coal seam thickness.

Table 6.6
Cont'd

SUMMIT AREA TRENCH SUMMARY

Year	Trench	C/C + R (m)	Sequence
1983 (cont'd)	83075	3.15/3.25	Klappan
	83078	0.60/0.60	Klappan
	83079	0.70/0.70	Klappan
	83080	0.50/0.50	Klappan
	83081	0.80/0.80	Klappan
	83082	0.15/0.15	Klappan
	83083	3.75/4.85	Klappan
1984	84001	0.80/0.80	Klappan
	84002	0.75/0.75	Klappan
	84008	0.54/0.80	Klappan
	84009	0.48/0.48	Klappan
	84013	0.72/1.55	Klappan
	84016	0.59/2.13	Klappan
	84017	0.85/0.86	Klappan
	84020	1.53/2.91	Klappan
	84021	0.82/0.97	Klappan
	84022	2.55/2.65	Klappan
	84023	1.20/1.44	Klappan
	84024	0.75/0.75	Klappan
	84025	0.89/1.72	Klappan
	84026	1.63/1.83	Klappan
	84027	2.69/3.32	Klappan
	84028	0.75/1.58	Klappan
	84029	2.52/2.88	Klappan
	84030	0.32/0.43	

Table 6.6
Cont'd

SUMMIT AREA TRENCH SUMMARY

Year	Trench	C/C + R (m)	Sequence
1985	85001	1.22/2.27	Klappan
	85002	4.37/4.37	Klappan
	85003+	0.72/0.72	Klappan
	85005	1.06/1.23	Klappan
	85009	1.44/2.47	Klappan
	85011	2.44/3.00	Klappan
	85012	1.87/2.52	Klappan
	85019	1.30/1.50	Klappan
	85020	1.30/1.06	Klappan
	85021	1.39/1.63	Klappan
1986	86019	1.27/1.39	Klappan
	86030	2.47/2.78	Klappan
	86031	1.46/1.59	Klappan
	86033	1.36/1.45	Klappan
	86024	0.96/1.16	Klappan
	86025	2.16/3.15	Klappan
1987	87300	1.01/1.46	Klappan
	87301	1.60/2.03	Klappan
	87302	2.94/3.14	Klappan
	87303	0.64/1.32	Klappan
	87304	0.90/1.45	Klappan
	87305	0.59/0.59	Klappan

Table 6.6
Cont'd

SUMMIT AREA TRENCH SUMMARY

Year	Trench	C/C + R (m)	Sequence
1987 (cont'd)	87306	0.91/0.91	Klappan
	87307	1.60/1.96	Klappan

Note: TRC86032 with a C/C +R = 0.60/0.62 was logged for the purpose of seam tracing but is not included in above due to insufficient coal thickness.
+ Relogged Trench 83048

6.4.2.3 Coal Seam Development

6.4.2.3.1 Klappan Sequence

Of the three peripheral areas (Summit, Nass and Skeena), the Summit South Area continues to have the greatest potential to contain economic anthracite reserves. The three target areas in Summit are the Marshall-Layton-Alvin Ridge Area, the Porky's Peak Area, and the Caribou Cirque Area. In total, 72 hand trenches have been excavated to date, including 8 in the 1987 field season (Table 6.6). The two diamond drill holes in the area, DDH82007 and DDH83003, intersect a total of 7 distinct anthracite horizons.

Seam tracing in 1987 resulted in a clearer understanding of the resource potential in each area. The Caribou Cirque Area contains the lowest package of seams within the Klappan Sequence (A' to D'). Seam thicknesses range from 0.59 to 2.78 m. An average vitrinite reflectance of 4.75% clearly indicates an anthracite rank. The average ash value for seams in the lower package is approximately 40%. The dip of the strata in a "bowl shape" toward the south (toward Lost Ridge), creates a promising mining situation. Limited outcrop south of this area requires

the implementation of mechanical trenching or possibly a limited drilling program to determine the extent, unweathered quality, and thickness of these seams.

The Marshall-Layton-Alvin Ridge Area contains the package of anthracite seams from E' to J'. Thickness of seams ranges from 0.75 to 2.54 m. Favorable structural conditions in the lowlands to the east of Marshall Ridge, around the "Boomerang", makes this an area of substantial interest. Trench 87301 on the east end of Marshall Ridge exists between two prominent sandstones (Plate 6-6), and represents a very short-lived coarsening upward sequence.

Anthracite seams designated K' to Q' occur in the Porky's Peak Area. Thickness of seams ranges from 0.70 to 3.20 m. The most reliable information in this area is taken from diamond drill hole DDH83003, which intersects a total of 5 seams with an aggregate true thickness in excess of 8.5 m over an interval of 126.61 m. These seams have been designated as M', N', O', P' and Q' (Table 6.7). Two zones within this drill hole which were previously interpreted as coal lost (1986 seams E' and F') have been reinterpreted to represent a low density, vuggy, bivalve zone (Plate 6-3).

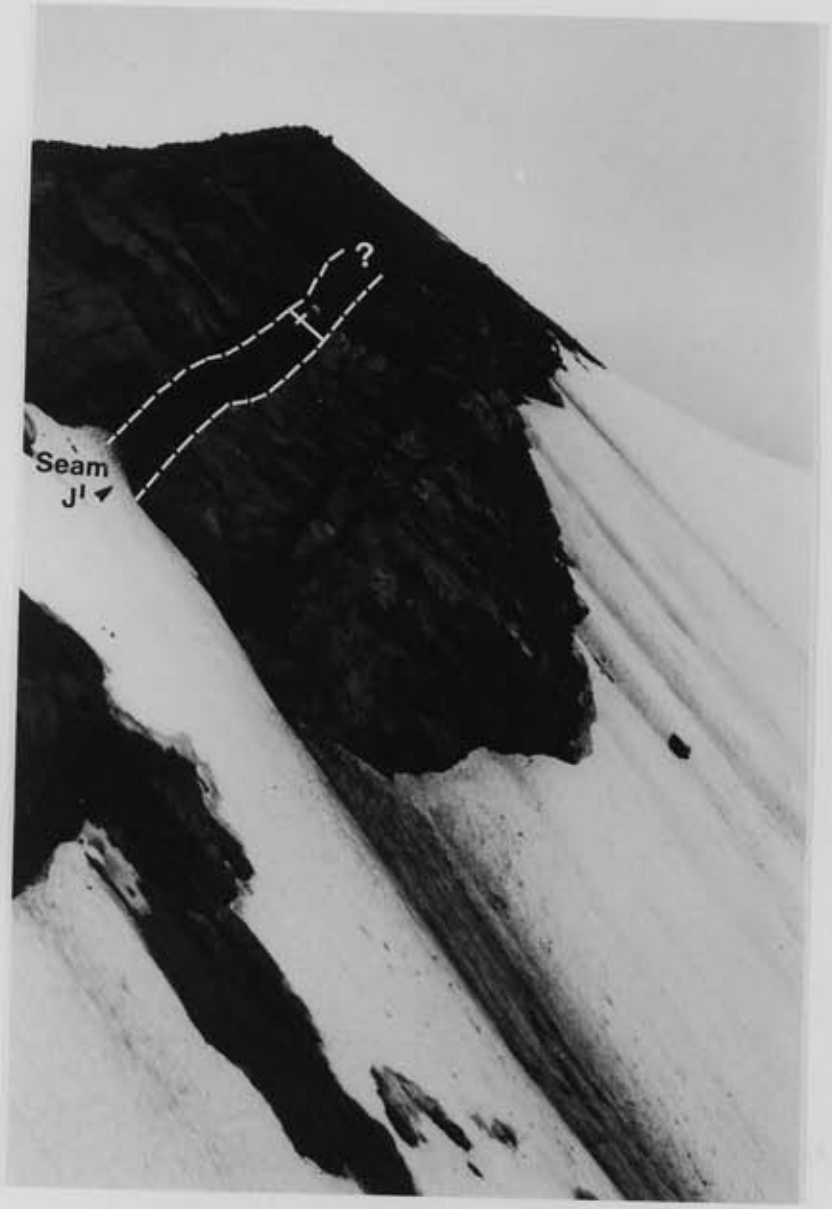


Plate 6-6 Trench 87301 located at the east end of Marshall Ridge exhibiting a coal seam between two sandstone beds. View looking south. (photograph courtesy of K. Hunter).

Table 6.7

SUMMARY OF SUMMIT AREA
DRILLED SEAM INTERSECTIONS

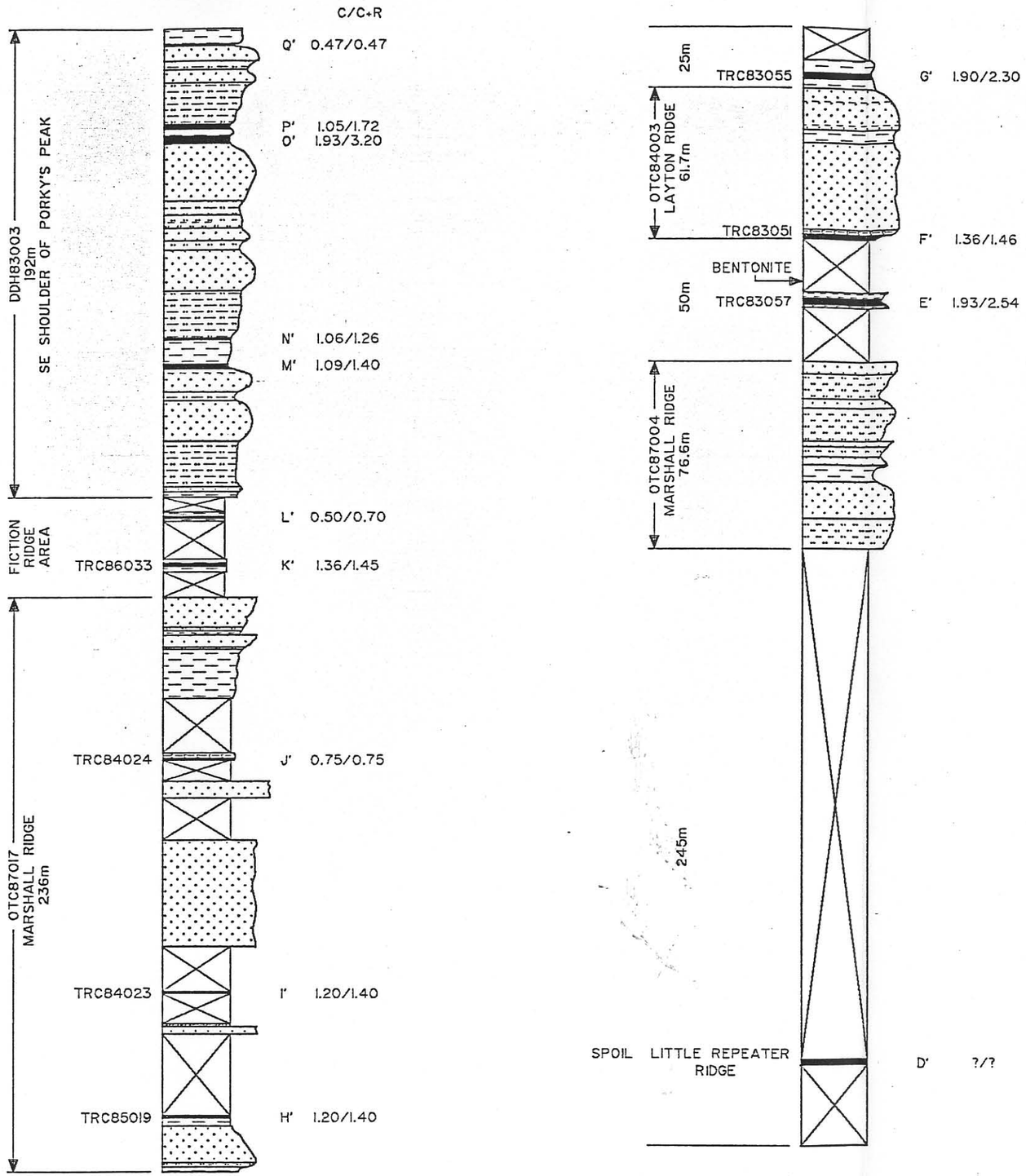
Drill Hole	Seam**	Drilled Interval (m)	Seam True Thickness (m)	Interseam True Thickness (m)	Coal (m)/ Coal + Rock
82007	S'	19.19 - 23.10	3.91		2.13/3.91
				33.85	
	R'	57.14 - 59.85	2.71		1.95/2.71
				21.41	
	Q'	81.26 - 81.71	0.45		Coal Loss
				14.85	
	P'	96.56 - 97.85	1.29		0.80/1.29
82003	Q'	In casing	0.47		0.97/0.47*
				27.34	
	P'	40.30 - 42.05	1.72		1.05/1.72
				2.71	
	O'	44.80 - 48.00	3.20		1.93/3.20
				76.58	
	N'	126.95 - 128.24	1.26		1.06/1.26
				9.15	
	M'	137.68 - 139.10	1.40		1.09/1.40

*Spudded into seam, coal unconsolidated and represents a minimum thickness.
**Seam designations are subject to confirmation by future drilling.

Diamond drill hole DDH82007, located near the airstrip, intersected four seams designated as P', Q', R', and S' (Table 6.7). They have a total true thickness of 8.36 m over an interval of 78.47 m.

Although no direct correlation between Summit South and the Lost Ridge Area exists at this time, it is believed that seam J' and above may represent the lowest package of seams encountered on Lost Ridge. An undergraduate thesis presently underway will help in determining whether a correlation is possible.

The Summit South stratigraphic sequence was constructed utilizing drill hole, outcrop, trench, and seam tracing information (Figure 6.4). The section extends from the Klappan/Spatsizi contact zone to the top of DDH83003 located near Porky's Peak, a vertical distance of approximately 1 000 to 1 200 m. This is only an approximation due to the number of covered intervals whose thickness were estimated. The 245 m covered interval between D' and E' may be as little as 100 m. This section represents a total of 17 seams with an aggregate coal/coal + rock thickness of 13.12 /15.63 m. The amount of overburden covering



MIDDLE TO LOWER KLAPPAN SEQ.
FOUND IN SUMMIT SOUTH

NOTE: THESE SEAM DESIGNATIONS ARE NOT CORRELATABLE WITH THOSE ON LOST RIDGE.

SCALE 1:2000

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FIGURE 6-4

SUMMIT AREA

COAL SEAM DEVELOPMENT

AUTHOR: A.PENMAN	DATE: 88/04/05
CHK'D BY: L.SAVOIE	KLAP:I205057]880072005.LG SAM

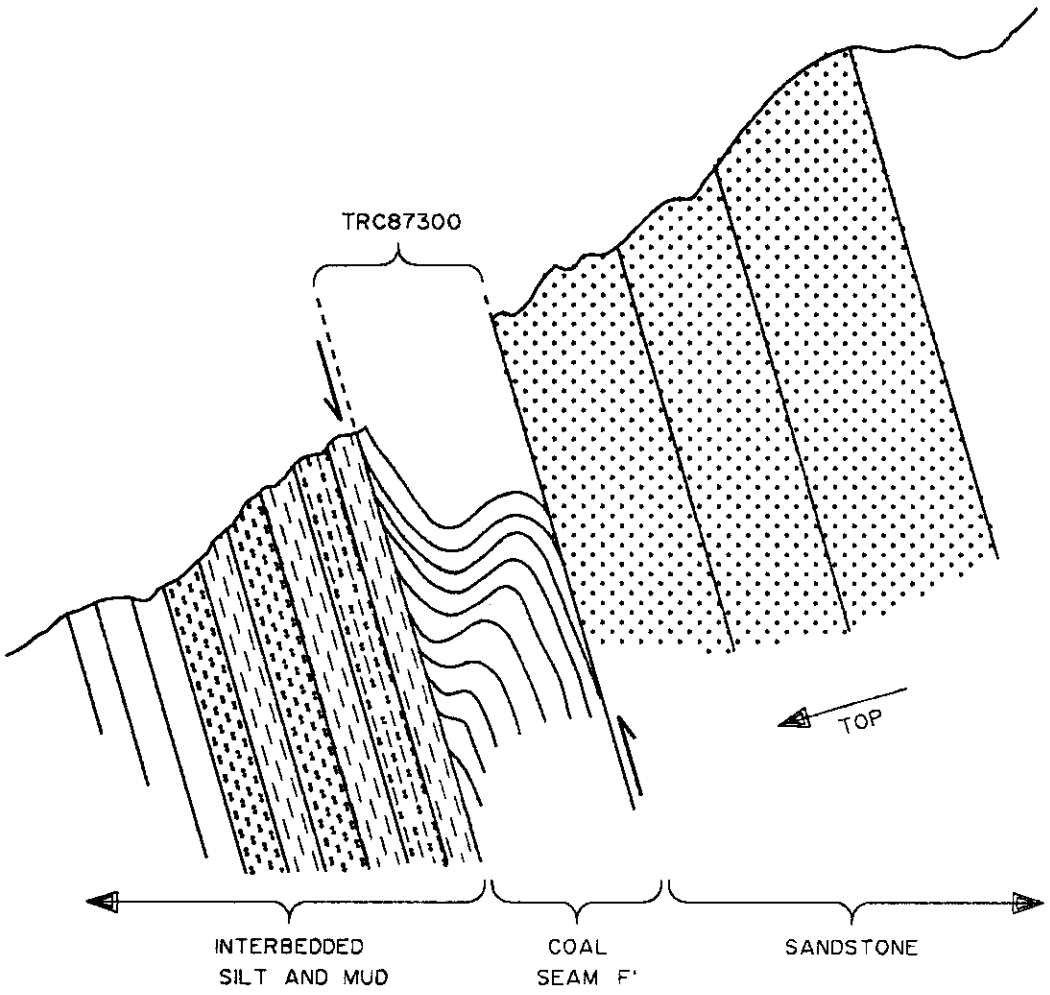
particular seams, along with accurate representation of the unweathered quality and thickness of particular seams will be key issues with respect to the potential mining of the Summit South Area.

6.4.2.4 Structure

The Summit Area displays many features common to the regional structural trend as described in Section 6.4.1 of this report. Detailed seam tracing in Summit South has resulted in an interpretation in the Marshall, Layton, and Alvin Ridge areas differing in several respects from that presented in the 1986 report. What follows is a description of the reinterpretation with presentation of new data relating to the structure of specific areas. This will be followed by some general conclusions on the area as a whole.

Reduced snow cover on the northwest side of Alvin Ridge led to a better understanding of the structure in this area. A large amplitude fold pair including a slightly overturned to upright section of strata composes the majority of the ridge (Plate 6-7). Parasitic folds were noted on the northeast upright limb of the syncline. Seam F' trenched at location TRC87300 exhibited a small scale "S" shaped drag fold within the seam (Figure 6.5) which illustrates bedding plane slippage between the coal and the surrounding

Plate 6-7 Northwest side of Alvin Ridge showing a fold pair with overturned to upright beds between the overturned anticlinal axis and the upright synclinal axis. View looking southeast.



SCALE 1:75

FIGURE 6-5

MOUNT KLAPPAN ANTHRACITE PROJECT

1987 SUMMIT AREA
INTERNAL "S" FOLDING OF
SEAM F' ON ALVIN RIDGE

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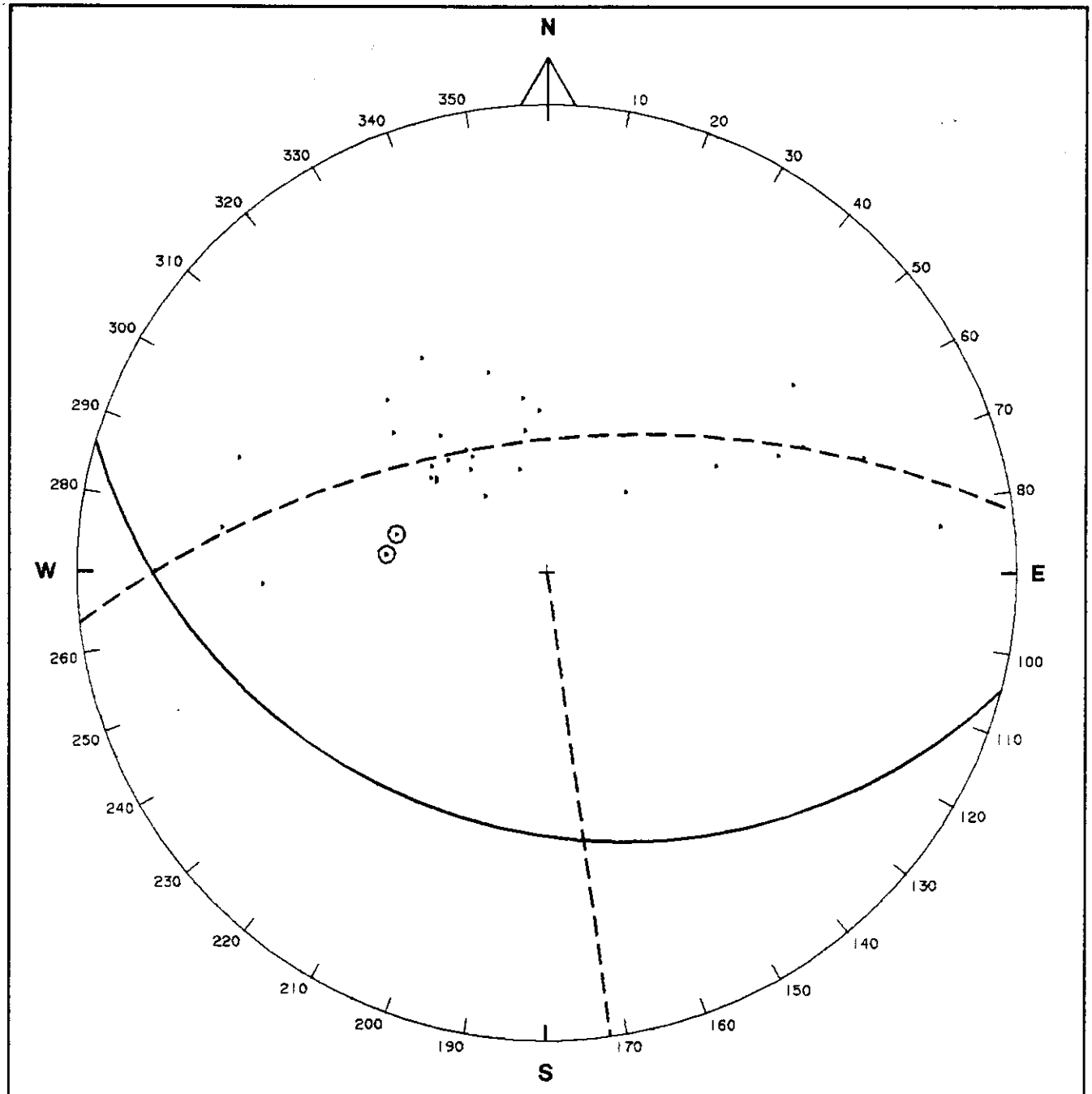
strata. At the north end of the ridge a reverse fault trending at 160° with a dip slip displacement of approximately 15 to 30 m truncates Seam G'. Another reverse fault on Kayleigh Ridge has a similar orientation and displacement.

Seam tracing on Marshall and Layton Ridge has allowed a clearer understanding of the interaction between F_1 and F_2 folds in the Summit Area. The Layton Ridge F_1 fold set trends at 172° plunging 30° S (Figure 6.6). This feature is complicated by the D2 event which had the effect of "kinking" the F_1 fold. This phenomenon is best seen in the lowlands to the north of Marshall Ridge where numerous sand ridge outcrops are kinked toward the south (Plate 6-8). An equal area plot shows a change in the axial plane orientation after the D2 event (Figure 6.7). The Marshall Ridge syncline is also influenced by the second deformational event. This fold trends at approximately 130° on the south side of the ridge, but the axis was kinked by the second deformational event, and on the east end of the ridge it trends at 210°, plunging 15° S (Figure 6.8).

Once thought to be underlain by numerous F_2 folds, the east end of Marshall Ridge has now been interpreted to be a continuous, steeply dipping, upright section (Plate 6-9). It is described in detail in OTC8717.



POLE TO BEDDING PLANE

TREND 172°

PLUNGE 30° S

FIGURE 6-6

MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT AREA - KLAPPAN SEQUENCE
LAYTON RIDGE F1 FOLD SET

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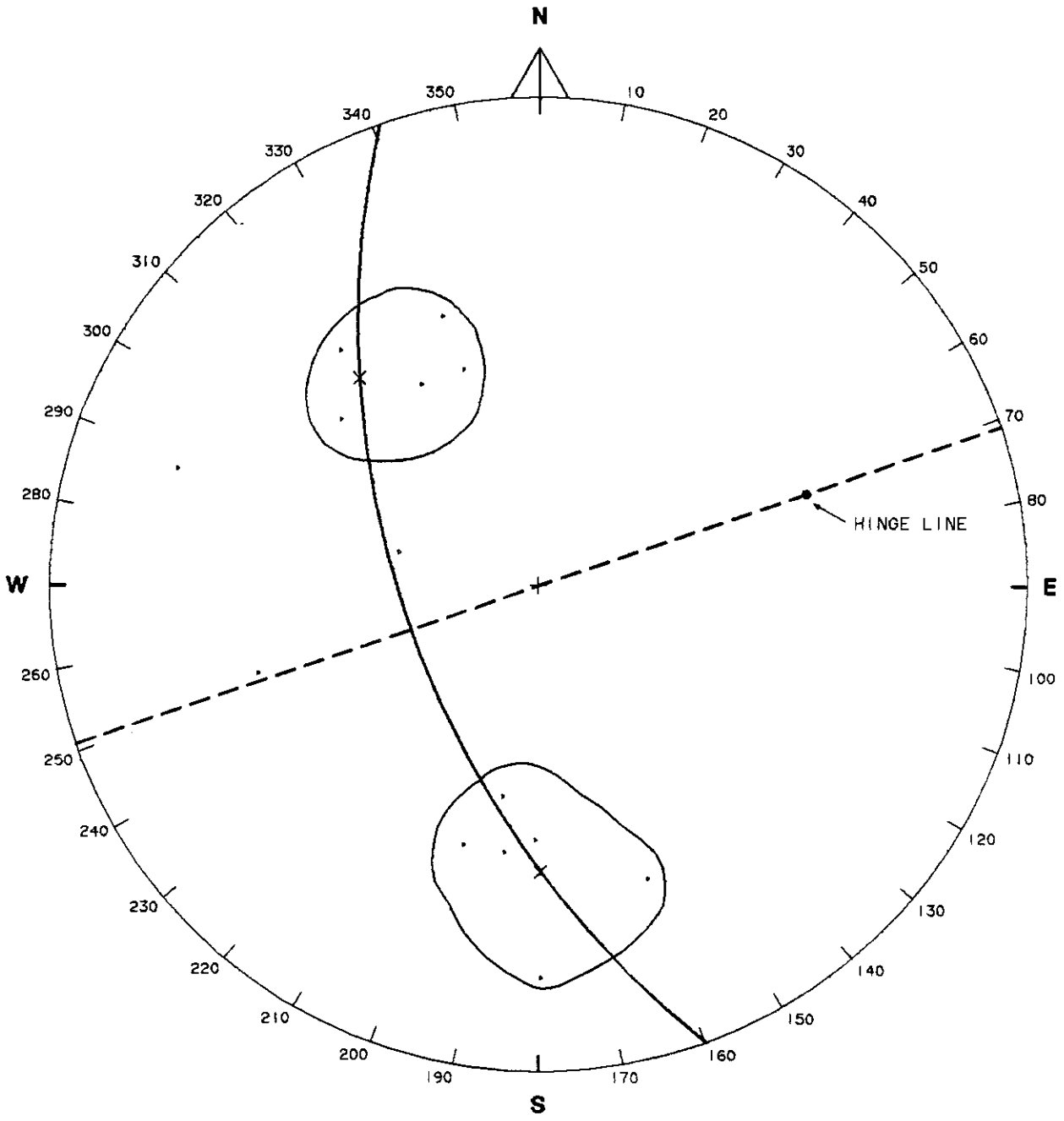
Plate 6-8 "The Boomerang" F1 fold kinked by the second deformational event. One kilometer north of Marshall Ridge. Porky's Peak and Fiction Ridge in the background. View looking east southeast from Alvin Ridge.



HINGE LINE 30° ⟶ 70°

AXIAL PLANE 70°/NEAR VERTICAL

FIGURE 6-7

MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT AREA - KLAPPAN SEQUENCE
LAYTON RIDGE F2 FOLD SET

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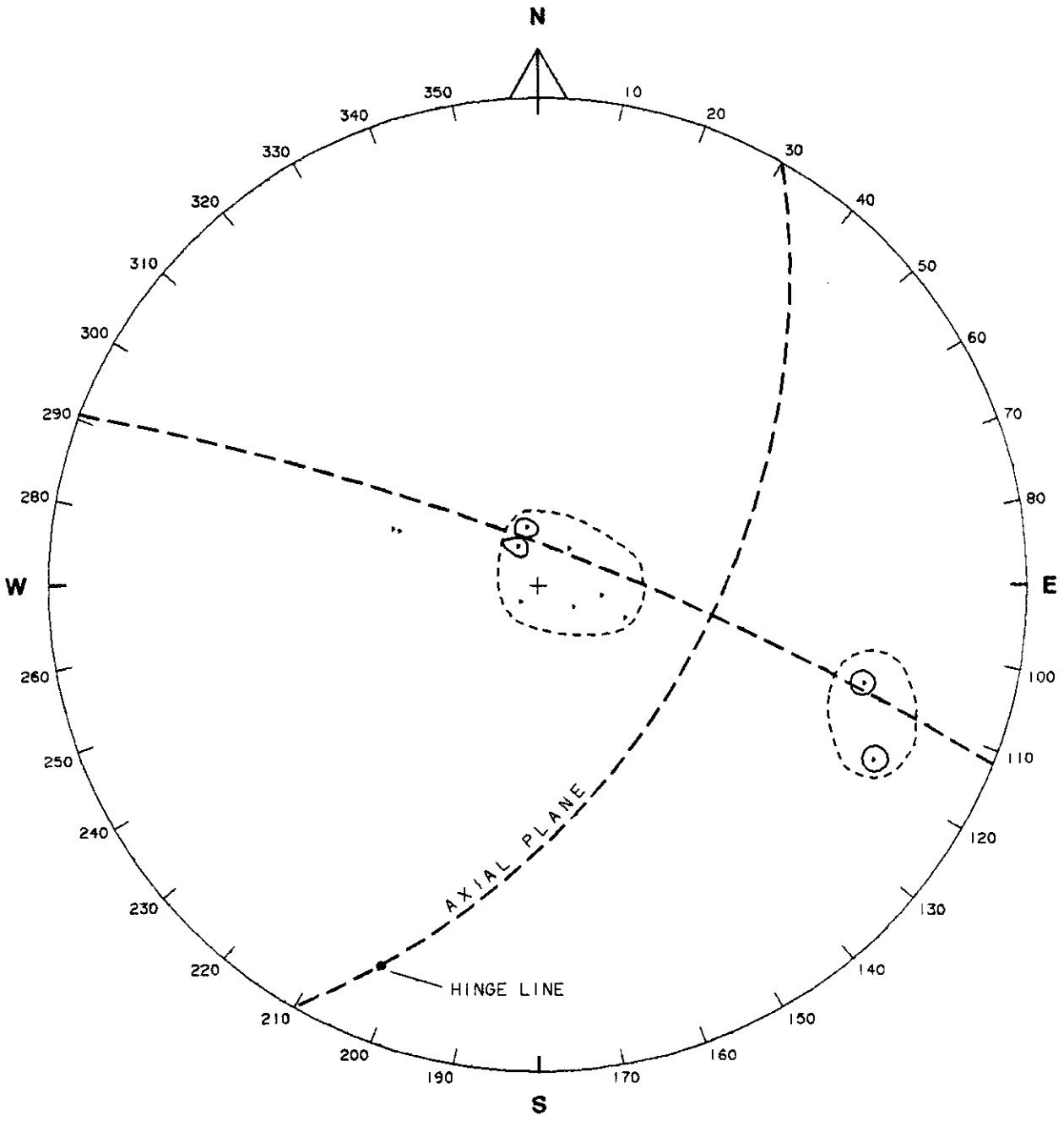

AXIAL PLANE 30°/34° NW

HINGE LINE 210° ⟶ 15°

FIGURE 6-8

MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT AREA - KLAPPAN SEQUENCE
MARSHALL RIDGE SYNCLINE

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Plate 6-9 East end of Marshall Ridge. View looking south.

The area between Marshall Ridge and Little Repeater Ridge consists of two monoclines which dip northward between 30° and 55°. They lower the Spatsizi/Klappan Sequence contact in elevation by approximately 200 m.

There is some minor thrust faulting in the Summit Area with the most notable example being situated on Little Repeater Ridge. It appears as though a less competent section of strata was thrust between two competent layers. The resulting configuration is a series of "S" folds at the top edge, overlying a series of "Z" folds at the base of the wedge (Plate 6-10). This feature develops into strictly planar bedding slip toward the west and is therefore difficult to identify. Toward the east a definite truncation can be observed (Plate 6-11). The strata above and below the thrusted wedge appears to be relatively undisturbed.

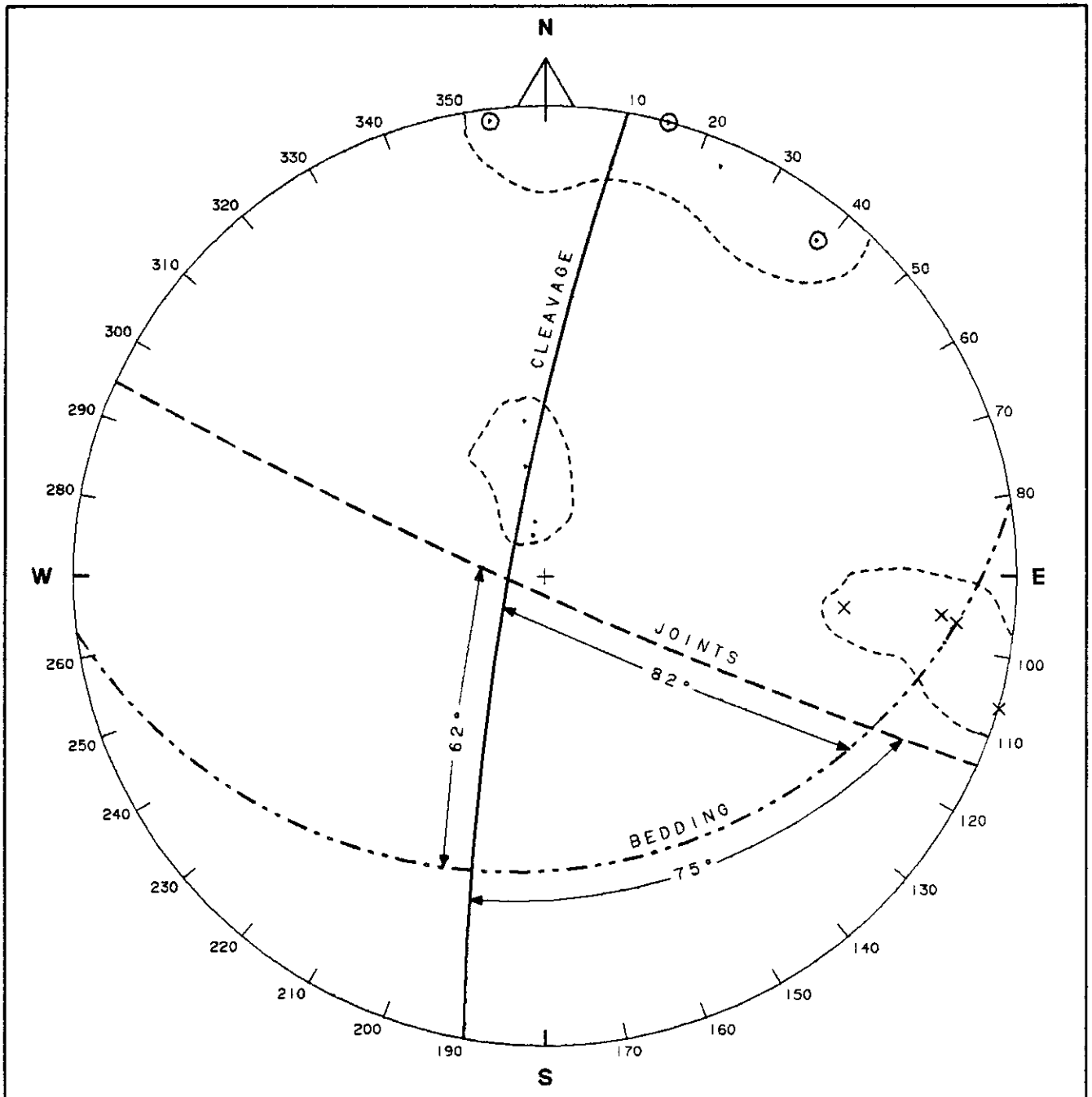
Mel's Rockpile, approximately 1 000 m west southwest of Porky's Peak on Map K11, is located on the southern edge of a domal feature (Plate 6-12). The dome is centred at the intersection of two anticlines (F_1 and F_2) oriented at right angles to one another. An equal area plot of this outcrop shows a strong cleavage, bedding, joint intersection of close to 90° (Figure 6.9). Water flowing beneath and frost action has led to the deterioration of this outcrop.

Limited outcrop to the north and east of

Plate 6-10 Little Repeater Ridge thrust fault. "S" drag folds overlying "Z" drag folds. View looking south southeast. (Photograph courtesy of K. Hunter).

Plate 6-11 Little Repeater Ridge thrust fault truncation at the southeastern edge of the thrust trace on Map J12. View looking southwest.

Plate 6-12 Mel's Rockpile . Frost action on the southern edge of the domal structure has resulted in a "rock glacier". View looking north northeast.



LEGEND

- BEDDING
- CLEAVAGE
- JOINT

FIGURE 6-9

MOUNT KLAPPAN ANTHRACITE PROJECT

SUMMIT AREA - KLAPPAN SEQUENCE
MEL'S ROCKPILE

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Porky's Peak hinders structural interpretation in this area.

A trend from large scale folding and faulting in the north and southwest regions of the Summit Area (Repeater, Kayleigh, Alvin Ridges and Caribou Cirque, Plate 6-13) to a smaller scale, more complex style of folding toward the east southeast (Fiction Ridge and Porky's Peak, Plate 6-14) is evident. The main cause of this phenomenon is a decrease in the ratio of competent versus incompetent rock strata. The decrease in thick continuous sand strata higher in section allows both deformational events to have more pronounced effects.

Structurally favourable areas for drilling include: near the hinge of the "boomerang" north of Marshall Ridge, along the sand ridges east of Porky's Peak, and east of Caribou Cirque. The area north of Marshall Ridge and the ridges east of Porky's Peak are favourable because they contain thick stratigraphic packages. Drilling would provide a clearer understanding of stratigraphy, seam distribution and coal quality of unweathered samples from these areas. A drill hole east of Caribou Cirque would augment the statigraphic information on the Lower Klappan sequence and possibly Upper Spatsizi sequence.

6.4.3 Nass Area

6.4.3.1 Spatsizi Sequence

The Spatsizi Sequence outcrops in the

Plate 6-13 A) Large amplitude folding on the west side of Caribou Cirque. View looking east. B) Folding and a reverse fault on the north face of Kayleigh Ridge. View looking south.

Plate 6-14 Tighter, more complex folding near Porky's Peak on Map K11. View looking northwest.

northwest Nass Area and retains most of the sedimentological features seen in the Summit Area (see Section 6.4.2). The uppermost 200 m of the estimated 1 200 m thickness of the Spatsizi Sequence has been documented in the Nass Area. Notable features include the occurrence of well preserved marine bivalves, Buchia and Hypoxytoma, on Calvin's Ridge. This location also contains belemnites which are commonly associated with marine influenced strata. On the basis of fossil content, the upper reaches of Barefoot Creek have been identified as Spatsizi. Acesta, Hypoxytoma and Buchia concentrica are common in this area. Randomly oriented fossil wood fragments within a sandstone were also found; these are typical of the upper Spatsizi.

In contrast with the Summit Area, the contact zone of the Spatsizi Sequence with the Klappan Sequence is somewhat more abrupt. Some of the diagnostic features defining the contact in Summit are missing but it is interpreted to lie below a basal coal seam (TRC85010) and above the marine influenced strata near Calvin's Ridge.

Structural complications affect the recognition of the contact along Pudecuff Creek. Descending the creek there is a transition from Spatsizi Sequence upstream to Klappan Sequence downstream. This apparent juxtaposition of Spatsizi above Klappan is due to the strata being inclined more steeply to the south than the slope of the creekbed.

Further to the south the beds enter a syncline. The continuation of the Klappan Sequence to the north is projected into an anticline wherein, at considerably higher elevation the Klappan was once carried over the Spatsizi but has been subsequently eroded. A similar situation occurs near the headwaters of Barefoot Creek. The occurrence of the contact zone at higher elevations beneath several of the permanent ice fields is possible.

6.4.3.2 Klappan Sequence

The entire Klappan Sequence is present in the Nass Area although very little of it outcrops between the Spatsizi Sequence in northwestern Nass and the Malloch Sequence in southeastern Nass. It can be subdivided into three main areas. The lower Klappan can be found near the northern end of Pudecuff and Barefoot creeks. The lower to mid Klappan is present in the Clyde Creek section and at the southern end of Pudecuff and Barefoot creeks. The upper Klappan is present on the ridge to the east of Nass Lake. Unfortunately the majority of the sequence is covered by swamps and vegetation in the valleys and is therefore difficult to assess.

The lower to mid Klappan Sequence geology in the Nass Area was primarily investigated by utilizing river cut exposures. Of particular interest is a large resistant sandstone unit that has been called

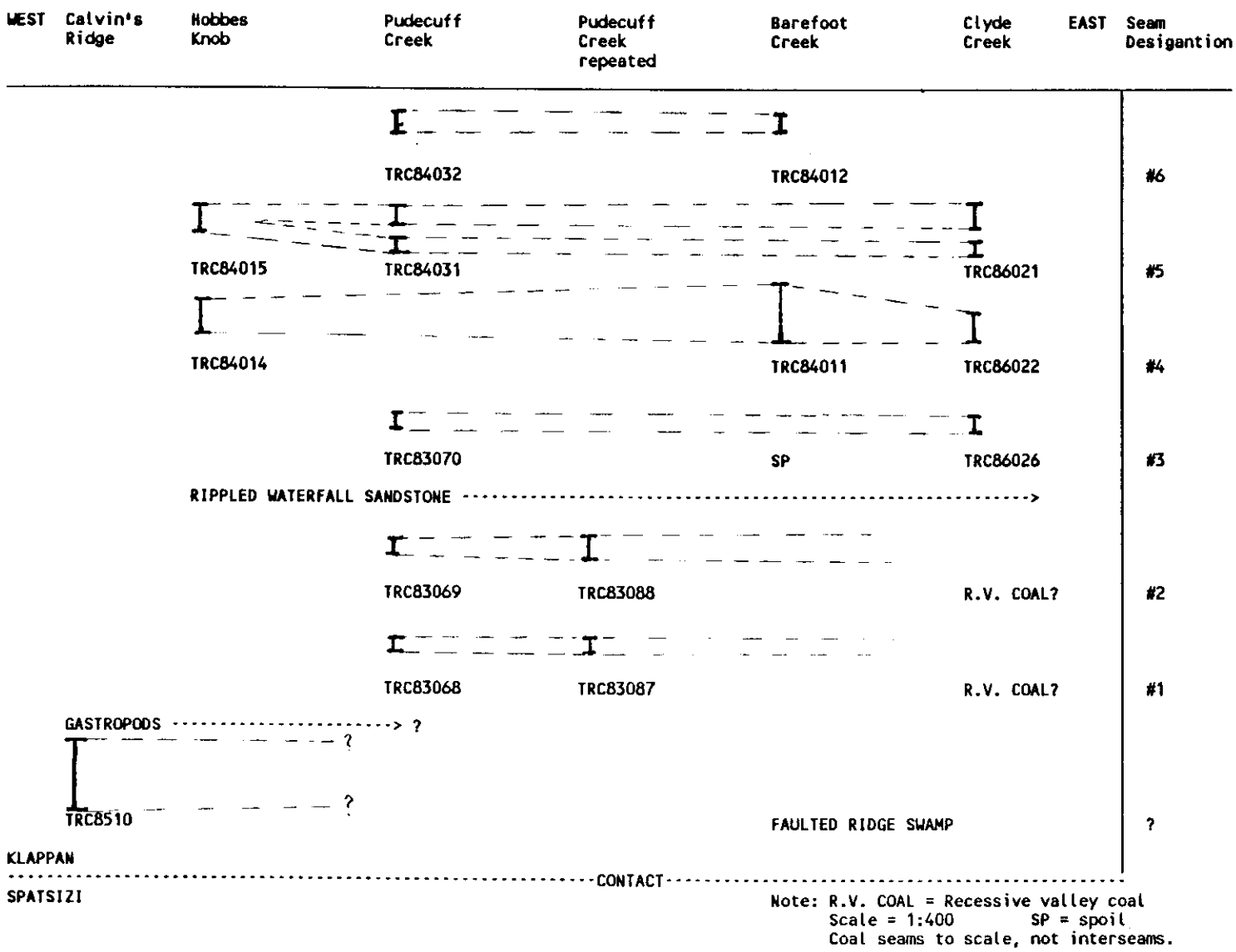
the "Rippled Waterfall Sandstone". This waterfall forming sand is approximately 4.0 m in thickness, coarsens upward, and typically exhibits a well preserved plane of sinuous wave ripples at the top of the unit. It has been used as datum in an attempt to correlate anthracite seams between Pudecuff, Barefoot, Clyde Creek and beyond (Table 6.8).

Abundant plant fossils have been found on each creek. Podozamites is common near the base of the Klappan, with Czekanowskia rigida and Ginkgo nana becoming more prevalent up section (downstream). By far the most common plant fossil is Nilssonia tenuicaulis. This fern is also found adjacent to many anthracite seams in Summit South and Lost Ridge.

Concretions are commonly found in the vicinity of Seam #3 (Table 6.8). These "turtle stones" were developed through the localized deposition of material from solution around a central nucleus which had the effect of hardening the mud and siltstone strata in a nodular shape. They range in length from less than .20 m to as large as 2.00 m (Plate 6-15). Gastropods were found to occur below seam #1.

The Klappan Sequence in the Nass Area represents the same prograding deltaic sequence as in the Summit or Lost Ridge areas with a more restricted development of anthracite seams. Lack of vegetative

TABLE 6.8
Nass Area Trench Correlation 1988



Note: R.V. COAL = Recessive valley coal
Scale = 1:400 SP = spoil
Coal seams to scale, not interseams.

Plate 6-15 Concretions or "turtle stones" found on Pudecuff and Clyde Creek. Photographs courtesy of K. Hunter.

matter during development or differences in sedimentation rates and environmental conditions may have hindered development of thicker anthracite seams. Although a large portion of the Klappan Sequence is not exposed in this area, the total thickness is interpreted to be somewhat less that that seen further east in the Lost Ridge Area.

6.4.3.3 Malloch Sequence

The Malloch Sequence has limited distribution within the Nass Area, although various exposures are present in the vicinity of Nass Lake. The Malloch type section (Appendix E: Malloch Sequence Type Section) was measured here in 1986 and contains 950 m of continuous section. Estimated at 1 100 m, the complete Malloch Sequence has not yet been observed in continuous section on the Mount Klappan property. The upper Malloch and its contact with the Devils Claw Sequence is not represented in the Nass Area, but is well exposed in the Skeena Area.

The most diagnostic feature of the Malloch Sequence is the presence of 1 to 10 m thick resistive sandstone and conglomerate channels which are often less than 20 m in lateral extent. These are commonly overlain by thinly interbedded fine grained sandstones, siltstones, mudstones and occasional thin coal seams. These fining upward cycles have been interpreted as successive active channel facies

overlain by abandoned channel or floodplain deposits. Studied in detail in 1986 (Summit-Nass-Skeena 1986 Geological Report: Section 6.4.3.3), these three facies are considered to be the result of deposition within a meandering to distal fluvial system.

6.4.3.4 Coal Seam Development

6.4.3.4.1 Klappan Sequence

The Nass Area's anthracite seam development is difficult to assess due to limited exposure and generally swampy terrain. The majority of field exploration concentrated on the correlation of anthracite occurrences between three major creeks (Pudecuff, Barefoot, and Clyde Creek). To date, a total of 35 trenches have been excavated in the Klappan Sequence transecting seams ranging from 0.77 to 4.47 m in thickness (Table 6.9).

Anthracite horizons have been identified in the lower to middle Klappan Sequence. The top 6 seams have been correlated with some consistency and have been designated seams 1 through 6 (Figure 6.10). They have an aggregate true thickness of 9.02 m over an interval of 141.00 m. The seams generally thicken in an easterly

Table 6.9

NASS AREA TRENCH SUMMARY

Year	Trench	C/C + R (m)	Sequence
1982	82021	3.26/3.57	Klappan
	82022	1.13/2.60	Klappan
1983	83068	0.63/0.86	Klappan
	83069	0.91/0.91	Klappan
	83070	0.67/0.95	Klappan
	83071	3.62/3.96	Klappan
	83072	3.13/3.51	Klappan
	83073	3.01/3.36	Klappan
	83076	1.20/1.54	Klappan
	83077	1.32/1.48	Klappan
	83082	1.00/1.27	Klappan
	83083	1.13/1.50	Klappan
	83084	0.90/1.59	Klappan
	83085	0.80/0.90	Klappan
	83086	1.51/1.96	Klappan
	83087	0.70/0.80	Klappan
	83088	1.15/1.50	Klappan
	83091'	3.26/3.57	Klappan
1984	84003	1.50/1.50	Klappan
	84004	0.74/1.39	Spatsizi
	84005*	2.58/2.95	Klappan
	84006	1.31/1.46	Klappan
	84007	0.90/0.90	Klappan
	84010	1.05/1.05	Klappan

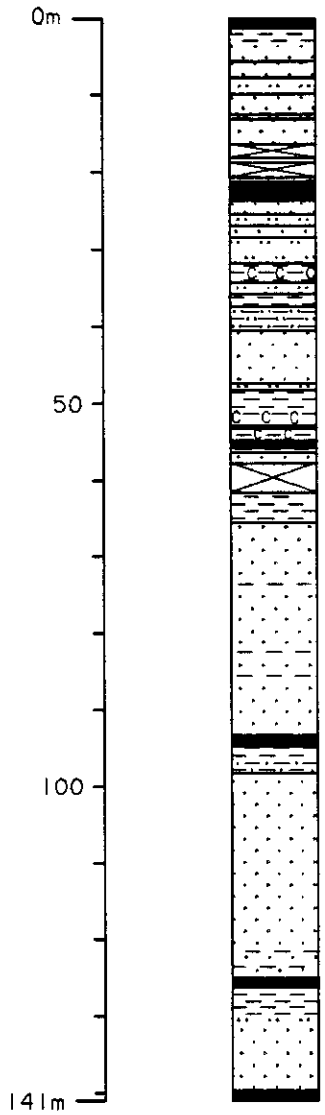
Table 6.9
Cont'd

NASS AREA TRENCH SUMMARY

Year	Trench	C/C + R (m)	Sequence
1984	84011	3.36/3.74	Klappan
(cont'd)	84012	1.00/1.00	Klappan
	84014	1.95/2.16	Klappan
	84015	1.55/1.70	Klappan
	84018	1.10/1.68	Klappan
	84031+	0.95/1.09; 0.97/1.00	Klappan
	84032°	1.55/1.82	Klappan
1985	85010-	3.15/4.47	Klappan
	85018	0.73/0.93	Klappan
1986	86021	2.16/3.07	Klappan
	86022	1.52/1.71	Klappan
	86023	1.08/1.08	Klappan
	86024	1.06/1.56	Klappan
	86025	1.00/1.07	Klappan
	86026	0.97/0.97	Klappan
	86027	0.71/0.77	Klappan
	86028	0.94/0.94	Klappan
	86036	1.09/1.19	Klappan
1987	No Trenches		

NOTE: TRCNR86029 with a C/C + R = 0.32/0.40 was logged for the purpose of seam tracing but has not been included in above due to insufficient coal thickness.

' retrench of 82021
* retrench of 83073
+ retrench of 83071
° retrench of 82072
- retrench of 84004



ANTHRACITE SEAM 6: TRC83083 (C/C+R=1.13/1.50)

ANTHRACITE SEAM 5: TRC86021 (C/C+R=2.60/3.07)

ANTHRACITE SEAM 4: TRC86022 (C/C+R=1.52/1.71)

ANTHRACITE SEAM 3: TRC86026 (C/C+R=0.97/0.97)

ANTHRACITE SEAM 2: TRC83069 (C/C+R=0.91/0.91)

ANTHRACITE SEAM 1: TRC83068 (C/C+R=0.63/0.86)

SCALE: 1:1000

FIGURE 6-10

MOUNT KLAPPAN ANTHRACITE PROJECT

CLYDE AND PUDECUFF CREEK, CENTRAL NASS AREA
COAL SEAM DEVELOPMENT
KLAPPAN SEQUENCE

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direction toward Lost Ridge. Trench 85010, interpreted to lie near the Spatsizi/Klappan contact, is an undetermined distance below seam 1 and has not received a specific designation (Table 6.8).

Three trenches east of Nass Lake, interpreted to lie near the Klappan/Malloch contact, appear to intersect seams that are laterally discontinuous. Samples from trenches 86027, 86028 and 86029 have a mean vitrinite reflectance value of 2.79% which is typical of coal in the vicinity of this contact.

The Nass Area contains portions of the Spatsizi and Malloch Sequences, and strata equivalent to the complete Klappan Sequence. Due to the low percentage of outcrop and lack of diamond drill hole information, however, an approximation of the thickness of the Klappan Sequence in this area is tenuous. The available data indicates an overall thickness less than is observed in the Lost Ridge and Summit South Areas.

6.4.3.5 Structure

The most notable structural feature of the

Nass Area is the Beirnes Synclinorium which is paralleled by the Nass River Anticlinorium beyond the western property boundary. Both these structures trend about 135° plunging to the southeast and are a product of the first phase of deformation. East of the synclinorium axis folds verge northeast with generally long shallowly dipping southwest limbs and short high angled to overturned northeast limbs. To the west of the axis folds display a southwesterly vergence. A variety of fold styles occur in the area of the synclinal axis.

Pudecuff Creek (Map I-14) exhibits strong F2 folding that plunges to the west at the north end of the creek and to the east near its southern confluence with Clyde Creek. The plunge in the Nass Area is typically 10° to 14°.

Faulting in the Nass Area is extensive in certain portions of the Klappan Sequence. The Faulted Ridge Swamp Area on Map I-13 has three major faults with horizontal displacements of up to 100 m. The faults displace large protruding ridges with a dextral sense of movement. A vertical component of unknown magnitude is suspected.

The Clyde Creek Area is of interest for its multitude of normal faults. At least eight fault planes have been measured in a 180 m span of outcrop along the south side of the creek (Plate 6-16).

Plate 6-16 Normal faulting along Clyde Creek. Note displaced anthracite seams. View looking south. Two people for scale. Photograph courtesy of K. Hunter.

Measured displacements range from <1 m up to 18 m. Due to the vegetative cover in Nass, it is not known whether this is an isolated case of intense faulting or if faulting is widespread in the Klappan Sequence of the Nass Area.

Two minor thrust faults have been recognized in the lower Malloch Sequence on the western boundary, and south of the southern boundary of the Nass Area. Both dip to the southwest and have displacements of approximately 10 m.

It has been observed that an increase in coarser grained sediments, in the upper Malloch Sequence, may have restricted the degree to which the strata has been folded. For the most part, folds tend to be very broad and typically upright. Near the Klappan/Malloch contact, however, a large scale recumbent fold located northeast of Nass Lake is a rare exception (Plate 6-17).

6.4.4 Skeena Area

Three of the four stratigraphic sequences of the Mount Klappan study area are at least partially represented in the Skeena Area. Within and adjacent to the Mount Klappan property is the upper portion of the Klappan Sequence, possibly the complete Malloch Sequence, and the lowermost 370 m of the Devils Claw Sequence. The Klappan and lower Malloch are poorly exposed in this area but there is excellent

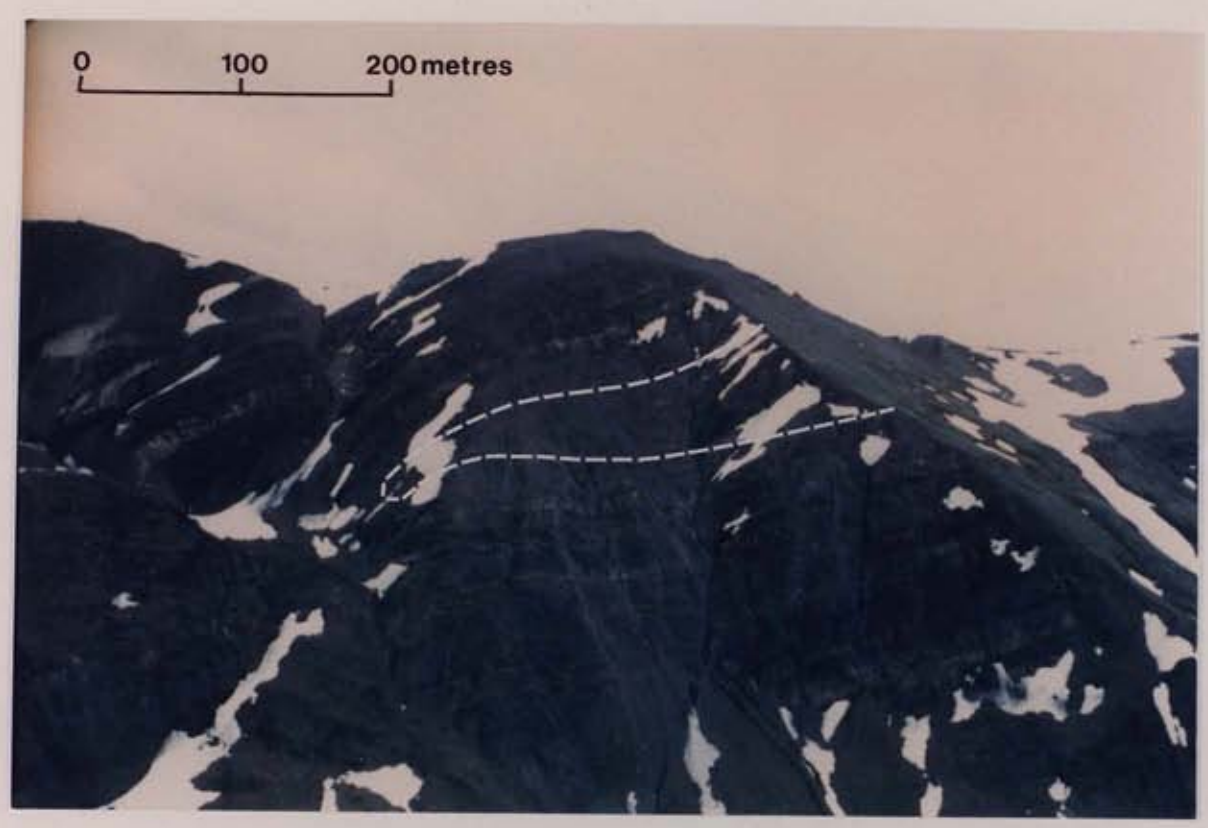

Plate 6-17 Recumbent fold east of Nass Lake near Upper Klappan / Lower Malloch contact. View looking east from helicopter.

exposure of much of the upper Malloch and all of the available Devils Claw Sequence. The degree of exposure is a reflection of the lithologies present within each of the sequences.

The Klappan, Malloch and Devils Claw Sequences have been interpreted to represent a prograding fluvial-dominated system supplied with sediment from tectonically active areas to the north and east. This active uplift and a slowly subsiding Bowser Basin combined to provide a thick succession of Lower Cretaceous clastic sediment. The upper half of this widespread coarsening upward cycle is well represented in the Skeena Area. The abundance of outcrop has permitted interpretation of the stratigraphic contact location, depositional environment, and post-depositional volcanogenic history for the upper Malloch/Devils Claw stratigraphy.

6.4.4.1 Klappan Sequence

Klappan Sequence sediments are not exposed in sections greater than 100 m in the Skeena Area and are tightly folded when present. They are interpreted to reach thicknesses of over 600 m in the Tahtsedle Creek and Skeena River valleys on the basis of the interpreted stratigraphic position of the exposed sediments in the Tahtsedle Creek gorge. This gorge, at the headwaters of Tahtsedle Creek, exposes approximately 75 m of upper Klappan Sequence strata and contains the only two Skeena Area coal seams thus far excavated.

The upper Klappan Sequence is dominated by bedded and interbedded to finely laminated sandstones and siltstones, commonly forming beds up to 10 m in thickness. Minor chert pebble conglomerates up to 5 m thick, thin carbonaceous mudstones, and thin coal seams are also present. Plant debris is especially common in the finer grained lithologies, with eight to ten plant macrofossil species identified to date. No marine fauna have been discovered in the upper Klappan Sequence in the Skeena Area.

The upper Klappan Sequence has been interpreted to represent a transitional delta plain to fluvial system. Its contact with the Malloch Sequence fluvial-dominated system is very gradational, and may be as thick as 200 m in this region.

6.4.4.2 Malloch Sequence

The Malloch Sequence, which conformably and gradationally overlies the Klappan Sequence, is believed to exist in its entirety in the Skeena Area, although much of its lower portion is not well exposed. In this area, 885 m of its total thickness (estimated at 1 100 m) has been measured to date.

Lithologically, much of the Skeena Area Malloch Sequence does not differ greatly from the measured type section of the Nass Area. The meandering fluvial to distal braided system

interpreted for the Malloch type section is believed to apply in the Skeena Area as well. However, because the upper Malloch is present in the Skeena Area, the braided fluvial facies is dominant.

Much of the lower three-quarters of the Malloch Sequence is characterized by repetitive fining upward, distinctly channeled packages diagnostic of a meandering fluvial environment (Plate 6-18). Active channel facies of conglomerate or trough to planar bedded sandstones fine upward to thinly interbedded siltstone and mudstone floodplain or abandoned channel deposits. These fine grained, interbedded sequences have sharp, commonly scoured upper contacts which are interpreted to represent successive channel incisions.

Within the upper half of the Malloch Sequence, especially the uppermost 200 m, a gradual coarsening upward trend becomes apparent, with sandstone and conglomerate units becoming thicker and more common as the Devils Claw contact is approached. Channel incisions continue to be common but display high width/depth ratios (Plate 6-19). Often, smaller channels incise larger ones, and thin fining upward cycles are present. Well developed cyclicity is lacking and lateral variation in grain size is common, especially within the coarser grained component. These features are interpreted as being deposited in a multi-channeled, laterally-migrating fluvial system like that of a braidplain or braided stream.

Plate 6-18 Meandering river channel deposits of the Malloch Sequence displaying well developed channel scour and lateral accretion features. Channel width approximately 60 meters.

Plate 6-19 Upper Malloch Sequence fluvial deposits with laterally discontinuous shallow sandstone and conglomerate channel incisions.

Coal development in the Malloch Sequence is restricted to minor bands rarely exceeding 30 cm in thickness. These are most commonly, but not always, found in the lower reaches of the sequence. Plant debris is common throughout; up to 19 plant macrofossil species have been identified. No marine fauna have been documented in the Malloch Sequence.

The slow transition from meandering fluvial to braided fluvial environments of deposition within the Malloch Sequence is reflected in the coarsening upward trend through its upper portion. Occasional smaller-scale (5 to 30 m) coarsening upward trends also become apparent near the top of the Malloch, and may be representative of briefer cycles of progradation.

6.4.4.2.1 The Malloch/Devils Claw Stratigraphic Contact

In the recent past attempts have been made to determine a traceable boundary between the Malloch and Devils Claw Sequences. The upper Malloch in the Skeena Area appears to reflect a slow transition from a distal braidplain (or braided stream) environment, up through a proximal braidplain, and into the Devils Claw alluvial fan environment. The sequence is representative of an overall prograding, completely terrest-

rial alluvial fan system with much evidence of rapid sedimentation rates. This progradation was triggered by increased and sometimes sporadic tectonic activity in and adjacent to the Bowser Basin.

Previous work has placed the stratigraphic contact at the lowest thick, laterally continuous conglomerate unit in the stratigraphic section. This unit is overlain by a strongly conglomerate dominated sequence. Further observation in the Skeena Area has indicated that the base of the conglomerate dominated alluvial fan facies can be locally gradational rather than abrupt. As a result, additional criteria for recognition of the stratigraphic contact are recommended as follows:

(1) Conglomerates and pebbly sandstones are the dominant lithotypes of the lower Devils Claw Sequence, making up from 40 to 70 percent of the total rock record, with a maximum thickness of inter-conglomerate units of less than 35 m. In contrast, below the contact, the upper Malloch Sequence has fewer, thinner, and more widely spaced conglomerate units, normally making up 5 to 15 percent of the rock record, usually with at least an 80 m spacing.

(2) Although certain fossil plant species ranged over a broad time period in the Cretaceous, some appear to have favoured specific environments. An example of this may be Cladophlebis virginiensis which is common throughout the upper Malloch braided alluvial environment but absent within the alluvial fan system. The highest appearance of Cladophlebis virginiensis occurs near the Malloch/Devils Claw contact. Other plant species like Nilssonia nigracollensis or Ginkgo sp. tend to show a similar trend to that of Cladophlebis sp., but range up to 250 m into the Devils Claw. Although these observations may reflect the poor preservation potential of plant debris in a high energy environment, and further work is recommended, they remain consistent with previous work in the Skeena Area.

The mass of conglomerate appearing at the Malloch/Devils Claw contact may be the product of an abrupt tectonic surge resulting in a sudden progradation of the fan system. Further study of the cyclicity present in the sediments of the upper Malloch and Devils Claw Sequences may provide a more complete tectonic model for the Bowser Basin and adjacent areas.

6.4.4.3 Devils Claw Sequence

The Devils Claw Sequence, (formerly Rhondda Sequence), which conformably overlies the Malloch Sequence, has a limited distribution within the Mount Klappan property. Although about 110 m of section is measurable within the property boundary, the sequence attains maximum thicknesses of up to 365 m nearby in the Skeena Area. The vertical distribution of sediments within the type section (one ridge southeast of Mount Gunanoot) is illustrated in Appendix E: Devils Claw Sequence Type Section.

The Devils Claw Sequence is characterized by thick, resistive, laterally extensive units of chert pebble conglomerate (Plates 6-20 and 6-21). These are commonly trough cross-stratified and sometimes planar-bedded, and often reach thicknesses of 30 to 40 m. Trough cross-stratified and planar-bedded sandstones are also present, along with lesser amounts of argillaceous siltstones and minor carbonaceous mudstones.

The sheetlike conglomerate units of the Devils Claw Sequence consist of stacked conglomerate channels with some crude pebble imbrication, varying degrees of clast roundness, and often poor clast sorting. The conglomerates are predominantly clast-supported and locally may be open-mict in character (limited to absent matrix) indicating very rapid

Plate 6-20 Thick, laterally extensive chert pebble conglomerate units characteristic of the Devils Claw Sequence.

Plate 6-21 Stacked sheet-like conglomerate units of the Devils Claw Sequence. At least 13 individual conglomerate packages form the background ridges.

deposition. Individual channels are highly variable in height and lateral extent and sometimes include scoured bases, rip-up clasts, fining upward cycles, and sharp upper contacts with fine grained units. Fossil logs present within the conglomerate units characteristically have orientations either perpendicular or parallel to flow direction.

The Devils Claw Sequence in the Skeena Area has been interpreted to represent the deposits of an extensive alluvial fan system influenced by a high sediment load and possibly sporadic tectonic activity. The sheetlike conglomerates result from rapid sedimentation as sediment-laden channels migrated laterally across the mid to distal segment of the broad fan system. The absence of debris flow deposits, the lack of pebbles and boulders >10 cm, the moderate rounding of clasts, and the sheetlike pattern of conglomerate deposition all suggest a mid to distal rather than proximal position on the fan.

Plant fossils are rare and poorly preserved in the Devils Claw Sequence, probably owing to the high energy environment of deposition. Ten species of plant macrofossils have been identified in the finer grained, between-channel sediments (Table 6.4).

6.4.4.4. Post-Depositional Volcanogenic History

In the Bowser Basin, the Upper Cretaceous is

recognized as a time of continued terrestrial sedimentation and severe deformation. While sedimentation continued over a folding and faulting Bowser Basin, high angle faulting and plutonism were occurring to the east in the Omineca Crystalline Belt. Within the Skeena area, a 2 m wide andesite dike was located transecting upper Malloch Sequence sediments at a high angle to bedding (Appendix F: KPNSKOTC87013). Although the dike has not yet been dated, its position within the sequence suggests that it may be related to the early phases of deformation and plutonism of the Upper Cretaceous.

The actions of hydrothermal solutions and the processes of weathering have likely altered the original mineralogy of the andesite dike. This is suggested by the presence of sericite, likely derived from the alteration of feldspars (Plate 6-22). Syn--depositional features present within the dike include tear-drop shaped vesicles and small remnants of resorbed previous melts. Vesicles are occasionally lined internally by alkali feldspar crystal growth and more commonly chalcedony cement growth, but post-formational carbonate infilling is most common. Plates 6-23 A and B show some of the crystal and cement growth present. The aphanitic hypocrystalline andesite dike shows strong textural variation from the margins to the centre, but a strong to weak trachytic texture is typical. Common syn-formational minerals present within the body include:

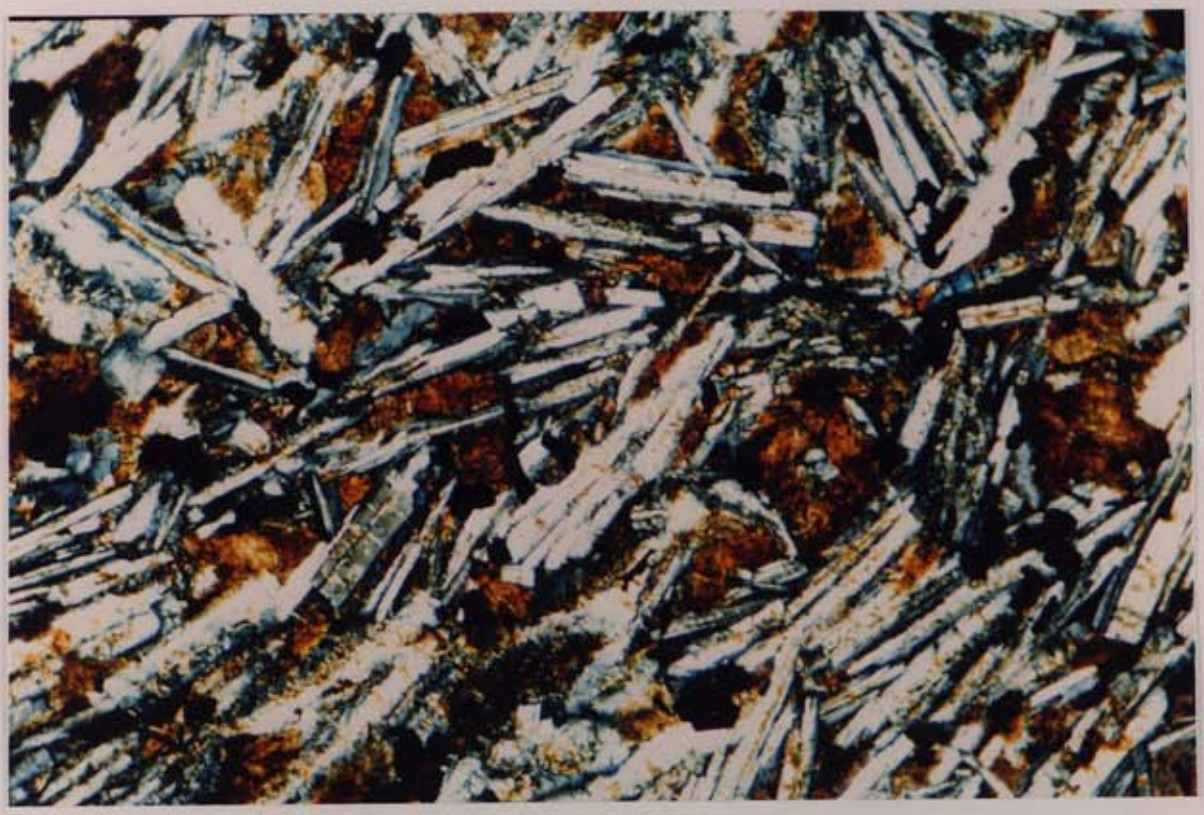

Plate 6-22 Plagioclase and alkali feldspar microlaths undergoing alteration to sericite and clays. (Andesite dike - magnification approximately 75X).

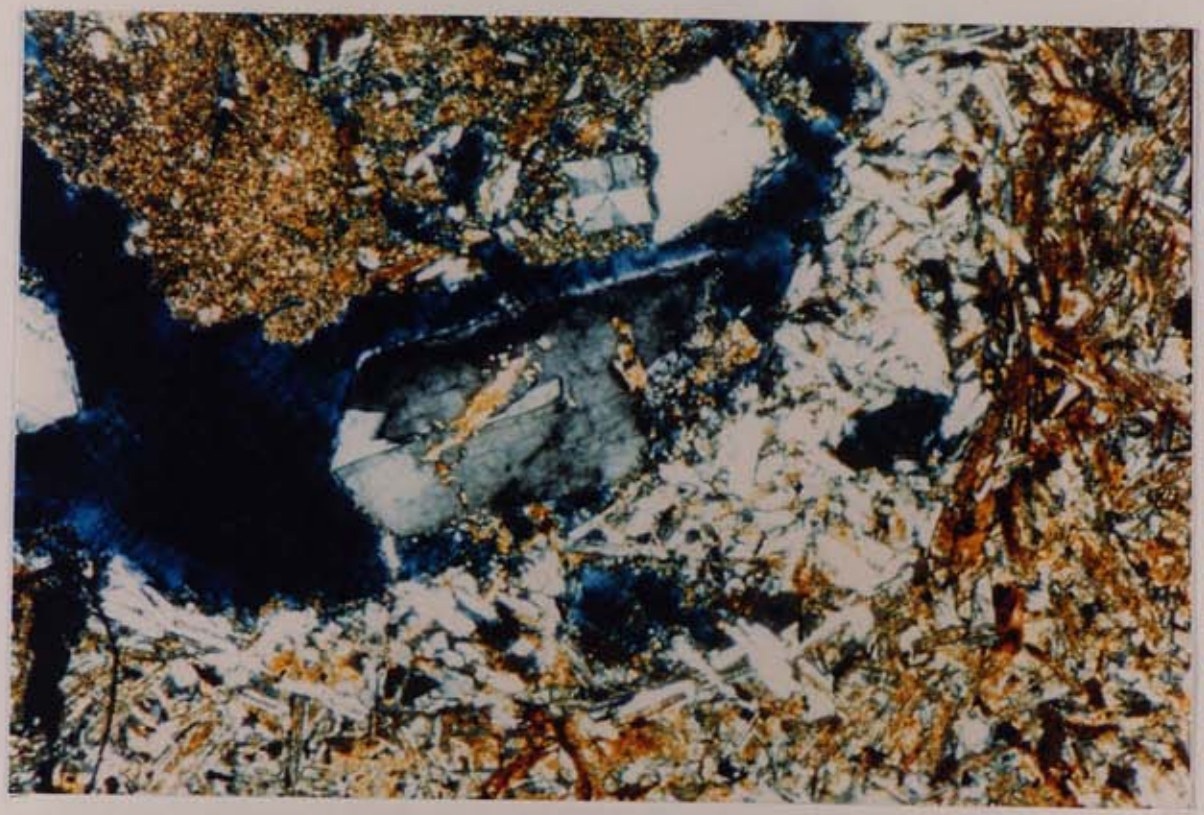

Plate 6-23 A) Alkali feldspar crystal growth along vesicle border (50X). B) Post-formational chalecedony cement growth and carbonate infilling of vesicles (75X).

plagioclase feldspar microlaths (altering)	- 35-40%
volcanic glass (SiO_2) (altered)	- 25-35%
alkali feldspar (altering)	- 5-15%
opaque minerals (altering)	- 5-10%
biotite	- 5%
muscovite (alteration product?)	- <2%

6.4.5 Summit-Nass-Skeena Area Fault Study

An undergraduate B.Sc. thesis completed in 1987 focussed on the analysis of faulting across the Mount Klappan property. Two major fault trends were observed. The first trend, common in the Summit Area northwest of Alvin Ridge, strikes 170° and dips 82° W. Actual strike measurements range from 150° to 185°. This fault set typically displays a normal dip slip displacement of 1 to several tens of metres. Oblique slip and right lateral strike slip displacements are also noted. The second major set of faults is widely distributed, and strike at approximately 035° and dip 75° W. The displacement is predominantly sinistral strike slip, although dip slip and oblique slip components were also noted. The curved nature of these faults may account for wide variations seen in the measured trend data. Two minor sets were noted that deviate slightly from the second major fault trend. They strike at 015° and 050°, both dipping 80° W (Hunter, 1987).

To build upon the above observations, future mapping of faulted areas should take into account location, orientation, waviness, displacement and spacing of all faults (Hunter, 1987).

7.0 RESOURCES

7.1 Mount Klappan Anthracite Project

7.1.1 Summary

The in-situ, largely speculative level of coal resources of the Mount Klappan Anthracite Project total over 5.5 billion tonnes in seams greater than 0.5 m in thickness to a maximum depth of 500 m below surface. Of this total potential, 97.8 million tonnes are defined as being measured resources. The following table summarizes the resource contributions from each area of the property in each resource category. These resource estimates do not imply mineability or economic viability. They represent estimated in-place anthracite resources only. The 1:50 000 Coal Resource Map (Appendix I) presents the distributon of resources over the Mount Klappan property.

Table 7.1

MOUNT KLAPPAN ANTHRACITE PROJECT
COAL RESOURCES (MT)

Area	Category			
	Measured	Indicated	Inferred	Speculative
Lost-Fox	85.7	108.5	138.7	705.2
Hobbit Broatch	12.1	24.5	369.1	673.9
Summit			32.6	1 389.8
Nass				1 984.8
Skeena				-
Total	97.8	133.0	540.4	4 753.7

Total Coal Resource Potential: 5 524.9 million tonnes

The coal seams of interest are contained within the strata of the Klappan Sequence. Coal measures of the Malloch and Spatsizi Sequences are not presently considered to be of economic importance and therefore, were not included in resources calculations.

The parameters within which the coal resources were classified and the procedures utilized in resource calculations are outlined in Section 7.3.3.

7.2 Summit-Nass-Skeena Area

7.2.1 Summary

The majority of the 3.4 billion tonnes of coal resource in the Summit-Nass-Skeena Area is at the speculative level (Table 7.2). At the inferred level, 32.6 million tonnes of resource lies within the southern part of Summit in two separate resource areas.

Two inferred resource areas are based on diamond drill hole seam intersections (DDH82007 and DDH83003) which have been tentatively designated as Klappan Sequence seams S' to P' (stratigraphic position is questionable), and Q' to M' respectively (Table 7.3). No overlap was included between these two adjacent resource areas due to the lack of outcrop control and the uncertainty of the stratigraphic position of the seams exposed in the trenches.

Table 7.2

SUMMIT-NASS-SKEENA AREA
COAL RESOURCES
(in million tonnes)

	Measured	Indicated	Inferred	Speculative
Summit Area			32.6	1 389.8
Nass Area				1 984.8
Skeena Area				-
Total				

Total Resources: 3 407.2 million tonnes

7.3 Procedures and Parameters

7.3.1 Introduction

In-situ coal resources are defined as in place coal (coal and partings) contained in seams occuring within specified limits of thickness and depth from surface. Resources are further defined through classification into "measured", "indicated", "inferred", and "speculative" categories based on the existence and relative spacing of coal seam exploration data. None of the figures in any of the categories make any implications as to the practical mineability of the resource.

The procedures for the resource calculations include standard methods utilizing geological cross-sections and maps as described in Section 7.3.2.

The Energy Mines and Resources Report ER79-9: Coal Resources and Reserves of Canada outlines guidelines for coal resource calculations in the Cordilleran Region. These EMR parameters were modified for use in the Mount Klappan Coal Project as outlined in Section 7.3.2.

The parameters utilized for the 1987 Mount Klappan Coal Project are described in Section 7.3.3.

7.3.2 Procedures

A distribution of valid data points for each seam was established through diamond drill hole intersections and trenches. Based on maximum allowable data point spacing resources were calculated for a specific category.

Measured and indicated resource figures are derived from polygons constructed horizontally around valid data points within the resource area. To date, in the Summit Area, only inferred resources have been established due to the existence of just one data point in the resource area. In this case a horizontal circle was drawn around the data point and projected perpendicularly onto the cross-section(s) intersecting the circles area of influence. The seam length was then measured within these limits.

In the Summit Area each resource area is represented by a single diamond drill hole. Each drill hole has been assigned a one km radius influence.

The third dimension required for coal volume calculation after seam thickness and length have been determined is "strike length" or "influence" of the seam. This measurement usually equals the cross-section spacing if it is less than or equal to the required data point spacing for the resource category under consideration. Where a seam projects to the surface within the influence boundary the influence is measured to the point of outcrop.

To outcrop coal tonnage in all categories a straight average of Mount Klappan coal quality data provided a specific gravity of 1.67 tonnes/m^3.

The resource calculation procedure is summarized by the following equation::

Tonnes of Coal =

Seam Thickness	x	Seam Length	x	Influence	x	Specific Gravity
(m)		(m)		(m)		(t/m^3)

Speculative resources were calculated using a slightly different procedure. The areal extent, on the 1:50 000 Regional Geology map (Appendix I), of the Klappan Sequence outside areas of a higher resource confidence was planimetered. The representative seam thickness of 10.30 m applied to this area is 25 percent of the average of the

combined coal thicknesses from the Lost-Fox (55.96 m) and Hobbit-Broatch (26.40 m) areas. This figure appears to be a reasonable estimate of the thickness of the coal-bearing section within the speculative resource area.

The previously determined specific gravity of 1.67 t/m^3 was used in the following equation summarizing speculative resource calculations.

Tonnes of Coal = Planimetered Area x 10.30 x 1.67
(m^2) (m) (t/m^3)

7.3.3 Parameters

Resource parameters described below were used throughout the property, however due to data point density only inferred and speculative resources apply directly to the Summit-Nass-Skeena Area. The classification scheme is illustrated in Figure 7.1.

Seams with thicknesses greater than 0.5 m were projected to a maximum depth of 500 m for resource calculations.

7.3.3.1 Measured Resources

Measured resources include those in-situ resources delineated through establishment of exploration data points and therefore reported with confidence as to the character and continuity of the

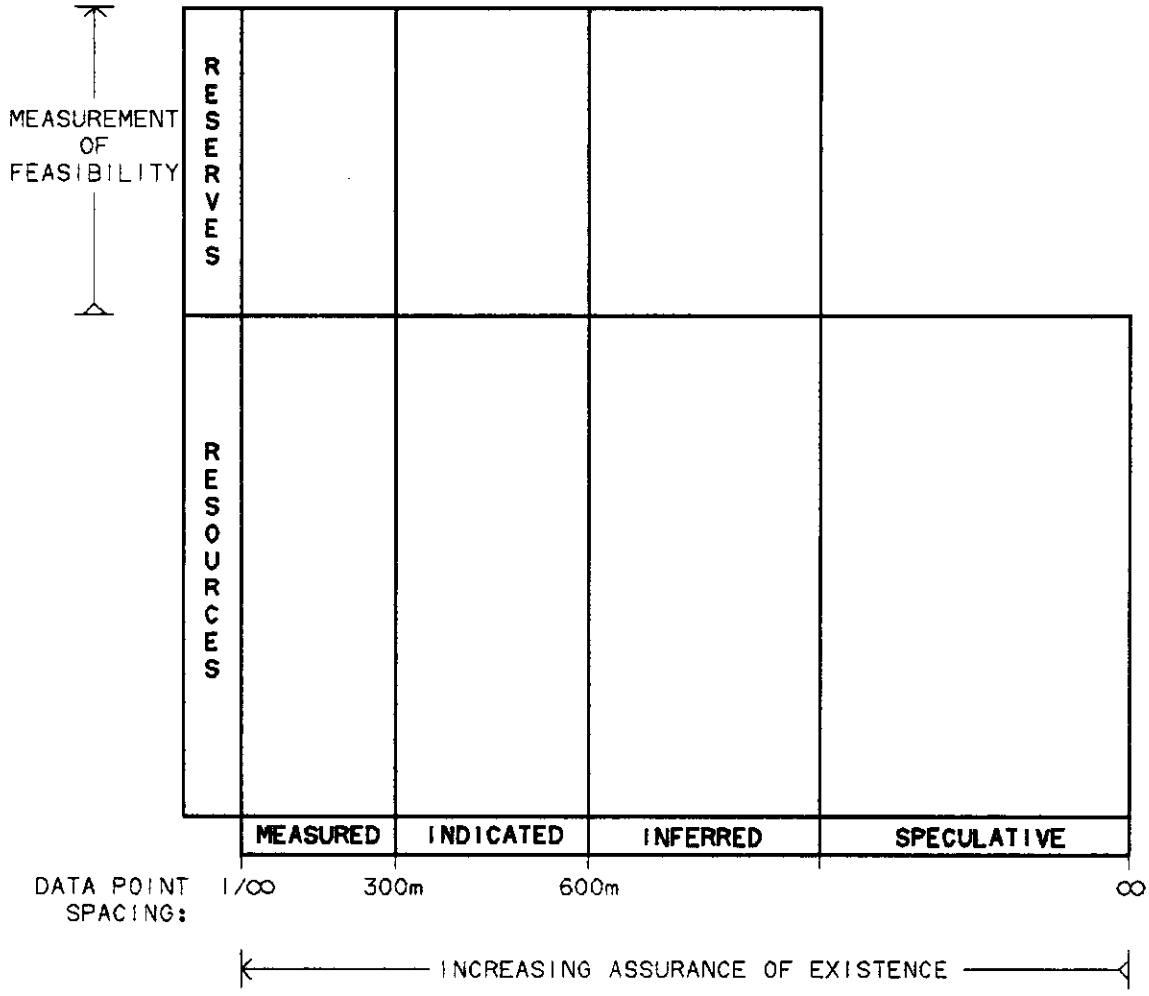

FIGURE 7-1

MOUNT KLAPPAN ANTHRACITE PROJECT

RESOURCE CLASSIFICATION SCHEME

GULF CANADA RESOURCES LTD.

GULF CANADA RESOURCES LTD.
05/02/87
KLAP:[205057]84132600!.CHT

coal seams. The maximum distance between data points, which may include adits, drill holes, trenches and outcrops, is 300 m.

7.3.3.2 Indicated Resources

Indicated resources include in-situ resources which are delineated using established data points as well as reasonable geological projections. The maximum distance between data points is 600 m.

7.3.3.3 Inferred Resources

Inferred resources include in-situ resources which are delineated utilizing regional geological data points which aid in the prediction of coal seam continuity. Report ER79-9 does not state a data point spacing for this category. For the purposes of standardization for the 1987 Mount Klappan Anthracite Project resource calculations, a maximum data point spacing of 2 000 m was used for the inferred level. The inferred resource summary for the Summit Area is given in Table 7.4.

Inferred resources within the Summit-Nass Resource Areas were based on seams containing 60 percent coal. Where a coal zone contained two distinct seams, thicknesses were summed.

7.3.3.4 Speculative Resources

Speculative resources include those in-situ resources calculated from a few scattered coal occurrences in areas of little or no geologic data where the coal-bearing sequence is interpreted to exist. There is no maximum spacing in this category.

Speculative resources are only a broad geological indication of the amount of coal which could be contained within the Klappan Sequence; the vast majority of this would not be mineable under current economic conditions.

8.0 COAL QUALITY

8.1 Summary

The 1987 coal quality program for the Summit Area consisted of proximate, gross calorific, sulphur analyses and vitrinite reflectance determination for 6 of 8 hand trenches. Vitrinite reflectance determinations were also performed on 10 trench samples from the 1986 program for the Summit and Nass Areas (Table 8.1 and 8.2).

Coal quality analyses were performed by Loring Laboratories. D.E. Pearson and Associates Limited conducted the coal petrology studies.

8.2 Procedures and Parameters

Accessible coal exposures greater than 0.5 m in true thickness were trenched, logged in detail and channel sampled during the course of routine traversing. Sample intervals were chosen from the descriptive log and reflected changes in the character of the coal seam. Substantial partings and obvious differences in coal position were sampled individually to enable tracing of these variations throughout the seam.

Appendix I contains all of the coal quality data for the 1987 trenches.

8.3 Summit Area

Eight trenches were excavated in the southern Summit Area to

Table 8.1

SUMMIT-NASS SKEENA AREA

TRENCH SAMPLE

AVERAGE COAL QUALITY SUMMARY

1987

	Summit
No. of Trenches Analysed	8
No. of Samples Included in Average	6
Proximate Analysis	
Residual Moisture (%)	2.31
Ash (%)	39.52
Volatile Matter (%)	10.75
Fixed Carbon (%)	47.42
Total Sulphur (%)	0.33
Gross Calorific Value (MJ/Kg)	16.35
Vitrinite Reflectance	4.21

*Experience indicates that volatile matter content may be increased due to oxidation of samples or elevated carbonate content within the ash component. Vitrinite reflectance confirms that these seams are of anthracite rank.

further define existing resource potential. Six of the eight samples were analysed for proximate, gross calorific and sulphur values. These along with 10 additional samples from 1986 underwent vitrinite reflectance studies (Table 8.3).

Coal quality analysis has proven useful in several respects. It facilitates seam tracing by indicating which occurrences may be related and lends a certain degree of confidence to correlations. Increasing Ro max % (vitrinite reflectance) can be used as an indicator of the proximity of the Klappan/Spatsizi Sequence contact.

The 1987 Summit-Nass-Skeena trenching program concentrated entirely on the Southern Summit Area. The majority of the samples analysed exhibited moderate weathering detected by proximate analysis (TRC87302 was highly weathered). The total moisture in the moderately weathered samples ranges from 11.5% to 15% as compared with an average of just over 5% for unoxidized drill core samples. TRC87302 displays a higher degree of weathering with a 23.59% total moisture content. Moderate weathering is also reflected in higher residual moisture values (2% to 3% as compared with under 2%) and higher volatiles (10.5% to 11.5% where, less than 8% would be expected). Again a higher degree of weathering is evident in TRC87302 where the volatile matter content equals 18.95%. Due to the weathered nature of some samples, the percentage of residual moisture and volatiles are artificially higher than would be expected in unweathered samples. This results in artificially lower values for ash and fixed carbon within the weathered samples.

(TRC87301 has residual moisture and volatile matter contents of 1.57% and 6.19% respectively and TRC87307 has a volatile matter content of 6.53%). This may be a function of an increase in coal rank at greater stratigraphic depth or of the physiographic settings of the trenches. High coal rank may also account for the apparent reduced weathering in the 1987 trenches as compared with weathering found in trenches from 1985 and 1986.

A mean vitrinite reflectance range of 3.4% to 5.1% is consistent with that expected of anthracite coal within the Klappan Sequence.

8.4 Nass and Summit 1986 Trench Samples

Additional vitrinite reflectance tests were performed on ten 1986 trenches. Seven of these trenches are located in the Nass River Area while the remainder are found in the Southern Summit Area. Most mean vitrinite reflectance values are typical of those expected from Klappan Sequence coal with the exception of three (TRC86027- 029) occurring in the Nass River Area. These lower values for these trench samples result from the trenches' proximity to the Klappan-Malloch contact.

9.0 LIST OF REFERENCES

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Appendix A

MOUNT KLAPPAN PROJECT LICENCES
1987

Summit Area

Licence	Effective Date	Hectares	Series	Block
7171*	Dec. 31/82	140.5	104-H-7	D
7173*	Dec. 31/82	140.0	104-H-7	D
7174	Dec. 31/82	280.0	104-H-7	D
7176	Dec. 31/82	277.0	104-H-7	D
7177	Sept. 1/81	280.0	104-H-7	D
7382	Mar. 15/82	280.0	104-H-6	H
7383	Mar. 15/82	108.0	104-H-6	H
7384	Mar. 15/82	281.0	104-H-7	D
7385	Mar. 15/82	204.0	104-H-7	D
7386	Mar. 15/82	280.0	104-H-7	D
7387	Mar. 15/82	280.0	104-H-7	D
7388	Mar. 15/82	172.0	104-H-7	D
7389	Mar. 15/82	275.0	104-H-7	D
7390	Mar. 15/82	280.0	104-H-7	D
7391	Mar. 15/82	115.0	104-H-7	E
7392	Mar. 15/82	260.0	104-H-7	E
7423	Mar. 15/83	281.0	104-H-7	D
7424	Mar. 15/83	280.0	104-H-7	D
7425	Mar. 15/83	280.0	104-H-7	D
7426	Mar. 15/83	280.0	104-H-7	D
7726	Jan. 10/84	280.0	104-H-6	A
7727	Jan. 10/84	280.0	104-H-6	A
7728	Jan. 10/84	280.0	104-H-6	A
7729	Jan. 10/84	280.0	104-H-6	A
7730	Jan. 10/84	280.0	104-H-6	A

Summit Area (cont'd)

Licence	Effective Date	Hectares	Series	Block
7746	Jan. 10/84	280.0	104-H-6	H
7750	Jan. 10/84	261.0	104-H-6	H
7751	Jan. 10/84	280.0	104-H-6	H
7752	Jan. 10/84	280.0	104-H-6	H
7754	Jan. 10/84	154.0	104-H-6	H
7755	Jan. 10/84	274.0	104-H-6	H
7756	Jan. 10/84	280.0	104-H-6	D
7757	Jan. 10/84	280.0	104-H-6	D
8047	Mar. 29/85	280.0	104-H-6	A
8048	Mar. 29/85	280.0	104-H-6	A

* Licence split between Summit-Nass Skeena and Lost-Fox Areas.

Summit Area Total Hectares = 8 822.5

Nass Area

Licence	Effective Date	Hectares	Series	Block
7150	Sept. 1/81	281	104-H-2	L
7154	Sept. 1/81	281	104-H-2	L
7421	Mar. 15/83	281	104-H-2	L
7422	Mar. 15/83	281	104-H-2	L
7427	Mar. 15/83	281	104-H-3	I
7428	Mar. 15/83	281	104-H-3	I
7429	Mar. 15/83	281	104-H-3	I
7430	Mar. 15/83	281	104-H-3	I
7431	Mar. 15/83	281	104-H-3	I
7432	Mar. 15/83	281	104-H-3	I
7487	Oct. 21/83	281	104-H-3	J
7488	Oct. 21/83	281	104-H-3	J
7506	Oct. 21/82	281	104-H-3	H
7507	Oct. 21/82	281	104-H-3	H
7508	Oct. 21/82	281	104-H-3	H
7509	Oct. 21/82	281	104-H-3	H
7510	Oct. 21/82	281	104-H-3	H
7511	Oct. 21/82	281	104-H-3	I
7512	Oct. 21/82	281	104-H-3	I
7513	Oct. 21/82	281	104-H-3	I
7514	Oct. 21/82	281	104-H-3	I
7515	Oct. 21/82	281	104-H-3	I
7516	Oct. 21/82	281	104-H-3	I
7517	Oct. 21/82	281	104-H-3	I
7518	Oct. 21/82	281	104-H-3	I

Nass Area (cont'd)

Licence	Effective Date	Hectares	Series	Block
7519	Oct. 21/82	281	104-H-3	I
7520	Oct. 21/82	281	104-H-3	I
7521	Oct. 21/82	281	104-H-3	I
7522	Oct. 21/82	281	104-H-3	I
7523	Oct. 21/82	281	104-H-3	I
7530	Oct. 21/82	281	104-H-2	L
7531	Oct. 21/82	281	104-H-2	L
7532	Oct. 21/82	281	104-H-2	L
7533	Oct. 21/82	281	104-H-2	L
7534	Oct. 21/82	281	104-H-2	L
7535	Oct. 21/82	281	104-H-2	L
7536	Oct. 21/82	281	104-H-2	L
8032	Mar. 29/85	281	104-H-3	J
8033	Mar. 29/85	281	104-H-3	J
8034	Mar. 29/85	281	104-H-3	J
8035	Mar. 29/85	281	104-H-3	J
8036	Mar. 29/85	281	104-H-3	J
8037	Mar. 29/85	281	104-H-3	J
8038	Mar. 29/85	281	104-H-3	J
8039	Mar. 29/85	281	104-H-3	J
8040	Mar. 29/85	281	104-H-3	J
8041	Mar. 29/85	281	104-H-3	J
8042	Mar. 29/85	281	104-H-3	J
8043	Mar. 29/85	281	104-H-3	J
8044	Mar. 29/85	281	104-H-3	J

Nass Area Total Hecatres = 13 769.0

Skeena Area

Licence	Effective Date	Hectares	Series	Block
7493	Oct. 21/82	282	104-H-2	G
7494	Oct. 21/82	282	104-H-2	G
7495	Oct. 21/82	282	104-H-2	G
7497	Oct. 21/82	281	104-H-3	G
7498	Oct. 21/82	281	104-H-2	G
7498	Oct. 21/82	281	104-H-2	G
7500	Oct. 21/82	281	104-H-2	G
7501	Oct. 21/82	281	104-H-2	G
7502	Oct. 21/82	281	104-H-2	J
7503	Oct. 21/82	281	104-H-3	K
7504	Oct. 21/82	281	104-H-3	K
7538	Oct. 21/82	281	104-H-2	F

Skeena Area Total Hectares = 4 785

Summit-Nass-Skeena Area Total Hectares = 27 376.5

Appendix B

DISTRIBUTION OF WORK BY LICENCE

1987

TRENCH NUMBER	LICENCE NUMBER
KNPSSTRC87300	7728
KNPSSTRC87301	7726
KNPSSTRC87301	7757
KNPSSTRC87302	7728
KNPSSTRC87304	8047
KNPSSTRC87305	8047
KNPSSTRC87306	off property
KNPSSTRC87307	off property

APPENDIX D

LISTING OF FOSSILS

SAMPLE NUMBER	GEOGRAPHIC LOCATION	STRATIGRAPHIC LOCATION	IDENTIFICATION (IF KNOWN)
SL870101	West Pond Cliffs, WLR	above M seam	Pterophyllum rectangulare Sphenopteris sp. bivalves
SL870102	Southern Mohawk, WLR	above J seam	Czekanowskia rigida Ginkgo nana Baiera gracilis Nilssonia tenuicaulis Nilssonia schaumbergensis abund. Pityophyllum nordenskioldii bivalve wood
SL870202	Little Klappan River	Lower Klappan	bivalves bivalve escape structure
SL870206	Little Klappan River	Lower Klappan	bivalves
KH870105	Nass	Lower Klappan	Podozamites lanceolatus Nilssonia tenuicaulis abund. Czekanowskia rigida Ginkgo nana
KH870201	Nass	Upper Spatsizi	abund. bivalves (sampled)
KH870203	Nass	Upper Spatsizi	abund. bivalves (sampled)
KH870301	Nass	Upper Spatsizi	bivalves unidentified plant (sampled)
SL870207	Little Klappan River	Lower Klappan	Nilssonia tenuicaulis Nilssonia canadensis Ptilophyllum montanense gastropods bivalves (sampled)
SL870301	Little Klappan River	L. Klappan/Spatsizi	bivalves: Staffinella
SL870303	Little Klappan River	L. Klappan/Spatsizi	bivalves (sampled): Acesta, Somapecte
KH870601	Nass	L./M. Klappan	Pityophyllum nordenskioldii Czekanowskia rigida Nilssonia tenuicaulis
GP/JW87	Knooph Hill	M. Malloch	Pityophyllum nordenskioldii Cladophlebis virginiensis fisheri Cladophlebis virginiensis martiniana Podozamites lanceolatus Nilssonia schaumbergensis Baiera furcata Pterophyllum rectangulare
KH870702	Nass	Spatsizi ?	Helminthopsis bivalves

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
KH870802	Nass	Klappan ?	Helminthopsis bivalves wood fragments
KH870901	Nass	L. Klappan	Helminthopsis
KH870906	Nass	Spatsizi	v. abund. gastropods
MB870508	Scree Bowl, WLR	below seam A	Helminthopsis plant fragments
SL870502	Scree Bowl, WLR	below seam A	wood frags.
MB870601	Fault Block near Twin Ponds, WLR	near seam I	tree branch imprints in ss
MB870607	Fault Block near Twin Ponds, WLR	below seam J	plant frags.
MB870705	Fault Block near Twin Ponds, WLR	above seam I	bivalve: poss. Ferganoconcha
MB870706	Fault Block near Twin Ponds, WLR	M. Klappan	Pityophyllum nordenskioldii or Czekanowskia rigida
SL870708	Southern Mohawk, WLR	below seam J	abund. Ginkgo nana Pityophyllum nordenskioldii Podozamites lanceolatus
SL870904	waterfall below SC04, WLR	near seam C	Nilssonia schaumbergensis Nilssonia tenuicaulis Czekanowskia rigida wood
MB870709	Fault Block near Twin Ponds, WLR	M. Klappan	plant frags. wood imprints
MB871201	West Pond Cliffs, WLR	M. Klappan	tree stump insitu (75 cm diameter) plant fragments
MB871203	West Pond Cliffs, WLR	M. Klappan	Staffinella (sampled DW870201) plant frags.
DW870309	west of SC04 cirque, WLR	above seam C	Helminthopsis bivalve imprint Nilssonia tenuicaulis
DW870501	near SC06, WLR	near seam E	Pityophyllum nordenskioldii Nilssonia tenuicaulis
DW870507	near SC06, WLR	M. Klappan	Helminthopsis
SL871001	northeast of TRC84309, WLR	M. Klappan	Nilssonia tenuicaulis Pterophyllum rectangulare Pityophyllum nordenskioldii Nilssonia sp.
SL871002	creek west of TRC84309, WLR	below seam J	abund. Ginkgo nana Nilssonia tenuicaulis Czekanowskia rigida

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
			Pityophyllum nordenskioldii Pterophyllum rectangulare Baiera furcata Baiera gracilis Podozamites lanceolatus Sphenopteris sp. branches
SL871204	base of West Pond Cliff, WLR	U. Klappan	Pityophyllum nordenskioldii Sphenopteris sp. petrified wood
SL871205	base of West Pond Cliff, WLR	U. Klappan	worm burrows clam escape structures plant hash
SL871402	Westend Cliff, WLR	above seam A-1 (?)	bivalves
SL871502	base of Mt. Klappan	above seam J	Pityophyllum nordenskioldii Nilssonia tenuicaulis Nilssonia schaumbergensis wood
SL871505	base of Mt. Klappan	M./U. Klappan	Pityophyllum nordenskioldii
SL871512	base of Mt. Klappan	near seam K	Pityophyllum nordenskioldii Equisetites lyelli tree trunks Nilssonia canadensis Czekanowskia rigida Podozamites lanceolatus Sphenopteris sp.
SL871603	base of Mt. Klappan	Upper Klappan	Pityophyllum nordenskioldii plant hash
SL871704	base of Mt. Klappan	U. Klappan or Malloch	abund. plants (mostly hash) Baiera furcata Czekanowskia rigida Nilssonia sp.
SL871801	base of Mt. Klappan	U. Klappan or Malloch	Podozamites lanceolatus
SL872001	near TRC84307	M. Klappan	bivalves
SL872002	near TRC84306	below I seam	Nilssonia tenuicaulis Nilssonia canadensis Nilssonia schaumbergensis Pityophyllum nordenskioldii
SL8721	upstream from SL871002	below seam J	Nilssonia tenuicaulis Nilssonia schaumbergensis Pityophyllum nordenskioldii Ptilophyllum montanense Athrotaxites berryi Elatides curvifolia Pterophyllum rectangulare

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
SL872203	south of SC04	below seam E ?	bivalves (sampled)
LS87017	Summit South	L. Klappan	Nilssonia tenuicaulis Ginkgo nana Nilssonia nigracollensis
OTC87013	south of Jack Creek, Skeena	U. Malloch/Rhonda	Coniopteris brevifolia Czekanowskia rigida Baiera furcata Baiera gracilis Ginkgo nana Pterophyllum rectangulare Nilssonia tenuicaulis Nilssonia nigracollensis Claudophlebis virginiensis Coniopteris yukonensis(?) Sagenopteris williemsii(?) Phoenicopsis angustifolia(?) Ginkgo pluripartita(?)
NGJ8701	Calvin's Ridge, Nass	U. Spatsizi	Staffinella Buchia Ferganoconcha Hypoxytoma or Acesta ? Belemnopsis sulcatus Buchia concentrica Ammonite (either Cranocephalites or Arctocephalites)
DW871202	Summit South	L. Klappan	Pityophyllum nordenskioldii Nilssonia canadensis Nilssonia tenuicaulis Czekanowskia rigida
DW871203	Summit South	L. Klappan	horseshoe worm burrows Paleodycton
OTC87016	Marshall Ridge, Summit South	L. Klappan	Helminthopsis Pityophyllum nordenskioldii
OTC87017	Marshall Ridge, Summit South	L. Klappan	bivalves Belemnite petrified wood Pityophyllum nordenskioldii Cladophlebis virginiensis
OTC87023	cirque below TRC82049, LR	L. Klappan	belemnite
TRC87006	backside WLR	seam G	Nilssonia canadensis
TRC87010	above West Pond, WLR	floor of seam O ?	plant hash Nilssonia canadensis
TRC87020	east of S. Mohawk, WLR	seam J	Nilssonia tenuicaulis Pterophyllum rectangulare Pityophyllum nordenskioldii

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
TRC87102	south of SC03, LR	seam H roof	Ctenis borealis Ginkgo nana Sphenopteris sp. Nilssonia schaumbergensis
MB/DW87101	top of Westend Cliffs, WLR	above seam A	wood Baiera gracilis Nilssonia tenuicaulis Athrotaxites berryi Ptilophyllum sp. bivalves (sampled): Panope (?) Belemnite (sampled)
DDH87001A	Box 21, 46 m from top	24 m below I seam	Helminthopsis
DDH87002A	Box 34, 72 m from top	15 m below I seam	Helminthopsis
DDH87002B	Bow 87, 177 m from top	17 m above H seam	Baiera furcata Nilssonia tenuicaulis
DDH87003A	Box 25, 55 m from top	11 m below I seam	Helminthopsis
DDH87003B	Box 27, 59 m from top	15 m below I seam	bivalve
DDH87004A	Box 15, 37 m from top	2 m below H/I seam	bivalve: Hypoxytoma(?) plant fragments
DDH87004B	Box 18, 42 m from top	7 m below H/I seam	Helminthopsis
DDH87004C	Box 26, 59 m from top	10 m above H seam	Helminthopsis
DDH87005A	Box 8, 29 m from top	5 m below K/L seam	Ginkgo nana Nilssonia tenuicaulis Nilssonia sp. Baiera gracilis poss. Nilssonia schaumbergensis poss. Baiera furcata
DDH87005B	Box 8, 30 m from top	6 m below K/L seam	Sphenopteris sp. Nilssonia tenuicaulis Nilssonia sp. Baiera gracilis poss. Baiera furcata wood
DDH87005C	Box 9, 32 m from top	8 m below K/L seam	Sphenopteris sp. wood
DDH87005D	Box 17, 48 m from top	1 m above K seam	Nilssonia sp. Czekanowskia rigida Nilssonia nigracollensis poss. Baiera furcata poss. Baiera gracilis wood
DDH87005E	Box 22, 59 m from top	immediately below K seam	Cladophlebis virginiensis wood

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
DDH87005F	Box 22, 60 m from top	immediately below K seam	Nilssonia sp.
DDH87005G	Box 25, 65 m from top	6 m below K seam	feeding traces
DDH87005H	Box 76, 165 m from top	near H/I seam	gastropods (.5 cm long)
DDH87005I	Box 76, 166 m from top	near H/I seam	gastropods bivalves: (1 x 1 cm), Ferganoconcha (3.5 x 2.25 cm)
DDH87005J	Box 77, 166 m from top	near H/I seam	gastropods bivalves (<1.5 cm long)
DDH87005K	Box 88, 189 m from top	4 m below H seam	bivalves: Herzogina but poss. Astarte or Staffinella
DDH87006A	Box 49, 104 m from top	6 m below I (?) seam	Nilssonia sp. Pterophyllum rectangulare Cladophlebis virginiensis martiniana (well preserved)
DDH87006B	Box 67, 142 m from top	3 m above H (?) seam	Pityophyllum nordenskioldii coalified plant frags.
DDH87007A	Box 82, 178 m from top	14 m above H (?) seam	Helminthopsis
DDH87007B	Box 87, 189 m from top	3 m above H (?) seam	Helminthopsis
DDH87007C	Box 92, 199 m from top	1 m below H (?) seam	Helminthopsis
DDH87007D	Box 94, 202 m from top	5 m below H (?) seam	bivalves
DDH87008A	Box 5, 19 m from top	immediately above I seam	Pterophyllum rectangulare
DDH87008B	Box 18, 47 m from top	28 m above I seam	Helminthopsis
DDH87008C	Box 23, 58 m from top	39 m above I seam	gastropods (1.5 cm in diametre)
DDH87009A	Box 13, 32 m from top	10 m above I seam	bivalve (qtz replaced)
DDH87009B	Box 23, 57 m from top	10 m below I seam	bivalve (pyritized): Hypoxytoma (?), Staffinella (?)
DDH87009C	Box 33, 79 m from top	9 m below H/I seam	Pityophyllum nordenskioldii Czekanowskia rigida plant fragments
DDH87009D	Box 34, 80 m from top	10 m below H/I seam	Pityophyllum nordenskioldii plant fragments
DDH87010A	Box 2, 5 m from top	24 m above H seam	bivalve (pyritized, .5 cm) plant fragments
DDH87010B	Box 3, 7 m from top	22 m above H seam	bivalves (pyritized): Astarte or Staffinella plant fragments

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
DDH87010C	Box 4, 10 m from top	19 m above H seam	bivalve
DDH87010D	Box 17, 38 m from top	4 m below H seam	Nilssonia sp. wood
DDH87011A	Box 3, 10 m from top	19 m above H seam	bivalve (.2 x .3 cm)
DDH87011B	Box 21, 46 m from top	12 m below H seam	Helminthopsis
DDH87012A	Box 37, 86 m from top	12 m above H seam	bivalve fragments
DDH87012B	Box 57, 127 m from top	2 m below H seam	bivalve fragments
DDH87013A	Box 42, 85 m from top	12 m above H seam	Helminthopsis
DDH87013B	Box 53, 107 m from top	8 m below H seam	Helminthopsis
DDH87014A	Box 22, 55 m from top	immediately below J seam	Helminthopsis
DDH87015A	Box 3, 8 m from top	immediately above L seam	bivalve: Herzogina
DDH87015B	Box 7, 16 m from top	8 m above K seam	Nilssonia tenuicaulis Cladophlebis virginiensis fisheri Athrotaxites berryi (?) Sphenopteris sp. Pityophyllum nordenskioldii (?)
DDH87015C	Box 10, 24 m from top	2 m above K seam	abund. Nilssonia canadensis Nilssonia tenuicaulis wood fragments
DDH87015D	Box 34, 71 from top	9 m below I seam	Helminthopsis
DDH87015E	Box 36, 74 m from top	8 m above H seam	occ. bivalve
DDH87015F	Box 37, 76 m from top	6 m above H seam	bivalves
DDH87015G	Box 38, 77 m from top	4 m above H seam	bivalve
DDH87015H	Box 39, 80 m from top	2 m above H seam	bivalves
DDH87015I	Box 47, 96 m from top	10 m below H seam	Helminthopsis
DDH87015J	Box 47, 97 m from top	11 m below H seam	Ginkgo nana
DDH87015K	Box 49, 100 m from top	14 m below H seam	Nilssonia sp.
DDH87015L	Box 51, 104 m from top	18 m below H seam	Helminthopsis
DDH87015M	Box 54, 110 m from top	24 m below H seam	bivalve: Ferganoconcha
DDH87015N	Box 56, 116 m from top	immediately below Ph seam	Nilssonia tenuicaulis Nilssonia schaumbergensis Pityophyllum nordenskioldii Czekanowskia rigida
DDH87016A	Box 2, 5 m from top	43 m above I seam	Helminthopsis

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
DDH87017A	Box 10, 25 m from top	immediately above K seam	Pityophyllum nordenskioldii Nilssonia sp.
DDH87017B	Box 12, 30 m from top	K seam	Nilssonia sp. Ginkgo sp. Czekanowskia rigida
DDH87017C	Box 35, 77 m from top	14 m below I seam	Baiera furcata
DDH87017D	Box 37, 82 m from top	14 m above H/I seam	abund. Pityophyllum nordenskioldii Sphenopteris sp.
DDH87017E	Box 38, 84 m from top	12 m above H/I seam	Pityophyllum nordenskioldii Ginkgo nana
DDH87017F	Box 39, 85 m from top	10 m above H/I seam	Pityophyllum nordenskioldii
DDH87017G	Box 39, 86 m from top	9 m above H/I seam	Ginkgo nana Baiera furcata
DDH87017H	Box 41, 89 m from top	6 m above H/I seam	Nilssonia sp. Baiera gracilis
DDH87017I	Box 43, 95 m from top	1 m above H/I seam	Cladophlebis virginiensis Nilssonia canadensis Pityophyllum nordenskioldii wood
DDH87019A	Box 25, 61 m from top	54 m below I seam	Czekanowskia rigida wood
DDH87019B	Box 72, 157 m from top	9 m above H/I seam	Pityophyllum nordenskioldii Podozamites lanceolatus
DDH87019C	Box 78, 168 m from top	immediately below H/I seam	Helminthopsis
DDH87019D	Box 81, 174 m from top	6 m below H/I seam	bivalve frags. Helminthopsis
DDH87019E	Box 81, 175 m from top	7 m below H/I seam	bivalve: Staffinella plant hash
DDH87020A	Box 8, 26 m from top	27 m above M/N seam	bivalve
DDH87020B	Box 9, 27 m from top	26 m above M/N seam	belemnite (1.5 cm diameter)
DDH87020C	Box 36, 82 m from top	immediately above M seam	Nilssonia canadensis
DDH87021A	Box 22, 46 m from top	13 m below I seam	bivalves
DDH87022A	Box 21, 45 m from top	19 m above O seam	Helminthopsis
DDH87022B	Box 35, 74 m from top	8 m below O seam	Helminthopsis
DDH87022C	Box 36, 76 from top	10 m below O seam	Helminthopsis
DDH87022D	Box 46, 96 m from top	2 m above N seam	bivalves

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
DDH87023A	Box 34, 88 m from top	16 m above K seam	bivalves (1.5 x 2 cm)
DDH87023B	Box 36, 92 m from top	13 m above K seam	bivalves (.75 x 1.3 x 2. cm)
DDH87023C	Box 38, 97 m from top	8 m above K seam	bivalves: Herzogina or Astarte
DDH87023D	Box 40, 101 m from top	4 m above K seam	bivalves
DDH87023E	Box 45, 111 m from top	5 m below K seam	bivalves (0.5 x 1.2 x 1.5 cm)
DDH87023F	Box 81, 182 m from top	2 m above K/L seam	bivalves: Herzogina or Astarte
DDH87024A	Box 17, 46 m from top	3 m below M/N seam	Staffinella
DDH87024B	Box 20, 52 m from top	9 m below M/N seam	Helminthopsis
DDH87024C	Box 32, 79 m from top	7 m above M seam	bivalves (<.5 x 3 cm) Helminthopsis
DDH87024D	Box 34, 82 m from top	4 m above M seam	bivalves
DDH87024E	Box 57, 128 m from top	8 m below L seam	Helminthopsis
DDH87026A	Box 22, 49 m from top	immediately above H/I seam	bivalves
DDH87026B	Box 27, 59 from top	10 m above H/I seam	bivalves
DDH87026C	Box 28, 61 m from top	11 m above H/I seam	bivalve: Ferganoconcha
DDH87026D	Box 35, 75 m from top	4 m below I seam	bivalves (1.5 cm in cross-section)
DDH87026E	Box 37, 81 m from top	immediately above I seam	Ginkgo nana Nilssonia sp.
DDH87026F	Box 38, 82 m from top	2 m above I seam	Pityophyllum nordenskioldii
DDH87026G	Box 82, 172 m from top	Ph seam	Nilssonia canadensis Nilssonia sp. Pterophyllum rectangulare (?)
DDH87026H	Box 84, 176 m from top	3 m below Ph seam	bivalves: Staffinella
DDH87027A	Box 50, 119 m from top	17 m above Gu seam	bivalves: Buchia, Hypoxytoma or Acesta gastropod
DDH87028A	Box 4, 25 m from top	7 m above O seam	Helminthopsis
DDH87028B	Box 5, 27 m from top	5 m above O seam	bivalves: Staffinella (1 x 3 cm), Ferganoconcha (.75 x 2. x 4. cm)
DDH87028C	Box 6, 29 m from top	3 m above O seam	bivalves: Herzogina or Staffinella
DDH87028D	Box 6, 30 m from top	2 m above O seam	Helminthopsis
DDH87028E	Box 7, 30 m from top	1 m above O seam	Helminthopsis bivalves

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
DDH87028F	Box 21, 61 m from top	1 m above M/N seam	Nilssonia schaumbergensis Ctenis borealis Nilssonia sp. Equisetites lyelli (stem x-section)
DDH87028G	Box 23, 63 m from top	immediately below M/N seam	bivalves (1 x 1.3 x 2 cm): Herzogina or Staffinella
DDH87028H	Box 24, 66 m from top	4 m below M/N seam	bivalves and plant frags in same beds Ginkgo pluripartita (?)
DDH87028I	Box 27, 73 m from top	11 m below M/N seam	bivalves: Staffinella or Herzogina
DDH87028J	Box 30, 79 m from top	11 m above M seam	Nilssonia sp.
DDH87028K	Box 47, 112 m from top	2 m below L seam	bivalves (1 x 2 x 2.5 cm) poorly defined
DDH87028L	Box 51, 121 m from top	18 m above K/L seam	Helminthopsis gastropods (.5 cm)
DDH87028M	Box 76, 171 m from top	20 m below K/L seam	bivalve frags.
DDH87028N	Box 77, 172 m from top	21 m below K/L seam	bivalves: Staffinella
DDH87028P	Box 78, 174 m from top	23 m below K/L seam	bivalves (3.5 x 4.5 cm)
DDH87028Q	Box 82, 182 m from top	18 m above K seam	bivalve frags.
DDH87028R	Box 83, 184 m from top	16 m above K seam	bivalves (poorly defined): Staffinella
DDH87028S	Box 88, 194 m from top	immediately below K seam	Nilssonia sp. Ctenis borealis (?)
DDH87028T	Box 99, 216 m from top	12 m below K seam	Ptilophyllum montanense
DDH87029A	Box 92, 194 m from top	8 m above G seam	bivalves
DDH87030A	Box 7, 33 m from top	1 m above M seam	Helminthopsis
DDH87030B	Box 19, 57 m from top	3 m above L seam	bivalves: Staffinella
DDH87030C	Box 20, 59 m from top	1 m above L seam	Cladophlebis sp. Sphenopteris sp.
DDH87030D	Box 21, 62 m from top	immediately below L seam	Baiera furcata coaly wood fragments
DDH87030E	Box 22, 63 m from top	1 m below L seam	bivalves
DDH87030F	Box 23, 64 m from top	3 m below L seam	bivalves bivalve escape tubes
DDH87030G	Box 26, 71 m from top	9 m below L seam	Helminthopsis
DDH87030H	Box 27, 74 m from top	12 m below L seam	Helminthopsis

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
			gastropod
DDH87030I	Box 28, 75 m from top	13 m below above L seam	bivalves (qtz replaced) almost coquina gastropods (.5 cm)
DDH87030J	Box 59, 137 m from top	8 m below K seam	Helminthopsis
DDH87030K	Box 78, 173 m from top	13 m above K seam	scaphopod (?) or Pseudobolus (?)
DDH87030L	Box 79, 174 m from top	11 m above K seam	bivalve (pyritized) belemnite (silicified)
DDH87030M	Box 81, 178 m from top	7 m above K seam	bivalve (pyritized): Buchia, Staffinella, Pseudobolus (silicified)
DDH87030N	Box 82, 185 m from top	immediately above K seam	bivalve (pyritized): Buchia, Staffinella
DDH87030P	Box 114, 245 m from top	immediately below I (?) seam	Nilssonia canadensis
DDH87031A	Box 17, 51 m from top	2 m below L seam	bivalve cross-section (1.7 cm)
DDH87031B	Box 20, 57 m from top	7 m below L seam	Helminthopsis
DDH87031C	Box 35, 85 m from top	3 m below K/L seam	bivalves: Ferganoconcha (1.8 x 4.2 cm), unknown (.1 x .2 cm)
DDH87031D	Box 36, 87 m from top	5 m below K/L seam	bivalves
DDH87031E	Box 37, 90 m from top	5 m above L seam	Helminthopsis gastropods bivalves: Ferganoconcha, unknown (.1 x .2 cm)
DDH87031F	Box 45, 105 m from top	9 m below L seam	Helminthopsis
DDH87031G	Box 52, 119 m from top	22 m below L seam	Helminthopsis
DDH87031H	Box 66, 148 m from top	11 m below K/L seam	Helminthopsis
DDH87031I	Box 69, 153 m from top	16 m below K/L seam	Helminthopsis
DDH87031J	Box 75, 166 m from top	29 m below K/L seam	Helminthopsis
DDH87031K	Box 80, 177 m from top	6 m above K seam	bivalves (2 x >2 cm)
DDH87031L	Box 81, 178 m from top	5 m above K seam	scaphopod (?)
DDH87031M	Box 82, 180 m from top	3 m above K seam	Ammonite
DDH87031N	Box 82, 181 m from top	2 m above K seam	bivalves: Inoceramus
DDH87031P	Box 88, 192 m from top	5 m below K seam	bivalves (qtz replaced)
DDH87031Q	Box 92, 201 m from top	13 m below K seam	Helminthopsis

SAMPLE NO.	LOCATION	POSITION	IDENTIFICATION
DDH87033A	Box 9, 48 m from top	5 m below K seam	rootlets (?)
DDH87033B	Box 14, 56 m from top	13 m below K seam	rootlets (?)

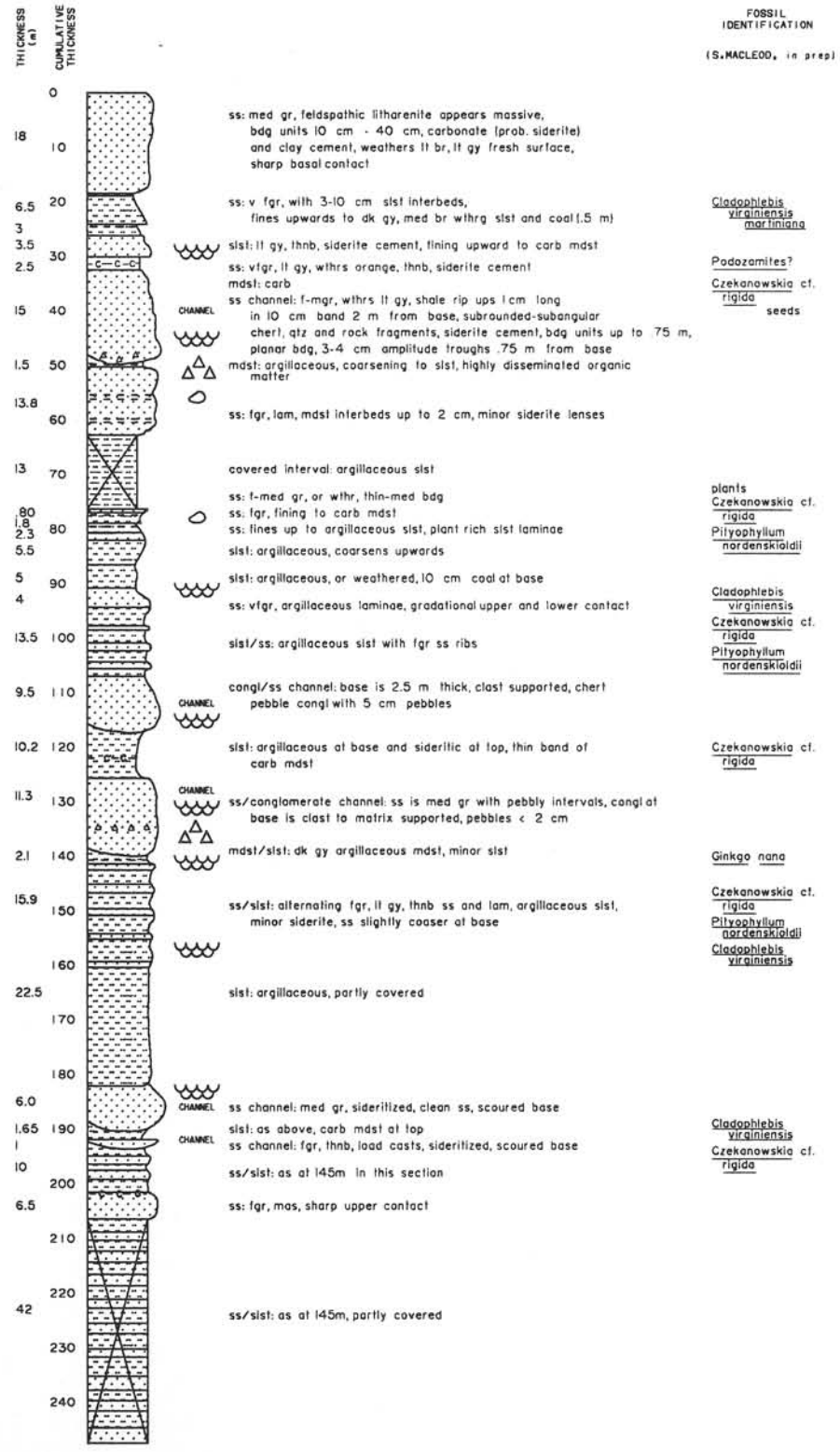
APPENDIX E

MALLOCH AND DEVILS CLAW TYPE SECTIONS

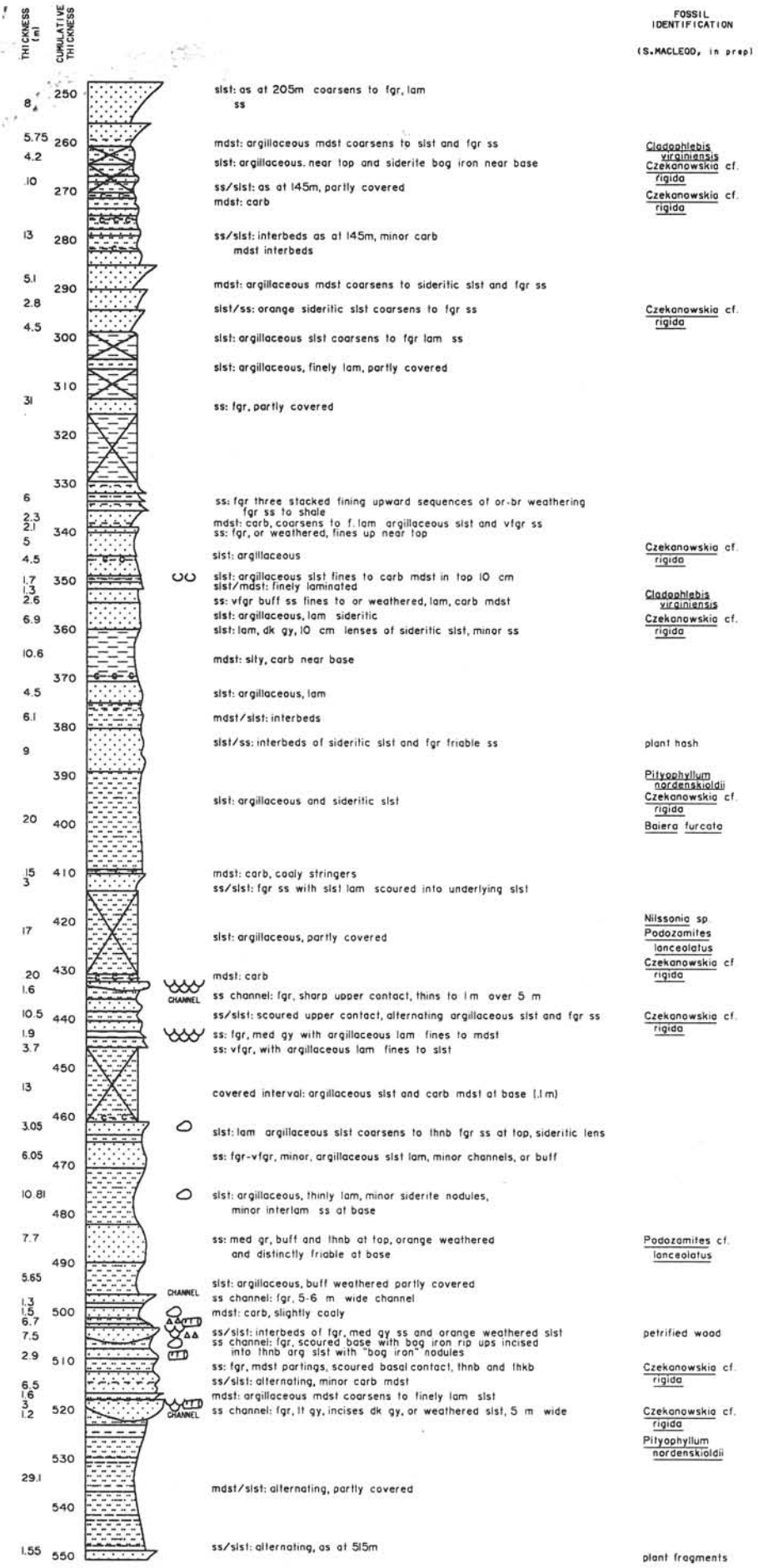
MALLOCH SEQUENCE TYPE SECTION

LONGITUDE: 129°00'06" W
LATITUDE: 57°11'01" N
TOTAL LENGTH: 953m

MEASURED BY: SE MACLEOD
LV HILLS



MALLOCH SEQUENCE TYPE SECTION CONTINUED



KLAP:[205,057]880072009.LG 88/03/28 SAM

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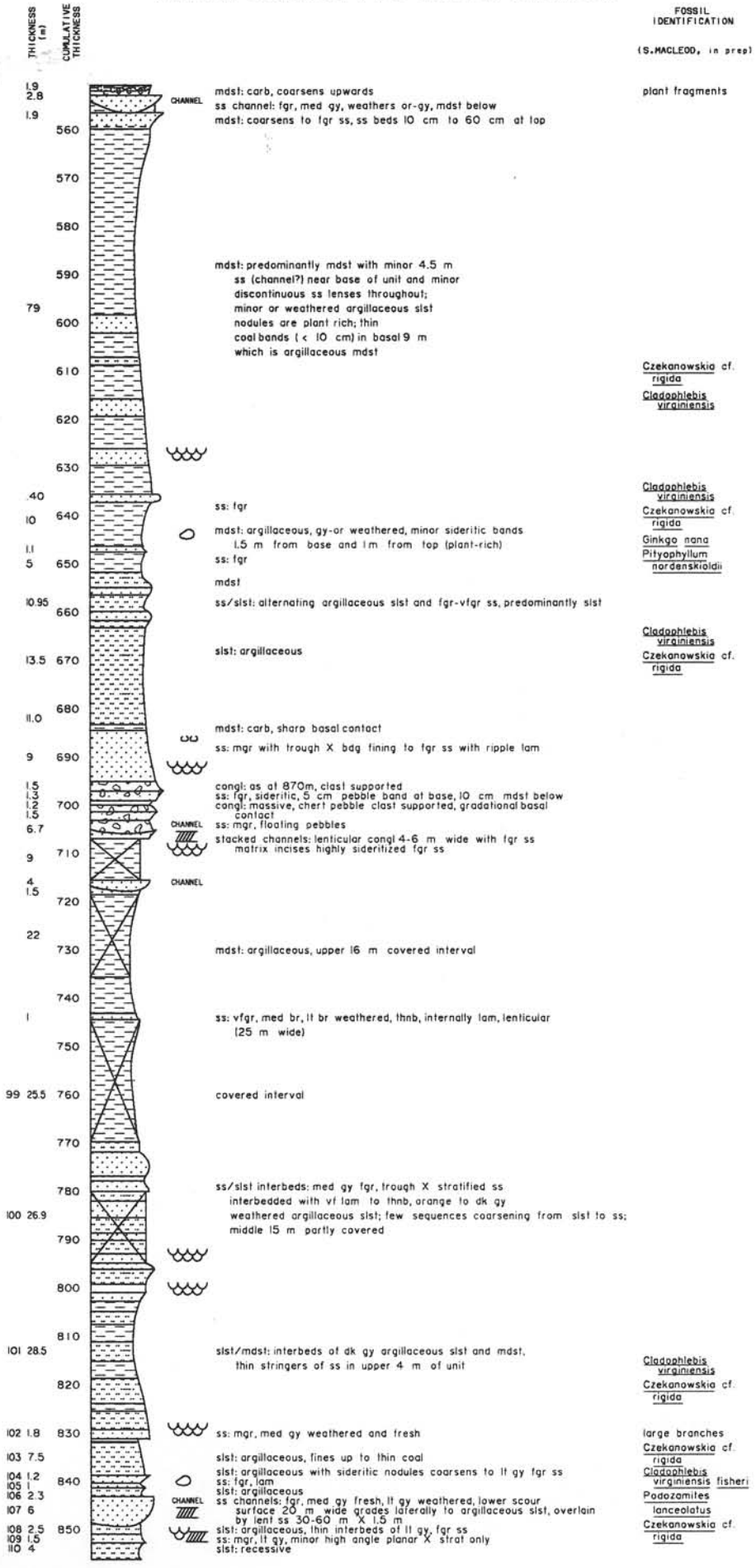
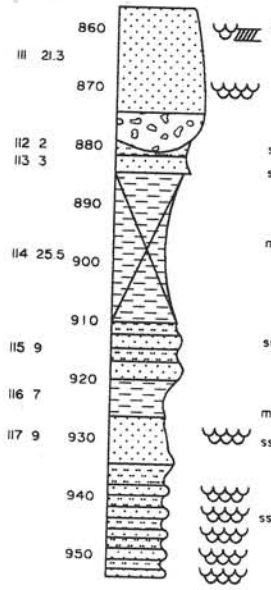


MALLOCH SEQUENCE TYPE SECTION CONTINUED



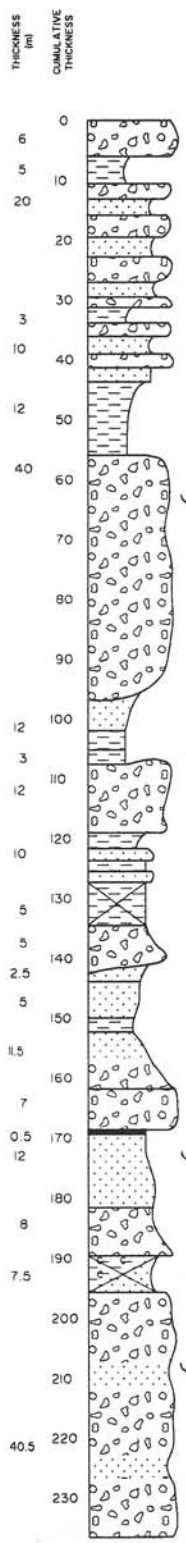
	FOSSIL IDENTIFICATION (S.MACLEOD, in prep)
congl/ss channel: ss is med gr, lt gy, minor high angle planar, X strat but mostly trough X strat, coarsens basally to chert pebble congl with scoured base, pebbles < 1 cm to 6 cm, dk gy, white, lt gy, poorly sorted, subrounded, some flattened, matrix is poorly sorted, iron stained mgr ss	tree trunks and branches
slst: argillaceous	
ss: vfgr, dk gy, lam, chert rich, argillaceous partings	
mdst: partly covered	
ss/slst interbeds: ss is lt gy, fgr and slst is dk gy, strongly internally lam	Czekanowskia cf. rigida
mdst: dk gy, very organic - rich, blocky fracture	
ss: fgr, or-gy weathered, lt gy, vthnb, internally lam bedding units alternate between 1 cm or less and 5-10 cm, iron stained	coalified wood petrified plant rootlet Nilssonia tenuicaulis
ss/slst: interbeds of f-mgr lt gy ss, dk gy to lt gy slst, and vfgr ss, all units vthnb to laminated, slst frequently sideritized and plant-rich	Ctenis borealis Czekanowskia cf rigida Czekanowskia cf rigida Cladophlebis virginiensis

DEVILS CLAW SEQUENCE TYPE SECTION

LONGITUDE: 128°50'36" W
LATITUDE: 57°05'50" N
TOTAL LENGTH: 420m

MEASURED BY: SE MACLEOD
LV HILLS

NB. UPPER 135 METRES APPROXIMATED; SECTION TOO STEEP TO CLIMB



FOSSIL IDENTIFICATION (S.MACLEOD, in prep)

congl: distinctively lt gy near top; pebbles to 10cm, clast supported mgr ss matrix, predominantly chert pebbles, subrounded

mdst: argillaceous, dk gy, recessive, sharp upper contact

congl/ss interbeds: ss weathers lt gy, sharp contacts chert pbl congl is clast supported as above,

recessive unit; dk br

congl/ss interbeds: as unit 3 above

mdst: carb, uniform, iron stained bands

congl: contains 5m x 40m channel, subrounded chert pebbles, clast supported, mgr ss matrix, large scale trough cross beds, scoured base, extremely resistant, weathers lt gy

mdst/ss: coarsening from arg mdst to mgr ss

mdst: carb, abrupt basal contact

congl: channel congl as at 60m in this section

mdst: minor stringers of ss

covered interval: recessive unit, probably mdst as above

congl: pebbles to 4cm at base, fining to 0.5 to 1cm at top, scoured base

ss: mgr, weathers med gy, feldspathic litharenite

ss: fgr; med gy, coarsens up from below

congl: chert pebble cgl as at 110m, fines upwards to carb mdst

congl: coarse chert pebble as at 60m, sharp basal contact

coal:

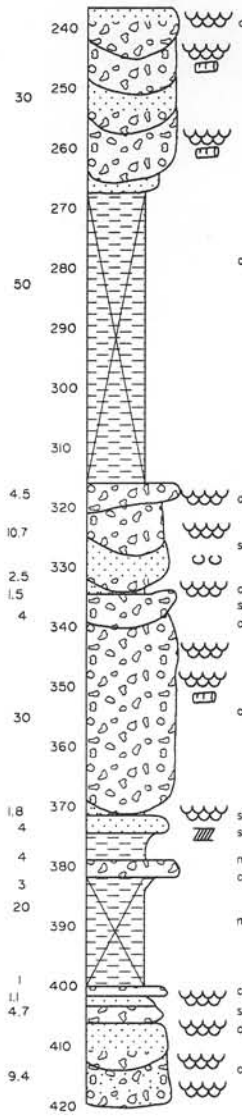
ss: fgr, weathers gy-br, trough cross bedded, gradational basal contact

congl: fine chert pbls, sub rounded, mgr ss matrix, as at 60m

covered interval: float consists of carb mdst and fgr ss

congl: chert pebble as at 60m; large scale trough cross beds, minor mgr ss interbeds as at 160m

DEVILS CLAW SEQUENCE TYPE SECTION CONTINUED



FOSSIL IDENTIFICATION

(S.MACLEOD, in prep)

congl channels: series of stacked chert pbl congl channels 0.5 to 3m high and up to 250m wide, scoured bases with abundant fossil lags, minor imbricated pebbles, rare openmict congl, scour marks, pebbles randomly oriented, angular to sub rounded, 1cm to 10cm long frequently fine upwards, minor mgr ss channels, generally clast supported — Czekanowskia cf. rigida (S.MACLEOD, in prep)

covered interval: scree covered recessive unit

congl: channel, minor ss interbeds, sharp contacts, chert pebble < 2cm long, congl as at 60m

ss: stacked mgr ss channels, discontinuous congl bands 2-10cm thick near top, scoured bases, minor ripples

congl: channel, chert pebble 1cm long, fines upwards

sist: dk gy, recessive

congl: channel, 16m wide, scoured base

congl: stacked channels generally < 2m high, basal congl laterally extensive, minor ss lenses with foresets, fossil trees, minor fining upward sequences in channels, pebbles up to 8 to 10cm, angular to sub rounded, clast supported

sist: dk gy

ss: f-mgr, dk gy, weathers gy-br, minor planar x beds, chert rich — Czekanowskia cf. rigida, Baiera furcata

mdst: arg, gradational upper contact

congl: as at 60m

mdst: partly covered, 1m thick congl lens in middle

congl: as at 380m, channel

ss: mgr channel, gradational basal contact to fine pbl congl

congl: channel, scoured base, matrix and clast support

congl/ss channels: series of stacked channels fining from chert pbl congl to ss, angular chert pbls, scoured contacts, minor floating pbls in ss, channels up to 1m x 15m

APPENDIX F

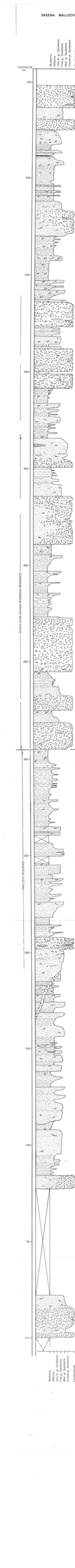
DETAILED SKEENA OUTCROP DESCRIPTION

(KPNSKOTC87013)

SKEENA: MALLOCH/DEVILS CLAW (RHONDDA) STRATIGRAPHIC CONTACT

OTC - 87013

A. LEDDA
G. MURRAY



APPENDIX G

KLAPPAN SEQUENCE BIOSTRATIGRAPHY CHART

741

KLAPPAN SEQUENCE BIOSTRATIGRAPHY AND MARKER HORIZONS

MOUNT KLAPPAN ANTHRACITE PROJECT

LEGEND

LITHOLOGIC SYMBOLS

SANDSTONE	BENTONITE
SILTSTONE	BRECCIA
COAL	CARBONACEOUS
MUDSTONE, CLAYSTONE	QUARTZ
TUFF	PYRITE
LIMESTONE	FERRUGINOUS
CORE LOSS	CONGLOMERATE

*TOP STRATIGRAPHIC SECTION IS GENERALIZED SECTION FROM 1984 AND 1985 DRILL HOLES,

MIDDLE STRATIGRAPHIC SECTION IS KPNLRDDH86026

LOWER STRATIGRAPHIC SECTION IS KPNLRDDH86024

**RELATIVE STRATIGRAPHIC POSITION OF LOWER TWO SECTIONS (INCLUDING SEAMS A-2 TO A-5)

SUBJECT TO COMFIRMATION UPON COMPLETION OF DRILLING OF DEEP HOLES

FOSSIL OCCURRENCES ARE FROM 1984 TO 1987 DRILL HOLES

GULF CANADA CORPORATION
24/02/87
KLAP:[2050571870006001.LG

APPENDIX H

1:500 000 NORTHWESTERN BRITISH COLUMBIA MAP

NORTHWEST BRITISH COLUMBIA

GULF CANADA CORPORATION

741

SCALE 1: 500,000

Kilometres 10 5 0 10 20 30 40 50 Kilometres

Miles 5 0 10 20 30 Miles

Legend

- Paved Highway
- Gravel Highway
- Gravel Road (Restricted use)
- Proposed Road
- Railway
- Existing Transmission Lines
- Proposed Transmission Lines
- Electrical Sub Stations
- Proposed Dam Site
- Proposed Pit, Mount Klappan Property
- Boundary, Park or Reserve
- Boundary, International
- Spot Elevation (feet above sea level)
- Mine (see separate list)
- Prospect
- Cities, Towns
- Contours (1000 foot interval)

COAL PROPERTIES

- GULF CANADA PROPERTIES LTD.
- 33 SUNCOR INC.
- 134 DOMINION ANTHRACITE LTD.
- 45 SHELL CANADA RESOURCES INC.
- 55 D. GROOT LOGGING LTD.
- 1 ESSO RESOURCES CANADA LTD.
- 2 ASHTON W. MULLAN
- 3 JOE HIDBER

MINES

2 DUTHIE — Ag, Pb, Zn, Au, Cd, Cu
3 SILVER STANDARD — Ag, Pb, Zn, Au, Cu
4 KITSAULT — Mo
5 SCOTTIE GOLD — Au, Ag
6 GRANDUC — Cu, Ag, Au
7 BAKER — Au, Ag

Produced jointly by GULF CANADA DRAFTING DEPT. and HARDY ASSOC. (1978) LTD., MAPPING SECTION.
Revised to Sept. 1986

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REFERENCE NOTE

Mines: from The Northwest Region - B.C. Regional Economic Study, 1982.

Prospects: from Kitimat-Stikine Regional District - 1:500,000 Regional Resource Map, 1981.

Base Map: from Dept. of Energy, Mines and Resources, Surveys and Mapping Branch, current N.T.S. series maps.

KEY MAP