BRITISH COLUMBIA RECONNAISSANCE

1984

SOUTHERN BOWSER PROGRAM

ROBERTA BERG

ACKNOWLEDGEMENTS

Thanks to Graham Farquharson, Al Peach, Ian Piwek, Jacqueline Stoochnoff and Valerie Tapley for their contributions to the field mapping program. Also appreciated are the geological maps and figures in the report drawn by Ian Piwek and comments and assistance from Al Peach.

Roberta Berg

November 23/84

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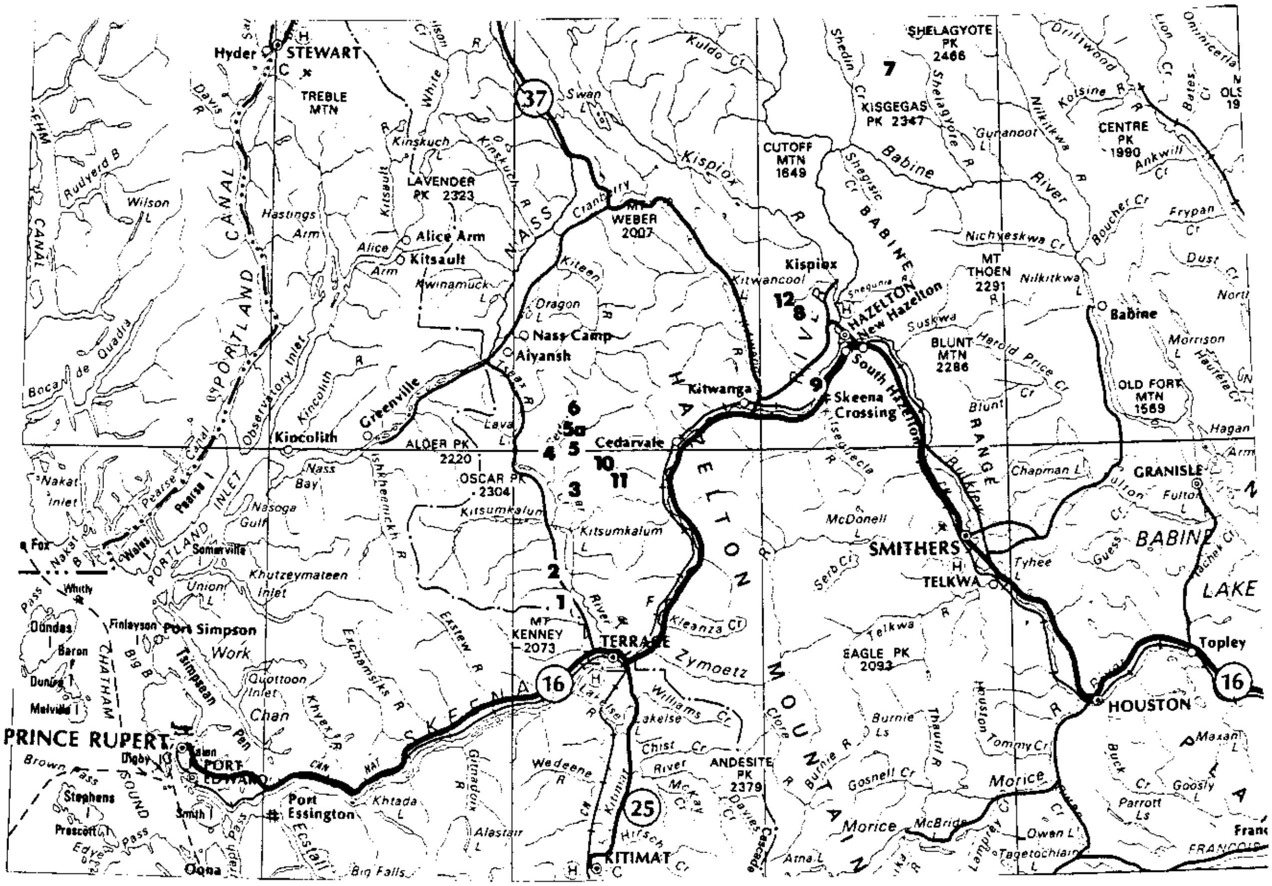

LOCATION OF PLATES

1.0 ABSTRACT

The 1984 Southern Bowser Reconnaissance Program investigated the depositional facies and coal bearing potential of the Middle-Late Jurassic to Lower Cretaceous Bowser Lake Group and the Lower Cretaceous Skeena Group. The 1983 Iskut Program set in the northern basin was successful in tracing the coastal facies trend in which coal was located. This area known as "Sweeny" is now under application for licence.

The delineation of the marine/continental sedimentary boundary for the Bowser Lake Group was completed in the southern and southeastern portion of the basin with eighteen coal occurrences mapped in deltaic sediments to the south of this boundary. Unfortunately the seams were thin, shaley and widely scattered and no one area looked exceptionally promising. Continuation of the program in 1985 would focus on further tracing of the boundary north to join that found in 1983 and the concentration of exploration in the paralic and deltaic/fluvial zones to the east.

Three coals were mapped in the Skeena Group, however time did not permit as extensive exploration as that given to the Bowser Group. Exploration in 1985 would concentrate mainly on Skeena sediments in remote areas followed by reconnaissance of probable occurrences in relationship to volcanic and intrusive contacts and regional trends.

2.0 INTRODUCTION

The Bowser and Skeena sedimentary basins are located in northwestern British Columbia (Figure 1) and consist of a series of marine, deltaic and fluvial sediments deposited throughout the Middle-Late Jurassic and Lower Cretaceous. Coal occurrences have been reported in both groups in the region outlined in Figure 2 and it is this area that was targeted for the 1984 Southern Bowser Reconnaissance Program. The main objective of the program was to analyze the groups lithologically and interpret depostional environments in order to assess the coal bearing potential. Areas identified as promising would receive a greater concentration of the reconnaissance effort.

Field activities commenced June 4, 1984 in Terrace and proceeded to Hazelton and Smithers, with two and occasionally three field crews covering road access in the areas of interest. Ridge work was based out of Smithers commencing June 27 until July 29, when crews were transferred to Sweeny. Follow-up work then proceeded from August 23-30, 1984.

Operational expenditures as of August 31, 1984 are listed in Table I with the remaining budget directed towards salaries and coal analysis.

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DISTRIBUTION OF BOWSER AND SKEENA GROUP SEDIMENTS

FIGURE 1

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1984 SOUTHERN BOWSER RECONNAISSANCE AREA

FIGURE 2 — 1:2,000,000

TABLE I

1984 SOUTHERN BOWSER OPERATING COSTS

ITEM	ESTIMATED COST	ACTUAL COST
Salaries	$ 84,000.00	78,788.50
Helicopter (+ fuel)	40,000.00	30,333.80
Accommodation and Subsistence	15,000.00	18,271.37
Travel Expenses	5,000.00	3,033.00
Truck Rental, Fuel and Repair	5,000.00	8,528.58
Coal Analysis	2,000.00	-
Misc. Material	4,000.00	2,875.76
	$155,000.00	$141,831.01

3.0 REGIONAL GEOLOGY

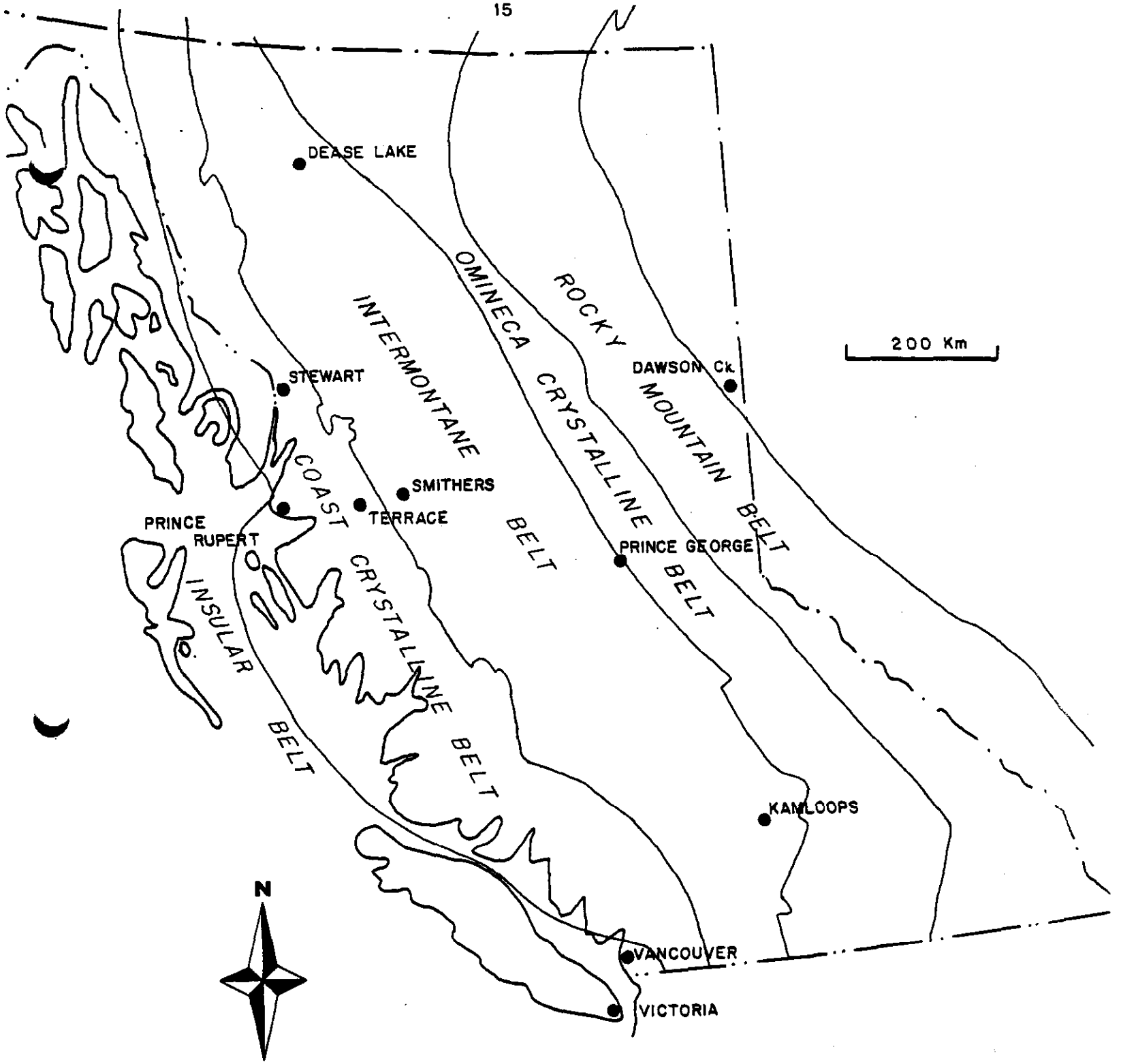
3.1 GEOLOGICAL HISTORY

The Bowser Basin is an orogenic successor basin lying within the Intermontane Belt of the Canadian Cordillera (Figure 3). Its genesis is linked to the vulcanism, mountain building episodes and plutonism brought about by the subduction of plate margins and the accretion of "foreign" terranes.

During the Lower and a portion of the Middle Jurassic, subaerial and subaqueous volcanics and associated sediments of westerly provenance were deposited as the Hazelton Group in an elongate eugeosynclinal trough formed between North America and Stikinia (Figure 4a and 5a). Sediment was also supplied southward into the trough by the Stikine Arch.

This basinal configuration changed during the Middle and Upper Jurassic due to the rising of the Skeena Arch which split the Hazelton Trough into the northern Bowser and southern Nechako Basins (Figure 5b). The arch contributed sediment northward for the Bowser Group while the rising Columbian Orogeny to the east supplied it westward and the Stikine Arch southward.

By the Early Cretaceous the Skeena Arch was no longer a positive topographic feature as another trough developed and was the locus of easterly derived deposition for the Skeena Group (Figure 4b and 5c). The Late Cretaceous - Paleocene Sustut Group succeeded the Skeena Group (Figure 4c) with sediments of the lower Tango Creek Formation derived from the eastern Columbian orogeny and those of the Brother's Peak Formation derived from the westerly Pacific Orogen.



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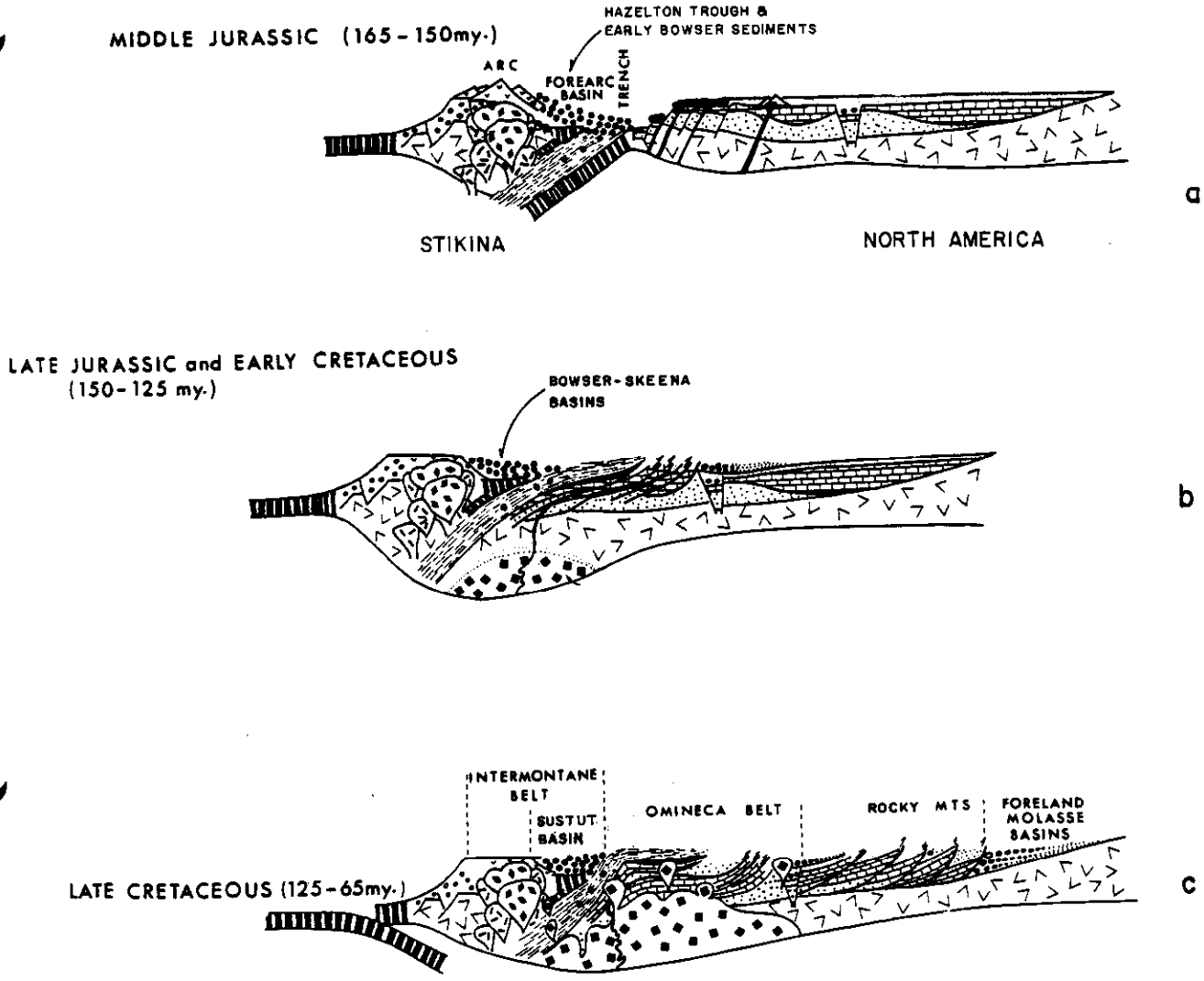
TECTONIC PROVINCES
OF THE
CANADIAN CORDILLERA

FIGURE-3



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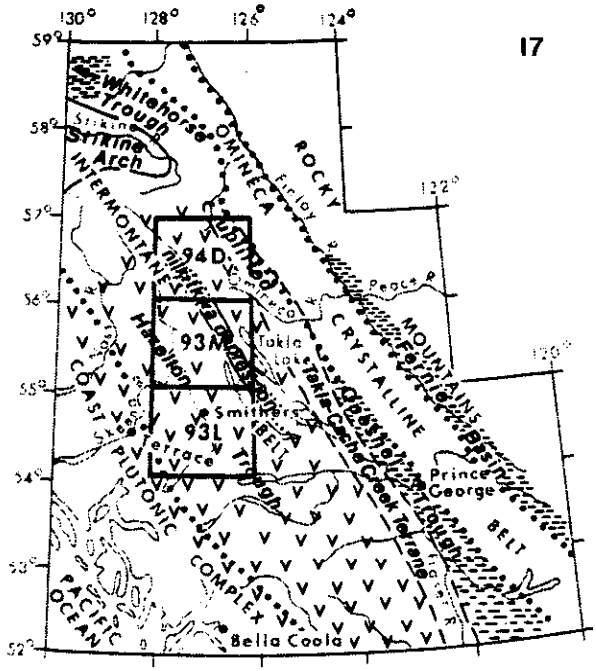
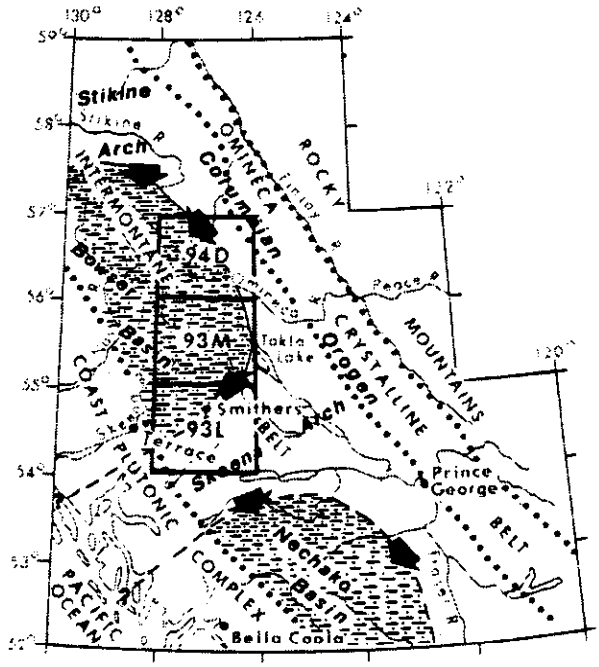
BASINAL GENESIS THRU NORTHERN BRITISH COLUMBIA

Figure 4 (Modified D.J.TEMPELMAN-KLUIT 1979)



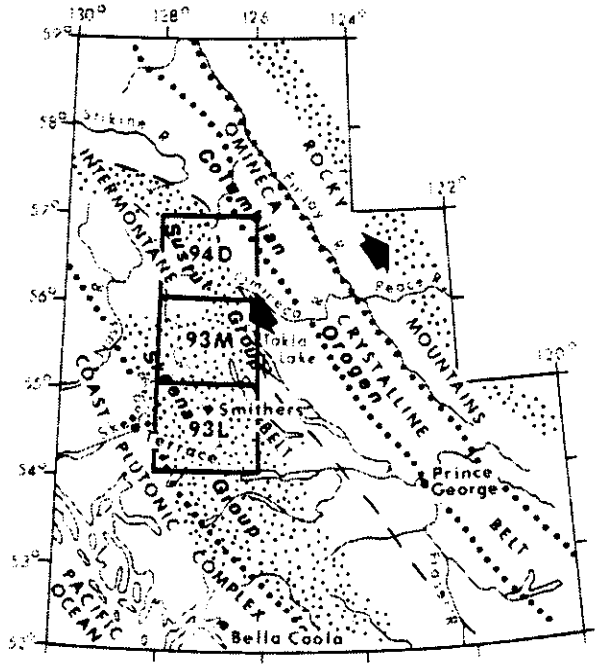
A

Lower and Middle Jurassic



B

Middle and Upper Jurassic Basins



C

Cretaceous Basin

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BASINAL OUTLINE FROM THE LOWER JURASSIC TO CRETACEOUS

Figure 5 (TIPPER & RICHARDS 1976)

3.2 STRATIGRAPHY

The main targets of study for the 1984 Southern Bowser Program were the coal bearing Bowser Lake and Skeena Groups. Unfortunately there are discrepancies between authors concerning the point at which Bowser Lake sedimentation stopped and Skeena began. Tipper (1976) dates the youngest Bowser sediments as late Oxfordian and the oldest Skeena as Hauterivian (Figure 6), the interval being a period of non-deposition and erosion. Richards (1976) though describes a continuous depositional cycle between the two groups with only minor periods of erosion. In this report Richards nomenclature and age relations are used.

3.21 BOWSER LAKE GROUP

The base of the Bowser Lake Group is dated anywhere from early Bajocian in the Nass River and Spatsizi map areas, to early Callovian in the Terrace, Hazelton and McConnell Creek areas (Figure 7). Locally, the nomenclature also differs; it is the Ashman Formation (Richards 1976) in the Hazelton area, either the Jackson Unit (Moffat, Bustin, 1983) or Duti-Slamgeesh Facies (Eisbacher, 1973) in the Spatsizi, and the Salmon River Formation (Grove, 1982) on the Nass River map.

The lithological description of the basal Bowser is consistent throughout the basin, but ranges in thickness from 300 to 1,800 meters. Throughout the basin the sediments overlie the volcanic and volcaniclastic sediments of the Lower and Middle Jurassic Hazelton Group. In the Terrace and northern areas this is an unconformable contact (Duffel and Souther, 1964) but grades southerly to a conformable interface with the lower Smithers Formation (Tipper and Richards 1976). This basal unit of the Bowser Lake Group is composed of dark marine laminated mudstones, siltstones and sandstones locally calcareous and tuffaceous, grading up-section into coarser littoral and fossiliferous nearshore deposits.

In the Smithers and Hazelton areas, the Trout Creek Formation overlies the Ashman Formation conformably and is described as a transistional facies up to 300 meters thick between marine and non-marine sediments consisting of sandstone, siltstone, conglomerate and thin coals (ibid., 1976). This is equivalent to the upper coarser portion of the northern Jackson and Duti-Slamgeesh sediments which are also transitional and a marine section of the undifferentiated Bowser Lake Group north of Terrace.

Conformably above the Trout Creek Formation is the "Lower Bowser Lake" subdivision which is equivalent to the lowermost Currier Unit and Groundhog-Gunanoot facies in the northern basin. At the base of the section the sediments are fine grained deltaic front, plain and slope deposits which grade up-section to fluvial and alluvial deposits, the whole section up to 500 meters in thickness. This then passes conformably into the "Intermediate Bowser Lake" subdivision which contains the same environmental assemblages as the "Lower Bowser Lake" but shows greater development of the deltaic continental floodplain facies. It is coeval with the continental upper Currier Unit and Groundhog-Gunanoot facies and the lower fluvial Jenkins Creek facies and McEvoy Unit. The age of the upper "Intermediate Bowser Lake" subdivision is undetermined, but it and the "Lower Bowser Lake" subdivision cover the largest area of the southern basin.

Stratigraphically above the "Intermediate" division lies the "Upper Bowser Lake" subdivision's lower floodplain deposits, the age of which is also questionable. Outcrop occurs only in low lying areas and is sparse due partly to its recessive nature. Due to the difference in outcrop distribution and the marked difference in induration from the "Lower" and "Intermediate" subdivisions, it is possible that there was a hiatus in deposition between the "Intermediate" and "Upper" divisions. It is likely the basinal configuration also differed as "Upper Bowser Lake" sediments occur as far east as the Babine River.

3.22 SKEENA GROUP

The Kitsun Creek sediments are the oldest deposits of the Skeena Group and are dominately alluvial deposits of quartz, pebble conglomerate, sandstone and overbank mudstone and coal. Above this occur the Rocky Ridge Volcanic flows and breccias which are followed by the micaceous sandstone, siltstone and coals of the fluvial fining upwards sequences of the Red Rose Formation, the coal bearing formation occurring at Telkwa. The occurrence of the Skeena Group is very local and scattered, being continental in the southern Hazelton and northern Smithers area, mixed fluvial and marine around Telkwa and marine in the extreme south. These are capped locally by the Brian Boru volcanics.

3.23 STRATIGRAPHIC CONFLICTS

Due to the differences between the "Intermediate" and "Upper Bowser Lake" subdivisions mentioned in Section 3.21, it is possible that the "Upper Bowser Lake" subdivision is a basal unit of the Skeena Group as it is equivalent in part to the Kitsun Creek sediments (Figure 6). Though it is in this stratigraphic interval that confusion and differences arise over naming and dating of outcrop due to the similar appearance of the "Upper Bowser" and Kitsun Creek rocks, it is possible that they are members of the same depositional event. Actually the confusion extends even into the "Intermediate" division which has been mapped in the southwest corner of the

Hazelton sheet directly juxtaposed to the Skeena Group's Red Rose Formation mapped on the northwest corner of the Smithers sheet, an age discrepancy of approximately 45 million years.

The problem is due to the time transgressive nature of the basinal sediments and their complex stratigraphy. For example, the Bowser Lake sediments become younger to the west on the Hazelton sheet and to the north on the Terrace sheet so basinal withdrawal was to the northwest. The Skeena Group though becomes younger and incidently marine, to the south of Smithers, so withdrawal was to the south. This difference in aging trends indicates that deposition of each group occurred under different basinal condition which may be related to the breaching of the Skeena arch (Figure 8). Therefore, where the two groups overlap, that is in the southern Hazelton and northern Smithers area, confusion over recognition and nomenclature arises.

4.0 BOWSER GROUP RECONNAISSANCE

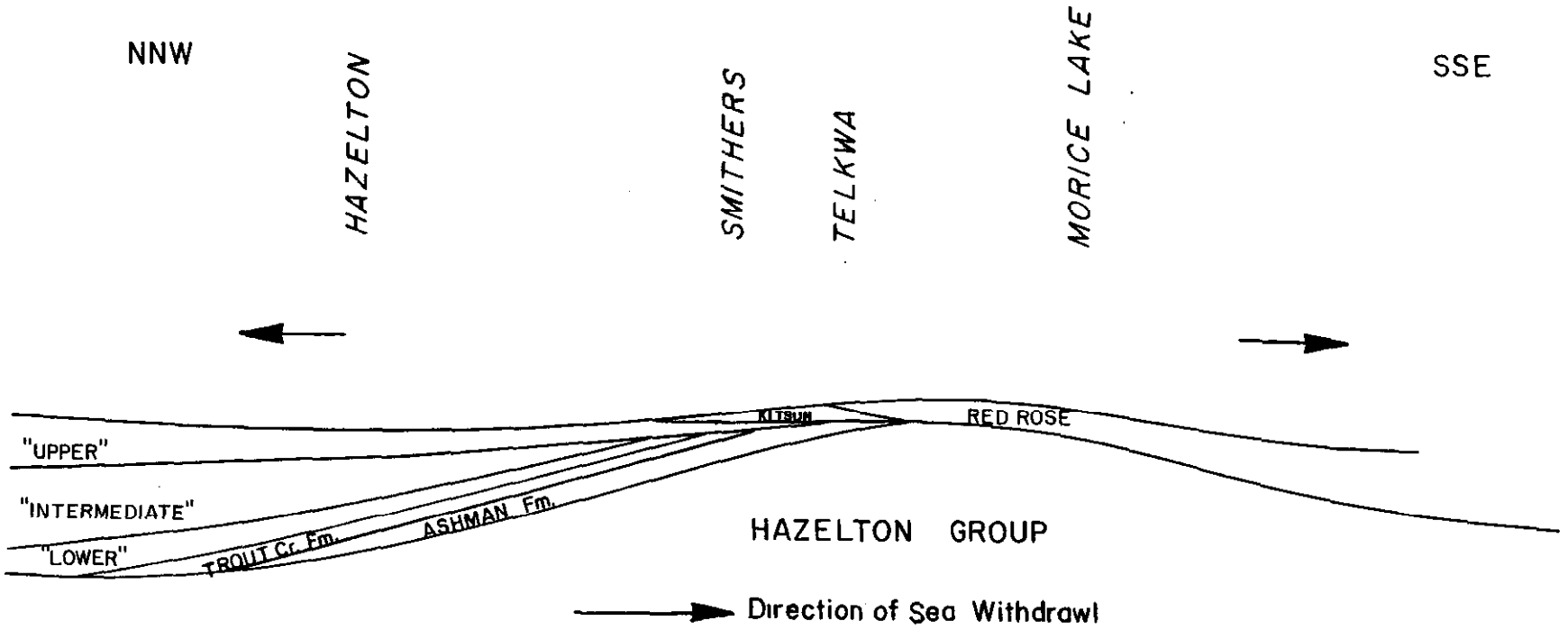
4.1 PREVIOUS WORK

In 1983 the Iskut Reconnaissance Program investigated an area in the northern Bowser Basin west of the known coal fields of the Groundhog. Reconnaissance involved mapping and interpretation of depositional facies trends in order to delineate coastal coal bearing sediments. This method was successful in tracing the paralic zone leading to the discovery of the Sweeny prospect (Figure 9).

4.2 RECONNAISSANCE APPROACH AND RESULTS

4.21 SOUTHWESTERN MARGIN OF THE BOWSER BASIN-TERRACE AREA

North of Terrace, the Bowser Group rocks consist of an undivided Upper Jurassic - Lower Cretaceous assemblage of siltstone, sandstone, greywacke, conglomerate, minor limestone and coal. Further north, in the Alice Arm area, the group has been separated into the middle Jurassic littoral sandstone and greywacke deposits of the Salmon River Formation and the Upper Jurassic Nass Formation of sandstone, siltstone, conglomerate, minor limestone and coal.



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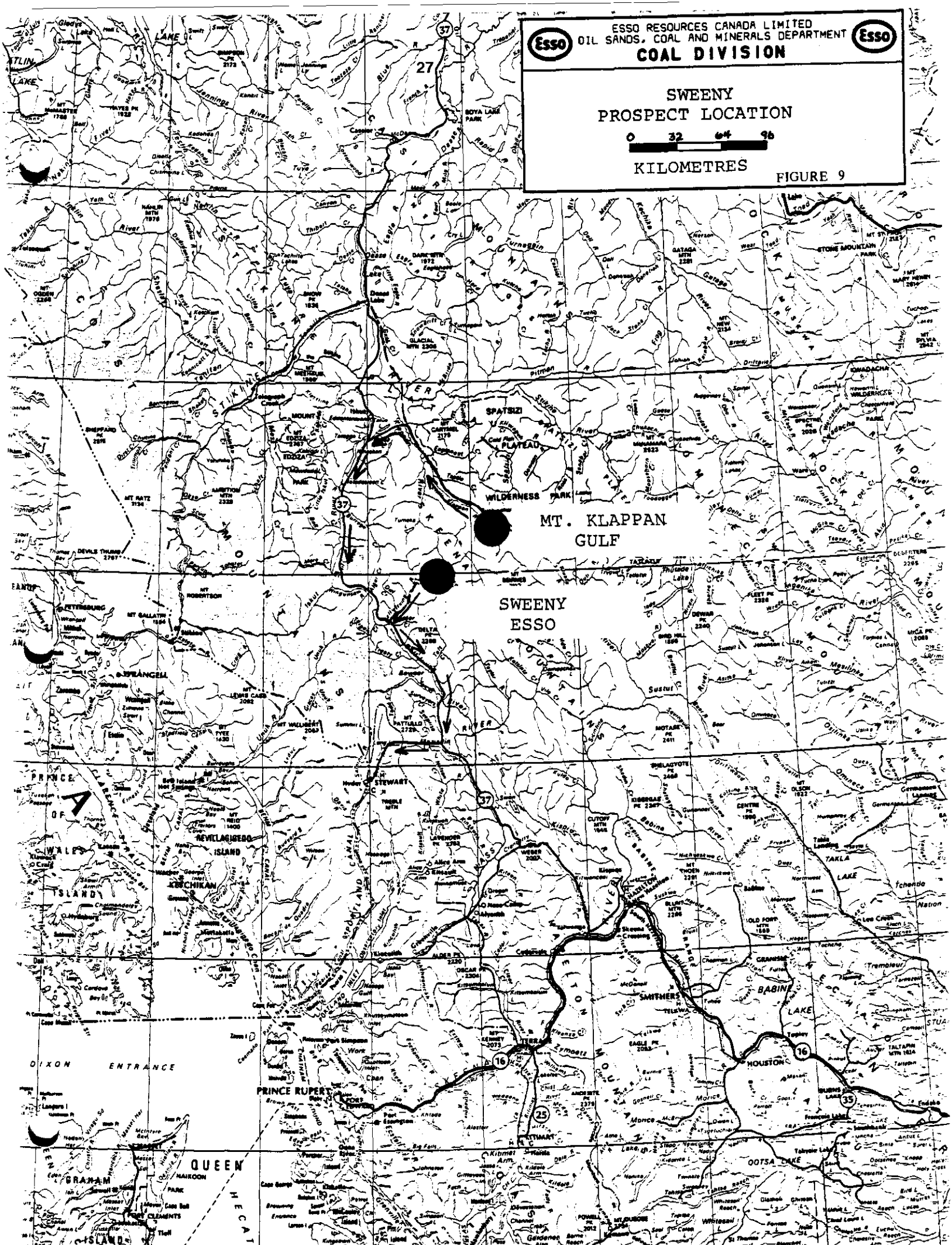
BOWSER-SKEENA BASINAL
RELATIONSHIPS CROSS-SECTION

FIGURE 8


ESSO RESOURCES CANADA LIMITED
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SWEENY
PROSPECT LOCATION
0 32 64 96
KILOMETRES
FIGURE 9
MT. KLAPPAN
GULF
SWEENY
ESSO
WILDERNESS PARK
SPATSIZI
PLATEAU
STEWART
PRINCE RUPERT
SMITHERS
HOUSTON
QUEEN
CHARLOTTE
ISLANDS
DIXON ENTRANCE
HECATE STRAIT

These clastics were deposited unconformably on the Lower Jurassic Unuk River Formation's volcanics and sediments on the western margin of the Bowser Basin. Tertiary intrusions of the Coast Plutonic Complex resulted in local metamorphism. The reconnaissance procedure in this area was to interpret and map the environmental facies present in the above formations to delineate coal-bearing strata in paralic or fluvial facies trends.

The sediments in the area are in the order of 2500 meters thick and can be divided into marine and delta plain deposits. These categories may seem too broad to be of use but the sediments are monotonous and lack any truly distinctive environmental indicators to further subdivide them. Using the described reconnaissance method, the interface between marine and continental deposits can be traced easily in the field and used to lead the direction of exploration.

The marine sediments are dominated by fine grained sandstone and mudstone usually thick to medium bedded with minor small scale cross-beds. They are well to moderately sorted though subangular and indicate rapid deposition in a particular energy realm with no reworking. This combined with the scarcity of fauna and bioturbution and alternating sandstone and mudstone interbeds suggests a marine turbidite sequence. The fresh colour is dark grey to black but weathers yellow grey to brown and grey black. The rocks are very hard due to their proximity to the coast intrusions and are commonly cut by quartz and calcite veins.

Between Sand Lake and Lava Lake (Appendix 2) lies the transitional zone between the delta plain and marine, but unlike the development that was found in this zone in the northern (Sweeny) and southeastern portions of the basin and was easily pinpointed, this change was much more subtle and gradual.

Sediments of the delta plain generally consist of moderately to well sorted subangular fine grained sandstones, siltstones and mudstones. Along the western border of the basin the source of the sediment was from eugeosynclinal volcanic arcs to the west whereas to the east the sediments become quartzose in nature due to the source being continental crust to the south. Chert pebble conglomerate, carbonaceous mudstone and coal are also found representing channel and over bank swamp deposits, but the dominant sediments are silts and fine sandstones of floodplain origin.

The fresh colour is dominately black to pale yellow brown or olive grey with Fe staining common where close to intrusions. Mudstones are usually thin, fissile and used as fault planes invaded by quartz and calcite veins which results in a graphitic texture and lustre. The sediments are thin to medium bedded (Plate 1) with fine laminations of siltstone and sand (Plate 2), ripples (Plate 3), and climbing ripples. Wood fragments, grass and reed like plant fossils are common on bedding planes. The plants are usually preserved

as impressions and the wood as impressions (Plate 4), as black shaley imprints (Plate 5 & 5A) or as carbonized remains (Plate 6). Calcite is common in the wood fragments and is probably a replacement of the wood's cellular structure. The weathering ranges from blocky in the coarser lithologies to needle-like in the finer sediments. Jointing is well developed and common and the sediments seem little affected by neighboring intrusions except for iron staining and local contact metamorphism.

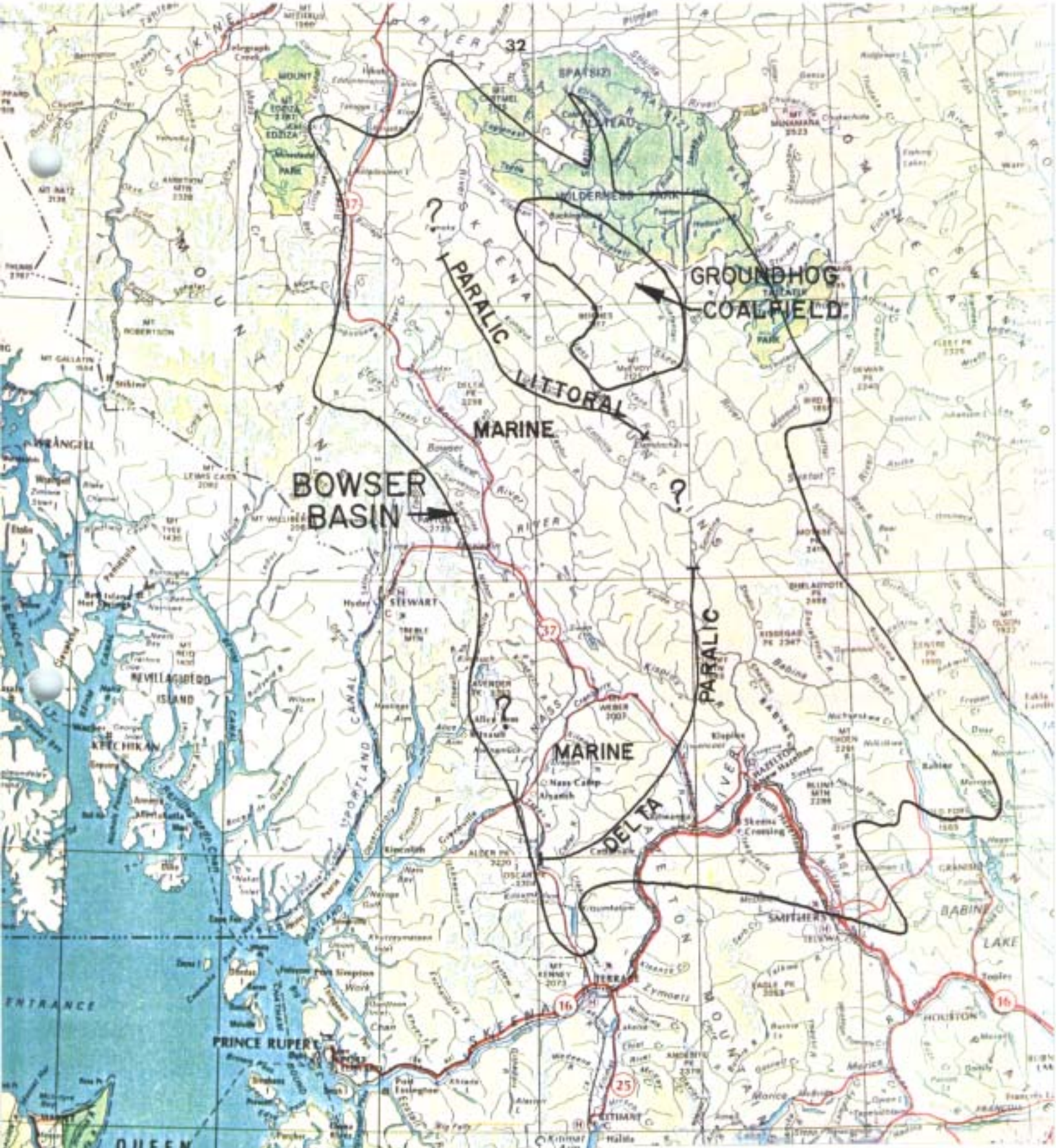
The occurrence of ripples, climbing ripples, relatively unsorted angular sediments and abundant plant material rarely carbonized, indicate rapid deposition on a delta plain. Sediments were quickly deposited and buried with no time for sorting or bog formation and though coal was found, the occurrences were few and always thin.

Due to the nature of the sediments and the conclusion drawn of a rapidly accumulating coastal plain, peat bog formation would not be expected to be extensive.

4.22 SOUTH AND SOUTHEASTERN BOWSER BASIN - HAZELTON AREA

The Bowser Lake sediments found in this quadrant of the basin are composed of Middle Jurassic to Upper Jurassic sediments of marine and continental origin. The lower most Ashman Formation rests conformably on the greywacke and sandstone of the Hazelton Group's Smithers Formation. The Ashman Formation was deposited in a marginal marine environment and consists of sandstones and shales which grade upward and laterally northward into the Trout Creek Formation of coarser continental clastics containing thin coal horizons. Conformable above this are the "Lower", "Intermediate" and "Upper Bowser Lake" subdivisions which have a much larger areal extent than the former units which occur only in small local areas and represent the maximum basinal extent. The above Bowser Lake sediments consist of continental, paralic, deltaic and marine deposits representative of a shoreline which prograded west and northwestwards throughout the Upper Jurassic.

The reconnaissance approach in this area was to locate the transistion zone between marine and continental sedimentation in the three "Bowser Lake" subdivisions which would yield paralic coals. Theoretically this zone would be traceable northwards to join the transistion zone located successfully by the same method in the 1983 Iskut Program (Figure 10).



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FACIES INTERPRETATION

1:2,000,000

FIGURE 10

The "Lower Bowser Lake" subdivision was found to be the southern equivalent of the northern paralic zone as it contained very similar lithological components. The sandstones are fine to medium grained, subrounded to subangular, usually moderately sorted and composed of quartz and lithic grains. The fresh colour ranged from light olive grey to pale yellow brown and the rocks were of moderate hardness. The most distinctive feature of the sandstones though was that they frequently contained pelecypod horizons ranging up to 3 meters thick (Plate 7). The pelecypods were usually disarticulated and replaced by white or black calcite though articulated shells were found preserved as impressions in finer grained lithologies. Siltstones occupy a larger proportion of the stratigraphic section and usually contain sandstone lenses, mudstone laminations, cross bedding, carbonaceous grass and blade-like plant fossils. Fresh surface colours are pale yellow brown to moderate yellow brown. Dark grey mudstone is also prevalent and commonly contains plant fossils, with one occurrence being considered carbonaceous mudstone. It is this shallow marine and terrestrial association that is also common to the coal bearing paralic zone occupied by the "Sweeny" licenses and as such the areas can be considered coeval shoreline assemblages.

The "Intermediate Bowser Lake" subdivision in this area seemed to be lithologically similar to those coastal plain sediments found to the west and described in Section 4.21. It is dominated by fine grained sandstones and siltstone, commonly iron stained due to the proximity to and invasion by intrusives. The fresh colours are dark grey to light brown and olive grey with the constituent grains being lithic, moderately sorted and subrounded. Interbedding of siltstone and mudstone is common and there are minor occurrences of ripples and shell imprints. Medium to thinly bedded fluvial sandstones are frequent and are usually medium to coarse grained, and are subrounded and poorly sorted. The fresh sandstones are pale yellow brown and commonly contain carbonaceous log debris.

Further north on Kispiox Mountain the sediments contain imprints and carbonaceous remains of plant fossils and there are several occurrences of carbonaceous shale. The sediments are thinnly bedded (Plate 8) with occasional siltstone ripups, pelecypod imprints and mudstone lenses with fresh colors ranging from dark grey to pale yellow brown and light grey brown. Considering the associated occurrences of plant fossils, carbonaceous shale, ripples, pelecypod shells and the dominately fine grained nature of the sediments a lower coastal plain facies would be assumed as the depositional environment.

The "Upper Bowser Lake" subdivision is also described as lower coastal (delta) plain deposits (Richards, 1980) with the sandstones being fine grained moderately sorted and subangular. They are usually thin to medium bedded with siltstones and mudstone (Plate 9), with fresh colours ranging from dark grey to light olive grey. Plant fragments are common in the siltstones as are fine crossbeds and sandstone laminations. A few occurrences of carbonaceous shale were noted, one in association with an iron concretionary, belemnite bearing siltstone.

4.3 COAL GEOLOGY

In total, there were eighteen coal and carbonaceous shale occurrences reported from the Bowser Lake Group with numerous other occurrences of carbonaceous plant and log fragments.

The thickest seam was 3.0 metres of interbedded coal and shale (Plate 10) which was overturned in an overthrusted syncline (Plate 11). The next thickest were two 0.5 metre seams which were highly weathered and very shaley (Plate 12). All the coals with the exception of two, were deposited in a deltaic floodplain facies and associated with overbank fines and plant fossils. S84028 and F84009 were the exception as they were associated with marine belemnites and shell horizons and represent a near-shore bog.

Mean maximum reflectances range from 3.43 to 6.57 with the lowest readings being from the "Upper Bowser Lake" subdivision and the highest from coals in proximity to intrusives. These values all fall within the anthracite to meta-anthracite range as do the rank values based on the fixed carbon dry, mineral-matter-free parameter. Proximate analyses are listed on Table II.

TABLE II

BOWSER LAKE GROUP COALS - PROXIMATE ANALYSIS RESULTS

SAMPLE NO. (REFLECTANCE)	GROUP		REC'D % H_2O	% H_2O	% VOL MATTER	% ASH	FIXED CARBON	% S	BTU/ LB	SPECIFIC GRAVITY
P 84034	"Upper Bowser	As Received	4.66	-	3.06	50.95	41.33	.24	4890	
(6.23)	Lake"	Air Dried	-	.99	3.18	52.91	42.92	.25	5078	1.82
		Dry Basis	-	-	3.21	53.44	43.35	.25	5129	
S 84028	"Upper Bowser	As Received	5.44	-	10.74	43.50	40.32	.61	6276	
(3.56)	Lake"	Air Dried	-	2.45	11.08	44.88	41.59	.63	6474	1.68
		Dry Basis	-	-	11.36	46.01	42.63	.65	6637	
B 84174	"Upper Bowser	As Received	1.92	-	7.33	63.09	27.66	.25	3562	
(5.37)	Lake"	Air Dried	-	.84	7.41	63.78	27.97	.25	3601	1.79
		Dry Basis	-	-	7.47	64.32	28.21	.25	3632	
S 84005	"Upper Bowser	As Received	3.01	-	4.85	69.79	22.35	.22	2528	
(5.18)	Lake"	Air Dried	-	1.47	4.93	70.90	22.70	.22	2568	1.94
		Dry Basis	-	-	5.00	71.96	23.04	.22	2606	
F 84009	"Lower Bowser	As Received	3.83	-	6.25	84.10	5.82	.21	598	
(-)	Lake"	Air Dried	-	2.32	6.35	85.42	5.91	.21	607	2.33
		Dry Basis	-	-	6.50	87.45	6.05	.21	621	
B 84016	Bowser Lake	As Received	2.19	-	2.14	66.68	28.99	.12	3300	
(6.57)	Group	Air Dried	-	.66	2.17	67.72	29.45	.12	3352	1.68
	(undifferentiated)	Dry Basis	-	-	2.18	68.17	29.65	.12	3374	
B 84144*	Bowser Lake	As Received	6.78	-	6.70	56.40	30.12	.13	3856	
(4.55)	Group	Air Dried	-	2.62	7.00	58.92	31.46	.14	4028	1.70
	(undifferentiated)	Dry Basis	-	-	7.19	60.51	32.30	.14	4136	
AP 84003	Bowser Lake	As Received	9.14	-	4.67	68.02	18.17	.10	2326	
(4.77)	Group	Air Dried	-	3.27	4.97	72.41	19.35	.11	2476	2.09
	(undifferentiated)	Dry Basis	-	-	5.14	74.86	20.00	.11	2560	
B 84029	Bowser Lake	As Received	1.22	-	22.36	49.29	27.13	.16	3744	
(5.95)	Group	Air Dried	-	.43	22.54	49.68	27.35	.16	3774	1.72
	(undifferentiated)	Dry Basis	-	-	22.64	49.89	27.47	.16	3790	
T 84018	Bowser Lake	As Received	2.84	-	7.08	47.24	42.84	.25	5968	
(3.43)	Group	Air Dried	-	1.55	7.16	47.87	43.41	.25	6047	NSS
	(undifferentiated)	Dry Basis	-	-	7.28	48.62	44.10	.25	6142	
AP 84011	Bowser Lake	As Received	.99	-	7.79	75.90	15.32	.10	1741	
(-)	Group	Air Dried	-	.53	7.83	76.25	15.39	.10	1749	2.21
	(undifferentiated)	Dry Basis	-	-	7.87	76.66	15.47	.10	1758	
S 84120	Bowser Lake	As Received	21.39	-	16.95	25.92	35.74	.30	6502	
(1.6)	Group	Air Dried	-	6.30	20.20	30.89	42.61	.36	7750	1.60
	(undifferentiated)	Dry Basis	-	-	21.56	32.97	45.47	.38	8271	
B 84143 A	Bowser Lake	As Received	6.95	-	11.22	58.05	23.78	.15	3648	
(3.52)	Group	Air Dried	-	3.77	11.60	60.03	24.60	.15	3772	NSS
	(undifferentiated)	Dry Basis	-	-	12.05	62.38	25.57	.16	3920	

* Equilibrium Moisture = 8.5%

5.0 SKEENA GROUP RECONNAISSANCE

5.1 PREVIOUS WORK

Skeena Group sediments at Chisholm Lake and Telkwa were previously investigated for coal potential in October 1977 by Imperial Oil Limited Minerals - Coal. No coal outcrops were sighted at the Chisholm Lake prospect so it was concluded that no economic coal measures existed. Telkwa, though, was promising and coal licenses were applied for but unfortunately they were under application, and subsequently granted to another company.

5.2 RECONNAISSANCE APPROACH AND RESULTS

The Skeena Group volcanics and sediments occur mainly in an area roughly outlined by the Smithers-Terrace-Hazelton triangle. These Upper Cretaceous coal measures are present in the Hauterivian Kitsun Creek sediments and the Middle Albian Red Rose Formation with both sections containing dark shales, micaceous greywacke, sandstone, chert and volcanic pebble conglomerates and coal. Both sequences are, in places, topped by related volcanic sequences; the Kitsun Creek by the Rocky Ridge andesites and the Red Rose Formation by

Brian Boru tuffs and flows. These sediments were laid down by fluvial processes during regressive marine conditions and were much more widespread than is observed today. Those basinal remnants which were preserved occur in several different modes:

1) Graben structures in the "basement" of Lower Cretaceous Hazelton Group Telkwa volcanics.

2) Unconformable contacts to the underlying Hazelton Group.

3) Low-lying areas along stream and river courses in the vicinity of the Hazelton Group.

4) Non-conformable contacts to Late Cretaceous and Eocene volcanics.

5) Topped by volcanics of the Rocky Ridge and Brian Boru Formations.

These small basin occurrences have a general north to north-westerly structural trend with dips ranging between 5 to 30 degrees with a few basins (Nanika Mtn. and Thautil River) containing synclinal structures. The depths to basement range from 200-300 metres in the shallower basins to over 500 metres in the thicker sequences.

The procedure for reconnaissance was based on the nature of the above occurrences, and evidence of basinal features from geo-magnetic exploration targets, and one listed in order of decreasing importance:

1) Map existing basins that have had little or no reported activity.

2) Traverses in low-lying area and across regional strike and fault blocks in the Hazelton Group basement to locate any unmapped Skeena Group outlines.

3) Traverses in the mapped areas of the Rocky Ridge and Brian Boru volcanics which may reveal sediments above or below the contacts.

4) Traverses to concentrate on areas of intrusive contacts.

The Kitsun Creek sediments are present in the northern Smithers area and are very similar in appearance to the "Upper Bowser Lake" subdivision and it is not unlikely that some Kitsun Creek sediments have been mapped as Bowser Lake and visa-versa. The sandstones are fine to coarse grained, subrounded and become increasingly poorly sorted the coarser they become. Colour ranges from dark grey to olive grey and greyish red due to the volcanic source. Volcanic and chert pebble conglomerate along with carbonaceous wood fragments and ironstone concretions are common.

The Red Rose Formation, though also of the Skeena Group, is quite different from the Kitsun Creek as it is very recessive and commonly micaceous. The dominant lithology is fine to medium grained massive sandstone containing bivalves, ammonites, wood, plant fragments and hematitic nodules. The sandstone was various shades of green with the siltsones and mudstones dark to pale brown. Symmetrical ripples, bioturbation and dessication cracks were common in all lithologies and two carbonaceous mudstone occurrences were noted.

5.2 RECONNAISSANCE APPROACH AND RESULTS

Three occurrences of coal were reported from the Skeena Group, one from the Kitsun Creek sediments and two from the Red Rose Formation.

The Kitsun Creek occurrence was described as stringers of vitrain in mudstone and resembled carbonized wood. It ranks as high volatile bituminous "C" according to classification under calorific value on the moist, mineral-matter-free basis but due to the extremely weathered condition of the sample the BTU value has been depressed making it unsuitable for rank established by this means.

Rank determination on the dry, mineral-matter-free basis classifies the coal as medium volatile bituminous. The mean maximum reflectance of 1.28 coincides with this rank. The environment of deposition for the Kitsun Creek occurrence was probably fluvial, but because extensive work was not done, this could not be substantiated.

The Red Rose coals probably representing a coastal bog development, were both very weathered and thin (less than .5 metres) and locally associated with marine sandstones containing bivalves and ammonites. Ranking by the moist, mineral-matter-free basis places the Red Rose coals on the border between high volatile bituminous "C" and subbituminous "A". Since the coals are so weathered though it is best to classify them according to their mean maximum reflectance of 0.95 as high volatile bituminous "A". Proximate analyses are shown in Table 3.

TABLE III

SKEENA GROUP COALS - PROXIMATE ANALYSIS RESULTS

SAMPLE NO. (REFLECTANCE)	FORMATION		REC'D % H_2O	% H_2O	% VOL MATTER	% ASH	FIXED CARBON	% S	BTU/ LB	SPECIFIC GRAVITY
S 84035	Kitsun Creek	As Received	7.17	-	19.80	30.35	42.68	.35	8076	
(1.28)		Air Dried	-	3.59	20.56	31.52	44.33	.36	8387	NSS
		Dry Basis	-	-	21.33	32.69	45.98	.37	8699	
B 84104	Red Rose	As Received	10.31	-	25.27	18.47	45.95	.37	8639	
(0.91)		Air Dried	-	5.63	26.59	19.43	48.35	.39	9090	NSS
		Dry Basis	-	-	28.18	20.59	51.23	.41	9632	
B 84105	Red Rose	As Received	11.29	-	28.28	15.43	45.00	.34	8537	
(0.95)		Air Dried	-	7.46	29.50	16.10	46.94	.35	8906	NSS
		Dry Basis	-	-	31.88	17.40	50.72	.38	9624	

6.0 DISCUSSION AND RECOMMENDATIONS

Coal occurrences were found in both the Bowser Lake and Skeena Groups using methods described in the Reconnaissance Approach sections.

Work done in the Bowser Lake Group located the boundary between dominately continental and marine sediments in the southern and southeastern portion of the basin (Figure 10). A total of eighteen coal and carbonaceous mudstone showings were noted and the following is recommended should there be a program of the same nature in 1985:

i) Though there were coals located north of Terrace on map sheets 103 I and 103 P, no further work is suggested due to the fact that the occurrences were sporadic, shaley in nature, and the environment of deposition too rapid for proper bog formation.

ii) Exploration should continue north of Hazelton to further define the continental/marine interface to join the zone traced in 1983.

iii) Once this is completed, work should be concentrated to the east of the interface in both the coastal and fluvial facies.

iv) If time permits, further step-out exploration can be done in the Alice Arm area where sediments shed off the western margin of the basin are reported to contain coal (Grove, 1982).

Preliminary reconnaissance of the Skeena Group located only two carbonaceous shale occurrences and because time did not permit further investigation outined in Section 5.2, the following are recommendations for 1985:

i) No further work between Hazelton and Smithers on Skeena sediments as the area is moderately populated and there are no reported substantial findings.

ii) Traverses recommended for location of Skeena sediments in the vicinity of Rocky Ridge and Brain Boru volcanics intrusive contacts and across regional strike be given low priority due to its highly speculative nature.

iii) Study of the Skeena Group occurrences north of Babine Lake where coal has been reported and, due to the remoteness of the area, perhaps not been properly investigated.

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8.0 APPENDICES

8.1 PLATES

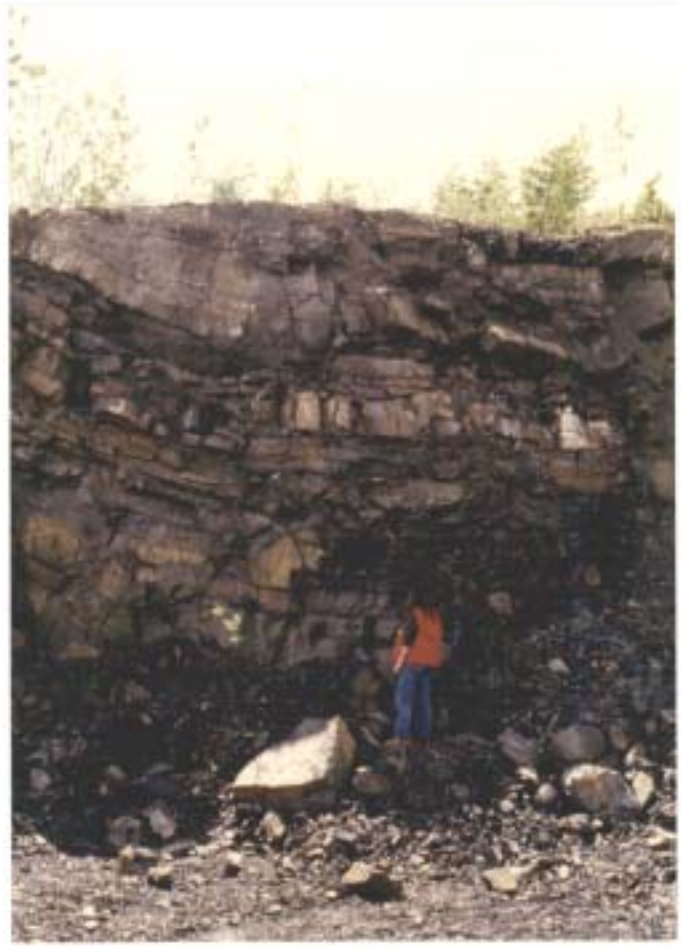

Plate 1: Thin and medium bedded sandstones and siltstones of the Bowser Lake Group north of Terrace.

Plate 2: Cross-bedded and finely laminated sandstone and siltstone (Bowser Lake Group).

Plate 3: Asymmetrical ripples in fine-grained sandstone (Bowser Lake Group).

Plate 4: Log impression in fine-grained sandstone (Bowser Lake Group).

Plate 5

Plate 5a

Plate 5 and 5a: Black shale imprints of log debris in fine-grained sandstone. (Bowser Lake Group).

Plate 6: Carbonized log imprints (Bowser Lake Group).

Plate 7: Pelecypod horizon in medium-grained sandstone ("Lower Bowser Lake" subdivision).

Plate 8: Thinnly bedded sediments on Kispiox Mountain ("Intermediate Bowser Lake" subdivision).

Plate 9: Sandstones, mudstones and siltstones along Skeena River ("Upper Bowser Lake" subidivision).

Plate 10: B84144 seam of interbedded coal and carbonaceous mudstone (Bowser Lake Group).

Plate 11: Structural complexity involving B84144 marked by arrow (Bowser Lake Group).

Plate 12: S84120 highly weathered and shaley (Bowser Lake Group).

APPENDIX 8.2

South Bowser 1984 - Coal Occurrances
(To Accompany Facies and Coverage Map)

#	STATION ID	GROUP (MAPSHEET)	DESCRIPTION
1	AP84003	Bowser (103I/15)	- Shell property on Little Cedar River; coal shale, waferlike, variable thickness avg. 20 cm; poddy, floored and roofed by dirty clay sst.
2	B84006	Bowser (103I/15)	- Shell property, carbonaceous shale, $\leq$ 1 m., small vitrain stringers visable.
3	S84023a	Bowser (103I/15)	- carbonaceous shale 10-15 cm., thin vitrain stringers visable, Fe stained.
4	B84143a	Bowser (103I/15)	- undetermined thickness, vitrain appears to be in log like pieces; roof consists of fine grained sst. and floor is mudstone; associated with mudstone containing needle-like or grassy plant fragment impressions.
	B84144	Bowser (103I/15)	- vitrain bands up to 5 cm. thick interbedded with carbonaceous mudstone; total interval 3.0 m, total coal approx. 1.0 m; roof consists of sltst. and floor of fine-medium grained sst; involved structurally in thrusted syncline/anticline.
5	B84016	Bowser (103I/15)	- carbonaceous shale containing wood fragments, 10 cm. thick.
6	AP84011	Bowser (103I/15)	- carbonaceous shale 15 cm; fissile, shiny and contains calcite veins; roof/floor of fine grained sst.
7	B84029	Bowser (103I/15)	- sheared coaly looking zone, undetermined thickness; contains calcite veins and roof/floor is sst; associated with fold and a fault offset therefore perhaps carbonaceous appearance is due to shearing.

#	STATION ID	GROUP (MAPSHEET)	DESCRIPTION
8	P84018	Bowser (103P/2)	- carbonaceous mudstone, 20 cm.; contains calcite stringers and floor/roof is siltstone.
9	B84174	Skeena or Upper Bowser (103P/1)	- carbonaceous mudstone (30 cm.) containing vitrain stringers; thinly bedded with siltstone and sst; appears to contain detrital muscovite.
	S84005	"	- carbonaceous shale associated with sst/mudstone interbeds.
10	T84018	Bowser (103P/1)	- occurrence of laminated coaly mudstone and mudstone 10 cm. thick, associated with plant fragment imprints.
11	S84120	Bowser (103P/8)	- very weathered carbonaceous seams; 2 seams of 1/2 m each, roof/floor is siltstone.
12	T84008	Bowser (1032/16)	- vitrain stringers in very weathered outcrop 10-15 cm. thick; associated with chert pebble conglomerate and fine grained sst.
13	F84009	Lower Bowser (93M/13)	- approximately 20 cm. vitrain stringers in 40 cm. carbonaceous mudstone interval, very weathered; roof-mudstone, floor - carbonaceous mudstone; associated with needle-like plant fragment impressions.
14	P84036	Upper Bowser (93M/5)	- very weathered and muddy Carbonaceous mudstone 10 cm. thick; floor/roof is siltstone.
15	P84034	Upper Bowser (93 M/5)	- 35 cm. of very weathered coal laced with calcite veins; roof-sst, floor-mudstone, in proximity (2 m) to an igneous dike.

#	STATION ID	GROUP (MAPSHEET)	DESCRIPTION
16	S84028	Upper Bowser (93M/4)	- 5 cm. of coaly material associated with thinly bedded mudstone and sst; mudstone contains belemnites and Fe nodules.
17	S84035	Kitsun (93L/13)	- stringers of carbonized wood fragments in mudstone.
18	B84105/104	Skeena (93L/3)	- undetermined thickness of carbonaceous (durain/fusian) material; very recessive and weathered outcrop.
19	P84134	Bowser (103P/1)	- carbonaceous mudstone up to .5 m, floor-sst, roof-mudstone.

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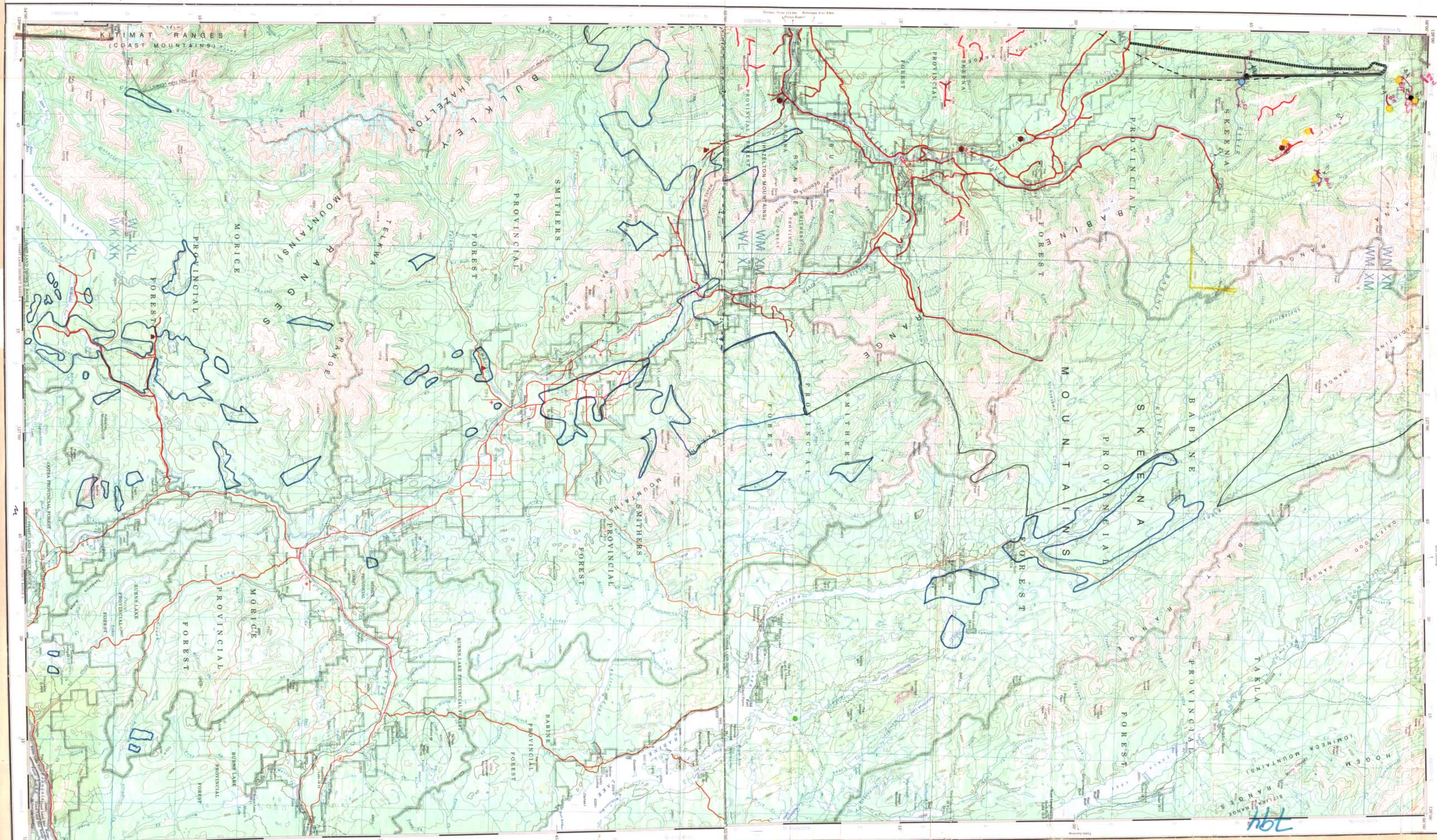

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FACIES AND COVERAGE MAP

Bowser Lake Group
Coal
Skeena Group
Coal

traverse Coverage

Marine – Continental Facies Boundary

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