

GEOLOGY OF THE CADOMIN EAST (83F/3) MAPSHEET

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EXECUTIVE SUMMARY

The Cadomin East (83F/3 East) mapsheet was mapped on a scale of 1:50 000. Some 4000 meters of Cretaceous and Tertiary strata are present in the area. The largely Tertiary Coalspur Formation contains the major economic coal seams, which were mined in the past and may well be mined in the near future. In addition, the upper Brazeau Formation contains coal seams up to 4 meters thick. These Brazeau coals have been insufficiently explored to make resource calculations or to establish seam correlations.

The economic coal seams of the Coalspur Formation are present in the area in three parallel bands in the Entrance Syncline and Coalspur Triangle Zone. The Mercoal band is the southernmost, contains the Mercoal Project of Manalta and dips to the northeast. The Coalspur band is in the middle and dips generally to the southwest. The Robb band is the northernmost band and contains northeast dipping strata and is less deformed than the Coalspur band.

Acknowledgements

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INTRODUCTION

The Coalspur Coalfield may well contain Alberta's next new coal mine and for this reason the AGS is performing mapping of the coal-bearing strata in this area. Another reason is that no recent geological maps exist of this area; the only available geological map is from MacKay, published in 1929. Fieldwork was performed during three weeks in the summer of 1989. The area is heavily forested and consequently the exposure of bedrock is limited. The main exposures are along McLeod River and MacKenzie Creek. Other exposures are along road, rail-road cuts and ridges formed by competent rock units.

Methodology

Information from outcrops and drill holes were collected with the TRIPOD Structural Geological Information System (Charlesworth et al., 1989). The coordinates of outcrops and drill holes are in a UTM grid (Zone 11). A geological map (enclosure) and cross sections (in preparation) were constructed with this computer system.

Outcrops

Information from 125 outcrops were entered in the database. Additional outcrop information was obtained from Johnston, 1985, and unpublished coal company exploration reports.

Drill holes

Information from 458 coal exploration drill holes were entered in the database. Most of these holes were drilled by Manalta, Luscar, Denison and Crows Nest Resources (Shell). The codes for the stratigraphic picks (including coal picks), that were entered in the database, are given in Appendix 1.

In addition, stratigraphic picks (done by the ERCB) from 12 oil and gas wells in this area were entered in the database (see maps by Carter Mapping Limited, 1987 and 1989).

STRATIGRAPHY

Some 4000 meters of Cretaceous and Tertiary strata are present in the area. The stratigraphic units are discussed separately from oldest to youngest.

Blackstone Formation

The formation consists largely of dark marine shale and siltstone, with minor beds of sandstone, bentonite and some ironstone concretions. Some 500 m of Blackstone sediments may be present in the hanging wall of the Brazeau Thrust

(enclosed map), although there may be structural repeats present. Its age is late Albian to late Turonian. Stott (1963) distinguishes 4 members in this formation, but they are not easily mappable in this poorly exposed area.

Cardium Formation

The Cardium Formation consists of marine sandstone, siltstones and shale. It forms a useful marker horizon for mapping purposes, because it is relatively thin (about 80 m) and the sandstones forms ridges, that are easy recognizable on the aerial photographs. The marine sandstones often contain hummocky cross beds and trace fossils. The Blackstone and Cardium formations form a coarsening upwards succession, indicative of a fall in relative sea-level.

Four members can be recognized in outcrop (Stott, 1963), but are too thin to be mappable on a 1:50 000 scale. The age of the formation is late Turonian to early Coniacian.

Wapiabi Formation

The Wapiabi Formation includes all the beds between the Cardium Formation and the greenish sandstones of the Brazeau Formation and is about 600 m thick. The age of the formation is Turonian to Campanian. Stott(1963) distinguishes 7 members in the Wapiabi Formation. However, the only easily mappable unit on a 1:50 000 scale is formed by the marine sandstones of the Chungo Member. For this reason the Wapiabi Formation is divided into the Upper and Lower Wapiabi members, whereby the base of the Chungo Member is used as marker horizon.

Lower Wapiabi members

The lower members are the Muskiki, Marshybank, Dowling, Thistle and Hanson members, which are dark grey, marine shales and siltstones. The Marshybank Member contains a larger percentage of siltstones and the Thistle Member consists of calcareous shales (Stott, 1963), but these members could not be mapped separately.

Upper Wapiabi members

The upper members are the Chungo and Nomad members. The Chungo consists of about 70 metres of fine grained, often reddish-brown weathering sandstones and minor siltstone. Hummocky cross-stratification and trace fossils, such as *Planolites* sp. and *Skolithos* sp., indicate that these sandstones are largely marine and clearly distinctive from the younger alluvial sandstones of the Brazeau, Coalspur and Paskapoo formations. Marine bivalves can be found.

The Nomad Member consists of dark grey marine shales in between the Chungo sandstones and the greenish sandstones of the Brazeau Formation. This member is about 30 metres thick.

Brazeau Formation

The Brazeau Formation, together with the Coalspur and Paskapoo formations forms part of the Saunders Group (Jerzykiewicz, 1985). The Brazeau Formation consists of about 1200 metres of sandstones, shales and some coal seams above the marine shales of the Wabiabi Formation and below the basal Entrance Conglomerate of the Coalspur Formation. Some exploration for coal in the Brazeau Formation has been performed by Luscar and Crows Nest Resources. Up to 4 metres of coal has been reported in their drilling programs.

Coalspur Formation

The Coalspur Formation (Jerzykiewicz, 1985) contains a 600 metres thick continental succession of interbedded sandstones, mudstones and thick economic coal seams. The base of the Coalspur Formation is the so-called Entrance Conglomerate. Thick coal seams interbedded with coaly shales and numerous bentonites occur in the upper part of the formation. This interval is known as the Coalspur coal zone (ERCB, 1989). Figure 1 shows the various coal seams in the area. The Val d'Or and Mynheer seams are recognizable in the whole area between Hinton and Coal Valley. The Cretaceous-Tertiary boundary is at the base of the Mynheer coal seam (Jerzykiewicz and Sweet, 1986). The Coalspur Formation represents a nonmarine, fluvially dominated environment of deposition.

Paskapoo Formation

The Paskapoo Formation consists of at least 1000 metres thick alluvial sandstones and mudstones above the uppermost coal seam of the Coalspur Formation, which is the Val d'Or Seam in the Cadomin area.

STRUCTURAL GEOLOGY

The major structures of the area are, from north to south the Pedley Thrust and Coalspur Triangle Zone (formerly called Coalspur Anticline), Entrance Syncline, Mercoal Thrust, Brazeau Flats, Brazeau Thrust, Brazeau Syncline and Cadomin Syncline. The economic coal seams of the Coalspur Formation are present in the area in three parallel bands in the Entrance Syncline and Coalspur Triangle Zone. The Mercoal band is the southernmost, contains the Mercoal Project of Manalta and dips about 30 degrees to the northeast. The Coalspur band is in the middle and contains the structurally thickened Coal Valley pod east of the map area and dips generally to the southwest. The Robb band is

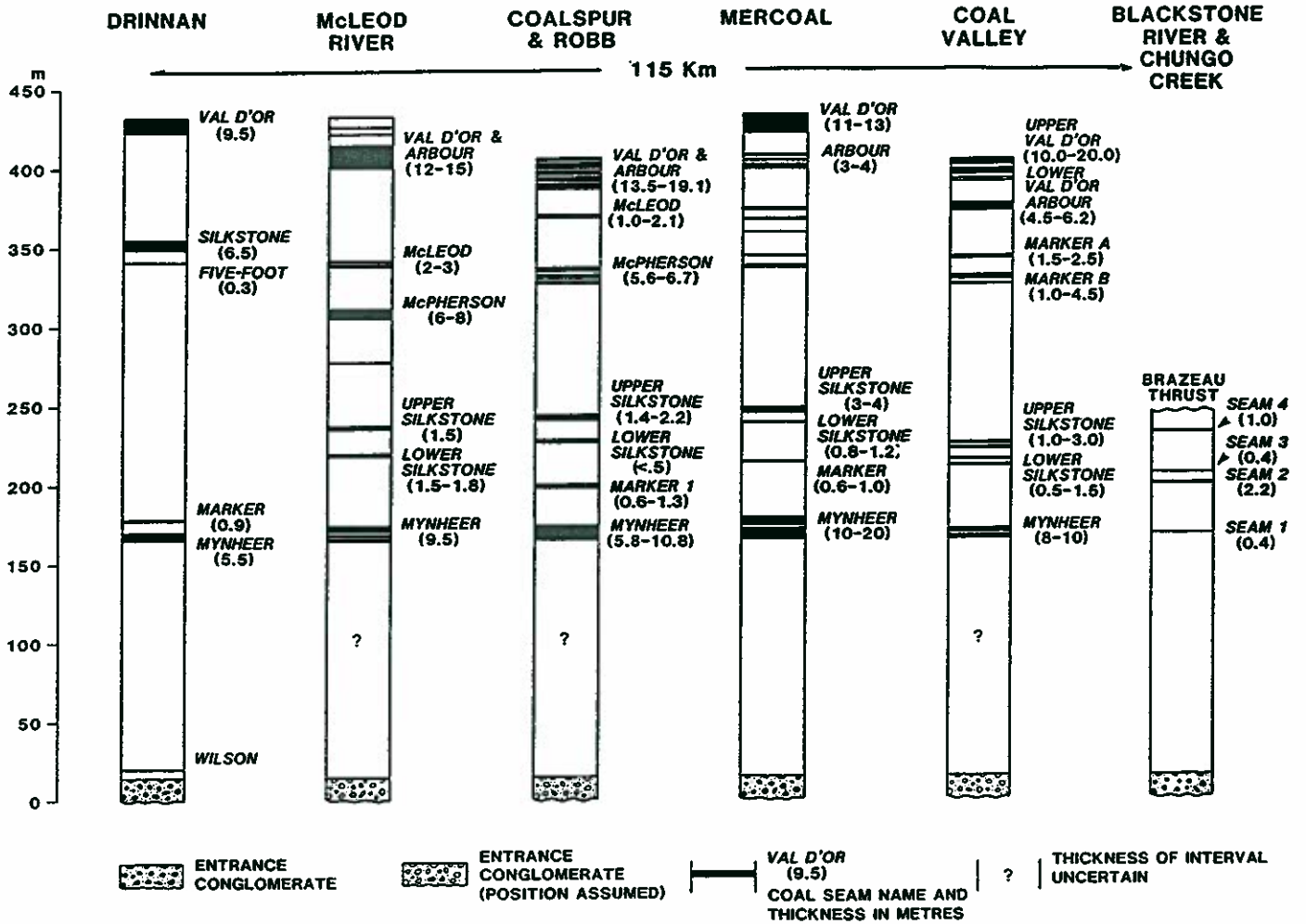


Figure 1. Nomenclature and correlation of coal seams of the Coalspur coal zone (from Jerzykiewicz, 1985).

the northernmost band and contains northeast dipping strata and is less deformed than the Coalspur band. In the Entrance Syncline, the Coalspur coals are buried at various depths (up to 1 km) and may form exploration targets for coal-bed methane.

The Pedley Thrust appears to have at least 1 km of southwest directed displacement. This fault defines the Coalspur Triangle Zone. The Mercoal Thrust may have about 2 km of southwest directed displacement and defines a triangle zone that probably formed before the Coalspur Triangle Zone. The Brazeau Thrust shows at least 3 km of northeast directed movements and places Blackstone shales on top of the Brazeau Formation. The Brazeau Syncline has an overturned southwest limb and is a tight fold.

COAL QUALITY

Coal Rank

Fourteen coal outcrops have been sampled by the AGS and the GSC between 1986 and 1989. Nine of the outcrops are of the Coalspur Formation and 5 are of the Brazeau Formation. The vitrinite reflectance analyses are presented in Appendix 2. Random vitrinite reflectances of the Coalspur Formation samples range between 0.48 and 0.63 %, which indicates a high-volatile bituminous B and C coal rank. The Brazeau Formation coals range from 0.62 to 0.67 % random vitrinite reflectance, which indicates largely high-volatile bituminous B coal rank. These Brazeau coals have been insufficiently explored to make resource calculations or to establish seam correlations. They may justify additional exploration, because the quality of these coals appears to be reasonable from limited analyses. For example, Rogan and Eldin (unpublished Luscar report on the Oppelt property, Appendix 5) report on a 4 m thick seam with an average ash content of 25.3 % (dry basis), which includes 7 to 8 thin clay partings.

Coal Exploration Drill holes

Twenty five drill holes contain coal quality information (see also Macdonald et al., 1989). Coal quality data generated includes:

- 119 complete Proximate Analyses from 20 drillholes
- 180 analyses of Ash and Moisture from 18 drillholes
- 86 analyses of Sulphur from 10 drillholes
- 6 analyses of Heating Value (as-received basis) from 2 drillholes
- 157 analyses of Heating Value (air-dried basis) from 22 drillholes
- 15 analyses of Heating Value (dry basis) from 1 drill hole
- 15 complete Ultimate Analyses from 4 drill holes
- 9 analyses of FSI from 4 drill holes.
- 30 complete Ash Analyses from 16 drill holes.
- 19 complete Ash Fusibility Temperatures from 15 drill holes.
- 10 (reducing atmosphere only) Ash Fusibility Temperatures from 1 drill hole

3 Hardgrove Grindability Index (HGI) determinations from
3 drill holes

70 analyses of Equilibrium Moisture from 14 drill holes

3 Specific Gravity determinations from 3 drill holes.

Weighted averages of proximate analyses for the
Paleocene Coalspur Formation coals (raw) have been generated
for 18 of the drillholes. Results are presented in Appendix
3.

REFERENCES

- Carter Mapping Limited (1987): Cadomin mapsheet - 83F3 & 6 (oil and gas well locations), Scale 1:50000.
- Carter Mapping Limited (1989): Foothills mapsheet - 83F2 & 7 (oil and gas well locations), Scale 1:50 000.
- Charlesworth, H.A.K., Guidos, J., Gold, C and Wynne, D. (1989): TRIPOD 4.0, a microcomputer program for storing, retrieving, displaying and analysing orientation, stratigraphic and positional data from drill holes, outcrops and seismic lines; Computer Manual, University of Alberta, 111 pages.
- ERCB (1989): Reserves of Coal, Province of Alberta. ERCB Report ST89-31.
- Jerzykiewicz, T. (1985): Stratigraphy of the Saunders Group in the central Alberta Foothills - a progress report; Geological Survey of Canada, Paper 85-1B, pp.247-258.
- Jerzykiewicz, T. and Sweet, A.R. (1986): The Cretaceous-Tertiary boundary, central Alberta Foothills. I: Stratigraphy; Canadian Journal of Earth Sciences, v.23, pp.1356-1374.
- Macdonald, D.E., Langenberg, C.W. and Gentzis, T. (1989): A Regional Evaluation of Coal Quality in the Foothills/Mountains Region of Alberta. Alberta Research Council, Earth Sciences Report 89-2.
- MacKay, B.R. 1929. Cadomin mapsheet; Geological Survey of Canada, Map 209A, Scale 1:63360.
- Stott, D.F. (1963): The Cretaceous Alberta Group and equivalent rocks, Rocky Mountains Foothills, Alberta; Geological Survey of Canada, Memoir 317, 306p.

**APPENDIX 1. HORIZON CODES FOR THE PICKS IN THE DATABASE OF THE
COALSPUR MAPPING PROJECT**

<u>HORIZON_CODE</u>	<u>HORIZON_DESCRIPTION</u>	<u>REMARKS</u>
BH	Bottom_of_Hole	no geological picks in this DH
	* * * * *	
P	Paskapoo Formation	
CS	Coalspur Formation	
CQ	Coalspur Coal; top 1st coal in DH	
CP	Coalspur Coal; btm 1st coal in DH	
CO	Coalspur Coal; top 2nd coal in DH	
CN	Coalspur Coal; btm 2nd coal in DH	
CM	Coalspur Coal; top 3rd coal in DH	
CL	Coalspur Coal; btm 3rd coal in DH	
CK	Coalspur Coal; top 4th coal in DH	
CJ	Coalspur Coal; btm 4th coal in DH	
CI	Coalspur Coal; top 5th coal in DH	
CG	Coalspur Coal; btm 5th coal in DH	
M6	Marker 6 (top of)	
V	Val d'Or Coal Zone (undif'd)	
VL	Top of Unit 6 of Val d'Or	
VK	Btm of Unit 6 of Val d'Or	
VJ	Top of Unit 5 of Val d'Or	
VI	Btm of Unit 5 of Val d'Or	
VH	Top of Unit 4 of Val d'Or	
VG	Btm of Unit 4 of Val d'Or	
VF	Top of Unit 3&2 of Val d'Or	
VE	Btm of Unit 3&2 of Val d'Or	
VD	Top of Unit 1U of Val d'Or	
VC	Btm of Unit 1U of Val d'Or	
VB	Top of Unit 1L of Val d'Or	
VA	Btm of Unit 1L of Val d'Or	
AT	Top of Arbour	
AB	Btm of Arbour	
LF	Top of Unit 3 of McLeod	

LE	Btm of Unit 3 of McLeod	
LD	Top of Unit 2 of McLeod	used as McLeod undif'd
LC	Btm of Unit 2 of McLeod	as above
LB	Top of Unit 1 of McLeod	
LA	Btm of Unit 1 of McLeod	
PD	Top of Unit 2 of McPherson	
PC	Btm of Unit 2 of McPherson	
PB	Top of Unit 1 of McPherson	used as McPherson undif'd
PA	Btm of Unit 1 of McPherson	as above
SF	Top of Unit 3 of Silkstone	
SE	Btm of Unit 3 of Silkstone	
SD	Top of Unit 2 of Silkstone	used as Silkstone undif'd
SC	Btm of Unit 2 of Silkstone	as above
SB	Top of Unit 1 of Silkstone	
SA	Btm of Unit 1 of Silkstone	
M1	Marker 1 (top of)	
ML	Top of Unit 6 of Mynheer	
MK	Btm of Unit 6 of Mynheer	
MJ	Top of Unit 5 of Mynheer	
MI	Btm of Unit 5 of Mynheer	
MH	Top of Unit 4 of Mynheer	
MG	Btm of Unit 4 of Mynheer	
MF	Top of Unit 3 of Mynheer	use as Mynheer undif'd
ME	Btm of Unit 3 of Mynheer	as above
MD	Top of Unit 2 of Mynheer	
MC	Btm of Unit 2 of Mynheer	
MB	Top of Unit 1 of Mynheer	
MA	Btm of Unit 1 of Mynheer	
Cr	Cretaceous (undif'd)	
BN	Entrance Conglomerate	
B	Brazeau Formation	
BT	Kbz coal; top 1st coal in DH	
BS	Kbz coal; btm 1st coal in DH	
BR	Kbz coal; top 2nd coal in DH	
BQ	Kbz coal; btm 2nd coal in DH	
BP	Kbz coal; top 3rd coal in DH	

EO	Kbz coal; btm 3rd coal in DH
EN	Kbz coal; top 4th coal in DH
EM	Kbz coal; btm 4th coal in DH
EK	Kbz coal; top 5th coal in DH
EJ	Kbz coal; btm 5th coal in DH
W	Wapiabi Formation
CH	Chungo &/or Solomon SS
Bd	Badheart Formation
Mu	Muskiki Formation
CR	Cardium Formation
BL	Blackstone Formation
Ka	Kaskapau Formation
Do	Doe Creek Member
Dn	Dunvegan Formation
Sh	Shaftesbury Formation
Ba	Base Fish Scale Zone
Bl	Blairmore Group
Vk	Viking Formation
Mp	Mountain Park Formation
Ls	Luscar Formation
Gl	Glauconitic Sandstone
Cd	Cadomin Formation
Nk	Nikanassin Formation
Fr	Fernie Group
Rk	Rock Creek Formation
Pk	Poker Chip Shale
Nr	Nordegg Formation
Sp	Spray River Group
Rd	Rundle Group
Tv	Turner Valley Formation
El	Elkton Member
Sd	Shunda Formation
Pe	Pekisko Formation
Bf	Banff Formation
Ex	Exshaw Formation
Wa	Wabamun Formation

Gr	Graminia Formation
Br	Blue Ridge Member
Cl	Calmar Formation
Ni	Nisku Formation
Ir	Ireton Formation
Ld	Leduc Formation
Sw	Swan Hills Member
Ep	Elk Point Group

APPENDIX 2. Vitrinite reflectance measurements

UTM (m)		Seam	Th (m)	Sample	Ro	SD
East	North					
Coalspur Formation						
496100	5894200		0.15	CS89-1	0.48	0.02
496100	5894200	V		CS89-1A	0.59	0.02
495200	5895480	V		CS89-2	0.58	0.03
486580	5893850			CS89-11	0.54	0.02
496230	5888640	V	2.0	CS89-12	0.58	0.02
497530	5887450	V		CS89-14	0.51	0.02
494470	5890050	A		CS89-16	0.61	0.01
499080	5892550	V	4.0	69/86	0.63	
498550	5899500	V	4.0	68/86	0.50	
Brazeau Formation						
493870	5889200			CS89-25	0.62	0.03
495420	5878650		0.50	CS89-36	0.67	0.03
491420	5883510			CS89-65	0.65	0.02
498250	5877300		0.40	CS89-107	0.67	0.03
498450	5879180		0.10	CS89-110	0.64	0.02

Th=Thickness Ro=Random vitrinite reflectance
SD=Standard Deviation V=Val d'Or A=Arbour

Appendix 3. Weighted averages of proximate analyses, Coalspur Formation coals, ERCB dataset (raw coal).
for the mapsheet 83F/3 (East Half).

*N.B. -1.0 = missing data

Hole Number	UTM Location		Depth(m)		H2O AR	H2O AD	←Dry Basis→					←Dry Ash Free→		
	East	North	Upper	Lower			Ash	VM	CV	FC	VM	CV	FC	
434506	499774	5884821	93.04	111.94	-1.00	4.39	20.25	-1.00	25.10	-1.00	-1.00	31.47	-1.00	
432708	498229	5886197	0.00	75.21	-1.00	2.83	23.30	33.40	23.37	54.92	37.82	30.77	62.18	
288712	499372	5885664	27.83	42.45	-1.00	2.50	9.20	36.60	28.49	54.20	40.31	31.38	59.69	
288688	498041	5887222	27.29	44.71	-1.00	3.30	8.20	38.10	28.61	53.70	41.50	31.16	58.50	
288720	497754	5887280	105.23	112.23	-1.00	3.10	9.30	36.80	28.19	53.90	40.57	31.08	59.43	
288738	497498	5887998	43.95	58.65	-1.00	3.30	8.90	37.00	28.62	54.10	40.61	31.42	59.39	
432625	497389	5887247	38.04	43.16	-1.00	3.98	14.67	32.39	26.75	55.41	37.96	31.35	64.93	
432757	497280	5887117	38.94	57.04	-1.00	3.58	36.90	-1.00	19.07	-1.00	-1.00	30.20	-1.00	
433110	498008	5887182	60.58	75.89	-1.00	4.66	22.67	-1.00	23.89	-1.00	-1.00	30.87	-1.00	
422022	492212	5891356	33.21	293.04	-1.00	5.87	31.10	27.10	21.23	41.80	39.45	30.77	60.55	
416776	498397	5899545	85.32	94.02	10.70	6.03	33.11	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	
416784	498426	5899580	49.98	76.40	-1.00	4.50	18.92	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	
415935	499659	5898556	25.20	72.60	-1.00	3.94	19.65	27.61	22.65	46.16	33.94	27.84	56.76	
416008	499702	5898593	47.44	63.42	-1.00	4.24	21.81	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	
416099	499464	5898959	143.45	234.70	-1.00	4.08	22.75	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	
416115	499070	5899101	59.66	83.80	-1.00	3.57	17.20	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	
416800	498498	5899651	123.58	217.40	-1.00	4.14	28.43	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	
421842	487073	5899160	135.34	385.54	-1.00	5.07	20.83	30.81	25.03	48.37	39.00	31.62	61.00	

APPENDIX 4. Unpublished reports on file or on fiche at the ERCB.

Crows Nest Resources Limited. 1981-12-18. Bryan Mountain Project - ERCB Permit for Bulk Coal Samples. ERCB Application No. 811040. Fiche of Application from ERCB Records Center.

Crows Nest Resources Limited. 1981-06-25. Bryan Mountain Project:Deep Drilling Application (Tp 49, R21, W5th). ERCB Application No. 810526. Fiche of Application from ERCB Records Center.

Denison Mines Limited - Coal Division. 1981-11-17. Application for Exploration Approval and ERCB Permit, Coalspur Area. ERCB Application No. 810921. Fiche of Application from ERCB Records Center.

Denison Mines Limited - Coal Division. 1981-07-10. Application for Exploration Approval and ERCB Permit, Coalspur Area. ERCB Application No. 810554. Fiche of Application from ERCB Records Center.

Denison Mines Limited - Coal Division. 1980-12-09. Application to modify Exploration Permit, Coalspur Area. ERCB Application No. 800974. Fiche of Application from ERCB Records Center.

Denison Mines Limited - Coal Division. 1980-05. Application for Exploration Permit, Coalspur Area. ERCB Application No. 800317. Fiche of Application from ERCB Records Center.

Dentherm Resources Limited - Denison Mines Limited - Manager. 1982-10-22. Application for Exploration Approval and ERCB Permit, Robb Block, Coalspur Area. ERCB Application No. 821033. Fiche of Application from ERCB Records Center.

Miller, D. C. 1975. Vitaly Coal Leases, Hinton Alberta. Bethlehem Copper Corporation. Report initially filed with Alberta Energy and now resides at the ERCB Library (Calgary).

North Canadian Oils Limited. 1975-07. Bryan Mountain Coal Prospect - Robb, Alberta, Canada - Exploration Application. ERCB Application No. 8675. Fiche of Application from ERCB Records Center.

**APPENDIX 5. Unpublished reports made available to the
Alberta Geological Survey.**

Dentherm Resources Limited - Denison Mines Limited. 1982-08.
Coalspur Feasibility Study - Volume 2 - Geology. Report
contains reduced regional geological map; approximate
scale of reduced map 1:90 000.

Manalta Coal Ltd. 1982-04. Mercoal Project, Deficiency
Responses, Technical Aspects.

Manalta Coal Ltd. 1982-04. Mercoal Project, Initial Mining
and Construction Phase Area - Supplemental Surficial
Overburden Program, 1982.

Manalta Coal Ltd. 1982-10. Supplemental Responses to
Technical Deficiencies, Mercoal Project.

Manalta Coal. Ltd. 1980-09-23. Application for Exploration
Approval and ERCB Permit, Coalspur Area. ERCB
Application No. 800749. Fiche of Application from ERCB
Records Center.

Mercoal Minerals Ltd. - Manalta Coal Ltd. 1982-04. Mercoal
Project, Technical Application to Develop a Mine and a
Mine Site. 7 Volumes.

Rogan, M. N. and Eldin, A. K. 1979-02. Luscar Ltd. - A
Drilling Reconnaissance and Geological Summary of the
Oppelt Property.

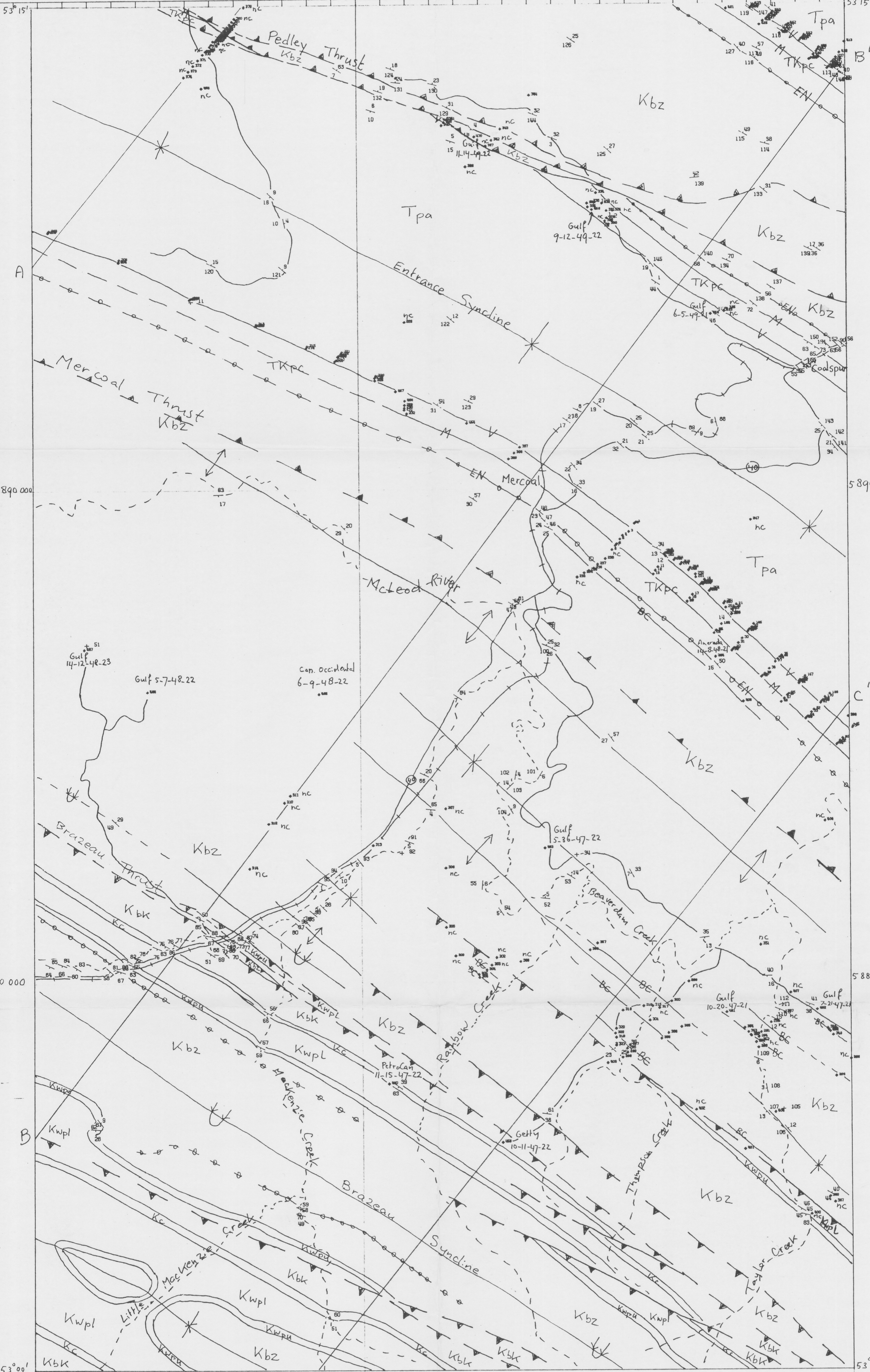
Woodley, M. 1979-06. Bighorn Project - Geological Evaluation.
Union Oil Company of Canada Limited - Minerals
Department. Report contains 1:25 000 scale detailed
geological maps.

485000

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Tpa - Paskepoos Formation
 TKpc - Coalspur Formation
 V - Val d'Or Coal seam
 M - Myntheer Coal seam
 ---E--- Entrance Conglomerate

Kbz - Brazeau Fm.
 BE - Brazeau coal seam
 Kwpu - Upper Wabiabi (Chungo and Nomed members)
 Kwpl - lower Wabiabi Fm.
 Kc - Cardium Fm.
 Kbk - Blackstone Fm.

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scale 1:5000

Geology by W. Langenberg

CADOMIN-EAST (NTS 83F/3)