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GEOLOGY AND COAL RESOURCES OF THE WAPITI FORMATION OF NORTH CENTRAL ALBERTA

by M. Chu

1978

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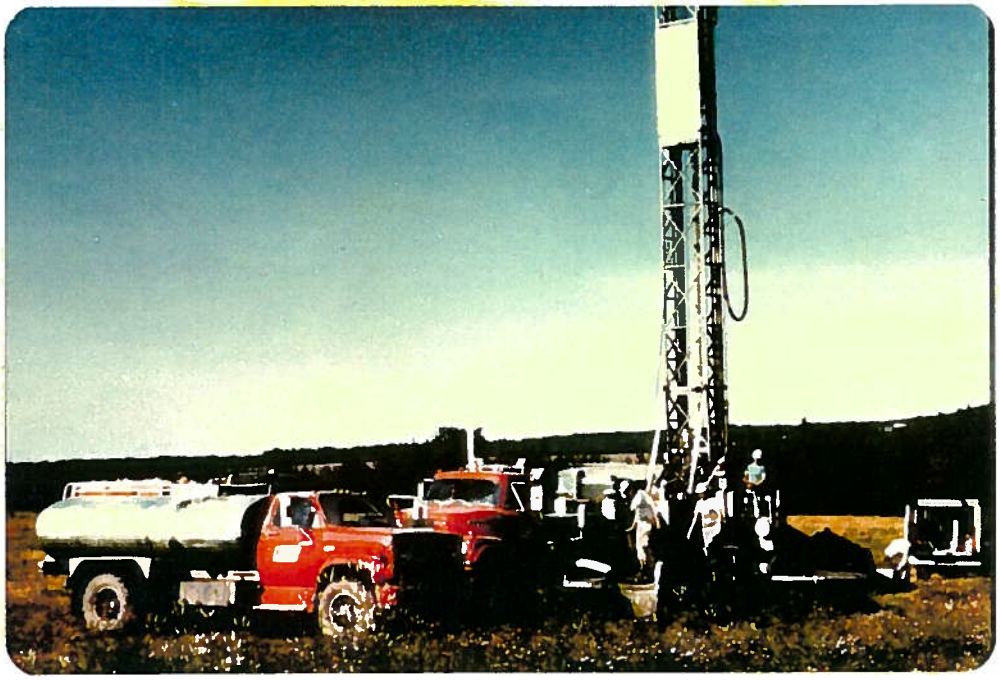

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GEOLOGY AND COAL RESOURCES OF THE WAPITI FORMATION OF NORTH CENTRAL ALBERTA

ABSTRACT

A study of coal resources of the Wapiti Formation shows that three coal zones in the area between Edmonton and Barrhead are of potential commercial value. A coal zone referred to in this report as the McKay equivalent can be correlated throughout the lower part of the Wapiti Formation. The associated coal seams are generally thin, although the beds locally thicken in a limited area between Westlock and Thorhild.

Two coal zones within the upper part of the Wapiti Formation are of commercial interest. The Clover Bar equivalent, a prominent coal zone in the Horseshoe Canyon Formation, and the overlying Weaver equivalent are recognized as the two major widespread coal zones, throughout the Edmonton and Barrhead areas.

Cross sections illustrate the regional structural and stratigraphic relationships of the Upper Cretaceous strata. Coal seam maps are presented including: the thickest seams 3 ft (1.5 m) or greater in thickness and aggregate thicknesses of all seams exceeding 3 ft (0.9 m) thick in any one section.

In the study area the total resources in coal seams 5 ft (1.5 m) or greater in thickness and in coal seams 3 ft (0.9 m) or greater in thickness but with an aggregate thickness of 5 ft (1.5 m) or greater, are 2.9 billion tons (2.6×10^9 t) and 4.7 billion tons (4.3×10^9 t) respectively.

ACKNOWLEDGMENTS

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Hi-Rate Drilling Co. Ltd. and Satellite Drilling Ltd. performed very efficient drilling operations. Canadian Arctic Survey Systems supplied geophysical logging services and Christensen Diamond Product (Canada) Ltd. capably supervised coring activities. Analytical work was carried out by Chemical and Geological Laboratories Ltd.

The writer is indebted to J. Wall and C. Singh who provided micropaleontological interpretations.

INTRODUCTION

The Alberta Research Council's investigation of relatively deep coal resources of the Alberta Plains region continued in 1977 under sponsorship of Alberta Energy and Natural Resources, with an evaluation of the northern extension of the Belly River and Horseshoe Canyon Formations (collectively termed the Wapiti Formation). The area of study lies between Tps 52 and 65, and R 19 W4th Mer and R 8 W5th Mer (Fig. 1). Sixty-two testholes were drilled in two main clusters, one in the Edmonton-Barrhead area, and the other northeast of Westlock. The holes were drilled to depths between 400 and 1000 ft (122.0 and 304.9 m) at a density of one testhole per township. The principal data obtained include gamma-ray, density, and resistance geophysical logs, drilling cuttings, and core. Cutting samples were described during the process of drilling at each site and selected coal cuttings were submitted for analyses. Four testholes were cored after pilot holes had been drilled to provide depths to the coal zones. Core samples were described in detail and selected intervals of coal from the cores were submitted for analyses. A typical core analysis and description are provided in figure 2.

From the test drilling structural cross sections were produced (Fig. 3), and the amount of coal present was estimated.

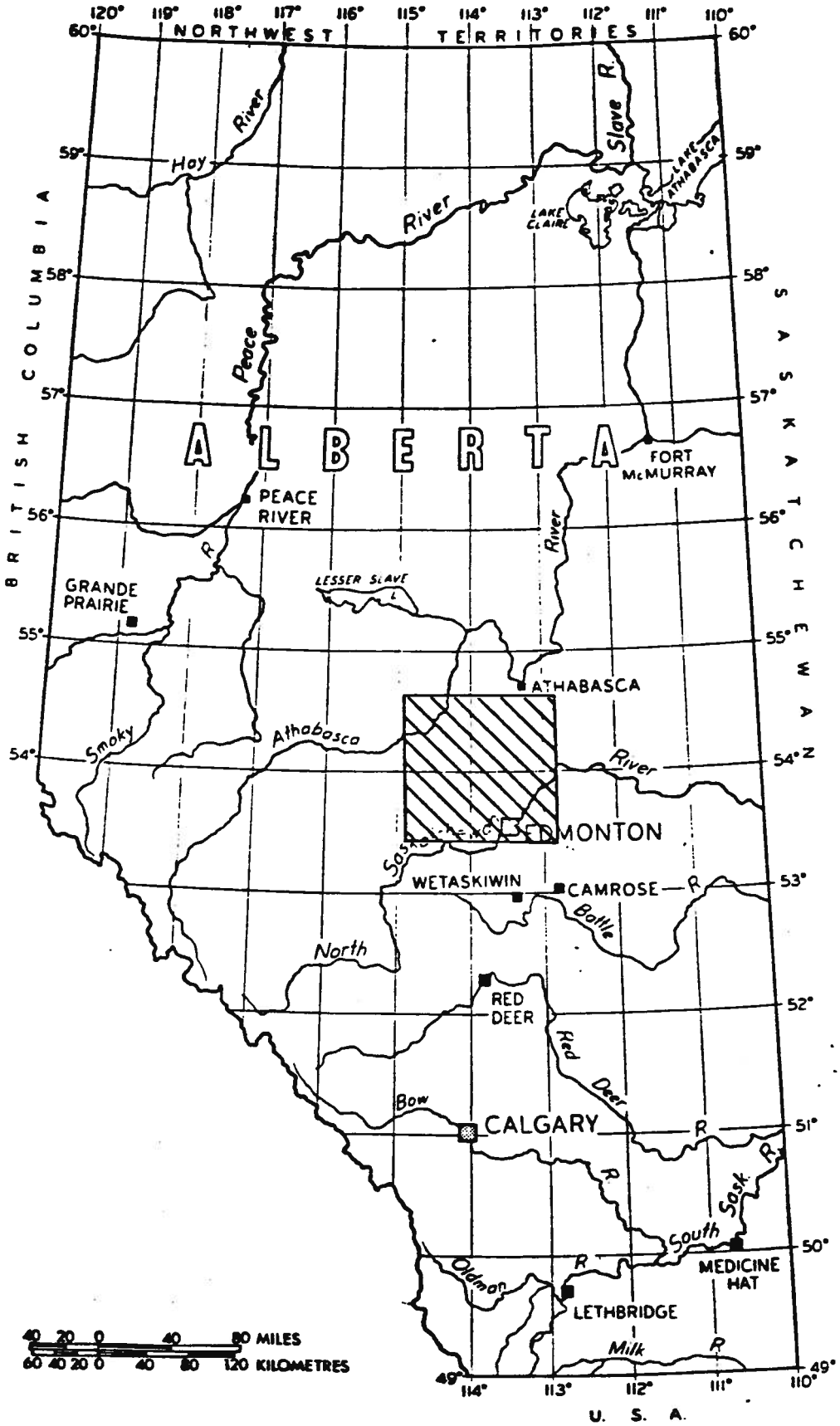
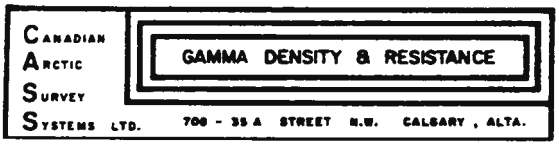
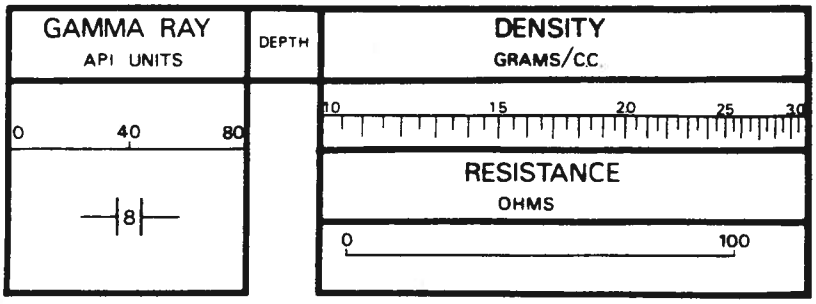


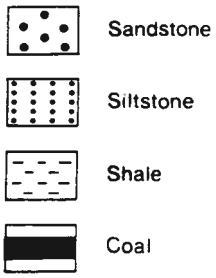
Figure 1 Area of Study

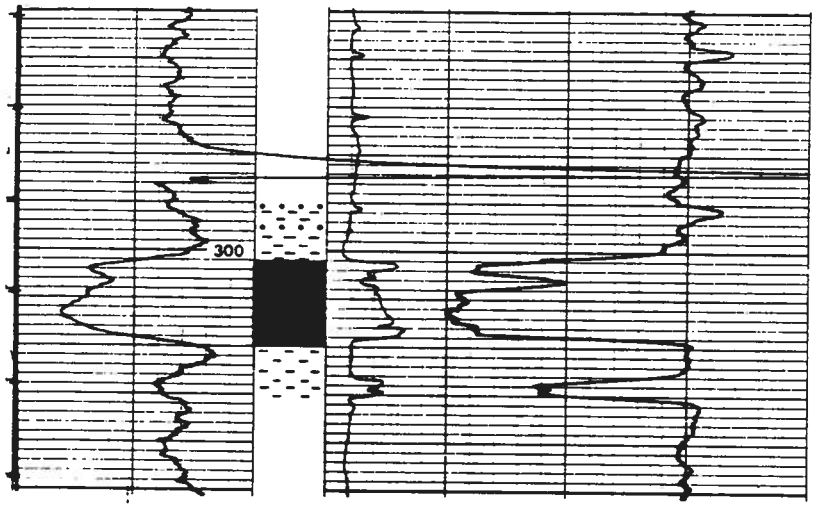
CORE DESCRIPTION

Alberta Research TH 26-77
N.E. 22-56-2W5 Grd. Elev. 2355









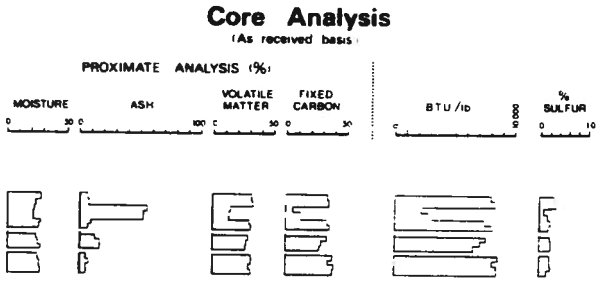


FIGURE 2

REGIONAL GEOLOGY AND NOMENCLATURE

The term Wapiti was first applied by Dawson (1881) in the Peace River area to a 300 ft (91.5 m) thick succession of sandstones, shales, and coal beds overlying a series of dark shales he named the Smoky River Shales. McLearn (1919) assigned 900 ft (274.4 m) of strata on the Smoky River south of Bezanson to the Wapiti Formation, and he stated that the top of the formation was not observable. Rutherford (1930) provided a more detailed description of the Wapiti Formation and felt that in the Grande Prairie area the formation was equivalent in age to the Belly River Formation.

Allen and Rutherford (1934) suggested that the beds defined by Dawson and McLearn are probably equivalent to those beds designated as Edmonton Formation by Selwyn (1874): "The Edmonton is extended west across the Smoky through the Grande Prairie district where the upper part of the Wapiti is correlated with the Edmonton on a lithological basis." North of the Edmonton region, Green (1972) mapped the entire succession overlying the Lea Park Formation (including the Belly River and Edmonton strata) as the Wapiti Formation. The present nomenclature is summarized in figure 4.

The Lea Park Formation, which underlies the Wapiti Formation in the northeast half of the study area, consists of dark gray marine shales. It is a prominent stratigraphic marker for both drilling depth control and stratigraphic studies. The dark gray shale of the Lea Park Formation is very distinctive and easily distinguished from the light colored basal sandstone of the Wapiti Formation.

The Wapiti Formation is composed of shales, siltstones, and sandstones deposited in a continental, deltaic environment as part of a northeast thinning sedimentary wedge. In the study area the formation, in most places, dips gently southwest at less than 40 ft per mile (7.6 m per km). A few outcrops occur within the study area and these have been examined and measured by Feniak (1944).

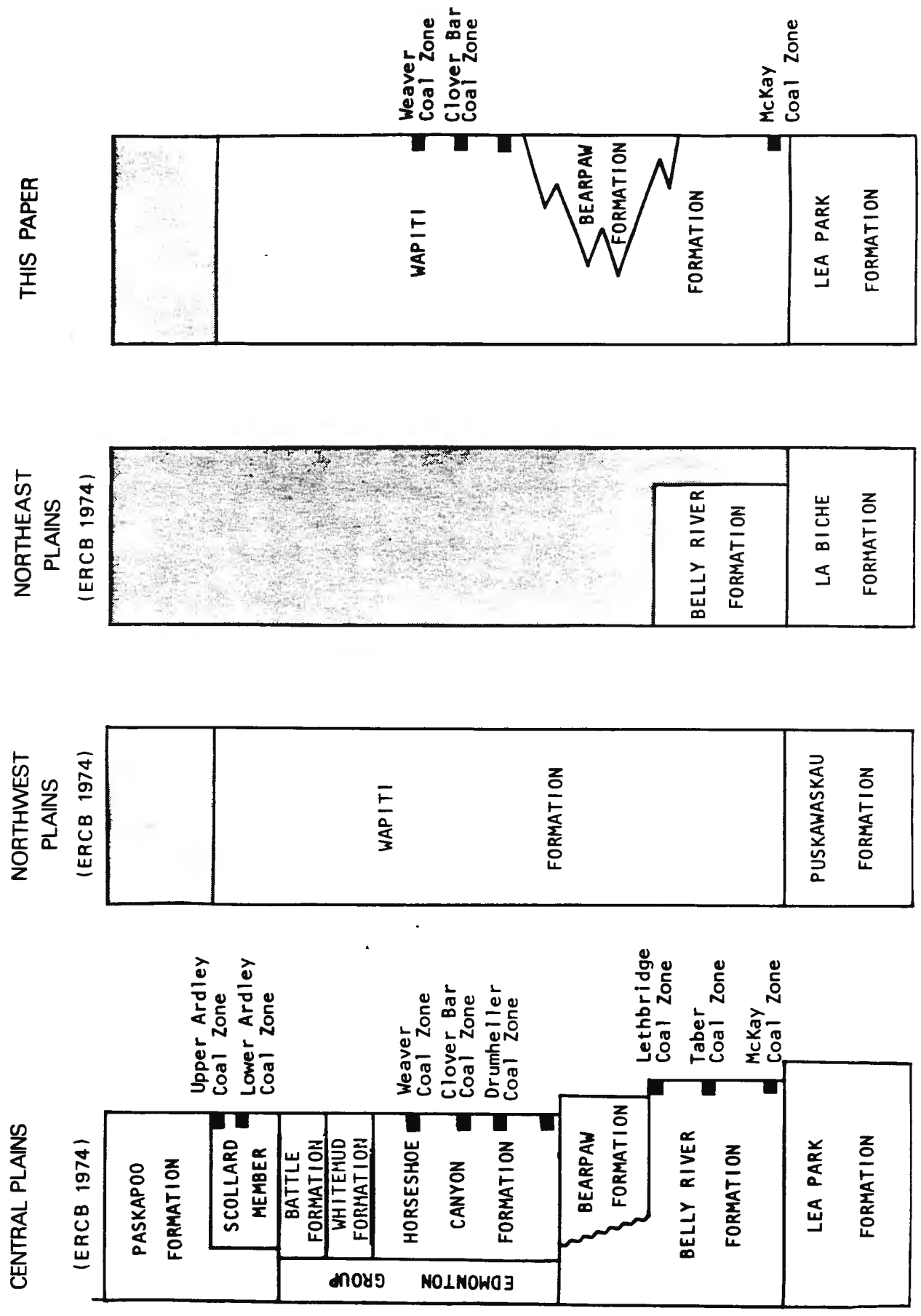


FIGURE 4. Stratigraphic Table

The northeast half of the study area is underlain by the lower strata of the Wapiti Formation which are equivalent in age to the Belly River Formation. The strata, predominantly shale, siltstone, and sandstone, were deposited in brackish water. Some intercalations of fresh-water and marine beds are present near the base of the formation. A prominent gray sandstone is present at the base of the formation. The lowermost Belly River coal horizon in the southern plains area, the McKay equivalent, can be traced into the study area utilizing McLean's (1971) cross section A-A and correlation line "1". The other three of the four coal zones recognized by Crockford (1949) in the Belly River Formation cannot be traced into this study area.

The Bearpaw Formation, a marine unit that separates the nonmarine Belly River and Horseshoe Canyon Formations in central Alberta, is believed to be present in the study area. The Bearpaw equivalent in the study area is composed of marine and nonmarine beds of variable thickness and lateral persistence; as a result, the contacts between it and the Belly River and Horseshoe Canyon equivalents are very difficult to determine. Feniak (1944) stated:

> "No outcrops of marine Bearpaw occur in the Athabasca-Barrhead map-area, and whether the formation is present or not is a matter of conjecture. No marine shales are exposed along Athabaska River where the Bearpaw might be expected to occur. However, topographic features on the basis of which Rutherford (1939) mapped the Bearpaw in the Edmondon map-area continue into Athabaska map-area and the formation was projected across the map-area on the basis of this topography and on the assumption that it is continuous and maintains the same regional strike."

No evidence of marine deposits was discovered in micropaleontological data of a cored interval, suspected to be in the Bearpaw equivalent, from testhole 37-77 (Tp 58, R 3 W5), in the Barrhead area (J. Wall, personal communication).

Duplicate samples of the same cored interval were examined by C. Singh and he suggested (personal communication): "There are no marine dinoflagellates in these samples. The microflora consisting of microspores, megaspores and pollen is of Late Campanian age. These samples should be assigned to the Belly River Formation, which was deposited under continental conditions."

Outcrop samples taken from along the North Saskatchewan River (S.W. Sec. 23, Tp 54, R 23 W4) were determined to be from the Bearpaw Formation and Wall (personal communication) comments as follows: "The environment of the assemblage seems to be shallow, marginal marine which tends to substantiate Green's (1972) interpretation that this locality is at or near the present distributional edge of the Bearpaw Formation."

The marine strata of the Bearpaw Formation cannot be recognized in the southwest half of the area but a projection of subcrop elevation from the south proved to be satisfactory for selecting the drilling depth below which the coal was unlikely to be present. As noted from testholes 7-75 and 39-77, coal beds were not found within the successions occurring 500 and 300 ft (152.4 and 91.5 m) respectively, below the lowermost coal-bearing units.

The beds of the upper part of the Wapiti Formation (equivalent to the lower portion of the Horseshoe Canyon Formation) are widespread throughout the southwest half of the study area. The strata consist of shales, siltstones, sandstones, numerous coal seams, and carbonaceous beds, together with bentonitic or silty shales and sandstones deposited in a fresh- to brackish-water, nearshore environment. It is difficult to correlate the coal seams because the units do not persist laterally.

WAPITI FORMATION COAL MINES

Several small mines have produced coal from the Wapiti Formation and figure 5 illustrates the distribution of sections containing mines or licensed for coal development. The information is derived from Campbell (1964, 1972).

Abandoned mines are scattered throughout the study area. Four coal mines are presently producing over 10,000 tons (9070 t) of coal per year from Wapiti seams for local domestic needs. The Star Key underground operations produced 10,265 tons (9310 t) during 1976 and the Egg Lake, North Point, and Picardville stripping operations produced 20,796, 13,261 and 11,988 tons (18862, 12027 and 10873 t) respectively during the same year (Energy Resources Conservation Board, 1977). The North Point mine produces coal from the lower part of the Wapiti Formation, whereas the remainder are producing from the upper part of the Wapiti.

WAPITI FORMATION COAL SEAMS

Shallow occurrences of Wapiti Formation coals have been investigated by several previous workers including Pearson (1960, 1961) who studied the upper part of the Wapiti Formation in the Morinville and Westlock-Barrhead areas. Campbell (1972) investigated coal in the lower part of the Wapiti in the Athabasca area. No attempt was made to correlate the coal zones mapped in this study with those defined in previous studies. However, "Clover Bar" was adapted as a zonal terminology from Pearson (1961). For a generalized history of the development of coal seam nomenclature the reader is referred to Holter and Chu (1976) and Holter, Chu and Yurko (1975).

The cross sections A-B, C-D, E-F and F-G (Fig. 6-9) demonstrate the regional geologic structure and stratigraphic relationships of the Upper Cretaceous coal zones and associated strata.

The McKay equivalent is stratigraphically the lowest coal zone in the Wapiti Formation and the coal-bearing interval varies in thickness from 20 to 100 ft (6.1 to 30.5 m). The unit appears to be thinner in those locations where the underlying sandstone is thickened (testholes 73-77 to 74-77). The coal seams within the unit are generally 3 ft (0.9 m) thick or less, except in the region of Tp 59, R 23 W4 and Tp 60, R 24 W4 where the seams thicken locally to 5 ft (1.5 m).

Two coal-bearing units above the McKay equivalent were recognized in the eastern part of the area. The units are between 15 and 20 ft (4.6 to 6.1 m) thick, containing two or three thin seams within each. Few of the seams are more than 3 ft (0.9 m) thick. The lower unit is found between 40 and 60 ft (12.2 and 18.3 m) above the McKay zone and does not persist laterally towards the west. The uppermost till is found 350 ft (106.7 m) above the McKay and only appears east of Tawatinaw in an area of high terrain.

Major coal zones recognized as the Clover Bar and Weaver equivalents in the Horseshoe Canyon Formation south of the Edmonton area may be correlated across the entire study area. A thin coal-bearing unit was noted 100 ft (30.5 m) below the Clover Bar zone and it is located immediately above the marine Bearpaw Formation or equivalent.

The Clover Bar coal zone is best developed in the southwest half of the study area. The zone is 20 to 100 ft (6.1 to 30.5 m) thick and as many as seven thin seams were noted in the area northeast of Edmonton where the unit is thicker. The zone thins towards the west but the individual coal seams within the zone thicken in that direction, reaching a maximum of 12 ft (3.7 m) in testhole 39-77 (Tp 58, R 6 W5).

The Weaver equivalent, situated from 30 to 150 ft (9.1 to 45.7 m) above the Clover Bar zone, is stratigraphically the highest coal zone in the Wapiti Formation. It varies from 10 to 100 ft (3.0 to 30.5 m) in thickness and is present throughout the southwest half of the area. The distribution of coal in the Weaver zone is similar to that in the Clover Bar zone in that the zone thins towards the west with the development of thicker but fewer coal seams in that direction.

A 6 ft (1.8 m) coal seam was noted 320 ft (97.6 m) above the top of the Clover Bar zone in testhole 30-77 (Tp 57, R 3 W5), but it cannot be traced over a large area and thins southward.

A 10 ft (3.0 m) thick coal-bearing unit is present 100 ft (30.5 m) below the Clover Bar in the area west of Lac La Nonne. The coal seams within this unit are thin and do not persist laterally.

COAL RESOURCES

In this study, two methods were used to delineate the distribution of coal and areas of potentially usable seams. The first method is based on the thickness of the "best" (thickest) coal seam greater than 5 ft (1.5 m) thick, intersected at any one testhole. Figure 10 shows areas underlain by those portions of the McKay, Clover Bar, and Weaver coal zones in which the thickest seam is thicker than 5 ft (1.5 m). Geophysical logs were used to determine where coal is present: coal is said to be present in those intervals in which the density readings are less than 1.7 gm/cc and gamma-ray counts are less than 48 API units. The coal thickness estimates shown in figure 10 may include some shale partings less than 1 ft (0.3 m). The limits of the areas outlined on figures 10 and 11 are projected approximately 4 miles (6 km) beyond the location of the testholes.

The coal seams of the Wapiti Formation are relatively thin. The areas which overlie coal beds 5 ft (1.5 m) thick or greater as delineated by this study are: southwest and southeast of Barrhead (Tp 57 and 58, R 3 to 7 W5), east of Sandy Lake (Tp 55 and 56, R 27, W4), and southeast of Wakomao Lake (Tp 59, R 23, W4). The thickest seams are present south of Barrhead.

It should be noted that the best seam encountered in testhole 30-77 (Tp 57, R 3 W5) is stratigraphically higher than the Weaver equivalent.

The total tonnage of coal, based on thickest seam greater than 5 ft (1.5 m) thick was calculated to be approximately 2.9 billion tons (2.6×10^9 t) assuming that the average specific gravity of coal is 1.5, and that 15 percent loss is allowed for undefined shale partings or similar factors. The tonnage estimated for the Clover Bar zone is approximately 1.7 billion tons (1.5×10^9 t).

In the second method of resource evaluation the total thickness of all seams exceeding 3 ft (0.9 m) in thickness within each testhole is computed. The areas overlying an aggregate thickness of 5 ft (1.5 m) or greater are then mapped. The results of this data compilation are shown in figure 11 and a list of individual seam thicknesses and associated depths is provided. The estimated amount of coal, using this method, is approximately 4.7 billion tons (4.3×10^9 t).

COAL CHEMISTRY AND QUALITY

As mentioned previously, selected cutting samples and core samples of coals were submitted for analysis.

Cutting samples from a number of the holes and from different coal zones within these holes were collected; the intervals are given in table 1. Proximate analysis (including moisture, ash, volatile matter, and fixed carbon), heating value determination, and measurement of percent sulfur were carried out under conditions described as: as analyzed and dry basis.

Proximate analysis, heating value, determinations and percent sulfur determination were also performed on core samples from testhole 26-77, Weaver coal zone. The results are shown on table 2. These analyses were performed under conditions described as: as analyzed, dry basis, and as received

An ultimate analysis was also done on coal samples from the above-mentioned core, and the results are shown on table 3. Moisture, ash, carbon, hydrogen, nitrogen, sulfur, and oxygen contents were determined under conditions described as: as analyzed, dry basis, and as received.

Heating values determined from cutting samples (Table 1) varied according to ash content. A maximum (dry basis) of 11,629 BTU/lb (26990 kj/kg) was recorded for testhole 42-77, (sample CU 27-77) in the Weaver coal zone. An average heating value of 10670 BTU/lb (24765 kj/kg) was found for samples containing less than 20 percent ash. Sulfur content (dry basis) varied from 0.22 percent (sample CU 26-77) in testhole 47-77, Clover Bar zone, to a high of 0.95 percent (sample CU 14-77) in testhole 30-77 in a coal zone above the Weaver coal zone.

Heating values determined from core samples (Table 2) from the Weaver coal zone, testhole 26-77 have a maximum (dry basis) of 11878 BTU/lb (27569 kj/kg) with an average of 11254 BTU/lb (26120 kj/kg) on coals containing less than 20 percent ash. Sulfur content ranged from 0.19 percent (sample CO 13-77) to a high of 0.45 percent (sample CO 2-77).

Sulfur content from the ultimate analysis of the above-mentioned core (Table 3, dry basis) ranged from 0.19 percent (sample CO 13-77) to a high of 0.34 percent (sample CO 16-77).

As equilibrium moistures were not determined, classification of the coals according to heating value is not possible. Stansfield and Lang (1944) classed the coals mined in the Edmonton area (see Fig. 5, Coal Mines, Wapiti Formation) as Sub-bituminous B and C.

Table 1: Proximate Analysis of Coal Cutting Samples

Sample Number	ARC Test Hole Number and Depth (Feet)	Condition*	PROXIMATE (Percent) Moisture	Ash	Volatiles	Fixed Carbon	Heating Value BTU/lb.	Sulfur (Percent)	Remarks
CU 1-77	T.H. 2-77 309 - 312	1	6.2	45.2	26.4	22.2	5449	0.69	Lethbridge Coal Zone
		2	-	48.2	28.1	23.7	5809	0.74	
CU 2-77	T.H. 3-77 228.5 - 232	1	6.2	10.7	37.6	45.5	9941	0.70	Lethbridge Coal Zone
		2	-	11.4	40.1	48.5	10598	0.75	
CU 3-77	T.H. 7-77 239 - 242	1	5.6	24.8	34.4	35.2	8120	0.77	Lowermost Lethbridge Coal Zone
		2	-	26.3	36.4	37.3	8602	0.82	
CU 4-77	T.H. 16-77 329 - 333.5	1	4.5	13.0	35.2	47.3	10524	0.48	Ardley Coal Zone #14
		2	-	13.6	36.9	49.5	11020	0.50	
CU 5-77	T.H. 19-77 217.5 - 219.5	1	5.6	13.5	32.3	48.6	9885	0.56	Ardley Coal Zone #14
		2	-	14.3	34.2	51.5	10471	0.59	
CU 6-77	T.H. 20-77 208 - 210.5	1	6.7	14.9	35.6	42.8	9479	0.31	Weaver Zone
		2	-	16.0	38.2	45.8	10160	0.33	
CU 7-77	T.H. 23-77 160 - 163.5	1	5.4	11.0	36.4	47.2	10043	0.25	Top Weaver Zone
		2	-	11.6	38.5	49.9	10616	0.26	
CU 8-77	T.H. 23-77 564 - 568.5	1	5.8	8.7	36.9	48.6	10289	0.28	Drumheller Coal Seam Equivalent
		2	-	9.2	39.2	51.6	10923	0.30	
CU 9-77	T.H. 24-77 590.5 - 594	1	6.7	11.3	34.6	47.4	9993	0.40	Drumheller Coal Seam Equivalent
		2	-	12.1	37.1	50.8	10711	0.43	
CU 10-77	T.H. 26-77 301 - 303	1	5.6	8.3	35.2	50.9	10237	0.30	Weaver Zone
		2	-	8.8	37.3	53.9	10844	0.32	
CU 11-77	T.H. 26-77 304 - 309	1	5.8	10.7	36.9	46.6	9938	0.25	Weaver Zone
		2	-	11.4	39.2	49.4	10550	0.27	
CU 12-77	T.H. 27-77 365 - 371.5	1	6.4	8.5	35.9	49.2	10290	0.27	Clover Bar Zone
		2	-	9.1	38.4	52.5	10994	0.29	
CU 13-77	T.H. 30-77 101 - 104	1	7.6	7.6	37.8	47.0	9838	0.41	Coal Zone Above Weaver
		2	-	8.2	40.9	50.9	10647	0.44	
CU 14-77	T.H. 30-77 105 - 107.5	1	6.7	14.6	37.0	41.7	9248	0.89	Coal Zone Above Weaver
		2	-	15.6	39.7	44.7	9912	0.95	
CU 15-77	T.H. 32-77 345.5 - 349	1	6.1	10.9	34.2	48.8	9403	0.37	Weaver Zone
		2	-	11.6	36.4	52.0	10014	0.39	

Table 1: Cont'd.

Sample Number	ARC Test Hole Number and Depth (Feet)	Condition*	PROXIMATE (Percent) Moisture	Ash	Volatiles	Fixed Carbon	Heating Value BTU/lb.	Sulfur (Percent)	Remarks
CU 16-77	T.H. 36-77	1	6.7	12.9	33.5	46.9	9959	0.30	Clover Bar Zone
	415 - 422.5	2	-	13.8	35.9	50.3	10674	0.32	
CU 17-77	T.H. 36C-77	1	6.6	8.6	36.7	48.1	10570	0.27	Clover Bar Zone
	390 - 391	2	-	9.2	39.3	51.5	11317	0.29	
CU 18-77	T.H. 36C-77	1	6.2	16.3	35.5	42.0	9601	0.33	Clover Bar Zone
	391 - 393	2	-	17.4	37.8	44.8	10236	0.35	
CU 19-77	T.H. 37-77	1	6.1	6.1	37.9	49.9	10854	0.26	Weaver Zone
	274 - 277.5	2	-	6.5	40.4	53.1	11559	0.28	
CU 20-77	T.H. 37-77	1	5.3	17.1	37.1	40.5	9416	0.29	Weaver Zone
	278 - 283.5	2	-	18.1	39.2	42.7	9943	0.31	
CU 21-77	T.H. 37C-77	1	6.5	9.3	36.7	47.5	10180	0.20	Weaver Zone
	274 - 278	2	-	9.9	39.3	50.8	10888	0.21	
CU 22-77	T.H. 37C-77	1	5.3	5.9	39.8	49.0	10915	0.25	Weaver Zone
	278 - 283.5	2	-	6.2	42.0	51.8	11526	0.26	
CU 23-77	T.H. 39-77	1	6.0	11.4	34.6	48.0	10209	0.28	Weaver Zone
	326.5 - 329.5	2	-	12.1	36.8	51.1	10861	0.30	
CU 24-77	T.H. 39-77	1	5.8	10.4	36.6	47.2	10478	0.33	Clover Bar Zone
	484.5 - 490.5	2	-	11.0	38.9	50.1	11123	0.35	
CU 25-77	T.H. 42-77	1	6.3	6.3	36.5	50.9	10896	0.27	Weaver Zone
	292.5 - 295.5	2	-	6.7	39.0	54.3	11629	0.29	
CU 26-77	T.H. 47-77	1	5.8	16.4	33.9	43.9	9328	0.21	Clover Bar Zone
	171 - 174.5	2	-	17.4	36.0	46.6	9902	0.22	
CU 27-77	T.H. 47-77	1	6.0	8.9	36.3	48.8	10438	0.34	Clover Bar Zone
	175 - 177.5	2	-	9.5	38.6	51.9	11104	0.36	
CU 28-77	T.H. 49-77	1	6.7	8.3	36.8	48.2	10429	0.32	Clover Bar Zone
	297 - 300	2	-	8.9	39.4	51.7	11178	0.34	
CU 29-77	T.H. 49-77	1	6.4	12.6	34.7	46.3	9925	0.32	McKay Zone
	670.5 - 673.5	2	-	13.5	37.1	49.4	10604	0.34	
CU 30-77	T.H. 55-77	1	6.4	9.4	36.3	47.9	10001	0.47	McKay Zone
	712 - 714	2	-	10.0	38.8	51.2	10684	0.50	

Table 1: Cont'd.

Sample Number	ARC Test Hole Number and Depth (Feet)	Condition*	PROXIMATE (Percent) Moisture	Ash	Volatiles	Fixed Carbon	Heating Value BTU/lb.	Sulfur (Percent)	Remarks
CU 31-77	T.H. 57-77	1	7.6	8.8	37.3	46.3	9963	0.30	McKay-Clover Bar
	49 - 51.5	2	-	9.5	40.4	50.1	10782	0.32	
CU 32-77	T.H. 65-77	1	7.3	8.2	37.5	47.0	9905	0.36	Weaver Zone
	79 - 81.5	2	-	8.8	40.5	50.7	10685	0.39	
CU 33-77	T.H. 68-77	1	6.2	11.6	37.6	44.6	9637	0.30	Weaver Zone
	155 - 157.5	2	-	12.4	40.1	47.5	10274	0.32	
CU 34-77	T.H. 70-77	1	6.6	14.9	34.8	43.7	9334	0.48	McKay Zone
	507 - 509	2	-	16.0	37.3	46.7	9994	0.51	
CU 35-77	T.H. 73-77	1	6.3	11.5	35.7	46.5	9842	0.51	McKay Zone
	449.5 - 452	2	-	12.3	38.1	49.6	10503	0.54	
CU 36-77	T.H. 77-77	1	5.8	17.0	33.0	44.2	9382	0.37	Drumheller Coal Seam
	607.5 - 609.5	2	-	18.0	35.0	47.0	9960	0.39	Equivalent
CU 37-77	T.H. 80-77	1	7.2	10.2	36.0	46.6	9966	0.21	McKay Zone
	592 - 597	2	-	11.0	38.8	50.2	10739	0.23	
CU 38-77	T.H. GP4	1	3.5	15.2	32.4	48.9	11316	0.38	
	638.5 - 641	2	-	15.8	33.6	50.6	11727	0.39	

*Condition: (1) As Analysed
(2) Dry Basis

Table 2: Proximate Analysis of Coal Core Samples (Weaver Coal Zone at TH26-77)

Sample Number	Depth (Feet)	Condition*	PROXIMATE (Percent) Moisture	Ash	Volatiles	Fixed Carbon	Heating Value BTU/lb.	Sulfur (Percent)
CO 1-77	301-301'7"	1	5.4	8.4	41.3	44.9	10611	0.38
		2	-	8.9	43.7	47.4	11217	0.40
		3	28.2	6.4	31.3	34.1	8054	0.29
CO 2-77	301'7"-302'3"	1	5.3	9.4	41.1	44.2	10584	0.43
		2	-	10.0	43.4	46.6	11176	0.45
		3	24.3	7.5	32.8	35.4	8460	0.34
CO 3-77	302'3"-302'11"	1	3.6	70.7	18.4	7.3	2730	0.11
		2	-	73.3	19.1	7.6	2832	0.11
		3	23.0	56.4	14.7	5.9	2181	0.08
CO 4-77	302'11"-303'8"	1	3.5	64.9	16.4	15.2	3489	0.20
		2	-	67.2	17.0	15.8	3616	0.21
		3	21.8	52.6	13.3	12.3	2828	0.16
CO 5-77	303'8"-304'1"	1	5.6	13.0	38.1	43.3	9990	0.28
		2	-	13.8	40.4	45.8	10583	0.30
		3	28.2	9.9	29.0	32.9	7599	0.22
CO 6-77	304'1"-304'7"	1	5.6	8.8	38.9	46.7	10627	0.23
		2	-	9.3	41.2	49.5	11257	0.24
		3	26.4	6.9	30.3	36.4	8285	0.18
CO 7-77	304'7"-305'1"	1	5.8	15.9	37.0	41.3	9630	0.26
		2	-	16.9	39.3	43.8	10223	0.28
		3	24.0	12.9	29.9	33.2	7769	0.21
CO 8-77	305'3"-305'9"	1	5.3	22.4	35.3	37.0	8904	0.28
		2	-	23.7	37.2	39.1	9402	0.30
		3	25.1	17.7	27.9	29.3	7042	0.22
CO 9-77	305'9"-306'3"	1	5.9	23.2	35.0	35.9	8561	0.28
		2	-	24.6	37.1	38.3	9098	0.30
		3	27.7	17.8	26.9	27.6	6578	0.22
CO 10-77	306'3"-306'9"	1	5.7	6.0	39.4	48.9	10923	0.26
		2	-	6.4	41.8	51.8	11583	0.28
		3	25.1	4.8	31.3	38.8	8676	0.21
CO 11-77	306'9"-307'3"	1	5.9	9.8	39.9	44.4	10280	0.26
		2	-	10.4	42.4	47.2	10925	0.28
		3	26.1	7.7	31.3	34.9	8074	0.21

Table 2: Cont'd.

Sample Number	Depth (Feet)	Condition*	PROXIMATE (Percent) Moisture	Ash	Volatiles	Fixed Carbon	Heating Value BTU/lb.	Sulfur (Percent)
CO 12-77	307'3"-307'9"	1	6.0	6.1	37.2	50.7	10746	0.29
		2	-	6.5	39.6	53.9	11432	0.31
		3	26.2	4.8	29.2	39.8	8437	0.23
CO 13-77	307'9"-308'3"	1	6.5	6.2	38.4	48.9	10788	0.18
		2	-	6.6	41.1	52.3	11538	0.19
		3	26.6	4.8	30.1	38.5	8469	0.14
CO 14-77	308'3"-308'9"	1	5.9	6.9	40.7	46.5	10789	0.35
		2	-	7.3	43.2	49.5	11465	0.37
		3	26.4	5.4	31.8	36.4	8438	0.27
CO 15-77	308'9"-309'3"	1	7.0	4.4	36.5	52.1	10953	0.34
		2	-	4.7	39.3	56.0	11777	0.37
		3	25.5	3.5	29.3	41.7	8774	0.28
CO 16-77	309'3"-310'	1	6.7	4.2	37.1	52	11082	0.32
		2	-	4.5	39.8	55.7	11878	0.34
		3	25.4	3.4	29.7	41.5	8861	0.25

*Condition: (1) As Analysed
(2) Dry Basis
(3) As Received

Table 3: Ultimate Analysis of Coal Samples (Weaver Coal Zone of TH 26-77)

Sample Number	Depth (Feet)	Condition*	ULTIMATE (Percent)						
			Moisture	Ash	Carbon	Hydrogen	Nitrogen	Sulfur	Oxygen
C06-77	304'1"-304'7"	1	-	8.79	63.21	4.77	1.31	0.23	21.69
		2	-	9.31	66.95	4.4	1.39	0.24	17.71
		3	26.39	6.85	49.28	3.24	1.02	0.18	13.04
C09-77	305'9"-306'3"	1	-	23.2	50.84	4.18	1.04	0.28	20.46
		2	-	24.65	54.02	3.74	1.1	0.3	16.19
		3	27.65	17.83	39.08	2.71	0.8	0.22	11.71
C013-77	307'9"-308'3"	1	-	6.15	64.41	4.99	1.4	0.18	22.87
		2	-	6.58	68.9	4.56	1.5	0.19	18.27
		3	26.61	4.83	50.57	3.35	1.10	0.14	13.4
C016-77	309'3"-310"	1	-	4.2	60.81	4.85	1.19	0.32	28.63
		2	-	4.5	65.19	4.4	1.28	0.34	24.29
		3	25.41	3.36	48.63	3.28	0.95	0.25	18.12

* Condition 1 - As Analysed
2 - Dry Basis
3 - As Received

CONCLUSIONS

Three prominent coal zones are present within the Wapiti Formation. These are: Weaver, Clover Bar and McKay. The lower part of the Wapiti Formation was evaluated in the northeast part of the study area and the upper part of the Wapiti was studied in the southwest. The McKay zone is traceable through the lower part of the Wapiti, but the coal seams are thin and of limited potential economic significance. Some thick coal beds are present in this zone in the area southeast of Wakomao Lake.

The Clover Bar zone, in the upper part of the Wapiti Formation, is of significant commercial interest, particularly in the area south of Barrhead. Coal seams in the overlying Weaver zone equivalent are generally thin, although the beds locally thicken in a small area southeast of Lac la Nonne.

A thick coal bed, overlying the Weaver zone, is locally well developed in the area east of Lac La Nonne.

Total tonnage of coal in areas underlain by seams thicker than 5 ft (1.5 m) is 2.9 billion tons (2.6×10^9 t) including 1.7 billion tons (1.5×10^9 t) within the Clover Bar zone. Tonnage calculated for areas underlain by a minimum aggregate thickness of 5 ft (1.5 m) of coal (assuming a minimum seam thickness of 3 ft (0.9 m) is calculated to be 4.7 billion tons (4.3×10^9 t) using these criteria.

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FIGURE 3

AREA OF STUDY AND LINES OF CROSS SECTION

^{76}■ 1974 Test Hole

^{24}● 1977 Test Hole ▲^{7} 1975 Test Hole ^{4C}● Core Hole

(— —) Formation Boundary (Approx.)

SCALE

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETRES

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LEGEND

TERTIARY AND CRETACEOUS

TKp Paskapoo Formation

CRETACEOUS

Kwt Wapiti Formation

Kbp Bearpaw Formation

Klp Lea Park Formation

R14 R13 R12 R11 R10 R9 R8 R7 R6 R5 R4 R3 R2 R1 R27 R26 R25 R24 R23 R22 R21 R20 R19 R18 R17 R16 R15

Tp 69 Tp 68 Tp 67 Tp 66 Tp 65 Tp 64 Tp 63 Tp 62 Tp 61 Tp 60 Tp 59 Tp 58 Tp 57 Tp 56 Tp 55 Tp 54 Tp 53 Tp 52 Tp 51 Tp 50 Tp 49 Tp 48 Tp 47

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FIGURE 5

COAL MINES, WAPITI FORMATION

☒ Existing Coal Mine .

■ Former Coal Mines and/or Areas Licensed For Development.

■[76] 1974 Test Hole

•[24] 1977 Test Hole ▲[7] 1975 Test Hole •[4C] Core Hole

~~~ (– – –) Formation Boundary (Approx.)

SCALE

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETRES

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LEGEND

TERTIARY AND CRETACEOUS

TKp Paskapoo Formation

CRETACEOUS

Kwt Wapiti Formation

Kbp Bearpaw Formation

Klp Lea Park Formation

R14 R13 R12 R11 R10 R9 R8 R7 R6 R5 R4 R3 R2 R1 R27 R26 R25 R24 R23 R22 R21 R20 R19 R18 R17 R16 R15

Tp 69 Tp 68 Tp 67 Tp 66 Tp 65 Tp 64 Tp 63 Tp 62 Tp 61 Tp 60 Tp 59 Tp 58 Tp 57 Tp 56 Tp 55 Tp 54 Tp 53 Tp 52 Tp 51 Tp 50 Tp 49 Tp 48 Tp 47

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FIGURE 6

STRUCTURAL CROSS SECTION A-B

ELEVATION ABOVE SEA LEVEL
METRES FEET

QUATERNARY

CRETACEOUS

UPPER

WEAVER ZONE

CLOVER BAR ZONE

ALBERTA RESEARCH
TH 32 - 77
5 - 23 - 56 - 3 W5
SURF. ELEV. 2295 Feet(699.7m)
TOTAL DEPTH 845 Feet(257.6m)

ALBERTA RESEARCH
TH 28 - 77
NE 17 - 57 - 2 W5
SURF. ELEV. 2240 Feet(682.9m)
TOTAL DEPTH 664 Feet(202.4m)

ALBERTA RESEARCH
TH 43 - 77
8 - 21 - 58 - 1 W5
SURF. ELEV. 2303 Feet(702.1m)
TOTAL DEPTH 503 Feet(153.4m)

WAPITI FM

ALBERTA RESEARCH
TH 45 - 77
9 - 15 - 59 -27 W4
SURF. ELEV. 2122 Feet(647.0m)
TOTAL DEPTH 1005 Feet(306.4m)

ALBERTA RESEARCH
TH 44 - 77
NE 10 - 60 - 26 W4
SURF. ELEV. 2120 Feet(646.3m)
TOTAL DEPTH 906 Feet(276.2m)

ALBERTA RESEARCH
TH 48 - 77
14 - 9-61 - 25 W4
SURF. ELEV. 2065 Feet(629.6m)
TOTAL DEPTH 706 Feet(215.2m)

ALBERTA RESEARCH
TH 70 - 77
NE 16 - 61 24 W4
SURF. ELEV. 2125 Feet(647.9m)
TOTAL DEPTH 705 Feet(214.9m)

ALBERTA RESEARCH
TH 63 - 77
2 - 21 - 62 - 23 W4
SURF. ELEV. 2253 Feet (686.9m)
TOTAL DEPTH 766 Feet (233.5m)

McKAY ZONE 7

LEA PARK FM

ALBERTA RESEARCH
TH 31 - 77
NE 22 - 55 - 3 W5
SURF. ELEV. 2403 Feet (732.6m)
TOTAL DEPTH 1005 Feet (306.4m)

Gravel
Drift
Sandstone
Siltstone
Shale
Shale, carbonaceous
Concretionary bed (hard ledge)
Coal

Top of bedrock
Formation boundary
Coal seam correlation (definite, uncertain)
Coal zone and/or coal-bearing interval
Coal drill cuttings sample
Cored interval

SCALE 1:250,000
Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilometres

SIMPLIFIED STRUCTURAL CROSS SECTION (A-B)

31-77 32-77 28-77 43-77 45-77 44-77 48-77 70-77 63-77

MILES 5 0 5 10 15 20
KILOMETRES 5 0 5 10 15 20 25 30

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FIGURE 7

STRUCTURAL CROSS SECTION C-D

ELEVATION ABOVE SEA LEVEL METRES FEET

QUATERNARY

CRETACEOUS

UPPER

ALBERTA RESEARCH
TH 58 - 77
8 - 20 - 64 - 1 W5
SURF. ELEV. 2060 Feet(628.0m)
TOTAL DEPTH 542 Feet(165.2m)

ALBERTA RESEARCH
TH 57 - 77
1- 22 - 63 - 1 W5
SURF. ELEV. 2020 Feet(615.9m)
TOTAL DEPTH 563 Feet(171.6m)

ALBERTA RESEARCH
TH 54 - 77
NE-15 - 62 - 27 W5
SURF. ELEV. 2027 Feet(618.0m)
TOTAL DEPTH 645 Feet(196.6m)

ALBERTA RESEARCH
TH 55 - 77
9 - 17 - 61-26 W4
SURF. ELEV. 2080 Feet(634.1m)
TOTAL DEPTH 821 Feet(250.3m)

ALBERTA RESEARCH
TH 48 - 77
14 - 9 - 61 - 25 W4
SURF. ELEV. 2065 Feet(629.6m)
TOTAL DEPTH 706 Feet(215.2m)

ALBERTA RESEARCH
TH 70 - 77
NE 16 - 61 - 24 W4
SURF. ELEV. 2125 Feet(647.9m)
TOTAL DEPTH 705 Feet(214.9m)

ALBERTA RESEARCH
TH 71 - 77
NE 21 - 60 - 23 W4
SURF. ELEV. 2252 Feet(686.6m)
TOTAL DEPTH 705 Feet(214.9m)

ALBERTA RESEARCH
TH 72 - 77
NE 20 - 60 - 22 W4
SURF. ELEV. 2195 Feet(669.2m)
TOTAL DEPTH 705 Feet(214.9m

ALBERTA RESEARCH
TH 73 - 77
9 - 16 - 59 - 22 W4
SURF ELEV. 2125 Feet(647.9m)
TOTAL DEPTH 701 Feet(213.7m)

ALBERTA RESEARCH
TH 75 - 77
NE 15 - 59 - 21 W4
SURF. ELEV. 2108 Feet(642.7m)
TOTAL DEPTH 604 Feet(184.1m)

ALBERTA RESEARCH
TH 74 - 77
2 - 27 - 59 - 20 W4
SURF. ELEV. 2115 Fee
(644.8m)
TOTA DEPTH 02 Feet
(153.0m

WAPITI FM.

McKAY ZONE 7

LEA PARK FM.

LEA PARK FM

Coal drill cuttings sample

Cored interval

Top of bedrock

Formation boundary

Coal seam correlation (definite, uncertain)

Coal zone and/or coal-bearing interval

Gravel

Drift

Sandstone

Siltstone

Shale

Shale, carbonaceous

Concretionary bed (hard ledge)

Coal

SCALE 1:250,000

Miles 5 0 5 10 15 20 Miles

Kilometres 5 0 5 10 15 20 25 30 Kilometres

SIMPLIFIED STRUCTURAL CROSS SECTION (C-D)

ELEVATION ABOVE SEA LEVEL METRES FEET

QUATERNARY

UPPER CRETACEOUS

58-77 57-77 54-77 55-77 48-77 70-77 71-77 72-77 73-77 75-77 74-77

WAPITI FM.

WAPITI FM.

McKAY ZONE 7

LEA PARK FM.

LEA PARK FM.

MILES

KILOMETRES

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FIGURE 8

STRUCTURAL CROSS SECTION E-F

ELEVATION ABOVE SEA LEVEL
METRES FEET

2400 2300 700 2200 650 2100 2000 600 1900 550 1800 1700 500 1600 1500 450 1400 400 1300

QUATERNARY

CRETACEOUS

UPPER

WEAVER ZONE

WAPITI FM

CLOVER BAR ZONE

ALBERTA RESEARCH
TH 42 - 77
8 - 20 - 59 -6 W5
SURF. ELEV. 2208 Feet(673.2m)
TOTAL DEPTH 684 Feet(208.5m)

ALBERTA RESEARCH
TH 39 - 77
4 - 27 - 58 - 6 W5
SURF. ELEV. 2145 Feet(654.0m)
TOTAL DEPTH 475 Feet(144.8m)

ALBERTA RESEARCH
TH 36 - 77
NE 22 - 58 - 5 W5
SURF. ELEV. 2200 Feet(670.7m)
TOTAL DEPTH 704 Feet(214.6m)

ALBERTA RESEARCH
TH 38 - 77
NE 17 - 58 - 4 W5
SURF. ELEV. 2155 Feet(657.0m)
TOTAL DEPTH 644 Feet(196.3m)

ALBERTA RESEARCH
TH 37 - 77
NE 20 - 58 - 3 W5
SURF. ELEV. 2152 Feet(656.1m)
TOTAL DEPTH 484 Feet(147.6m)

ALBERTA RESEARCH
TH 30 -77
NE 21 - 57 - 3 W5
SURF. ELEV. 2305 Feet(702.7m)
TOTAL DEPTH 744 Feet(226.8m)

ALBERTA RESEARCH
TH 28 - 77
NE 17 - 57 -2 W5
SURF. ELEV. 2240 Feet(682.9m)
TOTAL DEPTH 664 Feet(202.4m)

ALBERTA RESEARCH
TH 26 -77
NE 22 - 56 - 2 W5
SURF. ELEV. 2355 Feet(718.0m)
TOTAL DEPTH 764 Feet(232.9m)

ALBERTA RESEARCH
TH 25-77
NE 21 - 56 - 1 W5
SURF ELEV. 2350 Feet(716.5m)
TOTAL DEPTH 644 Feet(196.9m)

GAMMA RAY API UNITS 0 40 80
DENSITY GRAMS/CC 10 15 20 25 30
RESISTANCE OHMS 0 100

WAPITI FM

WEAVER ZONE

CLOVER BAR ZONE

Gravel
Drift
Sandstone
Siltstone
Shale
Shale, carbonaceous
Concretionary bed (hard ledge)
Coal

8 Coal drill cuttings sample

Cored interval

Top of bedrock

Formation boundary

Coal seam correlation (definite, uncertain)

Coal zone and/or coal-bearing interval

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SCALE 1:250,000
Miles 5 0 5 10 15 20 Miles
Kilometres 5 0 5 10 15 20 25 30 Kilometres

SIMPLIFIED STRUCTURAL CROSS SECTION (E-G)

ELEVATION ABOVE SEA LEVEL
METRES FEET
2400 700 2200 600 2000 1800 500 1600 1400 400 1200

QUATERNARY

UPPER CRETACEOUS

E 42-77 39-77 36-77 38-77 37-77 30-77 28-77 26-77 F 25-77 20-77 103-75 76-77 G 7-75

WEAVER ZN.

WAPITI FM

CLOVER BAR ZN.

5 0 5 10 15 20 MILES
5 0 5 10 15 20 25 30 KILOMETRES

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ALBERTA RESEARCH
TH 25 - 77
NE 21 - 56 - 1 W5
SURF. ELEV. 2350 Feet (716.5m)
TOTAL DEPTH 644 Feet (196.3m)

ALBERTA RESEARCH
TH 20-77
NE 21 55-27 W4
SURF. ELEV. 2280 Feet (695.1m)
TOTAL DEPTH 741 Feet (225.9m)

ALBERTA RESEARCH
TH 103 - 75
NE 20 - 55 - 26 W4
K.B. ELEV. 2282 Feet (695.7m)
TOTAL DEPTH 412 Feet (125.6m)

ALBERTA RESEARCH
TH 76 - 77
14 - 22 - 54 - 26 W4
SURF. ELEV. 2212 Feet (674.4m)
TOTAL DEPTH 645 Feet (196.6m)

ALBERTA RESEARCH
TH 7 - 75
8 - 22 - 54-25 W4
K.B. ELEV. 2257 Feet (688.1m)
TOTAL DEPTH 898 Feet (273.8m)

ELEVATION ABOVE SEA LEVEL
METRES FEET

QUATERNARY

CRETACEOUS

UPPER

WEAVER ZONE

WAPITI FM

CLOVER BAR ZONE

GAMMA RAY API UNITS
DENSITY GRAMS/CC
RESISTANCE OHMS
SPONTANEOUS POTENTIAL Millivolts
GAMMA RAY & CALIPER API UNITS
HOLE SIZE-INCHES
BULK DENSITY GRAMS/CC CORRECTION
CONDUCTIVITY Millimhos/m
INDUCTION CONDUCTIVITY 40" SPACING
RESISTIVITY Ohms m²/m 16" NORMAL
INDUCTION RESISTIVITY 46" SPACING

SCALE 1:250,000

Miles / Kilometres

FIGURE 9

STRUCTURAL CROSS SECTION F-G

Coal drill cuttings sample

Cored interval

SIMPLIFIED STRUCTURAL CROSS SECTION (E-G)

E — 42-77 — 39-77 — 36-77 — 38-77 — 37-77 — 30-77 — 28-77 — 26-77 — 25-77 — F — 20-77 — 103-75 — 76-77 — 7-75 — G

WEAVER ZN.
WAPITI FM
CLOVER BAR ZN.

MILES / KILOMETRES

Gravel
Drift
Sandstone
Siltstone
Shale
Shale, carbonaceous
Concretionary bed (hard ledge)
Coal

Top of bedrock
Formation boundary
Coal seam correlation (definite, uncertain)
Coal zone and/or coal-bearing interval

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FIGURE 10
BEST COAL DEVELOPMENT MAP

AREA OF McKAY COAL SEAM
5 FEET (1.5m) OR GREATER IN THICKNESS.

AREA OF CLOVER BAR COAL SEAM
5 FEET (1.5m) OR GREATER IN THICKNESS'

AREA OF WEAVER COAL SEAM
5 FEET (1.5m) OR GREATER IN THICKNESS'

AREA OF COAL SEAM ABOVE WEAVER ZONE
5 FEET (1.5m) OR GREATER IN THICKNESS'

(1.8) / (172.0) 6 / 564 ← THICKNESS OF THICKEST COAL SEAM IN FEET (m). / DEPTH TO COAL SEAM IN FEET (m).

■ 76 1974 Test Hole
• 24 1977 Test Hole ▲ 7 1975 Test Hole • 4C Core Hole
(—·—) Formation Boundary (Approx.)

SCALE
5 0 5 10 15 20 MILES
5 0 5 10 15 20 25 30 KILOMETRES

To accompany Alberta Research Council Report
by M. Chu

Alberta RESEARCH COUNCIL

LEGEND

TERTIARY AND CRETACEOUS
TKp Paskapoo Formation

CRETACEOUS
Kwt Wapiti Formation
Kbp Bearpaw Formation
Klp Lea Park Formation

R14 R13 R12 R11 R10 R9 R8 R7 R6 R5 R4 R3 R2 R1 R27 R26 R25 R24 R23 R22 R21 R20 R19 R18 R17 R16 R15

Tp 69 Tp 68 Tp 67 Tp 66 Tp 65 Tp 64 Tp 63 Tp 62 Tp 61 Tp 60 Tp 59 Tp 58 Tp 57 Tp 56 Tp 55 Tp 54 Tp 53 Tp 52 Tp 51 Tp 50 Tp 49 Tp 48 Tp 47

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TH	THICKNESS/DEPTH feet	metres
20-77	6.5/399	2.0/121.6
	3.5/525	1.1/160.0
21-77	3/577	0.9/175.9
23-77	3/160	0.9/48.8
	6/564	1.8/171.9
24-77	3/591	0.9/180.1
25-77	3.5/548	1.1/167.0
26-77	9/301	2.7/91.7
27-77	3/253	0.9/77.1
	7.5/364	2.3/110.9
28-77	3/154	0.9/46.9
29-77	3/197	0.9/60.0
	3/292	0.9/89.0
30-77	6.5/101	2.0/30.8
	4/282	1.2/86.0
32-77	3.5/345	1.1/105.2
35-77	3/317	0.9/96.6
36-77	7/415	2.1/126.5
37-77	12.5/274	3.8/83.5
39-77	7/484	2.1/147.5
41-77	3/247	0.9/75.3

TH	THICKNESS/DEPTH feet	metres
46-77	5/674	1.5/205.4
47-77	5.5/171	1.7/52.1
49-77	3/297	0.9/90.5
	3/671	0.9/204.5
52-77	3/463	0.9/141.1
54-77	3/523	0.9/159.4
57-77	3/447	0.9/136.2
60-77	4/554	1.2/168.9
64-77	3/149	0.9/45.4
65-77	3/402	0.9/122.5
	3/463	0.9/141.1
	3/482	0.9/146.9
68-77	3/156	0.9/47.5
72-77	3/569	0.9/173.4
73-77	3/481	0.9/146.6
76-77	3/316	0.9/96.3
	3/445	0.9/135.6
77-77	3/571	0.9/174.0
79-77	3.5/562	1.1/171.3
	4.5/571	1.4/174.0
80-77	5.5/592	1.7/180.4
82-77	3/364	0.9/110.9
	3/390	0.9/118.9

FIGURE 11

AGGREGATE THICKNESS OF COAL SEAMS

Aggregate Coal Thickness 5 Feet (1.5m) or Greater.

2 8 (2.4) — Number of Seams 3 Feet (0.9m) Thick or Greater; Aggregate Thickness of Seams in Feet (m).

■76 1974 Test Hole

•24 1977 Test Hole ▲7 1975 Test Hole •4C Core Hole

Formation Boundary (Approx.)

SCALE 5 0 5 10 15 20 MILES; 5 0 5 10 15 20 25 30 KILOMETRES

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