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Regional Evaluation of the Coalbed Methane Potential of the Foothills/Mountains of Alberta (Second Edition)

Alberta Energy and Utilities Board
Alberta Geological Survey

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Alberta Geological Survey

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Abstract

Coal is present in the Alberta Foothills/Mountains in five zones: the Kootenay, Gething, Gates, Brazeau and Coalspur coal zones. For coalbed methane (CBM) evaluation purposes, they can be divided into shallow (less than 1000 m depth) and deep (greater than 1000 m depth) coal zones. The potential gas content of all shallow coal zones totals about **878 x 10^9 m^3** (**31 Tcf**)[1] of CBM, which is considered an inferred, initial, in-place, coalbed methane resource estimate based on limited data. The limited amount of data on formation testing and measured gas content indicate that the inferred resource is bordering on the speculative category.

The gas content of all deep coal zones (deeper than 1000 m) totals **2.8 x 10^{12} m^3** (about **99 Tcf**) of in-place coalbed methane gas. Consequently, the total ultimate coalbed methane resource could be **3.7 x 10^{12} m^3** (**130 Tcf**). However, coalbed methane recovery from deep coals is generally not attempted because of the high cost of drilling and the low permeability that results from high overburden load and stress.

The only (limited) Foothills coalbed methane production has been from the southern Alberta Kootenay Coal Zone, which is very prospective for coalbed methane production. The shallow Gates Coal Zone in the central and northern Foothills is also prospective, but needs to be better tested. The best potential for coalbed methane in the Coalspur Coal Zone is in the Edson area (Entrance Syncline and Triangle Zone). The Kootenay and Gates coal zones are not well defined in the northern part of the Calgary (NTS 82O) map area. More work is warranted in this area to define these coal zones properly.

It is recommended that 1:50 000 scale geological maps be updated and additional cross-sections displaying coal zones be constructed.

[1] All results are reported in standard SI units. Because the petroleum industry still uses Imperial units, results are also given, in parentheses after the standard results, as: mcf, thousand cubic feet; mmcf, million cubic feet; Tcf, trillion cubic feet; and mD, millidarcies

1 Introduction

Conventional gas reserves in Alberta are predicted to decline in the next decade. The Alberta Government and the oil industry are, therefore, showing a renewed interest in exploring coalbed methane. Coalbed methane was neglected in the past in Alberta because it is cheaper to produce conventional gas. With the forecasted decline in gas reserves and increased demand and prices, however, industry's interest in Alberta's CBM potential is rising (Dawson et al., 2000). In addition, the government has an interest in more accurately estimating Alberta's potential and recoverable reserves to assist in development of its economic and fiscal policy.

A preliminary regional evaluation of the CBM potential of Alberta Foothills/Mountains coal zones was published as EUB/AGS Earth Sciences Report 2001-19 (Langenberg et al., 2001). The present report updates the CBM potential of these coals, based on improved map representation, rank determinations and additional cross-sections. A best estimate of their total gas content is given, based on these data. The gas content and related data are presented by dividing the area into nine map areas (Figure 1). Recommendations are given on how to obtain more reliable resource numbers.

2 Geology of Foothills/Mountains Coal Zones

The various coal zones of the Alberta Foothills/Mountains are shown in Figure 2 and are briefly discussed here, from oldest to youngest.

2.1 Kootenay Coal Zone

Alberta's oldest coal-bearing strata belong to the Kootenay Group, found in the southern Rocky Mountains and Foothills. The northern boundary of the Kootenay Group roughly follows latitude 52°N, which is the northern boundary of the Calgary map area (NTS 82O; Figure 1). The Kootenay Coal Zone has been described extensively by Gibson (1985). Macdonald et al. (1989) described some coal-quality aspects of the Kootenay.

The Kootenay Coal Zone forms part of the Mist Mountain Formation of the Kootenay Group. The Mist Mountain Formation thins from west to east to a zero erosional edge along the eastern margin of the Foothills (Gibson, 1985). Near the Clearwater and Red Deer rivers, this formation is no longer coal bearing and grades into the Nikanassin Formation. In this transition area, the Mist Mountain Formation (and Luscar and Kootenay groups) are not well defined, and more geological work on outcrop and well sections is needed to place the coal resources of this area in a proper stratigraphic framework. This will be important for the leasing of CBM resources because gas leases are issued based on stratigraphic position. Depending on where the Cadomin (or Dalhousie) is placed, coal seams might not always be placed in the proper coal zone. These sandstone and conglomerate units are not always easy to pick, and biostratigraphic analysis might be needed.

The Mist Mountain is composed of a thick, interstratified sequence of predominantly nonmarine siltstone, sandstone, shale and coal seams. The coal seams are thickest and most numerous in the western part of the region. Up to 12.6 m of cumulative coal was encountered in a well in the Pincher Creek area; this is typical of the thickness that can be expected in the western part of the region.

The coal-bearing lower Mist Mountain Formation was deposited in a coastal plain setting and passes transitionally up-section into an alluvial plain setting, represented by the upper Mist Mountain Formation (Gibson, 1985). Some of the peat swamps, therefore, developed in some kind of marine

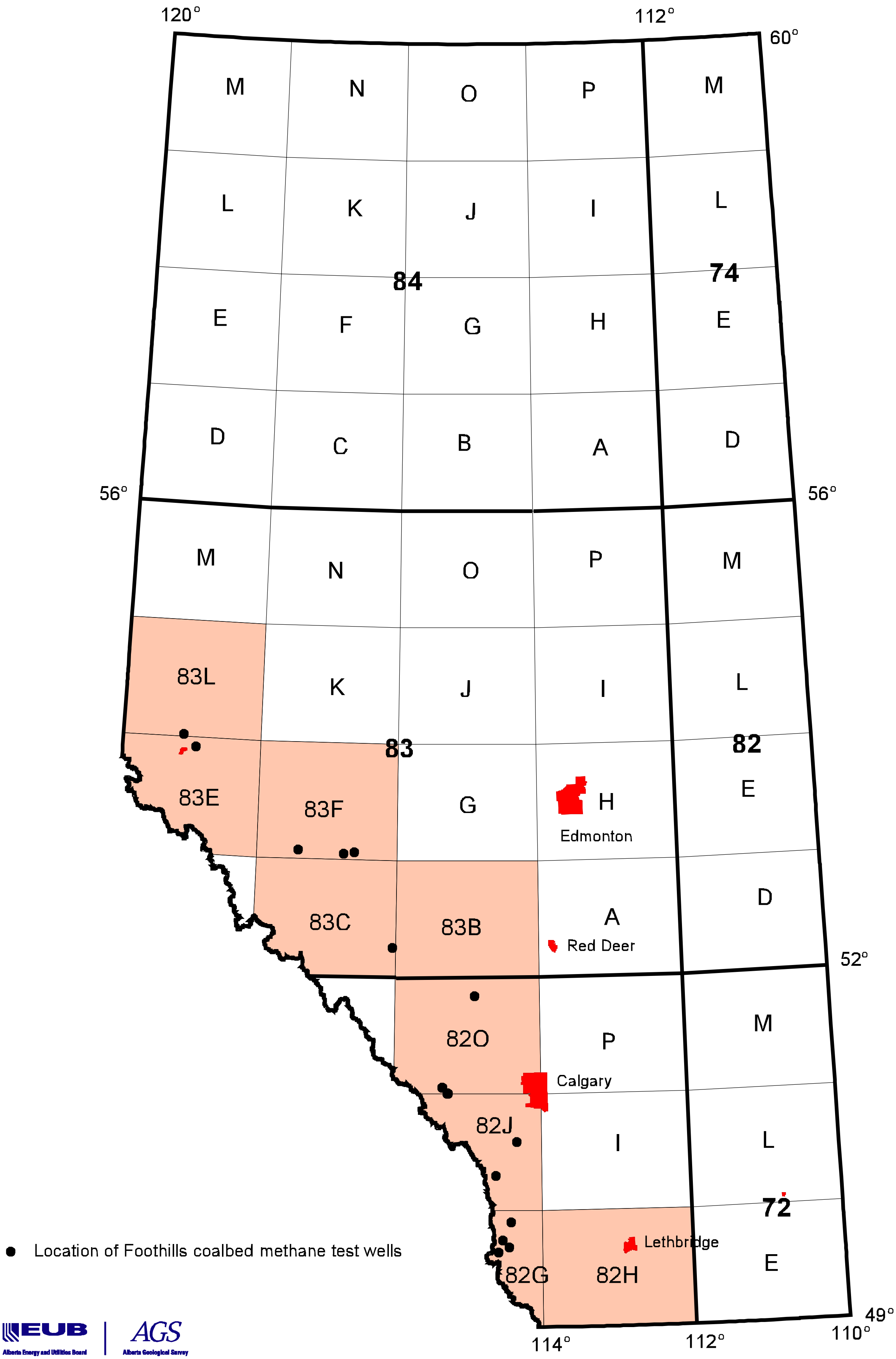


Figure 1. Location of NTS map areas and coalbed methane test wells.

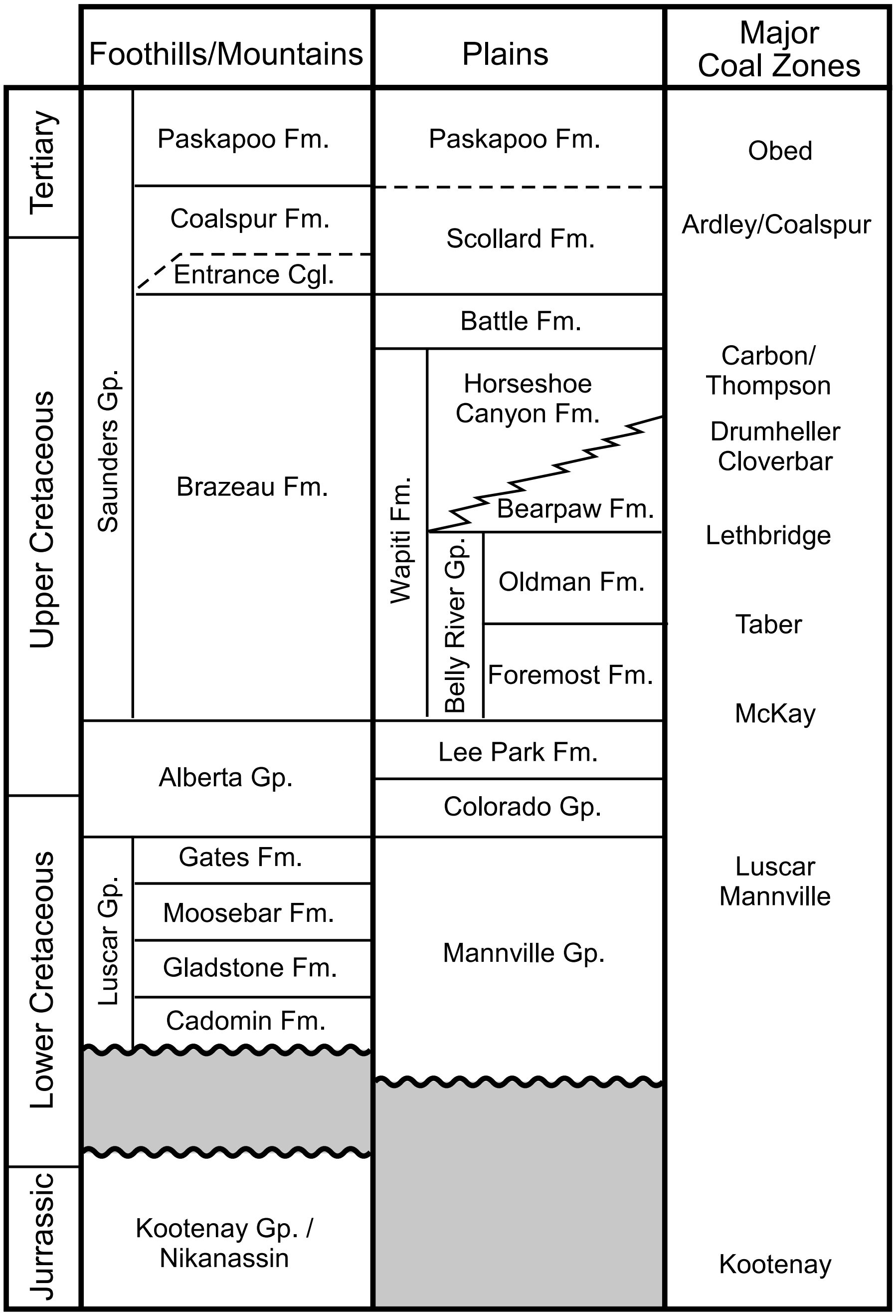


Figure 2. Coal-bearing rock units and coal zones in Alberta.

coastal environment.

2.2 Gething Coal Zone

The Gething Formation (type section along the Peace River) is mainly restricted to British Columbia, but extends into the northern Alberta Foothills and northern Interior Plains of the Wapiti area (NTS 83L; Figure 1). South of the Kakwa River, this stratigraphic interval has only minor coal seams, and the interval is called the Gladstone Formation. Coals of the Gething Formation have been described by Kalkreuth (1982) and Kalkreuth and McMechan (1984, 1988, 1996).

2.3 Gates Coal Zone

The Gates Formation of the central and northern Foothills (equivalent to the Spirit River Formation of the Interior Plains region) is an important coal-bearing unit. South of the Clearwater River (at latitude 52°N; Figure 1), it grades into the non–coal-bearing Blairmore Group. In this transition area, the Gates Formation (and Blairmore, Luscar and Kootenay groups) are not well defined, and more geological work on outcrop and well sections is needed to place the coal resources of this area in a proper stratigraphic framework.

The quality of Gates coal was discussed by Macdonald et al. (1989). The Gates Formation is the main source for Alberta's metallurgical export coal. The equivalent Spirit River Formation is important as a gas reservoir in the Deep Basin. Various data on Gates coal are presented by Kalkreuth and McMechan (1984, 1988, 1996) and Dawson and Kalkreuth (1994a, b).

The Gates Formation forms part of the Luscar Group of the central and northern Foothills of western Alberta. Outcrop of the Luscar Group is largely confined to the Inner Foothills, which consist largely of folded and faulted Lower Cretaceous rocks and are topographically higher than the Outer Foothills. The Luscar Group is at depth in the Outer Foothills and in the Interior Plains.

The largely nonmarine Gates Formation can be divided into three members, in ascending order: the Torrens, Grande Cache and Mountain Park members (Langenberg and McMechan, 1985). The age of the Gates Formation ranges from Early to Middle Albian. The basal Torrens Member, which is thin (about 30 m) compared with the other members, consists of sandstone deposited in a shoreface environment. The Grande Cache Member is characterized by coastal plain sandstone, shale and major economic coal seams. It grades into the Mountain Park Member, which consists of fluvial, fining-upward sandstone, shale and minor coal seams.

Macdonald et al. (1988) have shown several transgressive-regressive cycles in an overall prograding shoreline sequence for the Moosebar to Gates transition. Four marine cycles are recognized in outcrop in the Cadomin area, the lower three associated with possible wave-dominated prograding deltas and strandlines, the upper one having a more brackish (lagoonal, tidal channels, etc.) association.

Sedimentological examination of the lower three cycles in the Cadomin area shows a progression of offshore to shoreface to foreshore environments (strand plains), culminating in the deposition of peat units, such as the one found in the Jewel seam. The marine strata of the Moosebar-Gates transition at Cadomin are likely correlative with the more regional Wilrich and Falher cycles. These marine strata are divided into the first, second and third regional cycles, forming a series of prograding shorelines, coastal plain deposits and possibly tidal deposits. Seaward stepping of coastal shoreline sediments was the most common stratigraphic architectural style.

Sedimentary structures in sandstone of the Torrens Member at the base of the Gates Formation indicate shallow marine conditions. Peat swamps likely developed, initially, some distance landward on this coastal plain and eventually prograding northward with the shoreline. Subsequent marine transgressive periods reached as far south as Grande Cache. One of these reached the Cadomin area, as indicated by marine microfossils above the lower coal seams (Macdonald et al., 1988). Most of the coals of the lower Gates Formation are coastal plain coals. Coals higher in the succession were deposited on alluvial plains (Kalkreuth and Leckie, 1989).

2.4 Brazeau–St. Mary River Coal Zone

The Brazeau Formation of the central Alberta Foothills contains coals that are equivalent to those from the Belly River and Horseshoe Canyon formations. Jerzykiewicz (1985) redefined the usage of the term Brazeau for this specific stratigraphic interval.

The upper Brazeau Coal Zone is roughly equivalent to the Carbon-Thompson Coal Zone (Figure 2). The St. Mary River Coal Zone, which is stratigraphically below the Carbon-Thompson Coal Zone, could be recognized in southern Alberta south of latitude 51°N (Figure 1) and is equivalent to the Drumheller Coal Zone.

2.5 Coalspur Coal Zone

The Coalspur Formation of the central and northern Foothills (Jerzykiewicz, 1997) contains a 600 m thick continental succession of interbedded sandstone, mudstone and thick economic coal seams. The base of the Coalspur Formation is the so-called Entrance Conglomerate. Thick coal seams, interbedded with coaly shale and numerous bentonite layers, occur in the upper part of the formation. This interval is known as the Coalspur Coal Zone. The Val d'Or coal seam is at the top of the interval and the Mynheer coal seam is at the bottom. These seams (plus other coal seams) are recognizable throughout the area between Hinton and Coal Valley and can also be recognized extending into the Ardley Coal Zone of the Interior Plains (Dawson et al., 2000). The Cretaceous-Tertiary boundary is at the base of the Mynheer coal seam. The Coalspur Formation represents a nonmarine, fluvially dominated environment of deposition.

The Coalspur Coal Zone of the Coalspur Formation in the Foothills is equivalent to the Ardley Coal Zone of the Scollard Formation in the Interior Plains. Some aspects of this coal zone have been discussed in Macdonald et al. (1989). The Coalspur Coal Zone is between 200 and 300 m thick, with many different coal seams. Its cumulative thickness ranges up to 26 m; in places, it is more than 50 m thick due to tectonic thickening. The Coalspur Formation (and Coalspur Coal Zone) represents a sedimentary environment similar to that of the Ardley Coal Zone.

South of Calgary, the Coalspur Formation grades into the Willow Creek Formation, which is the non–coal-bearing equivalent of the Coalspur (and Scollard) Formation.

3 Methodology

Estimates of coal area (area underlain by a particular coal zone) and the thickness of coal beds allow a calculation of coal volume. Coal volume and gas content (based on coal rank) provide the means for calculating possible CBM gas volume, which is a possible, initial, in-place volume in EUB terminology (Alberta Energy and Utilities Board, 2001).

3.1 Coal Areas

Coal areas were defined for nine 1:250 000 scale map areas in the Foothills/Mountains (Figure 1). Three of these map areas are available as Geological Survey of Canada (GSC) geological map compilations: Wapiti (NTS 83L; McMechan and Dawson, 1995), Mt. Robson (NTS 83E; Mountjoy, 1978) and Calgary (NTS 82O; Ollerenshaw, 1978). For the other six map areas, the geology from in-house map compilations (Holter and McLaws, 1974) was used. On these maps, coal areas were defined based on the geological formations present in the subsurface. The present report uses ArcInfo® GIS format versions of these compilations to estimate the areal extent of the coal zones, based on stratigraphic map units. A previous report (Langenberg et al., 2001) used the geology from the *Geological Map of Alberta* (Hamilton et al., 1999), which is based on the in-house compilation, for this purpose. The present calculations are based on a more accurate map representation of stratigraphic units. The coal zones are subdivisions of presently mapped stratigraphic units. Future work will have to refine the surface (and subsurface) mapping of the coal zones.

The subsurface is known from seven regional structural cross-sections through the Foothills/Mountains, published in Rottenfusser et al. (1991). Six additional cross-sections were produced for this report (*see* enclosed cross-sections). These cross-sections are, from north to south, the Copton Creek, Moberly Creek, Hinton, Brazeau River, Nordegg and Red Deer River sections.

The coal-bearing Coalspur Formation was not mapped separately from the Brazeau and Paskapoo formations in the 1972 compilation. For that reason, the geology from the *Geological Map of Alberta* (Hamilton et al., 1999) was transferred to the 1:250 000 scale map areas. Coal areas were defined based on these map compilations, in the manner described below.

All areas where Triassic and older rocks outcrop were excluded as coal areas because no coal older than Jurassic is known in Alberta. Some younger coal is, in places, overlain by Triassic and older rocks as a result of faulting (e.g., the Lewis and McConnell thrust blocks), but these occurrences are generally situated beneath high mountain ranges, which would prevent drilling for CBM.

The area of a coal zone was defined as that area where the coal zone is exposed, together with all younger rocks. A certain percentage of the area must be excluded because the coal will be within 200 m of the surface and will be degassed to varying degrees. Some of the map compilations include Triassic and Jurassic rocks with the Lower Cretaceous coal-bearing rocks, so it was necessary to estimate, from the cross-sections, what percentage should be excluded.

Deformation involving folding and faulting must be taken into consideration in the resource calculations. Shortening by deformation results in a larger coal volume per unit area. Shortening in the Foothills/Mountains ranges from 10% to 50%. This implies that the area needs to be multiplied by a factor ranging from 1.11 to 2. Based on these considerations, an area correction factor ranging from 0.5 to 1.5 was used. This correction factor is somewhat arbitrary because it is based on the judgement and experience of the geologist. For example, the shortening can be measured from the cross-sections, but will vary considerably over a given area. More cross-sections will have to be obtained to get a better estimate of the shortening. More cross-sections and more well data will result in better resource estimates, although it must be realized that reliable regional resource estimates will be extremely hard to obtain in these types of deformed rocks. In addition, the coal zones are only mapped as separate units in a few areas. More surface mapping of the coal zones (combined with subsurface data from wells) is needed to define the coal areas more accurately.

From the cross-sections, shallow (roughly 200–2500 m depth) and deep (greater than 2500 m depth) coal zones can be distinguished. The 2500 m cut off was used because this enables a subdivision based on the outcrop maps, whereby the Gates and Kootenay coal from the Outer Foothills (which are deeper than 2500 m) can be distinguished from those in the Inner Foothills/Mountains (which are between surface and 2500 m). Coal zones between 200 and 1000 m in depth are optimal for CBM exploitation. In order to obtain a 1000 m cut off, an estimate of the percentage of the coal resources with depth less than 1000 m was obtained by applying a correction factor. The recalculated resources will be approximately 30% of the resources calculated for the 2500 m cutoff for most of the areas. This correction factor was estimated from the cross-sections for the various coal zones in the nine map areas.

The thickness of the coal in the various coal zones was estimated from the coal picks in the wells presented by Rottenfusser et al. (1991; *see* Appendix 1 and figure 3), together with the new picks obtained from the various wells examined during the 2000–2002 phase of work (Appendix 2 and Figure 3). Because of the deformation, the measured thickness along the well bore may not represent the true thickness. However, because the bedding plane dips are generally less than 30° in the areas of interest (*see* enclosed cross-sections), the thickness is, at most, 15% overestimated. This inaccuracy is minor compared to the inaccuracies in the estimation of an average thickness of coal in the various coal zones. For these reasons, resource numbers for the Outer Foothills will be more accurate than those for the Inner Foothills.

The volume of the coal in the various coal zones was calculated based on areal extent of the coal zone and the average thickness of the coal in the particular coal zone.

3.2 Cross-Sections

Data for the construction of the cross-sections were collected from various sources. Geological contacts and bedding orientations from geological maps are available digitally for various areas and were provided to the Alberta Geological Survey by Gaia Software Inc. in GaiaBASE® format. Dipmeter data, deviation surveys and geological tops came from the EUB and were entered into a GaiaBASE® database.

Surface bedding orientations, geological contacts, wells, dipmeter data and well tops were projected into the cross-sections using GaiaBASE®. Projection directions were chosen individually for different wells, surface domains and data types. Section FF′ is based on a cross-section published by LeDrew (1997) and section GG′ is based on a cross-section by MacKay (unpublished data). Tracings of seismic lines were obtained from a variety of petroleum and geophysical companies. Section AA′ was manually line-length balanced. Sections BB′, CC′, DD′ and EE′′′ were constructed using 2DMove® software from Midland Valley Exploration Ltd., after importing GaiaBASE® output into 2DMove®. Digital drawings were obtained from scanned line drawings of migrated versions of the seismic lines. These drawings were then depth-converted in 2DMove®, using interval velocities obtained from nearby well logs. Depth-converted horizons generally matched stratigraphic tops and could be used with only minor adjustments.

The section was then adjusted and completed to match well and surface geology information. The section was constructed in the 2DMove® environment using a model of flexural slip folding, maintaining bed length during deformation and allowing for upward decrease in fault displacements (line-length balancing).

3.3 Vitrinite Reflectance Data and Rank

To assess the coalbed methane potential of Alberta's coal-bearing rocks, it is necessary to determine the rank of the coals in the various coal zones. Large amounts of methane are generated during the coalification process (transformation of peat to coal). The degree of progressive transformation of peat is

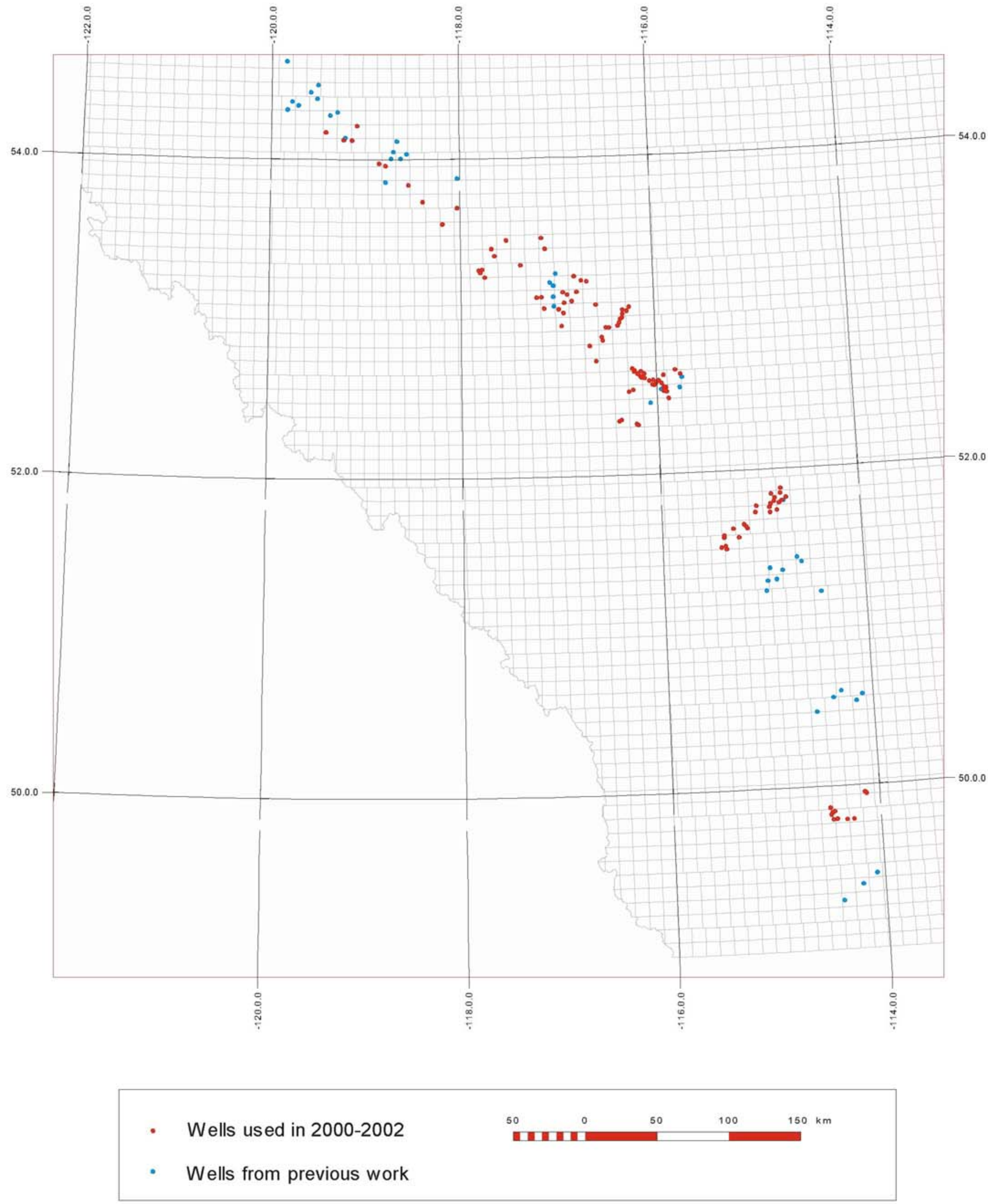


Figure 3. Location of wells used in this report.

defined as the rank of coal, which is expressed in the natural series from lignite to anthracite. The rank classes can be determined by measuring the reflectance of the maceral called vitrinite. A good correlation between rank determined from vitrinite reflectance and rank determined according to standard chemical methods (ASTM standard D-388) is generally accepted (Bustin et al., 1985). Chemical methods use fixed carbon contents (dry, mineral matter free) for higher ranks and calorific value (moist, mineral matter free) for lower rank coals. The vitrinite reflectance rank parameter has the advantage that it can be used on small samples, such as cuttings from oil and gas wells. In addition, it can be used over the entire range of coalification. For this reason, vitrinite reflectance has been used as the rank and maturity parameter (and, therefore, the coalbed methane potential indicator) for this study.

Pellets were made of coal particles collected from oil and gas well cuttings stored at the EUB Core Research Facility in Calgary. In addition, 13 samples from outcrops of St. Mary River Formation coal were collected during the summer of 2001 and prepared for analysis. These samples were ground and polished, and the vitrinite reflectance was measured according to standard procedures (ASTM standard D 2798-79). Vitrinite reflectance can be measured as mean random vitrinite reflectance (using nonpolarized light and calculating the mean of about 50 measurements), or as mean maximum vitrinite reflectance (using polarized light, rotating the microscope stage, measuring the maximum reflectance of about 50 individual vitrinite grains, and calculating the mean). The mean random measurements are easier and quicker. However, the mean maximum method is preferred by many petrographers for higher rank coals because the standard deviation is smaller and different populations (if they are present) are easier to differentiate. For the present study, average maximum vitrinite reflectance in oil was determined for the samples of the various coal zones. Many of these reflectance values are plotted on the enclosed cross-sections (see Enclosures 1–7).

Results of the determination of vitrinite reflectance at the laboratory of Fossil Fuels International are listed in Appendix 3.

3.4 Gas Content

Total gas-in-place (GIP) equals the product of coal tonnage and gas content per unit weight of coal. Because density is expressed in g/cm^3 and gas content in cm^3/g, the formula for the GIP calculation can be simplified. For each coal type, the density and gas content are considered constant and the GIP estimate, therefore, reduces to the product of coal volume and a constant. The constant is different for each type of coal and is calculated as the product of the density (in g/cm^3) and the gas content (in cm^3/g, on a dry, ash-free basis). For example, for a coal with density of 1.4 g/cm^3 and gas content of 10 cm^3/g, this constant is 14.

Consequently, the formula used is:

GIP (gas-in-place) = constant x coal volume
where the constant = density (in g/cm^3) x gas content (in cm^3/g)
and coal volume is generally in cubic metres (m^3)

Density is estimated from bulk density logs. The density logs from Foothills wells show that the density of good coal varies between 1.3 and 1.6 g/cm^3, so a good conservative estimate of density for all Foothills coal is 1.4 g/cm^3.

Gas content per unit weight can be estimated from coal rank data and depth, based on measured gas content from United States coal (Eddy et al., 1982). Most resource studies relate gas content to rank and depth (Scott et al., 1995); however, factors other than coal rank and pressure can influence gas sorption capacity (Levine, 1993). For this reason, the validity of the numbers was evaluated against measured gas content of desorbed core (*see* next section). From the previous work (Table 1), a conservative typical gas content of 10 cm^3/g for medium-volatile bituminous and higher rank coals, and 5 cm^3/g for high-volatile bituminous coal, can be assumed (*see also* Langenberg et al., 1997). Gas resources are estimated for each coal zone based on these data. It is important to realize that these are conservative values, which are based on the measured gas-content data of Table 1.

The values used for the curves presented by Eddy et al. (1982; *see* Figure 4) are unrealistic because the actual measured gas content in Alberta is lower than those of equivalent coals from the United States (Dawson et al., 2000). The gas content of the shallow coal zones (depth less than 1000 m) can be considered an inferred, initial, in-place resource estimate. The gas content obtained by the inclusion of the deep coal zones could be considered an ultimate resource.

It should be noted that the producibility of this gas is completely unknown. The few production tests on these coals indicate low permeability, possibly resulting from the pervasive shearing observed in many places. For this reason, reserves of Foothills CBM must still be considered zero.

4 Previous Coalbed Methane Exploration in the Alberta Foothills/Mountains

There have been only a few coalbed methane well sites with desorption and formation testing in the Foothills/Mountains area (Table 1). Relevant data for the present study, taken largely from Dawson et al. (2000), are summarized below.

4.1 Kootenay Group Coal

The Crowsnest Pass coal district in southwestern Alberta contains thick coals belonging to the Mist Mountain Formation (Kootenay Group). Coal rank ranges from high- to low-volatile bituminous, and net coal thickness locally exceeds 20 m. Gas content was estimated to be similar to that of the Elk Valley coalfield in British Columbia, ranging from 16 to 24 cm^3/g.

Four wells were drilled in the Coleman area (NTS 82G), by Canadian Hunter and Algas Resources, to Kootenay Group coals ranging in depth from 265 to 1399 m. Gas content determined by desorption ranged from 7.8 to 12 cm^3/g (ash normalized). This range in gas content is lower than gas volumes calculated using adsorption (Langmuir) isotherms, suggesting that these coals may be undersaturated. Formation tests indicated that coal permeability was low, in the range 9.9 to 19.8 x 10^{-16} m^2 (1 to 2 mD). One well, Algas Coleman, was put on test production and averaged 877 m^3/d (31 mcf/d).

Algas drilled another coalbed methane test well at Sullivan Creek (NTS 82J), west of Longview. This well targeted low-volatile bituminous coal of the Mist Mountain Formation (Kootenay), intersecting 14 m of coal between 121 and 227 m depth. One desorbed gas content was reported (7.8 cm^3/g), and formation testing indicated low reservoir pressures, low flow rates and low permeability.

SaskOil and Mobil drilled a coalbed methane test well close to Turner Valley (NTS 82J), targeting Mist Mountain coal in the depth range 859 to 938 m. Coal rank was determined to be high-volatile bituminous A, which is lower than the low-volatile bituminous rank measured in the Algas Sullivan well. A net coal thickness exceeding 20 m was encountered. Desorbed gas content was determined from cuttings, rather than core, and ranged from 5 to 11 cm^3/g as determined (6 to 14 cm^3/g on an ash-normalized basis).

The Canmore coalfield (NTS 82O) includes high-rank coal of the Mist Mountain Formation (Kootenay

Table 1. Summary of measured gas contents and formation-test data.

Well Identification	Company	Area	Formation	Top of interval (m)	Bottom of interval (m)	Desorption gas content (cc/g) (ash-normalized)	Number of tests	Formation tests
4-18-11-3W5	CanHunter	Coleman	Kootenay	500	525	na	na	1-2 mD
6-14-8-5W5	CanHunter	Coleman	Kootenay	1307	1399	9.87	20	1-2 mD
7-35-8-4W5	CanHunter	Coleman	Kootenay	394	485	7.92	35	1-2 mD
8-19-9-4W5	Algas	Coleman	Kootenay	265	354	12	6	31 mcf/d
10-34-15-5W5	Algas	Sullivan	Kootenay	121	228	7.8	1	1 mcf/d
8-10-19-3W5	Saskoil	Turner Valley	Kootenay	859	940	10.2	6	na
8-01-24-10W5	Algas 1	Canmore	Kootenay	235	288	20	?	19 mcf/d
4-06-24-9W5	Algas 2	Canmore	Kootenay	191	240	10	?	9 mcf/d
2-01-24-10W5	Algas 3	Canmore	Kootenay	304	305	20.8	?	36 mcf/d
9-21-24-10W5	Algas R1	Canmore	Kootenay	55	58	10	4	<10 mcf/d
10-21-24-10W5	Algas R2	Canmore	Kootenay	124	126	16	3	48 mcf/d
6-23-33-7W5	Northridge	Caroline	Gates	3016	3121	na	na	2.2 mcf/d
11-11-38-15W5m	Shell	Ram River	Gates	582	740	7	3	na
6-14-57-7W6	Mobil	Grande Cache	Gates	592	692	13.1	2	0.08 mD
8-21-58-8W6	Mobil/Smoky	Grande Cache	Gates	196	280	2.3	4	na
7-26-47-24W5 (#3046)	Cardinal River	Cadomin	Gates	253.9	260.2	6.6 (arb)	7	na
7-26-47-24W5 (#3072)	Cardinal River	Cadomin	Gates	303.3	413.6	17.7 (arb)	6	na
11-20-47-18W5	Conoco	Coal Valley	Coalspur	656.1	886.5	1.7	21	na
11-20-47-18W5	Conoco	Coal Valley	Brazeau	1114.3	1116.3	0.3	2	na
12-17-47-19W5	Luscar-Sterco	Coal Valley	Coalspur	46.6	300.8	0.05-3.22	30	na
8 minesite holes						(average 1.78)		

na = not available arb = as received basis

Data compiled from: Dawson et al., 2000, Feng and Augsten, 1980, Das et al., 1982

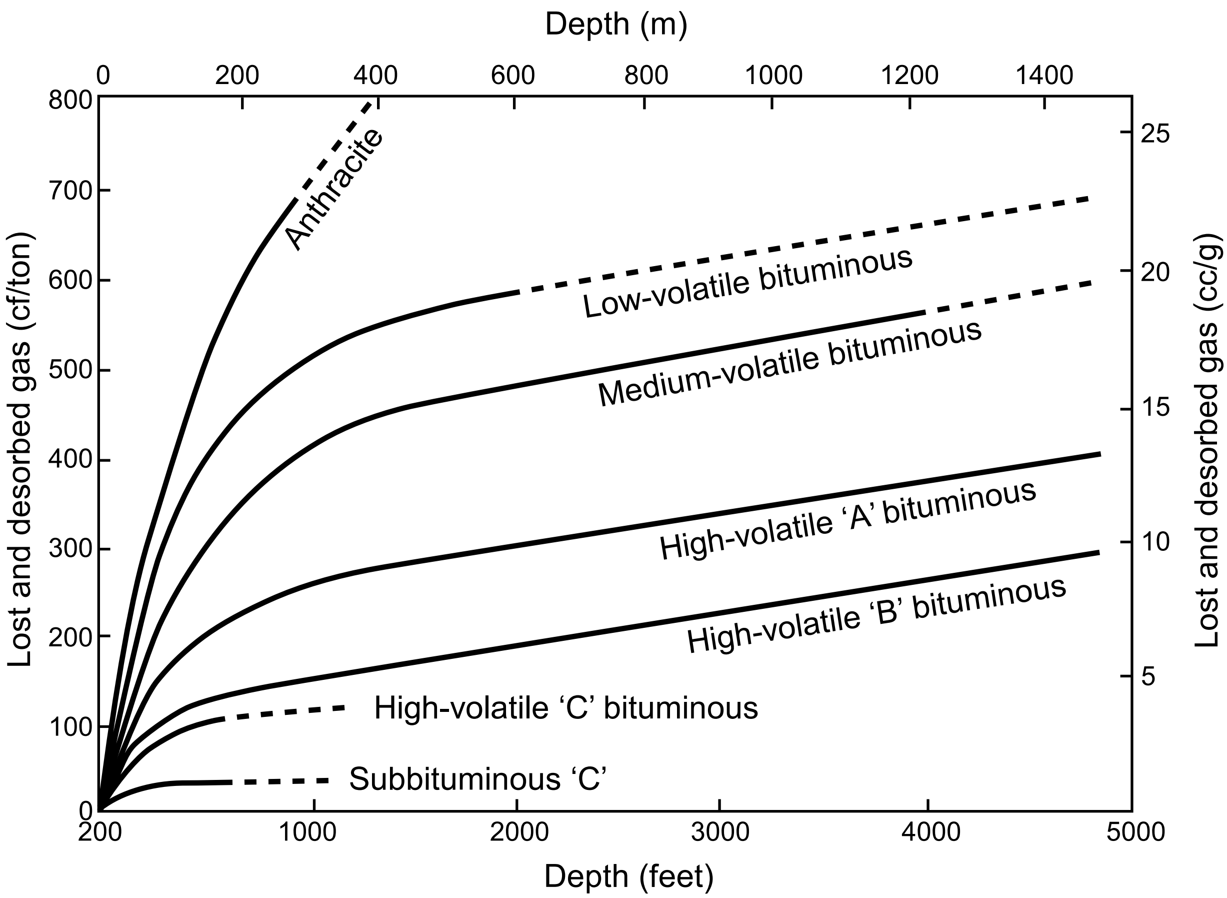


Figure 4. Estimated maximum producible methane content with coal rank and depth (from Eddy et al., 1982).

Group). Net coal thickness exceeds 15 m in this area. Historically, these low-volatile bituminous to semi-anthracite coals were reported to be gassy in underground workings (56 600 m^3/d or 2 mmcf/d of methane were ventilated from the Riverside Mine according to Dawson et al., 2000, p. 79) and have, therefore, been a target of coalbed methane exploration.

Dawson (1995) reported typical theoretical gas capacity (derived from predictions by Eddy et al., 1982) in the range 12 to 15 cm^3/g. Coalbed methane test wells were drilled by Algas in this area and small-scale production was attempted over a three-year period. Desorbed gas content ranged from 4 to 25 cm^3/g (ash-normalized), from stratigraphic depths ranging from 55 to 288 m. Deeper intersections had the greater gas concentrations. Formation testing indicated permeability ranging from 4.9 to 19.8 x 10^{-16} m^2 (0.5 to 2 mD). After stimulation and completion, the gas flow rates ranged from 14 to 1358 m^3/d (0.5 to 48 mcf/d).

4.2 Gates Formation Coal

The Grande Cache Member of the Gates Formation contains several thick seams and can attain a net coal thickness of up to 13 m (although local structural thickening is common). Coal from the Gates Formation in the central Alberta Foothills was investigated by Dawson and Kalkreuth (1994a). Based on an adsorption isotherm from a Nordegg minesite trench (NTS 83C) and the Eddy et al. (1982) curves for varying rank and depth (Figure 4), maximum gas capacity was calculated for the medium- to low-volatile bituminous coals. Gas content ranged from 10.9 to 18.3 cm^3/g for different areas, with depths ranging from 500 to 2400 m. No coal desorption measurements were available at the time of their report to allow comparison of theoretical capacity with actual gas contents.

Northridge Exploration conducted a drillstem test on gas flow from 8.5 m thickness Grande Cache Member coals, intersected at 3052 to 3072 m, while drilling a deeper hydrocarbon target in their Caroline 6-23-33-7W5 well (NTS 82O). A small gas blow of 62.3 m^3/d (2.2 mcf/d) was recorded, but the test was only carried out for 3 hours.

Coal from the Grande Cache Member in the Ram River area was tested by Shell Canada Resources (11-11-38-15W5, 20 km south of Nordegg in NTS 83C). Two cores containing high- to medium-volatile bituminous coal were recovered from depth intervals 697.6 to 706.6 m and 711.8 to 716.2 m. The cores missed the intended 4 m thick target (Jewel seam equivalent), only catching thinner coal horizons. Desorbed gas contents of the sampled coal ranged from 6.11 to 7.93 cm^3/g. Gas capacity calculated from Langmuir isotherms derived from the samples indicated a maximum capacity of 11.4 cm^3/g.

Two desorption tests were reported for the Jewel seam from within the Cardinal River mine area (NTS 83F; Feng and Augsten, 1980). Two core samples from the Gates Formation Jewel seam were desorbed. An average gas content of 6.6 cm^3/g was obtained at a depth of 256 m in borehole 3046, whereas borehole 3072 yielded an average gas content of 17.7 cm^3/g at a depth of 408 m.

Two wells were evaluated for coalbed methane potential in the Grande Cache area. Mobil Oil and Chevron Canada drilled a joint well near Susa Creek (6-14-57-7W6 in NTS 83E), targeting the Grande Cache Member at depths of 600 to 700 m. The intended thick coals were missed and only thinner, deeper Gladstone coals were cored. Sidewall cores were subsequently cut from the Grande Cache coal (the 0.5 m thick No. 3 seam) and one seam in the Gladstone Formation. Gas contents were 16.8 and 9.4 cm^3/g (ash-normalized basis), respectively. Langmuir-isotherm–derived gas capacities were in the 18 cm^3/g range for these medium-volatile coals.

Four drillstem tests were conducted on the No. 4 and No. 10 seams of the Grande Cache Member. Low permeabilities were encountered (7.9 x 10^{-17} m^2 or 0.08 mD), and gas flow rates of 10 m^3/d (0.35 mcf/d) and 145 m^3/d (5.1 mcf/d) were recorded from seam No. 4 and seam No. 10, respectively. The well was stimulated by fracturing the coal, but it is unclear if the gas flow rates obtained from the drillstem tests are from before or after fracturing (Dawson et al., 2000, p. 97).

Mobil Oil also tested a coal-exploration drillhole in collaboration with Smoky River Coal Ltd. near their No. 3 mine, 25 km north of Grande Cache (located in 8-21-58-8W6 in NTS 83L). The interval containing the No. 11 seam of the Grande Cache Member was cored at a depth of 244.7 to 233.5 m. The well did not reach deep enough to penetrate the No. 4 seam, the thickest seam in the area. A net thickness of 8.6 m of medium-volatile bituminous coal averaged only 1.8 to 2.8 cm^3/g gas (ash-normalized). The high ash content of the samples and shallow intersection depths may account for the low gas content, as the ash-normalized adsorption isotherm suggested a much higher gas capacity of 19.1 cm^3/g.

4.3 Coalspur and Brazeau Formation Coal

The Coal Valley area of the Foothills contains significant quantities of coal. The Tertiary Coalspur coals, which are being surface mined, are also present at depths that may make them suitable for coalbed methane production.

Desorption tests were conducted on drillcore samples collected from the Luscar-Sterco mine area at Coal Valley (NTS 83F) as part of an underground mine-feasibility study (Das et al., 1982). High-volatile bituminous coal from the Silkstone and Mynheer seams of the Coalspur Formation were tested. The Silkstone seam consists of two parts, an upper and a lower, separated by a 10 m parting. The upper ‘seam’ ranges in thickness from 2.4 to 5.8 m, whereas the lower ‘seam’ ranges from 0.6 to 1.6 m. The Mynheer seam lies 80 to 90 m below the Silkstone and averages 4 m in thickness. Sample depths ranged from 46 to 301 m, with gas content ranging from 0.05 to 3.22 cm^3/g and averaging 2.6 cm^3/g for the samples at depths greater than 200 m. Gas concentrations were presented on an ‘as received coal’ basis and ash content was not reported. Gas content showed a general increase with increasing depth, the Mynheer seam tending toward slightly greater gas contents than the Silkstone seam.

Conoco Canada evaluated the Val d’Or and Mynheer coal zones of the Coalspur Formation, and the Upper Brazeau Coal Zone in a coalbed methane test well near Coal Valley (NTS 83F). The Val d’Or samples averaged 1.40 cm^3/g at a depth of 656.1 to 662.6 m, with 5.7 m net coal thickness. The Mynheer samples averaged 0.9 cm^3/g at a depth of 879.8 to 886.5 m, with 4.9 m net coal thickness. The underlying Brazeau samples represented a thinner coal interval, with a net coal thickness of 0.59 m. The Brazeau gas content averaged 0.24 cm^3/g at a depth of 1114.3 to 1116.3 m (all on an ‘as received’ basis). All samples were high-volatile bituminous ‘B’ in rank. The gas content is lower than expected for this type of coal at this depth. The reason for this anomaly is not fully understood, although high average ash content of 30% for these Coalspur coals is certainly a contributing factor (Dawson et al., 2000, p.93).

5 Areal Extent and Gas Content of Coal Zones

Areal extent of coal zones for the nine map areas are discussed from north to south. Coal volume and gas content of the various coal zones in these areas are summarized in Tables 2 and 3.

5.1 Map Area NTS 83L (Wapiti)

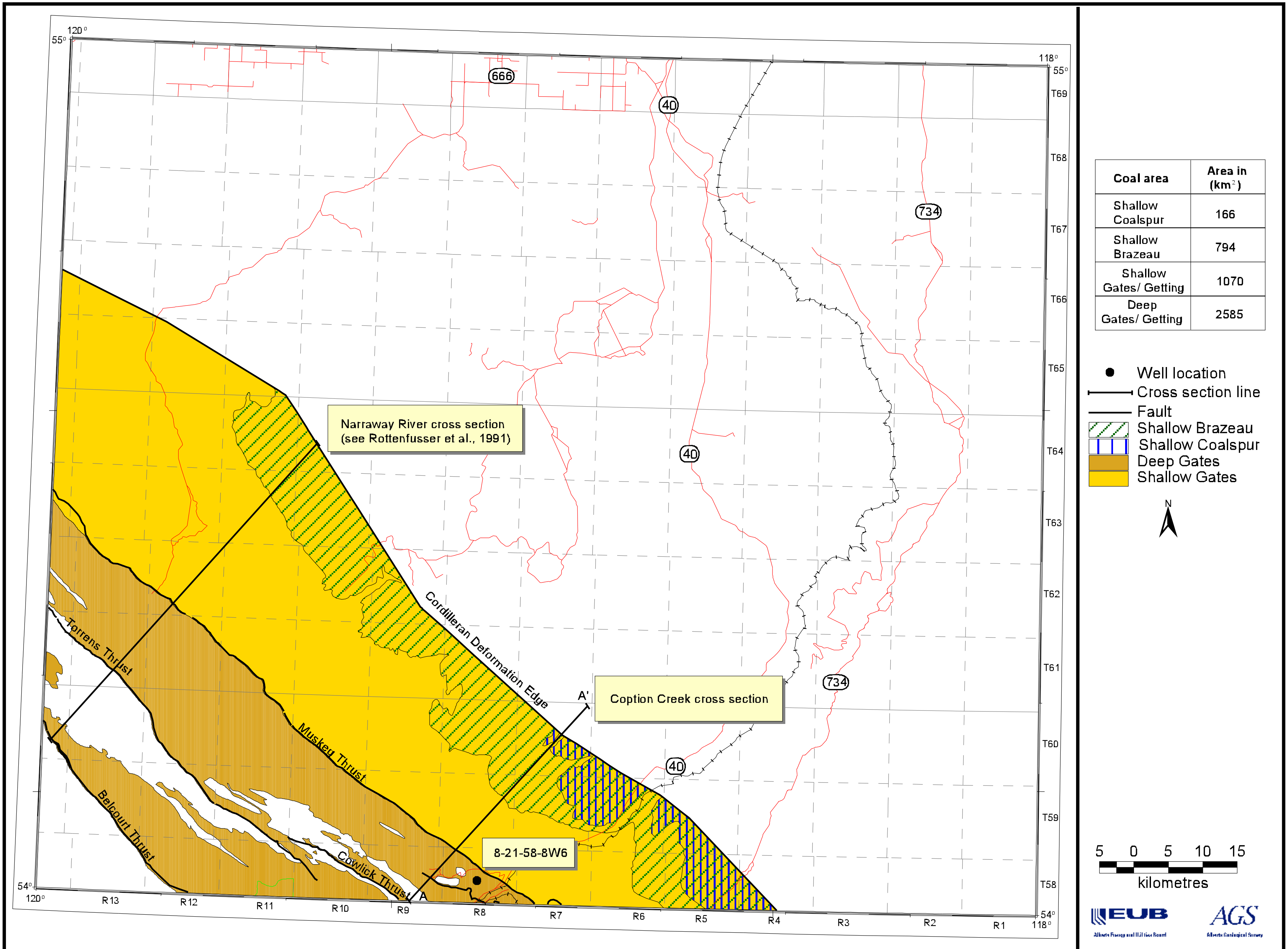
Major coal zones are present in the Brazeau, Gates and Gething formations (Figure 5). The Coalspur

Table 2. Gas content of shallow coal zones.

Coal zone	Area (km^3)	Area correction factor	Average thickness (m)	Coal volume (m^3)	Average density (g/cm^3)	Reflectance (% max)	Typical gas content (cm^3/g)	<2500 m inferred gas content (m^3)	Depth correction factor	<1000 m inferred gas content (m^3)
Wapiti (NTS 83L):										
Shallow Brazeau	794	0.5	2	7.94E+08	1.4	0.76	5	5.56E+09	1	5.56E+09
Shallow Gates	1070	1.25	8.5	1.14E+10	1.4	1.4	10	1.59E+11	0.6	9.55E+10
Shallow Gething	1070	1.25	2.3	3.08E+09	1.4	1.5	10	4.31E+10	0.5	2.15E+10
Mt. Robson (NTS 83E):										
Shallow Coalspur	485	0.7	3	1.02E+09	1.4	0.75	5	7.13E+09	1	7.13E+09
Shallow Brazeau	681	0.8	2	1.09E+09	1.4	0.78	5	7.63E+09	1	7.63E+09
Shallow Gates	1141	0.8	8	7.30E+09	1.4	1.35	10	1.02E+11	0.5	5.11E+10
Edson (NTS 83F):										
Shallow Coalspur	2341	0.7	13	2.13E+10	1.4	0.66	5	1.49E+11	1	1.49E+11
Shallow Brazeau	2655	0.8	3	6.37E+09	1.4	0.68	5	4.46E+10	1	4.46E+10
Shallow Gates	267	0.8	7	1.50E+09	1.4	1.3	10	2.09E+10	0.5	1.05E+10
Brazeau (NTS 83C):										
Shallow Coalspur	869	0.7	10	6.08E+09	1.4	0.66	5	4.26E+10	1	4.26E+10
Shallow Brazeau	939	0.8	3	2.25E+09	1.4	0.68	5	1.58E+10	1	1.58E+10
Shallow Gates	2592	0.8	7	1.45E+10	1.4	1.3	10	2.03E+11	0.6	1.22E+11
Rocky Mtn. House (NTS 83B):										
Shallow Coalspur	2722	0.7	4	7.62E+09	1.4	0.71	5	5.34E+10	1	5.34E+10
Shallow Brazeau	3177	0.8	2	5.08E+09	1.4	0.75	5	3.56E+10	1	3.56E+10
Shallow Gates	1331	0.8	5.5	5.86E+09	1.4	1.3	10	8.20E+10	0.3	2.46E+10
Calgary (NTS 82O):										
Shallow Brazeau	749	1	2	1.50E+09	1.4	0.78	5	1.05E+10	1	1.05E+10
Shallow Gates	1021	1.5	2.4	3.68E+09	1.4	1.3	10	5.15E+10	0.3	1.54E+10
Shallow Kootenay	2411	1.5	5	1.81E+10	1.4	1.6 - 2.0	10	2.53E+11	0.25	6.33E+10
Kananaskis (NTS 82J):										
Shallow St. Mary River	507	1	4.6	2.33E+09	1.4	0.75	5	1.63E+10	1	1.63E+10
Shallow Kootenay	1760	1	3.1	5.46E+09	1.4	1.1-1.7	10	7.64E+10	0.4	3.06E+10
Fernie (NTS 82G):										
Shallow Kootenay	1057	1.25	6	7.93E+09	1.4	1.25	10	1.11E+11	0.5	5.55E+10
Lethbridge (NTS 82H):										
Shallow Kootenay	23	1.5	3	1.04E+08	1.4	1	5	7.25E+08	0.5	3.62E+08
Total gas (<2500 m)								**1.49×10^{12}**		
Total gas (1000-2500 m)									**613×10^{9}**	
Total gas (<1000 m)										**878×10^{9}**

Table 3. Gas content of deep coal zones.

	Area (km^3)	Area correction factor	Average thickness (m)	Coal volume (m^3)	Average density (g/cm^3)	Reflectance (% max)	Typical gas content (cm^3/g)	Inferred gas content (m^3)
Wapiti (NTS 83L):								
Deep Gates	2585	1.1	10	2.84E+10	1.4	1.5	10	3.98E+11
Deep Gething	2585	1.1	4	1.14E+10	1.4	1.6	10	1.59E+11
Mt.Robson (NTS 83E):								
Deep Gates	1572	1.25	6	1.18E+10	1.4	1.4-1.8	10	1.65E+11
Edson (NTS 83F):								
Deep Gates	4221	1.25	7	3.69E+10	1.4	1.7	10	5.17E+11
Brazeau (NTS 83C):								
Deep Gates	1706	1.05	8	1.43E+10	1.4	1.7	10	2.01E+11
Rocky Mtn. House (NTS 83B):								
Deep Gates	3694	1.05	7	2.72E+10	1.4	1.5	10	3.80E+11
Calgary (NTS 82O):								
Deep Gates	929	1.25	3	3.48E+09	1.4	1.3	10	4.88E+10
Deep Kootenay	2169	1.25	4	1.08E+10	1.4	1.6	10	1.52E+11
Kananaskis (NTS 82J):								
Deep Kootenay	2711	1.2	2	6.51E+09	1.4	0.9	5	4.55E+10
Fernie (NTS 82G):								
Deep Kootenay	1545	1.25	2.5	4.83E+09	1.4	1.1	5	3.38E+10
Lethbridge (NTS 82H):								
Deep Kootenay	1852	1.25	3	6.95E+09	1.4	1.1	5	4.86E+10
Total gas (>2500 m)								**2.15×10^{12}**
Total gas (1000-2500 m - from Table 2)								**613×10^{9}**
Total gas (>1000 m)								**2.8×10^{12}**



Coal area	Area in (km^2)
Shallow Coalspur	166
Shallow Brazeau	794
Shallow Gates/ Getting	1070
Deep Gates/ Getting	2585

Figure 5. Areal extent of coal zones in map area NTS 83L (Wapiti) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Narraway River cross-section.

Formation is present near the surface, but is too shallow to be a CBM source and is, therefore, not included in the resource calculations.

The subsurface geology can be visualized from two cross-sections. The western cross-section, through the Narraway River area (*see* line of section on Figure 5), is presented in Rottenfusser et al. (1991) and is based on a cross-section now published in McMechan (1994). Coal zones were drawn on this section based on the coal picks. The Cutbank and Red Willow coal zones of the Brazeau Formation were drawn based on outcrop and coal-drilling information (Dawson et al., 1994). The Triangle Zone has a low-angle taper and is similar to structures found farther to the northwest (McMechan, 1985; *see also* McMechan, 1999).

The Copton Creek cross-section (AA′; Enclosure 1) was prepared for this report (*see* line of section on Figure 5). A classical triangle zone is observed in this area, with emergent, west-verging back thrusts (*see also* a nearby cross-section by McMechan, 1996). A high-quality pre-stack time migration of the seismic line shows no evidence for the Cutpick and East Cutpick thrusts shown by McMechan (1996) to emanate from the Paskwaskau detachment. Also, the location of the Morley Thrust is different in section AA′. There is also good evidence that the Copton Thrust soles out in the Paskwaskau detachment and does not cut the Cardium Formation. Cross-section AA′ is not a balanced section. However, considerable care was invested to portray structures with geometric accuracy, maintaining bed length. Folds were mostly interpreted as detachment and fault-propagation folds. Displacement is shown to decrease upward along thrust faults, which is consistent with shortening being transferred into folding.

Bed lengths were measured for the Cadomin and top Triassic horizons. They compare well in the eastern portion of the section up to the Cowlick Thrust. Some of the movement on the Muskeg Thrust is interpreted to be late and out of sequence (McMechan, 1999) and is carried to the surface.

From these cross-sections, five major coal zones can be distinguished: shallow Brazeau, deep Gates, shallow Gates, deep Gething and shallow Gething.

5.1.1 Shallow Brazeau Coal Zone

Coals in this succession are exposed on Nose Mountain and Morley Hill. They are fairly close to the surface and are rarely logged in wells (the interval is often cased). From mapping, two coal zones can be distinguished in the upper Brazeau: the Cutbank and Red Willow (Dawson et al., 1994). They measure 794 km^2 in area and the coal has an average cumulative thickness of 2 m. Some of this coal is shallower than 200 m, so only 50% of the volume is considered, giving a corrected total volume of 7.9×10^8 m^3.

The vitrinite reflectance of 0.76% (Table 2) indicates a gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **5.6×10^9 m^3**.

5.1.2 Shallow Gates Coal Zone

These coals have been targets for coal exploration in the western part of the area and are being mined at the Smoky River coal mine. The shallow Gates coals cover an area of 1070 km^2 and have an average thickness of 8.5 m. The shortening is estimated at 20%, so the correction factor is 1.25 and the corrected volume is 1.1×10^{10} m^3.

The rank of the coal is medium-volatile bituminous (average of 1.4% maximum vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3.

Consequently, the total methane content of the shallow Gates coals is estimated to be **1.6 x 10^{11} m^3**. From the cross-sections, it is estimated that 60% of this amount is shallower than 1000 m. Consequently, the expected gas content in coals less than 1000 m in depth is **9.6 x 10^{10} m^3**.

5.1.3 Deep Gates Coal Zone

The deep Gates Coal Zone can be easily mapped in all wells east of the Muskeg Thrust. It underlies an area of 2585 km^2 and the coal has an average cumulative thickness of 10 m. Shortening does not appear to be significant and is estimated at about 10%, so the correction factor is 1.1, and the corrected coal volume is about 2.8 x 10^{10} m^3.

The rank of the coal is medium-volatile bituminous (average of 1.5% maximum vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Gates coals is estimated to be **4 x 10^{11} m^3**.

5.1.4 Shallow Gething Coal Zone

This is the only area in the Foothills where this stratigraphic interval contains coals of significant thickness. Elsewhere, this interval is known as the Gladstone Formation, which has only minor coal. The shallow Gething coals cover the same area as the shallow Gates, 1070 km^2, and have an average thickness of 2.3 m. The shortening is estimated at 20%, so the corrected coal volume is 3.1 x 10^9 m^3.

The rank of the coal is low-volatile bituminous (average of 1.6% maximum vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Gething coals is estimated to be **4.3 x 10^{10} m^3**. From the cross-sections, it is estimated that 50% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **2.2 x 10^{10} m^3**.

5.1.5 Deep Gething Coal Zone

The deep Gething Coal Zone underlies the same area as the deep Gates Coal Zone (2585 km^2; *see* Figure 4) and has an average cumulative thickness of 4.6 m. The shortening is estimated at 10%, so the corrected coal volume is 1.1 x 10^{10} m^3.

Based on similar gas content and coal density, the total methane content of the deep Gething coals is estimated to be **1.6 x 10^{11} m^3**.

5.2 Map Area NTS 83E (Mount Robson)

Major coal zones are present in the Coalspur, Brazeau and Gates formations. The Gladstone Formation contains minor coals. Three cross-sections are used in this map area (*see* lines of section on Figure 6). The central cross-section is after Mountjoy (1978) and was updated with coal zones in Rottenfusser et al. (1991). No drilling for oil and gas took place west of the Mason Thrust, and the interpretation is based only on outcrops and seismic data. Isolated outcrops of lower Gates coals allow the Gates Coal Zone to be drawn on the section in this area. The depth of the Paleozoic can be inferred from seismic and stratigraphic thicknesses. The Findley Triangle Zone is underlain by an anticlinal stack of duplexes involving Paleozoic to Lower Cretaceous rocks. The upper and lower detachment surfaces come together in the Shaftesbury Formation. The Copton Creek (AA′) and Moberly Creek (BB′) cross-sections (Enclosures 1 and 2) display the depth and thickness of the various coal zones.

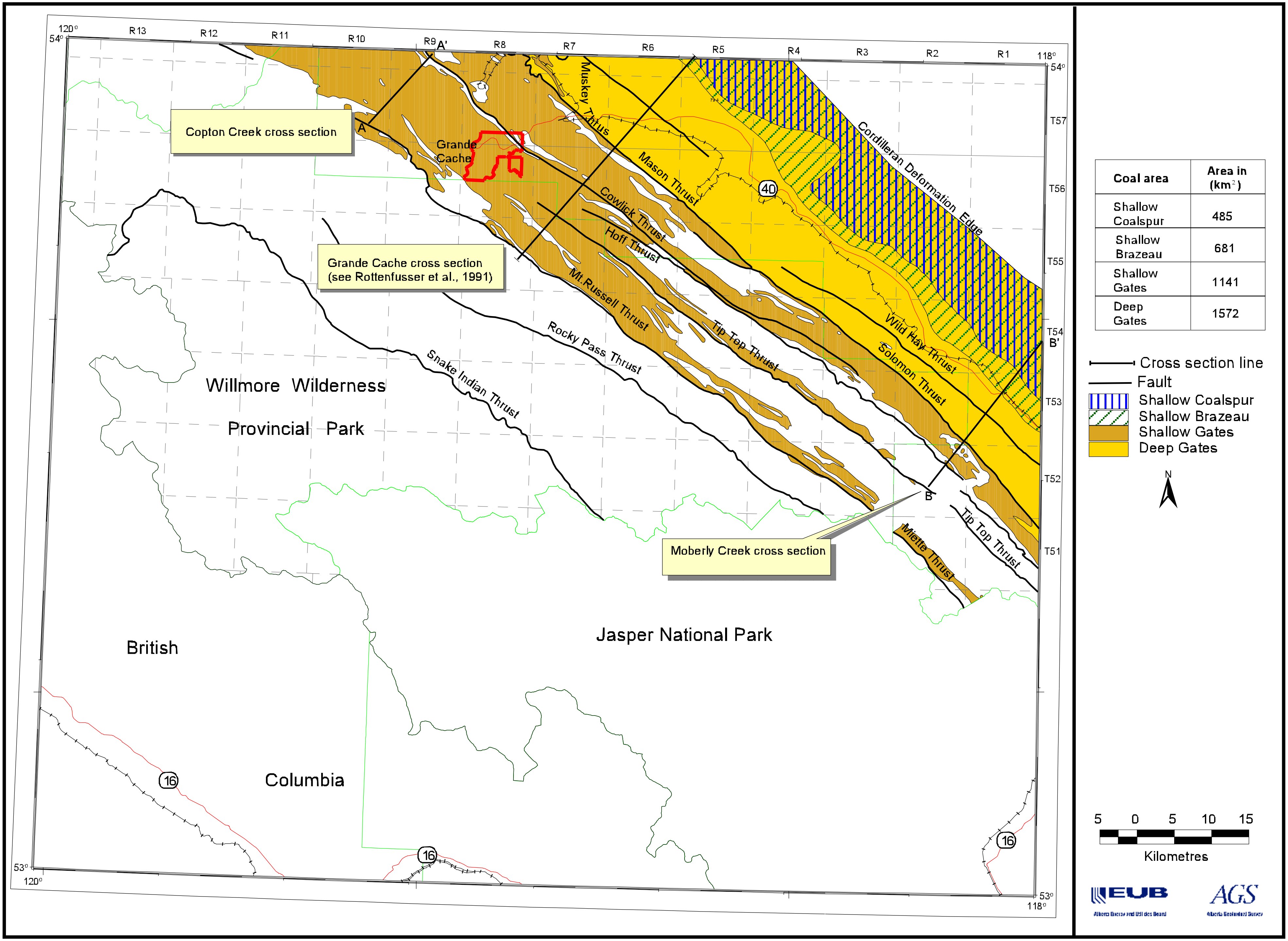


Figure 6. Areal extent of coal zones in map area NTS 83E (Mount Robson) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Grande Cache cross-section.

The structure in section BB′ is best described as a triangle zone with two major upper detachments. The cross-section is balanced between the northeast end of the section and the Hoff Thrust. Two distinct tectonic wedges are recognized. The upper wedge consists of a duplex involving the Kaskapau, Cardium, Muskiki and Marshybank formations and the lower portion of the Paskwaskau Formation. The roof thrust of the duplex is also the roof thrust of the Triangle Zone and runs in the Paskwaskau Formation. The Wildhay Thrust is the surface expression of the upper detachment. Some imbrications were interpreted to thicken the Brazeau Formation in its footwall, in what is described by Lang (1946) as an "imbricate zone." This may represent an original west-verging 'frontal ramp' of the upper detachment. However, the Paskwaskau detachment may continue westward across a large surface syncline, without associated thickening. The sole thrust of the duplex runs in the Kaskapau Formation.

The Kaskapau detachment is also the roof thrust of the lower Triangle Zone wedge, which involves the Dunvegan Formation and older strata. The sole trust of this lower duplex steps up from the west, where it runs at the base of the Devonian Fairholme Group, to the eastern half of section BB′, where it runs in the Fernie Formation. The easternmost portion of the lower duplex is characterized by low-amplitude detachment folds (above the Fernie detachment). In the western portion of the lower duplex, relatively high frontal ramps involve an almost complete Paleozoic section and created a high taper angle of the wedge.

A minor detachment is present in the Shaftesbury Formation. In the eastern portion of the section, it separates folds in the Dunvegan Formation from folds with different style and culminations in the underlying Luscar Group.

The Hoff Thrust is interpreted to carry in excess of 3 km of displacement. It represents a boundary, west of which the structural style and possibly the stratigraphy change. The westernmost part of section BB′, in the hanging wall of the Hoff Thrust, is characterized by steep bedding dips and tight, upright folds. The stratigraphic thickness of the Triassic interval also increases dramatically across the Hoff Thrust.

The Collie Creek Thrust shows minor offset at the surface. It is a minor backlimb imbricate on an anticline that is carried on a thrust with major displacement (approx. 4 km), which merges with the Kaskapau detachment.

Thrusts appear to have more displacement in the Paleozoic than in the Mesozoic part of the stratigraphic succession; however, the Mesozoic shows more folding than the Paleozoic. Considerable shortening by thrusting of the Paleozoic is balanced by folding in the Mesozoic. Most of the folds in the Mesozoic are detachment folds, and the folds in front of the thrusts are fault-propagation folds.

5.2.1 Shallow Coalspur Coal Zone

The Coalspur Coal Zone is well developed on the east limb of the Triangle Zone, covers an area of 485 km^2 and has an average thickness of 3 m. About 30% of the zone might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 1×10^9 m^3.

The rank of the coal is high-volatile bituminous (average of 0.75% maximum vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Coalspur coals is estimated to be **7.1×10^9 m^3**.

5.2.2 Shallow Brazeau Coal Zone

The Brazeau Coal Zone is developed on the east limb of the Triangle Zone, covers an area of 681 km^2

and has an average thickness of 2 m. About 20% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 1.1 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (average of 0.78% maximum vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **7.6 x 10^9 m^3**.

5.2.3 Shallow Gates Coal Zone

These shallow coals have been targets for coal exploration in the area and are being mined at the Smoky River coal mine. The shallow Gates coals cover an area of 1141 km^2 and have an average thickness of 8 m. The lower parts of the Luscar Group were not separated from the coal-bearing upper parts in the geological compilation, so some areas may not be underlain by Gates coal. In addition, some of the coal might be closer to the surface than 200 m. For these reasons, an area correction factor of 0.8 was used. Consequently, the volume of coal is estimated at 7.3 x 10^9 m^3.

The rank of the coal is medium-volatile bituminous (average of 1.35% vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Gates coals is estimated to be **1 x 10^{11} m^3.** From the cross-sections, it is estimated that 50% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **5.1 x 10^{10} m^3**.

5.2.4 Deep Gates Coal Zone

The deep Gates Coal Zone can be easily mapped in all wells east of the Mason Thrust. It underlies an area of 1572 km^2, and the coal has an average cumulative thickness of 6 m. Shortening is substantial in the Findley structure and is estimated at about 20%, so the volume must be multiplied by 1.25. Consequently, the coal volume is about 1.2 x 10^{10} m^3.

The rank of the coal is low-volatile bituminous (1.4%–1.8% average maximum vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Gates coals is estimated to be **1.6 x 10^{11} m^3**.

5.3 Map Area NTS 83F (Edson)

Major coal zones are present in the Coalspur, Brazeau and Gates formations. The Gates zones can be divided in deep and shallow (Figure 7). The Cadomin cross-section from Rottenfusser et al. (1991) and the new cross-sections CC′ and FF′ (Enclosures 3 and 6) were used (*see* lines of section on Figure 7). The eastern part of the Cadomin cross-section is well constrained by a seismic line (*see also* Lebel et al., 1996), whereas the western part is based mainly on surface information. The cross-section clearly shows the interaction between east-verging structures in the west and west-verging structures (Mercoal and Pedley thrusts) in the east. Details of the effects of this deformation on the coal zones are documented by geological mapping (Langenberg, 1993; Langenberg and LeDrew, 2001).

The structure of section CC′ is well constrained by seismic lines and can best be described as a Triangle Zone with a folded para-autochthonous wedge above it. Three distinct detachments are recognized, separating two intervals of imbrication within the triangle-zone wedge. They are 1) the lower detachment, stepping up from Cambrian strata to the Fernie Formation in the western portion of section CC′; 2) a detachment in the lower Blackstone Formation; and 3) the upper detachment, running in the uppermost Wapiabi Formation. The latter is also the roof thrust (or back thrust) of the Triangle Zone. A

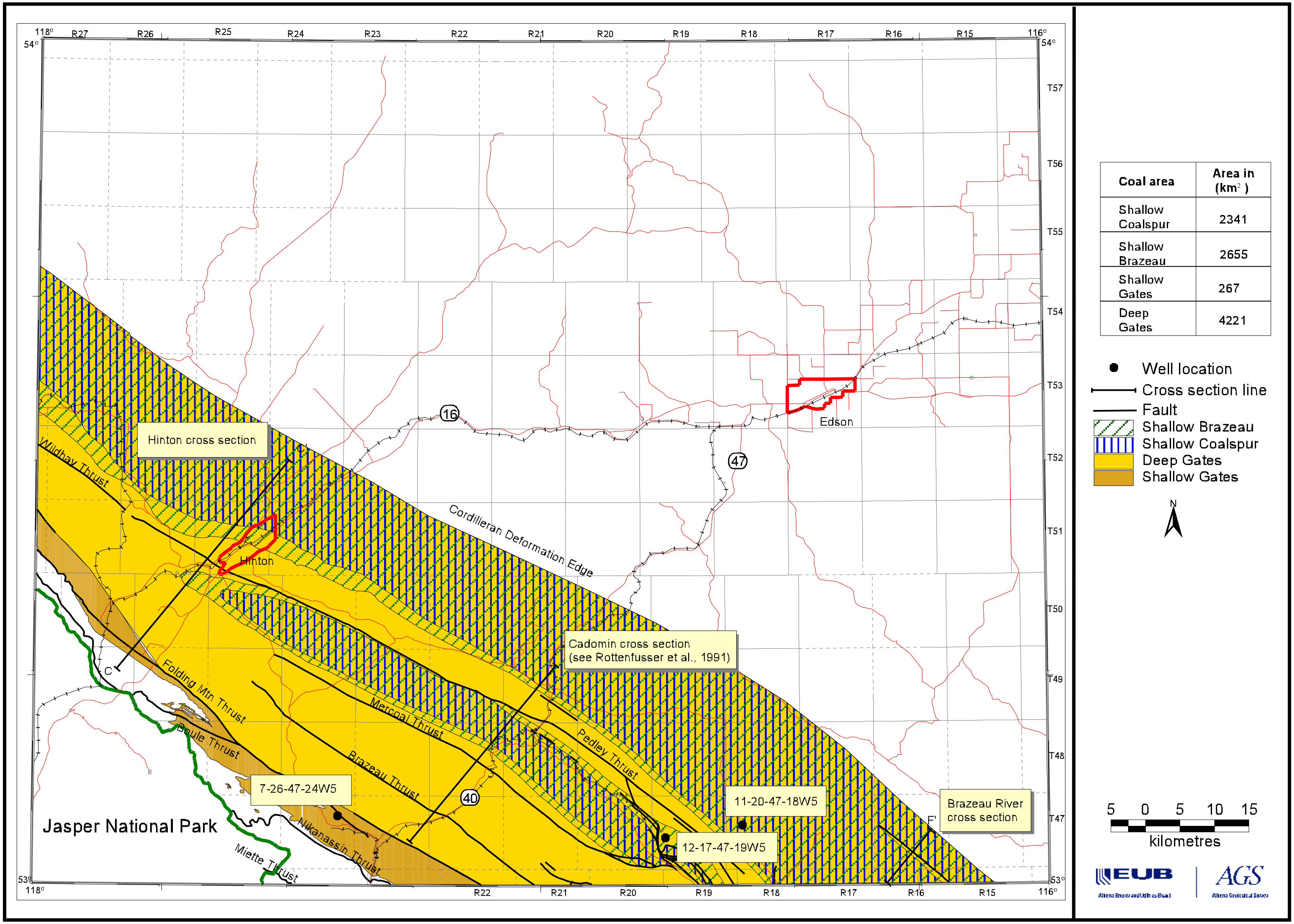


Figure 7. Areal extent of coal zones in map area NTS 83F (Edson) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Cadomin cross-section.

lower duplex comprises Jurassic and Cretaceous strata of the Fernie, Nikanassin, Luscar and lowermost Blackstone formations. In the western portion of the section, west of a frontal ramp in the lower detachment, the entire Paleozoic section is also included in the duplex. The upper interval consists of a duplex involving Cretaceous strata of the Wapiabi, Badheart and Cardium formations and the upper portion of the Blackstone Formation. The overlying para-autochthonous section comprises the lowermost Wapiabi (mainly the Chungo member), Brazeau and Coalspur formations, and the Tertiary Paskapoo Formation.

The cross-section is balanced from the northeast end to the Folding Mountain Thrust. Shortening within the para-autochthonous wedge is a result of folding and thrusting. Prominent surface expressions of this deformation are the Entrance Syncline and the Pedley Thrust, as well as a previously unnamed, west-directed thrust located at Seabolt Ridge (herein called the 'Seabolt Ridge Thrust') and the Seabolt Anticline and adjacent syncline in its footwall. Due to erosion, it is impossible to determine the exact amount of shortening to which the para-autochthonous wedge was subjected.

The Triangle Zone structure is also present in the Brazeau River area (Enclosure 6; section FF′), where the thick Coalspur coals at shallow depth form attractive CBM targets. Cross-section FF′ is based on a cross-section by LeDrew (1997) and is well constrained by a seismic line. The eastern part of the section is in the Edson map area (83F) and shows the interaction of the Brewster Thrust and an unnamed back thrust.

For the Hinton area, a stratigraphic cross-section displays the coal zones together with the major faults (Enclosure 8).

5.3.1 Shallow Coalspur Coal Zone

The Coalspur Coal Zone comes close to the surface and outcrops in the Triangle Zone near the Pedley Thrust and in the Entrance Syncline. It has been extensively mined in the past and is presently mined at Coal Valley (Luscar-Sterco) mine. It covers an area of 2341 km^2 and has an average thickness of 13 m. About 30% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 2.1×10^{10} m^3.

The rank of the coal is high-volatile bituminous (0.66% average maximum vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Coalspur coals is estimated to be **1.5×10^{11} m^3**.

The rank indicates reasonable gas content and the 13 m thickness results in large volumes. The coal is located in relatively simple, open structures with well-preserved cleats, although some calcite mineralization is present along these fractures (observed in outcrop at the Coal Valley mine). These data indicate a high CBM potential for these coals and, for this reason, a specialized coal-log analysis (termed LogFAC) was performed on four wells in the Hanlan area (Twp. 47, Rge. 17–18, W 5th Mer.). LogFAC analysis is a coal-log analysis procedure designed to estimate the abundance and openness of fractures (cleats) in coal, widely regarded as the primary control on coal permeability. LogFAC is a software package (RXO Technology, patents pending) that calculates invading mud filtrate volumes and generates a metric, termed the LogFAC Permeability Factor (LPF), a dimensionless factor that is not convertible to an accurate permeability (m^2 or mD) value at this stage of research. The four wells are located on the Alberta Syncline, just east of the Triangle Zone. An anomalous trend of LogFAC Permeability Factors of 1.6, indicating enhanced openness of fractures and possible elevated permeability, is noted in the Val d'Or B seam in an area of the Alberta Syncline. These results indicate a possible link between the elevated permeability factors and structural features.

Data from the nearby Conoco Hanlan 11-20-47-18W5 CBM well (Dawson et al., 2000) show that gas content is lower than expected for these coal ranks (about 2.1 cm^3/g). The reason for this anomaly is not understood because nearby shallow coal in the Coal Valley mine has gas contents of up to 3.2 cm^3/g (Table 1). High average ash content of 30% for this coal is certainly a contributing factor (Dawson et al., 2000, p. 93). Nevertheless, these data indicate that this is an area of reasonable permeability and gas content, where cautious CBM exploration could proceed.

5.3.2 Shallow Brazeau Coal Zone

The Brazeau Coal Zone, developed on the east limb of the Triangle Zone and in the Entrance Syncline near the top of the formation, covers an area of 2655 km^2 and has an average thickness of 3 m. About 20% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 6.4 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (0.68% average maximum vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **4.5 x 10^{10} m^3**.

5.3.3 Shallow Gates Coal Zone

These shallow coals have been targets for coal exploration in the southwestern part of the area and are being mined at the Cardinal River coal mine. The shallow Gates coals underlie an area of 267 km^2 and have an average thickness of 7 m. The lower parts of the Luscar Group were not separated from the coal-bearing upper parts in the geological compilation, so some areas may not be underlain by Gates coal. In addition, some of the coal might be closer to the surface than 200 m. For these reasons, an area correction factor of 0.8 is used. Consequently, the volume of coal is estimated at 1.5 x 10^9 m^3.

The rank of the coal is medium-volatile bituminous (1.3% average maximum vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Gates coals is estimated to be **2.1 x 10^{10} m^3**. From the cross-sections, it is estimated that 50% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **1.1 x 10^{10} m^3**.

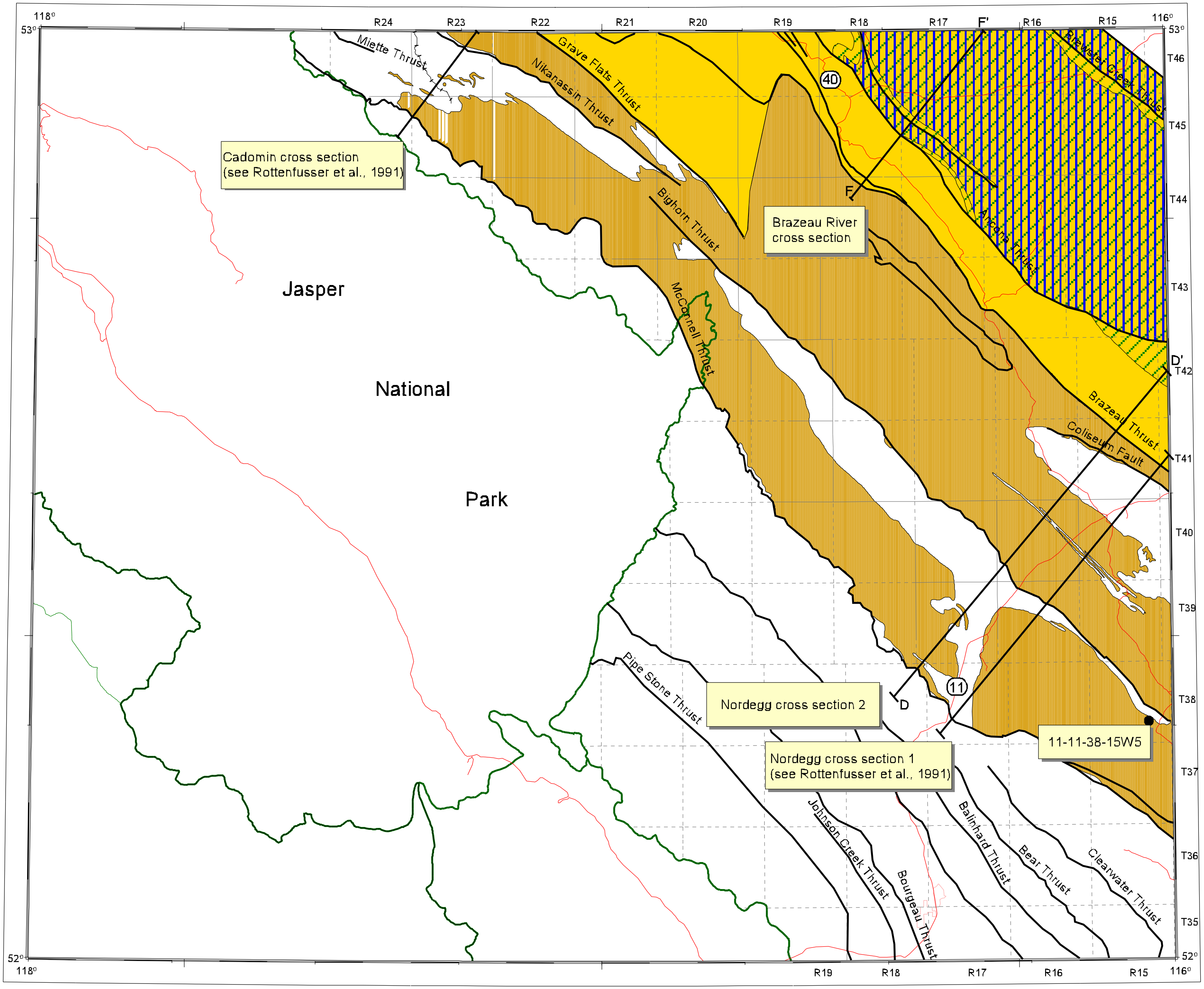
5.3.4 Deep Gates Coal Zone

The deep Gates Coal Zone can be easily mapped in all wells east of the Folding Mountain Thrust. It underlies an area of 4221 km^2 and the coal has an average cumulative thickness of 7 m. Shortening is present in the Triangle Zone and Mercoal structures and is estimated at about 20%, so the volume needs to be multiplied by 1.25. Consequently, the coal volume is about 3.7 x 10^{10} m^3.

The rank of the coal is low-volatile bituminous (1.7% average maximum vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total gas content of the deep Gates coals is estimated to be **5.2 x 10^{11} m^3.**

5.4 Map Area NTS 83C (Brazeau)

Major coal zones are present in the Coalspur, Brazeau and Gates formations, with the Gates zones being divided in deep and shallow (Figure 8). Two cross-sections from Rottenfusser et al. (1991) can be used for the present evaluation (*see* lines of section in Figure 8). The northern one is the western part of the Cadomin section, based on Mountjoy et al. (1992), and the southern one is part of the Nordegg 1



Coal area	Area in (km^2)
Shallow Coalspur	869
Shallow Brazeau	939
Shallow Gates	2592
Deep Gates	1706

- Well location
- Cross section line
- Fault
- Shallow Brazeau
- Shallow Coalspur
- Deep Gates
- Shallow Gates

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Figure 8. Areal extent of coal zones in map area NTS 83C (Brazeau) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Cadomin and Nordegg 1 cross-sections.

section, based on a seismic line through the Nordegg townsite (Perkins et al., 1984). In addition, two cross-sections were constructed for this report: the Nordegg 2 section (DD′; Enclosure 4) and the Brazeau River section (FF′; Enclosure 6).

The main structures of importance are the McConnell, Bighorn, Nikanassin, Grave Flats and Brazeau thrusts. Displacements along the Brazeau Thrust decrease to the north, and the boundary between the deep and shallow Gates zones steps from the Brazeau to the Grave Flats Thrust (an extension of the Folding Mountain Thrust) in the northern part of the map area.

The east-directed Ancona Thrust represents the eastern boundary of major Foothills deformation within the coverage of cross-section DD′. However, shortening is carried farther to the northeast along bedding-parallel detachments and is expressed in thrusting on the Brewster Creek and Sylvester Creek faults, which are located approximately 16 km northeast of cross-section DD′ (Jones, 1971; Jones and Workum, 1978). At this latitude, shortening may be carried even farther to the northeast along detachments in the Blackstone and Wapiabi formations, as illustrated by Skuce (1996).

Although tectonic wedging may have played a role in the formation of the Stolberg Anticline, there is no evidence from well or seismic data for a west-directed upper detachment, such as one would expect in a triangle zone. One minor back thrust is present, but can be easily attributed to late-stage shortening within the Stolberg Anticline. The Ancona Thrust, as mapped at the surface, appears to be rooted in the Shunda detachment. A folded detachment in the Brazeau Formation has been connected to the Ancona Thrust by Jones (1971). This usage has led to some confusion because the Ancona Thrust, as introduced by Douglas (1958), is the fault below the Stolberg Structure, which can be seen on seismic sections and cuts the Brazeau detachment.

Three distinct detachments are recognized in the easternmost portion of cross-section DD′. West of the Stolberg gas field, the basal detachment runs in evaporitic rocks of the Mississippian Shunda Formation. A frontal ramp in that detachment from the Shunda Formation to the lower Blackstone level is responsible for folding and thrusting of upper Mississippian to Luscar Group strata in the Stolberg structure. Imbrication and thickening of the Blackstone and Cardium formations in the Stolberg structure can be assigned to movement on the second detachment at the lower Blackstone level, which is partially independent of the basal detachment. The third detachment is located in the upper Wapiabi Formation. The Blackstone and Wapiabi detachments are interpreted to carry displacement northeastward, beyond the extent of cross-section DD′, to account for shortening on the Brewster Creek and Sylvester Creek faults (Jones, 1971).

Two major thrust faults dominate the western portion of cross-section DD′, the Brazeau Thrust and the Bighorn Thrust. They both have some 20 km of displacement at the Paleozoic level. Frontal imbricates, such as the Brazeau Range Fault and the Coliseum Fault, characterize the surface expression of these major thrusts.

The main frontal ramp of the Brazeau Thrust is interpreted to have climbed up from the Cambrian to the lower part of the Tertiary Paskapoo Formation (*see* new interpretation of the surface expression of the thrust within Tertiary strata on Enclosure 4). Later erosion of the footwall of this ramp led to the propagation of the Shunda detachment and a minor flat in the Banff Formation. Two detachments are interpreted to have been active in structures that are now in the hanging wall of the Brazeau Thrust. One detachment, at the base of the Luscar Group, is connected via several ramps with a second detachment at the lower Blackstone level.

Cross-section DD′ is not a balanced section. However, considerable care was taken to portray structures with geometric accuracy and to maintain bed length. Fold geometries were determined from seismic expression and well control. Fault-bend and fault-propagation fold geometries were interpreted, in most cases, with fault displacements decreasing upward to allow for transfer of shortening into folds. Detachment fold mechanisms were interpreted to be partially responsible for structures in the core of the Stolberg Anticline, in the Swale Creek Syncline and in the immediate footwall of the Bighorn Thrust near the surface.

The western part of the cross-section is somewhat problematic, because the section is near the Bighorn lateral ramp and tear faults (Douglas, 1956). The cross-section will not balance in this area, because some of the displacement is out of the section on this lateral ramp. It is, therefore, a schematic of how the subsurface could look.

The Triangle Zone structure is better developed in the Brazeau River area (Enclosure 6; section FF′), where the thick Coalspur coals at shallow depth form attractive CBM targets. Cross-section FF′ is based on a section by LeDrew (1997) and is well constrained by a seismic line. The western part of the section is in the Brazeau map area (83C) and shows the Ancona and Beaverdam thrusts in a possible relict triangle zone.

5.4.1 Shallow Coalspur Coal Zone

The Coalspur Coal Zone was encountered in several wells near the Stolberg gas field and outcrops along the North Saskatchewan River near Saunders, where it was mined.

The zone underlies an area of 869 km^2 and has an average thickness of 10 m. About 30% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 6.1×10^9 m^3.

The rank of the coal is high-volatile bituminous (0.66% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Coalspur coals is estimated to be **4.3×10^{10} m^3**.

5.4.2 Shallow Brazeau Coal Zone

Some coal is present in the upper part of the Brazeau Formation. However, the coal seems to be discontinuous and the coal zone is not well developed. The zone, which might outcrop along the North Saskatchewan River (Erdman, 1950), underlies an area of 939 km^2 and has an average thickness of 3 m. About 20% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 2.2×10^9 m^3.

The rank of the coal is high-volatile bituminous (0.68% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **1.6×10^{10} m^3**.

5.4.3 Shallow Gates Coal Zone

The shallow Gates coals were mined in the Nordegg area, and the old mine workings are currently one of the main tourist attractions for this area. These coals have been documented by Dawson and Kalkreuth (1994a), underlie an area of 2592 km^2 and have an average thickness of 7 m. It is estimated that 80% of this area is underlain by coal. Consequently, the volume of coal is estimated at 1.4×10^{10} m^3.

The rank of the coal is medium-volatile bituminous (about 1.3% vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Gates coals is estimated to be **2 x 10^{11} m^3**. From the cross-sections, it is estimated that 60% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **1.2 x 10^{11} m^3**.

5.4.4 Deep Gates Coal Zone

The deep Gates coals can be easily recognized in many wells (Dawson and Kalkreuth, 1994a). They underlie an area of 1706 km^2, and the coal has an average cumulative thickness of 8 m. Some shortening is present in the Triangle Zone structures, so the volume must be multiplied by 1.05. Consequently, the coal volume is approximately 1.4 x 10^{10} m^3.

The rank of the coal is low-volatile bituminous (1.7% average vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Gates coals is estimated to be **2 x 10^{11} m^3**.

5.5 Map Area NTS 83B (Rocky Mountain House)

Major coal zones are present in the Coalspur, Brazeau and Gates formations, with the Gates coal zones being divided in deep and shallow (Figure 9). The Nordegg 1 cross-section from Rottenfusser et al. (1991) and the Nordegg 2 cross-section (DD′; Enclosure 4) can be used for the present evaluation (*see* line of section on Figure 9). The main structures of importance are the McConnell, Brazeau and Ancona thrusts. The Brazeau Thrust separates the shallow and deep Gates coals.

5.5.1 Shallow Coalspur Coal Zone

The Coalspur Coal Zone was encountered in several wells near the Stolberg gas field, in the northwestern part of the map area. It underlies an area of 2722 km^2 and has an average thickness of 4 m. About 30% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 7.6 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (0.71% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Coalspur coals is estimated to be **5.3 x 10^{10} m^3**.

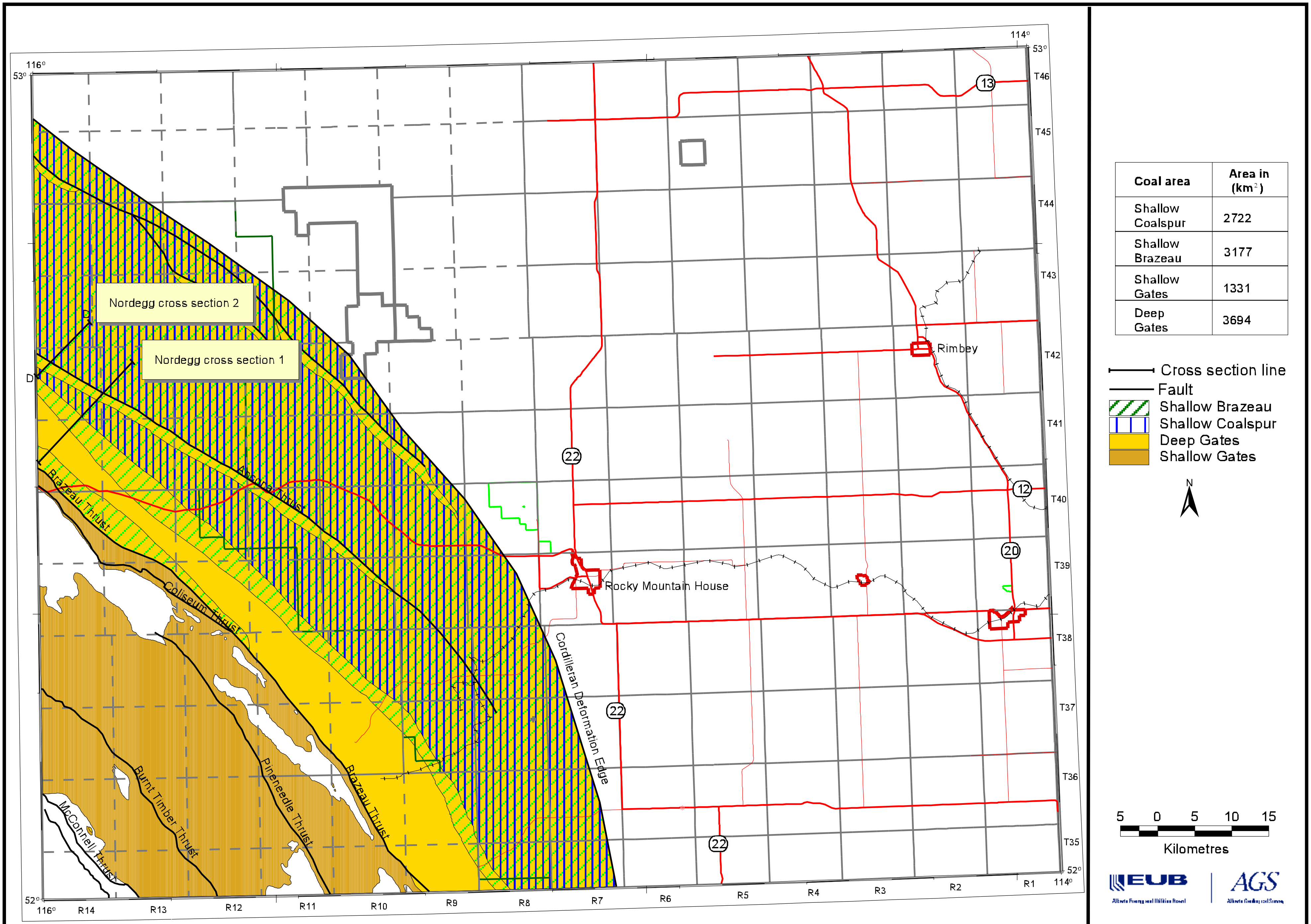
5.5.2 Shallow Brazeau Coal Zone

Coal is present in the upper part of the Brazeau Formation, underlies an area of 3177 km^2 and has an average thickness of 2 m. About 20% might be closer to the surface than 200 m and is therefore excluded. Consequently, the volume of coal is estimated at 5 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (0.75% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **3.6 x 10^{10} m^3**.

5.5.3 Shallow Gates Coal Zone

The shallow Gates coals of this map area have been documented by Dawson and Kalkreuth (1994a). The coals underlie an area of 1331 km^2 and have an average thickness of 5.5 m. It is estimated that about 80% of this area is underlain by coal, so the volume of coal is estimated at 5.9 x 10^9 m^3.



Coal area	Area in (km²)
Shallow Coalspur	2722
Shallow Brazeau	3177
Shallow Gates	1331
Deep Gates	3694

Figure 9. Areal extent of coal zones in map area NTS 83B (Rocky Mountain House) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Nordegg 1 cross-section.

The rank of the coal is medium-volatile bituminous (1.3% vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Gates coals is estimated to be **8.2 x 10^{10} m^3**. From the cross-sections, it is estimated that 30% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **2.5 x 10^{10} m^3**.

5.5.4 Deep Gates Coal Zone

The deep Gates coals can be easily recognized in all wells and have been documented by Dawson and Kalkreuth (1994a). They underlie an area of 3694 km^2 and the coal has an average cumulative thickness of 7 m. Some shortening is present in the Triangle Zone structures, so the volume must be multiplied by 1.05. Consequently, the coal volume is about 2.7 x 10^{10} m^3.

The rank of the coal is medium-volatile bituminous (1.5% average vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Gates coals is estimated to be **3.8 x 10^{11} m^3**.

5.6 Map Area NTS 82O (Calgary)

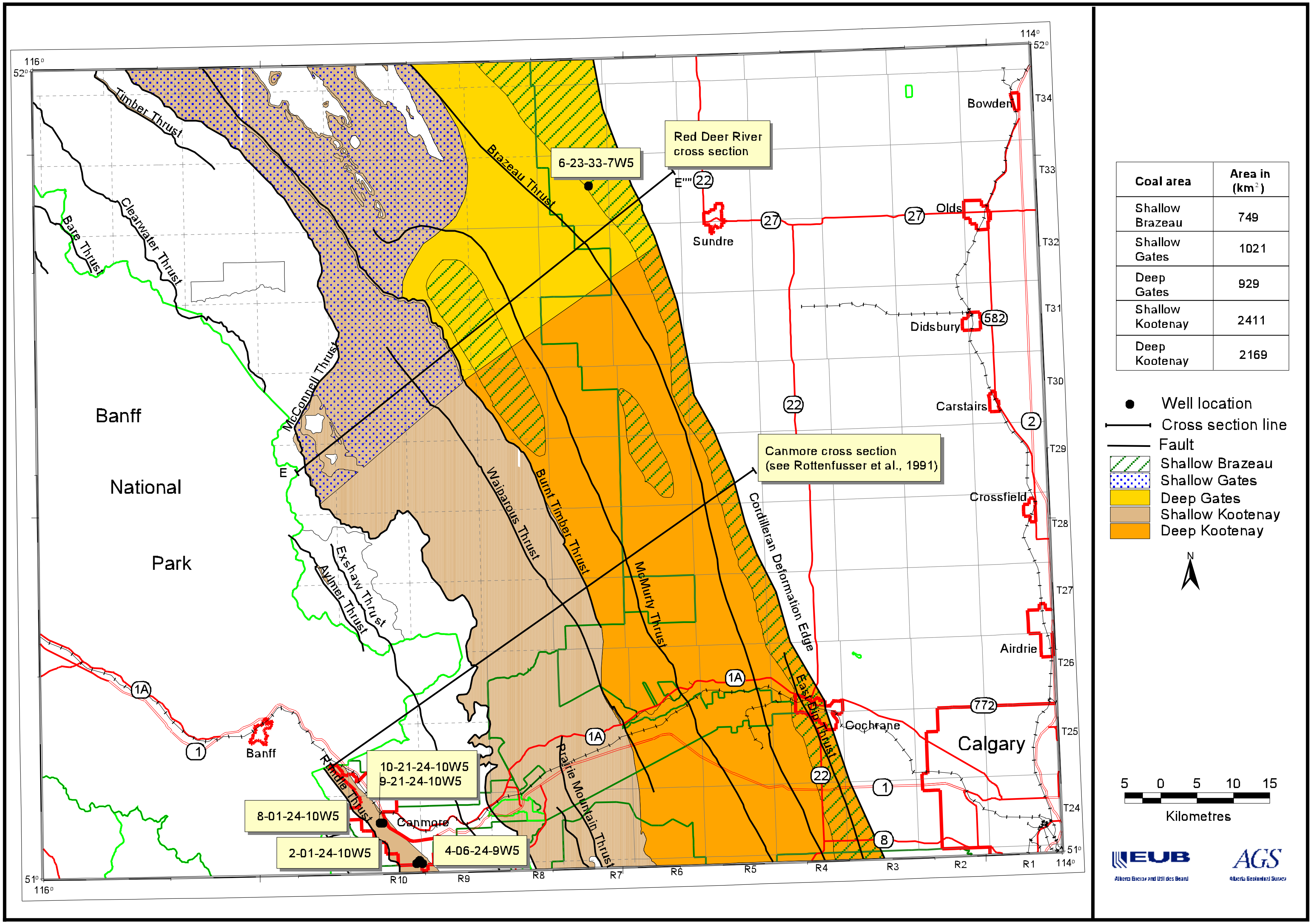
The major coal zones are in the Brazeau Formation and Kootenay Group, the Kootenay Zone being divided into deep and shallow (Figure 10). Minor coal is present in the Blairmore Group and Coalspur Formation, but these seams are too thin for CBM production. The structural Canmore (Rottenfusser et al., 1991; *see* line of section on Figure 10) and Red Deer River (EE′′′′; Enclosure 5) cross-sections display the subsurface geology of the area. The Canmore cross-section is based on Price and Fermor (1985). The most important thrusts are the McConnell, Burnt Timber and Brazeau thrusts. The McConnell Thrust separates the shallow and deep Kootenay coals.

Cross-section EE′′′′ spans the entire width of the Foothills Belt from the Triangle Zone to the hanging wall of the McConnell Thrust, where Paleozoic strata are exposed at the surface. The thrust front near Sundre has a ‘typical’ southern Alberta Triangle Zone geometry (Soule and Spratt, 1996). The surface expression of the Triangle Zone corresponds with the Raven River Anticline (Ollerenshaw, 1978).

The upper detachment of the Triangle Zone runs in the upper Brazeau Formation. Folding is caused by frontal ramps stepping up from the basal detachment in the Fernie Formation to the upper detachment. The most prominent detachment recognized in section EE′′′′ runs at the base of the Fernie Formation. In the eastern portion of the section, most of the displacement is carried on this detachment.

The Wapiabi detachment was active throughout the extent of section EE′′′′. This is evident in flats that had to be interpreted at the base of the Wapiabi Formation in many locations. A duplex structure that was interpreted within the Wapiabi Formation in the hanging wall of the Burnt Timber Thrust also has its sole thrust in the lower Wapiabi. Further evidence for the existence of this detachment can be found in an anticline in the immediate footwall of the Brazeau Thrust. Based on seismic data, the fold is interpreted as a transported fault-propagation fold with displacement being transferred to a flat in the lowermost Wapiabi Formation.

Two detachments of local importance are recognized in the western portion of section EE′′′′, where the Burnt Timber Thrust runs parallel to bedding within the Kootenay Formation for a minimum of 5.5 km and then in the Blairmore Group for approximately 14.5 km. The base of the Blairmore Coal Zone seems to have been the zone of weakness used by this detachment. However, it is not clear whether coals provided a glide horizon in the Kootenay Formation.



Coal area	Area in (km²)
Shallow Brazeau	749
Shallow Gates	1021
Deep Gates	929
Shallow Kootenay	2411
Deep Kootenay	2169

Figure 10. Areal extent of coal zones in map area NTS 82O (Calgary) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Highwood river cross-section.

The eastern portion of cross-section EE′′′′ is characterized by numerous imbrications of Cretaceous strata, separated by thrust faults with relatively minor displacements. The easternmost emergent fault, the Brazeau Thrust, also has the greatest displacement. The position and size of the Williams Creek Syncline, to the west of these imbricates, is controlled by a large ramp anticline on the basal detachment, involving Devonian and Mississippian strata.

The western portion of cross-section EE′′′′ is dominated by the Burnt Timber Thrust and the Panther River Culmination. The Burnt Timber Thrust carries a complete section of Cambrian to Tertiary strata in its hanging wall. It ramps relatively steeply through the complete Paleozoic section, has an extended flat in the Kootenay Formation and then the Blairmore Group, and again ramps steeply through the remainder of the stratigraphy. If, and how far, the thrust extends in the Fernie Formation cannot be determined due to the decoupling of structures on the Fernie detachment. Displacement on the Burnt Timber Thrust is estimated at 30 to 44 km, depending on how Cretaceous preshortening is balanced.

The Panther River Culmination is cored by a large anticline involving strata as old as Cambrian. Surface and well data seem to support the geometry of a fault-propagation fold, carried on the Panther Thrust, which is consistent with Ollerenshaw's (1978) interpretation. However, there is some evidence for fault repeats in the Kootenay and Blairmore strata in the footwall of this thrust and, to the south, the culmination is shown to be mainly cored by a duplex of Fernie, Kootenay and Blairmore strata (Soule, 1993). This is not shown in cross-section EE′′′′ due to conflicting information about thicknesses and positions of formation tops from various wells near the section. Further detailed study of these wells (Twp. 29–30, Rge. 10–11) is necessary to make a proper assessment of the structure.

Data from these wells do, however, support a significant westward thickening of the Kootenay Formation in the footwall of the Panther Thrust. This thickening trend is also accompanied by the appearance and thickening of coals in the Kootenay Formation. Thicknesses shown in cross-section EE′′′′ are based on averages and do not match all the wells in the vicinity. They are also drawn to be consistent with thicknesses reported by surface mapping in the Panther River Culmination.

The Gates Coal Zone (and Luscar Group) cannot be recognized in the southern part of the Calgary area, where this stratigraphic interval is occupied by the non–coal-bearing Blairmore Group. Because the transition is gradual, its accurate location will require more work. An approximate position is shown on Figure 10.

5.6.1 Shallow Brazeau Coal Zone

The Upper Brazeau Coal Zone may be equivalent to the Carbon-Thompson Coal Zone. Coal lower in the succession may be equivalent to the Lethbridge Coal Zone. However, accurate correlations are difficult because the Bearpaw Formation cannot be mapped. The coal underlies an area of 749 km^2 and has an average thickness of 2 m. Consequently, the volume of coal is estimated at 1.5×10^9 m^3.

The rank of the coal is high-volatile bituminous (0.78% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **1.1×10^{10} m^3**.

5.6.2 Shallow Gates Coal Zone

The shallow Gates coals are displayed on cross-section EE′′′′ (*see also* Dawson and Kalkreuth, 1994a). The coal underlies an area of 1021 km^2 and has an average thickness of 2.4 m. Consequently, the volume of coal is estimated at 3.7×10^9 m^3.

The rank of the coal is medium-volatile bituminous (1.3% average vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Brazeau coals is estimated to be **5.1 x 10^{10} m^3**. From the cross-sections, it is estimated that 30% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **1.5 x 10^{10} m^3**.

5.6.3 Shallow Kootenay Coal Zone

The shallow Kootenay coals underlie an area of 2411 km^2 in the Canmore area and have an average cumulative thickness of 5 m. Shortening by folding indicates that the areal extent of the coal must be multiplied by 1.5. Consequently, the volume of coal is estimated at 1.8 x 10^{10} m^3.

The rank of the coal is low-volatile bituminous to semi-anthracite (1.6–2.0% vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Kootenay coals is estimated to be **42.5 x 10^{11} m^3.** From the cross-sections, it is estimated that 25% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **6.3 x 10^{10} m^3**.

5.6.4 Deep Kootenay Coal Zone

The deep Kootenay Coal Zone can be mapped in all wells west of the erosional edge. The coal tends to be thinner than the shallow Kootenay and is often sheared. The coal underlies an area of 2169 km^2 and has an average cumulative thickness of 4 m. Some shortening is present in the Triangle Zone structures, so the volume must be multiplied by 1.25. Consequently, the coal volume is about 1.1 x 10^{10} m^3.

The rank of the coal is low-volatile bituminous (1.6% average vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Kootenay coals is estimated to be **1.5 x 10^{11} m^3**.

5.7 Map Area NTS 82J (Kananaskis Lakes)

The major coal-bearing units are the St. Mary River Formation and the Kootenay Group (Figure 11). The Highwood River cross-section from Rottenfusser et al. (1991) shows the subsurface geology of the area (*see* line of section on Figure 11). The interpretation is based on a cross-section, published in a guidebook by Gordy et al. (1975), which was previously published by Bally et al. (1966).

5.7.1 Shallow St. Mary River Formation

The St. Mary River Coal Zone can be mapped into the Triangle Zone from the plains. Some St. Mary River coals are exposed beneath the Longview Bridge. In the Foothills, the Bearpaw Formation generally cannot be mapped and the entire interval from Belly River to St. Mary River is mapped as Brazeau Formation. No significant coals were seen in the Brazeau interval west of the Triangle Zone. The St. Mary River coals, considered to have the same areal extent as the Brazeau interval (including the Belly River, Bearpaw and St. Mary River formations), underlie an area of 507 km^2 and have an average thickness of 4.6 m. Consequently, the volume of coal is estimated at 2.3 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (0.75% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow St. Mary River coals is estimated to be **1.6 x 10^{10} m^3**.

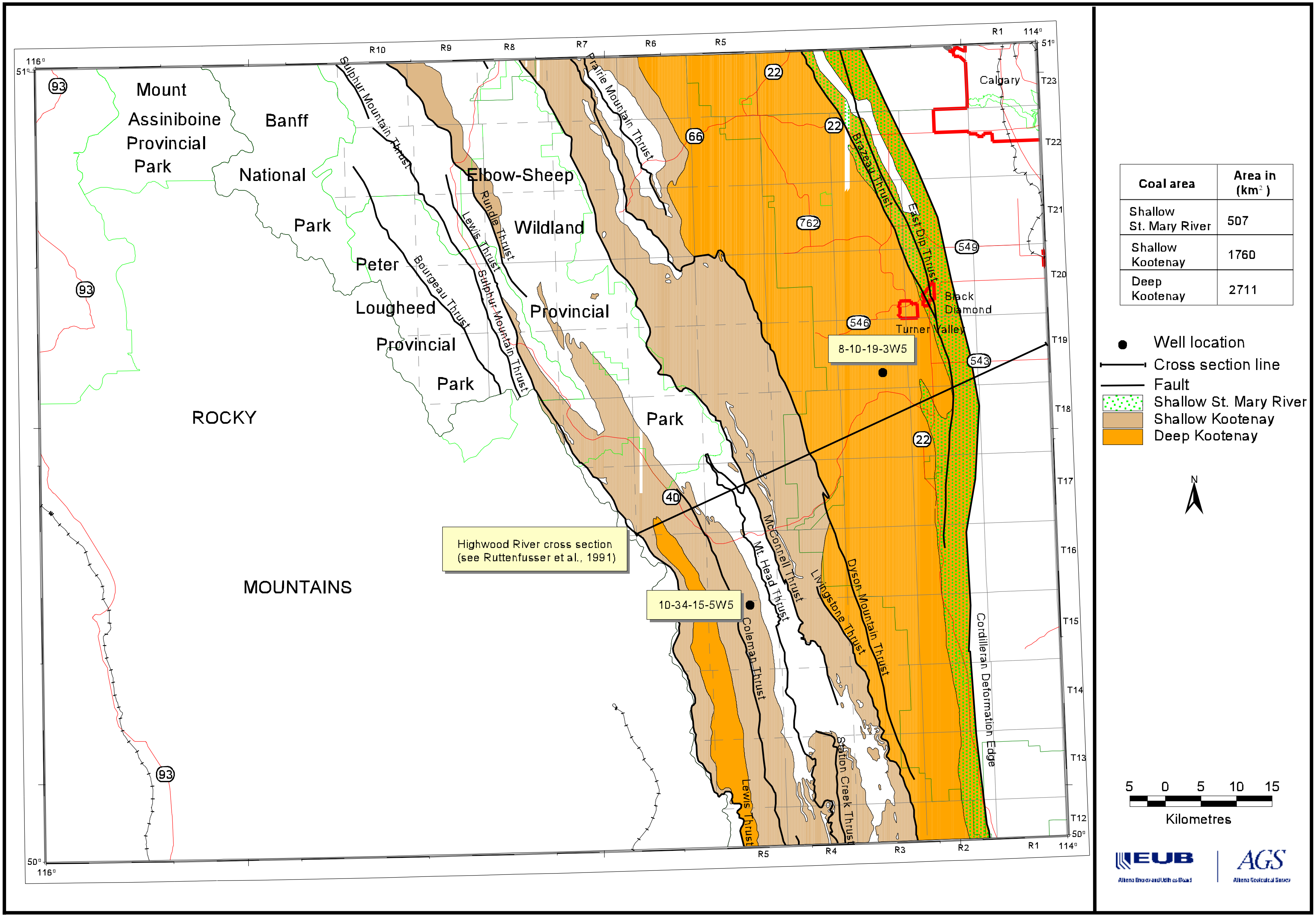


Figure 11. Areal extent of coal zones in map area NTS 82J (Kananaskis Lakes) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Highwood River cross-section.

5.7.2 Shallow Kootenay Coal Zone

Shallow Kootenay coals are present in the area between the Lewis and McConnell thrusts, and around the Moose Mountain culmination. The coals underlie an area of 1760 km^2 and have an average cumulative thickness of 3.1 m. Shortening by folding and thrusting is considered to be equalized by areas where the coal is too shallow or not present, so the area correction factor is 1. Consequently, the volume of coal is estimated at 5.5 x 10^9 m^3.

The rank of the coal is medium- to low-volatile bituminous (1.1–1.7% vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Kootenay coals is estimated to be **7.6 x 10^{10} m^3**. From the cross-section, it is estimated that 40% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **3.1 x 10^{10} m^3**.

5.7.3 Deep Kootenay Coal Zone

The deep Kootenay Coal Zone can be mapped in all wells west of the erosional edge. The coals underlie an area of 2711 km^2 and have an average cumulative thickness of 2 m. Some shortening is present in the Triangle Zone structures, so the volume must be multiplied by 1.2. Consequently, the coal volume is about 6.5 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (0.9% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Kootenay coals is estimated to be **4.5 x 10^{10} m^3**.

5.8 Map Area NTS 82G (Fernie)

The major coal-bearing units present in the Fernie map area are the St. Mary River Formation and the Kootenay Group. The St. Mary River coals are too shallow and are excluded from the present calculations (Figure 12). The cross-section for the Pincher Creek area from Rottenfusser et al. (1991) and the Oldman River cross-section (GG′; Enclosure 7) depict the subsurface geology of the area (*see* lines of section on Figure 12). The cross-section shows that the Livingstone Thrust brings Kootenay coals to the surface, and this thrust separates the deep and shallow Kootenay coals. Additional deep Kootenay coal is present in the Coleman Thrust sheet below the Lewis Thrust.

Cross-section GG′ spans the entire width of the Foothills Belt from the Triangle Zone to the hanging wall of the Lewis Thrust near the Alberta–British Columbia border. The thrust front near Maycroft has a southern Alberta Triangle Zone geometry (*see* nearby cross-section from Stockmal et al., 1996 and discussion in Stockmal et al., 2001).

The upper detachment of the Triangle Zone (Big Coulee Thrust) runs in the Bearpaw Formation. An additional (younger) upper detachment is located in the St. Mary River and Willow Creek formations east of the Triangle Zone. Lower detachments are present in the Fernie, Blackstone and Wapiabi formations. The most prominent detachment recognized in section GG′ runs in the Fernie Formation. In the eastern portion of the section, considerable displacement is carried on this detachment. In the west, these movements are linked to the Burmis Thrust. Duplex thrusting above the Burmis Thrust created the traps for the Coleman gas field. Possible basement faults (interpreted from seismic data) may be triggers for thrust ramps.

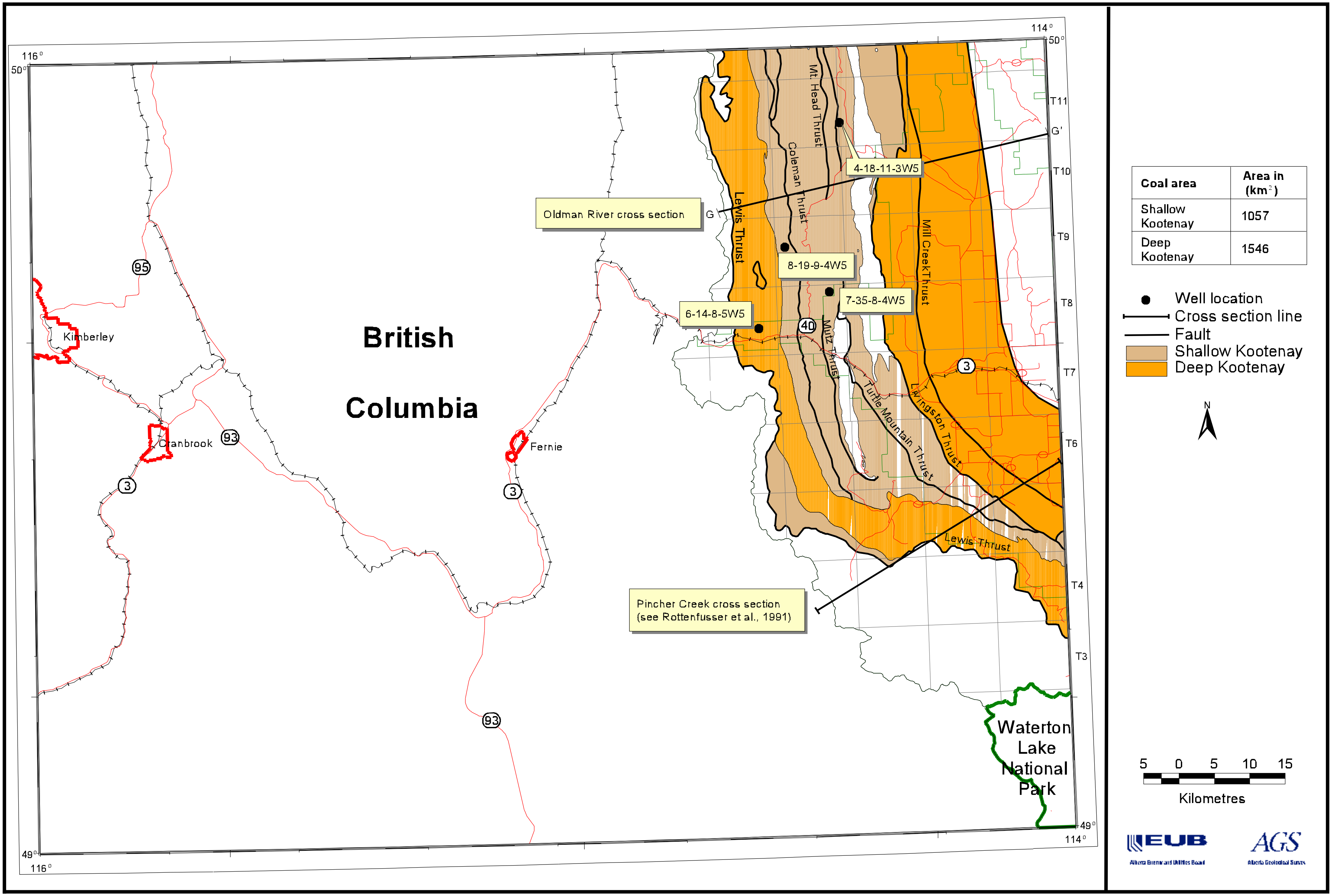


Figure 12. Areal extent of coal zones in map area NTS 82G (Fernie) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Pincher Creek cross-section.

5.8.1 Shallow Kootenay Coal Zone

Shallow Kootenay coals have been mined in the Crowsnest Pass in the past. The major coal-bearing unit of the Kootenay Group is the Mist Mountain Formation. Shallow Kootenay coals are present in the area between the Lewis and Livingston thrusts. The coals underlie an area of 1057 km^2 and have an average cumulative thickness of 6 m. Shortening by folding and thrusting is considerable, so an area correction factor of 1.25 is used. The volume of coal is estimated to be 7.9 x 10^9 m^3.

The rank of the coal is medium-volatile bituminous (1.25% vitrinite reflectance), which implies a conservative gas content of 10 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Kootenay coals is estimated to be **1.1 x 10^{11} m^3.** From the cross-section, it is estimated that 50% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **5.5 x 10^{10} m^3**.

5.8.2 Deep Kootenay Coal Zone

The deep Kootenay Coal zone can be mapped in all wells west of the erosional edge. The coals underlie an area of 1545 km^2 and have an average cumulative thickness of 2.5 m. Some shortening is present, so the volume must be multiplied by 1.25. Consequently, the coal volume is about 4.8 x 10^9 m^3.

The rank of the coal is high-volatile bituminous (1.05% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Kootenay coals is estimated to be **3.4 x 10^{10} m^3**.

5.9 Map Area NTS 82H (Lethbridge)

The major coal-bearing units present in the Lethbridge map area are the St. Mary River Formation and the Kootenay Group. The St. Mary River coals are too shallow and are excluded from the present calculations (Figure 13). The cross-section for the Pincher Creek area from Rottenfusser et al. (1991) is partly in this map area and depicts the general subsurface geology of the area (*see* line of section on Figure 13). It shows the extension of the Livingston Thrust, which brings Kootenay coals to the surface in the western part of the area.

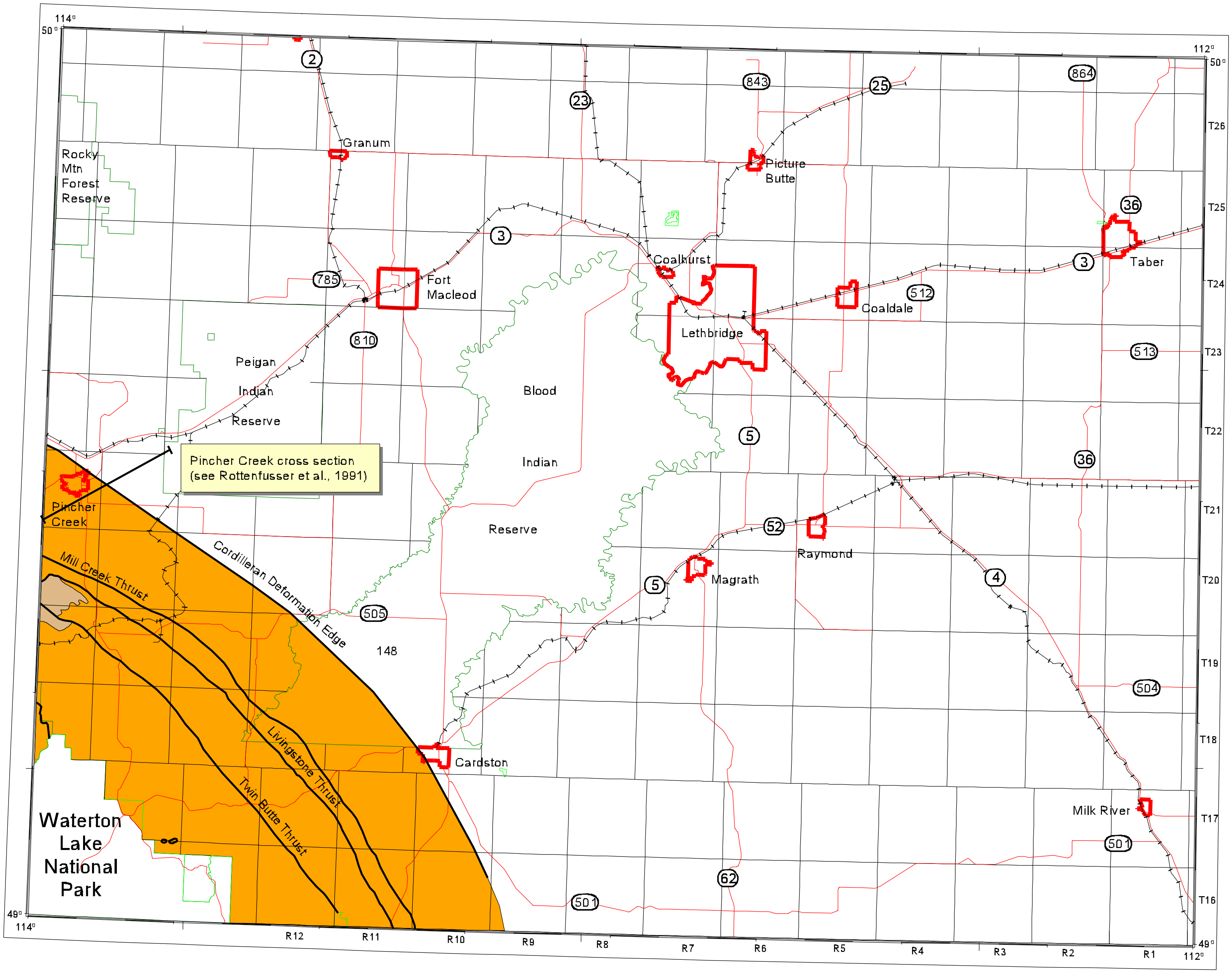
5.9.1 Shallow Kootenay Coal Zone

Shallow Kootenay coals are present in the western part of the area. The coals underlie an area of 23 km^2 (*see* Figure 13) and have an average cumulative thickness of 3 m. Shortening by folding and thrusting is considerable, so an area correction factor of 1.5 is used. The volume of coal is estimated to be 1 x 10^8 m^3.

The rank of the coal is high-volatile bituminous (1% vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the shallow Kootenay coals is estimated to be **7.2 x 10^8 m^3**. From the cross-section, it is estimated that 50% of this amount is shallower than 1000 m. Consequently, the expected gas content of coals less than 1000 m in depth is **3.6 x 10^8 m^3**.

5.9.2 Deep Kootenay Coal Zone

The deep Kootenay Coal Zone can be mapped in all wells west of the erosional edge. The coals underlie an area of 1852 km^2 (*see* Figure 13) and have an average cumulative thickness of 3 m. Some shortening is present, so the volume must be multiplied by 1.25. Consequently, the coal volume is about 7 x 10^9 m^3.



Coal area	Area in (km²)
Shallow Kootenay	23
Deep Kootenay	1852

Figure 13. Areal extent of coal zones in map area NTS 82H (Lethbridge) and location of cross-sections. Refer to Rottenfusser et al. (1991) for Pincher Creek cross-section.

The rank of the coal is high- to medium-volatile bituminous (1.1% average vitrinite reflectance), which implies a conservative gas content of 5 cm^3/g (Eddy et al., 1982) and a density of 1.4 g/cm^3. Consequently, the total methane content of the deep Kootenay coals is estimated to be **4.9 x 10^{10} m^3**.

6 Estimated Volumes of In-Place Coalbed Methane

Coalbed methane recovery from deep coals is generally not attempted because of the high cost of drilling and the low permeability that results from high overburden load and stress. The gas contents of all shallow coal zones (less than 1000 m depth) total **878 x 10^9 m^3** (**31 Tcf**) of in-place CBM (Table 2), which is considered an inferred, initial, in-place, CBM resource estimate based on limited data. The limited amount of data on formation testing and measured gas content indicate that the inferred resource is bordering on the speculative category. Most people still consider the reserves of Foothills CBM to be zero.

The gas content of coal zones at depths between 1000 and 2500 m is estimated at **613 x 10^9 m^3** (Table 2). The gas content of coal zones below 2500 m depth is estimated at **2.1 x 10^{12} m^3** (Table 3). This implies that the total gas content of all deep coal zones (deeper than 1000 m) totals **2.8 x 10^{12} m^3** (about **99 Tcf**) of in-place CBM gas. Consequently, the total ultimate CBM resource could be **3.7 x 10^{12} m^3** (**130 Tcf**). However, this number has to be considered speculative as well.

7 Conclusions and Recommendations

The shallow Kootenay coals have optimal rank and gas content. This information, combined with the observed cumulative thickness of up to 20 m (in the Canmore area), indicates favourable areas for coalbed methane exploration. The shallow Kootenay coal is the only Foothills/Mountains coal that has produced any CBM gas (Table 1). Active CBM exploration is presently underway in the southern Alberta Foothills, as well as in British Columbia. It should be noted that most published formation tests were performed in shallow Kootenay coal, whereas only one test was completed in shallow Gates coal. The Kootenay and Gates coal zones are not well defined in the northern part of the Calgary (NTS 82O) map area. More work is required in this area to properly define these coal zones.

The thickness and rank distribution (largely medium volatile and higher ranks) of the shallow Gates Coal Zone indicates optimal coalbed methane potential for these coals. The (sometimes) extensive shearing of these coals may lower the CBM potential in some areas. In the inner Foothills of the Wapiti (NTS 83L), Mount Robson (NTS 83E), Edson (NTS 83F), Brazeau (NTS 83C) and Rocky Mountain House (NTS 83B) map areas, the coals are at reasonable depth and would, therefore, be the main prospects. In the Wapiti map area (NTS 83L), wells could be completed in both the Gates and Gething coal zones, which would make drilling cost effective. The shallow Gates Coal Zone needs to be better tested in all these areas, using formation tests and coring techniques.

From the combination of thickness, rank and permeability factors, the best potential for coalbed methane in the Coalspur Coal Zone appears to be in the Edson (NTS 83F) map area, in the structure known as the Entrance Syncline and the nearby Triangle Zone (southeast of Hinton).

The 1:50 000 scale geological maps of the coal-bearing formations need to be updated. Without adequate outcrop mapping of the coal zones, accurate resource values cannot be obtained for the coals involved. In addition, the subsurface mapping of the coal zones using Foothills oil and gas wells is still inadequate. Many more coal picks from wells must be added to the AGS coal database. More cross-sections, which show the subsurface location of coal zones, must be constructed. The present availability of 14 cross-sections is inadequate to properly evaluate this large and structurally complex area. As a result, the continuity of coal zones might have been overestimated in this report. Resource values for the outer Foothills can be expected to be more accurate than those for the inner Foothills.

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Appendix 1. Coal picks from 1991 AGS coalbed methane study.

PINCHER CREEK AREA				
Well Location	**Top (m)**	**Bottom (m)**	**Thickness**	**Coal Zone**
00/05-07-004-03W5	3095	3096	1	Kootenay
	3102.5	3104.8	2.3	Kootenay
	3105.8	3106.5	0.7	Kootenay
	3127.3	3129.7	2.4	Kootenay
00/02-16-005-02W5	1677.8	1678.7	0.9	Kootenay
	1678.7	1679.3	0.6	Kootenay
	1679.3	1680.3	1	Kootenay
	1680.3	1681	0.7	Kootenay
	1681	1681.7	0.7	Kootenay
	2782	2783.3	1.3	Kootenay
	2784.5	2785.1	0.6	Kootenay
	2793.3	2794.1	0.8	Kootenay
	2794.5	2795.1	0.6	Kootenay
	2798.5	2801.5	3	Kootenay
	2809	2810.4	1.4	Kootenay
	2813.8	2818	4.2	Kootenay
	2935.3	2936.3	1	Kootenay
	2937.1	2939.6	2.5	Kootenay
00/11-04-006-01W5	4212.5	4214	1.5	Kootenay
	4220	4221	1	Kootenay
HIGHWOOD RIVER AREA				
00/10-25-017-05W5	317.9	319.2	1.3	Kootenay
	330.5	332.1	1.6	Kootenay
	1285.7	1287.8	2.1	Kootenay
			0	
00/11-32-018-01W5	1192.5	1194.8	2.3	St. Mary River
	1252.6	1254.1	1.5	St. Mary River
	1278.4	1279.5	1.1	St. Mary River
	1305.5	1306.6	1.1	St. Mary River
	1311	1316.7	5.7	St. Mary River
	1325.8	1327	1.2	St. Mary River
	1507.4	1508.2	0.8	Lethbridge
	1515.1	1515.8	0.7	Lethbridge
00/16-14-018-02W5	1446	1449	3	St. Mary River
	1458.2	1458.8	0.6	St. Mary River
	1562	1563	1	St. Mary River
00/08-30-018-03W5	1500	1500.4	0.4	Kootenay
	1559.8	1560.2	0.4	Kootenay
	1564.2	1565	0.8	Kootenay
	1570.6	1571.2	0.6	Kootenay
	1853.8	1855.1	1.3	Kootenay
	1889.4	1890.6	1.2	Kootenay
	1932.5	1933.5	1	Kootenay
	1982.9	1984	1.1	Kootenay
	3326	3326.5	0.5	Kootenay
	3533.2	3535.2	2	Kootenay
	3539.4	3540	0.6	Kootenay

Appendix 1. Coal picks from 1991 AGS coalbed methane study.

Well Location	Top (m)	Bottom (m)	Thickness	Coal Zone
00/06-11-019-03W5	886.1	887.6	1.5	Kootenay
	889.7	891.8	2.1	Kootenay
	910.7	911.8	1.1	Kootenay
	934	935.3	1.3	Kootenay
	3165	3165.8	0.8	Kootenay
	3179.8	3180.7	0.9	Kootenay
CANMORE AREA - Coal picks				
Well Loc	**Top**	**Bottom**	**Th**	**Coal Group**
00/15-24-026-08W5	2381.3	2382.3	1	Kootenay
	2421.8	2422.6	0.8	Kootenay
00/11-14-027-07W5	3314.2	3315	0.8	Kootenay
	3321.4	3322.5	1.1	Kootenay
	3332.5	3335.4	2.9	Kootenay
00/02-18-027-07W5	2948.2	2949.8	1.6	Kootenay
	2954.1	2955	0.9	Kootenay
	2956.8	2958.5	1.7	Kootenay
	3358.8	3359.8	1	Kootenay
00/11-22-028-05W5	1029.5	1030.3	0.8	Brazeau
	1652.6	1653.5	0.9	Brazeau
	1750.4	1751.2	0.8	Brazeau
00/15-32-028-05W5	487	487.5	0.5	Brazeau
	520	521.5	1.5	Brazeau
	699.5	700	0.5	Brazeau
	983	983.4	0.4	Brazeau
	1053	1053.3	0.3	Brazeau
	1354	1354.5	0.5	Brazeau
00/05-05-028-06W5	2406.1	2406.7	0.6	Kootenay
	2802.9	2804.3	1.4	Kootenay
	3261	3262	1	Kootenay
00/09-08-028-07W5	2296	2296.5	0.5	Lethbridge
NORDEGG AREA - Coal picks				
Well Loc	**Top**	**Bottom**	**Th**	**Coal Group**
00/16-33-038-16W5	1055.4	1058.1	2.7	Gates
	1731	1732	1	Gates
00/10-15-040-15W5	181	183.1	2.1	Gates
	225.4	226.3	0.9	Gates
	227.6	228.1	0.5	Gates
	249.9	255	5.1	Gates
	287.4	289.9	2.5	Gates
00/03-23-041-13W5	897.3	898.2	0.9	Coalspur
	917.4	919.1	1.7	Coalspur

Appendix 1. Coal picks from 1991 AGS coalbed methane study.

Well Location	Top (m)	Bottom (m)	Thickness	Coal Zone
	958.7	960.4	1.7	Coalspur
	968.5	970.3	1.8	Coalspur
	980.3	981.2	0.9	Coalspur
	997.5	998.3	0.8	Coalspur
	1344.2	1345.2	1	Brazeau
	3367.7	3369.3	1.6	Gates
	3443	3446	3	Gates
	3446.7	3447.5	0.8	Gates
	3460.7	3462.1	1.4	Gates
	3471.3	3472.3	1	Gates
00/10-16-041-14W5	484.1	484.9	0.8	Coalspur
	535.1	535.9	0.8	Coalspur
	3169.6	3170.7	1.1	Gates
	3255.5	3259.3	3.8	Gates
	3314.3	3318.6	4.3	Gates
	3365.3	3367.2	1.9	Gates
	3369	3371.6	2.6	Gates
	3422.2	3423.1	0.9	Gates
00/06-12-042-13W5	922.8	924.6	1.8	Coalspur
	943.6	945.3	1.7	Coalspur
	954.6	955.3	0.7	Coalspur
	1003.9	1005.4	1.5	Coalspur
	1062.3	1063	0.7	Coalspur
	1300	1300.9	0.9	Brazeau
	1314.2	1315.3	1.1	Brazeau
	1328.9	1331.5	2.6	Brazeau
	3141.3	3142.3	1	Gates
	3217.1	3221.1	4	Gates
	3233.5	3234.2	0.7	Gates
CADOMIN AREA - Coal picks				
Well Loc	**Top**	**Bottom**	**Th**	**Coal Group**
00/11-15-047-22W5	3378.3	3379.3	1	Gates
00/10-20-047-21W5	2586.4	2589.2	2.8	Gates
	2682.9	2684.1	1.2	Gates
	2706.4	2709.4	3	Gates(Jewel Seam)
00/14-08-048-21W5	1019	1020	1	Brazeau
	3804.8	3806	1.2	Gates
	3842.4	3843.3	0.9	Gates
	3869.2	3870.5	1.3	Gates
	3898	3899.4	1.4	Gates(Jewel Seam)
	3901.7	3903.6	1.9	Gates(Jewel Seam)
	4038.8	4039.8	1	Gething
00/06-09-048-22W5	2541	2542.2	1.2	Gates
	2576.7	2577.8	1.1	Gates
	2602.1	2603.1	1	Gates
	2613.8	2614.8	1	Gates
	2634.2	2636.3	2.1	Gates(Jewel Seam)

Appendix 1. Coal picks from 1991 AGS coalbed methane study.

Well Location	Top (m)	Bottom (m)	Thickness	Coal Zone
	2637.2	2638.5	1.3	Gates(Jewel Seam)
00/06-05-049-21W5	319.1	320.1	1	Coalspur
	328	330.7	2.7	Coalspur
	436.3	438	1.7	Coalspur-(Mynheer Seam)
	438.7	439.7	1	Coalspur-(Mynheer Seam)
	922.9	923.8	0.9	Brazeau
	945.3	945.9	0.6	Brazeau
	991.6	992.7	1.1	Brazeau
	996.8	998	1.2	Brazeau
	3284.7	3287.7	3	Gates
	3330	3331	1	Gates
	3332.2	3333.6	1.4	Gates
	3431.6	3432.2	0.6	Jewel Seam (Gates)
00/09-12-049-22W5	871	872.3	1.3	Brazeau
	875.9	876.8	0.9	Brazeau
	893.9	894.8	0.9	Brazeau
	950.6	951.2	0.6	Brazeau
	1202.4	1203.3	0.9	Brazeau
	3335.4	3338.4	3	Gates
	3354.9	3355.8	0.9	Gates
	3368	3371	3	Gates
	3405.5	3406.4	0.9	Gates
	3444.5	3445.4	0.9	Gates
	3478	3481.7	3.7	Jewel Seam (Gat
00/11-33-049-21W5	645	645.8	0.8	Coalspur-(Val d'Or Seam)
	646.2	649	2.8	Coalspur-(Val d'Or Seam)
	649.5	655.2	5.7	Coalspur-(Val d'Or Seam)
	656	657	1	Coalspur-(Val d'Or Seam)
	657.6	659.1	1.5	Coalspur-(Val d'Or Seam)
	660.2	662	1.8	Coalspur-(Val d'Or Seam)
	662.4	663.1	0.7	Coalspur-(Val d'Or Seam)
	677.6	678.5	0.9	Coalspur-(McLeod Seam)
	711.5	712.5	1	Coalspur-(McPherson Seam)
	713.2	715	1.8	Coalspur-(McPherson Seam)
	715.9	718	2.1	Coalspur-(McPherson Seam)
	797.8	799.1	1.3	St. Mary River
	825.8	829.4	3.6	Coalspur-(Mynheer Seam)
	831	832	1	Coalspur-(Mynheer Seam)
	1183	1185	2	Brazeau
	3351.2	3353.8	2.6	Gates
	3382.4	3383.3	0.9	Gates
	3383.8	3384.7	0.9	Gates
	3411.2	3412.3	1.1	Gates
	3415	3416.7	1.7	Jewel Seam (Gates)
	3436	3437.5	1.5	Jewel Seam (Gates)
	3558.5	3559.2	0.7	Gething
00/15-03-046-21W5	2295.7	2297.6	1.9	Gates
	2415.7	2417.2	1.5	Gates
	2434.3	2436.1	1.8	Gates
	2450.3	2452.5	2.2	Jewel Seam (Gates)

Appendix 1. Coal picks from 1991 AGS coalbed methane study.

Well Location	Top (m)	Bottom (m)	Thickness	Coal Zone
GRANDE CACHE AREA - Coal picks				
Well Loc	**Top**	**Bottom**	**Th**	**Coal Group**
00/06-23-056-06W6	889.9	891.2	1.3	Gates
	932.9	934.8	1.9	Gates
	949.1	950.3	1.2	Gates
	951.2	952.1	0.9	Gates
	996	997	1	Gates
	997.9	999.7	1.8	Gates
	1021	1023.8	2.8	Gates
	1170.7	1171.3	0.6	Gething
00/10-32-057-06W6	2218.4	2220	1.6	Gates
	2228.5	2229.3	0.8	Gates
	2247.5	2249.8	2.3	Gates
	2264.1	2265	0.9	Gates
00/11-20-058-04W6	927	928	1	Coalspur
	1024	1025	1	Coalspur
	3654	3655	1	Gates
	3656	3657	1	Gates
	3695	3696	1	Gates
	3710.5	3712	1.5	Gates
	3751.5	3753	1.5	Gates
	3776.5	3777	0.5	Gates
	3894.5	3896	1.5	Gething
00/15-11-058-05W6	943	944	1	Coalspur
	952.8	953.5	0.7	Coalspur
	1092.5	1093.5	1	Coalspur
	3809.5	3810	0.5	Gates
	3823	3824	1	Gates
	3861	3864.2	3.2	Gates
	3885.5	3886.5	1	Gates
	3888	3889.9	1.9	Gates
	3890.1	3890.6	0.5	Gates
	3913.5	3915	1.5	Gates
	3915.2	3915.6	0.4	Gates
	4033.5	4034.5	1	Gething
00/10-29-058-05W6	745.5	746.3	0.8	Coalspur
	806.7	807.5	0.8	Coalspur
	851.9	852.5	0.6	Coalspur
	853.7	854.6	0.9	Coalspur
	915	916	1	Coalspur
00/10-07-058-05W6	535	537.1	2.1	Coalspur
	541.8	542.7	0.9	Coalspur
	668	669.2	1.2	Coalspur
00/06-22-059-05W6	814.9	815.6	0.7	Coalspur
	903.7	904.3	0.6	Coalspur
	3557.7	3558.5	0.8	Gates
	3559.3	3560.4	1.1	Gates

Appendix 1. Coal picks from 1991 AGS coalbed methane study.

Well Location	Top (m)	Bottom (m)	Thickness	Coal Zone
	3568.3	3569.9	1.6	Gates
	3590.9	3593.2	2.3	Gates
	3608.5	3610	1.5	Gates
	3634.4	3636.4	2	Gates
	3648.1	3650.4	2.3	Gates
	3676.5	3677.5	1	Gates
	3849.9	3850.6	0.7	Gething
	3850.8	3851.4	0.6	Gething
NARRAWAY RIVER - Coal picks				
Well Loc	**Top**	**Bottom**	**Th**	**Coal Group**
00/06-19-063-10W6	801.5	801.8	0.3	Brazeau
	3262.3	3263.5	1.2	Gates
	3280.6	3282	1.4	Gates
	3285	3286	1	Gates
	3302	3302.7	0.7	Gates
	3310	3311	1	Gates
	3318	3319.1	1.1	Gates
	3332.7	3333.2	0.5	Gates
	3334	3335	1	Gates
	3359	3360	1	Gates
	3558.8	3559.9	1.1	Gething
	3614	3616	2	Gething
	3664.5	3665.2	0.7	Gething
00/05-03-063-11W6	2683.3	2684.2	0.9	Gates
	2704.7	2705.5	0.8	Gates
	2732.7	2734	1.3	Gates
	2752.8	2754.2	1.4	Gates
	2802.8	2807	4.2	Gates
	3028.4	3030	1.6	Gething
	3049	3050	1	Gething
	3151.5	3152.8	1.3	Gething
	3172	3172.4	0.4	Gething
00/06-24-062-11W6	3196.8	3198	1.2	Gates
	3225	3225.7	0.7	Gates
	3260.7	3261.7	1	Gates
	3294.3	3295	0.7	Gates
	3336.4	3340.5	4.1	Gates
	3341.5	3343.4	1.9	Gates
	3374.5	3375.1	0.6	Gates
	3385.4	3386.2	0.8	Gates
	3524.9	3525.7	0.8	Gething
	3537.5	3539	1.5	Gething
	3547.4	3548.3	0.9	Gething
	3553.2	3554.2	1	Gething
	3571.8	3572.2	0.4	Gething
	3592.2	3592.8	0.6	Gething
00/11-03-062-12W6	2528.8	2529.7	0.9	Gates
	2545.5	2546.8	1.3	Gates
	2610.1	2611.9	1.8	Gates

Appendix 1. Coal picks from 1991 AGS coalbed methane study.

Well Location	Top (m)	Bottom (m)	Thickness	Coal Zone
	2696.4	2704.8	8.4	Gates
	2760	2761.3	1.3	Gates
	2772.1	2773.8	1.7	Gates
	2916.8	2917.8	1	Gething
	2927	2927.7	0.7	Gething
	2956.4	2957	0.6	Gething
	2980	2980.9	0.9	Gething
00/01-18-062-12W6	2103.6	2105.1	1.5	Gates
	2182.5	2184	1.5	Gates
	2235	2241.5	6.5	Gates
	2437.8	2438.2	0.4	Gething
	2455.7	2456.5	0.8	Gething
00/15-26-061-13W6	889.3	890.5	1.2	Gates
	904.9	905.5	0.6	Gates
	982	983.5	1.5	Gates
	992.7	993.9	1.2	Gates
	1048.5	1049.7	1.2	Gates
	1050.6	1055.2	4.6	Gates
	1076.2	1077.7	1.5	Gates
	1090.8	1092.4	1.6	Gates
	1117.7	1119.8	2.1	Gates
	1228.7	1229.6	0.9	Gething
	1237.8	1238.7	0.9	Gething
	1256.1	1256.7	0.6	Gething
	1261.9	1262.8	0.9	Gething
00/09-11-065-13W6	2901	2902	1	Gates
	2963	2969	6	Gates
	3010.5	3012	1.5	Gates
	3192.5	3194	1.5	Gething
	3208.5	3209	0.5	Gething

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
OLDMAN RIVER AREA						
NTS 83G						
00/03-03-010-03W5	1902.4	1903.0	6240	6242	0.6	Kootenay
	2163.4	2164.0	7096	7098	0.6	Kootenay
	2498.8	2499.4	8196	8198	0.6	Kootenay
	2500.0	2500.6	8200	8202	0.6	Kootenay
Structural Repeat	3059.8	3060.4	10036	10038	0.6	Kootenay
00/05-01-010-04W5	458	460			2.0	Kootenay
	552	553			1.0	Kootenay
Structural Repeat	2954	2956			2.0	Kootenay
Structural Repeat	2957	2958			1.0	Kootenay
00/07-03-010-04W5	950.6	951.8	3118	3122	1.2	Kootenay
	953.7	954.9	3128	3132	1.2	Kootenay
	958.2	959.1	3143	3146	0.9	Kootenay
	1011.0	1011.6	3316	3318	0.6	Kootenay
00/08-16-010-04W5	1436	1437			1.0	Kootenay
	1493	1494			1.0	Kootenay
	1497	1500			3.0	Kootenay
	1505	1506			1.0	Kootenay
	1511	1512			1.0	Kootenay
	1517	1518			1.0	Kootenay
	1536	1537			1.0	Kootenay
Structural Repeat	2958	2959			1.0	Kootenay
00/03-22-010-04W5	1167	1168			1.0	Kootenay
aka 00/04-22-010-04W5	1204	1205			1.0	Kootenay
	1224	1225			1.0	Kootenay
	1270	1272			2.0	Kootenay
	1293	1294			1.0	Kootenay
00/08-33-010-04W5	1482.9	1485.4	4864	4872	2.4	Kootenay
aka00/07-33-010-04W5	1512.8	1514.0	4962	4966	1.2	Kootenay
	1548.4	1548.8	5078.8	5080	0.4	Kootenay
	1653.0	1655.5	5422	5430	2.4	Kootenay
Structural Repeat	3472.0	3474.4	11388	11396	2.4	Kootenay
Structural Repeat	3521.3	3522.6	11550	11554	1.2	Kootenay
00/04-18-011-01W5	503	510			7.0	Kootenay
from Dawson et al., 2000	511	512.5			1.5	Kootenay
	518.5	524			5.5	Kootenay
	533	534.5			1.5	Kootenay
	541.5	542.7			1.2	Kootenay
	554	555			1.0	Kootenay
	580	581			1.0	Kootenay
00/14-30-011-01W5	1064.2	1065			0.8	St. Marry River
	1909	1910			1	St. Marry River
	2131	2132			1	St. Marry River
00/08-36-011-02W5	854.6	855.8	2803	2807	1.2	Belly River
	1918.6	1919.5	6293	6296	0.9	Belly River
	1929.9	1930.8	6330	6333	0.9	Belly River
	4066.2	4066.8	13337	13339	0.6	Kootenay
	4083.2	4083.8	13393	13395	0.6	Kootenay

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	4152.1	4152.7	13619	13621	0.6	Kootenay
RED-DEER AREA						
NTS 82O						
00/08-14-026-04W5	1099	1101			2	Brazeau
	1210	1211.5			1.5	Brazeau
	1492	1493			1	Brazeau
	1505	1506			1	Brazeau
	1531	1532			1	Brazeau
	1569	1570.5			1.5	Brazeau
	1600	1601			1	Brazeau
00/09-29-029-10W5	1478	1479			1	Kootenay
	1508	1509			1	Kootenay
	1947	1948			1	Kootenay
00/14-32-029-10W5	1486	1487			1	Kootenay
	1489	1490			1	Kootenay
	1512	1514			2	Kootenay
Structural Repeat	1695	1696			1	Kootenay
00/07-36-029-11W5	1771.5	1773			1.5	Kootenay
00/06-20-030-09W5	1860.5	1862			1.5	Gates
Structural Repeat	2412.5	2413			0.5	Gates
	2414	2415			1.0	Gates
	2492	2495			3.0	Gates
	2530	2531			1.0	Gates
	2586	2587			1.0	Gates
	2590	2591			1.0	Gates
00/09-19-030-10W5	1426	1427			1	Gates
	1580	1581.5			1.5	Gates
	1746	1747			1	Gates
	1853	1853.5			0.5	Kootenay
	1854.5	1855.5			1	Kootenay
	1908	1910			2	Kootenay
	1911	1912.5			1.5	Kootenay
	1926	1927			1	Kootenay
00/05-29-030-10W5	1526.5	1527.1	5007	5009	0.6	Gates
	1812.2	1812.8	5944	5946	0.6	Kootenay
	1835.7	1836.3	6021	6023	0.6	Kootenay
00/03-12-031-09W5	2844.5	2845.5			1.0	Gates
	2898	2899			1.0	Gates
	2944	2945			1.0	Gates
00/13-12-031-09W5	2697.6	2698.2	8848	8850	0.6	Gates
	2764.0	2765.2	9066	9070	1.2	Gates
00/13-14-031-09W5	2861.0	2861.6	9384	9386	0.6	Gates
00/02-12-031-10W5	1735.0	1736.0	5690.8	5694.1	1.0	Gates
	1737	1738	5697.4	5700.6	1.0	Gates
	1953.0	1954.0	6405.8	6409.1	1.0	Gates
Structural Repeat	2122.0	2123.0	6960.2	6963.4	1.0	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	2131.0	2132.0	6989.7	6993.0	1.0	Kootenay
	2146.5	2147.5	7040.5	7043.8	1.0	Kootenay
	2173	2174	7127.4	7130.7	1.0	Kootenay
	2192	2193	7189.8	7193.0	1.0	Kootenay
	2208.0	2209.0	7242.2	7245.5	1.0	Kootenay
	2240.0	2241.0	7347.2	7350.5	1.0	Kootenay
	2247	2248	7370.2	7373.4	1.0	Kootenay
00/06-18-032-06W5	416.2	417.1	1365	1368	0.9	Brazeau
	3022.9	3023.8	9915	9918	0.9	Gates
	3110.7	3111.6	10203	10206	0.9	Gates
00/06-32-032-06W5	2903.4	2904.3	9523	9526	0.9	Gates
	3024.4	3025.6	9920	9924	1.2	Gates
	3033.2	3034.1	9949	9952	0.9	Gates
00/06-10-032-07W5	1295.7	1297.0	4250	4254	1.2	Brazeau
	3325.0	3325.9	10906	10909	0.9	Gates
	3373.5	3374.4	11065	11068	0.9	Gates
	3377.4	3378.0	11078	11080	0.6	Gates
	3385.4	3386.0	11104	11106	0.6	Gates
00/11-22-032-07W5	3172.6	3173.8	10406	10410	1.2	Gates
	3198.8	3200.6	10492	10498	1.8	Gates
	3202.4	3203.7	10504	10508	1.2	Gates
	3206.7	3207.3	10518	10520	0.6	Gates
00/02-34-032-07W5	721.5	722.5			1.0	Brazeau
00/13-10-032-08W5	1123	1124			1.0	Brazeau
	1778	1779.5			1.5	Brazeau
00/07-27-032-08W5	2740	2742			2.0	Gates
	3353	3354			1.0	Gates
	3585	3586			1.0	Gates
	3655	3656.5			1.5	Gates
00/06-03-033-06W5	706	707.5			1.5	Coalspur
	898	899			1	Coalspur
	962	963			1	Brazeau
	972.5	973.5			1	Brazeau
	992.5	993.5			1	Brazeau
	1000	1001			1	Brazeau
	1014.5	1015.5			1	Brazeau
	1154	1156			2	Brazeau
	1179	1180			1	Brazeau
00/07-04-033-06W5	511	511.5			0.5	Brazeau
	2848	2849			1.0	Gates
	2910	2912			2.0	Gates
	2926	2927			1.0	Gates
	2929	2930			1.0	Gates
00/14-11-033-06W5	1073	1075			2.0	Brazeau
	2745	2746			1.0	Gates
	2806	2807			1.0	Gates
	2856	2857.5			1.5	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
00/12-21-033-06W5	1041.5	1042.7	3416	3420	1.2	Brazeau
	1149.4	1150.6	3770	3774	1.2	Brazeau
	2931.1	2932.0	9614	9617	0.9	Gates
	2936.6	2937.2	9632	9634	0.6	Gates
	2961.9	2962.8	9715	9718	0.9	Gates
00/11-33-033-06W5	1175.3	1175.9	3855	3857	0.6	Brazeau
	2869.2	2869.8	9411	9413	0.6	Gates
	2932.3	2932.9	9618	9620	0.6	Gates
	2951.8	2953.0	9682	9686	1.2	Gates
	2957.9	2958.8	9702	9705	0.9	Gates
	2977.4	2978.4	9766	9769	0.9	Gates
00/06-01-033-07W5	1088.5	1089.5			1.0	Brazeau
00/15-12-033-07W5	639.0	640.2	2096	2100	1.2	Brazeau
Structural Repeat	641.2	642.1	2103	2106	0.9	Brazeau
	2943.9	2945.1	9656	9660	1.2	Gates
00/06-23-033-07W5	3016.0	3017.0			1.0	Gates
From Dawson et al., 2000	3052.0	3054.0			2.0	Gates
	3065.7	3072.2			6.5	Gates
	3085.3	3086.0			0.7	Gates
	3117.0	3120.5			3.5	Gates
NEW NORDEGG AREA						
NTS 83B						
00/16-33-038-16W5	1054	1055.5			1.5	Gates
	1731	1732			1	Gates
	1777	1778			1	Gates
00/06-34-038-16W5	1113	1115			2	Gates
	1175	1176			1	Gates
	1196	1197			1	Gates
	1237.3	1238.8			1.5	Gates
00/04-09-039-17W5	619	620			1	Gladstone
Structural Repeat	639	640			1	Gladstone
Structural Repeat	678	679			1	Gladstone
Structural Repeat	724	725			1	Gladstone
Structural Repeat	730.5	731.5			1	Gladstone
Structural Repeat	736	737			1	Gladstone
Structural Repeat	741	742			1	Gladstone
Structural Repeat	770	771			1	Gladstone
Structural Repeat	780	781			1	Gladstone
Structural Repeat	785	786			1	Gladstone
Structural Repeat	795	796			1	Gladstone
	2937	2938.5			1.5	Gates
Structural Repeat	2939	2939.7			0.7	Gates
	2987	2988			1	Gates
00/13-10-039-17W5	411	411.5			0.5	Gates
	423	425			2	Gates
	459.5	460.5			1	Gates
	676.5	677			0.5	Gladstone
00/11-25-040-14W5	3244.2	3245.4	10641	10645	1.2	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	3334.1	3336.6	10936	10944	2.4	Gates
	3336.9	3338.4	10945	10950	1.5	Gates
	3355.5	3356.7	11006	11010	1.2	Gates
	3368.6	3369.5	11049	11052	0.9	Gates
00/10-10-041-14W5	3097.3	3098.5	10159	10163	1.2	Gates
	3180.8	3186.0	10433	10450	5.2	Gates
	3289.9	3293.0	10791	10801	3.0	Gates
	3321.6	3322.9	10895	10899	1.2	Gates
00/10-11-041-14W5	490.2	490.9	1608	1610	0.6	Coalspur
	2957.3	2958.5	9700	9704	1.2	Gates
	3034.1	3036.6	9952	9960	2.4	Gates
	3066.5	3067.1	10058	10060	0.6	Gates
	3077.4	3079.0	10094	10099	1.5	Gates
	3120.4	3121.0	10235	10237	0.6	Gates
	3125.6	3126.2	10252	10254	0.6	Gates
	3136.3	3137.2	10287	10290	0.9	Gates
	3150.6	3151.2	10334	10336	0.6	Gates
00/10-15-041-14W5	824	824	2702	2704	1	Coalspur
	3299	3302	10820	10830	3	Gates
	3357	3358	11012	11014	1	Gates
	3416	3421	11204	11220	5	Gates
	3459	3462	11344	11354	3	Gates
	3492	3493	11454	11456	1	Gates
00/10-22-041-14W5	3302.1	3306.1	10831	10844	4.0	Gates
	3317.1	3318.0	10880	10883	0.9	Gates
	3376.2	3377.7	11074	11079	1.5	Gates
	3391.5	3392.7	11124	11128	1.2	Gates
00/07-23-041-14W5	3136.0	3137.0			1.0	Gates
	3138.5	3141.0			2.5	Gates
	3223.5	3224.5			1.0	Gates
	3225.0	3226.0			1.0	Gates
	3226.5	3227.0			0.5	Gates
	3236.8	3237.7			0.9	Gates
	3278.0	3279.0			1.0	Gates
00/10-33-041-14W5	3338.0	3340.5			2.5	Gates
	3374.0	3375.0			1.0	Gates
	3392.0	3393.0			1.0	Gates
	3407.5	3408.5			1.0	Gates
00/15-14-042-13W5	990	991			1	Coalspur
	1031	1032			1	Coalspur
	1390.5	1391.5			1	Brazeau
	3210	3211			1	Gates
	3279	3283			4	Gates
	3295	3297			2	Gates
00/10-28-042-13W5	724.4	725.0	2376	2378	0.6	Coalspur
	860.4	861.3	2822	2825	0.9	Coalspur
	926.8	927.4	3040	3042	0.6	Coalspur
	928.0	929.0	3044	3047	0.9	Coalspur
	967.1	967.7	3172	3174	0.6	Coalspur
	973.8	974.4	3194	3196	0.6	Coalspur

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	998.8	999.4	3276	3278	0.6	Coalspur
	1056.7	1057.3	3466	3468	0.6	Coalspur
	1271.3	1272.3	4170	4173	0.9	Brazeau
	1400.3	1400.9	4593	4595	0.6	Brazeau
	1401.2	1402.1	4596	4599	0.9	Brazeau
	3181.1	3182.3	10434	10438	1.2	Gates
	3245.4	3248.2	10645	10654	2.7	Gates
	3249.4	3250.0	10658	10660	0.6	Gates
	3262.8	3263.7	10702	10705	0.9	Gates
00/06-05-042-14W5	3331.7	3332.3	10928	10930	0.6	Gates
	3414.0	3417.7	11198	11210	3.7	Gates
	3457.0	3458.5	11339	11344	1.5	Gates
	3472.3	3474.0	11389	11395	1.7	Gates
00/10-15-042-14W5	1143.5	1144.5			1.0	Coalspur
	1152.0	1152.8			0.8	Coalspur
	1154.0	1154.6			0.6	Coalspur
	1183.0	1184.0			1.0	Coalspur
	1237.0	1238.0			1.0	Coalspur
	1495.0	1496.0			1.0	Brazeau
	3528	3529			1	Gates
	3572	3572.5			0.5	Gates
	3583.5	3584			0.5	Gates
NEW NORDEGG AREA						
NTS 83C						
00/10-31-041-14W5	3208.8	3211.0	10525	10532	2.1	Gates
	3253.7	3255.5	10672	10678	1.8	Gates
00/07-25-041-15W5/2	3202.5	3204.5			2	Gates
	3226	3228			2	Gates
	3248	3249			1	Gates
	3276	3278			2	Gates
00/10-26-041-15W5	496.5	498			1.5	Coalspur
	538.5	539.5			1	Coalspur
	634	635			1	Coalspur
	653	654			1	Coalspur
	655	655.5			0.5	Coalspur
	714	715.5			1.5	Coalspur
	1102	1104			2	Brazeau
	3620	3623			3	Gates
	3663	3663.5			0.5	Gates
	3708	3711			3	Gates
00/10-07-041-16W5	1053.4	1055.5	3455	3462	2.1	Gates
	1211.0	1212.2	3972	3976	1.2	Gates
	1230.5	1232.3	4036	4042	1.8	Gates
00/11-16-041-16W5	360.4	361.3	1182	1185	0.9	Gates
	364.3	364.9	1195	1197	0.6	Gates
	365.2	365.7	1198	1199.5	0.5	Gates
	365.9	366.2	1200	1201	0.3	Gates
	386.9	387.8	1269	1272	0.9	Gates
	406.7	407.0	1334	1335	0.3	Gates
	407.3	407.9	1336	1338	0.6	Gates
	408.2	409.1	1339	1342	0.9	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	432.3	432.9	1418	1420	0.6	Gates
	433.5	433.8	1422	1423	0.3	Gates
00/11-01-042-15W5	2940.9	2942.1	9646	9650	1.2	Gates
	3018.9	3021.3	9902	9910	2.4	Gates
00/06-03-042-15W5	3046.5	3047.5			1	Gates
	3123.5	3124.8			1.3	Gates
	3164	3165			1	Gates
	3177.5	3179			1.5	Gates
	3207	3209.5			2.5	Gates
	3209.7	3211			1.3	Gates
	3284	3286.5			2.5	Gates
00/13-07-042-14W5	3045	3047.5			2.5	Gates
	3074	3076			2	Gates
	3091.5	3093.5			2	Gates
	3122	3124			2	Gates
	3147.5	3150			2.5	Gates
00/02-08-042-15W5	3344.5	3346.5			2	Gates
AKA-00/06-08-042-15W5/0	3368.5	3372.5			4	Gates
	3409	3409.5			0.5	Gates
00/03-13-042-15W5/2	3275	3276			1	Gates
	3316.5	3317			0.5	Gates
	3351.5	3354			2.5	Gates
	3395.5	3396.5			1	Gates
00/06-20-042-15W5	3188.4	3189.9	10458	10463	1.5	Gates
	3222.6	3224.4	10570	10576	1.8	Gates
	3246.0	3247.6	10647	10652	1.5	Gates
	3269.8	3271.0	10725	10729	1.2	Gates
00/05-30-042-15W5	3231.5	3232.5			1	Gates
	3278.5	3279.5			1	Gates
	3280	3281.5			1.5	Gates
	3305.3	3306.5			1.2	Gates
	3325.5	3326			0.5	Gates
00/07-13-042-16W5	2789	2790			1	Gates
	2864	2865			1	Gates
	2892	2892.5			0.5	Gates
	2893.5	2894.5			1	Gates
	2895	2896.5			1.5	Gates
00/07-23-042-16W5	3117	3118			1	Gates
	3156.5	3158			1.5	Gates
	3191.5	3192.5			1	Gates
00/05-27-042-16W5	3190.5	3192.5			2	Gates
	3211.5	3214			2.5	Gates
	3233	3234.5			1.5	Gates
	3252	3253			1	Gates
00/14-27-042-16W5	3031.5	3034			2.5	Gates
	3056.5	3058			1.5	Gates
	3064	3065			1	Gates

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	3134	3135			1	Gates
	3136	3137			1	Gates
	3151.5	3153			1.5	Gates
00/11-33-042-16W5	2821	2822.5			1.5	Gates
	2886.5	2888			1.5	Gates
	2933.5	2935.5			2	Gates
COAL VALLEY AREA						
NTS 83C						
00/08-24-043-19W5	2747.5	2748			0.5	Gates
	2751	2752.5			1.5	Gates
	2832	2833			1	Gates
	2862.5	2864.5			2	Gates
	2901.8	2904.5			2.7	Gates
	2905	2907			2	Gates
	2918.6	2920			1.4	Gates
	3087.5	3088.5			1	Gates
	3091	3091.5			0.5	Gates
00/03-27-044-19W5	1875	1876			1	Gates
	1907	1911.5			4.5	Gates
	1912	1913			1	Gates
	1997	1997.5			0.5	Gates
	2002.5	2004			1.5	Gates
	2026	2026.5			0.5	Gates
	2027	2027.5			0.5	Gates
00/04-03-045-18W5	742	743.3			1.3	Brazeau
	758	759			1.0	Brazeau
	802.2	804.4			2.2	Brazeau
	866.3	867			0.7	Brazeau
	3108	3109.5			1.5	Gates
	3113	3113.5			0.5	Gates
	3114	3115			1.0	Gates
	3205.5	3207.5			2.0	Gates
	3214	3215.5			1.5	Gates
	3216.5	3217			0.5	Gates
	3237.5	3239.5			2.0	Gates
	3255	3256.5			1.5	Gates
00/10-09-045-18W5	2858.5	2860			1.5	Gates
	2866.5	2868			1.5	Gates
	2983.5	2985			1.5	Gates
	2992	2993			1	Gates
	2994	2996.2			2.2	Gates
	2999	3000			1	Gates
	3009	3011			2	Gates
	3026.8	3028			1.2	Gates
	3028.5	3029			0.5	Gates
00/12-35-045-18W5	699.4	700			0.6	Brazeau
	714	715.2			1.2	Brazeau
	730.5	732			1.5	Brazeau
	744.5	746			1.5	Brazeau
	775.8	776.5			0.7	Brazeau

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
00/16-36-045-18W5	702.5	703.8			1.3	Coalspur
	707	708			1.0	Coalspur
	708.8	710.3			1.5	Coalspur
	767	768			1.0	Coalspur
	786	787.8			1.8	Coalspur
	794.8	796			1.2	Coalspur
	827.5	828.2			0.7	Coalspur
	932	935.2			3.2	Coalspur
	936	936.8			0.8	Coalspur
	952	953			1.0	Coalspur
	984	986			2.0	Coalspur
	3549.5	3550.5			1.0	Gates
	3605	3607			2.0	Gates
	3626.5	3627.5			1.0	Gates
	3628	3631			3.0	Gates
	3654.5	3658			3.5	Gates
00/06-03-046-17W5	985	986	3231	3234	1.0	Coalspur
	986.5	987.2	3236	3238	0.7	Coalspur
	1025	1025.9	3362	3365	0.9	Coalspur
	1026	1027	3365	3369	1.0	Coalspur
	1323	1324	4340	4345	1.0	Brazeau
	1329	1330	4360	4363	1.0	Brazeau
	1343	1343.7	4404	4407	0.7	Brazeau
	3434.1	3435.6	11264	11269	1.5	Gates
	3464	3467.4	11362	11373	3.4	Gates
	3487.5	3487.8	11439	11440	0.3	Gates
00/12-11-046-17W5	777.5	778			0.5	Coalspur
	787	788			1.0	Coalspur
	790.2	792.9			2.7	Coalspur
	795	795.8			0.8	Coalspur
	823	823.5			0.5	Coalspur
	824.5	826.5			2.0	Coalspur
	827	827.5			0.5	Coalspur
	827.6	828			0.4	Coalspur
	905	905.9			0.9	Coalspur
	955	956.8			1.8	Coalspur
	995.5	996			0.5	Coalspur
	1245	1246.8			1.8	Brazeau
	1256	1257			1.0	Brazeau
	1286	1286.5			0.5	Brazeau
	1287	1287.8			0.8	Brazeau
	1312.8	1314.2			1.4	Brazeau
	3403	3404.5			1.5	Gates
	3437	3440.5			3.5	Gates
00/07-23-046-17W5	745.2	747			1.8	Coalspur
	748.7	750			1.3	Coalspur
	750.5	751			0.5	Coalspur
	774.2	776.2			2.0	Coalspur
	777	778.9			1.9	Coalspur
	797	797.8			0.8	Coalspur
	798	799			1.0	Coalspur
	818	819			1.0	Coalspur
	856.5	858			1.5	Coalspur
	902.5	903.5			1.0	Coalspur
	904	904.9			0.9	Coalspur

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	913.8	914.5			0.7	Coalspur
	952	953.5			1.5	Coalspur
	956	957.5			1.5	Coalspur
	1244.8	1247			2.2	Brazeau
	3406.5	3408			1.5	Gates
	3424.5	3426.3			1.8	Gates
	3463.5	3465			1.5	Gates
00/13-24-046-17W5	684.3	685			0.7	Coalspur
	688	689.7			1.7	Coalspur
	691	692			1.0	Coalspur
	711	712.5			1.5	Coalspur
	727.4	728			0.6	Coalspur
	873.5	875			1.5	Coalspur
	886	887.5			1.5	Coalspur
	892.2	893.5			1.3	Coalspur
	1187	1188			1.0	Brazeau
	3391	3392			1.0	Gates
	3392.5	3393			0.5	Gates
	3409	3409.7			0.7	Gates
	3410.2	3412			1.8	Gates
	3443.5	3444			0.5	Gates
	3444.1	3445.5			1.4	Gates
00/15-03-046-21W5	2295.5	2297			1.5	Gates
	2415.5	2417			1.5	Gates
	2434	2436			2	Gates
	2450.5	2452.5			2	Gates
	2561	2563.5			2.5	Gates
COAL VALLEY AREA						
NTS 83F						
00/08-36-046-17W5	662.5	663.5			1.0	Coalspur
	664	666.5			2.5	Coalspur
	674.5	676			1.5	Coalspur
	677	677.5			0.5	Coalspur
	678	678.8			0.8	Coalspur
	698.8	700			1.2	Coalspur
	701.5	702.5			1.0	Coalspur
	723	725			2.0	Coalspur
	729	730			1.0	Coalspur
	771.4	772.8			1.4	Coalspur
	773.3	775.2			1.9	Coalspur
	816.5	818			1.5	Coalspur
	819.1	819.7			0.6	Coalspur
	823.3	823.9			0.6	Coalspur
	824.4	825.5			1.1	Coalspur
	846	846.5			0.5	Coalspur
	954	955			1.0	Coalspur
	963	963.8			0.8	Coalspur
	996	998			2.0	Coalspur
	1008.5	1009			0.5	Coalspur
	1275	1275.5			0.5	Brazeau
00/12-04-047-16W5	678.5	679.2			0.7	Coalspur
	697.5	698.2			0.7	Coalspur
	698.8	699.5			0.7	Coalspur

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	713.5	714			0.5	Coalspur
	715	717			2.0	Coalspur
	746.5	747			0.5	Coalspur
	782.5	783.5			1.0	Coalspur
	826.5	827			0.5	Coalspur
	856.5	857			0.5	Coalspur
	872	874			2.0	Coalspur
	875	876.3			1.3	Coalspur
00/02-07-047-16W5	783	784			1.0	Coalspur
	784.7	786.4			1.7	Coalspur
	800	801.6			1.6	Coalspur
	802.2	802.8			0.6	Coalspur
	803.1	804			0.9	Coalspur
	820	821.5			1.5	Coalspur
	821.7	822.2			0.5	Coalspur
	841.5	843			1.5	Coalspur
	853.5	854.5			1.0	Coalspur
	942.5	943.5			1.0	Coalspur
	944	945			1.0	Coalspur
	951	952			1.0	Coalspur
	984	987.5			3.5	Coalspur
	1239	1240.5			1.5	Brazeau
	1264	1265			1.0	Brazeau
	3197	3198			1.0	Gates
	3222	3222.7			0.7	Gates
	3238	3238.8			0.8	Gates
	3243	3244.5			1.5	Gates
	3269.5	3272			2.5	Gates
02/06-15-047-16W5	823.8	825.3	2702.9	2707.8	1.5	Coalspur
	1007	1009.8	3304.0	3313.2	2.8	Coalspur
	3115	3116	10220.3	10223.6	1.0	Gates
	3171.3	3172.5	10405.0	10409.0	1.2	Gates
	3192	3194	10473.0	10479.5	2.0	Gates
00/11-20-047-18W5	656	657.5			1.5	Coalspur
	658.25	661.5			3.25	Coalspur
	661.8	662.8			1	Coalspur
	692.5	694			1.5	Coalspur
	745	746.8			1.8	Coalspur
	755	756			1	Coalspur
	833.5	835.8			2.3	Coalspur
	840.3	841.5			1.2	Coalspur
	879.7	883.6			3.9	Coalspur
00/12-34-047-20W5	1206.2	1207.7			1.5	Brazeau
	1261	1262			1	Brazeau
	3496	3496.8			0.8	Gates
	3497	3498.5			1.5	Gates
	3499	3500			1	Gates
	3530	3530.8			0.8	Gates
	3538	3539.8			1.8	Gates
	3540	3541			1	Gates
	3557.5	3559			1.5	Gates
	3618.5	3620			1.5	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
00/11-01-047-21W5	2648.5	2650			1.5	Gates
	2650.8	2652			1.2	Gates
	2694	2695			1	Gates
	2715.5	2717.7			2.2	Gates
	2742	2744			2	Gates
00/02-15-047-21W5	2956	2957			1	Gates
	2957.5	2958			0.5	Gates
	3065	3066.5			1.5	Gates
	3067.5	3070			2.5	Gates
	3138	3140			2	Gates
	3140.5	3143			2.5	Gates
	3146.8	3148			1.2	Gates
	3148.8	3150			1.2	Gates
	3150.5	3151			0.5	Gates
	3151.5	3152.5			1	Gates
00/16-25-047-21W5	609.8	611.3	2000	2005	1.5	Coalspur
	627.7	629.0	2059	2063	1.2	Coalspur
	682.0	682.6	2237	2239	0.6	Coalspur
	683.5	684.1	2242	2244	0.6	Coalspur
	695.7	697.6	2282	2288	1.8	Coalspur
	701.2	702.7	2300	2305	1.5	Coalspur
	3756.4	3757.0	12321	12323	0.6	Gates
	3757.3	3758.8	12324	12329	1.5	Gates
	3759.8	3761.0	12332	12336	1.2	Gates
	3800.3	3801.5	12465	12469	1.2	Gates
	3822.3	3823.2	12537	12540	0.9	Gates
	3864.6	3865.2	12676	12678	0.6	Gates
	3865.5	3867.7	12679	12686	2.1	Gates
00/11-15-047-22W5	1523	1524			1.0	Brazeau
	3377	3378			1.0	Gates
00/05-17-048-20W5	3330.5	3331.4	10924	10927	0.9	Gates
	3430.5	3433	11252	11260	2.5	Gates
00/12-24-048-20W5	509.3	510			0.7	Coalspur
	510.5	512			1.5	Coalspur
	808	809			1	Brazeau
	846	847.5			1.5	Brazeau
	850	850.7			0.7	Brazeau
	851	852			1	Brazeau
	856	857			1	Brazeau
	890	891			1	Brazeau
	3355	3356			1	Gates
	3370	3371			1	Gates
00/15-10-049-19W5	599.1	601.5	1965	1973	2.4	Coalspur
	604.6	606.1	1983	1988	1.5	Coalspur
	607.3	608.8	1992	1997	1.5	Coalspur
	659.8	661.0	2164	2168	1.2	Coalspur
	661.9	663.1	2171	2175	1.2	Coalspur
	773.5	774.4	2537	2540	0.9	Coalspur
	774.7	778.0	2541	2552	3.4	Coalspur
	3100.6	3102.1	10170	10175	1.5	Gates
	3102.4	3103.7	10176	10180	1.2	Gates
	3158.5	3159.5	10360	10363	0.9	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	3180.5	3181.4	10432	10435	0.9	Gates
	3194.5	3195.4	10478	10481	0.9	Gates
00/06-17-049-19W5	614.8	615.8			1	Coalspur
	618	620			2	Coalspur
	620.5	622.3			1.8	Coalspur
	623	624.1			1.1	Coalspur
	627	628.5			1.5	Coalspur
	629.5	630.8			1.3	Coalspur
	631	631.8			0.8	Coalspur
	677	678.2			1.2	Coalspur
	679	680.5			1.5	Coalspur
	743.2	744.2			1	Coalspur
	795.6	796.5			0.9	Coalspur
	797	797.5			0.5	Coalspur
	798.3	799.5			1.2	Coalspur
	800	801			1	Coalspur
	1051.2	1052			0.8	Brazeau
	1087	1088.5			1.5	Brazeau
NEW CADOMIN AREA						
NTS 83F						
00/11-24-048-21W5	3349	3349.5	10985	10986	0.5	Gates
	3350	3351.5	10988	10993	1.5	Gates
	3352.5	3353.5	10996	10999	1	Gates
	3381.5	3382	11091	11093	0.5	Gates
	3453.5	3456	11327	11336	2.5	Gates
00/05-07-048-22W5	2789	2790	9148	9151	1	Gates
	2816	2817	9236	9240	1	Gates
	2908	2909	9538	9542	1	Gates
	2926	2929	9597	9607	3	Gates
	2960	2963	9709	9719	3	Gates
00/06-09-048-22W5	2541.3	2543	8335	8341	1.7	Gates
	2577	2578	8453	8456	1	Gates
	2614	2615	8574	8577	1	Gates
	2635	2637	8643	8649	2	Gates
	2638	2638.5	8653	8654	0.5	Gates
00/03-26-049-20W5	3237.5	3239	10619	10624	1.5	Gates
	3241	3242	10630	10634	1	Gates
	3245.5	3247.5	10645	10652	2	Gates
	3258	3259	10686	10690	1	Gates
	3272.5	3273	10734	10735	0.5	Gates
HINTON AREA						
NTS 83F						
00/06-28-049-26W5	1209	1210			1	Gates
	1240	1241			1	Gates
	1295	1297			2	Gates
	1322.5	1324			1.5	Gates
	1389	1394			5	Gates
	1418	1420			2	Gates
00/07-24-050-24W5	3801	3804			3	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	3809	3809.5			0.5	Gates
	3814.5	3816			1.5	Gates
	3817	3817.5			0.5	Gates
	3821.5	3824			2.5	Gates
00/06-06-050-26W5	576.2	579.3	1890	1900	3.0	Gates
00/12-08-050-26W5	1121.3	1124.4	3678	3688	3.0	Gates
aka 00/11-08-050-26W5	1440.9	1441.2	4726	4727	0.3	Gates
	1441.5	1442.1	4728	4730	0.6	Gates
	1563.4	1564.0	5128	5130	0.6	Gates
	1592.7	1593.3	5224	5226	0.6	Gates
	1669.5	1670.1	5476	5478	0.6	Gates
Structural Repeat	2437.2	2438.4	7994	7998	1.2	Gates
00/07-12-050-27W5	542.7	548.8	1780	1800	6.1	Gates
aka 00/10-12-050-27W5	747.3	748.5	2451	2455	1.2	Gates repeat?
	755.5	756.7	2478	2482	1.2	Gates repeat?
00/05-25-051-22W5	3192.5	3193			0.5	Gates
	3227.5	3228			0.5	Gates
	3231	3232			1	Gates
00/10-08-051-25W5	3636	3637.5			1.5	Gates
	3672	3673			1.0	Gates
	3702	3704			2.0	Gates
00/11-30-051-25W5	1716.5	1717.4	5630	5633	0.9	Brazeau
	1860.4	1861.0	6102	6104	0.6	Brazeau
	1968.9	1970.4	6458	6463	1.5	Brazeau
	3819.2	3820.4	12527	12531	1.2	Gates
	3831.1	3832.6	12566	12571	1.5	Gates
	3867.4	3868.0	12685	12687	0.6	Gates
	3868.9	3871.0	12690	12697	2.1	Gates
	3882.0	3882.9	12733	12736	0.9	Gates
00/02-22-052-22W5	3062	3063			1	Gates
	3068	3068.5			0.5	Gates
	3123	3124.5			1.5	Gates
	3125.5	3126.5			1	Gates
	3170	3174			4	Gates
00/07-18-052-24W5	426	427			1	Coalspur
	431	432.2			1.2	Coalspur
	480	483			3	Coalspur
	496	496.5			0.5	Coalspur
	497	498			1	Coalspur
	500	501			1	Coalspur
	502	503			1	Coalspur
	519	519.5			0.5	Coalspur
	520	520.5			0.5	Coalspur
	559	559.5			0.5	Coalspur
	560	561			1	Coalspur
	630	631			1	Coalspur
	664.5	665.5			1	Coalspur
	669	670			1	Coalspur
	974	975			1	Upper Brazeau

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	989	990			1	Upper Brazeau
	1069.5	1071			1.5	Upper Brazeau
	3455.5	3456.5			1	Gates
	3550	3551			1	Gates
	3555	3556			1	Gates
	3557.5	3558			0.5	Gates
	3572	3573			1	Gates
MOBERLY CREEK AREA						
NTS 83E						
00/11-23-053-02W6	3167.1	3168.3	10388	10392	1.2	Gates
	3334.1	3334.8	10936	10938	0.6	Gates
	3335.7	3336.6	10941	10944	0.9	Gates
	3418.9	3419.5	11214	11216	0.6	Gates
	3420.1	3420.7	11218	11220	0.6	Gates
	3422.0	3423.8	11224	11230	1.8	Gates
00/07-26-054-01W6	513.5	514.5			1	Coalspur
aka 00/08-26-54-01W6/2	515	516			1	Coalspur
	566.5	567.5			1	Coalspur
	1011	1012			1	Brazeau
	1048	1048.5			0.5	Brazeau
	1049	1049.5			0.5	Brazeau
	3679	3681			2	Gates
	3715	3716			1	Gates
	3731.8	3733			1.2	Gates
	3873	3874.5			1.5	Gething
00/04-09-055-03W6	2813	2816			3	Gates
	3039	3040.5			1.5	Gates
	3042	3043			1	Gates
	3057	3058.5			1.5	Gates
	3059	3060			1	Gates
00/01-35-056-01W6	875.0	875.6	2870	2872	0.6	Coalspur
	877.7	878.4	2879	2881	0.6	Coalspur
	880.5	881.1	2888	2890	0.6	Coalspur
	941.8	942.1	3089	3090	0.3	Coalspur
	957.3	957.9	3140	3142	0.6	Coalspur
	1417.7	1418.3	4650	4652	0.6	Brazeau
	1926.5	1927.1	6319	6321	0.6	Brazeau
	3354.9	3357.3	11004	11012	2.4	Gates
	3359.1	3360.4	11018	11022	1.2	Gates
	3361.6	3362.2	11026	11028	0.6	Gates
	3375.6	3376.8	11072	11076	1.2	Gates
	3419.2	3421.3	11215	11222	2.1	Gates
	3423.2	3423.8	11228	11230	0.6	Gates
	3583.2	3583.8	11753	11755	0.6	Gething
00/05-16-056-04W6	3165	3166			1.0	Gates
NEW GRANDE CACHE AREA						
NTS 83E						
02/11-26-057-06W6	1597.5	1599.5	5240	5246	2	Gates

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
	1636.0	1639.0	5366	5376	3	Gates
	1684.0	1685.0	5524	5527	1	Gates
	1685.7	1687.5	5529	5535	1.8	Gates
	1741.0	1742.0	5710	5714	1	Gates
00/10-32-057-06W6	2172.0	2173.2	7124	7128	1.2	Gates
	2218.4	2219.5	7276.4	7280	1.1	Gates
	2220.1	2220.7	7282	7284	0.6	Gates
	2229.3	2230.5	7312	7316	1.2	Gates
	2265.2	2266.2	7430	7433	0.9	Gates
COPTON AREA Coal Picks, Map Sheet 83L						
00/11-21-059-08W6	2810	2812			2	Gates
	2846.5	2848.5			2	Gates
	2884	2886			2	Gates
	2895	2895.5			0.5	Gates
	3012.6	3013.3			0.7	Gething
	3055	3056			1	Gething
	3063	3063.8			0.8	Gething
	3127.5	3128.5			1	Gething
00/15-23-059-09W6	2414.0	2414.6	7918	7920	0.6	Mtn Pk
	2532.9	2534.8	8308	8314	1.8	Gates
	2537.2	2537.8	8322	8324	0.6	Gates
	2542.4	2543.0	8339	8341	0.6	Gates
	2579.3	2580.2	8460	8463	0.9	Gates
	2580.8	2582.3	8465	8470	1.5	Gates
	2618.9	2622.0	8590	8600	3.0	Gates
	2630.2	2631.1	8627	8630	0.9	Gates
	2635.1	2636.6	8643	8648	1.5	Gates
	2883.5	2884.1	9458	9460	0.6	Gates
	2909.1	2910.4	9542	9546	1.2	Gates
00/11-25-059-09W6	2500	2501			1	Gates
AKA-00/14-25-059-09W6/0	2594.5	2595.5			1	Gates
	2601	2603			2	Gates
	2653	2654			1	Gates
	2686	2688			2	Gates
	2700.5	2701.5			1	Gates
	2705.5	2706.5			1	Gates
00/14-23-060-08W6	798	799			1	Brazeau
	979	980			1	Brazeau
	3299	3300			1	Gates
	3309.5	3311			1.5	Gates
	3360	3361			1	Gates
	3373	3374.5			1.5	Gates
	3384	3385			1	Gates
	3419.5	3421.5			2	Gates
	3460	3462			2	Gates
	3486.5	3488			1.5	Gates
	3497	3498			1	Gates
	3656.5	3658			1.5	Gething
	3667	3668.5			1.5	Gething
	3713.5	3714.5			1	Gething

Appendix 2. Coal picks from wells studied in 2000-2002.

Well Location	Top (m)	Bottom (m)	Top (ft)	Bottom (ft)	Thickness (m)	Coal Zone
00/03-10-060-10W6	2328.0	2328.7	7636	7638	0.6	Gates
	2441.0	2442.1	8006.5	8010	1.1	Gates
	2477.1	2479.6	8125	8133	2.4	Gates
	2482.9	2483.2	8144	8145	0.3	Gates
	2483.5	2486.3	8146	8155	2.7	Gates
	2767.7	2769.5	9078	9084	1.8	Gates
00/12-21-061-09W6	722	722.6			0.6	Brazeau
00/05-13-061-10W6	3218.5	3219.5			1	Gates
	3250	3251			1	Gates
	3259	3260			1	Gates
	3264.5	3267.5			3	Gates
	3279.5	3280.5			1	Gates
	3284.5	3285.5			1	Gates

Appendix 3. Vitrinite reflectance data from wells and outcrops studied in 2000-2002.

Well Location	Formation	Depth (m)	Sample Number	Rmax (%)	Standard Deviation	Number of Measurements	ASTM Rank
Brazeau River Area							
00/04-03-045-18W5	Gates	3110	01-211	1.21	0.06	20	MVB
	Gates	3115	01-212	1.29	0.05	20	MVB
	Gates	3210	01-213	1.31	0.09	6	MVB
	Gates	3240	01-214	1.32	0.06	20	MVB
	Gates	3255-3260	01-215	1.42	0.08	31	MVB
00/12-35-045-18W5	Brazeau	715	01-216	0.50	0.04	30	HVB-C
	Brazeau	745	01-217	0.54	0.06	32	HVB-C
00/16-36-045-18W5	Coalspur	710	01-218	0.47	0.04	30	HVB-C
	Coalspur	790	01-219	0.55	0.04	30	HVB-C
	Coalspur	935	01-220	0.54	0.05	41	HVB-C
	Coalspur	985	01-221	0.53	0.04	30	HVB-C
	Gates	3610	01-222	1.41	0.09	30	MVB
	Gates	3660	01-223	1.65	0.09	20	LVB
00/12-11-046-17W5	Gates	3440	01-224	1.34	0.09	50	MVB
00/07-23-046-17W5	Gates	3425	01-225	1.29	0.08	6	MVB
	Gates	3465	01-226	1.32	0.09	17	MVB
00/02-07-047-16W5	Gates	3200	01-227	0.89	0.06	30	HVB-A
	Gates	3275	01-228	1.15	0.13	40	MVB
02/06-15-047-16W5	Gates	3115-3118	01-229	1.07	0.04	28	HVB-A
	Gates	3169-3172	01-230	1.10	0.00	16	MVB
	Gates	3191-3194	01-231	1.12	0.00	26	MVB
Moberly Creek Area							
00/04-09-055-03W6	Gates	2810-2813	01-232	1.52	0.09	30	LVB
	Gates	3054-3057	01-233	1.62	0.12	30	LVB
00/05-16-056-04W6	Gates	3165-3170	01-234	1.42	0.05	30	MVB
00/07-26-054-01W6	Coalspur	515-520	01-235	0.53	0.03	30	HVB-C
aka 08-26-54-01W6/02	Coalspur	565-570	01-236	0.48	0.05	30	HVB-C
	Brazeau	1025	01-237	0.51	0.03	30	HVB-C
	Brazeau	1050	01-238	0.69	0.06	28	HVB-B
	Gates	3680-3685	01-239	1.32	0.04	30	MVB
	Gates	3720-3725	01-240	1.34	0.11	25	MVB
00/11-23-053-02W6	Gates	3163-3166	01-252	1.26	0.08	40	MVB
	Gates	3422-3425	01-253	1.36	0.07	25	MVB
Copton Creek Area							
00/11-21-059-08W6	Gates	2810	01-241	1.69	0.09	30	LVB
	Gates	2850	01-242	1.76	0.08	30	LVB

HVB = High Volatile Bituminous
MVB = Medium Volatile Bituminous
LVB = Low Volatile Bituminous

Rmax = Mean maximum reflrctance of vitrinite in oil

Appendix 3. Vitrinite reflectance data from wells and outcrops studied in 2000-2002.

Well Location	Formation	Depth (m)	Sample Number	Rmax (%)	Standard Deviation	Number of Measurements	ASTM Rank
	Gething	3065	01-243	1.72	0.07	30	LVB
00/14-23-060-08W6	Brazeau	805	01-244	0.48	0.04	30	HVB-C
	Brazeau	980	01-245	0.60	0.04	30	HVB-B
	Gates	3300	01-246	1.47	0.06	30	MVB
	Gates	3370	01-247	1.53	0.07	30	LVB
	Gates	3485	01-248	1.75	0.07	30	LVB
	Gething	3655	01-249	1.61	0.10	22	LVB
	Gething	3660	01-250	1.84	0.13	30	LVB
	Gething	3715	01-251	2.07	0.23	30	Semi-Anthracite
00/15-23-059-09W6	Gates	2410-2414	01-254	1.56	0.09	30	LVB
	Gates	2532-2535	01-255	1.52	0.08	30	LVB
	Gates	2633-2636	01-256	1.62	0.12	30	LVB
	Gates	2907-2910	01-257	1.80	0.08	30	LVB
00/03-10-060-10W6	Gates	2441-2444	01-258	1.72	0.06	31	LVB
	Gates	2474-2478	01-259	1.73	0.08	20	LVB
	Gates	2481-2484	01-260	1.97	0.11	50	LVB
	Gates	2764-2767	01-261	1.94	0.09	20	LVB
Red Deer River Area							
00/07-36-029-11W5	Kootenay	1775	02-212	1.93	0.08	30	LVB
00/09-29-029-10W5	Kootenay	1940-1950	02-213	0.98	0.05	30	HVB-A
00/14-32-029-10W5	Kootenay	1490	02-214	1.86	0.09	30	LVB
00/09-19-030-10W5	Gates	1585	02-215	1.79	0.11	30	LVB
	Kootenay	1850-1855	02-216	1.80	0.09	30	LVB
	Kootenay	1910-1915	02-217	1.91	0.11	30	LVB
00/05-29-030-10W5	Gates	1520-1527	02-218	1.59	0.09	30	LVB
	Kootenay	1834-1837	02-219	1.92	0.19	30	LVB
00/02-12-031-10W5	Gates	1734-1737	02-220	1.62	0.11	30	LVB
	Gates	2121-2124	02-221	1.69	0.10	30	LVB
	Kootenay	2145-2148	02-222	1.73	0.11	30	LVB
	Kootenay	2240-2243	02-223	2.16	0.15	30	Semi-Anthracite
00/06-20-030-09W5	Gates	1860	02-224	1.42	0.07	30	MVB
	Gates	2495	02-225	1.98	0.12	30	LVB
00/03-12-031-09W5	Gates	2900	02-226	1.46	0.07	30	MVB
00/06-18-0320-6W5	Brazeau	414-417	02-227	0.67	0.06	30	HVB-B
	Gates	3108-3112	02-228	1.25	0.08	30	MVB
00/06-32-032-06W5	Gates	3029-3032	02-229	1.41	0.08	30	MVB
000/6-10-032-07W5	Brazeau	1295-1298	02-230	0.66	0.08	20	HVB -B
	Gates	3371-3374	02-231	1.44	0.10	30	MVB

Rmax = Mean maximum reflrctance of vitrinite in oil

HVB = High Volatile Bituminous
MVB = Medium Volatile Bituminous
LVB = Low Volatile Bituminous

Appendix 3. Vitrinite reflectance data from wells and outcrops studied in 2000-2002.

Well Location	Formation	Depth (m)	Sample Number	Rmax (%)	Standard Deviation	Number of Measurements	ASTM Rank
00/11-22-032-07W5	Gates	3169-3172	02-232	1.32	0.09	30	MVB
	Gates	3203-3206	02-233	1.50	0.10	30	LVB
00/13-10-032-08W5	Brazeau	1780	02-234	0.73	0.04	20	HVB-A
00/14-11-033-06W5	Gates	2860	02-235				
00/12-21-033-06W5	Brazeau	1039-1042	02-236	0.61	0.07	30	HVB-B
	Gates	2929-2932	02-237	1.32	0.05	30	MVB
Hinton Area							
00/06-06-050-26W5	Gates	576-579	02-238	1.24	0.10	30	MVB
00/12-08-050-26W5	Gates	1444-1447	02-239	1.40	0.04	30	MVB
	Gates	2435-2438	02-240	1.62	0.12	30	LVB
00/05-25-051-22W5	Gates	3190-3195	02-241	1.37	0.12	30	MVB
	Gates	3230-3235	02-242	1.41	0.06	30	MVB
00/11-30-051-25W5	Brazeau ?	1965-1969	02-243	0.76	0.07	30	HVB-A
	Gates	3828-3831	02-244	1.93	0.11	30	LVB
	Gates	3867-3870	02-245	2.37	0.10	30	Semi-Anthracite
New Nordegg Area							
00/16-33-038-16W5	Gates	1054	01-265	1.25	0.06	30	MVB
00/06-34-038-16W5	Gates	1113	01-266	1.23	0.09	30	MVB
	Gates	1240	01-267	1.21	0.08	25	MVB
00/11-25-040-14W5	Gates	3336.9	01-268	1.37	0.08	20	MVB
	Gates	3355.5	01-269	1.27	0.11	25	MVB
00/10-10-041-14W5	Gates	3180.8	01-270	1.49	0.10	30	MVB
	Gates	3182.1	01-271	1.44	0.04	15	MVB
	Gates	3289.9	01-272	1.53	0.06	30	LVB
00/10-22-041-14W5	Gates	3302.1	01-273	1.30	0.05	30	MVB
	Gates	3376.2	01-274	1.18	0.15	21	MVB
00/07-23-041-14W5	Gates	3140	01-275	1.19	0.06	15	MVB
00/10-031-41-14W5	Gates	3208.8	01-276	1.34	0.09	30	MVB
	Gates	3253.7	01-277	1.18	0.07	30	MVB
00/09-33-041-14W5	Gates	3340	01-278	1.30	0.08	30	MVB
00/11-25-041-15W5	Gates	3230	01-279	1.47	0.07	30	MVB
	Gates	3280	01-280	1.41	0.08	15	MVB
00/10-26-041-15W5	Coalspur	495	01-281	0.48	0.06	30	HVB-C
	Coalspur	1105	01-282	0.60	0.05	35	HVB-B

Rmax = Mean maximum reflrctance of vitrinite in oil

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Appendix 3. Vitrinite reflectance data from wells and outcrops studied in 2000-2002.

Well Location	Formation	Depth (m)	Sample Number	Rmax (%)	Standard Deviation	Number of Measurements	ASTM Rank
	Gates	3710	01-283	1.23	0.06	30	MVB
00/06-05-042-14W5	Gates	3414	01-284	1.33	0.06	20	MVB
	Gates	3472	01-285	1.37	0.07	30	MVB
00/10-15-042-14W5	Gates	3525	01-286	1.64	0.10	20	LVB
00/11-01-042-15W5	Gates	3018.9	01-287	1.29	0.06	25	MVB
00/11-03-042-15W5	Gates	3210	01-288	1.35	0.05	15	MVB
	Gates	3285	01-289	1.34	0.05	25	MVB
00/03-18-042-15W5	Gates	3045	01-290	1.28	0.07	12	MVB
	Gates	3145	01-291	1.32	0.16	27	MVB
00/06-20-042-15W5	Gates	3222.6	01-292	1.31	0.14	18	MVB
	Gates	3269.8	01-293	1.35	0.09	12	MVB
02/15-25-042-16W5	Gates	3230	01-294	1.51	0.08	5	LVB
	Gates	3280	01-295	1.54	0.08	10	LVB
	Gates	3250	01-296	1.58	0.10	20	LVB
00/07-13-042-16W5	Gates	2895	01-297	1.22	0.09	22	MVB
00/07-23-042-16W5	Gates	3160	01-298	1.28	0.07	30	MVB
00/02-27-042-16W5	Gates	3195	01-299	1.25	0.12	21	MVB
	Gates	3215	01-300	1.31	0.10	20	MVB
00/14-27-042-16W5	Gates	3035	01-301	1.29	0.05	5	MVB
	Gates	3040	01-302	1.34	0.07	29	MVB
	Gates	3155	01-303	1.29	0.07	30	MVB
00/11-33-042-16W5	Gates	2820	01-304	1.24	0.11	20	MVB
	Gates	2935	01-305	1.32	0.09	25	MVB
Oldman River Area							
00/03-03-010-03W5	Kootenay	2498.8	02-259	1.31	0.06	5	MVB
00/05-01-010-04W5	Kootenay	458.0	02-261	1.21	0.10	30	MVB
repeat	Kootenay	2954.0	02-262	1.60	0.09	30	LVB
00/07-03-010-04W5	Kootenay	953.70	02-263	1.49	0.06	30	MVB
	Kootenay	1011.0	02-264	1.52	0.10	30	LVB
00/08-16-010-04W5	Kootenay	1497.0	02-265	1.50	0.06	30	LVB
	Kootenay	1517.0	02-266	1.50	0.08	30	LVB
repeat	Kootenay	2970.0	02-267	1.65	0.12	20	LVB
00/03-22-010-04W5	Kootenay	1165.0	02-268	1.45	0.07	30	MVB
	Kootenay	1270.0	02-269	1.47	0.12	30	MVB
00/08-33-010-04W5	Kootenay	3472.0	02-270	1.28	0.08	14	MVB
00/14-30-011-01W5	St. Mary R.	1915.0	02-271	0.74	0.06	30	HVB-A

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Appendix 3. Vitrinite reflectance data from wells and outcrops studied in 2000-2002.

Well Location	Formation	Depth (m)	Sample Number	Rmax (%)	Standard Deviation	Number of Measurements	ASTM Rank
Outcrop Samples							
WL01-SM-1	St. Mary River Fm.		02-246	0.57		20	HVB-B
WL01-SM-2	St. Mary River Fm.		02-247	0.64	0.04	50	HVB-B
WL01-SM-3	St. Mary River Fm.		02-248	0.63	0.03	50	HVB-B
WL01-SM-4	St. Mary River Fm.		02-249	0.55	0.03	50	HVB-C
WL01-SM-5	St. Mary River Fm.		02-250	0.66	0.03	50	HVB-B
WL01-SM-6	St. Mary River Fm.		02-251	0.61	0.04	50	HVB-B
WL01-SM-7	St. Mary River Fm.		02-252	0.60	0.03	50	HVB-B
WL01-SM-8	St. Mary River Fm.		02-253	0.67	0.03	50	HVB-B
WL01-SM-9	St. Mary River Fm.		02-254	0.63	0.03	50	HVB-B
WL01-SM-10	St. Mary River Fm.		02-255	0.64	0.04	50	HVB-B
WL01-SM-11	St. Mary River Fm.		02-256	0.64	0.02	50	HVB-B
WL01-SM-12	St. Mary River Fm.		02-257	0.48	0.05	30	HVB-C
WL01-SM-13	St. Mary River Fm.		02-258	0.63	0.03	14	HVB-B

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Enclosure 1

Cross Section, Copton Creek Area

Geology by T.E. Kubli and C.W. Langenberg

Published 2002

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AGS Alberta Geological Survey

CRETACEOUS AND PALEOCENE

- KTc / ccz — Coalspur Formation (ccz = Coalspur Coal Zone)

UPPER CRETACEOUS

- Kbz-u / Kbz-l — Brazeau Formation (u/l = upper/lower formation) (red is coal zone)
- Kp — Puskwaskau Formation
- Kcm — Cardium, Muskiki and Marshybank formations
- Kk — Kaskapau Formation
- Kd — Dunvegan Formation
- Ks — Shaftesbury Formation

LOWER CREATACEOUS

- gcz / KL / glcz — (gcz = Gates Coal Zone) Luscar Group (glcz = Gladstone Coal Zone)

JURASSIC AND CRETACEOUS

- JKfn — Fernie and Nikanassin Formations

TRIASSIC

- T — Triassic, undivided

CARBONIFEROUS and PERMIAN

- CP — Carboniferous and Permian, undivided

DEVONIAN

- Dp — Palliser Formation
- DF — Fairholme Group

CAMBRIAN

- C — Cambrian, undivided

Fault with sense of movement (defined, approximate)

Amoco Grande Cache 11-21-59-8W6 proj. 4.7 km NW — Gas well and distance of well projection

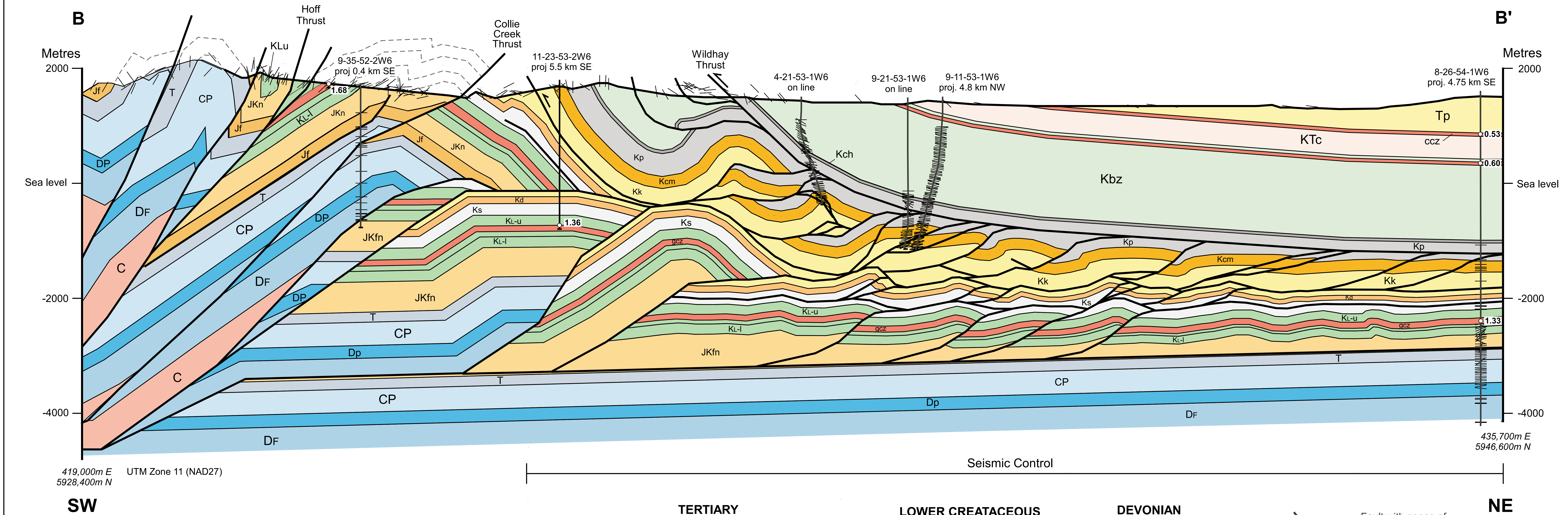
0.53 — Percentage of maximum vitrinite reflectance

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

Enclosure 2



TERTIARY

- Tp — Paskapoo Formation

CRETACEOUS AND PALEOCENE

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11-21-59-8W6 proj. 4.7 km NW — Gas well and distance of well projection

0.53 — Percentage of maximum vitrinite reflectance

Traces of bedding orientation

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

Cross Section, Moberly Creek Area

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Alberta Geological Survey

Enclosure 3

Cross Section, Hinton Area

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TERTIARY

- Tp — Paskapoo Formation

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- Kw — Wapiabi Formation
- Kc — Cardium Formation
- Kb — Blackstone Formation

LOWER CREATACEOUS

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JURASSIC AND CRETACEOUS

- JKfn — Fernie and Nikanassin formations
- JKn — Nikanassin Formation

JURASSIC

- Jf — Fernie Formation

TRIASSIC

- T — Triassic, undivided

MISSISSIPPIAN

- M — Mississippian, undivided
- MR — Rundle Group
- Mb — Banff Formation

DEVONIAN

- Dp — Palliser Formation
- Da — Alexo Formation
- DF — Fairholme Group
- Dfa — Fairholme Group and Alexo Formation, undivided

CAMBRIAN

- C — Cambrian, undivided

Fault with sense of movement (defined, approximate)

12-11-46-17W5 proj. 2.3 km NW — Gas well and distance of well projection

0.53 — Percentage of maximum vitrinite reflectance

Traces of bedding orientation

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

Enclosure 4

Cross Section, Nordegg Area

TERTIARY
- Tp — Paskapoo Formation

CRETACEOUS AND TERTIARY
- KTc / ccz — Coalspur Formation (ccz = Coalspur Coal Zone)

UPPER CRETACEOUS
- Kbz — Brazeau Formation (red is coal zone)
- Kw — Wapiabi Formation
- Kbc — Blackstone and Cardium Formations

LOWER CREATACEOUS
- gcz / KL / glcz — (gcz = Gates Coal Zone) Luscar Group (glcz = Gladstone Coal Zone)

JURASSIC AND CRETACEOUS
- JKfn — Fernie and Nikanassin Formations
- JKn — Nikanassin Formation

JURASSIC
- Jf — Fernie Formation

TRIASSIC
- T — Triassic, undivided

PALEOZOIC
- P — Paleozoic, undivided

MISSISSIPPIAN
- M — Mississippian, undivided

DEVONIAN
- Du — Palliser and Alexo formations
- DF — Fairholme Group (may include older units)

CAMBRIAN AND DEVONIAN
- CD — Cambrian and Fairholme Group, undivided

CAMBRIAN
- C — Cambrian, undivided (may include younger units)

Fault with sense of movement (defined, approximate)

12-11-46-17W5 proj. 2.3 km NW — Gas well and distance of well projection

0.53 — Percentage of maximum vitrinite reflectance

Traces of bedding orientation

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

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Enclosure 5

Cross Section, Red Deer River Area

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C.W. Langenberg

Published 2002

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Alberta Geological Survey

TERTIARY

- Tp — Paskapoo Formation

CRETACEOUS AND TERTIARY

- KTc — Coalspur Formation

UPPER CRETACEOUS

- Kbz-u / Kbz-l — Brazeau Formation (u/l = upper/lower formation) (red is coal zone)
- Kw — Wapiabi Formation
- Kbc — Blackstone and Cardium formations

LOWER CREATACEOUS

- KL / gcz — Luscar Group (gcz = Gates Coal Zone)

JURASSIC AND CRETACEOUS

- JKk — Kootenay Formation (red is coal zone)

JURASSIC

- Jf — Fernie Formation

MISSISSIPPIAN

- M — Mississippian, undivided
- MR — Rundle Group
- Mb — Banff Formation

DEVONIAN

- D — Devonian, undivided
- Dp — Palliser Formation
- DF — Fairholme Group (may include older units)

CAMBRIAN

- C — Cambrian, undivided

Fault with sense of movement (defined, approximate)

12-11-46-17W5
proj. 2.3 km NW — Gas well and distance of well projection

0.53 — Percentage of maximum vitrinite reflectance

Traces of bedding orientation

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

Enclosure 6

Cross Section, Brazeau River Area

TERTIARY
- Tp — Paskapoo Formation

CRETACEOUS AND TERTIARY
- KTc — Coalspur Formation; ccz (ccz = Coalspur Coal Zone)

UPPER CRETACEOUS
- Kbz — Brazeau Formation (red is coal zone)
- Kw — Wapiabi Formation
- Kc — Cardium Formation
- Kb — Blackstone Formation

LOWER CREATACEOUS
- KL — Luscar Group; gcz (gcz = Gates Coal Zone)

TRIASSIC, JURASSIC AND CRETACEOUS
- TJK — Triassic, Fernie and Nikanassin formations

MISSISSIPPIAN
- M — Mississippian, undivided

DEVONIAN
- D — Devonian, undivided

CAMBRIAN
- C — Cambrian, undivided

Fault with sense of movement (defined, approximate)

12-11-46-17W5 proj. 2.3 km NW — Gas well and distance of well projection

0.53 — Percentage of maximum vitrinite reflectance

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

Geology by C.W. Langenberg
Based on a cross section
by J. LeDrew (1997)

Published 2002

EUB Alberta Energy and Utilities Board

AGS Alberta Geological Survey

Enclosure 7

TERTIARY

- Tph — Porcupine Hills Formation

CRETACEOUS AND TERTIARY

- KTwc — Willow Creek Formation

UPPER CRETACEOUS

- Ksm — St. Mary River Formation
- Kbp — Bearpaw Formation
- Kbr — Belly River Group
- Kw — Wapiabi Formation (includes Milk River sandstone)
- Kc — Cardium Formation
- Kb — Blackstone Formation

LOWER CRETACEOUS

- KBL — Blairmore Group

JURASSIC AND CRETACEOUS

- JKk — Kootenay Formation (red is coal zone)

JURASSIC

- Jf — Fernie Formation

MISSISSIPPIAN AND PERMIAN

- MPRM — Rocky Mountain Group

MISSISSIPPIAN

- M — Mississippian, undivided

DEVONIAN

- D — Devonian, undivided

CAMBRIAN

- C — Cambrian, undivided

Fault with sense of movement (defined, approximate)

12-11-46-17W5
proj. 2.3 km NW — Gas well and distance of well projection

0.53 — Percentage of maximum vitrinite reflectance

Traces of bedding orientation

Scale 1:50 000

0 1 2 3 4 5 Kilometres

0 1 2 3 Miles

Cross Section, Oldman River Area

Geology by P. MacKay and C.W. Langenberg

Published 2002

EUB Alberta Energy and Utilities Board

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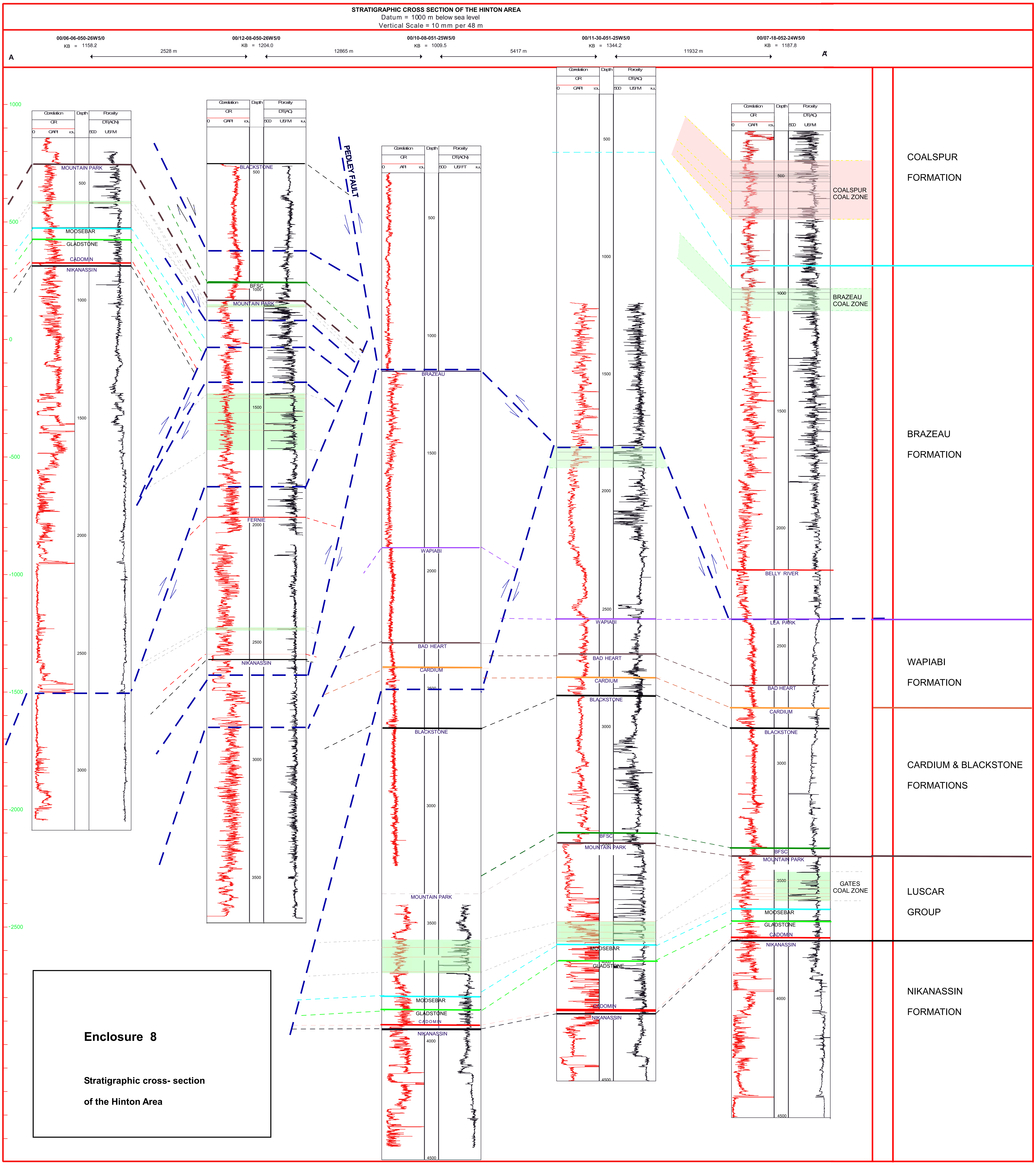
STRATIGRAPHIC CROSS SECTION OF THE HINTON AREA
Datum = 1000 m below sea level
Vertical Scale = 10 mm per 48 m
A
A'
00/06-06-050-26W5/0
KB = 1158.2
2528 m
00/12-08-050-26W5/0
KB = 1204.0
12865 m
00/10-08-051-25W5/0
KB = 1009.5
5417 m
00/11-30-051-25W5/0
KB = 1344.2
11932 m
00/07-18-052-24W5/0
KB = 1187.8
Correlation
Depth
Porosity
GR
DT(AC)
GAPI
US/M
PEDLEY FAULT
MOUNTAIN PARK
MOOSEBAR
GLADSTONE
CADOMIN
NIKANASSIN
BLACKSTONE
BFSC
FERNIE
BRAZEAU
WAPIABI
BAD HEART
CARDIUM
BELLY RIVER
LEA PARK
COALSPUR COAL ZONE
BRAZEAU COAL ZONE
GATES COAL ZONE
COALSPUR FORMATION
BRAZEAU FORMATION
WAPIABI FORMATION
CARDIUM & BLACKSTONE FORMATIONS
LUSCAR GROUP
NIKANASSIN FORMATION
Enclosure 8
Stratigraphic cross- section of the Hinton Area