Organic petrology, thermal maturity and Rock-Eval/TOC for upper Paleozoic to Upper Cretaceous strata from wells near Liard River, northeast British Columbia

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Introduction

Approximately 64 core and 93 drill cuttings samples were collected from shale and siltstone intervals in Middle Devonian to Upper Cretaceous strata in the following seven well sections located between N59° 15' and N60° and W122° and W125°, northeast British Columbia (Figure 1):

Aquitaine Tatoo a-2-D	a-2-D/94-O-11
IOE Pan Am Viscount a-77-D	a-77-D/94-O-11
Amin-Aquitaine Windflower d-87-A	d-87-A/94-O-11
Amoco LaBiche a-67-D	a-67-D/94-O-13
Imperial Pan Am LaBiche b-55-E	b-55-E/94-O-13
Central Leduc Toad River No.1	c-10-E/94-N-7
IOE Dunedin a-75-E	a-75-E/94-N-8

The samples were collected as part of a study of the organic petrology, thermal maturity and Rock-Eval\TOC, hydrocarbon potential and thermal maturity of the Upper Devonian and Lower Carboniferous in the northern part of the Liard Basin and adjacent platform in the southern District of Mackenzie and northeastern British Columbia (Potter, 1998). Samples (100g) were hand picked from washed cuttings or core (C) and are labeled according to the logged depths and assigned GSC C-numbers (Tables 1 & 2). The stratigraphic intervals sampled are indicated in Figure 2.

Methods

Rock-Eval /TOC analyses were carried out using standard procedures at GSC Calgary (Snowdon and Fowler., 1986) and the raw data are presented in Table 3. Organic petrology and thermal maturity was determined on polished particulate pellet samples using a Zeiss Universal (USMP) microscope-photometer with incident white and fluorescent light sources and x25 and x40 oil immersion objectives. Petrographic characterization of the dominant and subordinate organic components (Table 4) was based on the maceral concept, using the maceral (Sentfle *et al.*, 1993) and microbitumen (Potter,1998) classifications shown in the Appendix A, Tables A3 and A2, respectively; matrix lithologies were characterized using numeric codes shown in Appendix A1, Table A1.

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In the absence of vitrinite reflectance data, thermal maturity was determined using a fluorescence index (Potter, 1998; Appendix, Table A3) and microbitumen reflectance (%BR $_o$, Table 5). Vitrinite reflectance-equivalent values (%VR$_o$) were determined from the Type 3 or Type 4 microbitumen Ro data using formulae derived from Potter (1998) and Jacob (1985); these are also listed in Table 5.

Hydrocarbon potential

Modeling studies in the Beaver River region of the Liard Basin carried out by Morrow et al., 1993 (*see also* Morrow and Potter, 1998) would suggest that the Carboniferous in the deeper parts of the basin entered the oil window in Late Carboniferous times. Petrography and maturation data from this study suggest that Carboniferous source rocks such as Prophet, Banff, and Cretaceous intervals in Fort St. John Group in the Viscount area exhibit hydrocarbon potential. Potential source rocks in the Toad River and Dunedin areas are severely overmature and therefore present little or no hydrocarbon potential. Maturity data from the LaBiche and Maxhamish areas indicate that the Carboniferous source rocks are in the upper oil window and at Tattoo, maturity indicators place them in peak of the oil window. However, maceral analysis of dispersed organic matter in the Carboniferous source rocks suggest they are gas-prone and therefore the potential for gas is greatest in the northern and eastern parts of the study area.

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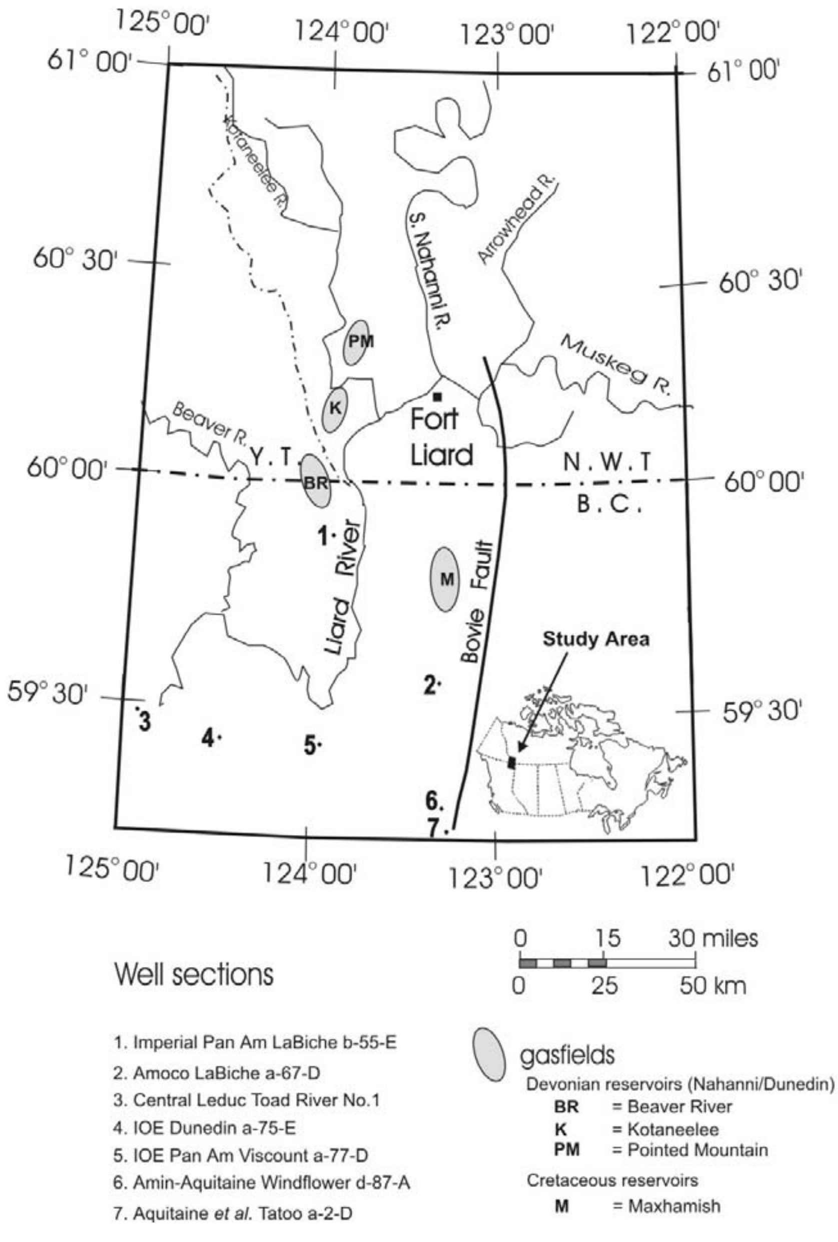

Figure 1. Study area showing sample locations and gasfields

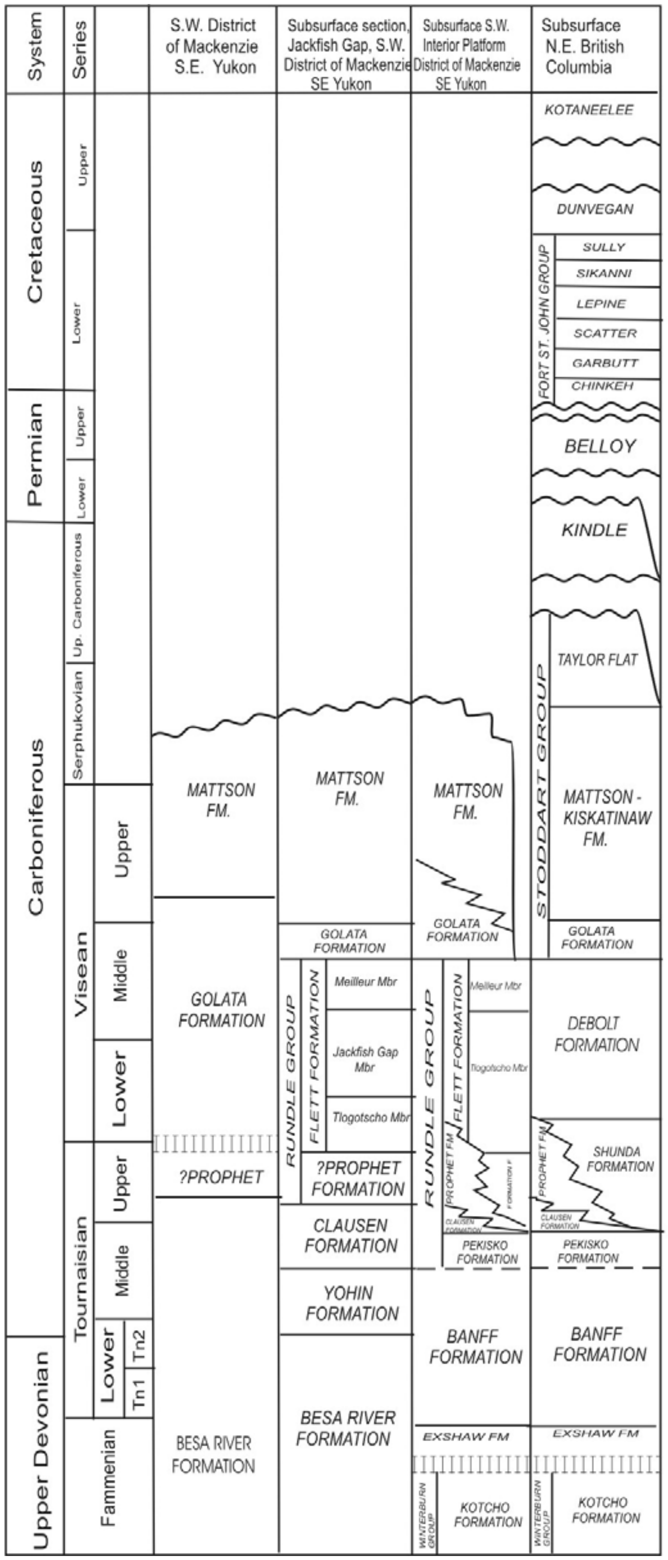

Figure 2. Stratigraphic chart for study area; compiled from Belyea and McLaren (1961), Richards (1989), Torrie (1974) and Leckie et al. (1991).

Table 1. Sampling locations, GSC sample numbers and type of analyses performed

c #[1]	Well name	Location	Number of Samples [2]		GSC #	Type of Analysis carried out			
			Cuttings[2]	Cores[2]		PQ [3]	BRo	REv	TOC
1	Imperial Pan Am LaBiche b-55-E	b-55-E NTS 94-O-13	24 (14)	14 (4)	C186772	38	38	18	18
2	Amoco LaBiche a-67-D	a-67-D NTS 94-O-13	14 (1)		C186777	14	14		
3	Central Leduc Toad River No.1	c-10-E NTS 94-N-7	13 (10)	10 (8) + 9[3]	C186774	13	13	13	13
4	IOE Dunedin a-75-E	a-75-E NTS94-N-8	21		C186770	21	21	16	16
5	IOE Pan Am Viscount a-77-D	a-77-D NTS 94-O-11	21 (6)	30 (14)	C186771	16 (8)	16	16	16
6	Amin-Aquitaine Windflower d-87-A	d-87-A NTS94-O-11		5 (5)	C186773	5(7)	5	5	5
7	Aquitaine Tatoo a-2-D	a-2-D NTS 94-O-11		6 (6)	C186775	6 (5)	6	6	6

[1] section numbers used in Figure 1
[2] number in columns 4 & 5 is the total number of samples collected and analyzed for VRo and Rock-Eval-TOC; number in parentheses indicates the number of Upper Devonian and Lower Carboniferous samples analyzed
[3] PQ = qualitative organic petrology; number in parentheses indicates samples for palynology
[4] indicates samples collected for CAI analysis

Table 2. Stratigraphic intervals sampled

		M. Dev.	Up. Dev.	Carboniferous							Perm.		Trias	Cretaceous	
														Lr.	Up.
#[1]	Well name		BR	Bf	Pe	Cl	Pr	De	Go	Ma/ Kis	TF/Kd	Be/Fan	T-G	FSJ	D/W/K
1	Imperial Pan Am LaBiche b -55 -E									X	X	X	X	X	
2	Amoco LaBiche a.67-D									X		X	X	X	X
3	Central Leduc Toad River No. 1	X	X							X					
4	IOE Dunedin a-75-E									X	X	X	X	X	
5	IOE Pan Am Viscount a -77- D			X		X		X	X	X	X	X	X	X	X
6	Amin-Aquitaine Windflower d -87- A									X					
7	Aquitaine Tatoo a-2- D									X					

see figure 1 for location map

BR = Besa River Fm.; Bf = Banff Fm.; Pe = Pekisko; Cl = Clausen Fm.; Pr = Prophet Fm.; De = Debolt Fm.; Go = Golata Fm.; Ma = Mattson Fm.; Kis = Kiskatinaw ; Perm = Permian; TF = Taylor Flat Fm; Kd = Kindle; Be = Belloy Fm; Fan = Fantasque; T-G = Toad-Grayling Fms.; FSJ = Fort St. John Group; D = Dunvegan Fm; W = Wapiti Fm.; K = Kotaneelee Fm.

Table 3. RockEval-TOC Data

Well no.	Sample interval												
(Fig. 1)	Depth (ft)[1]	Depth (ft)[2]	Fm[3]	Tmax[4]	S1[5]	S2[6]	S3[7]	PI[8]	S2/S3	PC[9]	TOC[10]	HI[11]	OI[12]
1	1291	1291	Dun	426	0.10	0.87	0.44	0.10	1.97	0.08	0.95	91	46
1	1291	1291	Dun	426	0.10	1.00	0.49	0.09	2.04	0.09	1.00	100	49
1	1831	1880	FSt.J	430	0.19	1.93	0.41	0.09	4.70	0.17	1.59	121	25
1	1831	1880	FSt.J	430	0.19	1.79	0.40	0.10	4.37	0.16	1.60	111	25
1	2531	2590	Lep	434	0.22	1.74	0.35	0.11	4.97	0.16	1.50	116	23
1	2531	2590	Lep	435	0.21	1.71	0.36	0.11	4.75	0.16	1.49	114	24
1	3041	3100	Lep	432	0.16	0.80	0.31	0.17	2.58	0.08	0.87	91	35
1	3041	3100	Lep	434	0.16	0.80	0.29	0.17	2.75	0.08	0.86	94	34
1	3451	3490	Lep	437	0.12	0.86	0.27	0.12	3.18	0.08	0.93	92	29
1	3451	3490	Lep	435	0.13	0.92	0.27	0.12	3.40	0.08	0.95	96	28
1	4961	5000	Sca	438	0.18	1.27	0.51	0.12	2.49	0.12	1.00	127	51
1	4961	5000	Sca	437	0.18	1.26	0.53	0.12	2.37	0.12	0.98	128	54
1	5091	5140	Gar	440	0.37	1.93	0.36	0.16	5.36	0.19	1.55	124	23
1	5091	5140	Gar	439	0.40	2.06	0.36	0.16	5.72	0.20	1.57	1.31	22
1	5351	5400	Gar	445	0.30	1.49	0.45	0.17	3.31	0.14	1.31	113	34
1	5351	5400	Gar	442	0.32	1.58	0.49	0.17	3.22	0.15	1.35	117	36
1	5970	6050	T-Gr	440	0.18	0.83	0.42	0.18	1.97	0.08	0.80	103	52
1	5970	6050	T-Gr	441	0.17	0.83	0.42	0.17	1.97	0.08	0.81	102	51
1	6321	6360	T-Gr	445	0.04	0.08	0.26	0.33	0.30	0.01	0.24	33	108
1	6321	6360	T-Gr	408	0.04	0.06	0.26	0.40	0.23	0.00	0.22	27	118
1	6741	6790	T-Gr	n/a	0.03	0.02	0.,37	0.75	0.05	0.00	0.29	10	194
1	6741	6790	T-Gr	n/a	0.03	0.01	0.38	0.75	0.02	0.00	0.20	5	190
1	7421	7460	Bel	456	0.99	2.77	0.37	0.26	7.48	0.31	3.40	81	10
1	7421	7560	Bell	457	1.06	3.04	0.40	0.26	7.60	0.34	3.67	82	10
1	7451	7480	Bell	448	0.23	0.24	0.16	0.50	1.50	0.03	0.41	58	10
1	7451	7480	Bell	448	0.24	0.28	0.15	0.46	1.86	0.04	0.43	65	34
1	8241	8290	Ma-K	458	0.36	1.03	0.18	0.26	5.72	0.11	2.12	48	8
1	8241	8290	Ma-K	460	0.36	1.10	0.22	0.25	5.00	0.12	2.36	46	9
1	8971	8980	Ma-K	467	0.07	0.23	0.15	0.23	1.53	0.02	0.63	36	23
1	8971	8980	Ma-K	470	0.09	0.29	0.14	0.24	2.07	0.03	0.64	45	21
1	9381	9390	Ma-K	502	0.06	0.18	0.49	0.25	0.36	0.02	0.67	26	73
1	9661	9700	Ma-K	529	0.05	0.24	0.30	0.18	0.80	0.02	1.10	21	27
1	9661	9700	Ma-K	528	0.06	0.28	0.32	0.18	0.87	0.02	1.10	21	27
1	9921	10000	Ma-K	520	0.06	0.23	0.44	0.21	0.52	0.92	1.00	23	44
1	9921	10000	Ma-K	520	0.07	0.26	0.44	0.22	0.53	0.02	1.01	25	43
3	4048		BR	553	0.07	0.08	0.09	0.50	0.88	0.01	1.79	4	5
3	4048		BR	548	0.09	0.07	0.10	0.56	0.70	0.01	2.18	3	4
3	4062		BR	403	0.27	0.20	0.07	0.59	2.85	0.03	1.14	17	6
3	4062		BR	344	0.31	0.24	0.08	0.57	3.00	0.04	0.43	16	5
3	4066		BR	306	0.12	0.02	0.00	0.86	-	0.01	1.82	1	0
3	4365		BR	399	0.08	0.05	0.00	0.67	-	0.01	1.49	3	0
3	4365		BR	358	0.08	0.03	0.00	0.80	-	0.00	1.32	2	0
3	4377		BR	442	0.09	0.02	0.22	0.90	0.09	0.00	0.72	2	30
3	4377		BR	373	0.09	0.03	0.02	0.75	1.50	0.01	0.74	4	2
3	4449		BR	365	0.09	0.12	0.00	0.45	-	0.00	0.43	27	0
3	4449		BR	-	0.05	0.00	0.00	1.00	-	0.00	0.31	0	0
3	4454		BR	394	0.04	0.05	0.00	0.50	-	0.00	0.28	17	0
3	4454		BR	390	0.07	0.11	0.00	0.39	-	0.01	0.37	29	0

3	5165		BR	326	0.18	0.06	0.00	0.75	-	0.02	0.56	10	0
3	5165		BR	-	0.11	0.07	0.00	0.61	-	0.01	0.33	21	0
3	5175		BR	-	0.12	0.06	0.00	0.67	-	0.01	0.19	31	0
3	5175		BR	308	0.10	0.06	0.00	0.62	-	0.01	0.15	40	0
3	5188		BR	442	0.17	0.10	0.02	0.65	5.00	0.02	0.66	15	3
3	5188		BR	444	0.16	0.10	0.15	0.62	0.66	0.02	0.57	17	26
3	5341		M. Dev	-	0.01	0.00	0.00	-	-	0.00	0.03	0	0
3	5341		M. Dev	-	0.01	0.00	0.00	-	-	0.00	0.02	0	0
3	5347		M. Dev	-	0.01	0.00	0.00	-	-	0.00	0.08	0	0
3	5347		M. Dev	-	0.02	0.00	0.00	1.00	-	0.00	0.07	0	0
3	5357		M. Dev	-	0.01	0.00	0.00	-	-	0.00	0.04	0	0
3	5357		M. Dev	-	0.01	0.00	0.00	-	-		0.03	0	0
4	1161	1220	FsJ	433	0.30	1.40	0.93	0.18	1.50	0.14	1.34	104	69
4	1161	1220	FsJ	434	0.31	1.48	0.95	0.17	1.55	0.14	1.38	107	68
4	1501	1550	FsJ	429	0.28	3.11	0.47	0.08	6.61	0.28	1.89	164	24
4	1501	1550	FsJ	428	0.28	3.14	0.47	0.08	6.68	0.28	1.86	168	25
4	1911	1950	FsJ	436	0.22	1.52	0.70	0.13	2.17	0.14	1.25	121	56
4	1911	1950	FsJ	435	0.22	1.51	0.74	0.13	2.04	0.14	1.23	122	60
4	2401	2450	Lep	439	0.22	1.60	0.32	0.12	5.00	0.15	1.34	119	23
4	2401	2450	Lep	440	0.22	1.62	0.33	0.12	4.90	0.15	1.33	121	24
4	3001	3050	Lep	440	0.14	1.09	0.40	0.11	2.72	0.10	0.97	112	41
4	3001	3050	Lep	437	0.15	1.15	0.40	0.12	2.87	0.10	0.98	117	40
4	3441	3500	Lep	442	0.17	1.25	0.50	0.12	2.50	0.11	1.17	106	42
4	3441	3500	lep	444	0.16	1.16	0.42	0.12	2.76	0.11	1.08	107	38
4	4001	4050	Lep	448	0.31	1.28	0.39	0.20	3.28	0.13	1.09	117	35
4	4001	4050	Gar	448	0.30	1.26	0.42	0.19	3.00	0.13	1.10	114	38
4	4421	4490	Gar	450	0.27	2.10	0.62	0.11	3.38	0.19	2.40	87	25
4	4421	4490	Gar	448	0.26	1.97	0.54	0.12	3.64	0.18	2.10	93	25
4	6621	6670	Gar	460	0.16	0.58	0.53	0.22	1.09	0.06	1.01	57	52
4	6621	6670	Gar	455	0.17	0.59	0.55	0.22	1.07	0.06	0.91	64	60
4	6951	7000	Gar	445	0.25	0.83	0.52	0.23	1.59	0.09	1.22	68	42
4	6951	7000	Gar	445	0.26	0.82	0.51	0.24	1.60	0.09	1.59	51	32
4	8311	8360	T-Gr	439	0.14	0.46	0.25	0.23	1.84	0.05	0.68	67	36
4	8311	8360	T-Gr	440	0.14	0.46	0.25	0.23	1.84	0.05	0.66	69	37
4	10211	10260	Fan	395	0.06	0.16	0.14	0.27	1.14	0.01	0.25	64	56
4	10211	10260	Fan	394	0.06	0.18	0.15	0.25	1.20	0.02	0.23	78	65
4	12100	12160	Mat-K	367	0.28	0.26	0.16	0.52	1.62	0.04	2.37	10	6
4	12100	12160	Mat-K	366	0.27	0.25	0.16	0.52	1.56	0.04	2.38	10	6
4	12251	12300	Bff	391	0.40	1.47	0.29	0.22	5.06	0.15	2.25	65	12
4	12251	12300	Bff	383	0.41	0.99	0.36	0.29	2.75	0.11	1.82	54	19
4	12721	12780	Bff	406	0.18	0.23	0.06	0.45	3.83	0.03	1.73	13	3
4	12721	12780	Bff	364	0.20	0.26	0.07	0.43	3.71	0.03	1.93	13	3
5	2141	2190	FSt.J	425	0.14	1.74	0.43	0.07	4.04	0.15	1.06	164	40
5	2141	2190	FSt.J	427	0.15	1.84	0.42	0.08	4.38	0.16	1.17	171	39
5	2491	2540	FSt.J	428	0.22	3.25	0.46	0.06	7.06	0.28	1.79	181	25
5	2491	2540	FSt.J	429	0.21	3.32	0.46	0.06	7.21	0.29	1.80	184	25
5	2941	3000	FSt.J	431	0.14	2.04	0.37	0.06	5.51	0.18	1.39	146	26
5	2941	3000	FSt.J	432	0.13	2.16	35.00	0.06	6.17	0.19	1.42	152	24
5	3521	3580	FSt.J	430	0.15	2.00	0.29	0.07	6.89	0.17	1.25	160	23

5	3521	3580	FSt.J	434	0.15	2.00	0.28	0.07	7.14	0.17	1.23	162	22
5	4131	4170	FSt.J	437	0.29	2.50	0.21	0.10	11.90	0.23	1.41	177	14
5	4131	4170	FSt.J	438	0.28	2.50	0.21	0.10	11.90	0.23	1.41	177	14
5	4291	4340	FSt.J	438	0.75	5.27	0.22	0.12	23.95	0.50	2.03	259	10
5	4291	4340	FSt.J	438	0.77	5.20	0.23	0.13	22.60	0.49	2.05	253	11
5	4951	4990	FSt.J	441	0.31	1.79	0.22	0.15	8.13	0.17	1.11	161	19
5	4951	4990	FSt.J	438	0.33	1.92	0.18	0.15	10.66	0.18	1.10	174	16
5	5381	5440	FSt.J	440	0.92	3.42	0.26	0.21	13.15	0.36	2.13	160	12
5	5381	5440	FSt.J	440	0.92	3.53	0.29	0.21	12.17	0.37	2.29	154	12
5	6501	6550	FSt.J	401	0.04	0.05	0.17	0.50	0.29	0.00	0.17	29	100
5	6501	6550	FSt.J	n/a	0.04	0.06	0.16	0.40	0.37	0.00	0.18	33	88
5	6861	6890	FSt.J	453	0.78	1.11	0.20	0.41	5.55	0.15	1.38	80	14
5	6861	6890	Bel	452	0.78	1.10	0.20	0.41	5.50	0.15	1.38	79	14
5	8081	8110	Ma-K	449	0.21	0.85	0.35	0.20	2.42	0.08	1.31	64	26
5	8081	8110	Ma-K	432	0.22	1.11	0.35	0.17	3.17	0.11	1.41	78	24
5	8401	8440	Gol	497	0.14	0.35	0.62	0.29	0.56	0.04	0.89	39	69
5	8401	8440	Gol	498	0.13	0.35	0.61	0.27	0.57	0.04	0.91	38	67
5	9620	9640	Pro	370	0.45	0.28	0.24	0.62	1.16	0.06	1.00	28	24
5	9620	9640	Pro	394	0.45	0.27	0.24	0.62	1.12	0.06	1.06	25	22
5	9661	9690	Pro	368	0.47	0.33	0.23	0.59	1.43	0.06	1.12	29	20
5	9661	9690	Pro	447	0.47	0.38	0.23	0.56	1.65	0.07	1.15	33	20
5	9951	9980	Bff	395	0.13	0.18	0.13	0.43	1.38	0.02	0.23	78	56
5	9951	9980	Bff	n/a	0.12	0.11	0.19	0.55	0.57	0.01	0.20	55	95
5	10421	10460	Bff	323	0.10	0.10	0.14	0.50	0.71	0.01	0.24	41	58
5	10421	10460	Bff	n/a	0.09	0.06	0.14	0.64	0.42	0.01	0.23	26	60
6	1469		M-K	408	0.01	0.12	0.00	0.09	15.00	-	0.05	280	10
6	1503		M-K	390	0.01	0.05	0.33	-	0.11	-	0.03	136	1000
6	1515		M-K	316	0.02	0.04	0.05	0.33	0.93	-	0.03	149	167
6	1519		M-K	345	0.01	0.05	0.07	0.25	0.66	-	0.03	150	300
6	1528		M-K	355	0.02	0.07	0.01	0.25	3.50	-	0.04	175	25
7	1617.5		M-K	437	0.74	12.60	0.90	0.06	14.03		5.00	249	18
7	1625.5		M-K	436	0.18	0.41	1.67	0.31	0.24		0.54	74	305
7	1631		M-K	440	0.54	3.06	0.39	0.16	7.64		2.18	136	18
7	1647		M-K	438	0.71	3.89	0.66	0.16	5.93		2.50	151	26
7	1655		M-K	440	0.49	4.80	1.03	0.09	4.65		2.39	208	45
7	1661.5		M-K	442	0.25	2.95	0.94	0.26	3.13		1.80	164	52

[1] top of sample interval, depth below KB

[2] bottom of sample interval, depth below KB

[3] formation sampled, as per figure 2

[4] Tmax = temperature (^{o}C) at the top of the S2 peak

[5] S1 = hydrocarbons evolved at 300^{o}C (mg hydrocarbon/g rock)

[6] S2 = hydrocarbons evolved T 25O^{o} C/min between 300^{o} and 390^{o}C

[7] S3 = organic carbon dioxide eveloved at 300^{o} - 390^{o}C

[8] Production Index = S1/S1+S2

[9] Pyrolitic carbon

[10] TOC = Total Organic Carbon , wt. % of whole rock sample

[11] HI = Hydrogen Index, S2/TOC

[12] OI = Oxygen index, S3/TOC

Table 4. Organic Petrological Composition

Well no.	Sampling interval				Stratigraphic	Lithology	Dominant maceral	Minor component
	top (ft)	top (ft)	top (m)	top (m)	interval.			
1	241	290	73.46	88.39	Kotaneelee	4/8	matrix, bituminite //l bdg., pellets	indigenous bitumens (types 2-5) pyrite
1	451	580	137.46	176.78	Ft Nelson		matrix bituminite; pyrobitumen	
1	1291	1330	393.50	405.38	Dunvegan	4	alginite, liptodetrinite	indigenous bitumens (types 1, 2 & 3)
1	1831	1880	558.09	573.02	Sully/Lepine	5	alginite, liptodetrinite	indigenous bitumens (types 2 & 3)
1	2531	2590	771.45	789.43	Lepine	4	liptodetrinite, alginite, matrix bituminite	vitrinite
1	3041	3100	926.90	944.88	Lepine	5/7	Bituminite; indigenous bitumens (type 3)	indigenous bitumens (type 4)
1	3451	3490	1051.86	1063.75	Lepine	5	Bituminite, liptinite, amorphous bituminite	
1	3851	3890	1173.78	1185.67	Scatter	4	liptodetrinite, alginite, matrix bituminite	indigenous bitumens (types 2, 3, & 4)
1	4351	5400	1326.18	1645.92	Garbutt	5	bituminite //l bedding, liptodetrinite, matrix bituminite	indigenous bitumens (types 3 & 4)
1	4361	4440	1329.23	1353.31	Scatter	4	liptodetrinite, alginite, matrix bituminite	inertinite, vitrinite, indigenous bitumens
1	4961	5000	1512.11	1524.00	Scatter	4	liptodetrinite, alginite, matrix bituminite	indigenous bitumens (types 2, 3, & 4)
1	5091	5140	1551.74	1566.67	Toad-Grayl	4	Bituminite //l bedding	inertinite, indigenous bitumens
1	5598		1706.27		Toad-Grayl	5	Bituminite //l bedding,	indigenous bitumens (types 2, 3, & 4)
1	5970	6050	1819.66	1844.04	Toad-Grayl	4	bituminite //l bedding, alginite, liptodetrinite	indigenous bitumens (types 3 & 4)
1	6321	6360	1926.64	1938.53	Toad-Grayl	5	indigenous bitumens (types 3 & 4)	alginite, bituminite
1	6741	6790	2054.66	2069.59	Toad-Grayl	5	indigenous bitumens (types 3 & 4), bituminite	
1	6831	6860	2082.09	2090.93	Belloy	4	indigenous bitumens (types 3 & 4), bituminite	
1	7351	7380	2240.58	2249.42	Belloy	3	indigenous bitumens (types 3, 4 & 5)	spiculites
1	7451	7480	2271.06	2279.90	Belloy	3	indigenous bitumens (types 3, 4 & 5)	inetrinites
1	7571	7580	2307.64	2310.38	Matt-Kiskat	2	indigenous bitumens (types 3, 4 & 5)	sporinite
1	8427		2568.55		Matt-Kiskat	7	Bituminite, liptinite, amorphous bituminite	indigenous microbitumens (types 3 & 4)
1	8431		2569.77		Matt-Kiskat	4	Bituminite //l bedding; liptodetrinite	indigenous bitumens (types 3 & 4)
1	8955		2729.48		Matt-Kiskat	3/4	bituminite //l bedding; liptodetrinite, alginite	vitrinite, inertinite
1	8971	8990	2734.36	2740.15	Matt-Kiskat	2	indigenous bitumens (types 3, 4 & 5)	inertinite, vitrinite
1	9381	9390	2859.33	2862.07	Matt-Kiskat	5	indigenous bitumens (types 3, 4 & 5)	bituminite
1	9661	9970	2944.67	3038.86	Matt-Kiskat	4	Bituminite //l bedding	indigenous bitumens (types 3, 4 & 5)
1	9921	10000	3023.92	3048.00	Matt-Kiskat	4	indigenous bitumens (types 3, 4 & 5)	
3	4048		1233.83		Besa River	4	bituminite, indigenous bitumens (types 3,4 & 5)	high grade microbitumens (high TOC)
3	4062		1238.10		Besa River	4	bituminite, indigenous bitumens (types 3,4 & 5)	high grade microbitumens
3	4066		1239.32		Besa River	4	high grade indigenous microbitumens	

3	4365		1330.45		Besa River	4	matrix bituminite, indigenous bitumens (types 3,4 & 5)	inertinite
3	4377		1334.11		Besa River	2/4	matrix bituminite; indigenous microbitumens	anisotropic microbitumens
3	4449		1356.06		Besa River	4	matrix bituminite; indigenous microbitumens	
3	4454		1357.58		Besa River	4	matrix bituminite; indigenous microbitumens	
3	5165		1574.29		Besa River	4	matrix bituminite; indigenous microbitumens	
3	5175		1577.34		Besa River	4	matrix bituminite; indigenous microbitumens	
3	5188		1581.30		Besa River	4	matrix bituminite; indigenous microbitumens	
3	5341	5357	1627.94	1632.81	M. Dev	1	high grade microbitumens	
4	1161	1220	353.87	371.86	FSt.J	4/5	bituminite //l bdg; alginite, liptodetrinite	inertinite; indigenous bitumens (types 2,3)
4	1501	1550	457.50	472.44	FSt.J - Sik	4/7	bituminite //l bdg; alginite, liptodetrinite	fluor. indigenous bitumens (types, 1,2,3 & 4)
4	1911	1950	582.47	594.36	FSt.J - Sik	4/7	bituminite //l bdg; alginite, liptodetrinite	fluor. indigenous bitumens (types, 1,2,3 & 4)
4	2101	2150	640.38	655.32	FSt.J - Lep	4	alginite; bituminite //l bdg	sporinite dolom alginite
4	3001	3050	914.70	929.64	FSt.J - Lep	5	bituminite //l bdg; alginite	indigenous bitumens (types 3 & 4)
4	3441	3500	1048.82	1066.80	FSt.J - Lep	2	alginites (dolomitized)	bituminite
4	4010	4050	1222.25	1234.44	FSt.J - Lep	5	bituminite; alginites (dolomitized)	
4	4421	4490	1347.52	1368.55	FSt.J - Gar	4	matrix bituminite; indigenous microbitumens	vitrinite (caving/add), sporinite
4	4801	4830	1463.34	1472.18	FSt.J - Gar	5		
4	5311	5360	1618.79	1633.73	FSt.J - Gar	5/7	bituminite; alginites; liptodetrinite; indigenous bitumens	vitrinite
4	5878		1791.61		FSt.J - Gar	4	matrix bituminite; bituminite //l bdg; liptodetrinite	inertinite
4	5885		1793.75		FSt.J - Gar	4/7	matrix bituminite; bituminite //l bdg; liptodetrinite	alginite; indigenous microbitumens
4	5934		1808.68		FSt.J - Gar	4	matrix bituminite; bituminite //l bdg; liptodetrinite	pellets; indigenous microbitumens
4	6621	6670	2018.08	2033.02	FSt.J - Gar	5/7	reworked & oxidized OM & cavings	coaly caving/add)
4	6951	6970	2118.66	2124.46	FSt.J - Gar	4	matrix bituminite; bituminite //l bdg; liptodetrinite	
4	7668		2337.21		Toad-Grayl	4	matrix bituminite; bituminite //l bdg; liptodetrinite	pellets; indigenous microbitumens
4	7677		2339.95		Toad-Grayl	4	matrix bituminite; bituminite //l bdg; liptodetrinite	pellets; indigenous microbitumens
4	8311	8360	2533.19	2548.13	Toad-Grayl	8	reworked bituminites; cavings abt	
4	8751	8770	2667.30	2673.10	Toad-Grayl	6/8	reworked bituminites; cavings abt	
4	9111	9140	2777.03	2785.87	Toad-Grayl	8	reworked bituminites; coal & shale cavings abt	
4	9501	9540	2895.90	2907.79	Toad-Grayl	5/8	bituminite; indigenous bitumens	

4	10211	10260	3112.31	3127.25	Belloy	5	bituminite; indigenous bitumens	
4	10426		3177.84		Belloy	2	matrix bituminite; bituminite //l bdg;	chitin, indigenous bitumens
4	10431		3179.37		Belloy	2	matrix bituminite; bituminite //l bdg;	chitin, indigenous bitumens
4	10437		3181.20		Belloy	2/4	matrix bituminite; bituminite //l bdg;	
4	10977		3345.79		Matt/Kisk	4/7	bituminite //l bdg; indigenous bitumens; inertinite	
4	10983		3347.62		Matt/Kisk	4	bituminite //l bdg; indigenous bitumens;	vitrinite, high grade sporinite
4	10998		3352.19		Matt/Kisk	4		bituminite //l bdg; indigenous bitumens;
4	11254		3430.22		Matt/Kisk	5	bituminite //l bdg;matrix bituminite;	high gradesporinite
4	11264		3433.27		Matt/Kisk	5	bituminite //l bdg;matrix bituminite;	
4	11286		3439.97		Matt/Kisk	5	bituminite //l bdg;matrix bituminite;	high grade sporinite; inertinite
4	11531		3514.65		Matt/Kisk	7	matrix bituminite; bituminite //l bdg;	
4	11522		3511.91		Matt/Kisk	4	matrix bituminite; bituminite //l bdg;	high grade liptinite sporinite; ind. bitumens
4	12100	12160	3688.08	3706.37	Matt/Kisk	4	matrix bituminite; bituminite //l bdg;	indigenous bitumens
4	12251	12301	3734.10	3749.34	Matt/Kisk	4	indigenous bitumens	bituminite; anisotropic bitumens
4	12441	12510	3792.02	3813.05	Matt/Kisk	2/4	indigenous bitumens	
4	12721	12780	3877.36	3895.34	Matt/Kisk	4	indigenous bitumens	
5	821	860	250.24	262.13	Dunvegan	4	bituminite //l bdg; alginite, vitrinite	indigenous microbitumens; inertinite
5	1521	1570	463.60	478.54	Dunvegan	6/9	vitrinite, inertinite in coal; alginite (marine), bituminite	indigenous bitumens; cutinite, suberinite
5	1901	1950	579.42	594.36	Lepine	4	bituminite, alginite, liptodetrinite	indigenous microbitumens
5	2141	2190	652.58	667.51	Lepine	4	bituminite //l bdg;matrix bituminite;	indigenous microbitumens, sporinite, vitrinite
5	2491	2580	759.26	786.38	Lepine	4	bituminite, alginite, liptodetrinite	indigenous bitumen (types 2,3) sporinite, alginite (Tas.) vitrinite
5	3531	3580	1076.25	1091.18	Lepine	4	alginite, liptodetrinite, bituminite	
5	4131	4170	1259.13	1271.02	Lepine	2/4	reworked OM, bituminite, liptodetrintie, alginite	indigenous bitumens (types 3,4)
5	4291	4340	1307.90	1322.83	Lepine	5	reworked OM bituminite, alginite, liptodetrinite	indigenous bitumens (types 2,3 & 4)
5	4431	4440	1350.57	1353.31	Scatter	4	bituminites//l bdg; alginite. Liptodetrinite	indigenous bitumens (types 2,3 & 4)
5	4581	4620	1396.29	1408.18	Scatter	7	bituminite, alginite, liptodetrinite	indigenous bitumens (types 2,3 & 4)
5	4951	4990	1509.06	1520.95	Garbutt	4	bituminite, alginite, liptodetrinite, indigenous bitumens	vitrinite
5	5691	5710	1734.62	1740.41	Garb/Chink	4	matrix bituminite; bituminite //l bdg;indigenous bitumens	fusinite, liptodetrinite
5	6111	6120	1862.63	1865.38	?	5	bituminite //l bdg; alginites (dolomitized); ;liptodetrinite	indigenous bitumens
5	6501	6550	1981.50	1996.44	Toad-Grayl	5	bituminite, alginite, liptodetrinite- highly oxidized	indigenous bitumens

5	6861	6890	2091.23	2100.07	Belloy	4	matrix bituminite; bituminite //l bdg;indigenous bitumens	
5	7881	7910	2402.13	2410.97	Matt-Kiskat	4	matrix bituminite; bituminite //l bdg;indigenous bitumens	
5	8081	8110	2463.09	2471.93	Matt-Kiskat	5/7	matrix bituminite; bituminite //l bdg;indigenous bitumens	fusinite, alginite,liptodetrinite
5	8401	8440	2560.62	2572.51	Golata	4/5	bituminite //l bdg;indigenous bitumens	vitrinite
5	8591	8600	2618.54	2621.28	Debolt	2	bituminite //l bdg;indigenous bitumens	Golata cavings
5	9161	9190	2792.27	2801.11	Deb/Shunda	2/3	matrix bituminite; bituminite //l bdg;indigenous bitumens	
5	9611	9640	2929.43	2938.27	Prophet	2	matrix bituminite; bituminite //l bdg;	indigenous bitumens; microfracture network
5	9661	9690	2944.67	2953.51	Prophet	2	matrix bituminite; bituminite //l bdg;indigenous bitumens	
5	9761	9790	2975.15	2983.99	Clausen	5	bituminite //l bdg;indigenous bitumens	bituminite //l bdg;indigenous bitumens
5	9951	9980	3033.06	3041.90	Banff	4	matrix bituminite; bituminite //l bdg;indigenous bitumens	alginite
5	10361	1039 0	3158.03	3166.87	Banff	5	bituminite //l bdg; alginite	indigenous bitumens
5	10421	1046 0	3176.32	3188.21	Banff	5	bituminite //l bdg; alginite	indigenous bitumens
6	1496		455.98		Matt/Kisk	4	bituminite //l bdg; high grade sporinite & indigenous bitumens	?fish scales
6	1503		458.11		Matt/Kisk	8	bituminite //l bdg; high grade sporinite & indigenous bitumens	graphitized, vesicular microbitumens
6	1515		461.77		Matt/Kisk	8	bituminite //l bdg; high grade sporinite & indigenous bitumens	graphitized, vesicular microbitumens
6	1519		462.99		Matt/Kisk	8	bituminite //l bdg; high grade sporinite & indigenous bitumens	graphitized, vesicular microbitumens
6	1528		465.73		Matt/Kisk	8	bituminite //l bdg; high grade sporinite & indigenous bitumens	graphitized, vesicular microbitumens
7	1618		493.01		Matt-Kiskat	4	Sporinite, vitrinites, alginite (freshwater)	indigenous bitumens (types 2-5) pyrite
7	1626		495.45		Matt-Kiskat	8	Sporinite, vitrinites, inertinite	alginite (freshwater), indigenous bitumens
7	1632		497.28		Matt-Kiskat	4	sporinite, bituminite //l bdg. alginite (freshwater)	inertinite, alginite (marine) liptodetrinite
7	1662		506.43		Matt-Kiskat	4	sporinite, liptodetrinite, alginite (freshwater)	
7	1655		504.44		Matt-Kiskat	4	sporinite, bituminite //l bdg. Liptodetrinite	alginite

Table 5. Reflectance Data

Well no.	Sampling interval				% Reflectance																				Fluores
	Depth (ft)*		Depth (m)		vitrinite				indigneous bitumens																index
	top	base	top	base	calc**	Meas			Type 1			Type 2			Type 3			Type 4			Type 5			Type 6	
						mean	st dev	n	mean	st dev	n	mean	st dev	n	mean	st dev	n	mean	st dev	n	mean				
1	241	290	73.46	88.39	0.81				0.18	0.02	8	0.25	0.01	2	0.49	0	1	0.66		1	1.08	0.09	11	1.37	1
1	451	580	137.46	176.78	0.75										0.47		1	0.57	0	3	0.75			1.67	
1	641	690	195.38	210.31	0.75										0.37			0.57	0.05	20	0.86	0.03	3	1.9	
1	1291	1330	393.50	405.38	0.82	0.6		1				0.28	0.02	2	0.52	0.01	2	0.68	0.03	15	1.1	0	1		
1	1831	1880	558.09	573.02	0.81							0.31		1				0.67	0.04	3	1.02	0.01	3	1.26	
1	2531	2590	771.45	789.43	0.88				0.17	0.02	3	0.22	0	1	0.65	0	1	0.78	0.07	3				1.24	
1	3041	3100	926.90	944.88	0.89				0.17			0.23	0.02	3	0.55	0.02	2	0.8	0.07	4	1.06	0.09	18	1.3	
1	3451	3490	1051.86	1063.75	0.91				0.18		1	0.26	0.01	2	0.62	0.06	9	0.82	0.05	8	1	0.04	6	1.23	
1	3851	3890	1173.78	1185.67	1.01				0.17	0.01	3	0.24	0.02	4	0.44	0.02	4	0.98	0.05	8	1.17	0.02	4	1.52	
1	4361	4440	1329.23	1353.31	0.88				0.17	0.01	6	0.32	0.02	2	0.55	0.08		0.77	0.06	7	1	0.05	6	1.24	
1	4961	5000	1512.11	1524.00	0.99				0.18		2	0.26	0.04	8	0.66	0.03	2	0.96	0.08	8	1.17			1.61	
1	5091	5140	1551.74	1566.67	0.96				0.19	0.02	4	0.34	0.01	2	0.57	0.04	8	0.91	0.05	7				1.86	
1	5351	5400	1630.98	1645.92	0.9	0.82			0.26	0.02	2	0.35	0.02	6	0.65	0.03	2				1.13			1.48	
1	5598		1706.27		0.98							0.31	0.02	2	0.51	0.04	7	0.95	0.08	15	1.31			1.64	
1	5970	6050	1819.66	1844.04	1.13				0.28	0	2	0.34	0.02	6	0.59	0.04	4	1.18	0	1	1.46	0	1		
1	6321	6360	1926.64	1938.53	1.11				0.22	0.02	2							1.15	0.05	2	1.56	0.12	4	1.84	
1	6741	6790	2054.66	2069.59	1.10													1.13	2		1.56	0.05	14		
1	6831	6860	2082.09	2090.93	1.10										0.67	0.07	5	1.13	0.07	12	1.53	0.08	15	2.1	
1	7351	7380	2240.58	2249.42	1.01				0.16						0.52	0.02	2	0.99	0.02	2	1.5	0.06	8	2.34	
1	7421	7460	2261.92	2273.81	1.10										0.51	0.01	2	1.13	0.12	6	1.66	0.08	14		
1	7571	7580	2307.64	2310.38	1.18				0.19	0	1							1.26	0	1					
1	8427		2568.55		1.23							0.54		1	1.04	0.11	13	1.34	0.01	2	1.54	0.06	9		
1	8431		2569.77																0.65	0.9					
1	8955		2729.48		1.23	1.18			0.21									1.34			1.5			2	
1	8971	8990	2734.36	2740.15	1.33							0.54		1	1.04	0.11	13	1.51	0.09	11	1.89	0.17	3		
1	9381	9390	2859.33	2862.07	1.41										1.25	0.08	16	1.63	0.08	20	1.95	0.01	3	2.43	
1	9661	9970	2944.67	3038.86	1.41							0.48		1	1.33	0.06	15	1.64	0.07	10	2.19	0.24	7		
1	9921	10000	3023.92	3048.00	1.48							0.68		1	1.47	0.05	7	1.75	0.08	20	2.32	0.6	11		
3	4048																	3.56	0.014	7	4.68	0.29	13		
3	4062		1238.10		2.55													3.48	0.81	20	4.58	0.16	12	5.36	
3	4066		1239.32		2.70													3.72	0.12	5	4.53	0.19	22	5.08	
3	4365		1330.45		3.03										3.4	0.22	4	4.26	0.22	8	4.87	0.19	29		
3	4377		1334.11		3.10										3.41	0.22	4	4.37	0.21	15	5.06	0.15	10		
3	4449		1356.06		3.13										3.68	0.07	2	4.42	0.21	6	4.95	0.46	4		

3	4454		1357.58												3.55	0.04	3				5.18	0.17	6		
3	5165		1574.29		3.29										4.06	0.14	12	4.68	0.04	4	5.28	0.3	7		
3	5175		1577.34		3.26							2.87	0.25	4	3.87	0.27	8	4.63	0.21	5	5.85	0.36	4		
3	5188		1581.30												3.68	0.09	19	4.65	0.09	8	5.04	0.11	17		
3	5341	5357	1627.94	1632.81	3.20										3.98	0.11	9	4.53	0.2	14	5.39	0.38	37		
4	1161	1220							0.16	0.02	5				0.34	0.02	4	0.5	0.05	17	0.81	0.05	10	1.41	
4	1501	1550							0.15	0.02	4	0.24	0.03	3	0.35	0.02	4	0.59	0.06	10	0.85	0.04	7	1.2	
4	1911	1950	582.47	594.36	0.76							0.29	0	2	0.42	0.03	9	0.6	0.05	12	0.88	0.05	12	1.25	
4	2401	2450			0.81				0.19	0	1							0.67	0.03	9	0.97	0.06	5	1.24	
4	3001	3050							0.17	0	1				0.46	0.06	5	0.8	0.04	4	1.07	0.07	12	1.44	
4	3441	3500													0.57	0.01	2				1.17	0.08	4		
4	4001	4050	1219.50	1234.44	1.05							0.37	0.02	2	0.72	0.03	4	1.05	0.72	1.1	1.33	0.03	6	1.66	
4	4421	4490													0.75	0	1	0.97	0.07	16	1.23	0.05	15	1.69	
4	4801	4830																0.9	0.03	10	1.24	0.08	4		
4	5311	5360													0.74	0	1	1.06	0.09	14	1.34	0.07	7	1.71	
4	5878														0.95	0.03	2	1.24	0.04	5	1.57	0.05	5	2.07	al-5
4	5885														0.88	0	1				1.5	0.04	5	1.99	6
4	5934														1.14	0.03	4	1.44	0.06	10	1.65	0.05	2	1.91	6
4	6621	6670	2018.08	2033.02											0.96	0.05	2	1.28	0.02	2				1.53	
4	6951	6670	2118.66	2033.02	1.19							0.4	0.03	4	0.92	0.18	4				1.62	0.02	2		
4	8311	8360	2533.19	2548.13								0.91	0.1	2	1.35	0.04	2	1.57	0.06	4					
4	8751	8770	2667.30	2673.10	1.23							1.04	0.04	5	1.4	0.03	6				1.92	0.12	5	2.31	
4	9111	9140	2777.03	2785.87											1.43	0.06	2	1.8	0	1	2.42	0	1		
4	9501	9540	2895.90	2907.79	1.65										1.54	0.07	3	2.02	0.1	6	2.5	0	1		
4	10211	10260	3112.31	3127.25	1.87										1.87	0.04	7	2.39	0.14	20	3.38				
4	10426		3177.84		0.51										2.15	0.12	13	2.43	0.17	10	2.86	0.19	25	3.19	
4	10431		3179.37												2.24	0.07	3	3.07	0.35	35					
4	10437		3181.20												2.41	0.24	45	3.13	0.29	13					
4	10977		3345.79		2.05										2.67	0.22	29	3.21	0.02	21	4.38	0.5	17		
4	10983		3347.62												2.62	0.25	19	3.43	0.27	34				5.07	
4	10998		3352.19												2.52	0.19	5	3.54	0.3	4	4.04	0	1		
4	11254		3430.22												2.63	0.1	8	3.32	0.23	30	4.5	0.48	5		
4	11264		3433.27												2.52	0.18	22	3.3	0.31	38	4.61	0.33	6		
4	11286		3439.97		2.6										2.51	0.2	9	3.3	0.25	37	4.25	0.2	2		
4	1152		3511.91												2.6	0	1	3.42	0.23	15					

	2																								
4	12100	12160	3688.08	3706.37	2.5										2.4	0.3	17	3.44	0.4	5					
4	12251	12300	3734.10	3749.04								2.08	0.09	10	2.66	0.18	8	3.46	0.12	4					
4	12441	12510	3792.02	3813.05											2.82	0.12	8	3.4			3.98	0	1		
4	12721	12780	3877.36	3895.34											2.58	0.1	3	3.41	0.23	10	4.4	0.12	6		
5	821	860	250.24	262.13	0.76	0.65	0.03	6	0.15	0.01	22	0.23	0.04	8	0.38	0.03	6								
5	1521	1570	463.60	478.54		0.63	0.04	6	0.12	0.05	3				0.43	0.02	7								alg: 2-3
5	1901	1950	579.42	594.36		0.65	0.03	3	0.17			0.22			0.34	0.01	6	0.48	0.03	15	1.07	0.17	7	1.97	alg:4
5	2141	2190	652.58	667.51	0.82	0.74	0.04	3	0.15	0.01	2	0.21	0.01	2	0.37	0.02	7	0.5	0	1	1.09	0.09	3		alg:4
5	2491	2580	759.26	786.38		0.7	0	1	0.15	0.01	2	0.25	0.03	3	0.35	0.02	3	0.53	0.02	2	1.1	0.05	3		
5	3531	3580	1076.25	1091.18		0.75	0.03	2				0.24	0.03	5	0.47	0.02	3				1.27	0.1	2		
5	4131	4170	1259.13	1271.02								0.35	0.02	2	0.53	0.01	3	0.73	0.03	3	1.35	0.08	7		
5	4291	4340	1307.90	1322.83	398.65																				
5	4431	4440	1350.57	1353.31					0.16	0.02	4	0.27	0.06	8	0.48	0.06	17	0.78	0.04	10	1	0.08	8	1.2	
5	4581	4620	1396.29	1408.18					0.18	0.01	2	0.36		1	0.56	0.02	2	0.81	0.04	6	1.24	0.14	7		
5	4919.5*	4828	1499.46	1471.57								0.23	0.02	7	0.47	0.05	12	0.84	0.02	9	1.05	0.1	15		
5	4928		1502.05									0.23	0.02	7	0.47	0.04	5	0.85	0.01	6	1.11	0.1	7		
5	4951	4990	1509.06	1520.95								0.32	0.07	9	0.58	0.4	9	0.89	0.06	8	1.07	0.02	5	1.28	
5	4951	4990	1509.06	1520.95	1.1	1.01														0.9					
5	5381	5440	1640.13	1658.11					0.16	0.01	3	0.26	0.04	6	0.57	0.05	6	0.92	0.07	10	1.43	0.02	4	2.42	
5	5691	5710	1734.62	1740.41											0.68			0.97	0.08	14	1.32	0.01	2	1.52	
5	5996	6821	1827.58	2079.04								0.63	0.05	4	0.86	0.04	3	1.17	0.08	23	1.5	0.07	20		
5	6008*	6821	1831.24	2079.04												0	1	1.2	0.03	3	1.56	0.08	8	1.77	
5	6015		1833.37													0.09	13	1.24	0.02	5	1.61	0.07	18	2.41	
5	6018		1834.29												1.07	0.05	4	1.28	0.04	4	1.58	0.08	8	1.9	
5	6111	6120	1862.63	1865.38	1							0.31	0.02	3	1.1										
5	6501	6550	1981.50	1996.44														1.18	0.06	8	1.5				
5	6828		2081.17												1.07	0.1	14	1.32			1.58	0.08	8		
5	6861	6890	2091.23	2100.07								0.85	0.03	0	1.18	0.03	14	1.44	0.08	23	1.69	0.06	6		
5	7455		2272.28					pellet:	0.16	0.01	50	0.65	0.07	7	1.14	0.13	7				1.65	0	1		
5	7463		2274.72												1.15	0.03	16	1.31	0.06	15	1.67	0.02	2		
5	7477*	7425	2272.28	2274.72								0.86	0.03	10	1.16	0.03	14	1.45	0.03	9					
5	7625		2324.10					pellet:	0.17	0.02	19	0.91	0.09	11	1.14	0.06	15				1.81	0.08	15		
5	7881	7910	2402.13	2410.97											1.19	0.04	10	1.47	0.16	7	1.89	0	1		
5	8006					1.33	0.03	11	0.19	0.01	3	0.79	0.06	6	1.1		33								

5	8000	8011	2438.40	2441.75					0.19	0.03	16	0.79	0.06	3	1.13	0.03	43	1.41	0.03	6	1.63	0.07	15		
5	8081	8110	2463.09	2471.93		1.33	0.02	4				0.93	0.05	21	1.15	0.07	24	1.51	0.08	22	1.93				
5	8245		2513.08						0.22			1.04	0.04	2	1.2	0.03	11	1.58	0.05	9	1.86	0.08	15	2.33	
5	8401	8440	2560.62	2572.51	1.42	1.35	0.02	7							1.27	0.02	4	1.6	0.06	25	1.78	0.05	11	2.08	
5	8523		2597.81									0.96	0.08	8	1.35	0.03	6	1.61	0.04	7	1.94	0.09	7	2.57	
5	8591	8600	2618.54	2621.28		1.33	0.02	3							1.46	0	1	1.61	0.06	6	2.11	0.2	14		
5	9161	9190	2792.27	2801.11								1	0.02	3	1.41	0.05	5	1.78	0.02	4	2.08	0.08	10	2.78	
5	9611	9640	2929.43	2938.27								1.01	0.03	3	1.4	0.07	7				1.93	0.03	3	2.42	
5	9661	9690	2944.67	2953.51	1.48										1.4	0.03	2	1.74	0.03	3				2.35	
5	9761	9790	2975.15	2983.99		1.67	0.06	8				1.24	0.03	7	1.4	0.07	11	1.67	0.06	8	1.91	0.05	5	2.23	
5	9783		2981.86					pellet:	0.16						1.54	0.05	3	1.8	0.05	6	2.26	0.18	8		
5	9951	9980	3033.06	3041.90								1.25	0.02	3	1.49	0.04	5	1.78	0.02	2	2.63	0.18	3	3.37	
5	10234*	10241	3119.32	3121.46								1.27	0.03	3	1.47	0.05	3	1.8	0.03	3	2.32	0.3	6		
5	10245		3122.68	3121.46																					
5	10254		3125.42	3121.46																					
5	10361	10390	3158.03	3166.87								1.27	0.03	2				1.86	0	1	2.72	0.05	2		
5	10421	10460	3176.32	3188.21																					
7	1496	1528	455.98	465.73														10.5	2	6	17.87	2.03	3		
7	1617.5		493.01			0.81	0.03	11	0.16	0.02	7	0.31	0.04	6	0.53	0.02	2	0.66	0.04	27	1.31	0.12	9		
7	1625.5		495.45			0.82	0.01	5	0.19	0.12	4							0.69	0.06	25	1.33	0.08	10	1.58	4-sp
7	1631.5		497.28			0.79			0.1	0.01	2	0.24	0.04	9	0.51	0.04	4	0.68	0.05	9	1.38	0.05	2		4-sp
7	1647.0		502.01			0.8	0	1	0.16	0.02	9	0.26	0.04	16	0.49	0.06	7	0.67	0	1					3-alg; 5-sp
7	1655.0		504.44			0.8	0	1	0.16	0.02	5	0.25	0.03	8	0.46	0	2	0.64	0	1					
7	1661.5		506.43						0.18	0.03	7	0.29	0.05	11	0.49	0.05	3	0.7	0.01	5					

* asterisk & top depth only indicates core sample

** calculated from bitumen type 4, after Jacob, 1985

APPENDIX A

Table A1 Numeric codes for rock matrix lithology; see Table 4.

Numeric code	1	2	3	4	5	6	7	8	9
Rock type	carbonate	calc.[a] shale	marl	carb.[b] shale	shale	cherty shale	carb.[b] siltstone	siltstone (lean)	coal

[a]calc. = calcareous [b]carb. = carbonaceous

Table A2 Petrographic and genetic classification of solid bitumen, after Potter, 1998; see Table 4.

Relative reflectance*	Reflectance increasing----------------------------------►					
	low Ro			medium Ro	high	very high
Bitumen type	1	2	3	4	5	6
Maceral affiliation	alginite sporinite	liptinite-bitumen transition	bituminite I & II**	mineral-bituminous matrix***	early hydrocarbons	pyrobitumens

* Gentzis, 1991; ** Teichmüller & Ottenjann, 1977; *cf.* amorphinite (van Gijzel, 1959; Sentfle *et al.*, 1987); *** Robert (1981); cf. matrix bituminite (Creaney , 1980).

Table A3 Classification of dispersed organic matter using the maceral concept (from Sentfle *et al*., 1993; modified)

Reflected light	Transmitted light	Multimode illumination
huminite/vitrinite collotelinite* detrovitrinite*	woody	vitrinite
inertinite fusinite semifusinite funginite** macrinite micrinite inertodetrinite	coaly	inertinite
liptinite sporinite cutinite suberinite resinite chlorophyllinite liptodetrinite	herbaceous	liptinite
alginite	algal	
bituminite exsudatinite	amorphous	amorphinite
faunal relicts		faunal relicts
mineral-bituminous groundmass (matrix bituminite)***	amorphous	bituminous mineral groundmass bitumen
Teichmüller & Ottenjann (1977); * ICCP (1995); ** ICCP, 1998; *** Creaney (1980)	Burgess (1974)	van Gijzel (1979); Sentfle *et al.* (1987), modified

Table A4 Liptinite fluorescence index (Potter, 1998)

Fluoresence index	1	2	3	4 4d*	5	6	7	8	9	10
colour	green	light yellow	med yellow	butter yellow	yellow-orange	orange	light brown	med brown	dark brown	black

* 4d = dull yellow