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Rock-Eval 6 / TOC analyses from outcrop samples in northern Mackenzie Mountains, eastern Richardson Mountains, and southern Peel Plateau and Plain, Northwest Territories and Yukon, Canada
NTS 106E, F, G, H, L

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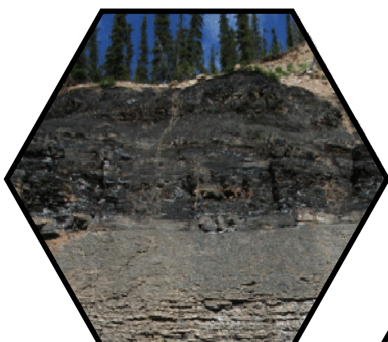

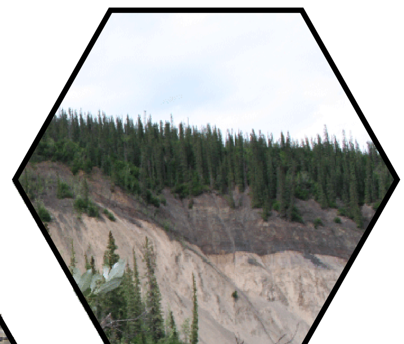

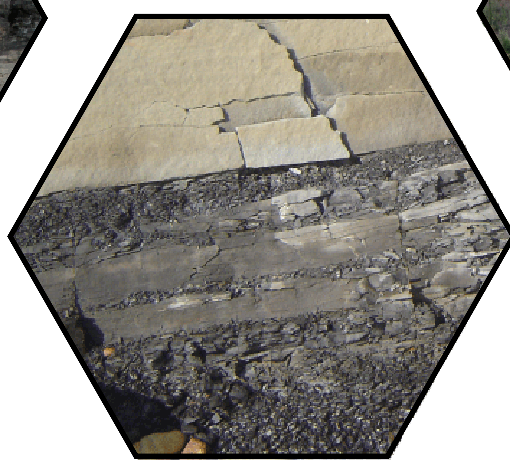

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INTRODUCTION

Rock-Eval 6 pyrolysis and total organic carbon (TOC) analyses were performed on 144 samples collected from outcrop in the northern Mackenzie and eastern Richardson mountains, at the margin of Peel Plateau, as well as from Peel Plain (Figure 1).

These samples were collected to evaluate the source rock potential and thermal maturation of specific formations ranging from Proterozoic to Cretaceous. The new data will augment previously reported data from well cuttings and outcrops (reported in Pyle et al., 2006a; 2006b). The data are reported in a Microsoft ® Excel spreadsheet, as well as a shapefile (in ESRI's ArcView® .shp format) to enable their integration into existing data sets or mapping programs.

The analytical results will be further studied and incorporated into petroleum system work as part of a project entitled *"Regional Geosciences Studies and Petroleum Potential, Peel Plateau and Plain"*; a joint research effort of the Northwest Territories Geoscience Office, Yukon Geological Survey, and Geological Survey of Canada (Pyle et al., 2006a). Project information, scope, and related research documents are available at http://www.nwtgeoscience.ca/petroleum/PeelPlateau.html.

FIELD METHODS

Rock hammers were used to collect samples from outcrop. Attempts were made to sample fresh, unweathered material where possible, by digging into the outcrop face. In many cases, particularly for friable shale, surface weathering and oxidation extended for some distance from the surface. Samples were placed in labeled polyethylene bags and sealed. Table 1 indicates the number of samples from each unit.

LABORATORY METHODS

Rock-Eval 6 instrumentation and applications have been reviewed in Lafargue et al. (1998). Analyses were conducted at the Organic Geochemistry Labs of the Geological Survey of Canada (GSC) in Calgary, on a Delsi Rock-Eval 6® unit equipped with a Total Organic Carbon analysis module. Prior to analysis, samples were pulverized with an agate mortar and pestle, and weighed. Sample size ranged from 20 to 70 mg. The analysis methods employed at the GSC – Calgary lab are further outlined in Stasiuk and Fowler (2004).

ANALYTICAL RESULTS

Table 2 lists the Rock-Eval 6 analytical results. Unprojected shapefiles (in ESRI's ArcView® format) are appended in the digital version of this report, with sample locations and Rock-Eval 6 analyses. Figures 2 to 5 are modified van Krevelen diagrams of hydrogen index versus oxygen index crossplots.

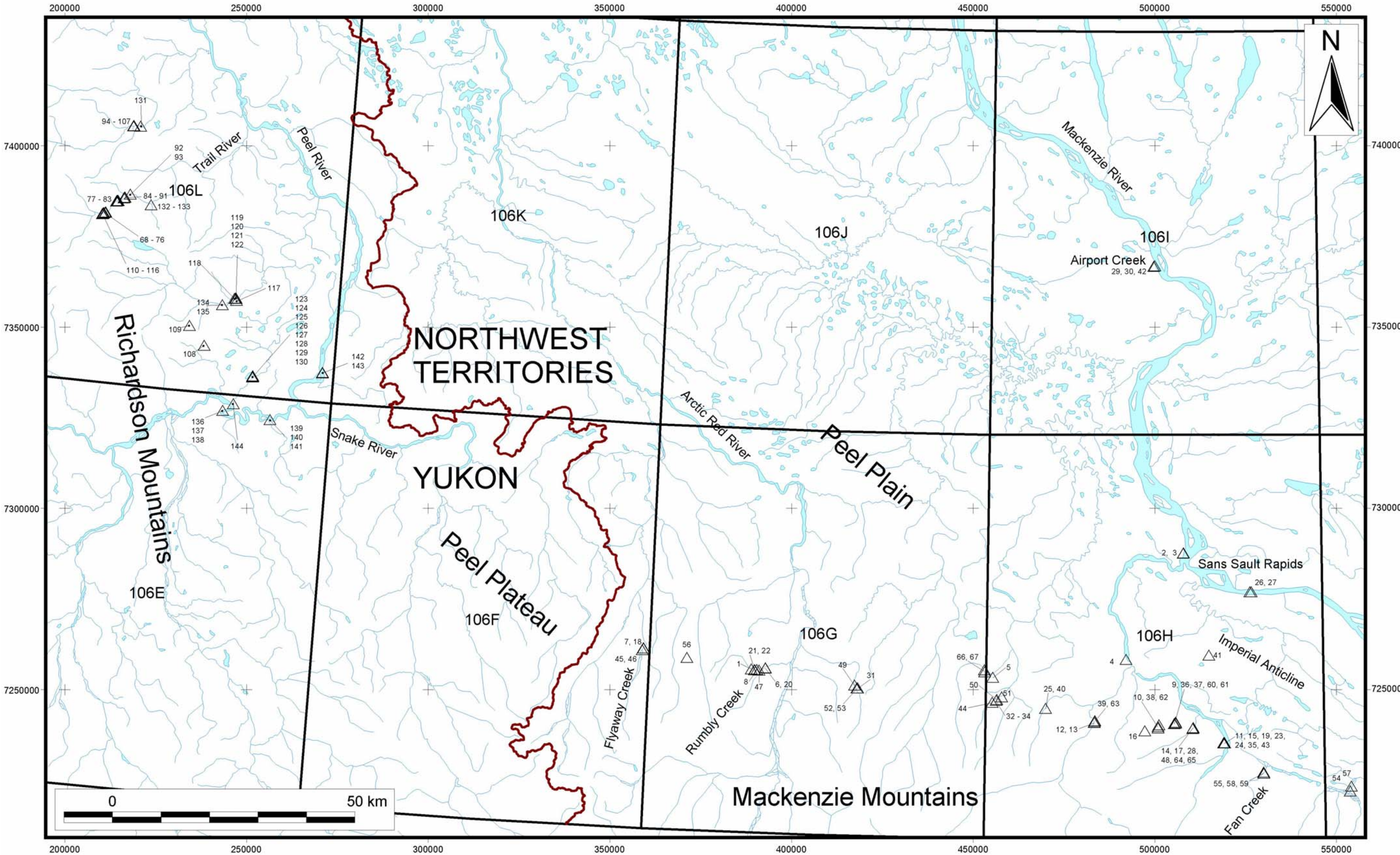

Figure 1. Sample locations (keyed to Table 2). Grid coordinates are UTM, NAD 83. Geographic locations mentioned in text are labeled, as are the 1:250 000 scale NTS map sheets

Unit	*Age*	*Number of samples*
Trevor Formation	Cretaceous	2
Arctic Red Formation	Cretaceous	11
Martin House Formation	Cretaceous	3
Triassic undivided	Triassic	2
Tuttle Formation	Mississippian	25
Tuttle and/or Imperial formations	Mississippian to Upper Devonian	4
Imperial Formation (including questionable Imperial Formation)	Upper Devonian	23
Undefined shale (Tuttle or Canol formations or equivalent)	Mississippian or older	11
Canol Formation	Upper Devonian	25
Ramparts Formation (including Kee Scarp Member)	Middle Devonian	6
Upper Member, Hare Indian Formation	Middle Devonian	10
Bluefish Member, Hare Indian Formation	Middle Devonian	13
Hume Formation	Middle Devonian	4
Landry Formation	Lower Devonian	1
Road River Group	Cambrian to Devonian	1
Mount Cap Formation	Cambrian	2
Katherine Group	Proterozoic	1

Table 1. *Summary listing of number of samples collected from various units*

Sample Location on Figure 1	*Sample Number*	*Unit*	*UTM E*	*UTM N*	*UTM zone*	*S1*	*S2*	*PI*	*S3*	*Tmax*	*TOC*	*OI*	*HI*
1	06LP-14-05	Arctic Red	388935	7255664	9	0.02	0.19	0.09	3.12	605	5.10	61	4
2	06LP-19-08	Arctic Red	507827	7287534	9	0.01	0.24	0.04	0.16	438	0.57	28	42
3	06LP-19-10	Arctic Red	507891	7287663	9	0.01	0.25	0.05	0.25	440	0.44	57	57
119	TNT-CR-025D	Arctic Red	516545	7346522	8	0.18	2.68	0.06	0.96	435	2.38	40	113
120	TNT-CR-025G	Arctic Red	516462	7346551	8	0.17	3.09	0.05	0.77	434	2.50	31	124
121	TNT-CR-025I	Arctic Red	516472	7346546	8	0.11	1.67	0.06	0.52	437	1.83	28	91
122	TNT-CR-025J	Arctic Red	516671	7346529	8	0.13	2.59	0.05	0.26	436	2.61	10	99
4	06-TH-03-A	Arctic Red	492076	7258261	9	0.04	1.05	0.03	0.17	440	1.55	11	68
5	06-TH-04-C	Arctic Red	455393	7253310	9	0.10	1.81	0.05	0.34	442	2.08	16	87
117	TNT-CR-025A	Arctic Red	516767	7345965	8	0.20	4.46	0.04	0.09	435	2.80	3	159
118	TNT-CR-025B	Arctic Red	516217	7346447	8	0.14	0.99	0.13	0.14	425	1.64	9	60
6	06LP-07-01	Bluefish	392782	7255859	9	0.02	0.44	0.05	3.18	596	6.84	46	6
7	06LP-14-04	Bluefish	359298	7261429	9	0.01	0.04	0.27	0.24	606	0.48	50	8
8	06LP-16-05	Bluefish	390454	7255482	9	0.01	0.05	0.12	0.13	607	0.74	18	7
9	06LP-17-03	Bluefish	505359	7240562	9	1.05	14.26	0.07	0.49	454	7.86	6	181
10	06LP-17-06	Bluefish	500927	7239377	9	1.34	12.66	0.10	0.21	452	7.08	3	179
11	06LP-17-09	Bluefish	518955	7235234	9	0.71	15.55	0.04	1.28	448	9.56	13	163
12	06LP-18-01	Bluefish	483352	7240896	9	1.64	8.02	0.17	0.98	470	10.10	10	79
13	06LP-18-03	Bluefish	483322	7240942	9	1.09	4.43	0.20	0.74	468	5.68	13	78
14	06LP-19-13	Bluefish	510398	7239210	9	0.97	13.28	0.07	0.78	450	7.15	11	186
15	06LP-21-06	Bluefish	518975	7235232	9	0.93	15.55	0.06	0.87	445	7.82	11	199
16	06LP-21-12	Bluefish	497246	7238580	9	0.95	10.37	0.08	1.19	449	7.92	15	131
17	06-TH-02-E	Bluefish	510442	7239211	9	0.68	13.01	0.05	2.01	448	8.90	23	146
18	06-TH-16-D	Bluefish	359252	7261415	9	0.02	0.19	0.10	0.27	607	5.82	5	3
20	06LP-07-05	Canol	392840	7255969	9	0.02	0.60	0.04	0.66	596	6.80	10	9
21	06LP-14-06	Canol	389858	7255391	9	0.03	0.18	0.14	0.18	603	3.10	6	6
22	06LP-14-07	Canol	389831	7255368	9	0.01	0.45	0.03	0.32	602	7.54	4	6
23	06LP-17-12	Canol	519186	7235220	9	1.66	12.85	0.11	0.39	446	5.04	8	255
24	06LP-17-13	Canol	519256	7235226	9	0.46	4.89	0.09	0.89	446	3.12	29	157
25	06LP-18-11	Canol	469913	7244785	9	1.81	9.83	0.16	0.24	456	8.29	3	119
26	06LP-19-03	Canol	526145	7276924	9	1.45	21.08	0.06	0.18	442	5.61	3	376
27	06LP-19-05	Canol	526580	7276934	9	1.47	21.77	0.06	0.58	440	6.75	9	323
28	06LP-19-16	Canol	510564	7239400	9	1.19	14.63	0.08	0.34	448	5.90	6	248
29	06LP-20-02	Canol	499693	7366664	9	0.14	6.96	0.02	6.10	424	4.89	125	142
30	06LP-20-03	Canol	499709	7366676	9	0.02	0.32	0.05	4.46	487	2.92	153	11
31	06-TH-06-E	Canol	418214	7250364	9	0.02	0.50	0.03	1.46	594	6.13	24	8
32	WGZ-012-06	Canol	456313	7246944	9	0.49	4.12	0.11	0.32	467	7.30	4	56
33	WGZ-013-06	Canol	456313	7246944	9	0.15	1.36	0.10	0.38	459	3.52	11	39
34	WGZ-014-06	Canol	456313	7246944	9	1.29	2.02	0.39	0.15	465	2.89	5	70
68	TNT-TR-001A	Canol	478123	7366448	8	0.02	0.04	0.31	0.42	610	5.33	8	1
69	TNT-TR-002	Canol	478147	7366501	8	0.01	0.06	0.21	0.50	609	4.06	12	1
70	TNT-TR-003	Canol	478153	7366536	8	0.02	0.02	0.40	0.78	424	3.75	21	1
71	TNT-TR-004	Canol	478147	7366501	8	0.01	0.06	0.17	0.65	488	4.39	15	1
111	TNT-TR-024B	Canol	477802	7366192	8	0.01	0.05	0.17	0.42	610	3.70	11	1
112	TNT-TR-024C	Canol	477802	7366192	8	0.02	0.08	0.20	0.28	610	5.05	6	2
113	TNT-TR-024E	Canol	477887	7366189	8	0.01	0.12	0.09	0.31	609	5.63	6	2
114	TNT-TR-024G	Canol	477989	7366393	8	0.01	0.03	0.26	0.39	609	3.34	12	1
115	TNT-TR-024I	Canol	478054	7366379	8	0.01	0.16	0.06	1.13	609	6.19	18	3
116	TNT-TR-024K	Canol	478119	7366453	8	0.03	0.10	0.26	0.33	610	6.25	5	2
36	06LP-17-01	Hare Indian	505405	7240609	9	0.19	1.36	0.12	0.21	457	1.18	18	115
37	06LP-17-02	Hare Indian	505405	7240609	9	0.12	0.23	0.35	0.15	451	0.31	48	74
38	06LP-17-07	Hare Indian	500908	7239745	9	0.01	0.08	0.10	0.19	456	0.11	173	73
19	06LP-17-11	Hare Indian	519178	7235231	9	2.37	27.93	0.08	0.84	454	13.31	6	210
39	06LP-18-04	Hare Indian	483417	7241272	9	0.01	0.03	0.14	0.29	456	0.06	483	50
40	06LP-18-10	Hare Indian	469896	7244795	9	0.01	0.05	0.13	0.16	458	0.05	320	100
41	06LP-19-12	Hare Indian	514875	7259452	9	0.86	16.60	0.05	0.34	445	3.60	9	461
42	06LP-20-05	Hare Indian	500027	7366843	9	0.00	0.04	0.11	0.39	429	0.06	650	67
43	06LP-21-08	Hare Indian	519049	7235320	9	0.82	11.18	0.07	1.38	447	6.23	22	179
35	06LP-21-11	Hare Indian	519022	7235302	9	0.97	20.07	0.05	0.66	452	9.35	7	215
44	06LP-02-06	Hume	455204	7246442	9	0.02	0.21	0.10	0.27	476	1.65	16	13
45	06LP-14-02	Hume	358872	7260939	9	0.01	0.02	0.24	0.27	435	0.23	117	9
46	06LP-14-03	Hume	358913	7260987	9	0.00	0.01	0.26	0.27	427	0.07	386	14
47	06LP-16-04	Hume	391098	7255282	9	0.01	0.16	0.07	0.97	608	5.68	17	3
48	WGZ-004-06	Imperial	510560	7239442	9	0.83	9.42	0.08	0.20	438	3.60	6	262
49	WGZ-011-06	Imperial	417385	7251181	9	0.01	0.17	0.04	0.35	526	0.73	48	23
50	WGZ-016-06	Imperial	456532	7247207	9	0.02	0.19	0.12	0.16	470	0.40	40	48
51	WGZ-019-06	Imperial	457879	7247919	9	0.01	0.15	0.09	0.25	459	0.24	104	62
52	WGZ-024-06	Imperial	417960	7250400	9	0.07	0.56	0.11	0.25	575	4.44	6	13
53	WGZ-026-06	Imperial	417960	7250400	9	0.11	0.21	0.34	0.29	597	2.62	11	8
54	WGZ-033B-06	Imperial	553766	7221988	9	0.01	0.22	0.03	0.21	436	0.45	47	49
72	TNT-TR-007	Imperial	478543	7366649	8	0.01	0.07	0.07	0.35	594	0.76	46	9
73	TNT-TR-008	Imperial	478489	7366667	8	0.13	0.18	0.43	1.58	324	6.41	25	3
74	TNT-TR-009	Imperial	478545	7366689	8	0.01	0.06	0.11	0.27	606	1.11	24	5
75	TNT-TR-010	Imperial	478605	7366713	8	0.00	0.05	0.03	0.17	602	0.73	23	7
76	TNT-TR-011	Imperial	478711	7366788	8	0.02	0.04	0.37	0.88	428	6.98	13	1
77	TNT-TR-012A	Imperial	481330	7370081	8	0.02	0.44	0.04	0.46	607	7.03	7	6
78	TNT-TR-012D	Imperial	481404	7370113	8	0.00	0.11	0.04	0.20	546	0.62	32	18

Sample Location on Figure 1	Sample Number	Unit	UTM E	UTM N	UTM zone	S1	S2	PI	S3	Tmax	TOC	OI	HI
79	TNT-TR-012F	Imperial	481439	7370117	8	0.00	0.12	0.03	0.78	555	0.77	101	16
80	TNT-TR-013A	Imperial	481618	7370239	8	0.01	0.16	0.07	0.35	540	0.80	44	20
81	TNT-TR-013B	Imperial	481469	7370231	8	0.01	0.14	0.04	0.49	554	0.73	67	19
82	TNT-TR-013E	Imperial	481778	7370230	8	0.01	0.13	0.05	0.17	540	0.64	27	20
83	TNT-TR-013F	Imperial	481790	7370212	8	0.00	0.06	0.06	0.08	539	0.33	24	18
136	TNT-PR-032A	Imperial?	515914	7315451	8	0.05	0.31	0.15	1.44	480	0.99	145	31
137	TNT-PR-032B	Imperial?	515914	7315451	8	2.48	2.93	0.46	0.23	431	3.94	6	74
138	TNT-PR-032C	Imperial?	515914	7315451	8	1.06	2.82	0.27	0.30	438	5.07	6	56
144	TNT-PR-035A	Imperial?	518634	7317560	8	1.78	6.20	0.22	0.14	443	4.22	3	147
55	06LP-24-01	Katherine	529996	7227242	9	0.01	0.05	0.15	0.16	561	0.45	36	11
56	06LP-13-14	Landry	371207	7258850	9	0.00	0.03	0.12	0.27	449	0.13	208	23
57	06-TH-20-E	Martin House	554108	7223314	9	0.08	1.54	0.05	0.30	434	1.49	20	103
142	TNT-PR-034A	Martin House	542248	7328354	8	0.12	3.56	0.03	0.30	432	1.73	17	206
143	TNT-PR-034B	Martin House	542240	7328515	8	0.02	0.92	0.02	0.22	435	0.71	31	130
58	06LP-24-02	Mount Cap	529949	7226910	9	0.00	0.05	0.10	0.26	505	0.21	124	24
59	06LP-24-05	Mount Cap	530065	7226918	9	0.01	0.03	0.22	0.28	563	0.16	175	19
60	06LP-17-04	Ramparts	505781	7240738	9	0.22	14.53	0.02	0.54	451	6.45	8	225
61	06LP-17-05	Ramparts	505734	7240911	9	0.06	2.05	0.03	1.06	455	1.92	55	107
62	06LP-17-08	Ramparts	501118	7240210	9	0.85	4.39	0.16	0.31	459	2.43	13	181
63	06LP-18-05	Ramparts	483471	7241317	9	0.88	6.07	0.13	0.58	456	4.81	12	126
64	06LP-19-14	Ramparts	510480	7239341	9	0.80	24.06	0.03	0.47	453	9.43	5	255
65	06LP-19-15	Ramparts	510512	7239373	9	0.14	34.48	0.00	1.33	449	12.43	11	277
110	TNT-TR-024A	Road River	477802	7366192	8	0.02	0.04	0.34	0.21	609	2.28	9	2
66	06-TH-12-B	Trevor	453161	7254872	9	0.04	1.20	0.03	0.24	441	1.71	14	70
67	06-TH-12-C	Trevor	453061	7255421	9	0.01	0.32	0.03	0.47	451	1.48	32	22
108	TNT-SH-022	Triassic	509132	7332767	8	0.01	0.33	0.03	0.69	421	0.19	363	174
109	TNT-SH-023	Triassic	504581	7337836	8	0.02	0.41	0.06	0.76	421	0.20	380	205
84	TNT-TR-014A	Tuttle	483250	7371104	8	0.05	0.36	0.13	0.43	451	0.62	69	58
85	TNT-TR-014C	Tuttle	483250	7371104	8	0.02	0.30	0.06	0.13	447	0.67	19	45
86	TNT-TR-014G	Tuttle	483250	7371104	8	0.19	4.84	0.04	0.36	451	4.22	9	115
87	TNT-TR-015J	Tuttle	483445	7371302	8	0.02	0.56	0.03	0.31	457	1.00	31	56
88	TNT-TR-015K	Tuttle	483479	7371292	8	0.01	0.21	0.02	0.30	451	0.28	107	75
89	TNT-TR-016A	Tuttle	483552	7371310	8	0.45	20.57	0.02	0.26	435	6.42	4	320
90	TNT-TR-016C	Tuttle	483552	7371310	8	0.07	3.51	0.02	0.21	437	2.59	8	136
91	TNT-TR-016-2	Tuttle	483570	7371318	8	0.05	2.05	0.02	0.55	434	2.29	24	90
92	TNT-TR-017A	Tuttle	484937	7372301	8	0.10	1.93	0.05	0.45	437	1.98	23	97
93	TNT-TR-017C	Tuttle	484937	7372301	8	0.07	2.52	0.03	0.26	432	1.80	14	140
94	TNT-RR-019E	Tuttle	483970	7391103	8	0.10	10.71	0.01	3.62	430	10.37	35	103
95	TNT-RR-191	Tuttle	483970	7391103	8	0.04	0.89	0.05	0.53	451	2.86	19	31
96	TNT-RR-019K	Tuttle	483995	7391125	8	0.01	1.57	0.01	0.50	434	2.03	25	77
101	TNT-RR-020H	Tuttle	484059	7391144	8	0.91	64.15	0.01	7.92	425	29.30	27	219
102	TNT-RR-020H	Tuttle	484059	7391144	8	0.73	66.60	0.01	7.85	424	40.25	20	165
103	TNT-RR-020M	Tuttle	484061	7391137	8	0.11	1.21	0.09	1.86	427	3.35	56	36
104	TNT-RR-020O	Tuttle	484061	7391137	8	0.28	24.07	0.01	16.90	426	26.18	65	92
105	TNT-RR-020O	Tuttle	484061	7391137	8	0.27	26.49	0.01	14.05	429	37.40	38	71
106	TNT-RR-020S	Tuttle	484055	7391159	8	0.08	0.73	0.10	0.28	437	1.46	19	50
107	TNT-RR-020V	Tuttle	484041	7391149	8	0.02	1.45	0.02	0.49	428	1.92	26	76
131	TNT-RR-028A	Tuttle	485951	7391245	8	0.02	0.49	0.03	0.25	440	0.77	32	64
132	TNT-TR-029A	Tuttle	490861	7369955	8	0.05	0.81	0.06	0.16	425	1.37	12	59
133	TNT-TR-029C	Tuttle	490861	7369955	8	0.17	8.55	0.02	0.24	425	3.60	7	238
134	TNT-CR-031A	Tuttle	512994	7344407	8	0.10	4.52	0.02	0.37	431	3.07	12	147
135	TNT-CR-031C	Tuttle	512994	7344407	8	0.65	16.21	0.04	0.29	433	8.69	3	187
97	TNT-RR-020A	Tuttle/Imperial?	484113	7391184	8	0.04	2.22	0.02	0.15	430	2.33	6	95
98	TNT-RR-020B	Tuttle/Imperial?	484090	7391172	8	0.09	1.45	0.06	0.49	424	2.92	17	50
99	TNT-RR-020C	Tuttle/Imperial?	484090	7391172	8	0.06	1.00	0.06	0.19	423	1.94	10	52
100	TNT-RR-020F	Tuttle/Imperial?	484066	7391159	8	0.04	2.14	0.02	0.10	430	1.54	6	139
123	TNT-CC-026B	undefined shale	523198	7325395	8	0.48	5.30	0.08	0.08	443	2.54	3	209
124	TNT-CC-026C	undefined shale	523163	7325413	8	2.37	11.37	0.17	0.19	444	4.04	5	281
125	TNT-CC-026D	undefined shale	523163	7325413	8	2.18	9.87	0.18	0.12	441	3.47	3	284
126	TNT-CC-026E	undefined shale	523225	7325515	8	2.27	8.08	0.22	0.13	441	3.10	4	261
127	TNT-CC-026G	undefined shale	523295	7325620	8	1.42	31.45	0.04	0.64	436	12.17	5	258
128	TNT-CC-026I	undefined shale	523167	7325671	8	0.01	0.05	0.17	0.24	437	0.07	343	71
129	TNT-CC-026J	undefined shale	523167	7325671	8	1.47	21.18	0.06	0.64	440	9.24	7	229
130	TNT-CC-026K	undefined shale	523167	7325671	8	1.59	21.03	0.07	0.36	443	8.64	4	243
139	TNT-PR-033A	undefined shale	529110	7314150	8	0.27	1.56	0.15	0.28	497	4.54	6	34
140	TNT-PR-033B	undefined shale	529110	7314150	8	0.10	1.03	0.09	0.50	574	3.89	13	26
141	TNT-PR-033C	undefined shale	529110	7314150	8	0.01	0.05	0.18	0.15	354	0.03	500	167

Table 2. *Rock-Eval 6 and TOC results from collected samples. Sample location column corresponds to Figure 1, UTM E = Universal Transverse Mercator east coordinate, UTM N= Universal Transverse Mercator north coordinate (both are NAD 83), S1, and S2 units are mg hydrocarbon per g rock, S3 units are mg CO_2 per g rock, PI =production index = S1/(S1+S2), Tmax units are °C, TOC = total organic carbon in weight percent, OI = oxygen index = mg CO_2 per g TOC, HI= hydrogen index = mg hydrocarbons per g TOC*

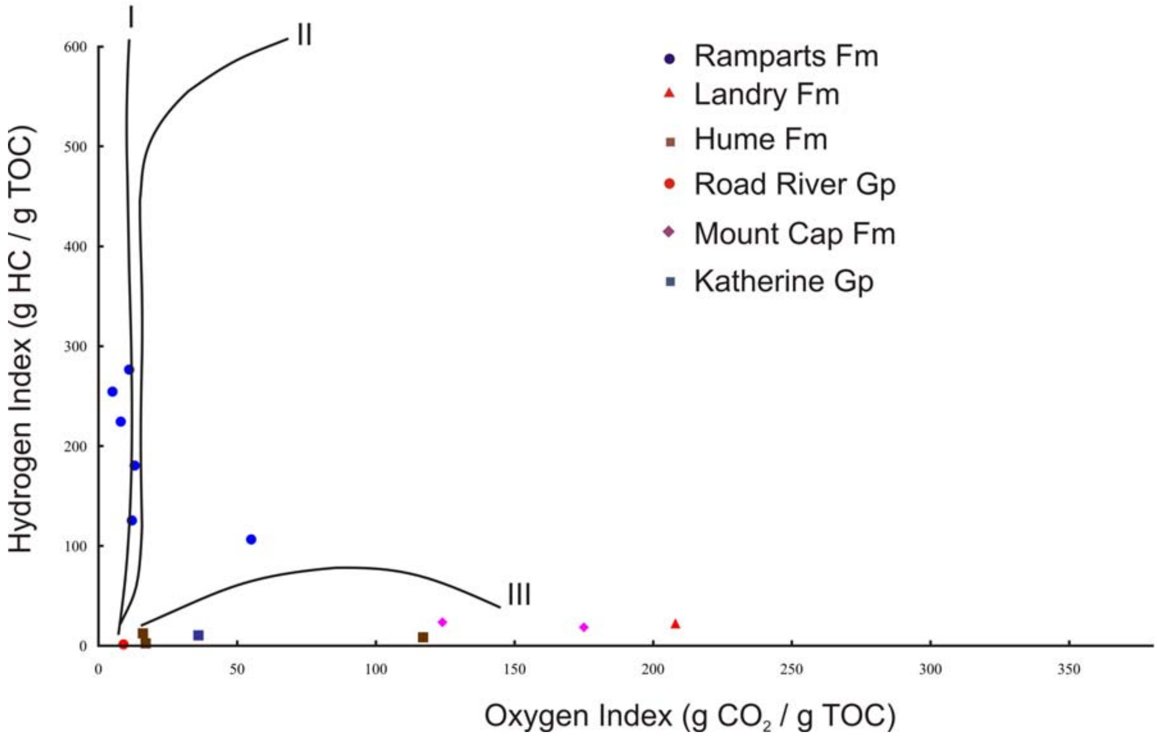

Figure 2. *Hydrogen index versus oxygen index crossplot for discriminating kerogen type (labeled I, II, and III). Middle Devonian Ramparts Formation and older samples are plotted (one Hume Formation outlier with oxygen index of 386 is not plotted)*

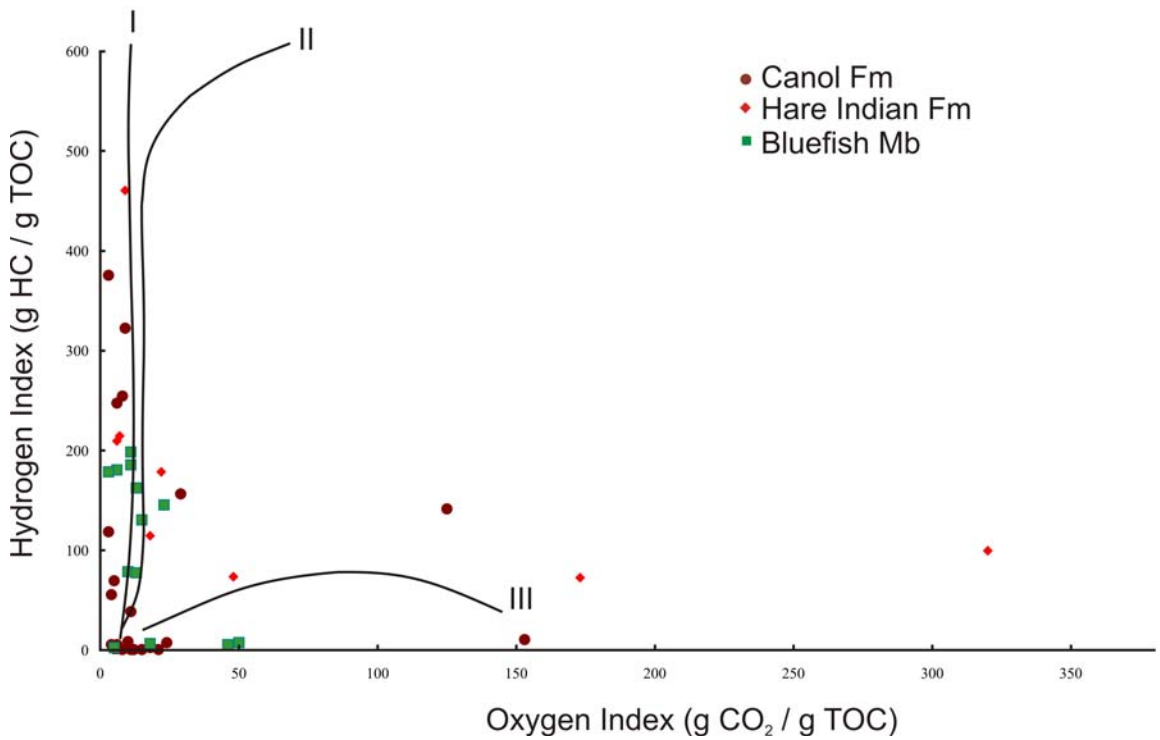

Figure 3. *Hydrogen index versus oxygen index crossplot for discriminating kerogen type (labeled I, II, and III). Middle and Upper Devonian Canol and Hare Indian formations samples are plotted (two Hare Indian outliers with oxygen indices of 480 and 650 are not plotted)*

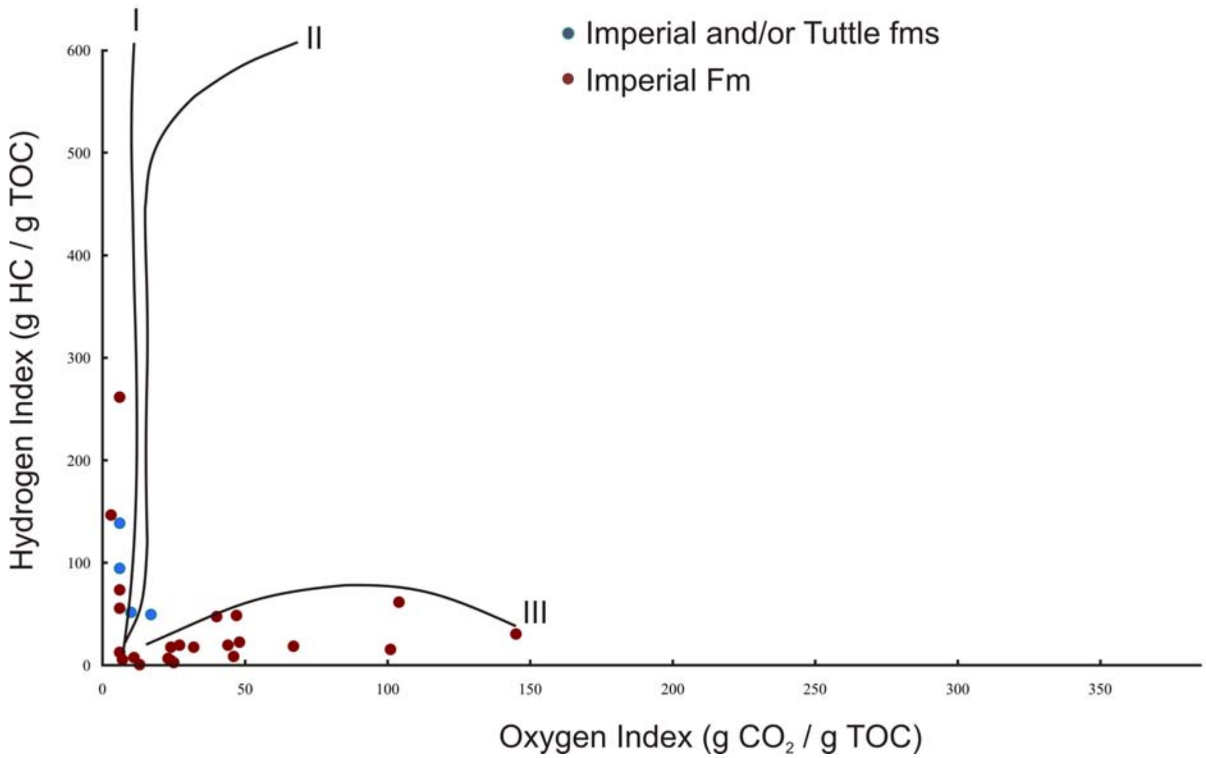

Figure 4. *Hydrogen index versus oxygen index crossplot for discriminating kerogen type (labeled I, II, and III). Upper Devonian Imperial and unresolved Imperial and/or Tuttle formation samples are plotted*

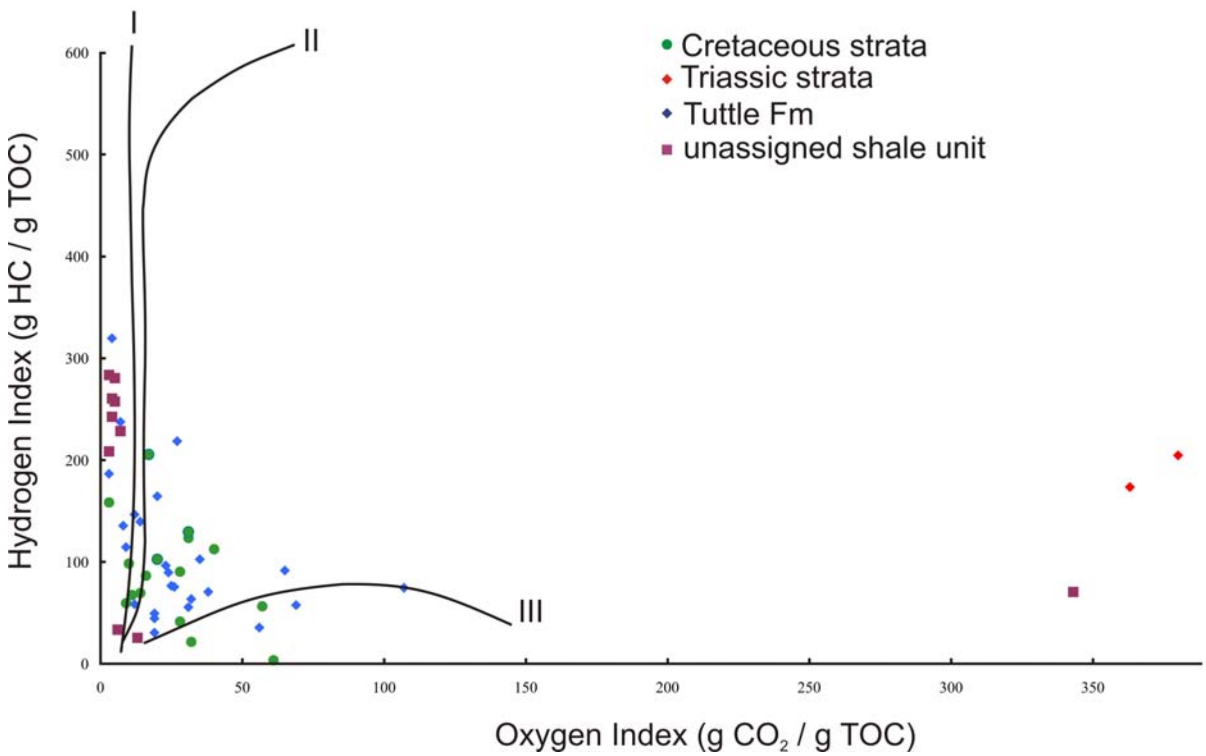

Figure 5. *Hydrogen index versus oxygen index crossplot for discriminating kerogen type (labeled I, II, and III). Tuttle Formation, Mesozoic strata, and "unassigned shale" samples are plotted. The unassigned shale unit (previously mapped as Carboniferous) may be either Tuttle Formation or Canol Formation. See discussion below*

DISCUSSION

Katherine Group

A single sample from Proterozoic Katherine Group shale at Fan Creek had a low TOC value of 0.45%, although this was probably higher originally as the sample was overmature based on a T_{max} value of 561 °C. Type III kerogen is indicated (Figure 2).

Mount Cap Formation

Two samples collected from Mount Cap Formation at Fan Creek showed virtually no source rock potential (0.16 to 0.21% TOC), and were overmature based on T_{max} values (505 and 563 °C). Type III kerogen is indicated (Figure 2). However, better source rock samples (4% TOC) were collected from the region in reconnaissance studies in 2005 (Pyle et al., 2006b).

Landry Formation

A single sample from Landry Formation argillaceous limestone had no source rock potential (0.13% TOC).

Hume Formation

Four samples from Hume Formation yielded TOC values from less than 0.1 to 5.7%. Type III kerogen is indicated (Figure 2). Samples collected were judged to be overmature, based on T_{max} values. Those samples collected at Flyaway Creek (Figure 1), where maturity indicators were unreliable, were deemed overmature based on comparison with Hare Indian Formation Bluefish Member sample data.

Hare Indian Formation – Bluefish Member

Bluefish Member is the basal member of Hare Indian Formation; and is known to have very good source rock potential. Samples collected in this study had TOC values of 5 to 10%, with two outliers with less than 1% TOC. Kerogen type seems to be mainly Type I, with some samples indicating Type III (Figure 3). Sample maturity from T_{max} is within the oil window, increasing to overmature in the Arctic Red River area and westward (Figure 2).

Hare Indian Formation – Upper Member

The Upper Member of Hare Indian Formation is mainly greenish grey shale and limestone. The Upper Member has generally poor source rock potential (1.5% and less TOC) except where the beds are gradational with black shales of overlying Ramparts Formation (3% and more TOC). Kerogen types I (in black shale) to III (in greenish grey shale) are indicated (Figure 3). The source rock is mature in the area of Imperial Anticline, and at high maturity (within oil window) to the south and west along the Mackenzie Mountains front (Figure 2).

Ramparts Formation

The lower part of the Kee Scarp member (Carcajou marker of Tassonyi, 1969; Muir and Dixon, 1984) includes dark shales interbedded with limestone. Samples collected from this member indicate very good source rock potential (TOC values range from 2% to more than 12%). Dominantly Type I kerogen is indicated (Figure 2). Maturity levels (from T_{max}) are in the upper part of the oil window.

Canol Formation

Canol Formation is known to have very good source rock potential; samples collected in this study had TOC values of 2.9 to 8.3%. Canol samples range from immature in northeast Peel Plain at Airport Creek, to overmature from the Arctic Red River and west (Figure 1). Both types I and III (but dominantly Type I) kerogen are indicated (Figure 3).

Imperial Formation

Samples from Imperial Formation ranged from less than 0.5% to greater than 7% TOC, indicating poor to very good source rock potential. Maturity of outcrop samples from T_{max} values is late to post-mature, but some immature to early maturity samples were collected in the Richardson Mountains. Types I and III (but dominantly Type III) kerogen are indicated (Figure 4). The questionable Imperial and/or Tuttle samples have types I and/or II kerogen.

Tuttle Formation

Samples from Tuttle Formation and shales assigned to unit Cf by Norris (1981) have generally good to very good source rock potential, with TOC values in the 1 to 10% range (excluding four low outliers and four coaly (?) samples with greater than 26% TOC). Samples are immature to within the oil window. A range of kerogen types from I to III is indicated (Figure 5). To the north, along Trail River (Figure 1), Braman and Hills (1992) dated strata assigned to unit Cf as equivalent in age to Tuttle Formation, so we have included it here with Tuttle Formation.

Unassigned shale beds

Samples from an undefined shale, assigned to map unit Cf by Norris (1981), generally have excellent source rock potential with TOC values of 2.5% to more than 12% (excluding two low outliers). Maturity is just within the oil window. Type I kerogen is indicated (Figure 5).

Although assigned to map unit Cf (Norris, 1981; 1982), the outcrop lithologies and weathering characteristics are similar to Canol Formation. Canol Formation equivalence is also supported by Rock-Eval parameter characteristics. Ongoing palynological work should resolve the issue.

Triassic Rocks

Two Triassic limestone samples were collected, however these had poor source rock potential (0.19 and 0.20% TOC).

Cretaceous Rocks

Cretaceous samples from Martin House, Arctic Red, and Trevor formations are predominantly good source rocks (range 0.44 to 5.10% TOC, with 75% of samples between 1 and 2%), and at early maturity (top of oil window) in Peel Plateau. Types I, II, and III kerogens are indicated (Figure 5). The lowest TOC samples are siltstones of Arctic Red Formation from Peel Plain at Sans Sault Rapids (06LP-19-08, 10). These are poor source rocks, at early maturity. Sample 06LP-14-05 had the highest TOC at 5.1%, and unreliable maturity indicators, but it is questionable whether this was Cretaceous shale, or possibly Canol or Imperial formations.

CONCLUSIONS

Initial analyses of samples collected confirm the excellent source rock potential of Canol Formation and Bluefish Member of Hare Indian Formation in Peel Plateau and Plain. The black "Carcajou" shale of Ramparts Formation is also an excellent potential source rock. Maturity in the Middle Devonian to Lower Carboniferous shales varies across the study area, but samples are mainly from the upper part of the oil window. Cretaceous source rocks are good but at early maturity. Imperial Formation and Hume Formation samples vary in quality but locally are good source rocks. Very few Lower Paleozoic and Proterozoic samples were collected, although there may have been some gas-generating potential in Cambrian and Proterozoic shale.

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