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Publications in this series have not been edited; they are released as submitted by the author.

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INTRODUCTION

The Upper Devonian Imperial Formation and uppermost Devonian to possibly lowermost Carboniferous Tuttle Formation cover a large swath of the Northwest Territories in both outcrop and in the subsurface, extending north along the Mackenzie Valley from about latitude 63°N, under Peel Plain and Peel Plateau, and the western part of the Anderson Plain. Outcrops are present on the north flank of the Mackenzie Mountains, east flank of the Richardson Mountains, in the Campbell Uplift near Inuvik, and scattered outcrops in Anderson Plain. The bulk of this clastic wedge is Imperial Formation; the Tuttle Formation is limited to the eastern flanks of the Richardson Mountains and westernmost Peel Plateau. Imperial strata represent the first significant influx of siliciclastic strata onto a shelf that had been dominated by platform carbonates since the late Cambrian.

One hundred twenty-two wells have penetrated this clastic wedge (Fig. 1 and Appendix 1) and several thousand kilometres of reflection seismic image the formation (paper copies of this data are available from the National Energy Board). Only 13 wells contain core from the Imperial Formation (Appendix 2). These data form the basis for this study, wherein internal correlations are illustrated on log cross sections, the character and distribution of the Imperial and Tuttle formations are outlined, and the sedimentological character is briefly described and interpreted.

PREVIOUS WORK

Pugh (1983, 1993) wrote the most recent comprehensive study of the Imperial and Tuttle formations in the subsurface of the Northwest Territories and northeastern Yukon. He also included a comprehensive review of the checkered history of the naming of the Imperial Formation and formally defined the Tuttle Formation (Pugh, 1983). Outcrop along Imperial River on the north flank of the Mackenzie Mountains were designated the type section (Hume and Link, 1945) and the Pacific Peel YT F-37 well contains the type section of the Tuttle Formation (Pugh, 1983). Chi and Hills (1976) reported on megaspores, and Braman (1981) on miospores from the Imperial Formation. Richards et al. (1997) reviewed Imperial and Tuttle geology for the Richardson Mountains and Eagle Plain. They also indicated that the youngest age of the Tuttle Formation is not certain, and that both formations may be Upper Devonian. Allen et al. (2009) cited an early Carboniferous age for the Tuttle Formation.

STRATIGRAPHY

Imperial and Tuttle strata attain thicknesses up to 2922m in the McPherson B-25 well, on the east flank of the Richardson Mountains (Fig. 2). Although well spacing is highly variable and not very dense, and mid-Cretaceous erosion has modified thicknesses, the isopachs suggest that the Imperial and Tuttle strata formed lobate accumulations (Fig. 2), especially on Peel Plain.

Imperial strata are everywhere underlain by a distinct succession of radioactive shale, siltstone and local reefal carbonate of the Horn River Group (Pugh, 1983: Fig. 3). The group is divided into the basal Hare Indian Formation which rests abruptly on underlying platform carbonates of the Hume Formation, overlain by the locally developed carbonate of the Ramparts Formation, in turn overlain by the Canol Formation. In places the Ramparts Formation is absent and Canol strata rest directly on Hare Indian beds. Hare Indian strata have been subdivided into a basal radioactive shale unit, the Bluefish Member, overlain by the informally named Grey Shale Member, in turn overlain by the Black Shale Member (Fig. 3; Pugh, 1983). Correlations indicate that the Bluefish and Grey Shale members, and part of the Black shale Member, underlie the Ramparts Formation, whereas the upper part of the Black Shale Member may be a lateral equivalent of the Ramparts Formation (Figs. 3 and 4). The Horn River Group is more thickly developed east and southeast of the Ramparts carbonates and is readily subdivided into its constituent formations and members (Fig. 3), whereas to the west, northwest and north of the Ramparts Formation the divisions are less well defined and the interval becomes very thin (Figs. 5 and 6), especially on the Tuktoyaktuk Peninsula (e.g., in the Angasak L-03 and Kilannak A-77 wells; Fig. 7). Imperial strata gradationally overlie the Canol Formation. Ramparts strata have a limited distribution around the Norman Wells area where the only producing oil field in the Northwest Territories is located, with oil in the Ramparts Formation. The Ramparts Formation contains reefal and platform carbonates, the former oil-bearing. Radioactive shale of the Canol Formation rest abruptly on the Rampart Formation and where Ramparts strata are absent it overlies the Hare Indian Formation (Fig. 3).

Reflection seismic data that image the Horn River Group indicate that the interval consists of very low-angle, shingled clinoforms. This is consistent with the well correlations that show stratigraphic horizons that can be correlated over large areas (Fig. 3).

There have been few attempts at subdividing the Imperial Formation (e.g., Tassonyi, 1969) and tend to be local studies and the units identified do not appear to be identifiable over the basin. Internal correlations clearly show that consistent regional to basin-scale lithological subdivisions are not

readily identified (Figs. 3 to 8), with the exception of a prominent limestone unit (Jungle Ridge limestone; Tassonyi, 1969) and a locally developed sandstone near the based of the Imperial Formation, the Canyon Creek sandstone (Tassonyi, 1969; Fig. 3). Tassonyi (1969) divided the Imperial into a lower and upper member, with the Jungle Ridge limestone and Canyon Creek sandstone within the lower member. However, the correlations presented here and with access to reflection seismic, it is apparent that the Jungle Ridge limestone represents a major event in Imperial deposition and can be used to subdivide the Imperial into three regional units a Lower Clastic Unit, the Jungle Ridge Member, and an Upper Clastic Unit. The Jungle Ridge Member is usually only a few metres thick but has a prominent signature on geophysical logs (Fig. 3). The Lower and Upper Clastic units are several hundred metres thick in places and form the bulk of the Imperial Formation. However, the Jungle Ridge Member and Canyon Creek sandstone are found only east of the Norman Wells area (Fig. 3). This is due to the westerly thinning of the Lower Clastic Unit and Jungle Ridge Member, readily seen on the cross section (Fig. 3) and unpublished reflection seismic data. The seismic character of the Lower Clastic Member is that of a westerly prograding and thinning series of sigmoid clinoforms capped by the Jungle Ridge limestone. The Upper Clastic Unit also consists of westerly to southwesterly prograding sigmoid clinoforms, overlying the Jungle Ridge Member.

Richards et al. (1997) described an abrupt contact for the Tuttle Formation in Eagle Plain and the flanks of the Richardson Mountains. In the type section (Fig. 6) the gamma-ray log indicates a probable abrupt basal contact for the first Tuttle sandstone. However, between wells the base of the Tuttle Formation is a facies contact throughout most of the study area and is diachronous on a regional scale (Figs. 5 and 6). On Figure 5 the interval identified as Tuttle Formation appears to be laterally equivalent to a shale-dominant interval of the Imperial Formation, further indicating a major diachronous boundary for the Tuttle Formation.

SEDIMENTOLOGY AND DEPOSITIONAL HISTORY

Descriptions from field and subsurface studies (Hills and Braman, 1978; Tasssonyi, 1969; Pugh, 1983, 1993; Aitken et al., 1982; Hadlari et al., 2009; this report) indicate a predominance of shale with widely scattered occurrences of sandstone-rich intervals within the Imperial Formation. Cored intervals are few and dominated by shale with thin interbeds of, predominantly, very fine to fine grained sandstone (Appendix 2). Sedimentary structures and facies associations within the cores suggest a turbidite origin for the sandstone beds (i.e., they have Bouma-type features). In outcrops, sole structures are common on the sandstone beds (personal observations from the Inuvik area), also

indicating their turbidite origin. The deep-water origin of much of the Imperial Formation is further supported by the dominance of large clinoform reflections on seismic. Although the clinoforms are dominated by fore-set and bottom-set reflections there are some top-sets preserved which would suggest the presence of shelf deposits in places. The clinoforms tend to prograde to the west and southwest. These sedimentological characteristics and seismic facies are consistent with the Imperial Formation being dominated by slope, basin plain, and local submarine fan deposits.

The general orientation of the clinoforms indicates a major source terrain to the east and northeast. Embry and Klovan (1976) described and interpreted an aerially extensive and thick Middle to Late Devonian clastic succession in the Arctic Islands which originated from an orogenic upland (Pearya) northeast of the Arctic Islands as well as the Greenland Shield. The Imperial and Tuttle formations appear to be a continuation of this clastic wedge and probably were sourced from the same orogenic uplands, and possibly from the Canadian Shield.

Imperial deposition was initiated after a major transgression over a pre-existing shelf formed by the Hare Indian and Ramparts Formation. Early phase of transgression resulted in the deposition of the Canol Formation, an organic-rich shale, followed by the generally regressive Imperial Formation. Two major phases of clinoform development are evident in the Imperial Formation, separated by the Jungle Ridge Member that is interpreted to be a transgressive limestone bed.

Tuttle strata have been interpreted as predominantly fluvial by Richards et al. (1997), but their lateral equivalency with Imperial facies in some places indicates there may be a mix of fluvial, deltaic, shallow marine, and shelf facies. The apparent gradation from deep-water and slope deposits of the Imperial to shallower water shelf and fluvio-deltaic beds in the Tuttle Formation indicate a continuum of sedimentation with a common source area.

FIGURE CAPTIONS

Figure 1. Location of wells and cross sections.

Figure 2. Isopach map of Imperial and Tuttle formations, Northwest Territories and northeastern Yukon.

Figure 3. Correlations in the Horn River Group and Imperial Formation; well Attoe Lake I-06 to Dahadini M-43, Peel Plain to central Mackenzie valley (see Fig. 1 for location).

Figure 4. Correlations in the Horn River Group and Imperial Formation; well South Ramparts I-77 to East Hume River N-10, south Peel Plain and Mackenzie valley (see Fig. 1 for location).

Figure 5. Correlations in the Horn River Group and Imperial Formation; well Peel River YT F-37 to Tree River H-38, northern Peel Plain and Plateau (see Fig. 1 for location).

Figure 6. Correlations in the Horn River Group and Imperial Formation; well South Ramparts I-77 to Stony I-50, Peel Plain (see Fig. 1 for location).

Figure 7. Correlations in the Horn River Group and Imperial Formation; well Kiligvak I-29 to Kilannak A-77, Tuktoyaktuk Peninsula (see Fig. 1 for location).

Figure 8. Correlations in the Horn River Group and Imperial Formation; well Arctic Red River O-27 to South Peel D-64, southern Peel Plain (see Fig. 1 for location).

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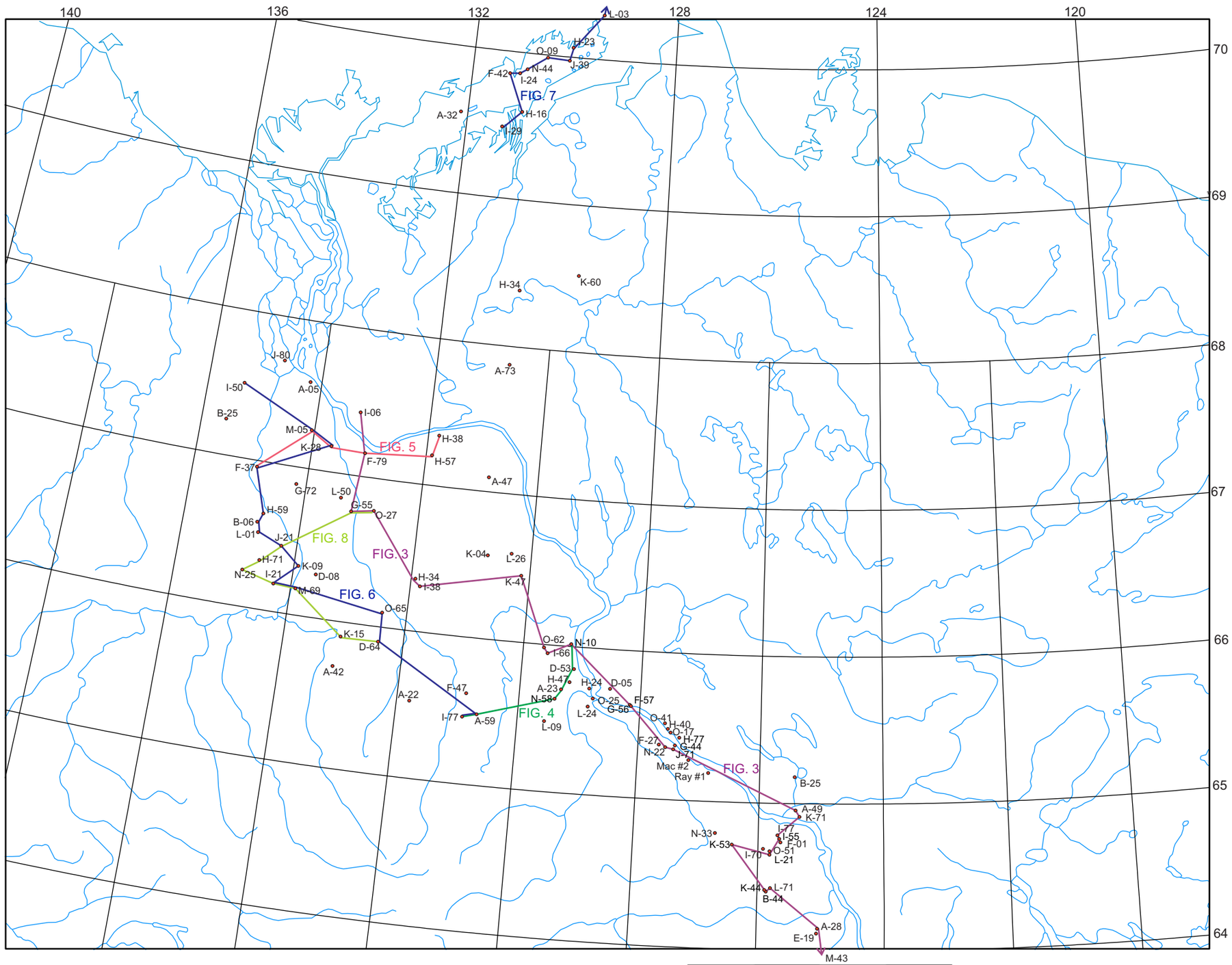

Figure 1. Location of wells and cross sections.

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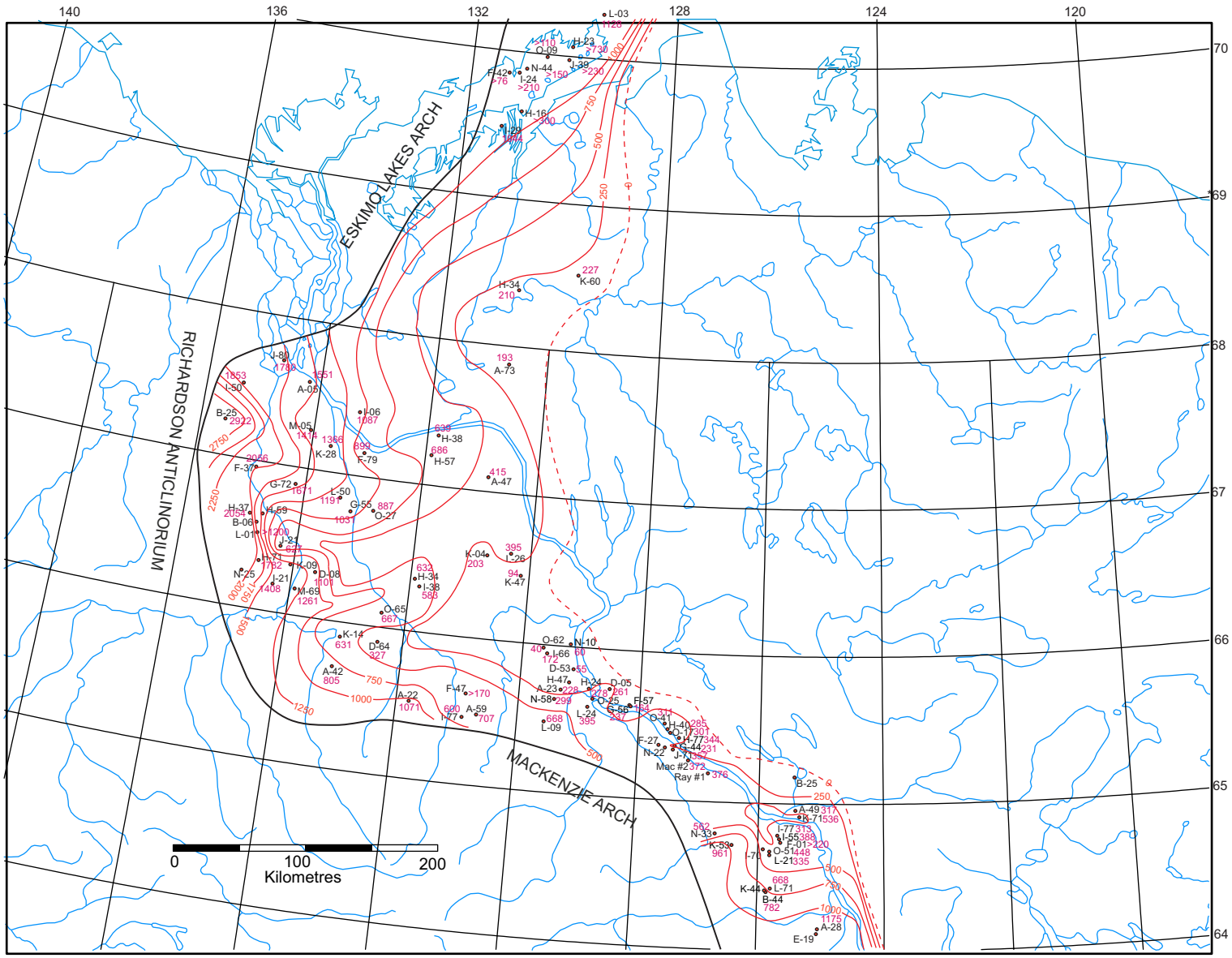

Figure 2. Isopach map of the Imperial and Tuttle Formations, Northwest Territories and northeastern Yukon.

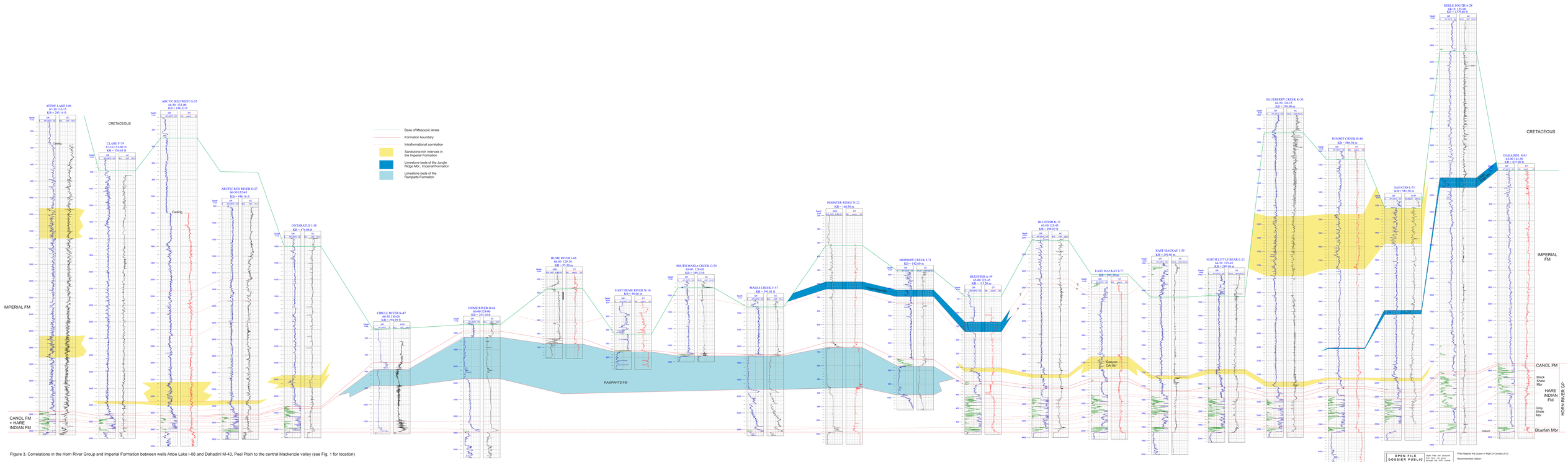

Figure 3. Correlations in the Horn River Group and Imperial Formation between wells Attoe Lake I-06 and Dahadini M-43, Peel Plain to the central Mackenzie valley (see Fig. 1 for location)

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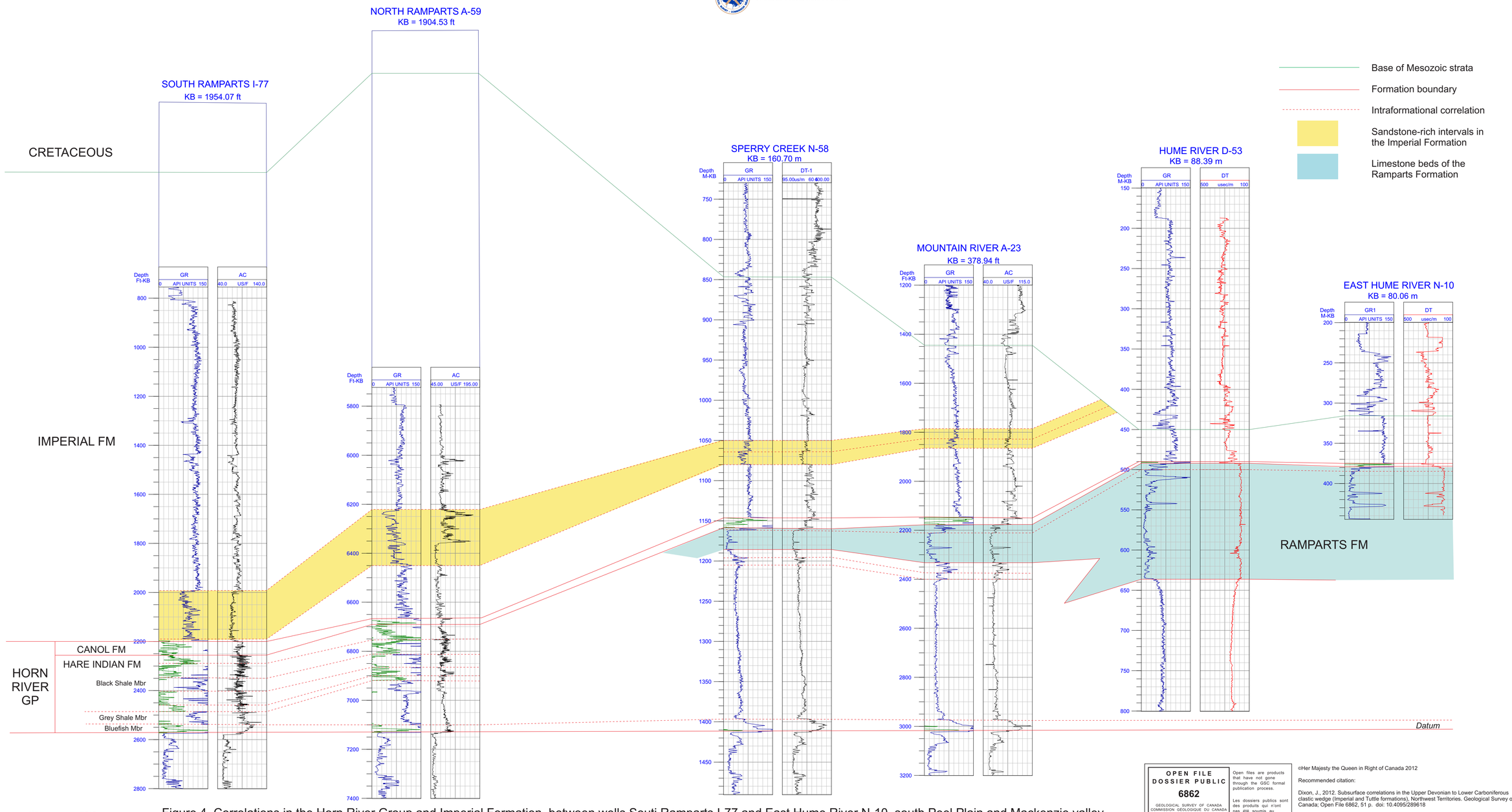

Figure 4. Correlations in the Horn River Group and Imperial Formation, between wells Soutj Ramparts I-77 and East Hume River N-10, south Peel Plain and Mackenzie valley (see Fig. 1 for location).

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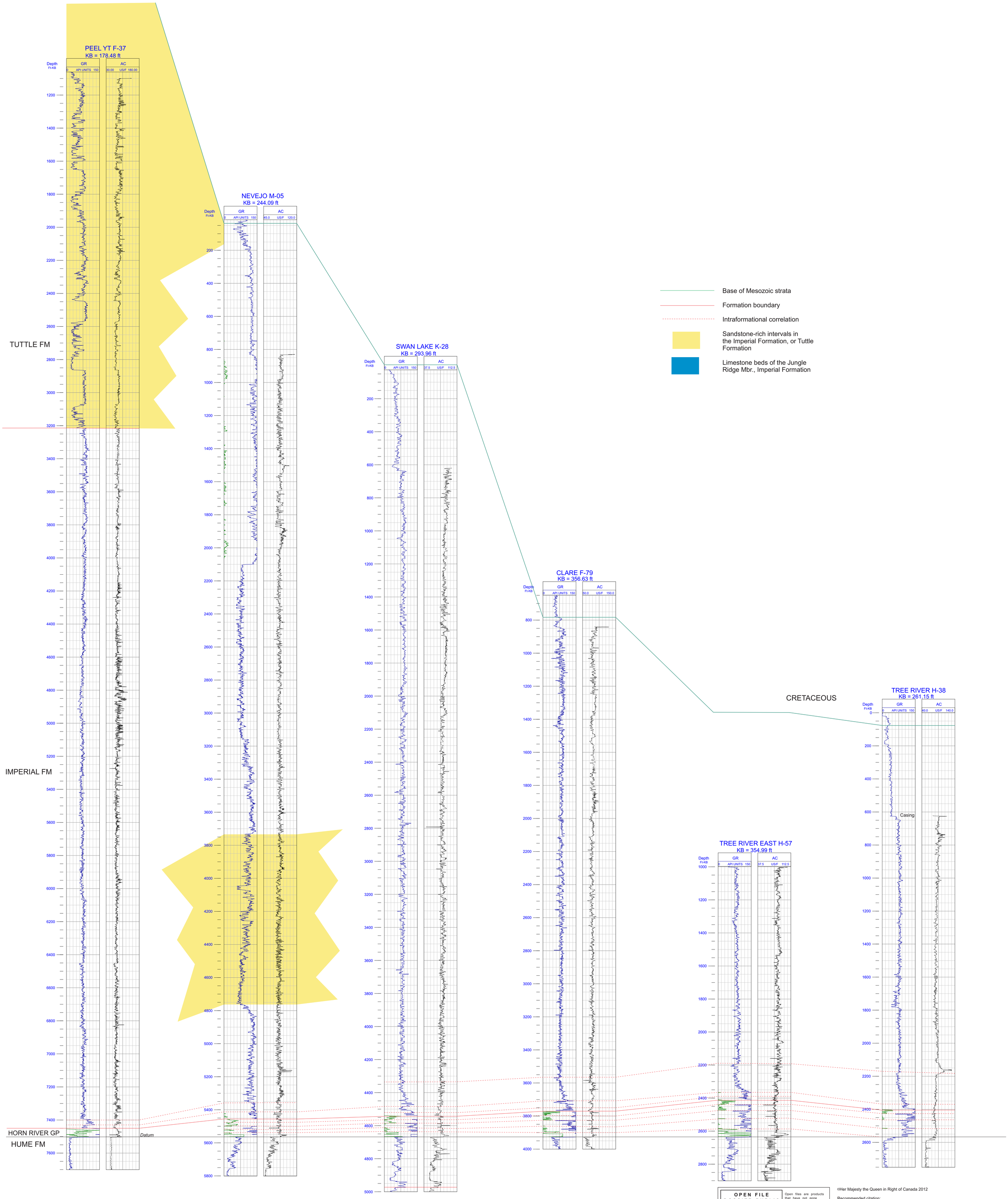

Figure 5. Correlations in the Horn River Group, Imperial and Tuttle formations, between wells Peel YT F-37 and Tree River H-38, northern Peel Plain and Plateau (see Fig. 1 for location)

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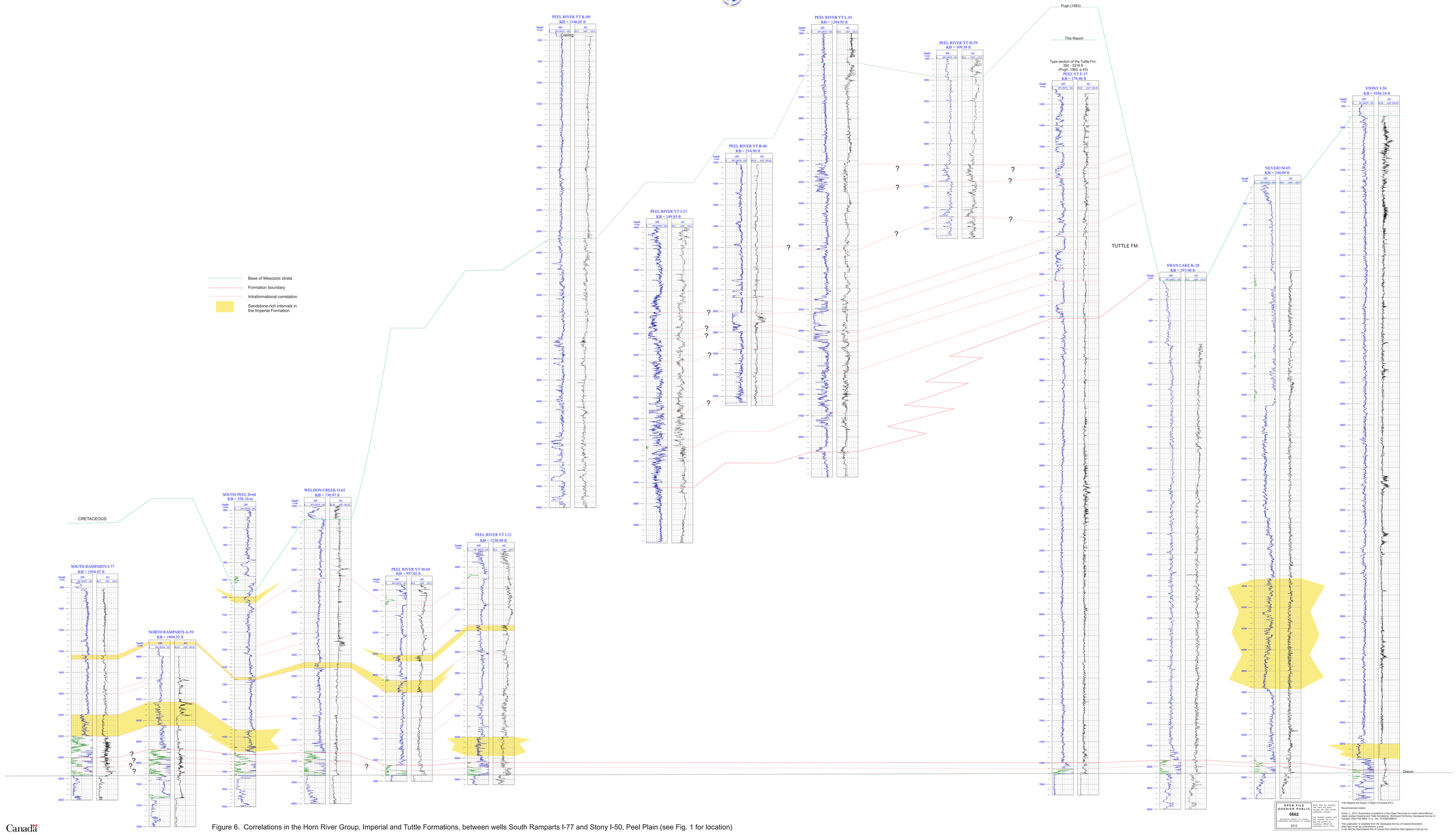

Figure 6. Correlations in the Horn River Group, Imperial and Tuttle Formations, between wells South Ramparts I-77 and Stony I-50, Peel Plain (see Fig. 1 for location)

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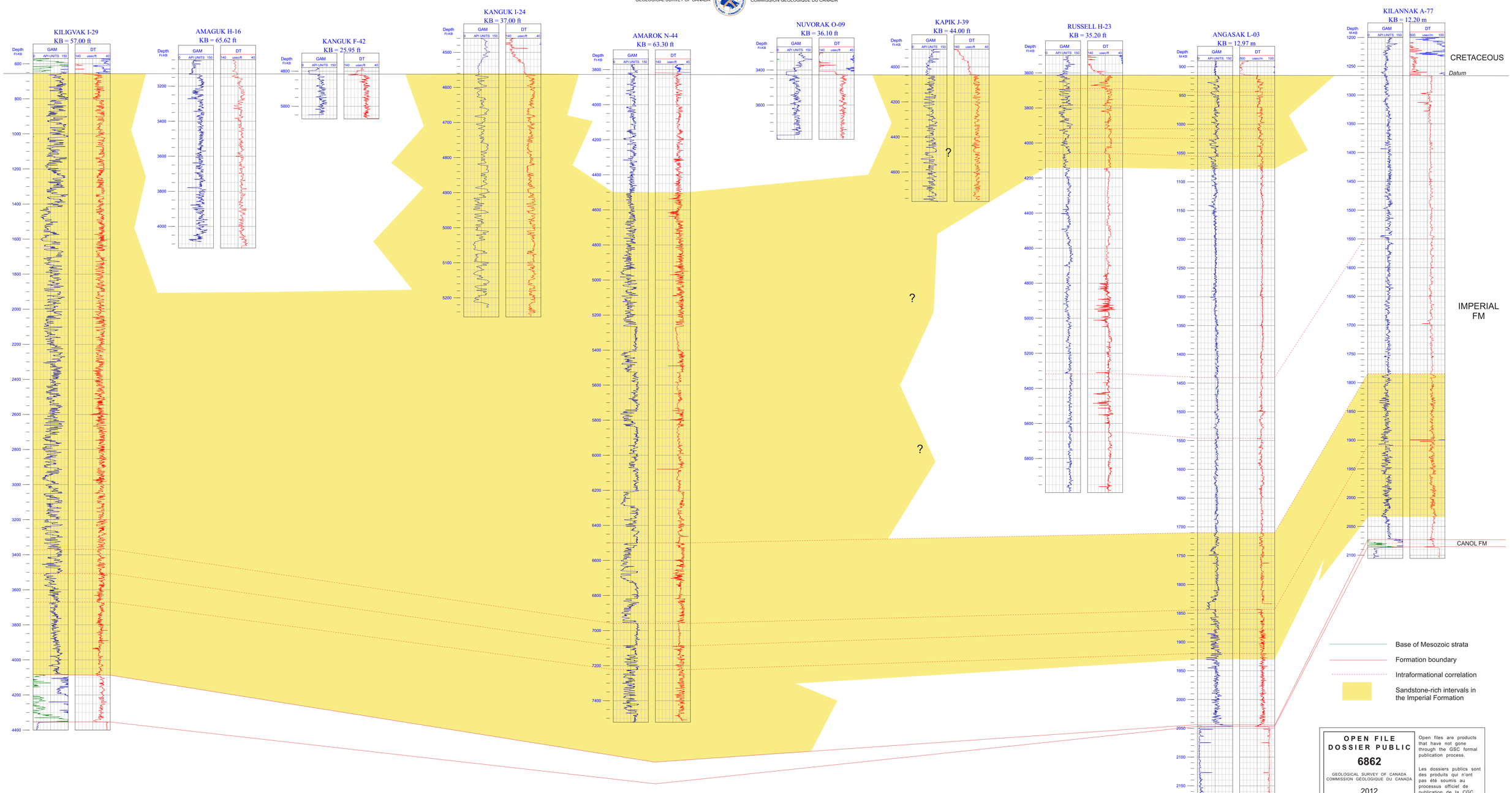

Figure 7. Correlations in the Horn River Group and Imperial Formation between wells Kiligvak I-29 and Kilannak A-77, Tuktoyaktuk Peninsula (see Fig. 1 for location)

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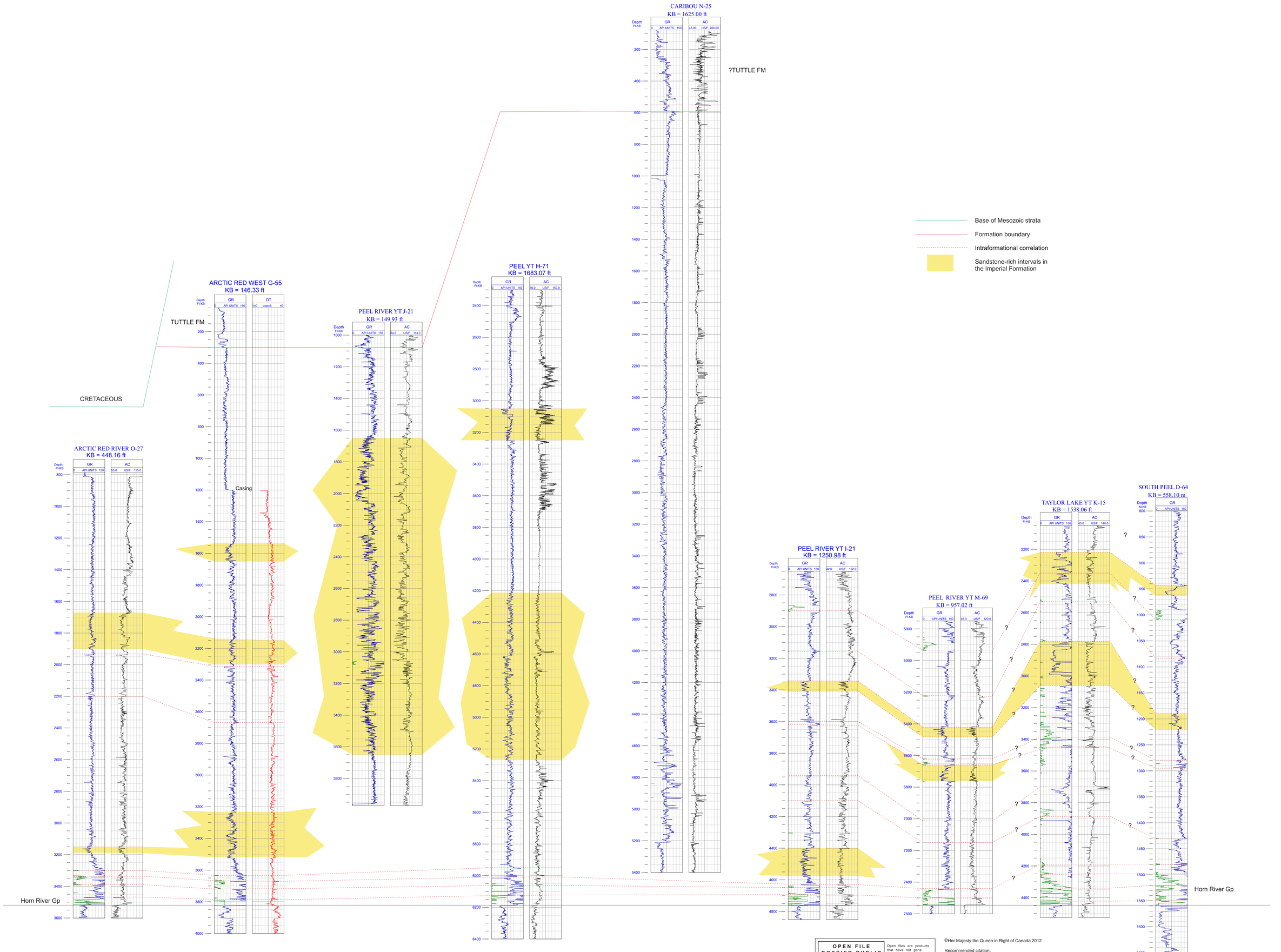

Figure 8. Correlations in the Horn River Group and Imperial Formation between wells Arctic Red River O-27 and South Peel D-62, southern Peel Plain (see Fig. 1 for location)

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APPENDIX 1

IMPERIAL AND TUTTLE FMs - TOPS

Log depths

Well Name	Tuttle Fm		Tuttle	Imperial Fm		Jungle Ridge Mbr				Horn R. Gp		Hume/Kee Scarp Ramparts		Thicknesses	
	Top		thickness	Top		Top		Base		Top		Top		Imperial	Mbr
	ft	m		ft	m	ft	m	ft	m	ft	m	ft	m	m	m
Amaguk H-16				3134	955.2						TD			>300	
Amarok N-44				3818	1163.7						TD			>150	
Angasak L-03					915						2043		2044.0	1128.0	
Arctic Red F-47				7204	2195.8						TD			>170	
Arctic Red YT C-60				528	160.9					5380	1639.8	5484	1671.5	1478.9	
Arctic Red West G-55		75.3	16.1	300	91.4					3630	1106.4			1015.0	
Arctic Red River O-27				390	118.9					3300	1005.8			886.9	
Attoe Lake I-06					0.0					3565	1086.6			1086.6	
Blueberry Creek K-53					1256						2217			961.0	
Bluefish #1A A-37				Eroded		1618	493.2	1630	496.8	2510	765.0	2565	781.8	760.0	3.7
Bluefish A-49					35		132		172		352		537	317.0	40
Bluefish K-71				2020	615.7					3780	1152.1	4338	1322.2	536.4	
Canyon Creek #1 G-51				10	3.0					1940	591.3	2020	615.7	588.3	
Canyon Creek #2 J-20				10	3.0						TD			>240	
Carcajou D-05					283.0						544.4		545	261.4	

Carcajou J-27				769	234.4					1342	409.0	1344	409.7	174.7	
Carcajou L-24				1495	455.7					2792	851	3042	927.2	395.3	
Carcajou O-25					320						598		600	278.0	
Caribou YT N-25		0	179.8	590	179.8					4514	1375.9	No Hume - intb'd		1196.0	
										Or possibly 521		with Road River			
Circle River #1 K-47				190	57.9					498	151.8	1330	405.4	93.9	
Clare F-79				780	237.7					3730	1136.9	3928	1197.3	899.2	
(A-1) Cranswick River A-22	453	138.1	222.5	730	222.5					3546	1080.8	3848.0	1172.9	858.3	
										or 3572 ft					
Cranswick YT A-42	3840	1170	728.5	6230	1898.9					6810	2075.7	7082.0	2158.6	176.8	
	Base of Tuttle not very clear on logs									or 6910 ft					
Crossley Lakes K-60				?459	139.9					1202	366.5	1310	399.3	226.6	
				or 179 ft		Canol to Hume Fm includes Hare Indian)									
Dahadini M-43A				?410	125.0					2715	827.8	3546	1080.8	702.8	
						Canol to Hume Fm includes Hare Indian)									
Deh Cho-2 B-14				?	?						435		634	?	
											or 490 m				
Deh Cho-1 B-25				?	?						?397		600	?	
Devo Creek P-45				?	?						?		138	?	
Discovery Ridge H-55					5.5						309.1			303.6	
Dodo Canyon K-03				2978	907.7					5192	1582.5	5805	1769.4	674.8	
										Base at some prominent sandstones					
East Hume River I-20					322.9						TD			>34	
East Hume River N-10					315.0						374.8		379.5	59.8	
East Mackay I-55					1379.2						1767	?	?	387.8	
				or 1340 m											

East Mackay I-77					1492.8						1806		2006	313.2		
										or 1806 m						
Fall Stone F-01					1179.5						TD			>220		
					or 1270 m											
Fish Lake G-60				710	216.4					1370	417.6	1648	502.3	201.2		
Fort Norman #1 C-35					0.0	165	50.3	175	53.3	TD						3.0
						Possible Jungle Ridge										
Grandview L-26					9.1					1327	404.5	1340	408.4	395.4		
Grandview Hills #1 A-04				150	45.7					1512	460.9	1873	570.9	415.1		
										or 1826 ft						
Hoosier Ridge #2 A-16				45	13.7					870	265.2	910	277.4	251.5		
										?						
Hoosier Ridge F-27					?						419		566			
										Canol to Hume includes Hare Indian						
Hoosier Ridge N-22				Behind casing							715					
													734			
Hume River D-53				1296	395.0					1475	449.58	1612	491.3	54.6		
												Kee Scarp				
Hume River I-66					495						667		687.5	172.0		
Hume River L-09				2040	621.8					4230	1289.3	5148	1569.1	667.5		
Hume River O-62				1504	458.4					1635	498.35	1650	502.9	39.9		
												Ramparts				
Judile #1 H-40				315	96.0					1250	381	1300	396.2	285.0		
Judile O-17				270	82.3					1258	383.4	1744	531.6	301.1		
				or 285 ft						or 1264 ft		Kee Scarp				
Judile O-41				238	72.5					1221	383.4	1352	412.1	310.9		
												Kee Scarp				
Kanguk F-42				4820	1469.1						TD			>76		
Kanguk I-24				4563	1390.8						TD			>210		
				Sandy Imperial												
Kapik J-39				4045	1232.9						TD			>230		

				Sandy Imperial												
Keele South A-28				3869	1179.3	5395	1644.4	5510	1679.4	7725	2354.6	8451	2575.9	1175.3	35.1	
Keele South E-19					945		1373		1406	>TD					33.0	
No file in GSC																
Kilannak A-77					1267						2073		2085.5	806.0		
Kiligvak I-29				660	201.2					4085	1245.1	4354	1327.1	1043.9		
				Sandy Imperial												
Little Bear I-70				5804	1769.1	6349	1935.2	6476	1973.9	TD (7020 ft)				127.0	38.7	
Base of Slater River at 5310 ft																
Little Bear M-39					936.0						1550			614.0		
No file in GSC																
Loon River #1				150	45.7					?500	152.4	560	170.7	106.7		
Loon River #2																
No file in GSC																
Loonex #1 G-12																
No file in GSC																
Mac #1 J-76				810	246.9					2002	610.2	2075	632.5	363.3		
												Ramparts				
Mac #2				1140	347.5					2360	719.33	2453	747.7	371.9		
												Ramparts				
Maida Creek F-57				923	281.3					1460	445.01	1518	462.7	163.7		
Maida Creek O-65					293.5						530.5		535	237.0		
Manuel Lake J-42				100	30.5					902	274.93	960	292.6	244.4		
Martin House L-50				370	112.8					4276	1303.3	4466	1361.2	1190.5		
McPherson B-25				?	29.0					9681	2950.8	9410	2868.2	2921.8		
				Operator 620 ft												
Mirror Lake N-33					364						926		1044	562.0		
Morrow Creek #1 G-51					0					758	231.0	994	303.0	231.0		

Morrow Creek J-71					500						857		892.5	357.0	
Mountain River A-23				1399	426.4					2148	654.7	2176	663.2	228.3	
Mountain River H-47				Probably eroded						226	68.9	388	118.3	68.9	
								Canol is atypical, low gamma-ray response							
Nevejo M-05				?	53.3					4815	1467.6	5563	1695.6	1414.3	
North Circle River #1 A-37				448	136.6					1164	354.8	1220	371.9	218.2	
	Poor quality gamma log			Top of Imperial uncertain											
North Little Bear L-21					1477						1812		1978	335.0	
North Little Bear O-51					1544						1992		2159	448.0	
										Or 2034 m					
North Ramparts A-59	?			4345	1324.4					6666	2031.8	7132	2173.8	707.4	
Nuvorak O-09				3432	1046.1						TD			>110	
Ontaratue H-34				852	259.7					2924	891.24	3226	983.3	631.5	
Ontaratue I-38				1011	308.2					2924	891.24	3234	985.7	583.1	
Ontaratue K-04				942	287.1					1608	490.12	1642	500.5	203.0	
				?											
Oscar Creek H-77				306	93.3					1433	436.78	1640	499.9	343.5	
Peel YT F-37	708	215.8	750.4	3170	966.2					7454	2272	7504	2287.2	1305.8	
Peel YT H-71		31.4	704.7	2415	736.1					5952	1814.2	6190	1886.7	1078.1	
		?													
Peel River B-06	1092	332.8	517.6	2790	850.4			>TD							
Peel River H-59	970	295.7		NDE											
Peel River J-21	1120	341.4	768.7	3642	1110.1					>TD					
Peel River L-01	2080	634.0	1115.6	5740	1749.6					>TD					

				?											
Peel River M-09	1882	573.6			?										
No file in GSC															
Peel River YT K-09	?			2465	751.3					>TD				>468	
Possible that strata identified as Imperial may be part of the Tuttle Fm, such as identified in nearby wells															
Peel River YT I-21		0	780.3	2560	780.3					4618	1407.6	4760	1450.8	627.3	
Peel River YT M-69	3262	994.3	801.0	5890	1795.3					7400	2255.5	7544	2299.4	460.2	
	?														
Point Separation #1 A-05					0						1550.5			1550.5	
No file in GSC															
Raider Island #1 F-39				395	120.4					1795	547.1	2035	620.3	426.7	
Drilled 1945				312ft by operator											
Ramparts River F-46					973.0						1247		1454	274.0	
	Canol to Hume interval contains Hare Indian etc.														
Ray #1 B-46				1943	592.2					3175	967.7	3260	993.6	375.5	
Drilled 1944															
Redstone #1 J-42				2020	615.7					?		2640	804.7	?	
Drilled 1946				Probable that Cretaceous sits on Canol rather than Imperial.											
Russell H-23				3613	1101.2						TD			>730	
Sah Cho L-71					1705		2084.8		?		2373		2535	668.0	
					or 1842 m										
Sainville River D-08	1884	574.2	431.0	3298	1005.2					5500	1676.4	5690	1734.3	671.2	
Sans Sault #1 H-24				1280	390.1					?		1423	433.7	?	
Drilled 1944															
Satah River G-72	551	167.9	106.4	900	274.3					6035	1839.5	6150	1874.5	1565.1	
	?														
Slater River A-37				540	164.6					2411	734.9	2828	862.0	570.3	
South Delta J-80				?	48.8					6000	1828.8	6018	1834.3	1780.0	
South Maida Creek G-56				912	278.0					1690	515.1	1728	526.7	237.1	
South Peel D-64				3774	1150.3					4846	1477.1	5117	1559.7	326.7	

South Ramparts I-77				230	70.1					2198	670.0	2574	784.6	599.8	
Sperry Creek N-58					847.5						1146		1153	298.5	
Stony I-50				860	262.1					6940	2115.3	Sits on Road River Gp			
				Operator pick											
Summit Creek B-44					1378.5						2161		2318.9	782.5	
TVD depths															
Swan Lake K-28				30	9.1					4510	1374.6	4970	1514.9	1365.5	
				?											
Taylor Lake K-15		641.9	410.3	3452	1052.2					4175	1272.5	4442	1353.9	220.4	
Tenlen A-73				99	30.2					719	219.2	1202	366.4	189.0	
Trail River H-37		646.2		4840	1475.2					8858	2699.9	8876	2705.4	1224.7	
Tree River B-10					45						498		577	453.0	
Tree River F-57					30.5					2352	716.9	2568	782.7	686.4	
Tree River H-38					82.3					2365	720.9	2560	780.3	638.6	
Tree River East H-57				50	15.2					2360	719.3	2638	804.1	704.1	
Weldon Creek O-65				1918	584.6					4106	1251.5	4338	1322.2	666.9	
Whirlpool #1 H-73				40	12.2					790	240.8	955	291.1	228.6	
Drilled 1948															
Wolverine H-34					70.1					920	280.4	1520	463.3	210.3	

APPENDIX 2

DESCRIPTIONS OF CORE WITHIN THE UPPER DEVONIAN IMPERIAL FORMATION, NWT

Elf Amaguk H-16

Core 2: 4112 – 4143 ft. 3 boxes. Slabbed. Badly broken core.
Examined 21st April 2010.
Imperial Fm.

Sandstone interlaminated to interbedded with shale. Dark grey colour.

Sandstone: fine to medium grained. Densely fractured – sub-vertical, calcite-filled, a few mm thick. At least one example of a sand-ball-like structure. Fine laminae are prevalent in thin sandstone beds

Imperial Cigol Amarok N-44

Core 1: 7634 – 76 52 ft. 6 boxes. Recovered 18ft. Partially slabbed.
Examined 21st April 2010.
Imperial Fm

Shale: black; highly fractured with abundant slickensides intercalated with intervals of less fractured silty mudstone. Fractures are sub-vertical and breaks shale into dagger-like fragments.

Bear Island #4 B-36
Core 2024 – 2029 ft. Core boxes labeled 36 to 39. 4 wooden boxes.
Examined 20th April 2010
Imperial Fm.

Shale: medium to dark grey. Poker-chip fissility. Faint traces of silt laminae.

Imperial Bluefish 1A A-37
Core 4: 1638 – 1653 ft. 2 wooden boxes. Poorly preserved, mostly full diameter.
Examined 21st April 2010.
Imperial Fm.

Mudstone: medium grey; some silty intervals. Badly broken segments of core. Traces of small (1-2 mm diameter) burrows in the silty beds.

Imperial Canyon #2 J-20
Core 1: 531 – 551 ft. 4 wooden boxes. Recovered 20 ft. Full diameter.
Examined 21st April 2010.
Imperial Fm

Shale: medium grey; fissile to "poker-chip" size fragments. No indications of silt/sand laminae

Core 2: 664 – 765 ft. 20 wooden boxes. Recovered 96 ft. Full diameter.
Examined 21st April 2010
Imperial Fm.

Outer surface of core badly reamed and difficult to see internal structures.

664 – 666' 2":	Shale: thin sandstone interbeds
666' 2" – 761'	Sandstone: fine grained. Generally uniform grain size throughout interval, with a few scattered coarse grains. A few intercalated mudstone beds that are more common in lower half of interval – up to 30 cm thick. Faint indications of fine laminae. Abrupt basal contact.
761' – 765'	Shale: medium to dark grey; very fissile resulting in badly broken core.

Core 3: 795 – 803 ft. 1 box.
Badly broken into small pieces of medium to dark grey shale.

IOE Clare F-79
Core 1: 851 – 871 ft. 4 boxes. Recovered 20ft. Slabbed.
Examined 21st April 2010.
Imperial Fm

Shale: medium grey; fissile, scattered very thin beds and laminae of siltstone. Siltstone beds tend to be finely laminated, and some consisted of small ripples (starved ripples). Minor bed loading in some ripple laminated beds.

Core 2: 1506 – 1520ft. 3 boxes. Recovered 14ft. Slabbed.
Examined 21st April 2010.
Imperial Fm

Shale: fissile. Lower 9ft is siltier – occurs mostly as fine silt laminae. One example of a low-angle sandstone dyke.

Core 3: 2175.21 – 2190ft. 4 boxes. Recovered 15ft. Slabbed
Examined 21st April 2010.
Imperial Fm.

Shale: fissile; similar to cores 1 and 2 but not as silty as core 2.

Core 4: 2965 – 2975ft. 2 boxes. Recovered 10ft. Slabbed
Examined 21st April 2010.
Imperial Fm

Interbedded mudstone and siltstone/sandstone: very thin to thin beds (few mm to 4 cm thick). Silty/sandy beds are finely laminated. Small load structures present on some of the sandy beds.


Core 4
6 in.
CLARE F-79
15 cm.


Core 4
6 in.
CLARE F-79
15 cm.

Chevron Hume River I-66
Core 3: 486.2 – 497.7 m. Slabbed
Martin House and Imperial Fms.

Imperial Formation erosionally overlain by Cretaceous Martin House Formation at 495 m. Imperial consists of medium grey, fissile shale with some silt laminae.

IOE Nuvorak O-09
Core 5: 3434 – 3464 ft 7 boxes. Slabbed.
Core 6: 3464 – 3494 ft. 8 boxes. Slabbed.
Well preserved in sandy parts, badly broken in shaly parts.
Examined 21st April 2010
Imperial Fm

Predominantly thin to very thick intervals of sandstone separated by thin shale intervals (few cm to about 20 cm thick). Dark grey throughout.

Sandstone: mostly fine grained. Multiple beds, a few cm to 30 cm thick. Scattered small to large, elliptical, rounded mudstone clasts. A few beds with coarse sand to granule size grains (usually present in the basal part of individual beds). Generally massive in appearance but with abundant occurrences of fine subhorizontal laminae. A few examples of deformed beds; usually in thin, laminated beds. Beds usually have erosional basal contacts. Ripple laminae are present at the top of some beds, especially where the sandstones grade up into interlaminated sand-mud. Some minor vertical fractures; usually calcite filled.


6 in.
NUVORAK O-09
15 cm.


6 in.
NUVORAK O-09
15 cm.


6 in.
NUVORAK O-09
15 cm.


6 in.
NUVORAK O-09
15 cm.

Imperial Raider island #1 F-39
Core 1753- 1764 ft. 2 wooden boxes. Recovered 10 ft. Poorly preserved.
Examined 20th April 2010.
Imperial Fm

Shale: medium grey. Very fissile. Only a few pieces of full diameter core preserved; most consists of small fragments.

Imperial Seepage Lake 1A 2L-28
Core 1: 985 – 1011 ft. 4 wooden boxes. Recovered 20 ft. Full diameter core. Badly broken core.
Examined 21st April 2010.

Silty to sandy mudstone: light to medium grey. Grade sup into a medium to dark grey fissile shale in upper 2-3 ft of core. No obvious sedimentary structures.

Chevron Sperry Creek N-58
Core 1: 848 – 863 m. 16 boxes. Recovered 16.9 m (more measured than indicated by official recovery value) Full Diameter. Well reserved.
Examined 21st April 2010
Imperial Fm.

848 – 851.1 m	Sandstone: very fine grained; medium greenish grey. Dominated by thoroughly bioturbated muddy sandstone with a few thin intervals of bedded sandstone. Carbonized wood fragments on bedding planes. Some vertical fractures. Some indications of load deformation. Abrupt basal contact.


Interval 848 - 851.1 m
SPERRY CREEK N-58
6 in.
15 cm.

951.1 – 853.6 m Thinly interbedded/interlaminated siltstone-sandstone-shale: coarse siltstone to very fine grained sandstone. Core readily splits into puck-sized pieces. Horizontal laminae the prevalent structure with some very small ripple forms. No clear signs of bioturbation. Transitional with underlying interval.


6 in.
SPERRY CREEK N-58
15 cm.
Interval 851.1 - 853.6 m

853.6 – 856.9 m Laminated mudstone – siltstone - sandstone: very fine laminae. Differs from overlying interval in that there is a greater percentage of silt/sand laminae and fewer thin beds. Also core tends to break into longer pieces than overlying interval. Contains two, thin, rust-coloured sandstone beds that are disrupted and contain small pebbles. These latter beds occur about 97 cm below top of interval (in box 7).


Within interval 853.6 - 856.9 m
SPERRY CREEK N-58
6 in.

856.9 – 860.5 m	Thinly interbedded and interlaminated sandstone-siltstone-mudstone: Dark grey mudstone. Fine laminae of siltstone/sandstone. Sandstone is very fine grained. Similar to interval 851 -853.6 m. Base of interval contains a distorted bed sitting on underlying sandstone. Transitional with overlying interval.
860.5 – 861.34 m	Sandstone: very fine grained with pebbles in basal 15 cm. Basal 15 cm consists of o lower 6 cm of pebble-bearing sandstone erosionally overlain by a thick sandstone interval that has a few pebbles in the lowermost few centimetres. Pebbles appear to be limestone and possible crinoid ossicles (in box 13).

861.34 – 862.19 m Interlaminated to very thinly interbedded mudstone-sandstone-siltstone: minor load deformation and some scattered occurrences of horizontal burrows.

862.19 – 862.29 m Granular to pebbly sandstone: loaded basal contact. Internally disrupted. Abrupt basal and upper contacts. (Box 14)

862.29 – 862.39 m Mudstone: contains fine laminae of silt/very fine sand. Splits readily along bedding planes.

862.39 – 864.59 m Interbedded to interlaminated mudstone-siltstone-sandstone grading up into predominantly muddy, very fine grained sandstone: Capped by a 5-6 cm thick bed of pebbly muddy sandstone. Pebbles appear to be limestone clasts. Abrupt upper contact. Vertical and horizontal burrows in lower 75 cm, becoming fewer in upper part of interval. Upper 50-60 cm appears to be disrupted.

Lower beds in interval
862.39 - 864.59 m

CDR Tenlen Lake A-73
Continuously cored (2" diameter core). Examined from 221 – 1200 ft.
Boxes 1 to139. Generally good recovery. Slabbed below 221 ft.
Examined 20th April 2010
Imperial, Canol and Hume Fms.

221' – 447' Predominantly sandstone with a few thin shale interbeds or laminae. Divisible into two parts:
221' – 327': Interbedded sandstone-mudstone. Sandstone beds range in size from a few mm up to 60 cm thick. Sandstone beds separated by laminated mudstone beds. Thicker sandstone beds tend to be laminated (sub-horizontal) and grade up into laminated mudstone (horizontal and ripple laminae). No indications of bioturbation. Transitional with underlying interval.

327’ – 447’: Predominantly very fine grained sandstone beds separated by thin laminated mudstone units. Common occurrence of amalgamated sandstone beds. Bouma-like turbidite features: massive or laminated in lower part gradationally overlain by laminated mudstone. Transitional with underlying interval.

447’ – 460.5’	Mudstone and very thin interbeds and laminae of very fine grained sandstone: light to medium grey colour. Transitional lower and upper contacts.
460.5 – 715.17’	Mudstone/shale: dark grey. Poker-chip to blocky pieces of core. Scattered, but not very common, thick (up to 50 cm) beds of very fine grained sandstone. Most sandstone beds are less than 10 cm thick. Sandstone beds have abrupt bases/tops. There are at least 8 discrete sandstone beds and fine laminae of sand towards base of interval.

Horn River Group

Arbitrary chosen at the base of a thin (3 cm) sandstone bed (box 68). Log depth for top of Horn River Gp is at 719 ft but there are no distinct lithological changes at the corresponding core depth.

715.17 – 790 ft.	Shale: dark grey to black; fissile to poker-chip breakage. One bed of dark grey, finely laminated, very fine grained sandstone at about 765-768.8 ft. (Is this Canol equivalent????)
790’ – 913’	Shale: (change in box 95) top depth chosen where the fissile overlying shale changes to more cohesive shale that tends to break into blocky pieces. Shale becomes more fissile in lower part of interval. Contains a few scattered, thin (few cm t o19 cm thick) sandstone beds. NOTE: Top of Black Shale Mbr, Hare Indian Fm., has a log depth of 800 ft but there are no distinct lithological changes at, or near, this depth. Also top of the Grey Shale Mbr at log depth 862 ft also is difficult to identify in the core
913’ – 980’	Mudstone/shale: (change in box 104) dark grey to black, brownish dark grey. Les fissile than overlying shale; core preserved in longer pieces. Abundant silt laminae. Transitional with underlying interval.
980’ – 1135’	Shale: (change in box 126) light to medium grey. Fissile to poker-chip breakage. Contains some dark grey intervals. Transitional with underlying interval.

1135’ – 1196.5’	Shale: (change in box 134). Dark grey to black fissile shale. A few scattered very thin beds (few cm) of very fine grained sandstone that tend to be more common in lower part of interval. This interval probably is equivalent to the Bluefish Mbr, Hare Indian Fm.
1196.5’ – 1199’	Missing core
1199’ -	HUME FM. Bioclastic limestone.

Imperial Whirlpool #1 H-73
Core 1: 803 – 815 ft. 3 wooden boxes. Full diameter.
Examined 21st April 2010.
Imperial Fm

Shale: dark grey. Badly broken into poker-chip and puck-size fragment. No indications of bioturbation and very few sand/silt laminae.