COLLIERY HERITAGE PROJECT: EXPLORATION AND REHABILITATION OF COMOX NO.3 MINE AS AN UNDERGROUND EDUCATIONAL SITE

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KEYWORDS: *Comox Colliery, No.3 Mine, Comox No.2 coal bed, Cumberland Member, Dunsmuir Member, Comox Formation, industrial heritage, tourist mine, coal geology, mining conditions, measured sections, underground geological methods, coal balls, Nanaimo Group.*

INTRODUCTION

This report is part of a series of geological and mining studies of the coalfields of Vancouver Island, begun in 1987. Knowledge of the geology and mining conditions of the coalfields is a prerequisite to informed decisions on current and future land-use and resource planning on the Island. In contrast to previous years' work, this study considers the industrial heritage and educational potential of one of the oldest coal mines in British Columbia, opened near the village of Cumberland in 1889 and abandoned in 1893. Comparisons are drawn between the educational and industrial consequences of various features of local coal geology, as exemplified by the No.3 Mine of Comox Colliery.

While researching mining activities in the Cumberland area as a retirement project in the summer of 1999, former colliery surveyor Robert Williams BCLS (retired) recognised No.3 Mine's potential for development as an industrial heritage and tourism site. The Village of Cumberland provided labour and equipment to briefly reopen three of the mine's portals for initial examination in September of 2000, and for a more detailed exploration of the underground workings in January of 2002.

HISTORY

First Nations people walking along creeks and rivers near Comox Lake may have observed coal outcrops several thousand years ago, but neither oral histories nor archaeological evidence are available to suggest that they made any use of the coal. In 1870 a British emigrant, Samuel Cliffe, prospected coal outcrops southeast of Comox Lake, for the Union Coal Company. Mine development was delayed until after the Union Coal Company was taken over by Dunsmuir, Diggle & Co. in 1881 (Isenor and others, 1987). The new owners traced the coal along the hillside east of Perseverance Creek (locally known as Coal Creek), and drove two adits and two airways into the uppermost of three coal beds in 1888 (Dick, 1889). Substantial surface facilities, including a weighing house and a long loading trestle, were constructed outside the lowest of the mine's portals. Mining continued until 1893 (Dick, 1894), at which time all equipment was withdrawn from the mine in favour of expanded production from thicker coal beds elsewhere on the property.

Although the mine was originally known as "The Adit Levels" or "Nos.1 and 2 Tunnels," (B. Nicholas, personal communication, 2001) from 1922 onwards it was known as No.3 Mine of Comox Colliery. No.3 was not officially reported as a producing mine after its closure in 1893, but further undocumented working was done in the 1930s and 1940s by Chinese miners who hauled sacks and wheelbarrow loads of coal from the mine down to Cumberland's Chinatown (W. Moncrief, personal communication, 2001). Despite the great age of the mine, its workings remained open and accessible until at least 1985, at which time it was still possible to enter one of the adit levels and conduct geological exploration (Cathyl-Bickford, 1988). In 1987 the mine's portals were blasted shut, and entry further discouraged by piling soil and rock over their mouths (R. Bone, personal communication, 1987).

LOCATION AND ACCESS

No.3 Mine is situated adjacent to the Village of Cumberland in the eastern foothills of the Beaufort Range, southeast of Comox Lake on Vancouver Island. The mine is served by recently-constructed all-weather gravel road, Rocky's Main, which branches from the Hamilton Lake logging road about one kilometre south of the village. Access to the mine may also be gained by means of a network of hiking and cycling trails which radiate from Cumberland's old Chinatown. The minesite was selectively logged during the summer and autumn of 2001, and many bedrock ledges are newly visible through openings in the forest cover. Most of the outcrops can easily be accessed by foot from the roads or trails, although getting to some requires scrambling through logging debris and thick underbrush.

GEOLOGICAL SETTING

The coals of the Comox coalfield are hosted by the Cumberland and Dunsmuir members of the late Cretaceous Comox Formation (Bickford and Kenyon, 1988; Mustard, 1994). The Comox Formation consists of interbedded sandstone, siltstone, mudstone and coal, with occasional thin beds of oil shale and conglomerate (Cathyl-Bickford, 2001). Most of the thick coal beds lie within the predomi-

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nantly nonmarine Cumberland Member of the formation, which contains six coals numbered 4, 3A, 3, 2A, 2 and 2R from base to top. Thinner but perhaps more laterally-continuous coal beds lie within the overlying predominantly marine Dunsmuir Member, which contains six coals numbered and lettered 1L, 1, 1R, Z, Y and X from base to top. Of the twelve correlatable coal beds within the Comox Formation, only the thickest four, presently known as the Nos. 4, 3A, 2 and 1 coal beds, have been mined (Graham, 1924).

PREVIOUS WORK

James Richardson (1872; 1873) first examined the Comox coalfield in detail for the Geological Survey of Canada. His work was followed-up by J.D. MacKenzie (1922), who measured several closely spaced sections of the Comox Formation along Perseverance Creek. Muller and Atchison (1971) compiled a regional synthesis of coal geology, including a structural map of the Comox coal mines. None of these workers did appreciable work underground in the Comox mines, with the exception of a few days' sectioning and sampling done by MacKenzie in the No.4 and No.5 mines on the north side of the Village of Cumberland. The bulk of MacKenzie's work remained unpublished owing to his sudden death in 1923, but many of his maps and notes have been preserved in the British Columbia Archives in Victoria, as part of Additional Manuscript 436.

More recent regional geological mapping is available for the Comox coalfield, including the vicinity of No.3 Mine, at 1:20,000 scale (Cathyl-Bickford and Hoffman, 1998). A detailed geological map (Figure 1) of the minesite area at 1:5000 scale was compiled during the summer of 2001 in support of the Village of Cumberland's application for a mine reclamation permit (Cathyl-Bickford and Williams, 2001).

DETAILED GEOLOGY

No.3 Mine was initially understood to have worked the Comox No.1 coal bed (Muller and Atchison, 1971; Saunders and others, 1974), but it is now thought to have worked the underlying No.2 coal bed. Reinterpretation of the stratigraphic position of No.3 Mine is based on comparison of marker beds exposed along the mine's access road (*see* Measured Section 9, in Appendix A) with the more complete section of the formation exposed in the canyon of Trent River above the Inland Island Highway (*see* Measured Section 10, in Appendix B). Eight previously-reported stratigraphic sections are contained in pa-

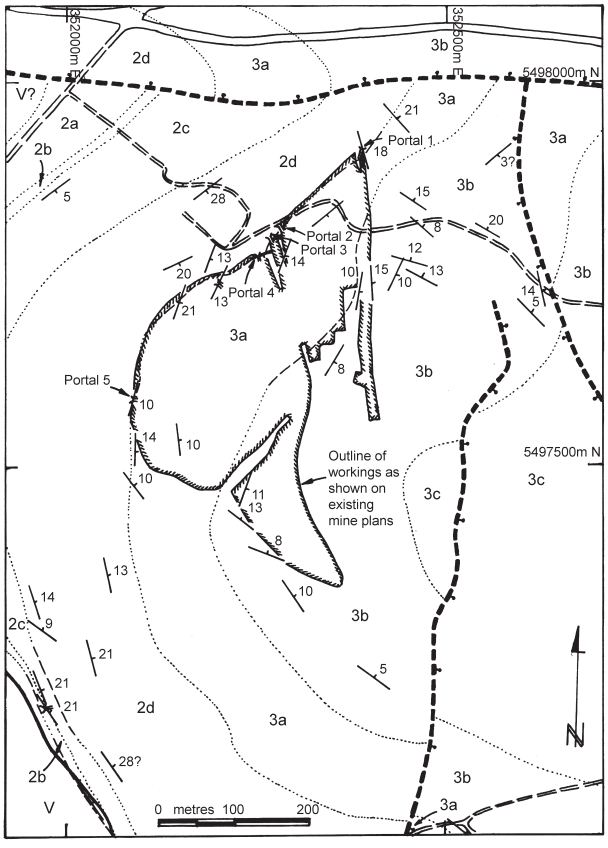

Figure 1. Geological map of No.3 minesite, showing reported extent of mine workings in relation to bedrock geology.

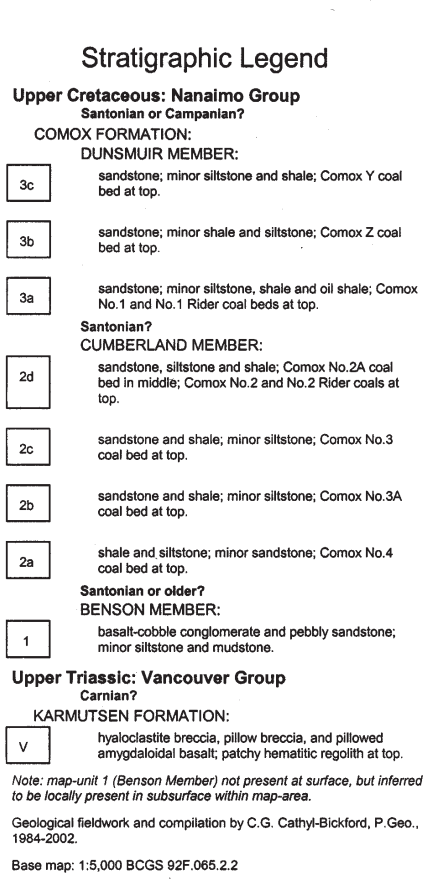

Photo 1. View southward into workings inbye Portal 4. Timber posts are 20 to 30 cm in diameter, and have single cap-pieces to spread load against carbonaceous mudstone roof of coal bed.

Photo 2. Original firewall of brick and stone, on north side of underground ventilation furnace, inbye Portal 5. Sandstone roof above furnace has been baked and reddened, and shows minor flaking.

pers by Kenyon and others (1991) and Cathyl-Bickford (2000).

The main roof of the No.2 coal bed at No.3 Mine consists of at least 6 metres of thin- to thick-bedded sandstone of the basal Dunsmuir Member of the Comox Formation. The sandstone contains locally-abundant coalified wood fragments and shell debris, with occasional large but poorly-preserved mollusc fossils (tentatively identified as *Inoceramus* sp.) The immediate nether roof of the No.2 coal bed consists of 30 to 50 centimetres of interbedded dark grey to black canneloid, carbonaceous and silty mudstone with occasional thin and thick bright coal bands, representing the uppermost part of the Cumberland Member of the Comox Formation.

The Comox No.2 coal bed itself has a gross thickness of 1.05 to 1.2 metres where exposed near the mine portals, but it probably thins to the south within the mine workings, as alluded to in inspector's reports (Dick, 1889; 1894). The coal bed consists of 80 to 90 centimetres of very hard, blocky, bright banded coal with thin but laterally-persistent partings of mudstone and siltstone. Partings were observed in surface exposures and within mine pillars, where some of the parting material has squeezed out into the adjacent workings, perhaps due to loading of the pillars. Coal balls, consisting of ellipsoidal masses of silicified plant material, are occasionally present within the No.2 coal bed. Plant-fossil preservation appears to be quite good: details of wood grain, including knots and compression wood, are evident in the coarser plant material within the coal balls.

The floor of the No.2 coal bed consists of thinly-interbedded mudstone, siltstone and sandstone, much of which contains fossilised plant roots and occasional entire coalified logs as well as coalified stumps in their growth position.

The coal-measures near No.3 Mine are gently folded into an east-plunging open syncline about 700 metres wide. Mine workings lie within the western nose of the fold where dips range from 8 to 14 degrees to the east and southeast.

Two minor extensional faults and one bedding-plane shear zone were observed during mapping, but none of these structures appear to be particularly extensive and the greatest fault displacement observed is just slightly over 2 metres.

MINING CONDITIONS

During the underground exploration in January 2002, observations were made of the performance of the roof and floor of the mine workings, as well as the support methods employed by the miners.

The basal Dunsmuir sandstone appears to form a very strong roof, standing unbroken across spans up to 20 metres wide, which is a creditable performance even considering the shallow cover (generally less than 10 metres) over the mine workings. Of greater significance, perhaps, is the apparent strength of the uppermost Cumberland mudstones, which form the immediate nether roof of the mine. In most cases these mudstones have been used as the working roof of the mine, and they are standing well with minimal bed separation despite the lack of effective artificial roof support in the mine.

Good roof performance has allowed the old workings of No.3 Mine to stand open for more than a hundred years, which provides some encouragement for the prospect of rehabilitating the mine for underground tours and education. However, such strong roofs might provide problems for future mines located deeper within the Comox coalfield, since delayed caving of mine roof can cause overloading of modern mechanised support systems, and can also cause severe air blasts within the mine workings.

The hard coal of the No.2 coal bed appears to form strong pillars, which have probably also contributed to the apparent long-term stability of the mine workings. When

the mine portals were dug out in January 2002, the coal broke out as very large blocks across the full thickness of the coal bed, each weighed between one and several hundred kilograms. During the period of main working of the mine in the 1890s, and indeed up until the end of the domestic coal era in the 1950s, such hard coal would have formed a high proportion of large lumps. Miners put considerable effort into increasing the proportion of lump coal within run-of-mine production, since the larger sizes of coal could be sold at much higher prices than the finer coal. However, modern coal markets do not place such a premium on large product sizes, and the No.2 coal's hardness could be detrimental to its economic value since machine power requirements and cutting-pick consumption are increased when working harder coal.

Piles of fine coal found during recent exploration of the mine suggest that the miners screened or raked the coal underground, discarding material smaller than 25 mm, and hauling only the larger lumps out of the mine.

The No.2 coal displays a well-developed face cleat striking 028 to 033, and dipping 70 to 80 degrees to the northwest, and an irregular butt cleat striking 115 to 125. The face cleat forms subparallel planes of weakness within the coal, affording a means for shearing of the coal face with hand tools. Unlike other still-accessible mine workings of similar vintage in the Vancouver Island coalfields, such as the Sage Mine on Newcastle Island and Dunsmuir's Original Entry in the northern part of the City of Nanaimo, the accessible coal faces of No.3 Mine do not show many pick marks or other tool marks. The original miners probably found it quite easy to wedge the well-cleated coal down from the coal faces.

Coal balls within the No.2 coal bed afford the possibility of an unusually-detailed view of Late Cretaceous flora, since their contained plant material was cemented and preserved prior to compaction of the coal-measures. On the other hand, the presence of coal balls is a detriment to future mining, since the coal balls are prone to sparking when encountered by coal-cutting equipment. Furthermore, coal balls are a potential source of instability in coal faces, and constitute an additional body of unsaleable waste to be handled and disposed of.

The floor of the No.2 coal bed is markedly softer and weaker than its roof. The floor appears to have heaved and rolled up into some of the workings, partially blocking the circulation of air within the mine and reducing travel within the workings to a muddy exercise of crawling on one's belly. The floor heaves may be due to load transfer from the mine's pillars into its floor, or may also be due to swelling of moisture-sensitive clays.

Although in the 1890s it might have been reasonable to expect miners to travel through workings no more than 90 cm high, modern mining equipment can only traverse and work such thin coal with difficulty. Even the most adventurous of tourists is unlikely to want to crawl through workings that have been partially blocked by floor heaves. On the other hand, the soft floor of the No.2 coal bed could be excavated with greater ease than the sandstone roof. Sufficient height for comfortable passage of visitors could be gained by lifting 1.2 to 1.5 metres of the mine's floor.

Pillars of remnant coal within the mine workings are surprisingly uncommon. Most of the mine's roof support appears to have been provided by timber props, 25 to 50 centimetres in diameter and 0.9 to 1.1 metres long, set on 1.2-meter centres. Along the sides of underground roadways, randomly-spaced rock-filled cribs supplemented the props. Not surprisingly, given the mine's great age, nearly all of the timbers were found to be rotten during the most recent examination of the mine, and most of the rock-filled cribs had partially or completely collapsed owing to failure of their timber frames.

No.3 Mine, like several other old collieries on Vancouver Island, was ventilated by means of an underground furnace. Furnaces typically were built within a coal bed, close to the bottom of an airshaft or the mouth of an adit. Because of the obvious risk of setting fire to the adjoining coal pillars, brick or stone firewalls were customarily built along either side of the furnace, and its grate was set between the walls. Remains of the No.3 furnace are preserved in the most southerly of the mine's five known portals. The furnace's firewalls were constructed with mortared stone blocks and bricks, paralleling each side of the portal and situated a few metres inside its mouth. The walls show signs of baking and heat-induced spalling, as does the mine's roof immediately between the walls. No sign of the furnace's grate is visible, but remnants of it may remain beneath the piles of rubble, which partially block the passageway between the furnace walls.

EXPLORATION METHODS AND RESULTS

Reopening of the mine entrance was easily accomplished by means of a tracked excavator provided by the works crew of the Village of Cumberland. About two hours of machine time were required to windrow logging debris that covered the minesite, and to dig out two portals which had been blocked by piles of earth and rock. One hour of machine time was devoted to reinforcing the covering over an existing gated access structure. Two hours of machine time were required to backfill and regrade the portals, ensuring that unsupervised visitors could not easily gain access to the mine. The total cost of a day's work at the mine was probably less than a thousand dollars, including volunteer labour that was donated on the Village's behalf.

Underground exploration was conducted by a party of three persons, led by a certificated fireboss, accompanied by a colliery surveyor and a mining geologist. Mine air was tested for carbon monoxide by means of Draeger tubes, and for methane by means of a portable methanometer. Several sets of tests were conducted, but neither gas was detected in the mine. Bearings and distances within the mine were determined by tape and compass, supplemented by laser rangefinder observations from the mine's portals. Progress within the mine was hampered by mounds of debris and heaved floor material, and by concerns for roof stability within untimbered areas. Nevertheless, three hour's work

underground was sufficient to establish the general conditions near the mine entries, and assess whether the proposed rehabilitation of the mine was feasible. Appropriate safety equipment such as hard hats, approved mine lamps and knee pads were used. Knee pads, although often forgotten, lend a precious level of comfort to underground geological mapping of thin coal beds.

Crawling about in a coal mine is exhausting work, made more difficult by the occasional need to belly one's way over piles of rock, or squeeze through a tight spot. Most of the mapping and safety equipment was carried by hand (requiring great dexterity to move it and use it effectively), or attached to work belts (thus affording considerable potential for jamming its owner between rocks and hard places). A lesson learned from trying to work within the mine is that tools and equipment should be attached to shoulder-straps or lanyards, so that they can be effectively dragged by one's feet as well as one's hands while crawling through the mine.

Large steel spikes that had been painted bright orange for easy recognition and retrieval temporarily marked geological control points within the mine. In an inactive mine such as No.3 Mine, spikes make good place-markers for mapping as well as for measurement of stratigraphic sections of coal pillars and exposed roof and floor strata. However, their use in an active mine might be less desirable, since any spikes left underground could puncture the tires of mobile equipment, or wreak havoc within a coal-preparation plant in the event that they found their way into the mined product.

Very few plans of the mine remain in existence, and the most detailed of them (held by the Cumberland Museum and Archives) was at some time in the past trimmed in such a manner as to cut off most of the workings of No.3 Mine. None of the various plans, at whatever scale, show internal details of No.3 Mine's pillars and underground roadways.

EDUCATIONAL POTENTIAL

No.3 Mine is unusual among coal mines, in that its current value is as an accessible example of Vancouver Island's industrial heritage, rather than a potential source of saleable coal. Based on the limited underground examinations done to date, the mine appears to be in good shape except for the condition of its timbers. The fact that the mine is still standing open is a rather encouraging sign for its prospects as a tourist site; good roof conditions will ensure the safety of visitors to the mine.

The most likely route for underground tours would be along the inside edge of the remnant barrier pillar that bounds the outcrop edge of the No.2 coal bed. Educational possibilities of No.3 Mine include demonstrating of the evolution of mining methods in the Comox coalfield (ranging from hand-hewing through early machine mining to modern continuous-miner and shuttle-car systems), seeing geological structures within coal-measures, and the palaeontology of animal and plant fossils, particularly the Cretaceous coal-ball flora. No.3 Mine, once it has been made safe, would be an excellent locale for teaching surface and underground geological mapping, since just enough geology is exposed to make an instructive, solveable puzzle to a would-be mapper.

As the mine currently exists, considerable rehabilitation would be needed before visitors could safely enter it. Although the roof conditions are remarkably good for a coal mine of its vintage, the timbering is unstable owing to rot and localised crushing by roof pressure. Mounds of fine coal, discarded rock, and heaved floor strata that litter the mine, make it impassable locally. In the absence of an accurate plan of the mine's workings, it is not possible to assess the extent to which pillars have been robbed, or the proportion of supported to unsupported roof.

Challenges to rehabilitation of the mine include: the possibility of spontaneous combustion when adequate ventilation is established; the unassessed potential for acid mine drainage from the workings or acid generation from any loose materials loaded out of the mine; and the unknown dimensions and locations of the mine's remaining pillars. Nevertheless, No.3 Mine affords the prospect of educating its visitors in the historic practices of coal mining in British Columbia, as well exposure to the emerging art and science of coal-mining geology.

ACKNOWLEDGEMENTS

Robert Williams brought the educational potential of the well-preserved workings of No.3 Mine to the Village's attention in the autumn of 2000, and since then he has been a hard-working and diligent colleague and an outspoken advocate for the mine. The Cumberland woods crew of Mike Hamilton Logging Ltd. built the access road to the mine and were most accommodating to a geologist's urgent, albeit unfathomable, need for better exposure of the Comox coal measures. Cumberland Mayor William Moncrief and Councillor Leslie Baird, underground manager Bruce Fairbrother, and mine inspector Ed Taje of the British Columbia Mines Branch have unstintingly given their support and wise counsel to this project. Peter Mustard of Simon Fraser University offered some insights into the geology of the Comox Formation at Trent River, but the sections accompanying this paper represent my own views on the subject. Clarity of expression within this paper was considerably improved by William McMillan's editorial ministrations.

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Measured Section No. 9

Comox Formation, Number Three Mine, Comox Colliery

Top of section: in cut on south side of Hamilton's logging road, at UTM (Zone 10, NAD 83) 352495 E., 5497820 N.
Base of section: in roadbed, outside No.4 portal of mine, at UTM (Zone 10, NAD 83) 352240 E., 5497797 N
NTS 92 F/11. TRIM 92F.065
Measured by: C.G. Cathyl-Bickford, May 5, May 8, June 30, July 2 and July 3, 2001.

Unit	Description	Thickness (m)	Height (m)
Comox Formation: Dunsmuir Member (53.58 m - incomplete):			
92	Sandstone - fine- to medium-grained, light grey to white, brown-weathering quartz-feldspar; feldspars mostly weathered to clay; clean but chalky due to weathering, thin to medium irregular beds; top covered by soil and sandstone debris; abrupt base.	1.45	59.85
91	Sandstone - medium-grained, clean, light grey, greenish-grey-weathering, quartz-feldspar, feldspars partially weathered to clay but in fresher zones this rock has fair to good intergranular porosity; thick-bedded, platy-weathering, with occasional finely-broken plant debris at bed tops; abrupt base.	1.80	58.40
90	Sandstone - fine-grained, light greenish-grey, brown-weathering, fair intergranular porosity; thin to medium-bedded, large-scale trough cross-beds; abrupt base.	2.83	56.60
89	Sandstone - very fine-grained, light greenish-grey, brown-weathering, quartz-feldspar-basalt, very silty, moderately- to intensely-bioturbated, thin-bedded, planar-laminated; gradational base.	0.87	53.77
88	Sandstone - fine- to medium-grained, light to medium grey, brown-weathering, quartz-feldspar, minor basalt, clean, no visible porosity, thick-bedded to massive, very thick planar lamination; hard; abrupt base.	1.05	52.90
87	Sandstone - very fine- to fine-grained, light greenish-grey, brown-weathering quartz-feldspar-basalt, trace disseminated pyrite; no visible porosity; very thin irregular beds, some shallow swaly cross-beds, prominently platy-weathering; forms a resistant ledge; abrupt base.	2.42	51.85
86	Sandstone - fine- to medium-grained, light to medium greenish-grey, brown-weathering, quartz-feldspar-basalt, no visible porosity; sparsely- to moderately-bioturbated; medium to thick-bedded, hummocky cross-laminated; abrupt base.	1.70	49.43
85	Sandstone - medium- to coarse-grained, medium olive drab, brown-weathering, silty, moderately- to intensely-bioturbated, occasional ellipsoidal concretions; thick-bedded, platy to blocky-weathering; gradational base.	1.28	47.73
84	Sandstone - fine- to medium-grained, light olive drab, brown-weathering, quartz-basalt, clean, thin to medium irregular beds, platy- to flaggy-weathering; partly covered by sandstone debris; base not seen.	2.35	46.45
83	(Concealed) - sandy loam and sandstone debris.	2.80	44.10
82	Sandstone - fine-grained, light greenish-grey, grey-weathering, quartz-basalt; flaggy-weathering; sparsely-bioturbated, with occasional *Ophiomorpha*; gradational base.	3.55	41.30
----- *Fault, probable; attitude: 118/65 SW; displacement 1.50 m down to southwest; beds matched across fault* -----			
81	Sandstone - fine- to medium-grained, medium greenish-grey, brown-weathering, quartz-basalt, thick- to very thick-bedded, blocky-weathering to massive; tight; erosional base.	2.40	37.75
80	Sandstone - fine-grained, silty; mostly concealed by sandstone rubble; gradational base.	0.22	35.35
79	Sandstone - very fine- to fine-grained, medium grey, silty, intensely-bioturbated, with many large burrows filled with medium- to coarse-grained sandstone; abrupt base.	0.45	35.13
78	Mudstone - dark brown, carbonaceous, hard, platy-weathering; abrupt base.	0.13	34.68
----- Roof of Comox No.1 Rider coal bed -----			
77	COAL - dull, stony, blocky-weathering; abrupt base.	0.04	34.55

76	Mudstone - black, coaly, with occasional large sand-filled burrows; weathered, soft; abrupt base.	0.03	34.51
75	COAL - dull banded, intensely-weathered, soft; abrupt base.	0.16	34.48
74	Mudstone - black, coaly, with occasional sand-filled burrows; abrupt base.	0.03	34.32
73	COAL - dull and bright, intensely-weathered, soft; abrupt base.	0.15	34.29
-----	Floor of Comox No.1 Rider coal bed -----		
72	Mudstone - olive drab, intensely rusty-weathering, rooty, soft; gradational base.	0.04	34.14
71	Mudstone - light grey, rooty, soft; probable seatearth; gradational base.	0.28	34.10
70	Mudstone - dark brown, carbonaceous, fissile, rubbly-weathering, with abundant finely-broken plant debris; abrupt base.	0.12	33.82
-----	Roof of Comox No.1 coal bed -----		
69	COAL - dull lustrous, hard; abrupt base.	0.04	33.70
68	COAL - dull and bright, clean, weathered; face cleat: 122/85 SW (5 to 8 mm spacing); butt cleat not seen; abrupt base.	0.18	33.66
67	COAL - dull and bright, intensely weathered, powdery; abrupt base.	0.13	33.48
66	COAL - dull banded, stony, weathered; abrupt base.	0.07	33.35
-----	Floor of Comox No.1 coal bed -----		
65	Mudstone - light brown, rooty, very soft; probably a seatearth; gradational base.	0.25	33.28
64	Mudstone - dark brown, carbonaceous, with occasional very thin bright coal bands; abrupt base.	0.18	33.03
63	Siltstone - dark grey, very thin-bedded, blocky-weathering, hard; abrupt base.	0.18	32.85
62	Mudstone - light brown, rooty, soft; probably a seatearth; gradational base.	0.11	32.67
61	Mudstone - dark brownish-grey, silty, with occasional thick bright coal bands; rooty at top, rubbly-weathering; abrupt base.	1.08	32.56
60	Mudstone - dark brown, very carbonaceous, brown- to reddish-brown-weathering; papery lamination, very thin planar beds; possibly an oil shale; abrupt base.	0.64	31.48
59	Mudstone - dark brownish-grey, very silty, spheroidal-weathering; gradational base.	0.32	30.84
58	Siltstone - dark brown, spheroidal-weathering, sandy, splintery, hard; attitude: 030/14 NE (locality A.2044); abrupt base.	0.47	30.52
57	Sandstone/Siltstone Laminite (60:40) interlaminated very fine-grained medium grey, rippled sandstone and dark brownish-grey siltstone with abundant finely-broken plant debris; abrupt base.	1.25	30.05
56	Sandstone - fine- to medium-grained, medium greenish-grey, quartz-basalt; plane-laminated at top, massive below; erosional base. Thickness varies from 0.51 to 0.58 m.	0.55	28.80
55	Sandstone/Siltstone/Coal Laminite (60:15:25) - interlaminated very fine to fine, light greenish-grey, quartz-feldspar-basalt sandstone and medium to dark grey sandy siltstone with abundant thin bands of dull and bright coal; abundant finely-broken plant debris throughout; sands are mostly clean; abrupt base. Thickness varies from 0.15 to 0.22 m.	0.18	28.25
54	COAL - dull, stony, with occasional sandy flaseroid ripples; slightly sheared; a persistent seamlet; abrupt base. Thickness varies from 0.01 to 0.02 m.	0.01	28.07
53	Sandstone - medium- to coarse-grained, medium greenish-grey, quartz-basalt, plane-laminated at top; massive below; rooty at top; abrupt base.	0.62	28.06
52	Siltstone - dark brownish-grey, slightly carbonaceous, with occasional flaseroid sandy lenses; very thin-bedded; some shell debris and possible insect fossils, and occasional finely-broken plant debris; base not seen.	0.71	27.44
51	(Concealed) - stony gravel and sandstone debris in gully.	(2.79)	26.73
	[**Note:** beds 40 through 50 are measured along the south side of the road, east of No.2 portal of the mine.]		
50	Sandstone - medium- to coarse-grained, light to medium greenish-grey, quartz-basalt, clean, platy-weathering; very hard and strong, forming ledge north of road; base not seen.	2.65	23.94
49	(Concealed) - sandy loamy soil and sandstone debris.	(1.80)	21.29

48	Sandstone - fine-grained at base, fining-upward to very fine-grained at top, silty throughout; medium grey, brown-weathering, quartz-feldspar-basalt, moderately to intensely-bioturbated throughout, massive; base not seen.	1.05	19.49
47	(Concealed) - sandy stony loam and sandstone debris.	(0.35)	18.44
46	Sandstone - coarse-grained, light greenish-grey, light grey-weathering, quartz-feldspar-basalt, cleaner than stratigraphically-lower beds, fair intergranular porosity, thick-bedded, with shallow trough cross-sets; sparsely- to moderately-bioturbated; base not seen.	0.90	18.09
45	(Concealed) - sandstone rubble.	(1.40)	17.19
44	Sandstone - medium- to coarse-grained, drab to brown-weathering, quartz-feldspar-basalt, medium- to thick-bedded; large-scale trough cross-laminated at base; plane-laminated above; erosional base. Thickness varies from 1.41 to 1.48 metres.	1.45	15.79
43	Sandstone - fine- to medium-grained, light to medium-greenish-grey, brown- to drab-weathering, quartz-basalt, cleaner than underlying beds; flaggy-weathering; abrupt base. Thickness varies from 0.68 to 0.75 metres.	0.71	14.34
42	Sandstone - fine- to medium-grained, medium greenish-grey, brown-weathering, very thin planar beds with a few silty laminae; markedly platy-weathering; no visible porosity; abrupt base.	1.44	13.63
41	Sandstone - fine-grained, medium greenish-grey, brown-weathering, quartz-basalt, very thin irregular beds with occasional silty laminae; locally-abundant finely-broken plant debris; gradational base; partly concealed by sandstone rubble.	1.40	12.19
40	Sandstone - medium- to coarse-grained, light greenish-grey, brown-weathering, quartz-feldspar-basalt, thin irregular beds, sparsely-bioturbated, flaggy-weathering; abrupt base. [**Note:** beds 21 through 39 are measured at locality A.1957 at and above the No.3 portal of the mine.]	1.13	10.79
39	Sandstone - fine to medium-grained, orange-brown-weathering, granitic, very thin-bedded, platy-weathering, with abundant finely-broken plant debris; sparsely to moderately bioturbated; gradational base.	1.47	9.66
38	Sandstone - medium-grained, light grey, orange-brown-weathering, granitic, clean, medium-bedded, prominently planar-laminated; exfoliates into thin rounded shells; abrupt base.	1.19	8.19
37	Sandstone - medium to coarse-grained, light grey, brown-weathering, granitic, clean, thick-bedded, plane-laminated at top, massive below; sparsely bio-turbated (*Ophiomorpha?*); very widely-spaced joints; abrupt, rolly, probably erosional base. Attitude: 015/6E (fair).	0.73	7.00
Comox Formation: Cumberland Member (6.27 m - incomplete):			
36	Mudstone - dark brownish-grey, slightly carbonaceous, with abundant silty flaseroid laminae and ripples; rubbly to platy-weathering; abrupt base.	0.07	6.27
----- Roof of Comox No.2 Rider coal bed (horizon only) -----			
35	Mudstone - black, canneloid, rubbly-weathering; abrupt base.	0.07	6.20
----- Floor of Comox No.2 Rider coal bed (horizon only) -----			
34	Mudstone - black, carbonaceous, with occasional thin bright coal bands; rubbly-weathering; abrupt base; parts freely at base.	0.04	6.13
----- *Bedding-plane shear zone, possible* -----			
33	Mudstone - dark grey, carbonaceous, slightly silty, rooty, with abundant thin bright coal bands; rubbly-weathering; abrupt base.	0.19	6.09
32	Mudstone - black, coaly, fissile, with abundant thick bright coal bands; platy-weathering; abrupt base. [**Note:** beds 32 through 36 form the nether roof of No.3 Mine]	0.12	5.90
----- Roof of Comox No.2 coal bed -----			
31	COAL - dull and bright, closely-cleated; face cleat: 122/75 SW (8 to 20 mm spacing); butt cleat poorly developed: 007/80 W (20 to 30 mm spacing); platy to blocky-weathering.	0.13	5.78

30	COAL - bright banded, hard, blocky; abrupt base.	0.10	5.65
29	Mudstone - dark brown, carbonaceous, slightly sheared, soft, compact; abrupt base.	0.04	5.55
28	COAL - dull and bright, hard.	0.10	5.51
27	COAL - bright banded, slightly sheared.	0.18	5.41
26	Mudstone - dark brownish-grey, carbonaceous, with occasional thin bright coal bands; rooty; abrupt base.	0.21	5.23
25	COAL - dull, stony, hard, with overhanging base.	0.05	5.02
24	Mudstone - black, coaly, with abundant thin bright coal bands; platy.	0.04	4.97
	[**Note:** beds 21 through 23 are measured at locality A.1983 on the east rib of No.4 portal of the mine.]		
23	COAL - bright banded, moderately hard; attitude at top: 025/13 SE (fair); abrupt base.	0.32	4.93
----- Floor of Comox No.2 coal bed -----			
22	Mudstone - dark brownish-grey, carbonaceous, with occasional thin bright coal bands; moderately soft; gradational base.	0.18	4.61
21	Mudstone - medium grey, brown-weathering, very thin-bedded, rooty, moderately soft; occasional poorly-preserved angiosperm leaves; abrupt base.	0.31	4.43
	[**Note:** beds 10 through 20 are measured along the west side of the side road to the No.3 portal of the mine]		
20	Siltstone - medium brownish-grey, sandy, slightly ferruginous, with occasional rootlets; very thin-bedded, platy-weathering, hard; abrupt base.	0.09	4.12
19	Mudstone - dark brown, slightly carbonaceous, rubbly-weathering, hard; gradational base.	0.05	4.03
18	Siltstone - dark brownish-grey, brown-weathering, sandy, spheroidal-weathering, thin-bedded, with occasional rootlets; abrupt base.	0.51	3.98
17	Mudstone - dark brown, dark brown-weathering, silty, fissile, flaky-weathering, very soft; abrupt base.	0.21	3.47
16	Sandstone - very fine-grained, medium grey, brown-weathering, silty, finely ripple-laminated, blocky- to rubbly-weathering, hard; abrupt base.	0.20	3.26
15	Siltstone - dark brown, brown-weathering, very sandy, very thin-bedded, hard; gradational base.	0.08	3.06
14	Sandstone - very fine-grained, medium grey, brown-weathering, silty, thick-bedded, with vague planar-lamination at top; moderately- to intensely-bioturbated, hard; abrupt base.	0.48	2.98
13	Sandstone/Siltstone Laminite (50:50) - very fine-grained sandstone and siltstone; medium grey, brown-weathering, platy-weathering, with occasional angiosperm leaves; slightly sheared; abrupt base.	0.06	2.50
12	Siltstone - dark grey, grey-weathering, slightly carbonaceous; gradational base.	0.04	2.44
11	Sandstone - very fine-grained, brown-weathering, silty, very thin-bedded, hard; abrupt base.	0.16	2.40
10	Siltstone/Sandstone Laminite (70:30) - dark grey siltstone and medium grey, very fine-grained sandstone; brown-weathering, trace disseminated pyrite, platy-weathering; abrupt base.	0.04	2.24
	[**Note:** beds 1 through 9 were measured in a temporary trench, excavated by Hamilton Logging during exploration for road-construction material.]		
9	Sandstone - very fine-grained, medium grey, brown-weathering, silty, quartz-basalt, spheroidal-weathering; gradational base.	0.22	2.20
8	Siltstone - dark brown, sandy, spheroidal-weathering, intensely-weathered, soft; abrupt base.	0.21	1.98
7	Sandstone/Siltstone Laminite (90:10) - medium grey, fine-grained silty sandstone and dark grey siltstone; patchy brown-weathering, with occasional carbonaceous laminae; thin-bedded, hard; abrupt base.	0.44	1.77
6	Sandstone - very fine- to fine-grained, medium grey, silty, quartz-feldspar-basalt, moderately bioturbated, hard; gradational base.	0.52	1.33
5	Sandstone - very fine-grained, medium brownish-grey, rusty-weathering, very silty, quartz-feldspar-basalt; massive, intensely-bioturbated; abrupt base.	0.26	0.81
4	Mudstone - light brown, brown-weathering, soft; probable seatearth; gradational base.	0.05	0.55

3	Siltstone/Sandstone Laminite (50:50) - very fine-grained brown-weathering sandstone and siltstone, platy-weathering; abrupt base.	0.10	0.50
2	Siltstone - sandy, medium brown, rusty-weathering, massive; abrupt base.	0.10	0.40
----- *Bedding-plane shear zone, possible* -----			
1	Siltstone - brownish-weathering, sandy, medium-bedded, blocky-weathering; sheared and soft at top, hard below; base not seen.	>0.30	0.30
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Measured Section No. 10

Comox and Trent River formations, along Trent River and Idle Creek

Top of section: at top of cliff in southeast bank of river, 150 m upstream from site of old Van West Logging bridge, at UTM (Zone 10, NAD 27) 356210 E., 5494830 N.

Base of section: on Idle Creek, 75 metres upstream of right-angle bend, at UTM (Zone 10, NAD 27) 354000 E., 5492820 N.

NTS 92 F/10 and 92 F/11. TRIM 92F.055 and 92F.056.

Measured by: C.G. Cathyl-Bickford and A. Inglis, 1983 (coals and associated shales); C.G. Cathyl-Bickford and C.R. Day, 1987 (units 1 through 130); C.G. Cathyl-Bickford, 2000 (units 131 through 164). Petrographic sampling by C. Kenyon, 1987.

Unit	Description	Thickness (m)	Height (m)
Trent River Formation: Puntledge Member (incomplete):			
164	Siltstone - dark grey, rubbly, with occasional large ellipsoidal concretions; forms top part of cliff; abrupt base.	6.00	314.97
163	Sandstone - fine-grained, light brown-weathering, pinches and swells as if boudined; thickness varies from nil to 15 cm; abrupt base.	0.10	308.37
162	Siltstone - dark grey, rubbly; gradational base.	2.20	308.27
161	Siltstone - dark grey, rubbly, with ellipsoidal concretions to bed height; gradational base.	0.20	306.07
160	Siltstone - dark grey, rubbly, with occasional sandstone dykes; abrupt base.	3.20	305.87
159	Sandstone - fine-grained, light brown-weathering, cherty, a prominent resistant bed which appears to be the source of sandstone dykes; thickness varies from nil to 60 cm; abrupt base.	0.20	302.67
158	Siltstone - dark grey, thin-bedded, platy; with occasional sandstone dykes; gradational base.	2.38	302.47
157	Siltstone - dark grey, rubbly-weathering, with abundant spheroidal concretions to bed height, and occasional sandstone dykes; gradational base.	0.30	300.09
156	Siltstone - dark grey, massive, rubbly-weathering, with occasional sandstone dykes; gradational base.	2.90	299.79
155	Siltstone - dark grey, thin-bedded, rubbly-weathering, with abundant large spheroidal concretions; gradational base; this bed forms riverbed at upstream end of bend around to north (section here continues upward in cliff on southeast bank) and reappears just upstream of the Van Logging Road ford.	1.28	296.89
154	Siltstone - dark grey, massive, rubbly, with occasional sandstone dykes; gradational base.	3.35	295.61
153	Mudstone - dark grey, hematitic-weathering, rusty in part, flinty, splintery; intensely-bioturbated at top; abrupt base; possible ash band.	0.03	292.26
152	Siltstone - dark grey, sandy, massive, rubbly-weathering, with occasional large ellipsoidal concretions; intensely bioturbated at top, gradational base; possible hardground.	1.57	292.23
151	Siltstone / Sandstone, very fine-grained - very thin to medium fining-upward interbeds of medium grey cherty, slightly bioturbated sandstone and dark grey siltstone; abrupt base.	0.95	290.66
150	Mudstone - dark grey, very silty, intensely bioturbated, with occasional sandstone dykes; occasional large ellipsoidal concretions at base; gradational base.	1.05	289.71
149	Sandstone - very fine-grained, medium grey, cherty, moderately bioturbated; concretionary; abrupt base; thickness varies from 5 to 8 cm.	0.07	288.66
-----	*Extensional fault, established (attitude: 050/56 NE; displacement: 2.4 m down to northeast; beds matched across fault); locality A.1788*-----		
148	Mudstone - medium grey, hematitic-weathering, rusty, flinty, fissile, moderately bioturbated, slightly sheared; abrupt base; thickness varies from 3 to 7 cm; probable ash band.	0.05	288.59

147	Mudstone - dark grey, very silty, intensely bioturbated, with occasional small irregular concretions; abrupt base.	1.33	288.54
146	Siltstone - dark grey, sandy, with occasional large ellipsoidal concretions to bed height; gradational base.	0.33	287.21
145	Siltstone / Sandstone, very fine-grained - thin fining-upward interbeds of dark grey siltstone and medium grey sandstone; moderately bioturbated; abrupt base.	0.43	286.88
144	Mudstone - dark grey, silty, rubbly, intensely bioturbated, with occasional large ellipsoidal concretions; gradational base.	0.50	286.45
143	Sandstone - very fine-grained, medium grey, cherty, intensely bioturbated; pinches out near larger sandstone dykes, and thins eastward to 1 cm; erosional base.	0.05	285.95
142	Mudstone - dark grey, very silty, thin to medium-bedded, slightly spheroidal-weathering, slightly bioturbated, with occasional shell fragments, occasional large ellipsoidal concretions and occasional sandstone dykes; gradational base.	1.38	285.90
141	Siltstone - dark grey, thin-bedded, rubbly, slightly spheroidal-weathering, with a few large concretions at top and occasional sandstone dykes throughout; gradational base.	1.95	284.52
140	Mudstone - dark grey, silty, platy to rubbly, with occasional large ellipsoidal concretions and occasional sandstone dykes; gradational base.	1.60	282.57
139	Mudstone - dark grey, silty, with occasional sandstone dykes; gradational base.	1.40	280.97
138	Siltstone - dark grey, platy, with occasional sandstone dykes; erosional base.	0.80	279.57
137	Mudstone - dark grey to black, rusty-weathering, silty, splintery, trace glauconite; abrupt base; thickness varies from 5 to 12 cm.	0.08	278.77
136	Mudstone - dark grey, very silty, rubbly to platy-weathering at base, spheroidal-weathering towards top; occasional small irregular concretions and occasional sandstone dykes; abrupt base.	2.02	278.69
135	Siltstone - dark grey, sandy, spheroidal-weathering, with abundant large ellipsoidal concretions to full bed height; occasional sandstone dykes; gradational base.	0.27	276.67
134	Siltstone - dark grey, rubbly, moderately bioturbated, with occasional large ellipsoidal concretions and occasional sandstone dykes; gradational base.	1.70	276.40
133	Siltstone - dark grey, sandy, rubbly, hackly fracture, intensely bioturbated; intensely sheared at base.	0.85	274.70

Trent River Formation: Cowie Member (1.50 m - complete):

132	Sandstone - fine to very fine-grained, ferruginous-weathering, intensely bioturbated, with some disrupted heavy-mineral laminae, and streaks of finely-broken plant debris; gradational base; possible hardground.	0.15	273.85
131	Sandstone - fine-grained, light grey, trough cross-bedded (indicated paleoflow is bi-directional at 185 and 005 -- possibly due to ebb and flood tidal flows?); gradational base.	0.75	273.70
130	Sandstone - fine-to-medium-grained, light grey, buff-weathering, medium-bedded, cross-laminated, clean, with *Thalassinoides* burrows.	0.60	272.95

Trent River Formation: Cougarsmith Member (9.20 m - complete):

129	Mudstone - dark grey, rusty-weathering, silty, with scattered finely-broken plant debris. Gradational base.	0.15	272.35
128	Siltstone - dark grey, sandy, rubbly.	1.05	272.20
127	Siltstone - as above, intensely-sheared (bedding-plane faulting), incomplete exposure.	8.00	271.15

-----Listric extensional fault, probable -----

Comox Formation: Dunsmuir Member (103.77 m - complete):

126	Sandstone - fine to medium-grained, white, composed of subequal amounts of quartz and kaolinised feldspar with minor volcanic rock fragments; clean		

	and well-sorted, but devoid of visible intergranular porosity. Massive-appearing, with local large-scale but subtle hummocky cross-stratification; gradational base.		8.70	263.15
125	Sandstone - medium-grained, light grey, clean, massive.		3.50	254.45
124	Siltstone - dark brownish-grey, orange to red-weathering, sandy, thin low-angle cross-beds; gradational base. Sample 83/S.562.		0.38	250.95
123	Sandstone - fine-grained, medium to dark grey, silty, organic-rich, intensely-bioturbated; gradational base.		0.50	250.57
122	Sandstone - fine-grained, light grey, clean, with large dark-rimmed, oblique, gently-curving burrows; gradational base.		4.40	250.07
121	Sandstone - as above but medium grey, rusty-weathering, soft, burrowed, blocky, with coaly plant trash and *Teredolites* burrows at base; erosional base.		0.60	245.67
-----Roof of Comox X coal bed -----				
120	COAL - bright banded, sheared at top; weathered.	) Channel sample:) CK 87-34/1	0.20	245.07
119	Sandstone - fine-grained, grey, soft, forms flaseroid ripples.		0.02	244.87
118	COAL - dull banded, parts freely at base.	) Channel sample:) CK 87-34/2	0.20	244.85
117	COAL - dull.	) Channel sample:) CK 87-34/3	0.12	244.65
-----Floor of Comox X coal bed -----				
116	Mudstone - dark brown, carbonaceous, soft, with abundant thin bright coal bands.		0.15	244.53
115	Sandstone - fine-grained, medium grey, with scattered fine plant debris; very thick planar beds; gradational base.		10.20	244.38
114	Sandstone - fine-grained, light greenish-grey, silty, ill-sorted, with much organic matter and occasional lenses of plant-bearing siltstone. Large vertical burrows (*Pelecypodichnus*?) and bivalves, including *Inoceramus* and *Mytilus*?; gradational base. Fossil collection FZ.51 (locality Z.51).		1.50	234.18
113	Sandstone - fine-grained, grading down to coarse-grained at base; light grey, arkosic, with scattered large dark-rimmed worm burrows at top. Massive-appearing but planar-laminated and friable, particularly in basal 1.2 m which is rusty-weathering.		10.70	232.68
-----Roof of Comox Y coal bed -----				
112	COAL - sheared and contorted.	) Channel sample:	0.15	221.98
111	COAL - bright banded, sheared.	) CK 87-40	0.03	221.83
110	Sandstone - medium-grained, black, coaly.	) [taken across beds	0.02	221.80
109	COAL - bright banded, sheared.	) 109 through 112]	0.10	221.78
-----Floor of Comox Y coal bed -----				
108	Mudstone - black, carbonaceous, rusty-weathering, sandy, fissile, with abundant thin bright coal laminae; gradational base.		0.03	221.68
107	Mudstone - brown, carbonaceous, rusty-weathering, sandy, fissile, with occasional thin bright coal laminae; gradational base.		0.07	221.65
106	Siltstone - dark grey, rusty-weathering, platy, with scattered plant debris; gradational base.		0.13	221.58
105	Sandstone - medium-grained, medium grey, rusty-weathering, bioturbated, with scattered plant fragments; gradational base.		0.20	221.45
104	Sandstone - medium-grained, light grey, cleaner than above, very thick-bedded to massive, with small coarsely-ribbed bivalves near base.		14.20	221.25
103	Sandstone - medium to coarse-grained, medium grey, herringbone cross-bedded, with heavy mineral bands; worm trail casts at base.		1.40	207.05
102	Mudstone - dark grey, very silty, thinly-laminated, platy, with sandy ripples and abundant finely-broken plant debris; occasional large thin-shelled pelecypods; gradational base. Geochemical sample 83/S.563.		1.20	205.65
101	Mudstone - as above, but dark grey to brownish-grey, thin-bedded and weak.		0.29	204.45
-----Roof of Comox Z coal bed ----				

100	COAL - bright banded.	) Channel sample	0.08	204.16
99	Sandstone - medium-grained, light grey, rooty, with coal spars; pinches and swells from 0.10 to 0.15 m.	) CK 87-41, of coal only) [taken across beds	0.13	204.08
98	COAL - bright banded.	) 96, 98 and 100]	0.03	203.95
97	Mudstone - brown.	)	0.01	203.92
96	COAL - bright banded.	)	0.04	203.91
-----Floor of Comox Z coal bed -----				
95	Sandstone - medium-grained, dark grey, bright orange-weathering, carbonaceous, rooty; undulating at top with coalified logs and bark chips; gradational base.		0.20	203.87
94	Sandstone - medium-grained, light grey, cleaner than above; thin to medium-bedded near top, becoming massive below. Some burrowed zones; gradational base.		16.80	203.67
93	Sandstone - fine to medium-grained, light grey, slight greenish tinge, with occasional heavy mineral laminae and a few disarticulated, coarsely-ribbed plicate pelecypod valves; gradational base.		1.80	186.87
92	Sandstone - coarse-grained, light grey, rusty-weathering, arkosic, with sulphate bloom. Undulating base marked by large ripples and *Teredolites*-burrowed coalified stumps; possible vertebrate tracks at base.		1.20	185.07
-----Roof of Comox No.1 Rider coal bed -----				
91	COAL - dull, dirty, with numerous sand-filled *Teredolites* burrows at top; many lenses of black, canneloid mudstone. Thickens from 0.10 to 0.13 m southwards along river bank.		0.08	183.87
-----Floor of Comox No.1 Rider coal bed -----				
90	Mudstone - brown to dark brownish-grey, delicately colour-banded, planar-laminated; in places papery-weathering; with scattered lenses of brown, orange-weathering calcareous sandstone. Distinctive low density and blocky cleat; occasional broad angiosperm leaves and phosphatic fish-scales; erosional base; probable oil shale.		5.60	183.79
89	Siltstone/Sandstone Laminite - composed of dark grey siltstone and medium grey, fine-grained sandstone; locally intensely bioturbated. Cut-and-fill scours within this unit are 0.4 m deep and 1.5 m broad, striking 120, with linguoid ripples showing paleoflow to ESE.		1.00	178.19
-----Roof of Comox No.1 coal bed -----				
88	COAL - bright banded, blocky, parting readily at thickness varies from 0.14 to 0.21m.	) channel sample) CK 87-42/1	0.17	177.19
87	COAL - dull and bright.	) channel sample) CK 87-42/2	0.14	177.02
-----Floor of Comox No.1 coal bed -----				
86	Mudstone - black, carbonaceous, with abundant thin bright coal bands; gradational base.		0.60	176.88
85	Siltstone - dark grey, carbonaceous at top, becoming sandy at base; thin-bedded; gradational base.		0.75	176.28
84	Sandstone - fine-grained, dark grey, silty, carbonaceous, thin-bedded; intensely-bioturbated: bedding mostly obliterated.		0.45	175.53
----- Roof of Comox No.1 Lower coal bed (horizon only) -----				
83	Mudstone - black, carbonaceous, rusty-weathering, silty; with locally-abundant plant debris and 10% thin bands of fine-grained rusty sandstone.		3.70	175.08
----- Floor of Comox No.1 Lower coal bed (horizon only) -----				
82	Sandstone - fine-grained, black, carbonaceous; gradational base.		0.30	171.38
81	Sandstone - fine grained at top, grading down to medium-grained below; light grey, clean, with *Thalassinoides*? burrows at top; gradational base. Hand-specimen 87/Z.65 at 168.08 m.		8.00	171.08
80	Sandstone - fine-grained at top, grading down to medium-grained below; light grey, clean, very thick-bedded, flaggy, with thick planar laminae containing heavy mineral streaks; some large-scale low-angle cross-lamination.		3.55	163.08

79	Sandstone - medium to coarse-grained, rusty-weathering, rippled at base; erosional base.		0.15	159.53

Comox Formation: Cumberland Member (157.88 m - complete):

78	Mudstone - black, canneloid, lustrous, with thin bright coal bands.		0.08	159.38
-----Roof of Comox No.2 coal bed -----				
77	COAL - bright, hard, clean.	) channel samples) CK 87-35 and) CK 87-36	0.32	159.30
-----Floor of Comox No.2 coal bed -----				
76	Mudstone - black, carbonaceous, with scattered thin bright coal bands.		0.09	158.98
75	Mudstone - light brown, soft, with finely broken plant debris; possible seatearth.		0.18	158.89
74	Siltstone - medium grey, becoming sandy at base.		0.37	158.71
73	Sandstone - fine-grained, light grey, clean, with some silty streaks and large worm burrows; medium hummocky beds.		6.70	158.34
72	Mudstone - dark grey, silty, with sandy streaks; thoroughly bioturbated.		0.61	151.64
71	Sandstone - fine to medium-grained, light grey, with dark silty lenses; thick-bedded, trough cross-laminated; large dark-rimmed worm and pelecypod burrows.		4.60	151.03
70	Sandstone - coarse-grained, white, rusty-weathering at base; arkosic, clean, medium-bedded, blocky; contains *Teredolites* burrows at base; erosional base cuts down 0.6 m into underlying beds, across a width of 3.7 m.		7.60	146.43
-----Roof of Comox No.2A coal bed -----				
69	COAL - dull and bright, sheared at base.	) channel sample) CK 87-43/1	0.15	138.83
68	Mudstone - brownish-grey, weak, rooty; possible seatearth.		0.12	138.68
67	COAL - dull and bright, with pyrite lenses.	) channel sample) CK 87-43/2	0.18	138.56
66	COAL - bright, contorted.	) channel sample) CK 87-43/3	0.23	138.38
65	Mudstone - black, coaly, intensely sheared, soft.		0.06	138.15
64	COAL - dull.	) channel sample) CK 87-43/4	0.17	138.09
63	Mudstone - black, coaly, sheared.		0.09	137.92
62	COAL - dull banded.	) channel sample) CK 87-43/5	0.17	137.83
61	Mudstone - dark brown, carbonaceous, hard.		0.08	137.66
60	COAL - inaccessible under water.		0.09	137.58
59	Mudstone - brownish-grey, sandy, with plant debris.		0.06	137.49
58	COAL - bright.	) channel sample) CK 87-43/6	0.15	137.43
-----Floor of Comox No.2A coal bed -----				
57	Sandstone - fine to medium-grained, light grey, coaly and rooty at top, with abundant plant debris.		4.60	137.28
56	(Concealed) - stony till. Comox No.3 coal bed may subcrop beneath till.		(19.20)	132.68
55	Sandstone - medium to coarse-grained, light grey, arkosic, medium to thick-bedded, large-scale low-angle cross-laminated; large swales at top; large worm burrows throughout.		12.00	113.48
54	Sandstone/Siltstone/Mudstone Laminite (70:30:0 at top, fining down to 10:60:30 at base) - very thin fining-upward beds; mudstones are black and carbonaceous.		4.60	101.48
53	(Concealed) - gravel.		(6.90)	96.88
52	Sandstone - fine-grained, dark grey, muddy, carbonaceous, platy, burrowed.		0.60	89.98

51	Sandstone - medium to coarse-grained, medium grey, arkosic, thick-bedded, with abundant coaly plant trash along bedding near top; intensely burrowed at top.	7.50	89.38
50	(Concealed) - gravel, with occasional small exposures of sandstone as above.	(9.10)	81.88
49	Sandstone - very fine-grained, medium grey, silty, hematitic-weathering, with locally-abundant muddy laminae; medium irregular beds with small burrows and scattered plant debris; cleaner at top; gradational base.	3.70	72.78
48	Siltstone - dark grey, hematitic-weathering, rubbly, with abundant plant debris including small coalified logs and twigs; gradational base.	1.76	69.08
47	Mudstone - dark grey, with abundant fine plant debris; some listric surfaces; minor shearing.	1.04	67.32
-----Roof of Comox No.3A coal bed -----			
46	COAL and Shale -interbedded bright coal and black mudstone; sheared; recessive.	0.21	66.28
45	COAL - bright banded, hard, clean.) channel samples) V.566 and CK 87-37/1	0.27	66.07
44	Mudstone - dark brown to black, carbonaceous, rusty-weathering; scattered coalified logs at top.	0.17	65.80
43	COAL - bright banded, hard, clean.) channel sample) CK 87-37/2	0.44	65.63
42	Mudstone - black, coaly, jarositic, with large coalified root masses near base, and coalified logs toward top.	0.66	65.19
41	COAL - bright banded, blocky, hard.) channel sample) CK 87-37/3	0.24	64.53
40	Mudstone - dark brown to black, coaly, hard.	0.05	64.29
39	COAL - dull, stony, hard.	0.05	64.24
38	Mudstone - dark brown to black, coaly, hard, with scattered thin bright coal bands; abundant coalified logs in basal 0.06 m.	0.33	64.19
37	COAL - bright banded, platy.) channel sample) CK 87-37/4	0.40	63.86
-----Floor of Comox No.3A coal bed -----			
36	Mudstone - black, carbonaceous, rooty; gradational base.	0.15	63.46
35	Mudstone - brown, rooty.	0.15	63.31
34	Sandstone - very fine-grained, dark grey, silty, rooty.	0.30	63.16
33	Sandstone - fine-grained, light grey, arkosic, thin-bedded, platy, with scattered large worm burrows; rooty at top.	1.50	62.86
32	Sandstone - coarse-grained, medium grey, arkosic, thin to medium-bedded, with scattered burrows. This unit is folded and sheared, and is poorly exposed.	9.30	61.36
-----*Fault, possible* -----			
31	Sandstone - medium-grained, medium grey, arkosic, thin to medium-bedded at top, becoming thick-bedded and blocky at base.	12.70	52.06
30	Sandstone - coarse-grained, light to medium grey, rusty at base, arkosic; a single very thick bed; erosional base.	1.50	39.36
-----Roof of Comox No.4 Rider coal bed -----			
29	COAL - dull and bright, blocky; slightly weathered.) channel sample) CK 87-47	0.21	37.86
-----Floor of Comox No.4 Rider coal bed -----			
28	Mudstone - dark brown, carbonaceous, hard.	0.14	37.65
27	Sandstone - very fine-grained, light brown, silty, soft and rooty at top; gradational base.	0.15	37.51
26	Sandstone - fine-grained, light grey, clean, arkosic, with occasional silty streaks; medium-bedded, large-scale festoon cross-bedded.	1.20	37.36
25	Mudstone - dark grey, carbonaceous, with a few thin bright coal bands.	0.30	36.16
24	Siltstone - dark grey, sandy, very thin-bedded.	0.80	35.86
23	Mudstone - dark grey, slight hematitic tinge, faint colour banding near base (silty streaks?), otherwise massive.	0.60	35.06

22	Sandstone - fine-grained, medium grey, arkosic, muddy, with 30% thin bands of dark grey silty mudstone; occasional rootlets; intensely bioturbated toward base.		1.10	34.46
21	Siltstone - dark grey, sandy, with abundant coalified logs and fine plant trash; gradational base.		2.10	33.36
20	Mudstone - dark grey, hematitic-weathering, rubbly, weak, with a few coalified stumps and large roots.		0.43	31.26
-----Roof of Comox No.4 coal bed -----				
19	COAL - bright banded; abundant calcite on cleats.	) channel sample	0.15	30.83
18	COAL - dull and bright, blocky, hard.	) CK 87-48 [across	0.20	30.68
17	COAL - dull banded, weathered.	) beds 17 through 19]	0.11	30.48
-----Floor of Comox No.4 coal bed -----				
16	Mudstone - black, coaly, hard.		0.24	30.37
15	Mudstone - dark grey, carbonaceous, hard.		0.33	30.13
14	COAL - dull, stony, pinches out to east. Thickness varies from nil to 0.12 m.		0.06	29.80
13	Mudstone - dark grey, carbonaceous, hard, fissile, with large concretions at base.		0.64	29.74
12	Sandstone - fine-grained, medium grey, with abundant muddy laminae; gradational base.		1.20	29.10
11	Sandstone - medium-grained, buff-weathering, arkosic, cleaner than above, with scattered large dark-rimmed worm burrows; gradational base.		2.40	27.90
10	Sandstone - medium-grained, as above, with abundant dark shaly streaks.		0.90	25.50
9	Siltstone - dark grey, sandy, intensely bioturbated, with a few coalified logs. Gradational base.		0.60	24.60
8	Sandstone - fine-grained, medium grey, intensely bioturbated, silty; gradational base.		0.60	24.00
7	Sandstone - medium to coarse-grained, orange-weathering, arkosic, medium-bedded, with minor silty streaks; gradational base.		1.80	23.40
6	Sandstone - medium to coarse-grained, as above but cleaner, thick-bedded; gradational base.		6.00	21.60
5	Sandstone - medium-grained, arkosic, very thin-bedded, low-angle cross-laminated, flaggy.		9.00	15.60
4	Mudstone - dark grey, silty, fissile, planar-laminated.		3.30	6.60
3	Mudstone - black, carbonaceous, with thick bright coal bands and occasional thin partings of sandstone.		0.60	3.30
2	Sandstone - medium-grained, orange-weathering, arkosic.		1.20	2.70
1	(Concealed) - gravel.		(1.50)	1.50
	Karmutsen Formation (incomplete):			
	Basalt - dark green, amygdaloidal.			