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BRAEBURN COAL AREA

(Also known as Nordenskiold Coal Area, Division Mountain Coal Area)

LOCATION AND ACCESS

N.T.S. 105 E/5 and 115 H/8; 61°21'N, 135°57'W. Located about 90 km northwest of Whitehorse and about 20 km southwest of Braeburn Lake. Road access is from Braeburn Lodge on the Klondike Highway; a tote trail follows the old Whitehorse-Dawson wagon road south for 20 km and then turns west for 7 km to Division Mountain.

HISTORY

Coal was first discovered on Division Mountain by John Quinn and H.E. Porter, who staked coal leases 8176 and 8177 in July 1903. Cairnes examined the area in some detail in 1908, and prepared a geological map at a scale of 2 miles to the inch. Part of this area was re-mapped by Lees in 1929-30 at 4 miles to the inch as part of Laberge map-area, and part by Tempelman-Kluit in 1970-72 at the same scale as part of Aishihik Lake map-area.

In April 1970 Arjay Kirker Resources, apparently acting on behalf of Teslin Exploration Ltd., acquired three coal exploration licences covering the Mount Vowles - Division Mountain area (C.E.L. No. 10 - 115 H/8, SE¼; No. 11 - 115 H/8, NE¼; No. 12 - 105 E/5, SW¼). In 1970-72 they carried out an exploration program consisting of geological mapping, bulldozer trenching, a trial induced polarization survey, and 1,047 m of diamond drilling in six holes. In December 1973 the company staked two coal mining leases (C.M.L. 2960 and 2962) covering the thickest coal seam outcrops on Division Mountain and one lease (2961) covering an exposure on Red Ridge, and relinquished the remainder of their licence area. These three leases were transferred to Braeburn Coal Ltd. in 1976.

In September 1970 Norman H. Ursel & Associates acquired one coal exploration licence covering the Cub Mountain area (C.E.L. No. 13 - 105 E/5, NW¼) and carried out geological mapping, but apparently failed to locate any more coal seams. This area was re-examined by Resoursex Ltd. in 1975 (C.E.L. No. 35), apparently also without result.

The writer visited these occurrences in August 1977 for Cyprus Anvil Mining Corp. and again in August 1978 for Utah Mines, and collected several coal samples for analysis.

Manalta Coal Ltd. acquired two coal exploration licences in 1978 (C.E.L. No. 99 - 115 H/8, NE¼ and No. 100 - 115 H/8, SE¼), but apparently failed to locate any additional coal seams.

DESCRIPTION

Coal seams occur on Red Ridge and Division Mountain. They are reported to occur within the uppermost beds of the Laberge Group, and are believed to be of Middle Jurassic age. However it seems more likely that the coal would be within the Tantalus Formation of Upper Jurassic to Lower Cretaceous age.

The Red Ridge exposure occurs in a gulley at about 685 m (2,250 ft) elevation on the steep, eastern flank of the ridge. The coal dips west, and lies between 200 and 240 m below the base of the overlying Tantalus Formation. This coal should reappear in the projected west limb of a syncline on the more gentle west slope of the ridge, but trenching carried out here in 1972 failed to locate any. A well-exposed section

along strike on the northeast face of Mount Vowles apparently contains no coal.

Several coal seams are exposed along a creek on the north slope of Division Mountain. Cairnes described one 2.1 m seam, one 1.2 m seam and several thinner seams. The work carried out by Teslin Exploration revealed eight seams with an aggregate thickness of 19 m over a stratigraphic interval of 65.5 m; these seams were reported to lie about 450 m below the base of the Tantalus, and may belong to a different coal horizon from that described by Cairnes. Seam thicknesses were reported as 0.9 m, 2.4 m, 0.6 m, 3.0 m, 4.4 m, 4.0 m, 3.2 m and 1.3 m, with the three thickest seams separated by only 1.1 m and 0.7 m of sandstone. The coal seams strike about 320° and dip from 65° west to vertical, thin rapidly with depth and laterally along strike, are cut by minor faults, and are cut and locally metamorphosed by andesite sills and dykes. They have been traced over a strike length of about 6 km.

COAL QUALITY

Cairnes gave two proximate analyses as follows:

	2.1 m Seam	0.5 m Seam
Moisture (%)	12.02	8.98
Ash (%)	11.14	13.10
Volatiles (%)	34.28	29.62
Fixed Carbon (%)	42.56	48.30

The samples analyzed by Teslin Exploration had an average raw calorific value of about 21,860 J/g (about 9,400 BTU/lb).

Oxidized outcrop samples collected by the writer from the three thickest seams yielded the following results:

Sample Number	DM1	DM2	DM3
Moisture (%)	9.83	7.97	7.20
Ash (%)	19.73	19.54	29.90
Volatiles (%)	28.48	29.96	27.53
Fixed Carbon (%)	41.96	42.53	35.37
Sulphur (%)	0.28	--	0.27
Calorific Value (BTU/lb)	8,100	8,500	7,390
(J/g)	18,840	19,770	17,190
Free Swelling Index	0	0	0
Vitrinite Reflectance ($\bar{R}_o$ max%)	0.59	0.59	0.64
Total "reactives" (%)	39	23	10

The vitrinite reflectances indicate that the ASTM rank of this coal is on the borderline between High Volatile B and C bituminous. The low proportions of "total reactives" (vitrinite + exinite) indicate that this coal has no potential for use as metallurgical coal or for conversion to liquid or gaseous fuels. It can therefore be characterized as a high-ash, low-sulphur thermal coal.

RESERVES

Teslin Exploration calculated drill-indicated reserves of about 2.5 Mt in the three thickest seams on Division Mountain. Additional

reserves may remain to be found in the area.

POTENTIAL FOR DEVELOPMENT

This occurrence is readily accessible and relatively close to potential markets. However, the scale of any mining development will be severely limited by the apparent small size of the deposit, by the lenticular shape and steep dips of the coal seams, and the high ash content. The potential for a small-scale operation supplying local markets with coal for domestic, commercial and industrial heating is considered quite good. This occurrence could also provide coal for a small-scale thermal power plant located close by.

Advantages

(1) Coal seams of mineable thickness present;
(2) Relatively accessible - only about 25 km from major highway;
(3) Relatively close to potential markets - about 90 km from Whitehorse and about 22 km from existing power grid;
(4) Drill-indicated reserves of 2.5 Mt open-pit coal present.

Disadvantages

(1) Coal relatively high in ash;
(2) Coal seams apparently lenticular and discontinuous;
(3) Coal seams steeply-dipping to vertical - high stripping ratio;
(4) Limited size of deposit and limited potential for expanding reserves.

RECOMMENDATIONS FOR FURTHER WORK

(1) Further geological work to determine whether the coal occurs within the Tantalus Formation or in the underlying Laberge Group.
(2) Further drilling and trenching required to prove up existing drill-indicated reserves and to extend reserve area;
(3) Further analytical work required, particularly washability testing;
(4) Preliminary engineering studies required in order to determine the technical feasibility of mining the coal, open pit design etc.;
(5) Preliminary economic feasibility study required in order to obtain a first estimate of coal cost.

REFERENCES

Cairnes (1909;1910b); Bostock and Lees (1938); Bell (1956); Campbell (1967); Hlavay (1970); Kirker (1970); Speelman (1970b); Archer and Cathro (1972); Craig and Laporte (1972); Phillips (1973b); Milner and Craig (1973); Tempelman-Kluit (1974a); Allen (1975a); Craig and Milner (1975); Russell (1978); Hill (1978e).

CARMACKS NORTH COAL AREA (TANTALUS BUTTE MINE)

LOCATION AND ACCESS

N.T.S. 115 I/1; 62°05'N, 136° 15'W. Located at Tantalus Butte, approximately 6 km northeast of Carmacks near the junction of the Klondike and Campbell Highways.

HISTORY

Originally staked in October 1905 as coal lease No. 16536 by C.E. Miller, with an additional lease (No. 19203) staked in August 1906 by Miss E. Eisenbeiser. The geology of the area was first mapped by Cairnes between 1906 and 1908 at a scale of 2 miles to the inch. The area was re-mapped by Bostock in 1931-34 at 4 miles to the inch as part of Carmacks map-area. Bostock's map was re-interpreted by Tempelman-Kluit in 1974 following extensive fieldwork in adjacent map-areas.

The Tantalus Butte Mine was opened in 1922 by Five Fingers Coal Company. The mine is reported to have produced from 300 to 900 tons per year from 1923 to 1938, most of which was used for domestic heating in Dawson. In 1947 Yukon Coal Company was incorporated as a wholly-owned subsidiary of Territorial Supply Company (itself a subsidiary of United Keno Hill Mines Ltd.), acquired all the assets of Five Fingers Coal Company, and reopened the Tantalus Butte Mine in order to supply coal to silver mines at Elsa and Calumet. In 1964 Yukon Coal staked one coal mining lease (No. 2941, renumbered No. 2959 in 1969) north of their crown-granted lots. In December 1965 Anvil Mining Corporation Ltd. staked four coal mining leases (Nos. 2950, 2952, 2955, 2956) surrounding the Yukon Coal property. In 1967 the boilers at Elsa were converted to oil firing, and on January 1, 1968 the coal mine was closed. From 1948 to 1967 inclusive the mine produced about 129,000 t of coal, most of which was used at Elsa and Calumet. Some shipments were also made to the Cassiar Asbestos mine during the 1950's, and small shipments were made to Dawson and Whitehorse for domestic heating purposes.

Late in 1968 negotiations began between Anvil Mining Corporation and United Keno Hill for the supply of coal to the Faro operation, and the Tantalus Butte Mine was reopened in 1969. The assets of Yukon Coal Company were transferred to Anvil on January 11, 1972.

In September 1970 Teslin Exploration Ltd. acquired three coal exploration licences in the area (No. 15 - 115 I/1, NE¼; No. 16 - east half of 115 I/1, NW¼; No. 17 - 115 I/1, SE¼). In September 1973 they drilled two holes approximately 5 km north of the Tantalus Butte Mine, but encountered only thin coaly partings. In December of that year they staked two coal mining leases (Nos. 2963 and 2966) north of the Anvil property and relinquished their licences.

During 1971-73 Anvil carried out a surface and underground exploration program, including an electromagnetic survey, surface and underground geological mapping, trenching, a cross-cut and 294 m of underground diamond drilling in 6 holes. This work resulted in the discovery of a greatly thickened coal seam at outcrop about 2 km north of the underground portal, and in 1975 a small open pit was started in this area. About 20,000 t were mined from this pit each year by a contractor during the summer. In 1976 Cyprus Anvil acquired an option on the Teslin leases, and during 1976-77 carried out extensive exploration of the entire property including geological mapping, trenching, 15 short "airtrac" rotary holes, 1,789 m of diamond drilling in nine holes, a

lease survey, aerial photography and photogrammetry, trial induced polarization, gravity, resistivity and electromagnetic surveys, 3,477 m of rotary drilling in 42 holes, and sample analysis. Early in 1978 a fire started by spontaneous combustion in an old part of the underground mine, and the workings were abandoned and sealed off. All subsequent production was from the open pit. From 1969 to 1981 inclusive total mine production was approximately 370,000 t of coal, nearly all of which was used for plant heating and concentrate drying at the Anvil Mine.

DESCRIPTION

Coal seams occur at several horizons within the Tantalus Formation of Upper Jurassic to Lower Cretaceous age. The Tantalus consists predominantly of quartz- and chert-pebble conglomerate with minor sandstone, siltstone, mudstone and coal horizons, and is at least 300 m in thickness in this area. Cairnes described three seams 2.6 m, 3.0 m and 2.1 m thick on the south face of Tantalus Butte, referred to by mine personnel as hangingwall seam, main seam and footwall seam respectively. A fourth seam was discovered in 1976 at the top of the Butte. Other seams were found by trenching and drilling to the east of the open pit, but it is not known for certain if these are new seams or are folded and/or faulted repetitions of the previously known seams.

So far only the "Main Seam" has proved to be of mineable thickness and quality and to demonstrate lateral persistence, and this seam has been mined extensively underground and in the open pit. In the underground workings the main seam varies from 2.1 to 4.3 m in thickness, dips 45 to 60° to the west, and is locally displaced by minor faults. In the open pit area the rocks are strongly deformed, having been affected by tight folds and associated faulting, and the coal is greatly thickened in fold cores and attenuated on fold limbs.

COAL QUALITY

Cairnes (1910b) provided the following analyses from outcrop samples of the three seams on Tantalus Butte (as received basis);

	Hangingwall Seam	Main Seam	Footwall Seam
Moisture (%)	13.64	16.32	12.87
Ash (%)	2.69	9.83	5.90
Volatiles (%)	31.83	31.72	31.72
Fixed Carbon (%)	51.84	42.13	49.51

Bostock (1936) provided the following analysis from the Main Seam in the underground workings:

	As Received	Dry Basis
Moisture (%)	6.1	--
Ash (%)	8.9	9.5
Volatiles (%)	31.2	33.2
Fixed Carbon (%)	53.8	57.3
Calorific Value (BTU/lb)	11,800	12,500
(J/g)	27,800	29,080
Sulphur (%)	0.4	0.4

During the 1976 exploration program coal was sampled from selected drill-hole intersections and from the open pit. Five foot core samples were combined as seam "composites" in order to give a representative analysis of individual seams. In addition the composites were float--sunk to yield 8% ash in the floats in order to simulate washing the coal. Some of the results were as follows:

New Seam (composite No. T-6):

Moisture 10.37%; Ash 35.74%; Volatiles 26.94%; Fixed Carbon 26.95%; Sulphur 0.48%; Calorific value 12,444 J/g (5,350 BTU/lb); Yield at 8% ash - nil.

Hangingwall Seam

Composite No.	T-1	A-1	A-2
Moisture (%)	4.87	1.81	1.95
Ash (%)	11.90	12.86	30.43
Volatiles (%)	33.02	32.57	28.87
Fixed Carbon (%)	50.21	52.76	38.75
Sulphur (%)	0.66	--	--
Calorific Value (BTU/lb)	11,250	12,350	9,500
(J/g)	26,168	28,726	22,097
Free Swelling Index	0	--	--
Yield at 8% ash (%)	93	--	--

Main Seam

Composite No.	T-2	T-4	T-11	*C-1
Moisture (%)	1.50	1.68	1.28	2.31
Ash (%)	14.69	16.70	16.77	8.65
Volatiles (%)	28.35	29.23	31.59	30.21
Fixed Carbon (%)	55.46	52.39	50.26	58.83
Sulphur (%)	0.52	0.45	0.62	0.50
Calorific Value (BTU/lb)	12,220	11,380	11,380	12.570
(J/g)	28,424	26,470	26,470	29,238
Free Swelling Index	1	½	1	½
Yield at 8% ash (%)	83	74	65	100

* Sample from open pit.

These results suggest an ASTM rank of Subbituminous C for the new seam, although indications were that the coal was oxidized, hence unoxidized coal could be rather higher in rank. Results from the hangingwall and main seams indicate a coal rank between High Volatile A and C Bituminous, with most samples being High Volatile B Bituminous. These two seams contain fairly good quality thermal coal with low sulphur and moderate ash content, which can be burned as mined for many applications (i.e. preparation plant facilities should not be required).

RESERVES

In 1976 Cyprus Anvil calculated reserves of about 57,300 t in the open pit area, most of which has since been mined. In addition there were measured reserves of about 27,000 t of developed coal in the underground workings and indicated recoverable reserves of about

254,000 t between the main entry and river level which were lost when the workings caught fire and were abandoned. Because of structural complexity and lack of data on the number and continuity of seams no reserve figures are available for the remainder of the property. Substantial quantities of coal remain in the ground at Carmacks North, but further exploration work would be required to outline reserves for mining by either underground or surface methods.

POTENTIAL FOR DEVELOPMENT

Cyprus Anvil have indicated that further mining at Tantalus Butte would be uneconomic for the foreseeable future, and that they intend to obtain their supply of coal for the Faro operation from the Ross River deposit (q.v.) from now on.

Because of structural complexity, variations in the number, thickness, lateral extent and quality of the coal seams, and the apparent limited size of the deposit, any future development would likely be limited to a small-scale operation supplying local markets for domestic, commercial and industrial use. This occurrence could also supply coal for a small-scale power station located close by.

Advantages

(1) Readily accessible and close to established infrastructure (village of Carmacks, Klondike and Campbell Highways, power grid);
(2) Relatively close to potential markets (180 km to both Whitehorse and Faro);
(3) Relatively good thermal coal - low sulphur and moderate ash - can be burned as mined for many applications;

Disadvantages

(1) Cheapest and most accessible coal already mined out;
(2) Additional exploration work required to define additional reserves;
(3) Limited size of deposit area - limited reserve potential.

RECOMMENDATIONS FOR FURTHER WORK

(1) Further trenching, drilling and quality testing would be required to define additional reserves;
(2) Preliminary engineering studies would be required to determine the technical feasibility of mining and to determine mining methods;
(3) Preliminary economic studies required to determine a first estimate of coal cost.

REFERENCES

Cairnes (1906, 1908a, 1908b, 1910b); Cairnes et. al. (1913); Bostock (1936, 1938, 1939, 1941); Bell (1956); Skinner (1961, 1962); Green and Godwin (1963, 1964); Green (1965, 1966); Campbell (1967); Findlay (1967, 1968, 1969); Hacquebard (1970); Craig and Laporte (1972); Milner and Craig (1973), Tempelman-Kluit (1974b); Craig and Milner (1975); Sinclair and Gilbert (1975); Sinclair et. al. (1975, 1976); Hill (1977, 1978a); Morin et. al. (1977); Marchand et. al. (1979, 1980); Debicki (1982).

CARMACKS SOUTH COAL AREA (TANTALUS MINE)

LOCATION AND ACCESS

N.T.S. 115 I/1; 62°05'N, 136°15'W. Located immediately southwest of the village of Carmacks, adjacent to the Klondike Highway. Remains of the old Tantalus Mine can be seen along the south bank of the Yukon River just to the east of the highway bridge.

HISTORY

Originally staked in June 1903 by C.E. Miller as coal lease No. 7623. The geology of the area was first mapped by Cairnes between 1906 and 1908 at a scale of 2 miles to the inch. The area was re-mapped by Bostock in 1931-43 at 4 miles to the inch as part of Carmacks map-area. Bostock's map was re-interpreted by Tempelman-Kluit in 1974 following extensive fieldwork in adjacent areas.

Five Fingers Coal Company began underground development at the Tantalus Mine in 1904, and production was reported as about 2,700 t in 1905, 4,700 t in 1906 and 9,000 t in 1907. Much of this early production was used by the river steamers, but because of difficulty in distributing the coal to fuelling points up and down the river they soon reverted to wood fuel. The mine continued to produce a few thousand tons per year for domestic heating in Dawson until 1918, after which production dropped to a few hundred tons per year. The underground workings had reached a fault beyond which the coal could not be located, and in 1922 the mine was closed in favour of development of the Tantalus Butte Mine 5 km to the north.

Yukon Coal Company acquired the property along with the other assets of Five Fingers Coal Company in 1947. The coal is reported to burning underground in the old mine workings, apparently ignited by a forest fire in the 1950's. In December 1965 Anvil Mining Corporation staked four coal mining leases (Nos. 2949, 2951, 2953 and 2954) around the Yukon Coal property, and in 1966-67 they carried out an exploration program consisting of geological mapping, trenching and shallow "air-trac" rotary drilling in an area to the southeast of the old Tantalus mine. Anvil later acquired the Yukon Coal property.

In 1970 Norman Ursel and Associates briefly examined the area and sampled the coal in one of Anvil's trenches. In September 1970 Teslin Exploration acquired three coal exploration licences in the area (No. 15 - 115 I/1, NE¼: No. 16 - east half of 115 I/1, NW¼; and No. 17 - 115 I/1, SE¼). In 1971 they drilled one diamond drill-hole about 4 km southeast of the old Tantalus mine and encountered coal with coking characteristics. In 1972 they prepared a geological map based upon aerial photograph interpretation, and in 1973 they drilled a second hole parallel to the first in order to obtain further samples for analysis. In November 1973 Teslin Exploration staked four coal mining leases (Nos. 2965 and 2967-69) south and east of the Anvil property.

In March 1976 Cyprus Anvil staked a further six coal mining leases (Nos. 2969-74) south and east of the Teslin leases, and in June of that year they acquired an option on the Teslin leases. In 1976-77 Cyprus Anvil carried out an exploration program consisting of geological mapping, trenching, 1,280 m of diamond drilling in seven holes, sample analysis, induced polarization, gravity, resistivity and electromagnetic surveys. This was followed up in 1979-80 with 3,365 m rotary-percussion drilling in 32 holes, trenching and sample analysis.

DESCRIPTION

Coal seams occur at several horizons within the Tantalus Formation of Upper Jurassic to Lower Cretaceous age. The Tantalus consists predominantly of quartz- and chert-pebble conglomerate with minor sandstone, siltstone, mudstone and coal horizons, and is at least 730 m thick in this area.

In the Tantalus Mine workings Cairnes described three closely-spaced seams dipping 24 to 40° to the east, with average thicknesses as follows: Upper seam - 0.9 m; Sandstone - 2.1 m; Middle Seam - 2.0 m; Sandstone - 1.2 m; Lower Seam - 2.3 m.

The coal exposed in trenches and diamond drill-holes to the southeast of the old Tantalus Mine averages about 6 m in thickness and has an average dip of about 70° to the northeast. It does not consist of a single seam, but is made up of a number of seams, each one being lenticular and impersistent with rapid lateral variations in thickness. The coal seams intersected in most of the rotary drill-holes are apparently rather thin and of poor quality. None of the seams exposed in trenches and drill-holes belong to the same horizon as that formerly mined at the Tantalus or Tantalus Butte Mines.

COAL QUALITY

In 1908 Cairnes provided the following analyses from samples from within the underground workings:

	Bottom Seam	Middle Seam	Top Seam
Moisture (%)	0.75	0.76	0.82
Ash (%)	20.43	15.9	8.03
Volatiles (%)	23.61	24.74	25.12
Fixed Carbon (%)	55.21	58.60	66.03

In 1972 Hacquebard use petrographic analysis to show that the lower and middle seams were together equivalent to the Main Seam at Tantalus Butte (Carmacks North coal area). The coal consists of 7 to 44% vitrinite and apparently lacks coking characteristics. However the Tantalus seam is higher in rank than the Main Seam at Tantalus Butte - Medium Volatile Bituminous as opposed to High Volatile B Bituminous - and this difference is attributed to the presence of about 300 m of strata belonging to the Carmacks Volcanics overlying the coal measures on Carmacks South but absent on Carmacks North.

Coal samples from Teslin Exploration's 1971 diamond drill-hole gave the following results:

Sample Number	1	2	3	4
Moisture (%)	0.48	0.51	0.29	0.54
Ash (%)	37.06	35.24	1.51	11.64
Volatiles (%)	19.37	20.60	28.71	26.49
Fixed Carbon (%)	43.09	43.65	69.78	61.67
Free Swelling Index	5½	9	6½	9
Vitrinite Reflectance ($\overline{R}_o$max%)	0.96	1.10	1.06	0.98

These samples were found on petrographic analysis to consist of about 98% vitrinite (ash-free basis), hence there was some doubt that the samples were fully representative of the coal seams. Additional samples were obtained from a second hole drilled in 1973, and the floats at S.G. 1.5 gave the following results:

Sample Number	1	2
Moisture (%)	0.79	0.63
Ash (%)	15.66	13.53
Volatiles (%)	28.40	29.50
Fixed Carbon (%)	55.15	56.28
Sulphur (%)	0.67	0.58
Vitrinite (%)(ash-free)	87	92
Vitrinite Reflectance ($\bar{R}_o$max%)	0.96	0.97

These results indicate a rank of High Volatile A to Medium Volatile Bituminous. It was concluded that this coal would not form a good coke on its own, but when washed could be blended with other western Canadian coals to produce a metallurgical quality coke.

During the 1976 exploration program coal was sampled from selected drill-hole intersections; five-foot core samples were combined as "seam composites" in order to give a representative analysis of the full coal seam intersection. In addition the composites were float-sunk to yield 8% ash in the floats in order to simulate washing the coal. Some of the results were as follows (air-dried basis):

Composite Number	A-3	T-5	T-7	T-8	T-9	T-10
Moisture (%)	0.49	0.81	0.93	0.54	0.46	0.58
Ash (%)	27.02	23.06	21.91	29.00	40.35	51.13
Volatiles (%)	21.26	21.46	21.84	22.12	18.04	16.55
Fixed Carbon (%)	51.23	54.67	55.32	48.34	41.15	31.74
Sulphur (%)	--	0.63	0.53	0.69	0.74	0.65
Calorific Value (BTU/lb)	10,710	11,040	11,420	10,270	8,310	6,290
(J/g)	24,910	25,680	26,560	23,890	19,330	14,630
Free Swelling Index	6½	½	6	6½	4	½
Yield at 8% ash (%)	--	55	52	39	30	14

It was determined by petrographic analysis that the vitrinite content of selected samples was between 42 and 66%, and that the lower FSI values observed in some composites was due to the oxidation of the vitrinite. Thus this coal horizon can be characterized as a high-ash coking coal.

During the 1979-80 exploration program rotary cuttings were sampled from selected coal seam intersections. Most such intersections proved to be very high in ash (28 to 65%, dry basis, although these values are not directly comparable with values obtained from diamond drill core). The coal was found to range in rank from Low Volatile Bituminous to Meta-anthracite. The high rank of the anthracite and meta-anthracite coal seams was attributed to thermal alteration associated with felsic volcanics and/or sills locally present within the sequence.

Thus the coal quality data obtained to date indicate that the coal present on Carmacks South varies widely in composition, rank and

quality. Vitrinite content ranges from 7 to 92%, and hence both coking and non-coking coals are present. Rank varies from High Volatile B Bituminous to meta-anthracite, and ash content ranges from 1.5 to 65%.

RESERVES

In 1976 Cyprus Anvil estimated inferred recoverable reserves of about 780,000 t in one small area where thick coal seams were exposed in trenches. No reserve calculations have been made for the remainder of the property.

POTENTIAL FOR DEVELOPMENT

Substantial quantities of both coking and non-coking coal are present within Carmacks South coal area, however the high ash contents of much of the coal, and consequent low yields on washing, indicate that large-scale mining to produce coking coal is unlikely to be economic within the foreseeable future. Large-scale mining to produce thermal coal could become economic in the future if users are equipped to burn high-ash coal (e.g. a small-scale power plant with fluidized bed combustion equipment). There is probably some potential for a small-scale mining operation supplying coal locally for domestic and commercial purposes. The high vitrinite content of much of the coal indicates this area could be suitable for in-situ gasification.

Advantages

(1) Readily accessible and close to established infrastructure (village of Carmacks, Klondike and Campbell Highways, power grid);
(2) Relatively close to potential markets (180 km to both Whitehorse and Faro);
(3) Coking coal present - could be blended with other coals from western Canada to produce metallurgical grade coke;

Disadvantages

(1) High to very high ash content of much of the coal;
(2) Further exploration work required to define reserves suitable for mining;
(3) Limited size of deposit area - limited reserve potential.

RECOMMENDATIONS FOR FURTHER WORK

(1) Further trenching, drilling and quality testing would be required to define reserves for mining either by open pit or underground;
(2) Preliminary engineering studies would be required to determine the technical feasibility of mining and to determine mining methods;
(3) Preliminary economic studies required to determine a first estimate of coal cost.

REFERENCES

Cairnes (1906, 1908a, 1908b, 1910b); Cairnes et. al. (1913); Bostock (1936); Bell (1956); Campbell (1967); Speelman (1970b); Hacquebard (1972); Nandi and Montgomery (1972, 1974); Milner and Craig (1973); Craig and Laporte (1972); Tempelman-Kluit (1974b); Craig and Milner (1975); Sinclair and Gilbert (1975); Russell (1977); Hill (1977, 1978a); Morin et. al. (1977, 1980); Marchand et. al. (1979); Adamson (1980).

KOTANEELEE COAL AREA

LOCATION AND ACCESS

N.T.S. 95 B/13; 60°50'N, 123°50'W. A large area underlain by the Mattson Formation in southwest Yukon and southeast Northwest Territories. The known coal seams are located in the Jackfish River - Sawmill Mountain area, about 40 km southwest of the settlement of Nahanni Butte, N.W.T. Access is presently only by boat on the Liard River or by helicopter; new Liard Highway scheduled for completion in 1983 will pass within 30 km of main coal occurrence.

HISTORY

Coal was first reported in 1945 by Hage, who correctly identified the Carboniferous age of part of the sequence but incorrectly assumed that coal occurrences on Mattson and Flett Creeks belonged to Cretaceous strata in the area. Patton reported a 1.2 m coal seam on Jackfish River, and Hacquebard and Barss established the Mississippian age of the coal.

During the summer of 1977 Utah Mines undertook a preliminary reconnaissance of a large area between Liard and South Nahanni Rivers, and located several coal seams 1 to 1.5 m in thickness. In 1978 the company obtained four Coal Exploration Licences (Nos. 105 - 108) covering map-area 95 B/13, and that year they carried out geological mapping at 1:50 000 scale and sampled several coal seam outcrops.

DESCRIPTION

At least two thick coal seams occur in the Lower Member of the Mattson Formation of Mississippian age. On Coal Mountain the lower seam is about 1.4 m thick and lies about 230 m above the base of the Formation, and the upper seam is about 1.2 m thick and lies about 15 m above the lower seam. Average dip of the strata on Coal Mountain is about 15° to the west. Coal seams are also expected to be present on the dip slope of Sawmill Mountain. A 1.5 m seam also outcrops on Mattson Ridge, where the strata have an average dip of 30° to the southeast.

Thin (0.3 - 0.6 m) coal seams are also present in the Upper Member of the Mattson Formation, about 600 to 900 m stratigraphically above the lower seams. This horizon has been reported in the Tika Creek area, about 50 km to the west of Sawmill Mountain.

COAL QUALITY

The few analyses which are available have all been performed on oxidized coal from outcrops. The average of seven samples collected by Utah Mines is as follows (air-dried basis): Moisture 7.23%, Ash 8.35%, Volatiles 34.24%, Fixed Carbon 50.18%, Sulphur 1.91%, Calorific Value 26,309 J/g (11,311 BTU/lb). Calorific value recalculated on a moist, mineral-matter free (mmmf) basis is 29,540 J/g (12,700 BTU/lb), which indicates an ASTM rank of High Volatile C bituminous. Free-swelling index varied from 0 to 1½; since analyses were performed on oxidized material this coal is potentially of coking quality. The sulphur content, at about 2%, is much higher than most Mesozoic and Tertiary coals in western Canada (usually less than 0.5%), but this could be overcome by blending with low-sulphur coal.

RESERVES

Utah Mines estimated hypothetical reserves of about 156 Mt in place in two small areas, based entirely upon outcrop data, as follows:

(1) Coal Mountain area - two seams, 1.4 m and 1.2 m thick, dipping at 12° - open pit reserves of 62 Mt and underground reserves of 65 Mt.
(2) Mattson Ridge - one seam, 1.4 m thick, dipping at 30° - underground reserves of 29 Mt.

Further reserves probably exist in the vicinity of the other coal seam outcrops reported from the Mattson Formation in surrounding areas.

POTENTIAL FOR DEVELOPMENT

Even though substantial quantities of coal are probably present, this area is relatively inaccessible, is remote from potential markets, and very little exploration work has ever been done. Exploring and developing this coal area would likely be very costly, hence the potential for either small-scale or large-scale development in the near future is not considered very great.

Advantages

(1) Large reserve potential - hypothetical reserves of 165 Mt in place in two small areas, with potential for additional reserves in surrounding areas;
(2) Seams of mineable thickness present - 1.2 to 1.4 m;
(3) Possibility of metallurgical grade coal;
(4) New Liard Highway will improve access;

Disadvantages

(1) Close to Nahanni National Park and important trophy hunting areas;
(2) Remote from markets - high transportation costs;
(3) Relatively high sulphur content;
(4) High costs for exploration and development work.

RECOMMENDATIONS FOR FURTHER WORK

(1) A considerable amount of drilling would be required to provide definitive information on the number, thickness and lateral extent of coal seams to enable a more accurate determination of reserves;
(2) Fresh unoxidized samples are required for improved quality data; petrographic data would determine the potential for metallurgical coal;
(3) Preliminary engineering studies would be required in order to determine the technical feasibility of mining the coal and to determine mining methods;
(4) Preliminary economic feasibility studies would be required in order to obtain a first estimate of coal cost.

REFERENCES

Hage (1945), Hacquebard and Barss (1957), Patton (1958), Douglas and Norris (1959; 1976), Harker (1963), Hill (1978d).

LONE PINE MOUNTAIN COAL OCCURRENCE

LOCATION AND ACCESS

N.T.S. 115 H/16; 61°56'N, 136°10'W. Located on the west side of Lone Pine Mountain, adjacent to the Klondike Highway, about 22 km south of Carmacks.

HISTORY

Originally staked as coal lease 4096 in January 1902 by H.E. Porter. The geology of the area was first mapped by Cairnes in 1906-08 at a scale of 2 miles to the inch. The area was re-mapped at 1:250,000 by Tempelman-Kluit in 1971-73 as part of Aishihik Lake Map-area.

The occurrence was re-staked in September 1958 by D. Jennings and A. Roy, who drove a 4.6 m adit the following year. Norman H. Ursel and Associates examined the area in 1970, and Milner and Craig examined the locality in 1973. Resoursex Ltd. acquired Coal Exploration Licence No. 36 (115 H/16, NE¼) in 1975 and did surface mapping that year. The writer examined the locality in 1977 for Cyprus Anvil and again the following year for Utah Mines.

DESCRIPTION

The coal outcropping beside the Highway is apparently within the Tantalus Formation of Upper Jurassic to Lower Cretaceous age. There are very few exposures within the area. Cairnes observed that seam thicknesses could not be measured because of the cover of superficial deposits. At the site of the old portal one seam about 2.1 m thick is faulted against chert-pebble conglomerate and is intruded by an irregular mass of feldspar porphyry. Coaly shale is also exposed in the power-line cut below and to the north of the portal. No trenching or drilling has ever been done in the area, hence there is no information on the number, thickness or lateral extent of coal seams.

COAL QUALITY

A sample collected by the writer in 1977 was found on petrographic analysis to be thermally altered, i.e. it was a natural "coke" - it contained small spherical vesicles and a very fine-grained anisotropic mosaic structure which suggest that the original coal was of rather low rank.

RESERVES

No reserve calculations have ever been made for this area.

POTENTIAL FOR DEVELOPMENT

No serious exploration work has ever been done in this area, largely because of the apparent lack of any significant reserve potential and the metamorphosed character of the coal at the only known outcrop. Thus the potential for development would appear to be severely limited.

Advantages

(1) Readily accessible and close to established infrastructure (Klondike Highway, village of Carmacks, power grid),
(2) Relatively close to potential markets (about 160 km from Whitehorse).

Disadvantages

(1) Apparent small size of deposit - lack of reserve potential;
(2) Metamorphosed character of coal - probably poor quality;

RECOMMENDATIONS FOR FURTHER WORK

In view of the lack of outcrop and the paucity of data on the area a small diamond drill program in order to obtain information on the number, thickness and lateral extent of coal seams and the extent of the thermal metamorphism is probably justified.

REFERENCES

Cairnes (1910b); Speelman (1970b); Craig and Laporte (1972); Milner and Craig (1973); Tempelman-Kluit (1974a); Allen (1975); Russell (1978); Hill (1978e).

PORTER'S COAL

LOCATION

N.T.S. 115 H/16; approx. 61°53'N, 136°07'W. Located on coal creek on the south side of Porter Mountain, about 400 m east of the Klondike Highway and about 29 km south of Carmacks.

HISTORY

Staked as coal lease 1447 in October 1900 by H.E. Porter, and reportedly surrounded by at least twenty others shortly afterward. The geology of the area was first mapped by Cairnes in 1906-08 at a scale of 2 miles to the inch. The area was re-mapped at 1:250,000 by Tempelman-Kluit in 1971-73 as part of Aishihik Lake Map-area. P.F. Guder staked the May mineral claims over the occurrence in April 1970, apparently unaware that mineral claims do not convey coal rights. Norman H. Ursel and Associates did some trenching in 1970 and revealed several thin coal seams. This occurrence was included within the area explored by Resoursex Ltd. in 1975 under coal exploration licence No. 36 (115 H/16, NE¼). The writer examined the area in 1977 for Cyprus Anvil and again in 1978 for Utah Mines.

DESCRIPTION

Cairnes reported finding coal seams up to 40 cm thick within the Tantalus Formation of Upper Jurassic to Lower Cretaceous age. These beds were described as folded and distorted by the intrusion of a syenite porphyry body. Norman H. Ursel and Associates reported finding a few seams less than 5 feet in thickness in apparently different horizons.

The Tantalus Formation outcrop containing the coal seams appears to be a small roof pendent of sediments within the feldspar porphyry. The outcrop presently exposed reveals about 15 m of interbedded sandstones, shales and coal seams, with beds of each up to 15 cm thick. The beds are a little contorted, but average dip is about 37° to the north. The contact with the syenite porphyry is not exposed, but a line dividing porphyry and chert-pebble conglomerate fragments can be readily observed in the soil.

COAL QUALITY

Cairnes gave the following analysis: Moisture 4.68%, Ash 7.47%, Volatiles 15.59%, Fixed Carbon 72.26%, which indicated a rank of anthracite.

Two small outcrop samples, one of very bright, hard coal from float and the other of rather dull, weathered coal from outcrop, were collected by the writer in 1977. Petrographic analysis showed that they had very different compositions; vitrinite + exinite (ash-free basis) was 84% for the bright coal but only 21% for the dull coal. However both had very high vitrinite reflectance values, 3.10 and 2.79% respectively, which confirms the rank as anthracite. The coal has therefore been baked by the syenite intrusion.

RESERVES

No reserve calculations have ever been calculated for this area. It is extremely unlikely that significant reserves are present.

POTENTIAL FOR DEVELOPMENT

This occurrence is evidently very restricted in area and the coal has been altered and deformed by the intrusion of the syenite porphyry. It is therefore considered that there is no potential for development of this coal.

RECOMMENDATIONS FOR FURTHER WORK

No further work is recommended in this area.

REFERENCES

Cairnes (1910b); Speelman (1970b); Craig and Laporte (1972); Milner and Craig (1973); Tempelman-Kluit (1974a); Allen (1975); Russell (1978); Hill (1978e).

GUDER'S COAL

LOCATION AND ACCESS

N.T.S. 115 H/16; approx. 61°55'N, 136°07'W. Located on the east side of the Klondike Highway about 1 km south of Porter's Coal and about 30 km south of Carmacks.

HISTORY

The geology of the area was first mapped by Cairnes in 1906-08 at a scale of 2 miles to the inch. The area was re-mapped at 1:250,000 by Tempelman-Kluit in 1971-73 as part of Aishihik Lake Map-area. This occurrence is believed to have been discovered by P.F. Guder in 1970, who dug a small hand trench in a coal seam beside the road. Later that year Norman H. Ursel and Associates did some bulldozer trenching. This area was also examined in 1975 by Resoursex Ltd. under coal exploration licence No. 36 (115 H/16, NE¼). The writer examined the locality in 1977 for Cyprus Anvil and again in 1978 for Utah Mines.

DESCRIPTION

The rocks exposed by trenching consist of contorted and faulted interbedded sandstone and thin coal seams which are close to vertical and strike approximately north-south. They could be in either the Laberge Group (Lower to Middle Jurassic) or in the Tantalus Formation (Upper Jurassic to Lower Cretaceous). The remains of a small adit were found close by - the origin of this is uncertain.

COAL QUALITY

A sample collected by the writer for petrographic analysis contained only 3% vitrinite - the principal component was found to be semifusinite (90%). Reflectance of vitrinite was 2.71%, which indicates an ASTM rank of anthracite, hence the coal has apparently been altered by nearby intrusions.

RESERVES

No reserve calculations have been performed for this area.

POTENTIAL FOR DEVELOPMENT

No serious exploration work has ever been done in this area, largely because of the apparent lack of any significant reserve potential and the metamorphosed character of the coal at the only known outcrop. The potential for development would appear to be severely limited.

Advantages

(1) Readily accessible and close to established infrastructure (Klondike Highway, village of Carmacks, power grid),
(2) Relatively close to potential markets (about 160 km from Whitehorse).

Disadvantages

(1) Apparent small size of deposit - lack of reserve potential;
(2) Metamorphosed character of coal - probably poor quality;

RECOMMENDATIONS FOR FURTHER WORK

In view of the lack of outcrop and the paucity of data on the area

a small diamond drill program in order to obtain information on the number, thickness and lateral extent of coal seams and the extent of the thermal metamorphism is probably justified.

REFERENCES

Speelman (1970b); Craig and Laporte (1972); Milner and Craig (1973); Tempelman-Kluit (1974a); Allen (1975); Russell (1978); Hill (1978e).

WHITEHORSE COAL AREA

LOCATION AND ACCESS

N.T.S. 105 D/6,11; 60°30'N, 135°15'W. Located to the south and west of Mount Granger, approx. 30 km south southwest of Whitehorse. A tote trail to the property was completed in the fall of 1982.

HISTORY

Discovered in 1899. Development work completed prior to 1906 included an 18 m tunnel and several open cuts. The geology of the area was first mapped at 4 miles to the inch by Cockfield and Bell in 1922 to 1924. The area was re-mapped at the same scale by Wheeler and others between 1946 and 1955. It is reported that the U.S. Army Corps of Engineers examined the area in 1942 and brought out a small tonnage for use in Whitehorse that winter.

Luscar Ltd. acquired three coal exploration licences in the area in April 1969 (No. 3 - 105 D/6, NW¼; No. 4 - 105 D/6, NE¼; No. 5 - 105 D/6, SW¼), and during that summer carried out geological mapping, hand trenching and sample analysis. In March 1971 Norman H. Ursel and Associates acquired one coal exploration licence in an adjacent area (no. 20 - 105 D/6, SE¼) and briefly examined the area that summer. In November 1974 and January 1975 Albert E. Savage acquired two coal exploration licences in the area (No. 33 - 105 D/6, SE¼ and No. 34 - 105 D/6, NE¼) and examined the area in the summer of 1975.

In early 1981 Echo Developers acquired one coal exploration licence (No. 301 - 105 D/6, NE¼). Later that year they assigned the licence to Whitehorse Coal Corporation, which staked two coal mining leases (Nos. 2989 and 2990) in February 1982. During the summer and fall of 1982 Whitehorse Coal Corp. constructed a tote trail to the property and did a small amount of trenching.

DESCRIPTION

Coal seams occur within the Tantalus Formation of Upper Jurassic to Lower Cretaceous age. The Tantalus consists predominantly of quartz- and chert-pebble conglomerate with minor sandstone, siltstone, mudstone and coal horizons, and is at least 550 m thick in this area. A total thickness of about 1,500 m is exposed near Double Mountain, but this is likely due to repetition by folding and/or faulting. The Tantalus beds can be traced for about 20 km southeastwards from the southern end of Fish Lake, and appear to occupy a fault-bounded block on the northeasterly-dipping west limb of the Fish Lake Syncline. Dips are generally steep to very steep - 45 to 80°- and the coal seams show the effects of strong deformation. The sequence is locally cut by igneous intrusions.

Cairnes described three seams of anthracite 3.0 m, 3.2 m and 0.8 m in thickness. Luscar Ltd. uncovered several seams by trenching, but it is not known precisely how these relate to the seams described by Cairnes.

COAL QUALITY

Cairnes provided the following four analyses:

A - average of 3.0 m seam at the end of the 18 m tunnel;
B - average outcrop sample of 0.8 m seam;
C - average outcrop sample of 3.2 m seam;
D - sample of an outcrop found in creek below camp.

Sample	A	B	C	D
Moisture (%)	2.15	3.76	3.78	2.35
Ash (%)	21.98	25.40	47.78	48.13
Volatiles (%)	6.01	8.34	10.06	6.65
Fixed Carbon (%)	69.86	62.50	38.38	42.27

The average of values obtained on nine outcrop samples collected by Luscar Ltd. was as follows (as received basis): Moisture 10.13%, Ash 48.11%, Volatiles 10.11%, Fixed Carbon 31.65%, Calorific Value 12,083 J/g (5,195 BTU/lb). The ash values of these samples ranged from 32% to 61%, which indicates that many of them were coaly shale rather than coal.

In 1982 Whitehorse Coal Corp. sent three samples of coal from outcrop for analysis and petrographic analysis. The results were as follows:

Sample	1	2	3
Moisture (%)	4.0	3.9	2.6
Ash (%)	34.1	37.4	43.2
Calorific Value (BTU/lb)	9,650	8,396	7,452
(J/g)	22,439	19,526	17,330
Vitrinite Reflectance ($\bar{R}_o$max%)	4.5	3.9	2.6

The vitrinite reflectances indicate an ASTM rank of meta-anthracite. Samples 2 and 3 were found to have a coke-like microstructure which suggests that the high rank is due to metamorphic alteration resulting from the presence of igneous intrusions in the sequence. Thus coal from this area can be characterized as a high-ash anthracite.

RESERVES

Luscar Ltd. estimated hypothetical recoverable reserves of about 2.4 Mt in three small areas, assuming a single seam 1.8 m thick and underground mining with 50% recovery. The potential for outlining significantly greater reserves is considered quite good.

POTENTIAL FOR DEVELOPMENT

Whitehorse Coal Corp. is currently planning a small-scale operation (perhaps 100 t/d) to supply coal locally. There are indications that there is some demand locally for stoker coal for domestic and commercial heating, and the raw coal +1" fraction could be used for such purposes. The potential for such an operation is considered good, although the company has been considerably hampered by lack of funds. Because of the apparent high ash content a preparation plant will be required to clean the remainder for sale as pulverized furnace/boiler fuel for industrial applications, and the economic viability of such an operation has yet to be determined. Larger-scale mining to produce thermal coal would probably be economic if users were equipped to burn high-ash coal (e.g. a small-scale power plant utilizing fluidized bed combustion). However, a great deal of exploration work, particularly drilling, will be required in order to provide definitive information on the number, thickness, lateral extent and quality of coal seams within the area.

Advantages

(1) Readily accessible and close to established infrastructure (Alaska Highway, City of Whitehorse, power grid);
(2) Close to potential markets - only about 50 km by road to Whitehorse;
(3) Anthracite rank thermal coal present.

Disadvantages

(1) Lack of information - only very limited exploration work has been done;
(2) High ash-content of coal - preparation plant required for most purposes;
(3) Steep dips and deformed nature of coal seams discovered to date - adverse mining situation.

RECOMMENDATIONS FOR FURTHER WORK

(1) Further exploration work (trenching, drilling, quality testing) is required in order to define reserves for mining either by open pit or underground;
(2) Preliminary engineering studies would be required to determine the technical feasibility of mining and to determine mining methods;
(3) Preliminary economic studies would be required to determine a first estimate of coal cost.

REFERENCES

McConnell (1901); Cairnes (1906, 1908b); Cockfield and Bell (1926, 1944); Wheeler (1952, 1961); Campbell (1959); Taylor (1969); Craig and Laporte (1972); Milner and Craig (1973); Hughes (1975); Savage (1975).

BUSH MOUNTAIN COAL AREA

LOCATION AND ACCESS

N.T.S. 105 D/6; 60°20'N, 135°03'W. Located on the east side of Bush Mountain, 4 km west of Annie Lake and about 45 km south of Whitehorse. A tote trail from the Annie Lake Road to the Idaho Hill silver property comes within about 1.5 km of the coal occurrence.

HISTORY

Tantalus Formation rocks were discovered by Cairnes in 1906 while making geological observations in the area. He visited the area again in 1909 while compiling a geological map of the Wheaton District. The area was re-mapped by at 4 miles to the inch by Cockfield and Bell in 1922 to 1924 and again at the same scale by Wheeler and others between 1946 and 1955.

There appears to have been very limited exploration work carried out in this area. Norman H. Ursel and Associates. obtained one coal exploration licence covering this area in March 1971 (No. 20 - 105 D/6, SE¼) and examined the area the same year. The area was re-examined in 1975 by Albert E. Savage under coal exploration licence No. 33.

DESCRIPTION

Coal seams occur within a small, downfaulted block of Tantalus Formation rocks of Upper Jurassic to Lower Cretaceous age. The Tantalus consists predominantly of quartz- and chert-pebble conglomerate with minor sandstone, siltstone, mudstone and coal horizons. Cairnes described three seams of anthracite 0.5 m, 1.8 m and 0.9 m thick, and he noted that the coal measures were considerably deformed but the strike was generally northerly and dips 60 to 80° to the east. He also described a fine-grained, dark-greenish andesite dyke about 4.6 m wide cutting vertically through the section.

COAL QUALITY

Cairnes provided a single analysis of a sample derived from the frozen outcrop of the 1.8 m seam: Moisture 4.78%, Ash 30.10%, Volatiles 8.62%, Fixed Carbon 56.50%. He noted that the high ash content was probably due to the incorporation of some sand and other materials in the sample. The anthracite rank of the coal is evidently due to heating by the igneous intrusions.

RESERVES

No reserve calculations have been made for the area. The potential for reserves in this ares is severely limited by the small size of the deposit.

POTENTIAL FOR DEVELOPMENT

The small deposit size, steep dips and presence of igneous intrusions indicate that the potential for development of this area is severely limited.

Advantages

(1) Relatively accessible - tote trail comes within 1.5 km of occurrence;
(2) Relatively close to potential markets - about 55 km by road to Whitehorse and about 35 km to Carcross.

Disadvantages

(1) High degree of deformation - steep dip of coal seams;
(2) Limited deposit size - very limited reserve potential;
(3) Lack of information - very little exploration work has been done.

RECOMMENDATIONS FOR FURTHER WORK

In view of the lack of data on the number, thickness, lateral extent and quality of coal seams within the area a limited trenching and drilling program is probably justified.

REFERENCES

Cairnes (1906, 1910a, 1912, 1916b); Bell (1956); Campbell (1967); Humeniuk (1972); Milner and Craig (1973).