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K-FERNIE COAL AREA 67(1)A SOUTH EAST 132

GEOLOGICAL SURVEY REPORT
OF FERNIE COAL MINE

FERNIE COAL FIELD, B.C., CANADA

FERNIE COAL MINE CO. LTD.

DIREKTOR GENERAL RESEARCH DEPT. NOV. 1967

MARUBENI CO. LTD. TOKYO

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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GEOLOGICAL SURVEY REPORT OF

FERNIE COAL MINE

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November, 1967

Fernie Coal Mine Co., Ltd.

Overseas Resources Research Dept.
Marubeni-Iida Co., Ltd., Tokyo

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SUMMARY

1. The coal concession of Fernie Coal Mine Co., Ltd. occupies a part of so-called "Fernie Coal Field" situated about 700 miles east of Vancouver, at the western front range of the Rocky Mountains, and it totally comprises 15,280 acres.
2. The distance between the nearest track of the Canadian Pacific Railway and the concession is some 10 miles along the existing dirt motor road.
3. There are 13 coal seams in the lower half part of the Kootenay Formation with an elevation of around 5500-6500 feet, along the flank of the Michel Ridge. The lower three coal seams, U4, U2 and M, have the thickness of 15-27 feet, 21-30 feet and 24-27 feet respectively.
4. Each coal seam indicates dipping of 10-45 degrees on the surface.
5. Total probable coal reserves of these three coal seams in the northern half of the property are estimated to be 400 million tons, of which about 65 million tons of the marketable -grade clean coal might be producible in the way of underground mining.
6. Samples collected from the tentative adit driven in the U2 seam, about 90 feet beneath the surface, indicate the following analytical results:

PREFACE

I am pleased to submit this report to you as a conclusion and recommendation on the second-stage geologic reconnaissance carried out this summer at the Fernie coal mine owned by Fernie Coal Mine Co., Ltd.

Our effort was concentrated to get a thorough grasp of the geological structure of coal seams and the nature of coal, for the purpose of examining the possibility of exporting coking coal to Japan from this concession.

		Floated S.G. 1.45	S.G. 1.60
Inherent Moisture	%	1.6	1.5
Volatile Matter	%	21.0	20.6
Fixed Carbon	%	71.0	69.8
Ash Contents	%	6.4	8.1
Calorific Value	Cal.	8,050	7,690
Fuel Ratio		3.4	3.4
Total Sulphur		0.4	0.4
Coke Button Index		7½	7

LOCATION & ACCESS

The concession is located in the northern half of Dominion Coal Block, some 12 miles east of the Fernie Township, as the crow flies, and it comprises 31 claims, totally 15,280 acres.

The distance between Vancouver and Fernie is some 644 miles along the highway and 360 miles in a bee line. The Canadian pacific railways pass through some 10 miles north of the coal field. The concession is accessible from the Michel or the Fernie township through motor road; the former is about 13 miles away from it and the latter 17 miles.

Although the gas pipe line goes from Alberta to United States through the coal field, there would be no unfavourable influence for mining operation.

GEOGRAPHY

The city of Fernie is one of the oldest coal mining and logging towns in Canada, with 3500 population.

The concession occupies the mountainous area of the western front of the Rocky Mountains, 5000-7000 feet above the sea level, a part of "The Rocky Mountain Forest" where, up to 6000 feet, is covered mostly with thick needle-leaved trees.

It is rather severely cold and has great amount of snow fall in winter time, which, however, would not become deterrent to the forthcoming mining activity and traffic.

The Michel Ridge, approximately 7000 feet above the sea level, range north and south in the northern part of the concession of which the highest peak is the Mt. Taylor with an elevation of 7391 feet.

The Leach Creek originated from the southern end of the Michel Ridge, runs through the concession and joins the Michel Creek at the north end of the concession. Another creek, the McEvoy Creek, runs through the middle of the concession to the east. All the valleys are deeply incised with glacial U-shape and occupied by perennial streams of clear water. The difference of altitude between the Michel Ridge and the Leach Creek or, and the Michel creek, is approximately 2000 feet. And the steep slope of the Michel Ridge consists of coal bearing sedimentary strata of the Kootenay formation.

GEOLOGY

I) Stratigraphy

This coal field consists of Mesozoic sedimentary strata, whose stratigraphic correlation is as follows:

<u>Geologic Age</u>	<u>Name of Strata</u>	<u>Thickness of Bed at/around the Mt. Taylor</u>
Lower Cretaceous	Blairmore Group	600- 900 feet (?)
	----- (Unconformity) -----	
Lower Cretaceous & Jurassic	Kootenay Formation (coal bearing bed)	(Mutz member 1050-1650 feet (Hillcrest 150- 360 feet (member (Adanac member 90- 150 feet ((Moose Mt. (member 450- 600 feet (?)

	Jurassic	Fernie Group

Detailed exposition of Mesozoic strata:

Fernie Group

The strata of Fernie Group form the Mesozoic Basin with the underlying Spray River Formation, and consist of alternating beds of shale, siltstone, and lesser amount of sandstone which holds the top of the Fernie Group and gradually changes to brownish quartzose sandstone as it goes to the upper part of the top zone. They are mainly marine strata.

Kootenay Formation

The Kootenay Formation is main coal bearing formation of this coal field, and can be divided into the following four members:

a) Moose Mountain Member

This is the lowest member of the Kootenay Formation, which comprises dark greyish, fine to medium-grained and hard greyish white quartzose sandstone, 450-600 feet (?) thick in this region. It is a distinguished key-bed of the formation, due to its ability to make numerous and remarkable outcrops. The occurrence of a large ammonite from the upper part of this formation indicates that the sandstone of the Moose Mt. Member is marine origin.

b) Adanac Member

The Adanac Member, 90-150 feet in thickness, consist^s of dark greyish and blackish mudstone, shale, lesser amount of siltstone and fine sandstone together with two coal seams named L-seam and M-seam.

c) Hillcrest Member

The Hillcrest Member consists of two or three beds of greyish fine to coarse grained carbonaceous sandstone with thin alternation of mudstone and siltstone and locally interbedded thin lenticular beds of conglomerate. It is about 150-360 feet thick.

d) Mutz Member

The upper member of the Kootenay Formation between the Hillcrest Member and the unconformable base of the Blairm Group, is represented by seven alternating strata of fine-coarse-grained

blackish grey sandstone bed and mudstone, shale, siltstone beds with widespread 1-3 thick coal seams, of which each bed has thickness of 150-450 feet respectively, totally 1050-1650 feet thick.

The Mutz Member is a major coal bearing strata in this coal field. And it has altogether 10 interbedded coal seams, named U₁ to U₁₀ from the base, among them 7 or 8 coal seams show more than 5 feet thick.

II) Geologic structure

The Kootenay Formation, coal-bearing strata, constitutes a synclinal basin situated in the north-east of the large Fernie basin which is separated from it by the Loop and Flathead faults running from north to south with 4500 feet throwing toward west.

The Loop and Flathead faults divide the area into two parts geologically: the north-eastern and the south-western parts.

The latter part is mostly occupied by upper strata more than the coal bearing bed, because of the McEvoy syncline at the middle of this part.

In the former part, the Kootenay formation, coal bearing bed, forms a small basin which is approximately 5.5 miles long from north to south and 3 miles wide east to west. In the basin, the axis of the Taylor syncline runs through along the Michel Ridge. The east and west wings of this synclinal structure along the Michel Ridge are mostly composed of the coal bearing Kootenay Formation.

The Michel thrust (1) runs through from north to south at the eastern slope of the Mt. Taylor, and the other one, the Michel throust (2) runs parallel with the distance of one mile to the east from the

thrust (1). Both of the two throw to the east about 1500 feet with dipping west. About one mile west of the Mt. Taylor a companion fault of the Loop fault runs through from north to south, throw 750 feet to west, and join the Flathead Fault.

A coal bearing bed on the west wing of the Taylor syncline generally strikes to the north 30 degrees to east and dips 30-60 degrees to the east, however it seems to be more gentle dipping into the deep place.

Structure of coal seams is rather complicated on the southern part of the east wing, because of a local complex geologic structure, such as small scale folding and faulting. However, it in the northern part shows rather a gentle dipping of 10-30 degrees to the west.

The Blairmore group strata overlies unconfirmably on the Kootenay Formation and consist of the Taylor Synclinal axis over the Michel Ridge.

COAL SEAM

There are at least 12 coal seams in the Kootenay Formation of the northern part of this concession.

Among the 12 coal seams, several favorable important coal seams can be ~~found~~ ^{found} into shaly beds of the middle and lower Mutz Member.

And it seems to have a tendency of becoming stable to the middle from the lower on variation of thickness and transverse, because of influence from structural movement of the underlying Fernie shale.

At the west wing of the Taylor syncline and the western flank of the Michel Ridge, the coal seam dips 30-60 degrees to the east within elevation of 5500-7000 feet above the sea. And at the eastern flank of the Michel Ridge, it shows 10-30 degrees to the west.

We can find each major coal seam has more than 5 feet in thickness which is a considerable thickness for favorable underground mining, and it can be traced to over than 1.5 miles along the strike side by bulldozer trenching.

More detailed discription on each major coal seam is as follows:

M seam

It, the lower most coal seam, exposed in the Adanac Member and 30-60 feet above the top of the Moose Mt. Member sandstone.

The thickness of this seam is 18-36 feet, including thin coaly shale band.

At the trench No. TW13 & TW5 in the west of the Mt. Taylor, coal thickness is 11-12 feet within 27 feet thick coal seam.

L seam

It is seen at intervals around 30-45 feet above the M-seam.

The thickness is 6-15 feet.

13 4.6

U2 seam

It is situated at 45-60 feet above the top of Hillcrest sandstone, usually being accompanied by two coal seams, U3 & U1 above and below with shaly band.

The thickness of this seam is 16-28 feet at the trench TW6 & TW8 in the west of Taylor Syncline, and its coal thickness is 14-22 feet. It is possible to trace 7500 feet along the west flank of the Mt. Taylor and also 5100 feet to the south from the Loop companion fault.

At the trench TE2, TE4, TE5 and TE6 which are between Michel Thrust (1) and (2) of the east wing of the Taylor Syncline, the coal seam is 14-55 feet thick, (in some parts, together with U1 & U3), and its coal thickness is 9-37 feet, (15 feet on the average).

It is positive to be traced upto the distance of 4500 feet along the east flank of Michel Ridge and more at least 6000 feet-tracing to the south will be possible, though the structure is rather complicated.

U4 seam

It is situated at 150-240 feet above the U2 seam, The thickness is 5-18 feet at the west of the Taylor Syncline and 6-28 feet at the east, and its coal thickness is 12-25 feet at the trench TW4 & TE3.

The seam has an undulation of thickness towards the strike side, however, as the clean coal are seen concentrating in the middle, it could be expected to yield effectively at the thickness of 5-6 feet.

U5 seam

It is situated at 60-150 feet above the U4 seam. The thickness is 18 feet at the trench TW7, seems to have a rather poor continuation in both strike and dip side^s as compared with U2 or U4 seam.

U6 seam

It occurs in 240-300 feet above the U4 seam and is 15-22 feet thick within 13-19 feet of coal thickness at the trench TW9, TW11 & TW3.

U7 seam

It is interbedded into thick sandstone bed at 150-180 feet above the U6 seam. This seam is fairly thin, such as 3-9 feet, and shows rather spreaded elongation to the strike side.

U8 & U9 seams

The two are 240-360 feet above the U7 seam with interbedded shale, and 6-9 feet thick each. These would be eroded out by unconformable surface between the Kootenay and the overlying Blairmore group in the southeastern area.

Regarding the coal seams of the northern and northeastern slopes of the Mt. Taylor, detailed investigation could not be carried out in this season. But it is certain from the surrounding geological structure that these coal seams extend to the northern and northeastern slopes of the Mt. Taylor, going along the mountain.

Horizontal trial heading, 95 feet deep and some 90 feet below the surface, was carried out for this seam at the trench TE6 on the east slope of the Michel Ridge.

NATURE OF COAL

Concerning the nature of coal in/around the Fernie coal field, I imagine as under.

- 1) Stratigraphically, the lower most coal seam shows lower volatile matter content of approximate 15-17%. And it increases to 27-29% at the upper most.
- 2) The highest figure of Coke Button Index was indicated on the coal of 20-23% volatile matter content.
- 3) So, considering from stratigraphic circumstance, only we expect to find a good nature of coal in the lower half of the Mutz member.
- 4) However, it is undeniable that the nature of coal is varied partially, suffering from local geologic variation such as minor faulting or folding.
- 5) Weathering of coal seems to extend to 30-200 feet deep, though the depth depends on places suffering from geographic and geologic conditions.

Detailed description on the nature of each major coal seam is as follows:

M seam

In summer of 1966, several drums of samples were collected from the tentative shallow adit, some 36 feet deep, in this seam.

The assay results of these samples are shown on the following table:

	Raw Coal	Clean Coal Prepared so as to contain around 10% ash.
Moisture total %	3.15	
Surface Moisture %	2.47	
Inherent Moisture %	0.68	1.4
Ash %	15.78	9.6
Volatile Matter %	17.38	15.7
Fixed Carbon %	66.16	73.3
Sulphur %	0.51	
B.T.U.'s	13,119.98	
Free swelling index	2.5	
Calorific Value		7680 Cal.-
Fuel Ratio (C/V.M.)		4.7
Pure Coal		89.0%
Pure Coal Calorie (Ash, Moisture-free)		8630

As pertinent and fresh coal samples for testing could not be collected during last reconnaissance due to the physical condition, nature of the original coal of this M-seam was not confirmed.

U2 seam

We carried out the Raw Coal test on samples which were collected from the adit in the U2 seam. The test result is attached at the end of this chapter.

U4 seam

Assay results of samples collected from the surface trench at the east side of the Taylor Syncline are shown on the following table.

Floated at S.G. = 1.6

Trench No.		TE3 lower	TE3 upper
Inherent Moisture	%	1.95	1.78
Ash	%	6.43 (4.6)	8.3 (7.2)
Volatile Matter	%	22.28	20.89
Fixed Carbon	%	69.34	69.03
Calorific Value		14,321	13,623
Sulphur	%	0.45	0.43
Free Swelling Index		1½	2-4½
<hr/>			
Float	%	96.42	95.13
Sink	%	3.58	4.87

RAW COAL TEST

Samples of several drums were collected from the tentative adit, some 95 feet deep. The test results of those samples are shown on the following table.

Raw Coal Test

... by MEIJI MINING CO., LTD.

Sample : Taken from U2 seam, adit No. TE-6

Contents

- 1) Raw Coal Sizing Test
- 2) Float and Sink Test (Washability Curve)
- 3) Proximate Analysis, Swelling Test (C.B.I.).

1) Raw Coal Sizing Test:

Sample : Fernie - A

1. Sizing Test : + 25 m/m - 0

Size	Wt.%
+ 25 m/m	16.5
25 - 10 m/m	23.2
10 - 5 m/m	15.2
5 - 0.5 m/m	36.9
- 0.5 m/m	8.2
Total	100.0

2. Sizing Test : + 25 m/m (16.5%). Crushed to minus 25 m/m

Size	Wt.%
25 - 10 m/m	68.6
10 - 5 m/m	23.5
5 - 0.5 m/m	5.9
- 0.5 m/m	2.0
Total	100.0

3. Composed size ratio after crushing: 25 m/m - 0

Size	Wt.%	Ash %
25 - 10 m/m	34.5)	
10 - 5 m/m	19.1)	18.3
5 - 0.5 m/m	37.9)	
- 0.5 m/m	8.5	20.5
Total	100.0	18.5

Sample : Fernie - B

1. Sizing Test : + 25 m/m - 0

Size	Wt. %
+ 25 m/m	7.0
25 - 10 m/m	25.7
10 - 5 m/m	16.2
5 - 0.5 m/m	41.4
- 0.5 m/m	9.7
Total	100.0

2. Sizing Test : + 25 m/m (7.0%), Crushed to minus 25 m/m

Size	Wt. %
25 - 10 m/m	69.9
10 - 5 m/m	21.0
5 - 0.5 m/m	7.0
- 0.5 m/m	2.1
Total	100.0

3. Composed size ratio after crushing : 25 m/m - 0

Size	Wt. %	Ash %
25 - 10 m/m	30.6)	20.5
10 - 5 m/m	17.7)	
5 - 0.5 m/m	41.9)	
- 0.5 m/m	9.8	18.9
Total	100.0	20.3

2) Float and Sink Test :

Sample: Fernie - A

Size : 25 m/m - 0.5 m/m

Wt.% : 91.5% per raw coal

Results

Sp. gr.	Wt. %	Ash %	Wt. %	Ash %	Wt. %	Ash %	M.P.
- 1.30	4.5	2.3	4.5	2.3	95.5	19.1	2.3
1.35	39.3	4.5	43.8	4.3	56.2	29.2	24.2
1.40	19.4	8.4	63.2	5.5	36.8	40.2	53.5
1.50	13.8	14.1	77.0	7.1	23.0	55.9	70.1
<u>1.60</u>	4.6	25.1	<u>81.6</u>	<u>8.1</u>	18.4	63.6	79.3
+ 1.60	18.4	63.6	100.0	18.3			90.8

Washability Curve

Specific gravity

Sample: Fernie - E

Size : 25 m/m - 0.5 m/m

Wt.% : 90.2% per Raw Coal

Results

Sp. gr.	Wt. %	Ash %	Wt. %	Ash %	Wt. %	Ash %	M.P.
- 1.30	2.7	1.4	2.7	1.4	97.3	21.0	1.4
1.35	29.9	3.8	32.6	3.6	67.4	28.6	17.7
1.40	25.8	7.7	58.4	5.4	41.6	41.6	45.5
1.50	14.2	14.3	72.6	7.2	27.4	55.7	65.5
<u>1.60</u>	4.9	24.2	<u>77.5</u>	<u>8.2</u>	22.5	62.6	75.1
1.60	22.5	62.6	100.0	20.5			88.8

Washability Curve

Specific gravity

3) Proximate Analysis

Data : Fernie - A, Fernie - B

On the both floating products of specific gravity of 1.45 and 1.60, having near 6 or 8 percent ash contents.

Minus 0.5 m/m size excluded.

Elements		Fernie-A		Fernie-B	
		F.1.45	F.1.60	F.1.45	F.1.60
Inherent Moisture	%	1.6	1.5	1.6	1.6
Volatile Matter	%	21.0	20.6	20.2	19.9
Fixed Carbon	%	71.0	69.8	71.8	70.3
Ash Contents	%	6.4	8.1	6.4	8.2
Total	%	100.0	100.0	100.0	100.0
Calorific Value	Cal.	8,050	7,890	8,010	7,840
Fuel Ratio	-	3.4	3.4	3.6	3.5
Total Sulphur		0.4	0.4	0.4	0.4

Swelling Test : Coke Button Index

Floating fraction	Fernie - A	Fernie - B
Sp.gr. F. 1.45	7½	6½
Sp.gr. F. 1.60	7	5½

COAL RESERVES

Estimated coal reserves, thinking of the economic mining condition, of only U2, U4 and M seams existing in the Taylor syncline and the north area of the section C in the map attached are as follows:

	Syncline east	west	Fault west	Total
M seam	82,167,000 t	60,505,000 t	22,438,000 t	165,110,000 t
U2 seam	89,601,000 t	39,102,000 t	13,965,000 t	142,668,000 t
U4 seam	68,581,000 t	24,579,000 t	7,448,000 t	100,608,000 t
Total	240,349,000 t	124,186,000 t	43,851,000 t	<u>408,386,000 t</u>

On the assumption that the minable limit is 15 feet thick, minable coal reserves are estimated as under:

	Syncline east	west	Fault west	Total
M seam	36,153,000 t	26,622,000 t	9,872,000 t	72,647,000 t
U2 seam	44,800,000 t	22,288,000 t	7,960,000 t	75,048,000 t
U4 seam	37,719,000 t	14,747,000 t	4,468,000 t	56,934,000 t
Total	118,672,000 t	63,657,000 t	22,300,000 t	<u>204,629,000 t</u>

And assuming that the recovery of mining and that of washing are 40% and 80% respectively, an estimated amount of marketable clean coal is as follows:

	Syncline east	west	Fault west	Total
M seam	11,569,000 t	8,519,000 t	3,159,000 t	23,247,000 t
U2 seam	14,336,000 t	7,132,000 t	2,547,000 t	24,015,000 t
U4 seam	12,070,000 t	4,719,000 t	1,430,000 t	18,219,000 t
Total	37,975,000 t	20,370,000 t	7,136,000 t	<u>65,481,000 t</u>

It will be difficult to find a suitable place where a huge amount of coking coal can be mined by open-pit, because of topographic condition and geologic structure. However, about 65 million tons of marketable clean coal might be produced only from the M, U2 and U4 seams of/around the Mt. Taylor by under ground mining.


CONCLUSION & RECOMMENDATION

As the coal field is situated in the Fernie Coal Mining Area, transportation facilities could be easily set up, and coal reserves of the lower three coal seams are estimated to be 400 million tons, of which 65 million tons of hard coking marketable coal might be produced by underground mining.

We could recognize it from the results of raw coal test that the nature of coal in this concession shows the high rating of hard coking coal, that is, 19 to 20 percent of volatile matter, 6 to 9 percent of ash content and also over 80 percent of washability.

So, it is recommended that the following field works should be carried out for engineering and feasible study on this coal concession.

- a) Sinking several deep drilling holes from the surface to confirm the structure of coal seams and the nature of coal in depth.
- b) Topographic mapping in a large reduced scale at the site.
- c) Trial heading of exploring tunnel at the befitting place to take samples and engineering designs.


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