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CLEAR HILLS IRON DEPOSITS

INFORMATION NEEDS

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Alberta
RESEARCH COUNCIL

Clear Hills Iron Deposits
Information Needs

Present Knowledge

The report "Peace River Iron Deposits" (Betram and Mellon, January 1973) effectively summarizes the present state of knowledge on the Clear Hills deposits. Known are the following:

1) grade: 32 to 35 percent Fe
2) Thickness: 5 to 30 feet
3) chemistry.

Partially known are:

4) benefication or smelting methods
5) mineralogy: basically oolitic sandstone, with iron-bearing minerals, siderite and geothite; however, variations across and in the different blocks of the deposit unknown.
6) reserves: not critical -- more than 200 million tons recoverable now proven
7) Rate of oxidation of unweathered ore with exposure.

Beneficiation Studies

These should be of primary consideration. Research is recommended on the following aspects related to ore beneficiation and smelting (see appended discussion by Bertram, August 1973).

1) grindability of the ore,
2) reducibility of the ore,
3) minimum level of reduction for efficient magnetic separation,
4) agglomeration (pelletizing) characteristics of the ore,
5) reducibility of the agglomerated ore,
6) smelting qualities and conditions,
7) quality of the steel produced from the iron.

Betram mentions the importance of using representative samples of the bulk of the ore. It should be noted that most large samples for previous beneficiation work were obtained from the weathered ore pit in block A (see Figure 1).

However the largest reserves are in the less accessible blocks B and C. Bulk sampling of these will require some overburden stripping, and perhaps building a winter access road.

Sampling Costs (100 ton buld sample)

Winter road: clearing 10 miles @ $400/mile	$ 4,000.00
Overburden removal and relevelling: 70 hours D7 @ $ 28/hour	2,000.00
Blasting: 5 hours @ $100/hour	500.00
Sealing and loading of ore samples	400.00
Hauling to railhead (Hines Creek): 60 miles @ 10¢/ton mile	600.00
Rail Freight to Edmonton: (approx. $10/ton)	1,000.00
Total	$ 8,500.00

Beneficiation Study Costs (P.R.& D. -- Alberta Research)

Monthly wages and salaries are estimated at $1,330/person professional and $700/person technical. The Product Research and Development Division approach is to apply a 2.1 factor to these wages to allow for overhead, some equipment and supply costs, and to provide basic services. Both direct wage costs and the 2.1 factor personnel costs estimates are given.

Systematic Beneficiation - Phase 1

	Direct Wage Estimates	2.1 Factor Wage Estimates
Personnel:		
professional wages 37.5 mos @ 1,330	$ 49,900	$ 104,700
technical wages 60 mos @ 700	42,000	88,200
Total Personnel	$ 91,900	$ 192,900
Equipment:		
minimum estimate	20,000	20,000
	$ 111,900	$ 212,900
possible additional equipment	35,000	35,000
Total for Beneficiation Studies	$ 146,900	$ 247,900

Reducibility, Smelting and Metal Testing - Phase II

		Direct Wage Estimates	2.1 Factor Wage Estimates
Personnel:			
professional	12 mos @ 1,330	$ 16,000	$ 33,600
technical	30 mos @ 700	21,000	44,100
Total Personnel		$ 37,000	$ 77,700
Additional Equipment and Renovations		20,000	20,000
Total for Phase II		$ 57,000	$ 97,700

Pilot Plant - Phase III

No breakdown available		$ 250,000 to	$ 500,000

Cummulative Totals:

Phase I	(low)	$ 111,900	$ 212,900
	(high)	146,900	247,900
Phase I (high) and Phase II		$ 203,900	$ 345,600
Phase I (high) and Phases II and III	(low)	$ 453,900	$ 595,600
	(high)	703,900	845,600

Mineralogy Studies

In conjunction with proposed beneficiation studies, petrological studies are required to determine the mineralogical variations across the deposit from weathered outcrops to unweathered portions within the different blocks. This would necessitate test drilling and coring to obtain samples from several (at least 10) localities, apart from the test drilling proposed subsequently for reserves evaluation.

Mineralogy Study Costs

Test drilling: 10 holes X 150 feet = 1,500 feet

Rotary:	1,200 - 1,400 feet @ $3/ft	$ 4,000
Coring:	10 holes X 25 feet @ $20/ft	5,000
		$ 9,000

Access trails required:

10 miles @ $312/mile	$ 3,000

Data evaluation:

1 qualified petrologist -- 6 months (12,000 x 2.1)	$ 24,000
1 technician -- 1 month (700 x 2.1)	1,500
	$ 25,500
Total	$ 37,500

Reserves

Reserves have been evaluated in four main blocks (see Figure 1). Those in blocks A and B are largely proven, by 120 and 115 drillholes respectively.
Reserves in blocks C and D are roughly outlined:

Block C: 684 million tons probable: based on 8 holes.

Block D: 205 million tons possible: based on 2 holes.

Approximately 100 additional holes in each block would closely define these reserves to proven.

Additional iron-bearing beds probably extend northwest from block A for up to 20 miles, as indicated by scattered oilwell data. The overburden reaches 500 feet or more, however, indicating a totally uneconomic mining proposition.

Reserve Evaluation Program

Blocks C and D.

Drilling costs: 200 holes x 150 feet = 30,000 feet

1) Rotary: 20,00 feet @ $3.00/foot	$ 60,000
2) Reverse circulation: 10,000 feet @ $6.00/foot	40,000
3) Coring in 50 holes x 20 feet @ $20.00/foot	20,000
4) Logging @ 75¢/foot	22,500
Drilling and logging	$ 162,500

Access trails will be required, in rough country.

40 miles at $312/mile	$ 12,500

Supervision: 6 months winter program

1 geologist + 1 technician ($12,200 x 2.1)	$ 25,000

Data evaluation: 6 months

1 geologist + 1 technician	$ 25,000
	$ 50,000
Total	$ 225,000

Total Costs of Peace River Iron Evaluation

Maximum estimates:

1. Sampling	$ 8,500
2. Beneficiation studies -- Phases I and II	$ 345,600
3. Mineralogical studies	$ 37,500
4. Pilot plant -- Phase III of beneficiation studies	250,000 to 500,000
5. Reserves evaluation	225,000
Total	$ 866,600 to 1,016,600

E. Bertram
August 7, 1973

SYSTEMATIC APPROACH TO BENEFICIATION OF PEACE RIVER ORE

INTRODUCTION

A considerable amount of experimental and pilot plant work has been performed on the Peace River ore. This work has taken place at various times and locations. Although the previous work is extensive, it has not been tied together and appears piecemeal. It is my proposal that a comprehensive program be set up to study all facets of the ore and the possible beneficiation techniques which can be used to upgrade the ore to a useable source of iron.

The study would involve an extensive beneficiation experimental program using freshly obtained samples which are representative of the ore body. In addition, research into the previous work would be carried out with respect to beneficiation and adopting new techniques that have been developed for beneficiation. The study would have to involve the pelletizing and/or sintering qualities of the concentrate since most iron-making procedures require the ore in this form. The actual decision on the iron-making prodedure and smelting of the ore could be left to a much later date, using tests on the agglomerate to determine the best procedure.

Beneficiation studies should be of prime consideration. The approach to beneficiation should be varied and involve systematic approaches to each technique now available. The following is a list of proposed technques which could be used as a start to studying the problems of beneficiation.

1. Flotation
    (a) iron ore float,
    (b) silica float;
2. Spiral separators (gravity differntial) or hydrocyclones;
3. Electrostatic separation;
4. Magnetic (high intensity);
5. Magnetizing roast - magnetic separation;
6. Solution type approaches
    (a) acid leach.

The basic ore should also be tested as to grindability characteristics and pellet or sinter-making qualities. Since both grinding and agglomeration qualities will be involved in each beneficiation technique they should be handled separately from the beneficiation techniques themselves.

An economic analysis of each process should be carried out at the conclusion of each process testing.

EXPERIMENTAL

The proposal would be to set up a laboratory - scale testing of each of the techniques involved, small-scale preliminary experiments to obtain the best techniques for the method chosen, then the ore would be concentrated in a large enough quantity to undergo agglomeration trials. With literature survey and equipment accumulation and setup, it could be estimated that each method tested would run into the order of 3 months work for a professional and a technician. Thus, depending upon the depth of knowledge required and the various pieces of equipment studied, the variation would problaby be 1 month either way.

The analytical procedures would probably require one full time analyst, and if 2 or more procedures were carried out in tandem, then an additional analytical techncician may be required. Since the grinding and agglomeration work would be involved in each beneficiation test, a separate technical group should be formed just for performing these tasks. Therefore, a single technician for grinding work and a single technician for agglomeration work would be required. A single professional may be required to supervise both of these operations.

Total time required to carry out the study of the ore would be as follows:

	Professional Man Months	Technical Man Months
Analyses and testing	7.5	15
Grinding	7.5	15
Agglomeration	7.5	15

Gravity type concentrators	some available Humphrey spirals $3,000 others $2,000
Flotation	laboratory cells available
Electrostatic separators	available from Energy, Mines and Resources, renovations $5,000
Magnetic separators	some equipment available (high intensity $10,000)
Magnetizing roast	ovens and heater for laboratory scale work, adaptions and construction $3,000

An equipment cost of $20,000 is the minimum visualized: a $55,000 equipment cost would facilitate a more vigorous and meaningful investigation of the ore.

If pilot plant scale experiments are to be carried out, then large equipment purchases would be required, as will as plant renovations.

Total time allotted	37.5 man months, professional
	60 man months, technical
Total equipment costs	$20,000 - $55,000

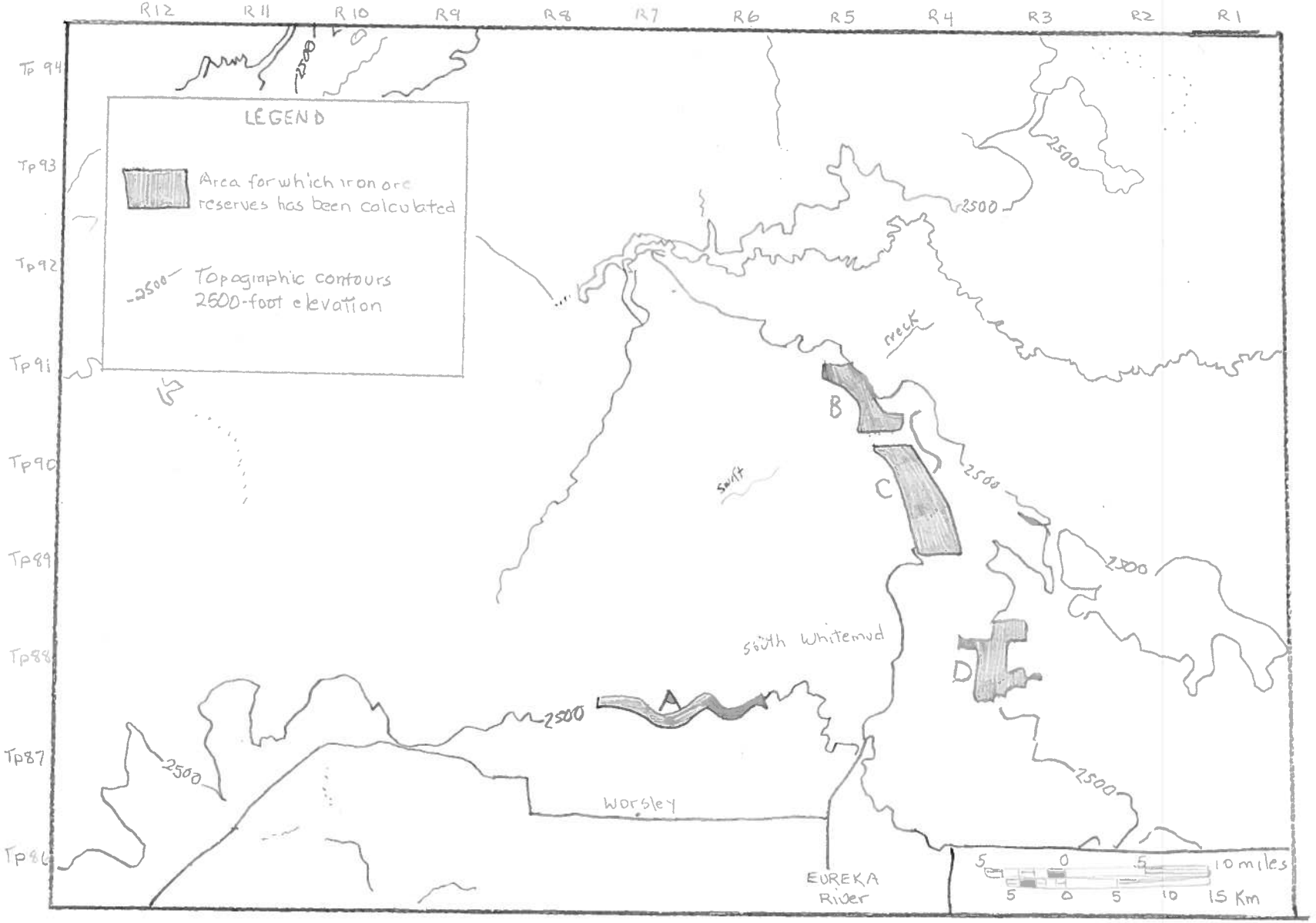
FURTHER EXPERIMENTAL WORK

Reducibility, smelting, and iron and steel qualities sould be determined after the best available beneficiation procedure has been determined. The testing of pellets for these characteristics would require additional equipment purchases: the actual experiments could not be started until after some beneficiation experiments were completed.

Time and equipment would probably run in the order of 12 months professional and 30 technical, with $20,000 for equipment, renovation, and supplies. If more than chemical tests or simple mechanical tests are required, for the iron and steel, then additional testing equipment may be required.

When a beneficiation procedure has been decided upon, the pilot plant scale costs could be determined. A rough estimate for pilot plant work would be $250,000 to $500,000, based on previously reported pilot plant development experience at the Product Research and Development Division. The pilot plant would involve work up to a pellet or sinter stage, and possible direct reduction trials. If smelting or melting trials are contemplated, then consideration should be given to the larger expenditures. The expense for a magnetizing roast pilot project would be much greater than for projects involving gravity or flotation techniques.

The time involved for a pilot plant scale project would be of the order of 1 to 1.5 years after the optimum beneficiation technique had been chosen.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LEGEND
Area for which iron ore reserves has been calculated
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