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R.657 Drill hole samples from Kara tungsten prospect.

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Forty six samples of drill hole core and sludge were submitted by Australia and New Zealand Exploration Company on behalf of Tasmix N.L.

The samples were stated to have been obtained from the Kara tungsten prospect, Hampshire, Tasmania, and to represent types of tungsten-bearing material intersected by the drill holes. They had been divided into three categories, A, B and C on the basis of the amount of scheelite present as determined by visual examination under ultra-violet light. The three categories were described as follows.

- (a) Hardly any visible scheelite. Nearly all tungsten present in secondary weathering products.
- (b) Some scheelite present, but not enough to account for all the tungsten.
- (c) Some minor weathering, but most or all of the tungsten appears to be present as scheelite.

Beneficiation and extraction tests were requested on composite samples from each of the three categories.

A list of the samples, giving drill hole number, depths and tungsten assays was provided (Appendix 1).

COMPOSITE SAMPLES

The composite samples were made up by combining all samples received into their respective categories, giving three composite samples, A, B and C. Composites A and B contained much weathered material; weathering was not so apparent in composite C. Magnetite was abundantly present in all three composites.

The samples were jaw crushed to -3 mm and assay and test samples cut out by mixing and riffing.

Assays

Sample	% WO ₃	% Bi	% Mo	% S.Fe	% Insol	% S
A	0.59	Tr	Tr	58.6	4.8	0.79
B	0.58	Tr	Tr	63.9	3.3	Tr
C	0.36	Tr	Tr	44.8	21.4	Nil

Mineralogy (by G.B. Everard)

Samples A and B consist of weathered material and the tungsten is probably present as tungstite, but the material is too fine grained for identification with the microscope.

Concentration by magnetic separation after fine grinding might permit the oxidised minerals to be identified by X-ray diffraction methods, but so far this has not been achieved.

Sample C contains scheelite and molybdenite and possibly bismuth sulphide. There is a great deal of magnetite and the rock material is only slightly weathered.

PRELIMINARY TESTS

Davis tube separation of magnetics

Small samples of pulverizer ground material were submitted to Davis tube magnetic separation tests. The ground material was approximately -150 μ m.

Results

Sample	Product	% Mass	% WO ₃	WO ₃	% Distn.
A	M/A	38.5	0.15	1.7	13.6
	N	61.5	0.60	100.0	86.4
	H	100.0	0.43		100.0
B	M/A	67.0	0.17	0.8	22.4
	N	33.0	1.20	19.9	77.6
	H	100.0	0.51	14.5	100.0
C	M/A	51.5	0.02	1.0	3.1
	N	48.5	0.64	100.0	96.9
	H	100.0	0.32		100.0

LARGER SCALE ORE DRESSING TESTS

An attempt was made to concentrate the tungsten-bearing mineral by ore dressing techniques embodying ball mill grinding, magnetic separation and froth flotation of tungsten minerals from non-magnetics.

The procedure was to ball mill 2 kg of ore to minus 250 μ m and magnetically separate the ground ore on a Dings-Crockett wet belt magnetic separator. The magnetics were cleaned once to yield M/S2 M/A.

The total non magnetics were thickened to about 30% solids and subjected to froth flotation using a reagent combination generally used in scheelite flotation. On sample A the flotation concentrate was cleaned once to yield F2C. On samples B and C, the concentrates were cleaned twice to yield F3C.

Flotation Conditions

Reagent	g/t		
	Rougher	1st Cleaner	2nd Cleaner
Soda ash	1340	-	-
Oleic acid	445	90	-
Tannic acid	9	-	-
"Calgon"	-	220	-
pH	10	10	10
MIBC	to froth	to froth	to froth

Conditioning time 10 minutes
 Flotation time 10 minutes (Rougher)
 8 minutes (1st Cleaner)
 8 minutes (2nd Cleaner)

Test Results

Sample A

Product	% Mass	% WO ₃	WO ₃ % Distn
M/S2 M/A	39.8	0.22	17.7
F1T	41.5	0.67	55.8
F2T	17.0	0.69	23.5
<u>F2C</u>	<u>1.7</u>	<u>0.86</u>	<u>3.0</u>
<u>H</u>	<u>100.0</u>	<u>0.50</u>	<u>100.0</u>

Sample B

Product	% Mass	% WO ₃	WO ₃ % Distn
M/S2 M/A	60.9	0.31	31.0
F1T	19.9	0.93	30.0
F2T	14.2	1.10	25.5
F3T	4.0	1.20	7.9
<u>F3C</u>	<u>1.0</u>	<u>3.40</u>	<u>5.6</u>
<u>H</u>	<u>100.0</u>	<u>0.61</u>	<u>100.0</u>

Sample C

Product	% Mass	% WO ₃	WO ₃ % Distn
M/S2 M/A	54.1	0.11	16.7
F1T	35.2	0.40	39.2
F2T	6.6	0.53	9.7
F3T	1.5	1.30	5.5
<u>F3C</u>	<u>2.6</u>	<u>4.00</u>	<u>28.9</u>
<u>H</u>	<u>100.0</u>	<u>0.36</u>	<u>100.0</u>

CAUSTIC SODA LEACH OF SAMPLE B NON-MAGNETICS

The mineralogy indicates that most of the tungsten in Samples A and B is present as tungstite, which should be soluble in caustic soda solution.

A test was undertaken to investigate the solubility of the tungsten in solutions of this chemical. Tests at 2%, 4% and 10% NaOH were undertaken. Sample B, non-magnetic material was chosen for the tests as this product had the highest WO₃ content of the three samples produced. The tests were conducted at room temperature at approximately 20°C. Charges of 30 g were used, the solid/solution ratio was 1:3 and the slurries were mechanically stirred over the test period of 8 hours.

Test Results

Solution	Feed (mg WO ₃)	Extract (mg WO ₃)	% Extraction
2% NaOH	321	16.7	5.2
4% NaOH	321	30.1	9.4
10% NaOH	321	32.4	10.1

COMMENTS ON TEST RESULTS

The tests outlined in this report should be regarded only as a preliminary study of the treatment problems involved.

Wet magnetic separation of ball mill ground ore is a relatively simple method of beneficiation and considerably reduces the bulk of material requiring subsequent treatment. This method of treatment is applicable to all three samples. The optimum grind mesh for the operation was not determined, but comparison of Davis tube results with the more coarsely ground (250 μm) large scale tests indicates that the latter is not fine enough.

Flotation of scheelite from non-magnetic material shows some promise in the case of Sample C. This procedure gave a 29% overall recovery in a concentrate assaying 4% WO₃ from an overall head feed containing 0.36% WO₃.

Beneficiation by flotation offers little chance of success in Samples A and B, the heavily weathered material.

In all cases, gravity concentration cannot be considered as the tungsten mineralization is evidently too fine to respond to this treatment.

Leaching of non-magnetic material with caustic soda solution at room temperatures gave indifferent results. The influence of heat and pressure has not been investigated.

CONCLUSION

The results obtained indicate that further investigational work is justified if the head grade were higher. Magnetic separation is a simple and economic means of reducing ore bulk without intolerable losses of tungsten. The optimum grind mesh for this operation has not been determined. Magnetite concentrates from this operation may have some commercial value.

A degree of concentration was obtained by flotation of tungsten bearing minerals from the non-magnetic fraction of the least weathered sample. This sample evidently contains much more scheelite than the weathered ore, and there is a possibility that finer grinding and/or different reagent combinations could result in an improvement on the results obtained.

Leaching with caustic soda solutions at room temperature and atmospheric pressure on weathered material gave low extractions. However there is a possibility that these results could be improved if heat and pressure were applied, and other hydro-metallurgical extraction processes investigated.

Mineralogical examinations indicate that the tungsten bearing minerals are too fine for gravity concentration to be considered.

APPENDIX 1. LIST OF SAMPLES.

Sample Number	Depth (m)	Assay* (ppm W)	Category
101/12	16.8 - 18.3	5830	B
13	18.3 - 19.8	3820	B
14	19.8 - 21.3	2930	B
15	21.3 - 22.9	2270	C
16	22.9 - 24.4	2850	C
103/12	16.8 - 18.3	7330	A
13	18.3 - 19.8	7220	A
14	19.8 - 21.3	4440	B
15	21.3 - 22.9	1360	B
16	22.9 - 24.4	2580	B
17	24.4 - 26.0	3750	B
18	26.0 - 27.4	1840	C
19	27.4 - 29.0	2420	C
108/18	19.5 - 20.7	9770	C
19	20.7 - 21.3	330	C
20	21.3 - 22.9	890	C
21	22.9 - 24.4	1360	C
120/ 6	4.6 - 5.5	2120	A
7	5.5 - 6.4	2000	A
8	6.4 - 7.3	1670	A
9	7.3 - 8.2	3080	A
10	8.2 - 9.1	3100	A
11	9.1 - 10.1	3190	A
12	10.1 - 11.0	4260	A
13	11.0 - 11.9	4650	A
14	11.9 - 12.8	4630	A
15	12.8 - 13.7	3200	A
16	13.7 - 14.6	3130	A
17	14.6 - 15.5	5020	A
18	15.5 - 16.5	5230	A
19	16.5 - 17.4	4000	B
20	17.4 - 18.3	4110	B
21	18.3 - 19.2	3480	B
22	19.2 - 20.1	5040	B
23	20.1 - 21.0	5400	B
24	21.0 - 21.9	4250	B
25	21.9 - 22.9	2780	B
26	22.9 - 23.8	4400	B
27	23.8 - 24.7	3130	B
28	24.7 - 25.6	3340	B
29	25.6 - 26.5	3750	B
124/12	9.1 - 10.1	6540	C
13	10.1 - 11.0	1090	C
126/29	29.3 - 30.2	1090	C
30	30.2 - 31.1	740	C
31	31.1 - 32.0	4690	C

* Results supplied by Tasminex N.L.

[1 August 1973]