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ANNUAL REPORT - EL 38/97
ABERFOYLE HILL - MHA
D McP DUNCAN

EXPLORATION LICENCE 38/97
ABERFOYLE HILL

MICROFILMED
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MINERAL RESOURCES	
EL 38/97	
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ANNUAL REPORT ON EXPLORATION
MARCH 1998 TO MARCH 1999

for
Mineral Holdings Australia Pty Ltd
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99-4310

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EL 38/97- Aberfoyle Hill- Annual Report

1.0 Introduction

EL 38/97 was granted to Mineral Holdings Australia Pty Ltd on 6th March 1998 for a maximum of 5 years to 6th March 2003 over an area of 4 sq km at Aberfoyle Hill to search for bentonitic clay. The EL is adjacent to RLs 8715 and 8723 held by the same company covering Fosters Marches for alluvial tin (Plan 1). The minimum expenditure commitment is \$10,000 over the first two years and the licence is subject to satisfactory annual reporting.

The target is bentonitic or smectite type clay suitable primarily as a pelletising agent for the Savage River iron ore mine but a wide range of other industrial uses would be considered such as in moulding agents, sealants, drilling muds, ceramics, paper, rubber, paints, water purification and chemical catalysts.

2.0 Previous Exploration

This account is partly derived from 1972 and 1980 reports by P B Nye to Mineral Holdings.

In 1969, Portland Holdings (W St C Manson) in the course of exploration for alluvial tin in the Great Northern Plains, discovered a light green clayey material at bedrock, between 14 and 15 feet in a back hoe hole (63). This was identified using XRD by the CSIRO (Dr J McAndrew) as bentonite and described as a light brown clay with a waxy lustre. Material (5lb) from this hole (sample B70/4) was sent to Savage River for physical property and balling tests and showed promise as a pelletising bonding agent although it tended to be sticky.

Subsequently, in the first phase of clay exploration (1970), W St C Manson granted an option to Minefields Exploration NL who put down four percussion holes, one adjacent to hole 63 and the others up to 200m from it in an area east of the Ringarooma River adjacent to the disused McGregor tin workings and now in the NE part of the current EL (Plan 2). The drill holes M1-4 were continued for at least 5 feet into bedrock and up to 18 feet in No1. The upper portions of the bedrock were green, grey or brown clays including fragments of dolerite in hole M1. Of fifteen samples sent to Savage River for further testing involving green ball moisture, drop numbers, and wet and dry compression strength, three (GS 5, 23 and 24) showed promise as a pelletising agent. Some samples were contaminated by quartz gravels.

In 1971, four back hoe pits were completed by W St C Manson, two (B1A and B1B) being adjacent to hole 63, one of which exposed the greenish bedrock, a third (B2) being 120m to the south and not being bottomed at 20 feet and the fourth (B3), 300m to the south (not on Plan 2, as unable to find plotted position), encountering the greenish material at 17.8 feet. Savage River carried out tests on samples probably from pits B1A and B1B and found the result on the latter to be comparable to Wyoming bentonite. Sodium modification also improved the swelling properties and dry strength.

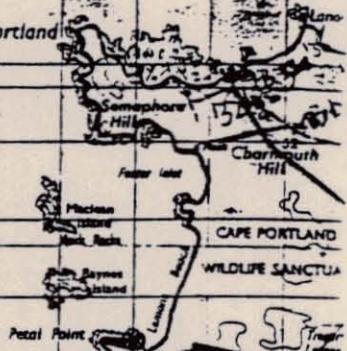
90

572004

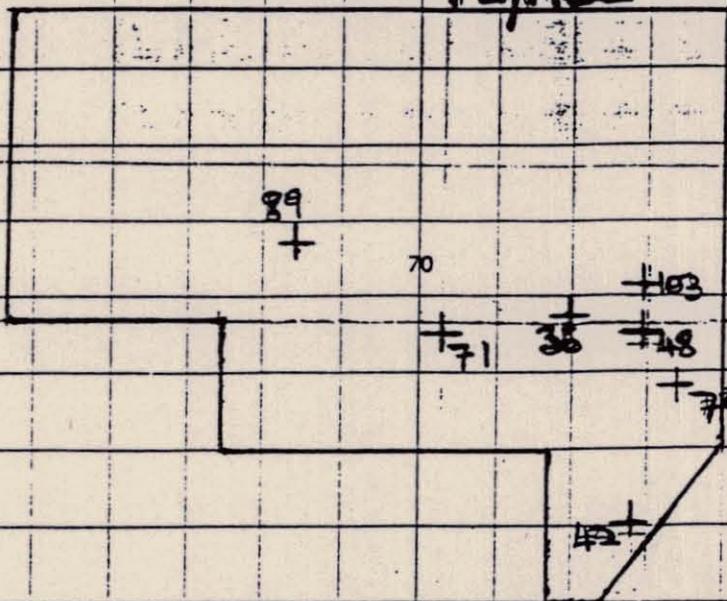
90

T2/MEL

Cape Portland



CAPE PORTLAND
WILDLIFE SANCTUARY



19/93

EL 19/93

H I N G A R O O M A B A Y

80

80

70

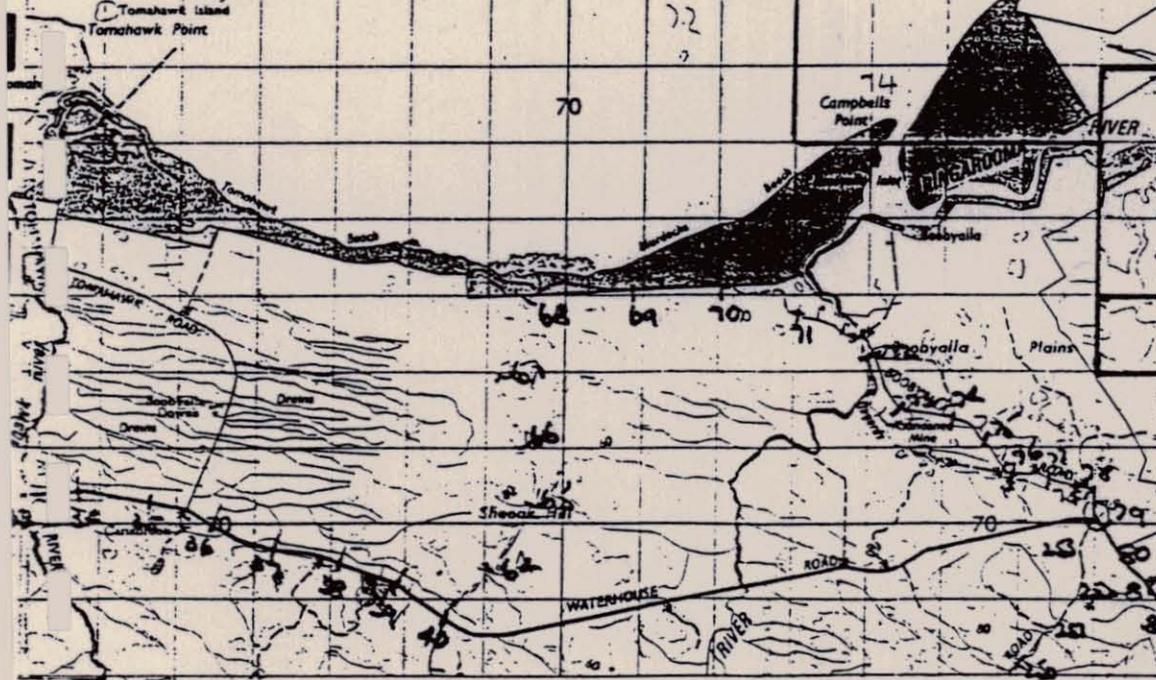
70

74

Campbell's Point

RIVER

RL 8715



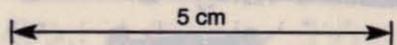
RL 8723

Aberfayre Hill

PLAN 1. MINERAL TENEMENTS

Scale 1:100,000

MHA



EL 38/97

5574 MOUNT CAMERON

572006

0116

0035

0117

CROWN LAND

.27

RINGAROOMA RIVER

HOLE 24

.28

B1A, B
Hole 63
M1

Back Hoe
HOLE 63
Portland Holdings 1969

HOLES M1-4
Minefields Exploration 197

PITS B1,2
Portland Holdings 1971

580,000E

Dry Gut Creek

24
Preussag

M4

B2

M2

M3

0032

gravel pit

mine

5,470,000 m N

0117

0022

.59

PITS 1-11
Mineral Holdings 1979
wet area

Aberfoyle Hill

Wakes Lagoon

McGregor Lagoon

5 cm

flume

Harwood's Lagoon

CROWN LAND

disused mine workings

PLAN 2

16.

1:10,000

Previous Exploration

.39

WATERHOUSE

gravel pit

gravel pit

disused mine workings

Crack

RIVER

abandoned mine

.38

Then in 1979, in the second phase of exploration, under a joint venture between Mineral Holdings and Preussag over EL 19/77, an alluvial tin hole 24, in the Dry Gut area, west of the Ringarooma River (Plan 2), returned a brown plastic clay. The hole was drilled to 30 feet, with 8 feet of sand overlying 17 feet of brown, black and blue clay over weathered to fresh dolerite. Material from this hole, submitted to the CSIRO, was studied (Hamilton and Li) by XRD, XRF, and differential thermal and thermogravimetric methods revealing that the clay was an expandable smectite of beidellite rather than montmorillonite type. Associated minerals were quartz, with traces of feldspar, cristobalite and possibly pyroxene.

This prompted the sinking of eleven test pits by Mineral Holdings (1979) in the Dry Gut area (Plan 2) which is now in the SW part of the current EL which recorded 6-12 feet of clay under 2-8 feet of sand. Each hole bottomed in clay at the limit of the back hoe's reach.

Some samples were sent to various companies for testing but the geological logs, the precise specimen descriptions and their detailed positions are not recorded. Steetley tested samples to a maximum depth of 3m and indicated an inferior grade of bentonite. Baroid Petroleum Services found that only a small percentage of the samples had bentonite and that the majority was halloysite and quartz. Engelhard's tests showed that the clay consisted of 39% bentonite and up to 33% free silica and that the material was beidellite (a Mg-rich montmorillonite). Romud Pty Ltd evaluated the clay from pits 4 and 5 and reported the bentonite content as 39%. Cudgen RZ Limited regarded bentonite sample 6 (pit 6?) as closest to Wyoming grade clay. The Tasmanian Department of Agriculture measured four samples from near surface sites and indicated two samples as mainly montmorillonite and some kaolinite and the remainder as mainly kaolin with some illite and traces of montmorillonite.

The third phase began in 1984 when CRA and Mineral Holdings, in joint venture, developed fourteen shallow auger holes in the Dry Gut area (positions unknown) and sent samples of clay to AMDEL for testing. CRA concluded that the clay was of variable character and up to 50% was bentonitic. The clay deposit was derived from the weathering of underlying dolerite giving iron and magnesium -rich bentonites and it passed up into transported sandy clays.

3.0 Current Exploration

Previous exploration has suggested that clay extends under cover over at least a square kilometre and that in places the thickness approaches at least 4m thick under overburden of up to 3m of sand. Testing by various companies has shown that the type of clay and its quality is variable but that some is bentonitic and suitable as a pelletising agent.

The regional geology of the area is shown in Figure 1 as mapped by Mineral Resources Tasmania (Boobyalla map sheet- 8416S(24)). Dolerite (Jdl) is exposed on both banks of the Ringarooma River, particularly on the west side of Aberfoyle Hill, in the old Dry Gut tin workings and is inferred to underlie the flat plain running west from these workings. To the south, Devonian-Carboniferous granite (Dbag) occupies a low range of hills. A veneer of Tertiary sediments (Ts)- sands, gravels and clays- obscures the

solid bedrock of the southern part of the licence and gives way to Quaternary sands to the north. Alluvial tin deposits have been exploited in these sediments in the Aberfoyle and McGregor workings in the east and in the Dry Gut workings in the west. Clay has been developed on the dolerite presumably mainly in the Tertiary and has been preserved from erosion probably by subsidence on normal faults defining the landward part of the Boobyalla Basin.

A fourth phase of investigation was considered necessary to determine the geology of the clay deposit, the quantity of the better grades and compositions of the bentonitic clays and to provide a range of quality samples of known location and of at least 3kg in size for testing.

A drilling program to achieve the above objectives was carried out from 8th to 11th March in the Dry Gut area in the SW of the current licence. All permissions were received from the Mineral Resources Tasmania, and through that Department, the land managing agencies and the grazing leasee, the Rushy Lagoon Station. The status of the land is Crown Land- Deferred Forest Land and is part of a Ramsar Site (for water bird protection).

The program consisted of 10 holes with an aggregate depth of 76m. The position of the holes were as close as possible to the inferred location of the pits of the back hoe campaign except that the old tin workings were avoided (Plan 3). The drilling was carried out by KMR Drilling Pty Ltd of Richmond, Tasmania. No earthworks for access or sumps were required.

The planned drilling technique was hollow augers with the capture of an undisturbed 3.5 inch diameter core contained in a wireline retrieved barrel to give good quality clay samples, uncontaminated and of sufficient size for industrial testing (+ 3kg). Troubles associated with the operation of the new wireline system caused substantial core loss in the first four holes. These were being largely overcome when further difficulties were experienced when the barrel jammed in the auger string as the holes got deeper than 5m due to insufficient tolerance particularly where the augers were dented. A second technique was then tried with the clay core being collected within the augers in a split tube but was discontinued when the metal cutters were destroyed on the bedrock of the fourth hole. From hole 5 onwards, a solid auger string was used for drilling with samples being grabbed from the spirals on withdrawal of the lead auger. This gave less satisfactory results than core sampling considering the potential for contamination of the clay but was thought to be good enough for the scout drilling program to continue. The samples were logged and stored in sealed plastic bags to allow moisture retention in the clay.

The holes were progressed to the full length of the drill string (12.5m, hole 5) or until refusal (the normal case) on the bedrock which took place between 2 to 12m. The holes were then sealed and the land surface restored and rehabilitated.

wet/areas

572009

PLAN 3⁶

0117

CROWN LAND

1:10,000

Current Drilling

5 cm

579,000 W E

.27

Dry Gut Creek

RINGAROOMA RIVER

RIVER

5,470,000 W N

0117

0022

.59

HOLES 1-10 Mineral wet area Holdings 1999



flume

5469900

.39

WATERHOUSE

gravel pit

Creek

gravel pit

CROWN

RINGAROOMA

4.0 Results

The results from the drilling are summarised in Table 1 and the logs of the holes and the sampling scheme are contained in the Appendix.

The clays have a range of colours - brown, grey, yellow, blue, green, white, black and red (in order of incidence)- and textures - waxy, plastic and sticky.

Table 1

Hole No	Clay (m)	Overburden (m)	Description
1	3	1	brown grey clays
2	4.2	2	yellow, grey and brown clays
3	2.75	1.5	brown plastic and grey sticky clays
4	0.75	1	yellow and brown clays
5	10.5	2	grey and yellow (blue) clays
6	10.1	2	brown, grey and white clays
7	5.7	2	green, brown and blue clays
8	9.9	0.3	grey, brown and blue clays
9	6	1	brown clays
10	7	1	yellow, brown and red clays

5.0 Interpretation

The scout drilling program has confirmed a clay deposit over an area of 0.25sq km based on 10 drill holes ranging from 100 to 250m apart.

The clay is from 0.75 to +10.5m thick, averaging 6m and occurs under a sandy overburden from 1 to 2m thick. This gives an inferred geological in situ resource of 1.5 million cu m or 2.8 million tonnes (assuming an SG factor of 1.86 and rounding) of mixed clays.

The thickest section of clay is on a 20m high ridge covered by the two northern most holes 5 and 6 which show a 10m thickness of grey, yellow and brown, plastic to sticky clay over an area of about 200m by 100m inferring approximately 200,000 cu m or 372,000 tonnes. At an annual production of say 15,000 tonnes per annum, this would give about 25 years supply.

This ridge runs off the licence and if the clay proves to be worthwhile pursuing then the next square kilometre to the west should be added to the licence.

The overburden is commonly 1-2m thick of fine grained, grey sand passing into brown, sandy clay locally called "coffee rock". Occasional small patches of coarse, siliceous (silcrete?) gravels and cobbles, possibly of Tertiary age, exposed on small knolls on the flat plain towards the old tin workings, did not prove to be widespread and were not encountered in the drilling.

The clays commonly overlie and are derived from a Jurassic doleritic bedrock or more rarely a possible metasediment (Mathinna ?) bedrock for three of the southern holes (1, 9 and 10).

6.0 Future Program

Ten composite samples of clays (each sample + 3kg) have been sent for industrial testing to Sud-Chemie A G, Munich, Germany and Australian Bulk Minerals, Burnie (Appendix).

Fourteen specific clay samples have been sent for clay identification to Amdel Ltd, Adelaide (Appendix) comprising thirteen from the drilling and one from surface sampling of clay derived from dolerite exposed in the old Dry Gut workings.

If the results of these investigations are positive, consideration will be given to further drilling to measure a resource and possible bulk sampling to prove up an industrial use for the clay.

7.0 Conclusions

The current drilling program has confirmed the presence of a clay deposit averaging 6m thick under a sandy overburden 1-2m thick stretching from the old tin workings of the Dry Gut area, adjacent to the Ringarooma River, under the flat plain to the west.

This gives an inferred in situ resource of approximately 2.8 million tonnes of clay. The variety of colours and textures seen in the samples suggests that the deposit contains a range of clay types.

Previous industrial and scientific testing of clay from the area of the licence indicates that swelling smectite types are present some comparable to Wyoming bentonite, others with inferior properties. Other clay types suggested by testing are kaolinite, halloysite and illite.

Smectites clays include montmorillonite and beidellite, the main constituents of bentonite clay deposits. In the most exhaustive scientific test to date, CSIRO identified one sample of clay from the area as beidellite.

Tests currently being run by Sud-Chemie A G, Australian Bulk Minerals and Amdel will go far to determining the value and possible end uses for this clay deposit.

572012

APPENDIX

- : Logs of auger drill holes DGH 1-10**
- : Sample information**
- : Description and location of composite samples for Sud-Chemie A G,
Australian Bulk Minerals and Amdel**
- : Previous industrial and scientific evaluation tests for clay 1970-1982**

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prep'n	DESCRIPTION
		0			ABERFORTH HILL - DRY GUT PROSPECT
		1m		001	0-1m; brown ^{sandy} soil, occ frags qtz to 1cm.
		2.5m		002	1-2.5m; brownish grey clay with some qtz residual (50% core loss)
		2.5m 4m		003	2.5-4m; brownish grey clay - as above (60% core loss)
		4.5m		004	4-4.5m; brown clay with oxidised bedrock fragments (meta-sediment?)
				ECH	ECH - hard bedrock; broke cutters
					<u>Summary</u> : brown grey clay 3m (1-4m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prep'n	DESCRIPTION
		0		005	0-1m; dark grey sandy soil becoming coffee wtk (hard pan)
		1m		006	1-2m; dark to light brown sandy clay (50% core loss)
		2m		007	2-2.75m; waxy yellow grey clay (quartz, kbb, frags)
		2.75m		008	2.75-3.5m; grey brown clay wtk
		3.5m		009	3.5-4.25m; as above (dolerite frags) (15% core loss)
		4.25m		010	4.25-5m; as above (dolerite and meta sediment frags) (15% core loss)
		5.0m		011	5-5.75m; waxy chocolate brown clay (dolerite frags)
		5.75m		012	5.75-6.2m; brown clay (oxidised dolerite frags) (45% core loss)
		6.2m			6.2-7m; oxidised, altered dolerite (50% core loss)
		7m		EOH	EOH - unable to proceed due to hard bedrock.
					<u>Summary:</u> yellow, grey and brown clays 4.2m (2-6.2m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prepn	DESCRIPTION
		0		013	0-1.5m; sand (top 0.2m black soil)
		1.5m		014	1.5-2.75m; dark brown plastic clay
		2.75m		015	2.75-3.5m; waxy greeny brown clay (40% core loss)
		3.5m		016, 017	3.5-4.25m; greeny grey sticky clay (from outside in spirals)
		4.25m		018	017, light green gritty clay in end of auger tube.
		5m			4.25-5m; altered dolomite (rock frags and gravel)
				LOH	LOH - unable to proceed, heavy bedrock.
					<u>Summary:</u> brown plastic clays and grey sticky clays 2.75m (1.5-4.25m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prepin	DESCRIPTION
		0		019	0-1m; Fg grey sand
		1m		020	1-1.75m; yellow brown clay
		1.75m		021	1.75-2m; brown oxidised dolomite with some light clayey zones
		2m		EDH	EDH - unable to proceed, hard ground
					<u>Summary:</u> yellow and brown clays 0.75m (1-1.75m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No Depth (m) Prep'n	DESCRIPTION	DESCRIPTION
		0			Hollow Auger Core Drilling	Solid Auger Drilling
		1m		022	0-1m; fg grey sand	0-5m
		2m		023	1-2m; sand (1-1.20 brown coffee wk, tertiary gravel pau?)	SAMPLES FROM SPIRES 5-12.5m
		2.75m		024	2-2.75m; brownish grey, plastic clay	
		3.5m		025	2.75-3.5m; yellow clay (plastic)	
		4.25m		026	3.5-4.25m; yellow white clay (plastic)	
		5m		027	4.25-5m; grey yellow plastic clay	END CORE SAMPLES ↑
		6m		028	5-6m; grey yellow sticky clay	AUGER SAMPLES ↓
		7m		029	6-7m; as above	
		8m		030	7-8m; as above	
		9m		031	8-9m; as above	
		10m		032	9-10m; as above	
		11m		033	10-11m; as above	
		12.5m		034	11-12.5m; blue clay	
				END	END OF DRILL STRING	
					Summary: grey and yellow (blue) clays 10.5m (2-12.5m)	

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prepin	DESCRIPTION
		0			SOLID AUGER DRILLING
		1m		035	0-1m; fg grey sand
		2m		036	1-2m; brown sandy clay (coffee wk = hard pan)
		3m		037	2-3m; light brown clay
		4m		038	3-4m; grey white plastic clay
		5m		039	4-5m; yellow grey plastic clay
		6m		040	5-6m; as above
		7m		041	6-7m; light yellow brown clay
		8m		042	7-8m; yellow brown clay
		9m		043	8-9m; light brown plastic clay
		10m		044	9-10m; light grey gritty clay
		11.5m		045	10-11.5m; light brown clay
		12.1m		046	11.5-12.1m; light grey brown clay
				LOH	LOH unable to proceed with drill - too hard
					<u>Summary:</u> brown, grey and white clays 10.1m (2-12.1m)

MINERAL HOLDINGS PTY LTD

572019 DRILL

GEOLOGICAL RECORD

HOLE No.

DGH 7

11/MARCH/99

REF. No.

EL 38/97

SHEET No.

1 of 1

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prep'n	DESCRIPTION
		0			SOLID AUGER DRILLING
		1m		047	0-1m; fg grey sand
		2m		048	1-2m; dark grey sandy clay
		3m		049	2-3m; olive green plastic clay
		4m		050	3-4m; tan brown plastic clay
		5m		051	4-5m; as above (gritty?)
		6m		052	5-6m; brown plastic clay
		7m		053	6-7m; dry blue clay
				054	7-7.7m; brown blue clay with dolerite frags
		7.7m		EOH	EOH unable to proceed with drill - too hard
					<u>Summary:</u> green, brown and blue clays 5.7m (2-7.7m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prep'n	DESCRIPTION
		0			SOLID AUGER DRILLING
		1m		055	0-1m; grey clay ^{with} 0.30m fg grey sand
		2m		056	1-2m; sticky chocolate brown clay
		3m		057	2-3m; sticky grey blue clay
		4m		058	3-4m; sticky brown grey clay
		5m		059	4-5m; sticky coffee brown clay (dolomite frags)
		6m		060	5-6m; as above
		7m		061	6-7m; as above
		8m		062	7-8m; as above with numerous dolomite frags.
		9.5m		063	8-9.5m; grey clay with dolomite grit
		10.2m		064	9.5-10.2m; yellow brown gritty clay.
				EOH	EOH unable to proceed with drill - too hard
					<u>Summary:</u> grey, brown and blue clays to 9.9m (0.3-10.2m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No Depth (m) Prep'n	DESCRIPTION
		0		065	0-1m; fg, grey sand
		1m		066	1-2m; yellow brown plastic clay (occ. grit)
		2m		067	2-3m; coffee brown clay
		3m		068	3-4m; orange brown clay (occ. grit - dolomite)
		4m		069	4-5m; crumbly brown ochreous clay (occ. fags metaxid, dolomite)
		5m		070	5-6m; as above (occ dolomite, other fg fags)
		6m		071	6-7m; as above (occ silicate? granite?, other fags)
		7m		EOH	EOH - very slow drilling; no incentive to proceed.
					<u>Summary:</u> brown clays 6m (1-7m)

Core lift	Core loss (%)	Depth (m)	Graphic Log	Sample No. Depth (m) Prepn	DESCRIPTION
		0		072	0-1m; Fg sand getting into clay
		1m		073	1-2m; yellow grey clay (qtz frags to 10mm)
		2m		074	2-3m; dry tan yellow clay (qtz frags to 20mm, also silicates, quartz?)
		3m		075	3-4m; chocolate brown to red clay (qtz & dolomite frags)
		4m		076	4-5m; rust red plastic clay (embedd. rock frags)
		5m		077	5-6m; dry brown clay with frags (metasediment?)
		6m		078	6-7m; as above
		7m		079	7-8m; as above
		8m		EDH	EDH - very slow drilling; no incentive to proceed.
					<u>Summary:</u> yellow, brown and red clays 7m (1-8m)

MINERAL HOLDINGS — SAMPLE INFORMATION

PROJECT NAME	PROSPECT NAME	SAMPLE TYPE	SAMPLED BY	SAMPLE DATE		
ABERFOYLE Hill	DRY Gut	Core	DMH/D	9-12-03 199		
SAMPLE NO	HOLE ID	FROM	TO	NORTHING	EASTING	COMMENTS
141001	DGH1	0	1m	COMPYTES		CORE
002	"	1	2.50 x	SC	SR	A907
003	"	2.50	4.00 x	908	909	"
004	"	4.00	4.50 x			"
005	DGH2	0	1m			CORE
006	"	1	2			"
007	"	2	2.75 x			A082
008	"	2.75	3.50 x			"
009	"	3.50	4.25	080	081	"
010	"	4.25	5.00 x			"
011	"	5.0	5.75 x			A083
012	"	5.75	6.20			"
013	DGH3	0	1.5m			CORE
014	"	1.50	2.75 x			"
015	"	2.75	3.50 x	086	085	A084
016	"	3.50	4.25 x			A087
017	"	"	"			"
018	"	4.25	5.00			"
019	DGH4	0	1m			CORE
020	"	1	1.75			CORE
021	"	1.75	2.00			CORE
022	DGH5	0	1.2m			CORE
023	"	1.20	2.00			"
024	"	2.00	2.75 x			A090
025	"	2.75	3.50 x	088	089	"
026	"	3.50	4.25 x			"
027	"	4.25	5.00 x			A091
028	"	5.00	6.00 x			A092
029	"	6.00	7.00 x			"
030	"	7.00	8.00 x	094	093	"
031	"	8.00	9.00 x			"
032	"	9.00	10.00 x			A092
033	"	10.00	11.00 x			"
034	"	11.00	12.00			"

MINERAL HOLDINGS — SAMPLE INFORMATION

PROJECT NAME		PROSPECT NAME		SAMPLE TYPE	SAMPLED BY	SAMPLE DATE	
ABERFORTH HILL		DRY GUT		ANGLER	DAVID D	9-12-03-99	
SAMPLE NO	HOLE I.D.	FROM	TO	NORTHING	EASTING	COMMENTS	
035	DGH6	0	1m			ANGLER	
036	"	1	2m			"	
037	"	2	3			"	
038	"	3	4	x		A 095	
039	"	4	5			"	
040	"	5	6	x		"	
041	"	6	7			"	
042	"	7	8			096 097	
043	"	8	9	x		"	
044	"	9	10			"	
045	"	10	11.5	x		"	
046	"	11.5	12.1			"	
047	DGH7	0	1m			ANGLER	
048	"	1	2			"	
049	"	2	3			"	
050	"	3	4	x		A 098	
051	"	4	5			"	
052	"	5	6	x	100	099	
053	"	6	7	x		"	
054	"	7	7.7m			"	
055	DGH8	0	1m			ANGLER	
056	"	1	2			"	
057	"	2	3	x	902	903	
058	"	3	4	x		A 901	
059	"	4	5	x		A 904	
060	"	5	6	x	906	905	
061	"	6	7	x		"	
062	"	7	8			"	
063	"	8	9.5			"	
064	"	9.5	10.20			"	
065	DGH9	0	1m			ANGLER	
066	"	1	2	x		"	
067	"	2	3	x		"	
068	"	3	4	x	912	911 A 910	
069	"	4	5	x		"	
070	"	5	6	x		"	
071	"	6	7			"	

572026

COMPOSITE CLAY SAMPLES FROM ABERFOYLE HILL
FOR TESTING BY SUD CHEMIE

SAMPLE NO	HOLE ID	FROM (m)	TO (m)	STATUS	COMMENTS
SC 080 4kg	DGH 2	2	2.75	CORE	waxy yellow grey clay
		2.75	3.5		grey brown clay
		4.25	5		as above
		5	5.75		waxy chocolate brown clay
SC 086 3.25kg	DGH 3	1.5	2.75	CORE	dark brown plastic clay
		2.75	3.5		waxy greeny brown clay
		3.5	4.25		greeny grey sticky clay
SC 088 4.75kg	DGH 5	2	2.75	CORE	browny grey plastic clay
		2.75	3.5		yellow clay
		3.5	4.25		yellow white clay
		4.25	5		grey yellow plastic clay
SC 094 4kg	DGH 5	5	6	AUGER	grey yellow sticky clay
		6	7		as above
		7	8		as above
		8	9		as above
		9	10		as above
10	11	as above			
SC 096 5kg	DGH 6	3	4	AUGER	tan grey to white plastic clay
		5	6		yellow grey plastic clay
		8	9		light brown plastic clay
		10	11.5		light brown clay
SC 100 4kg	DGH 7	3	4	AUGER	tan brown plastic clay
		5	6		brown plastic clay
		6	7		blue clay
SC 902 3.5kg	DGH 8	2	3	AUGER	sticky grey blue clay
		3	4		sticky brown grey clay
SC 906 5.25kg	DGH 8	4	5	AUGER	sticky coffee brown clay
		5	6		as above
		6	7		as above
SC 908 4.75kg	DGH 1	1	2.5	CORE	browny grey clay
		2.5	4		as above
		4	4.5		brown clay
SC 912 4.75kg	DGH 9	1	2	AUGER	yellow brown plastic clay
		2	3		coffee brown clay
		3	4		orange brown clay
		4	5		crumbly brown clay
		5	6		as above

COMPOSITE CLAY SAMPLES FROM ABERFOYLE HILL
FOR TESTING BY AUSTRALIAN BULK MINERALS

SAMPLE NO	HOLE ID	FROM (m)	TO (m)	STATUS	COMMENTS
SR 081 4kg	DGH 2	2	2.75	CORE	waxy yellow grey clay
		2.75	3.5		grey brown clay
		4.25	5		as above
		5	5.75		waxy chocolate brown clay
SR 085 3.5kg	DGH 3	1.5	2.75	CORE	dark brown plastic clay
		2.75	3.5		waxy greeny brown clay
		3.5	4.25		greeny grey sticky clay
SR 089 5.25kg	DGH 5	2	2.75	CORE	brownish grey plastic clay
		2.75	3.5		yellow clay
		3.5	4.25		yellow white clay
		4.25	5		grey yellow plastic clay
SR 093 4kg	DGH 5	5	6	AUGER	grey yellow sticky clay
		6	7		as above
		7	8		as above
		8	9		as above
		9	10		as above
10	11	as above			
SR 097 5kg	DGH 6	3	4	AUGER	tan grey to white plastic clay
		5	6		yellow grey plastic clay
		8	9		light brown plastic clay
		10	11.5		light brown clay
SR 099 4kg	DGH 7	3	4	AUGER	tan brown plastic clay
		5	6		brown plastic clay
		6	7		blue clay
SR 903 3.5kg	DGH 8	2	3	AUGER	sticky grey blue clay
		3	4		sticky brown grey clay
SR 905 4.75kg	DGH 8	4	5	AUGER	sticky coffee brown clay
		5	6		as above
		6	7		as above
SR 909 4.75kg	DGH 1	1	2.5	CORE	brownish grey clay
		2.5	4		as above
		4	4.5		brown clay
SR 911 4kg	DGH 9	1	2	AUGER	yellow brown plastic clay
		2	3		coffee brown clay
		3	4		orange brown clay
		4	5		crumbly brown clay
		5	6		as above

572028

CLAY SAMPLES FROM ABERFOYLE HILL
TO BE TESTED BY AMDEL

SAMPLE NO	HOLE ID	FROM (m)	TO (m)	STATUS	COMMENTS
A 082	DGH 2	2	2.75	CORE	waxy yellow grey clay
A 083	DGH 2	5	5.75	CORE	waxy chocolate brown clay
A 084	DGH 3	2.75	3.5	CORE	waxy greeny brown clay
A 087	DGH 3	3.5	4.25	CORE	greeny grey sticky clay
A 090	DGH 5	2	2.75	CORE	browny grey clay
A 091	DGH 5	4.25	5	AUGER	grey yellow plastic clay
A 092	DGH 5	9	10	AUGER	grey yellow sticky clay
A 095	DGH 6	3	4	AUGER	grey white clay
A 098	DGH 7	3	4	AUGER	tan brown plastic clay
A 901	DGH 8	3	4	AUGER	brown grey clay
A 904	DGH 8	4	5	AUGER	coffee brown clay
A 907	DGH 1	1	2.5	CORE	browny grey clay
A 910	DGH 9	3	4	AUGER	orange brown clay
A913	Dry Gut workings			GRAB	light grey clay after dolerite

SAVAGE RIVER MINES

P.O. BOX 446, BURNIE, TAS. 7320

2

Interoffice Communication

572029

TO Mr. R.T. Sanden

DATE September 16, 1970

FROM P.M. Cameron

COPIES TO M. Beech-Jones
P.J. Busby
File

SUBJECT EVALUATION OF BENTONITE SAMPLE - NO. B70/4

Preliminary physical testing of the sample of bentonite of unknown origin supplied on August 3, 1970 has been completed. The test results have indicated that further investigation of the potential of this bentonite as a pelletizing bonding agent could be justified.

The proposed standard procedure for evaluating bentonite samples submitted for laboratory balling tests was adopted. The results are as follows:

Crude Bentonite

The 5 lb. sample, designated B70/4, consisted of small irregular shaped nodules and clusters of grey coloured bentonite with yellowish particles adhering to the surface. Size analysis of the crude sample was:

+16mm	3.6 wt %
-16+9mm	68.2 wt %
-9 +5mm	8.8 wt %
-5mm	19.4 wt %

The +16mm fraction consisted entirely of clusters of small nodules which compacted on compression.

Stage Ground Bentonite

The physical properties of the stage ground bentonite compared with those for plant ground Wyoming bentonite are as follows:

<u>Property</u>	<u>Unknown Bentonite</u>	<u>Wyoming Bentonite</u>
1. Size Analysis		
+150#	0%	0%
+200#	10%	11%
-200#	90%	89%
2. Grit Number	2.3	3.5
3. Colloid Content	39%	67%
4. Barrel Yield	< 52	52
Marsh Funnel	16.5 seconds	20.0 seconds
5. Bulk Density	47.5 lb/ft ³	38.8 lb/ft ³
6. Specific Gravity	2.2	2.4
7. Ignition Loss	17.2%	6.12%

572030

Stage Ground Bentonite (Contd.)

<u>Property</u>	<u>Unknown Bentonite</u>	<u>Wyoming Bentonite</u>
8. SiO ₂ Content	49.6	66.2
9. Al ₂ O ₃ Content	19.8	15.1

Balling Test

Laboratory balling tests were carried out in accordance with the Pickands Mather laboratory standards using both the unknown and Wyoming bentonite at the rate of 15 lb/long ton dry concentrate. Concentrate was obtained from the plant and had the following properties:

1. Moisture Content	9.5%
2. Blaine Index	1640 cm ² /gm
3. Fe ²⁺ Content	21.3%

The balls formed with Wyoming bentonite were round, dry and firm. No problems were encountered during balling.

The balls formed with the unknown bentonite were very wet on the outside and tended to stick together. Balling was difficult as the balls continually adhered to the side of the balling tyre. The lack of moisture retaining characteristics were considered as possibly indicative of a non-swelling bentonite.

The green ball properties determined for -13.3 +12.7mm balls were as follows:

<u>Property</u>	<u>Unknown Bentonite</u>	<u>Wyoming Bentonite</u>	<u>P.M. Min. Standards</u>
1. Addition Rate	15 lb/long ton dry concentrate		
2. Moisture Content	8.7%	8.4%	-
3. Drop Number	5.6	6.0	8
4. Wet Compression Strength	4.6 lb	4.6 lb	3 lb
5. Dry Compression Strength	10.0 lb	10.4 lb	8 lb

The low drop number obtained with both ball samples was attributed to the relatively low moisture content of the balls.

Conclusion

The sample of unknown bentonite shows promise of being a suitable pelletizing bonding agent. It is suggested that laboratory balling tests be continued.

P. M. Cameron

P.M. Cameron

SAVAGE RIVER MINES

RECEIVED	ASST. REGISTRAR	REGISTRAR	D.S. & E.
ANSWERED	DEPT. OF MINES	E&IL	
REF. No.	263/77		JN.

Process Development

P.L. Report No. 1002

February 18, 1971

PORTLAND HOLDINGS PTY. LTD. BENTONITE CLAY SAMPLES - LABORATORY INVESTIGATION

SUMMARY

Fifteen samples of Portland Holdings Pty. Ltd. bentonite type clay, as submitted to Savage River Mines by Minefields Exploration N.L., have been tested and evaluated as to their suitability as pelletizing additives.

This testwork and evaluation lead to the conclusion that consideration of the material tested as a pelletizing additive is not warranted at this time.

Additional testwork on the samples received is not recommended.

INTRODUCTION

This report serves to record testwork performed on several samples of Portland Holdings Pty. Ltd., bentonite type clay submitted to Savage River Mines on October 24, 1970 by Minefields Exploration N.L. Reference to these samples may be noted in a letter dated November 5, 1970 from Mr. Alan L. Alexander to Mr. W. Muloin. Reference to preliminary testwork performed on similar material may be noted in a memorandum from Mr. P.M. Cameron to Mr. R.T. Sanden, dated September 16, 1970. Both of these pieces of correspondence are included in the appendix to this report for reference.

The sole purpose of this report and its contained data is to demonstrate the suitability of the bentonite type clays tested as pelletizing additives. It is not the purpose of this report to evaluate the material tested as a bentonite.

SAMPLES TESTED

Fifteen (15) samples were received for testing. These samples were numbered as GS 5, 6, 8, 9, 14, 15, 16, 18, 19, 22, 23, 24, 28, 29, and 30. These samples were received as wet pulps resultant from wet drilling. No other history or description of the samples was received. Table No. 1 of this report tabulates the physical features of the samples as received.

SAMPLE PREPARATION

All samples received, each weighing approximately 20 pounds, were oven dried at 105°C to an 8% H₂O content. They were then stage ground to 90% -200 mesh.

These dried and ground samples served as source supply for all subsequent testwork. All sample remaining, following our testwork, has been saved as a "hold" sample and is available.

TEST PROCEDURE

Standard Pickands Mather balling tests were performed on each of the samples received and prepared. This is to say that a specified amount of each sample was mixed with concentrate and balled. Comparison was made of the properties of wet and dried balls thus obtained with the properties of balls obtained in a control test using an equal amount of known bentonite with an identical concentrate.

For reference the additive level (test samples and known bentonite) was 15 lb/dry ton concentrate. The known bentonite used as a control or standard was "Wyoben". The concentrate used was identical in all cases and was obtained from daily production.

Evaluation of balling was made by observing green ball moisture, drop numbers, wet compression strength and dry compression strength.

TEST RESULTS

All balling test results obtained are included within Table No. 2 of this report.

INTERPRETATION OF TEST RESULTS

Three, only, of the fifteen samples tested show any promise as pelletizing additives. These are GS 5, 23 and 24. Values received for dry compression strength with each of these three samples approach our desired standard. Values for unit compression strength exceed our standard in two of the three samples. Values for drop numbers are low in all three cases.

In addition to commenting on physical values received in our balling tests it is felt that attention should be called to several visual observations.

First, it was noted that the samples tested were very sensitive to water addition, ie the critical balling moisture level could easily be exceeded. This is often experienced with non-swelling type clays.

Secondly, it was noted that quartz pebbles of considerable size were present in several of the crude samples. Some of these pebbles approached two (2) inches in diameter. Such pebbles could create problems in grinding.

Thirdly, it was noted that pieces of basalt were present. This could indicate that the clays tested were bentonite in a relatively early stage of development.

CONCLUSIONS AND RECOMMENDATIONS

Data, as developed in our testwork, is not sufficiently positive to suggest any consideration of Portland Holdings Pty. Ltd., bentonite type clay (as represented by the samples received) as a pelletizing additive, at this time.

Further, this data does not lead to any conclusions which warrant further activity on our part in evaluating this material as a pelletizing additive.

Positive data was received on three (3) only of fifteen (15) samples tested. In the event that the supplier were to demonstrate that these samples represent the greater portion of his deposit, or if he were to develop an up-graded bentonite product from this deposit as represented by the samples tested, we could then consider a re-evaluation of this data and an extension of our testwork.

TABLE NO.1

PHYSICAL FEATURES OF PORTLAND HOLDINGS BENTONITE SAMPLES

Sample No.	Colour	Texture (Moisture Content of Crude Sample)	Grain Size (Dried Crude Sample)	Remarks
GS - 5	Cream	Fluid	Fine grained with some coarse pieces	
GS - 6	Light Brown	Fluid	Fine to coarse grained	2"-3" quartz pieces present
GS - 8	Dark Brown	Fluid	Fine to medium grained	
GS - 9	Dark Brown	Fluid	Fine grained to ½" pieces	
GS - 14	Light Brown	Colloidal	Fine grained	
GS - 15	Brown	Almost Solid	Fine to very coarse grained	
GS - 16	Dark Brown	Colloidal	Fine grained	2" basalt pieces present
GS - 18	Light Brown	Fluid	Fine grained to 1" pieces	Large quantity free quartz present
GS - 19	Light Brown	Fluid	Fine grained to 1" pieces	
GS - 22	Light Brown	Gel	Fine grained to 1" pieces	
GS - 23	Dark Brown	Fluid	Fine to large grained	Free basalt and talc minerals present.
GS - 24	Dark Brown	Solid	Fine to large grained	Free basalt and talc minerals present
GS - 28	Light Brown	Fluid	Fine grained to 1" pieces	
GS - 29	Dark Brown	Fluid	Fine grained to 1" pieces	1" pieces basalt present
GS - 30	Light Brown	Fluid	Fine grained to 2" pieces	2" pieces basalt present

TABLE NO.2 - EVALUATION OF PORTLAND HOLDINGS BENTONITE SAMPLES

RESULTS OF LABORATORY BALLING TESTS

572035

Sample	Green Ball Moisture (wt %)	Drop Number	Wet Compres- sion Strength (lbs)	Dry Compres- sion Strength (lbs)
PM Specification (Minimum)	-	8.0	3.0	8.0
Wyoben-Plant Ground	9.1	5.5	3.2	7.1
Wyoben-Lab. Ground	9.1	5.4	2.6	6.1
GS - 5	9.3	5.7	2.8	5.7 x
GS - 6	9.1	4.8	3.2	4.7
GS - 8	9.4	6.5	3.1	4.1
GS - 9	9.4	6.1	3.3	4.8
GS - 14	9.0	4.3	2.9	3.3
GS - 15	9.0	4.7	3.1	4.2
GS - 16	9.2	5.5	2.3	4.1
GS - 18	9.1	4.4	2.3	3.2
GS - 19	9.1	4.7	2.6	3.0
GS - 22	9.5	6.2	3.3	4.8
GS - 23	9.0	4.7	3.5	7.0 x
GS - 24	9.0	4.6	3.6	7.0 x
GS - 28	9.0	5.1	3.4	3.0
GS - 29	9.0	4.5	3.4	4.2
GS - 30	9.2	5.4	3.3	3.6

APPENDIX 1 : Memorandum covering preliminary evaluation of Portland Holdings bentonite sample.

TO: Mr. R.T. Sanden

September 16, 1970

FROM: P.M. Cameron

Copies: M. Beech-Jones
P.J. Busby
File

572036

EVALUATION OF BENTONITE SAMPLE - NO. B70/4

Preliminary physical testing of the sample of bentonite of unknown origin supplied on August 3, 1970 has been completed. The test results have indicated that further investigation of the potential of this bentonite as a pelletizing bonding agent could be justified.

The proposed standard procedure for evaluating bentonite samples submitted for laboratory balling tests was adopted. The results are as follows:

Crude Bentonite

The 5lb. sample, designated B70/4, consisted of small irregular shaped nodules and clusters of grey coloured bentonite with yellowish particles adhering to the surface. Size analysis of the crude sample was:

+16mm	3.6 wt %
-16+9mm	68.2 wt %
- 9+5mm	8.8 wt %
- 5mm	19.4 wt %

The +16mm fraction consisted entirely of clusters of small nodules which compacted on compression.

Stage Ground Bentonite

The physical properties of the stage ground bentonite compared with those for plant ground Wyoming bentonite are as follows:

<u>Property</u>	<u>Unknown Bentonite</u>	<u>Wyoming Bentonite</u>
1. Size Analysis +150#	0%	0%
+200#	10%	11%
-200#	90%	89%
2. Grit Number	2.3	3.5
3. Colloid Content	39%	67%
4. Barrel Yield	< 52	52
Marsh Funnel	16.5 seconds	20.0 seconds
5. Bulk Density	47.5 lb/ft ³	38.8 lb/ft ³
6. Specific Gravity	2.2	2.4
7. Ignition Loss	17.2%	6.12%
8. SiO ₂ Content	49.6	66.2
9. Al ₂ O ₃ Content	19.8	15.1

Balling Test

Laboratory balling tests were carried out in accordance with the Pickands Mather laboratory standards using both the unknown and Wyoming bentonite at the rate of 15 lb/long ton dry concentrate. Concentrate was obtained from the plant and had the following properties.

1. Moisture Content	9.5%
2. Blaine Index	1640 cm ² /gm
3. Fe ²⁺ Content	21.3

The balls formed with Wyoming bentonite were round, dry and firm. No problems were encountered during balling.

The balls formed with the unknown bentonite were very wet on the outside and tended to stick together. Balling was difficult as the balls continually adhered to the side of the balling tyre. The lack of moisture retaining characteristics were considered as possibly indicative of a non-swelling bentonite.

The green ball properties determined for -13.3 + 12.7mm balls were as follows:

<u>Property</u>	<u>Unknown Bentonite</u>	<u>Wyoming Bentonite</u>	<u>P.M. Min. Standards</u>
1. Addition Rate	15 lb/long ton dry concentrate		
2. Moisture Content	8.7%	8.4%	-
3. Drop Number	5.6	6.0	8
4. Wet Compression Strength	4.6 lb	4.6 lb.	3 lb
5. Dry Compression Strength	10.0 lb	10.4 lb.	8 lb

The low drop number obtained with both ball samples was attributed to the relatively low moisture content of the balls.

Conclusion

The samples of unknown bentonite shows promise of being a suitable pelletizing bonding agent. It is suggested that laboratory balling tests be continued.

P.M. Cameron

SAVAGE RIVER MINES

P.O. BOX 446, BURNIE, TAS.

572038

4

Interoffice Communication

TO Mr. R.T. Sanden

DATE September 28, 1971

FROM M. Beech-Jones

COPIES TO

G.C. Reynolds
B.R. Sheppard
J.W. Cooper
Q.C. Committee

SUBJECT Portland Holding Bentonite

Preliminary evaluation of the two Portland Holding bentonite samples has been completed.

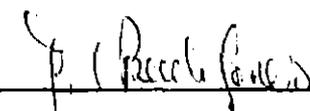
The standard laboratory balling procedure was used to evaluate the samples in comparison with Wyoming bentonite. The results were particularly promising on sample 1B1 which produced green balls of comparable wet and dry strength to Wyoming bentonite.

The samples were submitted as yellow free flowing materials; sample 1A1 was a powder; sample 1B1 was in the form of granules. The samples were stage ground to 90% -200 mesh. The bentonite was used at a rate of 15 lbs/long ton standard concentrate (1610 Blaine, 84.8 -325 mesh).

RESULTS

<u>Bentonite</u>	<u>Ball H₂O</u>	<u>Drop No.</u>	<u>Wet Compression</u>	<u>Dry Compression</u>
Wyoming	9.3	6.8	2.65	7.5
PH 1A1	9.0	5.6	2.43	5.9
PH 1B1	8.9	4.7	2.88	7.2

It is recommended that the evaluation be extended to include fired pellet properties.



M. Beech-Jones

MBJ:LK

SAVAGE RIVER MINES

5
572039

P.O. BOX 446, BURNIE, TAS.

Interoffice Communication

TO Mr. M. Beech-Jones DATE October 14, 1971

FROM P. M. Cameron COPIES TO G. C. Reynolds
Q. C. Committee

SUBJECT Portland Holdings Bentonite

Laboratory balling tests with two samples of sodium modified bentonite supplied by Portland Holdings were repeated (ref. memo M. Beech-Jones, September 28, 1971). A sample of the laboratory green balls was tested and the remainder were placed in inconel wire baskets and indurated in Furnace No. 1 on October 12. The compression strength of the fired pellets was determined. For comparison, a balling test was carried out with a sample of Wyoming bentonite. All tests were carried out using identical samples of Port Latta concentrate. Bentonite was added at the rate of 15 dry lb/dry ton concentrate.

The test results were as follows:

Bentonite Sample	Wyoming	P.H. 1A/1	P.H. 1B/1
Green ball - % H ₂ O	10.0	9.5	9.8
- Drop Number	7.5	5.9	7.1
- Wet compression (lb)	3.5	2.6	3.0
- Dry compression (lb)	9.7	9.6	9.6
Fired Pellet			
- Compression strength (kg)	375	369	418

The results indicate that the Portland Holdings bentonite sample as tested may be expected to produce pellets with comparable physical properties to pellets produced with Wyoming bentonite.

It is considered that the sodium modified bentonite sample supplied by Portland Holdings warrants further consideration. It is recommended that Portland Holdings carry out a detailed analytical and mineralogical investigation which would include determination of the sodium - montmorillonite content of their bentonite after sodium modification.



P. M. Cameron

PMC:SH

11-11-11
PM Research Lab
Report No. 199
Project No. 480
November 11, 19

SAVAGE RIVER - PORTLAND HOLDINGS BENTONITE

Summary

Two samples of Portland Holdings bentonite were evaluated using standard balling tests with Savage River concentrate. Results were compared with those using the laboratory standard, Volclay.

When using an addition rate of 10.0 lb/Lt, sample A/1 imparted a dry strength of 8.2 lbs, sample B/1 11.2 lbs and Volclay 12.3 lbs.

It is concluded that Portland Holdings sample B/1 is superior to A/1 as it imparts 27% higher dry strength at equivalent addition rate. The B/1 sample does produce a ball having 9% lower dry strength than Volclay but it is still considered to be an acceptable bentonite.

Introduction

Two samples of bentonite, identified as Portland Holdings samples A/1 and B/1, were received along with a request from Savage River Mines to run evaluation tests.

Procedure

The moisture of the Portland Holdings bentonite was determined and found to be between 5-6%. The bentonite was ground to 100% -200 mesh and used at an addition rate of 10.0 lb/Lt to make balls with Savage River concentrate following standard procedures. Balls were also made using Volclay bentonite at the 10 lb/Lt addition rate.

572041

Results

Hentonite	Ball Moist. %	Drop No.	Green Str., lb	Dry Str., lb
P.H. A/1	8.8	5.2	3.8	8.2
P.H. B/1	8.9	6.9	3.9	11.2
Volclay	9.2	9.0	4.3	12.3

RC Moe

R. C. Moe

RCM:mb

LABORATORY REPORT

Evaluation of TASMANIAN BENTONITE...LTR. 1000...SERIES

Lab. I.D. NO. LTR-1006-4
 Manufacturer MINERAL HOLDINGS AUSTRALIA PTY. LTD.
 Sample Name & No. BENTONITE SAMPLES EL19/77 Hole 4 and EL19/77 Hole 5
 Date Supplied 4-6-79
 Date Tested 6-6-79

AIM To evaluate the bentonite using the Methylene Blue Capacity to give an indication of the percentage of bentonitic material present in each sample.

METHOD The standard Methylene Blue Capacity test was used on the two samples using methylene blue indicator at 9.5g USP grade Methylene blue per litre.

(This concentration is slightly higher than the API concentration used but this factor is taken into account when calculating bentonite content after the titration)

RESULTS HOLE 4 SAMPLE

100 ppb sample used.

600 rpm	11	Methylene Blue Capacity calculated at 6.5 giving 39 lb of bentonitic material per 100 lb of sample tested.
300 rpm	6	
PV cps	5	
YP lb/100 sq ft	1	
AV cps	5.5	

HOLE 5 SAMPLE - 100 ppb used.

600 rpm	35	Methylene Blue Capacity calculated at 6.5 also giving 39 lb bentonitic material per 100 lb sample tested.
300 rpm	28	
PV cps	7	
YP lb/100 sq ft	21	
AV cps	17.5	

CONCLUSIONS Hole 5 sample showed significantly higher viscosity than Hole 4 sample but further work should be done using lower concentrations of bentonite combined with either caustic soda, soda ash or other bentonite extenders.

SIGNED. Art.

Date ... 8-6-79

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INSTITUTE OF EARTH RESOURCES

DIVISION OF MINERAL CHEMISTRY

MINERALOGICAL AND CHEMICAL PROPERTIES
OF BENTONITE CLAY FROM TASMANIA

by

J.D. HAMILTON AND C. LI

-- Mineral Chemistry Communication --
Restricted Circulation

May 1979

MINERALOGICAL AND CHEMICAL PROPERTIES
OF BENTONITE CLAY FROM TASMANIA

J.D. Hamilton and C. Li

1. INTRODUCTION

A small hand specimen sample of a dark-brown plastic clay was received from Mineral Holdings Australia Pty Ltd with a covering letter to Dr. A. Reid (11/4/79). The letter requested that the material be assessed as a potential bonding clay for the pelletizing of Savage River iron ore, using techniques proposed in a previous communication with Savage River Mines (15/10/71). This report covers results so far obtained from clay in tests carried out using X-ray diffraction, X-ray fluorescence, differential thermal and thermogravimetric methods of analysis.

2. EXPERIMENTAL METHODS

X-ray diffraction traces were obtained from samples of the clay (a) after drying overnight at 100°C, and (b) after drying under vacuum overnight. The whole-sample clay was also examined by XRF to ascertain its chemical constitution, and by DTA/TGA to determine its thermal reaction and weight variance characteristics.

A small quantity of the 100°C-dried clay was also dispersed in water, and after several hours of sedimentation the upper zone of the suspension was sampled by pipette. Aliquots of this colloid-rich suspension were allowed to air-dry on glass slides to provide oriented aggregate specimens for X-ray diffraction study. One sample was analysed without further treatment; another was saturated with glycerol prior to examination; and a third was heated at 600°C for half an hour before the diffraction study was carried out.

3. RESULTS

3.1 Chemical composition

The chemical composition of the whole-sample material expressed on a 100°C-dry basis is shown in Table 1. The low total of 97.6% cannot yet be explained with certainty, but suggests that some reabsorption of atmospheric moisture by the sample has occurred, probably during the weighing out of material for XRF specimen preparation. If allowance is made for this rehydration, the SiO₂ content of the material would recalculate to near 70%. The other components would likewise be increased in proportion.

The weight loss on drying the clay (as received) at 100°C was 30.54%.

3.2 X-ray diffraction analysis

X-ray diffraction patterns obtained from the whole-sample clay material after oven-drying and after vacuum drying are shown in Figure 1. With the exception of some very weak features attributable to kaolinite (7.13 Å), feldspar (3.18 and 3.24 Å), with possibly some cristobalite (4.00 Å) and pyroxene (2.96 Å), the patterns correspond with the spacing configurations of quartz and montmorillonite. In both diagrams, the primary basal reflection of the clay mineral appears as a broad shoulder peak in the region of 6°2θ, indicating that the interlayer regions of the mineral structure have been extensively rehydrated through contact with moisture in the air. The diffraction peaks of the quartz are sharp and very well defined by comparison with those of the clay mineral.

Oriented-aggregate diffraction patterns obtained from the glass-mounted colloid fraction material are presented in Figure 2. In the diagrams from the air-dried and glycerol-treated specimens, the two small peaks at 7.13 Å and 3.57 Å are the principal basal reflections of a minor kaolinite component. Since kaolinite is destroyed by heating at 600°C, these peaks do not appear in diagram (c). The 001 peak of the dominant montmorillonite species is situated at 5.6°2θ in the pattern from the air-dried sample. This corresponds with a basal spacing of 15.4 Å and indicates the presence of a double layer of water molecules of the type

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usually associated with Ca^{++} or Mg^{++} saturated forms of the mineral. Broad peaks at $\sim 17^{\circ}2\theta$ and $\sim 28^{\circ}2\theta$ in the same pattern are the third and fifth order reflections of the same basal spacing sequence.

Glycerol treatment of the sample induces an increase in the basal spacing from 15.4 \AA to 18 \AA [see Fig. 2(b)]. This change results from the replacement of the original water layers by a thicker double glycerol molecular layer system. The X-ray pattern shows a clear sequence of six diffraction orders within the range 0° - $34^{\circ}2\theta$, and is characteristic of a fully expanding smectite structure.

The effect of heat treatment at 600°C on the hydrated clay was to drive off the interlayer water and collapse the mineral to a mica-like form with a fundamental 00ℓ spacing of 10 \AA [Fig. 2(c)]. This response is again typical of a smectite mineral.

3.3 Thermal analysis

Differential thermal and thermogravimetric curves, obtained from the whole-sample material, are shown in Fig. 3. The strongly endothermic weight loss reaction at approximately 150°C is attributable to the evolution of 6.3% hygroscopic and interlayer water, evidently from the smectite mineral component. A similar, but less intense endothermic effect at $\sim 550^{\circ}\text{C}$ registers an additional loss of hydroxyl water ($\sim 3.3\%$) mainly from the expandable clay, but presumably also contributed to by the kaolinite trace component. The second small dehydroxylation reaction near 650°C involves the release of a further 0.6% of structural water from the montmorillonite. Finally, two exothermic reactions are registered at $\sim 900^{\circ}\text{C}$ and $\sim 1150^{\circ}\text{C}$, neither associated with changes in specimen weight. These effects stem from the recrystallization of the dehydrated clay structures.

4. DISCUSSION

The results of X-ray diffraction analysis clearly indicate that the clay is composed largely of a montmorillonite-type expandite clay mineral, but is contaminated with appreciable amounts of free silica in the form of quartz, and trace quantities of feldspar, kaolinite and

possibly cristobalite. That the quartz and feldspar are relatively coarse-grained constituents is indicated by their complete absence from the colloid fraction ($< 5 \mu\text{m}$) separated after sedimentation of a water dispersion of the clay.

The chemical assay for the whole-clay material registers an SiO_2 content well above that expected for a pure, essentially aluminous montmorillonite, i.e. 57-62% (Deer, Howie and Zussman, 1962). If a contamination level of 20% is allowed for quartz, the analysis recalculates as shown in Table 1, column 2. This predicted composition appears reasonable for montmorillonite except in that the total $\text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ is far too high. Since it is unlikely that the clay contains appreciable free iron oxide (the material is grey rather than brown or red) or kaolinite, it must be tentatively concluded that both these chemical components are in fact substantial in the smectite and that the structure could be beidellitic rather than strictly montmorillonitic in character (Mackenzie, 1969, p.509).

Thermal analysis shows that the smectite structure is "abnormal" with respect to dehydroxylation (Cole and Hosking, 1957; Mackenzie, 1969, p.504) and probably has been developed by degradation of a mica-parent mineral rather than via direct crystallization from amorphous glassy or gelatinous phases. Derivation from such highly charged species as biotite mica would readily explain why the smectite is beidellitic rather than montmorillonitic and would account for the substantial Fe and K contents of the material.

There can be little doubt that the interlayer cation populations of the smectite mineral component are complex. K, Ca and Na are certainly represented on these sites, but the role of the more substantial Mg species is uncertain, since it could be present in the lattice structures as well as in exchange positions.

5. CONCLUSIONS

The clay is composed largely of an expandable smectite mineral, probably of beidellitic rather than montmorillonitic character. This mineral component appears to be basically aluminous, but almost certainly contains iron and magnesium as well in its structural layers. The

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TABLE 1

CHEMICAL ANALYSIS OF BENTONITE CLAY FROM TASMANIA

	%*	%†
SiO ₂	66.96	60.74
TiO ₂	0.75	0.96
Al ₂ O ₃	16.17	20.70
Fe ₂ O ₃	6.76	8.65
MgO	1.19	1.53
CaO	0.31	0.40
K ₂ O	0.72	0.91
Na ₂ O	0.22	0.28
H ₂ O ⁺	4.53	5.76
P ₂ O ₅	0.03	0.04
Total	97.64	99.97
H ₂ O ⁻	30.54	

* Analysis (on 100°C dry basis) of whole-clay sample material.

† Composition of smectite component estimated from total clay analysis by allowing for 20% quartz contamination.

FIGURE LEGENDS

- Figure 1 X-ray diffractograms of whole-sample bentonite clay.
(a) after drying at 100°C overnight; (b) after vacuum drying overnight.
- Figure 2 Oriented aggregate X-ray diffraction patterns of the < 5 μm colloid fraction from the bentonite clay.
(a) air-dried material; (b) glycerol saturated sample;
(c) sample after firing at 600°C for ½ hour.
- Figure 3. Thermal analysis patterns of whole-sample bentonite clay.

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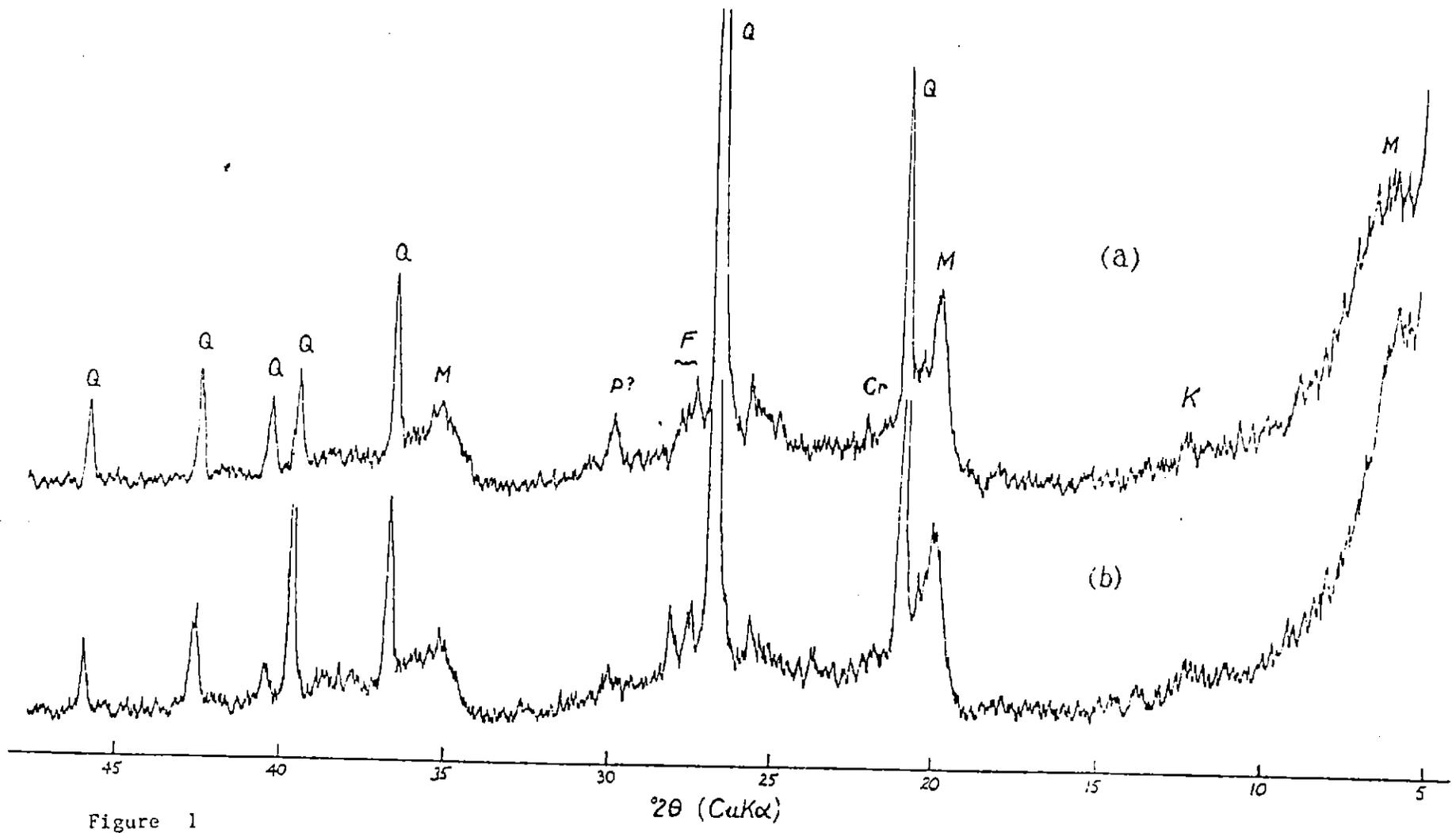


Figure 1

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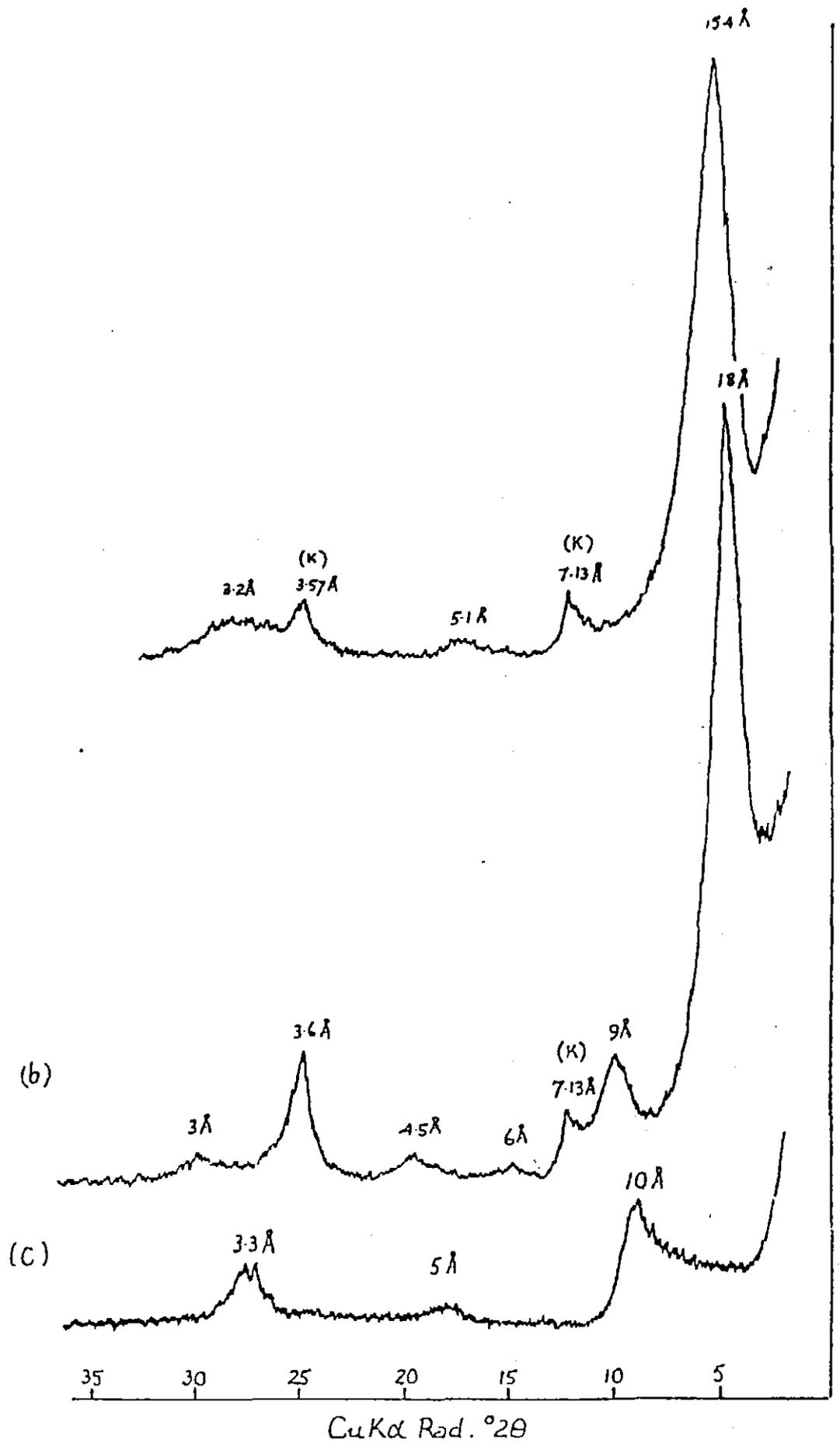


Figure 2

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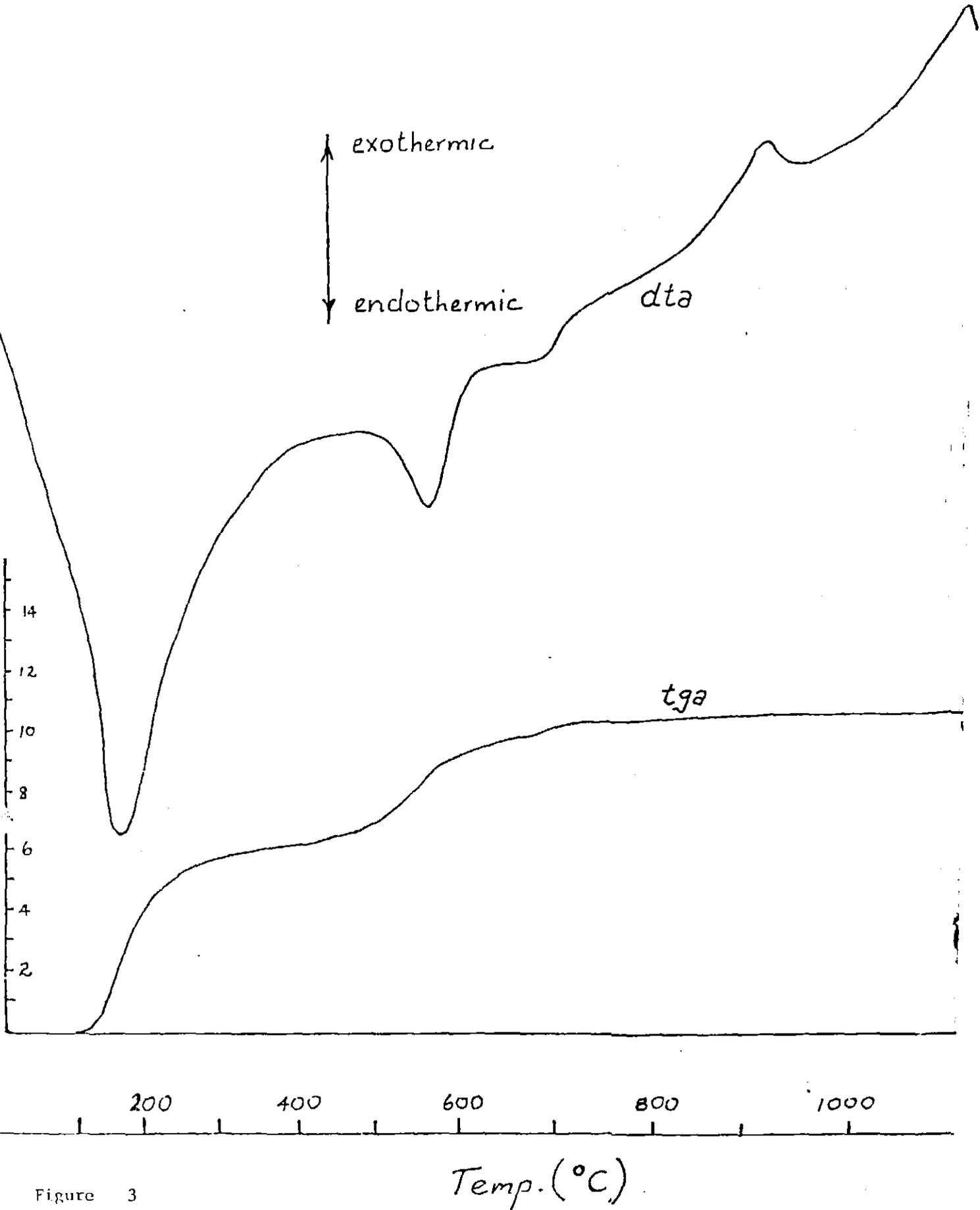


Figure 3

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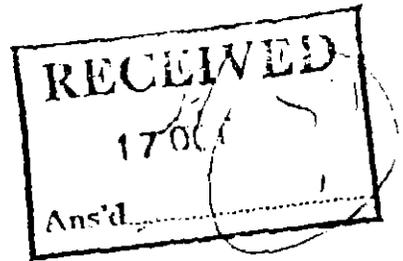
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TELEPHONE: 288 2189

HEAD OFFICE
M.B.L. BUILDING
24 QUEEN STREET
BRISBANE
P.O. BOX 2194,
BRISBANE 4001

15 October, 1979

Mr N. M. Thomas,
Mineral Holdings Australia Pty Ltd,
2nd Floor,
100 Collins Street,
MELBOURNE, VIC. 3000



Dear Sir,

TASMANIAN BENTONITE

Please find enclosed laboratory report on your Tasmanian Bentonite samples giving cation exchange capacity, apparent viscosity, plastic viscosity, yield point, gel strength - zero minutes, gel strength - ten minutes, pH, fluid loss. These have also been tested in parallel with three U.S.A. samples - for your interest the comparative results have been included.

Bentonite sample No. 6 is getting close to the quality of interest and we would appreciate more samples taken from that area if they are available. In order to be of commercial interest we feel the quality has to exceed that of your No. 6 sample approaching that of the Wyoming material.

W. R. Cameron

Yours faithfully,
CUDGEN R.Z. LIMITED

R. A. Cameron
.....
R. A. CAMERON
MANAGING DIRECTOR

Encl.

*L. Skelton on known
G.C. with the remaining
material not held
of 27/10*


ENGELHARD
MINERALS & CHEMICALS DIVISION
 ENGELHARD MINERALS & CHEMICALS CORPORATION
 HUNTSVILLE, ALABAMA 35894 • TELEPHONE 205/885-1000 • CABLE ADDRESS 111111

September 26, 1980

Mr. Anton Lindenmayer
 78-15 64th Place
 Glendale, New York 11385

Re: Tasmanian Mineral Properties
 Mineral Holdings (Australia) Pty. Ltd.

Dear Mr. Lindenmayer:

We appreciate your pursuit of information and samples for us in connection with the subject bentonite, kaolin (and mica) properties. Based on what we have seen so far our interest in these deposits at this time must be considered minimal. The two-ounce sample of kaolin is simply not enough for us to make a meaningful technical evaluation, and your Australian friends seem to be unable or unwilling to provide larger samples or additional information. // Very likely this is because they, in reality, have only limited information themselves. So, to speak of these properties as "deposits" and to discuss the financial structuring of a commercial venture is highly premature. It would be more realistic to term them simply mineral occurrences which Mineral Holdings is attempting to promote. And, without knowing more about these occurrences, we certainly cannot justify sending a geologist around the world for a field inspection.

In any event our conclusions, based on the information you've provided, are not very encouraging, as we will describe briefly below.

Kaolin

- The particle size distribution data suggests that the kaolin indeed has a fine particle size, which is good. But the data do not indicate what type of sample was tested -- a crude kaolin, a kaolin washed through a 325 mesh screen, or an even more extensively processed and fractionated material. Without a 5-lb sample for testing ourselves we cannot verify these data. The brightness (color) is poor, however, as pointed out by Mr. Volker of Associated Pulp and Paper Mills. If he considers this kaolin so well suited for paper applications, why doesn't his company develop it?

- continued -

Mr. Anton Lindenmayer

September 26, 1980
Page 2

- Our past experience with kaolins from Tasmania has been very discouraging. They generally contain high percentages of other clay minerals which adversely affect the performance of the kaolin in paper; and there is no known technology for effectively and economically removing these contaminating clay minerals.
- The small two-ounce sample resembles fragments of kaolinized granite, which one would expect in northern Tasmania. This interpretation is supported by the test report on the mica samples, which describes them as representing a greisenized (altered) granite. In this type of "primary" kaolin the contaminating clay mineral referred to in the preceding paragraph is likely to occur, as our past experience confirms. There is only one area in the world that I'm aware of where this type of kaolin is suitable for use in paper coating. (And, we would not be interested in kaolin which cannot be used for paper coating.)
- The "strong local demand" for kaolin which you mentioned is still too small to justify a kaolin mining/processing operation of the scale at which we would be interested. It is too small to support another producer of the kinds of kaolin products currently produced in Australia. And, we do not believe that Mineral Holdings' clay, as reflected by the small sample, has potential for being processed into the higher grades of paper coating and filler clays now being imported into the country.
- The comment that the kaolin's 20% silica content occurs as diatomite is quite surprising and somewhat questionable from a geological standpoint. If it is true, the kaolin's origin would be sedimentary instead of primary and not related directly to an altered granite. I doubt that this is the case; but in any event it would not improve this clay's commercial potential.
- The principal, if not only, advantage this clay occurrence has is its location and accessibility to infrastructure. Producing electricity for a mineral operation by hydroelectric or coal-fired generators would very likely not be economically feasible, however.

Bentonite

- The thicknesses of this clay and its sandy overburden are economically attractive from a mining viewpoint, but the clay itself is very poor. Tests show that it consists of only 39% bentonite and up to 33% free silica contamination (quartz). Wet processing required to remove the ~~quartz~~ would represent a competitive economic disadvantage.

- continued -

believed to
be diatomite

Mr. Anton Lindenmayer

September 26, 1959
Page 1

- The bentonite mineral comprising this clay is beidellite, a montmorillonite having a high (2.17%) magnesium content. It is non-swelling and has very poor gelling and absorption properties. To render it useful in commercial applications in which these properties are essential would require, if economically feasible, expensive processing. Its dark brown, gray or black color also renders it useless for applications requiring a high brightness (white color). It is somewhat plastic and might be suitable as a ceramic, refractory or iron ore pellet bonding clay; but these markets are not of interest to us. //

Mica

- The mica content in the crude material is only 22-23%, excluding the minus 30 micron fraction (slimes). This yield is too low for beneficiation by flotation or other methods to be economically viable, unless other minerals could be recovered as co-products.

In summary, we see nothing in the samples or information so far supplied which would justify further investigation by Engelhard. Nevertheless, we do appreciate your bringing these properties to our attention.

Very truly yours,



A. F. Alsobrook
Manager, Exploration &
Geological Services

AFA:dsa



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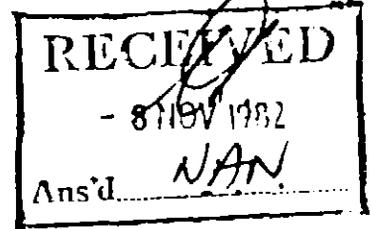
DEPARTMENT OF AGRICULTURE

G.P.O. Box 192 B

Hobart, Tasmania 7001

Enquiries: Mr L.R. Richley
Telephone: 30 8022 Extn 2262
Telex: TASAG AA 58333

Our Reference: 19/6C
3 November 1982



Mr N.M. Thomas
Mineral Holdings Australia Pty Ltd
2nd Floor
100 Collins Street
MELBOURNE Victoria 3000

Dear Mr Thomas

At this stage I have taken a number of clay samples from the four sites shown on the attached map. X-ray diffraction tests showed that some of the samples were predominantly montmorillonite whereas the others contained only traces of this clay mineral. Further physical tests carried out on these two types gave the following results:-

Site	Sample	Depth (cm)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)
1	1 +	40				
2	2A*	50-100				
2	2B+	150-200				
3	3 +	40	74	35	39	13
4	4 *	70-170	137	27	110	28

* These samples had a high total clay content consisting mainly of montmorillonite and some kaolin.

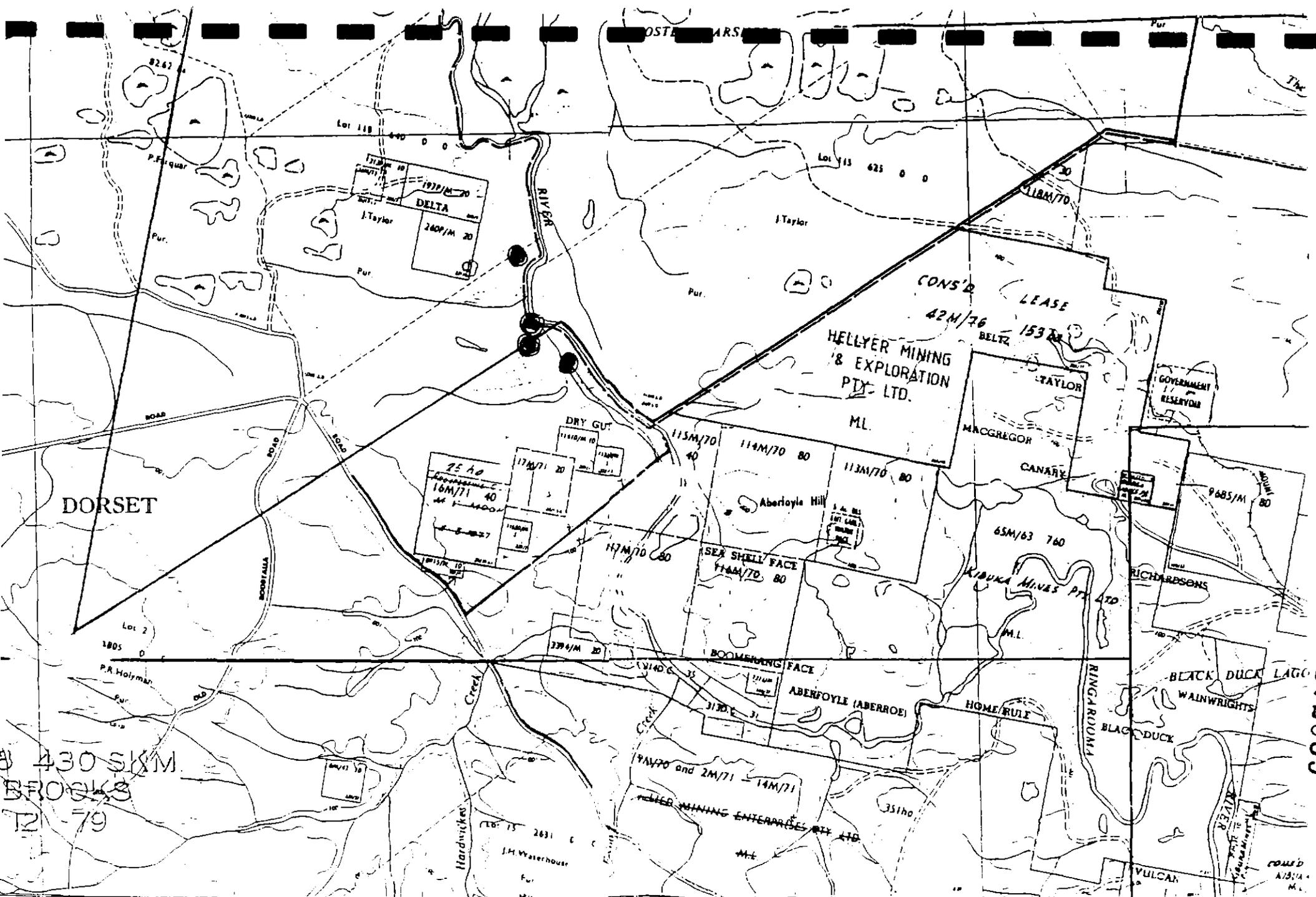
+ These samples had only a moderate clay content which mainly consisted of kaolin with some illite and only traces of montmorillonite.

Material comprising samples 2A and 4 may be suitable for sealing leaky dams. I will be carrying out further tests during November and will report to you on the results.

Yours sincerely

(L.R. Richley)
SOIL CONSERVATION OFFICER

Copy to CAA
14/11/82



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