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HUSKISSON ASBESTOS PROJECT

1971/1972 SUMMER FIELD SEASON REPORT

AUSTRALIAN ANGLO AMERICAN LIMITED

Incorporated in the State of Victoria

72-851

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HUSKISSON ASBESTOS PROJECT1971/1972 SUMMER FIELD SEASON REPORT1. SUMMARY

An evaluation was made of the asbestos potential of part of the Huskisson serpentinite.

Search for fibre bearing serpentinite shows that economic asbestos (more than 1% visual fibre) is largely confined to a 800' by 200' area in the NE section of the ultrabasic, and wherein it is only patchily developed.

Visual grade estimations give an average of 3.1% fibre, with values ranging from .9% to 5.6%. Fibre lengths do not exceed 3/16". An economic orebody is not indicated.

2. INTRODUCTION2.1. Reasons for investigation

The Huskisson serpentinite had initially been considered an exploratory target for nickel mineralisation and investigations of parts of this body have been carried on since 1968/69. Road construction last summer exposed chrysotile asbestos developments which were considered interesting enough to warrant further exploration and evaluation.

2.2. Intentions

The objectives of this project were to examine the ultrabasic with a view to outlining the asbestos zone or zones and to evaluate zones with economic potential.

2.3. Regional geological setting

The Huskisson serpentinite lies within a thick folded sequence of Palaeozoic sandstones, greywackes, tuffs, siltstones and limestone, (TAS 2-293). This sedimentary sequence may form the eastern limb of the Huskisson syncline, a large open structure with a NW trend.

The ultrabasic rocks are exposed over a narrow belt, at least 10 miles long, that extends south from Lynch creek to Renison Bell east.

2.4. Geomorphology

The Huskisson area is typical of the west coast of Tasmania with steep ridges and incised streams. In contrast to the regional vegetation there is a distinct botanical change over the serpentinite. Small gums, acacia, ti-tree, bauera, sword grass and heavy undergrowth cover the serpentinite whereas tall myrtle and gum, blackwood, sassafras and light undergrowth grow on the sediments.

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Soil over the serpentinite is black to brown, typically thin, and contains fragments of serpentinite. In many instances the serpentinitised ultrabasic weathers to a distinctive light, milk chocolate brown colour, and chrysotile asbestos fibre occurs as lustrous brown bands within white alteration veins that criss-cross the weathered surface of the serpentinitised rock.

2.5. Previous investigations

Grid cutting and sampling from 1968 to 1971 established a nickel-cobalt anomaly in the Huskisson serpentinite, which was partly tested by a 600' diamond drill hole in 1971.

Chrysotile asbestos was exposed at four localities on the Huskisson north and south roads during their construction in 1970/71. Minor follow up work, consisting of blasting and costeaning over 160' at the best locality, was undertaken at that time.

2.6. Work undertaken in 1971/72

Exploration for fibre bearing serpentinite and evaluation of grade by visual estimation was achieved by shallow costeaning, line cutting, blasting, and detailed geological mapping at 1:100 scale of all access - costeans, tracks, roads, grid lines and exploratory lines.

Because of the lack of structural data on the serpentinite, costeaning was commenced on the 1969/70 grid lines, which at 235° are roughly perpendicular to the eastern contact in the main area of interest. After completion of three such costeans, bulldozing on these grid lines was diverted to test for extensions of asbestos zones or other prospective areas. Costeaning on the north road asbestos areas proved that they were not significant.

Terrain difficulties, with cliffs and steep ridges, particularly on the western edge of the pyroxenite zone, and east of the Huskisson south road precluded costeaning in a regular pattern, but access to and mapping coverage of these areas was achieved by costeaning from the west to the eastern cliffs and mapping the middle gaps on grid or exploratory lines.

Bulldozers used were a Caterpillar D6C (125 HP) with rippers and a Caterpillar D69U (97 HP) with winch. Generally, two bulldozers operated together, the smaller clearing trees and undergrowth ahead while the larger costeaned. It was found that the combination of a heavy powerful bulldozer with an experienced driver was necessary to give value for money in costeaning operations.

Costeans, tracks, grids, etc., were surveyed by tape, compass and clinometer, but magnetitic variations between compass back sights and fore sights, occasionally up to 20°, were so great due to the large amounts of secondary magnetite present that a theodolite survey of the perimeter

3/ was necessary to provide

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was necessary to provide the basis for an accurate base map.

Serpentinised rocks were differentiated wherever possible into their original lithologies to aid an understanding of the geology of the ultrabasic.

The presence of asbestos veins, and individual fibre lengths, were tested by utilising the fluffing property of chrysotile. A fine dental probe or small carpenter's scribe were used to tease out and check the fibre.

Finally, the grade of two separate fibre zones was evaluated by detailed measurements of fibre in costean sections which had been cleaned by blasting and/or sweeping and brushing.

3. GEOLOGY

3.1. Ultrabasic rocks

3.1.1. General

The Huskisson serpentinite is comprised of, in order of abundance, dunites, peridotite and pyroxenites with a complete range between the olivine-rich rocks and the pyroxene-rich rocks. Most of the ultrabasics have been partly serpentinitised and such alteration has been complete in the case of all the dunites, some of the peridotites, and a few of the pyroxenites.

3.1.2. Alteration

Serpentinisation of this essentially bi-mineralic suite resulted in distinctive products.

All olivine altered to an antigorite mesh, of grain size directly proportional to the original olivine crystals. Production of secondary magnetite almost certainly related to the iron-content of olivine, resulted from serpentinitisation. Secondary magnetite has a variety of habits, forming individual grains and filaments or where in cleavages, shears and fractures, blebs, often imparting a dark colour and/or banded appearance to the host rock. Thin chrysotile veins were sufficiently porous for the concentration of dusty magnetic opaques as well, and often appear dark.

Serpentinisation of orthopyroxene gave rise to similar but optically continuous antigorite throughout individual crystals. In general there is a dearth of talc, carbonate and chlorite. There is no evidence of magnesia or silica metasomatism. Thermal metamorphism of contact rocks is either slight or absent, indicating a cold intrusion.

3.1.3. Dunite

In thin section the serpentinitised dunite is seen to form a mesh-structure of antigorite due to replacement of olivine. Chromite, primary and secondary magnetite,

4/ manganese, and

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manganese, and chrysotile are generally subordinate components.

Partial alteration of the serpentine minerals to cloudy clay imparts a typical milky green colour to the serpentinised dunite and accounts for their crumbly nature and susceptibility to erosion.

Dunites are best developed in the western part of the ultrabasic giving way to peridotites and pyroxenites elsewhere. This crude layering could be accounted for by early magmatic segregation.

3.1.4. Peridotites

Peridotites and hartzburgites rank a close second to dunite in terms of areal extent.

Serpentinised olivine enclosed by pyroxenes have become either a pale yellow-green or dark black-green antigorite mesh. In the former matrix relict darker green pyroxene crystals are prominent in hand specimen. Complete serpentinisation of olivines and pyroxenes can produce mesh textures identical to those described for dunite.

The peridotites are composed of serpentinised olivine, orthopyroxene and clinopyroxene, with minor chromite and magnetite.

Peridotites are occasionally inhomogeneous and may include small dunitic or orthopyroxenite segregations. Fracture patterns align themselves to outcrop changes in rock composition.

Hartzburgites consist of serpentinised olivine and coarse grained orthopyroxene (bronzite) and could represent the primary magma.

3.1.5. Pyroxenites

The pyroxenites seem to be resistant to serpentinisation. Most are coarse grained orthopyroxenites which contain abundant bronzite crystals as well as minor enstatite crystals. Minor medium-grained serpentinised olivine crystals occur as inclusions in bronzite and accessory chromite occurs interstitially.

Serpentinisation of the mineral constituents is the same as that of other rock types producing mainly greenish black antigorite. Relict pyroxene textures are generally retained or show as pseudomorphs and are the means of identifying this group in the field.

3.1.6. Banded ultrabasics

A feature not clearly understood at this time is the banding or layering in serpentinised rocks which mostly crop out in a narrow roughly linear zone southwards from T2B to C2 within largely pyroxenite areas (see TAS 2-294). This lineament lies between the western dunite

and the eastern peridotites. Development of banding is not continuous.

The banded rocks consist of serpentinitised orthopyroxenite/dunite or serpentinitised peridotite/dunite in layers with sharp contacts and of average width 2" bed which vary from $\frac{1}{2}$ " to 1'. The layers generally strike roughly E-W with moderate to steep dips to the north.

From field observations it would seem that these bands are repetitive and possibly rhythmic and may well represent pseudostratification.

Moderate grade ($\approx 2\%$) chrysotile asbestos usually veins the banded serpentinites, often aligned parallel to the layering.

3.2. Minor intrusives

3.2.1. Norite

A brown, completely oxidised coarse grained igneous rock crops out on the Huskisson north road. This was reported previously as a possible gossan but has been found to be an intensely altered norite. The orthopyroxenes are completely altered to "boxworks" of secondary goethite resembling a gossan boxwork. There are no sulphides. The norite is thought to have affinities to the ultrabasic intrusion in view of the common orthopyroxene content.

3.2.2. Dolerite

A tholeiitic dolerite (microgabbro) occurs at two places along the ultrabasic-sediment contact on the west. The rock is quite fresh but there is no evidence of intrusive character.

"Microgabbro" floats have been reported from the eastern contact as well and two small zones of altered dolerite or fine hornblende gabbro were intersected by DDH1 in sediments close to this ultrabasic contact.

3.2.3. Intrusive acid(?) igneous rock

Acid? igneous rock float was picked up below 40N, 500' within peridotite - and a "?mineralised porphyry" had been reported earlier from 40N, 300'. The presence of an acid or intermediate intrusive is significant in that in other areas, e.g., Thetford, Quebec, intrusion of small granite and syenite bodies are thought to produce intense serpentinitisation and formation of asbestos veining. This intrusive at Huskisson could be correlated with the best asbestos zone nearby.

3.3. Sediments

A thin band of limestone abuts against and is intruded by the serpentinite on its western contact. Further north, quartzite, tuffaceous sandstone, sandstone and conglomerate float were noted.

Sandstone, siltstone and tuff float occurs on the western contact.

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Xenoliths of country rock crop out within the serpentinite at two places. This and the fact that the intrusion as a whole is slightly discordant to the regional rocks leads to the suggestion that the plane of injection was a fault.

3.4. Structure

The Huskisson serpentinite strikes N-S forming a sinuous outline within slightly discordant country rocks (see TAS 2-294). It is thickest, 3,500', in the area of present investigation, just south of Lynch creek, where it bulges out to the east, whereas to the north along the Huskisson river it narrows to 400' and in the south forms thin discordant dykes.

The eastern contact is known to be near vertical but the attitude of the intrusion is unknown.

Considerable variations in dips and strikes of the pseudostratification imply great structural complexity. Internal structure of the serpentinite being that of multiple injection, layering and large scale apophysis development is evident from the sharp intrusive contacts between rock types, and the outcrop pattern.

The presence of xenoliths of country rock caught up in the serpentinite, the intense shearing, fracturing and brecciation, especially at the contacts, and the surrounding relatively low grade of regional and contact metamorphism, indicate a tectonic emplacement, probably before development of the Huskisson syncline.

As the country rocks are folded and contorted with intraformational folding it is possible, although there is no conclusive evidence for this, that the ultrabasic has been sympathetically folded as well.

3.5. Mineralisation

3.5.1. Asbestos

Fine chrysotile cross fibre and slip fibre is present on a microscale in all ultrabasic rock types. However, economic grade asbestos is confined to the serpentinitised pyroxenites and pyroxene rich peridotites.

Chrysotile cross fibre occurs as discrete veins cutting the rock, as numerous fine stringers parallel to the internal pyroxene relict cleavages or parallel to contacts of different ultrabasic rocks, and as stringers of recrystallised but still fibrous material in brecciated zones. Chrysotile filled shears and fractures are most common, frequently incorporating secondary magnetite and manganese oxides.

Fibre colour is a pale translucent fawn except where the chrysotile veins have acted as porous zones for the concentration of dusty magnetic opaques liberated during serpentinisation. The individual fibres are not brittle and

7/ fluff out well when

fluff out well when teased indicating an acceptable strength.

All the fibre is chrysotile asbestos and it is virtually all cross fibre, although minor slip fibre occurs in most shear sections.

The grade is variable longitudinally and latitudinally over any of the fibre zones. The main fibre zone is 100' long by 75-20' wide in a T-shape, and is exposed by costeans AC, BC, and CC near the eastern contact. Asbestos zones are of limited areal extent being discontinuous over relatively short distances.

Orientation of the veins within a zone often follows a polygonal pattern and tends in part to be anastomosing.

The best grades are where the veins curve around fractured boulders, rather like foliation layers. In addition, discrete veins may be aligned parallel to layering in some rocks. Vein widths range from microscopic to 1" but the widest veins are rarely unbroken and are split by fine layers of serpentinite or fine hair-like fractures. These partings are invariably parallel or subparallel to the vein walls. An average vein would be 5/16" wide and split into four 1/32" fibre sections and two 1/16" fibre sections, with the shorter fibre sections separated from each other by 1/32" serpentinite layers and the two 1/16" sections split by a fine hair crack.

Fibre lengths do not exceed 3/16" and measurable lengths are generally in the range 1/32" to 1/16".

3.5.2. Sulphides

One peridotite specimen at 45N, 631' (see TAS 2-294) carries insignificant ultrafine sulphide, probably pentlandite, in what appears to be the cores of larger areas of antigorite after olivine.

4. ASBESTOS GRADE EVALUATION

Two small costean sections, CE1 along 15' of costean AC and CE2 along 10' of costean 35N(0) were cleaned for evaluation by blasting and sweeping (see TAS 2-294).

4.1. Percentage grade

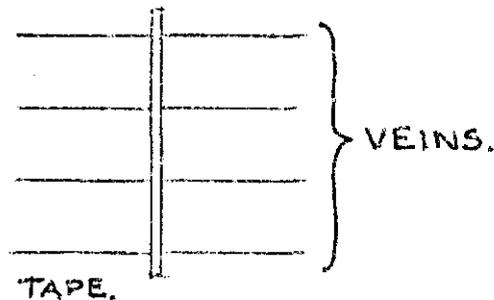
A comprehensive tabulated field evaluation form was designed for use in costeaning and drilling operations by combining and adapting features of both Woodsreef and Canadian Government forms.

Fibre-counts were recorded in the field by laying a tape along the length of the costean and measuring the number, length and angle of incidence of individual veins that cross the tape in each specific interval of five feet. The reason for selecting a five foot interval is to

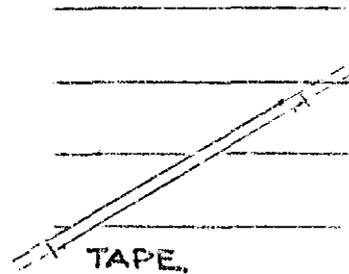
facilitate calculation in that one sixteenth of an inch of fibre in five feet total 960 which approximates 1000 and hence an approximate but direct percentage figure for the fibre content is obtained.

$$\text{Grade \%} = \frac{\sum \text{sixteenths inch}}{1000 (\approx 960)} \times \frac{100}{1} \text{ or } \frac{\sum \text{sixteenths inch}}{10}$$

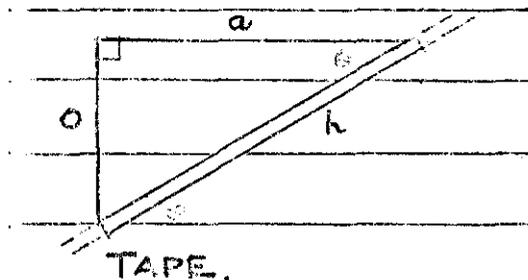
A correction factor for each vein not intersecting the tape at right angles is applied by multiplying its length by a factor (f) which is the cosecant of the angle of incidence.



If the tape is perpendicular to the veins, the maximum number of veins will be intersected and hence the true grade can be obtained.



If the tape is oblique to the veins, less will be intersected and incorporated in grade estimations.



It is necessary to increase each vein length measurement by a factor of $\frac{h}{a}$ i.e. cosec θ where θ is the angle of incidence to the tape.

Results from the evaluations of the two costeans are tabulated on the attached sheets. The percentage figures shown are conservative in that they take no account of slip fibre which could upgrade the milled product. Also, the fibre that is visible on the weathered surface is usually only a proportion of the total fibre in the rock, and it is a safe assumption that if 1% of the surface outcrop is represented by fibre, then the deposit could contain at least 1.5% fibre in the unweathered rock at depth.

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PROJECT. HUSKISSON ASBESTOS

COSTEAN N° CE-1

FOOTAGE 0' - 5'

G E O L O G Y .

VEIN	1/32	1/16	2/16	3/16	4/16	5/16	6/16	7/16	8/16	>1/2	T	f	T.f
10°	 15										1.5	5	7.5
20°	 12	1	1	1							7.5	3	22.5
30°	"	1									2	2	4
40°	 12		1								3.5	1.5	5.25
45°												1.4	
50°												1.3	
60°	 3	 4	1	1							12	1.1	13.2
70°	"		1								3	1	3

Serpentinised pyroxenite

Strike of costean 284°

Σ 1/16^{Hrs} 55.5
Volume% 5.6

PROJECT

COSTEAN N° CE-1

FOOTAGE 5' - 10'

G E O L O G Y .

VEIN	1/32	1/16	2/16	3/16	4/16	5/16	6/16	7/16	8/16	>1/2	T	f	T.f
10°	 3										3	5	15
20°	 2 1/2	1									3.5	3	10.5
30°												2	
40°		1									1	1.5	1.5
45°												1.4	
50°												1.3	
60°												1.1	
70°												1	

Serpentinised pyroxenite

Strike of costean 231°

Σ 1/16^{Hrs} 27
Volume% 2.7

011
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PROJECT HUSKISSON ASBESTOS

COSTEAN N° CE-1

FOOTAGE 10' - 15'

GEOLOGY.	VEIN	1/32	1/16	2/16	3/16	4/16	5/16	6/16	7/16	8/16	>1/2	T	f	T.f	
		Serpentinised pyroxenite Strike of costean 231°	10°	1 1/2	1									1.5	5
20°													3		
30°	1 1/2		1									1.5	2	3	
40°													1.5		
45°													1.4		
50°	 2 1/2		1										3.5	1.3	4.55
60°	1 1/2		 4		1 3								7.5	1.1	8.25
70°	 4 1/2		 3										7.5	1	7.5

Σ 1/16 lbs 30.8
Volume% 3.1

PROJECT

COSTEAN N°

FOOTAGE

GEOLOGY.	VEIN	1/32	1/16	2/16	3/16	4/16	5/16	6/16	7/16	8/16	>1/2	T	f	T.f
			10°											
20°													3	
30°													2	
40°													1.5	
45°													1.4	
50°													1.3	
60°													1.1	
70°													1	

Σ 1/16 lbs
Volume%

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PROJECT. HUSKISSON ASBESTOS

COSTEAN NO CE-2

FOOTAGE 0' - 5'
35N(0) 155' - 161'

GEOLOGY.	VEIN	1/32	1/16	2/16	3/16	4/16	5/16	6/16	7/16	8/16	>1/2	T	f	T.f
Serpentinised pyroxenite Strike of costean 124°	10°												5	
	20°		'									1	3	3
	30°												2	
	40°		'	'								3	15	45
	45°	"	"	"	1							11	14	15.4
	50°		3	1	3								13	
	60°	"										1	1.1	1.1
	70°	"		"		1						9	2	9

Σ 1/16ths 33

Volume% 3.3

PROJECT

COSTEAN NO CE-2

FOOTAGE 5' - 10'
35N(0) 161' - 166'

GEOLOGY.	VEIN	1/32	1/16	2/16	3/16	4/16	5/16	6/16	7/16	8/16	>1/2	T	f	T.f
Serpentinised pyroxenite Strike of costean 124°	10°												5	
	20°												3	
	30°												2	
	40°	"										2	15	3.0
	45°	2		1								2	14	2.8
	50°			2									13	
	60°	"	"									3	1.1	3.3
	70°	1	2										1	

Σ 1/16ths 9.1

Volume% .91

4.2. Fibre lengths and product

With fibre lengths of no greater than 3/16" and generally in the range of 1/32" to 1/16" the Quebec Standard Grade for such a product could be between 5D (paper fibre) and 6D (waste, stucco or plaster) or even lower (see Table 2).

5. CONCLUSIONS

5.1. Geological

The Huskisson serpentinite is a petrologic and structural complex of ultrabasic rock formed possibly by multiple injections of differentiation products from a theoretical peridotite magma. The mass is slightly transgressive to the invaded sedimentary rocks. One intrusion phase of pyroxenitic rocks includes sections of hypothetically magmatic-differentiated layers in situ.

Asbestos mineralisation favours the pyroxenitic rocks but has limited areal extent, being discontinuous over relatively short distances, and is considered to be generally of low grade.

5.2. Project outcome

Evaluation showed beyond all reasonable doubt that there is little likelihood of an economic deposit of asbestos in the Huskisson serpentinite.

6. PLANS

TAS 2-293	Huskisson Asbestos Location Plan
TAS 2-294	Huskisson Asbestos Geology

M. FIGOTT

March 1972

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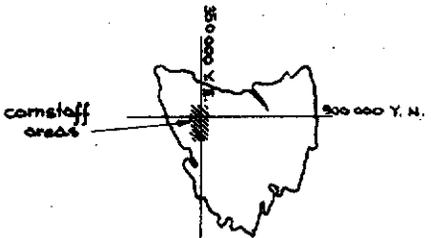
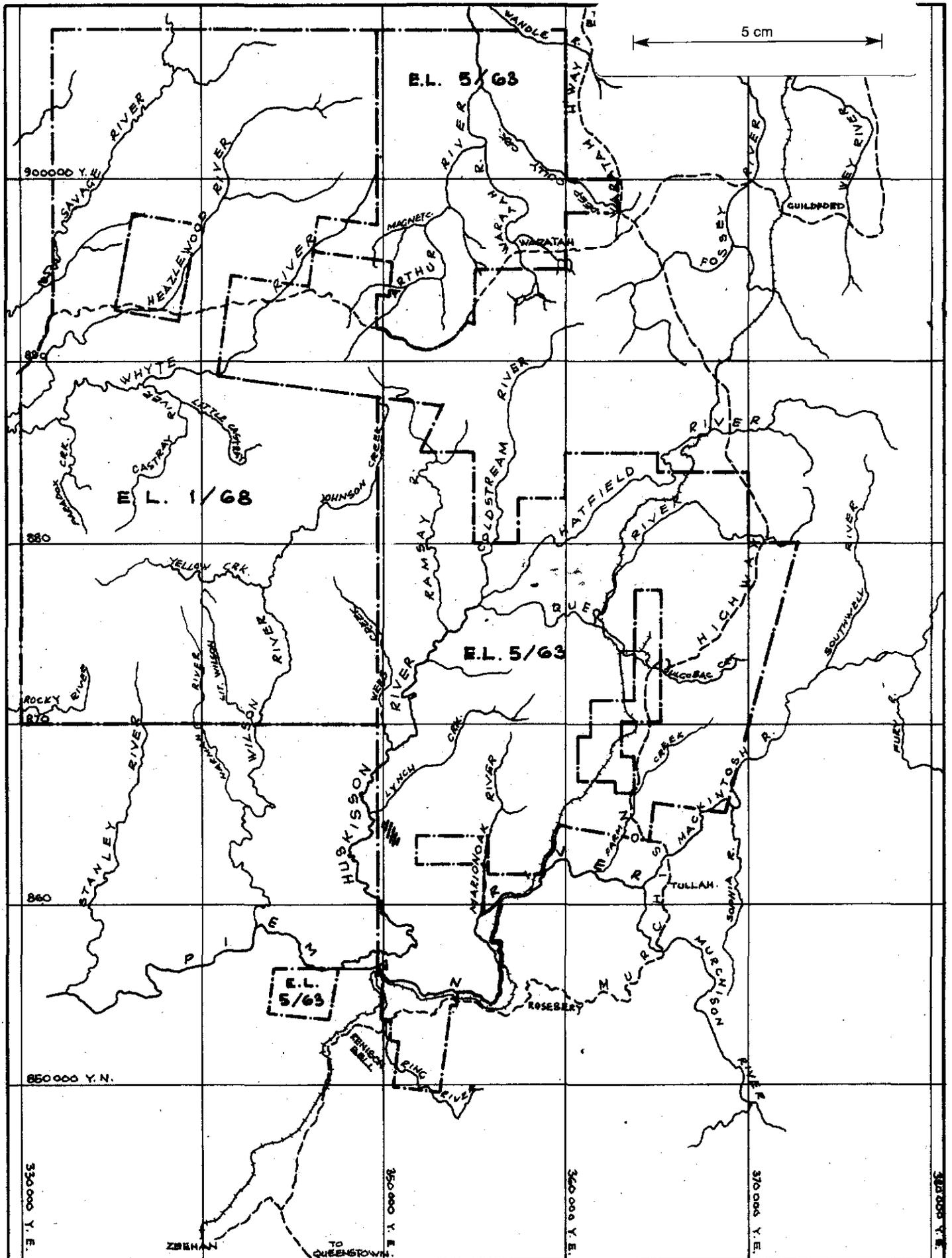
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TABLE 2

QUEBEC STANDARD GRADING SYSTEM

<u>GRADE</u>		<u>FIBRE LENGTH</u>			
		<u>+ 1"</u>	<u>4</u> <u>Mesh</u>	<u>10</u> <u>Mesh</u>	<u>Pan</u>
No.1	Crude - All over 3/4"			(2/16" 3/16")	1/16"
No.2	Crude - All over 3/8"				
3F	Spinning or textile fibre	10.5	3.9	1.3	0.3
3K		7	7	1.5	.5
3R		4	7	4	1
3T		2	8	4	2
3Z		1	9	4	2
4A	Shingle fibre	0	8	6	2
4D		0	7	6	3
4H		0	5	8	3
4K		0	4	9	3
4M		0	4	8	4
4T		0	2	10	4
4Z		0	1.5	9.5	5
5D	Paper fibre	0	.5	10.5	5
5K		0	0	12	4
5R		0	0	10	6
6D	Waste, stucco or plaster	0	0	7	9
7D	Refuse or shorts	0	0	5	11
7F		0	0	4	12
7H		0	0	3	13
7K		0	0	2	14
7M		0	0	1	15
7R		0	0	0	16
7T		0	0	0	16
			1.7	6.7	7.6
7RF	Floats - No test				
7TF	Floats - No test				
8S	Sand - No test				
8T	- No test				
				Mill product weighing between 35 pounds and 75 pounds per cubic foot loose measure.	
9	Gravel and stone			Mill product weighing over 75 pounds per cubic foot loose measure.	

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HUSKISSON ASBESTOS

LOCATION PLAN

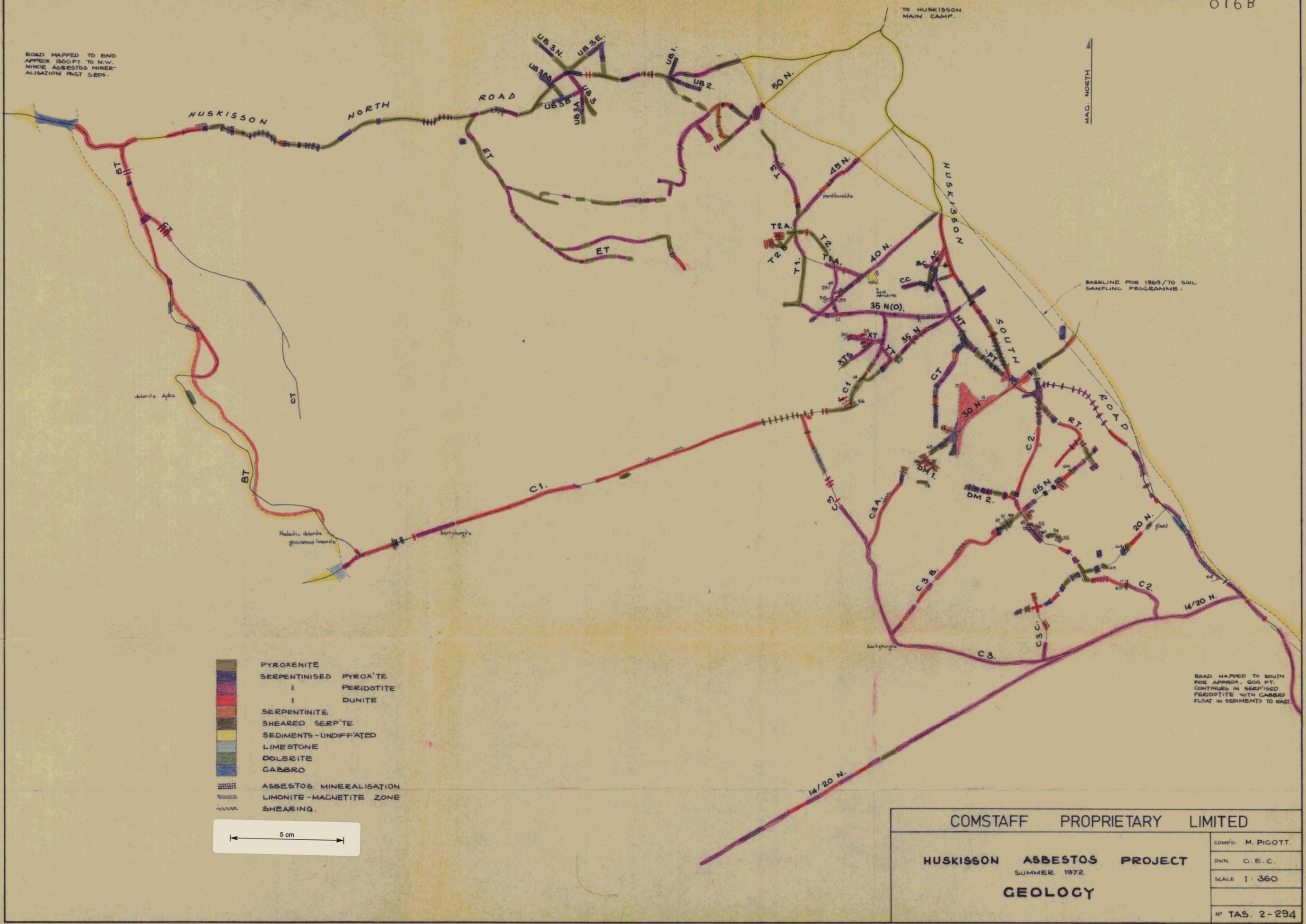
DRAWN G.C.	COMPILED	SCALE 1:250,000.	TAS-2-293
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016A

016B

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ROAD MAPPED TO END APPROX 1800 FT. TO N.W. MINOR ASBESTOS MINERALISATION PAST SEDS.



BASELINE FOR 1969/70 SOIL SAMPLING PROGRAMME.

- PYROXENITE
- SERPENTINISED PYROXITE
- PERIDOTITE
- DUNITE
- SERPENTINITE
- SHEARED SERP'TE
- SEDIMENTS - UNDIFF'ATED
- LIMESTONE
- DOLERITE
- GABBRO
- ASBESTOS MINERALISATION
- LIMONITE-MAGNETITE ZONE
- SHEARING.

5 cm

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HUSKISSON ASBESTOS PROJECT	
SUMMER 1972	
GEOLOGY	
COMP'D. M. PIGOTT.	
DWN. G. E. C.	
SCALE 1: 360	
N° TAS. 2-294	