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SML 58, SML 82, SML 82A AND SML 82B

MOUNT FITTON AREA

PROGRESS AND TECHNICAL REPORTS FOR THE PERIOD 1/7/63 TO 30/6/71

Submitted by
Industrial Rock Mines Pty Ltd
1970

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PRIMARY INDUSTRIES AND RESOURCES SA

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TENEMENT HOLDERS: Industrial Rock Mines Pty. Ltd.

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GEOLOGICAL SURVEY OF SPECIAL MINING LEASE NO. 58

MT. FITTON AREA, S.A.

Interim Report

to

Industrial Rock Mines Pty. Ltd.

by

E.K. Sturmfels, D.Sc.
Consulting Geologist

With 3 Plates

Diamond Creek,
Victoria

29th June, 1964

Contents

Summary

Talc occurs in the Mt. Fitton area in a massive recrystallized dolomite of Proterozoic age. The larger talc deposits are concentrated on its margins. This massive dolomite cuts through bedding and formation boundaries and available evidence suggests that it was originally a limestone reef. The dolomite is much affected by shearing, whilst the overlying less competent beds have been folded. Talc occurrences are invariably connected with shear zones and shear faults. It is thought that a combination of metasomatic and structural processes might be responsible for the preferential location of talc deposits along the margins of the dolomite : shearing might have weakened the rock and opened the way for metasomatic replacements.

Introduction

According to instructions received I mapped geologically parts of the Mt. Fitton area, S.A., within the boundaries of Special Mining Lease No. 58, between 10th October and 20th November, 1963, and again between 20th March and 5th April, 1964, as a first step of a comprehensive exploration program. A total of about four weeks was spent on a regional survey, and the remainder of the time on the mapping of individual deposits.

Talc occurrences, the main target of the Company's exploration program, were known to be restricted to a large body of massive dolomite, and all major deposits had been found close to its edge (Plate 1). The regional geological survey therefore concentrated on the dolomite area and tried in particular to solve the stratigraphical and structural relationships between dolomite and adjoining rocks and their bearing on the formation of talc.

The dolomite and its boundary were mapped with the aid of air photographs enlarged to a scale of 1 inch = 400 feet, a scale of sufficient size to allow even minor structural features to be shown. For the purposes of this report, this map has been reduced to a scale of 1 inch = 1000 feet (see Plates 2 and 3).

Stratigraphic Sequence

Alluvial soils and gravels occur along some of the larger creeks, in particular along Mundawatana Creek.

High-level gravels (possibly of Pleistocene age) cover a small basin on the eastern side of the area mapped. A thin irregular veil of such gravels to the south (in the vicinity of 29°55'S, 139°28'E) conceals in places the underlying dolomites, but has not been shown on the map.

The bulk of the rocks in the area belongs to the Proterozoic (Adelaide System). The massive dolomite seems to represent a local thickening of thin dolomite beds as they occur elsewhere in the Yankaninna Formation (1). The contact with the underlying boulder tillites of the Bolla Bollana Formation is probably unconformable. Upwards the dolomite seems to cut through at least one formation boundary and to reach close to the top of the Amberoona Formation, as shown in the diagram (Fig. 1). The diagram also indicates that most formations get thinner in a northerly or north-easterly direction or pinch out altogether.

The rocks of the Proterozoic in the area investigated have been subject to a fairly low degree of metamorphism :

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(1) These formations have been defined by R.P.Coats, 1964, Geol. Surv. S. Aust., Quart. Notes 9, pp. 7-12.

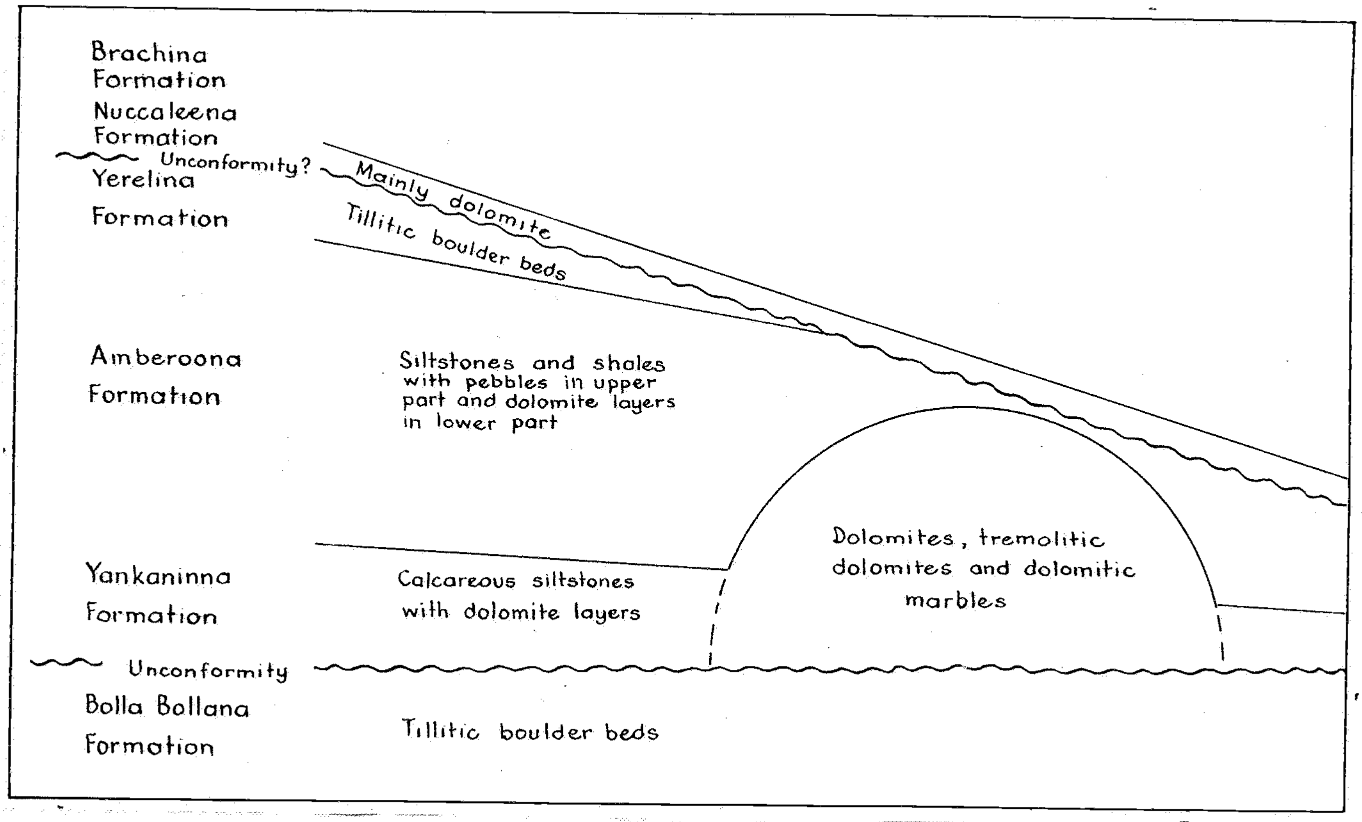

Fig. 1 : Probable stratigraphic correlations, Mt. Fitton area, S.A. (2).
Approx. vertical scale : 1 in.= 4,000 ft.

the dolomites were recrystallized to dolomitic marbles ; tremolite and scapolite are probably derived from what were originally impurities in the dolomite ; and epidote and zoisite occur in the overlying siltstones and shales.

Massive Dolomite - Host Rock of Mineralization

The massive dolomite covers an area of 16.5 sq.miles, almost entirely within Special Mining Lease No. 58. To the north, the dolomite continues as a thin bed, not more than 40 or 50 ft thick, for some distance. To the south, any continuation there might have been has been cut off by faulting. Bedding is rarely visible and few reliable strike and dip readings could be obtained. I estimate the maximum thickness of this dolomite mass at perhaps 5,000 or 6,000 ft.

Dolomite marbles, sheared dolomites and tremolitic dolomites are the main rock types present. Rocks consisting predominantly of tremolite occur in places. Silicified

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(2) Formation names and definitions after Coats, R.P., 1964, Geol. Surv. S.Aust., Quart. Notes 9, pp. 7-12 ; Dalgarno, C.R., and Johnson, J.E., 1964, Geol. Surv. S.Aust., Quart. Notes 9, pp. 12-15 ; and B.G. Forbes (personal communic.)

dolomites were noticed in the vicinity of major talc deposits, but they do not seem to extend to any depth. I suspect that they might be of secondary origin, perhaps formed, like duricrust, during a period of more intense weathering. Black tremolitic dolomites and black siltstones occur near the lower formation boundary between Billy Spring and Mundawatana Creeks, and siltstone layers similar to the siltstones which overlie the formation are interstratified with dolomites near Billy Spring (3).

The present form of the dolomite mass has been shaped by shearing and only to a minor degree by folding. There are no indications of flowing and the great variations in thickness as they appear today must have existed in the original sediments. The boundary of the massive dolomite can be seen in many places to form angles with the direction of bedding ; siltstone beds extend across this boundary into the massive dolomite ; whilst elsewhere dolomite beds part from the main body of dolomite and continue into the overlying siltstones. All these features suggest that the dolomite mass was originally a limestone reef, probably formed by calcareous algae.

Structure

The regional dip in the area mapped is to the west, but is modified by folding and faulting. Most dip readings were in the range 10^{o} to 50^{o}.

The massive dolomite as the more competent material reacted to compressional stress mainly by shearing, whilst the overlying rather incompetent thin-bedded siltstones, shales and dolomite layers were folded. Steeply dipping to vertical shears and shear zones traverse the whole of the dolomite area ; along most of them individual displacement was small to negligible (4). Of the two conjugate shear directions, the west-north-west set is very much better developed. Shears striking south-west to west-south-west are found near Billy Spring and in the extreme south of the area.

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(3) For details of rock composition see the petrological study by Stillwell, F.L., and Edwards, A.B., 1951, Geol. Surv. S.Aust., Bull. 26, pp. 101-108.

(4) Only shear faults with noticeable displacement are shown on the geological map.

Major strike faults separate the massive dolomite from the underlying tillitic boulder beds near Billy Spring, from the overlying siltstones and shales (equivalents of the Amberoona Formation) to either side of Mundawatana Creek, and from siltstones of doubtful stratigraphic position south of Mt. Livingston.

Talc Deposits

The geological map (Plates 2 and 3) shows all talc occurrences as they were known in March, 1964. During the last three months, in the course of an intensive prospecting campaign, B.S. Easdown has located many more, but no detailed information is available as yet.

Composition and appearance of the talc may vary from place to place as well as within one and the same deposit. Chlorite, dolomite, tremolite and pyrite might be important harmful constituents which can adversely affect the quality of the product.

Talc deposits are found invariably within the dolomite mass along lines or zones of shearing, most of them along the prevalent steeply dipping to vertical west-north-west set, and only a few along the conjugate south-west to west-south-west set. At No. 6 Deposit (and possibly also in one or two other places) talc follows two sets of flatly dipping shears which are arranged to either side of minor anticlinal west-north-west striking folds, not unlike the shearing at Bendigo, which is responsible for its famous saddle reefs.

All the known major deposits are very close to the edge of the dolomite. In some cases the apparent distance on the map might be quite large, but because of rather flat dips the original direct distance to the top of the dolomite (before it had been removed by erosion) was very much shorter. In the case of Lademan and Standley's Deposit (5), for instance, which is on the map nearly half a mile away, the direct distance was probably not more than 400 or 500 ft.

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(5) Held as a Mineral Claim and therefore not covered by Special Mining Lease No. 58.

It is a common feature of talc deposits of this type to be restricted to dolomite rocks which could supply the necessary magnesia. The prevalence of talc deposits in the marginal zone of the dolomite is not unique either, but much harder to understand. On the face of it, it could be explained as a stratigraphic, as a metasomatic, or as a structural phenomenon :

(1) A bed of a particular composition might have favoured the deposition of talc.

(2) A metasomatic exchange of ions between dolomite and overlying siltstones might have provided a sufficient amount of silica to form talc close to the boundary.

(3) Shearing as a rule does not provide open spaces where mineral deposition could take place, but it does weaken the rock and permit easy penetration by solutions. Where shears are coupled with anticlinal folds, their direction might conceivably grade into that of tension cracks, leaving open spaces suitable for mineralization.

As has been pointed out above, the dolomite cuts across formation boundaries and the bulk of it appears to be massive without any indications of bedding. Layers with a different composition have been found in places, but not anywhere near the major talc deposits.

Under metamorphic conditions a metasomatic replacement of carbonate rocks can undoubtedly take place. However, there is no evidence for such a process on a regional scale.

In all cases examined, the occurrence of talc appeared to be restricted to shear zones, as already mentioned. The larger talc deposits were found where the dolomite is cut by a number of shear faults. Only traces of talc were seen where the boundaries of the dolomite are not faulted at all or are formed by major strike faults. No. 4 and No. 5 Deposits occur in what could be interpreted as anticlines, but no such correlation could be put forward for many of the other talc occurrences.

A combination of metasomatic and structural processes seems to be the most likely explanation of the features observed. Under this concept, talc would be formed where shearing has weakened the rock and opened the path for metasomatic replacements, and the amount of talc deposited would depend largely on amount and intensity of shearing.

Tremolite which is widespread throughout the whole dolomite and occurs in talc too, was probably formed well before the talc as a product of general metamorphism.

Other Mineral Occurrences

Low-grade tremolite asbestos has been found in several places on the western side of the dolomite area. What appears to be the largest of these occurrences is situated about ¾ mile west of No. 7 Deposit. The fibres are short and brittle and the material seen so far would be quite unsuitable as an industrial asbestos.

What seems to be a fairly extensive deposit of crystalline magnesite occurs on the southern and south-western flank of Mt. Livingston. In places, the magnesite is interbedded with, or occurs in the immediate vicinity of, talc lenses.

Small occurrences of red and yellow ochre near Mt. Livingston are recorded as mineralogical curiosities.

Superficial occurrences of manganese oxides have been found in several places, some rather prominent ones about ½ mile south of the Camp. Manganese occurrences of this type invariably deteriorate rapidly towards depth, and if they are not very extensive and reasonably high-grade on the surface, they are not likely to be of any consequence.

The Billy Spring Mine with its mixed and refractory ore of lead, zinc and copper lies a few hundred feet above the massive dolomite (6). A thin copper vein occurs not far from the Camp. Recently, B.S. Easdown when prospecting found quite a number of further lead and copper showings in various parts of the dolomite area (7).

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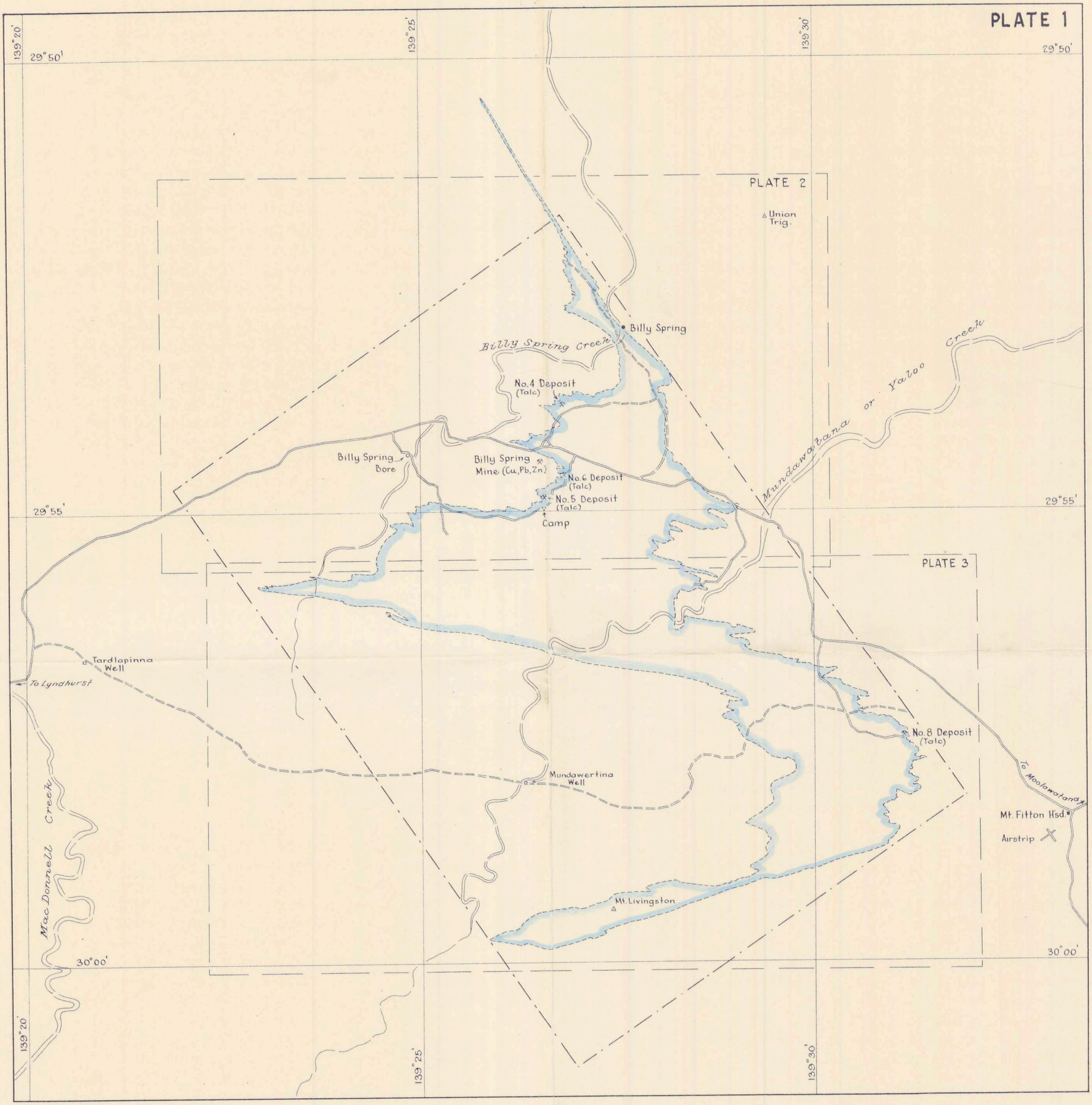
(6) The Billy Spring Mine is subject of a separate Mineral Lease and therefore not covered by Special Mining Lease No. 58. For a description see Nixon, L.G.B., 1960, Dpt. Mines S.Aust., Min. Rev. 112, pp. 19-25.

(7) Information regarding the precise location of these occurrences is not available as yet and they could therefore not be shown on the accompanying plans.



LOCALITY MAP
MT. FITTON AREA, S.A.

SCALE: 1 INCH = 1 MILE

0 1 2 3 MILES

Road (suitable for trucks)

Track (for four-wheel drive vehicles)

Special Mining Lease No. 58

Mine or open cut

Massive dolomite

6048

E.K. Sturmfels, 15/4/64


INTERIM GEOLOGICAL MAP
MT. FITTON AREA, S.A.
SPECIAL MINING LEASE NO. 58
SHEET 1
SCALE : 1 INCH = 1000 FEET
0 1000 2000 3000 4000 FEET
Road suitable for trucks
Track for four-wheel-drive vehicles
Triangulation station or cairn
Building
Shaft
Spring
Well
Water bore
Boundary of Special Mining Lease
Formation boundary, established or indicated
" " , inferred
Boundary of separate bed
Fault, established or indicated
" , inferred
Strike and dip of bedding, inclined
" " " " " , vertical
Strike and dip of fault, inclined
" " " " " , vertical
Mineral occurence (width in feet)
ab = asbestos (tremolite)
Cu = copper
mg = magnesite
Mn = manganese
oc = ochre
Pb = lead
ta = talc
Zn = zinc
Quaternary
1 Alluvium
2 High-level gravels
Proterozoic
3 Siltstones and shales (Amberoona Formation ?)
A Dolomite bed
4 Recrystallised dolomites (Yankaninna Formation ?)
B Siltstone bed
5 Massive tillites and quartzites (Bolla Bollana Formation ?)
E. K. Sturmfels, 15/4/64
139°25'
139°30'
29°55'
29°51'45"S. 139°26'45"E.
29°54'44"S. 139°21'50"E.
Union Trig
Billy Spring
Billy Spring Creek
No. 1 DEPOSIT
No. 4 DEPOSIT
LEWIS DEPOSIT
Billy Spring Bore
To Lyndhurst
BILLY SPRING MINE
No. 6 DEPOSIT
No. 5 DEPOSIT
No. 7 DEPOSIT
Office
Camp
LADEMAN & STANDLEYS
Proposed Landing Ground
Yaloo Creek
Mandawertina Creek
For continuation see Sheet 2
NMF 38
604-9


PLATE 3
For continuation see Sheet 1
LESLIES
Mundawatana
or
Yaloo
Creek
CREEK JUNCTION DEPOSIT
No. 8 DEPOSIT
Mundawertina Well
Mt. Lavington
30°00'
Road suitable for trucks
Track for four-wheel-drive vehicles
Triangulation station or cairn
Building
Shaft
Spring
Well
Water bore
Boundary of Special Mining Lease
Formation boundary, established or indicated
" " , inferred
Boundary of separate bed
Fault, established or indicated
" , inferred
Strike and dip of bedding, inclined
" " " " " , vertical
Strike and dip of fault, inclined
" " " " " , vertical
Mineral occurence (width in feet)
ab = asbestos (tremolite)
Cu = copper
mg = magnesite
Mn = manganese
oc = ochre
Pb = lead
ta = talc
Zn = zinc
Quaternary
1 Alluvium
High-level gravels
Proterozoic
2 Siltstones and shales (Amberoona Formation?)
3 Dolomite bed
4 Recrystallised dolomites (Yankaninna Formation?)
5 Siltstone bed
6 Massive tillites and quartzites (Bolla Bollana Formation?)
INTERIM GEOLOGICAL MAP
MT. FITTON AREA, S.A.
SPECIAL MINING LEASE NO.58
SHEET 2
SCALE: 1 INCH = 1000 FEET
0 1000 2000 3000 4000 FEET
604-10
E.K. Sturmfels, 15/4/64

147/65 Env. SR 604

INDUSTRIAL ROCK MINES PTY. LTD.

013

Miners and Suppliers of INDUSTRIAL MINERALS

Registered Office: 65 Beach Street, Port Melbourne, *Telephones:* Melbourne 64 2611 (5 lines), Mt. Egerton 34
Proprietors of Mt. Egerton Fine Clay Co., Lillicur Diatomaceous Earth Quarries, Taralga (N.S.W.) Calcite Quarries, Gumeracha (S.A.) Talc Mines

14th September, 1966.

The Director of Mines,
Department of Mines,
Box 38,
Rundle Street Post Office,
ADELAIDE, S.A.

Dear Sir,

Re. Special Mining Lease No. 82
(formerly No. 58)

The following is the progress report (Administrative) for the 6 months ended 30th June 1966 in connection with the above lease.

DRILLING PROGRAM.

The drilling program which it was anticipated would be completed during this period was deferred because of equipment difficulties.

The program involves the completion of approximately 18,000 feet of drilling in a period of about 6 weeks using an Air-trac drill with ancillary sample collection equipment. A problem arose in obtaining a suitable sample collector for the purpose, there being many types of this equipment in use, but none which met our particular requirements. In February it was decided to design and make our own sample collector and as at 30th June the design was still the subject of controversy, but has since been finalised and the equipment is at the time of writing almost ready for preliminary field test.

It is now apparent that we will not be able to get this program under way until after the new year.

FIELD WORK.

Some further trenching was completed on Prospect No. 24 (see our 2nd Technical Report) and as a result of this it has been decided to take up this deposit and work it at an early date.

Further trenching work was also completed on Prospect No. 22 but results here remain inconclusive.

In addition, although not strictly a matter covered by the above Mining Lease (which is for talc and magnesite only) a prospecting program was carried out in search of a workable deposit of crystalline tremolite. This occupied approximately 12 man weeks of labour and involved the use of heavy plant, but was in general unsuccessful. It established the existence only of very large quantities of tremolitic dolomite of no apparent commercial value.

OTHER ACTIVITY.

Collation of results to date was completed during the period and our second full technical report was lodged with your Department on 29th June 1966.

EXPENDITURE.

Money spent in connection with the project during the period covered by this report was $2870, bringing the total expenditure since work commenced under the previous lease to $16742.

Yours faithfully,
INDUSTRIAL ROCK MINES PTY. LTD.,

W. M. SHARPE.
Director.

NOTED
Director of Mines

SHEET 1
INDUSTRIAL ROCK MINES PTY. LTD.
SPECIAL MINING LEASE NO. 82 (ex-58)
MT. FITTON AREA, S.A.
SCALE: 1 INCH = 1000 FEET
0 1000 2000 3000 4000 FEET
Road suitable for trucks
Track for four-wheel-drive vehicles
Triangulation station or cairn
Building
Shaft
Spring
Well
Water bore
Formation boundary, established or indicated
" " , inferred
Boundary of distinct bed
Fault, established or indicated
" , inferred
Strike and dip of bedding, inclined
" " " " " , vertical
Dolomite host rock
Talc deposit worked in open cut
Talc vein or stringer, position established
" " " " , position approximate
Area with manganese
Magnesite deposit, position established
Area with magnesite occurrences, approximate extent.
Other minerals, worked in open cut
" " , minor occurrence
ab = asbestos (tremolite)
Cu = copper
Mn = manganese
ms = magnesite
oc = ochre
Pb = lead
sch = scheelite
ta = talc
Zn = zinc
Boundary of Special Mining Lease
Boundary of Mineral Lease or Claim
Talc prospect outside existing Mineral Lease suggested for further exploration
This plan is based on a geological map prepared by E.K. Sturmfels and on information obtained by the Company's personnel in 1964 and 1965
W.M. Sharpe, Manager
15/3/66
Union Trig
Billy Spring
Billy Spring Creek
Billy Spring Bore
To Lyndhurst
No. 4 DEPOSIT
No. 1 DEPOSIT
LEWIS DEPOSIT
BILLY SPRING MINE
No. 6 DEPOSIT
No. 5 DEPOSIT
No. 7 DEPOSIT
LADEMAN & STANDLEYS
Camp
Office
Landing Ground
Yaloo Creek
Mandawalana
29°55'
139°25'
139°30'
For continuation see Sheet 2

ENV 604-6


SHEET 2
For continuation see Sheet 1
LESLIES
Yaloo or Creek
Mundawatana
CREEK JUNCTION DEPOSIT
No. 8 DEPOSIT
Mundawertina Well
Mt Livingston Spring
Mt Livingston
Road suitable for trucks
Track for four-wheel-drive vehicles
Triangulation station or cairn
Building
Shaft
Spring
Well
Water bore
Formation boundary, established or indicated
" " , inferred
Boundary of distinct bed
Fault, established or indicated
" , inferred
Strike and dip of bedding, inclined
" " " " " , vertical
Dolomite host rock
Talc deposit worked in open cut
Talc vein or stringer, position established
" " " " , position approximate
Area with manganese
Magnesite deposit, position established
Area with magnesite occurrences, approximate extent
Other minerals, worked in open cut
" " , minor occurrence
ab = asbestos (tremolite)
Cu = copper
Mn = manganese
ms = magnesite
oc = ochre
Pb = lead
sch = scheelite
ta = talc
Zn = zinc
Boundary of Special Mining Lease
Boundary of Mineral Lease or Claim
Talc prospect outside existing Mineral Lease suggested for further exploration
This plan is based on a geological map prepared by E.K. Sturmfels and on information obtained by the Company's personnel in 1964 and 1965
W.M. Sharpe, Manager
15/3/66
To Mt Fitton and Moolawatana
INDUSTRIAL ROCK MINES PTY. LTD.
SPECIAL MINING LEASE NO. 82 (ex-58)
MT. FITTON AREA, S.A.
SCALE: 1 INCH = 1000 FEET
0 1000 2000 3000 4000 FEET
30°00'
ENV 604 - 7

TALC AND OTHER MINERAL PROSPECTS
ON SPECIAL MINING LEASE NO. 82 (FORMERLY NO. 58)
MT. FITTON AREA, SOUTH AUSTRALIA

Second Technical Report

to

Mines Department of South Australia

by

Industrial Rock Mines Pty. Ltd.

With 2 Plates

Industrial Rock Mines Pty. Ltd.,
65 Beach Street,
PORT MELBOURNE.

W. M. Sharpe,
MANAGER.

17th June 1966.

Contents

Plates: Industrial Rock Mines Pty. Ltd. - Special Mining Lease No. 82 (ex-58), Mt. Fitton Area, S.A. Date 15:3:66 (in Two sheets).

Summary

Some 15 talc prospects which warrant further investigation have been located on Special Mining Lease No. 82; one is a deposit which was worked to a small extent in the past, but all others are untouched. Numerous deposits of crystalline magnesite have been found which warrant further investigation. Surface indications are of at least 1½ million tons of this mineral with magnesium carbonate content of between 92% and 96%. Showings of manganese oxides, and small showings of copper, lead and zinc, tremolite asbestos, ochre and turquoise are not regarded as of likely economic significance.

Introduction

Following a geological survey of the area of Special Mining Lease No. 82 (formerly No. 58) (see report dated 29th June 1964 by E. K. Sturmfels D.Sc. entitled "Geological Survey of Special Mining Lease No. 58 Mt. Fitton Area S.A.") a prospecting reconnaissance was undertaken during the period March 1964 to December 1965.

The whole of the outcropping dolomite host rock was covered at 50 ft. traverse intervals by Company personnel who recorded all showings of talc and other minerals.

Showings thus recorded were appraised by the Company's geological consultant Dr. E. K. Sturmfels.

Samples taken in the course of this work were in general submitted only to identification tests, but in the case of manganese oxides and magnesite some quantitative analysis was undertaken.

This report is not concerned with prospects occurring on existing mineral leases and claims within the boundaries of the Special Mining Lease.

Talc Prospects

A large number of talc occurrences have been found in the area, ranging from mere traces up to widths of 40 or 50 feet.

All occurrences recorded are shown on the accompanying plates.

In the following list however, only those appraised as worthy of further investigation are recorded. The numbers correspond to the same identifying numbers on the plates.

(11) An at least 25 ft. wide talc lens concealed at either end under silicified siltstone overburden. A substantial deposit could be present.

(12) Talc appears to occur over an area of several thousand square feet near the crest of a ridge. Scratching with a bulldozer, which was apparently done a few years ago, has destroyed much surface evidence. Colour of exposed talc is poor.

(13) Talc in a 45 ft. wide rabbit warren occurs on the same line as talc lenses within ML 3156 and could therefore indicate presence of a deposit of some length.

(14) A nearly 100 ft. wide zone of talcose slates adjoining the faulted dolomite-siltstone contact passes into talc towards the east. As the fault and the dolomite-siltstone contact appear to dip to the south, the talcose slates could be underlain by a large talc deposit.

(15) A talc lens which might have reserves of 100 to 200 tons per vertical foot. Quality of exposure varies from off-white to tremolitic.

(16) "Leslie's Deposit". A lens of about 100 to 150 tons per vertical foot which has previously been worked to produce a few hundred tons of first grade or near-first grade. The lens appears likely to continue to greater depth.

(17) Outcrops of talc extend over a fairly large area high on a ridge. The quality on the whole seems fairly good, but individual lenses are not very large, the largest lens carrying hardly 100 tons per vertical foot.

(18) Talc is exposed on the top of a land slide on Mundawatana Creek. A trench has shown the talc has a width of 19 ft. and that quality is variable, but on an average probably second-grade.

(19) Fairly flat dipping talc, which is visible along a 200 ft. water course, but concealed elsewhere under overburden, could form part of a deposit of considerable size.

(20) Isolated occurrences are distributed over a considerable area covered otherwise by rubble or scree. A trench has exposed talc interbedded with dolomite layers over a width of 26 feet.

(21) Several rabbit warrens on a fairly large ironstone flat have brought talc to the surface and suggest the possibility of a sizeable talc deposit. A 4 ft. test pit was entirely in soft decomposed talc, and a second 3½ ft. pit in soil and talc pieces. Fresh talc has not been encountered and its quality is not known.

(22) An extensive and impressive outcrop of white or near-white talc, with an apparent width of up to 45 feet, but appears also to be interspersed with dolomite.

(23) A bifurcated occurrence of rather hard, light-grey, translucent talc contains between 100 and 150 tons per vertical foot. Talc of similar appearance which grinds to a nice white colour occurs on the same line, 1,200 feet to the east, but in small linses.

(24) An isolated lens of greyish translucent talc seems to exhibit a particularly good colour when ground. Apparent high quality is offset by small size and remote location.

(25) A number of small talc outcrops, with the remainder being concealed under overburden, could indicate the presence of a 20 to 30 ft. wide talc lens.

Magnesite Prospects.

Magnesite occurrences have been found in many parts of the area. In most cases the magnesite appearing to issue from fractures or shear zones, and to replace dolomite beds. The occurrences appear to be independent of the distribution of other minerals, and to be restricted, stratigraphically speaking, to the lower part of the dolomite mass.

The largest concentrations have been found to the north of the No. 1 Talc Deposit; between 1 and 2 miles east of the camp; and on the slopes of Mt. Livingston.

On surface indications there would appear to be at least 1½ million tons of magnesite in the area.

Seven samples from separate locations, carefully taken and considered to be characteristic of the material which forms the bulk of the three main occurrences mentioned above, were analysed at the Company's Port Melbourne Laboratory, and yielded the following results:

General Location	Percentages.				
	$MgCO_3$	$CaCO_3$	Fe_2O_3	Al_2O_3	SiO_2
Larger Area Mt. Livingston.	92.8	0.7	2.1	2.0	3.6
Larger Area Mt. Livingston.	93.0	0.6	1.7	3.2	3.3
Smaller Area Mt. Livingston.	93.5	0.8	2.0	2.1	3.1
1 to 2 miles East of Camp.	95.6	1.0	2.2	1.4	1.4
1 to 2 miles East of Camp.	95.0	0.4	3.0	0.8	0.7
1 to 2 miles East of Camp.	93.0	0.6	2.7	1.3	0.8
North No. 1 Talc Deposit.	95.1	0.9	2.6	1.3	0.8

The unweathered magnesite is light bluish-grey in colour and of crystalline structure.

Further investigation is proposed.

Other Minerals

Occurrences of manganese oxide, though in places prominent on the surface are regarded as unlikely to extend to any depth, and to be in the main of low grade. A number of selected specimen samples were analysed at the Company's Port Melbourne laboratory and yielded the following results:

Approximate Location		Percentages			
		Total Mn Exp'd. as MnO_2	MnO_2 by Avble Oxygen Method	Acid Insol-ubles.	Fe_2O_3
½ Mile Sth. Camp. Specimen	1.	8.2	-	4.88	2.62
"	2.	2.7	-	2.30	2.34
"	3.	27.2	19.7	3.10	4.60
"	4.	10.4	-	5.08	2.28
"	5.	57.4	45.9	19.10	4.35
"	6.	80.7	61.5	4.96	4.44
1 Mile Sth. Camp. Specimen	1.	8.4	-	4.90	12.80
"	2.	4.6	-	5.32	4.79
"	3.	8.4	-	4.28	9.14
"	4.	21.8	13.9	3.68	13.33

Approximate Location.			Percentages. Total Mn Exp'd. as MnO_2	MnO_2 by Avble Oxygen Method	Acid Insol-ubles.	Fe_2O_3
Vicinity "Leslie's" Talc Deposit.	Specimen	1.	5.7	-	2.20	6.02
	"	2.	6.5	-	2.54	14.49
	"	3.	10.0	-	5.24	5.92
	"	4.	24.1	16.2	4.68	5.37

Weak copper, lead and zinc mineralisation has been observed in a number of places in the dolomite, but nothing which would even remotely approach a prospect of economic significance has been found. In view of the proximity of the zinc-lead-copper ore of the Billy Springs Mine, which occurs in the overlying siltstones, the degree of mineralisation in the dolomite is rather lower than might have been expected.

Other minerals which have been found include tremolite asbestos, ochre and turquoise, but none of these seems to be present in sufficient size or quality to warrant further investigation: the fibres of tremolite asbestos are short and brittle and unsuitable for industrial purposes; while ochre and turquoise are only mineralogical curiosities.

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MAGNESITE IN THE MT. FITTON AREA
SOUTH AUSTRALIA

(SPECIAL MINING LEASE NO. 82)

Report

to

Industrial Rock Mines Pty. Ltd.

by

E.K. Sturmfels, D.Sc.,
Consulting Geologist

With 4 Plates

Diamond Creek,
Victoria

17th April, 1967

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SUMMARY

Crystalline magnesite has been found in the Mt. Fitton area in many places in a 12 miles long belt which follows the lower edge of a dolomite mass of late-Proterozoic age. The Mt. Livingston Deposit with indicated reserves of 1½ million tons is situated on a steep slope high above the valley and could be worked with ease. Bulk samples from the surface indicate an average of over 93% magnesium carbonate ; lime is practically absent, but silica, alumina and iron contents are fairly high. The Deposit 1 Mile East of Camp and others are much smaller and more irregular, interfingering with country rock, but they seem to carry less silica and alumina. Total inferred reserves could be of the order of 5 to 10 million tons. The magnesite was probably formed by replacement of dolomite in the course of magmatic activity in nearby areas. The possible use of magnesite from these deposits is severely restricted, partly because of its composition, but more so because of the distance from transport.

INTRODUCTION

The presence of magnesite in the Mt. Fitton area had not been known until a geological survey of the Company's Special Mining Lease No. 58 (now No. 82) in 1964 stumbled unexpectedly on the Mt. Livingston Deposit. In the following year G. Laver, the Company's prospector, found a large number of magnesite occurrences along the eastern side of the main dolomite mass. The Mt. Livingston Deposit is in rather a remote position, but elsewhere some quite conspicuous outcrops were found within a few hundred yards of well beaten roads or tracks : prospectors and geologists like myself must have passed them or even walked over them many a time quite unawares.

Distribution and approximate extent of the numerous occurrences were plotted by the Company's prospector and an undergraduate from Adelaide during two short prospecting campaigns in 1965. I surveyed three of the more impressive deposits in some detail in the same year, and I have seen most of the other occurrences, but the unpromising economic prospects did not seem to justify a closer examination at this stage. For the same reason, no subsurface work such as driving or drilling has been done, and no information is therefore available on the composition away from outcrops and on the likely extent towards depth.

In this report I have collated the information collected to date, as requested.

DISTRIBUTION OF MAGNESITE

The magnesite of the Mt. Fitton area is crystalline, with a greenish, greyish or brownish tone. A brown surface crust is due to weathering. It is very similar in appearance to certain types of dolomite, and it can be differentiated from dolomite only by its higher weight. Bromoform has proved to be useful during prospecting and field work : magnesite sinks slowly, dolomite rises very slowly, and calcite rises quite fast, provided there is no excessive amount of iron.

The host rock of the magnesite is identical with the host rock of the Flinders talc deposits : a massive dolomite of Upper Proterozoic age at the northern end of the Flinders Range. This dolomite mass takes its place in the Adelaide System between the Lower and the Upper Glacial Beds, overlying the former unconformably. It consists of crystalline dolomites, sheared dolomites and dolomites with tremolite. Its thickness varies between less than a hundred feet and 5,000 or 6,000 ft over a distance of only a few miles. The bedding where discernible is comparatively flat ; individual dip readings range from 10° to 50° ; the average regional dip is about 20° or 25° to the west. I suspect that this thick dolomite mass is derived from a limestone reef which has been slightly deformed.

All outcrops of magnesite occur close to the eastern and southern margins of the dolomite, that is stratigraphically speaking in its lower horizons. Areas with magnesite are shown on Plate 1. In most cases such areas comprise a large number of small magnesite occurrences with dolomite occupying the greater part of the surface.

Three areas were chosen for further investigations : the deposit at Mt. Livingston because of its obvious size, the Deposit 1 Mile

East of the Camp because it appeared to be the largest one apart from Mt. Livingston, and the Deposit ¼ Mile North of No. 1 Talc Deposit because of conspicuous outcrops and alleged size. Each one of these three deposits though probably of the same origin presents a different appearance as will be shown below. From what I have seen it seems that most other magnesite occurrences would present an outcrop pattern similar to that of the Deposit One Mile East of the Camp, though in most cases less extensive.

MT. LIVINGSTON DEPOSIT

This deposit occurs on the south-western flank of Mt. Livingston and in the upper half of a nearly thousand foot escarpment. Mt. Livingston is the highest point (2,020 ft) of a small, but quite impressive range along the southern edge of the dolomite. The escarpment is the topographical expression of a near-vertical fault which separates the hard crystalline dolomite from much softer shales and siltstones to the south. Fault and escarpment can be traced for a distance of about 5 miles.

The deposit is within a hundred feet of this fault line (Plate 2). It includes one large continuous though irregular lens in the centre, covering about 3 acres, a medium-sized one to the west, a smaller one to the north, and a number of small isolated patches on the eastern side. Together they extend over a length of 1,100 ft, a width of 400 ft, and a vertical range of nearly 400 ft. The slope is in places steeper than 1 in 1.

The larger magnesite lens seems to be cut off on its south-eastern side along lines parallel to the main fault. I suspect that these are minor faults en échelon, which are closely associated with the origin and emplacement of the magnesite. However, scree and slope wash largely conceal the contact and make it difficult to prove its nature.

Strike and dip can be traced from the surrounding dolomite into the magnesite ; the regional strike is about 60° or 70°, (true bearing), roughly parallel to the bearing of the main fault, and the average dip, between 45° and 50° to the north-west. The elongation of the main magnesite body follows the same south-west direction, and either bedding or faulting could be the determining factor.

Small talc veins occur. The talc lenses on the south-eastern edge of the magnesite are all off-colour, greyish or chloritic. Many occupy small shear zones (bearing about 90° - 100°) which are arranged in relation to the main direction of movement (about 65°) as are the barbs to the shaft of a feather ("pinnate shears"). Neither shearing nor talc veins have been observed in the complementary direction. One small talc lens well away from the main fault, on the northern side of the magnesite, was found to carry talc of an exceptionally white colour, equal to the best, but reserves are negligible and access would be extremely difficult.

Bulk samples were taken in three places after drilling and firing. The slightly discoloured outer layers of the magnesite were discarded as they might have been affected by weathering. Analyses of the fresh material by the Company's Laboratory showed an average of 93.1% magnesium carbonate, little lime, but high silica, alumina and iron contents (Table 1). However, it must be admitted that sample localities were chosen with a certain, though unavoidable bias, and are therefore not necessarily truly representative : because of the difficult terrain and the weight of the drill bulk samples could be taken only from places which were reasonably accessible, and the prominent rock faces which were chosen might well have been prominent because of a silica content higher than average. It is therefore possible that the true average composition is slightly different from that shown in the Table.

Table 1 : Bulk Samples from Mt. Livingston Deposit

Sample No.	285	287	288	Average
SiO_2	3.6	3.3	3.1	3.3
Al_2O_3	2.0	3.2	2.1	2.4
Fe_2O_3	2.1	1.7	2.0	1.9
MgO	44.4	44.5	44.7	44.5
CaO	0.4	0.3	0.4	0.4
$MgCO_3$	92.8	93.0	93.5	93.1

The three lenses of the Mt. Livingston Deposit together carry some 13,400 tons of magnesite per vertical foot (for details see Table 4). Country rock which occurs as lenses within, or as tongues protruding into, the magnesite and which would need to be removed in the course of open cut operations is estimated at an additional 3,030 tons per vertical foot. However, this figure (and the other figures for country rock shown in Table 4) do not include any rock which might have to be excavated for the construction of adits, benches, or other engineering purposes.

In the absence of any drilling or underground workings, expectation of extent towards depth and estimates of reserves must be based largely on geological premises. I therefore prefer to leave the problem of reserves until the various magnesite deposits and their origin have been discussed.

The Mt. Livingston Deposit is obviously very suitable for open cut working down to a level somewhat below the lowest level at which magnesite is exposed. Further down, provided the magnesite persists, a modified form of glory hole from which the material could be extracted through tunnels would substantially reduce the amount of waste to be moved. A steep drop of some 400 or 500 ft would in either case permit easy disposal of waste and overburden down the slope.

Transport would probably be the most difficult problem any operator would have to face. The shortest route of access from the railway siding at Lyndhurst would follow the main road eastwards to a point halfway between Mt. Freeling Homestead and the Flinders Talc Mine, and then a track to Mundawertina Well. From this well onwards a new road would be required : it would first run through flat country to the northern side of Mt. Livingston, and then in a half-circle around the western end of the Mt. Livingston Range to a loading point below the deposit, a distance of about 4½ miles. Additional expenditure would be required for improving the existing 7 or 8 mile long track from Mundawertina Well to the turnoff. The total distance to Lyndhurst is about 80 miles.

To get the magnesite from the deposit itself to the loading point below, a simple chute would probably suffice. Alternatively a loading point could be established at the northern side of the mountain. This would reduce road transport by about 2½ miles and cut down costs for road construction, but would require an over 4,000 ft long belt conveyor.

DEPOSIT ONE MILE EAST OF CAMP

To the east of the Company's camp a chain of magnesite outcrops extends for a distance of over a mile to the eastern side of the dolomite mass. The most prominent exposures are found where a creek has cut a fairly steep valley, about a mile east of the camp, and this area has been mapped in some detail (Plate 3).

Magnesite and dolomite outcrops are closely interwoven in a pattern more irregular than that of Mt. Livingston. The alignment of magnesite lenses indicates a preference for the main direction of shearing (about 120° and nearly vertical), whilst the edges of the lenses follow in many cases what seems to be a complementary direction of jointing (about 50°). Strike and dip in the magnesite lenses, where it can be recognized, is identical with strike and dip in the surrounding dolomite ; the dip is generally flat, exceeding 20° only occasionally. Strike and dip also control the arrangement of dolomite tongues within the magnesite, as for instance very clearly east of Stn. 1045.1.

As at Mt. Livingston, bulk samples were taken after drilling and firing and the discoloured outer crusts were generally discarded (Samples 301-303, Table 2). An additional sample was taken because of its superior colour (Sample 304). Silica and alumina contents were found to be substantially lower than in the Mt. Livingston samples, but iron oxide, apart from Sample 304, slightly higher.

Table 2 : Samples from Deposit One Mile East of Camp

Sample No.	301	302	303	304	
Type of sample	Bulk sample	Bulk sample	Bulk sample	Grab sample	Average
SiO_2	1.4	0.7	0.8	1.5	1.1
Al_2O_3	1.4	0.8	1.3	1.6	1.3
Fe_2O_3	2.2	3.0	2.7	1.2	2.3
MgO	45.7	45.4	44.5	45.5	45.3
CaO	0.6	0.2	0.3	0.4	0.4
$MgCO_3$	95.6	95.0	93.0	95.2	94.7

Two small areas of magnesite could possibly be worked, the larger one to the north of the creek bend, and the smaller one to the west (Plate 3). Together they contain 2,860 tons per vertical foot. Lenses, layers and protruding tongues of country rock, which would need to be excavated in an open cut together with the magnesite, amount to an additional 1,460 tons per vertical foot. The available tonnage per vertical foot is thus much lower than at Mt. Livingston and the ratio of waste to magnesite, considerably higher. Estimates of reserves will be given in a later chapter.

The deposit can easily be reached from the road to Mt. Fitton and Moolawatana Homesteads. An access road could turn off at the run-through, first heading south to the creek, and then upstream along the southern bank of the creek, a distance of less than a mile. A direct road from the Company's camp would be slightly longer. The total distance to Lyndhurst Railway Siding either way would be about 80 miles.

DEPOSIT ¼ MILE NORTH OF NO. 1 TALC DEPOSIT

Impressive outcrops of magnesite about ¼ mile north of No. 1 Talc Deposit and 2 miles north-north-east of the camp rise steeply from the surrounding undulating dolomite area and present the appearance of a substantial deposit. To show that this impression is misleading and that magnesite occupies only a very minor part of the surface, the most striking exposures were mapped in some detail (Plate 4).

The magnesite lenses dip at about 25°-30° to the west or south-west conformably to the bedding of the country rock. Three parallel narrow and near-vertical veins which branch off from them consist of blobs of magnesite only a few feet long alternating with ferruginous dolomite. At a bearing of about 80° the veins follow joints which are complementary to the predominant direction of shearing; westwards they are cut off sharply where the dolomite is overlain by siltstone.

In view of the small size of the deposit only one bulk sample was taken and analysed (Table 3). It shows a composition similar to the samples from the Deposit One Mile East of Camp, with comparatively little silica and alumina, but a fairly high iron content.

Table 3 : Bulk Sample from Deposit ¼ Mile North of No. 1 Talc Deposit

Sample No.	305
SiO_2	0.8
Al_2O_3	1.3
Fe_2O_3	2.6
MgO	45.5
CaO	0.5
$MgCO_3$	95.1

The two larger lenses carry together only 570 tons of magnesite per vertical foot. Protruding tongues of dolomite and dolomite layers in between amount to another 220 tons. Similar lenses occur further to the south, but even so the limited surface extent coupled with a flat dip suggest that total reserves would be very small.

The deposit is best reached by branching off the Mt. Fitton and Moolawatana road and turning north just beyond the run-through, following the track to Billy Springs for about 1¾ miles, and then heading westwards through open country for less than ½ mile.

ORIGIN AND RESERVES

As subsurface information is lacking completely, an evaluation of likely extent and reserves must depend on the posed origin of the magnesite : if deposited together with the surrounding sediments we would look along the strike for a possible continuation or repetition, but if formed from solutions rising from depth we would expect a predominantly vertical arrangement.

The three deposits described though varying considerably in size and appearance are otherwise very much alike. In all three, magnesite forms irregular lenses in dolomite. The shape of the lenses seems to be determined by joint, shear and fault lines as well as by the strike and dip of the original sediments ; in many places this strike and dip has been preserved in the magnesite and conforms closely to that of the surrounding dolomite. Minerals associated with the magnesite include talc (at Mt. Livingston) and ferruginous dolomite veins (¼ mile North of No. 1 Talc Deposit).

Available evidence thus suggests that the magnesite deposits were formed by the replacement of dolomite. Whether this dolomite was the original sediment or whether it was in the first place a limestone which was transformed into dolomite by some diagenetic or metamorphic process is immaterial for our purposes.

The solutions responsible were apparently of magmatic origin, rising along fault or shear zones, then spreading sideways and replacing the dolomite, preferably following bedding planes. What might have been one of the channelways which carried the mineralizing solution is exposed along the southern edge of the Mt. Livingston Deposit : a near-vertical plate-like body of coarse-crystalline magnesite. The extent of replacement varies from place to place : in the Deposit One Mile East of Camp some of the magnesite layers are only a few feet thick, alternating with unreplaced dolomite beds of similar width, but at Mt. Livingston the magnesite body extends uninterruptedly over a vertical thickness of at least 200 ft.

Chemically the replacement process seems to have introduced magnesia and a minor amount of iron and carried away practically all the lime. As the molar volume of magnesite is 13% smaller than that of dolomite and since there are no obvious indications of reduction in volume such as breccias or major cavities, it must be assumed that the attacking solutions also carried a surplus of CO_2. Silica and alumina, on the other hand, judging from the few available analyses of dolomite from the area, were probably constituents of the original sediment.

The magnesite occurrences are restricted to the eastern and southern sides of the dolomite mass, which represent the stratigraphically lower horizons, as has already been mentioned. This peculiar distribution could be due to the greater vicinity to the magmatic source (granitic rocks occur a few miles to the east), or alternatively to a property of the lower dolomite beds, which made them more suitable for replacement. I rather favour the first explanation.

A deposit of obviously the same origin and very similar composition, but larger, occurs some 30 miles to the south on Balcanoona Station. The origin of the magnesite deposits near Copley, on the other hand, is doubtful : magnesite and dolomite form alternate layers not more than a few feet thick in a series of calcareous shales ; an origin as a primary sediment has been postulated, but an origin by replacement does not seem to be impossible.

Deposits of crystalline megnesite in other countries, including the major exporters of the Steiermark, Austria, and the Liao-tung Peninsula, Manchuria, resemble those of the Mt. Fitton area in most respects : they occur as lenses in dolomites or limestones ; they usually carry a few percent of silica, alumina and iron oxide, and they are frequently associated with siderite deposits or other iron-rich phases. It is generally agreed that these deposits were formed by the replacement of an original carbonate rock by a solution of magmatic origin, probably rich in volatile matter and thus particularly mobile. However, the actual mechanism of the reactions which took place is still a matter of controversy.

From the mode of emplacement as outlined above we can predict that the individual magnesite lenses in the Mt. Fitton area will follow largely the existing strike and dip of the beds. On the other hand, to find repetitions of the lenses we must follow the mineralizing channel-ways downwards. In cross section we may expect the deposits to have the shapes of one-sided pine trees mutilated by the ~~S.E.C.~~ HOLG, with the trunk representing the main channelway and the branches the individual replacement bodies.

Indicated reserves include those parts which are exposed and the size of which can be estimated with some confidence. Where the bedding dips into the hill the elevation of the lowest exposures has been used as the bottom of indicated reserves ; where the bedding rises in the same direction, the lowest exposed bedding plane has been used. We thus obtain the following figures for indicated and readily available reserves : Mt. Livingston, 1,500,000 tons, Deposit One Mile East of Camp, 150,000 tons, and Deposit ¼ Mile North of No. 1 Talc Deposit (investigated parts only), 19,000 tons. For details see Table 4.

Table 4 : Reserves of Deposits Investigated

	Tons per vertical foot		Ratio waste to magnesite	Indicated reserves of magnesite tons
	Magnesite	Country rock as layers or tongues in magnesite		
Mount Livingston Deposit				
Lens A	10,000	2,700	27:100	1,250,000
" B	2,870	90	3:100	245,000
" C	530	240	45:100	5,000
Total	13,400	3,030		1,500,000
Deposit 1 Mile East Camp				
Area A	1,970	1,220	62:100	140,000
" B	890	240	27:100	10,000
Total	2,860	1,460		150,000
Deposit ¼ Mile North of No. 1 Talc Deposit	550	210	38:100	19,000

Inferred reserves cover the extent of magnesite below the lowest exposures and are based on geological albeit reasonable deductions. No definite figures can be given at the present stage. However, if we admit the posed origin and shape of the deposits as described above, we can reasonably expect that inferred reserves will be of the order of several million tons in the Mt. Livingston Deposit and several hundred thousand tons in the Deposit One Mile East of Camp. Total reserves in the Mt. Fitton area could be between 5 and 10 million tons.

POSSIBLE USES

As magnesite is hardly used in its natural state, possible uses depend entirely on its chemical composition. In comparison with magnesite from other sources the Mt. Fitton material is distinguished by its low lime content. The silica content in the Deposit One Mile East of Camp is reasonably small by world standards ; the average content of samples from the Mt. Livingston Deposit is too high, but as has been explained is not necessarily as large throughout the deposit. Contents of alumina and iron oxide are high in both deposits. Table 5 compares Mt. Fitton magnesite with other Australian sources.

Table 5 : Composition of Australian Magnesites

	Fifield B.H.P. Specific. (4)	Fifield Average 1939/43 (1)	Fifield Average grade shipped (2)	Balcanoona Grab sample 1957 (3)	Balcanoona Average grade (4)	Copley 861 ton parcel (1)	Mt. Fitton Area 1 Mile East Camp	Mt. Fitton Area Mt. Livingston
SiO_2	2.0 max.	2.13	2.13	2.64	.	)	1.1	3.3
Al_2O_3	1.5 max.	0.95	0.45	.	.	) 5.9	1.3	2.4
Fe_2O_3	.	0.26	0.5	1.18	1.8	)	2.3	1.9
MnO	.	0.15	.	.	.	.	.	.
MgO	45.0 min.	44.62	45.5	44.6	.	44.0	45.3	44.5
CaO	2.0 max.	2.20	1.2	0.96	.	2.6	0.4	0.4
$MgCO_3$	.	93.3	95.2	93.3	.	92.0	94.7	93.1

Dead-burned magnesite, a refractory which can withstand basic slags and high temperatures, is used in the steel and copper industries and in certain types of rotary kilns. The Australian consumption of dead-burned magnesite amounts to between 50,000 tons and 55,000 tons a year, corresponding to between 100,000 and 110,000 tons of raw magnesite. B.H.P., the main consumer, obtains part of its requirements from Fifield and the remainder from overseas.

Caustic-calcined magnesite is used in a number of industries, but total annual consumption in Australia is only about 6,000 or 7,000 tons (corresponding to 12,000-14,000 tons of raw magnesite). No statistics detailing the various uses are available, but the following seem to be the main consumers : glass industry (2,000-3,000 tons of caustic-calcined magnesite), farming (1,500-2,000 tons), asbestos-magnesia insulation (about 1,000 tons), oxychloride cement (750-1,000 tons), fused magnesia (500-1,000 tons) and other chemicals (about 500 tons). The paper industry could be a future important consumer of caustic-calcined magnesite, using it for sulfite paper pulp.

For use as a refractory, lime is an objectionable impurity ; alumina should not exceed 1% or 2%, but a certain amount of silica is acceptable, particularly if the magnesite is intended for the bottom of an open hearth furnace ; and a few percent of iron oxide are quite desirable. In many cases where the original iron content is too low

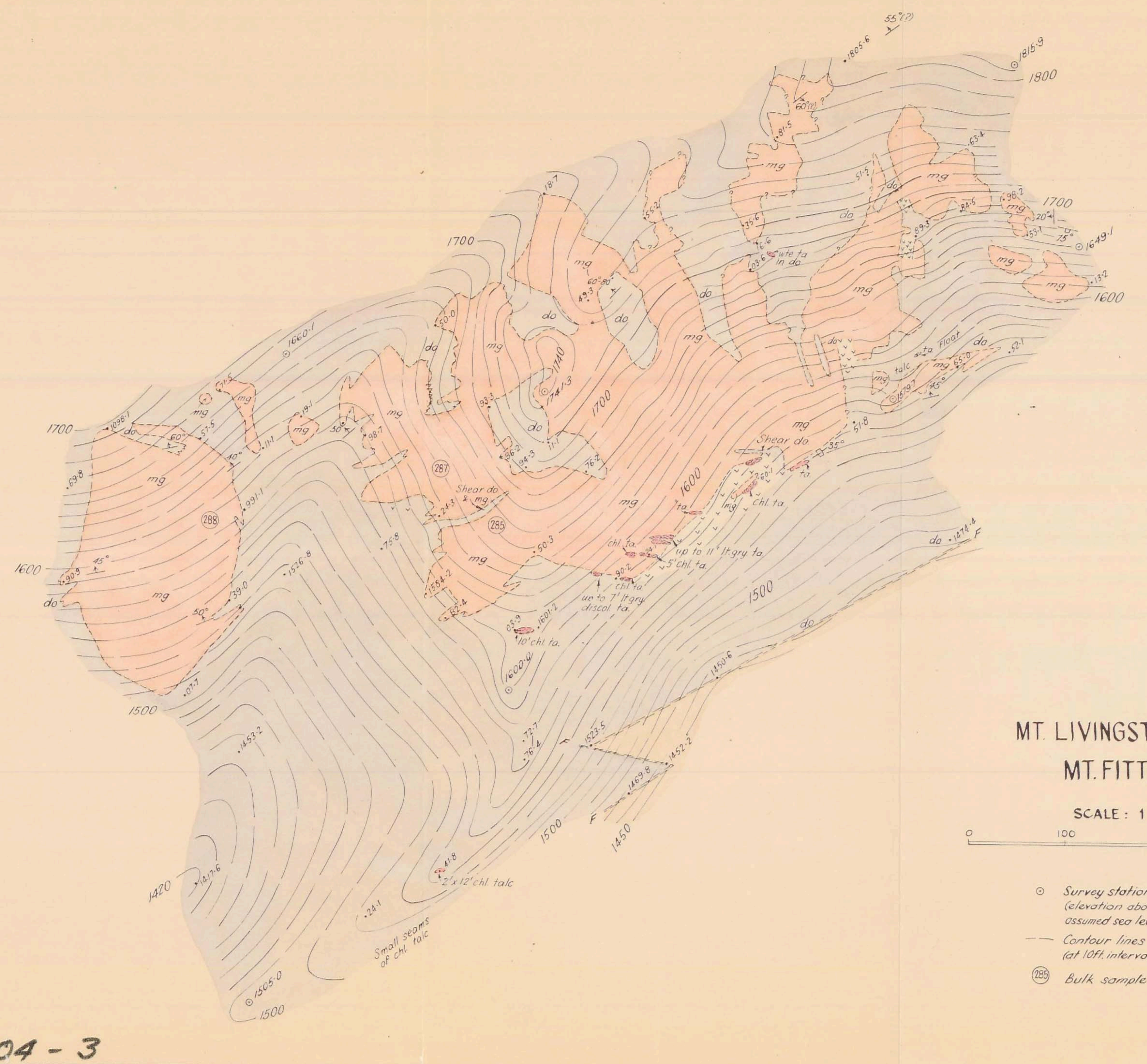
(1) Fisher, N.H., 1946 : Bur. Min. Res. Aust., Mineral Resources of Australia No. 11
(2) McLeod, I.R., 1965 : Bur. Min. Res. Aust., Bull. 72, p. 386
(3) Nixon, L.G.B., 1959 : Dpt. Mines S. Aust., Min. Rev. 108, pp. 82/83
(4) Swan, D.A., 1965 : Report for Industrial Rock Mines Pty. Ltd. of 16/9/65

finely powdered iron ore is actually added to the kiln charge. On present indications it would appear that magnesite from the Deposit One Mile East of Camp would pass, whilst magnesite from the Mt. Livingston Deposit would be slightly below standard. However, it is worth noting that the Balcanoona Deposit with a composition apparently very similar to that of Mt. Livingston has been seriously considered by B.H.P. as a source of magnesite for its furnaces.

The glass industry, apparently the largest consumer of caustic-calcined magnesite, requires a raw material with less than 0.1% Fe_2O_3 ; only the highest grades qualify. For oxychloride cement the low lime content of Mt. Fitton magnesite would be quite suitable, but the fairly high iron content would probably cause discolouration. The iron content would also be excessive for paper pulp, but would not matter for asbestos magnesia insulation, stock feed and acid neutralization.

Another disadvantage of Mt. Fitton magnesite, in addition to its chemical impurities, would be the distance from rail and coast : road transport of 80 miles and rail transport of another 173 miles to Port Augusta. However, despite its remote position, I understand that magnesite from this area could be sent to the East Coast at a price similar to, or possibly even slightly lower than, Fifield magnesite, provided sufficient large sales, say some 70,000 or 80,000 tons per year, could be established. Of course transport costs could be reduced to nearly half if the magnesite were burned nearby. This is not quite as impossible as it might sound. Leigh Creek coal could conceivably be carried as back-loading, or better still the gas pipe from the fields in the north-east of the State might pass in the vicinity and natural gas could become available.

Because of the double handicap of shortcomings in composition and high transport charges it is unlikely that Mt. Fitton magnesite could compete overseas. B.H.P. has its own ample supplies at Fifield and Balcanoona, and the Mt. Fitton material does not seem to be suitable for many consumers of caustic-calcined magnesite. It is thus unlikely that any larger-scale sales for this magnesite could be found just now. However, the world demand for magnesite is still increasing, and the establishment of a new iron and steel industry in Australia, independent of B.H.P., if it should ever take place, could well provide a substantial outlet.



MT. LIVINGSTON MAGNESITE
MT. FITTON AREA, S.A.

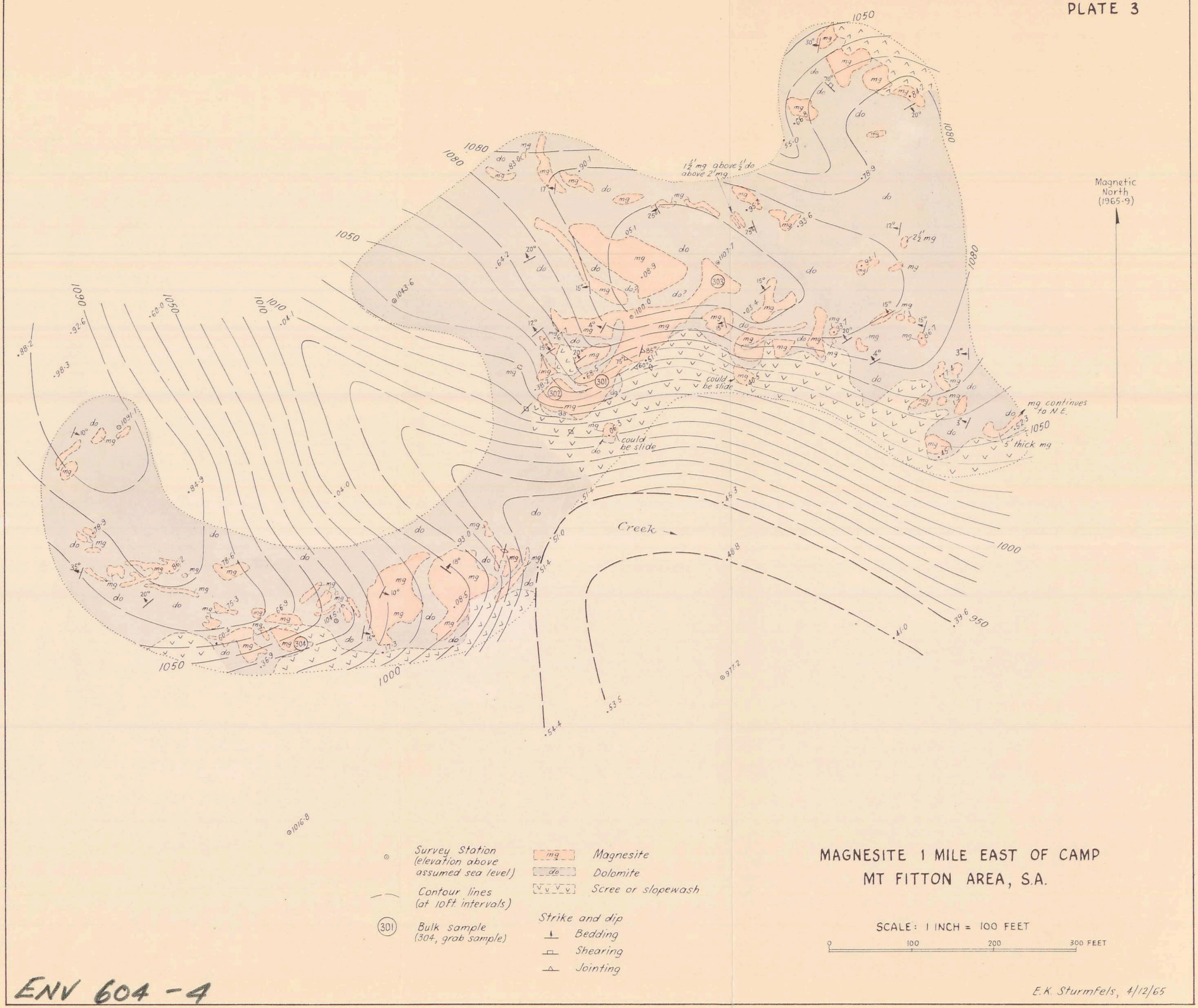
SCALE: 1 INCH = 100 FEET

0 100 200 300 400 FEET

E.K.Sturmfels 14/6/65

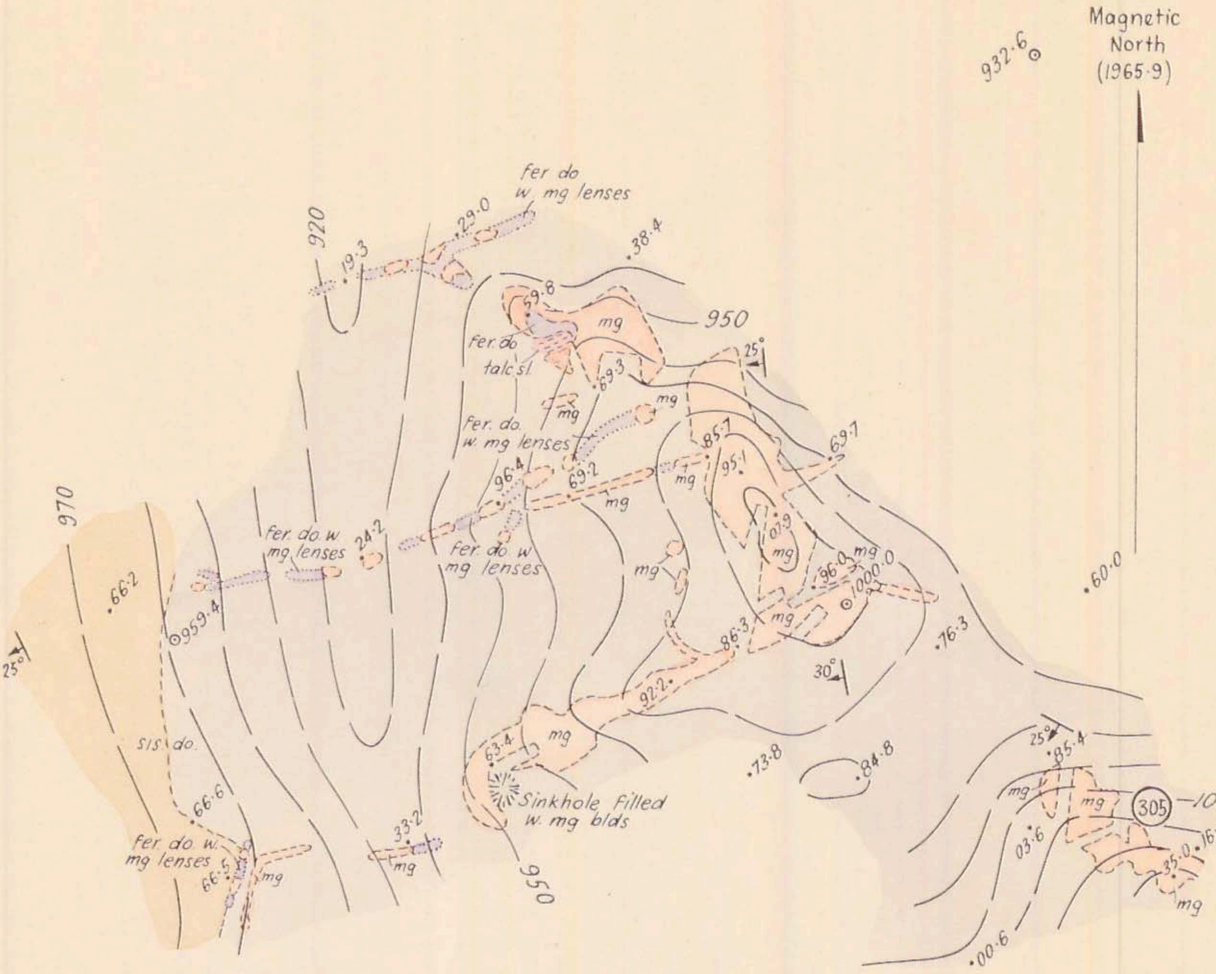
ENV 604 - 3

PLATE 3



MAGNESITE 1 MILE EAST OF CAMP
MT FITTON AREA, S.A.

PLATE 4



MAGNESITE
¼ MILE NORTH OF Nº1 TALC DEPOSIT
MT FITTON AREA, S.A.

SCALE: 1 INCH = 100 FEET

0 100 200 300 FEET

⊙	Survey Station (elevation above assumed sea level)	mg	Magnesite
		Fer do	Ferruginous dolomite
⌒	Contour lines (at 10 ft. intervals)	do	Mostly dolomite
		Talc sl.	Talcose slate
(305)	Bulk sample	sls	Siltstone .
		⊥	Strike and dip of bedding

ENV 604 - 5

E.K. Sturmfels 6/12/65

Env: 6ry

E. K. STURMFELS, D.Sc.
CONSULTING GEOLOGIST
TELEPHONE: 438 1247

033

ALLENDALE ROAD
DIAMOND CREEK
VICTORIA

18th April, 1967.

Memorandum to : The Manager
Industrial Rock Mines Pty. Ltd.

from : E.K. Sturmfels

re : <u>Talc Prospect No. 24, Mt. Fitton Area, S.A.</u>

With one Plate

As requested I have set out below my assessment of No. 24 Talc Prospect in the Mt. Fitton area, S.A.

The prospect occurs on a fairly steep slope, about 5 miles south-east of No. 5 Deposit and the camp, and about 1½ miles west-south-west of No. 8 Deposit. It was found by the Company's prospector, G. Laver, in 1964. I saw it in May 1965, and again in October of the same year after two shallow trenches had been dug.

The prospect is situated within the main dolomite mass, but not far from its top, a position favoured by most talc deposits. It consists of a 200 ft long lens of grey translucent talc with dolomite bands. The strike is about 70°, parallel to the direction of the larger shear zones and faults in the area. The thickness increases westwards, from about 7 ft near the highest point to a maximum of about 18 ft further down the hill. I estimate the average thickness over the whole length and including dolomite layers at between 7 and 8 ft.

The two trenches have been cut across the near vertical lens at right angles to the strike : Trench A, near the highest point, with a total width of about 7 ft of alternating talc and dolomite layers, and Trench B, 40 ft to the west, with a width of nearly 16 ft. When I saw the trenches they had not penetrated beyond the influence of weathering and slope creep, and my log (shown in the Appendix) is therefore based in parts on a possibly arbitrary interpretation. Most of the talc layers were between 1 and 3 ft thick. I estimate the bulk composition in the two trenches as follows, Trench B probably being closer to the average composition of the deposit than Trench A :

	Trench A (near highest point)	Trench B (40 ft west of Trench A)
Total thickness of lens	6.8 ft	15.7 ft
High-grade talc	62%	45%
High-grade talc with dolomite crystals	-	12
Low-grade talc	12	25
Dolomite	26	18

Talc from this prospect resembles closely talc from No. 8 Deposit. As in the case of No. 8 Deposit, strong translucency creates wrongly the impression of deep colour. In actual fact the talc when milled is of an exceptionally good white colour. The high grade is confirmed by two analyses of talc samples which were picked at random in the trenches : alumina as well as iron oxide contents are low.

	Random sample Trench A	Random sample Trench B
SiO_2	.	.
TiO_2	0.02	0.05
Al_2O_3	0.04	1.2
Fe_2O_3	0.85	1.2
MgO	32.2	32.2
CaO	nil	trace
Loss on ignition	4.8	5.3
Water soluble B.P.C.	0.07	0.06
Acid soluble B.P.C.	0.26	0.46
Colour, dry milled	better than "first grade"	"first grade"
Colour, fired	suitable for ceramics	suitable for ceramics
Slip	excellent	excellent
Resistance to wetting	fair	fair

An access route could either follow the old Mt. Fitton-Lyndhurst road, when last seen hardly better than a track, and then turn eastwards, or alternatively turn off the road to No. 8 Deposit first heading south-westwards and then westwards. Either way a mile of new road would be required ; the old track on the first-mentioned route would need in addition some substantial improvements.

I estimate that the deposit contains about 60 tons of high-grade talc per vertical foot. Serious disadvantages are the thinness of the individual talc layers which will make hand-picking necessary, and the remote position. However, the talc appears to be of an unusual quality, and by opening it up from the gully below a face of some 40 ft could be developed without moving much country rock apart from that contained in the lens itself. I would therefore regard No. 24 Prospect as a potential small producer of high-grade talc.

Appendix

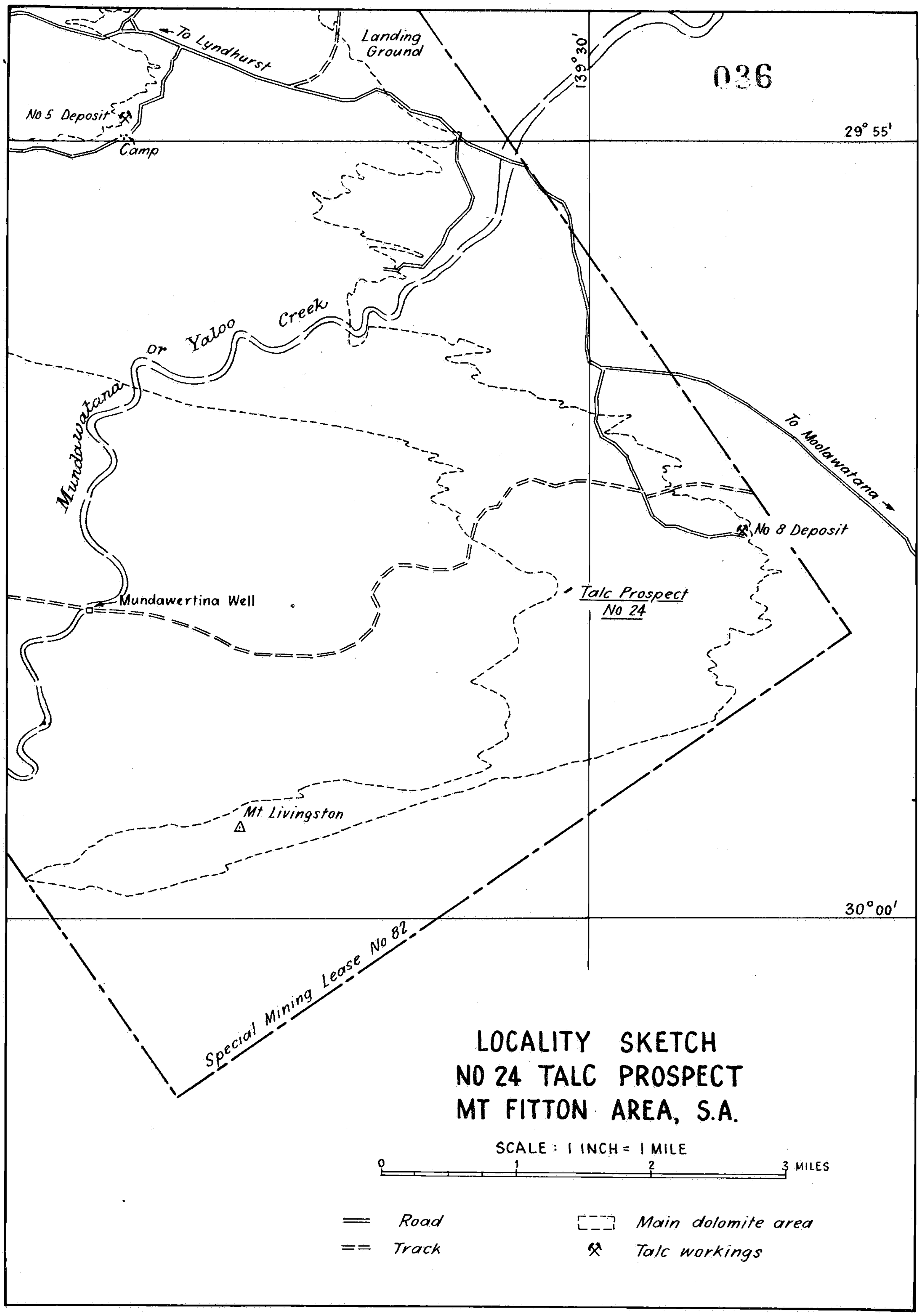
Logs of Trenches, Prospect No. 24

Trench A (near highest point)

South	0.0- 0.2 ft	dolomite
	0.2- 1.7	translucent off-white talc (dip approx. 70° to the south)
	1.7- 1.9	dolomite
	1.9- 2.7	sheared talc
	2.7- 4.3	dolomite
	4.3- 7.0	translucent off-white to light-grey talc
North	7.0-13.5	dolomite with thin talc layers

Trench B (40 ft west of Trench A and down-hill)

South	0.0- 0.3 ft	dolomite
	0.3- 1.2	translucent grey talc
	1.2- 2.4	dolomite
	2.4- 4.3	translucent greenish-grey talc with large dolomite crystals
	4.3- 6.0	translucent greenish-grey talc
	6.0- 6.3	dolomite
	6.3- 8.0	translucent greenish-grey talc
	8.0- 9.6	sheared talc with lime films and (?) dolomite
	9.6- 9.9	dolomite
	9.9-10.8	sheared talc with lime films and (?) dolomite
	10.8-12.0	translucent grey talc
	12.0-13.0	dolomite
	13.0-14.5	sheared talc with large dolomite crystals
	14.5-16.0	translucent grey talc
	16.0-20.0	dolomite with talc seams



LOCALITY SKETCH
NO 24 TALC PROSPECT
MT FITTON AREA, S.A.

037

NOTE
on
DRILLING AT THE CREEK JUNCTION TALC DEPOSIT
MOUNT FITTON AREA, S.A.
SPECIAL MINING LEASE NO. 82A

for
Industrial Rock Mines Pty. Ltd.

by
E.K. Sturmfels, D.Sc.
Consulting Geologist

With 1 Appendix
and 1 Plate

Diamond Creek,
Victoria

13th October, 1970

Summary

Extensive drilling on the southern side of the old Creek Junction Deposit has revealed a 30 ft wide belt of what appears to be rather low-grade talc, but has not encountered talc likely to be of greater economic value.

Introduction

The Creek Junction Deposit, 4 miles south-east of No. 5 Talc Deposit and the camp, was worked on a small scale prior to 1963. In view of the comparatively narrow widths of the exposed talc lenses and their variable colour this deposit had been paid little attention until the recent drilling campaign.

As instructed I visited the locality on 19th August and logged bore holes and samples. A topographical survey of the bore sites had been carried out by P.B. Blackwell some time previously.

Exploratory Work

A small soil-covered area adjoining old pits on the southern side of the Creek Junction Deposit has been covered by a total of 59 inclined bore holes arranged along eight north-south traverses (see the accompanying plan). They were drilled with a wagon drill at inclinations varying between 40° and 60° and to a maximum depth of 90 ft.

The eastern side of the area has been covered reasonably well by bore intersections, with only minor gaps. Coverage along the more westerly lines, however, is inadequate : many of the holes were abandoned at 10 or 20 ft depth without any attempt of drilling another hole to cover the interval. Bore hole projections on the accompanying plan show the extent of such gaps.

Results of Drilling

Talc intersections were noticed in a number of bores, but most of them appeared to be rather low-grade. The best-coloured talc was seen in cuttings from Bore 11-5 between 15 and 20 ft depth, but this represents a true width of only about 3 ft. A west-south-west striking belt of low-grade talc, or perhaps rather interbedded talc and dolomite lenses, can be followed from Bore 12-8 to Bores 13-7 and 13-8 and on to Bore 14-6 ; it might continue towards Bores 15-6 and 16-6, but it is impossible to be certain because of the large gaps between bore intersections. Overlapping talc intersections in Bores 13-7 and 13-8 suggest a horizontal width of the talc belt of about 30 ft and a northerly dip of between 65° and 70°.

Evaluation

Drilling has revealed a fairly extensive belt of what appears to be rather low-grade talc and a small occurrence of somewhat higher grade. It is unlikely that either will be of greater economic value. The quality of the talc in the belt could be ascertained easily by a north-south trench across Bore Site 13-7 and I recommend that this be done.

I feel that this drilling campaign was rather unnecessary. Prospecting could have been carried out more cheaply and more effectively by following the lines of mineralisation from existing talc exposures and tracing and testing them below soil-covered ground by trenching.

APPENDIX

BORE LOGS
CREEK JUNCTION DEPOSIT

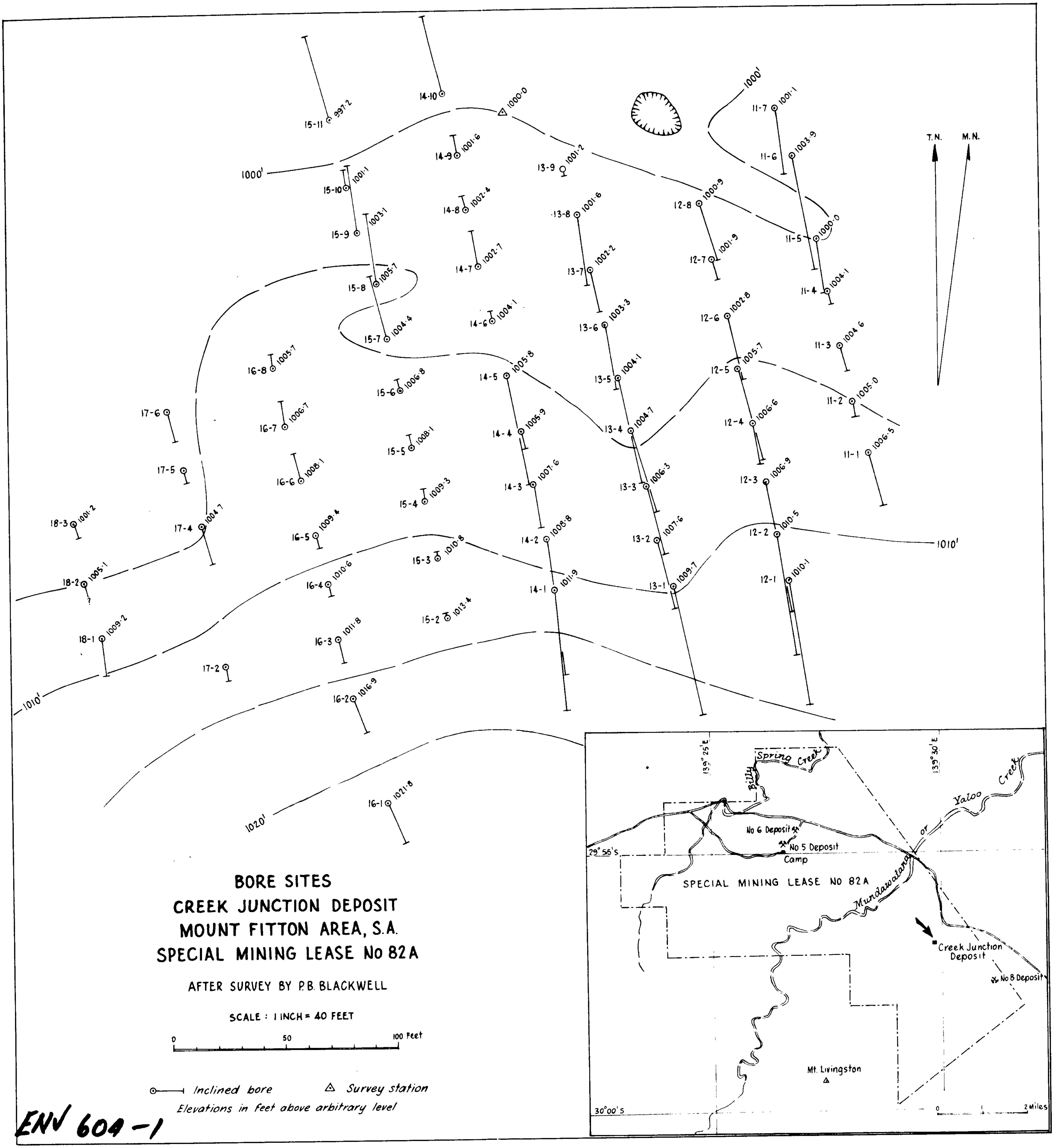
Bore 11-1	53° in 158° (1)	
	0-40 ft	dolomite
11-2	53° in 164°	
	0-10 ft	probably surface material
11-3	55° in 157°	
	0-20 ft	probably surface material
11-4	55° in 159°	
	0-10 ft	probably mostly surface material, a little talc
11-5	54° in 164°	
	0-15 ft	dolomite
	15-20	off-white to cream talc
	20-26	light-ochre low-grade talc
	26-30	light-reddish-brown material with minor talc
	30-40	probably talcose dolomite
Bore 12-1	52° in 164°	
	0- 3 ft	sheared talcose dolomite
	3-10	sheared or decomposed dolomite
	10-90	crystalline dolomite
12-2	53° in 164°	
	0-30 ft	probably mainly surface material
	30-47	crystalline dolomite
	47-50	talcose dolomite
	50-90	crystalline dolomite
12-3	49° in 161°	
	0-50 ft	surface material and sheared or decomposed dolomite
	50-60	probably sheared or decomposed dolomite
	60-90	crystalline dolomite
12-4	52° in 162°	
	0-30 ft	probably surface material
12-5	53° in 158°	
	0-50 ft	sheared or decomposed dolomite
	50-70	crystalline dolomite
12-6	50° in 159°	
	0-40 ft	sheared or decomposed dolomite
	40-45	no sample
12-7	51° in 157°	
	0-10 ft	sheared or decomposed dolomite
	10-14	crystalline dolomite
12-8	49° in 156°	
	0-10 ft	sheared or decomposed dolomite
	10-20	cream-coloured low-grade talc
	20-30	sheared dolomite
	30-40	talcose dolomite grading into low-grade talc

(1) The first figure gives the inclination, and the second figure, the magnetic bearing

Bore 13-1	50° in 160°		
	0-20 ft	sheared or decomposed dolomite	
	20-26	crystalline dolomite	
	26-36	dolomite, talcose in parts	
	36-90	probably crystalline dolomite	
13-2	51° in 158°		
	0-50 ft	sheared or decomposed dolomite	
13-3	51° in 158°		
	0-50 ft	sheared or decomposed dolomite	
13-4	52° in 156°		
	0-60 ft	crystalline dolomite	
13-5	53° in 160°		
	0-50 ft	crystalline dolomite	
	50-70	sheared or decomposed dolomite	
	70-80	crystalline dolomite	
13-6	52° in 162°		
	0-40 ft	sheared or decomposed dolomite	
	40-47	crystalline dolomite	
13-7	51° in 160°		
	0-10 ft	cream low-grade talc	
	10-15	cream low-grade talc and poorly rounded quartz (possibly from top of hole)	
	15-20	sheared dolomite, poorly rounded quartz (from top of hole ?) and a little talc	
	20-30	crystalline dolomite	
13-8	51° in 165°		
	0- 4 ft	surface material	
	4-10	talcose dolomite	
	10-40	cream to buff low-grade talc	
	40-50	poorly-rounded quartz (from top of hole ?) and crystalline dolomite	
Bore 14-1	54° in 167°		
	0-90 ft	dolomite	
14-2	48° in 165°		
	0-30 ft	probably surface material	
	30-90	dolomite	
14-3	51° in 163°		
	0-10 ft	surface material and much poorly-rounded quartz	
	10-30	sheared or decomposed dolomite	
14-4	58° in 157°		
	0-10 ft	mainly quartz pebbles, some other surface material	
	10-15	sheared or decomposed dolomite, some quartz pebbles (from top of hole ?)	
14-5	51° in 161°		
	0-30 ft	probably mainly surface material	
	30-66	talcose dolomite	
	66-70	cream-coloured low-grade talc	
	70-80	sheared or decomposed dolomite	

Bore 14-6	57° in 344°	
	0- 8 ft	cream-coloured low-grade talc
14-7	49° in 342°	
	0-10 ft	poorly-rounded quartz and surface material
	10-16	no sample
	16-20	decomposed or sheared dolomite, some poorly-rounded quartz (from top of hole ?)
	20-25	decomposed or sheared dolomite
14-8	collapsed	
	0-10 ft	surface material and poorly-rounded quartz
14-9	51° in 342°	
	0-15 ft	crystalline dolomite
14-10	collapsed	
	0- 5 ft	surface sand
	5-30	decomposed or sheared dolomite grading into crystalline dolomite
	30-60	no sample
	60-77	crystalline dolomite, some large pieces of talc (from top 30 ft of hole ?)
Bore 15-2	57° in 335°	
	0- 3 ft	decomposed or sheared dolomite
15-3	53° in 344°	
	0- 4 ft	no sample
15-4	55° in 347°	
	0-10 ft	decomposed or sheared dolomite
15-5	collapsed	
	0-10 ft	decomposed or sheared dolomite
15-6	59° in 335°	
	0-10 ft	sheared or decomposed dolomite, some discoloured talc
15-7	55° in 339°	
	0-20 ft	decomposed or sheared dolomite
	20-50	crystalline dolomite
15-8	53° in 344°	
	0-52 ft	crystalline dolomite
15-9	collapsed	
	0-40 ft	crystalline dolomite
	40-50	dolomite and talc
15-10	53° in 341°	
	0-13 ft	decomposed or sheared dolomite
15-11	54° in 335°	
	0-64 ft	mainly dolomite (depth markings on sample bags obviously wrong)
Bore 16-1	50° in 150°	
	0-30 ft	sheared or decomposed dolomite

Bore 16-2	51° in 152°	
	0-26 ft	dolomite
16-3	46° in 161°	
	0-15 ft	surface material
16-4	47° in 155°	
	0- 8 ft	surface material
16-5	collapsed	
	0-8 ft	surface material and decomposed dolomite
16-6	51° in 338°	
	0-10 ft	mainly surface material
	10-20	sheared dolomite with a little talc
16-7	51° in 344°	
	0-17 ft	surface material grading into crystalline dolomite
16-8	collapsed	
	0-10 ft	decomposed or sheared dolomite
Bore 17-1	40° in 164°	
	0- 3 ft	dolomite
17-2	51° in 162°	
	0-10 ft	surface material and decomposed dolomite
17-4	55° in 156°	
	0-10 ft	probably surface material
	10-30	dolomite
17-5	53° in 153°	
	0- 8 ft	mainly surface material
17-6	57° in 157°	
	0-10 ft	sheared dolomite and talc
	10-12	sheared dolomite and much talc
	12-20	sheared dolomite with some talc
	20-26	talcose dolomite
Bore 18-1	50° in 165°	
	0-10 ft	no sample
	10-26	decomposed or sheared dolomite grading into crystalline dolomite
18-2	48° in 155°	
	no record, no sample	
18-3	52° in 152°	
	0-10 ft	surface material and dolomite



BORE SITES
CREEK JUNCTION DEPOSIT
MOUNT FITTON AREA, S.A.
SPECIAL MINING LEASE No 82A

AFTER SURVEY BY P.B. BLACKWELL

SCALE : 1 INCH = 40 FEET

0 50 100 Feet

⊙—⊢ *Inclined bore* △ *Survey station*

Elevations in feet above arbitrary level

ENV 604-1

043

Env. 604

NOTE
on
NO. 19 TALC PROSPECT
MOUNT FITTON AREA, S.A.
SPECIAL MINING LEASE NO. 82A

for

Industrial Rock Mines Pty. Ltd.

by

E.K. Sturmfels, D.Sc.
Consulting Geologist

With 1 Plate

Diamond Creek,
Victoria

14th October, 1970

Summary

Material similar to talc, with an exceptionally good slip, but of a generally poor colour, has been exposed in a bulldozer trench at No. 19 Prospect. It is probably derived from an impure dolomitic source rock by decomposition in situ. The extent of the material is not as extensive as had been hoped for. Drilling has covered a large area, but has supplied very little information.

Introduction

No. 19 Prospect is situated some 3 miles south-east of the Company's main talc workings and the camp. It was discovered during the 1964 prospecting campaign : outcrops of flat-dipping talc or a talc-like mineral were observed over a length of 240 ft along a small gully running parallel to the strike of the surrounding dolomite ; a minor part of the material visible was off-white, but the bulk was intensely coloured, mainly deep-brown. The occurrence was thought worth further investigations because of the extent of the exposures and the exceptionally good slip of the material. It was thought possible that the surrounding soil-covered flat ground might be underlain by similar material (as indicated on the accompanying plan).

As requested I visited the prospect on 19th August to examine the results of exploratory work.

Exploratory Work

Exploratory work on the prospect includes a bulldozer trench, 49 vertical bore holes and a topographical survey by P.B. Blackwell (see the accompanying plate).

The bulldozer trench has been cut along the gully over a length of 250 ft and to a depth of about 10 ft ; it has exposed talc-like material over most of its length and down to its bottom. Minor parts are off-white, but the bulk of the material is just as discoloured as it was in the surface exposures.

The 49 vertical bores had been sunk some time ago with a wagon drill and samples of the cuttings had been left in thin plastic bags on the bore sites. However, at the time of my visit, most of the bags had perished and the labels or markings had become illegible. Judging from the remnants left at the bore sites it appears that the great majority of bores was drilled from top to bottom in dolomite. At only one site (Assumed Level 989.1) did I find a sample of talc-like material representing a reasonable thickness (11 ft) and a reasonable colour.

The area has been surveyed with considerable, and rather unnecessary, precision by P.B. Blackwell. The accompanying plate represents a reduced version of his plan, with some geological information added.

Origin and Composition

The material in the bulldozer cut does not resemble any of the talc in the larger deposits of the Mt. Fitton area. It is largely structure-less, an irregular mixture of brown, red and off-white patches of a talc-like mineral with sandy and silty lenses and some quartz pebbles. Where layers can be distinguished they are found to be parallel to the bedding in the surrounding country rock (strike approx. 70° mag., dip 50° S).

What seems to be the somewhat weathered source rock outcrops some 200 ft upstream : a sheared probably dolomitic marl with abundant talk-like flakes and occasional pebbles.

Concentration in situ by decomposition of this marl, not necessarily in the course of weathering, seems to be the most likely origin of this material, with identical strike and dip readings in bulldozer cut and country rock as a strong support. The pebbles found, on the other hand, cannot be used as valid evidence for redeposition as they also occur in the likely source rock.

The nature of the mineral in the bulldozer trench is still doubtful. According to its appearance it could be talc or pyrophyllite, and as a matter of fact it was regarded as pyrophyllite for quite a while. The only available analysis cannot be reconciled with any likely mineral of the mica and talc family (see Table of Analyses on next page). However, according to D.A. Swan, the material analysed was not examined microscopically and might have consisted of a mixture. The samples I had collected from the same locality could not be differentiated under the microscope from the usual talc of the Mt. Fitton area : the same shape and arrangement of the fibres, the same or nearly the same refractive indices, and the same angles of the optical axes.

The flakes in the supposed source rock could, at a casual glance, be regarded as muscovite or phlogopite, but to the touch they are soft and flexible like talc. Optical properties of the flakes are consistent with either talc or phlogopite. However, the prevalence of flakes and the abundance of hematite inclusions is not normally found in the nearby talc deposits.

It seems possible that this material has had an origin slightly different from the normal talc of the area : it might have been originally phlogopite formed in impure dolomitic rocks at the same time and under the same pneumatolytic

	No. 19 Prospect Anal. Rodda Pty.Ltd.	Typical Analyses			
		Talc Flinders Range, S.A.	Pyrophyllite North Carolina	Phlogopite crystall. limest., Mt.Braccio, Italy	Phlogopite Burgess, Ontario
SiO_2	50.4	60.88	65.74	35.64	41.18
TiO_2	3.1	0.10	0.41	2.83	0.39
Al_2O_3	17.6	1.98	27.71	15.13	12.52
Fe_2O_3	1.1	0.83	0.21	2.65	0.00
FeO		-	-	1.55	0.30
MnO	.	-	0.00	-	0.04
MgO	16.7	31.18	0.02	27.62	27.32
CaO	0.3	0.14	0.12	tr.	0.00
Na_2O	0.9	-	0.60	3.58	0.88
K_2O	-	-	0.18	6.49	11.93
F		-	-	-	6.74
CO_2		-	-	-	-
H_2O+	9.8	4.08	4.90	4.23	1.06
H_2O-		-	0.29	0.81	0.00
	99.9	100.09	100.18	100.53	102.90
O=F					2.84
					100.06

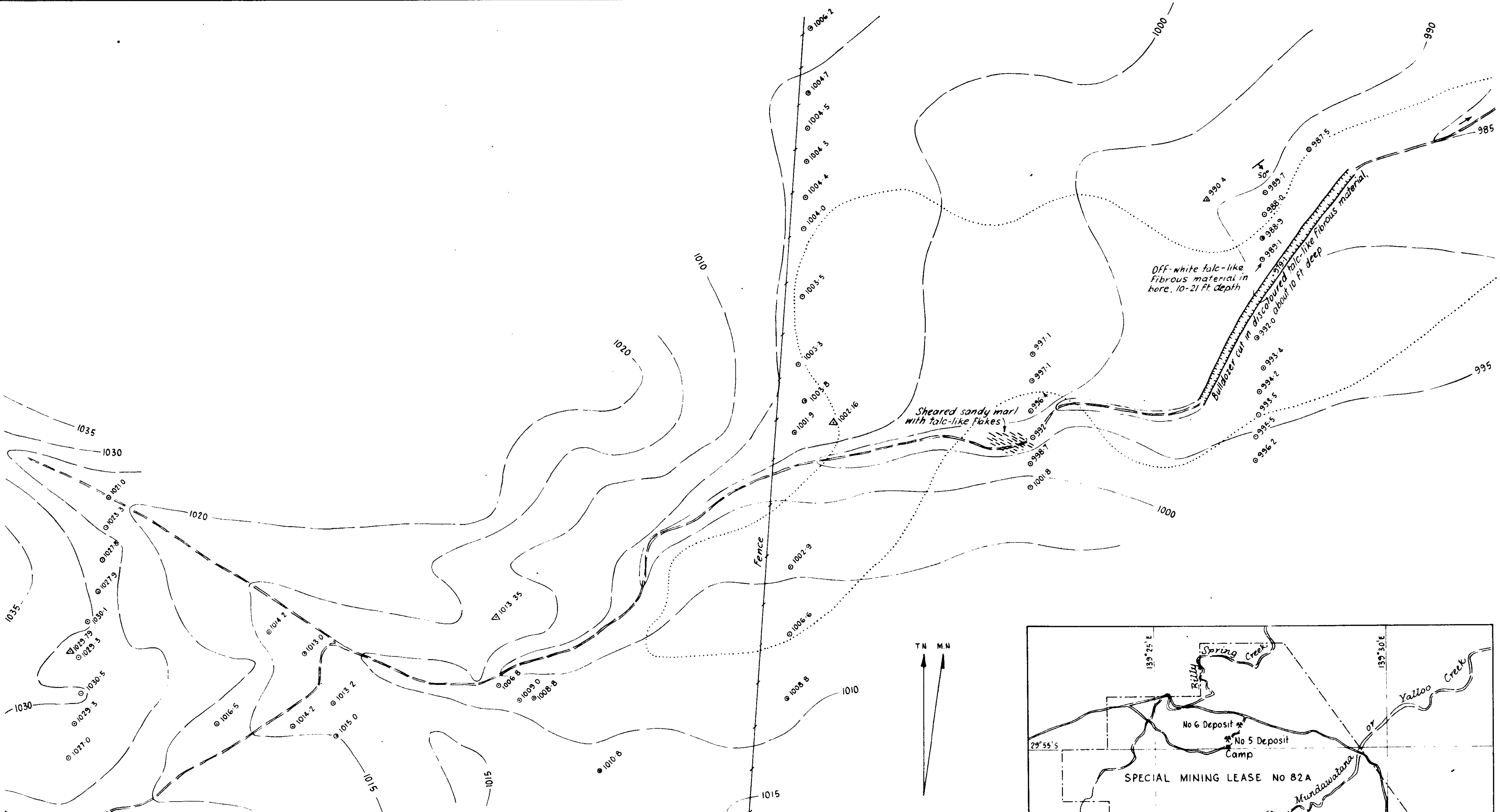
conditions as for instance the nearby scheelite occurrence, and later transformed into a talk-like mineral under altered stress and temperature conditions. If we accept the quoted chemical analysis as correct, we must assume that either the talc in the trench is mixed mechanically with pyrophyllite, or a mixed-layer mineral is present, differentiated from talc by the addition of alumina layers (suggested by Dr. J. McAndrew of C.S.I.R.O.). Derivation from an original phlogopite would also supply an explanation for the unusually high titanium content of the trench material.

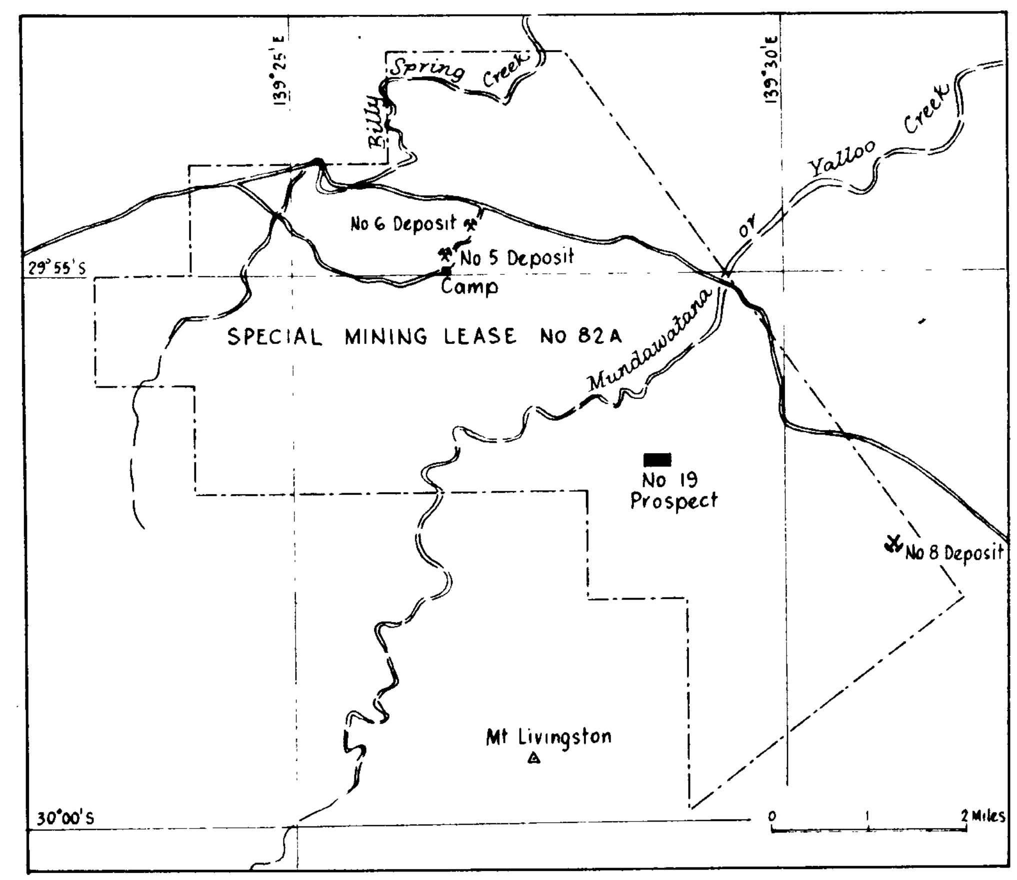
Evaluation

The talc-like material does not seem to improve much in colour with depth, contrary to expectations, and the horizontal extent is definitely less than had been hoped for. On the other hand, the material is not restricted to the surface, as had been assumed initially, but appears to continue to some depth.

The drilling done has supplied little information. Most of the holes were drilled well outside the area of interest, quite a number right between outcrops of crystalline dolomite.

I expect that this material, despite its attractive physical properties, would be too discoloured and too impure to be worked profitably at such a remote locality, and I doubt very much if beneficiation, though perhaps technically possible, would be a paying proposition in view of the small size of likely reserves. I therefore do not recommend any further investigations.





No 19 PROSPECT
MT. FITTON AREA, S.A.
SPECIAL MINING LEASE No. 82A

AFTER SURVEY BY P.B. BLACKWELL

SCALE : 1 INCH = 80 FEET

0 100 200 300 400 Feet

△ Survey station

⊙ Bore, vertical

Elevations in Feet above arbitrary level

Strike and dip of bedding

Area conceivably carrying talc-like material below overburden

ENV 604 - 2