

GSREP9

TASMANIA
DEPARTMENT OF MINES

GEOLOGICAL SURVEY REPORT
No. 9

THE
REX HILL MINE

by

G. URQUHART, M.Sc.

Issued under the authority of
The Honourable ERIC ELLIOTT REECE, M.H.A.,
Minister for Mines for Tasmania.



1967

REGISTERED WITH G.P.O. FOR TRANSMISSION BY POST AS A BOOK

D. E. WILKINSON, Government Printer, Tasmania.

Contents

	PAGE
ABSTRACT	5
INTRODUCTION	7
General	7
Previous Literature	7
Location and Access	7
Acknowledgements	7
GENERAL GEOLOGY	9
Topography	9
Rock Types and Structure	9
GEOLOGY OF THE MINE AREA	10
Relief	10
Rock Types	10
Coarse-grained porphyritic granite	10
Fine-grained porphyritic granite	10
Dolerite	11
Permian sedimentary rock	13
Rock Structure	13
Faulting	13
Jointing	13
Shearing	15
Quartz-greisen leaders	15
Fluorite veinlets	16
Aplite dykes and veins	16
Summary of structure	16
MINOR MINERAL OCCURRENCES	16
Excavations A-I	16-19
MAIN OREBODY (OPEN CUT: EXCAVATION J)	19
Form	19
Ore Minerals, Gangue and Structural Control of Metallization	21
Crystal quartz/greisen core	21
Cassiterite emplacement in altered aureole rock	22
Sulphides	24
Type of Deposit and Origin	24
Wall Rock Alteration	25
PARAGENESIS AND TEMPERATURE OF FORMATION	27
Summary of Age Relationship	28
Discussion	28
PRODUCTION AND GRADE	30
ORE RESERVES	31
CONCLUSIONS	32
REFERENCES	33

List of Figures

	PAGE
Fig. 1. Rex Hill Tin Mine. Geology and Topography	6
Fig. 2. Plan and Sections. Rex Hill Mine Workings	8
Fig. 3. Stereographic Plot of Joint Poles in Granite (Mine Area)	12
Fig. 4. Stereographic Plot of Poles of Structures in Open Cut and Mine Area ..	14
Fig. 5. Stereographic Plot of Joint Poles in Open Cut	18
Fig. 6. Rex Hill Mine: Open Cut	20
Fig. 7. Intersecting quartz-cassiterite (C_1) healed frac- tures (f_1) and closely-spaced sulphide and cassiterite bearing fractures (f_2)	23
Fig. 8. Diagrammatic representation of sulphide and cassiterite relationships	26
A. Arsenopyrite - pyrite - chalcopyrite - galena assemblage	26
B. Cassiterite - pyrite - sphalerite - chal- copyrite - galena assemblage ..	26
C. Cassiterite - arsenopyrite - pyrite - sphalerite - chalcopyrite - galena assemblage ..	26

GEOLOGY OF THE REX HILL MINE

Abstract

A rich pipe containing cassiterite and sulphides constitutes the Rex Hill orebody situated in the Rossarden-Storys Creek tin mining district in NE Tasmania. The host rock is granite of Devonian age, source of the tin deposits localized elsewhere by fissures, joints and faults.

The varied structural controls of metallization are unlike others in the district. The orebody consists of a steeply plunging pipe located on a northerly trending line along which smaller greisenized bodies are strung out. The direction of the line coincides with the trend of one of the three regional joint systems in granite.

The pipe orebody on surface consists of a central crystal quartz/greisen core surrounded by an aureole of altered rock in which much of the tin is concentrated. Cassiterite is of two ages: the earlier associated with quartz in "healed" veins and stringers derived from original fractures; the later structurally controlled by a concentric arrangement of closely-spaced hairline fractures in altered rock around the central core. Sulphides, consisting of arsenopyrite, pyrite, sphalerite, chalcopyrite and silver-bearing galena are present both in the core and altered aureole rock.

The structure and geology indicate the pipe to be of diatreme origin.

Introduction

GENERAL

The Rex Hill mine (also known as the Mt Rex mine) is situated in a tin mineral district about 6 miles from the operating tin mines at Rossarden and Storys Creek in NE Tasmania.

At the request of the licence holders, Messrs. R. D. Brinkman and D. Dicker, a geologic and topographic survey was made of the mine in order to provide a plan map showing the geology and mineral occurrences in the immediate vicinity of the main pipe-like orebody. It was hoped that a survey such as this would shed light on some puzzling features of the structural control of the deposit and by so doing perhaps assist in locating new ore. This report is accompanied by a contoured geological map (fig. 1), a detailed plan of the open cut (fig. 6) and sections of the main orebody (fig. 2). Petrographic and minergraphic descriptions of rock types and mineral associations are included in the report in the belief that they will contribute to a better understanding of the tin-bearing granites of NE Tasmania and their ore deposits.

PREVIOUS LITERATURE

Previous reports on the mine include those by Montgomery (1892), Waller (1901), Nye (1927), Reid (1928), Reid and Henderson (1929), Nye (1934), Henderson (1935), and Blissett (1959); together they adequately summarize the history, geology of the orebodies, the grade and value of the ore mined, and production figures for the life of the mine. Much of the information contained in the earlier reports is still useful, especially that relating to the geology and grade of ore found at depth. At the present time the mine is flooded 12 feet below the adit level; consequently the geology underground described by the previous writers cannot be verified.

LOCATION AND ACCESS

The Rex Hill mine is situated 6.6 miles distant from Avoca. Access is by way of the New Stanhope road for 1.7 miles from the junction with the Avoca-Storys Creek road, thence 1.2 miles along a rough track which leads to the mine.

ACKNOWLEDGEMENTS

The writer was assisted by student D. Paterson in the plane table survey of the mine area and later by prospector W. Pitulej in the geological mapping of the deposits.

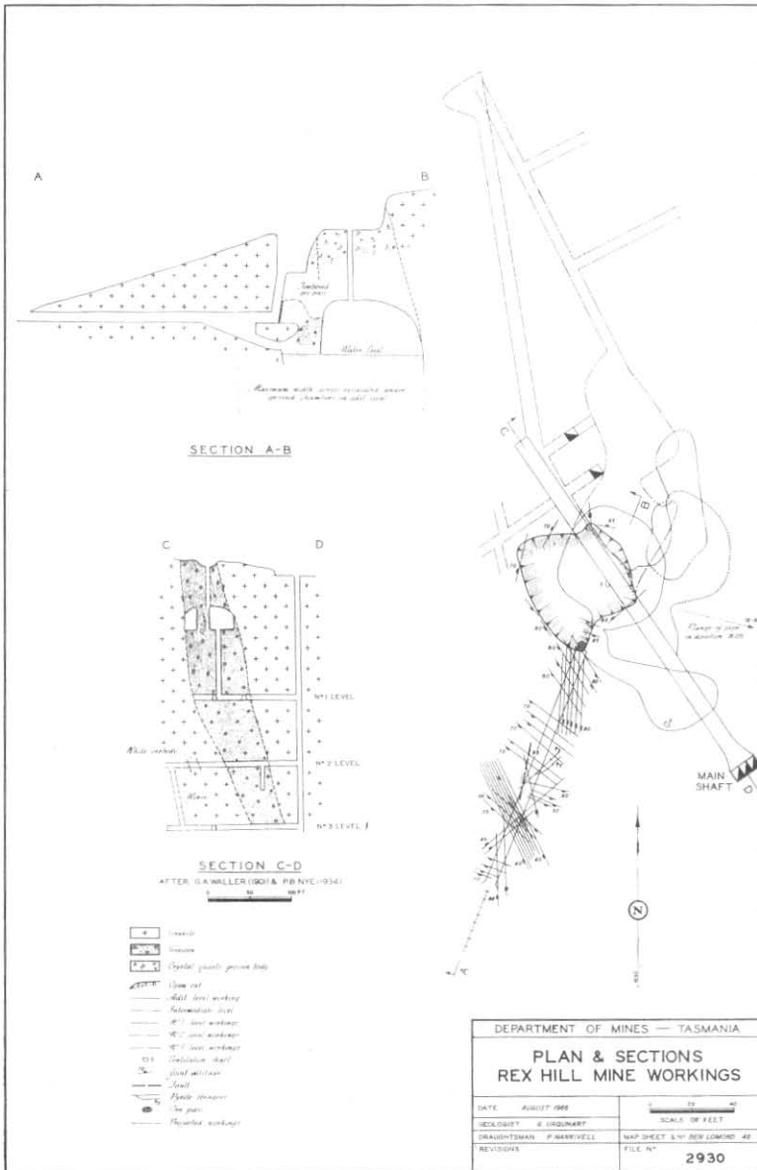
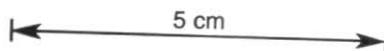


FIGURE 2



General Geology

TOPOGRAPHY

The mine is situated at an altitude of approximately 2000 feet a.s.l. on the steeply sloping flanks of Mt Rex which forms a projecting spur in the highly dissected escarpment zone 3-4 miles wide separating the floor of the Fingal Valley (650-700 ft) from the sloping plateau surface (2300-2600 ft) on which are located the Aberfoyle and Storeys Creek tin mines.

A track from the mine leads N for a distance of 0.7 miles to Buffalo Brook where the concentrating plant has been erected. The stream bed at this point is about 320 feet below the adit level of the mine.

ROCK TYPES AND STRUCTURES

Blissett's geological map (1959, fig. 21) locates the mine near the SW boundary of a faulted wedge of granite trending in a NW direction and bounded by the Castle Carey and Gipps Creek Faults. These faults, within or near the escarpment zone, downthrow to the SW and NE respectively, with the result that Jurassic dolerite abuts granite along the Castle Carey Fault in the mine area (fig. 1). The vertical displacement on the Castle Carey Fault, which is the main one in the district and may be regarded as the western boundary fault on the Ben Lomond Granite, is at least 1500 feet in the vicinity of the mine (Blissett 1959, p. 44) but decreases to 1200 feet farther N.

Within the faulted wedge of granite four miles long by one mile wide, 4 other deposits in addition to the one on Mt Rex are present. They are the Great Republic (tin), Ben Lomond (tin), Ben Lomond (tungsten) and Long Tunnel (tin) mines. The cassiterite-bearing quartz veins and fissure veins forming these tin deposits are notable for their similarity of structure, the veins all striking in a direction ranging from 320° to 340° Mag. which is the direction of the dominant joint pattern, itself parallel or sub-parallel to the direction of major faulting. The wolfram-bearing quartz veins of the Ben Lomond tungsten mine on the other hand trend in a direction ranging from 25° to 35° Mag., quite different from the direction of the cassiterite-bearing veins. Unless otherwise stated, all bearings in this Report are Magnetic.

The structural control for tin deposition in the Rex Hill mine (discussed under orebodies) is not consistent with the controls evident in the other mines of the district. Cassiterite leaders and greisenized metallized bodies trend in two different directions and the main orebody is not linear but pipe-like in form.

Flat-lying Permian sedimentary rocks overlie granite at higher altitudes where they cover irregular areas of the plateau surface.

Geology of the Mine Area

RELIEF

The difference in altitude in the area represented by fig. 1 is almost 300 feet; the slope of the ground toward the gully in the S of the map is therefore fairly steep. To the N, beyond the map limits, the slope is down towards Buffalo Brook situated about half a mile away.

ROCK TYPES

COARSE-GRAINED PORPHYRITIC GRANITE

Granitic rock of Devonian age is best exposed in the N and S of the area (fig. 1) where it forms the crest of the spur and the hillock respectively. The hillsides are covered with rounded boulders and blocks of granite but the sloping ground makes it difficult to know whether the larger blocks represent bedrock. Rock outcrops are exfoliated and weather in the typical onion-shaped form. The Castle Carey Fault to the W of the area truncates granite and brings it into contact with Jurassic dolerite.

The granite is medium- to coarse-grained in texture and contains phenocrysts of carlsbad-twinned feldspar ranging in size from half an inch up to 2 inches, set in a medium-grained groundmass of feldspar, quartz and a little biotite. Rounded quartz grains between a quarter of an inch and half an inch in diameter are also scattered through the fabric. In places the phenocrysts of quartz and feldspar are so dense that the rock is coarse-grained and perhaps better described as a granite porphyry. No marked alignment of the feldspars, such as that found in the Blue Tier region (Reid and Henderson, 1928), was observed.

Microscopic examination of thin sections of granite (slides 66-111 and 66-112) show potash feldspars consisting of orthoclase, microcline, and orthoclase or microcline perthite. The large subhedral to euhedral grains are very much altered to kaolin and sericite and a few are carlsbad-twinned. The smaller potash feldspar crystals in the groundmass are anhedral, 2-3 mm in size. The quartz phenocrysts range from 4 mm to 7 mm in size but in the groundmass reach a maximum size of 1 mm. All the quartz is characterized by its wavy extinction and absence of inclusions. Plagioclase laths, 0.5-1.5 mm long in the groundmass, are also altered (mainly to sericite), but to a lesser degree than the potash feldspars. Albite twinning can be readily detected. The refractive index, optically -ve sign and the extinction angle of the albite twins (13° - 16° in slide 66-111, 5° - 25° in slide 66-112) indicate a composition ranging from Ab_{60} to Ab_{75} . The average composition seems to be Ab_{68} . The accessory minerals consist of muscovite, biotite and associated sphene. Epidote is present in minor amount.

FINE-GRAINED PORPHYRITIC GRANITE

Pale microgranite or porphyritic granite is fine-grained and sugary textured, containing phenocrysts of feldspar (6-25 mm in size) and quartz (3-13 mm in size). Many of the quartz pheno-

crystals are subhedral and roughly square in cross section which suggests they may be β quartz. The rock resembles in some ways the fine-grained granite on Blue Tier where this rock is the host to, or closely associated with, many of the cassiterite deposits.

Porphyritic granite in the vicinity of the mine occupies large irregular areas in the coarse-grained granite (fig. 1). Some of the contacts can be clearly demarcated on the evidence of weathered rubble, elsewhere however the contacts between the two rock types are vague and appear to merge into one another.

The rock in thin section (66-114) under the microscope is seen to consist of potash feldspar, quartz, plagioclase and muscovite. The potash feldspar, in grains 2-4 mm in size, is so altered to clay mineral that identification is difficult. Some crystals are carlsbad-twinning. Quartz comprises an estimated 40% of the rock in anhedral and subhedral grains ranging from 0.25-2 mm in size. The larger quartz crystals are fractured, typical of β quartz. The euhedral and subhedral laths of plagioclase 1-2 mm long are albite-twinning and show alteration to sericite. The composition is much the same as in the coarser-grained granite, i.e., Ab_{60-75} . Muscovite and a minor amount of sphene are the accessory minerals.

An aplite dyke, 1 foot wide, in excavation B traverses the coarse-grained granite host rock in a direction 20° . The contacts although sharp are intergrown. Megascopically the aplite and fine-grained granite are alike in texture and grain size. Aplitic rock under the microscope (slide 66-115) is seen to consist mainly of quartz and potash feldspar in a finer grained, sericitized, kaolinized groundmass.

Most of the mineral occurrences in the mine area are located in altered coarse-grained granite although the main orebody lies close to fine-grained porphyritic rock which the writer interprets to be a late, differentiated phase poor in volatiles of the coarse-grained granite which it either intruded or partly assimilated along intrusive contacts. The genetic origin and relationship of the cassiterite deposits relative to the two granitic rock types is difficult to prove in the field; in this respect the deposits resemble those found in both fine-grained and coarse-grained granite on the Blue Tier (Reid and Henderson, 1928). Volatile tin compounds were possibly derived from the original differentiation of a coarse-grained granite magma, and passed by successive differentiations and segregations into magmas and solutions of different composition before being finally emplaced.

DOLERITE

Fine- and medium-grained Jurassic dolerite is present on the western side of Castle Carey Fault. The contact with granite is ill-defined to the S in the bottom of the gully but to the N is very easy to identify even though not exposed. The highly jointed dolerite weathers in small blocky angular fragments in marked contrast to the rounded boulders and blocks of granite. The boundary between the two rock types is sharp and well-defined.

Dolerite in thin section (66-116) is seen under the microscope to be composed mainly of pyroxene, plagioclase and accessory minerals. The pyroxene was identified as pigeonite because of the small axial angle (2V practically 0). The small 2V gave optic

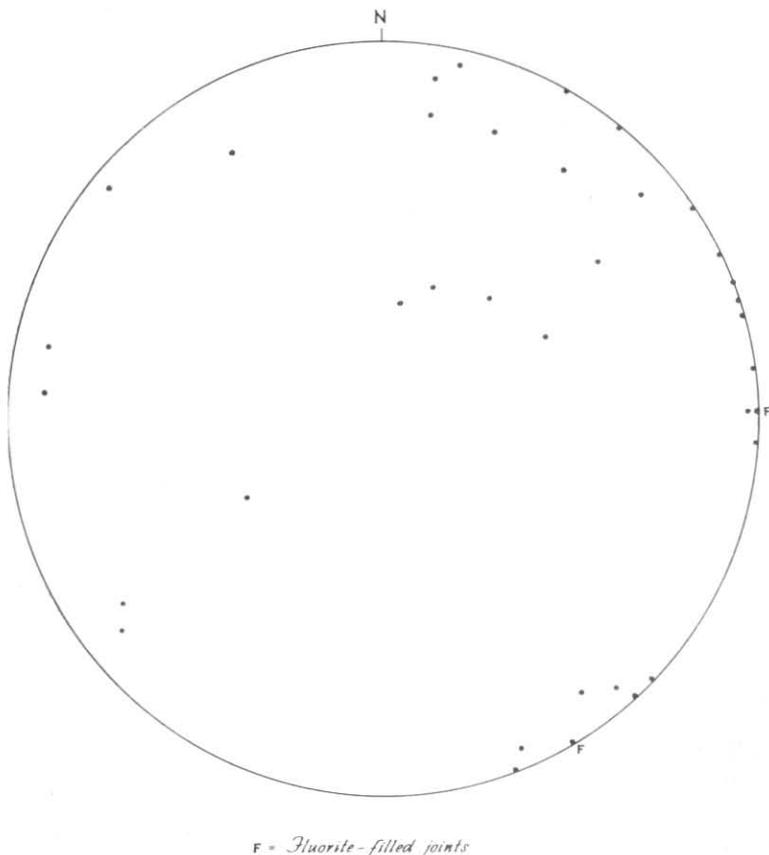


FIG. 3 JOINT POLES IN GRANITE (MINE AREA)

figures indicative of a uniaxial mineral, but repeated observations on different crystals established the fact that the mineral is biaxial (+ve). For a certain composition pigeonite should have $2V=0$; a uniaxial pigeonite from Mull has been described by Hallimond (quoted by Rogers and Kerr, 1942, p. 267).

The pigeonite crystals in the slide are 2-3 mm in size, optically or sub-optically intergrown with plagioclase laths in the equigranular interlocking groundmass. Other interference figures indicate that another pyroxene, probably augite or diopside, is also present. The plagioclase crystals in the groundmass are in subhedral and euhedral laths 0.1-0.5 mm long, and show albite- or carlsbad-twinning. Larger plagioclase crystals as much as 1 mm in size have



a tendency to be simple carlsbad-twinned. The plagioclase corresponds to a composition of Ab_{35-45} . Accessory minerals include magnetite and sphene in the groundmass.

PERMIAN SEDIMENTARY ROCK

Basal Permian sediments to the NE of the mine overlie the bevelled granite surface at an altitude of about 300 feet above the mine and form a plateau bounded by a 15-20 feet high scarp. The indurated arkose forming the basal section is poorly-bedded and composed of grit containing sporadic rounded grey chert pebbles as much as 2 inches in diameter. Thin lenses of cherty rock are intercalated in the succession and indicate the bedding of the sediments, which dip at about 2° to the SE. The consolidated basal grit superficially resembles the coarse-grained granite but is distinguishable from it by the absence of feldspar phenocrysts and the tabular form of the weathered fragments.

ROCK STRUCTURE

FAULTING

Movement on the vertically dipping Castle Carey Fault is at least 1500 feet, but the rocks at the contact are not highly silicified or sheared. The curving fault trends in a northerly direction in the mine area; farther N past Buffalo Brook the trend swings westward and the fault occupies depressions in the topography giving rise to a fault line valley. The very minor brecciation and silicification along the contact and the curving trace of the fault at first suggest an intrusive contact but this is not borne out by the regional geological map of Blissett (1959, fig. 21).

JOINTING

Inasmuch as jointing is a structural control of mineralization in other tin deposits of the district, its possible significance in this mine is readily apparent. Figs. 1 and 2 of the mine area and adit respectively show that the joint directions are variable without any one pattern appearing dominant. A stereographic plot of the poles of granite joints on the lower hemisphere of a Schmidt equal area net emphasizes the existence of three distinct and separate patterns (fig. 3). The first system of joints trends in a NW-NNW direction parallel to the direction of major faulting and dips at variable angles mostly to the SW. The second system of vertical joints trends in a northerly direction and is associated with greisen leaders. The third system of steeply-dipping associated joints trends in a direction $45^\circ-70^\circ$.

The excavations on mineralized bodies in the mine area (fig. 1) follow a line trending N through the deposits, so that one structural control may be related to the joint system in this general direction. Jointing along the length of the adit is prominent but complex (fig. 2), as many as ten different joint sets having been noted, ranging in direction from 290° to 45° .

Two of the sets dip to the E or NE, the others dip in directions ranging from SW to NW. Four of the sets dip at angles less than 40° , the remainder dip steeply at angles from 60° to vertical. The

Jointing in dolerite is intense and closely-spaced (13-50 mm apart) which facilitates the breakdown of this rock into angular fragments. The major northeasterly (55°) joint pattern in the rock is unexpectedly different from the trend of the Castle Carey Fault in a northwesterly direction but corresponds to the system of joints in a granite trending in a northeasterly direction although dipping more steeply to the NW.

The basal Permian beds are intersected by two widely-spaced joint sets which split the rock into massive blocks. One joint set which strikes in a direction 145° and dips 80° to the NE may be related to the major faulting in the area, the other which strikes in a direction 75° and dips 80° to the SE reflects a direction of shear in granite.

SHEARING

A shear, poorly exposed over a width of about 40 feet, trends in a direction 75° - 80° in granite between excavation I and the gully. Shearing in the same direction is evident in workings situated 0.4 mile down the road where pits and a shaft have been sunk over a width of 10 feet on two siliceous sulphidic shears, one 3 feet wide, the other 5 feet wide, which form a separate lineament from that in the mine area but trend and dip (60° - 90° SE) in the same direction.

The shear zone indicated on fig. 1 is associated with cassiterite-bearing quartz-greisen leaders and quartz veins.

A minor shear or fault in the adit trending 10° offsets a pyrite vein trending 48° , the displacement being W side S. A minor 1 inch wide shear in granite striking 295° was measured on surface near the camp.

The crystal quartz/greisen body in the main open cut displays brecciated rock and pug-filled shears which strike 160° - 170° and dip to the NE. These structures which are restricted to the body of rock in the open cut have a different origin from the regional structures noted above and will be discussed in the section on ore-bodies.

QUARTZ-GREISEN LEADERS

Quartz-greisen leaders, in places cassiterite-bearing, are mainly disposed along two general directions (fig. 4), one of which corresponds to the trend of a joint system, the other to the trend of the shear. Fig. 1 shows that the excavations are broadly situated along a northerly trending line through the deposits. Some of the quartz-greisen leaders in this direction (which ranges from 350° - 20°) were formed along vertical joint planes and may be associated with tourmaline to form barren or cassiterite-bearing leaders ranging in width from a quarter of an inch to eight inches. The veins (or "leaders") are sporadically exposed in gully, pit, trench or road sections in the southern part of the mapped area and generally occur singly.

Quartz-greisen veins are also closely associated with and aligned parallel to the shear which trends in a direction 80° and dips

steeply to the S. The veins in one 10 feet wide section form a series of closely- and widely-spaced parallel bands ranging in width from 2 to 6 inches. These are best exposed in the man-made gully which resulted from sluicing of the overlying ground in bygone days. The veins are barren, or cassiterite may be very finely disseminated and not readily detectable in them over much of their strike length. The shear structure and the quartz-greisen veins associated with it are later than the northerly trending greisen leaders. The age relationship is shown in the gully close to the intersection of the two systems where tourmalinized stringers are truncated by quartz-filled shears. In this vicinity also greisen veins as much as 9 inches wide are filled in the centre by quartz veinlets up to half an inch across.

Quartz-greisen leaders 2-4 inches in width traverse coarse-grained granite in excavation B along a direction 145° , which differs from the directions of the other leaders and veins in the mine area.

FLUORITE VEINLETS

The quarter inch wide vertical fluorite veinlets exposed over a width of 10 feet on the northern wall of excavation B trend in a direction 60° . Fluorite veinlets in the main open cut orebody fill joints which range in direction from 150° - 180° . Fluorite in places forms the centre of narrow quartz-filled joints.

APLITIC DYKES AND VEINS

The 1 foot wide vertical aplite dyke transgressing coarse-grained granite in excavation B in a direction 20° M has been mentioned. The host rock is highly foliated (strike 300° , dip 35° to the SW). The aplite dyke was fractured rather than foliated when the rocks were stressed.

Three or four fine-grained altered granite veins and dykes transect the eastern wall of excavation F. They strike in a direction 90° and dip 60° to the S.

SUMMARY OF STRUCTURE

The broad outline of structure in the mine area shows that joints of many different trends can be assigned to three distinct joint systems. Quartz-greisen leaders (barren or metallized) are formed in places along joint planes which strike in a northerly direction. Similar quartz-greisen veins (tourmalinized in places) are associated with a later shear which strikes in a direction 75° - 80° and dips steeply to the S. Larger greisen bodies have been prospected by pits and trenches and lie roughly along a northerly trending line.

The structure in the main open cut orebody and subsidiary greisenized bodies is included below in descriptions of the various mineral occurrences.

MINOR MINERAL OCCURRENCES

EXCAVATION A

The water-filled pit about 10 feet deep shows jointing in two directions: 145° , dip 75° NE and 65° , dip 70° SE. Metallization in the excavation was not seen but material on the dump consisted of

dark green altered rock in places carrying pyrite, chalcopyrite, sphalerite and galena. Cassiterite is finely disseminated and not richly concentrated overall.

EXCAVATION B

The workings consist of an open trench 20-25 feet deep excavated around a pod of greisenized silicified rock about 15 feet long by 10 feet wide which in places is vuggy and partly composed of crystal quartz. Greisen veins and leaders 2-4 inches wide and fluorite-filled joints are sporadically exposed on the N wall. The coarse-grained granite host rock is highly foliated on the S wall and traversed by an aplite dyke 1 foot wide.

The quartz pod is enclosed by altered silicified coarse-grained granite. The termination to the pod and the greisenized aureole is abrupt, at least to the N and W. Cassiterite is apparently restricted to the altered, greisenized aureole surrounding the quartz pod but is sparse and finely disseminated. No sulphides were seen.

EXCAVATION C

No metallization is present in this shallow pit which has been sunk on the contact between fine- and coarse-grained granite.

EXCAVATION D

A fine-grained northerly trending greisen zone 2-3 feet wide is exposed in the 8 feet deep pit in which jointing is present in two directions: 45°, dip vertical and 140°, dip 80° NE. The griesen may be formed along the contact between fine- and coarser-grained granite. Metallization is not visibly present.

EXCAVATION E

A greisen body about 2 feet wide is evident in the shallow trench and in the water-filled shaft. Host rock on the eastern side is fine-grained granite overlain by 3 feet of coarse-grained granite. Sulphides are absent, and finely disseminated cassiterite is sparse.

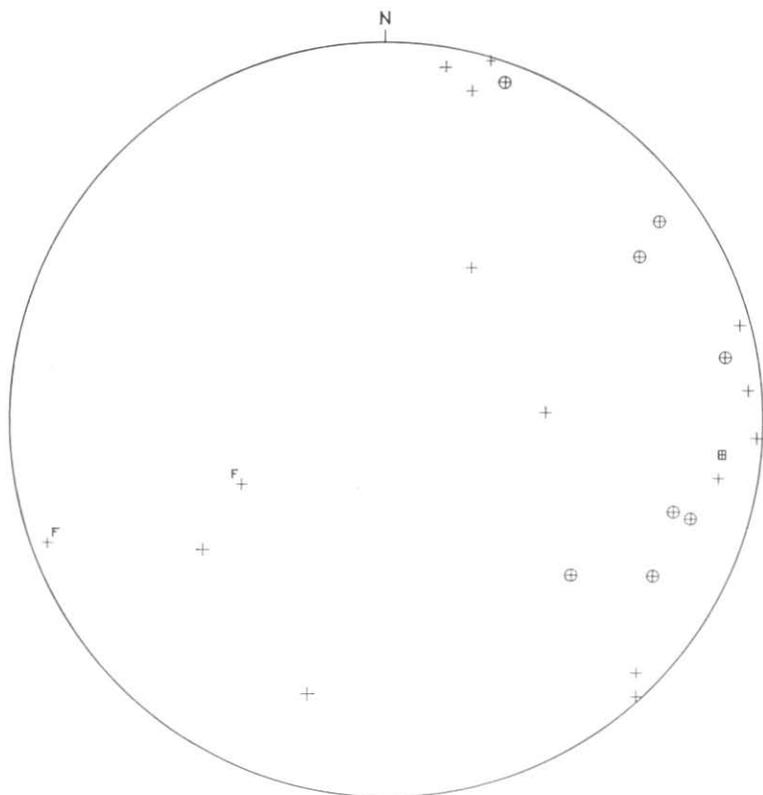
EXCAVATION F

The 10 feet deep water-filled trench has been excavated along a fine-grained greisenized vein trending 15° in porphyritic granite. The vein is 8 inches wide in the southern end of the trench and is composed of quartz and tourmaline in altered rock. Locally the vein is so heavily impregnated that it changes to a quartz-tourmaline rock. Cassiterite is sparse, finely disseminated and not readily visible.

Three or four altered fine-grained granite veins 2-6 inches wide transect the eastern wall of the trench. They strike E and dip 60° S. A shallow trench at the southern end has been sunk on a 3 inch wide barren shear striking 80° and dipping 60° S.

EXCAVATION G

Metallization is best observed in the dump material rather than in the 2-3 feet wide pit sunk on a body of greenish fine-grained granite greisen. The rock carries sporadic altered feldspar pheno-



+ = Unmineralized joint, ⊞ = 'Healed' joint, cassiterite (C₂) bearing
 ⊕ = Fracture joint, cassiterite (C₂) bearing. F = Fluorite-filled joint

FIG. 5 JOINT POLES IN OPEN CUT

crysts and quartz crystals. Cassiterite in irregular masses up to half an inch in size is intergrown around quartz crystals in vugs scattered through the host rock. Cassiterite is also associated with 0.5-1 inch wide bands or irregular pockets of silicified rock, or it may form euhedral crystals between prisms of quartz, or be disseminated in irregular granular clusters through the host. The structure and localization of tin in this small body of rock is similar in some ways to that found in the main open cut orebody. Vertical jointing in the two pits of this excavation is prominent in a direction 165°.

EXCAVATION H

The rock extracted from this 10 feet deep pit is mostly greenish fine-grained greisenized granite, generally soft and friable, in places



silicified and hard. Some quartz crystals in the altered rock are zoned and form agate-like grains embedded in the matrix. A few feldspar phenocrysts are rimmed by a soft greenish talcose mineral, probably kaolin.

Very fine-grained euhedral cassiterite crystals are dispersed in the friable rock which seems to form a plug-like body on which the pit has been sunk. A 6 inch wide vertical greisen vein carrying disseminated cassiterite forms the eastern wall of the excavation and trends 175° . Prominent closely-spaced vertical joints strike due E.

EXCAVATION I

The small shaft at I has been sunk on the major shear which is indicated on surface by numerous silicified and sheared fragments mixed with the granite rubble. The shear is apparently devoid of cassiterite at this site.

MAIN OREBODY (OPEN CUT: EXCAVATION J)

Form .

The outline of the main open cut orebody on surface and its form at depth is revealed by figs. 1, 2, and 6 and sections A-B, C-D which show that the orebody is a roughly cylindrical pipe plunging about 80° in a direction 105° . The longest dimensions on surface (cf. fig. 6) are 60 feet by 45 feet. The flooded workings extend to a depth of 290 feet on No. 3 level (section C-D; fig. 2).

The centre of the pipe consists of a crystal quartz/greisen core formed by a discrete irregular body of vein quartz ramifying through and enclosing highly altered host material (fig. 6). The rock is characterized by the presence of vugs lined and filled with single and compound quartz crystals, some as much as 4 inches long having a diameter of 3 inches. In places, the infilling vein quartz forms bands up to 6 inches in width, or irregular crystalline lenses up to 2 feet in width.

The crystal quartz/greisen body is surrounded by an aureole of altered, greisenized and/or silicified material (originally coarse-grained granite) which is 20 feet wide on the W side. The aureole on the E side and to the N and S of the crystal quartz/greisen rock is narrower, thus on surface at least it is irregularly formed around the core. The aureole rock is at present being mined for its cassiterite content. The shape of the open cut (fig. 6) and the geology represented in it shows that surface workings have defined almost the full extent of the core and aureole rock which together comprise the pipe-like orebody. The perimeter of the open cut along much of its length (except over a width of about 5 feet along the NW rim) represents the contact between silicified altered rock and relatively unaltered coarse-grained granite which may nevertheless be cassiterite-bearing in a few places. Elsewhere along the perimeter remnants of altered rock which have not been extracted still cling to the walls.

The transition from altered aureole rock to coarse-grained granite is irregular but sharp. The contact is clearly demarcated in certain sections where it is exposed. In the NE part of the open cut two sets of joints seem to exercise a rough structural control

on the formation of greisenized rock, one vertical set spaced up to 2 feet apart strikes in a direction 165° , the other complementary set spaced at intervals of half an inch up to 1 foot apart strikes in a direction 105° and dips at an angle of 65° N. Greisenized rock in places terminates against these planes. In the northern part of the open cut, on the other hand, foliation in the rock imposed by closely-spaced fractures (f_2 , a dominant structural control of metallization) transects the contact between altered rock and coarse-grained granite without effecting any control on the formation of altered rock. Thus certain widely-spaced fractures appear to be pre-greisenization, other closely-spaced fractures post-greisenization but still pre-ore.

The contact between aureole rock and granite in the southern part of the open cut is vertical but in the northern part dips steeply northward at the bottom of a face of granite. Along the NW rim of the open cut a tongue of metallized altered rock exposed in the full height of the face persists in a NW direction. In the NE wall a protrusion of cassiterite-bearing greisen under a 4 feet thick cap of granite narrows in a northerly direction in which it seems to be structurally controlled by a set of vertical joints trending in a direction 355° .

Sections A-B and C-D and the plan of the workings (fig. 2) indicate that the pipe is not vertical. The geometric solution of the structure shows that the pipe plunges at an angle of about 80° in a direction 105° . Section C-D (after Waller, 1901 and Nye, 1934) shows too that the orebody retains its cylindrical form and dimensions at the lowest depth of 290 feet.

Ore Minerals, Gangue and Structural Control of Metallization

Minerals found in the main orebody include cassiterite, arsenopyrite, pyrite, sphalerite, chalcopyrite and galena containing silver. The mine initially commenced working before 1900 to recover silver and lead until the operators realized that cassiterite was sufficiently concentrated to render the mining of this mineral more profitable. The sulphides in a sense constitute the gangue minerals in the present mining operations because they are difficult to separate entirely from cassiterite and so lower the average assay of the cassiterite concentrate.

Crystal Quartz/Greisen Core

Cassiterite was not observed by the writer in the crystal quartz/greisen body although Reid and Henderson (1929) reported that cassiterite fills geodes in quartz and is associated with sulphides which form around the cassiterite crystals. It is interesting to note that the aureole rock rather than the crystal quartz/greisen core is at present being extracted from the open cut although the core may well carry lesser quantities of disseminated cassiterite. The localization of cassiterite in host rock was not observed underground but section A-B (fig. 2) shows that chambers on the adit level have been excavated in rock which presumably consisted of both crystal quartz/greisen and altered aureole material. Sulphides within the crystal quartz/greisen core are either:—

- (i) Intergrown in the interstices of quartz crystals lining vugs.

- (ii) Pockets of massive sulphide as much as 1 foot wide intimately associated with crystalline quartz areas or in tabular bands between them.
- (iii) Disseminated through greisen of the core forming irregular sulphide centres generally less than one quarter inch in size.
- (iv) Emplaced as granular (buckshot) concentrations (mainly galena and pyrite) in white soft pug zones up to 4 inches in width.

Galena, sphalerite and pyrite are the most abundant sulphide minerals in the central core of the open cut, chalcopyrite is sporadic and arsenopyrite if present is in small amount. Sphalerite is dark in colour, almost black, and probably represents the iron-rich variety known as marmatite. Fluorite is later than quartz and forms the centre of some quartz-fluorite veinlets which traverse greisen, or may be disseminated in patches up to 1 inch in size through the contact zone of the central core.

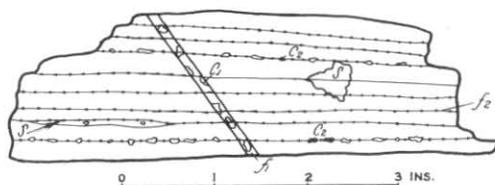
Cassiterite Emplacement in Altered Aureole Rock

The manner in which cassiterite is emplaced in the open cut orebody is controlled by certain of the structures which are shown in fig. 6.

Two structural controls exist for cassiterite deposition; one of these (designated by f_1) is evident as a quartz-healed cassiterite-bearing tension fracture set in which the individual veinlets are regularly spaced at intervals which may range from 3 to 4 inches to 18 inches or more apart. This controlling structure was only observed *in situ* at one place in the open cut but numerous examples are present on the surface in boulders of rock in which the healed metallized joints, between one eighth and one half inch in width, are spaced less than 1 foot apart. Dark blackish-red cassiterite (C_1) may be either richly and continuously disseminated as granular aggregates associated with quartz in the healed fractures or poorly and sporadically disseminated in them. Together the healed fractures form parallel lines of quartz-cassiterite veinlets and stringers traversing the host rock (fig. 7).

A thin section (66-118) of a poorly-metallized veinlet under the microscope shows that cassiterite in irregular grains 0.1-2 mm in size is haphazardly dispersed in a quartz veinlet up to 2 mm wide, consisting of equi-grained anhedral quartz crystals producing an allotriomorphic texture. The vein material is free of the inclusions which are characteristic of the highly siliceous host rock. In another area of the same slide cassiterite is preferentially emplaced along micro bands of sericitic clay mineral formed within or bounding the quartz veinlet.

The second and dominant structural control for cassiterite emplacement (designated by f_2 , fig. 6) is evident in many places of the open cut as closely-spaced (3-25 mm) sheeted jointing which imparts a fracture foliation to the rock. The hairline fractures intersect and cut through the quartz and cassiterite contained in the healed fractures (f_1) but do not displace them. The fracture foliation is formed equally in altered aureole rock and in coarse-grained granite.



C_1 & C_2 - Cassiterite of 1st & 2nd generations. S - Sulphide

Cassiterite disseminated in irregular clusters and as 'dusty' grains along f_2 fracture planes. Sulphide (S) formed along f_2 fractures but also cut by them. C_1 - ○ C_2 - ●

FIG 7 INTERSECTING QUARTZ-CASSITERITE (C_1) HEALED FRACTURES (f_1) & CLOSELY SPACED SULPHIDE & CASSITERITE-BEARING FRACTURES (f_2)

The most striking structural feature of the fracture foliation is its almost concentric attitude around the central core in the open cut (fig. 6) where it is best exposed in altered aureole rock and granite in the workings on the western side. The stereographic plot (fig. 5) of the poles of the fractures shows that they lie near the circumference of the great circle and are distributed over a wide arc unrestricted to any one of the regional joint systems.

The stereographic diagram on the lower hemisphere of a Schmidt equal area net is inconclusive and contradictory for it can be interpreted to show that the fractures are cylindrical and steeply dipping (the majority of poles plot on one side of the net), or conical. The ambiguity arises from an insufficient number of fractures around the open cut being available for measurement.

The closely-spaced fractures (f_2) as already stated are the dominant structural control of metallization. The hairline fractures are filled with a yellowish-green fine-grained aggregate consisting of sericite and clay mineral. Cassiterite (C_2) is emplaced along the fractures as disconnected dark granular clusters or in places as euhedral crystals. In rich ore the lines of veinlets consist almost wholly of cassiterite which was first localized along the fractures and then replaced the host rock over a width of 3-6 mm. Not all of the closely-spaced fractures are metallized in this way, intervening fractures between cassiterite-bearing ones, although exactly the same outwardly, may be barren or coated with very fine-grained dusty cassiterite (fig. 7). By contrast with rich ore, cassiterite crystals and fine-grained aggregates in lower grades of ore are more widely strung out along the fractures and give rise to disseminated tin stringers.

Cassiterite (C_2) veinlets in coarse-grained granite are also localized by folia due to fracturing but metallization does not extend more than a few feet beyond the limits of altered aureole rock. The same system of close fractures (f_2) traverses both silicified altered rock and adjacent granite in the northern face of the open cut; cassiterite is richly concentrated in the fractures in altered rock but rapidly becomes sparser in the fractures in granite.



Cassiterite exceptionally is not controlled in its deposition by the healed joints or close fractures described above but is found in small rich pockets consisting of myriads of fine-grained crystals interspersed in a white puggy matrix.

Sulphides

Where sulphides are sparse in the aureole rock the metals either form thin lenses, bands or sporadic wider veins localized by fractures, or irregular disseminations which may themselves be cut by the fractures. Sulphides in greisenized rock free of fractures impregnate the matrix as irregular disseminations which range from 6 mm to 15 cm in size. Where metallization is more intense sulphides form larger pockets of massive ore which consist of intergrowths of the different sulphide minerals. All gradations between tenuously and intensely metallized rock can be seen.

Fluorite veinlets and filled joints in the open cut trend in a direction 340° - 360° which corresponds to that of one of the regional joint systems in the mine area. Fluorite veinlets elsewhere are aligned in a NE direction which corresponds to another of the regional joint systems (fig. 4). A late barren quartz generation is evident as thin veins cutting cassiterite- and sulphide-bearing fractures and healed joints.

Type of Deposit and Origin

The main open cut orebody is considered to be of diatreme origin because of the following features:—

- (i) The cylindrical pipe-like form of the orebody.
- (ii) The presence of a discrete central core or plug of crystal quartz/greisen which was formed by the infilling of a vent.
- (iii) The aureole of altered greisenized rock which surrounds the plug.
- (iv) The concentric pattern of the metallized fractures (f_2) in the aureole around the plug.

The concentric structure originated either by the rock yielding to regional stresses around the anisotropic crystal quartz/greisen plug subsequent to its formation, or by fracturing imposed at the time of vulcanism when explosive gases burst through the cover rocks to form a pipe. It is difficult to establish which mechanism controlled the formation of fractures.

It was hoped that the stereographic pole plot of metallized fractures (f_2) would be indicative of the mechanism of formation but the diagram (fig. 4) is inconclusive.

The metallized outwardly dipping fractures and the minor inwardly dipping curving fault in the open cut (fig. 6) may have originated according to the mechanics of fracturing proposed by Anderson (1936) and Jeffreys (1936) for the formation of ring

dykes and cone sheets. In this theory the rocks above a subterranean upwelling magma were fractured in one of two ways depending on whether lithostatic pressure (due to the weight of overlying rocks) or hydrostatic pressure (due to the magma) was dominant. The resulting fractures governed the emplacement of ring dykes and cone sheets respectively. The analogy of structure is readily apparent on a much smaller scale in the open cut, the hydrostatic pressure governing the formation of fractures having been supplied by explosive escaping gases.

Structures which have been ascribed to a diatreme origin include the sulphide-bearing deposit of the Tribag mine in Ontario (Blecha, 1965) and the diamond-bearing kimberlite bodies in South Africa (Wagner, 1914), but the origin of these pipe-like bodies is controversial. The suite of sulphide minerals in the much larger pipe orebody of the Tribag mine is similar to that found in the Rex Hill mine. Mining operations in South Africa show that kimberlite pipes pass downward into dykes.

The Rex Hill mine is located on a northerly trending line along which many of the other greisenized bodies lie. This general direction corresponds to that of one of the three main joint systems in the area. The main pipe orebody was therefore localized by this system of joints which may have been metallized prior to the formation of the pipe (cf. the northerly trending attitude of the earlier quartz-cassiterite (C_1) healed fractures (f_1), fig. 6). Henderson (1935) reported also that a vertical N-S vein 3-4 feet wide forms the northern extension of the pipe orebody between levels 2 and 3 which gives credence to the view that the pipe originated along fissures trending in this northerly direction.

The quartz pod in excavation B surrounded by altered rock probably formed in analogous fashion to the main orebody although the dimensions are much smaller. All the other greisenized and in places metallized bodies in the mine area are considered by the writer to have been structurally controlled by joints or minor shears.

The cassiterite and sulphides present in the various metallized bodies are of the fissure filling and replacement type, either emplaced in open spaces or in wall rock altered by the passage of mineralizing solutions and vapours through fissures. The bodies were probably metallized at the time of or soon after the formation of the fissures.

Wall Rock Alteration

Volatiles permeating the granite along channels provided by joints, shears, fractures and pipe openings alter the walls to varying degrees in the process known as greisenization (see Blissett, 1959, p. 50). The altered rocks observed in the excavations of the mine area consist of all transitions between slightly greisenized coarse-grained granite and highly silicified and altered rock which constitutes the aureole of the main pipe.

Granite which has been moderately greisenized varies in colour from pale yellow to dark green. Remanent feldspars, some of which

are rimmed by alteration products, and agate-zoned quartz phenocrysts may remain in the matrix of some fine-grained greisenized rock. Quartz grains in slide 66-136 are interspersed in a fine-grained matrix consisting of sericite and clay mineral. Subhedral or euhedral cassiterite crystals as much as 0.75 mm across and irregular sulphide disseminations (sphalerite) up to 3 mm wide are present in the groundmass between these quartz crystals or replace the host rock around quartz grain boundaries. Anhedral fluorite crystals which attain a maximum size of 3.5 x 1.5 mm are sporadic in the slide as seen under the microscope.

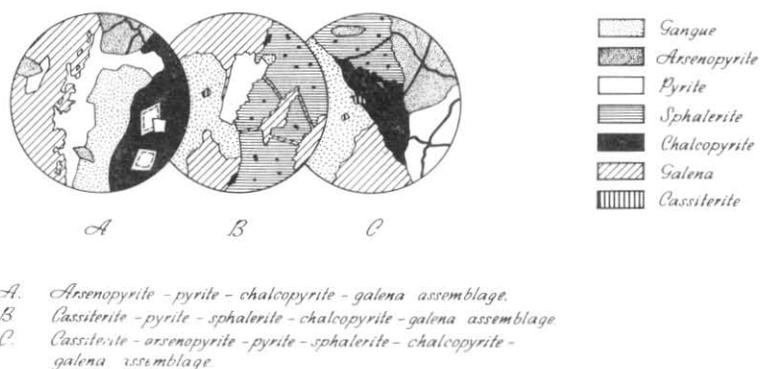
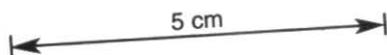


FIG. 8 DIAGRAMMATIC REPRESENTATION OF SULPHIDE AND CASSITERITE RELATIONSHIPS



Paragenesis and Temperature of Formation

The paragenesis of the sulphides has been established from the study of six polished sections numbered 66-118 to 66-123. The boundary relationships of sulphides and cassiterite in the suite as a whole are represented ideally for the sake of clarity in the diagrams A, B and C of fig. 8 which show that the sequence of sulphide deposition is:—arsenopyrite, pyrite, sphalerite, chalcopyrite and galena.

The minerals were identified under a maximum magnification of about x283. Very small blebs of bornite? are present in small amount in chalcopyrite at the contact with galena in section 66-121.

Arsenopyrite and pyrite, the hardest and the earliest formed minerals, generally have mutual boundaries. This makes the relative age difficult to determine. In section 66-118, however, pyrite is formed around a characteristic wedge-shaped arsenopyrite crystal and is later. Arsenopyrite and pyrite in sections 66-119 and 66-122 are fractured and filled with chalcopyrite veinlets. In sections 66-120 and 66-121 pyrite cubes 0.2-0.5 mm in size are scattered through a chalcopyrite host or are aggregated together to form pyrite areas. Pyrite crystals in section 66-122 show an internal zoning (cf. fig. 8A) where they are surrounded by chalcopyrite and also show evidence of two pyrite generations. The mineral is moderately anisotropic under crossed nicols in the suite of polished sections and resembles marcasite in this respect.

Much of the sphalerite is exsolved with chalcopyrite, thereby indicating that the two minerals are contemporaneous. The exsolutions form globules and blebs in sphalerite. Some of the chalcopyrite veinlets (with unmatched walls) traversing sphalerite may represent exsolutions at the grain boundaries of sphalerite. Sphalerite and chalcopyrite generally have mutual boundaries or chalcopyrite may embay and encroach upon sphalerite (carries texture) and leave isolated residuals near the contact (fig. 8C). Sphalerite is later than pyrite, shown by the texture in fig. 8B where sphalerite has unevenly replaced one side of a pyrite crystal.

Chalcopyrite in places shows copper oxidation products. Cassiterite in section 66-122 is present in the gangue as crystals up to 1 mm in size. One crystal is partly surrounded by chalcopyrite (fig. 8C) but alteration minerals were not observed rimming the cassiterite. This might indicate that the sulphides (deposited at a lower temperature) are later than cassiterite.

Galena formed later than sphalerite, indicated by veinlets of galena traversing sphalerite (fig. 8B), and later than pyrite, shown by the formation of carries texture (fig. 8A). The galena-chalcopyrite sequence, however, is not definite; in most areas these two minerals have mutual boundaries. Some boundary textures indicate that galena was the last mineral to form, in others blebs of chalcopyrite replace sphalerite and galena along their contact (fig. 8B), suggesting that chalcopyrite may have been the last mineral to form.

The age relationship of sulphides to the two phases of cassiterite emplacement and their distinctive structural controls is noteworthy. Sulphides are not present in the quartz-healed cassiterite-bearing fractures belonging to the system f₁, whereas sulphides and cas-

siterite (C_2) are controlled in their deposition by the later fracture system f_2 . Disseminated sulphide areas are also transected by fractures of this system which indicates that some sulphides at least formed prior to fracturing and also prior to the last cassiterite generation. Thin lenses and bands of sulphide along some fracture planes enclose euhedral cassiterite crystals; sulphide lenses may be also coated on their external surfaces with very fine-grained "dusty" cassiterite which again suggests that cassiterite was the last mineral to form.

SUMMARY OF MINERAL AGE RELATIONSHIP

Summarizing the age relationships of cassiterite and sulphides it may be said that:—

- (i) The earlier cassiterite (C_1) generation is associated with healed fractures (f_1) in the aureole rock.
- (ii) The second cassiterite (C_2) generation is associated with a fracture foliation (f_2) in the host aureole rock and adjacent granite. The closely-spaced metallized fractures transect the healed quartz-cassiterite fractures to form in places criss-crossing diamond shaped patterns. Cassiterite crystals formed in vugs between quartz crystals in the central core.
- (iii) Sulphides in the central core are implanted on earlier cassiterite crystals. Sulphides in the aureole rock formed along some fractures and were localized by them; elsewhere sulphides are transected by these fractures (f_2).
- (iv) Thin sulphide lenses and bands enclose cassiterite (C_2) formed in the f_2 fractures but may also be coated with "dusty" cassiterite.

DISCUSSION

The relationships described above indicate two distinct ages for the emplacement of tin, confirmed by the greisenized tin-bearing leaders and veins of different ages which intersect each other in the mine area. The northerly trending greisen leaders (related to a distinct joint system) are truncated and terminated by later greisen veins associated with a shear zone which trends $75^\circ-80^\circ$.

Field evidence suggests that as the coarse-grained granite magma crystallized, it differentiated into a fine-grained porphyritic granite, which formed above a temperature of 573°C (indicated by the presence of β quartz). The cooling magma fractured along a line of weakness and formed northerly trending joints which subsequently acted as channels for mineralizers at different places. The hydrothermal solutions migrated along the channels and formed greisen bodies and leaders belonging to the first phase of cassiterite metallization. With continuation of crystallization, vapour pressure built up in the magma reservoir until it exceeded the pressure of the relatively thin cover of rock. The volatiles burst through the overlying rock along the previous line of weakness to form a diatreme. Close fracture patterns, arranged around the diatreme, and the main body of the diatreme itself were subsequently metallized in the

ensuing second cycle of cassiteritization. The shear formed at this time and greisen veins associated with it were metallized in the same cycle.

The age of the sulphides is uncertain. Evidence shows that sulphides were deposited between the two phases of cassiterite metallization and also after the second cassiterite (C_2) generation.

The two other unmetallized joint systems in the mine area (cf. fig. 4), one trending northeasterly, the other northwesterly and related to major Tertiary faulting, are regarded as post-ore.

The northwesterly trending joints in other mines of the district (p. 9) are a major structural control of ore deposition. Inasmuch that the granite (and presumably the metallization) is Devonian in age the major Tertiary faults appear to be dislocations along pre-existing lineaments which are reflected in the northwesterly trending joints.

Cassiterite forms at a high temperature corresponding to the emplacement of a granite magma which A. H. Clark (1964) suggested might consolidate at a temperature of $700^\circ\text{C} \pm 50^\circ$ under a fairly low confining pressure. Tin can be transported as the volatile SnF_4 compound which decomposes in the presence of water vapour to form cassiterite (SnO_2) and hydrofluoric acid which in turn reacts with the wall rock to produce altered greisenized rock.

Insufficient geobarometric and geothermometric work has been done on the sulphides to determine their temperatures of formation but L. A. Clark (1960) recorded that arsenopyrite and pyrite cannot form together above $491^\circ\text{C} \pm 12^\circ$. This being so, the upper limit of temperature of formation of the sulphides in the Rex Hill orebody is given.

Production and Grade

The Rex Hill Tin Mining Co. mined 3000 tons of ore which yielded 170 tons of cassiterite concentrate between the years 1893 and 1900. Nye (1934) reported a total of 826 tons of concentrate produced up till 1913.

Independent sampling of the lower levels in 1934 and 1935 gave conflicting assay results in which the metallic tin content ranged from 3.1% to 0.01%. The mine closed down because of the decreasing grade of ore at depth and it seems likely that the lower values of the assays (Henderson, 1935) are a truer reflection of metal content at depth. Waller (1901) reported that about 20 tons of silver-lead ore were recovered, assaying 80 oz/ton of silver.

A recent assay of a sample taken over a length of about 9 feet in aureole rock from the western side of the open cut is included in the report by Manson *et al.* (1966). The assay gave the following result:—

	%
Tin (Sn)	4.8
Tungsten (WO ₃)	Trace
Copper (Cu)	0.26
Lead (Pb)	0.15
Zinc (Zn) ..	0.92
Sulphur (S)	14.2

A parcel of concentrate from the mine was also recently analysed in the Laboratory of the Department of Mines and found to contain:—

	%
Zn	17.20
Pb	11.56
Sn	9.83
Tungstic Oxide	0.22
Gold ..	Nil
Silver	6 oz 13 dwt 14 gr/ton

A parcel of crushed ore submitted by the lessees to the Risdon works of the Electrolytic Zinc Co. was assayed and found to contain:—

	%
Zinc ..	22.0
Lead ..	16.0
Copper	2.5
Tin	2.2
Iron ..	11.3
Cadmium	0.1
Total Sulphur	16.3
Insoluble (mostly silica)	17.2
Silver ..	12.5 oz/ton
Gold ..	0.05 oz/ton

The concentrating plant, situated near Buffalo Brook 0.7 mile NW of the mine, is currently being modified to incorporate a jaw crusher, set of rolls, rod mill, pulsator and Wilfley table which together will concentrate the heavy minerals but not entirely remove sulphides from the cassiterite fraction.

Ore Reserves

The ore reserve calculated for the aureole rock on the western side of the open cut down to the adit level is approximately 1000 tons, assuming a tonnage factor of 13 cu. ft/ton. The grade of this ore, if it remains consistent, would vary between 4.8% and 2.2% metallic tin. The figures are based on the assays given above.

The ore reserve of the crystal quartz/greisen core is approximately 2300 tons but the grade of tin in this sulphidic ore is unknown.

The results are better summarized in figures:—

$$\text{Ore reserve of aureole} = \frac{13,000 \text{ cu. ft}}{13 \text{ cu. ft/ton}} = 1000 \text{ tons}$$

$$\text{Ore reserve of crystal quartz/greisen core} = \frac{30,000 \text{ cu. ft}}{13 \text{ cu. ft/ton}} = 2310 \text{ tons}$$

The walls of the chambers on the adit level need to be carefully sampled to delineate possible N-S or other extensions of the main pipe orebody.

Hosking (1965), in an excellent review of types of tin deposit, their genesis and characteristics, stated that "associated with the obvious zone of wall-rock alteration adjacent to a tin lode there is an envelope of rock, which is commonly broader, in which anomalous concentrations of the ore-forming metals were deposited during the time of ore formation". Such envelopes on or near surface could be revealed by geochemical analyses (e.g., gallein colorimetric or dithizone methods) of soil samples taken on a grid pattern over the mine area.

Conclusions

The dimensions of the main pipe orebody, the associated rock types, high grade of tin ore, two phases of cassiterite emplacement related to separate and distinct structural controls, and the presence of silver and at least 5 sulphide ores render this mine unique in Tasmania. Many endogranitic pipe bodies have been reported in the Herberton tin field in Northern Queensland (Zimmerman, 1965) and also in New South Wales. The Carpathia mine near Ardlethan is similar in size, shape and grade and contains the same assemblage of sulphide minerals.

In general, pipe bodies from these fields are characterized by their irregular shape, unusually high grade and simple mineralogy. They are usually located on or near steeply dipping fracture planes and in places are strung out along the plane as irregular, disconnected pods to which the tin is restricted.

Many tin deposits of the granitic metallogenic region in NE Tasmania are seemingly related to aplite and fine-grained granite associated with or intrusive into coarse-grained granite (cf. Aberfoyle mine and Blue Tier tinfield). In the district of the Rex Hill mine most of the vein deposits are structurally controlled by faults or joints trending in a northerly and/or northwesterly direction (e.g., Aberfoyle and Storeys Creek mines); farther afield in deposits of the Blue Tier area the control is in many places lithologic, disseminated cassiterite having formed in finer-grained granite beneath a flat lying cover of porphyritic granite, or as irregular bodies having flat floors. No other deposits, to the writer's knowledge, show evidence of a diatreme origin so well as does the Rex Hill mine.

References

- ANDERSON, E. M., 1936—The dynamics of the formation of cone-sheets, ring-dykes, and cauldron-subsidence. *Proc. Roy Soc., Edinburgh*, 56(2), 128-157.
- BATEMAN, A. M., 1950—*Economic mineral deposits* (2nd ed.). John Wiley and Sons, New York.
- BLECHA, M., 1965—Geology of the Tribag mine. *Bull. Canad. Min. Metall.*, 58, 1077-1082.
- BLISSETT, A. H., 1959—The geology of the Rossarden-Storeys Creek District. *Bull. Geol. Surv. Tas.*, 46.
- CLARK, A. H., 1964—Preliminary study of the temperatures and confining pressures of granite emplacement and mineralization, Panasqueira, Portugal. *Inst. Min. Metall.*, No. 694, pp. 813-824.
- , L. A., 1960—The Fe-As-S System. Variations of arsenopyrite composition as functions of temperature and pressure. *Ann. Rep. Dir. Geophys. Lab., Carnegie Inst., Washington*, Year Book 59, pp. 127-230.
- HENDERSON, Q. J., 1935—The Mount Rex mine. *Rep. Dep. Min. Tas. (Unpublished)*.
- HOSKING, K. F. G., 1965—The search for tin. *Min. Mag.*, 113, pp. 368-383, 448-461.
- JEFFREYS, H., 1936—Note on fracture. *Proc. Roy Soc., Edinburgh*, 56, 158-163.
- MANSON, W. ST C., JAMES, P. L. and WELLINGTON, H. K., 1966—R.514—Mt Rex Tin concentration test. *Tech. Rep. Dep. Min. Tas.*, 10, 135-137.
- MASON, B., 1952—*Principles of geochemistry*. John Wiley and Sons, New York.
- MONTGOMERY, A., 1892—Report on the Ben Lomond District. *Ann. Rep. Sec. Min. Tas.*, 1891-92.
- NEUMANN, H., 1948—On hydrothermal differentiation. *Econ. Geol.*, 43, 77-83.
- NYE, P. B., 1927—Rex Hill Tin Mine. *Rep. Dep. Min. Tas. (Unpublished)*.
- , 1934—The Mount Rex Mine. *Rep. Dep. Min. Tas. (Unpublished)*.
- REID, A. M., 1928—Rex Hill Tin Mine. *Rep. Dep. Min. Tas. (Unpublished)*.
- and HENDERSON, Q. J., 1928—Blue Tier Tinfield. *Bull. Geol. Surv. Tas.*, 38.
- , 1929—The Avoca Mineral District. *Bull. Geol. Surv. Tas.*, 40.
- ROGERS, A. F. and KERR, P. F., 1942—*Optical Mineralogy*. McGraw-Hill Book Co. Inc., New York.
- WAGNER, P. A., 1914—The diamond fields of Southern Africa. *Johannesburg: The Transvaal Leader*.
- WALLER, G. A., 1901—The tin-mining district of Ben Lomond. *Ann. Rep. Sec. Min. Tas. for 1900-1901*, pp. 302-342.
- ZIMMERMAN, D. O., 1965—Tin ore deposits of Australia. *Geology of Australian Ore Deposits. Eighth Commonwealth Min. Metall. Cong.*, v.1, pp. 39-45.