

UR 1954/30-56

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GEOLOGICAL REPORT  
ON  
ALL NATIONS MINE AND SURROUNDING AREA  
1309 - TRANS

TABLE

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SUMMARY

The whole of the 80 acres of Lease 58M/51 including within its boundaries lease 35M/48 is within the mineralised zone.

Within this zone in the sedimentary rocks there has been a localisation of quartz veins carrying Wolfram.

The localisation of these veins may be due to several factors the most important is a shielding lense of conglomerate.

There is no recognised structure for localisation of veins in the "Porphyry" in the same sense as in the Quartzites.

The prospects of recovering the veins dislocated in the All Nations Mine are good.

The possibility of the vein in Pochins Adit making towards the west are good

The outcrops in every possible case were mapped and the altitude of beds and fractures determined where possible. These were not very many and were extrapolated beyond reliable limits.

Past mineral faulting has played an important role in the life of the All Nations Mine.

INTRODUCTION:

This survey was carried out at the request of the Directors of the Tasmanian Tungsten Development Company and Mr. C. G. Sulzberger representing A.J. Rowe to the Director of Mines.

The survey conducted during November-December, 1953, was undertaken to investigate:

- (i) Present and potential ore occurrences.
- (ii) Extent of future development possibilities.
- (iii) General relationship of the ore veins.
- (iv) The overall geological structure.

AREA:

The area surveyed was the 80 acres held by A.J. Rowe. Included within its boundaries and appearing near the western boundary is the lease of 10 acres 35M/48 held by the Tasmanian Tungsten Development Company No Liabilities.

LOCATION:

The leases are situated about 1 mile south-east of Moina township. The north-west corner of lease 58M/51 occurs on the branch road 21 chains south-west of the junction of the Cradle Mountain-Dalcoath roads. Height above sea level is about 2,000 feet.

2.

Access into the area and up to the mines on <sup>33</sup> the lease is good. The main Cradle Mountain-Wilmot-Devonport highway passes a few chains west of the workings. The roads on the lease itself are all weather roads which lead right up to the mine dumps. Most of the road systems in this area are metalled.

The nearest township is Wilmot situated 11 miles north and the nearest shipping port is Devonport situated 36 miles north.

Moina is now a "Ghost" town, the only building still standing of former days is the Post Office which still functions as such. The re-opening of the Shepherd and Murphy Mine now known as the Moina Tungsten Tin Development Company No Liability has brought with it hydro-electric power which should be available within a short space of time if required at any mines in its immediate vicinity for lighting, power for electric drills, magnetic separators &c.

#### PHYSIOGRAPHY:

Within the 80 acres examined the relief is moderate, some minor streams traverse the area flowing northwards into Narrawa Creek. A conglomerate ridge running almost east-west and  $3\frac{1}{2}$  chains north of the southern boundary line forms the most prominent physiographical feature in the block, it is also the highest ground in the area.

That portion of the block north of the Conglomerate ridge has a fairly even gradient dipping northwards at about  $10^{\circ}$ . The southern side of the ridge forms a scarp face composed of conglomerate which extends eastwards well down the Forth Valley and westwards to the Lady Barron Mine. South of the ridge the slope shallows to an almost flat plain and continues in that direction as part of the plateau.

On the south-east corner of the block the land form dips sharply down to the Forth River at a slope of  $40^{\circ}$ , the river is about 1,000 feet below the plateau here. Off the western boundary the country generally falls away more gently into the Iris River valley which is about 600 feet below the plateau.

#### VEGETATION:

Over most of the eighty acres large eucalypts were scarce although some good saplings of stringy bark were growing in the north-west corner of the 80 acre lease and good timber is available just outside the lease off this corner.

The northern slope had been burnt out recently and was fairly clear of thick secondary growth, patches of button grass also helped expedite the surveying on this slope. The southern slope was extremely thick, the scrub consisted mainly of tea tree and survey lines had to be out to all stations and important outcrops this necessarily impeded progress.

HISTORY:

The earliest recorded production from the All Nations Mine is 2 tons in the second quarter 1905, since then till 1942 the total recorded production figures available are 35.582 tons of Wolfram valued at £5,704. Production ceased during 1913-14 commenced in 1915 and ceased from 1921-35. From 1936-41 there was some activity in the area but production figures for 1942 are again zero.

It is not clear whether the figures represent tonnages extracted from a particular mine or whether they represent the sum total tonnage production of all the mines on the lease, the latter is probably the case.

Within the 80 acres surveyed five prospects showed a vein or veins carrying Wolfram, of these three had been worked extensively enough to indicate they must have been on a profitable basis for a time at least.

Data available does not enable one to write an accurate account of the discovery and development of the various mines.

SURVEYING:

The type of country and the nature of the problem warranted a close instrumental survey of the whole area. The instrument used for surface work was a Hilger and Watts No. 1 Microptic Theodolite. All underground mapping was done by tape and compass and tied onto a surface station.

An assumed datum of 2,000 feet was taken for station A and the instrument was orientated on a compass bearing.

Rock exposures were very few and every outcrop seen in situ was mapped, where possible the altitude of the beds was determined.

A search for fluorescent minerals of economic considerations was made with an ultra violet lamp in the various accessible mine workings and on the spoil heaps. A very sparsely distributed mineral giving a golden yellow fluorescence was seen but not identified.

Although no scheelite was found in this area it should be noted that in a more calcic environment it does occur as for instance at the Shepherd and Murphy Mine.

GENERAL GEOLOGY:

Most of the 80 acres are composed of three broad divisions of rock type, these are -

- (i) The "Porphyry" a pseudo igneous rock.
- (ii) The Conglomerate.
- (iii) The Tubicolar Quartzites and Shales.

The porphyry occupies the southern one-fifth of the 80 acre lease and unconformably underlies the conglomerate. The age of the original sediment is not

known but may be of Cambrian or earlier age.

Unconformably overlying the "Porphyry" is the "Ghost" conglomerate equivalent to the West Coast Range Conglomerate. Its contact with the porphyry runs almost east-west curving northwards in the east and southwards in the west giving an elongated inverted S shape in plan.

Conformably overlying the conglomerate are the quartzite and shale beds equivalent to the Caroline Creek formation.

East of the eastern boundary of lease 58M/51 and lower down in the Forth Valley a granite of variable composition and colour called here a grey granite occurs.

Originating in the granite and penetrating the "Porphyry" and overlying sediments are numerous quartz, pegmatitic, and aplitic veins.

The age of granite and the accompanying veins is considered to be Lower Devonian.

#### DETAILED GEOLOGY:

##### Porphyry:

This rock occurs along the southern one-fifth of lease 58M/51. In mapping the "Porphyry" three types have been described which are probably variations of the one original rock.

##### (i) The red porphyry:

This rock was found in varying amounts on most of the spoil heaps being most abundant around the three eastern shafts of the Lawkemlaw Mine.

In hand specimens the rock is uniform massive and soft, the red colour in the rock is due to iron oxide staining which in some specimens form alternating dark and light bands giving the appearance of bedding.

Numerous small fractures filled with a greenish creamy mineral about 1/50 inch wide traverse the rock in those specimens seen around the Lawkemlaw Mine. The material in the small fractures is hydrothermally altered.

Phenocrysts of quartz and a greenish mineral in places more completely altered to a creamy white and described by previous writers as altered feldspar are quite easily seen. The altered greenish mineral has well developed crystal faces which are easily distinguishable, in the less altered specimens the mineral seems to be platy.

The crystal form is not that of a feldspar and the platy nature of the less altered crystals is not a property of any of the feldspar group.

##### (ii) The grey-quartz-porphyry:

A hard grey medium grained highly siliceous rock found immediately beneath the conglomerate. The phenocrysts are quartz and a much altered and often completely leached ferromagnesium mineral

probably hornblende. Lineations in the rock are clearly seen especially in the weathered specimens.

**(iii) Grey-quartz-hornblende-porphry:**

This rock is of variable hardness varying from a very soft kaolin like rock to a hard compact massive siliceous rock. The phenocrysts are quartz and tabular shaped crystals of a ferromagnesium mineral probably hornblende.

The ferromagnesium mineral shows a marked orientation in the hand specimen and should be of value in petrofabric analysis.

The porphyry has been described by previous writers as being of Devonian age and of igneous origin.

It should be pointed out that on the eastern side of the Forth River almost opposite the Pig and Whistle Mine extending from Tin Spur to Olivers Hill almost three miles to the south the same suite of rocks is referred to as the Porphyroids. These rocks are now considered to be of sedimentary origin.

Some pertinent facts concerning the contact of the "Porphyry" and the overlying conglomerate may be discussed here to throw light on the true relationship of these rocks and the origin of the "Porphyry".

- (i) The contact between the two rocks is irregular.
- (ii) The Porphyry changes under the conglomerate between Tin Spur in the north to a sediment in the south at McCoys road.
- (iii) The "Porphyry" never intrudes the overlying rocks though other phases of the granite do so e.g. the pegmatite, quartz and aplitic veins.
- (iv) In other local areas where the "Porphyry" is seen in juxtaposition with the sediments the relationship is a faulted one.
- (v) The "Porphyry" is the same as that described as being a porphyroid on the eastern side of the Forth River.
- (vi) The porphyritic texture can be seen in the base of the Ghost conglomerate at tin spur where the granite is only some fifty feet away.
- (vii) The porphyry is always under the conglomerate or quartzites.

These facts indicate important differences from those ideas previously held viz.,

- (i) They indicate that the porphyry is of an older age than those sediments overlying it.
- (ii) The rock is not of igneous origin, rather a soaked sediment now having the appearance of an igneous rock.

The age of porphyritisation is post Ordovician, its most probable age is Lower Devonian, that is, the accepted age of the granite activity.

June Group:

This group of rocks contains the West Coast Range Conglomerate. This formation name has been discarded and the sediments are now grouped with the West Coast Range Conglomerate as part of that formation. The Caroline Creek sandstones and shales and the Gordon River limestone.

In the area surveyed the Gordon River Limestone is not represented although it does occur in the Iris river valley to the west of the western boundary of lease 58M/51.

Ghost Conglomerate:

The name "Ghost" conglomerate has been applied to this bed because the similarity of the matrix and cement often makes the pebbles difficult to pick out and they appear as "Ghost" pebbles.

The bed unconformably overlies the "Porphyry" and in the mapping of its outcrop shows a thinning from east to west in the area surveyed. The thickest portion of the conglomerate is just inside the eastern boundary of lease 58M/51, here the bed is about 100 feet thick in the western portion of the lease it has thinned to 15 feet. On Sayers block to the east the conglomerate is absent. This thickening and thinning of the conglomerate is seen more clearly between the quartzites and porphyry on Oliver's Hill where the irregularities of the underlying porphyry surface causes the conglomerate to thicken or thin rapidly, being thickest in the "valleys" of the porphyry surface, it is presumed that the nature of the contact on lease 58M/51 is no different from that seen on the other side of the Forth River.

The pebbles forming the matrix vary in size from peas to a close fist and average size however is about 2 inches by  $1\frac{1}{2}$  inches, most of them are milky white although occasionally a pink pebble may be found. The cement is also a milky white colour which sometimes merges almost completely with the matrix the whole forming a massive white siliceous hard competent rock.

No definite bedding planes were observed in the conglomerate, on its surface three places which were taken as bedding planes were measured these showed an average dip of  $20^{\circ}$  to  $350^{\circ}$ , the strike  $260^{\circ}$ .

Because it is the hardest rock in the area the conglomerate has formed a ridge which forms a marked physiographical feature.

In the sections drawn from the plan accompanying this report the contact of the conglomerate and the porphyry has been drawn as regular and even, this is not the case as has been pointed out earlier, investigations in other parts of the area shows the contact to be irregular, however since we have no knowledge of what the shape in section will be of the contact of these two rock types no geological boundaries have been drawn.

It is emphasised that the few readings obtainable were extrapolated beyond reliable limits and used to give us the basic structure which is believed to be correct although details if and when obtained may show some differences.

It is interpreted from observations on Sayers Block, Olivers Hills and lease 58M/51 that the conglomerate may form isolated lenses along its strike and dip, one such lense occurring on lease 58M/51.

The conglomerate is the most competent rock in the area surveyed and has resisted fracturing which has given us tension gashes seen in the quartzites and "porphyry".

This resistance to fracturing has made the conglomerate a poor host rock, quartz veins carrying wolfram were seen in the conglomerate north of the Lawkewlaw Mine and others in an open cut in the conglomerate north-west of the western end of the Pig and Whistle open cut. None of these veins were more than two inches wide most were only a fraction of an inch.

It may be noted that the surveying in of No. 2 Lode west of the X-cut in the Pig and Whistle Mine shows the vein passing under the conglomerate, no evidence of this vein penetrating the overlying conglomerate and appearing on its surface was found. Unfortunately the timbering had collapsed and no examination could be made in this mine of what happens to the vein when it reaches the contact of the porphyry and conglomerate, however about five hundred feet east-north-east of the Pig and Whistle Mine. Mr. A. McIntosh Reid in Bulletin 29 "Geological Survey" page 91 records a similar occurrence - "The conglomerate rock has not been fractured and contains little wolfram only near the point of contact with the underlying quartz porphyry. A fair amount of wolfram bearing lode material however has been deposited as a horizontal ore body between the conglomerate and porphyry".

These observations indicate that there are possibly other veins not exposed at the surface which on penetrating the porphyry have been prevented from reaching the surface by the shielding lense of overlying conglomerate, it is obvious then that the extent of the conglomerate and its thickness are vital factors in planning future prospecting programmes in this area. The thicker the conglomerate the greater its competence and the less likelihood of fracturing as a result of this we may expect few mineralised fractures and these will probably be uneconomic propositions.

So far as is known no shafts, workings or drill holes have penetrated through the conglomerate into the "Porphyry" and our knowledge of its shape and size are limited by those observations taken along the ridge and extrapolation northwards.

#### Tubicolar Quartzites and Shales:

These sediments cover nearly four-fifths of the area surveyed but do not outcrop to any great extent. Nearly every exposure of these rocks in-situ was surveyed and where possible the altitude of the beds determined.

The beds conformably overly the Ghost Conglomerate and have a general strike of 260° dipping at 25° north.

Due to the scarcity of suitable outcrops only a few dip strike readings could be taken, these show a gradual change in strike direction from east to west between Pochins Adit and the X-cut at the All Nations Mine. In all, the number of readings taken between these two places was about fourteen, however it was observed that the beds in and around Pochins Adit dip towards the north-east at the eastern end of the open cut line of the All Nations Mine, the beds dip towards the north and in the vicinity of the X-cut of the All Nations Mine the beds dip towards the north-west. 39

The sediments consist of beds varying from grits to shales. The basal bed immediately overlying the conglomerate is a grit followed by a white to grey quartzite containing numerous tubicolar casts which are across the bedding plane. On the weathered surfaces of the rock these fossils are prominent measuring  $\frac{1}{4}$ - $\frac{1}{3}$  inch in diameter and from 3-6 inches long. Other observers have described them as being up to 18 inches in length. In a freshly broken rock the fossils are far less obvious. Cross bedding is quite clearly seen in the quartzites.

Overlying the quartzites are finer grained sediments ranging from fine grained quartzites to siliceous shales. In the bedding planes of these finer grained sediments a small type of worm like cast was seen ranging in diameter from  $\frac{1}{10}$  to  $\frac{1}{5}$  inch and varying in length from  $\frac{1}{2}$ - $1\frac{1}{2}$  inches.

The sediments do not grade up simply from a grit base to siliceous shales, there are other grit beds in the sequence which indicate there were smaller rythms in the main cycle of sedimentation.

Somewhere in this stratigraphic sequence a sharpstone conglomerate occurs, its position is not known. A cursory glance at this bed in outcrop may lead to the erroneous conclusion that it is a fault breccia which it resembles. It is important to recognise the true nature of this rock because we do have low angle thrust faults with accompanying breccia zones of past mineralisation period.

The stratigraphic sequence of quartzites and shales is only imperfectly known.

A warning may be given here, that, as in the case of the conglomerate only a few readings were taken of the altitude of the beds, these were extrapolated beyond reliable limits and were used to help grasp the main structure.

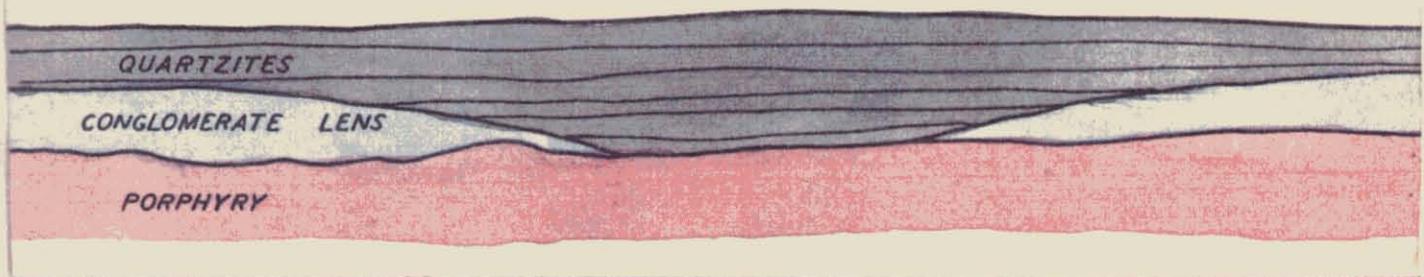
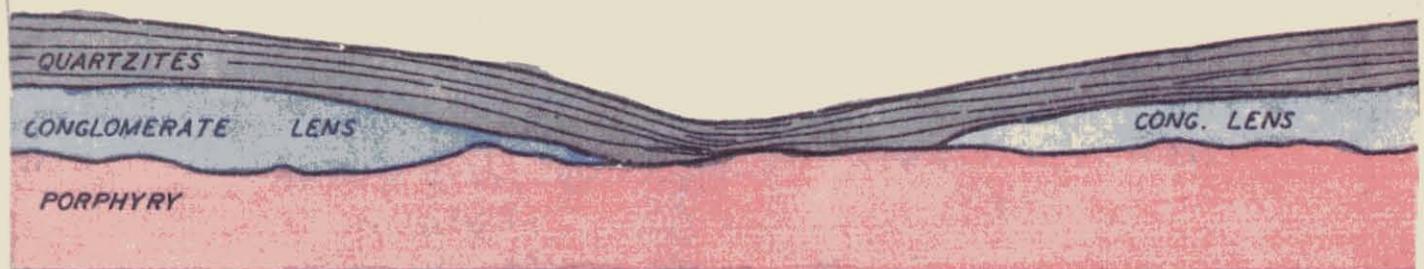
It was observed that the angle of dip of the sediments as a whole tended to increase towards the north.

The estimated thickness of the sediments in a line running east-west through pochins adit and along the drives of the All Nations Mine is about 150 feet.

In the All Nations Mine a thrust fault dislocating the veins occurs in the bedding plane with a breccia zone of a little over six feet. The relative movement of this fault was hanging wall south i.e. a low angle thrust fault.

1. DIFFERENTIAL COMPACTION:

The initial flexuring took place with the compaction of the sediments. As the sediments accumulated the weight of the overlying beds squeezed the water out of the rock and forced the particles closer together reducing the porosity. The reduction in volume in some cases may be considerable, for instance muds may be deposited with an initial porosity of 80 or 90 per cent, and sands may have a porosity of over 40 per cent.. The water content and porosity are directly related to the type of sediment, with the coarser sediments showing less change in volume than the finer grained ones, this concept is illustrated in the sketch below and the principal applied to sediments on lease 58M/51.

BEFORE COMPACTIONAFTER COMPACTIONTECTONICS

(2) Compression: During the Tabberabberan orogeny tangential compressive forces threw the comparatively flat lying sediments into great folds the distance between anticlinal axes being about two miles, in between these main fold axes disharmonious and drag folding occurred.

Contemporaneous with the folding was a period of granite activity and metallogenesis. The granite is of an intrusive nature at depth. To accommodate this mass of granite the rocks around it were forced up into a great oval dome with the longer axis about two miles running approximately east-west.

This arching of the overlying rocks placed them in tension which was relieved by fracturing giving us tension gashes. These tension gashes when mapped over the whole area show a parallelism to the main Dalcoath Anticlinal axis.

In the accompanying sketch the parallelism of the veins to the axis of the fold and the dip of the sediments away from the granite mass can be seen.

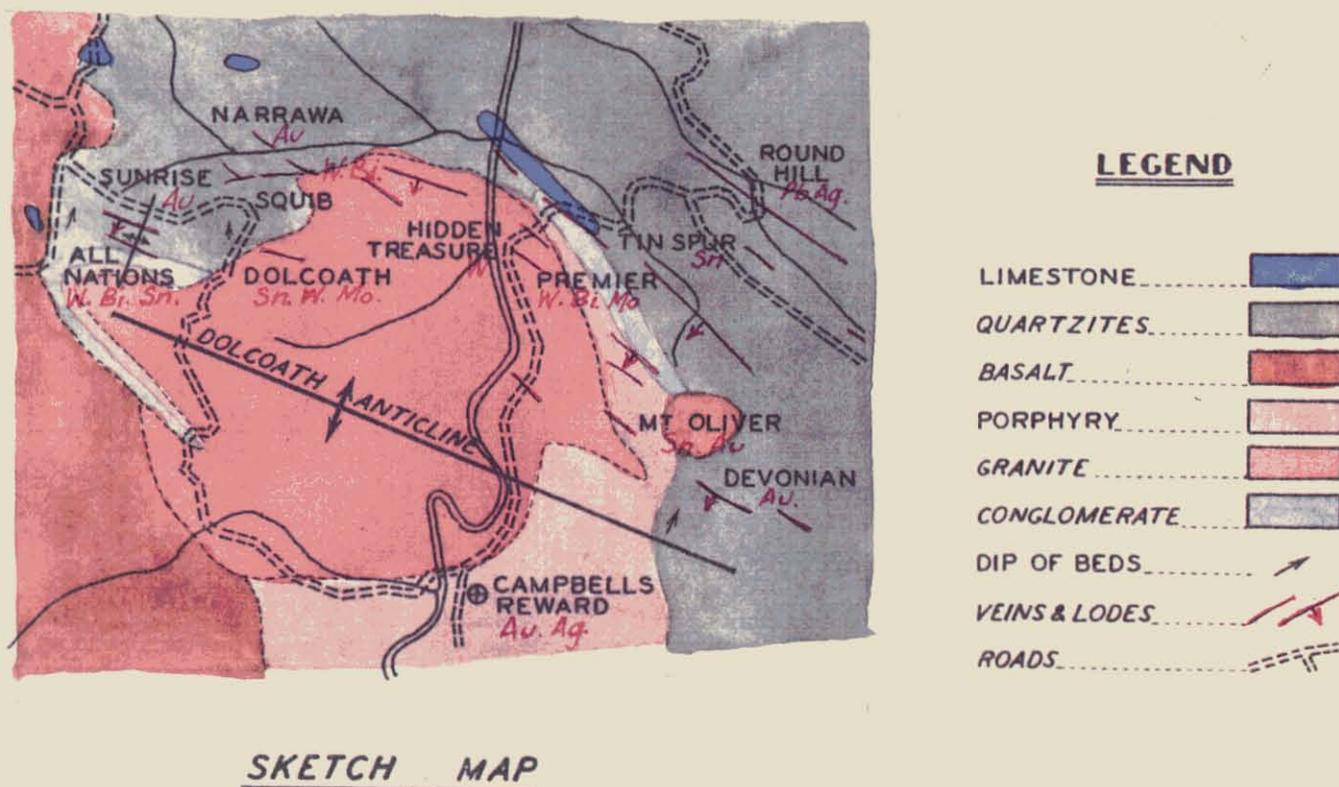


FIG. B

### FRACTURING:

#### Tension Gashes:

These fractures have been partly dealt with in the section dealing with compression. The sketch above shows only those veins occupying tension gashes which have been developed or prospected. There are a host of other veins not wide enough to be of value which have nevertheless occupied the same sort of fissures.

It would be appropriate here to point out that these tension gashes are occupied by two types of veins (i) Quartz veins (ii) Aplitic veins. Of these the Aplitic veins are never of economic importance and because of this should be recognised in the field.

Criteria for recognition of quartz and aplitic veins

<u>QUARTZ VEINS</u>	<u>APLITIC VEINS</u>
(i) Colour:- White	(i) Colour:- Variable from light grey to darker greenish grey.
(ii) Grain Size:- Very coarse grained, individual crystals may be measured in inches.	(ii) Grain Size:- Very fine grained individual crystals are not well formed.
(iii) Fracture:- Uneven	(iii) Fracture:- Even
(iv) Composition:- Large well formed crystals of quartz, tin, wolfram, in some veins mica and feldspar, minor amounts of gold, pyrite and Bismuth compounds occur.	(iv) Composition:- Very fine grained may contain tin and wolfram, does carry small amounts of pyrite. The tin and wolfram content if present is very low. Some samples of these veins when assayed showed us tin or wolfram values.
(v) These veins form the economically important deposits in the area.	(v) These veins have been referred to as lodes in other reports and in some cases have been sunk on but proved barren.

The parallelism of the tension fractures and the conformity of their dips has previously led to the erroneous conclusion that veins continued for a great many more feet than is actually the case, in the All Nations Mine, for instance two and possibly three separate veins occur.

The fact must be recognised and it cannot be over emphasised that unless a vein is continuously exposed along its length it is unwise to interpolate. There is no necessary connection between veins because of similarities of dip, strike or thickness. The sequence of events after differential compaction till the formation of tension gashes is illustrated in the figures below.

FIG. C (i)

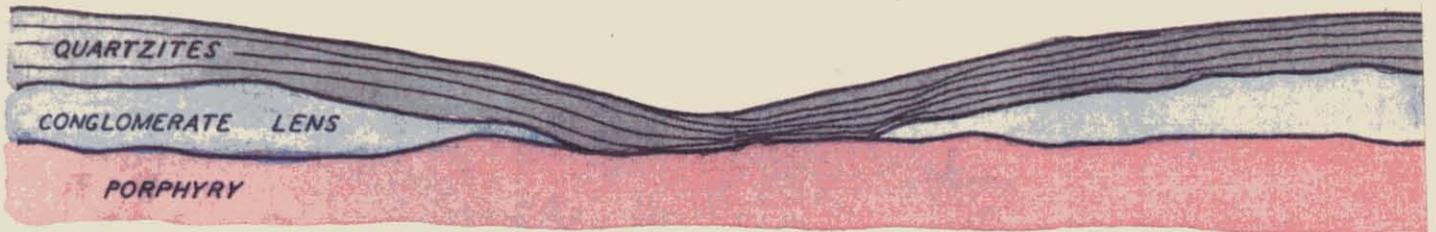


FIG. C (ii) AFTER GRANITE INTRUSION

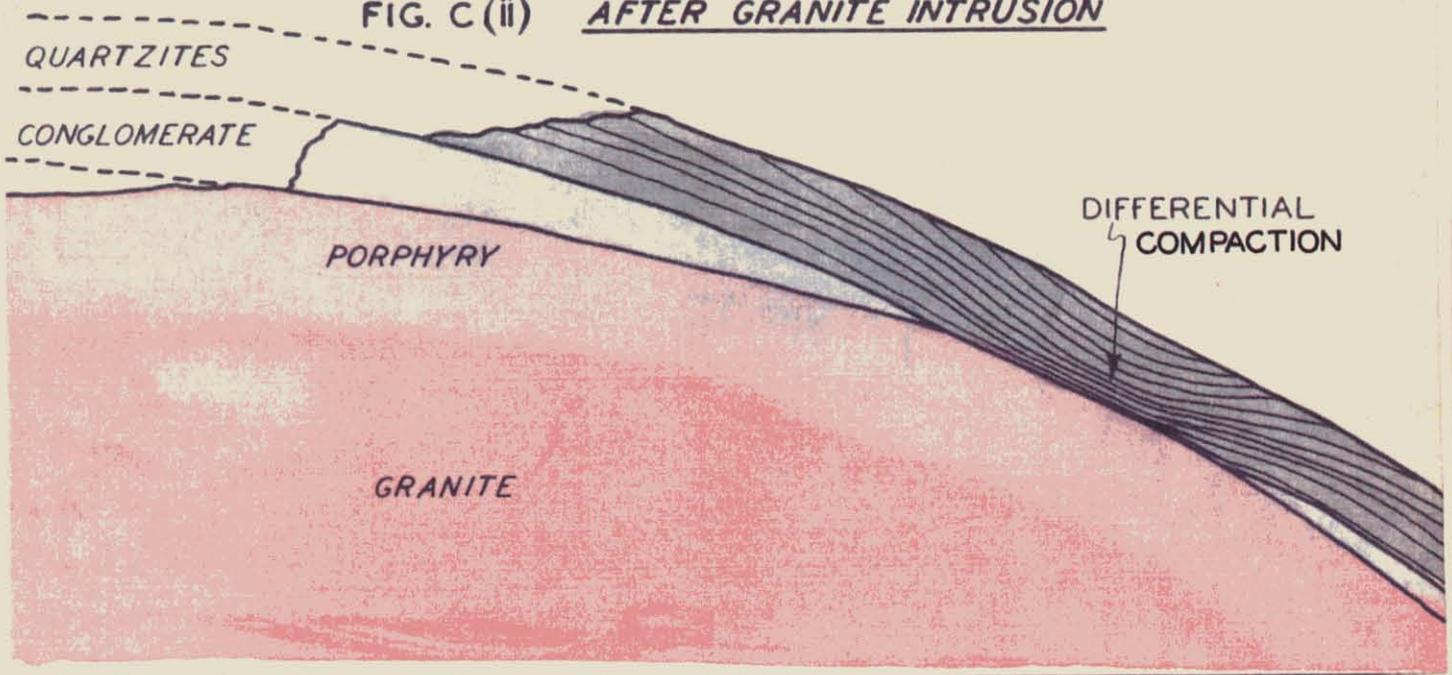
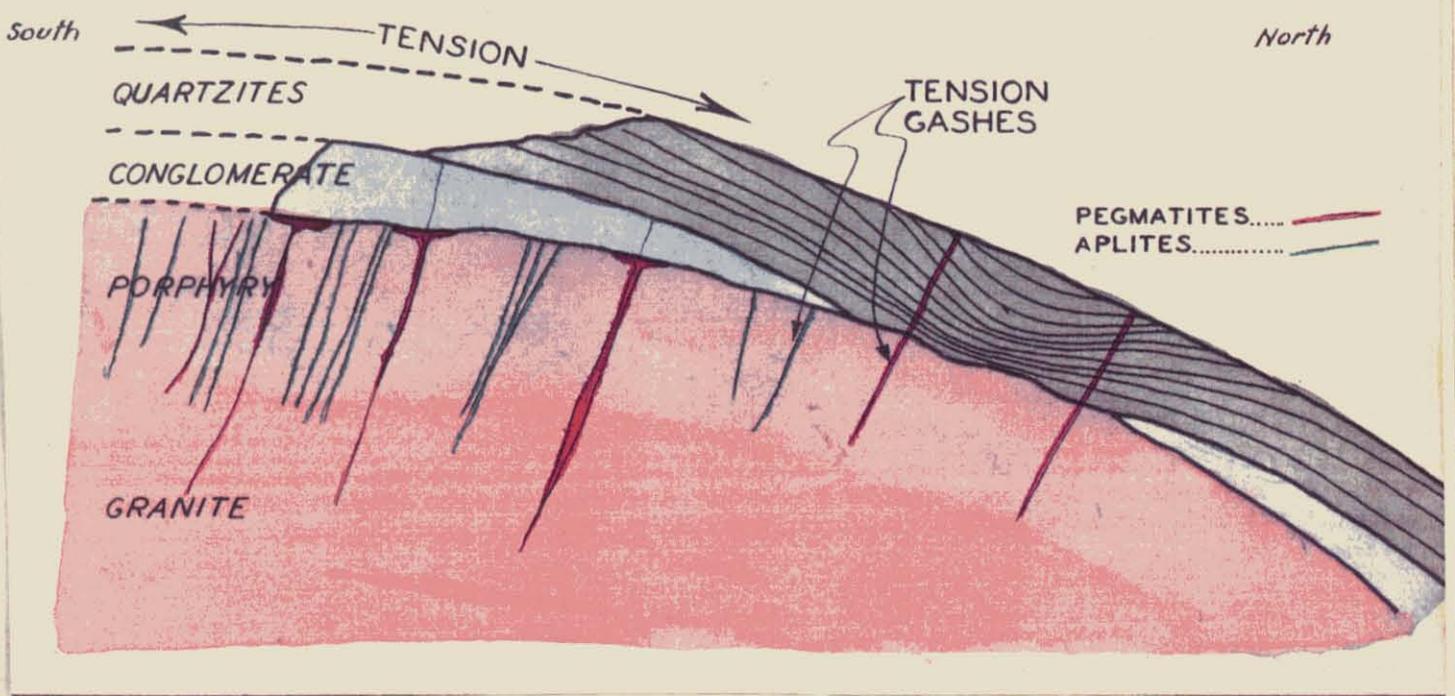


FIG. C (iii) FORMATION OF TENSION FRACTURES



FAULTING:

Under this heading the high angle thrust fault and low angle thrust fault are discussed.

## (i) High angle thrust fault.

This fault does not occur within the boundaries of lease 58M/51, however since it is post mineralisation and has affected any veins which may have been in its path it is included in this report. On the air photographs this fault line may be traced from the Iris river nearly to the Forth running parallel to and in Bismuth Creek. The bearing of the fault is  $315^{\circ}$  magnetic, dipping north-east.

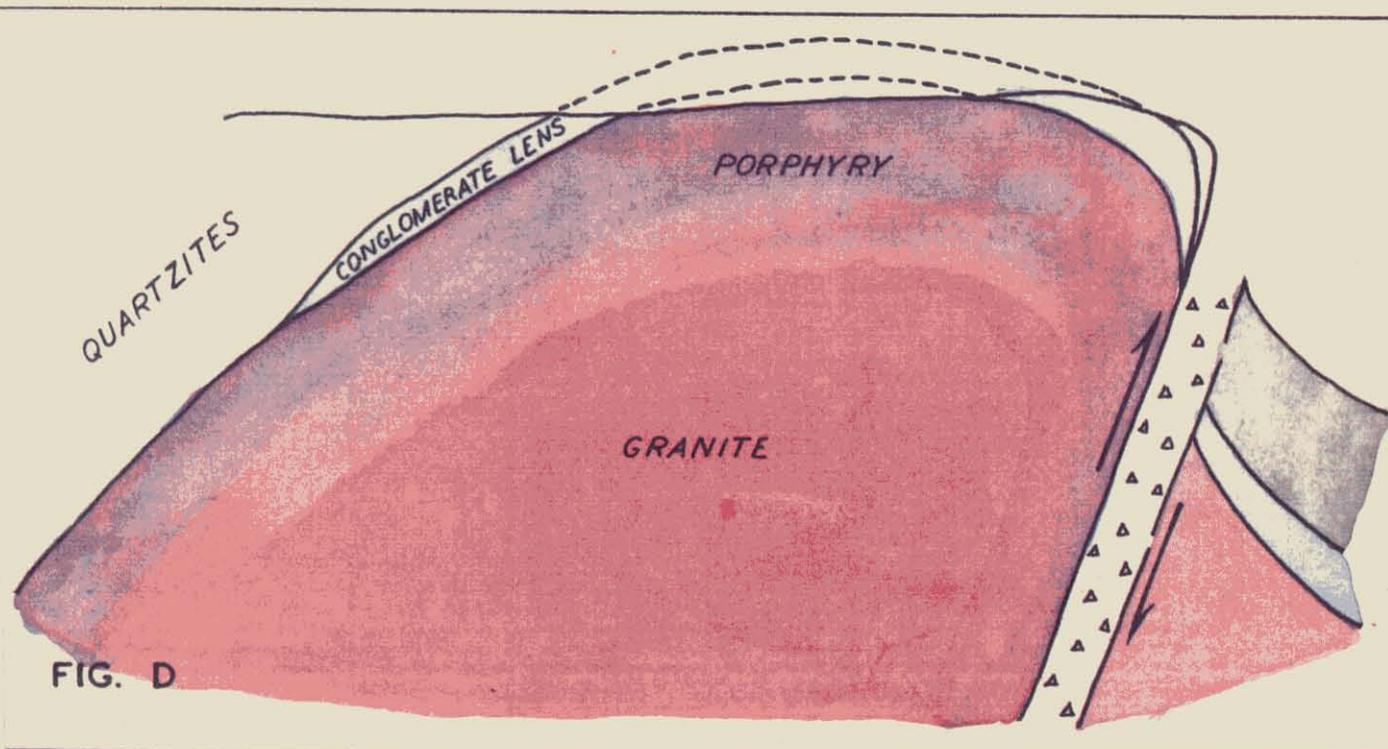
The best exposure of the fault occurs where it crosses the Cradle Mountain road above Bismuth Creek, here the breccia zone is about fifty feet wide and the disturbed zone extends about twenty-five feet on either side of the breccia.

Beds on the footwall side are dragged upwards whereas those on the hangwall side show opposite drag.

As a result of movement on the fault surface beds of younger sediments have been displaced and appear opposite or below older rocks.

Mineralised veins of the same age as those occurring in the All Nations Mine and other mines in the area have been dislocated.

The direction of dip of the fault surface together with the other observed facts indicate the fault is a high angle thrust fault of post mineralisation age. The following sketch illustrates the main structure and interpretation.



Some clues to the magnitude of the displacement on either side of the fault may be obtained from the air photographs.

- (1) The axes of the synclines and anticlines are displaced with respect to one another on the opposite sides of the fault, the movement is left handed i.e. when facing the fault the opposite side has been displaced to the left, the amount of displacement along the fault line is nearly 70 chains.
- (2) The conglomerate which occurs on Mount Stormont if projected along the strike would occur to the south of the conglomerate outcropping on lease 58M/51.

(ii) Low angle thrust fault.

This fault occurs in No. 1 adit at 250 feet from the portal rising gradually to the south-east and dipping under the floor to the north-west. At 50 feet from the portal it occurs 20 feet under the floor. An inclined rise here exposes it down to No. 2 adit level, where it can be traced gradually dipping towards the west till it dips under the floor at 200 feet east of the X-cut. The fault occurs in the bedding plane, movement on it however is diagonal to the beds, slickensides strike  $20^{\circ}$ . Beds here dip  $25^{\circ}$  to  $35^{\circ}$ .

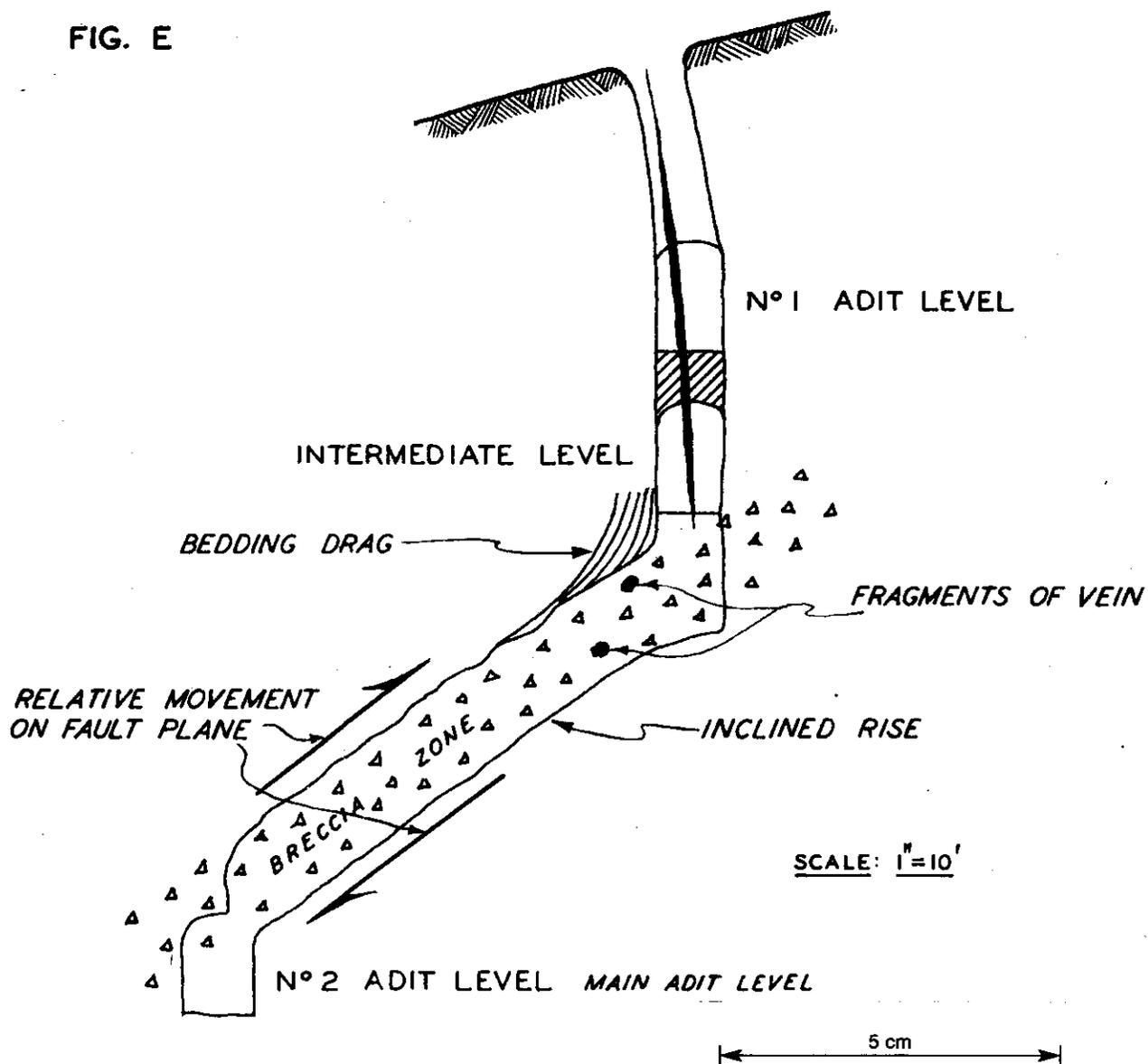
The best exposure of this fault is seen in an inclined rise which connects No. 2 adit level to an intermediate level about 20 feet below No. 1 adit level. This rise is situated at the face of the eastern drive on No. 2 adit level.

The observed important features were:

- (i) The fault had dislocated the vein.
- (ii) The fragmented portions of the broken vein were found in the breccia zone, these portions were displaced to the left with respect of those higher in the breccia zone.
- (iii) Drag on the beds indicated the hanging wall of the fault had moved south with respect to the foot wall, i.e. the fault was a reverse one and the movement right handed.
- (iv) The Breccia Zone was over 6 feet wide and was loose, indicating no great depth at the time of faulting.

The above observations are sketched below.

FIG. E



It is thought that other low angle thrust faults of similar nature to that described above may occur at depth in other bedding planes. One such probable plane is between the conglomerate and the overlying sediments.

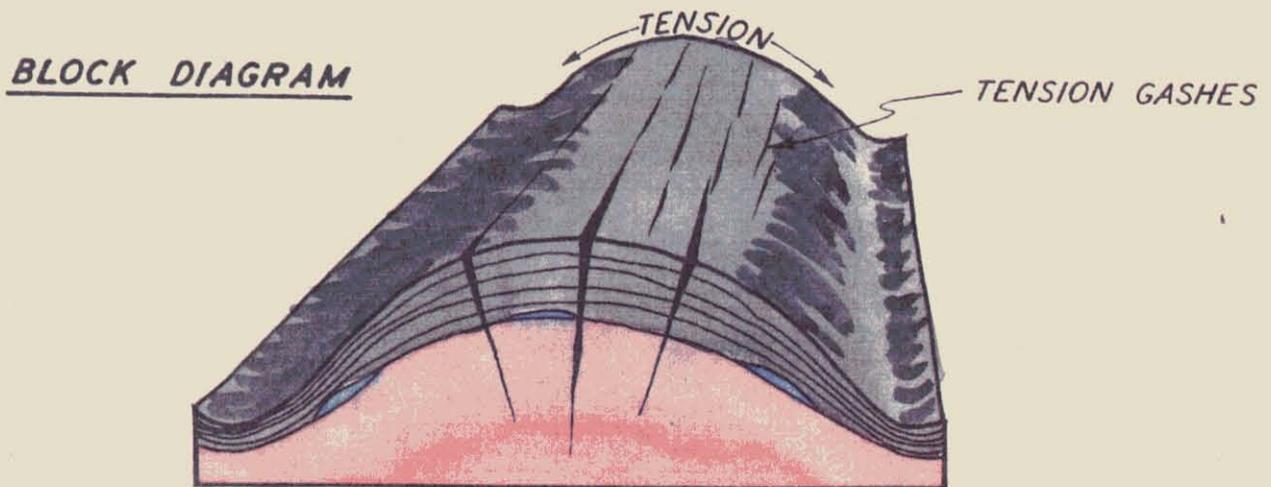
#### ZONE OF MINERALISATION:

The Dalcoath granite which is the source rock for the mineral deposits on lease 58M/51 has also been claimed as the source rock for the silver-lead deposits at Round Hill. The Tin Tungsten deposits of the Shepherd and Murphy and of the various other mines and prospects in the vicinity, the zone of mineralisation must then extend far enough to include these outlying mines in its orbit which places the entire 80 acres of lease 58M/51 within the zone of mineralization.

The problem to be solved is the factor or factors controlling the localisation of the veins of economic consideration and the probable reoccurrence of such veins elsewhere on the lease.

Over the whole area from the All Nations to Olivers Hill the veins show a parallelism to the Dalcoath Anticlinal Axis (see Figure B). This parallelism of veins is seen in the more detailed plan of the All Nations area and is explained for the area by referring to the main structure. With the arching of the Dalcoath Anticline the greatest tension was at right angles to this axis, this stress was relieved by tension gashes which formed at right angles to the direction of greatest tension hence parallel to the anticlinal axis. The idea is illustrated in the sketch below:-

FIG. F



Details of the vein structure and occurrence in the mines were examined where possible. The observations are summarised below.

- (i) In the All Nations Mine the veins dipped south at  $75^{\circ}$  -  $80^{\circ}$ , these large veins were at a steeper angle of dip than the jointing. The same relationship between the vein and jointing was observed in Pochins Adit. The difference in the angle of dip of the joints and veins was between  $5^{\circ}$  -  $10^{\circ}$ .
- (ii) The linear extension of the veins is beyond the minable limits this is seen in the All Nations Mine in the eastern drive of No. 2 adit level, and in Pig and Whistle Mine. The structure of the tension gash is described and illustrated

The extreme ends of the gash are very thin increasing in width as they approach the centre. Wolfram occurs along the entire length of the vein.

- (iii) The veins though genetically related have occupied tension gashes which form individual ore bodies.
- (iv) In the All Nations Mine we have two and possibly three veins their extremities overlapping and forming an en-echelon pattern. It should be noted that the veins are parallel.

- (v) These tension gashes may occur close enough together for collective development of the veins as was done in the Pig and Whistle Mine and at the All Nations Mine.
- (vi) The veins occurring in the "Porphyry" are genetically related to those occurring in the overlying conglomerate and quartzites, the original fissuring and consequent mineralisation had penetrated the "Porphyry" and quartzites where veins appear at the surface.
- (vii) The veins occurring in the All Nations Mine have been dislocated by a low angle right handed thrust fault, the displacement along the fault surface is not known.
- (viii) Veins occurring in the Pig and Whistle Mine dip at high angles both to the north and to the south.

#### LOCALISATION OF VEINS:

It should be pointed out at the start of this section that the ideas put forward here are based on the evidence already presented in this report, they are in fact hypothetical aspects based on visible data and geological concepts.

#### The All Nations Veins:

It is thought that the veins which occur in the All Nations Mine originally surfaced further north having been shifted to its present position by faulting.

The localisation of the fractures may be attributed to several factors.

- (i) It is believed (a) the conglomerate has either thinned considerably enabling tension fractures to occur in it and through it and continued through the quartzites to the surface or (b) the conglomerate has lensed out completely therefore the fracturing unimpeded continued to the surface. This idea is illustrated in Figure C (iii) page 12.
- (ii) The change in strike of sedimentary beds from Pochins adit to the All Nations Mine indicates
  - (a) Cross folding, slight or
  - (b) Differential compaction around a lense or around of older rock, or
  - (c) A combination of (a) and (b) placing the rocks in this area under greater tension than the surrounding area and thereby localising the widest tension gashes. The sketches below illustrate the combination of ideas.

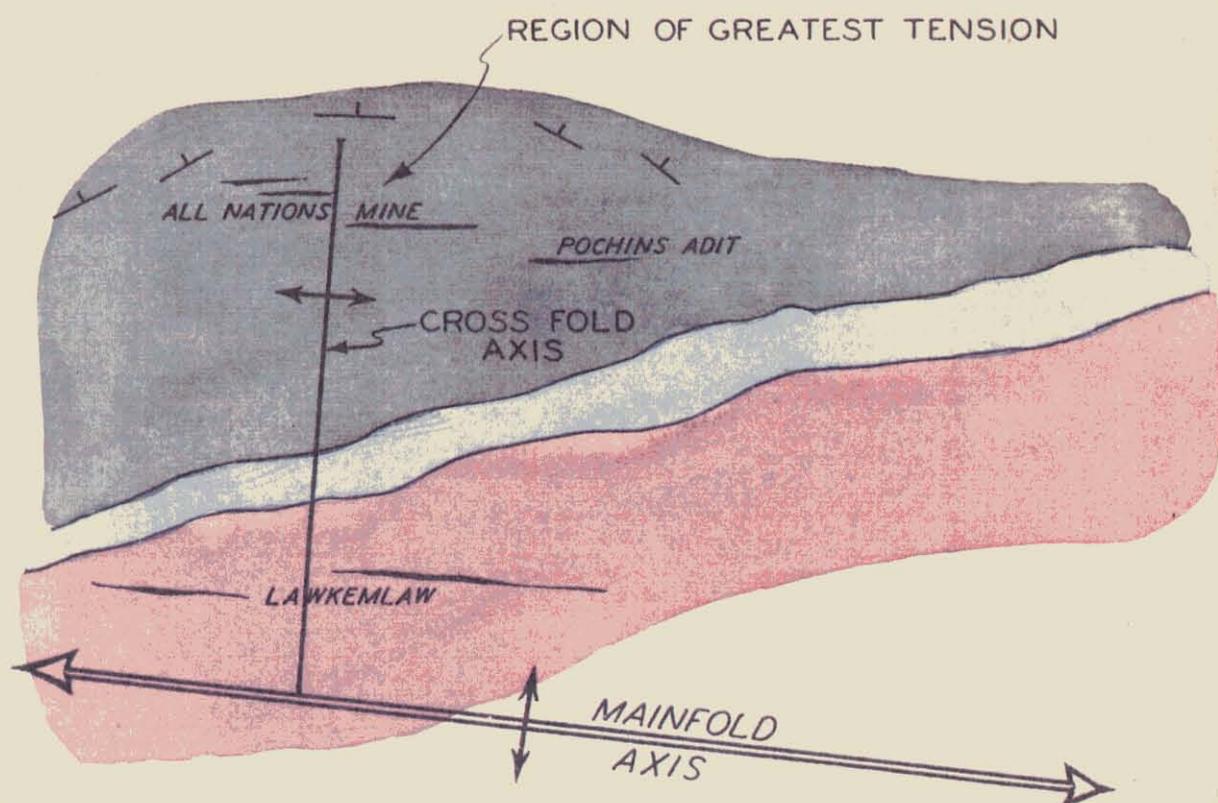


FIG. F

It is interesting to note that the Lawkemplaw Mine occurs in the "Porphyry" on the proposed cross fold axis.

It is also noteworthy that the vein which has improved in the face of the adit drive of Pochins Mine is striking in the direction leading to the area suggested as being in greatest tension, and improving in that direction.

- (iii) It has been observed that the dip of the sediments increases from south to north. More detailed work is needed in the mapping of the altitude of the sediments, it is suggested here that there may be a relationship between the occurrence of mineralised veins and the increase in dip of the sediments. Where the dip of the sediments is increased we may expect greater tension in the various beds and accompanying fractures, this may have taken place in the All Nations Mine. The idea is illustrated below.

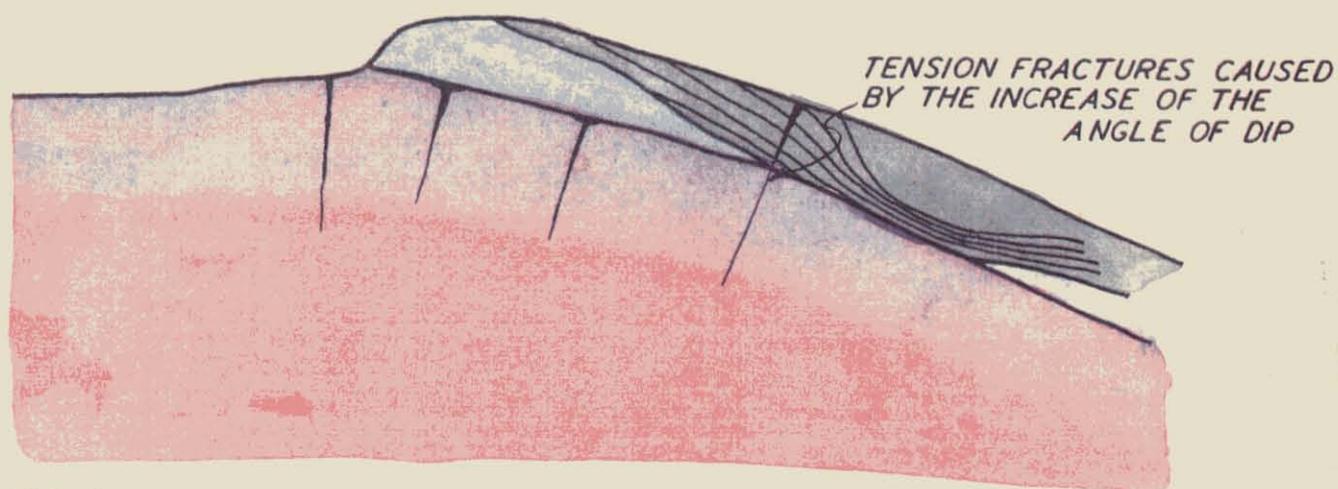


FIG. H

- (iv) The conglomerate bed besides localising the surfacing of the veins has also acted as a trap for the rising ore bearing solutions forcing them to spread laterally between the overlying conglomerate and "Porphyry". This "trapping" of the ore solutions is described in Bulletin 29 page 91 of the Geological Survey of Tasmania. It is suggested that where there is an overlying bed of conglomerate the case described in the abovementioned Bulletin is the rule rather than the exception.

#### Veins in the "Porphyry".

No reliable estimate can be given for the width of the veins occurring in the porphyry, from observations, and descriptions in previous literature of veins occurring in the mines in the porphyry, the impression given is that the veins are less than six inches wide on an average, but may go up to 8 inches.

If vein widths in those mines of the All Nations and the Shepherd and Murphy are compared with one another and those occurring in the porphyry it will be noticed that the higher up in the stratigraphic sequence the veins occur the wider they are. Some figures may be quoted here. Veins in the Shepherd and Murphy up to 30 inches wide. Veins in the All Nations Mine up to 20 inches wide. Veins in the Pig and Whistle Mine up to 8 inches wide.

This feature may be explained by referring to the type of openings the veins have occupied. Being tension fractures they will diminish with depth as they near the neutral zone in the fold structure.

The following sketch illustrates the concept.

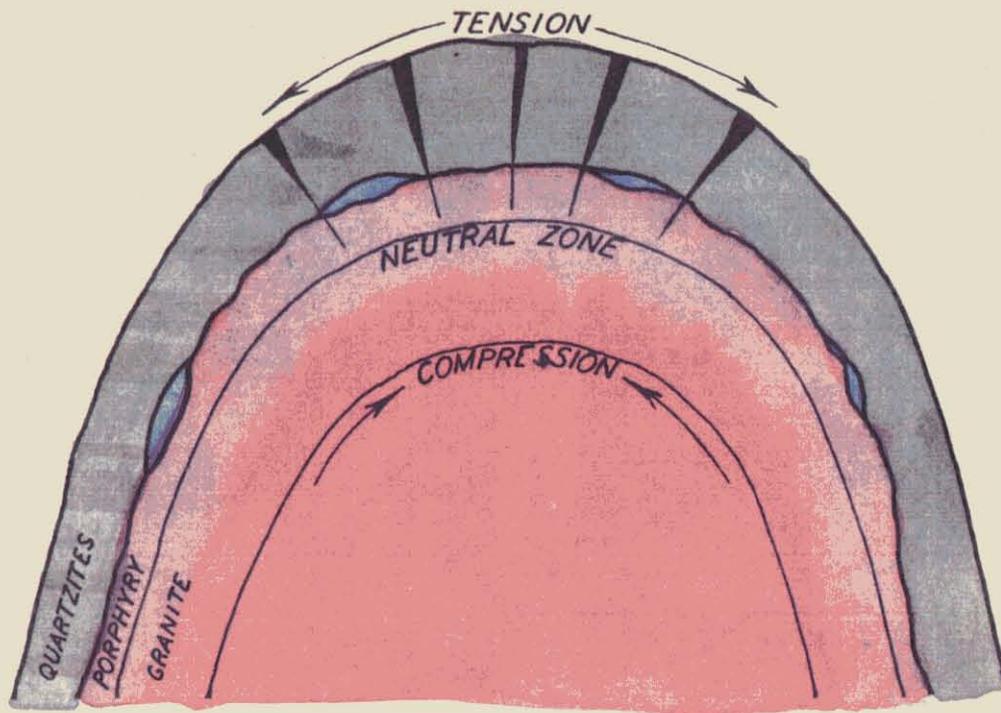


FIG. 1

- (ii) Since there is no shield of resistant rock between the granite and the "Porphyry" it is presumed that the occurrence of veins in this rock is more or less evenly widespread and more frequent than in the quartzites, from this it is inferred that there are possibly other veins occurring beneath the conglomerate lense and furthermore that these veins, unable to pass through the conglomerate have spread laterally between that rock and the "Porphyry" to form horizontal ore bodies of possible economic considerations.

This concept is illustrated in Figure C (iii) page 12 of this report.

- (iii) There may be some cross folding not apparent which has "localised" the veins in the porphyry. As pointed out previously the Lawkenlaw Mine occurs in a proposed cross fold.

#### MINES:

##### The All Nations Mine:

This mine is now held by the Tasmanian Tungsten Tin Development Company No Liabilities.

The workings are situated in the middle of lease 35M/48, a good road from the mine dumps connects with another road cutting across the north-west corner of the block which continues northwards to join the Middlesex road about 25 chains away.

The veins here have been mined entirely in the quartzites and shales, these sediments dip at  $25^{\circ}$  to  $35^{\circ}$  showing slight variations.

From an examination of the accessible workings in the mine it was thought that all the available vein material had been extracted.

It was noted that in the All Nations Mine at least two and possibly three veins have been worked collectively these are named:-

No. 1 vein : Occurs at the western end of the workings.

No. 2 vein : Occurs at the inclined shaft west of the cross cut.

No. 3 vein : Occurs at the eastern end of the workings.

These veins overlap one another the sketch on page 16 of this report shows the idea. The bearings of these veins were  $290^{\circ}$ .

#### DEVELOPMENT:

No. 1 vein: This vein is cut by the western drive on the main adit level at 32 feet from the portal. Stopping along the vein has been carried to the surface except for a small portion where it is 6 inches wide at 36 feet from the portal for a length of about 15 feet. At 110 feet and 150 feet respectively west of the main shaft, two rises connect with the surface. The workings have collapsed 10 feet beyond the western rise. The length of the drive from the portal to the face is 190 feet.

No. 2 vein: This vein has been driven on eastward from the cross cut. In the main adit level for 330 feet, the first 190 feet have been stoped, the vein beyond the stoping starts to thin and eventually dies out. At 300 feet and 330 feet respectively the drive is connected to an intermediate level by inclined rises. These rises are along a low angle thrust fault breccia zone which is the same as the bedding plane. This fault has dislocated the vein and can be traced in No. 1 adit level, the intermediate level and No. 2 adit level which is the main adit level, where it passes under the floor at 200 feet from the X-cut. It is believed that the fault continues westwards and has limited the depth to which the main shaft and winzes on the main adit level have been sunk.

No. 3 vein: This vein has been driven on eastwards for about 350 feet. The level has been called the No. 1 adit level and is about 30 feet above the main adit level, bearing  $110^{\circ}$ . Stoping commences at the portal continues for about 200 feet and is carried to the surface. At 230 feet from the portal the fault can be seen in the wall of the drive.

As it stands the mine is worked out. There are bright prospects for recovering the faulted portion of the veins. The veins may be dislocated again at depth. There is no reason why the recovered portions of the veins should not be the same as those already mined in width and value.

#### POCHINS ADIT:

This adit occurs nearly 8 chains east of the eastern end of the open cut line of the All Nations workings.

It is driven on for 80 feet on a general bearing of  $270^{\circ}$ . At the portal the beds have been sharply bent downwards further along the drive where the beds are normal, the dip is  $35^{\circ}$  towards the north-east. In the face of the drive a narrow vein two inches is exposed dipping at a greater angle than the jointing. This vein has shown an improvement since its first appearance in the adit and has good prospects of improving westwards. It has been pointed out earlier in this report that the vein is heading into the area where the tension is thought to be greater and where other veins of economic considerations have been worked.

THE PIG AND WHISTLE MINE:      TRANS. 1306

Situated just inside the south-east corner of lease 58M/51. All the workings of this mine are in the quartz porphyry. A good road from the mine dump connects with the Middlesex road to the north-west.

Development:

The veins have been opened up by means of two cross cut adits. The lower or No. 2 adit leading from an approach trench is 117 feet long. At 83 feet from the portal No. 1 vein has been intersected and driven on east and west. Eastwards stoping commences at the cross cut and continues for 38 feet up to a height of 15 feet, the vein seen in the backs was about 3 inches wide.

At 44 feet east of the cross cut the drive on No. 1 vein intersects the eastern drive of No. 2 vein. Stopping had ceased on both these veins before they met. 18 feet beyond this junction the stoping recommenced and continued for 13 feet, the vein measured was 3 inches wide. Vein dips  $80^{\circ}$  south.

The drive westwards on No. 1 vein has been described as taking a sinuous course which adequately describes it. No vein worth mining was cut for 202 feet where finally a vein of payable width was intersected and driven on both to the east and west. The dip of the vein is about  $80^{\circ}$  north.

Eastwards this vein has been driven on for 38 feet of which 29 feet have been stoped to the surface. The vein seen in the face was very thin and obviously lensing out.

The drive on this vein to the west has also changed course once or twice. At 80 feet from where the vein was first intersected the workings have collapsed.

The surface workings along this vein continues for over 240 feet and stoping has completely removed the vein between the surface and underground workings almost along the entire length.

No. 2 lode has been cut by No. 2 adit X-cut at 117 feet from the portal and driven on east and west of the intersection.

To the east the vein bears  $116^{\circ}$  dipping steeply to the south. At 55 feet east of the cross cut the drive is intersected by the east drive on No. 1 lode, forty feet of No. 2 lode has been stoped to the surface or nearly to the surface, the stopes were inaccessible.

Westwards from the cross cut the drive was mapped for 70 feet here the workings had collapsed. The vein had been stoped out the entire length of the west drive presumably to the upper level, no inspection was made of the stopes which were inaccessible.

#### ADIT CROSS CUT:

No. 1 has now completely collapsed except for about 5 feet situated at 40 feet from the approach.

No. 1 vein intersected in the approach to No. 1 adit cross cut at 15 feet from the commencement of the approach. To the east it has been stoped from the surface to a depth of about six feet over 100 feet. To the west no mining has been done although a costean has cut across the vein.

No. 2 vein was intersected at 55 feet from the start of the approach and driven on to the east and west of the intersection.

The workings to the east were inspected from the surface and may connect with the lower level no inspection was made along the level.

The western drive was quite inaccessible.

In a plan of the area it can be seen that the No. 2 vein west of No. 2 adit cross cut passes under the conglomerate. No inspection was made of the contact of the porphyry and conglomerate and its affect on the vein, these places were inaccessible.

#### THE LAWKEMLOW MINE:

This mine is entirely in the "Porphyry" but none of the workings were accessible during the survey of the area.

The mine is just over 10 chains to the south of the All Nations Mine and is served by a short road now overgrown with tea tree scrub.

The main workings consist of 5 vertical shafts. The eastern three shafts are connected by a drive at a 25 feet below the surface.

There seems to have been some driving done at about 20 feet below the surface in the two western shafts. The general bearing along the line of shafts was 290°. A vein 20 feet south-west of the westernmost shaft has been stoped from the surface over a length of 220 feet. The water level was about four feet below the surface of the ground along these workings.

The vein has been described as varying from 3 to 6 inches.

#### NICHOLLS AND SMITH TRIBUTE:

Some trenches dug to about 3 chains south-west of the Lawkewlow Mine are the sole workings of this prospect. No vein carrying wolfram was seen in situ though specimens on the dumps suggest it is there.

CONCLUSIONS:

- (i) There is a lense of conglomerate over the area surveyed which has controlled the surfacing of wolfram bearing quartz veins in the quartzites and shales.
- (ii) There may be cross folding which has localised those veins worth consideration.
- (iii) Differential compaction possibly with cross folding may have localised the veins in the quartzites and shales.
- (iv) There is a possibility of horizontal ore bodies occurring under the conglomerate.
- (v) The veins in the porphyry are generally not as wide as those in the sediments higher in the stratigraphic sequence.
- (vi) The search for veins in the porphyry must be done by active prospecting.
- (vii) There is low angle thrust faulting which is of Post Mineral age. These may recur at depth.
- (viii) The dislocated veins in the All Nations are of the same width and wolfram content below the fault as above it.
- (ix) There is a need for more detailed study of the fracturing and folding to help in more fully understanding the reasons for localisation of veins.
- (x) There may be a direct relationship between the high angle thrust fault and the low angle thrust fault, the drag of the beds on the high angle thrust may have been large enough to force them past one another in low angle thrusts.

RECOMMENDATIONS:

- (1) Steps be taken to recover the faulted portion of the Wolfram bearing quartz vein in the All Nations Mine. Two methods suggested for this recovery are:-
  - (a) Diamond Drilling
  - (b) Sinking and cross cutting.
- (ii) The possibility of geophysical methods for the location of horizontal ore bodies.
- (iii) The testing of the soil and subsoil for possible alluvial deposits.
- (iv) The continuation of the vein exposed in the face of Pochins Adit be tested to the west.

This testing should be done at depth since the low angle thrust fault possibly continues between the Adit and the surface.

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9/3/1954.