

STOREYS CREEK TIN MINING COMPANY N. L.

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REPORT ON THE REAPPRAISAL OF THE  
GEOLOGY OF THE STOREYS CREEK MINE

BY R. M. THOMSON,  
GEOLOGIST, A.M.P.L.

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## SUMMARY

Revised interpretations of structure and stratigraphy have been made on cross-sections 2500N 2900N and 3300N. A major fault, the S.E. Fault, has been defined located in the footwall of the deposit and with a normal dip-slip movement of 100-120 ft. An inclined longitudinal projection study of the major veins in the mine indicates that the veins comprise north-pitching, overlapping sheeted zones.

General conclusions are that:

1. The aplite cupola is the dominant controlling feature in the location of the veins.
2. It is suspected that the cupola is also the donor of the material required for the formation of the wolframite-cassiterite bearing quartz veins.
3. Local widening of veins can be attributed to control by pre-existing structures.
4. Bedding plane control is exercised in places giving rise to very regular veins with well developed, smooth walls.

The potential for 'along strike' extension of known vein systems for any distance does not seem great, either to the north or south. However, final testing of these areas has been recommended. The development of parallel veining within the mine area has only been partially investigated and further testing to the east and west of known veins has also been recommended.

## 1. INTRODUCTION

This report finalises the reappraisal programme undertaken by the author initiated in October 1967 in order to clarify the geology of the Storeys Creek Mine with a view to aiding exploration in the mine area. For further information on the initial aspects and interpretations of the reappraisal reference should be made to the previous report (1). All directions mentioned refer to Grid North i.e.  $38^{\circ}$  west of Magnetic North.

## 2. STRATIGRAPHY OF THE MATHINNA SEDIMENTS

Remapping of 800 ft. of the No. 1 Adit and 250 ft. of the cross cut immediately east of the shaft on 3 level has allowed a more definite interpretation of the stratigraphy and structure to be made on mine sections 2500N, 2900N and 3300N - see Figs 1, 2 and 3 respectively. For further details of the stratigraphy (nomenclature etc.) reference should be made to the previous report (1).

The approximate percentages of the major rock types in the mine area as represented on the three cross sections mentioned above are as follows:

	$\%$
Quartzitic rocks (quartzite, quartz-rich psammopelite and quartzite with subordinate inter- calated pelitic horizons).	98
Pelitic rocks (slate, psammopelite and psammopelite with subordinate intercalated quartzitic horizons).	2

The dominantly quartzitic sequence can be contrasted to the dominantly psammopelitic sequence at Aberfoyle Mine. No significant change has been made to the original interpretation of the degree of lensing and stratigraphic continuity of the rocks in the mine area.

## 3. STRUCTURE OF THE MATHINNA SEDIMENTS

### 3.1 Folding:

Eight major foldaxes, five synclinal and three anticlinal, have been designated S3, A4, S4, A6, S7, S8, A10 and S11, S3 being the most easterly structure - see Figs. 1, 2 and 3. These designations originate from W. Key's mine sections of 1959 and have a reasonable degree of agreement with axial positions of major structures of the current interpretation so the original

nomenclature has been retained to avoid confusion. The remainder of Key's designations up to A9 and S10 are minor structures whose axial positions do not agree with the current interpretation as well as do those of the major structures.

These major structures can be traced through the three sections shown, though they exhibit varying degrees of development. S3 has only been defined on section 2900N and its lateral extent is unknown. A4 can be traced through sections 3300N and 2900N to 2500N where it appears to be tightening. S4 can be traced through sections 3300N and 2900N and on section 2500N it becomes a less well defined feature consisting of more minor folding. A6 is a major feature of the mine and on section 2900N it can be traced from 11 level to the Adit levels where it becomes an asymmetrical structure with a flat western limb. Along strike it can be traced through sections 3300N and 2900N while on section 2500N this well defined anticline becomes more irregularly folded into an area of several more minor asymmetrical folds. S8 can similarly be traced through sections 3300N and 2900N at depth while on 2500N it is present only as a very minor syncline. As S8 fades out to the south it appears that the relatively minor structure S7 occurring in the upper levels on section 2900N becomes better developed to the south in the control area of asymmetrical folding, as seen on section 2500N. A10 can be traced through all three sections although on section 3300N it widens out and becomes less well defined. S11 has only been defined on section 2900N and its lateral extent is largely unknown hence the general picture in the mine area is one of large symmetrical similar - type folds flanking a control area of more irregular asymmetrical folding.

Hinge areas are rarely observed but at present the hinge of A10 is well exposed in the drill chamber on the 2900N crosscut West on 11 level and also the hinge of A6 can be partially seen at the top of the 2840N rise from 11 level and in the 2900 crosscut East on 9 level - see Fig. 4.

### 3.2 Faulting

#### 3.2.1 S.E. Fault System

Recently, mainly due to mine development on the south ends of 9 and 11 levels, a major fault has been defined and termed the S.E. Fault System, since it was initially outlined in the southern and eastern extensions of the mine. The faulting encountered on 9 and 11 levels was correlated with faulting of the 4-6-7 Caunter Vein on 6 and 7 levels and subsequent re-examination of drill core indicated extensions of this fault.

Kingsbury designated the term Major Fault to this faulting of the 4-6-7 Caunter Vein on 6 and 7 levels (presumably after drilling failed to locate the faulted extensions) and a limited amount of fault plane projection was carried out in the upper levels but apparently no attempt was made to correlate this feature with other areas of faulting of this type in the upper levels and in drill core throughout the mine. The fault can be recognised in drill core by the presence of fault gouge, broken core, high core loss and occasionally by high pressure water.

The fault system as seen on 9 and 11 levels consists of three closely spaced low angle faults; only one fault plane is seen on 6 and 7 levels although there may be more farther east. The fault planes can contain up to 3" of fault gouge and occasionally included subangular pebbles of country rock and quartz. The dips vary from  $15^{\circ}\text{W}$  to  $45^{\circ}\text{W}$  but average  $30-35^{\circ}\text{W}$  and contrast with the steep bedding faults found elsewhere in the mine. Projection of this system along dip and strike has enabled correlations to be made in the locations indicated in Appendix 1. These correlations define a major fault extending from R.L. 1940' to the surface (approx. 2600') and from 1500N on 5 level R.L. to 3800N on 6 level R.L. and converging on the Footwall Vein System in depth. As evidenced by the more widely spaced occurrence of these low angle faults in the adit levels it appears that the fault bifurcates in the upper levels. Several branch faults have also been recognised on 9 level; in the 2900N crosscut East two faults dipping at  $40-45^{\circ}\text{W}$  can be seen which appear to converge with the main fault to the north and which fade farther south (see Branch Fault 2 Fig 4). These have normal displacements of between 20 and 40 ft., and coupled with bedding faults, have caused an area of complex faulting. Another branch (or associated) fault can be seen 80 ft. north of the exposure of the main fault in the south end of 9 level, here the displacement is also normal and varies up to 10 ft. A further low angle fault with little displacement has been recorded in the H/W Dr. Nth at 2930N.

The strike of the system varies from  $010^{\circ}$  grid in the south to  $340^{\circ}$  grid in the north and from evidence from drill core it appears that the fault is a concave shaped feature in the footwall of the deposit which tends to 'wrap around' the veins to the north and south and displace them in depth. The Footwall Veins on 9 and 11 levels could extend north and intersect the fault and necessitate diamond drilling for the faulted extensions.

When projected to the surface the fault outcrops on the NW bank of Storeys Creek (no direct surface evidence can be found) and this feature could have been responsible for the abrupt change in direction of Storeys Creek once it emerges from the dolerite scree area to the north and could be the Creek Fault postulated in the past. The fact that the fault outcrops in the NW bank can be explained by the vertical formation of the valley after initial localisation by the fault or by the presence of similar faulting farther east, although this is not substantiated by fault intersections in D.D.H. U8-3 as would be expected.

On 9 and 11 levels in the south exposures, the fault is water-bearing whereas farther north in the mine no water has been encountered either in exposures or drillhole intersections. This can be explained by the presence of a small stream flowing into Storeys Creek just south of the 1A Adit portals which could be tapped by the fault in the south end only.

The latest movement sense on the fault is one of dip - slip as indicated by striated pyrite layers on a fault plane on 9 level F/W Drive Sth., Movement of 100-120' in a normal sense is indicated from the correlation of structure A6 across the fault in Fig.2 and A10 in Fig.1. This is further substantiated by the quartz intersections in D.D.H.'s U11-13 and U11-15 which have located the faulted extension of the Footwall Vein on 11 level.

An interesting feature of the fault can be seen in the 2900 cross-cut West on 11 level and in intersections in D.D.H.'s U11-6, U11-7 and U11-8 where the fault occurs on the aplite-sediment interface. It appears that the discontinuity between the aplite and Mathinna Sediments may have initially localised the fault in this area, but the fault trends away from the aplite along strike as well as up-dip.

The reason for the identification of this major feature at this relatively late stage in the mining of the deposit is due to its sub-parallel nature with the veins - excluding the Footwall System with which it converges. In the upper levels the economic limits of mining to the north and south have been reached before the fault has intersected the projected vein strike.

The fault has obvious post-ore movement and, as some branch faults can be seen to truncate bedding faults in the area east of the shaft on 9 level, it seems to be the last movement to have taken place in the mine area.

No evidence of its being a pre-ore feature has been observed. Three assays of fault material were taken from the Adit levels with the following results:-

<u>Co-ords</u>	<u>Assay width</u>	<u>% Sn.</u>
2030N 2687E	18"	0.06
2400N 2875E	6"	0.04
2370N 2908E	12"	0.32

The sub-parallel relationship between the fault and the majority of the veins appears to be coincidental and no genetic significance has been attributed to this feature regarding origin or control of mineralisation. This contrasts with the Aberfoyle No.1 Fault System which subparallels the main Aberfoyle veins and which is thought, owing to coincidence with fractured ground of a favourable character, to have provided channelways for the emplacement of the quartz veins (2). There is no definite evidence of the SE Fault System having acted as a channelway for mineralising solutions and the highest of the assays referred to above is regarded as being due to included faulted vein material.

### 3.2.2. Bedding faults:

Bedding faults are encountered throughout the mine, particularly in the central area between 4 and 6A levels and in the Sub-Footwall Vein area between 8 and 9 levels - as shown in Fig. 4. The majority of these faults are located on east-dipping fold limbs and have normal displacements of up to 8 ft. Kingsbury (3) has reported pre-ore bedding faults but most of the faults are post-ore.

### 3.3 JOINTING

Planar surfaces assumed to be joints have been occasionally observed throughout the mine but as yet no definite conclusions can be made about the development of joints in the mine area.

### 3.4 BRECCIA PIPE

A feature mapped by previous workers as areas of volcanic ash has been recognised as a form of hydrothermal alteration pipe consisting of country rock altered in situ to a soft grey clayey material, clay gouge and, on 11 level, unaltered angular blocks of country rock coated in carbonate and coarsely crystalline pyrite in an altered matrix. This feature is well shown on a simple mine plan model (at a scale of 100 ft. to 1 in.). The

pipe extends from 11 level to 3 level where it consists of several minor lenses and appears to be fading since it has not been observed above this point. The pipe has an average plunge of  $40^{\circ}$  to  $315^{\circ}$  grid and has a poorly defined and probably irregular outline.

Veining is truncated by the pipe, and appears to have collapsed into it, and in places veins are seen to be shattered in situ before disappearing into the pipe. Somemovement has occurred within the pipe as evidenced by occasionally observed dragged bedding and striated planar surfaces in the altered pipe material.

In places the pipe is mineralised with pyrite and marmatite; assay results of grab samples from the various pipe constituents can be seen in Appendix 2. The results for tin and wolfram are generally low and it is unknown whether the one high tin assay is due to primary mineralisation or secondary included vein material. It is assumed that the pipe is a latestage hydrothermal phenomenon and at the moment no reason for its localisation can be found.

#### 4. INCLINED LONGITUDINAL PROJECTION OF VEINS

This study was initiated in order to clarify the structure of the veins and their interrelationships and to investigate the relation of vein attitude to vein width. Conolly-style structure diagrams were constructed for all major veins. These consist of the contoured values of the perpendicular distance of the foot-wall of the veins from an arbitrarily chosen reference plane having the average dip and strike of the vein systems. Vein widths and dips were also recorded and vein width contour diagrams constructed. The Storeys Creek vein fall into two main systems - the Hanging wall and Footwall Systems; these are subparallel in strike but differ in dip. Hence in order to obtain a reference plane sub-parallel to the veins a plane was chosen for each system, since artificial structural trends would result from the use of one plane from which both vein systems diverge in depth. The orientation of the reference planes are as follows:-

H/W System: Ref. plane dip  $29^{\circ}$  W strike bearing  $03^{\circ}$  grid through co-ords 2900N, 2139E on 9 level.

F/W System: Ref. plane dip  $42^{\circ}$  W, strike bearing  $03^{\circ}$  grid through co-ords 2900N, 2214E on 9 level.

Most of the data was collected from mine plans where all the detailed vein information is recorded; the factsheets so constructed are filed in the geology office at Storeys Creek. The method of

projection is outlined in Fig. 5. It should be noted that all data on the projection plots below the intersection (distance L in Fig 5) of the reference plane and the horizon from which the data is taken.

#### 4.1 HANGINGWALL VEIN SYSTEM:

This system consists of six main veins in a sheeted zone as seen from Fig. 6, from south to north they are: Hangingwall Vein, South H/W Vein, North H/W Vein, West H/W Vein, No.2 Vein, No. 1 Vein and No. 2 Vein North. The characteristics of the individual veins are now described:

Hangingwall Vein: This is one of the major single veins in the mine and can be traced from the Adits to 11 level as seen in Fig 7. It is a flat north-pitching structure containing a large central high width area. Superimposition of the structure contour diagram - Fig 8, results in poor correlation between vein attitude and width as seen from the areas marked A and B in Fig. 8. "A" consists of a vague correlation between a structural "ridge" and a low vein width area, "B" consists of a vague correlation between a structural "valley" and a high vein width area.

It should be noted that the intersections of the two subordinate offshoots (West H/W Vein and North H/W Vein) both occur in the central high vein width area. Two 12" quartz intersections have been made in D.D.H.'s U11-10 and U11-12 on 11 level, these, together with the pinching central high zone indicate that an economic vein width will not persist far below 9 level.

South H/W Vein: This is a new vein appearing in the footwall of the H/W Vein on 9 level - see Fig. 6 - and can be seen to consist of two closely spaced veins "en echelon" in a rise at 2200N between 8 and 9 levels. No definite vein shape or size has been established yet, since the southern limit of this vein has been truncated by the S.E. Fault.

North H/W Vein: This is a narrow flat, north-pitching structure which slightly overlaps the upper margin of the Hanging wall Vein with which it has a pronounced sympathetically shaped outline - see Fig. 7. The vein contains two high width areas in its lower reaches. Superimposition of the structure contour diagram results in little correlation as seen from the areas marked C and D in Fig.8. C corresponds to a structural "ridge" coinciding with a high vein width area, as does area D but with less definition. This vein is an offshoot from the footwall of the Hangingwall Vein, the intersection being seen at 2800N. This vein does not persist below 8 level.

West H/W Vein: This vein has limited extent and is an offshoot from the Hangingwall of the H/W Vein and contains a vertically pitching high width area in the lower portion - as seen from Fig 9. Superimposition of the structure contour diagram - Fig. 10 - results in no obvious correlation with vein width.

No.2 Vein: This is another vein consisting of a generally steep north-pitching feature containing three wide zones - see Fig. 9. Superimposition of the structure contour diagram results in poor correlation with vein width in areas A and B in Fig. 10. "A" consists of a structural "valley" corresponding with a high vein width area and at "B" a small structural "dome" corresponds with a minor isolated high vein width area.

No.1 Vein: This vein generally overlaps the No. 2 Vein (in its footwall) and pitches in the same direction, fading in the region of 6 level. Comparison of the vein width contour diagram - Fig. 11 - and structure contour diagram - Fig. 12. - result in no obvious correlation. The vein, together with its lower branch contains a central wide zone reflecting the general vein shape.

No.2 Vein North: This vein has a general steep northerly pitch and contains a horizontal wide zone in its southern portion - see Fig. 13. It may consist of two separate veins since the correlation is dubious between 6 and 7 levels owing to lack of exposure. Superimposition of the structure contour diagram - Fig. 14 - results in a general coincidence of a structural "valley" with the high vein width zone.

It can be concluded that the only general pattern in the arrangement of the veins in the H/W System is the constant northerly pitch (regarding the No. 2 Vein Split as part of the F/W System), which is further considered in section 5. The interrelationships of the veins should be noted, particularly the lack of triple overlap. Correlation between vein width and attitude is poor and no consistent relationships have been observed.

#### 4.2 FOOTWALL SYSTEM:

This is the subordinate of the two systems and consists of: No. 1 Vein South, Footwall Vein, F/W Vein Split, No. 2 Vein Split and X-Vein. The characteristics of the individual veins are now described.

No. 1 Vein South: This is a complex, irregular vein consisting of many splits and branches and which extends from the Adit levels to below 9 level. The vein is truncated by the S.E. Fault on the south end of 9 level. Above 3 level the vein is a north-pitching structure while occurring as a vertical structure below 3 level. Due to its complexity only point value diagrams have been constructed for vein width and structure - see Figs. 15 and 16 respectively. Since contour diagrams are unavailable no conclusions can be made regarding correlation between vein width and attitude.

The vein intersects the F/W reference plane in the upper levels and splits into the East Branch, West Branch and E-W Link Vein at about 3 level. Lower down the vein splits into two sections which overlap slightly on 9 level while the appearance of the No. 1 Link Vein 'covers the gap' in the vein resulting from the splitting of the vein at a slightly higher level. Other areas of minor splitting are indicated on Fig. 15. The vein outline is still interpretive since in several areas the vein is inaccessible or unexplored.

Footwall Vein: This is the major economic vein of the F/W system, extending from about 3 level to below 11 level where it is displaced by the S.E. Fault as seen in Fig 17. The vein has an irregular hourglass shape and between 2700N and 2900N extends above 6 level where it is only partially explored and where further stoping is planned. A flat, north-pitching wide zone occurs in the upper portion, coinciding with the subhorizontal intersection of the F/W Vein Split - an offshoot from the footwall of the F/W Vein. In the central area the vein pinches rapidly, this "neck" coincides with the flat north-pitching intersection with the Sub-Footwall Vein high grade, flat vein which extends to 8 level (this vein has not been contoured since a separate reference plane is necessary for its representation). Below 9 level the strike length increases again together with the vein width. This wide zone can be seen to be narrowing at the point where the vein is displaced by the S.E. Fault, hence its southern extension beyond the fault is not expected to be great.

An explanation has not been found to explain the fact that the F/W Vein Split intersection coincides with a high vein width zone whilst that of the Sub-Footwall coincides with a low vein width zone. Comparison of the width contour and structure contour diagrams (see Fig. 18) does not result in any positive correlations.

F/W Vein Split: This vein branches off the F/W Vein just below 8 level. A central north-pitching high width zone has been defined on the basis that the vein exists north of 3300N on 11 level - see Fig. 19. No correlation exists between vein width and attitude - see Fig. 20.

No. 2 Vein Split: This vein extends from between 6 and 6A levels, where it can be seen close in the footwall of the No.2 Vein North, to 9 level (and probably to 11 level where its position is still doubtful) where it is close in the hangingwall of the F/W Vein Split - see Figs. 18, 6 and 13. Hence this vein acts as a link between the H/W and F/W Vein Systems. The vein appears to briefly intersect the F/W Vein Split on 8 level at 3400N. It is generally thin with a flat southerly pitch. No correlation exists between width and attitude - see Fig. 20.

X-Vein: Above 8 level the X-Vein extends to between 5 and 6 levels as a roughly symmetrical structure with a central high width zone - see Fig. 18. Its position on 9 level is still doubtful but from intersections in D.D.H.'s U9-22, U9-23 and U9-25 it appears that it will increase in strike length on 9 level and adopt a steep southerly pitch and flatten out to intersect the F/W Split (or fade) between 9 and 11 levels, but this is still a tentative interpretation. No correlation exists between vein width and attitude - see Fig. 20.

Vein outlines indicating the interrelationships between the veins in the northern and southern sections of the F/W System can be seen in Figs. 19 and 15 respectively. The sympathetically shaped, slightly overlapping and partially intersecting outlines of the F/W and No.1 South veins should be noted together with the fact that apparently different veins occur on 9 and 11 levels south of 2800N. The nature of the relationships of these two veins below 9 level in this area has yet to be clarified. As with the H/W System the lack of triple overlap should be noted.

It can be concluded that, similar to the H/W System, no general consistent pattern exists and each vein has its own characteristics of shape, pitch and width. No correlation was found between vein attitude and width. This can be explained by the fact that the vein openings are tension fissures where no correlation with attitude necessarily exists; This can be contrasted to the case of vein openings being caused by faulting along a warped plane resulting in open and closed areas which can often be related to

attitude. It is unfortunate that no assay data exists for comparison with vein widths, this appears to be a function of the coarse, erratically distributed ore which does not appear to facilitate representative sampling at an economic cost.

#### 4.3 RELATIONSHIP BETWEEN H/W AND F/W VEIN SYSTEMS

The major common characteristics of both vein systems is the varying northerly pitch, with the exception of the No. 2 Vein Split and (apparently) the X-Vein, the significance of these pitches is discussed in section 5. The high width zones within the veins vary from vertical to sub-horizontal with the 12" vein outline generally reflecting the shape of the central wide zones. A further characteristic of both systems is the occurrence of sympathetically shaped, slightly overlapping vein margins with very little triple overlap of veins in each system. The reasons for the development of two such sheeted zones of differing attitude are not fully apparent, however this is briefly discussed in section 5.

#### 5. RELATIONSHIP OF VEINING TO STRUCTURE AND STRATIGRAPHY

It was found that after comparing various vein structures and widths with the structure of the host rocks traversed that certain correlations exist regarding high vein width zones. The individual relations of the veins to structure and stratigraphy are now described.

Hangingwall Vein: (Fig. 7). The wide zone of 72" and higher coincides with the east limb of structure A10 and pinches against the hinge area as seen in Figs. 1 and 2. The 72" zone fades before reaching section 3300N where it can be seen that structure A10 has become less well defined. It appears that the Hangingwall Vein generally strikes a few degrees NE of the strike of the rock structure and it is this acute angular difference which gives rise to the flat northerly pitching intersection with the section of the east limb of A10 which coincides with the wide vein zone. The changes in strike of 9 level do not appear to affect this overall pitching trend. A minor vein located in the end of the 2900 crosscut West on 11 level appears to be a partly bedding controlled vein branching from the footwall of the Hangingwall Vein on 9 level - see Fig. 2.

South H/W Vein: (Fig. 7) Since data is only available from one horizon at the moment it is difficult to establish a width trend with any certainty but since the vein is sub-parallel in strike

and dips slightly flatter than the west limb of structure A10, a sub-horizontal or flat north-pitching trend can be expected, resulting from the intersection of these two features assuming a degree of structural control as exhibited in the case of the Hangingwall Vein.

North H/W Vein: (Fig 7). The two high width areas in the lower reaches of the vein do not correspond with any particular structural or stratigraphic feature. Since the vein orientation is similar to that of the Hangingwall Vein the general parallel vein pitch is regarded as being due to the same kind of structural control, only perhaps less well developed.

West H/W Vein: (Fig 9). The vein traverses the east limb of structure A10 but the vertically pitching wide vein area in the lower part cannot be related to any corresponding structural or stratigraphic feature.

No. 2 Vein: (Fig 9) The upper wide vein area is seen to coincide with the west side of the hinge area of structure A4 in Fig. 2. Since the vein appears to strike slightly N.E. of this structure and has a sub-parallel dip, the intersection of the vein and this structural feature pitches steeply to the north. It is this pitching intersection that coincides with the wide vein area. No particular stratigraphic horizon controlling this wide zone has been identified and apart from a general tightening of structure A4 no explanation can be given for the pinching of this wide zone to the north and south. The central horizontal high width zone occurs across the east limb of structure A6 and partially coincides with a pelitic horizon as seen from Fig. 3. No positive correlation with structure or stratigraphy can be found for the lowest wide zone.

The major, steep pitching wide zone of this vein should be contrasted to that of the Hangingwall Vein, since in the former the steep north-pitching zone results from the vein traversing the W limb of a major anticline whereas in the case of the latter the flat north-pitching zone results from the vein traversing the east limb of a major anticline. It should also be noted that the No. 2 and No. 1 veins come into close proximity in the lower wide zone of the No. 2 Vein.

This vein has only been partially explored on 9 level and at the moment not enough structural and stratigraphic data are available to attempt a correlation with vein structure in order to project the vein below 9 level. All that can be said is that a general pinching of the vein in depth is apparent from the already established trend.

No. 1 Vein: (Fig. 11) The central wide zone of the lower branch coincides with the hinge area of syncline s4 - see Fig. 1. Apart from this no other positive correlations exist with structure and stratigraphy.

No. 2 Vein North: (Fig. 13.) The wide vein area of this vein coincides with a zone of minor folding on the east limb of anticline A6 - see Fig. 3. The vein transects this structure to the north which may explain the pinching of this zone and suggests a degree of structural control. The vein is at present unexplored below 8 level and apart from the general steep northerly pitch no correlation with structure or stratigraphy of the host rocks has been established in order to project the vein downwards with any certainty.

No. 1 Vein South: (Fig. 15) No significant correlation with structure of stratigraphy has been observed regarding this irregular vein.

Footwall Vein: (Fig 17). This vein exhibits a particularly strong degree of structural and stratigraphic control in its localisation and development of wide zones. In Fig. 2 the vein shows almost perfect control of localisation by bedding between 8 and 11 levels on the west limb of anticline A6. Above 9 level the vein fades to the south at about 2800 N, this coincides with the fading to the south of A6 as a single major structure. On 11 level the vein changes strike a little and in Fig. 1 it can be seen to occur on the west limb of anticline A10. At 3100N on 11 level the vein begins to fade to the north and up-dip although the control structure persists.

Another striking feature also shown well on section 2900N is that the high width zones of greater than 72" occur only outside the areas of bedding control, and where the vein traverses the east limbs of structures A6 and A10 at approximately right angles above 8 level and below 11 level. The wide zones are subhorizontal and coincide with the horizontal intersection of the vein and the eastern anticlinal limbs.

Footwall Vein Split (Fig. 19). This vein is seen to be completely localised by bedding on the west limb of anticline A6 between 8 and 9 levels as seen from Fig. 3. It branches from the footwall of the Footwall Vein in the hinge area of A6 near 8 level. The vein is expected to extend to 11 level on the limb of A6 but will not persist far below this level owing to the

occurrence of the aplite body. The apparent northerly pitch cannot be explained since the vein is parallel to the west limb of A6 which acts as the control surface.

No. 2 Vein Split (Fig.19) Between 8 and 9 levels this vein can be seen to exhibit perfect bedding control on the west limb of A6 - see Fig.3. The degree of structural and stratigraphic control above this level is largely unknown. As with the preceding vein this can be expected to persist below 9 level on the control structure. There is no apparent reason for the southerly pitch of the vein since it is parallel to the folding.

X-Vein: (Fig. 19) At present too little is known of the structure of the far north of the mine to allow correlation with this vein.

It appears then that two types of structural control are evident i.e. bedding control and "cross-limb" control.

i Bedding Control This feature is a characteristic of the more steeply dipping F/W System and may have been a factor in determining the position and attitude of the system as a whole. This control is developed in a limited number of areas, as described above, and gives rise to very regular veining. A limited amount of vein projection along such control surfaces is possible but as has been seen pinching of veins can occur while the control structure persists.

ii Cross-limb Control Wide zones within some veins can be correlated with the dominantly quartzitic fold limbs traversed. The pitch of the wide zones depend on the angle of intersection of the vein with the fold limb. Hence as most of the veins appear to strike slightly NE of the fold structures, the intersections of the veins and folds pitch to the north. Two general types of intersection are recognised:-

- (a) Intersection of west dipping veins with east-dipping fold limbs to give flat pitching wide zones, e.g. Hangingwall Vein and Footwall Vein. In the case of the Footwall Vein cross-limb control gives rise to wider zones than the more regular bedding controlled area.
- (b) Intersection of west dipping veins with west-dipping fold limbs to give steep pitching intersections e.g. the upper part of the No. 2 Vein.

Unfortunately these controls are not consistently developed throughout the mine.

Limited evidence of joint control of veining can be observed on 7 level in the case of the 4-6-7 Caunter Vein where a planar control surface is followed by the vein. This plane dip at  $20-25^{\circ}$  SW with an average strike of  $305^{\circ}$  grid can be seen to transgress bedding.

In conclusion, it can be said that the angular strike difference between veins and rock structure appears to be a function of the orientation of the causational tensional stress since no vein control surfaces of this orientation have been identified. The shape of the veins and location of wide vein zones is thought to be the result of the interaction of this tensional stress and the local structure and stratigraphy. Where the tension-forming stress direction is approximately normal to fold limbs complete bedding control of veining results. Pitching vein features result from the intersection of tensional openings at an acute angle to structural and stratigraphic features which have a modifying effect on the shape and width of veining.

However, as seen from above, once a vein trend has been established and correlated with a structural or stratigraphic feature it should be possible to carry out projection of the vein if enough is known of the local fold structure and stratigraphy.

Unfortunately such correlations have only been feasible for vein widths of over 72". Apart from this, limited vein projection can be carried out by the establishment of wide zones on longitudinal projection but unless they are correlated with fold structures they cannot be projected very far with any certainty.

## 6. APLITE CUPOLA

The results of contouring the aplite surface from mine exposures and surface and underground diamond drill hole intersections can be seen in Fig. 21. The cupola is elliptically shaped in plan, trends N-S and plunges flatly to the north and more steeply to the south.

D.D.H. U11-6 was extended several hundred feet into the aplite as seen in Fig. 2, numerous diffuse quartz zones were intersected containing minor disseminated marmatite, pyrite and chalcopyrite and with occasional finely crystalline wolfram; these zones do not appear to have any economic potential. The quartz zones could be feeders for the veins in the more favourable structural environment of the Mathinna Sediments enveloping the cupola.

## 6.1 RELATION OF VEINING TO THE APLITE CUPOLA

From evidence in D.D.H.'s U11-9, U11-10 and U11-12 it appears that the Hangingwall Vein fades out as it approaches the level of the up-faulted cupola and down-dip extensions are not indicated in D.D.H. U9-17 on section 3000N. Whether this fading can be applied to other veins in the H/W System is unknown but this may be due to structural control rather than the spatial relationship to the aplite. The Footwall Vein has been bottomed on section 2900N (Fig.2) since it is faulted against the aplite, however the down-dip extension of the faulted section of this vein - see Fig. 1 - remains unknown at present. A flat dipping vein exposed in the 2900 crosscut East on 11 level was tested down-dip in the aplite by D.D.H. U11-14, this intersected numerous diffuse quartz zones and it is assumed that the vein diffuses into these zones once in the aplite. The relationship of the veins to the aplite on section 3300N (Fig.3) is complicated by the uncertain position of the S.E. Fault but they appear to be dipping steeply on to the side of the cupola. If the cupola is restored to its pre-faulted position the F/W Vein System can be seen to originate from the top of the cupola.

It is observed that the position of the limits of known economic veining roughly corresponds to the northern and southern limits of the 1800 ft. contour of the underlying aplite body as seen from comparing Figs. 6 and 21. It is also noticeable that the occurrence of veining is most intense above the centre of the aplite. Hence it seems that there is a general relationship between the occurrence of veining and the shape of the aplite cupola and as concluded in the previous report (1) it is thought that cupola is the dominant feature controlling the general attitude and extent of veining. The veining appears to fade as the cupola flattens to the north and south and is most strongly developed above the cupola peak. If this relationship is valid then the prospects of lateral repetition of veining associated with this cupola are not good. The occurrence of parallel veining within the mine area remains incompletely tested as illustrated by the recent exposure of the hitherto unknown east vein on 11 level, and by the occurrence of significant quartz intersections to the west in surface D.D.H.'s S.C.- 5 and S.C.-6.

## 7. CONCLUSIONS

1. No consistent correlations exist between vein width and vein attitude.

2. Vein width contour diagrams are the most useful result of the longitudinal projection study since they enable the structure of the veins and their interrelationships to be analysed and projected beyond explored areas.
3. The majority of the veins pitch to the north with the veins in each of the two main systems showing sympathetically shaped, slightly overlapping margins with only little triple overlap.
4. Two types of structural control are recognised:
  - i Bedding control - resulting in steep, regular planar veins.
  - ii Cross-limb control - resulting in limited development of pitching wide zones within the veins where they transect certainfold limbs.

Both these types of control are inconsistently developed and are subordinate to the major control exerted by the aplite cupola.

5. The prospects of lateral extension of veining are not good.
6. Knowledge of the development of parallel veining in the mine area is incomplete and remains to be tested.

## 8. RECOMMENDATIONS

### 8.1 EXTENSION OF STUDIES:

1. Since only limited projection of veining can be carried out following the establishment of pitching trends further work should be done to clarify the fold structures and vein patterns in the mine and detailed sections should be constructed at 1900N and 3800N. In this area in the lower levels, determination of the extent of veining still remains for the following: No.2 Vein, No.2 Vein North, F/W Vein Split, No.2 Vein Split and X-Vein. To this end plans recording structure and stratigraphy and the longitudinal projection factsheets should be kept up to date for the lower levels as part of normal routine work.
2. In order to assess the true significance of the distribution of wide vein zones a total width contour diagram should be constructed to include both vein systems. Unfortunately due to the use of two reference planes of different dip this will involve lengthy projection work which cannot be completed at the moment. However this would be a worthwhile exercise, especially considering that all the necessary data is now readily available.
3. A record should be kept of all joint occurrences in order to investigate further the relationship between jointing and veining.

## 8.2 EXPLORATION:

Exploration targets around the mine area can be subdivided as follows:-

### 8.2.1. Extension of veining to the south

Since the cupola flattens to the south the potential for the occurrence of economic veining does not appear to be good. However this area should be tested in order to write it off with certainty; this can be accomplished by two diamond drillholes.

Hole A: A steeply declined hole located about 200' NE of D.D.H. S.C.-14 - see Fig. 22. This would test a projected zone of veining beneath the S.E. Fault defined by the hangingwall and footwall of known veining in the south end. Any veining located would be new since the known veins are not expected to persist far to the south. The position of the hole is a compromise between the following factors:

1. The position of the one significant intersection in S.C.-14 is a 9" true width quartz vein with sulphides at 605'9".
2. The assumption that any veining will be north pitching. Hence if the intersection made near the end of S.C.-14 is a north pitching structure its down-dip extension should be tested farther north.
3. The area well to the south of current workings should be tested.
4. Position of buildings on the surface.

Bearing these facts in mind the orientation of the hole would be as follows:

LOCATION:	Surface, Storeys Creek
CO-ORDINATES:	1500N 2000E
R.L.:	Approx. 2550'
DECLINATION :	-80°
BEARING:	090° grid
DEPTH:	850 ft.
TARGET:	Southern extension of veining, with the target centre at approximately 11 level R.L.

Hole B: A vertical hole to be drilled from the south end of 3 level to test the northerly extension of the 9" vein intersected in S.C.-14 and to penetrate the upper section of the projected zone of veining. It should be noted that S.C.-14 did not fully penetrate this zone. This hole could be drilled by the Company E500 machine.

LOCATION:	3 level Storeys Creek Mine
COORDINATES:	1570N 2340E
RL:	2353'
DECLINATION :	-90°
DEPTH:	400 ft.
TARGET:	Southern extension of veining below the S.E. Fault.

### 8.2.2 Extension of veining to the north

Owing to the flattening aplite cupola the potential for lateral vein extensions in this area is also low. Testing of the area can be accomplished by two diamond drill holes with the alternative of driving north into this area from 9 level.

Hole C: A surface hole located about 700 ft. east of the collar positions of D.D.H.'s S.C.-2, 3, 4 and 7 - see Fig. 23. This would test a zone of veining projected north of the present workings and defined by the Hangingwall Vein above the S.E. Fault and what may be the faulted extension of the X-Vein below the S.E. Fault. This zone would be tested from below the 9 level R.L.

The No. 2 Vein North is not expected to extend far north since it is a steep pitching feature and the X-Vein appears to be pitching south.

LOCATION:	Surface Storeys Creek
CO-ORDINATES:	4300N 1430E
R.L.	2844'
DECLINEATION:	-66°
BEARING	090° grid
DEPTH	1300 ft.
TARGET	Northern extension of veining above and below the S.E. Fault.

It is hoped that it may be possible to correlate any intersections in this hole with those in the oblique surface holes SC-2, 3, 4 and 7. Site access is not difficult but a bulldozed track will be necessary.

As an alternative to this hole, driving on a bearing, could be undertaken from 9 level. About 700 ft. of driving would be necessary to intersect the target area defined in Fig. 23, the bearing and location of the drive would depend on the positions of the workings at the north end of 9 level at the time of driving. This alternative has the advantage of allowing testing of a greater extent by pattern drilling from the drive and of greater exposure of any intersected veining, however it will, of course, be more expensive. The decision on which alternative to adopt should be made on a cost-effectiveness basis, taking into account the difficulties involved in the disposal of the waste rock resulting from driving. This problem could be overcome by using this rock as fill for stopes yet to be excavated from 11 level.

Hole D: A steeply declined hole to be drilled from the north end of 1 level to test the upper part of the zone outlined in Fig. 23. This hole would be drilled into the aplite to determine

its depth. This hole would be drilled by the newer of the Company E500 machines.

LOCATION:	1 level Storeys Creek Mine
CO-ORDINATES:	4110N 2335E
R.L.:	2429'
DECLINEATION:	-80°
BEARING:	270° grid
DEPTH:	650 ft.

8.2.3 Extension of veining to the west

Knowledge of the development of parallel veins to the west remains incomplete and veining intersected in D.D.H.'s S.C.-5 and S.C.-6 has not been fully tested. Such testing could be accomplished by a horizontal hole from the end of the 2860N cross-cut West on 9 level, see Fig.24. This hole could be drilled by the newer of the Company E500 machines.

LOCATION:	9 level Storeys Creek Mine
CO-ORDINATES:	3028N 1557E
R.L.:	2107'
DECLINEATION:	horizontal
BEARING:	270° grid
DEPTH:	400'
TARGET:	Extension of veining intersected in S.C. 5 and S.C.-6.

8.2.4 Extension of veining to the east

The occurrence of veining to the east of present known veining has been indicated by the recent exposure of the east vein on 11 level. This vein does not appear to have been located elsewhere in the mine and testing of its extent has been planned. Further testing for the presence of veining in the footwall of the deposit will be carried out.

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APPENDIX 1

A. Location of underground S.E. Fault exposures.

Level	Co-ordinates		Dip (west)	Comments
No.3 Adit	2030N	2687E	35°	
"	2030N	2650E	40°	
"	2020N	2865E	flat	Doubtful identification
No.2 Adit	2370N	2908E	33°	
"	2400N	2875E	48°	
"	2415N	2800E	flat	
"	2535N	2805E	27°	Branch fault?
6	2470N	2535E	32°	Fault 4-6-7 Cntr. Vein
7	2470N	2450E	30°	Fault 4-6-7 Cntr. Vein
9	2100N	2180E	35° av.	Faults Sth H/W Vein
9	2120N	2205E	35° av.	Faults No.1 Vein Sth.
11	2440N	2065E	35° av.	Faults F/W Vein
11	2925N	2115E	32°	On aplite contact

B. Location of S.E. Fault intersections in drill core

Level	Hole No.	Intersection depth	Core loss	Remarks
6	U6-5	130' - 165'	8½ft.	
"	U6-10	191' - 238'	14 ft.	
"	U6-7	211' - 235'	84"	
"	U6-8	224' - 228'	16"	
"	U6-9	102' - 120'	16"	Doubtful correlation
7	U7-1	264' - 290'	36"	
"	U7-2	202' - 204'	12"	
"	U7-10	55½' - 60'	50"	Branch fault?
8	U8-1	192' - 215'	18'9"	
"	U8-7	142' - 176'	?	Very broken core
"	U8-10	167' - 204'	?	Broken core
"	U8-13	211½'	?	½" fault gouge
"	U8-14	96'	?	3" fault gouge
"	"	98'	?	3" fault gouge
"	U8-18	89'	?	18" broken core and gouge.
"	U8-20	31' - 32'	?	Broken core
"	U8-28	162' - 165'	24"	Grey fault gouge.
9	U9-31	225' - 235'	45"	
"	"	312' - 314½'	16"	Branch fault?
"	U9-30	104½' - 112½'	8'	Fault gouge.
"	U9-40	22½' - 25½'	13"	
"	U9-41	80' - 85'	?	

Level	Hole No.	Intersection depth	Core loss	Remarks
11	U11-6	53'4" - 61'4"	15"	Fault against aplite
"	U11-7	58'8" - 74'2"	57"	Fault against aplite
"	U11-8	62'2" - 69'9"	6'	Fault against aplite
"	U11-13	7'	1"	
"	U11-15	34'8" - 38'	3'	

APPENDIX 2

Assay Results from Grab Sampling of Hydrothermal Alteration Pipe.

Sample No.	Level	Location	Material Sampled	Assay %Sn.	Result %WO <sub>3</sub>
S307	4	2400N 2310E	Altered Country rock	0.08	0.05
S308	4	" "	Subordinate white kaolinitic material containing marmatite and pyrite.	0.69	0.08
S309	6	2400N 2270E	Grey clay gouge.	0.02	0.07
S310	6	" "	Subordinate white kaolinitic material containing pyrite and marmatite (?)	0.03	0.05
S312	8	2550N 2190E	Grey hard altered country rock with minor pyrite.	0.02	0.02
S311	8	" "	Grey gouge and altered country rock.	0.04	0.02
S313	9	2640N 2150E	Grey clay gouge	0.02	0.04
S314	9	" "	Grey altered country rock.	0.02	0.03
S315	11	2700N 2060E	Broken brown grey partly silicified material containing pyrite.	0.01	0.16
S316	11	2700N 2060E	Grey, hard altered country rock.	0.02	0.08
S317	11	" "	Grey slimey gouge.	0.02	0.08