ABERFOYLE TIN N.L.

GEOLOGICAL PROGRESS REPORT - LUTWYCHE PROSPECT

G. Krummel

February 1968

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SUMMARY

Detailed re-logging of all drill core from the Lutwyche Prospect and mapping of the 13 level drive at Aberfoyle Mine formed the basis of the present re-appraisal programme. Where warranted, existing vein information was augmented by assay data on their tin and wolfram trioxide content.

Several major folds were outlined in the area with the aid of form lines, but no direct causal relationship was found to exist between the latter structures and the main zone of mineralisation at the Lutwyche Prospect.

The Lutwyche Zone of fracturing and irregular veining re-established itself as the main control structure on the major zone of mineralisation of the area. Groups of narrow, irregular, mineralised quartz veins in several cases appear to be associated with fracturing in or near the cores of folds.

The exact cause of the veining at Lutwyche remains unknown and the precise correlation of individual veins still poses problems, but the present work suggested a number of targets for both surface and underground exploration. Execution of this work may lead to an increase in the indicated ore reserves for the prospect which at present, according to A.A.C. Mason stand at about 340,000 tons at 1.46% combined metal units.

INTRODUCTION:

Preliminary work in the Lutwyche Prospect up to 1963 outlined several veins mineralised with tin and wolfram in the area and provided some basic geological information on the prospect.

The following report describes the methods and results of a geological re-appraisal of the Lutwyche area (the location of which is shown on Fig. 1.). The basis of the investigation was the detailed re-logging of core from drill holes S14, S17, S19, S20, S21 and AU 13-6 with respect to detailed lithology, sedimentary and tectonic structures and veining. The geology as exposed in the 13 level cross-cut of the Aberfoyle mine was examined and mapped and the surface exposures were also examined.

The approach to the re-appraisal was an adaptation of a similar method used in a study of the structure in the Storeys Creek Mine Area by Hopwood & Collins in 1967.

The drill cores provided a wealth of useful information but data, particularly depth, derived from S14 is open to doubt on account of the disarrangement of the core.

Individual lithological units were for the most part easily recognisable in the drill cores examined. A tentative stratigraphic sequence for the rocks of the area was set up as a step towards the elucidation of the structure. In the absence of minor tectonic features related to folding, particular attention was paid to the recognition of depositional features in the sediments. These gave "way-up" criteria for the beds intersected. Current bedding and graded bedding provided reliable data in this respect. "Mimic" structures due to boudinage, slumping and fracturing shed doubt on some facing data derived from load casts and flame structures. In most cases the latter two features were used only as supporting evidence for facing data derived from graded bedding.

The interpretation of the results was hampered by the repeated appearance of lithologically similar rocks and by the lack of a distinctive marker horizon. Thus reliance had to be placed on form lines to determine fold shapes. The amount of dip of the bedding in drill core, supported by facing data was used as a guide to form lines to determine the shape of fold structures.

Attempts were made to correlate major folds in one drill section with corresponding folds in adjacent intersections. Known veining was super-posed upon the fold structures and their relationships investigated.

LITHOLOGY:

The sediments of the area belong to the Mathinna Group. Four major rock units were recognised in the drill cores from the area. These comprised psammites, pelites, aplite and dark, altered dyke material.

The sedimentary rocks of the sequence could be further sub-divided as follows on the basis of mineralogy, grain-size, hardness and colour:

Quartzites — Generally dark blue-grey, fine to medium grained, sometimes gritty, frequently massive and hard. Graded bedding, slumped bedding, current bedding and convolute bedding may be present.

Quartz-rich psammopelite — This is a gradational unit consisting of varying amounts of quartz grains in a dark pelitic matrix. Accessory biotite and muscovite as well as pyrite may be present. They are somewhat softer than the quartzites. Sedimentary structures are similar to those found in the quartzites.

Psammopelite — Dark grey or dark greenish grey, fine-grained and soft. Quartz grains, muscovite and pyrite may be present as accessory minerals. The rocks may be thinly banded or massive. Sedimentary structures are frequently well developed and may comprise graded bedding, load casts, current bedding and occasional flame structures.

Slate — Dark blue-grey to black, rarely greenish-brown, soft. Pronounced slaty cleavage.

Dark spots, consisting mostly of aggregates of fine-grained flakes of biotite may be superposed upon the rocks of the sedimentary sequence, probably as a result of contact-metamorphic affects. These are particularly noticeable on 13 level and the lower parts of the drill core of S21 and AU 13-6 (Fig. 2 and Fig. 5).

The Igneous rocks in the area may be described as follows:-

Aplite — Generally pale green, fine to medium grained, crystalline, hard, intrusive. May contain specks of sulphides.

Dyke Material — Dark greenish-brown, clay rick, chloritic rocks of crystalline aspect. Generally highly decomposed.

Transgressive contacts.

?Tuff: — A dark grey-green decomposed, medium grained, crystalline biotite-chlorite rock with a clay and carbonate rick matrix. May have concordant or discordant contacts. Tentatively identified as a tuff.

VEINING (SEE FIGS. 2, 4 AND 5)

Numerous quartz veins ranging in size from $\frac{1}{8}$" to 13" were intersected in drill holes S14, S17, S19, S20, S21 and AU 13-6. Most of these are small or barren, but there are many which carry sulphide mineralisation. Cassiterite and wolframite may sometimes be present. Individual small, narrow veins are difficult to correlate progressively from one drill hole to the next but two veins of major importance possibly arranged "in echelon" have been identified and traced throughout the area drilled. These two veins are designated the "Hanging Wall Vein" and "Pay Vein" respectively.

The Pay Vein (width 5" to 13") was identified in drill holes S14, S17, S19, S20 and S21. It is probably present in AU 13-6 but its exact identity among the group of veins in this drill hole is uncertain. It has been traced by drilling over a strike length of 850' and a downdip length of over 900'. Drilling also shows that the angle of dip of the vein decreases with increasing depth, averaging about 45° in AU 13-6.

Mineralogically the vein consists of coarse, white crystalline quartz with varying amounts of iron, copper and zinc sulphide, cassiterite and wolframite. Mica selvedge may be present. Assay results show uneconomic amounts of tin and wolfram in the Pay Vein intersections in S14, S17 and S20, but the grade of mineralisation of the vein with respect to combined metal content appears to improve with depth.

The Hanging Wall Vein:

This vein varied from ?2¼" to 11" in width and consists of coarse white crystalline quartz with varying amounts of sulphides, cassiterite and wolframite. Selvedge may be present along its contacts with the country rock but the vein contacts may be brecciated. The vein has been identified in drill holes S14, S21 and AU 13-6, but some doubt exists as to its precise identity in the latter drill hole. The vein has not been traced on surface and has not been identified in drill holes S17, S19 and S20.

The vein is unmineable in S14 but its grade improves with depth. If present correlations are valid then its width decreases with depth and it may tail off in a South easterly direction.

A number of minor veins ranging in size from 1" - 5" were intersected in the drill holes but accurate correlation of these veins between drill holes was not possible.

A number of these veins, which from available assay results appear to be unmineable, show a tendency to be grouped in a zone around the Pay Vein.

Three of four groups of these irregular quartz veins ⅛" - 2" wide were intersected in S17, S19, S20 and S21. These may carry sulphide minerals and, less frequently, cassiterite and wolframite. Individually they are too small to be mineable but they may be of economic interest if taken in groups over a given mining width.

Irregular veining consisting of bluish or pale grey quartz was frequently noted. It may carry pyrite or arsenopyrite mineralisation with some white mica. Cassiterite and wolfram are absent. The contracts of the vein are frequently indistinct and the veins appear to merge into the country rock. This suggests that the quartz was secreted into pre-existing fissures from the surrounding country rocks. This type of quartz is referred to as "country quartz". ~~This type of quartz is referred to as "country quartz".~~ This type of veining generally pre-dates mineralised veins and the latter frequently intersect it.

STRUCTURE (SEE FIG. 6 TO 9 INCLUSIVE)

The rocks in the Lutwyche area have a uniform north-westerly

strike. The dip of the beds varies between 50° and 85° to the southwest. Occasional reversals of dip to the northeast were observed both underground and in surface outcrop.

The only major fault structure so far recognised in the area is the north-west trending Kookaburra Fault located in a gully to the south of the Lutwyche outcrops. Correlation with drill core suggests that the fault dips steeply to the northeast. The precise effect of this fault on the Hanging Wall Vein and Pay Vein is not known, but Kingsbury suggests that a horizontal displacement of about 200 feet may have taken place along this fault.

Minor faulting in the area falls into two groups. The first of them includes north-westerly bedding faults, often with brecciation along planes of movement. Associated with these are faults with t he same strike as the bedding but with steeper or lesser dips. These are generally weak faults with small displacement, but movements along the fault planes provided limited space suitable for later infilling with mineralised quartz. The second group of faults consists of cross-faults striking in a northerly or north-easterly direction. They appear to be younger than the faults of the first group.

A major zone of brecciation and irregular quartz, quartz chlorite and quartz carbonate veining appears in the cores of drill holes S14, S17, S19 and S21. A second similar zone was noted in the upper parts of S17, S19 and S21. The former of these two zones of fracturing and veining can be correlated with a similar structure. This zone is designated the Lutwyche Zone of Fracturing while the second zone is termed the Kookaburra Zone of Fracturing.

Lutwyche Zone of Fracturing

A narrow belt of fracturing with numerous, narrow, irregular, generally barren veinlets of quartz, quartz-chlorite and quartz carbonate material. At the surface this zone follows the strike of the bedding but drilling shows that it dips more steeply to the south-west. Drilling indicates a strike length of at least 900'. This zone may be an old fault or a zone of repeated movement which may have become partially healed up by country quartz. Mineralised veins are few and scanty.

Kookaburra Zone of Fracturing

This is a narrow belt of fracturing similar to the Lutwyche Zone of Fracturing. Its strike is parallel to that of the Lutwyche zone. Near the surface it dips steeply to the south west but tends to flatten out with depth. Sections of this zone may carry narrow veinlets of quartz with cassiterite and wolframite. It may form an important water course at depth. (See Fig 6).

Folding

"Way-up" sedimentary criteria supported by changes in the angle of dip of the beds and dip reversals indicate that folding in the Mathinna sediments of the Lutwyche prospect is more widespread and intense than had hitherto been suspected. Few actual major fold hinges were observed in situ, although a number of minor folds were observed in drill cores. Both symmetrical and asymmetrical, irregular folds were mapped along the 13 level cross-cut. The axial planes of these folds strike north-west and dip to the south west at angles of 75° or more.

Fracturing of rock and re-healing of quartz in the axial zones of several large folds was recorded. Irregular country quartz veining is frequently found in the axial regions of folds. This relationship is well exposed on the 13 level crosscut.

A strong cleavage has been imprinted upon the slaty beds of this area and may also be observed in some of the psammopelites of the area. The relationship of this cleavage to the axial planes of the folds could not be observed in outcrop. The cleavage strikes to the north, north-west and dips steeply to the southwest. It was noted that the angle between the strike of bedding and cleavage may be as large as 20°. Bedding-cleavage lineations, when recognizable, plunge at angles of up to 20° to the Southeast.

INTERPRETATION AND DISCUSSION (SEE FIGS. 6 TO 9 INCLUSIVE)

Examination, correlation and interpolation of sedimentary, lithological and structural data collected during the present investigation indicates that strong deformation affected the Mathinna sediments at the Lutwyche Prospect. The rocks appear to have been compressed by forces acting along a north east-southwest trending axis into a series of asymmetrical folds. The shapes of the folds suggest a synclinorium to the north-east and an anticlinorium to the south west. Some brecciation, possibly due to axial plane movement appears to have occurred

in or near the cores of several of the fold forms outlined. Bedding-plane slip with the formation of occasional narrow breccias along the plane of movement appears to have been fairly common.

A comparison of the veining patterns with fold structures did not reveal a strong causal relationship. Individual small veins cannot be correlated over any great distances. However, a tendency for the veining to fall into groups or along zones was noted. Such zones, containing mostly narrow, scattered quartz veins with sulphides and tin/wolfram mineralisation could more readily be correlated with each other and similar surface out-crops and with structural features in the area. Thus in S17, S19, S20, S21 and AU 13/6, several zones of narrow scattered quartz veining can be correlated with axial regions of major folds, some minor folds and with similar zones in adjacent diamond drill holes.

Furthermore, there is a tendency for several lesser, mineralised quartz veins 2" - 5" thick to concentrate around the "Pay Vein" and the Hanging Wall Vein in drill holes S19, S20, S21 and AU 13-6. Individual members of this group may be sub-parallel to the Pay Vein or may dip towards it at various angles. Individual members of this group cannot be correlated with certainty between drill holes. Thus the area containing the Pay Vein and associated lesser quartz veins and the Hanging Wall Vein can conveniently be regarded as a broad zone of quartz veining of major importance. The approximate width of this zone increases from 80 feet in S20 to 160 feet in S21. The dip of this zone is about 60° to the south-west near the surface and flattens out to about 45° below S21. Inspection of sections suggests a loose association of this zone with an anticline.

The zone provides an easily identifiable, broad target for further exploration along strike and downdip. Its individual members may be matched with veins of the same zone in other drill holes as detailed information becomes available and their relationship studied.

The possibility of groups of veins forming economic units in the cores of folds cannot be neglected and this offers a secondary target for further exploration.

Finally, the nature of the Kookaburra and Lutwyche Zones of fracturing suggests that these zones do not form promising targets for further investigation.

Further comparisons of structures and veining allows a broad time relationship to be drawn for tectonic events in the area subsequent to folding. This time sequence may be subject to some modification as further detailed information on the geology of the area becomes available. Thus the Kookaburra and Lutwyche zones of fracturing both transgress the bedding and axial planes of major folds at depth. These two zones may have been the next major tectonic features to form in the area and were later partially healed up with "Country Quartz". Tensional strain was responsible for the formation of tension gashes which became infilled with quartz and tin/wolfram mineralidation during the later stages of intrusion of the Devonian Granite into the Mathinna sediments. The loci of development of these fissures were partly controlled by lithology, primarily quartzites and pre-existing, healed fracture zones. During this period the Lutwyche zone of fracturing emerged as a major control structure in the area. The Hanging Wall Vein and Pay Vein in particular was noted to "make off" this structure and diverge from it in depth.

The veins of the area are affected by numerous minor post-mineralisation faults trending north or north-east. The north-west trending Kookaburra fault possibly also exercises some control on the veining of the area.

RECOMMENDATIONS (SEE FIGS 2, 3, 6, 7, 8 & 9)

MINING

1. The number and grade of the quartz vein intersections in AU 13-6 warrant the extension of the 13 level drive by a further 650 feet in a direction of 028° grid from co-ordinates 7032N/ 2426E. This would provide access to the Hanging Wall - Pay Vein zone of interest and expose a number of quartz veins beyond this zone. The face of this completed crosscut would also provide a suitable site for any possible underground exploration in a northerly direction.

2. Development work could then be carried out along the strike of the "Pay vein" in a north westerly and south easterly direction. The Hanging Wall Vein should initially be developed in a north-westerly direction since its south easterly extension is not known at present.

3. Well mineralised other quartz veins encountered during crosscutting could be investigated for short distances initially.

UNDERGROUND DIAMOND DRILLING

A total of about 3,200 feet of drilling is proposed for additional testing of the "Hanging Wall - Pay Vein" zone at depth to augment existing geological information on the area and to assist in development planning. A prerequisite of the initial drilling programme would be the construction of two drill chambers at abo ut 7120N/2472E. These chambers should be sufficiently large to permit unhindered manipulation of 10 foot drill rods, say 12 feet x 10 feet x 8 feet approximately. These chambers could be utilised as underground storage rooms, workshops or pump stations etc. after completion of the drilling programme. The drilling footage could be distributed as follows:

AU 13-7 (Proposed: 7134N/2468E: to be drilled horizontally on a grid bearing of 348° to a depth of approximately 1,000 feet. Provides geological information on a hitherto untested area of the Hanging Wall - Pay Vein zone well ahead of proposed development work.

AU 13-8 (Proposed) 7134N/2468E to be drilled at an angle of -40° in a direction of 337° grid to a depth of approximately 550'. This drill hole would test the grade and down dip continuation of the major zone and interest and could supply information on the proximity of a granitic or aplite body at depth. The flattening of the dips of the Hanging Wall Vein and Pay Vein could be verified.

AU 13-9: 7124N/2490E, - 40° on a grid bearing of 058°, to test the downdip continuation of the major zone of quartz veining, to investigate the nature of the Hanging Wall Vein and to give information as to the proximity of a granite mass. Footage: 500 feet approximately.

AU 13-10: 7124N/2490E, horizontal on a grid bearing of 085°. This drill hole would test the downdip continuation of the Pay Vein zone from intersection in S17 and S19 and S20; the south easterly extension of the Hanging Wall - Pay Vein zone as intersected in AU 13-6; the presence and nature of the "Hanging Wall Vein". Footage 720 feet approximately.

Additional drilling amounting to approximately 430 feet is proposed to test veining in the footwall and hangingwall of the Pay Vein concurrently with development along the latter vein.

NOTE: Since the submission of this report, amended proposals arising from discussions held in Melbourne have been formulated. These amended proposals are shown on the accompanying plans Figs 2, 3, 6, 7, 8 and 9. D.K.T.)

SURFACE DIAMOND DRILLING:

1. D.H. to intersect Hanging Wall - Pay Vein at about 500 feet below surface. This would indicate the upper mineable limit of the zone.

2. The exact strike length of the Hanging Wall - Pay Vein Zone should be defined by diamond drilling at regular intervals of about 500 feet along the strike of the zone. Initially four drill holes of 1,000 feet each.

Summary of Drilling:-

Underground:	AU 13-7	1,000 feet	
	AU 13-8	550 feet	
	AU 13-9	500 feet	
	AU 13-10	720 feet	
	development drilling	430 feet	
			3,200 feet
Surface:	(i) *	2,000 feet	
	(ii)	4,000 feet	
	TOTAL	9,200 feet	

NOTE * See previous note regarding amended proposals. D.K.T.

Geological Mapping:-

Progressive detailed geological mapping of all areas exposed by the proposed underground development should be carried out. Detailed geological logging of all core from the proposed drill holes will be required.

APPENDIX

ASSAY RESULTS

D.D.No.	Depth	True Width	% Sn.	%WO_3	% CM	% CM once stoping width of 48"	Comment
S14	649'	11"	0.06	0.04	0.10	0.02	Hanging Wall
S14	795'	13"	0.06	0.04	0.10	0.03	Pay Vein
S17	334'	9"	0.95	0.37	1.32	0.25	Pay Vein
S17	357'	3"	0.26	0.09	0.35	0.02	
S17	375'	3"	0.04	0.09	0.13	0.01	1" Vein, 3" sample.
S17	389½'	2"	0.06	0.03	0.09	<0.01	
S19	364½'	5"	0.18	7.10	7.28	0.76	Pay Vein
S20	427½'	2¼"	0.42	3.61	4.03	0.19	
S20	478½'	5"	0.08	0.11	0.19	0.02	
S20	480¼'	10"	1.10	0.05	1.15	0.24	Pay Vein
S20	528¾'	2¼"	0.48	0.20	0.68	0.03	
S20	541'	3"	0.04	0.09	0.13	<0.01	
S20	637'	2"	0.04	2.93	2.97	0.12	Combined sample 1½" + ¼"
S21	579¾'	3¾"	0.35	0.05	0.40	0.03	
S21	596'	5½"	0.04	0.07	0.11	0.01	
S21	621'	2"	0.84	0.06	0.90	0.03	
S21	1059¾'	10¾"	14.1	0.03	14.13	3.15	Hanging Wall
S21	1155¾'	8"	0.07	0.64	0.71	0.19	
S21	1180¾'	12 3/8"	5.3	0.09	5.39	1.34	Pay Vein
S21	1206'	9¼"	0.04	0.05	0.09	0.02	
S21	1429½'	46"	0.04	1.17	1.21	0.15	approx. true width
S21	1525½'	4"	0.06	0.28	0.34	0.03	"
S21	1722'	4"	0.03	0.05	1.08	<0.01	"
S21	1865½'	4½"	0.09	0.06	0.15	0.01	"
AU 13/6	333'	2"	0.65	18.29	18.94	0.79	
"	336¾'	2½"	0.07	0.06	0.13	<0.01	
"	367'	1½"	0.05	0.08	0.13	<0.01	
"	372'	1½"	0.05	0.07	0.12	<0.01	
"	372½'	1½"	0.07	0.04	0.11	<0.01	
"	392'	2¼"	1.10	0.06	1.16	0.05	
"	408½'	2¼"	1.55	12.98	13.53	0.64	HangingWall
"	498'	4"	0.06	22.55	22.61	1.88	
"	504¾'	10"	5.50	1.58	7.08	1.47	Pay Vein
"	546¼'	3"	0.06	0.72	0.78	0.05	
"	569¾'	2¾"	0.01	0.10	0.11	<0.01	
"	577½'	2¼"	0.02	0.08	0.10	<0.01	
"	610½'	1¾"	0.03	0.10	0.13	<0.01	
"	625'	5"	0.88	3.45	4.33	0.45	
"	644'	3"	0.06	0.13	0.19	0.01	