GEOLOGICAL FACTORS CONTROLLING THE FUTURE OF THE MT. REX TIN MINE - AVOCA.

The present investigation was undertaken to determine the geological structure and features affecting the future development of the mine and examine the results of recent development work. In general, this report must be regarded as supplementary to those prepared by J.B. Scott, Secretary for Mines, and P.B. Nye, Government Geologist, in June last, namely "Notes on the Mt. Rex Mine" and "The Mt. Rex Mine" respectively: inasmuch as the previous investigators prepared reports based mainly upon old reports supplemented by a cursory examination of the mine, the writer had ample opportunity to study in detail the geological features, processes of ore deposition, distribution of tin values etc., and the following statement summarises his conclusions.

GENERAL GEOLOGY.

The ore-bodies are contained in granitic rocks of Devonian age. The normal granite of the area is composed principally of quartz and felspar, with very little biotite. Much of the felspar (orthoclase) occurs in large well defined idiomorphic crystals of the Carlsbad twin type and these are porphyritically distributed throughout the finer grained ground-mass of the granite. An apparently intrusive graphic granite composed almost wholly of felspars and quartz is associated with the ore-bodies, where exposed at surface but was not observed underground. The "tinstone" is not a typical greisen as the mica is only recognisable microscopically but from a genetic point of view the stone is essentially a stanniferous greisen.

The characteristic alterations of the country rock may be ascribed to a pneumatolytic and metasomatic metamorphism affected principally by the different compounds of flourine, boron etc., circulating in the systems of fissuring.

To the north, the granitic rocks are overlain by basal strata of the Permo-Carboniferous system. The western boundary marks the line of a great fault plane trending north westward, and with a downthrow to the south west. Permo-Carboniferous rocks and Mesozoic diabase abut the granite on the down-throw side of the fault.

ORE - GENESIS.

For the genetic investigation of ore-deposits, few factors are more important than the relationship of the ore bodies to the system of fracture of the country. The complexity of form of the Mt. Rex ore deposit is doubtless due to intersecting fissures, it is not unlikely that the contraction caused by the cooling outer crust would cause vertical as well as some horizontal joints or fissures. That the ore deposit is a replacement

of granite by solutions and gases rising along the intersecting joints is apparent from a study of the major joint systems.

There are two main sets of fracturing in this area, one approximately N.60° W and the other approximately N 17° E. The No. 3 level ore-body has been developed along fissures of the former system, while the latter appear to be associated with the main ore-body or "pipe". The general features of these deposits are the more or less circular or oval cross sections and the great irregularity in amount and direction of dip. A study of the "pipe" and joints shows that the ore-deposit is a replacement of granite by solutions and gases rising along the intersecting joints. The water (and gases) acted from incredibly small fissures and the most striking feature is the apparent insignificance, in width, of the determining joint with the volume of country altered. The process was probably as follows, the biotite of the granite country was altered to chlorite in which traces of sericitization was noticeable. A further change was marked by the development of sericite and pinite (massive muscovite). The felspars were subsequently altered to smaller grains of sericitic material and secondary quartz. With this, small percentages of tinstone, and to a much lesser degree the associated sulphides, chalcopyrite, pyrite, arsenopyrite, galena and sphalerite, were incorporated.

"Pipes" of this type may be permanent for considerable depths, seeing that the feeding mass is younger than the country and fairly deep seated. Limits, however, are set by the persistence of both joint sets. To summarise then, although the numerous ore-bodies have been developed as a result of the same process of mineralisation they occur as isolated "pipes" or "bulges" along one or more of the joint systems and may be connected only by means of an insignificant fissure filled with flourite to mark the passage of the mineralisers.

MINE WORKINGS.

Two levels only are available for inspection, namely No. 2 level at 210 feet, and No. 3 level at 310 feet.

On No. 2 level the drive has been extended another 32 feet where joints of the N 60° W system are strongly developed. Some are filled with pyrite, others with flourite and there is a more or less general impregnation of the country rock with sulphides such as arsenopyrite, chalcopyrite and pyrite etc. In places the rock is fresh, coarse felspar porphyry, although incipient alteration is apparent microscopically. The felspars are altered to quartz and sericite; biotite altered to muscovite, pinite-massive muscovite fringes some felspar. Sphalerite replacing felspar may be observed in one instance. There can be no doubt that the drive has intersected the upward continuation of the ore-body known as the No. 3 level ore-body, at the far end of No. 3 level. The No. 1 crosscut, north east from the winze could be examined in part only, owing to "mullock" but it shews evidence of greisenisation.

No. 2 north-east crosscut, 50 feet south from No. 1

crosscut, is shown, on the plan, compiled from mine plans supplied to the Mines Department, accompanying P.B. Nye's report, as only 37 feet long, whereas a chain and compass survey by the writer revealed an actual length of 55 feet. At six feet from the face greisenisation was observed. From a consideration of mine plans available it was thought previously that the north-south lode, cut at the surface in No. 2 shaft and shallow trenches to the north, had not been tested by any underground workings, but in view of the additional 18 feet of driving not shown on the mine plans and the evidence of greisenisation six feet from the face there can be no doubt that the No. 2 crosscut did cut the downward extension of north-south lode and that where intersected did not give any encouragement for further prospecting.

At 148 feet from the shaft, where the drive turned north east around the "pillar", the drive has been continued on line another 42 feet to what is known as "Milton's" face. At the end of the old drive a narrow quartz vein bearing N 22° E had been intersected and is apparently part of the joint system, which gave access to "mineralisers" responsible for the deposition of the large mass of galena exposed on the west wall of the drive near the "pigsty". In the new portion of the drive the main jointing appears to belong to the N 60° W system and the rocks show little or no alteration in the hand specimen. Microscopically, however, there is evidence of alteration. Felspars are clouded, and in part show fringes of pinite, muscovite and secondary quartz are present.

The only other new work on this level is a winze sunk to a depth of 31 feet on the White ore-body. There appears to be two main joints, bearing N 57° W showing more or less complete greisenisation with decreasing intensity of alteration between them. Bulk samples taken across the walls of the winze and assayed by the Government Chemist and Assayer, Launceston, give an indication of the value of the tinstone here.

Reg. No.	Sample No.	Location.	Tin Content%.
1206	No. 4	South Wall on bottom	0.32
1207	No. 5	" " 9 ft. up	0.23
1208	No. 6	West Wall 8 " "	0.19
1209	No. 7	" " on bottom	0.38
1210	No. 8	North Wall " "	0.04
1211	No. 9	" " 9 ft. up	0.22

No. 3 Level: At 99 feet from the shaft a south-west crosscut was driven 47 feet in an attempt to locate the downward extension of the White ore-body. A close examination reveals a slight alteration of the country rock indicating at least the passage of "mineralisers", much of the felspar (orthoclase) being quite fresh. Microscopically, however, the rock shows that it has been subjected, to a much lesser degree, to the action

of "mineralisers" - the felspars are in part sericitised; flourite is present in one section; no cassiterite was observed. Dish prospects by the Company indicated a trace of tin over a few feet, approximately 30 feet from the drive, the rest gave negative results.

At 155 feet from the shaft, in a south-westerly direction, a cross-cut has been driven a distance of 45 feet; at 17 feet from the drive a cuddy has been put in a north westerly direction a distance of 15 feet. Ten feet west of the cuddy a south-easterly drive was driven a distance of 30 feet. On the north wall of x-cut, from drive to cuddy, the granite has been completely greisenised and the following assays by the Government Chemist and Assayer of three sections indicate the relative tin content.

Reg. No. 1203 - No. 1 sample North Wall 0' - 6' Tin 0.7%

" " 1204 - No. 2 " " " 6' -12' " 0.06%

" " 1205 - No. 3 " " " 12' - 17' "0.08%

In the cuddy the granite only shows microscopic alterations and does not contain any tin. The crosscut or south easterly drive does not show any marked degree of mineralisation, and dish prospects gave negative results. The same series of fractures extends in a north easterly direction through the corner of crosscut connecting with the winze from No. 2 level. One fissure N 60° W is filled with flourite and appears to represent the ore channel which was followed down in the winze although the tin content at this level is very low.

Another crosscut was being driven at the time of the writer's examination on a fissure of the north westerly system from a point 45 feet north of the "winze" crosscut. Although there was no evidence of greisenisation or "tinstone" at this point, it was stated that dish prospects had influenced the selection of this crosscut.

The only other ore-body on this level is that known as the No. 3 Level ore-body. Beyond five samples across the floor of the chamber, one on the wall and six drill holes in the "back", no attempt has been made to further develop the ore-body on this level.

Regarding the structure here, the north western system of fractures appear to be the major ones with a subsidiary set practically east and west; small quartz veins indicate the latter.

The following analyses of bulk samples, taken in six foot sections from the corner of the chamber and west wall of drive, around the chamber to its junction with east wall of drive, are generally representative of the grade of the material as a whole:-

Reg. No.	Sample.	Metallic Tin content.
1219	No. 17	0.11%
1218	" 16	0.60
1217	" 15	0.01
1216	" 14	0.23
1215	" 13	0.06
1214	" 12	0.11
1213	" 11	0.06
1212	" 10	0.34
1222	" 20	0.06
1221	" 19	0.18
1220	" 18	0.38

Two main north westerly fractures are marked by bands of complete greisenisation, indicated by samples Nos. 10 - 18 and 14 - 16 respectively; between the two bands of greisen are "horses" of practically unaltered granite, incipient greisenisation being apparent in places only.

SURFACE WORKINGS.

Beyond sampling, no attention has been paid to any of the surface workings by the present Company, consequently not all were available for examination, therefore for the sake of brevity, reference will be made only to those which throw some light on the genesis of the ore-bodies.

The Small Open Cut Ore-body. This ore-body is exposed in an open cut 350 feet north west from the main shaft. It has developed around a series of fractures ranging in direction from N 80° W to N 65°W; a subsidiary set of "horizontal" fractures dip steeply to the south with a slight pitch to the east. At 22 feet west from the eastern end of the open cut is a dyke, eleven inches wide, of a highly felspathic rock, consisting essentially of felspar with a little quartz and containing a little tin. An assay of this material returned 0.52% tin. It coursed N 17° E and is practically vertical or probably has a slight dip to the west. Apparently is later than the "horizontal" jointing because in one instance shews a lateral displacement of approximately nine inches. Flourite is weal developed on the north-easterly jointing. There is the same decreasing intensity of greisenisation between "main" joints as observed elsewhere. The following bulk samples give an indication of the value of this deposit.

Reg. No.	Sample .	Location.	Tin content.
1223	No. 21	East end of Open cut.	0.24%
1224	" 22	South wall, centre of cut	Trace.
1225	" 23	Between greisen veins, south wall	Trace.
1226	" 24	Greisen vein to south of No. 23	0.14
1227	" 25	West end across 6 ft. section	0.04

The fine-grained graphic granite associated with the "tinstone" can be traced north of east to No. 3 shaft, indicating a possible connection; but samples taken from above the water level of No. 3 shaft have a very low tin content as the following results show:-

Reg. No.	Sample No.	Location.	Tin content.
1233	31	North wall No. 3 shaft	0.29
1234	32	East " " " "	.04
1235	33	South " " " "	Trace.
1236	34	West " " " "	Trace.

There is also a northern extension from No. 2 shaft of this fine-grained graphic granite. One sample from a six foot section on the east wall of No. 2 shaft, north of the timbering, gave a return of 0.68% tin.

Regarding Stephenson Ore-body this appears to be an isolated development as no connection could be traced. Fissures apparently so insignificant that they are not discernible cross the outcropping country providing access for the mineralisers. 76 feet S 28° E from Stephenson's Shaft, another development of greisen is exposed, but has not been opened up sufficiently to determine any structure but notwithstanding the fact that there is no evidence of a connection between these it is reasonable to assume from a consideration of the geological structure of the ore-bodies elsewhere that these represent a development along a series of north west joints. Bulk samples taken from the walls of Stephenson's shaft above water level give an indication of the value of this ore-body.

Reg. No.	Sample No.	Location.	Tin content%.
1228	26	North wall Stephenson's Shaft	Trace.
1229	27	South " " "	0.03
1231	29	East " " "	0.34
1230	28	76' south east of Stephensons shaft	Trace.

CONCLUSIONS & RECOMMENDATIONS.

The present survey was undertaken with the object of determining the geological structure and features affecting the future of the mine. There are two phases to the question, the structural details as a whole and the distribution of tin values. The first has been discussed at length already and may be summarised here as follows:- Two major fracture systems occur, one approximately N 20° E and the other N 60° W, which have been intimately associated with the development of the various ore-bodies. The main "pipe" was apparently developed along the N 20° E series, while the No. 3 level ore-body developed along fissures of N 60° W series. The main "pipe" is represented at No. 3 level by a flourite filled fissure, from which incipient greisenisation has extended laterally some little distance. The "White" ore-body could not be located at No. 3 level, although evidence of the passage of mineralisers was observed. Where the No. 3 level ore-body's upward extension was intersected on No. 2 level it was represented only by fissures filled in some, with flourite, in others pyrite, with an impregnation of the country rock with sulphides such as chalcopyrite, pyrite, arsenopyrite, galena and sphalerite in a very small proportion.

From a consideration of the geological structure, it is evident that the ore-bodies are isolated developments, and may be connected only by insignificant, partially greisenised "tracts" around flourite filled fissures. Therefore, any assumption that assumes that one ore-body is a continuation of another is made without due regard to the true nature of the deposits.

With regard to the distribution of tin values, these are undoubtedly becoming poorer at depth. Fissures which permitted the access of mineralisers becoming less frequent, with consequent increase of intervening country to be affected. Bulk samples taken and assayed by the Government Chemist and Assayer, indicate an average grade far below that worked by previous companies. An average of 20 samples gave 0.21% metallic tin.

Therefore summarising the data available as to the value of the ore-bodies the position is as follows:-

1. The Main Ore-body. This body has been removed almost entirely above No. 2 level. Apparently it does not continue down to No. 3 level without serious diminution almost to extinction, both in extent and tin content.

2. The White Ore-body This was followed down to a depth of 31 feet by means of a winze with decreasing tin values and could not be located at No. 3 level, although evidence of mineralisation was available.

No. 3. Level Ore-body. No. 2 level was continued to

cut the upward extension of this body and a sulphidic impregnation of the country rock together with flourite and pyrite filled joints was the only indication of having intersected the ore-body.

North and South Ore-body. There can be no doubt that the No. 2 crosscut on No. 2 level did intersect the downward continuation of the north and south ore-body and where cut was so small and contained such low tin values as to discourage any further development.

No further attempt has been made to develop any of the other outcrops.

By reason of the known ore reserves being depleted, the future of the mine depends upon the discovery of new ore-bodies. In view of the disappointing results obtained in relation to recent exploration the probability or otherwise of opening up new ore-bodies of economic importance beyond the limits of the present drives is a matter of costly speculation and there is no evidence to justify such a course.

(signed) Q.J. Henderson

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