SLOCAN PROPERTIES

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A Report on the Geology of the Queen Bess Mine

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The writer hopes that this report will meet with the reader's approval, and is herewith forwarded to Mr. Paul Billingsley for his personal inspection and approval before being distributed by him.

Respectfully submitted by:

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Kelowna Exploration Co. Ltd.,
Sandon, B.C.,
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Summary and Conclusions

Portal Orebody

This ore shoot, although situated on an exceptionally flatly-dipping part of the lode, is favourably located with respect to the probable intersection of the lode and No. 7 Fault. In this position, where an easterly movement of the hanging wall would be most effective, it lies just east of a "corner" about which there was an apparent counter-clockwise deflection of the hanging wall movement. In ~~addt~~ addition, the local westerly-dipping quartzites and argillites provided brittle walls for a maximum of brecciation. No. 7 Fault ~~may~~, to a slight extent, may have functioned as a westerly-dipping hood which could restrict ore-deposition to this section of the lode. The ~~position of the~~ orebody is probably situated on and above the Queen Bess axial plane.

Outer Orebody

Again, mineralization has apparently favoured a counter-clockwise bend in the lode, where an "open" structure could be maintained through the continuous easterly movement of the hanging wall. This bend of the lode is apparently related to two prominent structural features; the first being a northerly deflection of strike, accompanied by a flattening of dip, where the lode leaves a section of firm wall rocks to enter the soft, thin argillites of the intermediate barren zone; the second being an intersection with a northeasterly-dipping normal fault. This fault, inferred by the pattern of the workings above No. 5 Level, could also function as a "hood", under which rising ore solutions or volatiles would be restricted to a smaller section of the lode under the Queen Bess axial plane. Brecciation ("Brittle-failure") of the wall rocks probably accompanied lode movements within the section of westerly-dipping blocky argillites and quartzites, lying within and southwest of the "corner". With regard to structural control related to the dip of the lode, mineralization apparently favoured that vertical section where ~~an upward flattening of the lode dip accompanied~~ a change from a steep to flatter dip ~~accompanies~~ marks the upward course of the lode through the Queen Bess axial plane.

Inner Orebody

Pronounced structural control has been effected ~~by~~ through the combination of several strong factors. The more apparent of these are: the presence of favourable wall rocks, afforded by a thick section of westerly-dipping quartzitic beds, lying closely under the Queen Bess axial plane and the North Fault; a pronounced steepening of the lode above No. 6 Level; a major counterclockwise bend in the lode; a sinuous lode pattern accompanying this bend; the presence of the strong North Fault, which provides an extensive, impermeable "hood" over this section of the lode. Within the lower levels several strong southwesterly-plunging fault-lode intersections could have functioned as "feeders" to the structurally-favourable zone above.

The relationship between orebodies and specific fold and fracture structures, as described in the preceding pages, is illustrated by the composite plan, ~~logitudinal~~ longitudinal projections, and cross-sections accompanying this report. In general, those structures that appear most responsible in localizing ore deposition are listed as follows:

(a) The sections of westerly- and ~~vertically~~ vertically-dipping beds lying below and across the axial plane of the Queen Bess overturn.

(b) Sections of bedding composed of quartzite, or closely-interbedded quartzite and argillite, or of thickly-bedded to massive hard argillite or limestone. The important quality is the tendency to to deform as a brittle material, thereby developing permeable lode-breccias.

(c) Parts of the lode so curved as to allow a local counter-clockwise (plan view) deflection of the general easterly hanging wall movement. Such curved sections may develop at lode and cross-fault intersections, or at places where the lode traverses sections of wall rock of widely-differing ~~competency~~ competence.

(d) Steeply-dipping sections of the lode - preferably those affected by late normal displacements. (pre-galena fracturing)

(e) Rather flatly-dipping impermeable cross-faults, functioning as hoods over otherwise structurally-favourable sections of the lode.

(f) A wavy or sinuous lode trend at otherwise favourable sections.

Core from drill hole Q.B.-1 showed that a strong lode, with an encouraging amount of low-grade zinc ~~ore~~ mineralization, lies between No. 10 level and the ~~B-vein~~ "B-Tunnel". This lode, which is almost certainly continuous ~~between~~ with the lode mapped in the Road Tunnel, shows encouraging widths of fair zinc mineralization at the latter place also. This suggests that mineralization ~~has~~ spread rather extensively within this section of the lode southwest of No. 7 Fault. With the certain presence of competent, brittle wall rocks, and the possibility of ~~local variations of strike by~~ simple bends or fault-lode intersections within this section, there is a fair chance that the required ore-forming conditions may be present between No. 7 Fault and the Road Tunnel.

For one-half mile southwest of No. 10 portal, favourable bedding structures and rock types are present within the hanging wall of the lode. Steeply-dipping and folded sections of bedding above the apparent position of the Queen Bess axial plane, and involving successive sections of quartzite and argillite, provide a structural setting within which favourable structures could have developed along this section of the lode.

East of No. 7 Fault, and ~~pres~~ at a presumably steep section of the lode below ~~No. 6 level~~ the westerly end of No. 6 Level, the association of a thick band of quartzites with a probable counter-clockwise bend in the lode ~~may have combined to develop to~~ could possibly contribute ~~contributed~~ to the development of a favourable lode structure.

Geology of the Queen Bess Mine.

(~~abstract to precede main body of report~~).

Introduction

Acknowledgements.

In preparing geological maps, the writer made free use of small-scale preliminary sketches supplied by Mr. Billingsley. These illustrated long- and cross-sectional details of the mine geology, and have since proved to be highly representative of later detailed drawings. ~~based on subsequent mapping~~. Preliminary plans, prepared by the B.C. Department of Mines and C.E. Cleveland, have furnished much necessary geological detail, particularly of ~~those~~ workings that are now inaccessible. Much valuable information concerning the pattern of the lode, major cross-faults, and mineralization within now-inaccessible workings was gathered from Dr. A.M. Bateman's 80-scale composite mine plan.

Dr. E.B. Mayo's geological plan, with notes, provided the final details of No. 5 level structures. Mr. J. Lamb's 40-scale sketch sheets, with notes, of No's 6, 7, 9, 10, and "B-Vein" tunnels provided detailed geology of accessible sections of the mine. E.H. Nickel, and assistants D. Yorge and M. Kierans, supplied much of the 100-scale geological and topographic surface detail. The use of all of these ~~assistance~~ materials is gratefully acknowledged. Necessary survey control was established on the surface and underground by S. M. Gulley and B. T. Stephens, respectively. Much use was had of earlier topographic surveys done by S. Cramer.

Finally, the writer wishes to express his thanks to Mr. P. Billingsley and Dr. E. B. Mayo for checking the 40-scale drawings that will accompany this report. To Mr. M. J. McGarry the writer is very grateful for checking and typing this report.

Summary of 1949 Program

At the beginning of the field season it was decided that the existing survey control, with the accompanying topographical and geological maps, should be used as fully as possible. This material resulted from surveys by the B.C. Department of Mines personnel, and those accomplished earlier by S. Cramer for the Kelowna Exploration Company. ~~However~~, It was necessary that these surveys be coördinated with the Kelowna control in other parts of the area. To accomplish this, it was decided that a broad triangulation survey, which could be broken down where additional control was needed, would be most adaptable.

Preliminary work, directed towards the location of the primary stations of the triangulation net, was started by S. M. Gulley early in June. The completion of the net, with all necessary minor survey points throughout the Queen Bess-Idaho-Silver Ridge area, required the remainder of the summer.

One hundred-scale surface geological mapping was started within the Silverite-Palmita area. Detailed mapping over and about the old Palmita workings; presumably driven on the north-easterly extension of the Queen Bess lode, was completed by the third week of June. The geologists then ran their traverses into the Queen Bess area, and continued mapping in this, the Idaho, the Alamo, and Corinth areas for as long as favourable field weather permitted. In addition, No. 10 level of the Queen Bess was mapped in plan and section, on 100-scale, to assist in interpretation of the bedding structures of Queen Bess Ridge.

Late in September Mr. P. Billingsley and Dr. E. B. Mayo reviewed the field mapping accomplished. Concentrating on the Queen Bess Mine area, they recommended, (1.) the re-opening of the so-called "B-tunnel", (2.) diamond drilling from this tunnel and No. 10 level to test the westerly segment of the Queen Bess lode and (3.) the detailed geological mapping of all accessible workings in the Queen Bess mine. The diamond-drill program was carried on between October 15 and November 15. Poor weather and obstacles to drilling prevented the completion of all drilling planned. The 40-scale mapping of all accessible workings, including No's. 6, 7, 9, and

10 Levels, with the main connecting raise, plus "B-Vein" tunnel was done by J. Lamb during the first half of October.

The compilation of all geological information gained during the season has been continued by the writer, ~~when~~ work on other projects has permitted. It is hoped that this report will provide a satisfactory description of the geology of the mine area. For the history of the development and production of the mine, the reader is referred to G.S.C. Mem. 184 by C.E. Cairnes.

Accompanying Maps.

(1) Composite Plan of Surface and Underground Geology; scale 1 in. = 40 ft. The plan of the mine workings was derived from a 50-scale composite supplied by the B.C. Dept. of Mines, Victoria. Detail of the "Road Tunnel" was taken from C.E. Cleveland's 40-scale "Road Tunnel Assay Plan" of November, 1948. All geology plotted on No's. 1 to 4 levels, inclusive, was taken from A.M. Bateman's 80-scale "Geological map of the Queen Bess Mine", of 1920.

~~The coördinates shown on this map are those of Kelowna Exploration surveys. The bearing of all longitudinal section lines is N.E.; that of the cross-sectional lines is N.W.~~

(2) The forty-scale Longitudinal Vertical Projections of Footwall and Hanging Wall Geology were based on an old 50-scale vertical projection

of the mine workings and the composite plan of this report.

(3.) Of the four 40-scale cross-sections enclosed; No's 3 and 6½ were drawn through the main stoped sections of the lode; No. 5 was drawn through the intervening barren section; No. 11 is a corrilation of the geology of the new diamond drill holes and that of the mine workings.

General Geology of the Mine area.

General Lode Structure

The Queen Bess lode zone traverses the mine area on a general northeasterly strike, with steep to flat dips according to the competence of its wall rocks. Steeply-dipping sections are associated with harder, more thickly-bedded sections of argillite and quartzite. Three parallel lode strands have, in the past, been designated as the "A-," "B-," and "C-" veins. The "A-vein" has proved to be the largest and most productive structure; the "B-" and "C-" Veins are smaller, have produced little ore, and were explored by only a few hundred feet of underground workings. No recognizable extension of either the "B-" or "C-" vein has been found in the most fully-developed part of the mine, where a long cross cut was driven north from No. 5 Drift. Probably the northeasterly extension of the "C-" vein lies still beyond the crosscut. The so-called "B-" vein may represent the southwesterly extension of the main lode, or perhaps a footwall strand of the lode, - developed only in the most westerly section of the mine workings.

To the northeast, the main lode is interrupted by the North Fault, a strong northeasterly-dipping fault zone. Beyond the North Fault, the lode probably passes through the Palmita claim as a number of weaker parallel shears, rather than as a single strong structure. In this area the rather complex pattern of exploratory workings and the incompetent nature of the soft, flatly-bedded argillites support this inference.

Through the mine workings, in a southwesterly direction, the main lode has been traced to the westerly part of No. 5 Level, where it shows repeated large and small offsets to the north across a wide zone of strong, westerly-dipping bedding faults. The downward projection of members of this zone were mapped by A.M. Bateman and Kelowna geologists on No's 5, 7, and 10 Levels. ~~No. 5 ... Level~~. On No. 10 Level this system of steep faults has been mapped between points 550 and 950 feet from the portal. Apparently the main lode, on No. 10 level, crosses from the south to the north side of the tunnel close to the northeasterly edge of this zone on No. 10 Level.

Southwest of the cross-faults, the southwesterly extension of the lode was intersected by a drill hole aimed northwest from the portal section of No. 10 Level.

Farther to the southwest, the lode, with probable offsets on northwesterly faults, may be correlated with the strong, mineralized shear mapped in the Road Tunnel. Southwest of the Road Tunnel there are no direct surface expressions of the lode structure where it traverses the broad expanse of Howson Creek Basin. However, a southwesterly projection of the lode from the Road Tunnel, on a strike of approximately south 60 degrees west, shows a reasonable coincidence with a wide fracture-zone traversing Idaho Ridge. This zone, in turn lines up rather well with northeasterly projections of strands of the Idaho Lode. The Idaho Lode is a major structure rather similar in size and behaviour to the Queen Bess Lode; therefore, on the basis of projections, and similarity in character, the Queen Bess and Idaho Lodes are probably parts of the same northeasterly striking shear zone.

The course of the lode through the mine workings, following it to the northeast, bends to a more northerly bearing where it traverses a central section of flat, westerly-dipping, thin-bedded argillites between the Outer and Inner ore bodies. This swing in strike is accompanied by a flattening of the dips. Mineralization is almost negligible in this section. For over

300 feet west of its intersection with the North Fault, the lode, between No. 6 and No. 9 levels, is offset to the right by a number of westerly-dipping bedding faults. Coincident with these repeated offsets in the lower levels is a marked flattening of the dip of the lode, and mineralization becomes poorer with depth. In both the Outer and Inner ore zones mineralization definitely favours the upper, steeper sections of the lode. ~~structure~~.

The main lode ~~structure~~ is a zone of intense shearing and brecciation from a few feet to, locally, over 40 feet wide. Where the lode cuts firm, thickly-bedded argillites and quartzites, relatively larger proportions of brecciated wall rock form the lode-filling between well-defined walls. Where it cuts thinly-bedded, softer, more plastic sections of sediments, the filling is generally one of closely sheared "graphitic" material with variable amounts of relatively impermeable gouge. A flattening of the dip is almost general in these latter sections; the lode structure spreads out to form a wider, less well-defined zone of sinuous parallel shear-strands in which ore and gangue minerals form only as occasional narrow veins and pockets of restricted length and depth.

Galena and sphalerite, as cleanly-banded or mixed, brecciated vein fillings, are the chief ore minerals. Quartz, and minor calcite, siderite, and pyrite, are the predominant gangue minerals. Vein-fillings of rusty gouge and gossan show that post-ore oxidation of the mixed sulfides has been effective down to the lowest levels of the mine.

Major Bedding Structures

(a) North of lode; in footwall. A lack of information of the geology of the upper levels, and the scarcity of outcrops over the mine workings allows only an approximate interpretation of the footwall bedding structure through the productive section.

On the surface, to the northeast of the inner ends of No's. 7 and 9 Levels, is a thick section of thinly-bedded argillites, dipping flatly to the southwest. These include one prominent band of quartzites which outcrop on the Palmita claim. The argillite section has been traced from the Silverite area and south-west to about the crest of Queen Bess Ridge. Cross-bedding, with "tops" west, shows this section to be generally right-side-up. Soft broken layers, occasional highly-fissile beds, and frequent small bedding-slips are common. Although there is no direct proof of their continuity, these argillites may be continuous with a similar westerly-dipping section within the east part of the mine. Here, they steepen, with rolling attitudes, through the lower levels. Underground, however, the section is markedly more quartzitic than any supposedly-continuous section of fold- & shear-softened bedding mapped in the Palmita area. Silicification, adjacent to the lode, may be responsible for the difference.

Down the westerly slope of the ridge, from the "C"-portal to the 4300 foot elevation on Hawson Creek the bedding strikes northwesterly and dips steeply northeasterly. Rock types include medium- to thickly-bedded quartzites, quartzitic argillites, and soft argillites. "Tops" are to the west; small drag folds, developed through interbed adjustments to folding, are overturned to the northeast, and with axes plunging northwesterly at 5 to 15 degrees. Below the 4300-foot elevation, on Hawson Creek, ~~the~~ easterly-dipping quartzites gradually bend through vertical- to steep westerly dips, with little change of strike (from A.E. Butler's notes, Mr. Billingsley drew the Queen Bess axial plane through this point some three or four years ago). Within the easterly-dipping beds on the west slope of Queen Bess Ridge are a few small porphyry "sills". Within the quartzitic beds between Hawson Creek and the road, cherty-striped and pale massive beds indicate rather extensive silicification of the bedding.

From the "C"-portal to approximately 300 feet below the crest of the ridge is a steep westerly-dipping section of quartzites and argillites. A major reversal of dip was noted near the "portal of the" C-tunnel, where, at 150 feet in from the portal, northeasterly-dipping argillites are succeeded by a section of argillites and quartzites with moderate- to steep southwesterly dips as far as the face of the tunnel. A 200-scale footwall projection shows the latter section to be continuous with southwesterly-dipping beds which form the greater part of the footwall section within the mine workings. This projection also locates the axis of reversal to northeasterly dips near No. 2 Level, above the Outer orebody.

A generalized cross-section from the Silverite area, through Queen Bess Ridge to Hawson Creek, presents a broad recumbent bedding-fold, concave to the southwest, with the axial plane dipping gently southwest ~~to~~ through the ridge top, then more steeply southwest a short distance below the west slope, ~~then~~ emerging a little above the "B-" portal. Further to the southwest its continuation to a position somewhat below the "Road Tunnel is suggested by the presence of steep northeasterly-dipping beds in this area. An explanation of the much lower position of the axial plane in Hawson Creek may be based on the northwesterly plunge of minor fold axes within beds north of the lode. Assuming parallelism of minor and major fold axes, the indicated plunge of about 15 degrees northwest, could, in the horizontal distance of 2000 feet to the reversal in Howson Creek, drop the major axis 500 feet vertically. This corresponds closely with the difference in elevation between the reversal on Howson Creek and the Road Tunnel. In effect there may be a downwarp of the Queen Bess axial plane to the north - a departure from its usual southwesterly dip, and which is borne out by reconnaissance mapping in this area.

Locally, the curvature of beds close to the axial region of the overturned fold appears slighter than is usual, judging by the slow dip reversals on Howson Creek and, probably, in the west portals area. The "open" structure reflects the competent nature of the local assemblage of thick quartzites and argillites. Field observations ~~do~~ show a more complexly-folded structure farther to the southwest of the mine area. However the beds involved are typically incompetent thinly-bedded argillites.

dipping beds are uninterrupted by reverse-dip structures for several hundreds of feet. Sufficient evidence of "tops" from minor structures was present to map this as the Queen Bess axial zone with some certainty.

On the crest of Queen Bess Ridge, to the southwest of, and 350 feet above the reversal interbedded thick quartzites and thin sandy argillites dip approximately 50 degrees northeast. Between the ridge top and the reversal at the Forestry road dips decrease, locally to flat, wavy up-side-down attitudes, on approaching the axial plane.

Quartzites and argillites forming the south bluff area on the west slope of the ridge dip northeasterly with frequent local contortions. Drag folds are consistently overturned to the northeast, indicating that this section of beds is above the Queen Bess axial plane. The theoretical relationship between the symmetry of minor bedding drag-folds and their position with respect to major fold axes was outlined by Dr. E. B. Mayo in his report "Structural Principles and Carnation Surface and Underground Geology", 1949. The following figures and text interpret the minor fold structures mapped in the south bluff area by E. H. Nickel; sections are 'looking northwest':

3" space

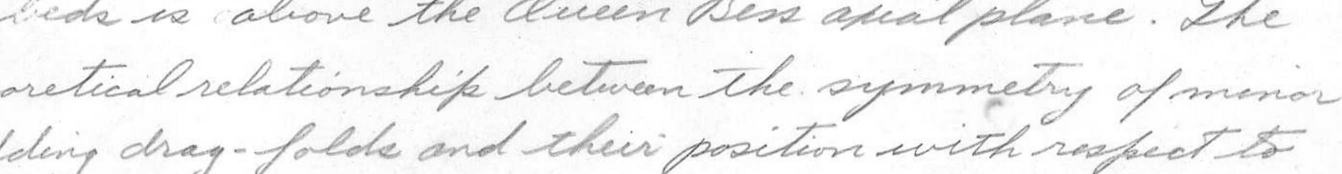

Fig 1(a) Fig. 1(b) Fig. 1(c) Fig. 1(d) Fig. 1(e) Fig. 1(f).

Reference to a 200-scale cross-section of the hanging wall structure through Queen Bess Ridge shows that this section of beds lies within 200 feet over the Queen Bess axial plane, locally. Fig. 1(a) represents the nature of interbed motion with respect to major fold axes. Figs 1(b) and 1(c) are actual structures observed at the south bluff — fig. 1(b) being a normal "east-dip panel" drag fold, and 1(c) the probable result of through-going displacement on a bedding fault, to produce the discordant contact of beds across the fault. Figs 1(d) and 1(e) pictured together illustrate the possible development of the structure. In addition, the single occurrence of anomolous drag folds; ie, overturned eastward in locally west-dipping beds is graphically explained in 1(f), showing the persistence of the local interbed movement throughout a local complication within the easterly-dipping section of beds.

Bedding ~~attitudes~~ within 2500 feet of the south bluff maintains consistent northwesterly strikes and uniformly steep northeasterly dips. Truncated cross-bedding shows that bedding "tops" face westward. Briefly, to the west of the mine area, bedding is that of the east-dip panel above the Queen Bess axial plane which, locally, appears to dip more steeply to the ~~west~~, much the same as in the footwall section. Between No. 5 portal and the Road Tunnel the apparent dip on section is about 25 degrees southwest.

Excepting a restricted section of soft, thinly-bedded argillites between the Outer and Inner orebody, the broad section of hanging-wall beds, as seen through most of No. 10 level and about one-half mile southwest of No. 10 portal, is made up of relatively competent beds. These include medium to thickly-bedded argillites, quartzites, and variably-silicified argillites and limestones. In particular, a belt of distinctive thinly-bedded pale cherty "quartzites" and silicified limestones extends northwest and southeast of the Road Tunnel. The localization of this zone of alteration suggests the presence of a "feeder" within the lode structures near the Road Tunnel. Such a structure could have formed between hard quartzites and soft argillites, the contact of which should be only a short distance to the west. The intrusion of the porphyry sill at the Road Tunnel may have been related to such a feature. The intensity of silicification is well shown within a band of altered limestone mapped on the upper and lower sections of the Alamo road, only 500 feet south of the Road Tunnel. Fig. 2 shows the intensity of silicification within these limestones.

3"-space

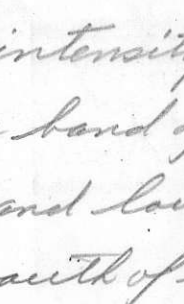

Fig. 2

Apparently, interbed motion has crackled a section of rather sandy gray limestones. Subsequent alteration, presumably by siliceous fluids following this broken zone produced pale cherty layers and left pieces of broken limestone as partly-altered residuals in the cherty matrix. Where silicification of limestone fragments was almost complete, only their darker hazy appearance distinguishes them from the matrix. Sections of similarly-altered beds have been mapped frequently in the field. Thick sections of beds showing a rather similar type of alteration were seen south of the Queen Bess lode about one-half mile southwest of the Road Tunnel. A similarly-altered belt of argillites was noted at the southeasterly contact of the Idaho stock, where a number of porphyry sills have penetrated the bedding north of the lode

DETAILED UNDERGROUND GEOLOGY

From experience gained from previous studies of the district, the following patterns and associations were expected: That relative hanging-wall motion along lode strands would be down and to the east; normal displacements would be general on cross-faults paralleling the bedding and related to inter-bed adjustments to folding; ore shoots would be localized near counter-clockwise bends in the lode at fault-lode intersections, or where the lode crosses formations of differing competence; mineralization would be stronger where the lode intersects competent wall rocks.

The broader association of orebodies with sections of west-dipping quartzitic beds, close to the axial planes of overturns (recumbent folds) was noted several years earlier by Mr. Billingsley and Dr. Mayo, based largely on Dr. Mayo's mapping in the Payne and Queen Bess areas. The general direction of relative hanging-wall movement was deduced early by Mr. Billingsley, and confirmed by Dr. Mayo in study of the 150' Lateral and West Silversmith area. The following text and accompanying maps describe the Queen Bess underground geology.

broader association of orebodies with sections of quartzitic, west-dipping beds close to the axial planes of overturns (recumbent folds) was noted several years earlier by Mr. Billingsley and Dr. Mayo, from a study based largely on geological mapping by the latter on the Payne and Queen Bess properties. Before the detailed study of the West Silversmith lode had been made, Mr. Billingsley had correctly deduced the general direction of relative hangingwall motion in the district lodes. The following text describes the detailed geology of the mine. The composite plans, longitudinal projections and cross-sections show most of the geological features that will be discussed.

No's. 1- to 4 Levels

Only the general pattern of the main lode, the more important cross-faults, and mineralization may be described. East of the portal area the lode trends easterly for about 250 feet, as measured on No. 3 Level. Following it inward, it bends to follow a northeasterly course for nearly 400 feet, as measured on No. 4 Level. From No. 1 Level to a short distance above No. 3 Level (Sec. 6½), the lode dips rather flatly to the south and southeast. Below No. 3 Level, it steepens in dip and maintains a steeper dip to an elevation probably well below No. 5 Level.

Near the portals, a small ore-shoot was mined between No's 4 and -2 levels on a relatively flatly-dipping

(30)

section of the lode structure. Along the ~~adjacent~~ northeasterly-trending section of the lode, on a sinuous section preceding a more northerly swing to the eastward, discontinuous veining of the lode produced the Outer orebody. This has been described by Cairnes as "a composite ore shoot generally raking to the east," and ~~length~~ extending from 400- to 600 feet from No. 4 portal. He notes that the wallrocks are interbedded argillites and quartzites.

Cross-cutting the lode to the northeast of the Outer orebody is an apparently strong, northeasterly-dipping fault. A few feet before, and for approximately 300 feet beyond its intersection with this Outer fault, as noted from the 4-Level pattern, the lode bends to a still more northerly trend. Within this section, where it traverses ~~a section of~~ soft, thinly-bedded argillites, the lode flattens in dip and is relatively unmineralized.

Still farther to the northeast the lode bends briefly to the east, and then resumes its northeasterly trend on a markedly irregular course. To the northeast, this productive section of the lode terminates against the North fault. This fault zone, probably up to 100 feet wide on No. 1 Level, strikes northwesterly ~~& dips northeasterly~~ with the bedding, and has developed in response to intense inter-bed adjustments in this section of, probably, east-dipping bedding. A.M. Bateman's map shows it to be a normal fault.

Although there is no detailed evidence of lode motion the sinuous trend of the structure; its apparent curvature and continuity at intersections with cross-faults, and the position of the Outer orebody with respect to a counter-clockwise bend of the lode, are all very suggestive of a predominantly easterly movement of the hanging wall ~~of the lode~~. Also, the small Portal orebody appears to have been emplaced close to a counter-clockwise bend where it emerges from a probable intersection with the No. 7 fault in the portal area.

No. 5 Level

The outer part of the level, to a point 50 feet southwest of Sec. 8, cross-cuts a zone of strong southwesterly-dipping faults lying in a section of blocky, quartzitic argillites. On what is probably the large No. 7 fault, the lode swings to the southeast, emerges on an easterly course, and undergoes further step-like southerly displacements on the No. 5-West and -East faults and intervening strands.

The contorted bedding structures west of No. 5-East fault suggest compression and consequent crumpling above a part of a fault-lode intersection where the easterly travel of the hanging wall has been crowded, locally, to the southeast, forming a typically "tight" "clockwise" corner."

Northeast of No. 5-East fault it follows an irregularly-curved course to the northeast between Secs. 6 and 8. Midway, crosses at least two southwesterly-dipping faults, undergoing small right-hand offsets on each, before continuing on an uninterrupted northeasterly course through the zone of the Inner orebody. As on the above levels, the lode is interrupted by the North fault.

No. 7 Level

Within the westerly 170 feet of drift, the lode follows a regularly-sinuous course through a section of flatly-rolling, southwesterly-dipping argillites. The lode structure is one of flatly-rolling braided shear strands, layered with gouge, but carrying no visible ore minerals. The average dip would be about 30 degrees southeast. The apparent folding of the lode, on gently-plunging axes, suggests a relative eastward movement of the hanging wall. However, a small steep footwall strand, traversing the cross-cut north of the west end, exhibits both shear cleavage for normal displacement and striae, in a_2. Evidently, easterly hanging-wall movement was followed by normal faulting — a common sequence of movements on Slocan lodes.

Northeast of this section, the drift, ~~with its gently dipping lode strands,~~ enters a steeper section of the lode, which may be traced through a stub drift northeast of sec. 3½. Near the latter point, "wrinkles" plunging at 32 degrees SSE, form the only direct evidence of the easterly hanging wall movement. The lode structure within this a bowed hanging wall strand, with a corresponding fold structure in the adjacent hanging wall beds, suggests the presence of a strong crumple plunging across the probable direction of hanging wall motion. This section of the lode lies between walls of blocky, quartzites, to thin-slaty argillite. ~~Between Secs. 6½ and 7, soft argillites turn westerly on the hanging wall of the lode~~. West of the clockwise bend in the lode at Sec. 6, and between walls of blocky argillite and quartzite (40-scale Vert. Projections) the lode was mineralized, forming what was the lower part of the Outer orebody. On the levels above, the wavy pattern of the lode suggests buckling of the structure ahead of the "corner."

At Sec. 6 the lode bends to a northerly, and then northeasterly strike which it holds to Sec. 5½. Within this section, where wall rocks are soft, thinly-bedded argillites, the lode has a flat, southeasterly dip which it keeps throughout all the levels in this section of the mine. This section of the lode, also, appears consistently barren throughout all levels. Hanging wall beds turn abruptly westward at the lode, confirming the inferred eastward movement of the hanging wall.

Between Secs. 4 and 5, where the lode enters a section of argillites and quartzites, it bends sharply to follow an easterly, then a northeasterly course to its intersection with the large North fault. Although there is no direct evidence of the direction of hanging wall motions, the irregular pattern of the lode, on this and higher and lower levels, suggests strong buckling on steeply-plunging axes, as might be produced by easterly movement of the hanging wall. Between Secs. 3 and $4\frac{1}{2}$ the lode has a relatively steep dip of about 50 degrees southeast. Within this steep, arcuate section mineralization was intense. From about 50 feet above No. 4 Level, and under the North Fault, the large Inner orebody extended as a thick ore zone to No. 6 Level. Below No. 6, and through No. 7 and lower levels, it fingered down to small ore shoots.

The long footwall crosscut, driven northwesterly from the Inner orebody, never reached its probable target - the supposed northeasterly continuation of the "C"-vein. Throughout its length the crosscut parallels the strike of bedding within a footwall section of westerly-dipping argillites and quartzites, and in which there appears to be frequent pronounced bedding faults.

No. 6 Level

Between Secs. $6\frac{1}{2}$ and 5, the lode has a curving northeasterly strike, and warps in dip, from about 45 degrees southeast at Sec. $6\frac{1}{2}$, to about 30 degrees southeast at Sec. 5. At the latter place it reflects the general flat dip of the barren section between orebodies, and traverses a similar section of flatly west-dipping soft argillites.

In this section, the width of the lode varies from about two to ten feet, and it is composed of rather barren rusty gouge and sheared wall rock. Near sec. 6, a minor fold axis, plunges 37 degrees southeast, and is overturned to the northeast. This b_2-lineation, with clockwise rotation, indicates easterly movement of the hanging wall. Near the west end of the level a minor fold axis, plunging 42 degrees southeast and showing rotation opposed to the hanging wall motion, is possibly related to movements on the nearby fault strand that dips 52 degrees southwest. Striae here, in a_1, appear more closely related to the expected inter-bed motion within the wall rocks rather than to hanging wall motion. ~~Grooves on the hanging wall of the 52-degree fault appear to be in a_1, thus supporting the above inference.~~ ¶ Mineralization in the west end of the level, where sections of the lode apparently have been stoped, indicate that the Outer orebody ~~probably~~ extended through, and rooted below No. 6. It also appears that the 52-degree fault restricted the eastward spread of mineralization in this section of the mine.

A few feet northeast of sec. 5 the lode bends sharply to an easterly trend for about 50 feet, reflecting the same corner in levels above, then resumes an interrupted northeasterly course through a zone of close bedding faults. Repeated southerly offsets on cross faults mark its course through this zone. Striae in a_1 confirm the normal motion on these bedding faults.

Beyond this section, and to the east of sec. 4, the lode section is a wide zone of strong shear strands and gouge. About midway along this section, near the footwall, minor drag-folds ~~are~~ plunging 19 degrees east and overturned to the south, are evidently in b_3. Almost directly south, on the hanging-wall, steep hanging-wall striae lie in the a_3 direction. In addition, minor footwall fractures dip steeply westward below a northerly-striking section of the lode. ~~The resulting angle of intersection between~~. These appear to be footwall "gashes". All of these minor structure point to the existence of a late component of normal faulting on the lode. This more steeply-dipping section of the lode is sparsely mineralized and is probably a downward extension of the lode structure containing the Inner orebody.

Quartzites, quartzitic argillites, and minor layers of soft argillite form the footwall bedding structure throughout this section.

At section 3½, a crosscut driven southeasterly on a narrow zone of bedding faults, was turned to the northeast, at 90 feet from the stub drift, to intersect a lode strand dipping thirty degrees southeast. This strand, carrying quartz and a minor amount of ore minerals, is presumably the flat downward extension of the Inner orebody lode structure. It is restricted in strike-length by strong southwesterly-dipping bedding faults. On the footwall of the bedding fault that connects this and the section to the west, drag folds, plunging southwesterly and overturned to the southeast, show a continuation of the easterly hanging wall movement from lode strand - to fault - to lode strand. It appears that this linking of the fault and westerly lode segment is by way of a clockwise hanging wall split from the latter, with a northeasterly continuation of the footwall section of the lode. The cross-fault probably joins the easterly segment through a counter-clockwise swing of footwall fault strands.

At 40 feet northeast of sec. 3, easterly-plunging drag folds, close to the hanging wall of the lode, are oriented as b_2-lineations, with clockwise rotation. These indicate an almost pure strike-slip displacement of the hanging wall to the northeast. Within this section minor southwesterly-dipping faults cross the lode without effecting noticeable displacements.

Beyond this section, to the northeast, the lode intersects a zone of strong bedding faults, where the identity of hanging wall and footwall strands is obscure. The fault zone may be the downward extension of the North fault, assuming that this structure, dipping northeasterly on the upper levels, reverses dip and frays out into smaller southwesterly-dipping strands near the contact of hard quartzitic and soft argillaceous beds. Through this section the lode should be strongly displaced to the southeast. ~~If this is the case, the wide, braided southeasterly-dipping shear within~~

northeast of this fault zone; the wide, braided, barren shear probably represents the faulted northeasterly extension of the lode into Palmita ground.

No. 9 Level

Northeast of the main Raise, to sec 3½, the trend of the lode on this level coincides with its trend on No. 7 Level. However, the 9-Level structure shows a markedly steeper dip. Evidently the stronger part of the lode steepens with depth below No. 7 Level; minor flatly-dipping hanging wall strands may be correlated with weak hanging wall shears on No's. 8 and 9 levels. Down-dip, the major steeply-dipping strand probably lies at, or just beyond, the east end of No. 10 Level.

On No. 9 Level, in the crosscut south of the raise, and in the crosscut near sec. 4, cleavage and drag-folding on lode strands again indicate late normal displacements following the stronger easterly hanging wall movement.

At sec. 3½, footwall strands of the lode turn sharply eastward but are cut off shortly by a hanging wall strand ~~of the lode~~. Farther eastward, the cross-cut intersects steep, mineralized lode strands. Still farther to the northeast, a strong erratic section of the lode continues to an intersection with a strong southwesterly-dipping fault. Small amounts of mixed galena and sphalerite were mined in this section. Cross-Sec. No. 3 shows a correlation of the flat section of lode below the Inner orebody with this section of the lode on No. 9 Level. Southwest of sec. 3, southwesterly plunging drag-folds on the hanging wall of the lode are overturned down-dip. These indicate the usual late component of normal displacement, or a downward deflection of local eastward hanging wall motion by an opposing southwesterly movement that may have originated from the cross-fault at the east end of the level. Minor drag-folds on this southwesterly-dipping cross-fault lie in the b_1 direction with counter-clockwise rotation, showing a marked normal displacement on what is probably a large bedding fault.

Throughout No. 9 Level, bedding in both the footwall and hanging wall of the lode is, with the exception of relatively thin sections of argillite, composed of gray quartzites and interbedded quartzites and argillites. The large southerly displacement of the easterly segment of the lode, as seen on No. 9 Level, must be caused by the lower westerly-dipping strands of the North fault, much as on No. 7 Level.

At the west end of the level the lode is apparently displaced to the south on a 70-degree, northeasterly-dipping normal fault, thereby carrying the downward projection of the westerly segment to a position south of No. 10 Level.

It is interesting to note the close correlation of the upward projection of the mineralized cross-fault at the east end of No. 9 Level and the southwesterly-dipping cross-fault above the old Palmita workings.

No. 7 Level - West

The only structure of real importance, judging by available information, is the 70-degree southwesterly-dipping fault shown at the second bend of the tunnel. It appears that the lode, on its southwesterly course, has been widely offset to the northwest on this fault which has been tentatively correlated on No's 5, -7, and -10 levels.

No. 10 Level

Within the inner 260 feet, a continuous section of rather thinly-bedded argillite dips southwesterly with rolling attitudes. ~~M~~ a few quartzitic beds are present. Locally, ~~bedding~~ drag-folds overturned to the southwest show that these beds belong to the major westerly-dipping section of the structure. To the west this section is interrupted by a steep easterly-dipping normal fault. From here to a point 950 feet from the portal, thickly-bedded argillites with minor quartzite layers show wavy, essentially-vertical dips. A few drag-folds overturned to the southwest were noted.

Between 850- and 950 feet from the portal is a zone of strong normal bedding faults, porphyry sills, and silicified bedding within which two strong fractures, showing normal displacements, angle acutely across the tunnel from east to west. These were assumed to be parallel strands of the lode, crossing from the south- to the north side of No. 10 Level at this fractured section. It seems probable that the westerly continuations of these strands are offset consecutively to the north along the large No. 5- and No. 7 Faults, crossing the level 120- and 300 feet west of this section. ~~From the point where the lode crosses the level, bedding to the northeast lies in the footwall of the lode and that to the southwest lies in the hanging wall.~~

From the lode to the portal, thick- and thin-bedded argillites dip steeply to the northeast and southwest. Frequent northeasterly- and southwesterly-dipping faults disrupt the continuity of bedding structures. A distinctive section of quartzitic (silicified?) argillities lies between 250- and 450 feet from the portal. Between 450- and 570 feet numerous ~~small~~ carbonate-filled joints may approximately parallel the lode to the north.

B-Vein Tunnel

This working, lying in the footwall of the Queen Bess lode, is occupied mainly by a thick section of steeply-dipping quartzites and steep porphyry "sills". These are bounded to the northeast, at 60 feet from the face, by an indefinite thickness of steeply-dipping argillites.

The 10-level contour of the Queen Bess lode, tentatively established through an intersection made in drill hole Q.B.-1, lies midway of No. 10 Level and the inner end of the B-vein tunnel. Locally, the attitude of the lode has not been determined, but it is probably essentially continuous with the lode in the Road Tunnel.

Westerly Segment of Lode

West of the No. 7 fault, ~~the~~ intersections made in drill-hole Q.B.-1 and -2 of the information contained in C.E. Cleveland's plan of the Road Tunnel, and possibly surface observations on the the so-called "B"-vein, provide all that is known about this section of the structure. A slight amount of exploratory work, however, should provide some definite information concerning the attitude and character of this segment of the lode.

Cross-Section No. 11 was drawn mainly from drill-hole data. An inferred lode dip is shown. Actually the dip may be much less, or it may flatten considerably above the end of drill-hole Q.B.-2 to match the portal section of the segment east of No. 7 Fault. However, the westerly segment, as shown in Q.B.-1 and the Road Tunnel, is a strong structure with ~~a~~ appreciable amounts of ore minerals at widely-separated sections of the lode. ~~A width of about 35 feet, between apparent footwall and hanging wall shears, is suggested.~~ A width of up to 10 feet of mineralized, brecciated, and sheared wall rock is suggested. If the mud seams intersected in Q.B.-1 represent the local footwall and hanging wall, the width may approach 35 feet north of No. 10 Level.

Between No. 7 fault and the Road Tunnel, thickly-bedded quartzites, thick argillites, and thinly-bedded argillite form a steep easterly-dipping section of hanging wall bedding. As has been described earlier, the Queen Bess axial plane apparently dips westerly from No. 5 portal through, or close to, the Road Tunnel (H.W. Project.), and this section of beds apparently lies closely below the plane.

Less is known about the footwall bedding. However, thick quartzitic sections within the "B"- and Road Tunnels, suggest additional thick sections of hard, brittle beds. As the footwall bedding attitudes closely match those on the hanging wall, they probably occupy a similar section with respect to the axial plane.

For approximately one-half mile southwest of No. 10 portal, the lode should intersect a favourable ~~mixed~~ assemblage of competent and incompetent quartzitic and argillaceous beds. In addition, to the westerly end of this section, prominent sections of west-dipping beds suggest the presence of strong recumbent folds well above the inferred position of the Queen Bess axial plane in this area.

The possibility of minor incompetent sections of bedding within this larger competent section, suggests the possibility of ~~strong~~ bedding faults which may form favourable "corners" along the lode. These, together with a strong lode and folded, brittle wall rocks might provide favourable exploration possibilities to the southwest of the Road Tunnel.