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A REPORT ON

THE GEOLOGY OF THE MAIN SHANGHAI CLAIMS
IN MAYO MINING DISTRICT

FOR

SILVER TITAN MINES LTD.

BY

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Mayo, Y.T.
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INTRODUCTION

This report attempts to interpret the geologic setting of the Shanghai silver-lead showings on Chambers Hill. A geologic map of the area is presented and a description to accompany it is included.

A geologic history is deduced from the description.

The writer spent one week (May 15 - May 22, 1963) on the property and was very ably assisted by John Brock.

Mapping was done on a 1:50,000 scale base map of the Department of Mines and Technical Surveys, enlarged to a scale of 500' = 1". Aerial photographs (approximate scale 3,000' = 1") were used as a mapping guide.

GENERAL CONDITIONS

A report on the main showings by Dr. A.E. Aho gives concise information concerning topography, timber, water, power, climate, costs and history, therefore these matters will not be dealt with in this report.

LOCATION AND ACCESS

The Shanghai mineral claims are situated about 30 miles NNW of Mayo, Y.T., north of the McQuesten River on Chambers Hill.

The property can be reached by several routes all of which involve a walk across the McQuesten Valley flats and crossing the river. An old trail follows the flats at the base of Chambers Hill.

LITHOLOGY

Chambers Hill is underlain by a folded succession of quartzites and schists of the Yukon Group. Sill-like lenses of sheared greenstone are locally plentiful in this succession. Post tectonic sills of biotite porphyry and biotite lamprophyre are present but scarce. The terminology for lithologic units is modelled after that used by A.E. Aho. The term middle quartzite has been rejected. No true stratigraphic column can be established and a description of rock types that make up the structural succession are therefore resorted to.

METAMORPHOSED SEDIMENTARY ROCKS

A. Upper Schist

This unit is made up largely of greenish and greyish quartz mica-schists. Thin limestone lenses are locally present.

1. Quartz chlorite schist.

This rock is generally light green in colour, it is made up of quartz and micas in varying proportions. The micaceous mineral is thought to be chlorite from hand specimen examination. The rock is well foliated and lineated. Quartz lenses (perhaps boudins) parallel to the foliation are locally plentiful. Grain size is such that individual mica flakes are distinguishable in hand specimens.

2. Light grey quartz mica-schist.

This rock differs from the one described above only in colour and grain size. In general these rocks are on the borderline between schists and phyllites since they are finer grained than the quartz chlorite schists. The grey colour may be due to a difference in the character or proportion of the micaceous minerals.

3. Limestone.

Grey, argillic, fine grained, thin bedded limestone is present in lenses in the upper schist. The rock is cut locally by irregular veinlets of coarse grained, flesh coloured calcite. This limestone is not phosphatic.

B. Upper Quartzite

The upper quartzite consists of massive grey quartzite locally tending to a micaceous quartzite. A few lenses of grey quartz mica-schist, described above, occur. These three rock types are more or less gradational into one another.

1. Grey massive quartzite.

This rock is fined grained and only very slightly micaceous. It has a blue grey to medium light grey colour and is well jointed. Bedding foliation is poorly defined. Irregular veinlets of white to brownish quartz cut the rock at nearly every outcrop. Quartz filled tension gashes are common.

2. Grey thin bedded micaceous quartzite.

This rock contains a little mica which lends it a better foliation than the massive quartzite described above, but aside from this the two rocks are identical.

3. Limy quartzite.

Within the grey quartzites are thin, (1' or less) layers of calcareous quartzites. On fresh surfaces these quartzites look exactly like some of the massive non-calcareous quartzites. The rock weathers differentially, it always stands in lower relief in an outcrop of the surrounding, more massive, grey, non calcareous quartzites.

C. Middle Schist

The middle schist is similar to the lower schist. Light green and grey quartz mica schists (described above) constitute it. No limestone was noted.

D. Lower Schist

This unit is very similar to the Middle and Upper Schist. It is made up of the light green and grey quartz mica schists described above. No limestone was noted but this does not discount its presence since exposure is poor.

E. Lower Quartzite

This unit is very similar to the upper quartzite. Massive grey quartzite with minor micaceous quartzites and grey quartz mica-schists constitute it. No limey layers were noted.

F. McQuesten River Schist

This schist unit crops out at only a few places at the SE end of the map area. It is lithologically identical to the middle and lower schist units described previously.

INTRUSIVE ROCKS

A. Greenstone

Greenstone crops out only on the lower parts of Chambers Hill (see map). Two large bodies occur and there are several smaller lenses. All the greenstones are discontinuous and sill like in shape. The greenstone is somewhat variable in composition from one place to another, this is also true even in one outcrop. It is dioritic to gabbroic in composition and is nearly always sheared: the foliation conforms to that of the host rocks.

A detailed petrographic description of greenstone similar to that at the Shanghai is given by McTaggart (1960).

B. Lamprophyre

Sill like lenses of lamprophyre occur at several places on Chambers Hill. The rock is unsheared and generally altered and is made up of fine grained (1 mm.) grey ground mass of quartz, feldspar and mica. Grains of biotite about 5 mm. across are scattered throughout and make up less than 10% of the rock. Pyrite occurs in anhedral grains and makes up less than 2% of the rock.

C. Rhyolite Porphyry

Lenses of rhyolite porphyry crop out at a few places on the property. The rock is made up of an aphanitic grey groundmass studded with phenocrysts of clear quartz (5%), 3 mm. across and tabular flakes of brown biotite (10%) 5 mm. across.

RELATIVE AGES

The relative ages of the quartzites and schists are not known since no stratigraphic tops could be determined. Greenstone is later than the schists and quartzites since it intrudes them.

Lamprophyre and rhyolite porphyry are both younger than the schists, quartzites and greenstones. Their relative ages are not known and they may be contemporaneous.

BASIC STRUCTURAL PATTERN

Four distinct phases of deformation can be recognized in the field. These phases are referred to in this report by successive Roman numerals. The relative ages of these four phases were determined from field relations.

Phase I; the dominant phase of folding has produced isoclinal to sub-isoclinal recumbent folds, whose fold axes plunge to the west.

Phase II; is a folding phase which has produced sub-isoclinal folds on SW plunging axis.

Phase III; is the latest folding phase. It has produced open warps on NW plunging axes.

Phase IV; is a brittle phase which produced genetically related fractures and faults of two main types.

1. Northeast trending NW dipping vein faults.
2. Northwest trending, near vertical cross faults.

MINOR STRUCTURES

A study of minor structures is well worth while, since this leads to a clear understanding of major structures and the stresses that produced them.

Phase I

Minor structures of phase I are folds, lineations and joints. The folds have axes whose average plunge is 260/12. (See appendix IV). Their shape suggests a differential movement of south up and over north.

Diagrams of some typical phase I folds are included in the Appendix IV. The folds are cylindroidal, similar and isoclinal and have rounded hinges. Their axial planes dip to NNW at about 15°. Phase I folds are found in both quartzites and schist, but are commoner in the former; folds of Phase I are more common than those of any of the other phases.

Wrinkle lineations associated with Phase I are parallel to the 'b' axis of folding, the fold axes. The statistical average of Phase I lineations is at 268/18. (See appendix IV).

ac-Joints related to phase I are present. Their average orientation is 165/80E. (See appendix V).

Phase II

Minor structures of phase II are folds and lineations. The statistical average of fold axes and lineations (appendix IV) is 220/10. The folds are isoclinal or sub-isoclinal, their sense of movement is opposite to those of phase I (see appendix IV for diagrams of typical phase II folds). Axial planes dip to the northwest at shallow angles (15-20°). Phase II folds are cylindroidal and similar, hinges are rounded. The folds occur in both schists and quartzites.

Wrinkle lineations are parallel to the fold axis and therefore in the 'b' direction.

No joints appear to be related to phase II folding.

Phase III

Phase III folds are mild open warps whose axes have a wrinkle lineation parallel to them. The warps are seen nearly exclusively in the schists although some folding of this Phase is also evident in the quartzites.

The statistical average of phase III lineations and fold axes is at 342/18.

A diagram of typical phase III warps is to be found in Appendix IV. The sense of movement is W and up over E. The axial planes of this late phase of plastic deformation dip to the NE at steep angles and it seems likely that one of the joint concentrations (average orientation 147/75 E) is parallel to this axial plane. (See appendix V). The small concentration of joints at 62/64SE is probably an ac-joint related to phase III (see appendix V).

Foliation - The reader is referred to Appendix VI throughout the following discussion.

The foliation exhibited on Chambers Hill is uniform and dips to the NW at shallow angles. The foliation is parallel to bedding in all instances where the two can be distinguished in the field. Since the foliation has been acted upon by three phases of folding it is difficult to relate it directly to all three of these phases of folding.

A stereographic projection of poles to bedding foliation reveals one large concentration at 74/15NW and one weak concentration at 82/38S. These two concentrations correspond approximately to the limbs of Phase I folds and if a great circle is drawn through them its pole falls close to the average phase I fold axis.

The conclusion is that phase I was much stronger than any of the successive phases of deformation since it has survived two later stages of folding without having been affected much.

The tendency of the poles to spread laterally in the large concentration is probably due to phase III folding.

It appears therefore that phase II has had little or no effect on the foliation and that the effect of phase III has been only slight. It is therefore safe to consider the area as primarily an isoclinally folded succession of phase I age. Other data such as the relative proportions and quality of linear features and joints also supports this theory.

<u>Faulting - Phase IV</u>

Phase IV is a brittle phase of deformation. Only faults have been produced by it. An idea of the stress pattern that produced these faults can be gained by a study of the field relations.

In the map area are NW? dipping faults which trend about N 45 E and near vertical ? faults which trend N 30 W. There are also minor fractures whose orientation is approximately 75/75SE and which have slickensides indicating only dip slip movement. Quartz filled tension gashes are present in the massive quartzites. Their orientation is 70/70NW.

These four features are apparently related to one another. The following theory attempts to elucidate this relationship. (Appendix VII gives a stereographic representation of the argument).

1. Tension gashes dipping NNW indicate a tension axis perpendicular to this plane.

2. A compression axis must exist perpendicular to the long axis of the tension gash and the tension axis.

3. Fractures that are likely to develop in such a state of stress are along the long axis of the gash and make an angle between 30° and 45° with the maximum stress axis. Such features would strike about N 70 E and dip NW at angles between 25 and 40° and SE at angles between 65 and 80°. The movement such fractures are likely to have is normal. The most likely orientation for fractures is the NW dipping one, since there is already a plane of weakness in this direction, i.e. the foliation plane.

4. Additional fractures that are likely to develop in such a state of stress are fractures that contain both the maximum and the minimum stress directions. In the case under consideration their orientation would be 160/90.

A comparison of the results of this argument with the actual field case reveals that these features check reasonably closely and it therefore seems possible that the theory here proposed is in fact valid.

It is possible that the cross-faults are related to the phase I deformation since their orientation is the same as that of many joints related to this folding phase.

MAJOR STRUCTURES

The following is a brief description of the salient structural features of the geologic map that accompanies this report. (See appendix I).

The main structural feature is a phase I recumbent isoclinal fold outlined by the quartzites. This fold plunges gently westward and shows the same sense of movement as the minor folds of this phase do.

A reconstructed projected cross-section of this fold is included in appendix VIII. The section is projected onto a plane perpendicular to the average plunge of phase I folds. The rather striking similarity of a minor fold of phase I to this cross-section is shown in the inset diagram of appendix VIII.

The effect of faults has been removed to show the fold's cross-section before fracturing occurred.

Aside from the main fold several faults figure prominently on the map. Faults trending NW have apparent dextral offsets except for one which has sinistral movement indicated. The movement on these faults is thought to be largely dip slip. Two NE trending faults occur at the showings. Both appear to have had dextral movement on them. Again it seems likely that this was dip slip rather than strike slip movement. The dip of these faults is not known certainly but it seems likeliest that they dip northwestward, in which case reverse movement is indicated.

GEOLOGIC HISTORY

The geologic history of the area can be summarized as follows:

1. Deposition of sandstones and mudstones in late Pre-Cambrian or early Paleozoic time.

2. Intrusion of gabbro-diorite as sills at some later time but before folding of phase I.

3. Folding in the succession indicated previously; first strongly on gently westward plunging axes, then weakly on southwestward plunging axes and lastly, moderately weakly on northwestward plunging axes. Low grade greenschist facies metamorphism accompanied this folding.

4. Intrusion of biotite porphyry and lamprophyre possibly contemporaneously.

5. Faulting and ore deposition related to a late brittle stage of stress.

6. Glaciation and erosion during the Pleistocene.

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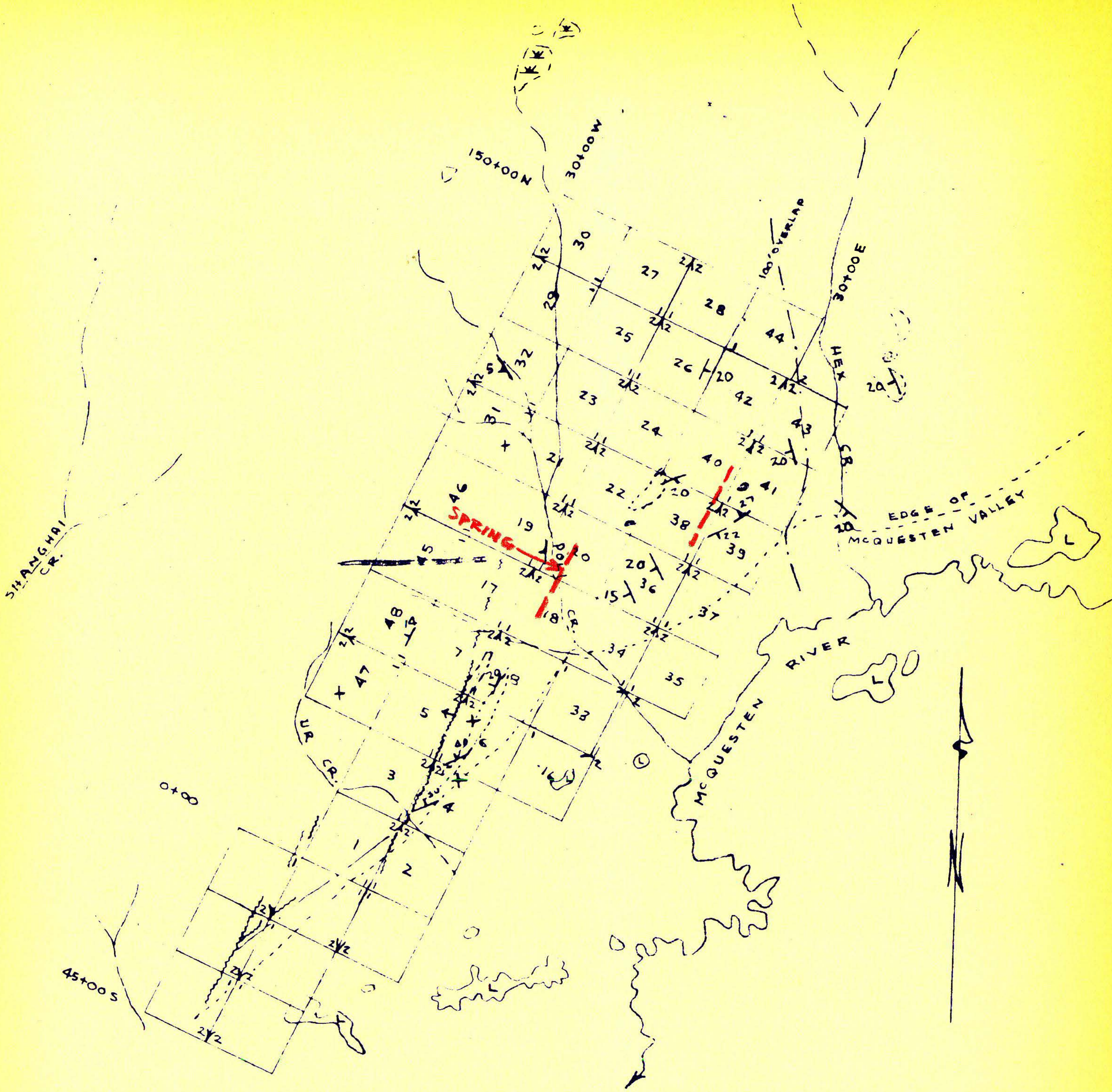

LEGEND

VEIN FAULT

20 DIP OF STRATA

CHAINED PICKET LINE

PORPHYRY

DIORITIC DIKE

GREENSTONE

UPPER SCHIST

CENTRAL QUARTZITE

LOWER SCHIST

PLAN OF
UR GROUP OF CLAIMS
MAYO MINING DISTRICT
YUKON

1 IN = 3000'

A.E. AHO MARCH 27, 1961

Figure 2