PRELIMINARY REPORT ON THE GEOLOGY OF THE TOP COPPER CLAIM GROUP

For

Bolivar Mining Corporation

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SUMMARY

A month has been spent in detailed structural mapping of the Top Copper Prospect, Atlin M.D., B.C., on scales of 1 inch to 200 feet and 1 inch to 500 feet. The geological development of the area can be summarized thus:

1. Deposition of the sequence argillites-sandstones-carbonates with incorporation of basic copper-bearing volcanics locally between the sandstones and carbonates.

2. Strong deformation of the sequence, polarity to the north, with simultaneous metamorphism to mid or upper greenschist facies, giving rise to recumbent isoclines with attenuated limbs. Axial directions are east-west with originally flat or shallow south-dipping axial planes.

3. A second deformation at high tectonic level (no metamorphism) with polarity toward the N.E. resulting in chevron folding of the first axial plane schistosity and bedding.

4. A broad arching about an E-W trending vertical? axial plane. The property constitutes the southern limb of an arch giving a southerly dip or plunge to all the above features. This arching was associated with NNE and NNW trending normal faults. Strike slip faulting along N-S faults probably postdates this arching.

5. Intrusion of basic, intermediate and acid dykes.

Copper sulphide mineralization has apparently been localized by metamorphism at the metabasite-marble contact, where the assemblage has locally been converted to a calc-silicate skarn assemblage by later intrusion of dykes. The initial deformation has probably resulted in concentration of sulphides in the noses of isoclinal folds.

Initial investigation has concentrated on the grid area 40-100E, 90-130N in which mineralization is most apparent. The following discussion will be of this area except where features elsewhere are relevant to its interpretation. The area, referred to as the "Main Ridge", is apparently the site of the nose of a synformal isocline, shows thick metabasic horizons and hence has potential as the site of economic concentrations of sulphides.

STRATIGRAPHY

The stratigraphic column and lithologic types established for the Main Ridge are as follows:

Oldest:

1. Garnet mica schist
   Garnetiferous gneiss
   Coarse amphibolitic gneiss
   Coarse biotite schist

2. Quartzite:

   2. Massive or weakly schistose quartzite (accessory actinolite, muscovite, chlorite, sulphides).

   2a. Muscovite quartzite with good schistosity.

   2b. Interbanded quartzite and mica schist.

3. Mica schist, often with biotite porphyroblasts.

4. Metabasic rocks, possibly hybridized with adjacent psammitic, pelitic or calcareous rocks, comprising:-

   4. Actinolite - chlorite phyllite and schist.

   4a. Actinolite gneiss
   Banded actinolite-chlorite gneiss
   (1/10"-1" scale banding, often (mobilized).
   Actinolite-biotite-chlorite quartzite.

   4b. Garnet ± diopside ± idocrase ± epidote ± calcite ± magnetite ± actinolite ± pyrrhotite skarn, epidote - actinolite rock. Pyrrhotite/magnetite (limonite) rich rock.

5. Mica schist, brown weathering (pyritic) micaceous quartzite, talc schist, actinolite mica schist.

6. Interbanded buff marble and silicates. Banding on a 5' to 1/10" scale. Close association with metabasic material. Actinolite bearing. Silicate bands are quartzose to micaceous, or calc-silicate.

7. Buff weathering marble, massive or with S_1 fracture cleavage. Occasional stringers and metabasic boudins.

8. Black, grey or white weathering tremolitic marble. Minor silicate stringers generally parallel to an S_1 fracture cleavage.

Intrusive:

9. Dolerite, lamprophyre?

10. Feldspar porphyry.

11. Quartz-feldspar porphyry.

The metamorphic grade of the rocks of the Main Ridge is thus mid or upper greenschist facies.

Copper mineralization is always associated with actinolite-bearing rocks and is often most apparent in skarn assemblages near dykes or close to faults. However, the lack of mineralization near dykes and faults away from metabasic horizons precludes their being the source of mineralization. Hence, the copper is thought to have been introduced with the basic rocks.

STRUCTURE

Nomenclature

S_o Bedding.

F_1 Axial direction of the first deformation - deep tectonic level, isoclinal folds. This direction is parallel to that of boudin rods in the attenuated limbs of the isoclines, and to biotite lineation in some of the mica schists.

S_1 Pervasive axial plane schistosity due to the first deformation and the metamorphism. Approximately parallel to the regional axial plane of F_1. Non-micaceous rocks have developed a fracture cleavage with less regular attitudes.

F_2 Axial direction of the second deformation - high level chevron folds. Represented on small scale by crenulations of the S_1 surface, and normal to slickensiding on S_1, due to interlaminer slip during folding.

S_2 Generally non-pervasive axial plane crenulation cleavage (strain-slip cleavage) due to the second deformation, parallel to axial planes of crenulations and approximately parallel to the axial plane of F_2 on a larger scale.

F_3 Axial direction of the third deformation - broad high level arching, given by crenulations on S_1 and S_2 and by statistical analysis of the variation in attitude of S_2.

Object of Structural Study

If copper has been introduced prior to F_1 and the metamorphism, it may be expected that these latter have localized and concentrated it. The site of such concentration will be the noses of the initial folds. Hence definition of the trends of these noses (F_1) and the modification by subsequent deformations (F_2, F_3) will serve to locate such concentrations.

Figure I summarizes the structure of the Main Ridge and can be seen in outcrop. Further evidence for the structural development postulated is given below:

F_1 Synform

1. Primary closures are very rare, indicating isoclinal folding with attenuated limbs and isolated noses of competent beds. Ductile boudins folded by F_2 are evidence of attenuation of the limbs.

2. Primary closures seen in outcrop have their axial directions modified by F_2, but oscillate around a trend approximately parallel with the trend of the Main Ridge.

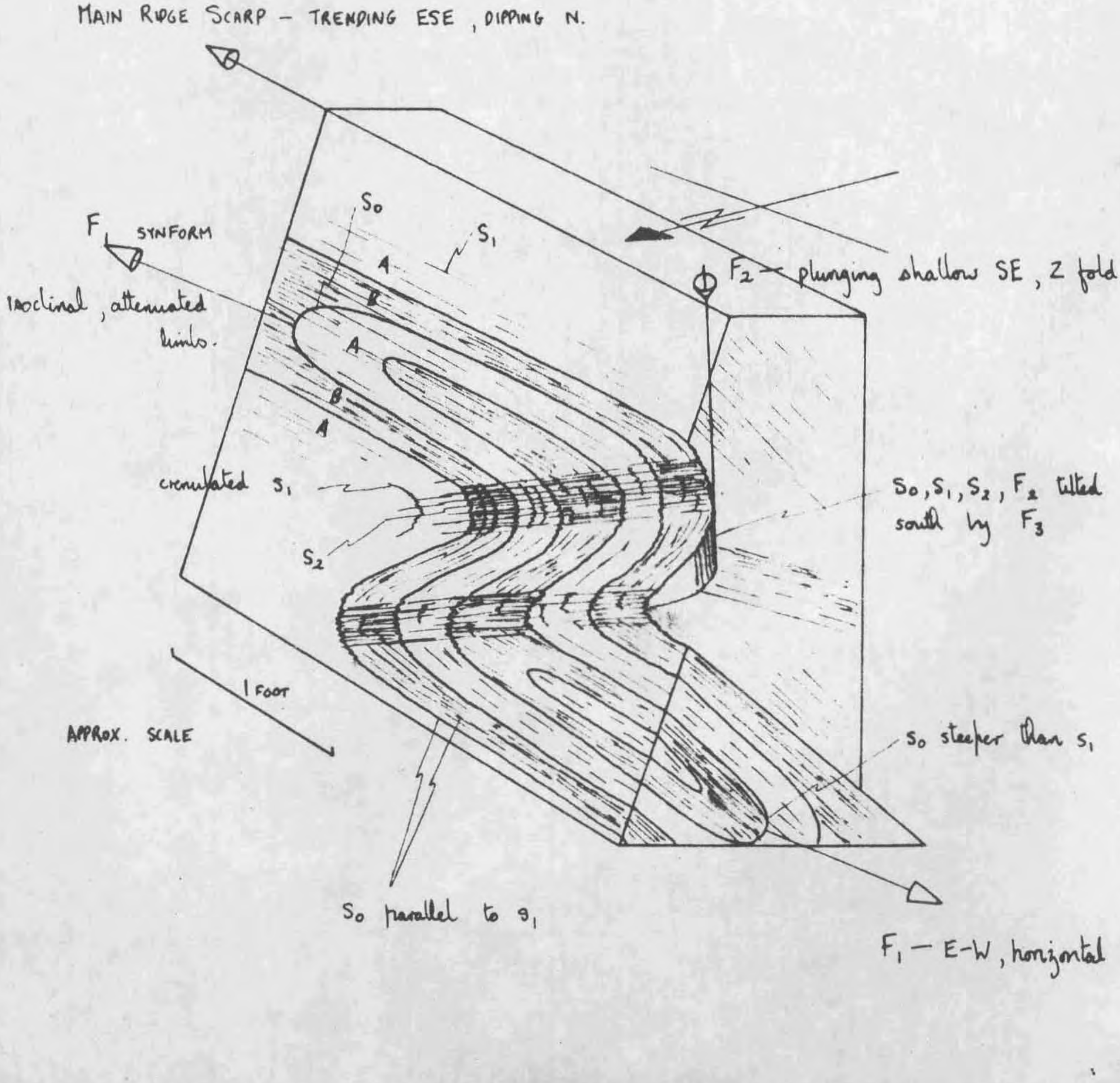
3. Lithological mapping shows that units have little tendency to close along the strike of the Main Ridge. Hence F_1 is probably approximately parallel to the Ridge trend. If at all, beds close to the east, indicating a snyformal closure with E-W trend or antiformal with SE-NW trend. The former is supported by those closures and S_o-S_1 intersections measured.

4. Outcrop high on the ridge has given four localities where S_o dips steeper than S_1, indicating an antiformal closure above, and synformal below - in the bulk of the ridge.

FIG I

BLOCK DIAGRAM SHOWING THE MAIN STRUCTURAL ELEMENTS PRESENT.

— MODIFIED AFTER A FIELD SKETCH MADE AT 112N/79E ON THE MAIN RIDGE LITHOLOGIES : INTERBANDED QUARTZITES (YELLOW – A) AND MICA SCHISTS (PINK – B).



5. Accepting the above, S_1 attitudes with E-W strike have a dip averaging around 30^{o} south - giving the dip of the axial plane of the F_1 synform.

6. Actinolite-bearing rocks hosting the copper commonly show mobilized gneissic banding and contain concentricly folded lenses of buff marble. Hence they are considered an incompetent horizon between the marble and the quartzite and thus should show considerable thickening in the hinge zones of F_1 (Figure II).

F_2 Chevrons

Whereas S_1 is by far the most common planar element in the area, F_2 is the most common linear element, being almost ubiquitous. F_2 structures outside the Main Ridge area appear to be very large e.g. a two mile long ridge of quartzite at the western edge of the claims is part of the lower limb of an F_2 recumbent fold. All variations from this size of structure to F_2 crenulations are found.

In the Main Ridge F_2 is represented on the largest scale by Z folds or monoclines (Fig. I), looking down plunge. This suggests that all the Main Ridge is the lower limb of a huge recumbent F_2 antiform (and/or the upper limb of a synform). A less spectacular theory is that F_2 is an asymmetric deformation with polarity to the SW, with no upper or lower limbs. However, the ridge to the west of the Main Ridge has larger structures asymmetric to the NE, arguing against this theory.

The effect on the F_1 synform in the Main Ridge is that lithologic units and hence F_1 noses are displaced to successively higher topographic position. This effect is partly balanced by a concomitant increase in ridge elevation, but it seems that the core of the synform may be exposed at the east end of the Ridge. Actinolite-bearing rocks are not well developed in this region, but those present are sulphide bearing and this area is the only occurrence so far of copper sulphide-bearing quartzites.

F_2 in the Main Ridge is somewhat uncharacteristic in that minor folds are not always chevron type - some are cuspate, some concentric, etc. In general the style seems to indicate a deeper tectonic level of deformation than elsewhere in the property, suggesting that the Main Ridge is an upfaulted block along N-S faults.

F_3 Arch

All the above structures, with the exception of the E-W trending F_1 directions, have a southerly dip or plunge. Westerly plunging crenulations seen on S_2 and overprinting F_2 crenulations on S_1 also suggest a weak N-S compression. S_2 planes show considerable variation over the property, while

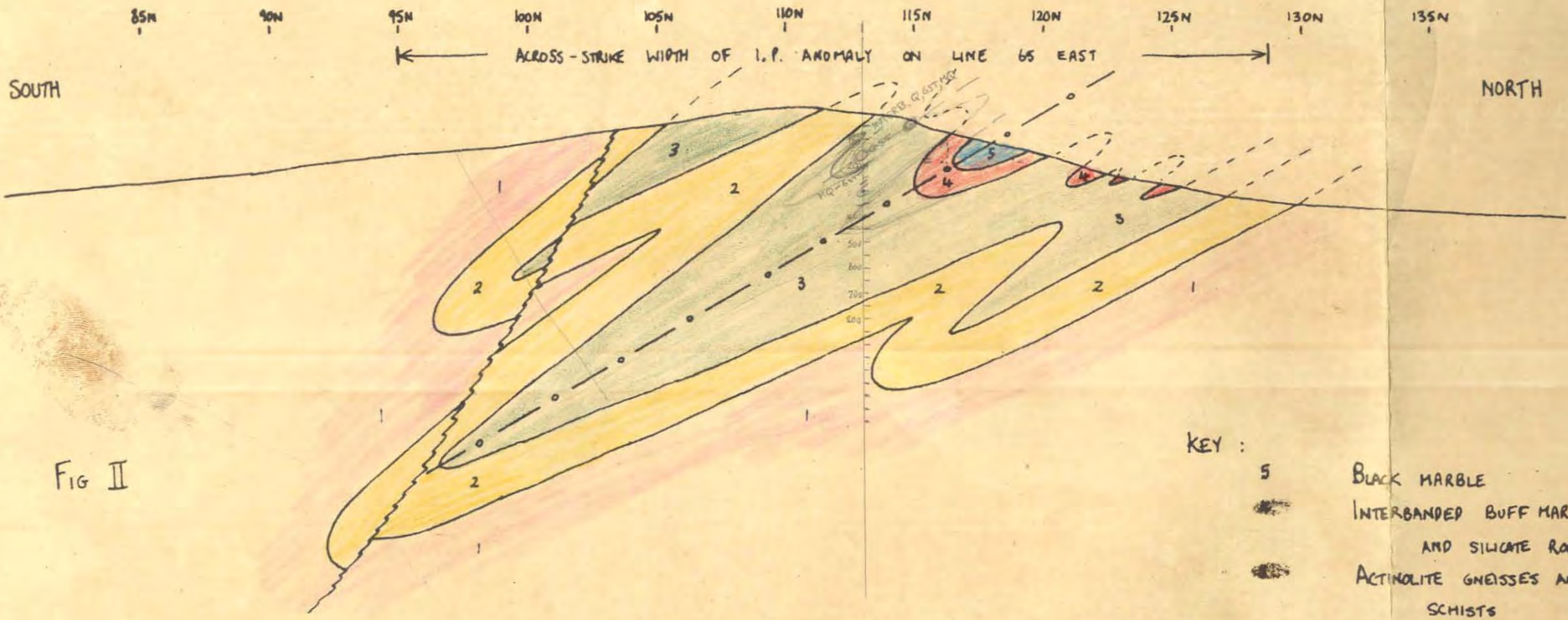


FIG II

KEY :

5 BLACK MARBLE

INTERBANDED BUFF MARBLE AND SILICATE ROCKS

ACTINOLITE GNEISSES AND SCHISTS

2 QUARTZITES

1 INTERBANDED QUARTZITES AND MICA SCHISTS

AXIAL PLANE OF 1ST FOLDING

FAULT

INFERRED GEOLOGICAL SECTION ALONG LINE 65E

Horizontal and vertical scale : 1 inch : 500 feet

Almost a profile section through F_1. Axial plane taken as dipping 30° grid south. Fault shown dips 65° S in upper part, becoming less steep with depth.

remaining fairly constant within a restricted area. Though these variations do not always point to N-S compression they suggest a deformation after F_2 - sterographic analysis may clarify the attitude of this deformation. There is a steepening of the southerly dip of F_2 and S_1 toward the south. The conclusion is that the property is on the southern limb of a broad E-W arch.

CONCLUSIONS AND RECOMMENDATIONS

The Main Ridge is potentially the site of economic concentrations of chalcopyrite in refolded hinge zones of the primary folds, preferentially at the contact between actinolite-bearing rocks and the overlying marbles, possibly throughout the former rock type.

On the 65E section, a vertical hole at 115N or 114N should intersect such ore if present. If marbles are drilled, a hole further south e.g. 112N may intersect the contact nose. Similar sites can be outlined on other sections through the ridge.