Appendix to 1983 Report

Esso

104B General

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GEOLOGY, ALTERATION, AND MINERALIZATION OF THE MITCHELL-SULPHURETS RIDGE AND SNOWFIELDS GOLD ZONE, SULPHURETS PROPERTY, NORTHWESTERN BRITISH COLUMBIA

(Epithermal and Porphyry Ag-Au)

SKEENA MINING DIVISION

NTS 104B-9E

LONGITUDE: 130°28'W LATITUDE: 56°31'N

ESSO MINERALS CANADA LTD.

M.G. LOMENDA

NOVEMBER, 1983

- Quartz Vein Zone
- Snowfield Zone

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TABLE OF CONTENTS

FIGURES

TABLES

MAPS

RECOMMENDATIONS

No further work is recommended on the Mitchell-Sulphurets Ridge.

SUMMARY

The Mitchell-Sulphurets Ridge is found on the eastern part of the Sulphurets Property. This ridge is thought to have potential to host economic epithermal Ag-Au mineralization as it is cut by a zone of intense sericitic alteration containing Ag-Au bearing quartz veins.

The Mitchell-Sulphurets Ridge is underlain by Lower to Middle Jurassic Hazelton Group sedimentary and volanic rocks, which are cut by a number of intrusives and by later dykes and faults. The stratigraphy is divided into two major groups -- the Lower Sediments, a sequence of relatively unaltered cherts, siltstones, sandstones, and shales; overlain by a package of pyroclastic and clastic rocks. The latter sequence is subdivided into a clastic unit composed of grits, sandstones, siltstones and conglomerates; a pyroclastic unit consisting of mafic, intermediate, and alkalic tuffs and breccias; and an undifferentiated unit of pyroclastics, clastics, and epiclastics. Diorite porphyry, syenodiorite porphyry, and syenitic intrusives and keratophyre dykes cut the volcanic and sedimentary sequence.

A large zone of sericite - (±chlorite) - pyrite-quartz alteration underlies the ridge. On the south side of the ridge, this alteration is controlled at least in part by lithology. On top of the ridge and on the northern slopes, sericitic assemblages are pervasive throughout all lithologies except the dykes, which post date the alteration. Propylitically altered volcanic and intrusive rocks fringe the sericitic zones.

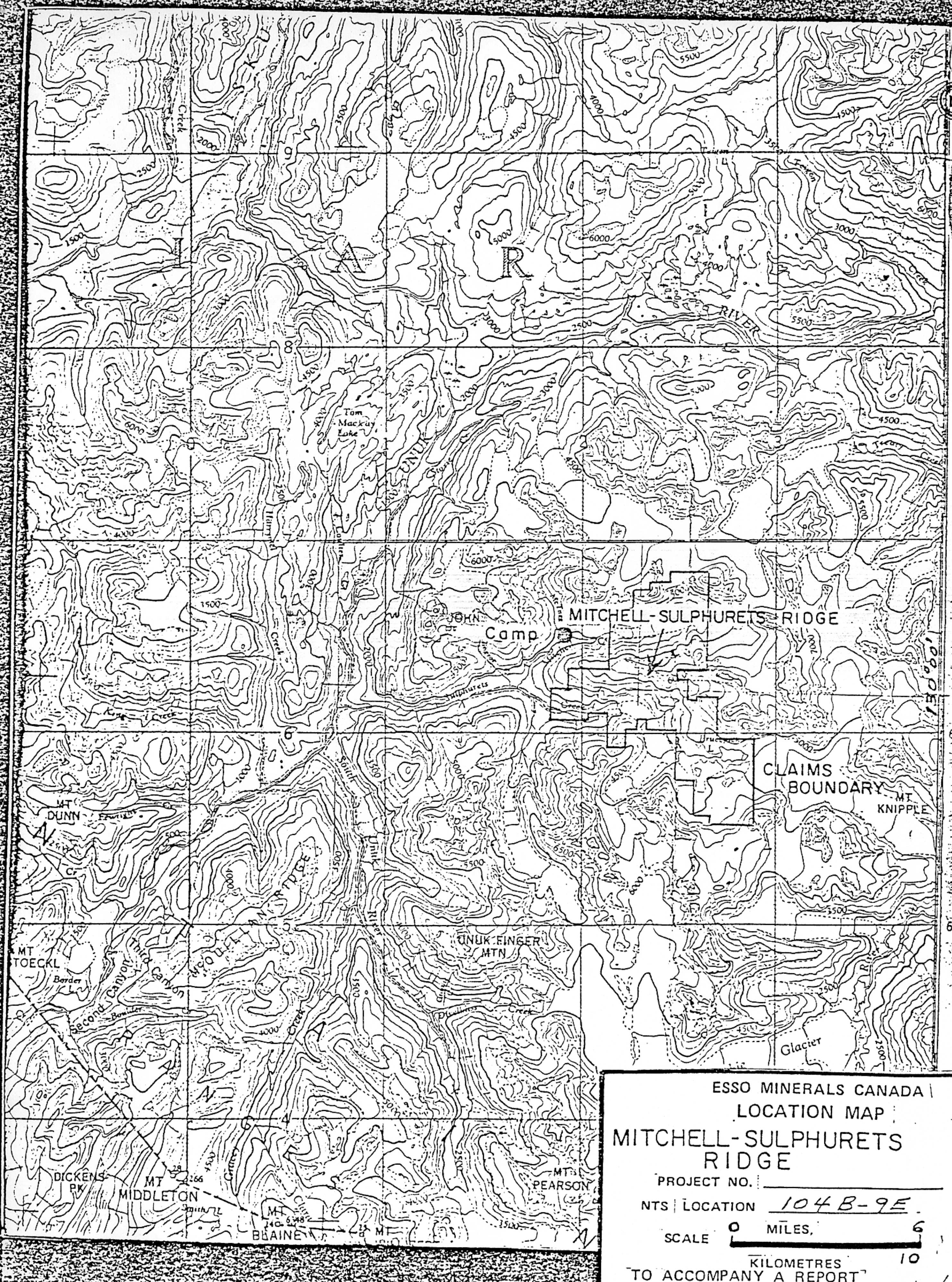
Rock samples from pyritic, sericitic areas assayed very low Ag-Au.

Barren and Ag-Au bearing quartz and quartz-barite veins are uncommon on most of the Mitchell Sulphurets Ridge. However, an area of intense silicification and Ag-Au quartz veining occurs in a zone of sericitic alteration on top of the ridge. Many en echelon veins form a zone trending about 40° azmuth covering an area about 335 m by 60 m. Mineralization in the veins is spotty, but very high grades can be found in places.

No explanation was found for the low grade porphyry Au in the Snowfield Gold Zone.

In Early Jurassic time, following the deposition of the deep water Lower Sediments, a volcanic pile developed in a shallow marine environment. Andesitic volcanics evolved to trachyandesites. Clastic sediments were deposited along the fringes of the volcanic pile and as intercalations. Diorite porphyry, syenodiorite porphyry, and syenite successively intruded the comagmatic pile and probably triggered the hydrothermal activity that sourced the alteration, quartz veining, and mineralization. In the Quartz Vein Zone, the Ag-Au mineralization probably occurred after the emplacement of the syenitic intrusives.

The geological mapping and rock assay sampling carried out in 1983 downgraded the economic potential of the Mitchell-Sulphurets Ridge.



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LOCATION MAP

MITCHELL-SULPHURETS RIDGE

PROJECT NO. ______

NTS LOCATION 104B-9E

SCALE 0 MILES 6 / KILOMETRES 10

TO ACCOMPANY A REPORT

BY M. LOMENDA DATED NOV/83

INTRODUCTION

The Mitchell-Sulphurets Ridge is an east trending ridge on the east side of the Sulphurets Property, flanked to the north by Mitchell Creek and to the south by Sulphurets Creek and the valley occupied by the Hanging Glacier (NTS 104B-9E) (Figure 1). This ridge is throught to have potential to host economic epithermal Ag-Au mineralization as it is underlain a zone of intense sericitic alteration and is cut by Ag-Au bearing quartz veins. Low grade porphyry Au occurs in the Snowfield Gold Zone on the north slope of the ridge.

GEOLOGY

A slightly modified version of Britten's (in Bridge et al., 1982) rock unit terminology is used in the report. Rock units were identified by megascopic examination in the field. Rock compositions that were not identifiable in the field were determined in 1982 by laboratory studies done by Britten.

The Mitchell-Sulphurets Ridge is underlain by Lower to Middle Jurassic Hazelton Group volcanic and sedimentary rocks, which are cut by three kinds of intrusives, an extensive zone of alteration, and by late dykes and faults. The understanding of the geology is greatly complicated by the pervasive sericitic alteration.

The stratigraphy is summarized as the Lower Sediments overlain by a complex pyroclastic-clastic sequence, which is subdivided into a Clastic Unit, Pyroclastic Unit, and an Undifferentiated Clastic-Epiclastic-Pyroclastic Unit. These rocks are described briefly in the ensuing section (Map 1).

Lower Sediments

The Lower Sediments are exposed on the lower south-facing slopes of the ridge where they consist of greenish grey to green, thin bedded chert, siltstone, and cherty siltstone. Westward along the nose of the Hanging Glacier, these sediments are composed of thin to medium bedded, fine to medium grained, siliceous sandstone. Individual sandstone beds are graded and are capped by a thin bed or parting of siltstone or shale. Scour, load, and dewatering structures are visible locally along the bedding contacts.

The Lower Sediments are relatively unaltered other than silicification near intrusive contacts.

Pyroclastic - Clastic Sequence

Clastic Unit

On the south side of Mitchell-Sulphurets Ridge, grit, sandstone, and minor conglomerate overlie the Lower Sediments. Typically, the arenaceous sediments are massive, poorly sorted, pyritic, sericitic, quartz rich, and lack good bedding features. Compositionally these rocks probably are arkoses and greywackes in which most of the feldspar and clay has been altered to sericite. Texturally the sandstones are medium to very coarse grained and grade into grits and quartz pebble conglomerates. In places, grits and thin conglomerate beds contain volcanic and sedimentary pebbles.

On the south side of Mitchell-Sulphurets Ridge, greenish grey unaltered or white altered siltstone is intercalated with arenaceous sediments in intervals from 1 - 20 m thick. Siltstone is relatively uncommon on the north slopes of this ridge.

In the western part of the map area, close to the Sulphurets Fault, outcrops of green to purple, fine grained tuffaceous rocks are found among outcrops of grits and sandstones. The contact relations between these lithologies are uncertain.

Pyroclastic Unit

Tuffs and breccias, which commonly are andesitic, occur along the crest of the Mitchell-Sulphurets Ridge. The breccias range from low to high matrix and contain fragments of feldspar porphyry. Breccia fragments range in size from 5 - 100 mm but locally, blocks greater than a half metre can be seen. Breccia matrices and tuffs usually are coarse grained, consisting of 1 - 5 mm plagioclase phenocrysts in a matrix of chlorite, feldspar, and lithic debris. Mafic content is relatively low although hornblende phenocrysts are present locally. Texturally the tuffs resemble feldspar porphyry.

West of the Snowfield Gold Zone, the tuff-breccias are trachytic to trachy-andesitic in composition (Britten, in Bridge et al., 1982). Eastward, these rocks abruptly pass into clastic, epiclastic, and tuffaceous rocks by facies change or a fault contact.

In the Snowfield Gold Zone, the highly altered breccias containing low-grade Au are assumed to be intermediate to mafic in composition. These rocks contain ragged, dark grey, chloritic fragments, ranging in size from 5 mm to about 1 m, which occur in a waxy, greenish grey, chloritic, sericitic, pyritic matrix. The original texture and compostion of the matrix has been lost in the alteration. These breccias grade west and north into clastic, epiclastic, and other tuffaceous rocks.

Undifferentiated Clastic - Epiclastic-Pyroclastic Unit

A large proportion of the rock on the north slopes of the Mitchell-Sulphurets Ridge have characteristics of both clastic and pyroclastic rocks. Differentiation of these rocks are made difficult by the alteration, possible structural disruption, iron staining, and complex interfingering. Typically these rocks contain sand and pebble size quartz, scattered pebbles of volcanics and dark, ragged, chloritic volcanic breccia fragments. In places, this rock is composed of a green, chloritic volcanic pebble conglomerate. In other areas it resembles a siliceous pebble grit or sandstone. This unit must represent a transition between volcanic and sedimentary rocks.

INTRUSIVE ROCKS

The intrusives have been grouped as diorite porphyry, syenodiorite porphyry, syenite, and keratophyre dykes. Age relations between these rocks are unknown.

Diorite Porphyrys

An elongate plug of diorite porphyry occurs on the north side of Mitchell-Sulphurets Ridge and bottoms on the south side of this ridge. This intrusive contains 20-40% 3-15 mm plagioclase phenocrysts and 3-10% 3-5 m hornblende phenocrysts in a grey-green, very fine grained groundmass.

Syenodiorite Porphyrys

Small masses of sericitically altered syenodiorite porphyry occur just westward of the diorite porphyry. It differs from the latter by the presense of Kspar in the ground mass.

Syenites

Several irregularly shaped small syenitic intrusives are exposed on the south side of Mitchell-Sulphurets Ridge. Contact relations with the Lower Sediments are irregular and gradational; contact with the overlying clastic rocks is gradational to sharp and sheared. The syenites are light greenish grey, fine to medium grained with textures ranging from granitic to weakly porphyritic. They contains 5-20% 1-5 mm hornblende needles and laths and 50-60% 1-5 mm Kpar in a finer grained groundmass.

Mafic Dykes

The nearly flat dipping dyke on the southwest slope of Mitchell-Sulphurets Ridge was identified as a keratophyre (groundmass Kspar) by Britten. This dyke is dark green, contains phenocrysts of hornblende and feldspar, and in places contains quartz amygdales. Other dykes in this area probably are of a similar composition.

STRUCTURE

The simpliest interpretation of the structure in the mapped portion of the Mitchell-Sulphurets Ridge is a homocline dipping moderately to steeply north (Maps 1, 3, 5, Figure 2). Sedimentary features in the Lower Sediments indicate that bedding tops face north. It is probable, however, that the structure is more complex as is suggested by the numerous intrusives in the area. Recognition of this structural complexity may be obscured by the foliation, pervasive alteration, and ice cover.

A stereonet plot of poles to bedding and foliation is presented in Figure 2. Bedding lies in a broad field caused partly by an increase in dip from south to north. Two foliation populations, one dipping steeply northward and the other dipping steeply northeastward, partly overlap and thus plot in a broad field.

Two north-northeast striking faults were mapped on the basis of abrupt changes of lithology and alteration along strike.

ALTERATION

Rocks underlying the Mitchell-Sulphurets Ridge are characterized by pervasive sericitic alteration (Map 2). Areas of propylitically altered volcanic and intrusive rocks are common fringing the zone of sericitic alteration. In places propylitic assemblages are overprinted by sericitic assemblages.

Sericitic Alteration

The sericitic assembleges are -- sericite, sericite-chlorite, and chlorite-sericite accompanied by pyrite and quartz. On the eastern part of Mitchell-Sulphurets Ridge, calcite and hematite can be found in this assemblage. Sericitic alteration results by the destruction of feldspar, clay and mafic minerals. Disseminations and local stringers and pods of fine to medium grained pyrite form 1-25% of the altered rock. Typically, however, pyrite content ranges between 3-10%. Silicification is minor other than in the Quartz Stockwork Zone and the Quartz Vein Zone where it consists of a fine network of quartz veins (1.0 to 1.5 cm) and fine grained groundmass silica.

On the south slopes of the Mitchell-Sulphurets Ridge, sericitic alteration is controlled at least partly by lithology (permeability). In this area, a thick zone of alteration is confined to the south and northwest by the geological boundaries of the host clastic unit. In places, this alteration has overstepped these boundaries and is found along fractures and shears in the bounding volcanic and intrusive rocks. In the central and eastern part of the ridge and on it's northern slopes, sedimentary, volcanic, and all of the intrusive rocks, except the dykes, are intensely sericitically altered.

Chlorite is common in the sericitic assemblage in the Snowfields Gold Zone. Chlorite probably is related to the composition of the underlying volcanics as this mineral is absent from the clastic rocks in this same area.

Propylitic Alteration

Propylitic alteration results from the destruction of feldspar to varying amounts of epidote, calcite, chlorite, quartz, and pyrite and preservation of the original rock textures. On the Mitchell-Sulphurets Ridge, weak to moderate alteration of this type can be seen in all volcanic and intrusive rocks that are not sericitically altered.

MINERALIZATION

Barren and Ag-Au bearing quartz veins are found in the sericitically altered areas of the Mitchell-Sulphurets Ridge, (Maps 1 and 2). The most important veined area, the Quartz Vein Zone is discussed in an ensuing section of this report.

Veining on the Mitchell-Sulphurets Ridge is comparatively minor excluding the Quartz Vein Zone on top of the ridge and the Quartz Stockwork Zone on the north slope. A few barren quartz and quartz-barite veins were found just southwest of the Quartz Vein Zone. East and southeast of this same zone, minor Ag mineralization was found in a few quartz and quartz-barite veins. The best mineralization was found in a vein (or veins), which is sporatically exposed for 25 m in the lower south slopes of the ridge. This barite-quartz vein is 0 - 1 m thick and trends 125°/63° NW parallel with the foliation. A chip across 25 cm of a well mineralized part of the vein assayed 0.035 oz Au and 12.55 oz Ag/ton. Ag minerals recognized in this vein were argentite, pyargerite, and tetrahedrite.

A number of highly pyritic samples were collected for rock assay (Table 1, Appendix 1). Au content in these samples ranged between 0.001 and 0.017 oz/ton and Ag varied from 0.01 to 0.025 oz/ton.

Malachite coated fractures are common in tuffaceous and sedimentary rocks near the Sulphurets Fault and in grits above the nose of the Hanging Glacier. Sphalerite and galena were found in quartz vein float near the Sulphurets Fault.

TABLE 1

Selected samples of sericitic, very pyritic rock from the Mitchell-Sulphurets Ridge. Sample 9801 - Quartz vein with galena and sphalerite; Sample 9805 - Barite vein with Ag minerals.

Sample No.	Au (oz/T)	Ag (oz/T)
8409	0.001	0.01
8410	0.001	0.03
8411	0.002	0.03
8420	0.002	0.13
8421	0.005	0.07
8422	0.011	0.05
8423	0.002	0.04
8424	0.002	0.18
8425	0.022	0.07
9801	0.061	2.29
9802	0.004	0.04
9803	0.001	0.08
9804	0.003	0.07
9805	0.035	12.55
9806	0.005	0.25
9807	0.008	0.23
9808	0.017	0.20
9828	0.007	
9829	0.011	

Quartz Vein Zone

In 1982, R. Britten reported the presence of Ag-bearing quartz veins on the Mitchell-Sulphurets Ridge. These veins were rediscovered in an intensely sericific and silicified area by W. Melnyk in 1983. A flagged grid was constructed over this area with a base line 340 m long and trending 63° azmuth. The grid was mapped at a scale of 1:500 (Map 3). Twenty chip and grab samples were collected of the mineralized veins and seven representative samples were taken of the country rock in the vicinity of the veins. These samples were assayed for Au-Ag (Map 4, Table 2, Appendix I).

Quartz veins range in width from 1 cm to about 1.5 m and can be traced laterally for 1 - 15 m. The thicker veins are pod-like and terminate abruptly or "horse tail" into thinner veins.

Ag and Au minerals found in these quartz veins are argentite, tetrahedrite, pyargerite, minor purple coatings of cerargerite, and rare specks of electrum. Mineralization in these veins is spotty although local very high grades can be found (Map 4). A chip sample across the most mineralized vein (12 m by 8 cm), which contains specks of electrum, assayed 8 oz. Au and 480 oz. Ag/ton. Samples collected from the silicified and non-silicified, sericitic country rock in the veined area assayed background Ag and Au.

A stereonet plot of the poles to fractures in the Quartz Vein Zone shows two broad fields of steeply dipping fractures -- one dipping north and the other dipping southwest (Figure 3). Mainly southwest dipping fractures are found in the eastern part of the grid; north dipping fractures are dominant west of about Line 40W. Comparison of this plot with a similar plot of the quartz veins (Figure 4) indicates that there is no obvious relationship between the fractures and these veins. The veins dip steeply northwest to southwest. Maps 3 and 4, however, show that many of the veins occupy a rough en echelon pattern that trends about 40° azmuth.

The mineralized quartz veins occur in a zone that is partly quartz flooded by networks of quartz veinlets (< 1 cm) and by fine grained groundmass silica. Precious metal content of this siliceous rock is low. Quartz flooding probably occurred during a later stage of sericitization as sericitic material is incorporated into in the siliceous rock and the boundaries of the silicified areas are gradational. Mineralized quartz veins cut both of these alteration types with sharp contacts and clearly post-date both events. Although these veins occur outside of as well as inside of the silicified areas, they likely were controlled by the same structures or events that caused the silicification.

In the easternmost part of the grid, thin veins, trending north to north-northeast, are found; westward, thicker northeast trending veins are found.

The original lithologies underlying the grid are difficult to recognize due to the prevasive alteration. Rocks at the western and of the grid probably are intrusive as they contain numerous 3 - 20 mm sericitic pseudomorphs presumably after feldspar phenocrysts. A volcanic breccia of possible intermediate composition was recognized against the ice in the northern part of the grid. Quartz pebbles were found in the altered rock along the baseline suggesting that clastic rocks occupy this area.

TABLE 2

Rock assay samples from the Quartz Vein Zone, Mitchell-Sulphurets Ridge.

Sample No.	Au (oz/T)	Ag (oz/T)	Interval (metres)	Comments
8412	0.615	15.75	0.6	Qtz vein with Ag
8413	1.631	127.75	-	Selected from 8412
8413	-	215.00	-	Rerun
8414	0.014	1.30	1.65	Silicified, pyritic, sericitic
8415	0.020	12.10	1.0	Qtz vein with Ag
8416	0.003	0.22	3.0	Qtz stockwork, pyritic
8417	0.002	0.21	-	Pyritic, sericitic
8418	0.029	1.03	-	Pyritic, sericitic
8419	0.002	0.13	-	Pyritic, sericitic
9809	8.044	480	0.08	Qtz vein, Ag, electrum
9810	0.043	5.19	0.8	Qtz vein, Ag
9811	0.012	0.72	2.9	Thin qtz. veins, altered rock
9812	0.017	12.50	1.6	Thin qtz veins (Ag) in altered rock
9813	0.009	3.28	0.5	Qtz vein, Ag
9814	0.146	0.51	2.7	Qtz veins, Ag
9815	0.044	1.78	0.5	Qtz vein, Ag
9816	0.025	0.48	2.0	Qtz vein, Ag
9817	0.099	29.70	2.6	Thin qtz veins (Ag) in volc.
9818	0.008	6.30	0.7	Qtz vein, Ag
9819	0.008	1.35	1.2	Silicified rock
9820	0.002	0.75	0.6	Qtz vein, Ag
9821	0.015	7.75	0.4	Qtz vein, Ag
9822	0.467	39.75	0.35	Qtz vein, Ag
9823	0.005	0.36	4.7	Sericite, chlorite, pyritic
9824	0.007	0.13	-	Sericitic, pyritic, sericitic
9825	0.005	0.27	10	Pyritic, sericitic, silicified
9826	0.004	0.26	10	Pyritic, sericitic, silicified
9827	0.002	0.24	10	Pyritic, sericitic, silicified

Snow field Gold Zone

In 1981, trenches blasted into the Snowfield Gold Zone contained intervals assaying up to 0.1 oz Au/ton. The highest of these assays were found adjacent to the ice. Mapping performed in 1983 indicated that the trenched area is underlain by sericite-chlorite altered intermediate to mafic volcanic breccia. The surrounding rock contain a distinct clastic component and are less chloritic. No other megascopic difference are apparent between these two areas. The alteration intensity and pyrite content of the Snowfield Gold Zone is similar to that of the surrounding rocks.

Molybdenite and minor chalcopyrite are present on the north slopes of the Mitchell-Sulphurets Ridge, west and northwest of the Snowfield Gold Zone. This mineralization occurs as scattered disseminations and as fracture fill with and without quartz.

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No Ag mineralization was observed on the north slope of the ridge.

CONCLUSIONS

Based on observations made on the Mitchell-Sulphurets Ridge, the sequence of geological events in this area are summarized below.

In Early Jurassic time, the Lower Sediments were deposited in a probable deep-water environment as cherty fine grained sediments and as turbidites. The overlying clastics and pyroclastics represent a shallowing event related to the build-up of a volcanic pile. Andesite and possibly more mafic volcanics evolved to trachyandesites and trachytes. Clastic and epiclastic sediments resulted from the reworking of the volcanic pile and from possible outside sources that would account for the high quartz content of these sediments. Deposition of the sediments occurred along the fringes of the build-up and as intercalations. The volcanics and surrounding sediments were cut by successive intrusive events that were in part coeval with the host rocks. Britten suggested that the sequence of intrusions on the Sulphurets Property was -- diorite porphyry, syenodiorite porphyry, syenite, and granite (outside of the 1983 map area).

The hydrothermal events that caused the sericitic alteration probably are related and to one or more of the intrusive types. According to Britten, an early hydrothermal event occurred during the intrusions of the porphyrys but the main hydrothermal system developed sometime after the syenodiorite porphyrys and granites were emplaced. All of the intrusives on Mitchell-Sulphurets Ridge are sericitically altered at least along their boundaries and along shears. Thus, some of the hydrothermal activity post-dates the syenites.

On Mitchell-Sulphurets Ridge, quartz flooding in the Quartz Vein Zone began during a later stage of sericitization. After sericite development and silcification ceased, Ag-Au bearing quartz veins were emplaced. The latter event probably post-dates the syenites.

The keratophyre dykes likely post-date the quartz veins as they are unaltered and are more mafic then the intrusive that probably triggered the veining and mineralization.

Britten cited evidence that the Mitchell-Sulphurets Ridge line may be at the highest level of the alteration-mineralization system. If so, stockwork or disseminated mineralization may be present at depth. Pyrophyllite and tourmalene, which indicate a high-level alteration environment, were reported in the Snowfield Gold Zone. The latter also was found on top of the ridge.

Evidence that upgrades the economic potential of the Mitchell-Sulphurets Ridge is the 335 x 60 m area that contains local high grade Ag-Au quartz veins. If the ridge is at the highest level of alteration and mineralization, then better grades may exist at depth. However, mapping and rock sampling carried out in 1983 probably lowered the potential of the ridge area. This prospect is clearly uneconomic if the Quartz Vein Zone represents typical mineralization that may occur at depth. The south slope of the Mitchell-Sulphurets Ridge, which represents the third dimension, of the alteration zone contains only sparce Ag-Au veins and exposes the base of this zone. Assay analyses of relatively fresh, pyrite, sericitic rocks downgrade the probablility of finding economic disseminated Au in the ridge.

REFERENCE

Bridge, D.A., Melnyk, W., and Britten, R., 1983, 1982 Exploration Report on the Sulphurets Property, Skeena Mining Division, B.C., EMC Rept.