Report on

THE RELATIONSHIP BETWEEN SULPHIDES AND WALLROCK ALTERATION, AND ITS IMPORTANCE TO EXPLORATION, ASHNOLA PROPERTY

Osoyoos Mining Division

(Lat. $49^{\circ}07'$ N; Long. 120° 20' W)

for

PRISM RESOURCES LIMITED

by

Dr. A.J. Sinclair, P. Eng.

September 22, 1975

INDEX

FIGURES

SUMMARY AND CONCLUSIONS

(1) A pyrite halo to the Ashnola porphyry copper deposit is horseshoe-shaped in plan view, has an approximate diameter of about 2 miles, and appears to have the 3-dimensional form of a vertical, partial cylinder.

(2) Hypogene sulphides are pyrite chalcopyrite and molybdenite in that order of decreasing abundance and paragenesis (oldest to youngest). Most sulphides occur in veinlets; a small amount occurs disseminated in alteration envelopes adjacent to veinlets; and a third form is disseminated grains (mainly pyrite) in the quartz diorite intrusion apparently unrelated to veinlets. Principal gangue minerals in veinlets are quartz, much less abundant sericite, and sporadic carbonate.

(3) Only limited evidence exists for crosscutting relations of the abundant sulphide-bearing veinlets both within and without the pyrite halo. Never-the-less, there is some suggestion that two geometric centres of mineralization exist that are probably separated to some extent in time. One stage of mineralization produced the cylindrical pyrite halo with at least a partial inner cylindrical zone of substantially higher grade copper (and molybdenum). The second centre (and phase) of mineralization coincides with

the quartz diorite stock and is a much smaller scale event at the present level of exposure than is that which formed the pyrite halo. Relative ages of the two postulated phases of mineralization are uncertain.

(4) Early attempts to map alteration assmeblages as a guide to exploration of the porphyry system have been hampered by scarcity of exposures, extensive weathering, and a dependence solely on a megascopic approach to mineral and textural analysis.

(5) Potassic alteration is recognizable only by detailed thin section examination. It is not locallized solely about the quartz diorite boss as indicated by Montgomery et al. (1975) but has been found locally elsewhere as minute quantities of hydrothermal biotite. Such occurrences, however, are within the core of the porphyry system.

(6) The dominant hydrothermal alteration is sericitization characterized by the assemblage quartz-sericite-pyrite which occurs throughout the porphyry system except where other assemblages are locally apparent, including biotite (as noted above) and red-brown veinlets of quartz-carbonate-pyrite.

(7) Sericitic alteration is pervasive in places, in which case the entire rock is bleached. Elsewhere bleached selvages about quartz-sulphide veinlets are present and it is

apparent that this type of alteration is part and parcel of hydrothermal deposition in the porphyry system.

(8) An early deuteric sericitization is apparent in all specimens examined as minor, pervasive replacement mainly of plagiolclase and to a lesser extent of fine-grained matrix.

(9) Thin red-brown veinlets containing quartz-carbonate and minor pyrite have been observed by the author only near mineralized rock and thus, may provide a useful megascopic feature in further exploration.

(10) Alteration effects appear to be substantially more intense in the core rocks enclosed by the pyrite halo. In general, thin alteration selvages are present about pyrite veinlets that form the halo, whereas, thick bleached selvages or pervasively bleached rock occur within the core zone.

(11) A re-evaluation of all geological information available for the Ashnola porphyry deposit, supplemented by microscope work, indicates strongly that the system compares favorably with the upper levels of the idealized porphyry copper model of Lowell and Guilbert (1970). This conclusion has important implications for further exploration in terms of geometry and depth of potential economic grade zones for copper and molybdenum.

INTRODUCTION

Ashnola property of Prism Resources Ltd. is in Osoyoos Mining Division on the eastern flank of Placer Mountain in the Okanagan Range, located principally to the west of Ashnola River and encompassing most of the drainage basin of McBride Creek. Approximate co-ordinates of the centre of the claims are 49°07'N. latitude and 120°20'W. longitude. Princeton, B.C. is about 23 miles NNW of the claims (see figure 1).

The property is easily accessible via a Forestry access (gravel) road extending from Highway No. 3 between Hedley and Keremeos, along the Ashnola River Road, and thence by a good quality bulldozer road extending from Ashnola River road westward along the north side of McBride Creek. Access is also provided from the west via a jeep road extending eastward from Highway No. 3 at Copper Creek, along the north side of Placer Creek to the head of McBride Creek drainage basin. The property is shown in figure 2.

The area is characterized by rugged topography and high relief. Ashnola River valley, within the claims groups, has elevations from 3700 to 3800 feet a.m.s.l. Peaks on the divide between McBride and Cat Creeks, about 2 miles west of Ashnola River, are approximately 6600 feet a.m.s.l. Twin peaks of Placer Mountain, about 4 miles further west, are at elevations of 7127 and 7231 feet respectively. In general, Ashnola River and McBride and Cat Creek valley walls are steep sided (30 degrees or more) and are heavily forested except where talus slopes have developed.

The area including Ashnola property was mapped geologically on reconnaissance scale by Rice (1947). In 1961 Kennco Explorations Ltd. conducted a detailed exploration program on part of the area, including geological mapping, a geochemical soil survey, geophysical surveys (including I.P.) and diamond drilling of 9 AX holes totalling about 2700 feet. Meridian Exploration Syndicate staked the property in 1966 and examined it in detail that summer. Their work included a stream sediment survey, geological mapping, a geochemical soil survey, 7000 feet of Self Potential survey, about 4.5 miles of bulldozer trenching and road building, and about 700 feet of drilling and blasting (Montgomery, 1966). In 1968 the property was under option to Quintana Minerals Corp. who drilled 6 NQ wireline holes totalling 2951 feet. In addition, geological mapping was done to establish alteration and mineral zoning patterns (Arnold, C., and D. Lowell, 1968). Further trenching and soil sampling was carried out in the Cat Creek Drainage Basin during 1969.

Subsequent work included an intensive geochemical and geophysical survey of the property by Prism Resources in 1970 and 1971 and additional percussion and diamond drilling by Getty mines in 1972 and by Craigmont mines in 1973.

Field studies of the spatial relationship between classes of wallrock alteration and sulphide concentrations have been carried out on a limited basis on the Ashnola property (e.g. Arnold and Lowell, 1968). Such data are of limited use due to the sporadic occurrence of outcrops in the area, and the difficulty of making macroscopic mineral identifications of the fine grained rocks that predominate in the area. Consequently, the application of contemporary zonal theory to exploration on the property requires detailed investigation of the nature of all hydrothermal effects (sulphides and wallrock alteration) and their interrelations.

The general geological nature of the rocks in the area indicate the presence of what can be described as a "porphyry system". Evidence includes the presence of a pyritized halo, locallized zones of copper and molybdenum sulphide concentrations in fractures and less abundantly as disseminated grains, extensive development of wallrock alteration the most obvious macroscopic indication of which is "bleaching", and the presence of porphyritic rocks - both intrusive and extrusive - that form the hosts for sulphides. These features combine in a manner to suggest that the present level of exposure represents the upper level of the idealized zoned porphyry copper model presented by Lowell and Guilbert (1970). Available evidence, furthermore, supports the suggestion that the system can be classified as simple, continental and volcanic according to classifications suggested by Sutherland Brown (1969), Linder (1975) and various other authors.

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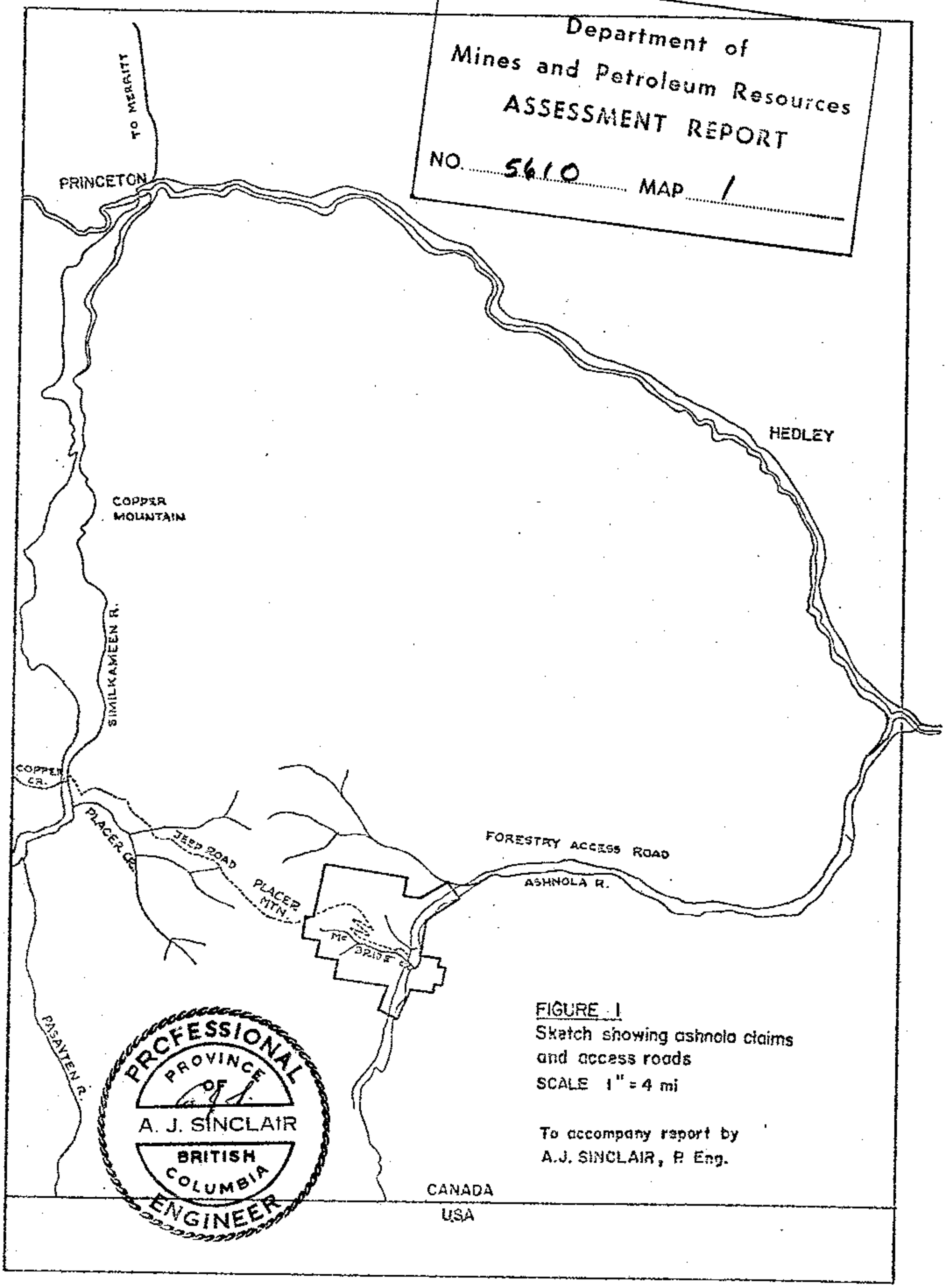
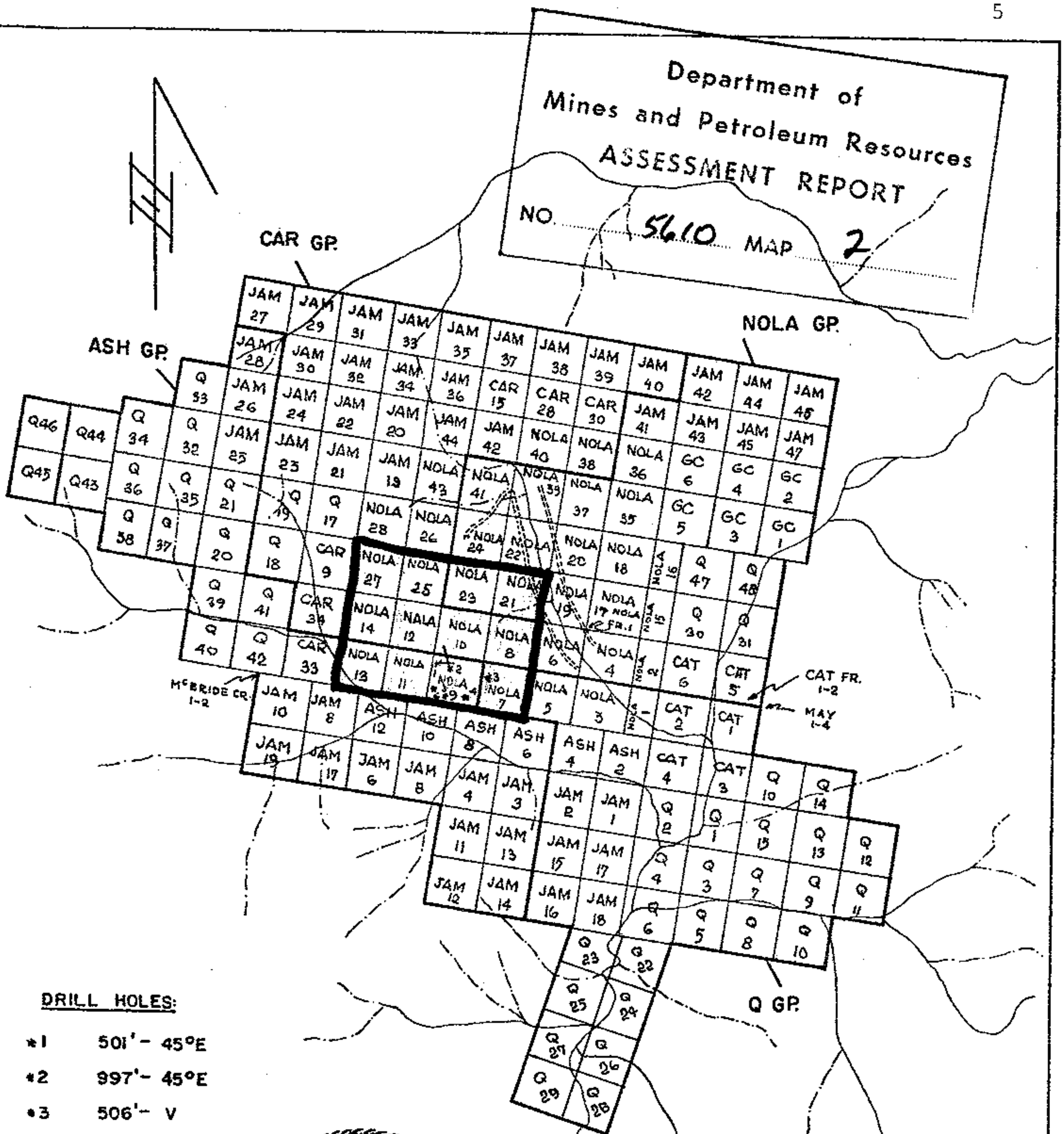


FIGURE 1
Sketch showing ashnola claims and access roads
SCALE 1" = 4 mi

To accompany report by
A.J. SINCLAIR, P. Eng.



DRILL HOLES:

*1	501' - 45°E	
*2	997' - 45°E	
*3	506' - V	
*4	408' - V	
*5	339' - V	
*6	200' - V	

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A. J. SINCLAIR

FIGURE 2

0 5000 10,000
feet (1:50,000

To accompany report by
A. J. SINCLAIR, P. Eng.

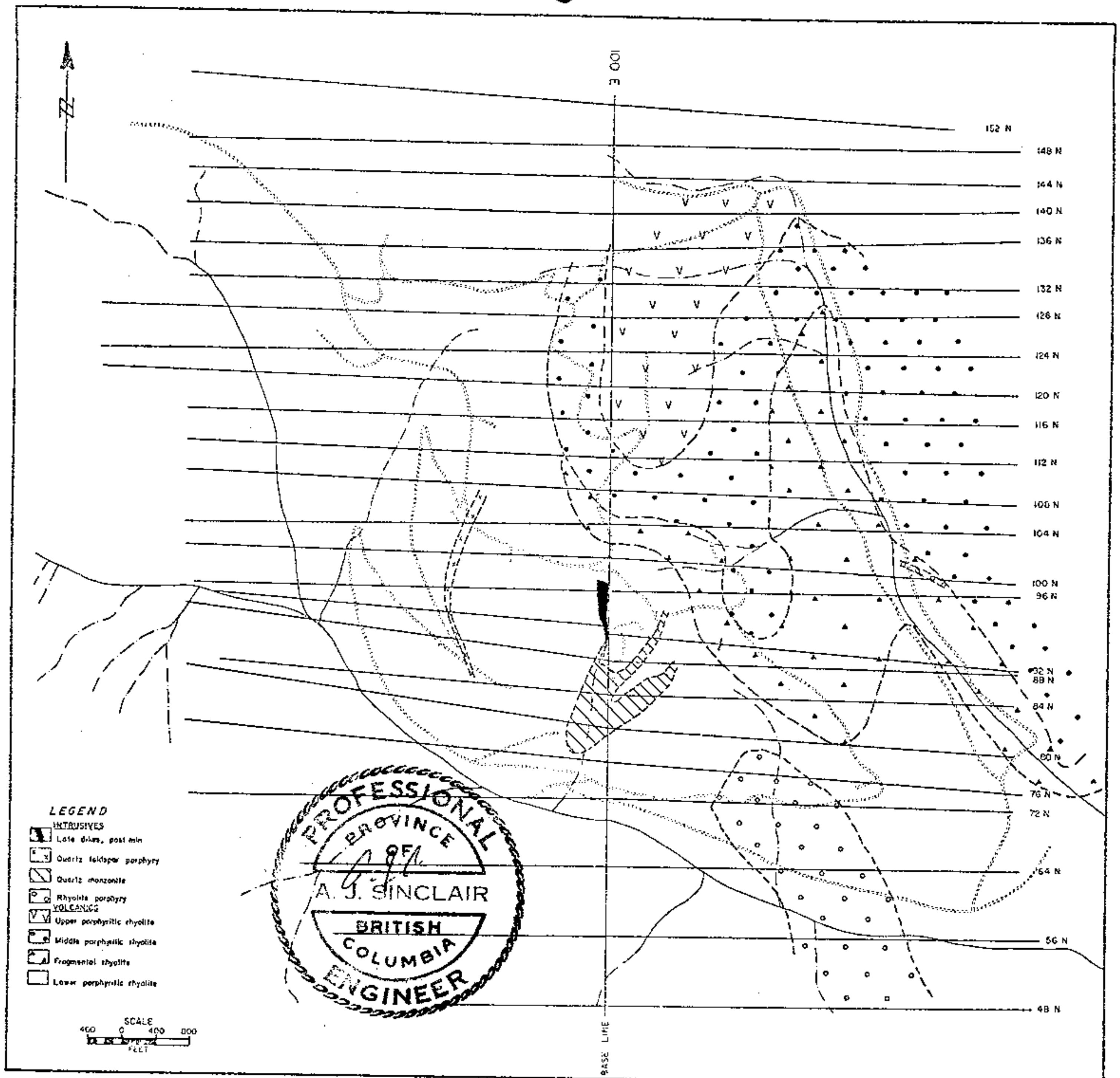
GENERAL GEOLOGY

Geology of the property was described first by Montgomery (1966), later summarized by Sinclair (1969) and recompiled and updated on the basis of additional diamond drill information by Cochrane (Montgomery et al., 1975). A generalized outline of the present concept of the geology of the property is shown in figure 3. For reference purposes this should be compared with figure 4 showing the position of the pyrite halo, and thus providing an indication of the geometry of the porphyry system relative to the country rocks.

Rice (1947) did regional mapping of a very large area including the Ashnola property and correlated the rocks underlying the property with the Lower Cretaceous Kingsvale Group. However, he emphasized the uncertainty of this correlation and suggested the possibility that the rocks might correlate in whole or in part with the Spence Bridge Group.

Outcrops are scarce and generally are extensively weathered and/or altered. Rock types on the property are principally rhyolitic and porphyritic. Several varieties are recognized as shown in figure 3. The most abundant rock type is the Lower porphyritic rhyolite that in most places is extensively altered. Where relatively fresh the rhyolite has a pale green to brownish aphanitic matrix and up to 20 percent phenocrysts of quartz, albite and K-feldspar. The effect of the most obvious alteration is to produce a white or "bleached" rock in which quartz eyes and relict feldspar phenocrysts are apparent.

The rhyolitic rocks are cut by several intrusions (see figure 3) of which the most important is a small irregular plug more-or-less centrally located in figure 3. This small plug is a zoned intrusion more basic at the margins than at the core. Because of this variability in composition it has been variously described as a quartz monzonite (Montgomery et al., 1975) or a quartz diorite (Sinclair, 1969). The stock is of considerable importance because it is mineralized both with chalcopyrite and molybdenite along joints with some pyrite both as veins and disseminated crystals.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76 N
72 N
64 N
56 N
48 N
LEGEND
INTRUSIVES
Late dikes, post min
Quartz feldspar porphyry
Quartz monzonite
Rhyolite porphyry
VOLCANICS
Upper porphyritic rhyolite
Middle porphyritic rhyolite
Fragmental rhyolite
Lower porphyritic rhyolite
SCALE
400 0 400 800
FEET
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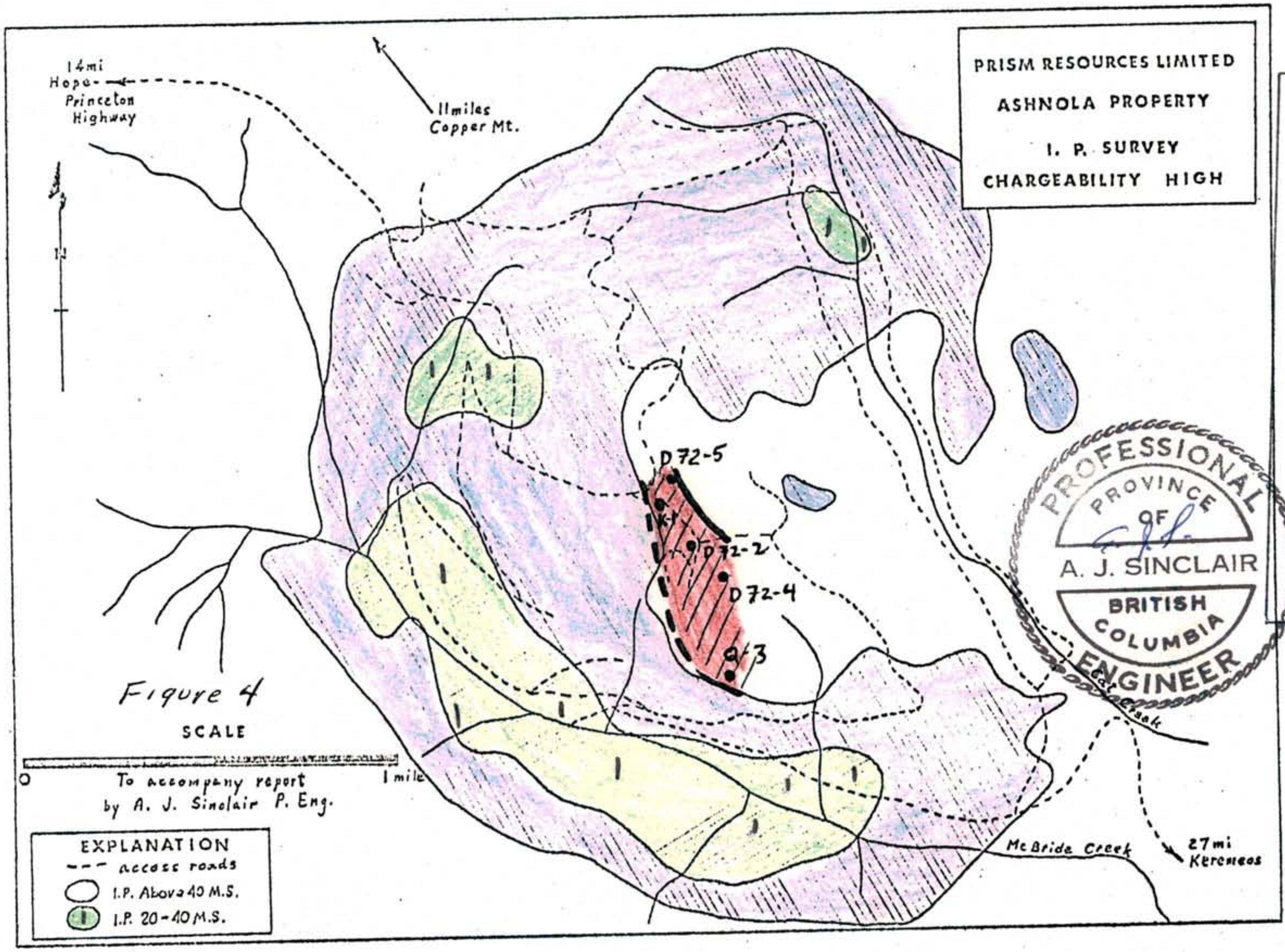
GEOMETRIC FORM OF MINERALIZED ROCK

Sulphide mineralization has occurred over an area more than two miles in diameter. The most obvious mineral species introduced in pyrite which is readily observable concentrated in numberous fractures in outcrops more-or-less concentrated in the outer parts of the mineralized region. Geometric form of this zone of concentration of pyrite is not apparent purely from outcrop patterns because of the scarcity of outcrops over much of the area in question. However, a relatively detailed induced polarization survey (Cochrane, et al 1970) resulted in recognition of a chargeability distribution pattern that provides insight into the large scale form of pyrite-rich rock. Chargeability results are summarized in figure 4, which in brief, shows a pronounced, horseshoe-shaped chargeability high (greater than 20 milliseconds) about 2 miles in diameter, surrounding a central chargeability low. Examination of drill core and surface exposures indicates beyond a doubt that the chargeability high coincides with a pyrite-rich zone in which the volume percent pyrite in surface rocks and drill core is commonly in the range 2 to 5 percent and locally exceeds 10 percent (Montgomery, 1966). There seems to be little doubt that this distribution pattern of pyrite-rich rocks represents a classical example of a pyrite halo of the type envisaged in the porphyry copper model proposed by Lowell and Guilbert (1970).

We thus have a reasonable picture of the 2-dimensional

Figure 4

Diagram showing the positions of 5 highest grade drill holes (labelled black dots) on the Ashnola property, relative to a horseshoe-shaped zone of chargeability (milliseconds) highs which is interpreted to indicate roughly the surface projection of a pyrite halo. The hachured zone, significantly enriched in Cu (and Mo) relative to adjacent rocks is located along the inner margin of the pyrite halo as expected in idealized porphyry systems and forecasted by the model of Lowell and Guilbert (1970). Grades of drill holes within this mineral zone are about 0.1% Cu whereas grades for dill holes outside the zone are more commonly in the order of 0.01% to 0.03% Cu.



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form of the Ashnola pyrite-zone, i.e. a horseshoe-shaped zone whose central trace coincides in general with the central trace of a chargeability high. There is no detailed information relating to the third dimension. However, the circular plan and smooth contours of the high chargeability zone virtually necessitate steep if not vertical dips for the pyrite-rich zone. Therefore, it seems reasonable to view the pyrite halo as a more-or-less cylindrical zone (perhaps slightly conical with apex up) and having a near-vertical axis. This concept is important in planning of follow-up exploration because of the scarcity of outcrop over much of the property. Thickness of the "walls" of the cylinder (i.e. thickness of the pyrite-rich zone) cannot be determined exactly because it is not possible to relate particular millisecond contours to specific pyrite contents. Furthermore, the margins are gradational, and thus arbitrary, particularly towards the core of the porphyry system where drill holes show the presence of small amounts of pyrite.

Distribution of sulphides of economic interest is of prime interest and can be examined from several points of view. In a general sense, geochemical data for soils shows anomalous molybdenum values to be locallized in a relatively small part of the total area and to be centered on a quartz diorite plug. This seems to indicate a relationship between the most obvious molybdenite concentration on the property and the quartz diorite plug, a relationship particularly obvious in the western part of the porphyry system where outcrops are relatively abundant. Molybdenite has not been found in great quantity in the eastern part of the mineralized zone but outcrops are scarce and overburden is sufficiently deep that concentrations, even were they present, might not be reflected in surface soil samples.

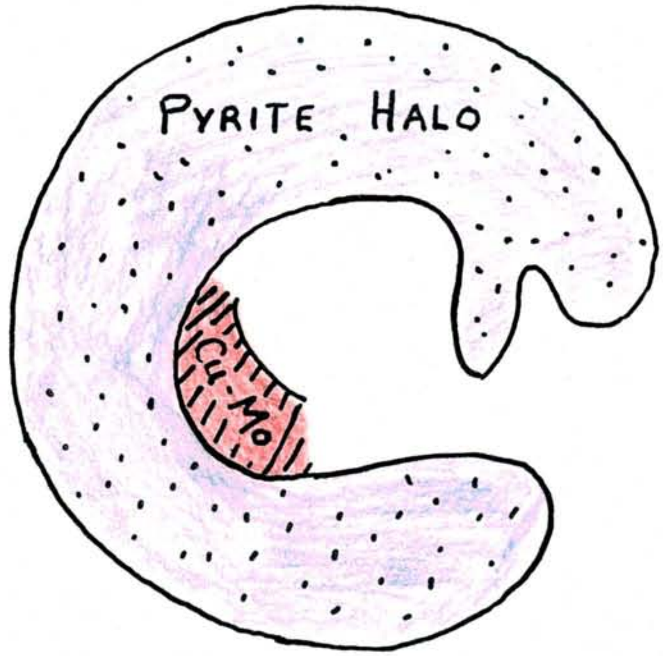
Distribution of anomalous copper values, on the other hand, shows a pattern that corresponds in part to the pyrite halo and in part to the plug with associated molybdenite. This relationship is well expressed by soil sample data: anomalous copper values outline the general form of the pyrite halo in an obvious but intermittent way. Drill core examination shows that the dominant copper-bearing sulphide is chalcopyrite, although minor supergene copper (chalcocite and covellite) has been recognized.

A particularly interesting approach to examining the distribution of primary copper is to study average copper assays for drill core below the zone of weathering (Sinclair, 1973). Some drill holes provide a substantial amount of assay information distributed over much of the mineralized zone and show a striking distribution pattern. Figure 5 shows two populations of average drill hole assays differing by nearly one order of magnitude. A low grade group can be represented by copper assays of about .01 to .03% whereas a higher grade group of assays (hachured zone, figure 5) is about 0.1% or slightly higher. Only drill holes provide average assays in the relatively high group! It is surely more than mere coincidence that these 5 relatively high grade holes occur together in an area containing no holes with average copper assays in the low group. In fact, the general position of these 5 high grade holes, on the inner side of the pyrite halo, is also of considerable interest, for such a distribution is consistent with the porphyry copper model of Lowell and Guilbert (1970). A consideration of the geometry of the pyrite halo and the related zone of relatively high grade copper suggests a useful working model for defining an exploration program for the property. Relatively rich copper zones can be expected in a cylindrical zone on or near the inner margin of the cylindrical pyrite halo! This model provides a guideline for outlining drill targets, the most obvious of which is a relatively deep drill hole beneath the known relatively high grade zone (Sinclair, 1973).

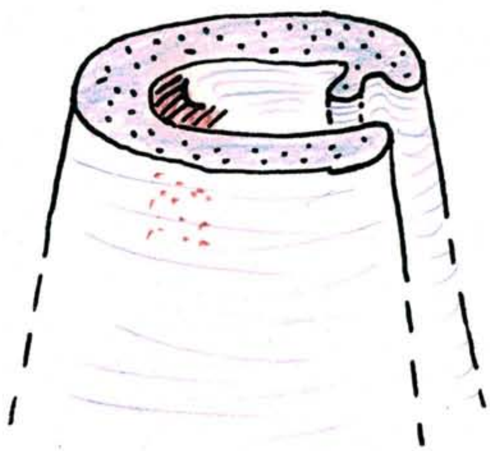
The gross geometry of the molybdenum-rich zone (which has associated copper) suggests that a phase of molybdenum and copper mineralization is related to the quartz diorite plug on which it is centered. This mineralizing episode is now best expressed on surface, is clearly visible in outcrops, and has certainly contributed substantially to the high anomalous silts found in McBride Creek (Montgomery et al., 1975). However, this mineralization does not seem to have been part of the mineralizing wave that produced the pyrite halo with its inner copper-rich ring. Basis of the foregoing statement is the fact that the two mineralized features, the halo and the plug, are each symmetric within themselves but are asymmetric with respect to each other--centers of the two minera-

Figure 5

Diagrammatic representation of important elements of the Ashnola porphyry system. A known, relatively high grade copper zone occurs along part of the inner margin of a well-developed pyrite halo. The pyrite halo is assumed to be more-or-less in the form of a vertical cylinder, perhaps tapered slightly upward (i.e. slightly conical). Disposition of drill information pertaining to the copper zone is limited. The possibility of a copper-rich zone around the entire inner margin of the pyrite halo is a possibility that remains to be tested. Depth extent of the copper-rich zone is unknown beyond the fact that some drill holes penetrate more than 400 feet below the surface. By comparison with porphyry models one might expect the grade to increase significantly with depthS



SCHEMATIC PLAN



3-D CONCEPTUALIZATION

Figure 5

INTERPRETED GEOMETRIC FORM

ASHNOLA PORPHYRY DEPOSIT

(not to scale)

to accompany report by
Dr. A. J. Sinclair, P.Eng

lized field related to the plug lies completely within the much larger mineralized field related to the pyrite halo. There is obviously a close correspondance between a group of anomalous soil coppers and the pyrite halo; there is an equally important correlation of relatively high grade copper cores and the inner margin of the pyrite halo. These two facts taken together imply a phase of copper mineralization related to hydrothermal development of the pyrite halo, virtually in the ideal sense presented in various porphyry copper models. Available evidence indicates that at least at the present level of exposure. little or no molybdenum was incorporated with this class of copper mineralization. One must bear in mind that geochemical evidence for the foregoing statement is relatively abundant in the western half of the porphyry system but is essentially absent in critical parts of the eastern part of the system.

A second phase of mineralization is obviously centered about the quartz diorite plug and consists of both copper and more prominent molybdenum than is present in the other copper association.

The relation between the two phases of mineralization is not obvious except that it seem unlikely they both formed at precisely the same time, principally because it is difficult to see how two so symmetric mineralized zones could develop about different but overlapping centers at precisely the same time without interfering with each other and producing a more complex pattern to the resulting mineralized zones.

However, no cross-cutting relations have been observed in drill core or outcrops to indicate which of the two mineralized zones might have developed first. From a practical point of view the important feature is that the two phases of mineralization are related genetically in the same large scale porphyry system!

HYDROTHERMAL EFFECTS

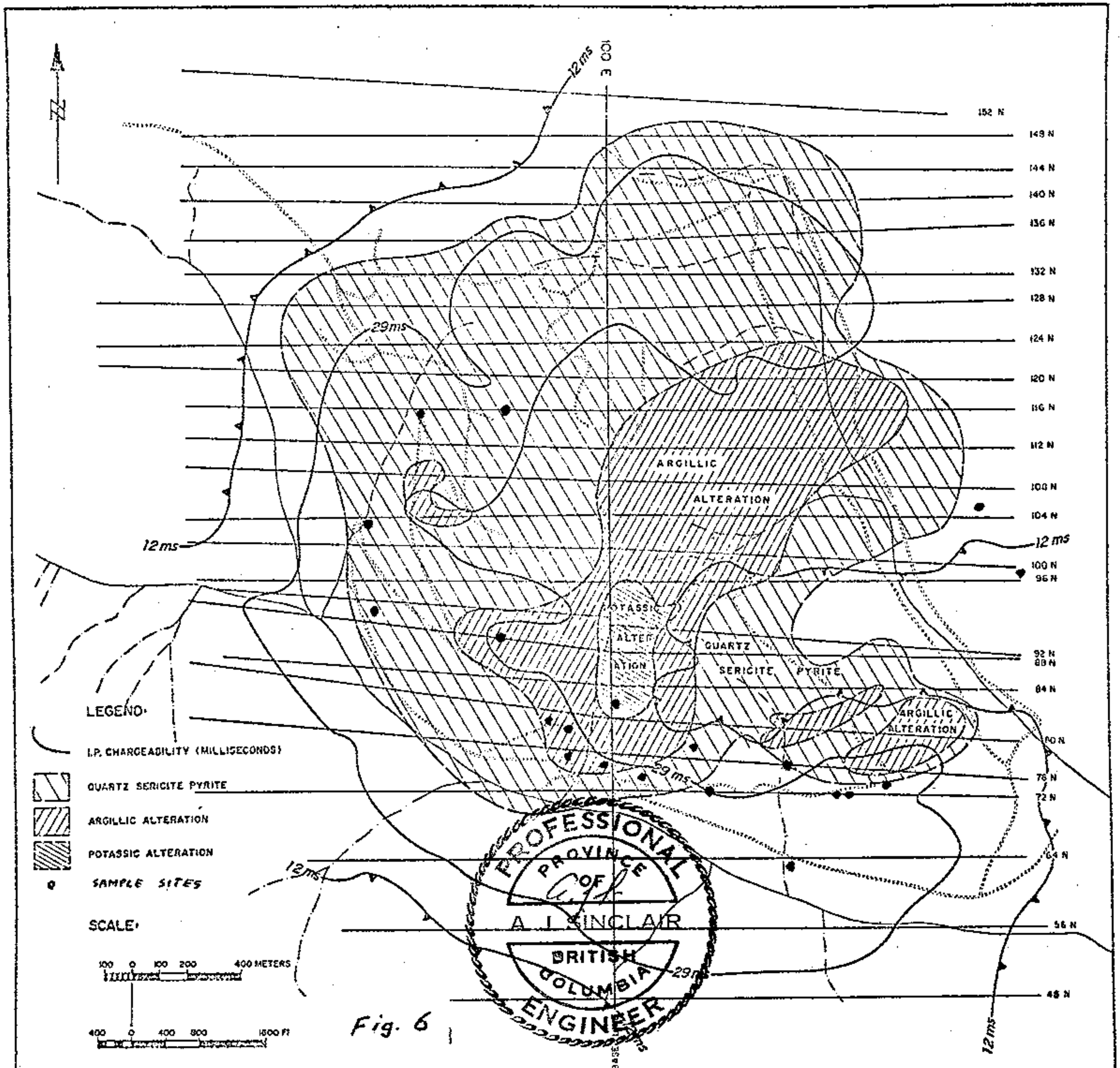
General

No evaluation of the total hydrothermal system at Ashnola has been attempted in the past, and those aspects that have been recorded and discussed suffer in general from the inability to describe hydrothermal features with confidence solely on the basis of visual examination of drill core and limited outcrops. One such early study dealing with field (megascopic) identification of various categories of hydrothermal alteration is shown in figure 6 (from Montgomery et al., 1975). This study, in common with an earlier one by Arnold and Lowell (1968) suffers from the limitation that many of the rocks and hydrothermal minerals are too fine-grained for safe visual determination, and only gross features, particularly textural, can be mapped with confidence. The field designation of alteration facies is very subjective and ambiguous when based only on megascopic mineral identification. In fact, the microscope work on which much of this report is based, shows that some of the nomenclature used in the foregoing field compilations is incorrect.

The purpose of the study reported here is to refine our ideas of alteration and sulphide deposition in the Ashnola porphyry system based on microscopic studies of a large suite of drill core and specially selected surface specimens. Outcrop samples were taken as a series of large chips (normally 5 or 6) taken randomly over an area of 100 to 200 square feet (depending on the outcrop situation). An effort was made to avoid, as much as possible, the effects of surface weathering on such chips, which hopefully reflected the local variability of hydrothermal effects. Drill cores were sampled to examine typical and particularly well-developed examples of hydrothermal effects that could be observed megascopically. One of the purposes of the sampling program was to permit correlation of results of the microscope studies with practical, recognizable types of hydrothermal features useful for field mapping purposes. Thin sections and polished sections were prepared from many of the samples. About 60 individual samples were examined in detail in this study. Sample locations are shown in figure 6.

Figure 6

Map showing the distribution of alteration zones based entirely on field mapping and megascopic identification of minerals. Black dots show the locations of sample sites for the microscope study on which much of this report is based. The alteration study is based largely on a compilation of data by D. R. Cochrane, P. Eng. (cf. Montgomery et al., 1975).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ATION
QUARTZ
SERICITE PYRITE
ARGILLIC
ALTERATION
LEGEND:
I.P. CHARGEABILITY (MILLISECONDS)
QUARTZ SERICITE PYRITE
ARGILLIC ALTERATION
POTASSIC ALTERATION
SAMPLE SITES
SCALE:
100 0 100 200 400 METERS
400 0 400 800 1600 FT
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Fig. 6

Quartz Diorite Pluton

The quartz diorite pluton is an irregular body about 2000 feet north-south by 600 feet east-west that intrudes a succession of rhyolitic porphyries. The intrusion is itself porphyritic in nature although this is not readily apparent in hand specimen. About 80 to 90 percent of the volume is phenocrystic (tightly packed) with the remainder being a very fine-grained mosaic interstitial to phenocrysts. Central parts of the plug contain very large K-feldspar phenocrysts up to 3 or 4 cms. in maximum dimension and other abundant minerals such as quartz and plagioclase are also coarser grained than near the margins. Quartz phenocrysts resemble those in the porphyritic rhyolite country rock. Plagioclase is andesine. Mafic minerals include biotite and hornblende and accessories noted are apatite and zircon.

Alteration: Plagioclase phenocrysts locally are sericitized pervasively, and elsewhere are essentially unaltered. Intermediate stages of sericitization are shown and generally show a control of alteration by twin planes and certain compositional zones. Plagioclase phenocrysts are cut by pyrite veinlets that locally contain sericite as flakes along and parallel to the margins of the vein. Sericitization in the plagioclase is minor and sporadic except for thin irregular selvages along epigenetic veins where an extensive 3-dimensional matte of small sericite crystals has replaced the plagioclase to varying degrees.

Biotite is partly chloritized with no particularly systematic mode of occurrence of chlorite. Replacement of biotite ranges from nil to almost complete. As the extent of biotite replacement increases the crystal form of the resulting pseudomorph deteriorates as the edges become more and more ragged. Inclusions of apatite are commonly present in biotite. Less common inclusions are magnetite and sphene. Magnetite is normally present in biotite that has been partly chloritized. Apatite crystals are aligned parallel to the cleavage and were probably trapped in the growing crystal face, thus are primary. The magnetite is certainly secondary and a product of chloritization. Large biotite crystals tend to retain the original crystal form regardless of the extent of replacement by chlorite. Small crystals, on the other hand, are all largely chloritized and retain no semblance of crystal form. In a few cases large biotite crystals are now completely replaced by coarse-grained sericite and chlorite interleaved. Only small amounts of carbonate are present and these show no particular association with plagioclase.

The matrix is very fine-grained and may be devitrified glass. It does not appear particularly altered although a few small grains of sericite and/or carbonate can be seen here and there.

<u>Sulphides:</u> Sulphides in and near the quartz diorite plug occur in two distinct forms: (1) disseminated, and (2) fracture filling.

Disseminated sulphides consist almost entirely of pyrite with rare chalcopyrite. In some cases disseminated pyrite grains about 1 to 2 mm in diameter make up 2 to 3 percent (volume) of hand sized specimens. Form of the grains is subhedral or anhedral. Chalcopyrite, if present, is partly moulded around pyrite grains to form partial rims. The implications seems to be that chàlcopyrite is at least in part, post-pyrite in age. Chalcopyrite grains are most commonly half to one-quarter the volume of associated pyrite grains. Disseminated sulphides are found locally through much of the drill-core that penetrates the quartz-diorite pluton in two recognizable forms (a) as disseminations concentrated near quartz-sulphide veinlets and almost certainly related genetically to such veinlets, and (b) as individual grains within fresh-appearing quartz diorite and apparently unrelated directly to hydrothermal effects such as quartz and/or sulphide veinlets. Disseminated sulphides are almost exclusively pyrite with minor amounts of chalcopyrite whereas vein sulphides although also containing abundant pyrite are relatively rich in chalcopyrite and molybdenite.

Veins are filled dominantly with a quartz-pyrite-sericite assemblage in which either quartz or pyrite can dominate and sericite might or might not be visible megascopically. Common accessory sulphides are chalcopyrite and molybdenite although these two sulphides are most obvious in small veinlets in which one or the other or both predominate, in some cases almost to the exclusion of pyrite and quartz. These veinlets are found both within the quartz diorite pluton and in adjacent country rock (porphyritic rhyolite) and the apatial association suggests that all are related to the same episode of mineralization.

Many samples show several directions of veinlets but no evidence has yet been found for a particular paragenetic sequence to those of differing mineralogy. The following criteria provide only a vague concept of paragenesis: (a) in quartz-pyrite veinlets pyrite invariably is centrally disposed, (b) pyrite-rich veinlets throughout the core and the pyrite halo generally contain only small amounts of chalcopyrite and/or molybdenite, (c) veinlets rich in chalcopyrite and/or molybdenite generally little pyrite and little quartz, and (d) chalcopyrite in a number of specimens can be seen to be wrapped around subhedral crystals of pyrite. The paragenetic interpretation of these textural and mineral association features is that quartz is early in the sequence, followed by pyrite which in turn was followed by chalcopyrite and probably molybdenite. It is probably that quartz deposited intermittently through the mineralizing episode, and that overlap occurred in the deposition of the sulphide minerals. It is further apparent that the position of molybdenite in the sequence of deposition based solely on its common occurrence with chalcopyrite, is uncertain. This paragenetic sequence, nevertheless, seems to be generally correct for the deposit although locally it would differ somewhat if only for the fact that not all minerals are present in all veinlets.

Porphyritic Rhyolite

Pyrite Halo: Diamond drill hole MC-2 was examined in detail as representative of the pyrite halo in the porphyritic rhyolite. The hole is collared in the central part of the pyrite halo in a zone where chargeability values are relatively high. The rocks penetrated by the drill hole are entirely porphyritic rhyolite that varies in character only slightly, apparently due to slight differences in the intensity of alteration effects. The drill core is characterized by the presence of thin seams of pyrite (and lesser quartz), commonly about 1 to 5 mm in width. A thin bleached occurs on both sides of some veinlets. Such alteration selvages are most pronounced if quartz is relatively abundant and is virtually lacking in veinlets that are almost entirely pyrite. Vein density is generally about 2 to 4 per foot of core but locally they are 6 to 8 per foot. Also there are local occurrences of substantially thicker veins, which are largely quartz-filled with little or no pyrite apparent. No diagnostic crosscutting relations have been observed. The only paragenetic information available comes from within individual veins and is similar to that already described for veinlets in the quartz diorite pluton. Sericite is common in these veins and is most abundant along the boundaries of veins and within their alteration haloes (selvages). Careful examination of hand specimens will invariably locate small flakes of sericite along vein margins and parallel to vein walls.

The most striking feature of the host rock is the lack of intensity of hydrothermal effects. The rock has been effected by deuteric alteration,principally a weak pervasive sericitization, but otherwise is not bleached (i.e. hydrothermally altered) to the same extent as much of the country rock in the core of the porphyry system.

Sulphides other than pyrite are found only locally in the pyrite halo. The former presence of chalcopyrite, for example, is most obvious in the oxidized zone where even small amounts of malachite stain are clearly evident. Both chalcopyrite and molybdenite are seen locally in small amounts in specimens from the pyrite zone and their scattered occurrence throughout the entire pyrite halo is indicated by the distribution of anomalour Cu and Mo soil values. Magascopic recognition of chalcopyrite is rare in surface specimens.

Core Rocks: Core rocks that are more-or-less encircled by the pyrite halo are largely porphyritic rhyolite. Here we are concerned principally with those rocks lying in the southern part of the porphyry system in the McBride Creek drainage basin because exposures and drill hole information are more abundant here than to the north, and weathering effects are less pronounced. Where fresh the rhyolite has a pale green or brownish aphanitic matrix with up to about 10 percent phenocrysts of quartz and feldspar. The principal megascopic effect of alteration is to produce a "bleached" rock almost white in colour. In fact, various stages of alteration are present and less altered rocks show the very definite relation between quartz-pyrite veinlets and hydrothermal alteration. Where the rock is not pervasively bleached thick bleached envelopes occur around quartz-pyrite veinlets and sericite concentrations are apparent. Gradational changes can be seen locally between the two end-member types of field relations described above and establish a spatial and probably genetic relations of sulphides and sericitization.

In thin section the rock is seen to consist of abundant phenocrysts of quartz and perthite in a dense matrix. Quartz phenocrysts are resorbed to some extent and in a few cases show limited shadowy extinction indicating slight deformation.

Phenocrysts are resorbed in the case of quartz and altered to differing degrees in the case of other minerals. Primary mafic minerals will be described later. Plagioclase is extensively sericitized and the less abundant K-feldspar is only slightly altered. The matrix is essentially microcrystalline to cryptocrystalline feldspar and quartz, that is somewhat variable is grain size and suggestive of formation be devitrification of glass. Elsewhere in the matrix small biotite crystals have been observed in association with magnetite and K-feldspar. This biotite appears to be primary.

A few patches of muscovite-biotite-spene-apatite-feldspar with grain size approaching the bulk of the matrix represent all that remains of primary mafic minerals. The outlines and mineralogical content of these patches suggest that the primary mineral was probably an amphibole, likely hornblende. Limited amounts of biotite cut coarse-graines quartz that occurs in veinlets, proving the secondary nature of the biotite.

No evidence for the presence of primary or secondary mafic minerals has been presented prior to the present study. However, the presence of both is now confirmed. A good example to illustrate the nature of such mafic minerals is from outcrop near drill hole Q-3. The rock is of particular interest because (1) it is mineralized, being cut by very thin pyrite-bearing veinlets and quartz-molybdenite veinlets very rich in molybdenite, (2) the nearby drill hole Q-3 is one of the richest drill holes on the property, and (3) the rock is cut by numerous thin pink veinlets (containing minor amounts of pyrite) that resemble those developed in rhyolitic country rock immediately adjacent to the quartz diorite plug. Mafic minerals although not abundant, have a particular textural pattern that indicates they are secondary and probably derived, at least in part, from primary amphibole. Minute grains of mafic minerals occur in clusters of the following associations:

(1) biotite-magnetite-feldspar-sericite with an overall diamond-shaped form to the concentration,

(2) magnetite-hornblende-biotite-sericite-feldspar-quartz-carbonate

(3) biotite-hornblende-magnetite-sericite-feldspar-apatite

In rare cases a small amount of biotite is chloritized. The important association appears to be magnetite-biotite-feldspar-apatite-carbonate which could well be an alteration product of amphibole. This combined with textural evidence indicates the original presence of primary hornblende.

Other alteration effects in the same rock are extensive sericitization of all plagioclase as well as minor carbonatization. In some plagioclase crystals minute sericite grains with random orientation are scattered throughout, although twinning is readily recognizable and in most crystals a vague normal zoning is apparent. The present composition of the plagioclase is not know accurately but based on refractive indeces estimations is probably nearly pure albite. Carbonate is rare in these plagioclase phenocrysts but is observed locally. Carbonate is present, however, in minor amounts scattered erratically through the matrix and could well have been formed by introduction of CO_2 with Ca derived from alteration of a somewhat more clacic plagioclase than now exists. In some cases sericite alteration is noticeably concentrated in particular twin segments, or growth zones.

Red-Brown Veinlets

Red-brown veinlets have been noted in two localities associated with mineralized rock: (1) in rhyolitic wallrock adjacent to the central quartz diorite pluton for several tens of feetaway from the contact into the wallrock, and (2) in outcrops near drill hole Q-3, one of the richest drill holes in terms of average copper assay.

The association with chalcopyrite and molybdenite is apparent in both cases and emphasizes the importance of this type of alteration, particularly because it is a type of alteration that is readily apparent magascopically. Thin section examination shows the mineralogy of these veinlets to be quartz-carbonate-sericite-pyrite and small amounts of anhedral masses of a highly birefringent, high refractive index material (possibly cassiterite). Pyrite is very uncommon and sericite is sporadic; quartz and carbonate are both commonly present although quartz is generally the more abundant of the two. The red-brown colour of these veinlets is not established but might be due to colouration in the carbonate.

Weathering

Weathering has been extensive over much of the area of concern, with the effects most pronounced in two distinct geological environments. Most obvious is the extensive limonite stain and/or gossan developed on exposures and near exposures (or present in the upper part of drill holes) of the pyrite halo. In some cases, particularly along the southern part of the pyrite halo on the north slope of McBride Creek, a fairly extensive gossan is developed locally and it is difficult to obtain fresh rock surfaces.

The second environment in which weathering is particularly pronounced is in fracture zones exposed in trenches along the central part of Cat Creek. Here the rocks are locally brecciated and weathering has been intense; so much so that sulphides are entirely leached. Small local patches of oxides (limonite and malachite) remain but extensive leaching has occurred.

Both of the environments are within the pyrite halo, the Cat Creek locale being augmented by the presence of breccias. It seems likely that the oxidation of pyrite has promoted the extensive weathering observed. One of the products of this intensive weathering is clay minerals (perhaps including sericite) as can be inferred from the very intense nature of some of the surface weathering. It seems likely that in such cases of pervasive weathering there will be difficulty in distinguishing hydrothermal effects from some surface or near-surface weathering effects. Fortunately the zones of particularly intense weathering are recognizable and, furthermore, surface effects are penetrated by drill holes. One should be aware, however, that locally some ambiguity exists in determining the origin of alteration effects. It is thus apparent that early attempts to map alteration, based solely on outcrops, were made complex and of dubious worth because of the superposition of weathering on hydrothermal effects and the problem of distinguishing the two.

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A. J. Sinclair

Dr. A.J. Sinclair, P. Eng.
September 22, 1975.

CERTIFICATE

I, Alastair J. Sinclair, of the city of Vancouver,

province of British Columbia, hereby certify:

1. That I am a Geological Engineer residing at 2972 W. 44th Ave., Vancouver, British Columbia.

2. That I obtained a B.A.Sc. degree in Applied Geology from the University of Toronto in 1957, an M.A. Sc. degree in Geological Engineering from the University of Toronto in 1958, and a Ph.D. in Geology from the University of British Columbia in 1964.

3. That I am a registered Professional Engineer in the Province of Ontario in the Mining Division, and in the Province of British Columbia in the Geology Division.

4. That I have practiced my profession for eighteen years.

5. That I have no interest directly or indirectly, nor do I expect to have any direct or indirect interest in the properties or securities of Prism Resources Limited.

6. That the accompanying report is based upon my studies of various reports on previous exploration work done on the Ashnola property, visits to the property, examination of drill core, and detailed examination of thin sections and polished sections.

Dated at Vancouver in the Province of British Columbia,

this 22nd day of September, 1975.

A.J. Sinclair

A.J. Sinclair, P.Eng.

ALLOTMENT OF EXPENDITURES

EXPENDITURES

Dr. A. J. Sinclair, P. Eng.	
Professional Services	$2990.00
Expenses (transportation, food)	225.50
F. E. Montgomery	
Preparation of polished sections and thin sections	63.00
TOTAL EXPENDITURES	$3278.50

These funds should be allocated as outlined in Affidavits on Application to Record Work filed in Vancouver on July 25, 1975. In brief, one year's assessment work is to be assigned to each of the following claims:

RED GROUP:	Jam 20, 21 and 22	(3)
ALPHA GROUP:	Q 1, 3, 6, 15, 16, 30, 31, 47 and 48	(9)

and two years assessment workis to be assigned to

ALPHA GROUP:	Q 2, 4	(4)
Total Number of Claim-years		(16)

Total Required Assessment 16 x $200.00 = $3200.00

PROFESSIONAL PROVINCE OF A. J. SINCLAIR BRITISH COLUMBIA ENGINEER

Attach to Assess Rpt 5610

APPENDIX

LIST OF SAMPLES STUDIED
(to accompany report by A.J. Sinclair dated Sept. 22, 1975)

Sample	Quantity of specimens	Rock Name
A 1	1	Fresh rhyolite porphyry
A 2	1	Quartz monzonite
A 3	1	Fresh grey rhyolite porphyry (with moly veinlet)
A 4	1	Bleached quartz-eye porphyry
GR 1	6	Veined (qtz) and bleached rhyolite porphyry
GR 2	6	Veined and partly bleached rhyolite porphyry (feld)
GR 3	4	Fresh rhyolite porphyry (feld)
GR 4	5	Veined and bleached quartz-eye porphyry
GR 5	5	Rhyolite porphyry
GR 6	5	Bleached quartz-eye porphyry
GR 7	5	Bleached rhyolite porphyry
GR 8	5	
GR 9	6	Weathered rhyolite porphyry (feld)
GR 10	6	Fresh grey rhyolite porphyry (feld)
GR 20	1	Wathered rhyolite porphyry

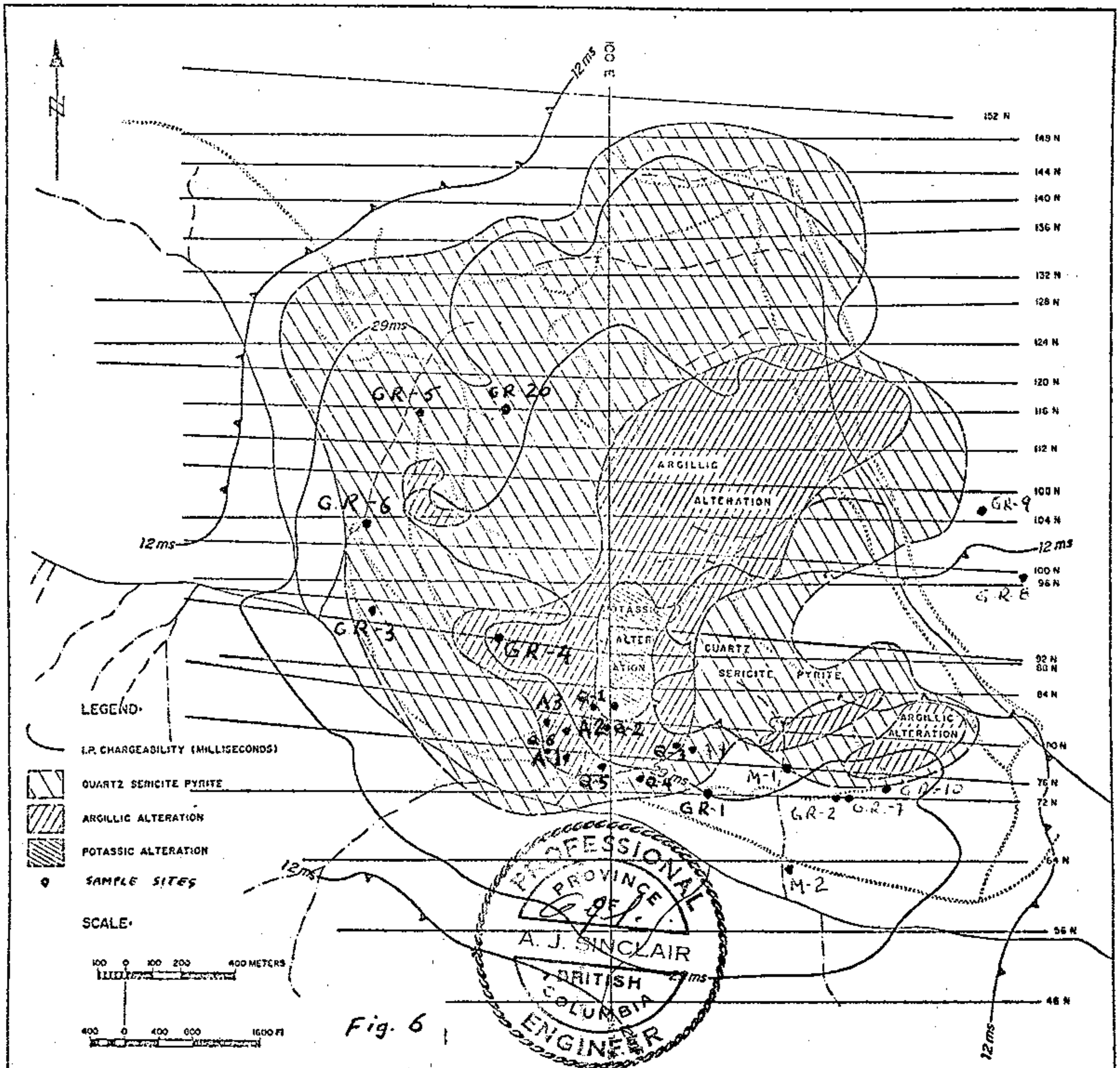
Drill holes MC-1 and MC-2 were examined in detail with specific sampling as follows:

MC-1 Six samples examined in detail from footages 172, 181, 196, 289, 334 and 335.

MC-2 Five samples examined in detail from footages 102, 131, 149, 225 and 336.

Drill holes Q-1, Q-2 and Q-3 were re-examined in detail and selected samples from holes Q-4, Q-5 and Q-6 were examined. See drill logs.

A total of 69 samples were examined in detail as well as re-examination of 8 drill holes.



N
100 E
12ms
29ms
152 N
148 N
144 N
140 N
136 N
132 N
128 N
124 N
120 N
116 N
112 N
104 N
100 N
96 N
92 N
88 N
84 N
76 N
72 N
64 N
56 N
48 N
ARGILLIC ALTERATION
POTASSIC ALTERATION
QUARTZ SERICITE PYRITE
GR-5
GR 26
GR-6
GR-9
GR-8
GR-3
GR-4
A3
A2
A1
GR-1
GR-2
GR-7
GR-10
M-1
M-2
LEGEND
I.P. CHARGEABILITY (MILLISECONDS)
QUARTZ SERICITE PYRITE
ARGILLIC ALTERATION
POTASSIC ALTERATION
SAMPLE SITES
SCALE
100 0 100 200 400 METERS
400 0 400 800 1600 FT
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Fig. 6