3341

GEOLOGY AND GEOCHEMISTRY

STEELE CREEK PROPERTY

55°55'N 125°20'W

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under the supervision of

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NORANDA EXPLORATION COMPANY, LTD.

OMINECA MINING DIVISION

April 1971 - August 1971

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT

NO. 3341 MAP

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A. INTRODUCTION

The Steele Creek property, situated approximately 30 miles northwest of Germansen Landing, B.C., is one of an ever-increasing number of recently discovered syenite copper deposits. These occurrences, principally in quartz deficient intermediate intrusive rocks, are characterized by (1) simple sulphide mineralogy, (2) pink K-feldspar alteration, (3) general lack of pyrite, absence of pyrite halo, and any spatial association of pyrite and ore minerals, (4) absence of molybdenum, (5) absence of sericitic alteration, (6) erratic sulphide mineralization, and (7) development of secondary calc-silicate minerals. The Steele Creek deposit ascribes to all these characteristics except the last.

The property was initially staked in the fall of 1970 due to high copper geochemical values obtained in Steele Creek during an earlier regional silting program. At the time of staking some precursory prospecting revealed chalcopyrite mineralization over a widespread area. In the winter of 1970-71 fifteen thin sections were made from collected samples and studied by the present writer. Topographic base maps on 1000' and 400' scales were prepared and a field program with emphasis on geology and geochemistry was initiated in late June. A crude grid was established to aid in orientation, sample collecting, and geological mapping. Samples for rock and soil geochemical analysis were collected from June through July on the KIP claims and through the middle of August on the STL claims. Geologic mapping of the property was completed during the same intervals.

B. CLAIMS & OWNERSHIP

The property consists of 133 contiguous mineral claims and fractions in the Omineca Mining Division of British Columbia (see Plate I). The claims are owned by Noranda Exploration Company, Ltd. N.P.L. and are listed as follows:

Claims	Record/Tag Nos.	Recording Dates
KIP # 1 - 12	91726-91737	Sept. 3/70
1 - 4 Fr.	91738-91741	"
13 - 18	92290-92295	Sept. 21/70
5 & 6 Fr.	92302-92303	"
25 - 44	200201M-200220M	July 7/71
45 - 52	200242M-200249M	"
53 - 56	200255M-200258M	"
7 - 14 Fr.	200229M-200236M	"
15 Fr.	200254M	"
PIK # 1 - 16	200260M-200275M	"
1 - 6 Fr.	200277M-200281M	"
STL # 1 - 8	200151M-200158M	Aug. 2/71
9 - 16	200162M-200169M	"
17 - 24	200173M-200180M	"
1 - 3 Fr.	200159M-200161M	"
4 - 6	200170M-200172M	"
7 - 9	200181M-200183M	"
KIP #16 - 19 Fr.	968448-968451	Aug. 12/71
57 - 62	968453-968458	Aug. 19/71
20 - 22 Fr.	968459-968461	"

C. LOCATION AND ACCESS

The Steele Creek property is located approximately 30 miles northnorthwest of Germansen Landing between latitudes 55°55' and 56°00'N and longitudes 125°20' and 125°25'W. The property is accessible by helicopter from Smithers or Ft. St. James. During the summer, however, at least one or more helicopters are based at Germansen Landing which means that less costly float-equipped aircraft or ground transportation can be utilized for a greater part of the distance. Although there is no direct access by road, a good dirt road exists from Germansen Landing north across the Osilinka and west to near the confluence of this river and Haha Creek passing within 2 miles of the north boundary of the property.

D. PHYSIOGRAPHY AND GEOMORPHOLOGY

The Steele Creek property lies in the center of the Omineca Mountains of the Central Plateau-Mountain Area of the Interior system of the Canadian Cordillera (Bostock, 1940, pp. 42-44). It is located in the heart of the northwesterly-trending Swannell Ranges at elevations from 4200' to 6200'. The property consists of 3 easterly-trending ridges and 2 intermediate valleys bordered by precipitous glacially carved slopes and cirques to the north and west and gentler slopes and open-ended trunk valleys to the east and south. The map-area is drained by numerous small ephemeral streams on the steeper, north-facing slopes and by 2 larger perennial creeks on the southerly slopes: Steele Creek flows easterly through the center of the property and then north to the Osilinka River; an un-named creek to the south flows roughly parallel to Steele Creek and then turns south to form a tributary of the Duckling Creek watershed. Valley floors and lower slopes are cloaked in scrub timber (mostly balsam and spruce) and "shintangle" to elevations of 5500'.

Approximately 95% of the outcrop encountered was above this elevation. A series of lateral moraines parallels the base of the north slope from Haha Creek to Steele Creek.

A notable feature of the terrain in this area is the persistency of north-facing slopes to be precipitous and unvegetated and south-facing slopes to be more gently sloping and vegetated. This appears to be a post-glacial modification of gross features originating from alpine glaciation and subsequently subjected to differential erosion. Erosional processes (chiefly ice-plucking) have been accelerated on the sheltered north slopes, and lessened on the south slopes where exposure to a longer growing season has resulted in a protective vegetation cover and immature soil development.

A well-developed rock glacier occupies a north facing cirque on the west-edge of the property - there has been apparently little relative movement in recent years as evidenced by substantial lichen growth on the upper surfaces of the rock fragments.

For a more comprehensive treatment of climate, glacial history, etc. the reader is referred to G.S.C. Memoir 274, Geology and Mineral Deposits of Aiken Lake Map-Area, B.C. by E.F.Roots, which fully describes the area to the immediate north of the Steele Creek map-area with which it is physiographically identical.

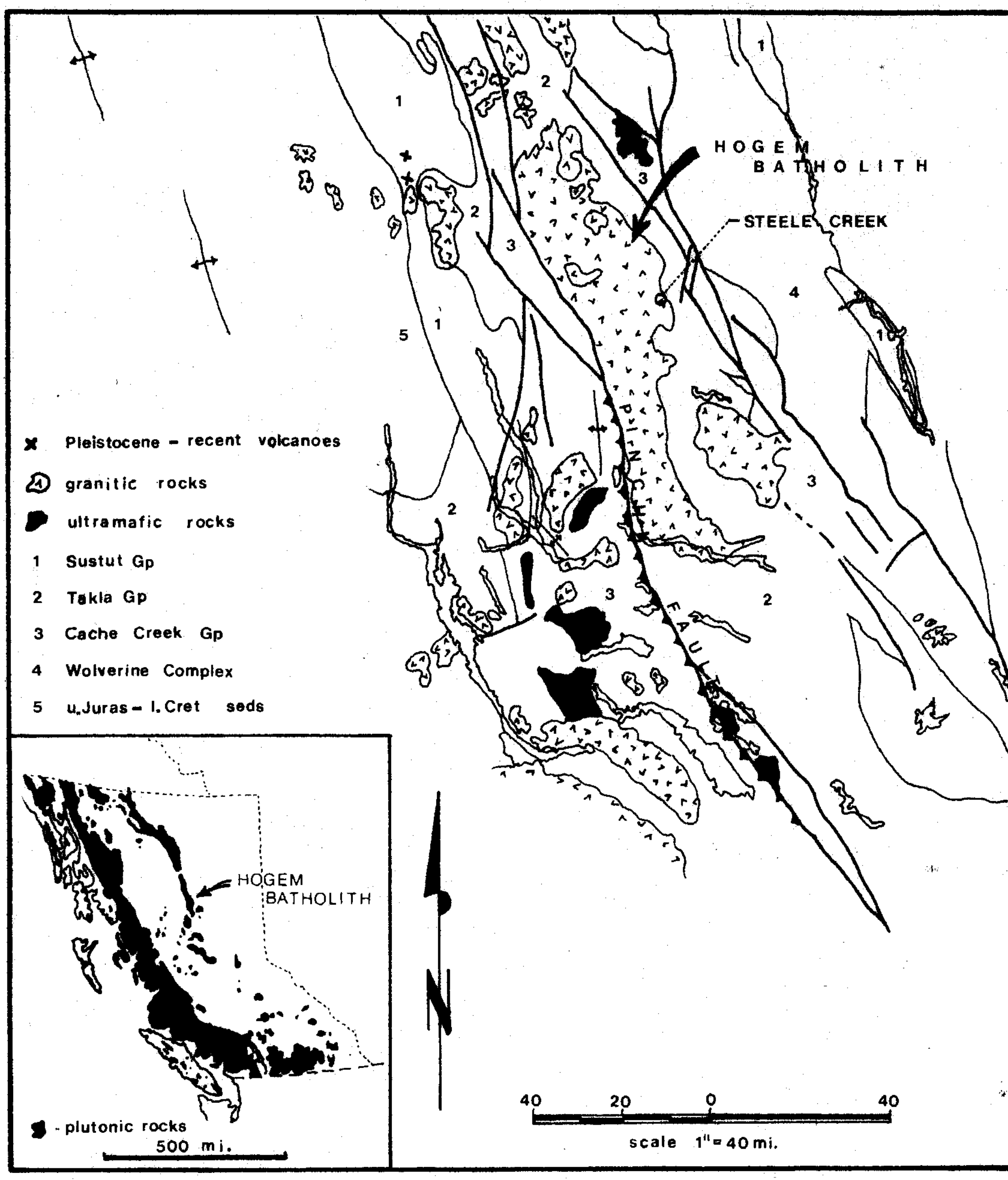

Fig. 1. Sketch showing location and geologic setting of the Steele Creek Property.

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E. GEOLOGIC SETTING

The Steele Creek property is underlain by quartz-deficient border-phases of the Hogem Batholith, the largest body of the Omineca Intrusions. The Hogem body, mainly granites and granodiorites, is a northwesterly-trending elongate pluton that extends from Chuchi Lake north for approximately 75 miles. It is bordered to the west by the Pinchi Fault and to the east by Takla volcanics. Three bodies of syenite are known to occur within the Hogem rocks: the Chuchi Lake syenite; the Duckling Creek (Lorraine) syenite; and the smaller Steele Creek syenite. The first two mentioned have been mapped by Armstrong (G.S.C. Memoir 252, p. 99) and the second has been investigated in more detail by Koo (1968). No mention of the Steele Creek syenite exists in the literature. These three bodies are all younger than the main Hogem intrusions and, as suggested by Armstrong, may represent either late phases of the Hogem or much later Cret - Tert. intrusions. Koo (ibid) however, has established a K/Ar date of 170$\pm$ 8 m.y. using biotite from "hypermelanic fenite". This presumably represents the last stage of magmatic activity associated with the Duckling Creek body and, if so, indicates emplacement of the syenites during the lower Jurassic. Acceptance of this date would push back Armstrong's Upper Jurassic-lower Cretaceous age for the Omineca intrusions correspondingly.

F. DETAILED GEOLOGY

1. Introduction

Quartz deficient border phases of the Hogem granodiorites underlie the Steele Creek property. A small plug of syenite extends from the center of the map-sheet to the northeast while more basic monzonitic-dioritic rocks outcrop on the north, west, and south sides of the property. Two main periods of intrusion are envisioned: a monzo-dioritic suite (Phase I) temporally and compositionally related to the bulk of the Hogem intrusions; and a younger, syenitic suite (Phase II) representing the last phase of magmatic activity associated with the Hogem Batholith. Phase I rocks consist of coarse-grained monzonites, fine-grained diorites, and fine-grained, mafic-rich dykes. Phase II rocks consist of porphyritic and pegmatitic syenites and associated fine-grained rocks. The action of metasomatizing fluids originating from the syenitic body has given rise to a highly irregular aureole of K-feldspathized monzonites. The intensity and extent of the metasomatism increase with grain size and fracture density. Two major trends of systematic jointing in the Phase I host rocks are apparently associated with emplacement of the Phase II stock. These are probably tensional features generated from intrusion and crystallization of the syenites. Quartz-veining is locally abundant in the syenite porphyries but absent in Phase I rocks. Copper mineralization occurs in the quartz-veins, syenites and K-feldspathized monzonites in minor amounts. Gossans are developed on the property but these are related to weathering of magnetite and ferromagnesian minerals and are not associated with sulphide oxidation.

2. Phase I Intrusions

a) Monzonites

(i) Introduction:

The monzonitic rocks that outcrop on the property are, where unmetasomatized, relatively homogeneous, medium-coarse grained mesocratic rocks that are compositionally close to the monzonite-diorite borderline - thus the designation monzo-diorites. The fabric is typically hypidiomorphic-equigranular though locally porphyritic development of K-feldspar and plagioclase has occurred. Inclusions of hybridized country rock or relict crystals are common in some places. Pink stringers are present in varying density in all the outcrops. Fresh rock becomes bleached in outcrop and weathers to a diagnostic light-coloured rubble.

(ii) Mineralogy and Textures:

An averaged modal composition based on thin section examination of four monzo-dioritic rocks yields the following mineral abundances: plagioclase 50%, K-feldspar (microcline and orthoclase) 25%, hornblende 10%, augite 5%, biotite 5% and minor quartz, chlorite, epidote, tourmaline, calcite, apatite, magnetite and sphene. Magnetite is always present, often in amounts up to 5% and is invariably associated with primary mafic minerals and their derivatives.

Plagioclase typically occurs as subhedral-euhedral Carlsbad-Albite twins varying in length from < 1 mm to 5 mm. Zoning was observed in only a few grains. Plagioclase composition varies from An_{32} - An_{60} (average An_{44}). Locally, reduction of other componental grain sizes results in a weak porphyritic texture (not readily observable in hand specimen) with andesine or andesine plus orthoclase phenocrysts and some specimens exhibit parallel alignment of phenocrysts. Saussuritization of plagioclase has occurred in selected grains and has been restricted to the more calcic core regions. In one specimen (B-1-2-70) nearly all the andesine laths exhibit flexed twin lamellae and crystal boundaries - this suggests deformation concomitant with crystallization of interstitial components.

K-feldspar occurs as euhedral grains, large interstitial anhedral aggregates, minute interstitial segregated anhedra, micrographic intergrowths with quartz, and as orthoclase rims around plagioclase. The greater abundance of K-feldspar is orthoclase but microcline is sometimes present as early-formed euhedral grains. Relatively fresh perthitic subhedral K-feldspar has also been observed. Where porphyritic textures have developed the groundmass becomes enriched in orthoclase such that K-feldspar, while occupying approximately 10% of the total rock composition, comprises up to 80% of the matrix. Here andesine, augite, and hornblende comprise the larger grains.

The predominant mafic mineral is green anhedral-subhedral hornblende which generally has been chloritized peripherally and sometimes completely. Hornblende is also present along uralitized margins of primary augite. Early-formed hornblende is present as distinct euhedral sections and fragments; late-crystallized hornblende is interstitial and exhibits poikilitic texture with euhedral andesine and quartz.

Greenish-black augite (light-green in thin section) is common as a primary mafic mineral but only rarely exceeds a modal composition of 5%. Most grains are euhedral and a few exhibit {100} twinning. Uralitized rims are common producing haloes of hornblende and tremolite-actinolite assemblages around relict pyroxene cores. Biotite as a primary mafic is rare but does occur in small amounts as an alteration product of hornblende. Accessory minerals include quartz, apatite, sphene, zircon, tourmaline, magnetite, and biotite. Secondary minerals include chlorite in amounts up to 10% and minor biotite, calcite, epidote, and tremolite-actinolite.

b) Fine-grained Diorites

(i) Introduction:

In the northeast part of the mapsheet fine-grained leuco - to melanocratic rocks of dioritic composition are present as late-stage Phase I dykes. Chilled margins and platy foliation have been observed in the diorite along abrupt monzo-diorite contacts. The melanocratic diorites comprise map unit di_1 and the slightly coarser-grained leucocratic phase comprises unit di_2. Local K-feldspathization has resulted in selective digestion of plagioclase by orthoclase and enrichment of albite. The bulk of the dioritic rocks, however, have remained impervious to the Phase II meta-somatic processes and are essentially fresh and unaltered.

(ii) Mineralogy and Textures:

Bulk composition and textural properties remain relatively homogeneous throughout the dioritic rocks. From hand specimen examination an estimated mineral composition is 50% subhedral-euhedral plagioclase (max. length 3 mm; avg. length 5 mm). 40% subhedral-euhedral prismatic augite (max. length 1 mm), fixed in a granular matrix containing a small percent magnetite. Augite locally has undergone uralitization to a soft green mineral (chlorite?). Fracture surfaces often contain pyrite and/or sericite and epidote along fracture planes is present but not abundant. Textures are predominantly hypidiomorphic-equigranular although on a microscopic scale large, widely-scattered laths of plagioclase and augite result in a pseudo-porphyritic fabric.

c) Dyke Rocks

Dykes of two distinct lithologies are associated with late-stage Phase I magmatism and are restricted in outcrop to the north part of the map-sheet. The more abundant unit is a hornblende porphyry (hp) in which dark-green, euhedral laths of hornblende (up to 3 mm in length) are randomly oriented in a fine-grained crystalline or aphanitic groundmass of dioritic composition. Phenocrysts of euhedral plagioclase (max. length 1.5 cm) may also be present in amounts up to 15%.

The less abundant member is a plagioclase porphyry in which pink-rimmed, euhedral plagioclase phenocrysts are regularly distributed in a dark-grey aphanitic matrix. Abundance of phenocrysts varies from 5% to approximately 50% of the whole rock: a well-developed foliation accompanies increased phenocryst concentrations. Magnetite is present in both types although to a much lower concentration in the plagioclase porphyry than the hornblende porphyry.

3. Transitional

(a) K-feldspathized Monzonites

(i) Introduction:

Mineralogic descriptions in the preceding sections have been restricted to relatively fresh members of the monzo-diorite suite. In certain areas, however, where increased fracture density and/or proximity to Phase II intrusions has aided in the migration and availability of altering fluids, weak to intensive K-metasomatism of Phase I rocks has occurred. All the rocks on the property exhibit some degree of stringering by K-feldspar-rich material which, rather than a result of some post-intrusive hydrothermal alteration, is likely penecontemporaneous with Phase II activity. Field relations, in particular dyking of the pink stringers by aplitic syenite and granite dykes, support this hypothesis.

K-metasomatism (predominantly K-feldspathization) of Phase I rocks ranges from wall-rock alteration along thin, widely-spaced fracture-fillings to wholly altered to pink, euhedral orthoclase and dark green hornblende with an entire suite of intermediate varieties. The bulk of the metasomatized rocks, however, are monzo-dioritic members having undergone only partial metasomatism such that original textures (although heterogeneity in fabric is more pronounced) are still recognizable. Development of pink orthoclase and increased amounts of hornblende has given the host rock a diagnostic pink and green hue. Because these rocks are easily recognizable in the field and because they indicate a definite chemical affiliation with Phase II magmatism, they have been mapped as a separate lithologic unit (kmon). It should be emphasized that these rocks are variably metasomatized monzo-diorites and, as such, contacts with unmetasomatized Phase I rocks are gradational and generally highly irregular.

(ii) Mineralogy and Textures

A typical K-feldspathized monzonite is composed of 30-40% anhedral-euhedral twinned plagioclase (avg. comp. An_{38}), 30-40% pink, cloudy, anhedral orthoclase, 10-15% green, anhedral, fragmented, biotitized hornblende, and minor amounts of quart, magnetite, apatite, sphene, etc. Plagioclase varies from fresh, euhedral, well-twinned grains to cloudy, embayed, and partially digested fragments wherein Ab-twin lamellae become less defined. Plagioclase fragments (remnant cores?) and quartz anhedra exist as inclusions in large, subhedral, poikilitic orthoclase. Hornblende typically has a pronounced anhedral outline with or without biotitization of grain margins. Biotite also occurs intergrown with hornblende and secondary biotite is locally concentrated along closely-spaced fracture planes. With an increase in metasomatic intensity, plagioclase becomes depleted and quartz entirely absent and the rock becomes enriched in orthoclase and mafic hornblende and is accompanied by progressive fabric inhomogeneity. Textures are locally very heterogeneous with irregular clotting of mafic minerals, depletion or increase in mineral abundances, variation in grain size, porphyritic development of hornblende and orthoclase, etc.

4. Phase II Intrusions - Syenites

a) Coarse-grained Syenites

(i) General Aspects:

In the north part of the Steele Creek map area a small stock of syenitic material intruded the Phase I rocks principally as a porphyritic phase comprising three units: a porphyritic orthosyenite (osp); a syenite megaporphyry (smp); and a K-feldspar pegmatite (Kpeg).

The first unit is a transitional phase from the syenite megaporphyry to the fine-grained orthosyenites (cf F.4.b). It exhibits discordant relationships with Phase I rocks and apparently intruded as early-stage dykes during Phase II plutonism. Although transitional in composition these rocks comprise an easily mappable unit distinguished by a small abundance of orthoclase phenocrysts randomly oriented in a fine-grained syenitic matrix and by their occurrence in compositionally and texturally unrelated host rocks. Rock type osp comprises approximately 5% of the syenitic rocks on the property.

As the concentration of K-feldspar phenocrysts increases so does the size of the individual grains. The syenite megaporphyry is characterized by remarkably large (max. length 3 inches), dark, tabular orthoclase crystals comprising 20% of the rock. A trend toward axial alignment and platy foliation of the feldspar tablates becomes apparent with increased concentrations and subsequent crowding of phenocrysts. The megaporphyry consists of approximately 20-70% orthoclase phenocrysts, 15-25% subhedeuhedral albitized and saussuritized calcic plagioclase (An_{32}), 5-10% hornblende as biotitized, subequant grain aggregates, 20-50% interstitial K-feldspar, minor amounts of interstitial and granophyric quartz, microperthite, sphene, magnetite, chalcopyrite, and secondary chlorite, sericite, and carbonate. Texture is typically hypidiomorphic-inequigranular and locally mafic-rich inclusions of Phase I rocks occur. Post-intrusive alkali alteration has occurred resulting in heterogeneous soda-and potash-feldspar-rich zones proximal to fractures and quartz veins.

A small, topographically well-defined plug of K-feldspar pegmatite outcrops in the northeast part of the property. This is a leucocratic, coarse-grained rock composed of approximately 75-80% orthoclase crystals in a light granular matrix of orthoclase; mafic minerals are absent. No thin section of this rock type has yet been studied but hand specimen examination shows that the phenocrysts tend to have rounded boundaries suggestive of partial resorption of early-formed orthoclase. Warped cleavage surfaces and a pseudo-radiating habit of crystals have been observed in some specimens: the former is indicative of some kind of directed stress during intrusion and the latter, a complex crystallization history.

b) Fine-grained Syenites

(i) General Aspects:

Small occurrences of pink, fine-grained syenitic rocks (unit os) exist in the north portion of the map-sheet that display both concordant and discordant relationships with the surrounding rocks. These are true orthosyenites and granites and it is likely that they have intruded the host rock as small apophyses and dykes generated from the syenite magma. They probably represent the last and somewhat complex phase of igneous activity associated with the Hogem Batholith: cross cutting textures with all the main intrusive phases, dykes, veins, and even themselves (i.e. at least two stages of late Phase II dyking) are observable.

Thin section examination of two orthosyenite samples yields the following averaged mineralogical composition: 70-80% anhedral-euhedral orthoclase; 10-15% anhedral-euhedral calcic plagioclase; 5% interstitial and myrmekitic quartz; 5% anhedral biotite and magnetite. As observed in outcrop quartz is often present in amounts 10% and thus local transitions from syenite to granite are effected. The granitic phases tend to aplitic textures while the quartz-deficient members tend to hypidiomorphic-granular or inequigranular textures. Plagioclase generally has a cloudy appearance in thin section and saussuritization of core regions has been intensive in select grains: myrmekitic and albitic rims are also common. Calcic plagioclase occurs principally as euhedral grains (micro phenocrysts) adjacent to small K-feldspar euhedra and/or perthitic intergrowths in a matrix of myrmekite, biotite, sphene, magnetite, and carbonate. Hornblende is present in small amounts (approximately 2%) in the syenitic phases while biotite predominates as the mafic constituent in the granitic phases. Locally, with the addition of large K-feldspar phenocrysts (max. 1 cm observed) a porphyritic fabric is developed (unit osp - see above).

5. Alteration and Sulphide Mineralogy

a) Introduction

Hydrothermal alteration, although widespread and of several varieties, has not been intensive in any of the Steele Creek rocks. In decreasing order of intensity the alteration types are as follows: K-feldspathization, biotitization, albitization, chloritization, epidotization, uralitization, and saussuritization. It is difficult, in the absence of a more exacting petrologic study, to determine accurately the nature of the first two kinds for it seems likely that potassic metasomatism occurred under a wide range of pressure-temperature conditions. K-feldspathization of Phase I rocks undoubtedly accompanied intrusion of the syenitic dykes and thus occurred at near magmatic temperatures. Large plates of biotite coating singly-terminated K-feldspar crystals in vuggy spaces and zones of pink feldspar development in the adjacent country rock are indicative of pneumatolytic and hydrothermal environments. Saussuritization, chloritization, uralitization, and some albitization are characteristic features of incipient deuteric alteration within the Phase I monzodiorites. Biotitization, albitization, and epidotization have been restricted to hydrothermal activity along open fractures and vugs. Quartz-veining in Phase II rocks is associated with the last phase of hydrothermal activity. Copper sulphide mineralization is a late-stage Phase II feature and is spatially related to quartz-veining and K-feldspar veining.

b) K-feldspathization

Potassic alteration in the form of desilication and subsequent enrichment of potash has affected significant volumes of the Phase I rocks around the syenitic stock. Grain size, fracturing properties, and intergranular permeability have greatly influenced the course of the metasomatism as the coarse-grained and more highly fractured monzonites have preferentially undergone metasomatism rather than the finer-grained diorites. Intimately associated with K-feldspathization has been migration and deposition of chalcopyrite (cf. 5. f) Sulphide Mineralogy).

c) Biotitization

Secondary biotite is most abundant along fracture surfaces where it forms sheet-like aggregates of euhedral crystals. In some rocks it occurs in the groundmass (at the expense of hornblende) up to amounts in excess of 30% - these locally enriched zones of biotite are commonly associated with increased amounts of copper sulphide. In one outcrop of K-feldspathized monzonites, a small greisen consists of 95% pegmatitic orthoclase smeared with sheets of pegmatitic biotite - the remaining 5% is fine-grained intergranular material. It is interesting to note that a rock chip sample from this location contained 448 ppm compared to a background of 90 ppm.

d) Incipient Alterations

Albite, chlorite, epidote, saussurite, and uralite occur as widespread but weakly developed secondary mineral assemblages in predominently Phase I monzonites. Albitization has occurred in K-feldspathized rocks where decalcification of plagioclase has resulted in sodic oligoclase or albite cores surrounded by albitic rims. Chlorite and epidote have formed at the expense of primary hornblende and secondary hornblende + tremolite-actinolite (?) have resulted from uralitization of augite margins. Locally epidotized stringers in the monzonites and fine-grained diorites are abundant.

Thin section study reveals saussuritization of calcic plagioclase as a present but not-common feature and has been restricted to plagioclase core regions in most areas.

e) Quartz Veins

Quartz flooding has occurred in the Steele Creek rocks but was restricted almost entirely to the center ridge and thus occurs principally in syenite megaporphyry; very minor occurrences of quartz veins in the K-feldspar host pegmatite have been noted. The veins range from less than one inch to one foot in width and are composed of milky comb and druse quartz and, locally, aggregates of euhedral hornblende. Blebs of chalcopyrite occur rarely within the veins or in adjacent wall rock. The presence of quartz veins in generally quartz-deficient host rocks leads to speculation about its sources. It has been reasonably postulated by J. Garnett (personal communication Aug. 1971) that, assuming the monzonitic rocks were somewhat richer in silica before intrusion of the syenites, "sweating-out" and localization of free quartz in the syenites may have resulted from the invading percolating syenitic juices during intrusion. Consideration of this same mechanism should perhaps also be given to syenitic invasion of the Takla volcanics which lie approximately one mile east of the property and in which quartz is a major constituent.

f) Sulphide Mineralogy

The only sulphides observed in the Steele Creek rocks are chalcopyrite, molybdenite, and pyrite. The first-named mineral is ubiquitous in occurrence; molybdenite was found only in one piece of float in the south portion of the property; and pyrite is restricted to fracture surfaces in the Phase I rocks. Copper mineralization occurs in all rock types (with the exception of the K-feldspar pegmatite) in background concentrations of approximately 90 ppm as blebs in quartz veins and as minute disseminations along intergranular boundaries in the host rock. Chalcopyrite abundance increases with the degree of K-feldspathized monzonites grade approximately 2-3% chalcopyrite (visual est.). These zones are easily observable in the field due to sheet staining of malachite on vertical faces. Pyrite occurs as fracture-coatings generally in fresh monzonites and, in weathered outcrop, imparts a distinctive reddish hue to the rocks. Distribution of pyrite does not bear any spatial relation to chalcopyrite occurrences.

6. Structural and Tectonic Aspects

Several major fracture trends are prominent (see Fig. 2) and several small scale faults have been observed in the Steele Creek rocks. The predominant fracture set strikes 30^{o}-40^{o} (dipping steeply to the northwest) and is best developed in the monzonites in the north portion of the map-sheet. Along the center ridge a number of quartz veins are exposed in megaporphyry. Their persistent occurrence at almost right angles to the major joint trends (i.e. 135^{o}-140^{o}) suggests silica flooding preceded evolution of the main fracture system.

In the southwest corner of the map-sheet a low-angle planar feature dipping to the northeast has been mapped as a thrust fault. It is exposed on a precipitous westerly slope and comprises a 10' thick zone of quartz-stock-work and pyritic gouge traceable over 1000'.

A trend to northeast striking, southerly dipping platy foliation of K-feldspar phenocrysts in the porphyritic syenites indicates a general movement of the magma in that line of direction. This is not, however, a well-developed fabric characteristic as it apparently is in the Duckling Creek syenite body a few miles to the south.

Emplacement of the syenitic stock into the monzonite host is considered to have been the forceful intrusion of a mobile magma. Brecciation, xenoliths, platy-foliation, absence of chilled border facies, sharp contacts, etc. are indicative of either: (1) a mesozonal environment of intrusion (Buddington, 1959), or; (2) epizonal emplacement of the syenite before complete crystallization of the monzonitic host had occurred.

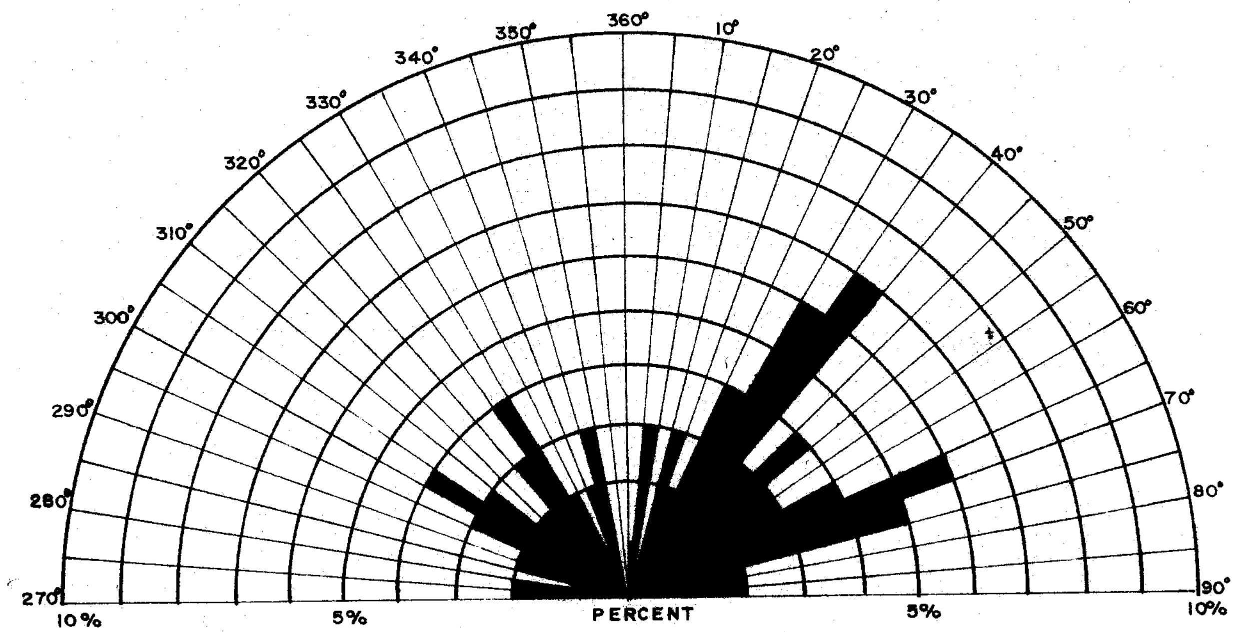

Fig. 2(a). Strike frequency diagram of FRACTURES on Steele Creek map-sheet based on 316 field measurements. Fractures steeply dipping to northwest.

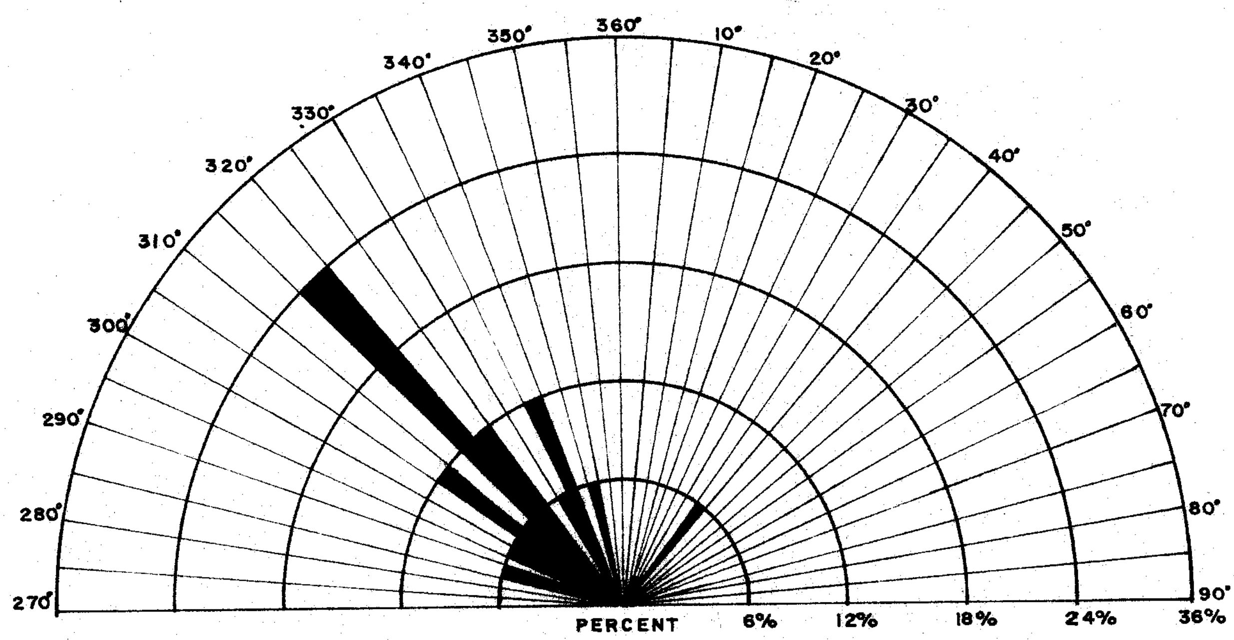

Fig. 2(b). Strike frequency diagram of QUARTZ-VEINS on Steele Creek map-sheet based on 17 field measurements. Dips vary from northeast to southwest.

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7. Petrogenesis

From textural and structural relationships several stages of magmatic to hydrothermal activity can be recognized. For brevity, a highly interpretative sequence of events is summed up in Fig. 3. It is thought that the monzonitic and syenitic bodies are late-stage differentiates of the parental Hogem (granodioritic?) magma. Differentiation trends were towards desilication and enrichment of soda and potash. Copper was mobile during the last phase of syenitic intrusion. Anomalous copper occurrences are intimately associated with K-feldspathized rocks in zones of increased fracturing intensity.

G. ROCK GEOCHEMISTRY

1. Introduction

Rock chip samples were initially collected at every outcrop in an attempt at saturation coverage of the property. Thus sample locations tend to be irregularly distributed and clustered around some outcrops. Later, a more systematic approach based on regular spacing of sample locations using the grid or chain and compass for locating stations was employed. In the steeper areas of outcrop it was deemed more practical (and probably more representative) to obtain samples from talus slopes using the method prescribed below. Two hundred and twelve samples were taken.

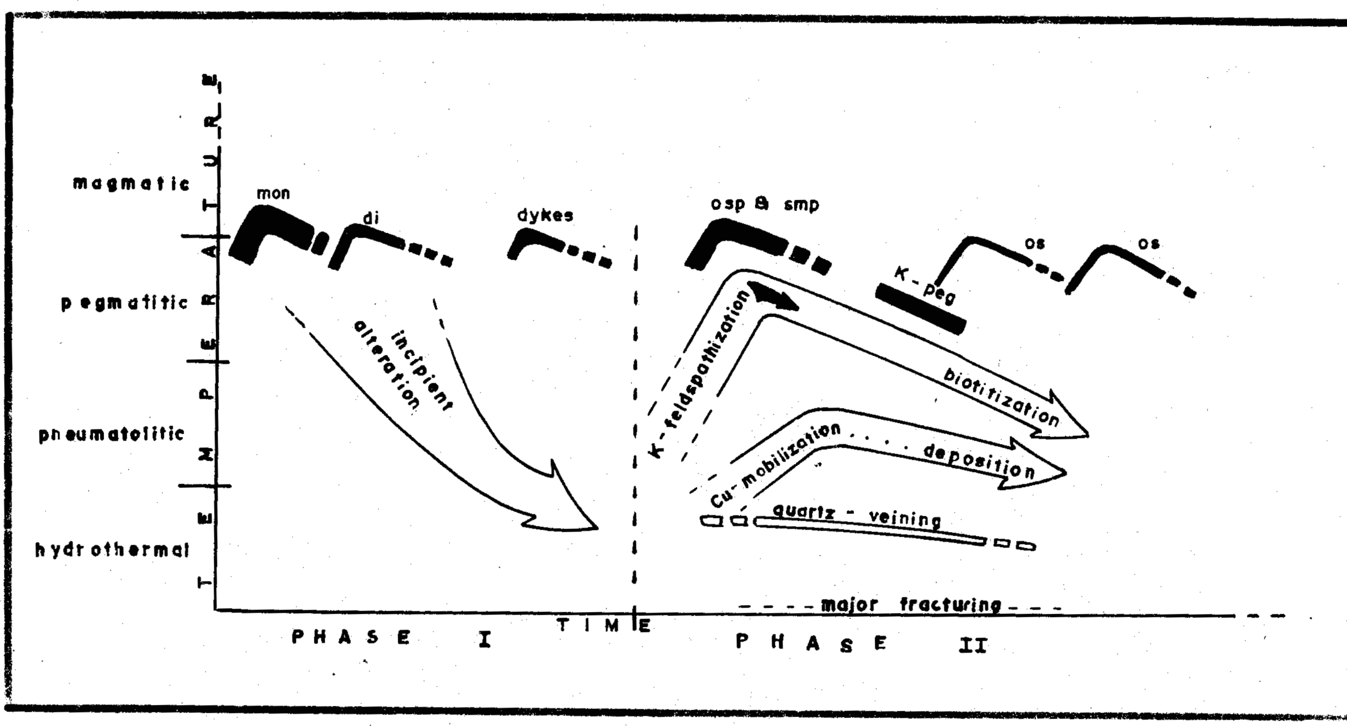

Fig. 3 Hypothetical sketch illustrating petrogenesis of Steele Creek lithologies

2. Sampling Method

Two techniques for obtaining samples were employed: linear sampling along talus slopes; and, circumferential sampling in outcrop. Samples taken in traverse along talus slopes were obtained at 500' intervals by locating a sample station and securing a rock chip every 5' for a distance of 50' each side of the station along traverse. In outcrop a station was located and twenty rock chips were collected around the station at approximately 20'-30' radius. Samples were placed in 8" X 13" 6 ml plastic sample bags and marked accordingly with indelible felt pens.

All samples were analyzed for copper by Core Laboratories - Canada, Ltd. (T.S.L.) in Smithers, B.C. (analysts R. Mode and N. Garner) and for copper, molybdenum, and zinc in the Noranda Exploration Co. Ltd. laboratory located at 1050 Davie St., Vancouver, B.C. (analyst E. vanLeeuwen.)

3. Laboratory Determination Method

a) Core-Labs Method

The samples were crushed and pulverized to -100 mesh, 1.5 g. of each sample were weighed out into a test tube containing 5 mls of combination 1:1 HCl and 1:1 HNO_3 and digested in a water-bath for three hours at $170^{o}F$. After cooling each sample was diluted to 15 cc, agitated and allowed to settle, and then analyzed for copper on a Jarrell-Ash Atom-Sorb Model spectrophotometer. The standards used were diluted solutions from prepared 1000 ppm Fisher standards and acid concentrations were the same for both sample and standard. Minimum detectability limit for copper is considered to be approximately 1 ppm copper.

b) Noranda Labs Method

The samples, pulps from Core-Lab analyses, are first pulverized to -200 mesh fraction. 1.0 g. of each sample is digested in 4 ml of $HClO_4$ and 1.0 ml of HNO_3 for approximately four hours. Following digestion each sample is diluted to 10 ml with demineralized water. A Varian Techtron Model AA-5 atomic absorption spectrophotometer was used to determine the parts per million copper, molybdenum, and zinc in each sample.

4. Presentation of Results

Results of the rock geochemistry survey are presented in Plate IVa and IVb of this report, plan maps showing copper and zinc abundances in ppm. Molybdenum values for all rocks registered 0 ppm and therefore they have not been included.

5. Discussion of Results

Values for total copper in whole rock analyses range from a background of 90 ppm to anomalous values of 600 ppm. Zinc background is 35 ppm and ranges from 16 ppm to 440 ppm. Plate IVa illustrates the diversity of anomalous copper occurrences (i.e. >180 ppm) and the restricted areal extent of each. These anomalies are caused by localized enrichment of chalcopyrite in pod-like zones associated with increased fracturing and K-feldspathization of the monzonite rocks.

Igneous rocks of intermediate composition average 30-35 ppm Cu, 60-72 ppm Zn, and 0.9-1.0 ppm Mo as background concentrations (Krauskopf, 1967). One must note that, although an occurrence of geological complexity, the Steele Creek body is comparatively Zn and Mo poor but enriched in Cu at nearly three times 'normal' background. Recent work by Brabec and White (1971) on the Guichon Creek Batholith has shown that economic localization of sulphides is not necessarily indicated by high background concentrations of the element concerned. It does seem reasonable, however, that in environments of increased background concentration mechanisms would not have to be as intense in order to effect an ore deposit. The rock geochemistry program has shown that additional rock sampling would be of little use in delimiting targets for further exploration.

H. SOIL GEOCHEMISTRY

1. Sampling Method

Because soil development is limited to the low elevation areas, soil sampling has necessarily been restricted to narrow zones along Steele Creek, the un-named creek to the south, and the northerly slopes of the STL claim group. Eleven flagged lines were established with chain and compass and sample stations were located @ 200' intervals. Holes were dug with a shovel to a depth at which the C horizon was encountered. Soil samples were obtained from the C horizon (and, where possible, from the B horizon) and placed in "Hi Wet Strength Kraft 31/2" X 61/8" Open End" envelopes and the location marked on the envelopes with indelible felt pens. One hundred and fifty samples were obtained from the KIP claims, 151 samples from the STL claims. All samples were analyzed for copper and molybdenum in the Noranda Exploration Company, Limited laboratory located at 1050 Davie Street, Vancouver, B.C., analyst, Evert vanLeeuwen.

2. Laboratory Determination Method

The samples are first hung in a drying cabinet for a period of twenty four to forty eight hours. They are then mechanically screened and sifted to obtain a -80 mesh fraction.

The determination procedure for total copper and total molybdenum is as follows: 0.200 grams of -80 mesh material is digested in 2 ml of $HClO_4$ and 0.5 ml. of HNO_3 for approximately four hours. Following digestion each sample is diluted to 5 ml. with demineralized H_2O. A Varian Techtron Model AA-5 Atomic Absorption spectrophotometer was used to determine the parts per million Cu and Mo in each sample

3. <u>Presentation of Results</u>

Results of the soil geochemical survey are presented in Plate V of this report, a plan showing Cu, Mo, and Zn determinations in parts per million. Results from the STL claims are shown in Plate VI.

4. <u>Discussion of Results</u>

Total copper values range from a background of 190 ppm to 4000 ppm. Values for total Mo range from a background of 2 ppm to 50 ppm. Zn values range from a background of 55 ppm to 150 ppm. In comparison with rock geochemistry, several features are immediately apparent: (1) soil background level for Cu is approximately twice that for rock; (2) the appearance of Mo in soils when undetectable in rock analyses; (3) doubling of Zn background in soils.

Soil development in Steele Creek and the un-named creek to the south is poor. Overburden consists of an unknown depth of talus covered by alpine vegetation and swampy organic deposits. The highest anomalous values on Steele Creek (i.e. 3000 and 4000 ppm Cu) were obtained from a marshy environment. Although Cu soil background for the entire property is 195 ppm, background for the Steele Creek samples alone is 335 ppm, 3½ times rock background. This anomaly has two explanations; either some kind of concentrating mechanism is operative, or Steele Creek itself is underlain by a zone of copper enrichment. Concentration could occur by hydromorphic and/or mechanical processes. Migration of talus downslope has doubtlessly occurred amd may have served to concentrate rocks from the copper-enriched zones above. Soils have not been run for soluble copper as yet but this might better define the anomaly. Two factors suggest the anomaly is not derived from underlying bedrock: (1) the probable thickness of the overburden; and, (2) the lack of pyrite in the rocks. The source of molybdenum in the soils is difficult to explain - it may be that organic processes have merely concentrated Mo ions that exist in undetectable quantities in the rock.

Plate VI shows an anomalous band of copper values trending north-south. Soil profiles are better developed in this area and it is likely that the values obtained are representative of the underlying bedrock.

1. SUMMARY AND CONCLUSIONS

The Steele Creek property is underlain by syenitic and monzonitic border phases of the Hogem Batholith. The syenites represent the latest stage of intrusion and have contact metamorphosed the adjacent monzonitic host rock producing zones of considerable geologic complexity. Copper was relatively mobile during this stage and concentrated in the contact zones and metasomatized rocks. Copper background for rocks of the Steele Creek area is approximately three times that of 'normal' intermediate igneous rocks (i.e. 90 ppm vs 30-35 ppm). Molybdenum and zinc values are abnormally low. Soil values for these three elements are approximately 2-3 times rock background. Copper mineralization is, however, very erratic and is irregularly concentrated in small, equidimensional, structurally-controlled zones that generally exhibit signs of potash-metasomatism. Geological and geochemical data do not eliminate the property from further exploration.

Respectfully submitted

T. Pearse

T. Pearse B.Sc.

Endorsed by

G.E. Dirom

G.E.Dirom, P.Eng.

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Qualifications of Field Personnel

Messrs. S. Wong, G. McKillop, and B. Bleaney have been employed by Noranda Exploration Company, Ltd. as senior field assistants and are currently working for their second year in this capacity.

Messrs. A. McKillop, B. Webster, and P. Tsang have been employed by Noranda Exploration Company, Ltd. as junior field assistants from May 1971 to September 1971.

All have been instructed in the necessary field procedures by J.D. Knauer, Geochemist, and Gavin E. Dirom, P.Eng.

Gavin E. Dirom, P.Eng.

STATEMENT OF QUALIFICATIONS

I, Tony D. Pearse of the Town of Smithers, Province of British Columbia do certify that:

1. I have been an employee of Noranda Exploration Company Ltd., since March 1971.

2. I am a graduate of the University of British Columbia with a Bachelor of Science Degree in Honours Geology.

3. I am a member of the Geological Association of Canada - Cordilleran Section and a Junior Member of the Canadian Institute of Mining and Metallurgy.

4. I have held the positions of field geologist and geological assistant for various companies over the past six field seasons.

Dated at Smithers
this 3rd day of
October, 1971

T. D. Pearse

T. D. Pearse
Geologist
Noranda Exploration Company, Ltd.

To accompany Geological & Geochemical Report by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division — work supervised by G.E. Dirom, P. Eng.

Dated Oct. 1, 1971.

T. Pearse

G. R. Dirom

Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #4

3341 M4

REVISED	CLAIM GROUPING	
	PROJECT: STEELE CREEK	
PROJ. Nº 1015	SURVEYED BY: T.P.	DATE: SEPT. 1971
N.T.S. 93N/14W	DRAWN BY: A.P.	SCALE: 1" = ½ mi.
DWG. Nº PLATE I	NORANDA EXPLORATION CO. LTD. OFFICE: SMITHERS	

Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #5

To accompany Geological & Geochemical Report by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division – work supervised by G.E. Dirom, P. Eng.

Dated Oct. 1, 1971.

T. Pearse

REVISED	–Preliminary Survey–
SEPT. 1971	CLAIM LOCATION & TOPOGRAPHY
	PROJECT: STEELE PROPERTY
PROJ. Nº 1015	SURVEYED BY: T.P. DATE: AUG 1971
N.T.S. 93N/14W	DRAWN BY: T.P. SCALE: 1" = 400'
DWG. Nº PLATE II	NORANDA EXPLORATION CO. LTD. OFFICE: SMITHERS

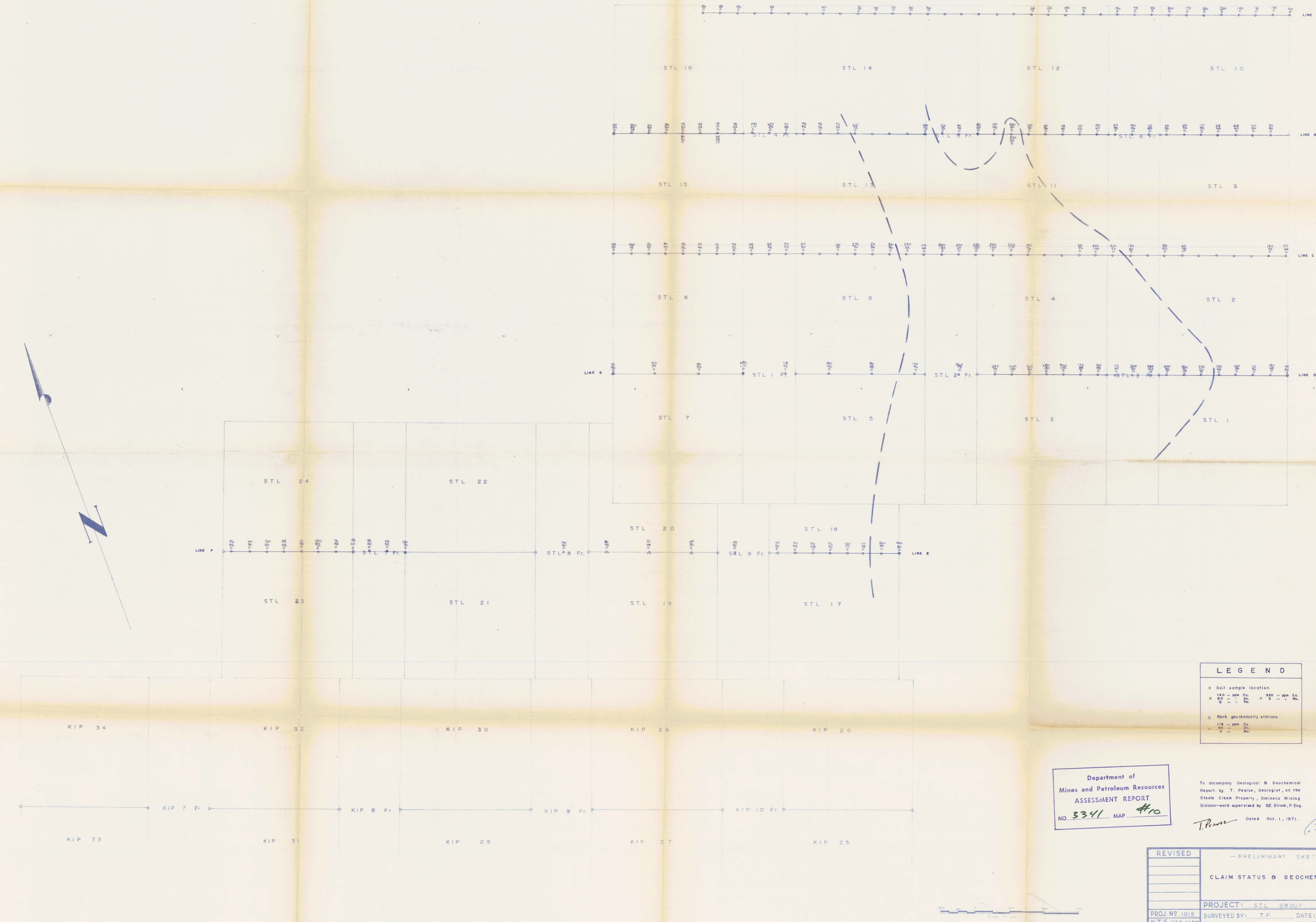

6
LEGEND
outcrop
talus
geologic contact: observed, probable
gossan
fault: actual, probable dip S.E.
thrust fault
major fracture dip N.W.
quartz vein dip S.E.
platy foliation: dip S.E.
Cu. mineralization
pyrite
Mo. mineralization: float
dyke: observed, probable
SCALE 1" = 400'
LITHOLOGIC UNITS
Lower Jurassic (?)
PHASE II - syenites
os – Fine-grained, leucocratic, aplitic, orthosyenite and granite plus associated dykes
kpeg – K-feldspar pegmatite
osp – porphyritic orthosyenite
smp – syenite megaporphyry
kmon – K-feldspathized monzonite
PHASE I - monzonites
hp – hornblende porphyry and related mafic-enriched dykes
di – di1 – melanocratic fine-grained diorites
di2 – leucocratic fine-grained diorites
mon – monzo-diorites
Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #6
To accompany Geological & Geochemical Report by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division - work supervised by G.E. Dirom, P. Eng.
T. Pearse
Dated Oct. 1, 1971
REVISED
GEOLOGY
PROJECT: STEELE PROPERTY
PROJ. No
N.T.S. 93N/14W
DWG. No
PLATE III
SURVEYED BY: T.P.
DATE: AUG 1971
DRAWN BY: A.P.
SCALE: 1" = 400'
NORANDA EXPLORATION CO. LTD.
OFFICE: SMITHERS

SCALE 1" = 400'
LEGEND
△ 43 Read 43 ppm Cu.
Background = 90 ppm
To accompany Geological & Geochemical Report by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division—work supervised by G.E. Dirom, P. Eng.
Dated Oct. 1, 1971.
Department of Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #7
REVISED
SEPT. 1971
ROCK GEOCHEMISTRY
COPPER
PROJECT: STEELE PROPERTY
PROJ. Nº 1015
N.T.S. 93N/14W
SURVEYED BY: T.P.
DATE: AUG 1971
DRAWN BY: A.P.
SCALE: 1" = 400'
DWG. Nº
PLATE IV-A
NORANDA EXPLORATION CO. LTD.
OFFICE: SMITHERS


SCALE 1" = 400'
LEGEND
Δ32 Read 32 ppm Zn.
Background = 35 ppm
Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #8
To accompany Geological & Geochemical Report by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division — work supervised by G.E. Dirom, P. Eng.
Dated Oct. 1, 1971.
T. Pearse
REVISED
SEPT. 1971
ROCK GEOCHEMISTRY
ZINC
PROJECT: STEELE PROPERTY
PROJ. Nº 1015
N.T.S 93N/14W
DWG. Nº
PLATE IV-B
SURVEYED BY: T.P.
DATE: AUG 1971
DRAWN BY: A.P.
SCALE: 1" = 400'
NORANDA EXPLORATION CO. LTD.
OFFICE: SMITHERS


9
BASE 100 00 E LINE
SCALE 1" = 400'
L. 12000 N
L. 10800 N
L. 10000 N
L. 8500 N
L. 7600 N
L. 7200 N
L. 6800 N
L. 54 00 N
Camp 1
Camp 2
Camp 3
LEGEND
SOIL SAMPLE LOCATION
READ 95ppm Cu., 60ppm Zn., 7 ppm Mo.
READ 600 ppm., 0 ppm Mo.
Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #9
To accompany Geological & Geochemical Report by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division-work supervised by G.E. Dirom, P. Eng.
Dated Oct. 1, 1971.
T. Pearse
REVISED
SEPT. 1971
SOIL GEOCHEMISTRY
PROJECT: STEELE PROPERTY
PROJ. Nº 1015
N.T.S. 93N/14W
SURVEYED BY: T.P.
DATE: AUG 1971
DRAWN BY: a.p.
SCALE: 1" = 400'
DWG. Nº
PLATE V
NORANDA EXPLORATION CO. LTD.
OFFICE: SMITHERS

10



Department of
Mines and Petroleum Resources
ASSESSMENT REPORT
NO. 3341 MAP #10

To accompany Geological & Geochemical Report. by T. Pearse, Geologist, on the Steele Creek Property, Omineca Mining Division—work supervised by G.E. Dirom, P.Eng.

T. Pearse
Dated Oct. 1, 1971.

REVISED

— PRELIMINARY SKETCH —

CLAIM STATUS & GEOCHEMISTRY

PROJECT: STL GROUP P.F.U.
PROJ. Nº 1015
N.T.S. 93N/14W
SURVEYED BY: T.P.
DATE: AUG-SEPT 1971
DRAWN BY: T.P.
SCALE: 1" = 400'
DWG. Nº
PLATE VI

NORANDA EXPLORATION CO. LTD.
OFFICE: SMITHERS