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The Whiting Creek copper-molybdenum porphyry, west-central British Columbia

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ABSTRACT

The Whiting Creek deposit is a calc-alkaline copper-molybdenum porphyry located 115 km due south of Smithers, in the Tahtsa Lake region of west-central British Columbia. Mineralization occurs within a 2 km by 5 km zone of extensively hornfelsed, fractured and pyritized Lower Jurassic Hazelton Group (Telkwa Formation) volcanic rocks which are intruded by Late Cretaceous stocks, plugs, breccias and dikes.

Molybdenite is concentrated in a quartz stockwork within what was originally a 300 m by 900 m oval plug of siliceous quartz porphyry located on the northwest margin of the Whiting stock. Better MoS_2 grades occur near the margin of the plug and are associated with strong to intense pervasive phyllic alteration. The centre of the quartz porphyry plug has largely been destroyed by intrusion of a younger monzonite porphyry intrusion which hosts minor copper and molybdenum. Quartz-molybdenite veining extends into marginal hornfelsed volcanic rocks and forms a poorly defined zone of low-grade mineralization.

Fracture controlled quartz-chalcopyrite-molybdenite (up to 3% Cu) occurs in a K-feldspar altered zone along the northwest margin of the 3.5 km diameter Whiting granodiorite stock. The zone is poorly defined but may extend into marginal volcanic rocks. The Ridge zone contains an estimated 31.6 million tonnes grading 0.112% MoS_2 and 0.06% Cu.

Whiting Creek is similar to other deposits related to Bulkley Intrusions such as Huckleberry, Ox Lake and Coles Creek. Whiting Creek is unique with respect to the very large size of the system, complexity of the intrusive system and presence of rhyolite-associated molybdenum.

Introduction

The Whiting Creek deposit is a calc-alkaline copper-molybdenum porphyry located in the Tahtsa Lake region of west-central British Columbia. Kennecott Canada Inc. and its forerunner, Kennco Explorations (Western) Ltd., have owned the claims covering the deposit since its discovery in 1963.

Whiting Creek is located on the south slope of Sibola Peak, 115 km due south of Smithers, British Columbia in NTS map-areas 93E/11 and 14 (Latitude 53°45′ N, Longitude 127°12.5′ W). Sweeney Lake is located on the south boundary of the property (Fig. 1).

Access from Houston is provided by 120 km of forestry access roads via Owen and Nadina lakes. Access onto the property is a four-wheel drive road which leaves the forestry road at the north tip of Sweeney Lake.

The deposit lies at the east end of the Sibola Range in the transition zone between the Coast Mountains and the Nechako Plateau. Topography is rugged north of Whiting Creek and moderate in the south. Elevations range from 2190 m at Sibola Peak to 940 m at Sweeney Lake. Small icefields occupy cirques on the north side of Sibola Peak.

Treeline occurs at approximately 1500 m. Below this elevation alpine fir, lodgepole pine, balsam fir, minor spruce and hemlock occur.

History

The earliest recorded exploration in the general area was in 1913 when placer gold was discovered in Sibola Creek, which drains the east side of Sibola Peak. Subsequent exploration resulted in the discovery of gold-quartz veins on Sibola Peak and several base metal showings in the same general area (Duffell, 1959).

Kennco Explorations (Western) Ltd. was first attracted to the area in 1959 by anomalous copper and molybdenum values in water and sediment samples from Whiting Creek. Further stream sediment sampling by Kennco in 1962 resulted in staking of the gossan in 1963.

In 1964 and 1965, Kennco completed detailed stream geochemistry, geological mapping, soil geochemistry, magnetometer and I.P. surveys over 26.1 km of grid, 5795 m of trenching, Winkie drilling and 17 diamond drill holes totaling 950 m. The best mineralization was encountered in a quartz porphyry plug where DDH-1 intersected 82.2 m averaging 0.10% MoS_2 and 0.09% Cu.

In 1972, the property was optioned by Quintana Minerals Corporation who completed a rock geochemical survey and drilled one vertical 457 m hole.

In 1980 and 1981, the property was explored by SMDC Mining Ltd. (now Cameco Corporation). Work comprised geological mapping, 33.2 km of I.P. surveying, 69.4 km of magnetometer surveying, soil geochemistry over 69.4 km of grid, 39 percussion drill holes totaling 2792 m, and 26 diamond drill holes totalling 5891.3 m. Drilling of the quartz porphyry (Ridge zone) resulted in the definition of drill-inferred reserves of 123.5 million tonnes averaging 0.043% MoS_2 and 0.062% Cu including 40 million tonnes at 0.10% MoS_2 and 0.17% Cu.

In 1991, Kennecott Canada Inc. drilled two diamond drill holes.

In 1992, New Canamin Resources Ltd. optioned the property and in 1993 completed an airborne geophysical survey over part of the property, as part of a larger regional survey over the Huckleberry porphyry copper deposit. A follow-up program was proposed for 1994.

Exploration Techniques

Although the large prominent gossan on the south slope of Sibola Peak must have attracted prospectors for many years, iniopen to expansion. Drill targets have been defined on the West Taurus and McCord Creek zones.

The Taurus property has good potential to host an economic copper-molybdenum-gold (?) porphyry deposit, based on the following points:

- a favourable geological environment with strongly altered and mineralized intrusive and subvolcanic rocks;
- similarity to the nearby Casino deposit;
- an open-ended mineral reserve with the potential for economic grades of copper and molybdenum has been identified at the East Taurus zone;
- based on limited testing, gold grades could be economically significant; and
- drill targets have been established at the West Taurus and McCord Creek zones.

TABLE 1. Significant drill hole intercepts, East Taurus zone

Year	Hole type	Hole No.	Length (m)	Intercept From (m)	To (m)	Interval (m)	Cu (%)	Mo (%)	Au (ppb)
1971	DDH	6	110	43	111	68	0.317	0.030	n/a
				55	111	56	0.357	0.030	
				64	96	32	0.470	0.030	
1971	DDH	7	107	40	75	35	0.360	0.015	n/a
1975	DDH	75-1	277	15	277	262	0.345	0.039	n/a
				52	277	225	0.368	0.039	
				252	277	25	0.401	0.039	
1975	DDH	75-2	276	0	276	276	0.183	0.019	n/a
				58	276	218	0.220	0.019	
1978	DDH	ET-1	189	137	189	52	0.190	0.020	n/a
				174	189	16	0.210	0.030	
1979	DDH	ET-2	290	55	290	235	0.260	0.048	n/a
				171	290	119	0.320	0.063	
1980	DDH	24	107	5	107	102	0.200	n/a	n/a
				67	107	40	0.430		
1993	RCH	93-5	93	35	84	49	0.470	n/a	161

n/a = not analyzed

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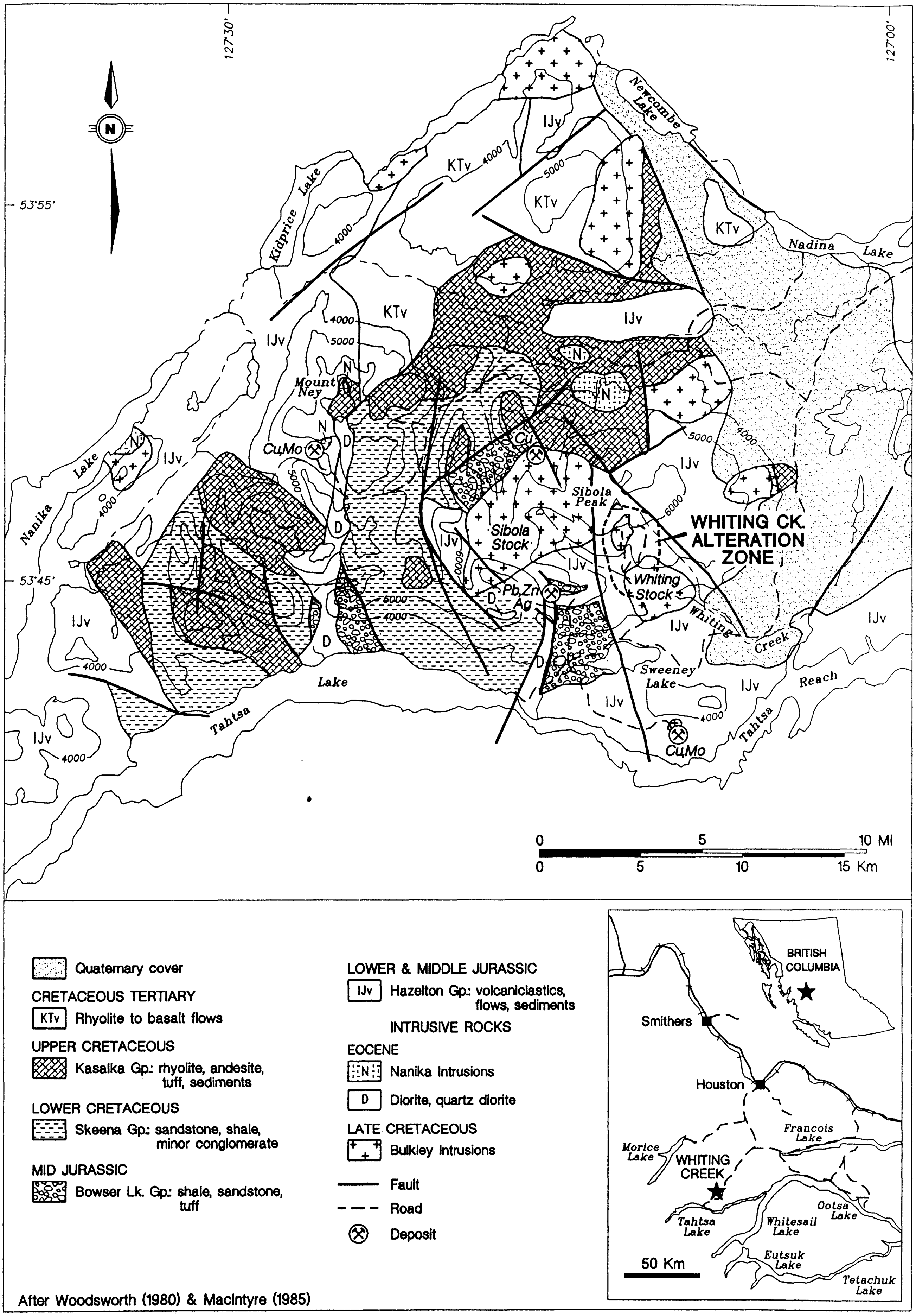

FIGURE 1. Location of Whiting Creek sulphide system and regional geology.

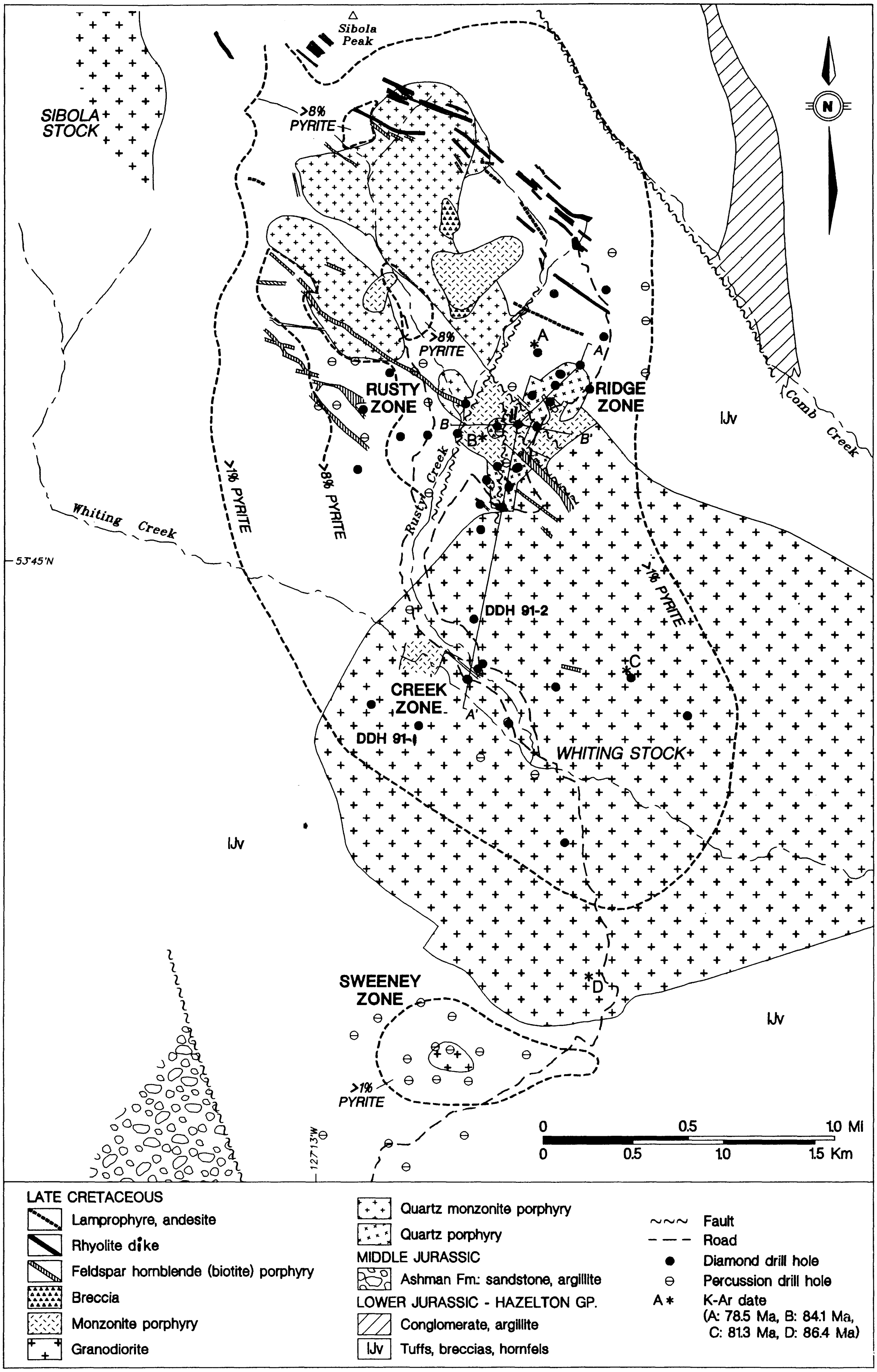

FIGURE 2. Generalized property geology, drillhole locations, and radiometric age dates.

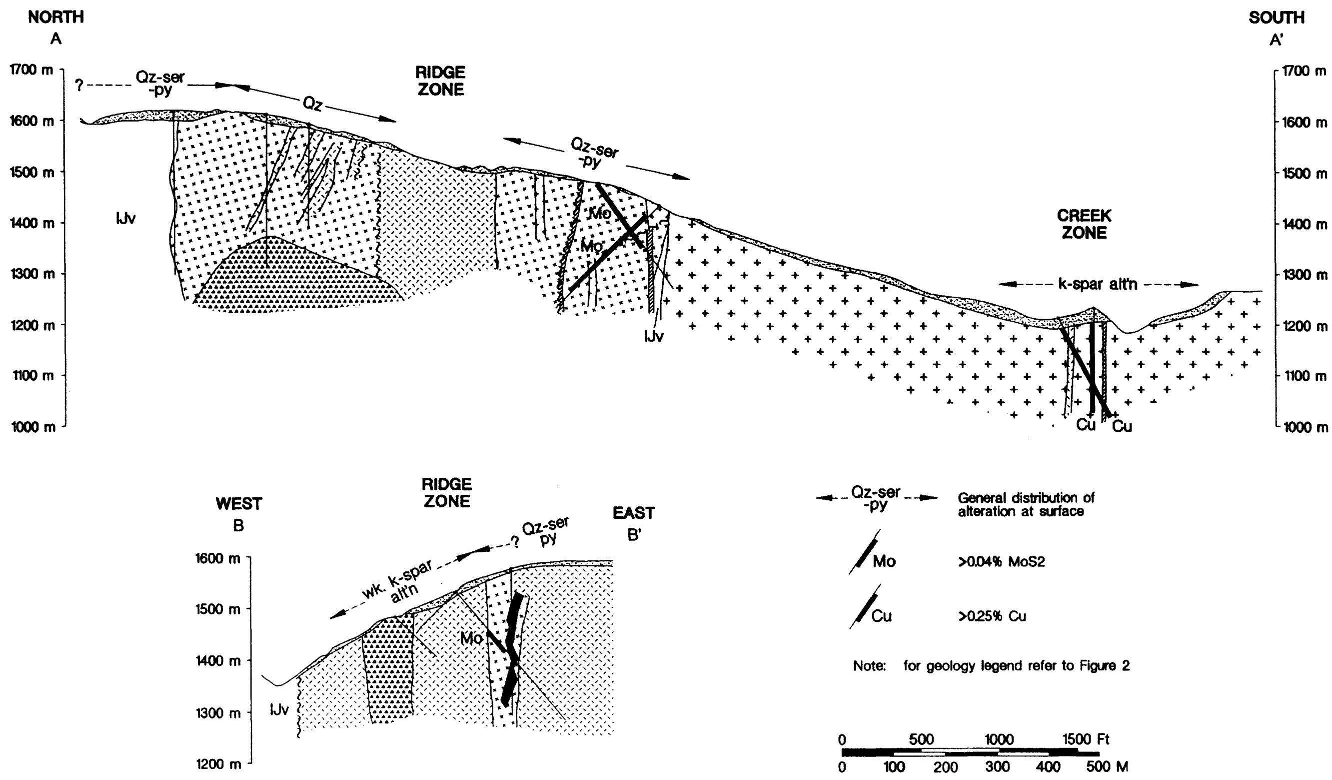

FIGURE 3. Geological sections through the Creek and Ridge Zone (A-A′ and across the north end of the Ridge Zone (B-B′). Sections and legend are located on Figure 2.

tial discovery of porphyry-style mineralization is attributed to silt geochemistry.

Above treeline, detailed evaluation is hampered by extensive talus and oxidation and leaching of surface outcrops. Ferricrete is locally extensive. At lower elevations exploration is hampered by widespread moderately thick to very thick till and alluvial deposits.

In the higher alpine areas, I.P. surveys were hampered by poor contact in the talus; however, rock geochemistry defined a 1500 m by 1200 m molybdenum anomaly over what is now known as the Ridge zone. Anomalous copper values form an arcuate zone peripheral to the molybdenum anomaly on the south, west and north sides. Soil sampling was unreliable in the alpine areas showing no or erratic anomalous values over mineralized zones. In areas of lower elevation, I.P. (dipole-dipole; electrode spacing 100 m; n = 1 to 4) was effective in locating pyritized areas.

Percussion drilling was used extensively in 1980 and 1981 to test several lower priority zones. Although a rapid, cost-effective prospecting tool, diamond drilling proved to be the only reliable method of determining copper and molybdenum grades with confidence.

Regional Geology

The oldest rocks in the area of Whiting Creek (Fig. 1) are Lower to Middle Jurassic Hazelton Group andesitic tuffs, breccias, agglomerates and flows assigned to the Telkwa Formation (Woodsworth, 1980; MacIntyre, 1985). At the west end of Sweeney Lake the Telkwa Formation is unconformably overlain by marine sedimentary rocks of the Middle Jurassic Bowser Lake Group. Hazelton and Bowser Lake group rocks are deformed by broad open to tight, generally northerly trending folds. North and west of Whiting Creek, Lower Jurassic Skeena Group sedimentary rocks are unconformably overlain by Upper Cretaceous continental volcanic rocks of the Kasalka Group. Kasalka Group rocks are unconformably overlain to the north by Upper Cretaceous to Tertiary volcanic rocks.

Copper and molybdenum mineralization at Whiting Creek and at numerous other localities in the Tahtsa Lake area is associated with Late Cretaceous Bulkley Intrusions. MacIntyre (1985) recognized three subdivisions of these intrusions: (1) isolated stocks of porphyritic hornblende-biotite granodiorite; (2) large zoned intrusions of equigranular biotite-hornblende granodiorite and biotite-hornblende quartz diorite such as the Sibola and Whiting stocks; and (3) porphyritic hornblende-biotite quartz monzonite dikes and stocks which cut (1) and (2). Copper-molybdenum mineralization is also associated with Eocene Nanika Intrusions.

Faults, fractures and late-stage dikes in the area are predominantly northwest-trending.

Geology of Whiting Creek

Whiting Creek is underlain by Lower Jurassic Hazelton Group volcaniclastic rocks and minor Middle Jurassic Bowser Lake Group sedimentary rocks which have been intruded by a wide variety of igneous bodies with associated mineralizing events. Property geology is shown in Figure 2.

Hazelton Group

Rocks of the Hazelton Group (Telkwa Formation) predominantly comprise green and purple andesitic volcanic breccias, lapilli-tuffs, crystal tuffs and very minor andesitic flows. Bedding generally trends north-northwest and dips 50 degrees to 80 degrees west.

Bowser Lake Group

Volcanic sandstone, fossiliferous greywacke and minor argillite and chert pebble conglomerate, mapped on the southwest side of the property, were assigned to the Ashman Formation of the Bowser Lake Group on the basis of fossil evidence. The unit appears to be in fault contact with Hazelton Group volcaniclastic rocks to the east.

TABLE 1. Average partial whole rock chemistry — Whiting Creek intrusives

	Granodiorite[1]	Monzonite porphyry[1]	Feldspar dikes[1]	Porphyry	Quartz porphyry[1]
			Weight %		
SiO_2	66.3	65.7	61.5		80.1
TiO_2	0.49	0.53	0.69		0.14
Al_2	15.6	15.6	16.9		11.4
FeO	3.8	3.9	5.7		1.3
MgO	1.9	1.8	2.7		0.31
CaO	2.9	2.1	3.5		0.09
Na_2O	3.7	3.1	3.1		0.16
K_2O	3.3	3.4	3.1		4.3
			ppm		
Rb	70	84	75		84
Sr	410	51	495		51
Mo	4	218	4		218
Cu + Zn	241	34	140		34
W	2	20	1		20
F	400	370	410		370

[1]: Granodiorite — 5 analyses; monzonite — 5 analyses; feldspar porphyry dikes — 2 analyses; quartz porphyry — 19 analyses.

Intrusive Rocks

Aplitic Quartz Porphyry

A 200 m by 900 m quartz porphyry plug is located along the northwest margin of the Whiting stock. The unit is dominantly an aplite containing 10% rounded, often corroded, 0.5 mm to 4 mm quartz phenocrysts. Locally the rock varies to non-porphyritic aplite, aplitic quartz feldspar porphyry or equigranular quartz monzonite with prominent micrographic texture. Drilling has shown that the contacts of this unit are essentially vertical (Fig. 3).

Thin, glassy, barren quartz stringers are common, as are 1 mm to 2 mm myrmekite-like (or crenulate) quartz layers. Quartz-molybdenite mineralization is most abundant in this unit.

Quartz Monzonite Porphyry

Irregular bodies of light grey quartz monzonite underlie the central part of the Whiting Creek hydrothermal system. An aplitic quartz-orthoclase matrix hosts 30% 2 mm to 5 mm plagioclase crystals, 15% 1 mm to 3 mm quartz crystals and 5% to 10% biotite books. The unit is locally strongly altered to quartz-sericite.

Whiting Granodiorite Stock

A 3 km by 4 km stock of biotite granodiorite is centred about 4.5 km south-southeast of Sibola Peak. The stock is generally medium grained, sub-porphyritic but varies from equigranular to porphyritic. One millimetre to 6 mm subhedral to euhedral plagioclase crystals occur in a matrix of plagioclase, orthoclase and quartz. Partly chloritized biotite is common as 1 mm to 3 mm plates and minor hornblende forms euhedral crystals up to 6 mm in length. Magnetite and apatite are minor accessories.

Quartz-pyrite-chalcopyrite-bornite-molybdenite mineralization is common along and north of Whiting Creek in the Whiting granodiorite.

Monzonite/Latite Porphyry

Monzonite porphyry occurs mainly as two irregular plugs in the centre of the gossan and as a body cutting and adjoining the quartz porphyry on the west side. The unit comprises 25% grey-white, euhedral, 1 mm to 3 mm plagioclase phenocrysts in an aphanitic pink-grey matrix. Chloritized hornblende is the principal mafic mineral of the central plugs but chloritized biotite is the main mafic near the quartz porphyry. Pyrite, chalcopyrite and rare quartz-molybdenite veins occur within monzonite porphyry.

A closely related 100 m diameter intrusion breccia is located on the west side of the quartz porphyry within a monzonite porphyry stock. The breccia comprises large (up to 2 m long) angular clasts of monzonite porphyry, 1 cm to 3 cm clasts of molybdenite-bearing siliceous rock (quartz porphyry?), and small rounded andesite fragments in a fine-grained quartz-orthoclase matrix. Chalcopyrite and molybdenite are commonly disseminated in the matrix. Breccia contacts are gradational.

A 200 m wide body of pink latite porphyry cuts granodiorite along Whiting Creek. Partially epidotized, 1 mm to 9 mm plagioclase phenocrysts occur in an aphanitic pink matrix. Fine biotite and pyroxene(?) give the rock a speckled appearance. Chalcopyrite veining, disseminated pyrite and bornite and have been noted within the unit.

Andesitic Feldspar Hornblende Porphyry Dikes

Medium-grey, northwest-trending, feldspar hornblende (biotite) dikes are common cutting the sulphide system. Pale grey, 2 mm to 5 mm plagioclase crystals, 2 mm to 4 mm hornblende crystals occur in a fine- to medium-grained matrix with or without 2 mm to 4 mm biotite plates. Chalcopyrite-pyrite veinlets frequently occur within the dikes.

Rhyolite (Felsite) Dikes

A swarm of pale grey to cream dikes trends northwesterly across the north part of the gossan. Locally, 5% to 10% 1 mm plagioclase phenocrysts occur in the microcrystalline orthoclase matrix. Disseminated pyrite occurs locally.

Postmineral Dikes

Barren andesite, lamprophyre and diabase dikes occur at scattered localities on the property.

Petrology of Intrusive Rocks

Average major oxides compositions (Goodz et al., 1983; MacIntyre, 1985) for four major intrusive units from Whiting Creek are summarized in Table 1. $Na_2O + K_2O$ versus SiO_2 for all samples is plotted in Figures 4a and 4b. The plots emphasize the distinctive, rhyolitic composition of the quartz porphyry relative to the other intrusions, the granodioritic composition of the coarser grained intrusions and the slightly more basic composition (andesite-dacite) of the feldspar porphyry dikes. The monzonite and granodiorite compositions (Table 1) are essentially identical and suggest that the monzonite is a closely related phase or a textural variant of the Whiting Creek granodiorite.

Radiometric Dating

Three intrusive samples and one hornfels sample were dated at The University of British Columbia using K-Ar techniques (Mor-

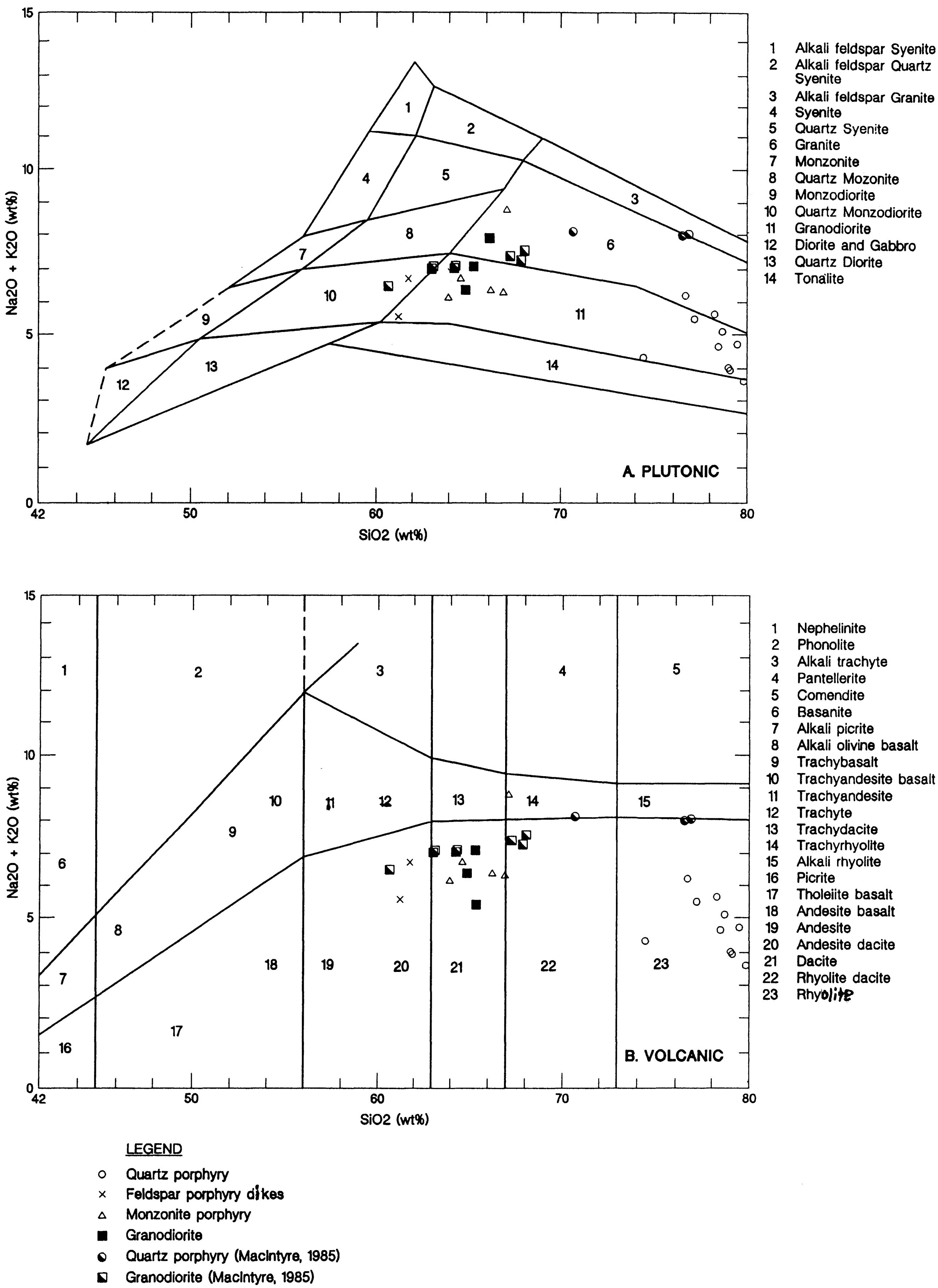

FIGURE 4. Discrimination plots (after Middlemost, 1985) of Whiting Creek intrusions. (A) plot for plutonic rocks such as granodiorite and monzonite; (B) plot for volcanic rocks such as andesitic dikes and quartz porphyry.

tenson et al., this volume). The sample of a hornfelsed volcanic rock returned a date of 78.5 Ma while the samples of granodiorite, monzonite porphyry and quartz monzonite returned dates of 81.4 Ma, 84.1 Ma and 81.3 Ma, respectively. MacIntyre (1985) reported a younger 76.0 Ma age from a quartz-biotite-feldspar porphyry dike cutting the Whiting Creek granodiorite. Ages for the principal intrusions and biotite hornfelsing are indistinguishable within the error limits (±3 Ma) and emphasize the close temporal relationship between all the granadioritic intrusive phases and the alteration/mineralization.

Structure

Structure on the property is dominated by a strong northwest trend which is followed by most intra- and postmineral dikes. Major faults following Comb Creek and Whiting Creek, many creek gullies and numerous faults within the quartz porphyry also follow this northwest trend.

Steeply dipping, mineralized and unmineralized fractures have a strong northwest-southeast trend. Less common directions of veinlets and fractures include 110°, 160° and 220° steeply dipping structures and 255° and 125° moderately- to shallowly-north dipping structures.

Mineralization and Alteration

Zones of economic interest at Whiting Creek lie within a 2 km east-west by 5 km north-south zone of intensely fractured, pyrite-rich volcanic and intrusive rocks. Above treeline, weathering of this system results in a spectacular red, yellow and brown gossan.

Copper and molybdenum mineralization is widespread throughout the pyrite system and can be divided into the four principal zones described in more detail below. No significant gold or silver values have been detected during routine analysis of drill core.

Biotite hornfelsing has affected most of the volcanic rocks in the upper parts of the property. Hornfelsing results in a dark brown sheen on fresh rock surfaces due to up to 80% felted biotite and lesser magnetite. Propylitic alteration, defined by the presence of epidote, calcite and chlorite, is common in the volcanic rocks marginal to the sulphide system.

Ridge Zone

The Ridge zone has been the focus of the majority of work on the property. Quartz-molybdenite stockwork mineralization is hosted within the quartz porphyry and in the marginal hornfelsed volcanic rocks. Molybdenite most commonly occurs within ribboned quartz veins and veinlets, occasionally in fractures without quartz and rarely as disseminations. Earliest veins are barren quartz followed by veinlets of pyrite, quartz-chalcopyrite-pyrite, molybdenite ± quartz, pyrite ± quartz and finally anhydrite. Diamond drilling in the zone has encountered up to 252 m grading 0.111% molybdenite, but overall values are lower. It has been estimated that the Ridge zone contains a drill-indicated resource of 31.6 million tonnes grading 0.112% MoS_2 and 0.06% Cu. Tungsten is locally anomalous (up to 245 ppm) in the quartz porphyry and in marginal volcanic rocks.

Zones of highest molybdenite occur along the northeast contact and along the south and southwest contacts and are characterized by pervasive quartz flooding or strong phyllic alteration (Fig. 3; Figs. 5a and 5b) and strong stockwork development of ribboned quartz veinlets. Phyllic alteration has resulted in 1% to 2% pyrite, replacement of feldspar phenocrysts and matrix orthoclase by sericite and locally, where most intense, by topaz. Distribution of K_2O and F in the quartz porphyry (Figs. 5c and 5d) show a close correlation with MoS_2.

Copper is not abundant in the zone except within younger hornblende biotite monzonite porphyry and associated breccias which cut the quartz porphyry (Fig. 5b). The unit is weakly mineralized with disseminated chalcopyrite and veinlets of quartz-chalcopyrite and quartz-molybdenite which commonly have K-feldspar envelopes. North of the Ridge zone, core from deeper drill holes within hornfelsed volcanic rocks displays pyrite veinlets with pink-grey K-feldspar envelopes.

Rusty Zone

The Rusty zone is a poorly defined copper-molybdenum zone located up to 1 km west of the Ridge zone and south of an altered quartz monzonite porphyry stock. Molybdenite, generally averaging less than 0.03% MoS_2, occurs in quartz veinlets cutting strongly biotite hornfelsed tuffs. Copper grades are better in the Rusty zone with up to 0.244% Cu over 92.1 m intersected in drill holes. However, average copper grade appears to be elevated by supergene chalcocite forming on pyrite in the top 40 m of the hole. Below the supergene zone, copper mainly occurs as veinlets and disseminations of chalcopyrite and lesser bornite within the feldspar-biotite-hornblende porphyry and andesite dikes which post-date molybdenum mineralization. This results in a general negative correlation between copper and molybdenum grades.

Potassic alteration is commonly associated with chalcopyrite in the Rusty zone where it occurs as secondary biotite replacement of hornblende and as partial replacement of primary biotite.

Creek Zone

The Creek zone occurs along Whiting Creek within the Whiting Creek biotite hornblende granodiorite (Figs. 2 and 3) and marginal to a body of pink latite porphyry. The extent of the zone is not well defined but it is at least 600 m north-south by 700 m east-west. The best drill intersection was 196 m averaging 0.27% Cu and 0.026% MoS_2. The better copper grades are associated with fracture controlled quartz-chalcopyrite ± pyrite ± epidote veinlets. Molybdenite occurs within steeply dipping quartz veinlets.

Quartz-chalcopyrite-epidote and quartz-pyrite-epidote veinlets display pink K-feldspar envelopes and biotite is replaced by secondary biotite. Phyllic alteration locally overprints potassic alteration with quartz-muscovite envelopes bordering sulphide veinlets.

Sweeney Zone

The Sweeney zone occurs in an overburden-covered area on the southside of the Whiting stock. Percussion drill testing of an oval, 1.5 km long I.P. anomaly located a large zone of pyritized, hornfelsed volcanic rocks marginal to a small satellitic granodiorite plug. Minor disseminated chalcopyrite and molybdenite occur within the granodiorite but values decrease rapidly away from the plug.

Supergene Characteristics

Mineralized outcrops in alpine areas are generally strongly fractured and leached of sulphides leaving widespead yellow, bright orange and red limonite. The bright orange and red limonite mainly occur in areas of phyllic alteration. X-ray diffraction of the yellow limonite identified the dominant mineral as jarosite with minor montmorillonite and sericite. The red limonite is composed mainly of sericite with minor montmorillonite and kaolinite. Presumably the sericite is coloured by hematite in quantities too small to detect.

Minor supergene copper enrichment occurs at the top of several percussion holes and in one diamond drill hole located at higher elevations in the Rusty zone. Chalcocite on pyrite was noted in the top 30 m to 40 m of the holes and copper grades decrease from 0.3% Cu in this supergene zone to approximately 0.2% Cu below.

Discussion and Conclusions

Copper-molybdenum mineralization associated with granodioritic intrusions at Whiting Creek (e.g., Creek zone, Sweeney zone) is similar in age and geological setting to mineralization associated with other Bulkley Intrusions, such as Huckleberry, Ox Lake and Coles Creek. Differences to these other deposits include the larger

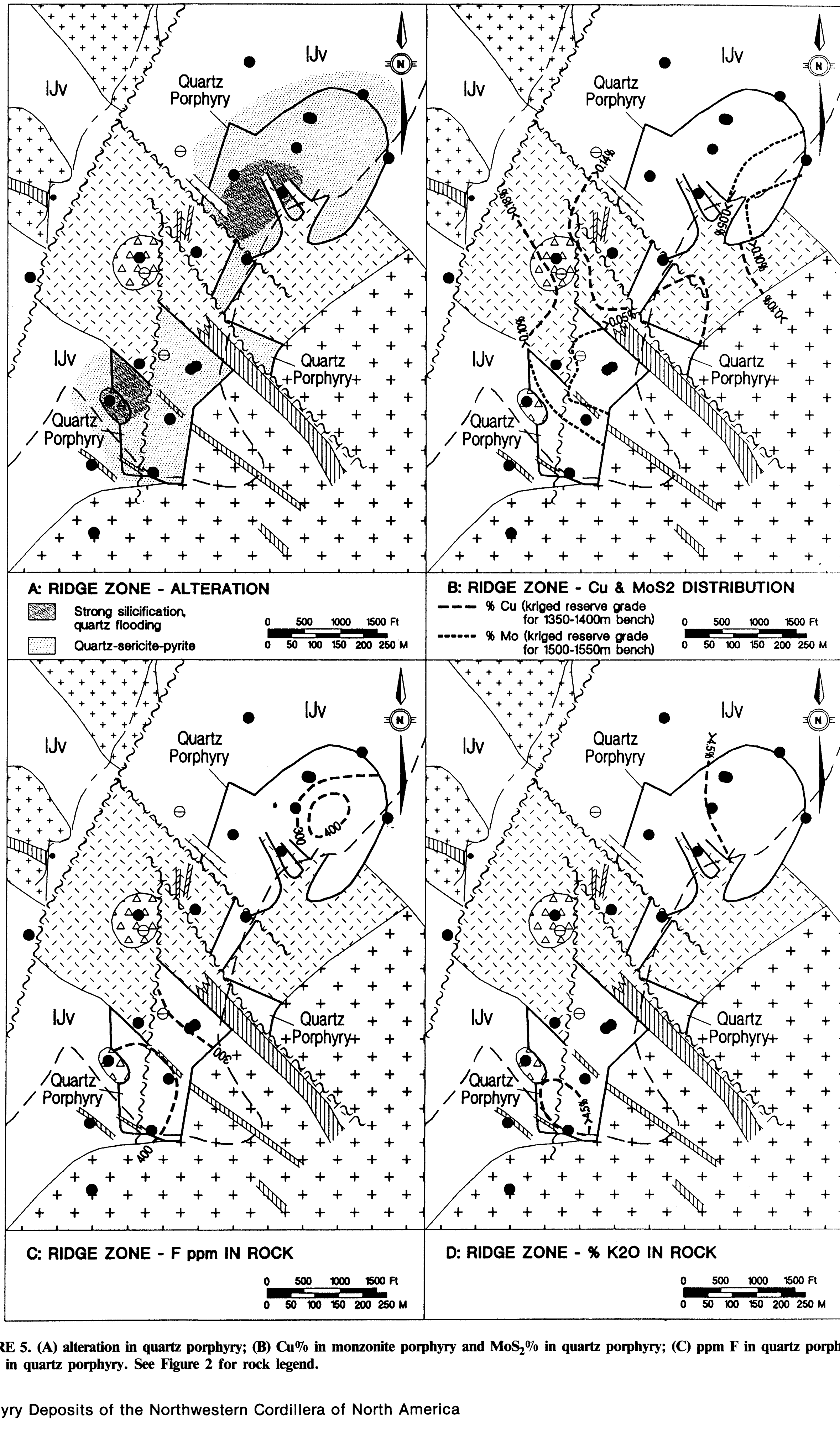

FIGURE 5. (A) alteration in quartz porphyry; (B) Cu% in monzonite porphyry and MoS_2% in quartz porphyry; (C) ppm F in quartz porphyry; (D) K_2O% in quartz porphyry. See Figure 2 for rock legend.

hydrothermal system at Whiting Creek (10 km^2 versus approximately 1 km^2) and the multiple, complex intrusive history at Whiting Creek.

The simple, single phase geometry of molybdenum mineralization and the petrology of the quartz porphyry suggest the Ridge zone can be classified as a Rb, Sr and TiO_2-depleted, stock-type calc-alkaline molybdenum deposit after Westra and Keith (1981). They suggest the silicic rhyolitic stock associated with molybdenum mineralization results from differentiation and shallow emplacement (1 km to 3 km) of a volatile-rich melt from a granodiorite magma emplaced at deeper crustal levels. The myrmekitic (crenulate) quartz layering, breccia bodies, and micrographic textures in the quartz porphyry support shallow emplacement and rapid chilling. Molybdenum mineralization in the Ridge zone has characteristics similar to the Glacier Gulch molybdenum deposit near Smithers (Bright and Jonson, 1976; Atkinson, this volume), including: (1) multiple intrusion of granitic units; (2) intimate association of molybdenite with quartz porphyry; and (3) marginal weak copper mineralization. Significant differences between the two deposits include the reported age of 60 Ma to 65 Ma for intrusion and mineralization at Glacier Gulch and the uniform, more siliceous compositions for all intrusive phases.

The large hydrothermal system, numerous porphyritic intrusions, numerous breccia bodies and presence of dike swarms suggest Whiting Creek may have been a volcanic centre. The juxtaposition of a high-level porphyry molybdenum system with a deeper level porphyry copper-molybdenum system may indicate telescoping of mineralization and alteration.

Much of the sulphide system at Whiting Creek remains underexplored. Areas to the west of the Creek zone have potential for mineralization in a Huckleberry-type setting, marginal to the intrusion. Gossanous, leached areas north of the Rusty zone but within or below the pyrite halo have not been drill tested.

Acknowledgments

The authors thank previous workers and co-workers from SMDC Mining Ltd. (Cameco) and Kennecott Canada for their contributions at Whiting Creek. Jenna Hardy provided critical reading of the paper. Figures were drafted by William Taylor and Les Lyons at Luminai Drafting who made order out of chaos.

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