The Poplar copper-molybdenum-gold porphyry deposit, central British Columbia

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ABSTRACT

The Poplar copper-molybdenum-gold porphyry deposit is hosted by a calc-alkaline intrusion belonging to the Bulkley Intrusive Suite of Late Cretaceous age. The deposit is located within the Intermontane Belt in west-central British Columbia and lies in the Interior Plateau physiographic region west of Prince George, British Columbia.

The Poplar stock intrudes Jurassic Hazelton Group volcanic and volcaniclastic rocks which include a significant clastic sedimentary component. The stock appears to be the exposed part of a larger intrusive batholith, broken by post mineralization, north-northwest trending normal faults downthrown to the west.

The deposit was discovered by classical prospecting in the early 1970s and extensively explored by Utah Mines Ltd. during the period 1974 to 1981. Geological mapping, geophysical surveying and diamond drilling served to delineate a copper-molybdenum resource of 236 million tonnes grading 0.37% Cu equivalent.

The Poplar deposit is hosted by a biotite feldspar monzonite porphyry. Copper and molybdenum mineralization is associated with significant potassic and propylitic alteration; sulphide minerals consist of pyrite, chalcopyrite and molybdenite. The chalcopyrite is commonly disseminated and associated with sericitized biotite, while molybdenite occurs predominantly in veins associated with gypsum and quartz.

Diamond drilling on the Poplar stock in 1991 expanded reserves in the higher grade core of the deposit. In the northeast area of the claim block a soil geochemical survey has delineated a strong copper anomaly which overlies a zone of propylitic alteration in a porphyritic biotite feldspar monzodiorite. This stock was drill tested in the 1991 program, and returned significantly anomalous values in copper, molybdenum and gold.

Introduction

The Poplar copper-molybdenum-gold porphyry deposit was discovered in 1971 by classical prospecting techniques, and staked on behalf of El Paso Mining & Milling Company. Preliminary geochemical soil sampling, geological mapping and bulldozer trenching did not provide sufficient encouragement and the property was quit-claimed to the original stakers. Utah Mines Ltd., now BHP Minerals Canada Ltd., optioned the claims in 1972. Extensive exploration and preliminary development work were completed on the property from 1974 through 1982. Subsequent to Utah's option, the claims were examined by many companies but no work was carried out. In 1991 the property was optioned by Metamin Enterprises Inc., and the option was transferred to New Canamin Resources Ltd. who completed a diamond drilling program in the fall of 1991.

The deposit occurs along the Skeena Arch in the Intermontane Belt, and is within one of the many calc-alkaline intrusions collectively known as the Bulkley Intrusive Suite. The porphyry has intruded Hazelton Group volcanic and sedimentary rocks of Jurassic age. The deposit occurs in a feldspar-biotite monzonite porphyry which grades into a hornblende monzonite border phase.

The Poplar stock appears to be part of a larger buried intrusion of batholithic dimensions. Widespread phyllic alteration is imposed on the country rock and the intrusion. Mineralization in the porphyry occurs in a zone of potassic alteration within a surrounding halo of propylitic alteration, consisting of disseminated chalcopyrite and a stockwork of quartz veins with included molybdenite.

There are several intrusive stocks exposed on the property, all are apparently part of the batholith. One such stock outcrops in the northeast part of the property east of China Creek. A large copper soil geochemical anomaly is associated with this stock, the anomaly being first drilled in the 1991 program. Disseminated chalcopyrite and pyrite is hosted in a biotite feldspar monzodiorite porphyry within a zone of propylitic alteration. Samples from the China Creek porphyry are strongly anomalous in copper and molybdenum. Further work is required to evaluate this target.

The Poplar deposit is located in west-central British Columbia, 260 km west of Prince George and 75 road km south of Houston (Fig. 1). The property is centred at Latitude 54°1′ North and Longitude 126°58′ West and is within N.T.S map sheets 93E/15W, 93L/02W and 93L/03E. The claims lie on the north side of Tagetochlain Lake, commonly known as Poplar Lake (Fig. 2).

The property is accessed by logging roads from Highway 16 at Houston, British Columbia, to the south along the Morice River Forest Service road and the Morice-Tahtsa F.S.R. to the east end of Poplar Lake. The "Poplar Main" haul road accesses the northeast part of the claim block, while the trail to the Forest Service camp ground on the east end of Poplar Lake continues on as the access trail to the main drill area on the property.

Poplar Lake lies at an elevation of 825 m above sea level. The ground on the north shore slopes up to the high hill of Poplar Mountain at 1800 metres. The claims cover this south facing slope which is made up of several wide benches and small hills. The slopes are dissected by three or four south and southwest flowing streams that are deeply incised close to the lake.

The vegetation is typical of the Interior Plateau with thick stands of conifers such as spruce, hemlock, fir and lodge pole pine with many areas of open meadow. The meadows are covered with grasses and have a thick development of black, chernozem type soils which appear to inhibit the growth of coniferous trees. There are open stands of deciduous trees such as aspen adjacent to the meadows on the benches with cottonwoods occurring along the creek banks. The grass meadows are utilized as summer cattle range by local ranchers.

History and Previous Work

The Poplar deposit was discovered by traditional prospecting along the lake shores and surrounding creeks and hills. The dis-

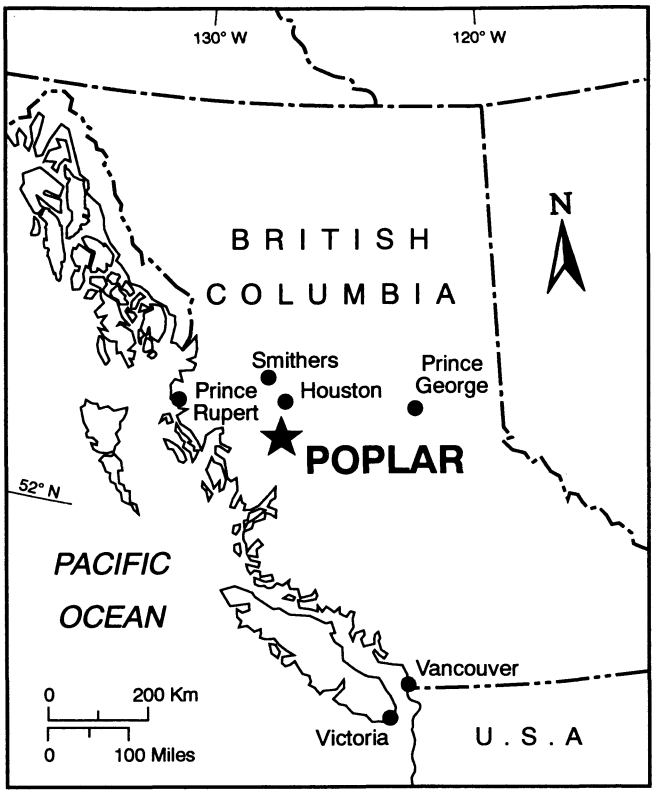

FIGURE 1. Poplar property location map.

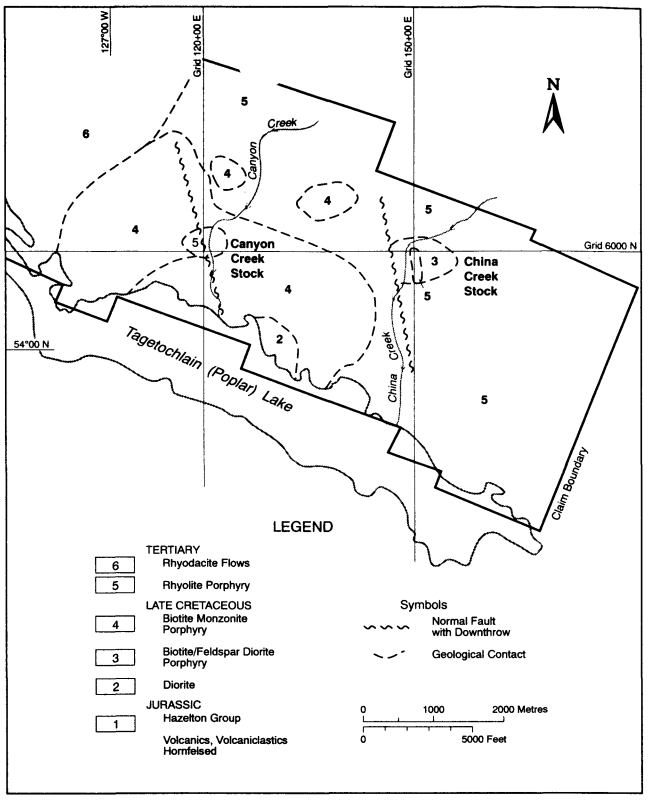

FIGURE 2. Generalized property geology.

covery of malachite in outcrop at the lake shore and malachite associated with chalcopyrite mineralization outcropping in Canyon Creek led to the staking of the claims in 1971 by F. Callaghan, F. Onucki and C. Critchlow for El Paso Mining & Milling Company.

Programs of geochemical soil sampling, geological mapping and bulldozer trenching were carried out in 1971 and 1972 under the direction of Harold Jones, for El Paso Mining & Milling Company. Results were disappointing and the property was returned to the original stakers.

The property was optioned by Utah Mines Ltd. in 1974, who conducted an ongoing exploration program up to 1977. Work included geological and topographic mapping, grid establishment by line-cutting and surveying, soil geochemical surveys, geophysical surveys including ground magnetometer and induced polarization surveys. Forty diamond drillholes totalling 8281 m were completed during this period. In 1978, the property was the subject of a Master's thesis by P.M. Mesard at The University of British Columbia, and N.C. Carter of the British Columbia Department of Mines and Petroleum Resources collaborated with a program of K-Ar age dating of rocks that host the porphyry copper deposit.

Utah Mines Ltd. renewed work on the property in 1980 by extending the diamond drilling program. A total of 17 900 m in 73 drill holes was completed by 1982, for an expenditure of about $2,500,000 (1982 dollars). Preliminary reserve figures were published by Utah Mines Ltd., and estimated at 285 million tons (260 million tonnes) of 0.37% Cu "equivalent" at a 0.25% Cu "equivalent" cut-off (Bowen, 1982).

In April 1982, Utah Mines Ltd. filed ten years of assessment work on the claims and returned the property to the original vendors. The property was examined by Ainsworth-Jenkins Holdings Inc. in 1991 and optioned by Metamin Enterprises Inc. The option agreement was later acquired by New Canamin Resources Ltd. In the fall of 1991 a diamond drilling program, totalling 1300 m, was completed on the original Poplar porphyry and the China Creek stocks.

Applied Exploration Techniques

The Poplar deposit was discovered by traditional prospecting methods along the rocky shores of lakes and creeks into the surrounding hills. Subsequent exploration utilized soil geochemical surveys and geophysical surveys, such as ground magnetometer and induced polarization surveying, to delimit areas of interest around the areas of mineralized outcrop.

A soil geochemical survey was completed by El Paso Mining and Milling Company in 1971 over the initial claims area. The "B" horizon was sampled on a grid system of 200 foot line intervals with 100 foot sample spacing, and a 7400 foot baseline. The samples were analyzed for copper, molybdenum and silver. Molybdenum results were of little significance, while copper indicated a collection of 500 ppm anomalous highs within a broader anomalous area of 200 ppm located in the area west of Canyon Creek (Fig. 2). The 500 ppm copper distribution suggests a glacial dispersion from west to east, which is in agreement with Tipper (1963) who has shown west to east ice movement on the adjacent Nechako River map-area. Silver values greater than 4 ppm were scattered, some of which coincided with greater than 500 ppm copper. The anomalous copper values in soil are not fully explained by known mineralization or by reported ice movement in the area.

The ground magnetometer survey conducted by Utah Mines Ltd. in 1976 produced a very subdued response. The main feature was a large central area of very gentle magnetic relief surrounded by areas of higher magnetic response (Bowen, 1976). Maximum anomaly values were in the order of 1500 gammas.

Induced polarization surveys were conducted by Utah Mines Ltd. in 1974 and 1975. Bowen (1976) reported that n = 2 and n = 4 data show anomalous chargeability values from line 10 400E to 13 400E and from 5100N to 6750N or an anomaly length of 3 km east-west and 1.6 km north-south. The high chargeability response was attributed to widespread pyrite and possibly clay alteration. It was noted that the apparent resistivity values did not show any obvious correlation with chargeability data. The apparent resistivity values varied from 50 to 2400 ohm-metres with most of the area

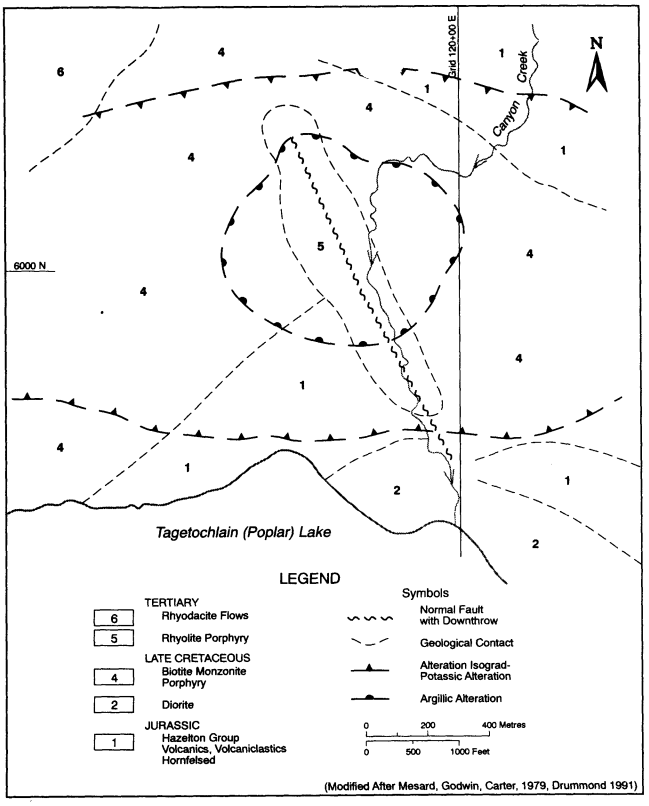

FIGURE 3. Generalized bedrock geology of Canyon Creek area, Poplar porphyry deposit.

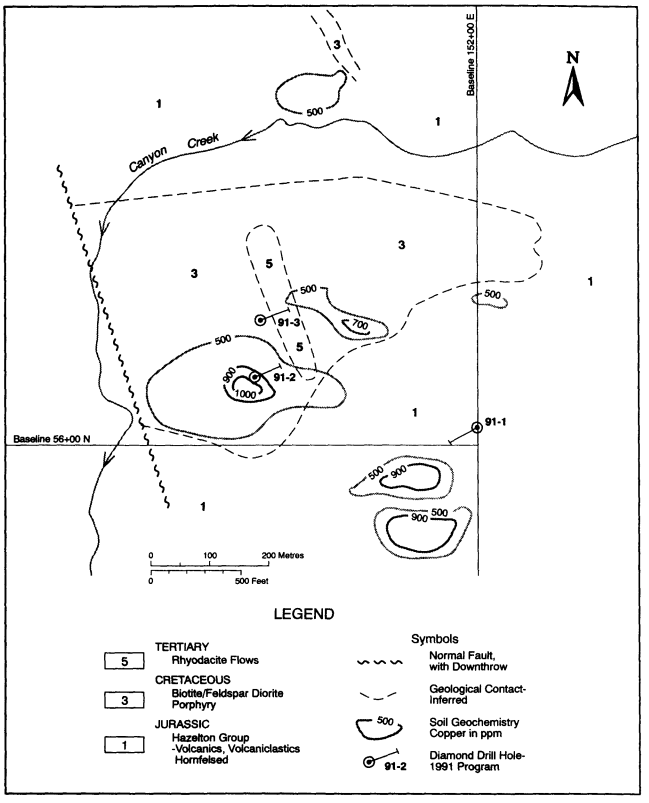

FIGURE 4. Bedrock geology of China Creek area, Poplar porphyry deposit with copper soil geochemistry and 1991 diamond drill hole locations.

showing 150 to 500 ohm-metres. The copper geochemistry and mineralization lie within the induced polarization anomaly and together cover an area of 1.5 km by 1.0 km which is about twice the area tested by drilling.

Regional Geology

The Poplar deposit lies within the Intermontane Belt, east of the Coast Crystalline Belt and south of the Skeena Arch. The Intermontane Belt is underlain principally by Mesozoic volcanic and sedimentary rocks. The Skeena Arch was a prominent transverse structure during early Mesozoic time and marks the boundary between the Bowser successor basin to the north and an area to the southeast covered by Early to Late Tertiary volcanic rocks.

Tectonic deformation in Early Cretaceous time resulted in north-northeast and northwest-trending block faulting of the Skeena Arch. Many of these block faults localized the intrusion of numerous granitic stocks and plugs in Late Cretaceous and Early Tertiary time.

Age dating of the biotite monzonites of the Poplar porphyry by Mesard et al. (1979) returned ages correlative with the ages of the Bulkley Intrusions (Carter 1981), indicating a Late Cretaceous age. Disseminated copper-molybdenum mineralization at the Huckleberry and Ox Lake porphyry deposits, approximately 60 km to the south, is associated with the Bulkley Intrusive Suite.

Property Geology

The Poplar copper-molybdenum-gold porphyry deposit is centered on a differentiated calc-alkaline stock of Late Cretaceous age which intruded into volcanic and sedimentary rocks of the Hazelton Group of Jurassic age (Fig. 2).

The Hazelton Group rocks are exposed on the eastern and western parts of the claim block. Two units were differentiated by earlier workers: the lower unit is volcanic and consists of fine- to medium-grained feldspar porphyry tuffs and agglomerates with massive andesites and gabbroic rocks, interbedded with a few narrow argillite beds; the upper unit is mainly sedimentary, with up to 400 m of a basal gritty argillite overlain by medium- to coarse-grained polymictic sandstones and conglomerates.

Several stocks of differing composition crop out within the claim block; however, all of the earlier drilling was carried out in the Canyon Creek area on the "Poplar stock", a feldspar biotite porphyry monzonite intruded into cherty argillites and sandstones (Fig. 3).

The Poplar stock is zoned, with a core of biotite monzonite porphyry that grades into a hornblende monzonite border phase. The stock is cut by northwest-trending postmineral felsic dikes. Mesard et al. (1979) carried out age determinations on biotites from a "biotite monzonite porphyry" associated with the Poplar deposit. The K-Ar analyses were performed at the Geochronology Laboratory of the Department of Geological Sciences at The University of British Columbia. Apparent ages of 71.9 ± 2.5 Ma and 75.1 ± 2.3 Ma were returned on biotite separates from two samples. These ages place the intrusions in the Late Cretaceous, correlative with the age of the Bulkley Intrusions (Carter, 1981).

The stock exposed in the China Creek area is a biotite feldspar monzodiorite porphyry to diorite porphyry (Fig. 4). This stock appears higher in the intrusive system than the Poplar porphyry, as indicated by the alteration assemblage associated with the China Creek mineralization. The China Creek stock is part of the Poplar porphyry system, separated from the main Poplar porphyry by block faulting.

Several intrusive dikes or small plugs are associated with the Poplar porphyry, the most common variety is a "quartz-eye" rhyolite to rhyodacite porphyry containing characteristic rounded quartz augen up to 6 mm across in a white to tan aphanitic groundmass. A pink to maroon coloured porphyritic rhyodacite with plagioclase phenocrysts and quartz augen up to 5 mm across intrudes the China Creek stock as dikes or late stage plugs into the main stock of monzodiorite porphyry.

The larger intrusive body which includes the Poplar and the China Creek stocks is dissected by a s of parallel, post mineralization, late stage normal block fau. ending north-northwest and with downthrow to the west (Fig. 2). These fault zones were more susceptible to erosion and are now occupied by Canyon Creek on the west and by China Creek on the east. The faults have dissected the two porphyry stocks to some extent and appear to have formed the loci for intrusion of Tertiary rhyolite to rhyodacite dikes or plugs.

The fault in the Canyon Creek area, cuts the "Poplar porphyry" and may even have an element of post-glacial movement. East of Canyon Creek the glacial drift and glaciofluvial gravel are 24 m to 30 m thick while the overburden on the west of the canyon of the creek is 1 m to 3 m thick as shown by several drill programs (Fig. 3). There is no evidence of similar post-glacial movement on the China Creek Fault (Fig. 4).

All significant hydrothermal alteration and sulphide mineralization is restricted to the Poplar and China Creek stocks and their thermal aureoles. Hornfelsing in the volcanic rocks occurs for over 300 m from the intrusive contacts. The hornfels aureole is more strongly developed around the China Creek stock than around the Poplar stock.

The major alteration assemblages reported by Mesard et al. (1979) and observed in drill core are:

1. Potassic: potassium feldspar + secondary biotite + magnetite + gypsum ± quartz ± hematite;
2. Phyllic: quartz + sericite + pyrite ± gypsum ± clay ± carbonate ± hematite;
3. Argillic: clay ± sericite ± carbonate ± quartz, and;
4. Propylitic: chlorite ± carbonate ± epidote ± albite.

Phyllic alteration is widespread, enveloping the potassic and propylitic alteration associated with mineralization.

Economics

Preliminary reserves calculated by Utah Mines Ltd. in 1982 (Bowen, 1982), based on 17 000 m of drilling, were estimated to be 260 million tonnes grading 0.37% Cu equivalent, using 1982 prices for copper and molybdenum. Gold was not assayed on a systematic basis. Some drill holes were composited over intervals of 30 feet (9.14 m) and assayed for gold but with limited success.

The drill core from the 1991 drill program was systematically assayed in 3 m intervals for copper, molybdenum, gold and silver. The results confirmed the earlier assay results and, because of the closer, infill nature of the spacing of the drill holes, did expand the estimated reserves of the higher grade core of the Poplar porphyry deposit. The reserves grading higher than 0.4% Cu were increased from approximately 28 million tonnes to just under 40 million tonnes.

Utah Mines Ltd. carried out metallurgical test work on several tonnes of drill core from the earlier drill programs in 1980 or 1981. Some test work has been carried out on drill core from the 1991 drill program to determine the acid leach parameters of the mineralized rock for SX/EW recovery of copper from the higher grade core of the Poplar deposit. The results of this recent work are still pending.

The area surrounding the deposit has been logged in recent years, and while Poplar Lake does receive some recreational usage for fishing and hunting it is not a prime tourist destination. The environmental impact of a large open pit mine should not have a significant impact on the area. With proper planning the visual impact could be minimized during the mine life and reclamation of waste and tailings piles should not be onerous. There has been no acid base accounting tests done on the rocks of the porphyry deposit, however, the presence of carbonate associated with the phyllic alteration assembage could be beneficial. The potential for acid rock drainage is unknown at this time.

Discussion and Conclusions

The Poplar porphy posit occurs in one of several stocks which appear to form apophyses above a larger buried intrusive body; the China Creek porphyry is a similar stock. The larger intrusion appears to strike east-northeast and has been involved in the regional block faulting associated with the waning of the Skeena Arch as a major tectonic feature within the Intermontane Belt.

The block faults have a north-northwest strike and are downthrown to the west. Two of these faults cross the property, one along Canyon Creek on the west, dissecting the Poplar deposit, and another along the lower trace of China Creek cutting off the China Creek stock on the west. These faults appear to be post mineralization but are associated with the late stage Tertiary rhyolite and rhyodacite intrusions within both stocks.

The Poplar deposit has a core of potassic alteration surrounded by a zone of phyllic alteration, imposed on a biotite monzonite porphyry. The alteration at the China Creek stock is propylitic, imposed on a feldspar-biotite monzodiorite to diorite porphyry. Mineralization in both stocks is the same, with chalcopyrite and molybdenite the main economic minerals while pyrite is ubiquitous in the Poplar stock and magnetite-hematite is common in the China Creek stock.

There has been no further systematic exploration of the surrounding area since the mid-1970s; the Poplar porphyry was the only area of anomalous soil geochemistry to be drilled at that time. During the 1991 drill program of New Canamin Resources Ltd., the China Creek porphyry was tested with three diamond drill holes, two of which returned anomalous values in copper, molybdenum and gold.

Acknowledgments

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