GEOLOGY OF THE POPLAR PORPHYRY COPPER–MOLYBDENUM DEPOSIT
(93L/3E; 93E/15W)

By P. M. Mesard and C. I. Godwin
Department of Geological Sciences, University of British Columbia
and
N. C. Carter
Senior Geologist, British Columbia Ministry of Mines and Petroleum Resources

INTRODUCTION

The Poplar copper-molybdenum porphyry deposit, 50 kilometres south-southwest of Houston, is centred near 54 degrees 01 minute north and 126 degrees 50 minutes west. The property is accessible from Houston via 80 kilometres of forest access roads along the Morice River, Owen Lake, Tahtsa Reach, and Poplar Lake. The deposit is situated on the northeast shore of Tagetochlain (Poplar) Lake in an area of moderately rolling topography which ranges in elevation from 840 metres at lake level to 1 110 metres at the western edge of the study area (Fig. 37). Two small streams, Canyon Creek and East Creek, traverse the area. Grassy, open meadows alternate with local stands of aspen, fir, and pine. Meadows in the area are used by local ranchers for cattle grazing.

The property has been optioned since 1974 by Utah Mines Ltd. Development work to 1977 has included geological and topographic mapping, soil geochemistry, magnetometer, induced polarization, and legal land surveys, and 40 diamond-drill holes (ranging from 119 to 300 metres in length) totalling 8 281 metres.

This paper is a preliminary report on fieldwork undertaken during the summer of 1978 on the Poplar property, which will form the basis for an M.A.Sc. thesis project by the senior author. Work is continuing on details of petrology, mineralization, and alteration, and the spatial distribution of these features. Geochronometric studies are also in progress.

Field studies consisted of mapping the geology of the area surrounding the deposit at a scale of 1:2500, and logging the majority of the drill core. Special emphasis was placed on detailed logging of drill holes along an east-west cross-section (eight holes), and a 035 azimuth section (four holes), through the deposit (Fig. 37, filled circles). Other holes (Fig. 37, open circles), logged in less detail, facilitated extrapolation from these cross-sections. A computer compatible data base system was used to log the core in detail (Blanchet and Godwin, 1972; Godwin, *et al.*, 1976; and Wilton, 1978). Data collected are amenable to computer processing for studies involving a large number of variables. Such studies can define statistical correlations between separate geologic features and their spatial distribution (compare Cargill, 1975; Wilton, 1978).

This study is supported jointly by the British Columbia of Mines and Petroleum Resources and by a National Research Council of Canada grant to Godwin. Discussions with T. G. Schroeter of the Ministry of Mines and Petroleum Resources, Dr. A. J. Sinclair of the University of British Columbia, and Dr. T. A. Richards of the Geological Survey of Canada during visits in the field were helpful. Utah Mines Ltd. have generously given permission for this project and have provided a large amount of background data. Interest shown by B. Bowen and A. J. Schmidt is gratefully acknowledged.

GEOLOGY

Figure 37 shows the generalized geology of the Poplar porphyry deposit based on surface geology and information from drill holes. Mineralization appears to be genetically related to a Late Cretaceous porphyritic stock which intruded and locally metamorphosed volcaniclastic and epiclastic country rocks. Several post-mineral dykes intrude both the stock and the surrounding sedimentary rocks, and may be equivalent in age and composition to Tertiary (?) volcanic rocks in the western and central part of the study area.

Field descriptions, as follows, are provided in order of decreasing age as determined from crosscutting relationships.

Hazelton Group (?) (Units 1a and 1b)

Potassium/argon age analyses (*see* table) from the biotite monzonite porphyry indicate that the sedimentary rocks surrounding the deposit are of pre-Late Cretaceous age. Lithologies of these sedimentary rocks are similar to those described by Tipper and Richards (1976, p. 27) for the upper portion of the Early to Middle Jurassic Hazelton Group. Hazelton (?) rocks consist of two distinct units: a volcaniclastic and epiclastic volcanic member (unit 1a) and an epiclastic member (unit 1b). Contacts delineating the upper and lower units were not observed.

Unit 1a is composed of dark grey to pale tan dust and lapilli tuff, argillaceous tuff, and siltstone. Local lenses of medium to fine-grained sandstone, up to 1 metre thick, are interbedded with these tuffaceous rocks. Bedding attitudes are 050 to 075 degrees with dips of 50 to 80 degrees southeasterly. Unit 1b is a moderately sorted, polylithic conglomerate and sandstone. The conglomerate consists of up to 85 per cent rounded to subangular clasts of quartz, banded chert, and tuff, less than 2 centimetres in diameter. The matrix consists of fine-grained tuff and quartz, and is locally chloritic. Sandstone of this unit, which underlies and locally is interbedded with the conglomerate, consists of well-rounded to angular, medium to fine-grained quartz, plagioclase, and chert.

POTASSIUM–ARGON ANALYTICAL DATA[a] FROM THE POPLAR PORPHYRY DEPOSIT, BRITISH COLUMBIA

SAMPLE NO. OR NAME	LOCATION[b] LAT. (N); LONG. (W)	ROCK UNIT; ROCK NAME[b]	MINERAL DATED	%K+S[c]	$\frac{^{40}Ar^{*}}{^{40}Ar\ TOTAL}$[d]	$^{40}Ar^{*}$[d] ($10^{-5}cm^{3}STP/g$)	APPARENT[e] AGE (Ma)	TIME[f]
G76TR22	54° 01′ 126° 50′	3: biotite monzonite porphyry	biotite	7.14+0.07	0.878	2.088	71.9±2.5	Late Cretaceous
POPLAR LAKE	54° 01′ 126° 50′	3: biotite monzonite porphyry	biotite	7.00+0.04	0.915	2.139	75.1±2.3	Late Cretaceous

[a] All analyses done in the Geochronology Laboratory, Department of Geological Sciences, The University of British Columbia.

[b] G76TR22 is from drill hole 23 (depth 52 m); POPLAR LAKE is from suboutcrop near the collar of drill hole 12.

[c] 'S' is mean deviation of duplicate analyses.

[d] 'Ar*' indicates radiogenic argon.

[e] Decay constants used: $\lambda = 0.585 \times 10^{-10} yr^{-1}$, $\lambda = 4.72 \times 10^{-10} yr^{-1}$, $^{40}K/K = 1.19 \times 10^{-4}$.

[f] Time designation after Obradovich and Cobban, 1975.

Diorite (Unit 2)

Diorite is observed in outcrops which form local ridges on the southern and southeastern portions of Figure 00. This diorite, generally porphyritic, contains up to 20 per cent coarse-grained, euhedral hornblende in a fine-grained to aphanitic groundmass. Medium-grained phenocrysts of plagioclase are abundant, and medium-grained biotite phenocrysts are minor. Although potassium feldspar phenocrysts were not observed, the groundmass is locally pinkish grey indicating that is may contain appreciable potassium feldspar. Magnetite is common in the groundmass. This unit is locally mineralized with minor disseminations of pyrite and/or traces of chalcopyrite. The diorite was observed in chilled contact against the Hazelton (?) conglomerate (unit 1b).

Biotite Monzonite Porphyry (Unit 3)

Biotite monzonite porphyry has distinctive medium-grained euhedral phenocrysts of plagioclase and biotite in a pink to dark grey aphanitic groundmass. Minor medium-grained hornblende and rare potassium feldspar phenocrysts (most pink feldspars are hematitized plagioclase) are observed locally. Textural variations are common. Contacts between this unit and the Hazelton (?) sedimentary rocks are typically highly fractured, sheared, and steep. Hydrothermal alteration within the biotite monzonite porphyry is extensive and variable. Sulphide minerals are most abundant in this unit, but are absent in younger rock units. Therefore, the biotite monzonite porphyry is very closely related to the formation of the Poplar deposit.

Two samples of biotite monzonite porphyry have yielded K/Ar model ages of 71.9±2.5 Ma and 75.1±2.3 Ma (*see* table). This Late Cretaceous age suggests that the biotite monzonite porphyry is synchronous with granitic stocks associated with the Bulkley intrusions defined by Carter (1974, 1976; compare MacIntyre, 1976) which are host to other copper and molybdenum deposits in the area including Huckleberry and Ox Lake.

Porphyritic Rhyodacite Dykes and Flows (?) (Units 4a and 4b)

Porphyritic rhyodacite (Fig. 37, unit 4a) intrudes the biotite monzonite porphyry and Hazelton (?) sedimentary rocks. These dykes have fine to medium-grained plagioclase phenocrysts set in a maroon aphanitic groundmass. Quartz eyes, up to 5 millimetres in diameter and medium-grained biotite occur locally. Oriented phenocrysts define a trachytoid texture, emphasized by elongated amygdules.

Volcanic flow (?) rocks (Fig. 37, unit 4b) are found in Canyon Creek and capping (?) a hill in the western portion of Figure 00. These rocks are porphyritic and composed of up to 50 per cent fine to medium-grained phenocrysts of plagioclase, biotite, hornblende, and potassium feldspar. The aphanitic groundmass is reddish brown to pink in colour. Locally the unit is trachytoid.

These flows (?) are typically fresh and unmineralized, yet occur adjacent to highly altered biotite porphyry. These volcanic rocks therefore were not present at the time of intrusion, alteration, and mineralization of the deposit. Megascopically these flows (?) resemble the dykes in mineralogy and texture, and are tentatively considered to be comagmatic; the dykes, thus, were 'feeders' for the volcanic rocks and locally intrude them. Faulting has placed unit 4b against highly altered argillites of the Hazelton (?) Group in Canyon Creek, but the nature of the contact in the western part of Figure 37, between volcanic rocks and the altered intrusion is unknown.

Porphyritic Quartz Eye Rhyolite Dykes (Unit 5)

Porphyritic quartz eye rhyolite is distinctively white to tan in colour. The unit is composed of abundant well-rounded quartz eyes, up to 6 millimetres in diameter, with medium-grained euhedral plagioclase and biotite phenocrysts in an aphanitic groundmass. Porphyritic quartz eye porphyry is the most abundant dyke rock and is observed intruding all other units, except the volcanic flow (?) rocks (unit 4b).

ALTERATION AND MINERALIZATION

All significant hydrothermal alteration and sulphide concentrations are restricted to the Hazelton (?) Group layered rocks, the diorite, and the biotite monzonite porphyry. Alteration assemblages, whose localizations are strongly controlled by structure, are complex and variable in intensity and distribution. Pervasive alteration is volumetrically most abundant, but veins and associated envelopes are also commonly observed, especially at rock unit contacts. On the basis of field studies the major alteration assemblages 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
(4) PROPYLITIC: chlorite ± carbonate ± epidote ± albite (?)

These assemblages are commonly superimposed on one another (for example, potassium feldspar veins cut pervasively sericitized rocks). The most widespread alteration is phyllic, followed by potassic and propylitic. Argillic alteration is minor.

Sulphide minerals, in order of decreasing abundance, include: pyrite, chalcopyrite, and molybdenite. Traces of sphalerite, galena, tetrahedrite, covellite, and chalcocite occur in veins. Chalcopyrite, commonly as disseminations, is closely associated with sericitized biotite. Molybdenite occurs mainly in veins associated with gypsum and quartz.

STRUCTURE

This study is centred in a region characterized by extensive block faulting (MacIntyre, 1976; Woodsworth, personal communication, 1978). Structures on Figure 37 are interpreted from scant outcrop, drill-hole information, and from aerial photographs. The dominant structural feature is the north-northwest-trending shear zone parallel to the porphyritic quartz eye rhyolite dyke in Canyon Creek. Outcrop in the creek is well jointed, sheared, and quartz veined. A dominant set of joints trends 010 to 025 degrees azimuth and dips 75 to 90 degrees to the northwest. Numerous dykes and shear zones on Figure 37 parallel this trend, but are truncated in the northern part of Figure 37 by an easterly trending fault. Displacement along faults could not be determined.

REFERENCES

Blanchet, P. H. and Godwin, C. I. (1972): 'Geolog System' for Computer and Manual Analysis of Geologic Data from Other Deposits, *Econ. Geol.,* Vol. 67, pp. 796-813.

Cargill, D. G. (1975): Geology of the 'Island Copper' Mine, Port Hardy, British Columbia, unpubl. Ph.D. thesis, *University of British Columbia,* 211 pp.

Carter, N. C. (1974): Geology and Geochronology of Porphyry Copper and Molybdenum Deposits in West-Central British Columbia, unpubl. Ph.D. thesis, *University of British Columbia.*

.... (1976): Regional Setting of Porphyry Deposits in West-Central British Columbia, *in* Porphyry Deposits of the Canadian Cordillera, A. Sutherland Brown, ed., *CIM,* Special Vol. 15, pp. 227-238.

Godwin, C. I., Hindson, R. E., and Blanchet, P. H. (1977): 'Geolog,' A Computer-based Scheme for Detailed Analysis of Stratigraphy, Especially as Applied to Data from Drill Holes in Coal Exploration or Development; *CIM,* Bull., Vol. 70, No. 783, pp. 123-132.

MacIntyre, D. G. (1976): Evolution of Upper Cretaceous Volcanic and Plutonic Centres and Associated Porphyry Copper Occurrences, Tahtsa Lake Area, British Columbia, unpubl. Ph.D. thesis, *University of Western Ontario,* p. 148.

Obradovich, J. D. and Cobban, W. A. (1975): A Time-Scale for the Late Cretaceous of the Western Interior of North America, *Geol. Assoc. Canada,* Special Paper No. 13, pp. 31-54.

Tipper, H. W. and Richards, T. A. (1976): Jurassic Stratigraphy and History of North-Central British Columbia, *Geol. Surv., Canada,* Bull. 270, p. 73.

Wilton, D. C. (1978): A Genetic Model for the Sustut Copper Deposit, North-Central British Columbia, unpubl. M.Sc. thesis, *University of British Columbia,* p. 213.

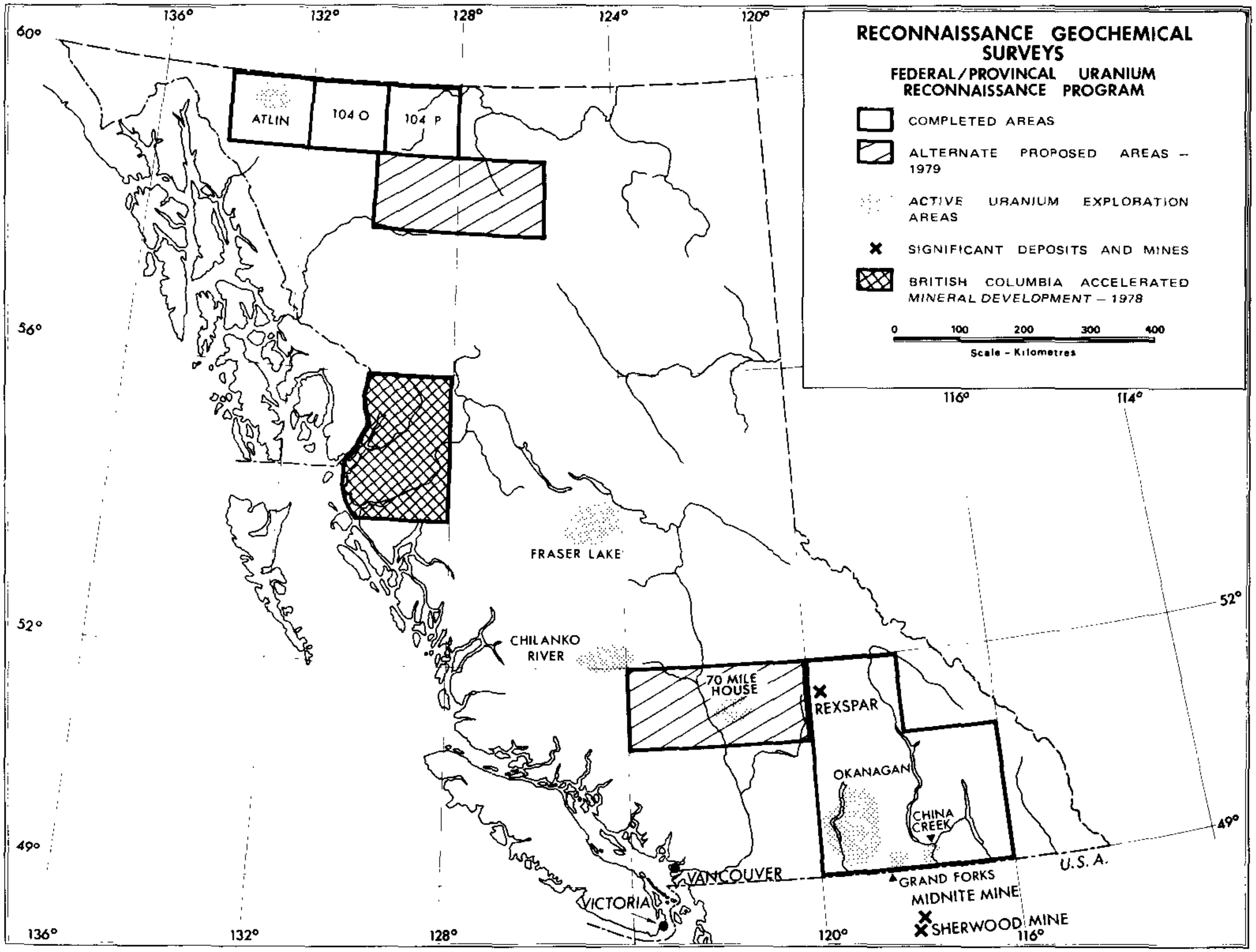

Figure 38. Index map, reconnaissance geochemical surveys.