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The Whipsaw porphyry system, Similkameen district, British Columbia

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ABSTRACT

The Whipsaw property contains copper, gold, silver, molybdenum, zinc and lead mineralization which is related to the Whipsaw porphyry stock. This Late Cretaceous to Middle Tertiary stock intrudes the mineralized contact between the Upper Triassic Nicola Group volcanic rocks and the Jurassic-Cretaceous Eagle granodiorite. Copper, molybdenum and gold mineralization occurs mainly in the Nicola rocks, and is related spatially to the perimeter of the Whipsaw porphyry. Deposits containing gold, silver, zinc and lead mineralization in pyrite-bearing quartz veins and in wallrock adjacent to the veins occur to the south of the area of porphyry mineralization.

Copper-zinc stream sediment anomalies, which gave an intense rubeanec acid test response, were discovered in 45 Mile and 47 Mile creeks in 1959, and were traced upstream to the northern and southern contact areas of the Whipsaw porphyry. In 1987, upon consolidation of several properties by World Wide Minerals Ltd., an exploration program covering the entire area of interest was initiated. The property is still at the early drilling stage of exploration.

Drill holes, based on geophysics and geochemistry correlated with geology, have intersected substantial lengths of 0.2% Cu to 0.3% Cu mineralization with some molybdenum, and have indicated gold potential in the southern part of the porphyry area. The Whipsaw property is accessible, and there is good infrastructure already in place in the Princeton area.

Introduction

The Whipsaw property, located in the Similkameen district of British Columbia, contains copper, gold, silver, molybdenum, zinc and lead mineralization in several zones related to the Whipsaw porphyry intrusion and extending over a large area north and south of Whipsaw Creek (Fig. 1). Placer deposits containing gold and platinum were mined in Whipsaw Creek downstream to the east of the property. After the original staking of gold-bearing, quartz-sulphide vein deposits in 1908, several owners held mineral claims in the area. Geochemical stream sediment and soil anomalies, derived from porphyry mineralization, were detected in 1959 in 45 Mile and 47 Mile creeks which enter Whipsaw Creek from the north (Fig. 2). The claim situation became complex after the discovery of the porphyry potential. In 1987, for the first time, the ground was consolidated by World Wide Minerals Ltd., making it possible to plan exploration projects without property line constraints, as was the case in all the pre-1987 work (Richardson, 1988a).

The present Whipsaw property covers 4150 ha. It hosts at least two styles of mineralization: predominantly porphyry copper, molybdenum and gold mineralization around and within the Whipsaw porphyry intrusion (here termed the porphyry area); and gold-, silver-, zinc- and lead-bearing quartz veins and related replacement mineralization in several showings south of the porphyry area.

The Whipsaw property is in the Similkameen Mining Division, British Columbia, at latitude 49°17′ N, longitude 120°45′ W on NTS Map 92H/7 (Fig. 1). The property is 170 km east of Vancouver and 26 km southwest of Princeton. Similco Mines Ltd.'s Ingerbelle and Copper Mountain copper-gold deposits are situated 15 km east-northeast of the property.

Access from Vancouver is via Highway 401 to Hope and Highway 3 to Princeton (Fig. 1). Thirteen kilometres south of Princeton, a good logging road leaves Highway 3 and follows the north bank of Whipsaw Creek southwestward to the property, a distance of 15 km. Numerous logging and mining roads give good access to most parts of the property.

Whipsaw Creek flows eastward through the middle of the property (Fig. 2). The topography within the property is generally moderate with some deeply incised valleys. Elevations range from 1385 m to 1660 m. The property is covered with large stands of conifers with little undergrowth. Extensive logging is currently being done, and there are increasing areas of clearcut. In general, outcrop is sparse, but in many areas the overburden is less than one metre thick.

History

Although placer deposits in the Tulameen and Similkameen rivers and their tributaries had been known since the 1860s, it was not until 1885 that rich placer deposits of gold and platinum were discovered in Granite Creek near the town of Tulameen (Fig. 1). The bonanza period of placer mining lasted for a decade. During this period, gold and platinum placer deposits were discovered in Whipsaw Creek downstream to the east of the present Whipsaw property. Prospecting for bedrock deposits led to the staking of gold- and silver-bearing veins in the central part of the property in 1908 (Fig. 2). These veins were explored at the time and in the years since then by trenching and underground work.

In 1959, reconnaissance stream sediment sampling by Texas Gulf Sulphur discovered significant stream sediment copper-zinc anomalies in 45 Mile and 47 Mile creeks, tributaries entering Whipsaw Creek from the north (Bacon, 1960). Follow-up work outlined soil geochemical, electromagnetic and induced polarization anomalies near the headwaters of 47 Mile Creek (Fig. 2; Bacon, 1960 and 1961; Holyk, 1962). The geochemical anomalies originated from the weathering of porphyry copper-molybdenum-gold mineralization in the northern part of the present property. This anomalous area was explored successively by Texas Gulf, by a joint venture composed of Dome Exploration (Canada) Ltd., Moneta Porcupine Mines Limited and Tennessee Corporation, by Amax Exploration Inc. and by Newmont Mining Corp. of Canada Ltd. (Seraphim, 1963; Hallof 1963; Mustard, 1969; Macauley and Paulus, 1971). Diamond drilling programs, based on the various geochemical and geophysical surveys, gave significant intersections of 0.2% Cu to 0.3% Cu with accompanying molybdenum (Heim, 1987). Samples collected in an extensive 1970 soil sampling program were analyzed for copper only. This survey obtained anomalies over areas of known mineralization and also led to the discovery of the BZ zone, which lies within the southern part of the porphyry copper area (Fig. 2).

In 1985, World Wide Minerals Ltd. conducted soil sampling

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in the area of the BZ trenches to test for both precious and base metals (Heim, 1985). It was found that the entire area of the BZ trenches was within a large copper-zinc soil anomaly accompanied by anomalous gold, silver and arsenic values. In 1986, the trenches were extended and rock samples were cut, one of which assayed 11.62 g/t Au and 185.1 g/t Ag across 0.61 m in a shear zone, which confirmed the presence of gold in the porphyry area (Heim, 1987).

In 1987, World Wide Minerals Ltd. conducted a soil sampling program over the central part of the property. A total of 5580 samples was collected and analyzed for gold and, separately, for 31 elements using the inductively coupled plasma (ICP) method. The company also carried out a combined magnetic and very low frequency electromagnetic (VLF-EM) helicopter-borne survey over the southern part of the property (Walker, 1987). In late 1987 and January 1988, the company completed 30 diamond drill holes totalling 3048 m on part of the BZ zone and, south of the porphyry area, on the Silvertip and Metestopher showings (Richardson, 1988b). In August 1988, additional soil sampling was completed on claims staked to protect the northwest and southeast extensions of geochemical anomalies outlined by the 1987 soil sampling program (Richardson, 1988c). In 1990, World Wide Minerals Ltd. conducted a three-hole diamond drilling program to test further the copper mineralization north of the Whipsaw porphyry (Richardson, 1990a and 1990b).

In 1991, the northern half of the Whipsaw property was optioned to Phelps Dodge Corporation of Canada, Limited; it conducted diamond drilling and percussion drilling programs in 1991 and an additional, small diamond drilling program in 1992 (Fox, 1992; Fox and Goodall, 1992). Drilling was confined to parts of the porphyry area surrounding the Whipsaw porphyry stock and to the area north of the known mineralization.

In all, thirty-two diamond drill holes totaling 4348 m and ten percussion holes totaling 693 m have been drilled to explore the porphyry potential of the property. In addition, fifteen closely-spaced diamond drill holes totaling 1410 m were drilled to investigate the BZ zone. Within the property, but outside the porphyry area, several diamond drill holes were drilled by various companies to investigate sulphide-bearing quartz veins and to investigate rusty areas in the Eagle granodiorite.

Regional Geology

Three major rock units occur in the vicinity of the Whipsaw property: the Nicola Group, the Eagle granodiorite and the Whipsaw porphyry (Rice, 1947; Fig. 1). The Upper Triassic Nicola Group rocks are predominantly volcanic with some sedimentary horizons (Fig. 2). Within the Whipsaw property, there is a transition zone several hundred metres wide in which the volcanic rocks consist of hornblende schists that increase from greenschist grade to amphibolite grade of metamorphism westward toward the Eagle granodiorite (Anderson, 1971). A unit of marble south of the Whipsaw porphyry indicates the presence of limestone in the Nicola Group.

The Eagle granodiorite is Jurassic-Cretaceous in age, and is a gneissic, coarse-grained, pale grey, biotite granodiorite. The gneissosity strikes 330° to 340° and dips 50° to 60° W, parallel to the contact of the Eagle granodiorite with the Nicola Group volcanic rocks and to the schistosity within the Nicola Group volcanic rocks. Iron staining occurs in the Nicola Group transition zone rocks and in the Eagle granodiorite west of the contact, indicating the presence of various amounts of pyrite. From west to east, the transition zone section is granodiorite, patches of altered Nicola Group rocks in granodiorite, alternating volcanic and dioritic rocks and, finally, chloritic schists made up of altered Nicola Group rocks.

The Eagle granodiorite-Nicola Group contact is intruded by the Whipsaw porphyry and related apophyses and dikes. This intrusion is thought to be Late Cretaceous to Middle Tertiary in age (Anderson, 1971).

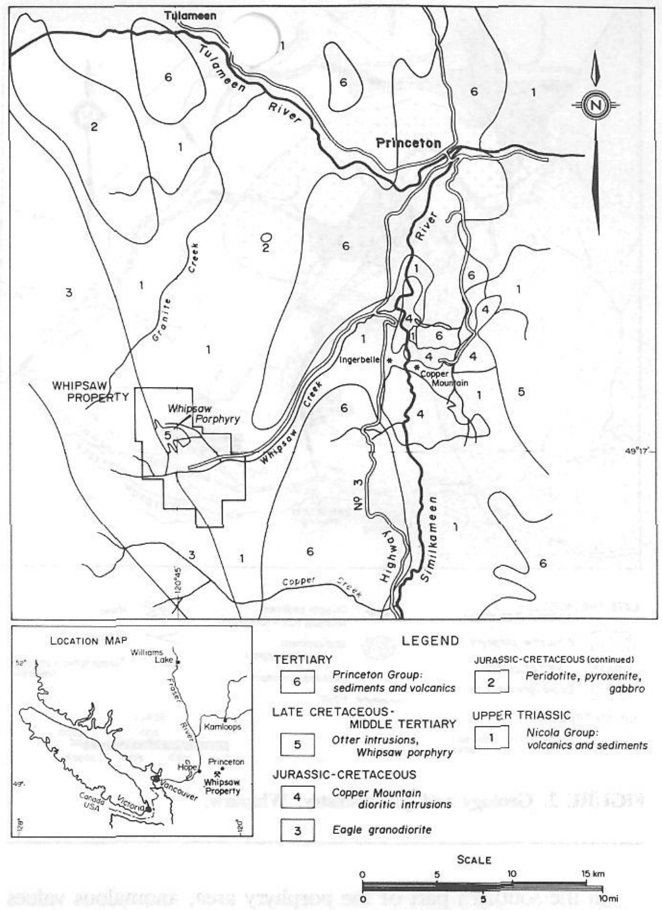

FIGURE 1. Location and regional geology, Whipsaw.

Geology of the Mineral Deposit

Most of the basic geological mapping of the porphyry area was conducted by Amax Exploration Inc. (Mustard, 1969). The geological mapping showed that the Whipsaw porphyry is a composite stock made up of feldspar-biotite porphyry, biotite porphyry, quartz-feldspar-biotite porphyry and quartz porphyry phases (Mustard, 1969). The contact of the stock is brecciated wherever exposed, the fragments being Eagle granodiorite or Nicola Group rocks depending on which of the two is intruded. Porphyritic rocks, which make up the matrix of the breccias, are commonly comminuted.

The stock has finer-grained apophyses and related dikes extending northward and southward along and near the Eagle-Nicola contact (Fig. 2).

The Whipsaw porphyry is the source of a large hydrothermal system with which at least two types of mineral deposits are related. Porphyry copper-molybdenum-gold mineralization occurs as disseminations and in veinlets in Nicola Group rocks bordering the porphyry and in shear zones in the outer portions of the porphyry (Forsythe, 1983; Richardson, 1990b).

Fracture zones up to several metres wide have been logged in drill core and mapped in outcrop, indicating the presence of several large faults. Linears on air photographs have been interpreted as faults with various strikes.

Most of the copper and molybdenum mineralization found to date is in propylitized and silicified Nicola Group volcanic rocks. The rocks are usually aphanitic and dark grey with approximately 5% pyrite as disseminations and within stockworks. Very fine-grained chalcopyrite occurs both as disseminations through the matrix and associated with pyrite on fractures and along the schistosity. Minor fine-grained molybdenite occurs in the selvages of quartz veinlets.

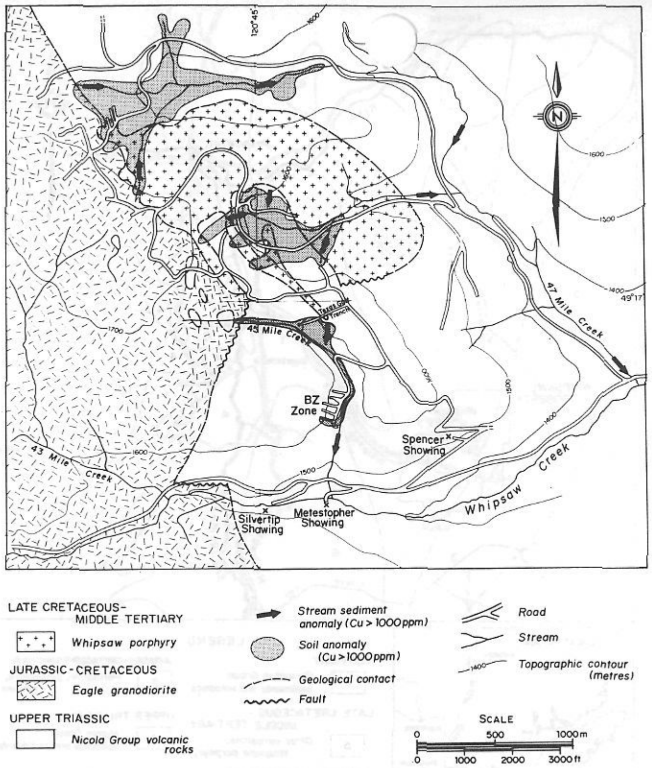

FIGURE 2. Geology and geochemistry, Whipsaw.

In the southern part of the porphyry area, anomalous values of gold occur in soil samples and, associated with arsenic, were intersected in a diamond drill hole near the Texas Gulf trench (Fig. 2). Further south, at the BZ zone, surface samples and diamond drill core also contained anomalous gold: DDH W87-5 intersected 5 m assaying 1.84 g/t Au.

To the south of the BZ zone, the porphyry copper-molybdenum-gold mineralization decreases in intensity. Gold-silver-copper-zinc-lead mineralization occurs in pyrite-bearing quartz veins and associated disseminations at the Silvertip and Metestopher showings and, south of the area shown in Figure 2, at the Five Fissures and Knight and Day showings. An area with narrow skarn zones, found immediately north of Whipsaw Creek near the Nicola-Eagle contact, contains the most consistent gold-in-soil anomalies on the property.

Applied Exploration Techniques

Geochemistry

The discovery of the porphyry copper-molybdenum-gold potential of the Whipsaw property was made by testing the stream sediments of 45 Mile and 47 Mile creeks using the rubeanic acid test (Bacon, 1960). The anomalous stream sediments were followed upstream to the emergent areas of the anomalies, which commonly are swampy (Fig. 2). Later, Dome Exploration (Canada) Ltd.'s detailed geochemical work began with a stream sediment and soil survey using the Bloom Nitrate extraction method in the field and, in addition, using X-ray analysis to determine copper, lead and zinc in samples collected at each site (Seraphim, 1963). Amax conducted extensive stream sediment and soil surveys testing for copper and molybdenum using hot acid extraction methods (Mustard, 1969). The stream waters were also sampled for copper and molybdenum. Newmont optioned the property from Texas Gulf and carried out soil sampling north of the Whipsaw porphyry to confirm and extend the earlier results (Macauley and Paulus, 1971). The copper-rich swamps lying north and south of the Whipsaw porphyry have been studied in detail (Gunton and Nicol, 1974; Lett, 1978). Although, in most tests, the tills underlying the swamps were low in copper, Lett found that the till at the upper (west) end of the branch of 47 Mile Cre[illegible]ing south of the porphyry assayed as high as 0.5% Cu. Mo[illegible]cently, in 1987, World Wide Minerals Ltd. conducted an extensive soil survey over the southern half of the porphyry area. The samples were analyzed for gold and, separately, for 31 elements using the ICP method.

Data from the various surveys have been correlated on a map with a scale of 1:2500. The results are shown in generalized form in Figure 2 on which the soil anomalies containing above 1000 ppm Cu are outlined. Molybdenum soil anomalies with values up to 86 ppm Mo almost coincide with the copper anomalies. Several very intense, local geochemical anomalies with values up to 18 000 ppm Cu are related to springs within the extensive geochemical anomalies north and south of the Whipsaw porphyry. These intense, local anomalies are attributed to water flowing in the faults and washing copper mineralization (Lett, 1978).

In summary, the porphyry potential was recognized using field geochemistry. The geochemical anomalies were followed up 45 Mile and 47 Mile creeks to the anomalies' emergent areas lying north and south of the Whipsaw porphyry. The potential areas of copper mineralization were outlined using soil sampling.

Geophysics

Several geophysical surveys have been completed on various areas of the property. After following the geochemical stream sediment anomalies to their emergent areas at the heads of 45 Mile and 47 Mile creeks, Texas Gulf Sulphur Inc. tested these areas, which were north and south of the Whipsaw porphyry, using ground magnetic, dual frequency induced polarization (I.P.) and McPhar vertical loop electromagnetic surveys (Bacon, 1960 and 1961). A vertical loop EM anomaly 600 m long coincided with the axis of one I.P. anomaly. The Moneta Porcupine-Dome-Tennessee joint venture extended the area covered by the Texas Gulf I.P. survey and also conducted a detailed dual frequency I.P. survey in the central part of the Texas Gulf survey area (Hallof, 1963; Seigel, 1964). These surveys outlined strong I.P. anomalies striking 330° parallel to the schistosity in the altered Nicola Group volcanic rocks. Amax Exploration Inc. conducted a ground magnetic survey to aid geological interpretation (Mustard, 1969). Newmont conducted a pulse I.P. survey over the mineralized area north of the porphyry to outline the I.P.-responsive area indicated by earlier reconnaissance work (Ballantyne, 1971; Macauley and Paulus, 1971). This survey showed that the I.P.-responsive area coincided with a swamp known to be anomalous in copper and molybdenum and to be in an area underlain by Nicola Group volcanic rocks. When the I.P. anomaly was diamond-drilled, the holes intersected copper and molybdenum mineralization. This indicates that the swamps, although they are accumulator areas for copper and molybdenum travelling in the stream system from the vicinity of the Eagle-Nicola contact, are underlain by copper- and molybdenum-bearing rocks.

The property lies within a region covered by an airborne magnetometer survey which was flown jointly by the Geological Survey of Canada and the British Columbia Ministry of Energy, Mines and Petroleum Resources (Geological Survey of Canada, 1973). The survey was flown with a helicopter, and was published on a scale of 1:50 000. The survey recorded an intense, positive magnetic anomaly within the east boundary of the property and a small, positive magnetic anomaly at the northwest corner of the Whipsaw porphyry near the contact of the Eagle granodiorite and Nicola Group rocks. The latter anomaly is at the postulated centre of the molybdenum mineralization (Anderson, 1971).

In 1987, World Wide Minerals Ltd. flew a combined magnetic and VLF-EM survey over the southern portion of the porphyry area (Walker, 1987). Several VLF-EM anomalies were outlined south of Whipsaw Creek. The conductors are believed to be caused by sulphide-bearing quartz veins and shear zones that lie south of the porphyry area. In addition, the magnetic anomaly near the northwest edge of the Whipsaw porphyry and the large, very intense magnetic anomaly within the east boundary of the property were mapped in detail. The latter is probably caused by an ultrabasic intrusion.

Except for the airborne surveys, a[illegible] geophysical surveys were limited in area and did not extend s[illegible]n to the gold-bearing BZ zone which is within the southern part of the porphyry area.

Economics

The Whipsaw property is at the early drilling stage of exploration; no ore reserves have been defined to date. Several older drill intersections contained 0.2% Cu or greater over lengths of up to 79 m (Paulus, 1972). In 1990 and 1991, four of the diamond drill holes gave results as follows:

Hole	From (m)	To (m)	Width (m)	Cu (%)	Mo (%)
W90-7	10.20	37.00	26.80	0.298	0.015
and	48.25	69.75	21.50	0.217	0.011
W90-8	50.00	68.00	18.00	0.243	0.006
and	97.00	118.00	21.00	0.360	0.024
W91-1	20.40	78.60	58.20	0.241	0.009
W91-2	39.60	116.00	76.40	0.205	0.008

The above intersections assayed a trace of gold.

Other targets, based on geology and geophysical and geochemical anomalies, have been only partially tested or are untested.

Discussion and Conclusions

Porphyry-type mineralization was discovered on the Whipsaw property in 1959, and, over the years, several substantial copper, molybdenum and gold intersections were obtained in trenches and limited drill programs. Within the known areas of porphyry mineralization, there are several targets based on geology, geochemistry and geophysics that have yet to be tested.

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