Copper Canyon porphyry copper-gold deposit, Galore Creek area, northwestern British Columbia

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ABSTRACT

The Copper Canyon property is located in the Galore Creek area of northwestern British Columbia. Porphyry copper-gold mineralization on the property is notable for its high gold content and close spatial relationship with a distinctive suite of high level syenitic and monzonitic intrusions, and pseudoleucite-bearing volcanic country rocks. The style of alteration and mineralization is similar in many respects to the nearby Galore Creek deposits.

The current geological resource of 32.4 million tonnes grading 0.75% Cu, 1.17 g/t Au and 17.1 g/t Ag is insufficient to support a mining operation, but definition of additional reserves combined with improved transportation infrastructure in the region may change this in the future. The climate, topography and proximity to an active glacier indicate that the most likely production scenario is an underground bulk mining operation, with the ore being milled offsite.

Introduction

The property is located at 57°07′ North latitude, 131°21′ West longitude, on NTS sheet 104G/3W, approximately 160 km northwest of Stewart and 90 km south of Telegraph Creek (Fig. 1). The Galore Creek camp and airstrip are located 6 km to the west. Current access to the property is via helicopter either from Galore Creek, or from the Bronson Creek airstrip 32 km to the south-southeast.

The deposit occurs within the Boundary Ranges of the Coast Mountains, on the north side of the east fork of Galore Creek, which flows northerly into the Scud River and thence westerly to the Stikine River.

Topography is rugged. In the deposit area, elevations range from 1130 m to 1750 m. Valley glaciers and permanent snow and ice fields are characteristic of the region at these elevations, and at its southern limit, mineralization is truncated by the East Fork Glacier.

The property is entirely above the treeline, and except for areas of moraine cover and talus slopes, outcrop is abundant.

History

The original claims were staked in August 1956 by the American Metal Co. Ltd., a predecessor company of Canamax Resources Inc., to cover prominent malachite-stained limonitic outcrops. Limited small diameter diamond drilling (7 holes, 1009 m) was conducted in 1957. Based on this drilling, 24.5 million tonnes at 0.72% Cu, 0.41 g/t Au and 10.3 g/t Ag was inferred (27 million tons grading 0.72% Cu, 0.012 oz/t Au and 0.30 oz/t Ag).

Apart from limited geophysical surveys in the period 1962 to 1966, the property remained dormant until 1988, when it was re-examined by Canamax for its gold potential, and mapped by the British Columbia Geological Survey as part of regional mapping of the Galore Creek area (Logan and Koyanagi, 1989). This coincided with a period of greatly increased exploration activity in northern British Columbia following the discovery of the Snip gold deposit in the Iskut River area 30 km to the south-southeast (Bottomer and Caulfield, 1991).

In 1990, the Copper Canyon property was optioned to Consolidated Rhodes Resources Ltd., who carried out a diamond drilling program in the fall of that year totalling 3805 m in 13 NQ diamond core holes.

Exploration Techniques

The rugged relief of the area, combined with recent glacial retreat, has exposed pyrite and chalcopyrite mineralized outcrops over a large area (Fig. 2); hence prospecting and geological mapping were used directly to define targets for the initial diamond drilling program.

The severe topography inhibits systematic grid-based geophysical surveying. Reconnaissance induced polarization surveying in 1964 and 1966 defined chargeability anomalies which are in part coincident with the near surface mineralization. Two airborne magnetometer surveys are known to have covered the property. The first was a Varian-type survey flown in 1962, and the second an Aerodat survey flown in 1989. Both detected a positive magnetic anomaly associated with the intrusive syenite.

The 1957 diamond drilling used a lightweight rig drilling AX-sized core. Recovery was poor, averaging less than 50% overall and much less in some mineralized intervals. The 1990 drilling recovered larger diameter NQ-sized core, utilizing a Longyear 38 wireline drill. Core recoveries of 98% or better were obtained. Comparison of the results from holes drilled from the same locations in 1957 and 1990 indicate little variation in the copper content, but an upgrade in the gold content by a factor of two to three in long sections of the 1990 holes. While some of this difference may be due to improved laboratory techniques and sensitivities for low level gold analyses, non-representative sampling in the recovered portion of the 1957 drilling is likely also a factor.

Regional Geology

The property is located within the accreted Intermontane Belt of coastal British Columbia, close to its western boundary with the Coast Belt. In this area, the Intermontane Belt consists of deformed late Paleozoic to Mesozoic island arc volcanic and sedimentary rocks intruded and stabilized by granitic rocks of Jurassic to Tertiary age (Fig. 2). The region is within the Stikinia terrane.

The geology of the Galore Creek area is discussed in detail by Enns et al. (this volume), and by Logan and Koyanagi, 1989.

Deposit Geology

The Copper Canyon deposit is centred about a Lower to Mid-

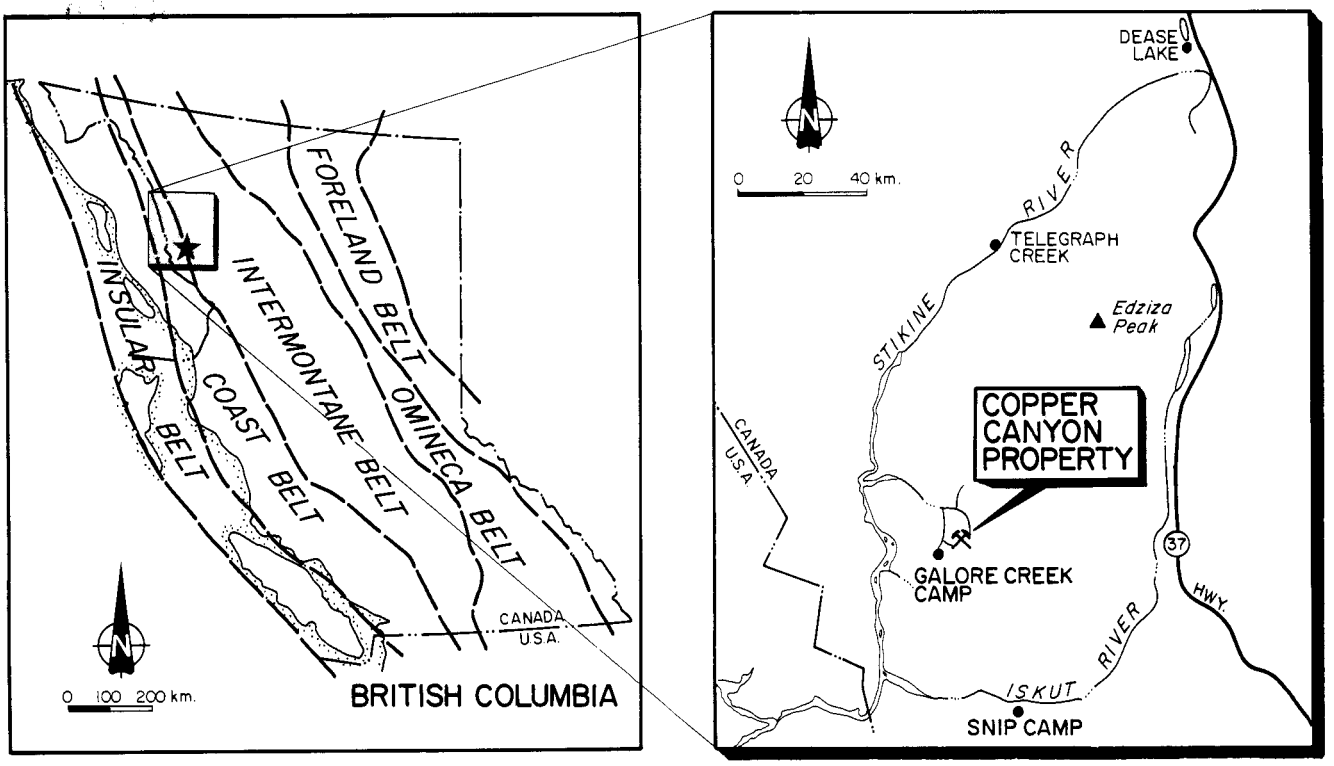

FIGURE 1. Location map of the Copper Canyon property.

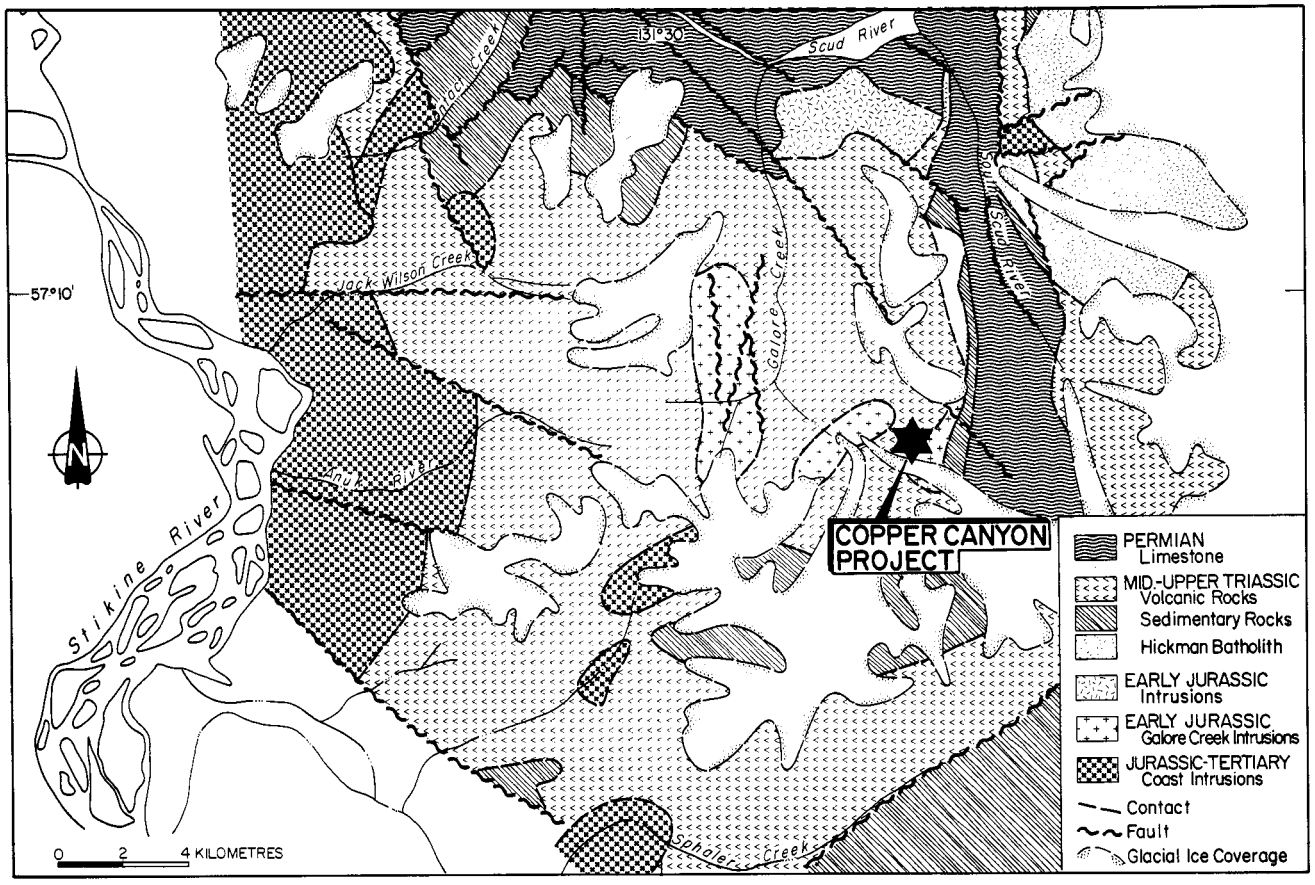

FIGURE 2. Regional geology map of the Copper Canyon area.

dle Jurassic composite alkaline intrusive stock and dike complex (part of the Galore Creek Intrusions of Logan and Koyanagi, 1989), which intrudes Upper Triassic intermediate volcanic rocks of the Stuhini Group along the footwall side of an easterly dipping thrust fault (Fig. 3).

The upper plate rocks consist of an overturned, easterly dipping succession of recessive weathering Middle Triassic black shales and (?) Stuhini Group volcanic rocks, capped by cliff-forming Permian limestones. Postmineral Tertiary dikes cut all these rocks. Three copper-mineralized zones, centred about the alkaline intrusive com-

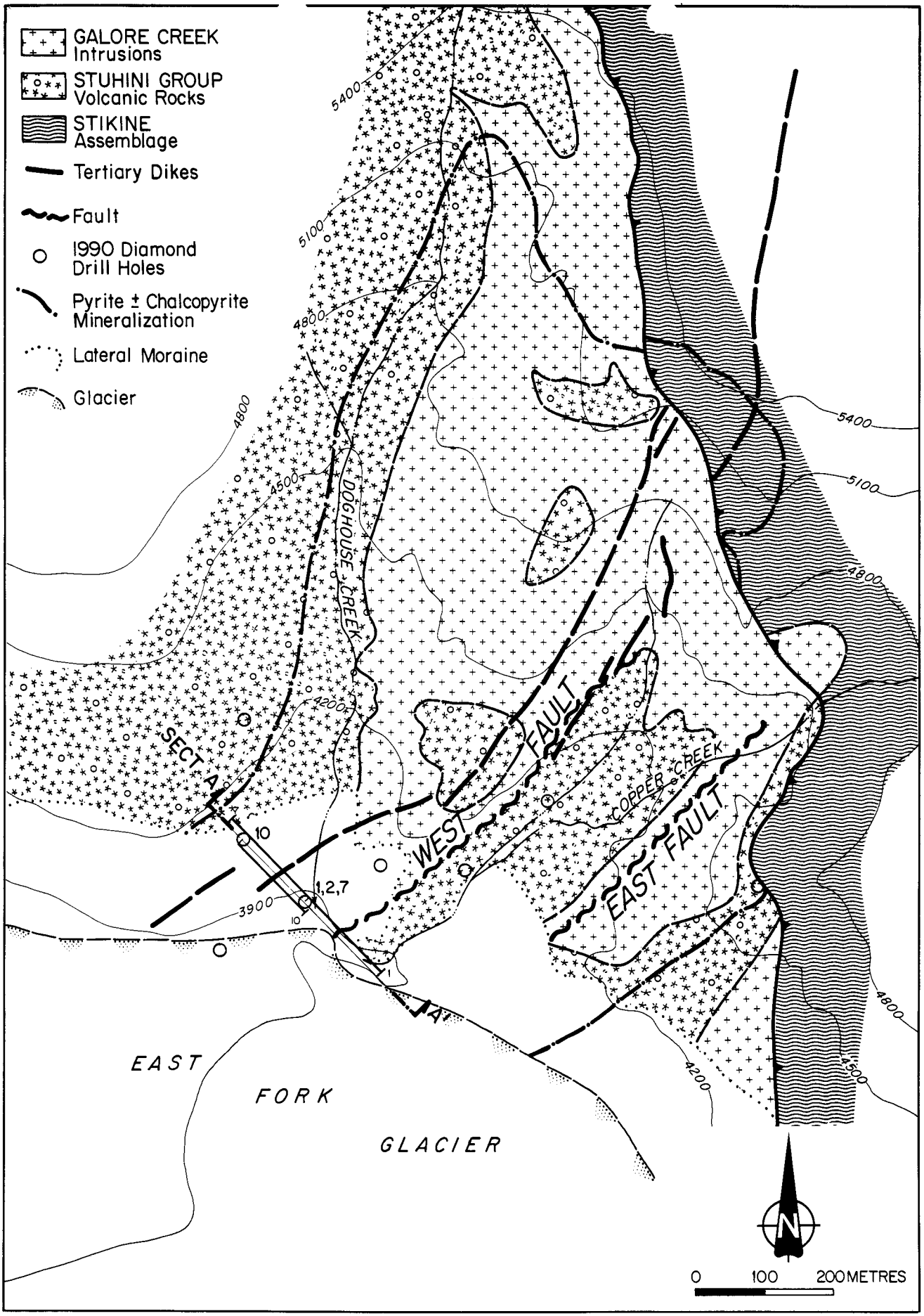

FIGURE 3. Property geology, Copper Canyon deposit.

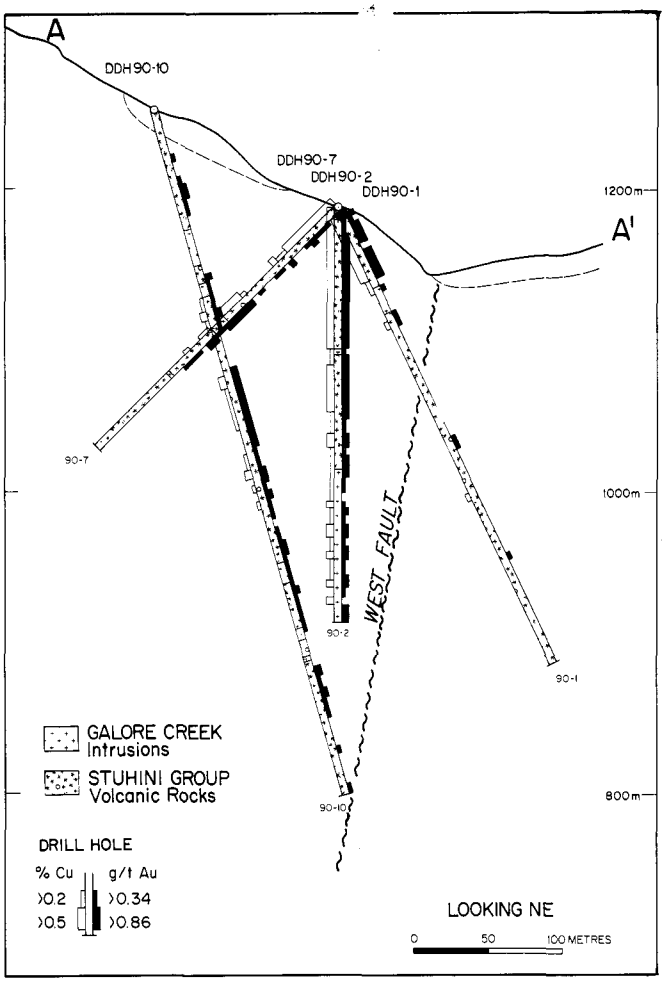

FIGURE 4. Diamond drillhole cross-section AA' (Fig. 3) Central Copper zone, Copper Canyon deposit. Note: elevated gold values.

plex, have been outlined within a larger envelope of pyritized rocks (Fig. 3). Only the Central Copper zone has been drilled to any extent and unless noted otherwise, the following observations refer only to this zone.

Volcanic rocks of the Stuhini Group are the main hosts for mineralization. West of the thrust fault, the volcanic rocks dip gently to moderately northwest, and are exposed over a stratigraphic thickness of at least 1200 m. Lithologies present include pseudoleucite-bearing phonolite, trachyte and trachyandesite flows and fragmental units.

The Galore Creek Intrusions have not been petrographically examined, but macroscopically range from equigranular monzonite and syenite to orthoclase megaporphyritic syenites and local intrusive breccias. The early intrusive phases are commonly mineralized, but copper grades are lower than in the volcanic rocks.

Several strong northeast and north-northwest striking faults manifested as zones of gouge and broken rock are associated with the Central zone (Fig. 3). The best-defined is the northeast-trending West Fault, which dips steeply to the northwest and forms the footwall of the upper portion of the Central Copper zone mineralization along the lower course of Copper Canyon (Fig. 4). Structural and stratigraphic interpretations suggest that significant pre-thrusting normal movement has occurred on the West Fault. The West Fault was important in the localization of some of the alkaline intrusive phases, and the emplacement of mineralization.

Hydrothermal alteration associated with Central zone mineralization is both fracture-controlled and pervasive, and is asymmetrically zoned about the West Fault. It consists of (1) an inner pyritized and argillized zone on the southeast, or footwall side of the West Fault; (2) intense potassic alteration, characterized by pervasive K-feldspar and patchy l rong biotite development coincident with the Central zone; (3) an outer pyritized potassic zone to the northwest of (2); and (4) an outermost propylitic zone to the northwest characterized by chlorite, calcite, earthy hematite and minor epidote.

Other features of the alteration are the local development of calc-silicate minerals, particularly garnet, common late anhydrite veining, in places with minor fluorite, calcite and zeolites, and widespread finely disseminated specular hematite.

Metallic mineralization consists almost exclusively of hypogene pyrite and chalcopyrite, with minor hematite, magnetite, sphalerite, galena and native gold. In contrast to the Galore Creek deposits, magnetite is not as abundant and bornite is absent. Molybdenite has not been observed. Pyrite is more abundant and widely distributed than chalcopyrite. Overall sulphide content rarely exceeds 15%, and typically ranges between 3% and 10% within the Central Copper zone. In the inner and outer pyrite zones, sulphide content generally ranges from 5% to 15% and 1% to 5%, respectively. Pyrite and chalcopyrite occur as disseminations, fracture fillings, and thin veinlets. The disseminated mode is volumetrically the most abundant. Within the Central Copper zone, the highest copper grades generally occur in the more intensely K-feldspar and biotite altered rocks. The highest gold grades occur either in association with chalcopyrite in intense K-felspathized and/or garnetized zones, or in discrete structurally controlled pyritic zones.

Peripheral to the main copper mineralization are some markedly more gold-rich zones, e.g., DDH 90-10, 94 m @ 2.1 g/t Au, 0.26% Cu (Fig. 4), and gold-bearing shear structures, e.g., DDH 90-02, 10 m @ 4.8 g/t Au, 0.22% Cu, and 5 m @ 7.5 g/t Au, 0.23% Cu. The presence of these intercepts suggests potential for Snip-type mesothermal lode gold deposits associated with the Galore Creek Intrusions (cf. Rhys, 1993). This potential was not assessed during the 1990 exploration work.

Multi-element geochemical analyses indicate a moderate positive correlation between gold and copper values, and copper and zinc while silver correlates most strongly with arsenic. Zinc values generally range from 200 ppm to 1500 ppm and arsenic from 50 ppm to 200 ppm. Molybdenum levels are generally 10 ppm or less, even in high-grade copper intervals.

Economics

Based on the results of the 1990 program, drill-indicated geological resources in the Central Copper zone are estimated as 32.4 million tonnes grading 0.75% Cu, 1.17 g/t Au and 17.1 g/t Ag (35.7 million tons grading 0.75% Cu, 0.034 oz/t Au, and 0.50 oz/t Ag). This figure was derived manually from drill cross-sections projected over a strike length of 330 m, and to an average depth of 300 m.

A cutoff grade of 0.5% Cu equivalent (assigning 0.34 g/t Au equivalent to 0.15% Cu) was used to define the boundaries of the mineralization. The Central Copper zone as currently defined is a tabular, northwest-dipping zone up to 275 m thick and at least 600 m long, within which occur a series of structurally concordant, bifurcating slabs of higher grade mineralization which have been drilled to a maximum depth of 295 m. The zone is open along strike to both the northeast and southwest although to the southwest further exploration is restricted by the presence of the East Fork Glacier (Fig. 3). To the northwest, mineralization remains open at depth, while to the southeast, it is limited by the West Fault.

Due to steep slopes and attendant avalanche risk, extreme weather conditions, and proximity of the East Fork Glacier, the only mining scenario contemplated to date has been underground bulk mining using block caving or a similar technique.

Given certain assumptions regarding infrastructure, and long-term metal prices of US $1.00/pound for copper and US $350/ounce for gold or higher, threshold tonnages of 50 million tonnes to 100 million tonnes at currently defined average grades could produce acceptable commercial rates of return. These tonnages are considered potentially attainable given the open-ended

nature of the Central Copper zone, and of drilling on the other known zones on the property.

Detailed environmental studies have not been initiated, but limited petrographic work and field observations suggest that the waste rock may be acid consuming due to the carbonate mineral content.

Discussion and Conclusions

The Copper Canyon deposit is similar in most respects to the nearby Galore Creek deposits (Allen et al., 1976; Enns et al., this volume). Distinctive features are the high gold content and spatial association with pseudoleucite-bearing volcanic rocks. The latter are unusual for the Stuhini Group, and their association with a distinctive suite of high level alkaline intrusions suggests a possible co-magmatic link.

Emplacement of the alkaline intrusive complex, block faulting and mineralization show a close spatial and temporal relationship. Mineralization occurs both within the alkaline intrusions and in the volcanic rocks, but the higher grade areas found to date are volcanic-hosted. Some late syenite dike phases are weakly mineralized and altered, and cut earlier more intense alteration and mineralization, indicating that the main period of emplacement of the copper-gold mineralization took place during the period of alkaline intrusive activity. These intrusions are assigned to the mid-Jurassic by Logan and Koyanagi, 1989, but recent U-Pb dating of the Galore Creek syenites (Mortenson et al., this volume) suggests an Upper Triassic to Lower Jurassic age (197 Ma to 210 Ma).

While currently uneconomic, the Copper Canyon deposit represents a significant high-grade copper-gold resource. Future development of a large-scale mining operation is dependent on the provision of transportation infrastructure into the region, and development of the Galore Creek deposits. On a smaller scale, the potential for Snip-type gold-bearing shear systems peripheral to the porphyry mineralization has received little attention, and warrants further exploration.

Acknowledgments

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