RG Letter

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BRITISH COLUMBIA

PROPERTY FILE

October 4th, 1996

Mr. Larry Reaugh,
Verdestone Gold Corporation,
#310-1959 152nd Street,
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Dear Mr. Reaugh

Thank you very much for providing the opportunity for me to visit your Salal Creek Molybdenum JV property, north of Pemberton. I have always had an interest in molybdenum deposits and have been aware of the Salal Creek occurrence for years but have never before had the chance to visit it. I appreciate the time that Andris and Mark took in telling me about the project and their patience in showing me around its highly unstable slopes.

For your interest, I enclose a copy of a paper that Peter Christopher and I wrote for the recently published CIM Special Volume 46 (Porphyry Deposits of the Northwestern Cordillera of North America). It describes our joint recollection of the Adanac molybdenum deposit, near Atlin, which I drilled for Placer Development (as was) in the early 1980s.

There are some surprising similarities between the deposits, despite the obvious differences in scale. Both deposits are circular in nature and formed along the contact between an older coarser-grained and a younger finer-grained or porphyritic variety of quartz monzonite. Also in both cases, the mineralization is predominantly fracture controlled and, I suspect, increases in those parts of the deposit that had good ground preparation immediately prior to emplacement of the younger (core) intrusion. By the look of it, in both cases the best mineralization occurs, or is likely to occur, in parts of the deposit that were deformed and broken up and subsequently injected by several later pulses of progressively more evolved quartz monzonite - the fine-grained quartz monzonite at Adanac.

The scale difference is important. At Adanac the ring of mineralization had a diameter of about 500 metres. Half the deposit was down-dropped though faulting and the "high grade" zone was limited to a small section of the mineralized ring. The Salal Creek molybdenum deposit is, from my understanding of the area, a 5,000 metre diameter ring - huge by comparison and pretty difficult to test with two holes!

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I did notice one significant difference to Adanac. I don't recollect seeing so much iron or pyrite at Adanac. The difference may be significant as oxidation of the pyrite will have produced acidic waters that will have leached molybdenum loosely attached on joint surfaces. I saw enough ferri-molybdite (the yellow stain) on rusty rocks at Salal to think that there must have been considerable destruction of molybdenite near surface.

This too, may be significant. The Adanac deposit is located in the floor a cirque and when we came to drilled it we found that the molybdenum was almost completely removed from the surface rocks down to the level of the water table. You wouldn't have known that there was a deposit there at all but for the presence of molybdenum and ferri-molybdite in rocks cropping out in the creek bed itself. This leads me to wonder if the past emphasis on the Float Creek area at Salal isn't, in part, a function of the fact that active erosion there is constantly providing access to fresh molybdenite. It is one of the few areas where one can see significant amounts of mineralization.

I have no problem endorsing Don Mustard's ideas about the property and the potential for a Henderson-type deposit at depth, however, I wonder if there aren't other exploration opportunities around the deposit ring that might not involve placing the drill rig out on such a limb! Irrespective of what happens this fall, I would encourage you to take a walk around the ring and look for areas where leaching may have occurred. You might be surprised at what you find at shallow depth under apparently "barren" gossanous, jointed rock.

Once again, thank you very much for arranging the visit. I look forward to seeing the results of your current program and hope to see you up there again next year.

Yours truly, Robert Pinsent

Robert Pinsent,
Regional Geologist,
Southwestern Region

Marine disposal of tailings into the 365 m depths of Alice Arm was selected. Tailings were transported in 50 cm polyethylene pipe over a distance of 7.25 km horizontally and a 460 m vertical drop from the mill to Alice Arm. Concrete drop boxes spaced every 50 m to 100 m along the tailings pipe maintained a grade of 0.8% and a fluid velocity of 1.8 m/sec. to 2.1 m/sec. The tailings were discharged 50 m below the surface of Alice Arm into the more tranquil deep waters not subject to wave action.

Systematic monitoring of metal content of both marine sediments and benthic marine species in Alice Arm conducted by Amax during and subsequent to the operating period confirmed the conclusions of the original studies, that the disposal system would have minimal impact on the ecological system of the inlet. The monitoring studies demonstrated that the distribution of deposited tailings has remained virtually unchanged since 1982; that a levelling off of metal contents in surface sediments occurred subsequent to cessation of mining as the layer of natural sediments covering the tailings deposits continued to increase in thickness; and that no progressive bioaccumulation of metals has occurred over time in the benthic marine species monitored. With equilibrium having been demonstrated over eight consecutive years (1982 to 1990), the monitoring program was suspended following the 1990 survey with the approval of both federal and provincial authorities.

Conclusions

During its brief productive life, virtually all operational parameters at the Kitsault mine were either as predicted from the feasibility study of within the normal range of variance expected for a start-up operation. As such, the Kitsault mine was a technical success from both an operational and environmental protection point-of-view. However, Kitsault is also an example of both the economic vulnerability of a relatively high-cost mining operation and the importance of timing with respect to mine development in order to capitalize on favourable market conditions.

The development of the mine was undertaken to enable Amax to meet its customers' requirements in the face of a world-wide shortage of molybdenum which appeared to be developing in the late 1970s. Unfortunately, by the time the Kitsault mine was operational in the early 1980s, the global economy had slipped into one of the deepest and most prolonged recessions in recent history. Molybdenum consumption was in sharp decline while production, due in part to the slow response of the principal producers, continued to rise. The resultant metal surplus translated directly into unsold inventory and sharply lower prices. In 1979, the year of commencement of construction, the average U.S. spot price for molybdenum was US$23.86 per pound. In November 1982, at the time of shutdown, the U.S. spot price was US$3.06 per pound. This compared to an operating cost per pound of molybdenum produced at Kitsault in 1982 of US$4.84, or $4.48 allowing for a silver credit of $0.36. Since shutdown, molybdenum prices have continued to remain depressed due to the large molybdenum inventories held during much of the 1980s and, more recently, to increased by-product production from porphyry copper deposits. For Kitsault, that particular window of economic opportunity was lost.

Decisions on whether and when to make the large capital expenditures necessary to bring large low-grade mines into production will never be easy. However, it is critical to the economic well-being of mining companies that they be able to capitalize on such narrow windows of opportunity. This will not be achievable unless governments streamline the approval process and remove the impediments contributing to the increasingly lengthy lead times which have become so common in obtaining approval for mine developments in Canada.

Acknowledgments

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Adanac (Ruby Creek) molybdenum deposit, northwestern British Columbia

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ABSTRACT

The Adanac molybdenum porphyry deposit near Atlin, in northwestern British Columbia, was discovered in 1905. It was explored extensively between 1967 and 1980.

The deposit is within a complex, multi-phase, quartz monzonite stock that is a satellite of the post-accretionary, Surprise Lake Batholith. Biotite K-Ar dates range from 70.3 ± 2.4 Ma to 71.6 ± 2.1 Ma, indicating a Late Cretaceous age of emplacement.

The deposit comprises an irregular-shaped ring or halo peripheral to a quartz monzonite porphyry dome, or "cupola". The shape of the ring, and of a small, fine-grained quartz monzonite intrusion, and the presence of higher-grade mineralization on the eastern flank of the cupola, suggest partial control by a premineral structure. The deposit is truncated by a steep, northwesterly dipping, normal fault (Adera Fault) that down-dropped the northern half of the deposit by a minimum of 100 m.

The deposit lacks strong zonal alteration but there are narrow envelopes of potassic alteration around some veins and local zones of intense wall-rock silicification. There is considerable retrograde alteration along postmineral faults and fractures.

Molybdenite occurs in veins and fractures, many of which are relatively flat-lying. They occur in all phases of quartz monzonite. Molybdenum is the only element of economic significance. There are vein and skarn occurrences with tungsten, tin, lead, zinc and precious metals peripheral to the deposit.

In 1981, Placer Development Limited reported an "undiluted mineable mineral reserve" of 151 971 000 tonnes grading 0.063% Mo at a cutoff grade of 0.04% Mo and a strip ratio of 1.5:1.

Introduction

The Adanac molybdenum deposit (Lat. 59° 42.5′N, Long. 133° 24′W; NTS 104N/11W) is about 22 km northeast of Atlin in northern British Columbia (Fig. 1). It is at an elevation of 1460 m, in the floor of an alpine cirque at the head of Ruby Creek.

History

The deposit was discovered in 1905 but had limited exploration until the current owners, Adanac Mining and Exploration Limited, staked the property in 1967 (Sutherland Brown, 1970). Adanac diamond drilled 80 holes (12 775 m) and established the presence of a large "porphyry-type" molybdenum deposit. The company conducted preliminary metallurgical tests and economic studies and optioned the property to Kerr Addison Mines Limited in 1970.

Kerr Addison diamond drilled 47 holes (5626 m) and drove 589 m of drift, 246 m of crosscut and 281 m of raise in the "higher-grade" core of the deposit in 1971. The company extracted 9545 tonnes of ore for on-site processing and completed a feasibility study.

Climax Molybdenum Corporation of British Columbia Limited optioned the property in 1973. The company drilled a further nine holes (2672 m) and developed a geological model for the formation of the deposit (White et al., 1976). Noranda Mines Limited took a short option on the property from 1976 to 1977. Placer Development Limited (Placer Dome Inc.) acquired the Adanac property in 1978. In 1979, it diamond drilled 49 holes (6028 m) in the higher-grade core of the deposit to evaluate inconsistencies in molybdenum grade as determined from drill core and raise sample assays. In 1980, the company drilled a further 27 holes (4858 m) around the periphery of the deposit and completed the geotechnical, social and economic studies required to complete a full feasibility study.

In 1979 and 1980, the Geological Survey Branch of the British Columbia Ministry of Energy, Mines and Petroleum Resources mapped the area and collected samples for geochemical study and age determination.

Regional Geology

The regional geology of the Atlin area has been mapped by Aitken (1959) and the setting of the Adanac deposit has been described by Christopher and Pinsent (1982). The deposit is in the Mount Leonard Stock, a satellite of the Cretaceous, Surprise Lake Batholith (Fig. 1). The stock is a composite quartz monzonite intrusion that cuts through deformed and metamorphosed Pennsylvanian and Permian-age volcanic and sedimentary strata (Cache Creek Group), serpentinite (Atlin Intrusions), and Jurassic diorite (Fourth of July Batholith).

The Ruby Creek drainage was close to its present configuration in the Late Tertiary-Quaternary period when a volcano erupted and filled the lower part of the drainage with volcanoclastic debris and columnar olivine basalt.

Deposit Geology, Alteration and Mineralization

The geology of the deposit is described by Sutherland Brown (1970), White et al. (1976) and by Christopher and Pinsent (1982). The following discussion is an interpretation of the geology based on previous deposit descriptions and the results of exploration carried out by Placer Development Limited between 1979 and 1980.

The deposit (Fig. 2) is located near the northeastern contact of a stock that comprises several distinct phases of quartz monzonite. These are differentiated on the basis of composition, gross texture and apparent cross-cutting relationships. The most widespread is a coarse-grained to aplitic and/or weakly porphyritic variety of "hybrid" quartz monzonite that occurs throughout the stock.

The deposit area is anomalous, in that it is the locus of several

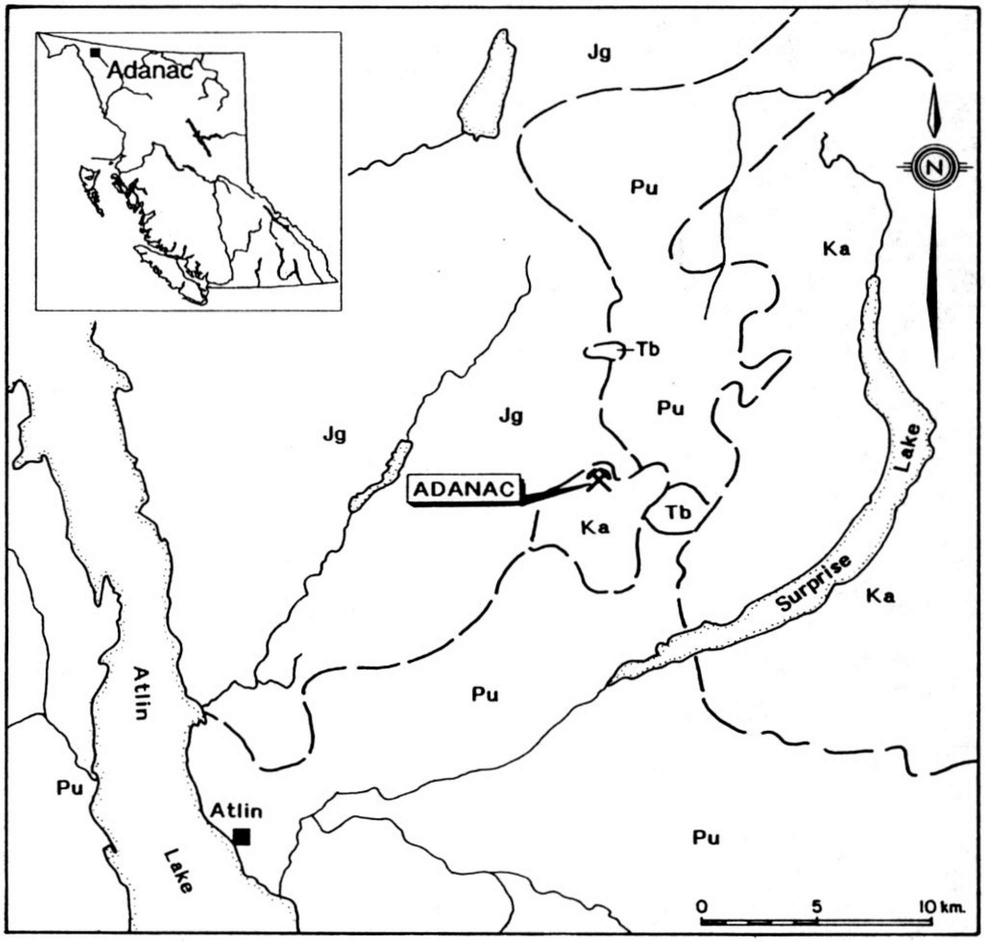
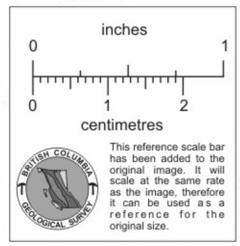


FIGURE 1. Location (inset) and simplified regional geology of the Adanac area, northwestern British Columbia. Tb = Tertiary and Quarternary olivine basalt and scoria; Ka = Cretaceous alaskite and quartz monzonite; Jg = Jurassic granitic rocks; Pu = Pennsylvanian and Permian ultramafic, sedimentary and volcanic rocks (undivided). Geology after Aitken (1959).



types of quartz monzonite in addition to the regional "hybrid". Some varieties have only been identified in the adit and in drill core. The deposit area comprises six main mappable quartz monzonite units: (1) the regional coarse-grained to aplitic "hybrid" which (2) locally takes on a distinctly coarse-grained appearance (both defined as Coarse Granite by White et al., 1976); (3) mafic porphyry (Medium Granite as in White et al., 1976); (4) sparse porphyry (Porphyritic Granite as in White et al., 1976); (5) crowded porphyry (Crowded Porphyry as in White et al., 1976); and (6) fine-grained (Fine Granite as in White et al., 1976) as well as minor variants, including plutonic breccia. Surface rocks are weathered and veins and fractures are leached to depths ranging from less than 1 m, near Ruby Creek, to approximately 30 m, in the vicinity of the Adera Fault.

White et al. (1976) used surface mapping and diamond drill data to determine the three-dimensional distribution of the main rock types. The authors established the presence of two adjacent, largely subcropping, "porphyry" (Porphyritic Granite and Crowded Porphyry) cupolas. They recognized that the mineralized zones paralleled the contacts of the cupolas and they determined that the higher-grade molybdenum zone, identified and sampled by Kerr Addison, was restricted to the eastern flank of the western (sparse porphyry) cupola. They also established that the deposit was truncated by a northeasterly trending fault. Placer Development Ltd. conducted a drill program to confirm the above geological relationships and establish grade distribution in the higher-grade zone. The program confirmed weak mineralization in a discontinuous blanket above the subcropping portion of a sparse quartz monzonite porphyry cupola. It also established the presence of a ring of better-grade mineralization around its outer edge. At the 1448 m elevation the central core of the cupola is approximately 500 m in diameter and it is surrounded by a ring of mineralization approximately 200 m wide. The east side of the ring, which contains the bulk of the higher-grade mineralization, deviates from the expected annular shape. It is markedly linear, reflecting a local change in the control on mineralization. The ring and the cupola are both off-set by movement on the Adera Fault (Fig. 2).

Sections through the zone of higher-grade mineralization (Figs. 3 and 4) show a relatively flat-lying regional contact between the two early phases of quartz monzonite (coarse-grained and mafic porphyry) and apparently discordant, cross-cutting, contacts for the two later, porphyries (sparse and crowded). They also show a sill-like body of mineralized fine-grained quartz monzonite that forms a distinctive plutonic breccia at the south end of the higher-grade zone. The fine-grained quartz monzonite appears to be a late intrusion emplaced along part of the axis of the higher-grade zone. Other sections show that the sill is irregular and that it is restricted to the panel of cap-rock immediately above and between the two cupolas. It appears to thin and feather out toward the two porphyries and the Adera Fault.

The Adera Fault is a broad composite structure that has off-set a large portion of the deposit. Drilling indicates that some of the deposit is caught up in the fault zone and suggests that still more is down-dropped to the north with little apparent lateral off-set. Drill data suggest that the northern part of the deposit is down-dropped a minimum of 100 m.

Molybdenite occurs in all the principal rock types including the fine-grained intrusion in the higher-grade zone. It occurs in sulphide veins, as coatings on fractures, and as coarse and fine rosettes and

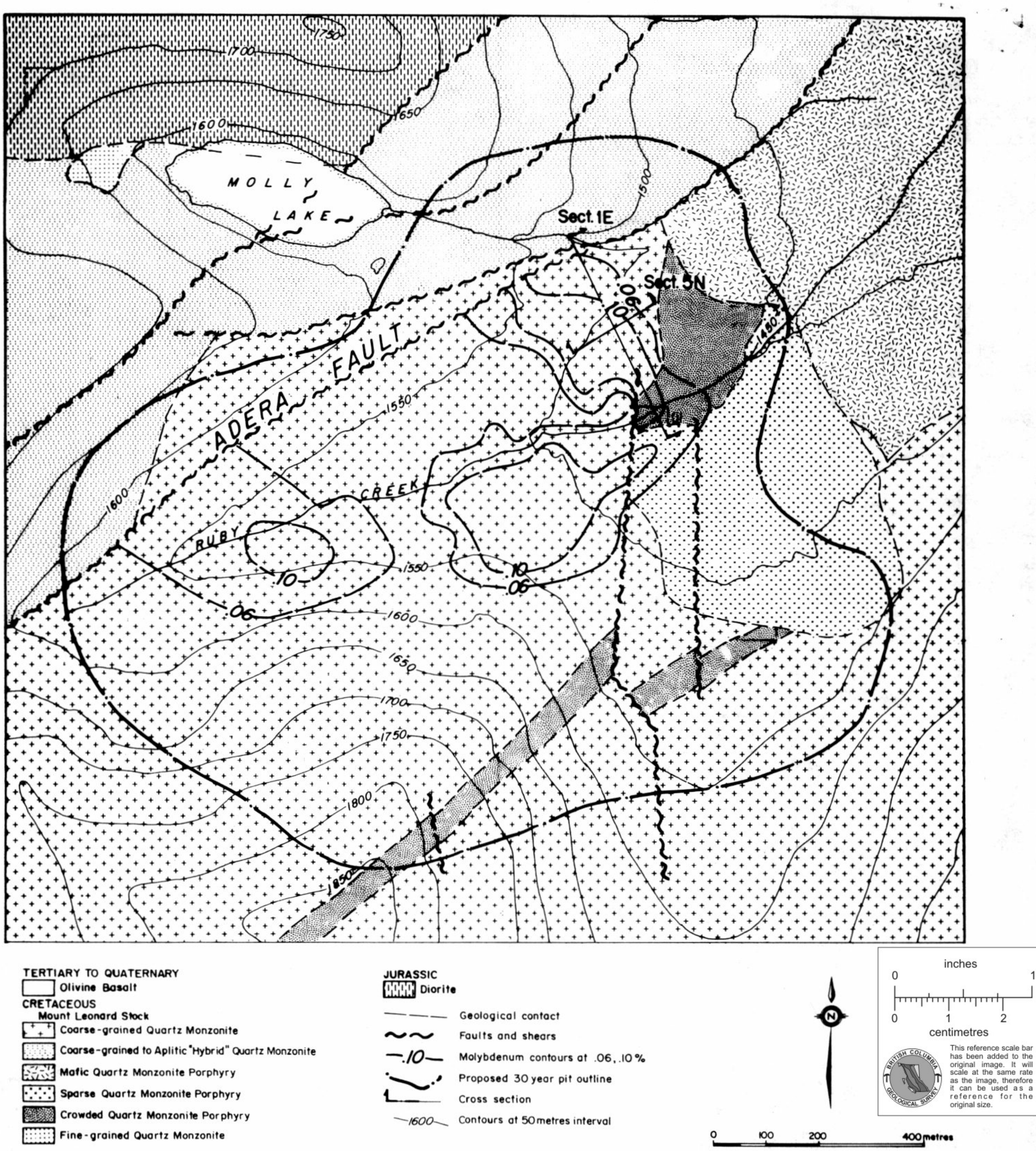


FIGURE 2. Simplified geological map of the Adanac deposit area showing (1) the outline of the deposit (>0.06% and 0.10% Mo) at the 1448 m elevation level; (2) the outline of Placer Development's proposed "30 year" pit; and (3) the location of sections 1E and 5N.

blebs in both smokey and clear quartz veins. It also occurs as streaks and smears in deformed rock within the Adera Fault and other fracture zones. Most of the mineralized structures are 1 mm to 3 mm wide, although some of the sub-horizontal veins are up to 3 cm wide. Mineralized quartz veins locally contain trace amounts of one or more of orthoclase, biotite, sericite, carbonate, pyrite, scheelite or fluorite. White et al. (1976) established four principal vein directions: 036°/82° southeast, 330° to 345°/70° to 80° southwest, 083°/77° northwest and nearly horizontal. The best mineralization is found in the northeasterly trending and the sub-horizontal fracture sets. There are few clear cross-cutting age relationships between the veins.

Mineralized rocks are weakly altered except in localized zones of intense silicification. Some quartz veins have narrow potassic alteration envelopes. The rocks have undergone regional retrograde

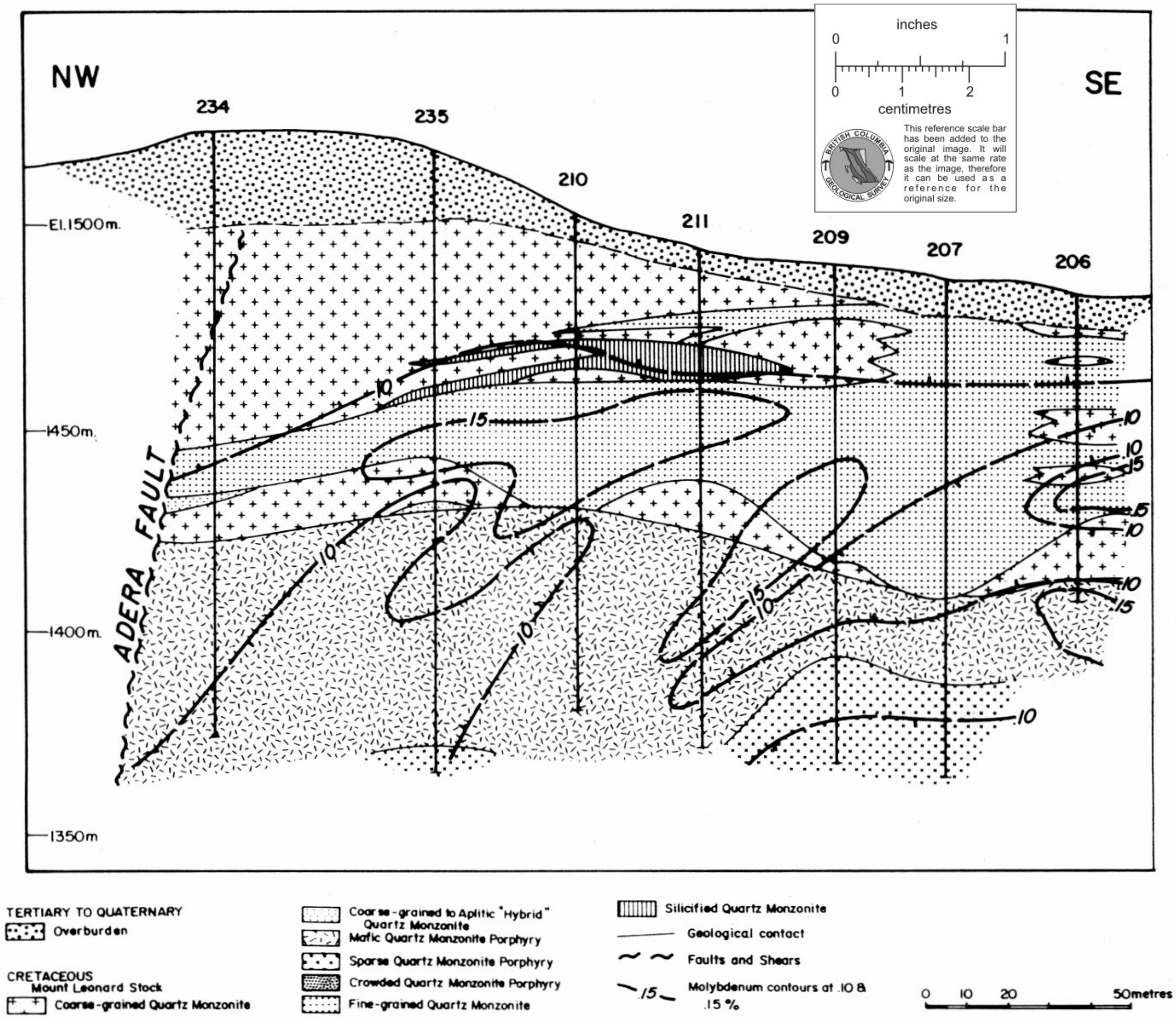


FIGURE 3. Simplified geological longitudinal section (1E; facing northeast) through the Adanac high-grade zone showing molybdenum distribution (>0.10% Mo and >0.15% Mo).

alteration. Feldspars are weakly to intensely altered to carbonate and clay. This type of alteration is particularly well developed in fault zones. As part of its environmental assessment, Placer Development Ltd. conducted a detailed study of uranium distribution in the deposit. The company analyzed the total uranium content of over three thousand, 3.0 m core samples. The principal rock types show an increase in average uranium content with age, as indicated by observed and inferred cross-cutting relations. Coarse-grained quartz monzonite averages 11 ppm U (592 samples), mafic porphyry averages 12 ppm U (52 samples), crowded porphyry averages 17 ppm U (186 samples), sparse porphyry averages 19 ppm U (377 samples) and fine-grained quartz monzonite averages 24 ppm U (14 samples). The results show that the magma became increasingly enriched in uranium as it evolved. Electron microprobe data from the Geological Survey of Canada show that the element is in the mineral thorite (S. B. Ballantyne and A. L. Littlejohn; pers. comm.).

K-Ar age determinations on biotite samples from four quartz monzonite phases encountered in drilling in 1979 show little age differentiation (Christopher and Pinsent, 1982). They range from 70.3 ± 2.4 Ma (mafic porphyry) to 71.6 ± 2.1 Ma (sparse porphyry).

Lithogeochemical studies carried out by Placer Development and the British Columbia Ministry of Energy, Mines and Petroleum Resources show a strong positive correlation between molybdenum and fluorine. They show no apparent correlation between molybdenum and uranium content.

Other showings in the immediate vicinity of Adanac include tungsten and tin-bearing veins and skarns and base and precious-metal vein systems that are commonly controlled by northeasterly directed structures. They are not related to the main porphyry deposit.

Economics

The Adanac deposit contains veins and fractures with appreciable coarse-grained molybdenite that produces a strong "nugget effect" that complicates economic evaluation. Kerr Addison drove an adit and crosscut into the higher-grade portion of the deposit and raised on drill holes to obtain bulk samples for comparative analysis. Geostatistical studies showed that high-grade values (>0.2% MoS_2) in drill core were commonly down-graded and low-grade values (0.05 to 0.10% MoS_2) were commonly up-graded by bulk samples. The studies also indicated that molybdenum values were twelve times more projectable in a horizontal sense than they were in a vertical sense. They indicated a need for close spaced drilling and careful attention to both core recovery and sample preparation.

In 1979, Placer Development Ltd. drilled in the higher-grade zone on 30 m centres. It compiled the new assay data with that of earlier

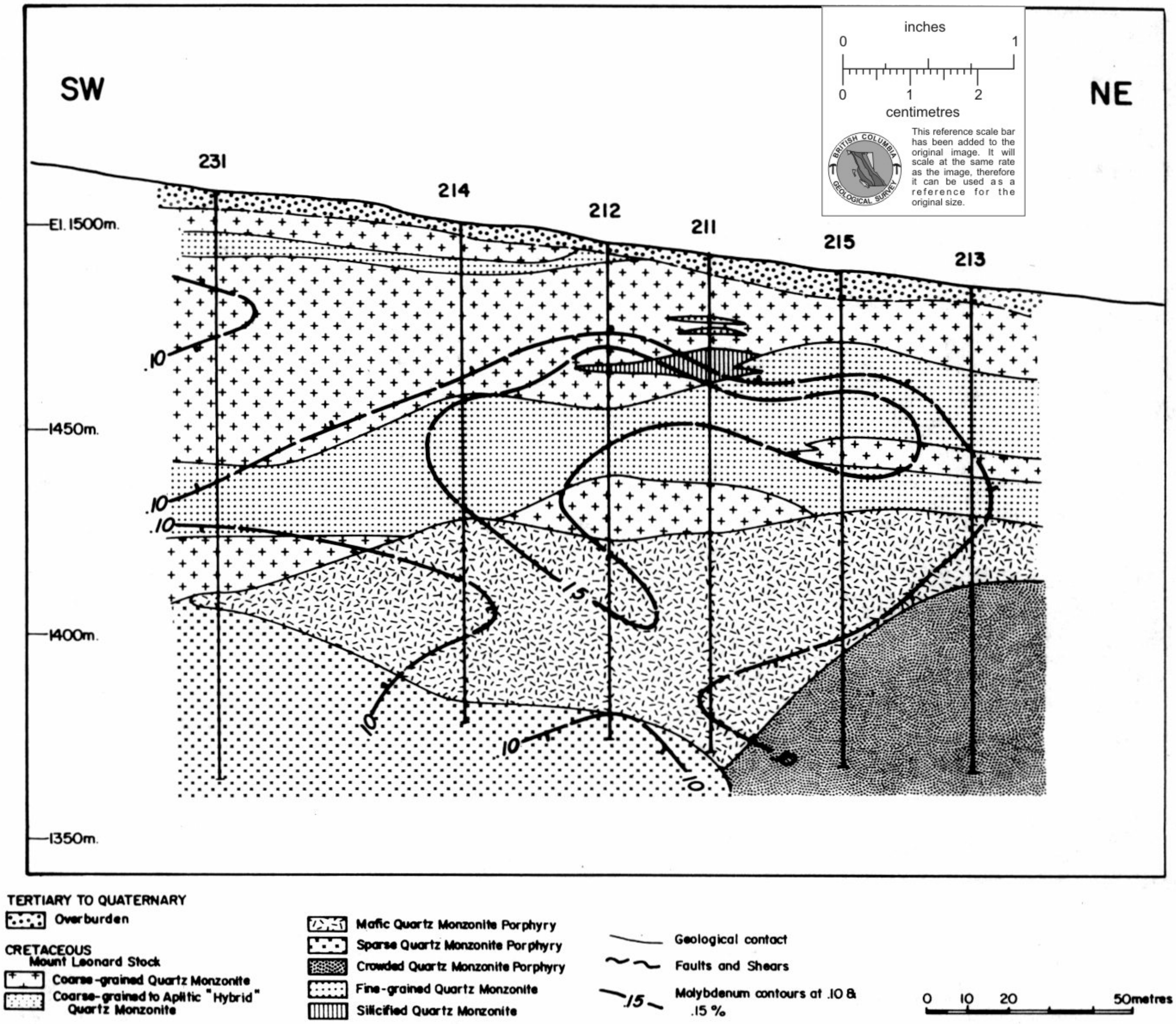


FIGURE 4. Simplified geological cross section (5N; facing northwest) through the Adanac high-grade zone showing molybenum distribution (≥0.10% Mo and >0.15% Mo).

studies and calculated new reserves by kriging. The company established a geological reserve of 270 million tonnes grading 0.053% Mo at a 0.03% Mo cutoff and/or 187 million tonnes grading 0.061% Mo at a 0.04% Mo cutoff.

In 1981, Placer Development Ltd. filed a Stage II "Environmental and Socioeconomic Assessment" with the British Columbia Ministry of Energy, Mines and Petroleum Resources (Garga and McCreath, 1981). The report describes plans to operate a conventional open-pit mine with a 14 000 tonne per day mill based on a mineable reserve of 151 971 000 tonnes grading 0.063% Mo at a 0.04% Mo cutoff and a strip ratio of 1.5:1. The mine would have a nominal life of approximately 30 years. The company planned to extract the higher-grade zone early and stockpile low-grade ore so as to keep the mill feed grade above 0.088% Mo during the first three years of operation. The project was shelved when the price of molybdenum dropped in the early 1980s.

Discussion

The Adanac deposit is an annular occurrence above and peripheral to a partially buried sparse porphyry pluton. The east side of the annulus is an area of both local geological complexity and higher-grade mineralization. It is markedly linear and it is the locus of intrusion of a late, fine-grained phase of quartz monzonite.

Geological data suggests that the stock, in the vicinity of the deposit, may have developed in intrusive stages separated by periods of deformation. Textural and lithogeochemical (uranium) data suggest that coarse-grained and mafic (less evolved) quartz monzonite magmas crystallized early and were fractured prior to injection of progressively more evolved magmas that cooled more rapidly forming sparse and crowded porphyries, and fine-grained quartz monzonite.

The shape of the fine-grained sill and the angular nature of the fragments in the plutonic-breccia in the zone of higher-grade mineralization are consistent with intrusion into previously deformed rock. Similarly, the linear nature of the zone of high-grade mineralization is consistent with control by an underlying, northwesterly trending, premineral, structure.

The timing of the mineralizing event is uncertain. The ring of mineralization is draped around the sparse porphyry pluton and is probably related to it. However, the chemically more evolved, and probably younger, fine-grained phase is also well mineralized. It may also have contributed to the mineralization. The higher-grade zone appears to owe its existence to improved ground preparation on the east side of the sparse porphyry cupola and the introduction of the fine-grained quartz monzonite sill. Biotite dates suggest that the deposit may have formed over a very short time span.

Acknowledgments

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