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# Adanac (Ruby Creek)

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## Abstract

*The Adanac (Ruby Creek) molybdenum deposit, near Atlin, British Columbia, is within the northeast edge of the composite, partially zoned, Early Tertiary Mount Leonard boss. Of the five major rock units in the Ruby Creek area, coarse granite, medium-grained granite and crowded porphyry are host for most of the molybdenite, and the porphyritic granite of the Ruby Creek stock is the principal source. Younger equigranular and fine-grained granites produced minor molybdenite. Alteration effects include mild sericite and clay after plagioclase and weak chloritization of biotite. The major rock units, which are chemically and modally very similar, are alkali granite.*

*The northeast-trending 21-m-wide Adera fault transects the Mount Leonard boss and may have incorporated a small portion of the Ruby Creek deposit on its numerous slip surfaces. Most of the coarse molybdenite-bearing quartz veins appear to have developed in gently dipping tension fractures overlying the Ruby Creek stock. The deposit does not resemble the roots of a major porphyry system.*

## Introduction

THE RUBY CREEK DEPOSIT is about 40 km northeast of Atlin, British Columbia, near the head of the Ruby Creek valley (Lat. 59°42.5′N and Long. 133°24′W; NTS 104N/11W) at an elevation of 1463 m (Fig. 1).

Molybdenite-bearing exposures were known in Ruby Creek as early as 1905 (Sutherland Brown, 1970, p. 34). Adanac Mining and Exploration Limited staked the discovery claims in 1967 and commenced drilling in 1968. Work since that time, mostly during a 1970-1971 option by Kerr Addison, produced 19,812 m of diamond drilling in 114 holes, 1219 m of rotary drilling in 16 holes, nearly 823 m of underground development, bulk sampling, pilot mill tests and a full-scale feasibility study. Climax Molybdenum Corporation of British Columbia, Limited maintained an option from 1973 through 1975. Published tonnage and grade, established by Kerr Addison during its option, were 94,350,000 tonnes of 0.16 per cent molybdenite.

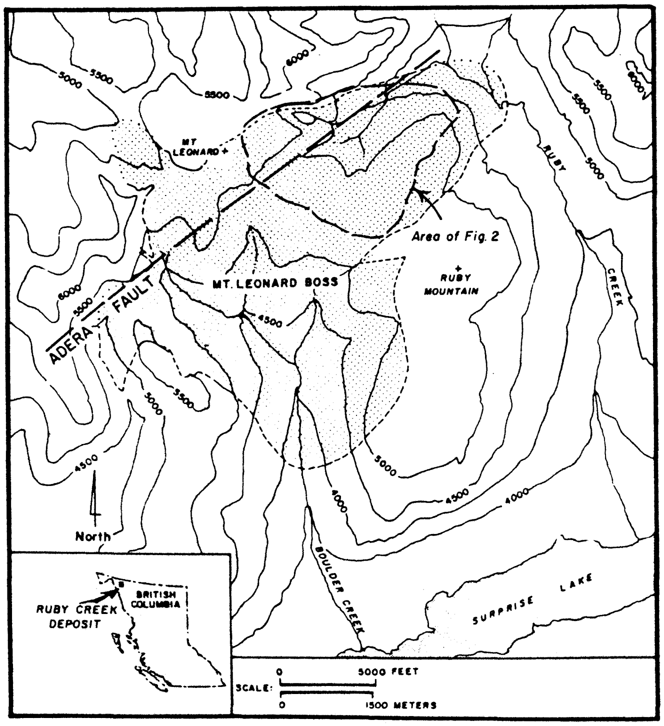

FIGURE 1 — Map showing location of the Adanac (Ruby Creek) deposit (Mount Leonard Boss outline modified after Janes, 1971).

## Geology

### GENERAL STATEMENT

The Ruby Creek deposit is within the northern edge of the Mount Leonard boss, a composite 22-square-km Early Tertiary intrusion that injects the Jurassic(?) Fourth of July Creek batholith and the Late Paleozoic Cache Creek metavolcanics (Christopher *et al.*, 1972, and Aitken, 1959) (Fig. 1). The boss is divided by the Adera fault into a northern area composed of porphyritic granite and a southern area that is mostly coarse granite. The porphyritic granite displays biotite and plagioclase enrichment near the contact and an interior potassium feldspar increase, typical of a normally zoned pluton. The coarse granite, although it shows no such zoning, does contain a large variety of relatively minor intrusive rock types. The textural and mineralogical similarity between coarse granite of the boss and coarse granite of the adjacent Surprise Lake batholith strongly suggests that the Mount Leonard boss is a satellite of the batholith.

Six major and several minor rock units occur in the vicinity of the Ruby Creek deposit (Fig. 2). Crosscutting relationships define an age sequence, from oldest to youngest, of coarse granite, medium-grained granite, crowded porphyry, porphyritic granite, equigranular granite, fine-grained granite and composite porphyry dyke.

### COARSE GRANITE

Coarse granite, the oldest and most common rock type of the Mount Leonard boss, is host for the porphyritic intrusions and much of the molybdenite in the Ruby Creek deposit (Fig. 2). The coarsely crystalline equigranular granite contains buff-coloured perthitic potassium feldspar, plagioclase, gray quartz, biotite, and traces of apatite, sphene, allanite, zircon and magnetite. Perthite crystals average 15 mm in length, but locally reach 40 mm. Quartz averages 8 mm long and biotite 3 mm. Mafic biotite-rich clots as long as 5 cm are widely scattered and are typical of the rock type. Local pegmatite pods, 15 to 30 cm in length, contain inward-penetrating smoky quartz and buff feldspar crystals.

A modified textural variety of coarse granite contains normal large feldspar and quartz crystals, but has varying amounts of a more finely crystalline (average size 3 mm) groundmass that may form as much as 20 per cent of the rock. This modified coarse granite

TABLE 1 — Chemical Analyses and Norms of Rocks from the Mount Leonard Boss, With an Average for Comparison (weight per cent)

|  | Coarse Granite (inside Ruby Creek deposit) | Coarse Granite (outside Ruby Creek deposit) | Medium-Grained Granite | Crowded Porphyry | Porphyritic Granite (Ruby Creek stock) | Porphyritic Granite (north of Adera fault) | Equigranular Granite | Fine-Grained Granite | Average Alkali Granite (Nockolds, 1954, p. 1012) |
|---|---|---|---|---|---|---|---|---|---|
| **No. of Samples** | 3 | 3 | 2 | 3 | 2 | 1 | 1 | 1 |  |
| $SiO_2$ | 75.1 | 75.8 | 74.6 | 76.17 | 76.5 | 77.3 | 76.2 | 76.5 | 73.86 |
| $Al_2O_3$ | 12.4 | 12.4 | 13.2 | 12.6 | 12.4 | 12.3 | 12.1 | 12.7 | 13.75 |
| $TiO_2$ | 0.14 | 0.17 | 0.22 | 0.18 | 0.17 | 0.14 | 0.14 | 0.12 | 0.20 |
| $Fe_2O_3$ | 0.22 | 0.15 | 0.10 | 0.30 | 0.45 | 0.11 | 0.24 | 0.33 | 0.78 |
| FeO | 0.61 | 0.93 | 1.29 | 0.82 | 0.62 | 0.65 | 0.59 | 0.59 | 1.13 |
| MnO | 0.02 | 0.02 | 0.05 | 0.33 | 0.03 | 0.01 | 0.04 | 0.02 | 0.05 |
| MgO | 0.13 | 0.08 | 0.39 | 0.23 | 0.23 | 0.06 | 0.12 | 0.08 | 0.26 |
| CaO | 0.70 | 0.54 | 1.29 | 0.78 | 0.61 | 0.22 | 0.67 | 0.69 | 0.72 |
| $Na_2O$ | 2.99 | 3.08 | 3.71 | 3.46 | 3.29 | 3.32 | 3.67 | 3.59 | 3.51 |
| $K_2O$ | 5.52 | 5.26 | 4.19 | 4.88 | 4.82 | 4.93 | 4.76 | 5.01 | 5.13 |
| **Total** | 97.83 | 98.43 | 99.04 | 99.75 | 99.12 | 99.04 | 98.50 | 99.63 | 99.39 |
| Q | 34.55 | 35.66 | 32.70 | 34.64 | 36.99 | 38.16 | 34.89 | 34.55 | 32.2 |
| or | 32.62 | 30.98 | 24.77 | 28.84 | 28.50 | 29.12 | 28.12 | 29.61 | 30.0 |
| ab | 25.28 | 26.44 | 31.42 | 29.27 | 27.84 | 28.11 | 31.05 | 30.37 | 29.3 |
| an | 3.49 | 2.67 | 6.43 | 3.89 | 3.05 | 1.09 | 2.50 | 3.42 | 2.8 |
| C | 0.22 | 0.60 | 0.20 | 0.20 | 0.64 | 1.10 | — | 0.12 | 1.4 |
| wo | — | — | — | — | — | — | 0.33 | — | — |
| hy | 1.06 | 1.54 | 2.96 | 2.15 | 1.11 | 1.05 | 1.01 | 0.84 | 1.7 |
| il | 0.27 | 0.32 | 0.42 | 0.35 | 0.32 | 0.27 | 0.27 | 0.23 | 0.5 |
| mt | 0.32 | 0.21 | 0.14 | 0.44 | 0.65 | 0.16 | 0.35 | 0.48 | 1.2 |

is typical of the contact areas near younger porphyry intrusions and is probably the result of injection and partial assimilation of the coarse granite by the younger units. Locally, however, it occurs in areas, as on the ridge at the head of Ruby Creek, where no younger porphyries are known. Here, the modified texture may reflect either the proximity of a porphyry stock below the surface or possibly the crystallization of volatile-rich residual fluids in the interstices between large crystals.

Several sill-like masses of fine-grained granite transect coarse granite in the cliff faces on the north side of Black Diamond ridge (Fig. 2). Sills dip 17 to 27 degrees south into the hillside and range from 0.5 to 1.5 m in width. The presence of sharp upper, but gradational lower, contacts suggests that the sills may actually be a part of the same intrusive event that produced the coarse granite. Textural changes of this character have been described as layering in other portions of the Surprise Lake batholith (LeAnderson, 1975, personal communication).

## MEDIUM-GRAINED GRANITE

Medium-grained granite bounds the eastern portion of the Ruby Creek deposit (Fig. 2). Contacts with older coarse granite are always sharp, and at two locations the medium-grained granite intrudes the coarse variety. The average grain size of plagioclase and quartz is about 4 mm, although potassium feldspar crystals commonly reach 6 mm in length; biotite rarely exceeds 1 mm. Apatite, zircon, allanite and magnetite are common accessory minerals.

Chemical analyses show that the medium-grained granite has more CaO and FeO and less $SiO_2$ and $K_2O$ than any major rock type of the Mount Leonard boss. The rock is still a granite, however, as indicated by comparison with Nockolds' values (Table 1).

## CROWDED PORPHYRY

Crowded porphyry forms an elongate intrusion about 430 m long within the northern portion of the Ruby Creek deposit (Figs. 2 and 3). Based on general reconnaissance, this is the only place where crowded porphyry has been observed, either in the Mount Leonard boss or in the Surprise Lake batholith. The stock intrudes coarse- and medium-grained granite, but may owe its irregular shape to truncation by the younger porphyritic granite.

Crowded porphyry contains greater than 60 per cent phenocrysts in a matrix that is variably aphanitic and phaneritic, with an average grain size of about 1 mm. Contacts between phases with different groundmass grain sizes are commonly gradational, but local sharp contacts indicate that the aphanitic-matrix variety intruded the phaneritic-matrix type. Irregularly shaped bodies of the aphanitic-matrix variety do not exceed 4.6 m in diameter.

Potassium feldspar phenocrysts average 8 mm long, plagioclase 5 mm, quartz 3 mm and biotite 1 mm. Larger phenocrysts of potassium feldspar, however, locally reach 25 mm in long dimension.

## PORPHYRITIC GRANITE

Porphyritic granite forms three stocks in the vicinity of the Ruby Creek deposit (Fig. 2). The Ruby Creek stock is about 550 m long in outcrop, with a subsurface shoulder extending approximately 900 m westward beneath its roof of coarse granite (Fig. 3). Contacts of the Ruby Creek stock with medium-grained granite are always sharp, whereas contacts with crowded porphyry are in part sharp and in part gradational. Contacts with coarse granite, on the other hand, are always gradational and typically show areas of mixed rock where large xenocrysts from coarse granite give

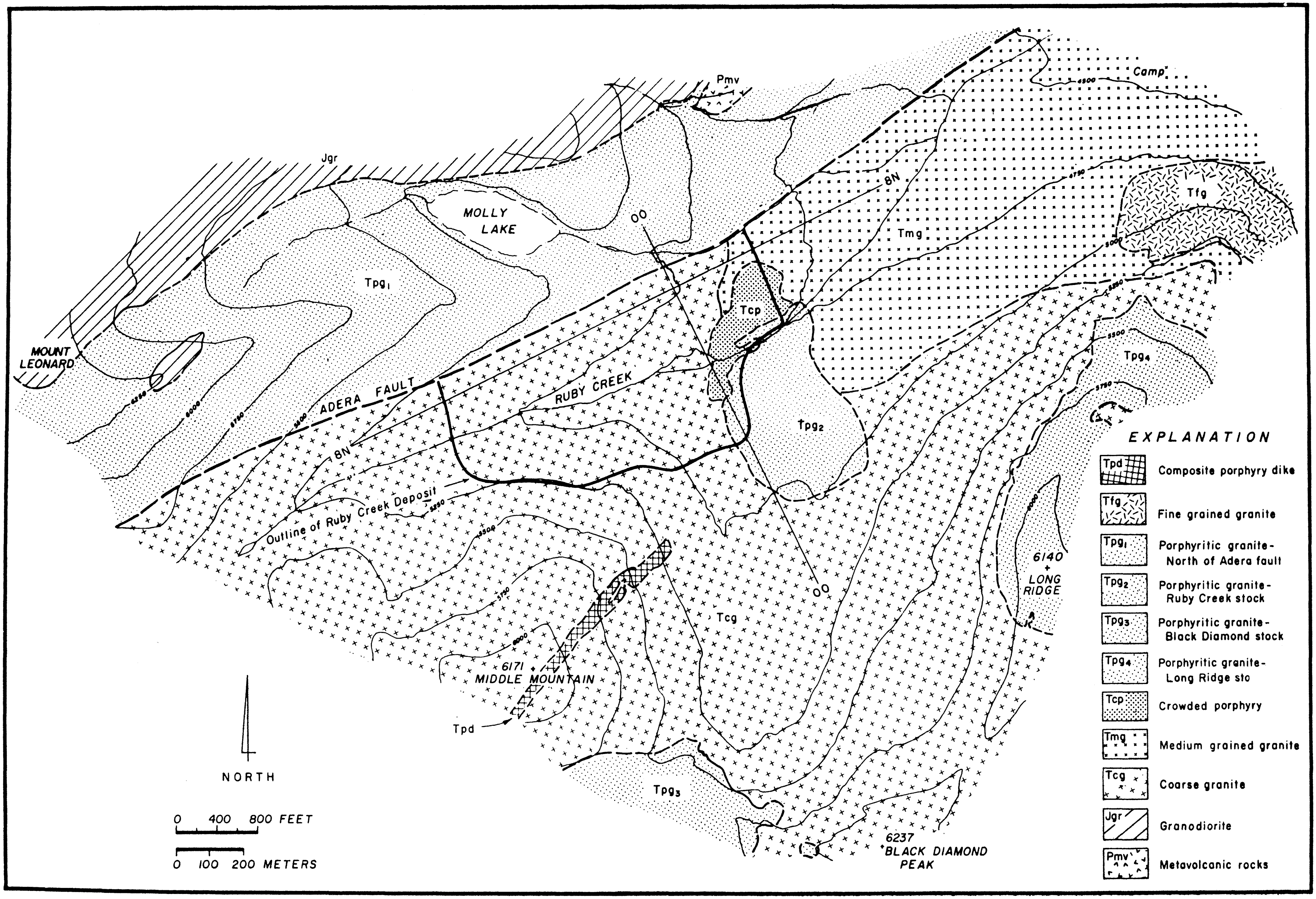

FIGURE 2 — Generalized geologic map of the Ruby Creek area.

the porphyritic granite the appearance of a banded porphyry.

The Black Diamond stock on the ridge south of the Ruby Creek deposit is elongate northwest and about 600 m long (Fig. 2). The Long Ridge intrusion in the eastern part of the map area is about 1000 m long. Contacts of these intrusions with coarse granite are commonly gradational over distances of at least 6 m.

Porphyritic granite of the three stocks is variable in its phenocryst size and abundance. Although the Ruby Creek stock contains several cross-cutting phases with slightly different textures, its phenocrysts average 6 mm in length and about 20 per cent in abundance. Black Diamond phenocrysts average 5 mm long and 12 per cent of the rock, whereas phenocrysts from the Long Ridge intrusion average 8 mm and about 20 per cent of the rock. The larger phenocrysts in the narrow Long Ridge intrusion may be due to a greater influence of included xenocrysts from coarse granite.

Porphyritic granite north of the Adera fault generally has an average phenocryst size and abundance like that of the Black Diamond intrusion. Near contacts with the Fourth of July Creek batholith, however, the biotite-rich contact phase is locally phenocryst free.

The matrix in all areas of porphyritic granite averages 0.15 mm. Potassium feldspar phenocrysts are the largest, followed by plagioclase, quartz and biotite. Magnetite, sphene and allanite are accessories.

### EQUIGRANULAR GRANITE

Equigranular granite occurs at a depth of 402 m in one deep drill hole in the central portion of the Ruby Creek deposit. The granite is variably gray and pink in colour, unlike any other unit in the Mount Leonard boss. Average grain size is 7 mm, although potassium feldspar crystals that reach 10 mm locally create a sub-porphyritic texture in what is generally an equigranular rock.

Although the granite is chilled against what is thought to be a mafic inclusion, rather than the overlying porphyritic granite, its fresh appearance, position at depth and paucity of mineralization suggest that the equigranular granite is younger than the rocks above it. A drill-hole intersection of more than [illegible]5 m infers that the equigranular granite is a major post-mineral intrusion that may underlie the entire Adanac deposit.

### FINE-GRAINED GRANITE

Fine-grained granite is common as dykes and irregularly shaped intrusives that transect the Ruby Creek stock and older rocks in the Adanac mine workings. The largest mass exposed in the drifts is about [illegible]5 m long. Outside the deposit, on the north end of Long Ridge, fine-grained granite composes an intrusion at least 55 m in length (Fig. 2). The fine granite is a porphyritic rock, with an average phenocryst size of 3 mm and an abundance of 5 per cent or less. Matrix grains are 1 to 2 mm in diameter.

### COMPOSITE PORPHYRY DYKE

Although poorly exposed, the 30-m-wide composite porphyry dyke can be traced in float about 700 m northeast from the top of Middle Mountain to the alluvium of the Ruby Creek valley (Fig. 2). The dyke has two phases — a 1-m-wide finely crystalline mafic border in sharp contact with a felsic porphyry interior. The mafic border is composed of 1-mm-long plagioclase laths, with interstitial brown biotite, pale green acicular amphibole, abundant apatite and magnetite. The interior phase contains phenocrysts of potassium feldspar, rounded quartz, and partially K-feldspathized and sericitized plagioclase. The interior matrix is a micrographic intergrowth of quartz and potassium feldspar, with patches of partially chloritized brown biotite and sericitized plagioclase. Ovoid mafic inclusions up to 17 cm long suggest that the interior intruded the border.

The mineralogic similarity between the felsic interior of the composite dyke and other rocks of the Mount Leonard boss strongly suggests that the dyke is a part of the same igneous system. The micrographic texture and alteration indicate the presence of volatiles and imply that the dyke was emplaced late in the evolution of the system. The dyke is similar to composite dykes described in the Little Belt Mountains of Montana by Witkind (1970).

### MISCELLANEOUS ROCK TYPES

Late granite dykes, with an average grain size of 4 mm, commonly contain crenulate quartz-feldspar pegmatite zones up to 22 cm wide along contacts. Basalt dykes were noted, but not described.

## Chemistry and Modal Analyses

The major rock units of the Mount Leonard boss are alkali granite (Nockolds, 1954, p. 1008) (Table 1). Although the term alaskite (Aitken, 1949, p. 60) is used for quartz- and potassium-feldspar-rich granite that contains moderate amounts of albite and minor mafics (Bateman, 1963, p. D-13), other definitions (AGI, 1962, p. 13) restrict the term to quartz - potassium feldspar rocks with little or no plagioclase. Alaskite was originally defined as an equigranular, non-porphyritic granite (AGI, 1962, p. 13). Because the rocks of the Mount Leonard boss contain as much as 39 per cent plagioclase, as well as porphyritic variants, the less specific term, granite, is here preferred.

Except for the medium-grained granite, the rocks of the Mount Leonard boss are chemically indistinguishable. Even the slightly more mafic medium-grained variety fits well within the granite field of most igneous rock classifications. Modally, the rocks are also very similar (Table 2). The only prominent variation is in the changes from the contact to the interior in the porphyritic granite north of the Adera fault.

## Structure

The Adera fault bounds the northern edges of the Ruby Creek deposit (Fig. 2). Although well located by drilling, stream alignment and rock type changes in the Ruby Creek area, the fault is generally poorly exposed. Its trace across the Mount Leonard boss is based solely on the boundary between porphyritic granite on the north and coarse granite on the south (Fig. 1).

Between Molly Lake and Ruby Creek, the fault strikes N 65°E and dips about 80°N (Fig. 2). Its main strand, defined by intense argillization and slickensided molybdenite, is about 37 m wide, although a more extensive zone of broken and moderately argillized rock may exceed 150 m. The Adera is probably a normal fault, but the magnitude of vertical as well as

TABLE 2 — Modal Analyses of Rocks from the Mount Leonard Boss

| | Coarse Granite (inside Ruby Creek deposit) | Coarse Granite (outside Ruby Creek deposit) | Medium-Grained Granite | Crowded Porphyry | Porphyritic Granite (Ruby Creek stock) | Porphyritic Granite (north of Adera fault — interior) | Porphyritic Granite (north of Adera fault — transition) | Porphyritic Granite (north of Adera fault — border) | Equigranular Granite | Fine-Grained Granite |
|---|---|---|---|---|---|---|---|---|---|---|
| **No. of samples** | 10 | 12 | 5 | 5 | 10 | 17 | 4 | 3 | 5 | 6 |
| Quartz | 38.8 | 35.9 | 32.8 | 36.8 | 37.5 | 38.3 | 34.9 | 34.1 | 36.2 | 36.5 |
| K-spar | 36.5 | 33.4 | 22.2 | 29.4 | 31.7 | 30.8 | 31.5 | 22.0 | 30.8 | 35.3 |
| Plagioclase | 22.2 | 26.8 | 39.2 | 30.0 | 27.8 | 26.4 | 28.1 | 35.9 | 30.4 | 26.7 |
| Biotite | 0.7 | 1.9 | 3.2 | 1.6 | 1.4 | 2.0 | 4.0 | 6.2 | 1.2 | 0.3 |
| Opaque | 0.3 | 0.3 | 0.2 | 0.2 | 0.3 | 0.2 | 0.2 | 0.1 | 0.2 | 0.3 |
| Sphene | Tr | Tr | Tr | Tr | Tr | — | — | — | Tr | 0.1 |
| Zircon | Tr | Tr | Tr | Tr | Tr | Tr | — | — | Tr | Tr |
| Apatite | — | Tr | — | — | Tr | — | — | — | Tr | — |
| Allanite | 0.1 | Tr | — | — | Tr | Tr | Tr | Tr | — | Tr |
| Epidote | Tr | Tr | — | — | — | — | — | Tr | — | — |
| Sericite | 0.2 | 1.0 | 0.7 | 0.1 | 0.1 | 1.3 | 0.5 | 0.9 | 0.2 | Tr |
| Clay | 0.4 | 0.3 | 1.0 | 1.1 | 0.7 | 0.4 | 0.5 | 0.2 | 0.6 | 0.3 |
| Chlorite | 0.5 | 0.2 | 0.6 | 0.6 | 0.4 | 0.3 | 0.2 | 0.6 | 0.1 | 0.3 |
| Fluorite | 0.1 | 0.2 | 0.1 | Tr | Tr | 0.3 | 0.1 | — | 0.2 | 0.1 |
| Carbonate | 0.2 | — | Tr | 0.2 | 0.1 | Tr | — | — | 0.1 | 0.1 |
| Plagioclase in Perthite | 6.4 | 6.3 | 0.6 | 1.0 | 0.4 | 0.5 | 0.3 | 0.2 | 1.5 | 0.8 |
| $\frac{\text{Chlorite}}{\text{Chlorite} + \text{Biotite}} \times 100$ | 42 | 10 | 16 | 27 | 22 | 13 | 5 | 9 | 8 | 50 |

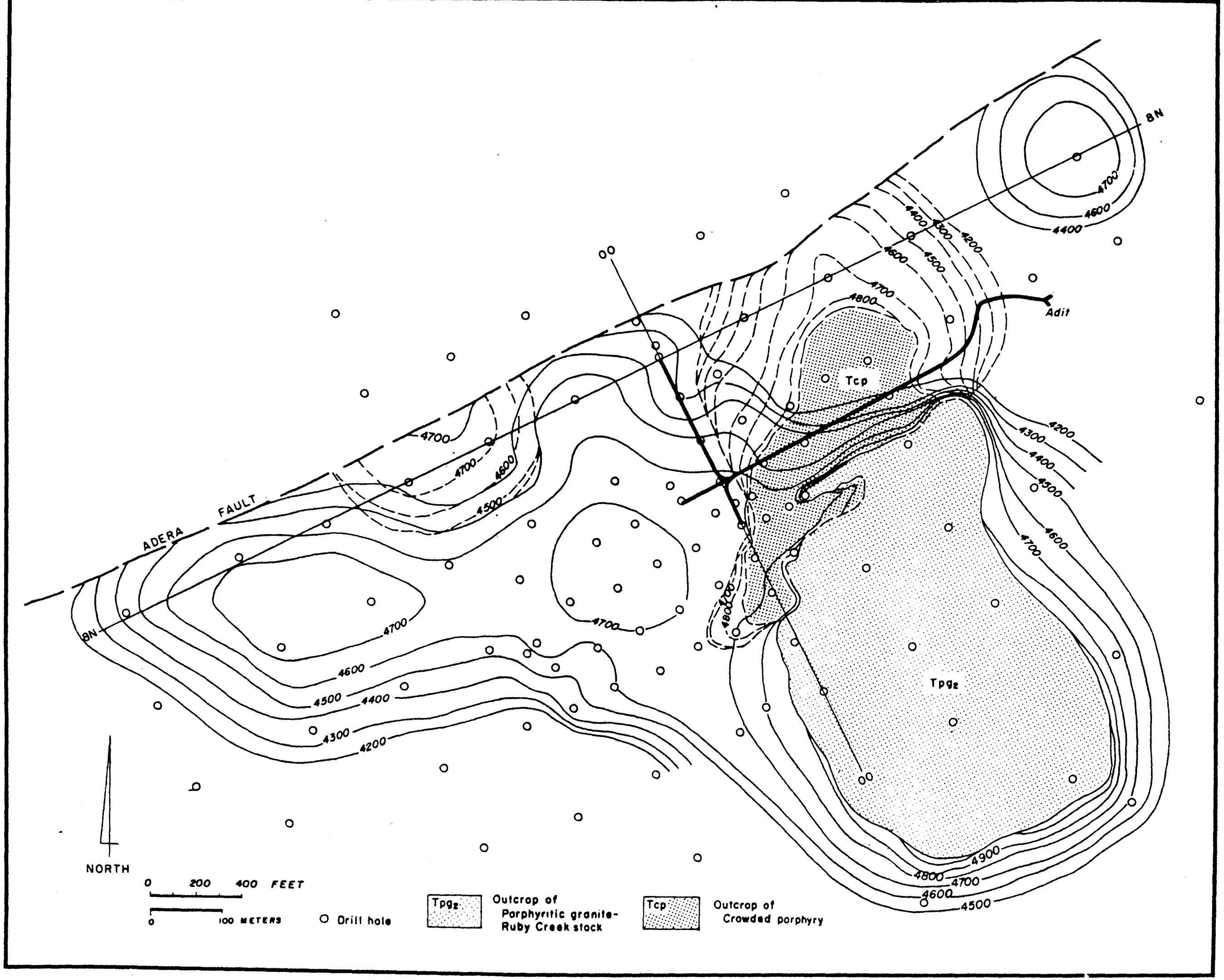

FIGURE 3 — Contour map on the surfaces of the Ruby Creek and crowded porphyry stocks.

possible strike-slip movement is unknown. In spite of abundance of drilling in both footwall and hanging wall, no marker units can as yet be correlated across the fault. Post-intrusion and post-ore movement is unquestionable, but the proximity of the orebody and intrusive complexity to the Adera fault suggests a possible early movement history that may have localized these ore and ore-related events.

About 500 fracture measurements in the vicinity of the Ruby Creek deposit yield four principal trends, N36°E/82°SE, N15-30°W/70-80°SW, N83°E/77°NW and nearly horizontal with variable strike. Molybdenite veins parallel the N36°E and nearly horizontal fractures. Limited data suggest that fracture density, defined as the number of fractures per 6.1 m, is not as great in outcrops of the deposit as it is on some of the surrounding ridges.

## Mineralization

### MOLYBDENUM

The Ruby Creek deposit is approximately 1036 m long, 550 m wide and 198 m thick (Fig. 2). Molybdenum-bearing veins extend some distance beyond these dimensions, as in Drill Hole 00-8N (Fig. 3), but they contribute little to the economic viability of the deposit.

There are two vein types. The most common variety contains inward-penetrating molybdenite rosettes, as large as 20 mm, in a smoky quartz matrix. The rosettes are distributed erratically along vein boundaries, a characteristic that made accurate sampling of the Ruby Creek deposit particularly difficult. Veins are locally vuggy and rarely contain fluorite, pyrite and powellite (Sutherland Brown, 1970, p. 34). An average width is 3 mm, although 5-cm-wide veins occur in the underground workings. The veins are widely spaced and generally dip less than 30 degrees.

A second vein type averages less than 3 mm wide, contains little quartz and dips steeply. Although composed largely of molybdenite, these veins are too widely spaced to contribute significantly to the tenor of the deposit.

Veins occur in all major rock types, but are most common in the coarse granite, crowded porphyry and porphyritic granite. Fine-grained granite dykes cut molybdenum-bearing veins, but are also cut by the veins.

Areas of greater than 0.1 per cent molybdenite mineralization form blanket-like zones that reflect the gentle dips of the large molybdenite veins. Zones reach 60 m thick, but are commonly separated vertically by 15- to 30-m barren, or very low grade, intervals. Section 8N (Fig. 4), which follows the long direction of the deposit, shows the effect of connecting 0.1 per cent molybdenite intervals between drill holes so that the zones parallel the contacts of crowded porphyry and Ruby Creek stocks. Alternative ways of connecting these intervals exist, but the results shown in 8N are certainly permissive. Section 00 (Fig. 5), which is normal to 8N, shows the richest concentration of molybdenite in the Ruby Creek deposit. Again, 0.1 per cent molybdenite zones approximate the contact of the Ruby Creek stock.

The apparent coincidence of 0.1 per cent molybdenite zones with the contacts of the Ruby Creek stock suggests that the stock is the source of the mineralization and that fracturing in the country rock adjacent to and within the stock served to concentrate the veining. The high-grade zone shown in Section 00 occurs in an area where the Ruby Creek and crowded porphyry stocks are adjacent. Perhaps the crowded porphyry intrusion also produced molybdenite, and the overlap of mineralization from both intrusions created the high-grade zone in this particular location.

Molybdenite zones to the west in Section 8N also approximate the contact of the Ruby Creek intrusion,

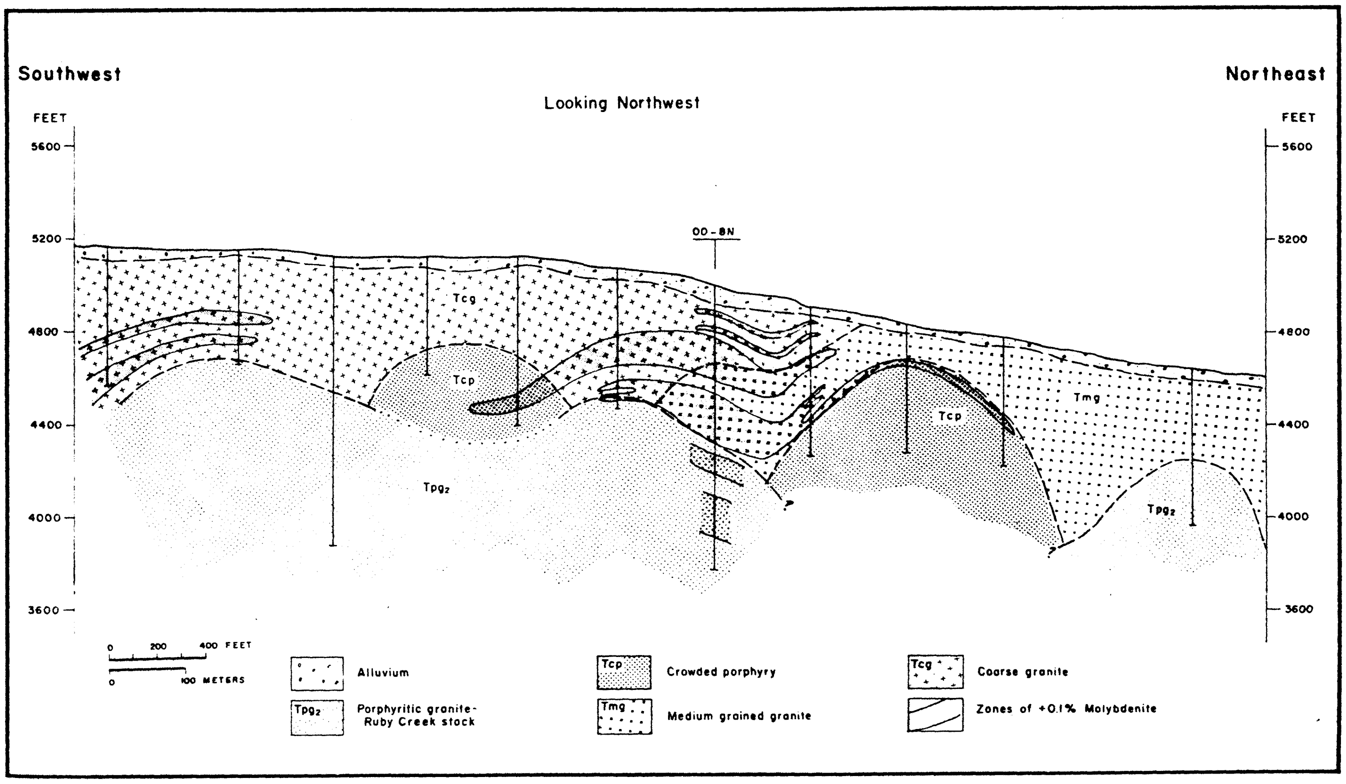

FIGURE 4 — Generalized geologic Section 8N.

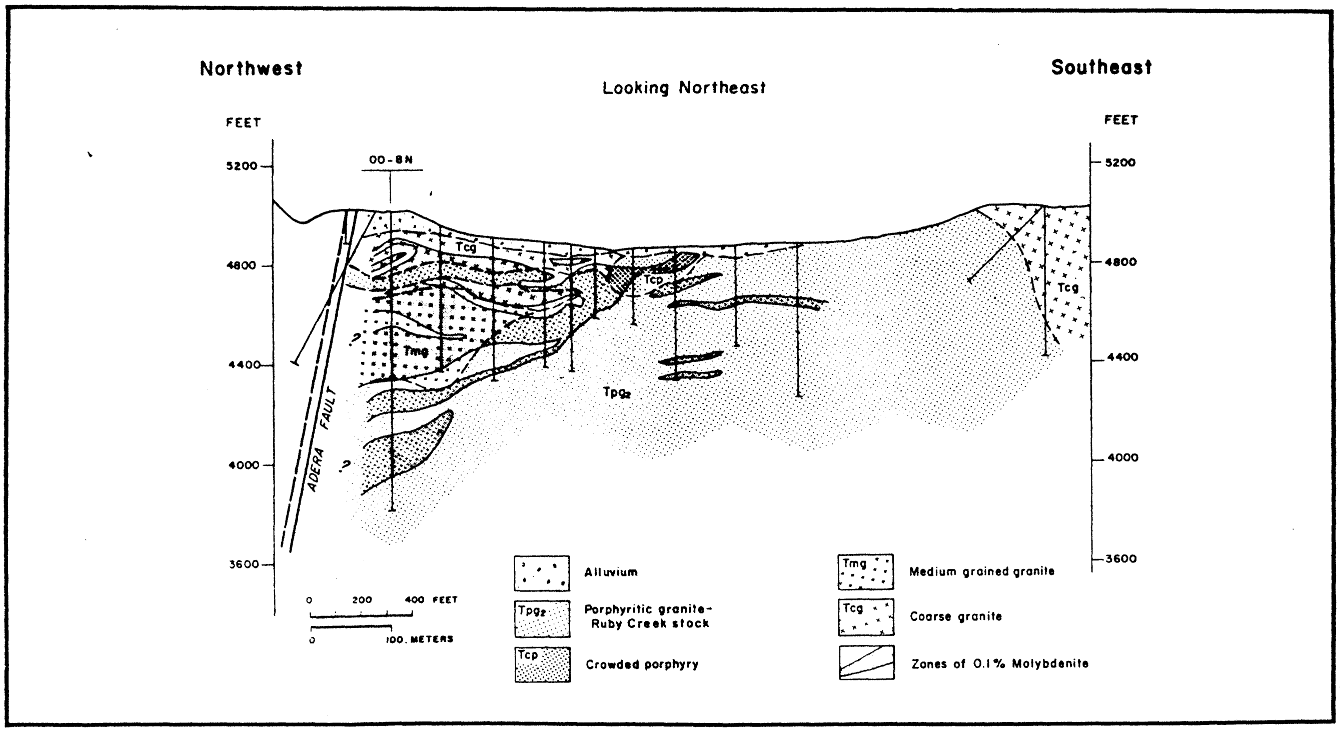

FIGURE 5 — Generalized geologic Section 00-short.

again suggesting the genetic and localizing influence of the stock. The vuggy nature, coarse molybdenite and gentle dips of the veins, as well as the molybdenite zones, may reflect the filling of flat-lying tension fractures that resulted from relaxation of upward magma pressure after emplacement of the stocks.

Narrow 0.1 per cent molybdenite zones occur within the Ruby Creek and crowded porphyry stocks some distance from the contacts (Figs. 4, 5). Hole 00-8N penetrated the best mineralization of this type yet observed (Fig. 4). These zones could either be associated with younger phases of the intrusions or perhaps with the underlying mass of equigranular granite.

Section 00 shows the abrupt truncation of excellent mineralization against the Adera fault (Fig. 5). Zone plans also suggest that a small high-grade area of molybdenite was removed by faulting. Drilling on the hanging wall of the Adera fault did not penetrate the offset portion. Drilling through the fault, however, revealed considerable molybdenite on numerous fracture surfaces 183 m west of Section 00. The offset portion may be distributed along fracture surfaces within the Adera fault itself.

Limited, but spectacular, coarse molybdenite-bearing quartz veins on the north end of Long Ridge may be associated with the fine-grained granite intrusion that is topographically beneath it. Likewise, similar veins on the ridge at the head of Ruby Creek may be related to an unexposed intrusion.

In summary, molybdenite mineralization in the Ruby Creek deposit issued from and collected in fractures near the Ruby Creek and crowded porphyry stocks. The deposit owes its existence to the proximity of the two mineralizing intrusions and to the fortuitous erosion level that allows surface access to molybdenite associated with the west-trending subsurface shoulder of the Ruby Creek stock. Exploration on the south and east edges of the Ruby Creek stock revealed no additional crowded porphyry intrusions, no gently dipping contacts and very little molybdenite.

### TUNGSTEN

Wolframite occurs in the hematite-stained quartz clasts of a 3-m-wide open fault breccia on the north side of Black Diamond ridge (Fig. 2). The fault zone, which continues for over 330 m on strike, may be associated with tungsten mineralization at the Black Diamond prospect on the south side of Black Diamond peak. Less extensive tungsten-bearing zones occur on the east end of Long Ridge. The open through-going character of these breccias suggests that the tungsten mineralization is much later and probably unrelated to the molybdenite deposit at Ruby Creek.

## Alteration

Weak propylitic alteration in the Ruby Creek deposit is defined by chlorite after biotite, as well as by clay, sericite, and carbonate after plagioclase. Chloritization is reflected in the percentage increase of chlorite plus biotite in all rock types within the deposit. Clay alteration is suggested by the slight clay increase in the plagioclase of coarse granite (Table 2).

Because sericite values in the coarse granite from outside the deposit include sericite after biotite, they do not reflect accurately the amount of sericite after plagioclase (Table 2). Qualitative estimates, however, confirm a slight increase in sericite after plagioclase near molybdenum. Carbonate is unique to the deposit (Table 2).

In addition, allanite-rimmed epidote is most abundant in the medium-grained granite within the molybdenite zone. Sutherland Brown (1970, p. 35) recognized a weak fracture-controlled pyrite halo in medium-grained granite east of the deposit.

All of these alteration products occur in small quantities and some are only slightly more abundant near molybdenum than they are elsewhere in the Mount Leonard boss. Propylitic alteration within the deposit probably resulted from a weak hydrothermal enhancement of deuteric effects noted throughout the boss. K-feldspathization of plagioclase, although well documented by replacement perthite in the coarse granite, is no more extensive within the deposit than it is outside. It most likely resulted from a pervasive late magmatic event having nothing directly to do with the hydrothermal event associated with molybdenum mineralization.

Rare planar zones of potassium feldspar flooding, as much as 15 cm wide, but generally less than 5 cm, are exposed in the adit. Most zones contain central fractures and some contain molybdenite-bearing quartz veins. The zones occur in coarse granite, porphyritic granite and fine-grained granite.

## Conclusions

Emplacement and subsequent release of hydrothermal solutions from the crowded porphyry and Ruby Creek stocks produced most of the molybdenite in the Ruby Creek deposit. Gently dipping tension fractures developed in overlying host rocks during relaxation of upward magma pressure after initial emplacement. Large molybdenite crystals probably grew in these fractures through precipitation in open spaces. The association of higher grade mineralization with the overlap area between the two intrusions indicates that both produced molybdenite. The association of most large veins with contacts of the Ruby Creek stock, however, suggests that it was the principal source rock. Later emplacement of the fine-grained and equigranular granites may have added small amounts of molybdenite.

The process of intrusion and mineralization was probably rapid. The chemical and modal similarity of these rocks suggests little time for crystal fractionation and the development of compositional variants. The lack of strong alteration probably indicates an isothermal environment of ore formation that might best be maintained by continued emplacement of hot magma into surrounding still-warm host rocks.

Mineralization may have extended over the top of what is now the eroded portion of the Ruby Creek stock. There is no evidence to suggest, however, that this mineralization would have been any higher grade than that which occurs over the west-trending subsurface shoulder of the Ruby Creek stock or, at the very best, any higher grade than that which occurs in the overlap area between the crowded porphyry and Ruby Creek intrusions. There are no greisen veins, quartz-sericite-pyrite veins or envelopes, lower argillic alteration zones or any other indication that the Ruby Creek deposit might represent the roots of a major porphyry molybdenum system such as the Henderson orebody in Colorado.

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