



LITHOGEOCHEMICAL STUDY OF THE 'CASSIAR MOLY' DEPOSIT
CASSIAR MAP-AREA
(104P)

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INTRODUCTION

Recent regional mapping in Cassiar map-area (*see* Geological Fieldwork 1978 and 1979, Papers 1979-1 and 1980-1) has focussed on a number of areas with significant molybdenum mineralization. The main prospects include the Storie Mo (Casmo) project of Shell Canada Resources Limited, the 'Cassiar Moly' prospect (MI 104P-35) of Cassiar Resources Limited, and the Lamb Mountain (STAR or WINDY) molybdenum-tungsten prospect (MI 104P-3) of Union Carbide Exploration Corporation Limited. All these deposits are associated with Upper Cretaceous rocks of the so-called Troutline Creek quartz monzonite or Cassiar Stock, a coarse-grained porphyritic pluton emplaced along the eastern margin of the late Lower Cretaceous Cassiar batholith (Panteleyev, 1980).

Cassiar Moly deposit was selected for closer examination during 1980 in order to investigate the litho-geochemical expression of this large, diffuse mineralized zone. The prospect offers an opportunity to sample mineralized rocks that are well exposed in an area with much topographic relief. Figure 16 outlines the 10-kilometre-square area investigated and shows locations of 52 samples collected over a vertical range of 860 metres. The samples are currently being analysed for a number of elements including molybdenum, tin, tungsten, and fluorine.

EXPLORATION HISTORY

Molybdenite showings are on the flanks of a 2 185-metre peak approximately 9.5 kilometres south of Cassiar townsite. The showings were discovered in 1966 and acquired by Value Line Minerals Limited, of Calgary, as the RUSTY, ELOISE, X, and other claim groups (MI 104P-35). Starting in 1967 the company explored the prospect for three consecutive summers. Their main effort was spent in driving a 1 023 (1 067 ?)-metre adit northwestward to intersect favourable rock types and to pass beneath small high-grade showings west of the peak (Fig. 17). In addition, some geological mapping, prospecting, and limited diamond drilling were done. Drill results are poorly documented and available information is fragmental. It is said (C. J. Brown and other sources, 1980, personal communication) that four drill holes totalling 532 metres were completed from underground and two surface diamond-drill holes totalling 457 metres were put down east of the adit. Samples from the underground workings show molybdenite concentrated in narrow fractured zones, some with spectacular grades. One sample contained 4.17 per cent MoS₂ over 1 metre and another had 1.64 per cent MoS₂ over 3 metres. However, over-all molybdenite grade is low, for example, 0.026 per cent MoS₂ across 100 metres in the crosscut (*see* Assessment Reports 1700 and 7206).

The property was relocated in 1977 by W. Elsner as the ANGEL group and subsequently acquired by Cassiar Resources Limited. Cassiar considered the possibility of ore at depth and, in 1980, remapped the property. Accessible portions of the mineralized zone were tested with three angle holes drilled westerly for a total depth of 1 370 metres.

GEOLOGY

'Cassiar Moly' deposit is in the south-central part of the Troutline Creek quartz monzonite stock more than 2 kilometres from the nearest intrusive contact with Paleozoic metasedimentary rocks. The claim area is dominated by a large northward trending rusty zone of closely jointed and fractured rocks that are associated with small, finer grained intrusive rocks.

Rocks in the study area consist, in essence, of two granitic types: (1) the regional coarse-grained rocks and their local textural variants (Fig. 16, map units 1, 1A, and 1B), and (2) small bodies of equigranular alaskite and quartz monzonite porphyry as well as some related aplite and pegmatite segregations.

Map unit 1 is regional in extent and is a megacrystic hornblende biotite quartz monzonite or granite porphyry. It contains perthitic K-feldspar phenocrysts up to 4 centimetres in length as well as somewhat smaller phenocrysts of quartz, plagioclase, and biotite. The matrix is a fine to medium-grained mosaic of quartz-plagioclase-orthoclase-biotite and rare hornblende. Over-all colour is pink though there are local variations to grey.

The main textural variant (map unit 1A) of the megacrystic porphyry is a rock of similar composition and colour but with smaller phenocrysts. It ranges from very coarse-grained porphyry with K-feldspar phenocrysts to 2 centimetres in a medium-grained matrix, to coarse-grained porphyry with both K-feldspar and albite phenocrysts to 1 centimetre in a finer grained matrix. It can also be medium grained, equigranular, or porphyritic with medium-grained feldspars and biotite set in a finer grained matrix.

The other textural variant (map unit 1B) is similar to map unit 1A. It can be distinguished by its grey matrix that is caused by abundant fine-grained biotite. The biotite is bimodal and present both as grains to 5 millimetres in size and as fine, disseminated flakes dispersed throughout the matrix. In addition, this grey porphyry contains a greater than average number of inclusions. The inclusions are commonly spherical bodies a few centimetres to 50 centimetres in size although larger, tabular zones are present southwest of drill hole 3. The inclusions consist of fine-grained biotite quartz diorite to quartz monzonite and are thought to be granitized roof zone metasedimentary rocks.

Rapakivi texture, mantling of K-feldspar phenocrysts by albite, is common in all coarse porphyritic rocks in the map-area. This texture is characteristic of map units 1A and 1B.

Map unit 2 is a heterogeneous assemblage of mainly fine-grained leucocratic rocks but also includes coarse quartz feldspar porphyry, minor aplite, some pegmatite pods, and lenses or screens of megacrystic porphyry. The rocks form northeasterly to northward trending, steeply dipping dykes that crosscut the coarser rocks of units 1, 1A, and 1B. The dominant rock type of unit 2 is a fine-grained equigranular to granophyric alaskite that grades into buff to pink, fine to medium-grained porphyritic quartz monzonite. Contained within the finer grained zones are 'blind' lensoid bodies of coarse-grained quartz-eye feldspar porphyry, some of which have albite as the dominant feldspar phenocryst. In addition, a few quartz feldspar porphyry dykes up to 5 metres in width cut the megacrystics textural variants. These small dykes commonly have thin pegmatite selvages and, in one locality, pods of greisen occur along the contact.

Contacts between map units 1, 1A, and 1B as shown on Figure 16 are arbitrary. Distinctions are based on differences in grain size, texture, fabric, and colour. Mapping shows that changes are gradational and related to topography. That is, the coarse porphyries occur as subhorizontal zones and the textural variants are exposed on ridge crests at the highest elevations.

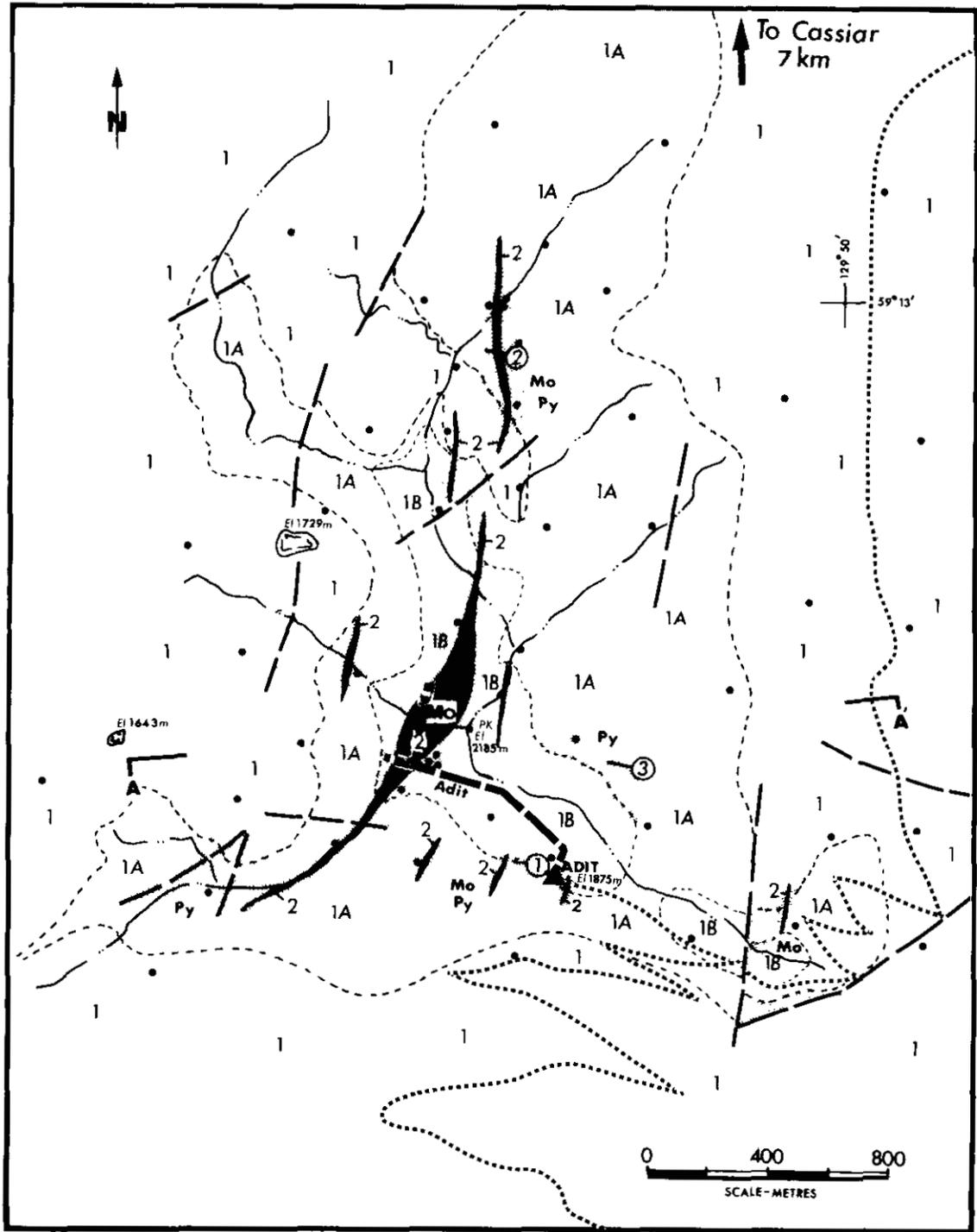


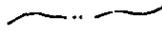
Figure 16. Geology of the 'Cassiar Moly' deposit (MI 104P-35).

LEGEND

CASSIAR STOCK (TROUTLINE CREEK QUARTZ MONZONITE) 73 ± 2.5 Ma

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|---|--|
| <div style="border: 1px solid black; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 2 </div> | <p>MINOR INTRUSIONS, SEGREGATIONS: FINE TO MEDIUM-GRAINED, EQUIGRANULAR, BUFF TO PINK QUARTZ MONZONITE; IN PART PINK QUARTZ MONZONITE PORPHYRY, K-FELDSPAR MANTLING RARE TO ABSENT; INCLUDES SOME QUARTZ-EYE PORPHYRY, APLITE, AND RARE PEGMATITE, MAFIC-RICH SEGREGATIONS, GREY QUARTZ MONZONITE INCLUSIONS AND MINOR XENOLITHS WITH SULPHIDE AND CALC-SILICATE MINERALS</p> |
| <div style="border: 1px solid black; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 1 </div> | <p>REGIONAL UNIT: MEGACRYSTIC HORNBLENDE BIOTITE QUARTZ MONZONITE PORPHYRY; PINK, VERY COARSE GRAINED</p> |
| <p style="text-align: center;">TEXTURAL VARIANTS OF UNIT 1</p> | |
| <div style="border: 1px solid black; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 1A </div> | <p>BIOTITE QUARTZ MONZONITE PORPHYRY AND PORPHYRITIC QUARTZ MONZONITE; MEDIUM TO COARSE GRAINED, PINK AND GREY, K-FELDSPAR PHENOCRYSTS ABUNDANT, MANY MANTLED BY ALBITE</p> |
| <div style="border: 1px solid black; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;"> 1B </div> | <p>QUARTZ MONZONITE PORPHYRY; GREY, SOME FINE-GRAINED BIOTITE IN MATRIX, K-FELDSPAR VARIES IN ABUNDANCE, ALBITE MANTLING COMMON TO RARE IN K-FELDSPAR-ALBITE PORPHYRY, GREY FINE-GRAINED INCLUSIONS COMMON</p> |

SYMBOLS

- | | |
|---|---|
| RIDGE CREST |  |
| ACCESS ROADS |  |
| 1980 DIAMOND-DRILL SITE |  |
| INTRUSIVE CONTACT, GRADATIONAL |  |
| INTRUSIVE CONTACT, DISTINCT |  |
| FAULT/FRACTURE ZONE |  |
| ROCK GEOCHEMISTRY SAMPLE SITE |  |
| MINERALIZED ZONE INDICATING MAIN SULPHIDE MINERALS .. |  |

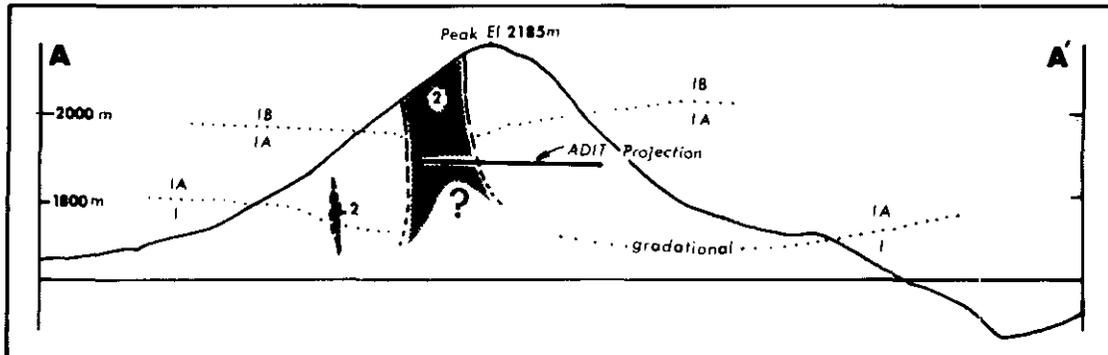


Figure 17. 'Cassiar Moly' deposit, cross-section A-A', looking northward.

Clearly the fine-grained leucocratic to porphyritic rocks of map unit 2 crosscut the coarser porphyries; in detail their contact relations are enigmatic. Frequently it appears that rocks of unit 2 are intergradational with rocks of map unit 1 and its variants, especially at the terminations of the dyke-like bodies. In such settings there appears to be a zone of mutual interaction between the alaskitic rocks and the coarse porphyries. At outcrop scale this interaction is expressed as mixed coarse-fine lithologies. The mixed zones contain small aplite dykes, simple pegmatite pods, and rare, zoned spherical segregations up to 1 metre in diameter with quartz-orthoclase pegmatite cores and biotite-rich, molybdenite-bearing, layered rinds. Away from the dyke terminations the contact between both large and small dykes and coarse country rocks is sharp or consists of aphanitic to aplitic alaskite, fine-grained equigranular quartz monzonite, or porphyritic quartz monzonite in a layered zone up to 1 metre in width. However, it is unlikely that the rocks of unit 2 are actually chilled against the coarser rocks. Instead, the contact zone appears to be one of mutual quenching of two, crystal-bearing magma mushes that contain pockets of volatile-rich residual fluids.

Jointing is well developed throughout the map-area. Joint-bounded blocks in the coarse megacrystic porphyry tend to be large and rectilinear but those in the textural variants and map unit 2 are more slab like. The grey porphyry of map unit 1B, for example, has closely spaced, curvilinear slab-jointing. Faults tend to follow the two main joint sets; they dip steeply and trend 010 and 040 degrees.

Traces of molybdenite and minor pyrite are found in fractured and fine-grained rocks and dykes of map unit 2 as well as in isolated areas along the ridge southeast of the peak. Within this broad zone of diffuse mineralization, molybdenite is present mainly as small rosettes and flakes in the fine, granular rocks and in fractures and joints within quartz feldspar porphyries and their adjoining megacrystic porphyries. One of the main controls of mineralization is increased fracture density and the best mineralization occurs where closely spaced fracture sets intersect. The fractures in this case are joints and minor fault zones with argillic alteration (so-called 'shears') that parallel the main steeply dipping 010 and 040-degree joint sets. Two other joint sets containing pyrite and some molybdenite trend northwesterly and northeasterly with 45 to 60-degree northward dips. These intersecting flatter joint sets give rise to rusty stain on many of the outcrop faces.

Locally 'high grade' pods with spectacular coarse molybdenite crystals up to 4 centimetres in size are found in or near rocks of map unit 2. These zones are small in size and erratically distributed. They consist either of quartz-rich layered pegmatite a few metres to a maximum of 12 metres in size and much smaller bodies of spherical, zoned pegmatite with biotite-rich rinds or, rarely, quartz-sericite-rutile-molybdenite greisen. One pegmatite locality west of the peak contains layered pyrrhotite-bearing calc-silicate rock that is presumably derived from calcareous xenoliths.

Quartz veins are not common and no breccia of consequence has been recognized. Some fractures have vuggy crystalline quartz linings with or without molybdenite and/or pyrite. Many of the massive quartz veins contain molybdenite and less commonly K-feldspar, magnetite, and traces of fluorite. Rock alteration is unobtrusive and that which occurs is generally argillic-type related to fracture zones and faults.

A MODEL FOR 'CASSIAR MOLY' DEPOSIT

The 'Cassiar Moly' prospect is not like the typical Cordilleran stockwork or porphyry-type molybdenum deposits. Nonetheless, it is becoming increasingly evident from ongoing work both there and at the nearby Storie molybdenum deposit, that this style of deposit has economic merit and importance. This type of molybdenum environment can be called the 'dry,' fracture-related, alaskite-pegmatite type.

These deposits occur in shallow settings in the roof zone or in cupolas of small batholithic intrusions, in this case the Troutline Creek quartz monzonite (Panteleyev, 1980). Evidence for high level emplacement includes the following:

- (1) Large-scale subhorizontal textural and possibly compositional layering (that is, flat-lying contacts of major map units 1, 1A, and 1B).
- (2) Abundant inclusions and xenoliths of granitized metasedimentary and calc-silicate rocks; a large marble-skarn roof pendant was mapped 4.6 kilometres to the northwest (Panteleyev, 1980).
- (3) Abundance of: porphyritic, Rapakivi, and granophyric textures, miarolytic cavities, and sheeted, curvilinear joints.

It appears that magma was emplaced in a single episode, then underwent normal fractional crystallization. The extensive development of Rapakivi texture with albite mantling perthite phenocrysts reflects solidus-solvus shifts caused by changes in water pressure within the cupola zone during crystallization. These disequilibrium conditions may have occurred as a result of emplacement of the steep dyke-like bodies of map unit 2. The dykes represent residual melts of near minimum granite melt composition that were segregated and quenched by influx into zones of dilation. Consequently, contacts are intergradational with the megacrystic country rocks and there are crosscutting finer grained alaskitic rocks. There is no evidence of any other more forceful pressure release, such as venting or piercement of the subhorizontal layers in the cupola zone by younger intrusions.

Quenching of residual fluids to produce alaskites resulted in synchronous deposition of disseminated rosettes and flakes of molybdenite in the fine-grained rocks. Elsewhere, concentration by diffusion of volatiles from interstitial fluids produced local pockets of vapour saturation that resulted in crystallization of pegmatite, greisen pods, and also weak mineralization in early formed fractures, joints, and faults. The amount of volatiles evolved was relatively small and too limited to cause brecciation, hydrofracturing, extensive quartz vein stockworks, quartz flooding, or widespread rock alteration. The impact of meteoric water also was too limited in the granitic mass to cause any significant late-stage argillic or phyllic alteration.

In summary, the potential of this type of geological setting and style of molybdenum mineralization might be underestimated because this type of mineralization could be an expression of leakage from a zone of volatile concentration at depth. If such volatile entrapment exists, the potential for significant volumes of mineralization is enhanced. Hopefully this and other lithogeochemical studies will help to discriminate between potentially productive versus barren intrusions.

Useful comparisons between the setting of the Cassiar molybdenum deposits might be made with similar molybdenum deposits at Questa, New Mexico (Carpenter, 1968), Newfoundland (Whalen, 1980), and in the Grenville province (Vokes, 1963).

ACKNOWLEDGMENTS

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REFERENCES

- Campbell, D. D. (1968): Cassiar Molybdenum Property, Geological Summary Report, *B.C. Ministry of Energy, Mines & Pet. Res.*, Assessment Report 1700.
- Carpenter, R. H. (1968): Geology and Ore Deposits of the Questa Molybdenum Mine Area, Taos County, New Mexico, in Ore Deposits of the United States, Vol. 2, J. D. Ridge, editor, *AIMME*, pp. 1328-1350.
- McClintock, J. (1979): Report on Cassiar Molybdenum Property, *B.C. Ministry of Energy, Mines & Pet. Res.*, Assessment Report 7206.
- Panteleyev, A. (1979): Cassiar Map-Area (104P), *B.C. Ministry of Energy, Mines & Pet. Res.*, Geological Fieldwork, 1978, Paper 1979-1, pp. 51-60.
- (1980): Cassiar Map-Area (104/P), *B.C. Ministry of Energy, Mines and Pet. Res.*, Geological Fieldwork, 1979, Paper 1980-1, pp. 80-88.
- Vokes, F. M. (1963): Molybdenum Deposits of Canada, *Geol. Surv., Canada*, Economic Geology Report 20, 332 pp.
- Whalen, J. B. (1980): Geology and Geochemistry of the Molybdenite Showings of the Ackley City Batholith, Southeast Newfoundland, *Cdn. Jour. Earth Sci.*, Vol. 17, pp. 1246-1258.