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STORIE

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THE CASMO DEPOSIT:

A Geological Overview of a Late Cretaceous Molybdenite Deposit in Northern British Columbia

ABSTRACT

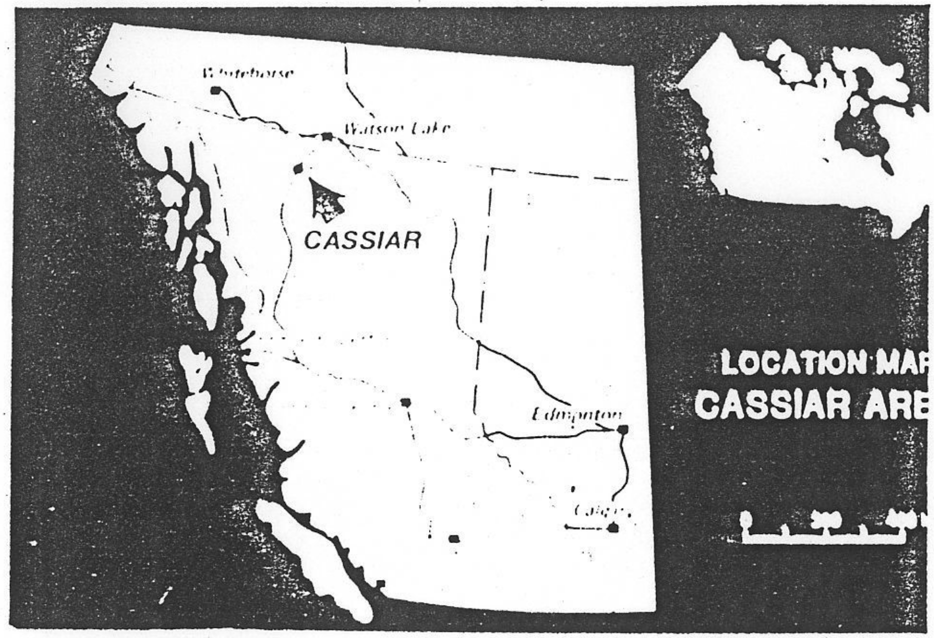
The Casmo molybdenite deposit is located six kilometres south-east of Cassiar in Northern British Columbia and was discovered in the early 1950's. New Jersey Zinc Exploration optioned the property in 1964. From 1964 until 1968 New Jersey Zinc completed approximately 7,000 metres of diamond drilling. In 1971 Levana Exploration optioned the property and drilled an additional 960 metres. The ore reserves in 1971 were 50.6 million tonnes at a grade of 0.123% MoS_2.

The property lay dormant from 1971 until 1979 when Shell Canada Resources optioned the property from New Jersey Zinc. To date, Shell has completed 8,500 metres of diamond drilling and has increased the reserves to 100 million tonnes at a grade of 0.130% MoS_2.

The deposit is hosted by the Cassiar Stock, a 72 MYR quartz monzonite intrusion of the Cassiar Batholith. Mineralization is fracture controlled and hosted in quartz-pyrite fracture fillings.

The deposit exhibits many of the fingerprints associated with classic molybdenite systems. Work carried out to date suggests, however, that Casmo may represent a different style of molybdenite system.

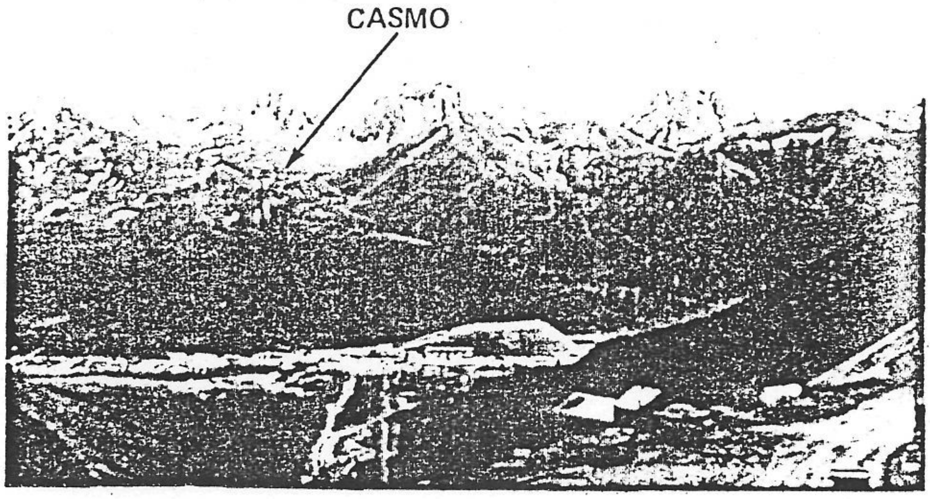
Analogies? - Ruby Ck - flat-lying
- Logtung (+Fl, Be, W)



SLIDE 1 - B.C. LOCATION MAP

The Casmo molybdenite deposit is situated six kilometres southwest of the asbestos mining town of Cassiar in Northern British Columbia, at an elevation of approximately 1,550 metres.

Cassiar is 600 kilometres from tidewater at Prince Rupert, British Columbia and 160 kilometres from the Alaska Highway at Watson Lake, Yukon Territory. A two lane, all season gravel and pavement highway connects Cassiar to both Stewart and Watson Lake.

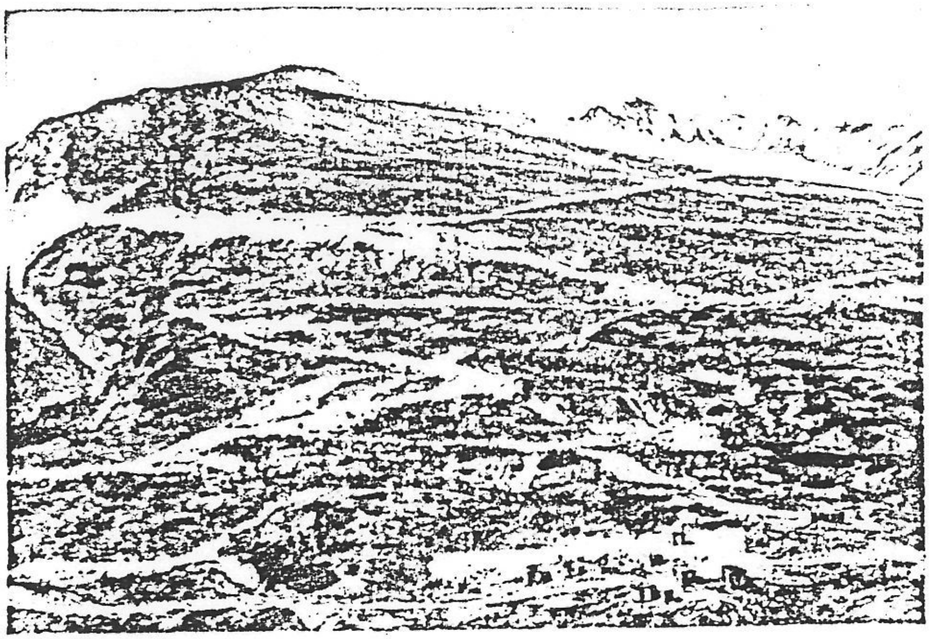


SLIDE 2

This is a view looking south toward Casmo near the Cassiar Asbestos open pit.

The Casmo property is located here and is accessed by a four-wheel drive road.

The town of Cassiar is in the foreground.



SLIDE 3

This is a view of the Casmo property looking west.

Molybdenite mineralization at Casmo was first discovered by prospecting during the early 1950's.

The New Jersey Zinc Exploration Company optioned and began the first important exploration of the property in 1964.

From 1964 to 1968 approximately 7,000 metres of diamond drilling was completed by New Jersey Zinc.

At the end of 1968, the drill indicated reserves were 34 million tonnes at a grade of 0.120% MoS_2.

In 1971, Levana Exploration, a subsidiary of Cyprus Mines, drilled 960 metres in four holes and projected the drill indicated plus inferred reserves to 50.6 million tonnes at a grade of 0.123% MoS_2.

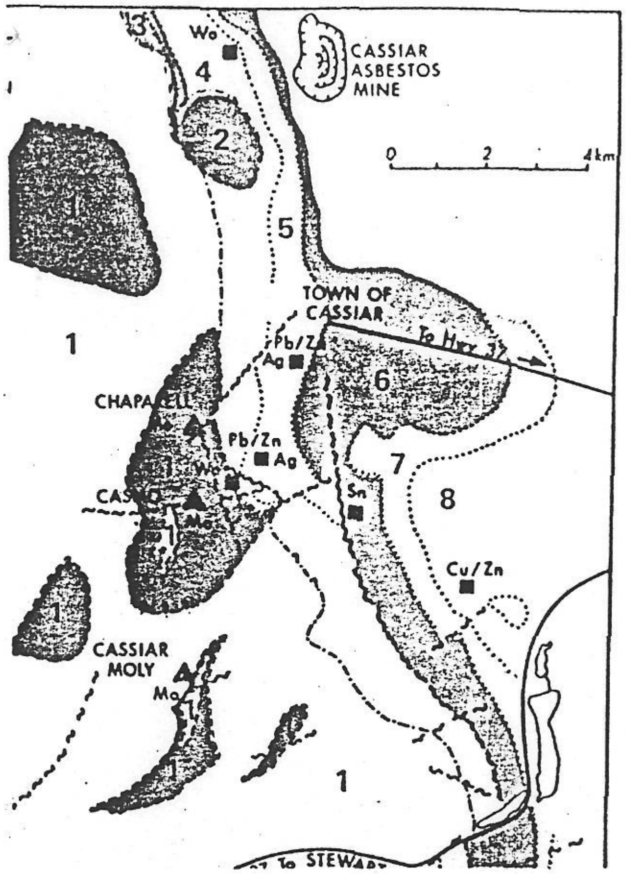
The property lay dormant from 1971 until 1979 when Shell Canada Resources entered into an option agreement with New Jersey Zinc.

Shell drilled 2,000 metres in 1979 and increased the grade to 0.137% and the drill indicated reserves to 51 million tonnes. During 1980 Shell drilled an additional 6,500 metres.

The drill indicated reserves now stand at 100 million tonnes at a grade of 0.130% MoS_2.

The deposit ~~has~~ been drilled to a vertical depth of 300 metres.

There is no evidence to date suggesting higher grade material beneath the presently known mineralization.



1 CRETACEOUS: CASSIAR STOCK
2 CRETACEOUS: CONTACT STOCK
3 PROTEROZOIC: GOOD HOPE GROUP - CARBONATE AND SLATE
4 LOWER CAMBRIAN: ATAN GROUP - QUARTZITE
5 LOWER CAMBRIAN: ATAN GROUP - CARBONATE
6 CAMBRIAN: KECHIKA GROUP - ARGILLITE, PHYLLITE
7 ORDOVICIAN: SANDPILE GROUP - DOLOMITE
8 MISSISSIPPIAN: SYLVESTER GROUP - GREENSTONE, ARGILLITE

Map: After A. Panteleyev, B.C.D.M. Paper 1978-1.

SLIDE 4 - LARGE SCALE REGIONAL GEOLOGY

This is a regional geological map of the Cassiar Area. (North is toward the top of the slide).

The Cassiar Area falls within the Omenica tectontic belt of the Canadian Cordillera.

The Casmo deposit is hosted by the Cassiar Stock.
The stock is emplaced along the eastern margin of the Cassiar Batholith.

The Cassiar Batholith lies to the west of this map and is mainly quartz monzonite and granodiorite, dated at 102 MYR.

The Cassiar stock is 32 x 13 kilometres in area, and elongated north/south. It is a 72 MYR old quartz monzonite intrusion, with an older coarse grained, quartz monzonite outerzone, a middle zone of medium to coarse grained quartz monzonite and a younger core of fine grained quartz-feldspar porphyry. The stock dips steeply to the east and shallowly to the west.

On its eastern contact, the Cassiar stock has intruded a proterozic to upper paleozoic shelf sequence of Carbonate, Clastic, and Volcanic rocks that make up the western limb of the McDame Synclinorium. These rocks are regionally conformable, strike northwesterly and dip to the east.

Within the thermal aureole of the stock east of Casmo, the Cambrian Atan Group carbonate member (Shown in blue) is host to several Ag-Pb-Zn replacement veins developed along east/west structures which are thought to be related to the molybdenite bearing system.

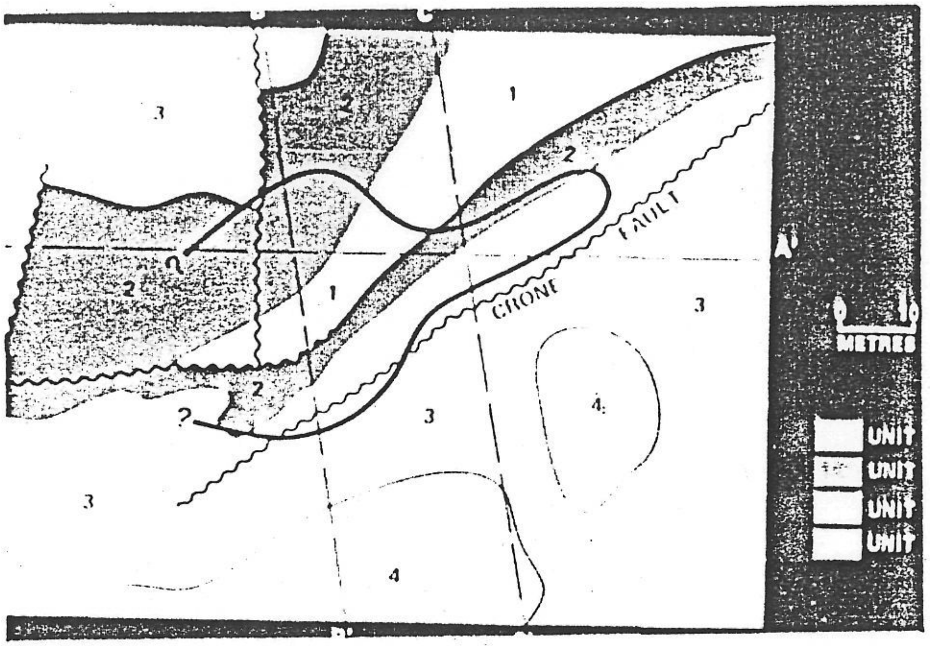
One occurrence is situated within a north/south fault zone at the Atan/Kechika Contact and contains 1% Sn.

Two other molybdenite occurrences are situated near Casmo, the Chaparell Showing and the Cassiar Moly Property.

Cassiar Moly lies approximately 6 kilometres south of Casmo and is similar to Casmo however no significant tonnage has been outlined on the property to date.

The Chaparell Showing is a small molybdenite bearing pegmatite lense, north of Casmo.

A small scheelite bearing garnet-diopside skarn is present along the eastern margin of the property.



SLIDE 5 - PROPERTY GEOLOGY (PLAN)

This is a geological plan of Casmo. This line is greater than 0.070% MoS_2 contour at 1400 m. North is toward the top of the slide and the horizontal distance across the map area is 2.0 km.

Four main units have been recognized on the property, each is distinguishable on the basis of color, grain size, and phenocryst type.

Unit 1 is the part of the megacrystic outerzone of the stock.

Unit 2 outcrops as an elongate body 5 km long and 1 km wide that trends northward paralleling the eastern border of the stock. The Casmo, Cassiar and Chaparell occurrences all occur proximal to the eastern margin of Unit 2.

Unit 3 outcrops mainly along the eastern margin of Unit 2 and has a more limited distribution than Unit 2.

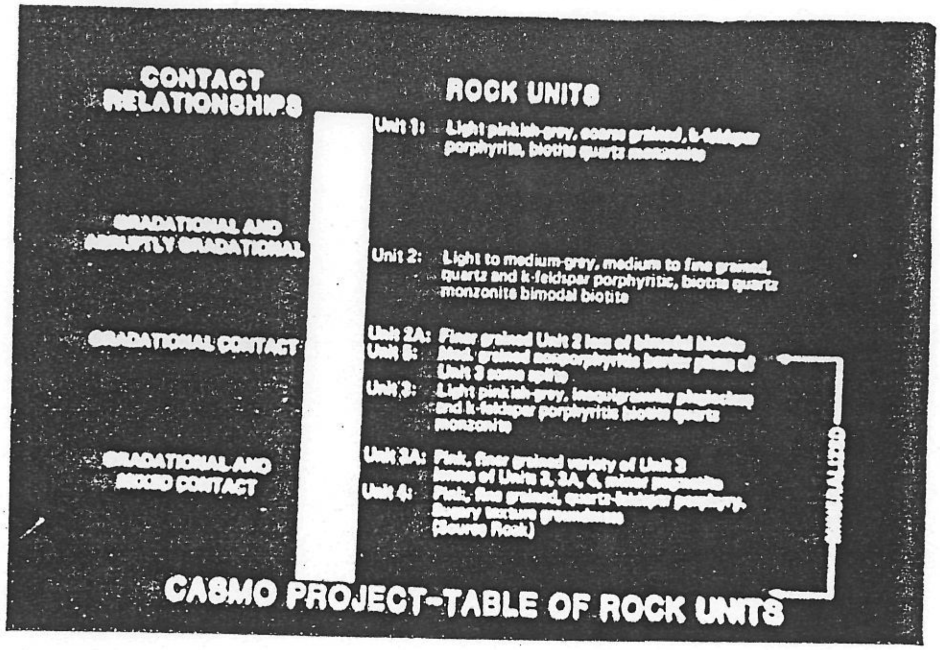
Unit 4 outcrops usually within areas of Unit 3.

Units 2 and 3 form the medium grained middle zone of the stock and Unit 4 the fine grained core.

Information gathered primarily from drill core, indicates that contacts between units are thin, "abruptly gradational", zones over a few metres with some sharp contacts and are in some cases a zone of mixing.

Units 1, 2, and 3 appear to be sheet-like bodies dipping shallowly to the west, steeply east. Unit 4 has an erratic distribution at surface, and at depth, and is mushroom shaped in cross-section with a northwestward dipping upper contact.

The property is covered by a thin mask of glacial till, outcrop density is about 5%.



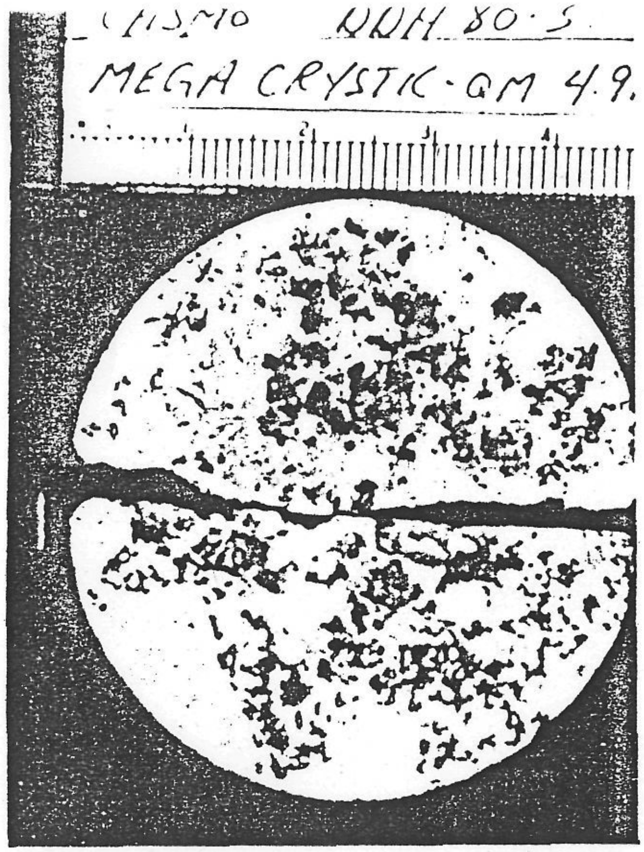
SLIDE 6 - TABLE OF INTRUSIVE UNITS

This table shows the assumed relative ages of the four units and their contact relationships as observed in drill core.

Grain size generally decreases from Unit 1 to Unit 4 as does phenocryst size and amount. Sharp, chilled contacts are very rare and cases where one unit has crosscut another or has stoped into another have not been observed.

Units 2A, 5, and 3A are sub-units occurring along contacts.

The following nine slides are photographs of polished core pieces of the units. The bottom half of each sample has been stained for k-feldspar.



SLIDE 7 - SLIDE OF UNIT 1

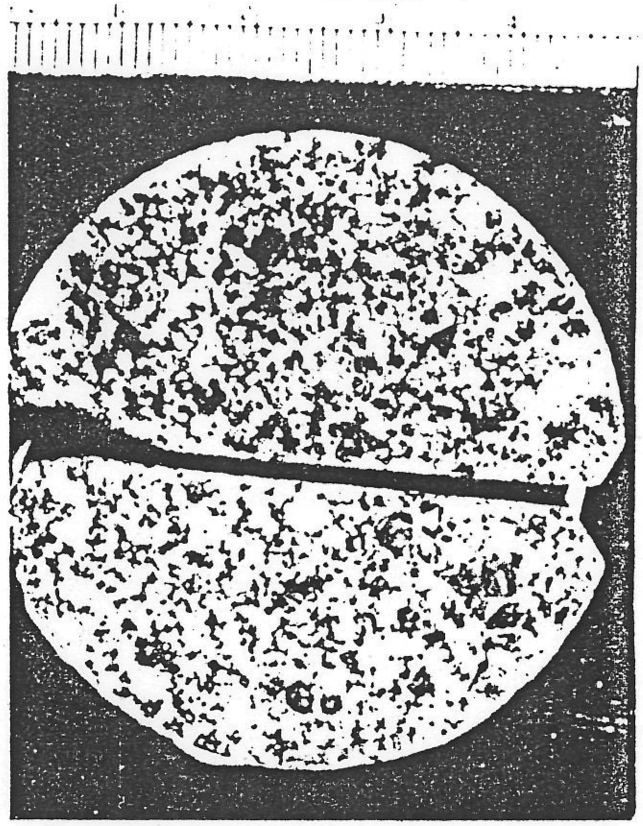
This is an example of Unit 1.

Unit 1 is a light pinkish-grey, coarse grained, k-feldspar porphyritic, biotite quartz monzonite. Potash feldspar phenocrysts are 1 cm - 2 cm with some megaphenocrysts as large as 4 cm.

Quartz occurs as phenocrysts 5 mm to 2 cm in size; and are actually aggregates of smaller quartz grains.

Biotite occurs as 2 mm to 3 mm flakes and clusters of flakes.

Plagioclase phenocrysts are 5 mm to 1.5 cm.



SLIDE 11 - SLIDE OF UNIT 3

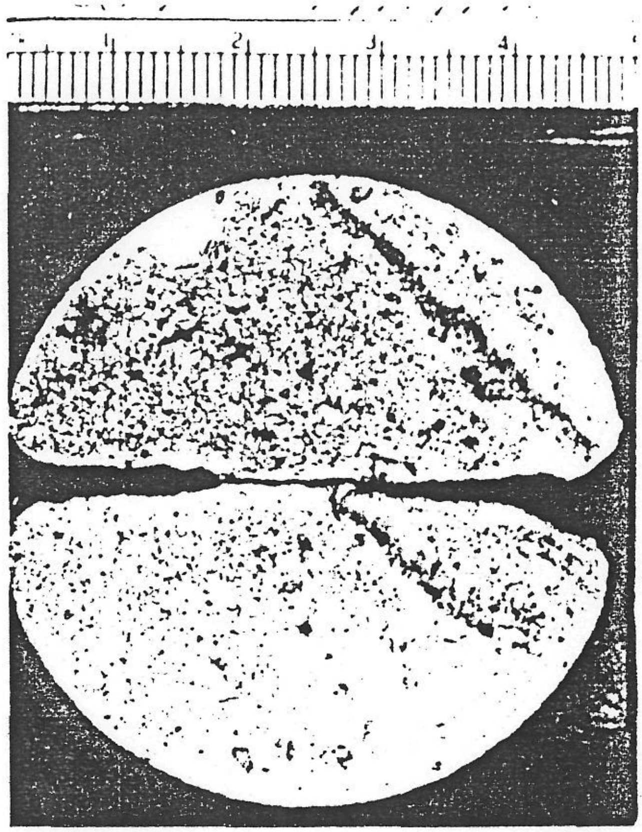
This is an example of Unit 3.

Unit 3 is a light pinkish-grey, inequigranular, plagioclase and k-feldspar porphyritic, biotite, quartz monzonite.

Unit 3 varies from weakly porphyritic to porphyritic.

Quartz up to 1 cm, k-feldspars up to 3 cm and plagioclase from 5 mm to 1 cm make up the phenocrysts.

Biotite occurs as 1 mm to 3 mm flakes and clusters of flakes.



SLIDE 13 - SLIDE OF UNIT 4

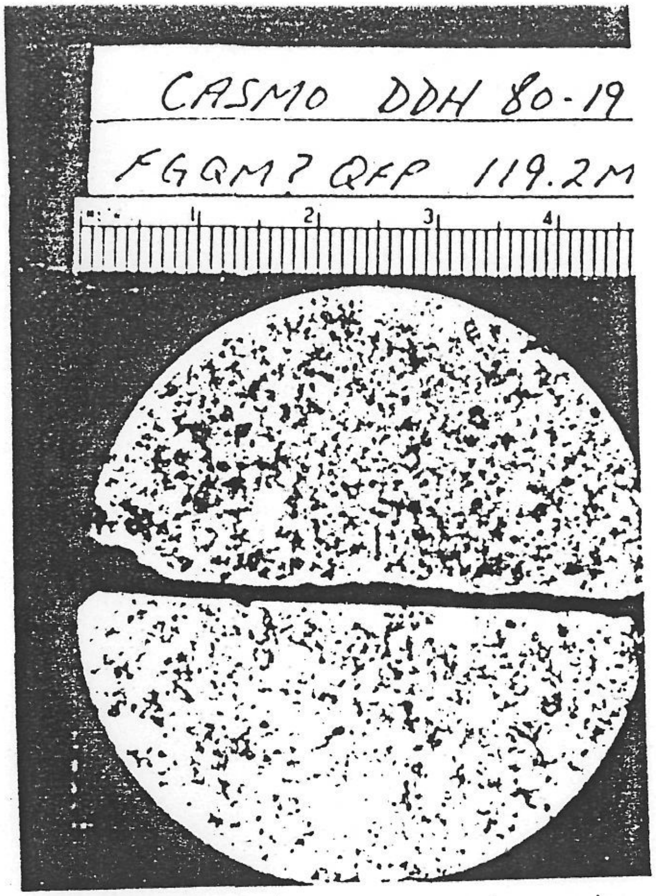
This is an example of Unit 4.

Unit 4 is a pink, fine grained, quartz-feldspar porphyry.

The groundmass has a distinct sucrosic texture imparted by rounded quartz grains less than 1 mm in size. K-feldspar phenocrysts are 2 mm to 5 mm in size and scarce plagioclase phenocrysts are 1 mm to 3 mm.

The groundmass is less than 1 mm.

Biotite is an occasional accessory mineral.

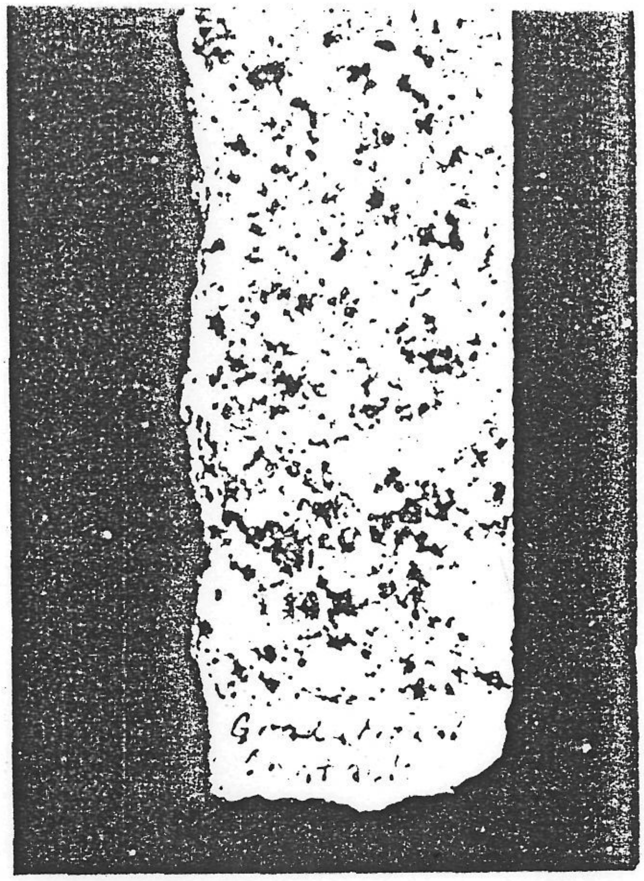


SLIDE 14

This is a coarser grained example of Unit 4.

The contact between Unit 3 and Unit 4 is gradational and often a zone of mixing.

Unit 3 becomes distinctly pink, has a finer grained groundmass, more pink k-feldspar, and fine grained quartz grains. The groundmass approaches the sugary texture of Unit 4.



SLIDE 15 - GRADATIONAL CONTACT

This slide is an example of the gradational 3 - 3A contact with Unit 3 at the bottom of the slide and Unit 3A in the upper portion. In mixed contact zones Units 3, 3A, and 4 interfinger over several metres.

Petrographic studies have shown that all plagioclase is either albite or oligoclase, zoned, with more calcic rims and more sodic cores. In Unit 1, the plagioclase cores are An_{34} with An_{18} rims and in Unit 4 the cores are An_{18} with An_0 rims.

Potash feldspar are perthite and microcline.

The large potash feldspar phenocrysts of Units 1 and 2 are perthite with polysynthetically twinned plagioclase exsolution lamelle in a microcline host.

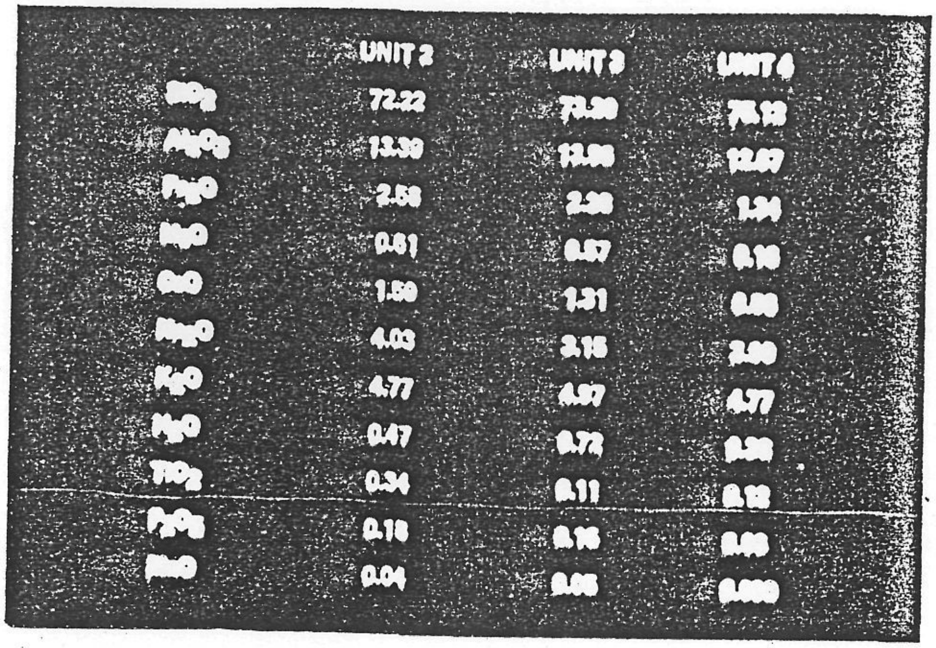
Matrix and small potash feldspar phenocrysts are microcline without the exsolution lamelle.

Quartz phenocrysts are usually clusters of grains rather than individual crystals. Matrix quartz appears as granophyric intergrowths with feldspars in Unit 1. Overall, quartz becomes finer grained from Unit 1 to Unit 4.

Biotite is usually corroded except where armoured by quartz and feldspar, indicating early crystallization.

Accessory minerals include apatite, zircon, sphene and rulite. Primary muscovite is present as isolated flakes and as minor secondary overprints on magmatic minerals.

Molybdenite occurs as a trace fine grained accessory mineral in Units 1 and 2.



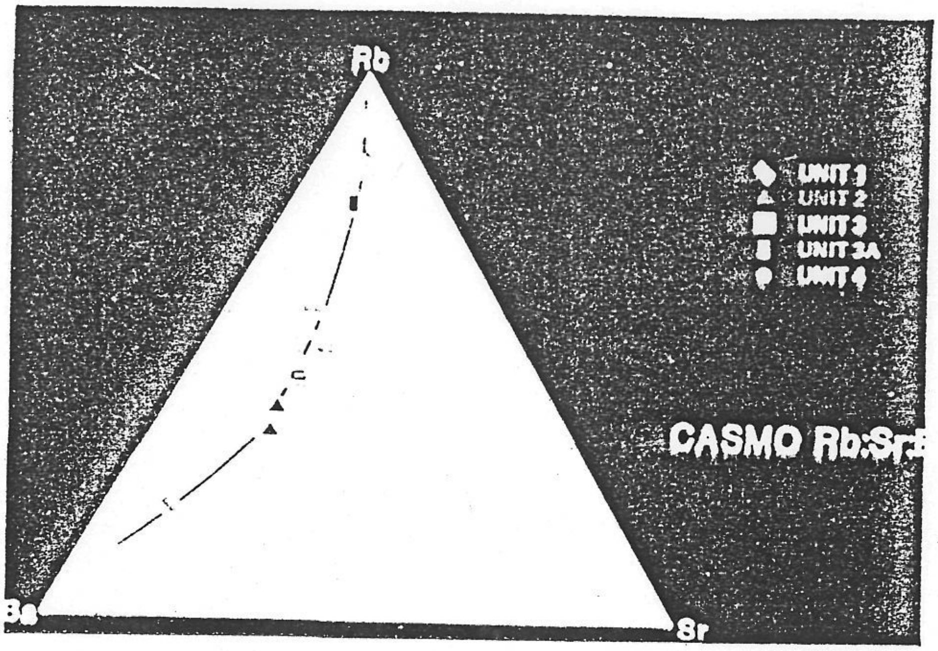
	UNIT 2	UNIT 3	UNIT 4
SiO_2	72.22	[illegible]	75.12
Al_2O_3	13.30	[illegible]	12.67
Fe_2O_3	2.58	[illegible]	1.34
MgO	0.61	0.57	0.16
CaO	1.50	1.31	[illegible]
Na_2O	4.03	3.15	[illegible]
K_2O	4.77	4.97	4.77
H_2O	0.47	0.72	[illegible]
TiO_2	0.34	0.11	0.12
P_2O_5	0.18	0.16	[illegible]
MnO	0.04	0.05	[illegible]

SLIDE 16

This table of the major oxides shows the units to be slightly high in silica and within the chemical bounds of quartz monzonites.

The silica content becomes enriched from Unit 1 to Unit 4.

Alumina is depleted from Unit 1 to Unit 4 as are iron, manganese, calcium and sodium.



SLIDE 17 - Rb:Sr:Ba TERNARY DIAGRAM

This ternary plot illustrates a high degree of magmatic-hydrothermal fractionation from Unit 1 to Unit 4.

All Casmo rocks appear to be part of a highly fractionated system. They are enriched in uranium, beryllium, niobium, slightly enriched in tin, with spotty enrichment in tungsten and fluorine.

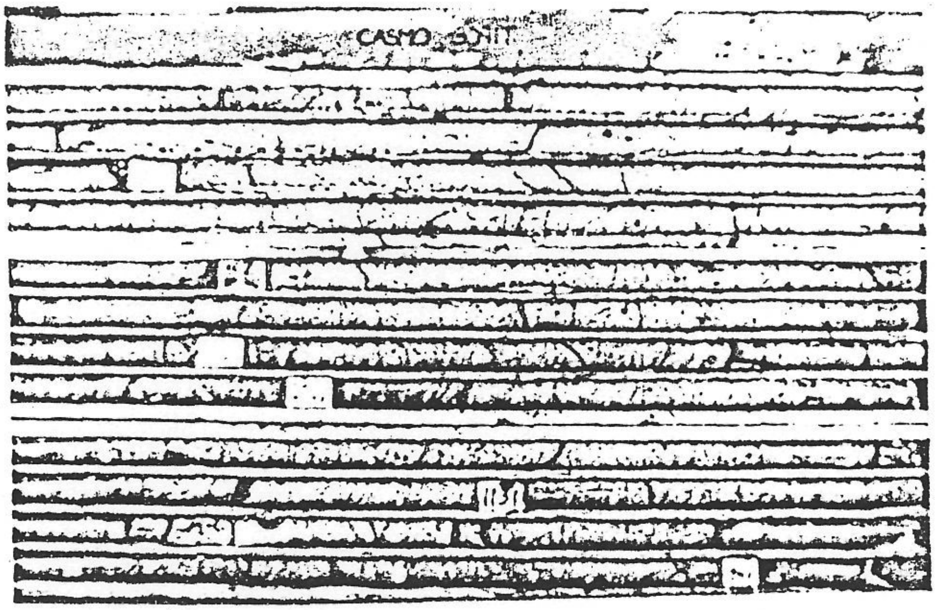
Casmo rocks lack strong development of typical alteration patterns usually associated with most molybdenite deposits.

Pervasive k-spar flooding, silicification, kaolinization, and the widespread development of secondary biotite, and muscovite are absent.

Three alteration assemblages have been recognized:

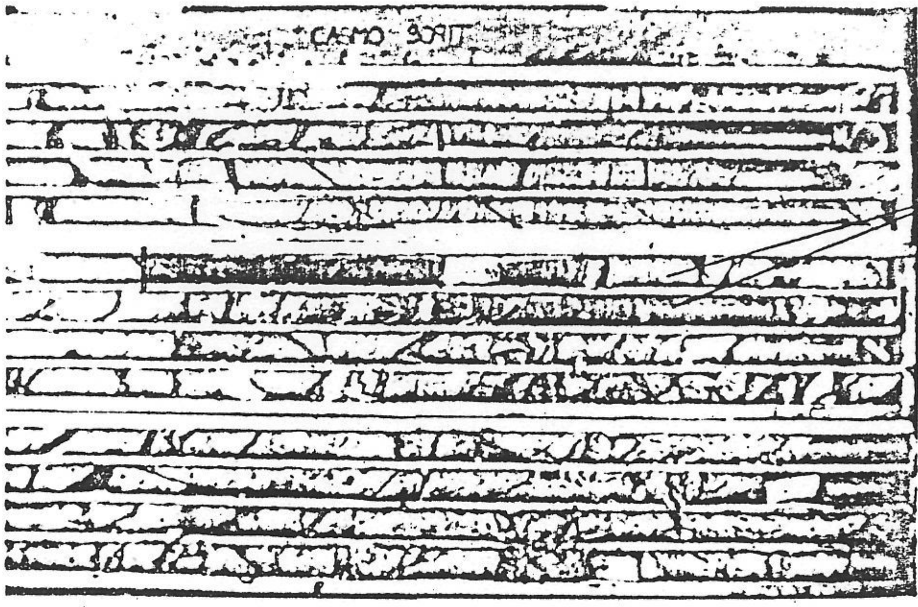
1. Widespread weak propylitic alteration;
2. Erratic argillic alteration;
3. and Fracture controlled potassic alteration.

All rocks are weakly but pervasively propylitized. The feldspars are lightly dusted with clay minerals, sericite and local clots of epidote and carbonate. Biotite is partly replaced by muscovite and opaque minerals. Plagioclase zoning is unaffected.



SLIDE 18 - 80-14 BOXES 61 - 63

This is an example of weak argillic alteration. The rock is essentially unaltered. Plagioclase feldspars have been replaced by illite, and are bright white with a soft texture.

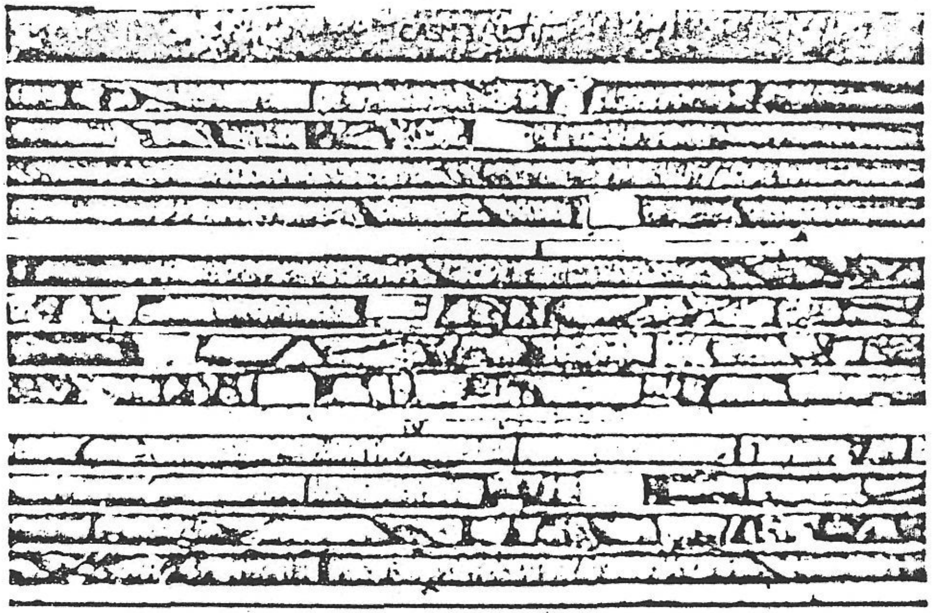


SLIDE 19 - 80-13 BOX 43 - 45

This slide is an example of strong argillic alteration shown in the lower two boxes. Here the rock is totally altered to a dark green color. Plagioclase feldspars are dark green and either hard or soft in texture. Biotite is absent and the potash feldspars are light grey and dusted with kaolinite.

As argillic alteration increases the plagioclase feldspars become greener in color due to an increased of montmorillonite over illite; the plagioclase can have either a hard or soft texture. Biotite becomes increasingly corroded toward stronger alteration zones and its breakdown is thought to contribute to the production of montmorillonite. Potash feldspars are only affected in cases of strong alteration.

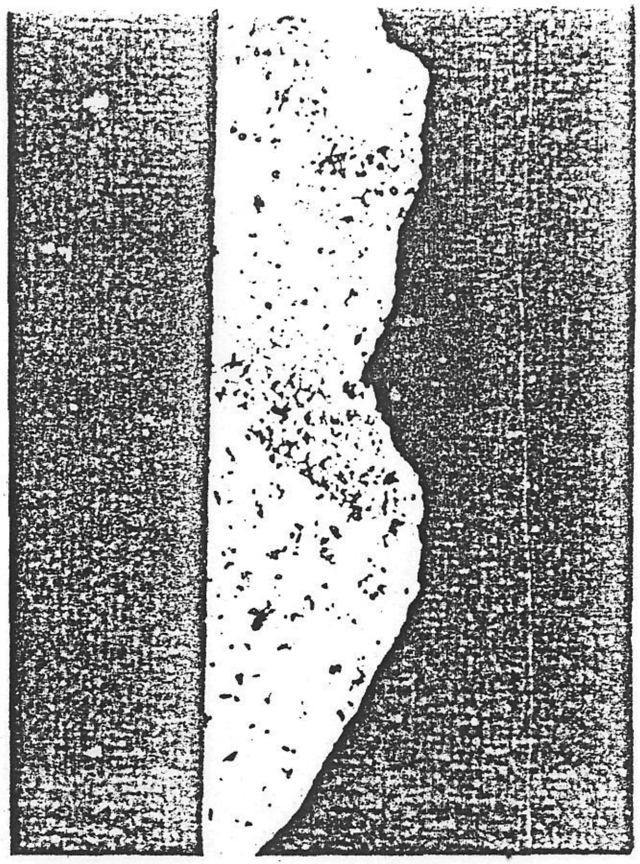
Strong argillic alteration is usually associated with fault zones and mineralization.



SLIDE 20 - DDH 80-7 BOXES 19 - 20

K-spar envelopes along fractures, are the most common form of potassic alteration.

The fractures are less than a millimetre to a few mm thick, with some reaching vein size up to 10 cm thick and are the most important carrier of molybdenum in the mineralized zone, and occur with or without quartz, green muscovite, and pyrite.



SLIDE 21 - ROCK SLIDE: SHARP ALTERATION CONTACTS

A notable feature of the argillic alteration are the extremely sharp contacts, shown here.

Zones of strongly argillized rocks can occur over several metres, bounded by fresh rocks tens of metres thick with no evident related faulting.

In a general sense the alteration increases towards mineralization but there is no one to one correlation. Thick zones of strong argillic alteration bounded by unaltered rock, and zones of dense hairline fracturing with potassic envelopes both occur in barren rock, and ore grade mineralization often occurs within unaltered rocks.

There is no pyrite halo perse as interstatial pyrite is generally weak or absent even in well mineralized zones. Pyrite bearing fractures are, however, characteristic of the deposit and are common throughout mineralized and unmineralized rocks.

There is no discernable alteration pattern visible at surface.

SLIDE 22 - SUMMER VIEW OF CASMO

This is a view of Casmo, looking west.

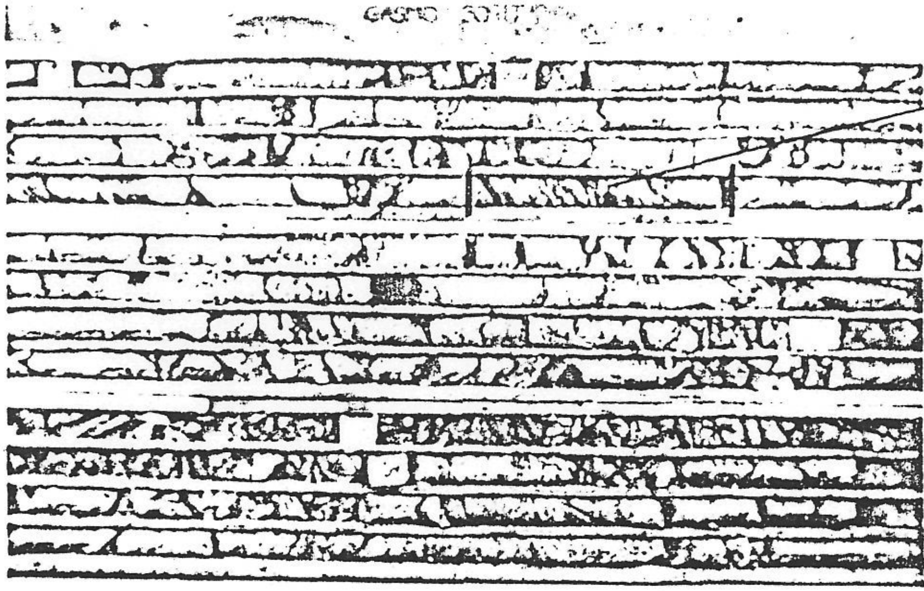
The Crone fault, expressed by the steep-sided gully - here - traverses the property at 070^{0} and is the dominant structural feature of the deposit. Movement is normal with a dip slip component of 100 metres with the north side thrown down with respect to south.

Another strong easterly trending fault north of the Crone Fault and two northerly trending faults are inferred by the juxtaposition of Units 2 and 3 at surface.

Numerous fault zones were encountered in drill holes appearing as broad shear zones or zones of horsetail faults which are difficult to correlate between holes.

Unit contacts appear to be favoured sites for movement.

The deposit lies within a strong zone of jointing that strikes 075^{0} and dips about 55^{0} north.

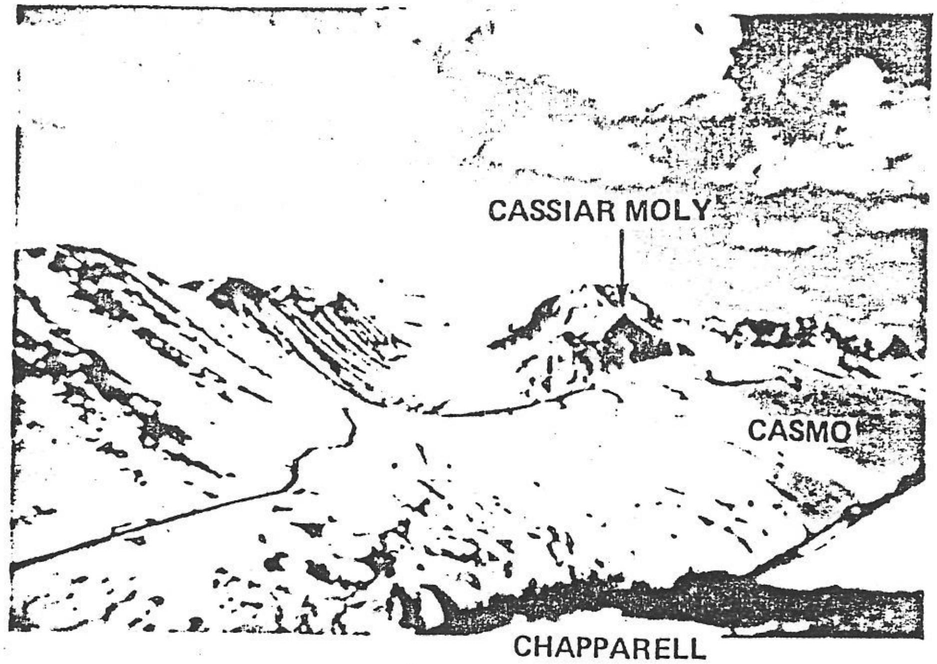


SLIDE 23 - 80-16 BOX 60 - 62

Post mineralization movement has severly disrupted some mineralized zones producing gouge seams with grey clay bands containing mechanically dispersed molybdenite grains.

Many molybdenite bearing fractures are either slickensided or shattered.

Most of the rocks exhibit some degree of structural alteration. A mild crushed texture is common where grain boundaries have been broken and displaced less than a millimetre imparting a gritty texture to the rock.

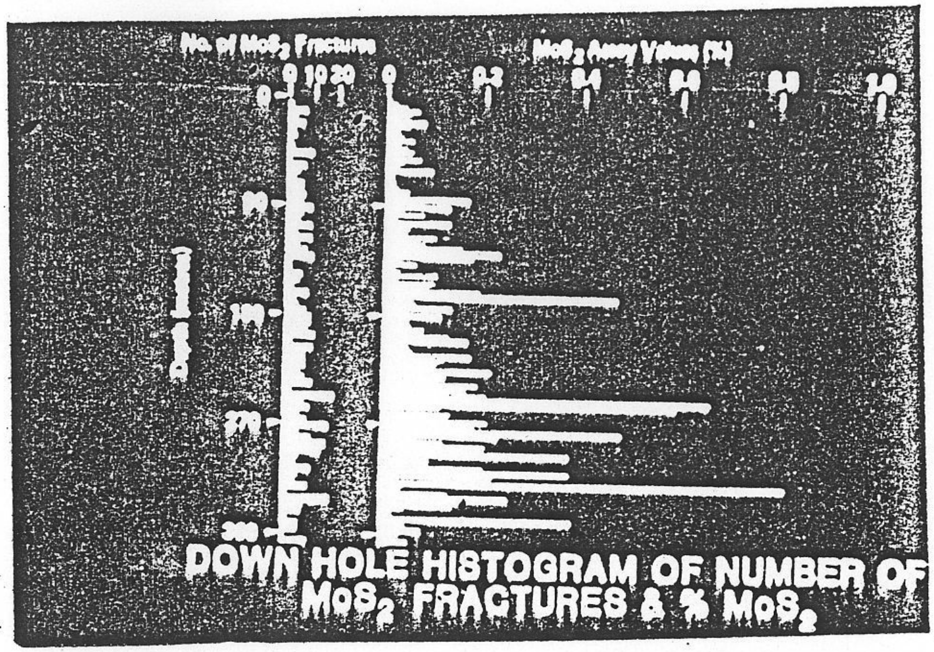


SLIDE 24 - WINTER SHOT OF CASMO LOOKING SOUTH

This slide is looking south from the Chaparell Showing.

The north/south alignment of the molybdenite occurrences along this visible trough suggests some structural control for the emplacement of the Cassiar stock.

The north/south alignment of moly occurrences and the localization of sulphide replacements along east/west faults in the Atan Carbonates, as well as strong east/west jointing indicates a fundamental structural role at Casmo.



SLIDE 25 - HISTOGRAM OF MoS_2 FRACTURES

This slide shows the fracture controlled nature of the mineralization.

Molybdenite is the only valuable mineral present. It occurs as selvages along quartz and quartz-pyrite bearing fractures and, to a minor degree, as moly paint on dry fractures, smears along slip surfaces, grains along slickensided fractures, and in rare cases as disseminated 2 - 3 mm rosettes.

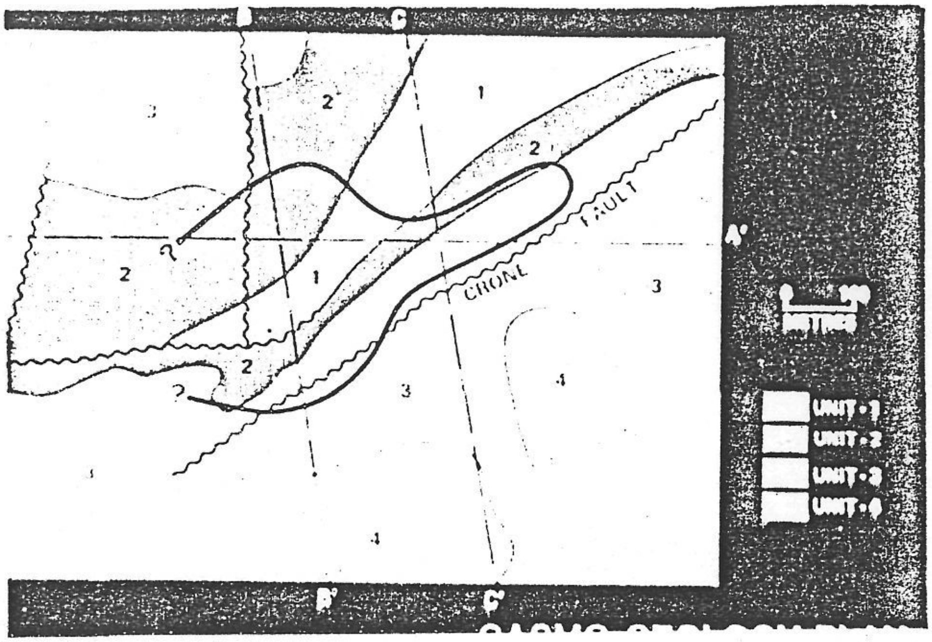
Some molybdenite is also present as microscopic grains interstatial to muscovite and altered feldspars in Units 1 and 2, but does not make ore grade.

Fractures are usually less than a mm to a few mms thick, with some several cm thick.

Three fracture orientations have been recognized on the property: east strike shallow dip north; east strike steep dip south and north strike vertical. East striking, shallow northward dipping fractures predominate and carry the major portion of the mineralization.

Some fractures carry green muscovite, purple fluorite, and beryl. These fractures have random orientation distribution and usually do not contain molybdenum.

No stockwork quartz exists at Casmo.

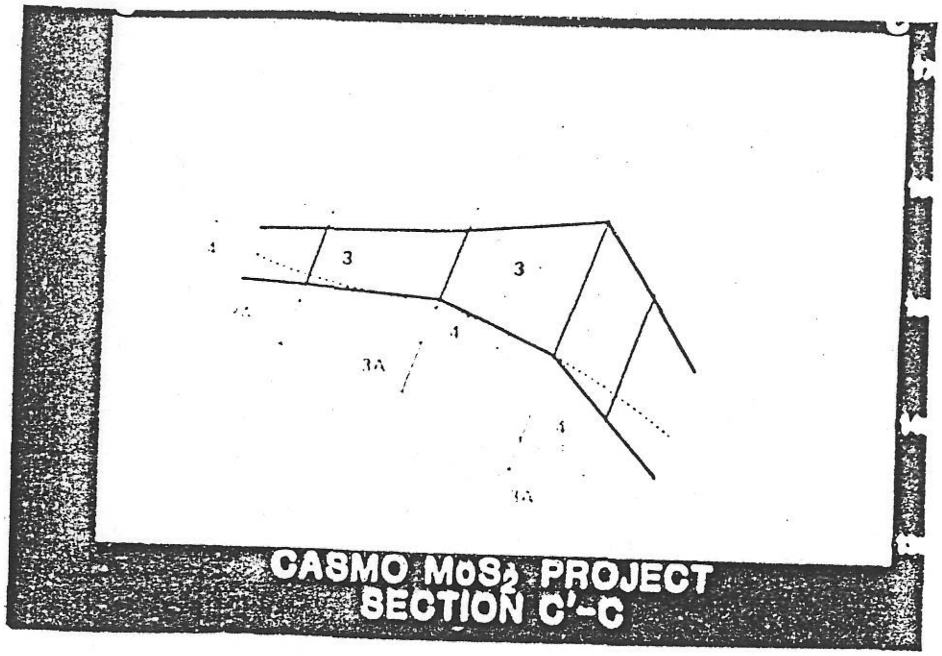


SLIDE 26 - GEOLOGICAL PLAN

The dark outline is > 0.07% MoS_2 contour of the mineralization projected to surface from 14,00 metre level.

Drilling has traced the mineralization over a length of 1,000 m, a width of 500 m, and a thickness of 20 to 100 m. It forms a blanket that is thin, flat lying, and only a few metres below the surface on the eastern and southern portions of the property. The deposit becomes thicker and plunges gently to the west, and thickens and dips sharply to the north. The rough axis of the deposit rakes to the northwest.

The deposit is essentially buried except for a few scattered small MoS_2 bearing fractures and quartz veins. A large molybenite bearing quartz vein outcrops in the Crone Fault gully.



SLIDE 27 - SECTION C1 - C

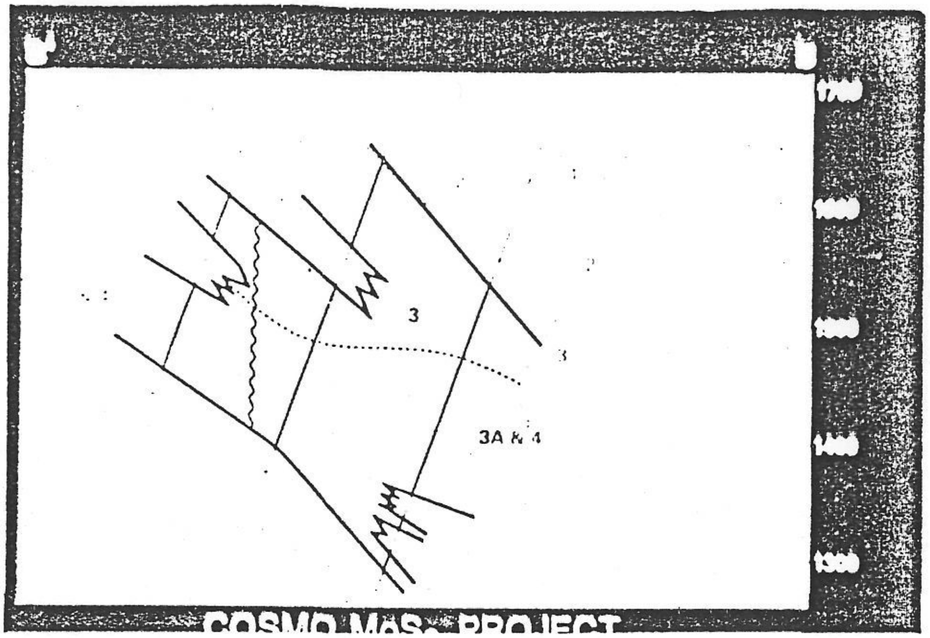
This is an eastern section throughout the deposit. North is to the right.

The spacing between drill holes is 100 metres.

The light orange area is > 0.07% MoS_2.

While the mineralization does not show a preference to a particular rock type, ore grade mineralization occurs proximal to Units 3 and 4.

The sharp drop to the north, north of hole 80-8 may be due to faulting.

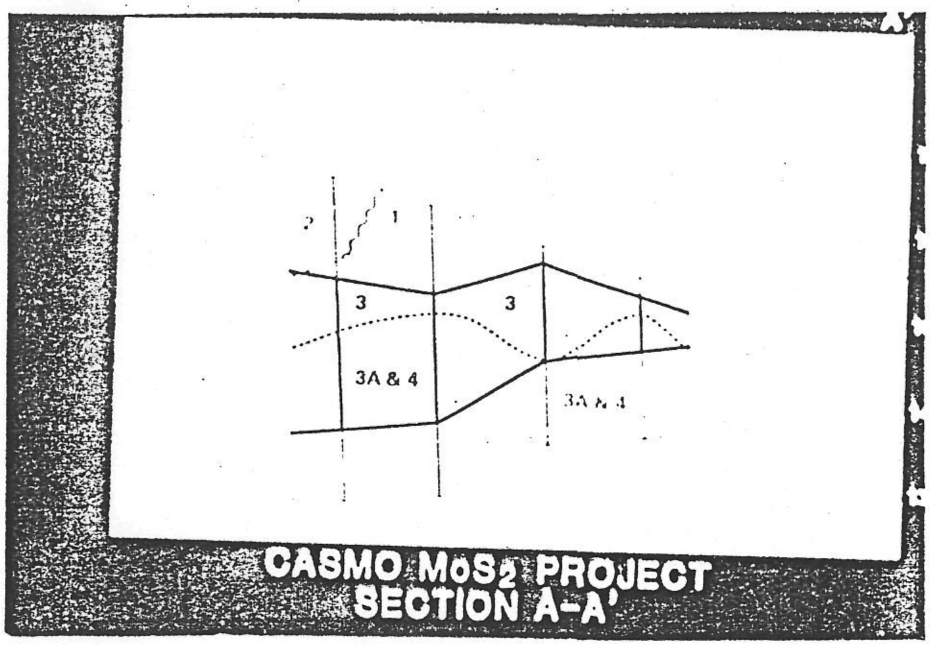


SLIDE 28 - SECTION B1 - B

The Crone Fault is shown on this western section.

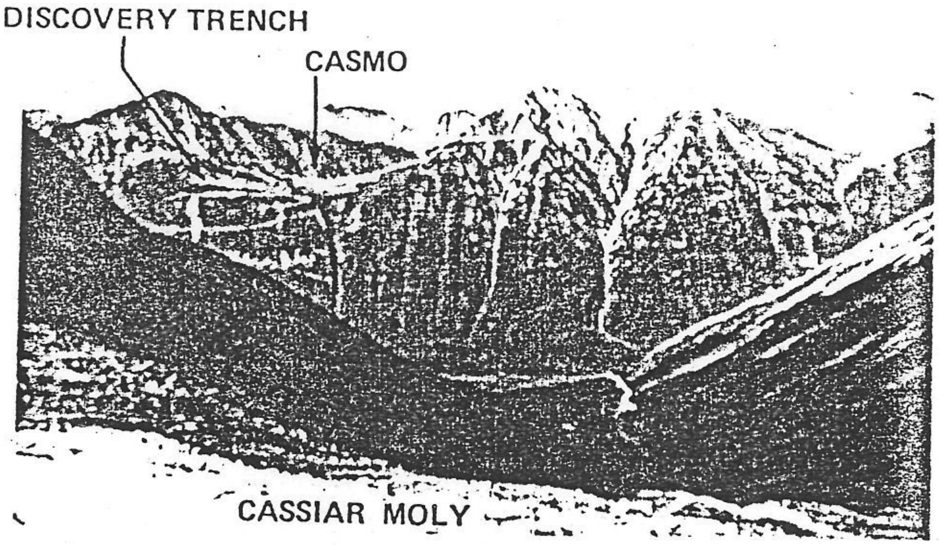
This north/south section again shows that the mineralization tends to follow the unit contacts.

Mineralization does not occur uniformly throughout the deposit, as shown by the sections, but rather as several northward dipping tabular sub-zones of higher grade mineralization separated by lower grade material.



SLIDE 29 - SECTION A - A1

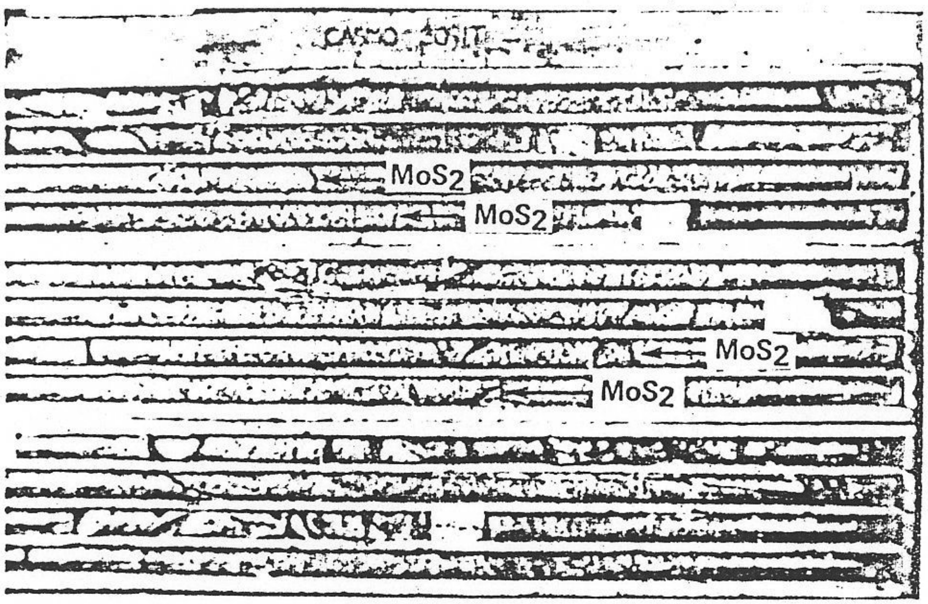
This E - W section shows the flat lying nature of the deposit to the west, following the trend of the Unit 3 - 4 contact.



SLIDE 30 - LOOKING NORTH FROM CASSIAR MOLY

This is a view looking north toward Casmo.

The ore body has been drilled to a vertical depth of 300 metres and is open to the north and west and east and is cut off to the south by this steep sided valley. The mineralization lays closest to the surface, along the slope, where it was exposed in a discovery trench.

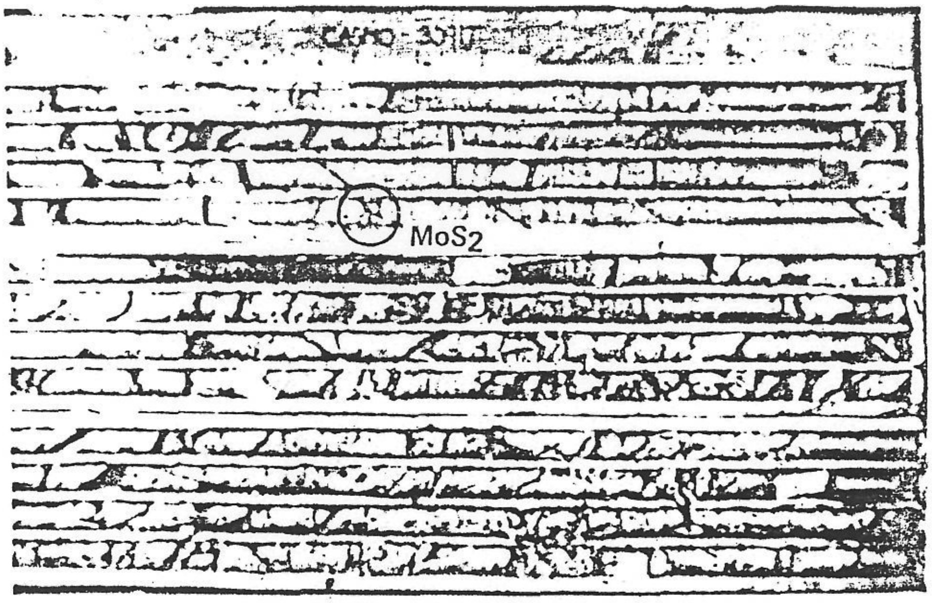


SLIDE 31 - 80-17 BOX 43 - 45

This slide shows the typical style of mineralization in a relatively unaltered Unit 3.

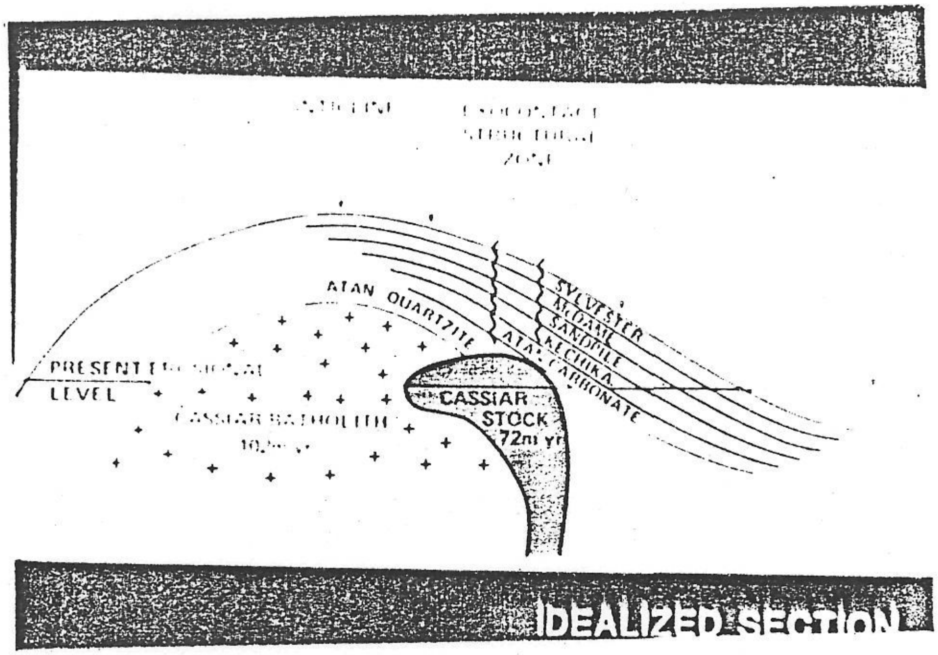
The molybdenite occurs as selveges along thin quartz pyrite fracture fillings some of which have potassic envelopes.

Note that the moly-bearing fractures are parallel, only in rare instances do they cross cut.



SLIDE 32 - 80-13 BOX 43 - 45

This slide more clearly shows the molybdenite selveges. Again note the sharp alteration contacts.



SLIDE 33 - IDEALIZED EAST/WEST SECTION

This is an east/west section summerizing, in a schematic manner, the general geological picture at Casmo.

The Cassiar Batholith is shown to have intruded along the axis of an anticline west of the McDame synclinorium. The Cassiar Stock may have intruded as a sill-like body along the eastern outer contact of the batholith, possibly localized along the structurally weak flex point between the anticline and syncline.

The Cassiar Stock is approximately 30 million years younger than the batholith, suggesting that is is a separate intrusive event, rather than a late stage differentiate of the batholith.

SLIDE 35

Casmo lacks many of the characteristics of classic molybdenite deposits. There is no evidence of forceful intrusive events; such as breccias, breccia pipes, dyke swarms, strong stockwork quartz, and crosscutting contacts between units. Alteration patterns are not consistant and their development overall, is weak.

Casmo rocks are however, chemically similar to other deposits in that they are part of a highly evolved system.

THANK YOU.

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