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MEMORANDUM:

To: S.J. Tennant/R. Shklanka   Date: May 31, 1982

From: R.H. Pinsent   File: V-164

RE: REGIONAL GEOLOGY AROUND ADANAC MOLYBDENUM DEPOSIT

Introduction:

The attached 1:50,000 scale regional geological map of the Adanac Area, N.E. of Atlin (104N), is based on published and assessment report data and on extensive field work carried out in 1980 and 1981. The map also shows the distribution of the principal mineral deposits in the area and the locations of Fipkie (heavy mineral) sample sites.

The following somewhat speculative observations can be made about the regional geology and the nature of the mineral deposits.

Regional Geology:

The rocks are broadly speaking divided into the same units identified by J.D. Aitken in 1959. In the present case, however, the map has been simplified to the extent that meta-sedimentary, meta-volcanic and meta serpentinitic rocks have been compiled under a single heading, Cache Creek Group, (Unit 1). The Fourth of July batholith, by contrast, has been subdivided into two phases; quartz monzonite (Unit 2) and diorite (Unit 3). The Adanac quartz monzonite stock (Unit 4), although it is also known to be composite, has not been subdivided. The late Tertiary to Quaternary Volcanics are designated as Unit 5.

The geological map shows that Cache Creek Group rocks of Pennsylvanian and Permian age were intruded and hornfelsed by the Fourth of July batholith in Jurassic time. Both of the above were subsequently intruded by the Adanac stock, which is an off-shoot from the Surprise Lake batholith, in the Late Cretaceous (71 m.a.). The whole assemblage was subsequently eroded to approximately its present level prior to the development of Late Tertiary to Quaternary volcanic centres. These developed on and around Volcanic and Ruby Creeks.

The geology of the Adanac area is strongly influenced by a series of normal faults, spaced 1-3 km. apart, which follow the Adera trend. These faults are vertical and they strike NE-SW. Block movement on the fault set appears to have caused considerable vertical readjustment. A second, presumably earlier, fault set runs approximately N-S, through the molybdenum deposit at Adanac.

Mineral Deposits:

1. Adanac Molybdenum Deposit

The Adanac Molybdenum deposit consists of a circular zone of molybdenite mineralization around a dome of sparse quartz monzonite porphyry. The deposit is completely encased within a composite stock of quartz monzonite which has been uplifted and eroded close the the level of the mineralization. "The high-grade trough" at Adanac pobably owes its existance to a local improvement in ground preparation resulting from movement on a N-S oriented structure immediately to the east of the mineralizing dome. Movement on this structure (the Boulder Creek fault) evidently post-dated the initial stage of development of the Adanac stock but pre-dated (a) the final intrusion of the dome itself, (b) the formation of lenses of aplite and breccia which are restricted to the trough, and (c) the period of active mineralization.,

Approximately half of the molybdenum deposit has been removed by movement on the Adera fault and the subparallel Molly Lake fault. The combined fault system probably down throws to the north as quartz monzonite immediately to the north of the fault appears to be a chilled variety similar to that found in small windows of outcrop surrounded by diorite in the floors of several of the cirques to the north of the Adera fault. These windows probably represent the tips of cupolas above a large, diorite covered, extension of the Adanac stock which has been down dropped to the north. There is a good chance therefore that the missing part of the deposit may be found by deep drilling north of the fault.

The early coarse-grained, quartz monzonite to the south of the Adera fault has a strong fracture parallel to it. This is not as well developed in the sparse porphyry of the dome itself, perhaps indicating that a relatively early structure has been reactivated to form the Adera fault after the development of the dome and the mineral deposit. The presence of a crowded porphyry dyke and a major quartz-wolframite vein (Black Diamond) parallel to the Adera Fault system supports the contention that the NE-SW structural style partially predates intrusion of the porphyry dome and the period of mineralization.

The Black Diamond vein system was evidently inactive and partially exposed by the time the Ruby Mountain Volcano erupted at the end of the Tertiary. The Adera Fault system has not been active since the last period of valley glaciation at the head of Ruby Creek.

2. Volcanic Creek Molybdenum Deposit

The Volcanic Creek molybdenum deposit consists of a large area of gossanous diorite which displays a weak quartz-carbonate vein stock work. The system is locally weakly mineralized with coarse grained molybdenite. The gossan appears to be developed along an axis subparellel to the Adera fault set. It decreases in intensity with increase in elevation and appears to be in the process of becoming unroofed. Th gossanous diorite is bounded by an Adera-type fault to the NW, which juxtaposes Fourth of July diorite and quartz monzonite, and by the northern extension of the Boulder Creek fault to the east. It's eastern contact is with Cache Creek meta-sediment. The junction of these two structures is marked by the Tertiary Volcanic cone on Volcanic Creek. The mineralized gossan appears to be a faulted block of pyritic halo comparable to that found around the Adanac deposit. The centre of mineralization responsible for the intense hydrothermal activity at the head of Volcanic Creek is probably a similar, buried, sparse porphyry stock. It evidently does not outcrop. The most likely place to find the stock would be along the Boulder Creek structure, either underlying the gossanous diorite or the equally gossanous meta-sediment.

3. Steamboat Mountain Molybdenum Prospect

The Steamboat Mountain molybdenum showing is located on a plateau of Fourth of July quartz monzonite 600 m above the floor of the Fourth of July Creek. It consists of local, scattered, veins of quartz with coarse molybdenite. The rock is relatively unaltered and only weakly deformed. There is no sign of a younger sparse porphyry intrusive centre or the development of a pyritic halo. The soil Mo anomaly located on the east slope of the mountain may indicate (a) improved mineralization at depth, (b) the presence of a mineralized pipe (see Red Mountain) or (c) down hill dispersion of coarse molybdenite released from the scattered quartz veins noted on top of the plateau.

4. Red Mountain Molybdenum Prospect

The Red Mountain molybdenum prospect consists of a small pipe of weakly mineralized, highly altered, crackle brecciated, Fourth of July quartz monzonite. The pipe is surrounded by strongly sheet fractured, gossanous, quartz monzonite. The slabby nature of the breccia fragments in the pipe suggests a collapse origin for the structure. The surrounding quartz monzonite is only weakly altered and there is no sign of a major quartz vein stockwork. The pipe appears to have developed along a plane of structural weakness which is subparallel to the Adera fault. The depth to the source of the mineralization in the pipe is unknown.

The plane of structural weakness on Red Mountain is itself strongly altered and weakly mineralized. Soils on the slope below the structure are erratically, weakly, anomalous in Cu, Pb, Zn and Ag. No visible mineralization was found in the fault.

5. Atlin Ruffner Silver Mine

Th Atlin Ruffner Silver deposit consists of a mineralized fracture on the west slope of Mt. Vaughan. The fracture is one of several which strike approximately east-west and dip 50-70 degrees north. This appears to represent the main fracture direction in this fault block. The fractures cut Fourth of July quartz monzonite. Characteristically they show evidence of extremely intense deformation and brecciation prior to the injection of dykes of "lamprophyre" or "andesite". These were subsequently refractured and the whole system was later mineralized. The vein material consists of silver bearing galena, sphalerite, arsenopyrite, pyrite, chalcopyrite, pyrrhotite, tetrahedrite, ruby and native silver. The gangue consists of quartz, carbonate and gouge. One of the veins (Ruff) is associated with minor molybdenite which occurs in quartz veinlets in the adjacent quartz monzonite.

6. Mt. Leonard Mineral Deposits

Several mineral showings are known on Mt. Leonard, north of the Aderafault. These include three showings in Adanac quartz monzonite exposed in windows in the diorite floors of north facing cirques, where mineralized, theporphyry is very sericite-clay altered and gossanous and it contains abundant leached quartz viens. There is very little sulphide visible but the porphyry is anomalous in Pb, Zn, Ag, F $\pm$ As and traces of W. In one locality the porphyry is intensely fractured and veined with barren quartz. These veins are oriented parallel to the Adera Fault.

Although Sn and W are not recorded as being major constituents of the veins to the north of the Adera fault, they are both abundant constituents of heavy mineral samples 133 and 143.

7. Boulder Creek (north) Mineral Deposits

The Adanac quartz monzonite to the south of the Adera fault is also cut by a system of narrow (.5-2.0 m) quartz veins which strike approximately parallel the fault. The quartz veins are accompanied by weak to intense sericite-clay alteration and local greissenization of the surrounding quartz monzonite. The veins characteristically contain quartz, wolframite andarsenopyrite. Locally they may also contain molybdenite, fluorite, sphalerite, tetrahedrite and/or galena. The Black Diamond W vein is characteristic of the vein set.

Tungsten is also found in a pocket of mineralized Cache Creek skarn adjacent to the Adanac stock on the west side of Boulder Creek. Metasomatized diopside-garnet skarn, derived from calcareous sediment and limestone, contains massive, locally banded, lenses containing pyrrhotite with disseminated chalcopyrite, scheelite and minor tetrahedrite. The skarn locally contains trace amounts of tin.

8. Boulder Creek (South) Mineral Deposits

The mineralization changes in character towards the south end of Boulder Creek but it retains a similar structural style. Cache Creek Group low-grade meta-sediments, meta-volcanics (andesites) and altered meta-serpentinites are cut by narrow veins (1 cm - 1 m) which contain white quartz and carbonate, with minor pyrite, galena and traces of free gold. The veins strike approximatly N45 degrees E, parallel to both the Adera fault system and a major joint set. Mineralized quartz veins in ultramafic rocks are enveloped by zones of intense carbonitization.

Discussion:

The regional geology around the Adanac molybdenum deposit seems to be controlled by a set of normal, vertical block faults which strike NE-SW. These faults were probably active before, during (?) and after emplacement of the Adanac stock. They probably represent a high-level response to a period of unlift and erosion which started in the Late Jurassic.

The Adanac stock, south of the Adera fault, probably represents a subvolcanic magma chamber which periodically vented above a Cretaceous unconformity causing the magma to chill and giving rise to a number of discrete and recognizable rock types in the chamber below.

No extrusive rocks of equivalent age and composition are known in the vicinity of Adanac but the Sloko Group volcanics (albite trachyte, albite rhyolite, dacite, andesite, basalt and related pyroclastic strata) southwest of Atlin Lake may be related. These Late Cretaceous or Tertiary Volcanics unconformably overlie reformed Jurassic sediments of the Laberge Group. The Au deposit at the Engineer Mine on Taku Arm is in fractured Laberge Group sediment below the pre-volcanic unconformity and it may well be related to a Volcanic Centre on Engineer Mountain.

This raises the question of the origin of the placer gold at Atlin. The gold bearing, fracture controlled, vein system at the south end of Boulder Creek may represent the root of a subvolcanic system similar to that at the Engineer Mine. This has all but been eroded away, leaving the Au bearing placers.

The Adanac stock appears to extend to the north of the Adera fault, below a cover of diorite. The cupola tips are weakly mineralized (Pb, Zn, Ag) but there is no obvious sign of a major associated hydrothermal centre mineralized with molybdenum at depth. The mineralization has not, however, been fully evaluated. The Volcanic Creek molybdenum deposit is part of a large, pyritic, hydrothermal system which seems to be partially controlled by the Boulder Creek and Adera fault systems. In this case an underlying porphyry cupola has yet to be identified.,

The Steamboat and Red Mountain molybdenum prospects so far lack both a recognizable hydrothermal centre of any size and evidence for porphyry intrusion. These two showings may be connected to a very deep centre of mineralization or one covered by glacial debris in the Fourth of July Creek drainage.

Conclusions:

The geology around the Adanac deposit is strongly influenced by a set of NE-SW trending block faults. These faults are similar to those found controlling the Trout Lake Graben and the stucture of the Fire Mountain molybdenum deposit. The faults control the level of erosion and the type of mineralization exposed in each block. Uplift and erosion in the Cretacous was probably followed by the intrusion of the Adanac stock and probably also by contemporary explosive subareal volcanism dated at $\pm$ 71 m.a. Mineralization occured during the waning stages of the plutonic event. Subsequent rapid upward movement on the Adanac block resulted in the complete erosion of the volcanic cover and the underlying stock to the level of the molybdenite mineralization

The map shows that the Adanac stock extends to the north of the Adera fault, under a thin cover of Fourth of July diorite and quartz monzonite. It also shows that the molybdenum mineralization extends beyond the known extent of the underlying stock. The conclusion is that the Fourth of July Creek area has excellent potential for molybdenum deposits but, on the basis of the data available, these are probably either very deeply buried or covered by thick glacial overburden. In either case they will be difficult to find and exploit.

If the origin of the placer gold at Atlin is a volcanic-related epithermal system similar to that found at the Engineer Mine located on Taku Arm to the southwest, then there seems little likelihood of finding an extensive near-surface epithermal deposit in the vicinity of the placer camp. In the absence of recognizable Cretaceous Volcanics and an identifiable land surface, it seems likely that the level of erosion is below that required for the rocks to host this type of deposit.

We may, however, be looking at the root zone of such a system; as was suggested by Aitken (1959). The area to the southwest of Atlin, where the hilltops are unconformably covered by Sloko Group Volcanics would seem to be a better area to prospect.

R.H. Pinsent

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