New Afton
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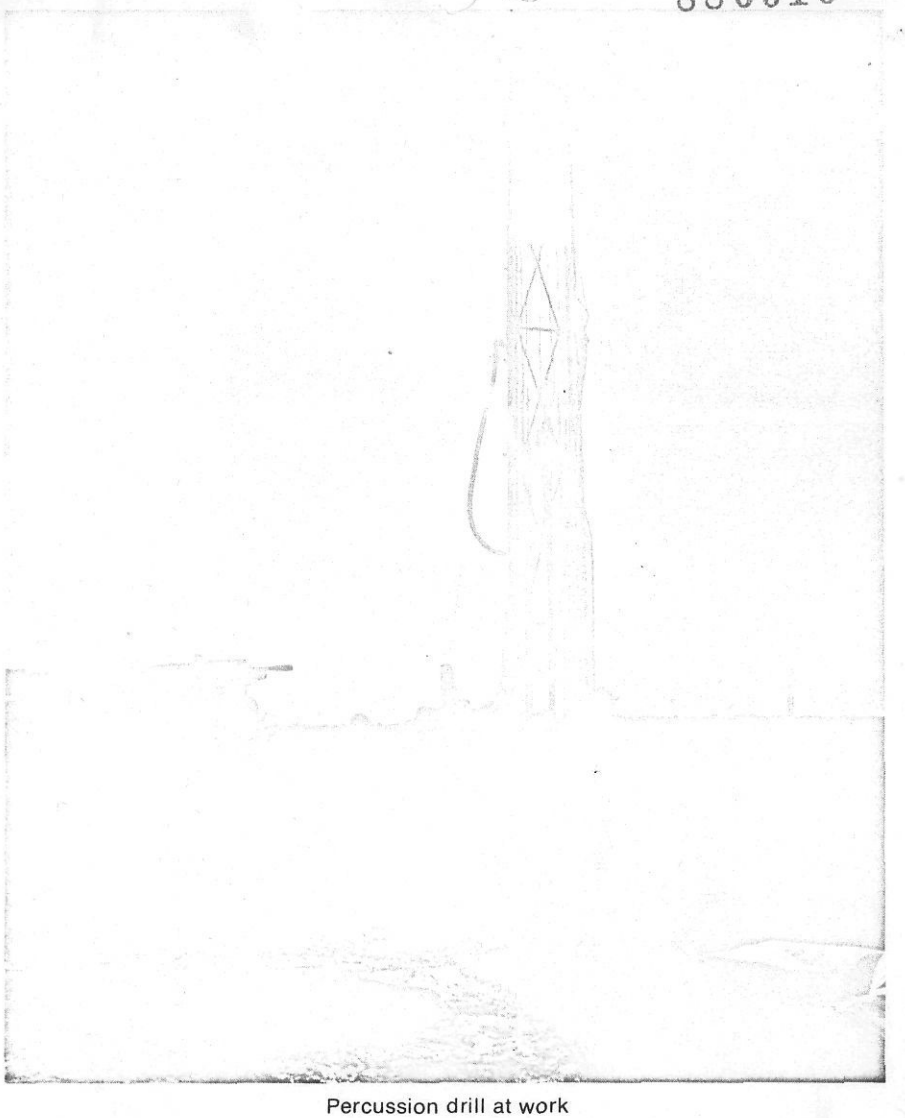

Percussion drill at work

The Afton Discovery

1. ABSTRACT:

Discovery of the Afton orebody in late 1971 — early 1972 caused a boom on the Vancouver Stock Exchange that surpassed all records. Many features of the orebody — location, grade, metal content, etc. are unusal. Control of the property developed into a legal battle between two large Canadian mining Companies. The following article describes what has been found and done to-date. The author is the founder and ex-President of Afton Mines Ltd.

2. HISTORY:

Descriptions of the many copper occurrences in the Kamloops area can be found in the B.C. Minister of Mines Annual Reports. The first reference is for the year 1871, and showings on what is now Afton are first described in the report for 1898. At that time, an English Company excavated a shaft 330 feet deep and many pits and trenches in the Afton Mines area. This shaft was called "Pothook", and much of the later work was centered around it.

The only mines in the Kamloops area that have been worked to any extent are the Iron Mask — 4 Miles East of Afton, and the Copper King — 5 Miles North West of Afton. These produced 180,000 tons of 1.6% copper and 7500 tons of 2.6% copper, respectively. The Iron Mask was equipped with a small mill and ran intermittently from 1903 to 1927.

Axel Berglund, a prospector, staked 8 claims over the Pothook workings in 1949. Mr. Berglund named his claims "Afton" (being "afternoon" in Swedish) and that is the origin of the name of the present company. These were optioned to Kennecott Copper who drilled 12 holes near the shaft in 1952.

Next, Graham-Bousquet optioned the property and staked many additional claims, and did considerable geochemical and geophysical work, in 1956-57. They found a great number of anomalies, but dropped the property after drilling a few of them East of the Afton claims.

Noranda optioned the same area in 1958 and drilled a few very shallow holes on the Afton claims. New Jersey Zinc ran an I.P. Survey in 1960 and detected an anomaly over the Pothook shaft, but did not follow up.

Chester Millar became interested in the Afton claims in 1964, when he was working as a drilling contractor on a nearby property.

After an unsuccessful attempt to get Rolling Hills Copper Mines interested, he got Colonial Mines to commence percussion drilling around the Pothook shaft. This work was abandoned after completing only 11 holes. Mr. Millar then formed a private syndicate to carry on, and staked further claims adjacent to the Trans-Canada Highway. The syndicate was formed in 1965 and drilled another 30 holes and did an I.P. Survey as well as maintaining the payments of $1,000.00 per month to the prospector. These drill results indicated an East-West trending zone of copper mineralization which carried on beyond the drilling area to the West, and extended below the bottom of the percussion drill holes. The I.P. Survey showed a large anomaly, also trending East-West, centered several hundred feet South of the Pothook shaft. This put the Pothook mineralization as found by drilling to lie along the North side of the I.P. anomaly in a position of fairly low readings. Other high I.P. readings were found over magnetite veins which outcropped North and East of the Pothook zone.

A well-known firm of geological consultants were hired to write a report on the property, with the view to obtaining public financing. This was received in 1967, and contrary to Mr. Millar's wishes, recommended drilling nine diamond drill holes on wide spacings related to I.P. highs. A public underwriting was finally completed in 1969, and 5 of the nine holes were drilled in 1970. The results showed that the I.P. anomaly pas-

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A paper delivered to the Vancouver Exploration group, January, 1973.

sing just South of the Pothook copper zone was caused by pyrite disseminated in the intrusive rocks. One hole, located about 3500 feet North-West of the Pothook shaft, in a small I.P. "bulge" on the main anomaly, intersected 170 feet of 0.4% copper in a zone of heavy to massive magnetite veining. The other four holes recommended were not drilled since Mr. Millar considered them wasteful.

Duval Corporation were given the rights of first refusal in return for an up-to-date engineers' report. This report recommended further wide-spaced diamond drilling similar to the first consultants' report.

Quintana Minerals optioned the property in 1970-71 and drilled seventeen percussion drill holes, on wide centers over much of the unexplored parts of the claim area. Nothing was found, and this option expired August 31, 1971.

Afton Mines Ltd. still had $70,000.00 left in the treasury. The Directors decided to abandon the consultants recommendations and to revert back to percussion drilling in areas showing copper mineralization. This work commenced in the first week of September, 1971, and Mr. Millar drilled the first hole of this new series personally, using a home-made drill of somewhat radical design.

Afton drilled seventeen vertical percussion holes, on 100 foot centers and 300 feet deep, during September, 1971. These filled in an area about 400 feet square, and commenced beside the diamond drill hole previously described as being 3500 feet North West of the Pothook shaft. This first set of holes lay just East of a small dry lake, and about 500 feet South of the Trans-Canada Highway. Most of these holes bottomed in ore, and drilling was suspended in order to arrange further financing. Percussion drilling and diamond drilling were re-commenced in November, concurrently with a stock underwriting. The percussion holes were maintained on 100 foot centers, and the diamond drill holes on 400 foot centers. All holes were vertical.

The I.P. Survey of this area has been done with 200 foot electrode spacings, and had indicated an anomaly of fairly small dimensions. A new I.P. SUrvey which utilized 400 foot electrode spacings showed anomalous conditions to extend much further West than hitherto expected. It soon became apparent why this discrepancy in the I.P. Surveys existed. The drilling to the West showed an increasingly thick cover of tertiary sediments capped the ore zone, accentuated by a rise in topography. The percussion drill had increasing difficulty penetrating this cover as it moved Westward. The under-lying mineralized rocks were quite soft, and so rotary drilling was tried and found quite successful. Subsequent rotary and diamond drilling showed that about 300 feet of tertiary sediments capped the ore on the West side of the lake.

During the period September, 1971 until June, 1972, when work was suspended due to litigation, Afton Mines completed 28,778 feet of diamond drilling, 17,475 feet of rotary drilling, and 26,425 feet of diamond drilling. All but three of these holes were vertical, on 100 foot centers, and ranged in depths to 1500 feet.

Much drilling remains to be done. The ore zone has apparent boundaries to the North and East, but is open down-dip (South) and along strike (V). Important tonnages of ore also lie around the Pothook shaft, in a zone similarly open down-dip and to the West.

Chester Millar

One of the more recent success stories in British Columbia mining history has been that of Afton Mines Ltd. near Kamloops. This is the story of its development which, in the main, reflects the dedication and determination of Chester Millar who is responsible for the material printed here.

Mr. Millar was born in Powell River and, after receiving his early education there, went on to the University of British Columbia where he graduated in 1950 with a B.A.Sc. in geological engineering.

His experience since that time has been extensive and varied, starting as engineer in charge of the Crow's Nest Pass Coal Company open pit mine in Fernie in 1950-51. Successively he was engineer in charge of the Argonaut iron mine at Campbell River; project engineer for Dawson Wade & Macco Ltd. on the Upper Cambell hydro project; President, C.F. Millar Limited; Chief Engineer and Project Manager, Campbell-Bennett Ltd.; General Manager Tsimpsean Company (logging) Port Simpson, B.C.; Exploration Engineer and/or Manager for New Jersey Zinc and Rolling Hills Copper Mines.

In 1965 C. F. Millar Limited became the first percussion drilling contractor in Western Canada and was involved in early stages of Gibraltar, Lornex and Similkameen discoveries. In the same year he founded Afton Mines Ltd. and, as this story relates, discovered the main Afton orebody in 1971. He is also the founder of M.B.H. Developments Ltd., and Western Blasting Ltd., sub-contractors at Western Mines Ltd.

3. REGIONAL GEOLOGY

To quote from a Report by Messrs. L.W. Saleken and P.M. McAndless, Geotec Consultants Ltd. April 1972:

"The Afton area is underlain by Upper Triassic Nicola volcanics which have been intruded by a North West trending intrusive mass referred to as the Iron Mask Batholith. The Batholith consists of a coarse-grained gabbro-diorite phase and a finer-grained microdiorite-micromonzonite phase, both of post Upper Triassic age. Occurring as intrusions within the Batholith are a series of picrite basalts. Associated with the Batholith are two post Iron Mask intrusions, the Sugarloaf porphyritic microdiorite and the Cherry Creek trachytelatite porphry and breccia. Middle Eocene Kamloops group volcanics and sediments cap the above rocks. The area has been faulted and glaciated to form its present topography.

Copper mineralization is mainly associated with the Sugarloaf and Cherry Creek intrusions and occurs as veins, stockworks and disseminations. Chalcopyrite and native copper are the principal copper bearing minerals and are commonly accompanied by magnetite, hematite and pyrite. Chalcocite and bornite often occur. Associated alteration is generally propylitic with calcite, epidote, albite, apatite and pink orthoclase commonly occurring. Important local structures include faulting, brecciation and shattering. Favorable regional structures include north west trends and those associated with the emplacement of the post Iron Mask intrusions."

4. DETAILED GEOLOGY:

To quote from a Report by C.W. Bell, Canex Placer Ltd. June 1972:

"The rocks studied range from quartz diorite through diorite and monzonite to syenite. The alteration is generally so intense that the original character of the rocks is not readily discernible.

The presence of nepheline in syenite and monzonite phases of the Cherry Creek intrusive is demonstrated, as for example in sections from diamond drill holes 71-2 and 72-4.

One of the most striking results of the present study is the evidence of pronounced saussuritisation. Breakdown of the feldspars has yielded secondary calcite, epidote and quartz. At the same time, the feldspars have suffered var-

Panoramic view of Afton claims

ious degress of kaolinization.

Chloritization of the ferromagnesian minerals (augite, hornblendes and biotite) is fairly strong and in some sections the mafica are completely altered to chlorite.

Hematite has been observed developing from magnetite and the pink to reddish coloration of the feldspars is due primarily to the presence of myriads of fine inclusions of blood-red hematite. The latter occur as finely microcrystalline granules only detected under high power magnification. One very unusual feature is the discovery of tourmaline in DDH 72-4, at 299', in nepheline syenite country-rock.

Strong suggestions have been made regarding the presence of Nicola volcanics which are mineralized. Drill core examined in the field does include certain sections which are characteristic of andesite and andesite tuff. However, it is well known that andesites and their tuff derivatives are readily altered or dioritized and thus some zones mapped as diorite or microdiorite may easily be derived from metamorphism of andesitic lavas and tuffs of the Nicola group."

5. MINERALOGY:

To quote from a Report by J.D. Lowell, October, 1972:

"Mineralization in the district tends to be spotty, and hydrothermal alteration is neither very intensive nor very extensive as compared with typical porphry copper occurrences. None of the Iron Mask Copper deposits has the combination of mineral assemblages and concentric alteration zoning characteristic of porphyry copper mineralization.

Mineralization is related to open-space fillings and occurs as veins and fracture fillings. The intensity of mineralization and alteration is controlled by the intensity of fracturing (e.g. brecciation and shearing).

The principal minerals recognized are native copper, chalcocite, bornite, chalcopyrite, magnetite and hematite.

In summary, the mode of occurrence of the mineralization is as follows:

NATIVE COPPER: along fractures; massive slightly porous in form, sometimes dendritic and spherulitic — concretionary occurs with chalcolite, magnetite, and hematite.

CHALCOCITE: along fractures, microgranular and massive; occurs with native copper, bornite, magnetite and hematite.

BORNITE: veinlets; massive, associated with epidote and calcite; occurs with chalcolite, magnetite and hematite.

CHALCOPYRITE: along fractures as minor occurrences.

MAGNETITE: along fractures, veinlets and as disseminations; occurs with the copper minerals and as a rock forming mineral.

HEMATITE: As magnetite, considered an oxide of magnetite."

6. MINERAL ZONING:

To quote a Report from L.W. Saleken, April, 1972:

"Vertical mineral zoning occurs in DDH 71-2. Five distinct mineral zones are recognized:

1. Native Copper Zone.
2. Native Copper-Calcocite Zone
3. Chalcocite-Bornite Zone.
4. Bornite-Chalcopyrite Zone.
5. Magnetite Zone.

The lateral extent of the Zones is not known at present. Zonal boundaries tend to be gradational. Post-mineral faulting has greatly disturbed and dissected the Zones.

7. GEOLOGICAL HISTORY:

(Again quoting from L.W. Saleken)

"During Upper Triassic Time, a thick covering of marine sediments and lava material of the Nicola Group were deposited over a Paleozoic erosional surface. Subsequently, a period of regional deformation and erosion took place. In the earliest part of the Mesozoic, the Iron Mask Batholith was intruded along North West rending zones of weakness. Domal uplift accompanied by faulting, brecciation and fracturing of the Nicola, and intrusive phases were intruded along the South West and North East flanks of the main Batholith. Following the intrusive activity, mineralizing solutions permeated along post-intrusive fissure systems and concentrated in zones of intense fracturing and brecciation. Late Mesozoic-early Tertiary Time saw an intensive period of differential erosion and weathering of the country rock under fluctuating climatic conditions.

Continued erosion during the Tertiary resulted in further unroofing of the Iron Mask Batholith and the reduction of the land to a surface of generally low relief. Early Tertiary volcanics and sediments were deposited in flanking basins. During the late Tertiary, differential uplift occurred — rejuvenating the erosional cycle. The Tertiary era ended with the area standing comparatively high and with a climatic change that brought on glaciation.

Glacial erosion during the Pleistocene (last million years) greatly modified pre-existing topography and deposited a thick glacial mantle."

CONCLUSIONS:

1. Afton's Lake Zone is located in an area of structural intersections that have undergone intensive brecciation and fracturing. Breccias and fracture zones as evidenced in DDH 71-2 extend to a depth of greater than 800 feet.
2. Mineralization occurs primarily along fractures and within brecciated areas in the form of native copper, chalcocite, bornite and chalcopyrite. Magnetite and hematite are pervasive.
3. As evidenced in DDH 71-2, the copper mineralization occurs as a vertical zonal arrangement to a depth of 800 feet. The zones are gradational and frequently dissected by post-mineral structures.
4. The zones were developed by a supergene enrichment process, whereby the chalcocite was derived from the oxidation of primary sulphides (chalcopyrite, bornite), Na-

tive copper, so far as present evidence indicates, formed from the oxidation of chalcocite."

8. GEOPHYSICAL SURVEYS:

Apart from the I.P. Surveys abovementioned, an E.M. Survey was done by Graham Bousquet in 1957. Results indicated a great number of short, E.W. trending conductors. Subsequent shallow drilling by that Company and Noranda failed to find worthwhile values associated with these E.M. anomalies.

Magnetometer work has been tried elsewhere in the Kamloops area and found to give mostly meaningless results. Afton did not try magnetometer surveys since the relatively large amounts of magnetite outcropping as veins North of the Pothook shaft would similarly give meaningless results. One percussion hole in the main Afton orebody intersected 30 feet of massive magnetite. Ore values existed immediately above and below this intersection, but the magnetite section assayed less than 0.05% cu. This indicates the native copper is not associated with magnetite.

9. GEOCHEMICAL SURVEYS:

To quote from a Report by B.W. Smee, Barringer Research, January, 1973:

"Samples were taken at various depths in the soil profile and analysed for multi-elements plus pH.

In general the pH of the soil is very high, which seems to inhibit the mobility of copper laterally in the soil. The amount of cold extractable copper is quite high, especially near surface, indicating some upward mobility of ions, which would also fit in with the presence of the caliche layer in the soil.

Zinc in soil appears to help sort out the large number of copper anomalies, with the only really anomalous values being on line 2 W at 7 S and the East West line near the pit.

The fluorine shows a few high values associated with copper near the pit area, but in general the fluorine is not as definitive as the zinc in sorting out the copper anomalies.

Other elements analysed included lead, silver and molybdenum; none of which showed any distinctive anomalies or patterns."

10. METALLURGY:

To quote from a Report by J.C. Loretto, H.A. Simons International) Ltd. August 1972:

"The tests indicate that during grinding the gangue grinds normally (I.E. finer with increased grinding time), but the metallic copper tends to flatten with little change in its mesh passing size. Flotation of the mineral after grinding and desliming gave poor results due mainly to the low recovery of the coarse (plus 65 mesh) copper.

However, reasonably good recoveries were obtained by medium fine grinding (50-65% minus 200 mesh) and removal of a highgrade concentrate by screening at 65 mesh followed by desliming and flotation of the deslimed screen undersize. Satisfactory recoveries and grades were obtained by flotation and cleaning of the deslimed minus 65 mesh portions.

From these tests, it is concluded that at least 90% of the copper can be recovered with about half of the recovery being in a concentrate of over 90% copper and the other half in a flotation concentrate running over 50% copper.

Further testwork is required to determine whether the variation between samples that has been experienced so far will continue, and to test various flotation variables with the object of reaching an all flotation circuit if possible. Also, a small tonnage pilot plant would still appear to be necessary to confirm the laboratory work and to determine how to control the grinding of the metallic copper.

Metallurgical Testing Results

TEST A-120	% COPPER	% RECOVERY
(a) Screen Concentrate	93.4% copper	60.1%
(b) Flotation Concentrate	47.3	28.4
(c) Combined Concentrate (a) & (b)	71.2	88.5
TEST A-121		
(d) Screen Concentrate	94.1% copper	46.1%
(e) Flotation Concentrate	56.9	44.1
(f) Combined Concentrate (d) & (e)	71.3	90.2

SEMI-QUANTITATIVE SPECTROGRAPHIC ANALYSIS ON AFTON CONCENTRATES FROM TEST A-121.

	SCREEN CONCENTRATE % WEIGHT	FLOTATION CONCENTRATE % WEIGHT
Copper	94.1%	56.91
A_{12} O_3	0.04	8.9
CaO	0.3	1.0
MgO	0.07	3.3
SiO_2	4.3	21.7
FeO	0.07	2.9
Na_2O	Trace	1.9
K_2O	Trace	0.8
Gold	not detected	Trace (however is believed to be economically significant).
Silver	0.01	0.01

(Mo, As, Bi, Co, V, Ni, & Pb are virtually non-existent)."

11. TONNAGE AND GRADE ESTIMATES:

(Open Pit Quantities only).

1. Quoting from a Report by M.P. Lipkewich, Teck Corporation, August 1972:

   31,600,000 Tons ore @ 1.06% copper; 103,000,000 Tons waste.

2. Quoting from figures supplied by D. Graham, Computer Associates August, 1972:

   47,000,000 Tons @ 0.79% copper; 214,000,000 Tons waste.

(Both of these estimates use an 0.25% copper cut-off, and are based on information accumulated prior to July, 1972:)

12. LEGAL PROBLEMS:

The validity of an Agreement between Afton and Canex Placer Ltd., whereby Canex Placer assumes exploration and feasibility expenditures, then production commitments if warranted, has been tested by the Supreme Court of B.C. The action was brought on by Teck Corporation, who are major shareholders. The Court ruled this Agreement to be valid and binding, however, Teck Corporation are appealing the decision.

Canex Placer have resumed diamond drilling and other works necessary for a feasibility study. Management of the Company has been taken over by Teck, however Canex Placer retain management over the property. The situation thus remains something of a problem for all concerned, and clarification of the necessary responsibilities will ultimately have to be determined.