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KENNCO EXPLORATIONS, (WESTERN) LIMITED

FINAL REPORT - 1967

WATERTON COPPER PROJECT
(Goble Option)

Waterton Area, Alberta

Latitude: 49°12'N; Longitude: 113°59'W

(Budget Code 01-127)

By

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KENNCO EXPLORATIONS, (WESTERN) LIMITED

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SUMMARY

The Waterton Copper property was optioned from Frank Goble and Associates in the latter part of 1966. It is situated in Southwestern Alberta, just north of Waterton Lakes National Park. Bornite and chalcocite occur in quartzites of the Upper Grinnell formation. This is part of a large block of Precambrian sediments, dykes, and sills of the Belt Series, that has been thrust over Palaeozoic sediments. Parts of the dykes and sills are also mineralized.

Kennco drilled three AX holes totalling 203 feet, of which 86 feet were drilled in 1966. Midwest Diamond Drilling drilled one BQ hole 357 feet deep. The steepness of the topography necessitated helicopter support for the diamond drilling. Thirty-one surface samples were taken; representing 610 feet of chip sampling and one grab sample.

Geologic mapping revealed that chalcocite-bornite mineralization occurs for about 2500 feet laterally in quartzite beds on the north side of Yarrow Creek. The sediments strike N30°W, and dip about 20° SW. The mineralization is confined

to the Upper Grinnell, but since only one lateral dimension was available for study, its configuration within this formation is not known. In detail, the mineralization occurs only in white or green quartzite beds and associated green argillite, and it is entirely absent from interbedded red argillite and red sandstone. The BQ drill hole cut the entire favourable Upper Grinnell section. The type and amount of mineralization encountered was identical to the mineralization that was observed within a few inches of surface in outcrop. The short mineralized sections (usually less than one foot thick) grade about 0.1% Cu, although one 1.6-foot section grades about 0.7% Cu. Over the five-foot assay increments, the grade of the mineralized quartzite beds in drill core generally ranges from 0.01% to 0.1% Cu. The highest silver assay was 0.03 oz/ton Ag.

Similar chalcocite-bornite mineralization occurs further north in Blind Canyon, and on the south side of Spionkop Creek valley. These showings are of very limited size; the best showing being 1½ to 4 feet thick along 1100 feet of quartzite. Uneconomic mineralization also occurs in the Lower Grinnell, in the Siyeh, and in the Appekunny quartzite overlying the extensive Purcell diorite sill.

Bornite-chalcocite, and pyrite-chalcopyrite mineralization occur in the Purcell diorite sill wherever there is a fine-grained, chilled margin. The sill is concordant with the sediments which dip about 20° SW. Only one part of the sill has a mineable combination of thickness and grade. It is on the north-central part of the property. Chalcocite-bornite mineralization, with grades ranging from 1.83% Total Cu to 3.45% Total Cu, occurs in a block of ground that may be 1000 feet x 1000 feet x 10 feet thick. There is a possibility that this mineralization may extend further to the southwest.

The option payment due on October 15, 1967 was not made, and the option was terminated at that time. The claims are in good standing for the required 90 days beyond the end of the option.

CONCLUSIONS AND RECOMMENDATIONS

1. The best mineral showing in the Upper Grinnell formation is on the north side of Yarrow Creek valley. It was investigated by surface mapping and diamond drilling. The type and amount of mineralization intersected by DDH WB-1 is similar to the mineralization that was outlined by surface mapping. This hole was drilled in the most favourable part of the mineralized area, and core recovery was good enough to give reliable assays. It averages 0.01% to 0.1% Cu, and thus is too low grade to be of economic interest; therefore, no further work is warranted on this showing. Other showings in the Upper Grinnell are too small to be of interest.

2. The mineral showings in the Lower Grinnelll, at the top of the Appekunny, and at the base of the Siyeh, are too small or too low grade to be of economic interest.

3. Some of the mineralization in the extensive diorite sill is of mineable grade and thickness; but the indicated size is less than one million tons, with restricted potential for increasing this. Exploring this zone would be costly, and there is little possibility of finding a large orebody; therefore no further work is recommended.

INTRODUCTION

The Waterton Copper property was optioned from Frank Goble and Associates near the end of the field season in 1966. Some work was done, when weather permitted, through October and early November. This consisted of further surface inspection, and drilling one AX size x-ray diamond drill hole to a depth of 86 feet. It cut the uppermost quartzite bed of the favourable Upper Grinnell formation. No significant mineralization was found, but little mineralization had been found in that particular bed on surface.

The start of field work in 1967 was delayed by an unusually heavy snowfall late in April. It was planned to do geologic mapping while bulldozing a road to the proposed drill sites during June. BQ wireline drilling was to proceed during July. After the snow melted, it was found that a road could not be constructed without considerable rock work; therefore, a helicopter was hired on contract for one month. The availability date for the helicopter determined that the drillers would start to move in on July 5. Several factors caused problems, and increased the cost. The helicopter had just come off overhaul, and was not adjusted to peak performance for about ten days after the contract started. Strong winds also contributed to delays in flying in the heavy equipment. A vertical lift of 800 feet was required on the 2000-foot water line. Thus a pumpman was required on each shift, and line breaks caused several half-day shutdowns.

The geologic mapping recorded the extent and relative grade of the mineralization. The wireline drilling and one x-ray drill hole explored the relationship between copper grade at surface, and the grade in rocks that were known to be unweathered. Two of the x-ray drill holes tested indications of mineralization below the Upper Grinnell. The field program was completed by chip sampling the mineralization in the Purcell sill.

LOCATION AND ACCESS

The property is situated in Alberta, about 14 miles north of the southwest corner of the province, at Latitude 49°12'N, Longitude 113°59'W. Most of the claims are between Yarrow Creek and Spionkop Creek, in Sections 4, 5, 8, 9, 16, 17, 20, 21, Township 3, Range 30 west of the 4th meridian; and Sections 1, 11, 12, 13, 14, 15, 23, 24, Township 3, Range 1 west of the 5th meridian.

Elevations on the property range from 5000 feet to 8300 feet. The mineralized Grinnell section in Yarrow Creek valley ranges from 5800 feet to 6800 feet. Drill hole WB-1 is at 6300 feet. Tree line is usually about 5500 feet to 6000 feet. On the eastern margin of the claims, the alpine grass merges into scrub poplar and prairie grass. Elsewhere, the alpine grass merges into scrub pine and pine forest. Much of the area is characterized by a series of moderate slopes, underlain by argillite and soft sandstone; interrupted by cliffs formed by quartzite, dolomite, and diorite sills.

The Goble property is 20 air-miles south of Pincher Creek, and about 30 miles from there by road. Roads to gas wells of Shell Canada Limited in Yarrow Creek and Spionkop Creek valleys give access to the southern and northern parts of the property at about 5000 feet elevation. The distance from the Yarrow Creek road to the main showings is one-half mile horizontally, and one quarter mile vertically.

Pincher Creek is two miles south of Highway No. 3, the southern branch of the Trans-Canada Highway. This is paralleled by the southern line of the Canadian Pacific Railway. A spur line serves Shell's natural gas cleaning plant, eight miles north of the property.

Plans were made to gain access to the main showing area (6400 feet elevation) by bulldozing a two-mile road from Shell's Waterton Well No. 6 (5450 feet elevation). The route appeared feasible in November 1966; but in the Spring of 1967 it was found that some of the lower sections of the route (which had been snow-covered in November) would have required expensive rock work. This necessitated a change to helicopter supply. The level area at Well No. 6 was used as the staging point for flying in the drilling equipment. Permission to use the road to this well had already been obtained from Shell, and from G.S. Cairns, on whose property the road commences. Permission was also obtained from the Department of Lands and Forests because part of the road is in the Crowsnest Forest District. The permission from Shell expired at the end of 1967. The permission from G.S. Cairns applies to Kennco personnel only and expires at the end of 1968.

Helicopters are not very satisfactory in this area because of the problems created by strong winds. June, July, and August are the only months of the year during which helicopters can operate effectively.

GEOLOGY

Geologic mapping was done during June by J.H. Koo. The Grinnell section in the Yarrow Creek area was studied in detail, and the geology on the rest of the property was mapped on a regional scale. In late July and early August, Eric Goble further prospected the Grinnell section in Blind Canyon and Spionkop Creek, and sampled the mineralization in the Purcell diorite sill at the top of the Appekunny. The geology is shown on Plate No. 2, at a scale of 1" = 500'. This also shows the surface assays for total copper, sulphide copper, and silver. It also shows an approximate outline of the property.

General Geology

The Goble property is underlain by Precambrian sediments of the Belt Series (Appekunny, Grinnell, and Siyeh formations), which have been intruded by Purcell diorite sills and dykes. All these rocks contain some mineralization, but the best copper mineralization is in the Upper Grinnell formation, and in an extensive Purcell sill which intruded along the uppermost bed of the Appekunny. These rocks outcrop for about 4¼ miles in a general north-south direction across the property. This represents a strike length of about 2¾ miles.

The Appekunny formation consists mainly of argillites in the lower part; but light greenish-grey, coarse-grained quartzites become dominant in the upper part. It is overlain conformably by the Grinnell formation.

The Grinnell formation consists of argillites and quartzites. It is divided into Lower and Upper members. The Lower Grinnell member is about 400 feet thick, and consists of reddish argillite, mottled and interbedded with minor amounts of yellowish green argillite. It contains thin bands (usually not more than a few inches thick) of white to brown, medium-grained quartzite, and reddish, fine-grained sandstone. In the uppermost 30 feet of the Lower member, the quartzite beds gradually increase in frequency and thickness, marking the transitional zone between the Lower and Upper members.

The Upper Grinnell member is about 300 feet thick, and consists of red, and minor green argillite interbedded with white, green, and red quartzites. The quartzite beds range in thickness from a few inches to a few tens of feet. About 50 percent of the Upper Grinnell is white quartzite (based on DDH WB-1). Individual beds (or groups of beds) can be traced along the half-mile exposure most intensively studied, but there is considerable variation in thickness and purity. Thus, vertical sections 400 feet apart could only be co-related after some of the beds had been traced along strike. Mud cracks, ripple marks, and cross bedding are commonly associated with the quartzite beds. A high percentage of the Grinnell mud cracks examined are concave upwards. This indicates that the muds were probably deposited under fresh water (Twenhofel; p. 590).

Flat argillite "pebbles", about ½ inch to 1½ inches long, are fairly common in the quartzites, particularly near the base of some of the quartzite beds. These are intraformational conglomerates, and it is reasonably certain that the argillite pebbles were locally formed, soft, mud flakes, rather than stony pebbles, when emplaced. A similar erosional situation can be seen in present-day sediments where finer-grained mud is deposited on coarse-grained mud or sand; when mud cracks cut below this interface, the finer-grained mud peels off, and is easily carried away during the next high water stage to form mud "pebbles". The green argillite pebbles were probably derived from mud that was deposited in deeper water as thin bands between sand beds; subsequent erosion would easily remove the sand as grains, but the mud would have enough cohesiveness to remain as flakes.

The Siyeh formation conformably overlies the Grinnell. It is composed of carbonates, argillites, and quartzites. In the lowermost 30 feet of the Siyeh, dark grey carbonaceous argillites are interbedded with six to eight bands (each several inches thick) of white to light grey quartzite containing pyrite spheres. Light to dark greenish argillites are dominant in the lower and upper parts of the Siyeh. Yellowish-brown weathering, resistant dolomite and limestone beds are dominant in the middle part.

A Purcell diorite sill occurs below or within the uppermost quartzite bed of the Appekunny formation. The thickness of Appekunny quartzite above the sill varies from 5 to 25 feet. The thickness of the sill varies from about 20 feet to about 75 feet. Regionally, it is conformable to the sediments, which dip about 25° SW. A chilled margin is not always present, but where it is, it consists of a fine-grained, tough, blue-grey rock which characteristically contains some disseminated sulphide mineralization, regardless of whether it is the upper or lower margin of the sill. The mineralization consists of various combinations of chalcocite, bornite, chalcopyrite, and pyrite. There are no lithological differences apparent between those parts of the sill bearing chalcopyrite, and those bearing bornite-chalcocite mineralization. Disseminated pyrite, sometimes accompanied by chalcopyrite, is usually present in the adjacent quartzite.

The central part of the sill is a brown-weathering, coarse-grained, dark rock. It commonly has large biotite flakes, and plagioclase crystals up to three inches long which have a stellate arrangement. It is characteristically unmineralized.

Other Purcell dykes and sills intrude the Grinnell and Siyeh formations in the best mineralized area. They range in thickness from 1 to 15 feet. They are commonly mineralized near their margins, and mineralization extends into the adjacent quartzite. The dykes often occupy faults.

Environment of Deposition

The regional environment of deposition for the Upper Grinnell sediments is considered by the writer to have been either subaerial deltaic or valley-flat flood plain. A subaerial environment with seasonal flooding is indicated by the prevalence of red argillite, numerous mud cracks, and the repeated fluctuation vertically from red to green in the colour of the sedimentary laminae. Either a deltaic or a flood plain environment is indicated by the type of sediments, i.e. clay, silt, and sand, but no gravel. The degree of sorting indicates frequent abrupt changes in conditions of sedimentation that are associated with seasonal flooding. This results in a complex assemblage of clean sand beds containing mud flakes, muddy sand beds, and finely laminated muds. Fresh water deposition is indicated by mud cracks that are concave upwards.

Describing the Upper and Lower Grinnell, Price (p. 6) states ... "The Grinnell thins from approximately 1,700 feet in southwestern Clark Range adjacent to Sage and Kishinena Creeks to 1,100 feet in the southeast, east of Mount Blakiston; to 750 feet in northeastern Clark Range on Pincher Ridge; and to 350 feet in northwestern Clark Range near Hollebeke Mountain."... This covers an area which is about 38 miles in north-south dimension (actually N25°W), and 20 miles in east-west dimension. However, the east and west margins are erosional boundaries; and the formation also extends further to the south into the United States.

On or near the property, the local distinguishing characteristics of the Upper Grinnell are readily visible for at least five miles. In the most intensively studied area in the Upper Grinnell, sequences that are predominantly quartzite or predominantly argillite can be traced for over half a mile along strike. This type of sedimentation could have taken place on a delta with a large, seasonally flooded, subaerial plain caused by a relatively stationary sea level; or it could have taken place on a large valley-flat flooded plain. The Upper Grinnell formation as a whole is too extensive to be entirely lagoonal.

Details of the mineralization are discussed later in the report; however, it might be mentioned here that minor indications of mineralization occur regionally at scattered intervals in the Upper Grinnell. On the Goble property, traces of mineralization appear to be confined to an area three miles by half a mile, which is elongated almost parallel to the regional elongation of the Grinnell formation as a whole (see shaded areas of potential mineralization on Plate No. 2). Considering the dimensions only, this could have been a lagoonal area at the edge of a large delta; but there is nothing within the sedimentary features that indicates lagoonal deposition. Rather than pinching out at the edge of the mineralized area, the quartzite beds continue with no change in thickness or general characteristics.

The abrupt colour change of the Siyeh, and the presence of several thin beds of carbonaceous shale indicate a deeper water environment. Carbonate beds also indicate this. However, there was some shallow water deposition, as indicated by a distinctive rock type formed by alternate thin layers of white sand and brown mud; the mud cracked into thin polygons, and the intervening space was completely filled with sand (Lahee, p. 79, figure 46).

Structure

The sediments strike approximately N30°W, and dip about 20°SW; although locally dips range from 10° to 40°. There is no major folding, but there are some small drag folds adjacent to faults. Faulting is fairly common both on a large and small scale in the area mapped in detail. Elsewhere on the property, large faults are easily observable. The entire Precambrian Belt section here has been overthrust from the west to cover Palaeozoic sediments. Natural gas is produced from the latter, but the structural traps are reported to be relatively small.

Reverse faults, striking from N15°W to N45°W, and with dips of 70°W to 90°, are fairly numerous in the central part of the main mineralized zone. Displacement varies from a few inches to 200 feet. A few thrust faults were found that strike N45°E, and dip 15° to 25°NW. The reverse and thrust faults are truncated and offset by other faults which are generally small and have various directions of strike and dip.

Purcell diorite dykes have intruded along some of the large faults, so that in places it is difficult to recognize the original fault planes. However, mylonites and slickensides are partly preserved in places, and sediments are displaced on opposite sides of the dykes.

Some faults appear to have resulted from intrusion of the large diorite sill into the uppermost quartzite bed of the Appekunny formation. These faults cut part of the Lower Grinnell, and the Appekunny quartzite above the sill; but do not pass through the sill, nor cut the Appekunny formation below it.

Other faults, mostly small ones, cut the mafic sills and dykes found in the Grinnell and Siyeh formations.

Mineralization

Mineralization has been found - in the quartzites of the Upper Grinnell formation, in the margins of Purcell diorite dykes and sills, in quartzites of the Appekunny and the Lower Grinnell where they are adjacent to dykes or sills, in thin quartzites near the base of the Siyeh, and in a few narrow quartz veins in the middle Siyeh.

Upper Grinnell

The mineralization in the Upper Grinnell, found by surface mapping, consists chiefly of bornite and chalcocite. Minor chalcopyrite occurs in the uppermost quartzite bed, and immediately adjacent to a few dykes. Bornite is slightly more plentiful than chalcocite in the lower quartzite beds and near the lateral margins of the 2500-foot wide mineralized area. The mineralization occurs in the quartzite beds, chiefly those that are white or greenish in colour, and is often more abundant along the tops or bottoms of thin quartzite interbeds, and around argillite pebbles. The mineralization is interstitial to the quartz grains. In the central part of the zone, argillite pebbles contained in the quartzite are occasionally mineralized with minute tabular bornite grains, regardless of whether the surrounding quartzite is mineralized or not. These bornite grains appear to have been concentrated along the original bedding planes of the argillite pebbles. Also in the central part of the zone, a few bornite stringers, less than one quarter inch wide, were found in fractures crosscutting the bedding, regardless of whether the rock was argillite or quartzite. Usually, these stringers are bordered on both sides by pink orthoclase stringers one tenth of an inch wide. Specks and stains of malachite, very minor azurite, and dark orange to light brown limonite are associated with bornite and chalcocite, and in a few places with chalcopyrite. In many places where no positive sign of primary or secondary mineralization can be recognized at the weathered surface of the quartzite, bornite, chalcocite, and malachite are visible in the fresh rock at a depth of not more than a few inches. Weak indications of mineralization occur in various beds of the Upper Grinnell along a horizontal distance of about 2500 feet. The sediments strike N30°W, and dip about 20° SW; but since only one lateral dimension of the mineralization is available for study, its configuration within the sediments is not known. The best showings of chalcocite with bornite occur in the highly faulted area in the central part of this zone. To the west of the central area, the indications of mineralization are mostly in bedrock; but are mostly in float to the east of the central area. Mineralization also occurs in the margins of, and adjacent to, mafic dykes in the central area; nevertheless, mineralization in the quartzite occurs up to 1000 feet away from known dykes.

The mineralization in the Upper Grinnell, intersected by DDH's WB-1 and WX-1, consists of disseminated chalcocite and bornite, with minor chalcopyrite, and very rarely a few grains of pyrite. There are also a few stringers of these minerals. The mineralization occurs in the white and green quartzites. Within these beds, the chalcocite and bornite may occur - finely disseminated between quartz grains; minutely disseminated as tabular grains in green argillite pebbles or selvages; between quartz grains rimming argillite pebbles; and in green argillite bands that are adjacent to mineralized quartzite. Rarely, chalcocite and bornite occur in minute stringers parallel to the bedding plane of argillite pebbles or beds. In a few cases, mineralized hairline fractures extend at right angles from the stringers. Chalcocite and chalcopyrite were observed along, or associated with, fractures. This is a fairly common mode of occurrence for the minor amounts of chalcopyrite that are present. The chalcopyrite appears to have been introduced later than the bornite, and later than most of the chalcocite. The pyrite occurs mostly along fractures. Although the overall features of the deposit are compatible with a syngenetic origin, there has undoubtedly been some minor movement of metals within the deposit. There may be weak mineral zoning, but this is based solely on surface mapping. Chalcocite and bornite appear to be equally prevalent in the center of the deposit, with chalcocite diminishing toward the margins. Chalcopyrite appears to be more prevalent in the highest quartzite bed.

Similar mineralization occurs in Upper Grinnell quartzites almost directly on strike to the north - in Blind Canyon, and on the south side of Spionkop Creek. These are very small showings; although the general lithologic characteristics of the Grinnell formation remain the same. In Blind Canyon, only a few mineralized sections were found, each of which was less than one foot thick. On the south side of Spionkop Creek, only one bed was found with appreciable mineralization. The bed is three to four feet thick, and was traced for about 1100 feet. In places, only the center 1½ feet of the bed is mineralized.

None of the mineralization in the Upper Grinnell is of ore grade over mineable thicknesses. The best mineralization in DDH WB-1 occurs in a 40-foot section of white and green quartzite at 220 to 260 feet. The average grade is 0.05% Cu, and 0.01 oz/ton Ag. Within this bed there was a 1.6-foot section grading about 0.7% Cu, and several short, sparsely mineralized sections grading about 0.1% Cu. A few similar, short, sparsely mineralized sections occur in other quartzite beds cut by DDH WB-1. Mineralization is slightly more abundant in the lowermost one-third of the Upper Grinnell section. The grade over most of the drill hole ranged from trace to 0.01% Cu (i.e. 100 ppm Cu). Geochemical analysis of DDH WX-1 drill core indicated that the background copper content of unmineralized rock is 5 to 10 ppm Cu for red argillite (four samples), and 7 to 12 ppm Cu for quartzite (two samples). This is slightly lower than the background copper content of present-day stream sediments in this area. Silver was assayed only in the section from 220 to 260 feet in DDH WB-1. There is an increase in silver content where there is an increase in copper content; but the assays are so few and so low that a reliable trend cannot be established. Using the few figures available, the relationship of % Cu to oz/ton Ag is about 5 : 1.

Bornite from surface samples showed no detectable rhenium content. According to published reports, in other deposits which are deficient in molybdenite, the rhenium appears to be associated with the highest-copper-content mineral; which is bornite in the most notable example (Dzhezkazgan). Where there is a chalcocite-bornite combination such as at Waterton, chalcocite might be the "carrier", if any rhenium were present.

The amount of mineralization intersected by DDH WB-1 is very similar to the amount of mineralization which is observable within a few inches of surface in the Upper Grinnell outcrop. Since this hole was drilled in the most favourable part of the mineralized area, and since core recovery was good enough to give reliable assays, no further drilling is warranted in the Upper Grinnell at Yarrow Creek. Elsewhere on the property, mineral showings in the Upper Grinnell can be rejected because of their limited size.

Lower Grinnell

In the Lower Grinnell formation, downhill from the main mineralized area, a few quartzite beds several inches thick are mineralized with disseminated bornite and chalcocite. Malachite and azurite are visible at the surface. The mineralized quartzite beds are above and below two diorite sills, each about five feet thick, which are mineralized near their margins with disseminated bornite and minor chalcopyrite.

Drill hole WX-2 was drilled near the base of the Lower Grinnell, about five feet away from an XRT-size hole drilled by Frank and Eric Goble in 1966. They reported good copper mineralization, but their core recovery was very poor. Kennco's drill hole cut mineralized boulders of white quartzite, apparently from the Upper Grinnell, in the overburden from surface to 36 feet. This quartzite "core", totalling 0.5 feet in "length", assayed 0.22% Cu. The Lower Grinnell red argillite from 36 feet to 45 feet assayed 0.01% Cu. No mineralization was observed. This drill hole explained the mineralization reported to be in the Lower Grinnell argillite. Similar red argillite in DDH WX-3 assayed a trace in copper.

Appekunny

Disseminated pyrite and minor chalcopyrite occur extensively in the 5 to 25 feet of Appekunny grey quartzite overlying the Purcell diorite sill that outcrops for a strike distance of three miles across the property. Occasionally, the quartzite below the sill is also mineralized. None of this is extensive enough to be of economic interest, but some of it might be mined if mineralization in the underlying sill were being mined. Unfortunately, the quartzite contains only pyrite where it overlies the best mineralization in the sill (at sample sites 9963 to 9965). DDH WX-2 intersected a few grains of bornite apparently replacing part of a greenish grey argillite pebble in grey argillaceous quartzite. A few grains of chalcopyrite occur in similar quartzite in DDH WX-3. Assays ranged from trace to 0.02% Cu.

Siyeh

In the lowermost 30 feet of the Siyeh formation, six to eight quartzite beds, each several inches thick, contain disseminated pyrite and very minor chalcopyrite. Some of the pyrite occurs as spherical nodules about 1/10 inch in diameter. Some pyrite, and most of the chalcopyrite, occur as small angular blebs and appear to replace impurities in the quartzite. In places, limonite stains, and cavities of spherical or irregular shape, remain near the surface of the quartzite. In DDH WX-1, the best mineralization in the Siyeh contained 0.02% Cu over two feet. In this bed, the estimated ratio of pyrite to chalcopyrite was about 3 : 1.

Quartz Veins

Several short quartz veins, a few inches wide, were found in the middle and lower part of the Siyeh formation in Blind Canyon. Some of these were sparsely mineralized with chalcopyrite, galena, and sphalerite.

Purcell Diorite Sill

Economically significant mineralization occurs in the sill only where there is a definite chilled margin. This is a fine-grained, tough, blue-grey rock at the top or bottom of the sill. The mineralization is disseminated, and consists of various combinations of chalcocite, bornite, chalcopyrite, and pyrite. The best mineralization, consisting of chalcocite and bornite, occurs on the northeast corner of the property between sample sites 9964 and 9965 (see Plate No. 2). To the west of this, between sample sites 9967 and 9972, the mineralization consists of chalcopyrite, with minor pyrite at some sites. To the south of sample site 9964, that is, between sample sites 9980 and 9981, the mineralization consists of chalcopyrite with lesser amounts of bornite. South of sample site 9982, the mineralization consists of chalcopyrite, with varying minor amounts of bornite and/or pyrite. Very minor galena also occurs at sample site 9962. At DDH WX-3, the chilled margin is very thin, and thus there is very little mineralization, except for acicular crystals of arsenopyrite in the six inches of chilled phase, and scattered patches of extremely fine-grained arsenopyrite in the coarse-grained phase. No lithologic differences are apparent between those parts of the sill bearing chalcopyrite, and those bearing bornite-chalcocite mineralization. However, there is a distinct difference between mineralized and barren rock, in that the chilled phase is mineralized, and the coarse-grained phase is virtually barren. Significant amounts of malachite occur in some of the better mineralized samples, as can be seen by the difference in total copper and sulphide copper. These data are plotted on MISSING Plate No. 2, and in Table I. Most of this malachite occurs as a coating on fractures or on the surface; however, no estimate can be made of the amount of sulphide leaching that has taken place. Thus, no estimate can be made of which assay, total copper or sulphide copper, comes closer to representing the unweathered grade. In most cases, this distinction is unimportant, either because the total copper content is not of economic interest, or because even the sulphide copper assay is of interest.

It is reasonable to suspect that the sill mineralization may be erratic, and may fluctuate considerably within a few tens of feet. If so, the interpretation of drill hole results would be difficult, and there would be a serious practical problem in mining. But for the initial study, the chip samples must be taken at their face value.

The only part of the sill that has a mineable combination of thickness and grade is on the north-central part of the property between sample sites 9964 and 9965. Sampling on both sides of a ridge has permitted sampling in two directions, and thus has indicated a zone that might be about 1000 feet by 1000 feet; with an average thickness of about 10 feet, at the top of the sill. At site 9965, there is 8 feet of 3.45% total copper (2.40% sulphide copper) and 0.86 oz/ton Ag. (Sample site 9966 is on the lower sill contact. The center five feet of sill is unmineralized). At site 9963, 700 feet to the east of 9965, there is 15 feet of 1.83% total copper (1.08% sulphide copper) and 0.69 oz/ton Ag. At site 9964, 1400 feet south of 9963, there is 3 feet of 0.28% total copper (0.14% sulphide copper) and 0.03 oz/ton Ag. A three-foot thickness with this grade is not mineable, but the mineralization is the same chalcocite-bornite type as at 9963 and 9965; and it is not unreasonable to assume that mineable mineralization might extend for 1000 feet south of sample site 9963. There is no exposure of the sill beyond 150 feet west of sample site 9965, and it may not be continuous to site 9969. At the latter site, the mineralization is entirely chalcopyrite, and the grade of 1.07% total copper over 11 feet may not be economic for underground mining. Thus, we might assume that samples 9963, 9964, and 9965 indicate a block of ground approximately 1000 feet by 1000 feet by 10 feet thick, which would contain somewhat less than one million tons (not making any allowance for pillars). The overlying Appekunny quartzite does not contain copper mineralization, and the only possibility of extending this ore-grade mineralization would be to the southwest. A substantial increase in tonnage would be required before it would be of economic interest. The topography to the southwest is fairly rugged, but is not nearly so bad as at DDH WB-1 in Yarrow Creek valley. Drilling for an extension of this zone would be very costly, and the possibility of proving up an orebody is remote. Mineralization of this type might be difficult to mine, if there were unpredictable fluctuations in grade. The tough, fine-grained host rock might be somewhat expensive to drill and blast. However, the mineralized thickness would be fairly easy for miners to follow, using the overlying Appekunny as a marker.

The silver content increases where the copper content increases; although there is no constant ratio. In the best mineralization, there is about $\frac{3}{4}$ oz/ton silver, and it would be a significant by-product metal. There is usually only a trace of gold, and it would be of no economic importance.

The nickel content remains constant at about 0.005 to 0.010% nickel, regardless of changes in the copper content, and regardless of whether the fine-grained margin or the coarse-grained center was sampled. This suggests that the nickel occurs in the silicate latices, rather than occurring as a sulphide.

Vancouver, B. C.

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[redacted]

R. W. Stevenson

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TABLE I

Surface Samples

Sample No. KX	Remarks	Diorite sill	Thickness of sill in feet	Sample from upper contact	Sample from lower contact	Chalcocite	Bornite	Chalcopyrite	Pyrite	Galena	Specular hematite	Malachite	Sample width in feet	% Total Copper	% Sulphide Copper	oz/ton Silver	oz/ton Gold	% Nickel	% Zinc
9961	Cuts Siyeh-Claim 81	x						x					11	·01	·00	·018	·002	·015	
9962		x	2.5	x				x	x	x			18	·01	·00	·013	·002	·010	
9963		x	40	x		x	x		x				15	1·83	1·08	·685	·002	·010	
9964		x		x		x	x						3	·28	·14	·031	·002	·010	
9965		x	17	x		x	x					x	8	3·45	2·40	·860	·001	·007	
9966		x	17		x	x	x					x	4	3·40	2·02	·887	·002	·005	
9967		x	13		x			x				x	3·5	·42	·16	·055	·001	·005	
9968		x	19		x			x	x			x	8	·26	·16	·022	·001	·005	
9969		x	20	x				x					11	1·07	·87	·031	·001	·007	
9970	Along upper contact	x											400	·66	·38	·062	Tr	·005	
9971		x		x				x	x			x	3·5	·82	·67	·139	Tr	·008	
9972		x	15		x			x					8	·11	·04	·042	Tr	·007	
9973		x		x				x		x			7	·52	·36	·031	Tr	·005	
9974	To check a high Ag assay	x											32	·01	·00	·013	Tr	·008	
9975		x		x				x				x	6	·21	·17	·022	Tr	·008	
9976		x	40		x			x	x		x	x	4·5	·12	·08	·022	Tr	·010	
9977		x		x			x	x	x			x	2·5	·50	·17	·060	Tr	·005	
9978	Float	x		?				x	x			x	Grab	·12	·04	·018	Tr	·007	
9979		x		x		x	x	x				x	4.25	·09	·04	·034	Tr	·007	
9980		x		x			x	x				x	3·5	·21	·15	·026	Tr	·007	
9981		x		x			x	x	x				9	·36	·27	·031	Tr	·008	
9982		x		x			x	x	x			x	5	·60	·45	·031	Tr	·007	
9983		x		x		x	x	x					3	·17	·09	·037	Tr	·012	
9984		x			x	x		x					5	·23	·16	·037	Tr	·007	
15804		x											12	·02	·01	·037	Tr	·007	·003
15805		x											12	·02	·01	·042	·001	·005	·004
9999	10' bed of quartzite. Exposed for 250'												3	·76	·26	·177	Tr	·002	
10000	Exposed for 20'												6	·15	·06	·013	·001	·002	
15801	Quartzite												1	·07	·02	·018	·001	·002	
15802	14' bed of quartzite. Exposed for 200'												0·5	·83	·70	·124	·001	·002	
15803	6' bed of quartzite. Exposed for 400'												0·7	1·36	·66	·258	·001	·002	

The complete thickness of sill is not always exposed.
Some of the minerals are present in minor quantities.

APPENDIX I: Diamond Drill Logs

(WB-1, WX-1, WX-2, WX-3)

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
0.4	14.0							KX9901	4.0	14.0	10.0	.01	
								KX9902	14.0	21.0	7.0	.01	
								KX9903	21.0	28.0	7.0	Tr	
								KX9904	28.0	37.0	9.0	Tr	
								KX9905	37.0	44.0	7.0	Tr	
								KX9906	44.0	52.0	8.0	Tr	
								KX9907	52.0	57.0	5.0	Tr	
								KX9908	57.0	62.0	5.0	Tr	
						12.5	23°	KX9909	62.0	67.0	5.0	Tr	
								KX9910	67.0	72.0	5.0	.01	
								KX9911	72.0	77.0	5.0	Tr	
								KX9912	77.0	87.0	10.0	.01	
14.0	37.0							KX9913	87.0	91.0	4.0	Tr	
								KX9914	91.0	96.0	5.0	Tr	
								KX9915	96.0	101.5	5.5	Tr	
								KX9916	101.5	103.0	1.5	Tr	
28.4	-	x				16.5	23°	KX9917	103.0	108.0	5.0	Tr	
								KX9918	108.0	113.0	5.0	Tr	
								KX9919	113.0	114.5	1.5	Tr	
								KX9920	114.5	119.0	4.5	Tr	
								KX9921	119.0	120.5	1.5	Tr	
37.0	52.0							KX9922	120.5	125.0	4.5	Tr	
								KX9923	125.0	130.0	5.0	Tr	
								KX9924	130.0	135.0	5.0	Tr	
								KX9925	135.0	140.0	5.0	Tr	
						40	18°	KX9926	140.0	143.5	3.5	Tr	
						43.5	22°	KX9927	143.5	146.5	3.0	.05	
								KX9928	146.5	150.0	3.5	Tr	
								KX9929	150.0	155.0	5.0	Tr	

WATERTON COPPER - Log of DDH No. WB-1

Depth	:	357'
Dip	:	90°
Azimuth	:	-
Collar	:	1+50S; 0+55E. 69' at 164° From NW corner of Bighorn No. 5.
Elevation	:	6300'
Core Type	:	BQ Wireline
Started	:	July 18, 1967
Finished	:	July 28, 1967

From	To	Description
0.0	0.4	CASING - NO CORE
0.4		UPPER GRINNELL
0.4	14.0	WHITE QUARTZITE. The drill hole is collared a few feet below the top of the Upper Grinnell, which is visible in outcrop a few feet away. This is the uppermost quartzite bed, and it was intersected in DDH WX-1 at 46'. It contains a few green argillite pebbles, also a few selvages of green argillite. There are a few minor bands of red argillite. 9.5-10.0, red argillite. 11.5-12.2, interbands of red sandstone and red argillite. Average recovery is 74%, but much of the core loss is in the first two feet of quartzite, and in the red argillite.
14.0	37.0	RED SANDSTONE, INTERBEDDED WITH GREENISH SANDSTONE, AND SUGARY WHITE QUARTZITE. The red sandstone has a muddy red interstitial filling; it is the predominant rock. The argillite pebbles are mostly red. 28.4, very minor chalcocite in sugary white quartzite. 34.4, weak slickensides, core angle of 75°, i.e.- dip of fault is 15°. Movement was mostly strike-slip. Average recovery is 82%.
37.0	52.0	RED ARGILLITE; CONTAINS FIVE WHITE QUARTZITE BANDS, FROM 0.4' TO 1.2' THICK. The red argillite is finely banded. The quartzite commonly has bands and selvages of green argillite, but pebbles of red argillite are also common. Quartzite bands at 37.9-38.6, 40.0-40.5, 41.4-42.6, 46.4-47.6, 49.5-49.9. 40.3, weak limonite stain on near-vertical fracture; also at 49.7. Average recovery is 94%.

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
52.0	72.9							KX9930	155.0	165.0	10.0	Tr	
56.2	-	x						KX9931	165.0	175.0	10.0	Tr	
63.9	-	x						KX9932	175.0	185.0	10.0	Tr	
67.8	68.2	x		x				KX9933	185.0	192.5	7.5	Tr	
72.9	73.0	x		x				KX9934	192.5	198.5	6.0	Tr	
								KX9935	198.5	203.5	5.0	Tr	
								KX9936	203.5	212.0	8.5	.01	
								KX9937	212.0	220.5	8.5	Tr	
								KX9938	220.5	225.0	4.5	.01	.004
								KX9939	225.0	230.0	5.0	Tr	.004
								KX9940	230.0	235.0	5.0	Tr	.004
								KX9941	235.0	240.0	5.0	.03	.004
								KX9942	240.0	245.0	5.0	.09	.022
								KX9943	245.0	250.0	5.0	Tr	.006
								KX9944	250.0	255.0	5.0	.07	.013
								KX9945	255.0	260.0	5.0	.22	.029
								KX9946	260.0	270.0	10.0	Tr	
77.0	91.0							KX9947	270.0	280.0	10.0	Tr	
						79.5	25°	KX9948	280.0	289.0	9.0	Tr	
								KX9949	289.0	295.7	6.7	.01	
								KX9950	295.7	303.5	7.8	Tr	
								KX9951	303.5	307.5	4.0	.03	
								KX9952	307.5	309.4	1.9	.04	
								KX9953	309.4	311.3	1.9	.03	
								KX9954	311.3	314.0	2.7	Tr	
91.0	140.0							KX9955	314.0	324.0	10.0	.01	
91.2	-	x						KX9956	324.0	334.0	10.0	.01	
94.2	-	x						KX9957	334.0	344.0	10.0	Tr	
95.1	-	x						KX9958	344.0	347.8	3.8	.01	
96.3	-	x						KX9959	347.8	349.5	1.7	Tr	
103.5	-	x						KX9960	349.5	357.0	7.5	Tr	
123.9	-	x											
126.8	-	x											

Log of DDH No. WB-1 - cont'd

From	To	Description
52.0	77.0	WHITE QUARTZITE, CONTAINS A FEW THIN BANDS OF GREEN ARGILLITE. Upper contact grades upwards from white quartzite into 4" of pale green argillite, which changes colour abruptly to red argillite, with no apparent change in texture. The upper 5' of this bed is sparsely mineralized on surface, but virtually no mineralization is identifiable in the core. 56.2, a few minute grains of chalcocite. 59.7-60.1, red argillite. 63.9, a few specks of chalcocite and malachite. 67.8-68.2, minor chalcocite and chalcopyrite, along fractures, with green argillite pebbles, and with black carbonaceous pebbles. 72.9-73.0, about 1% chalcocite - disseminated and on short fractures. Very minor chalcopyrite. Average recovery is 99%.
77.0	91.0	RED ARGILLITE; APPRECIABLE FINELY INTERBEDDED GREEN ARGILLITE. Grades into red and green sandstone at 87.2-90.0. In places, the red argillite is mottled with green, and the same series of fine sedimentary bands changes vertically from red to green. The green bands commonly have a few quartz grains in them. Average recovery is 71%.
91.0	140.0	GREENISH AND WHITE QUARTZITE WITH INTERBEDDED GREEN ARGILLITE. CONTAINS THREE 1' TO 2' BEDS OF RED ARGILLITE AT 101.5-103.0, 113.0-114.5, 119.0-120.5. 91.2, seam 1/50" x 3/8" of chalcocite along center of a green argillite pebble. 91.6-91.8, a few thin red argillite pebbles. Also at 92.4-92.8. 94.2, ½" band of disseminated chalcocite, lenses out about 4/5 of the way through the core.

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
143.5	146.5												
145.9	-			x									
150.0	155.0												
154.0	155.0			x									

Log of DDH No. WB-1 - cont'd

From	To	Description
		95.1, a few specks of chalcocite in a green argillite pebble. 96.3, minute specks of chalcocite in green argillite selvages. 101.5-103.0, red argillite with a few thin bands of green argillite. 103.2, a few specks of chalcocite. 103.0-103.5, scattered rose quartz grains in the quartzite. 113.0-114.5, red argillite. 119.0-120.5, red argillite grading into red sandstone below. 123.9, a few specks of chalcocite. 124.0-125.0, a few patches of red sandstone. 126.8, a few specks of chalcocite. 128.7, a few calcite stringers 1/8" wide. 128.0-131.9, green argillite - no bedding planes. Average core recovery is 78%.
140.0	143.5	RED ARGILLITE AND RED QUARTZITE. THE QUARTZITE IS BADLY FRACTURED AND IS HEMATITE STAINED. THERE APPEARS TO HAVE BEEN SOME FAULTING. THE SLICKENSIDE PLANES ARE MOSTLY STEEP. Hematite staining on slickenside planes. Average core recovery is 80%.
143.5	146.5	WHITE QUARTZITE INTERBEDDED WITH GREEN ARGILLITE. 145.9, minor chalcopyrite along fractures. Average core recovery is about 90%.
146.5	150.0	RED ARGILLITE. Very fine grained, no quartz layers. Average core recovery is 60%.
150.0	155.0	WHITE QUARTZITE WITH BANDS OF GREEN ARGILLITE. FRACTURE ZONE, WITH SLICKENSIDES. 151.0-152.5 and 154.0-155.0, open fractures; some fractures exhibit slickensides. Minor carbonate on some of the fractures.

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
155.0	203.5												
188.5	-		x			166	35°						
192.5	198.5	x	x			183	25°						
199.4	-	x				202	27°						
202.0	-	x	x										

Log of DDH No. WB-1 - cont'd

From	To	Description
		154.0-155.0, a few specks of chalcopyrite on some fractures; also pyrite. 151.0, a few red argillite pebbles. Average core recovery is 60%.
155.0	203.5	RED SANDSTONE, MINOR AMOUNTS OF RED ARGILLITE. CONTAINS TEN BEDS OF WHITE QUARTZITE, FROM A FEW INCHES TO 3' THICK. THE BEDS FROM 192.5 to 198.5 ARE MINERALIZED WITH BORNITE AND CHALCOCITE. 155.0-157.5, fine grained red argillite. 156.5, a 1" band of sugary textured vein quartz fills in apparent fracture in the red argillite. It has a dip of about 65°. 157.5-157.7, green argillite and green quartzite. 161.3-162.6, white quartzite, with green argillite selvages. 166.0-167.0, selvages of green argillite in the red sandstone. 169.2-170.5, white quartzite, with selvages of green argillite. Also a few red and green argillite pebbles near the bottom. 171.0-175.0, numerous bands of impure white to reddish quartzite. Red argillite pebbles are fairly common. Some beds are contorted, possibly due to penecontemporaneous slumping. Similar red and white quartzite layers at 176' to 178'. 182.7-183.0, white quartzite. 187.8-188.6, greenish white quartzite contains several small pebbles of light grey argillite along one bedding plane. These are well mineralized with extremely small specks of what appears to be bornite. 192.5-195.5, 196.8-197.1, 197.4-198.5, greenish quartzite, with green argillite selvages. Contains extremely fine grained chalcocite and bornite disseminated between quartz grains, and very finely disseminated in several small grey argillite pebbles. Between these beds, there is reddish sandstone, and a few thin layers of red argillite.

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
203.5	212.0												
205.7	207.7	x	x	x									
208.9	211.5	x	x										
212.0	220.5												
214.2	214.8		x			217.5	25°						
220.5	260.0												
221.0	221.5	x				249	20°						
236.5	-				x								
237.8	238.1	x	x										
238.4	240.0	x	x	x									
241.3	241.8	x	x										

Log of DDH No. WB-1 - cont'd

199.2-199.7, greenish argillite. A few specks of chalcocite occur in a streak of reddish quartzite at 199.4 .
201.6-202.5, white quartzite with green argillite selvages. Very minor bornite and chalcocite in some grey argillite pebbles.
202.5-203.5, fine grained red argillite.
Average core recovery is 81%.
Core recovery in the quartzite section from 192½ to 198½ appears to be close to 100%.

203.5 212.0 WHITE QUARTZITE WITH SELVAGES OF GREEN ARGILLITE. SOME SECTIONS MINERALIZED WITH CHALCOCITE, BORNITE, AND CHALCOPYRITE.
205.7-207.7, 208.9-211.5, minor amounts of finely disseminated chalcocite and bornite; also a few grains of chalcopyrite. The chalcocite is usually between the quartz grains, and occasionally in minute fractures. The bornite is usually extremely finely divided and occurs in grey and green argillite pebbles and selvages. The chalcopyrite is in minute fractures.
207.7-208.9, mostly pale green argillite.
Average core recovery is 97%.

212.0 220.5 RED ARGILLITE. ALSO CONTAINS A FEW BANDS OF GREEN ARGILLITE AND WHITE QUARTZITE. MINOR BORNITE MINERALIZATION. The red and green argillite are generally fine grained, and very finely banded.
213.7-214.2, green argillite.
214.2-214.8, white quartzite with bands of green argillite. Very fine grained bornite in some of the grey argillite selvages.
216.1-216.5, white quartzite with green argillite selvages.
216.5-220.5, some slight rumpling of a few argillite beds, possibly penecontemporaneous.
Average core recovery is 87%.

220.5 260.0 WHITE QUARTZITE WITH SELVAGES OF GREEN ARGILLITE. ONE BED EACH OF RED SANDSTONE, AND RED ARGILLITE. MINOR BORNITE AND CHALCOCITE MINERALIZATION. RICH SECTION AT 254.8-256.4.
220.5-221.0, green argillite.
221.0-221.5, minor chalcocite, associated with green argillite pebbles.

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
242.0	-	x	x										
243.0	-	x											
243.7	-	x											
245.5	-	x											
254.0	254.3	x	x										
254.8	256.4	x	x										
257.4	257.7	x											
258.0	258.7	x	x										
259.2	-	x	x										
260.0	289.0												
270.7	270.9	x				277	25°						
279.3	-	x			x								

Log of DDH No. WB-1 - cont'd

From To Description

224.5-225.2; green argillite.
228.2-228.8; red sandstone, thin bands of red argillite.
229.6-230.0, fine grained red argillite.
236.5, a few specks of pyrite on a fracture.
237.8-238.1, a few disseminated grains of bornite and chalcocite. Also at 238.4-240.0, with one grain of chalcopyrite. Chalcocite and bornite also at 241.3-241.8, 242.0, 243.0, 243.7, 245.5, 254.0-254.3.
254.8-256.4, relatively rich section of chalcocite and bornite disseminated mineralization. At 256.3, there is a ½" stringer of massive bornite and chalcocite, 1/40" thick, along the bedding plane in a green argillite pebble, with hairline stringers of mineralization extending across the pebble. Two other pebbles are similarly mineralized.
257.4-257.7; very sparse chalcocite.
258.0-258.7, sparse bornite and chalcocite in green argillite section. Some are streaked along bedding planes where there are a few quartz grains.
259.2, minor chalcocite and bornite.
Average core recovery is 80%.
About 5' of core appears to have been ground in the run between 243.5 and 254.0.

260.0 289.0 RED ARGILLITE. CONTAINS BEDS OF GREEN ARGILLITE UP TO 1' THICK, AND BEDS OF WHITE QUARTZITE UP TO 2' THICK. ALSO SOME NARROW BANDS OF RED SANDSTONE.
260.0-260.8, green argillite.
261.5-261.8; green argillite.
261.8-262.5, white quartzite.
263.7-264.2; white quartzite.
264.2-264.8; green argillite.
264.8-267.5, interbedded red quartzite and white quartzite, with a few thin bands of red and green argillite. Also a few red argillite pebbles.

		Mineralization				Bedding				Assays			
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
289.0	295.7												
289.1	289.4	x	x										
290.1	-	x											
298.2	-	x		x									
294.8	-	x											

Log of DDH No. WB-1 - cont'd

From	To	Description
		268.2-269.5, white quartzite, green selvages. Red pebbles and interstitial filling for bottom 0.5'. 270.4-270.7, green argillite. 270.7-272.3, white quartzite, green argillite selvages and pebbles. A few specks of chalcocite at 270.7-270.9. 272.6-273.2, green argillite and quartzite. 276.0-277.0, red sandstone, minor green quartzite. 278.4-278.6, white quartzite. 279.2-280.0, green argillite and white quartzite , ½" dark band at 279.3 appears to be well mineralized with chalcocite, also a few grains of pyrite. 281.9-283.2, white quartzite, with a few green selvages. At 282.0, a few grey pebbles contain minute specks which may be either hematite or chalcocite. 283.4-283.8, white and green quartzite. Appear to be small ripple marks at the top. 285.8-286.2, reddish quartzite. 287.0-287.3, white quartzite with numerous red argillite pebbles. 287.6-289.0, green argillite. Average core recovery is 93%.
289.0	295.7	WHITE QUARTZITE: FAIRLY NUMEROUS GREEN SELVAGES AND PEBBLES. 289.1-289.4, very fine grained chalcocite and bornite mineralization, mostly in the green argillite, but a few grains are also in the quartzite. In the argillite, it is mostly in very thin plates parallel to the bedding, but there are a few mineralized transverse fractures. 290.1, a few specks of chalcocite. 292.8, chalcocite and minor chalcopyrite rimming green argillite pebbles. 294.8, chalcocite rims green argillite pebbles. Average core recovery is 96%.

		Mineralization				Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
303.5	307.5												
306.1	-	x											
306.2	307.0	x		x									
307.5	357.0												
309.7	310.3	x				352	25°						
335.0	-				x	355	25°						

Log of DDH No. WB-1 - cont'd

From	To	Description
295.7	303.5	RED ARGILLITE, SOME GREEN ARGILLITE AND ONE BED OF WHITE QUARTZITE. 296.8-298.2, white quartzite with green argillite selvages, also at 298.8-298.9. 297.7, minor amount of dark metallic mineral at top of a green argillite band. From the red streak, it would appear to be hematite. Average core recovery is 95%.
303.5	307.5	WHITE QUARTZITE WITH SELVAGES OF GREEN ARGILLITE. 304.0-304.2, band of red argillite. 306.1, minor amount of chalcocite disseminated in a green argillite band. 306.2-307.0, scattered grains of chalcocite, interstitial to the quartz. Also a few grains of chalcopyrite, in or adjacent to, fractures. Average core recovery is 95%.
307.5	357.0	RED ARGILLITE. SHORT SECTIONS OF GREEN ARGILLITE, WHITE QUARTZITE AND RED SANDSTONE. BECOMES INCREASINGLY FINE GRAINED, AS IT GRADES INTO LOWER GRINNELL. 309.4-311.3, white quartzite with selvages of green argillite. 309.7-310.3, a few grains of chalcocite in the quartzite. 311.3-314.0, white quartzite with red pebbles. Red and green argillite at 312.5-313.0. 315.0-315.7, reddish quartzite. Also at 317.4-319.1, 319.6-319.7, 320.1-320.2, 320.8-320.9, 324.6, 324.8-326.2, 334.5-335.0, 341.8-342.0. 335.0, minor pyrite, at least partly on a weak fracture. 347.8-349.5, white quartzite, a few green selvages, and a few green and grey pebbles. 351.5-352.2, reddish quartzite, a few red argillite pebbles. 354.5-355.3, grey and white quartzite, a few green argillite selvages and reddish bands.

Log of DDH No. WB-1 - cont'd

From	To	Description
		355.8-356.7, reddish quartzite; contains a few red argillite pebbles.
		Average core recovery is 97%.
		End of drill hole at 357'.
		Average core recovery for entire drill hole is 85%.
		No radioactivity in drill core.

Mineralization				Bedding		Analyses										
From	To	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	PPM Cu	PPM Pb	PPM Zn	PPM Mo	PPM Ni	PPM Co	Oz/ton Ag
4.0	40.3															
6.6	-	x	x	6.8	25°	KX9601	15.0	16.0	1.0	88	12	61	9	10	12	.009
8.7	14.5	x	x	13.8	25°	KX9602	22.0	23.0	1.0	43	14	65	0	20	20	.018
14.9	-		x	15.5	15°	KX9603	33.5	34.5	1.0	68	213	61	2	5	12	.015
15.3	-		x	19.3	20°	KX9604	40.0	43.0	3.0	239	88	63	2	2	16	.018
17.0	17.1	x	x			KX9605	46.2	50.0	3.8	28	16	25	2	2	5	.006
17.3	17.5		x			KX9606	50.0	55.0	5.0	25	31	25	2	2	5	.006
18.9	-		x			KX9607	55.0	58.5	3.5	7	4	11	0	2	0	.003
19.3	-		x			KX9608	60.0	65.0	5.0	12	6	12	0	2	0	.003
22.6	-	x	x			KX9609	65.0	70.0	5.0	7	8	24	0	5	5	.006
22.7	22.8		x			KX9610	70.0	75.5	5.0	7	2	12	0	5	5	.006
24.1	-		x			KX9611	75.0	80.0	5.0	5	2	16	0	5	5	.006
25.7	-		x			KX9612	80.0	86.5	6.5	10	4	34	2	8	16	.006
33.5	34.5	x														
37.7	-		x													
40.1	-		x													

WATERTON COPPER - Log of DDH No. WX-1

Depth	:	86.5'
Dip	:	90°
Azimuth	:	-
Collar	:	0+00N; 0+00E. 185' at 344° from No. 1 post of Bighorn No. 10.
Elevation	:	6410'
Core Type	:	AX (x-ray)
Started	:	October 9, 1966
Finished	:	November 22, 1966

From	To	Description
0.0	4.0	CASING. No core recovered.
4.0	46.2	SIYEH FORMATION. Grey argillite, a few thin bands of quartzite.
4.0	40.3	LIGHT GREY ARGILLITE. Bedding is not always readily apparent, but still shows up in the parting angle, and in occasional selvages of darker coloured material. Dendritic manganese oxide occurs on a few fracture planes. Usually very fine grained, but occasionally with about 10% quartz grains. Rarely, bedding oriented, thin plates of carbonaceous matter(?). 7.3, ½" band of grey quartzite; edges are irregular, and partly interbedded with argillite. 6.6, 8.7-14.5, 22.6, thin, irregular veining of quartz and calcite, slightly rusty and corroded; dips are usually near vertical. Sparse oxidized sulphides. Mostly pyrite, some chalcopyrite. 8.3, 2" of hairline fractures filled with pyrite (or chalcopyrite?), on one fracture there is discoloured pyrite(?). The amount of sulphides is extremely small, and they are partly oxidized. 13.0, ½" white quartzite band, regular contacts. 14.9, 15.3, 24.1, spherical and semi-spherical pyrite nodules, 1/20" to 1/10" diameter. 17.0, 2" band of impure quartzite. Contains about 1% sulphides, mostly as irregular blebs of pyrite, but there is also minor chalcopyrite. 17.3-17.5, thin pyrite plating and black staining on fractures, and associated with a few quartz grains. 18.5, ½" band white quartzite. 18.9, minor pyrite; also at 19.3, 24.1, 25.7, 37.7, 40.1. 20.0-20.5, several 1" bands of impure quartzite. 22.7-22.8, minor pyrite associated with finely cross-bedded fine grained quartzite.

Mineralization				Bedding		Analyses										
From	To	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	PPM Cu	PPM Pb	PPM Zn	PPM Mo	PPM Ni	PPM Co	Oz/ton Ag
40.3	42.2															
40.3	42.2	x	x	41.5	15°											

Log of DDH No. WX-1 - cont'd

From	To	Description
		24.8, ½" band of grey quartzite. 25.4, 1" band of grey quartzite. 27.0-32.0, core box upset by wind. Core not in correct sequence. Within this footage there is a 2" thickness of very finely banded black and grey argillite. There is also a 5" thickness of light grey quartzite, in which there are numerous flat pebbles(?), about 1/8" to 1/4" thick, and ½" to over 1¼" long of calcareous argillite (or impure limestone). 33.2, a few hairline calcite stringers. 33.5-34.5, grey quartzite, minor pyrite, a few specks of chalcopyrite. 35.5-36.3, fine grained white quartzite, grades into impure grey quartzite on bottom 2". 38.5, core blocked in mud? Average core recovery is 53%, but on individual runs is often 70%.
40.3	42.2	GREY QUARTZITE. Both contacts are gradational with argillite; also contains a few selvages of argillite. Mineralized with about ½% sulphides in ratio of 3 pyrite: 1 chalcopyrite. The sulphides occur as small blebs; many of the pyrite blebs are spherical. Most of the chalcopyrite and some pyrite are in more angular blebs, and appears to replace impurities in the quartzite. There is minor oxidation of sulphides near fractures. This bed is similar in appearance to a quartzite bed which outcrops near the base of the Siyeh on the next ridge, 400' to the southwest (except that in the outcrop, most of the sulphides are oxidized. The casts are similar to the shape of the sulphides in the drill core). Average recovery is probably about 90%, but cannot be determined exactly because of argillite at top and bottom of the drill run. Most of the core loss is assumed to have been in the argillite. (Average recovery for the run from 40.0' to 43.0' is 73%).

Mineralization				Bedding		Analyses										
From	To	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	PPM Cu	PPM Pb	PPM Zn	PPM Mo	PPM Ni	PPM Co	Oz/ton Ag
42.2	46.2															
43.5	44.0	x	x	44.5	15°											
46.2	65.5															
				46.2	12°											
				49.4	20°											
				57.7	22°											

Log of DDH No. WX-1 - cont'd

From	To	Description
42.2	46.2	LIGHT GREY ARGILLITE. Similar to that from 4'-40'. 43.5-44.0, three ½" bands of grey quartzite, each with minor pyrite and chalcopyrite, some in small blebs, and some interstitial to the quartz grains. Average recovery is 70%. Average recovery throughout Siyeh is 56%.
46.2	86.5+	GRINNELL FORMATION. Quartzite; red and green sandstone; red and green argillite. Contact with Siyeh is conformable, and is similar to argillite/quartzite contacts within the Siyeh. The formational contact is at the top of the first thick quartzite bed. Below this there is no grey (or grey-green) argillite which is characteristic of the Siyeh,
46.2	65.5	QUARTZITE. Mostly a white quartzite consisting of glassy to light grey grains. The interstitial material is relatively soft and white; and has an appearance similar to sericite. Infrequently, there are subangular white fragments (1/20") which may have been weathered feldspar fragments. At 47.9, there is part of a concentrically banded oölite (1/30") with a quartz grain nucleus. The rock breaks partly across the quartz grains, and partly around them. At several places, there are varying amounts of green argillaceous material mixed with the quartz grains (up to 70% argillite over sections of ½" to 1"). There are thin, interbedded selvages of pure argillite. Also, small, green argillite pebbles. These are usually at the base of the "muddy" section of quartzite. Very rarely, there are unweathered, hard, black sand grains that could be obsidian. Virtually no core recovered at 58.5 to 59.0, and 62.0 to 63.5. There is a small amount of soft red argillite core, suggesting that this type of rock was present in the lost core sections.

Mineralization				Bedding		Analyses										
From	To	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	PPM Cu	PPM Pb	PPM Zn	PPM Mo	PPM Ni	PPM Co	Oz/ton Ag
65.5	86.5															
70.2	-		x	67.8	20°											
75.5	-		x	69.5	25°											
76.9	-		x	71.4	25°											
				80.0	17°											

Log of DDH No. WX-1 - cont'd

From	To	Description
		Lower contact, with red sandstone, is fairly sharp, against a ½" band of green argillite at the base of the white quartzite, but for 6" above this there is a slight reddish cast to the quartzite. Minor pyrite at upper contact, and at 48.0-48.5, 49.1, 49.7-49.8, 50.9-51.2, 53.1. Green argillaceous sections at 48.0-48.9, 49.4, 49.7, 50.7, 51.2-53.4, 63.5-63.8, 65.5. Red argillaceous sections at 58.5-59.0, 62.0-63.5. 49.7, cavity .7" x .1", containing a few white zeolite crystals. Minor pyrite in adjacent fractures. 49.9-50.4, several near-vertical fractures, some filled with calcite in 1/20" wide stringers. Very weak oxidation (i.e. limonite staining). Also at 55.2-55.4, 63.9-65.1. 51.4, a few reddish sand grains. 53.4, 1" x ¼" green argillite pebble, minute amount of carbonate along lower surface (HCl test). Average recovery is 63%. Average recovery, omitting core lost in soft red argillite bands, (i.e. recovery of quartzite) is 70%.
65.5	86.5	RED ARGILLACEOUS SANDSTONE. Contains selvages of red and green argillite; also red and green argillite pebbles. There are a few short sections of greenish-white quartzite, but it is usually relatively impure. Some of the pebbles have grey or green centers with red borders. Occasionally there is some cross-bedding. Relating this rock to the nearby outcrop in the gully: there is a much higher quartz-grain content in the drill core than is apparent in the weathered rock. 66.8, a few fine quartz stringers. 70.1, a 1/20" layer of calcite occurs below a green argillite pebble. 70.2, minute plates of pyrite in the red argillite, also at 76.9. Also, pyrite plates on a fracture in quartzite at 75.5.

Log of DDH No. WX-1 - cont'd

From	To	Description
		73.0-75.4, relatively pure white quartzite. Has a few hairline fractures, cemented with calcite. Similar quartzite at 75.7-76.2, and 82.0-83.0. 76.7, minute calcite stringers. Also a short quartz stringer in an argillite selvage or pebble. Appears to be quartz crystallized in an exfoliated hollow in the argillite. Average recovery is 72%. Drilling suspended at 86.5'.

Mineralization						Bedding		Assays					
From	To	Chalcocite	Bornite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag
36.0	45.0					40	30°	KX9985	0.0	36.0	0.5	.22	
								KX9986	36.0	45.0	9.0	.01	
								KX9987	45.0	49.5	4.5	Tr	
								KX9988	49.5	52.0	2.5	.02	
45.0	52.0												
51.0	-		x			51	30°						

WATERTON COPPER - Log of DDH No. WX-2

Depth : 52'
Dip : 90°
Azimuth : -
Collar : 10+25S; 8+65E. 400' at 228° from No. 2 Post of Bighorn No. 5.
Elevation : 5790'
Core Type : AX (x-ray)
Started : June 16, 1967
Finished : July 3, 1967

From	To	Description
0.0	36.0	OVERBURDEN. THE UNDERLYING BEDROCK IS LOWER GRINNELL, NEAR THE BASE OF THE LOWER GRINNELL. THE PEBBLES FROM THE OVERBURDEN ARE ABOUT 50% RED ARGILLITE, PROBABLY FROM THE LOWER GRINNELL; AND 50% WHITE QUARTZITE, PRESUMABLY FROM THE UPPER GRINNELL. Most of the quartzite pebbles have some malachite, either coating fractures, or between quartz grains. (In this context the word "pebbles" refers to short pieces of core cut from quartzite boulders). A few grains of bornite, and possibly of chalcocite, are visible in the quartzite. This must have been the source of most of the mineralized core obtained by Frank Goble in an XRT drill hole 5' north of DDH WX-2. Other mineralization may have come from the Appekunny quartzite, which he presumably cut from 45' to 50'. (Total length of pebbles is 0.5').
36.0	45.0	LOWER GRINNELL RED ARGILLITE. Fine grained, virtually no quartz grains. Contains a few narrow bands of green argillite, and possibly two 1/8" bands of green quartzite. Core is badly broken. Average recovery is 23%.
45.0	52.0	APPEKUNNY GREY ARGILLACEOUS QUARTZITE. There is considerable argillaceous interstitial material in most of the quartzite. 50.0-50.3, fairly pure white quartzite; contains a few greenish grey argillite pebbles. 51.0, a few grains of bornite appear to be replacing grey argillite. The outline of the argillite is not very sharp, but it may have been a pebble or a mud flake. 51.8, a 1" band of pure white quartzite. Average core recovery is 43%. End of hole is at 52.0' Average core recovery for the entire drill hole is 37%.

Mineralization						Bedding		Assays							
From	To	Chalcocite	Arsenopyrite	Chalcopyrite	Pyrite	Depth	Calculated Dip	Sample No.	From	To	Length	% Cu	Oz/ton Ag	Oz/ton Au	% Ni
8.0	28.0														
						23	20°	KX9989	8.0	18.0	10.0	Tr			
								KX9990	18.0	28.0	10.0	Tr			
								KX9991	28.0	33.5	5.5	Tr			
								KX9992	33.5	39.0	5.5	Tr			
								KX9993	39.0	45.0	6.0	.01			
								KX9994	45.0	45.5	0.5	.01	.023	.001	.005
								KX9995	45.5	50.5	5.0	.01	.018	Tr	.005
28.0	45.0							KX9996	50.5	55.5	5.0	.01	.018	Tr	.005
44.0	-			x		29	20°	KX9997	55.5	60.5	5.0	.01	.018	Tr	.007
								KX9998	60.5	65.5	5.0	.00	.015	Tr	.007
45.0	65.5														
45.0	65.5		x	x	x										

WATERTON COPPER - Log of DDH No. WX-3

Depth	:	65'
Dip	:	90°
Azimuth	:	-
Collar	:	1+55S; 10+85E
Elevation	:	5800'
Core Type	:	AX (x-ray)
Started	:	July 6, 1967
Finished	:	August 2, 1967

From	To	Description
0.0	8.0	CASING - NO CORE.
8.0	28.0	LOWER GRINNELL RED ARGILLITE. Generally very fine grained. Only a few ¼" bands of whitish quartzite. Also a few thin bands of green argillite. 11.0-12.0, mottled green spots. 21.2, a few pebbles of red argillite in 1" band of impure quartzite. Average core recovery is 48%.
28.0	45.0	APPEKUNNY GREY ARGILLACEOUS QUARTZITE. Contains a fairly high percentage of argillite. The contact is somewhat gradational over about 2'. Virtually unmineralized. 29.0-29.4, fairly pure white quartzite; contains a few greenish grey argillite pebbles. Very similar to the quartzite band in WX-2 which occurs 5' below the base of the Lower Grinnell. Similar quartzite also at 31.5-32.0, and 33.0-34.0, 35.0-35.6. 38.0, thin coating of epidote on a fracture, core angle is 65°. 38.5-39.0, several limonite stained fractures, almost parallel to core length. 40.0-42.5, no core. 44.0, a few grains of chalcopyrite occur in a very small selvage of darker material. There are several near-vertical fractures in the core. 44.5, contact zone, partly fragments in fine grained dyke material. Average core recovery is 37%.
45.0	65.5	PORPHYRITIC DIORITE SILL. Groundmass is moderately fine grained. There is very little chilled margin. Feldspar laths are common, usually in the order of 1/8" x 1/2", but

Log of DDH No. WX-3 - cont'd

From	To	Description
		radiating clusters of crystals contain feldspar laths about ½" x 1½" in size. From 45.0 to 45.5, there are scattered, acicular grains of arsenopyrite, up to 1/8" long. Elsewhere in the core, there are scattered patches of extremely fine grained arsenopyrite, also a few grains of pyrite (or chalcopyrite). Minor epidote occurs along some fractures.
		50.5, 1/8" stringer of quartz, with minor calcite and epidote.
		Average core recovery is 72%.
		End of the drill hole at 65'.
		Average core recovery for the drill hole is 53%.

APPENDIX II: Environmental Diamond Drill Log

WATERTON COPPER - Environmental Log of DDH No. WB-1

From	To	Description
357	307	Red argillite with a few ribbon quartzite beds. The argillite beds are fairly pure mud, and often finely banded. There are very few quartz grains mixed in with the mud. The fine grained nature of the sediment indicates quiet water deposition (but perhaps also a source deficient in quartz grains); the red colour indicates shallow water or subaerial deposition. Presumably submergence was slow and the delta land surface was usually close to sea level, or else deposition was on a very large valley flood plain. The few white quartzite beds, a foot or more thick, indicate a seasonal change in sedimentation rather than a difference in source. From outcrop examination, it is known that even thin quartzite beds have a lateral extent of at least 1500'; that is, an individual bed can be traced along strike, but sections are not easily compared without tracing individual beds because the main divisions of quartzite units and argillite units change considerably in thickness from place to place, and individual laminae within the main units also change in thickness or sometimes pinch out.
307	295.7	Red argillite beds and quartzite beds. The argillite is still predominantly fine grained, but the quartzite beds are thicker than before, and have some very clean sections intimately interbanded with fine grained green argillite. The latter may indicate slightly deep water, i.e. less oxygen.
295.7	287	White quartzite. Bands of green argillite are fairly common. The quartzite "grades into" a 1½' bed of green argillite at the top. This in turn "grades into" red argillite. The "gradational" contacts are fairly sharp, but they are termed gradational because they do not appear to represent a striking change in environment. That is, there are numerous thin green bands in the quartzite, but at the top of the bed

From	To	Description
		it is all green argillite for $1\frac{1}{2}$', perhaps indicating the end of flooding that may have carried in sand grains and caused slightly deeper water (i.e. there is a significant change in grain size, but no colour change). Then there is a change from green argillite to red argillite over about 1"; indicating abundant oxygen, but still a water-lain sediment (i.e. there is a significant change in colour, but no change in grain size). Some of the mineralization is very finely distributed between cleanly washed sand grains. Some are in the coarser sand that sometimes accumulates immediately adjacent to pebbles (i.e. in their current shadow). Some are in thin streaks of quartz grains in the argillite bands, and also in fine grained argillite; but this only occurs where the adjacent clean quartzite is also mineralized. For the most part these are the places where one might expect to find syngenetic mineralization occurring; but it is also where one would expect to find remobilized mineralization. Some mineralization appears to partly replace argillic material or mafic constituents in argillite pebbles; or occurs along fractures, or occurs in minute veinlets in argillite pebbles or bands. A fracture associated occurrence is more common with chalcopyrite than with chalcocite or bornite.
287	260	Red argillite. Contains a few thin bands of green argillite, and a few bands of quartzite, both red and green. The red quartz-grain rock is usually termed sandstone in this log because it is usually more impure and less well cemented; the green and white quartz-grain rock is somewhat better cemented, with fracture being partly across, and partly around the grains, and is usually termed quartzite. However, the chief difference between red and green sediments is the higher oxygen content of the iron oxide in the red sediments, and the greater prevalence of

From	To	Description
		quartz in the greenish sediments. This is assumed to indicate periods of varying water inflow and depth, probably related to climate, either of short term or seasonal duration. A few argillite "pebbles" are present. These are somewhat more common near the base of the quartzite beds. It is reasonably certain that they were emplaced as mud flakes rather than as stony pebbles. They appear to be exactly the same as the argillic sediments; some of them appear to have been slightly bent at about the time of burial rather than after lithification; and they rarely sink into the underlying sediments, indicating they were probably still porous and light. There are two common sources of such mud flakes. One is mud that has been exposed to the air and cracked; if there is a finer grained top layer, this will peel off in flakes and be swept along in the next flood stage. The other source (particularly suggested for the green mud flakes) is clay that was laid down in thin layers between sand beds. Subsequent erosion would easily remove the sand as grains, but the mud has enough cohesiveness to remain as flakes.
260	220	Green and white quartzite, with some green argillite. One short band each of red argillite and red sandstone seem to indicate that only a slight change in conditions was needed to produce a colour change. There is a 1' bed of fairly pure green argillite at both top and bottom of the unit, perhaps indicating slightly deeper water before and after deposition or reworking of the sand grains. The section from 256.4 to 254.8 has the best mineralization in the drill hole; yet there is nothing to indicate why it should be better mineralized than the other white quartzite beds. There is not enough mineralization in the entire drill hole to make well documented statements about where miner-

Environmental Log of DDH WB-1 - cont'd

From	To	Description
		alization occurs, but two things seem obvious (if this is syngenetic mineralization). First, local conditions of deposition are important; there is no mineralization in even thin bands of red argillite or red sandstone within a mineralized unit of white or green quartzite. Second, the amount of copper coming in from the source must also vary with seasonal variations in precipitation because many of that bed that appear to be favourable are unmineralized.
220	212	Red argillite with only minor white quartzite. Weak mineralization in the quartzite even though it is a thin bed.
212	203	Clean white quartzite, with a 1' band of pale green argillite in the center. No green argillite at upper or lower contacts. The mineralization is generally similar to that in the less pure green argillic quartzites.
203	140	Red sandstone with lesser amounts of red argillite, and narrow bands of impure white or green quartzite. Some of the quartzite beds are mineralized, indicating very little change in sedimentary conditions was needed to deposit copper minerals. The quartzite beds become thicker toward the top of the unit.
140	91	Green and white quartzite. Similar in appearance to the quartzite unit at 260 to 220, except that there is no green argillite bed at the bottom or top (although there is some green argillite near the top of the underlying red argillite); and except that mineralization generally is somewhat weaker, and there is no relatively rich section near the bottom.

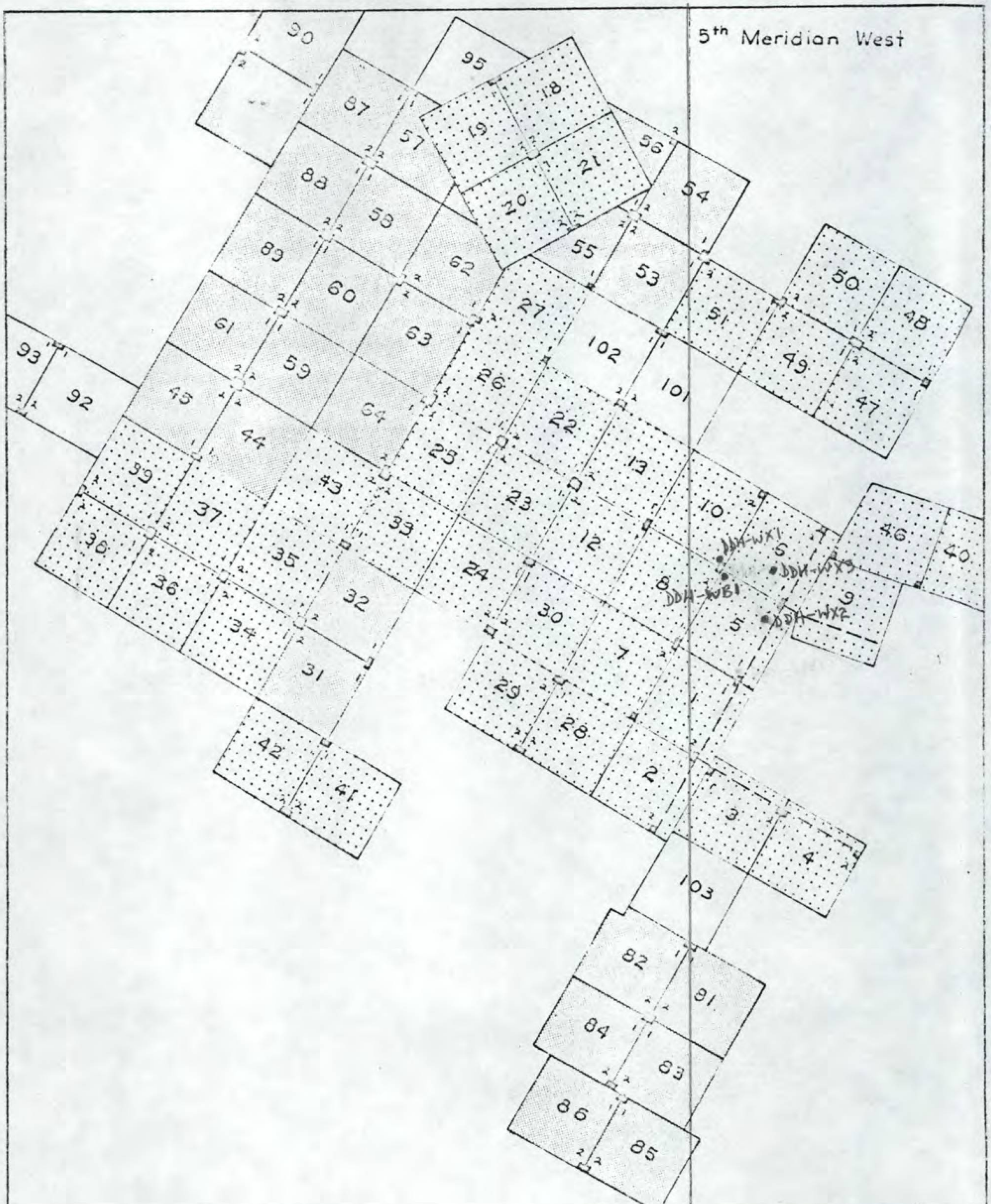
Environmental Log of DDH WB-1 - cont'd

From	To	Description
91	77	Red argillite, probably deposited under conditions slightly deficient in oxygen because there is a moderate amount of green mottling in the argillite.
77	52	White and green quartzite. It is fairly uniform throughout. Mineralization is sparse, but as in some other beds, there is slightly more mineralization in the lower half of the bed.
52	14	Red argillite predominates in the lower half of the unit, but the grain size is coarser in the top half, i.e.- mostly red sandstone. There are a few thin beds of white quartzite but virtually no mineralization, perhaps indicating a lack of copper in the source; either because of seasonal conditions, or because the source copper body has been eroded away.
14	0	White quartzite with a few narrow bands of red argillite. The lack of mineralization may indicate a change of source, since the bed is similar to other mineralized quartzite below (except for a little less green argillite).

The sudden appearance of thin dark carbonaceous beds at the base of the Siyeh indicates more rapid submergence of the basin. That is followed by deeper water sedimentation in the form of grey shales, and dolomite.

End of log.

PLATE No. 1 114° 00' W 19680021



Legend

Claim-outline & number	4
Claim line & posts	
Group No. 1	
Group No. 2	
Ungrouped	

KENNCO EXPLORATIONS (WESTERN) LIMITED

Waterton Copper Project
Waterton Alberta

Claim Plan

DATE: 24/10/67	DRAWN BY:	PLATE NO.: 1	
REVISED BY	DATE	SCALE: 1" to 2640'	