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PRELIMINARY REPORT

on

THE GEOLOGY OF THE ANYOX-MAP AREA, WHICH INCLUDES THE HIDDEN CREEK AND BONANZA COPPER DEPOSITS.

BY

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HIDDEN CREEK / ANYOX (103P 021)

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C O N T E N T S.

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INTRODUCTION

General Statement.

It is the aim of the following short preliminary report to present the more important results of the geological field-work carried on in the immediate vicinity of Anyox during the past summer. Because the weather was exceptionally favourable and also owing to the fact that in succeeding years the traversing of the surrounding forested area will become progressively more difficult through the falling of the trees which, within the area examined, have been universally killed by the fumes from the smelter, the maximum effort was directed to geological mapping and to a careful examination of the large number of outlying mineral claims held both by your Company and by other interests. Comparatively little time was devoted to a detailed study of the geological relations of the obviously extensive and valuable "Hidden Creek" and Bonanza copper deposits; nor was there opportunity to examine the "Red Wing" group of mineral claims on Glacier Creek which are owned by your Company. The aim of the present preliminary report is merely to report progress and explain the geological relations as displayed on the accompanying map; in the following summer when the

field work has been completed, a final detailed report will be prepared.

During the summer of 1916, Mr. F. 3. Falconer of the Geological Survey of Canada prepared an excellent topographical map of an area embracing about 20 square miles in the vicinity of Anyox. Manuscript copies of this map on a scale of 1000 feet to an inch with a 20 foot contour interval were generously supplied to the writer by Mr. W. H. Boyd, Chief of the Topographic Branch of the Geological Survey. One of these manuscript copies served as a basis for the geological map accompanying this report. On this map, there have been placed the boundaries of the numerous mineral claims held by your Company within the area.

The writer is deeply indebted to many of the mine officials and especially to Mr. E. E. Campbell, the Superintendent of Mines at Anyox, and the Assistant Superintendent, Mr. F. E. Patton, who in every possible way facilitated the prosecution of the work. In the course of mining operations, Messrs. Campbell and Patton had systematically gathered much valuable geological information and the writer thus found himself in an atmosphere of mutually helpful suggestion and criticism.

Previous Work.

In 1911, Mr. R. G. McConnell, now the Deputy-Minister of Mines in Ottawa, made a hurried geological reconnaissance of the upper reaches of Observatory Inlet including the area within

which Anyox is situated. In 1913 he also spent a few days re-examining the "Hidden Creek" and the "Bonanza" copper depo

Undoubtedly it was due to inadequate time for the necessary detailed work that he regarded the green schists at Bonanza mine as altered argillites and "the greenish chlorite schists" of the No.2 ore-body of the Hidden Creek mine as "pro bably of sedimentary origin, but the original characters have been entirely obscured by the repeated metamorphism of the re In another report, he states that "Beds and bands of greenston probably largely of pyroclastic origin occur with the argilli and constitute the country rock of the second ore-body." +2

He thus failed to recognize that all of the greensto and green schists within the Anyox-map area are in reality the more or less intensely metamorphosed equivalents of extensive bodies of an intrusive porphyrite and that the ore-bodies of Hidden Creek and Bonanza occur in the immediate vicinity of the contacts between the bodies of altered porphyrites (amphibolit and the argillites.

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+1 Summary Report of Canadian Geological Survey,1913,pp.55-57.
+2 Canadian Geological Survey, Memoir 32, p.85.

GENERAL GEOLOGY

General Statement.

The broad central portion of the Coast Range of British Columbia and Southern Alaska is chiefly composed of vast bodies of granite, granodiorites and allied rocks which here and there enclose areas, usually small but occasionally large, that are underlain by more or less altered remnants of those formations into which the granitoid magmas advanced. These scattered areas are underlain by variable proportions of sedimentary and volcanic rocks, schists, slates, crystalline limestones and greenstones.

From a mining point of view, the economic possibilities of the Coast Range are restricted to these isolated areas and to the flanks of the Range in the vicinity of granitic rocks. Prospecting operations should be confined to such areas which are very favourable to the occurrence of valuable mineral deposits, and although the topography is very rough, the Range is so deeply dissected by fiords that a very large proportion of its total area is accessible. To my mind, there is no known portion of Canada of similar area which gives more promise of reward to systematic prospecting than these favourable areas within the Coast Range.

Anyox is situated within such an area of sedimentary rocks and greenstones that, lying within the heart of the Coast Range, is completely surrounded by granitic rocks. The boundaries of this area, which probably comprises at least 125 square miles, have not been exactly defined, but it is known to extend westward

"Granby Extension" Claims

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& 10.

"Rambler" & Quartz Vein

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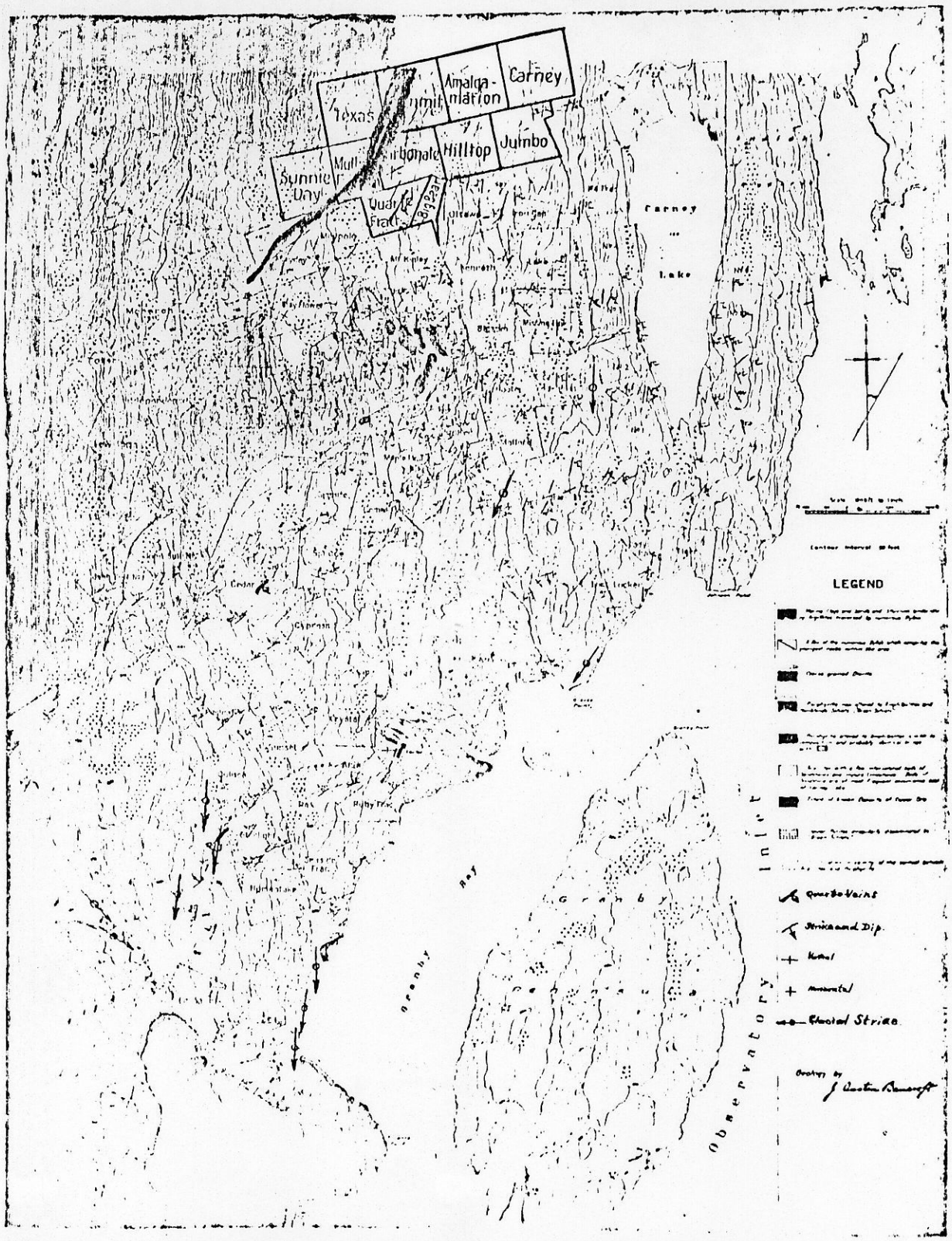


Plate 4 showing position of "Granby Extension" Group of Claims and position of Quartz Veins referred to in Report.

and northward from Granby Bay to Portland Canal, while to the south-eastward it rapidly narrows and probably terminates a short distance inland from the south-eastern shore of Observatory Inlet. On the north-western shore of Observatory Inlet this area has a width of nearly nine miles, while on the opposite or south-eastern shore it is approximately two miles wide.

THE ANYOX-MAP AREA.

The geological map which accompanies this report includes about 20 square miles in the immediate vicinity of Anyox; hence it embraces only a comparatively small fraction of the larger area referred to in the preceding paragraph, and it does not include any part of the irregular granite contact which forms the boundary of the larger area.

The Anyox-map area is underlain by argillites and greenstones both of which are traversed by a multitude of dykes. In places, the argillite series includes a few intercalated beds of sandstones and occasional irregular bands of impure limestones. These sedimentary rocks have been much folded and in very many localities have been intricately crumpled. The greenstones, which in part are schistose, are the more or less altered equivalents of extensive bodies of fine-grained porphyrites which are intrusive into the argillite series. The ore-deposits within the area have developed through processes of replacement and are distributed along and in the immediate vicinity of the contacts between the argillite series and the altered porphyrites. The argillites are frequently

intersected by narrow quartz veins; in a few localities, these veins attain large dimensions, and occasionally carry irregularly scattered grains of one or more of the following minerals - pyrite, pyrrhotite, zinc blende, chalcopyrite and galena. The area is traversed by a few faults trending approximately north and south; the most prominent of these faults is responsible for the sharp offsetting of the contact between the argillites and the greenstones where this contact crosses Falls Creek.

The argillite series, the greenstones, the quartz veins and the ore-deposits are traversed by a vast number of dykes of different ages, which are very variable in their dimensions and include a great variety of rock types. Some of these dykes constitute the youngest rocks within the area.

During the Pleistocene Ice Age, the region was occupied by a confluent ice-sheet which, during its maximum development, covered all or the mountains that now have altitudes of less than 6,000 feet. Within the area embraced by the Anyox map, the general movement of the ice-sheet was towards S5°-20°W.; but, in places, topographic irregularities were responsible for very marked deviations from the general direction. Glacially transported boulders of copper-ore are of frequent occurrence within that portion of the district over which the ice-sheet moved after having crossed the areas within which ore-deposits are known to be located. After the recession of the ice-sheet, the land stood a few hundred feet lower than it does at present, and what are now the lower lands were then occupied by the sea. Hence, that

broad embayment of lowland, which lies between the "beach" port of the town of Anyox and the foot of the hills on which the"min town is situated, is almost universally underlain by stratified and sands that were deposited under marine conditions.

THE GRANBY BAY ARGILLITE SERIES.

All of the sedimontary rocks within the area belong to series which is almost entirely composed of argillites; in addit the series includes a few intercalcated beds of sandstones and occasional bands, usually narrow and very irregular, or impure limestones. These sedimentary rocks are the oldest rocks within the area.

The argillites are fine-grained, compact rocks which va from black to light gray in colour; usually beds of dark gray col predominate. The individual beds vary from less than an inch to three or four feet in thickness. Frequently even the thickest bed display a remarkably fine variegated banding which corresponds to the bedding. In common with shales, the argillites represent consolidated ~~sands~~ muds, but they differ from shales in that they occur in distinct beds which do not break or fracture along planes of lamination.

For the most part, these argillites are composed of extremely minute grains of quartz, together with a few particles of feldspar, kaolin, flakes of sericite, and much finely diffused

carbonaceous material. Occasionally grains of calcite, a little chlorite, a few small flakes of biotite and muscovite, extremely minute grains and prismatic crystals of rutile, and frequently more or less abundantly disseminated grains of pyrite and pyrrhotite are also present. Variations in the colour of the argillites chiefly depend on the relative abundance of the dust-like particles of carbonaceous material; weathered surfaces are frequently reddish or rusty in appearance because of the oxidation of disseminated grains of the iron sulphides.

To the east of Carney Lake, intercalated layers of feldspathic sandstone are of very frequent occurrence within the argillite series. On the summit of the highest ridge (about 600 feet above sea-level) between Carney Lake and Hastings Arm, massive beds of coarse-grained feldspathic sandstones aggregate 300 feet or more in thickness, individual beds, some of which are 8 and 10 feet thick, being separated by thin bands of argillites. Within that portion of the area westward from Carney Lake, layers of sandstones are present in some localities but they are comparatively thin and usually fine-grained.

Thin bands of impure limestones or calcareous argillites are more widely distributed. These very impure limestones form but a small fraction or one per cent. of the whole sedimentary series. Usually, the individual bands pinch and swell in a very irregular

manner; often they may be traced only a few feet or yards along the strike. Successive layers of these calcareous argillites rarely, if ever, exceed a few feet or yards in thickness in any one locality and usually they are more or less intricately folded. Frequently they contain ~~or are associated with~~ irregular calcareous concretions; upon weathering, both the impure limestones and the concretions often give rise to irregular hollows and cavities on exposed surfaces.

No fossils have been found within the Granby Bay Argillite Series and hence their geological age has not been definitely determined. Certainly they are older than the Coast Range granite rocks which intrude them and which in other portions of the Coast Range have been found to range from Upper Jurassic to Lower Cretaceous in age. It is probable that the argillites were deposited either during the Carboniferous or the Triassic periods. From an economic point of view, the age of the rocks is not of essential importance but emphasis must be given to the important fact that prior to the advance of the granite magmas of the Coast Range, the argillite series had been intruded by extensive bodies of porphyrites which have been altered to greenstones and "green schists".

ALTERED PORPHYRITES OR AMPHIBOLITES.

Within the Anyox-map area, there are two separate areas underlain by altered intrusive porphyrites or amphibolites; westward, both of these areas pass beyond the limits of the map and it is the

belief of the writer that at some distance in this direction it will probably be found that both of these areas belong to one and the same intrusive body of porphyrite. For the present, however, they will be considered as separate, the larger or Northern area occupying the whole north-western portion of the map, and the smaller or Southern area, lying to the westward of Bonanza creek and extending from its mouth for about three-quarters of a mile upstream. Immediately north of the central portion of the map, the Northern body of amphibolites sends forth an arm which expands into an area with curved boundaries that has a maximum width from east to west of about 2,500 feet, and a length from north to south of 3,000 feet; along and in the vicinity of the southern and eastern contacts of this subsidiary area, the known Hidden Creek copper deposits are situated. About three-quarters of a mile up Bonanza creek, the Bonanza copper deposit is situated in the vicinity of the eastern contact of the Southern body of altered porphyrites.

The terms "greenstones" and "green schists" proved to be convenient field names for the more massive and the more schistose phases, respectively, of these altered porphyrites. Within all parts of both the Northern and the Southern areas, these rocks have been more or less intensely metamorphosed and are more or less greenish in colour.

In the Southern area they are almost universally foliated, though not schistose, except in a very few places near their contact

with the argillites; viewed broadly, they are slightly coarser in grain and contain a larger percentage of visible hornblende than the porphyrites of the Northern area. Nevertheless many specimens may be collected in one area which are identical in appearance with those from the other area.

In the Northern area, the altered porphyrites are more universally massive or but faintly foliated, the foliation becoming more pronounced along broad zones of shearing or locally in the neighbourhood of their contact with the argillites. Within the immediate vicinity of Hidden Creek mine they have been rendered schistose and have been appropriately called "green schists" by the officials engaged in operating the property.

In general, these altered porphyrites have the composition of altered andesites. Usually, they are fine grained; it is only in places that they now display the porphyritic structure which warrants their being called "porphyrites". Under the microscope, they are found to be chiefly composed of a meshwork of fibrous green secondary hornblende, fine needles of which penetrate remnants of grains of plagioclase; variable amounts of chlorite, epidote, secondary quartz and small disseminated grains of magnetite are present, as well as occasional grains of one or more of the following minerals:- biotite, sphene, zoisite, pyrite and pyrrhotite. Where schistose, these rocks usually contain large proportions of

chlorite and quartz, and, in places, abundant small fibres of actinolite. Ore-bodies No.2 and No.3 at the Hidden Creek mine lie within green schists of this character and very close to their contact with the argillites.

CONTACT METAMORPHISM OF ARGILLITES AND PORPHYRITES.

In very many places in the vicinity of their contact with the bodies of altered porphyrites, the argillites have been extensively silicified, viz., converted through processes of replacement and recrystallization into dense, fine-grained rocks of light gray colour which retain all the details of stratification and under the microscope are found to be chiefly composed of a fine mosaic of quartz grains and flakes of muscovite with occasionally some biotite, a little chlorite and usually more or less abundantly scattered grains of iron sulphides. When in the vicinity of the contact with the altered porphyrites, the argillites include bands of impure limestones, the calcite within them has been recrystallized while silicification was in progress; occasionally within these limey bands, actinolite and tremolite have been developed. In fact, irregularly disseminated grains of calcite are of very frequent occurrence in many places where the argillites have been silicified; it is impossible to determine whether this calcite was brought from depth by the silica-and sulphide-bearing waters, or whether it represents a redistribution of the calcite content of former calcareous bands of argillites.

That these processes of silicification and m
not only attended the intrusion of the porphyrites but
active while the porphyrites were being foliated and i
sheared into schists, is clear from the field relations.
that there were two distinct periods of silicification,
accompanying or immediately following the intrusion of t
porphyrites and the other contemporaneous with or subseq
development of foliation in these rocks; the evidence is
it having been one continuous and prolonged performance.

In some places along the northern contact of the
or Bonanza body of porphyrites, great slabs of argillites w
rifted off by the advancing magma are more or less completel
silicified while the porphyrite enclosing them is to-day mas
and shows no trace of silicification. On the other hand wher
in the vicinity of the contact with the porphyrites the argil
have been extensively silicified, the marginal portions of the
altered porphyrites (greenstones) have also been more or less
silicified and mineralized; especially is this true where in the
vicinity of the contact, the greenstones are schistose, the degre
of silicification of the greenstones in such localities depending
upon the extent to which they have been foliated.

The above considerations are important from an economic
point of view because the development of the ore-bodies at

Hidden Creek was coincident with the extensive silicification of the argillites and to a much less degree of the greenstones in their vicinity.

Frequently where in the vicinity of their contact with the bodies of altered porphyrites the argillites have not been silicified and also in the immediate neighbourhood of a few of the larger dykes in the area, the argillites display a spotted or "knotted" appearance. The spots or "knots" are somewhat lighter in colour and are also harder than the argillite bands within which they have developed; on weathered surfaces they frequently stand out prominently in relief attaining a maximum of about two inches in length and an inch across. This development is due to partial recrystallization of the argillites, each "knot" being composed of a mosaic of quartz grains with abundant flakes of biotite and muscovite. Such spotted argillites are especially well developed in places in the vicinity of the porphyrite-argillite contact which crosses the "Maypole", "Mayday", "Mayflower" and "Gama" mineral claims.

DIKE ROCKS.

A vast multitude of dikes traverse all of the other rock-types in the area. In general, the more massive or faintly foliated phases of the altered porphyrites (greenstones) resisted fracture much more readily than the comparatively brittle and stratified argillites, and hence dikes are much more numerous in those portions of the area

underlain by the Granby Bay Argillite Series than within the area of greenstone. A majority of the dykes traversing the argillites assume directions approximately coincident with the strike and dip of the planes of bedding; but many others cut across the bedding in any direction and dip at all angles. Especially in localities where the argillites have been much folded and crumpled or in certain places in the vicinity of the contact between the argillites and the more resistant greenstones, veritable swarms of dykes are present. That the dykes have thus been injected in localities where least resistance was offered to their advance is likewise evidenced by the frequency with which they appear in local swarms along the inner margin of the silicified zone that in places lies between the unaltered argillites and the greenstones, and also in those localities within the greenstone areas where schistosity is most pronounced.

The vast majority of the dikes are less than three feet in width; a xxxx considerable number of them, however, range from three to twenty-five feet in width; while a few of them are between twenty-five and forty feet wide.

The large, more or less irregular dike-like mass of coarse-grained diorite or gabbro-diorite which forms the steep face of the southern slope of the prominent ridge or escarpment that occupies the northern portion of the Mayday and Maypole mineral claims, and which passing eastward across West Hidden Creek suddenly curves to the north along the contact between the greenstones and the

argillites, attains a maximum width of about 800 feet, This dike-like mass constitutes the largest body of coarsely crystalline rock in the area. It is dark, grayish-green rock of plutonic character. About two-thirds of its volume is hornblende while the remainder of the rock is composed of plagioclase, with a few flakes of biotite, some chlorite, abundantly disseminated small grains of magnetite and a few widely scattered grains of pyrrhotite; some of the hornblende has the appearance of having been developed from augite.

Some of the dikes extend for hundreds of yards maintaining a constant strike and remarkably uniform width. It is quite common within this area for a small stream to flow along a dike for hundreds of feet or yards at a stretch. Many of the dikes are, however, extremely irregular, varying much in their width and twisting and turning both as regards their strike and their dip.

The dikes include a great variety of interesting rock-types - diorites, diorite-porphyrites, malchites, gabbro-diorite porphyrites, diabases, kersantites, bostonites (felsites), minettes, quartz porphyries, aplites and pegmatites, etc. In colour, they vary from white or light gray in the bostonites, granites, aplites, pegmatites and many of the quartz porphyries, through various shades of gray to the very dark gray or black of some of the diorites, diabases and kersantites; some of the latter display a slightly greenish tinge because of incipient decomposition. The only granite dikes observed in the area are distributed along and within a few hundred yards of the shore between Falls and Bonanza creeks where

they traverse argillites; westward from the mouth of B several dikes and small bodies of granite outcrop promi two or three pegmatite dikes were observed in the area; these are in the vicinity of the Bonanza ore-body, - no coarse-grained pegmatite dike that crosses Mineral creel flowing across this ore-body, enters Bonanza creek from Aplite dikes are not common, but are well exemplified by dike which outcrops about 1000 feet N.N.E. of Bill Hanna on the Quartz Fraction mineral claim which belongs to th Extension group of claims; Hanna did some prospecting wo dike but his was a forlorn hope.

With the exception of granite, aplite and pegma all of the other varieties of dikes mentioned above have encountered in the workings of the Hidden Creek mine.

That the dikes have been successively injected i the frequency with which they intersect each other; in som one can distinguish dikes of at least five successive ages. number of granite, pegmatite and aplite dikes within the ar nowhere observed to intersect other dikes, although they a dark dikes; there are so few of these light coloured granit that it cannot be stated with certainty that they are the o the area. Apart from these granitic dikes, however, the dark dikes (augite-kersantites), which are of frequent occurrence

widely separated points, are older than any of the other dike
mica-dikes were followed in turn by a series of dark dikes (d
diorite porphyrites, etc.,) which are intersected by light col
dikes (quartz porphyries and bostonites) and these are in turn
a successive series of dark dikes which constitute the youngest
in the area.

All of the different varieties of dikes traverse both
bodies of altered porphyrites (greenstones) and the Granby Bay A
Series. None of the dikes display any tendency to foliation and
it is concluded that all of them were injected subsequent to the
development of foliation and schistosity in the greenstones. More
it is plain that the porphyrites were altered to greenstones and w
foliated and in places rendered schistose immediately prior to or
during the advance of the extensive bodies of Coast Range granites.
With these facts in hand and from his previous experience in
geological work on the coast of British Columbia, *1 the writer con-
cludes that while a few of the dikes (the granite, pegmatite, aplite
and coarse gabbro-diorite dikes) within this area were injected
during some stage in the invasion of the region by the Coast Range
granites, the intrusion of the vast majority of the dikes marked the
closing down of this prolonged period of igneous activity.

Although the dikes include a great variety of rock-types,
they are of little economic interest except in so far as they aid in
working out the geological history of the ore-deposits and serve as an

*1. "Geology of the Coast and Islands between the Straits of Georgia and Queen Charlotte Sound, B.C." by J. Austen Bancroft, Can. Geol. Surv. Memoir No. 23, pp. 111-119.

index of the amount of deformation that the area has experienced since the dikes were intruded. All of the dikes are later than the ore-deposits; where they traverse the ore-bodies, their contacts are sharply defined and they display no evidences of having been bathed by silica and sulphide-bearing waters; in some instances, they include angular fragments of ore and silicified wall rock.

Immediately adjacent to some of the dikes, where they intersect the ore, the copper values are somewhat higher than in adjacent portions of the ore-bodies. Apparently the waters, which attended or followed the intrusion of some of these dikes, dissolved some of the chalcopyrite in the ore and redeposited it in the vicinity of their contacts; in other words, the dikes did not introduce new copper values but to a very minor degree redistributed the previous copper content of the ore.

Some of the dikes are locally cut by narrow veins of calcite and zeolites with occasionally a little quartz. Especially is this true where the dikes cut the greenstones or green schists; frequently irregular veinlets of these minerals also traverse the green schists. In the course of mining operations cavities within these narrow veins are occasionally encountered which are lined with beautiful crystals of calcite and zeolites; the most common zeolites in this locality are apophyllite and natrolite.

So numerous are the dikes traversing some of the ore-bodies

that in mining they impose the necessity of handling considerable barren rock. Especially will this prove to be the case in connection with working the Bonanza copper deposit on Bonanza creek. The geological plan of the 385 level of the Hidden Creek mine that accompanies this report shows that 56 dikes have been encountered in the workings on this level.

STRUCTURAL GEOLOGY.

The area has passed through two periods of major deformation, the first prior to or contemporaneous with the intrusion of the bodies of porphyrite, and the second when the region was invaded by the Coast Range Granites. From the point of view of geological time, it seems quite probable that the second period of deformation followed soom after the first. The argillites have been subjected to both of these periods of deformation; it was during the second period that the porphyrites were altered to amphibolites or greenstones and in part to green schists.

The argillites are much folded and in places are intricately crumpled. Some of the folds and even the minor crumplings are overturned toward the southeast; an excellent example of such an overfold is well displayed on the cliff immediately east of the Hospital at "the beach".

On the accompanying geological map, numerous observations of the strike and dip have been recorded. A glance at this map will serve to show that although the argillites are locally crumpled, their

general strike is roughly parallel to their contact with the Northern body of altered porphyrite. Except in the vicinity of the Southern or Bonanza body of altered porphyrite, the argillites within the southern and western parts of the area strike in a general north-easterly direction while turning in sympathy with the contact of the Northern body of porphyrite, their general strike becomes nearly N. to S. in the eastern and northeastern portions of the area. In general along the southern contact of the Northern body of porphyrite (greenstone), the argillites dip steeply (usually at angles which exceed 45°) beneath the greenstone; in many places, they "roll" along their dip in a complicated manner; in a few places, the argillites assume vertical positions along this contact.

The strike of the argillites curves most sharply from N.E. to approximately N. about the southeastern and eastern borders of the expanded arm of greenstones which protrudes eastward from the main Northern body of greenstone and occupies a position north of the approximate centre of the map-area. It is along and in the vicinity of this sharp curve in the contact between the greenstones and the argillites that the ore-bodies, Numbers 1 to 5, of the Hidden Creek mine are situated. Along the southeastern portion of this curve, No. 1 ore-body lies within the silicified argillites which are in contact with and dipping steeply to the N.W. beneath the greenstones (or "green schists"); here the argillites not only are much crumpled

along their strike but they"roll"or are corrugated in a complicated manner along their dip.

Along the southern portion of the eastern border of the sharp curve in the contact (referred to in the preceding paragraph) between the greenstones and the argillites, the greenstones extend for a few hundred feet eastward beneath the argillites, and where the greenstones terminate, the argillites turn so that they dip beneath them. Numbers 4 and 5 ore-bodies have thus been outlined by drilling through unaltered argillites exposed at the surface. The uppermost portion of No. 4 ore-body approaches at one point to within 110 feet of the surface and lies in the upper part of the zone of silicified argillites that are resting upon the altered greenstones, while to the eastward No.5 ore-body lies within silicified argillites that are dipping N.W. and W. beneath the eastern margin of the greenstone. Ore-bodies No. 2 and No.3 lie completely within schistose greenstones; prior to being eroded, the upper portions of these ore-bodies were certainly in direct contact with and probably extended into the argillites which then covered them.

In the immediate vicinity of the Southern or Bonanza body of porphyrites, the strike of the argillites is ever parallel to the contact. The argillites thus enwrap this body of porphyrite, and the contact passes beneath the argillites at low angles that vary from 12° to 40°. The Bonanza ore-body, about three-fourths of a mile up

Bonanza creek, dips eastward at an angle of about 20° and lies at the contact between the argillites and the porphyrite; in this locality both the marginal portions of the body of porphyrite and the adjacent argillites have been recrystallized and mineralized.

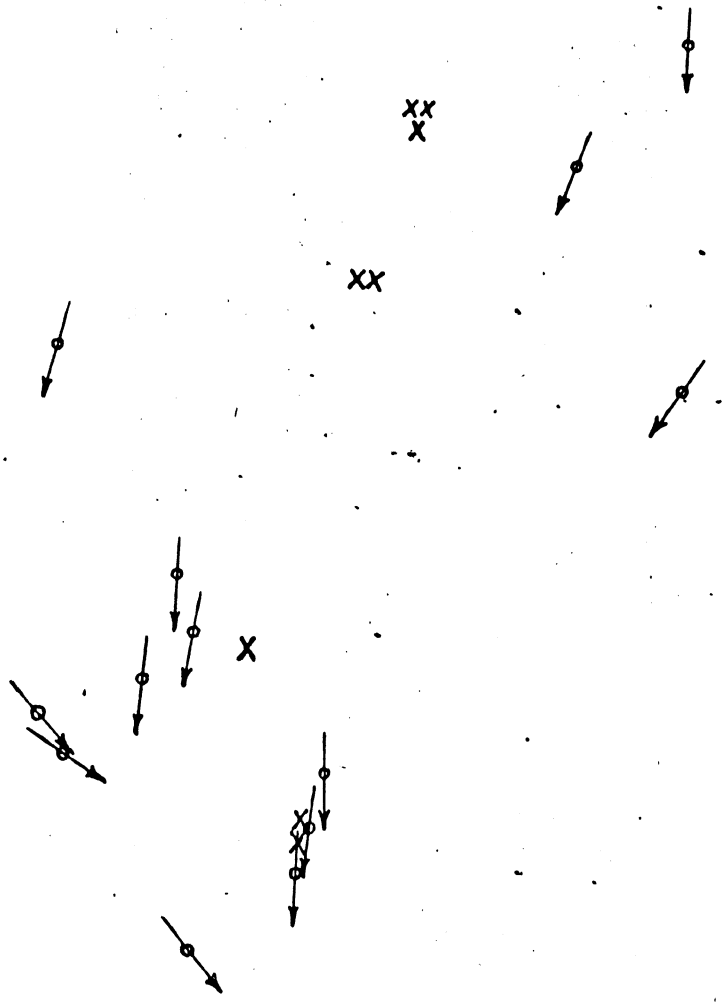
It was apparently during the time when the bodies of porphyrites were being altered and foliated (viz., during the intrusion of the Coast Range granites) that the area was traversed by faults which trend approximately N. to S. The only prominent fault observed within the area is the cause of the sharp offset in the southern contact of the Northern body of porphyrite where this contact crosses Falls Creek. Striking approximately N. to S. this fault has a throw or downward displacement of several hundreds of feet on its west side. Southward, it was found impossible to trace this fault in the crumpled argillites, but where it passes from the argillites to the greenstones, a heavy fault breccia is developed which is best exposed about a mile above the dam on Falls Creek. Within the breccia at this point, abundant angular fragments of both greenstones and argillites are present.

In numerous other parts of the area, zones of intense crumpling and shearing associated with minor faulting likewise trend approximately N. to S. with minor throws downward toward the west. The Eastern Branch of Hidden Creek for several hundred yards above the portal of Tunnel 150 has cut a deep valley along such a line of

weakness as is shown by the crumpling of the argillites and the frequent occurrence of the slickensided surfaces of minor fault planes.

That the dikes were injected later than the major crustal disturbances which produced the intricate folding of the argillites, the fault on Falls Creek and the zones of intense crumpling and minor faulting, such as the zone displayed along East Hidden Creek, is shown by the fact that dikes in such localities have not been cut off and displaced to any important degree. That crustal readjustments continued or were occasionally repeated to a minor degree along such zones after the intrusion of some of the older dikes is demonstrated by very minor folding and minor offsets in some of these dikes. The majority of the dikes do not continue across but die out within these zones of disturbance; in most instances, the few dikes which were successful in making their way across are very irregular in width and assume devious courses.

Throughout the whole area, irregularities in strike and dip of individual dikes are almost always due to the irregular manner in which the fractures that they occupy sought out lines of least resistance. That at least minor crustal readjustments took place during the period of dike injection is shown, however, by the frequency with which some of the dikes are traversed by minor faults which have developed local "jogs" and slickensided surfaces; especially is this true of the older dikes. That the augite-kersantites, as a class, have been dislocated more frequently than



X = Boulders of Ore.

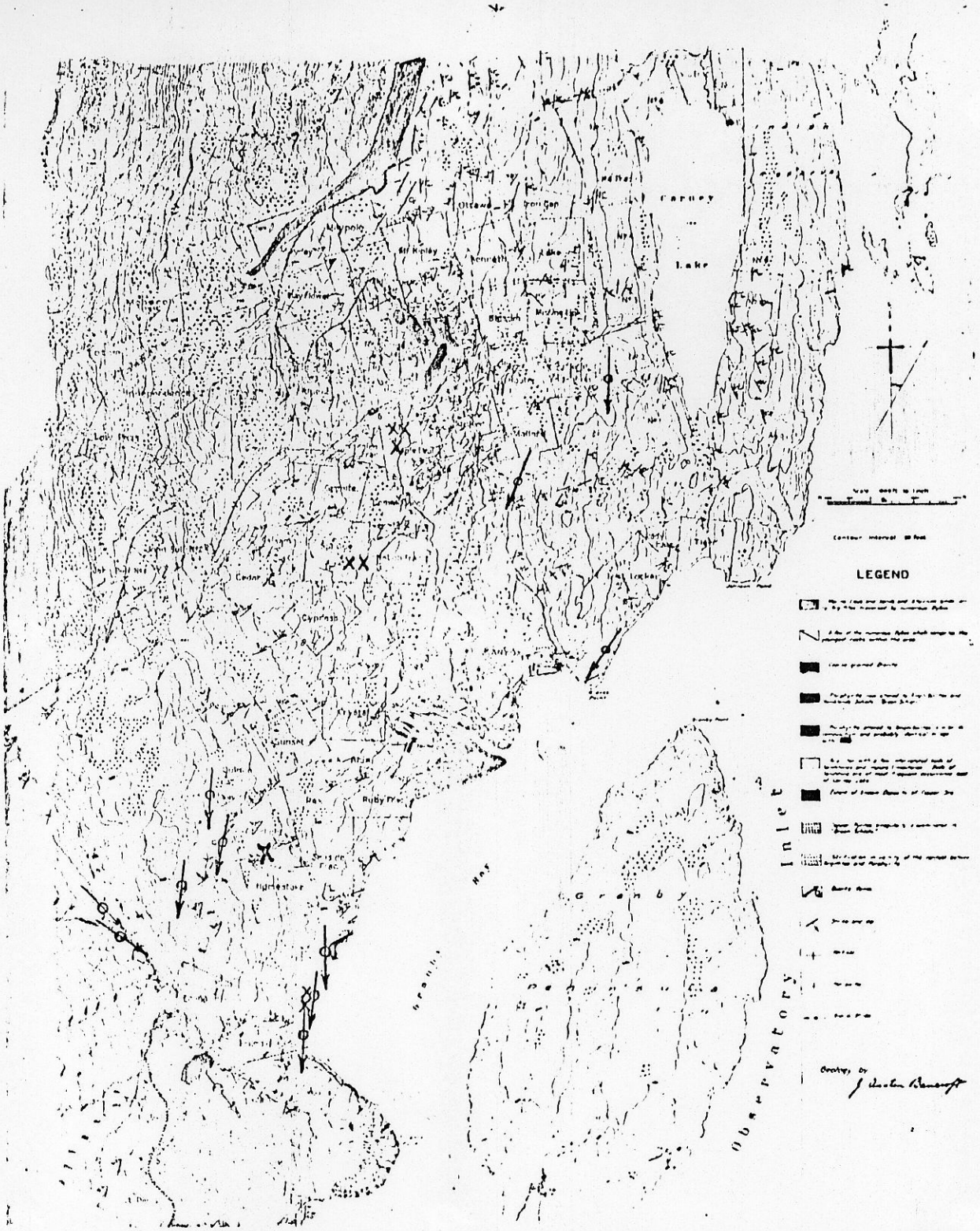


Plate 2 showing direction of movement of Ice-sheet and distribution of the erratic Boulders of Ore.

the other dike varieties is probably not only due to their being the oldest of the dikes but also to their high mica content which played a part somewhat similar to a lubricant in facilitating movements of readjustment.

QUATERNARY DEPOSITS.

During the Pleistocene Ice Age, the whole Coast Range was occupied by a confluent ice sheet of such thickness that, at least in the vicinity of Anyox, only those mountain summits which are now 6,000 feet above sea-level protruded above its surface. That portion of this ice-sheet which moved across the Anyox area helped to swell the volume of the heavy stream of ice which discharged through Observatory Inlet to the Pacific Ocean. In crossing the Anyox area, the general direction of movement of the ice was towards S.5° - 15° W. but, locally, the basal portion of the ice-sheet was deflected by irregularities in topography. Thus, where confined within the deep lower portion of the valley of Bonanza creek, the ice moved approximately parallel to the valley which trends to the southeast. It is probable that for some time after the disappearance of the main ice-sheet, the valley of Bonanza creek was occupied by a glacier.

Glacial debris has been abundantly though very irregularly strewn over the area; in general, deposits of such debris are thick in the depressions and either thin or more usually absent on the ridges. Many of the valleys were filled with boulder clays which

are very heavily laden with boulders and pebbles to elevations of between 500 and 800 feet above the present sea-level; especially is this true of the majority of the tributary streams which enter Falls Creek and Hidden Creek.

Observations concerning the movement of the ice-sheet have a direct economic bearing in that boulders of copper ore are widely scattered over certain portions of the area. Some of these boulders of ore are very large, and in some instances, prospectors have excavated in their immediate vicinity in the hope of finding the ledge from whence the boulders have been derived. Even the comparatively small number of arrows which have been placed on the accompanying map to indicate the directions toward which the ice was moving serve to delimit in a general way the possible source of a boulder of ore in a certain locality. For example, it is obvious that boulders of ore scattered along the trail that follows the shore between Bonanza and Falls creeks could not possibly have come from the John Bull claims which are situated on the west side of Falls creek, about two miles from its mouth. No boulders of ore have been observed to the north or east of the contact between the Hidden Creek greenstones and the Granby Argillite Series. On the accompanying map, the position of some of the large boulders of ore are indicated; all of the boulders noted are similar in character to some phase of the known Hidden Creek ore bodies. Some boulders of ore, whose positions were not definitely located were observed on

the slope of the steep hill immediately west of Bonanza creek and above the trail leading to Bonanza mine; they were similar in character to the ore of the Bonanza mine.

When the ice-sheet receded, the land stood at a lower level than at present and the sea occupied the lower lands. An arm of the sea then extended into Carney Lake. The tract of lowland whic with an average width of 3,000 feet, extends inland for a maximum distance of about a mile from"the beach" portion of the town, is almost universally underlain by marine clays and sands. The railway from Tunnel 150 to the smelter follows the western margin of this lowland; for some distance, the waggon road from the beach to the mine follows its eastern border and the base-ball grounds are situated near its centre. In looking down from some neighbouring hill, it does not require a vivid imagination to realize that this lowland the southern margin of which forms an ideal site for the beach portion of the town was comparatively recently an arm of Granby Bay.

The stratified clays are bluish in colour very plastic and tenacious and in some localities are so absolutely free from grit that they are drawn upon to supply all of the tamping material used in mining operations.

In some localities, these stratified clays contain abundant shells, some of which are identical with species now living in the nearby ocean. At an altitude of 120 feet above sea-level, the stratified clays, which are exposed immediately west of the waggon

road from the beach to the mine and just south of the bridge crossing the East Branch of Hidden Creek, are filled with marine shells.

*1. Since the disappearance of the ice-sheet from the area, the smaller streams have cut sharp V-shaped valleys and with the gradual withdrawal of the sea to its present level, some of the streams have cut deep notches in the lower courses of their former valley floors. Thus the high, comparatively flat-topped bed-rock terrace on the east side of Bonanza creek beneath which the Bonanza copper deposit dips at an angle of 20° is a remnant of the older valley floor within which this creek has cut a ravine about 125 feet in depth.

*1. In this locality, the following shells were observed -
Gasteropods:- Neptuna despecta; Natica clausa; Bela turricula; Acmaea coeca; Acmaea testudinalis; Fissurella.
Bivalves:- Cardium Islandicum; Pecten Islandicus; Mya truncata; Leda permula; Mactra ovalis; Tellina.
Brachiopods:- Terebratella transversa.
And also fragments of a Serpula and of a large Barnacle.

Plate III.

Bancrofts Rept - 1918

GRANBY'S MINERAL CLAIMS AND COPPER DEPOSITS AT ANYOX.

If geological relations had been understood when the claims were located, it would have required comparatively few claims to control the possibilities of the occurrence of copper deposits within the map-area. Those claims control the possibilities of the situation which embrace not only the immediate contact between the bodies of altered porphyrites (now amphibolites, or greenstones and green schists) and the Granby Bay Argillite Series but which extend laterally from these contacts for sufficient distances to include all evidences of silicification of the argillites on the one hand and the schistose and silicified phases on the greenstones on the other; of equal importance are those claims, which extending laterally in the direction of the dip of these contacts, control the possibilities pertaining to the extension of the ore-deposits to depth.

The large number of claims within the area which are underlain by argillites that do not participate in the contact relations with the greenstones and the numerous claims that are located on massive or slightly foliated greenstones were carefully examined and found to be no value except in so far as they have served to prevent outside individuals or companies from interfering with Granby's mining and smelting operations.

The immediately preceding statements must not be interpreted as meaning that ore-deposits will be found on all claims distributed along the greenstone-argillite contacts. Along considerable stretches

of these contacts, there has been comparatively little silicification of the argillites and the greenstones have not been strongly altered. Even where the argillites and greenstones have been most extensively silicified and the greenstones in part rendered schistose and both of these rock-types impregnated with disseminated grains of iron sulphides, it does not necessarily follow that ore deposits are present; yet, such localities are favourable to the occurrence of ore-bodies. In many places and sometimes for many hundreds of feet at a stretch the argillite-greenstone contacts are so effectually concealed by a covering of soil that the contact relations can not be determined.

CONTACT OF NORTHERN BODY OF PORPHYRITE.

From the northern border of the map southward to the northeastern corner of the "Maypole" claim, the large dike of coarse diorite shown on the map has been intruded along the contact between the argillites and the greenstones.

In crossing the "Maypole", "Mayday" and "Mayflower" claims, the contact is for the most part covered, but where exposed at intervals, the argillites are comparatively little silicified, the greenstone is quite massive and there are no indications that would suggest the presence of ore-bodies.

Along the western and southern margin of the apex of the wedge-shaped area of argillite (see Plate III.) that terminates

on the "Gama" claim, both the greenstones and argillites are extensively silicified and in places are impregnated with abundantly disseminated grains of pyrrhotite and pyrite. Extending from A. to B. (see Plate III.), this silicified zone has a length of about 500 feet and a maximum width of 200 feet, lying in part on the "Rupert" claim. No copper minerals were observed in any of the numerous outcrops within this zone, but, even if the chances are extremely doubtful, two or three well placed diamond-drill holes are needed to definitely determine the absence or presence of ore.

Along the eastern margin of the above mentioned wedge shaped area of argillites on the "Gama" claim (viz., from C. to D. in Plate III.) the contact is exposed at intervals along the upper portion of the eastern slope of a steep hill. The contact is dipping toward the north and west, and the argillites are much crumpled, yet in some places resting horizontally on the greenstones which are here quite strongly foliated. For the major part of the distance from C. to D., the exact contact is not exposed but in places the argillites and especially the greenstones have been much silicified and impregnated with disseminated grains of iron sulphides. Especially along the lower and middle slopes of the hill, the greenstones are strongly foliated and between E. and F. (see Plate III.) on both the "Rupert" and "Gama" claims and at elevations of between 750 and 850 feet above sea-level, these green schists are in many places very irregularly mineralized with disseminated grains of pyrrhotite, pyrite and a little copper pyrites. The schists are striking N.-S. and dipping from 40° to 65°

toward the west, mineralization is parallel to the schistosity. In general, the grains of copper pyrites are widely scattered, but in places zones of the schist, several yards in length and three or four feet in width are partially silicified and carry probably about 1.5 per cent. in copper, the ore being analogous in character to that of the No. 3 ore-body of the Hidden Creek mine. In several places, excellent specimens of ore, carrying several per cent. in copper can here be collected. Two or three shots have been discharged at points along the middle slope of the hill; evidently this prospecting work was done long before Granby acquired the property and since then has been forgotten. The mineralization is extremely irregular; considering however its proximity to the Hidden Creek ore-bodies, further prospecti work is warranted to ascertain if portions of the mineralized schists may be developed as low-grade ore.

Between D. and G., contact relations are concealed by swamp and soil; from G to H, the argillites are "spotted" but little silicified and there are practically no indications of mineralization.

From H crossing West Hidden Creek to I, the most northerly point on this contact on the "Donald" claim and around to K, the vicinity of the contact is heavily covered by swamp and glacial soil and its position as represented on the map must be regarded as only approximately correct; argillites in outcrop along the little stream (J in Plate III), immediately north of the contact as indicated on the map, are silicified and carry abundantly disseminated grains of ~~pyrrhotite~~ pyrrhotite and pyrite.

At K, the exact contact is exposed and is dipping 40° to

50° toward the north-east. The argillites are not extensively silicified but the green schists here pass to the eastward beneath the argillites. Between K and the eastern margin of the glory hole of No. 2 ore-body, the contact rises 200 feet; exposed at intervals along the steep hillside to the north of this glory hole, the contact is likewise dipping steeply to the eastward, but the schistosity of the green schists is dipping steeply toward the west.

To the eastward of the contact between the point I and the northern end of Ore-body No.2 as shown on the map is a promising field for exploration, the limit of the possibilities of the discovery of ore depending on how far eastward the green schists with attending silicification pass beneath the argillites; how far they extend in this direction can not be determined by surface observations, but probably not more than a few hundred feet at the most when, as farther south where No. 5 ore-body has been developed, it will probably be found that the argillites turn and dip beneath them. Within the silicified zone above the contact of the green schists as it dips to the eastward, ore-bodies may occur as well as in the vicinity of the eastern margin of the green schists beneath the argillites. It must be made plain that no one can guarantee the presence of ore-bodies along here; but it is interesting to be able to report that at the suggestion of the writer, a bore-hole was put down at point L (Plate III) toward the east at an angle of 45°; before passing into argillites, it penetrated 28 feet of practically solid pyrrhotite which, however, unfortunately carried only a trace of copper.

Although the stretch of the contact referred to in the preceding paragraph is considered to be a field worthy of exploration, drilling from the surface would be costly owing to the greatly increased thickness of the argillite cover. For example, eastward between I and L which are at elevations of 700 and 750 feet above sea level respectively the greenstones as exposed at K are dipping at least 40° to 50° toward the north east, and to the eastward of the eastern boundary of the "Donald" claim, the steep ridge that rises to between 1000 and 1250 feet above sea level is entirely composed of argillites. About the only exploration that could be wisely done from the surface would consist of two or three drill holes inclined to the eastward in the vicinity of the contact at two or three carefully selected points between the northern end of Ore-body No.2 and point L and two vertical holes between L and M in the vicinity of the trail shown on the map. Even if these holes did not lead to the discovery of ore, they would yield data which would be valuable in planning underground drilling that might later be carried on when the deeper portions of No. 5 ore-body are being worked.

Ore-bodies No. 2 and No.3 are in reality more or less heavily mineralized green schists. Although on the accompanying geological map and on Plate III, the boundary of Ore-body No.3 is represented by a closed line, in reality its northern boundary should be left open for this boundary merely represents the northern limit to which drilling has been carried. At N, there is an exposure of the schists from which copper-bearing specimens of a grade equal to the

average grade of No. 3 ore-body may be collected. There is, tho reason to hope that when drilling operations are carried northw No. 3 ore-body may be found to be of considerably larger dimensi than as represented on Plate III.

Here and there between O and P on the "Donald" claim irregular streaks or bands of the green-schists, up to a few feet across, contain scattered grains of copper pyrites and pyrrhotite where narrow quartzose streaks or bands are present the mineraliz is more pronounced and in a few places specimens carrying several cent. in copper may be collected. In general, however, in so far as one can judge from the scattered rock exposures, the mineralizatio is too erratic and too low-grade in copper to be of value.

The general contact relations associated with the occurrenc of ore-bodies Nos. 1, 4 and 5 have already been described on pages 22-23 of this report.

Between the southwestern end of Ore-body No.1 and the easte end of Ore-body No.6 (which lies on the boundary line between the "Rudge" and the "Buffalo" claims) should be especially propitious ground for exploration by drilling as is also the case in the vicinity of the contact on the Buffalo and "Kaien" claims for at least 700 feet southwest of Ore-body No.6. Along here, the immediate contact is almost everywhere covered up but in numerous places the argillites and altered greenstones outcrop in close proximity. The argillites along here are much crumpled both along the strike and the dip and silicification of the argillites has been extended to very variable

distances from the contact. In places of much crumpling, silicification has in places extended in irregular tongues far into the dark and practically unaltered argillites. For example, one of these irregular tongues of silicified argillites extends for 600 to 700 feet below the contact on West Hidden Creek. On both sides of the creek at Q, these silicified argillites contain some solid pyrrhotite carrying traces of copper; along the western bank at this point practically solid pyrrhotite is exposed for a length of 20 feet, but a horizontal drill hole showed the pyrrhotite to be only about five feet in thickness. Where it crosses West Hidden Creek, the argillite-greenstone contact is exposed; fifteen feet or so upstream from the contact, the greenstones hold an inclusion of argillites, 10 or 12 feet in width and with its length parallel to the contact. Although the argillites have been irregularly silicified from the contact downstream to Q, no traces of copper were observed except in the occurrence of pyrrhotite at Q. If ore occurs between the southwestern end of Ore-body No.1 and the eastern end of Ore-body No.6 it appears to me probable that it will be in the form of a number of comparatively small irregular bodies. It is possible that when the workings of the 150 level are carried to the southwestern end of Ore-body No.1, it may be found expedient to extend a drift southwestward to work Ore-body No.6; if this be done, the drilling of the ground between these ore-bodies would be more advantageously carried on underground.

From where it crosses the eastern boundary of the "Kaien" claim to where it meets Falls Creek, the contact has not as yet been

examined carefully by the writer. It was crossed at a dozen or more different points; in the major number of instances, the immediate contact was covered, but in other places, there was so little silicification of the argillites as to preclude the possibility of the occurrence of ore-bodies.

On the western side of Falls Creek, the contact crosses the "John Bull" claims (see Plate I). These claims were carefully examined but no traces of copper were found on them. In the vicinity of where the trail leading to Maple Bay crosses the contact on the "John Bull No. 1" claim, the greenstones and to a less degree the argillites are irregularly silicified and impregnated with pyrite and pyrrhotite. The iron sulphides are especially abundant at point R (marked on Plate I) on a little brook just a few yards above where it is cut by a trail. Here a little prospecting work has been done at a few points where the silicified greenstones are heavily charged with pyrrhotite and pyrite. The irregular character of the silicification and mineralization and the absence of grains of copper pyrites makes it improbable that an ore-body is present. To make certain, a drill hole might be put down at this point; if no copper values were encountered, further drilling on these claims would not be advisable.

From the immediately preceding pages, it will be observed that there yet remains considerable favourable ground which should be explored in the hope that new ore-bodies may be discovered. It is

evident that the known ore-bodies have been proved up in what is obviously the most favourable ground. Future drilling in search of new ore-bodies will plainly be highly speculative in comparison with the drilling that has been done to date.

THE HIDDEN CREEK ORE-BODIES.

The Hidden Creek ore-bodies 1, 2, 3, 4 and 5 occur within the southern end of a ridge which terminates about two miles north of Granby Bay. Ore-bodies 1, 2 and 3 outcrop at the surface at maximum elevations of about 800, 900 and 625 feet, respectively, above sea-level. As has been previously described, Ore-bodies 4 and 5 lie within the silicified zone beneath the argillites and were proved up by drilling.

There are three operating levels at elevations of 150, 385 and 530 feet, respectively, above sea-level; the 150 tunnel has merely been extended to meet Ore-body No. 1, and from this level considerable diamond drilling has been done. In the early stages of mining development, levels were also established at 630 and 700 feet above sea-level; those portions of these levels which penetrated ore have been largely engulfed in the glory holes. Total development work in Hidden Creek mine, including drifts and raises, amounts to 37,000 feet, and about 96,000 feet of diamond drilling has been done.

As stated on the opening page of this report, comparatively little time was devoted during the past summer to a detailed study of the known ore-bodies. In fact, only some of the rainy days were spent

underground in ascertaining the geological relations on the 385 and 150 levels of the Hidden Creek mine.

Accompanying this report is a copy of the geological map which has been prepared of the 385 level; even this map is not complete as it is necessary to gather further data concerning the silicified argillite-greenstone contact from 50 Drift westward. Previous to completing a similar map of the 150 level, it will be necessary to examine diamond drill cores. Next summer, geological maps of each of the other levels will be prepared and diamond drill records and cores will be examined; it will then be possible to prepare vertical sections through the ore-bodies and to discuss data concerning the extension of the deposits to depth.

The ore-bodies have originated through processes of replacement in which silicification was accompanied by deposition of the following sulphides:- pyrite, pyrrhotite, copper pyrites, occasionally a little zinc blende, in places a few small crystals of arsenopyrite and very rarely a few grains of galena. That the replacement and mineralization has been brought about by hydrothermal action is very evident.

Ore-bodies 1, 4 and 5 (see Plate III) have developed by replacement of the argillite series and even those portions which are practically solid sulphides very frequently display a fine-banding which represents the original bedding of the argillites. These ore-bodies are distributed within and especially toward the outer portion of the broad silicified zone which lies between the unaltered argillites and the green schists. For the most part the silicified

zone in the vicinity of these ore-bodies has been developed by silicification of argillites but towards the innermost portion of the zone the green schists have also been silicified; it is often impossible to distinguish with the naked eye certain phases of the silicified green schists from the silicified argillites. Ore-bodies 1, 4 and 5 conform to the foldings and contortions of the argillites. In many places, the practically solid sulphide masses pass laterally into silicified argillites more or less heavily impregnated with disseminated sulphides; much of this ore is of this siliceous character and the copper values decrease so gradually that the boundaries of what can be designated as ore must be determined by assays.

Ore-bodies 2 and 3 have been developed through mineralization and silicification of schistose zones in the altered porphyrite or greenstone in the vicinity of its contact with the argillites.

Ore-body 6 developed at the immediate contact, and involved the replacement of both the schistose greenstone and the argillites.

Broadly interpreted, the variations in the average compositions of the different ore-bodies are dependent upon whether the ore has been developed by the replacement of argillites or of green schists. The average composition of the "high grade" portions of each of the ore-bodies are given in the following table:-

No. of Ore-body.	Cu.	Ins.	SiO_2	Fe.	CaO.	S.	Al_2O_3	MgO.
1.	2.17	26.1	22.7	29.8	5.0	30.1	4.6	1.2
2.	2.24	37.6	31.3	26.0	3.2	18.2	10.3	3.8
3.	1.75	48.4	39.4	21.7	1.8	8.1	11.5	6.6
4.	1.71	8.9	7.0	41.5	9.0	31.6	1.9	0.5
5.	3.03	17.9	16.5	34.1	5.2	33.3	1.6	n.d.*1
6.	2.56	42.3	31.1	27.1	4.8	22.0	9.1	n.d.*

The average compositions of the "low grade" portions of each of the ore-bodies are now given:-

No. of Ore-body.	Cu.	Ins.	SiO_2	Fe.	CaO.	S.	Al_2O_3	MgO.
1.	0.8	40.6	35.9	23.6	5.4	21.1	5.9	2.0
2.	0.7	42.8	34.2	24.2	3.4	26.2	10.8	4.7
3.	0.66	50.0	42.2	22.0	1.4	7.8	11.5	6.9
4.	0.7	9.0	6.8	40.7	7.6	36.1	2.2	1.5
5.	0.7	45.8	41.5	24.8	3.3	19.0	5.1	n.d.
6.	0.74	62.3	55.8	14.6	3.6	9.6	10.1	n.d.

The average compositions of total shipments to end of August 1918 are now given:-

No. of Ore-Body.	Cu.	Ins.	SiO_2	Fe.	CaO.	S.	Al_2O_3	MgO.
1.*2	2.22	21.7	18.8	31.8	5.5	32.1	3.7	1.6
2.	2.12	34.6	27.6	28.2	3.8	21.6	7.7	4.2
3.	1.26	46.2	39.1	20.7	3.1	11.6	11.0	6.2
4.	1.05	11.2	9.8	37.8	5.0	41.9	1.9	n.d.

*1. n.d. = Not determined.

*2. Includes 37,000 tons shipped from No.5 Ore-body.

It will be observed that Ore-bodies 2 and 3 which have been developed in the green schists are comparatively high in alumina, silica and magnesia and low in lime and sulphur. In Ore-body 3, mineralization is not as heavy as in Ore-body 2 and pyrrhotite preponderates over pyrite; hence the percentages of iron and especially of sulphur in 3 are lower than in 2.

The difference in the average analysis of Ore-bodies 1, 4 an 5 depend chiefly upon (1) the degree to which the sulphides have replaced the argillites,(11) the relative proportions of the different sulphides present. Ore-bodies 4 and 5 more closely approach being uniform solid sulphide masses than Ore-body 1. Different portions of each of these ore-bodies vary much in composition; different parts of the same stope may yield ores of quite different compositions.

The gangue minerals associated with No.1 Ore-body are chiefl quartz and calcite with comparatively small and variable amounts of sericite, chlorite, muscovite, tremolite, and less frequently a few scattered flakes of biotite, and minute grains of sphene. Very often quartz is present without calcite; in a few places, calcite preponderates over quartz. The tremolite has developed in argillites that were originally calcereous. It is probable that similar gangue minerals are present in Ore-bodies 4 and 5, samples of which have not as yet been examined in thin section under the microscope.

Ore-bodies 2 and 3 include the following minerals as

gangue-quartz, secondary green hornblende, actinolite, chlorite, biotite, epidote, zoisite, plagioclase, orthoclase and calcite.

Prior to the opening up of Ore-body 5, the ore from the Hidden Creek mine carried average combined values in gold and silve of about 30 cents a ton. Ore-body 5 carries considerably higher values in these precious metals. 30,000 tons from Ore-body 2 carried 0.25 ounces of silver, 0.006 ounces of gold and 1.8 per cent of zinc 35,000 tons, of which 30,000 tons were taken from Ore-body No.1, and the remainder from Ore-body 5, yielded 0.77 ounces of silver, 0.015 ounces of gold and 1.10 per cent. of zinc. It is probable that the gold and part of the silver values are associated with the copper pyrites and that the zinc blende likewise carries silver. Some samples of ore containing numerous little crystals of arsenopyrite yielded only traces of gold and silver.

Ten thin sections of ore from Ore-bodies 1 and 2 have been examined under the microscope. Of the sulphides, pyrite undoubtedly crystallized first and, when present, zinc blende comes next in order of crystallization. The pyrrhotite and copper pyrites generally crystallized together with a tendency in some instances for the latter to lag behind the former.

That since their formation, the ore-bodies have been subjected to great pressure (dynamo-metamorphism) is shown by the frequent granulation both of the grains of sulphides and of some of the gangue minerals, and often by the intense crumpling of the chlorite and mica.

Ore-body No.1 strikes about N.30°E. and dips about 75°, on the average, toward the north-west. In general the ore-body conforms to the argillites and hence where the argillites have been buckled up along the dip, the ore-bodies roll heavily into the footwall and locally display a reverse dip. The ore-body outcrops for a length of about 1000 feet with an average elevation of 700 feet above sea-level. Underground it has been found to have a maximum length of 1500 feet and varies from 100 to 250 feet in width, while diamond drilling has followed it down to 140 feet below sea-level. Diamond drilling on the 150 level shows that at that depth it includes practically the same volume of solid sulphides as on the 385 level. At depth, there is very little, if any, decrease in the copper content; the development work on the 385 level and the diamond drilling on the 150 shows that on each of these levels, the ore carries 2 per cent in copper.

This ore-body is in reality a series of bodies of practically solid sulphides (pyrite, pyrrhotite, copper pyrites and frequently a little zinc blende) distributed for the most part within the outer portion of the silicified zone that lies between the unaltered argillites and the green schists, the sulphide masses often passing gradually into portions of the silicified zone which carry more or less abundantly disseminated grains of the sulphides mentioned. *1.

Frequently the sulphide masses include ribbon-like bands or

*1. See the geological map of the 385 level on a scale of 40 feet to the inch which accompanies this report.

large irregular masses of argillites which have been more or less silicified and mineralized. The proportion of the different sulphid varies much from place to place. For example, zinc blende is frequently absent, but in places comparatively small portions of th ore are rich in this mineral. Much of the solid sulphide ore is low in copper than much of the siliceous ore. Ore-body 1 includes a ver large tonnage of sulphide ore which is almost exclusively pyrite carrying low values in copper and would be eminently suitable for th manufacture of sulphuric acid. On September 1st. 1918, according to the estimate of Messrs. E.E.Campbell and F.E.Patton, 3,513,500 tons of "high grade" ore with an average copper content of 2.17 per cent and 3,461,000 tons of "low grade" ore carrying 0.8 per cent of copper were blocked out in Ore-body 1.

The green schists enclosing Ore-body 2 have an average strike of N.15° W. On both the 385 and 530 levels, the dip of the schists locally varies from 40° to 70° toward the west; on the 385 level, their average dip is 50° and on the 530 level, 55° toward the west. Similarly the green schists enclosing Ore-body 3 have an average strike of N.20° W. and on the 530 level an average dip of about 60° toward the west. In both of these ore-bodies, the sulphides have been deposited parallel to schistosity, chiefly in the form of abundantly disseminated grains, but in part as narrow bands or as comparatively small lenticular bodies of solid sulphides which trend parallel to the schistosity. On the 630 level, Ore-body 2 carried 2.6 per cent of copper, on both the 530 and 385 level its

average copper content is 2.1 per cent. Although its mineralization is parallel to the schistosity which dips westward, Ore-body 2 plunges 30° to 35° toward the north with its longest axis corresponding to the strike of the enclosing schists. The original outcrop of this ore-body possessed an average elevation of 800 feet. On the 530 level lenses of solid sulphides are more numerous and of much larger dimensions than on the 385 level. Both the length and width of this ore-body decrease quite rapidly with depth; on the 630 level, the maximum length of the high grade portion of the ore-body was 520 feet with a maximum width of 265 feet while on the 385 level, the corresponding dimensions have decreased to 285 feet and 150 feet, respectively. The drilling that has been done on the 385 level seems to show that the lateral dimensions decrease even more rapidly below this level than was the case above it; yet at the northern end of this level, high grade ore has been followed down by an inclined diamond drill hole in the direction of the plunge of the ore-body to a vertical depth of 95 feet below this level. It will be a surprise to the writer if the ore is not found to extend to considerably greater depth, with more gradual decrease in copper values than is shown by the drilling. With the possibility in mind that, disregarding the plunge of the ore-body, further ore might be discovered at depth in the direction of the dip of the schists enclosing the ore, at the suggestion of the writer, two diamond drill holes, Numbers 98 and 104 which had been previously put down, were extended to greater

depths. In hole 98, no copper values were encountered from the 385 level downward for about 200 feet. Hole 104 had been previously put down through the southern end of Ore-body 3 and had passed into barren ground from 74 feet above the 385 level.to a short distance below this level. At depths of 258 - 263 feet, 263-273 ft., 273 - 283 ft.*, 294'- 304 ft., 304 - 312 ft. below the 385 level copper values of 1.5%; 1.3%; 0.9%; 0.7% and 2.7%, respectively, were encountered. This result indicates the advisability of exploring to the northward of hole 104 by drilling at a few points to ascertain whether the schistose zones in which ore-bodies 2 and 3 occur are mineralized at greater depths.

On the 385 level between Ore-bodies 2 and 3, there is a barren, intensely sheared zone which dips steeply toward the east; within this zone the schists are readily broken up, very rich in chlorite and much slickensiding is in evidence. The significance of this zone must be determined later by observations on upper levels. On the 385 level, it would appear that this zone had originated previous to the development of these ore-bodies.

On September 1st. 1918 according to the estimates of Messrs. Campbell and Patton, 3,104,300 tons of high grade ore with an average copper content of 2.24 per cent and 2,970,500 tons of low grade ore carrying 0.70 per cent of copper were blocked out in Ore-body 2. They likewise estimate that in Ore-body 3, there have

* 283-294 feet - no assay had been made prior to my leaving Anyox.

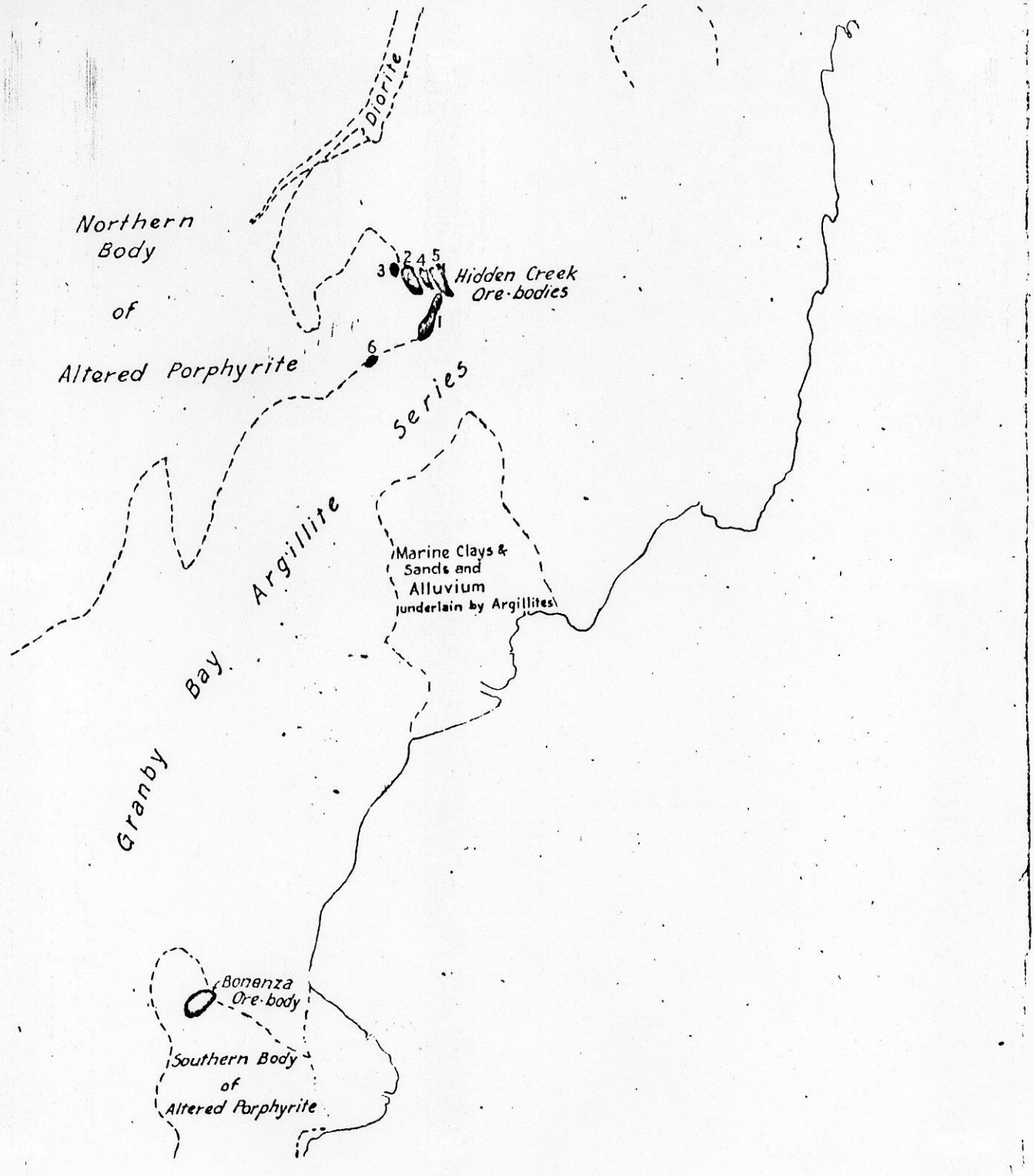
been proved up 1,332,300 tons of high grade ore carrying 1.75 per cent of copper and 1,837,000 tons carrying 0.66 per cent.

As yet, the writer has not had the opportunity to examine Ore-body 4, nor to examine the diamond drill records pertaining to Ore-bodies 5 and 6. A considerable portion of ~~the~~ Ore-body 4 that has been proved up is solid pyrite which is high in sulphur and very low in copper values. Of this ore-body, there have been blocked out 212,400 tons of high grade ore carrying 1.71 per cent in copper and 164,000 tons containing 0.70 per cent copper.

Ore-body 5 strikes N. - S. and dipping to the west plunges to the north. On the 385 level, the practically solid sulphide portion of this ore-body has a length of nearly 500 feet and an average width of about 110 feet. Below the 150 level, the volume of solid sulphides decreases rapidly and at depth, especially towards its northern end, it passes into siliceous ore containing disseminated sulphides. This ore-body is richer in copper and carries somewhat higher values in precious metals and in zinc than the other ore-bodies; where on the 385 level the ore-body is penetrated for about 120 feet by Drift 20A. the ore is especially rich in copper, much of it carrying from 8 to 12 per cent. According to Messrs. E.E.Campbell and F.E.Patton, on September 1st. 1,597,500 tons of ore carrying on the average 3.03 per cent in copper and 720,500 tons of low grade ore carrying 0.70 per cent had been blocked out in this ore-body.

The eastern end of Ore-body 6 lies about 850 feet west of the southeastern end of Ore-body 1. Diamond drilling has shown it to have a length of about 500 feet and a maximum width of about 110 feet; its dip would appear to be very nearly vertical. Diamond drilling has proved up 305,250 tons of ore with an average copper content of 2.56 per cent, and 116,000 tons of 0.74 per cent.

It is probably unnecessary in this report for the writer to state that, in his opinion, your Company, both in its Hidden Creek and Bonanza copper deposits possessesvaluable mines whose future possibilities have by no means been exhausted by the diamond drilling that has been done. With these properties in hand, it is to be hoped that the Granby Company will especially avail itself of every opportunity to carry on exploration for and to gain control of all promising mining properties that may be discovered in favourable areas in the northern parts of the Coast Range in British Columbia.


Diorite
Northern
Body
of
Altered Porphyrite
3
2 4 5
Hidden Creek
Ore-bodies
1
6
Granby Bay Argillite series
Marine Clays &
Sands and
Alluvium
underlain by Argillites
Bonanza
Ore-body
Southern Body
of
Altered Porphyrite

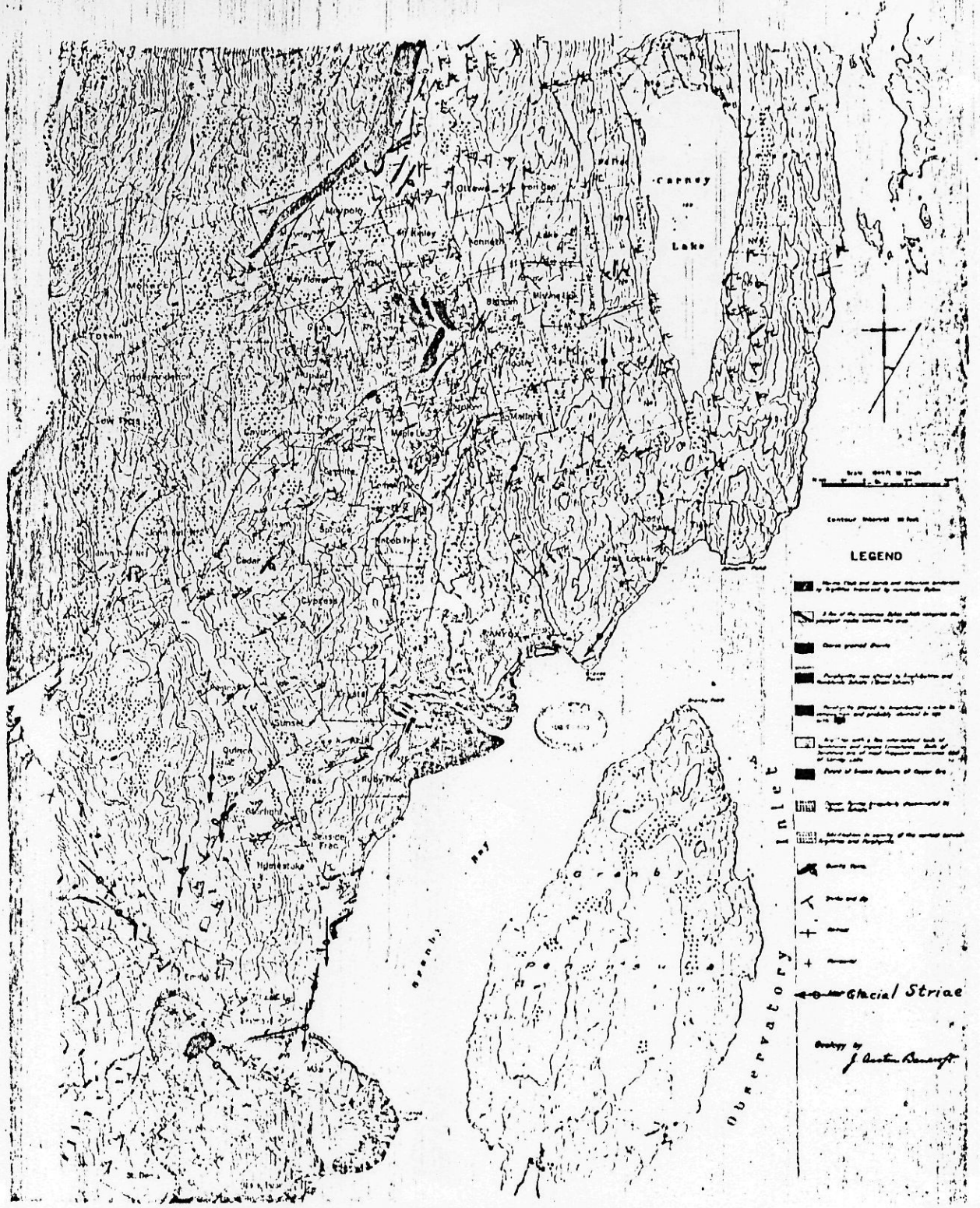


Plate 1. showing Geological Boundaries and position of known Ore-bodies

QUARTZ VEINS.

Smelting operations at Anyox annually demand a heavy tonnage of quartz. Hence, in carrying on the field-work, the writer was on the alert for any possible source of silica which might supplement the present sources of supply. The writer has been hoping to hear that the necessity of mining barren quartz from several properties would be obviated by success in your negotiations for the purchase of the "Dolly Varden" and "Wolf" properties, about 19 and 21 miles, respectively up the Kitsault river which flows into the head of Alice Arm about 18 miles from Anyox. As stated in my report to Mr. E.E. Campbell on June 17th, 1918:- "When one considers these properties from the point of view of the silver contents of the quartz from the "Dolly Varden" and the "Wolf" and in the light of the tonnage of quartz that is required in smelting the Anyox copper ore, it seems advisable for the Granby Company to secure these properties if reasonable terms can be obtained."

The Rambler Claim.

If you are not successful in obtaining the "Dolly Varden" and the "Wolf" at reasonable terms, it may well prove advisable for you to obtain control of the large quartz vein on a claim called "The Rambler" which was staked on October 23rd,

1917, by Thomas McRoster. The quartz vein in question is barren and hence if not used as a source of flux for smelting operations, it will be of no value to the owner.

The "Rambler" claim (see Plate 4) is situated immediately west of Granby's "Starlight" claim, which lies between Falls and Bonanza Creeks with its S.E. corner post about 1800 feet from the shore of Granby Bay at an elevation of 550 feet above sea-level. The most northerly exposure of the quartz vein outcrops a few yards west of where the trail leading from Granby Bay to Maple Bay on Portland Canal crosses the western boundary of the "Starlight" claim - viz. about 4000 feet from the shore of Granby Bay by this trail. The vein strikes N 35° E and dips 40° toward the northwest; it traverses argillites parallel to their bedding. The vein is exposed for about 800 feet along its strike. Within a distance of 600 feet, prospecting work has exposed its entire width at only three places and in each instance its width of outcrop is about 54 feet, its true width or thickness being about 34 feet. Its southern extremity frays out into a series of irregular tapering quartz veins and stringers. At its most northerly exposure, already referred to as being near the Granby Bay - Maple Bay trail, the true width or thickness of the vein is about 34 feet and it here passes beneath swampy soil.

With the exception of a few places where small portions of it carry disseminated grains of pyrite and pyrrhotite and a few scattered grains of zinc blende, the vein is composed of pure milky white quartz. An assay of some of the most highly mineralized fragments yielded only traces of gold and silver. Locally the vein is traversed by two or three narrow dark dikes.

From the most northerly exposure of this vein, it is 1550 feet in a straight line and down grade (with a descent of about 180 feet) to the nearest point on the road leading from the smelter to the dam on Falls Creek; from this point on this road it is about 3900 feet by road or 3500 feet by the pipe line to the smelter.

The Cedar Claim.

On Granby's Cedar Claim, about 325 feet from its south-eastern boundary line and at an elevation of about 975 feet above sea level (see ~~map~~ Plate 4 accompanying this report), there is an irregular quartz vein which can be traced for about 300 feet and in one place can be determined to have a width of outcrop of 25 or 30 feet. The vein is striking N 35° E and dipping 50°-60° toward the northwest. There is not sufficient of the vein exposed to enable

one to form a definite idea of its true dimensions. Some of the quartz carries scattered grains of pyrite. From the location of this vein to the railway leading from Tunnel 150 to the smelter, it is 2600 feet in a straight line with a descent of 800 feet; it is about 4500 feet from this point on the railway ~~from~~ *to* the smelter.

Judging from the crumpled character of the argillites in the vicinity of this quartz occurrence, it is probable that prospecting work would show the quartz vein to be very irregular; nevertheless, the day may come when the demand for quartz will be such as to warrant that prospecting work be done on this vein.

Claim Fraction between Cedar and John Bull No. 2 Claims.

At an elevation of 750 feet above sea-level and 160 feet from the northwestern boundary of the Cedar claim at a point about 400 feet from its S.W. corner post, an irregular quartz vein 22 feet in width, is exposed in a cliff 20 feet high. The strike of the enclosing argillites is N 64° E with a dip of 75° toward the northwest, but the vein can be traced only for a few feet along the strike when it passes beneath soil cover. This quartz occurrence is mentioned here merely to record its presence within the area; the quartz is barren and the location is not favourable as regards transportation to the smelter.

THE "GRANBY EXTENSION" GROUP OF CLAIMS.

This prepossessing name has been given to a group of eleven claims ("Texas", "Summit", "Amalgamation", "Carney", "Sunny Day", "Mulligan fraction", "Carbonate", "Hilltop", "Jumbo", "Quartz fraction" and the "Big Bear fraction") which are held by a prospector, Bill Hanna, who, it is said, is associated with certain men from Toronto.

In a compact group, these claims are immediately adjacent to the northern boundary of your Company's claims. The position of these claims is shown on the accompanying photograph of the map (Plate 4). They have not been surveyed and, as staked, occupy a considerably larger area than shown on this map. The geology of their northern extension on the ground beyond the limits of the map involves merely a continuation northward of the argillites, the large dike-like mass of coarse-grained diorite, and the altered porphyrite (greenstone) which occupy the northern portion of the map-area.

The most southerly of the claims of this group are the "Quartz" and the "Big Bear" fractions which lie between the Granby Company's "Ottawa" and "Maypole" claims and immediately north of Granby's "McKinley" claim; hence, the southern boundary of the "Quartz" and "Big Bear" fractions of this group is situated about 2600 feet north of the northern margin of the glory hole of Granby's No. 2 ore-body.

These claims have been held (1) in the hope that the ore-deposits on the Granby's claims would be found to extend northward into the claims of this group and (2) because of the discovery of a large quartz vein on the "Quartz fraction" and of small quartz veins on some of the other claims.

The large quartz vein on the "Quartz fraction" outcrops and has been exposed at intervals by prospecting work for a length of at least 900 feet at elevations of between 825 and 1060 feet above sea-level along the lower slope of the northern extension of the same ridge as that within which Granby's No 1, 2, 4 and 5 ore-bodies are situated. The vein traverses argillites and striking a few degrees east of north, dips 55° to 70° toward the east; within its exposed length, it is

irregular in width, extreme variations being from 2 to 15 feet in true width. In many places it contains small brecciated fragments of argillites. For the most part, the vein is barren quartz throughout its whole length; in some places, however, comparatively small portions of the vein contain irregularly disseminated grains of pyrite, pyrrhotite, zinc blende and occasionally a few scattered grains of galena and copper pyrites. An exceptionally well mineralized sample of this vein yielded on assay 0.10% of copper, 1.8 ounces of silver, and 0.01 ounces of gold.

At an elevation of about 1000 feet above sea-level and close to the northern boundary of Granby's "McKinley" claim, Hanna has done some prospecting work at a point where the argillites are somewhat brecciated and traversed by irregular quartz veins; for the most part, the individual veins are only a few inches in width, but one lenticular vein swells to 3 or 4 feet in width for a distance of a few yards. The quartz carries a few scattered grains of pyrite and pyrrhotite.

At an elevation of about 980 feet and a few yards south of its northern boundary, Hanna has done some prospecting work on your Company's "McKinley" claim. He has here driven a short tunnel into argillites traversed by abundant reticulating veinlets of quartz, some of which carry a few disseminated grains of pyrite and pyrrhotite.

Both on the Carbonate and the Amalgamation claims, he has likewise discovered unimportant veins of quartz which for the most part are barren but in which small portions of the veins carry a few scattered grains of either one or more of the following sulphides - pyrite, pyrrhotite and zinc blende.

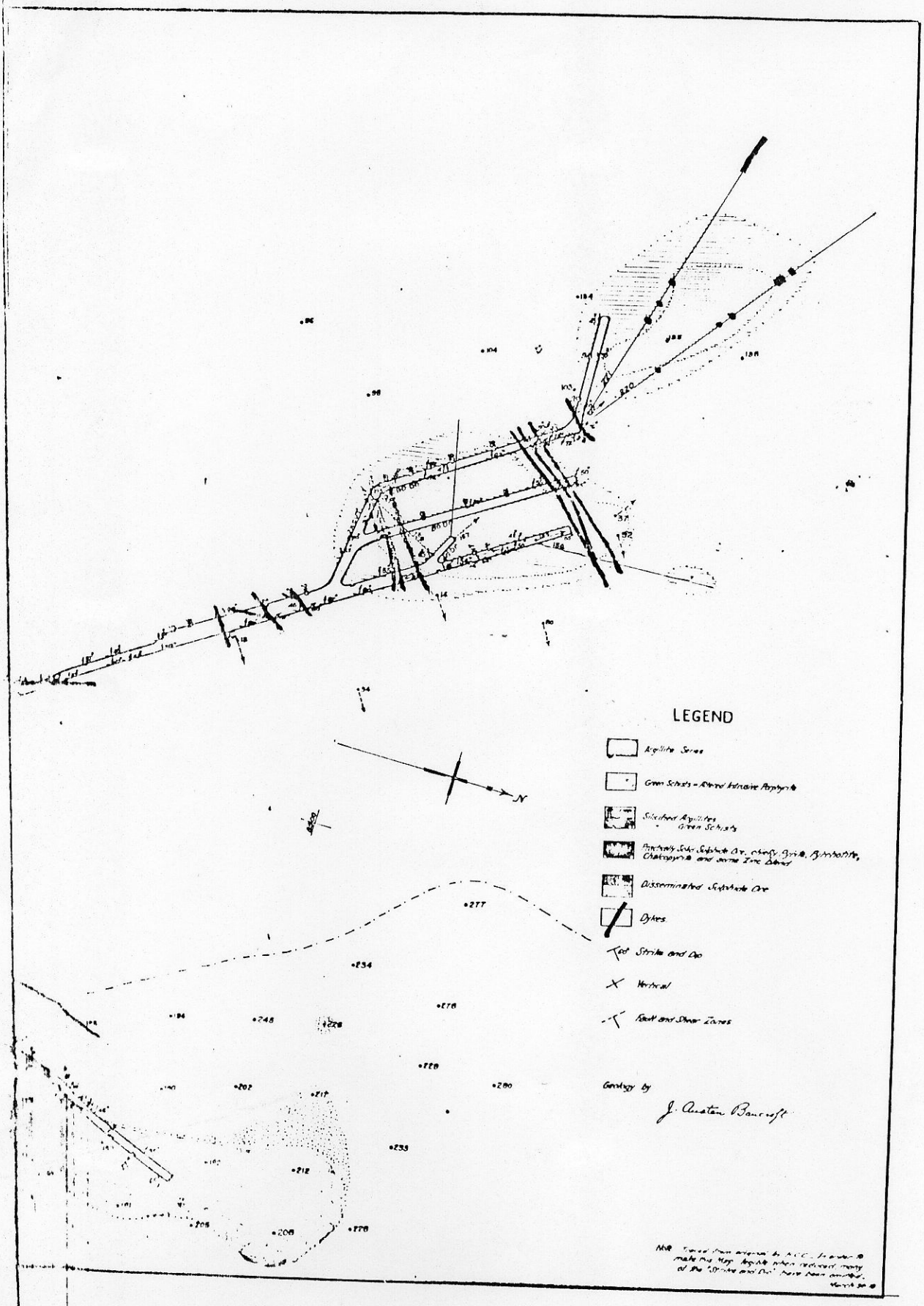
Hanna's attention has also been attracted to a few places where the argillites weather rusty because of the presence of disseminated grains of pyrite and pyrrhotite.

Nothing of economic value has been discovered on this group of claims. The large quartz vein referred to is not even attractive as a source of silica flux for the smelter.

The realization that Granby's Hidden Creek ore-bodies are distributed along and in the immediate vicinity of the contact between the argillites and the altered intrusive porphyrite (green schists and greenstone) at once removes the supposition that might otherwise be associated with the statement that the most southerly of the "Granby Extension" group of claims are situated on the northern extension of the same ridge as that on which your Company's ore-bodies, Numbers 1, 2, 4 and 5 are situated. The contact in question does not follow the ridge,

but curves in such a manner that it nowhere approaches within less than 1250 feet of the southern boundary of the "Quartz fraction", the most southerly of the Granby Extension group of claims. In my opinion the "Granby Extension" group of claims are of no value.

J. Austen Bancroft


LEGEND
Argillite Series
Green Schists - Altered Intrusive Porphyrite
Silicified Argillites
Green Schists
Partially Oxidized Sulphide Ore, chiefly Pyrite, Sphalerite, Chalcopyrite and some Zinc Oxides
Disseminated Sulphide Ore
Dykes
Strike and Dip
Vertical
Fault and Shear Zones
Geology by
J. Austen Bancroft
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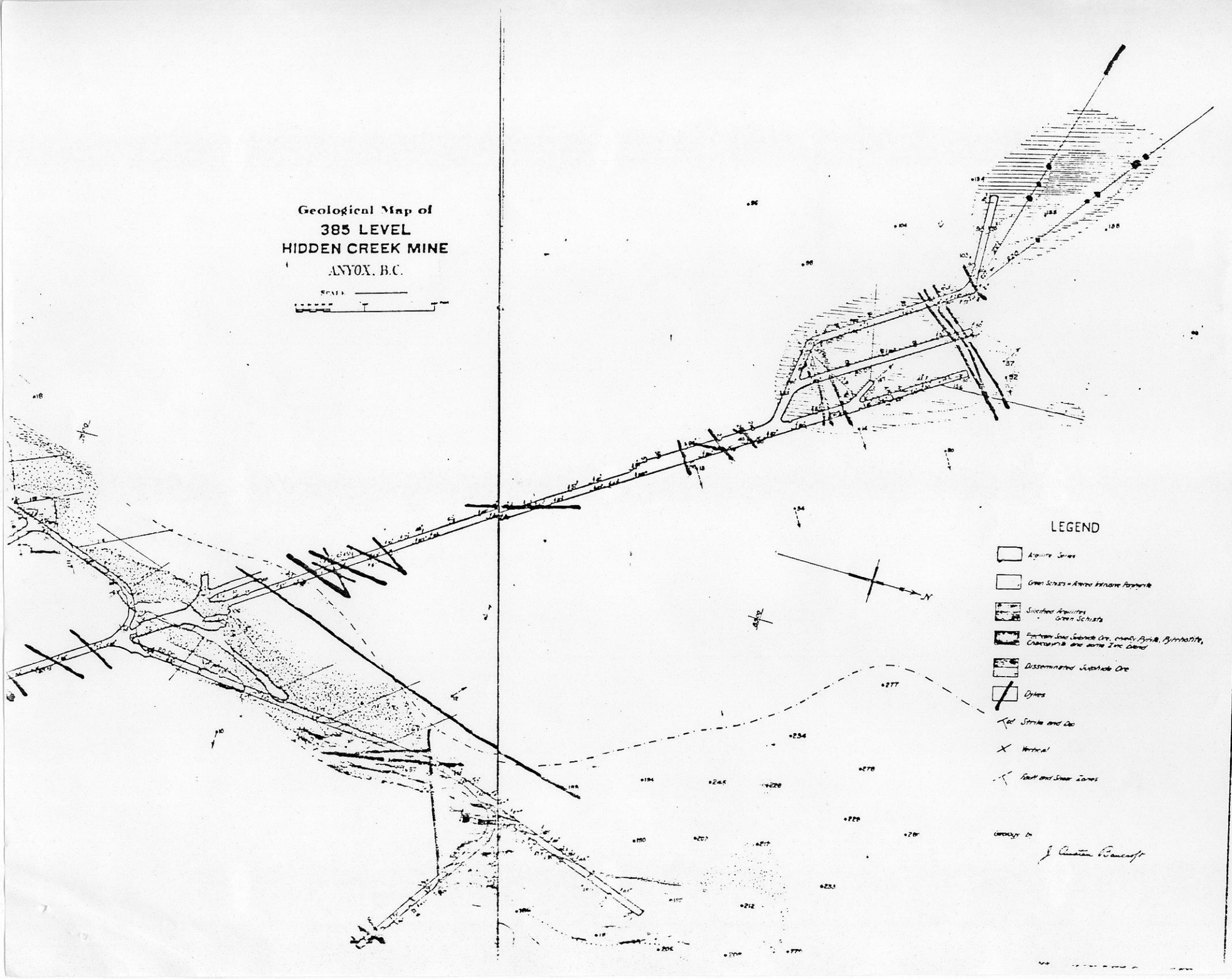
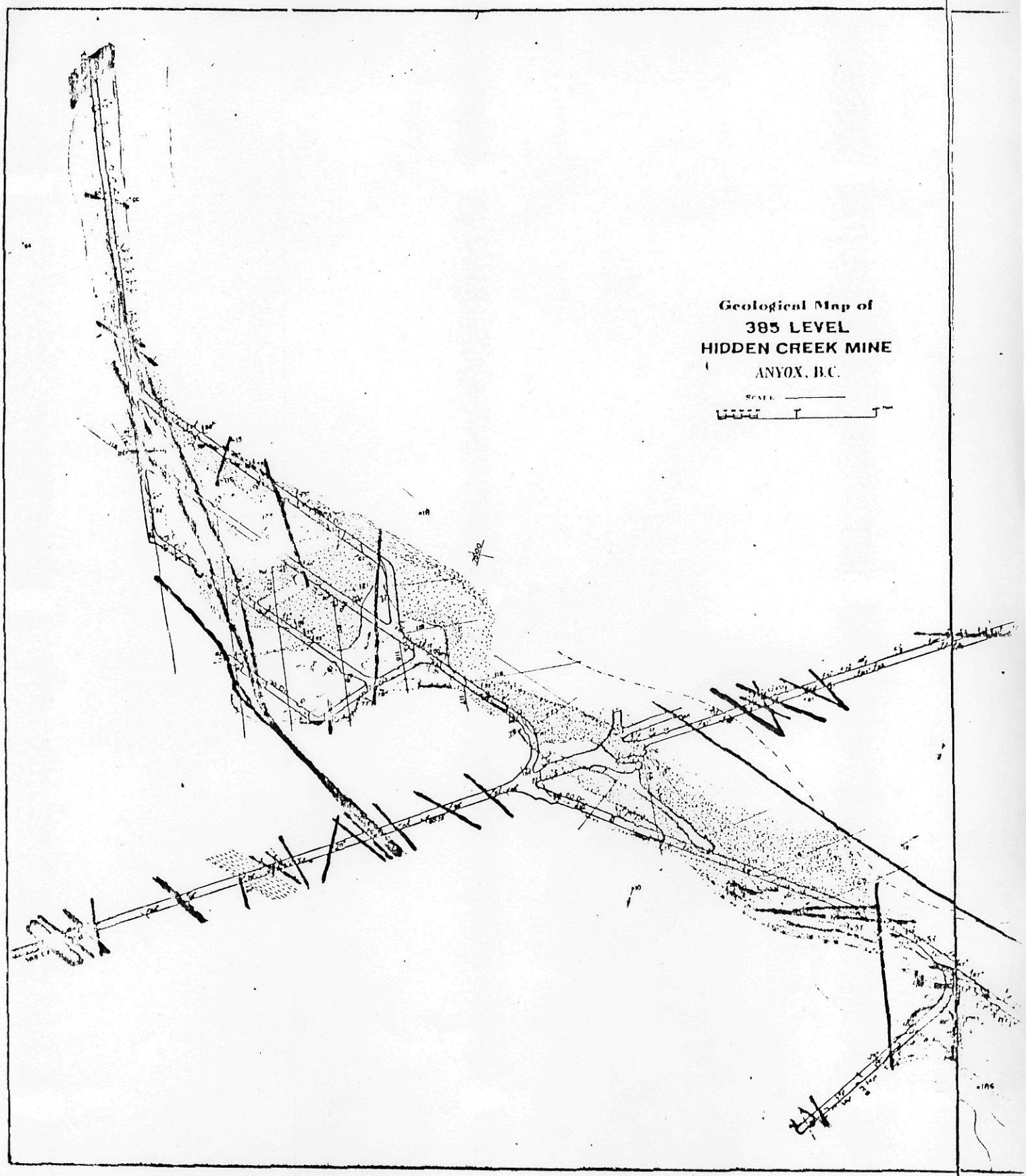
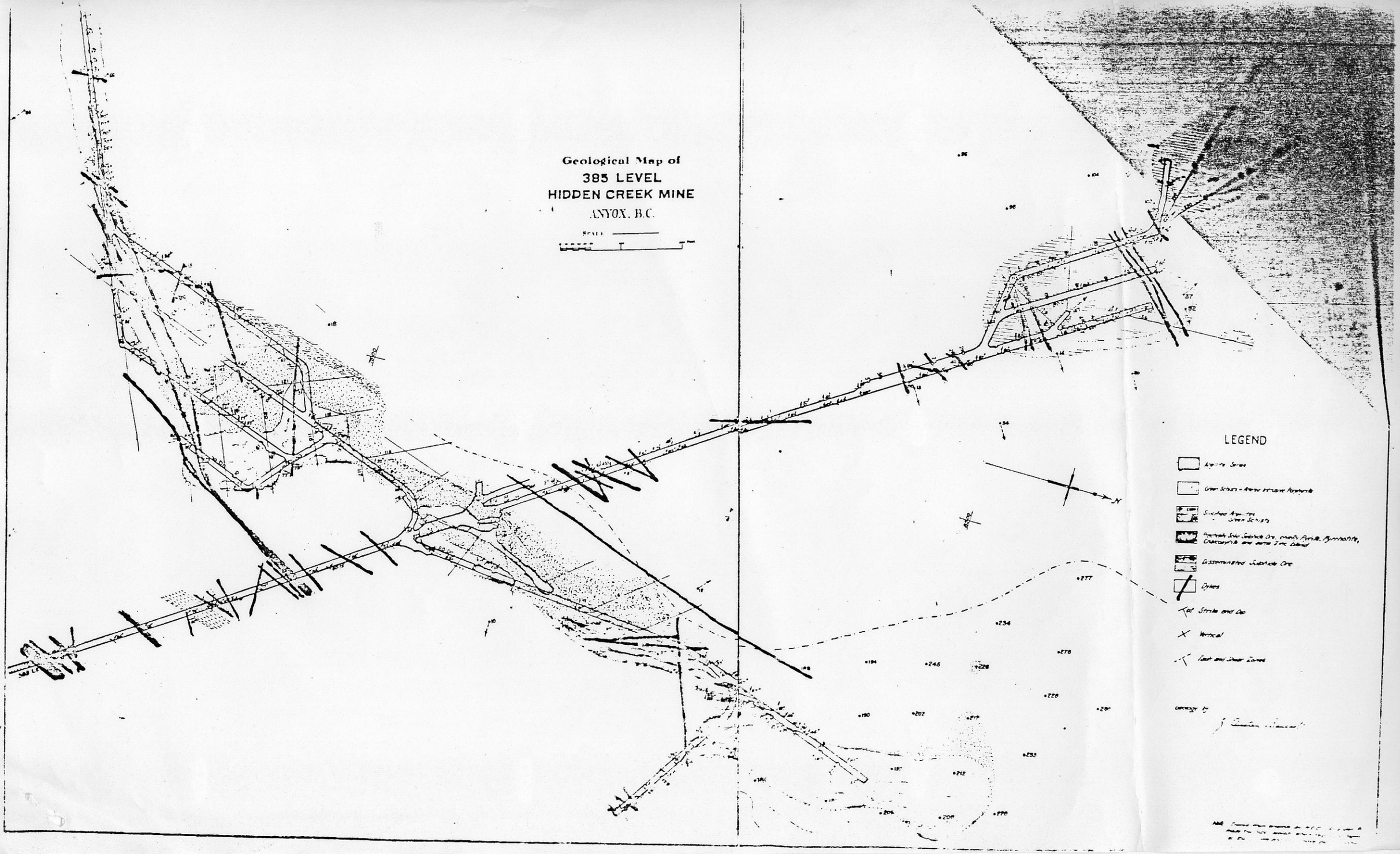

Geological Map of
385 LEVEL
HIDDEN CREEK MINE
ANYOX, B.C.
SCALE
LEGEND
Argillite Series
Green Schists - Altered Intrusive Porphyrite
Silicified Argillites
Green Schists
Siliceous Sericite Quartz Ore, mainly Pyrite, Pyrrhotite, Chalcopyrite and some Zinc Blend
Disseminated Sulphide Ore
Dykes
Fol. Strike and Dip
Vertical
Fault and Shear Zones
Geology by
J. Austin Bancroft


Geological Map of
385 LEVEL
HIDDEN CREEK MINE
ANYOX, B.C.
SCALE


Geological Map of
385 LEVEL
HIDDEN CREEK MINE
ANYOX, B.C.
SCALE
LEGEND
Argillite Schist
Green Schists - Altered Intrusive Porphyrite
Siliceous Argillite, Green Schists
Massive Sulphide Ore, mainly Pyrite, Pyrrhotite, Chalcopyrite and some Zinc Blende
Disseminated Sulphide Ore
Dykes
Fault, Strike and Dip
Vertical
Fault and Shear Zones
Compiled by