No 1

GEOLOGY OF THE BROOKBANK GOLD DEPOSIT

GEOLOGY OF THE BROOKBANK GOLD DEPOSIT

by

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THESIS

A thesis submitted in partial fulfilment for the degree of Master of Science to the Department of Geology, University of Manitoba

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PART I

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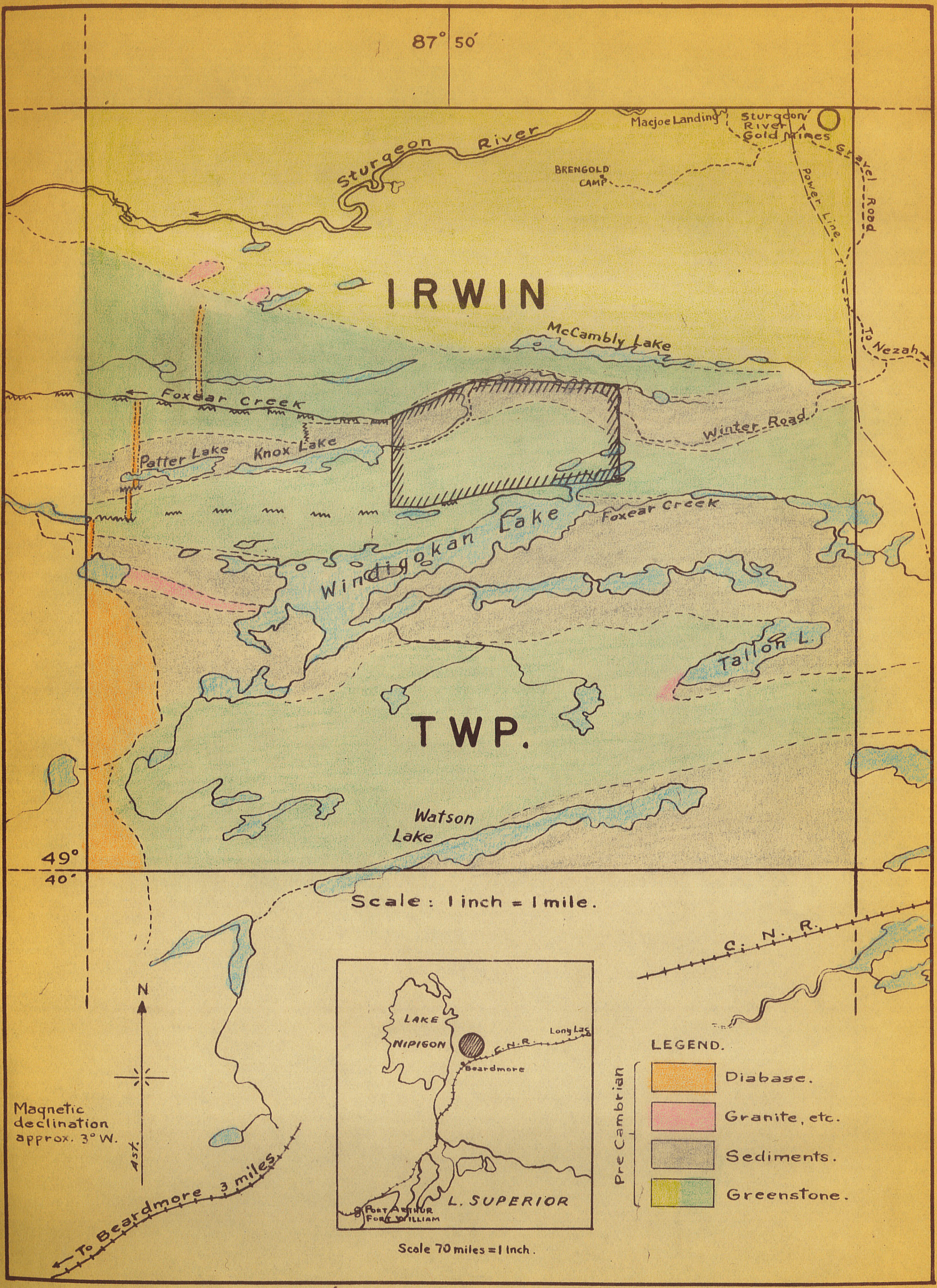
INTRODUCTION

In the spring of 1944 the writer was engaged to make a geological map of a group of eighteen mineral claims known as the Brookbank group in the central part of Irwin township, Ontario. A program of surface diamond drilling was also undertaken and this work ran concurrently with the mapping till the fall of 1944. The drilling was done along a major contact zone between Keewatin greenstones and Temiskaming type sediments where, in certain areas of intense alteration, gold values were obtained.

Several geological problems developed during the course of the work and the thesis here presented is a treatment of these problems. Very little previous investigation of the Brookbank geology had been done and the only known literature is a brief report by Dr. H.C.Laird in 1936 for the Ontario Department of Mines. Mining companies had engineers, geologists and prospectors make cursory examinations at different times prior to the writer's field work. Many of these previous examiners held the opinion that there was likely a close genetic connection between gold and hematite; also that outcrops of certain dense light colored rocks were rhyolites. There also existed an uncertainty as to whether the coarse greenstones were intrusives or coarse central parts of flows. The present work endeavours to throw light on these problems as well as others encountered during the study of the general geology.

ACKNOWLEDGEMENTS

The field work was done with the able assistance of Mr. Gordon Dickson of Beardmore,Ontario. Dr. A.M.Bell of the Geology Staff of Noranda Mines Ltd.,furnished many valuable suggestions during the course of the field work,and kindly made possible the use of recorded data. The following members of the Geology Staff of the University of Manitoba kindly contributed in various ways. Dr.A.T.


87° 50'
Sturgeon River
Macjoe Landing
Sturgeon River Gold Mines
Gravel Road
BRENGOLD CAMP
Power Line
IRWIN
McCambly Lake
To Nezah
Foxear Creek
Winter Road
Patter Lake
Knox Lake
Windigokan Lake
Foxear Creek
Tallon L.
TWP.
Watson Lake
49° 40'
Scale: 1 inch = 1 mile.
C. N. R.
N
Magnetic declination approx. 3° W.
Ast.
To Beardmore 3 miles
LAKE NIPIGON
C.N.R.
Long Lac
Beardmore
L. SUPERIOR
Port Arthur
Fort William
Scale 70 miles = 1 inch.
LEGEND.
Pre Cambrian
Diabase.
Granite, etc.
Sediments.
Greenstone.
V.D.C. 12/45.

KEY MAPS.

Prince and Dr. G. M. Brownell furnished many valuable suggestions, particularly involving the petrologic problems. Professor E. I. Leith gave valuable guidance in the preparation of the photomicrographs, and Kenneth Wilson made excellent polished sections on the Graton Vanderwilt machine. Doctor Petrie and Doctor Neamton of the Physics department both advised and assisted in performing the spectroscopic analysis.

LOCATION AND ACCESS.

The area mapped comprises a block measuring approximately 2 miles long and one mile wide, which lies between Foxear creek and Windegokan lake in the central part of Irwin township. This location is about 10 miles in a straight line east of the town of Beardmore, which is located on the Little Long Lac line of Canadian National Railways. Access from Beardmore to the Brookbank property is via the Trans Canada Highway, eastward to Nezah, thence northward by bushroad and trail to make a total travelling distance of nearly 27 miles (See Key maps)

Topography

The whole area in the vicinity of Beardmore is one of usual Precambrian topography, and the claim block mapped represents a fairly typical cross section. The ridges trend reughly east and west and the relief in general is not high. The intervening low areas are filled with glacial drift and an overall mantle of moss that encroaches on the ridges, so for this reason bare rock outcrops are not plentiful. Many of the low areas are swamps and muskegs. Water is not scarce except in very dry seasons, and there is an abundant growth of small to medium size timber and small bushes. Two prominent east west fault scarps form parallel ridges about 100 feet in height, one along the north boundary of the claims and the other along the south boundary.

PREVIOUS MAPPING IN THE AREA.

Geological mapping of the area east of Lake Nipigon has been carried on at intervals since the 1860's. Wilson (1) made a comprehensive report in 1910. Coleman and Moore (2) did geological work on the iron ranges in 1907-08. Burrows (3) in 1917 mapped the area along the railway in the eastern part toward Long Lac. In the following season Tanton (4) examined the Beardmore-Nezah area. In the summer of 1927, Langford (5) mapped the same area on a more detailed basis. The most recent and most detailed mapping of the geology was done during the summers of 1935 and 1936 by Bruce and Laird (6), their work extending two townships northward from Beardmore. Laird mapped the western part which includes Irwin township and Bruce's work extended about to the eastern boundary of Irwin township. Their report and maps have been largely used by the writer as valuable references.

MAPPING OF THE CLAIM BLOCK.

The mapping of the property necessitated considerable line cutting. A base line location roughly parallel to, and close to the indicated strike of the main ore zone was selected. This line was run with a transit and tied in with the Coleman property on the east, which had been surveyed, so that a known azimuth was conveniently obtained. Wooden hubs were driven and marked at every 100 feet on the base line which was run N81° - 31'E for a distance of 9438 feet from west to east boundaries of the property. It was proposed to run a second parallel base line across the southern half of the claim block, but a saving in time was gained by utilizing the old east west claim lines. These old lines were partially cleared and consecutive bearings were taken with a Brunton compaass from west to east boundaries. The plotted result showed a rather sinuous overall line, but later a series of north south cross lines from the main base line were tied in to this makeshift line in a sufficient number of places to make it accurate enough for general mapping. Adjustments in plotting were necessary only in a few places, thus a wide grid system of established lines was eventually obtained and further detailed mapping was done between these lines with a Brunton compass and pacing. A detailed map of the No. 1 zone on a scale of 50 feet to the inch was done by plane table as this was the only portion of the property sufficiently cleared of timber to permit plane table operation. Magnetic disturbances were observed during compass work in only one location, near D. D. hole No. 15. A concrete bench mark was established as a reference elevation for drill holes.

The general mapping was done on a scale of 200 feet to the inch. Drill hole sections were prepared on a scale of 20 feet to the inch.

After the close of the field season, considerable time was spent in the drafting room, and the following set of finished maps and plans were made:

1. General geological map of claim area, scale 1" to 1000'
2. Detailed geological map of claim area, scale 1" to 200'
3. # Detailed geological plan of No. 1 ore zone, scale 1" to 50'
4. # Detailed assay plan of No. 1 ore zone, scale 1" to 20'
5. Detailed surface sampling plans (miscell) scale, 1" to 20' - 50'.
6. Sections of D. D. holes with geology and assays, scale 1" to 20'.

\# Including all D. D. hole projections.

GENERAL GEOLOGY

The area in general is largely underlain by Keewatin lavas with infolded bands of Timiskaming type sediments. Toward lake Nipigon there are wide-spread areas covered by flat laying diabasic sills of assumed Keweenawan age. A large area of granite intrusives of post Timiskaming age occupies the greater part of Elmhirst township which corners on Irwin township to the northeast. A few dikes of Keweenawan diabase cut across the lavas and sediments, notably in the western part of Irwin township.

The Brookbank group of claims partly covers one of the sedimentary bands and the group is staked so that the northern part covers the contact zone between sediments and greenstone. Greenstone occupies over two thirds of the claim block and includes sheared andesitic lavas and diorites. A few narrow tuff horizons are interbedded with the lavas. The sediments, though sheared along the contact, are a solid unit and no intrusives were found within them. The trend of schistosity, bedding, and flows is all east-west parallel to the sediment greenstone contact. No later intrusions except quartz veins were found in the greenstone areas cutting either the diorite or the andesites. Late regional faulting has produced two major fault scarps striking east-west, one skirts the northern limits of the claim area and the other traverses along the southern boundary. The sediment-greenstone contact zome is highly altered, sheared and schisted. Silicification, carbonatization and pyritization have occurred and it is in this zone that the important gold values were found. Numerous small quartz veins outcrop at many localities in the greenstone area, a few of which carry gold values. Zones of rock alteration are numerous and seem to follow andesite diorite contacts, some being lightly pyritized. The general geological picture is fairly simple at first sight, but several problems developed as work progressed and these are presented separately in the following pages.

STRATIGRAPHY.

A complete section of rocks in the area studied is shown by the structural diagram accompanying the 200' scale geological map. The sequence in the diagram from south to north is as follows: andesite lavas alternating with diorite intrusives; greenstone-sediment contact masked by intense alteration; narrow band of altered iron formation; arkose; slate ~~mudstone~~; greywacke; conglomerate; greywacke. The tops of sedimentary beds face north and greywacke is the predominant rock type. The rounded pebbles of the conglomerate thin out and disappear into greywacke both on the bottom and top of the conglomerate bed. The slate and iron formation bands are narrow and were seldom observed to be more than several feet in width. Lithology of the different rock types are discussed under the heading of Petrology and Petrography.

Gradation of grain size in individual beds was the only criterion found usable for direct determination of tops of beds. The narrow band of altered iron formation fringing the ore zone is considered to be the basal member of the sedimentary series, and it is likely that an unconformity exists between this band and the adjacent greenstones to the south. A natural source for this iron rich band would be the weathering of the greenstones, and the stratigraphic sequence of arkose and then slate both after the iron formation, would represent the natural order of erosion from such a mass, after the first lateritic mantle had been removed. Thus, northward facing beds are compatible in this respect with structural evidence.

The presence of an intra-formational lense of conglomerate (see p. 17) containing rounded water worn pebbles in a fine angular matrix is difficult to explain. The angular matrix is characteristic of the surrounding sediments and appears to grade into them. The pebbles thin out and gradually disappear into the greywacke both to north and south of the conglomerate bed which would suggest that this lenticular bed had been formed as a talus deposit, possibly from a pre existing conglomerate. This suggested origin would explain its incongruous relation to the enclosing sediments.

STRUCTURE.

The general structural picture is fairly simple and has been outlined in the description of the general geology. The sediments dip steeply to the north in the central and western parts of the property and are structurally conformable with the lavas, the tops of which are indicated to face north. Recognizable pillows were found in only two small outcrops of lava and only a small fraction of these pillows were sufficiently preserved from shearing effects to be useful as criteria. One of these outcrops is near the northwest corner of claim number 29040, the other is near the northwest corner of claim number 29032. Toward the eastern part of the property the sediments reach the apex of a broad gentle fold along their strike, along the eastern limb of whidh they gradually assume a change from vertical to steep southward dips.

The andesites and diorites are difficult to separate in mapping. The diorites are strongly suggestive of sills in their lineal east-west distribution between andesite flows. These east-west striking contacts have in many places afforded a structural weakness for the introduction of quartz veins and mineralizing solutions.

The ore zone itself is a very strong and persistent zone of alteration about 100 feet in width, where explored by drilling along a strike length of 1800 feet. It appears to be continuous but is likely intermittent along the sediment-greenstone contact for several miles, this contact having been the controlling structural feature. Identical material has been found on other properties from 2 to 3 miles east of the Brookbank claims, and also on the Coleman property to the west. Strong differential movements must have occurred along the whole zone as evidenced by the intense shearing of many parts.

The regional faults have been described under the heading of General geology. This regional faulting is, at least in part, post Keewenawan as it displaces diabase dikes of that age, notably in the western part of Irwin township. How much later the last movement occurred after consolidation of the Keewenawan dikes is a question, but it is the writer's opinion that the time gap was large. This view is held by consideration of the relief of the fault scarps which rise abruptly to heights of 100 feet and more. The relief might prove to be considerably greater if the depths of the accompanying drift filled depressions were known. On the north fault the scarp face is sedimentary and on the south fault the scarp face is greenstone. There could have been more than one period of movement along these faults but the latest movement could easily have occurred much later than Proterozoic time. These southward facing scarps are probably to some extent the product of the plucking action of glacial ice. Later movement during the Pleistocene epoch when isostatic adjustment followed the ice retreat, might have accentuated this feature.

Laird[6] describes the regional faults in the area as part of a system of block faulting. They are considered to be true fault scarps. In the Brookbank vicinity no signs of slickensiding or other criteria were observed, with the possible exception of occasional small patches of chlorite material on the face of the south fault scarp. The plucking action of glacial ice would tend to remove any such features. No evidence was found on the Brookbank property to indicate relative movement or amount of displacement along the major faults there, but 2 miles westward along the strike of the north fault, a diabase dike shows a displacement of one half mile which is considered to be largely a horizontal displacement.

HISTORICAL GEOLOGY.

From the data of the foregoing pages a summary of the probable geologic history is briefly constructed.

The Keewatin lavas were poured out on an unknown floor. During this period of volcanism slight intervals of ash deposition and sedimentation occurred, now represented by tuff beds and thin horizons of iron formation. Then followed intrusions of diorite probably as sills into the Keewatin lavas. There may have been some degree of attendant folding. A period of orogeny in the general area then must have occurred as evidenced by the many granite pebbles in the Timiskaming type sediments. Following the period of orogeny there was a long period of erosion, the start of which at least was likely characterized by rapid denudation of high, rugged, uplands by torrential stream action. The clastic arkoses, greywackes and conglomerates were laid down during this period.

A period of folding followed the erosional interval. Both the lavas and sediments were folded conformably into close synclines and anticlines. There was probably widespread vulcanism at this time which corresponds to the Algoman age, and the granite now exposed north east of Irwin township is considered a part of this intrusive complex. The Algoman orogeny sheared and metamorphosed many of the pre existing rocks. The ore at the Brookbank and vicinity could have been formed during this period. The conditions were undoubtedly suitable for a metallogenetic period so it is therefore quite reasonable to assign the ore zone to this age.

Following the Algoman orogeny there was a long interval of erosion until the Keweenawan diabases were formed. Disturbances after this latest igneous activity subsided are evidenced by the regional faults which cut all rocks. A tremendous period of erosion reduced the whole area to the present day peneplain, upon which Pleistocene glacial drift was spread, and recent alluvium accumulated.

MINERALIZATION.

Nearly all the sulfide mineralization observed on the property occurs along the main ore zone and consists essentially of fine pyrite. Only in occasional narrow bands of an inch or less is the mineralization heavy. Very fine hematite, though lesser in amount, is similarly distributed. Much of the hematite is the specular variety and occasional coarse flakes occur. Chalcopyrite is rare and a very few flecks of molybdenite were observed. On the Coleman property which covers the western extension of the main ore zone the same suite of minerals is found, but with the addition of occasional sphalerite. Visible gold is quite rare.

The gangue minerals are essentially quartz and carbonates, but the gangue grades locally into schistose, chloritic or sericitic phases, as could be expected in a zone of such intense alteration. The gold values tend to be associated with a pink siliceous type of alteration, the pink color being considered as due to finely dispersed hematite in the siliceous gangue. Occasional narrow white quartz veins which transect the main ore zone were found to be barren of gold values wherever sampled.

Most of the numerous quartz veins on the property are very lightly mineralized with fine to medium grained pyrite, some being almost barren of mineralization. The presence of abundant sulfides does not necessarily indicate gold values of importance in the quartz veins, although this criterion can be used with a fair degree of accuracy on the main ore zone. One of the quartz veins carries occasional galena; another shows considerable fine grained barite with quartz as the gangue minerals.

In addition to the main ore zone, sulfide mineralization occurs as sparsely disseminated fine grained pyrite in some of the outlying alteration zones. These zones vary in width from 2 to 50 feet and are confined to diorite andesite contact areas.

ROCK ALTERATION.

The greatest zone of alteration is the main ore zone itself. (often referred to as the Number One Zone). The general features have already been described. Forty drill holes transected this zone at different places along the strike so an excellent average cross section of its character is easily obtained. An inspedtion of the geological plan shows that the zone of intense alteration is continuous along the explored strike length and averages between 50 to 75 feet in width. In this portion the original rock in the greater part of it is scarcely recognizable. From the north margin there is a gradual gradation northward into arkose, and southward into greenstone. An overall width of what can be termed altered material is thus over a hundred feet in some places. There are some lens shaped 'horses' of comparatively unaltered material distributed here and there throughout the zone. In contrast with this there are some areas of 'paper' schist.

The usual sequence of material in the main ore zone from south to north is as follows:- First, there is well fractured greenstone containing occasional small stringers of hard, reddish, siliceous material, with slight pyritization. A few narrow lenticular bands of schistose greenstone are present. The rock changes to northward into a highly brecciated dark brown to buff colored material largely composed of iron carbonate and finely dispersed quartz and a fine network of quartz and carbonate veinlets is commonly seen. Narrow irregular areas of pink to reddish fine grained siliceous material are a consistent feature of the zone and seem confined largely to the greenstone side. Rather fine grained pyrite is liberally distributed throughout the whole zone, but concentrated only in certain narrow bands, usually in the more siliceous phases. When the north margin of the zone is approached, the first evidence of a change is the appearance of a narrow band of dense black cherty material in places less than one inch in thickness. Preceding or following it for a few inches there is usually a dark cherty phase of the alteration. This cherty horizon is interpreted as being originally a narrow band of iron formation. Following this northward is a highly schistose, sericific phase which grades into a light cream colored schistified arkose. The arkose within variable distances usually changes into a fine grained dark slaty (mudstone) phase, and thence into greywacke.

The wallrock of quartz veins seldom shows any appreciable alteration. A second type of alteration zone follows diorite - andesite contacts and is essentially a quartz-carbonate type with none or very slight pyritization. The intensely altered parts of these zones resemble rhyolite in the hand specimen and have been locally considered as such. A siliceous nature is predominant, but usually specimens containing some carbonate can be found. A test of hardness is necessary to identify the carbonate portions as there is slight variation in color and the rock is all very fine grained. At many places there is a platy subschistose structure. Examinations across the width of these areas, (usually not more than 20 feet) shows a gradation on either side into normal greenstone. Specimens from one of those zones on claim No. 29028 (specimen series No. 114-115) show small quartz 'eyes' in a felsitic looking groundmass which by appearance is a typical felsite or rhyolite porphyry. These quartz 'eyes' may be introduced or may be residual, the question being discussed further in the petrographic description. It is only by study of the marginal phases of these zones that their true nature can be interpreted.

PETROLOGY AND PETROGRAPHY

Andesite

The three main rock types as identified in the field are each rather typical of their class. The andesites are fine grained, dark greenish, and often schistose. Amygdules and ellipsoidal structures were rarely observed. Occasional narrow tuff horizons are interbedded with flows and such horizons have suffered the most intense shearing. In some places there are narrow bands up to several inches in width of brecciated andesite in a dense siliceous matrix. These minor brecciated bands do not appear to be localized, but have a random distribution throughout the andesite areas. Evidently, during the periods of movement, the tuff (?) horizons absorbed much of the shearing stress and subsidiary cross fractures in the more massive andesite produced the small brecciated zones which were subsequently healed by the injection of siliceous material.

A typical thin section of andesite shows a fine grained aggregate of plagioclase and chloritic material, the plagioclase being much altered to zoisite, epidote and carbonate. In a few specimens some greenish amphibole grains are still recognizable and many specimens show finely disseminated magnetite.

Diorite.

The diorite is a medium grained dark greenish rock which weathers to a rough surface with white and light grey colors predominant. An ophitic texture is sometimes easily seen in the hand specimen, due to characteristic lath shaped crystals of plagioclase enclosed by comparatively large and prominent amphibole crystals. A few quartz grains are sometimes visible.

Nearly twenty specimens of this rock type were examined in thin section. Most of these were definitely recognizable both in the hand specimen and under the microscope, as the dioritic type. The plagioclase has in most cases undergone considerable alteration to zoisite, epidote, carbonate, chlorite and other minor products. In a few sections extinction angles were measurable, which was done by the statistical method of Michael Levy. The refractive indices in all sections, where comparable, were found to be slightly less than balsam.

This fact, in conjunction with extinction angles, makes the plagioclase an albite of composition $Ab_{95}An_5$. Many grains were tested for optic sign but all interference figures obtained were obscure. The optic angle is indicated to be large and twinning bands are invariably coarse. No zonal growths were observed, but a few intergrowths with quartz do occur.

The amphibole in the diorite shows varying degrees of transition to chlorite, and has the optical properties of common hornblende. Wavy extinction is very common, a feature which is noticeable also in many plagioclase and some quartz grains. Curvature of fibrous amphibole areas is a common feature in conjunction with wavy extinction, and is further evidence that the rock mass underwent a period, or periods of, deforming stress. The presence of another ferromagnosian mineral not now indentifiable, is indicated by areas of pure chlorite which give a characteristic ultra blue under crossed nicols. Examination of many of these chlorite areas adjacent to hornblende shows rather sharp euhedral boundaries, instead of the usual ragged interfingering contact between the two minerals. Quartz grains and biotite are present in a few sections. Some of the quartz grains appear to be secondary.

The diagnostic mineral of these diorites is ilmenite, which is well distributed, and commonly fairly coarse grained. In nearly all specimens the ilmenite grains are partly or completely altered to leucoxene. Some grains have advanced in alteration to become what appears to be fine aggregates of titanite crystals.

A specimen of dioritic appearing rock taken from the far eastern part of the property is an exception to the usual type. In thin section this rock shows fairly coarse and abundant crystals of a fresh looking pyroxene. An examination showed the optical properties to be very similar to pigeonite. According to Hess[8]. pigeonite is confined to extrusive rocks. Unfortunately only one specimen of this rock was obtained because its different nature was not discernable in the hand specimen.

Arkose.

This rock is medium grained, buff to cream colored, and usually quite schistose. Highly schistose sericitic phases are quite common along the north margin of the ore zone. This latter type in thin section consists of numerous sub-angular quartz and feldspar grains in a schistose matrix of sericite and carbonate. The carbonate is probably all secondary and the spheroidal unfractured type of quartz grains have probably also been introduced. The presence of a few angular grains of red jasper is a very characteristic feature. A few grains of pyrite and leucoxene (?) were observed.

Greywacke.

The greywacke in hand specimens is a typical grey fine grained rock showing a clastic nature in the coarser varieties.

There is considerable lithlogical variation over short distances. In some places the greywacke grades directly into arkose, and in others, a fine dense mudstone phase intervenes over a distance of several feet in the direction of stratigraphic sequence. The greywacke in the vicinity of the main ore zone gets progressively coarser going north (across the bedding) and hence there is a gradual change into coarser material,until the conglomerate, which contains well rounded large pebbles, is reached. Angular fragments predominate in the arkose and greywacke; rounded pebbles begin to appear frequently only in the northern reaches of the coarser greywacke.

constituents are chlorite, sericite, leucoxene and ilmenite.

115 - 2. Composition similar to 115 - 1, but is generally a more altered, schistose and finer grained rock. Chlorite, carbonate and ilmenite are more abundant. Ilmenite is stringy in habit. Small euhedral cubes of pyrite are common.

115 - 3. Composition similar to 115-1, but there is appreciably more quartz. The general appearance is more granular although alteration of the plagioclase is developed to about the same extent as in 115 - 1. Some of the quartz grains tend toward euhedral forms and lack the usual fractures and strain shadows. This may be secondary quartz. In the hand specimen, numerous small quartz 'eyes' are visible, a feature which makes the rock resemble a quartz porphyry.

<u>Note:</u> Suite 142 was taken across altered diorite, with 142-1 recognizable as diorite in hand specimen; 142-3 and 142-4 not recognizable as diorite.

<u>Suite No. 142</u>. (1) The feldspar is almost completely altered to carbonate and zoisite. The ferro magnesian minerals are completely altered to chlorite. A few quartz grains are present which show carbonate filled fractures, others show intergrowth patterns in which the enclosed feldspar is completely altered, and some grains have corroded margins. The latter features may be due to original deuteric action in the rock magma. A few rather coarse fractured grains of ilmenite - leucoxene are present.

142 - 2. Similar in composition to 142 - 1, but leucoxene is more abundant. Numerous lath shaped crystals of plagioclase are still recognizable, but otherwise alteration is similar to 142 - 1. The rock is noticeably finer grained.

142 - 3. A fine grained aggregate of zoisite, epidote, quartz grains and carbonate. Leucoxene is scarce. Alteration has advanced to a high degree.

142 - 4. Largely composed of fine quartz grains and irregular patches and streaks of carbonate. Other minerals are quite scarce. Small shreds of white mica and occasional shreds of biotite are noticeable, particularly as the filling of a continuous fracture which cuts all other mineral grains.

Note: Suite 114 was taken from close vicinity of suite 115, but in hand specimen appeared to have greater carbonate content than 115. Number 114-1 appears least altered in hand specimen; 114-3 the most altered.

Suite No. 114. (1) The plagioclase is badly altered to epidote and other products. Chlorite and carbonate are present, and a schistose structure is noticeable, which enfolds some of the quartz grains. Leucoxene is scarce.

114 - 2. Fine carbonate almost entirely obscures the original rock material. Quartz grains are abundant and the appearance of many of them suggest secondary origin. Chlorite is scarce. Leucoxene and pyrite are present.

114 - 3. Very similar to 114 - 2, except that the structure is more schistose.

ALBITIZATION.

It is rather surprising to find albite as the plagioclase in a rock classified as diorite, but this is attributed to widespread and uniform albitization of the diorite.

There is not complete agreement between investigators of the problem of albitization. A general opinion as applied to large bodies of igneous rocks is that the process is a late magmatic one of deuteric nature whereby soda rich solutions permeate and chemically react with the freshly consolidated rock. It is aptly described in the words of Bailey and Grabham[15] as, "the freshly consolidated basic rock was stewed in a concentrated solution of sodium carbonate". Dewey and Flett[16] state in their conclusions from a detailed study of spilitic lavas that, "good evidence exists to prove that albitization took place soon after the rocks had solidified". Gilluly[17] found evidence for believing that large bodies of albite granite in Oregon had been formed by hydrothermal alteration of hornblende quartz diorite with which they were associated. Bowen[18] considers all albite rich bodies to have been formed by replacement, and points out the absence of glassy rocks corresponding to albite rich granites. Albitization of intrusive rocks is mentioned by Daly[17] in his discussion of the 'spilitic suite' of lavas, and is also not uncommonly described in geological reports of different areas in the Canadian Shield, notably in the Bourlamaque district of northwest Quebec.

The petrography of the Brookbank diorite shows a typical assemblage of albitization products. The plagioclase has been transformed to albite and is filled with many small grains of epidote and other alteration products. The usual retinue of other secondary minerals

Such as zoisite, carbonate, chlorite, sericite, kaolin, etcetra, is well represented in thin section. Brownell and Kinkel[20] in describing the spilitic lavas of the Flin Flon mine area say "the sodic plagioclase indicates that albitization has accompanied the alteration of the lavas, with calcium of the original basic feldspar entering into the epidote, leaving only the sodium for the plagioclase". This statement could be applied to the Brookbank diorite.

The alteration of plagioclase of feldspars is discussed by Clarke[14] who considers that carbonated waters acting on the anorthite molecule will result in the formation of calcite and separation of silica, and that a residual albite-quartz mosaic will form. He refers to the formation of epidote and quartz. MacGregor[21] states that, "the preferential clouding of basis plagioclase is due to its having an original iron content higher than that of albite or potassic feldspar".

Park[22] in a recent publication, suggests albitization produced in thick, successive, submarine basaltic flows. According to Park, a mantle of $CaCO_3$ precipitated by the flows would form an insulating blanket to retain heat in the flow which would promote conditions for deuteric action. Sodium ions produced from trapped and heated sea water, together with free silicic acid generated by decomposition of silicate minerals would enter into the reaction. Park suggests the following equation:

$$2Na^{+} + CaAl_2Si_2O_8 + 4SiO_2 \rightarrow Ca^{++} + 2NaAlSi_3O_8$$

at temperatures of 310 to 330 degrees C., and cites the experimental work of Eskola et al[23] with spilitic reactions.

It is difficult to postulate the exact mechanism whereby the Brookbank diorite was albitized. The albite-quartz mosaics mentioned by Clarke are not uncommon. Some of the quartz grains not in association with albite may have been attendant upon the formation of epidote, but this is doubtful as some of the thin sections with abundant epidote show little or no quartz in association with it. It is certainly reasonable to assume that the metamorphism which altered the feldspar must have had some effect on the ferro-magnesian minerals of the diorite so that molecular readjustments and substitutions took place between minerals. No transition stages from pyroxene to amphibole were observed, but the albitization of the plagioclase is apparently complete.

In summary, it is considered that in the case of the Brookbank diorite,the original plagioclase was broken down by thermal metamorphism to form albite, and the liberated lime combined with other products, both reduced and introduced, to form such new minerals as zoisite,epidote and carbonates.

PART II

GEOLOGICAL PROBLEMS.

The problemsinherent to this work, and discussed under the following headings are:-

Diorite and Andesite

Age of the Diorite

Paragenesis of Ore Zone Minerals

Gold Deposition and Significance of Regional Faulting.

DIORITE AND ANDESITE

One of the earliest problems encountered in mapping the Brookbank property was that of differentiating between the andesites and diorites. It was realized that the coarse grained greenstone areas could be either dioritic intrusives or central parts of andesitic flows. Exposures of bare rock were not plentiful, and nowhere on surface was an unquestioned intrusive relationship seen. As mapping progressed, the field evidence indicated diorite rather than andesite, but such evidence was never quite conclusive. Diamond drilling results helped somewhat to clarify the picture.

When actual contacts are obscured by overburden, or shearing and alteration, then the above problem is often a difficult one, and is recognized as such by different writers. Cook James & Mawdsley[9] refer to it in their report on the Rouyn Harricanaw area. In the present map area both Bruce and Laird[6] mention the difficulty and say that some areas of greenstone are questionable in regard to an extrusive or intrusive origin.

In the present treatment of this problem of separating diorite from andesite, the points for discussion are arranged as given below.

Pro diorite:

1. Coarseness of grain
2. Rather fresh appearance.
3. Irregular outline of some masses.
4. Small isolated masses.
5. Petrologic (ilmenite content).
6. Abrupt changes in grain size near margins.

Pro andesite:

1. Coarseness of grain in central part of thick flows.
2. General lineal east-west trend of bodies.
3. Presence of amygdules and pillows.
4. Presence of tuffs.
5. Extensive beds of known andesitic lavas in the area.

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[6] E. L. Bruce. "The Eastern Part of the Sturgeon River Area" p. 20.
H. C. Laird, "The Western Part of the Sturgeon River Area" p. 70.
Ont. Department of Mines, vol. XLV. 1936.

(1). <u>Coarseness of grain:</u> This criterion in itself is of slight value as it indicates only the possibility of diorite being present.

(2). <u>Fresh appearance</u>: In the central part of coarse grained greenstone areas the rock has a fresher, less altered appearance. This could be due to the concentration of shearing and schisting in the more susceptible and absorptive flow contacts and tuff beds which would tend to give such finer grained phases a more deformed, older appearance. The criterion of fresh appearance then, by itself, is not accredited with much weight.

(3). <u>Irregularity of shape:</u> This feature as applied to surface views is quite noticeable in a few particular cases. In sectional view of some of these cases the same irregularity is indicated. It must be borne in mind while dealing with this point, that the overall general trend of the coarse greenstone appears to be parallel and conformable with the bands of fine grained greenstone.

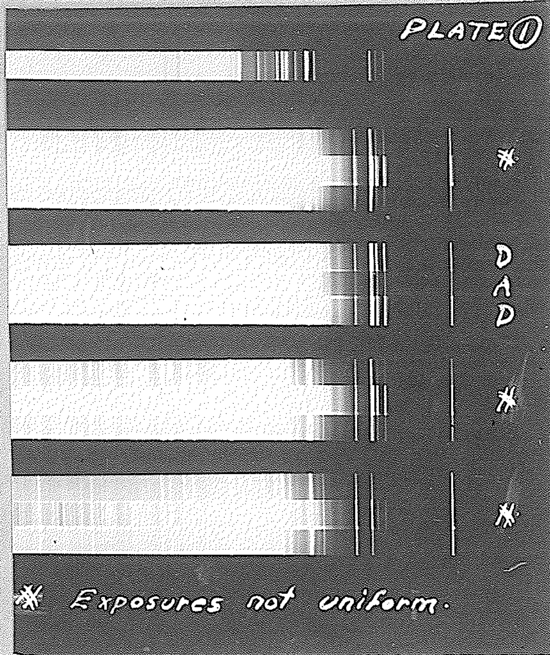
Along the No. 1 zone in the vicinity of drill hole No. 24, and again near drill hole No. 13, the coarse grained masses are irregular, show embayments, and cut the general east-west trend of the zone. Similar although less marked intrusive features can be seen elsewhere on the claim map. In some places there appear to be small tongues of andesite projecting into the central parts of coarse greenstone masses, as in the center of claim No. 29030. Such features strongly suggest the lavas to be infolded small remnants. Third dimensional possibilities must be considered in treatment of these surface views, but it would still be difficult to imagine any normal flow sequence producing the above described effect.

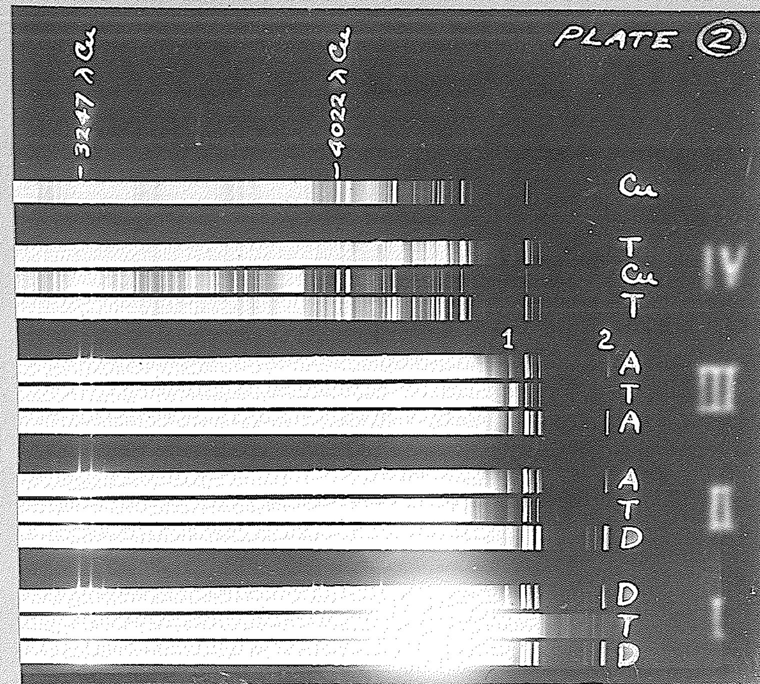
The section made by drill holes No's. 21 and 37, (see fig. 1) shows a narrow mass of coarse greenstone at one place only about 10 feet thick and lying between massive fine grained andesite of comparatively great thickness. This narrow strip of coarse material is obviously an off-shoot from the roughly circular mass indicated near drill hole No. 24, and referred to in the preceding paragraph. It would also be very difficult to reconcile this case as a flow sequence, especially when the change of grain size is so abrupt and the coarse material is so narrow in width. These criteria of shape and outline strongly suggest that part at least, of the coarse greenstone are intrusive diorites. If they were intruded in the form of sills between rough irregular flow contacts it would easily explain many of the marginal features described.

(4). Small isolated masses: Small lenticular shaped masses of coarse greenstone, several feet in cross section, were sometimes encountered in the drilling. These were observed notably in drill holes No's. 2, 4, 6, and on surface near drill hole No. 6. They were regarded for a time as being merely unaltered remnants in the ore zone, but some were found in contact with fine grained andesite. These masses are probably satellitic to the large dioritic mass lying south of the No. 1 zone. This feature supplements and reinforces the evidence presented in (3) for the presence of intrusive diorite.

(5). Petrologic differences: The rock considered as diorite nearly always contains very noticeable amounts of ilmenite in varying degrees of alteration to leucoxene. Such grains are sometimes discernable in hand specimens. A thin section study of specimens considered to be definite andesite failed to show the presence of ilmenite or leucoxene, but the extreme fineness of grain of many of these specimens makes identification very uncertain, so that optical tests cannot be taken as conclusive. From a table compiled by the writer, the relative frequency of ilmenite in diorite as compared to andesite is as 60 to 14 respectively. These figures are in relative frequency of parts per hundred and were computed from analytical data from 16 diorite and 14 andesite samples from different areas as reported by Newhouse[10]. The same data given by Newhouse show that in andesite the frequency of magnetite is greater, being 79 as compared to 31 for diorite. The greater frequency of ilmenite in diorite is a fairly well established fact, and is mentioned by Dana[13] and also by Clarke[14]. (see p. 27b*)

(6). Abrupt changes in grain size: The actual contacts between andesite and dioritic rocks were nearly always found to be obscured by shearing. In the few exceptions observed, the change in grain size always appeared to be too abrupt for normal flow cooling conditions. In flows approaching 100 feet in thickness, it is doubtful if a change from medium to very fine grained rock would take place within a distance of five feet. Such a relation was observed particularly near the southwest corner of Claim No. 29037. This is more suggestive of the cooling margins of an intrusive body.





(see p. 27b)

Note: The bracket at 4982 denotes a cluster of closely spaced Titanium lines within this range. Wave lengths from Standard Tables.

Lineal Enlargement x 10
from marks 1 to 2.
(PLATE 2.)

COMPOSITE OF SIGNIFICANT LINES

The asterik denotes lines which are weaker or lacking in the "A" or Andesite samples as compared to the "D" or Diorite samples.

A Titanium comparator sample "T" is shown with each set of A and D samples in Plate 2. All A and D samples were exposed for 60 seconds. The exposure time of the comparator was varied from 15 to 30 seconds. An arc was used, with copper electrodes.

Figure 7.

EXPLANATORY NOTE (re plate 2, p.27a)

On plate 2 page 27-a, it will be noticed that under mark "2" the titanium comparator sample marked "T" shows no lines in any of the four horizontal groups except faintly in the bottom group I. This fact appears confusing as the plate does not therefore totally correspond to lines marked Ti on the enlarged diagram below.

The explanation of the above lies in the timing of the exposures. It was found by repeated trials that the copper (electrode) spectrum tended to blot out other spectra, and consequently the timing of exposures had to be minimized, especially when the Ti standard alone was used with copper. This same trouble to a more marked degree rendered carbon electrodes quite useless for the purpose of the present work. There would appear to be a delicate balance of exposure timing necessary to achieve ideal results if such is possible with the equipment used. A difference of 5 seconds makes a noticeable difference in the intensities of some lines. Aside from this other variables not reckoned with may exist.

It was found that to bring out significant lines on the A and D trials, that a 60 second exposure was best,-yet with the T sample a 30 second exposure was a maximum, otherwise the copper lines would interfere. The T sample was prepared in solution form similar to the A and D samples, and then diluted to a strength approximating the expected Ti content of the A and D samples.

At least a dozen trial plates were made previous to the present ones marked 1 and 2. What could be termed a conclusive result was never obtained on any one plate, but certain small consistent differences between A's and D's were noted in the better exposures on some of the plates. No single plate contained a complete group of properly exposed trials considered good enough for reproduction. Even the present plates 1 and 2 are far from perfect.

Under mark "2" on the plate the Ti spectra are lacking except in Group I where an exposure of 30 seconds was given to the T sample, -which brought out the lines here but apparently overexposed that portion near mark"1". The other T samples in groups II, III, and IV were given varying exposures down to 15 seconds.

Under mark"2" the line marked 5675 Ti, for A's and D's seems greatly accentuated as compared to the same line for Ti (GroupI). This is probably due to coincidence of a Sodium line of same wavelength. Both A and D samples would naturally have a considerable Na content. This line probably should not have been marked with an asterik on the diagram.

In summary it may be said that results as judged by plates 1 and 2 alone do not present an ideal picture to show a difference in Ti content between A and D samples. It is the writer's opinion however, that by also considering results from preceeding trials , that such a difference does exist. In any case there is certainly a difference whether or not confined to Ti alone. The ultimate aim was to discover any difference between the two rock types, A and D.

\# The results of the spectroscopis analysis do not necessarily indicate that the andesites contain less ilmenite than the diorites, but merely less titanium content. The titanium bearing mineral in the andesites is as yet, actually unidentified. (Ref. p.28, paragraph one, and p.27(5).

Spectroscopic Analysis.

Due to the fineness of grain of the andesite samples optical methods were not satisfactory to determine comparative amounts of titanium minerals in the diorite and andesite samples. Therefore, a spectroscopic analysis of each rock type was made in an effort to detect any noticeable difference in titanium content. (see p. 27 b *)

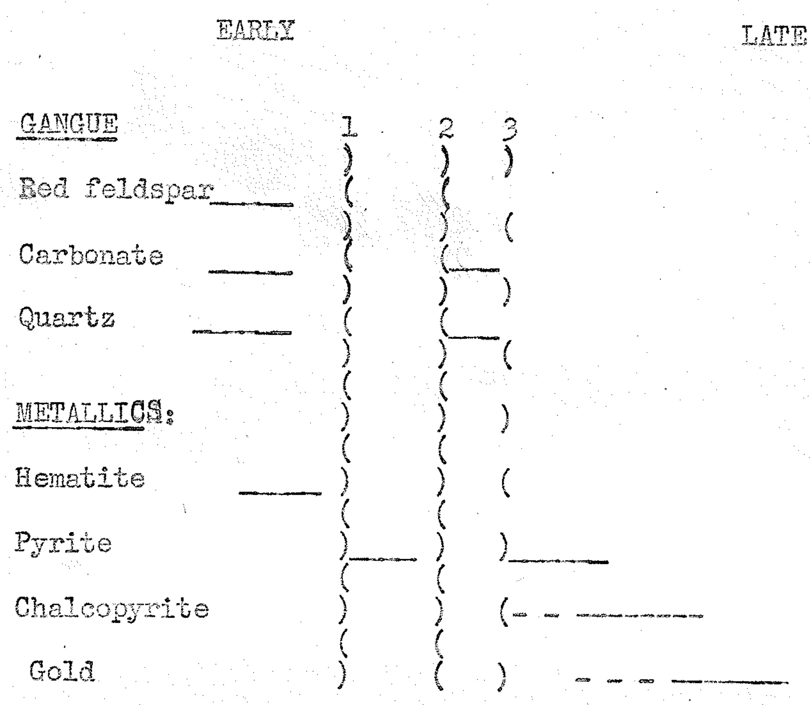
Three typical samples of diorite showing ilmenite were chosen along with three typical samples of andesite showing amygdules. Small chips were taken from each specimen, powdered in an agate mortar, screened to minus 100 mesh, and half gram samples were taken from the well mixed screenings of each sample. These portions were then fused with sodium carbonate, taken up with hydrochloric acid, evaporated and filtered to remove silica, and finally a 30 cc. sample in solution form was obtained, thus ensuring equal and representative distribution of material. Measured drops of this solution were then transferred to specially prepared copper electrodes and allowed to evaporate. An equal number of successive evaporations were thus made from each sample until the electrodes were sufficiently 'loaded'.

Many unsuccessful attempts were made with the spectroscope before a significant result was achieved. Certain spectrum lines of titanium not obliterated by copper or other spectrum lines were finally found, which were diagnostic of diorite samples. A known titanium sample was used as a comparator to enable direct matching of lines. The results are reproduced and shown in diagram form (Fig. 7..). No quantitative results were attempted as the facilities for this purpose were not available.

PARAGENESIS OF THE ORE MINERALS.

Polished sections in bakelite mounts were prepared from twelve specimens of ore from the number one zone. Most of the specimens were from diamond drill core and had a known gold content. Polishing was done on the Graton Vanderbilt automatic polisher.

The paragenesis as interpreted from a study of the above specimens is graphically represented below. The dotted lines represent a possible time range of introduction. The broken vertical lines represent periods of fracturing.



A cutting relationship was the essential criterion used to determine age sequence. Largely on this basis certain definite features were established as follows:

(1) The early gangue consists of red feldspar, carbonate and quartz. This forms the fragmentary material in the brecciated ore.

(2) Pyrite is concentrated along fractures in the early gangue.

(3) Numerous quartz-carbonate veinlets cut through the early gangue and form the cementing material of typical breccia types of ore. These veinlets often follow the paths of the first fracturing. This is evident by the crushed, broken and sometimes partly replaced pyrite grains enclosed within the walls of the quartz-carbonate veinlets.

(4) A third period of fracturing is evident by occasional small, and apparently unfilled fractures which cut quartz-carbonate veinlets.

(5) A late age of pyrite is represented by a few cubes of pyrite observed to be blocking the continuity of the late fracturing. These cubes of pyrite must have grown after the fractures were formed.

(6) Gold and chalcopyrite particles of extremely small size occur in fractures in pyrite, and sometimes appear completely enclosed in pyrite grains or in gangue.

(7) Gangue replaces both hematite and pyrite, at least to a small degree. Frequent gangue filled fractures with unmatched sides can be found in these metallics.

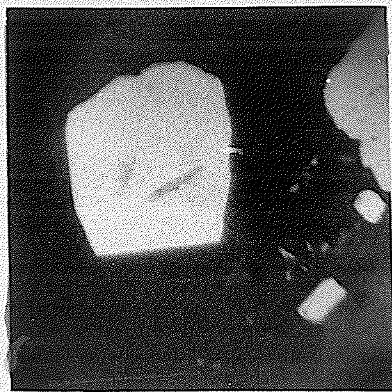


Figure 2.

Hematite (grey) in pyrite. x 130.

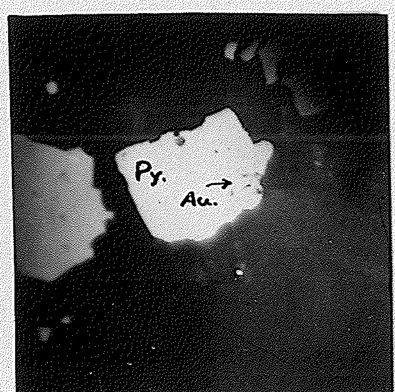


Figure 3.

Gold in pyrite. x 130.

(8) In some places quartz replaces carbonate, and in others the reverse condition is indicated.

(9) The early carbonate is often buff colored and the later carbonate is white or clear.

(10) The late gangue material has replaced the early gangue to a varying extent.

It is questionable if the gold and chalcopyrite should be placed after the final fracturing. It is the usual case that gold is one of the latest metallics, and this is largely the reason it has been so placed in the present case. There is no visual evidence to prevent placing the gold with the second fracturing, i.e. contemporaneous with the late gangue. The gold and chalcopyrite are grouped together simply on the basis of a similar mode of occurence.

The pyrite - hematite age relation was not based directly on a cutting relationship. In fact some grains of hematite could be interpreted as post pyrite in age, due to an apparent clustering around some of the pyrite grain boundaries. A complete study however, shows that such clustering is more likely to be a residual feature caused by unassimilated hematite remaining around pyrite margins. On the average, the hematite grains in pyrite are noticeably smaller than those in gangue. It is more normal to expect hematite as an earlier mineral.

The relation between metallics and gangue is not the usual condition. According to Bastin [11], the gangue is usually the host. There is no question that to some degree at least, the gangue has replaced metallics, in the case of the Brookbank ore.

The reddish color of the ore is considered to be due largely to fine red feldspar, and partly to fine (usually specular) hematite as determined by optical examination. The red coloration of the feldspar itself could quite easily be caused by sub microscopic hematite inclusions. The red color of aventurine and some other varieties of feldspar is considered by some investigators to be due to the presence of fine hematite.

The relative ages of the early gangue minerals are not certain. Some of the quartz is probably secondary, i.e., introduced during the second gangue forming period. The inner parts of some of the more intact fragments of early gangue in breccia, are quite siliceous, so it is presumed likely that quartz was one of the early gangue constituents.

In view of the extremely small size of the gold particles as indicated by the polished section studies, it would seem advisable that further studies in this direction should be made before any milling plans are formulated for this property.

Figure 4.

Hematite (light grey) cut by veinlets of gangue (black). x58.

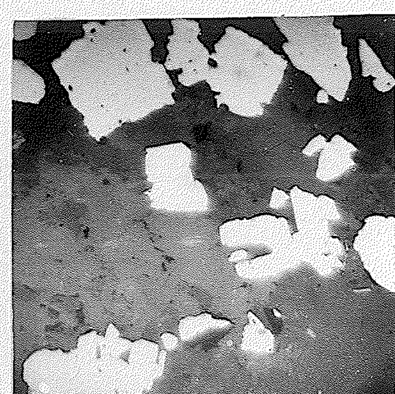


Figure 5.

Pyrite (white) replaced by gangue (dark). x 58.

AGE OF THE DIORITE.

This problem is simply a question of whether the diorite is pre or post Timiskaming. Nowhere, in the writer's experience, was any diorite found intruding the Timiskaming type sediments on the Brookbank or adjacent properties. It must be borne in mind however, that the writer's field observations were limited to these properties. Laird[6] mentions diorites cutting both sediments and lavas and tentatively classes such diorites as Algoman but gives no specific description of outcrops. He does however, say that they occur as rounded bosses and broad dikes. His petrographic description checks reasonably with that of the Brookbank diorite, but as the description is not a detailed one, and as all diorites have the same general petrology, a correlation on this basis cannot be regarded as conclusive. Furthermore, the Brookbank diorites are characteristically sill shaped; this feature alone would argue against a correlation. Bruce[6] describes post Timiskaming diorites cutting sediments in Legault township approximately 14 miles east of the Brookbank claims, and says, "Generally the diorite is not in contact with the sediments, and in appearance it is so similar to the massive greenstones to the south that the exact contact between the two is not easily located." Bruce[6] gives a fairly detailed petrographic description of a diorite dike 150 feet wide, which cuts the sediments. The feldspar is andesine of composition Ab_5An_5.

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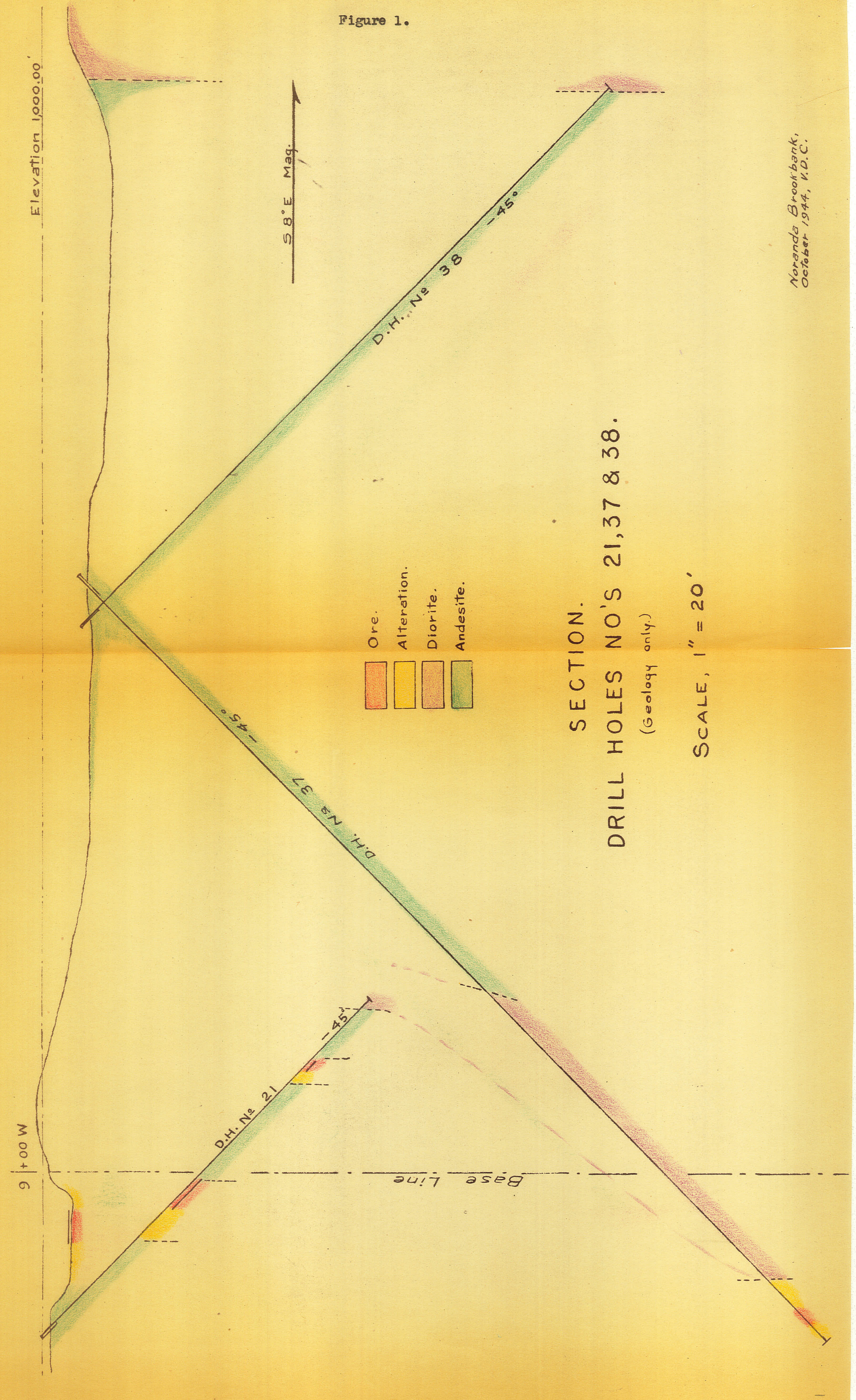
[6] E.L. Bruce, "The Eastern Part of the Sturgeon River Area" p.21
H.C. Laird, "The Western Part of the Sturgeon River Area" p.79
Ontario Department of Mines, Vol. XLV. 1936.

Figure 1.


Elevation 1,000.00'
S 8° E Mag.
D.H. No 38
-45°
Noranda Brookbank,
October 1944, V.D.C.
Ore.
Alteration.
Diorite.
Andesite.
SECTION.
DRILL HOLES NO'S 21,37 & 38.
(Geology only.)
SCALE, 1" = 20'
D.H. No 37
-45°
D.H. No 21
-45°
9+00 W
Base Line

and no mention is made of ilmenite being present. Obviously this description does not check with the Brookbank diorite.

Assuming the Brookbank diorite to be post Timiskaming, it seems difficult to understand how the sediments would entirely escape intrusion, while the nearby lavas for a known contact distance of several miles have been prolifically intruded. The only explanation conceived by the writer is the fact that the sediments are confined to synclinal troughs. An idealized structural diagram has been prepared. (See fig. 6.)

There is an outcrop of diorite separated by about 25 feet of swamp from an outcrop of arkosic sediments at one locality a few feet from the west end of the Brookbank base line. The appearance of the arkose gives no suggestion of the presence of a nearby intrusive.

An approach to the problem was made by a study of the detrital assemblage in the sediments. Results were negative. The feldspar grains gave no indication as having been derived from erosion of the diorite. In fact, very few of the feldspar grains were found to be optically similar to those of the diorite. (See petrographic description of sedimentary rocks). The original source, however, could not have been far distant as the grains are markedly angular. No diagnostic minerals were observed in the sediments, although there is little to be expected as such, from a petrographic examination of the diorite. In consideration of the above remarks it must be borne in mind that the stratigraphic horizon of the sediments sampled may not be at all representative of the present adjacent area of exposed igneous rocks.

As the Keewatin lavas and Timiskaming type sediments both were folded at the same time, it is reasonable to expect any pre Timiskaming intrusive to be structurally deformed by such folding. The generally massive appearance of the Brookbank diorite argues against this X. Nevertheless, it should be considered as a possibility. Some of the Keewatin andesites show an almost equally massive character, but in this case it has been previously suggested that tuff beds and flow contacts absorbed much of the attendant folding stresses. If the diorites were part of that pre-folded assemblage, then the same tuff beds and all contacts would act similarly as stress absorbers for the diorite bodies, particularly if they were in the form of sills.

Consideration again of the widespread albitized and chloritized nature of the Brookbank diorite strongly indicates it to be of an earlier age than the comparatively fresh andesine variety described by Bruce as cutting the sediments in Legault township.

X Outcrops of sheared diorite have been found on the Brookbank claims.

GOLD DEPOSITION

A study of the paragenesis has indicated the gold to be a late formed metallic, which is the usual case with gold ores. The existence of apparently unconnected blebs of gold enclosed in pyrite grains is not necessarily indicative of early gold. This feature, although not proven in the case of Brookbank ore, is considered to be a result of the polishing which tends to heal over, or otherwise obscure the very minute fractures. Keys[12] draws attention to this feature in his description of the Hollinger Gold ores.

It is usual to consider hematite as an early mineral, but this was actually not expected to be the case in the Brookbank ore. The very common association of hematite with gold as indicated by surface sampling, had created the impression that the two minerals had a close genetic connection, and hence the hematite was considered possible as being a late type. A reconsideration of the field evidence however, makes such evidence compatible with the paragenesis as constructed from the study of polished sections. It is true that the best gold values are very commonly found in a pinkish siliceous type of rock alteration. The pink color is attributed to finely dispersed hematite, and this color contrast to the other drab colored rocks, draws attention. The essential feature however, for gold deposition is considered to be the siliceous, easily fractured nature of the rock which makes it a suitable host. An inspection of the best gold bearing specimens showed nearly all to be quite siliceous, and most of them pink to reddish in color. The exceptions were several dark grey, often cherty types, which under the microscope showed little or no hematite.

Several narrow quartz veins transacting the main ore zone in irregular patterns are commonly barren of gold. Out of a series of samples taken from these veins there were one or two exceptions which did carry gold. This fact is interpreted to indicate the veins to be pre gold in age and that the very occasional gold content is merely fortuitous as a result of parts of the veins happening to be in the path of a set of later gold bearing fractures.

It is not likely that the above interpretation applies to the numerous outlying quartz veins on the property. It is not known if these veins are all of the same age though many of them carry low gold values. A few carry medium to high values and visible gold has been reported found in them. In the main ore zone the presence of abundant fine pyrite is frequently diagnostic of a fair gold content. In the outlying quartz veins, samples showing abundant sulphides seldom had more than a very low gold value. The best gold assays were generally obtained from white to grey, well fractured, lightly pyritized quartz with chloritic seams. This association, however, did not always hold. Briefly, diagnostic field features are lacking for prediction of a gold content in the outlying quartz veins.

The age of gold deposition must be post-Timiskaming as the ore zone itself is later than the sediments. If the diorite is pre-Timiskaming there can be, of course, no genetic connection between it and the gold, an idea which has been considered by some as applicable to this local area. The diorite itself in a few instances is fractured and contains auriferous quartz veins. This fact, of course, would not necessarily preclude the diorite as an ore bringer even if it were post-Timiskaming.

Tyson[7] suggests the regional faults to have been a locus of ore deposition, and also suggests a connection in this respect with the gold deposits of Little Long Lac situated 35 miles to the east. It is quite possible that regional faults could have acted as channels for ascending ore solutions. This is a general theory which is supported by the proximity of gold deposits to regional faults in many mining areas. An outstanding example as pointed out by Tyson is the Porcupine - Beatty - Noranda Rouyn - Malartic system, which extends along an east west direction for nearly 100 miles. The faults in the Sturgeon River area have not been traced through to the Little Long Lac gold area as the intervening country is too heavily overburdened. The only correlation so far accomplished according to Bruce[6] between rocks of the two areas is that of sedimentary bands, by actual tracing of outcrops.

Any connection that the regional faults may have with gold deposition in the case of the Brookbank ore is open to question. The writer does not favor the affirmative view for two reasons. First, there is little if any sign of mineralization along or near the faults, and secondly, the faults are considered to be of post ore age. The faults displace the Keewanawan diabases of the area, and so far, no mineralization at least of gold bearing type, has been found in these rocks. The magmatic source of gold bearing solutions was probably some granite intrusive not exposed in the vicinity, but likely belonging to the same intrusive period as the large granitic mass exposed north east of Irwin township.

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7 A. E. Tyson "Report on Gold Belts in the Little Long Lac Sturgeon River District", Can. Mining Journal, Vol. 66, 1945, p 839-50.

CONCLUSIONS

The area studied by the writer represents only a small fraction of the whole map area. Therefore, the inferences drawn that would have regional application should, as a matter of principle, be regarded as tentative .

(1) It is concluded that intrusive diorite is present on the Brookbank claims.

(2) The age of the diorite is held most likely to be earlier than the deposition of the sediments.

(3) The deposition of gold took place at a late stage in comparison with the other ore minerals.

(4) There is no genetic connection between gold and hematite in the sense that hematite must indicate the presence of gold.

(5) Light colored rocks on the Brookbank claims, which resemble rhyolite are more likely to be alteration products than acid lavas.

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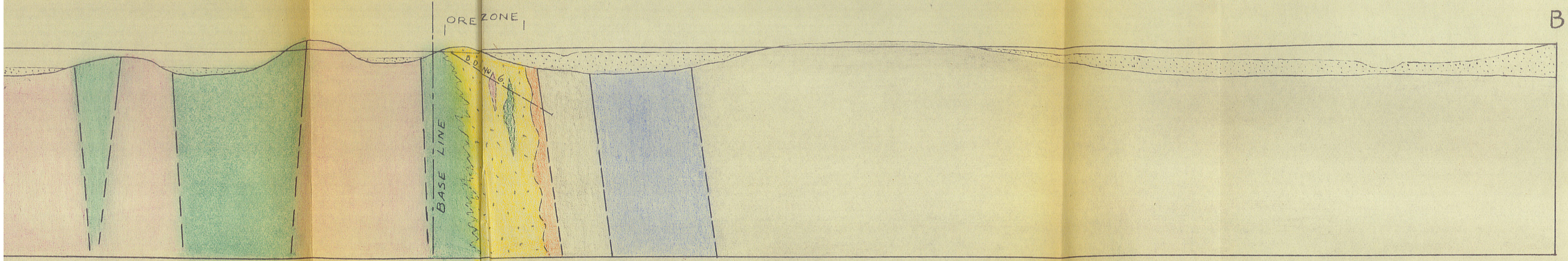
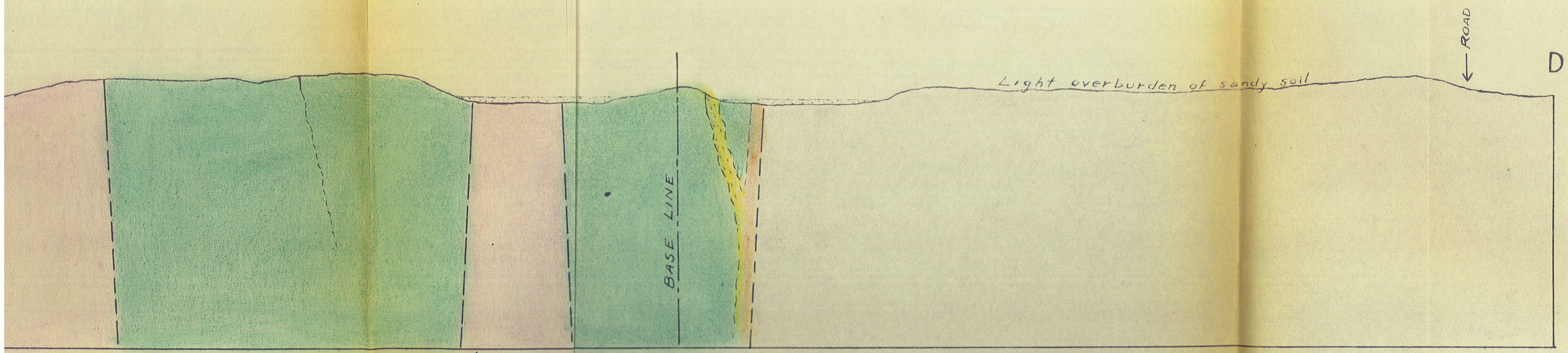


SUMED STRUCTURE ALONG A – B



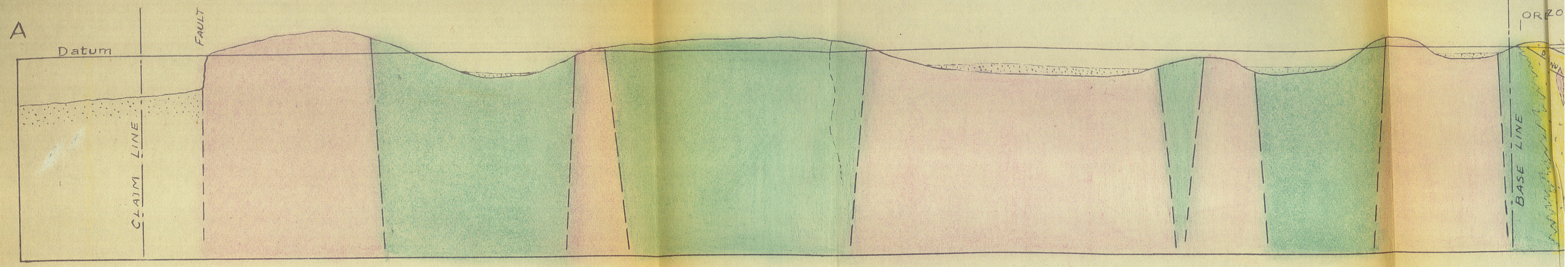
SUMED STRUCTURE ALONG C – D

HORIZONTAL AND VERTICAL
SCALE

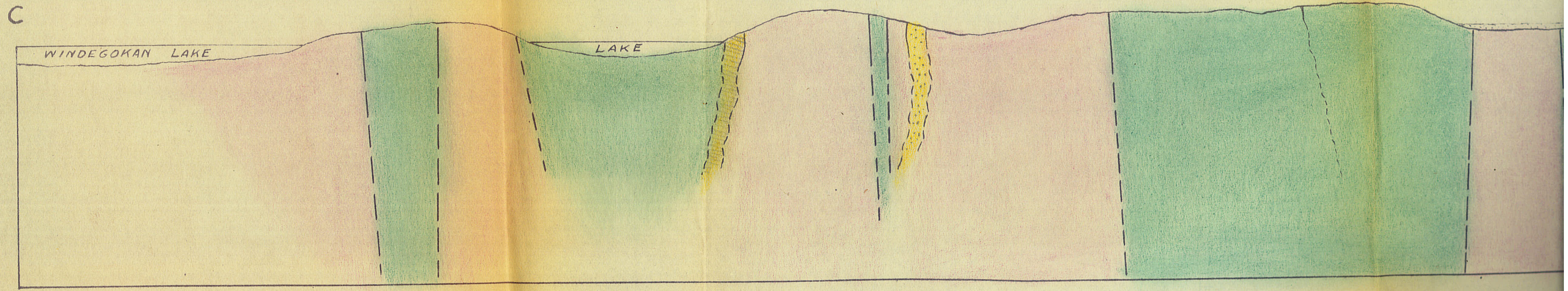
1" = 200'

See LEGEND on accompanying geological map.

V.D.C.



ASSUMED STRUCTURE ALONG A-B



ASSUMED STRUCTURE ALONG C-D

HORIZONTAL AND VERTICAL
SCALE

1" = 200'