MINERALOGY & PETROLOGY
OF DYNASTY TAY RIVER
BASE METALS PROSPECT
BY
E. Mortensen - 1965

SEA

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ABSTRACT

This thesis entails microscopic examination and description of diamond drill core from four drill holes covering an area of one-quarter square miles.

Mineral claims studied are in the Dynasty Exploration Ltd. SEA group of claims located three-quarters of a mile east of the north-eastern corner of Swim Lake, (62°10' North latitude, 130°48' West longtitude) Yukon Territories. Whitehorse is 140 air miles to the south west.

Pyrrhotite, pyrite, sphalerite, galena and chalcopyrite (in decreasing order of abundance) constitute the sulphide mineralization. These minerals occur in veins, parallel to the cleavage in a sericite-quartz schist wallrock. Veins commonly range in width from 1 mm. to several tens of cm., some are as wide as 3 m. The mineralized schists are an upper member of a sequence of metamorphosed sediments and altered volcanics of Mississippian age or older.

The deposit is classed as a hypothermal vein-replacement type. Ore controls appear to be:

1) proximity to granitic intrusions of Mid-Cretaceous age.
2) highly developed closely spaced planes of foliation which the mineralized veins parallel.

ACKNOWLEDGEMENTS

The author wishes to thank Mr. J. Farley and Mr. G. Davis of Dynasty Exploration Ltd., for samples, maps, drill core logs and much verbal information, without which this thesis work could not have been done.

Thanks go also to Dr. A. J. Sinclair who served as thesis supervisor.

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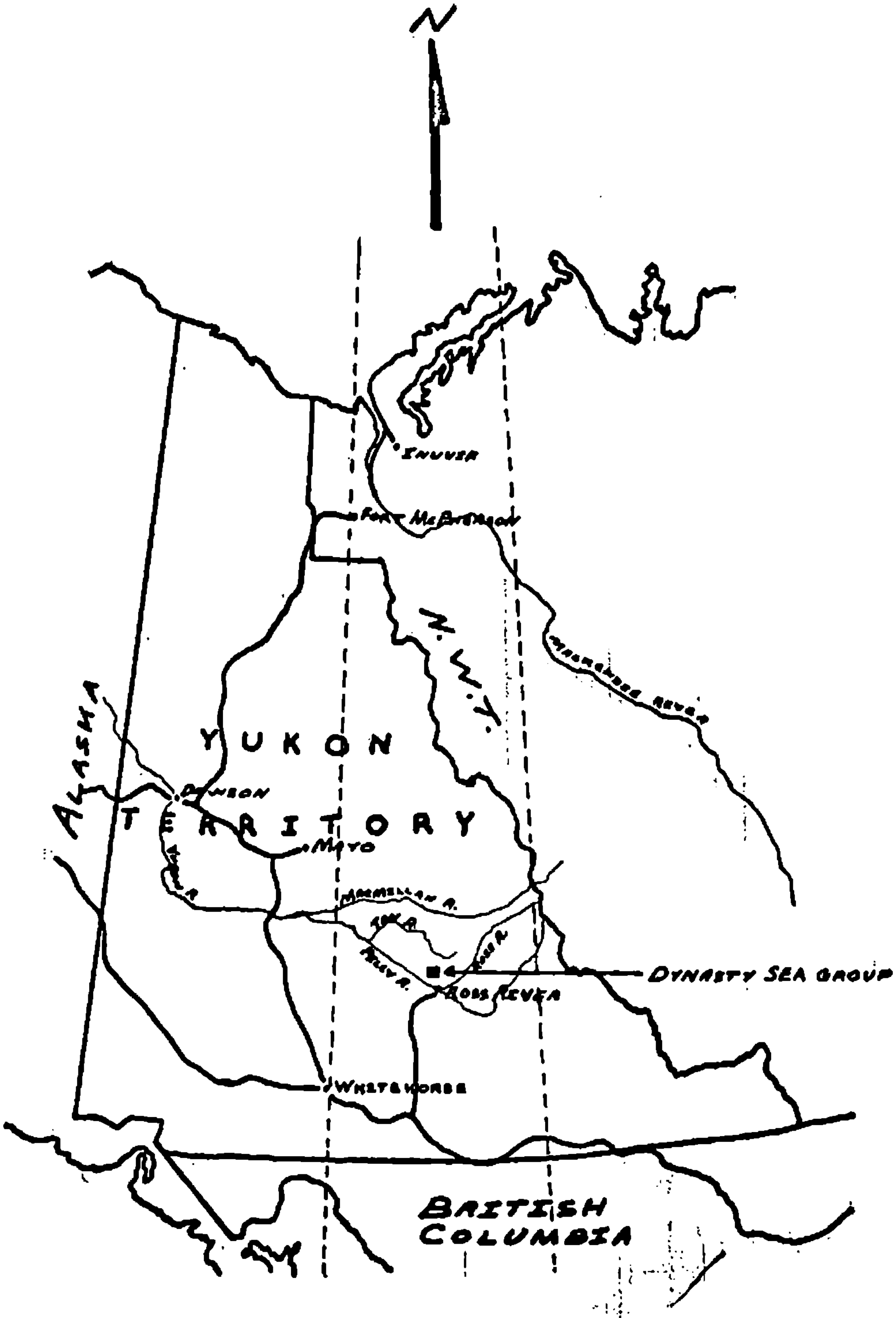
ILLUSTRATIONS



SCALE = 1 INCH = 140 MILES

INTRODUCTION

Microscopic examination of the diamond drill core from Dynasty Exploration Ltd. SEA group of mineral claims (Swim Lake, Yukon) was done to:

1) determine composition and texture of the fine-grained country rock schists.
2) determine relationship between country rock and the sulphide-gangue units.
3) determine interrelationships between the sulphide minerals.
4) determine the ore controls present, if any.

The author has not personally visited the property. Maps, rock samples and diamond drill core logs were kindly made available by the staff of Dynasty Exploration Ltd.

Petrological and mineralogical information in this thesis was obtained by the author's study of sixteen thin sections, twenty hand specimens and twenty-five polished sections during the winter of 1964-65.

Location

Dynasty Exploration's SEA group of mineral claims (SEA group; numbers 63, 65, 67 and fractions 2, 3, and 4) are located at 132°40' West longtitude and 62°10' North latitude, approximately 140 miles north east of Whitehorse, Yukon Territories. Ross River, the nearest settlement, is 20 miles to the south east of the claims group at the junction of Canol road and the Pelly River. Swim Lake, the largest lake of the Swim Lakes chain, is the nearest landmark. The claims are three-quarters of a mile to the south east of its north-eastern corner.

Access

Up to the present time access has been mainly by air from Whitehorse. The Swim Lakes make excellent landing sites for small float or ski equipped planes. It is also possible to gain access by small boats down the Pelly River from Ross River (see page 5) and then via tote road overland.

During March 1965, an attempt will be made to transport heavy equipment to the claims by truck from Ross River, via a bulldozed trail and the frozen surface of the Pelly River.

Physiography

Mountains, with peaks up to 6763 feet elevation, lie to the west and north of the valley containing the Swim Lakes chain. Peaks with lower elevation (5000 feet) and a more gentle rolling topography lie south and east of Swim Lakes Valley.

Swim Lake, 3 miles long and 1-1/2 miles wide, is the largest of the Swim Lake chain. The valley floor on which it lies (elevation 3000 feet) is about 20 miles long, 8 miles wide, elongated in a northerly direction and shows only minor relief. Drainage of the valley is southward to the Pelly River.

The effect of Pleistocene glaciation is seen in the broad, relatively smooth valleys rising abruptly to steep irregular mountain slopes.

Brief History of Property

A drilling program was initiated in 1964 to investigate magnetic anomalies previously found in the area. Outcrop of bedrock on the claims is very limited due to the prevalence of glacial and alluvial overburden with an average thickness of about 20 feet. Hence, extensive drilling and trenching is necessary for assessment work. In 1964, 5 drill holes were completed to depths varying from 160 feet to 400 feet. Further diamond drilling is scheduled for 1965.

GENERAL GEOLOGY[1]

In the area immediately surrounding Swim Lake, as in most other low-lying areas of the Tay River Map sheet, most of the bedrock is overlain by Pleistocene glacial till and alluvium. Only the highest mountains in the area were not ice covered at some stage.

Beneath the till and alluvium in the Swim Lake area is the upper parts of a Mississippian (or older) sequence of quartzose granulite, skarn, sericite quartz schists, hornfels and phyllites several thousand feet thick. This sequence grades upward into strata consisting mainly of thin altered andesite with minor amounts of crystalline limestone. The andesites were largely removed by erosion in the area of the Dynasty SEA group of claims. Sulphide mineralization on the Dynasty property seems to be restricted to the sericite-quartz schist and chlorite-quartz schist of the upper parts of this unit (Unit 7 of Roddick and Green[1]).

The above Mississippian (or older) sequence is underlain by Upper Devonian-Lower Mississippian (?) sedimentary and metamorphic rocks several thousand feet thick. Dominant constituents are chert-pebble conglomerates, chert, shale, slate, limestones and quartzites. Similar underlying Ordivican-Silurian rocks are believed to be separated from the Upper Devonian-Lower Mississippian (?) unit by an unconformity.

Granodiorite and adamellite, with minor amounts of diorite

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1 J. A. Roddick and L. H. Green - G.S.C. Preliminary Map 13-1961; Tay River, Yukon Territories; Sheet 105K.

and gneiss, intruded the above sequences to form the core of the Anvil range. Many other smaller stocks are present throughout the region. Intrusive nature of these rocks is shown by cross-cutting relations, sharp contacts and very rare xenoliths.[1] Sulphide mineralization is found in localized areas where these intrusives are flanked by the Mississippian sediments and meta-sediments. The probable age of the intrusions is Middle Cretaceous,[1] suggested by comparison with similar igneous rocks in the Itsi Mountains.

A major northwest striking strike-slip fault with possible upthrow of the south-western side, the Tintina fault, passes approximately 8 miles to the south west of the Swim Lake area. There appears to be no association between this fault and mineralization of the Swim Lake properties. Blind Creek follows a smaller and similarly unassociated fault.

Structures

Because outcrop on the property is very limited, knowledge of subsurface geology must necessarily come from trenching, diamond drill core and study of scattered outcrops in the surrounding area.

Original bedding cannot be detected in hand specimen but secondary foliation (described in detail on page 11) is well developed. This secondary foliation strikes 045°, a dip of $10-20^{\circ}$ to the north west is prevalent.

Axes of numerous minor folds and lineations roughly parallels the flow-cleavage plane strike direction.

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1 J. A. Roddick and L. H. Green - G.S.C. Preliminary Map 13-1961; Tay River, Yukon Territories; Sheet 105K.

A series of discontinuous lateral faults with small displacement cross the property with a north to northwesterly trend and appear to be post-mineralization in age.

PETROLOGY

Surface Outcrop

Two specimens, from a small outcrop immediately east of DDH#3, were available for study. They are known to represent the lithologic units exposed but the structural relationship between them is unknown.

Specimen A

Megascopically it is a fine-grained highly altered rock with a blue-green cast. Vugs and earthy pockets are common. Sulphides (galena, chalcopyrite and sphalerite) occur as disseminated blebs that make up less than 4% of the rock.

Microscopic determination gives estimated abundances of:

Antigorite	50%
Calcite	35
Chlorite	10
Sulphides	5
Epidote	Trace

Microscopically, calcite occurs as fine-grained secondary fracture filling material and as inward projecting crystals in filled vugs. Fine grain serpentine makes up the main mass and also occurs as inward projecting threads associated with calcite in the vugs.

Epidote and chlorite are randomly disseminated.

Sulphides are disseminated or occur as discontinuous stringers in brecciated zones 1-2 mm. wide.

Specimen B

Megascopically this is a highly altered rock composed of relatively large epidote concentrations in a fine-grained, dark yellow-green groundmass. The rock crumbles easily to ragged irregular fragments.

Microscopic examination gives estimated abundances of:

Tremolite	25%
Calcite	20
Kyanite	15
Epidote	10
Unresolvable	30
Actinolite	Minor

Microscopically, it is a highly altered metamorphic rock with porphyroblasts of epidote and kyanite in a groundmass of fine grain tremolite, calcite and material too finely divided to identify.

The material of unknown composition is too finely divided to enable resolution of individual grains. Relief of the material is slightly less than n_ϵ of calcite (1.486); transmits plane polarized light poorly, giving a grey-brown color. It appears to be isotropic when viewed under crossed nicols.

Sub-Surface Petrology

The fine-grained nature of these rocks makes hand specimen mineral identification difficult. However, when the constituent minerals are known from microscopic examination, general rock types can be recognized and named in hand specimen by colour and texture with a high degree of certainty.

The following data was obtained by examination of diamond drill core from four drill holes. A representative suite of core samples, consisting of eighteen core specimens and sixteen corresponding thin sections, was available.

Rock Types and Descriptions

Three distinct types of rock can be recognized. Each type grades imperceptibly into either of the other types.

Sericite-quartz schist (Type #1).

In hand specimen this is a fine-grained lepidoblastic schistose rock. Layers of sericite about 1 mm. wide are separated by parallel aphanitic-quartz layers of the same width. The rock splits easily along the sericite layers, resulting in a smooth planar cleavage surface with moderate relief and few disruptions. Color of the abraded sides of the core is greenish-grey, and on cleavage planes it has the distinct whitish cast of sericite.

Approximate bulk composition determined by microscopic examination is:

	Range	Average
Quartz	30-80%	55%
Sericite	30-50	35
Chlorite	0-10	5
Sulphides	0-30	5

Bands containing approximately 90% sericite, 10% fine-grained semi-opaque unresolvable material and finely divided disseminated sulphides, alternate with parallel layers containing; 85% quartz, 15% sericite, minor chlorite and finely divided disseminated sulphides. Each layer is about 1 mm. thick.

Cleavage planes are marked by the bands containing 90%

sericite as short slender shreds showing perfect parallel alignment. The disseminated sulphides (see page 24) show a slight elongation parallel to the sericite alignment. These finely divided sulphides are not part of the main, later mineralization and are of no economic interest.

Grain size in the quartz rich bands is uniform at about 0.07 mm. diameter, but a maximum of 0.2 mm. diameter is not uncommon. Grains are anhedral, equidimensional, irregular and tightly interlocking. Some sericite is scattered interstitially in the quartz but most is concentrated along thin "∫" shaped bands about 1 mm. apart, the non-distorted mid-part of the "∫" is roughly perpendicular to the main foliation. The "∫" shape is attributed to drag folding of the sericite of a weak primary foliation by the shearing movements that produced the stronger secondary cleavage.

Chlorite is generally restricted to the quartz rich bands as irregular agregates of small shreds and flakes which show little or no preferred orientation.

Chlorite-sericite quartz schist (Type #2).

Except in DDH#4, from which no samples were available, this type constitutes less than 1/5 of the lithologic column.

Fissility is less well developed than in the sericite quartz schist, the rock cleaves along an irregular line due to the discontinuous and irregular nature of the sericite bands along which cleavage takes place. Quartz, as in type #1, is very fine grained. Color of the abraded sides of the core is a distinctly darker green than the sericite-quartz schist; whitish color of the cleavage planes remains the same.

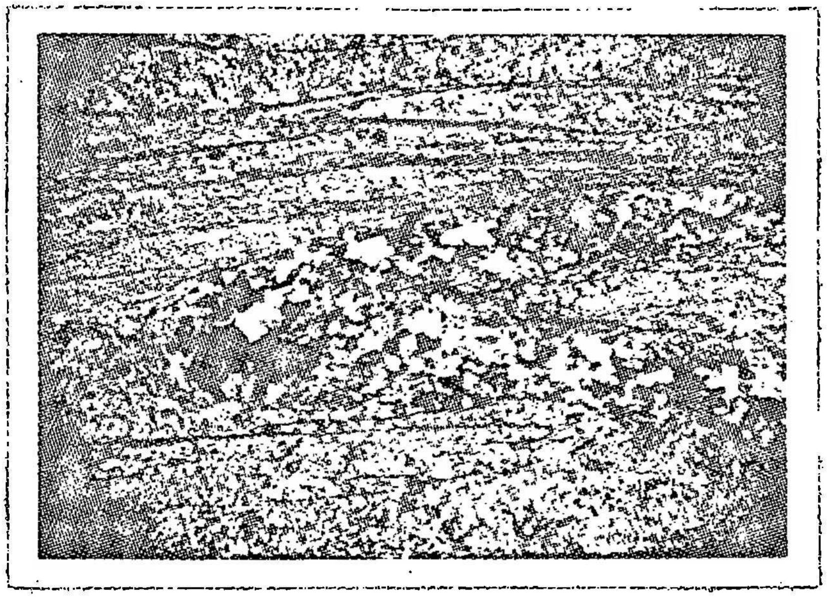


Plate 1 - Pseudofold in cross-cutting portion of a vein. Parallel bands are sericite on cleavage planes of sericite-quartz schist. (P.P.L., x 50)

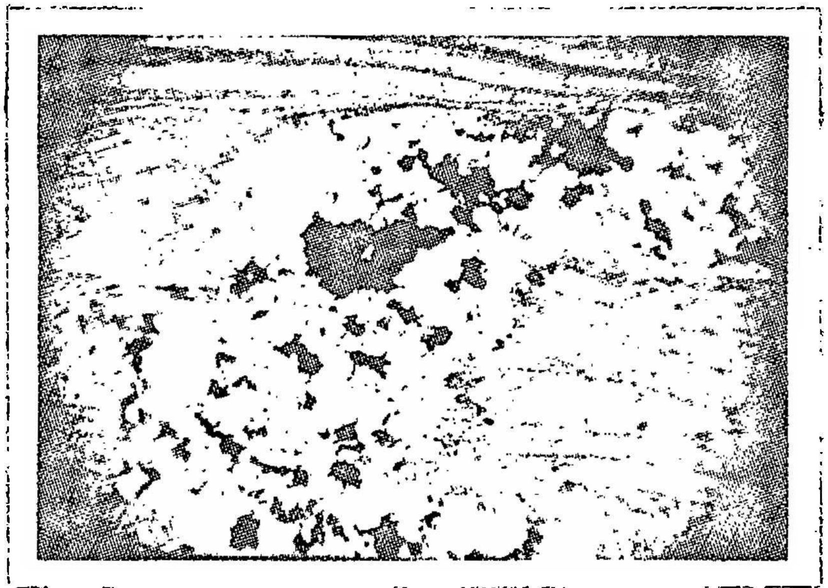


Plate 2 - Pseudofold in a vein. Note relict sericite projecting into vein as continuation of sericite rich cleavage plane of sericite-quartz. (P.P.L., x 150)

Approximate bulk composition determined by microscopic examination is:

Quartz	42%
Sericite	25
Chlorite	25
Sulphides	8

Sub-parallel laminae with high quartz content alternate with bands rich in aligned sericite, much as in the sericite-quartz schist, but the sericite bands are not as continuous. These bands pinch-out or merge with other bands giving the uneven cleavage surface.

Chlorite is concentrated in the quartz rich bands where it occurs as flakes and irregular aggregations of flakes with no preferred orientation.

Quartz grain size is slightly greater than that found in the sericite-quartz schist, but not to an extent where it is noticeable in hand specimens.

Minor amounts of sulphides (see page 24), probably present in the sediment before developement of the schistosity, occur as finely divided disseminations in both the sericite and quartz layers. In the sericite rich layers the disseminated blebs show a slight elongation parallel to the sericite alignment. In the quartz rich bands secondary sulphide content and grain size is greater than in Type #1, with a marked tendency to associate with chlorite segregations. These secondary sulphide grains appear to have been introduced at the time of the main mineralization.

Sericite quartz schist with fine granular quartz bands (Type #3).

Megascopically, this rock displays very fine grained quartz bands alternating with sericite bands, essentially with the same relationship as in the sericite quartz schist. This orderly sequence is broken at varying intervals (several cm. apart) by thicker, more coarsely crystalline bands of quartz easily seen in hand specimen. General trend of these bands is to parallel the schistosity but cross cutting is common. The quartz granule bands cross cut for a short interval before continuing parallel to the schistosity. An average band is about 5 mm. wide and the range of widths is from 1 mm. to ten's of cm. Sulphide content of these granule bands varies from 0-30%.

Approximate bulk composition determined by microscopic examination is:

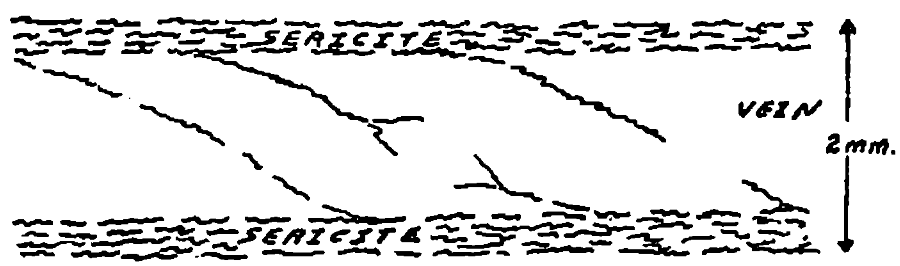
	Range	Average
Quartz	35-75%	55%
Chlorite	15-40	20
Sericite	10-30%	15
Sulphides	0-30	15

Microscopically, the texture and composition of most of this rock unit is a typical sericite-quartz schist. One significant feature is the presence of the quartz granule-chlorite-sulphide veins. These veins are generally parallel to the foliation but as noted previously in discussion of hand specimens, cross cutting relations are common.

Quartz grain size is generally less than 0.5 mm. in the veins, an increase by a factor of 10 relative to the size in the undisturbed quartz rich layers of the schist. Grains have irregular outlines and are tightly interlocking.

Chlorite commonly makes up 20% of the veins. It occurs as: (1) discontinuous borders 0.2 mm. wide where the veins are in contact with foliated sericite of the enclosing schist; (2) irregular aggregates of flakes in the vein; (3) isolated grains interstitial to the quartz. Chlorite content is noticeably increased in the quartz-rich bands in the sericite-quartz schist adjacent to cross cutting portions of the veins. The non-alignment of the isolated chlorite flakes in this environment suggests introduction at time of quartz-sulphide vein emplacement, after the strong secondary cleavage was developed.

Very little sericite is present in the veins, at most 5%. It occurs as included flakes interstitial to the quartz and chlorite, and as relict, partly replaced layers across the veins. These relict layers are continuations of layers in the host rock, and many retain the original fine grained disseminated sulphide. Most layers show very little or no signs of physical disruption. Where the veins parallel the schistosity included sericite is much less common. This type of inclusion is due to dilation of the sericite layers by the vein, as shown in sketch below.



Sulphide interrelationships in these veins are described on pages 25-29.

Plate 3 - Presulphide cross cutting veinlet of gypsum. Note relict sericite(s) in upper left part of vein. Quartz (Q) and sulphide (SP) make up vein. (P.P.L., x 50)

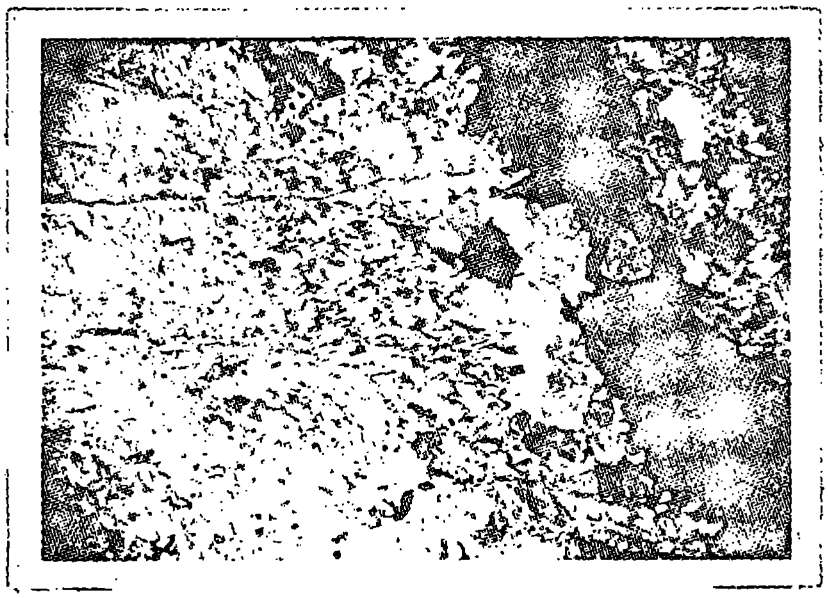


Plate 4 - DDH#2-223. Gypsum (white coarse grains) as open space filling in fracture zone. Relict sericite projects into gypsum showing that some replacement of wallrock has occured. (X-Nicols, x 50)

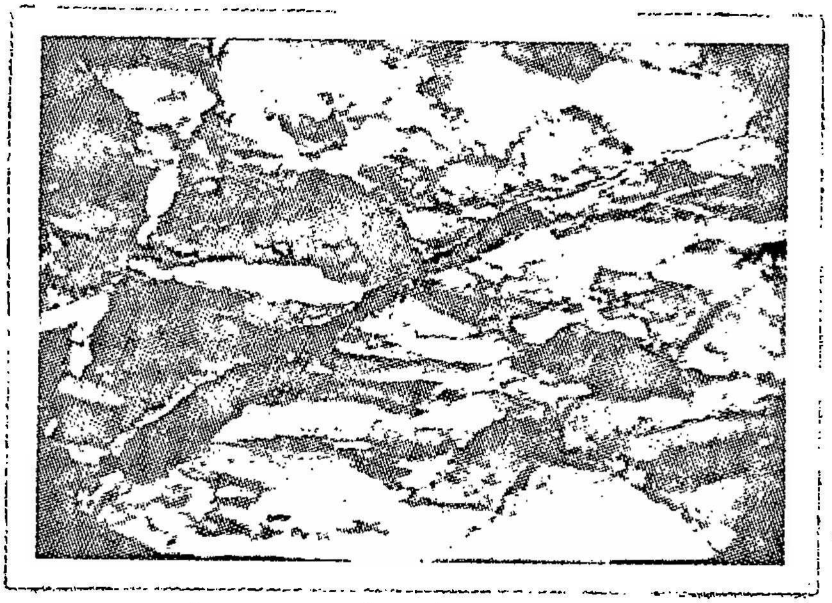


Plate 5 - DDH#1-96. Metamorphic-quartz (grey) cut by galena (black). (X-Nicols, x 50)

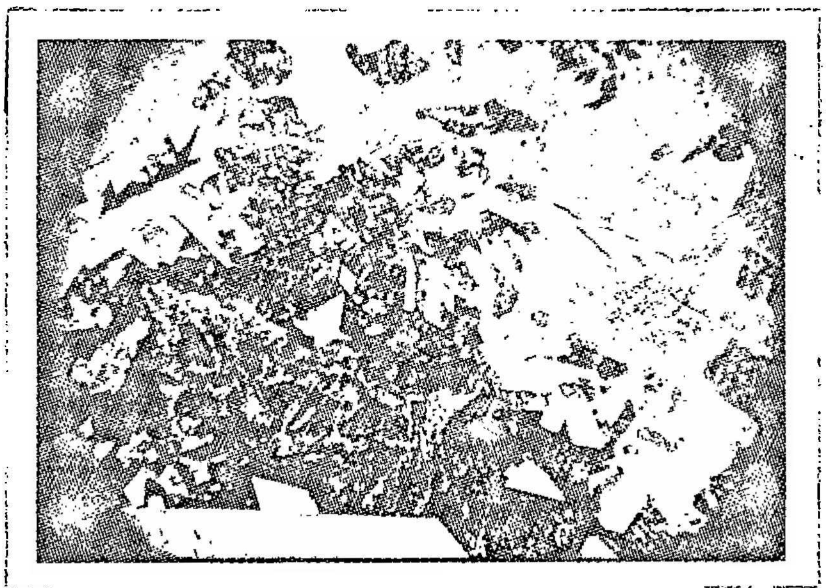


Plate 6 - DDH#2-223. Gypsum (white), chlorite (grey) and fine grain calcite (black) as open space fracture filling. (X-Nicols, x 150)

Local Variation of the 3 Rock Types

1) Veins greatly increase in thickness locally to form massive quartz-chlorite-sulphide zones up to 4 meters wide. Sulphide content in these zones is greater than 30%.

2) Serpentine occassionally makes up to 20% of the bulk composition of the chlorite-sericite-quartz schist. These serpentine-rich types are very limited in extent both horizontally and vertically.

3) Gypsum and chlorite crystals found in a fracture zone at the 223 foot level in DDH#2 show characteristics of growth in a non stress environment. (See page 18).

4) Massive metamorphic-quartz zones were noted but are uncommon. (See page 18). The zones are associated with massive sulphides and are partly replaced by the sulphide rich veins. Parallel, elongated quartz grains about 7 mm. long interlock tightly, show undulatory extinction and good lattice parallelism. No samples were available enabling the determination of the relationship between those dynamically metamorphosed orthoquartzites and the country rock.

5) Cross cutting "veinlets" of talc 2 mm. wide were noted in a serpentine rich portion of the chlorite-sericite quartz schist at the 125 foot mark of DDH#2.

Relation of Sulphide-Gangue Unit to the Schists

In zones where the sulphides comprise 2-30% of the rock they generally occur in or near quartz-chlorite (see page 15). These veins show a preferred orientation parallel to the plane of schistosity but cross cutting is not uncommon. Relation between massive sulphide zones and country rock is unknown.

Minor amounts of sulphides occur in the country rock (see pages 25 and 28) as irregular masses associated with chlorite in the quartz-rich bands near veins. These sulphide masses appear to have been emplaced simultaneously with the veins by replacement of quartz.

It appears that the veins (quartz-chlorite-sulphide) replaced the country rock along preferred planes. Few instances of forceful emplacement were found, and then as dilation of the cleavage plane sericite layers. (See page 16). The cross cutting portions of the veins are clearly the result of emplacement by replacement (see page 16), but no fracturing that could guide orientation and position was found.

It is proposed that most if not all the quartz gangue in the veins is reconstituted country rock quartz.

Relation of Sulphides to Gangue

Typical relative abundances where sulphides comprise 2-30% of the rock:

Quartz	40%
Sulphides	2-30
Chlorite	15-30
Sericite	5
Calcite	0-50

Relative abundances in massive sulphide zones:

Sulphides	30-90%
Quartz	5-40
Chlorite	5-30

Textural studies indicate that sulphide and gangue minerals generally crystallized nearly simultaneously. Locally, all the sulphides except pyrite show evidence of crystallization after the gangue minerals.

Calcite gangue seems to be confined to the upper zone of DDH#2 where it is the only gangue mineral present, with equal parts of sulphide. This calcite gangue may be the result of reconstitution of a calcareous horizon.

Plate 7 - Very fine-grained calcite (post-mineralization) along vein boundary and cross cutting vein (X-Nicols, x 150)

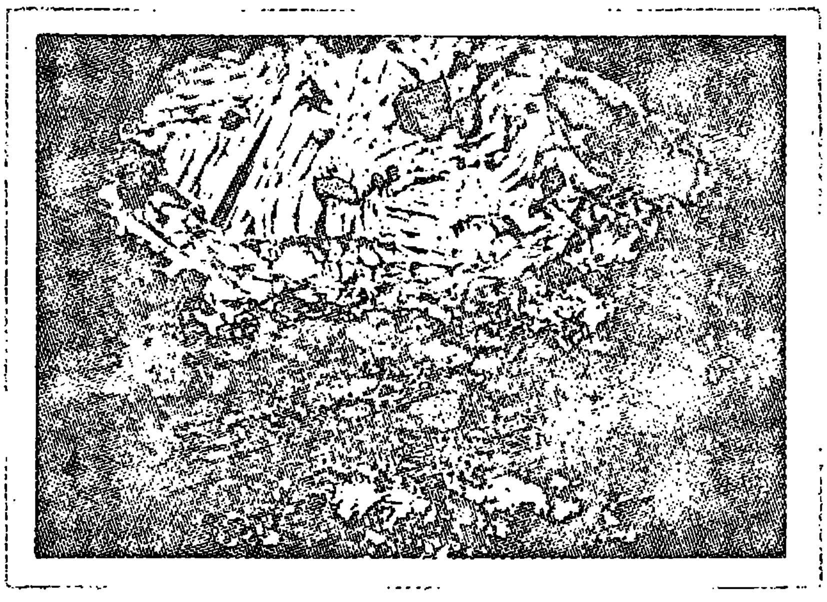


Plate 8 - Galena (white) with included sericite (grey). Anhedral grains are quartz. Chlorite is interstitial to quartz. (P.P.L., x 150)

MINERALOGY

Surface Outcrop

The 2 surface specimens available for study are slightly mineralized, with sulphides making up less than 4% of the total rock.

Estimated relative sulphide abundance:

Chalcopyrite	30%
Sphalerite	25
Galena	25
Goethite	10
Hematite	10
Pyrite	Trace
Melanterite	Reported

Chalcopyrite occurs as irregular blebs up to 1.5 cm. maximum diameter and as disseminated blebs about 15 microns across. Replacement by goethite and/or hematite is found along fracture lines and localized spots within the otherwise massive chalcopyrite (see page 27). Goethite-hematite mixtures rim the disseminated blebs.

Sphalerite and galena occur in intimate association as discontinuous fillings in brecciated zones about 3 mm. wide and as 10-15 micron blebs disseminated in the country rock.

Pyrite is found as finely divided disseminated particles.

Sulphides in the disseminated state make up only a small fraction of the total mineralization.

Subsurface

Microscopic examination of diamond drill core indicates the presence of two generations of sulphides.

First generation sulphide occurs as evenly disseminated blebs in the wallrock. Average grain size is in the 4-5 micron range. Due to the small size a positive identification could not be made but pyrite seems most likely. Along the sericite rich cleavage planes these blebs are noticeable elongate parallel to the sericite alignment, suggesting deformation at the time of schistosity formation. Authigenic pyrite in the pre-metamorphic argillaceous sandstone, or metamorphically induced pyrite, seems a likely origin for these blebs.

Sulphides of the vein-type second generation are the only ones of economic interest.

Relative abundance of second-generation sulphide determined by microscopic examination is:

	Range	Average
Pyrrhotite	10-95%	45%
Pyrite	5-90	40
Sphalerite	0-40	8
Galena	0-15	3
Chalcopyrite	0-10	3
Marcasite	0-5	1
Melanterite	Reported	-

Relative concentrations of sulphides varies greatly but pyrrhotite and pyrite always predominate, with pyrrhotite generally more abundant than pyrite. A ratio of 6:1 of (pyrite + pyrrhotite)/(sphalerite + galena + chalcopyrite) is most common.

Modes of Occurence

Pyrrhotite

1) In veins and massive sulphide zones, pyrrhotite occurs as tightly interlocking irregular grains. Average grain size is about 0.15 mm., but varies from 0.02 mm. to 0.5 mm., with grain size generally smallest in the massive sulphide zones. Shreds of sericite may be included in grains near the vein boundaries.

2) Pyrrhotite also occurs as irregular segregations in the quartz rich bands of the country rock short distances from the veins.

3) Minor amounts occur as small exsolution blebs in sphalerite. This is a localized feature and uncommon in this deposit.

Pyrite

Pyrite always occurs as rounded anhedral grains in the veins or a short distance removed in the country rock. Where pyrite is the dominant sulphide in the veins, grain size reaches a maximum of 1 cm. Grain size decreases to about 0.2 mm. where pyrrhotite is the dominant sulphide.

Sphalerite

Sphalerite shows a light yellow-brown internal reflection, indicating low iron content.

1) Most common occurence is as irregular isolated grains, having an average diameter of about 0.3 mm. (maximum about 0.6 mm.), surrounded by pyrrhotite and pyrite grains.

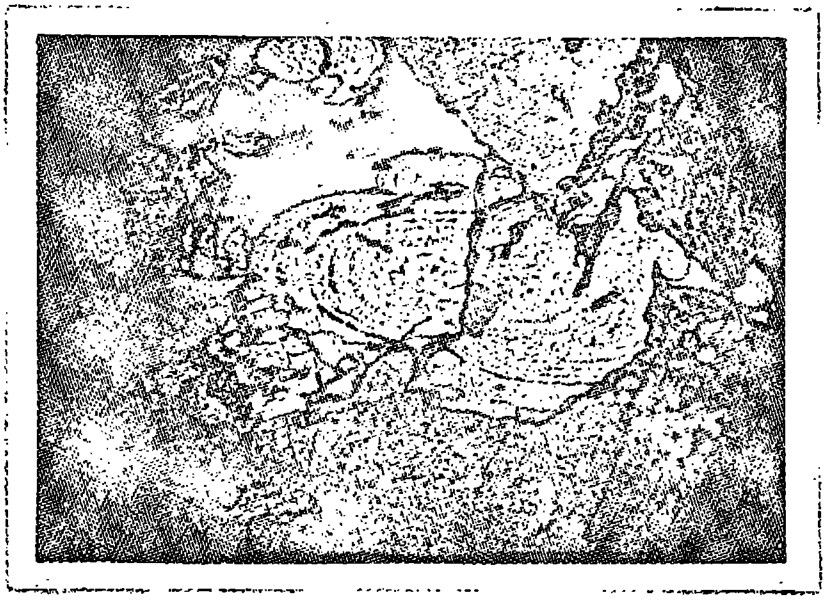


Plate 9 - DDH#1-96. Marcasite as alteration product of pyrite and/or pyrrhotite. Dark mineral is quartz gangue. (P.P.L., x 50)

Plate 10 - DDH#1-96. Marcasite as alteration product of pyrrhotite. Dark mineral is quartz gangue. (P.P.L., x 50)

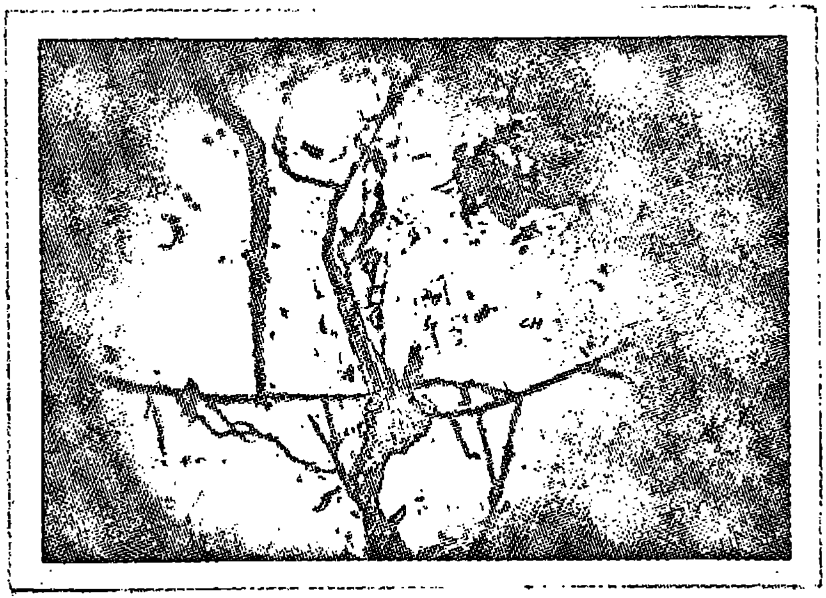


Plate 11 - Goethite-hematite as chalcopyrite alteration products. Surface outcrop. (P.P.L., x 250)

Plate 12 - Chalcopyrite exsolution from sphalerite. High relief dark mineral is quartz gangue. Large white grain is galena. (P.P.L., x 250)

2) Sphalerite, more commonly than the other sulphides, forms irregular blebs in the quartz rich bands of the country rock near vein boundaries.

Galena

1) Galena's major manner of occurence is as interstitial segregations of irregular outline between pyrrhotite and pyrite grains. These segregations may reach 2.5 mm. in size but are generally about 1.5 mm. across the maximum diameter.

2) Stringers of galena about 3 mm. wide were noted at the 68 foot level of DDH#5. In these stringers galena generally constitutes the only sulphide but may be associated with sphalerite.

Chalcopyrite

1) Generally occurs as irregular masses up to 0.3 mm. maximum diameter interstitially between grains of the other more abundant sulphides.

2) In several specimens chalcopyrite was noted as exsolution blebs in sphalerite grains (see page 27).

3) Galena grains at the 223 foot level of DDH#2, where the galena is near the vein boundary, are rimmed by a thin discontinuous band of chalcopyrite.

Marcasite

Marcasite is found only as an alteration product of pyrrhotite and pyrite near previously described metamorphic-quartz zones.

Curved layers of marcasite alternate with thinner parallel bands of an unknown dark material. Concentric alternating bands form "pseudo-oölites" about 2 mm. across (see page 26).

TABLE I[3]

TRACE ELEMENTS OF UPPER SULPHIDE

ZONE OF DDH#2

Manganese	1.5
Titanium	.2
Barium	.06
Nickel	.02
Vanadium	.02
Chromium	.003
Cobalt	.003
Boron	.001
Silver	.0001
Gold	Trace
Strontium	Trace
Tin	Trace

Note: This table excludes essential elements present in known sulphides and silicates.

The trace element content agrees quite well with figures given by Mason[4] for an average sandstone. This coincidence may or may not substantiate the view that the gangue is largely reconstituted wallrock (metamorphosed argillaceous sandstone). Due to many unknown factors and possible variations the correlation between the figures may be meaningless.

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3 Semi Quantitative Spectrographic Analyses
Analyst: Coast Eldridge, Engs. & Chemists Ltd.
Source: Dalmage & Campbell, Consulting Engineers.

4 Mason, B., 1952 - Principles of Geochemistry, 2nd Edition, John Wiley & Sons Inc.

TEMPERATURE OF FORMATION

Using the method advocated by Arnold (1962)[5] two samples of pyrrhotite were x-rayed to find the d(10$\bar{1}$2) spacing and hence the temperature at which the pyrrhotite formed.

This method is based on the defect-lattice structure of pyrrhotite in which the iron content decreases as temperature increases. As iron content increases (greater atomic-percentage of iron) the d(10$\bar{1}$2) lattice spacing increases. Once the d(10$\bar{1}$2) spacing is known, iron content and temperature of formation can be determined by reference to the experimental data of Arnold (1962).[5] It appears that the pyrrhotite-pyrite system is largely independent of pressure and volatile phases such as water and carbon dioxide.

Primary assumptions on which pyrrhotite-pyrite geothermometry is based are:

1) Trace element content of the pyrrhotite is insufficent to effect temperature-composition relationship. Arnold determined that this was generally the case. In this deposit possible substitutions for the Fe^{2} ion are Ni, Co, Cu and Mn.

2) Temperature of formation is above 325°C., below which complex polymorphic inversions of pyrrhotite occur.

3) Chemical equilibrium between pyrite and pyrrhotite was attained. Simultaneous deposition is not necessary for this if later phase has attained equilibrium with first phase.

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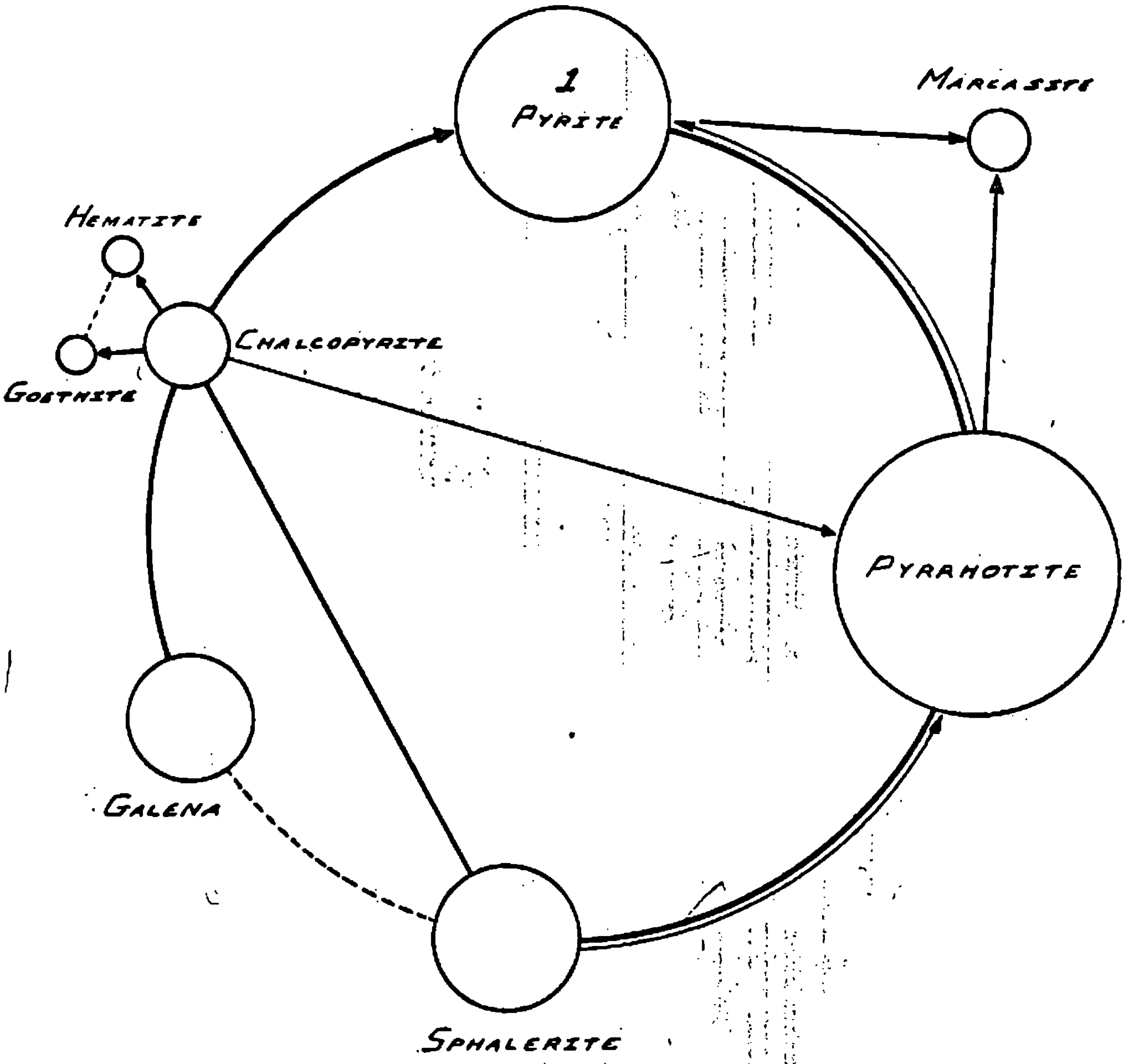
5 Arnold, R. G., 1962, Equilibrium Relations Between Pyrrhotite and Pyrite from 325° to 743°C., Ec. Geol., Vol. 57.

PARAGENETIC SEQUENCE



A sample from DDH#2-75 gave 480°C. as temperature of formation; one from DDH#1-96 gave 450°C. Inherent error is given by Arnold as ± 50°C.

Chalcopyrite exsolutions from sphalerite were noted in several places. This would indicate a minimum temperature of formation in the 350-400°C. (Bueger, 1934)[6] range, substantiating the x-ray determination.

PARAGENETIC SEQUENCE

In cross cutting portions of the quartz-sulphide veins most of the first generation sulphide has been replaced by and incorporated into the second generation sulphides.

Textural studies showed mutual boundaries between the constituent sulphides of the second generation to be the most common relationship.

Chalcopyrite, galena and sphalerite formed simultaneously after pyrite and pyrrhotite. Pyrrhotite shows very limited replacement by these later sulphides and pyrite is effected only slightly more.

Fractures in pyrite, which are localized and uncommon, are filled by sphalerite, chalcopyrite and pyrrhotite. It is expected that if more polished sections were studied galena would also be found as a fracture-filling in pyrite.

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6 Edwards, A. B., 1954, Textures of the Ore Minerals and Their Significance; Brown, Prior, Anderson Pty. Ltd.

CLASSIFICATION AND ORIGIN

The sulphide mineralization zones in the Tay River area are always found near Mid-Cretaceous granitic intrusives. It appears that the mineralization originated by some mechanism related to the igneous activity.

The author proposes that quartz-sulphide veins were emplaced by replacement of the wallrock schists by minerals carried in hydrothermal solutions. Very little forceful injection was found, and that was as dilation of sericite along the sericite rich cleavage planes. The quartz gangue in the veins probably originated by reconstitution, with accompanying increase in grain size, of quartz present in the country rock. Calcite gangue of the upper sulphide zone in DDH#2 may be due to a similar reconstitutional process of a calcereous horizon or lense.

Slight differences in composition may have been responsible for vein positioning in the cross cutting portions. No sign of fracturing transverse to schistosity that could influence vein position was found. The veins parallel to the schistosity were controlled by the sericite rich cleavage planes.

Temperature of formation of the deposit is 465°C. ± 50°C., determined by using Arnold's pyrite-pyrrhotite equilibrium method (see page 31).

Using Lingram's scheme of classification, this deposit fits the category of hypothermal replacement.

CONCLUSION

Sulphide mineralization of the Dynasty Exploration Ltd. SEA group of claims appears to be a direct result of granitic intrusion of Mid-Cretaceous age into Mississippian (or older) meta-sediments. The meta-sediments are predominantly sericite-quartz schist that probably originated by regional metamorphism of an argillaceous sandstone.

The mineral deposit is a hydrothermal replacement-vein type formed at approximately 465°C., ± 50°C.

Ore controls appear to be:

1) Proximity to granitic intrusives of Mid-Cretaceous age.
2) Cleavage of the country rock, which the mineralized zones roughly parallel.

Vangorda Mines Ltd. (presently inactive) have done extensive assessment work on a lead-zinc prospect twelve miles west of the Dynasty SEA group of claims. Examination of two sulphide specimens and available geological information showed similar country rock and mineralization on the Vangorda property as on the Dynasty property.

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