THE PETROGRAPHIC ANALYSIS OF
THE HOST ROCK
AND VAESITE BEARING HORIZON ON
THE NICK PROPERTY, YUKON TERRITORY

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An Undergraduate Thesis

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A Petrographic Study of the Host Rocks and Mineralized Horizon, of the Nick Property, Yukon Territory.

Abstract:

The Nick Property hosts a stratigraphic unit rich in nickel, zinc, and platinum group elements. The stratigraphy, nature and textures of the Nick Property are similar to sedimentary exhalative deposits of the Selwyn Basin. The spacial relationships of the metallic phases will be discussed in conjunction with assay data from drill core and handsamples from outcrop to provide a better understanding of the nature of the mineralized zone. Discussions will be included concerning the distribution of metalliferous phases, such as: (1) the distribution of lead, zinc and nickel contained in the diagenetic pyrite, (2) the nickel and platinum group element associations of this deposit type ,and it's application to further study and exploration, and (3) similarities between the geological relationship of the Nick Property to other deposits. The results of this study should produce a better understanding of the geology of the property and the ore forming system.

INTRODUCTION:

This geologic research report is based on petrographic and x-ray powder diffraction analysis carried out on samples taken from the Nick Property, Yukon Territory. The analysis of the petrographic thin sections and polished sections provides a useful tool for the interpretation of textural and mineralogical relationships between the metallic phases of a deposit. The use of X-ray diffractometry is useful for the identification of relatively large, pure samples. However, its usefulness diminishes with the complexity of the mineralogy of the sample. For example, the intergrown nature of the fine grained sulfides (10-30 um) could not be separated. The identification of clay and silicate phases can be done using this method.

A literature search will be undertaken to compare the Nick deposit to a deposit of a similar nature. Additional information regarding the nature of the deposit will be utilized from prior field work completed by Archer, Cathro & Associates Ltd. during the 1988 field-season. The mineralogy of the Nick deposit will be defined and compared to various types of sedex and stratiform sedimentary mineral deposits.

REGIONAL GEOLOGY:

The Nick property is located in the Northern extremity of the Selwyn Basin, in an outlier of basinal sediments on the MacKenzie Carbonate Platform. The property is located at 64 degrees 43' N latitude, 135 degrees 13' W longitude, on the northeast margin of the Selwyn Basin. (see map, figure .1)

The stratigraphy of the region is composed of a series of clastic and chemically deposited sedimentary rocks. The top of the sequence is comprised of a shale unit which is composed of two parts. The upper unit is a brown weathered shale with minor fine grained chert pebble conglomerates that is equivalent to Green's unit 14 (Green, 1972). The upper shale unit is thought to be equivalent to the Upper Earn Formation. The lower unit is a thinly bedded black to silvery black weathered shale with underlying black chert and limestone, equivalent to unit 13 (Green, 1972). The lower shale unit is equivalent to the Lower Earn Formation. These two units can be correlated with the Canol and Imperial Formations in the Selwyn Basin. Underlying the shale units in the area is a black, thinly-

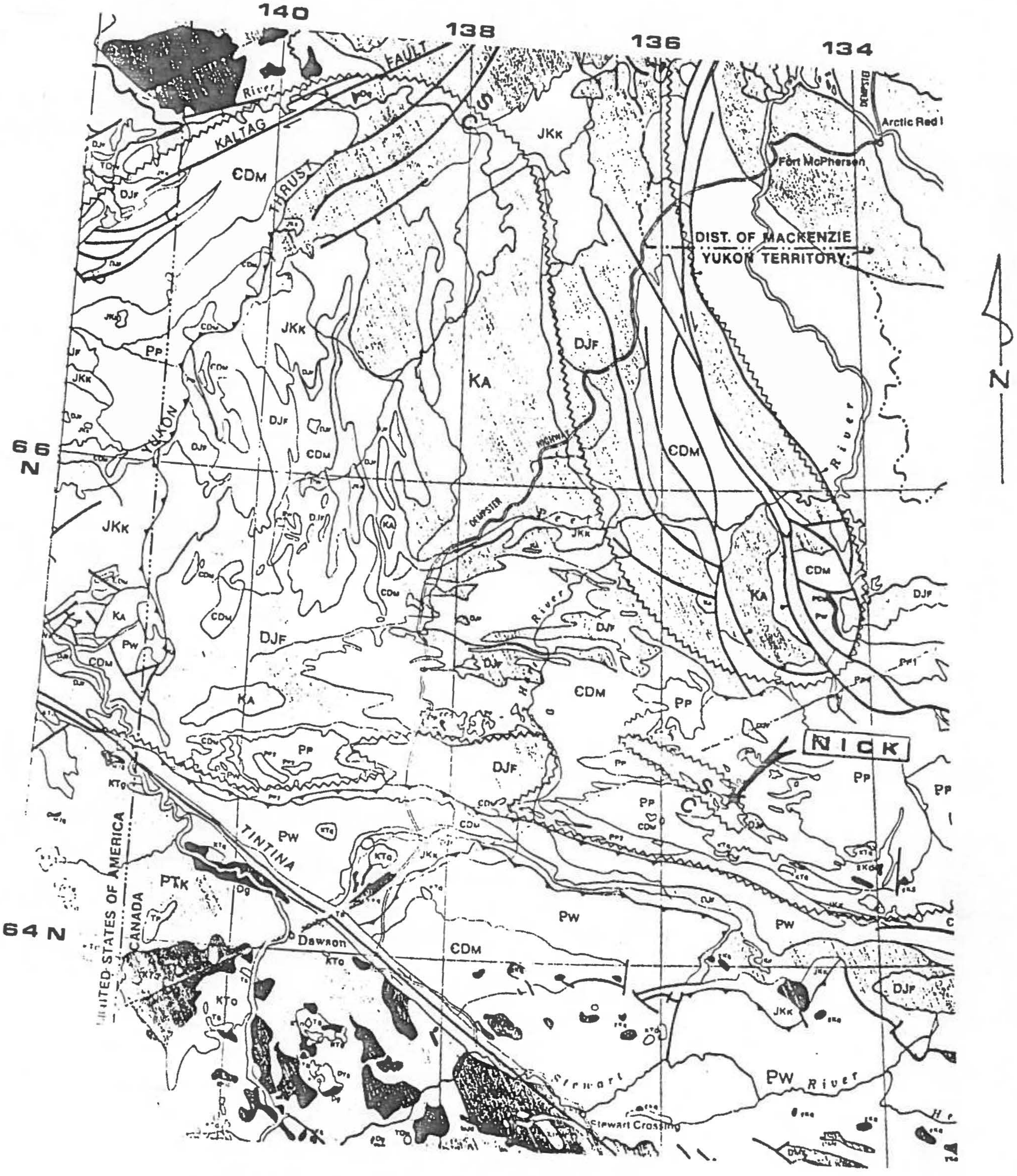


FIG. 1 LOCATION MAP

50KM.

bedded limestone unit which is locally known as the Limestone Ball Member. Underlying the Limestone Ball Member is a calcareous shale unit. This unit mapped by Green (1972), is known as unit 12, and is equivalent to the Road River Formation.

The structure of the area may be controlled by post depositional normal faults which are thought to be responsible for the preservation of this shale outlier. The underlying limestone unit has a strong control on the synform in the region. The Devonian to Permian age shales in the region overlie the thick Ordovician to middle Devonian limestones. The remapping of the area has determined that the two outliers to the north and east of the main shale unit 14, (Green, 1972), are actually a parallel basin and an extension of the main shale unit, respectively (Cathro, 1988) (see fig. 2 & 3). The Paleozoic sediments of the syncline are in fault contact with the Precambrian MacKenzie Carbonate Platform to the east of the Nick Property. This fault is post depositional and may be responsible for the preservation of the shale outlier.

PROPERTY GEOLOGY:

Stratigraphy

The nickel bearing strata is overlain by interbedded brown argillaceous shale, silvery black siliceous shale, black carbonaceous and phosphatic cherts. This unit is divided into two subdivisions: the upper division is dominated by clastic sedimentary rocks, such as, brown argillites and occasional fine detrital cherty quartz sandstones. The upper clastic division is more recessive than the lower division. The lower division is composed mainly of chemically and biochemically precipitated sediments, such as, phosphatic and carbonaceous cherts, siliceous shales and minor

LEGEND

QUATERNARY

26 Unconsolidated glacial and alluvial deposits

CARBONIFEROUS TO PERMIAN

14 Black- and silvery-weathering shale; minor chert-pebble conglomerate

DEVONIAN TO CARBONIFEROUS

13 Black shale, chert and minor limestone

SILURIAN (?) TO MIDDLE DEVONIAN

12 Dark grey-weathering, black, thin-bedded, platy limestone

DEVONIAN

10 Light grey limestone and dolomite

ORDOVICIAN AND SILURIAN

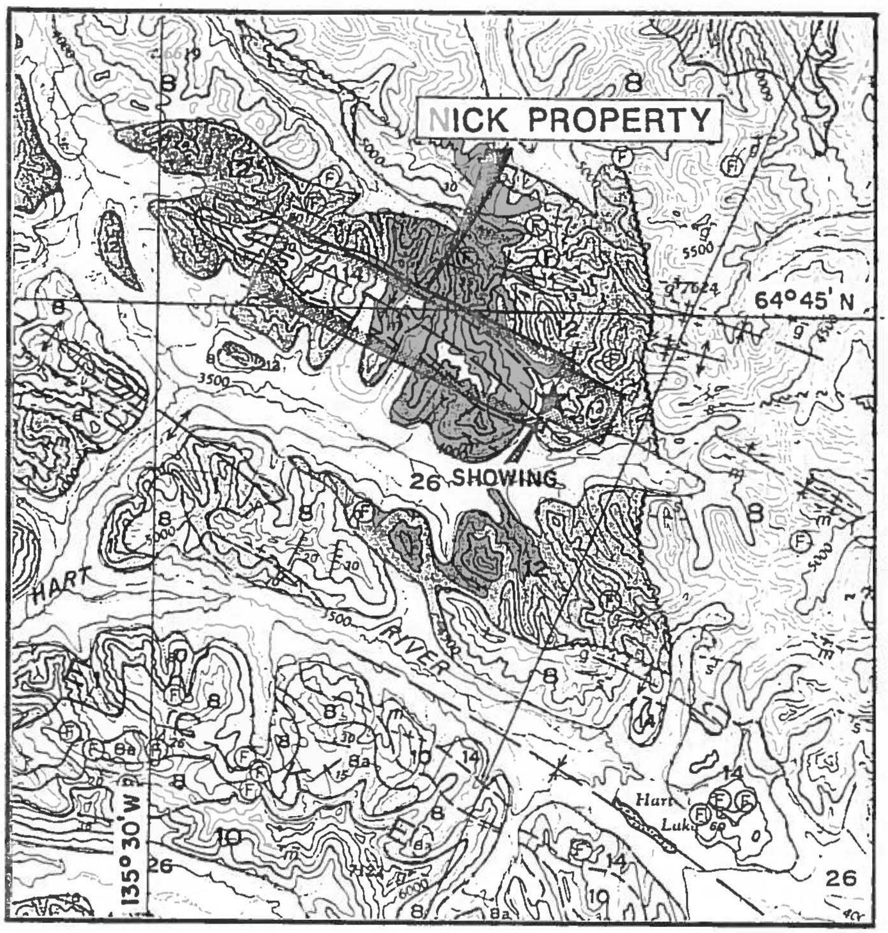
9 Road River Formation: Black chert and black argillite

8 Grey-and buff-weathering dolomite and limestone

PROTEROZOIC

2 Dolomite, slate, minor phyllite and quartzite

1 Argillite, slate and phyllite



From GSC Map 1282 A and Memoir 364
by L.H. Green, 1972

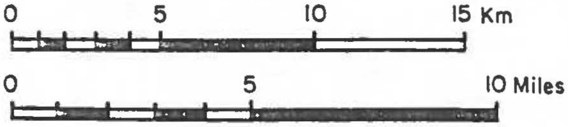
Figure 2

REGIONAL GEOLOGY

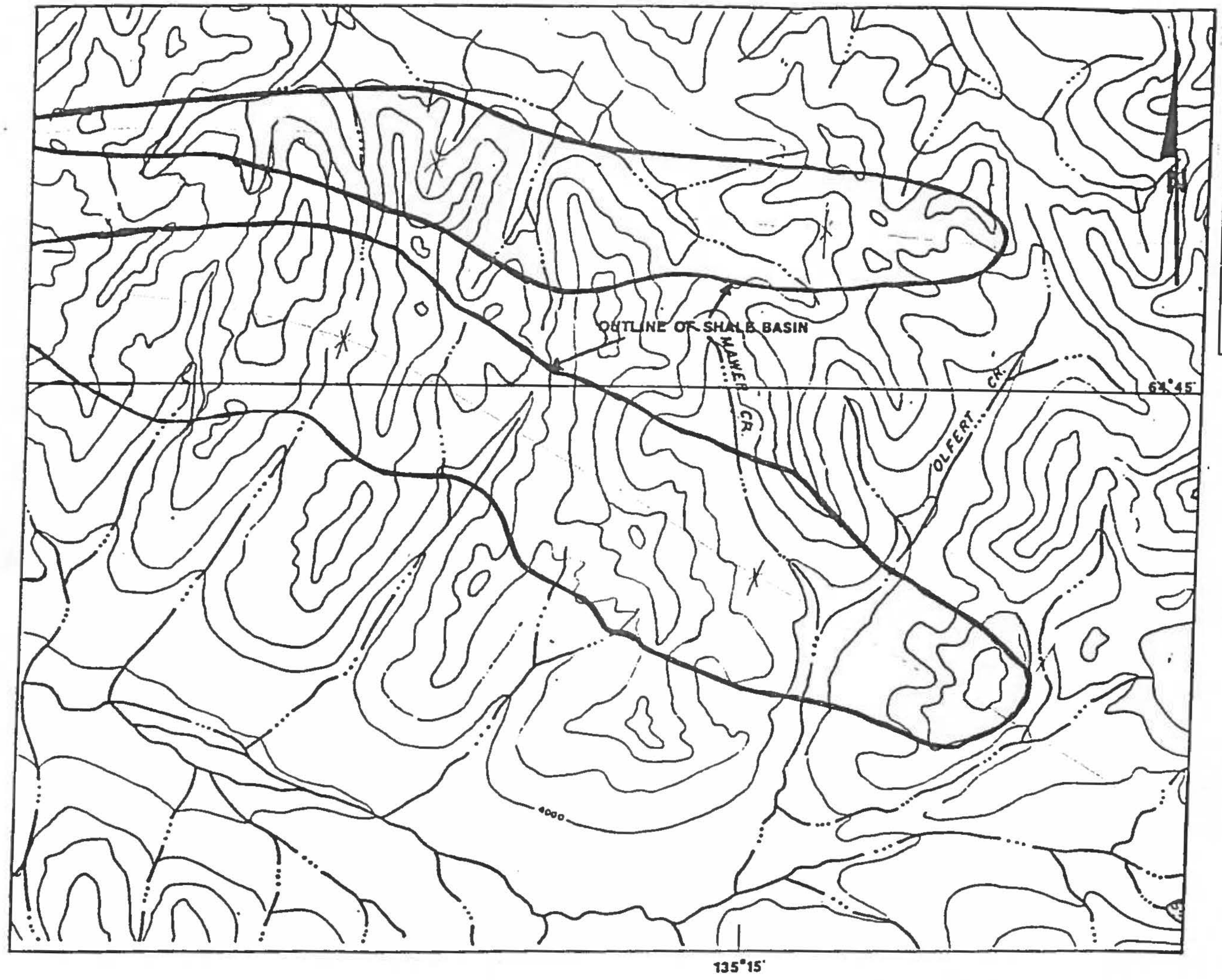
NICK PROPERTY, YUKON

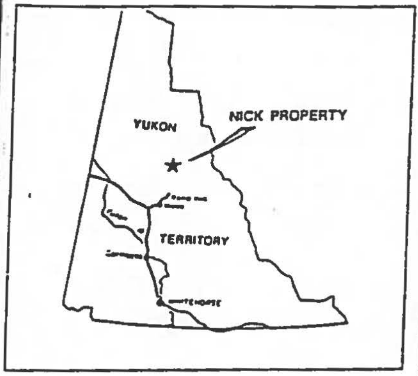
NDU RESOURCES LTD.

SCALE 1:250,000



(report by R.J. CATHRO dated Aug./88)





OUTLINES OF BASINAL
SHALE OUTLIERS

Figure: 3.

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED

NICK PROPERTY, YUKON

NDU RESOURCES LTD.

PAK-MAN RESOURCES LTD.

2001 RESOURCE INDUSTRIES INC.

SCALE 1:45,690

To accompany a report by R.J. Cathro dated Nov/88 calcareous shales. The lower division is up to 250 metres thick in the syncline (Cathro, 1988).

The nickel bearing strata is located stratigraphically above a thinly bedded limestone member. Locally this limestone unit is known as the "Limestone Ball Member". The Limestone Ball Member is a marker horizon due to its relative resistance and ease of definition in outcrop. The Limestone Ball Member derives its name from the boulder size, oval to round clasts, of grey limestone in a black shaley chert matrix. The boulders vary in size up to two metres long and one metre high. This unit is known to underlie the nickel mineralized bed from the northwest of the headwaters of Mawer Creek to the southeast extremity of the syncline east of Olfert Creek (Cathro, 1988). The northeast and southwest boundaries are unproven. Throughout the basin, as seen in outcrop and drill core, the thickness of the Limestone Ball Member is less than five metres.

The limestone unit is underlain by a dominantly siliceous thin shale, below which is a five to ten metre thick black limestone unit conformably overlying a calcareous shale member, up to 100 metres thick according to Cathro (1988). The thin siliceous shale is thought to be the Road River Formation. However, it may be confused with the (Canol) Lower Earn Formation, Green's units 10 and 13 respectively (1972). As mentioned by R.J. Cathro (1988), the clarification of this could be done by using diagnostic graptolite fossils used to separate the older Silurian to Middle Devonian from the younger Middle Devonian to Mississippian shale.

This stratigraphic sequence is similar to that of the marginal platform deposits of Morganti (1981). The figure below shows the generalized stratigraphic columns of the Nick location and the typical Platform Marginal deposit of Morganti (1981).

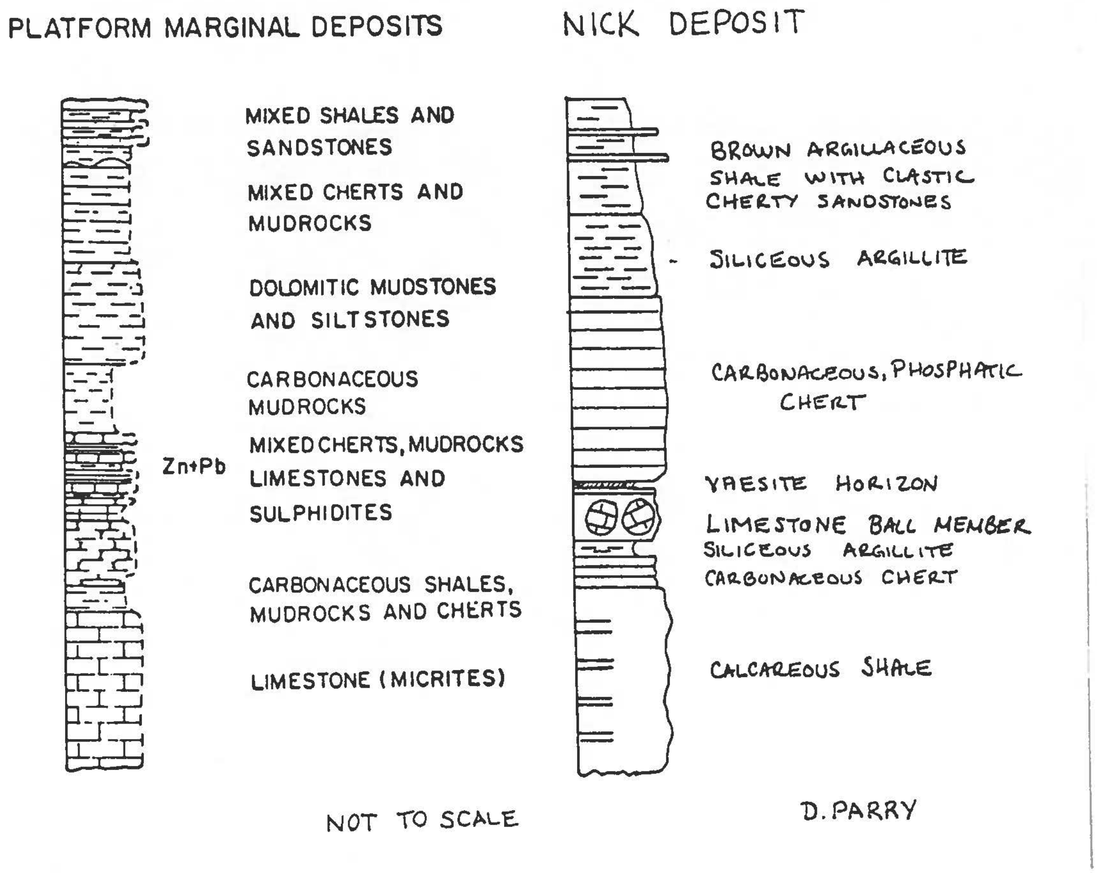


fig. 4

Structure

The nickel mineralization is located between the siliceous black chert and the limestone Ball Member in the limbs and trough of a gently folded synform. The direction of thickening of the vaesite horizon has not been determined from structural mapping. However, it has been determined that the nickel horizon either pinches out or is truncated by faulting between the drill holes situated in Olfert Creek and the single hole in Mawer Creek, 1600 metres to the northwest. It is also likely that the vaesite horizon exists in the outlier to the north of the main synform (see fig. 2 & 3).

The texture of the vaesite horizon is described by Cominco (1981) and Cathro (1988) as having been formed through soft sediment deformation. According to Davis, (1984) " *Wet sediments may slump, flow, fold or fault* *where inadequately supported or, where triggered to do so by earthquake shocks. Resulting structures are confined to a very narrow stratigraphic interval overlain by strata that are not themselves internally deformed..".*

This explanation parallels the textural relationships found in the chert, vaesite and limestone horizons. The clasts of the Limestone Ball Member are noted to lie with bedding slightly oblique to the underlying shales. The formation of the limestone balls have been interpreted as a result of dissolution of calcite along joints (Cathro, 1988). The orientation of the limestone balls may well be due to rolling, or sliding down a paleoslope. This may provide evidence to show that the environment for deposition was a slope and not a flat lying third order basin (Ross, personal communication, 1989). The fact that the sulfide horizon shows these slumping textures, may provide an impetus to study the structure and stratigraphy to determine the direction of movement of the vaesite layer and Limestone Ball Member and thus a direction of possible origin. As discussed in Morganti (1981), the importance of the study of these slump and flow structures preserved in the rock record may help define the source and possible origin of structurally thickened horizons.

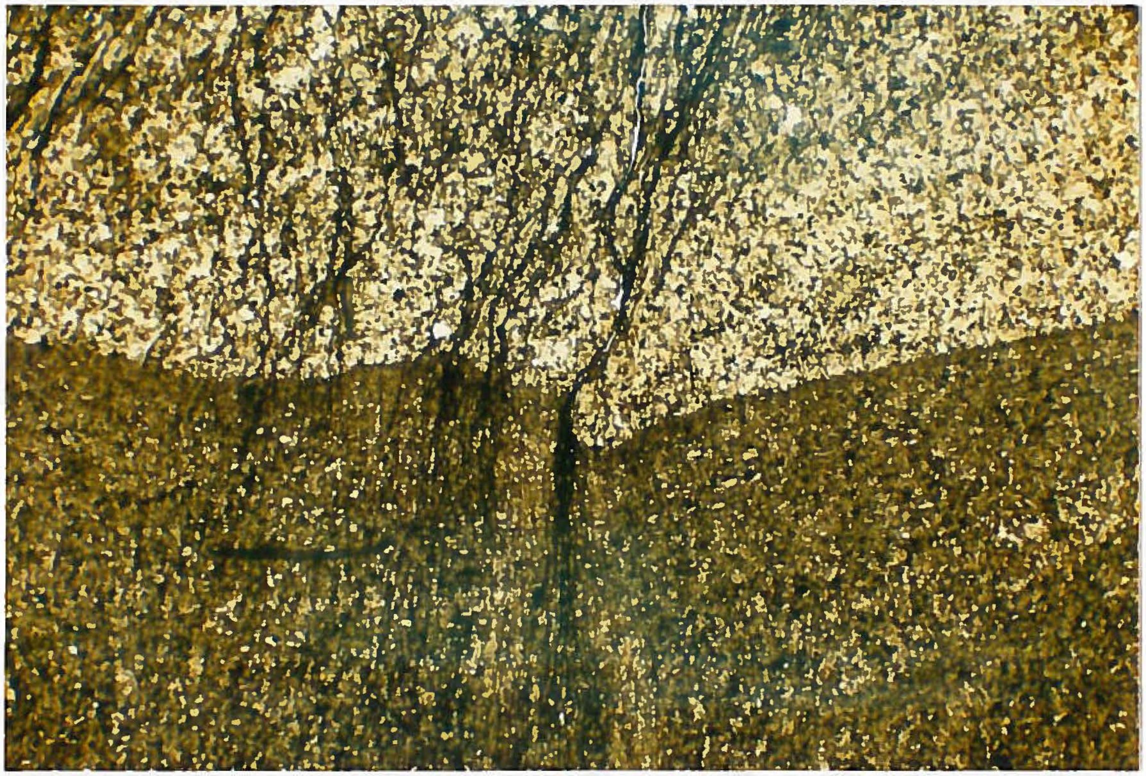
Host Rock Mineralogy

The host rock mineralogy is described in Appendix A, pages 1-27. In discussing the host rock mineralogy, the rock types will be grouped according to lithology. These types are: (1) fine grained clastics, (2) siliceous shales and carbonaceous to phosphatic cherts, and (3) micritic limestones. The order of these is equivalent to descending through the stratigraphic column (see fig. 4, page 5).

The fine grained clastics are at the top of the sequence observed at the Nick Property. They consist of non-siliceous argillites with a few thin beds of coarser, fine grained chert pebble sandstone and conglomerates. The individual beds are relatively homogeneous. The sequence generally coarsens upwards with argillites becoming less siliceous and resistive to weathering, and sandstones and fine pebble conglomerates becoming more numerous. Sample B is representative of the quartz, chert sandstone within this unit. (see page 1 of Appendix A) This sample is a detrital quartz-chert fine grained sandstone. The quartz grains are subrounded to rounded indicating a relatively distant source. The chert clasts are angular to subangular suggesting a relatively proximal source. Detrital magnetite was deposited with the quartz and chert, and formed detrital grains, and where oxidized formed the hematitic cement. The rock has undergone burial metamorphism which is responsible for recrystallized quartz infilling joints forming veinlets. The goethite and limonite which coats some of the grains and is pore filling, is likely an effect of diagenesis and supergene weathering, respectively. This unit is comprised of clastics and is named the Upper Earn Formation.

The Lower Earn Formation is composed of siliceous shales, carbonaceous and phosphatic cherts. The siliceous silvery black shales are, in fact, slatey and they form the upper portion of the Lower Earn Formation. The bedding is defined by laminations of varying concentrations of carbonaceous material. The mineralogy of the samples A-1 and C is dominantly illite with various amounts of silica in the form of chert, microcrystalline quartz and chalcedonic quartz flame structures. The slates were likely derived from colloidal clays which were regionally metamorphosed at low grade and imparted with an axial planar cleavage.

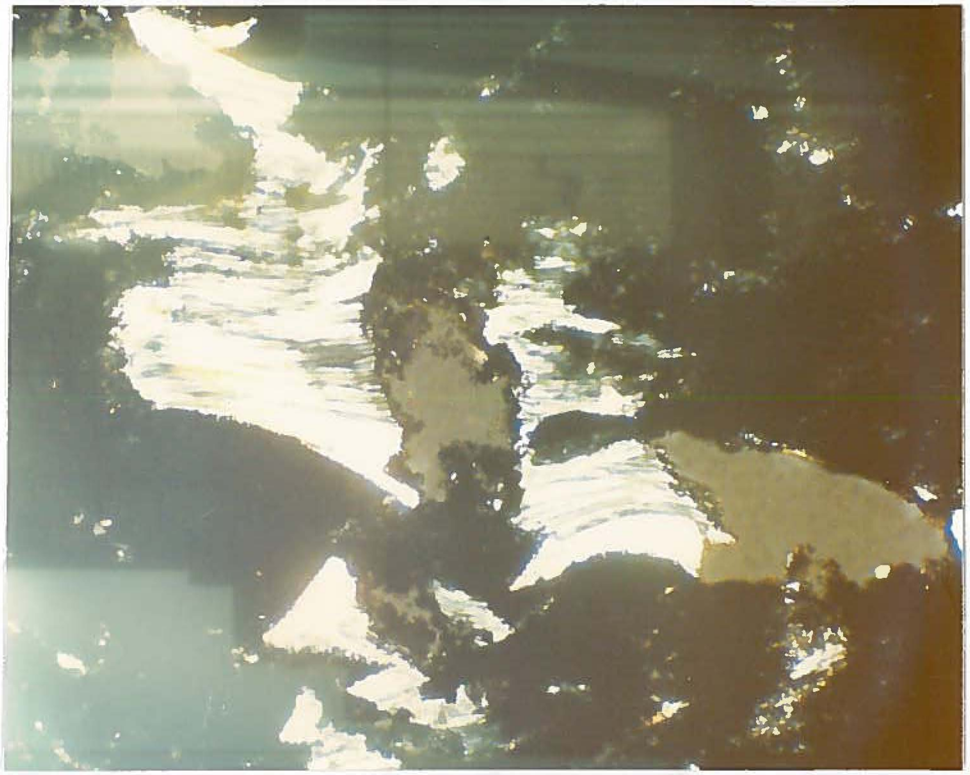
PLATE: 1



|←——1.25 mm——→|
Transmitted Plane Polarized Light (TPPL)

Silvery black shale, Lower Earn Formation. (Sample A-1)
Showing the conduits of carbonaceous material in the illite rich shale.

PLATE: 2

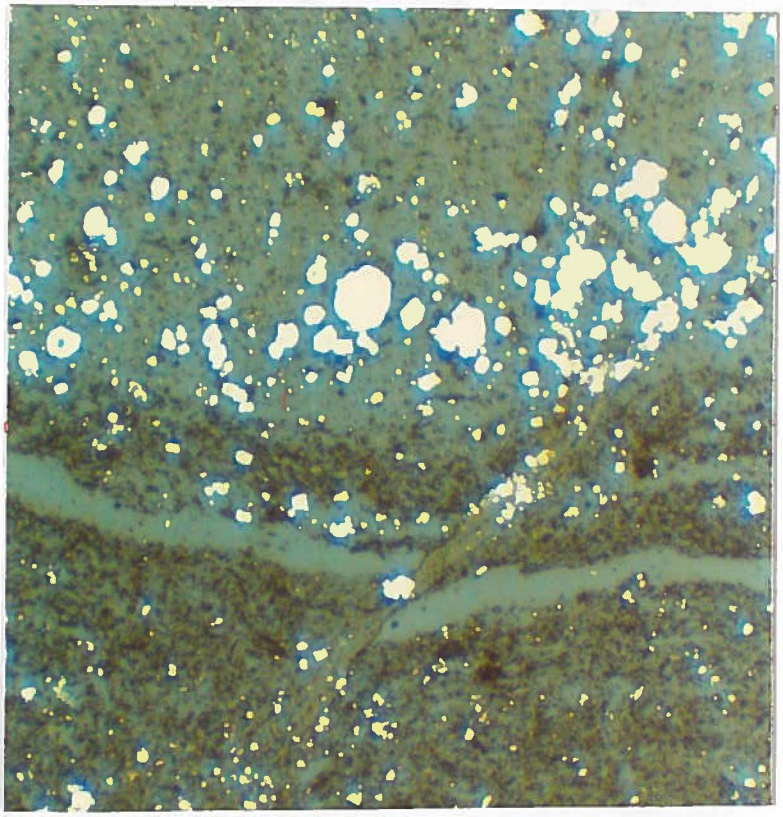


⊢—— 90 µm ——⊣

Transmitted Cross Polarized Light (TXPL)

Pyrite (grey) which is semi-homogenized and from which have grown siliceous flame structures, or "pressure shadows" of chalcedonic quartz white in black chert. (Sample 9049)

PLATE: 3



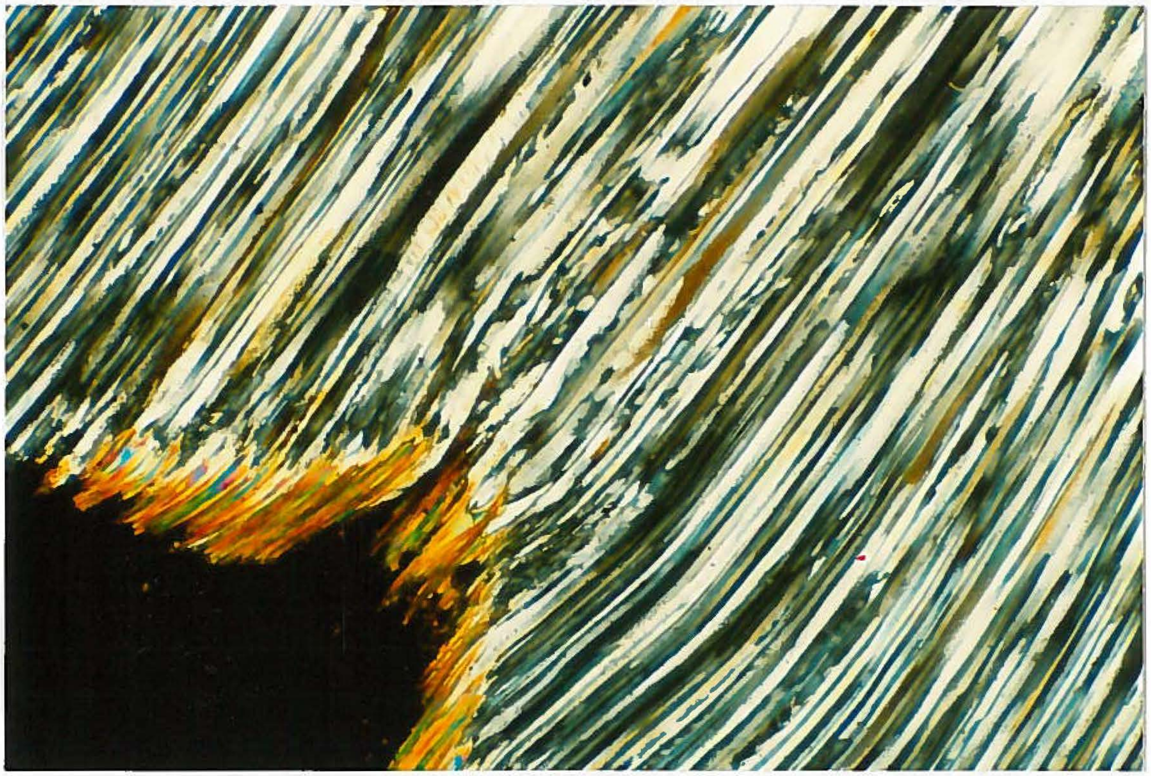
Reflected Plane Polarized Light (RPPL)

The photomicrograph shows the base of a pyrite (white) layer. The band becomes more densely packed with semi-homogenized pyrite towards the top. The band of (grey) recrystallized quartz at centre shows the slight soft sediment deformation. Plane polarized reflected light (polished thin section). (Sample 9048)

This axial planar cleavage is a conduit for the transport of carbonaceous material within the slate (see plate 1). Descriptions of these samples are in Appendix A, pages 3-7.

The cherts form the lower portion of the Lower Earn Formation. They are represented by samples 9048, 9049, R-1, R-3 and R-6 in Appendix A, pages 8-16. These chert samples are all very uniform in appearance. They typically are finely laminated with pyrite in the form of framboids. This framboidal nature is an indication that these sulfides formed during diagenesis (Udubasa, 1984, Chauhan, 1984 and Nair and Ray, 1984). The pyrite framboids have altered in some cases to subhedral pyrite cubes. The samples are enriched in pyrite to approximately five percent, with varying amounts of chalcedonic quartz as flame structures of up to four percent (see plate 2). The presence of the wider bands of pyrite, such as observed in sample 9048, are common throughout the chert units in drill core (see Appendix C) and is indicative of a greater source of iron and sulfur. The sample 9048, which contains the band of pyrite, has also undergone a minor amount of deformation. The sample observed in plate 3 shows a minor amount of soft sediment deformation which may be responsible for the chalcedonic fibres in sample A. The pyrite in this band has (20 P.P.B.) trace platinum group elements, background arsenic levels and only slightly higher than normal estimated lead, zinc, iron and gold concentrations (Cathro, 1988, Assay Data). The source for the pyrite bands in the chert is unlikely to be the same as that which produces the vaesite-pyrite horizon at the base of the chert unit. The arsenic path finder element for the vaesite horizon is typically much higher than was observed in the pyrite bands in the chert unit.

PLATE: 4

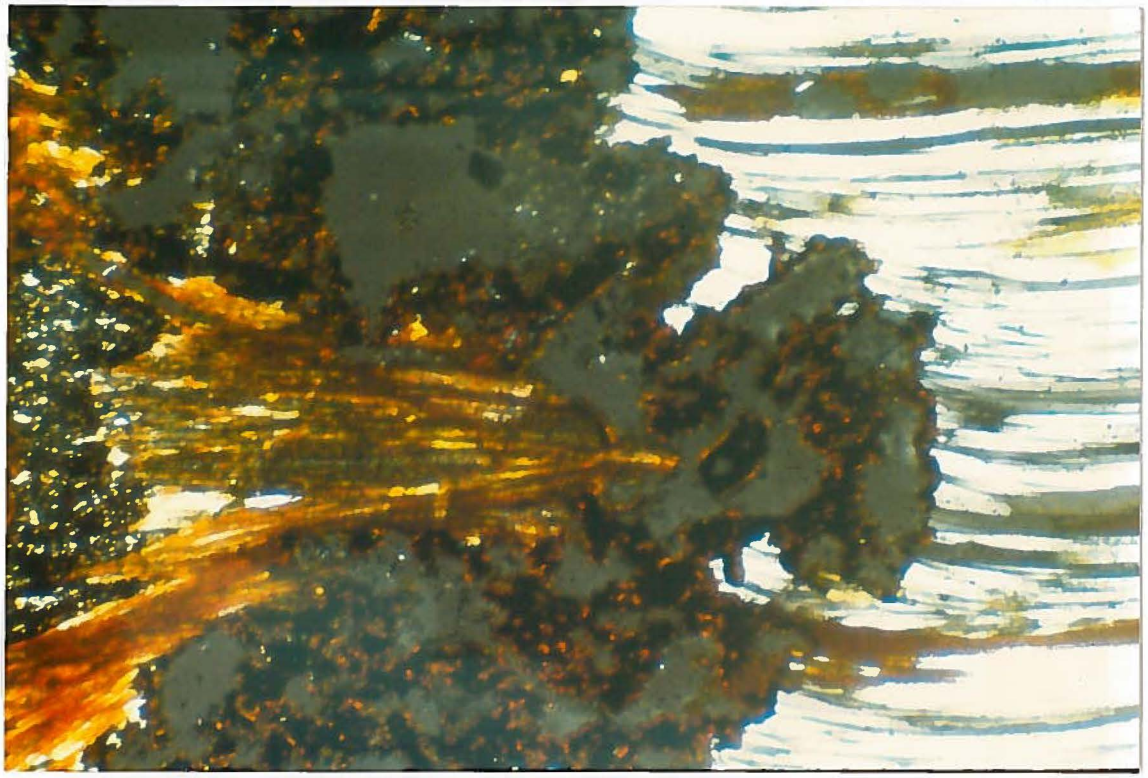


1.77 mm

Transmitted Cross Polarized Light (TXPL)

This photomicrograph shows chert host (black) with chalcedonic quartz (white-grey) fibres which have grown towards the direction of extension in this sample. (Sample A)

PLATE: 5



1.77 mm

Transmitted Cross Polarized Light (TXPL)

This photomicrograph shows the chalcedonic fibres (white to grey) on the right growing from the side of the cavity which is composed of limonite (reddish brown) and chert speckled yellow and black far left. The dark grey-green color represents vesciles in the sample probably due to weathering. (Sample A)

Within the cherty portion of the Lower Earn Formation are siliceous fibres formed in fractures, developed parallel to bedding. These structures take the form of sheared veinlets. These structures are found in association with both the chert and/or pyrite. They are commonly composed of quartz, hematite and limonite (see plates 4 and 5). Usually these fibrous masses form at the top of a pyrite band, however, they do form between chert beds which show slight soft sediment deformation (see Appendix A, pages 17-18). The structures are the result of soft sediment deformation and produce the fine white bands of siliceous material which range in size from submicroscopic to 18 cm^2 in area and 2 cm in depth.

Within the chert unit are minor thin beds of limestone with fine carbonaceous lamellae and pyritic euhedral crystals. The limestone units commonly have recrystallized sparry calcite in veinlets along fractures, probably the joints in the limestone (see Appendix A, pages 19-20).

The Limestone Ball Member which underlies the vaesite horizon, is composed of boulders of micritic limestone. This unit has recrystallized sparry calcite forming veinlets along probable joints in the limestone (see Appendix A, pages 19-20) and is underlain by a thin black chert and a thick calcareous shale.

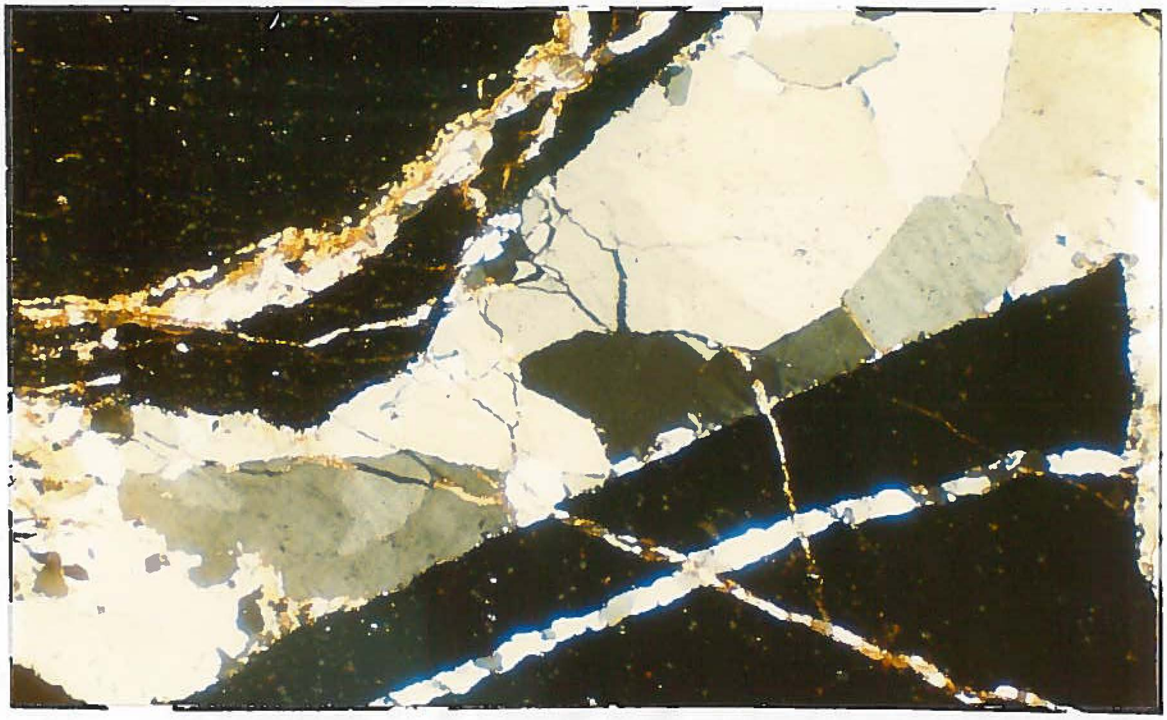
A breccia sample was found which had penetrated upwards through the stratigraphic column, and may be of interest in the study of later deformation and hydrothermal fluid movement. It is unique in that it is the only hydrothermally altered sample taken from the property which has been analyzed in this study. The sample, R-5, found at 80.74 m depth in drill hole 88-4 is comprised of quartz, calcite, epidote, carbonaceous shale fragments and chert fragments (see plates 6 & 7). This sample is described in detail on pages 23-25 in Appendix A. It was taken from the drill core approximately 60 metres above the Limestone Ball Member. The vaesite horizon directly overlies the Limestone Ball Member to the southwest and, therefore, this latent breccia sample cannot be linked to the formation of the vaesite. However, fluid inclusions from this breccia sample may be of use in determining the nature of the hydrothermal fluids which circulated through this sequence after deposition. This small breccia pipe contained two-phase fluid inclusions of primary (negative crystals), pseudosecondary and secondary nature. Several of the inclusions contained H_2O and CO_2. At room temperature the CO_2 bubble was very active (see plates 8 & 9). Many of the inclusions of the secondary type were formed from the necking down of elongate inclusions. Fluid inclusion studies on an insufficient population of inclusions is of little scientific value because of the existence of error introduced by only one sample.

Mineralization

The mineralization occurs in a thin bed of stratiform sulfides between the overlying black cherts and underlying Limestone Ball Member. The mineralogy of the vaesite (NiS_2) horizon is very complex. The minerals present are pyrite, a variety of pyrite called melnikovite (Harris, J.F., 1988), vaesite, sphalerite, various forms of chert and bitumen. The association of minerals and textures in this stratiform deposit are unusual. The study of the mineralogy was conducted using petrographic reflected and transmitted light microscopy x-ray diffraction with additional identification procured from a report by J.F. Harris (1988) in which he analyzed several of the finer grained minerals by Scanning Electron Microscope.

The Nick mineralization is present in disturbed, rhythmically deposited lamellae which form individual layers up to 3 mm thickness. The

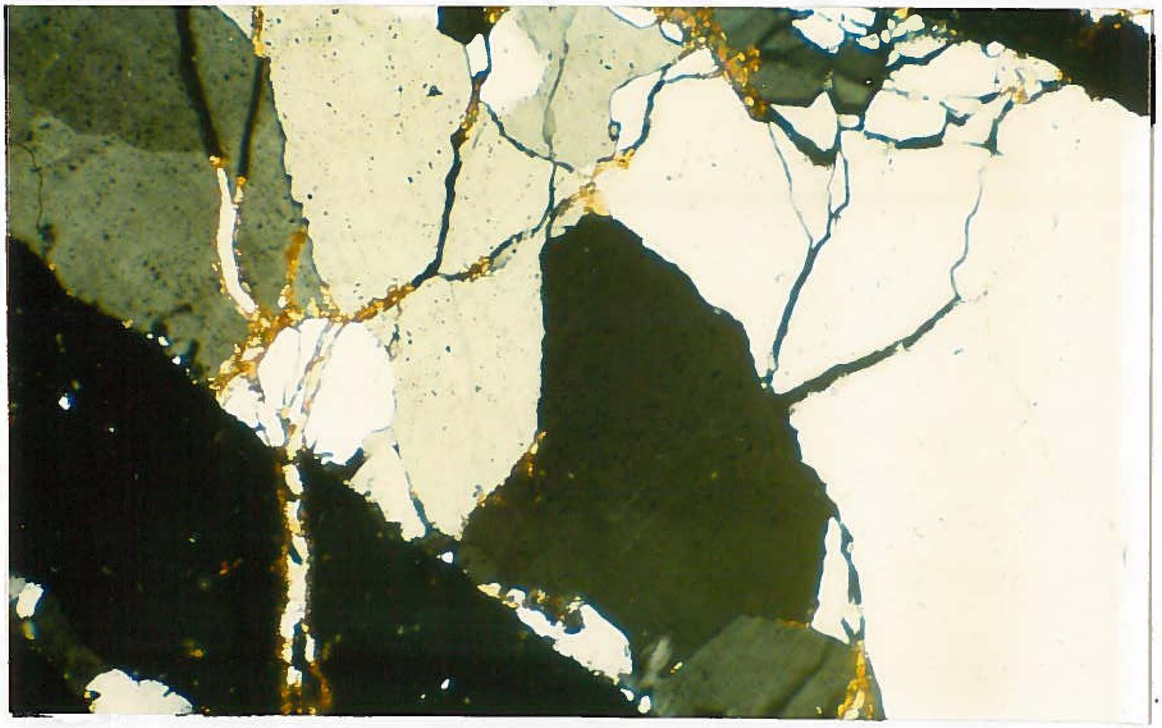
PLATE: 6



2.48 mm

Transmitted Cross Polarized Light (TXPL)
Cross cutting relations in the quartz breccia sample (R-5).

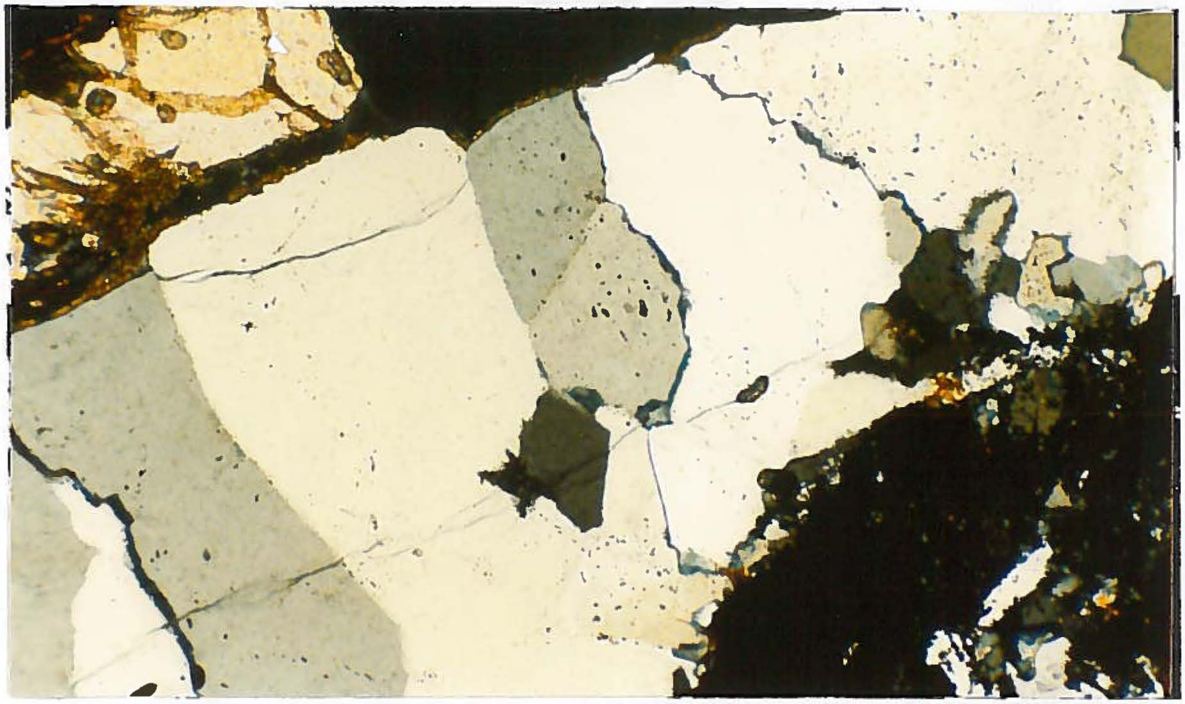
PLATE: 7



900 µm

Transmitted Cross Polarized Light (TXPL)
Higher magnification of above. (R5, DDH88-4, 80.74m)

PLATE: 8

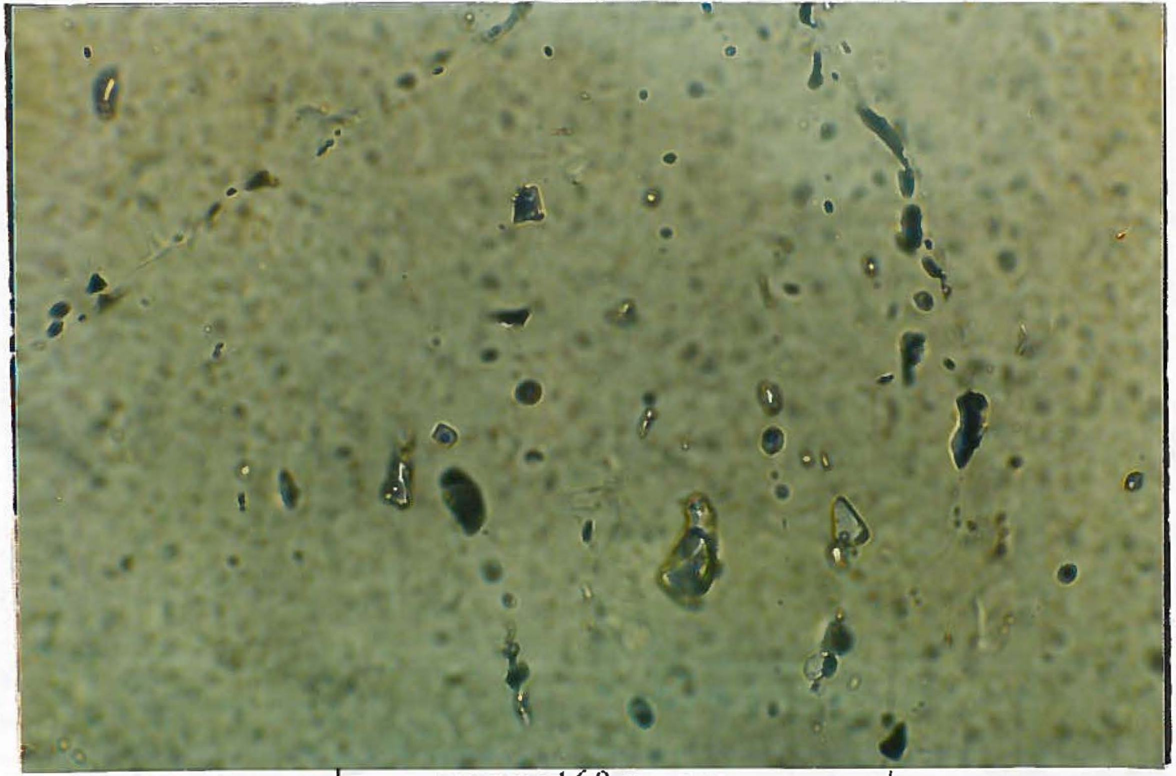


800 μm

Transmitted Cross Polarized Light (TXPL)

Multiple fields of fluid inclusions in quartz-epidote breccia sample.

PLATE: 9



160 μm

Transmitted Cross Polarized Light (TXPL)

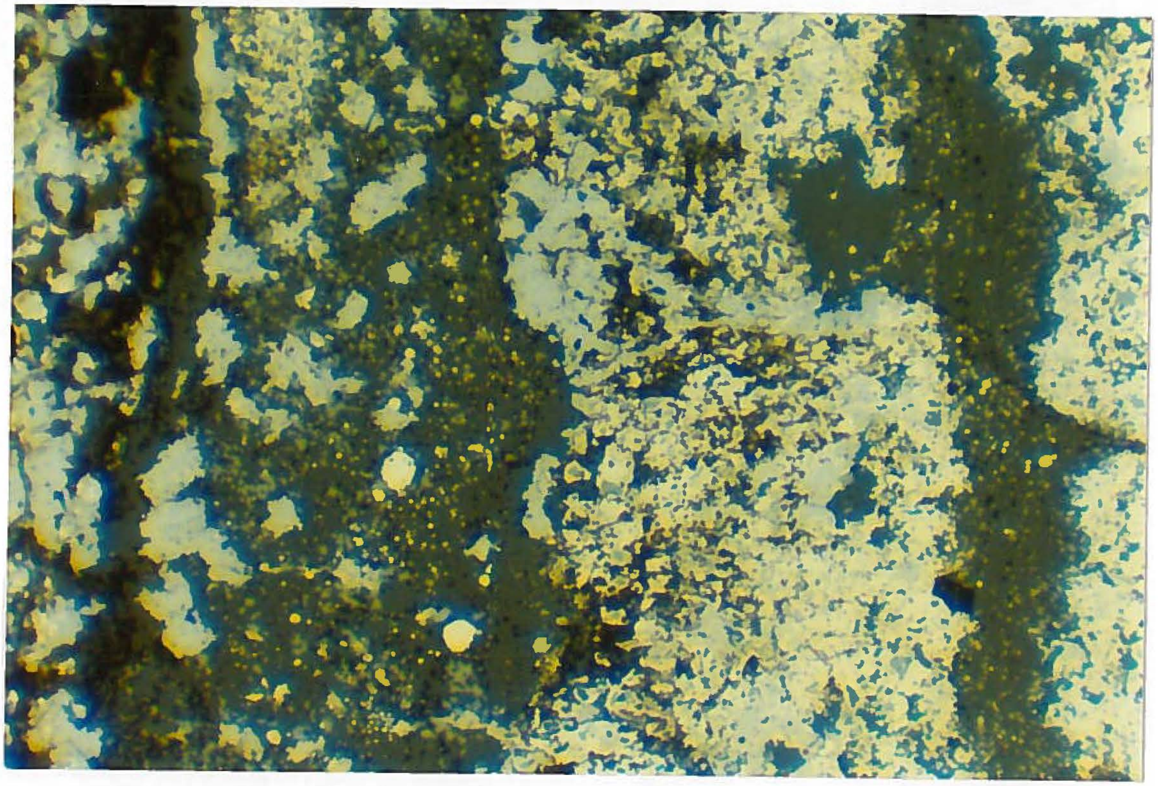
A view of several primary double phase fluid inclusions in quartz from the sample above. (Sample R5, DDH 88-4, 80.74m) nickel mineralized horizon varies from 2 cm to 10 cm in thickness. Each lamellae is unique. No layered sequence of mineralization is apparent , although there exists an affinity for the deposition of sphalerite after that of pyrite, melnikovite and vaesite. This apparent sequence of mineralization may be due to the solubility of zinc, iron and nickel in exhaled thermal brines, or the late incorporation of base metals. The mineralized layers are typically interlaminated with carbonaceous and phosphatic chert and nodules of probably biogenetic chert. The appearance of the laminae are expressed in plate 10.

The deposition and formation of the mineralized zone is thought to occur through a process of diagenetic recrystallization from colloidal sulfides (Chauhan, 1984). The pyrite which occurs in these layers as globular bands may be intergrown or rimmed by arsenic (plates 11 & 12) similar to the spheroidal pyrite grains of two Romanian examples described by Udubasa, (1984). Furthermore, Udubasa outlined a genetic link between framboidal pyrite and an accessibility to carbonate in the host rocks.

The bands which formed in the cherts and shales above the mineralized zones contain much higher concentrations of framboidal pyrite. This may be a result of increased carbonate in both the rocks and marine waters. The lack of framboidal textures in the mineralized strata may be due to hydroplastic dewatering of the pyrite which would cause a homogenization of the pyrite (Chauhan, 1984). This process would also produce the siliceous flame structures in the pyrite of the upper shales and cherts, and the fibrous siliceous material within the vaesite horizon.

The chalcedonic siliceous fibres which are found in association with the pyrite layers have also been reported in the Ordovician greywacke from southwest Scotland and in Precambrian cherts in the algal zone of the

PLATE: 10

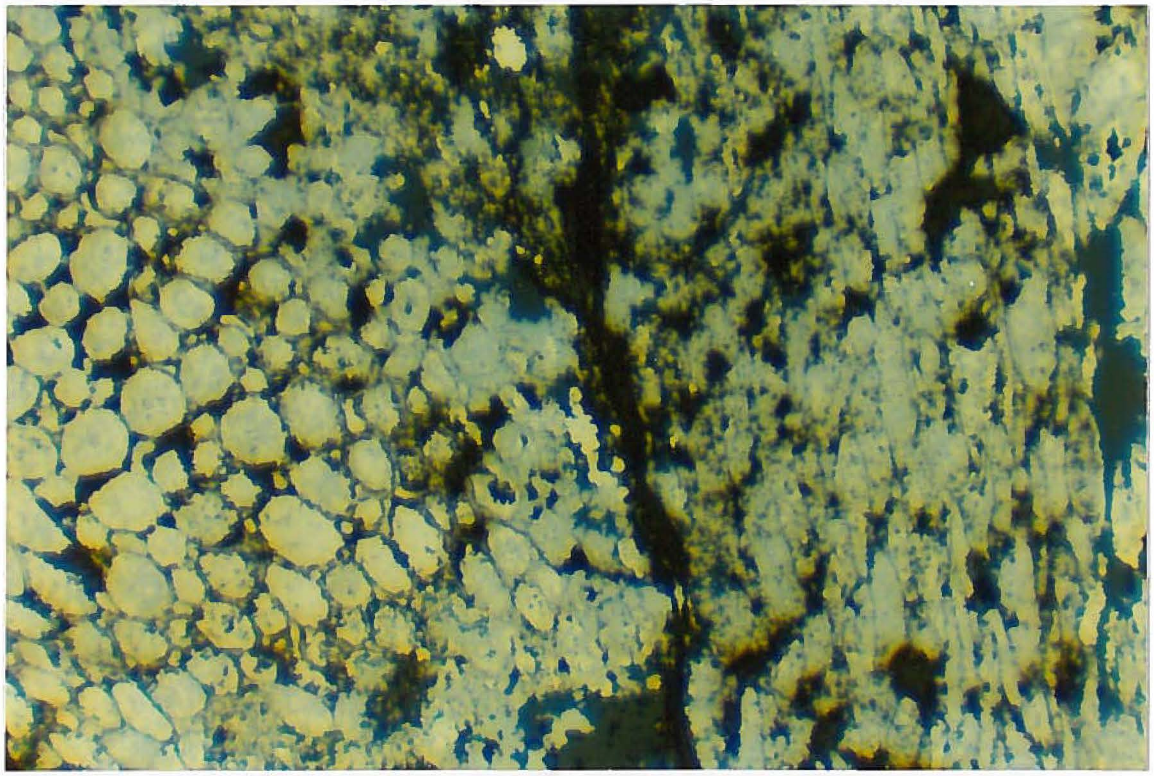


2.0 mm

Reflected Plane Polarized Light (RPPL)

Typical field showing the intense variation in textural relations and mineralogy. The wide band right of centre is composed of pyrite (yellow), melnikovite (brownish yellow, interior of band), vaesite (pale grey) and sphalerite (dark green-grey). This laminar band is suspended in a framboidal pyrite rich chert. The interlaminations and fine intergrowths are typical of the vaesite horizon. (Sample Nick outcrop A-1)

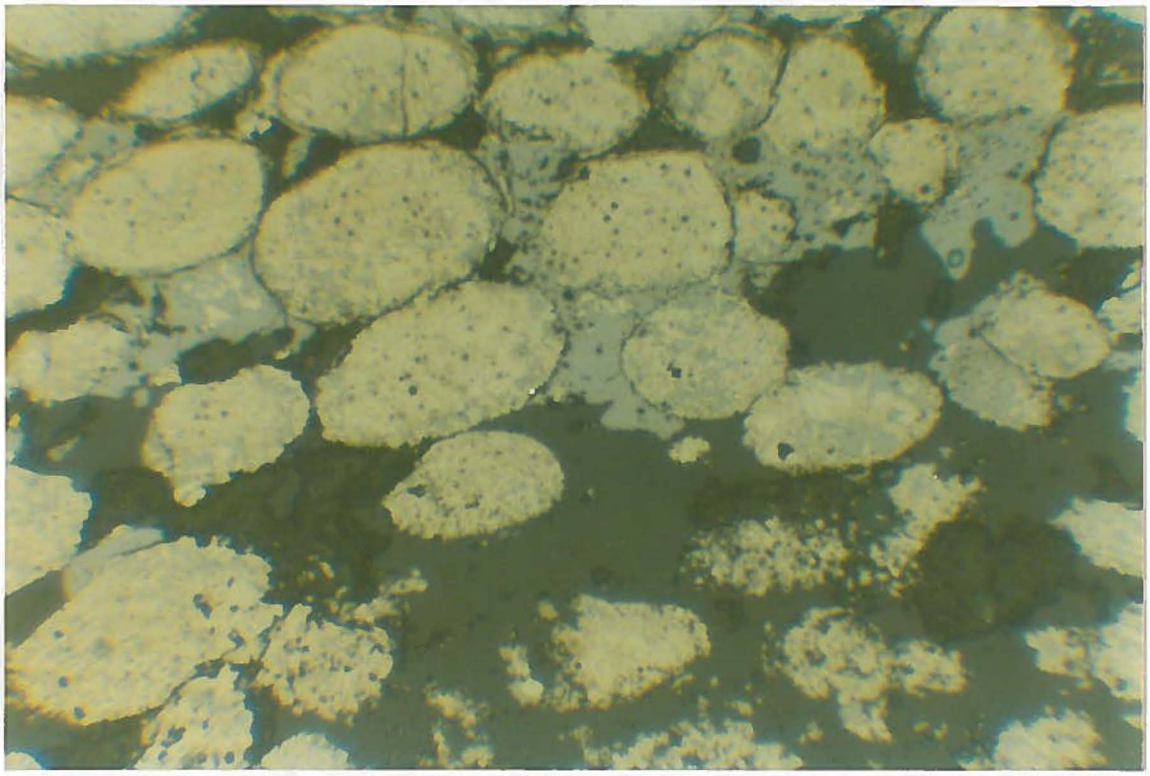
PLATE: 11



├——500 µm——┤
Reflected Plane Polarized Light (RPPL)

Similar to plate 12, the homogenized framboidal pyrite (creamy white) and vaesite (blue grey) has been compressed and attenuated in the band to the right by soft sediment deformation. The band to the left shows a little deformation near the interface between the bands. (Sample Nick outcrop A-1)

PLATE: 12



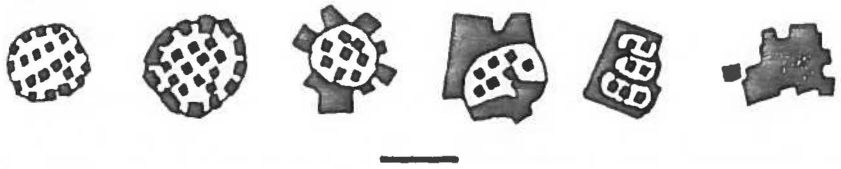
250 μm

Reflected Plane Polarized Light (RPPL)

Spheroidal masses of homogenized pyrite (creamy white) and melnikovite (brownish cream) with intergrown vaesite (blue grey). Carbonaceous chert (dark green) and vaesite (blue grey) with (yellow) pyrite and intergrown pale green colored sphalerite (1-10 um) in the interstitial vaesite. Note the rim on the spheroids which may be due to arsenic. (Sample Nick outcrop A-1)

Gunflint, and Biwabik Formations (Kelling, 1971, Tyler and Barghoom, 1963 in: Nair and Ray, 1984). "Such zones or rims are produced either by contraction as a result of conversion of the amorphous iron sulfide into crystalline pyrite and their filling by diagenetic silica/carbonate (or pyrite/vaesite) or, by the development of stress shadows during epimetamorphism and the filling of spaces" (Nair and Ray, 1984).

Chauhan (1984), suggested two processes which produce homogenized pyrite. The first *sammelrekristallisation* which results from the coalescence of the microcrysts of pyrite, expelling the trapped material, producing a welded texture. The second process introduces a later pyritic fluid which produces a second generation of pyrite infilling in the voids and replacing trapped material, similar to figure 5, from Udubasa, (1984)



Gradual transformation of framboidal pyrite to euhedral pyrite grains in a hydrothermally affected black shale, Rotunda-Strimbu area, Baia Mare region, N. Romania. Scale bar is 10 μm

G. Udubaşa

The *sammelrekristallisation* method of homogenization is in keeping with the homogenized and semi-homogenized pyrite of the cherts and shales of the overlying strata, and to a lesser extent may play a role in the homogenization of the vaesite horizon. The infilling of diagenetically formed framboids by a second generation of nickel, zinc, iron and sulfur is conceivable as a process for the formation of intergrown vaesite, sphalerite, melnikovite in the banded layers and at the margins of the banded layers.

The diagenetic events which produce the mineralization in the vaesite layer are a variation on that proposed by Chauhan, (1984). (See Table 1.)

Table 1. Generalized diagenetic events during crystallization of metallic sulfides

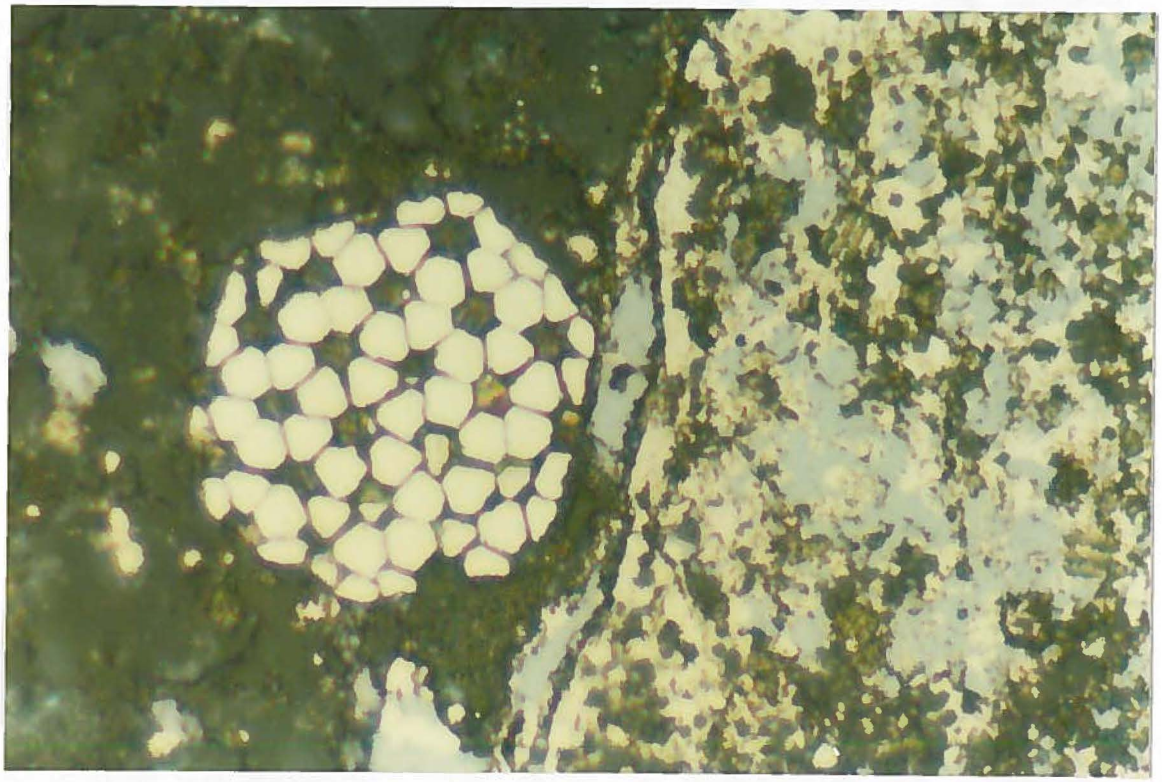
	1st diagenetic stage (depositional)	2nd diagenetic stage (shallow burial)	3rd diagenetic stage (cementation – premetamorphic)
Pyrite	Tiny pyrite grains and distinct framboids appear. Tiny grains of pyrite assemble in cubic outlines	Cementing pyrite appears; *Sammelrekristallisation* takes place	Either grains or framboids cemented together or with one another to form bigger crystals
Sphalerite	–	First appears in small amounts	Mainly crystallizes during this period
Galena	–	–	Makes appearance during early part of this stage and mainly crystallizes through this stage

D.S. Chauhan

The Nick Property mineralization varies with respect to the introduction of nickel in the same stage as that of pyrite *sammelrekristallisation* (stage 2). An example of the effects of mineralization of this type is illustrated in plate 13. Samples from this horizon do not show any intergrowths of galena, and assays show very low concentrations of lead. Therefore, this horizon has not undergone the third stage of diagenetic crystallization.

The pyrite vaesite horizon is composed of the diagenically semi-homogenized pyrite intraclasts (Nair and Ray, 1984). These intraclasts maintain the initial structure and mineralogy of the lamellae prior to the penetrative deformation. The maintenance of these intraclasts in the deformed unit provide a relative timing for the deformation. The deformation may have ended the second stage of diagenesis or occurred afterwards (see table 1, Chauhan, 1984 and plate 14).

PLATE: 13

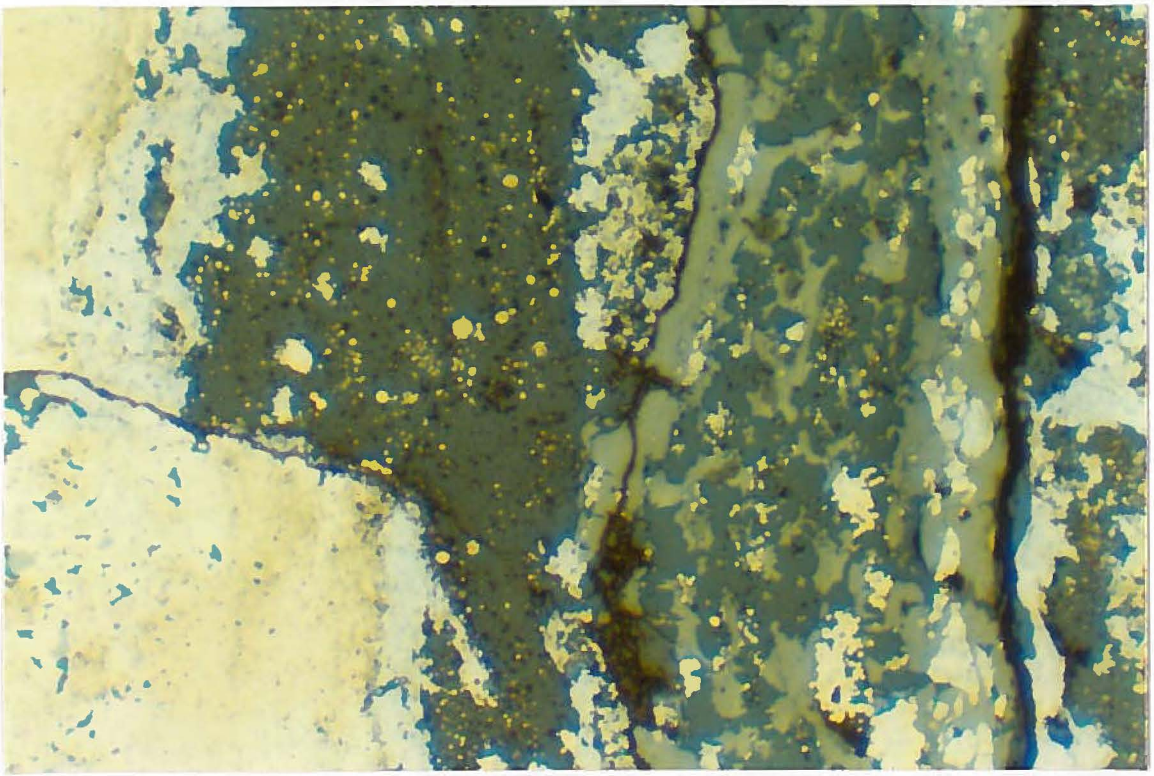


├── 60 µm ──┤

Reflected Plane Polarized Light (RPPL)

Pyritohedron (pale creamy yellow) formed from smaller pyritohedron contained within the chert band (dark grey-green). The chert if interspersed with pyrite framboids and amalgamations of vaesite, pyrite, melnikovite and minor sphalerite. The pyrite band to the right is partially homogenized (near stage 2) and is admixed with sphalerite (blue-grey color). The dark green-grey material is carbonaceous phosphatic chert which was trapped in the original pyrite framboids. Several pyrite framboids are still visible in the band. (Sample Nick outcrop A-1)

PLATE: 14



├──── 200 μm ────┤

Reflected Plane Polarized Light (RPPL)

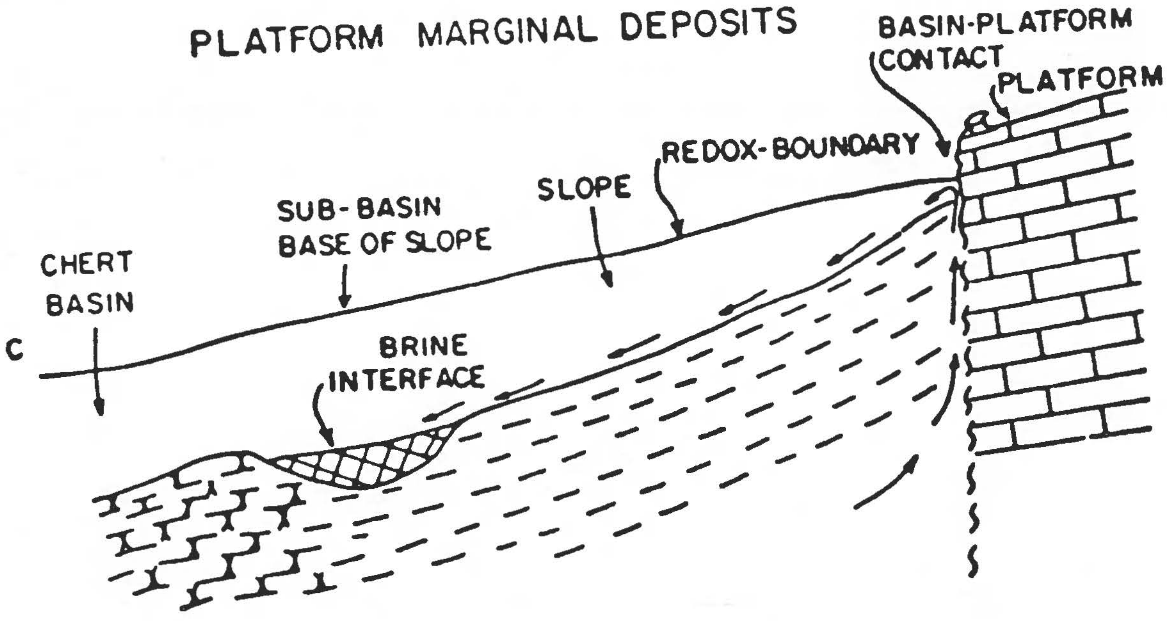
The photomicrograph above shows the intraclasts of pyrite (yellow) and vaesite (blue grey) deformed with framboidal chert conforming to the intraclasts (dark grey with yellow flecks and blebs). Intergrown sphalerite and chert show a later development yet, with near straight layer boundaries. The brown bands which are positioned on either side of the sphalerite chert lamellae may be bitumen. (Sample Nick outcrop A-1)

The deformation of the finely laminar sulfide layers at the nodular cherty boundary is complex. The sulfides show deformation around the chert nodules, but blebs of sulfides contained within the nodule are underformed (see plates 15 & 16).

DEPOSITIONAL MODEL:

As alluded to previously, the model for the transport and deposition of metals closely ressembles that of sedimentary exhalative deposits. Sedex deposits of the Selwyn Basin, and other regions, are differentiated by the source of the fluid, the method of transport and depositional location. Morganti (1981) suggested three tectonstratigraphic environments; epicratonic deposits, flysch deposits and platform marginal deposits.

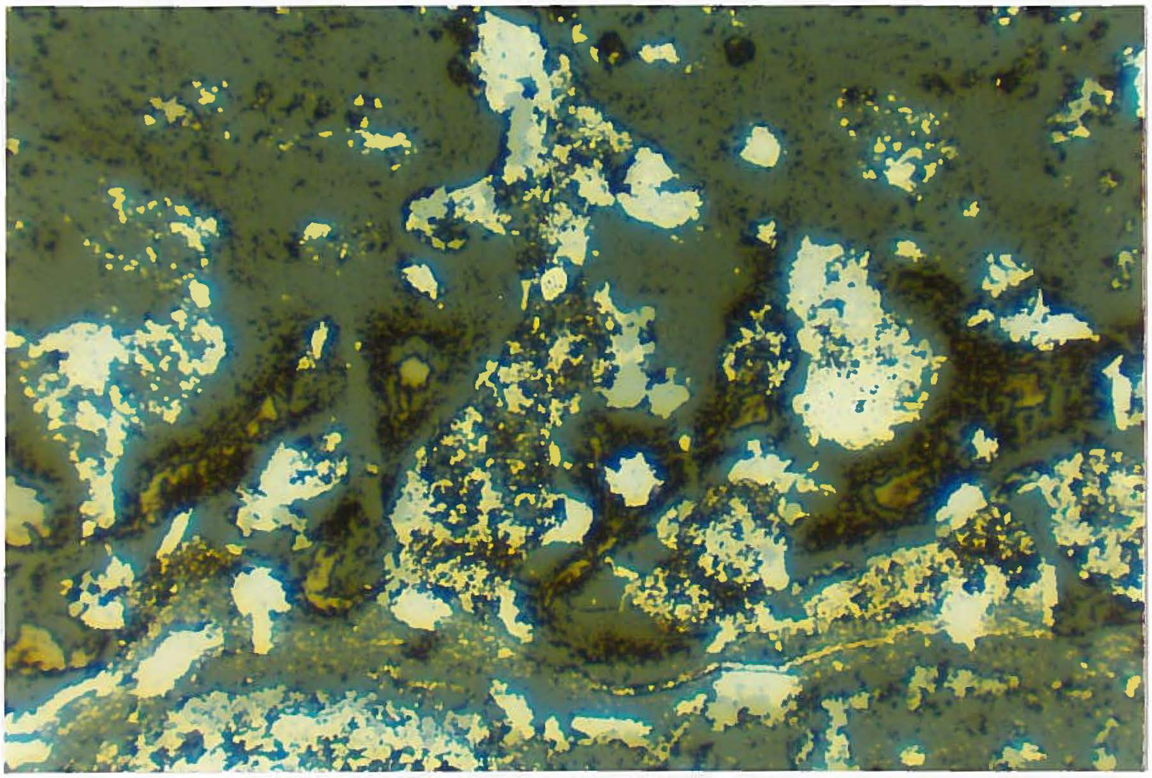
Using the Morganti model for platform marginal deposits, as seen in fig. 6, the factors which are present at the Nick Property show a strong resemblance to this model.



(Morganti, 1977).

Fig. 6

PLATE: 15

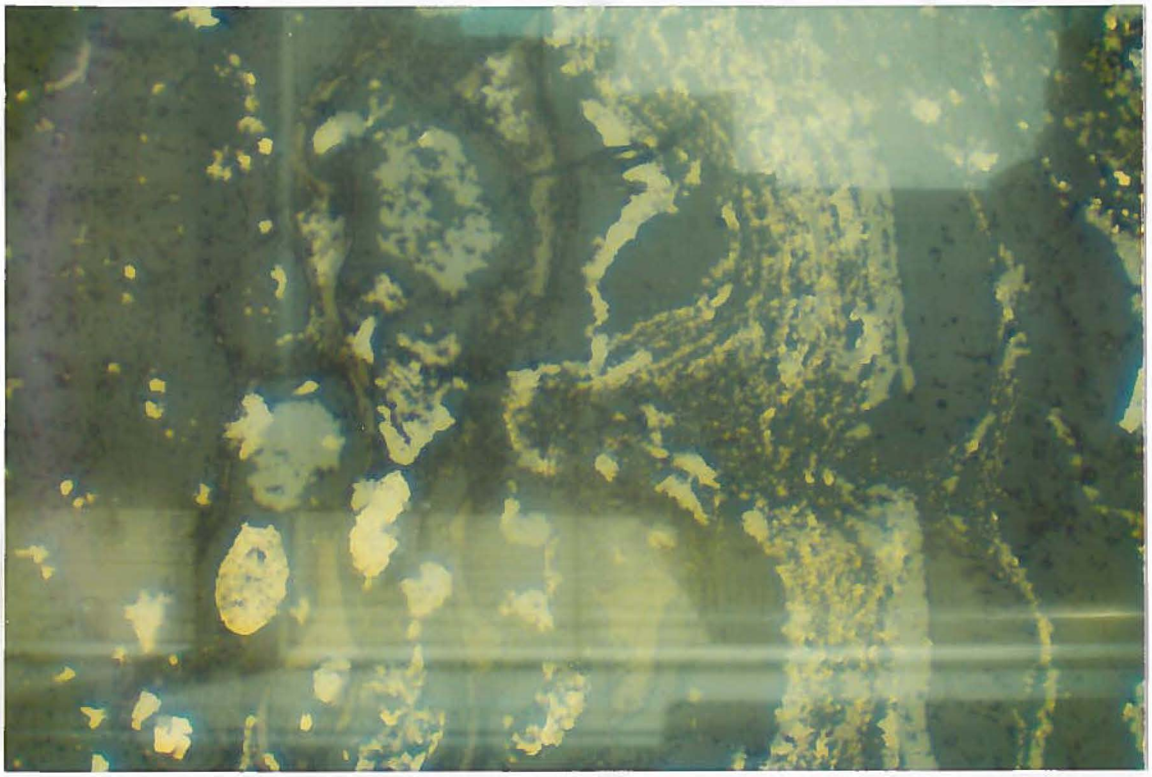


⊢——— 500 µm ———⊣

Reflected Plane Polarized Light (RPPL)

The photomicrograph above shows a chert nodule, sulfide lamellae boundary. The sulfides: vaesite (blue grey), pyrite (yellow), melnikovite (brownish yellow) and sphalerite (light greenish grey) are intergrown into chert (dark green-grey) nodule which contains blebs of bitumen (?) at the boundary (dark brown). Notice the compaction and conforming of pyrite to the chert nodule during soft sediment deformation and the 40 um pyrite framboid in the nodule. (Sample Nick outcrop A-2)

PLATE: 16



├──── 80 µm ────┤

Reflected Plane Polarized Light (RPPL)

The above photomicrograph was taken along the same boundary where the sulfide was deformed more readily by the confining pressure and the rigid chert nodule. (Sample Nick outcrop A-2)

The Nick mineralization is rich in nickel and platinum group element, with lesser amounts of molybdenum. This varies from the typical lead, zinc sulphide occurences of the OP, ANNIV and XY deposits of the Western Selwyn Basin. The absence of the high barium concentrations at Nick compared to their presence at the Flysch - Epicontinentlat type deposits, attests to a dissimilarity in the metal source, transport and depositional system. The above sketch of the model proposed by Morganti (1977 <u>in</u>: Morganti, 1981) shows the pooling of sulphide rich brines at the lithological interface between shales and cherts. However, at the Nick Property, the mineralization occurs above the Limestone Ball Member and a thin layer of chert. The formation of this minalization occurs below the redox boundary, probably in an euxinic region. The concentration of nickel and PGE's may have been encouraged by the activity of micro-organisms or bacteria in this environment.

The structural parameters such as the fault bound carbonate margin, paleoslope indicators and host rock lithology can be shown to parallel those of the Western Selwyn Bassin deposits (see fig. 7).

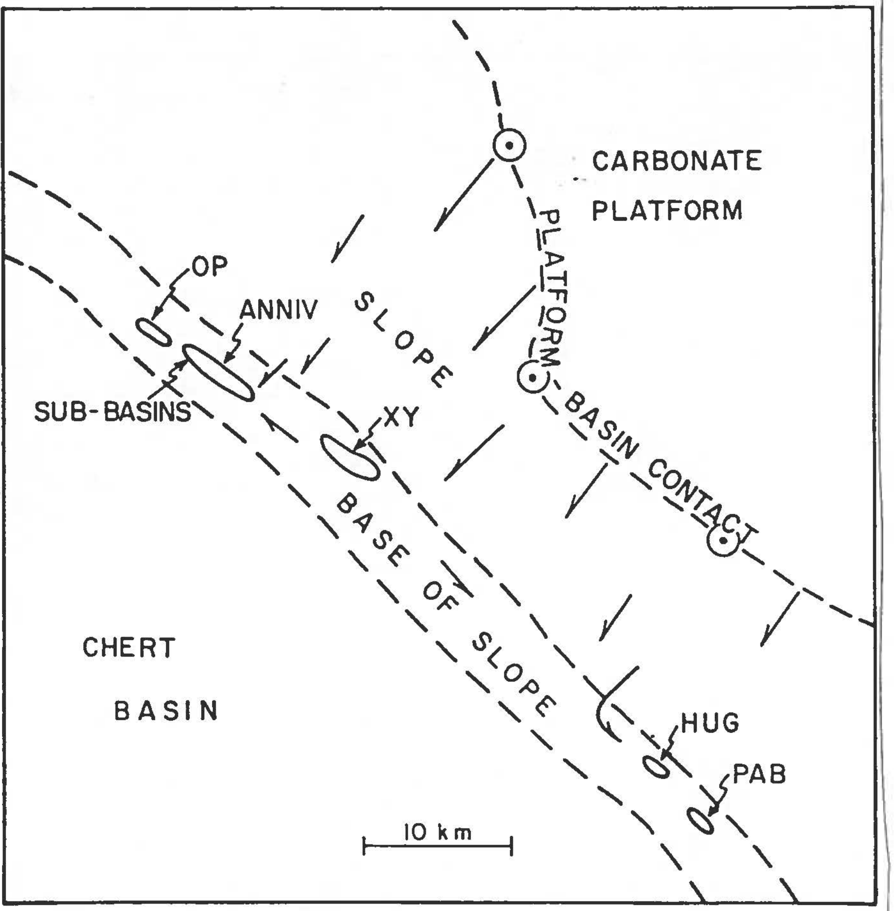


Figure 7 *General model for the formation of the platform-marginal deposits showing the geometry of the platform-slope-base of slope and chert basin facies. Arrows show surface movement of ore fluids which migrate up to the sediment-water interface, down the basin slope and are trapped in the sub-basins at the base of the slope.*

The framboidal and recrystallized forms of pyrite serve as good guides in the tracing of economically important base metals which form intergrowths with the pyrite (i.e. framboidal pyrite will contain little zinc and nickel, whereas recrystallized or overgrown pyrite will usually indicate high base metal concentrations). The determination of diagenetic pyrite helps in discovering of the probable time of base metal fixation and behavior of post depositional soft sediment deposition.

DISTRIBUTION OF METALS:

The assay results of samples from the vaesite layer are tabulated in Appendix B. These results provide information regarding the distribution of nickel, zinc, barium, platinum group elements and various other metals contained within this horizon. The vaesite layer maintains a respectable grade of approximately 4.4% nickel throughout the explored region. The other base metal values for concentrations vary, zinc ranges from approximately 770 to 10,000 grams/tonne, and values for lead concentration are appreciably lower. The molybdenum values range between 1454 and 3930 grams/tonne. The element arsenic consistently parallels the variation in the percentage of nickel and therefore is a useful tracer element for the nickel bearing zone. The precious metals; platinum, palladium, gold and silver also closely parallel the nickel concentration.

From the assay data and field relations it become apparent that the source for both the nickel and base metals is probably the same one that supplies the precious metals. The variations in the concentration may be caused by a number of reasons. Firstly, deposition may involve a micro-organism which is responsible for nickel precipitation which itself is concentrated in certain environments and secondly, the paleo-terrain may effect the concentration of the hydrothermal brine fluid, in channelways on slope and third order basins at the break-in-slope of the basinal margin.

THE COMPARISON OF THE NICK PROPERTY WITH OTHER SIMILAR EXAMPLES:

The Nick mineralization is unique although the components are similar to several different metal bearing regions world wide. In Southern China, the Lower Cambrian is an important ore genetic epoch. The black shales series of this region contains phosphorite, stone coals and Ni-Mo polyelemental rich beds (Fan, 1983). At the Kasompi Mine in Zaire, vaesite and pyrite have been reportedly found in occurrences with dolomite (Cathro, 1988). Several Chinese locations exist according to Coveney and Chen (1988).

The Songlin occurrence, for example, contains a nodular sulfide lense 5 to 15 cm thick within a black shale which contains up to 4% nickel, 4% molybdenum, 2% zinc, 0.7 ppm Au, 50 ppm Ag, 0.3 ppm Pt and other platinum group elements. Vaesite is present with other nickel and molybdenum sulfides in microspheroids of organic matter in thin beds up to 5 cm thick (Fan, 1983). Several other localities exist which contain this similar nodular Ni-Mo sulfide occurrence.

At a location in the Hunan Province, Cambrian aged shales contain these Ni-Mo rich nodules and are associated with P.G.E.'s (Fan, 1983). The nodular textures exhibited together with other factors imply that submarine hydrothermal springs related to basement faulting may have been responsible for the metals (Chen, 1988 in: Coveney and Chen, 1988).

In the Lower Cambrian, in the Hunan Province, a series of strata resembles the stratigraphy and mineralization of the Nick Property. The Niutitang Formation in Tianmenshan is compared with the Nick Property stratigraphy (in descending order):

a) Dark grey and black illite shale, intercalated with grey dolomitic lenticles. This shale is 35 to 40 metres thick, and is characterized by fine lamellae of pyrite.

b) Black argillaceous siliceous rock (approximately 18 metres thick).

c) Black dolomitic shale and silty shale 1.2 to 1.5 metres thick, containing fine discontinuous pyrite laminae of 2 to 3 mm thickness.

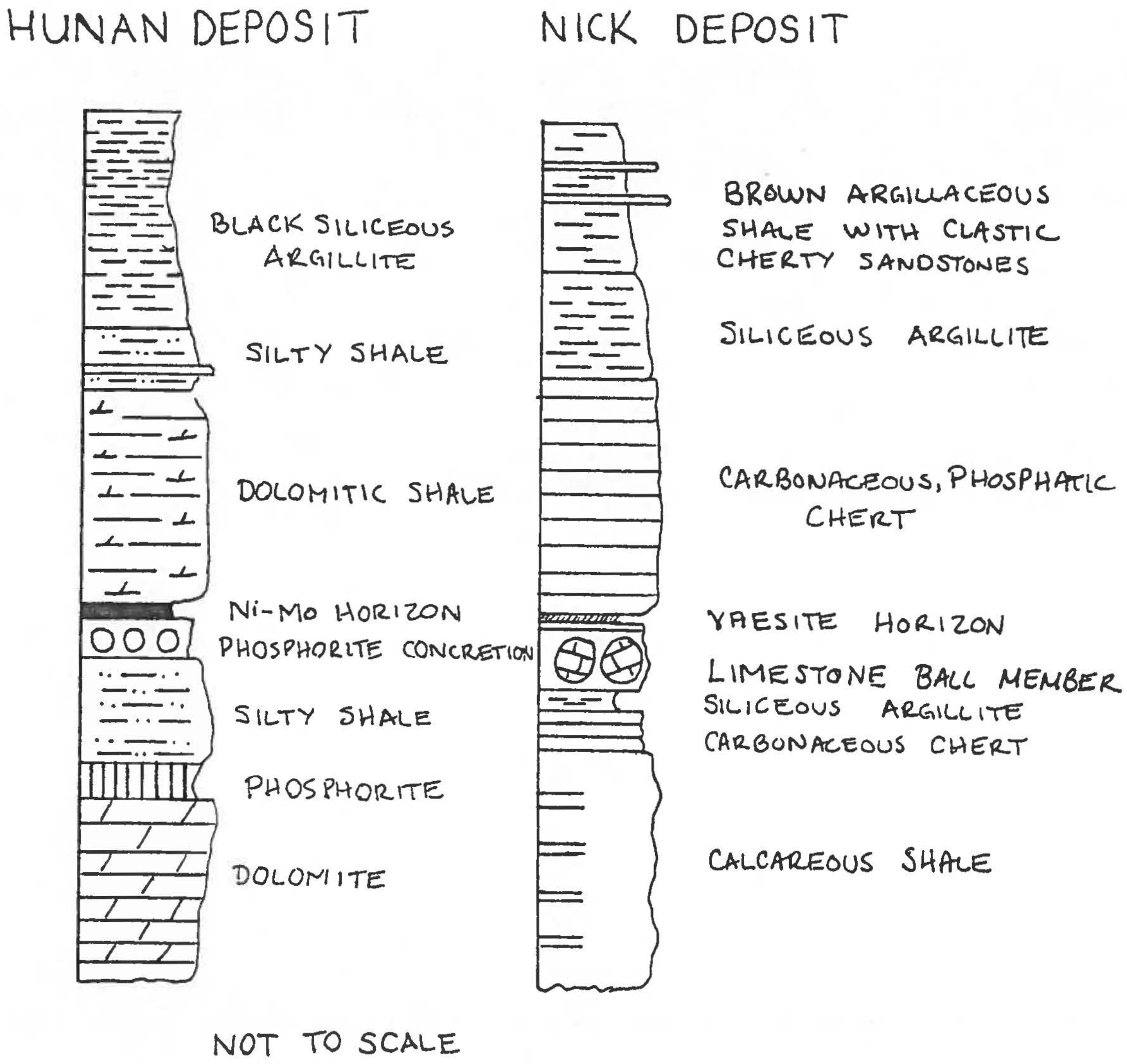
d) Black shale with phosphatic concretions and Ni-Mo polyelement beds commonly the phosphatic concretions overlie the Ni-Mo horizon (2 to 5 cm thick).

The units (a-d) closely resemble the sequence at the Nick Property which is composed of a clastic fine grained shale horizon equivalent to (a), a siliceous black shale unit equivalent to (b), a black chert with intercalations of calcareous shale equivalent to unit (c), and the vaesite horizon which is equivalent to unit (d) (Fan, 1983).

The Chinese sequence which contains the polymetallic beds has several striking similarities to the Nick Property:

1) The Lower Cambrian black shale series is located between two thick layers of argillaceous carbonates.
2) The Chinese example and the Nick Property both show generally shallowing upwards sequences.
3) Both host units are composed of dark shales, and siliceous black rocks with the mineralized zone at the base.
4) Both contain the nickel-molybdenum mineralization suites.

See figure below.



DISCUSSION:

The Nick Property may be characterized as a non-magmatic hydrothermally derived deposit type related to rifting and basin development. Kissen, (1988) suggests that a suite of five elements: nickel, cobalt, arsenic, bismuth and silver is related to shale hosted deposits, which contain in addition, Mo Tl, Se, Cd. According to Pereira (1977), Ni, Pt, Co and Cr metals are plate margin indicators, and can be linked to certain localities, for instance, Ni is associated with the Mekong fold belt sediments. According to Coveney and Chen, (1988) the Pennsylvanian age shales of the central U.S. may have similar ore grade enrichments associated with basement faults associated with the Central North American Rift System and other structures. The Nick deposit, like many of the Chinese deposits, has a strong affinity for Pt and Ni with lesser affinities for Co and Cr. In Eisbacher (1985), conclusions were drawn which correlated the Southern Chinese, Eastern Australian and Western North American Precambrian strata. These regions were later rifted away from one another during the Early Paleozoic. On two of these three continents black shale related Ni, Mo, Pt type deposits have been discovered near the paleo-rift margins.

Kissen (1988), provided geochemical evidence for the transport of Ni and Co in hydrothermal systems. However, the Nick mineralization has a low Co:Ni ratio. Kissen (1988), conceived highly saline, oxidizing carnate fluids mobilizing Ni, Co, As, Bi, and Ag from black shales, sulfide rich metavolcanics, and other continentally derived strata in a rifting environment. The transport of this fluid through open structures near the basin margin mixing with diluting and cooling ground waters may reduce the Ag, Co, and Bi concentration in such a way that a more concentrated nickel, arsenic, molybdenum and P.G.E. rich brine would exhale. Localized factors such as carbonaceous sediments or, pyritic sulfides in fahlbands could be the location for deposition of these base and precious metals (Kissen, 1988).

CONCLUSION:

This study is important because of the understanding one can draw from it pertaining to the local geology and constraints on the ore forming system. The distribution of nickel and platinum group elements was shown to be enriched in a horizon which is characterized by the homogenization of pyrite with intergrowths of sphalerite and minor nodules of black chert. The nature of the Nick deposit, strongly favors the platform marginal model for ore formation.

The nickel, molybdenum, P.G.E. metal association in sedimentary black shale environments is shown to occur at only one other location worldwide, in the Hunan Province, China. These metal associations may also be linked to rifting of the Proto-Pacific Ocean. This type of deposit should be given more attention in both the research and the exploration fields because of its unusual metal associations and correlation with rifting continental margins of the Proto-Pacific.

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APPENDIX A

PETROGRAPHIC DESCRIPTIONS

Page: 1

Petrographer: D. Parry

Date: January 23, 1989

Thin Section: B **Hole:** - **Depth:** -

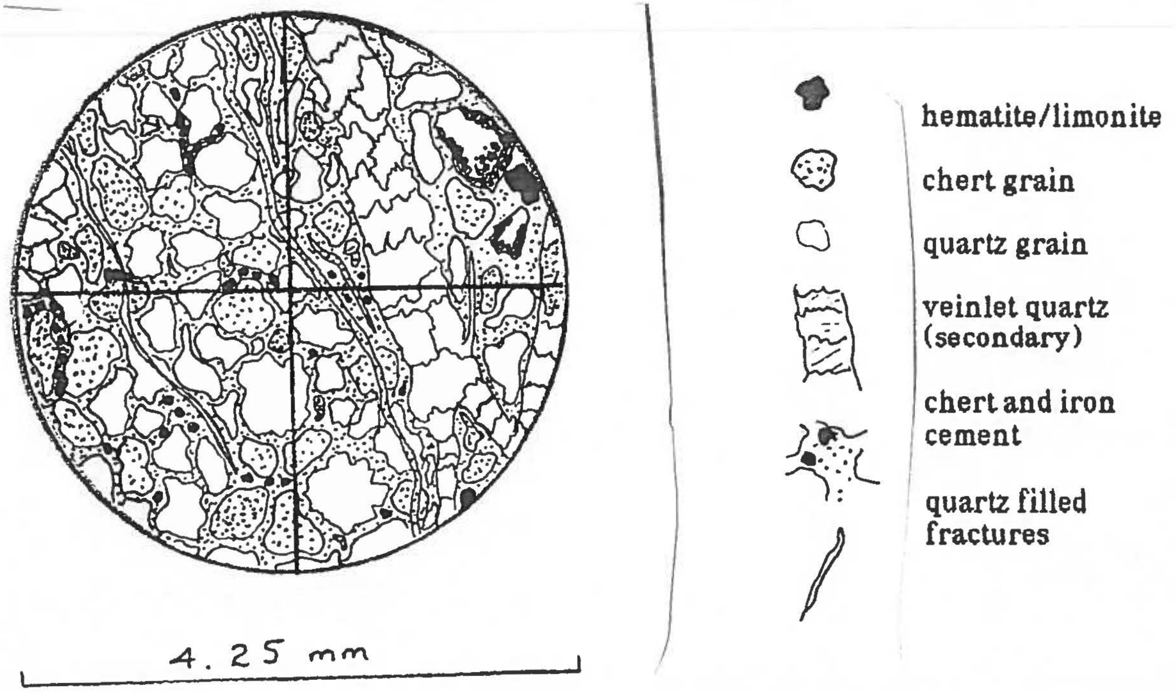
Rock Name: Quartz-Chert Sandstone

Location: Upper Earn, Fine Clastic Unit

Transparent Minerals:	**%**	**Texture:**
polycrystalline quartz	40%	detrital grains rounded to subrounded; pressure solution, silica suturing & silica cement as cements
quartz	~4%	recrystallized as veinlets up to 1 mm thick
chert	50%	detrital angular - subangular (250-500 µm)
hematite altered to goethite and limonite (iron stain and cement)	5%	anhedral, subhedral and euhedral cubes found coating grains and filling pores
sphene (titanite)	<0.1%	only observed as nucleus of chert graines also occasionally found within chert

Opaque Minerals:	**%**	**Texture:**
hematite	1%	detrital magnetite oxided to hematite
		sorting is poor to moderate
		grains are anhedral ranging in size from
		0.1 mm to 0.25 mm

Diagram: **PPL:** X **XPL:** ______ **Scale Bar:** 4.25 mm



Alteration Minerals:

limonite + goethite

Notes:

Formed from the hematite and magnetite during hydrous oxidation in post depositional stage of alteration probably due to supergene weathering effects.

Stages of Alteration:

(1) Authigenic chert formation during diagenesis.

(2) Alteration of pyrite and/or magnetite - to hematite during diagenesis.

(3) Supergene alteration produces goethite and limonite.

Paragenesis:

(1) Detrital chert and quartz with sphene as nucleus of cherty grains deposited in situ.

(2) Magnetite and hemitite coat some polycrystalline quartz and chert crystals.

(3) Introduction or remobilization of iron and silica, forms secondary chert - hematite cement.

(4) Fracturing occurs probably along jointing planes and later introduction of quartz and hematite produces veinlets.

Petrographer: D. Parry

Date: February 3, 1989

Thin Section: A-1

Hole: -

Depth: -

Rock Name: Silvery Black Shale

Location: Earn Outcrop A

Transparent Minerals:	**%**	**Texture:**
illite with varying amounts	90%+	microcrystalline, poorly laminated, mixed
of carbon		in lamellae with carbonaceous material
microcrystalline quartz	~6%	bundles of acicular crystals
(chert) and chalcedonic		<0.1 mm in length, perpendicular to
quartz		bedding probably diagenetic quartz
		growths as pressure shadows

Opaque Minerals:	**%**	**Texture:**
carbon	3-4%	disseminated, microcrystalline anhedral
hematite	<1%	disseminated, subhedral, subcubic,
		probably oxidized pyrite

Diagram: **PPL:** X **XPL:** ______ **Scale Bar:** 1.77 mm

Transmitted Plane Polarized Light (see plate 1)

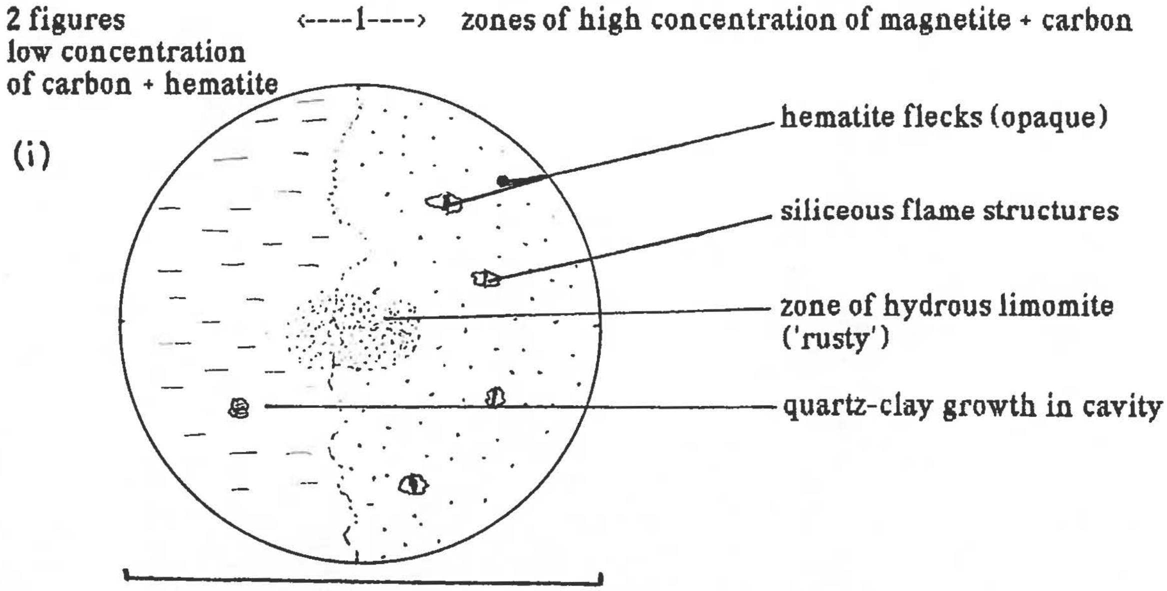
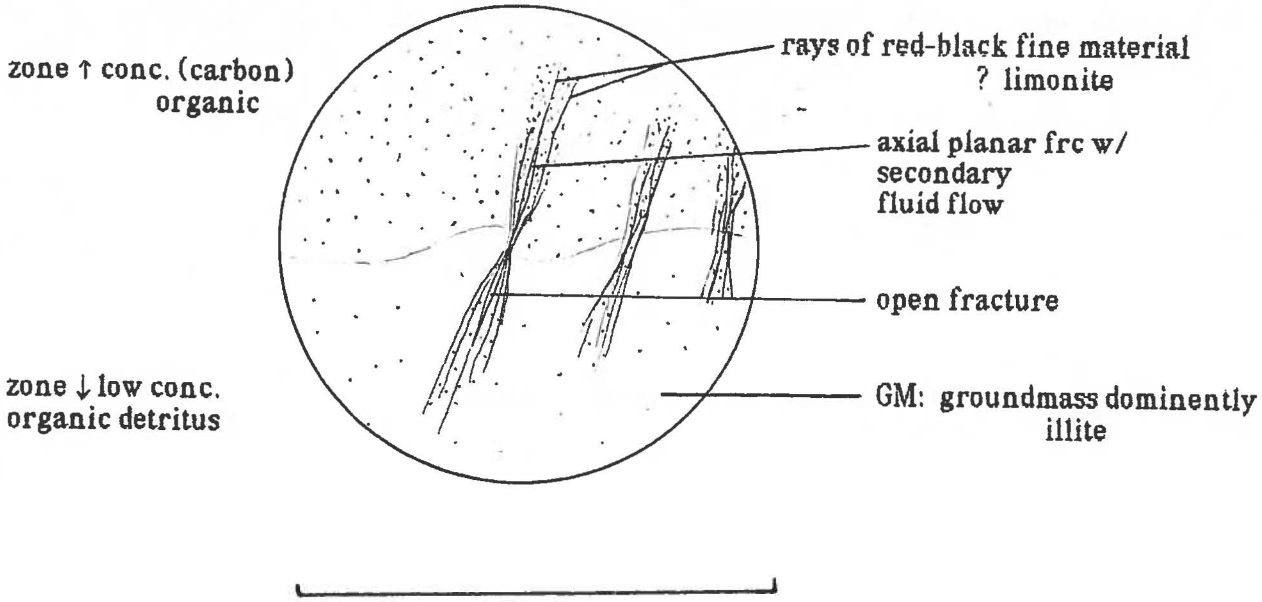


Diagram: **PPL:** X **XPL:** ______ **Scale:** 4.5 mm

figure (ii)



Alteration Minerals:	**%**	**Texture(s):**
poorly defined carbon/iron	1-3%	fracture filling, semiplanar
in rays		perpendicular to bedding

Stages of Alteration:

None: Weak diagenesis creating micronodules of carbon with associated flame structures, perpendicular to bedding (foliation 1), parallel with (foliation 2) axial planar cleavage.

Paragenesis:

The shale unit has undergone regional metamorphism which has caused dehydration with fluid movement between layers of different organic concentrations, fluids transport perpendicular to (foliation 1) bedding.

Petrographer: D. Parry **Date:** February 3, 1989

Thin Section: C **Hole:** - **Depth:** -

Rock Name: Shale (Silvery Black) **Location:** Lower Earn, Outcrop C

Transparent Minerals:	**%**	**Texture:**
clays and graphite	~92%	sub parallel orientation of carbonaceous
		material in argillaceous shale
quartz	>7%	microcrystalline (< 10 microns) anhedral
		commonly forms aggregates perpendicular
		to primary foliation (bedding)
quartz	3 %	bundles of acicular crystals < 0.1 m form
		pressure shadows perpendicular to bedding

Opaque Minerals:	**%**	**Texture:**
none	0 %	

Notes:

V. weak crenulation to primary foliation (assumed bedding).

Planes of weakness observed by fracture filling of mount epoxy at 60-62 degrees to primary foliation.

Siliceous flame structures probably caused by movement of carbonaceous or hematitic material and silica being produced from reaction of during diagenesis.

No diagram; sample is highly carbonaceous and difficult to sketch.

Similar to sample A-1, but richer in carbon.

Paragenesis:

Deposition of argillaceous sediment, diagenetic dewatering of clays, breakdown of organic material to carbon, movement of carbonaceous material and the production of pressure shadows. An event of folding causes second foliation, crenulation of bedding.

Alteration Minerals:	**%**	**Texture(s):**
none		

Stages of Alteration:

none

Paragenesis:

Deposition of carbonaceous shale and interstitial rare quartz.

The carbonaceous shale has undergone only minor diagenesis and only weak folding on a regional scale.

Petrographer: D. Parry **Date:** March '89

Thin Section: 9048 **Hole:** - **Depth:** -

Rock Name: Phosphatic Chert **Location:** Lower Earn Formation

Transparent Minerals:	**%**	**Texture:**
carbonaceous chert	80%	fine lamellae, orientation of flame structure is nearly perpendicular to bedding
quartz and amorphous silica	7%	anhedral-amorphous fracture filling surround pyrite band like in slide 9049 (diag. 2)

Opaque Minerals:	**%**	**Texture:**
pyrite	1%	disseminated (framboidal)
pyrite	12%	band of pyrite is approximately 1.0 cm in thickness; the band is subhedral to cubic relatively homegeneous composed of pyrite

Diagram: **PPL:** X **XPL:** **Scale Bar:** 4.5 mm
Reflected Light

Diagram 1

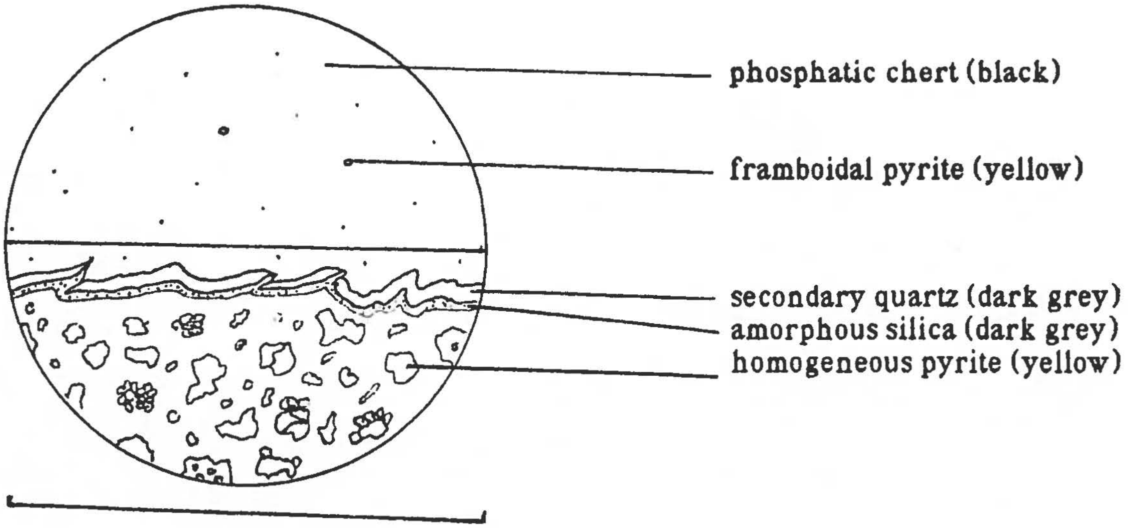


Diagram: **PPL:** X **XPL:** ______ **Scale Bar:** 4.5 mm

Diagram 2

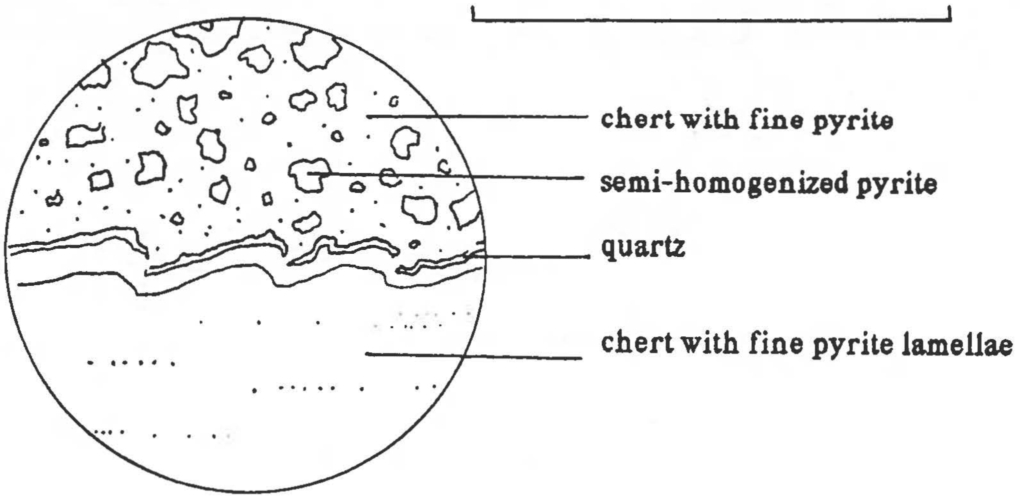


Diagram 3

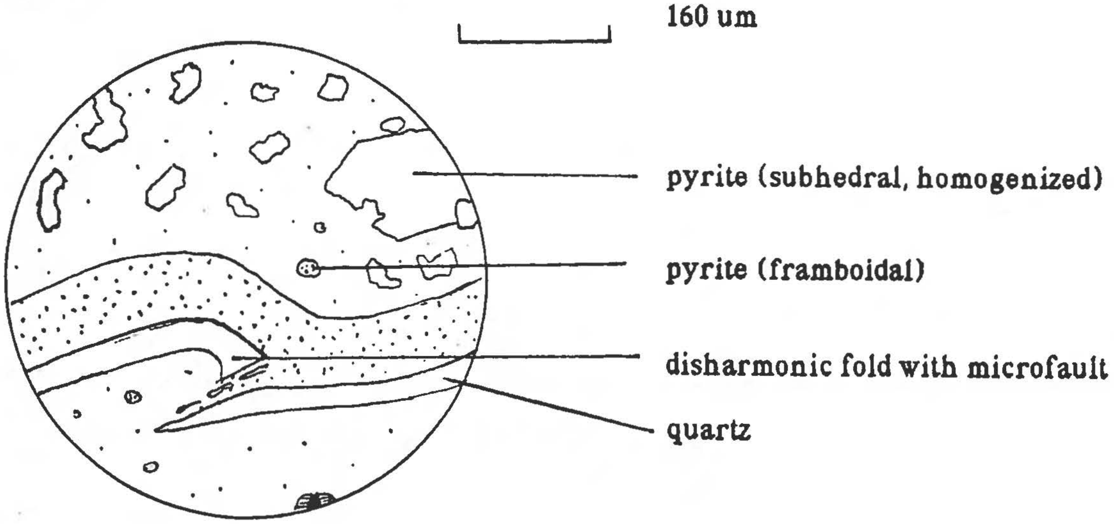
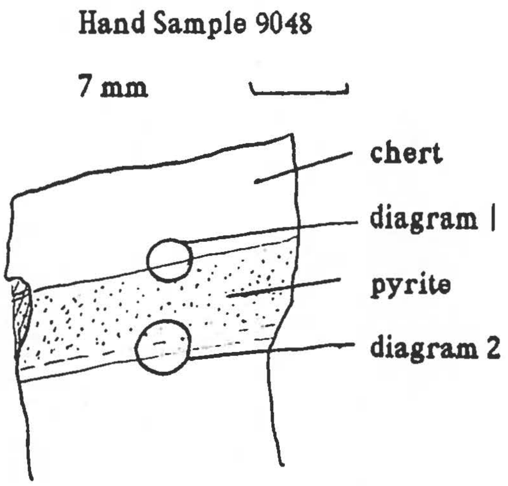


Diagram 4



Petrographer: D. Parry **Date:** January 24, 1989

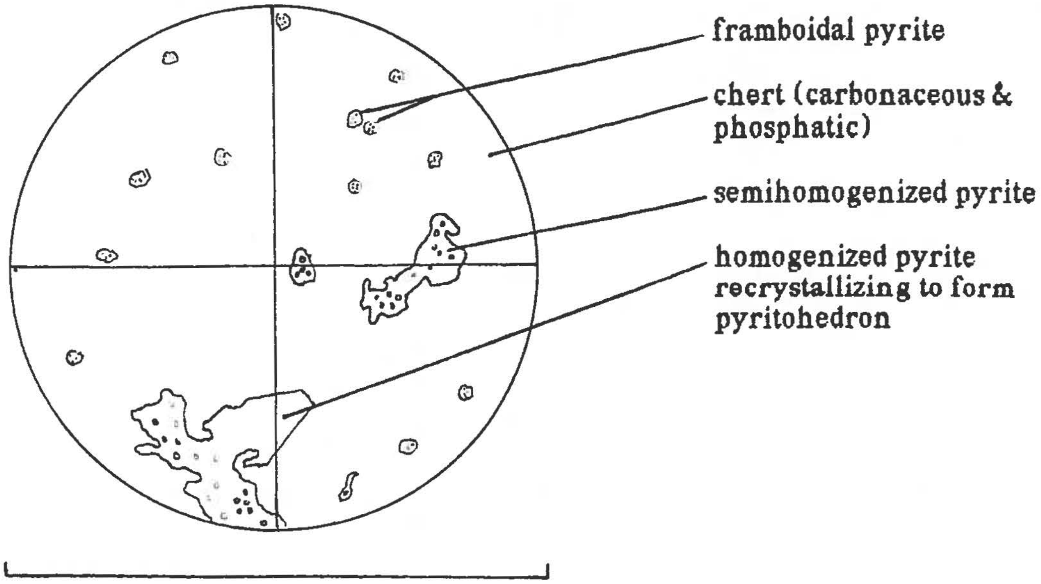
Thin Section: 9049 **Hole:** - **Depth:** -

Rock Name: carbonaceous-phosphatic chert

Transparent Minerals:	**%**	**Texture:**
quartz fracture filling	2%	fracture filling - pervaded into lost rock
quartz	~1%	minor detrital quartz (< 250 µm) subrounded
carbonaceous-phosphatic	93%	amorphous, indistinguishable from shale in thin section, very dark (> 80% absorption reflection or/in PPL/T) very hard sample
chert		
vesicles	> 1%	frc and interstitial cavities filled with epoxy in thin section
sericite	> 1%	forms a precipitate on fracture surfaces

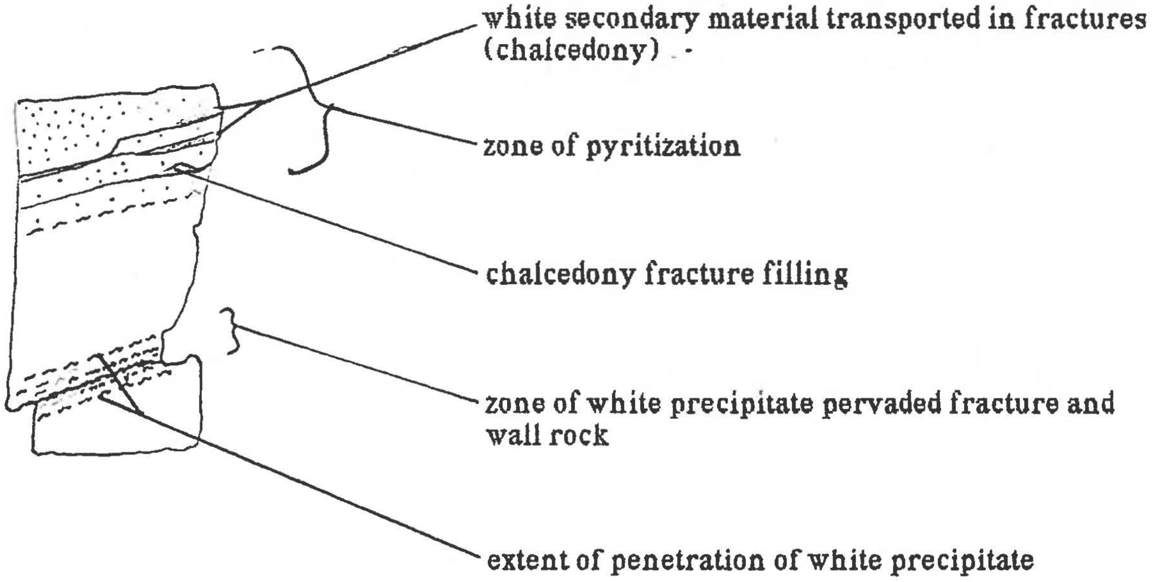
Opaque Minerals:	**%**	**Texture:**
pyrite (secondary)	3-4%	framboidal to cubic, beginning to homogenize, pervaded into porous altered chert along a micro fractures

Diagram: **PPL:** X Reflected Light **XPL:** **Scale Bar:** 356 µm



9049

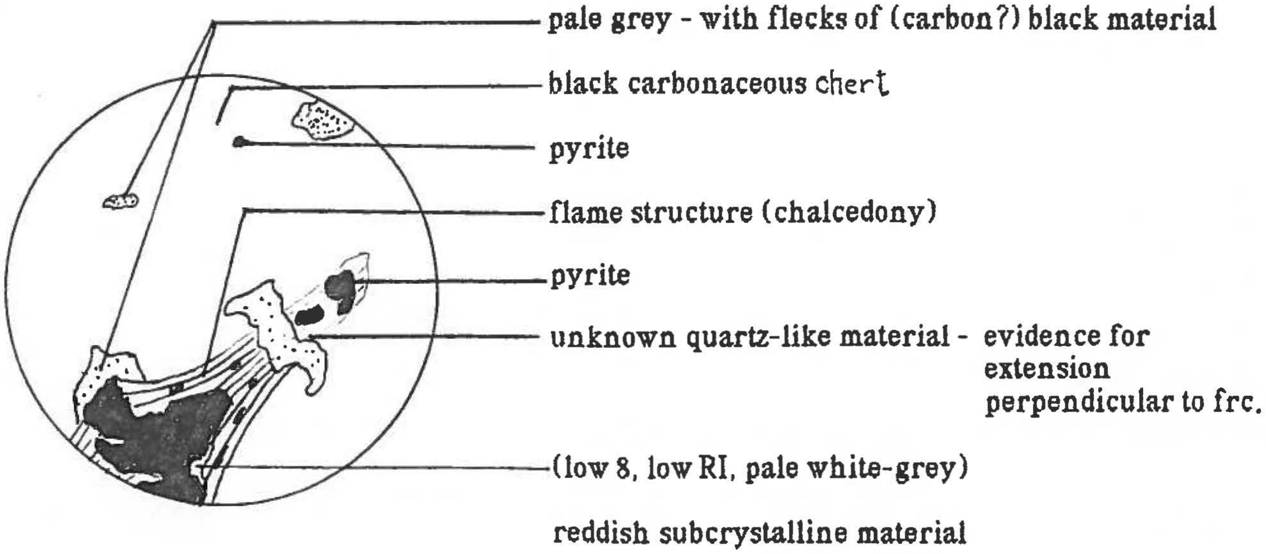
diag. 1



diag. 2

Sample 9049 Disseminated pyrite in carbonaceous chert
2 zones of chert parting - quartz precipitation.

ppl. transmitted 500X Field = 356 um



Alteration Minerals:	**%**	**Texture(s):**
pyrite	<0.5%	anhedral secondary
amorphous silica	5-8%	occasional replacement/etching of pyrite
single phase pyrite	3-4%	amorphous-framboidal, anhedral, subhedral, subcubic, subdodecahedral - occasionally pyritohedral (homogeneitization has occurred)

Stages of Alteration:

No deformation or strong alteration, only weak diagenesis and cool fluid circulation has occurred. Cubic pyrite has formed from framboidal pyrite. Diagenetic siliceous material probably quartz infills fractures as last stage diagenesis.

Paragenesis:

Deposition of phosphatic-carbonaceous chert, minor diagenetic formation of pyrite ~1/2%.

Fracturing occurs, chert is etched and replaced by secondary pyrite and quartz.

Pyrite is diagenetically altered from microcrystalline framboidal pyrite to semi-homogenized pyrite crystals.

Late weathering has oxidized pyrite to limonite on exposed surfaces.

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Petrographer: D. Parry **Date:** March 26, 1989

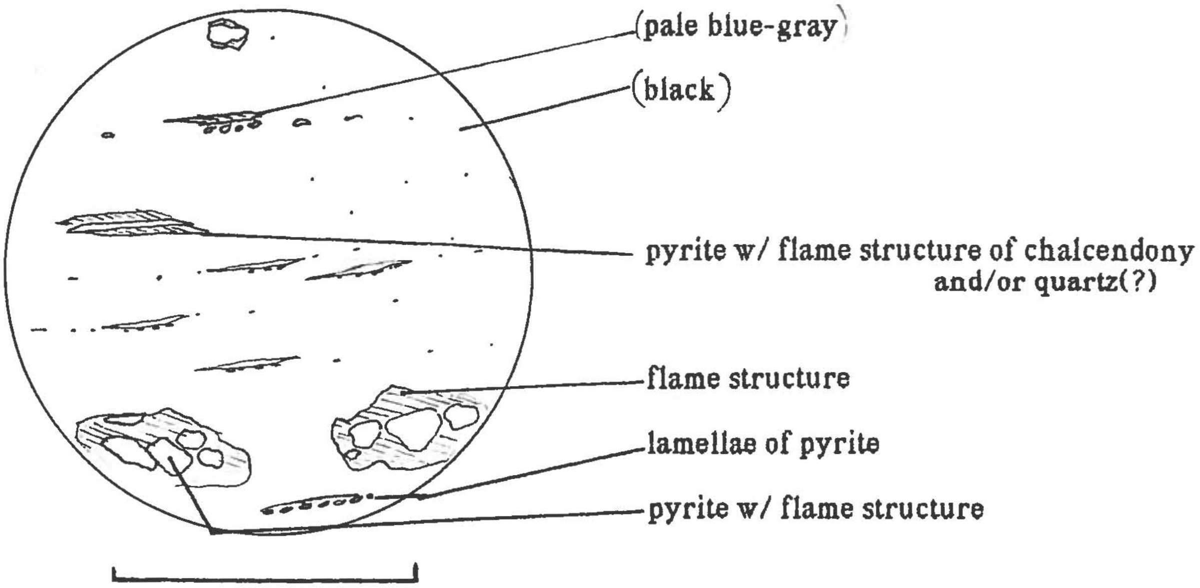
Thin Section: Nick Hole (R-1) **Hole:** 4 **Depth:** 43.65 m

Rock Name: Pyritic Black Chert

Transparent Minerals:	**%**	**Texture:**
carbonaceous, chert	75%	amorphous, unoriented in thin section
quartz	10%	chalcedonic flame structure
		elongate crystals radiating from opposite
		sides of pyrite crystals
		usually at 10-15% from normal

Opaque Minerals:	**%**	**Texture:**
pyrite	15%	subhedral - occasionally small broken
		lamellae of pyrite indicating primarily
		sedimentary structure

Diagram: **PPL:** ______ **XPL:** X **Scale:** 0.2 mm **Power:** 200 X



Alteration Minerals:	%	Texture(s):
chalcedonic quartz		forms flame structures around pyrite crystals

Stages of Alteration:

1) Diagenetic recrystallization of quartz forming chalcedonic flame structures.

2) Pyrite diagenetically grows from framboidal pyrite to sub-cubic homogenized pyrite.

Paragenesis:

Deposition of cherty shale with lamellae of pyrite.

Diagenetic growth of pyrite and chalcedonic flame structures.

Homogenization of framboidal pyrite to sub-cubic pyrite.

Petrographer: D. Parry **Date:** March 26, 1989

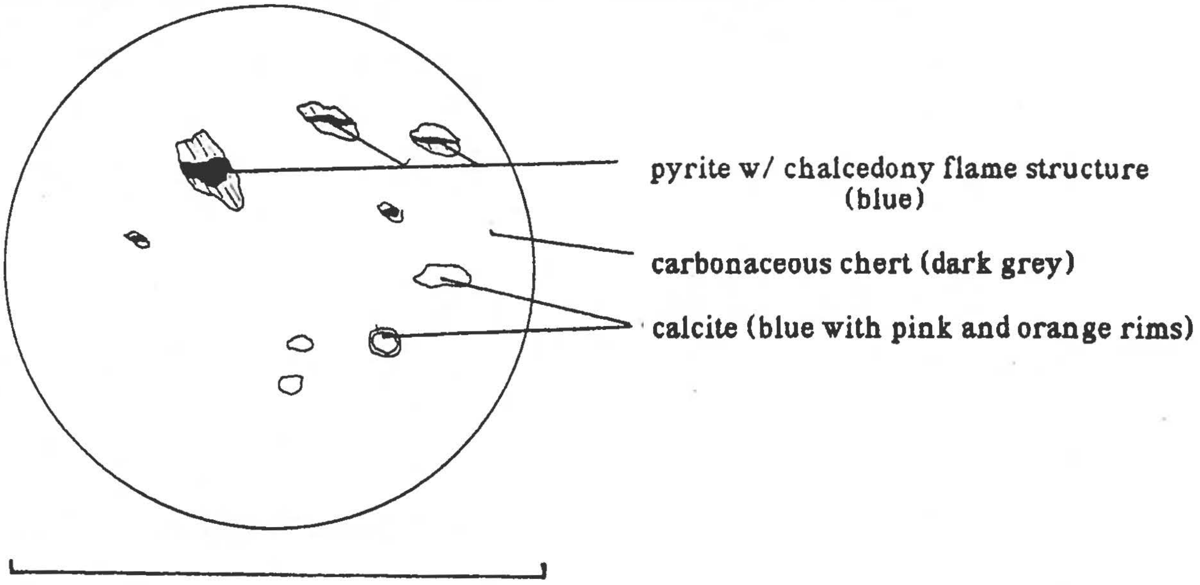
Thin Section: Nick Hole (R3) **Hole:** 4 **Depth:** 95.20 m

Rock Name: Carbonaceous, Pyritic Chert

Transparent Minerals:	**%**	**Texture:**
carbonaceous chert	93%	amorphous/finely laminated
chalcedonic quartz	3-4%	forms pressure shadows along margins
		of pyrite crystals
		flame structures perpendicular to bedding

Opaque Minerals:	**%**	**Texture:**
pyrite	3-4%	subhedral to anhedral up to 250 um
		diameter, fine laminations of pyrite
		separated by ~2-3 mm average

Diagram: **PPL:** ____ **XPL:** X **Scale Bar:** 1.77 mm



Petrographer: D. Parry **Date:** March 26, 1989

Thin Section: Nick Hole 4 (R6) **Hole:** 4 **Depth:** 86.56 m

Rock Name: Carbonaceous Chert W/ Strain Filled Chalcedonic Quartz

Transparent Minerals:	**%**	**Texture:**
chalcedonic quartz	1-2%	strained, interstitial between lamination
		of carb. shale occasionally surrounding
		pyrite as flame structures
carbonaceous chert	98-99%	finely laminar bedded
		strongly carbonaceous

Opaque Minerals:	**%**	**Texture:**
pyrite	<0.5%	framboidal - subhedral (< 75 um)
		finely laminar beds of pyrite

Paragenesis:

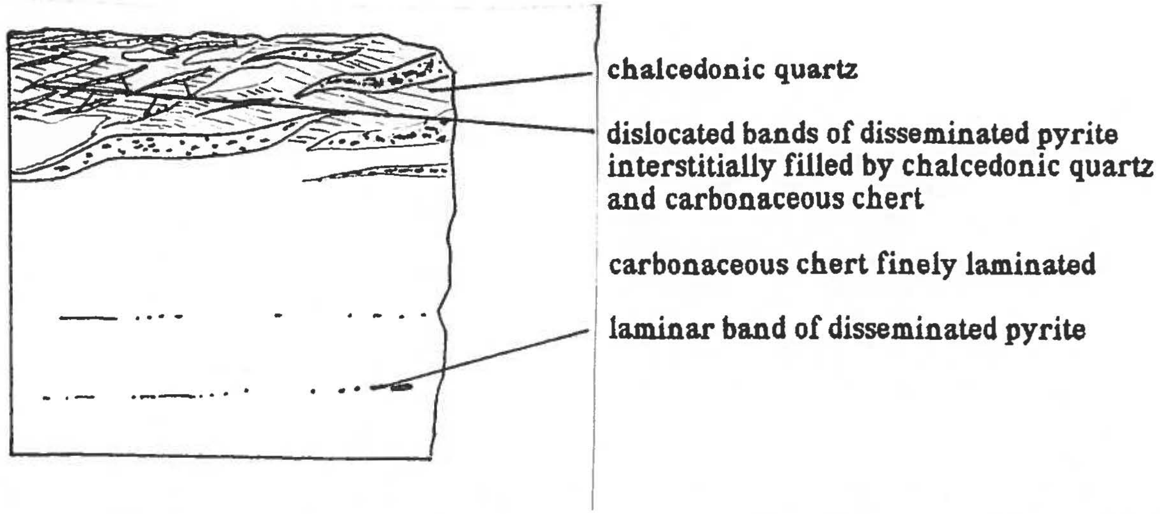
(1) Deposition of carbonaceous chert and pyrite.

(2) Dislocation by extension/shear & precipitation of formation fluids rich in silica (chalcedonic quartz).

Diagram:

Scale: 6 cm = 8 mm

diagram of silicate/pyrite band in sample (R6) using binocular microscope



Page: 17

Petrographer: D. Parry
Date: January 24, 1989

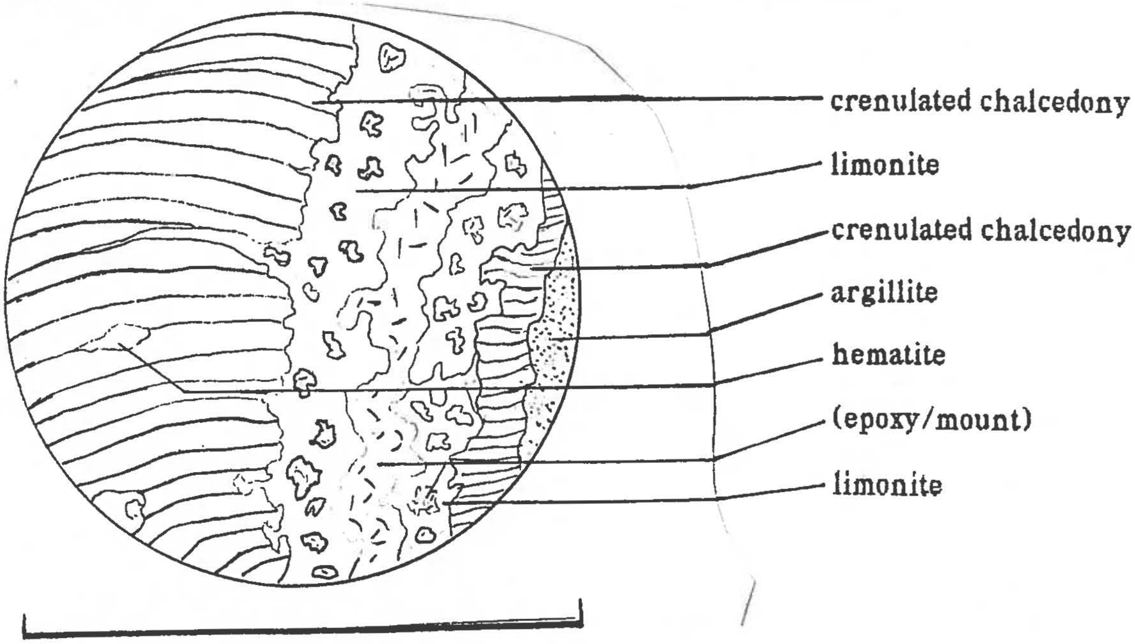
Thin Section: A
Hole: -
Depth: -

Rock Name: Siliceous Fibres in Phosphatic Chert Unit
Location: Outcrop A

Transparent Minerals:	**%**	**Texture:**
chalcedony	83%	moderately crenulated lensoid
		veinlet, (dextral sense of movement)
vesicles	6%	form between lenses of chalcedony

Opaque Minerals:	**%**	**Texture:**
limonite/hematite	11%	amorphous, interstitial
		between fibres of chalcedony
		(weathered colliform masses)

Diagram: **PPL:** X **XPL:** **Scale Bar:** 1.75 mm



Alteration Minerals:

limonite

Notes:

amorphous iron oxide deposited during formation of siliceous fibres

Stages of Alteration:

Clays of argillite undergo dewatering, due to compaction. Fluids move iron from pyrite and other metals in shale to sites of deposition such as: fractures and tension gashes in argillite in the vicinity of the cherty argillite/limestone ball member contact.

Paragenesis:

Argillaceous sediment deposited. Loading occurs, burial metamorphism and diagenesis alter clays to mainly illite. Fractures open and allow movement of fluids into cavities formed along chert-limestone ball member interface. Quartz and chalcedony are precipitated onto walls of the cavities. Fluids deposit silica and 'clog' cavity. Further shear movement reopens veinlets and fluids again migrate through the rock and precipitate pyrite (probably) which later oxidizes to limonite.

Page: 19

Petrographer: D. Parry **Date:**

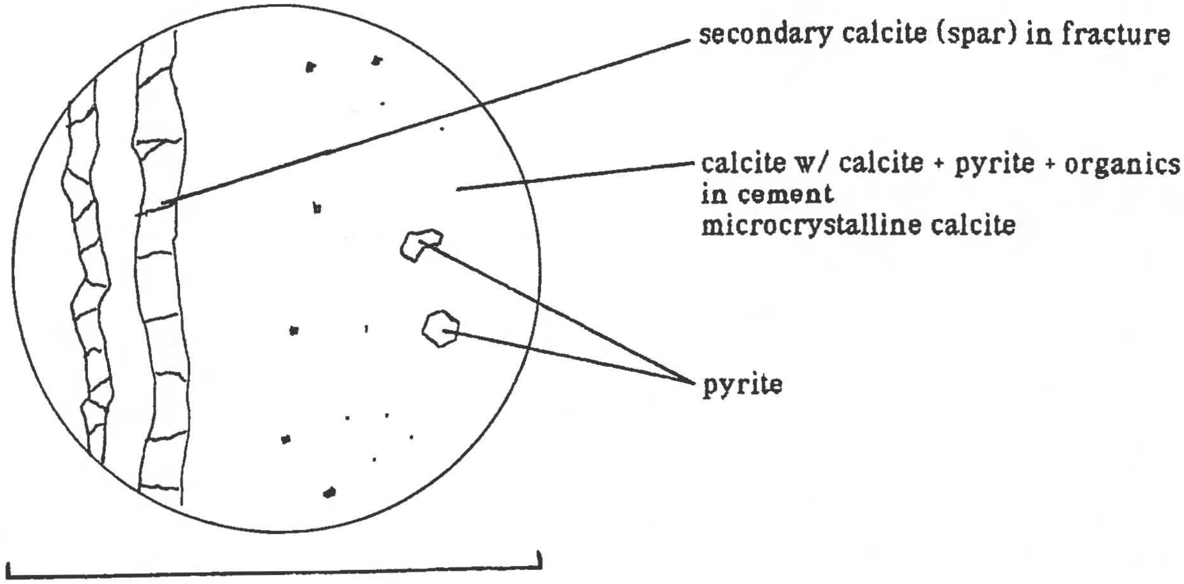
Thin Section: Nick Hole (R4) **Hole:** 4 **Depth:** 41.85 m

Rock Name: Disseminaetd Pyrite in Finely Laminated Limestone (Grey White Speckled Limestone)

Transparent Minerals:	**%**	**Texture:**
calcite	92%	recrystallized, calcite cement, trapped
		black organic flecks in cement, common
		50 µm average grain size
organic material	<2%	amorphous - trapped in cement

Opaque Minerals:	**%**	**Texture:**
pyrite	~6%	subhedral to framboidal, hard to
		distinguish - 120 µmmax. grain size
		- 2 µm max. grain size
		- ~ 6 µm average grain size

Diagram: **PPL:** X **XPL:** **Scale Bar:** 1.77 mm



Alteration Minerals:	%	Texture(s):
none		

Stages of Alteration:

Diagenetic crystallization of pyrite from framboids to cubes and dodecahedrons (rare) usually large ~ 120 μm.

Paragenesis:

Primary calcite deposition.

Diagenic crystallization of pyrite (no sphalerite on margins).

Secondary calcite in fractures perpendicular to bedding (probably axial planar cleavage w/ calcite ppt.).

Petrographer: D. Parry **Date:** March 26, 1989

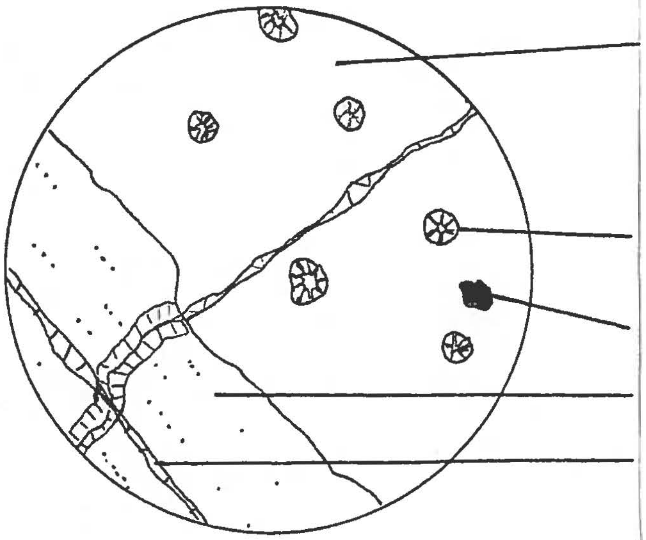
Thin Section: Nick Hole (R2) **Hole:** 4 **Depth:** 141.80 m

Rock Name: Crackle Brecciated Cherty Shale w/ Calcite (Fracture Filling Interstitial)

Transparent Minerals:	**%**	**Texture:**
chert	10%	interstitial between dislocated lamallae
		of carbonaeous shale
calcite	~35%	interstitial in chert/shale clasts
		fracture filling
carbonaceous shale (lithic fragments)	20%	angular fragments w/ calcite fracture fill
carbonaceous chert	25%	forms pellets ~0.3 to 1.5 mm diameter
		subangular clasts separated by dislocated
		lamellae of carbonaceous shale

Opaque Minerals:	**%**	**Texture:**
pyrite	< 1%	forms aggregates of micro cubic pyrite

Diagram: **PPL:** ____ **XPL:** X **Scale Bar:** 1.77 mm



(carbonaceous limestone)

two stages of chert/microcrystalline quartz deposition in fractures

silica/chert filled vescicles (ave. 1.77-2.50 µm) well rounded

pyrite blebs, amalgamated in chert

dense carbonaceous (pyritic) chert

calcite fracture infill

quartz fracture infilling

Alteration Minerals:	**%**	**Texture(s):**
calcite		forms in fractures, in stages of dissolution

Stages of Alteration:

none visible

Paragenesis:

(1) Limestone deposited.

(2) Carbonaceous chert deposited with diagenetic pyrite.

(3) Dissolution of limestone.

(4) Brecciation of limestone and chert (probably collapse due to dissolution).

(5) Deposition of silica in fractures.

(6) Deposition of calcite in fractures.

(7) Deposition of silica (2nd stage of silica).

(8) Crystallization of subhedral to euhedral microcrystalline pyrite.

Petrographer: D. Parry

Date: March 26, 1989

Thin Section: Nick Hole (R5)

Hole: 4

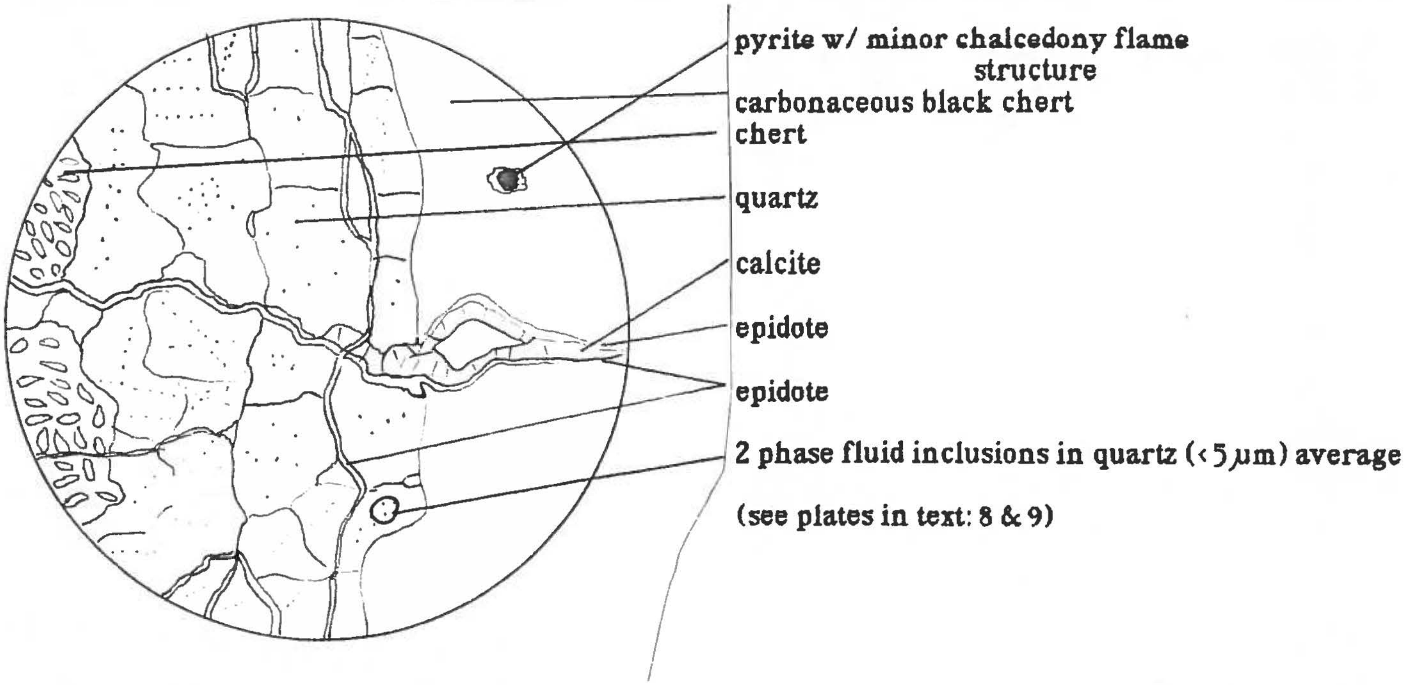
Depth: 80.74 m

Rock Name: Quartz-Calcite Supported Lithic Breccia

Transparent Minerals:	**%**	**Texture:**
quartz	23%	anhedral-subhedral, ave. grn. ~ 0.75 mm diameter
		subhedral (fractured)
chert	30%	(lithic frag. (15-20%) anhedral, ave. gr. size ~ 0.65 mm dia. (remobilized (10-15%
calcite	18%	subhedral; ave. gr. size ~ 0.50 mm dia.
carbonaceous shale fragments	25%	(max. size 8 mm x 8 mm) angular lithic fragments (ave. size 2.5 mm x 6 mm) (min. size ~ 0.25 mm dia)
epitdote	4%	anhedral, fracture filling

Opaque Minerals:	**%**	**Texture:**
pyrite	< 1%	subhedral (near cubic) in the
		cherty-shale fragments only

Diagram: **PPL:** ___ **XPL:** X **Scale Bar:** 4.5 mm/f.v.



(see plates in text: 8 & 9)

360 µm

calcite rhombs

chert w/ lithic frags

epidote fracture filling

Plate A

(PPL:)

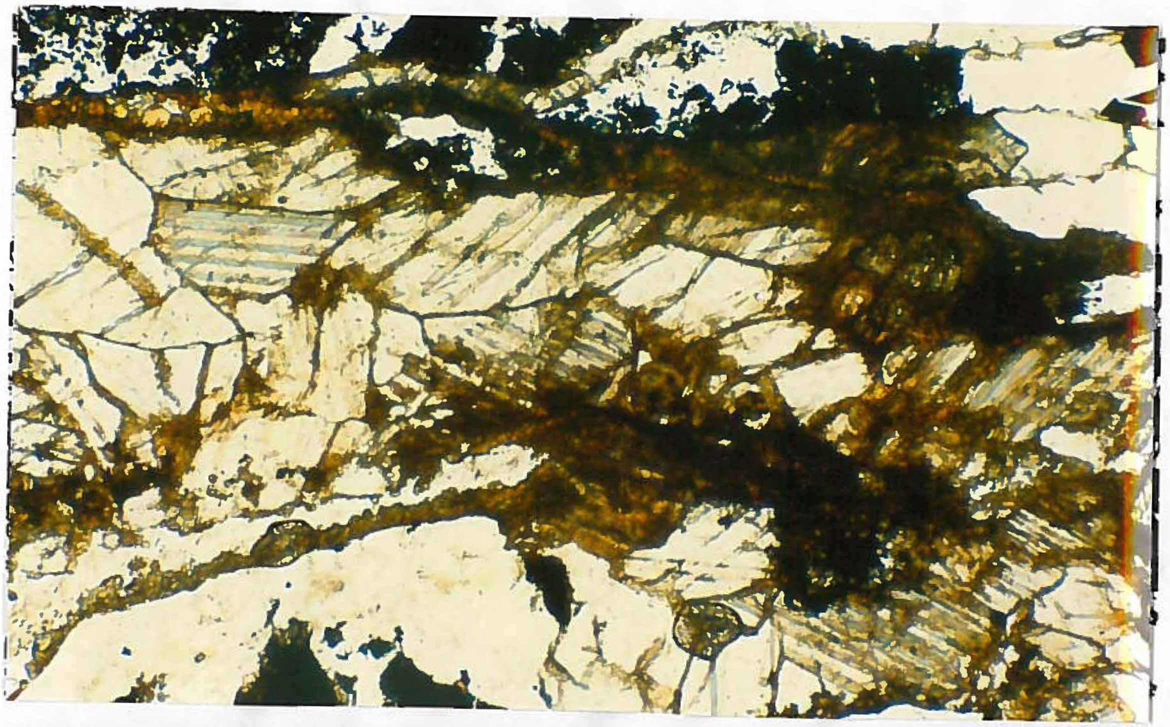
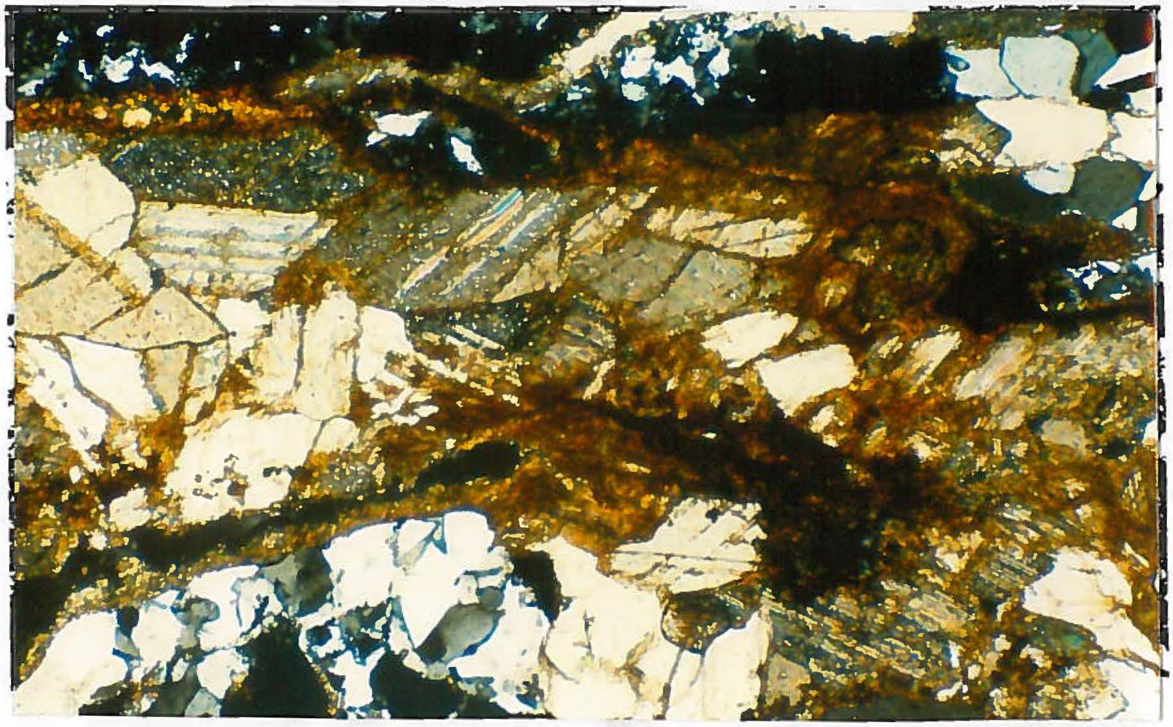


Plate B

(XPL:)



Alteration Minerals:

quartz, chert, epidote, calcite

Notes:

by determining the cross cutting relations the paragenesis of the deposition of alteration minerals was determined

Stages of Alteration:

Fracture/fault and introduction of hydrothermal fluid.

Deposition of quartz, 2nd movement of fluid pathway.

Deposition of chert + quartz, 3rd movement of fluid pathway.

Deposition of epidote and calcite.

(See Plates, A & B)

Paragenesis:

(1) Fracturing of host rock.

(2) Injection of quartz rich fluid.

(3) Precipitation of quartz along lithic fragments and host rock contacts.

(4) Fracturing of quartz supported breccia.

(5) Precipitation of chert and later fracture in fluid pathway.

(6) Precipitation of epidote.

(7) Precipitation of calcite.

(8) Precipitation on epidote.

Petrographer: D. Parry **Date:** January 1, 1989

Thin Section: Outcrop A-1 **Hole:** - **Depth:** -

Rock Name: Mineralized Vaesite **Location:** Outcrop A-1 (Olfert Creek)

Transparent Minerals:	**%**	**Texture:**
carbonaceous and/or phosphatic chert	~88%	amorphous bands which are present between layers of sulfides (also forms nodules)
quartz	2%	microcrystalline to subcrystalline forms in cherty nodules and is exsolved from pyrite bands
unidentified brown material probably bitumen	< 1%	amorphous masses commonly form parallel to bands of pyrite/melnikovite/ and vaesite
Opaque Minerals:	**%**	**Texture:**
pyrite and melnikovite	43%	forms subcolliform bands, subhedral aggregates of homogenized pyrite
vaesite	13%	interstitially in bands of homogenized pyrite framboids the vaesite is finely intergrown with the pyrite
sphalerite	4%	commonly forms as intergrown with pyrite and vaesite, predominantly on either top or bottom of each layer

See plates in text, numbers 10 through 16.

Alteration Minerals:	**%**	**Texture(s):**
quartz (microcrystalline)	‹ 1%	Is exsolved from the chert and pyrite layers. It forms siliceous fibres in some samples probably formed from effect of soft sediment deformation

Stages of Alteration:

Diagenetic growth of pyrite framboids and other sulfides become incorporated.

Soft sediment deformation causes fine lamellae to be disturbed with pyrite-vaesite layers conforming to harder chert nodules.

Paragenesis:

Diagenetic growth of pyrite framboids at sediment water interface.

Incorporation of nickel into pyrite amalgamations and bands in the form of vaesite.

Sphalerite is incorporated into the pyrite during homogenetization, typically on only one side of the bands.

Formation of cherty nodules, possibly by biogenesis.

Deposition of cherty sediment in fine rhythmic beds between the pyrite-vaesite layers.

APPENDIX B

SUMMARY OF MINERALIZED ZONE ASSAY DATA

APPENDIX B
MINERALIZED ZONE ASSAY DATA

Location	Ni %	Zn PPM	Pb PPM	Mo PPM	Ba PPM	As PPM	Pt PPB	Pd PPB	Au PPM	Ag PPM
Outcrop A	*5.8	8000	-	-	20000	-	-	-	-	-
	5.5	9586	-	1454	90	1254	540	210	58	10.1
	4.6	138	-	2650	3000	2990	310	150	50	7.8
Outcrop B	*2.9	2530	-	-	2800	-	-	-	-	-
	3.6	5710	-	1265	40	2560	280	120	86	9.2
Outcrop D	+4.4	772	-	1485	60	2260	5	<2	6	12.6
DDH 88-1 (1801)	2.9	6590	76	1570	<10	1985	<62	62	-	6.8
DDH 88-3 (1035)	5.0	10040	130	392(	170	3930	434	155	-	12.2
	$\bar{x}$	$\bar{x}$								
	4.34 %	~5420 ppm								

NOTES:

- \- Archer, Cathro (1988)
- * Cominco (1987)
- \+ Strongly Oxidized
- ( ) Assay Number

All data supplied by (Archer, Cathro & Associates Ltd.,(1981))

APPENDIX C

DRILL LOGS

APPENDIX D

ASSAY DATA FROM DRILL LOGS

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T ARCHER CATHRO & ASSOC. (1981) LTD.
OX 4127
WHITEHORSE, Y.T.
Y1A 3S9
Project : NDU NICK
Comments:

Page N :1-A
To
Date : .-SEP-88
Invoice # :I-8822412
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8822412

SAMPLE DESCRIPTION	PREP CODE		Al %	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Ga ppm	Hg ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm
1801	299	238	0.85	6.8	1985	< 10	< 0.5	< 2	0.27	15.0	131	189	167	>15.00	< 10	< 1	0.23	20	0.09	154	1570

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Invoice # :I-8822412
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8822412

SAMPLE DESCRIPTION	PREP CODE		Na %	Ni ppm	P ppm	Pb ppm	Sb ppm	Sc ppm	Sr ppm	Ti %	Tl ppm	U ppm	V ppm	W ppm	Zn ppm
1801	299	238	0.01	>10000	710	76	45	4	34	0.02	——	< 10	370	40	6590

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Date :16-SEP-88
Invoice # :I-8822411
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8822411

SAMPLE DESCRIPTION	PREP CODE		Ni %	Pt oz/T	Pd oz/T
1801	258	--	2.90	< 0.002	0.002

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Tot. P 1
Date :29-SEP-88
Invoice # :I-8824185
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8824185

SAMPLE DESCRIPTION	PREP CODE		Al %	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Ga ppm	Hg ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm
1576	205	238	0.43	1.8	30	340	< 0.5	< 2	1.02	16.0	8	254	45	1.85	< 10	< 1	0.14	10	0.08	114	59
1577	205	238	0.64	1.0	20	640	0.5	4	8.61	7.0	3	152	34	1.03	20	2	0.20	< 10	0.19	109	41
1578	205	238	0.28	1.2	25	360	< 0.5	< 2	0.16	13.0	3	183	70	1.23	< 10	1	0.09	< 10	0.03	75	41
1579	205	238	0.35	1.2	30	360	< 0.5	< 2	0.43	6.0	6	167	48	1.40	< 10	1	0.12	10	0.04	93	64
1580	205	238	0.36	0.6	35	310	< 0.5	< 2	1.73	6.0	7	110	54	1.72	< 10	< 1	0.12	20	0.07	171	85
1581	205	238	0.13	0.8	5	280	< 0.5	18	>15.00	0.5	1	23	17	0.20	20	< 1	0.03	< 10	0.49	118	6
1582	205	238	0.25	0.8	15	260	< 0.5	4	8.45	2.5	2	123	15	0.70	10	1	0.08	< 10	0.16	77	41

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CERTIFICATE OF ANALYSIS A8824185

SAMPLE DESCRIPTION	PREP CODE		Na %	Ni ppm	P ppm	Pb ppm	Sb ppm	Sc ppm	Sr ppm	Ti %	Tl ppm	U ppm	V ppm	W ppm	Zn ppm
1576	205	238	< 0.01	178	1440	16	5	1	119	< 0.01	< 10	< 10	207	< 5	1130
1577	205	238	0.01	96	>10000	12	5	4	674	< 0.01	< 10	10	304	10	530
1578	205	238	< 0.01	147	410	26	5	< 1	43	< 0.01	< 10	< 10	160	< 5	986
1579	205	238	< 0.01	209	510	16	< 5	< 1	55	< 0.01	< 10	< 10	176	< 5	484
1580	205	238	< 0.01	303	560	8	< 5	1	142	< 0.01	< 10	< 10	298	< 5	530
1581	205	238	0.01	19	220	6	< 5	< 1	563	< 0.01	10	< 10	77	< 5	71
1582	205	238	< 0.01	134	350	16	< 5	1	364	< 0.01	< 10	< 10	225	< 5	265

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Tot. Pa 1
Date :14-NOV-88
Invoice # :I-8826955
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8826955

SAMPLE DESCRIPTION	PREP CODE		Al %	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Ga ppm	Hg ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm
1033	299	238	0.24	< 0.2	130	330	< 0.5	< 2	1.15	30.0	35	51	103	4.28	< 10	< 1	0.10	20	0.05	86	159
1034	299	238	0.52	4.2	150	630	< 0.5	< 2	1.11	57.0	50	91	97	5.03	10	1	0.18	30	0.07	84	123
1035	299	238	0.40	12.2	3930	170	< 0.5	< 2	0.34	61.0	258	126	363	>15.00	10	< 1	0.12	10	0.05	300	3920
1036	299	238	0.47	3.0	105	610	< 0.5	< 2	0.17	4.0	26	76	56	3.06	10	< 1	0.19	20	0.04	58	354

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P.O. # :NONE

CERTIFICATE OF ANALYSIS A8826955

SAMPLE DESCRIPTION	PREP CODE		Na %	Ni ppm	P ppm	Pb ppm	Sb ppm	Sc ppm	Sr ppm	Ti %	Tl ppm	U ppm	V ppm	W ppm	Zn ppm
1033	299	238	< 0.01	1785	4780	54	10	< 1	206	< 0.01	30	30	69	< 5	1650
1034	299	238	< 0.01	3660	4780	52	20	2	197	< 0.01	< 10	< 10	193	< 5	3020
1035	299	238	0.01	>10000	1170	130	< 50	2	62	< 0.01	< 10	40	422	< 5	>10000
1036	299	238	< 0.01	871	550	32	10	< 1	32	< 0.01	10	< 10	203	< 5	537

Chemex Labs Ltd.

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ARCHER CATHRO & ASSOC. (1981) LTD.

1016 - 510 W. HASTINGS ST.
VANCOUVER, BC
V6B 1L8
Project : NDU(NICK)
Comments:

Page :1
Tot. . .s:1
Date :12-NOV-88
Invoice # :I-8826954
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8826954

SAMPLE DESCRIPTION	PREP CODE		Zn %	Ni %	Ag oz/T	Pt oz/T	Pd oz/T					
1033	208	--	0.15	0.17	0.05	0.006	< 0.001					
1034	208	--	0.27	0.34	0.07	0.004	0.001					
1035	208	--	1.04	5.00	0.21	0.014	0.005					

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RCHER CATHRO & ASSOC. (1981) LTD.

BOX 4127
WHITEHORSE, Y.T.
Y1A 3S9

Project : NDU NICK
Comments:

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Tot. P. 2
Date : 20-SEP-88
Invoice # : I-8823286
P.O. # : NONE

CERTIFICATE OF ANALYSIS A8823286

SAMPLE DESCRIPTION	PREP CODE		Al %	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Ga ppm	Hg ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm
1802	205	238	0.72	0.4	10	280	0.5	2	0.09	1.5	7	84	34	1.58	< 10	< 1	0.21	10	0.10	61	57
1803	205	238	0.96	0.6	15	190	0.5	< 2	0.57	2.0	51	102	64	1.68	< 10	< 1	0.28	10	0.12	58	54
1804	205	238	0.82	0.2	20	180	0.5	2	0.95	1.5	18	81	47	2.09	< 10	< 1	0.24	10	0.10	40	76
1805	205	238	0.82	0.4	15	110	0.5	4	0.09	1.0	8	85	33	1.54	< 10	< 1	0.23	10	0.10	38	54
1806	205	238	1.00	0.6	20	80	0.5	4	0.10	1.0	10	84	41	2.06	< 10	< 1	0.32	10	0.17	76	59
1807	205	238	0.65	0.6	15	130	0.5	2	0.14	1.0	6	98	40	1.50	< 10	< 1	0.20	10	0.10	57	55
1808	205	238	0.67	0.4	10	220	0.5	2	0.50	1.0	4	112	30	1.20	< 10	< 1	0.20	10	0.20	62	33
1809	205	238	0.75	0.6	15	100	0.5	< 2	0.17	1.0	6	102	33	1.62	< 10	< 1	0.23	10	0.09	59	58
1810	205	238	0.98	0.6	20	100	0.5	< 2	0.42	1.0	7	107	33	1.85	< 10	< 1	0.31	20	0.15	90	60
1811	205	238	0.87	0.6	10	140	0.5	4	0.41	1.5	5	89	33	1.51	< 10	< 1	0.26	10	0.17	107	40
1812	205	238	0.87	0.6	20	140	1.0	< 2	0.41	5.0	8	108	51	1.81	< 10	1	0.28	10	0.16	155	48
1813	205	238	1.08	0.6	20	130	1.0	< 2	0.38	2.5	7	91	37	1.79	< 10	< 1	0.33	10	0.22	85	50
1814	205	238	0.84	0.6	20	300	0.5	2	0.20	4.0	5	122	25	1.15	< 10	< 1	0.25	10	0.21	54	47
1815	205	238	1.22	1.2	40	120	1.0	< 2	0.20	33.0	8	141	75	1.65	< 10	< 1	0.34	20	0.13	66	56
1816	205	238	1.28	< 0.2	20	500	1.0	2	2.25	15.5	7	156	37	1.20	< 10	1	0.35	20	0.86	121	37
1817	205	238	1.17	0.2	30	230	1.0	4	1.39	9.5	9	126	48	1.60	< 10	< 1	0.30	20	0.30	88	63
1818	205	238	0.77	0.4	15	480	0.5	4	0.09	5.5	15	150	22	1.04	< 10	< 1	0.13	< 10	0.07	39	35
1819	205	238	0.64	0.2	10	500	0.5	2	0.11	1.5	16	154	17	0.81	< 10	< 1	0.11	< 10	0.05	34	37
1820	205	238	0.70	0.4	65	330	0.5	4	0.18	3.0	10	136	27	1.53	< 10	< 1	0.17	20	0.08	49	144
1821	205	238	1.13	< 0.2	35	340	1.0	2	2.61	2.0	9	138	55	2.06	< 10	1	0.33	30	0.16	205	88
1822	205	238	0.65	< 0.2	15	680	0.5	4	7.66	1.5	6	142	48	1.10	< 10	< 1	0.20	< 10	0.19	168	46
1823	205	238	0.35	< 0.2	5	380	< 0.5	< 2	2.99	1.5	2	188	37	0.54	< 10	< 1	0.10	< 10	0.07	59	26
1824	205	238	1.19	< 0.2	25	480	1.0	< 2	2.57	2.5	12	124	26	1.96	< 10	1	0.39	20	0.24	261	74
1825	205	238	0.30	< 0.2	5	320	< 0.5	10	>15.00	0.5	2	86	65	0.35	< 10	< 1	0.07	< 10	0.49	103	15
1826	205	238	0.86	< 0.2	10	610	0.5	4	11.55	1.5	6	101	23	0.92	< 10	2	0.29	< 10	0.28	121	48
1827	205	238	0.53	< 0.2	10	390	0.5	8	>15.00	0.5	3	80	54	0.44	< 10	< 1	0.15	< 10	0.49	78	23
1828	205	238	0.93	< 0.2	20	570	0.5	2	8.74	1.5	4	96	21	0.93	< 10	2	0.29	< 10	0.32	63	50
1829	205	238	1.21	< 0.2	25	350	1.0	2	10.60	3.0	6	111	32	1.40	< 10	2	0.40	< 10	0.31	92	70
1830	205	238	0.20	< 0.2	< 5	370	< 0.5	12	>15.00	< 0.5	2	17	52	0.17	< 10	< 1	0.05	< 10	0.52	87	8
1831	205	238	1.47	0.2	10	130	1.5	< 2	0.94	2.0	37	118	13	4.57	< 10	2	0.37	20	0.43	955	51
1832	205	238	1.31	0.4	25	40	1.0	2	0.11	2.5	10	75	37	2.57	< 10	< 1	0.35	10	0.24	76	57
1833	205	238	1.09	0.4	15	110	1.0	< 2	0.07	4.0	7	91	31	1.59	< 10	< 1	0.27	10	0.21	43	43
1834	205	238	1.00	0.2	20	100	1.0	< 2	0.03	5.0	9	95	35	1.76	< 10	< 1	0.26	10	0.10	42	61
1835	205	238	1.03	< 0.2	20	140	1.0	< 2	0.47	2.0	8	84	42	1.77	< 10	< 1	0.30	10	0.09	47	60
1836	205	238	0.72	< 0.2	20	270	0.5	4	0.97	1.0	8	56	48	1.74	< 10	< 1	0.12	10	0.93	140	56
1837	205	238	0.92	< 0.2	20	290	0.5	2	0.39	1.0	8	44	46	1.65	< 10	< 1	0.14	10	0.81	102	56
1838	205	238	0.62	< 0.2	20	120	0.5	< 2	0.10	1.0	6	64	33	1.64	< 10	< 1	0.17	10	0.08	39	55
1839	205	238	0.67	0.2	20	120	0.5	< 2	0.26	1.0	7	49	39	1.81	< 10	< 1	0.20	10	0.07	65	74
1840	205	238	0.61	0.2	20	110	0.5	< 2	0.22	1.0	5	78	28	1.52	< 10	< 1	0.19	10	0.09	67	55
1841	205	238	0.82	0.2	15	120	0.5	< 2	0.38	3.5	6	58	37	1.48	< 10	< 1	0.25	10	0.17	91	49

CERTIFICATION : ____________________

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ARCHER CATHRO & ASSOC. (1981) LTD.

BOX 4127
WHITEHORSE, Y.T.
Y1A 3S9
Project : NDU NICK
Comments:

Page :1-B
Tot. s: 2
Date :20-SEP-88
Invoice # :I-8823286
P.O. # :NONE

CERTIFICATE OF ANALYSIS A8823286

SAMPLE DESCRIPTION	PREP CODE		Na %	Ni ppm	P ppm	Pb ppm	Sb ppm	Sc ppm	Sr ppm	Ti %	Tl ppm	U ppm	V ppm	W ppm	Zn ppm
1802	205	238	0.01	110	230	14	< 5	1	29	0.01	< 10	< 10	110	< 5	208
1803	205	238	0.01	122	200	12	< 5	2	30	0.01	< 10	< 10	207	< 5	292
1804	205	238	0.01	142	230	14	< 5	1	45	0.01	< 10	< 10	134	< 5	206
1805	205	238	0.01	104	250	10	< 5	2	36	0.01	< 10	< 10	117	< 5	181
1806	205	238	0.01	124	150	10	< 5	3	19	0.01	< 10	< 10	141	< 5	215
1807	205	238	0.01	107	220	6	< 5	1	32	< 0.01	< 10	< 10	139	< 5	231
1808	205	238	0.01	74	360	2	< 5	1	84	< 0.01	< 10	< 10	153	< 5	154
1809	205	238	0.01	116	310	10	< 5	1	36	0.01	< 10	< 10	165	< 5	196
1810	205	238	0.01	118	390	14	5	2	84	0.01	< 10	< 10	250	< 5	223
1811	205	238	0.01	100	370	10	5	2	56	0.01	< 10	< 10	274	< 5	238
1812	205	238	0.01	122	170	14	5	2	38	0.01	< 10	< 10	446	< 5	738
1813	205	238	0.01	123	690	14	5	2	73	0.01	< 10	< 10	491	< 5	386
1814	205	238	0.01	134	200	4	5	1	26	0.01	< 10	< 10	383	< 5	366
1815	205	238	0.01	173	600	16	15	3	44	0.01	< 10	< 10	638	< 5	1850
1816	205	238	0.01	132	2130	10	5	3	231	0.01	< 10	< 10	576	< 5	982
1817	205	238	0.01	172	470	6	10	3	129	0.01	< 10	< 10	451	< 5	710
1818	205	238	0.01	190	600	2	5	1	188	< 0.01	< 10	< 10	254	< 5	774
1819	205	238	0.01	188	440	4	5	1	121	< 0.01	< 10	< 10	177	< 5	551
1820	205	238	0.01	902	610	6	5	1	55	< 0.01	< 10	< 10	208	< 5	489
1821	205	238	0.01	295	560	4	5	3	98	0.01	< 10	< 10	735	< 5	431
1822	205	238	0.01	155	640	10	5	3	260	< 0.01	< 10	< 10	576	< 5	244
1823	205	238	0.01	83	280	6	< 5	< 1	147	< 0.01	< 10	< 10	261	< 5	181
1824	205	238	0.01	249	440	12	5	3	108	0.01	< 10	< 10	1020	< 5	445
1825	205	238	0.01	47	220	2	< 5	1	592	< 0.01	< 10	< 10	279	< 5	100
1826	205	238	0.01	144	340	12	< 5	3	410	0.01	< 10	< 10	762	< 5	246
1827	205	238	0.01	75	180	8	< 5	2	358	< 0.01	< 10	< 10	528	< 5	120
1828	205	238	0.01	153	170	14	5	3	262	0.01	< 10	< 10	820	< 5	241
1829	205	238	0.01	231	350	8	5	3	347	0.01	< 10	< 10	969	5	409
1830	205	238	0.01	26	190	2	< 5	< 1	597	< 0.01	< 10	< 10	157	< 5	55
1831	205	238	0.01	331	500	2	< 5	3	68	0.01	< 10	< 10	910	10	754
1832	205	238	0.01	133	300	12	< 5	3	33	0.01	< 10	< 10	227	< 5	182
1833	205	238	0.01	111	330	6	< 5	3	49	0.01	< 10	< 10	254	< 5	216
1834	205	238	0.01	127	230	10	< 5	3	61	0.01	< 10	< 10	163	< 5	201
1835	205	238	0.01	120	2230	10	< 5	3	475	0.01	< 10	< 10	241	< 5	206
1836	205	238	0.01	118	290	14	< 5	3	129	< 0.01	< 10	< 10	120	5	221
1837	205	238	0.01	120	270	6	< 5	3	65	< 0.01	< 10	< 10	141	< 5	202
1838	205	238	0.01	108	490	14	< 5	1	56	< 0.01	< 10	< 10	154	< 5	184
1839	205	238	0.01	139	750	18	< 5	2	78	< 0.01	< 10	< 10	151	< 5	196
1840	205	238	0.01	98	240	8	< 5	1	37	< 0.01	< 10	< 10	177	< 5	194
1841	205	238	0.01	110	460	14	5	2	60	0.01	< 10	< 10	364	5	506

CERTIFICATION : ______________

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BOX 4127
WHITEHORSE, Y.T.
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Project : NDU NICK
Comments:

Page 1 2-A
Tot. 1 :2
Date :20-SEP-88
Invoice # :I-8823286
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CERTIFICATE OF ANALYSIS A8823286

SAMPLE DESCRIPTION	PREP CODE		Al %	Ag ppm	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Ga ppm	Hg ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm
1842	205	238	0.52	< 0.2	15	410	0.5	< 2	1.21	4.0	12	155	56	1.76	< 10	< 1	0.15	10	0.11	290	24
1843	205	238	0.75	< 0.2	15	90	0.5	< 2	1.17	2.5	5	94	31	1.77	< 10	< 1	0.24	10	0.15	88	47
1844	205	238	0.69	< 0.2	10	530	0.5	6	8.31	11.0	5	94	30	1.01	< 10	< 1	0.21	< 10	0.22	100	37
1845	205	238	0.50	< 0.2	20	250	0.5	< 2	0.56	9.5	6	85	39	1.35	< 10	< 1	0.13	20	0.05	50	50
1846	205	238	1.15	< 0.2	35	100	1.0	< 2	0.22	3.5	12	130	62	2.13	< 10	2	0.30	20	0.12	108	92
1847	205	238	0.14	< 0.2	10	360	< 0.5	10	>15.00	< 0.5	8	17	37	0.96	< 10	< 1	0.04	< 10	0.42	224	12
1848	205	238	0.70	< 0.2	15	410	0.5	< 2	2.75	2.0	14	91	35	2.10	< 10	< 1	0.21	10	0.15	270	64
1849	205	238	0.12	< 0.2	< 5	260	< 0.5	10	>15.00	< 0.5	3	17	39	0.29	< 10	< 1	0.02	< 10	0.38	177	4
1850	205	238	0.71	< 0.2	15	510	0.5	< 2	6.84	1.5	6	111	19	1.17	< 10	< 1	0.23	< 10	0.23	98	51
1851	205	238	0.16	< 0.2	< 5	340	< 0.5	10	>15.00	< 0.5	5	40	13	0.50	< 10	< 1	0.03	< 10	0.42	201	7
1852	205	238	0.34	0.2	15	320	< 0.5	2	2.14	2.0	7	100	59	1.24	< 10	< 1	0.10	20	0.07	136	54
1853	205	238	0.57	< 0.2	10	500	0.5	2	3.91	1.5	5	229	43	1.01	< 10	< 1	0.17	< 10	0.13	96	44
1854	205	238	0.50	< 0.2	10	480	0.5	6	10.05	1.5	5	108	13	0.77	< 10	< 1	0.17	< 10	0.16	94	32
1855	205	238	0.62	< 0.2	10	520	0.5	2	8.57	2.0	4	67	42	0.87	< 10	1	0.20	< 10	0.21	74	50
1856	205	238	0.70	< 0.2	20	530	1.0	2	4.33	2.0	24	71	38	2.86	< 10	< 1	0.19	< 10	0.23	440	56

CERTIFICATION : ____________________

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Page 1 2-B
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CERTIFICATE OF ANALYSIS A8823286

SAMPLE DESCRIPTION	PREP CODE		Na %	Ni ppm	P ppm	Pb ppm	Sb ppm	Sc ppm	Sr ppm	Ti %	Tl ppm	U ppm	V ppm	W ppm	Zn ppm
1842	205	238	0.01	98	70	6	5	1	130	< 0.01	< 10	< 10	303	< 5	718
1843	205	238	0.01	112	360	10	5	2	96	0.01	< 10	< 10	360	5	369
1844	205	238	0.01	105	2780	8	5	3	568	< 0.01	< 10	< 10	344	5	601
1845	205	238	0.01	128	1820	8	5	1	76	< 0.01	< 10	< 10	238	< 5	646
1846	205	238	0.01	406	690	10	5	3	87	0.01	< 10	< 10	683	< 5	568
1847	205	238	0.01	55	190	6	5	1	485	< 0.01	< 10	< 10	133	10	171
1848	205	238	0.01	224	450	6	< 5	1	132	< 0.01	< 10	< 10	577	5	470
1849	205	238	0.01	21	250	< 2	< 5	1	952	< 0.01	10	< 10	115	< 5	72
1850	205	238	0.01	165	430	10	< 5	2	297	< 0.01	< 10	< 10	617	< 5	265
1851	205	238	0.01	32	230	< 2	< 5	< 1	489	< 0.01	< 10	< 10	133	< 5	87
1852	205	238	0.01	162	240	4	< 5	1	103	< 0.01	< 10	< 10	306	< 5	327
1853	205	238	0.01	149	650	6	5	1	197	< 0.01	< 10	< 10	596	< 5	242
1854	205	238	0.01	109	210	2	< 5	2	364	< 0.01	< 10	< 10	447	< 5	219
1855	205	238	0.01	144	280	6	< 5	2	323	< 0.01	< 10	< 10	631	< 5	271
1856	205	238	0.01	281	440	4	< 5	2	182	< 0.01	< 10	< 10	520	< 5	649

CERTIFICATION : ____________________

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-1 **Page** 1 **of** 2

Elevation
Drill contractor CARON
Logged by F. ANDERSON
Total depth 77.42m (254')
Coordinates
Hole started
completed
Core size NQ
Dip -50°
Target
Azimuth 225°

▥ CHERTY ARGILLITE
▤ LIMEY SHALE
▧ NiS HORIZON
▦ BRECCIATED CHERT
▦ LIMESTONE BALL MARKER
▤ SHALE
— 18° BEDDING/LAMINATION
/ 60° FRACTURE/ AXIAL PLANE CLEAVAGE

Depth m	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy	Sample Number	Assay Interval	Assay Results					
									Ni ppm	Co ppm	Mo ppm	Zn ppm	Ag ppm	As ppm
	95%		(ANGLE TO CORE AXIS)				1802 A	1.52-4.52	110	7	57	208	0.4	10
5			78° 60° 25°	LAMINATED BLACK CHERT WITH BEDS 3 TO 18 CM THICK, SHALE LAYERS UP TO 5 mm THICK, OFTEN BOUNDED BY A WHITE, SOFT, FIBROUS SILICATE. SMALL SHEAR AT 5m, ZONE OF NUMEROUS HAIRLINE FRACTURES 5.79-7.90			1803 A	4.52-7.62	122	51	54	292	0.6	15
	100°						1804 A	7.62-10.67	142	18	76	206	0.2	20
10				8.16 - FRACTURED, LAMINATED CHERTY ARGILLITE, WITH BEDS 5 TO 40 CM. THICK SHALE LAYERS AND WHITE SILICATE UP TO 5 mm THICK PY LAMINATIONS WITH UP TO 1% DISSEM. PY			1805 A	10.67-13.72	104	8	54	181	0.4	15
							1806 A	13.72-16.76	124	10	59	215	0.6	20
15	96°		70°				1807 A	16.76-19.81	107	6	59	231	0.6	15
							1808 A	19.81-22.86	74	4	33	154	0.4	10
20	98°			17.15 LAMINATED, BLACK, CHERTY ARGILLITE WITH AN INCREASE IN SHALE LAYERS AND WHITE SILICATE LAYERS. SHALE LAYERS 1-2 mm THICK.			1809 A	22.86-25.91	116	6	58	196	0.6	15
				19.82 DISSEMINATED CARBONATE IN LAMINATED BLACK CHERTY ARGILLITE INCREASE IN PY BANDS CHERT BEDS 4 TO 35 cm THICK			1810 A	25.91-28.96	118	7	60	223	0.6	20
25			66°	22.36 BLACK, LAMINATED CHERTY ARGILLITE WITH 1 TO 5 mm SHALE AND SILICATE LAYERS. CHERT BEDS ARE 2 TO 30 cm THICK.			1811 A	28.96-32.0	100	5	40	238	0.6	10
							1812A	32.0-35.05	122	8	48	738	0.6	20
30				31.14-33.0 - SEVERAL 4mm PY BANDS, 60% PY, 40% MUD.			1813 A	35.05-38.1	123	7	50	386	0.6	20
		PY PY PY					1814 A	38.1-41.15	134	5	47	366	0.6	20
35				36.80 - BLACK, LAMINATED, CHERTY ARGILLITE WITH 8 TO 25 cm THICK BEDS. SHALE LAYERS UP TO 3mm THICK. SULPHIDE CONTENT INCREASE TO OVER 1% SECTION IS FRACTURED ~ PERPENDICULAR TO BEDDING			1815A	41.15-44.2	173	8	56	1850	1.2.	40
							A1033	41.16-41.35	1785	35	159	1650	< 0.2	130
40			53°	41.20 - 1-3mm CONVOLUTED PY BANDS ENCLOSING SHALE			A 1034	41.35-41.42	3660	50	123	3020	4.2	150
	96°	PY					1816 A	44.2-47.24	132	7	37	982	< 0.2	20
45			70°	42.9 - LAMINATED, BLACK, CHERTY ARGILLITE WITH 3 TO 5% WHITE SILICATE			1817 A	47.24-50.30	172	9	63	710	0.2	30
				46.82 - DARK GREY, LIMEY SHALE, GRADES TO MUDDY LIMESTONE, 1% SILICATE LAMINAE										
				47.56 - LAMINATED, BLACK CHERTY ARGILLITE. BLOCKY CORE, WITH FRACTURES ~ PARALLELING CORE AXIS.										

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-1 **Page** 2 **of** 2

Elevation
Drill contractor
Logged by
Total depth
Coordinates
Hole started
completed
Core size
Dip
Target
Azimuth

Depth	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy	Sample Number	Assay Interval	Ni ppm	Co ppm	Mo ppm	Zn ppm	Ag ppm	As ppm
							1818A	50.3-53.34	190	15	35	774	0.4	15
55	100%		65°	52.91 - BROKEN, BLACK LAMINATED CHERTY ARGILLITE, BEDS 1 TO 10 cm THICK. WHITE SILICATE COMPRISES 5% OF ROCK AS CRENULATED BANDS UP TO 3cm THICK. SHALE LAYERS DISAPPEAR.			1819A	53.34-56.39	188	16	37	551	0.2	10
							1820A	56.39-59.65	902	10	144	489	0.4	65
60	100%		65°	59.13 - 59.23 - NiS HORIZON. 10 cm of MASSIVE SULPHIDE, PY AND VAESITE ?, AS CONVALUTED BANDS, 1 TO 5 mm THICK, INTERSPERSED BY THIN GRAPHITIC SHALE LAMELAE			1801A	59.13-59.23	2.9%	131	1570	6590	6.8	1985
				59.23 - 60 - IRREGULAR SILICATE BANDS CONTAINING BRECCIATED BLACK CHERT FRAGMENTS			1821A	59.23-62.48	295	9	88	431	<0.2	35
65				60-61.08 - HARD BLACK SHALE, FRACTURED NEAR PARALLEL TO CORE AXIS			1822A	62.48-64.62	155	6	46	244	<0.2	15
				61.08 - 77.42 LIMESTONE BALL MEMBER WITH SILICEOUS SHALE OR CHERT/ARGILLITE BETWEEN BALLS			1823A	64.62-64.92	83	2	26	181	<0.2	5
70	100%			61.35-67.0 - SILICEOUS SHALE, LOCALLY FRACTURED PARALLEL TO CORE AXIS			1824A	64.92-66.29	249	12	74	445	<0.2	25
				67-69 - LIMESTONE			1825A	66.29-67.97	47	2	15	100	<0.2	5
75	98%			69.0-69.5 - CHERTY ARGILLITE 69.5-71.40 - LIMESTONE BALLS MIXED WITH CALCAREOUS ARGILLITE MATRIX			1826A	67.97-69.65	144	6	48	246	<0.2	10
				71.40-73.0 - CHERTY ARGILLITE			1827A	69.65-70.71	75	3	23	120	<0.2	10
80				73.0-73.85 - LIMESTONE 73.85-74.90 - CALCAREOUS SHALE			1828A	70.71-73.76	153	4	50	24	<0.2	20
				74.9-75.27 - LIMESTONE			1829A	73.76-75.29	231	6	70	409	<0.2	25
				75.27 75.42 - CHERT 75.42-76.22 - SHALE			1830A	75.29-75.74	26	2	8	55	<0.2	<5
				76.22-76.52 - LIMESTONE 76.52-76.72 - CHERT			1831A	75.74-77.42	331	37	51	754	0.2	10
				76.72-77.42 - ARGILLITE										

▥ CHERTY ARGILLITE
▤ LIMEY SHALE
▧ N.S HORIZON
▦ BRECCIATED CHERT
▦ LIMESTONE BALL MARKER
▤ SHALE
/75° BEDDING/ LAMINATIONS
↗75° FRACTURES/ AXIAL PLANE CLEAVAGE

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-2 **Page** 1 **of** 2

Elevation
Coordinates
Dip -90°
Azimuth 225°

Drill contractor CARON
Hole started **completed**
Target

Logged by F. ANDERSON

Total depth 85.54 (280)
Core size NQ

Depth m	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy	Sample Number	Assay Interval	Assay Results
5	56°		15° ?	3.08 - BLACK CHERT WITH 3% QUARTZ STRINGERS UP TO 2 mm WIDE.					
10	71%		19° ?	8.0 - BLOCKY CHERT AND SHALE BEDS 5 TO 30 cm THICK.					
15	72%			16.92 - BLACK CHERT WITH SHALE LAYERS UP TO 5 mm THICK.					
20		Py Py	11°	5 TO 15 cm THICK BEDS. SILICATE BANDS AND PYRITE LAMINAE					
25	95%	Py Py Py		23.10 - BLACK LAMINATED CHERT WITH, 1-5 mm THICK, SHALE BEDS. 2 TO 25 cm THICK BEDS. <1% DISSEMINATED PY.					
30	95%	Py Py Py	71° 17° ?	31.70 - BLACK LAMINATED CHERT WITH 2 TO 30 cm THICK BEDS					
35									
40	98%			40.31 - BLACK CHERTY ARGILLITE AND CALCAREOUS SHALE WITH 1 TO 18 cm BEDS SEPARATED BY SILICATE					
45			63°	AND SHALE LAYERS UP TO 1 cm THICK. SILICATE BANDING AND VEINING IS AS HIGH AS 20%					
			50°	47.70 - CALCAREOUS GREY SILICEOUS SHALE					

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-2 **Page** 2 **of** 2

Elevation	Drill contractor	Logged by	Total depth
Coordinates	Hole started	completed	Core size
Dip	Target		
Azimuth			

Depth m	% Recov	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy
	100%	55°	48.15 - BLACK-GREY, CHERTY ARGILLITE WITH 2 TO 20 cm THICK BEDS. 3 TO 10% PERVASIVE SILICATE STRINGERS.		
55	98%		56.62 - 57.05 - LIMESTONE BALL WITH SILICATE STRINGERS CONTINUED FROM CHERTY ARGILLITE THRU INTERVAL		
60		78°	57.06 - 57.08 - 3 cm OF SILICATE WITH CHERT BRECCIA FRAGMENTS. 57.08 - SILICEOUS SHALE WITH 5 mm TO 15 cm BEDS, <1% SILICATE STRINGERS		
65	100%	40° 20° ?	65.29 - INTERVAL COMPOSED OF ZONES OF SILICATE WITH BLACK CHERTY BRECCIATED FRAGMENTS OR BLACK CHERTY SHALE WITH PERVASIVE SILICATE VEINLETS PARALLEL TO AND OBLIQUE TO BEDDING		
70		65° 90°	69.91 - 70.58 - 60 cm OF LIMESTONE BALL WITH A 7mm ACICULAR WHITE SILICATE BAND. 70.58 - 76.92 - BRECCIATED CHERT		
75			76.92 - 78.46 - SILICEOUS SHALE WITH 1% SILICATE 78.46 - 78.56 - 10 cm OF A LIMESTONE BALL		
80			78.56 - 79.54 - CALCAREOUS SHALE 79.54 - 80.0 - LIMESTONE BALL 80.0 - 80.62 - CALCAREOUS SHALE 80.62 - 81.55 - LIMESTONE BALL 81.55 - 81.85 - CALCAREOUS SHALE		
85		63°	81.85 - 82.16 - LIMESTONE BALL 82.16 - 82.50 - CALCAREOUS SHALE 82.50 - 82.90 - LIMESTONE BALL 82.90 - 85.35 - SILICEOUS SHALE, BRECCIATED AT TOP AND BOTTOM, CARBONATE MATRIX		

Sample Number	Assay Interval	Assay Results Ni ppm	Co ppm	Mo ppm	Zn ppm	Ag ppm	As ppm
1576 A	66.15 - 69.23	178	8	59	1130	1.8	30
1577 A	69.23 - 72.31	96	3	41	530	1.0	20
1578 A	72.31 - 75.4	147	3	41	986	1.2	25
1579 A	75.4 - 77.38	209	6	64	484	1.2	30
1580 A	77.38 - 79.4	303	7	85	530	0.6	35
1581 A	79.4 - 81.5	19	1	6	71	0.8	5
1582 A	81.5 - 85.35	134	2	41	265	0.8	15

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-3 **Page** 1 **of** 2

Elevation
Coordinates
Dip -46.0°
Azimuth 045°

Drill contractor CARON
Hole started **completed**
Target

Logged by F. ANDERSON

Total depth 55.17m (181')
Core size NQ

- ▥ CHERTY ARGILLITE
- ▤ LIMEY SHALE
- ▨ NiS HORIZON
- △ BRECCIATED CHERT
- ▦ LIMESTONE BALL MARKER
- ▭ SHALE
- —70° BEDDING/LAMINATIONS
- ↗60° FRACTURES/AXIAL PLANE CLEAVAGE

Depth	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy
	78%			2.0 - BLACK LAMINATED CHERT (.5-3 cm)		
5			81°	WITH <1% HAIRWIDTH TO 2mm WHITE SILICATE AND PYRITE BANDS PARALLELING LAMINAE		
10	98%		83°	13.0 - BLACK, LAMINATED CHERT WITH		
15	85°	Py Py	87°	1-10 cm THICK BEDS, UP TO 2mm THICK SHALE BEDS 15.50 - HARD, LAMINATED CHERTY ROCK WITH THIN SHALE LAYERS FORMING CHERT BEDS 7cm THICK.		
20		Py	82°	19.50 - BLACK, LAMINATED (1 TO 3 cm) CHERTY ARGILLITE WITH 20% SHALE LAYERS		
25		Py Py	78° ↗20°			
30		Py Py △ △ △	81° ↗35°	32.0 - 33.0 - BRECCIATED CHERT		
35	100%	▦ ▦	↗33° 81°	WITH SILICATE MATRIX, MATRIX SUPPORTED 33.0 - BLACK, LAMINATED CHERTY ARGILLITE WITH 2% WHITE SILICATE BANDS UP TO 2cm THICK		
40	100% 96%		66° 78°	36.90 - 37.45 - LIMESTONE BALL? 37.45 - LAMINATED, BLACK CHERT WITH <1% SILICATE. BEDS ARE 1 TO 5 cm THICK 39.38 - BLACK CHERT WITH 5% WHITE SILICATE BANDS		
45	83% 100% 65%	△ △ △ ▦ ▦ ▦ ▦	83°	43.20 - 43.22 - 2.5 cm OF CONVOLUTED SULPHIDE BANDS 1 TO 4 mm THICK. (70% PYRITE, 25% SILICIFIED SHALE, 5% WHITE SILICATE) 43.22 - 43.27 - SHALE 43.27 - 44.68 - FRACTURED BLOCKY CHERT		
	100%	▦ ▦ ▦		44.68 - 51.0 - LIMESTONE BALL MEMBER.		

Sample Number	Assay Interval	Assay Results					
		Ni ppm	Co ppm	Mo ppm	Zn ppm	Ag ppm	As ppm
1832 A	2.15 - 5.23	133	10	57	182	0.4	25
1833 A	5.23 - 8.31	111	7	43	216	0.4	15
1834 A	8.31 - 11.38	127	9	61	201	0.2	20
1835 A	11.38 - 14.46	120	8	60	206	<0.2	20
1836 A	14.46 - 17.54	118	8	56	221	<0.2	20
1837 A	17.54 - 20.62	120	8	56	202	<0.2	20
1838 A	20.62 - 23.69	108	6	55	184	<0.2	20
1839 A	23.69 - 26.77	139	7	74	196	0.2	20
1840 A	26.77 - 29.57	98	5	55	194	0.2	20
1841 A	29.57 - 32.31	110	6	49	506	0.2	15
1842 A	32.31 - 32.61	98	12	24	718	<0.2	15
1843 A	32.61 - 35.66	112	5	47	369	<0.2	15
1844 A	35.66 - 38.71	105	5	37	601	<0.2	10
1845 A	38.71 - 41.76	128	6	50	646	<0.2	20
1846 A	41.76 - 43.50	406	12	92	568	<0.2	35
A 1035	43.50 - 43.53	5.0%	258	3920	10,040	12.2	3930
A1036	43.53 - 43.60	871	26	354	537	3.0	105
1847 A	44.50 - 45.11	55	8	12	171	<0.2	10
1848A	45.11 - 45.57	224	14	64	470	<0.2	15
1849A	45.57 - 45.87	21	3	4	72	<0.2	<5

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-3 **Page** 2 **of** 2

Elevation
Coordinates
Dip
Azimuth

Drill contractor
Hole started **completed**
Target

Logged by

Total depth
Core size

Depth	% Recov	Visual Log	Struct.	Lithology	Alteration	Sulphide & Alteration Mineralogy	Sample Number	Assay Interval	Ni ppm	Cu ppm	Mo ppm	Zn ppm	Ag ppm	As ppm
				51.0 - 55.17 - CALCAREOUS SHALE AND CHERTY ARGILLITE BEDS 1 TO 20 cm THICK.			1650 A	45.87 - 46.63	165	6	51	265	<0.2	15
55	78%						1851 A	46.63 - 46.94	32	5	7	87	<0.2	<5
							1852 A	46.94 - 47.55	162	7.	54	327	0.2	15
							1853 A	47.55 - 48.46	149	5	44	242	<0.2	10
							1854 A	48.46 - 49.07	109	5	32	219	<0.2	10
							1855 A	49.07 - 52.12	144	4	50	261	<0.2	10
							1856 A	52.18 - 55.17	281	24	56	649	<0.2	20

- ▥ CHERTY ARGILLITE
- ▤ LIMEY SHALE
- ▨ N.S HORIZON
- ▦ BRECCIATED CHERT
- ▦ LIMESTONE BALL MARKER
- ☰ SHALE
- ▥ SILICEOUS SHALE

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-4 **Page** 1 **of** 3

Elevation
Coordinates
Dip -45°
Azimuth 025°

Drill contractor CARON
Hole started
Target

Logged by F. ANDERSON
completed

Total depth 144.5 m (474')
Core size NQ

Depth m	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy										Sample Number	Assay Interval	Assay Results					
	95%		80°	CHERTY ARGILLITE AND SILICEOUS SHALE, LAMINATIONS 5 mm TO 10 cm																			
5	99%		85°	6.7 - BLACK, LAMINATED CHERTY ARGILLITE, 5 TO 25 cm THICK BEDS																			
10	100%			11.37 - CHERTY ARGILLITE BEDS, 1 TO 8 cm THICK, SEPARATED BY UP TO 5 mm THICK SHALE LAYERS. UP TO 2 mm PY LAMINAE.																			
15	99%		68°	12.89 - 13.23 - WHITE AND GREY SPECKLED LIMEY CORE. 13.23 - CHERTY ARGILLITE BEDS 0.5 TO 1 cm THICK, THIN SHALE OR SHALE/SILICATE LAYERS.																			
20	100%		90°	20.57 - MASSIVE, LAMINATED (2 TO 8 mm) CHERT, 1% PY LAMINAE.																			
25	100%			24.38 - GREY, BANDED SILICEOUS SHALE, BEDS 2 TO 45 cm. AMOUNT OF SULPHIDES LESS.																			
30	100%			27.95 - BLACK, LAMINATED (1 TO 3 cm) CHERTY ARGILLITE WITH 1 cm SILICATE BANDS AND MUDSTONE BANDS.																			
35																							
40	100%		90°	41.54 - 42.28 - GREY/WHITE SPECKLED LIMESTONE 42.28 - 43.46 - BLACK CHERTY ARGILLITE BEDS - 1 TO 15 cm THICK																			
45	100%			43.46 - 43.89 - SILICEOUS SHALE, PALER THAN ARGILLITE 43.89 - CHERTY ARGILLITE, BEDS ARE 2 TO 10 cm THICK, <1% SILICATE BANDS 47.55 - SILICEOUS SHALE, LIGHTER GREY THAN ARGILLITE AND NON-LAMINATED																			

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-4 **Page** 2 **of** 3

Elevation
Drill contractor
Logged by
Total depth
Coordinates
Hole started
completed
Core size
Dip
Target
Azimuth

Depth	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy	Sample Number	Assay Interval	Assay Results
		Py Py	83°	50.29 - BLACK, CHERTY ARGILLITE BEDS, WEAKLY LAMINATED, 0.5 TO 5cm THICK 1% PY BANDS					
55	100%			53.34 - LAMINATED ARGILLITE BEDS, 1 TO 8cm THICK, UP TO 5mm SHALE LAYERS, 1% PY BANDS					
60	100%	Py	90°	61.57 - WEAKLY LAMINATED, BLACK, CHERTY ARGILLITE WITH 5 TO 20 cm THICK BEDS. PY BANDS HAVING 10cm SPACING					
65				62.79 - LAMINATED BLACK TO GRAY BLACK ARGILLITE/SILICEOUS SHALE. WITH 5 TO 10cm THICK BEDS. PY BANDS, HAVING 15 cm SPACING AND SILICATE BANDS					
70	100%	Py		69.5 - LAMINATED BLACK TO GRAY BLACK ARGILLITE/SILICEOUS SHALE WITH 1 TO 13cm THICK BEDS. NO SILICATE BANDS.					
75		Py		78.03 - WEAKLY LAMINATED, BLACK CHERT BEDS, 5 TO 30 cm THICK BEDS. MINOR SILICATE BANDS, UP TO 5mm THICK.					
80	100%	A A	83°	80.68 - 81.08 - CARBONATE MATRIX SUPPORTING BRECCIATED CHERT CLASTS. 81.08 - WEAKLY LAMINATED CHERTY ARGILLITE WITH 2 TO 20 cm THICK BEDS. <1% SILICATE LAYERS					
85		Py Py		86.56 - SAME AS 81.08 BUT WITH >1% WHITE SILICATE					
90		Py	90°						
95	100%	Py Py Py		94.79 - 95.40 - LIMEY SHALE, SILICA RICH 95.40 - HARD, GREYISH, CHERTY ARGILLITE WITH 2 TO 12 cm THICK BEDS. <1% SILICATE AND PY LAMELLAE.					

ARCHER, CATHRO & ASSOCIATES (1981) LIMITED **PROJECT** NDU **PROPERTY** NICK **HOLE NO.** 88-4 **Page** 3 **of** 3

Elevation	Drill contractor	Logged by	Total depth
Coordinates	Hole started	completed	Core size
Dip	Target		
Azimuth			

Depth	% Recov	Visual Log	Struct	Lithology	Alteration	Sulphide & Alteration Mineralogy	Sample Number	Assay Interval	Assay Results
105									
110									
115	100%		70° 63°	114.61 - 115.61 - FRACTURED, BLACK ARGILLITE WITH 1 TO 7 cm THICK BEDS 115.61 - UNFRACTURED BLACK/GREY ARGILLITE WITH <1% SILICATE LAYERS 118.87 - BLACKISH GREY, WEAKLY LAMINATED CHERT/ARGILLITE WITH 15 TO 40 cm THICK BEDS					
120	100%		70°	121.0 - LAMINATED CHERT WITH 2 TO 10 cm THICK BEDS. 122.32 - CHERTY ARGILLITE WITH MINOR (<5 cm) SECTIONS OF SILICEOUS LIMEY SHALE. 2-3% WHITE SILICATE BANDS.					
125			76°	126.89 - BLACK ARGILLITE/SILICEOUS SHALE WITH 2 TO 15 cm THICK BEDS. <<1% SILICATE OR PY.					
130	95%			132.59 - SILICEOUS GREY SHALE WITH 1 TO 5 cm THICK BEDS. SOME DISSEMINATED CARBONATE					
135	100%			134.11 - SLIGHTLY LIMEY, LAMINATED, SILICEOUS SHALE. 136.09 - LAMINATED LIMESTONE, CHANGING GRADUALLY TO SHALE					
140	100%			139.3 - CHERT AND UP TO 1 cm SHALE LAYERS 140.51 - 140.82 - LIMESTONE BALL 140.82 - 141.43 - CHERT/SHALE MATRIX 141.43 - 143.41 - LIMESTONE BALLS ALTERNATING WITH A SHALE/CHERT MATRIX					
145				143.41 - 144.5 - LIMEY, SILICEOUS SHALE WITH 2 TO 7 cm THICK BEDS					