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The Examination of the Mount Alcock Area Through Eight Polished Sections

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Summary

The Mount Alcock Deposit is a sediment hosted submarine exhalative barite lead zinc silver deposit set within the Devonian basinal facies rocks of the Kechika Trough of northeast British Columbia (MacIntyre 1982). A series of eight polished sections made from seven core samples and one surface handsample taken across a mineralized zone underwent a textural and mineralographic analysis by the author during the fall of 1989. From these samples, possibla sites for anomalous Ag values were identified and overall mineralogical construction were examined.

Introduction

Potentially economic stratiform barite-sulphide deposits have recently been discovered in Devonian basinal rocks in northeastern British Columbia. This new mineral district is over 180 kilometres long and includes nine major occurrences, including Mount Alcock and Cirque. The Cirque is the largest known deposit, with reserves of at least 30 million tonnes averaging 10 percent combined lead-zinc and 47 grams of silver per tonne (MacIntyre 1982).

Preliminary stratigraphic and sedimentological investigations suggest that the stratiform massive pyrite and bedded barite deposits formed in third order basins within a northwest trending structurally controlled trough (MacIntyre 1982). The exhalative venting, whicb appears to have been accompanied by synsedimentary faulting, took place during the early stages of a major eastward directed marine transgression (MacIntyre 1982). Dewatering of metal enriched shales and subsequent brine discharge along fault zones within the trough is the mechanism envisaged for formation of the deposit (MacIntyre 1982).

Regional Geology

The Driftpile Creek - Akie River Ba-Zn-Pb district is located within the western half of the Rocky Mountain Fold and the Thrust Belt of northeast British Columbia. This part of the tectonic belt is underlain by folded and thrust-faulted continental-margin sedimentary strata of early to mid Paleozoic age (MacIntyre 1982). Stratiform barite-sulphide deposits of the district occur within Devonian basinal facies clastic rocks exposed in ranges east of the Rocky Mountain Trench (fig. 2).

The geologic setting and nature of the stratiform barite-sulphide deposits of the Driftpile Creek - Akie River district is strikingly similar to that of the Meggen district in West Germany (Krebs 1981). At Meggen, a massive pyrite core is surrounded by a laterally equivalent barren barite facies. The pyrite facies apparently formed within a reducing third-order basin near an exhalative vent while the barite was deposited in more oxygenated waters peripheral to the seafloor depression (Krebs 1981).

A similar lateral zonation is apparent in the deposits of the Driftpile Creek - Akie River district, where barren barite typically grades westward and basinward into sulphide-bearing barite and ultimately into predominantly massive pyrite with minor barite (MacIntyre 1982). The symmetry of the zonation is not known, because the western part of the sedimentary trough in which the deposits formed is typically thrusted away. If the deposits formed by exhalation of heated metalliferous brines into euxinic strongly reducing third-order basins, as implied by the models established by Finlow-Bates (1980) and Sato (1972) for genesis of this ore type of deposit, then the apparent westward increase in pyrite content observed in the Driftpile Creek - Akie River district suggests that exhalative vents were located in this direction. These vents may have been localized along the deep crustal breaks inferred earlier for the tilting of fault blocks.

Local Geology

The stratigraphic position of the barite-sulphide deposits of the Mt. Alcock area suggests that mineralization occurred at the transition from a starved basin regime represented by cherty rocks underlying the deposits to a deeper, more open-water normal marine environment with higher sedimentation rates as represented by overlying black silty shales (MacIntyre 1982). This Late Devonian marine transgression, which is well documented by Morrow (1978), apparently advanced eastward with time while areas west of the Kechika Trough began to rise and be eroded, shedding sediment eastward into a subsiding trough. Subsidence must have been rapid in order to drown the carbonate reefs. Such rapid subsidence would result in dewatering of basinal shales due to increasing hydrostatic pressure (MacIntyre 1982). Such dewatering processes could have been important in providing metal-enriched fluids for formation of the barite-sulphide deposits in a manner similar to that proposed by Badham (1981). Elevated thermal gradients near the deeper-seated faults would tend to accelerate this process and also enhance the metal-carrying capacity of the brines (MacIntyre 1982). With time, the source fluids would finally be exhausted and precipitation of barite and pyrite would eventually be terminated.

Mineralographic Analysis

A total of eight polished sections taken from seven drill core sample and one surface handsample were analyzed. The following is a generalized description of ore mineralogy. Complete descriptions for each individual section can be found in appendix 1.

note: The eighth section, 89-2-32.7 , is all gangue (90 percent barite, 10 percent quartz) and is not included in this discussion. Gangue mineralogy is brief and sketchy due to the lack of an accompanying thin section.

1. Pyrite: Pyrite occurs in all sections, usually having a framboidal texture and atoll structures associated with them. However in the surface and shale samples pyrite also appears as anhedral to euhedral grains, commonly rectilinear. Grain boundaries are well defined. The boundary with sphalerite is often jagged and irregular. The nature of the pyrite suggests that, paragenetically, pyrite was the first sulphide to appear, or this may merely reflect the ease of recrystallization, and the last to subside. The euhedral pyrite is associated with the lower vent area of many
massive sulphides. Overall the pyrite occurs in layers.
2. Galena: Galena occurs in all sections except for samples 89-3-104 and 89-3-62 where only pyrite and shale were dominant. The galena usually occurs as sharp irregular anhedral grains and commonly rectilinear in shape. However, most of the galena is not characterized by cleavage pits, and lacks a contact boundary with the pyrite. Although in one case (89-3-75.3), an atoll structure surrounds a grain of sphalerite and galena is found. In general the galena occurs in layers with minor amounts of sphalerite and barite inclusions poikiloblastically enclosed. This may reflect that galena may have formed syngenetically with the other

sulphides.

3. Sphalerite: Sphalerite occurs in all sections except for sample 89-3-104. It is usually found as smooth but irregular grains, and rectilinear in shape. Internal reflections are generally common, usually pale brown, suggesting moderate iron content. The grain form and size are apparently controlled by the same mechanisms as galena. In general sphalerite is poikiloblastically enclosed by gangue and sulphides. Framboidal pyrite occurs in an emulsion like texture in one section (89-3-62.5) and appears to reflect an origin syngenetic with the pyrite. Otherwise boundary with pyrite is often very jagged. Overall sphalerite usually occurs in layers.

4. Tetrahedrite: Tetrahedrite occurs in four sections. They usually occur in three forms; a) very minor amounts in atoll structures of pyrite. b) banded in well defined boundaries with galena and barite, and showing brown-red internal reflections. c) Selvages in irregular boundaries (myrmeketic) with barite and sphalerite. They also are characterized by the distinctive brown-red internal reflections.

(Photos of case a, b, and c in appendix ii)

Of economic interest are sections Surf and 89-3-71.7 where case b and c were noted in moderate quantities respectedly. In general the tetrahedrite often rims the barite and have no inclusions. Although minor amounts of tetrahedrite are found in pyrite atoll structures it is economically insignificant, but it may have origins syngenetic with galena and sphalerite.

5. Barite: Barite was the most abundant mineral in the samples, occurring as euhedral grains that often controled the

sulphide grain boundaries. Always decussate

6. Quartz: Quartz was common throughout the deposit as rounded anhedral grains. Always decussate

Paragenesis

Paragenetically, minerals like barite and quartz appear to have formed prior to sulphide deposition, as is evidenced by the poikiloblastic enclosure of the minerals by pyrite, galena, and sphalerite. The paragenetic order for the sulphide phases is interpreted to have begun with pyrite, followed by sphalerite, tetrahedrite, and finally galena. Textures and structures perceived in unmetamorphosed members of the shale hosted group collectively indicate low temperature metamorphism and melt deformation. Grain sizes of sulphide particles are exceedingly fine, and may cause diffculties in economic separations. Delicate lamination, fine graded bedding, the presence of sulphide overgrowth, framboidal pyrite, atoll structures, and soft sediment deformation textures seem to be consistent with low temperature, stagnant biologically inflnencad environments.

Beneficiation

In order to achieve the most economic production of the ores present in the Mount Alcock deposit, special considerations related to mineral processing must be taken into account. In this case of the precious metal mineralized zones, the ore minerals of interest are tetrahedrite, galena, and sphalerite. Liberation of these species is relatively easy according to their intergranular relationship, but it would in general require grinding to a mesh size of approximately 350 mesh (tetrahedrite may require 500 mesh in some samples). This in turn is followed by a flotation process to separate the individual phases. Here, difficuties may arise ln the form of sliming.

Conclusion

From the texture and mineralogy of the sections analyzed, support for the theory of this deposit being formed in a third order basin is presented. Additionally, the source of anomalous silver values, though not certain, can be narrowed down to the tetrahedrite. Consequently a generalized plan for exploration may be formed. Specifically the Devonian section containing barite beds down dip to the west, as they may grade into a sulphide-bearing facies as they approach a vent. Overall, the deposit is a sediment hosted submarine exhalative deposit, and it is apparent that this important class of base metal sulphide deposit is now well represented in British Columbia.

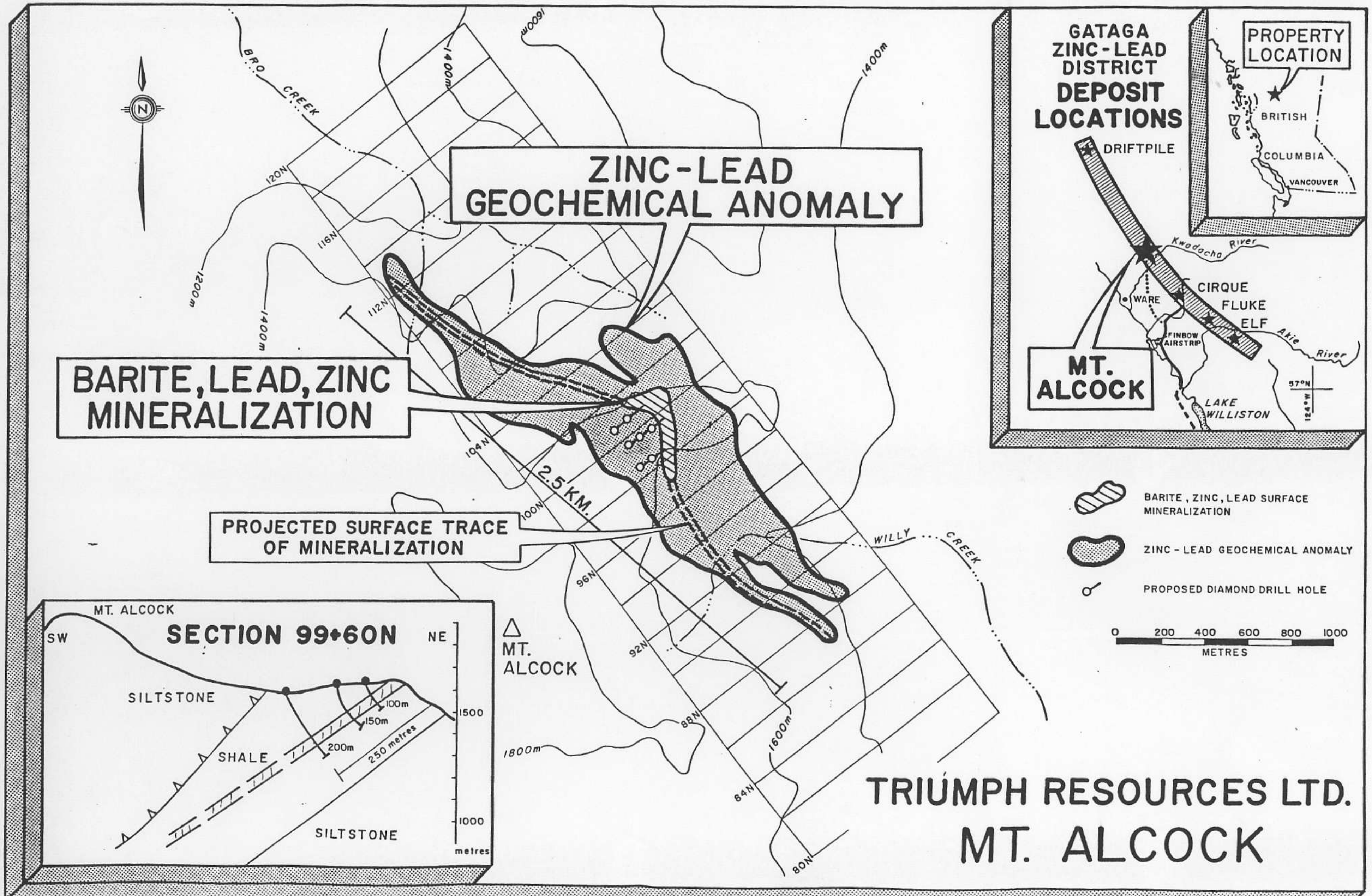


Fig 1 Location of Mount Alcock Deposits.

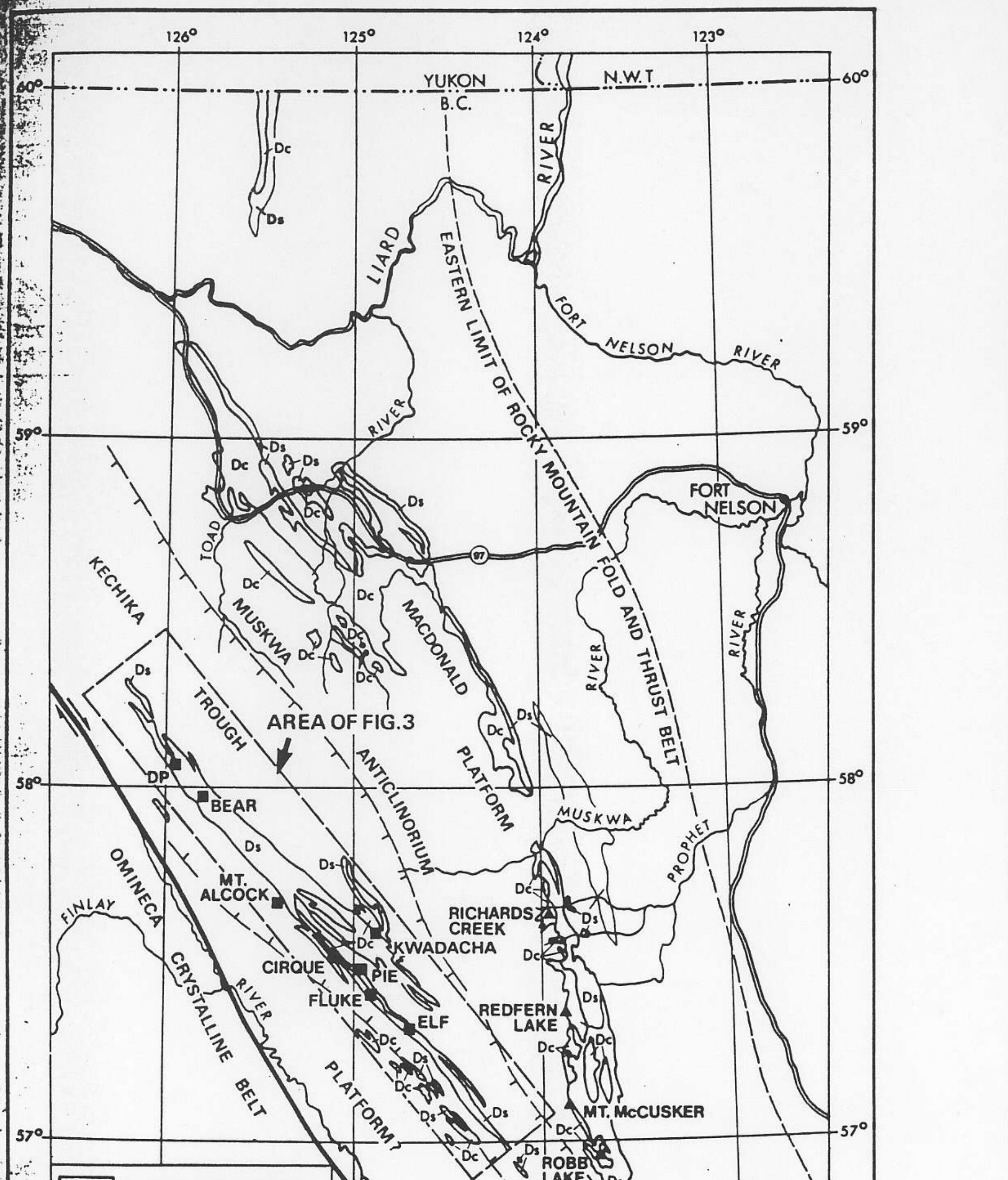
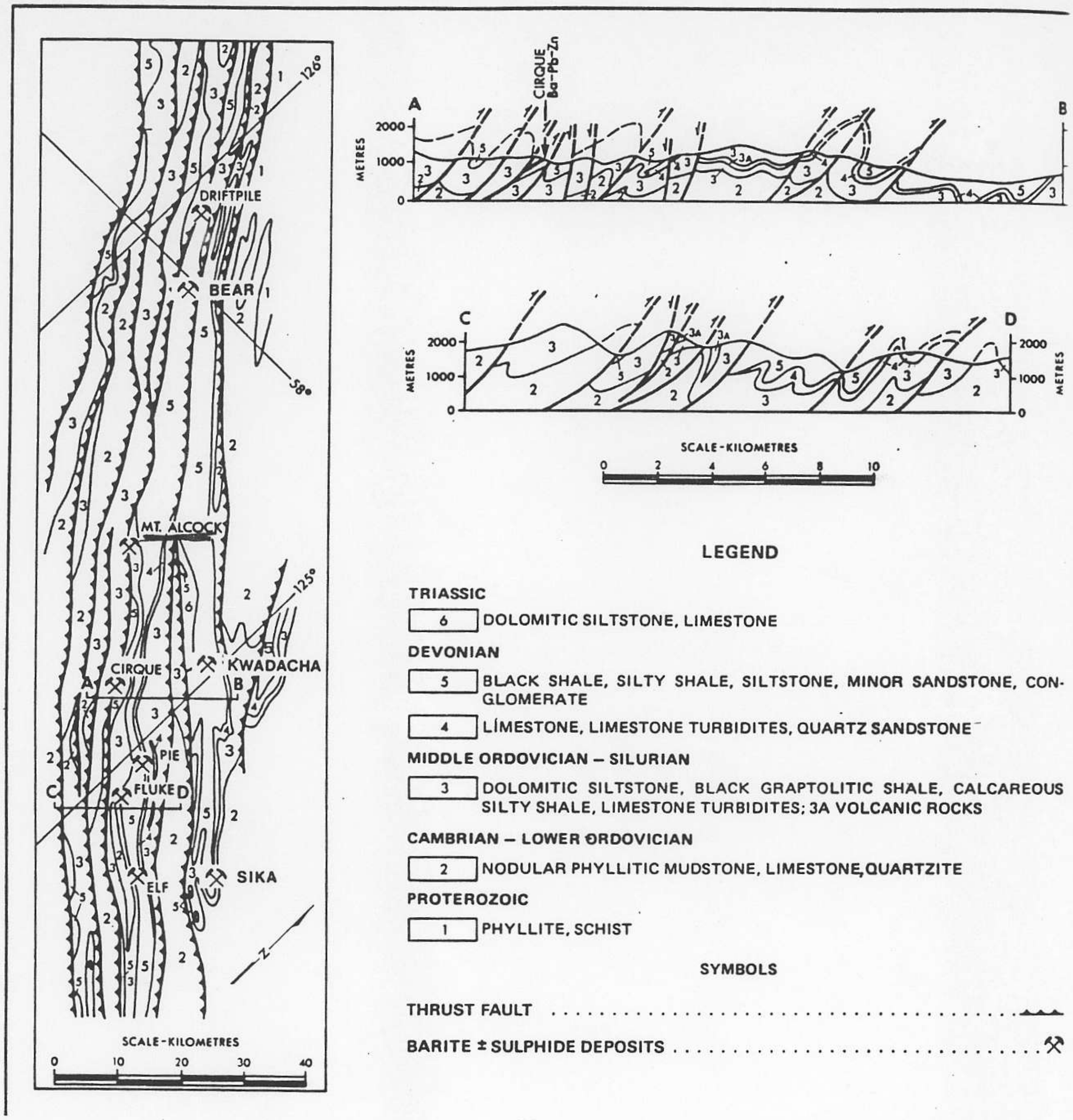


Fig. 2 Distribution of Devonian shale and carbonate rocks in Northeastern British Columbia. (MacIntyre 1982)



Fig, 3 General geology of the Driftpile Creek - Akie River Ba-Zn-Pb mineral district. (MacIntyre 1982)

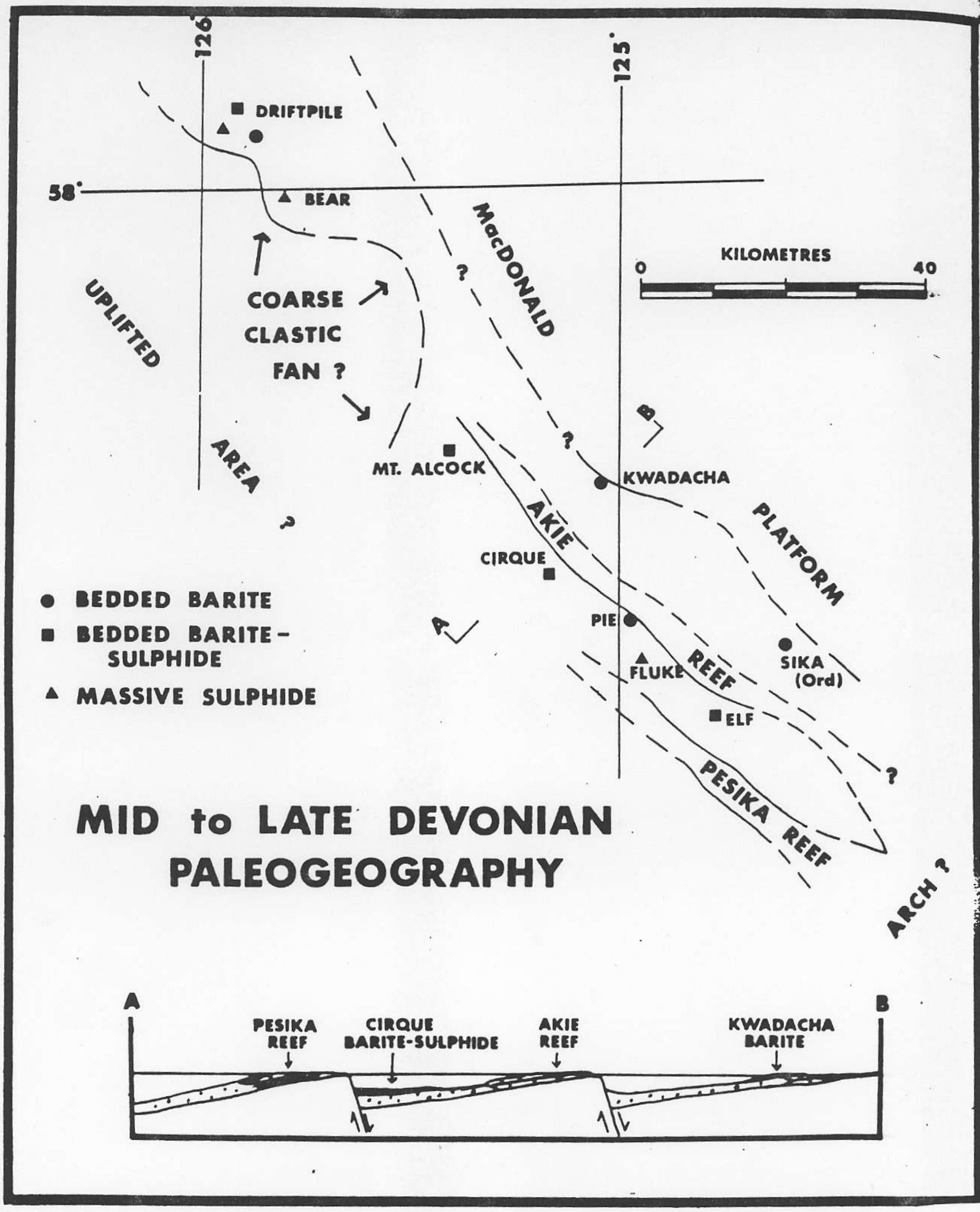
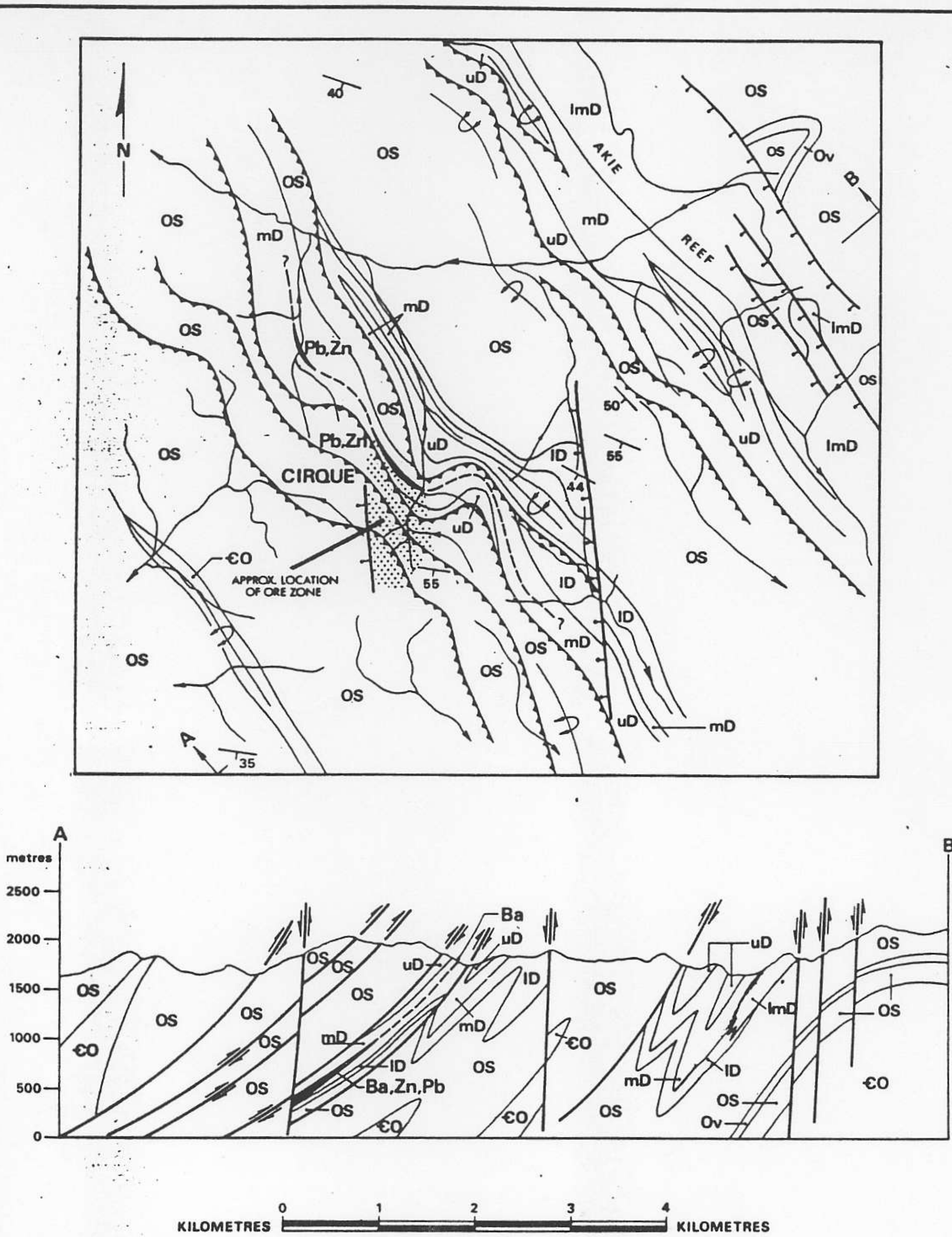


Fig. 4 Location of mineral deposits and reconstruction of Mid to Late Devonian paleogeography of the Driftpile - Akie River District. (MacIntyre 1982)



LEGEND

UPPER DEVONIAN (MISSISSIPPIAN)

uD — BLACK SHALE, SILTY SHALE, MINOR LIMESTONE

MIDDLE/UPPER DEVONIAN

mD — SILICEOUS SHALE, CHERT, MINOR SILTSTONE, BARITE, PYRITE

LOWER/MIDDLE DEVONIAN

lmD — BIOCLASTIC LIMESTONE (AKIE REEF)

LOWER DEVONIAN

lD — SILTY SHALE, SILTSTONE, MINOR LIMESTONE

ORDOVICIAN/SILURIAN

OS — DOLOMITIC SILTSTONE, BLACK SHALE, SILTY SHALE, MINOR LIMESTONE, CHERT; VOLCANIC ROCKS (Ov)

CAMBRIAN/ORDOVICIAN

€O — PHYLLITIC, NODULAR MUDSTONE, SILTSTONE, LIMESTONE

SYMBOLS

NODULAR BARITE ....

BEDDED BARITE, MASSIVE PYRITE ....

OVERTURNED ANTICLINE ....

OVERTURNED SYNCLINE ....

BEDDING ....

FAULT: NORMAL; THRUST ....

Fig. 5 Geology in the vicinity of the Cirque Deposit.
(MacIntyre 1982)

ROCK DESCRIPTIONS **SAMPLE NUMBER** Surf.

LOCATION/PURPOSE - Surface specimen.

MEGASCOPIC DESCRIPTION - Banded galena & sphalerite. with graphite alterations in a quartz & barite ground mass. Bedding can be seen.

MICROSCOPIC DESCRIPTION -

phases present	areal %
Barite	70 %
Galena	16 %
Sphalerite	7 %
Pyrite	1 %
Tennantite/ Tetrahedrite	6 %

Galena

Isotropic
White-grey in colour
Boundary with gangue smooth but irregular
Maximum size ≅ .4mm x .4mm
Usually containing round inclusions of sphalerite & Barite. Galena occurs in bands and shows no cleavage pits.

Surf

Sphalerite	Isotropic light-grey in colour Boundary with gangue rounde[d] but irregular. Grain boundari[es] commonly rectilinear. Maximum size .08mm x .06mm. Shows pale yellow internal reflection[s]. Sphalerite occurs in bands
Pyrite	Isotropic light honey yellow in colour Pyrite is frambodial with a maximum grain size ≅ .01mm found in Barite. Some frambod occurs in sphalerit[e] as inclusions (emulsion texture) minor amounts of atoll structure occurs.
Tennantite/ Tetrahedrite	Isotropic grey-green in colour myrmeketic texture inter-growth in Barite. Maximum size ≅ 0.02mm x 0.02mm but usually occurs in curved veins. Some occurs in core of pyrite atolls. Shows red-brown internal reflections. Veins crosscuts layers of galena, sphalerite and pyrite, but rims barite.

Appendix i: Detail descriptions of each section.

ROCK DESCRIPTIONS **SAMPLE NUMBER** 89-3-71.7

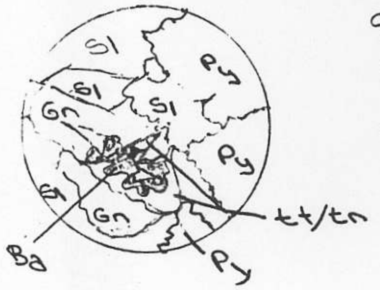
N/A

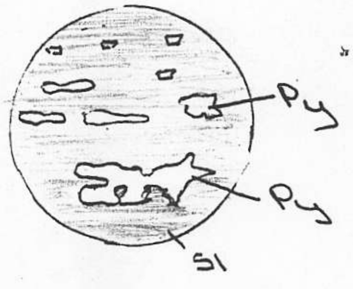
LOCATION/PURPOSE - Drillhole No. 3
Depth. 71.7m

MEGASCOPIC DESCRIPTION - Banded sphalerite and pyrite

MICROSCOPIC DESCRIPTION -

phases present	areal %
Pyrite	35
Sphalerite	25
Galena	15
Tennantite/ Tetrahedrite	8%
Barite	10%
Qtz	7%





Pyrite

Isotropic
light honey yellow in colour
large anhedral to euhedral
grains usually rectilinear
Boundary with sphalerite
is often jagged and irregula
Inclusions of sphalerite
occasionally occurs but mainl
as fingers. Maximum Size=
4mm x 4mm. Some atoll
Structures also appear.
Pyrite occurs in large
bands.

Sphalerite

Isotropic
light grey in colour. Large anhedral grains commonly rectilinear. Boundary with pyrite often very jagged Inclusions of pyrite occurs often. Sphalerite - Galena boundary smooth but irregular. Inclusions of Galena common. Sphalerite occurs in layers and show pale brown - yellow internal reflections

Galena

Isotropic
white - grey in colour
usually in small euhedral grains .07mm x .07mm, but Maximum size ≅ 1.0 mm x 1.0mm often shows inclusions with Sphalerite. Boundaries with pyrite are rare.

Tennantite / Tetrahedrite:

Isotropic
Grey - Green in colour
Brown - Red internal reflection
Maximum size ≅ .01mm x .05mm
Boundaries with galena & Barite smooth & rounded. One small layer occurs near top of sample. Tetrahedrite usually rims barite

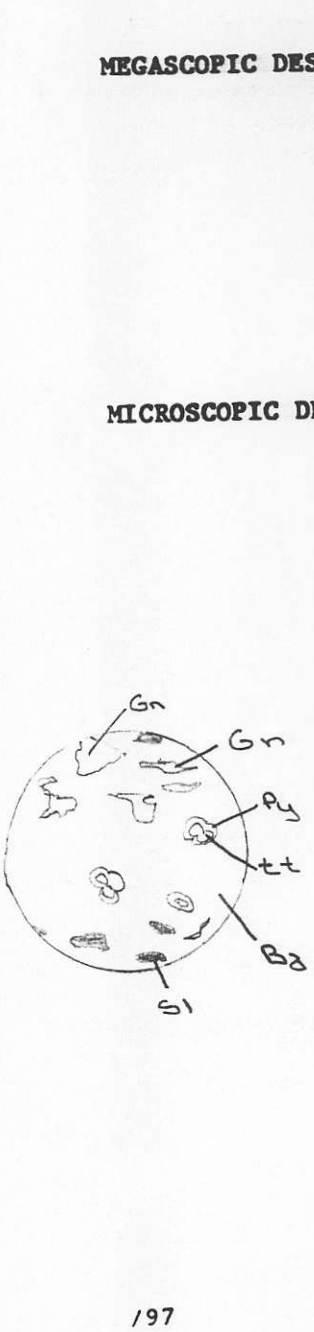
ROCK DESCRIPTIONS **SAMPLE NUMBER** 89-3-75.3

LOCATION/PURPOSE - Drillhole No. 3
Depth 75.3m

MEGASCOPIC DESCRIPTION - banded galena & sphalerite in a qtz & barite groundmass. Bedding can be seen

MICROSCOPIC DESCRIPTION -

phases present	areal %
Barite	80%
Sph	10%
Gal	5%
Py	1.5%
Qtz	3%
tt	0.5%



Sphalerite

Isotropic
light grey in colour
Maximum size ≈ .1mm x .05mm
Boundary with gangue (Barite) generally smooth and rounded. Some grains are in contact with Galena. Grain boundaries are smooth but irregular. A few grains show emulsion texture with frambodial pyrite.
Sphalerite shows light brown internal reflections rectilinear in shape occurs in layers

Galena-

Isotropic
White-Gray in colour. Maximum size ≅ .1mm x .02mm. Boundary with gangue generally sharp and irregular. Grains often contains inclusions of Barite and sphalerite. No cleavage pits were seen. Galena is roughly rectilinear in shape and occurs in layers.

Pyrite-

Isotropic
light honey yellow in colour
Usually rounded grains. Grain boundaries well defined. Some grains show atoll structures with the core being barite or Tennantite/Tetrahedrite.
Maximum size ≅ 0.15 mm x 0.15mm
Grains are anhedral and also usually occurs in layers.

Tennantite/Tetrahedrite:

Isotropic
Grey-Green in colour
Maximum size ≅ 0.05mm x 0.05mm
Boundary within gangue is very jagged and irregular.
Usually surrounded by barite but some can be found in core of pyrite atolls.
Do not show brown-red internal reflections.

SAMPLE NUMBER 89-3-62

ROCK DESCRIPTIONS

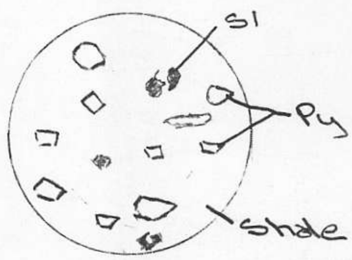
N/A

LOCATION/PURPOSE - Drillhole No. 3
Depth 62.0 m

MEGASCOPIC DESCRIPTION - 4 layers of pyrite in an argillite/shale groundmass

MICROSCOPIC DESCRIPTION -

phases present	areal %
Pyrite	15%
Sphalerite	3%
Shale	82%



Pyrite - Isotropic
light honey yellow colour
mainly anhedral grains
but some are euhedral
Grain boundaries are
well defined and commonly
rectiliner. Maximum
size ≅ 0.1 mm
Some grains are rounded
but they all are confined
in layers

Sphalerite Isotropic
light grey in colour
rare smooth irregular grains
roughly rectiliner in shape
Maximum size ≅ .03×.01mm
Grains are sporadic and show
no internal reflection

ROCK DESCRIPTIONS

SAMPLE NUMBER 89-3-104

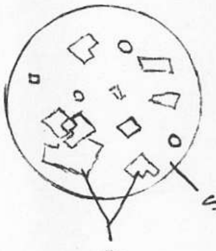
N/A

LOCATION/PURPOSE - Drillhole No. 3
Depth 104 m

MEGASCOPIC DESCRIPTION - one layer of pyrite in shale groundmass

MICROSCOPIC DESCRIPTION -

phases present	areal %
Pyrite	45%
Shale	55%



Pyrite

Isotropic.
light honey yellow colour
Grains are anhedral to euhedral in a shale matrix.
Grain boundaries are well defined, commonly rectiliner
Maximum grain size ≅ 0.1mm

ROCK DESCRIPTIONS

N/A

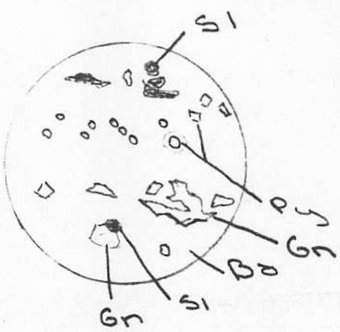
SAMPLE NUMBER 89-6
62.5

LOCATION/PURPOSE - Drillhole No. 6
Depth 62.5

MEGASCOPIC DESCRIPTION - Banded galena & sphalerite in a qtz - barite ground mass
Bedding can be seen

MICROSCOPIC DESCRIPTION -

phases present	areal %
Barite	83%
Galena	5
Sphalerite	10
Pyrite	2



Galena

Isotropic
White-grey in colour
Boundary with Barite sharp and irregular.
Maximum size ≅ .4mm x .2mm
Roughly rectilinear in shape. A few contain inclosions of sphalerite. No cleavage pits are seen. Galena occurs in bands.

89-6-62.5

Sphalerite

Isotropic
light grey in colour
Maximum size 0.1mm x 0.08m
Boundary with gangue (Barite) generally smooth and rounded. Some grains are in contact with galena. Sphalerite shows light brown internal reflections rectilinear in shape and occurs in layers. A few inclusions of sphalerite occurs in Galena.

Pyrite

Isotropic
light honey yellow in colour usually rounded in frambоidal grains. Grain boundaries are well defined. Some grains show atoll structures with the core being barite. Maximum size ≅ .01mm x .01mm. Grains usually occurs in layers.

ROCK DESCRIPTIONS **SAMPLE NUMBER** 89-9-85

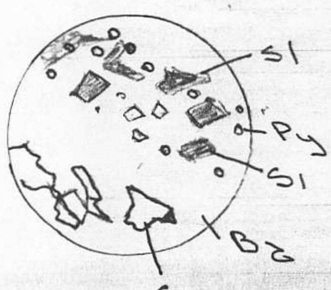
N/A

LOCATION/PURPOSE - Drillhole No.9
Depth 85.0 m

MEGASCOPIC DESCRIPTION - Banded galena & sphalerite in a qtz & barite groundmass. Bedding can be seen.

MICROSCOPIC DESCRIPTION -

phases present	areal %
Barite	68
Galena	10
Sphalerite	15
Pyrite	5
Te	2



Galena Isotropic
White-grey in colour
Boundary with Barite smooth but irregular.
Maximum size ≅ .4mm x .2mm
Roughly rectilinear in shape. Contains small inclusions of sphalerite
No cleavage pits are found. Galena occurs in bands

/97

Sphalerite	Isotropic light grey in colour Maximum size ≈ 0.1m × .05mm Boundary with Barite generally smooth and well defined. Some grains are in contact with Galena. Sphalerite shows light brown internal reflections rectilinear in shape. Generally sphalerite occurs in layers.
Pyrite	Isotropic light honey yellow in colour. Usually rounded grains (framboidal) or euhedral squares. Grain boundaries well defined. Some grains show minor atoll structures with the core being barite or tennantite. Maximum size ≈ 0.03mm × 0.03mm. Grains also occurs in layers.
Tennantite/Tetrahedrite	Isotropic Grey-Green in colour Maximum size ≈ 0.02mm × 0.02mm Boundary with gangue is very jagged and irregular. Usually surrounded by barite or rims sphalerite. Minor amounts can be found in core of the pyritic atolls.

ROCK DESCRIPTIONS **SAMPLE NUMBER** 89-2-32.7

N/A

LOCATION/PURPOSE - Drillhole No.2
Depth 32.7 m

MEGASCOPIC DESCRIPTION -
Massive Barite

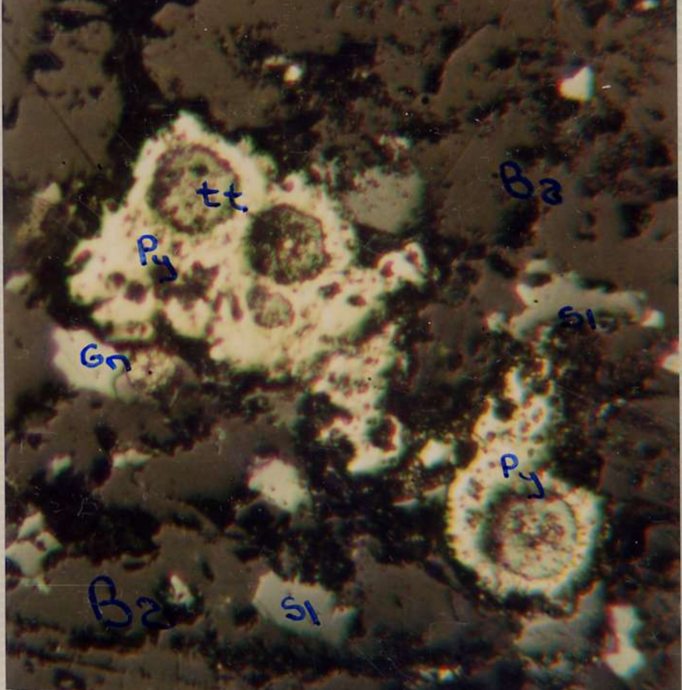
MICROSCOPIC DESCRIPTION -

phases present	areal %
Barite	90 %
Quartz	10 %

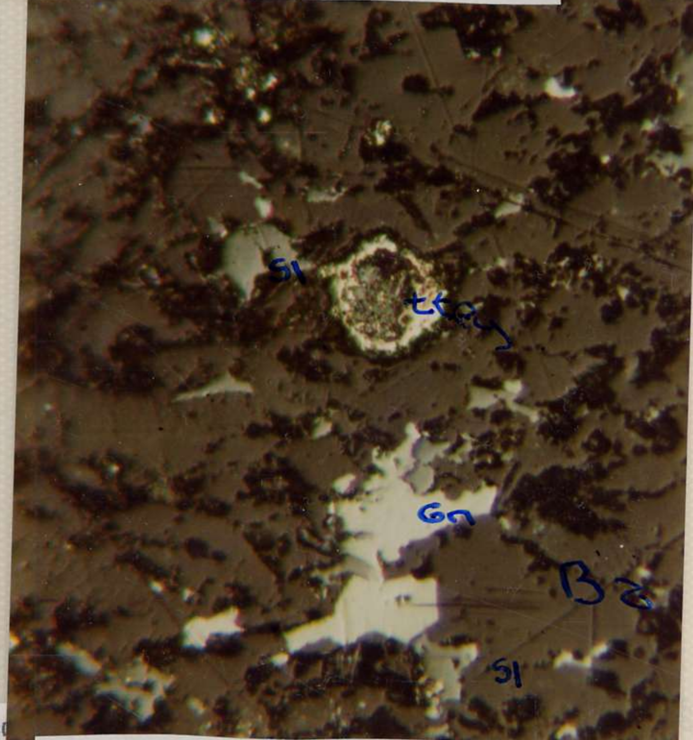
Barite : Gangue mineral
Massive and decussate

Qtz : Gangue mineral
anhedral grains and
decussate.

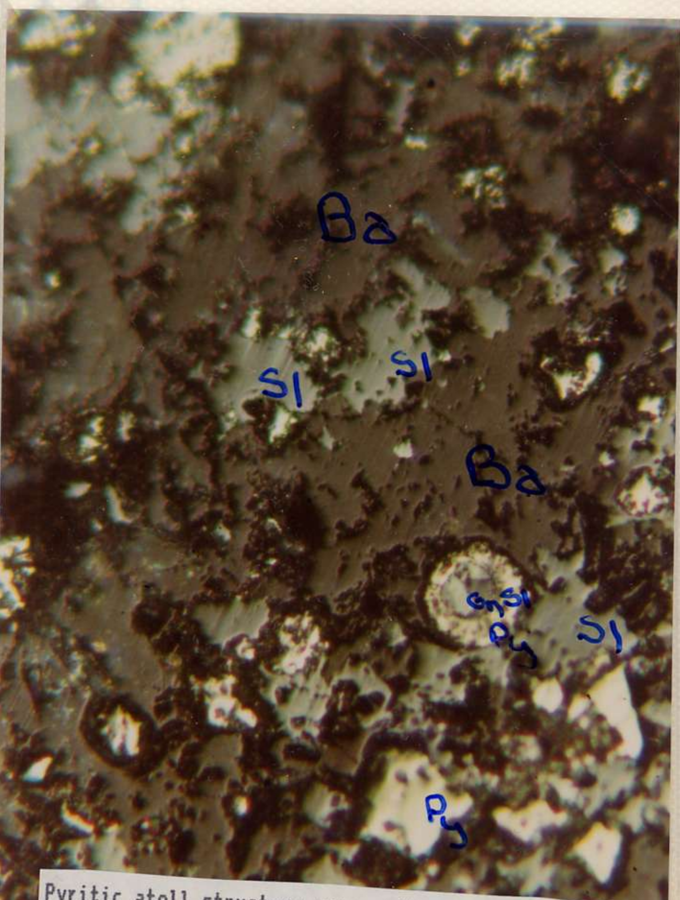
Appendix ii: Microphotographs of mineralogy and structures



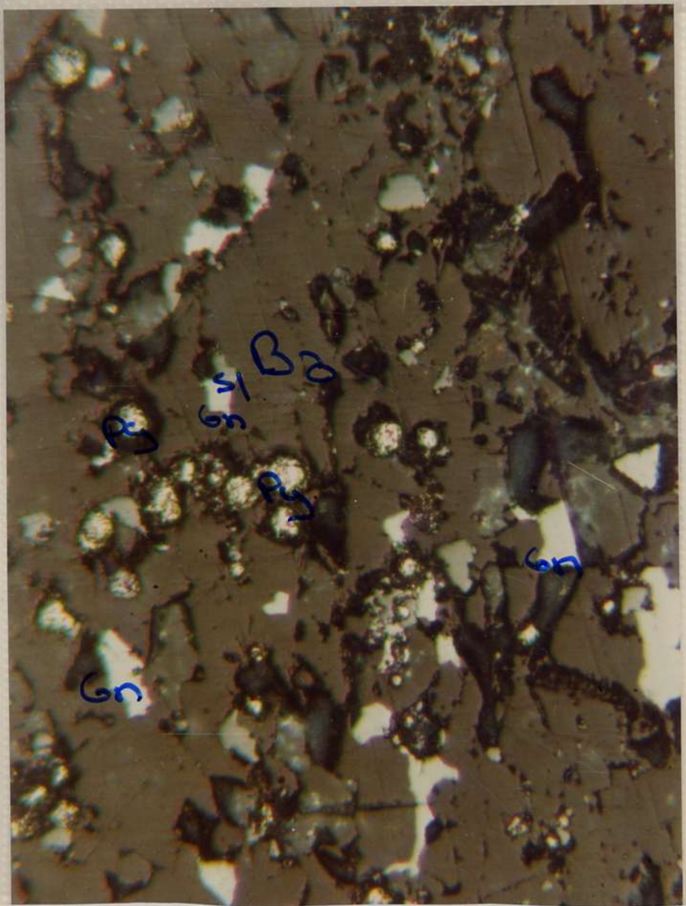
Pyritic atoll structures with tennantite core with galena and sphalerite grains enclosed in barite. Sample: 89-3-75.3



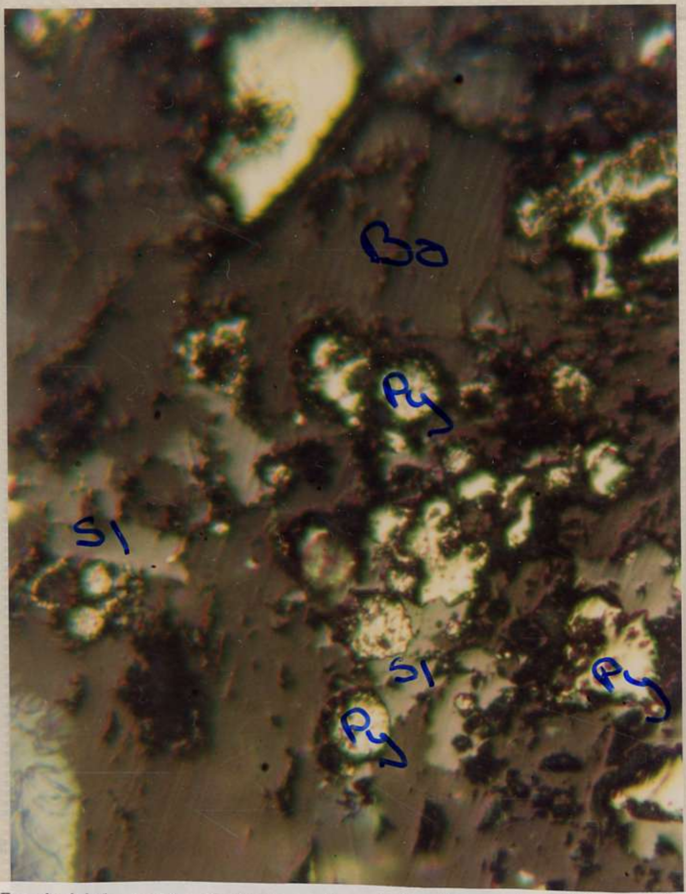
Pyritic atoll structure with tennantite core, may be interpeted as mineralized bacteria. Sample: 89-9-85



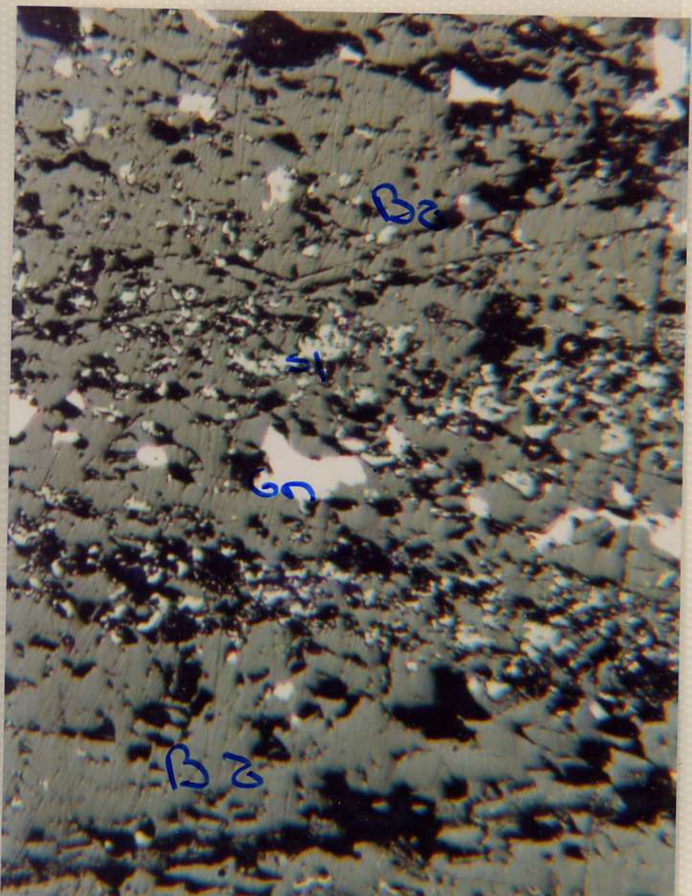
Pyritic atoll structure surrounding a grain of galena and sphalerite. Sample: 89-9-85



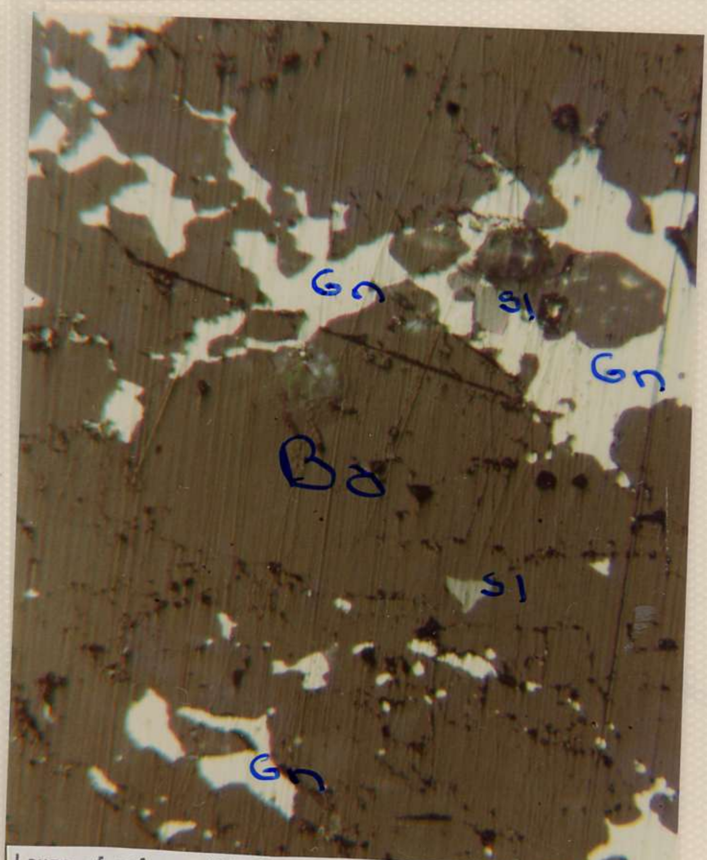
Layered framboidal pyrite enclosed by barite with minor grains of galena and sphalerite. Sample 89-6-62.5



Framboidal pyrite inclusions in sphalerite enclosed in barite. Sample: 89-3-71.

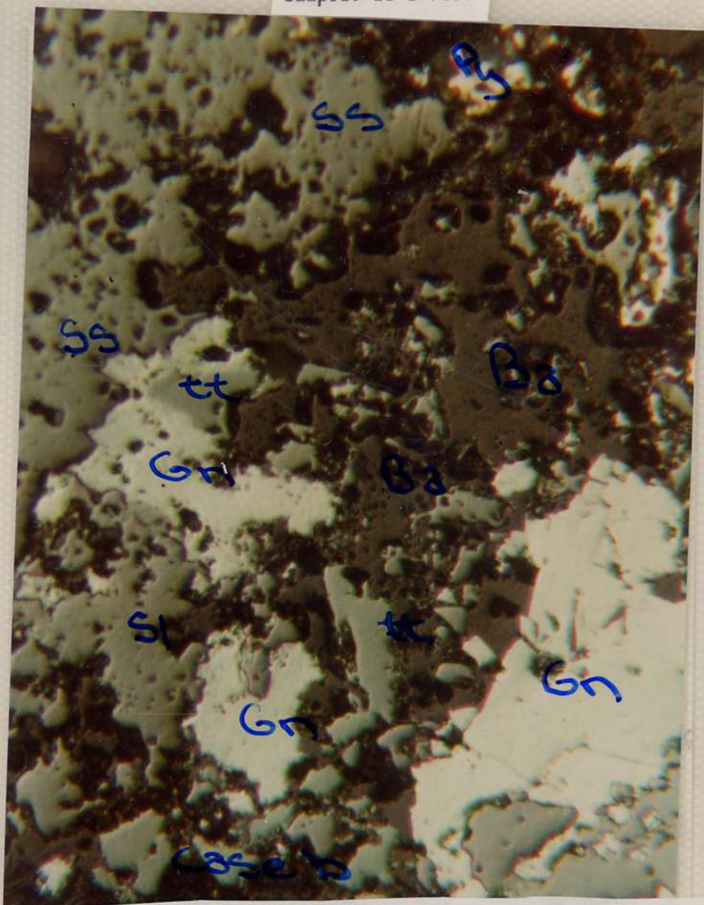


Banding of galena between two layers of sphalerite enclosed in barite. Sample: 89-3-75.3

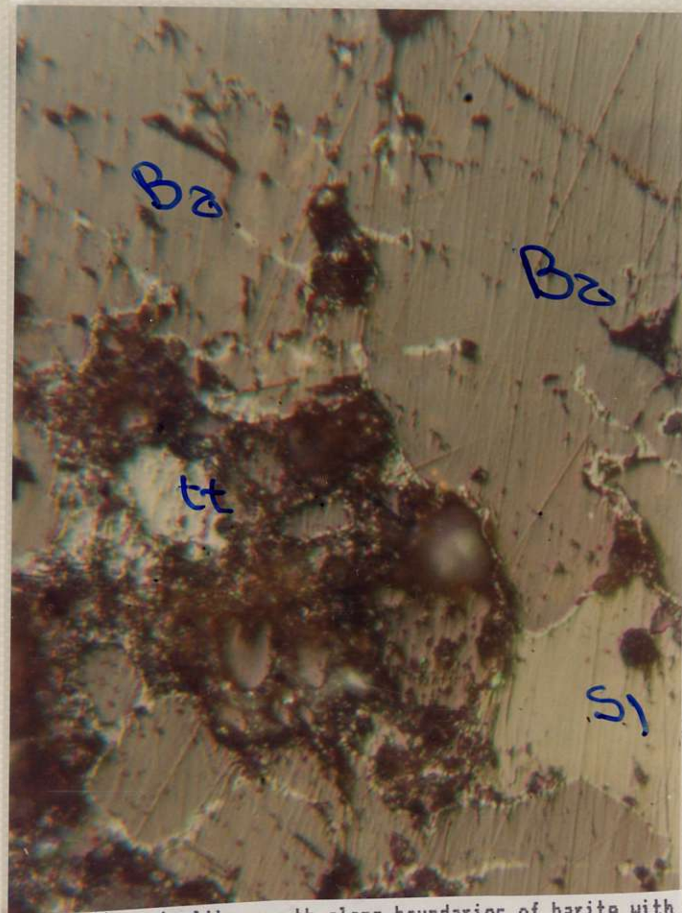


Layer of galena with minor inclusion of sphalerite enclosed in barite. Sample: Surf

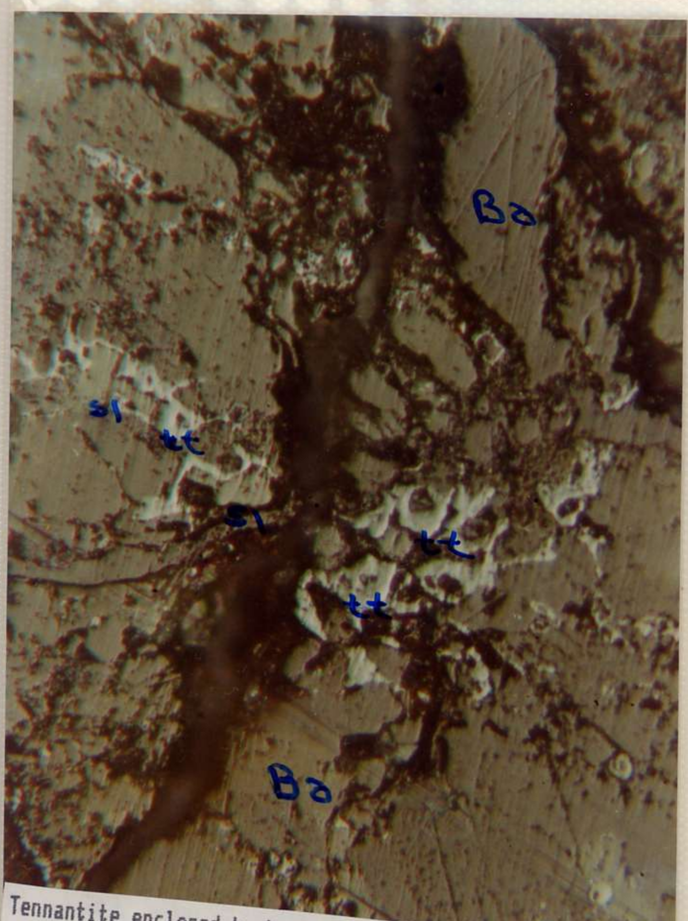
Sample: 89-3-71.7



Tennantite grains showing irregular boundaries with barite and inclusions with galena. Present for colour comparison sphalerite.

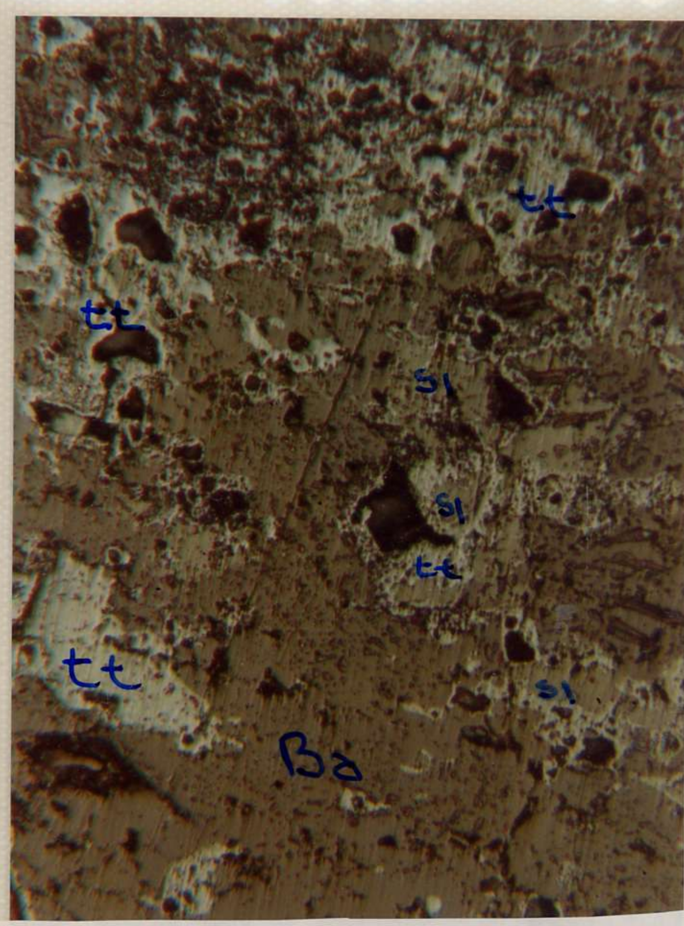


Tennantite vein like growth along boundaries of barite with one minor grain. Sample: Surf

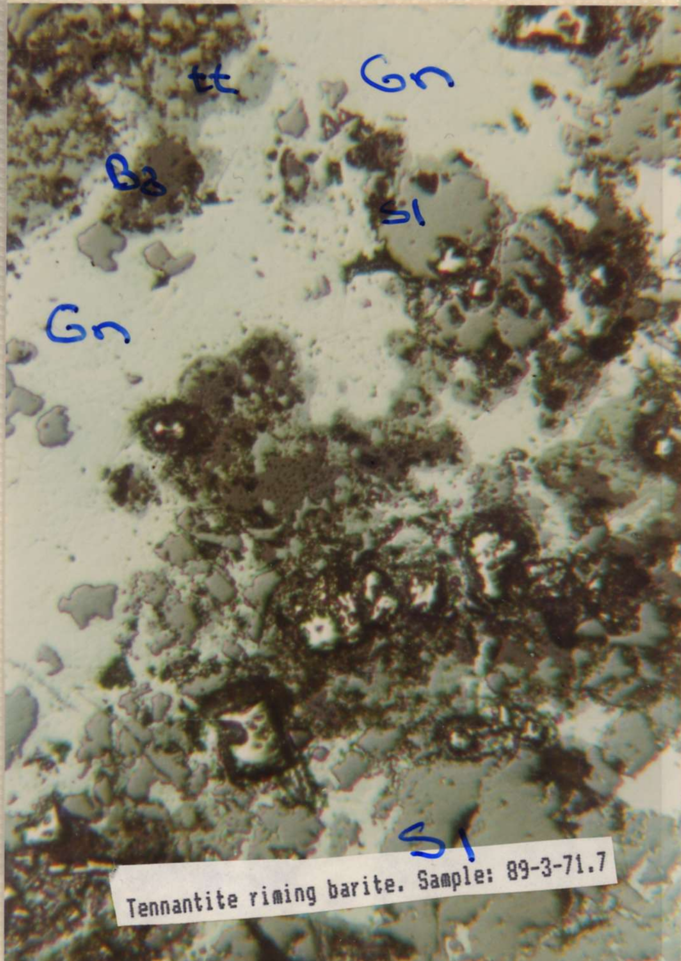


Tennantite enclosed by barite, although there are some inclusions and reaction rims in sphalerite. Sample: Surf

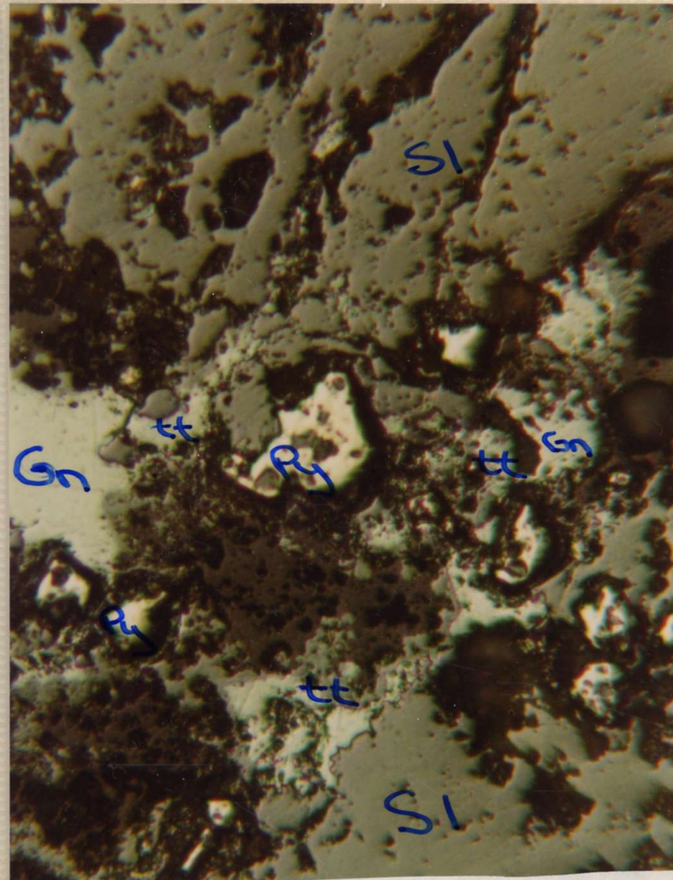
Case c



Tennantite riming sphalerite enclosed in barite. Sample: Surf



Tennantite riming barite. Sample: 89-3-71.7



Tennantite riming barite, and showing no contact with sphalerite.

Sample: 89-3-71.

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