BARKER MINERALS Ltd.

22117 37A Ave, Langley, BC, Canada V2Z 1N9
• Tel: (604) 530-8752 • Fax: (604) 530-8751

PETROGRAPHIC REPORT

Part 1
December 1994
Part 2
February 1995

By: Andrzej Skupinski, Ph.D.

ref: 106

Part 1

Ore Petrography
Samples: (1).27.76PT, (2).09-14-94-9, (3).DD3 & (4).DD3 B
By
Andrzej Skupinski, Ph.D.
For
Barker Minerals Ltd
December 1994

Part 2

Ore Petrography
Samples: 94-10-1352, 94-10-1352 bis, 94-10-1358
By
Andrzej Skupinski Ph.D
For
Barker Minerals Ltd
February 1995

Calgary, Alberta

TABLE OF CONTENTS: PAGE

INTRODUCTION:

Two polished slabs were analyzed with a polarizing Zeiss microscope in reflected light. The gangue minerals were not analyzed.

The main purpose of the study was examination of ore minerals their textures and alterations. Those studies were made from the point of view of Gold mineralization.

SAMPLE 1. 27.76 PT (GRAMS AU) 94-1199

Mineral Content:

Pyrrhotite (predominant)
Pyrite (abundant)
Melnikovite (common)
Chalcopyrite (minor)
Galena (minor)
Bismuth (minor)
Tellurides (minor)
Gold (trace)

Opaque Mineralogy and Textures:

Sulphide mineralization has been developed extensively in the form of cementing networks of the intergranular spaces within Quartz. The original sulphide mineralization is characterized by idiomorphic growth of **Pyrite** (Plate 1, Fig. A and C) 0.1-1.0 mm in size. Most of the larger crystals are fractured, few are broken. Some fractures are filled with **Chalcopyrite**.

The intracrystalline porosity is uncommon in Pyrite. Infrequent crystals display zoning due to porosity distribution. Within some pores **Gold** and likely **Cubanite** occur (Plate 2, Fig. B).

The Pyrite mineralization was followed by two coeval phases: **Pyrrhotite-Chalcopyrite**. Pyrrhotite is ubiquitous, while Chalcopyrite is uncommon. Both sulphides occur as anhedral infillings of the gangue Quartz. Against Pyrite, crystallization of Pyrrhotite and Chalcopyrite was postkinematic (Plate 1, Fig. B and C).

The development of Pyrrhotite and Chalcopyrite is postkinematic toward the brittle Pyrite deformation.

Melnikovite is the colloform variety of Pyrite, it is a product of the Pyrrhotite alteration. Melnikovite is common on borders and along fractures of the Pyrrhotite grains (Plate 1, Fig. C).

Galena and native **Bismuth** occur as the replacements within Pyrrhotite (Plate 1, Fig. C). Both are anhedral.

The native **Bismuth** and other tellurides (**Tellurbismuth** and tellur-bismuth compounds) also occur as inclusions in the gangue Quartz. They are irregularly shaped,

94-1199

and up to 0.03 mm in size. Other tellurides are uncommon. An anhedral inclusion of **Calaverite** ($AuTe_2$) was found in Pyrrhotite (Plate 2, Fig.C). It likely is intergrown with a native **Tellurium**.

Gold occurs in two textural relationships to the sulphides. Primarily, as discrete anhedral inclusions at structural voids inside the Pyrite crystals (Plate 2, Fig. B). Secondly as a fine-grained precipitate within Quartz.

The three grains of Gold detected in Quartz are highly euhedral and 0.01-0.013 mm in size (Plate 2, Fig. A and D). They are located closely to the sulphide edges.

Sequence of Mineralization:

1. Pyrite crystallization
2. Pyrrhotite and Chalcopyrite crystallization
3. Galena an Bismuth replacements in some Pyrrhotite
4. Tellurides and Gold

Comments:

Gold, in the analyzed sample, occurs as a native metal and as a gold-tellurium compound. The gold tellurides display physical properties different than those of native Gold (e.g. the superficial properties). The above circumstance can seriously affect the technology of Gold extraction and mining economy.

In case of the common fine-grained development of tellurides, the optical analysis is very difficult and should be assisted with an EDX scanning microscopy or microprobing.

SAMPLE 2. 09-14-94-9 94-1275

Mineral Content:

Pyrite (predominant)
Magnetite (abundant)
Chalcopyrite (minor)
Goethite (minor)
Pyrrhotite (trace)
Silver (2 tiny grains)
Gold (1 tiny grain)

Opaque Mineralogy and Texture:

The rock is banded with alternating cherty layers and elongated porphyroblastic Pyrite.

Magnetite is an original opaque mineral disseminated among Pyrite. It forms subhedral or anhedral grains up to 0.5 mm in size. They are commonly fractured and fissures are filled with gangue minerals. Some Magnetite grains are intergrown with fine-grained anhedral inclusions of **Chalcopyrite** up to 0.01 mm in size.

The irregularly shaped **Chalcopyrite** is ubiquitous in gangue minerals. The average size of grains is about 0.01 mm, larger grains are uncommon. Very small grains are seldom oxidized to Malachite.

Pyrite progressively replaces Magnetite. Inclusions of relictic Magnetite rarely occur in the Pyrite crystals (Plate 3, Fig. C). Chalcopyrite overgrown by Pyrite is uncommon (Plate 3, Fig. D).

Pyrite is sieve-textured (Plate 3, Fig.B), very porous and up to 2 centimetres in length. It forms elongated crystals, most commonly xenomorphic (anhedral). The poikilitic inclusions of gangue minerals are very common in Pyrite. Inclusions of Chalcopyrite and Pyrrhotite are uncommon. Pyrrhotite in the analyzed sample, has been found as inclusions in Pyrite only.

The alteration to Goethite (α-Fe_2O_3) are sometimes noticeable along crystal borders.

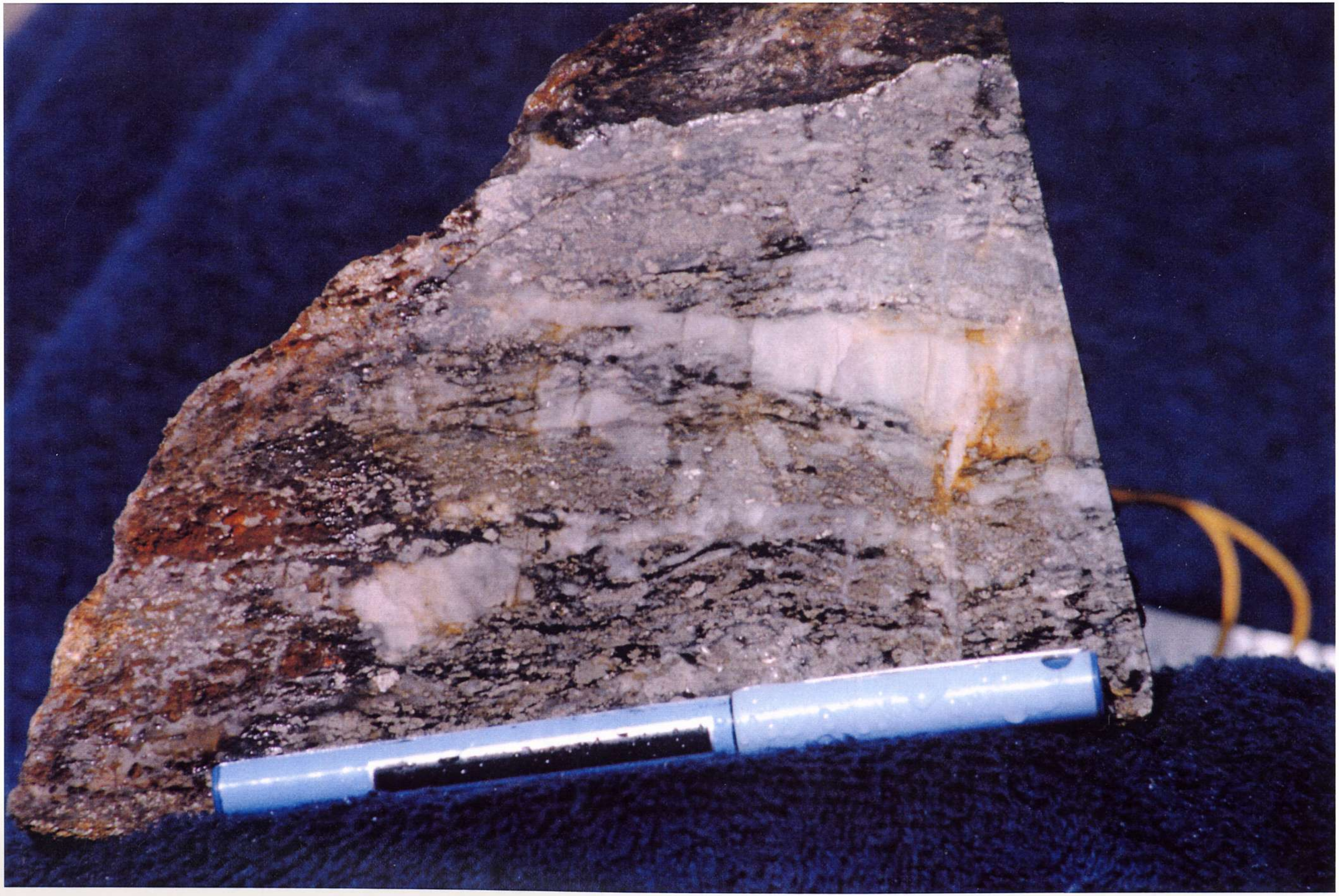
One grain of **Gold**, 0.005 mm in size was found in a pore within the Quartz (Plate 3, Fig. A).

Two very reflective grains of **Silver** about 0.01 mm in size were also detected.

Sequence of Mineralization:

1. Magnetite
2. Chalcopyrite crystallization
3. Pyrite poikiloblastic growth

Comments: About Gold mineralization, nothing can be concluded, as only one tiny particle has been found in the analyzed sample.



94-1275

SAMPLE 3.DD3 (94-1362)

General Remarks:

The rock is a metamorphic crystalline schist consisting of Garnet, Quartz, Chlorite, minor Amphibol and Ilmenite. The gangue minerals are commonly fractured and broken. The cataclasts have been cemented with sulphides.

The lateral part of the thin section is a Quartz veinlet with minor carbonates (Ankerite or Siderite) and Leucoxene clusters. The ore mineral composition of the main rock slightly differs from that of the quartz veinlet.

Mineral Content:

Main rock:	Marcasite (predominant) Chalcopyrite (minor) Ilmenite (minor) Arsenopyrite (trace)
Qz Veinlet:	Pyrite (common) Marcasite (less common) Pyrrhotite (minor) Chalcopyrite (minor) Goethite (minor)

Opaque Mineralogy and Texture:

Main rock: The crushed gangue grains have been originally cemented by **Pyrrhotite** and minor **Chalcopyrite**. The cementing network Pyrrhotite is totally replaced by **Marcasite**. The typical Pyrrhotite to Marcasite conversion (T>250°C) is displayed as the "birds eye" texture. Marcasite also infills fractures and pores within xenoblastic Garnets.

Chalcopyrite occurs unaltered as anhedral grains included in Marcasite. It is 0.1-1.0 mm in size.

Arsenopyrite single crystal has been found in the Marcasite network. It is highly euhedral, unaltered and 0.2 mm in size.

Ilmenite is the only opaque of the original crystalline schist. It forms rounded anhedral grains, up to 0.3 mm in size. Ilmenite is commonly sieve-textured and not altered.

Quartz Veinlet: The "birds eye" textured Marcasite, as a product of the Pyrrhotite alteration, is common in Quartz. It forms irregularly shaped clusters, which are oriented parallel to the veinlet extension. Pyritization of Marcasite is common.

Pyrite replacing Marcasite is usually fine-grained and forms colloform textures following the "birds eye" domains after Marcasite.

Pyrrhotite is seldom seen in voids of Quartz as isolated and unaltered grains. It forms anhedral grains, up to 0.3 mm in size. Pyrrhotite is usually accompanied by carbonates.

The contact zone of the veinlet **is highly porous**. The pores are intergranular voids in Quartz. The smallest micropores are about 0.01 mm in size, the larger ones are connected by channels. The width of channelling system varies from 0.1 mm up to 1 mm. Voids, partly or totally, are filled with colloform-textured **Goethite** (a-Fe^2O^3) and **Chalcopyrite**. Chalcopyrite, however, is less common.

Within a few micropores (pos. 19/73) unidentified metallic blebs were found. The blebs display white colour and a very high reflectivity. Some of them are harpoon shaped and under 0.002 mm in size.

Sequence of Mineralization:

1. Ilmenite (original opaque)
2. Pyrrhotite and Chalcopyrite
3. Marcasite (the Pyrrhotite alteration)
4. Pyrite (the Marcasite alteration)
5. Goethite (the sulphides oxidation)
6. Chalcopyrite (secondary – accompanied to Goethite)

Comments:

The original Pyrrhotite-Chalcopyrite mineralization has been formed in temperatures above 350°C. High temperatures of formation are common to almost all Pyrrhotite occurrences.

The Pyrrhotite-Marcasite conversion is possible under 250°C. The formation of Marcasite in the rock sample is related to the hydrothermal Quartz veining. Marcasite formation and the presence of iron-bearing carbonates in the Quartz veinlet infer that the respective minerlizing solutions were slightly acidic. The weak acidity and the temperature range were favourable for Gold precipitation.

The free Gold, however, has not been detected in the analyzed thin section. Nevertheless, that circumstance is not a proof of the rock barrenness. Further sections of the Quartz veinlet, expecially porous, should be analyzed for free Gold.

SAMPLE 4. DD3 B (94-1362)

General Remarks:

The sample is a heavily mineralized metamorphic crystalline schist similar to the DD3 sample. The gangue minerals are: Quartz, Garnet and Chlorite. Amphibole (Grunnerite) is less common. The Siderite carbonatization is ubiquitous.

The Garnets are commonly fractured or brecciated. Some portions of the rock consist of angular broken gangue mineral fragments held together by mineralizing sulphides. The structural porosity of sulphides is extensive.

Mineral Content:

Pyrite (predominant)

Pyrrhotite (common)
Chalcopyrite (less common)
Marcasite (minor)
Ilmenite (minor)
Arsenopyrite (trace)

<u>**Opaque Mineralogy and Texture**</u>:

The textures of cementation of the brecciated gangue minerals are similar to those observed in the sample DD3. The original **Pyrrhotite** was seldom accompanied by **Chalcopyrite**. The present cementing network predominantly consists of the alteration products after Pyrrhotite. About 90% of the total Pyrrhotite has been altered. The sulphides fill up the spaces between the gangue minerals and fractures within Garnets.

Pyrrhotite uncommonly occurs as anhedral relicts, up to 0.4 mm in size. They are rimmed by extensively pyritized **Marcasite**. The Pyrrhotite alteration was double. Primarily, it has been converted to Marcasite (T>250°C). Secondly, Marcasite was replaced by **Pyrite**. Marcasite sensu stricto occurs only as rims of some Pyrrhotite grains and as relicts within Pyrite. Pyrite is fine-grained anhedral and uncommonly colloform textured. The Chalcopyrite alterations have not been observed.

Arsenopyrite single cluster of euhedral crystals, 0.1 mm in size, occurs in the thin section.

Ilmenite grains are anhedral and up to 0.3 mm in size. The sulfurization of the Ilmenite is locally noticeable on the grain borders. The resulting alteration product is a fine-grained aggregatic Pyrite. The internal parts of the Ilmenite grains are unaltered.

<u>**Sequence of Mineralization**</u>:

1. Ilmenite (original opaque)
2. Pyrrhotite and Chalcopyrite
3. Marcasite (the Pyrrhotite alteration)
4. Pyrite (the Marcasite alteration)

<u>**Comments:**</u>

A free Gold has not been found in the analyzed thin section. Further conclusions are similar as in the DD3 sample.

EXPLANATIONS TO PLATES

Plate 1. **Textures.** Reflected light with Interference Contrast.

- A. Fractured Pyrite crystal in Pyrrhotite. Chalcopyrite infills structural void.
- B. Chalcopyrite crystallization on the border of Pyrite.
- C. Melnikovite alteration of Pyrrhotite between two euhedral Pyrite crystals.
- D. Progressive replacement of Pyrrhotite by Galena and Bismuth.

Plate 2. **Gold.** Reflected Light with immersion oil (except of the Fig. B which is with Interference Contrast dry).

- A. Euhedral crystal of Gold in Quartz between the Pyrrhotite grains.
- B. Gold and problematic Cubanite in structural pores of Pyrite.
- C. Tellurides infilling void in Pyrrhotite.
- D. Euhedral crystal of Gold in Quartz.

Plate 3. **Textures.** Reflected Light with Interference Contrast (except of the Fig. A which is with immersion oil and without IC).

- A. A Gold grain near the Pyrite.
- B. A sieve-textured Pyrite.
- C. Magnetite replaced by porphyroblastic Pyrite.
- D. Chalcopyrite overgrown by porphyroblastic Pyrite.

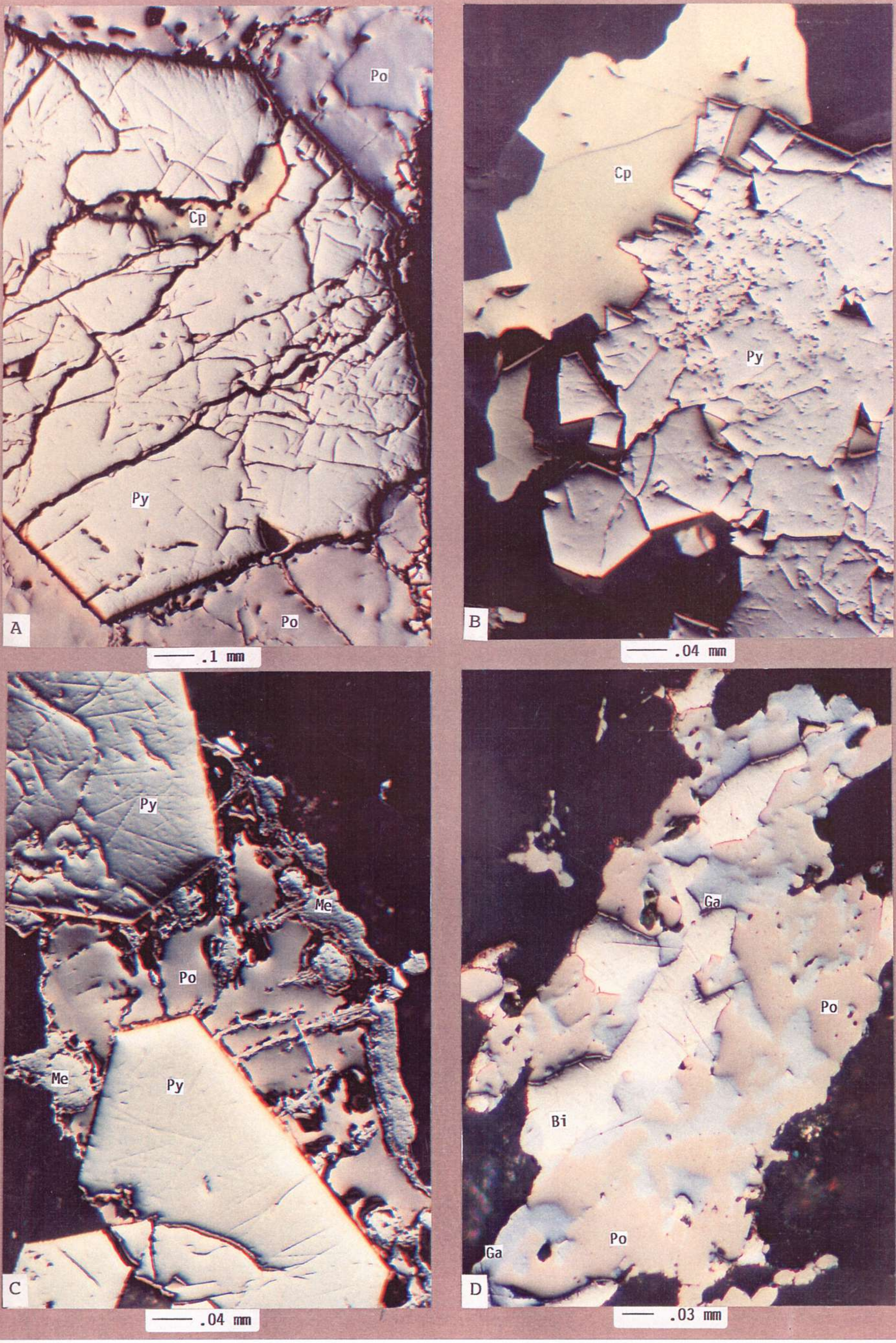
ABBREVIATIONS USED ON PLATES:

Au - Gold
Bi - Bismuth
Cp - Chalcopyrite
Cu - Cubanite
Ga - Galena
Ma - Magnetite
Me - Melnikovite
Po - Pyrrhotite
Py - Pyrite
Qz - Quartz

94-1362

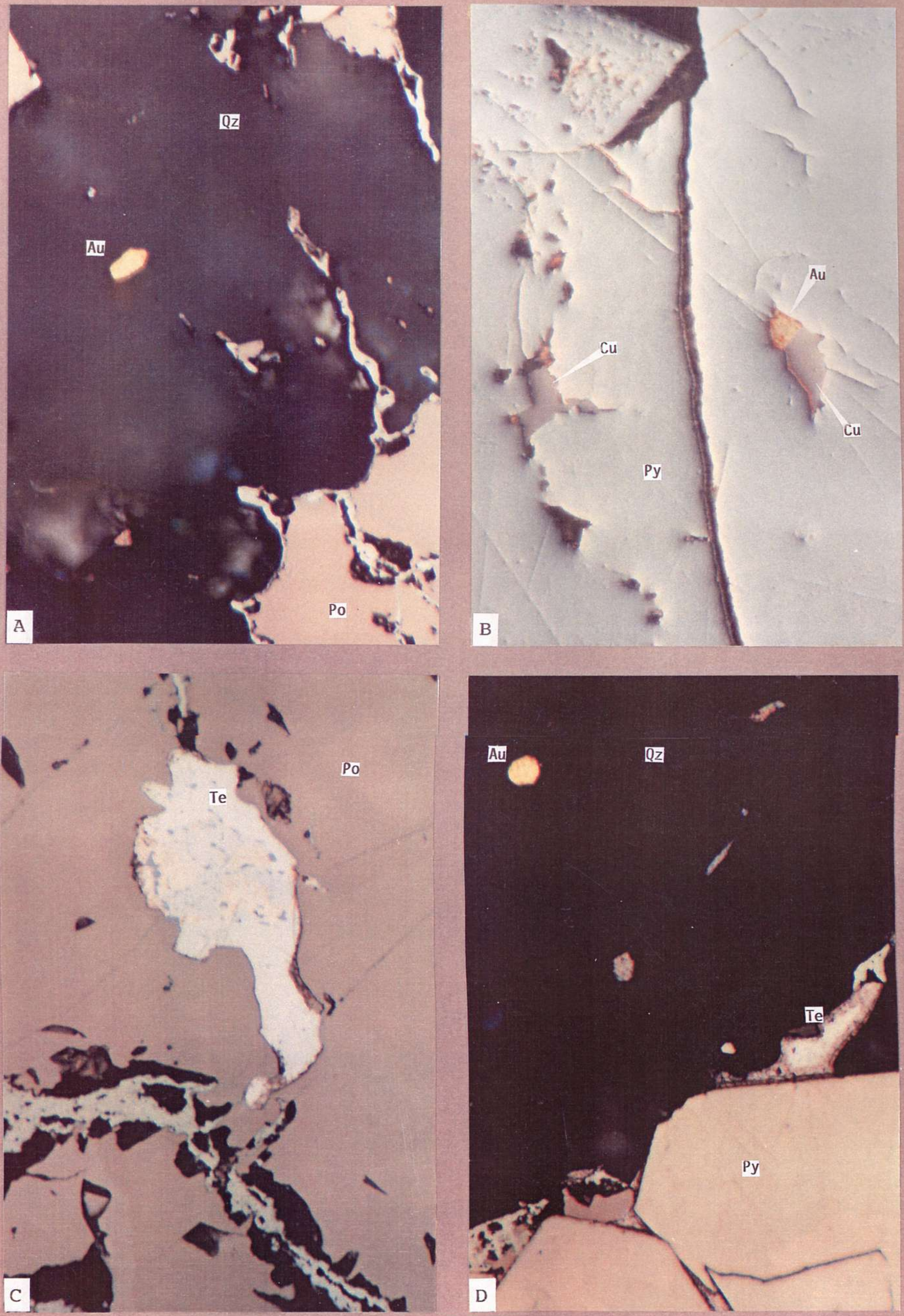
Sample #1. 27.76 PT

Plate 1



Sample #1.   27.76 PT

Plate 2



.01 mm

Sample #2.   09-14-94-9

Plate 3

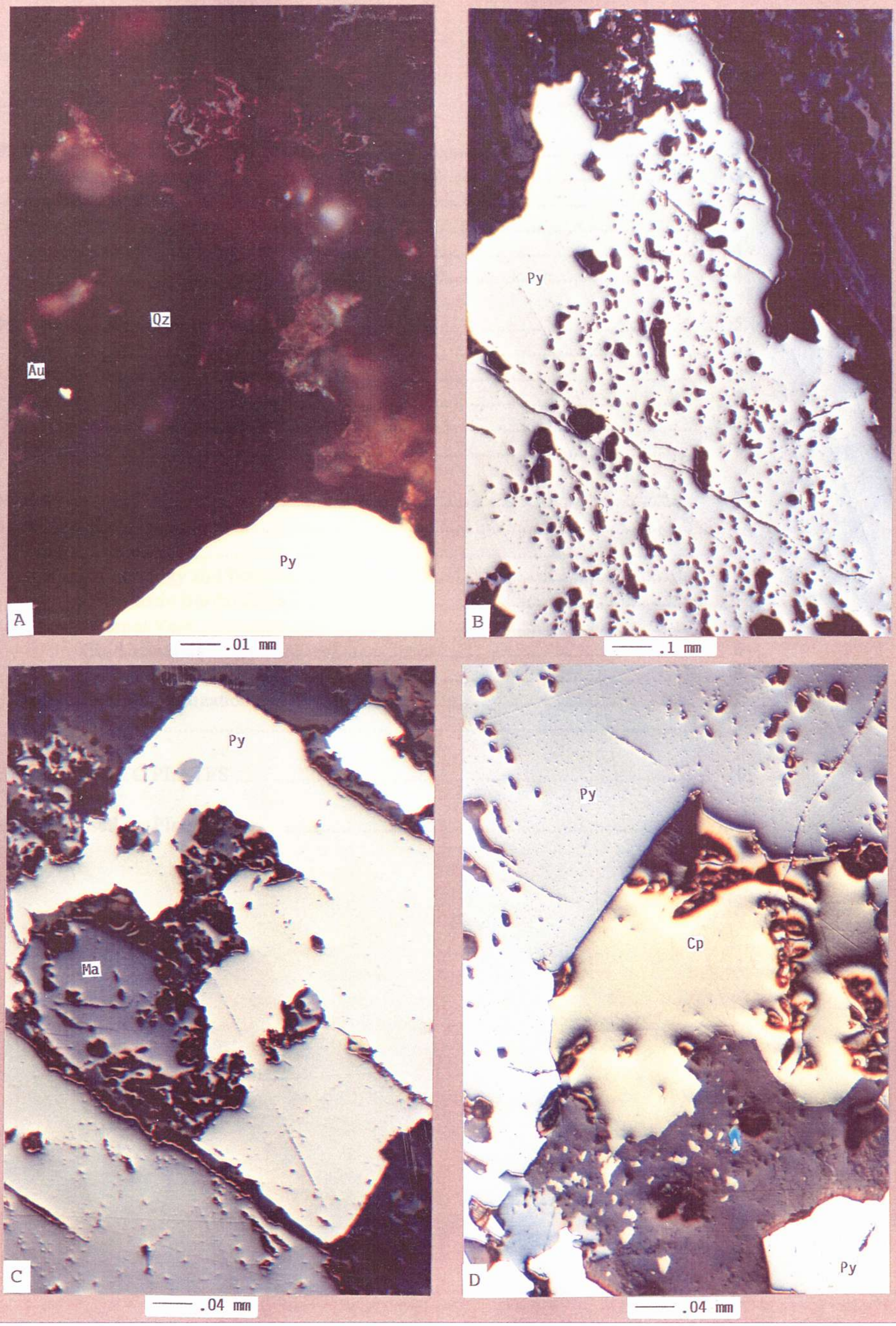


TABLE OF CONTENTS:

INTRODUCTION:

Three rock samples were analyzed in reflected light for content of native Gold and the related gold-bearing telluride mineralization.

The examination of other ore minerals, textures and alterations was performed. Except for the three polished thin sections, extra ten polished mounts were prepared. It was necessary to grind and polish some of the mounts three times, if the first section did not yield Gold grains. Gold was detected in the sample 94-10-1358. In the sample 94-10-1352 bis a few grains of a possible Silver has been found, but no Gold (see Plate 1).

Aside from Gold, very complex gold-bearing tellurides were detected. In the analyzed sample, tellurides can be even more important carriers of gold than native Gold itself. They require further studies and probing.

SAMPLE 94-10-1352

Macroscopic Description:

A very strong mineralization of Pyrrhotite intergrown with a minor Quartz and carbonate (Ankerite ?) is visualized by a magnifying glass.

Mineral Content:

Pyrrhotite (main sulphide)
Pyrite (common)
Melnikovite (common)
Chalcopyrite (less common)
Arsenopyrite (minor)
Goethite (minor)

Opaque Mineralogy and Textures:

Pyrrhotite is a host primary sulphide. It is developed as anhedral clusters about 2 cm in size. Pyrrhotite displays numerous cleavage cracks and tensional fissures. The tensional gaps are filled up with Quartz, carbonate and secondary sulphides: Pyrite, Chalcopyrite and less common Arsenopyrite. The structural porosity is widely developed, as about 10% of the fissures and cleavage cracks remain open. The open vugs are up to 0.5 mm in size.

Under crossed nicols, the twin lamellation and translation due to strong mechanical stressing is striking. Along some fissures an annealed dissaggregation of Pyrrhotite is noticeable.

In Interference Contrast, an unmixed variety of the softer Pyrrhotite (Pi) occurs within host Pyrrhotite (Po) which is harder. The softer variety of Pyrrhotite is minor and displays a lamellae texture.

Chalcopyrite is minor. It occurs in Pyrrhotite along fissures, or on rims of the silicified vugs. Chalcopyrite is anhedral, 0.1-05 mm in size.

A colloform-textured **Melnikovite**, which is gradually recrystallized into regular Pyrite crystals, uncommonly displays replacements within Pyrrhotite. The pyritization is under 5% of the total Pyrrhotite volume.

Pyrite in larger vugs and fissures, is commonly euhedral, up to 0.3 mm in size. It occurs in two varieties. The first one is yellow, and isotropic. Another one is yellowish-white and distinctly anisotropic. A subnormal anisotropy occurs particularly in **arseniferous Pyrite**.

Goethite occurs in pores of some Pyrite grains as a result of oxidation.

Arsenopyrite uncommonly occurs in cracks as a companion of Pyrite. In trace amounts, it also occurs in Pyrrhotite as fine lamellar inclusions.

Sequence of Mineralization and Events:

1. Pyrrhotite
2. Thermal breakdown of Pyrrhotite in two phases (~350°C).
3. Mechanical stressing of Pyrrhotite.
4. Silicification, carbonatization and secondary sulphide mineralization: Chalcopyrite, Pyrite, Arsenopyrite.

Comments:

Gold has not been found in sample. Hexagonal (harder)variety of Pyrrhotite (Po) formed at higher temperature, at about 350°C has been partly transformed in softer monoclinic Pyrrhotite.

Although native Gold has not been noticed in the analyzed sample, its occurrence is highly possible in paragenesis with later sulphides, silica and Ankerite.

SAMPLE 94-10-1352 bis

Macroscopic Description:

The rock sample is an irregularly-shaped Quartz-Ankerite vein heavily mineralized in sulphides. The vein is laterally bordered by the wall-rock crystalline schist. Magnetite is the only opaque occurring in the schist. It is disseminated and fine-grained. Pyrrhotite and Pyrite are the only macroscopically visible sulphides. On weathered surfaces, abundant rust occurs. The open vugs, up to 5 mm in size, randomly occur in the gangue minerals.

Mineral Content:

Pyrrhotite (dominant)
Pyrite (very common)
Melnikovite (common)
Marcasite (locally common)
Arsenopyrite (locally common)
Chalcopyrite (minor)
Magnetite (minor)
Goethite (minor)
Galena (trace)
Silver (3 grains)

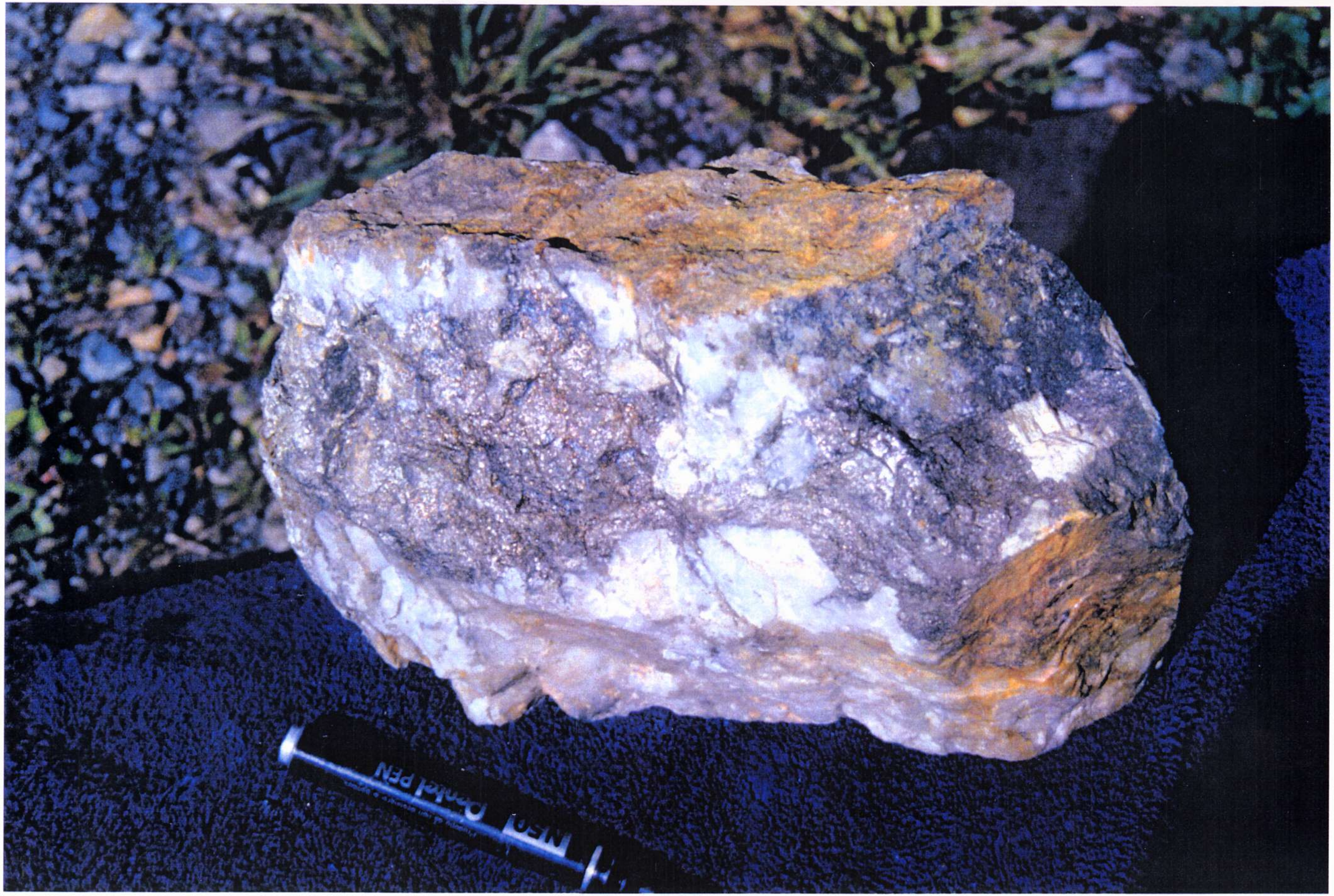
Opaque Mineralogy and Texture:

As in the sample 1352, **Pyrrhotite** is a primary sulphide. It forms irregularly-shaped clusters, about 3 cm in size, intergrown with gangue Quartz and Ankerite.

Due to tectonic strain, the structural porosity was widely developed in Pyrrhotite alongmicrocracks. The fissures and rounded vugs have been infilled with the gangue minerals and secondary sulphides. The twin lamellation and internal translations is common in Pyrrhotite. An examination of the Pyrrhotite in the Interference Contrast, discloses a very common unmixing of the low temperature Pyrrhotite (Pi) modification (see the former description). Pyrrhotite is successively replaced by Marcasite, Melnikovite and Pyrite. The textures of replacement are widely developed along cracks and borders of the Pyrrhotite grains. About 50% of the original Pyrrhotite was sulphurized to Pyrite. Within gangue minerals, randomly occur relicts of Pyrrhotite, up to 0.5 mm in size. Some of them are fresh, other display alterations to Marcasite and Melnikovite.

Pyrite occurs in two textural varieties. First one, probably older, is anhedral and strained. Along micro-cracks, it is commonly intergrown with anhedral **Arsenopyrite**. The second one is euhedral and borders larger vugs. Intercrystalline porosity is very common in euhedral Pyrite. Some pores are overgrown by the gangue minerals or by iron oxides, mainly Goethite (α-Fe_2O_3). A very common subnormal anisotropy indicates an arseniferous Pyrite.

Chalcopyrite occurs as anhedral fine-grained clusters in Quartz. It also overgrows rims of Pyrrhotite. Seldom, it is intergrown with **Galena** anhedral grains, below 0.1 mm in size (see



95-1349 "23 KM VIEN"

Plate 1, Fig. D). Galena intergrown with Chalcopyrite rarely occurs as inclusions in Ankerite.

Three grains of Silver, were detected in open vugs of Quartz and in a fractured Ankerite (see Plate 1, Fig. A, B and C). The grains, white in colour, display an unusually high reflectivity and are about 0.01 mm in size.

Sequence of Mineralization and Events:

1. Pyrrhotite formation
2. Thermal breakdown of Pyrrhotite in two phases (~350°C).
3. Mechanical stressing of Pyrrhotite.
4. Alteration of Pyrrhotite to Marcasite and Pyrite.
5. Arsenopyrite formation in deformed Pyrite.
6. Chalcopyrite, Galena and possibly Silver emplacement.

Comments:

Although native Gold has not been found in the studied sample, its occurrence is highly possible in paragenesis with Arsenopyrite, Galena and Silver.

Remarks: The sample was included in the bag number 94-10-1352. The sample is marked as 3-15-10. The corresponding polished thin section, however, has mistakenly been marked as 94-10-1358. In the present raport, the number **94-10-1352 bis** has temporarily been given to this sample.

SAMPLE 94-10-1358

Macroscopic Description:

The sample is a vein Quartz bordered by brecciated and partly oxidized sulphides (see Cataclastic Border Zone). Quartz is mechanically strained and slightly cleavaged. Some cracks in Quartz are infilled with strongly altered Pyrrhotite (see Internal Vein). Pyrite , Chalcopyrite and Pyrrhotite are noticeable macroscopically in the sample.

Mineral Content:

Sulphides:	Pyrite (dominant) Marcasite (very common) Pyrrhotite (common) Melnikovite (common) Chalcopyrite (less common) Galena (trace)
Oxides:	Magnetite (local) Goethite (local) Lepidocrocite (γ-FeOOH) (local)
Tellurides (minor):	Tetradimite (Bi_2Te_2S) Tellurbismutite (Bi_2Te_3) Petzite (Ag_3AuTe_2) (?) Nagyagite ($Pb_5Au(Te,Sb)_4S_5$)(?)
Native metals:	Bismuth (minor) Gold (trace)

Opaque Mineralogy and Texture:

Cataclastic Border Zone: **Pyrite** is a dominant sulphide. Together with sulphurized **Pyrrhotite,** it has been brecciated and then cemented by Quartz. The Pyrite cataclasms are up to 2 mm in size. The cracks among Pyrite grains are uncommonly infilled with **Chalcopyrite**.

Along the cataclastic border zone, Pyrrhotite is almost totally altered to **Marcasite**. Within birds-eye-textured agglomerations of Marcasite, Pyrrhotite occurs as relicts, up to 0.2 mm in size. Both, Marcasite and Pyrite are successively replaced by **Goethite** and **Lepidocrocite**. Lepidocrocite is commonly colloform-textured. **Gold** has not been found in the cataclastic zone

Internal Vein: Quartz is a main gangue mineral. It is mosaic-textured with sutured subgrains up to 5 mm in size. Due to tectonic deformation, undulose extinction of the mosaic subgrains is ubiquitous. The orientation of deformation bands is almost uniform along the thin section, and diagonally crosscutting the vein border. Minute fluid-gaseous inclusions are abundant in Quartz.

* 94-1358 is a piece off of 95-1270

MINERALOGY OF GOLD[12-19]

GOLD MINERALS[12,14]

Native and alloys

Native Gold	Au(Ag,Hg)
Electrum	(Au,Ag)
Cuprian gold	(Au,Cu)
Palladian gold	(Au,Pd)
Rhodian gold	(Au,Rh)
Iridian gold	(Au,Ir)
Platinian gold	(Au,Pt)
Bismuthian gold	(Au,Bi)
Auricupride	Cu_3Au
Tetraauricupride	CuAu
Rozhkovite	$(Cu,Pd)_3Au_2$

Intermetallic compounds

Weishanite	$Au_{1.2}Hg_{0.8}$
Goldamalgam	Au_2Hg_3(gamma)
Maldonite	Au_2Bi
Aurostibite	$AuSb_2$

Gold tellurides

Calaverite	$AuTe_2$
Krennerite	$(Au,Ag)Te_2$
Montbrayite	$(Au,Sb)_2Te_3$
Petzite	Ag_3AuTe_2
Sylvanite	$AgAuTe_4$
Kostovite	$CuAuTe_4$
Bilibinskite	$Au_3Cu_2Pb \cdot nTeO_2$
Bessmertnovite	$Au_4Cu \cdot nTeO_2$
Bogdanovite	$Au_5(Cu,Fe)_3\ (Te,Pb)_2$

Complex gold minerals

Nagyagite	$Pb_5Au(Te,Sb)_4S_{5-8}$

Sulphides/selenides

Uytenbogaardtite	Ag_3AuS_2
Liujinyinite	Ag_3AuS_2
Penginite	$Ag_4Au(S,Se)_4$
Petrovskaite	AuAg(S,Se)
Fischesserite	Ag_3AuSe_2

GOLD ASSOCIATED MINERALS[12]

may contain gold up to the following concentration (ppm)

Allemontite	500
Altaite	400
Native antimony	35
Acanthite	200
Native arsenic	150
Arsenopyrite	500
Aurian Silver	30%
Berzelianite	100
Bismuthinite	3,300
Chalcopyrite	20
Clausthalite	250
Native copper	200
Gersdorffite	100
Hessite	2,000
Iridosmine	10,000
Jarosite	7,900
Limonite, goethite	35
Melonite	3,200
Osmiridium	20%
Platiniridium	200
Native platinum	30,000
Pyrite	560
Pyrrhotite	22
Safflorite	700
Sphalerite	500
Stibnite	20
Native tellurium	30,000
Tetrahedrite	100
Ullmannite	20
Uraninite	30

The inclusions are in a variety of shapes. Their size is up to 0.02 mm. Bubbles of gas are commonly noticeable inside. Minor carbonates infill spaces among Quartz subgrains and in microcracks.

Pyrrhotite randomly occurs in intercrystalline vugs of Quartz. It forms elongated irregularly-shaped grains, up to 0.5 mm in width. On borders, the grains are successively altered to a colloform-textured **Melnikovite**, and then to **Marcasite** (see Plate 4, Fig. C). About 80% of the total Pyrrhotite has been sulphurized. Pyrrhotite and Marcasite are occasionally bordered by the second generation minerals: **Chalcopyrite, Bismuth, Gold** and telluride minerals. It is noticeable, however, that some portion of Chalcopyrite is coeval with Pyrrhotite. Tellurides are very common inclusions in Quartz. They are mineralogically complex, and due to fine-grained texture, hard to identify optically.

Gold Minerals: In four polished mounts and two polished thin sections, over 30 grains of native **Gold** were detected. The three largest grains were 0.03-0.05 mm in size. Other 27 grains were 0.01-0.03 mm in size. The grains are subhedral or euhedral in shape, especially those occurring in Quartz.

Native Gold mainly occurs close to the borders between sulphides and Quartz. Less frequently, it occurs as inclusions in Pyrrhotite or Marcasite (see Plates 3 and 5).

Frequently, Gold is intergrown with tellurides and native Bismuth (see Plates 2, 3 and 6). As a rule, all above minerals precipitate in close proximity to each other. They also tend to occur on the surface of sulphides, or very close to the sulphide edges. Bismuth and telluride grains are always anhedral and up to 0.1 mm in size. By visual evaluation, volumetric contribution of telluride minerals in Quartz vein is 100 times higher than that of native Gold.

Tellurides: **Tetradimite (Bi_2Te_2S)** is most common. Its hardness is lower than that of Gold. Most frequently, Tetradimite displays anhedral clusters, but euhedral grains with a layer structure also occur (see Plate 6, Fig. A). A very high reflectivity (~60%) and white creamy colour is characteristic. Between crossed nicols, anisotropy is weaker than that of Bismuth, but no reflection pleochroism is noticeable. Crystals commonly contain minute inclusions of harder grains. The inclusions display reflectivity power comparable to Galena.

Tellurbismutite (Bi_2Te_3) differs from Tetradimite by higher reflectivity power. Other optical charaeteristics are similar to that of Tetradimite. Uncommonly, it forms lamellar crystals (see Plate 4, Fig. D). A grain of a sandwitch-textured Tellurbismutite intergrown with Gold was found. Rounded inclusions of Galena have been observed in Tellurbismutite.

Petzite (Ag_3AuTe_2) displays polishing hardness intermediate between that of Gold and Tetradimite. At first glance, it resembles Galena, but is strongly anisotropic between crossed nicols. Its reflectivity is slightly higher than that of Galena. In linearly polarized light, a blue-reddish hue is characteristic. Grains of Petzite are anhedral. They are intergrown with Bismuth and tellurinm compounds. Gold grains are common companions of Petzite (Plate 2 & 5, Fig. D).

Nagyagite ($Pb_5Au(Te, Sb)_4S_5$) is rarer than Petzite. Together with Petzite, its reflectivity is similar to that of Galena. Anisotropy and bireflection pleochroism is distinctive. In contact with Petzite, Nagyagite grains display a higher polishing hardness.

Sequence of Mineralization and Events:

1. Pyrrhotite emplacement.
2. Pyrite emplacement.
3. Cataclasis of above sulphides accompanied with a synkinematic alteration of Pyrrhotite to Melnikovite and Marcasite.
4. Postkinematic Chalcopyrite emplacement in cracks between Pyrite and in Quartz.
5. Coeval mineralization of Bismuth, Tellurium and Gold.

Comments:

In the analyzed vein sample, the volume of gold-tellurium and gold-bismuth minerals is much higher than that of native Gold. Therefore, the economic potential of gold in compounds with tellurium and bismuth is probably higher than that of a native metal itself.

Due to fine-grained textures and polishing difficulties (too soft to take good polish), the optical determinations of gold-tellurides should be verified by microprobing or EDX analysis.

Remarks: Two polished thin sections corresponding to the sample 94-10-1358 has mistakenly been marked as 94-10-1352.

EXPLANATIONS TO PLATES

Plate 1. Sample 94-10-1352bis (A). Reflected light with I.C.

- A. Silver grain in open pore in Quartz.
- B. Another grain of Silver in porous Quartz.
- C. Silver grain in porous Ankerite.
- D. Altered Pyrrhotite, Chalcopyrite and Galena.

Plate 2. Sample 94-10-1358 (A). Reflected Light with I.C.

- A. Gold grains (yellow), Petzite (bluish) and Tetradimite (white-pinkish) overgrowing Chalcopyrite (green).
- B. A cluster of Chalcopyrite, Gold and different tellurides intergrown together.
- C. A small grain of Gold near the edge of Pyrrhotite (upper part of the picture). Tetradimite with Petzite (bluish) intergrown with Pyrrhotite (lower Part of the picture).
- D. Tellurbismutite, Petzite and Gold grains bordering partly altered Pyrrhotite.

Plate 3. Sample 94-10-1358 (A). Reflected Light with I.C.

- A. An anhedral grain of Gold intergrown with Tetradimite.
- B. Euhedral Gold (yellow) intergrown with Bismuth.
- C. Inclusion of Gold and native Bismuth in Pyrrhotite.
- D. Euhedral crystal of Gold intergrown with Tetradimite bordering Pyrrhotite in Quartz.

Plate 4. Sample 94-10-1358 (D). Reflected Light with I.C.

- A. A subhedral Gold grain in Quartz near strongly altered Pyrrhotite intergrown with three tellurides. A grey-bluish grain is Nagyagite.
- B. A small grain of Gold intergrown with Pyrrhotite near the edge of oxidized Melnikovite.
- C. Pyrrhotite altered on borders to Marcasite. In the upper part, an elongated crystal of telluride.
- D. An elongated crystal of Tellurbismuth intergrown with a narrow grain of altered Pyrrhotite.

Plate 5. 94-10-1358 (thin section). Reflected Light with I.C.

A. An euhedral grain of Gold with Pyrrhotite (brown-pinkish) and porous Melnikovite (grey-bluish).

B. As above, but in different location.

C. A grain of Silver in pore. A larger grain is Pyrite.

D. (Sample C) An anhedral grain of native Bismuth (white-pinkish) with inclusions of Nagyagite (dark grey). Pyrrhotite (brown-pinkish) is in centre. In the bottom two anhedral grains of Gold included in Quartz.

Plate 6. Reflected Light with I.C.

A. (Sample A) An euhedral cristall of Tetradimite in Quartz. On the polished surface, unidentified harder inclusions occur.

B. A grain of Gold (yellow) near Pyrrhotite (brown-pinkish) and tellurides (white and grey).

C. Bismuth and tellurides precipitated near sulphides.

D. A grain of Gold intergrown with Petzite.

ABBREVIATIONS USED ON PLATES:

Ag - Silver
Au - Gold
Bi - Bismuth
Ca - Carbonate
Cp - Chalcopyrite
Ga - Galena
Me - Melnikovite Ms - Marcasite
Po - Pyrrhotite
Py - Pyrite
Qz - Quartz
Td - Tetradimite or Tellurbismuthite
Te - All other tellurides

Projects Joranex 4 (page 1) Film Impresa 50 Data February 95

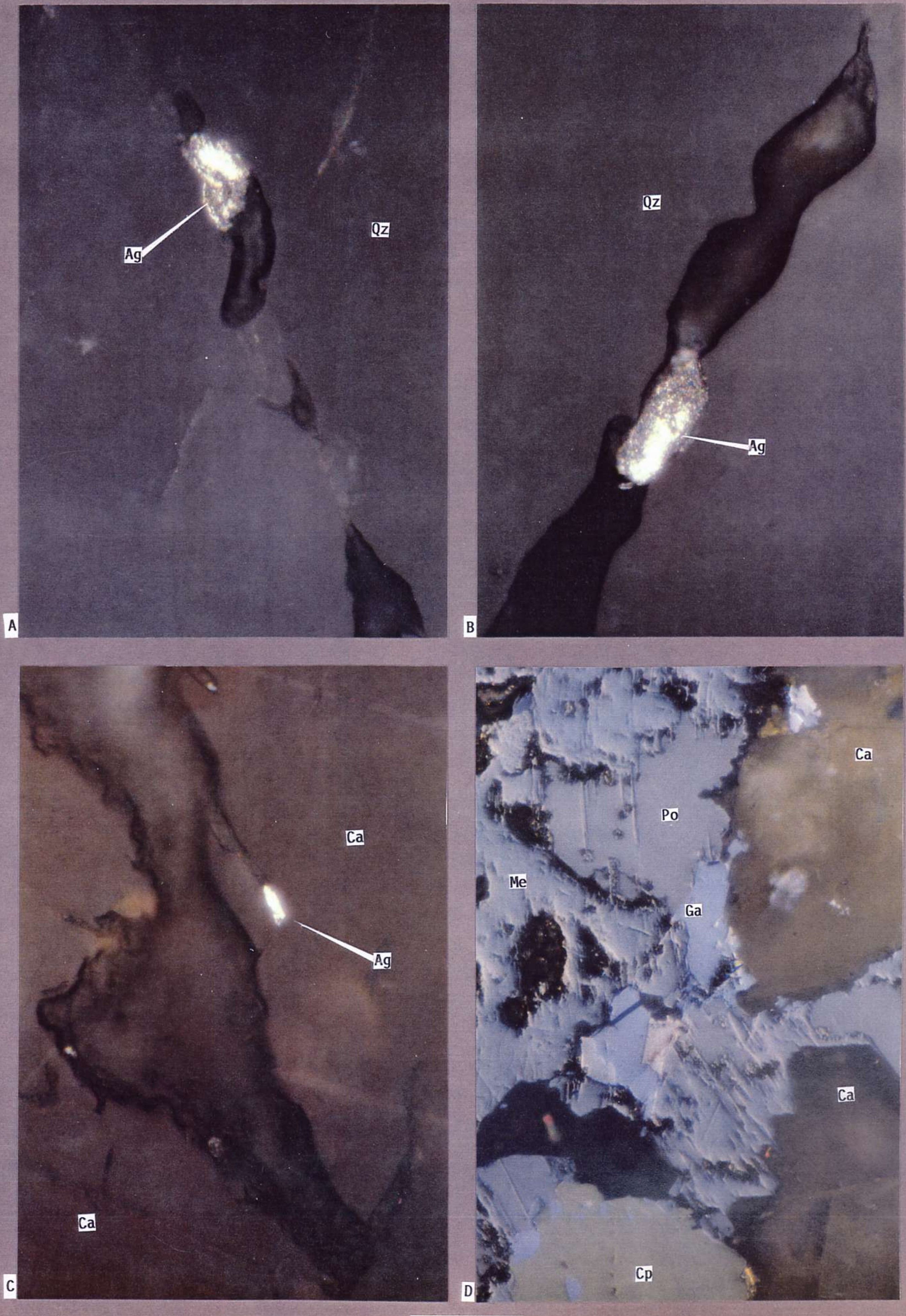
	Thin sect.	Lens	Subject	Remarks
1	94-10-1358(D)	40x IC	Au + Te + Ga	
2	-"-	16x IC.	-"-	
3	-"-	40x IC	Au + Po + Marasite	Au small grain
4	-"-	16x IC	-"-	
5	1358(c)	40x IC	Bi + Po + Au + Marc.	2 grains of Au
6	-"-	-"-	-"-	deffective picture
7	-"-	40x IC	Au + Te	integrated grain
8	Thin section (1358)	40x IC	Au + Po + Melnik.	a grain (I)
9	-"-	-"- IC	-"-	-"- (II)
10	94-10-1358(A)	-"- IC	Cp + Au + Tellurides + Bi	
11	-"-	-"-	-"-	Analyser disconnected
12	-"-	40x IC	Cp + Tell + Bi + Au	
13	-"-	-"-	Au + Bi inside Po + Cp	
14	-"-	-"-	Au + Tetradimite	integrated grain
15	-"-	-"	3 small grains of Au in grey Te	
16	-"-	-"-	Au + Te beside Po	
17	-"-	-"-	Au + Te bordering Po + Mark	
18	-"-	-"-	Tellurbismuthite crystall	or Tetradimite
19	-"-	-"-	-"-	Analyser disconnected
20	-"-	-"-	-"-	-"-
21	Thin section (1358)	40x	Cp + Silver in pore	no IC
22	94-10-1352bis(A)	40x	Silver in pore of Qz	-"-
23	-"-	40x	-"- -"-	-"-
24	-"-	40x	Silver in Carbonate	-"-
25	-"-	40x IC	Po + Cp + Tellurides	

Sample 94-10-1352 bis (A)

Projects Jorenex 4 (page2) Film Impresa 50 Data February 95

	Thin sect.	Lens	Subject	Remarks
26	94-10-1358(D)	40x IC	Au in Qz beside Po + Te	After next grinding and polishing +
27	—"—	16x IC	—"—	Deffective plct.
28	—"—	16x IC	—"—	—"— —"—
29	—"—	10x IC	Sylvanite + Po	+
30	—"—	10x	—"—	no IC
31	—"—	10x IC	—"—	other place +
32	—"—	10x	—"—	—"— —"— - no IC
33	—"—	40x	Cp + Au (small gr.)	
34	1358(C)	16x IC	Bi + 2 gr. of Au	
35	—"—	—"—	Bi + very small gr. Au	+
36	1358(A)	Deffective		
37	—"—	40x IC	Te in Po; Au grain	+
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				

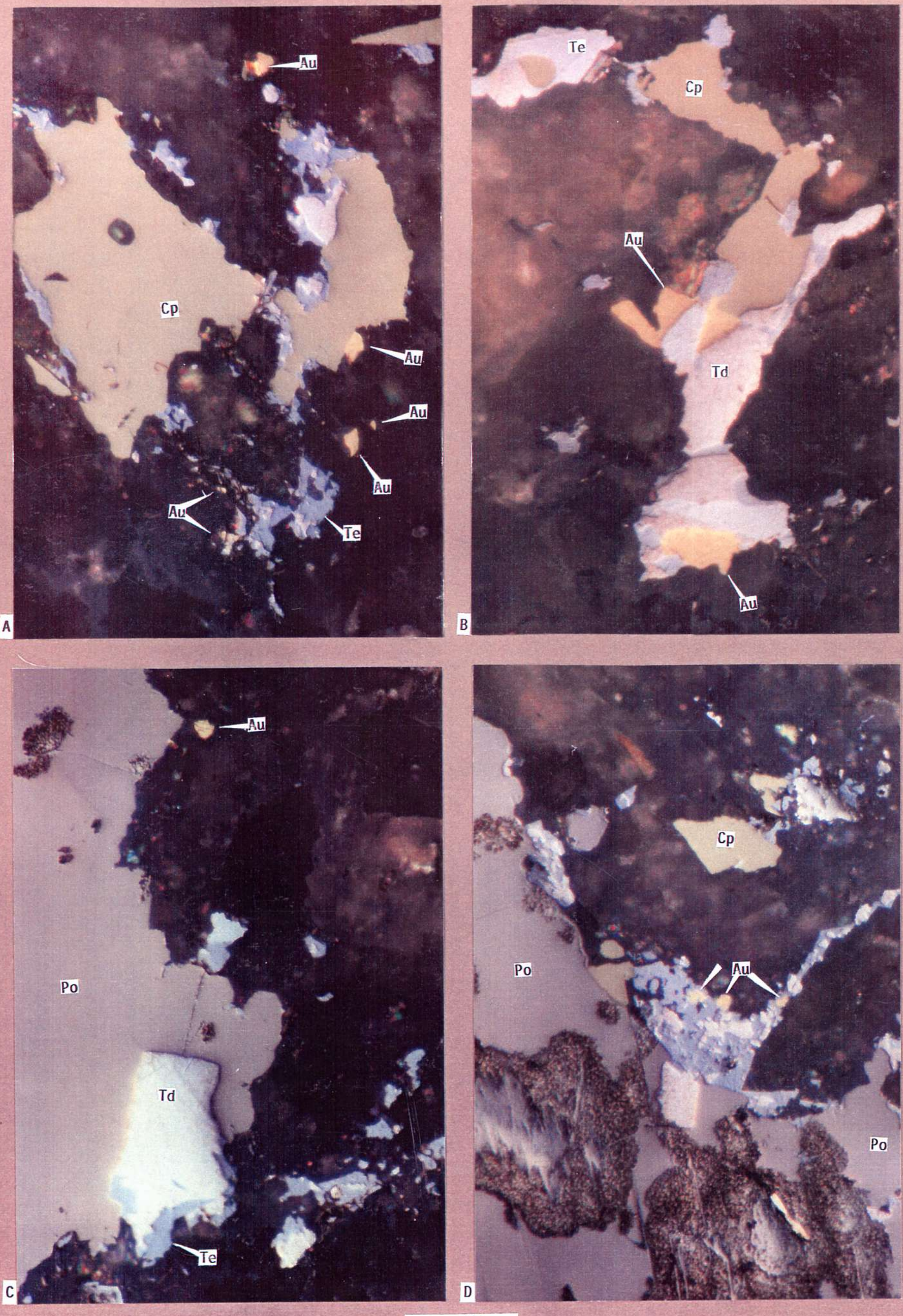
Sample 94-10-1352 bis (A)



—— .01 mm

Sample 94-10-1358 (A)

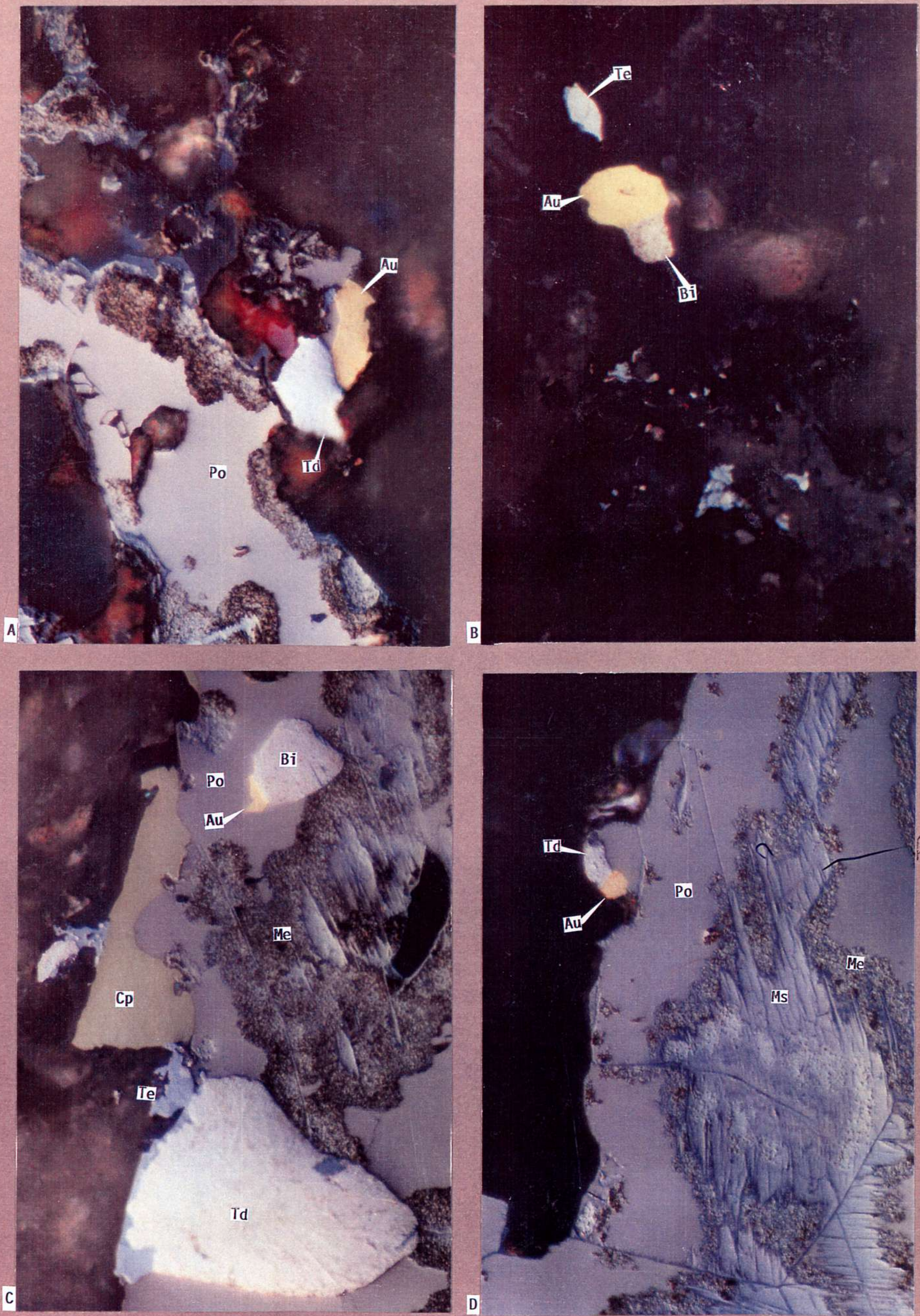
Plate 2



.01 mm

Sample 94-10-1358 (A)

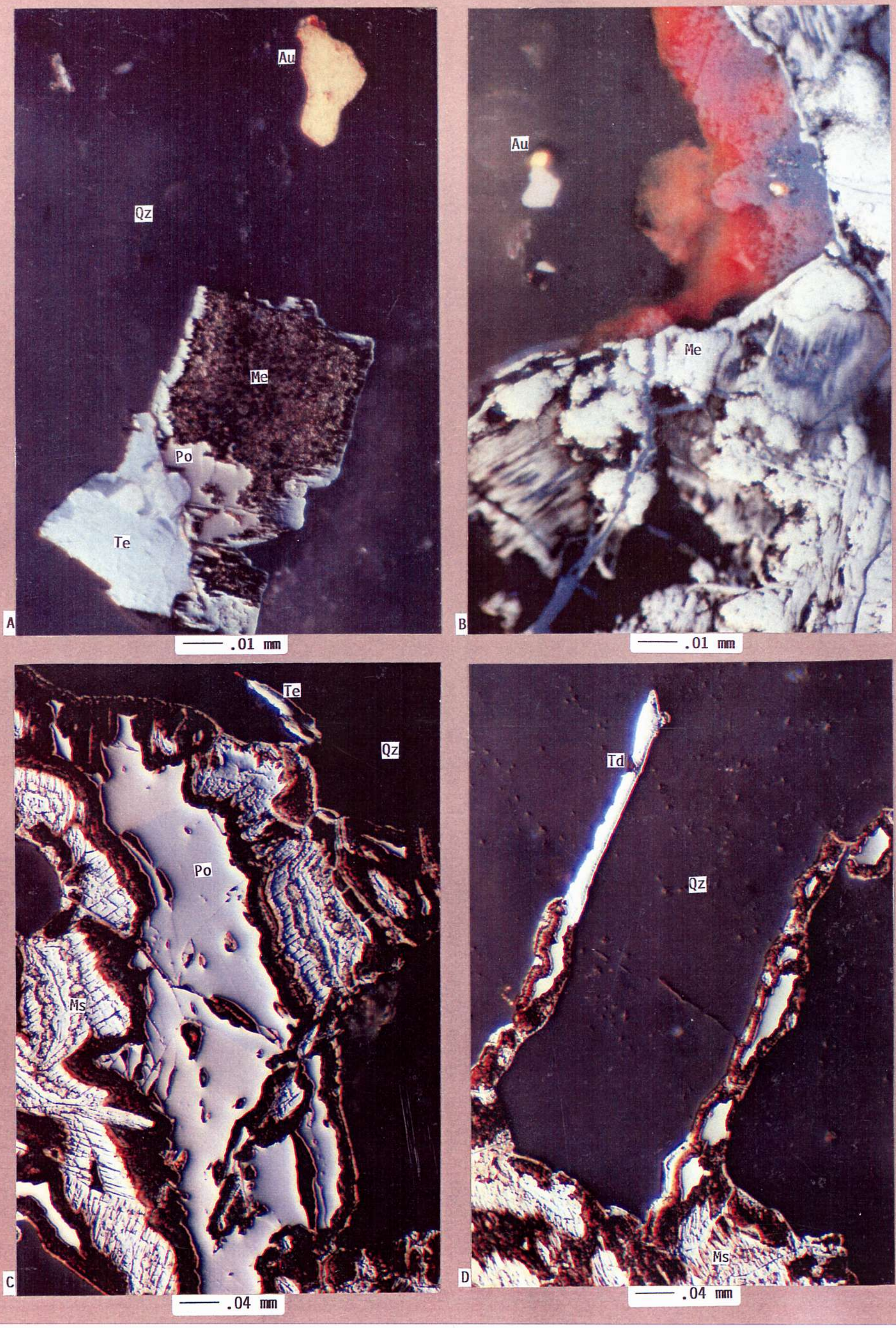
Plate 3



.01 mm

Sample 94-10-1358 (D)

Plate 4



Thin Section 94-10-1358

Plate 5

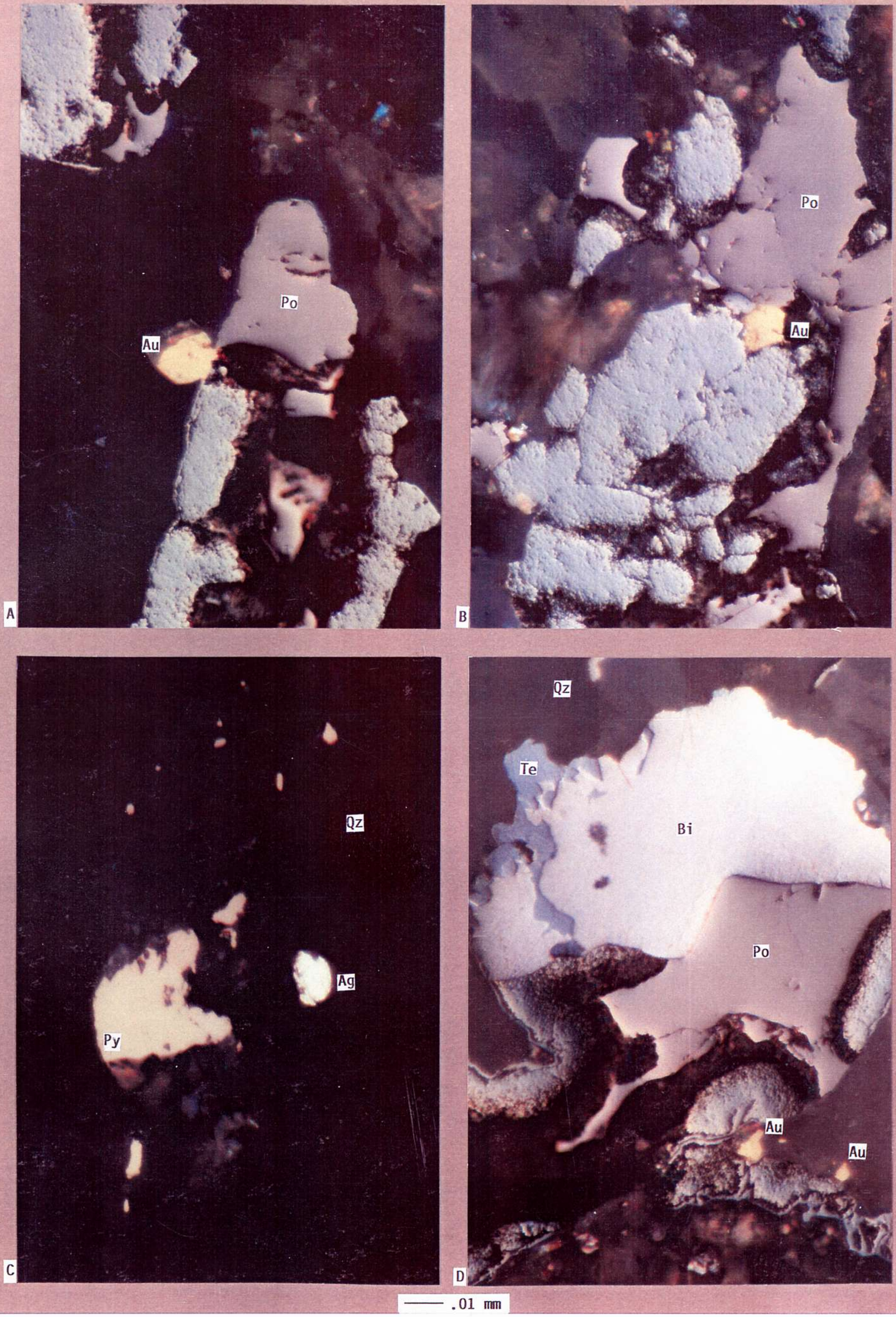


Plate 6