

## **Appendix 3**

Trafalgar Mineralogy March 2013 by Gary McArthur  
(McArthur Ore Deposit Assessments Pty Ltd).

**KEN MORRISON & ASSOCIATES**

**TRAFALGAR MINERALOGY**

**MARCH 2013**

**MODA**  
**microscopy**

**McArthur Ore Deposit Assessments Pty Ltd**

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# **KEN MORRISON & ASSOCIATES**

## **TRAFALGAR PROSPECT**

### **SULPHIDE MINERALOGY**

#### **Introduction**

Ken Morrison submitted two samples (TG1, TG2) of granodiorite from the Trafalgar Prospect for identification of any sulphides present.

Two polished thin sections were made from sample TG1 and one large polished thin section was made from sample TG2 by Simon Stephens (CODES, UTas).

The polished thin sections were examined using an optical microscope in transmitted and reflected light. All minerals were identified and the textural styles of each mineral present were described. Volume% were visually estimated.

Numerous photomicrographs were taken of all three polished thin sections to illustrate the textural features observed. These were annotated using PowerPoint.

#### **Summary**

The granodiorite is variably altered in both samples with sericite (and minor carbonate) partially replacing feldspars and biotite. In sample TG2 some of the biotites are replaced by chlorite. Rare disseminated pyrite, arsenopyrite and chalcopyrite are seen associated with the sericite alteration, and very rare disseminated sphalerite, galena and pyrrhotite were seen in sample TG1 in carbonate. An arsenopyrite-galena-cerussite veinlet in sample TG1 was host to 5 grains of electrum.

## Detailed Observations

### Sample TG1A

#### Non-sulphides

**Quartz** (80%) – crystals up to 6mm in coarse granular aggregates with feldspar, with interstitial sericite-carbonate

**Sericite** (10%) – irregular, vuggy, anastomosing veinlets <200µm wide of mostly finely crystalline sericitic muscovite; irregular fibrous masses interstitial to quartz-feldspar; scattered flakes <100µm replacing feldspar; rims <50µm wide replacing biotite; rare fibrous muscovite <500µm

**Feldspar** (5%) – equant, simply-twinned grains <5mm dusted by replacive sericite flakes

**Carbonate** (5%) – probable calcite – irregular coarse-grained veinlets up to 1.5mm wide; irregular medium-grained grains intergrown with sericite

**Biotite** (1%) – scattered flakes <600µm strongly replaced by sericite

**Rutile and titanomagnetite** (trace) – common acicular grains hosted by altered biotite <100µm; irregular, corroded aggregates <200µm hosted by sericite

**Zircon?** (trace) – scattered zoned crystals <100µm

#### **Sulphides (trace)** (in approximate descending order of predominance)

**Arsenopyrite** – mostly as disseminated rhombs <80µm hosted by quartz or sericite; less common as coarse aggregates up to 600µm in sericite – no associated gold seen

**Pyrite** – as narrow selvages <50µm wide coating narrow open cracks (later than sericite) weakly replaced by goethite

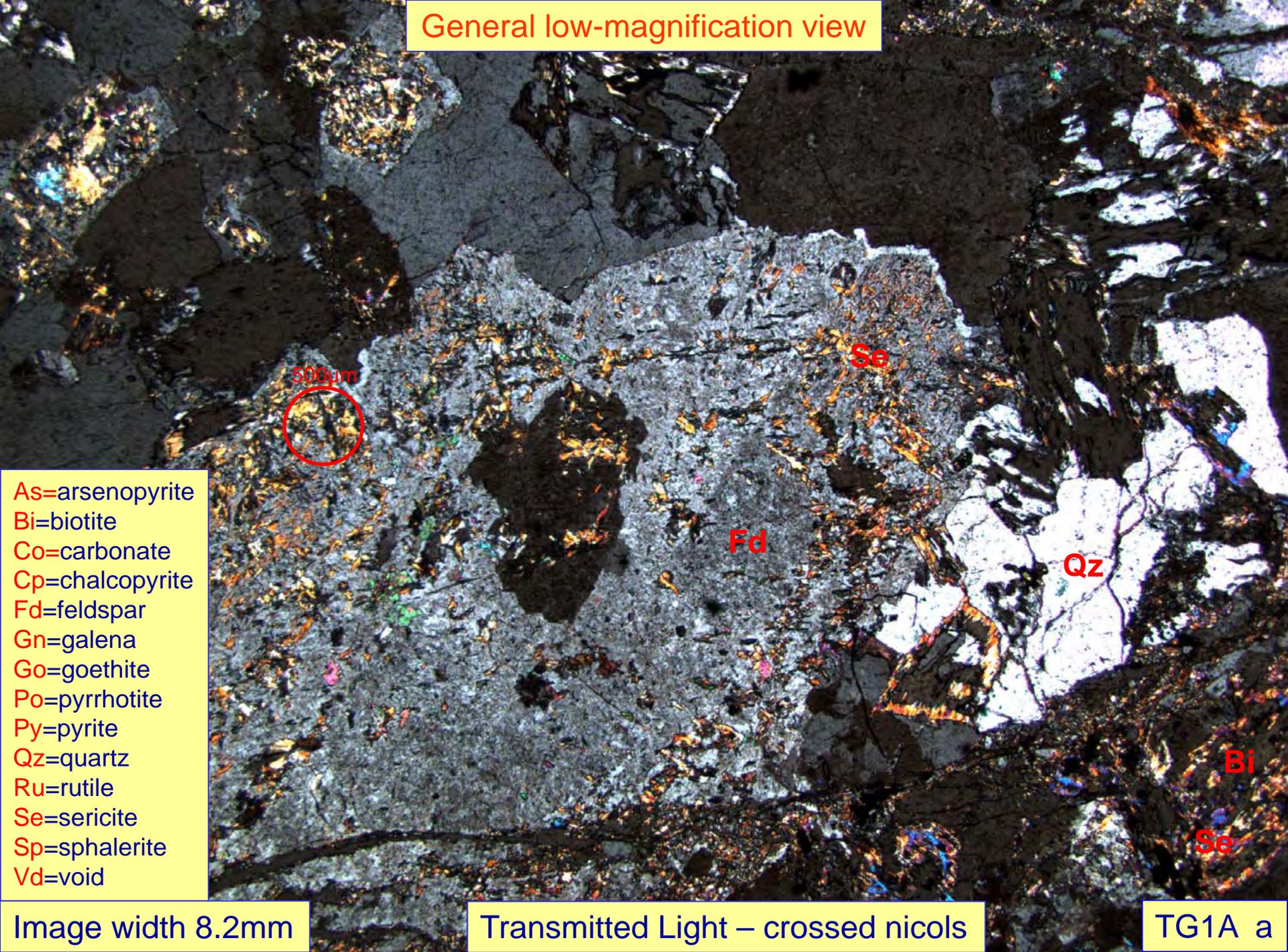
**Pyrrhotite** – as irregular blebs <100µm hosted by coarse-grained carbonate

**Sphalerite** – one 80µm grain of Fe-rich sphalerite in carbonate

**Galena** – one 50µm grain in quartz

**Chalcopyrite** – one 20µm grain hosted by carbonate near pyrrhotite

General low-magnification view



500um

Se

Fd

Qz

Bi

Se

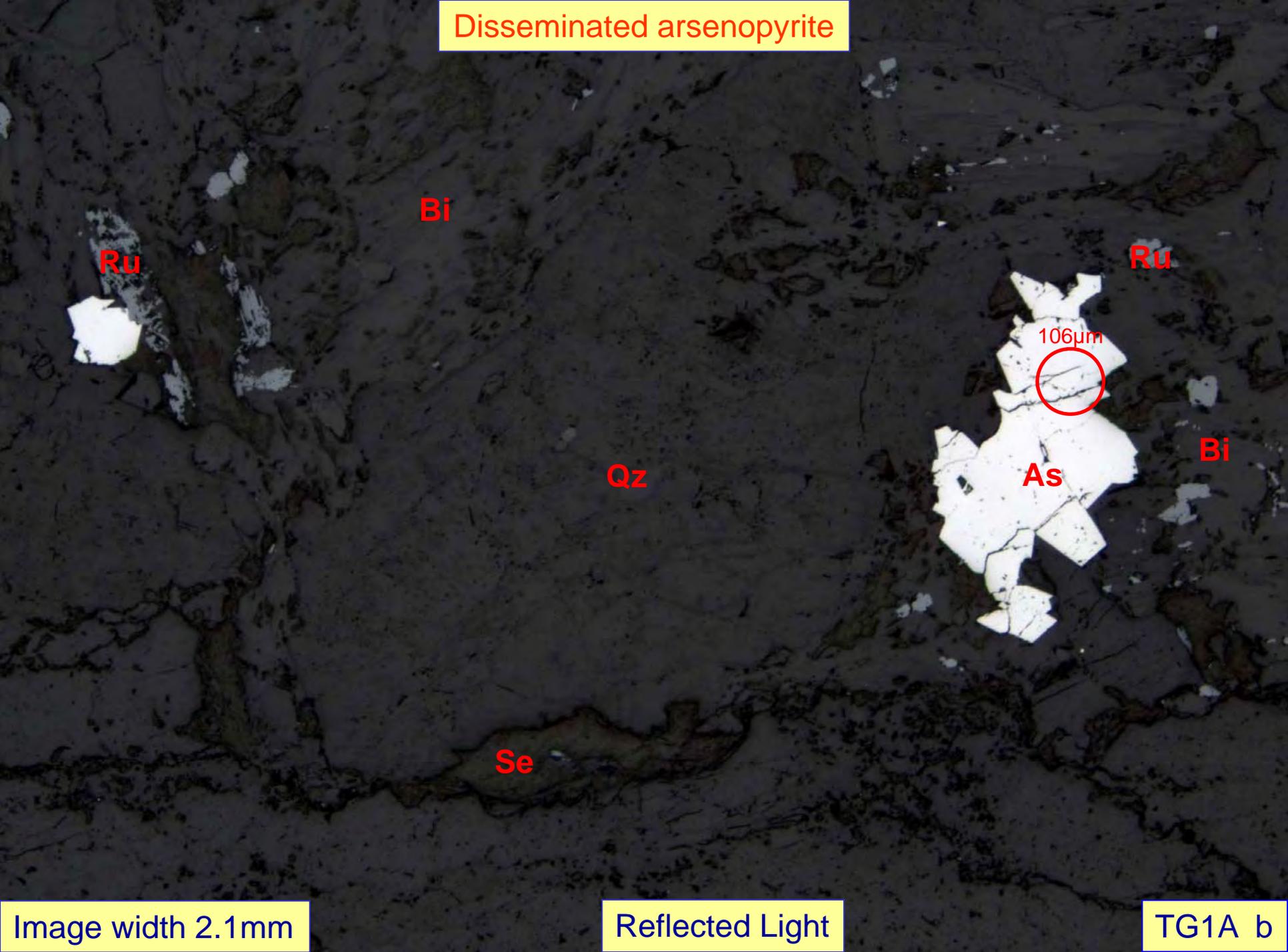
- As=arsenopyrite
- Bi=biotite
- Co=carbonate
- Cp=chalcopyrite
- Fd=feldspar
- Gn=galena
- Go=goethite
- Po=pyrrhotite
- Py=pyrite
- Qz=quartz
- Ru=rutile
- Se=sericite
- Sp=sphalerite
- Vd=void

Image width 8.2mm

Transmitted Light – crossed nicols

TG1A a

Disseminated arsenopyrite



Ru

Bi

Ru

106µm

Qz

As

Bi

Se

Image width 2.1mm

Reflected Light

TG1A b

Detail of rare mixed sulphides

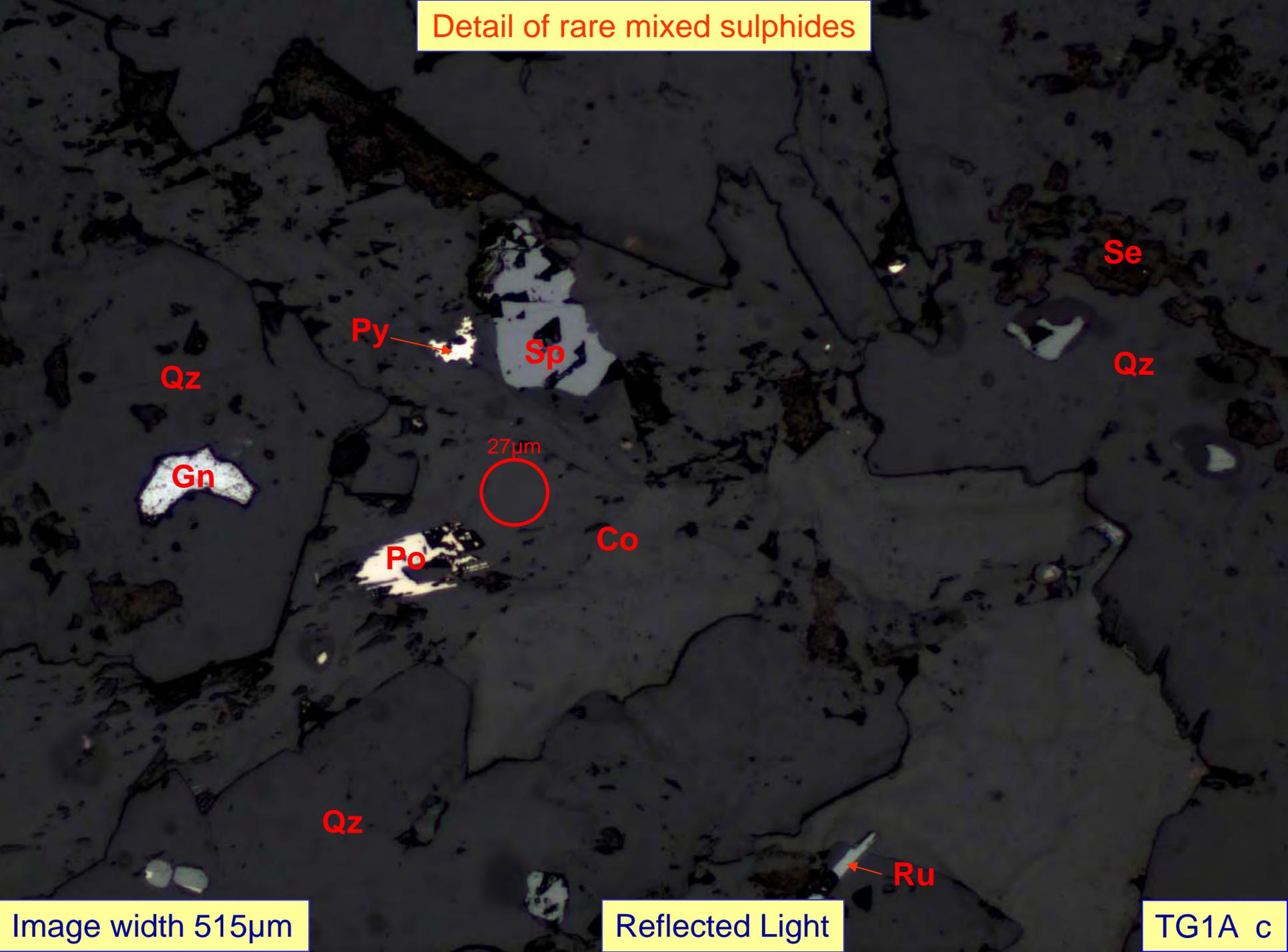


Image width 515µm

Reflected Light

TG1A c

Pyrrhotite-chalcopyrite in carbonate

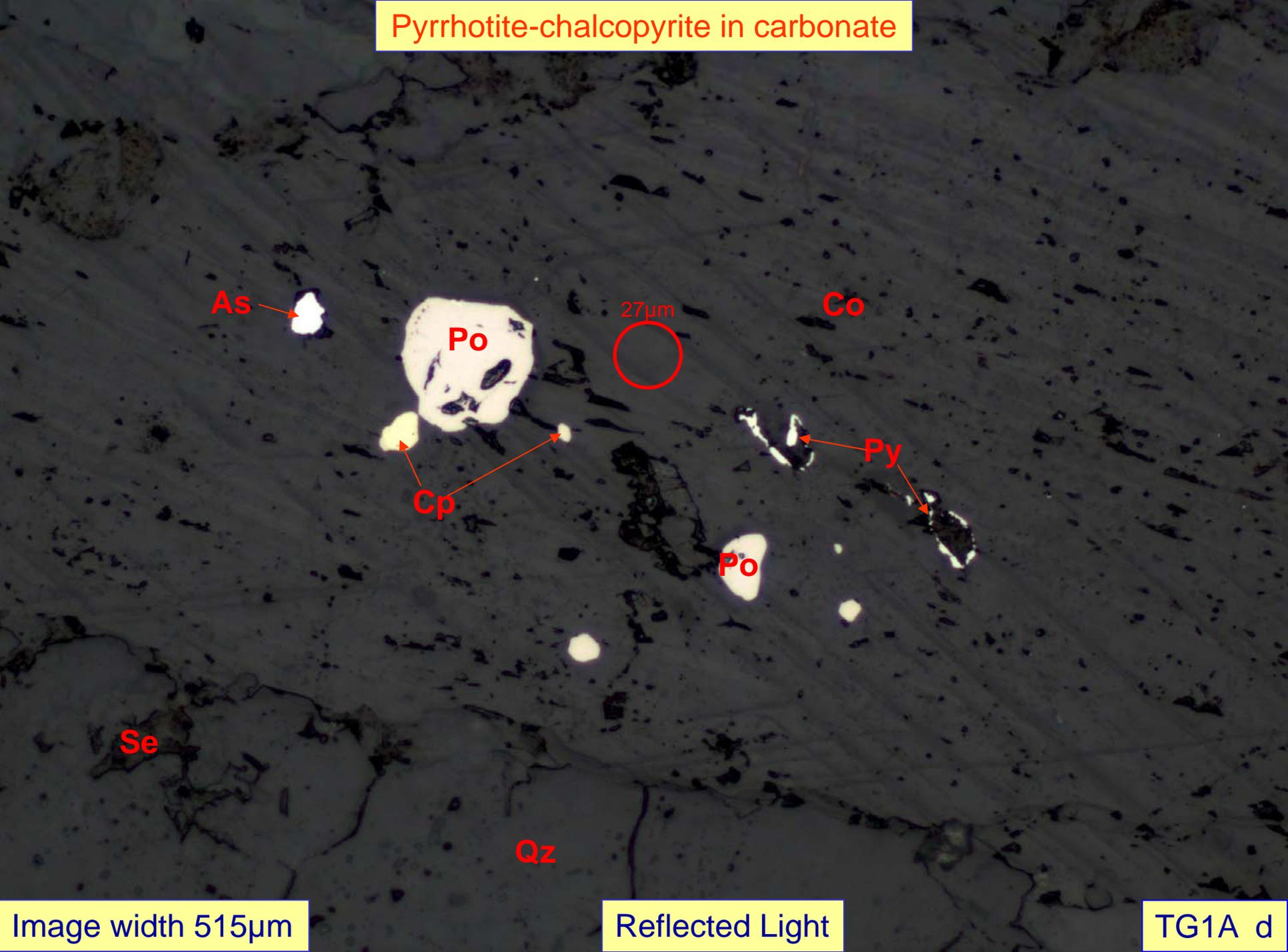
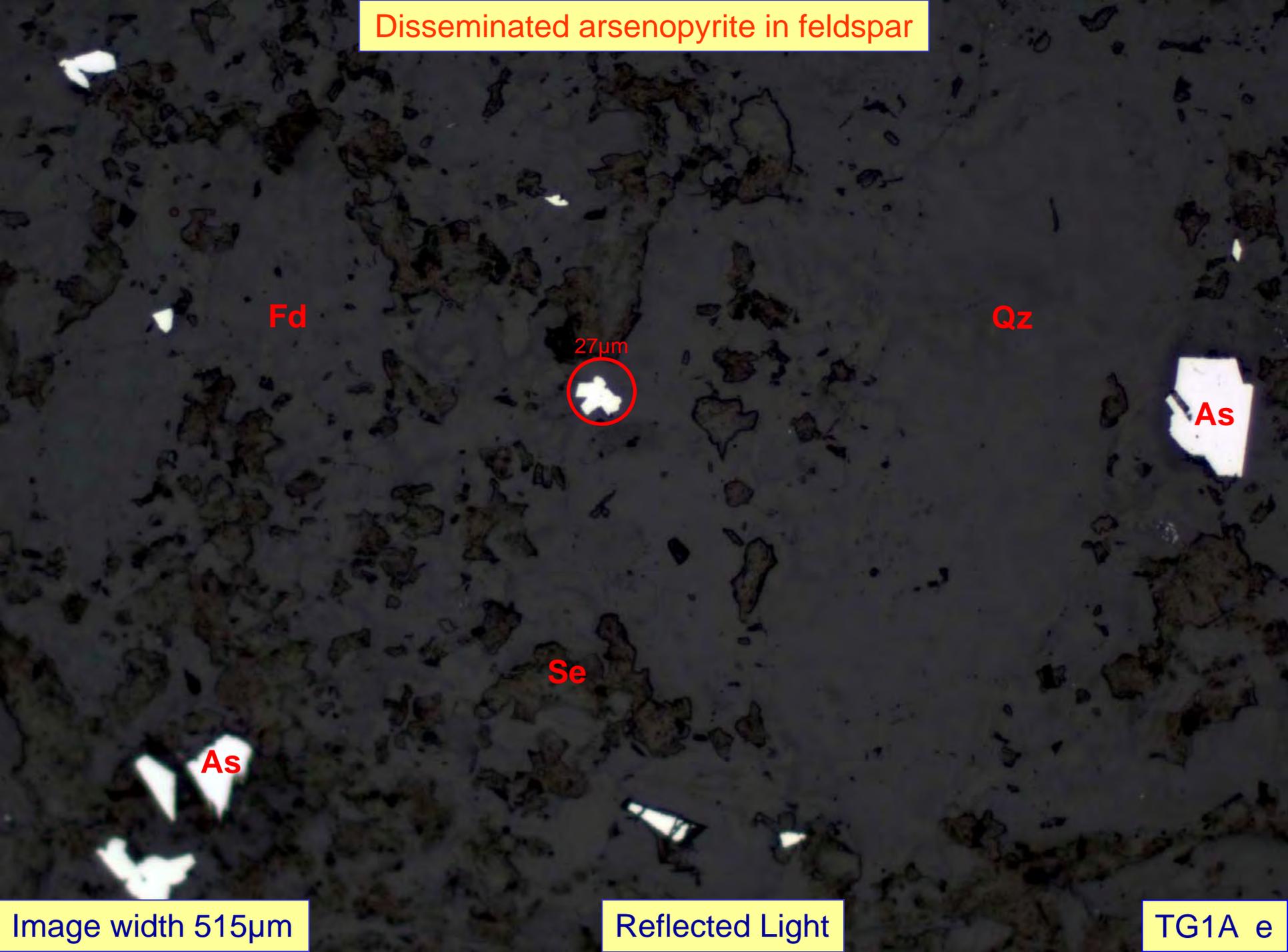


Image width 515µm

Reflected Light

TG1A d

Disseminated arsenopyrite in feldspar



Fd

Qz

As

27µm

Se

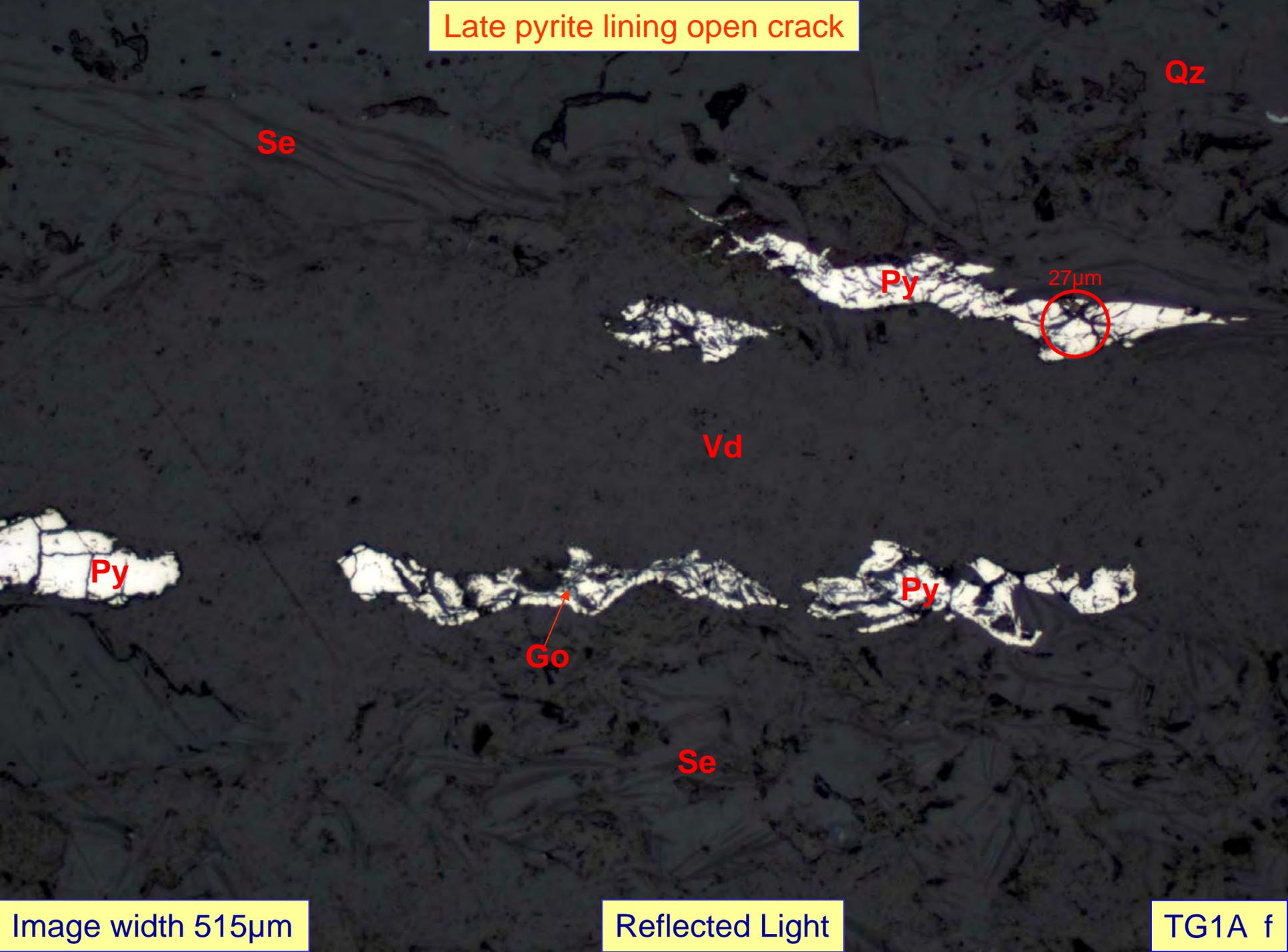
As

Image width 515µm

Reflected Light

TG1A e

Late pyrite lining open crack



Se

Qz

Py

27µm

Vd

Py

Go

Py

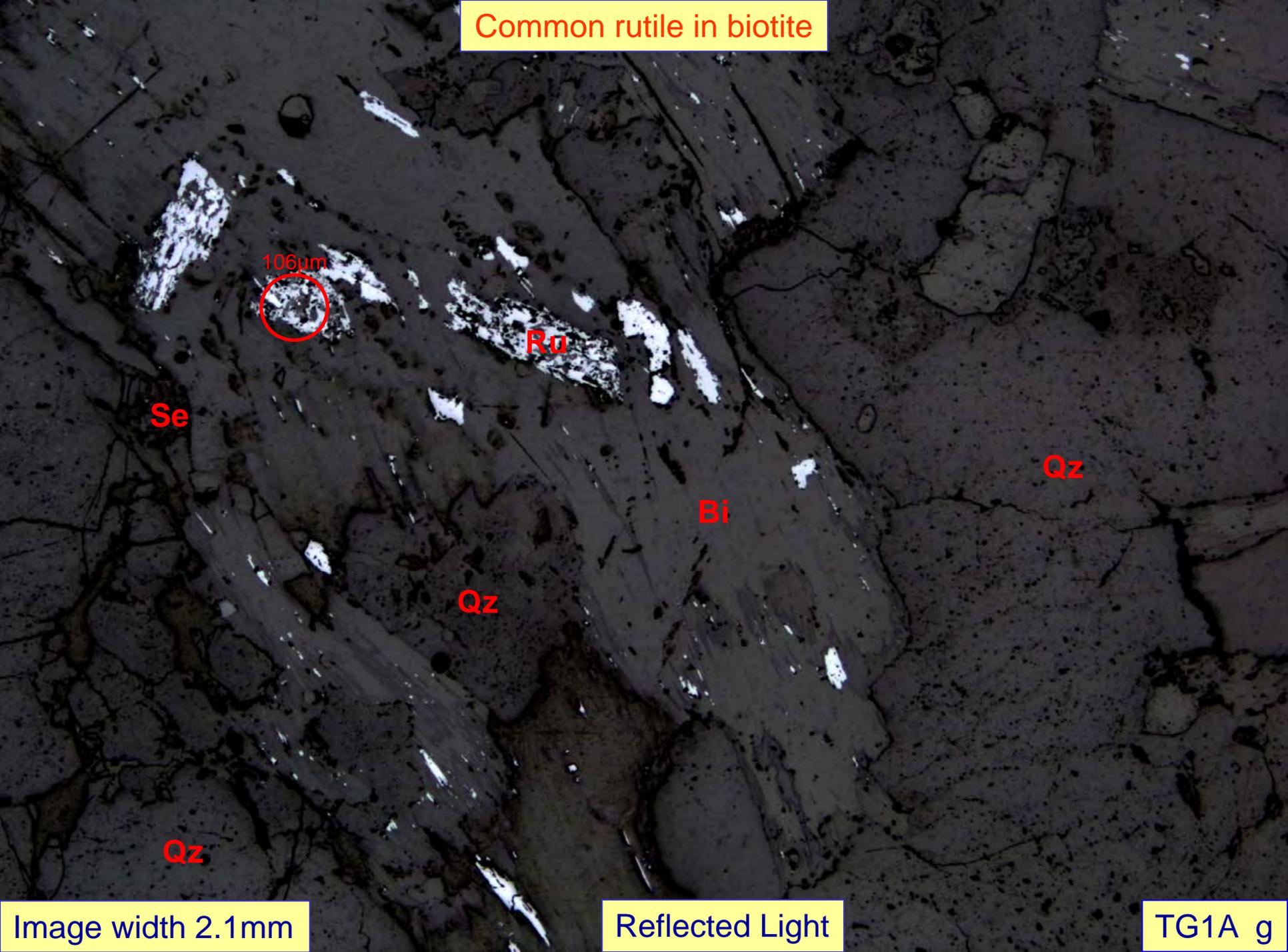
Se

Image width 515µm

Reflected Light

TG1A f

Common rutile in biotite



Se

106µm

Ru

Bi

Qz

Qz

Qz

Image width 2.1mm

Reflected Light

TG1A g

## **Sample TG1B**

### **Non-sulphides**

**Quartz** (55%) – crystals up to 5mm in coarse granular aggregates; intergrown with altered coarse feldspar/biotite on only one side of the sulphide veinlet

**Sericite** (15%) – scattered flakes <300µm strongly replacing feldspar; rims <50µm wide replacing biotite; rare fibrous muscovite <600µm

**Feldspar** (15%) – equant, simply-twinned grains <10mm uniformly replaced by sericite

**Biotite** (5%) – scattered flakes <2mm marginally replaced by sericite

**Rutile and titanomagnetite** (<1%) – common elongate grains <500µm with pyrite and rare chalcopyrite hosted by altered biotite

### **Sulphides and associated oxidation products (10%)** (in approximate descending order of predominance)

The vast majority of the sulphides are contained within one veinlet 0.5-7mm wide that runs the full length of the slide. Interstitial areas and minor cracks within the arsenopyrite are infilled by galena-cerussite and minor sphalerite.

**Arsenopyrite** (8%) – dominant as very coarse crystal aggregates growing on coarse quartz as a distinct veinlet. Less common on the quartz-rich side as scattered rhombs 100µm-1mm.

**Galena** (1%) – coarse interstitial <1.5mm and crack infills <50µm in arsenopyrite. Variably replaced by cerussite.

**Cerussite** (<1%) – irregular replacement <700µm of galena with microscopic galena relics <5µm; rare vuggy crystal groups; incipient replacement of galena along cleavage cracks <30µm wide; minor migration with goethite to fill late cracks <20µm in quartz/silicates

**Sphalerite** (<1%) – one area 1mm interstitial to arsenopyrite-quartz; common small interstitial fillings <200µm in arsenopyrite

**Pyrite** (<1%) – isolated, patchy infillings <150µm with minor marcasite interstitial to arsenopyrite but earlier than galena; very late imbricate, crustiform veinlets <100µm wide running parallel to the main arsenopyrite vein, partly oxidised to goethite; late irregular grains <150µm replacing biotite along cleavage planes, partly oxidised to goethite

**Smithsonite?** (trace) – one isolated 500µm colloform replacement of sphalerite

**Marcasite** (trace) – patchy grains <50µm intergrown with the first style of pyrite

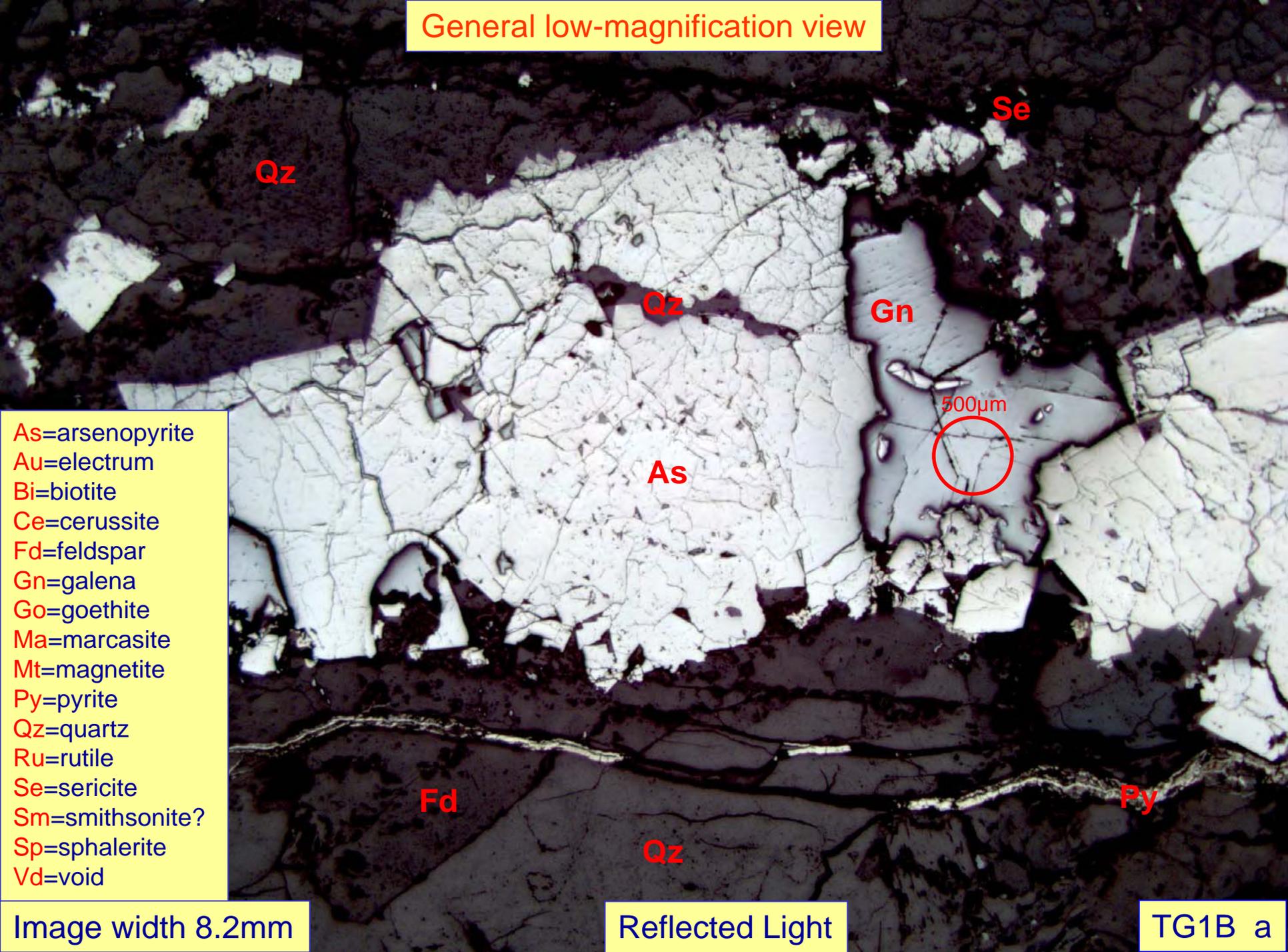
**Pyrrhotite** (trace) – rare blebs <20µm with galena hosted by sphalerite

**Electrum** (trace, 5 grains detected)

- a) 27µm x 8µm grain hosted by quartz-sericite infilling an interstice in arsenopyrite [49.00X, 13.92Y]
- b) 21µm x 8µm grain hosted by cerussite infilling a narrow crack in arsenopyrite [47.25X, 14.82Y]
- c) 12µm x 7µm irregular grain hosted by arsenopyrite [13.98X, 14.49Y]
- d) 15µm x 2µm grain (high Ag) hosted by quartz infilling a narrow crack in arsenopyrite [16.94X, 16.23Y]
- e) 8µm x 2µm grain hosted by galena infilling a narrow crack in arsenopyrite [16.71X, 16.10Y]

**Chalcopyrite** (trace) – very rare, isolated grains <40µm with pyrite in biotite

General low-magnification view



Qz

Se

Qz

Gn

As

500µm

Fd

Py

Qz

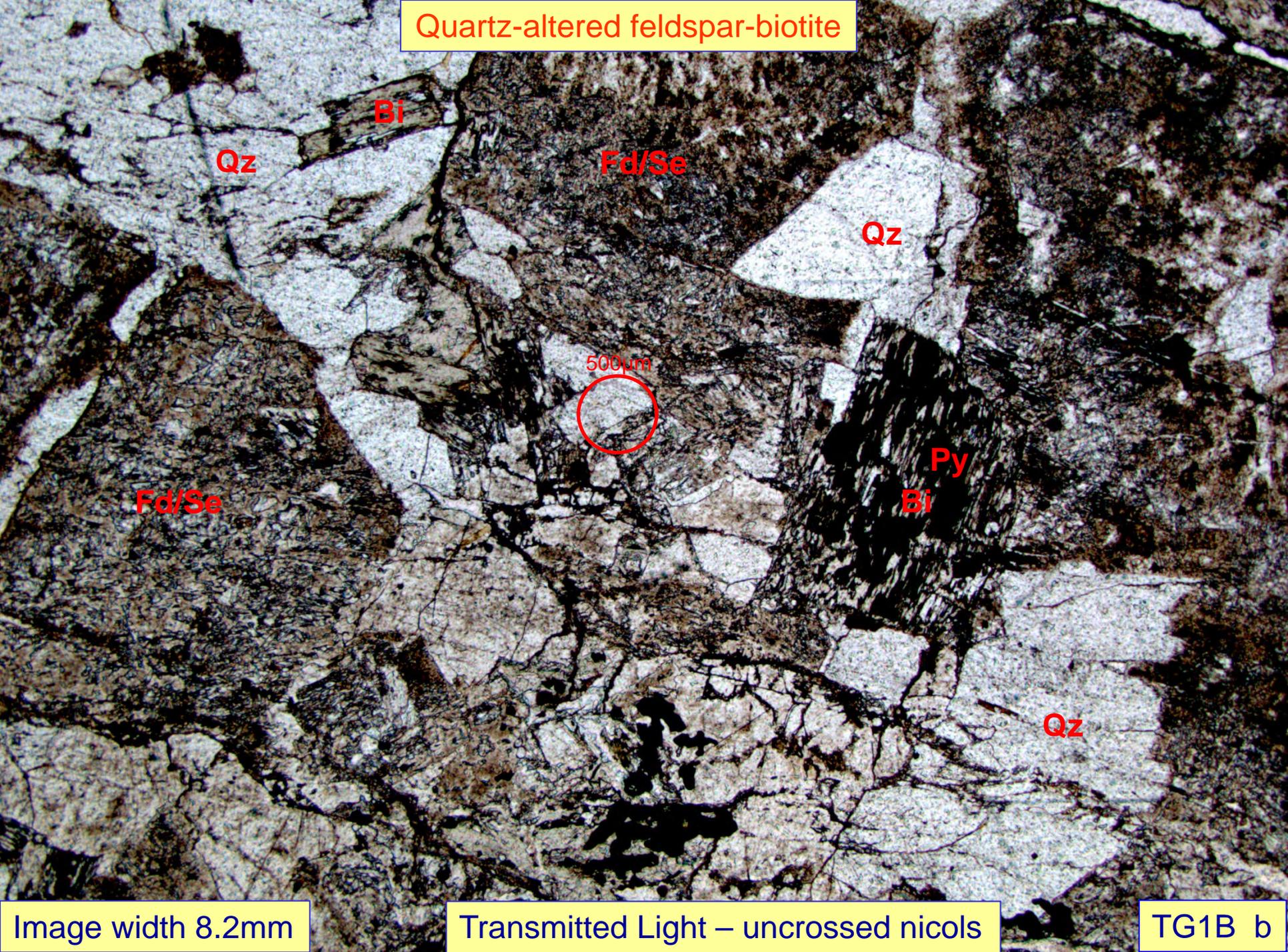
- As=arsenopyrite
- Au=electrum
- Bi=biotite
- Ce=cerussite
- Fd=feldspar
- Gn=galena
- Go=goethite
- Ma=marcasite
- Mt=magnetite
- Py=pyrite
- Qz=quartz
- Ru=rutile
- Se=sericite
- Sm=smithsonite?
- Sp=sphalerite
- Vd=void

Image width 8.2mm

Reflected Light

TG1B a

Quartz-altered feldspar-biotite



Qz

Bi

Fd/Se

Qz

500µm

Fd/Se

Py

Bi

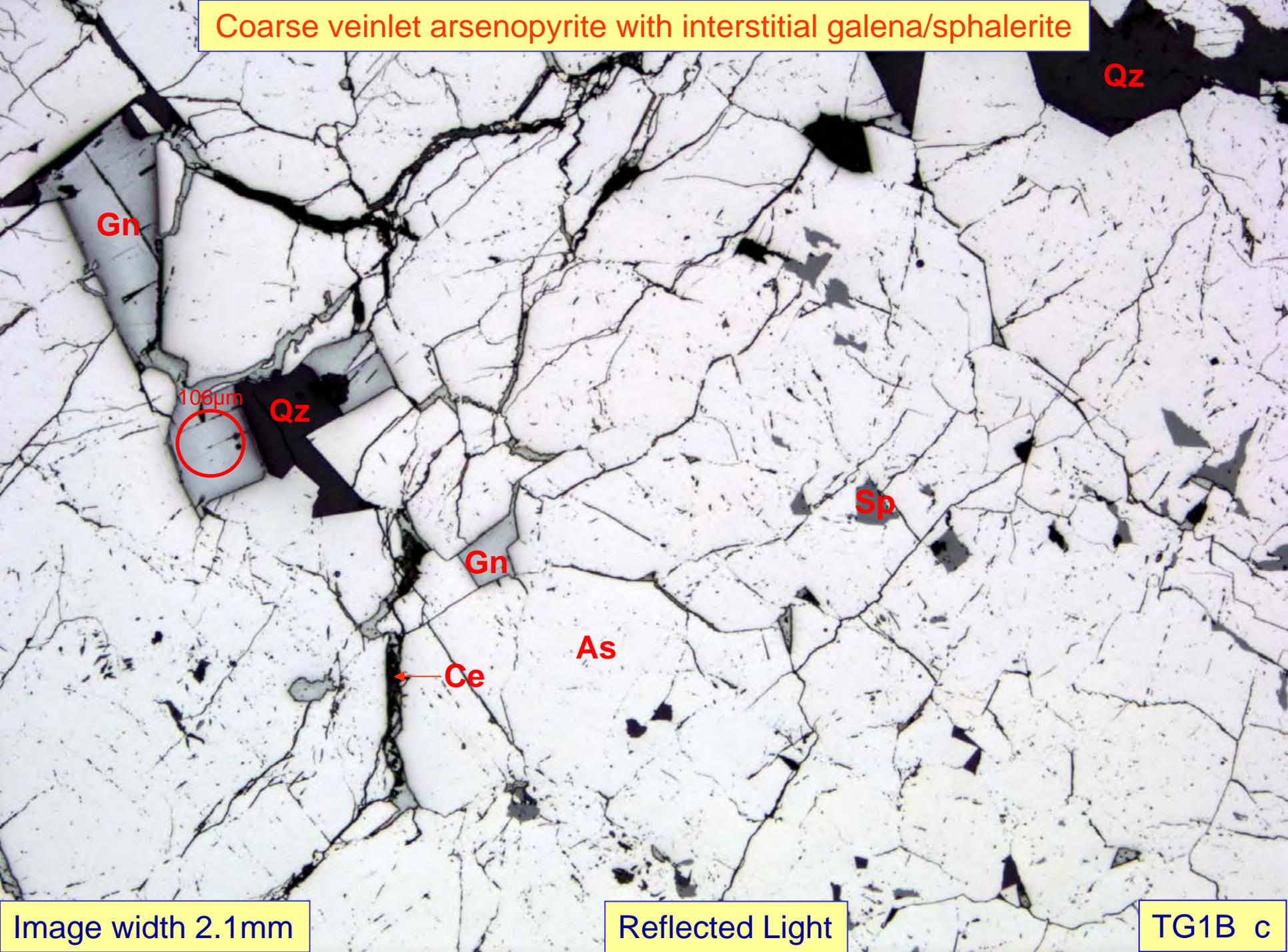
Qz

Image width 8.2mm

Transmitted Light – uncrossed nicols

TG1B b

Coarse veinlet arsenopyrite with interstitial galena/sphalerite



Qz

Gn

106µm

Qz

Sp

Gn

As

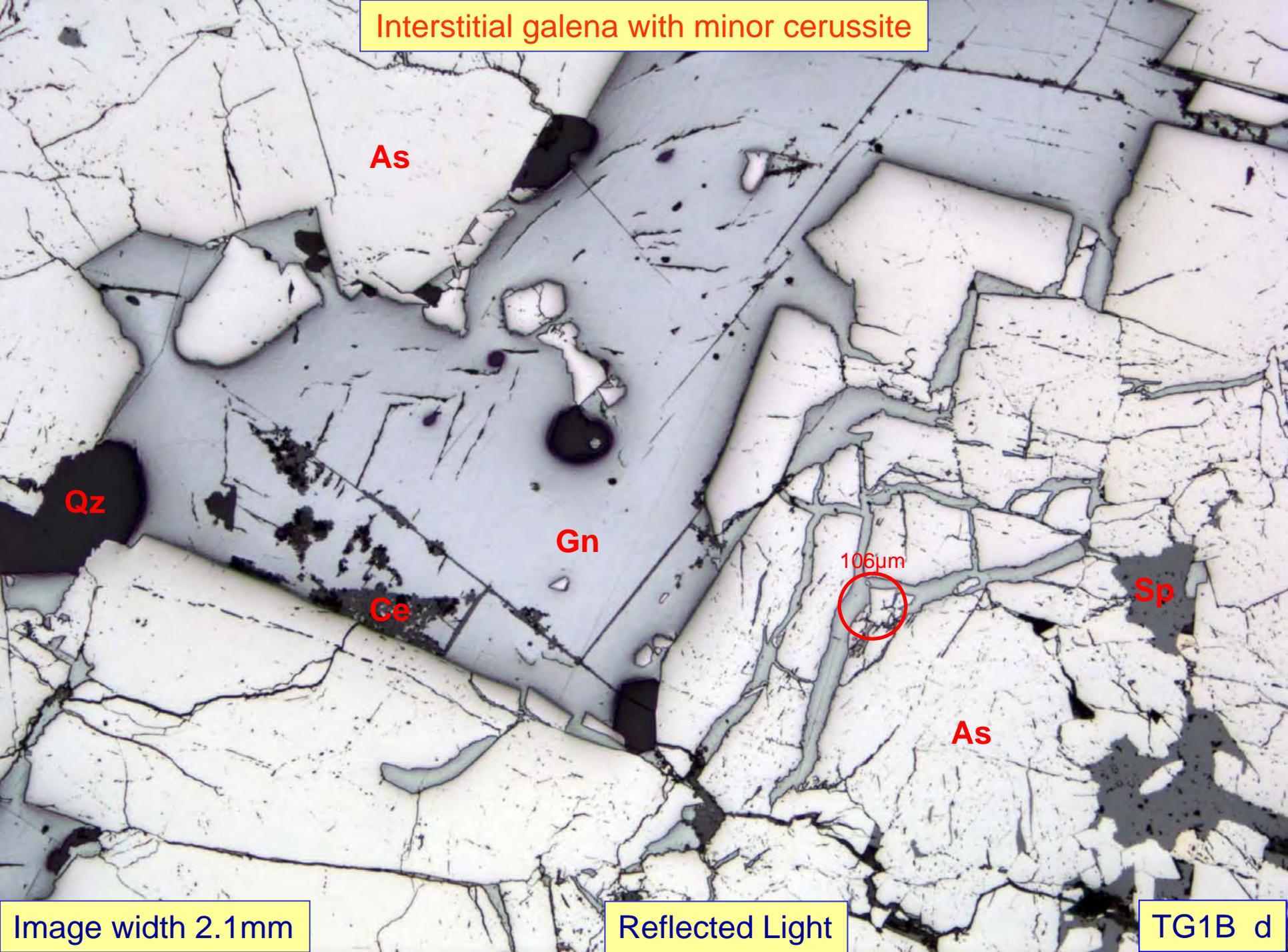
Ce

Image width 2.1mm

Reflected Light

TG1B c

Interstitial galena with minor cerussite



As

Qz

Gn

Ce

106µm

Sp

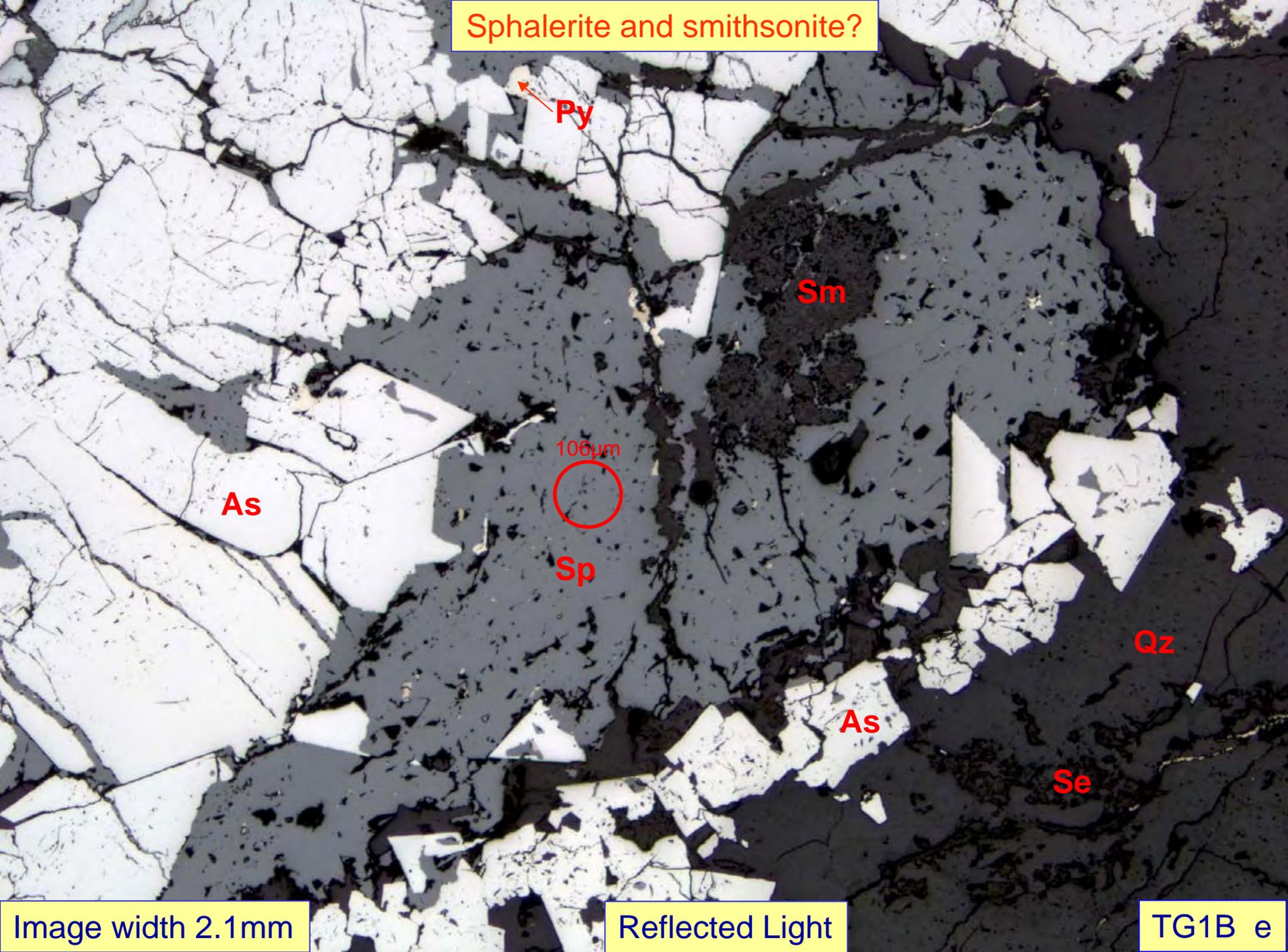
As

Image width 2.1mm

Reflected Light

TG1B d

Sphalerite and smithsonite?



Py

Sm

As

106µm

Sp

Qz

As

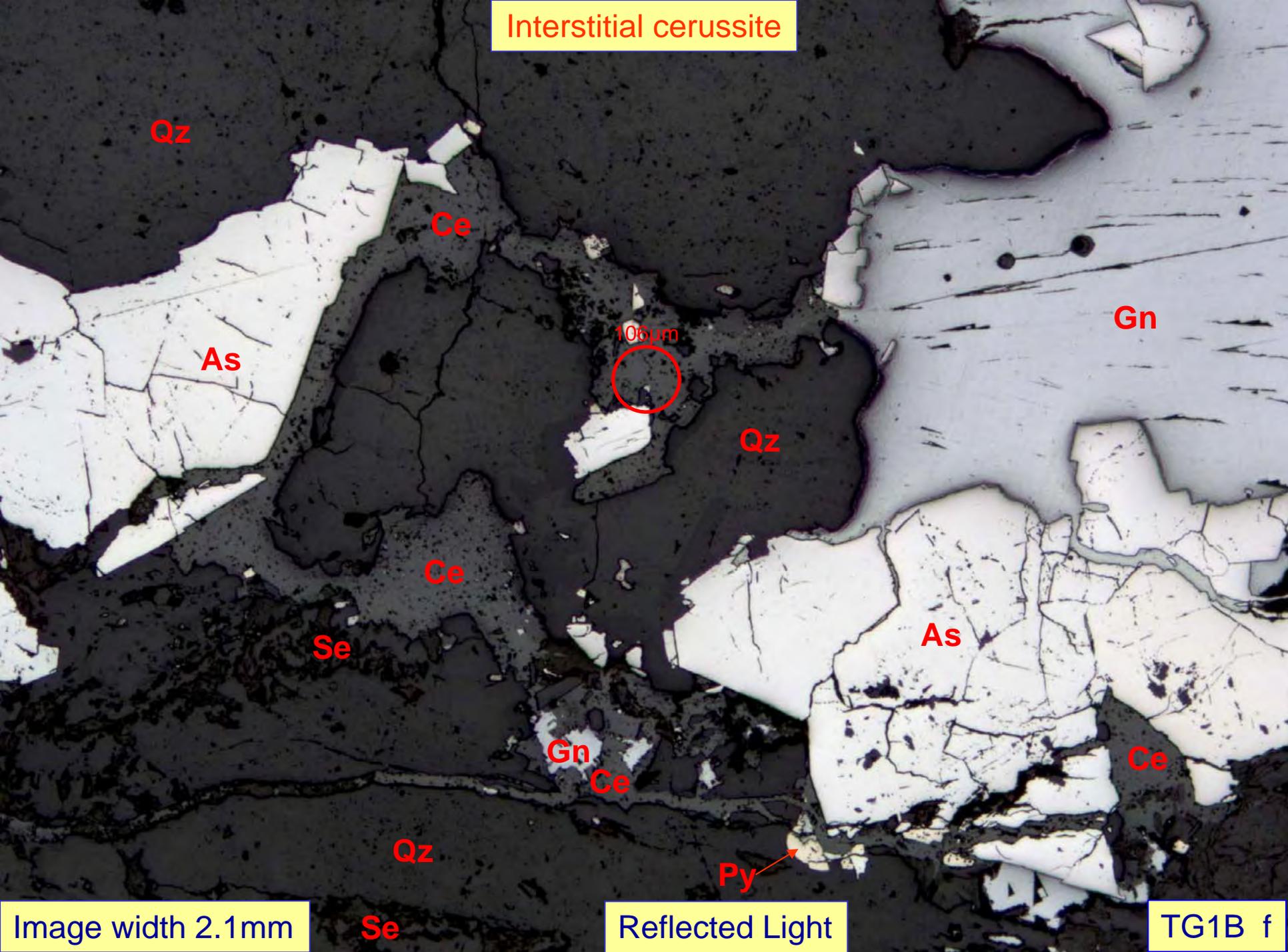
Se

Image width 2.1mm

Reflected Light

TG1B e

Interstitial cerussite



Qz

Ce

As

106µm

Gn

Qz

Ce

As

Se

Gn

Ce

Ce

Qz

Py

Image width 2.1mm

Se

Reflected Light

TG1B f

Drusy cerussite

Ce

Py

Ce

As

Gn

Vd

Vd

53µm

Ce

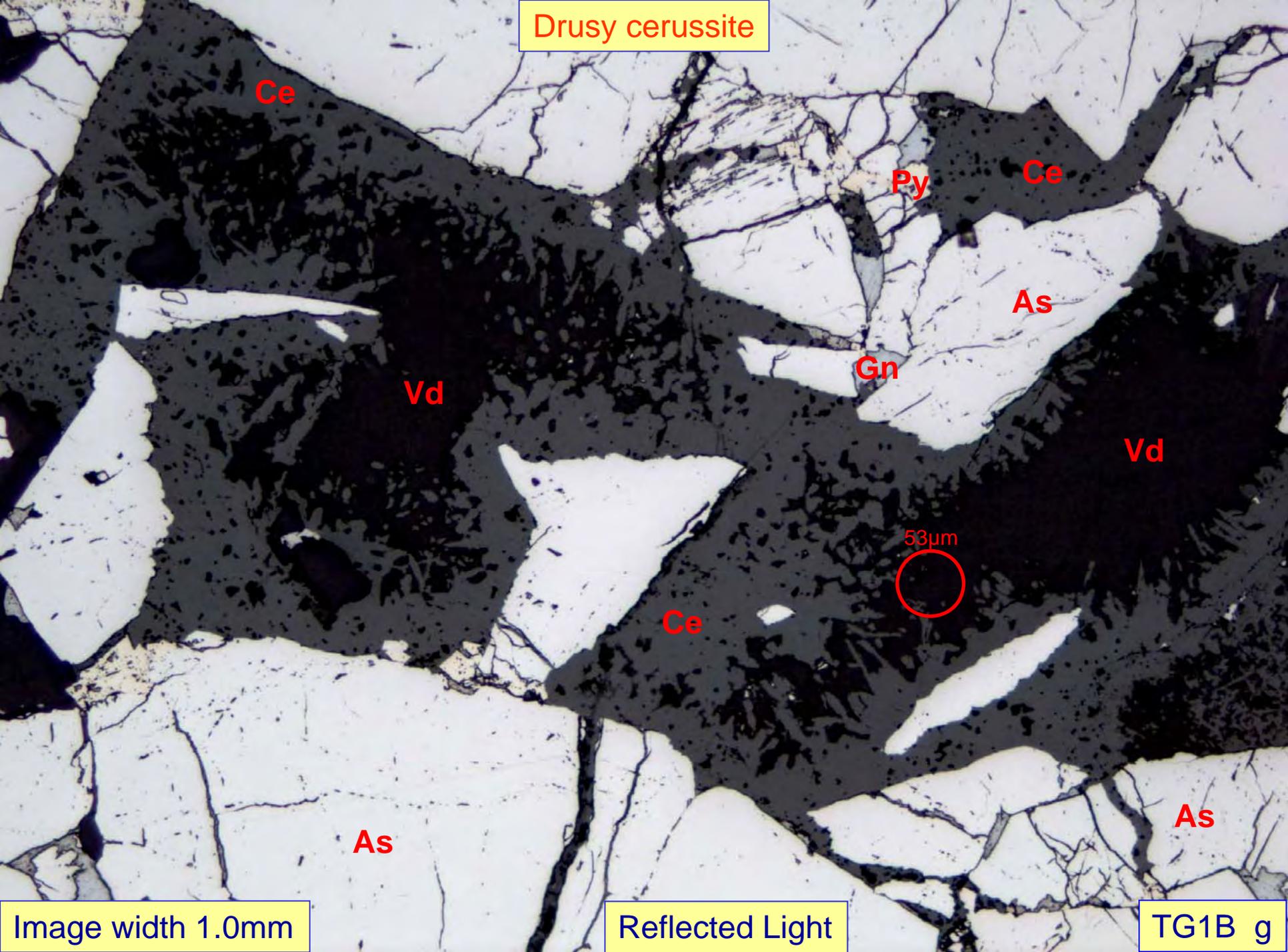
As

As

Image width 1.0mm

Reflected Light

TG1B g



Galena-cerussite

Ce

Gn

Vd

Py

As

53µm

Gn

As

Gn

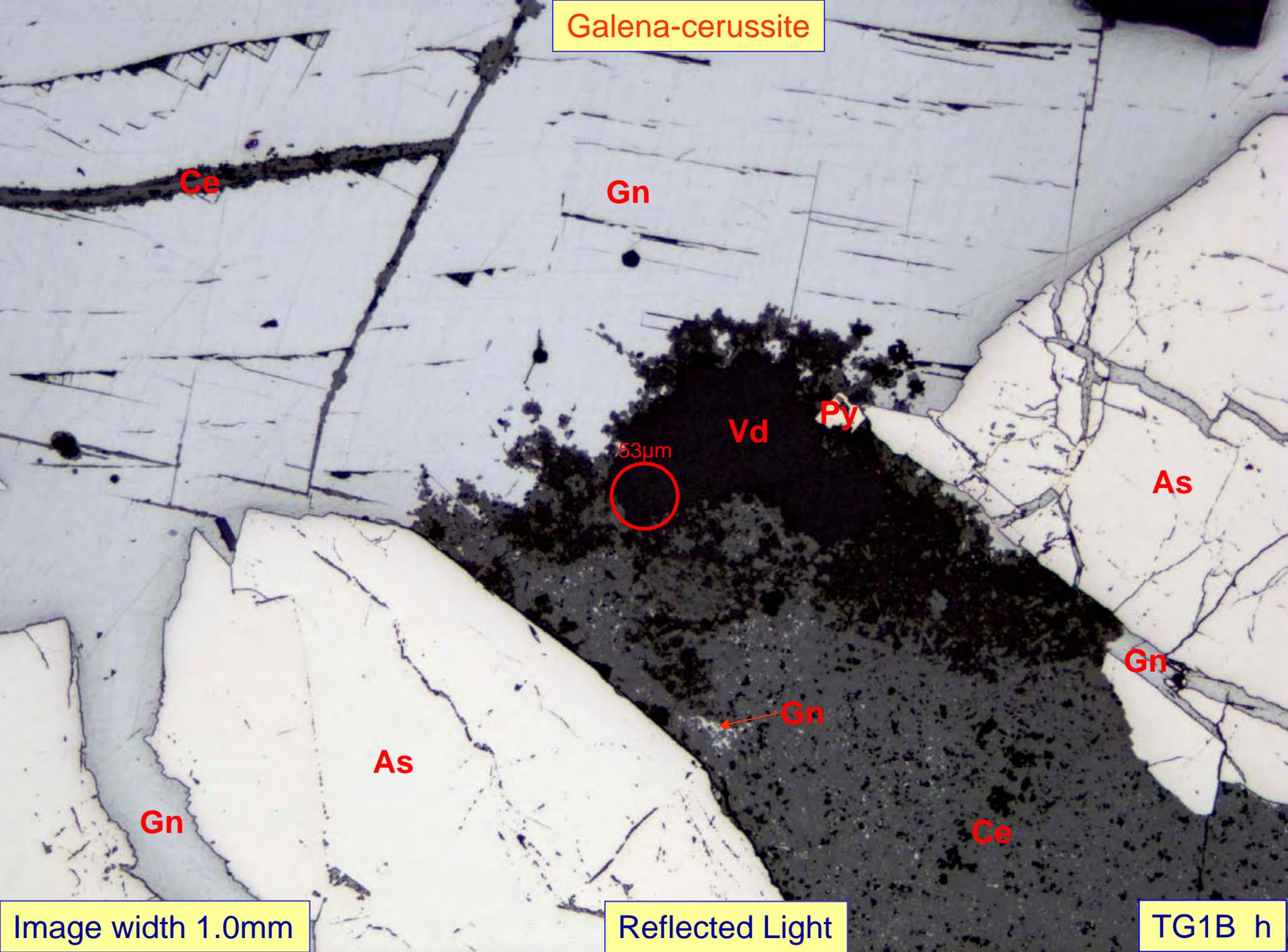
Gn

Ce

Image width 1.0mm

Reflected Light

TG1B h



Late pyrite rimming shattered arsenopyrite

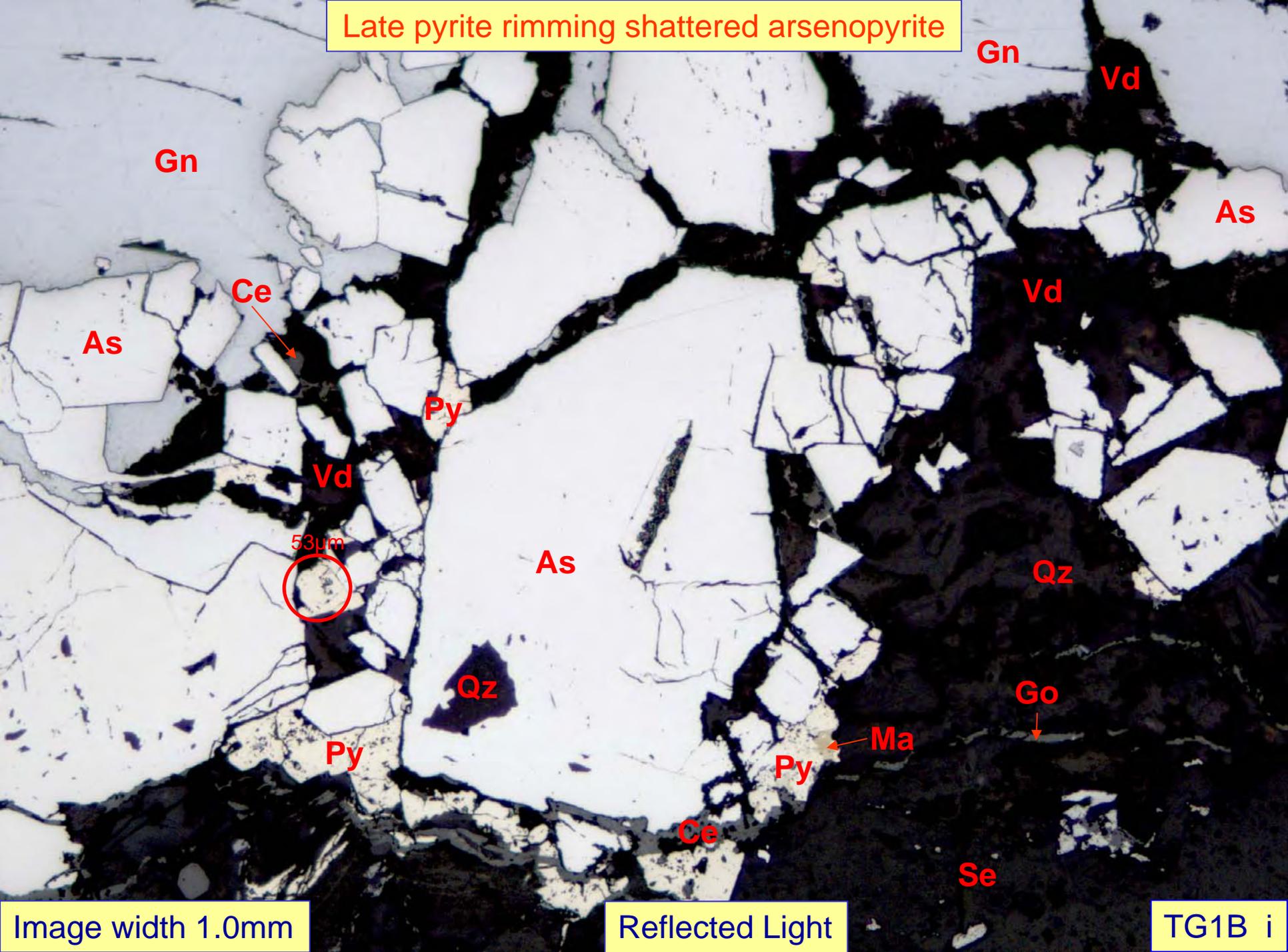
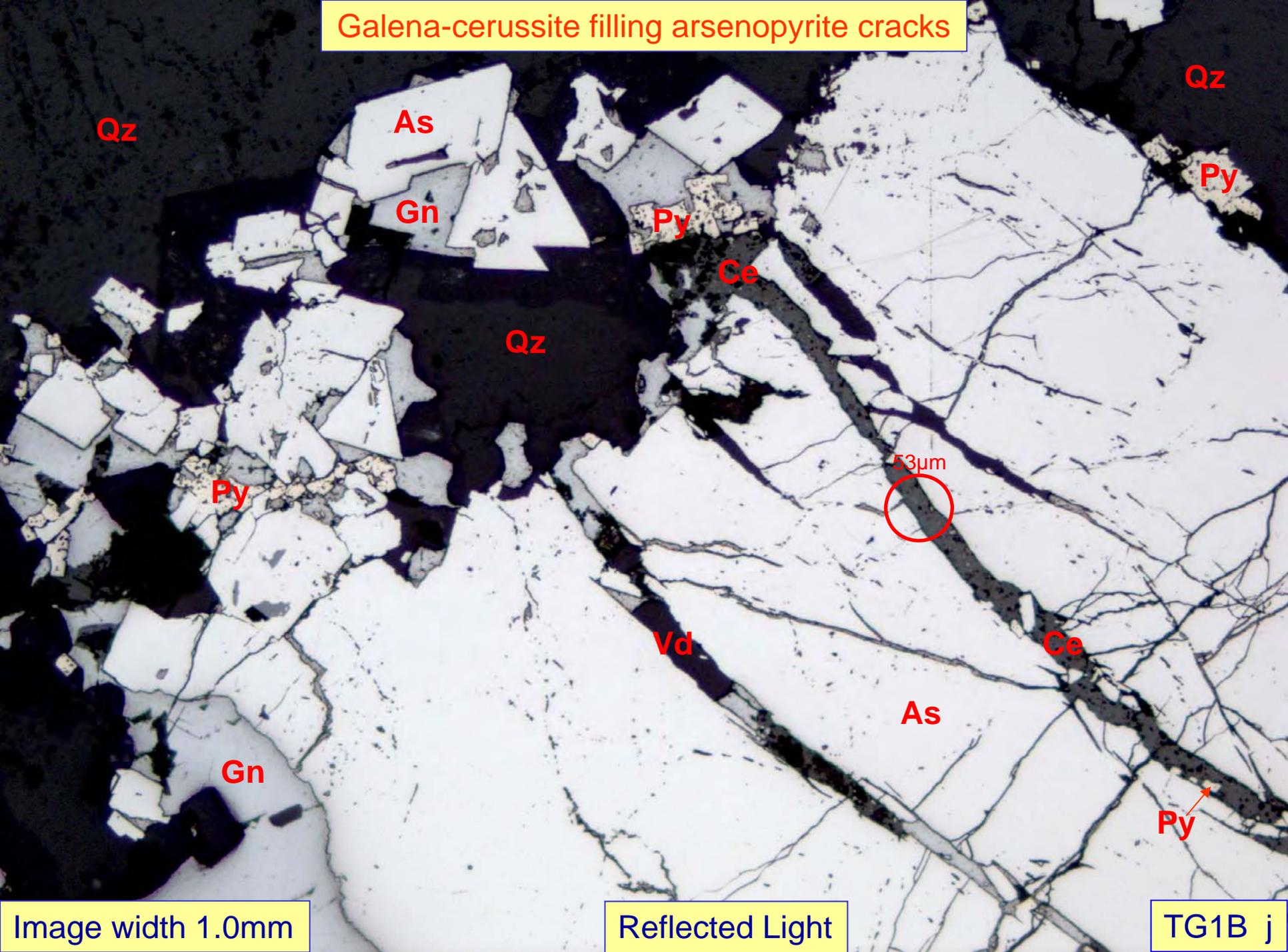


Image width 1.0mm

Reflected Light

TG1B i

Galena-cerussite filling arsenopyrite cracks



Qz

As

Gn

Py

Ce

Qz

Py

Qz

53µm

Py

Vd

Ce

As

Gn

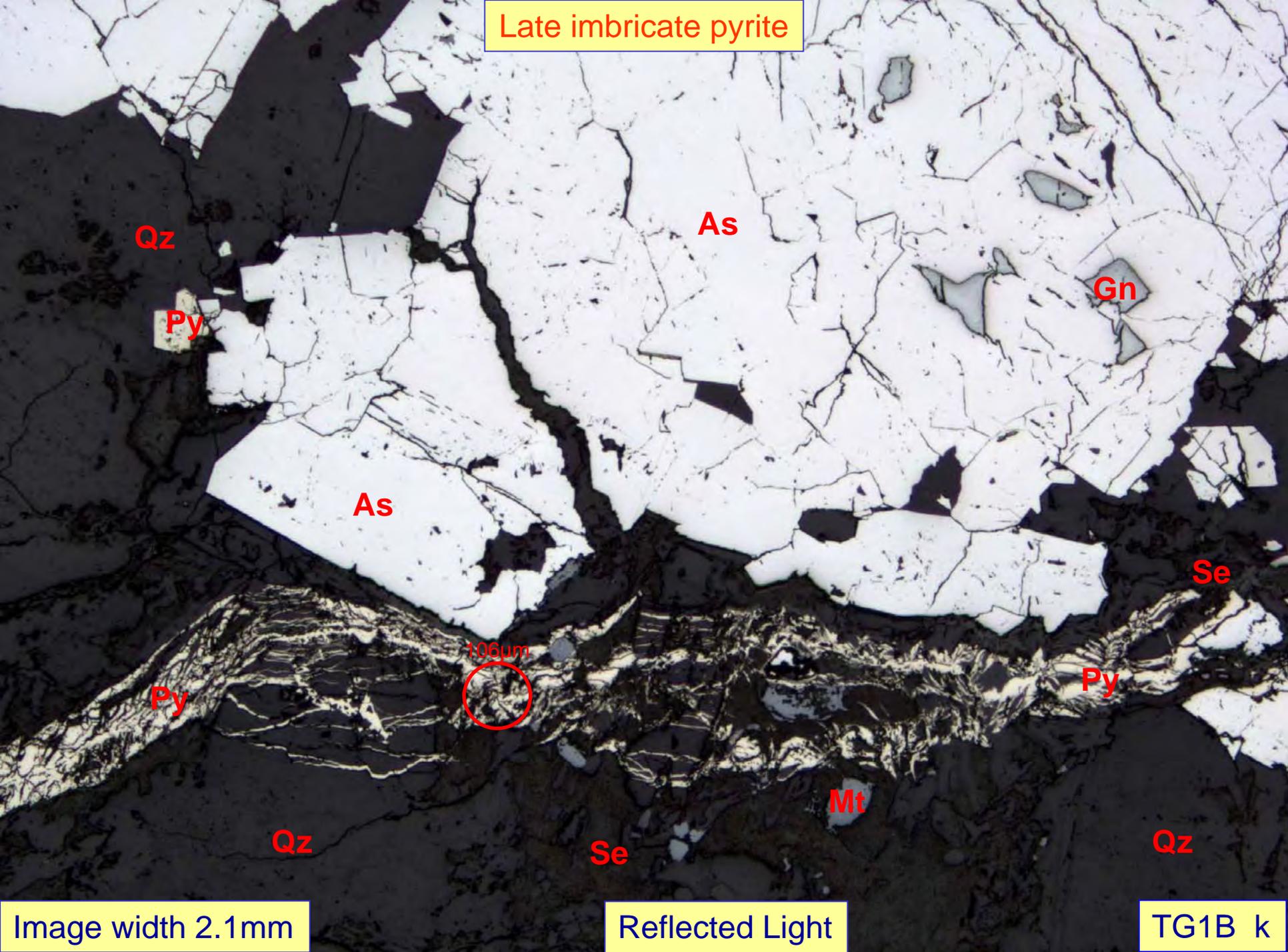
Py

Image width 1.0mm

Reflected Light

TG1B j

Late imbricate pyrite



Qz

Py

As

Gn

As

Se

106um

Py

Py

Mt

Qz

Se

Qz

Image width 2.1mm

Reflected Light

TG1B k

Pyrite replacing biotite

Qz

Fd

Py

Ru

106um



Bi

Bi

Se

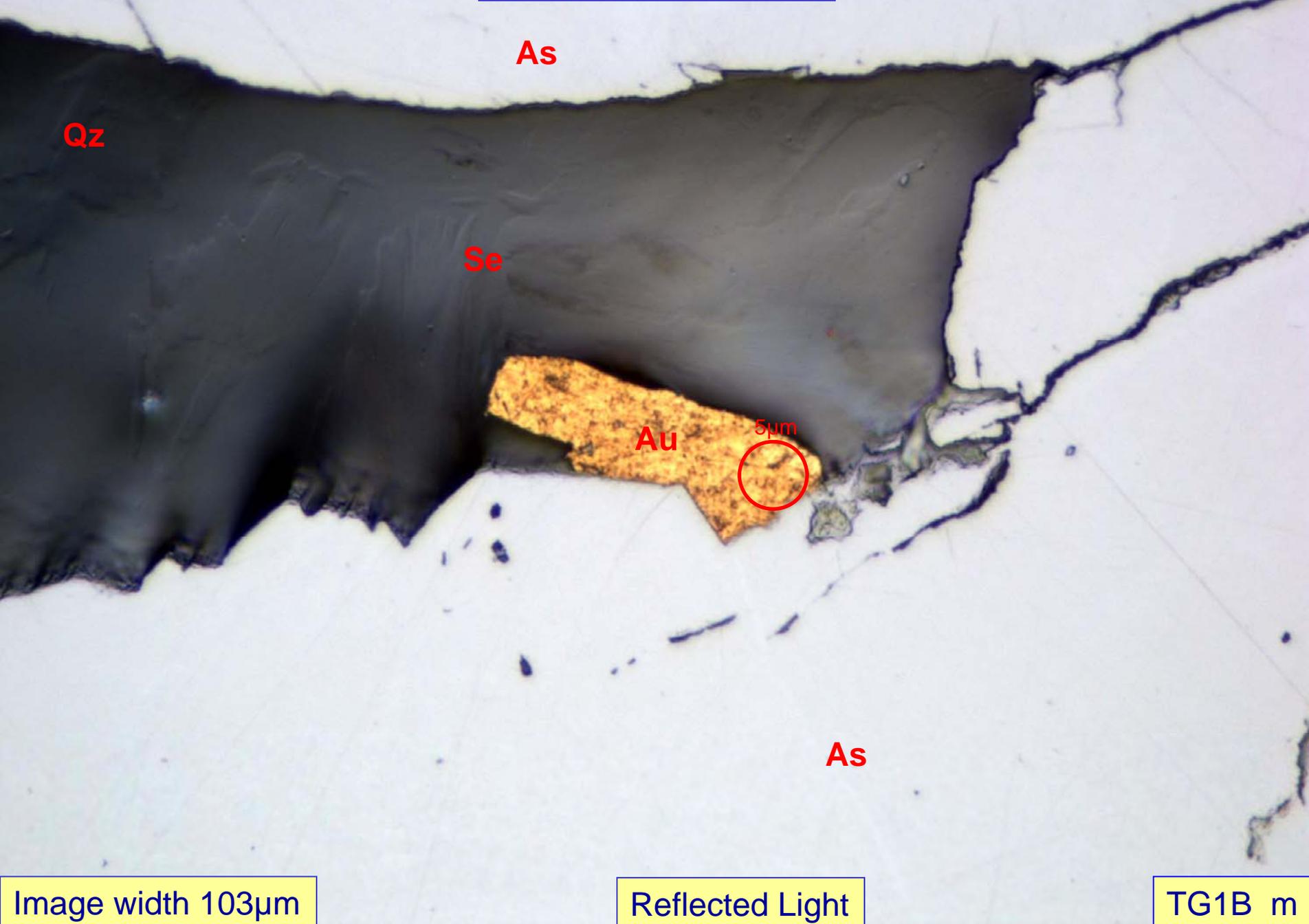
Qz

Py

Image width 2.1mm

Reflected Light

TG1B I



As

Qz

Se

Au

5µm

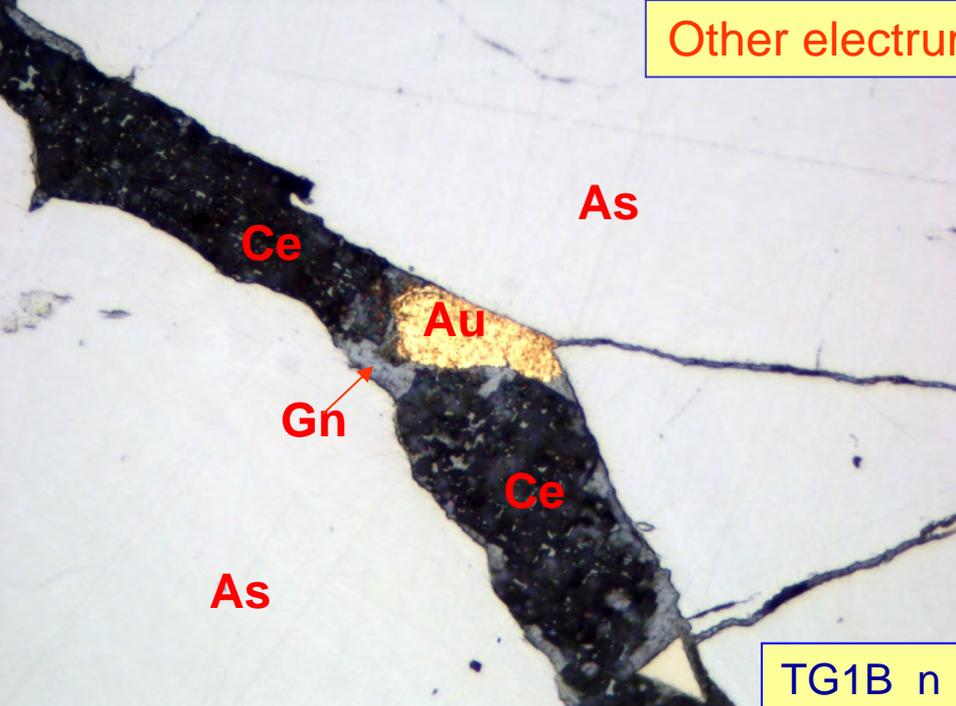
As

Image width 103µm

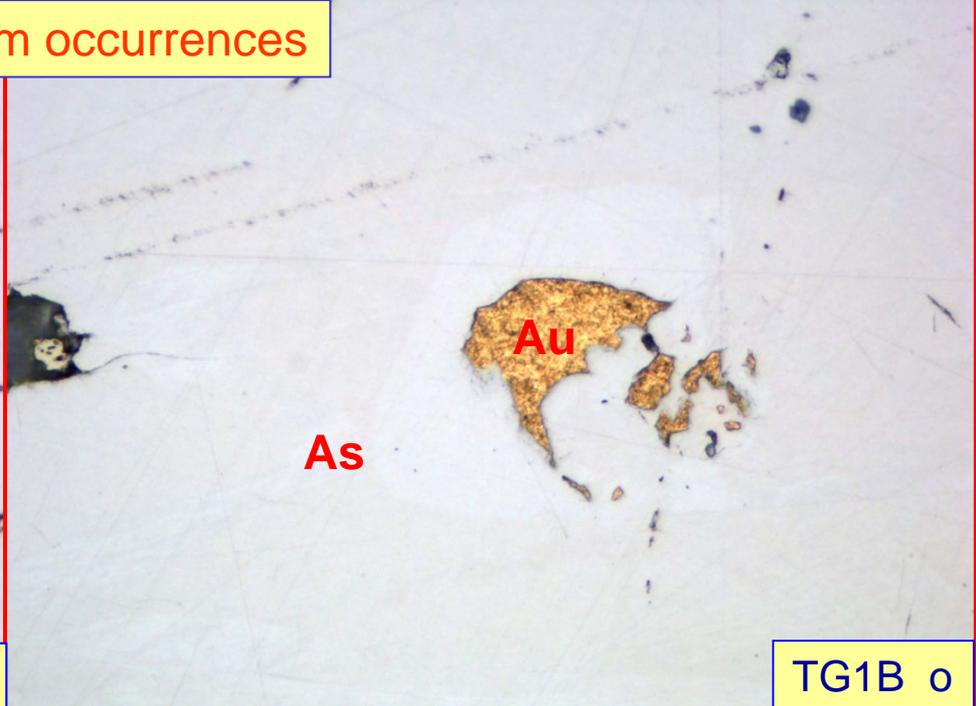
Reflected Light

TG1B m

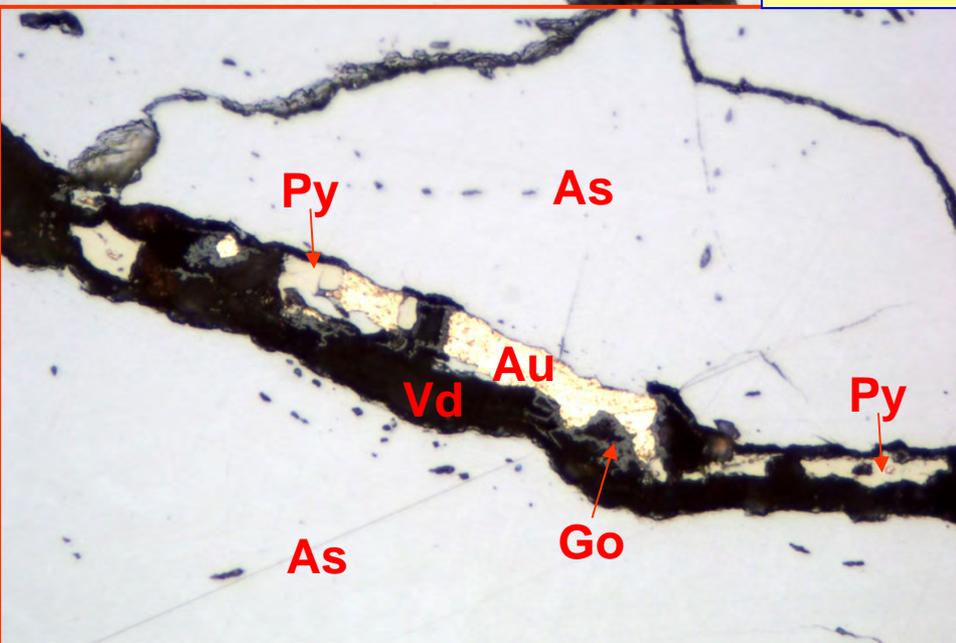
Other electrom occurrences



TG1B n

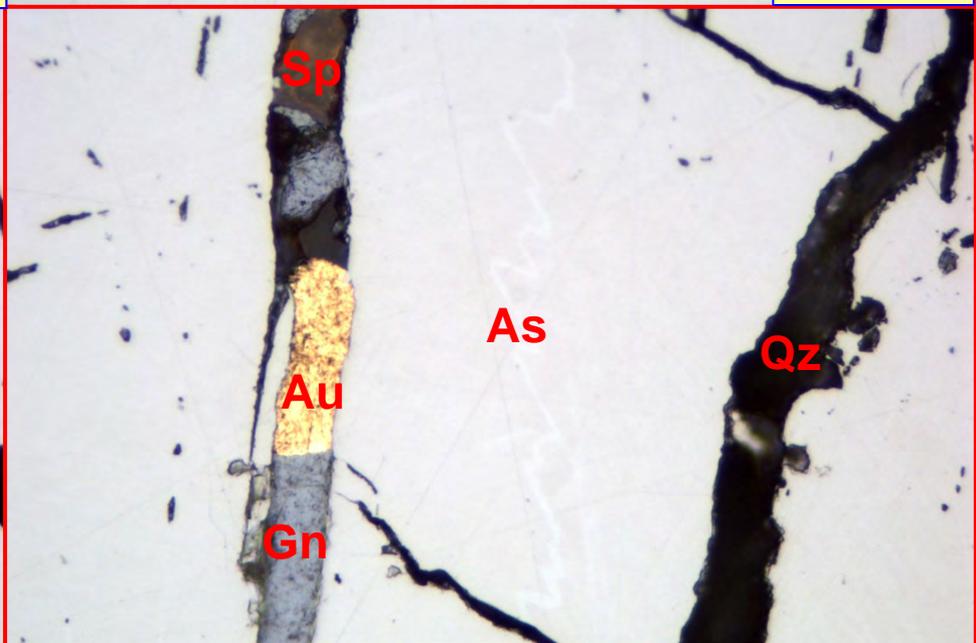


TG1B o



TG1B p

Image width 2 x 103µm



Reflected Light

TG1B q

## **Sample TG2**

### **Non-sulphides**

**Quartz** (55%) – crystals up to 10mm in coarse granular aggregates intergrown with altered coarse feldspar/biotite

**Feldspar** (25%) – equant, simply-twinning grains <7mm showing either: zonal core replacement by sericite, uniform replacement by sericite, or virtually fresh

**Sericite** (10%) – scattered flakes <500µm zonally replacing feldspar

**Biotite** (5%) – scattered flakes <2mm partially replaced by chlorite

**Chlorite** (5%) – partial or complete replacement of biotite

**Rutile and titanomagnetite** (<1%) – common elongate or equant grains <600µm hosted by biotite or chlorite after biotite

**Calcite** (<1%) – late narrow veinlets, sometimes with quartz; rare patches <400µm in altered biotite

**Zircon?** (trace) – scattered zoned crystals <120µm

### **Sulphides (trace)** (in approximate descending order of predominance)

**Pyrite** – <10µm wide replacements of biotite along cleavage planes; <300µm subhedra in quartz, <30µm crystals dusted through sericite-altered feldspar; <350µm aggregates in biotite; rare rimming zircon

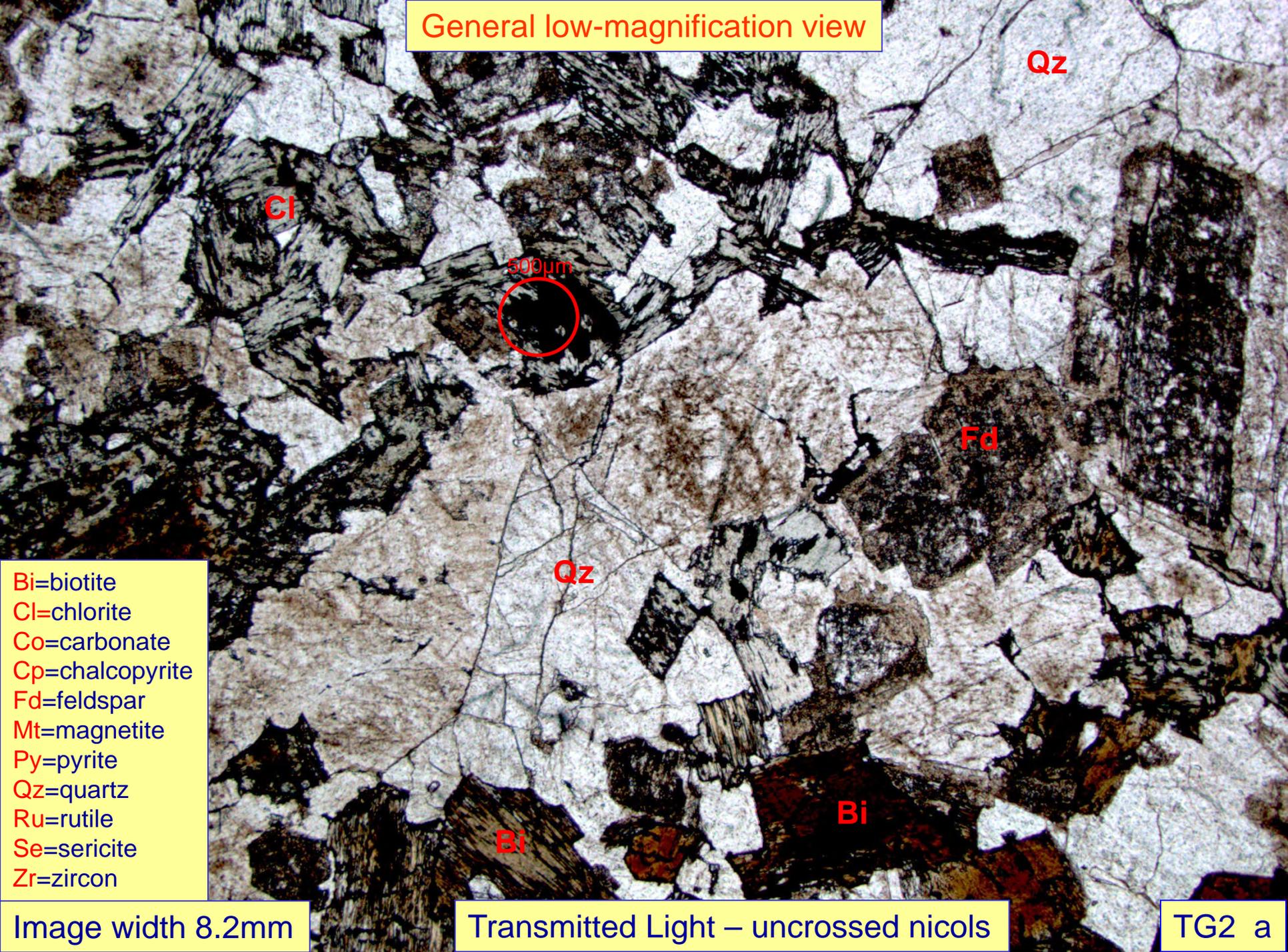
**Chalcopyrite** – <50µm grains in biotite or quartz near biotite.

**Arsenopyrite** – rare <50µm rhombs in chlorite

**Galena** – rare irregular grains <200µm in chlorite

**Unidentified sulphide** – very rare <20µm in biotite

General low-magnification view



- Bi=biotite
- Cl=chlorite
- Co=carbonate
- Cp=chalcopyrite
- Fd=feldspar
- Mt=magnetite
- Py=pyrite
- Qz=quartz
- Ru=rutile
- Se=sericite
- Zr=zircon

Image width 8.2mm

Transmitted Light – uncrossed nicols

TG2 a

Fresh and altered feldspar

Qz

Se/Fd

500µm

Cl

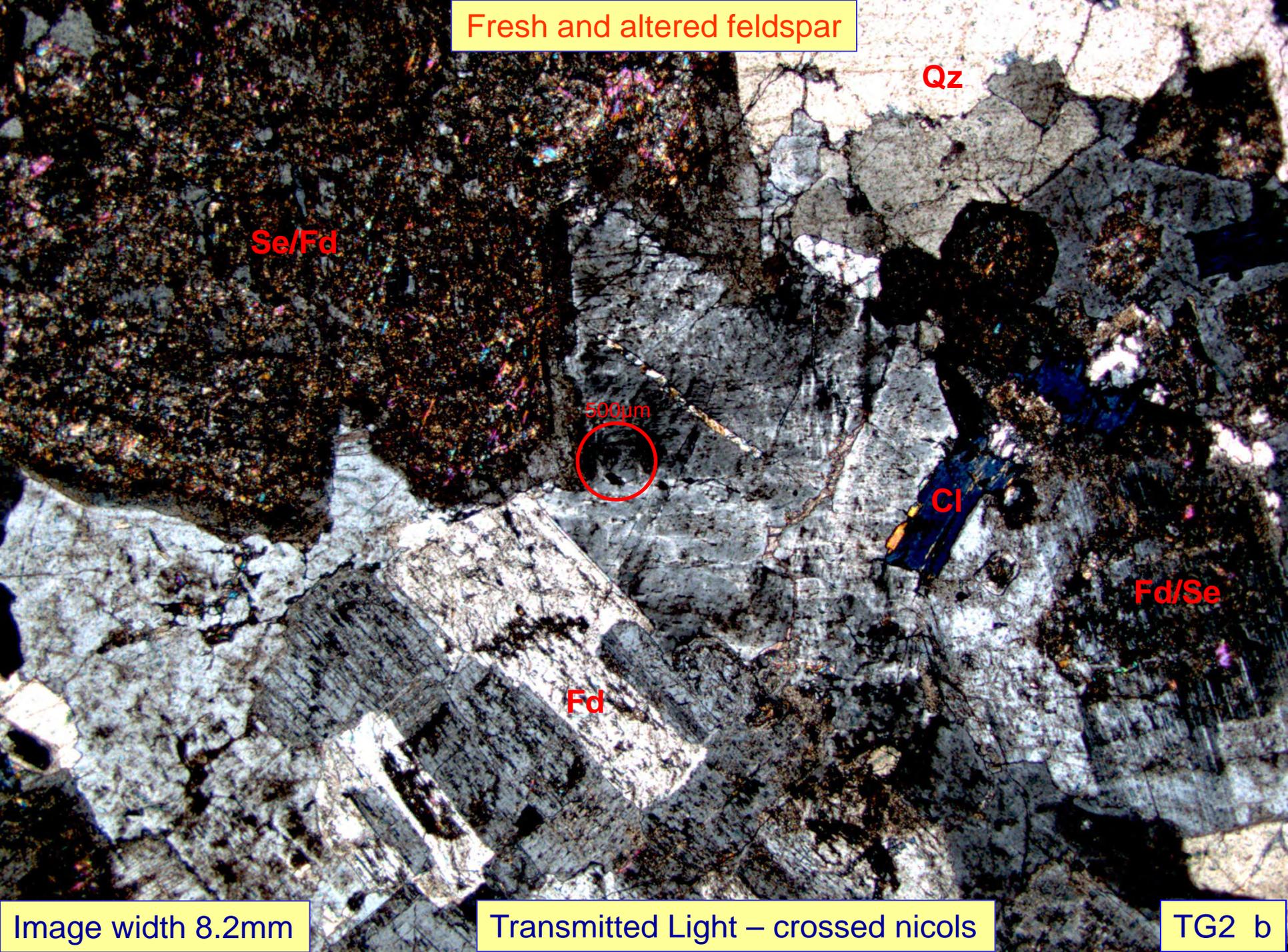
Fd/Se

Fd

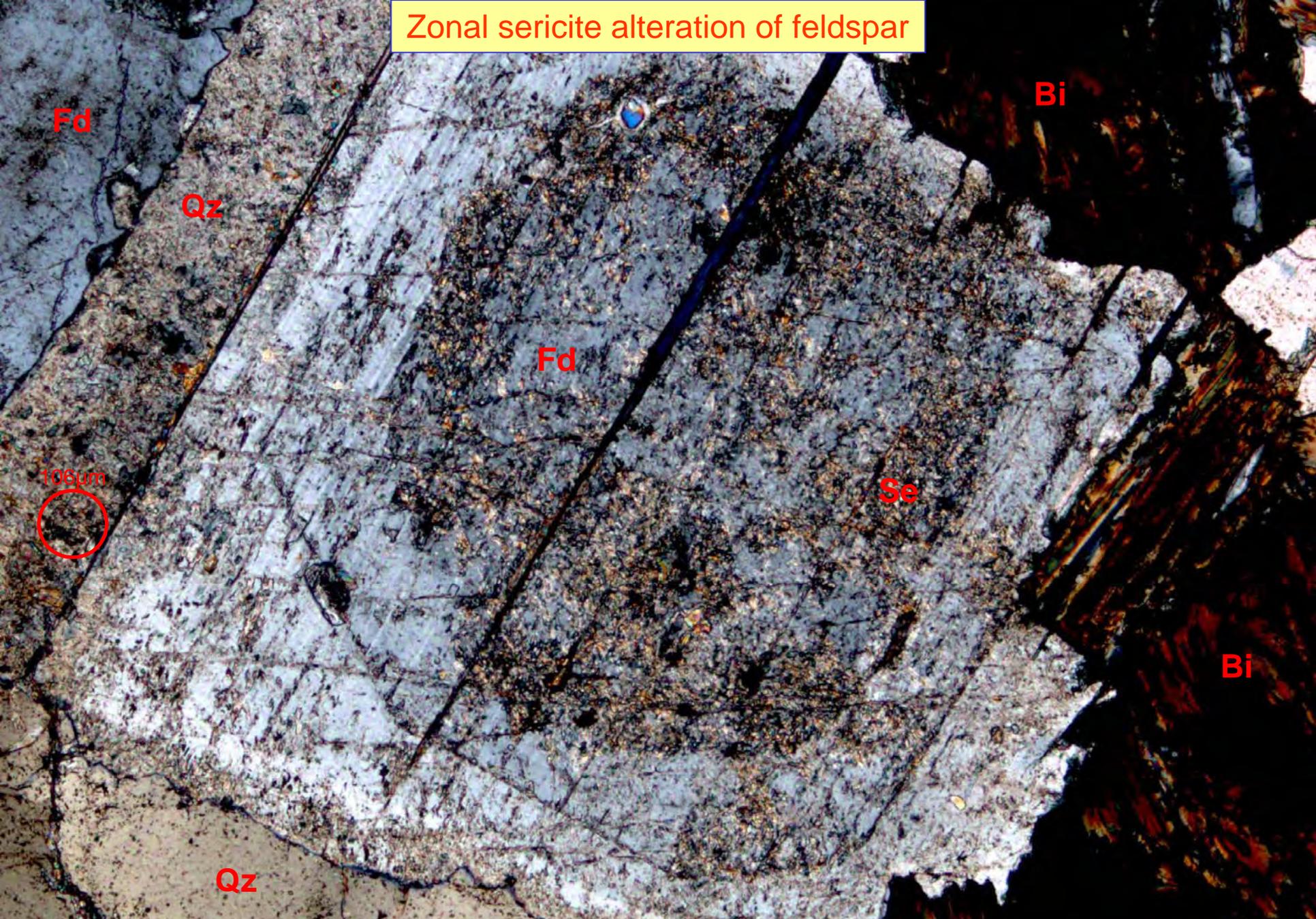
Image width 8.2mm

Transmitted Light – crossed nicols

TG2 b



Zonal sericite alteration of feldspar



Fd

Qz

Bi

Fd

Se

106um

Bi

Qz

Image width 2.1mm

Transmitted Light – crossed nicols

TG2 c

Titanomagnetite-rutile in biotite

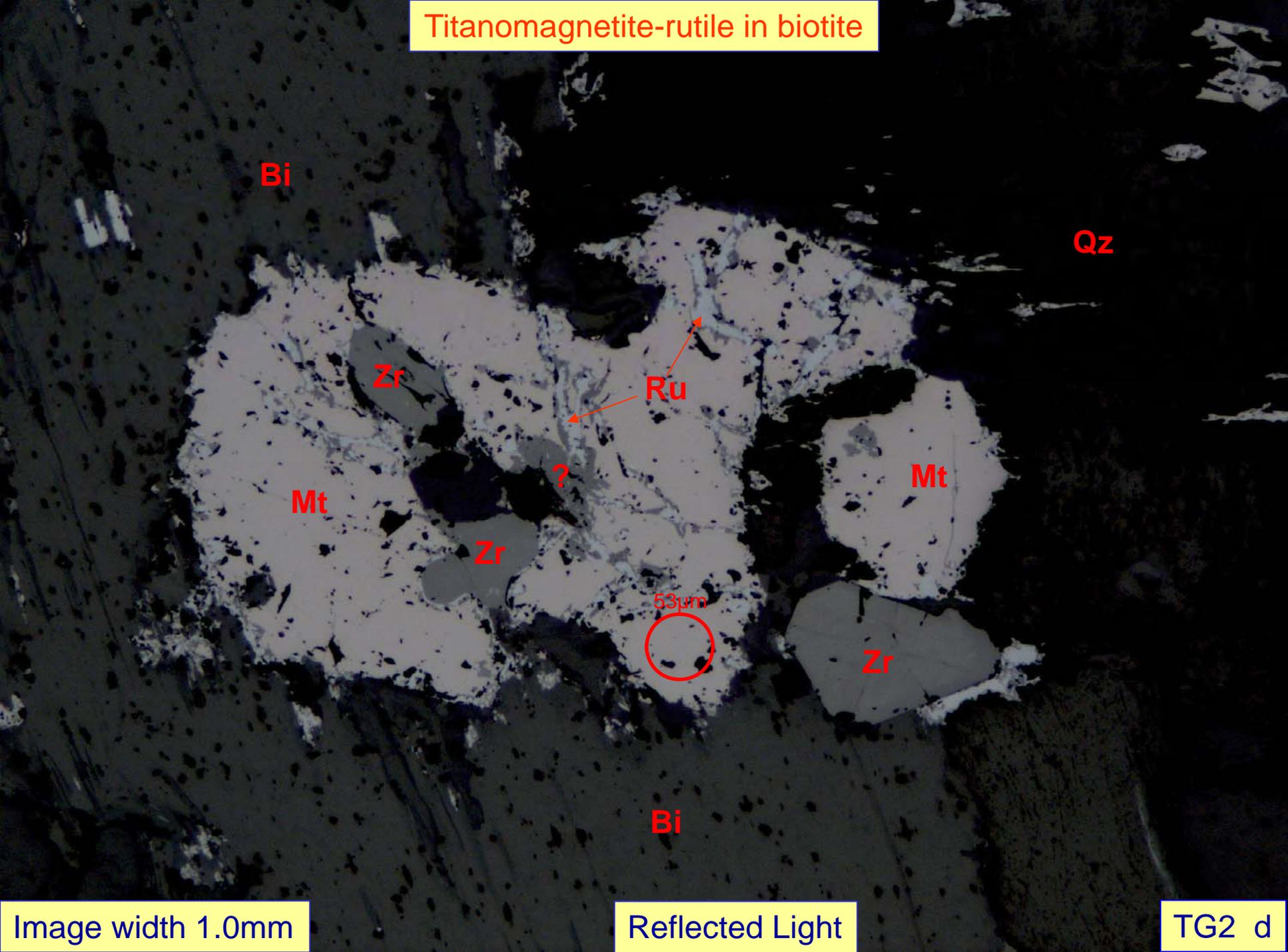
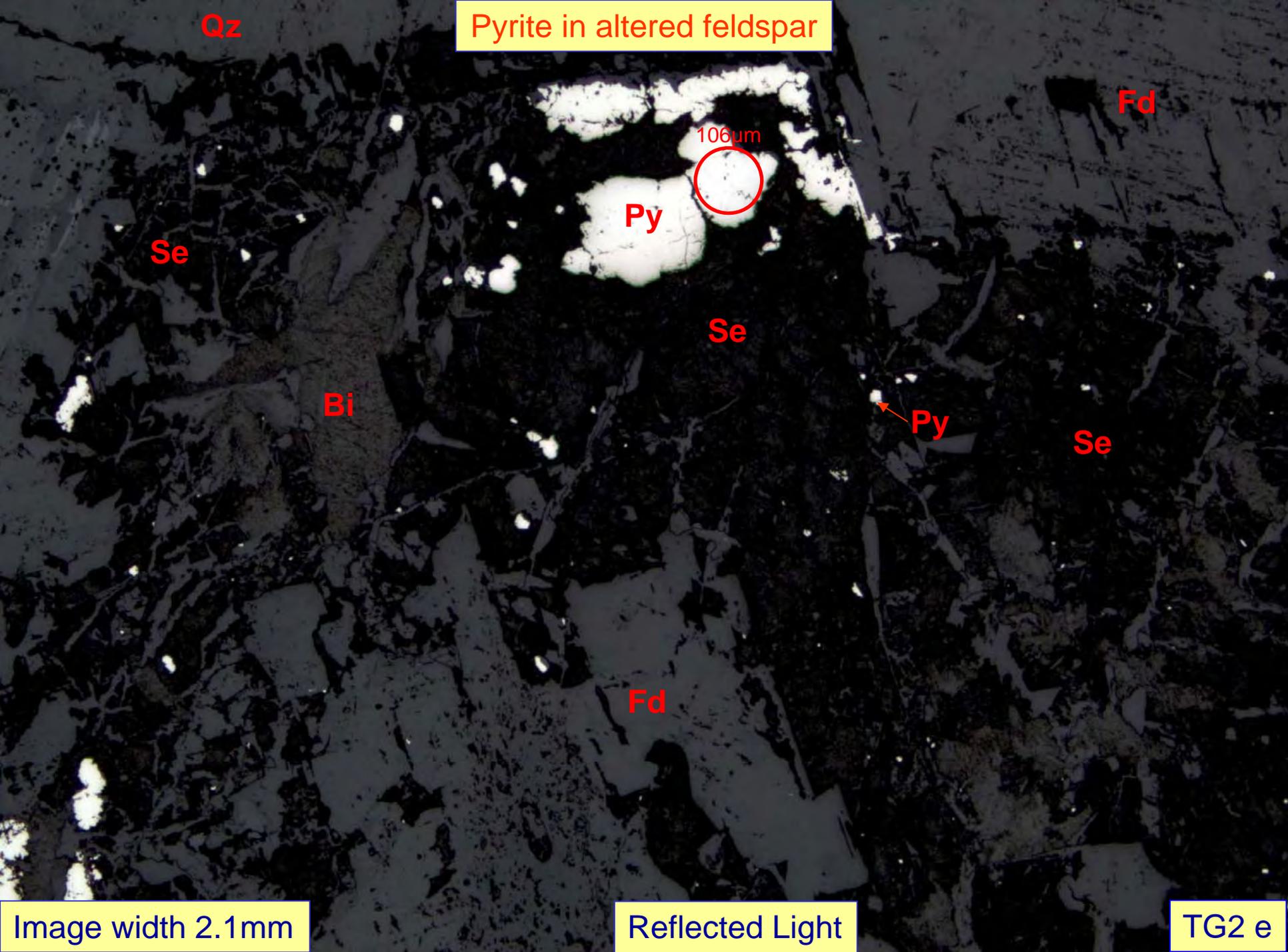


Image width 1.0mm

Reflected Light

TG2 d



Qz

Pyrite in altered feldspar

Fd

106µm

Py

Se

Se

Bi

Py

Se

Fd

Image width 2.1mm

Reflected Light

TG2 e

Pyrite on biotite cleavage plane

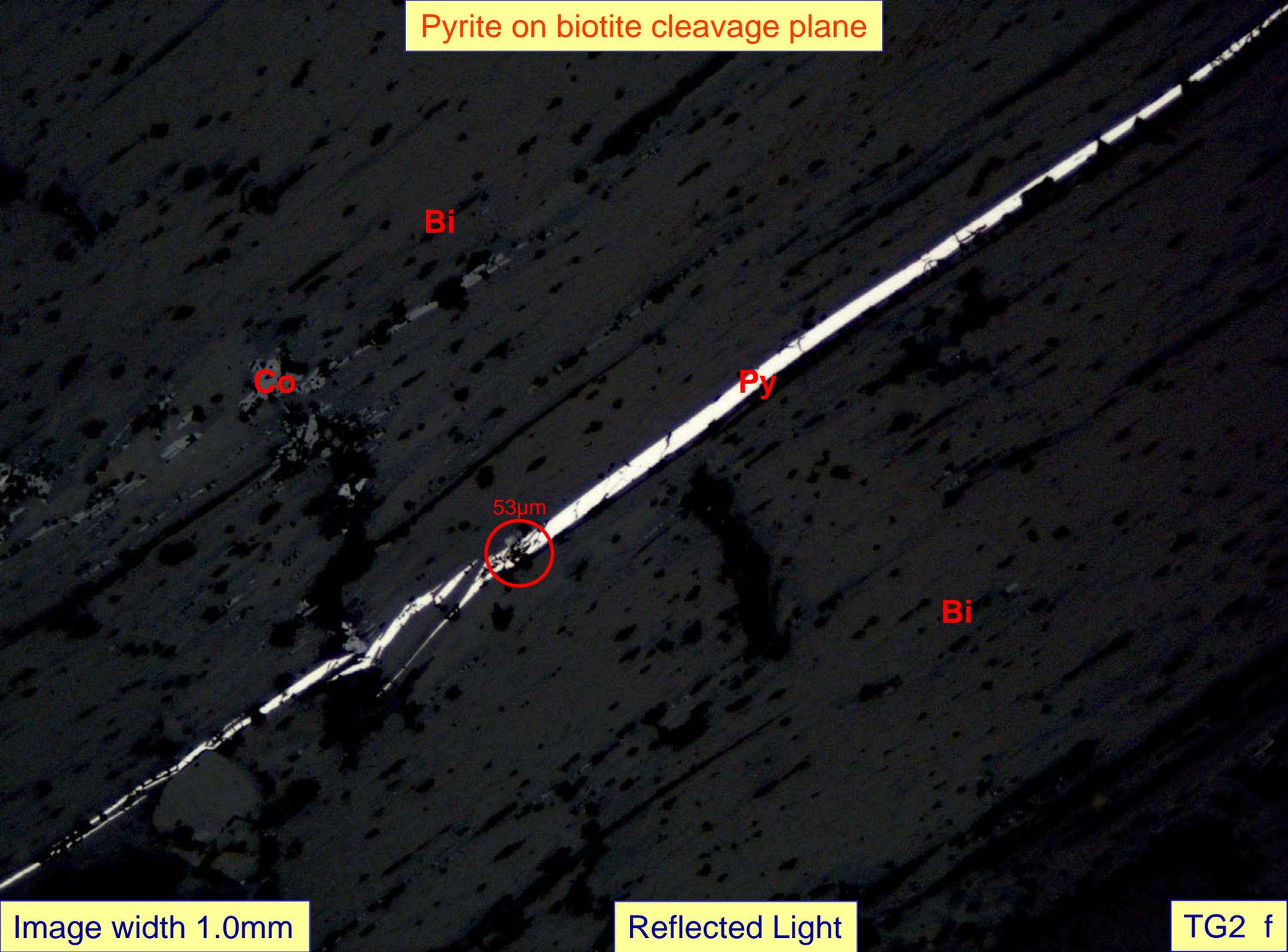
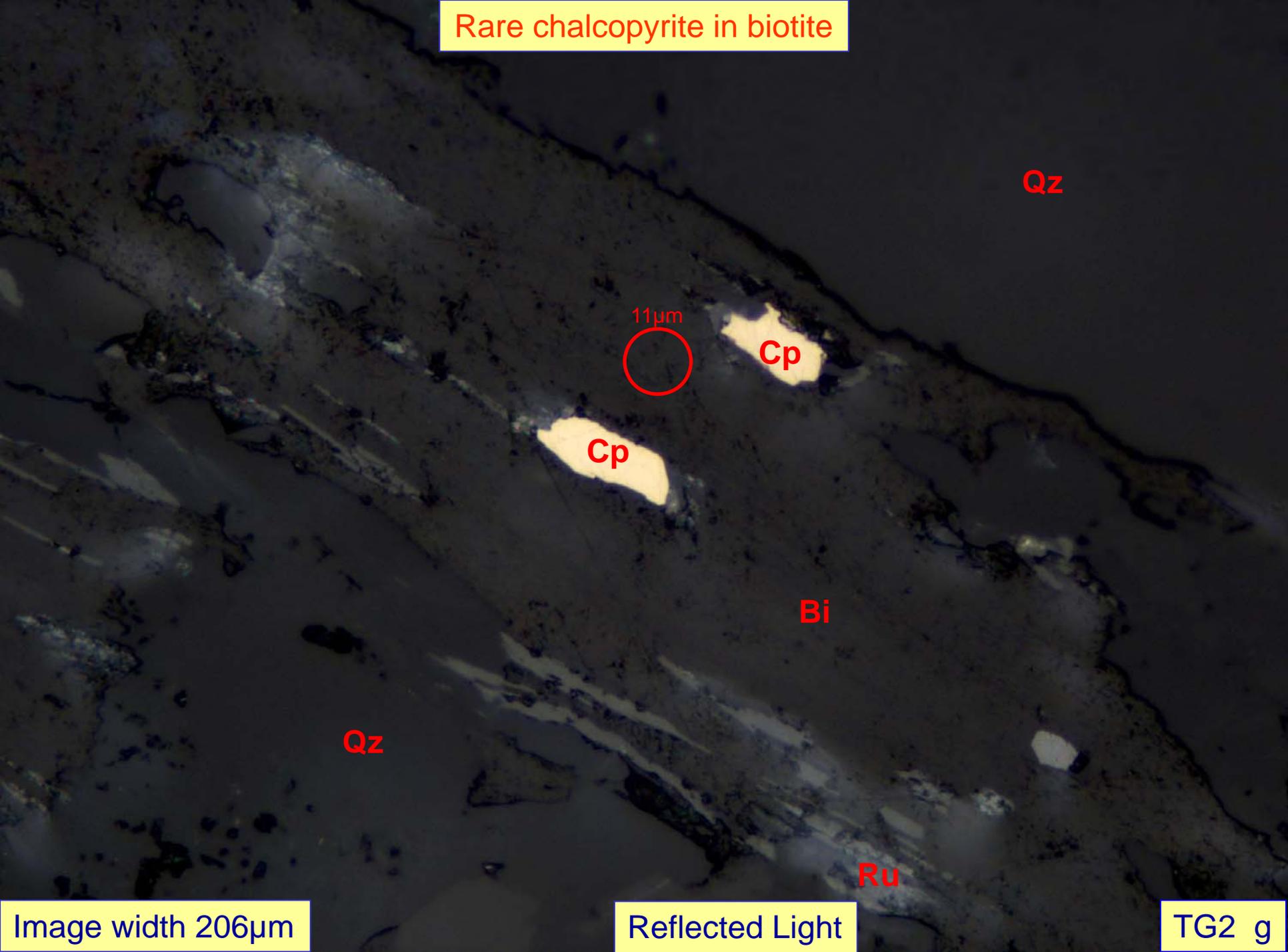


Image width 1.0mm

Reflected Light

TG2 f

Rare chalcopyrite in biotite



Qz

11µm

Cp

Cp

Bi

Qz

Ru

Image width 206µm

Reflected Light

TG2 g