

أعوذ بالله من الشيطان الرجيم

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ
الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ
الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ
الْحَمْدُ لِلَّهِ رَبِّ الْعَالَمِينَ

Uranium minerals in the granitic rocks

By

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Petrographic characteristics of the



uranium-mineralized granites

Granite

Textures and mineralogy

Classification of uranium deposits

Intrusive and metasomatic

Uranium minerals

Oxides, silicates, phosphates, vanadates and carbonates

Uranium-mineralized granites

Petrographic characteristics of the Uranium-mineralized granites

Granite

- Granite belongs to the acidic rocks that having more than 66% SiO₂ which is, expressed by high modal quartz (20% or more of the felsic fraction).
- The colour index is less than 10 in typical granites. Granite contains alkali feldspar > 35% total feldspar.
- The majority of granites are medium to coarse grained, their major contents are subhedral.

The common textures are:

perthitic

K-feldspar (orthoclase)

porphyritic

(orthoclase)

Large phenocrysts of orthoclase or

Rapakivi

orthoclase or

• K-feldspar graphic or micrographic in oligoclase

• Formed as Myrmekitic reaction between the partially crystallized magma and the

This intergrowth is Gneissose similar to the

At the margins of the pluton due to shearing during emplacement.

levels of the layered basic intrusions.

Mineralogy of granites

Essential minerals



Alkali feldspars

Plagioclase

Quartz



Mostly perthitic orthoclase and microcline.
Perthite could be seen in ordinary light due to selective alteration of their potassic and sodic phases.

Hornblende, hastingsite, riebeckite
containing inclusions and arfvedsonite

Calc-alkaline granite and Alkali granite

Mineralogy of granites

Accessory minerals

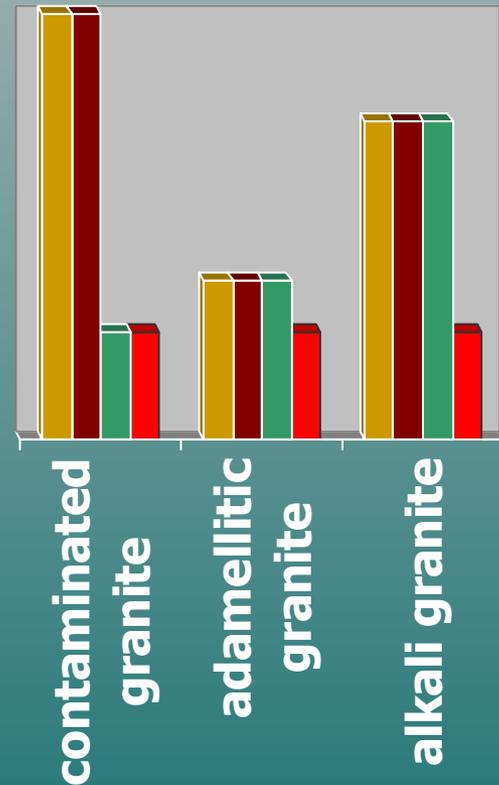


Apatite.

Sphene.

Zircon.

Magnetite.



Classification of the uranium deposits

Classification of uranium deposits (Young, 1988)

Sedimentary

Quartz-pebble conglomerate	(Elliot Lake - Canada)
Sialic volcanics	(Pena Blanca - Mexico)
Mafic volcanics	(Olympic Dam - Australia)
Contact	(Mary Kathleen-Australia)
Phyllites	(Forstau - Australia)
Unconformity-related	(Rabbit Lake - Canada)
Sandstones	(Gas Hills - U.S.A.)
Calcretes	(Yeelirrie - Australia)
Limestones	(Todilto - U.S.A)
Phosphates	(Baukoma - Zaire)
Hydrothermal veins	(Schwartzwalder - U.S.A.)

Classification of uranium deposits (Young, 1988)

Sedimentary

Effusive

Intrusive

Metasomatic

Metamorphic

Uncertain (Vein like)

Epigenetic

Granite

Classification of the uranium deposits

Uranium minerals

Uranium minerals

Oxides

Silicates

Phosphates

Vanadates

Carbonates

Uranium minerals

Oxides

Silicates

Phosphates

Vanadates

Carbonates

Zoom

Pitchblende

30

40

50

60

70

80







Pitchblende



Pitchblende



Zoom

UO_{2-x} ($0.0 < x < 0.25$)

Uraninite





$\text{UO}_{2-x} (0.0 < x < 0.25)$

Uraninite



$\text{UO}_{2-x} (0.0 < x < 0.25)$

Uraninite



UO_{2-x} ($0.0 < x < 0.25$)

Uraninite

Rotation



UO_{2-x} ($0.0 < x < 0.25$)

Uraninite





Rotation

UO_{2-x} ($0.0 < x < 0.25$)

Uraninite



Uraninite



UO_{2-x} ($0.0 < x < 0.25$)

Uraninite



$\text{UO}_{2-x} (0.0 < x < 0.25)$

Uraninite



Zoom

UO_{2-x} ($0.0 < x < 0.25$)

Uraninite





UO_{2-x} ($0.0 < x < 0.25$)

Uraninite



Zoom

UO_{2-x} ($0.0 < x < 0.25$)

Uraninite





UO_{2-x} ($0.0 < x < 0.25$)

90

Uraninite



$\text{UO}_{2-x} (0.0 < x < 0.25)$

Uraninite

Uranium minerals

Oxides

Silicates

Phosphates

Vanadates

Carbonates



Zoom

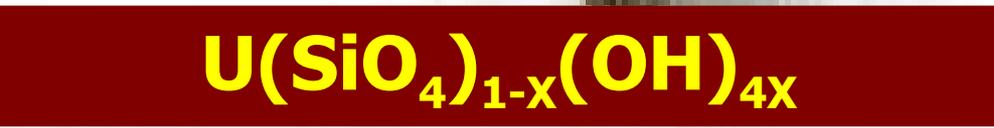


Boltwoodite





Zoom



Coffinite





Zoom



Cuprosklodowskite





Uranophane



Zoom



Uranophane





Soddyite



Kasolite

Uranium minerals

Oxides

Silicates

Phosphates

Vanadates

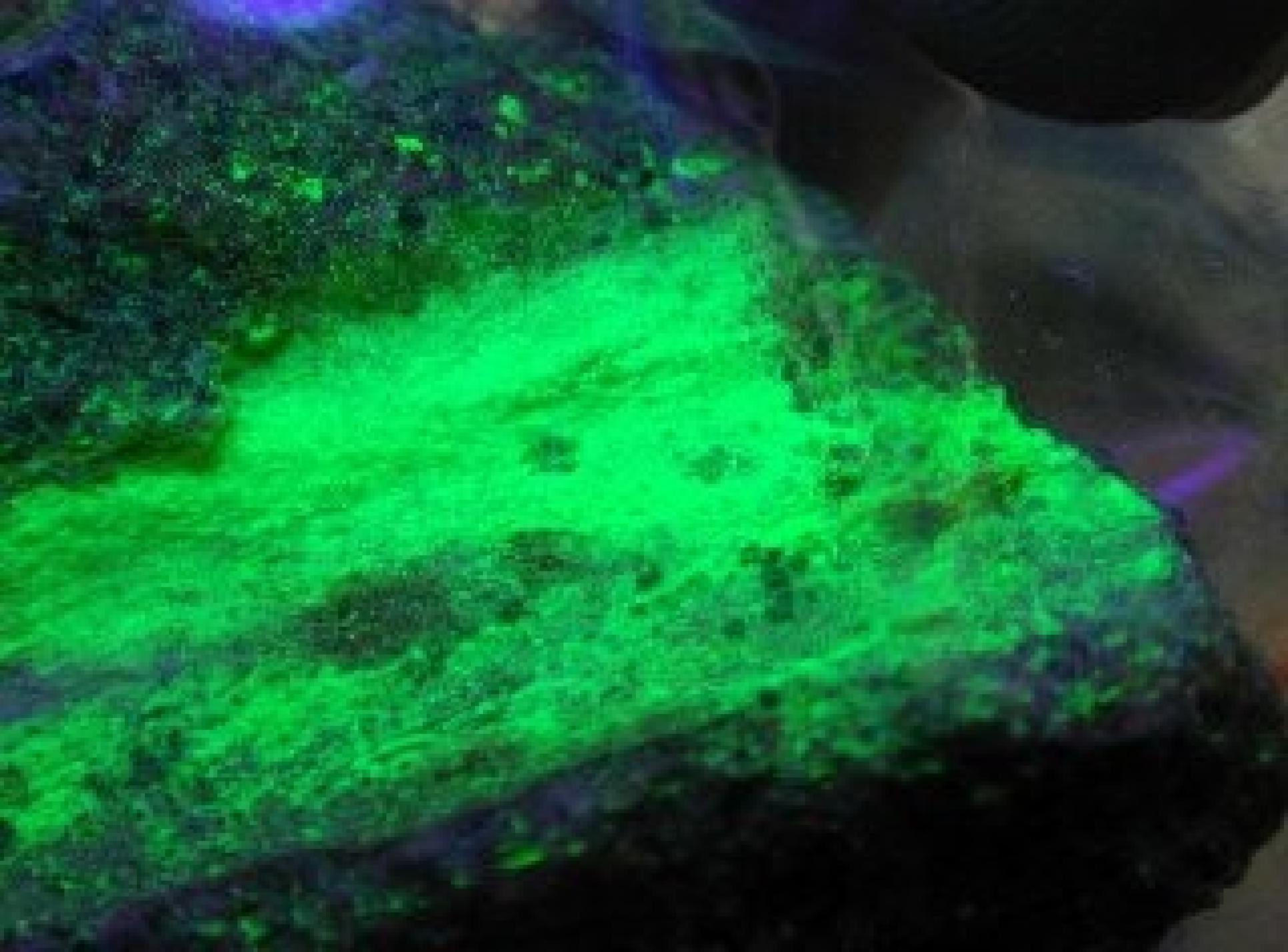
Carbonates



UV



Autunite





UV



Autunite

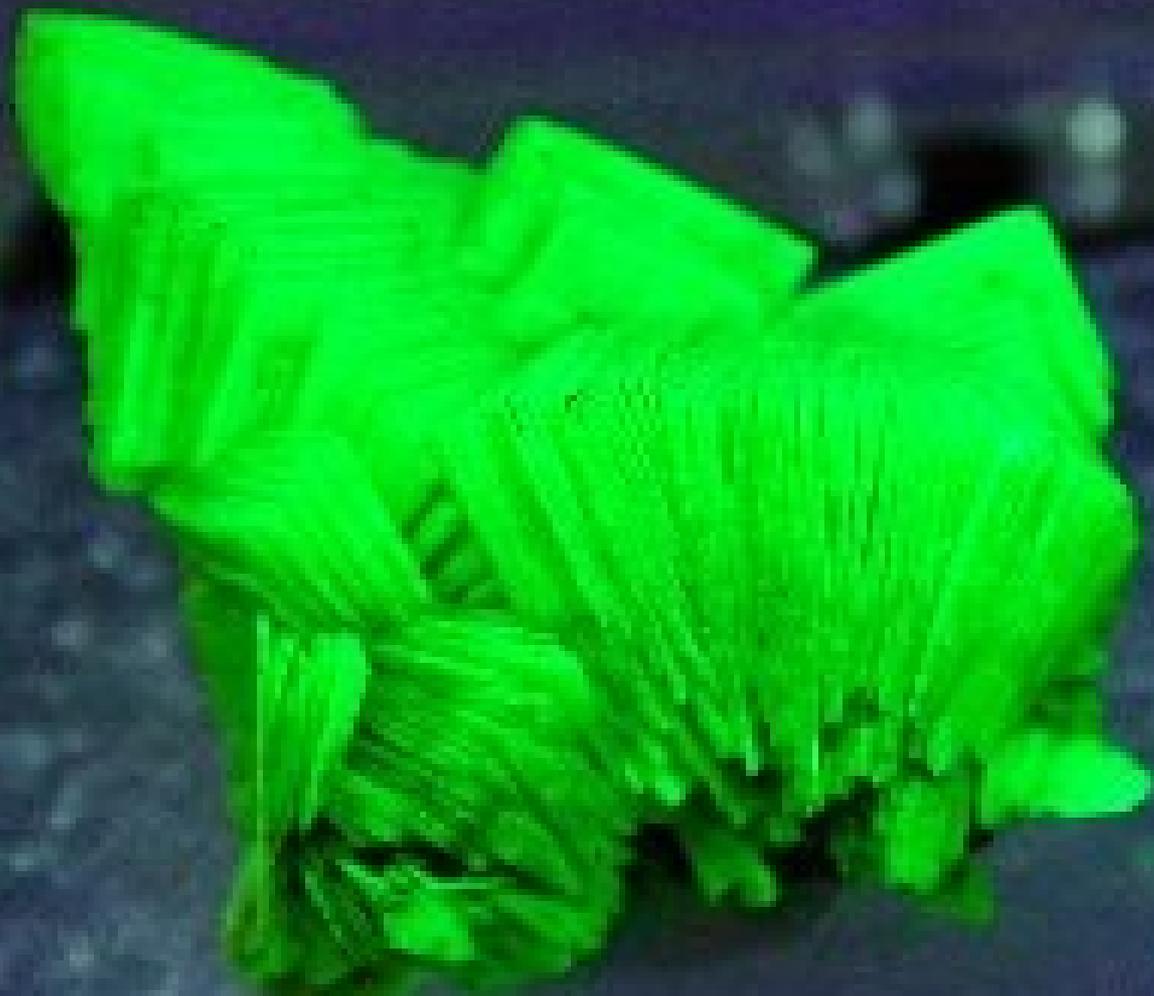




UV



Autunite





Zoom

UV

META AUTUNITE
DAYBREAK MINE, NEAR MT. SPOKANE
SPOKANE COUNTY, WASHINGTON



Meta autunite





Zoom



Coconinoite





Zoom

$(U,Ca,Ce)_2(PO_4)_2 \cdot 1-2H_2O$

Ningyoite





$\text{Cu}(\text{UO}_2)_2(\text{PO}_4)_2 \cdot 8-12\text{H}_2\text{O}$

Torbernite



Zoom



Phurcalite

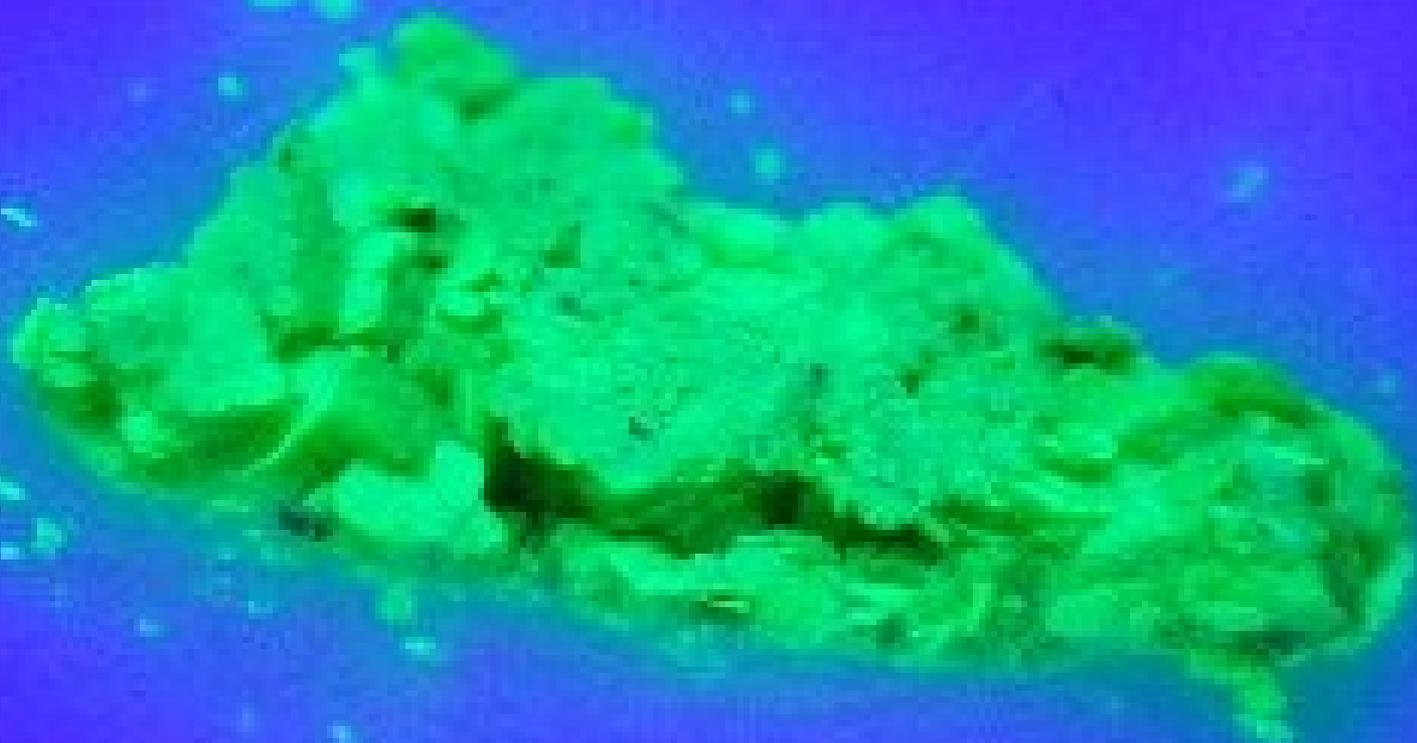




UV

Ba (UO₂)₂(PO₄)₂·12H₂O

Uranocircite



Uranium minerals

Oxides

Silicates

Phosphates

Vanadates

Carbonates



Zoom



Carnotite





Zoom



Tyuyamunite



Uranium minerals

Oxides

Silicates

Phosphates

Vanadates

Carbonates



UV

$\text{Na}_2\text{Ca}(\text{UO}_2)(\text{CO}_3)_3 \cdot 6\text{H}_2\text{O}$

Andersonite





Zoom

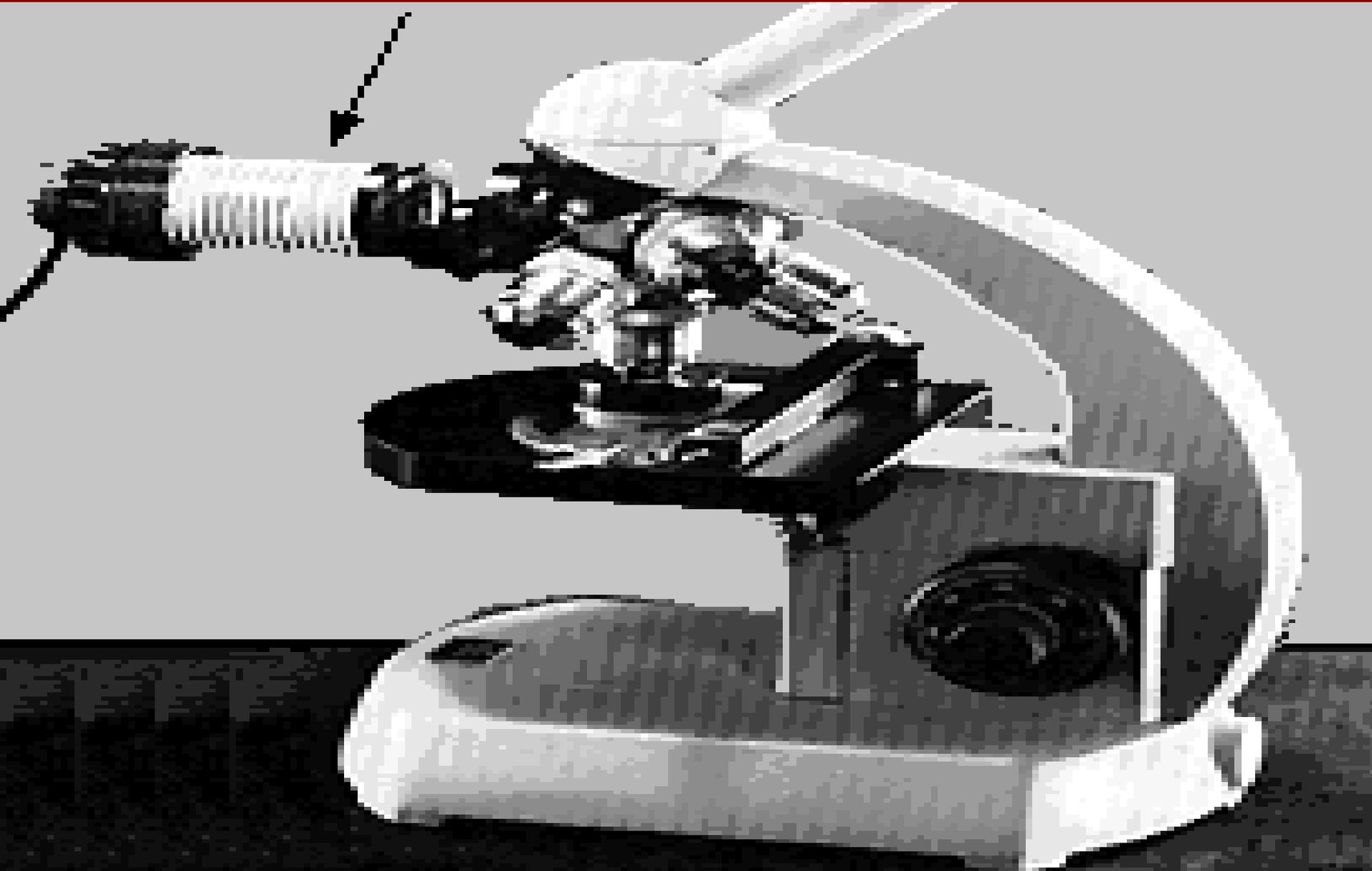
UV



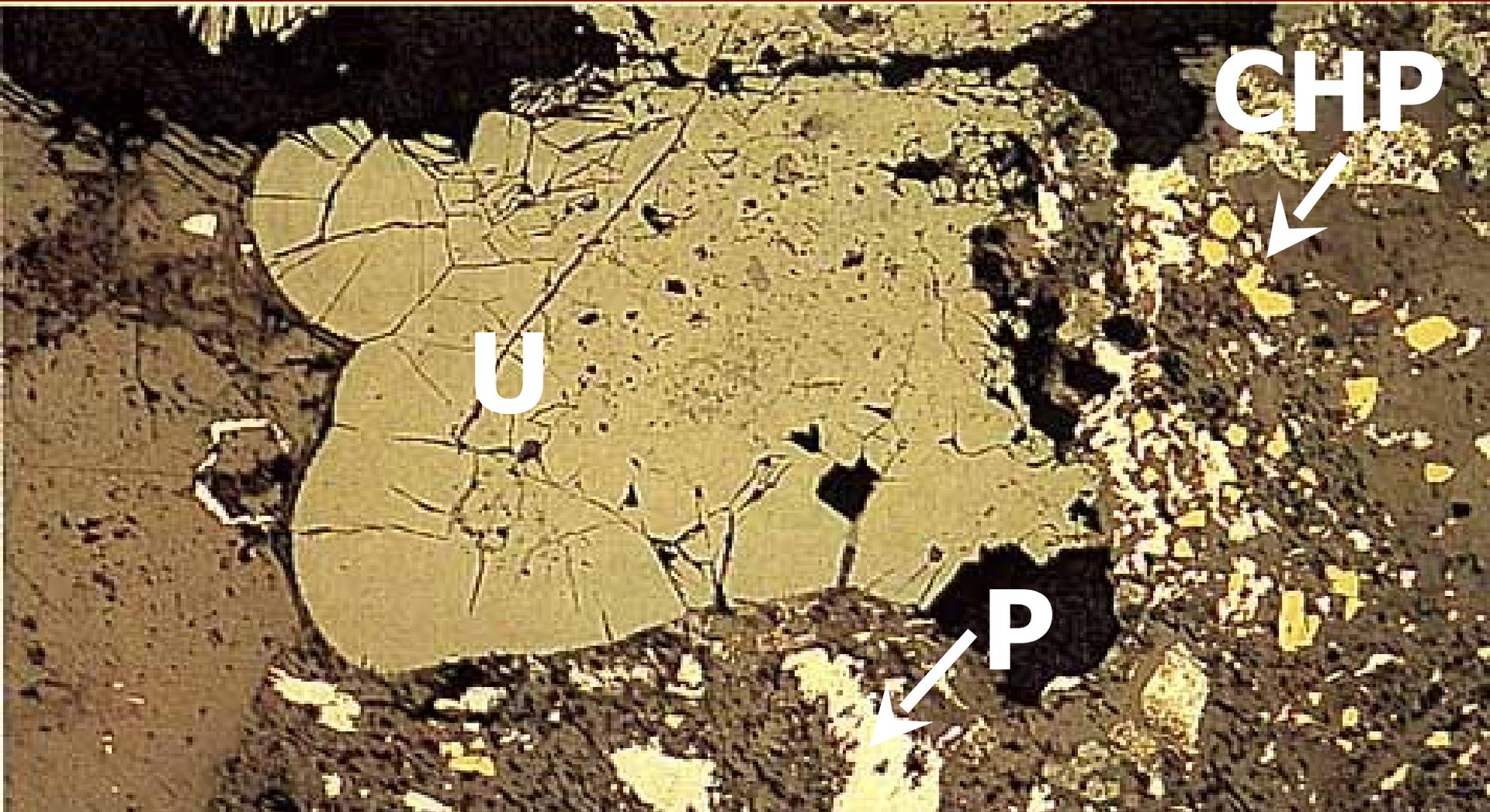
Liebigite



Under the ore microscope



Under the ore microscope



Uraninite (U), Pyrite (P) and chalcopyrite (CHP). Tyndrum, Scotland

Under the ore microscope



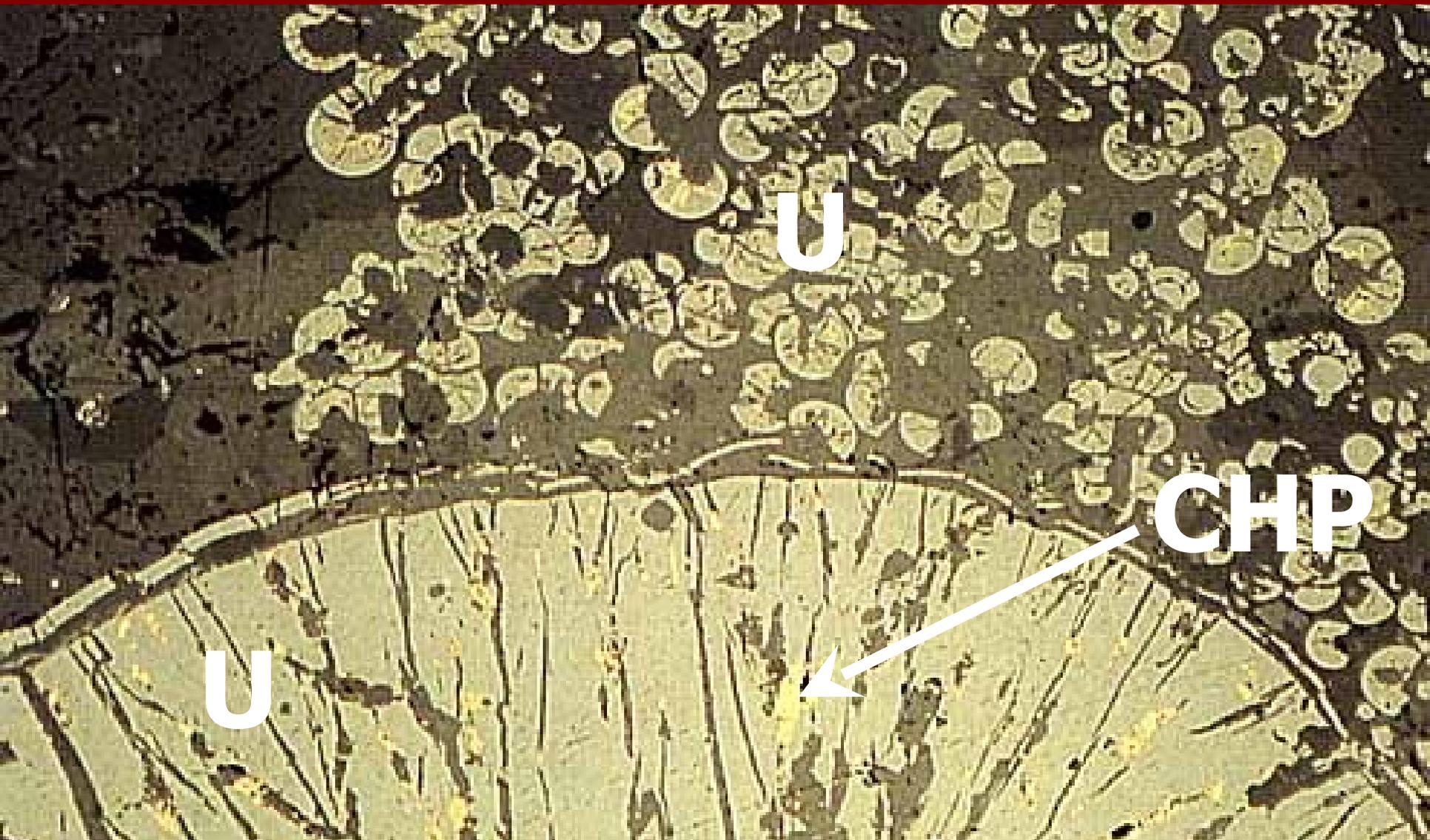
**Uraninite (U), galena (G) and chalcopyrite (CHP).
Tyndrum, Scotland**

Under the ore microscope



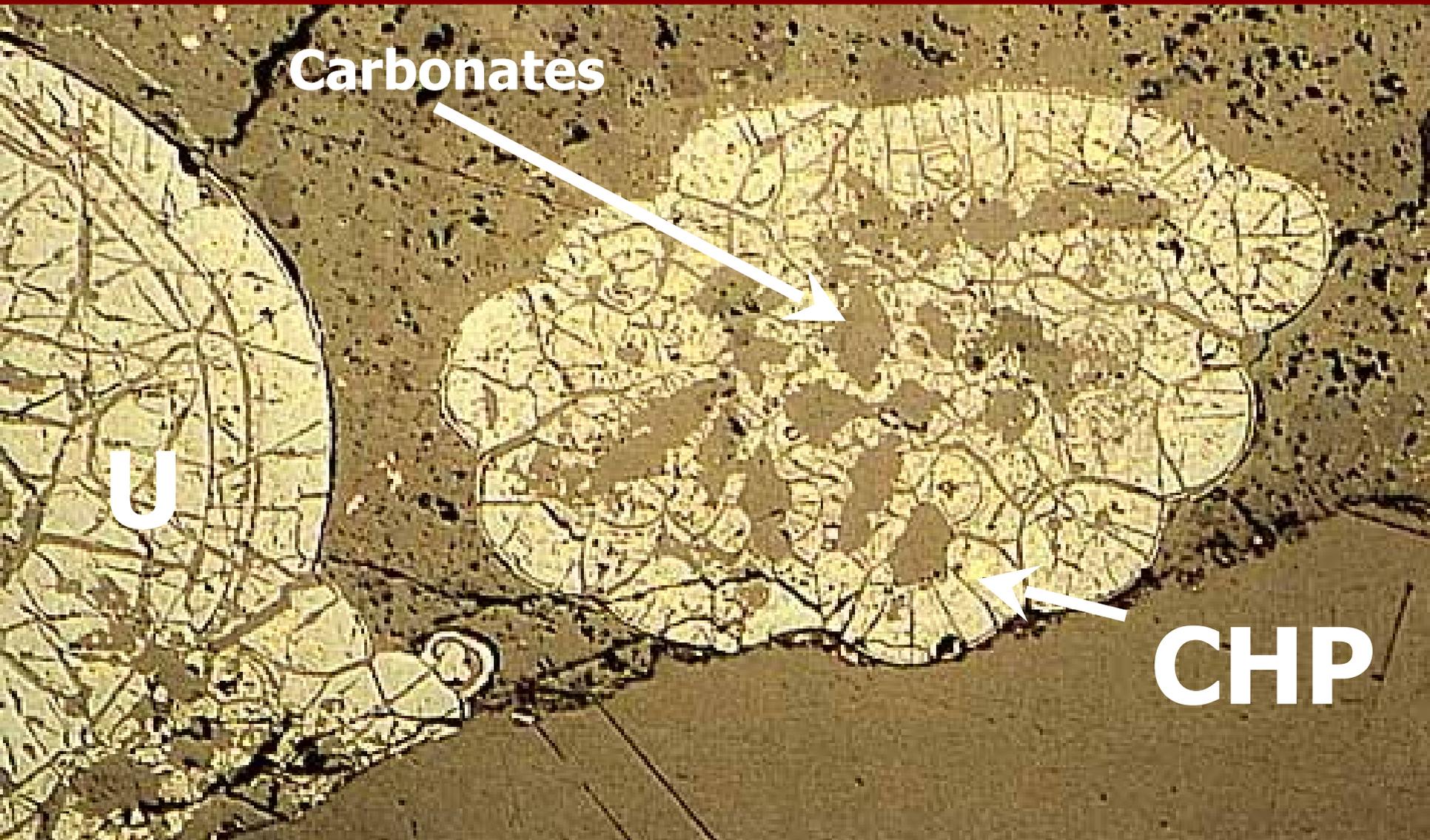
Uraninite (U) and chalcopyrite (CHP). Tyndrum, Scotland

Under the ore microscope



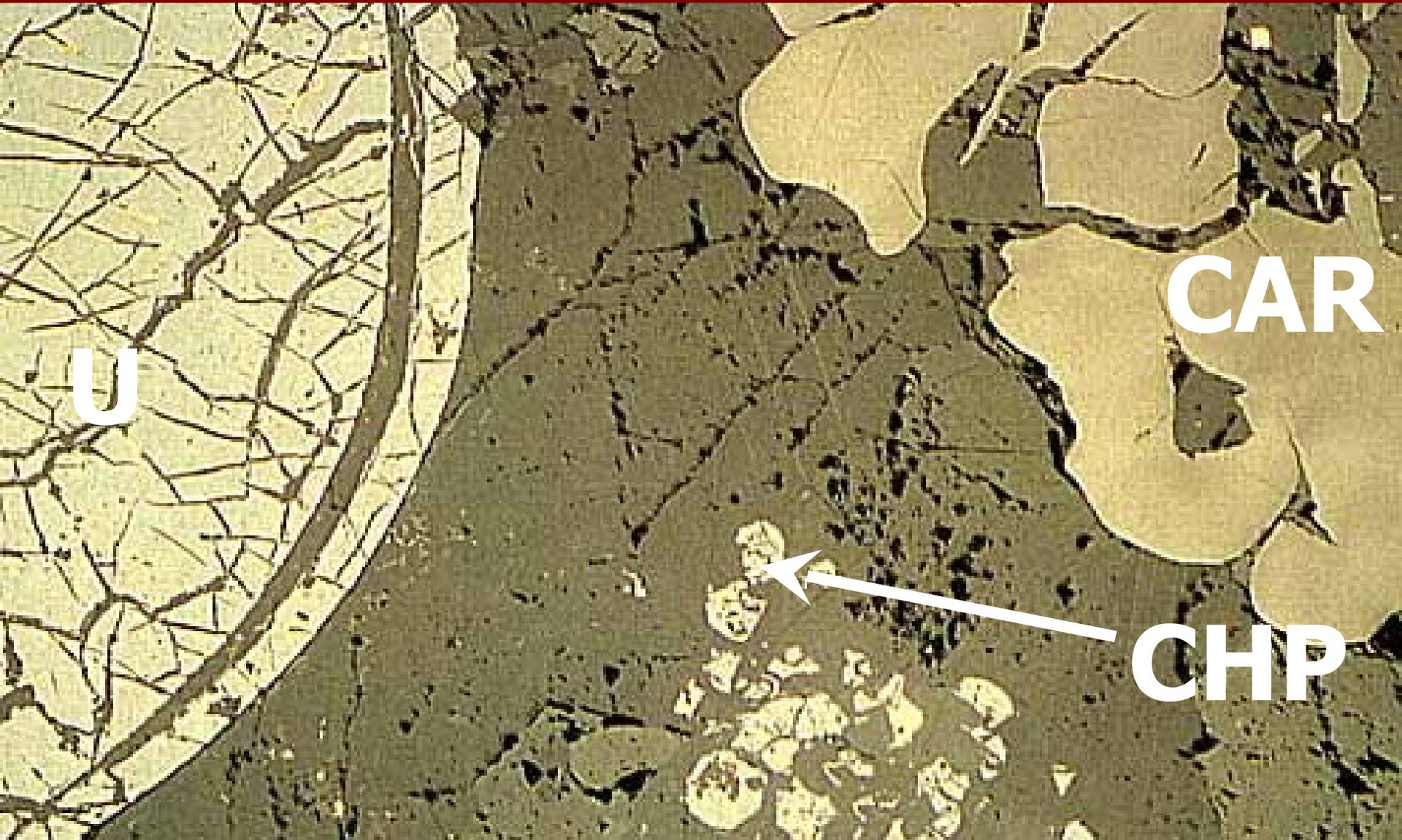
Uraninite (U) and chalcopyrite (CHP). Port Radium, Canada

Under the ore microscope



Uraninite (U) and chalcopyrite (CHP). Port Radium, Canada

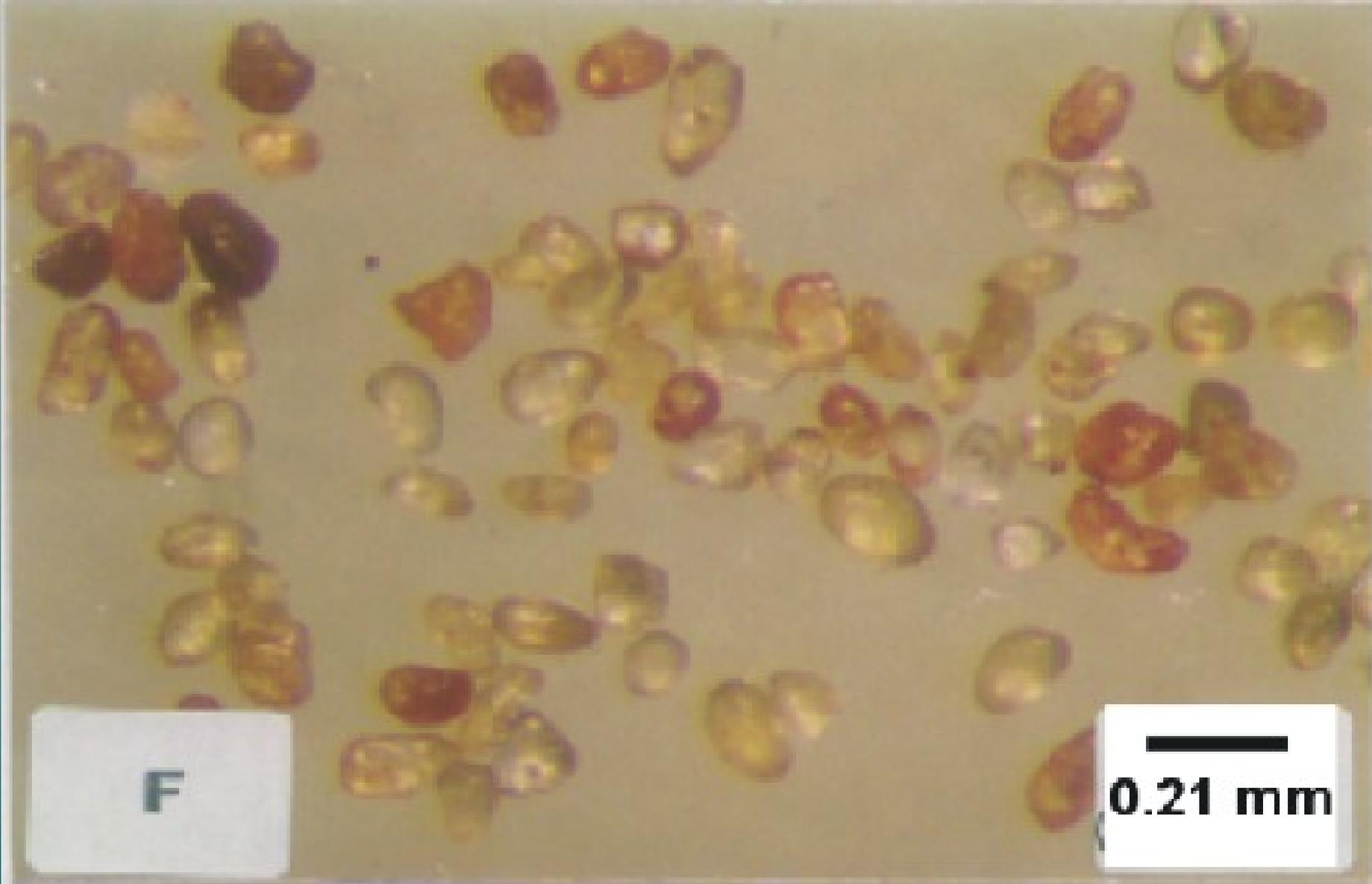
Under the ore microscope



Uraninite (U), carbonaceous matter (CAR) and chalcopyrite (CHP). Canada



Under the binocular microscope



Monazite crystals from El-Erediya granite.



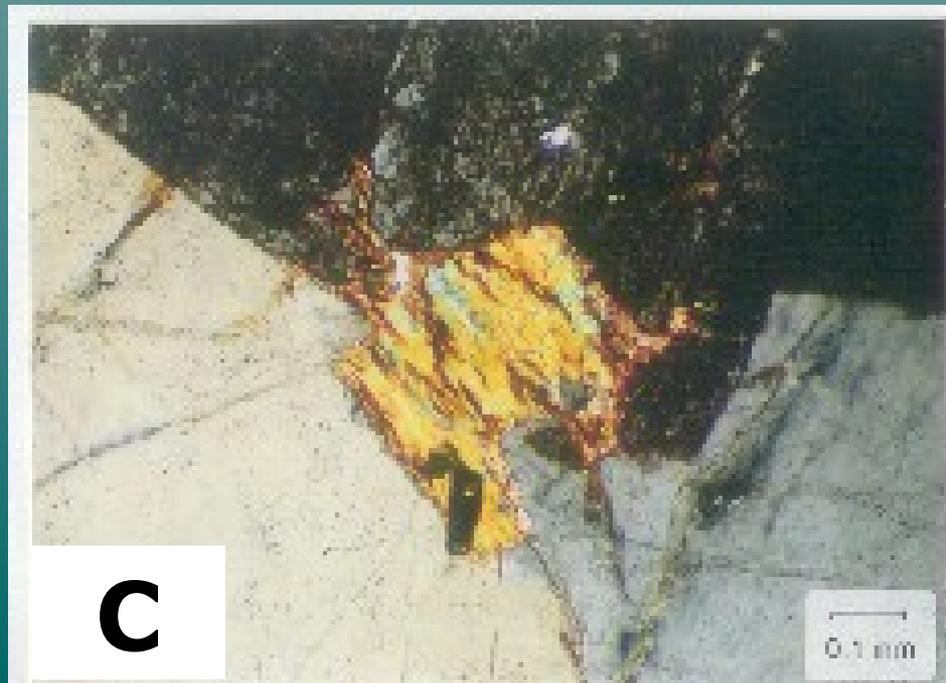
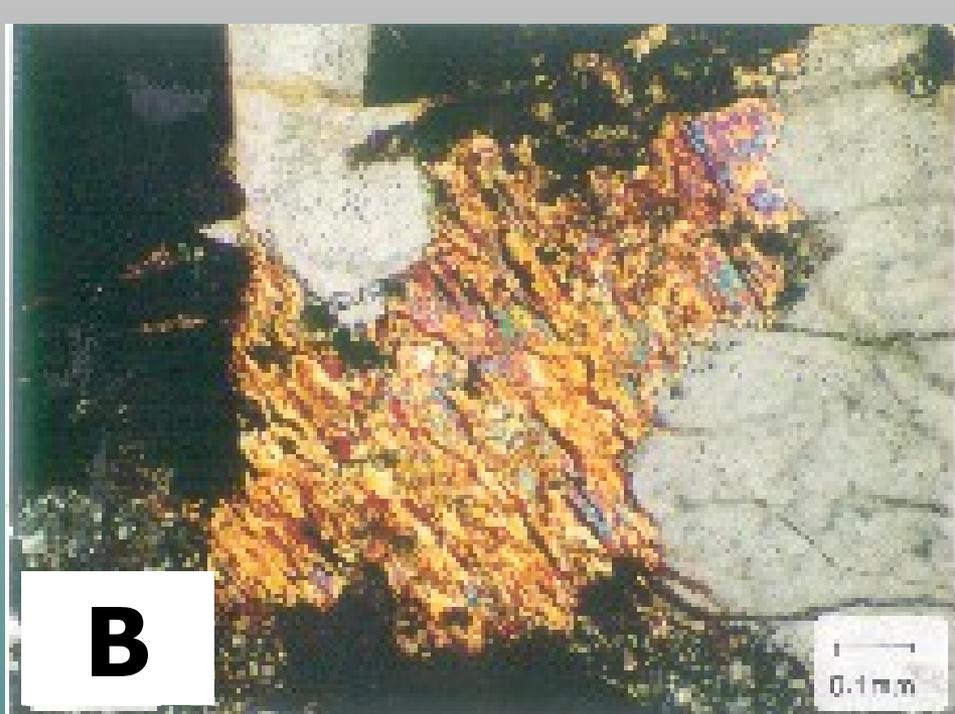
Uranophane

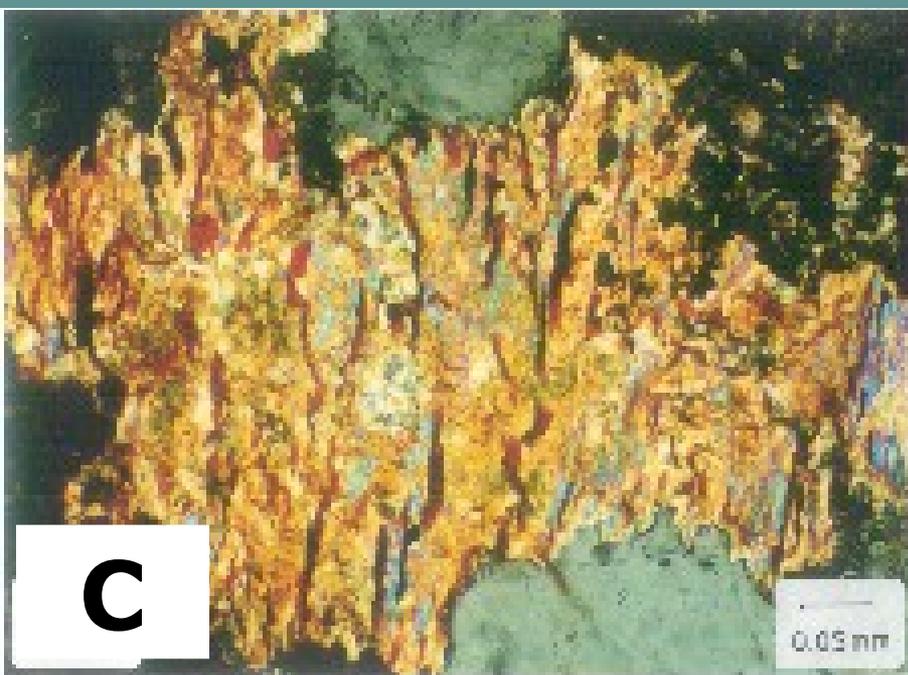
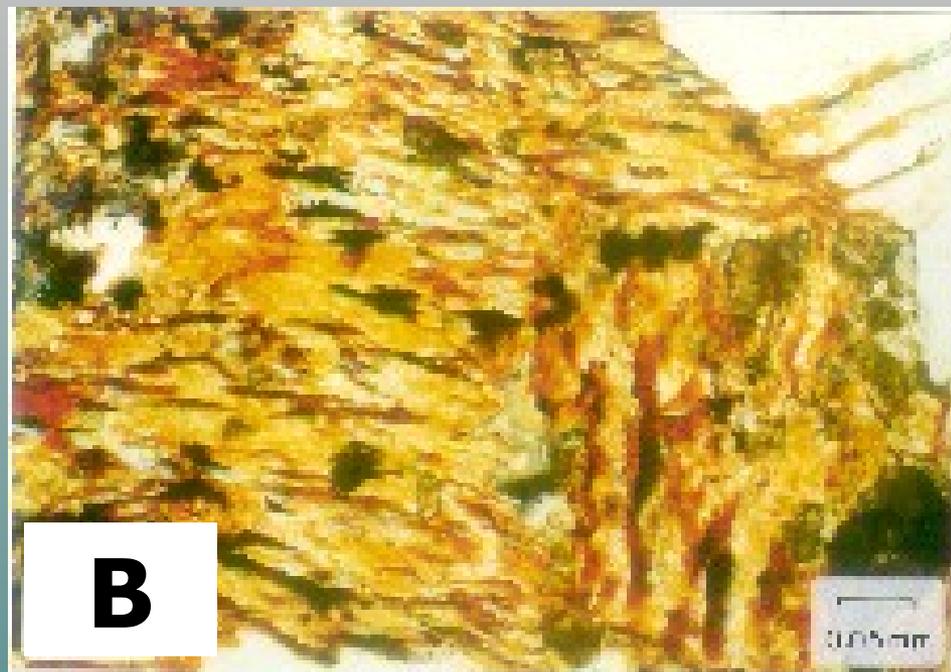
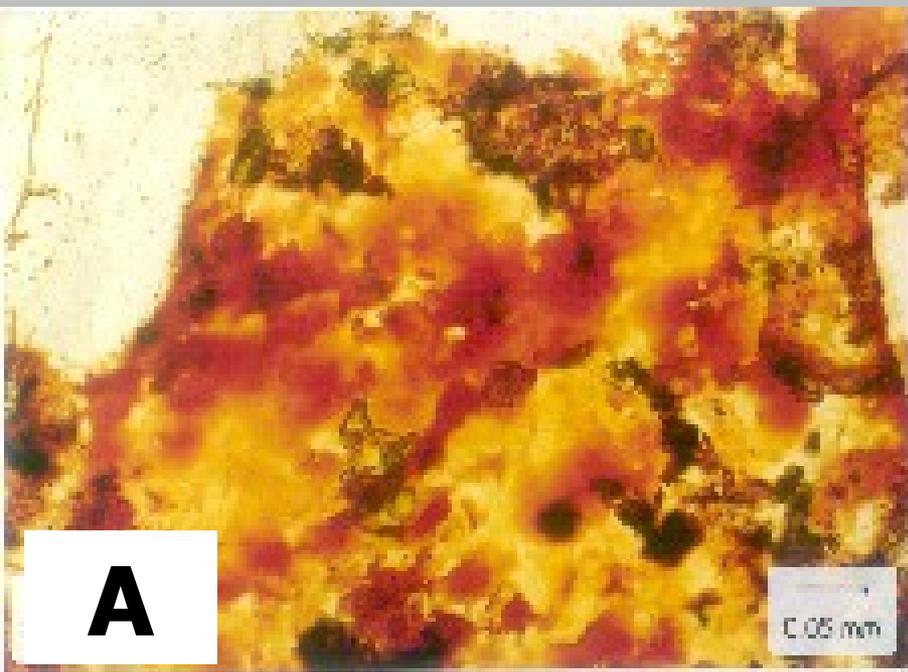




Under the polarizing microscope





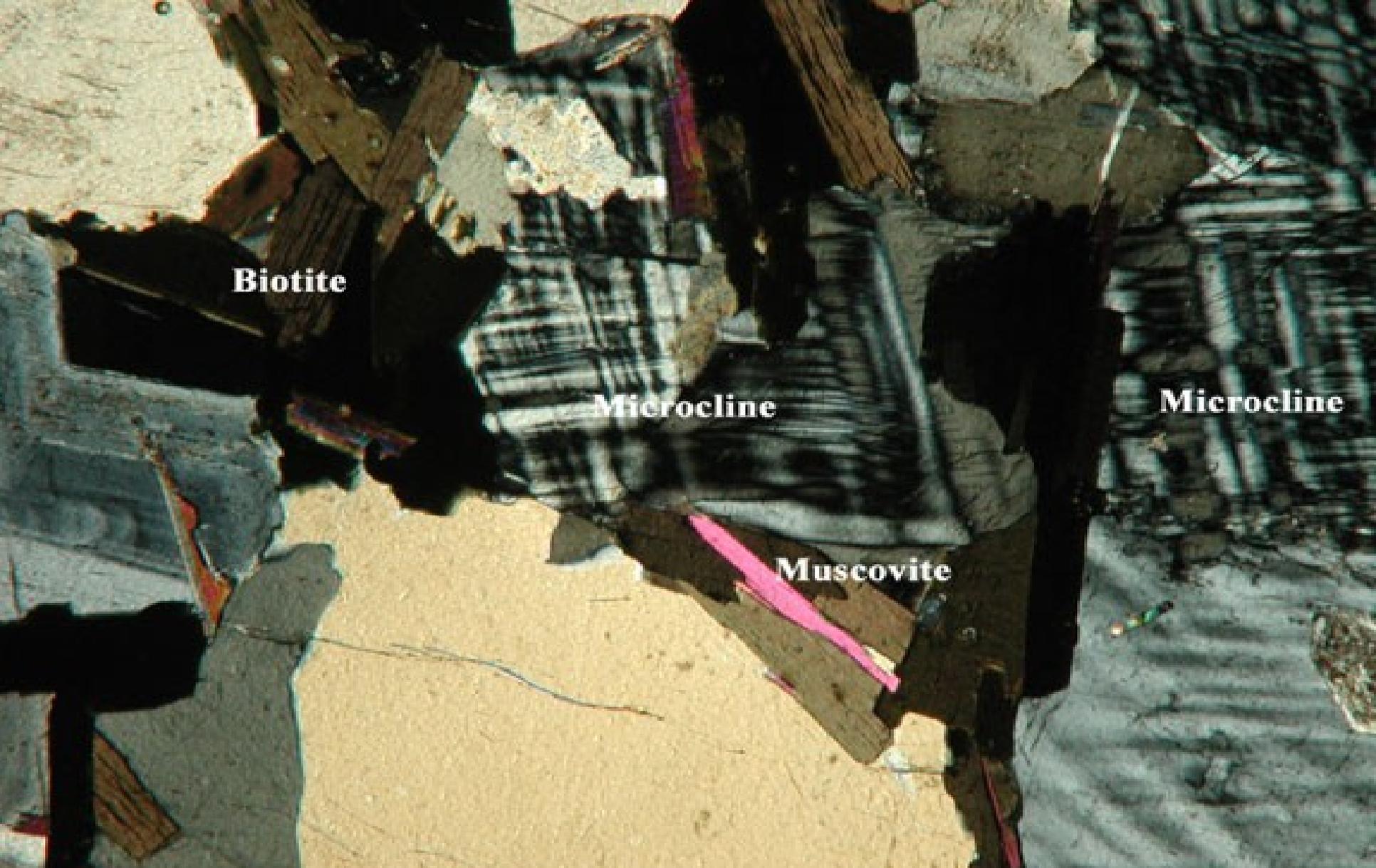


Granite

Classification of the uranium deposits

Uranium minerals

Uranium-mineralized granites



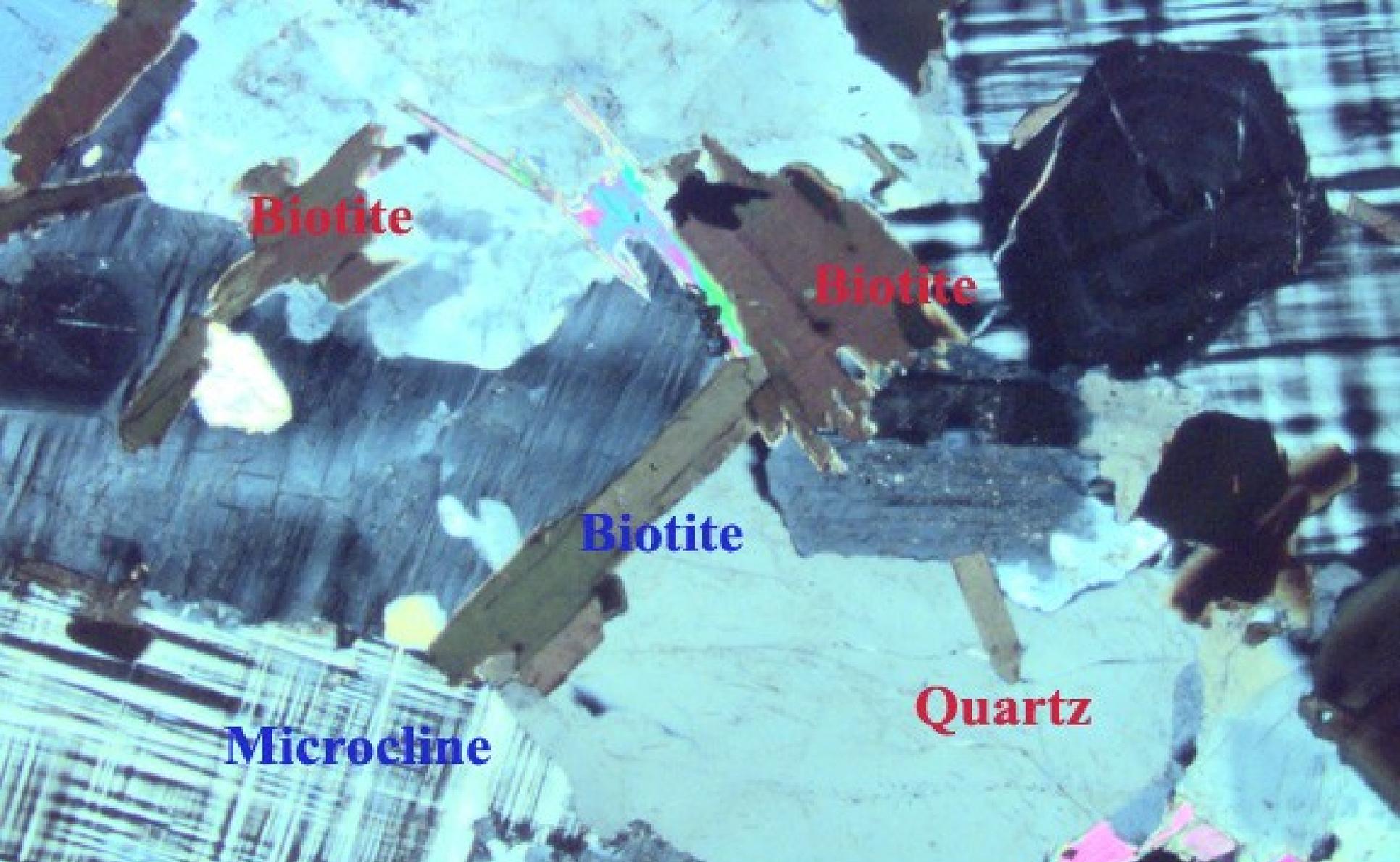
Biotite

Microcline

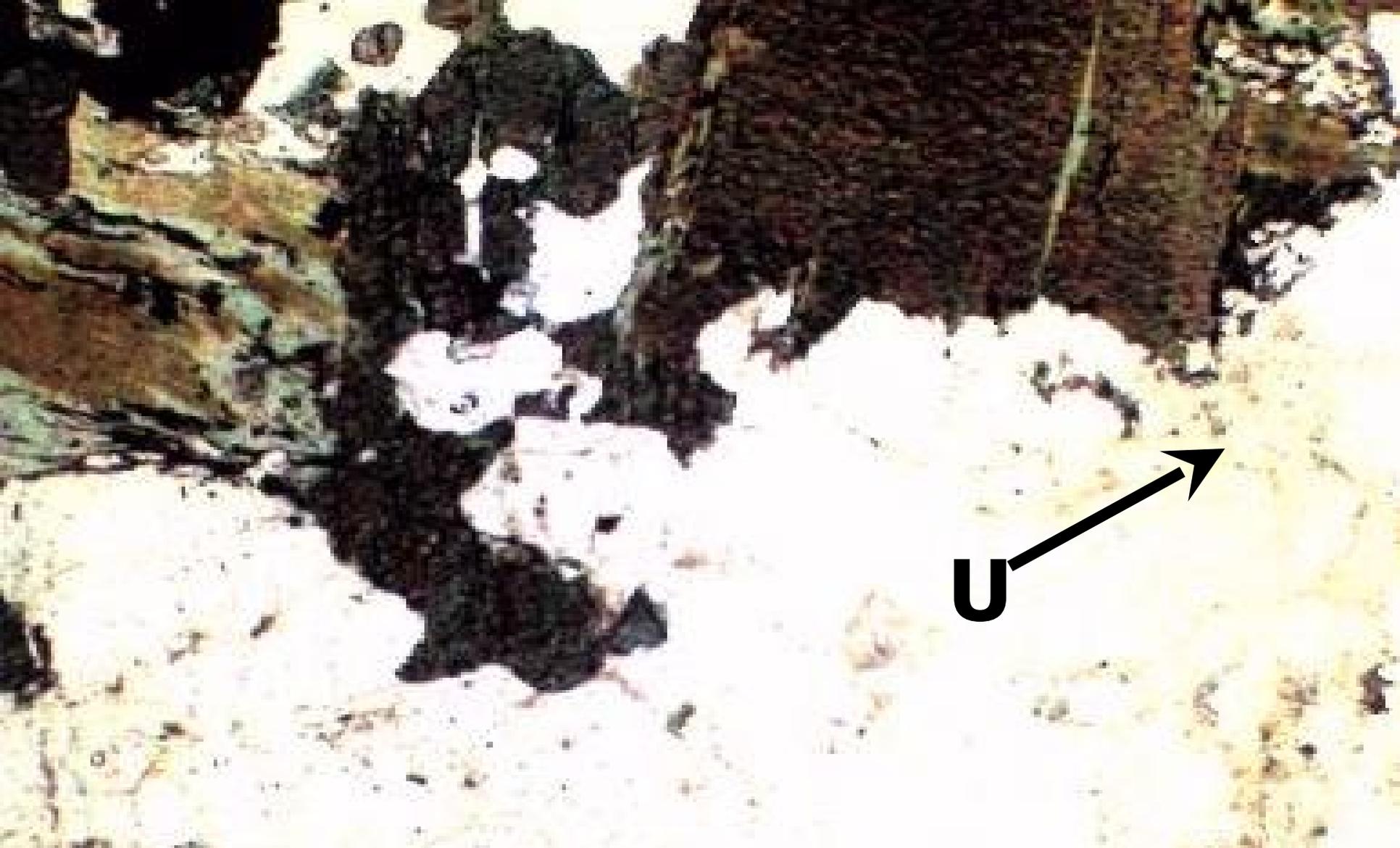
Microcline

Muscovite

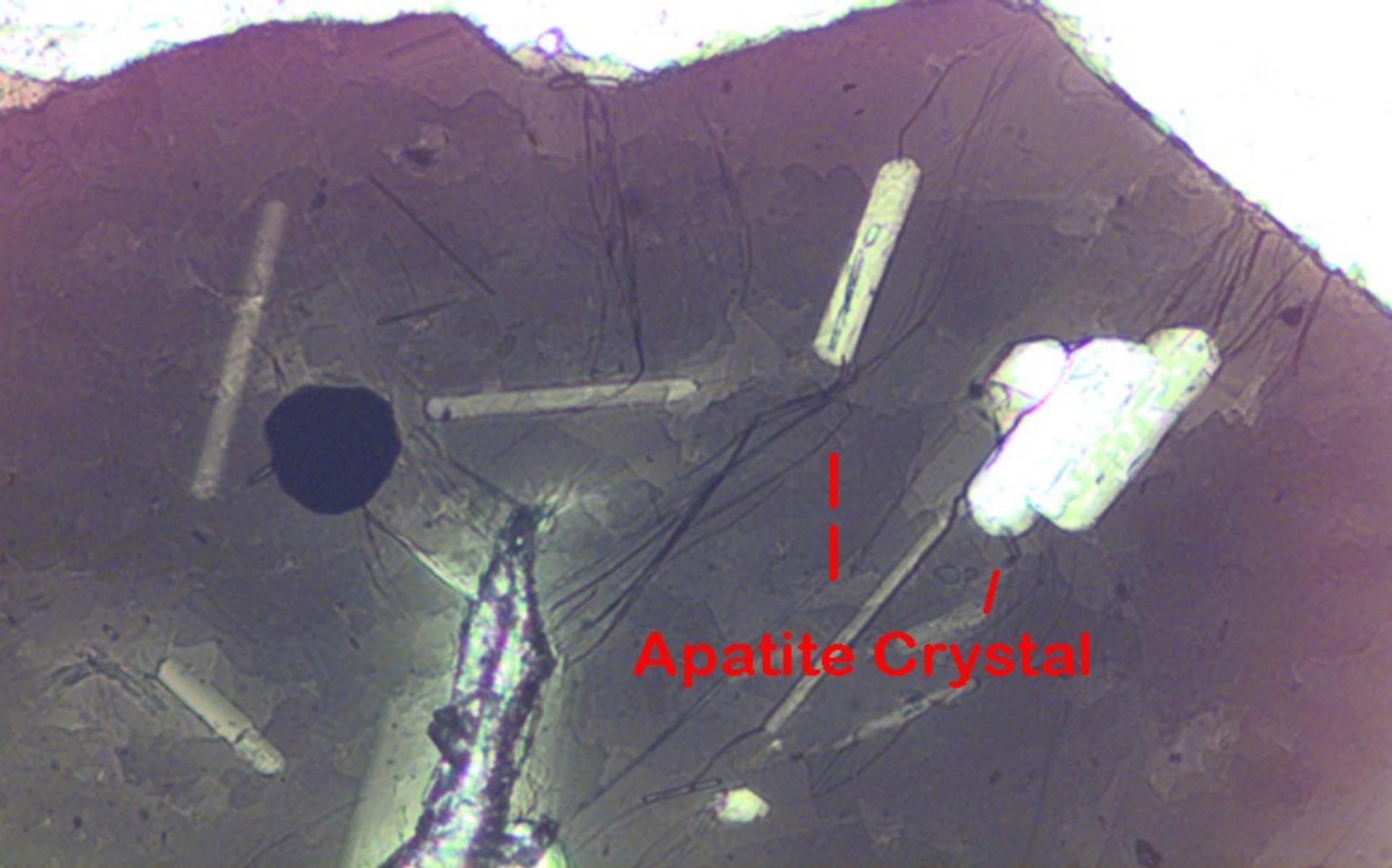
General view of granite



General view of granite



Uranophane



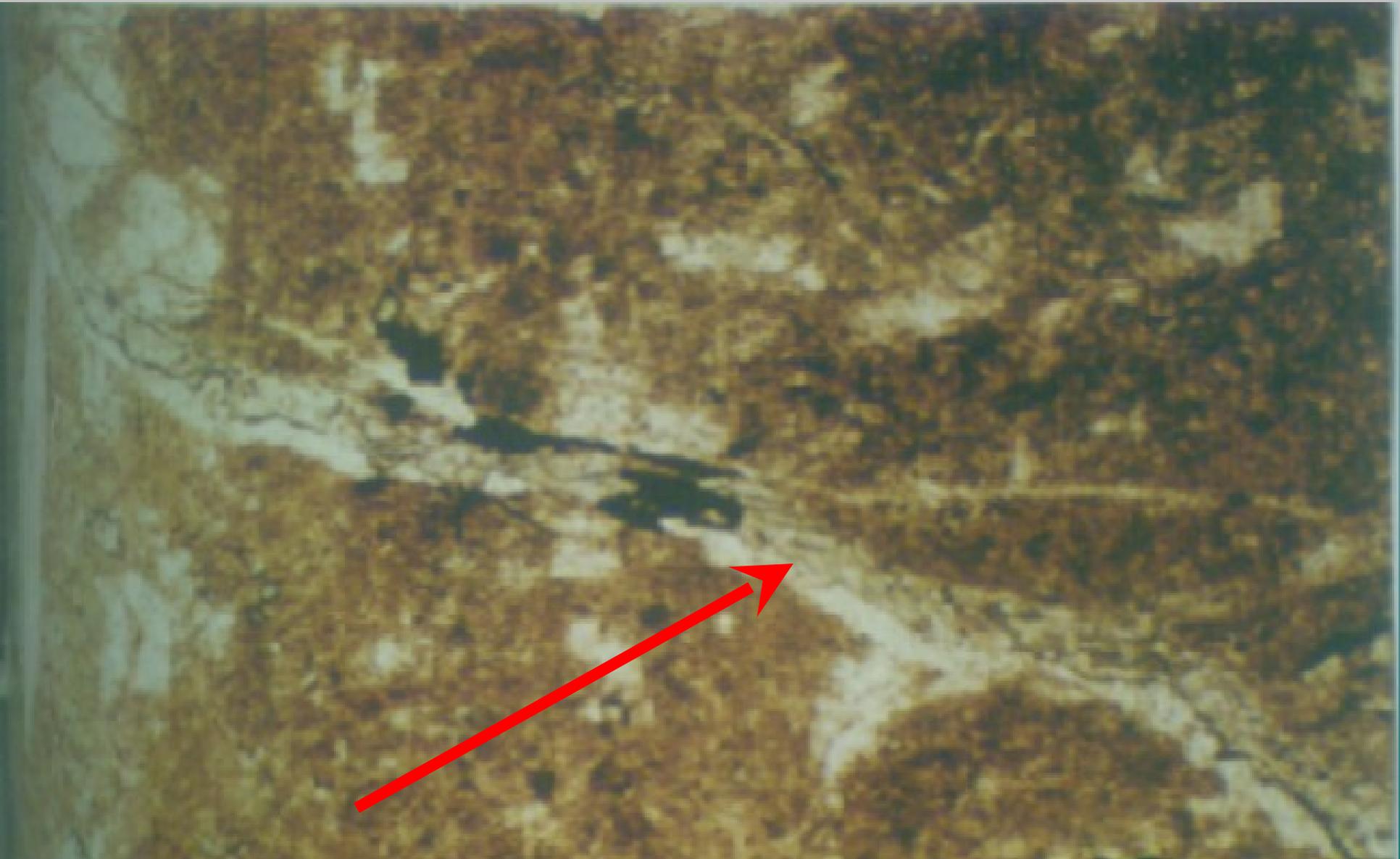
Apatite Crystal

Apatite in quartz.

Petrographic characteristics of the Uranium mineralized granites

The petrographic characteristics of the uranium-mineralized granites

The abundance of microfractures that are generally filled with iron oxides, quartz, fluorite and sometimes calcite.



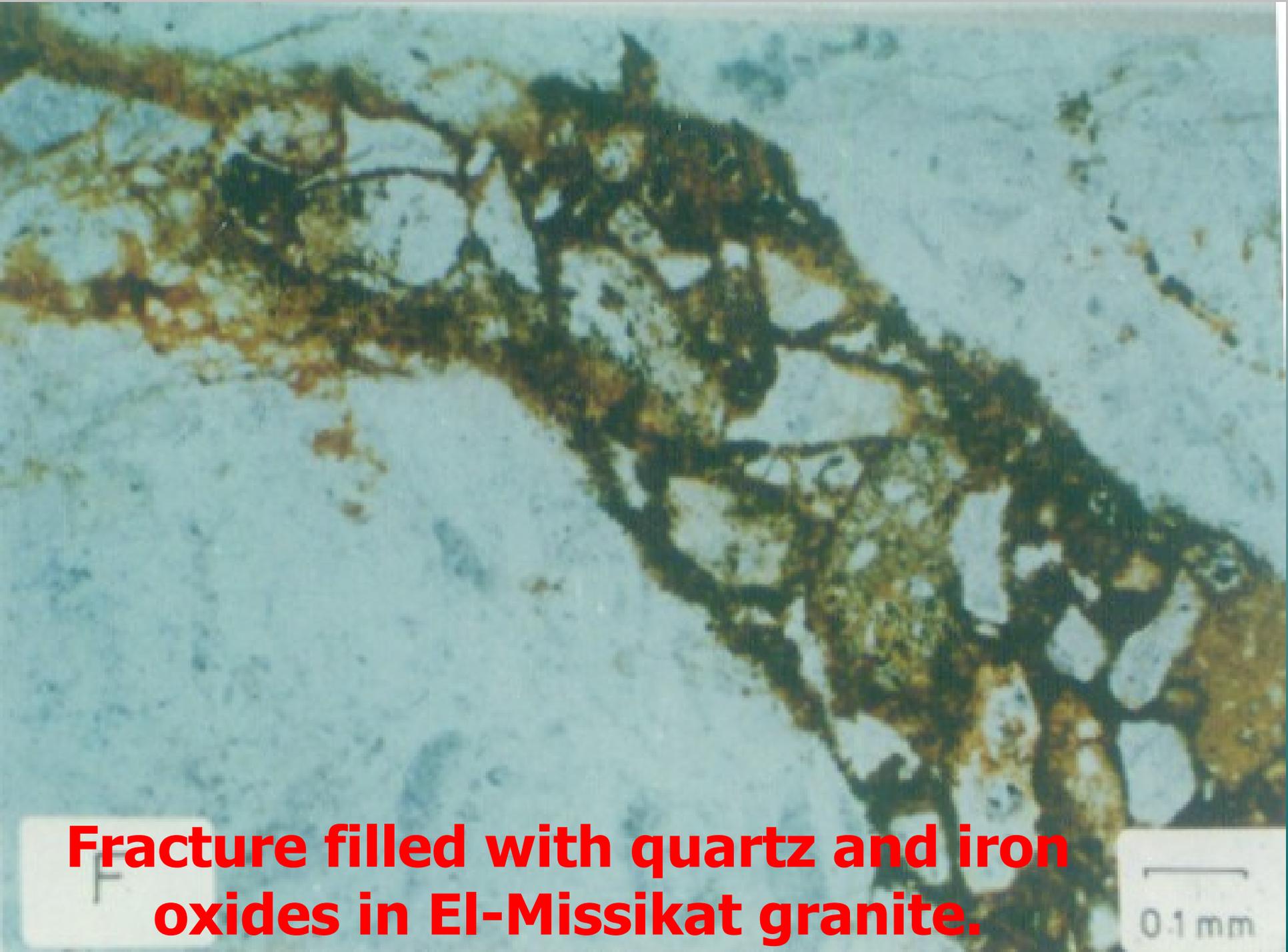
Fracture filled with calcite in El-Missikat granite.

0.18 mm



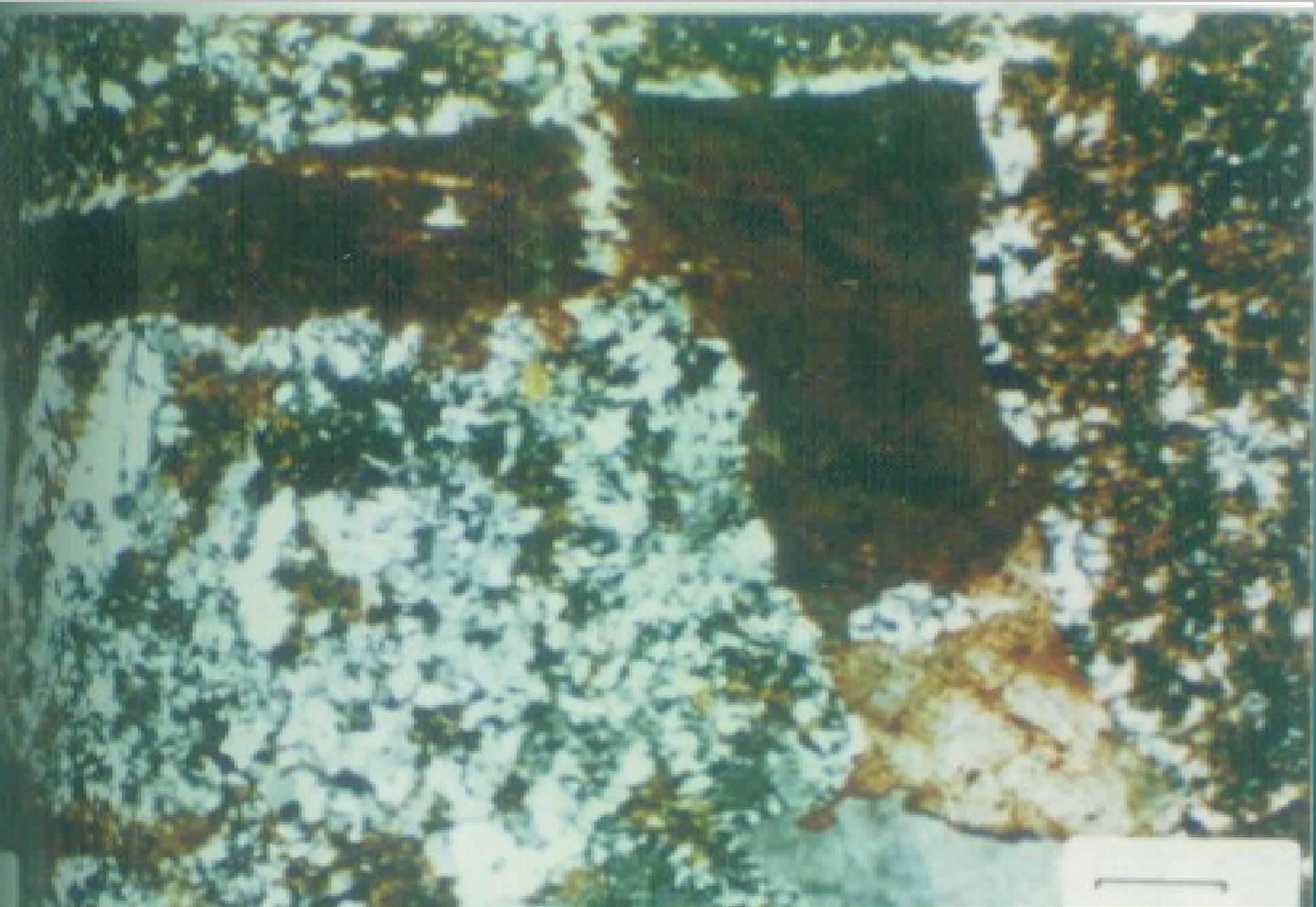
Fracture filled with calcite in FI-Missikat granite.

0.18 mm



Fracture filled with quartz and iron oxides in El-Missikat granite.

—
0.1 mm

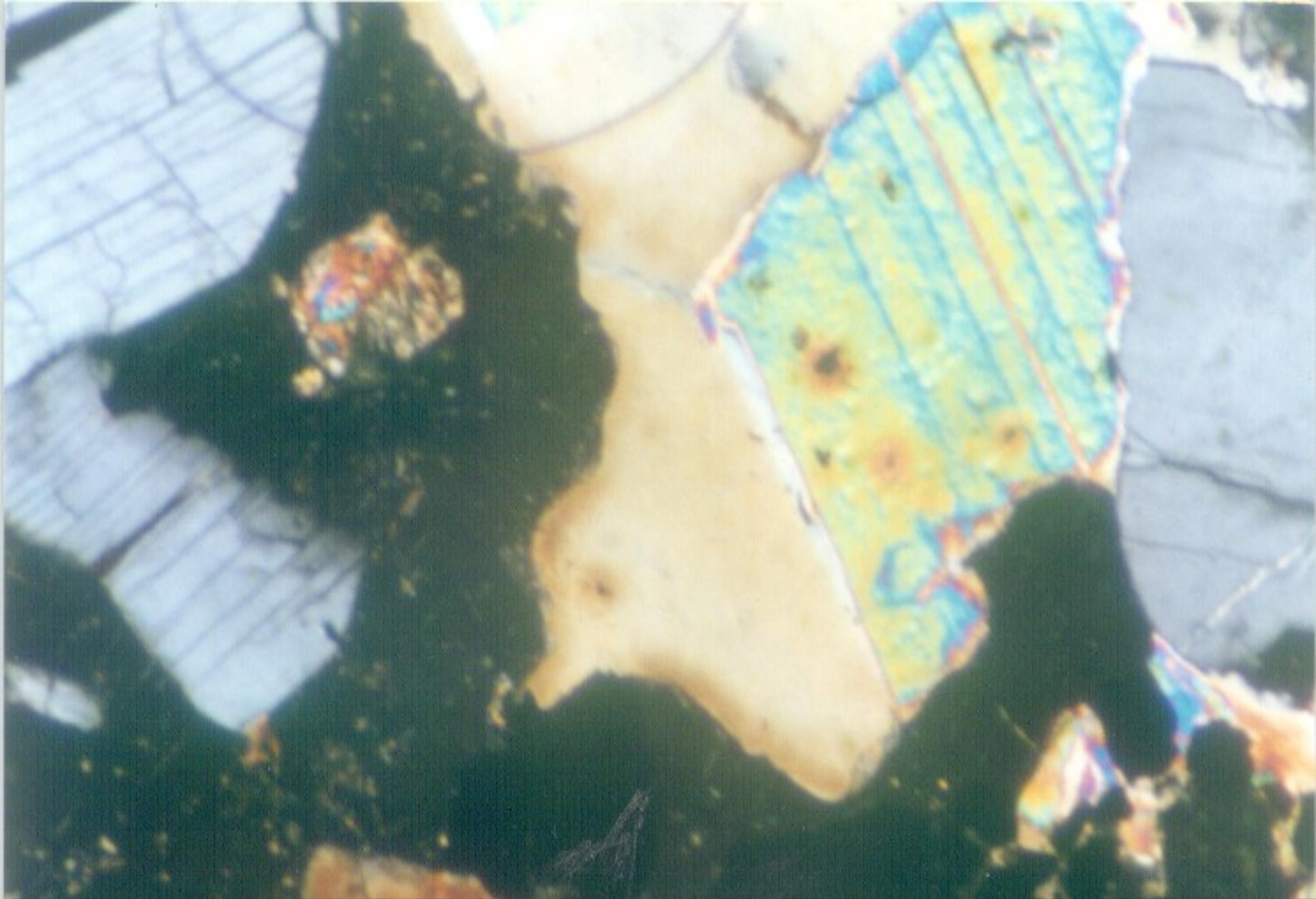


Fracture filled with iron oxides in El-Missikat granite.

The petrographic characteristics of the uranium-mineralized granites

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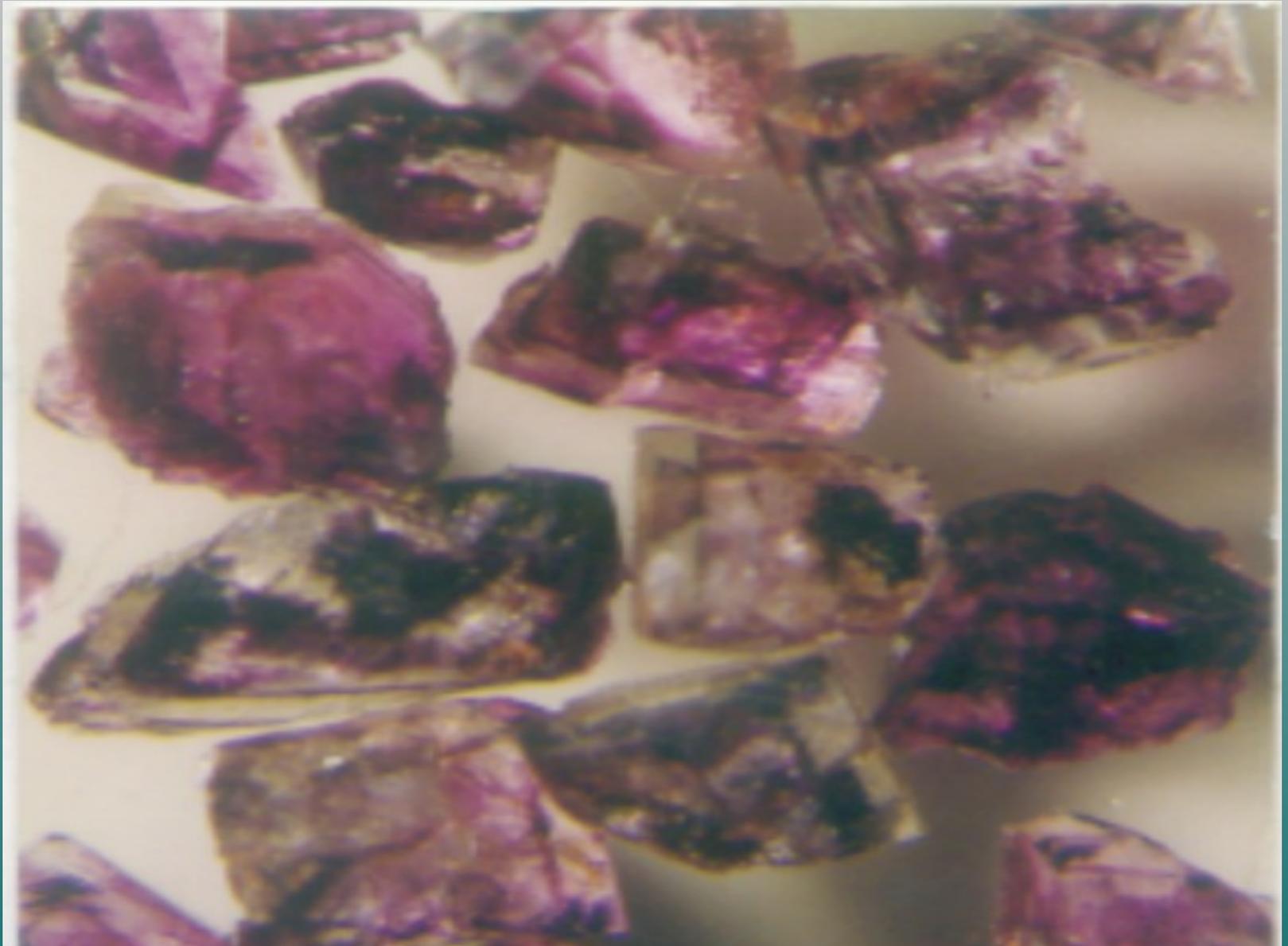
The common presence of multicolored fluorite crystals, especially the violet and purple variety



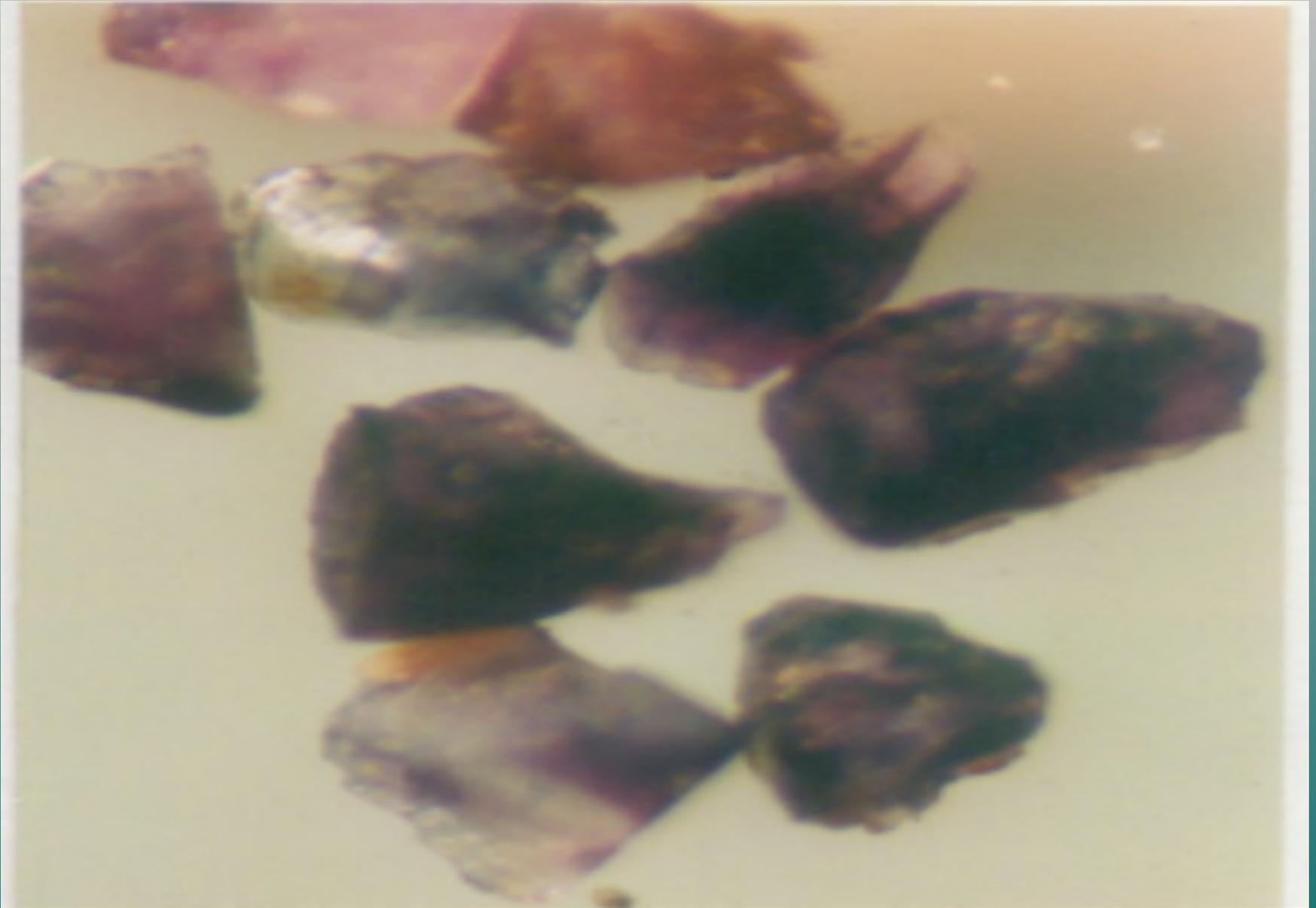
Cavity filled with fluorite in El-Erediya granite



Colorless fluorite from El-Missikat granite.



Violet fluorite from El-Missikat granite.



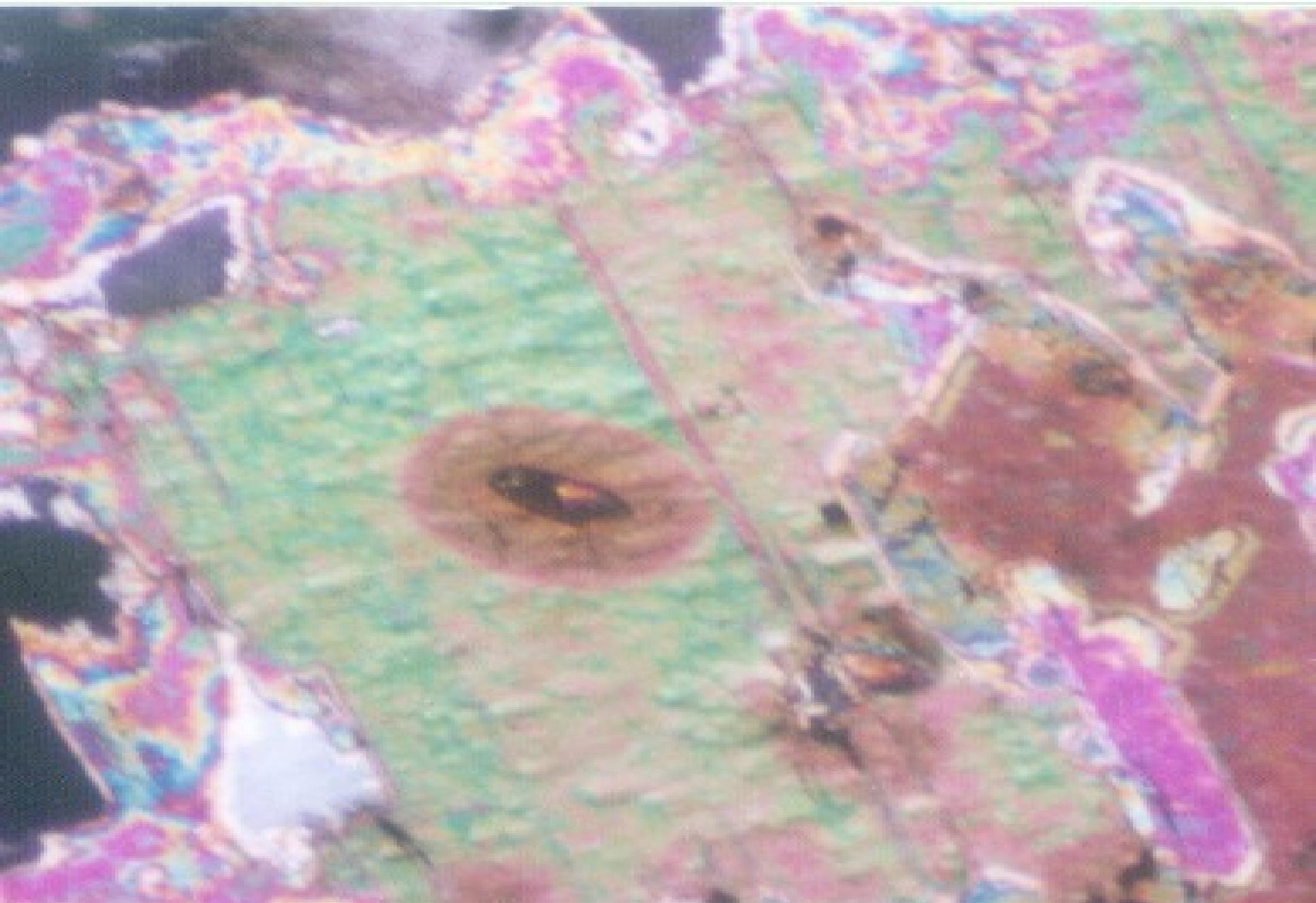
Blue-Violet fluorite from El-Missikat granite

The petrographic characteristics of the uranium-mineralized granites

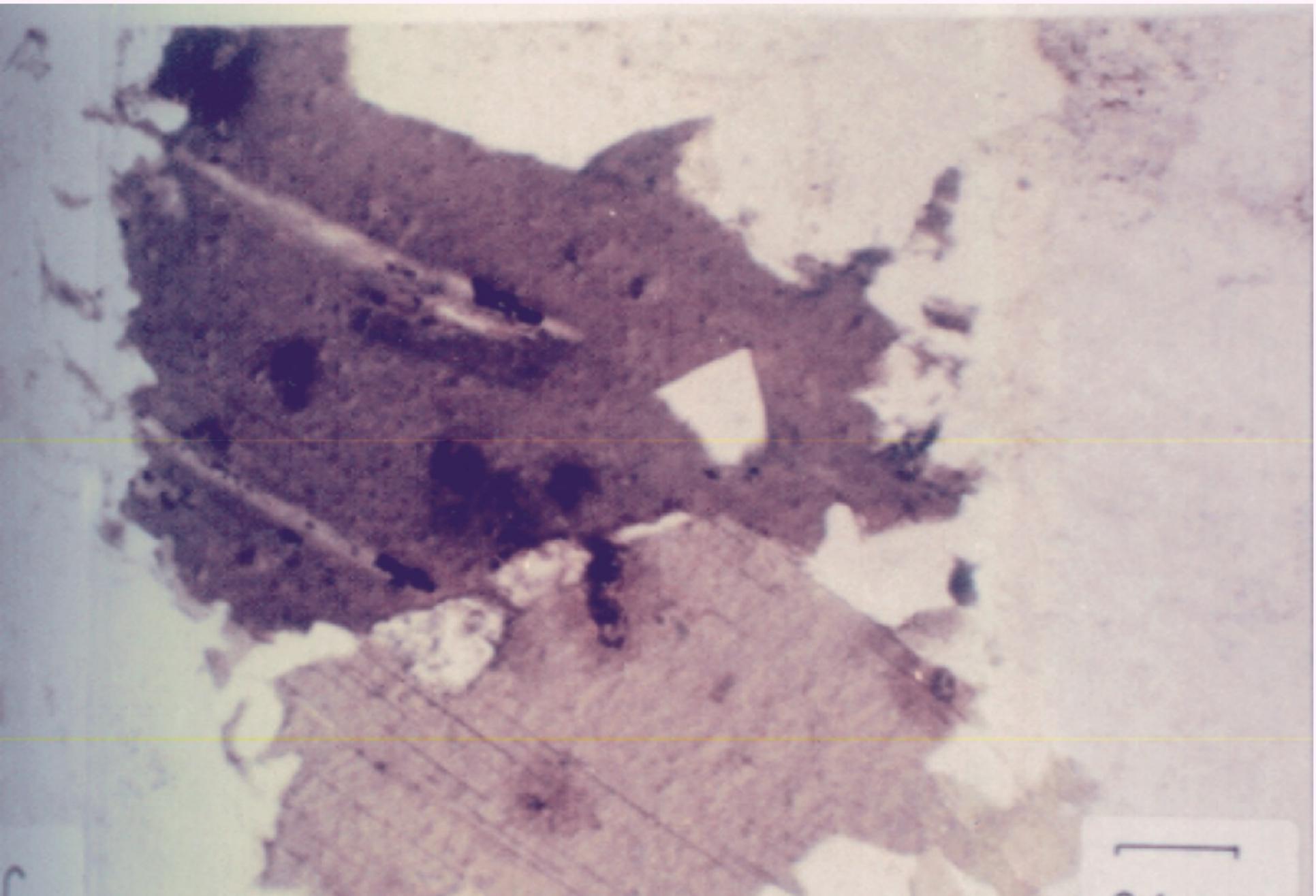
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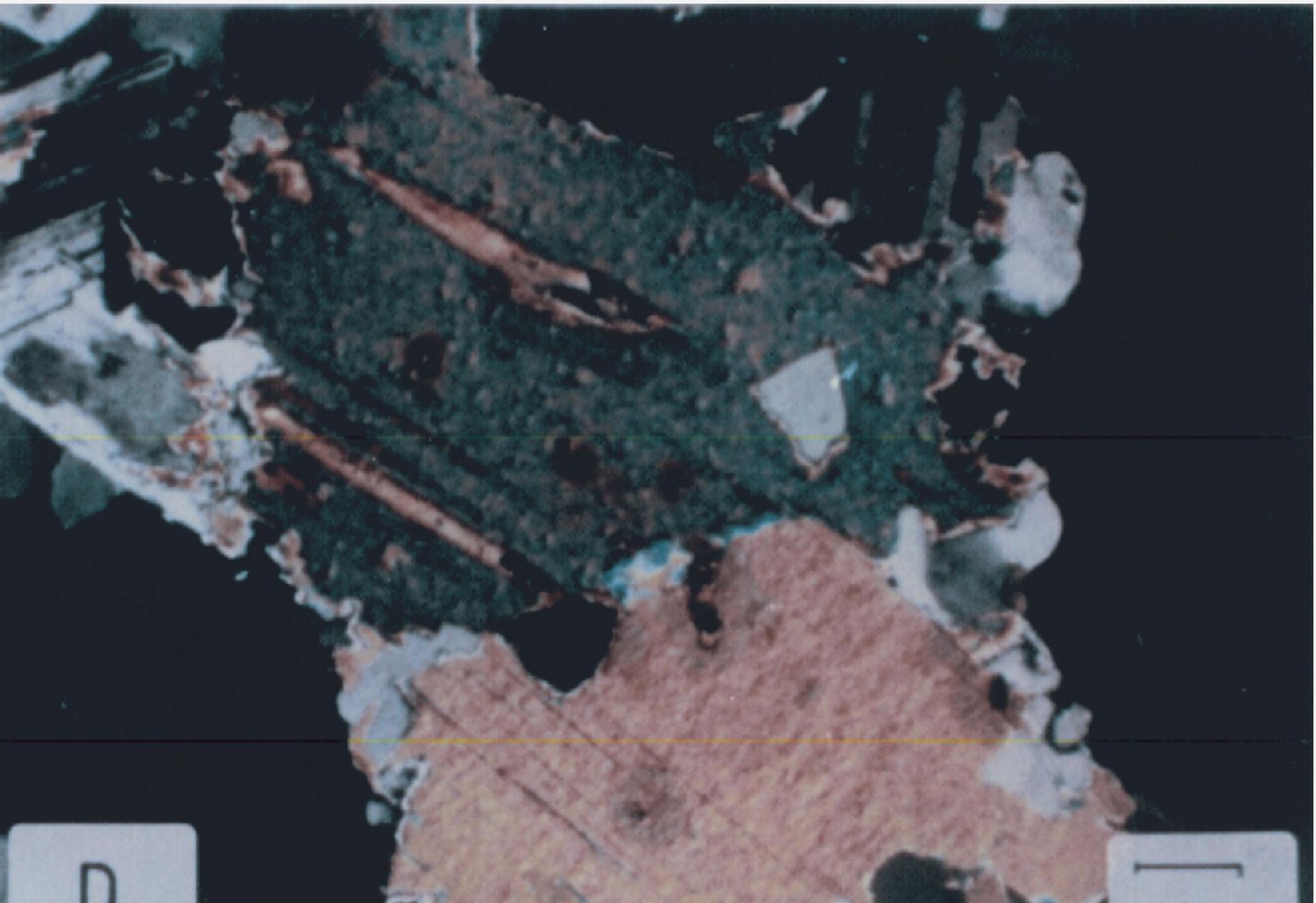
The common presence of pleochroic haloes in micas especially around some radioactive included crystals (e.g. monazite, thorite, allanite, zircon,.. etc).



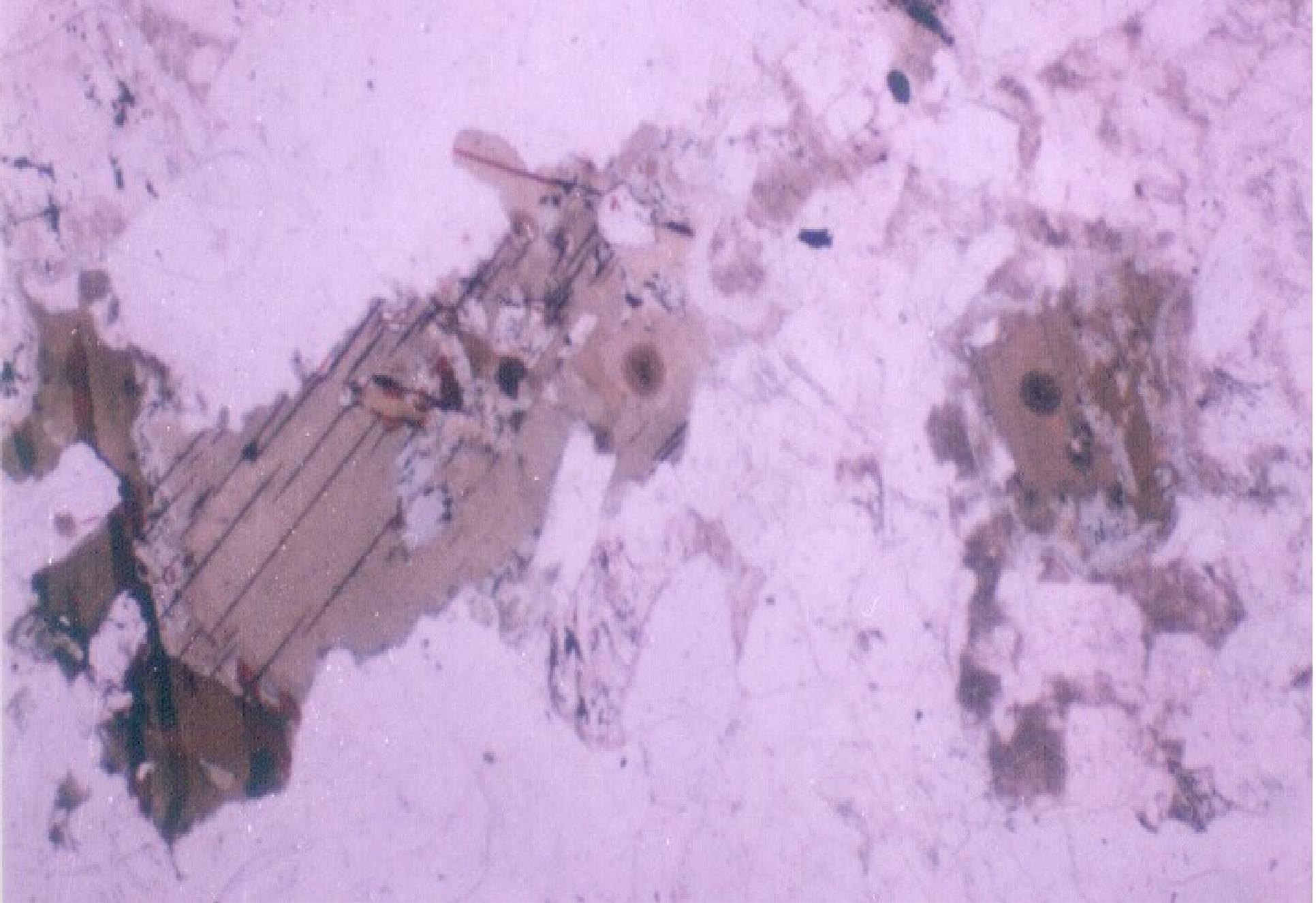
Pleochroic halos in biotite in Gattar granite.



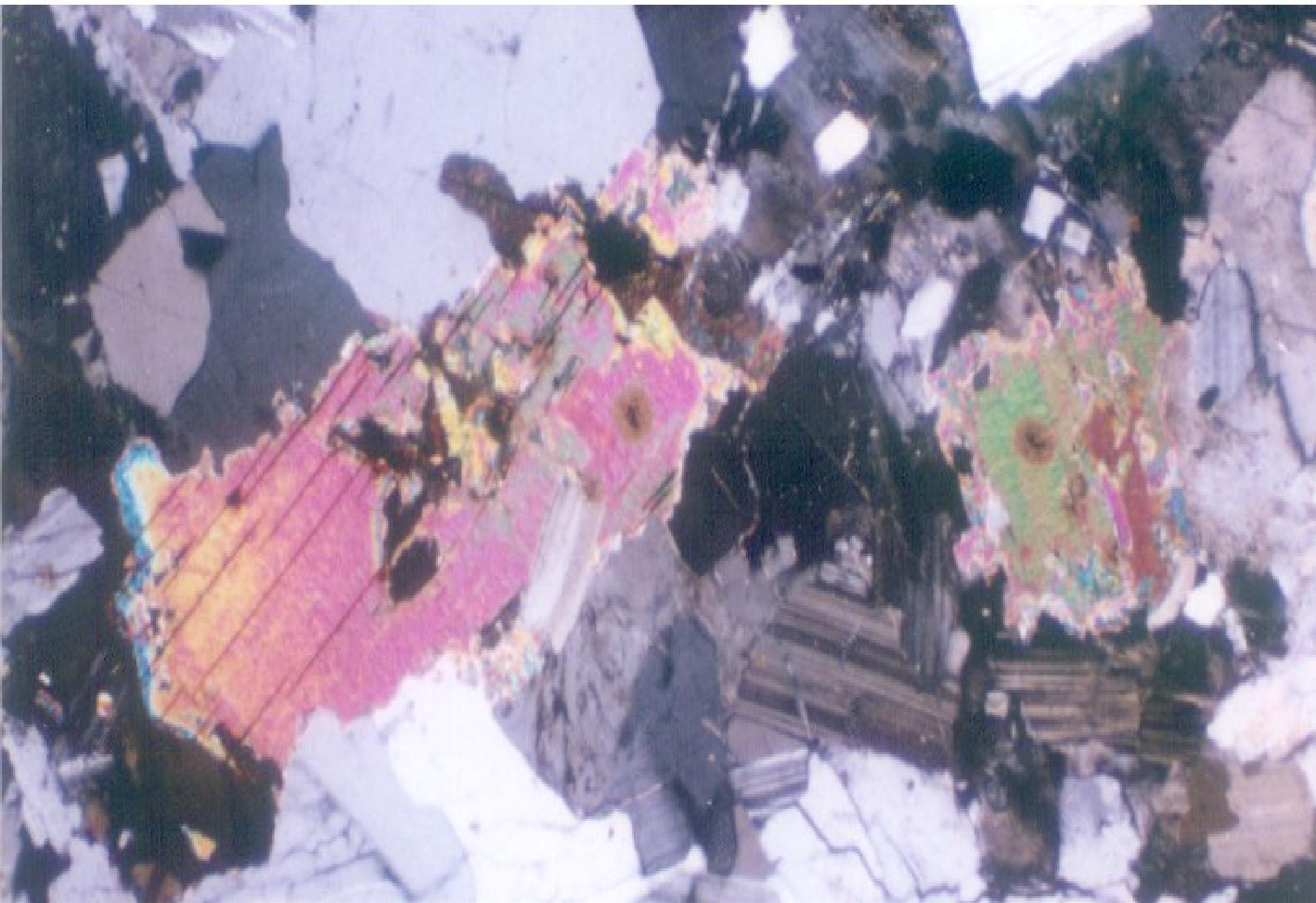
Pleochroic halos in biotite in El-Missikat granite.



Pleochroic halos in biotite in El-Missikat granite.



Pleochroic halos in biotite in El-Erediya granite.



Pleochroic halos in biotite in El-Erediya granite.

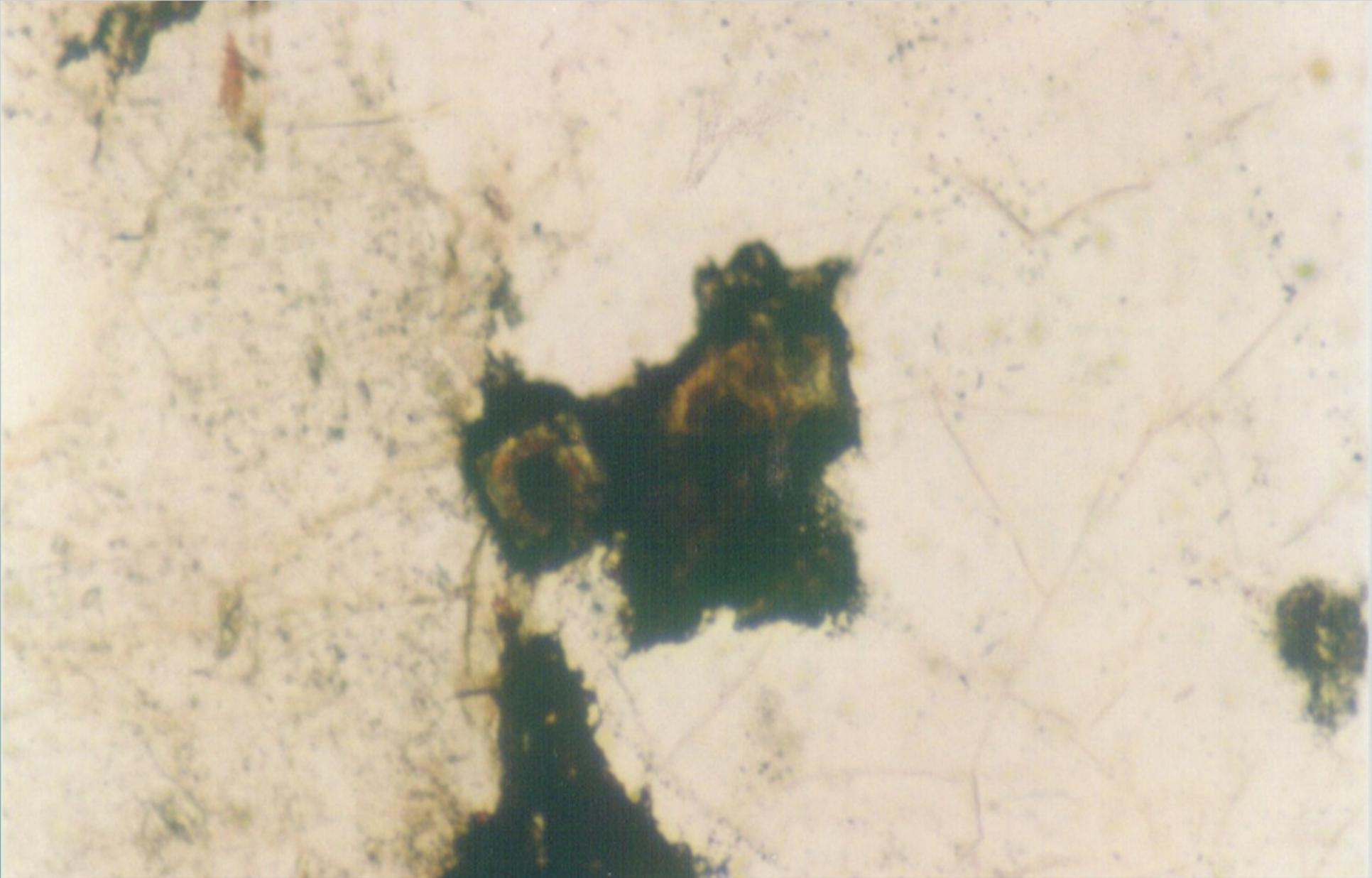
The petrographic characteristics of the uranium-mineralized granites

The abundance of microfractures that are generally filled with iron oxides, quartz, fluorite and sometimes calcite.

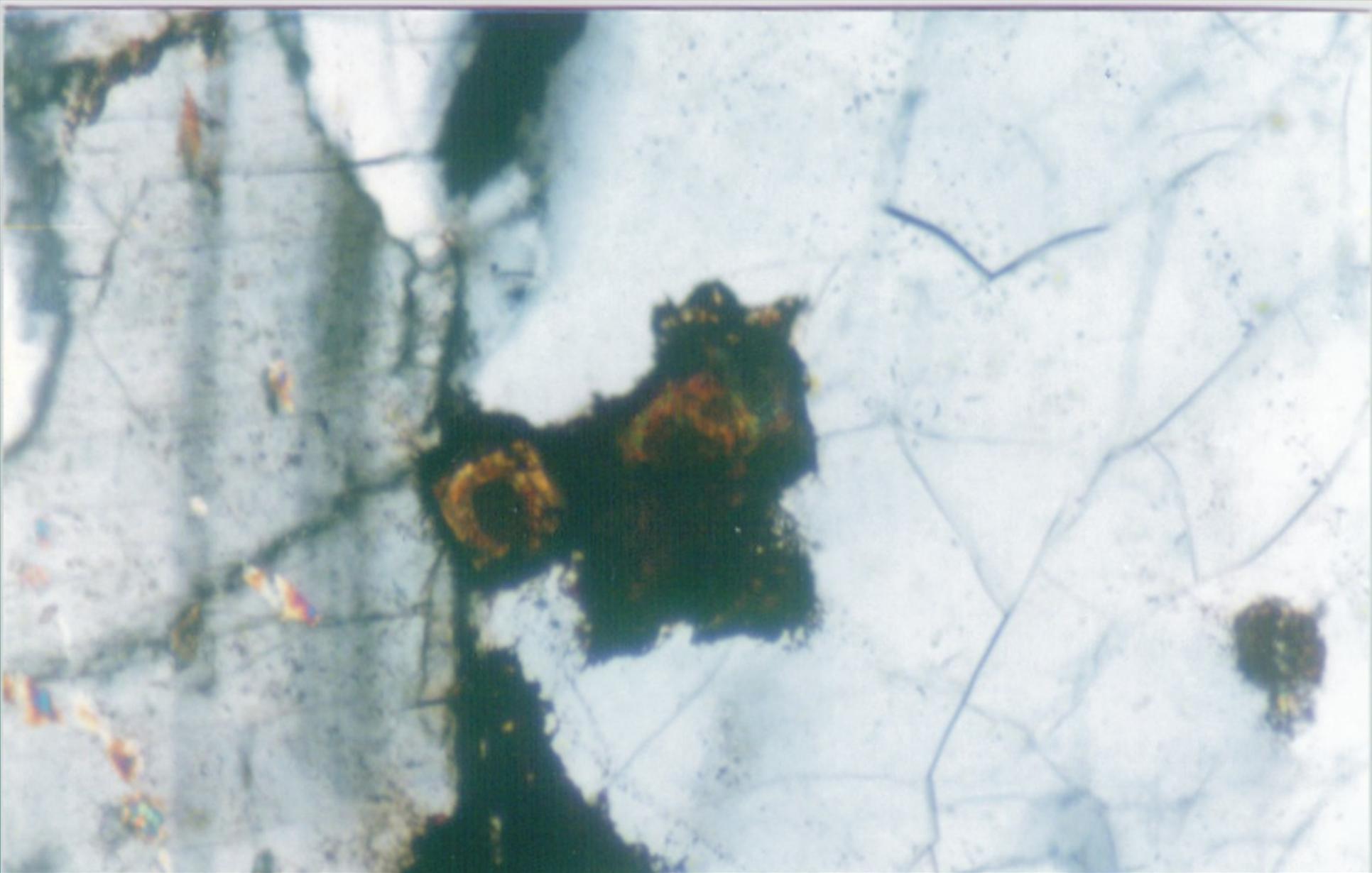
The common presence of multicolored fluorite crystals, especially the violet and purple variety

The common presence of pleochroic haloes in micas especially around some radioactive included crystals (e.g. monazite, thorite, allanite, zircon,.. etc).

The presence of monazite, allanite and zircon crystals especially those coated with iron oxides and metamict



Zircon crystals highly stained with iron oxides, El-Missikat granite.



Zircon crystals highly stained with iron oxides, El-Missikat granite.

The petrographic characteristics of the uranium-mineralized granites

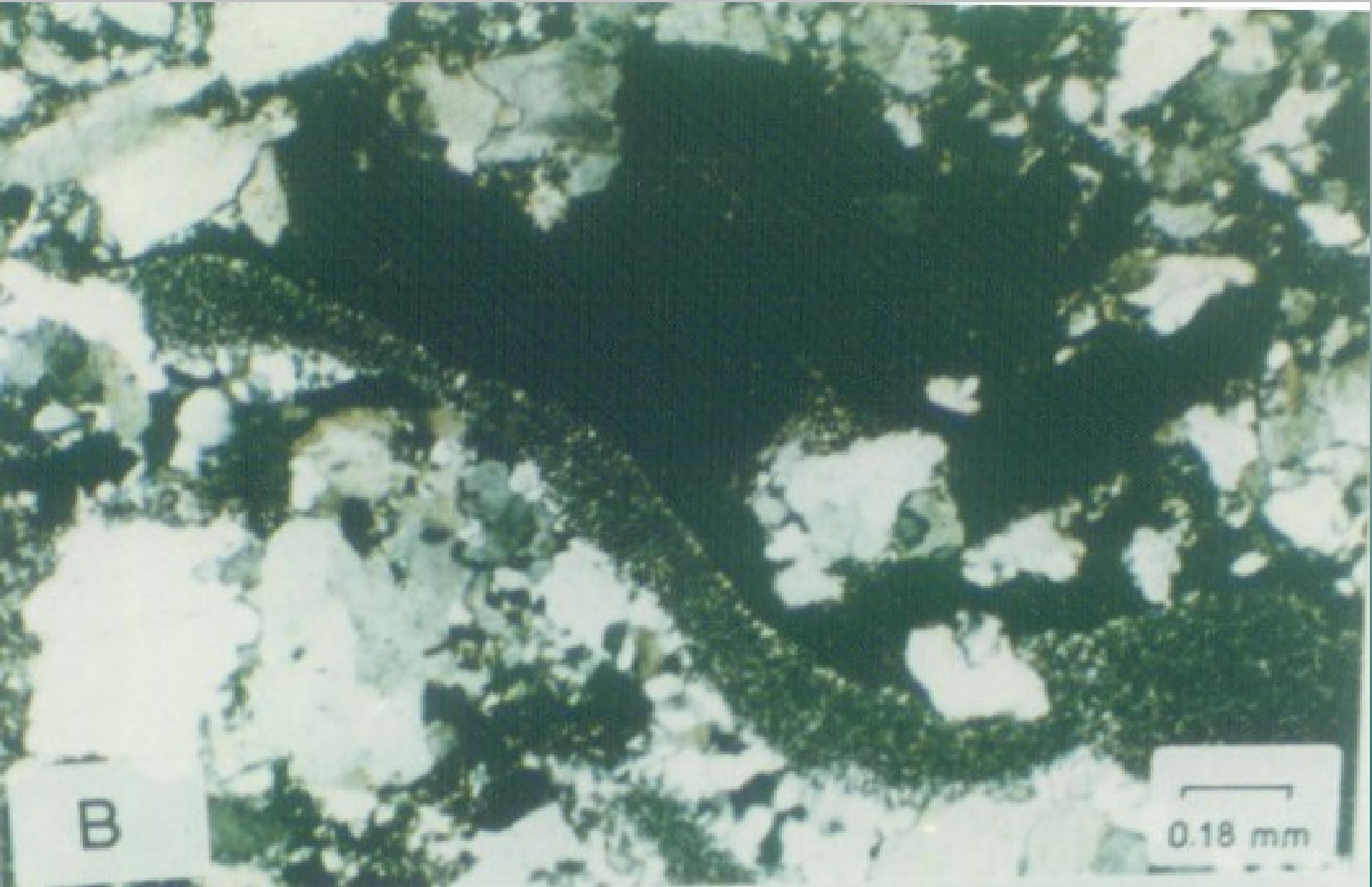
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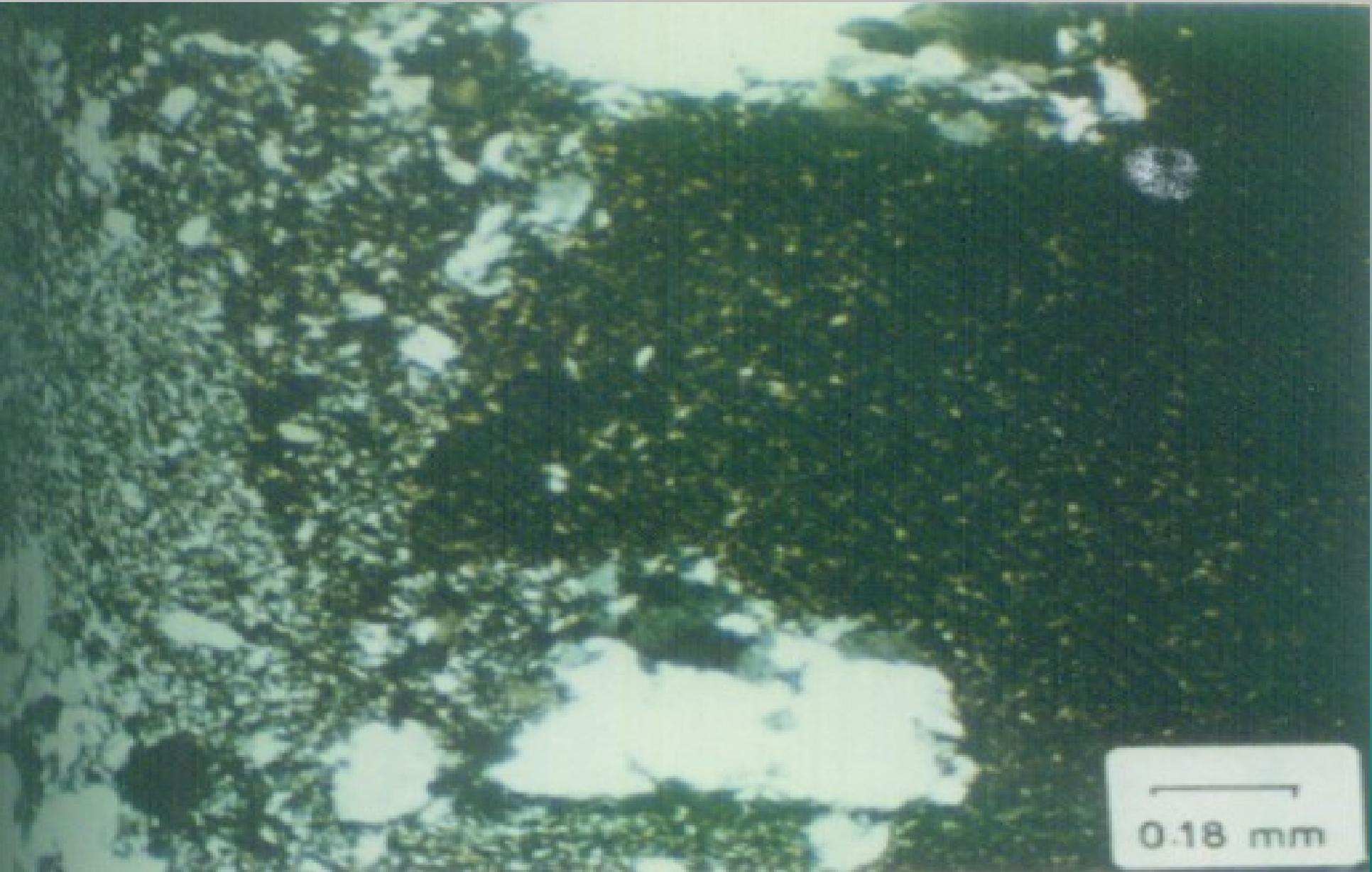
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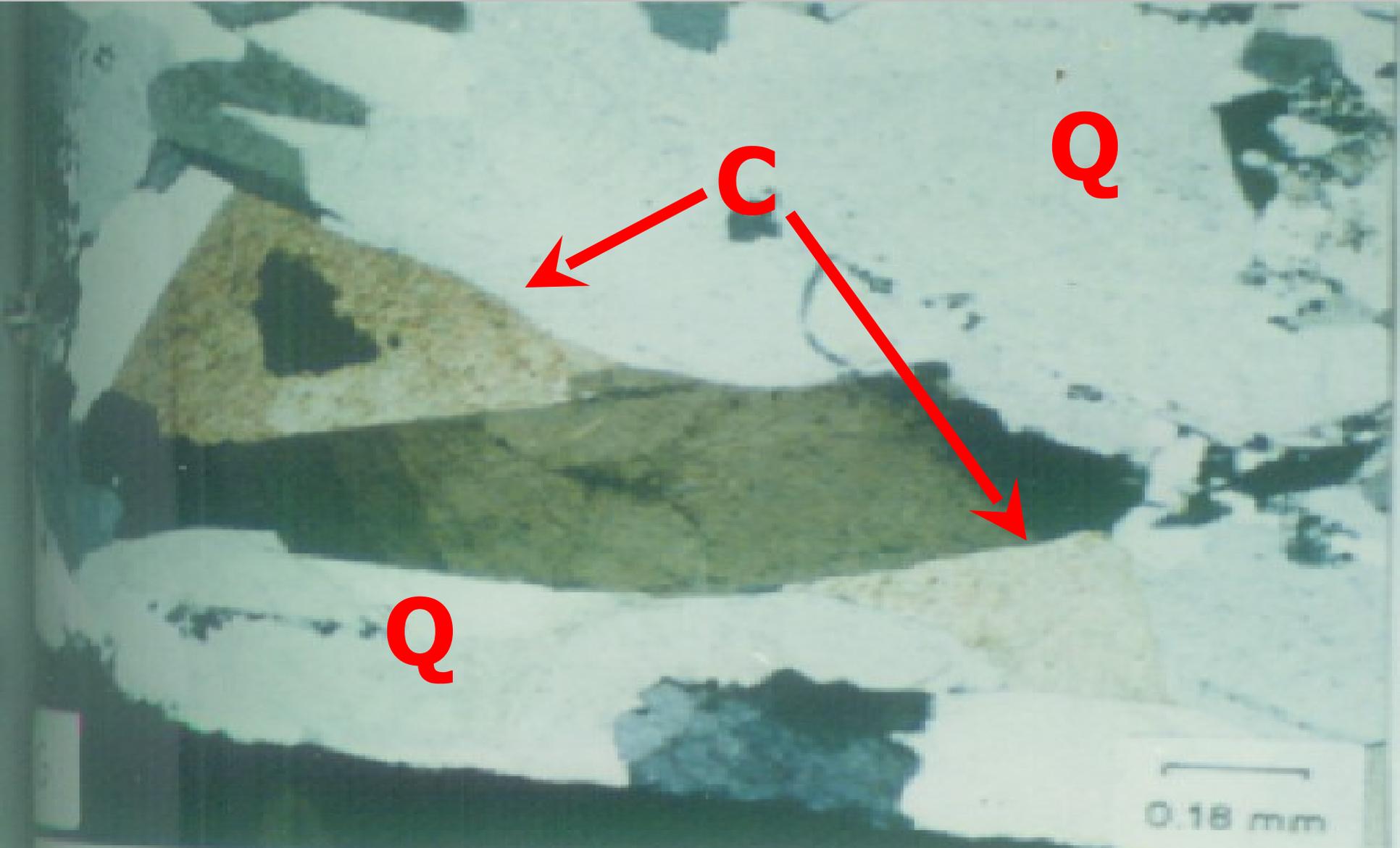
The wide spread alteration processes such as the silicification, ferrugination, kaolinization, epidotization, greisenization and carbonatization especially in granites associating the vein type uranium deposits as well as the amazonitization and/or albitization in those associating the metasomatic type uranium deposits.



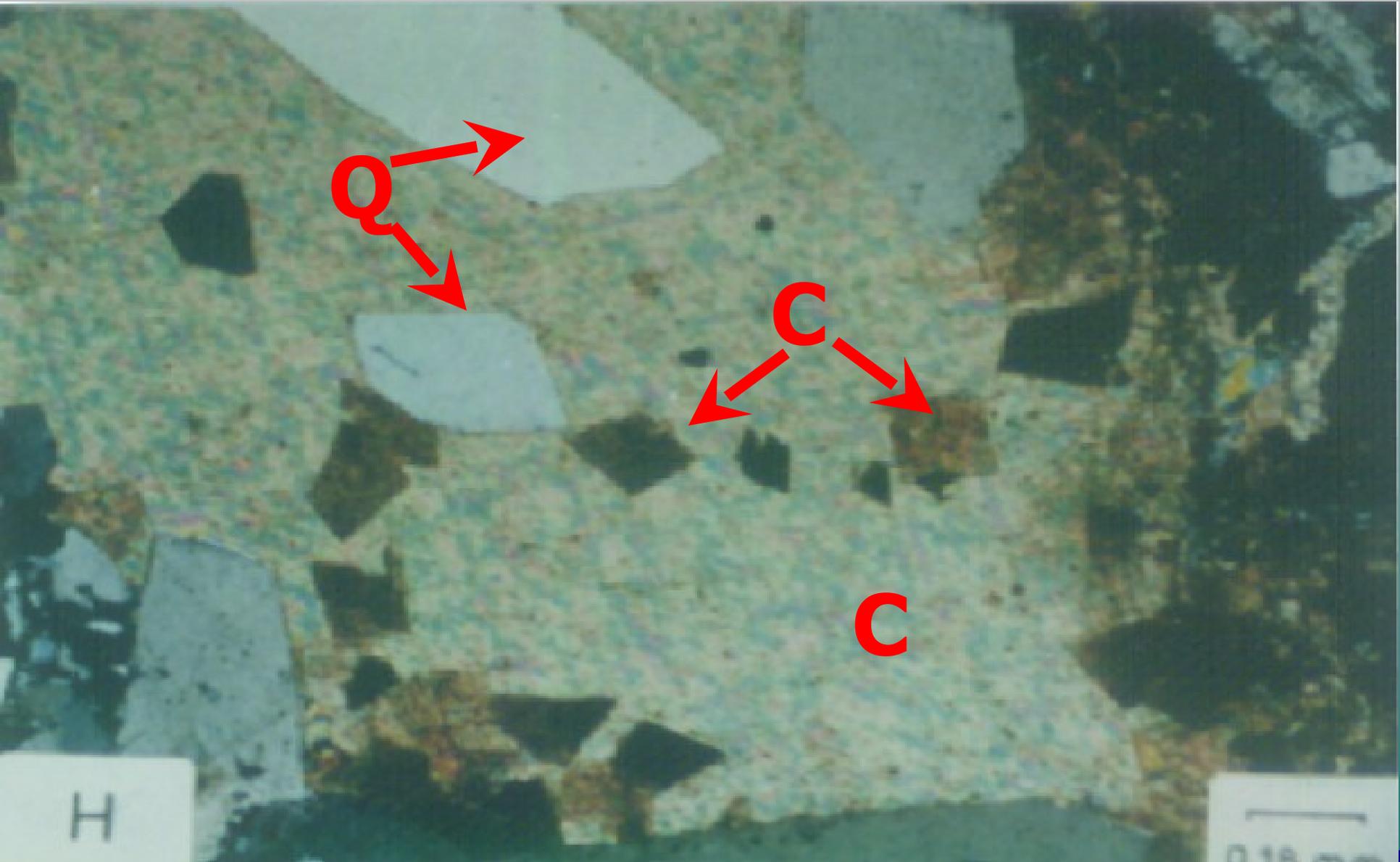
Microcrystalline quartz and amorphous silica in silicified granite, El-Missikat granite.



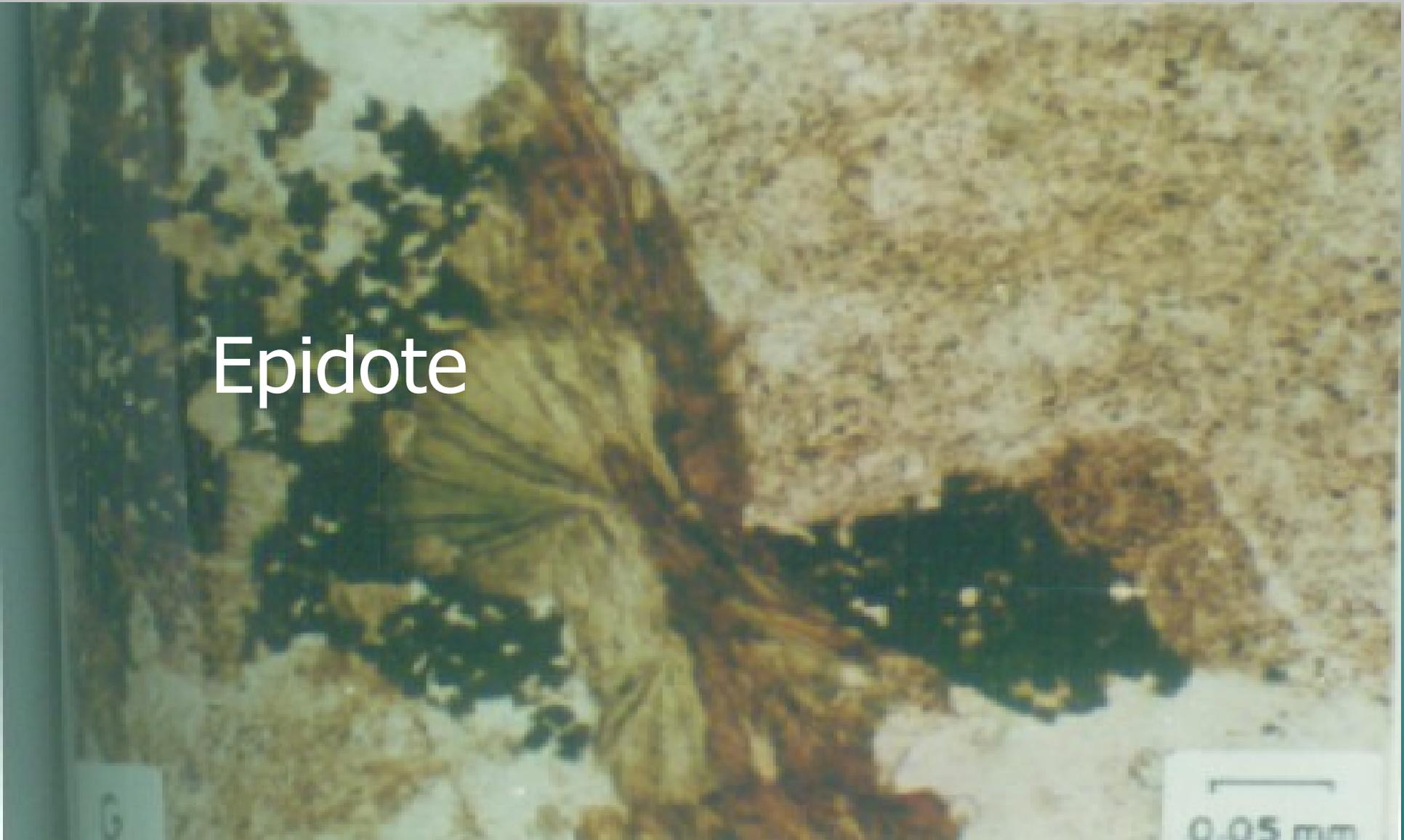
Microcrystalline quartz and amorphous silica in intensively silicified granite, El-Missikat granite.



Calcite (C) and Quartz (Q) filling fracture in El-Missikat granite.

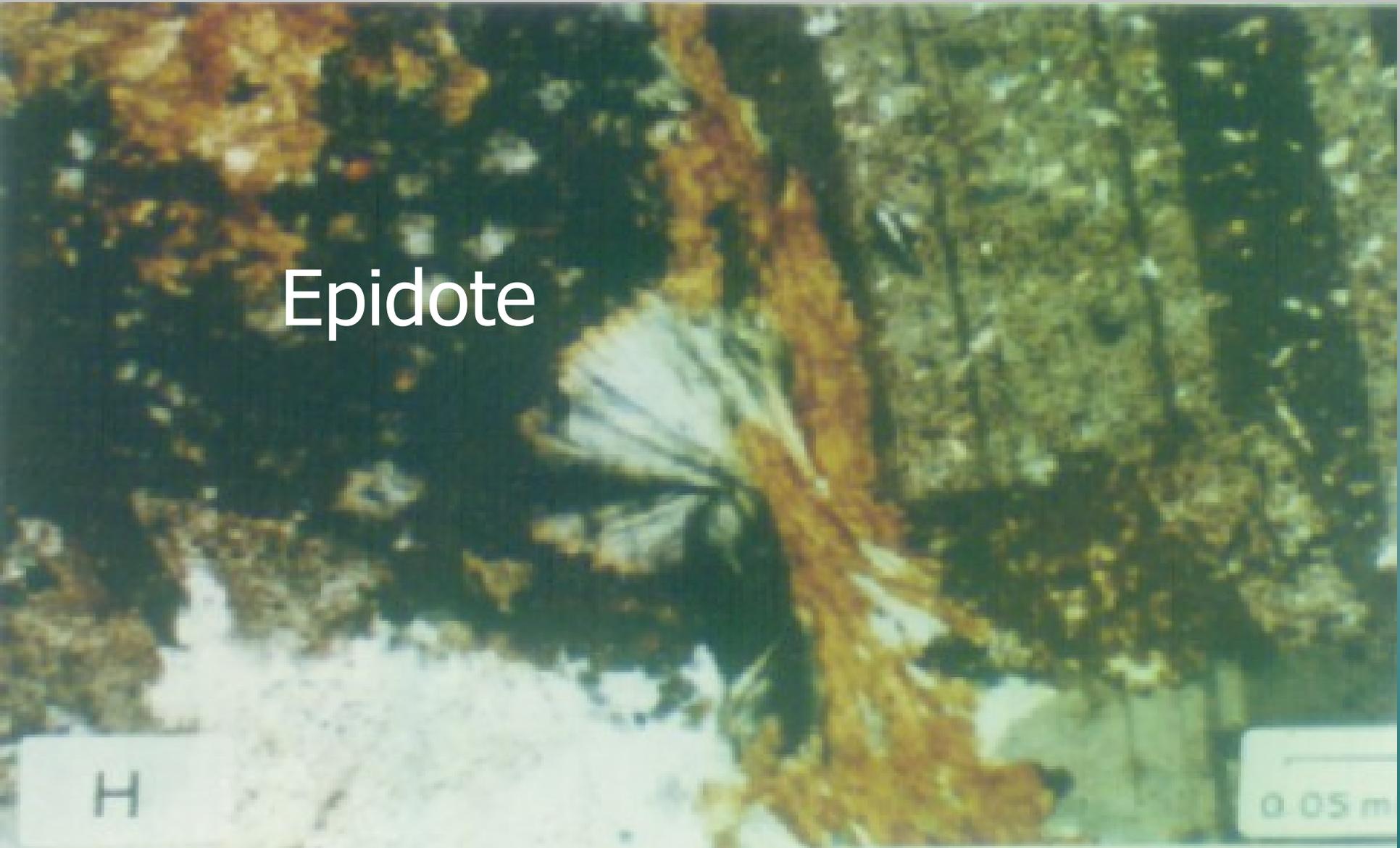


Cavity filled with Calcite (C) and Quartz (Q) in El-Missikat granite.

A photomicrograph showing a fan-shaped epidote crystal. The crystal is dark green to black, with a distinct fan-like internal structure. It is surrounded by a lighter, more granular matrix. A scale bar in the bottom right corner indicates 0.05 mm. The word "Epidote" is overlaid in white text on the left side of the image.

Epidote

**Fan-shaped epidote in epidotized granite,
P.L., El-Missikat granite.**

A photomicrograph showing a fan-shaped epidote crystal. The crystal is elongated and has a distinct fan-like internal structure. It is surrounded by a matrix of smaller, more equiaxed epidote crystals. The overall texture is characteristic of epidotized granite. A scale bar in the bottom right corner indicates 0.05 mm. A small white box with the letter 'H' is visible in the bottom left corner.

Epidote

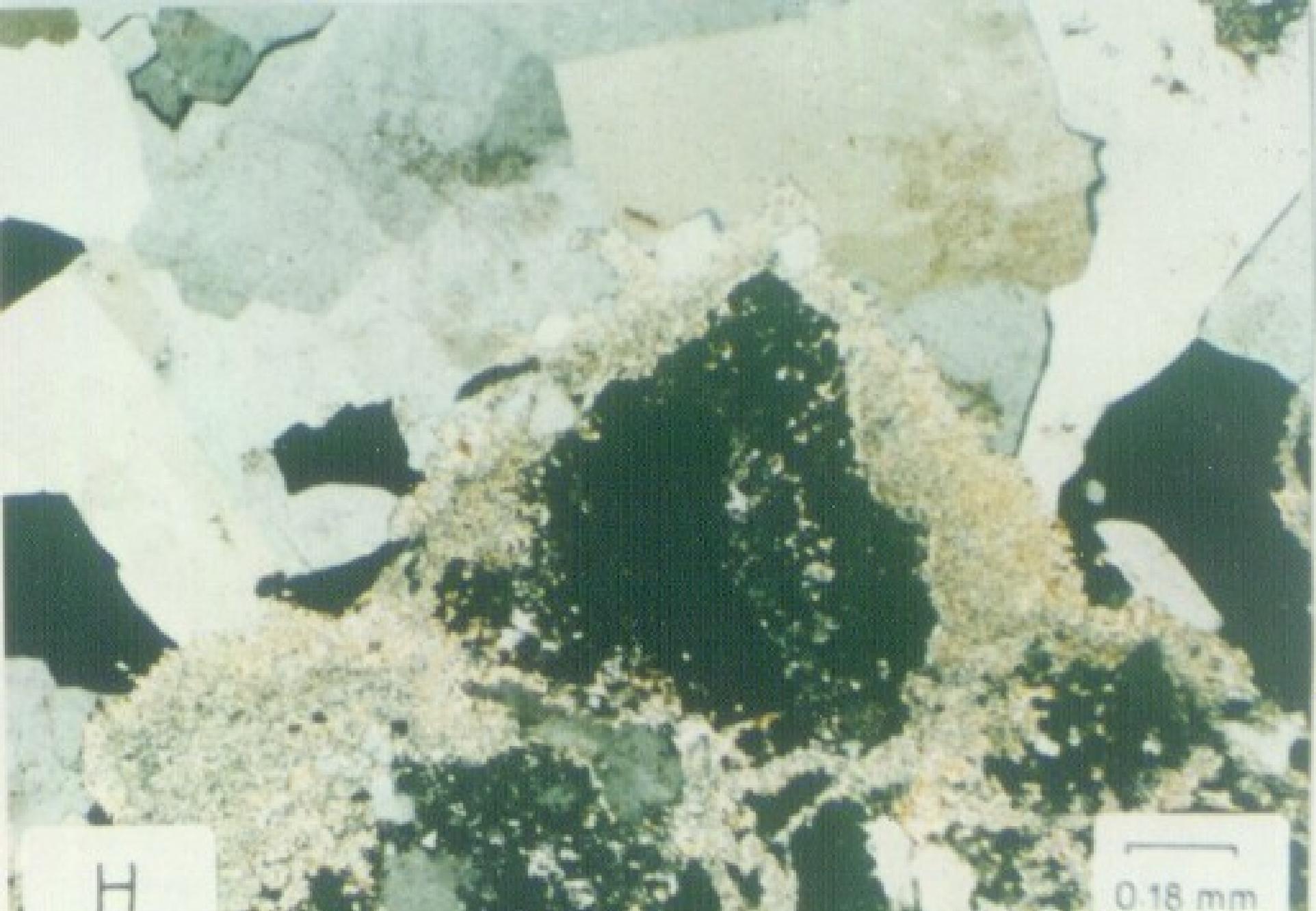
H

0.05 mm

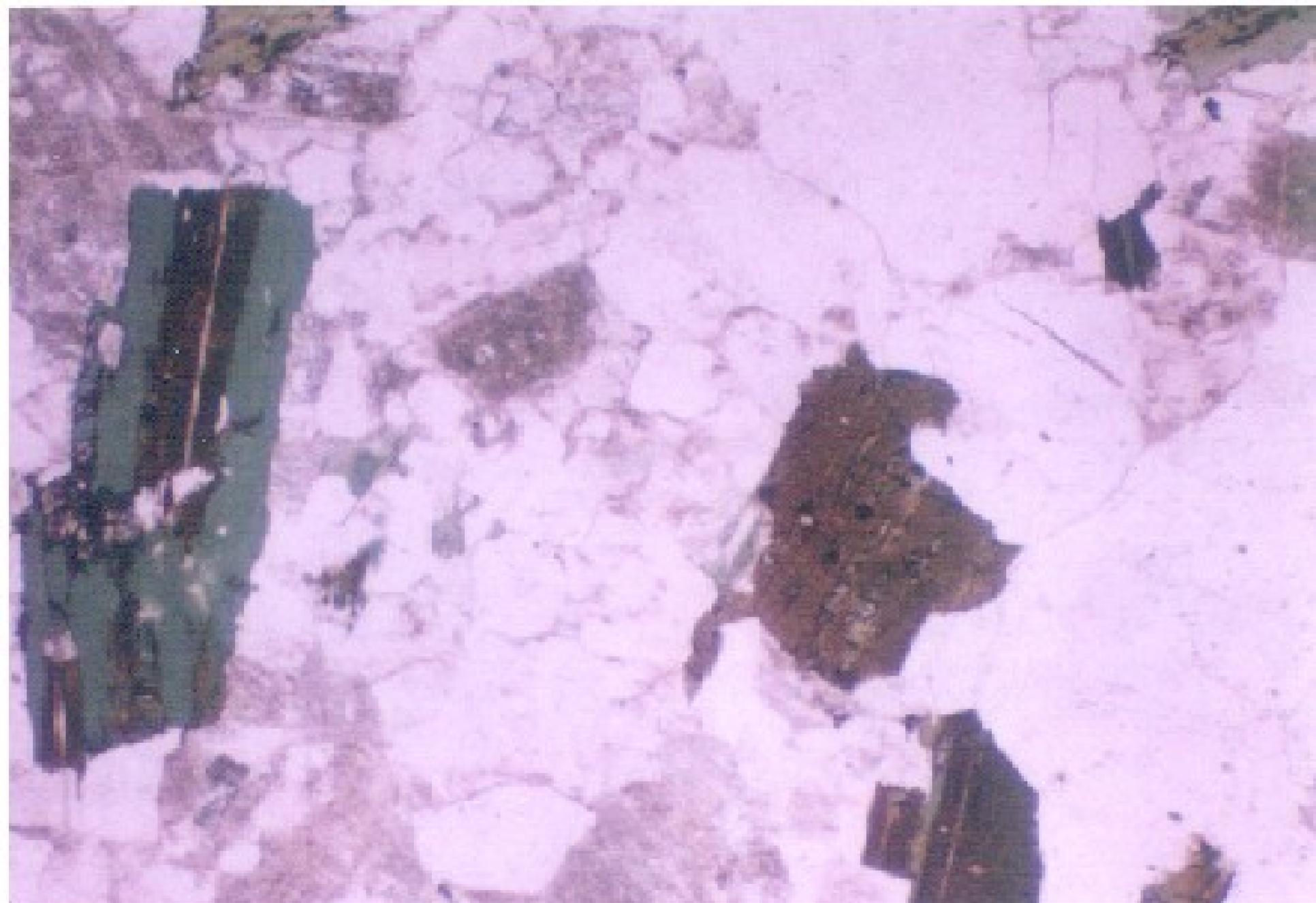
Fan-shaped epidote in epidotized granite, C.N., El-Missikat granite.



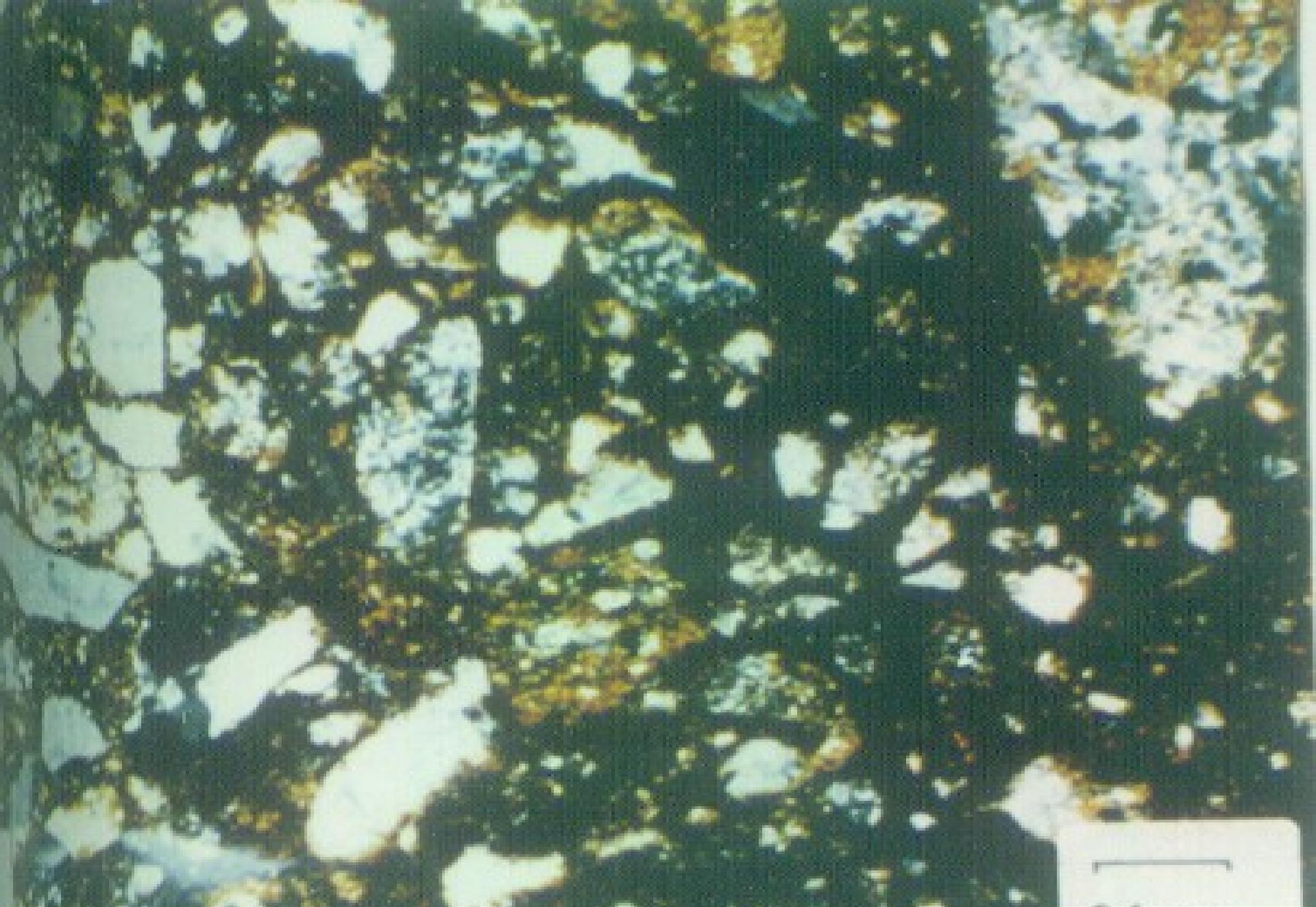
Kaolinized plagioclase in Gattar granite.



Intensively kaolinized granite, El-Missikat granite



Chloritized biotite in El-Erediya granite.



Intensively ferruginated granite, El-Erediya granite

The petrographic characteristics of the uranium-mineralized granites

- 1- The **abundance of microfractures** that are generally filled with iron oxides, quartz, fluorite and sometimes calcite.
- 2- The common presence of **multicolored fluorite crystals**, especially the violet and purple variety.
- 3- The common presence of **pleochroic haloes** in micas especially around some radioactive included crystals (e.g. monazite, thorite, allanite, zircon,.. etc).
- 4- The presence of **monazite, allanite** and **zircon** crystals especially those coated with iron oxides and metamicted.
- 5- The wide spread **alteration processes** such as the silicification, ferrugination, kaolinization, epidotization, greisenization and carbonatization especially in granites associating the vein type uranium deposits as well as the amazonitization and/or albitization in those associating the metasomatic type uranium deposits.

The background of the image is a dense, close-up view of various green leaves. Some leaves are a deep, dark green, while others are variegated with lighter, yellowish-green or lime green patches. The leaves have different shapes, some being more rounded and others more elongated. The lighting is soft, creating subtle highlights and shadows on the leaf surfaces, giving the image a textured and natural appearance.

Thank you