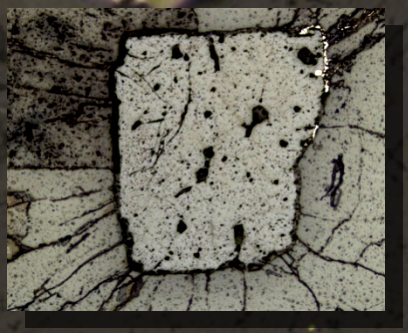
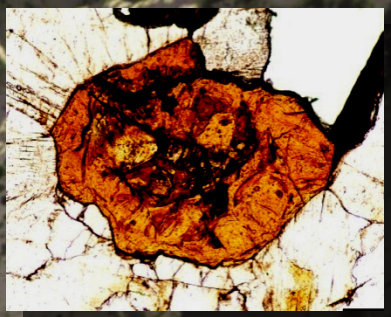
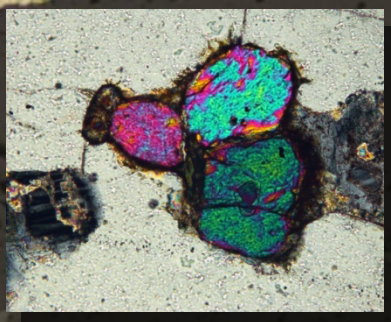
ATLAS OF ATOMIC MINERALS

(Major Geological Domains of India)







Atomic Minerals Directorate for Exploration and Research

ATLAS OF ATOMIC MINERALS

(Major Geological Domains of India)

Atomic Minerals Directorate for Exploration and Research

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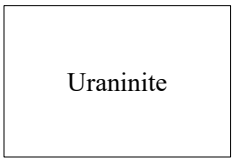
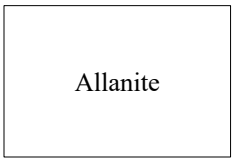
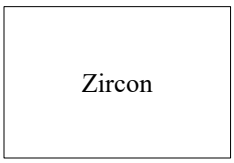
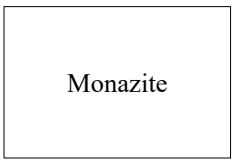








FOREWORD

Dheeraj Pande
Director
Atomic Minerals Directorate for Exploration and Research

The Petrological Microscope is an important tool to identify minerals in a rock specimen. Under microscope, there are two major classes of minerals viz. a) minerals that transmit light through them and b) minerals that reflect light. Minerals that transmit light include the common rock-forming minerals e.g. quartz, feldspar, mica, calcite, olivine etc. Opaque minerals that reflect light include many oxide phases such as magnetite, uraninite etc. and sulphide phases like chalcopyrite, sphalerite etc. The study of opaque minerals in polished thin section using the polarizing reflected-light microscope - commonly referred as ore microscopy - is the most important technique for the identification and characterization of the opaque phases in a sample and the textural relationship between them.

Identification of *atomic* minerals (minerals required for atomic energy program) i.e. uranium, thorium, rare metals (Li, Be, Zr, Nb-Ta) and rare earth(s) minerals under the ore microscope is a challenging task as the minerals have overlapping optical properties and form in a wide variety of geological environments. Besides, the radioactive phases (especially uranium-bearing minerals) are frequently metamictised and undergo replacement. However, these minerals can be readily identified by a combination of qualitative and quantitative techniques. The important quantitative parameters include indentation hardness, percent reflectance and spectral reflectance curves. The latter two properties are especially distinctive for the primary uranium minerals viz. uraninite, coffinite, brannerite and davidite. Auto-radiographic techniques are useful in locating very fine and sparsely distributed radioactive minerals. Ore microscopic techniques also provide an excellent means for determining the intergrowths of these minerals with other ore and gangue minerals. Such intergrowths are important in understanding the genesis of uranium, thorium, rare metals and rare earth(s) deposits. The Atomic Minerals Directorate for Exploration and Research (AMD), the oldest unit of

the Department of Atomic Energy (DAE) has carried out extensive exploration and research for *atomic* minerals in the last seven decades since its inception in July, 1949. Consequently, AMD has accrued a large digital archive of petro-mineralogical images (photomicrographs) of a wide variety of *atomic* minerals from major geological domains of India. On the occasion of the Diamond Jubilee (75th Anniversary) Year of foundation of AMD, the *Atlas of Atomic Minerals (Major Geological Domains of India)* is a befitting tribute to the hard work and dedication of Team AMD, especially the officers and staff of Mineralogy-Petrology-Geochemistry Group. The Atlas is a compilation of 75 photomicrographs (celebrating 75th Anniversary Year of foundation of AMD) of minerals of uranium, thorium, rare metals and rare earths illustrating the variety of grain size, texture, mineral replacement, presence of intergrowth and mode of occurrence of these minerals along with associated ore minerals. The photomicrographs, which have been captured using polarising microscope under transmitted or reflected light, are self explanatory although a brief description has been provided for each image. The Atlas will be immensely helpful for beginners, especially the Trainee Scientific Officers (TSO) of Geology discipline, as a visual guide for identifying *atomic* minerals from different geological domains of the country.

Contents

Uraninite

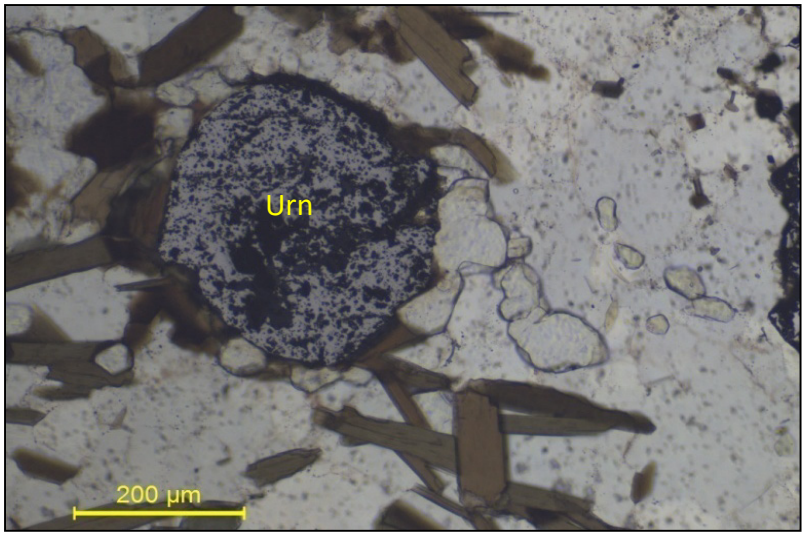


Fig.1: Uraninite (RL,1N).

Rock type: Quartz-biotite schist.

Locality: Jaduguda, East Singhbhum district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

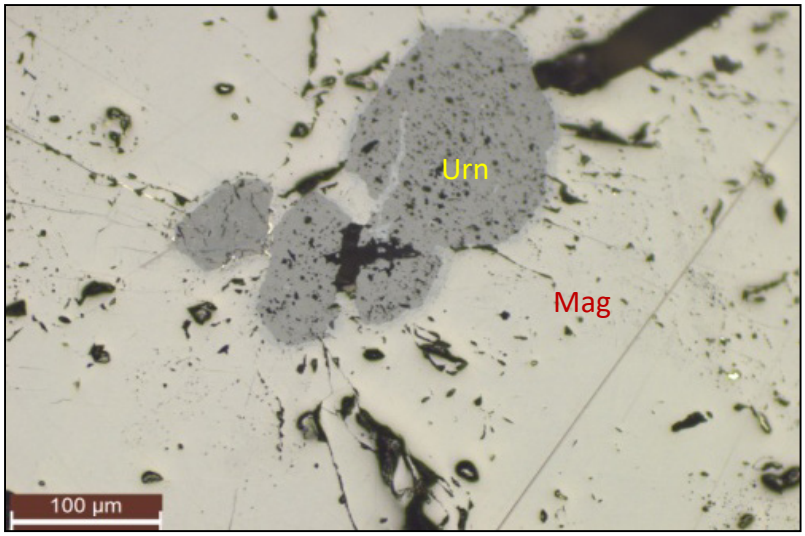


Fig.2: Uraninite within magnetite with radiation cracks (RL,1N).

Rock type: Quartz-biotite schist.

Locality: Jaduguda, East Singhbhum district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

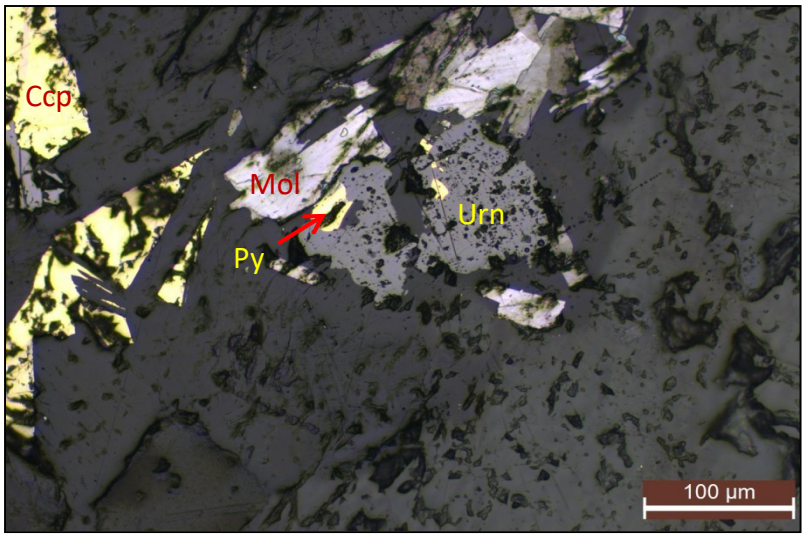


Fig.3: Uraninite associated with chalcopyrite, pyrite and molybdenite (RL,1N).

Rock type: Biotite- chlorite schist.

Locality: Pathargora, East Singhbhum district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

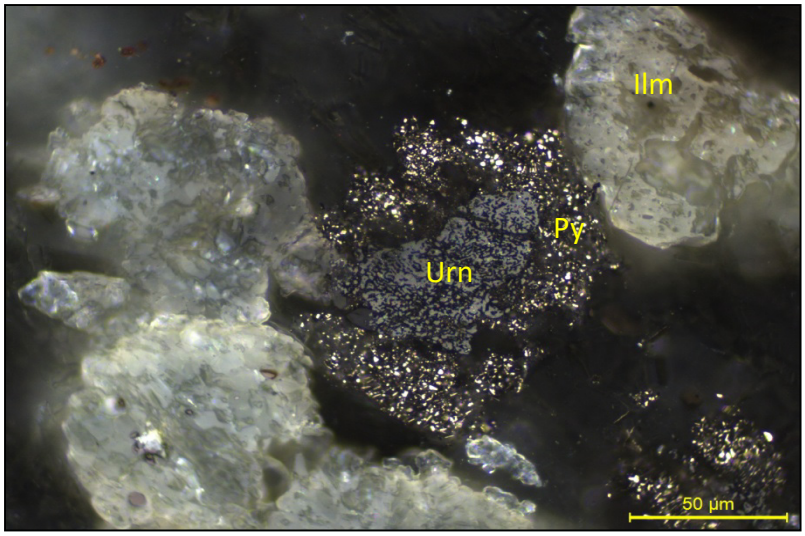


Fig.4: Uraninite in association with pyrite and altered ilmenite (RL,1N).

Rock type: Quartz Pebble Conglomerate (QPC).

Locality: Baratangra, Sundergarh district, Odisha.

Geological Domain: Archaean Iron Ore Group (IOG).

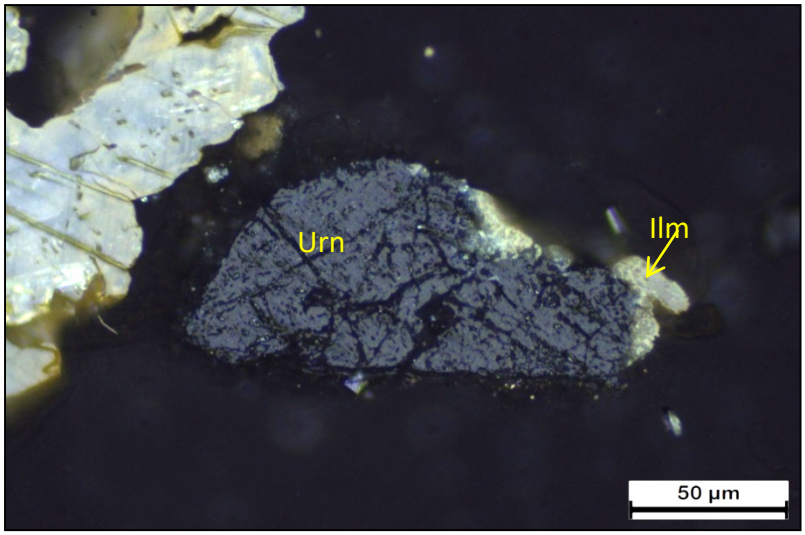


Fig.5: Uraninite in association with pyrite and altered ilmenite (RL,1N).

Rock type: Quartz Pebble Conglomerate (QPC).

Locality: Baratangra, Sundergarh district, Odisha.

Geological Domain: Archaean Iron Ore Group (IOG).

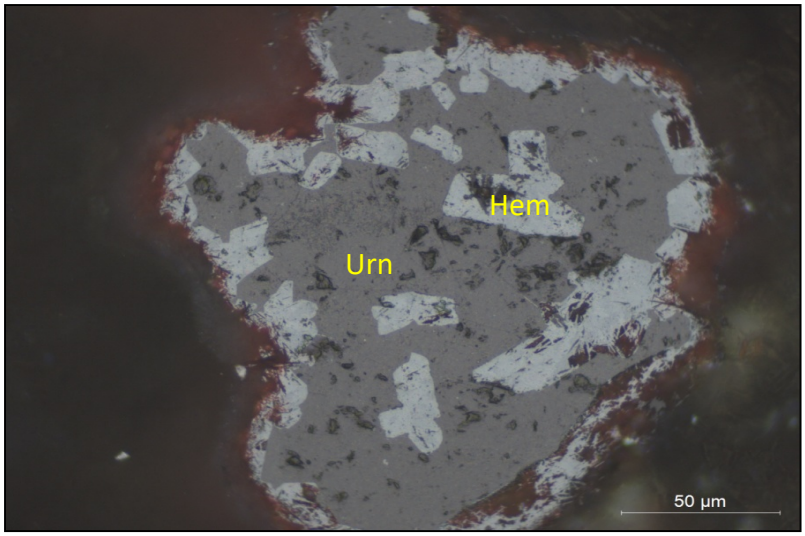


Fig.6: Uraninite with haematite (RL,1N).

Rock type: Serpentinite.

Locality: Kudada, East Singhbhum district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

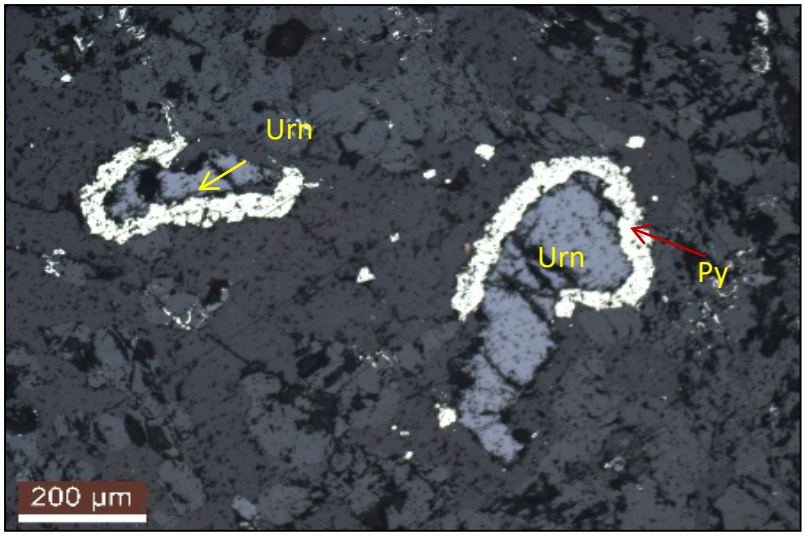


Fig.7: Anhedral uraninite partially rimmed by pyrite (RL,1N).

Rock type: Albitised calc-silicate rock.

Locality: Sewa Ki Dhani, Sikar district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

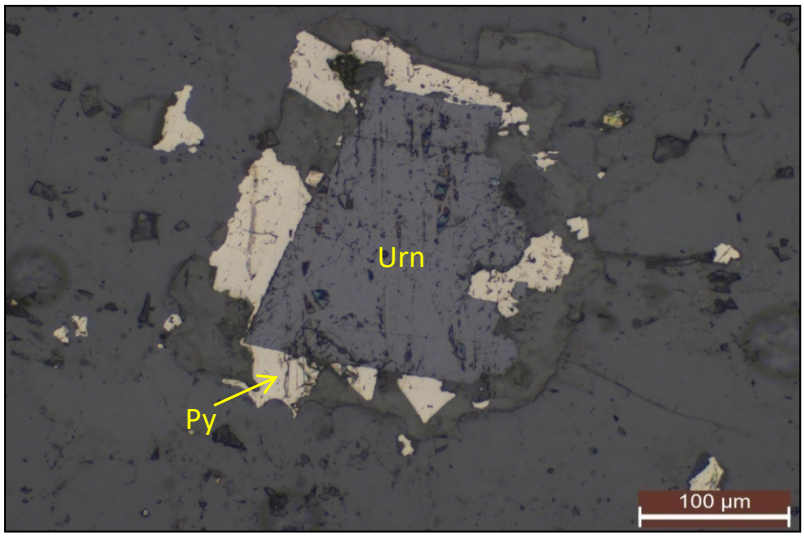


Fig.8: Euhedral uraninite rimmed by pyrite (RL,1N).

Rock type : Silicified quartz biotite schist.

Locality: Rohil, Sikar district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

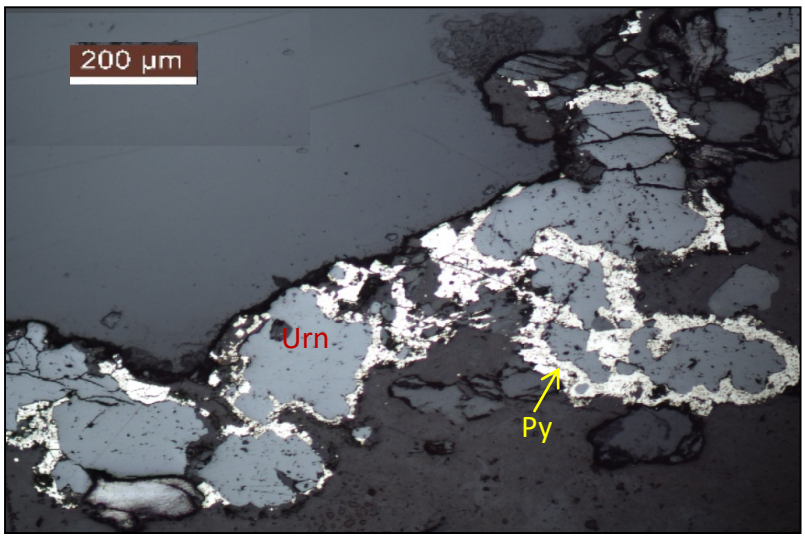


Fig.9: Anhedral uraninite partially rimmed by pyrite (RL,1N).

Rock type: Albitised calc-silicate rock.

Locality: Rambas, Mahendragarh district, Haryana.

Geological Domain: North Delhi Fold Belt (NDFB).

Uraninite

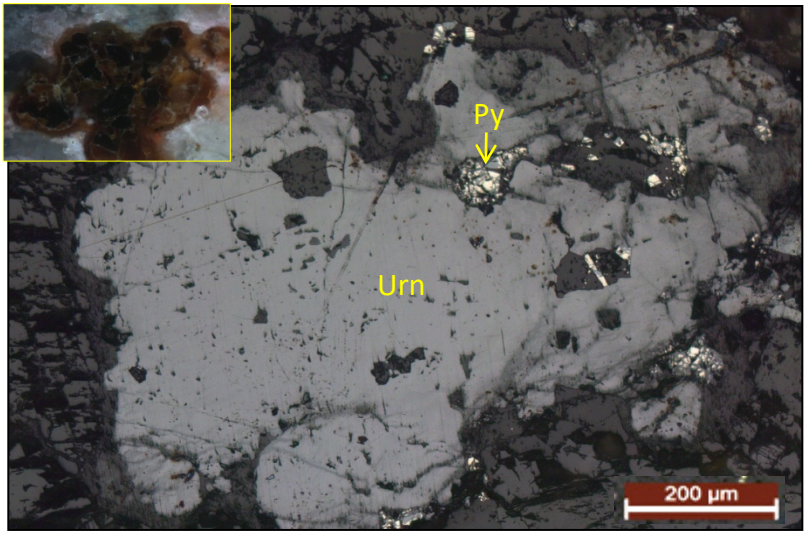


Fig.10: Altered uraninite with pyrite (RL,1N). Inset (RL,XN).

Rock type: Albitised calc-silicate rock.

Locality: Buchara, Sikar district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

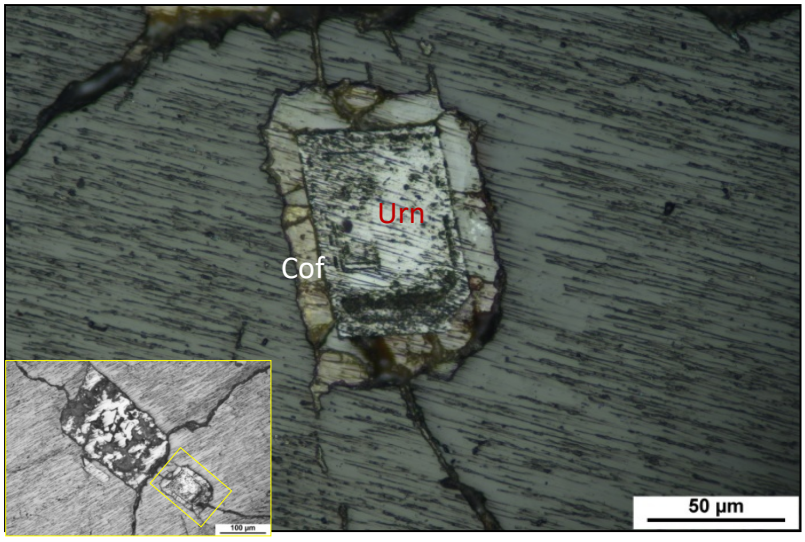


Fig.11: Euhedral uraninite with coffinite rim (RL,1N). Inset (RL,1N).

Rock type: Pegmatoid leucosome.

Locality: Kudar, Sonbhadra district, Uttar Pradesh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

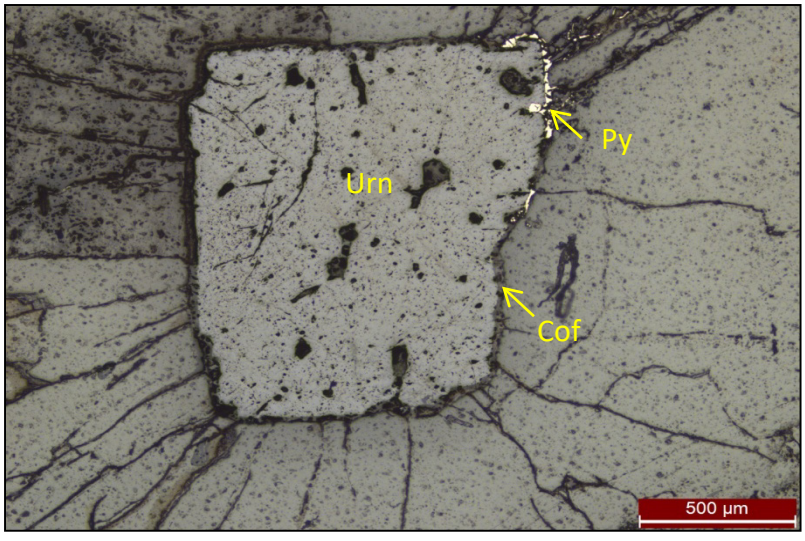


Fig.12: Euhedral uraninite, coffinitised at margins and partially rimmed by pyrite (RL,1N).

Rock type: Pegmatoid leucosome.

Locality: Kurludih, Balrampur district, Chhattisgarh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

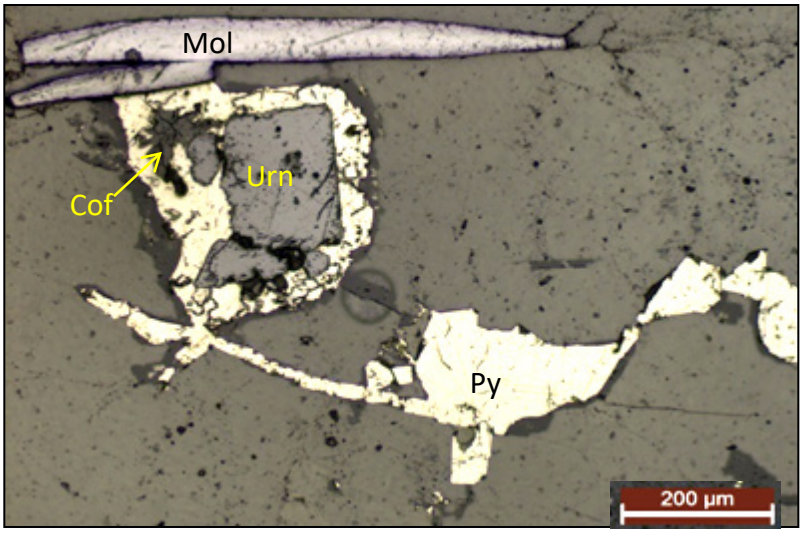


Fig.13: Uraninite, coffinitised along rim and mantled by pyrite in association with molybdenite (RL,1N).

Rock Type: Pegmatoid leucosome.

Locality: Dumarpan, Balrampur district, Chhattisgarh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

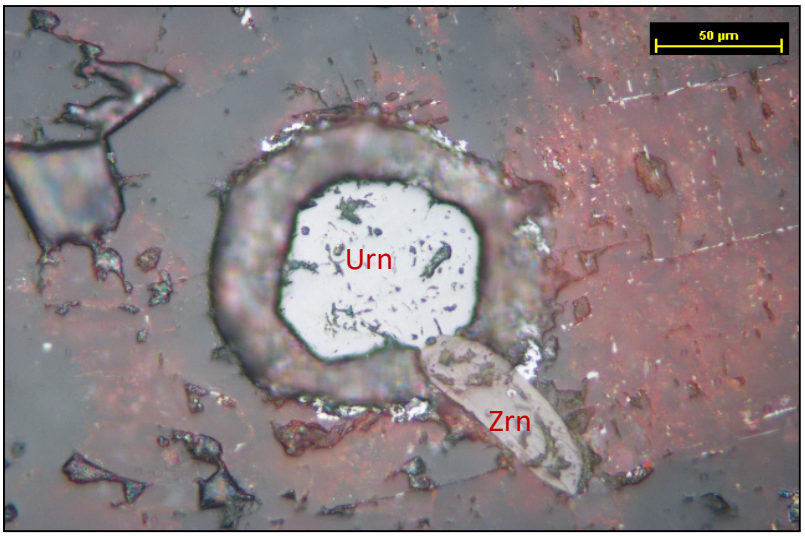


Fig.14: Uraninite intergrowth with zircon (RL,1N).

Rock type: Pegmatoid leucosome.

Locality: Naktu, Sonbhadra district, Uttar Pradesh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

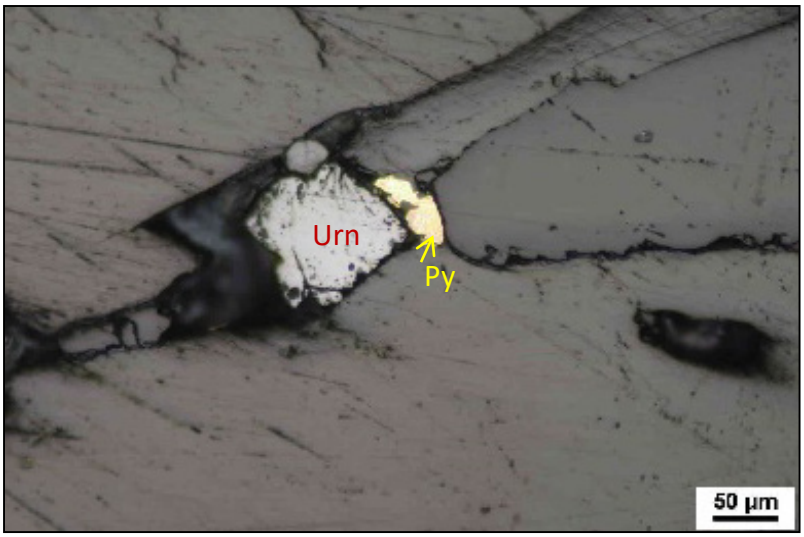


Fig.15: Euhedral uraninite in association with pyrite (RL,1N).

Rock type: Pegmatoid leucosome.

Locality: Anjangira, Sonbhadra district, Uttar Pradesh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

Uraninite

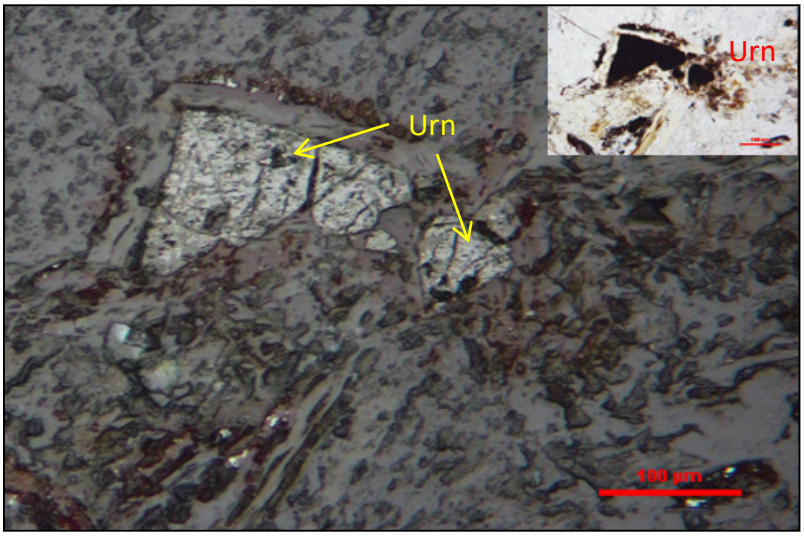


Fig.16: Fractured uraninite (RL,1N). Inset (TL,1N).

Rock type: Fractured granite.

Locality: Reddivaripalle, Annamayya district, Andhra Pradesh.

Geological Domain: T. Sundupalle Schist Belt.

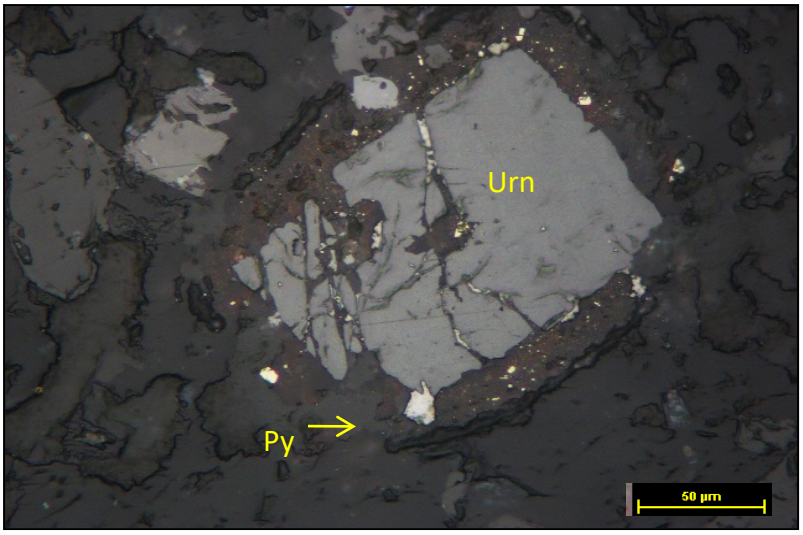


Fig.17: Fractured uraninite partially rimmed by pyrite. The fracture is also filled by pyrite (RL,1N).

Rock type: Fractured granite.

Locality: Reddivaripalle, Annamayya district, Andhra Pradesh.

Geological Domain: T. Sundupalle Schist Belt.

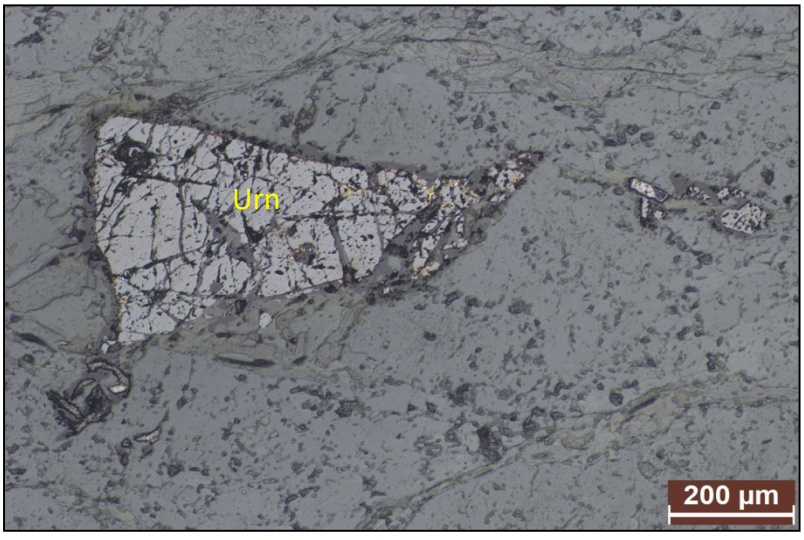
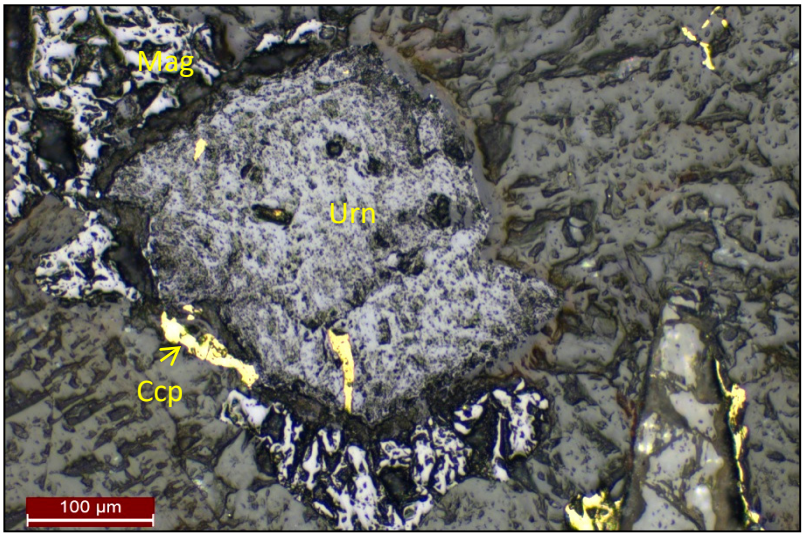


Fig.18 : Fractured uraninite (RL,1N).

Rock type: Leucosome of migmatite.

Locality: Demwe, Lohit district, Arunachal Pradesh.

Geological Domain: Sewak Group.



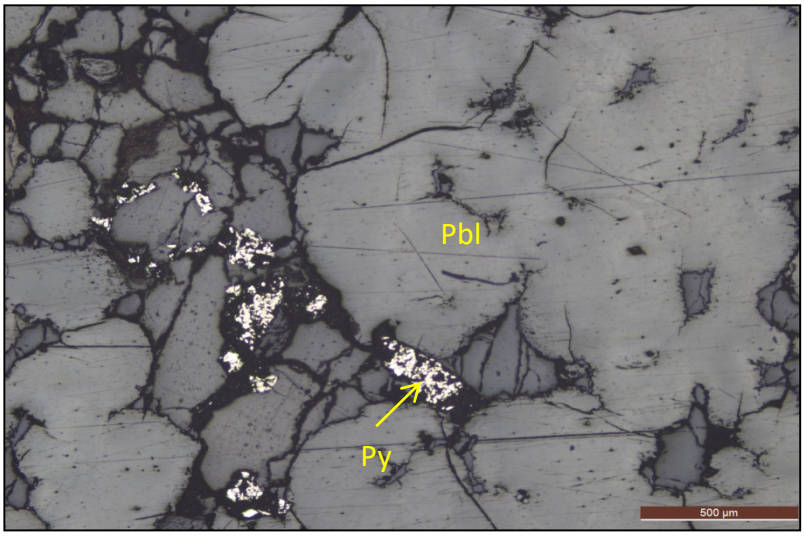
Uraninite

Fig.19: Uraninite in association with magnetite and chalcopyrite (RL,1N).

Rock type: Poly-metallic vein in gneiss.

Locality: Chhota Udaipur, Ajmer district, Rajasthan.

Geological Domain: Banded Gneissic Complex (BGC).



Pitchblende

Fig.20: Pitchblende in association with pyrite (RL,1N).

Rock type: Arkosic sandstone.

Locality: Domiasiat, South – West Khasi Hills district, Meghalaya.

Geological Domain: Mahadek Basin.

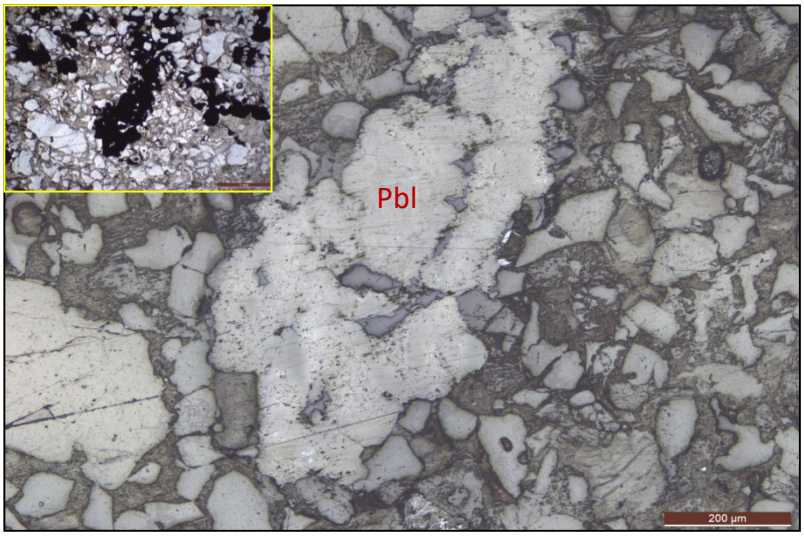


Fig.21: Pitchblende in interstitial spaces (RL,1N). Inset (TL,1N).

Rock type: Arkosic sandstone.

Locality: Wahkyn, SW Khasi Hills district, Meghalaya.

Geological Domain: Mahadek Basin.

Pitchblende

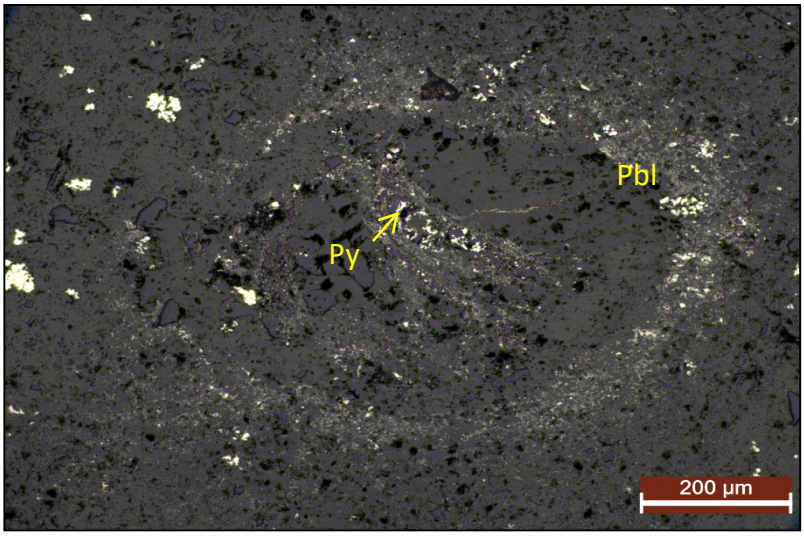


Fig.22: Pitchblende in association with pyrite in peloid (RL,1N).

Rock type: Impure dolostone.

Locality: Tummalapalle, YSR Kadapa district, Andhra Pradesh.

Geological Domain: Cuddapah Basin.

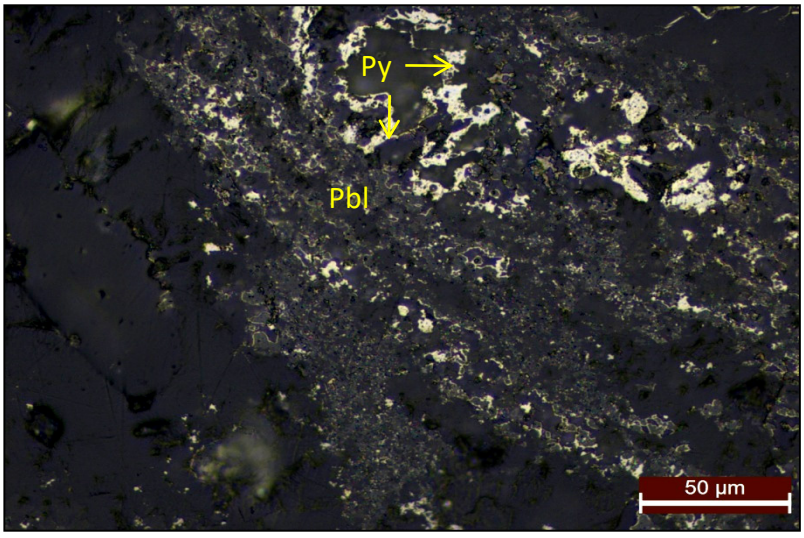


Fig.23: Pitchblende in association with pyrite (RL,1N).

Rock type: Impure dolostone.

Locality: Tummalapalle, YSR Kadapa district, Andhra Pradesh.

Geological Domain: Cuddapah Basin.

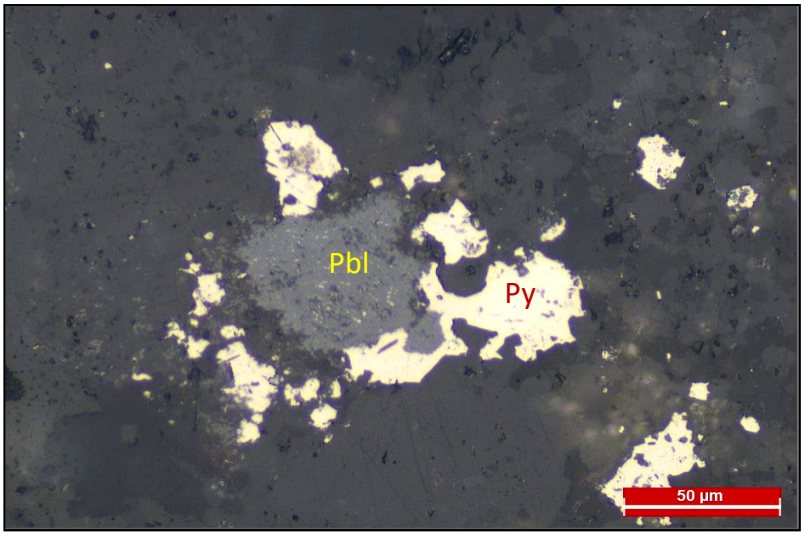


Fig.24: Pitchblende in association with pyrite (RL,1N).

Rock type: Impure dolostone.

Locality: Tummalapalle mine, YSR Kadapa district, Andhra Pradesh.

Geological Domain: Cuddapah Basin.

Pitchblende

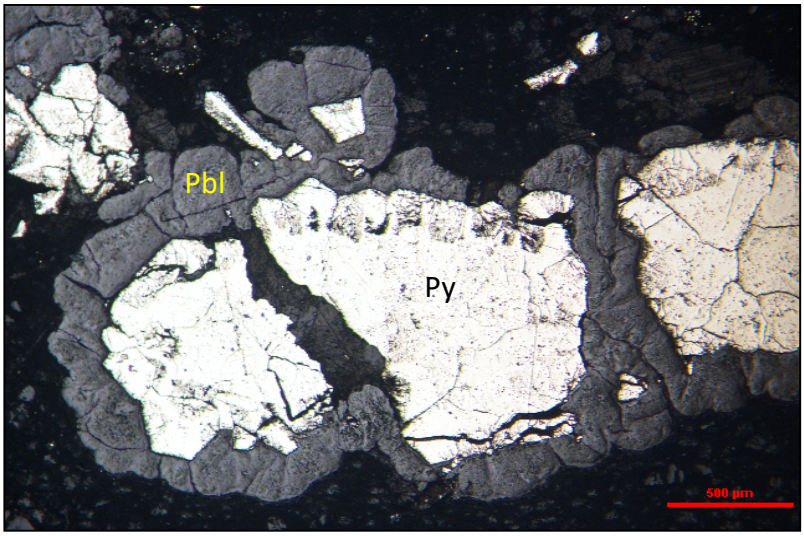


Fig.25: Pitchblende enclosing pyrite (RL,1N).

Rock type: Brecciated limestone.

Locality: Hulkal, Yadgir district, Karnataka.

Geological Domain: Bhima Basin.

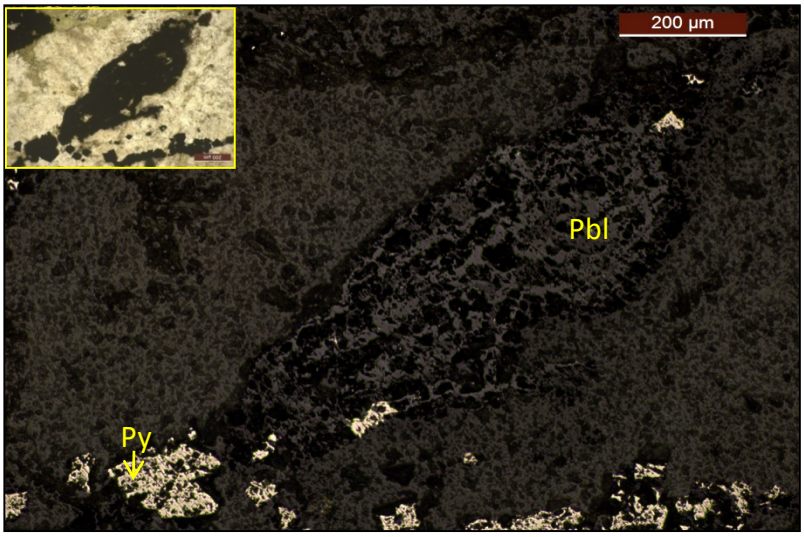


Fig.26: Pitchblende (partially coffinitised) in association with pyrite (RL,1N). Inset (TL,1N).

Rock type: Granite cataclasite.

Locality: Sarangapalli, Guntur district, Andhra Pradesh.

Geological Domain: Basement Granite underlying Kurnool Group.

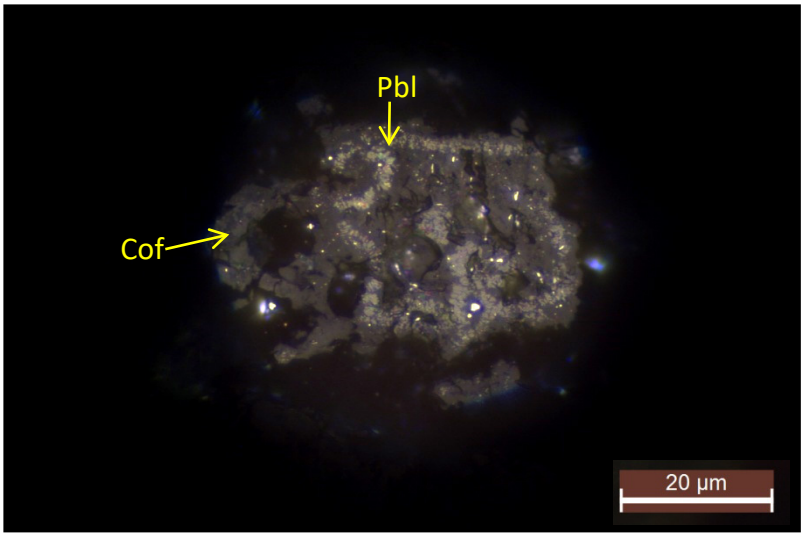


Fig.27: Pitchblende (partially coffinitised) in association with pyrite (RL,1N).

Rock type: Granite cataclasite.

Locality: Sarangapalli, Guntur district, Andhra Pradesh.

Geological Domain: Basement Granite underlying Kurnool Group.

Pitchblende

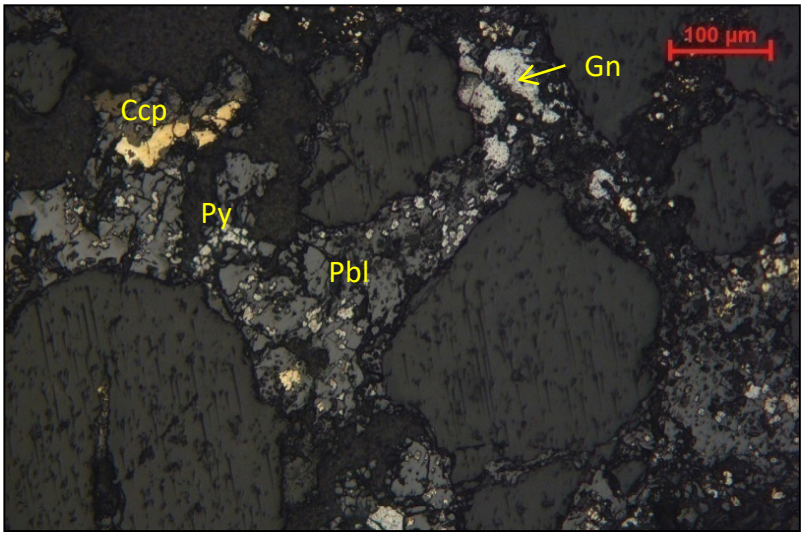


Fig.28: Pitchblende with galena, pyrite and chalcopyrite in interstitial spaces (RL,1N).

Rock type: Quartz arenite.

Locality: Suldhal, Belagavi district, Karnataka.

Geological Domain: Kaladgi Basin.

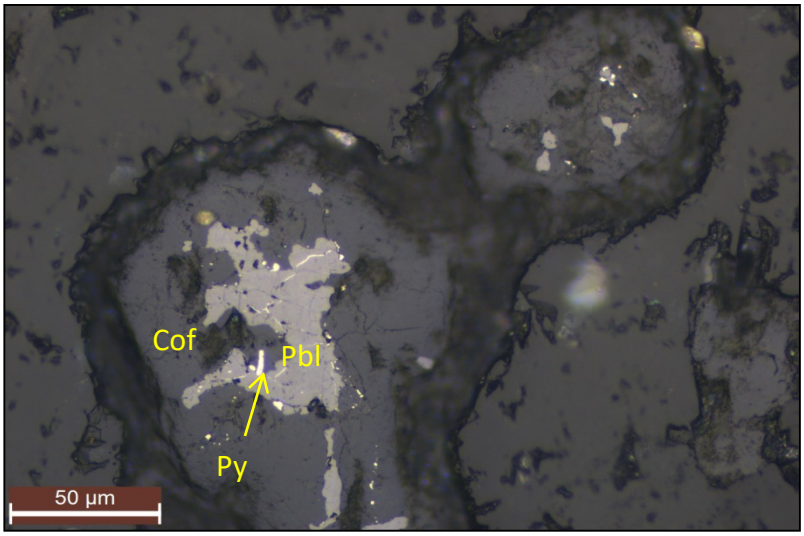


Fig.29: Pitchblende rimmed by coffinite, in association with pyrite (RL,1N).

Rock type: Quartz - biotite - chlorite schist.

Locality: Bagjata, East Singhbhum district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

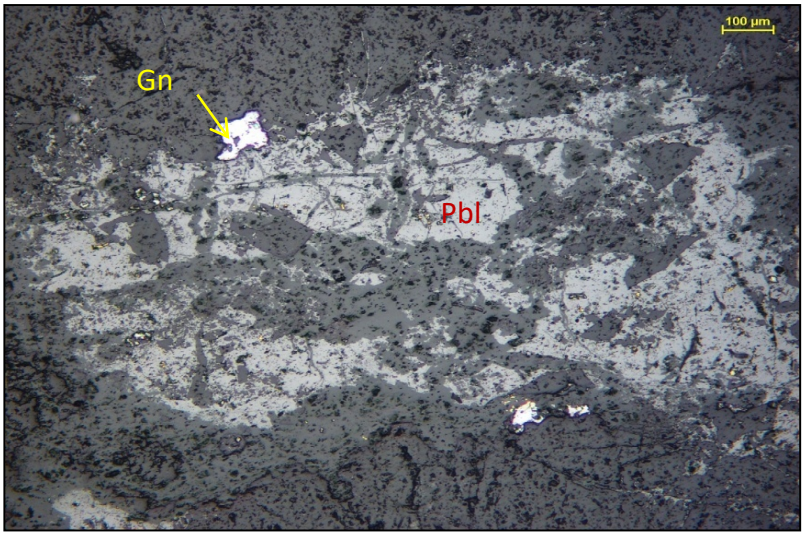


Fig.30: Pitchblende in association with galena (RL,1N).

Rock type: Quartz- chlorite vein in granite.

Locality: Kamaguttapalle, Chittoor district, Andhra Pradesh.

Geological Domain: Basement Granite underlying Cuddapah Basin.

Pitchblende

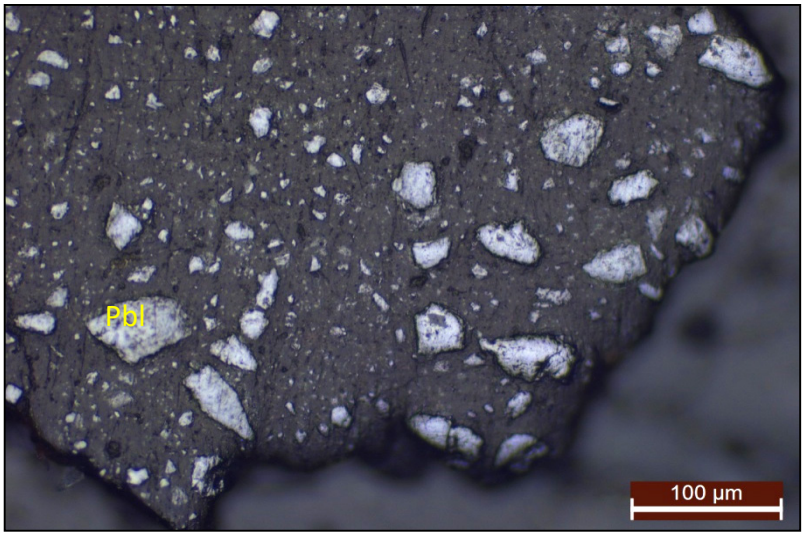


Fig.31: Pitchblende in clay stringers (RL,1N).

Rock type: Quartzite.

Locality: Chhinjra, Kullu district, Himachal Pradesh.

Geological Domain: Manikaran Quartzite (Lesser Himalaya).

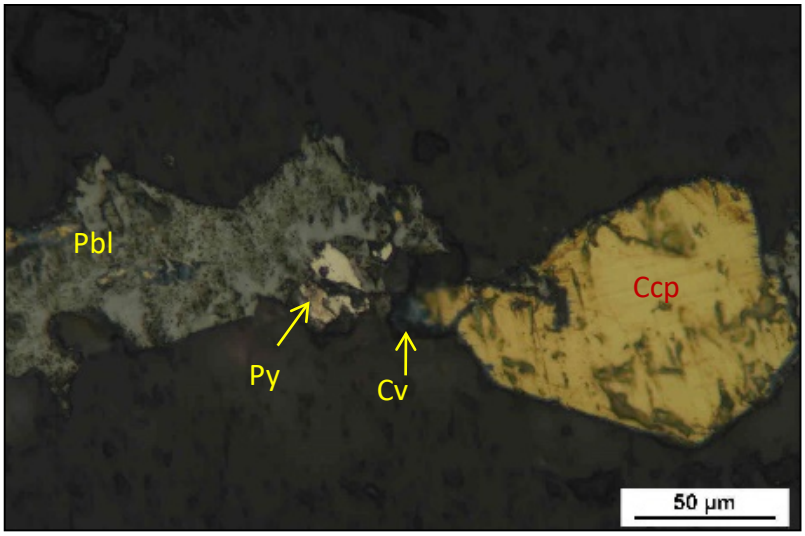


Fig.32: Pitchblende in association with pyrite, chalcopyrite and covellite (RL,1N).

Rock type: Quartzite.

Locality: Chhinjra, Kullu district, Himachal Pradesh.

Geological Domain: Manikaran Quartzite (Lesser Himalaya).

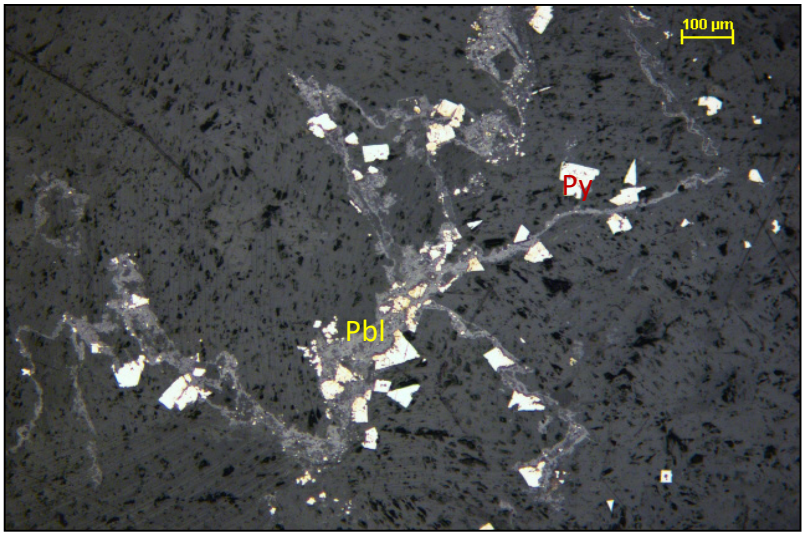


Fig.33: Pitchblende with pyrite in the fractures (RL,1N).

Rock type: Brecciated limestone.

Locality: Kanchankayi, Yadgir district, Karnataka.

Geological Domain: Bhima Basin.

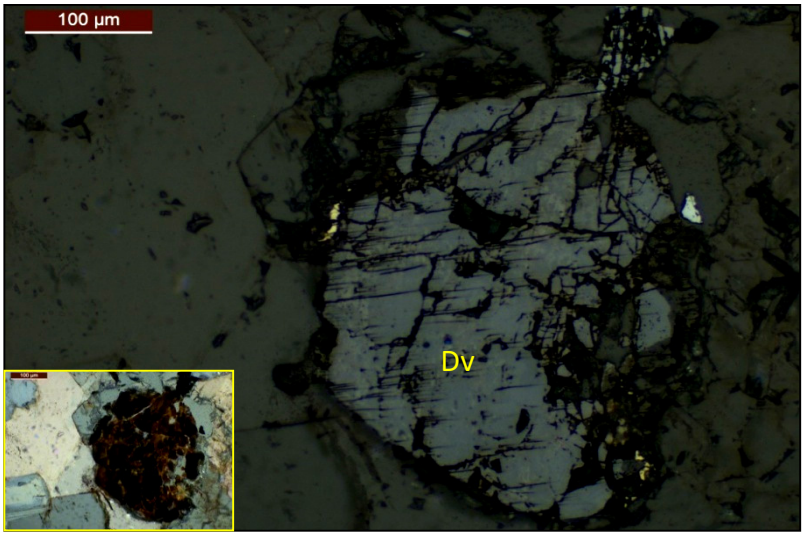


Fig.34: Davidite (RL,1N). Inset (RL,XN).

Rock type: Albitite.

Locality: Geratiyon- Ki - Dhani, Sikar district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

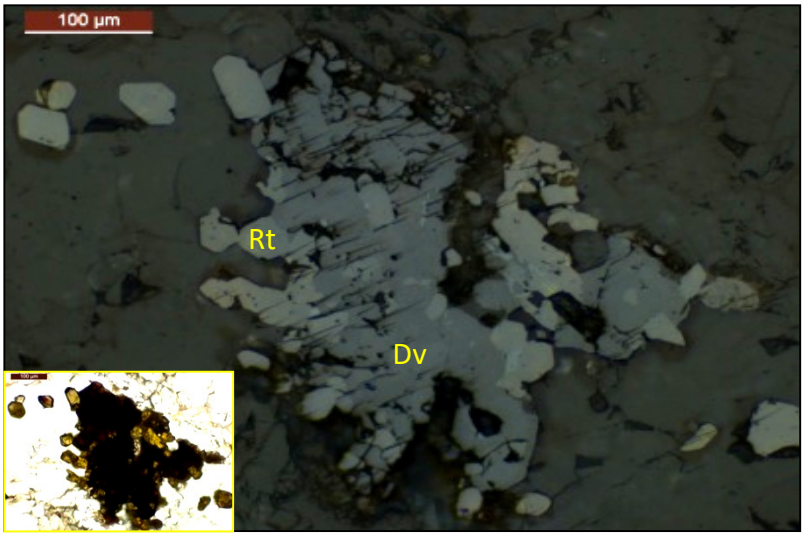


Fig.35: Davidite in association with rutile (RL,1N). Inset (TL,1N).

Rock type: Albitite.

Locality: Geratiyon- Ki - Dhani, Sikar district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

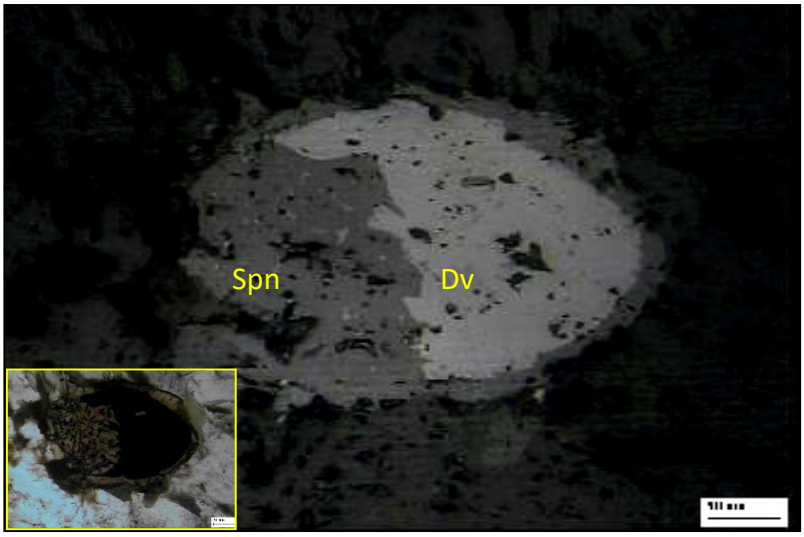


Fig.36: Davidite and sphene intergrowth (RL,1N). Inset (TL,1N).

Rock type: Albitite.

Locality: Bichun – Nayagaon, Jaipur district, Rajasthan .

Geological Domain: Banded Gneissic Complex (BGC).

Brannerite

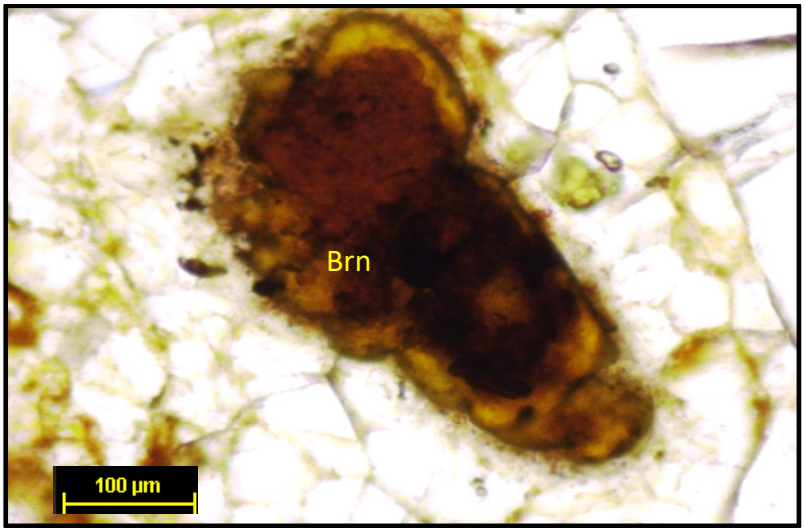


Fig.37: Brannerite (TL,1N).

Rock type: Brecciated albitite.

Locality: Gangutana area, Jhunjhunu district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

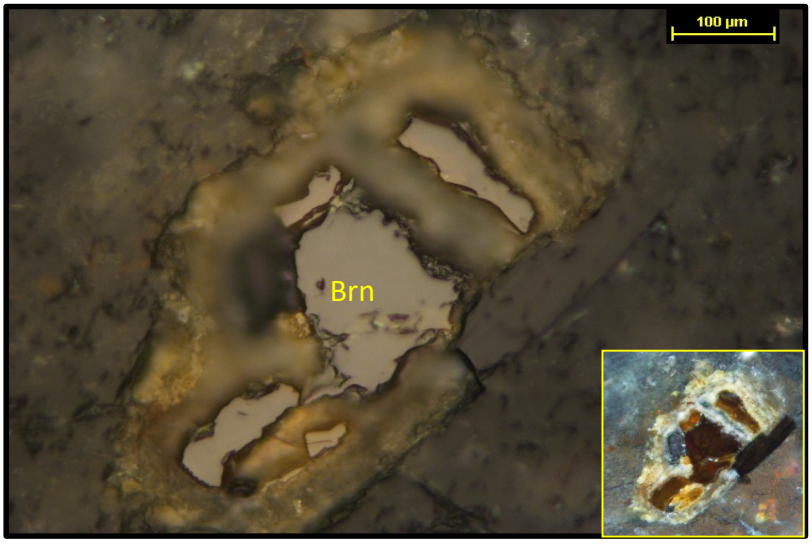


Fig.38: Altered Brannerite (RL,1N). Inset (RL,XN).

Rock type: Biotite-granite.

Locality: Vanjinagaram, Madurai district, Tamil Nadu.

Geological Domain: Southern Granulite Terrane.

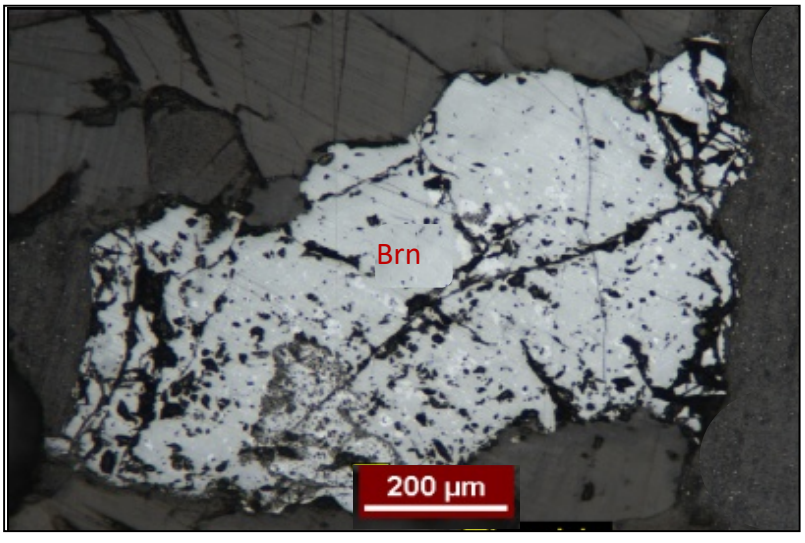
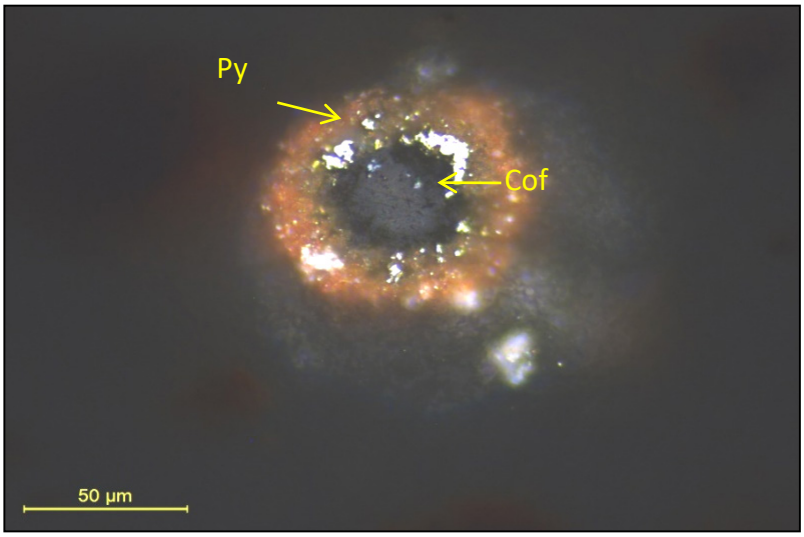


Fig.39: Brannerite (RL,1N).

Rock type: Mylonitised biotite - albitite.

Locality: Kalatopri, Sikar district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).



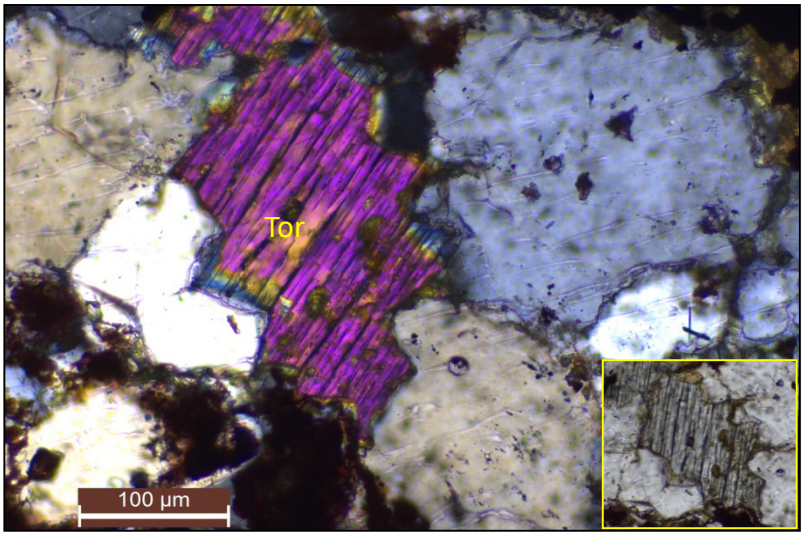
Coffinite

Fig.40: Coffinite in association with pyrite (RL,1N).

Rock type: Impure dolostone.

Locality: Tummalapalle mine, YSR Kadapa district, Andhra Pradesh.

Geological Domain: Cuddapah Basin.



Torbernite

Fig.41: Torbernite (TL,XN). Inset (TL,1N).

Rock type: Ferruginised & silicified rock.

Locality: Bari-Ainthi, Sidhi district, M.P.

Geological Domain: Mahakoshal Group.

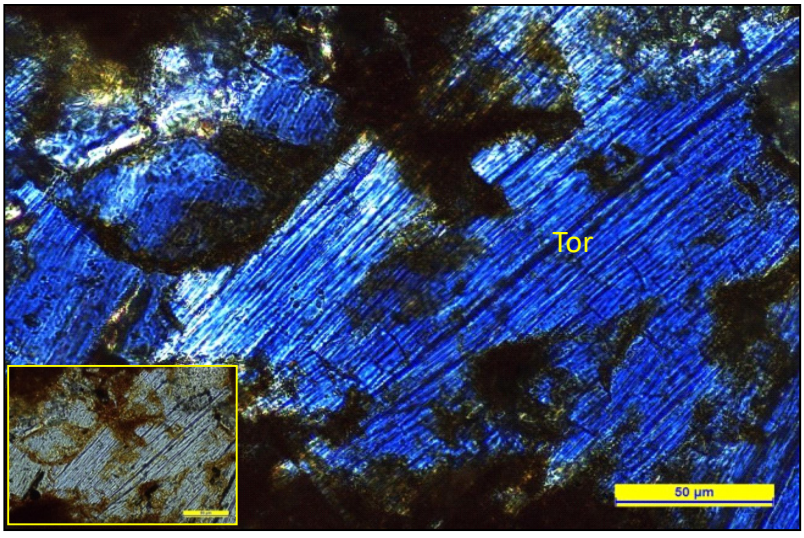
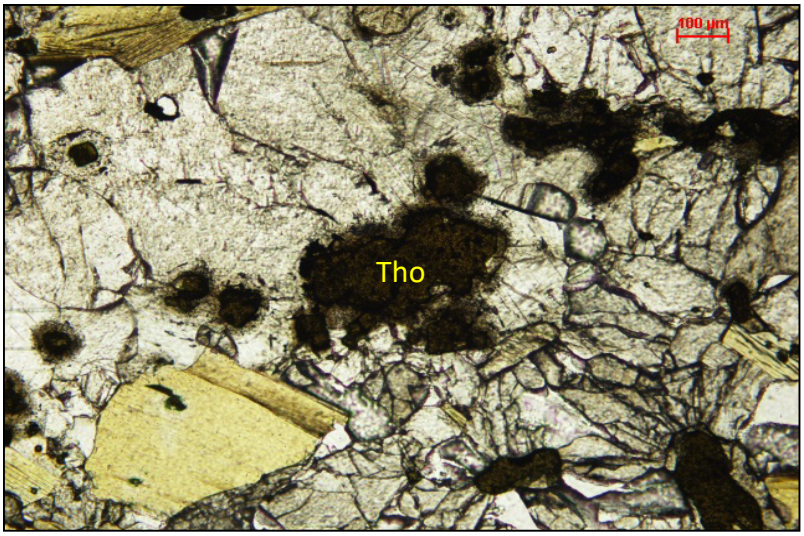


Fig.42: Torbernite (TL,XN). Inset (TL,1N).

Rock Type: Altered granite gneiss.

Locality: Sedal, West Kameng district, Arunachal Pradesh.

Geological Domain: Bomdila Group.



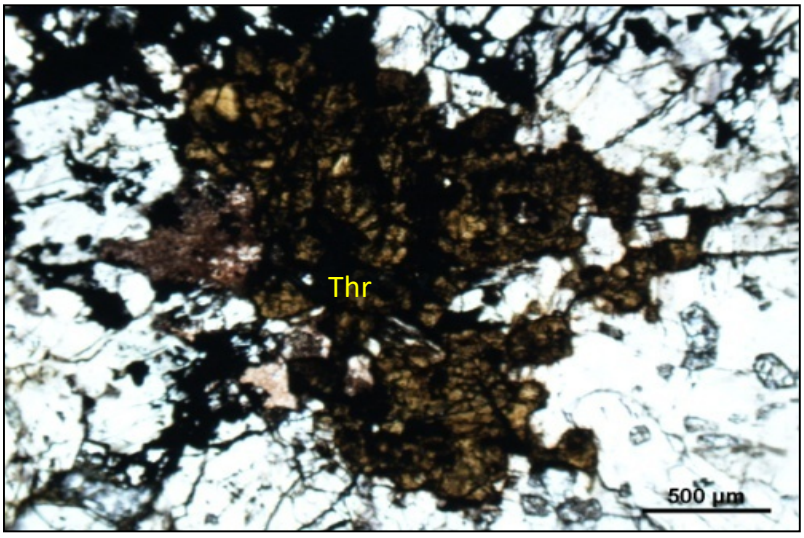
Thorianite

Fig.43: Thorianite (TL,1N).

Rock type: Carbonatite.

Locality: Pakkandu, Salem district, Tamil Nadu.

Geological Domain: Southern Granulite Terrain.



Thorite

Fig.44: Thorite (TL,1N).

Rock type: Albitised calc-silicate rock.

Locality: Rambas, Mahendragarh district, Haryana.

Geological Domain: North Delhi Fold Belt (NDFB).

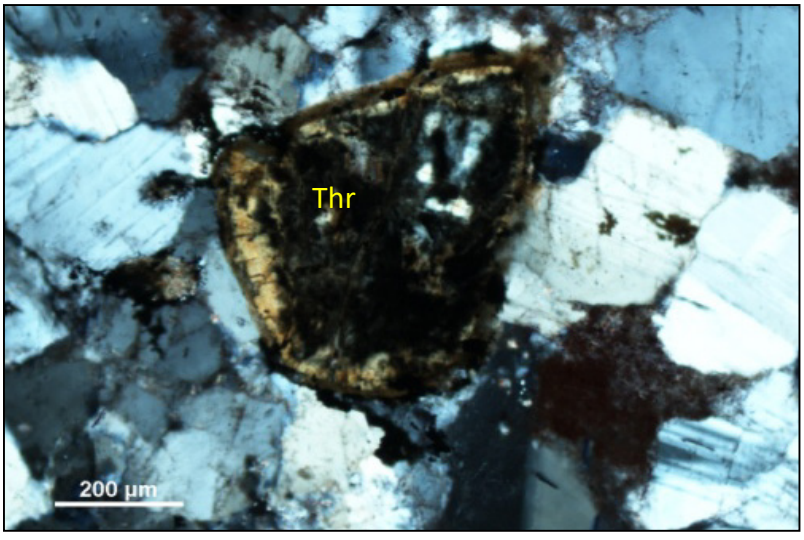


Fig.45: Thorite (TL,1N).

Rock type: Albitised quartzo-feldspathic rock.

Locality: Sareli Ki Dhani, Mahendragarh district, Haryana.

Geological Domain: North Delhi Fold Belt (NDFB).

Thorite

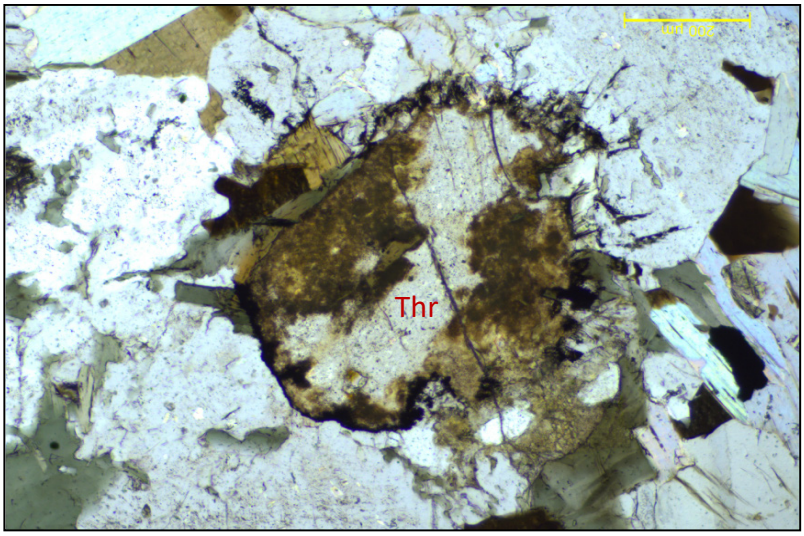


Fig.46: Thorite (TL,1N).

Rock type: Albite vein.

Locality: Pathargora, East Singhbhum district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

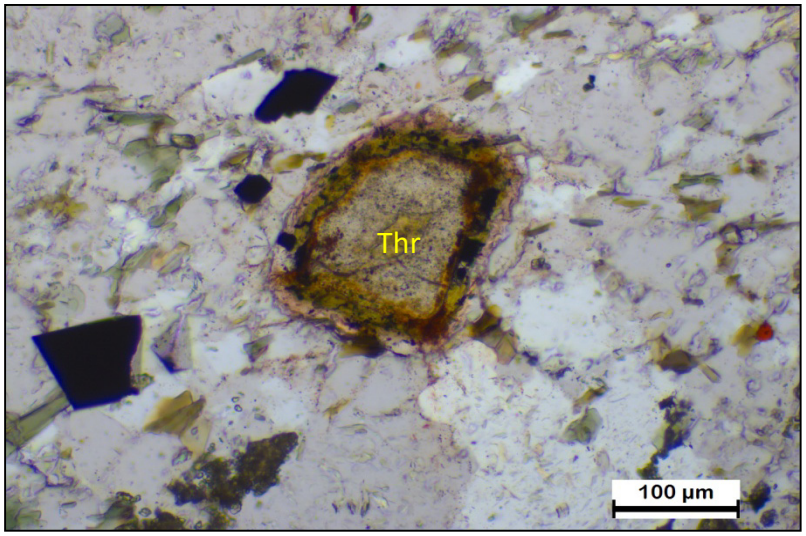


Fig.47: Thorite (TL,1N).

Rock type: Sericite-chlorite-quartz schist.

Locality: Kumari, Seraikela - Kharsawan district, Jharkhand.

Geological Domain: Singhbhum Shear Zone (SSZ).

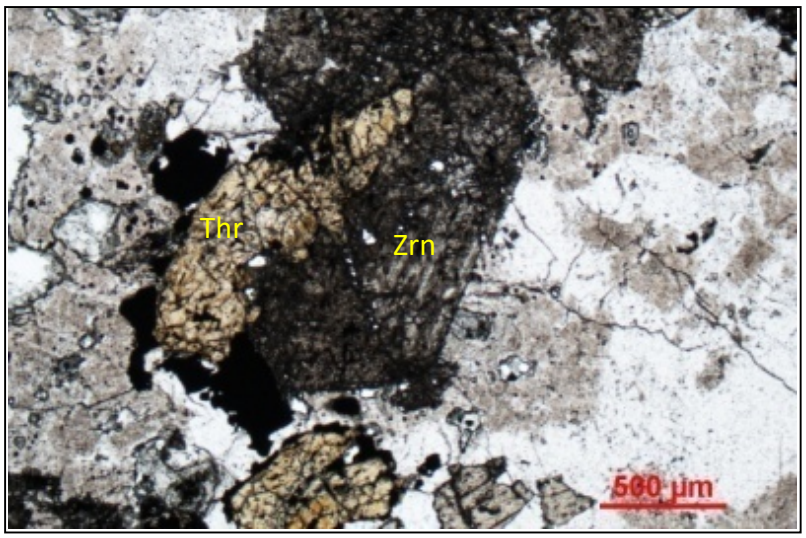


Fig.48: Thorite intergrowth with zircon (TL,1N).

Rock type: Albitised granitoid.

Locality: Gorir, Mahendragarh district, Haryana.

Geological Domain: North Delhi Fold Belt (NDFB).

Monazite

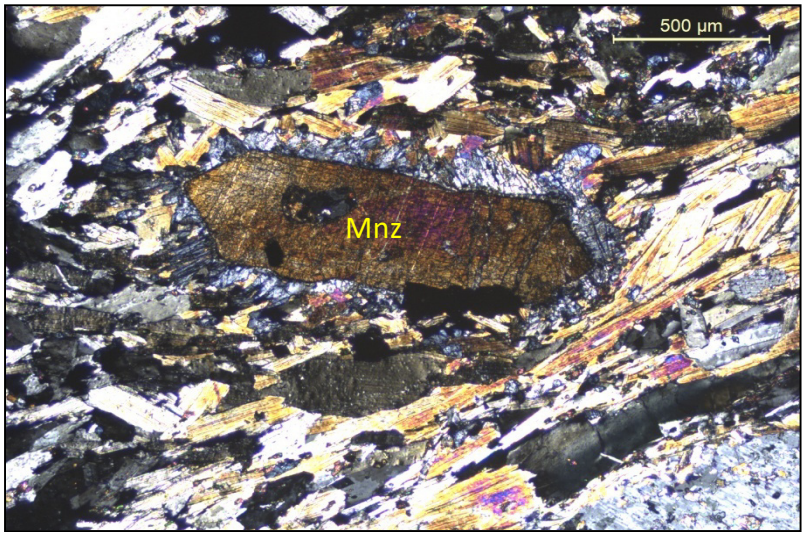


Fig.49: Monazite (TL,XN).

Rock type: Granite gneiss.

Locality: Hajjo Nala, Lohit district, Arunachal Pradesh.

Geological domain: Sewak Group.

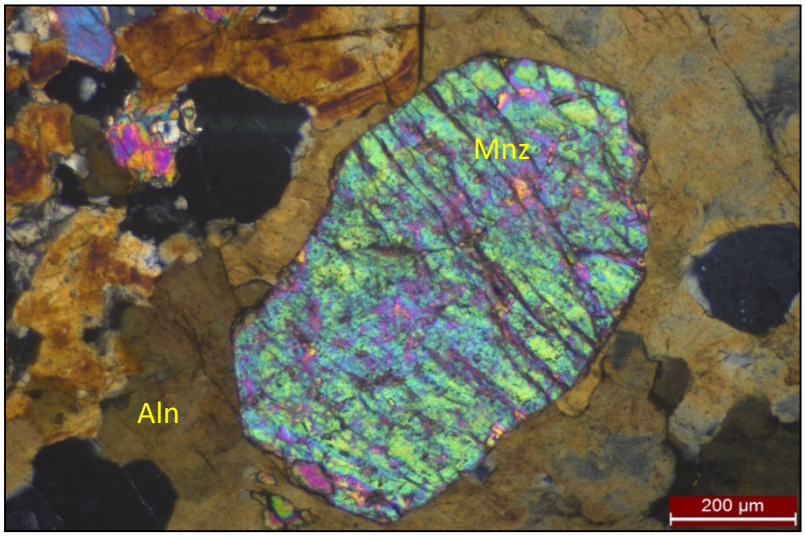


Fig.50: Monazite in allanite (TL,XN).

Rock type: Carbonatite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological domain: Dharmapuri Shear Zone.

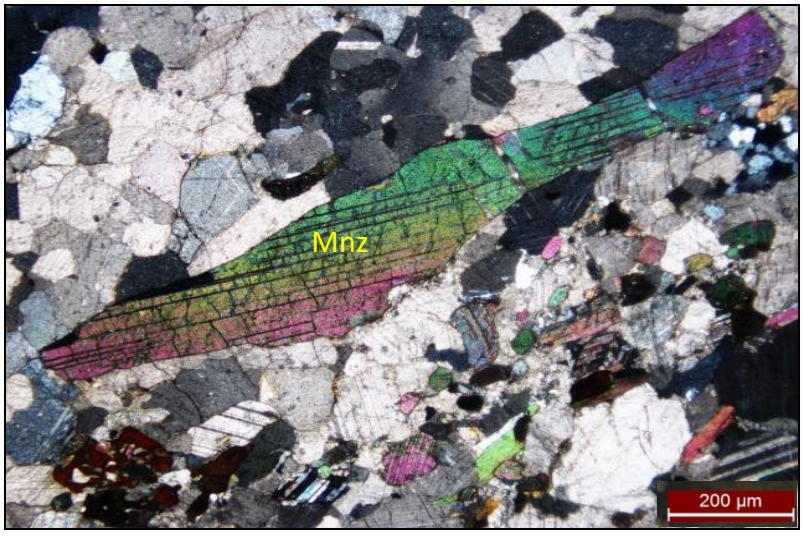


Fig.51: Monazite (TL,XN).

Rock type: Carbonatite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological domain: Dharmapuri Shear Zone.

Allanite

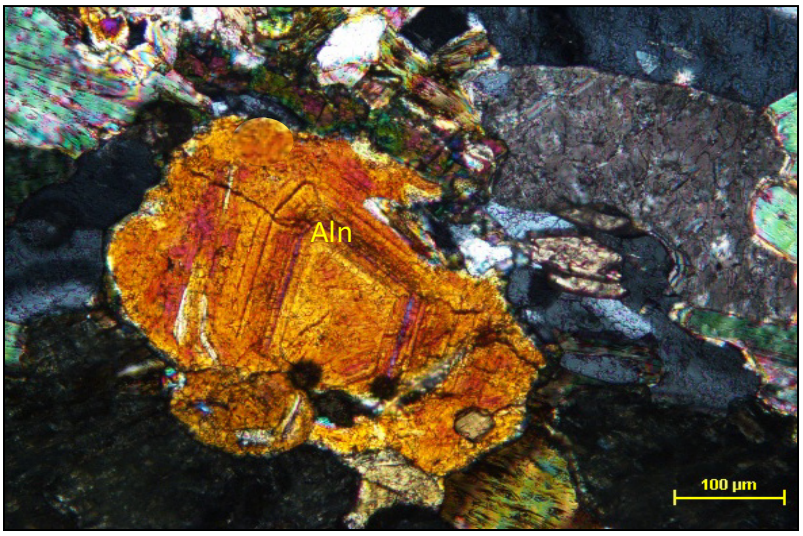


Fig.52: Zoned allanite (TL,XN).

Rock type: Syenite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological domain: Dharmapuri Shear Zone.

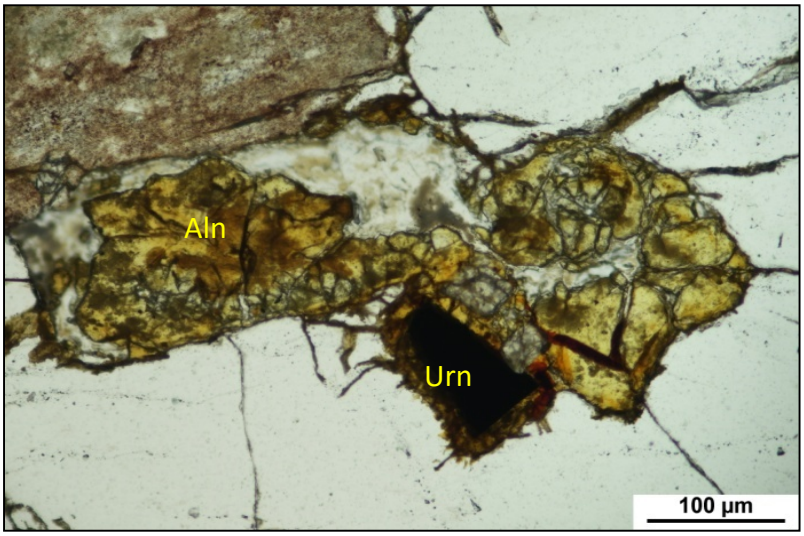


Fig.53: Allanite in association with uraninite (TL,1N).

Rock type: Pegmatoid leucosome.

Locality: Bichiari, Sonbhadra district, Uttar Pradesh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

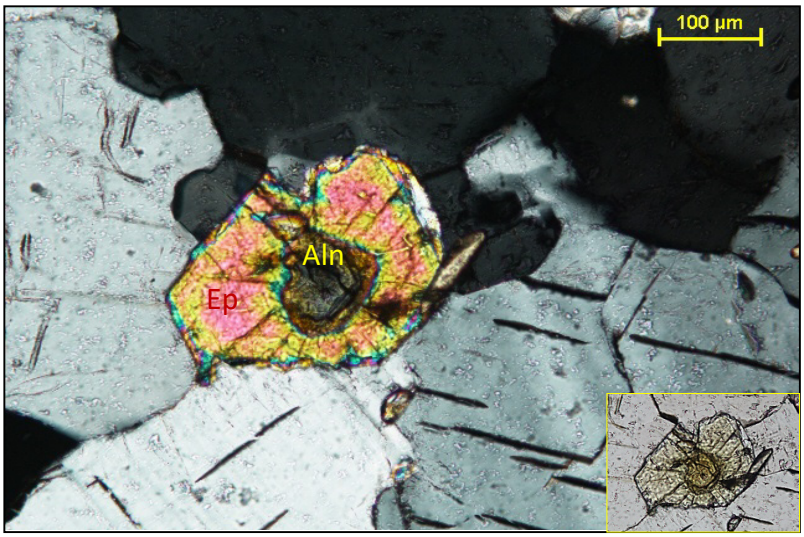


Fig.54: Allanite in epidote (TL,XN). Inset (TL,1N).

Rock type: Syenite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological domain: Dharmapuri Shear Zone.

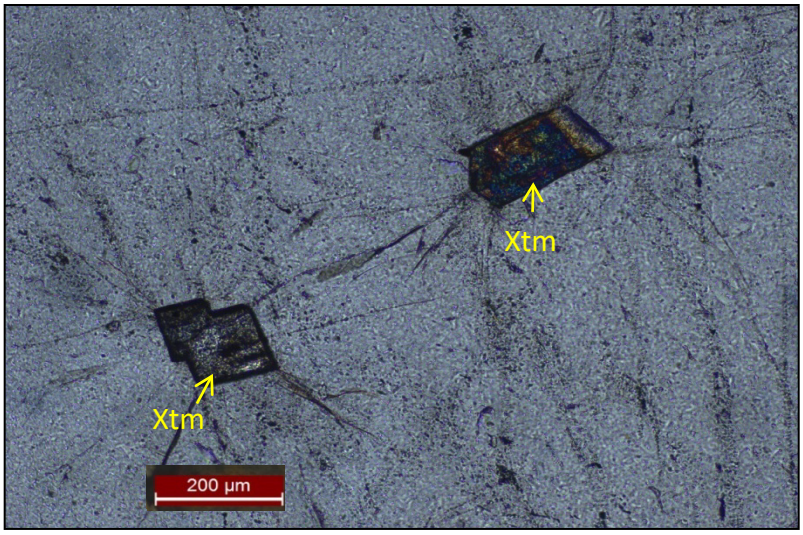


Fig.55: Xenotime inclusion in quartz with radiation crack (TL,XN).

Rock type: Pegmatoid leucosome.

Locality: Ucherwa, Balrampur district, Chhattisgarh.

Geological domain: Chhotanagpur Granite Gneiss Complex (CGGC).

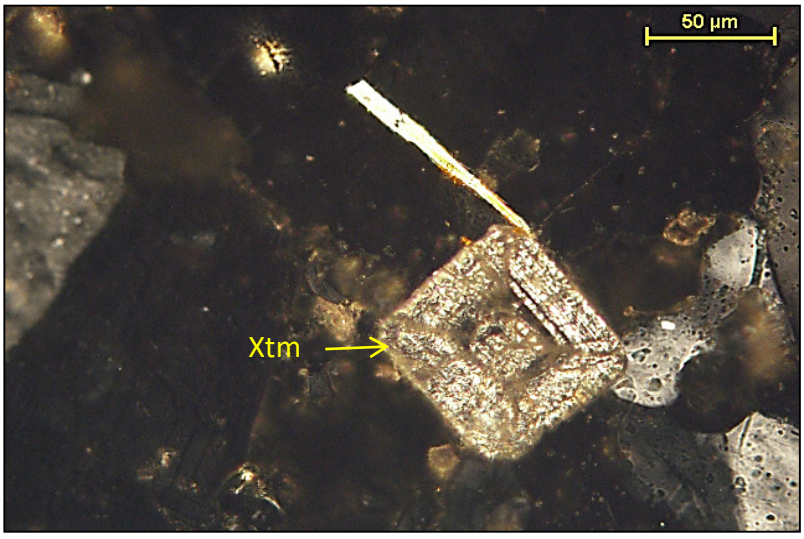


Fig.56: Xenotime (TL,XN).

Rock type: Syenite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological domain: Dharmapuri Shear Zone.

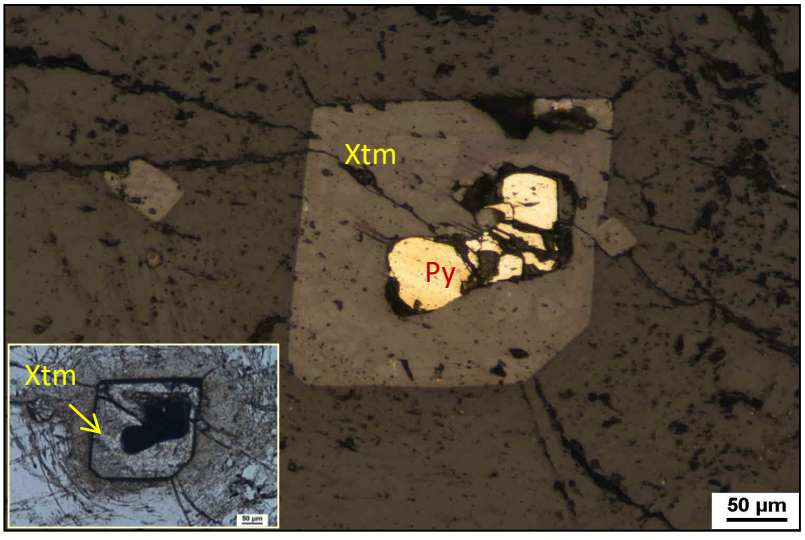


Fig.57: Xenotime with inclusion of pyrite (TL,1N). Inset (TL,1N).

Rock type: Pegmatoid leucosome.

Locality: Kudar-Nimna, Sonbhadra district, Uttar Pradesh.

Geological domain: Chhotanagpur Granite Gneiss Complex (CGGC).

Pyrochlore

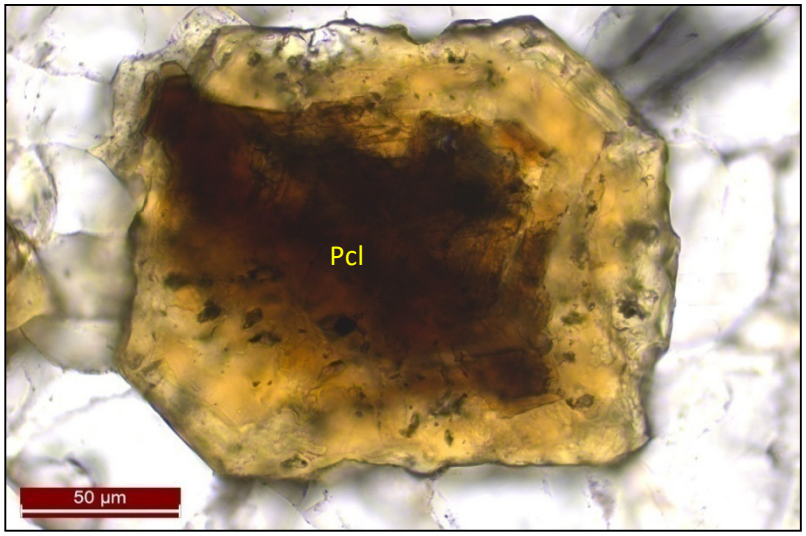


Fig.58: Zoned pyrochlore (TL,1N).

Rock type: Carbonatite.

Locality: Ambadungar, Chhotaudepur district, Gujarat.

Geological Domain: Ambadungar Carbonatite Complex.

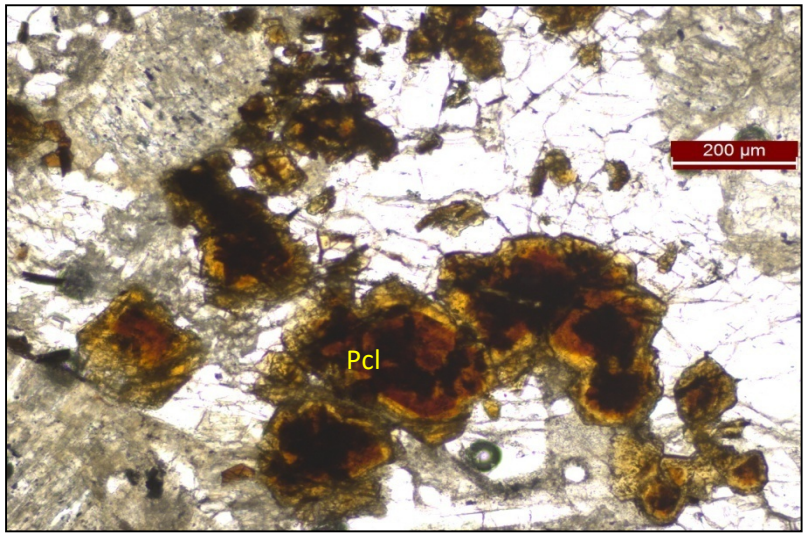


Fig.59: Zoned pyrochlore (TL,1N).

Rock type: Carbonatitite.

Locality: Ambadungar, Chhotaudepur district, Gujarat.

Geological Domain: Ambadungar Carbonatite Complex.

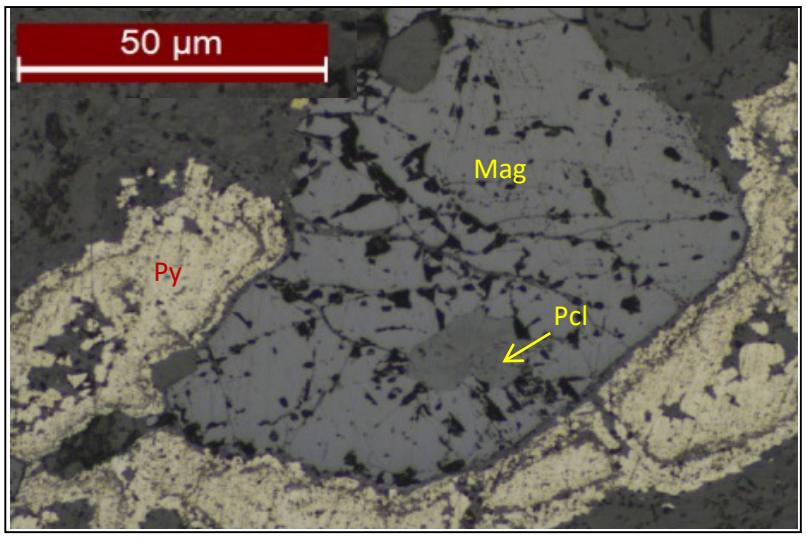


Fig.60: Pyrochlore within magnetite in association with pyrite (RL,1N).

Rock type: Phoscorite.

Locality: Ambadungar, Chhotaudepur district, Gujarat.

Geological Domain: Ambadungar Carbonatite Complex.

Betafite

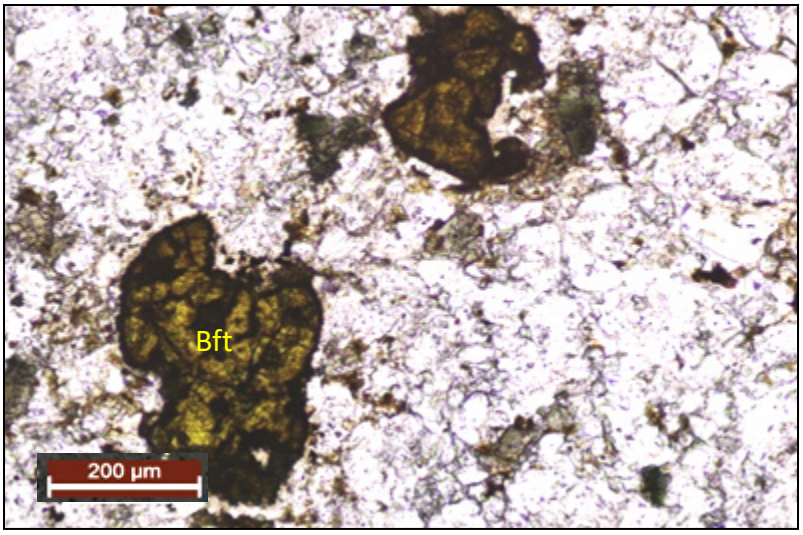


Fig.61: Betafite (TL,1N).

Rock type: Calcite infiltrated brecciated albite rock.

Locality: Mothuka, Jaipur district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

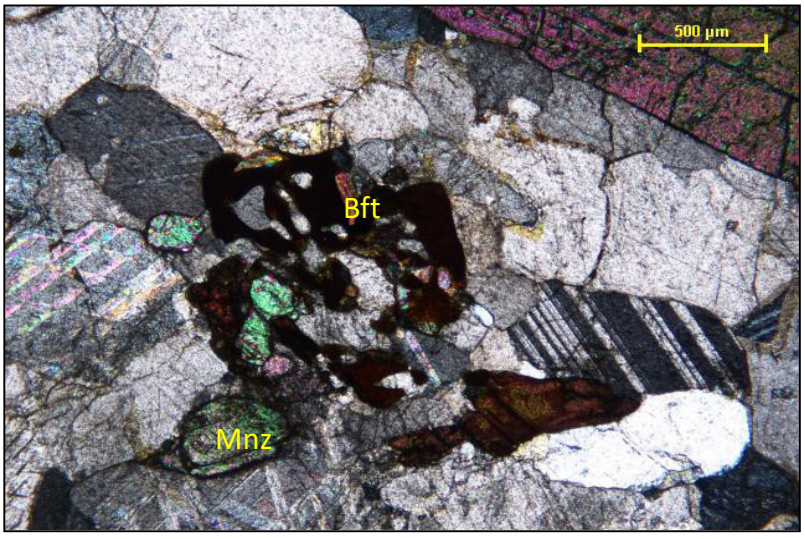


Fig.62: Betafite along with monazite (TL,XN).

Rock type: Carbonatite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological Domain: Dharmapuri Shear Zone.

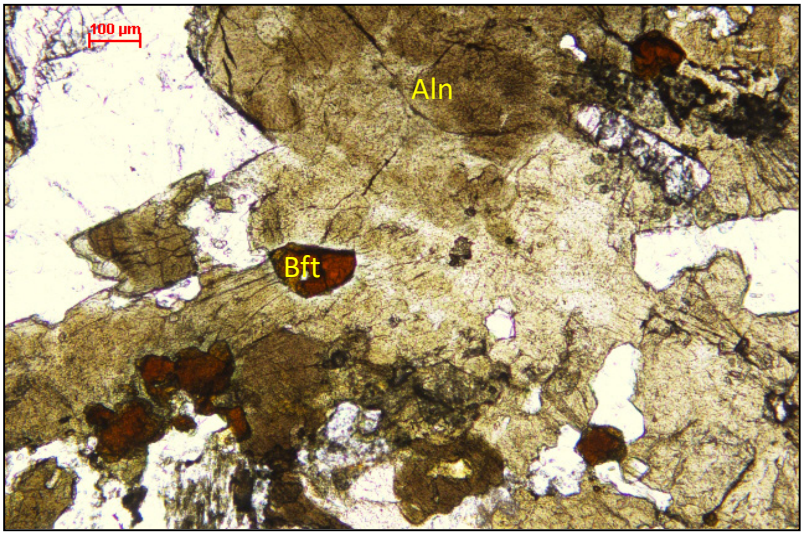
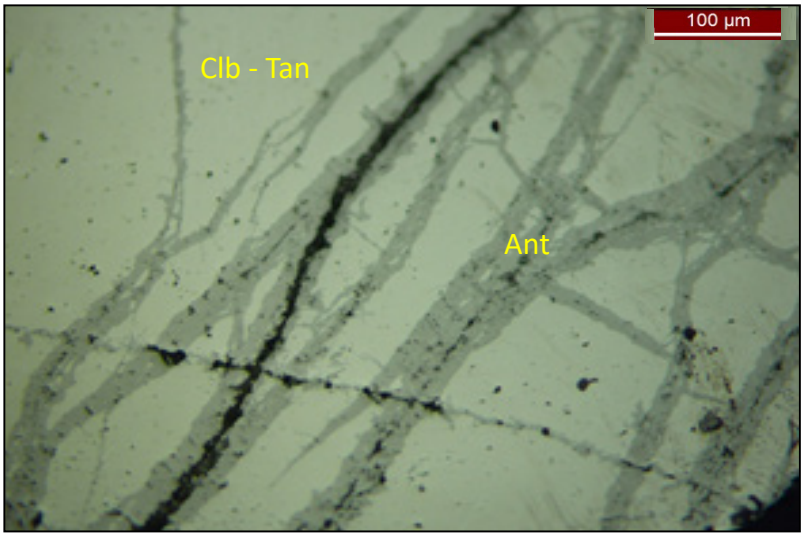


Fig.63: Betafite in allanite (TL,1N).

Rock type: Carbonatite.

Locality: Pakkanadu, Salem district, Tamil Nadu.

Geological Domain: Dharmapuri Shear Zone.



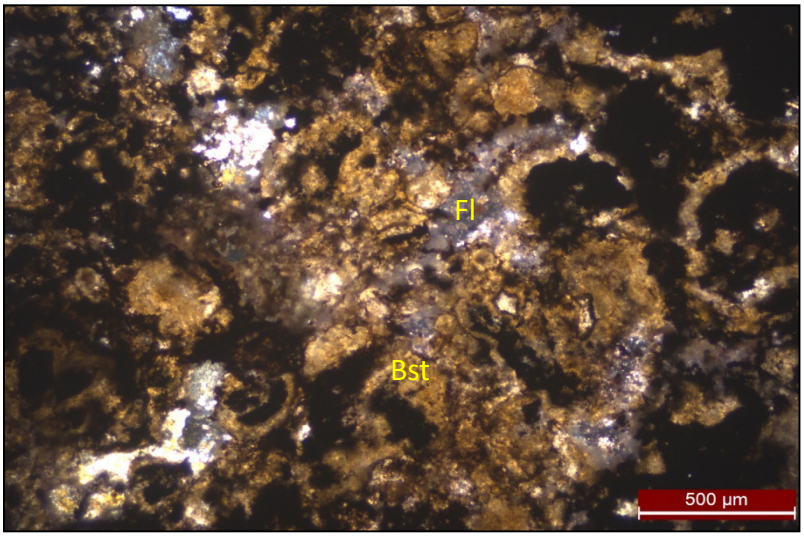
Columbite-Tantalite

Fig.64: Columbite-tantalite with anatase in fracture (RL,1N).

Rock Type: Pegmatite.

Loclocality: Marlagalla, Mandya district, Karnataka

Geological Domain: Nagamangala Schist Belt.



Bastnaesite

Fig.65 : Altered bastnaesite with fluorite (TL,1N).

Rock type: Carbonatite.

Locality: Ambadungar, Chhotaudepur district, Gujarat.

Geological Domain: Ambadungar Carbonatite Complex.

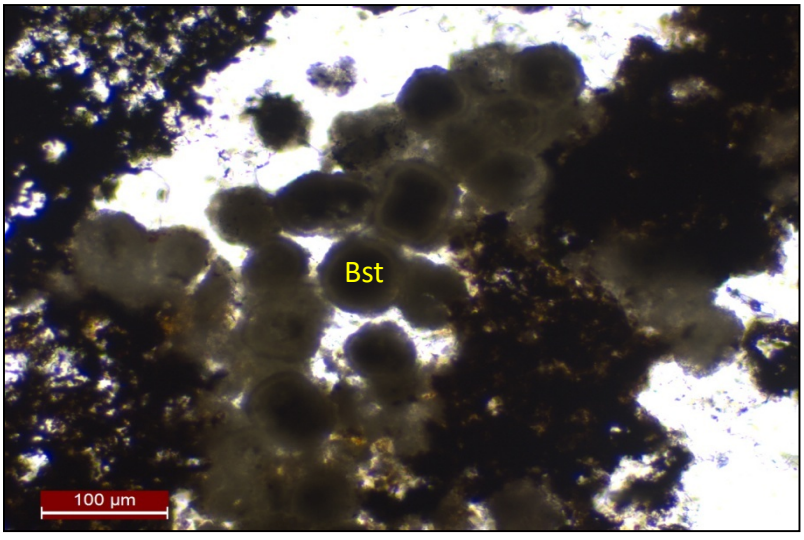


Fig.66 : Altered bastnaesite (TL,1N).

Rock type: Carbonatite.

Locality: Ambadungar, Chhotaudepur district, Gujarat.

Geological Domain: Ambadungar Carbonatite Complex.

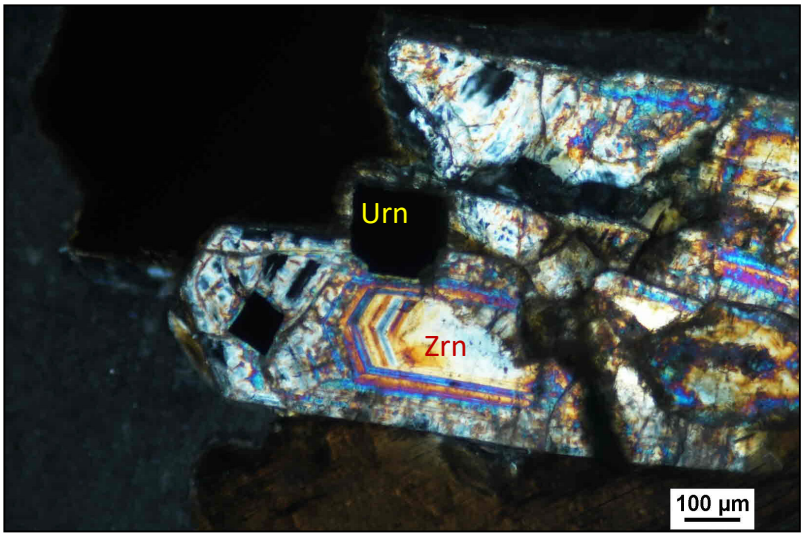


Fig.67: Euhedral uraninite inclusion in zircon (TL,XN).

Rock type: Pegmatoid leucosome.

Locality: Kudar, Sonbhadra district, Uttar Pradesh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

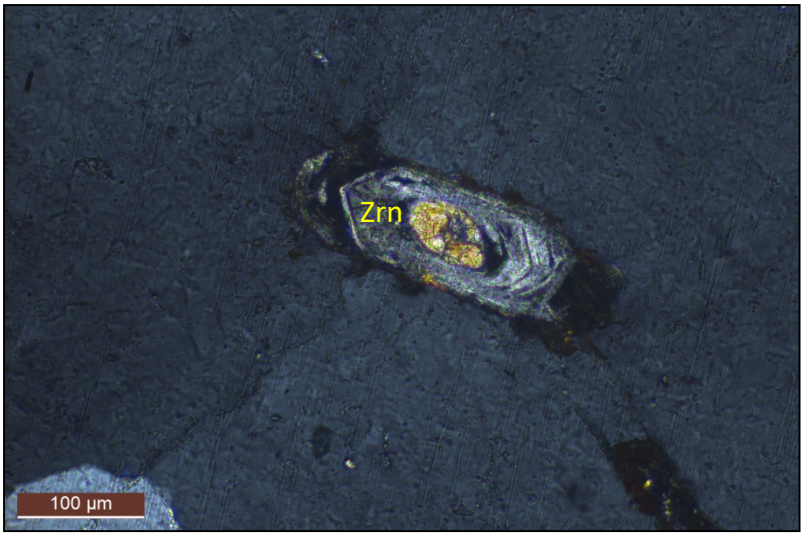


Fig.68: Zoned zircon with detrital core (TL,XN).

Rock type: Pegmatoid leucosome.

Locality: Kurludih, Balrampur district, Chhattisgarh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

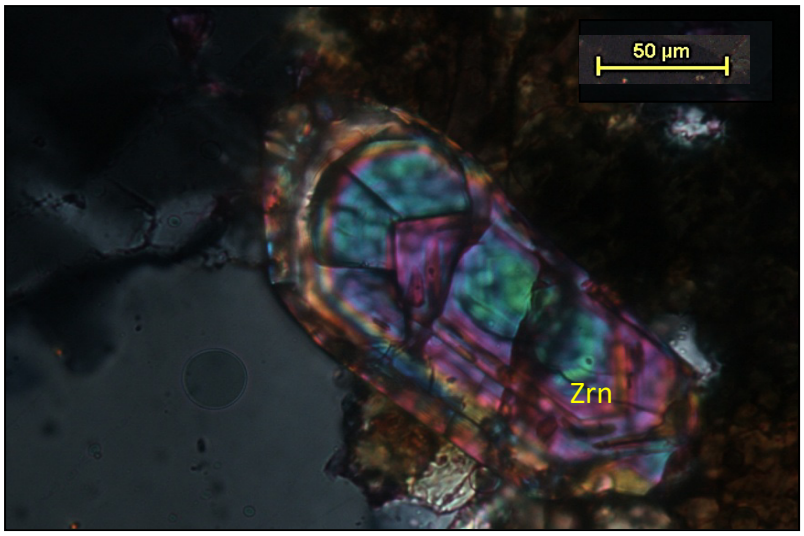


Fig.69: Zoned zircon (TL,XN).

Rock type: Albitised quartzo-feldspathic rock.

Locality: Gorir, Jhunjhunu district, Rajasthan.

Geological Domain: North Delhi Fold Belt (NDFB).

Zircon

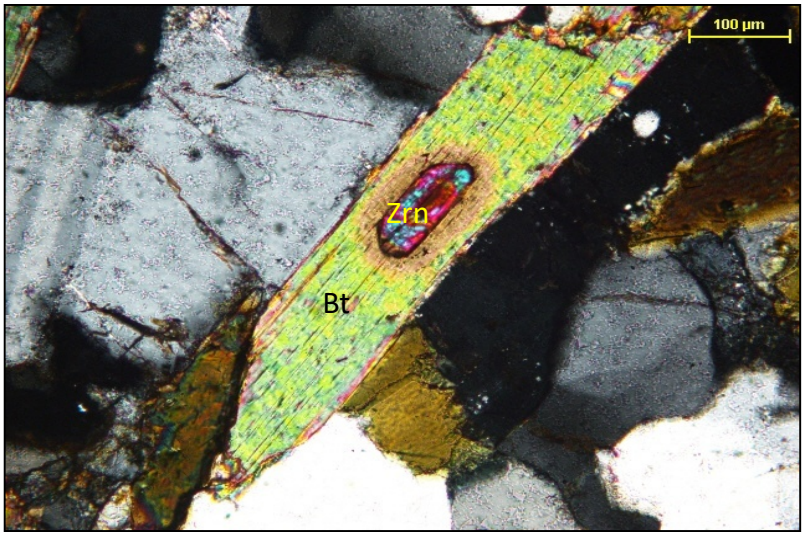


Fig.70: Zircon inclusion in biotite (TL,XN).

Rock type: Pegmatoid leucosome.

Locality: Naktu, Sonbhadra district, Uttar Pradesh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

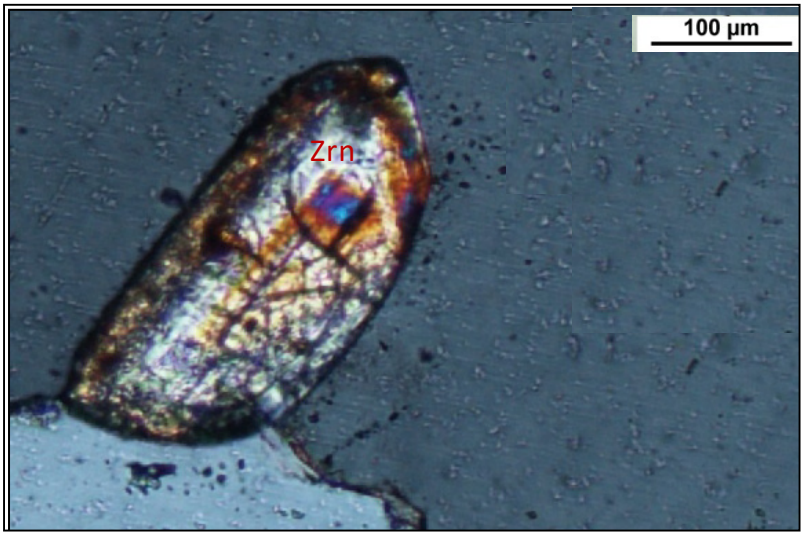


Fig.71: Zoned zircon (TL,XN).

Rock type: Granite.

Locality: Dosi, Mahendragarh district, Haryana.

Geological Domain: North Delhi Fold Belt (NDFB).

Beryl

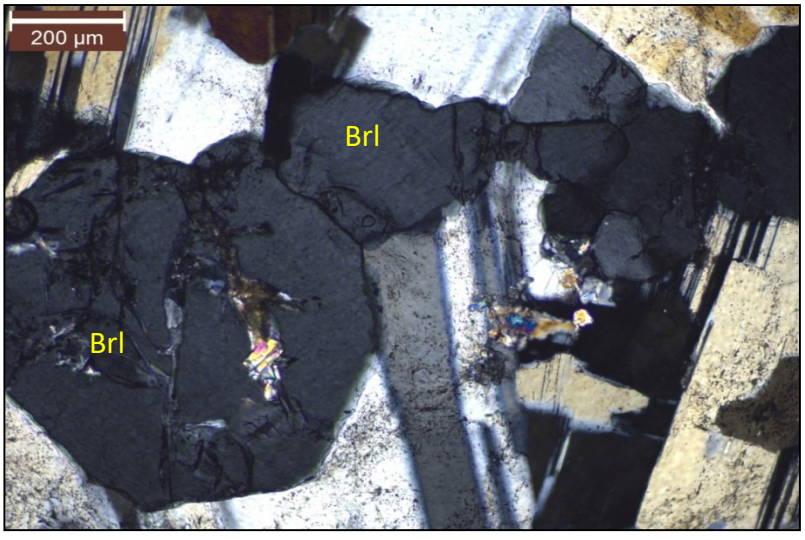


Fig.72: Beryl (TL,XN).

Rock Type: Pegmatite.

Locality: Garhtara, Korba district, Chhattisgarh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

Spodumene, Lepidolite

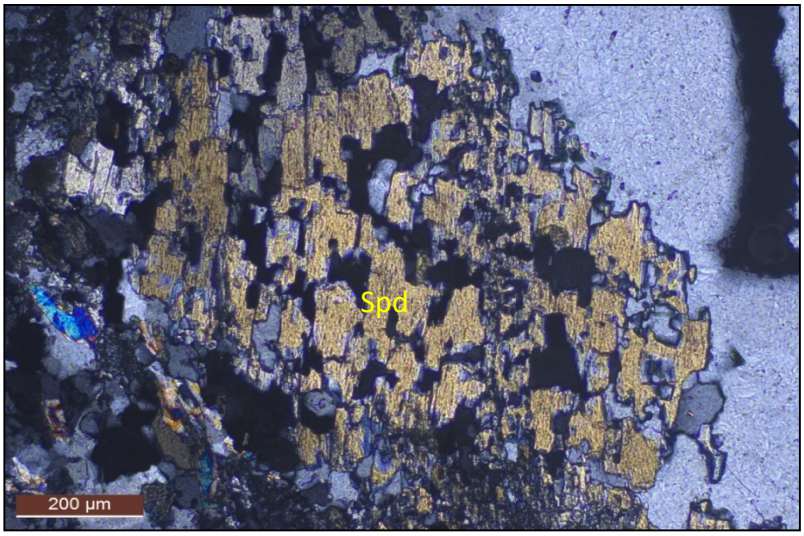


Fig.73: Intergrowth of spodumene with quartz (TL,XN).

Rock type: Pegmatite.

Locality: Mangalur, Yadgir district, Karnataka.

Geological Domain: Mangalur Schist Belt.

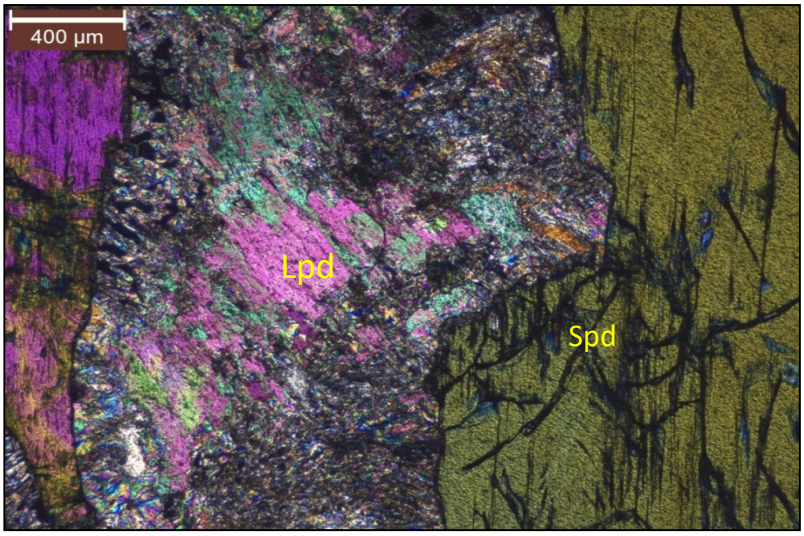


Fig.74: Lepidolite and spodumene (TL,XN).

Rock type: Pegmatite.

Locality: Mangalur, Yadgir district, Karnataka.

Geological Domain: Mangalur Schist Belt.

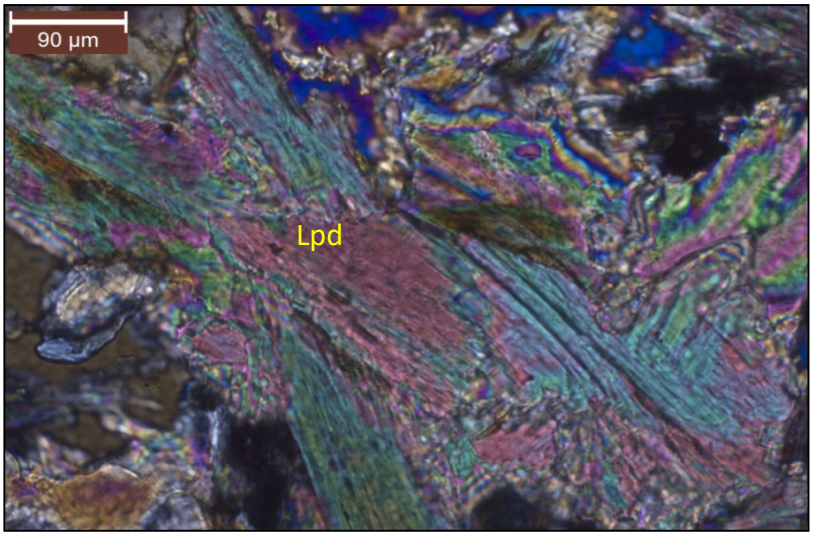


Fig.75: Lepidolite (TL,XN).

Rock type: Pegmatite.

Locality: Garhtara, Korba district, Chhattisgarh.

Geological Domain: Chhotanagpur Granite Gneiss Complex (CGGC).

Sr no.	Mineral name	Symbol	Crystal system	Chemical formula
1	Allanite	Aln	Monoclinic	$(Ca, Ce, La, Nd, Th)_2(Fe^{2+}, Fe^{3+}, Ti)(Al, Fe^{3+})_2Si_3O_{12}(OH)$
2	Anatase	Ant	Tetragonal	TiO_2
3	Bastnaesite	Bst	Hexagonal	$(Ce,Nd,Y,REE)CO_3F$
4	Beryl	Brl	Hexagonal	$Be_3Al_2(Si_6O_{18})$
5	Betafite	Bft	Isometric	$(Ca,U)_2(Ti,Nb,Ta)_2O_6(OH).$
6	Biotite	Bt	Monoclinic	$K(Fe^{2+},Mg)_2(Al,Fe^{3+},Mg,Ti)([Si,Al,Fe]_2Si_2O_{10})(OH)_2$
7	Brannerite	Brn	Monoclinic	$(U,Th,Ca)[(Ti,Fe)_2O_6]$
8	Chalcopyrite	Ccp	Tetragonal	$CuFeS_2$
9	Coffinite	Cof	Tetragonal	$U(SiO_4)_{1-x}(OH)_{4x}$
10	Columbite	Clb	Orthorhombic	$Fe^{2+}Nb_2O_6$
11	Covellite	Cv	Hexagonal	CuS
12	Davidite	Dv	Trigonal	$(Fe,U,Ce,La)_2(Ti,Fe,Cr,V)_5O_{12}$
13	Epidote	Ep	Monoclinic	$[Ca_2(Al_2Fe^{3+})](SiO_4)(Si_2O_7)O(OH)$
14	Galena	Gn	Isometric	PbS
15	Fluorite	Fl	Isometric	CaF_2
16	Hematite	Hem	Hexagonal	Fe_2O_3
17	Ilmenite	Ilm	Trigonal	$FeTiO_3$
18	Lepidolite	Lpd	Monoclinic	$\{K(Li,Al,Rb)_2(Al,Si)_4O_{10}(F,OH)_2\}$
19	Magnetite	Mag	Isometric	Fe_3O_4
20	Molybdenite	Mol	Hexagonal	MoS_2
21	Monazite	Mnz	Monoclinic	$(Ce,La,Nd,Th)PO_4$
22	Pitchblende	Pbl	Isometric	Varying mixtures of UO_2 & UO_3
23	Pyrite	Py	Isometric	FeS_2
24	Pyrochlore	Pcl	Isometric	$(Ca,Na,U,Ce\text{-}REE,Y\text{-}REE,Fe,Th,$ $Mn,Mg,Sr,K,Ba,Pb,$ $Bi,$ $Cs,Sb)_2$ $(Nb,Ta,Ti,Fe,Sb)_2$ $(O,OH,F)_7$
25	Rutile	Rt	Tetragonal	TiO_2
26	Sphene	Spn	Monoclinic	$CaTi(SiO_4)O$
27	Spodumene	Spd	Monoclinic	$LiAlSi_2O_6$
28	Tantalite	Tan	Orthorhombic	$(Mn,Fe)(Ta,Nb)_2O_6$
29	Thorianite	Tho	Isometric	$(Th,U,Ce)O_2$
30	Thorite	Thr	Teragonal	$Th(SiO_4)$
31	Uraninite	Urn	Isometric	UO_2
32	Xenotime	Xtm	Tetragonal	$Y(PO_4)$
33	Zircon	Zrn	Tetragonal	$Zr(SiO_4)$

This Atlas of Atomic Minerals from major geological domains of India comprises 75 photomicrographs of atomic minerals from important geological domains of the country.

On the occasion of Diamond Jubilee-75th Anniversary of the Foundation Day of Atomic Minerals Directorate for Exploration & Research (AMD), this Atlas is dedicated to all geoscientists of AMD who have carried out intensive exploration in major uranium, thorium, rare metals and rare earths provinces of India during the 75 years since inception of AMD.

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