

PETROGRAPHIC REPORT

CLIENT: Trevor Burr, AngloGoldAshanti
PROJECT/PROPERTY: CR STUDY
SAMPLE NUMBER: 863677

BY: James R. Shannon, Ph.D.
SAMPLE TYPE: Polished Thin Section
DATE: 19-July 2017

HAND SAMPLE DESCRIPTION: A small piece of core and thinsection billet show a medium gray, very fine to fine grained, biotite-rich, mylonitic schist. Biotite forms irregular incipient gneissic bands with abundant small eyes of carbonate. The sample is nonmagnetic with a pencil magnet. Relatively weak reaction with dilute HCl indicates the carbonate has dolomitic composition.

POLISHED-SECTION DESCRIPTION:

MINERAL	EST %	COMMENTS
RELICT	[5.1]	Rock lenses between biotite shear bands have relict plagioclase associated with recrystallized quartz and possible remnant grains of biotite
Plagioclase	5	Anhedral grains up to 0.9 mm; Remnant albite twinning; No evidence of zoning; Suggestion of intergrowth with other anhedral plagioclase grains; Some suggestions of semi-radiating textures
Apatite	0.1	Accessory, subhedral crystals up to 0.25 mm
METAMORPHIC	[94]	
Carbonate	48	Generally anhedral grains up to 1 mm and mosaic lenses up to 8 mm; Some rhombic shapes of euhedral dolomite are suggested; Dilute HCl indicates dolomitic composition
Biotite	30	Moderately-strong foliated biotite up to 0.5 mm; Some larger grains up to 1 mm may be remnants of earlier biotite
Muscovite	0.5	White mica interleaved-intergrown with biotite; Mostly occurs with foliated biotite in rock lenses
Quartz	10	Anhedral grains recrystallized into subgrain mosaics
Rutile	0.2	Tiny subhedral inclusions in biotite and chlorite
ALTERATION	(5)	Weak alteration or retrograde alteration of biotite
Chlorite	5	Greenish chlorite as elongated patches; Locally replaces biotite
SULFIDE	[0.1]	Minor disseminated sulfide grains as inclusions in biotite, carbonate and plagioclase
Pyrite	0.1	
Chalcopyrite	Tr	
Pyrrhotite?	Tr	

TEXTURES

The sample displays a well developed moderate-strong foliation with incipient gneissic banding and suggestions of C-S mylonitic fabrics. Biotite is concentrated and strongly foliated on braided shears (C surfaces) and also occurs in rock lenses as moderately-foliated (S surfaces) intergrowths with quartz and carbonate. Ductile C-S mylonitic shears usually have consistent

relations between the C and S surfaces that can be used to determine the sense of shear. This sample has unusual C-S fabrics that suggest a conflicting sense of shear.

The sample has unusual mineralogy with abundant biotite (about 30 percent) and dolomitic carbonate (about 48 percent). About 5 percent anhedral plagioclase grains appear to be relict grains from the protolith. They have remnant albite twinning, but no indication of zoning. They are intergrown with quartz, biotite and carbonate in the rock lenses. The quartz occurs as very fine grained patches of anhedral mosaic and may be recrystallized from larger grains that were intergrown with plagioclase. There are some larger biotite grains in the rock lenses that may be relict from the protolith. There is minor muscovite that is intergrown-interleaved with biotite. Most of the muscovite is intergrown with the foliated biotite in the rock lenses. The remnant textures in the rock lenses suggest some of the protolith consisted of a fine-medium grained intergrowth of plagioclase-quartz-biotite. It is unclear what the high dolomite content means and how it relates to the silicates.

The mylonitic textures suggest that deformation was mostly partitioned into biotite which was easily recrystallized into strongly foliated shear bands. The quartz was also plastically recrystallized. The dolomite appears to resist recrystallization, but shows strong deformation glide twinning.

METAMORPHISM

The sample has an unusual metamorphic assemblage consisting of dolomitic carbonate-biotite-quartz-muscovite-chlorite. The biotite-quartz-muscovite assemblage suggests a medium-high grade of metamorphism, probably equivalent to upper amphibolite facies. The chlorite patches suggest a weak lower grade overprint equivalent to greenschist facies.

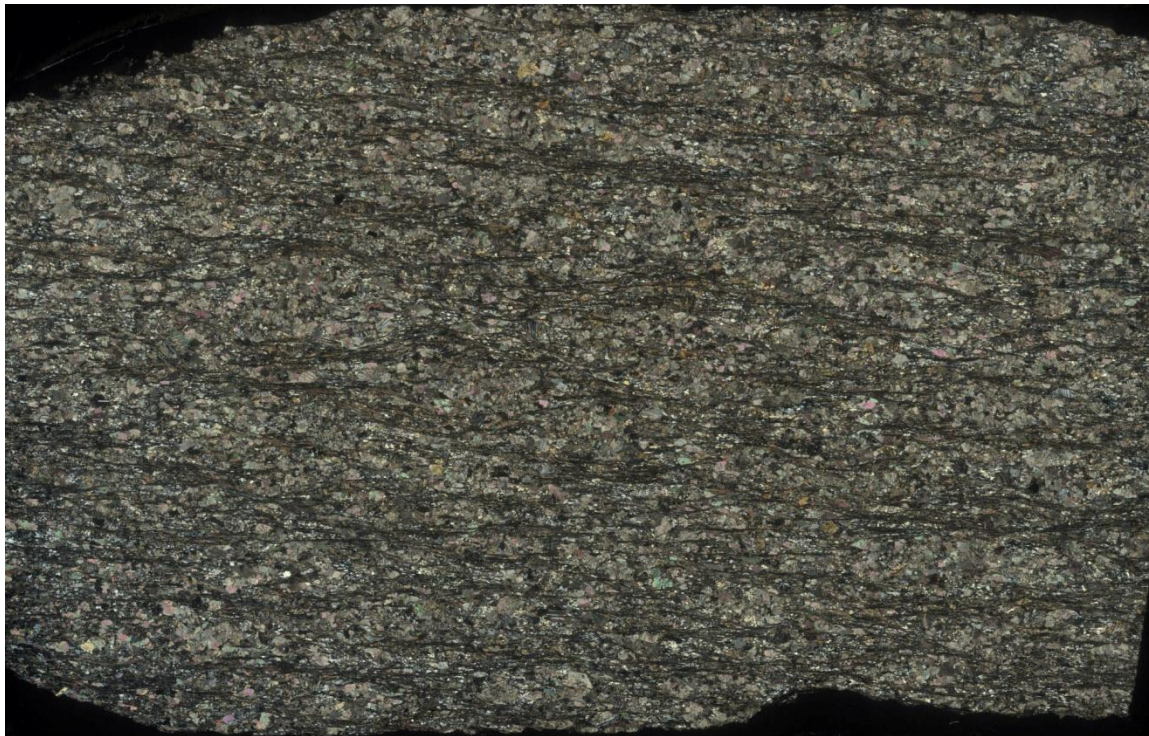
ALTERATION/MINERALIZATION

The rock is weakly altered with about 5 percent chlorite that locally replaces biotite. The chlorite occurs as elongated patches (up to 7 mm long) that are flattened parallel to the main foliation. The regular spacing of these chlorite patches suggests that they may have replaced a specific phase in the protolith, possibly a porphyroblast or phenocryst phase.

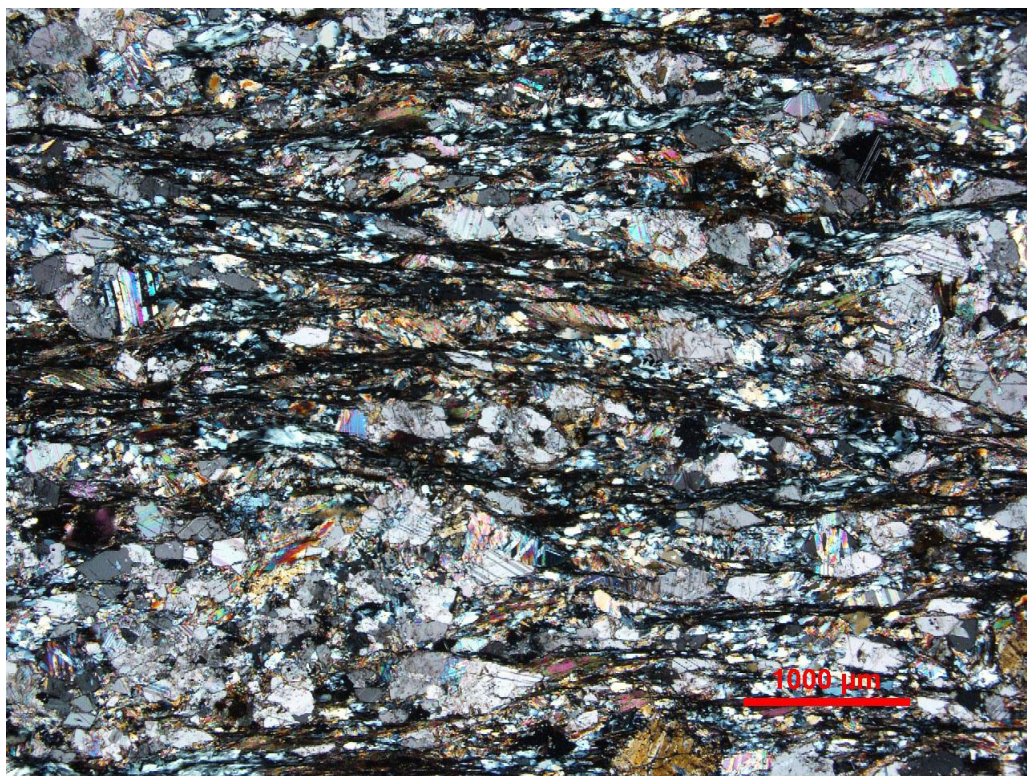
ROCK NAME: Gneissic, Mylonitic Biotite Schist

PROTOLITH

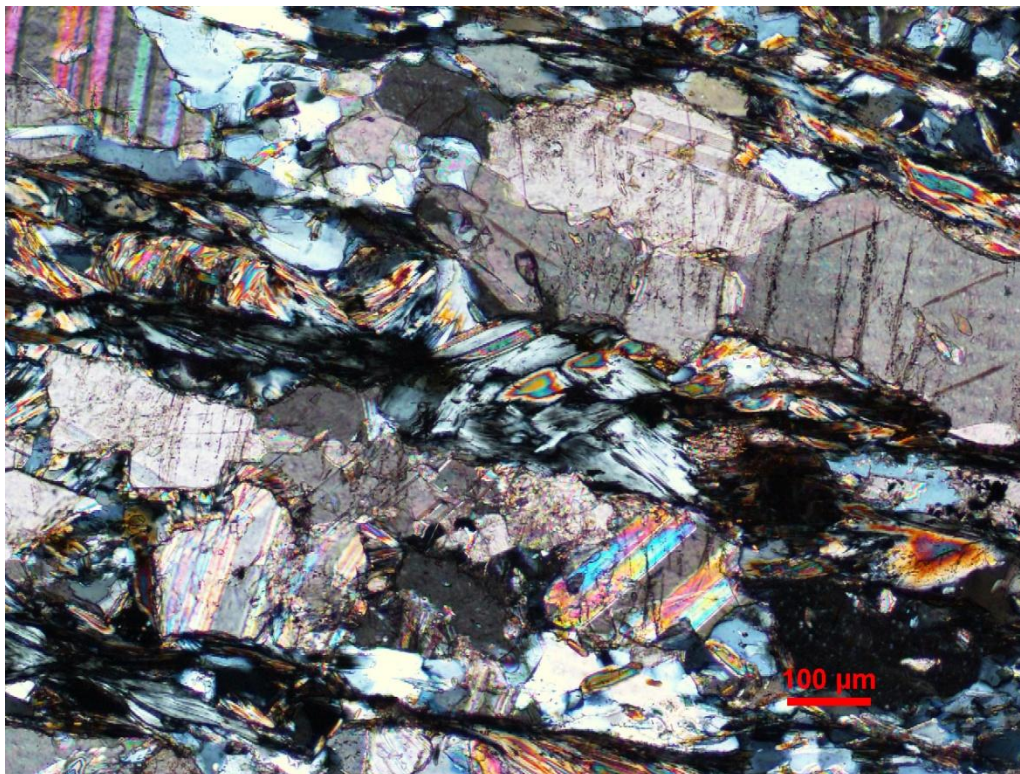
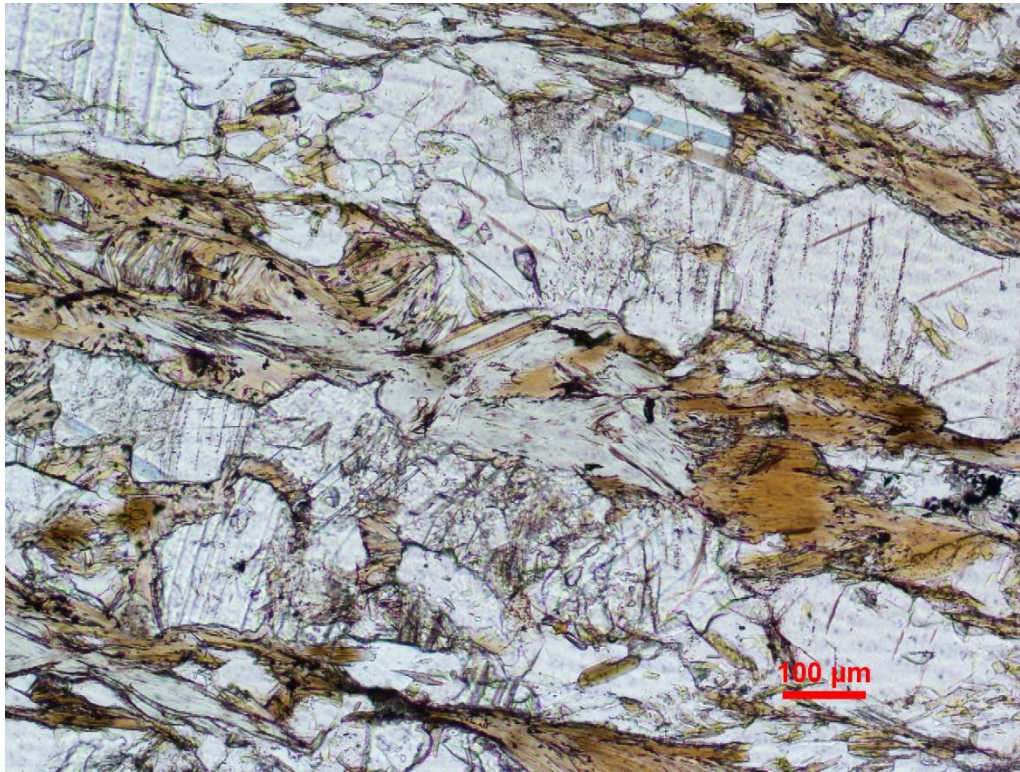
The nature of the protolith is uncertain. The remnant rock lenses suggest portions of the protolith consisted of a plagioclase-quartz-biotite silicate intergrowth. Other rock lenses consist predominantly of dolomite. Therefore, the protolith (possibly metamorphic) had significant components of silicates and dolomitic carbonate. The dolomite suggests a Mg-rich composition. The sample may represent an igneous or metamorphic protolith that had carbonate alteration.



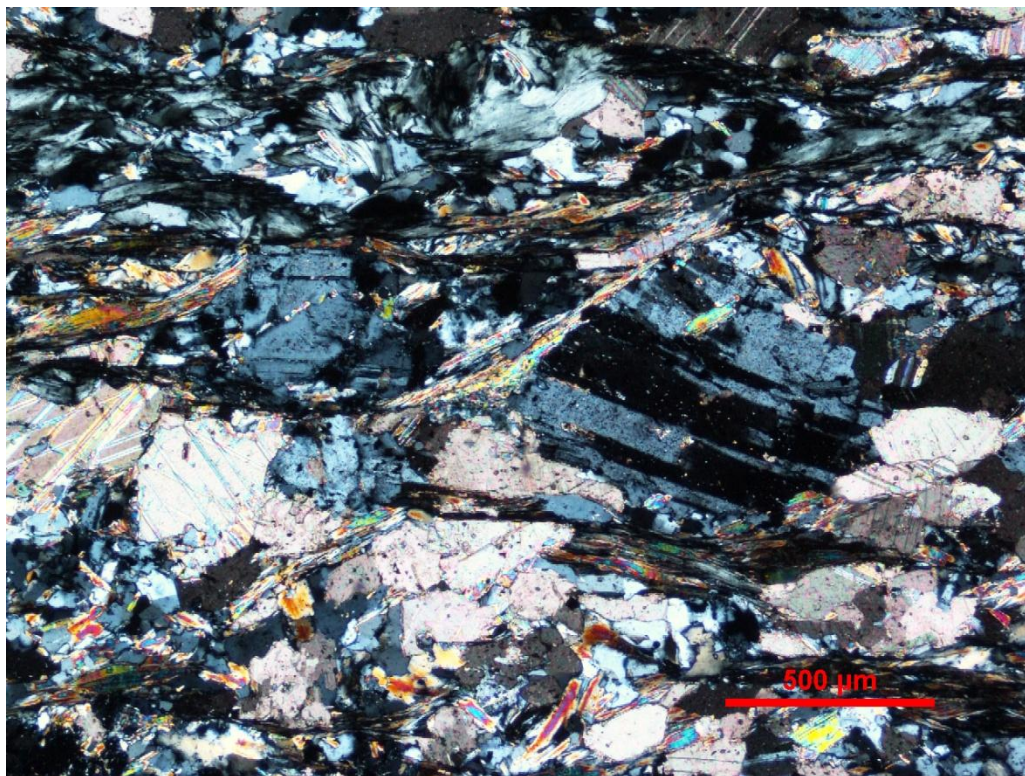
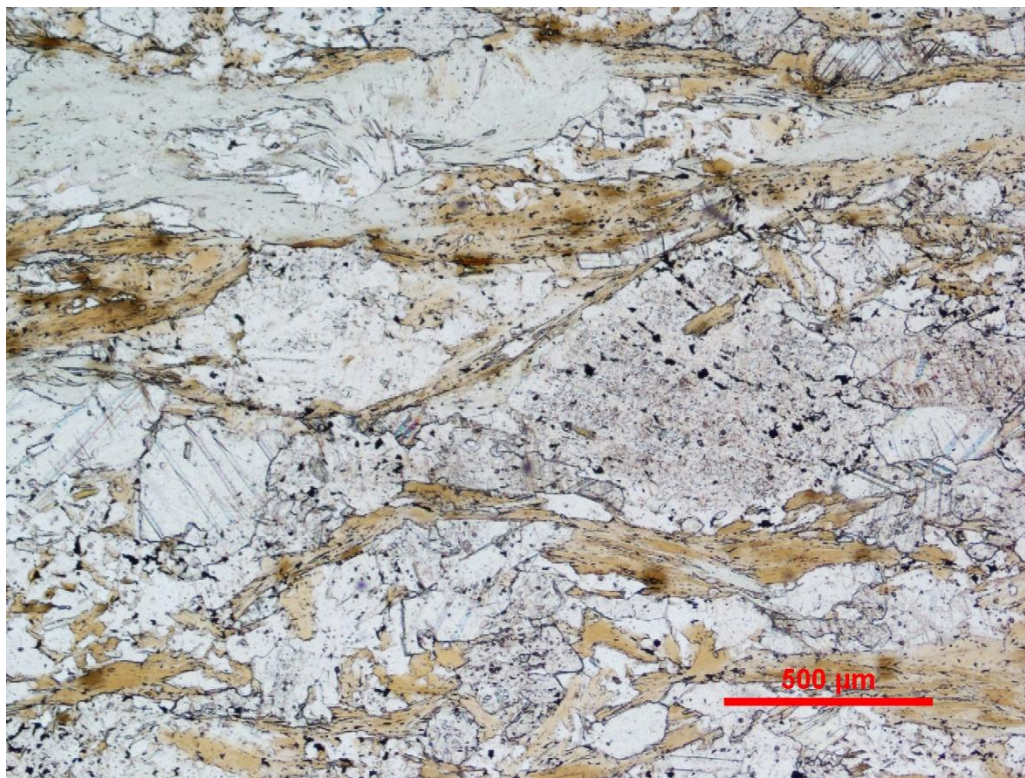
Sample 863677. Wide-field, fill-thinsection view showing very fine to fine grained moderately foliated rock with suggestions of C-S mylonitic fabrics. Top- plane light; Bottom- crossed polarizers.



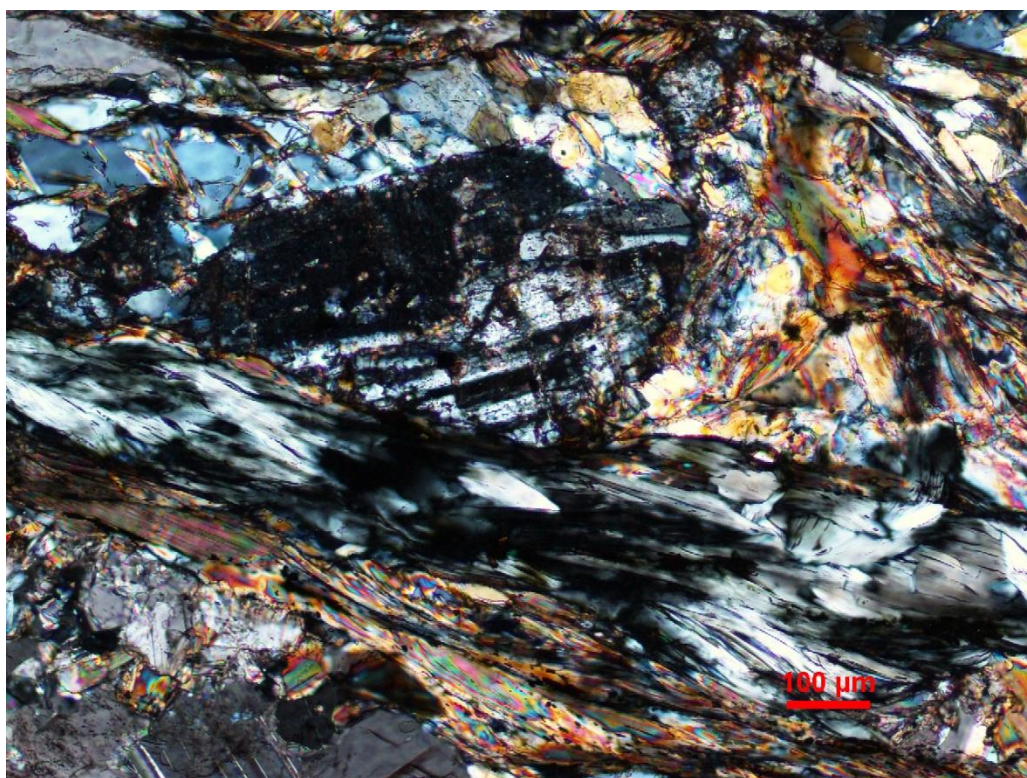
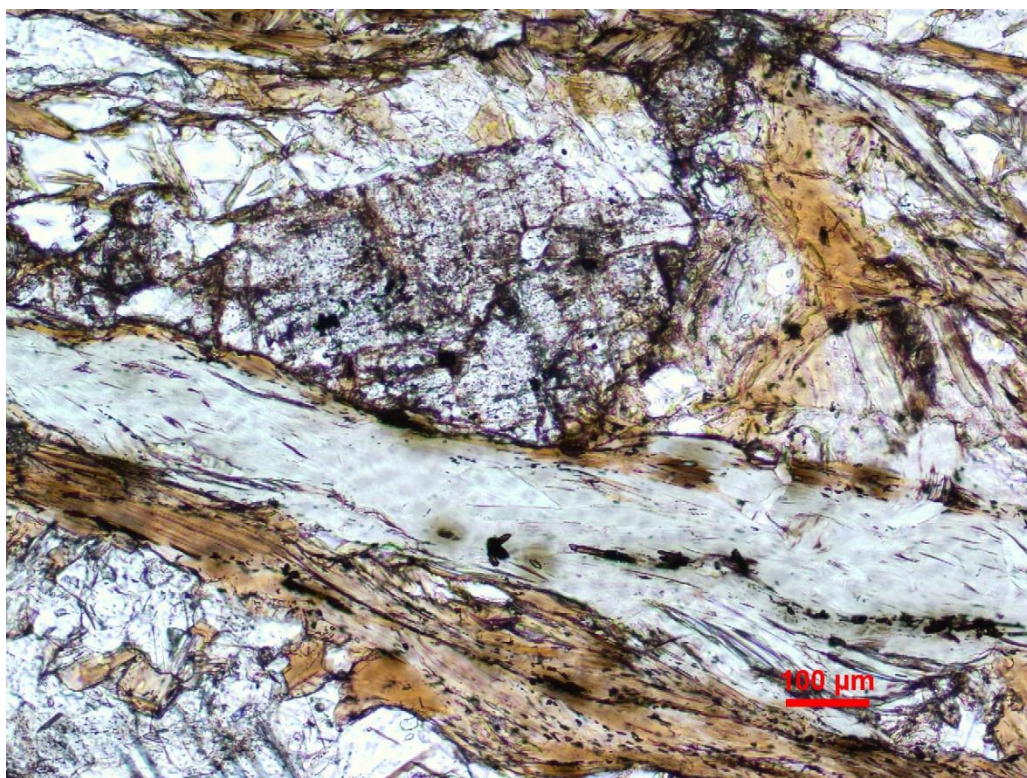
Sample 863677. Unusual mylonitized rock consisting of foliated biotite with abundant carbonate grains and lenses. Note local suggestion of C-S mylonitic fabrics and remnants of rock lenses. Top-plane light; Bottom- crossed polarizers.



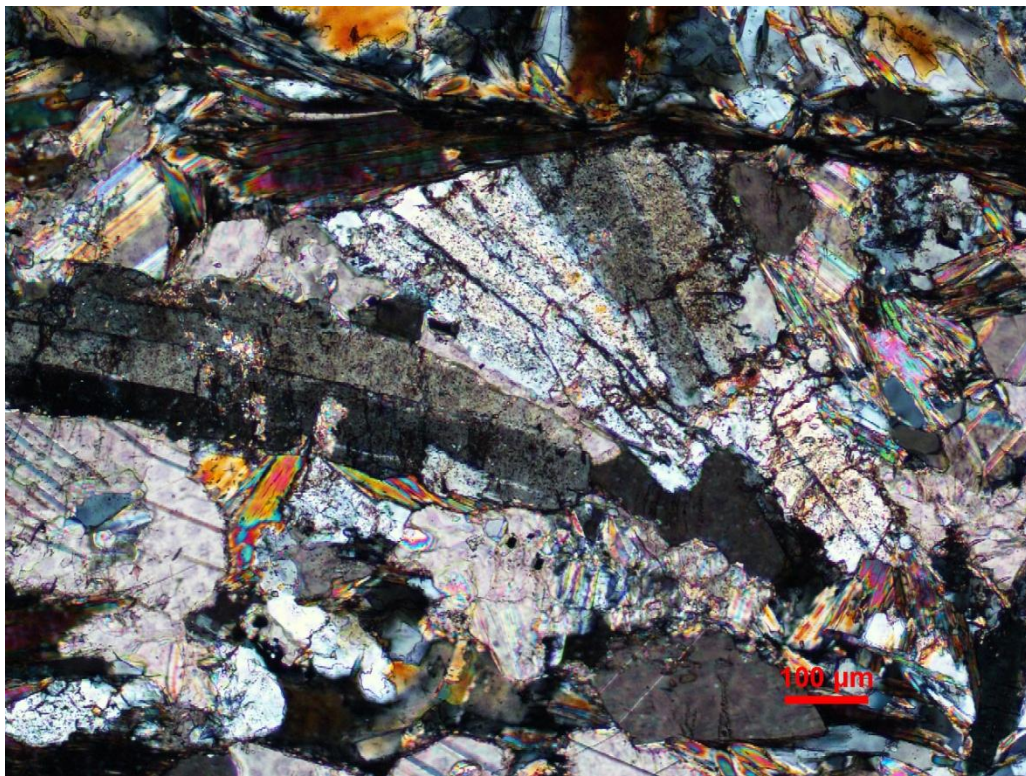
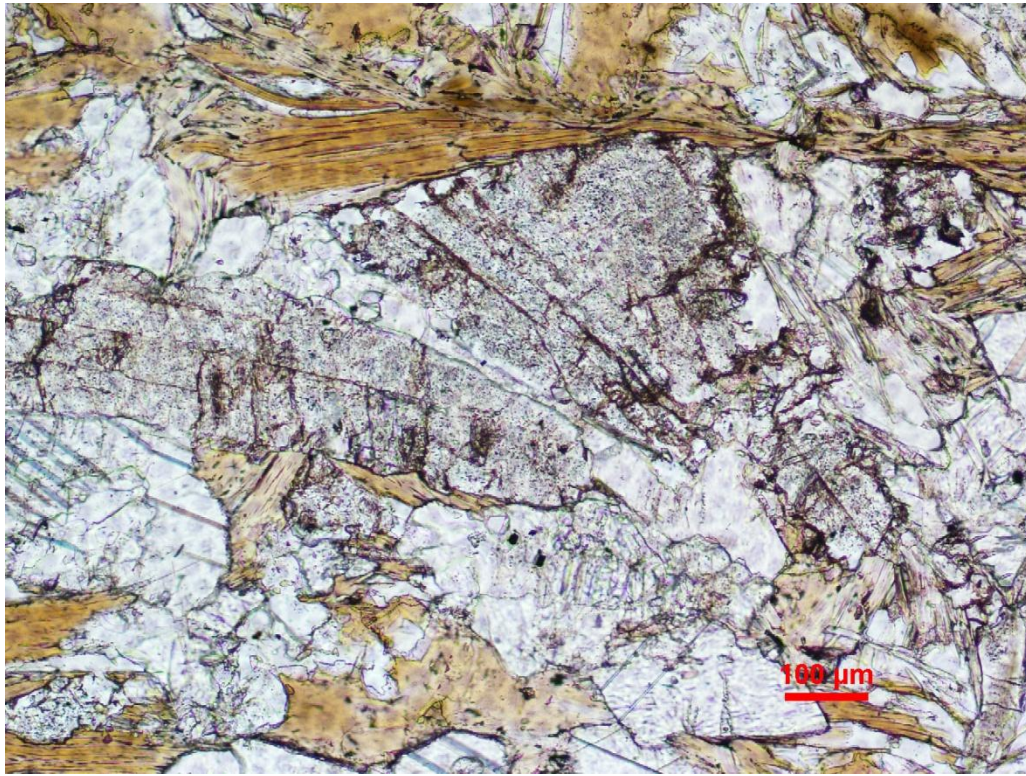
Sample 863677. Orthomylonite showing conflicting C-S mylonitic fabrics that suggest alternating shear sense. Top- plane light; Bottom- crossed polarizers.



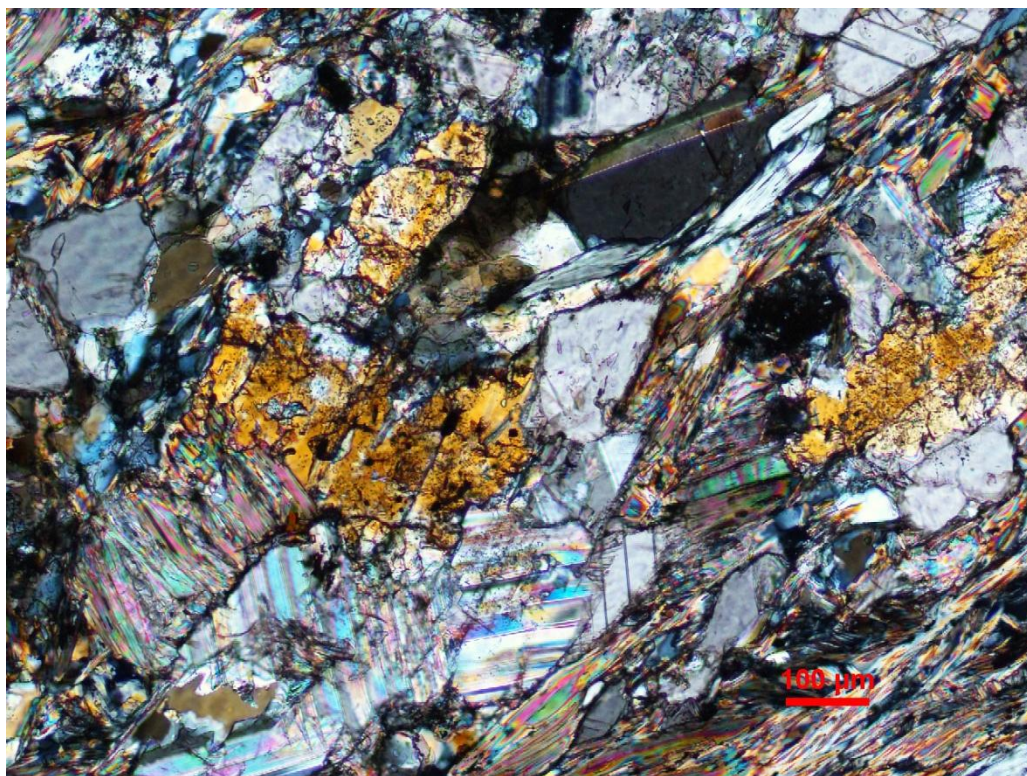
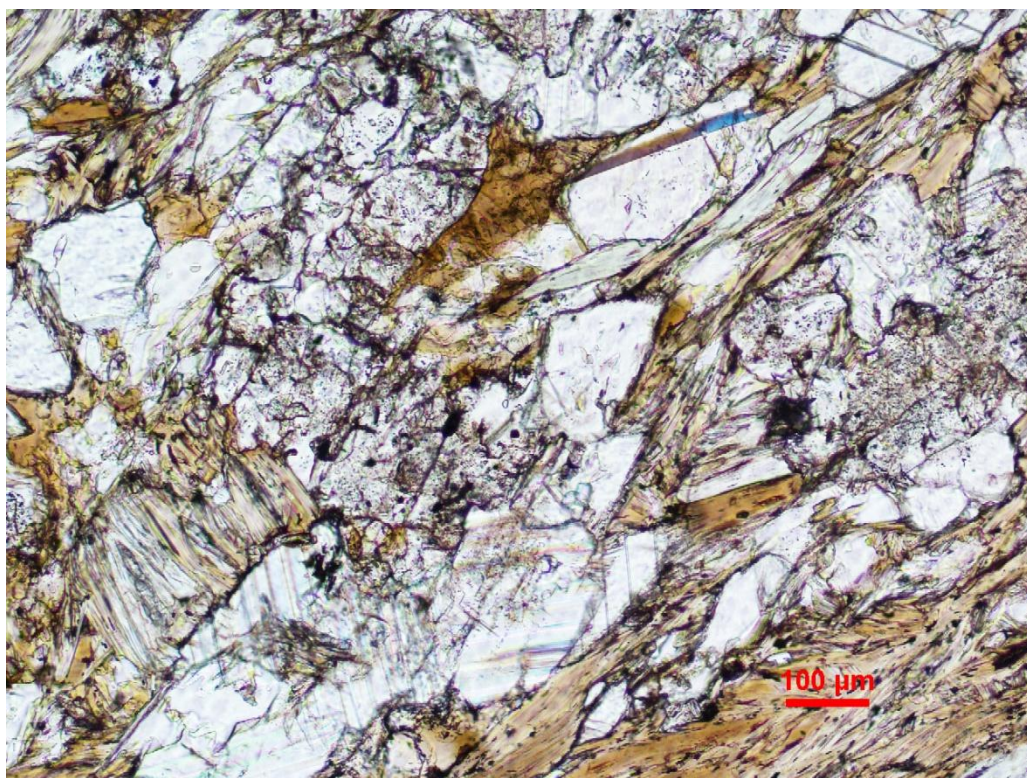
Sample 863677. Relict plagioclase grains with albite twinning in matrix of carbonate and foliated biotite. Top- plane light; Bottom- crossed polarizers.



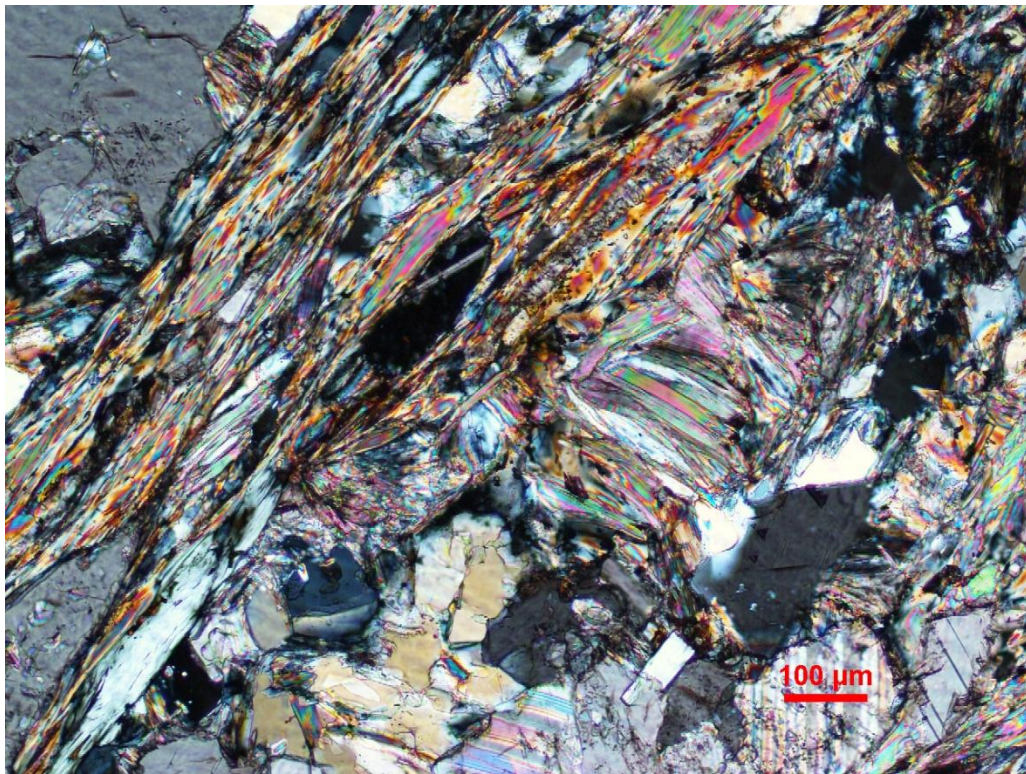
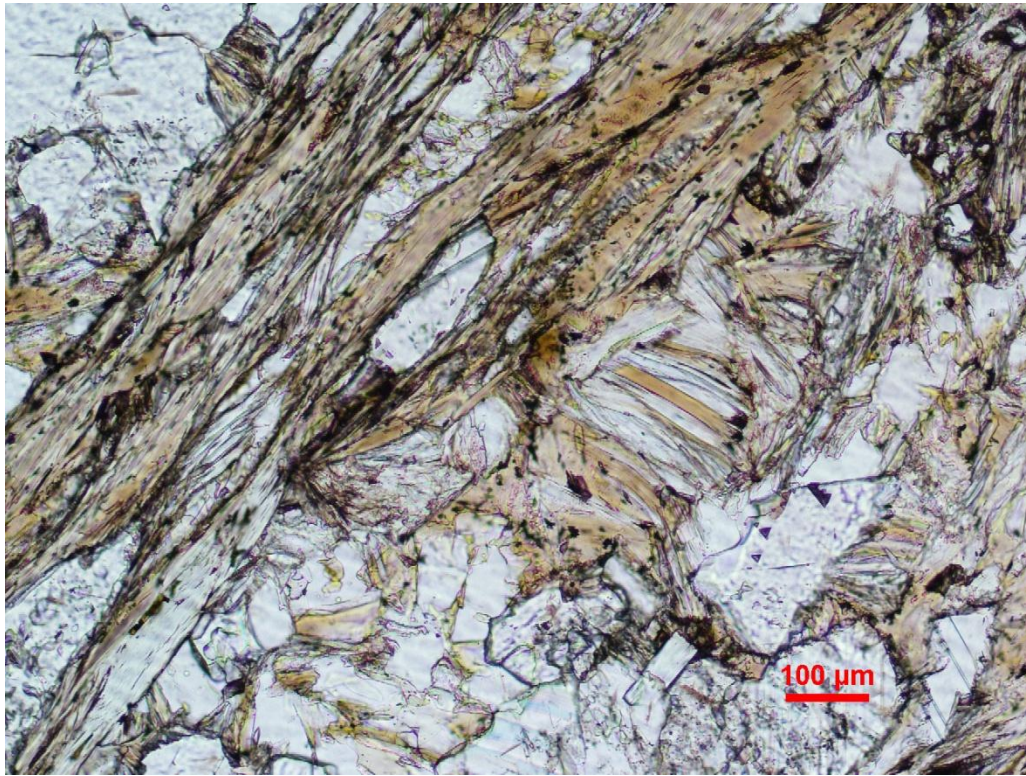
Sample 863677. Relict plagioclase with albite twinning next to recrystallized quartz. Top- plane light; Bottom- crossed polarizers.



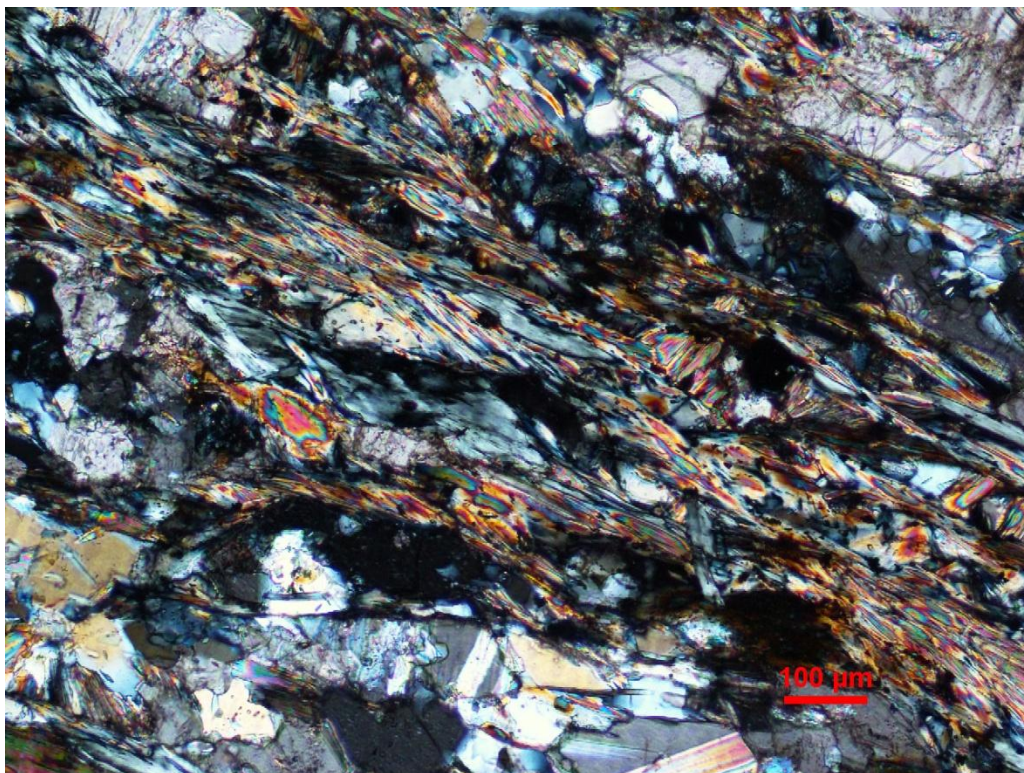
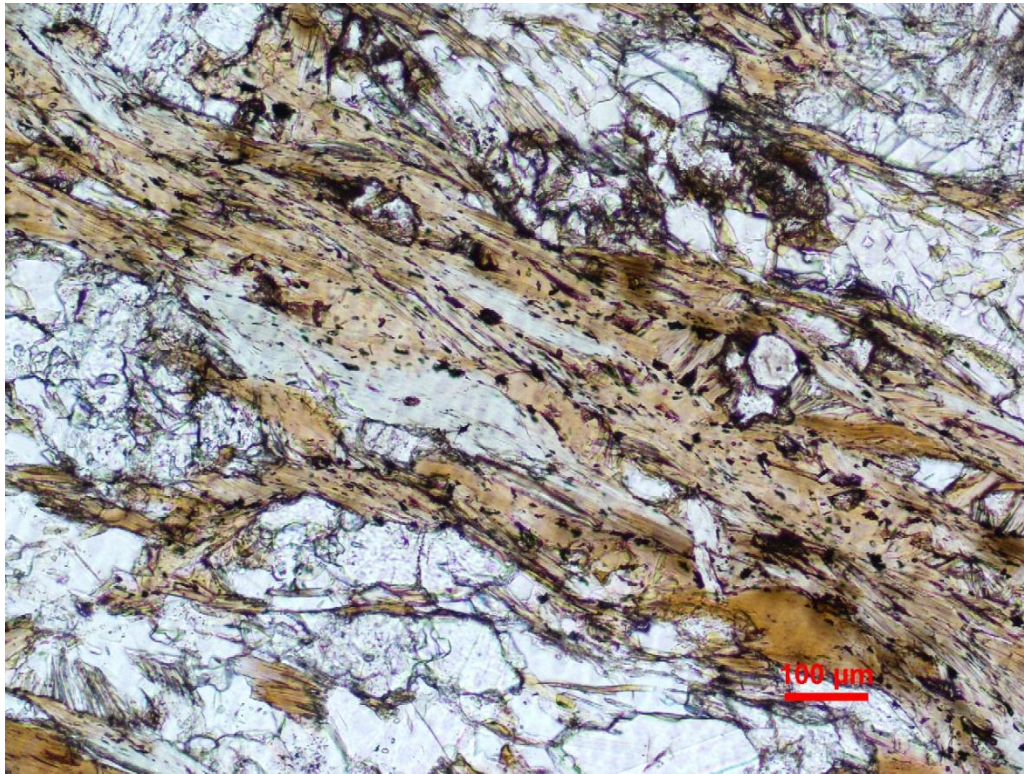
Sample 863677. Relict, elongated plagioclase grains with a semi-radiating habit. Top-plane light; Bottom- crossed polarizers.

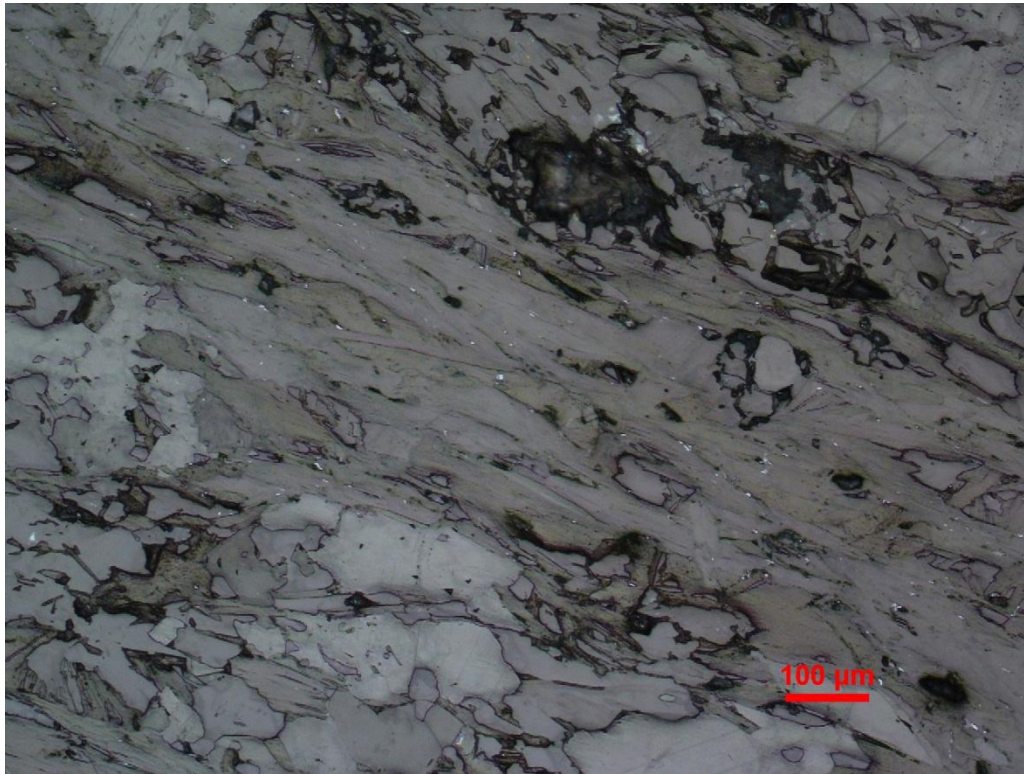


Sample 863677. Muscovite interleaved with biotite. Top- plane light; Bottom- crossed polarizers.

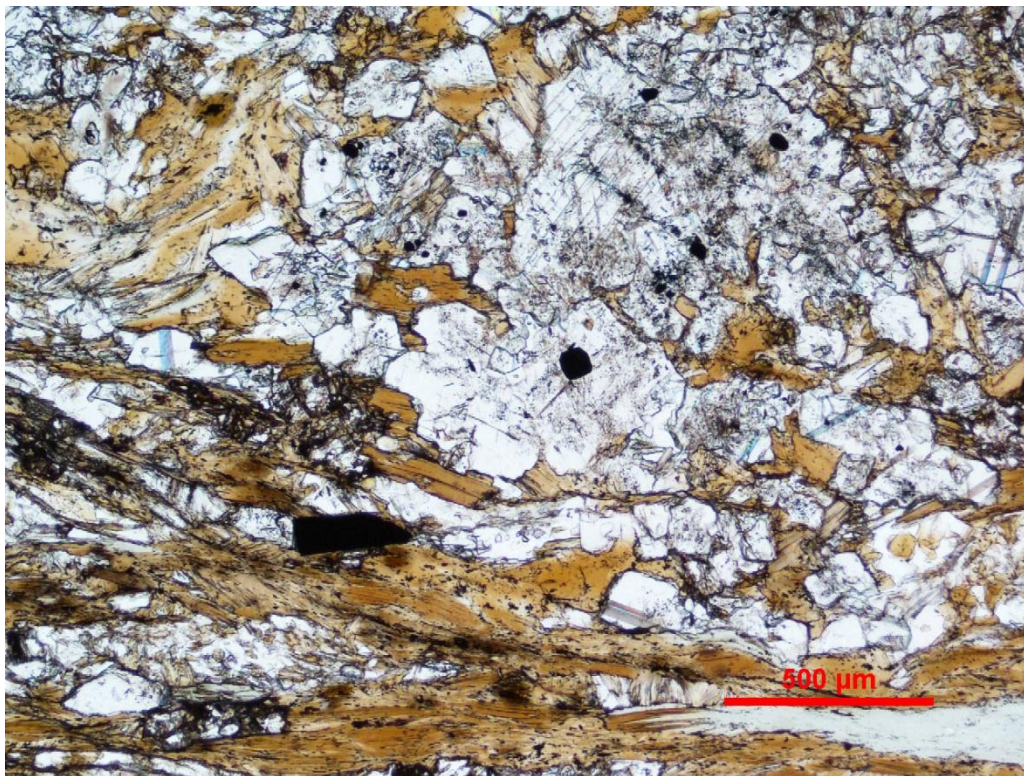


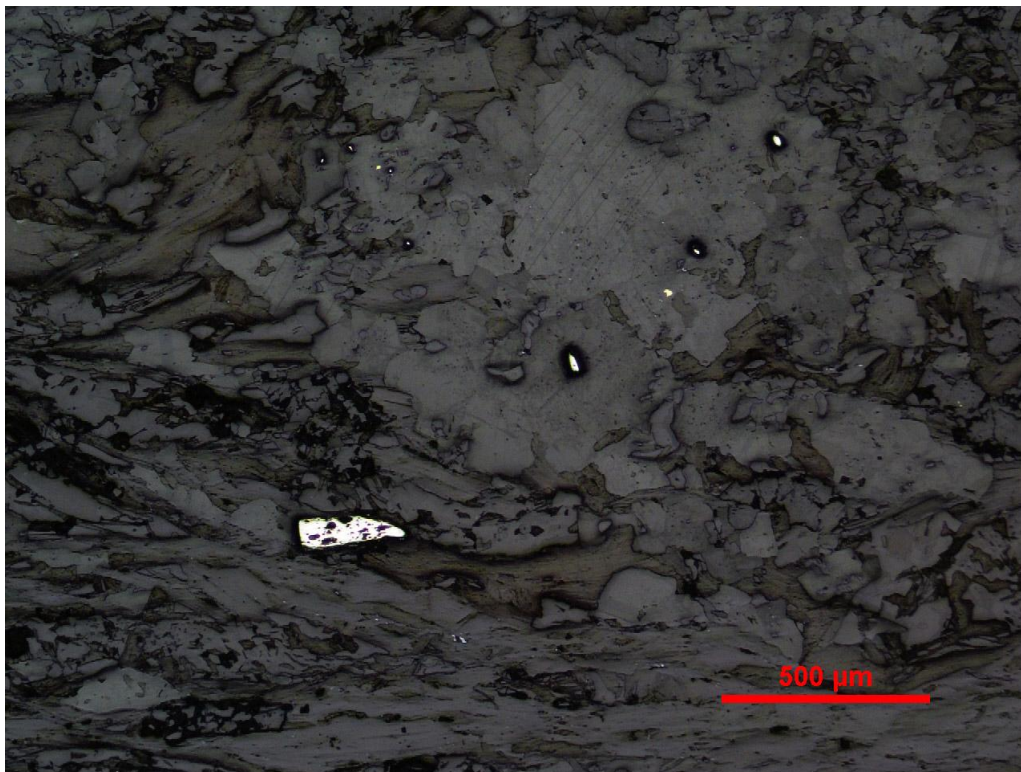
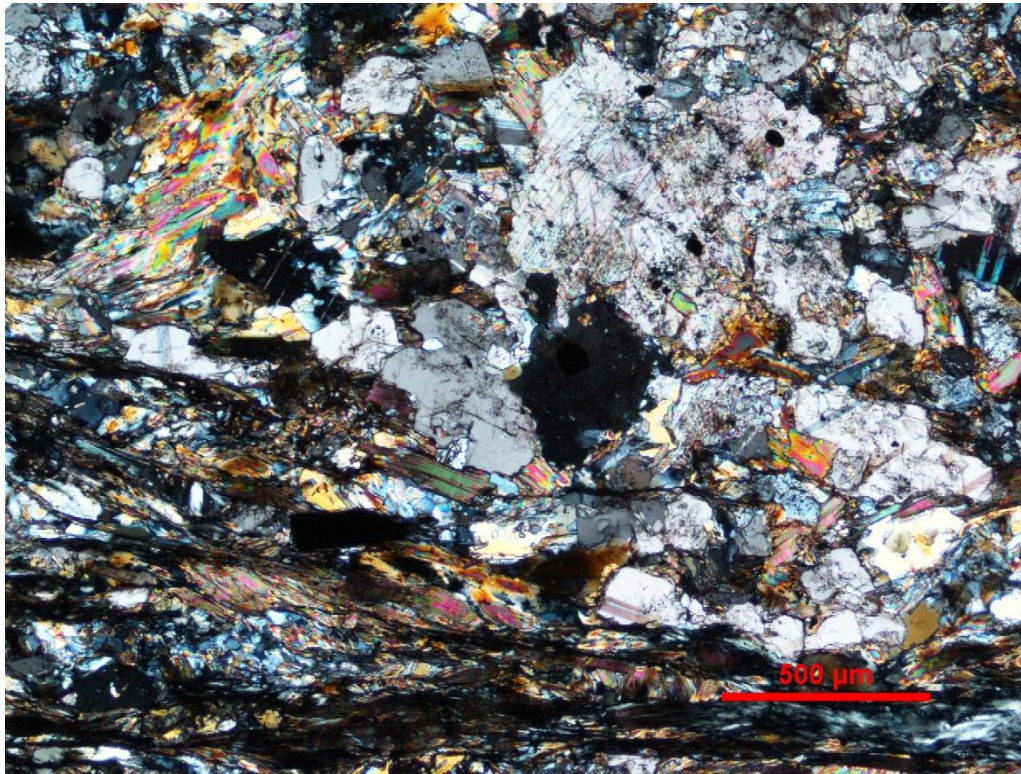
Sample 863677. White muscovite interlayered with brown biotite. Note some biotite-muscovite is oriented normal to main foliation, and chlorite replaces biotite (lower left). Top- plane light; Bottom- crossed polarizers.



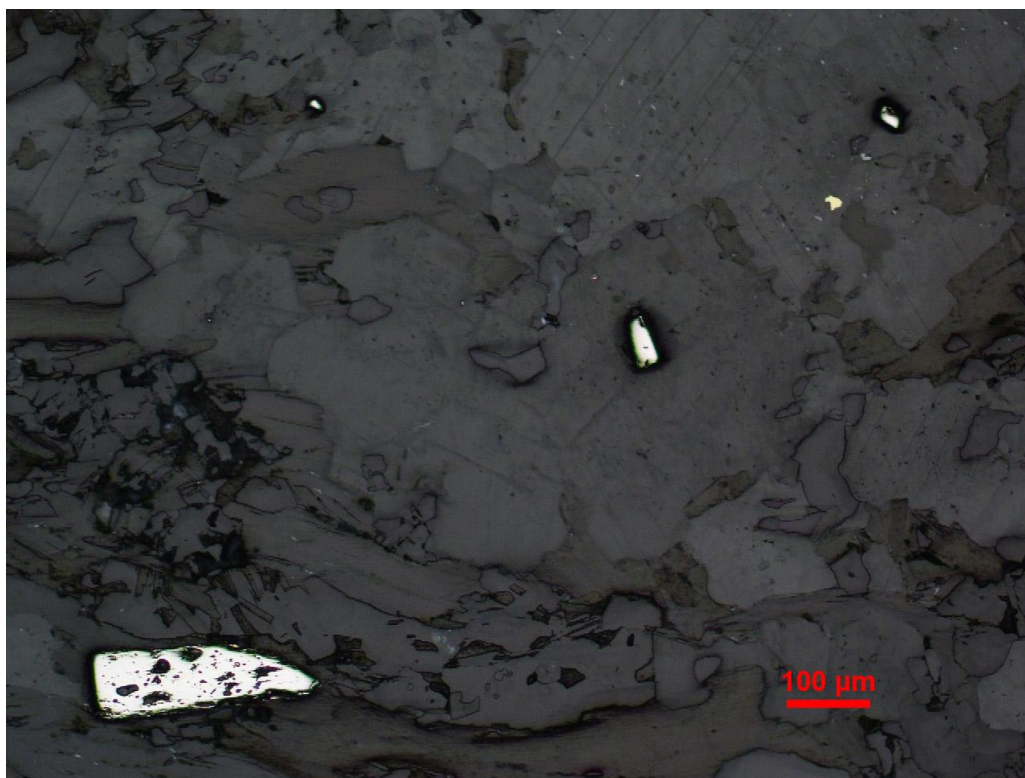


Sample 863677. Chlorite with rutile inclusions locally replacing biotite. Top- plane light; Middle- crossed polarizers; Bottom- reflected light.

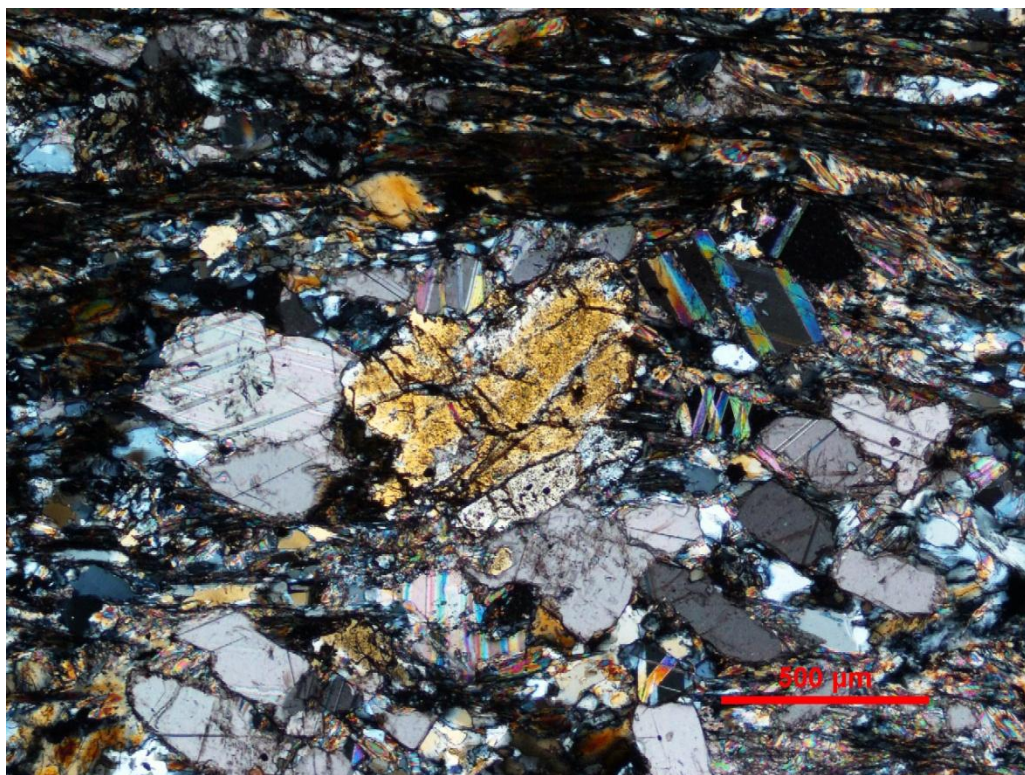


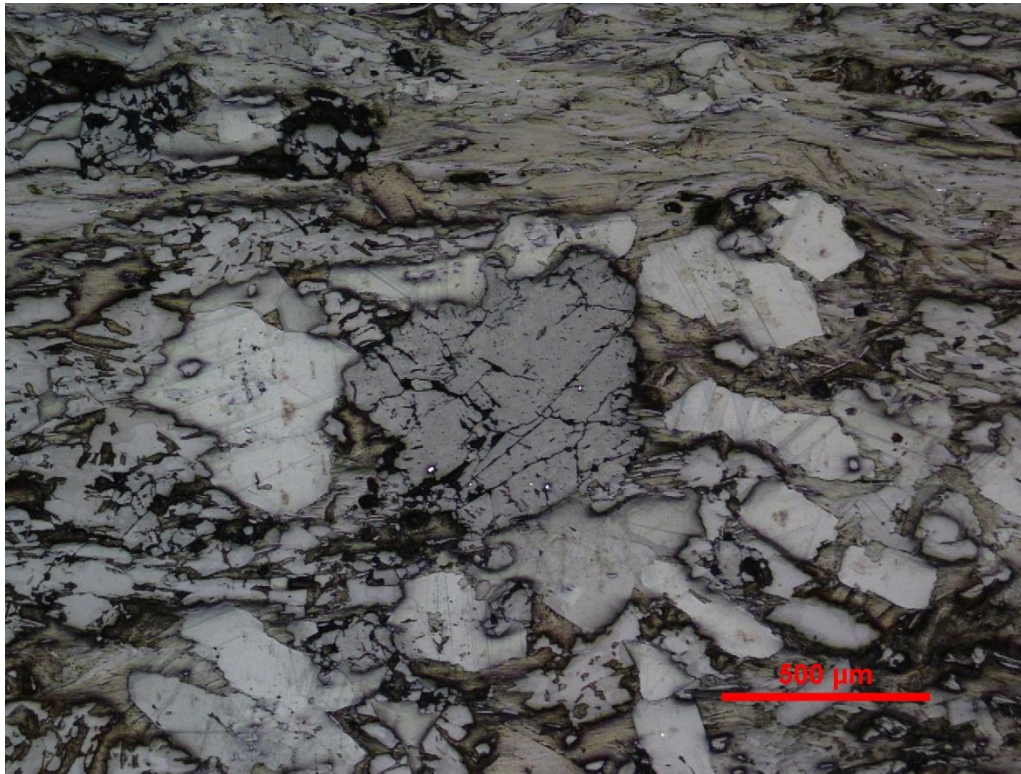


Sample 863677. Disseminated pyrite and chalcopyrite associated with biotite, plagioclase and carbonate. Top- plane light; Middle- crossed polarizers; Bottom- reflected light.

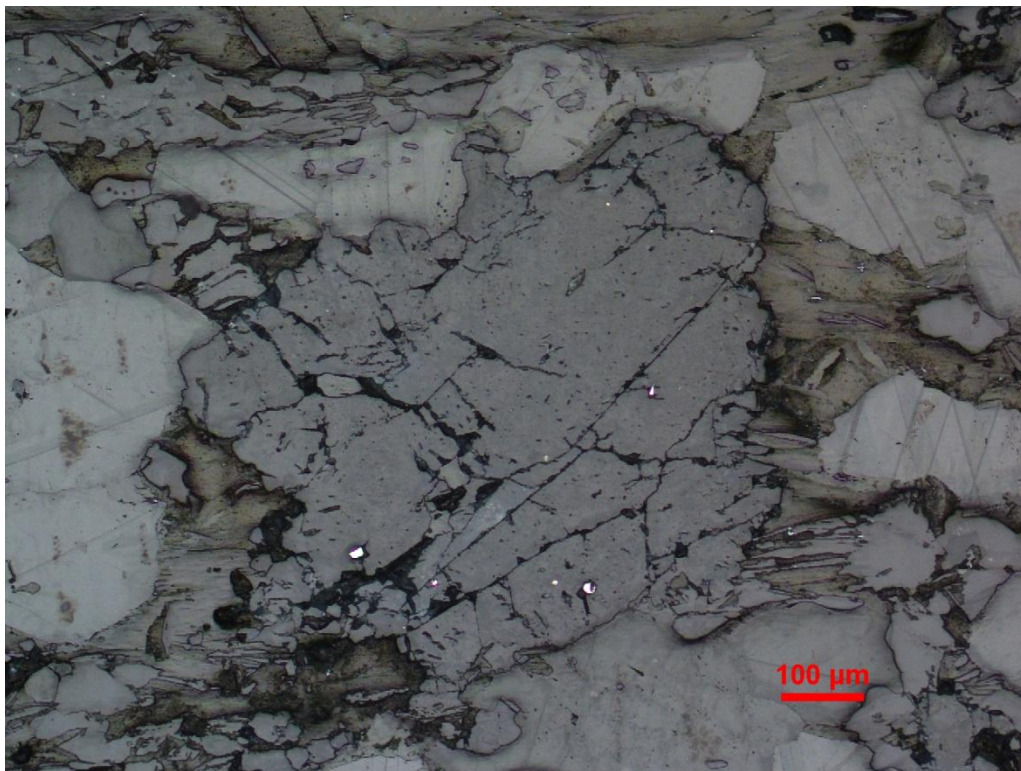


Sample 863677. Close up from above showing subhedral disseminated pyrite and chalcopyrite. Reflected light.

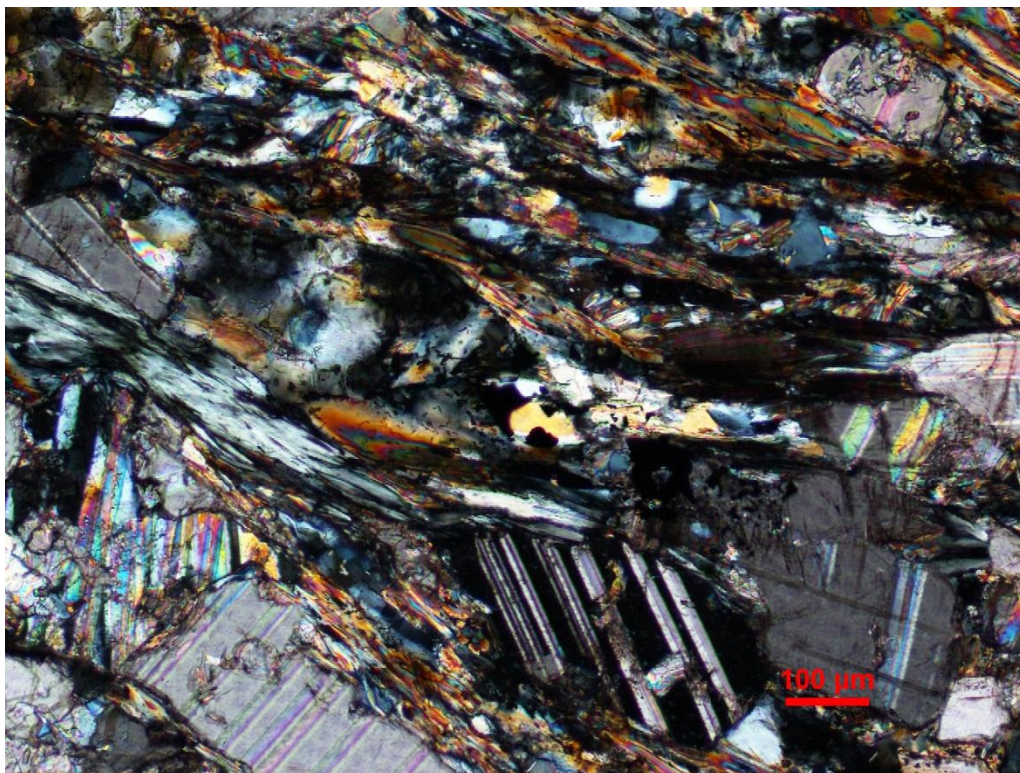
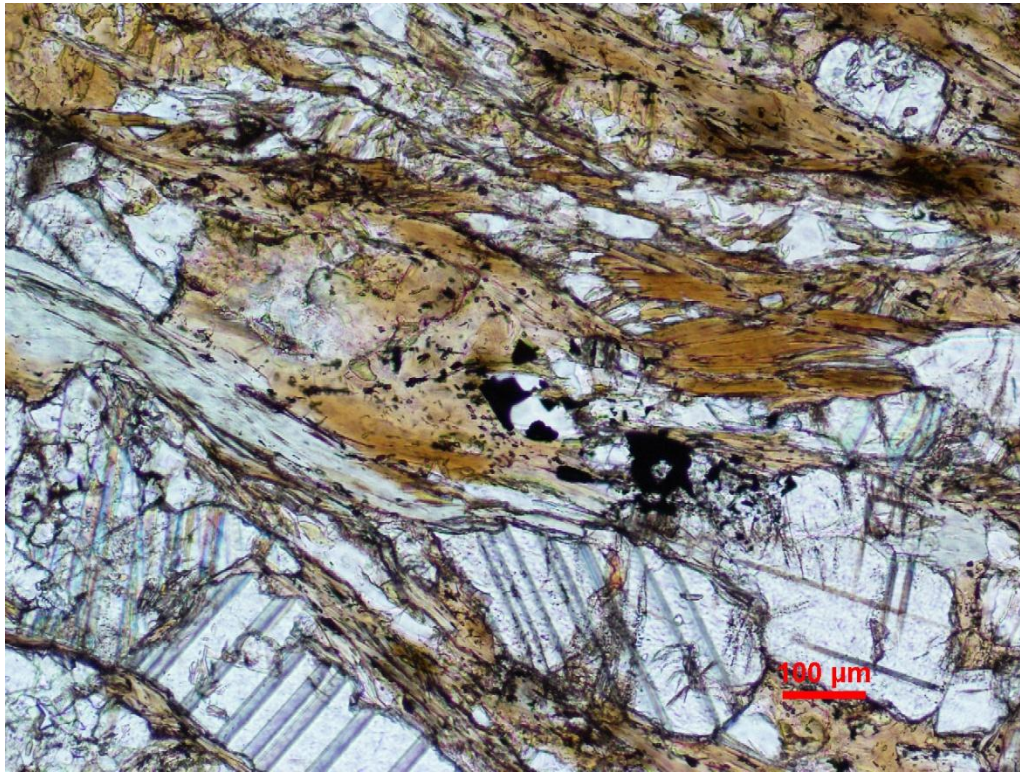


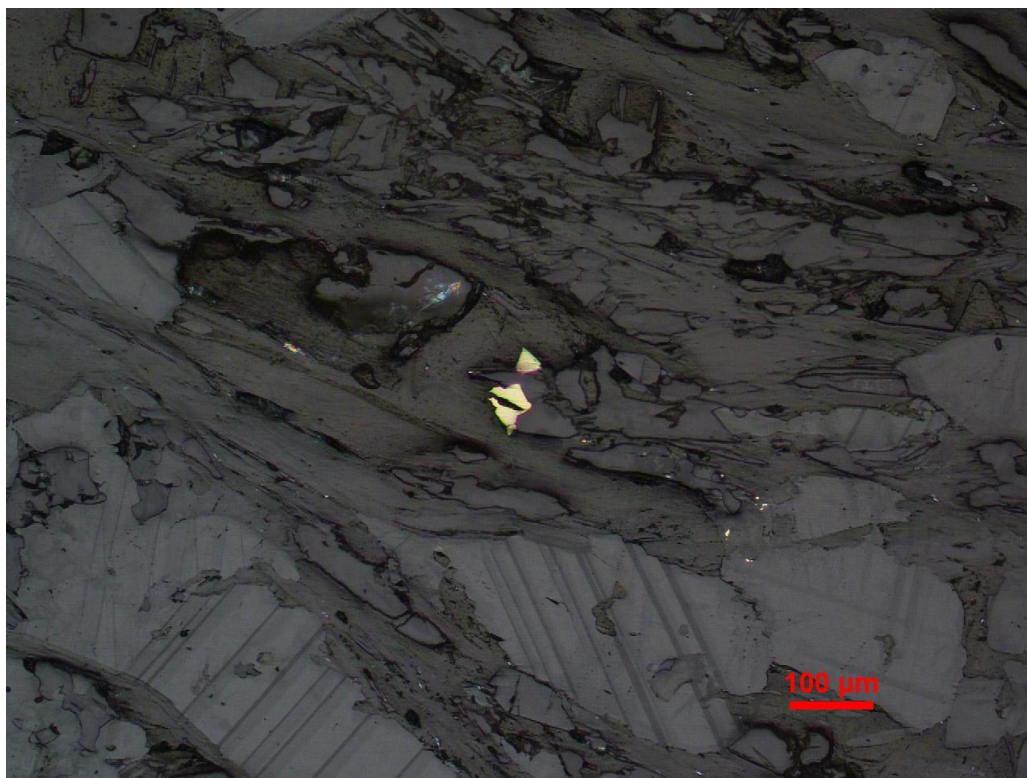


Sample 863677. Fine disseminated pyrite inclusions in relict plagioclase. Top- crossed polarizers; Bottom- reflected light.

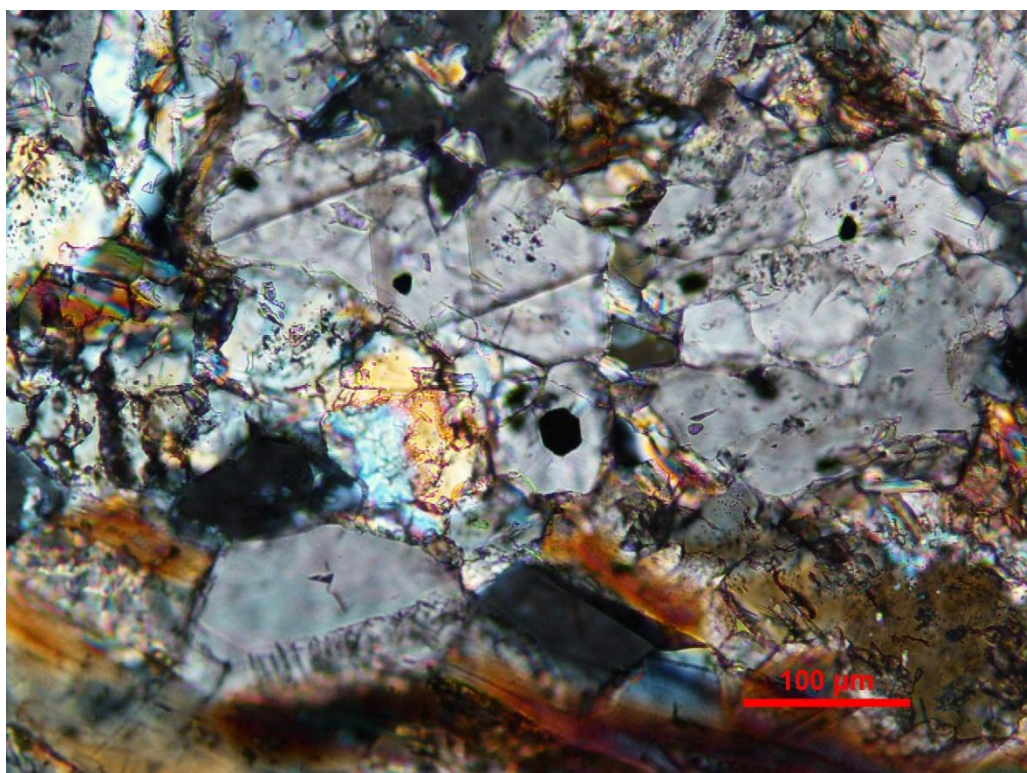


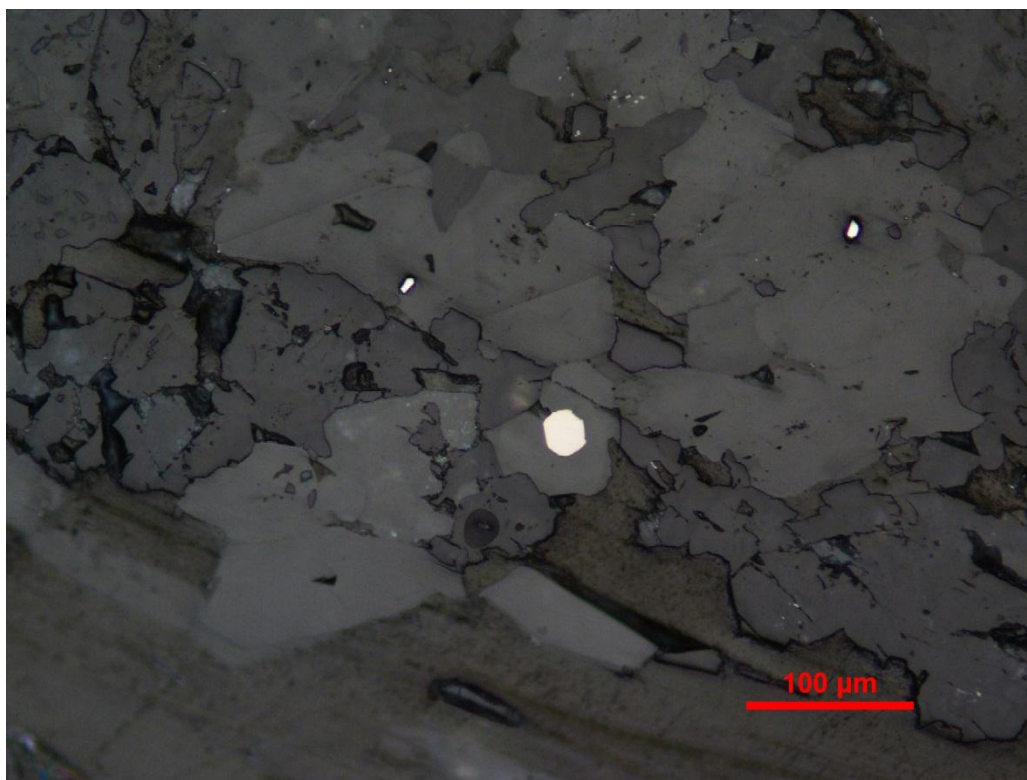
Sample 863677. Close up from above showing fine disseminated pyrite inclusions in relict plagioclase. Reflected light.





Sample 863677. Disseminated chalcopyrite associated with biotite and quartz. Note abundant deformation glide twinning in dolomite. Top- plane light; Middle- crossed polarizers; Bottom- reflected light.





Sample 863677. Disseminated pyrite and subhedral pyrrhotite(?) associated with carbonate.