

# PETROGRAPHIC REPORT

## 10 Rocks from the Allamber Prospect, Pine Rv. Orogen, Northern Territory



for

Thundelarra Ltd

(attn. Costica Vieru)

17/5/2015

Dr Anthony J Crawford  
A & A Crawford Geological Research Consultants

493 Tinderbox Rd, Hobart,  
TAS, Australia 7054  
Phone: 61-3-62293831  
E-mail: [PetrographEx@tasmanet.com.au](mailto:PetrographEx@tasmanet.com.au)  
Mobile 0487186659

# Petrographic Summary Report

## Introduction

This report includes petrographic descriptions of 10 rocks from the Allamber tenements held by Thundelarra Ltd in the Pine Creek Orogen, Northern Territory. Six samples with obvious sulfides were prepared as polished thin sections, with the remaining four, sulfide-free samples prepared as unpolished thin sections. Thin sections of all samples were scanned, to provide some visual context beyond the 2-4 photomicrographs provided for each thin section. No background geological information or maps were provided for this exercise, so the thin section descriptions are essentially 'stand alone'.

## Petrographic Summary

Table 1 provides summary petrographic descriptions of all samples examined. These are discussed below.

### *Altered granites*

All ten samples are of granitic rocks, most of which display strong fracturing, cataclasis and occasional minor brecciation (ie., with disruption of the rock fabric). The majority of samples showed the granite to be a distinctive microcline-phyric, biotite-bearing variety with blocky microcline phenocrysts to almost 1cm across in a finer-grained quartz-microcline-sodic plagioclase-biotite groundmass with common accessory zircons and minor apatite. Granophyric textures are well developed in sample 175, which also appears to lack the microcline phenocrysts that characterize the other granites in this set. This may be from a late dyke, or from the late crystallizing cupola domain of the granite intrusion drilled in this program. Alteration away from localized domains affected by hydrothermal alteration and greisenization include chloritization of biotite, and development of fine sericite through plagioclase, with microcline remaining fresh.

Almost all chips showed a strong fracture/cataclastic fabric, with irregular networks of fractures marked by sets of brittle fractures through feldspars, but more ductile behaviour of quartz, which is generally present as strongly strained, often elongate crystals, often strung out into streams with abundant sub-grain-recrystallization. Despite the strong fracture network, brecciation involving rotation of fragments is uncommon, but beads of recrystallized quartz are commonly developed along fractures in both feldspars and quartz.

## Petrographic Summary Report

### *Hydrothermal Alteration*

Many chips showed patchy development of hydrothermal alteration associated with the strong fracturing and cataclasis, and a number of chips in several slides consisted solely, or almost entirely of sulfides. The key alteration assemblage in these chips is white mica – tourmaline – quartz – pyrrhotite – chalcopyrite, occurring as irregular patches through locally greisenized granite, apparently replacing feldspars and quartz, but also occurring in occasional trails and veins. The white mica occurs as quite coarse-grained rosettes and sheaves aggregated in patches in which interstices are often chalcopyrite and pyrrhotite, or chalcopyrite hosting splintery, relic grains of pyrite and sparse sphalerite. In a few chips, tourmaline porphyroblasts occur in a finer-grained, strongly altered rock together with abundant fine-grained sericite rather than coarse white mica.

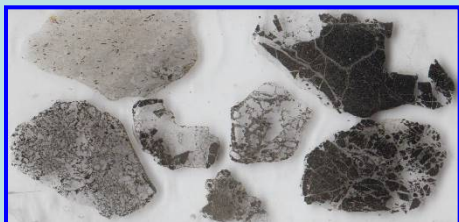
Although the main sulfide association with the white mica-tourmaline alteration is pyrrhotite-chalcopyrite, a number of chips composed solely of well annealed pyrite with occasional pale brown carbonate veinlets were also present in this set. One chip contained pyrite hosting small inclusions of tetrahedrite  $((\text{Cu}, \text{Fe})_{12}\text{Sb}_4\text{S}_{13})$ , and others contain tiny pyrrhotite and chalcopyrite inclusions. There is no obvious paragenetic relationship between these coarse pyrite chips and the chalcopyrite-pyrrhotite alteration, and the pyritic veins are considered to post-date the greisen alteration, since they show relatively weak brittle fracturing, and a rather coarse grainsize (to at least 1cm). Similar late pyrite-carbonate veins are also recorded cutting greisen in a very similar occurrence in the Reefton area, New Zealand (see later).

The nature of the fracturing – alteration event is difficult to evaluate from rock chips alone. Clearly, deformation was intense enough to cause ‘flowage’ of quartz, whereas the more brittle feldspars responded to the same deformation via fracturing. The general lack of textural disruption and fragment rotation, and very limited alteration of minerals (feldspars) adjacent to fractures, suggest that this fracturing may have been ‘tectonic cataclasis’ rather than fluid-driven hydraulic fracturing. If this is the case, the B+K+S-rich hydrothermal fluids responsible for the tourmaline - white mica - sulfide alteration are unlikely to be related to the immediate host granite, as it should be well and truly cooled below the ductile-brittle transition by the time of deformation, and associated late magmatic fluids would likely be exhausted. The fluids responsible for the observed alteration may instead be linked to a late dyke phase, perhaps represented by the granophyre-rich sample 175.

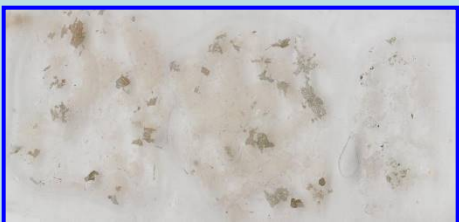
Table 1: Summary petrographic descriptions



TAL116 90-96m: *All chips are brecciated and crushed granitic rocks dominated by quartz and microcline with minor chloritized biotite. Alteration includes veins of bladed quartz, disseminated pyrite, and patches of chalcopyrite intergrown with tourmaline and minor pyrite and sphalerite.*



TAL117 70-76m: *All chips are brecciated, crushed and heavily quartz-veined microgranite, with varying amounts of well crystallized pyrite. One chip shows strong sericite alteration and contains porphyroblasts of tourmaline. The pyrite contains rare, tiny chalcopyrite and possible tetrahedrite inclusions.*



TAL126 122-126m: *All chips are very weakly altered, inequigranular biotite granite with moderate sericitization of plagioclase and partial chloritization of biotite. One chips shows slightly coarser white mica patches in plagioclase.*



TAL126 126-128m: *Chips include variably strained biotite-bearing microcline-phyric granites with some white mica-tourmaline alteration, an entirely metasomatic rock composed of intergrown tourmaline, chlorite, white mica, quartz and cusped chalcopyrite, and a chip composed of chalcopyrite hosting small tourmaline crystals and cut by veinlets of chlorite and pale brown carbonate.*



TAL126 128-131m: *All chips are biotite granites with occasional phenocrysts of blocky microcline, showing weak to moderate brecciation, partial chloritization of biotite and light sericite alteration of plagioclase. Hydrothermal alteration is insignificant.*



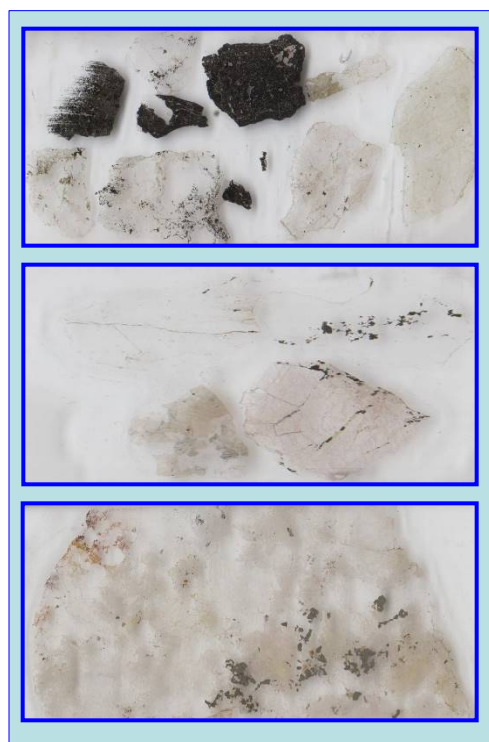
TAL126 140-148m: *Two chips consist almost entirely of coarsely crystalline pyrite with rare, tiny inclusions of pyrrhotite and chalcopyrite, and veinlets of pale brown carbonate and chlorite. The other two samples are moderately fractured microcline-phyric granite with a loose mesh of recrystallized polygonal quartz, and ~5-10modal% of seams of pyrrhotite and chalcopyrite.*



TAL136 109-113m: *All chips are microcline-phyric granite showing varying degrees of fracturing and development of narrow seams of quartz, with chloritization of biotite and moderate sericite alteration of plagioclase. One chip hosts a microdiorite inclusion composed of plagioclase, much less quartz and Kspar than the host granite, and sparse chloritized biotite.*



Table 1: Summary petrographic descriptions



*TAL136 114-116m: Most chips are fractured microcline-phyric granites with more ductile deformation shown by quartz. One chip shows local white mica-quartz-chalcopyrite alteration with a few small crystals of scheelite. Two chips consist entirely of annealed pyritic aggregates, and one consists of a brecciated pyrite aggregate invaded by streams of chalcopyrite.*

*TAL136 116-119m: All four chips are strongly fractured and veined microcline-phyric granites, with veins dominated by texturally variable, multi-stage quartz hosting minor chalcopyrite and pyrrhotite, and occasional tourmaline-chalcopyrite veinlets.*

*175: A moderately weathered granite with occasional granophyric textured quartz-Kspg intergrowths and scattered alteration patches consisting of small tourmaline crystals, pyrrhotite-chalcopyrite and quartz, but lacking the heavily fractured fabric of the preceding samples. Microclines are quite fresh, but plagioclases show patchy brown clay-sericite alteration.*

The style of hydrothermal alteration in the thin sections examined from this prospect are unlike any skarn-type alteration, and there are no typical skarnoid-type alteration phases. The limited alteration assemblage and the fine-grained nature of the white mica-tourmaline-quartz  $\pm$  chalcopyrite  $\pm$  pyrrhotite is more akin to a typical greisen (effectively an endogreisen, as it is hosted within granite).

The Allamby alteration assemblage as represented by the chips examined appears to be structurally controlled endogreisen. This occurrence shows many similarities to that at Bateman Cree - Kirwans Hill, in the Reefton area, South Island New Zealand. Here, in a structural corridor between two major fault systems, a thick sequence of greywackes of the Ordovician Greenland Group are intruded by a cupola of the large Late Devonian-Carboniferous Karamea Batholith. A set of sheeted, sulfide-bearing veins is developed within and above greisenized granite in zones of fracturing and cataclasis that extend up to 500m above the unaltered granite (Pirajno and Bentley, 1985). Sulfide assemblages include pyrrhotite and chalcopyrite, scheelite, and minor molybdenite, sphalerite, arsenopyrite and pyrite/marcasite. The post-magmatic, structurally controlled greisen mineralogy is dominated by tourmaline-muscovite and albite. Free gold

occurring in association with arsenopyrite and pyrite in veins marginal to the main scheelite-bearing veins have no match among the rocks examined from the Allamber prospect in this study.

The pattern of alteration in the Reefton system is structurally controlled, and most pervasive in envelopes surrounding the quartz veins, with early tourmaline-muscovite-biotite alteration within and proximal to the unaltered granite cupola, with pyrrhotite (and chalcopyrite, which with pyrrhotite replace biotite and tourmaline) in more distal veins, then clinozoisite and scheelite later and further out, followed by quartz-muscovite-scheelite veins, and late pyrite-carbonate-sericite in cross-cutting fractures.

The Allamber alteration system, and alteration associated with the Bateman Creek exposures of the system near Reefton, are both greisen-type, but clearly post-magmatic and structurally controlled. The Reefton occurrence contains significantly more metal content, both within endogreisen veins (Batemans Creek area), and in exogreisen veins in altered turbidites adjacent to the granites (Kirwans Hill). Scheelite is rare and fine-grained in the Allamber samples examined in this study, and considerably less abundant than pyrrhotite and chalcopyrite. Given the endogreisen nature of the Allamber alteration and veining, it is possible that higher W grades (ie. more scheelite) may occur in more distal veins, adjacent to the contact with, or within, the metasediments that host the granite associated with the Allamber alteration. However, by analogy with the Reefton example, any mineralization around the area drilled and represented by the chips examined in this study is likely to be small and uneconomic.

### Reference

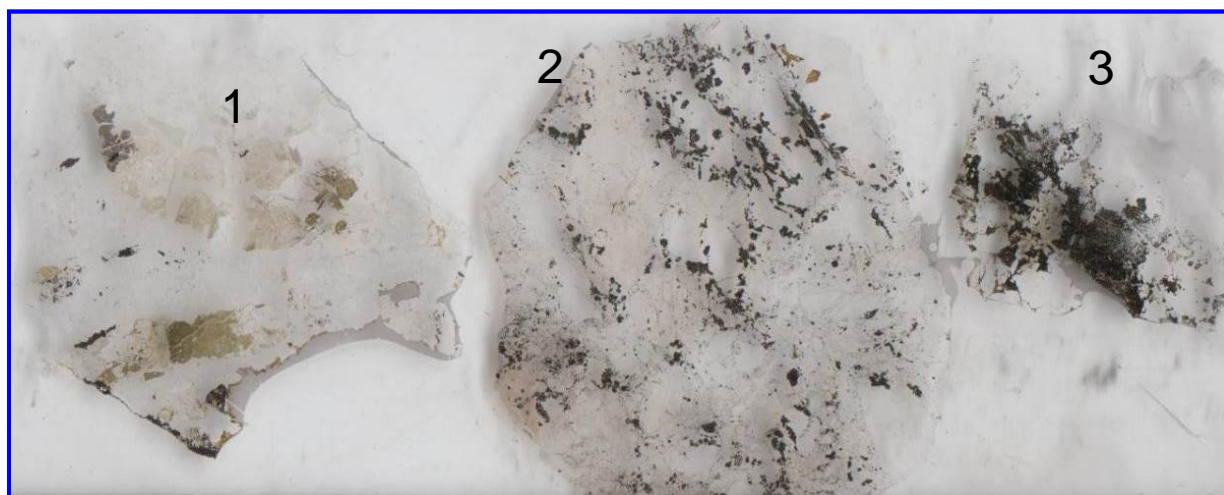
Pirajno, F. and Bentley, P.N., 1985. Greisen-related scheelite, gold and sulphide mineralisation at Kirwans Hill and Bateman Creek, Reefton district, Westland, New Zealand. *New Zealand Journal of Geology and Geophysics* 28, 97-109.

## SUMMARY

The three chips in this slide are all broadly granitic, but vary significantly in their grainsize and style of alteration. **Chip 1** is a fairly coarse-grained granite with alkali feldspars (showing microcline twinning) to 4-5mm long that show unusual brown, clayey alteration in irregular patches that shows local coarsening to white mica. Original magmatic quartzes are trained and fractured, with trails of tiny fluid inclusions. Minor original biotite is entirely chloritized, and contains occasional well formed zircons. This chip is transected by abundant veinlets of hydrothermal quartz showing an unusual bladed texture and peppered with almost submicroscopic graphite (? a totally non-reflective opaque phase). Occasional patches of fine-grained scheelite(?) are present, and host intergrown broken crystals of pyrite and minor brown-green tourmaline.

**Chip 2** is a brecciated and fairly finely smashed granite with scattered local aggregates of coherent original granite in a matrix of variably crushed granitic detritus hosting broken and angular crystals of quartz and microcline. Irregular streams of fine-grained pyrite occur throughout the crushed rock but don't define well defined veins. Very minor chalcopryite is associated with the pyrite, forming short streaks along fractures, and interstitially within some pyrite aggregates.

**Chip 3** is also a smashed granitic rock from the same protolith as Chips 1 and 2, but it contains more intense alteration, with abundant chalcopryite being intergrown with quite coarse quartz and aggregates of pale brown-green prismatic tourmaline. Small areas of yellowish to orange sphalerite with chalcopryite disease, and broken and sometimes splintery grains of pyrite occur within the chalcopryite.

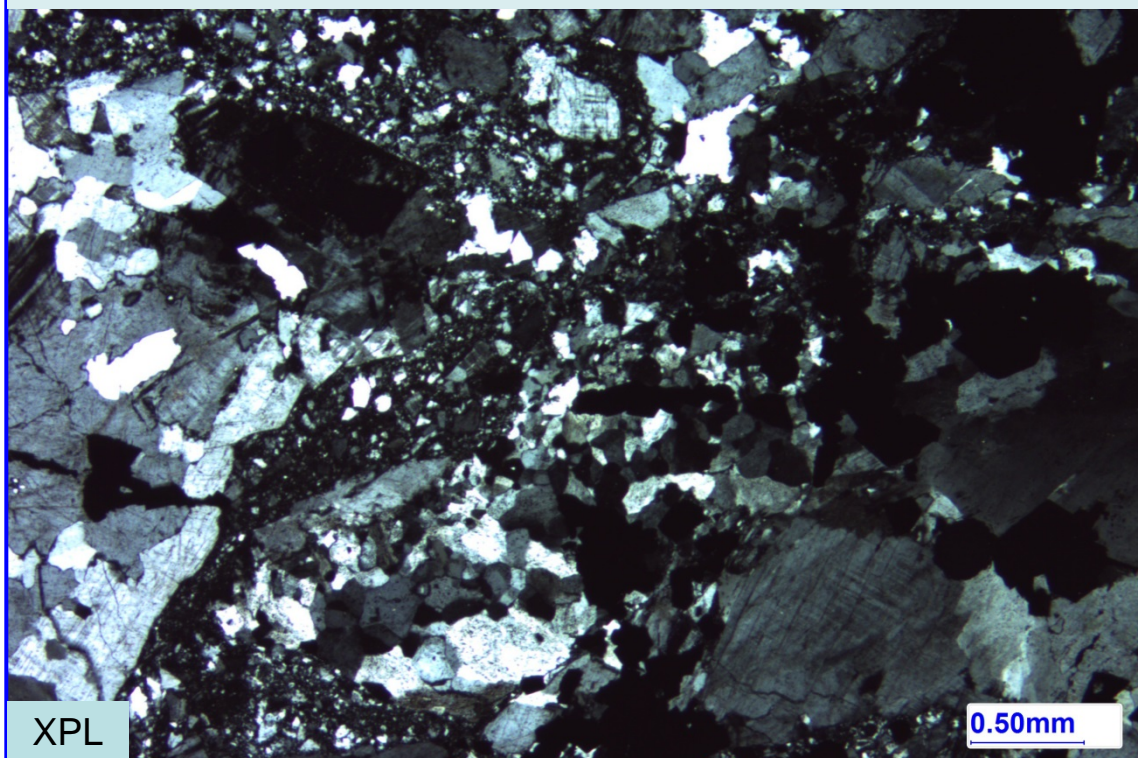




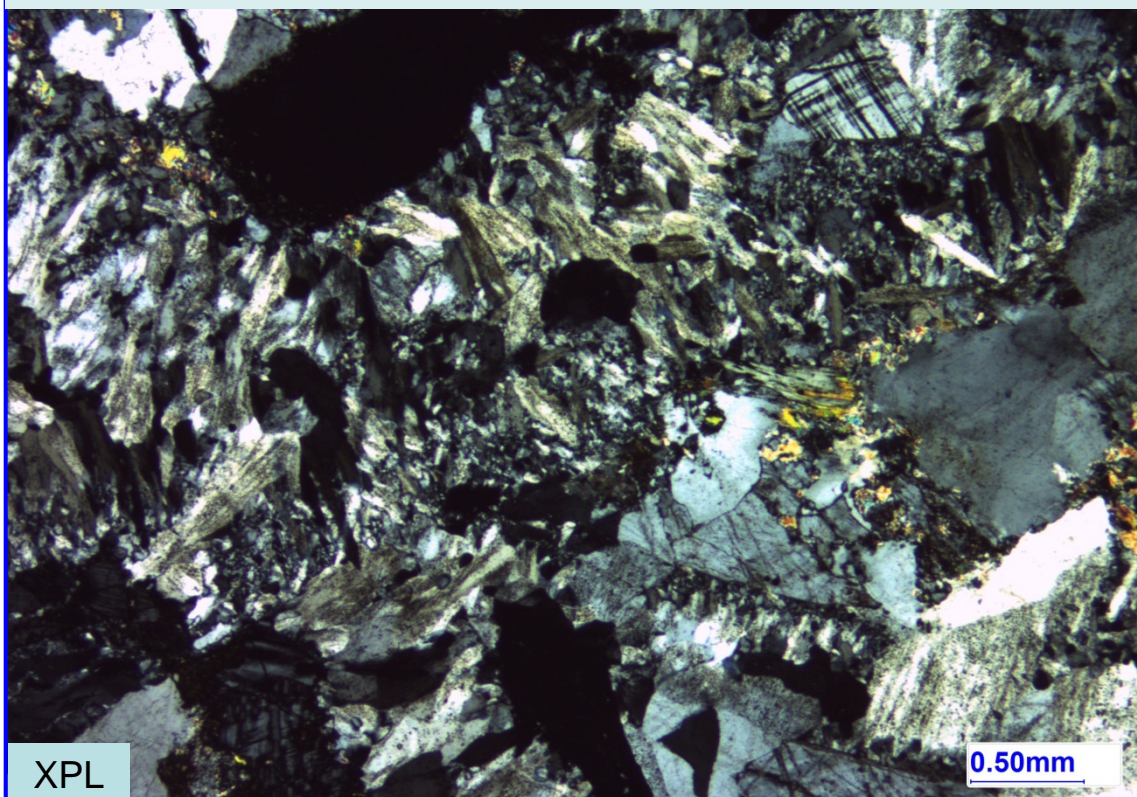
**SAMPLE NUMBER**

TAL116 90-96m

Brecciated granite (chip 2) with relic fragments of microcline and quartz and minor disseminated pyrite.



Veins of bladed quartz in brecciated granite

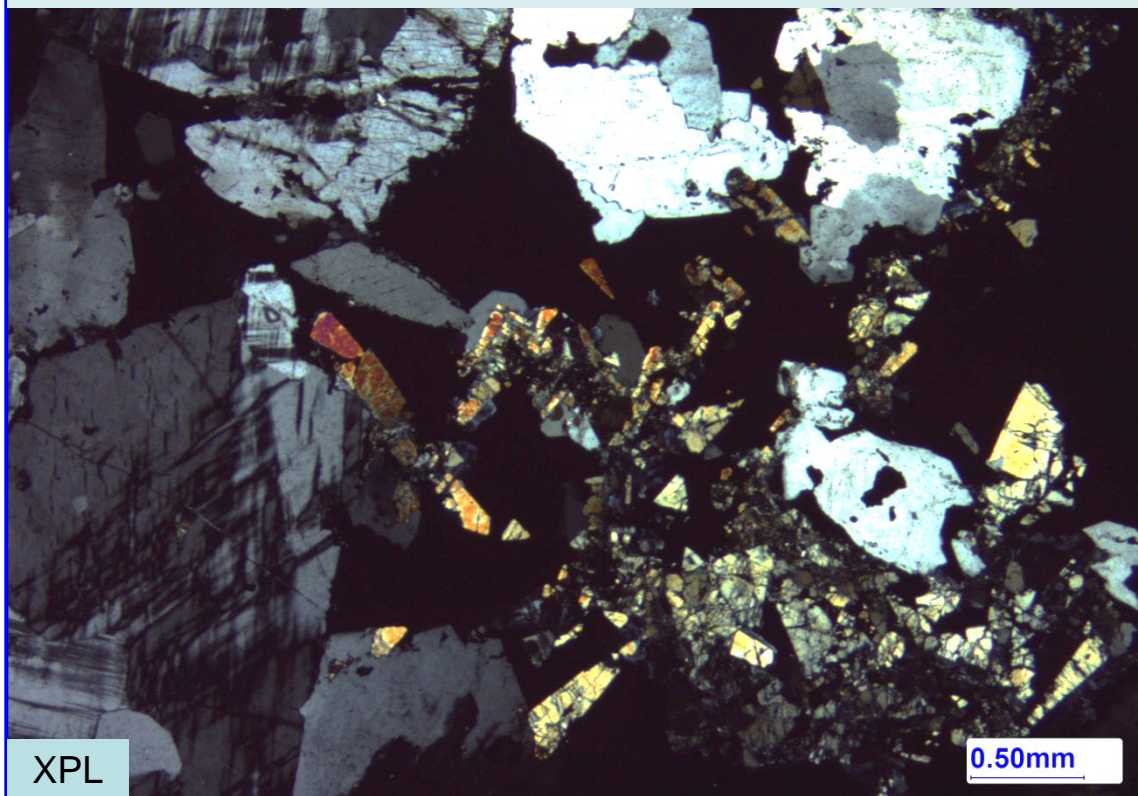




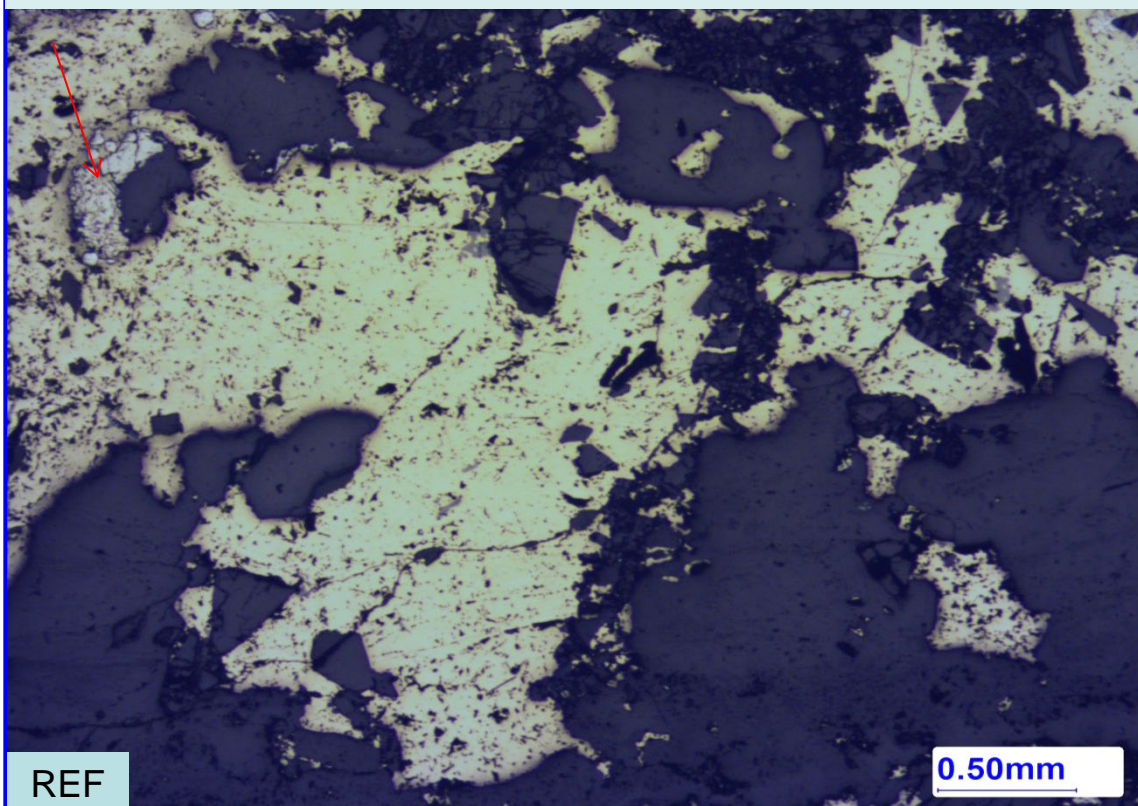
**SAMPLE NUMBER**

TAL116 90-96m

Tourmaline – quartz – chalcopyrite intergrowth in chip 3



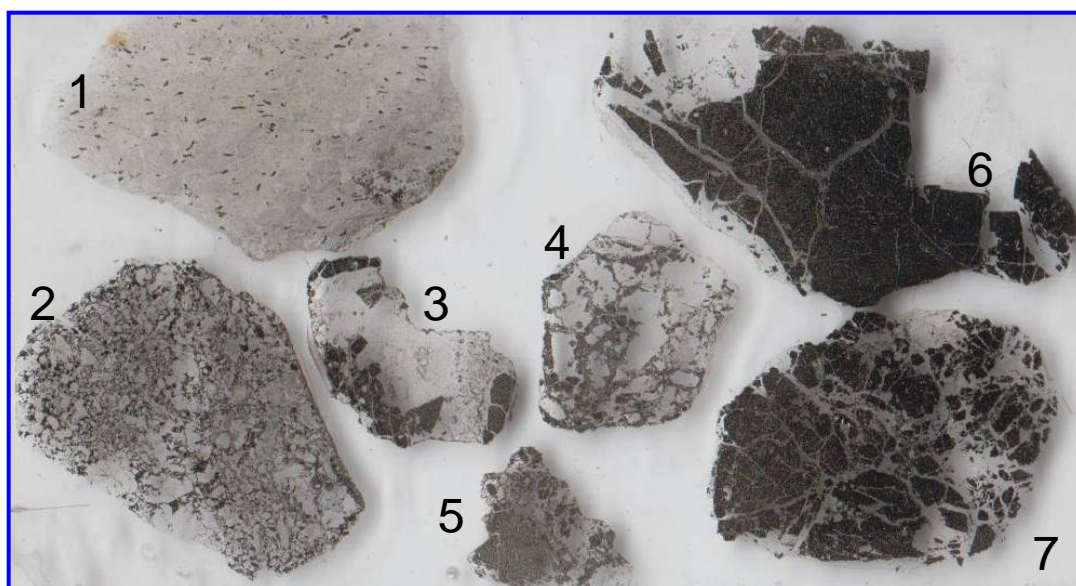
Tourmaline -quartz–chalcopyrite intergrowth in chip 3 –small broken pyrite crystals arrowed





## SUMMARY

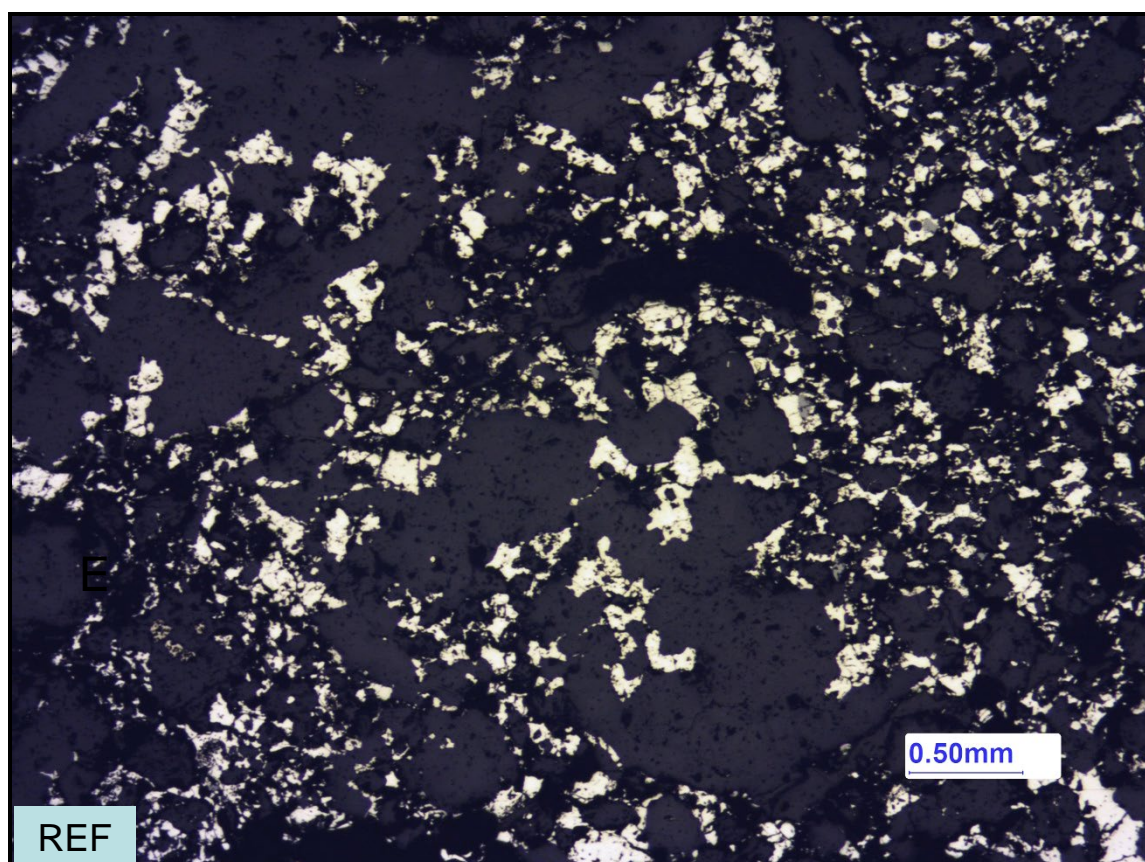
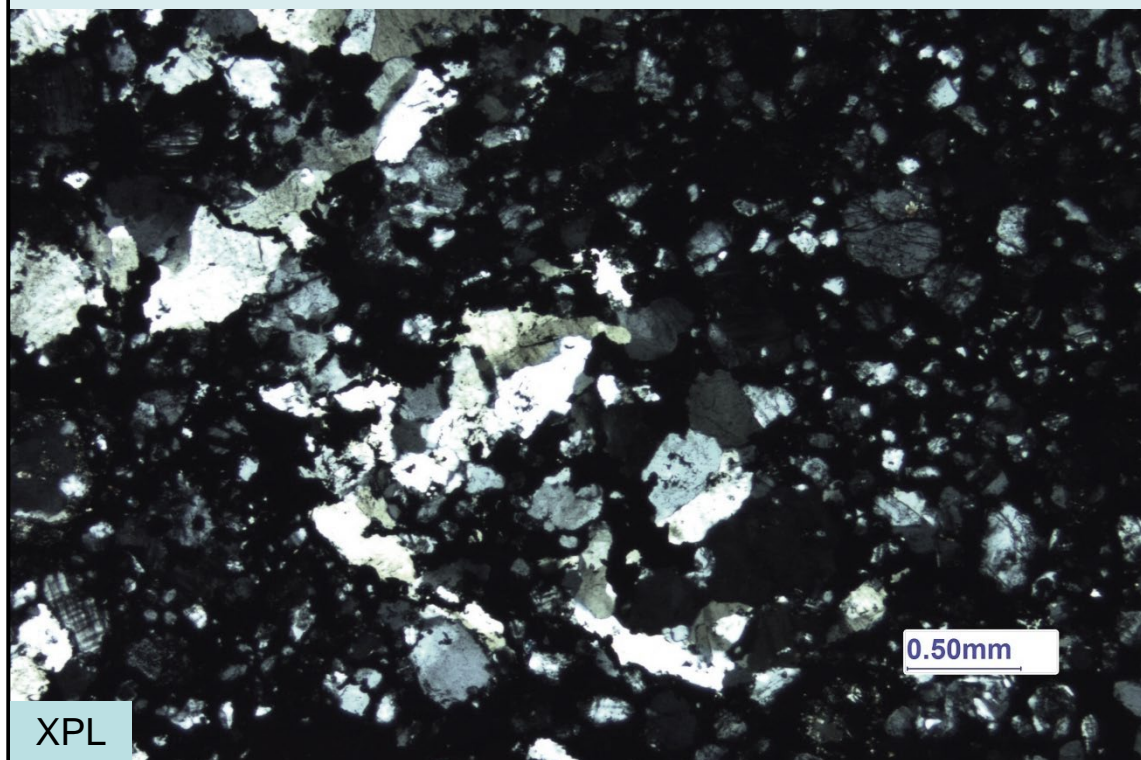
**Chip 1** is a fine-grained quartzo-feldspathic rock with intense sericite-tourmaline alteration and no trace of the protolith texture preserved. It contains scattered, tatty and 'moth-eaten' elongate to bladed ilmenite and prismatic tourmaline porphyroblasts to 1mm long, all set in dense fine-grained sericite with occasional tiny spots of chalcopyrite and pyrite. **Chip 2** is like those in the preceding sample, being a finely crushed granite with angular fragments of quartz and microcline, pervaded by a mesh of fine-grained pyrite that contains occasional small spots of both chalcopyrite and yellow sphalerite. **Chips 3, 4 and 5** are brecciated and strongly quartz-veined granite containing common mm-sized and smaller crystals of pyrite, many of which have themselves been shattered and disrupted, and which lack interstitial chalcopyrite or other base metal sulfides. The quartz hosting many of the sulfides, particularly in **Chip 4**, is strongly deformed and contains common chains of tiny fluid inclusions along healed fractures. **Chips 6 and 7** consist of coarse pyrite set in a matrix of vein quartz through a microgranite composed solely of quartz and microcline. A network of narrow quartz veinlets extends along fractures through the pyrite in both chips, which carries rare small spots of chalcopyrite, and another dark grey-green/brown sulfide, possibly tetrahedrite.



**SAMPLE NUMBER**

TAL117 70-76m

Chip 2: Same field of view in crossed polars and reflected light, showing mesh of fine pyrite through recrystallized quartz in smashed microgranite.

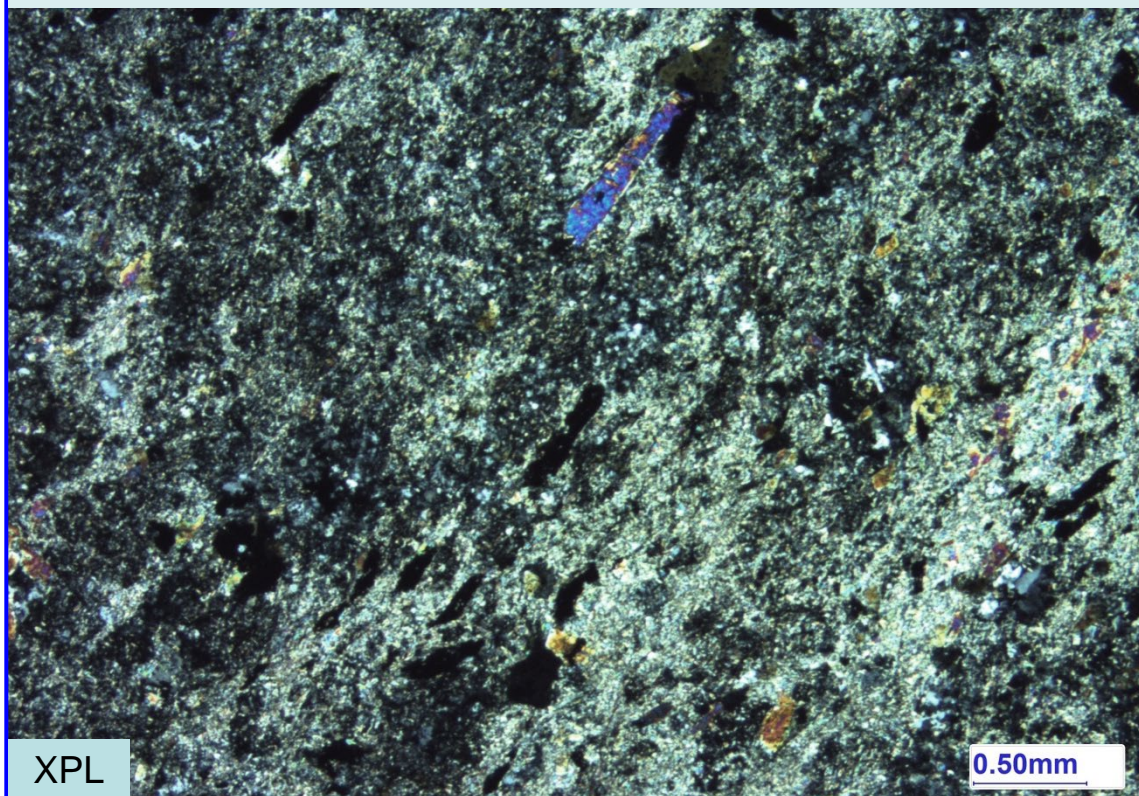




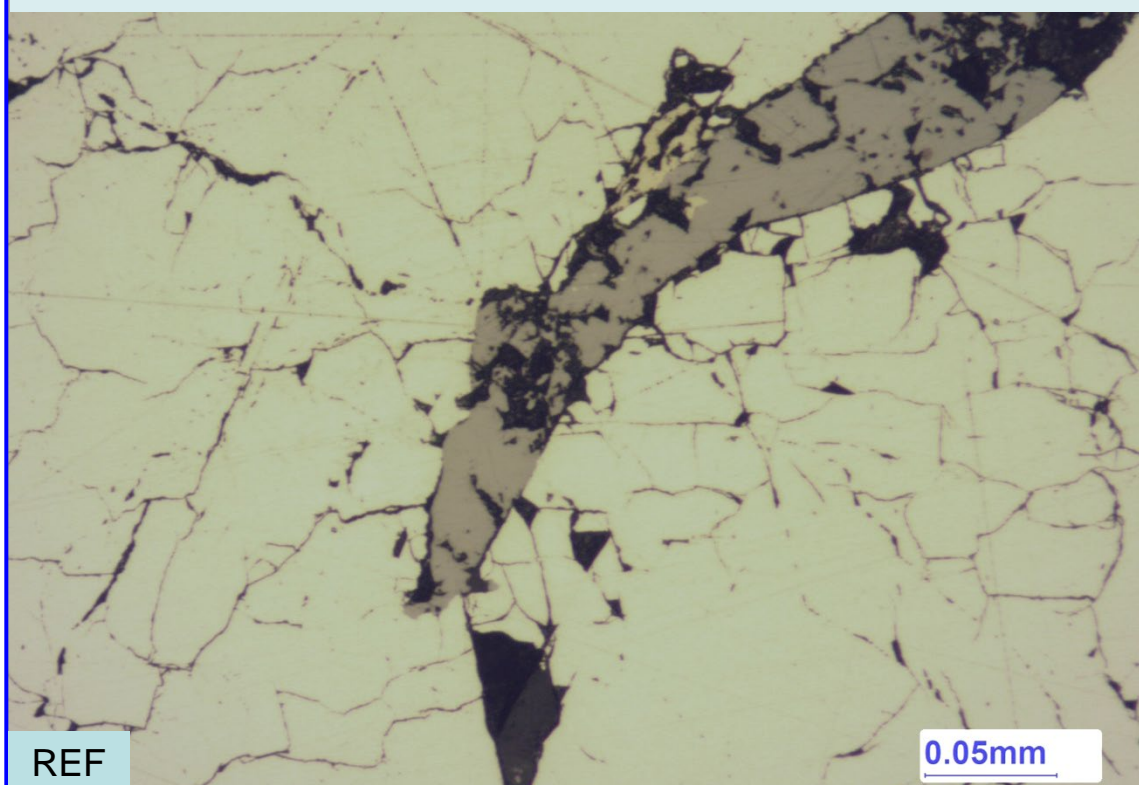
**SAMPLE NUMBER**

TAL117 70-76m

Chip 1: Strong sericite overprint with aligned tourmaline & ilmenite porphyroblasts



Tetrahedrite inclusion in pyrite in Chip 6



## SUMMARY

*All three chips are inequigranular biotite-bearing granites with scattered largely sericite-altered plagioclase phenocrysts to 8mm long set (the pinkish grains in the scanned thin section image below) in a 'groundmass' of subequal proportions of plagioclase and Kspar, and ~3-5modal% of coarse brown biotite that forms typically platy crystals to 3mm long. The plagioclase, whether phenocrysts or smaller crystals throughout the rock, forms subhedral crystals that retain occasional fresh patches, but are largely replaced by fairly fine-grained sericite. In contrast, the microcline-twinned Kspar is quite fresh and mainly anhedral. Quartz (~20-25modal%) is also anhedral with strain features and patchy extinction. Biotite is about 50% altered to pale green chlorite and tends to occur in clots of two or three crystals. In the right-hand chip, some coarser-grained white mica and pale carbonate are developed in plagioclases, but overall, the hydrothermal alteration of this rock is minimal.*

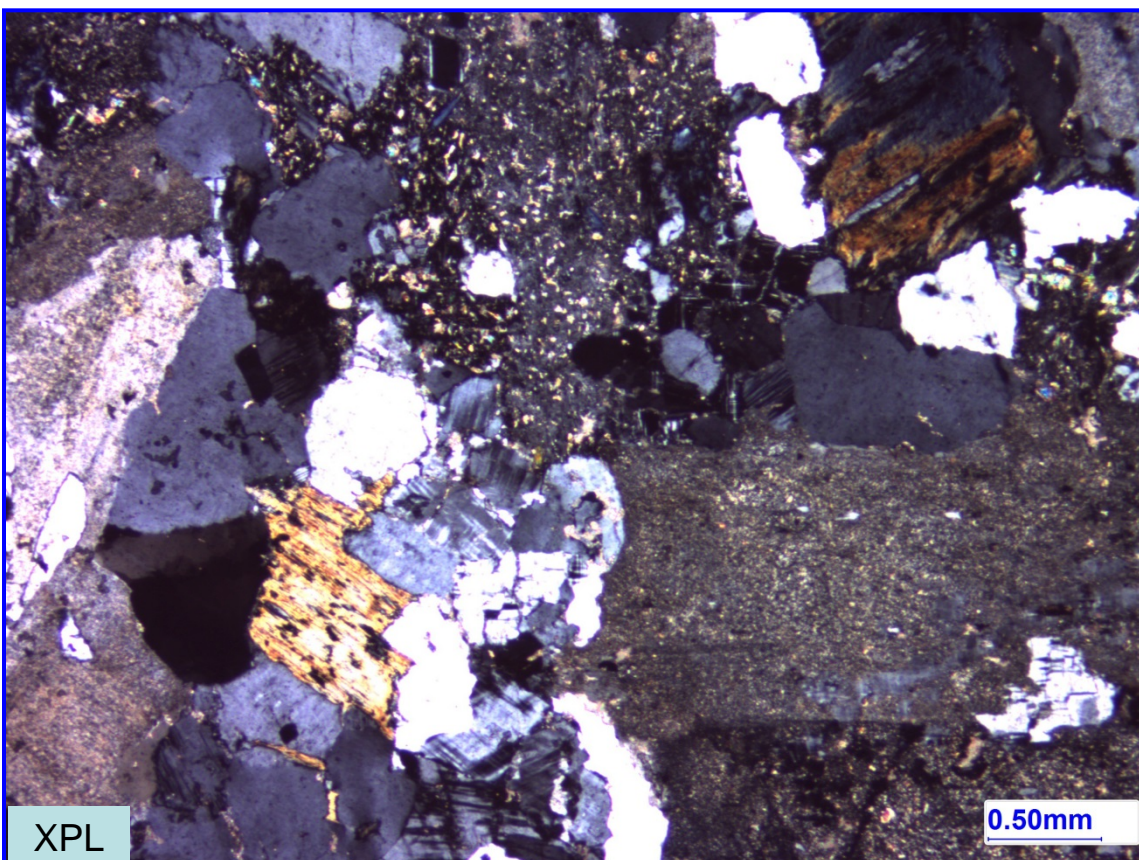
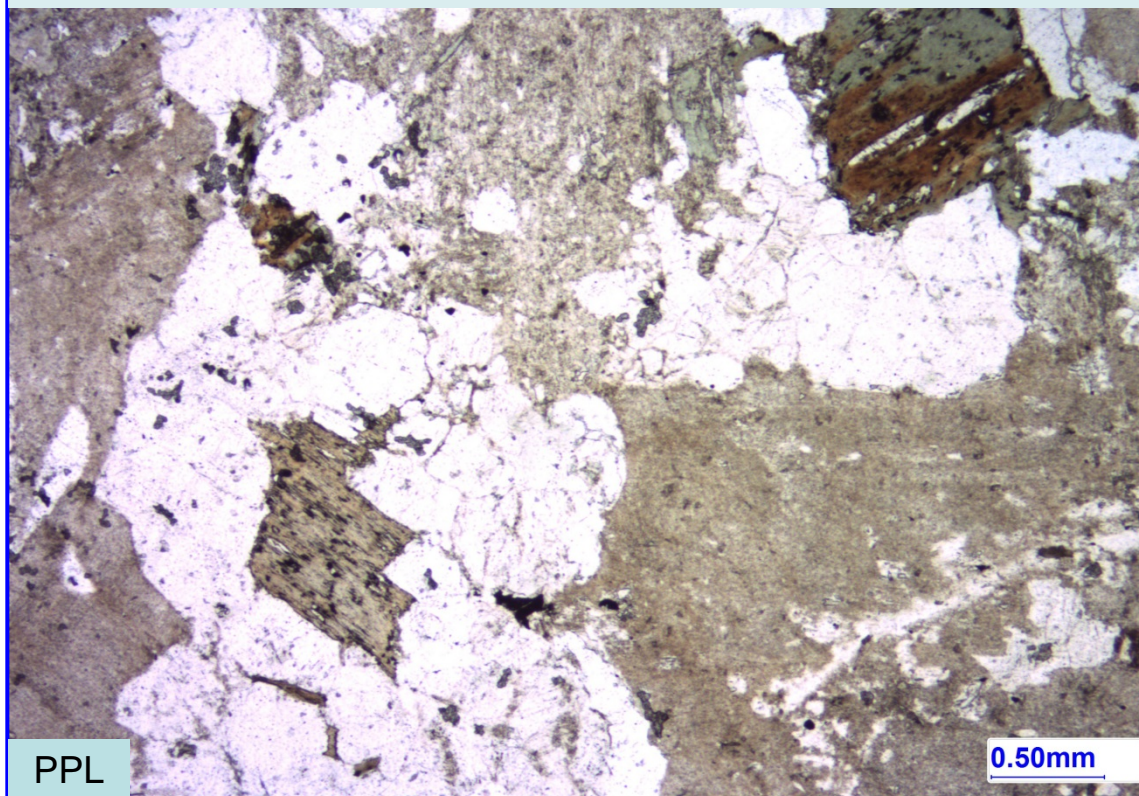




**SAMPLE NUMBER**

TAL126 122-126m

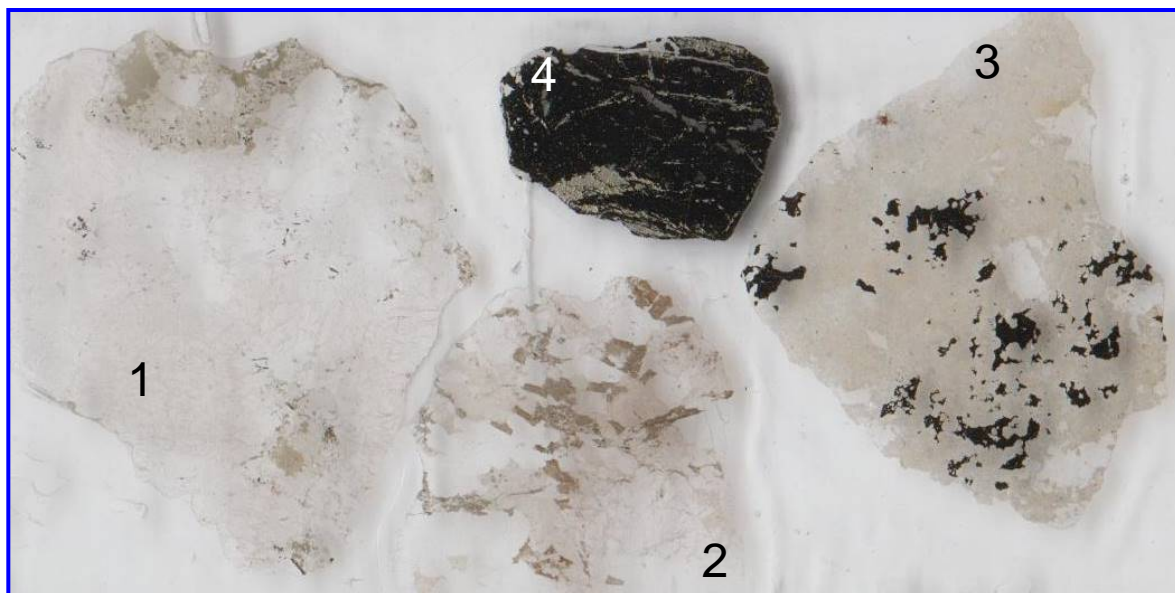
Sericite-altered plagioclase, partly chloritized biotite and fresh microcline.





## SUMMARY

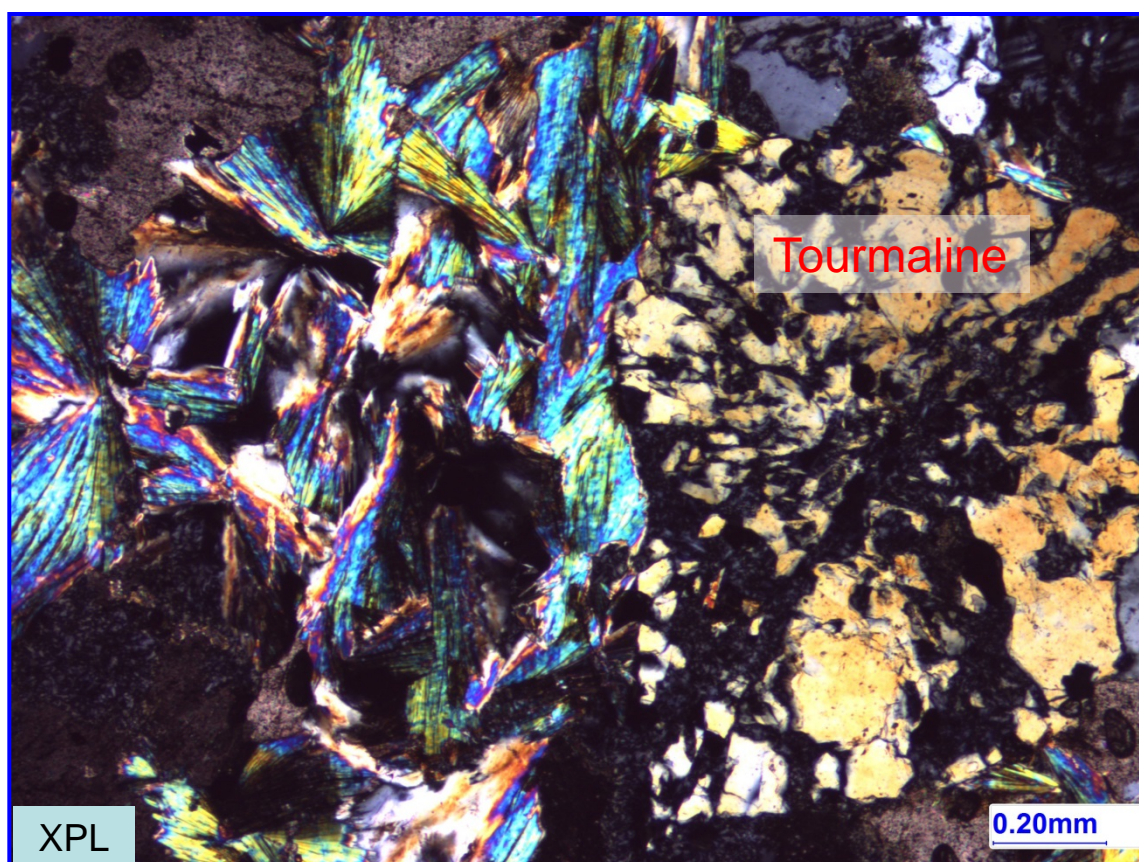
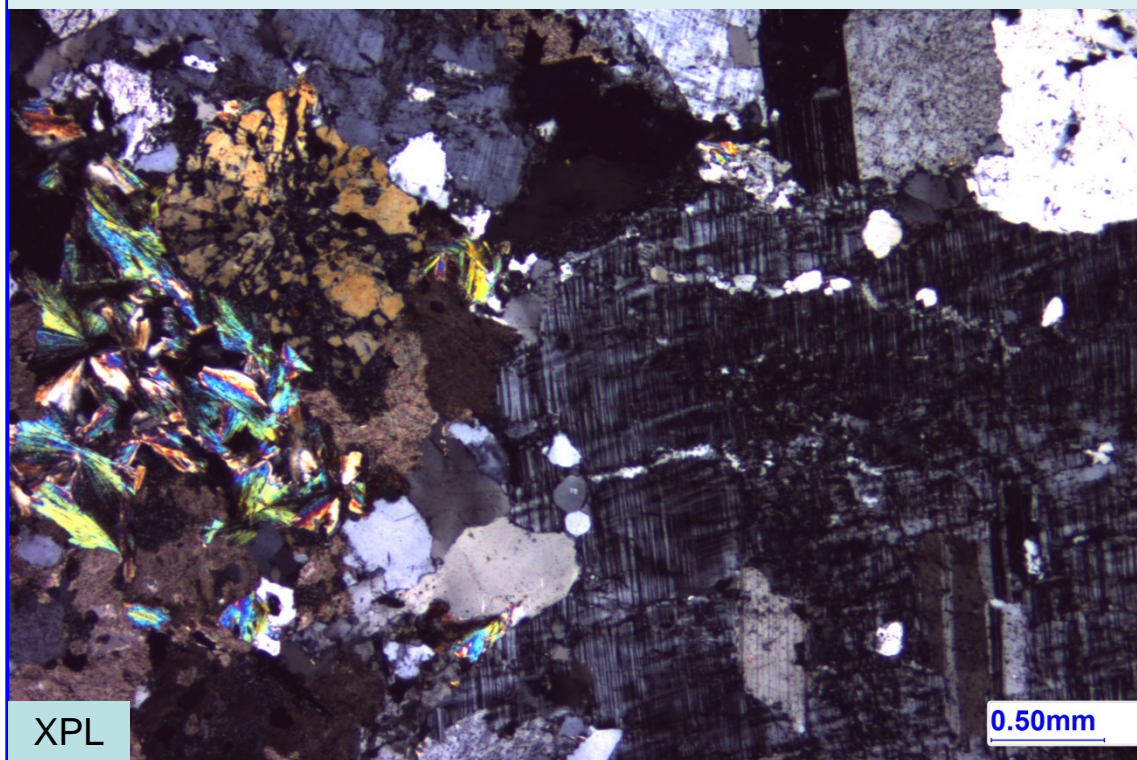
**Chip 1** is a microcline-rich fairly coarse-grained granite with fresh microcline crystals to almost 1cm across hosting small spots of both sodic plagioclase and quartz in a finer-grained, inequigranular groundmass of anhedral quartz, microcline and plagioclase, with no biotite in this chip. Local patches of quite coarse tourmaline and rosettes of white mica alteration, associated with pale brown carbonate. **Chip 2** is a strongly strained and weakly brecciated granite composed of microcline, lightly sericitized plagioclase and quartz, with common (~20modal%) partly chloritized biotite. Seams of subgrain recrystallization of quartz and white mica –chlorite alteration of deformed biotite are common. **Chip 3** is a metasomatic rock composed entirely of quartz, pale green-yellow tourmaline, chlorite, coarse white mica rosettes and ~5-8modal% of chalcopyrite, the latter forming cusped interstitial domains to several mm across. **Chip 4** is coarse chalcopyrite with narrow seams of chlorite, brown carbonate and occasional mm-sized tourmaline inclusions and scattered tiny inclusions of deep yellow-orange sphalerite (<<0.1modal% of the chalcopyrite chip).



**SAMPLE NUMBER**

TAL126 126-128m

Granitic microcline and quartz with a patch of pale brown carbonate- white mica-tourmaline alteration (detail in lower image)

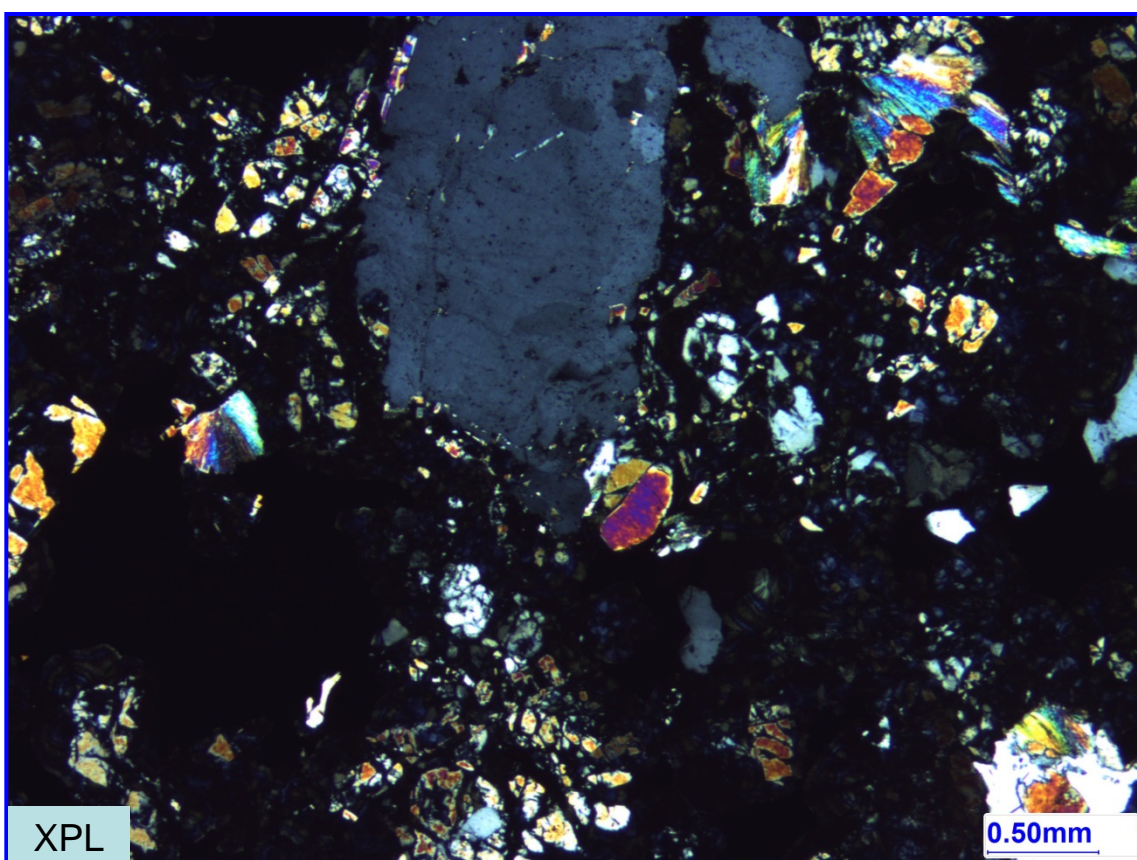
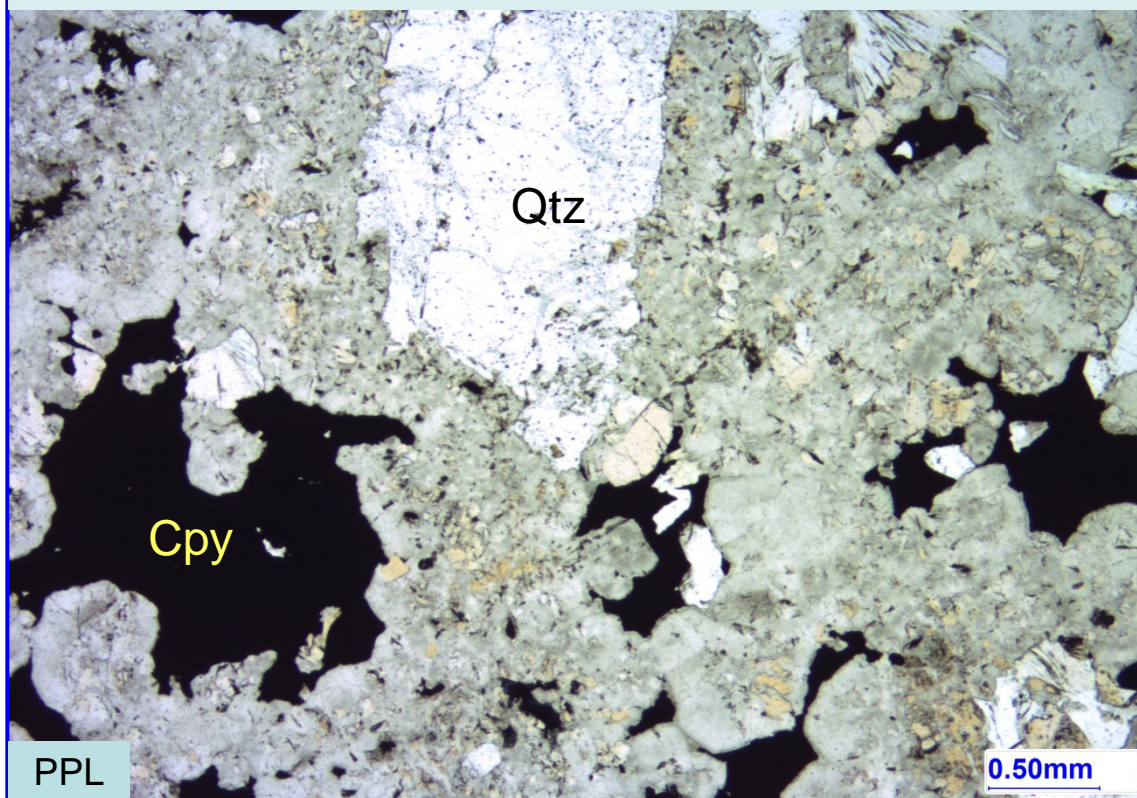




**SAMPLE NUMBER**

TAL126 126-128m

Quartz-tourmaline-white mica-chlorite-chalcopyrite metasomatic rock (Chip 3)



## SUMMARY

*All chips in this slide are petrographically identical, weakly fractured and brecciated microcline-phyric biotite granites in which occasional, almost cm-sized, fresh, blocky microcline phenocrysts are set in a quartz (~20modal%)-microcline (~20modal%)-plagioclase (~15modal%) – brown biotite (~10-15modal% but very variable between chips) 'groundmass. Limited chlorite alteration of biotite, and light sericitization of plagioclases is present in most chips. Robust small zircon prisms are relatively common. A moderate fracture network pervades most chips, although apart from limited development of small beads of quartz along some wider fractures, there is little or no fracture-related alteration.*

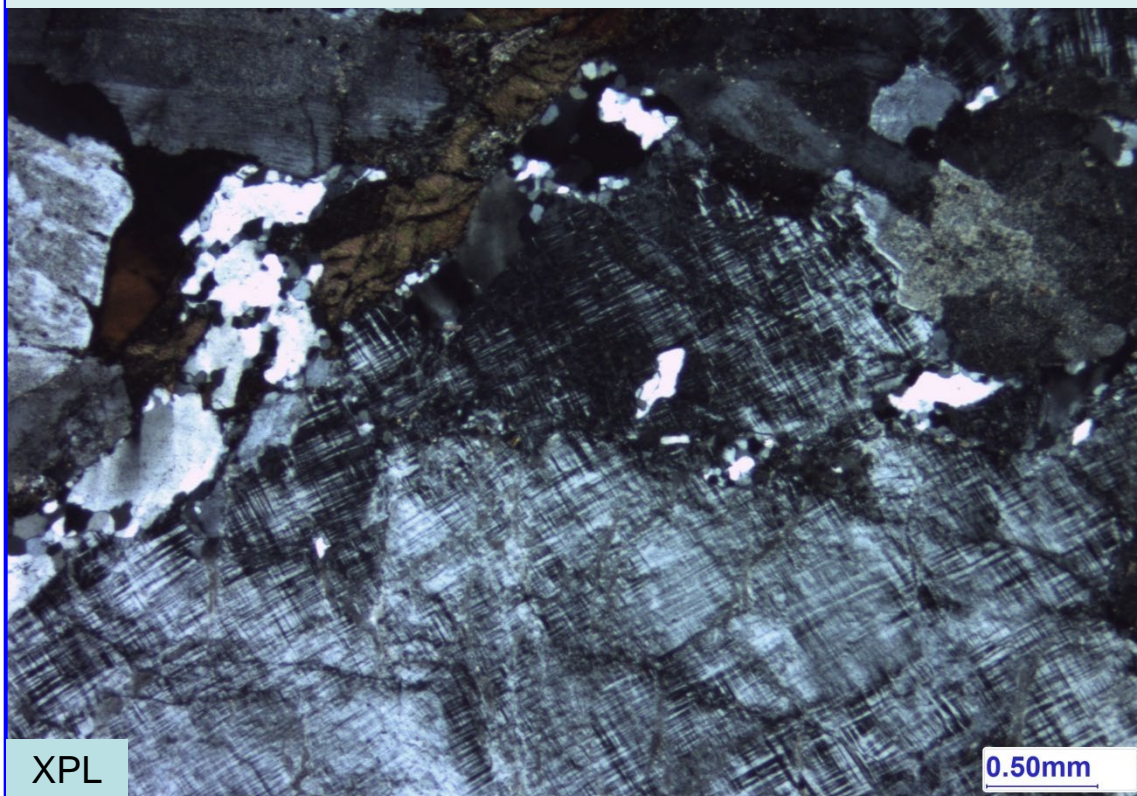




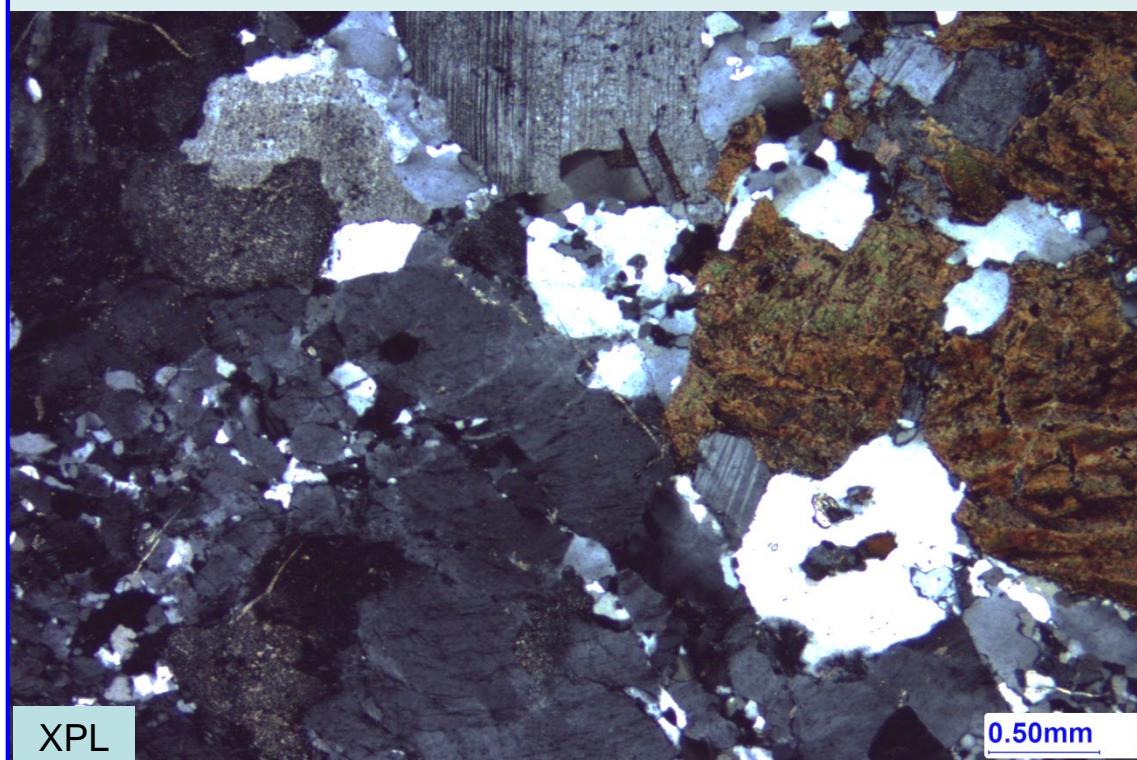
**SAMPLE NUMBER**

TAL126 128-131m

Network of fine fractures and quartz veinlets through microcline phenocryst



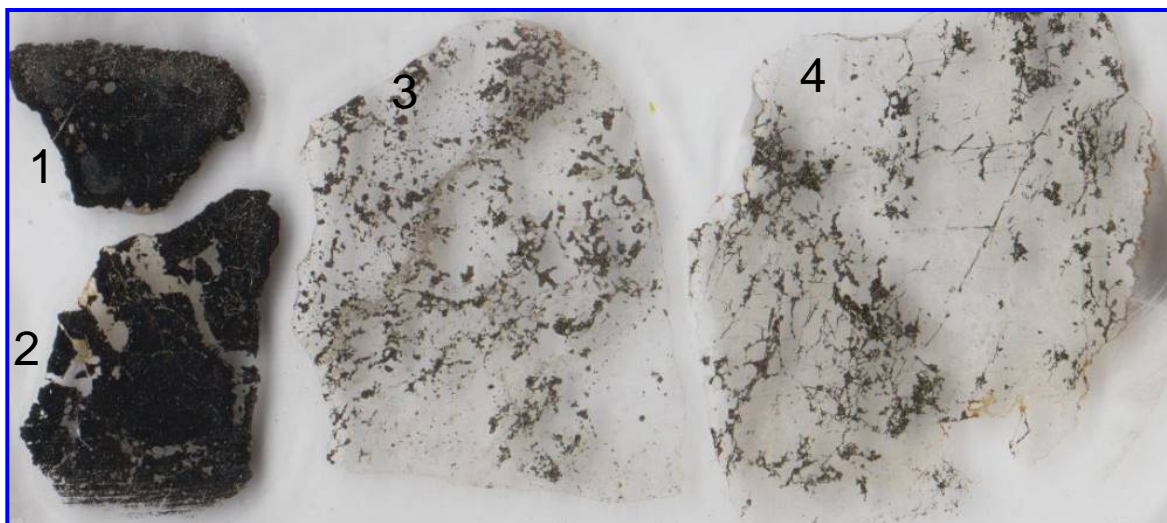
Biotite, quartz, Kspar and lightly sericitized plagioclase with narrow seams of quartz along fractures





## SUMMARY

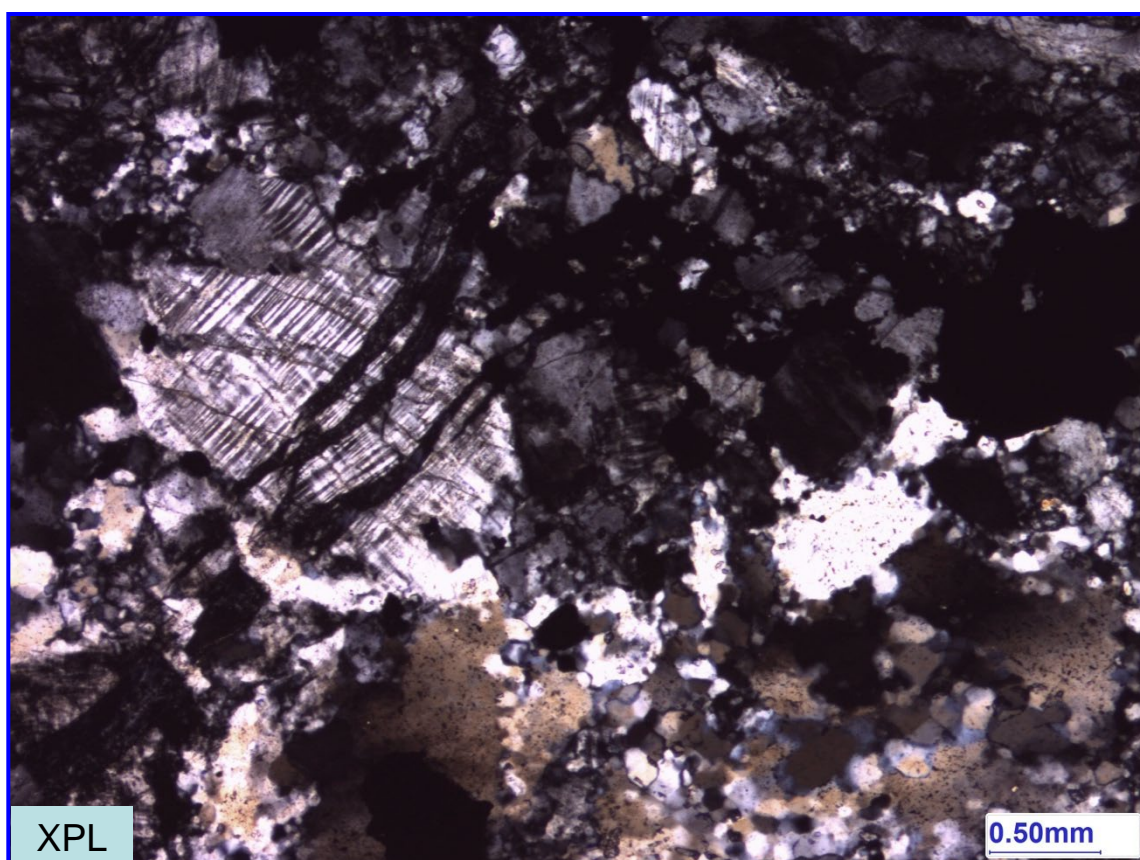
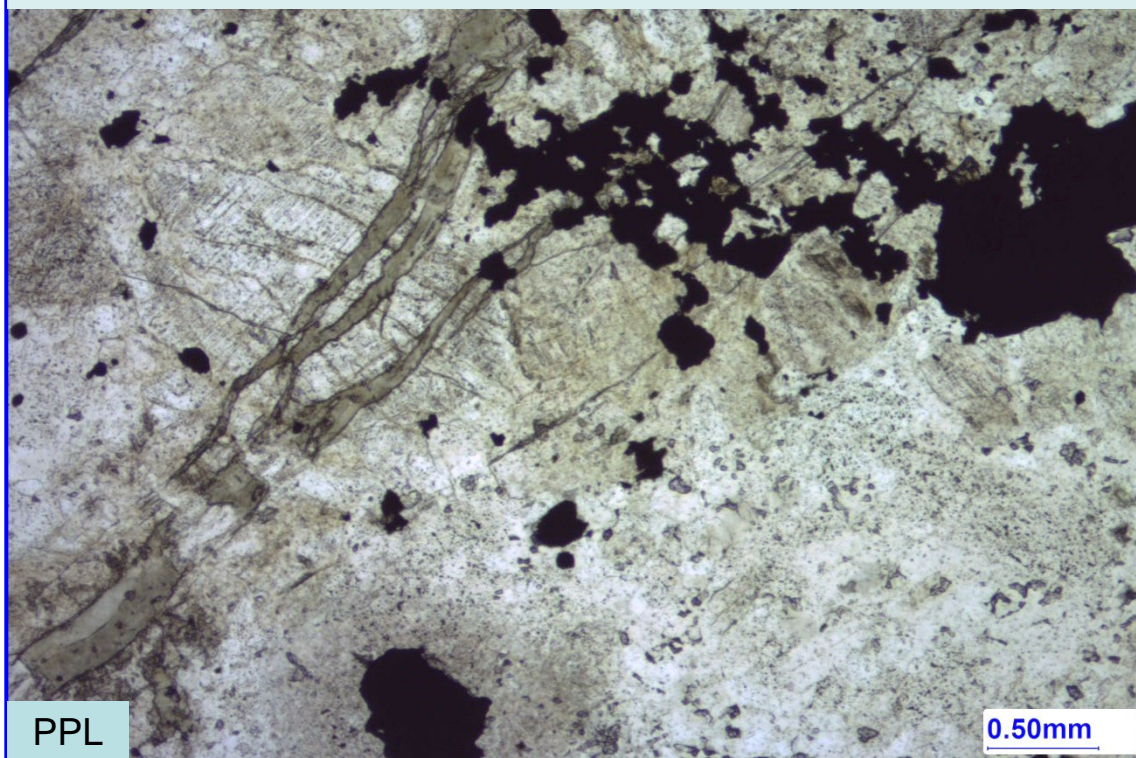
**Chips 1 and 2** are cm-sized pyritic grains. **Chip 1** contains a few small inclusions of pyrrhotite and sheaves of coarse white mica, whereas chip 2 is veined by pale brown carbonate and also contains a few tiny inclusions of both pyrrhotite and chalcopyrite. **Chip 3** is a heavily altered granite probably like the preceding sample but now pervaded by seams and patches of sugary, recrystallized quartz, subordinate chlorite, and abundant pale yellow tourmaline and sulfides forming a loose mesh through the rock. The sulfides are dominated by pyrrhotite and chalcopyrite, with the former significantly more abundant. **Chip 4** is another fractured and brecciated microcline-phyric granite, with generally fresh feldspars, but a mesh of fractures throughout, many of which are filled by sulfides (sometimes forming a central seam rimmed by pale green chlorite) and aggregates of polygonal, recrystallized quartz. In reflected light, the sulfides are seen to be pyrrhotite and chalcopyrite, in subequal proportions, with no trace of pyrite. A few small crystals of pale yellow tourmaline are present in the recrystallized quartz aggregates.



**SAMPLE NUMBER**

TAL126 140-148m

Seams of chlorite and sulfides cutting fractured and weakly brecciated microcline-phyric granite

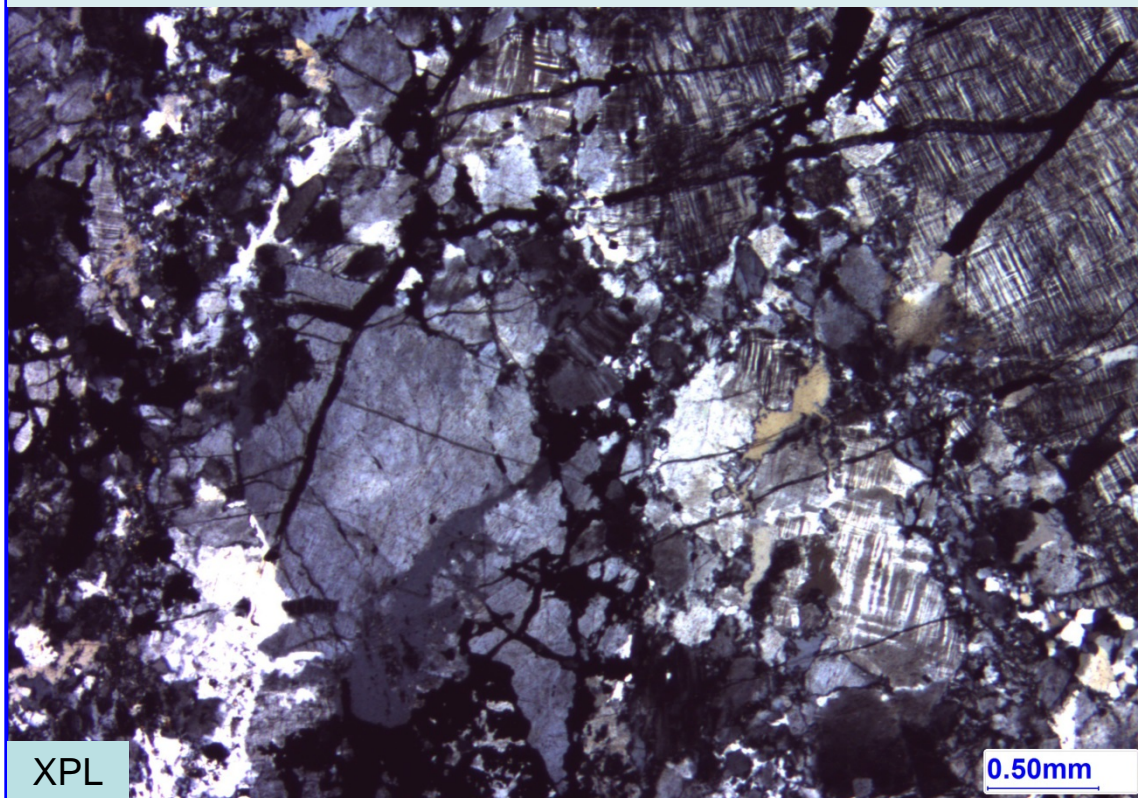




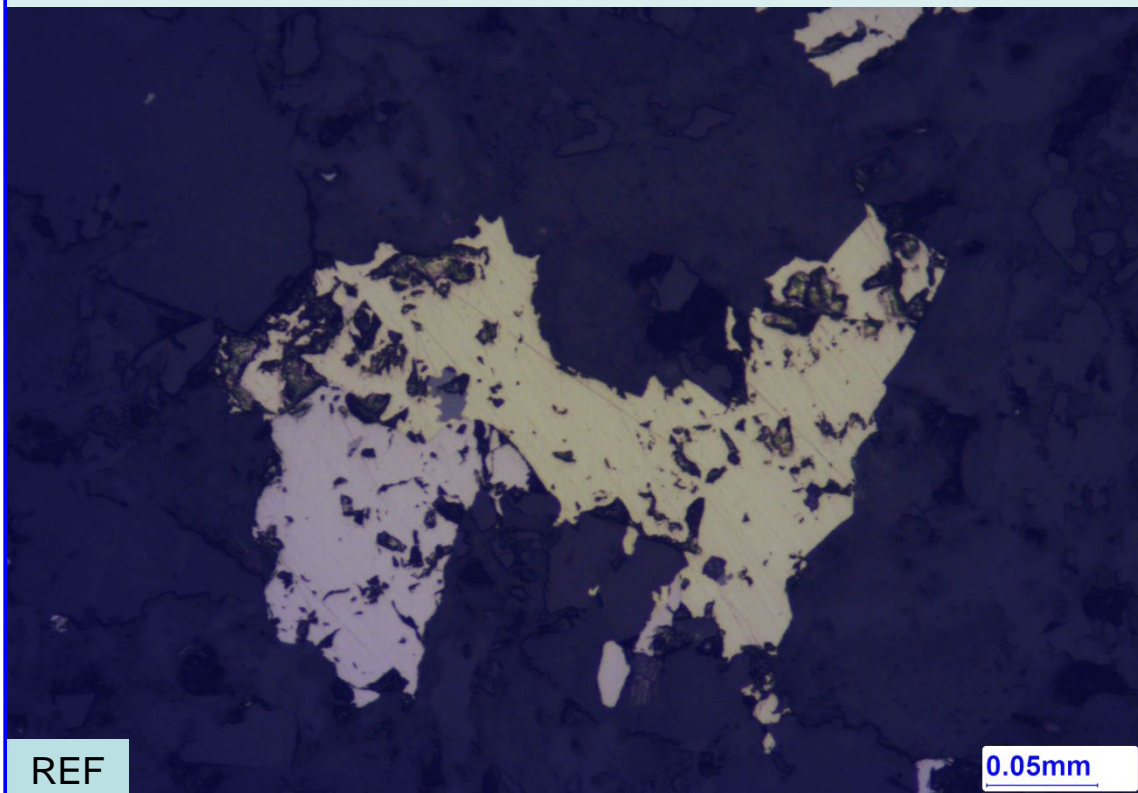
**SAMPLE NUMBER**

TAL126 140-148m

Seams of recrystallized quartz and sulfides along fracture network in cataclasized granite



Typical intergrown pyrrhotite-chalcocopyrite in Chip 3



## SUMMARY

*All the chips in this slide are of a microcline-phyric granite essentially identical to the protolith of those in the preceding samples described above. The are composed of blocky phenocrysts to 7-8mm of fresh microcline set in an inequigranular intergrowth of quartz (~25modal%), microcline (~30modal%) and sericite-altered plagioclase (~20modal%), with around 3-10modal% of chloritized biotite. These chips are on average slightly less fractured and brecciated than in the samples described above, but narrow seams of fine-grained quartz and chlorite are still present in most chips. The largest chip hosts a 1-2cm-sized cognate inclusion of microdiorite, composed of 0.5-1mm-sized crystals of plagioclase (lightly sericitized) and less common orthoclase, quartz and chloritized biotite. These chips lack any sign of hydrothermal alteration.*

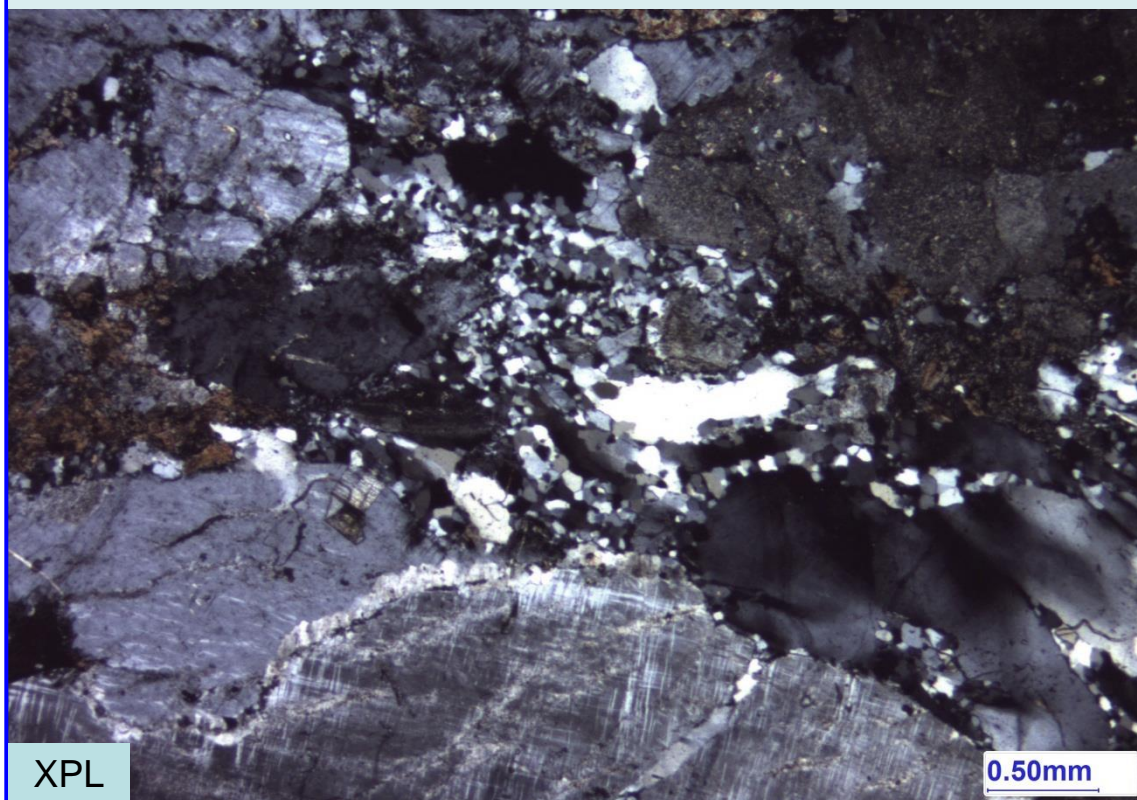




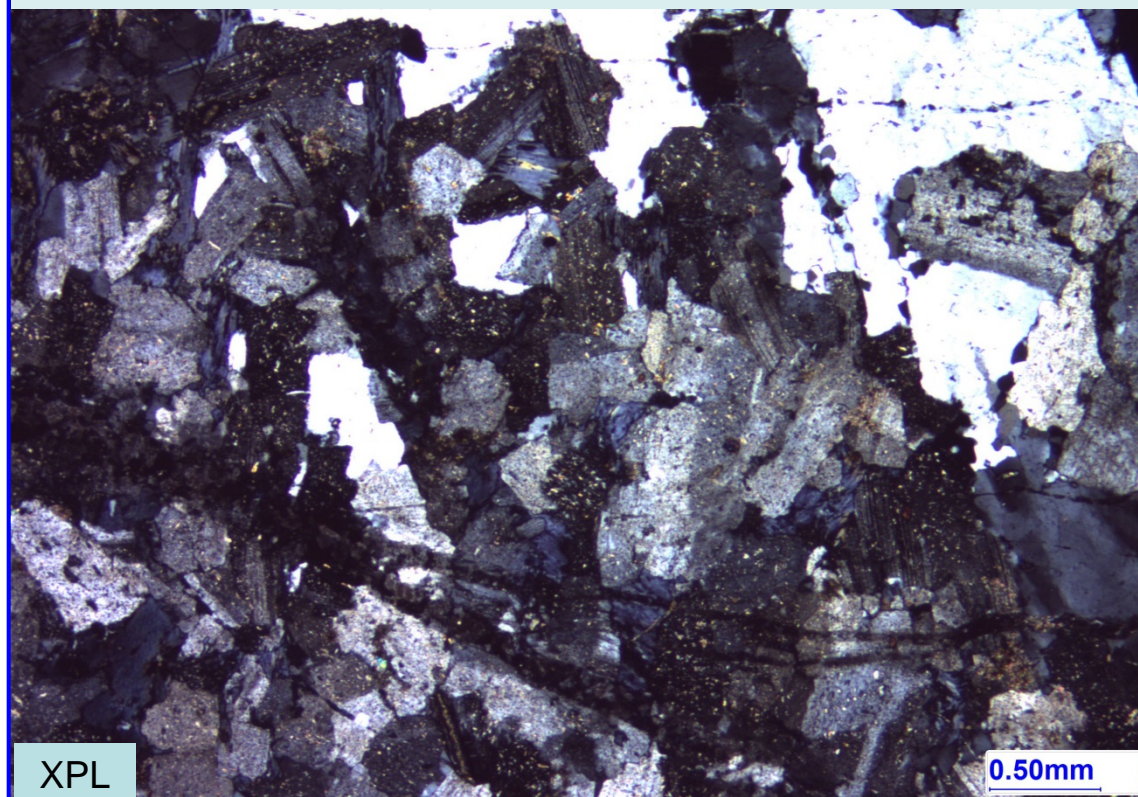
**SAMPLE NUMBER**

TAL136 109-113m

Seams of fine-grained quartz along narrow, irregular fractures in microcline-phyric granite



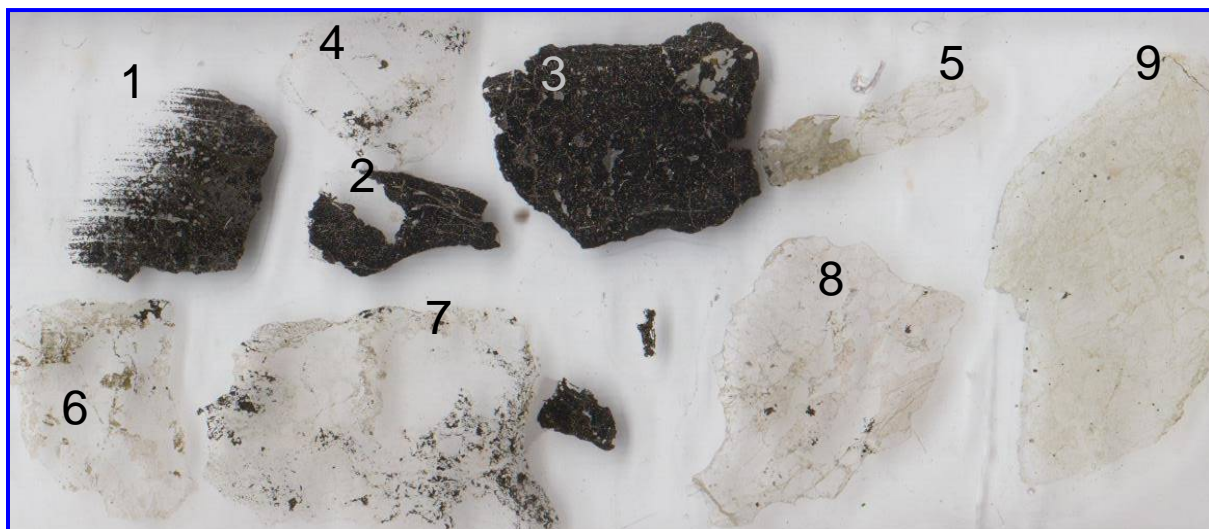
Contact between microdiorite inclusion and granite





## SUMMARY

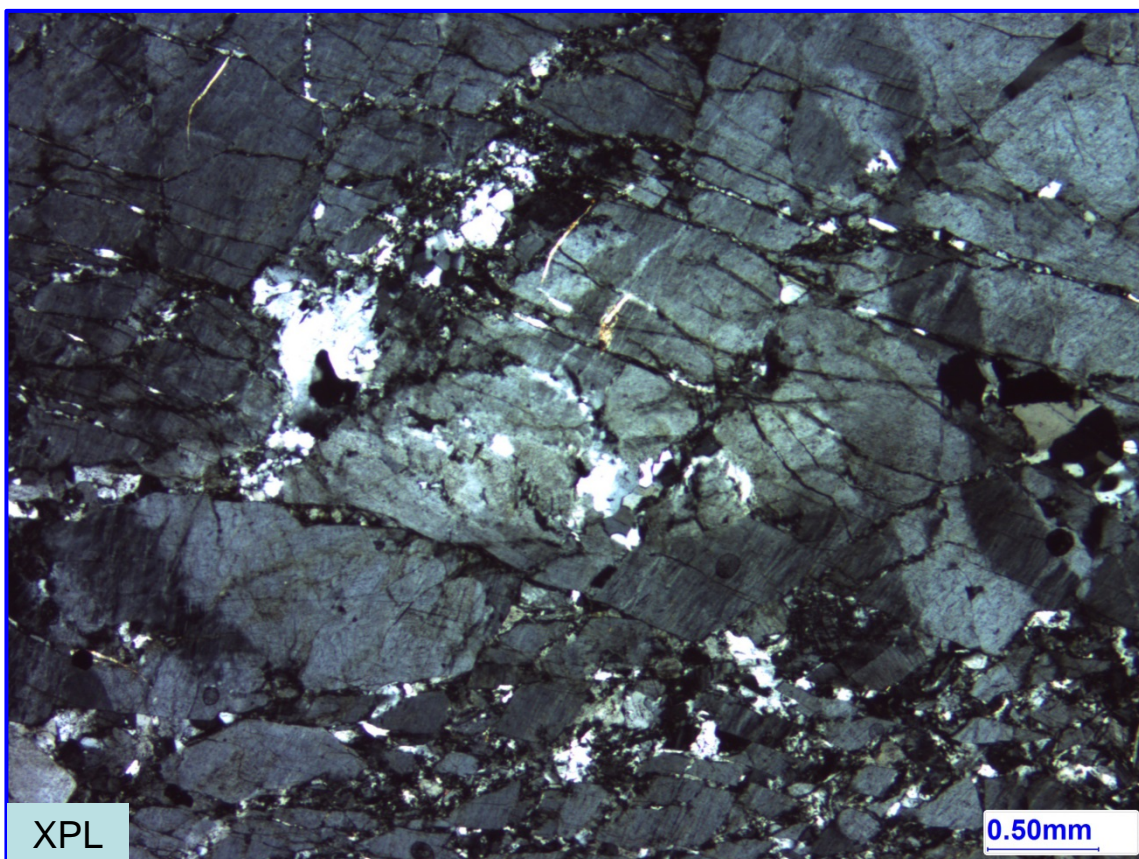
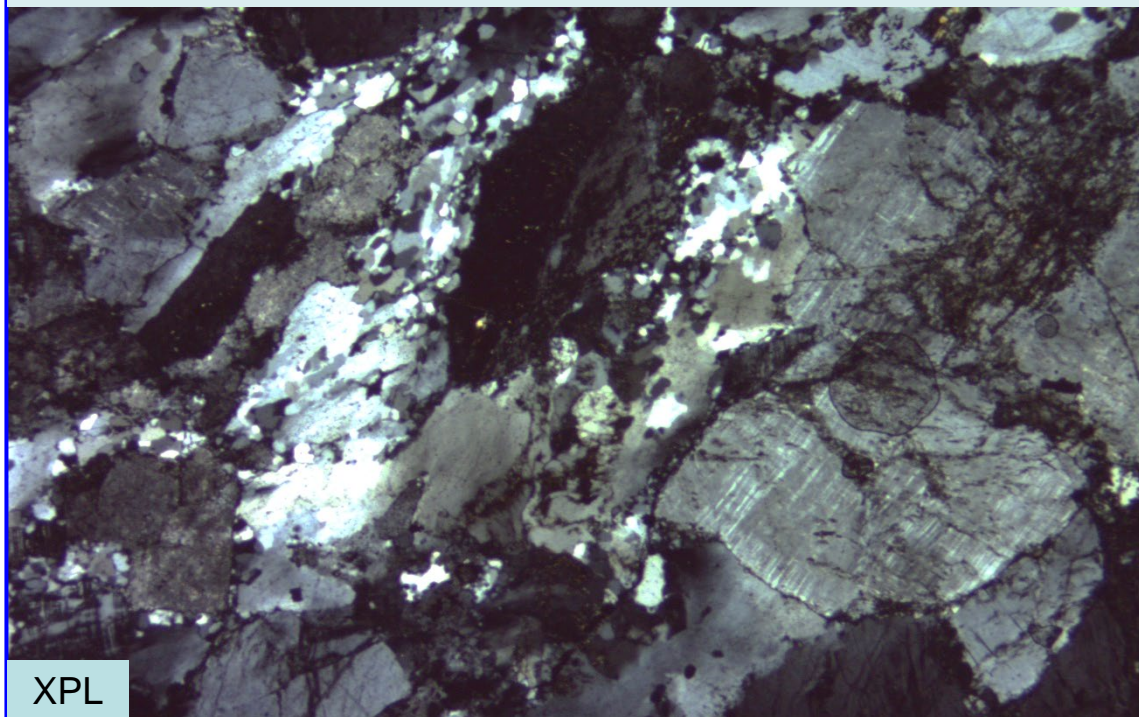
**Chips 2 and 3** in this slide consist solely of pyrite hosting rare, small quartz and pale brown carbonate spots. The pyrite appears to have annealed smaller grains into these larger aggregates with little or no trace of original grain margins. Sulfide **chip 1**, in contrast, consists of brecciated pyrite hosting streams of chalcopyrite, each making up about half of this chip. **The remaining chips** are all strongly fractured microcline-phyric granites with blocky fresh microcline crystals to ~6mm long, in a quartz-microcline-albite groundmass. An irregular crush fabric pervades all chips, and is mainly defined by hairline fractures sets and seams of recrystallized fine-grained quartz that in places show a fabric suggesting almost ductile deformation. In these grains, original quartz is streamed out into elongate, highly strained grains with abundant subgrain deformation, whereas the plagioclase and microcline crystals show only brittle fracturing. **Chip 7** shows a domain in which rosettes of coarse white mica are common, intergrown with interstitial chalcopyrite and euhedral quartz, and a few small crystals of deep yellowish brown scheelite(?).



**SAMPLE NUMBER**

TAL136 114-116m

Both images: Cataclasized granite with feldspars with brittle fracturing and quartz showing more ductile deformation, with strong internal deformation and subgrain recrystallization

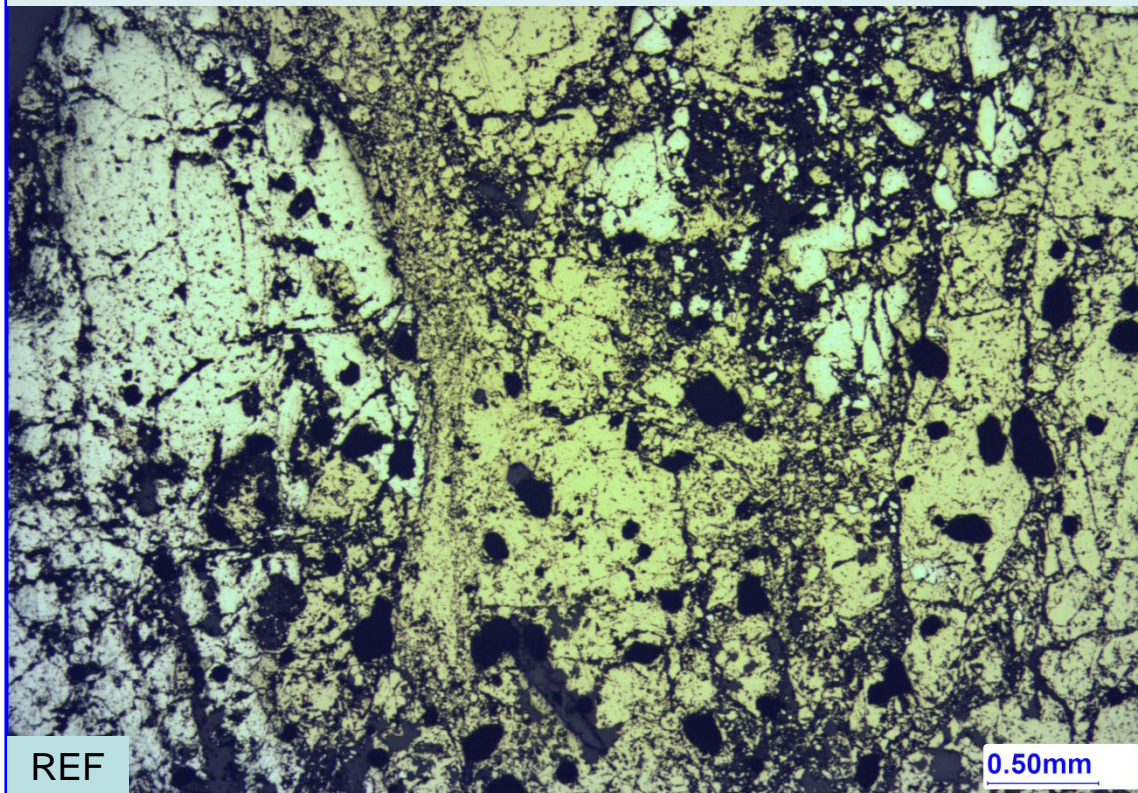




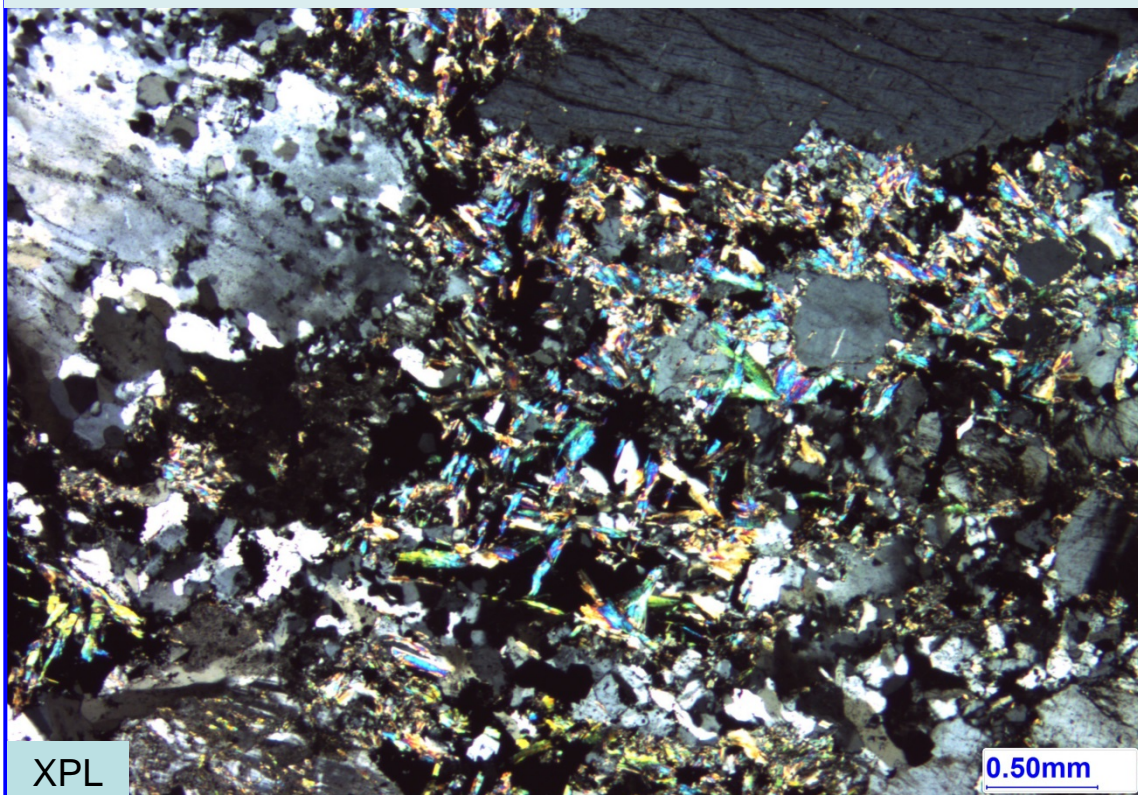
**SAMPLE NUMBER**

TAL136 114-116m

Brecciated pyrite aggregate enclosed in chalcopyrite, chip 1.



Intergrowth of coarse white mica, interstitial chalcopyrite, and quartz, chip 7.

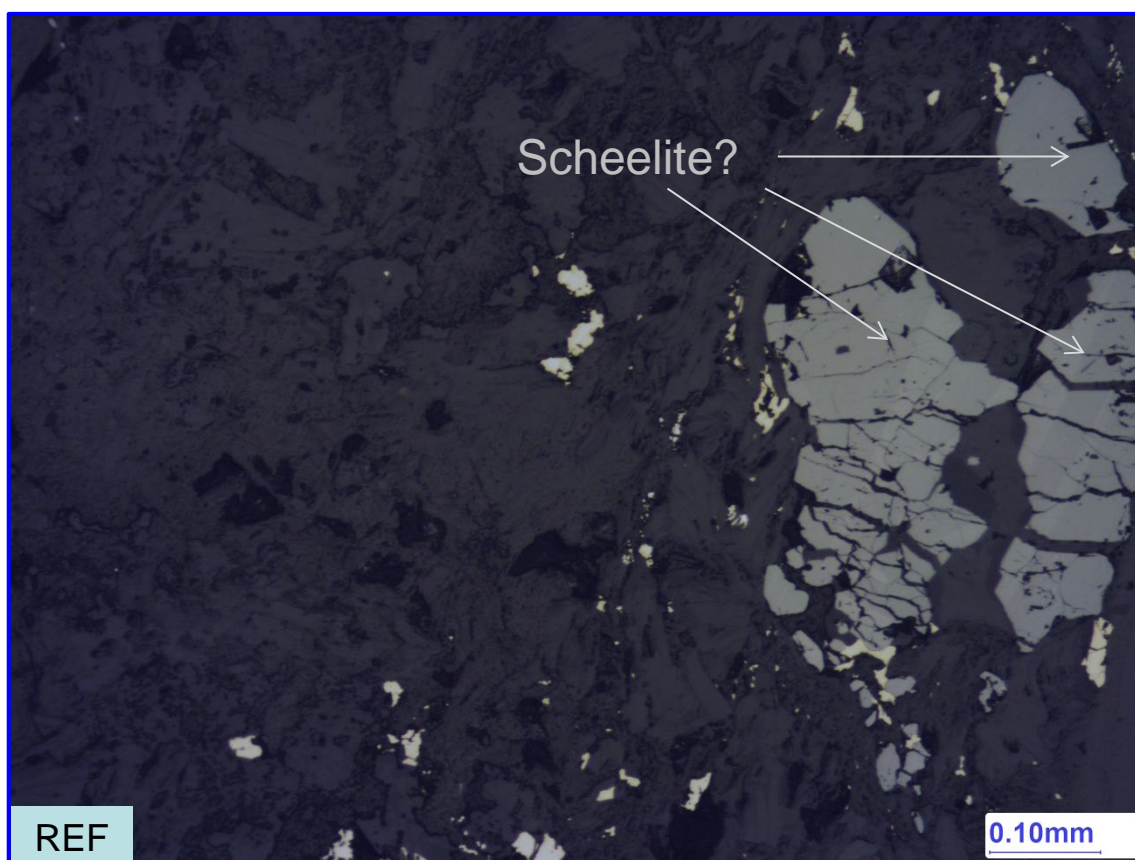
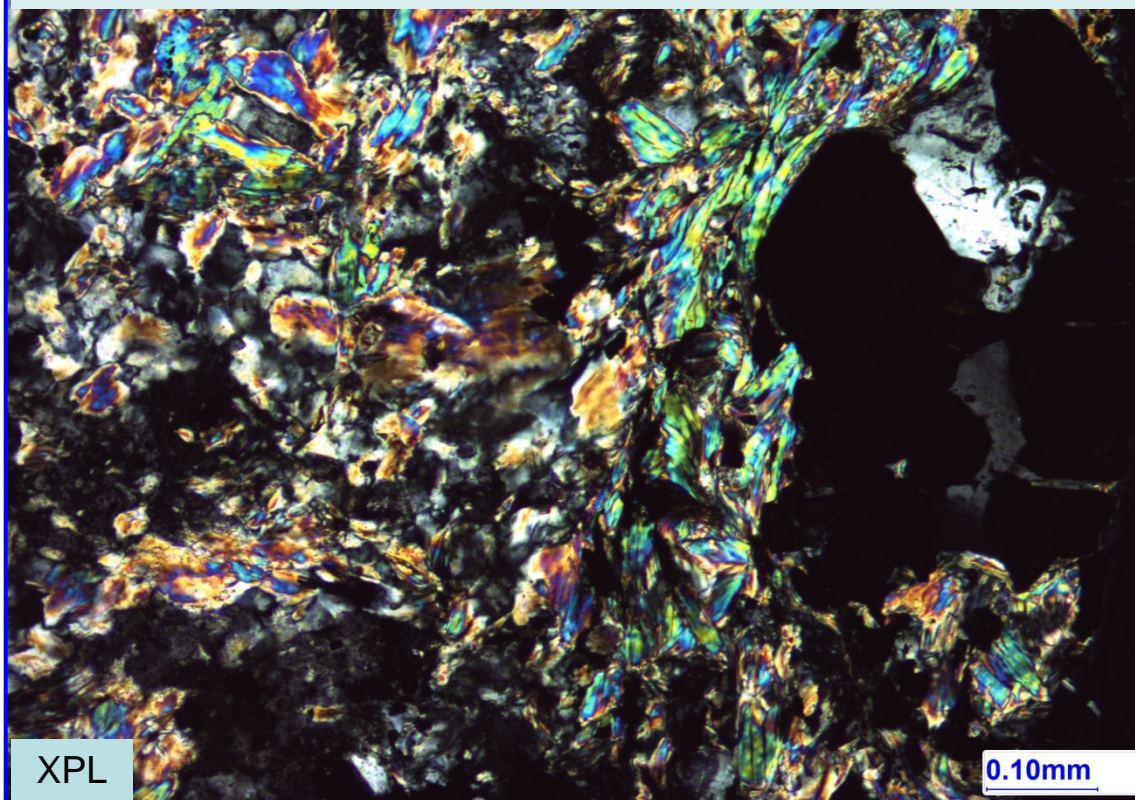




**SAMPLE NUMBER**

TAL136 114-116m

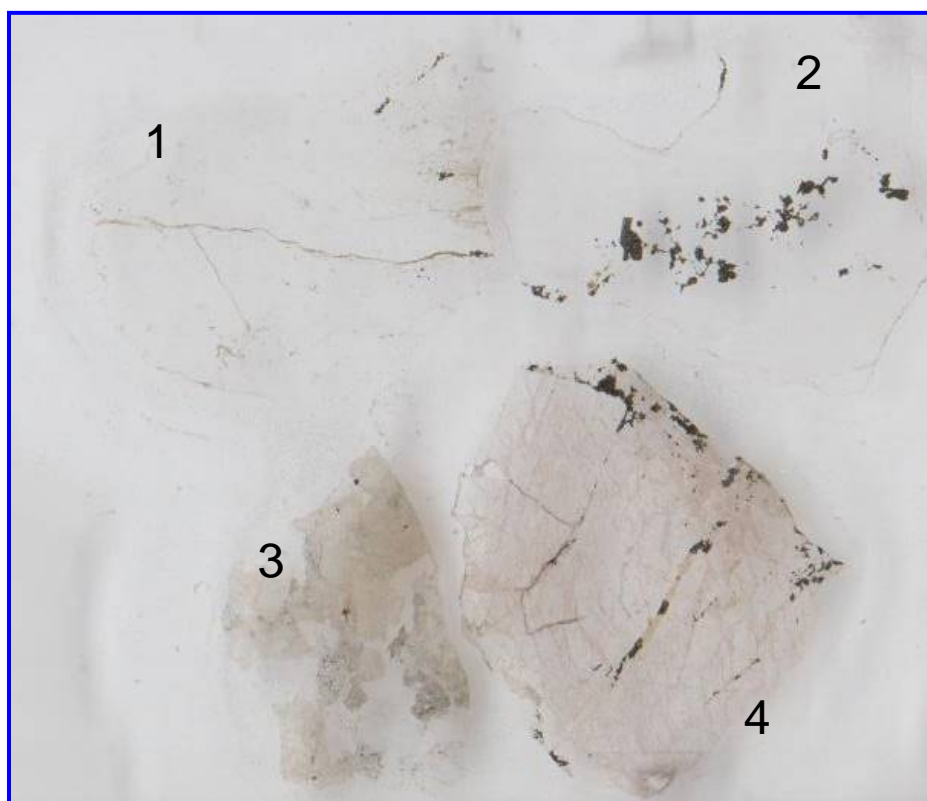
Small scheelite crystals (black) intergrown with white mica and quartz (chip 7).





## SUMMARY

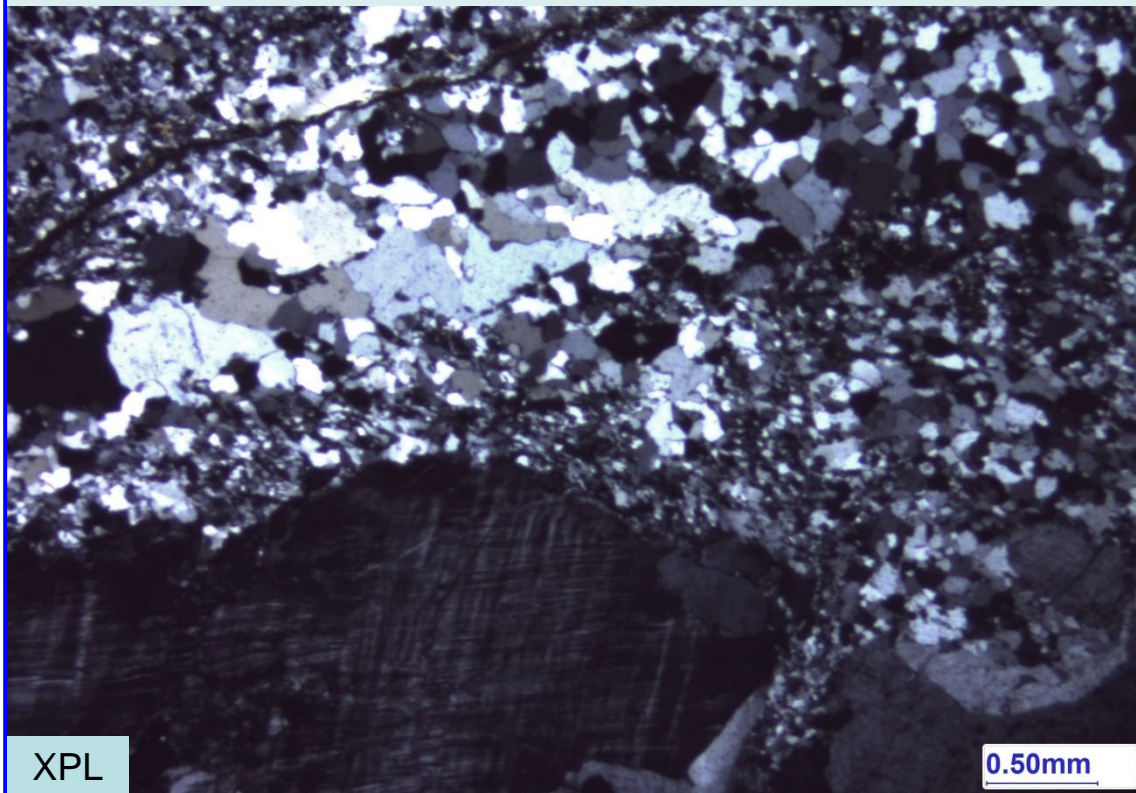
*All four chips are derived from a microcline-phyric granite protolith and show variable extents of deformation and veining. Feldspars show intense fracturing in three chips, and in two of these, quartz veins form a large proportion of the chip and show diverse textures, indicative of multi-stage veining and deformation. In **chip 2**, the quartz vein host spotty, fine-grained pyrrhotite and chalcopyrite intergrown with quartz, but lacking associated phyllosilicates. **Chip 3** is less smashed than the other three chips, and includes strained quartz, chloritized biotite, fresh microcline, and plagioclase that is largely replaced by fine-grained sericite. **Chip 4** includes a large, fractured microcline phenocryst with narrow seams of tourmaline and chalcopyrite, and local patches of white mica – quartz-chalcopyrite alteration.*



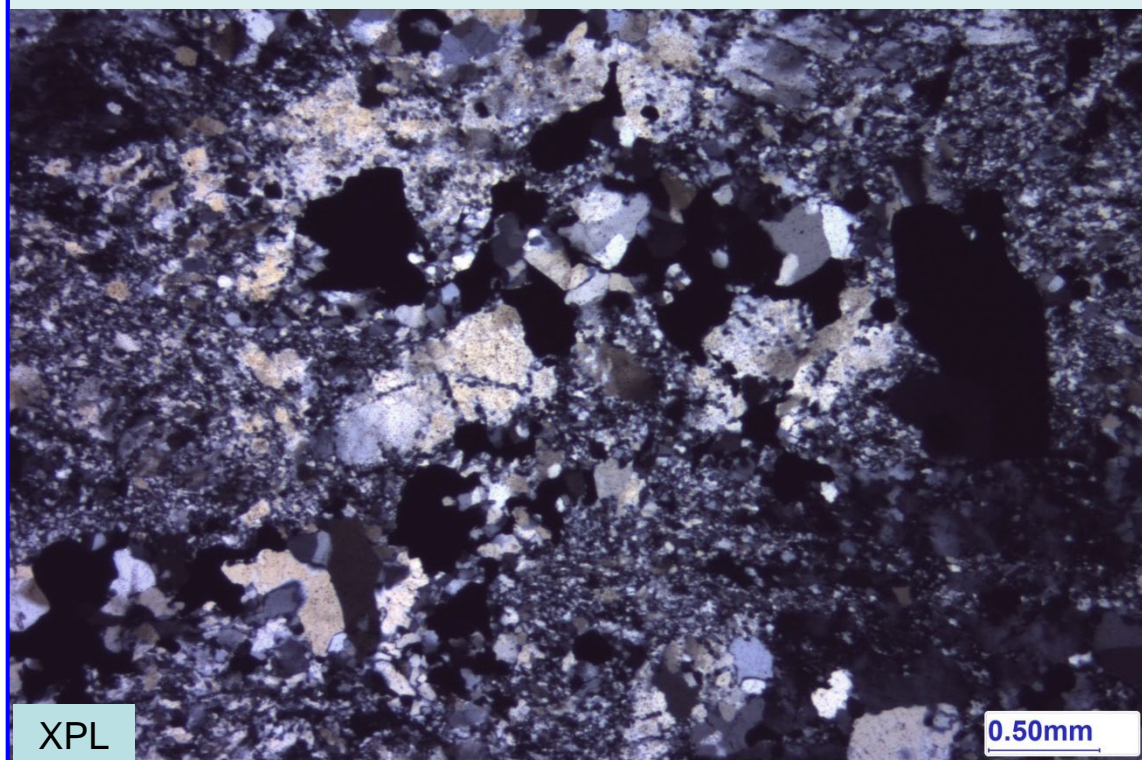
**SAMPLE NUMBER**

TAL136 116-119m

Heavily quartz-veined microcline-phyric granite, chip 1.

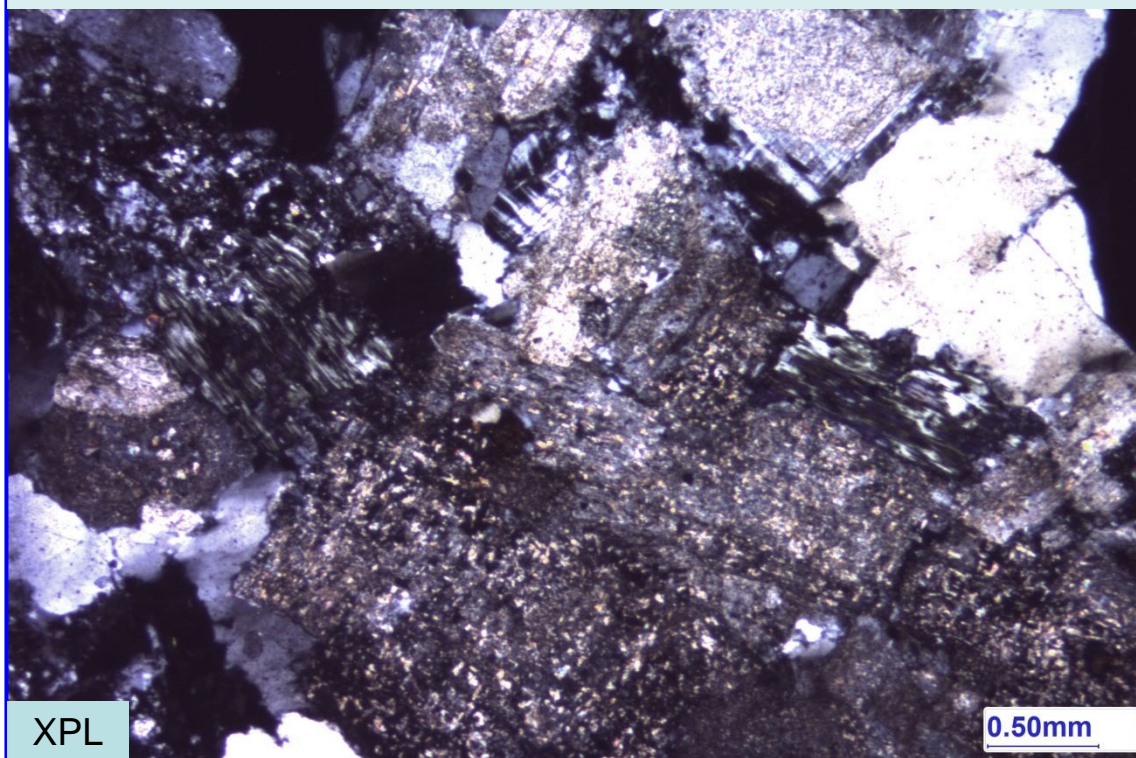


Cataclasized and altered granite with quartz veins, with disseminated pyrrhotite and chalcopyrite.

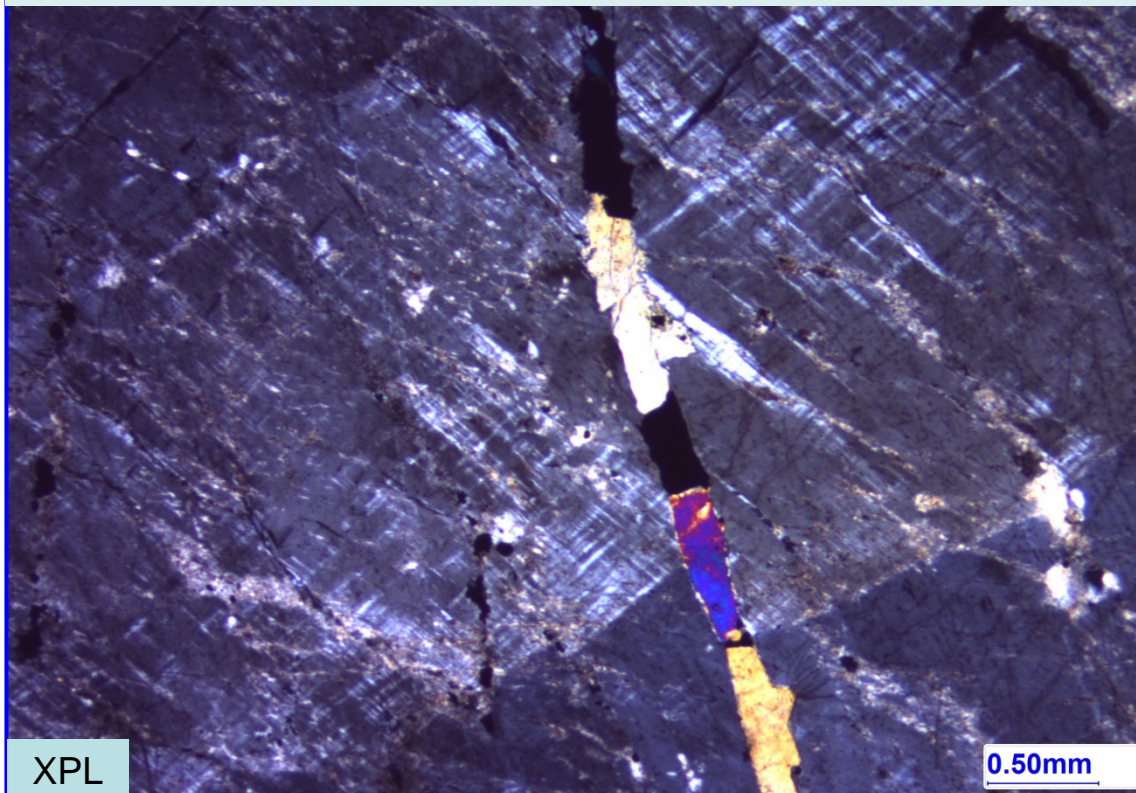




Chip 3: Granite with sericit3-altered plagioclase, strained quartz and chloritized biotite

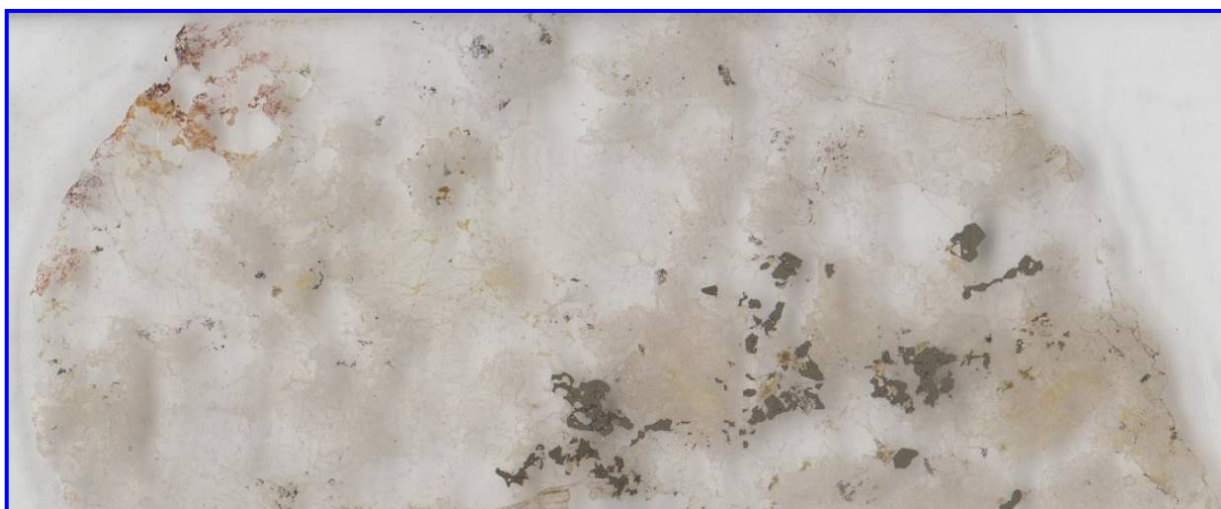


Chip 4: Microcline phenocryst with veinlet composed of tourmaline & chalcopyrite



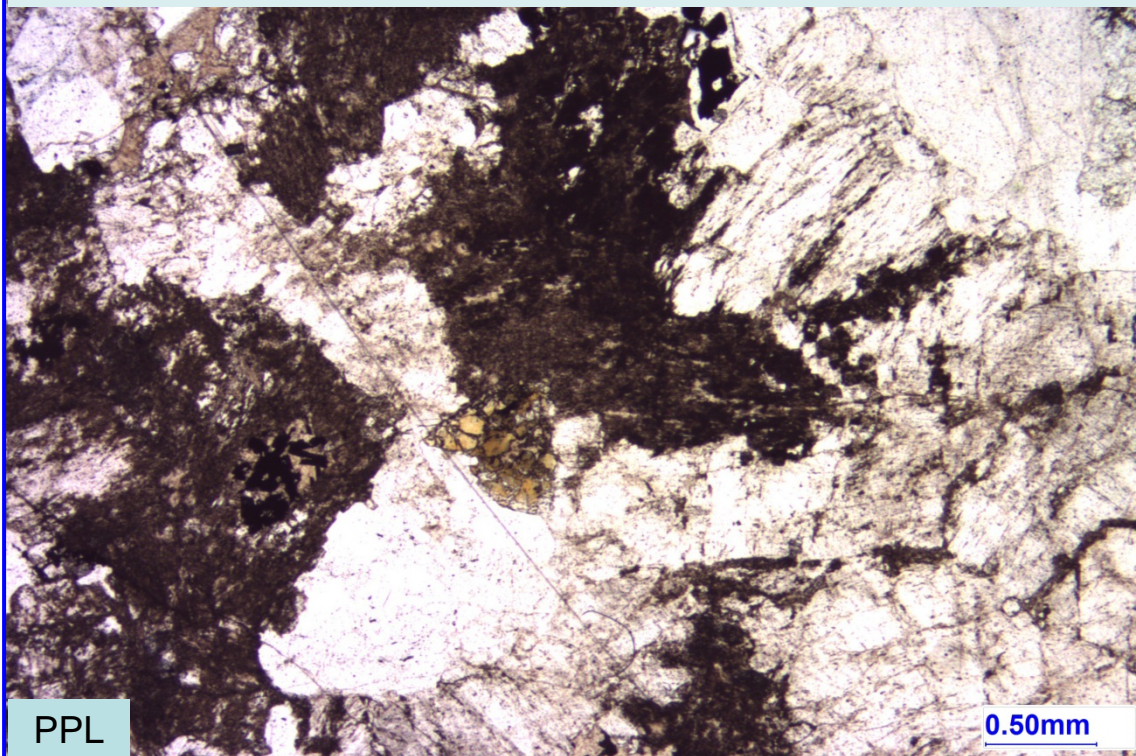
## SUMMARY

*This is a moderately weathered, slightly hydrothermally altered granite that differs from the preceding samples in lacking microcline phenocrysts (at least at the scale of the thin section), and also lacking the strong fracturing that characterizes the samples described above. Patches of granophyre are common in this rock, marked by distinctive intergrowths of quartz and microcline. Away from the hydrothermal alteration patches, microcline is quite fresh, and plagioclase is peppered with fine sericite and often shows almost isotropic clayey weathering. Biotites are replaced by chlorite that hosts common tiny titanite crystals. Diffuse patches of tourmaline – pyrrhotite – chalcopyrite hydrothermal alteration (evident as darker zones in scanned image below) are present, but there is no associated white mica.*

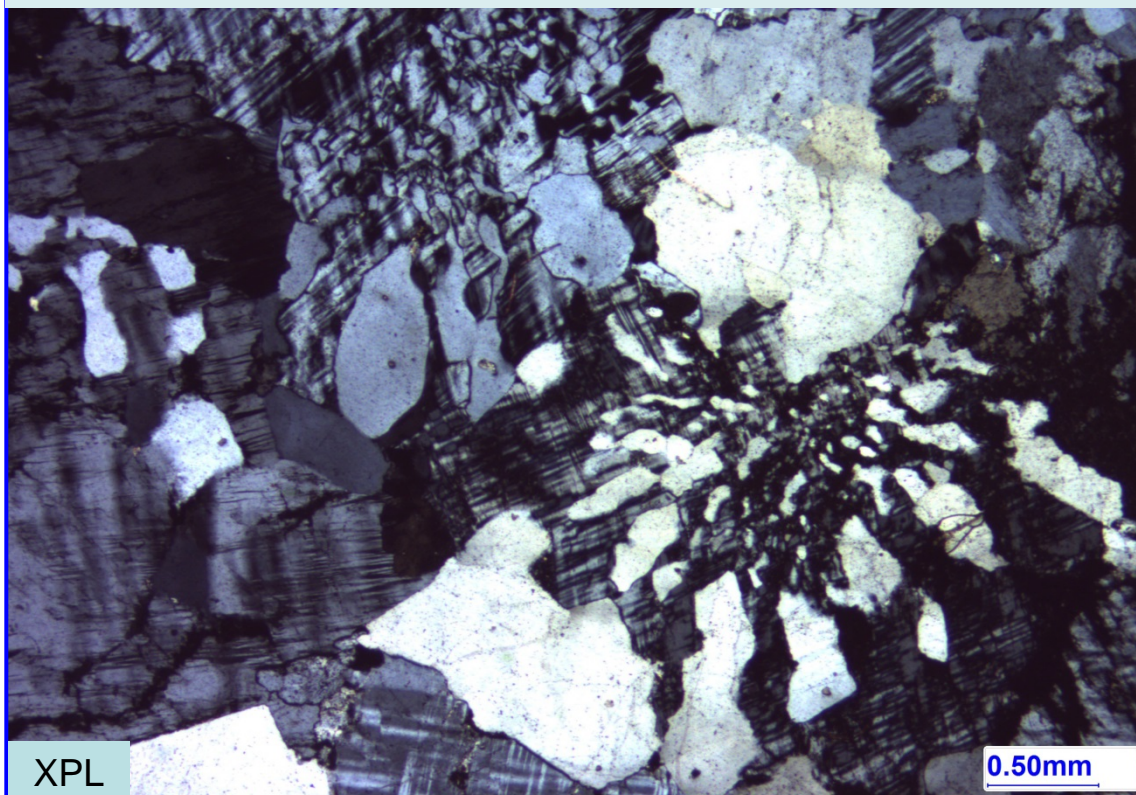




Small yellowish tourmaline crystal in cross section, with quartz, clay-altered plagioclases, and fresh microcline.



Granophyric-textured patches in granite, with fresh microcline





Cluster of tourmaline crystals in patch of quartz-tourmaline sulfide (chalcopyrite-pyrrhotite) alteration

