

PETROGRAPHIC REPORT

9 Rocks from Drillhole MXUD01,
Upper Sterling Valley,
W Tasmania

for
Unity Mining
(attn. Mike Blake)
1/2/2013

Dr Anthony J Crawford
A & A Crawford Geological Research Consultants

493 Tinderbox Rd, Hobart,
TAS, Australia 7054
Phone: 61-3-62293831

E-mail: Tony.Crawford@utas.edu.au
Mobile 0487186659

Petrographic Summary Report

Background

Nine samples from diamond hole MXUD01 Unity's tenements at the head of the Sterling valley were submitted for thin section examination to attempt to better characterize the rocks with respect to defining their rock type and alteration style.

All nine samples were prepared as standard (unpolished) thin sections on the basis of their lacking significant opaque phases. Both core slice offcuts and thin sections were scanned, and these scanned images are incorporated in the description of each sample to provide visual detail on the rocks examined and complement the representative photomicrographs provided.

Table 1 provides summary petrographic data for the rocks examined. A detailed core log for this drillhole was provided. A summary of the finding is presented below.

Summary and Implications

All but one sample, a strongly plagioclase-phyric andesite from 107.4m depth, are volcanoclastic metasediments varying in grainsize from siltstones to granule conglomerates. Clasts in all samples are the same assemblage, being dominated by detrital, often broken plagioclase phenocrysts and diverse fine-grained volcanic lithic clasts that are typically variably plagioclase-phyric felsic to andesitic lavas with groundmasses varying from formerly glassy to microlitic-textured. Plagioclase phenocrysts are typically albitized, but rarely show significant sericite or pale carbonate alteration. Mafic phenocrysts are not present as either detrital grains, nor as phenocrysts in the lava fragments. Importantly, quartz phenocrysts are also absent, both as detrital grains, and as phenocrysts in lithic clasts. The matrix of all these volcanoclastic metasediments probably originally incorporated a significant vitric component (comminuted glassy lithic clasts, probable vitric ash), but now consists of very fine-grained, often murky and turbid sericite-chlorite-carbonate±quartz intergrowths with streaky leucoxene aggregates. A number of samples show a well developed bedding-parallel foliation, and approaching the interpreted Henty Fault position around 170m depth, the rock shows an intense, almost mylonitic foliation.

The complete absence of any detrital quartz in the rocks below the interpreted Henty Fault position does not support their assigned Tyndall Group correlation. ***They show strikingly similar lithologies above and below the fault, and are all interpreted here to be CVC rocks.***

TABLE 1: Summary of Petrographic Features: Upper Sterling Valley Hole MXUD01

Drillhole	Depth (m)	Description
MXUD01	@ 84.8m	<i>A dark grey, indistinctly bedded, probably framework supported, volcanoclastic siltstone in which the dominant clasts are formerly glassy lavas, with subordinate but common tiny detrital plagioclase crystal fragments mainly smaller than 0.1mm long; detrital quartz is absent.</i>
MXUD01	@ 107.4m	<i>A massive, unfoliated, strongly plagioclase-phyric basaltic to andesitic lava characterized by abundant blocky, prismatic plagioclase phenocrysts in a fine-grained microphyric groundmass with a moderate chlorite-sericite-pyrite alteration assemblage.</i>
MXUD01	@ 153.1m	<i>A vaguely banded, weakly to moderately foliated, quite strongly hydrothermally altered clastic rock, probably a volcanoclastic sandstone, dominated by detritus from felsic to intermediate volcanics, including abundant detrital plagioclase phenocrysts and formerly glassy lava clasts.</i>
MXUD01	@ 155.9m	<i>A strongly foliated, almost schistose volcanoclastic rock, probably originally a lithic arenite or granule conglomerate, composed largely of strongly stretched, formerly glassy plagioclase-phyric dacite and rhyodacite lava clasts, with a strong but patchy chlorite-sericite-quartz alteration assemblage and late overprinting carbonate.</i>
MXUD01	@ 170.0m	<i>An intensely foliated, almost mylonitic, pale rock, probably originally a volcanoclastic siltstone, now dominated by fine-grained, often turbid carbonate and sericite intergrowths and tightly folded and locally transposed quartz- and quartz-carbonate veinlets.</i>
MXUD01	@ 170.5m	<i>A matrix-supported volcanoclastic siltstone with common detrital plagioclase grains, moderate development of a bedding parallel foliation, and bedding very vaguely defined by subtle changes in the average grain size and modal abundance of detrital grains. It shows quite strong chlorite-carbonate alteration.</i>
MXUD01	@ 177.2m	<i>A volcanoclastic fine sandstone with the detrital grain population dominated by broken plagioclase phenocrysts and subordinate felsic volcanic clasts, and a well developed probably bedding-parallel foliation. It shows a moderate chlorite-sericite-carbonate intergrowths.</i>
MXUD01	@ 180.9m	<i>An even coarser-grained, matrix-supported volcanoclastic sandstone with diverse volcanic lithic clasts, and abundant plagioclase phenocryst debris in a silty groundmass with a well developed bedding-parallel foliation. Alteration is moderate sericite-chlorite-carbonate.</i>
MXUD01	@ 214.0m	<i>A medium-grained, framework-supported volcanoclastic sandstone dominated by broken fragments of plagioclase phenocrysts (now albitized) mainly 0.5-1mm across. It shows no significant foliation, and a well developed chlorite-sericite-leucoxene±quartz alteration assemblage.</i>

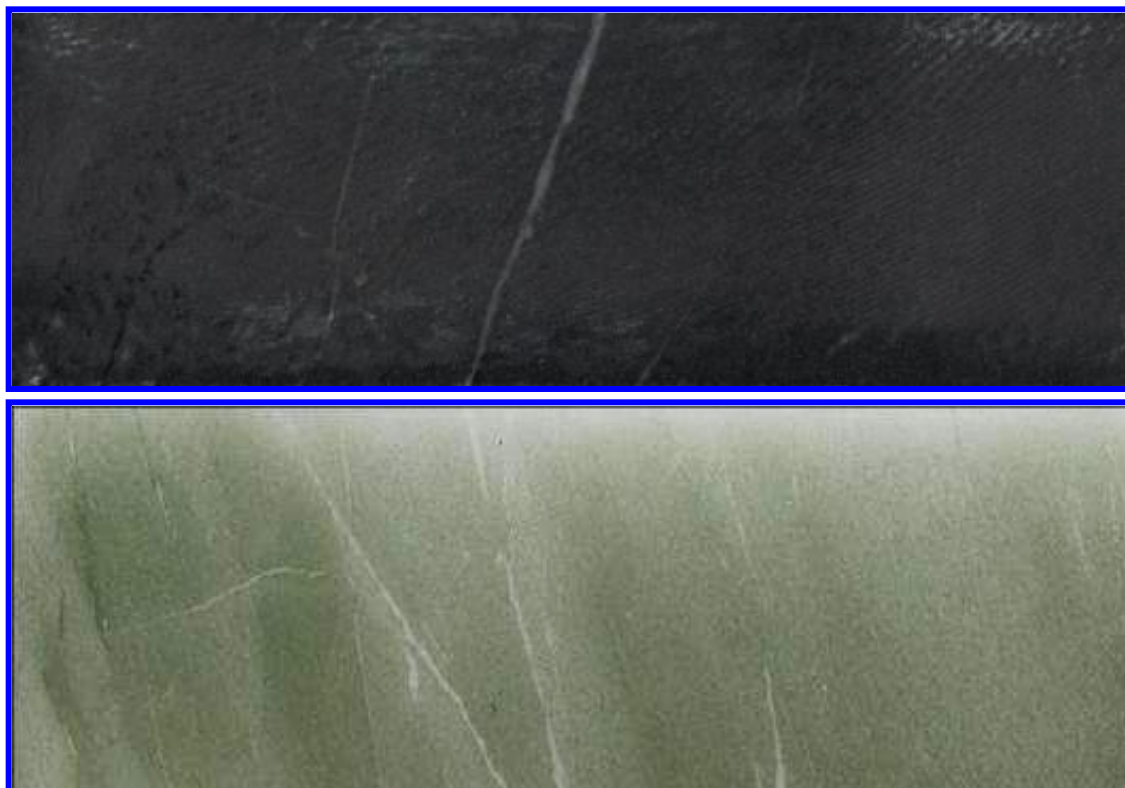
SAMPLE NUMBER

MXUD01 84.8m

PETROGRAPHIC DESCRIPTION

This is a dark grey, indistinctly bedded, probably framework supported, volcanoclastic siltstone in which the dominant clasts are formerly glassy lavas, with subordinate but common tiny detrital plagioclase crystal fragments mainly smaller than 0.1mm long; detrital quartz is absent.

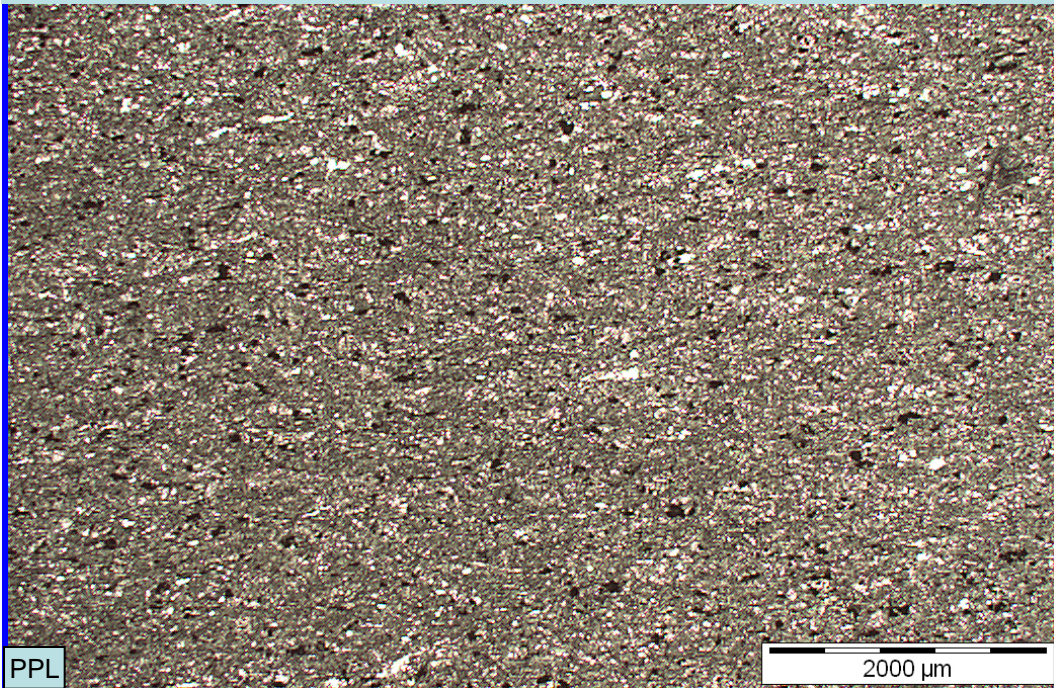
The weak colour banding in the scanned image of the thin section (below) reflects variations in the modal amounts of alteration-related chlorite and pale fine-grained carbonate, and there is no significance difference in the grain size and average modal amount of framework grains across the slide. A very weak foliation or lineation is produced by elongate trails of tiny leucoxene grains after former FeTi oxides, and streaks of green chlorite. Although angular, detrital plagioclase grains are relatively common, they still make up probably <5modal% of the framework grains in this rock, with the remainder being irresolvable and murky grains that were probably originally clasts of glassy felsic lava. Interestingly, very little or no detrital quartz grains are present. Devitrification and alteration of the significant glassy detrital fraction in this rock has produced extensive chlorite, along with subordinate sericite and leucoxene. The alteration contains more chlorite than might be expected in regional (burial) metamorphism of such a volcanoclastic siltstone, and may reflect a hydrothermal component of alteration. A few late, narrow calcite veinlets cut the slide.



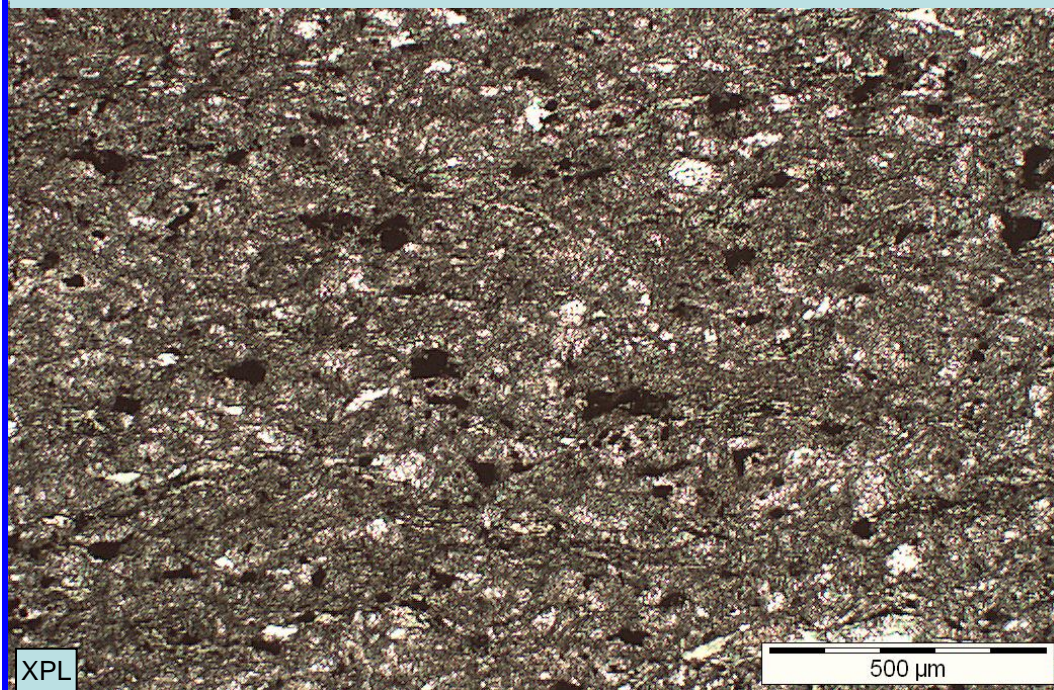
SAMPLE NUMBER

MXUD01 84.8m

Fine-grained volcanoclastic siltstone probably dominated by formerly glassy lithic clasts and occasional detrital plagioclase crystal fragments



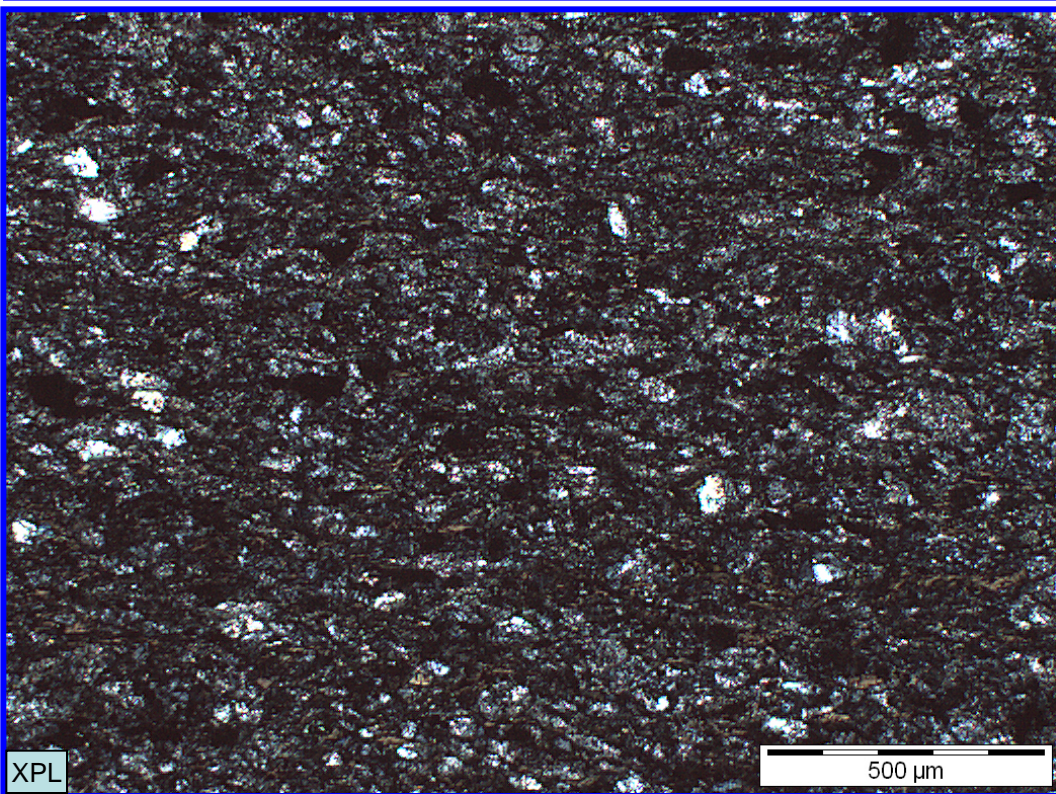
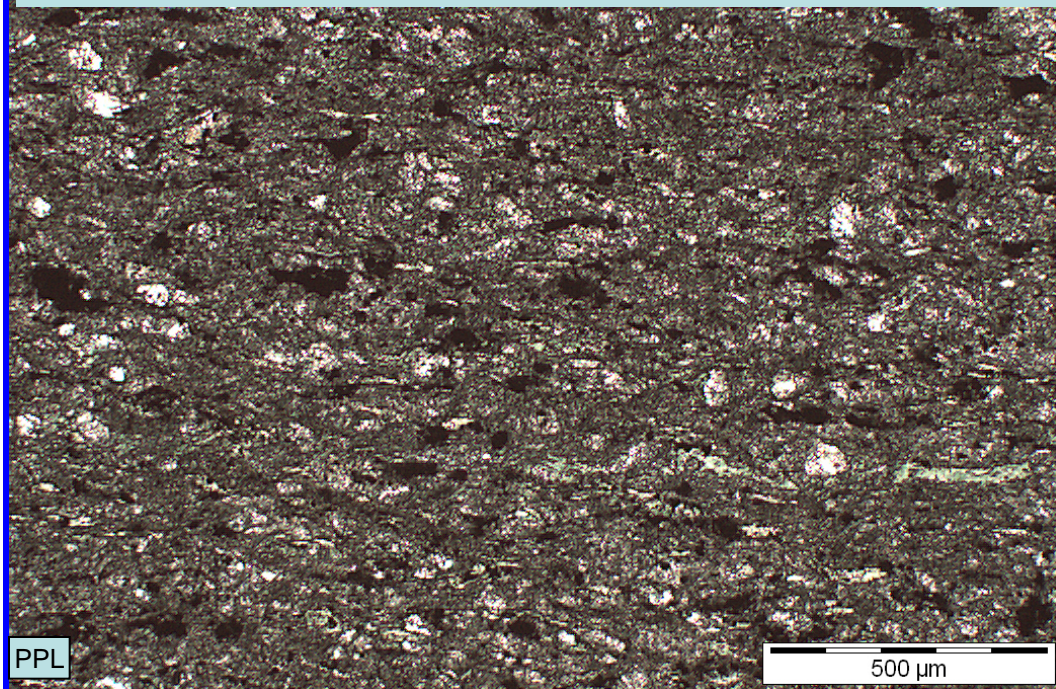
Strong fine-grained chlorite alteration, with dark leucoxene in part replacing former FeTi oxides and in part picking up Ti released by breakdown of glass



SAMPLE NUMBER

MXUD01 84.8m

Detrital plagioclase grains are more evident than altered, formerly glassy lithic clasts



SAMPLE NUMBER

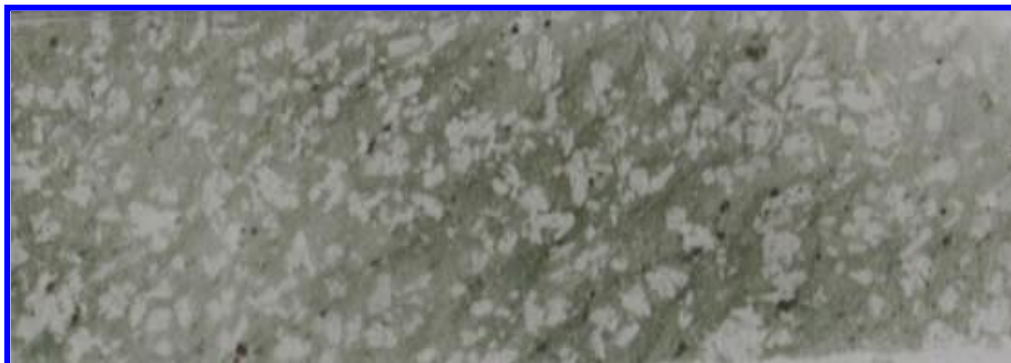
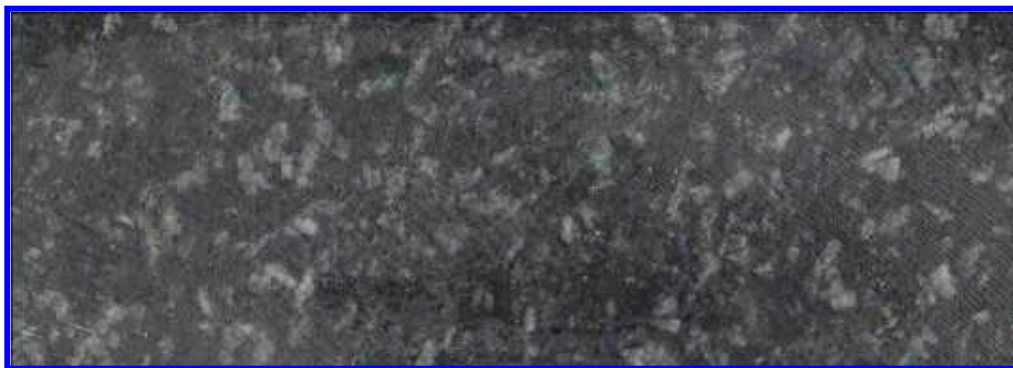
MXUD01 107.4m

PETROGRAPHIC DESCRIPTION

This is a massive, unfoliated, strongly plagioclase-phyric basaltic to andesitic lava characterized by abundant blocky, prismatic plagioclase phenocrysts in a fine-grained microphyric groundmass with a moderate chlorite-sericite-pyrite alteration assemblage.

The plagioclase phenocrysts (around 25-30modal%) are mainly 1-4mm long, often slightly rounded (magmatically resorbed), have been albitized, and are variably but mainly lightly speckled by sericite. Former mafic phenocrysts are rare and include one or two chloritized augite crystals around 1mm long, and ~0.5-1modal% of equant, 0.5-1mm-sized former FeTi oxide phenocrysts that are replaced by chlorite and fine-grained, dark leucoxene. The groundmass consists of a very fine-grained chlorite-sericite intergrowth hosting abundant, small, randomly orientated plagioclase laths and microlites and tiny leucoxene-altered FeTi oxides. Spotty, fine-grained, pale carbonate is developed locally and forms occasional narrow, discontinuous veinlets, and sub-mm pyrite occurs as short trails of crystals in quartz-chlorite veinlets, and rarely as isolated, disseminated crystals.

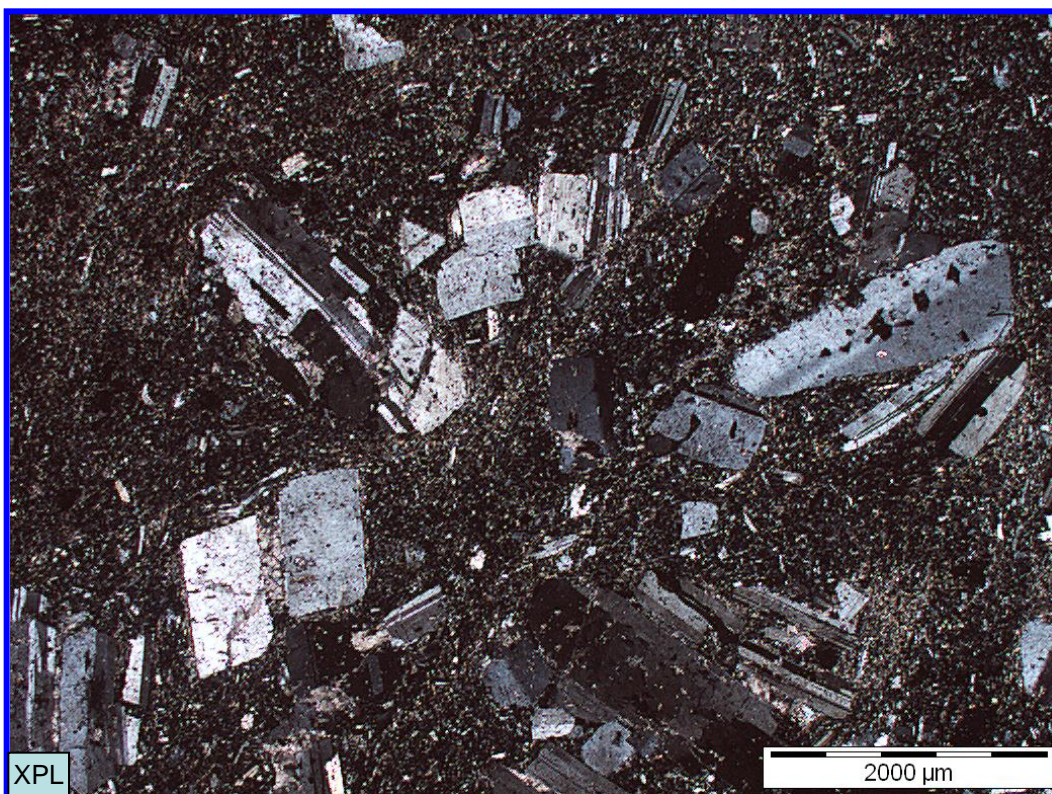
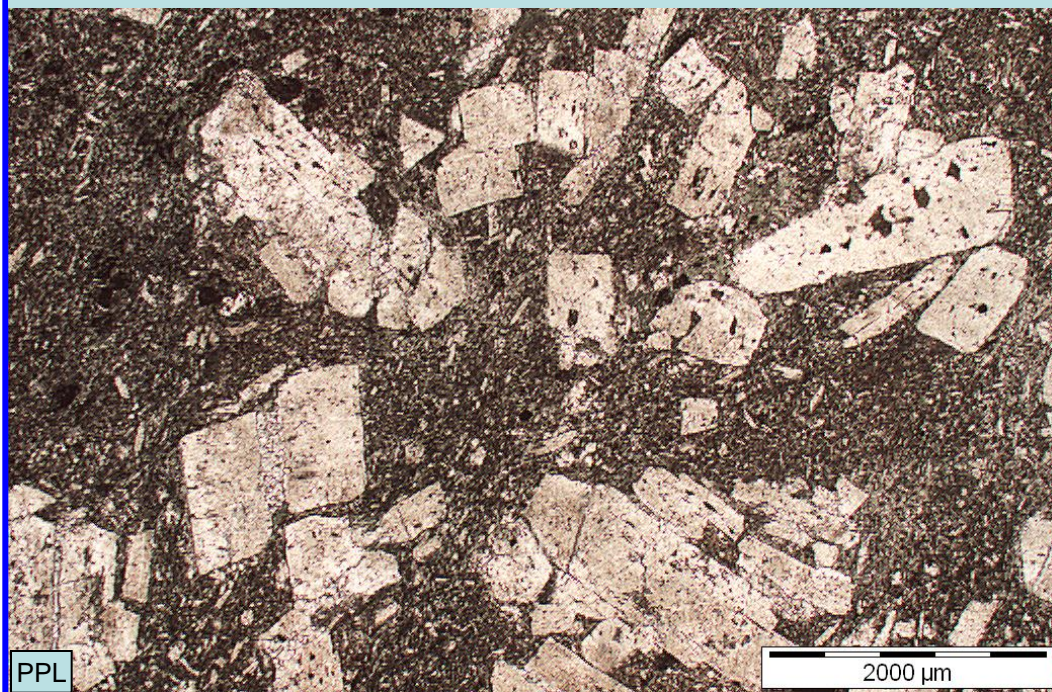
This distinctive lava probably crystallized from an andesitic magma, but by virtue of the abundant plagioclase laths and chlorite altered groundmass probably has a wholerock composition closer to basalt.



SAMPLE NUMBER

MXUD01 107.4m

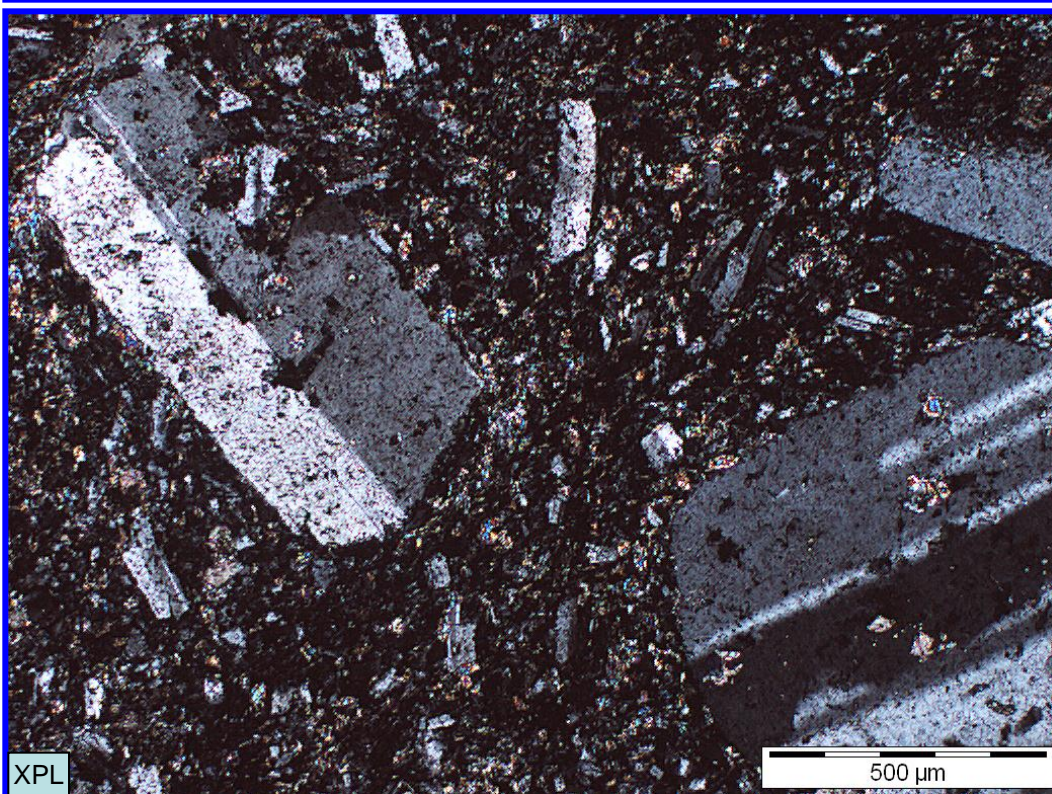
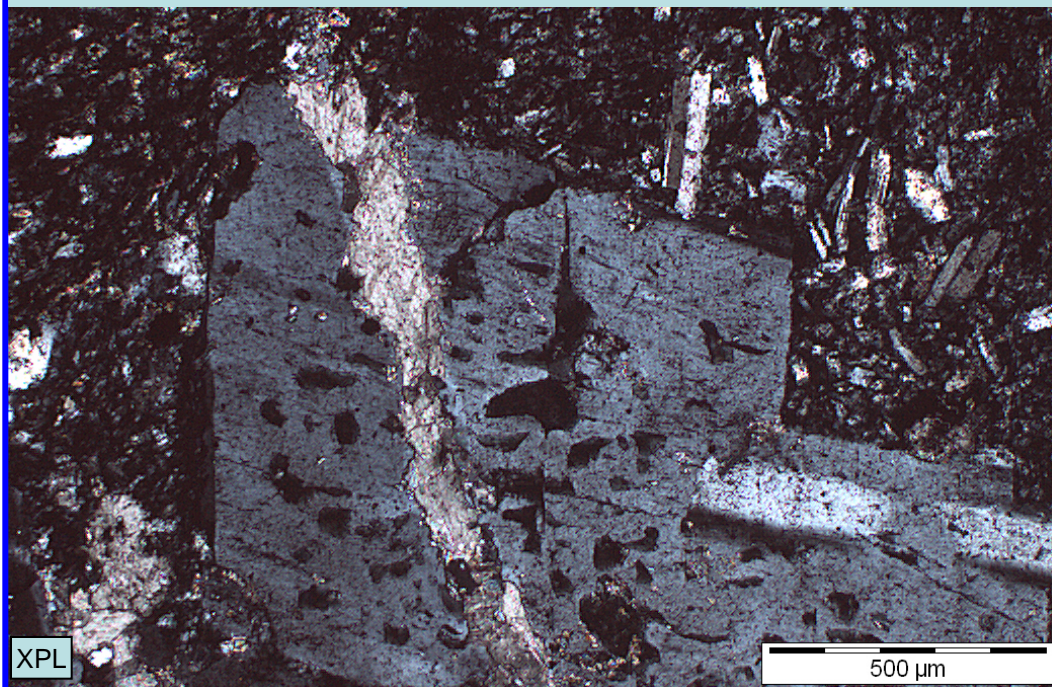
Abundant, blocky, albitized plagioclase phenocrysts in a fine-grained microlitic-textured groundmass



SAMPLE NUMBER

MXUD01 107.4m

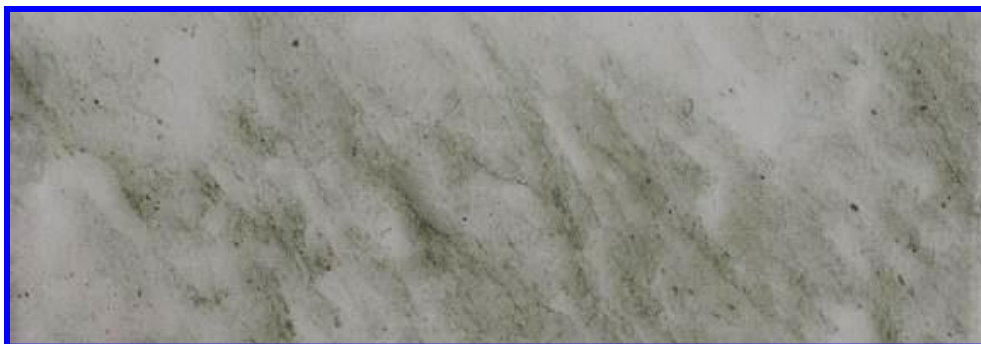
Typical altered microlitic groundmass and albitized plagioclase phenocryst with chloritized melt inclusions, cut by a pale carbonate vein



PETROGRAPHIC DESCRIPTION

This is a vaguely banded, weakly to moderately foliated, quite strongly hydrothermally altered clastic rock, probably a volcanoclastic sandstone, dominated by detritus from felsic to intermediate volcanics, including abundant detrital plagioclase phenocrysts and formerly glassy lava clasts.

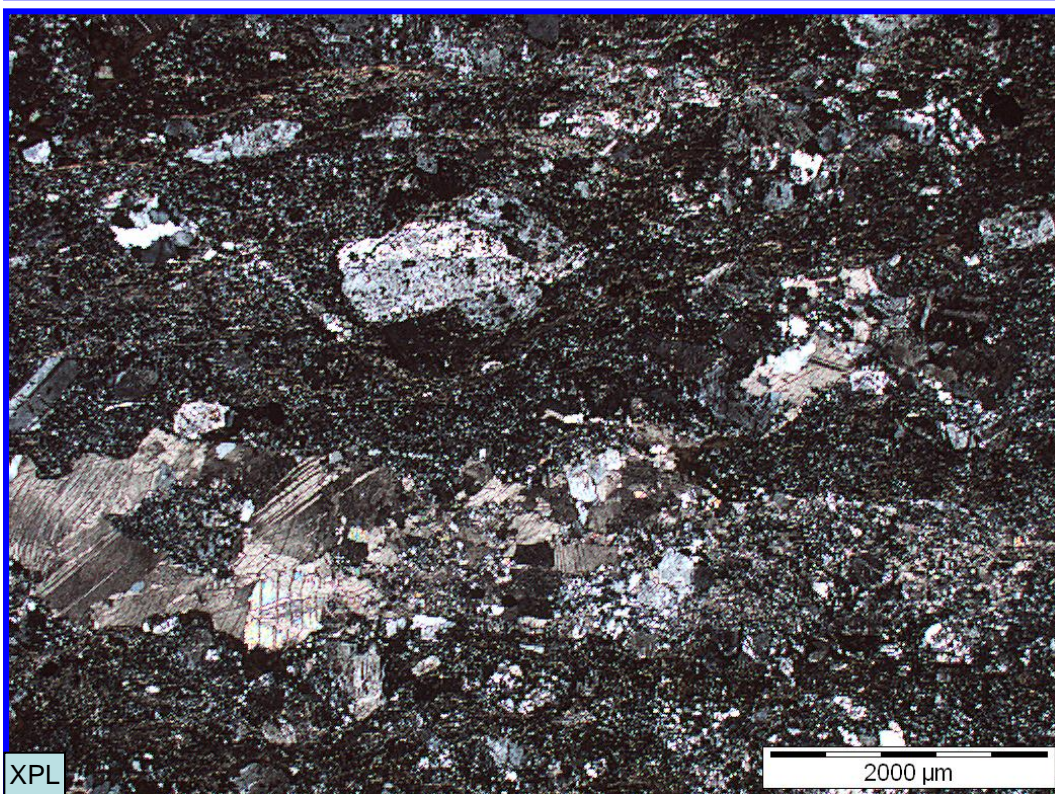
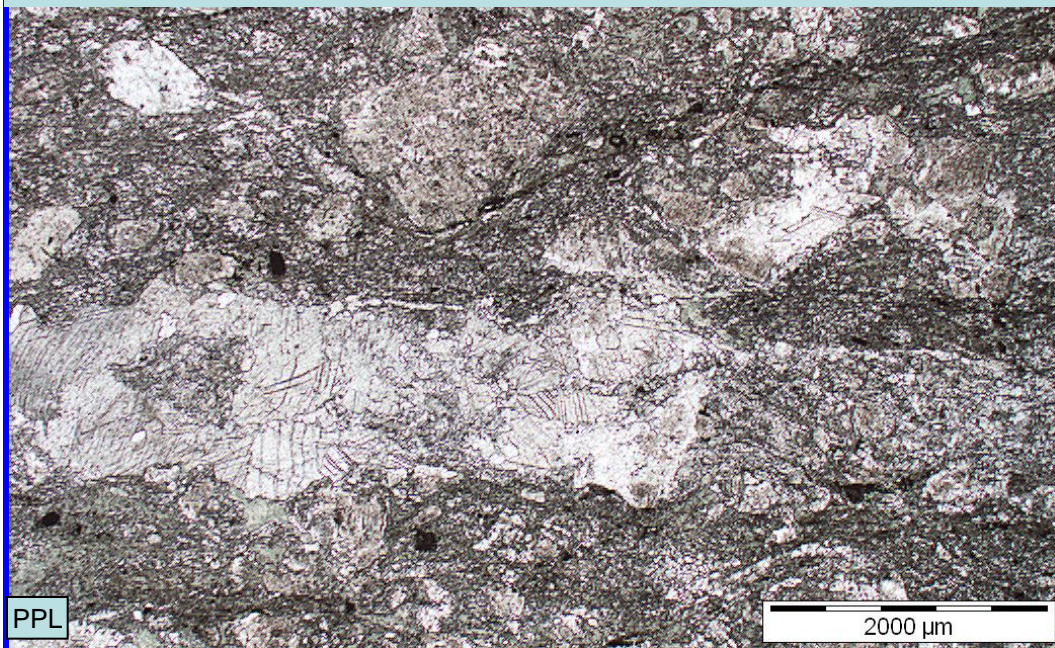
Clasts of mainly formerly glassy felsic lava up to about 5mm across are evident in places due to sharp variations in groundmass textures and abundances of plagioclase phenocrysts, but the similar alteration of these clasts to the vitric ash-dominated matrix makes it difficult to discern the lithic clasts over much of the thin section. Several clasts of plagioclase-phyric dacite preserve excellent perlitic cracks in the devitrified and recrystallized (to fine-grained quartzo-feldspathic intergrowths) groundmass. Changes in the abundance of detrital, often broken and angular plagioclase phenocrysts, from thin laminae or beds that are almost framework-supported and composed largely of detrital plagioclase, to beds almost devoid of detrital plagioclase crystals and composed of quartzo-feldspathic intergrowths riddled with chlorite, sericite and patchy secondary quartz, define an indistinct bedding. Bedding-parallel banding of chlorite-sericite alteration is common and defines the spaced foliation, but is not continuous across the slide. A patchy and variably developed late carbonate alteration is well developed, but the major alteration assemblage is quartz-chlorite-sericite. This sandstone is locally derived from a felsic to intermediate volcanic provenance.



SAMPLE NUMBER

MXUD01 153.1m

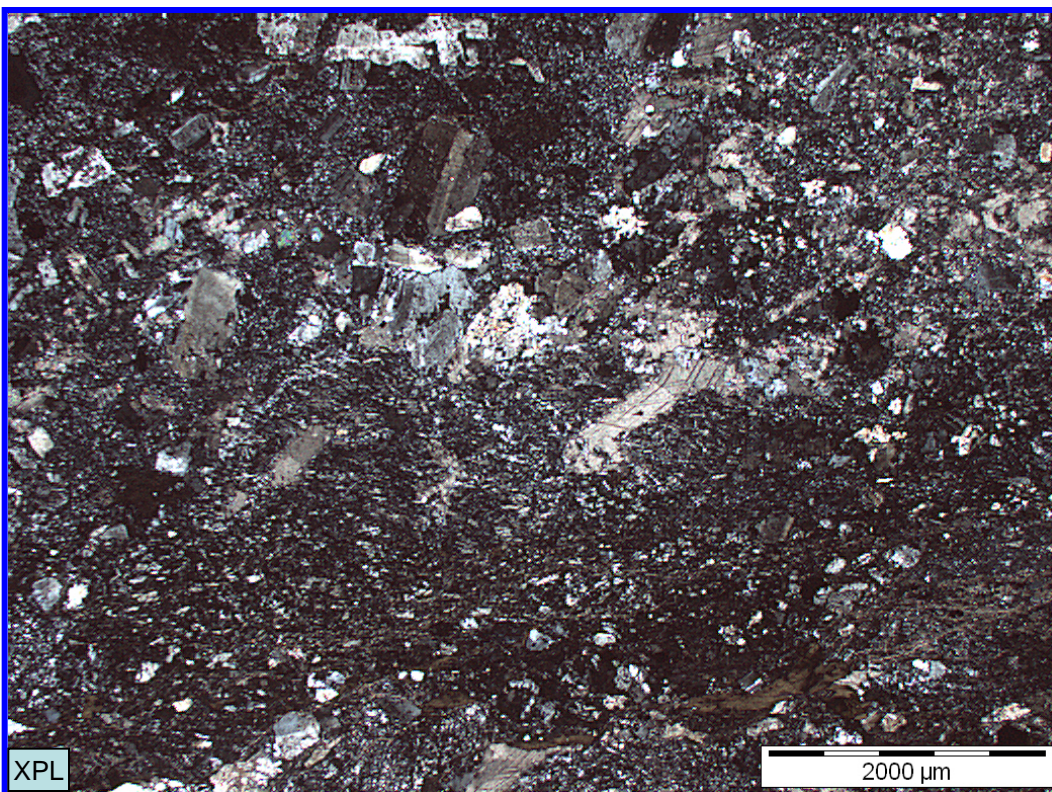
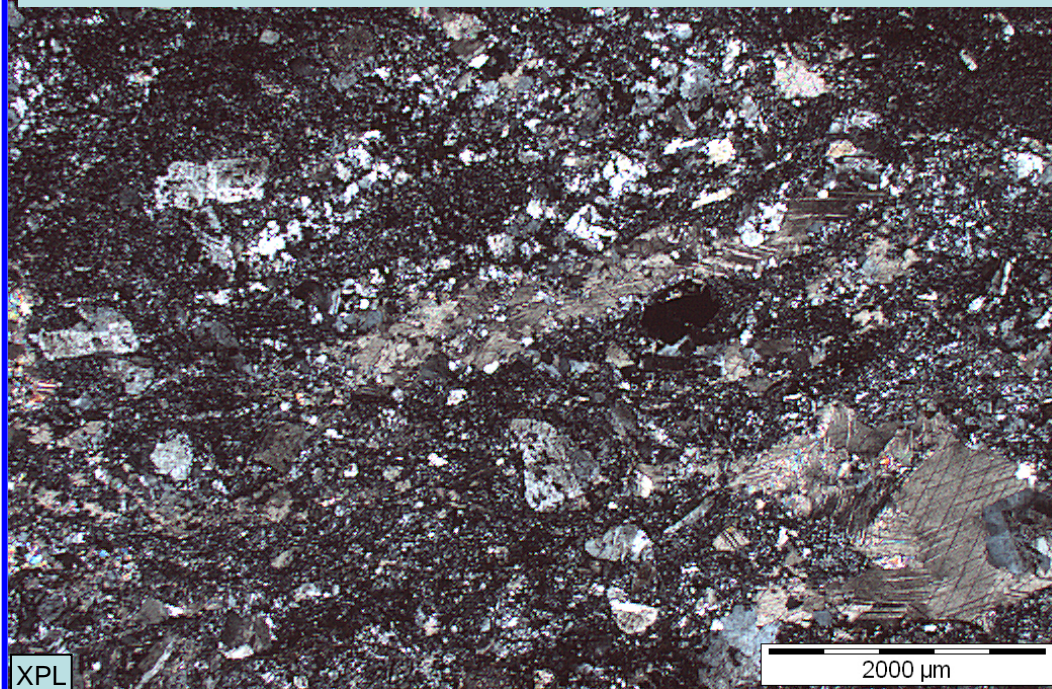
Moderate sericite-chlorite-defined foliation in sandstone dominated by devitrified and recrystallized formerly glassy lithic clasts, plagioclase phenocryst debris and altered, comminuted vitric ash matrix.



SAMPLE NUMBER

MXUD01 153.1m

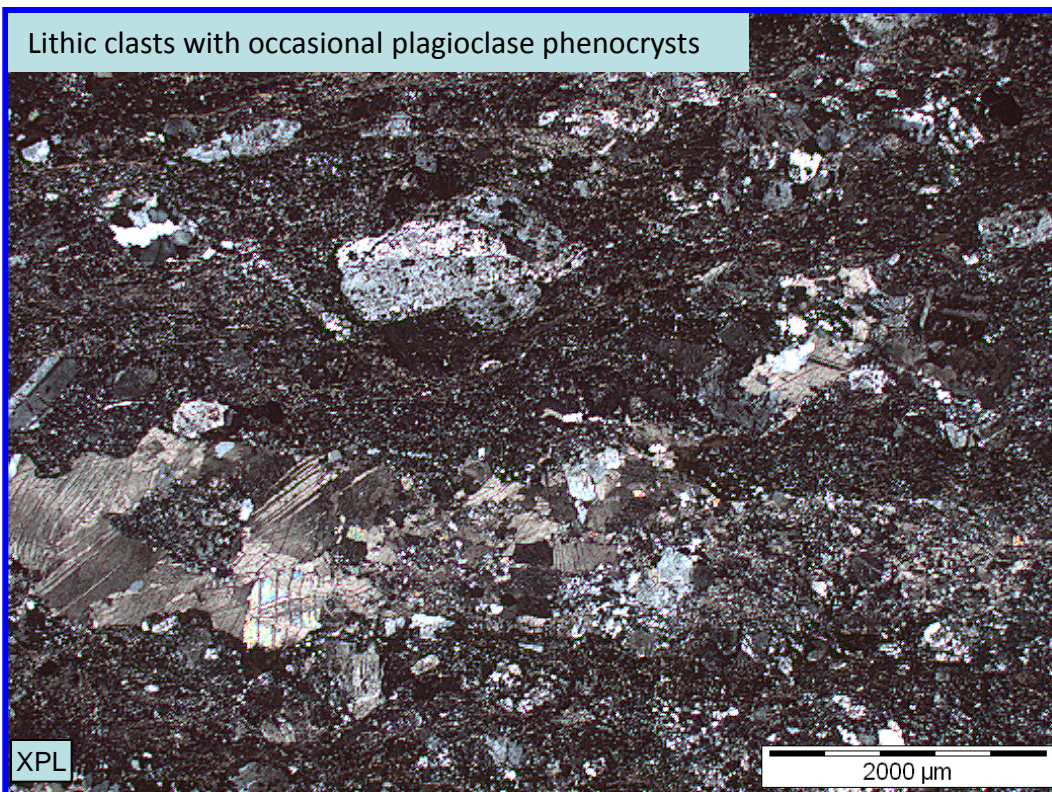
Patchy quartz-sericite-chlorite alteration being overprinted by pale carbonate alteration; note variable abundance of detrital plagioclase crystals



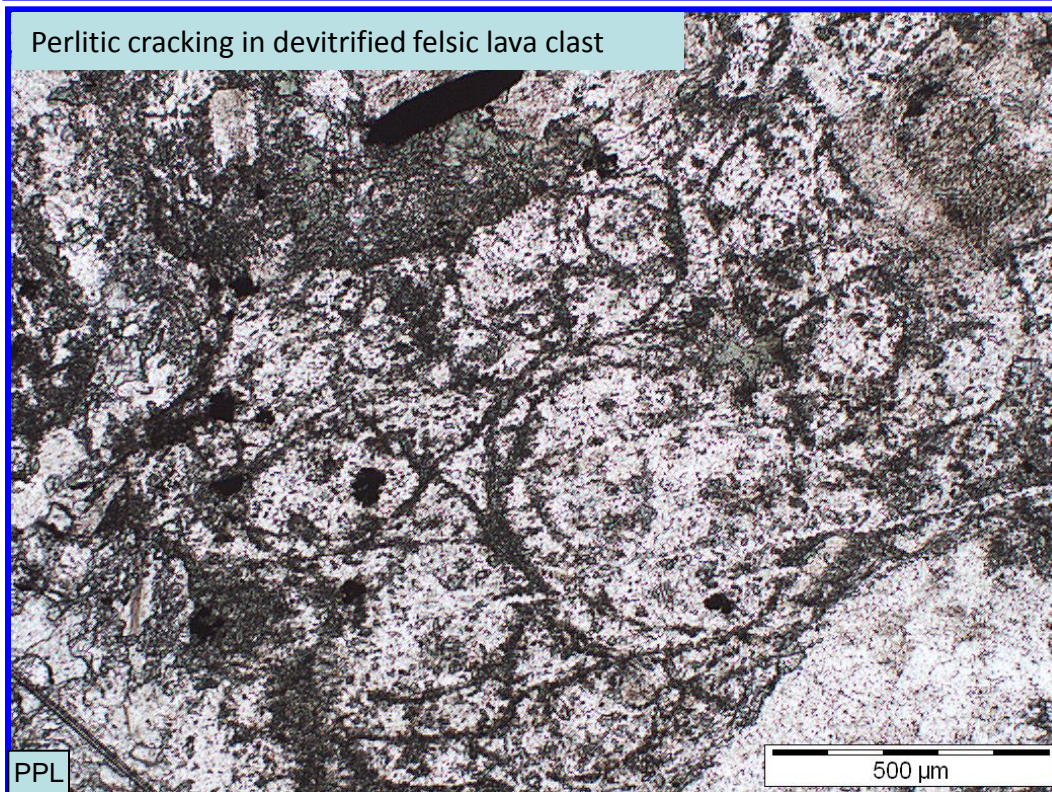
SAMPLE NUMBER

MXUD01 153.1m

Lithic clasts with occasional plagioclase phenocrysts



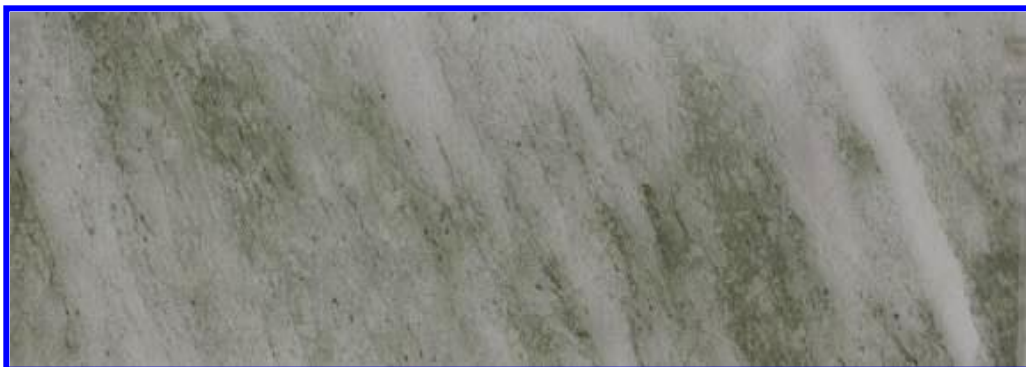
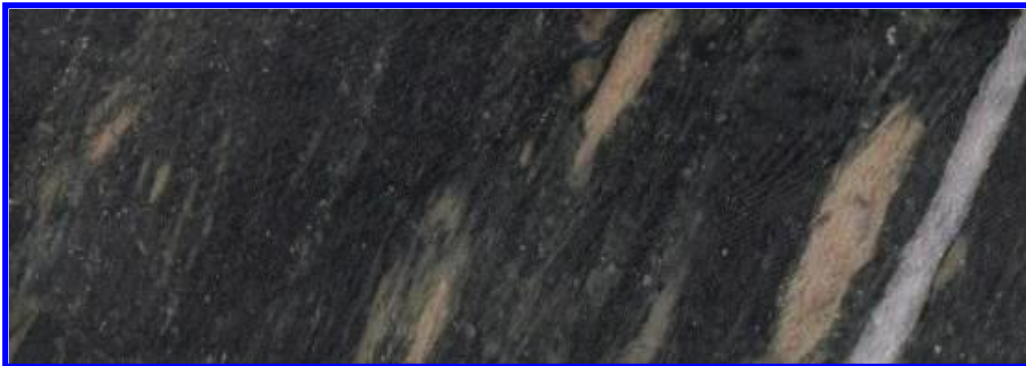
Perlitic cracking in devitrified felsic lava clast



PETROGRAPHIC DESCRIPTION

This is a strongly foliated, almost schistose volcanoclastic rock, probably originally a lithic arenite or granule conglomerate, composed largely of strongly stretched, formerly glassy plagioclase-phyric dacite and rhyodacite lava clasts, with a strong but patchy chlorite-sericite-quartz alteration assemblage and late overprinting carbonate.

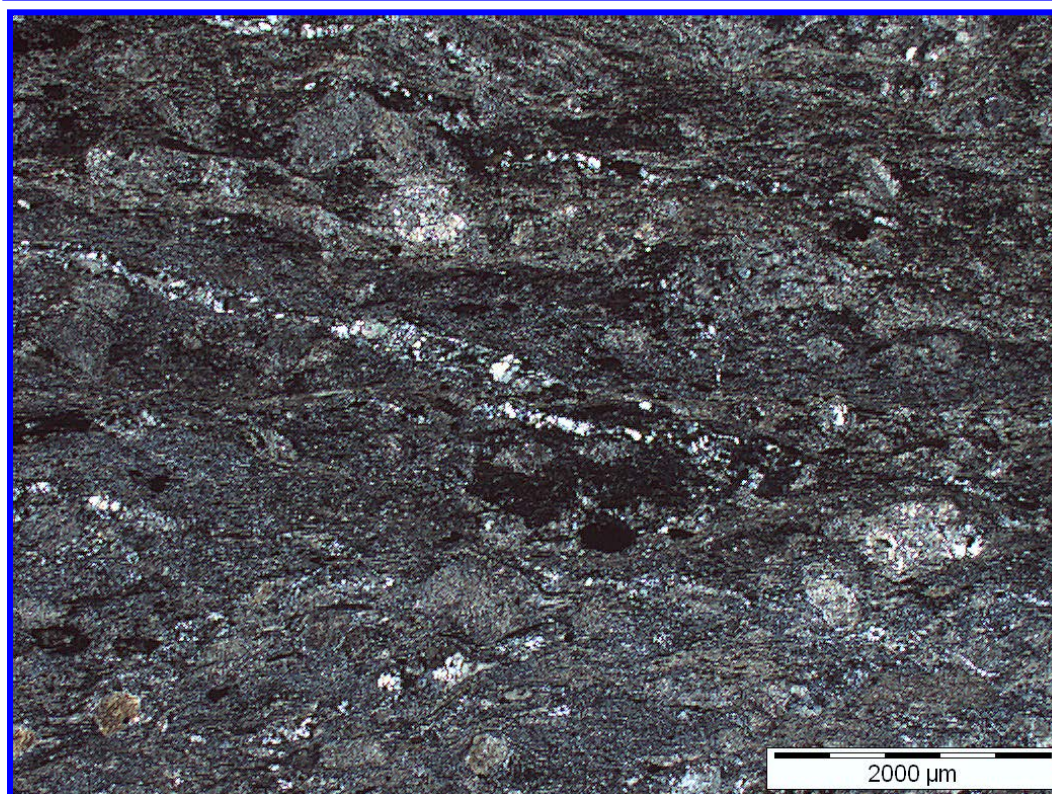
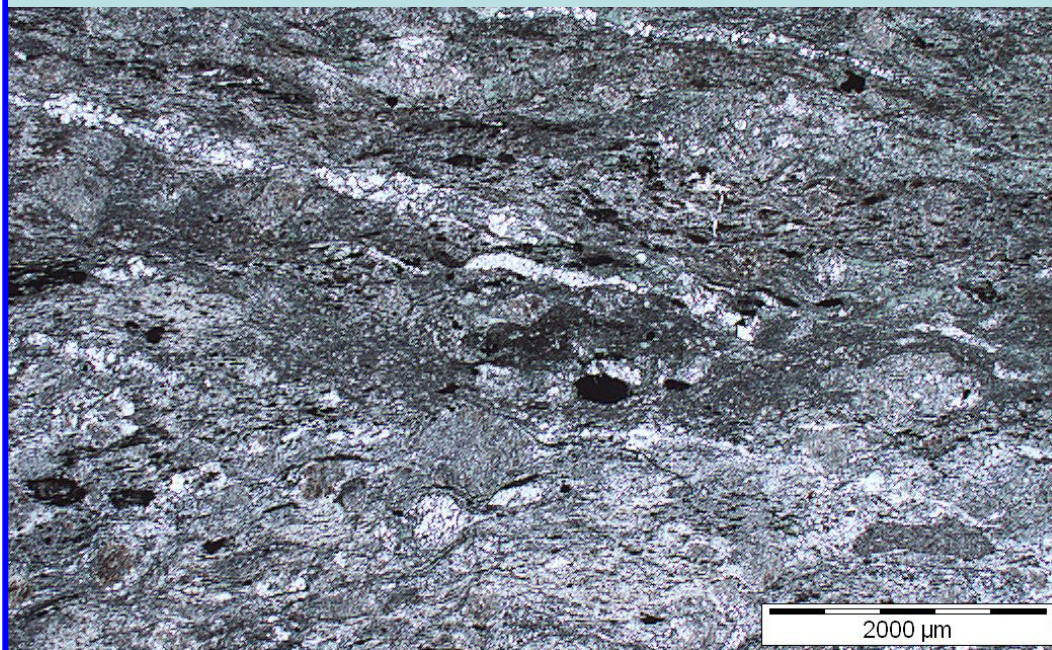
Unambiguous lithic clasts now up to at least 5mm long are still obvious in this slide, despite the strong stretching and foliation development. They are almost all moderately plagioclase-phyric felsic lavas, probably dacites to rhyodacites, with formerly glassy groundmasses that have thoroughly devitrified and then crystallized to mainly fine-grained quartz-feldspathic aggregates. Development of sericite-chlorite alteration with abundant fine, blebby, secondary quartz is notably patchy. The plagioclase phenocrysts are up to 3mm across, totally albitized, and variably speckled by fine-grained sericite. In many instances, the chlorite+sericite-defined foliation wraps around the plagioclase phenocrysts. A number of narrow bands in which plagioclase crystals are concentrated to form framework-supported thin beds indicate that this rock was probably originally a volcanoclastic sandstone or granule conglomerate. Cross-cutting veins and bedding-parallel domains of strong chlorite-quartz alteration appear to post-date a chlorite-sericite-quartz alteration assemblage, and are themselves overprinted by late carbonate (pinkish in the scanned images below), that appears to post-date foliation development.



SAMPLE NUMBER

MXUD01 155.9m

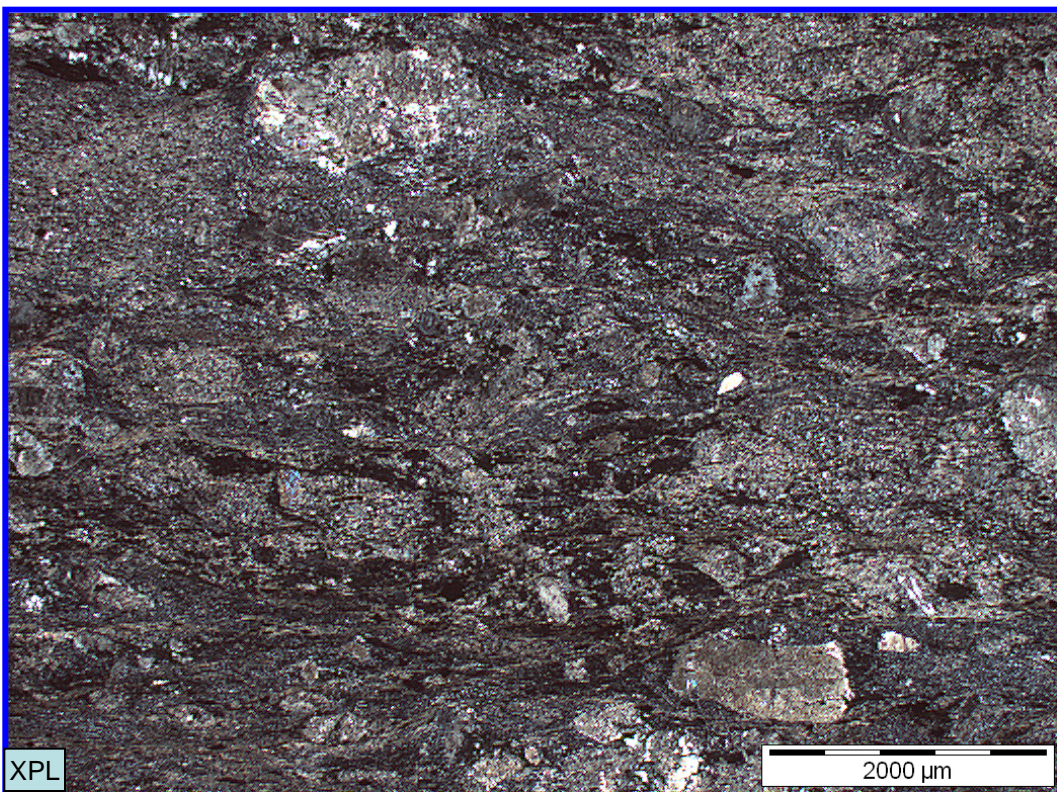
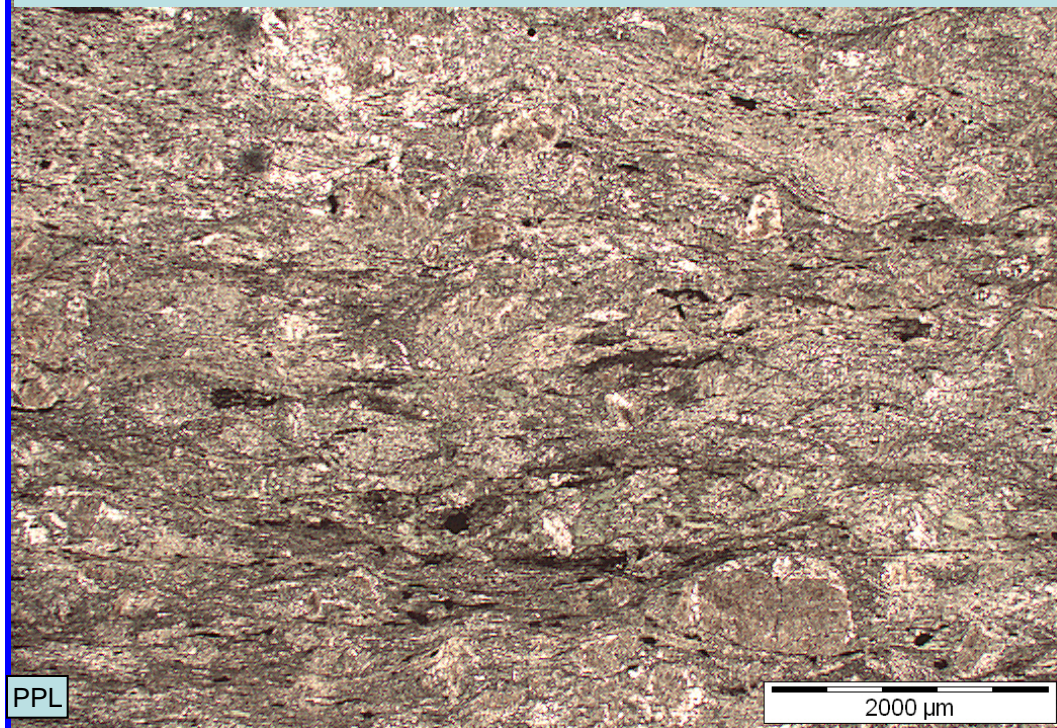
Moderate sericite-chlorite-defined foliation in sandstone dominated by devitrified and recrystallized formerly glassy lithic clasts, plagioclase phenocryst debris and altered, comminuted vitric ash matrix.



SAMPLE NUMBER

MXUD01 155.9m

Plagioclase-phyric, formerly glassy lava clasts in altered, foliated matrix



PETROGRAPHIC DESCRIPTION

This is an intensely foliated, almost mylonitic, pale rock , probably originally a volcanoclastic siltstone, now dominated by fine-grained, often turbid carbonate and sericite intergrowths and tightly folded and locally transposed quartz- and quartz-carbonate veinlets.

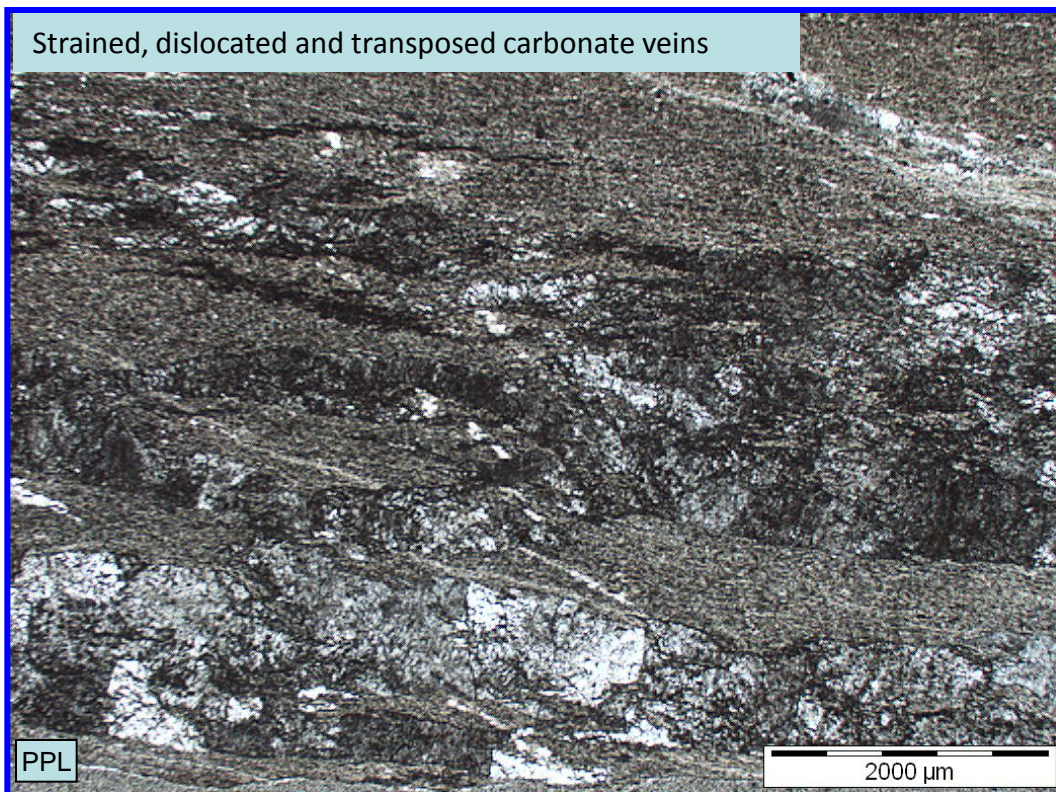
Occasional, tiny, detrital feldspar and quartz(?) grains are scattered through the rock, which is dominated by a very fine-grained strongly foliated sericite-carbonate intergrowth with a notable absence of chlorite. In the least carbonate –altered parts of the slide, there is no evidence of originally coarser-grained detritus or former plagioclase phenocrysts. Foliation-parallel veins of pale carbonate are common, and sometimes dislocated or transposed. Discontinuous, foliation-parallel and tightly folded veinlets composed of slightly coarser, sugary-textured quartz, pyrite , murky carbonate and white mica are present and probably represent an early vein set rotated almost entirely into the foliation during intense deformation. Evidence strongly suggests that this rock was originally a siltstone. The strong foliation and fine grainsize have generated an almost mylonitic appearance for this rock, but there is no obvious grainsize reduction or dynamic recrystallization that unambiguously define a mylonitic texture.



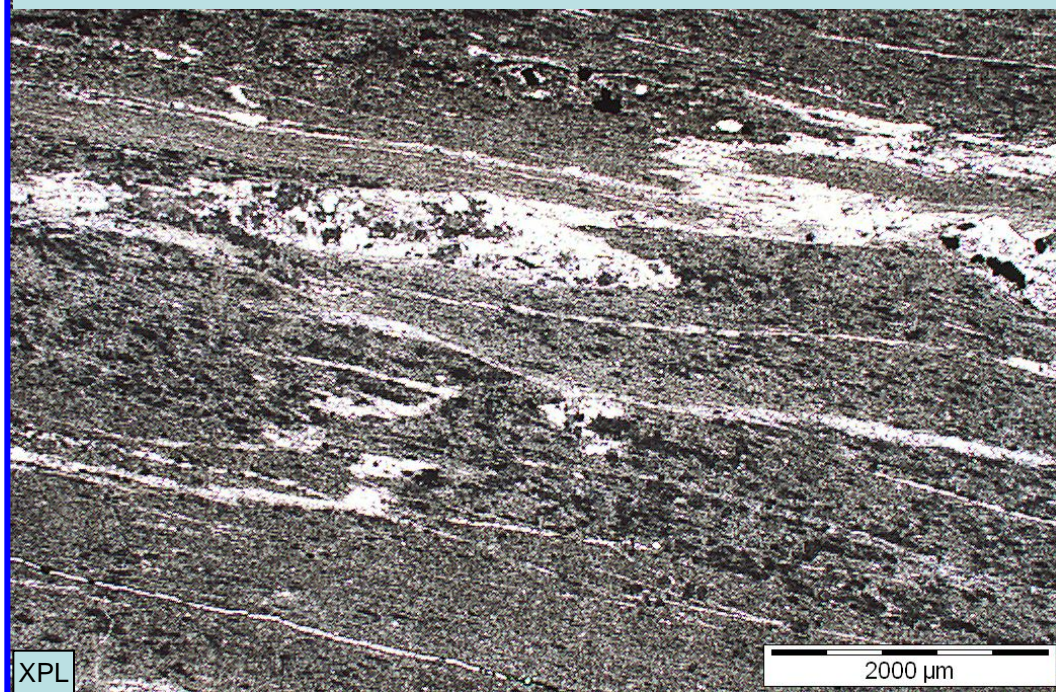
SAMPLE NUMBER

MXUD01 170.0m

Strained, dislocated and transposed carbonate veins

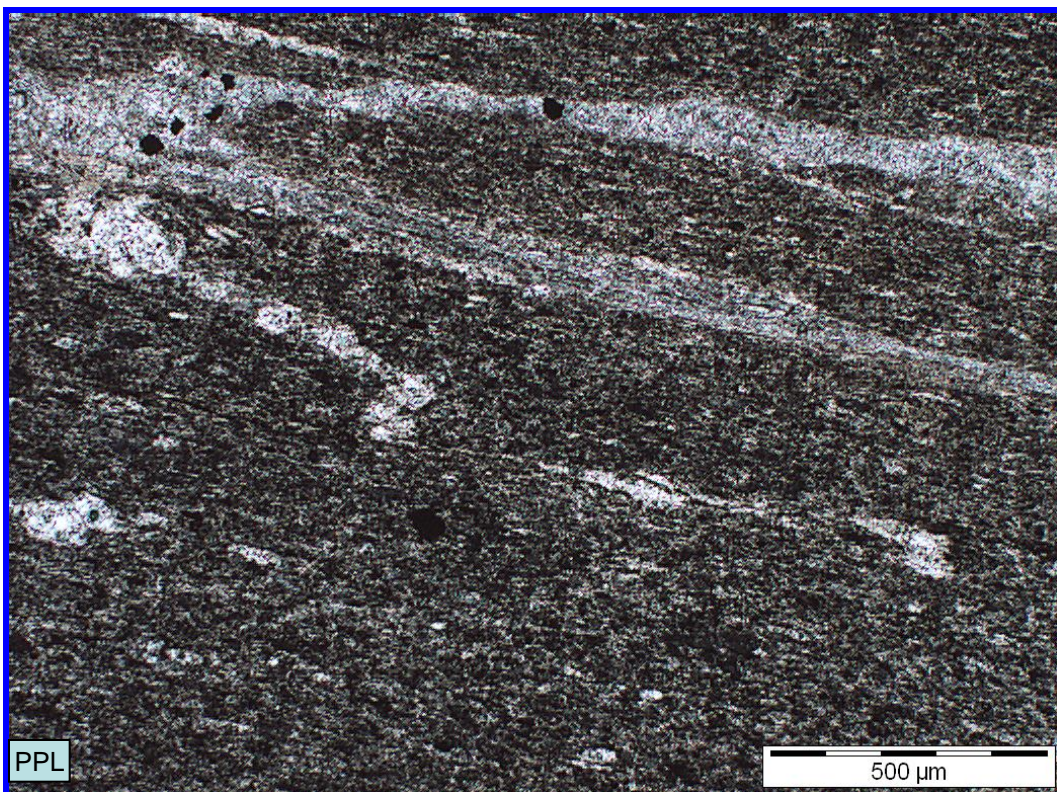


Tightly folded quartz-sericite vein in strongly foliated, extremely fine-grained sericite-carbonate-minor quartz matrix

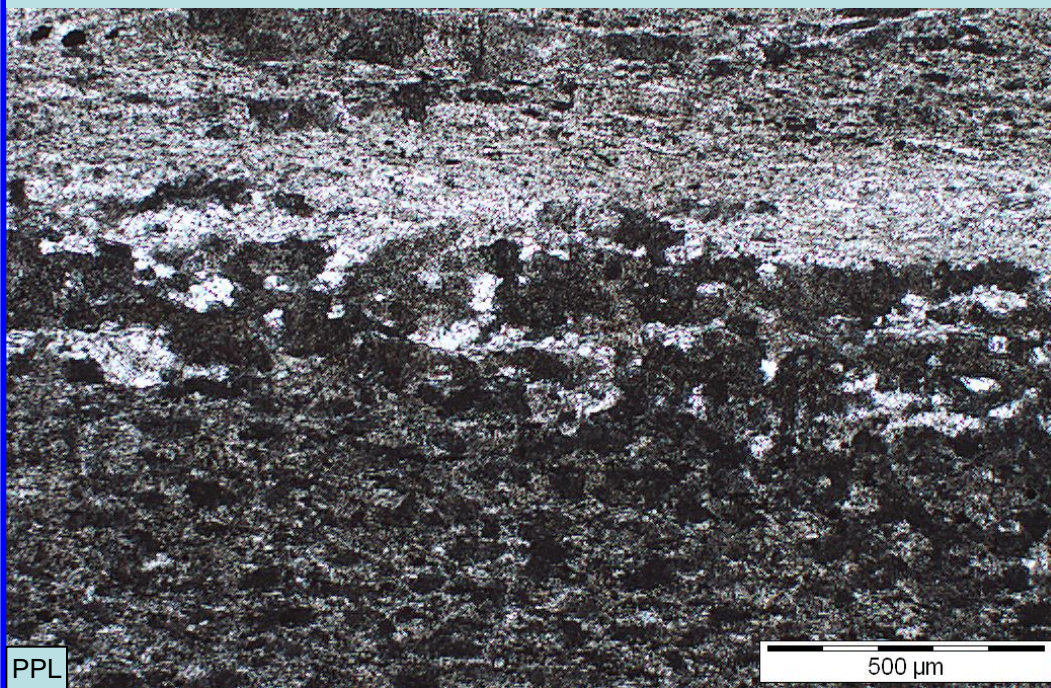


SAMPLE NUMBER

MXUD01 170.0m



Variably developed turbid, fine-grained carbonate (lower) and sericite (upper) alteration



PETROGRAPHIC DESCRIPTION

This is a matrix-supported volcanoclastic siltstone with common detrital plagioclase grains, moderate development of a bedding parallel foliation, and bedding very vaguely defined by subtle changes in the average grainsize and modal abundance of detrital grains. IT shows quite strong chlorite-carbonate alteration.

The detrital grain population is dominated by small (<0.3mm across), mainly angular fragments of plagioclase phenocrysts (~10modal%) and less easily discerned small lithic clasts of altered, formerly glassy felsic to andesitic lavas. These are set in a turbid, fine-grained and foliated matrix composed largely of chlorite and very fine-grained carbonate, with common trails of sericite. All three phases tend to form intergrowths that parallel and/or define the foliation, along with common short trails of dark leucoxenic aggregates. Detrital quartz grains are again notably absent. The original nature of the matrix is entirely obscured by the foliation development and strong chlorite-carbonate alteration, but it was almost certainly originally comminuted glassy lithic material and possibly some vitric ash. A few narrow, late carbonate veinlets cut the thin section. Apart from being less intensely foliated than the preceding sample from 50cm higher in the core, this rock clearly contains abundant chlorite in the alteration assemblage, which is absent from the intensely foliated rock from 170.0m.

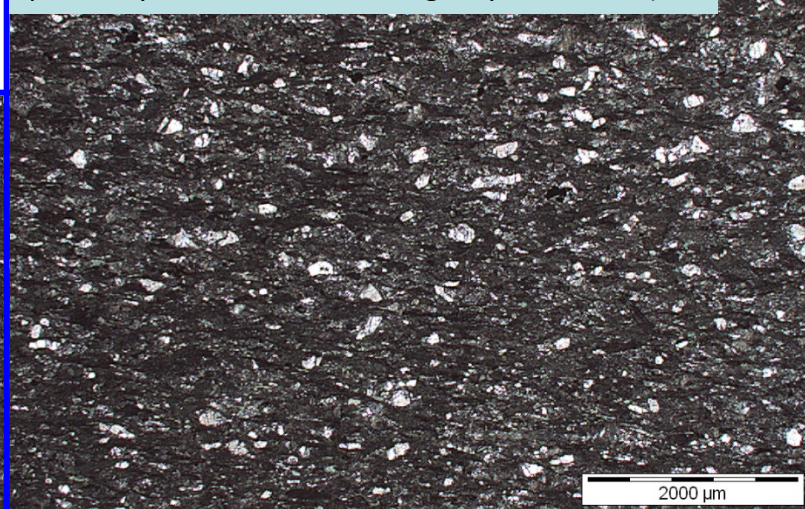


SAMPLE NUMBER

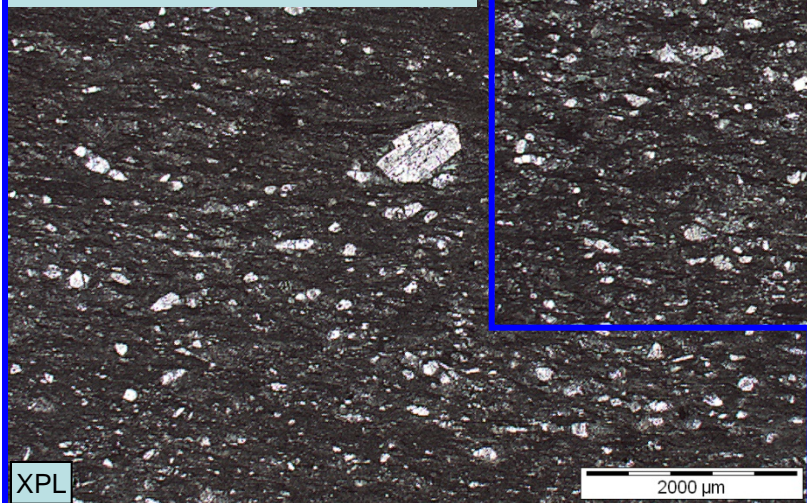
MXUD01 170.5m

Bed with more detrital grains (mainly plagioclase phenocryst debris and altered glassy lithic clasts)

XPL

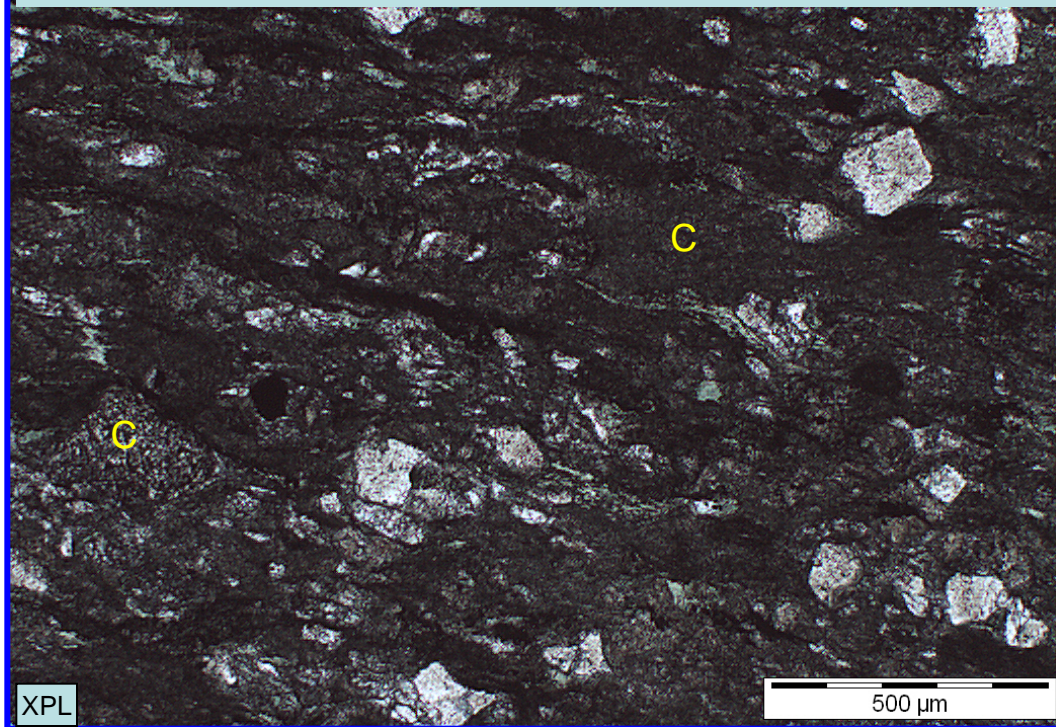


Bed with less abundant detrital grains



XPL

Detrital plagioclase phenocryst debris & altered glassy lithic clasts (C)

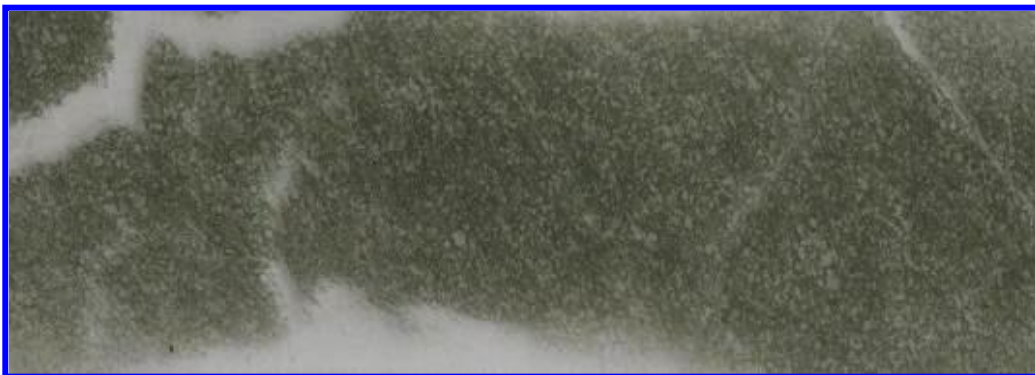


XPL

PETROGRAPHIC DESCRIPTION

This is a volcanoclastic fine sandstone with the detrital grain population dominated by broken plagioclase phenocrysts and subordinate felsic volcanic clasts, and a well developed probably bedding-parallel foliation. It shows a moderate chlorite-sericite-carbonate intergrowths.

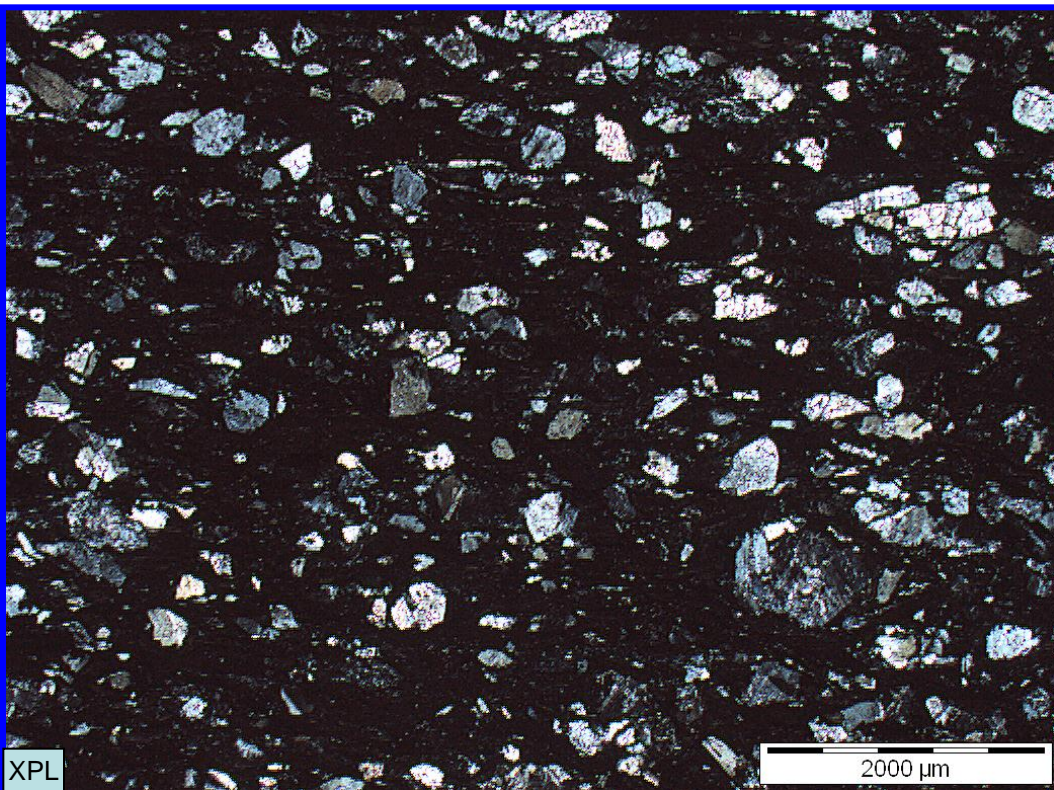
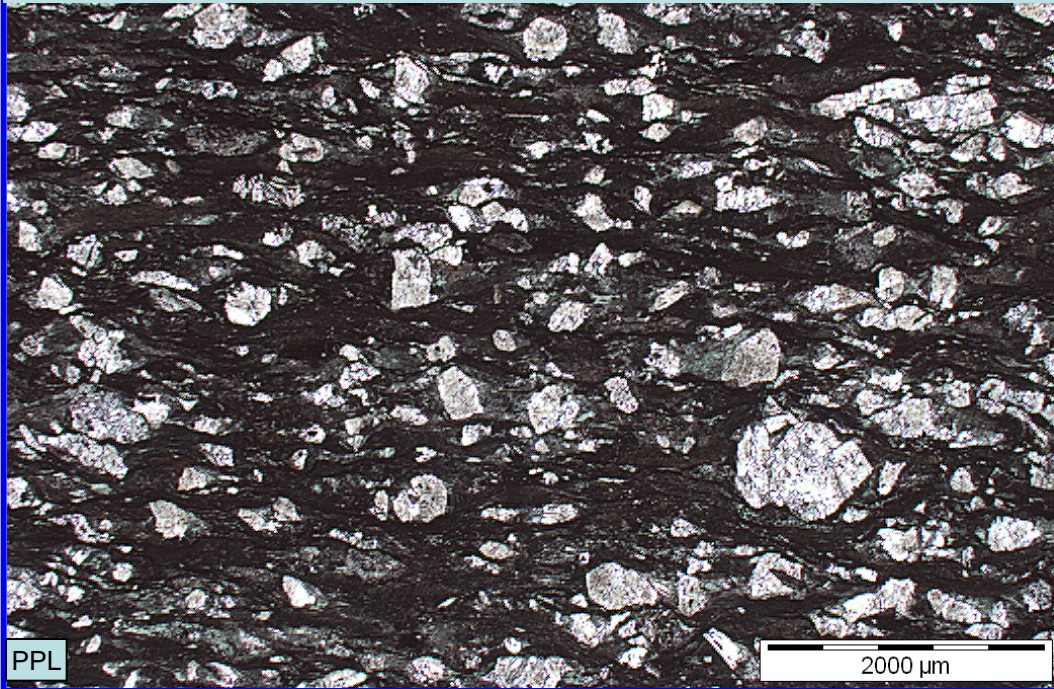
Detrital plagioclase phenocryst fragments, some almost entire crystals, others angular fragments of phenocrysts, are the dominant detrital grain component, and most are albitized, with weak and patchy pale carbonate overprinting. Slightly less common but still well represented are diverse formerly glassy lithic clasts, most of which are quite elongate along the foliation. Some lithic clasts show microlitic textures, others appear to have been entirely glassy, and are now replaced by mainly exceedingly fine-grained sericite-quartz-chlorite-carbonate intergrowths. The matrix makes up about 50-60modal% of this sandstone, and is present as an undulose, turbid and very fine-grained sericite-chlorite intergrowth with abundant wavy, fine-grained, dark, insoluble material recording significant pressure solution during foliation development. Detrital quartz is not present in this slide. In terms of grainsize and clast population, this rock could be a coarser-grained base of the preceding siltstone from 170.5m depth.



SAMPLE NUMBER

MXUD01 177.2m

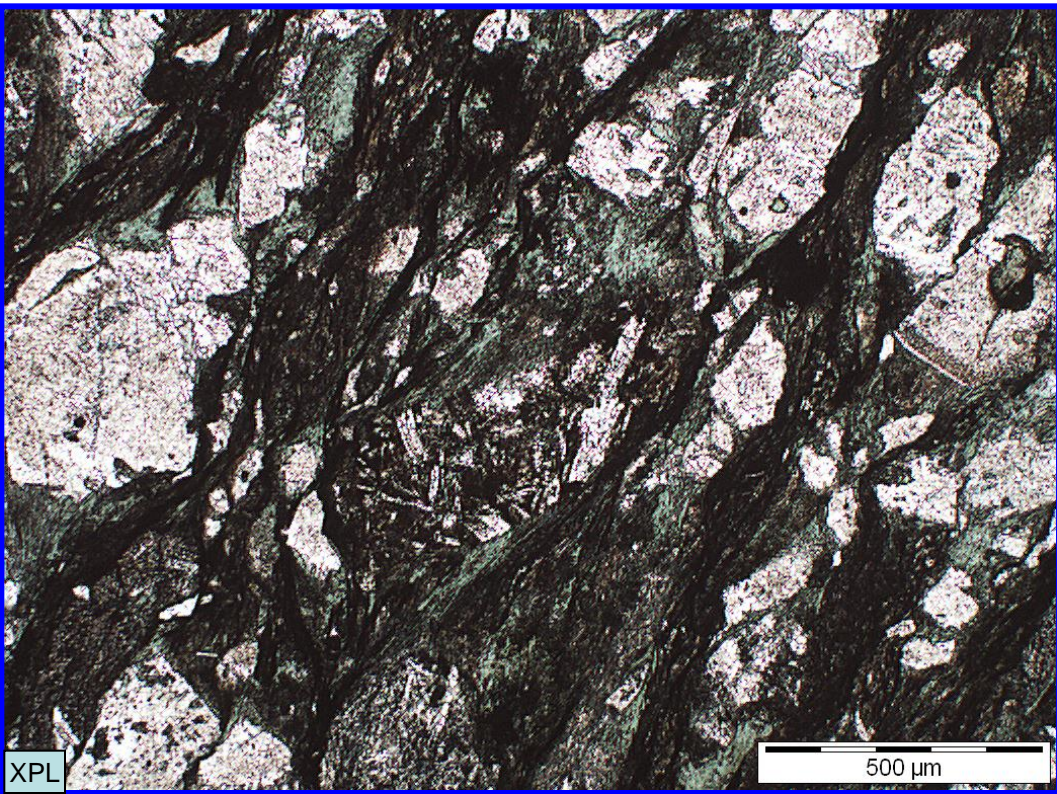
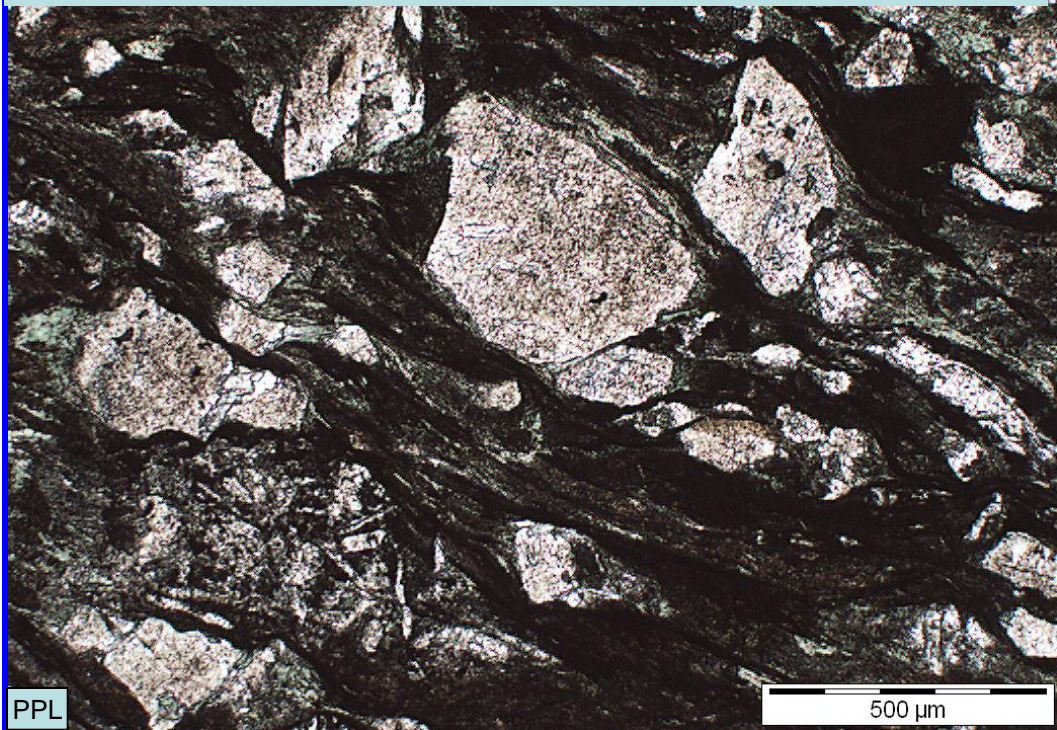
Moderately well developed foliation wrapping around angular, detrital plagioclase phenocrysts. Lithic clasts are less evident but not uncommon.



SAMPLE NUMBER

MXUD01 177.2m

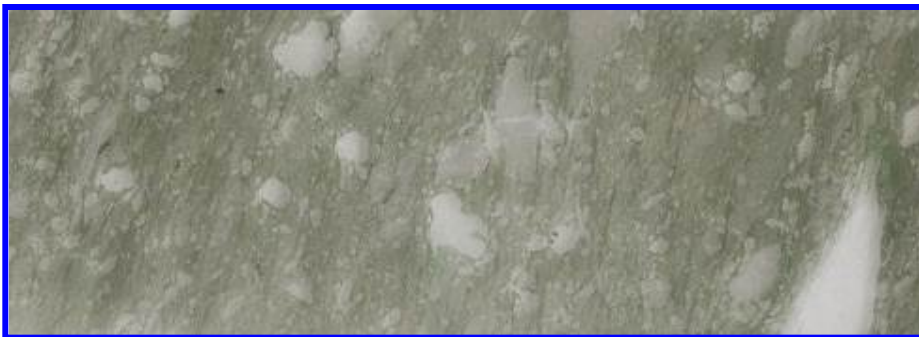
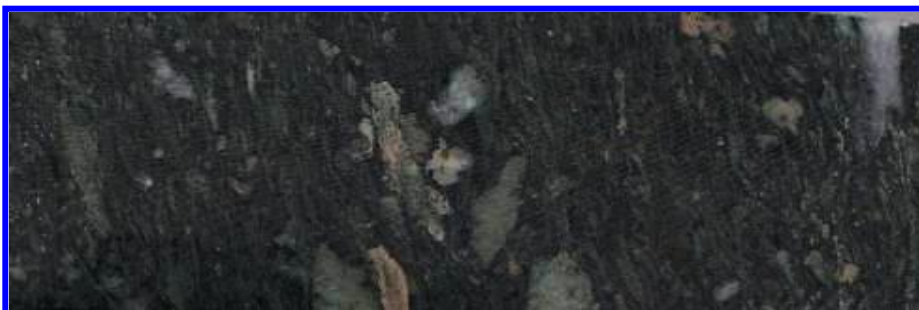
Angular detrital plagioclase phenocryst and fine-grained volcanic clast debris



PETROGRAPHIC DESCRIPTION

This is an even coarser-grained, matrix-supported volcanoclastic sandstone with diverse volcanic lithic clasts, and abundant plagioclase phenocryst debris in a silty groundmass with a well developed bedding-parallel foliation. Alteration is moderate sericite-chlorite-carbonate.

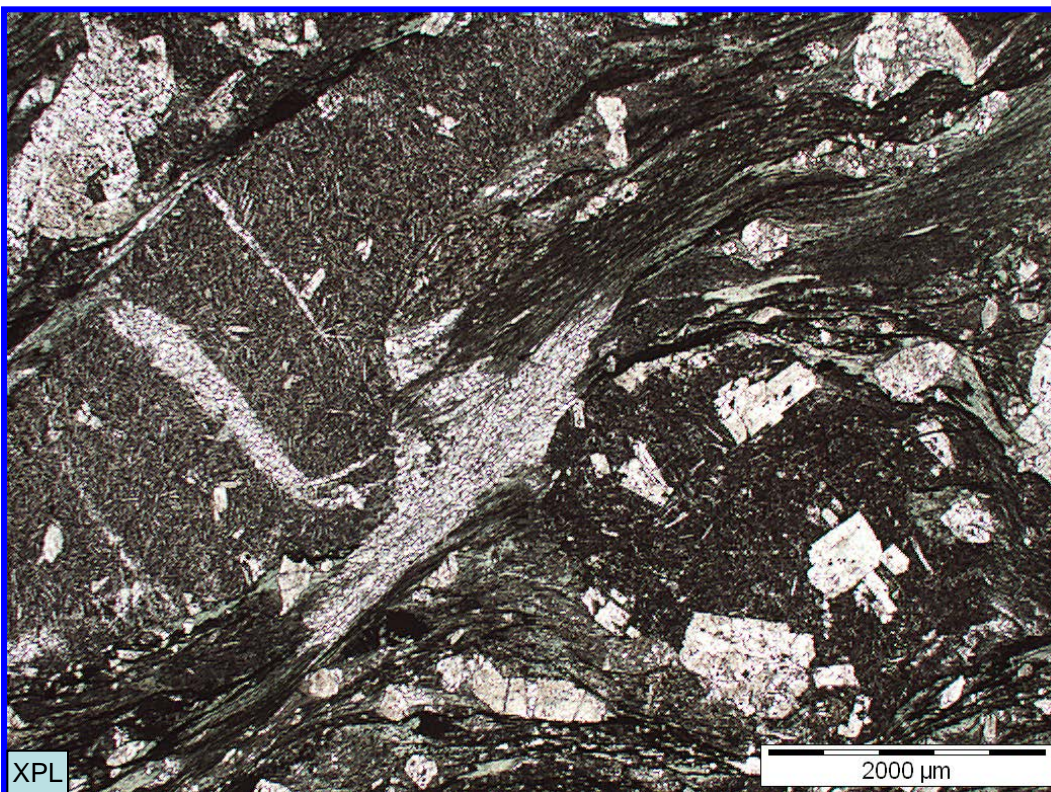
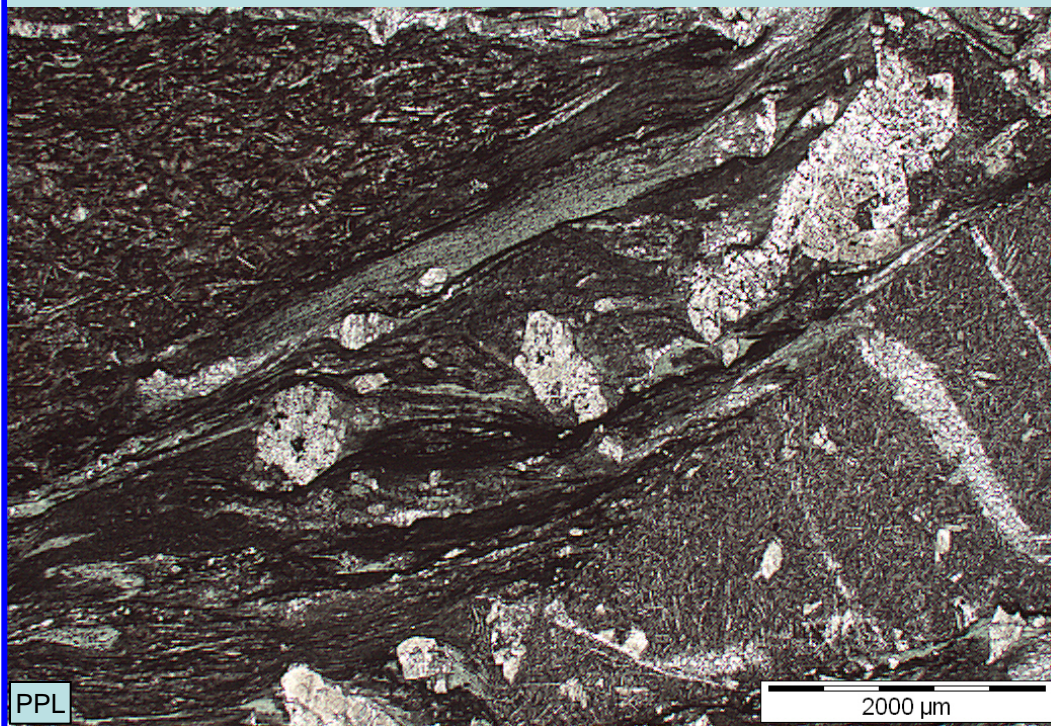
Lithic clasts are mainly rather elongate and subrounded and most a variably plagioclase-phyric felsic to intermediate lavas with groundmasses that vary from microlitic-textured to formerly glassy. Several clasts are also moderately vesicular, but none contain former mafic silicate phenocrysts, indicating none were basaltic andesite/basalt lithologies. Some detrital (albitized) plagioclase crystals are up to 4mm across, and compound plagioclase crystal aggregates are not uncommon. One apparent limestone lithic clast is probably a boudinaged carbonate vein. Although many lithic clasts are not elongate, those that are show a strong preferred orientation parallel with the foliation, indicating that the foliation is likely to be broadly bedding parallel. As in the preceding two volcanoclastic meta-sediments, the matrix in this rock is a murky very fine-grained intergrowth of sericite and chlorite, with common fine-grained carbonate and streaks and trails of leucoxene. The extent of alteration-recrystallization of the matrix suggests that it may originally have carried a significant detrital glassy component.



SAMPLE NUMBER

MXUD01 180.9m

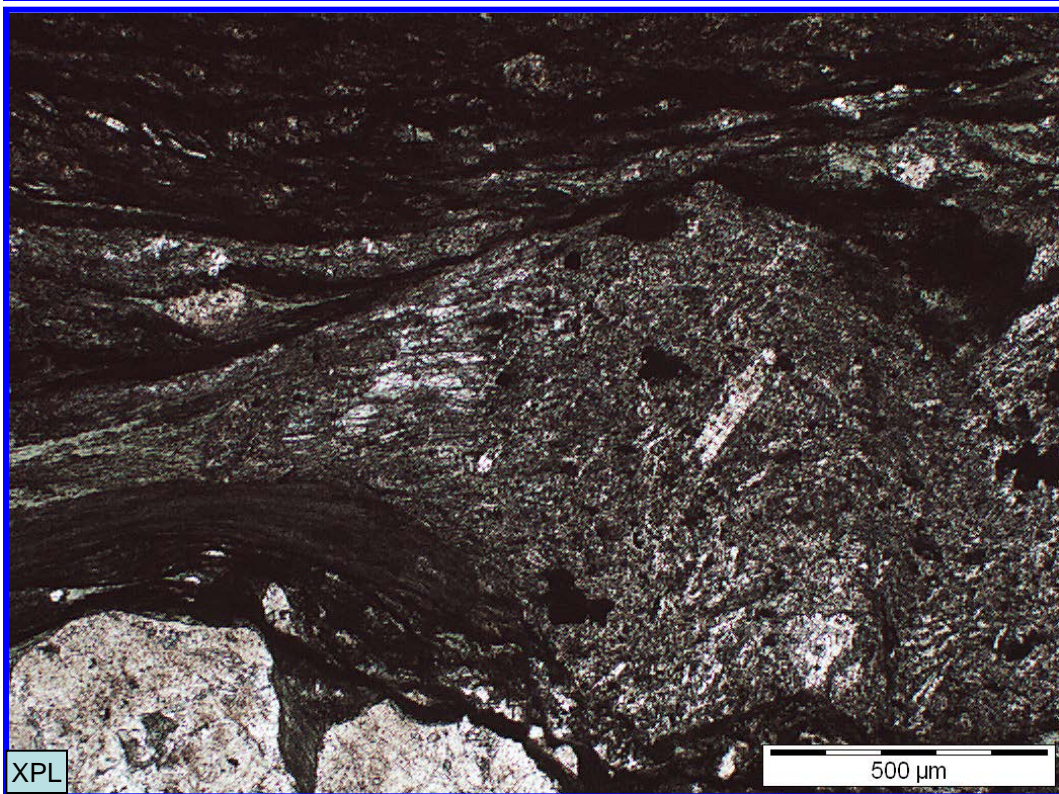
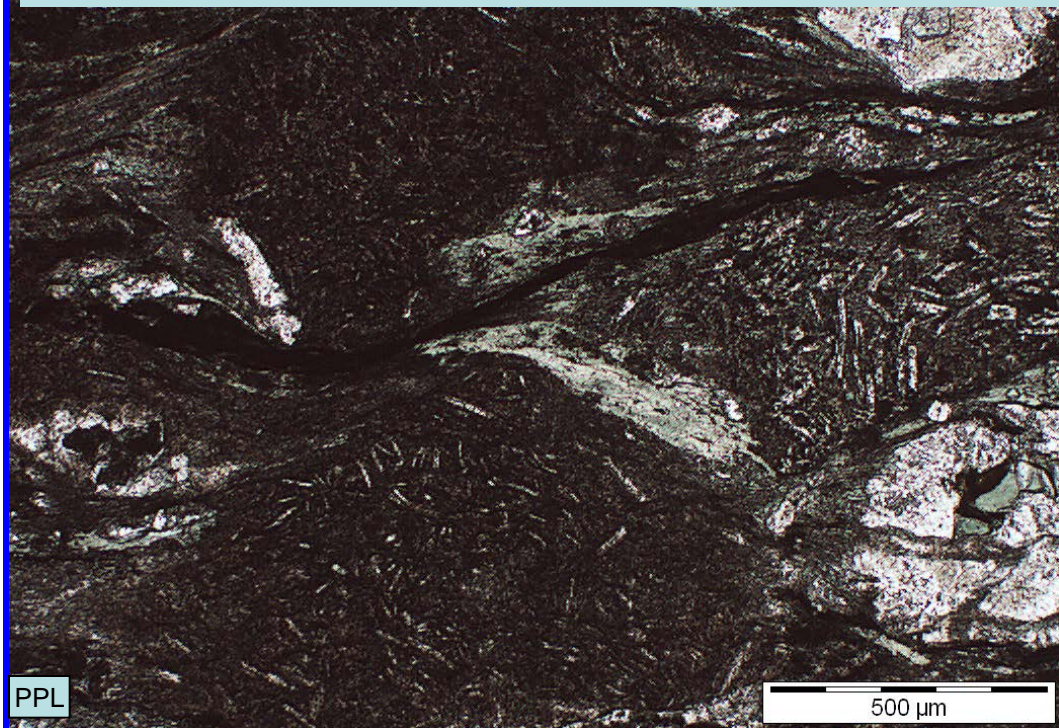
Diverse lithic clasts of felsic and intermediate lavas in a foliated matrix.



SAMPLE NUMBER

MXUD01 180.9m

Lithic clasts of altered volcanics and detrital plagioclase phenocryst debris



PETROGRAPHIC DESCRIPTION

This is a medium-grained, framework-supported volcanoclastic sandstone dominated by broken fragments of plagioclase phenocrysts (now albitized) mainly 0.5-1mm across. It shows no significant foliation, and a well developed chlorite-sericite-leucoxene±quartz alteration assemblage.

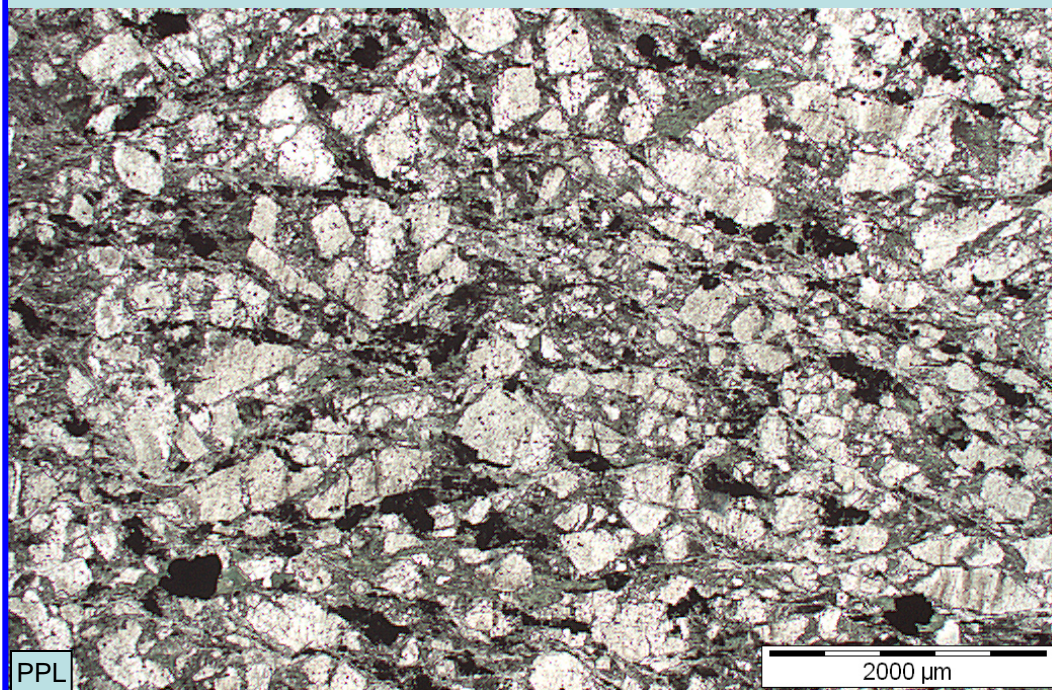
These make up about 60-65modal% of this sandstone, and there is a remarkable paucity of other types of detrital grains, with no lithic clasts or quartz detritus. The matrix of this sandstone is now composed mainly of chlorite and subordinate sericite, with both phases forming elongate, wavy and undulose trails that wrap around the detrital phenocrysts. Loose aggregates and trails of leucoxene are also common in the matrix, and do not appear to be replacing former FeTi oxides. Rather, they are probably picking up Ti and Ca released during alteration of original vitric material in the matrix. Carbonate is an insignificant component in this rock, and it is cut by numerous chlorite-quartz veinlets. It is difficult to determine whether the spaced, irregular foliation in this rock is bedding parallel, as clasts are not platy or elongate, and there is no apparent size grading of the detrital plagioclase crystals. The chlorite-sericite-quartz-leucoxene alteration is rather more well developed than expected in such a rock during typical low-grade regional metamorphic degradation.



SAMPLE NUMBER

MXUD01 214.0m

Angular and broken plagioclase phenocrysts (albitized) comprise the detrital grain population, with matrix chorite-sericite-leucoxene.



SAMPLE NUMBER

MXUD01 214.0m

