P310-324/76. Records Copy

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6.10.76

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28th September, 1976

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Attention Mr. R.B. Major

REPORT MP 304/77

YOUR REFERENCE:	Application dated 29/7/76
MATERIAL:	15 drill core specimens
LOCALITY:	Mt. Gee East Prospect, Mt. Painter area, Sth. Aust.
IDENTIFICATION:	P310/76-P324/76
DATE RECEIVED:	30/7/76
WORK REQUIRED:	Petrographic description

Investigation and Report by: Mrs. S. Whitehead
X-ray diffraction: Dr. R.N. Brown
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K. J. Henley

for F.R. Hartley
Director

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SUMMARY OF SPECIMENS

P310/76 TS36292 BFD 1 10.2m.	Feldspathic gneiss composed of potash/feldspar, plagioclase and biotite with minor (local) corundum. There has been local alteration to 'sericite' or montmorillonite? along fractures. A sedimentary origin is possible but all original features have been bliterated. (It is coarser grained than gneiss in samples P311, 312/76.)
P311/76 TS36293 and TS36482 MGD 151 94.28-94.44m.	Breccia containing large clasts of sericitized quartz-feldspar-biotite gneiss and of metasomatic, potash feldspar-iron oxide rock in a dark matrix of altered and heavily stained biotite and/or chlorite with minor quartz and calcite. Altered outer zones of some large clasts of gneiss are of turbid, metasomatic potash feldspar, quartz, mica and iron oxide. There is no conclusive evidence to show whether it is a tectonic or sedimentary breccia but certainly there has been some fracturing.
P312/76 TS36294 MGD 151 94.73m.	Sericitized and possibly chloritized, feldspathic gneiss now stained by iron oxide.
P313/76 TS36295 MGD 151 256.3m.	Altered 'granitic' rock or biotite-bearing gneiss which had been invaded by migratory quartz. Most of the feldspar has been replaced by clay minerals.
P314/76 TS36296 MGD 151 266.5m.	Altered metamorphic rock now composed of moderately coarse grained biotite and secondary clay minerals. It is possible that some, or all, of the clay replaced scapolite. It could have been a basic igneous rock but no original textures have been preserved.
P315/76 TS36297 MGD 151 5m.	Metasomatically altered quartz-feldspar-biotite gneiss. Alteration by metasomatising solutions in some zones has resulted in the replacement of much of the gneiss by potash feldspar and where this is coarser grained it could grade into a metasomatic 'granitic' or 'pegmatitic' rock. The full history has been very complex and has involved some additional fracturing and alteration.

P316/76
TS36298
MGD151
6.7 m.

Altered granite or adamellite in which all plagioclase has been replaced by hematite-stained 'sericite' and much of the potash/feldspar and biotite by other clay minerals. There are remnants of turbid potash/feldspar.

P317/76
TS36299
MGD 151
10.3 m.

Either porphyroblastic, adamellite gneiss or gneissic, porphyritic adamellite. All plagioclase and some microcline have been replaced by sericite and clay but former (?metamorphic) textures are clearly preserved.

P318/76
TS36300
MGD 151
14.1 m.

Extensively altered, granitic or adamellite gneiss (or gneissic adamellite) similar to and related to P317/76. There are irregular, possibly metasomatically altered patches in which potash feldspar predominates.

P319/76
TS36301
MGD 151
24.3 m.

Adamellite or adamellite gneiss similar to P317-318/76 but showing more extensive alteration to clay minerals. Most of the potash feldspar has now been replaced by clay and the plagioclase by 'sericite' and clay. There is little evidence of a foliation.

P320/76
TS36302
MGD 151
38.2 m.

Altered adamellite in which plagioclase has been sericitized but much of the microcline remains unaltered.
sericite

P321/76
TS36303
MGD 151
45.4 m.

Sericitized adamellite (or adamellite gneiss) has been deformed, sheared and fractured. Invading solutions have deposited abundant quartz in fractures and interstices. The associated silicates including minor microcline have been replaced by pink clay.

P322/76
TS36304
MGD 151
150.2m.

Breccia in contact with underlying quartz-feldspar-biotite gneiss. Monazite is concentrated in streaks of biotite in the gneiss adjacent to the contact. Material in the breccia shows evidence of tectonic stress. No recognizable evidence was found to suggest a sedimentary origin for the breccia.

P323/76
TS36305
MGD 151
151.1 m.

Adamellite gneiss. There is probably some introduced quartz which has modified the gneissic texture. Plagioclase has been sericitized and some microcline appears partly altered. Biotite has been bleached and there is a trace of calcite.

P324/76
TS36306
MGD 151
289.9 m.

Myrmekitic rock extensively altered to montmorillonite. It was formerly composed of radiating and myrmekitic intergrowths of quartz and albitic plagioclase with minor muscovite. Plagioclase has been partly replaced by pink-stained montmorillonite.

DESCRIPTION OF METAMORPHIC ROCKS FROM DRILL HOLES MGD151 AND BFD1 MOUNT GEE EAST PROSPECT

1. INTRODUCTION AND COMMENTS

Fifteen drill core specimens from the Mt. Gee East Prospect were submitted for petrographic description and, if possible, determination of origin. A check for fractured quartz suggestive of an astrobleme was also requested.

Most of these specimens are of metamorphic rock showing some evidence of a foliation and they have been classified as feldspathic gneiss, quartz-feldspar-biotite gneiss and adamellite gneiss. In the specimens from MGD151 there is generally no definite evidence from which to determine their origin and many have been extensively replaced by 'sericite' probably including montmorillonite and other clay minerals. Locally there is evidence of metasomatic alteration resulting in partial replacement by turbid microcline and in the breccia from 94.28-94.44 metres (P311/76) this metasomatic, microcline-rich rock contains anomalous magnetite (or martite).

No conclusive evidence was found from which to determine the origin of the breccias (P311 and 322/76).

The specimen from BFD1 (P310/76) is of feldspathic gneiss composed of potash/feldspar, plagioclase and biotite with minor corundum in one zone or layer.

No evidence was found of fractured, deformed or 'shocked' quartz suggestive of an astrobleme.

2. PETROGRAPHY

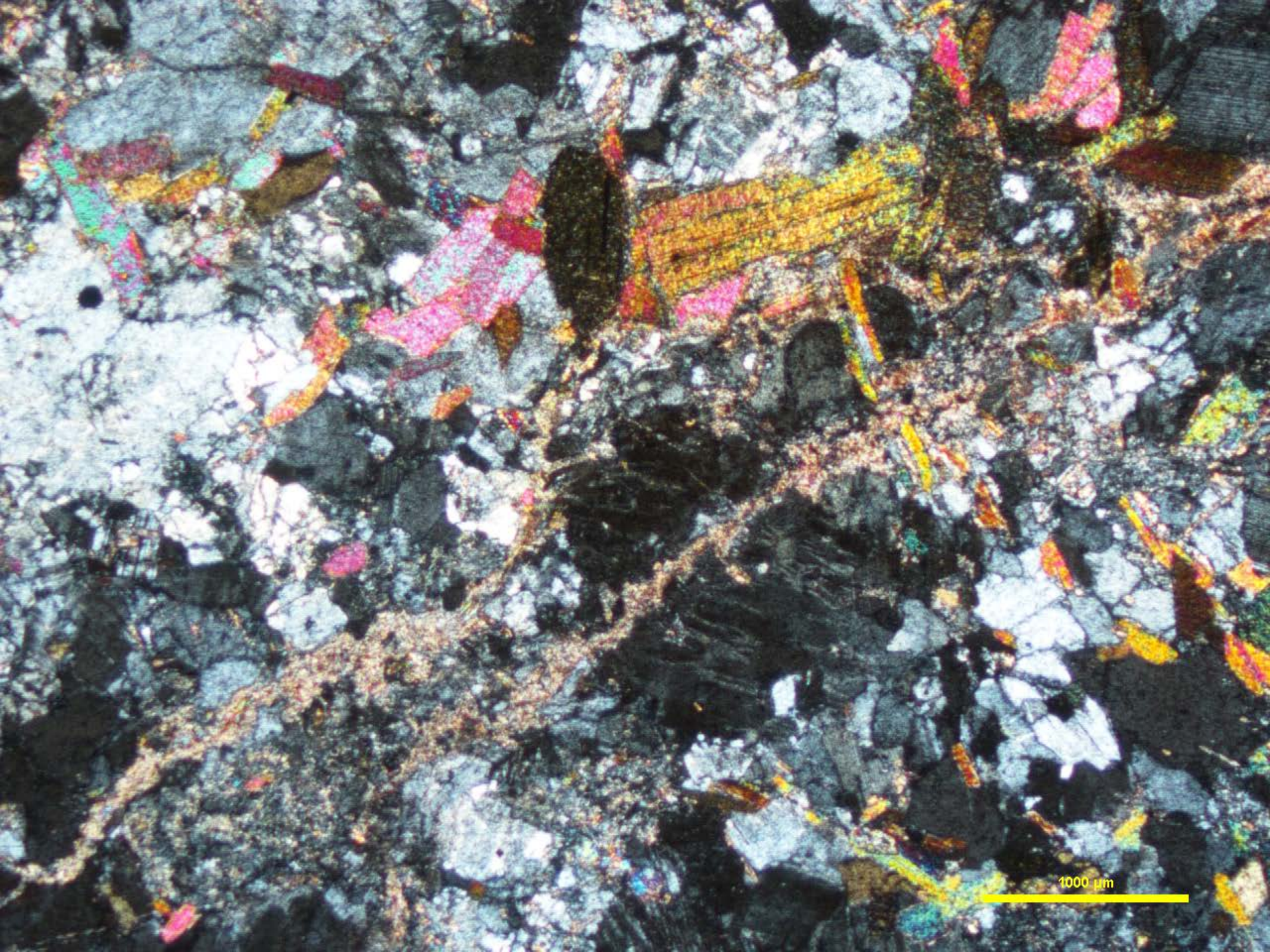
Sample P310/76; TS36292

Location:

BFD 1 at 10.2 m. Mount Gee East Prospect.

Hand Specimen:

A pale-coloured, medium grained rock with a very weak foliation defined mainly by sub-parallel concentrations and/or flakes of dark mica. This foliation dips at a moderate angle assuming the drill hole to be verticle. In parts of the specimen there are some irregular patches of pale-grey to very pale-green, fine grained alteration products, probably clay, and similar material occurs along some fractures.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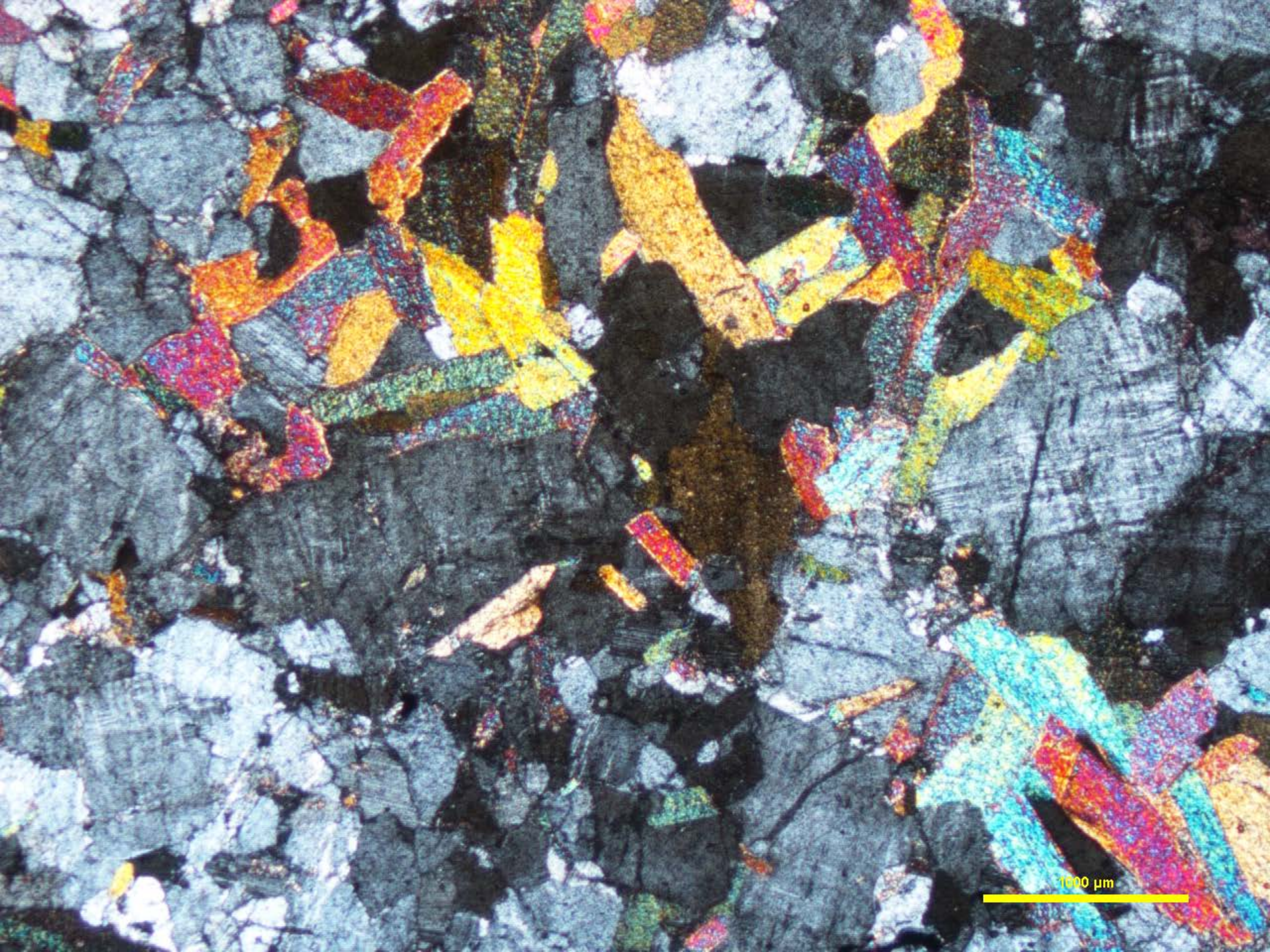
1000 µm

Thin Section:

A visual estimate of the constituents is as follows:

	%	
Potash feldspar	60-70	
Plagioclase	20-30	
Biotite	5-15	(varies)
Corundum (confirmed by XRD)	Trace-1	(local)
Opaque oxide	Trace	
Sphene	Trace	
Zircon	Trace	
Secondary sericite, clay & chlorite	2-3	

Potash feldspar and plagioclase form an uneven mosaic in which the grain size varies from 0.3 to 2.0 mm. but there is also some variation in grain size in different zones in that the area sectioned contains a zone rich in relatively coarse grained potash feldspar and a finer grained zone containing more abundant plagioclase. Biotite also varies in concentration and grain size with single, small flakes 0.3 to 0.8 mm. long occurring along grain boundaries and larger flakes up to 4.0 mm. long occurring as aggregates in a biotite-rich zone. There is very little evidence of a foliation in the area sectioned but some flakes of biotite and also some elongate aggregates of coarser grained biotite show a preferred orientation.

Much of the plagioclase shows fine twinning and extinction angles suggest that it is oligoclase. Most of the twinning in this plagioclase shows no evidence of deformation. Some potash feldspar shows patchy twinning typical of that of microcline but most of it is untwinned. Some potash feldspar shows vein-like patches of plagioclase resembling vein perthite and at least some of this could be a replacement texture. A few feldspar crystals are almost mesoperthite.

In the biotite-rich zone of the rock there are groups of small, irregularly shaped crystals of corundum and also a few irregularly shaped aggregates of corundum. Much of this corundum has a common grain size of 0.05 to 0.1 mm. with a few slightly larger aggregates and in a few places, small groups of now isolated grains are in optical continuity suggesting that the corundum has been partly replaced by later minerals. Many of these small aggregates now appear corroded and some are enclosed or partly enclosed by potash feldspar and plagioclase. A few are almost completely surrounded by biotite. This corundum occurs in a band about 6.0 to 8.0 mm. wide where it varies in concentration up to about 15-20%. The identity of the corundum was confirmed by X-ray diffraction.

The rock contains a few small aggregates of recrystallized leucoxene, a trace of opaque oxide and a minute trace of zircon.

Small fractures in the rock contain concentrations of very fine grained, micaceous clay-like minerals and sericite or montmorillonite. Locally there are also traces of very pale green chlorite. These micaceous, secondary minerals have corroded and encroached on the adjacent rock and also occur along some grain boundaries and cleavage planes in feldspar. It is possible that some zeolites could once have been present but none could be identified.

Conclusion:

This is a medium or moderately high grade metamorphic rock in which there is no definite evidence to show its origin. A metasedimentary origin is possible.

Sample P311/76; TS36293 & TS36482

Location:

MGD 151 at 94.28 to 94.44 m.

Hand Specimen:

This length of drill core contains some clasts 3.0 to 6.0 cm. in size of pink to brownish-grey rock showing a weak foliation and similar in general appearance to sample P312/76 (sericitized and chloritized feldspathic gneiss). The foliation direction varies in individual clasts being almost horizontal in some and almost vertical in the largest clast. There are also smaller fragments of pale-coloured feldspar. The matrix is dark greenish-brown and it contains numerous vein-like patches of white carbonate The larger clasts show a zone of bleaching or alteration at least 5.0 mm. thick in contact with the matrix.

Thin Section:

This is a breccia containing angular and subrounded clasts of sericitized quartz-feldspar-biotite gneiss and of coarse grained rock composed predominantly of potash feldspar with lesser iron oxide and minor biotite. There are also smaller clasts of potash feldspar and a few of strained and granulated quartz. The matrix is so heavily stained with brown iron oxide that it is almost opaque but much of it appears to be partly altered biotite and/or chlorite with some later calcite and quartz.

Some of the larger clasts are of moderately fine grained quartz-feldspar-biotite gneiss containing 2-3% iron oxide. Most of the feldspar in this gneiss has been replaced by sericitic material or clay and in general appearance this rock is very similar to the altered feldspathic gneiss of sample P312/76. Some of these clasts are angular but the largest clast (6 cm. long) appears

rounded or corroded. The outer bleached or altered zone in this large clast contains little or no sericite and its place has been taken by patches of turbid, possibly secondary microcline with a common grain size of 0.2 to 0.6 mm. and this is now intergrown with some quartz and aggregates of stained and altered biotite. Some of the microcline contains scattered crystals and aggregates of fine grained iron oxide, probably magnetite or martite. There are also a few small aggregates of fine grained, recrystallized leucoxene.

Some feldspathic clasts in this breccia are composed of very turbid, coarse-grained microcline, probably of metasomatic origin and this contains crystals and aggregates of iron oxide probably magnetite or martite in concentrations of up to 20%. The microcline also contains some small aggregates of brown-stained, bleached biotite or chlorite, a few small apatite crystals, traces of recrystallized leucoxene and some irregular patches of secondary quartz and calcite. It is possible that this rock represents metasomatically altered gneiss similar to the outer, altered zone of the larger clasts of feldspathic gneiss but at least some appear to contain additional iron oxide. Some of this coarse grained rock composed of turbid microcline has been fractured and the fragments differentially displaced.

The breccia also contains numerous small angular fragments 0.1 to 0.6 mm. in size mainly of turbid potash feldspar but also of quartz and sericite.

The matrix is very heavily stained by brown iron oxide and therefore its exact composition is difficult to determine by microscopic investigation. It appears to be predominantly partly altered and stained biotite, probably with some altered and stained chlorite. Many boundaries between clasts of sericitized gneiss and matrix are not clearly defined and it is possible that some fragments of gneiss have been partly replaced by matrix material. A few interstices contain late calcite and some contain late quartz. There are also a few small, crystalline aggregates of opaque iron oxide and a trace of leucoxene.

Conclusion:

This breccia is composed predominantly of clasts of sericitized quartz-feldspar-biotite gneiss and of metasomatic rock now containing abundant turbid microcline and an anomalous amount of iron oxide. It is possible that the metasomatic, microcline-rich rock represents altered portions of the gneiss as an altered and bleached border zone of one large clast shows a similar composition. The matrix is predominantly brown-stained, altered

biotite and/or chlorite. There is no absolutely conclusive evidence from which to determine the origin of this breccia but there is certainly some evidence of tectonic fracturing.

Sample P312/76; TS36294

Location:
MGD 151 at 94.73 m. Mount Gee East Prospect.

Hand Specimen:
Medium grained to moderately fine grained, dull greenish-grey rock which has a uniform composition throughout the 6cm. length of drill core. Textures revealed on the cut surface suggest a weak foliation.

Staining with cobaltinitrite shows a relatively minor amount of potash feldspar.

Thin Section:
A visual estimate of the constituents is as follows:

	%
Quartz	3-5
Extensively sericitized feldspar	>60
Iron oxide (probably mainly martite)	3-5
Heavily stained chlorite and biotite	20-25
Apatite	Trace-1
Leucoxene/sphene	Trace-1
Calcite veins	1-2

The minerals in this rock have been extensively replaced by sericite and/or fine grained muscovite and in places probably also by chlorite but the former textures are moderately well preserved. Many partly sericitized grains contain remnants of feldspar and in a few completely sericitized grains there are traces of relict textures suggesting former twinning typical of plagioclase and it is therefore concluded that much of the sericitized silicate was probably plagioclase. Remnants of potash feldspar are more abundant and this appears to have been more stable under conditions causing sericitization of plagioclase. Relict textures show that this was a fairly even grained metamorphic rock composed largely of feldspar crystals 0.2 to 0.5 mm. in size intergrown with generally minor amounts of quartz of a slightly finer grain size. The percentage of quartz varies and there is one thin zone or band containing more abundant quartz but whether this represents a more siliceous layer in metasedimentary rock or a former quartz vein, is not clear. Virtually all of the plagioclase

has been replaced by sericite and sericite has also invaded and partly replaced some of the potash feldspar.

Scattered through the rock there are some aggregates of opaque iron oxide 1.0 to 2.0 mm. long and many of these are elongated in a direction of weak foliation. Some feldspar crystals and crystalline aggregates are, or were, elongated in this direction. The iron oxide occurs in two distinctly different grain sizes with only a few relatively large aggregates of coarse grained hematite (probably oxidized magnetite) and a larger proportion of finer grained iron oxide. Much of the finer grained iron oxide occurs in interstices and along grain boundaries and it is possible that it crystallized at a later date.

Throughout most of the rock there are concentrations of brownish, limonite-stained chlorite and/or fine grained biotite in interstices and along most grain boundaries. Much of this micaceous material is very fine grained and it is possible that it has crystallized as a result of some form of metasomatic alteration. In places where this fine grained, interstitial micaceous material is heavily stained by brown iron oxide, it is almost opaque and its exact identity cannot be determined. Some interstices in these zones also contain small patches of calcite and the area sectioned contains portion of a small, discontinuous calcite vein.

Small crystals of apatite up to 0.3 mm. in size are scattered through the rock and there are a few small aggregates of recrystallized leucoxene.

Conclusion:

This is a sericitized and possibly also chloritized metamorphic rock which was probably a feldspathic gneiss. It is now more of less heavily stained by limonitic material which has obscured many features.

Sample P313/76; TS36295

Location:

MGD 151 at 256.3 m.

Hand Specimen:

A moderately coarse grained rock composed of white quartz, a very pale green "waxy" clay mineral and some biotite. Some portions of the rock show a weak foliation defined by preferred orientation of biotite but this is not apparent throughout the specimen. The rock is cut by one small shearing plane or fracture along which there are trace amounts

of a white mineral resembling gypsum.

Thin Section:

A visual estimate of the constituents is as follows:

	%
Quart	40-50
Microcline	5-10
Biotite	15-20
Clay minerals	30-40
Zircon	Trace

The rock now contains some irregularly shaped aggregates several millimetres in size of coarse grained quartz intergrown with patches of clay and aggregates of biotite. There are a few remnants? of microcline generally closely intergrown with some of the biotite. The clay minerals have clearly pseudomorphously replaced an earlier silicate which was intergrown with the quartz and biotite, and, although there are no relict textures from which to identify this mineral it was most likely a feldspar. Some areas of clay contain numerous flakes of muscovite showing sub-parallel orientation and also a few small quartz inclusion. In some areas there are aggregates of biotite showing sub-parallel orientation intergrown with minor amounts of much finer grained quartz and microcline with a common grain size of 0.3 to 0.6 mm.

Some of the coarser grained quartz contains inclusions or encloses some biotite and also very rarely some finer grained microcline and it is possible that this coarse grained quartz has either migrated and recrystallized or has been introduced into a formerly finer grained, gneissic rock.

Conclusion:

This was either a granitic rock or a biotite-bearing gneiss which was invaded by migratory quartz. Alteration (probably hydrothermal) has resulted in replacement of practically all feldspar by clay minerals.

Sample: P314/76; TS36296

Location:

MGD 151 at 266.5 m.

Hand Specimen:

A massive, dull yellowish-green to olive-green rock composed largely of moderately coarse grained biotite. Through this mass of biotite there are patches of very pale-green,

translucent and "waxy" clay 3.0 to 8.0 mm. in size. There is no evidence of a foliation in the hand specimen.

At the lower end of the drill core sample an irregular joint surface shows evidence of alteration which has resulted in the deposition of some soft, white to very pale-pink minerals probably including some zeolite.

Thin Section:

A visual estimate of the constituents is as follows:

	%
Biotite	60-65
Muscovite/sericite	2-3
Clay minerals	30-35
Zircon	Trace
Leucoxene/sphene	Trace
Calcite	Trace

Much of the rock is composed of intergrown biotite flakes 2.0 to 3.0 mm. long and, although the hand specimen did not show any recognisable evidence of a foliation, in thin section much of this biotite shows a preferred orientation suggesting a direction of foliation. Scattered through this mass of biotite there are round to oval and irregularly shaped patches of clay 3.0 to 6.0 mm. in size which show peculiar patterns resembling those of altered olivene, however, this clay does not show other features commonly found in altered olivene and it is thought that the mineral replaced was probably not olivene. One of these areas of clay contains two small crystals of very pale-pink zircon 0.1 to 0.2 mm. in size and a few similar zircon crystals are present in some biotite where they are surrounded by haloes of bright yellow coloration in the biotite. One area of biotite contains a few very small inclusions of a pale green mineral and these are also surrounded by yellow, pleochroic haloes.

Some zones of biotite have been altered and partly replaced by very fine grained sericite and minor amounts of coarser grained muscovite and, although these secondary micaceous minerals occur mainly in interstices they have locally corroded, veined and partly replaced some flakes of biotite. In one more extensively sericitized area there is some very fine grained calcite associated with traces of a very fine grained, dark mineral.

In one area of the section some patches of clay contain apparently unaltered remnants of an earlier mineral with moderately good cleavage and straight extinction and although this cannot be identified with certainty it is possibly scapolite.

Conclusion:

This is a metamorphic rock probably of basic composition in which practically all feldspar and/or scapolite? have been replaced by clay minerals. The thin section shows some evidence of a foliation not apparent in the hand specimen. It may have been a basic igneous rock but contains a few small zircon crystals which are not commonly present in basic igneous rocks.

Sample P315/76; TS36297

Location:

MGD 151 5m.

Hand Specimen:

Portion of the drill core is of a medium to fine grained, biotite-bearing gneissic rock and this has apparently been fractured and invaded by metasomatizing solutions which have resulted in bleaching and alteration and in one zone there is now a mass of coarser grained, pink feldspar associated with some clay. A relatively recent fracture or vein contains additional quartz and white clay.

Thin Section:

Some parts of the unaltered gneissic rock are composed predominantly of intergrown biotite and quartz, probably with varying amounts of feldspar, although insufficient of the fresh rock is included in the section to determine this accurately. Much of the biotite shows sub-parallel orientation defining the foliation and some quartz is also elongated parallel to this direction. There are a few small grains of zircon.

In one of the partly altered zones of gneissic rock, potash feldspar is now more abundant and most of the biotite appears freyed, corroded and bleached and numerous small remnants are now included within some of the potash feldspar. Elongate groups or aggregates of fine grained, recrystallized titaniferous material which has probably been released from the biotite, is now included in some of the potash feldspar and is associated with some of the partly altered biotite. Some of this feldspar shows twinning typical of microcline and locally it is cut by very small quartz veins. In the hand specimen this microcline-bearing, altered gneiss grades into the zone containing coarser grained potash feldspar but this coarse grained zone was not included in the thin section. This zone of altered gneiss contains bleached and altered remnants of biotite in an abundance of secondary potash feldspar it also contains scattered crystals and aggregates of iron oxide (2-3%) and one aggregate of monazite?.

The metasomatically altered gneissic rock is in sharp contact with a vein or zone of apparently intrusive material now composed of fine grained quartz and sericite with a few small remnants of biotite and very few grains of zircon. This contains a few larger patches of sericite and quartz up to 0.8 mm. in size and almost certainly it also represents corroded and metasomatically altered rock but it appears to have differed in composition and texture from the biotite-bearing gneiss.

Conclusion:

This was a quartz-feldspar-biotite gneiss containing moderately abundant biotite which was fractured and was locally, extensively altered by metasomatizing solutions. In some zones this alteration has resulted in extensive replacement of the gneissic rock by potash feldspar and, in more extreme conditions could possibly result in the development of a "granitic" or "pegmatitic" rock. The full history has been rather more complex than this with probably some additional fracturing and alteration.

Sample P316/76; TS36298

Location:

MGD 151, 6.7 m.

Hand Specimen:

A coarse grained rock containing up to 50% quartz intergrown with pale pink crystals of altered feldspar up to 8.0 mm. in size and some darker reddish patches of clay-like material which were found in the thin section to show many similarities to sericitized plagioclase.

Thin Section:

Because this rock is very coarse grained and the area sectioned may not be representative an estimate of the relative proportions of the minerals present would have little meaning.

Quartz now occurs as irregular patches and aggregates to over 10.0 mm. in size and almost certainly some of this quartz is secondary and has partly replaced the earlier rock. In one area some of this quartz contains corroded remnants of turbid and partly altered microcline? and also an aggregate of iron oxide associated with some sphene. Clearly some feldspar has been replaced by this quartz.

In other parts of the section finer grained quartz (2.0 to 3.0mm) is intergrown with crystals of a former mineral which has been replaced by sericite and this in turn has been stained by very fine grained hematite. Some relict textures in the sericitic

material suggest former cleavage planes or twinning planes and almost certainly this represents altered plagioclase. The rock also once contained some biotite flakes or aggregates up to 6.0 mm. long and these have been replaced by white mica, clay and leucoxenic material stained by varying amounts of brown iron oxide. The texture of the former biotite has been moderately well preserved.

Conclusion:

All the evidence in the hand specimen and thin section indicates that this is an altered granite or adamellite.

Sample: P317/76; TS36299

Location:

MGD 151, 10.3 m.

Hand Specimen:

A medium grained, gneissic rock composed of quartz and altered feldspar and showing a few larger porphyroblasts? of pink feldspar over 10.0 mm. in size. Staining tests showed that these larger crystals are of potash feldspar. Much of the feldspar has been altered and stained dull red by very fine grained iron oxide and the remaining feldspar is salmon pink. The foliation dips at a moderate angle assuming that the drill hole is vertical.

Thin Section:

A visual estimate of the constituents determined from the thin section and the hand specimen is as follows:

	%
Quartz	25-30
Microcline	30-35
Sericitized plagioclase	25-30
Partly altered biotite	5-10
Iron oxide	Trace-1
Zircon	Trace
Muscovite	Trace

Quartz and feldspar or altered feldspar crystals commonly 1.5 - 3.0 mm. in size are intergrown with smooth to slightly curved grain boundaries giving a texture typical of that of metamorphic rocks. Biotite and altered biotite occur as elongate aggregates mainly along grain boundaries and these aggregates are subparallel to the foliation, although the constituent flakes vary in orientation. Some of the quartz also occurs as elongate aggregates parallel to the foliation and many of the feldspar crystals are also slightly elongated in this direction. The section includes portion of a large porphyroblast of microcline

12.0 mm. in size and this contains a few inclusions of quartz and a few very small inclusions of sericitized plagioclase, mainly near the boundary. The large porphyroblast is cut by numerous small ?tension joints which are almost at right angles to the direction of foliation and these contain traces of sericite or clay. There are a few small zircon grains occurring mainly in aggregates of biotite but one small crystal was found included in altered feldspar.

All of the plagioclase has been completely replaced by sericite with minor amounts of slightly coarser grained muscovite but this fine grained mica has retained relict textures probably inherited from the lamellar twinning in the plagioclase. The external shape of these former crystals is clearly preserved even where smaller crystals are included within microcline. Small amounts of very fine grained, dark red iron oxide are present throughout the sericitic material and in places this iron oxide also outlines former twinning planes and/or cleavage planes. Some of the microcline also shows evidence of alteration in that many crystals show some more turbid zones in which there is less evidence of a typical microcline twinning and in a few places this apparently altered microcline contains some very fine grained iron oxide inclusions. Some of the biotite has been bleached and/or partly altered mainly to white mica, iron oxide and recrystallized titanium oxide but locally some remnants of altered biotite are ;included within a little migratory quartz.

Conclusion:

This is either a porphyroblastic adamellite gneiss or a gneissic, porphyritic adamellite. It has been altered by hydrothermal? solutions resulting in the complete replacement of plagioclase by sericite and iron oxide and also minor alteration of potash feldspar and biotite.

Sample P318/76; TS36300

Location:

MGD 151 at 14.1 m.

Hand Specimen:

An extensively altered rock containing quartz, altered feldspar and clay, mostly heavily stained by iron oxide. There is evidence of a foliation dipping at a moderate angle similar to that in sample P317/76 (at 10.3 m). This sample also shows a thin band of finer grained material parallel to the foliation which is probably material formed or deposited along a vein or joint.

Thin Section:

This is essentially very similar to Sample P317/76 and therefore it will not be described in detail. It is possibly coarser grained and in this portion of the rock practically all of the biotite, as well as all of the plagioclase, have been altered although former textures are well preserved. The plagioclase has been replaced by sericite and most of the biotite has been replaced by white mica and some iron and titanium oxides.

This differs from Sample P317/76 in that the textures suggest some replacement reactions between quartz and microcline. Some patches of quartz are extensively veined and corroded and have been partly replaced by very turbid microcline, some of which contains scattered, small crystals of iron oxide, probably magnetite or martite. Some isolated patches of quartz within this microcline still remain in optical continuity and appear to have been parts of a strained an incipiently granulated mass of quartz. In another area, however, reactions along a boundary between quartz and microcline appear to have resulted in some invasion of the microcline by quartz which has penetrated along cleavage planes and small fractures and another area of quartz contains a few small and apparently corroded remnants of microcline, although this interpretation is doubtful.

Conclusion:

This is an extensively altered granitic or adamellite gneiss or gneissic adamellite similar to and probably related to Sample P317/76. All plagioclase has been replaced by sericite and there is also evidence of some reactions involving quartz and microcline with the development of patches of very turbid and probably secondary microcline in some zones. Biotite has been more extensively altered than in Sample P317/76.

Sample P319/76; TS36301

Location:

MGD 151 at 24.3 m.

Hand Specimen:

An extensively altered, greyish-pink granitic or gneissic rock which is similar to Samples 317 and 318/76 but shows practically no evidence of a foliation. Clay minerals appear to be more abundant.

Thin Section:

This is similar to specimen 318/76 in texture and grain size and in the occurrence of quartz and sericitized plagioclase but it differs from P318/76 in that much of the microcline has also been extensively altered and has been replace by clay minerals, sericite and locally by some moderately fine grained

quartz. Biotite has been completely replaced by white mica stained by iron oxide. Some quartz grains are surrounded by irregular fringes of secondary overgrowth quartz which has penetrated the surrounding, altered feldspar.

Conclusion:

This is a granitic rock or adamellite or possibly adamellite gneiss, almost certainly related to samples P317 and 318/76 but it shows more extensive alteration of the feldspars in that much of the microcline as well as all plagioclase has now been replaced by sericite and clay minerals.

Sample P320/76; TS36302

Location:

MGD 151 at 38.2 m.

Hand Specimen:

A medium grained rock similar to P318 & 319/76 and showing evidence of only a very weak foliation almost parallel to the drill core specimen. It is composed of quartz, pink feldspar or altered feldspar and grains which have been replaced by very pale green sericitic material or clay.

Thin Section:

This is similar to specimens 318 & 319/76 in that it contained intergrown quartz, plagioclase and microcline with a common grain size of 2.0 to 6.0 mm. with lesser amounts of biotite occurring mainly along grain boundaries and trace amounts of zircon and opaque oxide. All plagioclase has been replaced by sericite but the external shape and some evidence of internal cleavage or twinning have been preserved. Much of the microcline had remained unaltered and the larger crystals contain a few inclusions of quartz and of sericitized plagioclase. Some of the microcline however shows patches or zones of much more turbid lmaterial in which there is now little or no evidence of typical microcline twinning. Biotite has been only partly altered to white mica and clay stained by iron oxide. Most of the remaining biotite however appears bleached and partly expanded.

There is practically no evidence of a foliation in the thin section but in one area much of the biotite shows a preferred orientation and this is probably the direction of foliation noted in the hand specimen.

One fracture or joint cutting the rock has been filled by brown limonitic material.

Conclusion:

This is an adamellite showing evidence of a very weak foliation. All plagioclase has been replaced by sericite but potash feldspar and biotite have only been partly altered. It is almost certainly related to specimens P316 to 319/76.

Sample P321/76; TS36303

Location:

MGD 151 at 45.4 m.

Hand Specimen:

An altered and iron oxide-stained rock containing some zones composed of relatively minor quartz and pink to red-stained clay and altered feldspar. These are separated by numerous large vein-like patches containing vuggy quartz associated with pale pink-stained clay. Because of the amount of alteration it cannot be certain from the hand specimen whether this is a fragmental rock or a fractured and sheared rock.

Thin Section:

The host rock contains intergrown quartz, microcline, zones which have been replaced by sericite and minor amounts of opaque oxide and apatite. In less altered areas some relict textures resemble those in the previous specimens of adamellite or adamellite gneiss but in other areas the sericitic material shows evidence of deformation, shearing or crumbling and more extensive staining by fine grained iron oxide. There are a few small remnants of biotite but most of the altered biotite has also been deformed or sheared and is now barely recognisable.

The fractured and sheared rock has been invaded by solutions from which abundant quartz has crystallized and much of this tends to form parallel and radiating crystals. Minor amounts of microcline are intergrown with this quartz adjacent to its contact with the sheared and altered adamellite and there are also scattered small patches of sericite and clay.

Conclusion:

By comparison with specimens from shallow depths it is concluded that this is a sericitized, fractured and sheared adamellite or adamellite gneiss and this has been invaded by solutions from which abundant quartz has been deposited in fractures and interstices. Most of the silicate which was intergrown with this quartz has been replaced by clay but there are minor remnants of microcline.

Sample: P322/76; TS36304

Location:
MGD 151 at 150.2 m.

Hand Specimen:
The lower portion of the drill core sample is of medium grained gneiss composed of quartz, feldspar and mica and the well defined foliation is dipping at a low angle, assuming the drill hole to be vertical. The other part of the sample is a fragmental rock or breccia containing clasts of quartz and feldspar in a darker matrix which contains moderately abundant altered and stained biotite. The contact between the gneiss and breccia is sharply defined and also dips at a moderately low angle. Adjacent to the contact the gneissic rock appears to contain more abundant pink feldspar, probably microcline.

Thin Section:
The gneissic rock is composed of quartz, microcline, some sericitic patches which may have been plagioclase and thin layers or elongate aggregates containing partly altered and stained biotite associated with some secondary white mica. At distances of 4.0 and 8.0 mm. from the contact streaks and thin bands containing altered and stained biotite also contain numerous crystals of monazite, 0.1 to 0.4 mm. in size, as well as a few small zircon crystals. This zone also contains scattered patches and small veins of calcite, some of which has partly replaced feldspar.

The actual contact is very sharply defined but irregular with numerous small angular projections and the general appearance suggests a fractured surface. Adjacent to the contact the breccia contains an abundance of deformed, chloritized and altered biotite which is now heavily stained by iron oxide and this concentration of biotite varies in thickness from less than 0.1 mm up to 2.0 mm. The remainder of the breccia contains clasts of quartz, quartz-microcline, deformed biotite and some clasts now composed of sericite in a matrix containing sericitic material and calcite. One of the larger clasts composed of quartz and minor microcline, shows evidence of strain, fracturing, granulation and partial recrystallization and clearly it has been subjected to considerable tectonic stress. Many of the flakes or clasts of mica are bent or fractured and extensively deformed.

Conclusion:
The sample contains breccia in contact with underlying quartz-feldspar-biotite gneiss and in a zone adjacent to the contact the gneiss contains an anomalous amount of monazite. Material

in the breccia shows evidence of tectonic stress but no recognizable evidence to suggest a sedimentary origin.

Sample: P323/76; TS36305

Location:
MGD 151 at 151.1 m.

Hand Specimen:
A medium grained rock composed of quartz, some feldspar and dark mica. There is a weak foliation almost parallel to the length of the drill core specimen but this appears to have been somewhat modified and obscured by irregular patches of coarse grained, possibly migratory or introduced quartz.

Staining with cobaltinitrite shows an uneven distribution of potash feldspar in that it is more abundant towards the upper portion of the specimen.

Thin Section:
This is a moderately coarse grained rock which, in some places is composed of intergrown quartz, microcline and a sericitized feldspar showing relict textures suggesting that it is altered plagioclase. Some deformed and partly altered biotite occurs along thin bands and in elongate aggregates which define the direction of foliation. In some areas there are large patches of coarse grained quartz which appear to have invaded and partly replaced the rock. Some of this quartz encloses remnants of biotite.

Some of the biotite aggregates contain scattered, partly metamict zircon grains up to 0.3 mm. in size.

Conclusion:
This is an adamellite gneiss in which plagioclase has been replaced by sericite and some microcline also appears partly altered. Some biotite has been bleached and most of it has been slightly altered. There is some migratory or recrystallized quartz which has modified the earlier gneissic texture.

Sample P324/76; TS36306

Location:
MGD 151 at 289.9 m.

Hand Specimen:
A pale pink to pale brown, fine grained rock with numerous altered patches now composed of pink-stained clay. This clay

swells on contact with water.

Close examination of the unaltered parts of the rock show some poorly defined spherulites or spherulitic structures 2.0 to 4.0 mm. in diameter and at least some of these have an internal radiating texture.

X-ray diffraction:

One of the spherulites was found to be composed of quartz and montmorillonite.

An X-ray diffraction trace of portion of the rock gave the following results.

Quartz	Dominant
Montmorillonite	Sub-dominant
Calcite	Accessory
Albitic plagioclase	Accessory
Muscovite	Accessory

Thin Section:

In addition to the minerals identified by X-ray diffraction the thin section shows a trace of microcline.

This rock was formerly composed largely of myrmekitic and radiating intergrowths of quartz and albitic plagioclase and optically continuous quartz in these intergrowths is generally of the order of 2.0 to 3.0 mm. in size. Much of the plagioclase has been replaced by extremely fine grained 'sericitic' material identified by X-ray diffraction as montmorillonite but the former myrmekitic texture has been clearly preserved. In a few areas the plagioclase and/or montmorillonite has been partly replaced by calcite.

A few flakes of muscovite, 0.5 to 1.0 mm. in size, are scattered through the rock, and a few of these have been bent or otherwise deformed. Some are associated with coarse grained quartz which occurs in interstices between a few spherulites or myrmekitic intergrowths. A trace of fine grained sphene or recrystallized leucoxene is associated with some muscovite.

Conclusion:

As this rock was composed predominantly of myrmekitic intergrowths of quartz and albitic plagioclase it has been classified as myrmekite. It is not clear whether these two minerals crystallized from intrusive material or whether the rock is a result of some complex replacement reactions.