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Director-General,
Department of Mines & Energy,
Post Office Box 151,
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Attention: J. Drexel

REPORT GS 494/80

YOUR REFERENCE:	Application dated 25 July 1979
MATERIAL:	17 rock specimens
LOCALITY:	Mt. Painter Province
IDENTIFICATION:	6737 RS 961-977
DATE RECEIVED	30 July 1979
WORK REQUIRED:	Petrographic description and comments on possible history and origin.

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DESCRIPTION OF SOME MT. PAINTER BRECCIAS AND GRANITIC ROCKS

1. SUMMARY OF SPECIMENS

Sample and Section No.	Brief description
6737 RS 965, JFD 7A/79; TS41964	Fine-grained leucogranite of uncertain origin. Microcline may be metasomatic or recrystallized. At one time there were a few interstitial voids which were filled by very fine-grained to chalcedonic quartz. It would be suitable for Rb/Sr geochonology.
6737 RS 966, JFD 8/79; TS41965	Fine-grained leucogranite with an almost spherical tourmaline nodule. In this nodule practically all feldspar (microcline) has been replaced by optically continuous tourmaline intergrown with quartz. The leucogranite has been partly replaced by sericite.
6737 RS 961, JFD 9B/79; TS41966	Fine-grained leucogranite similar to JFD 7A/79 with a zone in which microcline and muscovite have been extensively corroded and replaced by sericite. The zone not showing sericitic alteration has been locally granulated and may contain slightly more quartz.
6737 RS 967, JFD 10B/79; TS41967	Fine-grained leucogranite has been fractured and locally granulated. The fractured zone contains some specular hematite, traces of monazite (or xenotime?) and tourmaline and it has been extensively replaced by secondary quartz.
6737 RS 968, JFD 10C/79; TS41968	Granitic breccia in which the crushed matrix has been partly replaced by quartz, as in sample 10B, and this matrix contains some hematite and a trace of monazite?. Dark staining bordering clasts is hematite. An interesting feature is that the matrix once contained moderately large crystals of a relatively soluble mineral now replaced by vugs of quartz.
6737 RS 969, JFD 21/79; TS41969	Granitic breccia with some clasts showing evidence of abrasion. The silty material bordering the breccia on both sides shows features (graded bedding, cross-bedding and mica flakes parallel to the layering) strongly suggesting that it was transported and deposited by fluid, but this could have occurred in a fracture or void just as well as in a larger body of water. The silty material is composed of minerals derived from the leucogranite.

Sample and Section No.	Brief description
6737 RS 962, JFD 11/79; TS41970	Granitic breccia in contact with hematitic breccia. It is coarser-grained than the leucogranite and shows evidence of deformation, fracturing, local granulation and regrowth of both microcline and quartz. It has been invaded by hematitic material along interconnected fractures and the pattern also suggests some chemical corrosion. Specular hematite and monazite? were fractured before being cemented by the latest generation of quartz.
6737 RS 963, JFD 13/79; TS41971	Granitic breccia essentially similar to sample JFD 10C/79 (RS 968). It also has aggregates of vuggy quartz which almost certainly replaced crystals of a relatively soluble mineral as in JFD 10C/79.
6737 RS 964, JFD 16B/79; TS41972	"Silty layering in hematitic breccia". The textures in thin section are not conclusive but it is tentatively suggested that hematite and monazite? could have crystallized in situ in the breccia and this was followed by at least one episode of fracturing and/or crushing. The broken fragments were then moved, sorted and rearranged by solutions streaming through the fractured zone, resulting in local pockets of silty material.
6737 RS 972, JFD 24/79; TS41973	Fine-grained leucogranite. It would be suitable for Rb/Sr geochronology, but this would probably give an age of metamorphism or metasomatic alteration.
6737 RS 971, JFD 29/79; TS41974	Tentatively classified as a metasomatic granite with ?remnants of other rock. There is a trace of fluorite.
6737 RS 970, JFD 30/79; TS41975	Metasomatic granitic rock containing remnants of biotite schist which have not been completely digested or "granitized".
6737 RS 975, JFD 51/79; TS41976	Partly sericitized leucogranite with a porphyritic texture (porphyritic microgranite).
6737 RS 973, JFD 67A/79; TS41977	Deformed quartz-feldspar gneiss (or foliated leucogranite) in contact with quartz-tourmaline rock containing lesser microcline and minor oxidized pyrite. Tourmaline has been extensively fractured and this zone has been cemented and possibly partly replaced by late, moderately coarse-grained quartz. Because of the extensive fracturing it is not possible to determine whether it was a tourmaline-bearing pegmatite or a zone in the granite where feldspar was replaced by tourmaline (as in sample 8/79).

Sample and Section No.	Brief description
6737 RS 974, JFD 6/79; TS41978	Deformed and partly granulated, granitic rock with a zone or band containing a high proportion of intergrown, poikilitic tourmaline crystals. This tourmaline has probably replaced an earlier silicate mineral (?feldspar) and is now intergrown mainly with quartz. It differs from the tourmaline in some bands in samples described in Report 4858/79 in that it has crystallized in situ and does not occur as rounded or abraded grains. There is a band (?vein) of siliceous or silicified rock containing specular hematite.
6737 RS 976, JFD 53A/79; TS41979	Silicified brecciated granitic rock (or silicified granitic breccia).
6737 RS 977, JFD 54/79; TS41980	Granitic breccia with subparallel bands which have been preferentially replaced by tourmaline.

Note: In the following descriptions quantitative estimates of the minerals present are not given for some of the samples as this would be of no value in determining the possible origin and history of these deformed and metasomatically altered rocks.

Conventional nomenclature is not always satisfactory for descriptions and classification of these Mt. Painter rocks and the term "granite" is not meant to imply magmatic granite.

2. PETROGRAPHY

Sample: 6737 RS 965; TS41964

Applicant's number: JFD 7A/79

Photo location: NFM 17/88/35sp

Descriptive information: Described as pink saccharoidal leucogranite.

Hand Specimen:

This is a pale pink, moderately fine-grained (very fine-grained for granite) rock with a uniform grain size and a granular or saccharoidal texture. When closely examined it can be seen to be composed mainly of feldspar and quartz grains less than 1 mm in size and a few small flakes of muscovite which are more conspicuous on a joint surface. There are a few dark grains.

Thin Section:

Mineral assemblage:

	%
Microcline	70-75
Quartz	25-30
Muscovite	2-3
Hematite	Trace-1
Rutile	Trace
Zircon	Minute trace
Monazite?	Minute trace

The rock consists of intergrown microcline and quartz with a common grain size of 0.5-0.8 mm, but some of the microcline crystals are elongate and up to 1.5 mm long. In general, the quartz and microcline are intergrown with smooth to slightly irregular grain boundaries and most of the quartz grains are equidimensional. The elongate microcline grains show a preferred orientation which is more conspicuous when the section is examined between crossed nicols under very low magnification, and this suggests a very weak foliation which is not apparent in the hand specimen. Flakes of muscovite, generally between 0.2 and 0.5 mm in size, occur in some interstices and this does not show any evidence of preferred orientatio in the area sectioned. The quartz and muscovite are uniformly distributed with no apparent variations in concentration, except for one turbid patch 3 mm long where there is a higher concentration of muscovite occurring as isolated but optically continuous flakes intergrown with, and surrounded by microcline which contains concentrations of fine-grained iron oxide and has the appearance of having replaced an earlier mineral. The textures strongly suggest that some of this microcline has replaced muscovite, leaving the isolated corroded remnants still in optical continuity. This area of muscovite also contains two separated remnants of zircon and a few very small patches of probable monazite. Elsewhere in the rock there are traces of recrystallized titaniferous material, probably mainly rutile, and some of this which is included in a flake of muscovite shows some evidence of relict texture, suggesting that the muscovite and rutile replaced an earlier titanium-bearing mineral (possibly biotite?). One apparently rounded zircon grain 0.05 mm in size was found included within microcline and there is an almost opaque, elongate grain 0.5 mm long of a completely altered or metamict mineral also included in microcline

Close examination of the rock under high magnification shows that all of the microcline contains very numerous minute voids and also tiny flakes of hematite, and a few of the microcline crystals contain local concentrations of fine-grained hematite.

At one time the rock had a few interstitial voids generally less than 0.5 mm long but varying up to 1 mm long, and these have been filled by fine-grained to almost microcrystalline and chalcedonic quartz very lightly stained pale orange. In some of these interstices zones of growth and colloform-like layers are defined by variations in the pale orange staining. Another former void,now completely filled by slightly stained chalcedonic quartz, is within a single crystal of microcline which has possibly been fractured.

Conclusion:

From the evidence of present composition this could be classified as a fine-grained leucogranite, but it is possible that much of the microcline is metasomatic or has at least recrystallized. There has been some movement of solutions, resulting in the crystallization of slightly stained quartz in some interstitial voids.

The minerals are unaltered and it would therefore be suitable for Rb/Sr geochronology, but this may give an age of metamorphism or metasomatic alteration.

Sample: 6737 RS 966; TS41965

Applicant's number: JFD 8/79

Photo location: NFM 17/88/35sp

Descriptive information: Rounded ?xenolith within pink saccharoidal leucogranite.

Hand Specimen:

A slightly friable, pale pink rock similar to sample JFD 7A/79 with an almost spherical mass of darker coloured rock with a fairly sharply defined boundary.

Thin Section:

Mineral assemblage:

	%	
Microcline	45-50	
Quartz	25-30	
Muscovite	1-2	
Sericite and clay	10-15	
Tourmaline	10-15	(local concentration)
Leucoxene	Trace	

The leucogranite is very similar to that in sample JFD 7A/79 in that it is composed of a rather granular mosaic of intergrown microcline and quartz grains 0.5-0.8 mm in size with some elongate microcline grains which show preferred orientation. However, it differs in that there are some grains which have been completely replaced by sericite and this has also penetrated along some grain boundaries and along fractures in some microcline. Some microcline crystals appear to have been partly replaced by sericite in that they now have irregular and corroded boundaries against sericite, but the boundaries between microcline and sericite are generally very sharply defined with little or no gradation. Although it is almost certain that at least some of the sericite has replaced microcline, it is possible that other minerals have also been partly replaced by sericite.

The dark, almost spherical zone noted in the hand specimen is composed of about equal proportions of quartz and tourmaline with very minor sericite and leucoxene. Quartz is slightly coarser-grained than in the remainder of the rock and now occurs as aggregates of intergrown crystals which are up to 1 mm in size. Many of these quartz crystals show relict textures outlining the shape of former quartz grains of similar size and shape to those in the remainder of the rock, and these are surrounded by optically continuous overgrowths of secondary quartz which, in places, have intergrown to form aggregates. In one area some secondary quartz contains a few inclusions or remnants of microcline which, although now separated, are still in optical continuity. This secondary quartz is intergrown with a poikilitic mass of tourmaline which, although it forms a very porous mass, is in optical continuity throughout most of the nodule. This tourmaline contains numerous small patches of sericite and there are also a few small patches of sericite included within some of the secondary quartz adjacent to the tourmaline. This sericite in the tourmaline appears to have formed along numerous small fractures which also contain quartz, and the exact relationship between sericite and tourmaline is not absolutely certain.

Conclusion:

Fine-grained leucogranite with a tourmaline nodule. In this nodule practically all of the former microcline has been replaced by tourmaline and secondary quartz.

The leucogranite has been corroded and partly replaced by sericite.

Sample: 6737 RS 961; TS41966

Applicant's number: JFD 9B/79

Descriptive information: The sample is described as showing pink feldspar veining along joints within pink saccharoidal leucogranite.

Hand Specimen:

The area of the section was marked to include the vein material and an unaltered but weathered section of the granite for comparison.

Thin Section:

As the composition varies in different zone an overall estimate of the minerals present would have little meaning.

The area sectioned has two distinctly different zones, the significance of which is not absolutely certain.

One zone contains over 60% of microcline intergrown with quartz and about 1-2% of muscovite and it is essentially very similar to the leucogranite in sample 6737 RS 965 (JFD 7A/79), the main difference being that some of the quartz is slightly coarser-grained (up to 1 mm) and there are a few small leached or interstitial voids which are lined with opal and not the fine-grained to chalcedonic quartz noted in sample JFD 7A/79. In this zone there is also an area about 4 mm in size containing a concentration of recrystallized titanium oxide occurring as a loosely scattered group of turbid crystals up to 0.5 mm in size. Some of these occur in interstices between microcline crystals and some are partly enclosed by microcline. There is a trace of very fine-grained secondary carbonate in this zone.

The other zone in the thin section contains similar microcline, quartz and muscovite, but it also has 25-30% of secondary sericite which has extensively replaced some feldspar crystals, has penetrated along many grain boundaries and has partly replaced the muscovite flakes. There are now numerous subrectangular patches of sericite which contain only a few small, corroded remnants of microcline, but these still show some evidence of relict textures, probably inherited from the twinning. Some patches of sericite contain small, corroded remnants of muscovite and in a few places a little quartz also appears to have been corroded and partly replaced by the sericite; however, this interpretation is uncertain as it is always possible that the quartz enclosed or partly enclosed small crystals of microcline which have been replaced by the sericite.

Conclusion:

The results of examination of the thin section are not as expected and in this particular sample there is no definite evidence of feldspar veining. There is, however, an extensively altered zone in which microcline and also muscovite have been corroded and partly replaced by sericite and, in the area sectioned, the boundary between these zones is fairly sharply defined.

No evidence was found to suggest the introduction of microcline to the more dense and darker pink zone, but it does show some zones of granulation. It could also have slightly more and coarser-grained quartz but this would be difficult to determine accurately.

Sample: 6737 RS 967; TS41967

Applicant's number: JFD 10B/79

Photo location: NFM 17/88/35sp

Descriptive information: Described as "in situ" vesicular granitic breccia from joints of pink saccharoidal leucogranite.

Hand Specimen:

The rock has a fragmental structure with clasts varying in size up to 2 cm and also some smaller grains, and some of these fragments have been leached leaving irregularly shaped voids up to 1.5 cm long. Most of these voids are now lined with small projecting quartz crystals. The rock contains a few grains or aggregates composed of specular hematite and there is some white clay in a few of the voids lined with quartz crystals.

Thin Section:

A visual estimate of the minerals now present is as follows:

	%
Quartz	>60
Microcline	30-35
Muscovite	1-2
Hematite	1-2
Tourmaline and monazite	Trace

There are a few areas in this section a few millimetres in size which probably represent clasts, and these are of unaltered leucogranite very similar to that in sample JFD 7A/79 containing over 60% of microcline intergrown with quartz and a trace of muscovite, and there are a few elongate crystals of microcline showing preferred orientation in these zones. These portions of unaltered rock are surrounded and separated by zones which appear to have been fractured, crushed and granulated and extensively replaced by secondary quartz. There are some granulated zones composed of rather chaotically intergrown microcline and quartz with a common grain size of 0.05-0.1 mm and a few very small flakes or shreds of muscovite,and these zones also contain scattered specular hematite crystals 0.1-0.5 mm long. In places, secondary quartz has crystallized across this crushed or granulated material and there are places where moderately large quartz crystals contain turbid areas, small crystals or fragments of microcline, and also deformed flakes of muscovite. This quartz is intergrown with, or grades outwards into, the larger quartz crystals which project into leached voids and commonly show growth zones in the form of clouds of minute voids or impurities.

There are a few areas in the thin section containing higher concentrations of coarser-grained specular hematite and one of these, which is about 6 mm long x 4 mm wide, has some hematite crystals 4 mm long. Interstices between the crystals contain quartz, minor muscovite and a trace of microcline. There are also a few small crystals of monazite intergrown with, and partly enclosed by, this hematite. These larger aggregates of hematite are in granulated material which has been extensively replaced by quartz. One tourmaline crystal 0.6 mm in size, and a few smaller, isolated crystals or fragments of monazite were also found in this zone.

Some of the voids lined with projecting quartz crystals contain kaolin

and some of the voids which have been leached also contain small patches of kaolin, but no definite evidence was found from which to determine the origin of this.

At one end of one of the voids there is a pseudomorph of goethite 1 x 2 mm in size with an external shape strongly suggesting former pyrite.

Conclusion:

Fine-grained leucogranite which has been fractured and locally granulated. The extensively fractured zone contains minor specular hematite, traces of monazite and tourmaline, and it has been extensively replaced by secondary quartz.

Sample: 6737 RS 968; TS41968

Applicant's number: JFD 10C/79

Photo location: NFM 17/88/35sp

Descriptive information: As for 10B - vesicular granitic breccia from joints in pink saccharoidal leucogranite.

Hand Specimen:

A greyish-pink rock similar to sample JFD 10B in that it has a fragmental structure, but it differs in that the matrix is a slightly darker reddish-grey to brownish colour and some of the clasts are surrounded by a zone of dark staining. It contains a few aggregates or fragments of specular hematite similar to those in sample 10B.

One feature of interest in this sample is that the matrix has numerous vugs, 1-5 mm in size with a few up to 10 mm, lined with quartz crystals similar to those in sample 10B but, in this sample (10C) many of the vugs and also those which have been completely filled with quartz, are bounded by straight sides and some are almost rectangular. It is therefore suggested that these vugs were once occupied by crystals of a relatively soluble mineral, of which there is now no trace. Suggestions as to the identity of these leached crystals is little more than pure speculation and although a few are roughly rhombohedral they do not generally resemble carbonate crystals in external shape. Halite is another remote possibility.

Thin Section:

The unaltered clasts in the area sectioned are similar to the leucogranite already described and are composed of a rather granular intergrowth of microcline with lesser quartz and minor muscovite, but there is one clast which, although still composed of potash feldspar and quartz has an entirely different texture and would be described as a potash feldspar-quartz gneiss. It is coarser-grained and contains parallel, elongate strained crystals and aggregates of quartz 0.5-1 mm thick intergrown with elongate aggregates of very turbid microcline 1 to 1.5 mm thick. The boundaries of these very large clasts are not very sharply defined and this may be due, in part, to recrystallization in the matrix though it could also be that they have rather corroded boundaries, and in this sample the boundary zones and adjacent matrix are heavily stained by very fine-grained iron oxide which has penetrated along cleavage planes and grain boundaries and partly replaced much of the muscovite and some of the microcline. There are, however, a few smaller, angular clasts which do not show this surface staining and it may be that it only developed along certain fractured zones or channel-ways.

The matrix is similar to that in sample 10B in that it contains small crystals or fragments of microcline and some very small wisps of muscovite all lightly stained by iron oxide and cemented by secondary quartz. There are a few scattered crystals of specular hematite, a few crystals or fragments of monazite? and a few small crystals of rutile. There are also some aggregates of specular hematite similar to those in sample 10B.

There are scattered aggregates of vuggy quartz 1-4 mm in size and most of these show some evidence of former crystal shape which varies from roughly square to subrectangular in section, and although it is probable that these were once crystals of a cubic mineral, there is insufficient detailed evidence for this to be identified. These crystals have been completely leached and the voids filled by moderately coarse-grained quartz.

No textures were noted in the matrix to suggest that it was once in a fluidized state, but the whole appearance of the matrix is so chaotic that it is perhaps unlikely that any such textures would have survived. In one area there is a poorly defined quartz vein 2-3 mm thick which, in places, contains concentrations of recrystallized hematite, particularly where it cuts the iron oxide-stained zones bordering some of the clasts.

Conclusion:

Granitic breccia in which the crushed matrix has been partly replaced by quartz and, in general, the sample is very similar to 10C. No evidence suggesting that it was once fluidized could be found but it is doubtful if this evidence would survive.

One interesting feature of this sample is that there is strong evidence to show that the matrix once contained moderately large crystals of a relatively soluble mineral which have been replaced by vugs of quartz.

Sample: 6737 RS 969; TS41969

Applicant's number: JFD 21/79

Photo location: NFM 17/88/38sp

Descriptive information: Silty layering and breccia from joint within pink saccharoidal leucogranite.

Hand Specimen:

The sample contains a band 20-25 mm thick in which there are clasts (some rounded) of pink, fine-grained leucogranite up to 20 mm in size in a rather indeterminate matrix of generally similar composition to the clasts. On both sides of this band there are layers of much finer-grained silty material 6-8 mm thick and some of this surrounds a few of the clasts. Staining in this matrix gives the appearance of banding.

Thin Section:

The central zone is a breccia containing some clearly defined clasts of the fine-grained leucogranite which is, at least in places, indistinguishabl from that in sample 7A/79, and there are also clasts of this material which have less well defined and very indefinite boundaries. One of the clasts with well defined boundaries contains some groups of small iron oxide crystals (hematite or martite?) 0.03-0.15 mm in size concentrated mainly along one band and there is also a trace of monazite? associated with some of this iron oxide. Some interstices in this clast contain very fine-grained microcrystalline to chalcedonic quartz similar to that found in interstices in sample 7A/79. This clast appears rounded but the boundary is slightly irregular and it is surrounded by the fine-grained silty material. The matrix in this central zone contains quartz and microcline fragments 0.5-3 mm in size, a few very small muscovite flakes and traces of rutile, tourmaline and small opaque grains, cemented by slightly turbid, fine-grained quartz and also some very fine-grained microcline. However, it is difficult to determine whether or not this is simply much finer-grained material derived by crushing of the leucogranite. There is one elongate mass of vuggy quartz almost 3 mm long and the external shape of this shows some evidence of former crystal faces and it was almost certainly of similar origin to the patches of vuggy quartz in the previous sample. These quartz crystals projecting into the former void show one growth zone marked by a concentration of very fine-grained iron oxide and this is included within additional quartz which has grown on those crystals.

The finer-grained silty material bordering this breccia contains very small fragments of microcline and quartz varying in size from less than 0.02 mm up to 0.1 mm and there are numerous small flakes of muscovite up to 0.1 mm long. Many of these fragments are definitely angular, but at least a few appear partly rounded or abraded. They are very closely packed and the muscovite flakes and also some elongate fragments of microcline and quartz are orientated about parallel to the boundaries of this vein. This material varies slightly in grain size in poorly defined, subparallel bands which are 1-3 mm thick but, in places, some thin, finer-grained bands converge and coalesce simulating cross-bedding. In one area two of these bands even have the appearance of graded bedding in that they contain coarser material grading up to very fine material with a sharply defined boundary against some more coarser-grained material which grades up to very fine-grained material over a distance of 2 mm. These layers showing graded bedding are not straight and parallel but are rather lenticular and converge as if a cavity had been filled.

Conclusion:

Granitic breccia in which some clasts show evidence of abrasion. The silty material bordering the breccia has features which strongly suggest that it was carried and deposited by fluid and, as such, could therefore be classified as a siltstone. However, it could well be composed of rock flour derived from the crushed leucogranite and could just as well have been deposited in a fracture or cavity as in a larger body of water.

Sample: 6737 RS 962; TS41970

Applicant's number: JFD 11/79

Photo location: NFM 17/88/34sp

Descriptive information: Lower contact of lower hematitic breccia with granitic breccia.

Hand Specimen:

Portion of this rock is composed predominantly of pink feldspar and minor quartz and along the (?lower) boundary there is some textural evidence to suggest that some of this quartz and feldspar crystallized against another rock or fragment and it could therefore be portion of a vein. This zone contains a few aggregates of vuggy quartz 2-4 mm in size, some of which are partly bounded by straight edges, suggesting former crystals similar to those noted in sample JFD 10C/79.

In part of this specimen there are zones containing specular hematite generally associated with some small quartz crystals, and this occurs in an irregular network of intersecting fractures of veins cutting the pink granitic rock. Near one end of the sample there are a few leached voids a few millimetres in size stained by ochrous iron oxide, but there is insuffient evidence to identify the mineral leached from these voids.

Thin Section:

The pink granitic rock contains over 70% microcline with lesser quartz and a trace of muscovite, but its texture is different from that of the finer-grained leucogranite previously described. It is essentially much coarser-grained in that it does contain some large crystals of microcline which are optically continuous over distances of up to 6 mm, and there is also some coarser-grained quartz which encloses a few small patches of microcline. The larger crystals of microcline, however, show evidence of strain and some of them contain zones of granulated material where the microcline has been extensively replaced by fine-grained quartz. There are places where coarse-grained microcline is in contact with, or grades into, zones of finer-grained, recrystallized microcline which is probably the result of tectonic stress, and there are places (former voids) where some crystals and aggregates of microcline are partly surrounded by overgrowths of secondary microcline which have developed good crystal faces projecting into the former void. This has been overlain by quartz filling the voids. In another area microcline bordering a fracture now shows overgrowths of secondary microcline which in places has developed crystal faces and has intergrown to fill the former fracture.

Only one aggregate of vuggy quartz was included in the area sectioned and this does not have any significant shape.

In the hematite-bearing zone this mass of fractured, strained, granulated and recrystallized microcline and minor quartz has been invaded by a network of very irregular veins containing "hematitic breccia". There are some very irregular contacts between granitic breccia and hematitic breccia and the general pattern suggests that there was very probably some chemical corrosion of the granitic breccia along the numerous fractures penetrated by the hematitic material.

The hematitic material filling the numerous voids and veins contains scattered crystals of fragments of specular hematite varying in size from less than 0.1 mm to over 1 mm, a few crystals and fractured aggregates of monazite, a few leached voids which once contained unidentified crystals

(pyrite is one possibility), some angular fragments or remnants of the strained and granulated microcline, a few patches of sericite and a few euhedral to subhedral quartz crystals, all surrounded and cemented by a mass of intergrown quartz crystals 0.1-0.4 mm in size. Although it is probable that the hematite and monazite crystallized in situ in these veins and in (corroded?) voids, the present textures and pattern clearly indicate that there must have been some subsequent fracturing of both hematite and monazite before these were cemented by the latest generation of quartz.

Conclusion:

The granitic breccia in contact with the hematitic breccia shows evidence of extensive deformation, fracturing and recrystallization with some regrowths and overgrowths of both microcline and quartz.

All the evidence suggests that the hematitic breccia has invaded the granitic breccia along a network of fractures, and there is also evidence of chemical corrosion associated with this invasion of hematitic material. Although specular hematite and monazite probably crystallized in situ in the numerous veins of hematitic material, there has clearly been some fracturing of these minerals before they were cemented by the latest generation of quartz.

Sample: 6737 RS 963; TS41971

Applicant's number: JFD 13/79

Photo location: NFM 17/88/34sp

Descriptive information: Granitic breccia between lower and upper hematitic breccias.

Hand Specimen:

A coarse breccia containing clasts of pink granitic rock varying from a few millimetres up to several centimetres with a darker brownish-red matrix. The matrix contains a few aggregates of specular hematite and some of the larger clasts also contain some much finer-grained hematite. There has been some patchy staining in parts of the matrix and around some of the clasts but this could be a feature of porosity allowing solutions to penetrate.

There are scattered voids lined with quartz crystals and also a few aggregates of vuggy quartz varying in size from about 2 mm up to a void about 12 mm long. Most of these are of irregular shape but a few have some straight or almost straight edges possibly inherited from former crystals.

Thin Section:

The section contains some moderately well defined clasts containing at least 60% microcline with lesser quartz and minor mica and some of these are very similar to the moderately fine-grained leucogranite previously described. One of these larger clasts, however, contains bleached biotite instead of muscovite and it also contains a few scattered crystals and one aggregate of monazite? up to 0.5 mm long. The boundaries of some clasts are now not very clearly defined and it is uncertain whether this is a result of corrosion or of some recrystallization within the matrix which is composed of small fragments of microcline and quartz clearly derived from the granitic rock. The zones of dark staining referred to in your notes contain very fine-grained iron oxide essentially similar to that in sample 10C, and this has penetrated along grain boundaries and small fractures in the outer zone of the clast. There are also some irregular zones of iron oxide staining in the matrix.

The matrix is composed of a jumbled mass of microcline fragments varying in size from less than 0.02 mm to 0.5 mm and some quartz fragments also clearly derived from the granitic rock. It contains a trace of muscovite, a trace of tourmaline and a few crystals and crystalline aggregates of hematite. Much of it is very turbid, but as far as can be determined it is cemented mainly by secondary quartz, although there may have been some recrystallization of microcline.

The area sectioned contains a few patches of vuggy quartz 2-6 mm in size and although some of them show elongate and irregular shapes there are a few with a persistent suggesting of an almost square to equidimensional cross-section. The external shape of these is not consistent with irregularly leached voids and almost certainly they were once occupied by some mineral which at present cannot be identified.

Conclusion:

Granitic breccia essentially similar to sample JFD 10C/79 (6737 RS 968). It also contains some aggregates of vuggy quartz which almost certainly replaced crystals of a relatively soluble minerals which had been leached. Although most of these have irregular shapes, some show a persistent suggestion of a square cross-section.

Sample: 6737 RS 964; TS41972

Applicant's number: JFD 16B/79

Photo location: NFM 17/88/34sp

Descriptive information: Silty layering at the top of upper hematitic breccia.

Hand Specimen:

The specimen is predominantly dark greyish-red, fairly fine-grained hematitic breccia with one moderately large aggregate of intergrown crystals of coarse-grained specular hematite. Near one margin of the sample there is a zone containing some very fine-grained, dark red, silty material showing some evidence of layering and the thin section was prepared to cover this area.

Thin Section:

To describe all details of this rock thoroughly would require several pages and much of it would have no bearing on the problem of the silty layering, therefore only relevant details will be described.

In the zone of interest, there is a band or layer of moderately coarse-grained hematitic material containing fractured fragments of specular hematite varying in size from less than 0.05 mm to about 1 mm long, a few fragments of monazite? up to 0.2 mm in size, a few patches of sericite and very few flakes of muscovite in a turbid and iron oxide-stained matrix which is now predominantly secondary quartz. There has clearly been some movement of the fractured fragments of hematite and monazite but it is uncertain how far they have travelled. This coarser-grained zone has a fairly sharply defined boundary against much finer-grained material with subparallel laminations about 0.5 mm apart defined by staining. These finer-grained bands contain fragments of hematite and monazite mainly between 0.02 and 0.05 mm and small patches of orange staining suggest that this band may also once have contained another mineral or minerals (e.g. feldspar?), but the matrix has been replaced by a mass of fine-grained quartz which has recrystallized across the earlier fabric. The general appearance is certainly suggestive of a sediment but, as in sample JFD 21/79, it was not necessarily deposited in a large volume of water. This layered material is interrupted by what appears to be a large clast over 12 mm in size of hematitic breccia showing very confused internal structures, including a very turbid area containing some coarse-grained quartz and a rhomb-shaped void 2 mm in size which now contains quartz and a trace of monazite. The silty layering, although interrupted, does not appear to have been deformed by this large clast.

In other areas there is some very similar layering with variations in the size of hematite fragments in different layers and in the (underlying?) hematitic breccia there are a few clasts of granitic rock composed of microcline and quartz. Throughout the section most of the finer details of the matrix have been obliterated by secondary quartz which has crystallized across, and replaced, any earlier minerals. In general, this zone of hematitic breccia contains a slightly higher concentration of monazite fragments than breccias already described.

Conclusion:

The appearance in thin section is rather confusing and it can only be tentatively suggested that, although the hematite and monazite, etc., could well have crystallized in situ in the hematitic breccia, there has clearly

been some additional movement causing more or less extensive fracturing of the hematite and monazite, etc., and these fragments have been physically transported and rearranged by solutions streaming through this fractured breccia. This could result in small pockets of material resembling siltstone. The fine-grained matrix material has subsequently been replaced by quartz.

Sample: 6737 RS 972; TS41973

Applicant's number: JFD 24/79

Photo location: NFM 17/88/41s

Descriptive information: Saccharoidal granite submitted for determination of suitability for Rb/Sr dating.

Hand Specimen:

A pale pink, medium-grained (fine-grained for granite) rock with a uniform granular or saccharoidal texture and also an apparently uniform composition.

Thin Section:

This is very similar to sample JFD 7A/79 from the same location and it contains over 60% of microcline intergrown with lesser quartz, 1-2% of muscovite, and it has traces of rutile and hematite.

Quartz grains are distributed fairly uniformly throughout the rock and are generally 0.4-0.6 mm in size, approximately equidimensional and single, unstrained crystals. Microcline is slightly coarser-grained than the quartz and there are some elongate crystals up to 2 mm long which show preferred orientation, suggesting a very weak foliation. A few of the larger microcline crystals enclose or partly enclose some quartz grains but this is not common. There are a few small crystals of muscovite generally less than 0.05 mm in size in interstices.

The most abundant accessory mineral is very turbid rutile which occurs as scattered crystals, and also some groups of very small crystals which probably represent recrystallized leucoxene or titaniferous material derived from an earlier mineral. Some of these small groups of rutile crystals are included within larger microcline crystals. There is a trace of specular hematite included in quartz and the microcline contains some minute inclusions of hematite.

Conclusion:

The texture is not typical of an igneous rock but, on the evidence of composition it can be classified as a fine-grained leucogranite or microgranite.

As the minerals are unaltered it would be suitable for Rb/Sr geochronology but this may give an age of metamorphism or metasomatic alteration as it is almost certain that this rock is not in its original state.

Sample: 6737 RS 971; TS41974

Applicant's number: JFD 29/79

Photo location: NFM 17/88/45s

PEGMATOID.

Descriptive information: "Xenolithic" granite.

Hand Specimen:

A medium-grained, pink rock containing a high proportion of feldspar intergrown with lesser quartz. One zone contains a scattering of larger quartz grains or crystals up to 5 mm in size which do not form any recognisable pattern. There is one rounded zone of different composition which appears bleached and slightly porous.

Traces of purple fluorite were found on some joint surfaces.

Thin Section:

Mineral assemblage:

	%
Microcline	60-65
Quartz	35-40
Hematite	Trace
Fluorite	Trace
Rutile	Trace
Zircon	Minute Trace
Local sericite & muscovite	Trace
Secondary clay	Trace

The groundmass or matrix of the rock consists of turbid microcline intergrown with lesser amounts of quartz and the grain size is very variable between 0.2 and 1.5 mm. In some zones the appearance of the microcline suggests partial granulation and recrystallization and in a few places there are obvious overgrowths of microcline which have developed crystal faces projecting into voids now filled by quartz. Much of the quartz has crystallized in voids or interstices but there are also some crystals about 0.5 mm in size which were probably intergrown with the microcline. In one area there is a micrographic intergrowth of quartz and microcline. This moderately fine-grained rock contains a few large quartz crystals and aggregates up to 5 mm in size, some of which have moderately sharply defined boundaries and others have irregular boundaries. All of these show some evidence of deformation and incipient recrystallization under conditions of tectonic stress.

There is one moderately well defined area at least 8 mm long which was once a rock of different composition. It contains a higher concentration of quartz (60-65%) with a common grain size of 0.2-0.5 mm and interstices contain secondary sericite, ?bleached biotite, iron oxides and clay. This may have been a quartz-biotite metamorphic rock but it has been too extensively altered or weathered for its relationship to the enclosing rock to be determined with any certainty.

There are small crystals and aggregates of fluorite up to 0.5 mm in size filling a few interstices in the rock and there are a few scattered crystals of specular hematite. The section contains a group of secondary rutile crystals and a minute trace of ?monazite. There is also a trace of zircon.

Conclusion:

This is clearly a tectonically deformed and metasomatically altered rock containing some "foreign" rock type but there is no conclusive evidence to show whether or not it was a granitic breccia. It may be more appropriate to classify it as a metasomatic granite.

Sample: 6737 RS 970; TS41975

Applicant's number: JFD 30/79

Photo location: NFM 17/88/43sp

PEGMATOID.

Descriptive information: K-feldspar/quartz (leucogranite) possibly invading biotite schist. This rock is thought to be another variation of the "xenolithic" granite.

Hand Specimen:

Much of the rock is of pink granitic material but there are some irregular and elongate zones containing high concentrations of dark biotite. Surrounding these zones the pink granitic rock contains scattered, possibly partly digested remnants of biotite.

Thin Section:

As the composition varies in different zones, a quantitative estimate of the minerals would have little meaning for purposes of determining the origin of this rock.

The dark zones in this rock are composed predominantly of biotite flakes 1-2 mm long and in the least altered portions of these zones the biotite flakes show a preferred orientation, suggesting that these zones were moderately coarse-grained biotite schist. In the least altered zones the biotite is predominantly green, but it becomes progressively more orange- to brownish-coloured towards the outer, more altered parts of these zones. Two extensively fractured and partly altered patches of bluish tourmaline were found along the boundary of one of these zones of biotite schist and in another there are a few crystals of a mineral which may be xenotime. (Phosphate in the form of apatite is known to occur in some biotite schists in the Mt. Painter region.) If positive identification of this mineral is required at a later date it may be possible to remove some from the thin section for X-ray diffraction. One of these small crystals has a very turbid, altered central zone containing orange- to brown-stained isotropic material. Except for traces of opaque oxide no other minerals were found in the remnants of biotite schist.

In the outer zones of these dark areas the biotite schist has been invaded by potash feldspar which has penetrated along grain boundaries and in interstices and some biotite flakes have also been corroded and partly replaced by the potash feldspar. Proceeding outwards from the zones of biotite schist there is a gradation from areas still containing a moderately high proportion of biotite to areas now composed predominantly of turbid microcline containing small, corroded remnants of biotite and also small patches of muscovite which may have formed as the result of alteration of some of the biotite. There are scattered crystals of ?xenotime and/or monazite and also a few remnants of opaque oxide. In one area the scattered remnants of biotite have still retained evidence of subparallel orientation. There is one area 4 x 5 mm in size of extensively fractured, bluish tourmaline now cut by veins of microcline and also containing a little introduced quartz. In the outer zone of one area of partly altered biotite schist interstices between remnants of very pale orange, bleached biotite contain masses of fine-grained sericitic material and relatively few patches of secondary microcline.

In areas between the remnants of biotite schist the rock now consists mainly of turbid microcline containing small flakes and aggregates of muscovite and traces of bleached biotite which generally grade into, or

are intergrown with, the muscovite. There are a few aggregates of vuggy quartz which has crystallized late in the history of this rock and has filled some voids or interstices lined with microcline crystals showing small overgrowths.

Conclusion:

A metasomatic "granite" containing remnants of biotite schist which have been only partly digested or granitized.

Sample: 6737 RS 975; TS41976

Applicant's number: JFD 51/79

Photo location: NFM 18/15/7s

Descriptive information: Possibly hydrothermally altered Mt. Neill granite porphyry occurring in an interpreted fault zone.

Hand Specimen:

A very pale pink granitic rock with some suggestion of a porphyritic texture in that there are a few large feldspar crystals up to 8 mm long with a much finer-grained groundmass. There are also some similar large aggregates of crystals of a darker colour which were found in thin section to be crystals replaced by sericite or fine-grained muscovite.

Thin Section:

Mineral assemblage:

	%
Microcline	40-50
Quartz	25-30
Muscovite/sericite	25-30
Opaque oxide/leucoxene	Trace
Zircon(& xenotime)	Trace
Tourmaline	Minute Trace

This rock contains a few moderately large crystals of microcline 4-8 mm in size, numerous crystals of similar size which have been completely or almost completely replaced by fine-grained muscovite or sericite and a few moderately large quartz crystals up to 3 mm in size (5 mm in hand specimen) and these are surrounded by a much finer-grained groundmass composed almost entirely of intergrown microcline and quartz with a common grain size of 0.3-0.6 mm. Many of the microcline crystals both in the groundmass and occurring as phenocrysts have small patches which have been replaced by fine-grained muscovite or sericite, but in some there are zones or inclusions which have been preferentially replaced by sericite, the remaining microcline being relatively unaltered. There have also been some large crystals or phenocrysts which have been preferentially completely replaced by fine-grained muscovite, whereas the microcline in the surrounding matrix is virtually unaltered. However, no remnants or inclusions were found of plagioclase or any other evidence to suggest that the feldspar replaced by sericite was not microcline. One of the larger phenocrysts of microcline 8 mm long has a sharply defined central region 4 x 5 mm in size which has been completely replaced by fine-grained muscovite and an outer zone showing practically no evidence of alteration, but this outer zone shows some discontinuities and portions of microcline with slightly different optical orientation. Another microcline crystal was found with a small inclusion of microcline showing different optical orientation and some of the microcline crystals have inclusions of quartz. It is therefore probable that there is more than one generation of microcline and it may be that some microcline was more susceptible to alteration.

One of the larger quartz crystals has a well defined line containing traces of very fine-grained biotite and other dark impurities marking a former grain boundary which is now included within an overgrowth of later quartz.

The groundmass contains a few scattered crystals and aggregates of opaque material which is mainly leucoxene and there are a few groups of very small crystals mainly of zircon, but there is one group or loose aggregate of small crystals which may be xenotime.

Conclusion:

Porphyritic microgranite or leucogranite showing evidence of hydrothermal alteration which has resulted in replacement of some feldspar, probably microcline, by sericite or fine-grained muscovite. No evidence was found to suggest the former presence of plagioclase or evidence of soda metasomatism.

Sample: 6737 RS 973; TS41977

Applicant's number: JFD 67A/79

Photo location: NFM 17/94/21sp

Descriptive information: Fault breccia with a clast of foliated leucogranite and matrix of feldspar, quartz and tourmaline crystals.

Hand Specimen:

Portion of the rock is a pale pink granitic rock with a distinct foliation and this is in contact with a medium-grained rock containing moderately abundant, dark tourmaline crystals intergrown with quartz, some fine-grained mica and pink feldspar. There are also one or two crystals now composed of reddish-brown iron oxide which have external shapes suggesting former pyrite.

Thin Section:

Mineral assemblage (this varies in different zones):

	%	
Quartz	60-65	
Microcline	20-25	
Tourmaline	15-20	(more locally)
Muscovite	1-2	
Hematite	Trace	
Oxidized pyrite	Trace	
Xenotime?	Trace	

The pink gneissic rock consists of some orientated elongate aggregates and crystals of quartz intergrown with aggregates of turbid microcline associated with, or partly replaced by, fine-grained muscovite and it is cut by one or two very small quartz veins. This rock has a fairly sharply defined boundary against the darker rock which contains numerous crystals and angular fragments of tourmaline up to at least 2 mm in size, some crystals and aggregates of microcline and a few flakes of muscovite surrounded and enclosed by a mass of moderately coarse-grained late or secondary quartz which, in places, forms subhedral to euhedral crystals up to 2 mm long. Some of the tourmaline crystals are intergrown to form aggregates and many of them show patchy colouration. Some of the crystals have been extensively fractured and the fractures invaded by the surrounding quartz, and in one zone there appears to have been more intense brecciation resulting in the fragmentation of much of the tourmaline which now occurs as local concentrations of small, angular fragments now enclosed and cemented by the late quartz. This tourmaline-bearing zone also contains a few crystals of specular hematite and in the extensively brecciated zone this hematite has also been shattered and forms groups of small angular fragments similar to those of the tourmaline. There are a few small crystals of a mineral with moderately high refractive index and birefringence which is uniaxial positive and is more likely to be xenotime than zircon, but confirmation of this would require X-ray diffraction. A little recrystallized leucoxene or rutile is associated with some of this ?xenotime or ?zircon and these are also surrounded or enclosed by quartz.

The crystals of microcline occurring in the tourmaline-bearing rock are similar to those occurring in most of the "granitic" rocks so far

investigated, in that it contains clouds of minute voids and is slightly turbid. The microcline crystals in the tourmaline-bearing zone appear to be remnants but whether or not the former rock once had more abundant microcline which was partly replaced by tourmaline (as in sample JFD 8/79) is a matter for speculation. Some of the remaining microcline has been fractured and the fractures invaded by the enclosing quartz, and some of the coarse-grained quartz contains a few small inclusions or remnants of microcline.

There is a mass of goethite 3-4 mm in size which is almost certainly oxidized pyrite and this is surrounded by the secondary or late quartz.

Conclusion:

A clast or zone of deformed quartz-feldspar gneiss (or foliated leucogranite is in contact with quartz-tourmaline-microcline rock which has been extensively fractured in places and cemented by late or secondary quartz. Because of the extensive fracturing of the tourmaline-bearing zone it is not possible to determine whether or not it was a pegmatitic phase or whether it was a zone in the granitic rock in which feldspar had been preferentially replaced by tourmaline. The matrix of the tourmaline-bearing rock has been, at least partly and possibly extensively, replaced by the late quartz.

Sample: 6737 RS 974; TS41978

Applicant's number: JFD 6/79

Photo location: NFM 18/13/33sp

Descriptive information: Contact of ?silicified granitic breccia and black tourmaline-?hematite-bearing breccia. This rock is from another probable fault breccia.

Hand Specimen:

Portion of the sample is a medium-grained, pink, granitic rock containing a few scattered aggregates of dark tourmaline and this is separated from a band or zone of dark tourmaline-rich rock 5 cm thick by a band or vein 1-1.5 cm thick of granitic rock containing a higher concentration of hematite but very little tourmaline.

Thin Section:

This covers part of the dark, tourmaline-rich rock and part of the pink,granitic rock.

The pink, granitic rock contains a high proportion of microcline intergrown with lesser quartz and, although there are some microcline crystals up to 2 mm in size, much of the rock has been very extensively fractured and granulated and the few patches of coarser-grained quartz now show extensive undulose or strain extinction. There is also some secondary quartz which fills interstices and surrounds or encloses many of the smaller fragments of microcline in the extensively fractured zone.

The dark, tourmaline-bearing zone contains very porous, poikilitic aggregates of tourmaline extending over several millimetres and these contain numerous inclusions of quartz giving much of the tourmaline a sieve structure. Tourmaline crystals are intergrown to form relatively large, porous aggregates and some of the tourmaline crystals contain very turbid zones marked by tiny impurities with some evidence of relict textures inherited from an earlier mineral or minerals, and in a few of these turbid zones in tourmaline there are even a few small remnants of microcline. From this evidence it is tentatively suggested that this was once a quartz-feldspar rock in which the feldspar (probably microcline) has been almost completely replaced by tourmaline. There are a few small opaque grains in the quartz and also in the tourmaline and one porous crystal 0.5 mm long with a high refractive index and birefringence which is uniaxial positive and may be xenotime. The tourmaline in this zone has not been extensively fractured but there are a few small fractures containing quartz. There are some similar aggregates of porous tourmaline crystals scattered through the granitic rock described in the first paragraph and although some of these have been more extensively fractured than in the main tourmaline-bearing zone they still form continuous intergrowths of crystals.

Between the granitic rock and the tourmaline-rich rock there is a zone containing a complex intergrowth of quartz and turbid microcline with scattered crystals and aggregates of specular hematite amounting to about 5-10% of this part of the rock. This zone contains some secondary quartz which occurs as subhedral crystals up to 1 mm long and in places there are patches of what appears to be vuggy quartz. This appears to be a siliceous or silicified vein containing specular hematite but the boundaries are not very clearly defined and some of the secondary

quartz has certainly penetrated the adjacent rocks.

Conclusion:

Deformed and partly granulated granitic rock with a zone or vein containing a high concentration of tourmaline which has crystallized in situ and has probably replaced a silicate mineral, most likely feldspar, although there are other possibilities. There has been some subsequent fracturing but this has not been as extensive as that which occurred in the granitic rock, probably before crystallization of the tourmaline. The band of hematite-bearing rock separating these two zones is possibly a siliceous or silicified vein containing hematite.

The manner in which the tourmaline occurs in this rock differs from that in which it occurs in many of the samples described in report GS 4858/79 where there were tourmaline-rich bands. In many of the samples described in the above-mentioned report the tourmaline occurs as rounded and abraded grains and not as a continuous mass of intergrown crystals. There were, however, some specimens described in that report in which the tourmaline did form veins in granitic rock.

Sample: 6737 RS 976; TS41979

Applicant's Number: JFD 53A/79

Photo location: NFM 18/15/11sp

Descriptive Information: Recrystallised or silicified fault breccia. It is in contact with a more usual, less lithified and more obvious clastic breccia.

Hand Specimen:
A very pale pink, medium-grained rock with a few aggregates of coarser-grained quartz but no other special features. Staining with cobaltinitrite shows that it contains abundant potash feldspar.

Thin Section:
Mineral assemblage:

	%
Quartz	50-55
Potash feldspar	45-50
Hematite	Trace
Tourmaline	Trace
Rutile	Trace
Monazite?	Minute Trace
Xenotime?	Trace
Zircon	Trace

There is one zone about 6 x 8 mm in size which is similar to the moderately fine-grained leucogranite previously described in that it is composed mainly of microcline and quartz in which microcline predominates, and has a common grain size of 0.3-0.6 mm with some larger microcline crystals up to 1.5 mm in size. This contains traces of tourmaline and fine-grained muscovite, a few small crystals and aggregates of opaque oxide/leucoxene and a trace of ?zircon. The boundaries of this zone are no longer clearly defined and grade into a more quartz-rich matrix in which there are small remnants or fragments of microcline, many of them between 0.1 and 0.5 mm in size, enclosed and partly replaced by a mass of moderately coarse-grained quartz. Many of the quartz crystals are between 0.5 and 2 mm in size and the larger crystals contain numerous small fragments or remnants of microcline and also occasional crystals and aggregates of opaque oxide and recrystallized leucoxene or rutile. There are places where fragments or remnants of microcline had developed small overgrowths showing good crystal faces and these are surrounded by, or included within, the late coarser-grained quartz.

Conclusion:
Silicified, brecciated granitic rock or silicified granitic breccia.

Sample: 6737 RS 977; TS41980

Applicant's number: JFD 54/79

Photo location: NFM 18/15/13sp

Descriptive information: Float sample of layered granitic breccia, possibly from the same fault zone as sample JFD 53A.

Hand Specimen:

The rock is a darker greyish pink that sample JFD 53A/79, but it contains numerous paler pink clasts varying in size from 1-2 mm up to 15 mm. There are two darker bands varying in thickness up to about 8 mm and these contain concentration of tourmaline.

Thin Section:

Mineral assemblage:

	%
Microcline	55-60
Quartz	30-35
Tourmaline	5-10 (more locally)
Muscovite	1-2
Opaque oxide/leucoxene	Trace
Zircon	Minute Trace
Goethite	2-3

Textures in this rock show that it has been extensively crushed and it is now very difficult to determine the exact boundaries between clasts and matrix, but there are a few remnants of coarse-grained microcline up to 4 mm in size and one area of intergrown microcline, quartz and minor muscovite which is probably a clast of leucogranite. There are several clasts or fragments of microcline up to 1 mm in size which are turbid and show evidence of strain, and some of these are partly surrounded by small overgrowths of clearer microcline. There are several small flakes of muscovite, a few small crystals of either zircon or xenotime and a few opaque oxide grains generally less than 0.1 mm in size. Clasts and mineral fragments are now cemented by medium-grained quartz, much of which contains lines and aggregates of very fine-grained, brown iron oxide which appears to have formed around feldspar fragments before crystallization of the interstitial quartz. In general, the matrix is similar to that in sample JFD 53A/79, but it contains a lower proportion of late quartz.

In the area sectioned there is one poorly defined, tourmaline-bearing band which varies in thickness from 0.5-2 mm and locally branches to form a thin band less than 0.5 mm thick. Tourmaline occurs as irregular aggregates of intergrown crystals 0.2-0.6 mm in size and these form rather porous masses, some of which are enclosed by the late quartz. This tourmaline has crystallized in situ and although it has been fractured there is very little evidence of displacement and it has not been dispersed. There are some microcline crystals in the band containing tourmaline and there is no evidence to show that these had been partly replaced by the tourmaline. The general texture in this tourmaline-bearing zone is very similar to that in the remainder of the breccia and no evidence could be found to show why this zone was preferentially replaced by tourmaline; there are only traces of tourmaline in other parts of the rock. The relationship of tourmaline to the granitic breccia could be the same in this sample as in sample JFD 6/79 and its

location may be controlled by certain fractures which were open at the time boron-bearing solutions were permeating the rock.

Conclusion:

Granitic breccia with subparallel bands which have been preferentially replaced by tourmaline. No definite evidence could be found to show why these zones were more susceptible to replacement by the tourmaline but it could be that there were open fractures in these zones at the time boron-bearing solutions were permeating through the rock.