DESCRIPTION OF SOME MT PAINTER GRANITIC ROCKS, SEDIMENTS AND BRECCIAS

Department of Mines & Energy
South Australia

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GS 1/15/0

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Director-General,
Department of Mines & Energy,
EASTWOOD. 5063.

Attention: Mr R. Major

REPORT GS 1902/80

YOUR REFERENCE:	Application dated 16 October 1979
MATERIAL:	37 rock specimens
LOCALITY:	Mt Painter Region
IDENTIFICATION:	Samples 6737 RS 1088-1123 and RS 989
DATE RECEIVED:	19 October 1979
WORK REQUIRED:	Petrographic description and interpretation; identification of five minerals by X-ray diffraction.

Investigation and Report by: Sylvia Whitehead
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1. SUMMARY

Sample and Thin Section No.	Brief Description
6737 RS 1088, RBM 41A/79	The finely crystalline, orange to yellow and pinkish mineral was identified as monazite by X-ray diffraction.
6737 RS 1089-90, RBM 114/79	Black, bladed mineral is a mixture of cryptomelane and pyrolusite. The mineral in 'nail holes' in the black mineral is barite.
6737 RS 1091, RBM 127/79	Pale mineral in biotite schist identified as biotite-phlogopite by X-ray diffraction. Other near-white grains are apatite (identified microscopically and by microchemical test).
6737 RS 1092, RBM 130/79	X-ray diffraction suggests fluorine-substituted 1M or 3T phlogopite. This is a mica schist which has been silicified and the grey material is quartz containing some mica and fine-grained iron oxide.
6737 RS 1093, RBM 146/79; TS42504	Hematitic breccia containing hematite, goethite and lithic clasts in a matrix now composed of clay and very fine-grained iron oxide.
6737 RS 1094, RBM 119/79; TS42505	Hematitic breccia containing aggregates of specular hematite and minor monazite which have crystallized in situ. There was some additional movement before all interstices were filled by quartz. Lithic clasts are of silicified rock.
6737 RS 1095, RBM 116A/79; TS42506	Silicified hematitic breccia in which everything except hematite and monazite has been replaced by quartz. There is a little fluorite included in some quartz. There are two generations of hematite.
6737 RS 1096, RBM 117/79; TS42507, PS28205	Silicified, hematitic breccia similar to RS 1095 (RBM 116A/79). Much of the coarser-grained hematite has replaced earlier magnetite.
6737 RS 1097, RBM 135C/79; TS42508	Hematitic sandstone composed of transported and sorted quartz, hematite and probably feldspar (now replaced by clay) grains with traces of monazite and tourmaline.

Sample and Thin Section No.	Brief Description
6737 RS 1098, RBM 135B/79; TS42509	Hematitic breccia in which the larger specular hematite aggregates almost certainly replaced moderately large crystals of magnetite. Textures in the matrix are obscured by an abundance of fine-grained, micaceous hematite and, although it could have been hematitic siltstone, this could not be confirmed.
6737 RS 1099,1100, RBM 135A/79; TS42510, 42511	Layer of hematitic 'breccia' interbedded with hematitic siltstone and fine sandstone. The layers overlying the 'breccia' show graded bedding. It is uncertain how much hematite is clastic and how much may have crystallized from chemically precipitated iron oxide. Hematite aggregates in the coarser-grained layer very probably replaced magnetite. In the sandstone immediately overlying the 'breccia' there are small crystals which have been replaced by a mineral resembling secondary uranium phosphate.
6737 RS 1101, RBM 118A/79; TS42512	Probably a metasomatic microcline-rich rock containing relatively minor quartz, iron oxide (included in microcline) and traces of monazite. It has been extensively fractured, locally sheared and granulated (almost to mylonite) and invaded by secondary or migratory quartz.
6737 RS 1102, RBM 118B/79; TS42513	The rock is composed of well sorted clastic material, mainly microcline and quartz, but there are variations in grain size in some layers or zones. The material is immature and has been transported only a short distance but, as it has been transported, sorted and deposited this is classified as feldspathic sandstone even though it is reported to occur in a dyke-like (or fault?) body in granitic breccia. It has been cemented by quartz and shows later, mottled staining by iron oxide.
6737 RS 1103, RBM 118C/79; TS42514	Granitic breccia with a matrix stained by iron oxide. The material has not been transported far from the parent rock and the finer-grained matrix between the larger clasts is similar to the feldspathic sandstone of sample 118B/79 and is stained by iron oxide.
6737 RS 1104, RBM 118D/79; TS42515	Chert probably formed from chemically precipitated silica lightly stained by iron oxide.
6737 RS 1105, RBM 120/79; TS42516	Partly decomposed and stained quartz-?feldspar-mica schist.
6737 RS 1106, RBM 122A/79; TS42517	Breccia composed mainly of clasts of metasomaticall altered micaceous schist or gneiss which had been extensively replaced by microcline and quartz.

Sample and Thin Section No.	Brief Description
6737 RS 1107, RBM 122B/79; TS42518	Biotite-andalusite schist which has been invaded by secondary quartz.
6737 RS 1108, RBM 131A/79; TS42519	Breccia containing clasts of 'granitized' biotite-bearing schist or gneiss which has been extensively replaced by microcline and quartz. There has been additional fracturing and shearing after the 'granitization' and, after this latest episode of movement the breccia has been cemented by migratory quartz.
6737 RS 1109, RBM 131B/79; TS42520	Breccia similar to 131A but containing some clasts of granitic rock composed of quart and microcline without relict textures. The matrix contains specular hematite and minor monazite and textures suggest that these crystallized in the breccia but there has been additional movement after they crystallized and before the breccia was cemented by late quartz.
6737 RS 1110, RBM 131C/79; TS42521	Granitic breccia in which only a few of the clasts contain remnants of orientated biotite and most of them do not show relict textures. The matrix contains minor specular hematite and monazite similar to those in 131B and it is stained by later, very fine-grained hematite some of which is included in the late, cementing quartz.
6737 RS 1111-1112, RBM 131D/79; TS42522, 42523	Breccia containing some clasts of granitic rock in which feldspar had been extensively replaced by chlorite. The matrix has specular hematite, monazite and abundant chlorite as well as other silicates. Sample RS1112 is a sandstone occurring within the breccia and it contains transported and sorted material derived from the matrix of the breccia. There are layers of differing grain size in the hematitic-chloritic sandstone and, although the material is well sorted, it has not moved far from its place of origin.
6737 RS 1113, RBM 137/79; TS42524	Deformed 'leucogranite'. It has a granoblastic texture similar to quartz-microcline granulite and it has been slightly deformed by tectonic stress.
6737 RS 1114, RBM 138/79; TS42525	Granitic breccia in which many of the clasts are of coarse-grained microcline, probably metasomatic. The matrix consists of smaller fragments with interstitial sericite stained by iron oxide.
6737 RS 1115, RBM 139/79; TS42526	Extensively altered and stained rock with some relict textures suggesting a moderately fine-grained igneous rock (textures show some similarity to dolerite). Felspar is now K-feldspar and there is interstitial quartz. It could therefore be an extensively metasomatized rock resembling dolerite or a dyke rock related to rhyolite, depending on how much quartz and K-feldspar are secondary. It could also have been a volcanic rock

Sample and Thin Section No.	Brief Description
6737 RS 1116, RBM 140/79; TS42527	Breccia composed of extensively deformed and sheared leucogranite which had developed a foliation due to the deformation (not a relict foliation).
6737 RS 1117, RBM 141/79; TS42528	Granitic breccia with clasts of leucogranite which differ from those in sample RS 1116 in that they have not been extensively deformed and have not developed foliation. The matrix is of similar but much finer-grained material stained by iron oxide. There is a little secondary quartz.
6737 RS 1118, RBM 141/79; TS42529	Granitic breccia in which there has been only slight differential movement between some clasts. Clasts are of leucogranite (predominantly microcline) which was probably metasomatic. The matrix is of small chips derived from the leucogranite and minor sericite. It is stained by iron oxide and there is only a trace of secondary quartz.
6737 RS 1119, RBM 142/79; TS42530	Metasomatic, potash feldspar-rich rock which has had a complex history probably including more than one episode of K-feldspar metasomatism, fracturing or crushing and of development of orange staining in fractured or crushed material. Quartz was the last mineral to crystallize and this has filled interstices cementing the breccia.
6737 RS 1120, RBM 143A/79; TS42531	A metasomatic rock composed of microcline and quartz has some greenish-brown zones in which feldspar has been replaced by iron oxide-stained chlorite.
6737 RS 1121, RBM 143B/79; TS42532	Granitic breccia (tectonic) composed predominantly of metasomatic leucogranite. Fractured zones contain minor specular hematite, local concentrations of apatite and monazite and minor muscovite.
6737 RS 1122, RBM 143C/79; TS42533	Extensively fractured and/or crushed leucogranite (granitic breccia) which does not have the local concentrations of apatite and monazite noted in RS1121. There are, however, a few metamict crystals some occurring in groups. There is very little secondary quartz and the breccia has been cemented or healed by regrowth of microcline.
6737 RS 1123, RBM 143C/79; TS42534	Deformed and brecciated leucogranite similar to sample RS 1119 (142/79).
6737 RS 989, RBM 144/79; TS42535	Poorly sorted, conglomeratic rock containing some mature sediment derived from a variety of rock types and some immature sediment derived mainly from leucogranite and/or granitic breccia very similar to that occurring in the Mt Painter area.

2. MINERAL IDENTIFICATION

Sample: 6737 RS 1088

Applicant's No.: RBM 41A/79

Photo Location: NFM R18/009 (29)sp. No 2 workings, Radium Ridge.

This was submitted for determination of a pink or orange-coloured mineral by X-ray diffraction. The result of this investigation shows that the yellowish to orange-coloured mineral is monazite.

The sample has been re-submitted for fluid inclusion study.

Sample: 6737 RS 1089 & 1090

Applicant's No.: RBM 114/79

Photo Location: NFM R18/009 (66)s. Armchair Creek.

This was submitted for identification by X-ray diffraction of the black crystalline mineral and of the pink mineral in 'nail holes'.

X-ray diffraction shows that the black crystalline bladed mineral is a mixture of cryptomelane and pyrolusite, apparently in approximately equal proportions.

The pink to white mineral in 'nail holes' in the black mineral was found to be barite.

Sample: 6737 RS 1091

Applicant's No.: RBM 127/79

Photo Location: NFM R19/030 (13)s.

This was submitted for determination by X-ray diffraction of the pale mineral in biotite schist.

X-ray diffraction of the area marked showed a trioctahedral mica identified as ordinary biotite-phlogopite.

Visual inspection of the sample showed some other, almost white, grains and portions of these were removed and examined microscopically in temporary oil mounts. This examination suggested apatite and the presence of phosphate was confirmed by a microchemical test. It is therefore concluded that the other, pale-coloured mineral in this sample is apatite.

Sample: 6737 RS 1092

Applicant's No.: RBM 130/79

Photo Location: NFM R19/034 (5)s. Radium Creek Metamorphics.

This is a dark micaceous schist and identification of the grey mineral by X-ray diffraction was requested.

X-ray diffraction of the pale-coloured mineral showed trioctahedral mica with a low base spacing (9.99) and specialized diffraction peaks that allow it to be identified as fluorine-substituted 1M or 3T phlogopite (probably 1M).

As this may not be the mineral of interest it was then decided to prepare and examine a thin section of the rock.

TS42756:

The thin section contains about equal proportions of quartz and a very pale greenish to yellowish mica identified by X-ray diffraction as probably phlogopite. It has about 3-5% of opaque iron oxide and a minute trace of ?monazite.

The grey mineral referred to in the application form is almost certainly quartz and the texture of the quartz in this rock indicates silicification. In many areas there is now a mosaic of intergrown quartz grains 0.1-0.3 mm in size and this quartz has crystallized across the earlier schist and contains orientated flakes of the pale-coloured mica and also clouds of small iron oxide crystals, much of which is probably magnetite or martite. In some of this quartz there are parallel, thin lines of iron oxide outlining former cleavage planes almost certainly in mica, which has been replaced by the quartz. In other parts of the section there are disturbed and recrystallized zones containing coarser-grained mica and iron oxide and also some coarser-grained quartz and these tend to form irregular and vein-like patches in the finer-grained, partly silicified, mica schist.

In one area there is a little brown goethite which may be portion of a poorly preserved boxwork but the pattern is not sufficiently clear for this to be certain.

Conclusion:

This is a mica schist which has been partly silicified and the silcified zones contain concentrations of fine-grained iron oxide, at least some of which may have been released from the mineral or minerals replaced by the quartz. The grey mineral referred to is almost certainly quartz stained by some of the mica and fine-grained iron oxide.

3. PETROGRAPHY

Sample: 6737 RS 1093; TS42504

Applicant's No.: RBM 146/79
Photo Location: NFM R17/091 (54)sp. No. 6 workings - 100 ft. level adit.

Descriptive Information: Reported to be brown hematitic breccia from within the No. 6 workings and it is the most common type of hematitic breccia seen.

Hand Specimen:
A reddish-brown rock containing some crystals and small aggregates of specular hematite up to a few millimetres in size in a fine-grained matrix containing clay and reddish-brown ochrous iron oxide. There are some small crystals and aggregates of quartz and in one of these there is a trace of a flaky green mineral, probably torbernite. The sample was found to give a weak response when tested for radioactivity.

Thin Section:
The rock appears to be very weathered and the reddish-brown matrix is composed mainly of clay and very small particles of iron oxide, many of which are only a few microns in size but varying up to about 0.02 mm and there are also very small grains of similar size which are now composed of sericite and/or clay. There are a few small flakes of mica up to 0.1 mm long and a few small, angular chips of monazite about 0.05 mm in size. The small fragments of hematite, mica and monazite are scattered in a rather chaotic manner through the iron oxide-stained clay and no textures were found which would show or even suggest the origin of this breccia.

Larger clasts scattered through this fine-grained matrix include fragments of specular hematite crystals up to 1 mm long and a few larger aggregates of intergrown specular hematite crystals up to 4 mm in size, and, as at least some of these larger aggregates of specular hematite crystals show some evidence of internal structure it is possible that they represent hematite which has replaced an earlier mineral, possibly magnetite. Other aggregates of specular hematite, however, show no recognisable patterns. There are some clasts 1-1.5 mm in size composed mainly of finely crystalline goethite, a few clasts composed of coarse-grained quartz and a few which were probably once feldspar but which have been replaced by clay and sericite. There is one clast about 4 mm long which is altered granitic rock or granitic breccia with a local concentration of bluish tourmaline which has been fractured and veined or partly replaced by quartz. There is another clast 4 x 8 mm in size of a silicified rock, possibly gneiss, containing at least 3% of yellow rutile crystals and remnants of iron oxide-stained sericite or fine-grained muscovite.

The larger clasts are scattered at random through the finer-grained matrix and no definite evidence was found from which to determine the origin of this breccia. It has been cut by a later vein less than 1 mm thick which now contains clay and quartz. It differs from many breccias in the area in that the matrix has not been silicified.

Conclusion:
Hematitic breccia containing hematite, goethite and lithic clasts in a finer-grained matrix which is now mainly clay and very fine-grained iron oxide. There is no definite evidence from which to determine its origin.

Sample: 6737 RS 1094; TS42505

Applicant's No.: RBM 119/79
Photo Location: NFM R18/009 (143)s. On top of Radium Ridge above the N-W corner of the Radium Ridge Prospect.

Descriptive Information: Reported to be hard specular hematitic breccia with clasts of quartzite.

Hand Specimen:
A dark grey hematitic breccia with some clasts and patches of pale pink silicate. This contains a higher proportion of crystalline specular hematite than the previous sample and does not contain the soft, clay-rich matrix.

Thin Section:
This rock contains some porous aggregates of intergrown specular hematite crystals up to 10 mm in size and voids in these aggregates have been filled by moderately coarse-grained quartz. There are also many separate crystals and fragments of specular hematite, a few subhedral to euhedral quartz crystals and fragments and, in the area sectioned, there is portion of one of the larger clasts of quartzite. This quartzite is probably a silicified rock and now consists of intergrown quartz crystals, mainly between 0.5 and 1 mm in size but varying up to 2 mm and many of these show relict textures or growth zones marked by lines or thin zones of turbid brown staining. These zones of staining in the quartz do not form any regular pattern and the only conclusion which can be reached is that this 'quartzite' is a silicified rock. In one fractured zone this silicified rock has been invaded by an irregular vein of hematite similar to that in the surrounding breccia. Another smaller siliceous clast is of similar silicified rock in which some of the turbid and stained quartz has clearly replaced an earlier mineral or minerals (?possibly feldspar).

In one area in the breccia there is some monazite intergrown with hematite and although a few of the monazite crystals are up to 0.5 mm long other patches of monazite have been extensively fractured. There are a few small patches of sericitic material or clay enclosed and/or partly replaced by quartz and these may represent small remnants of feldspar but this is little more than conjecture.

There has been some additional movement and fracturing in this breccia and all interstices and any matrix which may have been present have been filled and/or replaced by later quartz. This movement and replacement by quartz has obliterated or obscured earlier relationships and many boundaries between clasts and matrix are now very difficult to locate.

Conclusion:
Hematitic breccia containing aggregates of intergrown specular hematite crystals, a few clasts of silicified rock and minor monazite. The general texture suggests that the hematite and monazite crystallized in situ but there has been some later movement before quartz filled all interstices and replaced any earlier matrix which may have been present. No evidence was found to suggest that this is not a tectonic breccia.

Sample: 6737 RS 1095; TS42506

Applicant's No.: RBM 116A/79
Photo Location: NFM R18/009 (146)s. On top of Radium Ridge above the Mt Gee Prospect.

Descriptive Information: Reported to be similar to RS 1094, RBM 119/79.

Hand Specimen:
This is a hard hematitic breccia which is similar in general appearance to sample RBM 119/79 (RS 1094). There are, however, a few small areas containing a darker purplish mineral which, when examined in a temporary oil mount, was found to be fluorite.

Thin Section:
The rock has been silicified and all minerals except hematite, monazite and one very small patch of weathered and stained mica have been replaced by a mass of intergrown quartz crystals generally between 0.3 and 0.8 mm in size but with a few larger crystals up to 1.5 mm long. The breccia certainly contains a few euhedral quartz crystals and aggregates of specular hematite crystals, at least some of which probably crystallized in situ. Relict textures show that in one area clasts 0.5-2 mm in size were moderately closely packed but, as these have all been completely replaced by secondary quartz their former identity cannot be determined. Areas of turbidity in some of these clasts suggest that feldspar may have been present but this is little more than a tentative suggestion. In another area there is a crystal of monazite almost 2 mm long intergrown with hematite and in other areas there are a few smaller crystals of monazite. The larger monazite crystal has been fractured but the fragments have not been displaced any great distance. Interstices in the breccia contain porous masses of a finer-grained, later generation hematite occurring as small platy or tabular crystals less than 0.05 mm in size and translucent red in thin section. These are included in the quartz crystals which have silicified the rock.

In one area relict textures outlined by the iron oxide suggest the former presence of a rhombohedral crystal possibly of carbonate and in one area some quartz contains a cloud of tiny carbonate inclusions along a small elongate zone. It is therefore possible that some carbonate was once present in this rock. A few quartz crystals contain small inclusions of fluorite up to 0.4 mm long and the relationship between these two minerals strongly suggests that this quartz crystallized after the fluorite. Some of the fluorite contains tiny inclusions of carbonate.

Conclusion:
Silicified hematitic breccia in which practically all minerals except hematite, monazite and traces of fluorite have been replaced by quartz. There were two generations of hematite and, in general, the textures suggest that it crystallized in situ.

Sample: 6737 RS 1096; TS42507; PS28205

Applicant's No.: RBM 117/79
Photo Location: NFM R18/009 (147)s.

Descriptive Information: Reported to be hematitic breccia composed of layers richer in specular hematite and layers rich in red ochre occurring as layers within Mt Gee quartz and it is overlain by the hematitic breccia of sample RBM 116A/79 (RS 1095).

Hand Specimen:
Dark greyish-red, hard rock composed mainly of hematite and quartz. There is an indistinct suggestion of layering due to variations in grain size.

Thin and Polished Sections:
The rock is composed predominantly of hematite and quartz occurring in about equal proportions; there is minor magnetite and a trace of monazite. Some of the quartz shows relict textures marked by iron oxide staining but there is insufficient evidence to identify the mineral or minerals replaced by the quartz.

The breccia contains aggregates of specular hematite, some of which have retained the external shape of former magnetite crystals 1-2 mm in size and there were also crystals or fragments of other minerals 1-2 mm in size which have been replaced by quartz. There are a few fractured and slightly dispersed aggregates and crystals of monazite generally less than 0.3 mm in size. Some monazite is intergrown with specular hematite.

There is a later generation of fine-grained hematite occurring mainly as tiny crystals filling or partly filling interstices in the breccia. These are included in quartz which has cemented and silicified the breccia.

The polished section contains aggregates of intergrown hematite crystals varying in size from 0.2 mm to 1 mm and most of these contain scattered, corroded remnants of magnetite. Where there are some larger areas of magnetite up to 0.1 mm in size these show evidence of oxidation to hematite along octahedral planes and these films of hematite coalesce and grade into the coarser-grained specular hematite which has replaced much of the earlier magnetite.

In interstices there are aggregates of much finer-grained specular or micaceous hematite and a little of this is included within some quartz.

Conclusion:
Silicified hematitic breccia. It is very similar to sample 6737 RS 1095 (RBM 116A/79) and the polished section shows that much of the coarser-grained specular hematite replaced earlier magnetite. There is no conclusive evidence of origin and many finer details have been obliterated by silicification.

Sample: 6737 RS 1097; TS42508

Applicant's No.: RBM 135C/79
Photo Location: NFM R17/086 (40)sp. East Painter above No. 5 workings.

Descriptive Information: This is described as red-brown ochrous hematite with gritty grains of kaolin and specular hematite. It is a sandstone and is the most common rock in this locality. It is the host to samples 135A & B/79 (RS 1098, 1099).

Hand Specimen:
A reddish-brown rock containing sand-sized grains of quartz, white clay and hematite in a brownish matrix.

Thin Section:
This rock contains moderately well sorted grains of quartz 0.4-0.6 mm in size with a few up to 1 mm long and there are some patches or aggregates of kaolin of a similar size which may represent altered feldspar grains, although this could not be confirmed. There are numerous elongate crystals and fragments of specular hematite varying in size from 0.2-0.5 mm long and there are a few scattered, angular fragments of monazite and also of rutile up to 0.4 mm long. There are a few grains or flakes of muscovite, one or two of tourmaline and a few very small grains of zircon. There are a few pseudomorphs of goethite and fine-grained hematite which, in shape and general appearance, are typical of oxidized pyrite crystals, and the largest of these is about 0.8 mm long. There is no definite evidence to show whether these pyrite crystals were clastic grains or whether the pyrite crystallized in situ. From the general appearance of the rock in thin section it is suggested that these grains were sorted and transported and almost certainly deposited by fluid and therefore it can be classified as a sediment, but the conditions under which the sediment formed are unknown. Many of the quartz grains now show small overgrowths with the former grain boundary marked by lines of tiny inclusions or impurities, but in general this secondary quartz occurring as overgrowths has not intergrown to fill interstices. The remaining interstices contain clay stained by varying amounts of very fine-grained, reddish-brown iron oxide. Some of this may have been derived from altered feldspar grains and much of it is too heavily stained by iron oxide for any evidence of texture to be preserved.

No evidence of bedding or layering was found in the thin section but there is a tendency for elongate fragments to be subparallel.

Conclusion:
Evidence in thin section suggests that the grains were transported and sorted before they accumulated and therefore this is classified as a sediment, i.e. a hematitic sandstone, but the exact conditions under which it accumulated are not known.

Sample: 6737 RS 1098; TS42509

Applicant's No.: RBM 135B/79
Photo Location: NFM R17/086 (40)sp.

Descriptive Information: Reported to be hematitic breccia interlayered in sample RBM 135C (RS 1097) and underlying sample 135A (RS 1099, 1100).

Hand Specimen:

Dark reddish-grey hematitic breccia in which there are scattered aggregates of specular hematite 2-6 mm in size which show regular patterns similar to those formed by hematite which has replaced magnetite. There are small patches or altered grains of clay and there are a few larger clasts of siliceous or silicified rock.

The matrix is fine-grained and contains abundant reddish hematite.

Thin Section:

The larger aggrega tes of hematite noted in the hand specimen are composed of intergrown tabular crystals which in many aggregates form a triangular pattern strongly suggesting that they formed from,or replaced former magnetite, and in a few of the larger aggregates there is certainly some evidence of former external crystal shape although this is not generally well preserved and most of the aggregates are very porous. Interstices between the specular hematite crystals contain very fine-grained sericite or clay in places intergrown with secondary quartz and this quartz has clearly crystallized after the hematite. The presence of clay or sericite within these aggregates of hematite is unusual and where similar aggregates have been found in other samples interstices generally contain only quartz or remain as voids. A crystal of monazite (now fractured) is intergrown with hematite on the edge of one of these porous aggregates of specular hematite.

There are a few scattered euhedral crystals and fragments of quartz 0.5-2 mm long and a few larger grains and clasts which are now composed predominantly of clay, although some contain quartz which was intergrown with the mineral now replaced by clay. This was most likely feldspar but conclusive proof is lacking.

These larger aggregates of specular hematite, quartz and altered ?feldspar are scattered through a moderately fine-grained matrix containing abundant small quartz crystals 0.1-0.2 mm in size, abundant small micaceous hematite crystals most of which are deep translucent red in thin section, a few flakes of muscovite about 0.1 mm long and small patches of clay. A few of the quartz grains show evidence of secondary overgrowths on earlier crystals or fragments and there are also a few small areas of chalcedonic quartz which is very probably secondary and has filled small voids, but in general any evidence of the origin of the quartz and its relationship to other minerals is obscured by the presence of fine-grained micaceous hematite along all grain boundaries. It could well have been a hematitic siltstone but the evidence in thin section is certainly not conclusive.

Conclusion:

Hematitic breccia in which the larger aggregates of specular hematite show textures strongly suggested that this hematite replaced former magnetite. There are also grains and fragments of quartz and some which are now composed of clay but possibly represent altered feldspar. Textures in the matrix have been obscured or obliterated by an abundance of very fine-grained micaceous hematite and, although it could have been a hematitic siltstone, this could not be confirmed.

Sample: 6737 RS 1099 & 1100; TS42510, 42511

Applicant's No.: RBM 135A/79
Photo Location: NFM R17/086 (40)sp. East Painter above No. 5 workings.

Descriptive Information: These two samples are from the same specimen which is orientated and it is reported that this rock type forms two elliptical pods at the top of sample 135C and below granitic breccia. Sample RS 1099 is a layer of hematitic breccia (similar to 135B or RS 1098) underyling the hematitic siltstone of sample RS 1100.

Hand Specimen:
This is an orientated sample and at the base there is a thin layer of hematitic siltstone 2-3 mm thick overlain by a zone or layer 15-25 mm thick containing aggregates of hematite and also some grains of quartz and clay (probably altered feldspar) 2-5 mm in size. Overyling this coarser-grained layer there is a thick layer of uniformly fine-grained siltstone which is laminated (sample RS 1100).

Thin Sections:
Sample RS 1099; TS42510:

Because of difficulty with the material the base of the sample was not preserved in the thin section but the evidence from the hand specimen suggests that it contains small, well sorted grains of quartz and elongate crystals or flakes of hematite which tend to be orientated parallel to the layering. The matrix is probably clay and ochrous hematite.

The coarser-grained zone is very similar to sample RS1098 and a full description will not be repeated. The larger aggregates of specular hematite have retained internal patterns strongly suggesting that hematite replaced magnetite, and there is also some evidence of former external shape, although this is not well preserved. Other larger grains are now composed mainly of fine-grained quartz and clay and similar quartz and clay occur in interstices between the specular hematite crystals in the hematite aggregates. This cannot be readily explained at present but probably both quartz and clay are secondary.

The matrix contains relatively minor, very fine-grained muscovite and quartz and probably also some clay but it has a higher proportion (over 70%) of fine-grained hematite than sample RS 1098 and this has obscured all finer details in the matrix. This fine-grained hematite has most certainly crystallized in situ and occurs as deep red, translucent crystals generally less than 0.05 mm in size.

Above the layer containing the larger specular hematite aggregates there is a finer-grained layer which has been silicified but relict textures show that it probably contained some small quartz grains 0.05-0.2 mm in size and the presence of very turbid silicified grains containing some remnants of clay suggests that small feldspar grains were probably also present. This layer has up to 30% of small tabular hematite crystals and/or fragments generally between 0.05 and 0.25 mm long and these show a preferred orientation parallel to the layering, but there are many which are orientated in other directions. There are a few flakes of muscovite and a few very small fragments of rutile, monazite and tourmaline. One unusual feature in this layer is the presence of a few small crystals 0.05-0.2 mm long, most of which have been replaced by a micaceous mineral with anomalous birefringence which is possibly a secondary uranium mineral, e.g. torbernite or autunite, and others have been replaced by an isotropic

or almost isotropic material. Most of these crystals appear prismatic but there are a few which have a hexagonal cross section. With the limited evidence available suggestions concerning the history of these grains is pure conjecture and although they could have been small crystals of apatite which have been replaced by secondary uranium phosphate, this is only one of a number of possibilities.

All remaining interstices have been filled by secondary quartz which has probably also replaced most of any matrix which may have been present and the quartz now forms a mosaic of intergrown crystals 0.1-0.2 mm in size which includes many small fragments of hematite, small patches of clay and the other minerals.

Contact between the hematite-rich layer containing moderately large aggregates of specular hematite and the finer-grained silicified layer is sharply defined and slightly undulating.

Sample RS 1100; TS42511:

This is very similar to the upper layer in sample RS 1099 described above and it is composed mainly of quartz and hematite with small patches of clay and minor muscovite but, as far as can be determined from the thin section, it lacks the trace amounts of rutile, monazite and tourmaline and also the small crystals or grains which have been replaced by a secondary ?uranium mineral. Only one very tiny zircon grain was found. Layering on a scale of 2-6 mm is clearly defined and, when the section is examined under very low magnification, graded bedding is conspicuous in all of these layers. When correctly orientated they contain coarser-grained quartz and hematite (0.05-0.1 mm) at the base and this becomes gradually finer-grained towards the top where a common grain size is 0.02-0.03 mm. Towards the top of these layers there is also a higher concentration of very fine-grained hematite which gives them a reddish appearance in hand specimen. As with the rest of the sample this portion has been silicified and probably many primary features have been obliterated or obscured. There is no clear evidence to show how much of the hematite in these layers was originally present as clastic fragments and how much may be secondary or may have crystallized from chemically precipitated iron oxide.

Much of this layering is straight and parallel but there are zones where the sediment has been disturbed early in its history, probably mainly by slight movements soon after it was deposited, but there is also some microfaulting and there is one area where structures could be interpreted as very small-scale cut and fill structures.

Conclusion:

All of the structural evidence strongly suggests that this is a sediment with layers of hematitic siltstone and fine sandstone showing graded bedding and a layer of coarser-grained material containing aggregates of specular hematite which were very probably originally moderately large crystals of magnetite. The siltstone and sandstone layers have been at least partly silicified.

One unusual feature is that in the hematitic sandstone immediately overlying the layer containing aggregates of specular hematite there are numerous small crystals which have been replaced by a mineral resembling secondary uranium phosphate.

On the evidence of textures and structures in this rock it must be classified as a sediment but the conditions under which the sediment accumulated are uncertain.

Sample: 6737 RS 1101; TS42512

Applicant's No.: RBM 118A/79
Photo Location: NFM 18/009 (149)s. Top of Radium Ridge north of Mt Gee.

Descriptive Information: This specimen comes from the eastern end of a narrow vertical dyke-like body orientated E-W within granitic breccia. This dyke-like body is about 30 metres long and varies from a few centimetres to 15 centimetres wide and the overall appearance suggests a fault.

Hand Specimen:
A medium-grained, predominantly pink rock with a fragmental structure due mainly to variations in colour. There are a few small vugs lined with quartz crystals.

Staining with cobaltinitrite shows an abundance of potash feldspar and in one finer-grained zone this has a streaky and granulated appearance.

Thin Section:
This contains over 70% of turbid potash feldspar intergrown with lesser amounts of quartz and it contains 1-2% of fine-grained iron oxide and traces of sericite and monazite. Some of the quartz is clearly secondary or migratory and has invaded fractured and crushed zones.

Areas which have been least altered contain very turbid microcline intergrown with some quartz crystals 0.5-1 mm in size and in one of these zones there is a group of elongate crystals of ?monazite. These zones have a rather granular texture and most of the microcline contains groups of iron oxide crystals 0.02-0.05 mm in size but most of these are less than 0.03 mm. In another of these areas composed predominantly of microcline some of the microcline crystals contain groups of small inclusions of muscovite as well as those of iron oxide and in another area some of the microcline contains groups of small quartz inclusions which extinguish simultaneously between crossed nicols and form patterns somewhat similar to myrmekitic intergrowths. It is possible that the microcline in this rock is metasomatic and the iron oxide included in it was derived from a mineral or minerals which the microcline replaced, but in general there are no relict textures to confirm this other than the rather indefinite suggestion of myrmekitic texture in a few places. It is clear, however, that before the latest episode of fracturing the rock was composed largely of microcline with relatively minor quartz, the iron oxide inclusions and traces of monazite.

This microcline-rich rock has been extensively fractured and some zones have been sheared or granulated and in these sheared zones much of the material has been reduced to a very fine grain size although it still contains scattered larger fragments of microcline and quartz 0.1-0.5 mm in size. This is the streaky material noted in the hand specimen. Some fractured zones have been invaded by secondary or migratory quartz and there are some areas of medium-grained quartz which contain very small, angular fragments of potash feldspar. Quartz has also penetrated small fractures in the larger crystals of microcline. In general, there is no evidence of secondary overgrowths of potash feldspar on the fractured microcline now included within quartz.

Conclusion:

This was probably a metasomatic, microcline-rich rock which also contained a little monazite. It has been extensively fractured and some zones have been crushed or sheared. Fractured zones have been invaded by secondary quartz.

Sample: 6737 RS 1102; TS42513

Applicant's No.: RBM 118B/79
Photo Location: NFM 18/009 (149)s. Top of Radium Ridge north of Mt Gee.

Descriptive Information: This comes from the middle of the zone of dyke-like body within the granitic breccia described for the previous sample.

Hand Specimen:
This is a much finer-grained rock than sample RBM 118A/79 and it has a siltstone or fine sandstone-like texture. It shows a peculiar mottling or patchy staining with areas of pinkish-grey and areas of brownish-red.

Staining with cobaltinitrite shows a moderate amount of fine-grained potash feldspar distributed uniformly throughout the rock. In one area there are a few larger grains of quartz and some containing potash feldspar intergrown with quartz.

Thin Section:
This is a fine-grained clastic rock which has been partly silicified. It contains up to 50% of angular microcline fragments, a lower porportion of quartz fragments, possibly 2-3% of sericite, a few iron oxide grains, a few small muscovite flakes and minute traces of apatite and tourmaline. Much of this clastic material is well sorted and a large proportion of it has a common grain size of 0.05-0.1 mm but there are some zones containing grains which are predominantly 0.1-0.2 mm in size and there are also areas in the thin section where the clastic material is bimodal in that there are some larger fragments 0.5-2 mm in size scattered through the well sorted, finer-grained clastic material. When the section is examined under very low magnification there is some evidence of banding or layering in that there is a zone or band over 10 mm thick of a slightly coarser-grained clastic material with a slightly wavy contact against the finer-grained material and in the finer-grained material at a distance of about 2-3 mm from this contact there is a thin, slightly wavy band or layer 1-2 mm thick which contains the scattered larger fragments. Near one end of the thin section there is another zone containing the larger fragments in the matrix of the very fine-grained material. This does not form a continuous band but is rather in the shape of an irregular pocket of the coarser-grained material.

Secondary or introduced quartz has crystallized across this rock filling all interstices and possibly replacing some interstitial material, but much of this secondary quartz contains sericite, some of which was probably present in interstices and some has replaced small grains. This secondary quartz has formed optically continuous overgrowths on the clastic quartz grains the boundaries of which are marked by lines of impurity or tiny inclusions in the secondary quartz.

The mottled staining noted on the hand specimen is a relatively recent feature and is due to the presence of iron oxide which has been deposited along many grain boundaries and has heavily stained and possibly also replaced or partly replaced much of the fine-grained sericitic material.

Conclusion:
This is a clastic rock composed of predominantly well sorted material although the grain size varies in different zones and, as these features indicate transport and sorting by fluid, this is classified as a sediment (feldspathic sandstone), but the material is very immature and has not been transported any great distance from the rock from which it was

derived. The clastic material could have been derived from crushed rock such as sample 118A which is reported to occur in the same fault zone but the exact mechanism by which this sediment was formed is unknown.

Sample: 6737 RS 1103; TS42514

Applicant's No.: RBM 118C/79
Photo Location: NFM 18/009 (149)s. Top of Radium Ridge north of Mt Gee.

Descriptive Information: This is reported to come from about the middle of the narrow dyke-like body within granitic breccia.

Hand Specimen:
A predominantly pink rock which is coarser-grained than sample 118B/79 and contains visible fragments of feldspar and quartz, many of which are between 1 and 3 mm in size and these are surrounded and cemented by a darker reddish-brown matrix.

Staining with cobaltinitrite shows an abundance of potash feldspar in the larger grains.

Thin Section:
This contains at least 50% of larger angular fragments composed predominantly of microcline and quartz and interstices between them contain a much finer-grained matrix also composed of small, angular fragments of microcline and quartz with traces of muscovite and very rare monazite.

The larger clasts vary in size from 0.5 mm to over 4 mm but many are within the range of 0.5-2 mm and they include many angular fragments of turbid microcline, some of quartz and many larger fragments composed of intergrown microcline and quartz. In some of the clasts the microcline contains numerous inclusions of iron oxide similar to that noted in sample 118A/79 and in one of the larger clasts there is an aggregate of intergrown monazite crystals 0.4 mm long. In one of the clasts composed predominantly of microcline there are small inclusions of quartz forming a pattern which shows some resemblance to myrmekitic intergrowths and this is also similar to textures noted in portion of sample 118A/79. The material forming this breccia has clearly not moved far from the adjacent parent rock but the boundaries of most of the fragments cannot be matched and clearly it is not a jig-saw breccia. There is, however, one zone of quartz 3 x 4 mm in size which is optically continuous although strained and is cut by fractures containing matrix material. There are a few zones composed of secondary quartz, some of which has elongate, almost fibrous or chalcedonic structure, but it is not absolutely certain whether these are portions of clasts or secondary quartz which has filled some interstices.

The larger clasts in this rock are only moderately closely packed and are generally just touching. Interstices contain moderately well sorted, smaller fragments of microcline and quartz many of them between 0.05 and 0.1 mm in size, and this material is similar to the feldspathic sandstone of sample 118B/79. It also contains interstitial sericite and this has been fairly heavily stained by very fine-grained iron oxide which has accumulated along grain boundaries and in the remaining interstices.

Conclusion:
Granitic breccia composed of material which has not moved very far from the parent rock which was probably similar to sample 118A/79. The fine-grained matrix is similar to the feldspathic sandstone of sample 118B/79 and is stained by iron oxide.

Sample: 6737 RS 1104; TS42515

Applicant's No.: RBM 118D/79
Photo Location: NFM 18/009 (149)sp. Top of Radium Ridge north of Mt Gee.

Descriptive Information: This is from the western end of the elongate dyke-like body represented by samples RS 1101-1104 reported to be within granitic breccia.

Hand Specimen:
This is a very fine-grained, pinkish-brown rock resembling chert in general appearance. It is cut by some quartz veins.

Staining with cobaltinitrite does not show any potash feldspar.

Thin Section:
The fine-grained, brownish rock is composed of very fine-grained to microcrystalline quartz and although there is a small-scale mottling due to brownish staining in the quartz there are no recognisable relict textures to suggest that this is a silicified, clastic sediment. There are a few small areas heavily stained by iron oxide and there are one or two very small voids which may have contained tiny crystals of an unidentified mineral.

Portion of one of the veins or zones of coarser-grained quartz is included in the section and this consists of almost fibrous chalcedonic quartz which forms bands and aggregates radiating out from small fractures. Along one of these fractures there are some fragments of microcline and other iron oxide-stained material. Some growth zones in this quartz are marked by accumulations of minute crystals a few microns in size which have been heavily stained and at least partly replaced by iron oxide but which still retain evidence of possible cubic crystal shape. These are too small to be identified.

There is a trace of very fine-grained hematite in some areas of chalcedonic quartz or quartz vugs.

Conclusion:
This sample is composed predominantly of silica which was almost certainly chemically precipitated.

Sample: 6737 RS 1105; TS42516

Applicant's No.: RBM 120/79
Photo Location: NFM R18/009 (160)s. North flank of Radium Ridge north of Mt Gee.
Descriptive Information: This specimen is reported to come from a lens of khaki micaceous rock from within granitic breccia.

Hand Specimen:
A uniformly fine-grained, khaki-coloured rock containing small flakes of mica visible to the naked eye. The rock appears weathered.

Thin Section:
Mineral assemblage:

	%
Quartz	20-25
Weathered and altered mica	20-25
Altered silicate mineral replaced by sericite and clay	45-50
Opaque iron oxide	2-3
Leucoxene	Trace-1
Secondary chloritic mineral	2-3
Apatite	Trace

This is an altered and weathered rock in which a large proportion of the silicate has been replaced by secondary minerals but the former texture has been moderately well preserved. Quartz has remained unaltered and this occurs as small grains generally between 0.1 and 0.5 mm in size and some of these are intergrown to form aggregates up to 2 mm long. Relict textures, some of which are marked by lines of iron oxide-stained chloritic material show that this quartz was intergrown with grains of other silicate minerals of similar size, although in places there may have been some larger grains. These have been completely replaced by varying proportions of sericite and clay and also orange- to brown-stained material, some of which may be chlorite and some may be clay. Intergrown with this quartz and altered silicate there are flakes of mica 0.3-0.6 mm long which have been partly altered, expanded and probably bleached, but some of these still retains traces of colour and pleochroism indicative of biotite. Many of these mica flakes show a preferred orientation which is parallel to a very weak schistosity, but this is not strongly developed and there are flakes which are orientated in other directions.

Elongate crystals and irregular aggregates of opaque iron oxide or iron-titanium oxide are scattered uniformly throughout the rock varying in size from less than 0.05 mm to 0.3 mm long. These do not show any readily recognisable shapes and although it is possible that the elongate grains may be, or may have been, ilmenite, this is not absolutely certain. There are also a few small aggregates of leucoxene or very fine-grained ?sphene some of which is associated with the opaque oxide and some occurs as isolated small grains or aggregates. There are a few very small grains of apatite.

Conclusion:
Partly decomposed and stained quartz-?feldspar-mica schist. There is no conclusive evidence to show the origin of the schist.

Sample: 6737 RS 1106; TS42517

Applicant's No.: RBM 122A/79
Photo Location: NFM R19/032 (27)s. 1.5 km N-NW of the Armchair.

Descriptive Information: It is reported to be a pod-like body of pink granitic breccia within a zone of ?mylonite (122B). 122A has clasts of biotite schist in a pink feldspathic matrix.

Hand Specimen:
A medium-grained, salmon-pink rock containing a few darker fragments 1-3 mm in size. Staining with cobaltinitrite shows an abundance of potash feldspar.

Thin Section:
The rock is a breccia containing many clasts between 2 mm and 8 mm in size and in the area sectioned there is also portion of a larger clast at least 12 mm in size. Most of these have relict textures and also contain micaceous remnants showing that they were once biotite schist or gneiss, but this schist or gneiss has been invaded and extensively replaced by both microcline and quartz and much of the former biotite has been bleached and/or replaced by sericitic material, leucoxene and iron oxides. There are traces of partly altered accessory minerals, probably mainly zircon, and in one clast there are elongate aggregates of recrystallized leucoxene, probably rutile. These clasts of metasomatically altered biotite schist or gneiss are orientated in varying directions and the boundaries against the matrix are not very clearly defined. In one area there is portion of a clast of moderately coarse-grained granitic rock composed mainly of microcline and quartz and another composed entirely or almost entirely of microcline.

The matrix contains much smaller fragments of potash feldspar and quartz varying in size from less than 0.05 mm to 0.5 mm and there are also flakes of muscovite and altered biotite, a few aggregates of recrystallized leucoxene or rutile and a few small grains of zircon and/or monazite. Sericitic material generally stained by iron oxide is present in many interstices and along grain boundaries and in this breccia there does not appear to have been any general silicification of the matrix. There are, however, some patches of secondary quartz with crystals up to 1 mm in size and these have developed crystal faces where they are projecting into a void or vug. There are a few aggregates of greenish tourmaline crystals in the matrix and these have been surrounded and invaded by the late quartz. There are also a few small fragments of monazite.

Conclusion:
Breccia composed mainly of fragments of metasomatically altered micaceous schist or gneiss. The schist or gneiss was almost certainly metasomatically altered before development of the breccia. There is no evidence to show the origin of this breccia but there is no reason for suggesting that it is not tectonic.

Sample: 6737 RS 1107; TS42518

Applicant's No.: RBM 122B/79
Photo Location: NFM R19/032 (27)s. 1.5 km N-NW of the Armchair.

Descriptive Information: It is reported to be associated with the breccia of sample 122A/79.

Hand Specimen:
A medium-grained rock with a strong schistosity defined by orientated mica flakes. There are some parallel layers of quartz 3-5 mm thick giving the appearance of a layered rock but this quartz may be secondary.

Thin Section:
This is a medium-grained schist which has been invaded by secondary quartz along some planes parallel to the schistosity and this quartz forms the parallel bands up to about 5 mm thick noted in the hand specimen.

The portions of schist which have not been invaded by secondary quartz are composed mainly of orientated biotite, andalusite and quartz with a little muscovite and varying amounts of altered silicate which has been replaced mainly by fine-grained mica or sericite. There are trace amounts of accessory minerals, mainly opaque oxide, recrystallized leucoxene, and an unidentified mineral which may be xenotime. Biotite and muscovite flakes are up to 2 mm long and are orientated parallel to the schistosity. Andalusite occurs as irregular crystals generally between 0.5 and 1 mm in size and most of it contains small inclusions of quartz. In general, the andalusite is surrounded by aggregates of quartz which are drawn out in the direction of schistosity, and some andalusite contains small inclusions of biotite. The altered silicate has been replaced by fine-grained, slightly greenish mica and there are strong yellow haloes around small inclusions of the unidentified accessory mineral. In one area there is a small remnant with textures resembling those of partly altered cordierite but there is insufficient of this for positive identification.

There are trace amounts of opaque oxide and leucoxene occurring as irregular grains up to 0.3 mm long and there are scattered grains and also an elongate or drawn out aggregate of a mineral with high refractive index and moderately high birefringence which, as far as can be determined, is uniaxial positive, but the refractive index appears to be too low for zircon. Pleochroic haloes have formed around this mineral in places and it is tentatively identified as possible xenotime.

Quartz has invaded this rock along some planes parallel to the schistosity and these now contain intergrown quartz crystals up to 4 mm long which appear strained and have sutured grain boundaries. Scattered through this quartz there are a few thin streaks of biotite and there is one thin band containing some biotite and the altered or sericitized mineral which could have been cordierite.

Conclusion:
Biotite-andalusite schist which has been invaded by secondary quartz. The schist may once have contained some cordierite and in places it has an anomalous amount of ?xenotime. The schist was probably derived from a sediment.

Sample: 6737 RS 1108; TS42519

Applicant's No.: RBM 131A/79
Photo Location: NFM R19/034 (8)sp. From the western flank of the Echidna Prospect.

Descriptive Information: It is reported to contain clasts of biotite-sillimanite schist (which is local basement) in a granitized matrix.

Hand Specimen:
A pink and grey breccia containing some large clasts 2-5 cm in size of a grey foliated rock in a predominantly salmon-pink matrix rich in potash feldspar.

Thin Section:
The rock is now composed mainly of microcline and quartz with minor amounts of biotite, iron oxide and sericite, a local concentration of tourmaline and traces of zircon and monazite with possibly a trace of ?xenotime. Although the dominant minerals are quartz and microcline the proportions vary in different zones and a quantitative estimate would have little meaning.

A large proportion of both the quartz and microcline is clearly secondary and although the textures vary and relict schistosity or foliation is still visible, boundaries between the clasts are no longer clearly defined. In some of the larger clasts the rock has been replaced mainly by microcline with relatively minor quartz and there are scattered small remnants of biotite and muscovite still showing subparallel orientation but now included within some relatively large patches of microcline. There are also elongate aggregates of finer-grained muscovite or sericite which has replaced an undetermined silicate mineral and although most of this fine-grained muscovite has not retained very much evidence of earlier textures there are a few places where it could have replaced a prismatic or almost fibrous mineral resembling sillimanite in general texture. However, as no unaltered sillimanite was found in the section, this cannot be confirmed. In other areas or clasts the schist or gneiss has been extensively replaced by quartz but evidence of the former foliation has been retained and there are small remnants of biotite, local concentrations of iron oxide and, in one or two bands, there are concentrations of equidimensional crystals which have been completely replaced by fine-grained muscovite. In one area or clast 4 x 8 mm in size there is a concentration (20-25%) of greyish to greenish tourmaline occurring as slightly porous, elongate masses intergrown with minor amounts of biotite and/or muscovite and the general pattern where these minerals are intergrown strongly suggests that the tourmaline replaced or partly replaced elongate aggregates of biotite. These areas or clasts of altered schist contain a few small zircon grains and a few larger crystals 0.2-0.4 mm long of monazite and possibly also xenotime. There are numerous elongate aggregates of fine-grained magnetite or martite and a few larger crystals or aggregates of iron oxide, some of which can be identified as specular hematite in the hand specimen.

There has almost certainly been repeated movement in this zone and at some time after the schist was extensively replaced by potash feldspar and quartz there has been an episode of fracturing and probably shearing. Some of the larger patches of microcline have been deformed, locally recrystallized and, in places, they grade into zones of much finer-grained granulated material. Some quartz has also migrated and recrystallized in interstices or voids in the breccia and patches of this late quartz enclose some small

fragments of microcline. As in many breccias in the Mt Painter area, quartz appears to have been the last mineral to crystallize.

Conclusion:

Breccia in which former biotite-bearing schist or gneiss was extensively replaced by microcline and quartz. There has been additional fracturing and shearing after 'granitization' of the schist or gneiss and after the last episode of movement the breccia has been cemented by migratory quartz

Sample: 6737 RS 1109; TS42520

Applicant's No.: RBM 131B/79
Photo Location: NFM R19/034 (8)sp.

Descriptive Information: This rock has also come from the western flank of the Echidna Prospect and is similar to sample RBM 131A/79 but it has specular hematite in the matrix.

Hand Specimen:
A breccia generally similar to sample 131A/79 (RS 1108) except that clasts of former schist or gneiss are not as large or as abundant and the rock contains some specular hematite in the matrix. Specular hematite is also concentrated in one moderately large clast which is at least 3 or 4 cm in size. There are some quartz vugs.

Thin Section:
This is a breccia essentially very similar to sample 131A/79 in that there are some clasts of granitized schist or gneiss which have been replaced mainly by microcline with relatively minor quartz, but this rock also contains some clasts of granitic rock composed of intergrown microcline and quartz which do not show any evidence of relict textures or mineral remnants to suggest that they represent granitized schist or gneiss. There are also some clasts of coarse-grained quartz, one of granitic rock containing quartz and sericitized feldspar with minor iron oxide, a few fragments of microcline and one composed almost entirely of intergrown microcline crystals.

In many parts of the rock boundaries between clasts and matrix are more clearly defined than in sample RBM 131A/79 and where these boundaries are well defined it is clear that granitization of the mica-bearing schist or gneiss occurred before the last episode of fracturing or brecciation. Secondary microcline which has replaced much of the schist is cut off abruptly at the boundary of the clast. Former biotite in one clast has been replaced by microcline and muscovite but there are still some concentrations of leucoxene or recrystallized leucoxene and traces of iron oxide marking relict textures inherited from the biotite.

The matrix in this breccia contains fragments of microcline and quartz, a few flakes of biotite, numerous fragments of specular hematite, a trace of monazite and one or two larger crystals (to 1.5 mm) which have been replaced by secondary iron oxide. There are small patches of sericite and in places the mineral fragments have a coating of very fine-grained, second generation or late, iron oxide. The breccia has been cemented by migratory quartz which has filled most interstices and completely surrounds some small mineral fragments.

The specular hematite in the matrix and also the minor amounts of monazite occur as separate crystals or fragments of crystals, but in places fractured fragments can be matched and it is almost certain that the hematite and monazite have not moved very far from where they crystallized and the biotite flakes mixed with some of this hematite are not sufficiently deformed to suggest extensive movement. There are also a few small aggregates or groups of tiny rutile crystals associated with some of the hematite and this also has not moved any great distance from its place of crystallization, although there are a few isolated small rutile crystals in the matrix.

In one area there is a small group of tourmaline crystals intergrown

with quartz and this may be a small clast of quartz-tourmaline rock derived from altered schist similar to that containing tourmaline described in sample 131A/79.

Conclusion:

This sample differs from 131A/79 in that, as well as clasts of granitized schist or gneiss, there are some clasts of granitic rock composed of quartz and microcline showing no evidence of relict textures. It also differs in that the matrix contains specular hematite and textures suggest that this and the accompanying minor monazite crystallized in the breccia but there has been some additional movement after they crystallized and before the breccia was finally cemented by late quartz.

Sample: 6737 RS 1110; TS42521

Applicant's No.: RBM 131C/79
Photo Location: NFM R19/034 (8)sp.

Descriptive Information: This is granitic breccia from the near the centre of the Echidna Prospect and it is reported to have purple hematite and a silty matrix.

Hand Specimen:
A pink microcline-rich breccia similar to that in samples 131A & B, except that the matrix contains very fine-grained, purplish iron oxide.

Thin Section:
The clasts in this breccia are composed of moderately coarse-grained microcline and quartz in varying proportions, one is composed almost entirely of intergrown microcline crystals, and one is predominantly quartz. They are similar to the granitic clasts in sample 131B in that many of them do not show any evidence of relict textures and although the granitic rock could well be metasomatic there is no evidence to prove this. There are, however, a few clasts which still contain some parallel orientated flakes of biotite enclosed by quartz or microcline and one of these also has a local concentration of tourmaline similar to that noted in a clast in sample 131A(but not as extensive). A few clasts contain minor iron oxide, some of which is specular hematite and some may be martite.

The matrix contains smaller fragments of microcline, quartz and biotite and it also contains a little specular hematite but this is present in lower concentrations than in sample 131B. There are traces of monazite generally associated with the specular hematite and some of this monazite has been fractured but the fragments have not been displaced any great distance. Some biotite flakes in the matrix have been deformed. This matrix is stained by a later generation of very fine-grained hematite which has accumulated along many grain boundaries and forms a very thin coating on many of the fragments of microcline and other minerals. In places it is associated with minor amounts of sericite and small patches of crushed and deformed biotite. It was deposited in situ and in places it is included within the late or secondary quartz which has filled interstices and has cemented the breccia.

Conclusion:
Granitic breccia with only a few clasts containing oriented biotite flakes suggesting metasomatically altered schist or gneiss. The matrix contains minor specular hematite and monazite and a later generation of fine-grained hematite which forms a coating on clasts. It is cemented by late quartz.

Sample: 6737 RS 1111 & 1112; TS42522 & 42523

Applicant's No.: RBM 131D/79
Photo Location: NFM R19/034 (10)s. From the Echidna Prospect.

Descriptive Information: Sample RS 1111 is a dark olive-green chloritic breccia and sample RS 1112 is reported to be a chloritic sandstone from within the chloritic breccia.

Hand Specimens:

Sample RS 1111 is a breccia containing one large clast several centimetres in size of granitic rock in which minerals other than quartz have been replaced or partly replaced by chlorite. Other clasts in the breccia are mainly of coarse-grained quartz but there is one containing parallel flakes of biotite which is probably granitized biotite schist or gneiss. The matrix contains biotite, hematite and a mass of iron oxide-stained chlorite.

Sample RS 1112 is a uniform fine-grained brownish-green rock with a sandstone-like texture and there is some evidence of layering with a few poorly defined layers containing slightly coarser-grained material and/or slightly more hematite.

Thin Sections:

Sample RS 1111; TS42522

Because of the rather friable nature of the matrix of this rock the only portion to survive sectioning was portion of the large clast. This contains crystals and aggregates of coarse-grained quartz 1-4 mm in size and a larger mass of quartz which may have been a vein and these quartz aggregates are intergrown with patches of brownish, iron oxide-stained chlorite in which there are small crystals and patches of microcline and traces of muscovite or sericite. In some patches of iron oxide-stained chlorite there are groups of irregular microcline grains up to 1 mm long which are now isolated from each other but still have the same optical orientation and it is clear that these are remnants of once larger crystals of microcline which have been extensively veined and replaced by the chloritic material. In some areas practically all of the feldspar has been replaced by chlorite but other areas still contain numerous scattered remnants of microcline which has been incompletely replaced by the chlorite. In one area there is some coarser-grained mica probably once biotite which has been altered to, or partly replaced by, the chlorite. Some areas of the secondary chlorite are stained by small, almost circular spots of very fine-grained hematite and some of goethite.

An examination of the hand specimen shows that this clast has a sharply defined boundary against the matrix and there are other smaller clasts composed of unaltered microcline or of unaltered microcline intergrown with quartz and these also have sharply defined boundaries. There is one zone of fine-grained chloritic material which is probably also a clast but this has been deformed. These features suggest that chloritization of the feldspar in this granitic rock occurred before development of the breccia or at least before the last episode of brecciation. The matrix was not included in the section but it contains an abundance of fine-grained, iron oxide-stained chloritic material, some specular hematite, biotite, minor monazite and small fragments of quartz and potash feldspar. There are some aggregates of specular hematite which have probably crystallized in the breccia but the manner in which the specular hematite fragments or crystals are concentrated along the boundary

of the large clast indicates some movement after the hematite crystallized.

Sample RS 1112; TS42523

This is reported to occur within the breccia described above.

This contains 30-40% of light-coloured minerals which are mainly quartz, microcline and silicate replaced by sericite and it has at least 20% of specular hematite fragments, at least 1% of monazite fragments, scattered flakes of muscovite and bleached or altered biotite and a few grains of rutile, apatite and tourmaline. The matrix surrounding and cementing these fragments is orange to brown iron oxide-stained chlorite similar to that occurring in the breccia.

The mineral fragments are all separate grains which have been moved from their place of origin and they have been sorted during transport. Most of the quartz, feldspar and micaceous grains are between 0.05 and 0.2 mm in size and hematite fragments vary from 0.05 to 0.4 mm long, but there are two layers about 3 mm thick and 5 mm apart which contain coarser-grained material with quartz and silicate grains up to 0.5 mm in one layer and up to 1 mm in the other layer and hematite fragments 0.5 to 1 mm long. In the coarser-grained of these two layers there are some lithic grains of quartz and feldspar and there is a higher concentration of hematite and monazite fragments in the coarser-grained layer.

Practically all of the mineral fragments are angular and a large proportion of elongate fragments,including most of the hematite, are subparallel to the layering.

The cementing matrix is mainly turbid orange to brown-stained chloritic material similar to that occurring in sample RS 1111 but there are a few small areas where there is some secondary quartz occurring as overgrowths on clastic quartz grains. There are a few oxidized pyrite crystals of uncertain origin but it is possible that these were also clastic grains.

Conclusion:

Sample RS 1112 can be classified as a hematitic, chloritic sandstone and it is composed of sorted but very immature material derived from the matrix of the surrounding breccia. The sorting of this material and the presence of layers of different grain size and also the general texture of the rock is indicative of transport by fluid and therefore the rock is classified as a sediment, but the material has not moved very far from its place of origin which was the matrix of the breccia and the exact manner in which the sediment was formed is not known.

Sample: 6737 RS 1113; TS42524

Applicant's No.: RBM 137/79
Photo Location: NFM R18/008 (70)s. Armchair Prospect north of the Armchair notice.

Descriptive Information: This is reported to be a pink, medium-grained, equigranular leucogranite in which the quartz has a slight foliation.

Hand Specimen:
A massive, salmon-pink rock composed of feldspar with uniformly distributed quartz grains which are of a uniform size but many are slightly elongated in a common direction giving the appearance of a weak foliation. There are a few grains of similar size of pale yellowish sericite.

Thin Section:
Mineral assemblage:

	%
Microcline	65-70
Quartz	30-35
Sericite	1-2
Muscovite	Trace
Iron oxide	Trace

The rock consists essentially of intergrown quartz and microcline crystals most of which are 1-2 mm in size and if the later foliation is disregarded it has a granoblastic texture very similar to that of granulite. Grain boundaries are curved to almost straight and triple-point junctions are common. There are a few grains which have been replaced or partly replaced by sericite and there are traces of sericite in some interstices and along a few grain boundaries. There are a few larger flakes of muscovite, mainly in interstices, but some muscovite is included within, or partly replaces, microcline.

The rock has been subjected to tectonic stress and this has resulted in deformation of the quartz grains which now show extensive strain between crossed nicols and some have begun to recrystallize. Microcline grains also show evidence of strain or undulose extinction between crossed nicols and in a few places a little quartz has encroached on adjacent microcline.

There are traces of fine-grained iron oxide associated with some sericite but no evidence of any other accessory minerals.

Conclusion:
This could be classified as a deformed leucogranite but its texture is similar to that of a microcline-quartz granulite which has been subjected to tectonic stress.

Sample: 6737 RS 1114; TS42525

Applicant's No: RBM 138/79
Photo Location: NFM R18/008 (84)s.

Descriptive Information: Reported to be a granitic breccia with clasts of pegmatite in a brown, silty matrix.

Hand Specimen:

This is a coarse breccia containing clasts of very variable size from a few millimetres to over 4 centimetres and some of these are of very coarse-grained microcline with one optically continuous microcline clast about 3 cm in size. In some areas there are minor amounts of fine-grained hematite and of white kaolin and in one area there is a trace of dark ?tourmaline.

Thin Section:

The clasts in this breccia are mainly of coarse-grained microcline with relatively minor coarse-grained quartz and one of the larger clasts composed of intergrown microcline and quartz has a microcline crystal about 8 mm long. This has been fractured and the fracture (0.5-1 mm wide) contains matrix material. This portion therefore resembles jig-saw breccia in that there has been little relative movement along the fracture but throughout the remainder of the thin section there is very little evidence to show that adjacent clasts can be matched. Another large clast containing very coarse-grained microcline has a zone which appears to have been a vein, or to be a vein, containing radiating aggregates with a fibrous texture which have been replaced by the microcline and minor sericite and chlorite. The microcline in this clast therefore appears to be metasomatic and to have crystallized across an earlier rock fabric. In another area of this clast some of the microcline contains groups of inclusions of iron oxide, possibly magnetite or martite. There are a few clasts in which the microcline contains patches of sericite and some of these also show traces of a former fibrous texture, but there is insufficient evidence to identify the former mineral. One microcline clast containing minor sericite has an area of tourmaline 0.5 mm in size and this has apparently been fractured and invaded by the microcline.

Interstices between the larger clasts contain closely packed, smaller fragments of turbid microcline and quartz varying in size from less than 0.05 mm up to about 0.3 mm and there are one or two fragments of monazite and muscovite. Interstices contain small amounts of sericite and this is stained by very fine-grained iron oxide which now occurs with sericite in the interstices and along boundaries of the fragments and grains. In some areas the breccia is cemented by late quartz but, in general, the interstices in the matrix contain only sericite and iron oxide.

Conclusion:

Granitic breccia in which many of the clasts are composed mainly of coarse-grained microcline, probably of metasomatic origin. The matrix contains smaller fragments of microcline and it is cemented mainly by interstitial sericite stained by iron oxide.

Sample: 6737 RS 1115; TS42526

Applicant's No.: RBM 139/79
Photo Location: NFM R18/008 (85)s.

Hand Specimen:

A dark pink, moderately fine-grained rock containing small aggregates of iron oxide up to about 0.5 mm in size scattered uniformly throughout the rock. There are small veins and patches containing an iron oxide-stained mica or chlorite and there are also some very small veins and patches containing quartz.

When the rock is stained with cobaltinitrite it shows an abundance of potash feldspar and the etching also emphasises some texture in that, at least in a few places, there are small, elongate crystals of feldspar most of them slightly less than 1 mm long. The etching also shows up the quartz which tends to occur in small veins and most of it appears to be secondary.

Thin Section:

Mineral assemblage:

	%
Turbid and stained microcline	60-65
Iron oxide & leucoxene	5-10
Quartz	5-10
Iron oxide-stained biotite & chlorite	5-10
Sericite	10-15
Apatite	Trace

This is an extensively altered rock containing a large proportion of very turbid and stained microcline which is probably secondary, intergrown with varying amounts of quartz which is probably also secondary In many areas there are textures similar to those in fine-grained or moderately fine-grained igneous rock in that there are elongate or tabular crystals of turbid potash feldspar mainly between 0.5 and 1 mm long but with a few up to 1.5 mm and these have apparently random orientation. Some of them show evidence of Carlsbad twinning but the twinning planes and also grain boundaries are rather hazy. Interstices between these elongate crystals contain varying proportions of moderately fine-grained quartz, sericite, partly bleached and altered biotite and chlorite, and there is generally some secondary iron oxide staining. Iron oxide crystals or aggregates 0.3-0.5 mm in size are scattered throughout the rock and at least some of these have external shapes suggesting former magnetite or titaniferous magnetite. They are associated with a little leucoxene and could represent the remnants of a primary iron-titanium oxide mineral present in a moderately fine-grained to medium-grained igneous rock. The general texture and grain size of these iron oxide crystals and aggregates is somewhat similar to that found in igneous rocks similar to dolerite and they occur generally in interstices between the turbid feldspar crystals. There are a few small grains of apatite and at least one prismatic apatite crystal 0.5 mm long.

In some areas the rock has recrystallized and the former textures have been obliterated, and in these zones the rock now consists of a very irregular intergrowth of turbid potash feldspar and quartz with irregular patches of mica or chlorite heavily stained by iron oxide. There are some crystals of iron oxide and recrystallized leucoxene.

There is also a fractured zone which, in places, has developed into a small-scale breccia and in this zone there is some secondary microcline which has crystallized across the earlier fabric.

Conclusion:

This is an extensively stained and altered rock which has locally been fractured and metasomatically altered but in places there are still relict textures suggesting that it was an igneous rock, possibly a moderately fine-grained dyke rock. Its original composition is uncertain and although the texture suggests a possible fine-grained dolerite, this would mean that both potash feldspar and quartz are secondary or metasomatic. If the potash feldspar and quartz are not metasomatic it could perhaps have been a dyke rock related to rhyolite or it could have been a volcanic rock. The evidence in thin section is not sufficiently clear or conclusive to choose between these possibilities.

Sample: 6737 RS 1116; TS42527

Applicant's No.: RBM 140/79
Photo Location: NFM R18/008 (86)s.

Hand Specimen:

A salmon-pink rock which is moderately coarse-grained in places and there are zones varying in size from a few millimetres to a few centimetres which show an indistinct foliation.

Thin Section:

The rock consists almost entirely of microcline and quartz in about equal proportions with traces of hematite, sericite or muscovite, and zircon.

The rock has a fragmental or brecciated structure with numerous clasts varying in size from 1 mm to over 6 mm composed of microcline and quartz and the matrix is mainly very fine-grained, sheared or crushed microcline and quartz. A few of the larger clasts contain some coarse-grained microcline with crystals up to 5 mm long but most of the clasts are of quartz-microcline rock which has been extensively deformed or sheared and which has developed a foliation. In the clasts most of the former coarse-grained quartz has been granulated to fine-grained aggregates with a grain size of 0.05-0.1 mm and many of these have been drawn out to form elongate ribbons of quartz. Microcline has also been granulated and drawn out to form lenticular, fine-grained aggregates which are elongated in the same direction as those of quartz. In texture and general appearance the quartz and feldspar in these clasts differs from that in metasomatically altered schist or gneiss which has been replaced by quartz and microcline and in which there is a relict foliation. In this rock the foliation is due to extensive deformation or shearing of the quartz and microcline. This could well have been metasomatic but there are now no relict textures or evidence of former minerals from which to determine the earlier history of the rock.

The matrix is a turbid mass of very fine-grained microcline and quartz containing a few scattered fragments up to 0.5 mm in size and traces of fine-grained muscovite and iron oxide. Some zones could almost be classified as mylonite and some of the boundaries between larger clasts and matrix are not clearly defined. Some clasts, however, do have clearly defined boundaries and the direction of foliation due to extensive deformation or shearing varies in the different clasts indicating that there has, in fact, been differential movement between the clasts.

In the area sectioned there is one leached void about 1 mm in size with part of a goethite boxwork but the pattern of this boxwork is not sufficiently well preserved for the former mineral to be identified. There is at least a little secondary or late quartz which may have replaced some of the matrix and this also shows evidence of strain or deformation.

Conclusion:

Breccia composed of extensively deformed and sheared leucogranite which could have been of metasomatic origin but evidence of earlier history has been obliterated by the deformation.

Sample: 6737 RS 1117; TS42528

Applicant's No.: RBM 141/79
Photo Location: NFM R18/008 (88)s.

Hand Specimen:

A salmon-pink granitic breccia containing clasts of medium-grained granitic rock up to about 4 cm in size with a slightly darker, fine-grained matrix.

Thin Section:

In this breccia the clasts are of leucogranite composed of turbid potash feldspar and quartz and the matrix is of similar, much finer-grained material stained by very fine-grained iron oxide.

The clasts are composed of intergrown quartz and turbid microcline with a grain size of 1-3 mm but there are a few larger microcline crystals (and clasts) up to 6 mm long. The potash feldspar in this rock is very turbid, probably due to weathering, and although some of it contains minor amounts of fine-grained iron oxide as inclusions, there is no definite evidence to suggest or confirm that it was metasomatic. Some of this leucogranite shows evidence of minor deformation and partial recrystallization of some of the quartz but there has not been the extensive deformation or shearing with development of a foliation as in sample RS 1116.

The matrix consists of smaller fragments of potash feldspar and quartz varying in size from less than 0.05 mm up to about 0.5 mm and, in general, potash feldspar predominates. There are a few small crystals and aggregates of iron oxide and in one area there is a little fine-grained specular hematite which has very probably crystallized in situ in the matrix. This hematite is associated with a little recrystallized leucoxene or rutile. The small grains in the matrix have a surface staining of very fine-grained, reddish-brown iron oxide and some interstices contain iron oxide-stained sericite. In some areas interstices have been filled by late quartz.

Conclusion:

Granitic breccia with clasts of leucogranite which differ from those in sample RS 1116 in that they have not been extensively deformed and have not developed a foliation.

Sample: 6737 RS 1118; TS42529

Applicant's No.: RBM 141/79
Photo Location: NFM R18/008 (88)s.

Hand Specimen:
A granitic breccia similar to sample RS 1117 but in which the matrix is slightly darker and not as well cemented.

Thin Section:
The clasts in this breccia are all of leucogranite and the matrix is composed of smaller fragments of similar material with slightly more iron oxide staining than in sample RS 1117.

The larger clasts are all composed of moderately coarse-grained microcline and quartz but two of those included in the area sectioned have peculiar features. In one large clast, and also in a few smaller, adjacent clasts, the quartz is fine-grained but has the same optical orientation in areas up to 2 mm in size and in these areas this quartz has retained the texture of micrographic intergrowths or myrmekitic intergrowths but it is now included within relatively large crystals of microcline. The fact that there are smaller clasts (up to 3 mm) with the same texture separated from the larger clast by distances of 1-4 mm shows that at least in places there has been very little differential movement between clasts but, in general, the boundaries of clasts cannot be matched and therefore it does not appear to be a true jig-saw breccia. Another large clast over 15 mm in size is composed of coarse-grained quartz and microcline and some areas of microcline contain concentrations (up to 40-50%) of finely crystalline iron oxide, some of which occurs as small crystals probably of martite and some as specular hematite. This iron oxide is now completely enclosed by large microcline crystals up to 5 mm long. These concentrations of iron oxide do not form any recognisable pattern and although it is possible that they represent remnants of an earlier rock type or iron derived from earlier minerals replaced by the microcline, this is difficult to prove. This clast also contains a few small crystals of monazite, a few small grains and aggregates of rutile or recrystallized leucoxene and a trace of late fluorite along a fracture. One of the crystals of monazite has been fractured, the fragments slightly displaced and the displaced fragments included within some of the coarse-grained microcline which clearly must have crystallized across the earlier rock.

This metasomatic leucogranite has been extensively fractured and there has certainly been some differential movement between clasts but, as the boundaries of many clasts appear rather irregular with some small embayments, it is possible that there has also been some chemical corrosion as well as mechanical brecciation. As noted above, there has been very little differential movement between some of the clasts. In a few places there are very small overgrowths of clear microcline on some of the microcline clasts or grains but there is very little of this secondary microcline. The matrix contains small chips of microcline and a few of quartz varying in size from 0.05 to 0.5 mm and there are a few crystals and fragments of monazite and of iron oxide similar to that noted in one of the clasts. In one area the matrix contains two aggregates of specular hematite 1 and 1.5 mm in size and this has almost certainly crystallized in situ. Some of the specular hematite crystals intersect to form a pattern but this is not sufficiently well developed for its significance to be determined. It could be that

the hematite replaced earlier crystals. The matrix is stained by very fine-grained iron oxide similar to that which stains the matrix in sample RS 1117, but generally it is present in slightly higher concentrations. Some interstices contain sericite stained by iron oxide and there are only a few small areas where interstices contain secondary quartz.

Conclusion:

Granitic breccia composed of clasts of leucogranite which could well have been of metasomatic origin. There has been very little differential movement between some of the clasts and the matrix is composed of small chips of microcline and lesser quartz also derived from leucogranite. This matrix is stained by very fine-grained iron oxide and there is only a trace of secondary quartz filling some interstices.

Sample: 6737 RS 1119; TS42530

Applicant's No.: RBM 142/79
Photo Location: NFM R17/089 (35)sp. 50 m north of Bill's Folly Lookout.

Descriptive Information: This is described as a pink feldspathic rock which forms a dyke-like body through kaolinised granitic basement rock.

Hand Specimen:
An orange-pink feldspathic rock with an extensively veined or fractured appearance. On one fractured surface there are a few scattered patches of pale, slightly greenish-grey rock averaging about 5 mm in size and these appear to be remnants of earlier rock which have not been completely stained or replaced by the orange to pink-stained feldspar. When the sample was stained with cobaltinitrite and also rhodizonate these areas did not stain for either potash feldspar or calcium-bearing plagioclase and therefore they may be predominantly quartz. Most of the rock was heavily stained by cobaltinitrite indicating an abundance of potash feldspar.

Thin Section:
The rock is composed predominantly of microcline with 20-25% of quartz, very minor sericite or fine-grained muscovite and traces of recrystallized leucoxene, hematite, local tourmaline, zircon and a metamict mineral. There is abundant evidence of metasomatic alteration and the rock has been extensively fractured and/or crushed.

Much of the rock now consists of microcline of varying grain size with a few optically continuous patches up to 2 mm long and this is intergrown with relatively minor amounts of quartz much of which appears to be secondary. Some of the microcline contains clouds of minute inclusions of hematite and also minute voids and some zones of microcline lack these minute voids and inclusions but show a pale orange staining. This pale orange staining in some areas forms a network of veins which coalesce and in other areas much of the rock shows this pale orange staining. There are zones where a single crystals of microcline covers zones containing minute inclusions and other zones with vein-like patches of the orange staining and these features suggest that this microcline is metasomatic and has crystallized across the earlier rock fabric but, in general, there is no evidence from which to determine the former composition of the rock. There are a few places where relatively large crystals of microcline contain films or groups of small quartz inclusions which extinguish simultaneously between crossed nicols and some of these quartz inclusions form patterns which are similar to,-but not as well preserved as, those resembling micrographic intergrowths or myrmekitic intergrowths noted in some clasts in sample RS 1118.

The metasomatic, microcline-rich rock has been extensively fractured and locally crushed and there are many zones which are now composed of very fine-grained potash feldspar, relatively minor quartz, and traces of fine-grained muscovite or sericite. Much of the pale orange staining is concentrated in the crushed zones but, as noted above, some of the microcline has grown across the orange staining and there has either been a regrowth of microcline or some of the crushed and fractured zones have been healed by microcline. It may be that the fractured and crushed rock was metasomatically replaced by microcline but there has certainly been additional extensive fracturing of the microcline. In this finer-grained matrix there are a few small fragments of monazite, a few grains of recrystallized titanium oxide crystals and one large group of recrystallized titanium oxide

about 3 mm long associated with a little specular hematite. In one area 1.5 mm long there is a porous mass of optically continuous tourmaline extensively veined by quartz and in one area of orange-stained, very fine-grained material there is a very turbid metamict crystal. In some other crushed, orange-stained zones there are a few scattered, tiny grains surrounded by haloes of reddish-brown staining similar to that sometimes caused by a radioactive element in an inclusion in feldspar.

The latest episode in the history of this rock following potash metasomatism, fracturing, orange staining and possibly additional potash feldspar metasomatism has been the introduction of quartz which has filled interstices in the breccia, and some of the microcline crystals bordering voids filled by this quartz have developed euhedral crystal faces.

Conclusion:

A metasomatic, potash feldspar-rich rock which has had a complex history including possibly more than one period of potash feldspar metasomatism and fracturing or crushing. At some time the fractured or crushed material has been stained orange and in places microcline has crystallized across this staining. The latest episode was introduction of quartz which has filled interstices and cemented the breccia.

Sample: 6737 RS 1120; TS42531

Applicant's No.: RBM 143A/79
Photo Location: NFM R17/089 (96)sp. 50 m S-E of Bill's Folly Lookout.

Hand Specimen:
The rock is composed largely of salmon-pink feldspar with lesser, moderately fine-grained quartz and there are some irregularly shaped zones 5-20 mm in size which are finely porous and darker greyish-brown in colour. A few small joints contain trace amounts of specular hematite.

Thin Section:
This was cut to include some of the brownish areas.

The orange-pink zones in the rock contain turbid microcline with a grain size varying from 0.5-2 mm and this is intergrown with finer-grained quartz and in one or two places some of the coarser-grained microcline contains inclusions of quartz which extinguish simultaneously and form patterns resembling micrographic or myrmekitic textures, but these are not very well preserved and have been slightly modified. Some of the coarser-grained microcline shows patchy orange staining as in sample RS 1119 and it is almost certain that this is a metasomatic, microcline-rich rock. It is cut by a few small fractures and along some of these there are concentrations of specular hematite crystals, traces of fine-grained muscovite and an occasional crystal of monazite. This specular hematite has crystallized in situ in the fractures.

The brownish zones are composed of quartz intergrown with patches of very fine-grained chlorite stained to varying degress by very fine-grained iron oxide and in some transition zones between the pink rock and the brownish zones there is microcline which has been partly replaced by the brown-stained chlorite. The chlorite replaces the microcline in a very irregular manner, forming small patches in the interior of the microcline crystal and not replacing it progressively from the grain boundary. In some transition zones, however, it is quite clear that microcline has been at least partly replaced by the fine-grained chloritic mineral. In the interior of the brownish zones there are only a few remnants of microcline and practically all feldspar and also a little ?muscovite or biotite have been replaced by the fine-grained, iron oxide-stained chloritic mineral. In some zones textures suggest that quartz has been introduced and has crystallized across some areas of altered rock and some of this quartz now contains small patches of brown-stained chlorite and also small grains or spots of the secondary iron oxide which formed in the chloritic aggregates.

Conclusion:
This is almost certainly a metasomatic rock composed of microcline and quartz and in the greenish-brown zones noted in the hand specimen the feldspar has been replaced by iron oxide-stained chlorite.

Sample: 6737 RS 1121; TS42532

Applicant's No.: RBM 143B/79
Photo Location: NFM R17/089 (96)sp.

Hand Specimen:

A breccia composed largely of pink-stained feldspar and minor quartz. Some zones are porous and leached and there are surfaces in these leached zones which are now encrusted with supergene opal. Clasts in this breccia are generally less than 5 mm in size but there are a few larger, pink, feldspathic fragments up to 15 mm.

Thin Section:

This is a breccia containing closely packed clasts most of which are composed of turbid, orange-stained microcline intergrown with lesser amounts of quartz and minor muscovite. This leucogranite is very probably of metasomatic origin and there is one area 6 mm in size composed of optically continuous microcline with some patches of pale orange staining. This microcline is similar to that in other specimens in that it contains very minute inclusions of hematite. There is one area in which quartz included within the microcline forms a typical myrmekite-like or micrographic intergrowth and this radiates out from a feldspar crystal 1 mm in size which has been replaced by sericite. This is similar to other relict textures of micrographic intergrowth or myrmekitic intergrowth noted in other specimens from this area.

The leucogranite containing a high proportion of microcline has been extensively fractured and interstices between the larger clasts contain small fragments of microcline and quartz and also higher concentrations of muscovite than in most of the clasts. In some areas fine-grained iron oxide-stained chlorite is present along grain boundaries and in interstices and this is similar to the chlorite which has replaced portions of feldspar in sample RS 1120. These extensively fractured zones contain scattered crystals and small aggregates of specular hematite and in one zone about 10 mm long there are concentrations of moderately coarse-grained apatite which shows patchy, pale-brown staining suggesting that it replaced pre-existing minerals. Some of this apatite has penetrated along boundaries between microcline crystals and it has, in turn, been extensively fractured. In another area there is a concentration of monazite in extensively fractured microcline.

Conclusion:

Granitic breccia of tectonic origin composed predominantly of leucogranite which was probably of metasomatic origin. Fractured zones and the finer-grained interstitial matrix contain minor amounts of specular hematite and muscovite and local concentrations of apatite and monazite.

A few interstitial voids are lined with a thin film of opal.

Sample: 6737 RS 1122; TS42533

Applicant's No.: RBM 143C/79
Photo Location: NFM R17/089 (96)sp.

Descriptive Information: This is described as a granitic breccia similar to sample 143B/79 but less weathered.

Hand Specimen:
A salmon-pink feldspathic rock containing scattered grains and/or aggregates of quartz 1-3 mm in size and traces of muscovite and hematite.

Thin Section:
This is an extensively fractured leucogranite which is essentially very similar to sample RS 1121 but the fractured zones are not as extensively stained and, in the area sectioned, there are no concentrations of apatite or monazite. There is, however, a local concentration of very turbid ?metamict crystals and traces of hematite and recrystallized titanium oxide.

The leucogranite contains a high proportion of microcline intergrown with quartz of varying grain size up to 2 mm and some of the microcline contains patches of muscovite and of quartz.

The microcline-rich rock has been extensively fractured and in fractured zones much of the microcline is now stained pale orange. Interstices in the breccia contain small, angular fragments of microcline and minor amounts of muscovite and in these fractured zones much of the microcline is now stained pale orange. There has been some regrowth of microcline in these zones and some small fragments show overgrowths with well developed crystal faces projecting into voids now filled by quartz. There are a few small aggregates of iron oxide and rutile or recrystallized leucoxene up to 1 mm in size and in two areas there are groups of very turbid, almost isotropic, metamict crystals 0.3-0.5 mm in size in the crushed and orange-stained microcline.

There is minor migratory or secondary quartz filling some interstices in fractured zones but, in general, the breccia appears to have been healed by regrowth of microcline.

Conclusion:
Extensively fractured and/or crushed leucogranite (granitic breccia) which does not have the local concentrations of apatite and monazite noted in sample RS 1121. There are, however, traces of an unidentified metamict mineral. There is minor secondary quartz filling some interstices in the fractured zones but, in general, the breccia has been cemented or healed by regrowth of microcline.

Sample: 6737 RS 1123; TS42534

Applicant's No.: RBM 143C/79
Photo Location: NFM R17/089 (96) sp. 50 m S-E of Bill's Folly Lookout.

Hand Specimen:

A salmon-pink rock which is moderately fine-grained and consists mainly of potash feldspar with lesser amounts of quartz. There is a little fine-grained muscovite along small veins or fractures and also a few crystals and small aggregates of hematite.

Thin Section:

This contains over 60% of microcline with 25-30% of quartz, 1-2% of fine-grained muscovite and traces of hematite, monazite and a metamict mineral. Much of the quartz which is intergrown with the microcline has a grain size of 0.2-0.4 mm and the microcline is generally slightly coarser-grained but shows a greater variation in grain size. The microcline is similar to that in sample 142/79 (RS 1119) in that much of it contains minute inclusions of hematite and there are veins and patches where it is stained pale orange. In general, however, there is much less of the pale orange staining than in sample 142/79.

There are some zones where the microcline has been fractured and crushed and probably healed by regrowth of the microcline, but this fracturing and/or crushing appears to have been much less extensive than in sample 142/79 (RS 1119). In this rock, however, there is no clear distinction between clast and matrix and although finer-grained zones containing scattered flakes of muscovite are probably the equivalent of the matrix in some of the other breccias the boundaries of clasts cannot be readily distinguished in this sample. There are a few crystals of specular hematite, one of which has been fractured and bent, and these are concentrated in the zones showing more evidence of fracturing and pale orange staining. There is a trace of monazite and there are a few very turbid metamict crystals similar to those noted in some other samples from this area. Some of the more fractured zones have been invaded by secondary or migratory quartz which has filled some interstices.

Conclusion:

Deformed and probably brecciated leucogranite which was probably of metasomatic origin and is similar to other samples from this area, particularly RS 1119 (142/79). In this sample there is less evidence of crushing and very little distinction between the clasts and matrix.

In all of the specimens 143A-C/79 from the ?fault breccia there has probably been some regrowth of microcline after fracturing or crushing and this has healed or partly healed some of the breccias but some zones have been cemented by introduced or migratory quartz. No evidence was found to suggest a range of types with remnants of clasts in 143A and the dark patches in sample 143A are zones in which feldspar has been partly to extensively replaced by iron oxide-stained chlorite. In sample 143B (RS 1121) there has been some introduction of phosphate in the form of apatite and monazite and other samples contain traces of monazite. There are traces of specular hematite in most of the samples with higher concentrations in 143B and there are also traces of an unidentified metamict mineral.

Sample: 6737 RS 989; TS42535

Applicant's No.: RBM 144/79
Photo Location: NFM R17/089 (17)s. Mt Gee East Prospect.

Hand Specimen:
A conglomeratic rock containing a few large, generally rounded grains and pebbles 2-20 mm in size scattered through a finer-grained, greenish-brown to greyish-brown matrix. The larger clasts vary in colour and composition and include some of granitic rock. Towards one end of the sample there is a higher concentration of medium-sized grains of pink feldspar and granitic rock.

Thin Section:
Mineral assemblage:

	%
Detrital quartz	40-45
Lithic grains	10-15
Potash feldspar grains	2-3
Muscovite	Trace
Opaque oxide & leucoxene	Trace
Zircon	Minute Trace
Chloritic matrix	40-45

This is a poorly sorted sediment containing material derived from a variety of source rocks and some of the sediment is very immature, some is probably mature.

The sediment contains at least 20% of large grains over 2 mm in size and although most of these are lithic grains they include a few of coarse-grained microcline and coarse-grained quartz. There are some well-rounded, large grains of older sedimentary or metasedimentary rocks including bimodal, sericitic quartzite, mica schist and micaceous quartzite or quartz-sericite metasediment and there is also a rounded grain of partly sericitized granitic rock 6 mm in size. Angular grains over 1 mm in size are mainly of leucogranite, microcline and quartz with a few other grains of uncertain origin. The microcline in these angular grains is turbid and it contains clouds of minute voids and minute hematite inclusions and some has partchy pale-orange staining. Some of this microcline contains groups of small iron oxide inclusions and in a few clasts of the leucogranite there are single crystals or groups of crystals of monazite. It is clear that these angular clasts have been derived from leucogranite and/or granitic breccia very similar to that occurring in many areas in the Mt Painter region. In general, they appear to have been subjected to very little abrasion but some have slightly rounded corners.

The finer-grained sediment contains abundant quartz grains varying in size from 0.02 mm to 0.6 mm and some of the larger ones are well rounded whereas many of the smaller ones are angular. There are also a few well rounded grains of acid volcanic rock of similar size to the quartz grains, some microcline grains most of which are angular, and a few other lithic grains including quartz-mica schist and mica schist. There are a few granins composed of quartz and sericite of undetermined origin and a few which are entirely sericite and which may be sericitized feldspar. There are a few small grains of leucoxene and opaque oxide and a few very small zircon grains generally less than 0.05 mm in size. There are a few flakes of muscovite up to 0.2 mm long and one small grain was found containing

blue tourmaline intergrown with a trace of quartz and opaque material. The quartz, feldspar and lithic grains are not very closely packed and many are not touching or are barely touching. They are surrounded and cemented by a mass of very fine-grained, greenish-brown iron oxide-stained chlorite, possibly with some very fine-grained biotite and/or sericite, and films of this material separate most of the grains. The fine-grained micaceous material cementing this matrix does not show any evidence of preferred orientation.

Conclusion:

A conglomeratic rock composed of poorly sorted material including some mature sediment derived from a variety of rock types and some immature sediment derived mainly from leucogranite and/or granitic breccia very similar to that occurring in the Mt Painter area.

Because the rock contains scattered, larger pebbles and a high proportion of much finer-grained matrix it resembles tillite in general appearance, but this does not necessarily imply that it is, in fact, tillite.