DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No.: 80/117

SADME MOUNT PAINTER DIAMOND DRILLING - 1976 - CORELOGS AND PETROGRAPHIC DESCRIPTIONS.

GEOLOGICAL SURVEY

by

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DME No.: 601/74

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SUMMARY

Diamond drillholes BFD1, MGD47A and MGD151 were cored in 1976 by the South Australian Department of Mines and Energy near Mount Gee and Mount Painter. This southern portion of the Mount Painter Inlier contains large volumes of granitic breccia of uncertain orgin, and the holes were sited to determine the depth of breccia, and to provide information on the nature and controls of contained uraniferous hematite mineralisation.

BFD1 was sited on a small pod of breccia but entered net-vein fractured and chloritised basement at 5.11m, and bottomed in similar rock at 36.87m.

MGD47A and MGD151 were both spudded in massive breccia. MGD47A cored chloritised breccia to 144.88m where hematitic breccia was encountered to the total depth of 169.70 m. MGD151 cored granitic breccia to 148.60m, where chloritic breccia was encountered to 179.80m; a 68.25 m thick hematitic breccia, resting directly on schistose and grantic basement, was found below this. The hole bottomed in aplite at 291.55 m.

Diagnostic evidence for origin of the breccia was not found.

INTRODUCTION

This report records the results of three diamond-drillholes, BFD1, MGD47A and MGD151, cored during May-June 1976 by the South Australian Department of Mines and Energy (SADME). The holes are in the southern Mount Painter Inlier of the northern Flinders Ranges, approximately 600 road kilometres north of Adelaide (Figs. 1 and 2).

The Department commenced detailed geological mapping of portion of the inlier in late 1974 to better define the extent of granitic breccia and contained uraniferous hematite

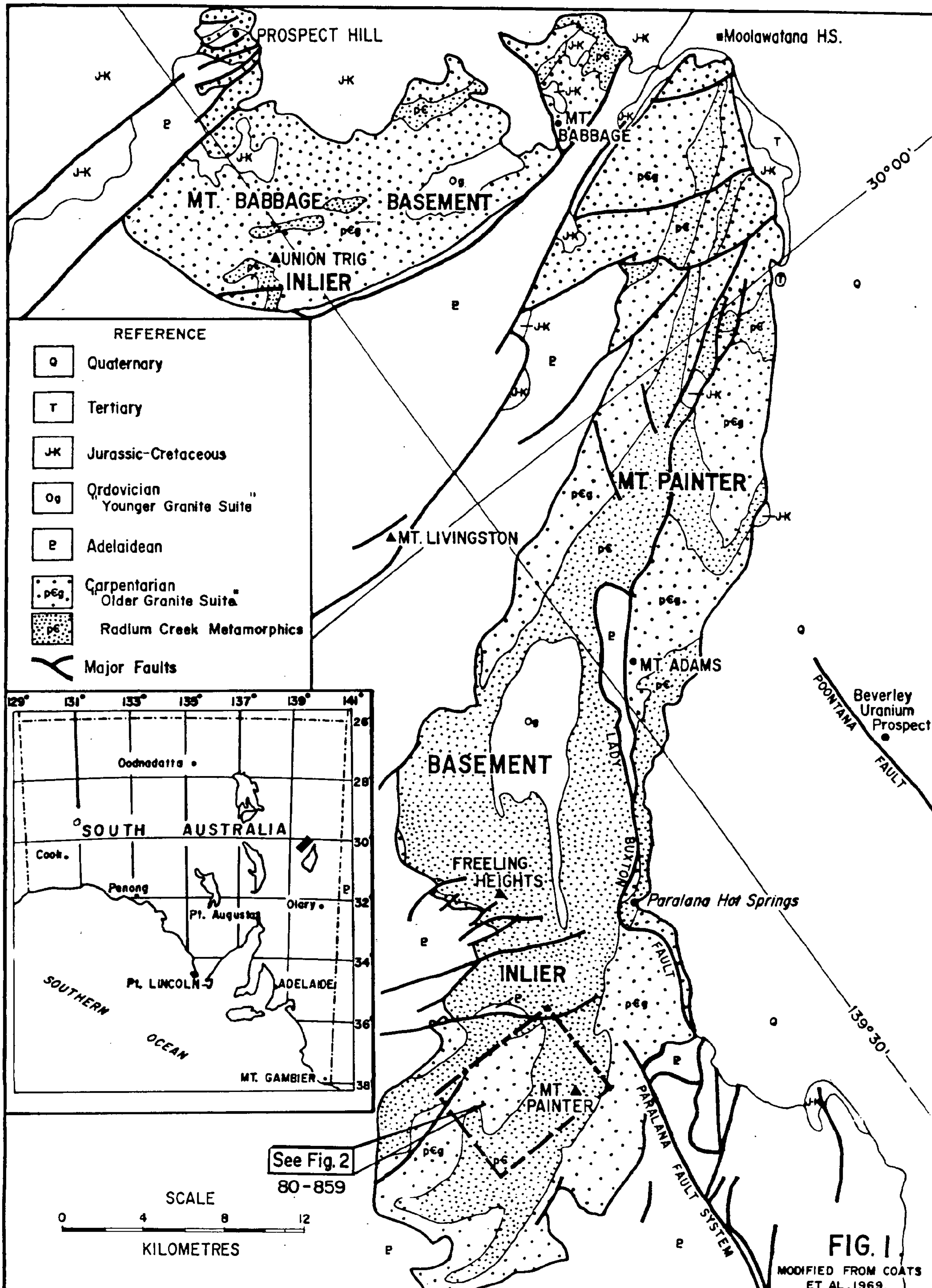

FIG. 1
MODIFIED FROM COATS ET AL, 1969.

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED J. F. D.	CDO 5/5/81 DATE
MOUNT PAINTER AREA	DRAWN E. C.	SCALE 1:250 000
DIAMOND DRILLING PROGRAMME 1976	DATE 5/12/80	PLAN NUMBER
REGIONAL GEOLOGY	CHECKED	S 15235

2249

mineralisation outlined earlier (1968-1971) by Oilmin and Transoil NL (Youles, 1975). Controversy regarding the origin of the breccia arose (Drexel, 1980), and three drillholes were consequently sited to provide information on the depth extent of granitic breccia and nature and controls of the uranium mineralisation.

Title to the ground discussed in this report is still held by Oilmin and Transoil NL under an exploration licence. Drilling and other data compiled by these companies, other than that released by Youles (1975), is therefore confidential.

GEOLOGICAL SUMMARY

Regional

The Mount Painter Inlier is one of two middle Proterozoic basement blocks immediately northwest of the inferred Curnamona Cratonic Nucleus of Thomson (1975). Its component rocks are metasedimentary and granitic, while the smaller Mount Babbage Inlier is primarily granitic (Coats et al, 1969; Coats and Blissett, 1971). Lower Palaeozoic granites and pegmatites intrude both basement complexes. Adelaidean metasediments and volcanics abut the inliers to the south and west, and Cainozoic-Mesozoic sediments abut the inliers and overlie the cratonic nucleus to the east. Mesozoic sediments are exposed north of the Mount Babbage Inlier (Fig. 1).

Acid volcanics from the Mount Painter Inlier and the Curnamona Cratonic Nucleus have been equated with those of the Gawler Range Volcanics 300-400 km southwest (Giles and Teale, 1979).

Local

Basement rocks represented on Figure 2 are biotite-feldspar-quartz schist and gneiss of the Radium Creek Metamorphics, and an unnamed magnetite-bearing gneissic granite belonging to the "Older Granite Suite" which intrudes the metamorphics. The "Younger Granite Suite" is represented by microcline-quartz-(plagioclase) pegmatite and granite of igneous and/or metasomatic origin.

The basement (and younger granites) are dissected by a series of northeasterly trending faults which contain pods of breccia. The breccias are cemented or veined with quartz and minor hematite of the Mount Gee unit (see below), and green, white and purple fluorite which occasionally shows colour zoning. Portions of breccia have been partially to completely potash metasomatised, such that these areas now appear as pink microcline-quartz granitoid resembling pegmatite.

Massive granitic breccia of the southern Mount Painter Inlier, in contrast with the fault breccias, are large irregularly shaped bodies with surface expressions of up to 3 km x 1 km (see Fig. 4, Drexel, 1980, and Fig. 2, this report). The bulk of the rock is comprised of locally derived granitic and metasedimentary basement clasts, and younger granitic intrusives. The clasts are angular to subrounded and range from granules to boulders of over 10 m. The most common matrix is silt- to sand-sized rock fragments which account for negligible to 75% of the rock volume (Youles, 1975).

Massive granitic breccia is intruded and overlain by a mildly uraniferous quartz-hematite lithology known informally as the Mount Gee unit. The combination of quartz-hematite layering, graded layering, and layering truncation suggestive of cross-bedding, indicate that it may have originated as a hot springs deposit, with associated dyking. The ?extrusive or ?surficially deposited portion of the unit appears to be the first of a series of mineralising events and has an estimated overall quartz-hematite ratio of 60:40. The intrusive portion of the unit, found within breccia, older basement and earlier formed portions of the Mount Gee unit, is generally quartz rich with very little hematite and represents late stage mineralisation.

Another late intrusive phase of the Mount Gee unit provided the uraniferous hematitic matrix for the hematitic breccia found as layers and dyke-like bodies within massive granitic breccia and basement (fig. 2 and Drexel, 1980). Chloritisation appears to be related to this mineralising event but is generally found adjacent to, normally topographically above, and not within the hematitic breccia (see Summarised Diamond-Drillhole Logs).

Hematite, and chlorite to a lesser extent, contain uranium in finely divided uraninite, with much smaller amounts in monazite. Youles (1975) quoted outlined reserves at Mount Painter to be 3.8 million tonnes at 0.1% U_3O_8, most of which are in hematitic breccia.

DIAMOND DRILLING

A Mindrill 1000 drillrig, coring with NQ and BQ wireline barrels, was used for all three holes. Total metreage drilled was 498.12 m with a core recovery of 486.21 m. All holes were spudded vertically, and a tropari survey on MGD151 showed little deviation:

50 m	89°
100m	90°
150m	89°
216m	90°

Difficult drilling conditions were encountered in all holes due to vughy and caving ground, and loss of drilling fluid. MGD47A was abandoned at 169.70m and failed to penetrate the base of the hematitic breccia. BFD1 was stopped at 36.87m after passing the zone of interest found in an adjacent percussion hole put down by a mineral exploration company. MGD151 was completed at the depth limit of the rig.

The holes were geophysically logged with some or all of neutron-neutron, gamma, self-potential and point resistivity methods. Caving ground hampered the geophysical exercise, however, and only the short hole BFD1 was logged to near total depth. The logs are stored in SADME open-file envelope No. 3931.

Petrographic descriptions of drillcore are given in Appendix B.

Eleven uranium analyses on portions of BFD1 and MGD151 (Amdel report AN1110/77) are listed at the end of the respective detailed logs. There has been no other geochemical work on the core.

Summarised Diamond-Drillhole Logs

Depth (m)	Thickness (m)	Description
		BFD 1
0-3		No recovery
3-5.11	2.11	Granitic breccia developed within pegmatite. Minor tourmaline and hematite, trace torbernite, some potash metasomatism of clasts.
5.11-36.87 (T.D.)	31.76	Chloritised and partially potash metasomatised fractured crystalline basement intruded by minor pegmatite. Trace to minor illite/montmorillonite, trace hematite, trace vughy quartz, trace pyrite in lower 3 m.
		MGD47A
0-3.40		No recovery
3.40-37.77	34.37	Chloritic breccia of angular to subrounded partially chloritised and potash metasomatised crystalline basement clasts to 5 m, averaging pebble to small cobble size. Chlorite dominates the matrix with trace to several percent calcite, trace purple fluorite, trace pyrite to 5mm, minor to several percent illite/montmorillonite.

37.77- 41.82	4.05	Brecciated conglomeratic rock resembling Sturtian tillite. Chloritic and granitic breccia up to 1.2 m thick is intercalated with ?tillite, with the rock contacts being angular and highly irregular. Minor calcite in breccia matrix.
41.82- 144.88	103.06	Chloritic breccia as above but with larger altered basement clasts to 10 m.
144.88- 169.70 (T.D.)	24.82	Hematitic breccia of granule to pebble sized crystalline basement clasts with occasional small cobble sized clasts in a red ochreous and specular hematite matrix. Trace to minor calcite and vughy quartz.
		MGD151
0-4		No recovery
4- 148.60	144.60	Granitic breccia of weathered and partially potash metasomatised angular to subrounded crystalline basement clasts to 17 m, averaging granule to small cobble size. Minor vughy quartz with pink montmorillonite.
148.60- 179.80	31.20	Chloritic breccia of granule to cobble, partially to completely potash metasomatised crystalline basement clasts in a dominantly chloritic matrix with minor red ochreous and specular hematite. Minor illite/ montmorillonite as fracture coatings and mineral replacement.
179.80- 248.05	68.25	Hematitic breccia of angular to subrounded crystalline basement clasts in a red ochreous and specular hematite matrix. Some clasts of aggregated hematite laths. Graded and laminated hematitic siltstone to sandstone layers occur in two sections of core totalling 4 m. Vughy and "nailhole" quartz are locally abundant. Trace purple fluorite, trace to minor illite/montmorillonite on fractures.
248.05- 277.90	29.85	Schistose basement with no brecciation or potash metasomatism. Trace to minor vughy quartz and illite/montmorillonite.
277.90- 279.91	2.01	Partly chloritised schistose basement, with a granule to pebble breccia incorporating some potash metasomatised clasts. Minor to abundant vughy quartz.
279.91- 286.11	8.20	Schistose basement as above
286.11- 291.55 (T.D.)	5.44	Highly altered rock invaded by probable montmorillonite-bearing fine-grained albitic aplite.

DISCUSSION

Basement Intersections

MGD151, which was considered in previous unpublished communications to have bottomed in breccia, is now thought to have penetrated schistose basement at 248.05 m. This is recognised through the lack of brecciation and potash metasomatism in the schist, gneiss and aplite below this depth, and the analogy with No. 3,4,5 and 6 Painter workings, and several unlabelled locations (Fig. 2), where hematitic breccia at the base of granitic breccia rests directly on basement. The small amount of breccia near the bottom of the hole is thought to be due to either faulting or fluid induced insitu brecciation as discussed in Drexel (1980).

The lower 31.76 m of BFD1 cored fractured and chloritised middle Proterozoic basement.

MGD47A did not penetrate basement, and bottomed in hematitic breccia at 169.7 m.

Brecciation

The cores of MGD151 and MGD47A contain large amounts of breccia with angular to subangular clasts. The average clast size is granule to cobble, but lengths of basement to 5 m, interpreted to be clasts, are relatively common. Altered basement blocks from 10-17m core length occur less frequently. The breccia belongs to the Radium Ridge Beds of Youles (1975), renamed massive granitic breccia in Drexel (1980).

Total initial thickness of breccia in the Mount Gee East Prospect is now thought to be at least 400 m. This figure is based on the 248m cored in MGD151, and the 150m rise to the topographic upper limit of breccia on Radium Ridge immediately north of the drillsite (Fig. 2). Complication of this thickness calculation by folding or major faulting is not suspected.

Drillhole BFD1 contains breccia of unknown affinities in the upper 5.11m. With its shallow extent and proximity to known basement, the breccia is unlikely to be related to that in MGD151 and MGD47A, and is more probably of fault or regolith origin. The remainder of the core shows chloritic net-vein fractured basement, which in places is so intense, that insitu breccia has developed.

Alteration and Mineralisation

1. Potash metasomatism is seen in the cores as pink microcline veins and partial to complete alteration of clasts. Feldspar rarely forms the matrix to breccia, which suggests that the metasomatic event occurred prior to or during brecciation. Alteration is most pronounced in zones of chloritisation.
2. Dark green chlorite occurs in the three cores as a mineral replacement, as veins within clasts and basement, and as matrix to the clasts. Chloritic breccia in MGD151 and MGD47A lies directly above and in contact with hematitic breccia. Trace to minor specular hematite occurs with chlorite, but little chlorite occurs in hematitic breccia.

   BFD1 shows partially chloritised and chloritic net-vein fractured basement from 5.11 m to total depth of 36.87 m. Minor hematite occurs just above and within the top few metres of the chloritic breccia.
3. MGD151 cored 68.25 m of hematitic breccia from 179.80-248.05 m. The breccia consists of fractured millimetre scale laths of specular hematite in finer grained red ochreous hematite, both of which act as matrix to basement clasts. Very fine-grained uraninite is the primary uranium mineral and is contained in hematite. The more uraniferous zones

within the core correspond to short lengths of densely aggregated specular hematite. Much of the hematite near Mount Painter intrudes pre-existing granitic breccia (Drexel, 1980).

4. Vughy and "nailhole" quartz is a common vein and matrix mineral in MGD151. The "nailholes" are prismatic cavities created by weathering out of laumontite (zeolite: (Ca, Na) $(Al_2Si_4)\ O_{12}.4H_2O)$) which crystallised prior to or simultaneously with the enclosing quartz. Bright pink montmorillonite found throughout the core is the breakdown product of laumontite. Secondary vein quartz is scarce in BFD1, and occupies only the last 0.7 m of core in MGD47A.
5. White, aggregated prismatic crystals of laumontite occur as a 1-2 cm wide vein at 261.08 m in MGD151.
6. MGD47A contains trace to minor amounts of calcite as a vein and matrix mineral. This is considered unusual in that calcite is rare within core and outcrop of breccia, and calcite within the quartz-hematite Mount Gee unit has, without exception, been pseudomorphed by quartz. This could be taken as evidence for calcite of MGD47A, with its associated purple fluorite and euhedral pyrite, to have been introduced to the breccia after formation of the Mount Gee unit and earlier formed calcite.
7. Torbernite flakes to 1 mm are sparsely scattered through core of BFD1 at about 5m depth.
8. Yellow-green illite/montmorillonite is a common secondary mineral on fracture surfaces throughout the three cores, and is occasionally found as a mineral replacement.

"Sediments" within the Breccia

Conglomeratic rock resembling Sturtian tillite is interspersed with chloritic and granitic breccia over a 4 m interval at approximately 40 m depth in MGD47A. Clasts in the ?tillite are porphyritic volcanics of exotic derivation, with pegmatite and heavy mineral laminated quartzite of possible local origin. The ?tillite/breccia contacts are highly irregular, and angular clasts of tillite have been incorporated within immediately adjacent breccia. This, along with the small amount of ?tillite present, suggest that it was included within developing breccia as previously lithified blocks.

Hematitic breccia of MGD151 contains several lenses of siltstone and sandstone up to a maximum thickness of 16 cm. Laminations are poorly to moderately developed and are subperpendicular to the core axis. The sandstone contains granules of basement and some pebbles of aggregated hematite laths. The limited distribution of sediments within hematitic breccia, lack of similar material within granitic breccia of the core, and the probability that hematite was introduced to granitic breccia as an epigenetic mineralisation (Drexel, 1980), indicate that the sediments may not have been derived by normal free surface deposition. It is suggested that they may have resulted from fluid winnowing of fines within a breccia pile.

CONCLUSIONS

The 1976 drilling programme provided core in areas which were previously penetrated only by percussion drilling, the data from the latter still being confidential.

248.05 m of granitic, chloritic and hematitic breccia were cored in MGD151 before passing into and bottoming in schistose, gneissic and granitic basement at 291.55 m. The Mount Gee East

Prospect is now thought to have contained at least 400 m of breccia, assuming breccia once filled the valley to the projected top of Radium Ridge, 150 vertical metres above the drillsite.

68.25 m of uraniferous hematitic breccia, resting on basement, were cored in MGD151. MGD47A, 250 m north, bottomed in possibly the same hematitic breccia body at 169.70 m, having cored 25.02 m of hematitic breccia below chloritised granitic breccia.

Neither MGD47A nor MGD151 yielded diagnostic evidence for origin of the granitic breccia or younger uraniferous chloritic and hematitic mineralisation.

BFD1 passed from a possible regolith at 5.11 m into net-veined fractured and chloritised basement. The hole was stopped at 36.87 m.

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Mineral Resources Section

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APPENDIX A

DETAILED DIAMOND-DRILLHOLE LOGS

BFD1, MGD47A, MGD151

Petrographic descriptions of the drillcore (Appendix B) are referenced in the detailed logs according to their SADME rock sample number e.g. RS1152. The full RS number is 6737RS1152 where 6737 is the National Mapping 1:100 000 sheet number.

SADME DIAMOND DRILLHOLE BFD1 T.D.36.87 m

DRILLED MAY 1976
LOGGED SEPT. 1980 by J.F. DREXEL

Depth (m)	Description
0-3	no recovery
3-4.27	pegmatite - coarse-grained quartz, pink and/or white feldspar, minor tourmaline and hematite veining along fractures; core is broken, weathered and partly sericitised; some breccia with clasts up to pebble size.
4.27-5.11	granitic breccia - sericitised pegmatitic clasts, some showing complete alteration to bright pink metasomatic feldspar, minor altered gneissic clasts, matrix of red ochreous hematite with small broken hematite laths; clast boundaries are not shape and appear to have been chemically corroded by the hematite; yellow/green illite/montmorillonite on fracture surfaces, trace amounts of torbernite crystals to 1 mm in vughs.
5.11-9.86	pegmatite - white feldspar and quartz with minor graphic exsolution of quartz, altered by sericitisation, weathering and introduction of red ochreous hematite in places; minor brecciation, yellow/green illite on fractures; minor goethite or limonite lined vughs may represent eroded sulphide veins.
9.86-10.80	granitic gneiss - fine grained, weakly foliated; minor pink feldspar veining and alteration (RS158 from 10.2m - granitic gneiss).
10.80-14.91	granitic gneiss - altered by pink feldspar, hematite and chlorite; extensively microfractured bordering on net-vein fracturing, minor near-insitu breccia; several biotite gneiss zones to 20 cm wide are unbrecciated; minor resorption of the biotitic zones by quartz/pink feldspar.
14.91-23.00	granitic rock - coarse-grained, foliated yellow/orange weathering pink feldspar/quartz rock with minor magnetite blebs to 5 mm and minor biotite, quartz occurs as elongate blebs to 5 mm; extensively net-vein fractured by dark green chlorite and trace hematite, minor jig-saw brecciation with granule sized clasts; bright pink metasomatic feldspar outlining of fractures and replacement of primary feldspars, minor vughy quartz veining; foliation 60-70^{o} to core axis (RS151 from 16 m -breccia).
23.00-24.59	metasediment - medium grained, pale brown; shows similar net-vein fracturing and alteration as above, minor chlorite replacement of rock away from the fractures with the fractures remaining essentially unaltered (RS1135 from 24.45-24.59 m - metasomatically altered metasediment).

24.59-31.17	granitic rock - similar to 14.91-23.00 m but with biotite to 5% giving a more pronounced foliation; some chlorite/pink feldspar/hematite alteration; quartz/white feldspar/iron oxide blebbed vein at 30.76 m contains several pyrite crystals to 5mm, this vein is surrounded by a bright pink metasomatic feldspar halo up to 3 cm wide; foliation 60-70^{O} to core axis; minor breccia (RS152 from 24.7 m - brecciated gneiss; RS173 from 30.25 m - acid gneiss veined by microcline).
31.17-33.76	biotite gneiss - gradational contact with less biotitic rock above; foliation 70^{O} to core axis well defined by biotite, biotite/quartz schist at 32.68-33.78 and 33.43-33.64; contains 3-6 mm augen-like blebs of plagioclase with 0.5 mm pink feldspar rims; very minor feldspar alteration and chloritisation (RS1136 from 32.70-32.77 m - partially metasomatised biotite schist).
33.76-36.87 Total depth	granitic gneiss - coarse grained, pink/orange weathering similar to top of hole with heavily chloritised biotite gneiss; minor net-vein fracturing but many fractures shows pink feldspar alteration and minor hematite veining; minor quartz veins to 7 cm wide, alteration veinlet with minor breccia and pyrite crystals to 5 mm at 34.31 m, chlorite/quartz/minor pyrite vein at 36.15 m.

ANALYSES

24.45-24.59	A397/76	RS278	42 ppm U
24.75-24.90	A398/76	RS299	20 ppm U

SADME DIAMOND DRILLHOLE MGD47A T.D.169.70 m

DRILLED MAY-JUNE 1976
LOGGED SEPT. 1980 by J.F. DREXEL

Depth (m)	Description
0-3.40	no recovery.
3.40-5.07	biotite chlorite quartz feldspar schist - highly weathered and altered, red and white clay blebs to 2 cm may represent altered feldspar or ?andalusite; minor quartz veining, minor waxy yellow/green illite/ montmorillonite on fracture surfaces; rock may be partly brecciated (RS 1152 depth unknown - illite).
5.07-18.42	chloritic breccia - shattered to brecciated granitic rock with minor gneissic horizons; dark pink feldspar of probable metasomatic origin is breaking down to red clay; network veining and breccia matrix of khaki coloured chlorite and calcite; trace amounts of limonite pseudomorphing euhedral pyrite within chlorite, several pseudomorphs still retain pyrite core e.g. 5.56 m and 16.57 m, trace amounts of purple fluorite associated with calcite veining e.g. 8.81 m, yellow/green illite/ montmorillonite as fracture coatings; core is friable in places (RS1137 from 9.20 m - montomrillonite).
18.42-18.64	chloritic breccia - dark green with subangular pebble sized clasts of pink metasomatised rock; fresh pyrite; calcite/purple fluorite veining; the core from this point down the hole is relatively unweathered.
18.64-19.98	chloritic breccia - slightly foliated dark pink granitic clasts in a matrix of dark green chlorite; foliation is defined by 0.1-1 mm hematite blebs; white calcite veining and blebbing with traces of purple fluorite, numerous sub to euhedral pyrite crystals to 5 mm; pyrite blebs also in the granitic clasts (RS 1138 from 19.22-19.29 m - potash metasomatised clast from chloritic breccia).
19.98-25.20	gneissic rock - highly altered pink feldspar/green clay/biotite/chlorite/quartz rock; minor pink granitic rock; minor brecciation; minor euhedral pyrite crystals to 4 mm in chlorite/calcite vein, trace purple fluorite, minor pink feldspar veining, yellow/green illite/montmorillonite as veins and fracture coating; foliation approximately 70° to core axis.
25.20-25.64	chloritic breccia - subangular granule-sized pink granitic clasts; narrow calcite veins and blebs, trace pyrite, weathered yellow/green illite/montmorillonite in vughs and fractures (RS1139 from 25.40-25.47 - chloritic breccia).
25.64-30.00	granitic rock - medium-grained pink metasomatic feldspar/quartz with slight foliation; remnants of partly feldspathised and chloritised ?biotite gneiss; chlorite veins to 2 cm, calcite veins to 2 mm; weathered yellow/green illite/montmorillonite with trace pyrite on

fractures; minor brecciation (RS1140 from 28.45 m - illite/montmorillonite rock).

30.00-37.08	foliated chloritised gneiss - patches of pink feldspar metasomatism; chlorite net-vein fracturing and brecciation in places, brecciation is more intense around the pink feldspar rock, mainly granule clasts of pink feldspar/quartz, yellow/green illite/montmorillonite on fractures; trace calcite, no pyrite.
37.08-37.77	chloritic breccia - angular to subangular granule to pebble feldspathised granitic and gneissic clasts.
37.77-38.56	?tillite - brecciated conglomeratic rock resembling Sturtain tillite; pebble-sized clasts within the ?tillite of porphyritic volcanics, pegmatite, quartz and quartzite, one 8 cm quartzite cobble shows heavy mineral banding; matrix to the ?tillite is red silt to sand but with irregularly shaped green coloured areas (?redox fronts); the brecciated ?tillite consists of highly angular pebble clasts in a calcitic matrix, the clasts have apparently not moved far and are not interspersed with granitic clasts above the ?tillite.
38.56-38.75	granitic breccia - pink granitic clasts with minor granules of ?tillite; minor calcite veining; contact with the tillite is angular and irregular.
38.75-38.94	?tillite - as above; upper contact with the granitic breccia is angular and highly irregular.
38.94-41.15	chloritic breccia - large amounts of apple-green ?chlorite/?illite; angular to subrounded clasts, many show partial to complete ?chloritisation; pink feldspathisation on fractures along which movement has taken place to produce the breccia.
41.45-41.82	?tillite - as above but internal clasts are more numerous; upper contact obscured in crumbly core, lower contact is partly obscured by a white vein of radiating ?laumontite crystals; trace of calcite veining.
41.82-46.15	basement rock - highly feldspathised and chloritised, now pink feldspar/quartz granitoid with some (biotitic) gneissic portions; minor calcite and calcite-trace purple fluorite veining; chloritic veins to 5 cm; yellow/green illite/montmorillonite as fracture coating and mineral replacement; minor breccia.
46.15-56.32	chloritised schistose basement - minor feldspathisation and ?ferruginisation, minor feldspathisation along joints; cm scale pink feldspar blebs may be porphyroblasts or non-chloritised remnants; trace amounts of calcite veining with very minor traces of purple fluorite, yellow/green illite/montmorillonite on fractures; no obvious breccia (RS1141 from 49.16-49.25 m - altered metamorphosed basement clast from breccia).

56.32-59.80	chloritic breccia - angular to subrounded granules to cobbles of highly altered and feldspathised basement gneiss and granite; partly calcareous matrix and minor calcite clasts, yellow/green illite/montmorillonite on fractures.
59.80-64.68	biotite ?metasediment - fine grained, foliated, with calcite/feldspar veining and minor feldspathisation, minor pegmatitic intrusion; trace calcite/pyrite/purple fluorite veining (63.19 m), yellow/green illite/ montmorillonite on fractures, parts of the core are very broken and crumbly but no obvious breccia (RS1142 from 62.29-62.33 m - altered feldspar-biotite hornfels).
64.68-66.55	basement rock - almost completely made over to pink feldspar which is breaking down to a red clay; some relicts of chloritised and/or sericitised biotite gneiss; minor calcite veining and blebbing, yellow/green illite/montmorillonite as fracture coating and mineral replacement.
66.55-70.80	chloritised biotite quartz gneiss/schist - pink feldspar and minor calcite veining, yellow/green illite/ montmorillonite as mineral replacement; core is crumbly in places; gneissosity 70° to core axis; minor breccia.
70.80-72.75	chloritic breccia - feldspathised clasts.
72.75-74.15	biotite ?metasediment - fine grained, foliated, similar to that at 64.50 m; pink feldspar veining and alteration; yellow/green illite/montmorillonite on fractures.
74.15-76.15	chloritic breccia - pink feldspar clasts of granule to pebble size with minor cobbles; much calcite in the more chloritic areas, much yellow/green illite/montmorillonite; large amount of the core is crumbly.
76.15-81.63	basement rock - coarse grained, foliated with blotchy alteration to chlorite and illite, minor calcite blebbing and veining (RS1143 from 77.25-77.35 m - altered granitic gneiss clast from chloritic breccia).
81.63-99.76	chloritic breccia - zones of finer detritus (mainly granules with minor pebbles) with much chlorite, coarser breccia contains cobble-sized clasts of gneiss and fine-grained biotite metasediment; pink feldspar veining and clast replacement; calcite veining and blebbing in the matrix; core is crumbly in places.
99.76-102.16	biotite schist - fine grained with minor pink feldspar and pyrite blebbing along the schistosity; minor calcite veining, schistosity is subparallel to the core axis; minor chloritic breccia zones to 4 cm.
102.16-104.14	granitic gneiss - coarse grained with pink feldspar veining and alteration, trace calcite; foliation approximately 50° to core axis.
104.14-144.88	chloritic breccia - similar to that at 98 m; angular to subangular granitic to schistose clasts, many show partial to complete feldspathisation, some ?granitic clasts show

complete alteration to khaki-weathering chlorite and quartz; calcite veining, trace purple and white fluorite in vein at 113.79 m, yellow/green illite/montmorillonite on fractures, trace vughy quartz.

144.88-169.70 Total depth	hematitic breccia - granule to pebble basement clasts with two clasts to 45 cm; possible fine-grained amphibolite clast at 164.56-164.63 m; matrix of red ochreous hematite with 0.1-1 mm specular hematite laths; some sections contain 80+% hematite; no obvious layering in the matrix; trace to minor calcite veining, vughy quartz intrudes core over the last 70 cm.

SADME DIAMOND DRILLHOLE MGD151 T.D.291.55 m

DRILLED JUNE 1976
LOGGED SEPT. 1980 by J.F. DREXEL

Depth (m)	Description
0-4	no recovery.
4-6.50	biotite schist - partially weathered with red clay along schistosity and joint surfaces; minor vughy quartz stringers; minor intertonguing of weathered pink medium grained gneiss or gneissic granite with very minor pink feldspar veining and alteration; schistosity 40° to core axis (RS163 from 5 m - quartz feldspar biotite gneiss).
6.50-21.24	granite or granitic gneiss - mottled pink/dark red, medium to coarse grained, occasional schistose bands to 4 cm oriented 50-55° to core axis; feldspars weathered to clay; core is crumbly in places; very minor blebs of hematite (?after magnetite), minor soft yellow/green talcose illite/montmorillonite along joints (RS164 from 6.7 m - altered granite; RS1144 from 8.58-8.64 m - altered granitic gneiss; RS165 from 10.3 m - altered porphyroblastic adamellite gneiss; RS 166 from 14.1 m - altered adamellite gneiss).
21.24-21.28	probable granitic breccia - granule to pebble granite and gneissic clasts in dark red silty matrix.
21.28-26.32	granite or granitic gneiss - mottled pink/dark red; biotite to 10%, minor vughy quartz veining, pink feldspar veining along fractures; has the appearance of a granite intruding a biotite gneiss; gneissosity 60° to core axis (RS167 from 24.3 m - altered adamellite gneiss).
26.32-26.47	granitic breccia - subangular granule to pebble biotite schist, medium grained pink granite and mottled pink/dark red granitic gneiss clasts; minor bright pink montmorillonite alteration; dark red silty matrix.
26.47-27.12	biotite gneiss - pink/dark red; gneissosity 70-75° to core axis.
27.12-28.50	granite or granitic gneiss - mottled pink/dark red; highly weathered to a kaolin-like material; yellow/green illite/montmorillonite with traces of red ?rutile along cleavages and fractures; some possible breccia.
28.50-29.60	granitic breccia - highly altered and friable; pebble to cobble pink granitic clasts are barely discernible; yellow/green illite/montmorillonite as fracture coating.
29.60-30.82	granite or granitic gneiss - mottled pink/dark red; weathered.
30.82-34.00	granitic breccia - highly weathered, subangular granule to cobble gneiss, schist and granitic clasts in a similar finer matrix.

34.00-40.17	granitic rock - medium grained, pink feldspar and quartz with minor hematite blebs to 3 mm, some pink/dark red mottling; most feldspar grains are altered to clay, vughy quartz veins to 4 cm across (RS168 from 38.2 m - altered adamellite).
40.17-41.40	granite or granitic gneiss - pink coloured; minor mm to cm wide biotite rich layers; feldspars partly altered to clay; minor yellow/green illite/montmorillonite on joints and as mineral replacement, minor vughy quartz, network of ?psilomelane veins at 41.35 m.
41.40-65.07	granitic breccia - weathered, angular to subrounded granule to cobble gneissic, granitic and schistose clasts in a finer matrix with some dark red silt to sand, some boulder sized clasts to 60 cm; minor to major amounts of vughy Mount Gee "nailhole" quartz with most "nailholes" filled with pink montmorillonite; some pebble sized gneissic clasts within the quartz with rims of pink montmorillonite; some resemblance of layering within the montmorillonite at 53.80 m; no core recovery between 41.56 and 41.94 m (probably a quartz vugh) (RS169 from 45.4 m - altered and fractured adamellite gneiss).
65.07-70.04	granitic breccia - as above but with minor vughy quartz and montmorillonite.
70.04-74.47	biotite gneiss - minor pink/dark red granite with irregular patches of granule to cobble granitic breccia up to 15 cm across; gneissosity varies from 45° to subparallel to core axis; vughy quartz over last 14 cm.
74.47-75.72	no recovery - probably a quartz lined vugh.
75.72-76.80	granitic breccia - subrounded weathered granitic and schistose clasts to pebble size with a quartz and red/brown silty matrix.
76.80-79.00	granite - weathered red/brown, medium grained with some pink feldspar alteration; minor probable breccia; minor vughy quartz veins.
79.00-79.40	granitic breccia - subangular granule to pebble clasts with one clast to 7 cm; vughy quartz with minor pink montmorillonite.
79.40-81.45	granite or granitic gneiss - weathered red/brown medium to coarse grained with minor hematite blebs; pink feldspar veining along fractures, minor quartz veins to 1 cm wide associated with white clay, minor yellow/green illite/montmorillonite on fractures.
81.45-84.83	granitic breccia - medium grained, mottled pink/dark red granitic and biotite gneiss granule to cobble clasts; much vughy quartz with pink montmorillonite and black ?psilomelane; red silty matrix in places.
84.83-86.00	granitic gneiss - medium to coarse grained, feldspars altered to dark red ?clay.

86.00-89.95	biotite gneiss - minor feldspar and quartz veining; minor breccia with clasts showing partial feldspathisation.
89.95-95.71	biotite ?phlogopite schist - some schist breccia, veined by vughy quartz; minor pink feldspar/quartz veining across the schistosity; one 2 cm wide cream coloured clay vein (RS159 from 94.28-94.44 m - granitic breccia with potash metasomatised clasts; RS160 from 94.73 m - altered metamorphic rock).
95.71-102.75	granitic breccia - angular to subrounded granule to cobble schistose and gneissic clasts in a red/brown silty matrix (RS1145 from 99.38-99.48m - granitic breccia).
102.75-107.50	granitic breccia - similar to above but higher % of biotite in clasts and matrix; vughy quartz and pink montmorillonite.
107.50-107.66	vughy quartz - minor "nailholes" and pink montmorillonite, aggregates of radiating submetallic grey ?pyrolusite crystals have infilled the vughs.
107.66-112.15	granitic breccia - minor vughy quartz and pink montmorillonite; trace of apple-green ?fluorite in quartz from 110.42-110.62.
112.15-114.86	biotite gneiss - reddened feldspar grains; vughy quartz veining and pink feldspar alteration along fractures.
114.86-148.60	granitic breccia - subrounded granules to cobbles of granitic and schistose clasts with many showing pink feldspar veining or partial to complete alteration to feldspar; red silty matrix in places; minor vughy quartz and pink montmorillonite (RS1146 from 139.00-139.19 m - altered granitic gneiss clasts from granitic breccia).
148.60-179.80	chloritic breccia - granitic breccia of granule to cobble gneissic and granitic clasts in a dominantly chloritic matrix with minor specular and red ochreous hematite; part matrix of vughy quartz; most clasts show both chloritisation and extensive alteration to dark pink feldspar; feldspathisation is generally associated with creation of vughs in the clasts, these vughs are usually lined with quartz and specular hematite crystals; minor yellow/green illite/montmorillonite along fractures and as a replacement of primary feldspar grains (RS170 from 150.2 m - breccia, RS171 from 151.1 m - altered adamellite gneiss clast from breccia; RS1147 from 154.00-154.16 m - potash metasomatised clast from breccia; RS1148from 166.82-166.97 m - altered clast from chloritic breccia).
179.80-204.41	hematitic breccia - angular to subrounded granule to pebble with minor cobble sized basement clasts in a matrix of red ochreous and specular hematite; matrix volume is greater than in granitic and chloritic breccias; massive vughy specular hematite from 194.31-195.37 m, 3 cm vugh of 0.5-1 mm purple fluorite crystals at 180.23 m, vughy quartz veining.

204.41-211.74	hematitic breccia - red ochreous and specular hematite matrix; some clasts are of aggregated specular hematite laths; minor to major Mount Gee "nailhole" quartz with ironstained clay filling the "nailholes".
211.74-214.93	hematitic breccia - laminated and graded siltstone to sandstone lenses up to 16 cm wide; layering is perpendicular to the core axis; granule sized basement clasts with some pebble sized clasts of aggregated hematite laths (RS1149 from 212.34-212.47 m - layered hematitic breccia and siltstone).
214.93-222.87	hematitic breccia - pebble to cobble clasts and lesser amounts of hematitic matrix than previous breccias; appreciable amounts of red expansive clay in the matrix; the larger clasts are of highly altered and partly ferruginised granite or granitic gneiss; yellow/green illite/montmorillonite along fractures, minor vughy quartz.
222.87-224.10	hematitic siltstone to sandstone - scattered granule sized basement clasts; very few hematite laths; poorly defined layering; veined and partly brecciated by vughy quartz; coarser pebble-sized clastics from 223.20-224.10 where hematite laths are more abundant.
224.10-226.05	hematitic breccia - highly altered cobble-sized granitic clasts; red ochreous and specular hematite matrix in minor abundance; vughy quartz; white clay on fractures.
226.05-248.05	hematitic breccia - abundant red ochreous and specular hematite matrix; many basement and aggregated hematite-lath clasts to cobble size; vughy quartz veins.
248.05-270.71	biotite quartz schist - quartz blebs to 1 cm may be pseudomorphing feldspar or ?sillimanite; the biotite has a waxy feel; interlayered with dark grey to black biotite/?phlogopite schist with waxy appearance and feel, the micas are contorted in these layers; blebs of green/blue mineral which may be a clay alteration of spinel or andalusite; vughy quartz with pink montmorillonite, minor yellow/green illite/montmorillonite on fracture surfaces, trace vughy quartz veins with white radiating acicular crystals of laumontite partially altered to clay (RS1150 from 253.88-254.00 m - altered biotite schist; RS161 from 256.3 m - altered biotite gneiss; RS1151 from 261.08 m - laumontite vein; RS162 from 266.5 m - altered metamorphic rock).
270.71-277.90	biotite quartz schist - similar to that above but quartz blebs not as well defined; intruded by narrow quartz veins to 2 cm, minor veining and alteration by pink feldspar; no well defined foliation and rock has been contorted but not brecciated.
277.90-278.45	granitic breccia - granule to pebble basement clasts in a rock flour matrix with minor hematite; some clasts are of pink feldspar which is uncommon in this section of the core.
278.45-279.82	schistose basement - highly altered; now quartz and khaki-

	weathering ?chloritic clay; abundant intrusive quartz.
279.82-279.91	granitic breccia - similar to 277.90-278.45.
279.91-286.11	biotite quartz schist - veined by vughy quartz and clay; rock is microfaulted but no obvious breccia.
286.11-291.55 Total depth	unrecognisable rock type - highly altered; invaded by quartz/white feldspar/muscovite rock resembling a fine-grained aplite; abundant pink montmorillonite, small areas of quartz/?chloritic clay rock similar to 278.45-279.82; trace calcite; no obvious breccia (RS172 from 289.9 m - myrmekite).

ANALYSES

165.50-166.50	A 388/76	RS 269	50 ppm U
166.50-167.50	A 389/76	RS 270	860 ppm U
167.50-168.50	A 390/76	RS 271	48 ppm U
193.75-194.75	A 391/76	RS 272	350 ppm U
194.75-195.75	A 392/76	RS 273	800 ppm U
195.75-196.75	A 393/76	RS 274	110 ppm U
232.50-233.50	A 394/76	RS 275	430 ppm U
233.50-234.50	A 395/76	RS 276	580 ppm U
234.50-235.50	A 396/76	RS 277	130 ppm U

APPENDIX B

Petrographic Descriptions of Diamond-Drillcore

Appendix B1: BFD1
Appendix B2: MGD47A
Appendix B3: MGD151

Extracted from Amdel Reports:

MP 3701/76:	Mrs. Sylvia Whitehead
MP 3339/76:	Mrs. Sylvia Whitehead
MP 304/77:	Mrs. Sylvia Whitehead and Dr. R.N. Brown
MP 1114/77:	Mrs. Sylvia Whitehead
GS 1460/81:	Mrs. Sylvia Whitehead and Dr. R.N. Brown

APPENDIX B1

BFD1

Sample P310/76; TS36292   6737 AS 158   AMDEL REPORT MP304/77

Location:
BFD 1 at 10.2 m. Mount Gee East Prospect.

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

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

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

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

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

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

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

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

Conclusion:

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

Sample No: P196/76; TS35867   AMDEL REPORT MP3701/76   6737RS 151

Location:
Diamond drill hole BFD 1 at 16 m. Bill's Folly Prospect, Mt. Painter area.

Hand Specimen:
The general appearance of the drill core sample suggests an extensively fractured granitic rock with concentrations of chlorite and possibly other dark minerals along the very numerous fractures and small veins. In a few places there are minor amounts of a pale-coloured carbonate, some of which was removed and examined in refractive index liquids and this was found to have a refractive index corresponding to that of siderite or a sideritic carbonate.

When examined under low magnification, traces of purple fluorite were found along some of the fractures.

Throughout most of the 18 cm length of drill core the granitic rock is a pale yellowish-orange colour with only a small patch of reddish feldspar but at the top of the specimen (16 m), there is a zone containing brick red feldspar associated with some moderately coarse-grained quartz. This patch of feldspar has irregular and rather diffuse boundaries, suggesting that it is not a clast but is some form of metasomatic alteration.

The length of drill core was etched and stained with cobaltinitrite and this shows only minor to trace amounts of potash feldspar throughout most of the length of the sample and showed that the brick red feldspar at 16 m is predominantly potash feldspar. Some pyrite is present in this zone containing red potash feldspar. Staining of the small slab from which the thin section was cut shows that some potash feldspar tends to occur along grain boundaries and along some small fractures.

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

	%	
Quartz	40-50	
Turbid, partly altered plagioclase	40-50	
Potash feldspar	3-5	
Muscovite	2-3	
Chlorite	2-3	(more locally)
Sideritic carbonate	1-2	(local)
Iron oxide	Trace	
Monazite	Trace	
Zircon	Minute trace	
Recrystallized titanium oxide	Trace	
Fluorite	Trace	(vein)

The general appearance of this rock in thin section is of a confused mass of plagioclase and patches of quartz which show some evidence suggesting recrystallization under conditions of tectonic stress and this mass has been fractured and invaded by solutions which have deposited chlorite, minor iron oxide and monazite, some secondary sideritic carbonate which is closely associated with chlorite and some late fluorite. Scattered patches of orange-stained potash feldspar also appear to be a form of alteration.

The plagioclase occurs mainly as aggregates of crystals, 0.5 to 1.5 mm in size, which have almost certainly been partly granulated or sheared and recrystallized and much of this plagioclase is associated with, or has been partly replaced by some fine-grained muscovite. Quartz occurs as irregularly-shaped and rather elongate masses and aggregates up to several millimetres long and sub-parallel orientation of these suggests a foliation similar to that in many gneissic rocks. At least some of this quartz has clearly migrated and recrystallized and some of the larger patches now enclose minor patches or remnants of plagioclase. Some finer-grained quartz is closely intergrown with the moderately fine-grained, probably partly-recrystallized plagioclase. It is uncertain whether the parent rock was a gneiss, composed mainly of plagioclase and quartz, or granodiorite.

In more altered parts of the rock turbid, orange-stained potash feldspar is moderately abundant and is intergrown with quartz, muscovite and traces of iron oxide and monazite. The general appearance in some places suggests that at least some potash feldspar may have replaced plagioclase.

Fine-grained, pale green chlorite occurs in varying concentrations throughout the rock, along numerous small fractures and grain boundaries and also along many of the cleavageplanes in plagioclase. In a few places, some of the feldspar has been almost completely replaced by chlorite associated by turbid, very fine-grained sideritic carbonate. The relationship between chlorite and potash feldspar, both of which appear to have replaced some plagioclase, is not clear.

Traces of opaque iron oxide occur mainly in a more extensively altered zone where plagioclase has been almost completely replaced by potash feldspar, muscovite and chlorite and this iron oxide is closely associated with some aggregates of medium-grained monazite. A trace of yellow sulphide, probably pyrite, is also present in this area and some may be associated with the iron oxide but a polished section would be necessary to confirm this.

The section contains portions of several veins or late fractures which have been filled by varying proportions of quartz, chlorite, sideritic carbonate and fluorite.

Conclusion:

The parent rock was composed largely of quartz and plagioclase but it is not clear whether it was an acid gneiss or a granodiorite-type of rock. There is evidence suggesting some recrystallization under conditions of tectonic stress and also evidence of local shearing and granulation and of fracturing. This is therefore almost certainly a tectonic breccia. It has been subjected to considerable metasomatic alteration and partial replacement by a variety of minerals, mainly chlorite, muscovite and potash feldspar. Other introduced minerals include sideritic carbonate, trace amounts of pyrite and monazite and some fluorite along numerous small veins. There are also trace amounts of iron oxide but it is not clear whether this was introduced or whether it has migrated and recrystallized. This rock contains only an insignificant amount of iron oxide

Sample: 6737 RS 1135 (JFD 11/80); TSC30334 AMDEL REPORT GS 1460/81.

Location:
Drillhole BFD1 at 24.45-24.59 m

Hand Specimen:
A medium-grained, pink and grey rock showing some evidence of compositional layering almost at right angles to the direction of the drillhole.

Staining with cobaltinitrite shows that some of these layers are composed almost entirely of potash feldspar whereas others contain quartz and little potash feldspar but the layers are not well defined and the layering is not regular. In some zones there are small fractures containing dark minerals.

Thin Section:
The rock now has a rather complex composition and at least in some zones it contains abundant microcline generally associated with lesser amounts of quartz, a little plagioclase, minor muscovite and scattered small grains of rutile. In places there are relatively large crystals of microcline 2 to 4 mm in size which have crystallized across the earlier rock fabric and now contain inclusions of quartz, muscovite and rutile. In some areas the microcline is stained orange.

In the thin section evidence of layering, visible in the hand specimen, is very indistinct but there is one band, possibly a darker layer in which there are flakes of pale brown mica, either phlogopite or bleached biotite which, in some areas, has been extensively replaced by later, very fine-grained chlorite and in another broad band 3 to 6 mm thick there is an anomalous amount of apatite occurring as scattered crystals and aggregates with a grain size of 0.2 to 0.5 mm. However, apatite is also present in some of the numerous veins or fractures which contain varying proportions of chlorite, fluorite and apatite and in some of the chlorite veins there is a little fine-grained, turbid carbonate which may be sideritic carbonate. In one area, carbonate is present in interstices between fluorite crystals in the vein. Chlorite is also present throughout many parts of the rock where it has penetrated along grain boundaries and partly replaced many silicate grains. In some areas, fine-grained carbonate has replaced earlier crystals and in this respect, this sample is unusual as carbonate is not generally found in Mt. Painter rocks.

Conclusion:
Metasomatically altered rock in which some zones have been replaced by potash feldspar and there is also moderately abundant secondary chlorite and a little carbonate. Evidence as to its original composition is inclusive and although it could have been a metasediment, it is unlikely to have been a quartzite. Some zones or bands where probably micaceous schist or gneiss and the presence of anomalous apatite suggests that it may originally have been a sediment of unusual composition.

Sample No: P197/76; TS35868, 35869; PS24917   AMDEL REPORT MP3701/76.
6737RS 152.

Location:

Diamond drill hole BFD 1 at 24.7 m. Bill's Folly Prospect, Mt. Painter area.

Hand Specimen:

This length of drill core is a breccia which varies in composition. The upper 8 to 9 cm contain clasts of pale grey to almost white rock fragments in an abundant green, chloritic matrix. There are only trace amounts of orange-stained feldspar.

The lower 8 to 9 cm has clasts containing moderately abundant orange to brick red-stained feldspar and quartz in a chloritic matrix which also contains some hematite and pyrite. Two thin sections were cut from this rock. Section 35868 from the lower, hematite-bearing zone and section 35869 from the upper zone which is relatively free from pink feldspar and iron oxide.

Thin Sections:

Upper zone

The minerals present in the area covered by the section are as follows:

	%
Quartz	35-40
Microcline	30-35
Biotite	5-10
Muscovite	Trace
Secondary chlorite	10-15
Siderite	1-2 (local)
Metamict zircon	Trace
Fluorite	Trace
Leucoxene	Trace
Opaque oxide	Trace

This is a medium-grained gneiss in which some bands are composed mainly of intergrown microcline and biotite (locally replaced by chlorite) with a common grain size of 0.4 to 0.8 mm but locally with some larger crystals of microcline. Much of the quartz now occurs as elongate aggregates and patches, some of which have optically continuous grains 4 to 5 mm long and these are sub-parallel to the general foliation as defined by preferred orientation of much of the biotite. At least some of the quartz appears to have migrated and recrystallized after the other minerals and some of it now contains a few inclusions of biotite.

There is a zone in which the rock appears to have been extensively fractured or crushed and this now contains small clasts of quartz, microcline and chloritized biotite in an abundant matrix of fine-grained chlorite. Chlorite has also penetrated other zones in the rock where it has replaced much of the biotite and probabl also some of the feldspar. Some of this chlorite is associated with very fine-grained, turbid sideritic carbonate and locally, with traces of fluorite.

One band in the rock contains some feldspar which has been extensively replaced by sericite and fine-grained muscovite and it is possible that this zone once contained some plagioclase.

Conclusion:

The upper zone in this sample is a gneiss, probably formerly composed mainly of quartz, microcline and biotite. It has been locally fractured or crushed and has been invaded by solutions and this has resulted in patchy and locally extensive replacement by chlorite and minor siderite and the introduction of traces of fluorite. Some zones also contain secondary muscovite and/or sericite.

Lower hematite-bearing zone

The minerals present in the thin and polished section from this zone are as follows:

	%
Quartz	35-40
Turbid potash feldspar (mainly microcline)	20-25
Chlorite	10-15
Muscovite and sericite	2-3
Hematite	15-20
Monazite	Trace
Fluorite	Trace
Siderite	1-2
Zircon	Trace
Pyrite	1-2

This is a breccia containing some clasts of turbid (brick red in hand specimen) potash feldspar, some of coarse-grained quartz and some composed of varying proportions of coarse-grained potash feldspar and quartz. There are also clasts now composed of quartz and chlorite and one of quartz, chlorite and fluorite and it is probable that the chlorite in these clasts has replaced feldspar. The thin section contains two clasts composed of finer-grained quartz with minor muscovite, chlorite and iron oxide and, in these, there is a marked foliation due to preferred orientation of the micaceous minerals and of elongate quartz grains, however, it is also possible that these may represent a silicified rock in which quartz has replaced a schist. Some of the muscovite is actually included within quartz. Although these clasts are separated by only a few millimetres, the direction of foliation differs in each clast, indicating that there has definitely been some movement.

The clasts vary in size from less than 0.5 mm to over 5 mm and they appear to be haphazardly mixed with no evidence of layering. There are some muscovite flakes and chlorite or chloritized biotite flakes which have been deformed and some of the turbid microcline shows evidence of strain. Some of the coarse-grained quartz has been granulated and partly recrystallized to a finer grain-size but there is one large clast of very coarse-grained quartz which shows no evidence of recrystallization. It is not possible to determine the origin of this breccia from the distribution of clasts and, although a sedimentary origin is possi le, no conclusive evidence was found to confirm this.

Interstices between the clasts contain varying proportions of chlorite and specular hematite with locally trace amounts of fluorite and sideritic carbonate. In zones containing higher concentrations of iron oxide, much of the hematite has clearly filled interstices and penetrated along grain boundaries and, in a few places, it has completely enclosed smaller clasts of quartz, feldspar, muscovite and chlorite or chloritized biotite. Some has also penetrated along fractures in a few of the larger clasts. Some of this hematite occurs as intergrowths of tabular crystals and, in general, these show no evidence of deformation. The pattern of distribution of this hematite strongly suggests that it crystallized in situ from solutions which were moving through the breccia. The polished section shows that pratically all of the iron oxide is specular hematite showing no textural evidence to suggest replacement of magnetite and only in one small area is there a trace of extensively oxidized magnetite.

Conclusion:

There is no conclusive evidence to show whether this breccia was of tectonic or sedimentary origin but the fact that it contains closely admixed clasts, apparently derived from different rock types, indicates that a sedimentary origin is at least possible. It is essentially similar to many of the hematitic breccias in the Radium Ridge Beds in that clasts of quartz and potash feldspar are abundant and the matrix contains moderately abundant chlorite with varying amounts of hematite. It differs from many specimens of hematitic breccia in the Radium Ridge Beds however, in that the hematite is not present throughout the breccia and where it is present in interstices, its mode of occurrence indicates that it has crystallized in situ from solutions which have been moving through the breccia. No satisfactory explanation can be given as to why it is abundant in some zones and absent from others.

Minor amounts of pyrite are closely associated with some of the hematite and, in one area, hematite has apparently crystallized around a group of pyrite crystals.

Sample: P452/76; TS36692
6737 RS 173

AMDEL REPORT MP 1114/77.

Location:
NFM R17/088. Drill hole BFD1 at 30.25 metres, Mt. Painter.

Rock Type:
Acid gneiss (field term leucogranite) with a vein of potash feldspar, chlorite and fluorite. Traces of a mineral of the thorogummite group are present in the vein but not in the gneiss.

Hand Specimen:
The drill core specimen is of a medium-grained, pale pink rock composed predominantly of quartz and feldspar. This is cut by a poorly defined and rather diffuse vein up to 1 cm thick which is predominantly a darker pink feldspar with some green chlorite.

Staining with cobaltinitrite shows abundant potash feldspar along the poorly defined vein and extending from this into adjacent paler coloured gneiss but some zones of the gneiss contain little or no potash feldspar.

Three surfaces and the thin section were autoradiographed. The rock specimens showed a few small spots of radioactivity all of which correspond to portions of the deep pink, feldspathic and chloritic vein. These grains were located and found to be a dull yellowish, crystalline material and one which was removed and investigated by X-ray diffraction was found to have a powder photograph corresponding to that of a member of the thorogummite-uranothorite-thorite group.

Thin Section:
The host rock is a moderately coarse-grained, acid gneiss composed predominantly of quartz and plagioclase with up to 10% biotite and trace to minor amounts of recrystallized leucoxene or sphene and zircon. Unaltered portions of this gneiss have a distinct foliation defined by parallel orientation of the flakes of biotite and this biotite shows some evidence of concentration along thin bands or layers which are parallel to the foliation. These bands containing concentrations of biotite also have concentrations of zircon and of dark leucoxene or sphene. The concentration of zircon crystals and recrystallized leucoxene along two parallel, thin bands or layers is sufficiently great as to suggest that they could have been layers containing concentrations of heavy mineral grains in an original sediment. Although some of the zircon appears to have at least partly recrystallized at least one of the grains still appears to be well rounded.

The diffuse vein is composed largely of microcline showing a slight pink staining and in some places this has penetrated along grain boundaries and has encroached upon and partly replaced some of the plagioclase in the adjacent gneiss. Other zones of plagioclase show only minor veining by the turbid and pink-stained, potash feldspar. As none of the radioactive mineral grains were included in the thin section it has not been possible to determine the relationship of the thorogummite to the potash feldspar.

After crystallization of the potash feldspar there has been a period of fracturing and/or shearing probably accompanied by some migration and recrystallization of quartz. There are now concentrations of chlorite in the fractured zone and chlorite lines many of the more recent, small fractures. Some of this chlorite is associated with forms of a clay-like mineral and these were followed by fluorite which occupies the central zone of some of the small fractures. In the gneissic rock adjacent to the diffuse vein much of the biotite has been partly replaced by chlorite.

Conclusion:

The host rock is an acid gneiss possibly derived from a sediment. The diffuse, reddish vein is composed predominantly of potash feldspar probably of metasomatic origin and at least some of this has encroached upon and partly replaced plagioclase in the adjacent gneiss. Subsequent fracturing along the same zone has been followed by the development of concentrations of chlorite associated with some sericite or clay-like mineral and deposition of late fluorite.

The radioactive mineral is a member of the thorogummite group and it is restricted to the vein but whether it was introduced at the time of formation of the potash feldspar or during later activity resulting in formation of chlorite and deposition of fluorite cannot be determined from the available evidence.

APPENDIX B2

MGD47A

Sample: 6737 RS 1136 (JFD 12/80); TSC30335 ANDEL REPORT GS 1460/81

Location:
Drillhole BFD1 at 32.70-32.77 m

Hand Specimen:
A moderately coarse-grained, dark green micaceous schist containing numerous blebs or small patches of pale grey to almost white silicate, some of which have thin rims of pink feldspar.

Etching with hydrofluoric acid followed by staining with cobaltinitrite shows only a trace of potash feldspar, some of it occuring as thin rims around the pale silicate blebs. These blebs and aggregates have become etched with hydrofluoric and are therefore not quartz. In thin section they are found to be almost entirely plagioclase.

Thin Section:
This is a coarse-grained schist containing a high proportion of orientated flakes of pale orange to pale green mica and most of these flakes have a slightly darker green rim suggesting incipient alteration along grain boundaries. It is either a phlogopite mica or biotite which has been bleached.

The pale-coloured aggregates visible in the hand specimen are composed almost entirely of intergrown crystals of plagioclase which varies in grain size up to 4 mm and some of these plagioclase crystals contain a few small inclusions of quartz. In some areas textures suggest that a little of this plagioclase has been partly replaced by orange-stained potash feldspar and fine-grained muscovite.

The biotite schist contains scattered, partly altered or partly metamict crystals which are either zircon or xenotime and this is about the only accessory mineral present. There are, however, scattered crystals and aggregates of moderately coarse-grained tourmaline which tend to occur in, or along small zones of possible fracturing or shearing and generally the plagioclase adjacent to these aggregates of tourmaline has been partly replaced by orange-stained potash feldspar. There is also a higher concentration of secondary, fine-grained muscovite in the zones containing tourmaline. Some of these zones also contain a trace of fluorite.

Conclusion:
Mica-plagioclase schist showing evidence of only mild metasomatic alteration resulting in minor replacement of some plagioclase by K-feldspar and muscovite and in the crystallization of a little tourmaline.

Sample: 6737 RS 1137 (JFD 13/80)

AMDEL REPORT GS 1460/81

Location:
Drillhole MGD47A at 9.20 m

Identification of the yellowish-green mineral coating joints and occasionally replacing portions of the rock was requested by X-ray diffraction.

X-ray Diffraction:
This gave the following results

Quartz	Dominant
Montmorillonite	Sub-dominant
Kaolinite	Accessory
Calcite	Accessory
Feldspar	Accessory
Muscovite	Trace
Talc	Trace

The phyllosilicate mineral is therefore predominantly montmorillonite with possibly some kaolinite.

Sample: 6737 RS 1138 (JFD 14/10); TSC30337 AMDEL REPORT GS 1460/81

Location:
Drillhole MGD47A at 19.22-19.29 m

Hand Specimen:
A pink, medium-grained rock containing scattered, small dark blebs of iron oxide which tend to be elongated in a common direction suggesting a former foliation. In one area there is a little yellow sulphide probably pyrite and there is also an irregular vein of white carbonate found in thin section to be calcite (stained with alizarin red-S).

Thin Section:
The rock is now composed of a mass of intergrown crystals of turbid and orange to pink-stained microcline. There are scattered aggregates of opaque iron oxide and recrystallized leucoxene, up to 5% of fine-grained muscovite and sericite, traces of monazite, apatite, quartz and chlorite and small veins and patches of calcite. There is also an aggregate of relatively coarse-grained sulphide predominantly, if not entirely, pyrite.

The microcline varies in grain size up to about 3 mm and the crystals are intergrown with very irregular grain boundaries. It shows patchy pale orange staining and most of it is crowded with minute impurities and voids. It has almost certainly crystallized across, and replaced, a pre-existing rock but has not preserved sufficient evidence of texture for this former rock to be identified. It is possible that the iron and titanium now forming scattered blebs or aggregates of iron oxide and rutile or leucoxene were derived from the earlier rock but, except for a suggestion of a foliation these opaque aggregates have not retained any recognizable relict textures. A few apatite crystals (at least 1%) 0.2 to 0.5 mm in size are scattered through the rock but do not show any pattern of concentration and there are also a few scattered scrystals of monazite. Some of the crystals of monazite and apatite are included within larger microcline crystals and there are also scattered inclusions of muscovite and small patches of sericite but it is uncertain whether these patches of mica are a result of alteration or were inherited from the earlier minerals.

There are traces of very fine-grained chlorite along small fractures and calcite is present along small veins and in a few interstices.

Conclusion:
A metasomatically altered rock now composed predominantly of orange-stained microcline. The dark blebs are concentrations of iron and titanium oxides which could have been derived from the earlier rock and the rock also contains traces of apatite and monazite. Late veins contain calcite.

Sample: 6737 RS 1139 (JFD 15/80); TSC30338 AMDEL REPORT GS 1460/81

Location:
Drillhole MGD47A at 25.40-25.47 m

Hand Specimen:
A pale greyish-green, predominantly fine-grained rock with a few scattered fragments or zones of pink feldspar. The rock has a few white carbonate veins found to be calcite by staining the thin section.

Staining with cobaltinitrite shows that the pink feldspar is potash feldspar.

Thin Section:
The rock contains angular fragments of slightly turbid potash feldspar, quartz and larger fragments composed of intergrown quartz, potash feldspar and minor sericite. There are also fragments in which some zones have been replaced by fine-grained chlorite and there are a few fragments now composed almost entirely of chlorite and quartz and in which relict textures show that the chlorite replaced earlier ?feldspar which was intergrown with the quartz. There are clasts in which some of the feldspar shows patchy replacement by chlorite and in some there is a little calcite associated with the chlorite. Some of the feldspar contains a little very fine-grained iron oxide and there are a few small grains of monazite.

The angular grains and larger clasts vary in size from 0.1 mm to over 5 mm and they are surrounded and cemented by a matrix composed mainly of chlorite and calcite. There are one or two fragments of monazite, traces of ?chloritized biotite, a minute trace of muscovite and in the thin section there is one moderately large pyrite crystal almost 1 mm in size. Both clasts and matrix are cut by veins containing calcite and a little quartz.

Conclusion:
Breccia containing clasts of partly chloritized granitic rock with a matrix which is predominantly chlorite and calcite. Both clasts and matrix are cut by a few calcite veins.

Sample: 6737 RS 1140 (JFD 16/80) AMDEL REPORT GS 1460/81

Location:
Drillhole MGD47A at 28.45 m

Hand Specimen:
A pale green rock which was submitted for identification by X-ray diffraction.

X-ray diffraction:
This consists largely or wholly of an interstratified clay with illitic and montmorillonitic components. There appears to be little else present (?trace of calcite). A better interpretation of the interstratified components and their relative proportions would probably be available if additional work (Code MC3) was done.

Sample: 6737 RS 1141 (JFD 17/80); TSC30340 AMDEL REPORT GS 1460/81

Location:

Drillhole MGD47A at 49.16-49.25 m

Hand Specimen:

A pink and dull green, medium-grained to coarse-grained rock with a poorly defined foliation. It is reported to be chloritized basement rock with pink feldspar blebs.

Staining with cobaltinitrite shows patches of potash feldspar.

Thin Section:

The rock contains very variable proportions of potash feldspar, sericite, chlorite, minor quartz and iron oxide, a trace of zircon and/or xenotime and a little secondary or migratory calcite.

The rock has been extensively altered possibly by hydrothermal solutions but relict textures show that it once had a granoblastic texture and the zones or blebs now visible as pink feldspar are areas composed of a mosaic of potash feldspar crystals 0.5 mm to 1.5 mm in size with a few up to 2 mm. Some of these show twinning typical of microcline and they are all, at least slightly turbid. These potash feldspar crystals were once intergrown with other grains of similar size or slightly smaller which have been replaced by a very fine-grained, very pale green mica loosely termed sericite but which may, in fact, be very fine-grained muscovite and there are some areas where some of the grains have been replaced by chlorite but this is present in much lower concentration than the very pale green, secondary mica. There are small grains of quartz in some interstices and there are also films of secondary mica and a few of chlorite along some grain boundaries of potash feldspar. There is no definite evidence from which to determine the identity of the mineral or minerals which have been replaced by mica and chlorite.

Opaque iron oxide comprises up to 5% of the rock occurring as isolated crystals and as groups and a few aggregates. Many of these crystals have an almost square cross section and they may be magnetite or martite. Some similar crystals have been replaced by calcite and contain remnants of opaque material. There are a few small crystals which are either zircon or xenotime.

The rock is cut by a few veins containing calcite and also veins containing both calcite and chlorite. Calcite has also invaded and partly replaced some zones of the rock adjacent to the veins and coarse-grained calcite contains remnants of chlorite, sericite and feldspar.

Conclusion:

A metamorphic rock which may have been a feldspathic gneiss or granulite has been partly replaced by secondary mica (sericite), chlorite and calcite.

Sample: 6737 RS 1142 (JFD 18/80); TSC30341 AMDEL REPORT GS 1460/81

Location:
Drillhole MGD47A at 62.29-62.33 m

Hand Specimen:
A grey, fine-grained rock reported to be fine-grained biotite metasediment.

Thin Section:
This rock once contained up to 50% of feldspar intergrown with lesser biotite and quartz and much of the feldspar had a grain size of 0.2 to 0.4 mm. Quartz and feldspar were intergrown with straight to curved grain boundaries giving the rock a granoblastic texture which was interrupted by flakes of biotite orientated in various directions. The feldspar has been completely replaced by very fine-grained clay minerals and sericite but in general, the earlier texture has been preserved. There are a few places where relict textures in the altered feldspar grains suggest cleavage and/or twinning planes but these are not sufficiently clear for the identity of the feldspar to be determined. The biotite flakes have been almost completely replaced by chlorite but in some there are small remnants of brown biotite interleaved with the chlorite.

Grains and aggregates of leucoxene or very fine-grained sphene associated with remnants of opaque oxide are scattered throughout the rock and vary in size from 0.05 mm to about 0.5 mm long. These are not concentrated in any particular zone or layer but are distributed fairly uniformly. There are also a few crystals of apatite up to 0.6 mm in size and a few groups and aggregates of apatite crystals up to 1.5 mm in size. Some of these are associated with migratory calcite and it is possible that this apatite has also migrated and recrystallized. However, it does not occur in any recognizable veins. There are a few small patches of calcite occurring mainly in interstices and there are also concentrations of calcite discontinuously along small fractures or shearing planes.

Conclusion:
Feldspar-biotite "hornfels" in which the feldspar has been completely replaced by clay and sericite and the biotite has been replaced by chlorite. There are slightly anomalous amounts of iron-titanium oxide and apatite and also a little migratory calcite.

Sample: 6737 RS 1143 (JFD 19/80); TSC30342 ANDEL REPORT GS 1460/81.

Location:

Drillhole MGD47A at 77.25-77.35 m

Hand Specimen:

A medium-grained rock containing pink, white, grey and green minerals and showing a weak foliation. The general appearance suggests complex alteration and some parts of the rock are friable due to the presence of clay-like minerals. This is reported to be altered gneissic basement submitted for detail description of the alteration.

Staining with cobaltinitrite shows some patches of potash feldspar.

Thin Section:

The remnants of unaltered rock are composed mainly of potash feldspar and quartz with minor opaque oxide and leucoxene and also small groups of zircon (or xenotime?) crystals. Textures suggest a medium-grained metamorphic rock with probably a granoblastic texture but quartz has migrated and recrystallized and some of it is now relatively coarse-grained with optically continuous patches over 5 mm long. These patches of quartz tend to be elongate in the direction of weak foliation but this is not strongly developed and this coarse-grained quartz now shows evidence of strain and incipient granulation. It encloses a few small crystals and aggregates of potash feldspar.

Potash feldspar varies in grain and some of it forms granoblastic aggregates with a grain size of 0.5 to 1.5 mm. This potash feldspar is intergrown with crystals of similar size which have been completely replaced by clay minerals, sericite and chlorite and the general form of alteration appears to be similar to that in sample 6737 RS 1141. Clay and sericite have replaced the bulk of these crystals and chlorite tends to be concentrated along grain boundaries and possible small fractures. Relict textures are not sufficiently well preserved for the altered crystals to be identified but feldspar, e.g., plagioclase, is one possibility. These altered crystals have also been invaded by small patches of calcite and there is calcite concentrated along some irregular and discontinuous veins and possible shearing planes. There are one or two small areas with chlorite showing relict textures probably inherited from flakes of biotite but these do not appear to have been abundant.

There are a few altered crystals of iron-titanium oxide 0.4 to 0.8 mm in size which now contain some leucoxene or sphene and a few altered opaque crystals now contain calcite generally associated with a little fine-grained sphene or leucoxene. There are a few small crystals of zircon, some enclosed, or partly enclosed, by the moderately coarse-grained quartz and two crystals of zircon up to 0.5 mm in size which have been fractured and the fragments displaced. There are a few small crystals of apatite.

Conclusion:

A weakly foliated metamorphic rock which could have been a granitic gneiss. Silicates, probably mainly feldspar, have been replaced by sericite and clay minerals, minor chlorite and minor calcite. The alteration is generally similar to that in samples 6737 RS 1141 and 1142 but the former rock was coarser-grained.

Sample: P166/76 6737 RS 1152 ANDEL REPORT MP 3339/76.

Applicant's Mark and Location:
MGD 47A. Drill hole MGD47A Radium Ridge latitude 30° 13'23" longtitude 139° 20'56". DEPTH UNKNOWN

The drill core sample contains some granitic or pegmatitic rock composed of pink feldspar and quartz and this is in contact with or has been invaded by a dark mass containing some chlorite. Joint surfaces are coated with a soft, pale green, clay-like mineral with a shining lustrous surface with a suggestion of slickensides. Identification of the pale green mineral was requested.

X-ray diffraction of the pale green mineral showed that it is a dioctahedral illite (type 1M) possibly somewhat interstratified.

The dark green chloritic mineral was confirmed as chlorite.

The hand specimen also contains a trace of purple fluorite.

<u>APPENDIX B3</u>

MGD151

Sample P315/76; TS36297 6737 RS 163 AMDEL REPORT MP304/77.

Location:

MGD 151 5m.

Hand Specimen:

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

Thin Section:

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

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

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

Conclusion:

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

Sample P316/76; TS36298 6737 AS 164 AMDEL REPORT MP304/77.

Location:

MGD 151, 6.7 m.

Hand Specimen:

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

Thin Section:

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

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

In other parts of the section finer grained quartz (2.0 to 3.0mm) is intergrown with crystals of a former mineral which has been replaced by sericite and this in turn has been stained by very fine grained hematite. Some relict textures in the sericitic material suggest former cleavage planes or twinning planes and almost certainly this represents altered plagioclase. The rock also once contained some biotite flakes or aggregates up to 6.0 mm. long and these have been replaced by white mica, clay and leucoxenic material stained by varying amounts of brown iron oxide. The texture of the former biotite has been moderately well preserved.

Conclusion:

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

Sample: 6737 RS 1144 (JFD 20/80); TSC30343 AMDEL REPORT GS 1460/81

Location:

Drillhole MGD151 at 8.58-8.64 m

Hand Specimen:

A medium-grained, banded gneiss containing very pale pink feldspar, dark mica, relatively minor quartz and grains which have been replaced by dark brownish-red material. These reddish grains are now very soft and occur in varying concentrations in different zones or layers. Much of the rock is very friable.

Thin Section:

The banded gneiss contains abundant microcline with a common grain size of 1 to 2 mm intergrown with varying proportions of quartz, subparallel flakes of partly altered biotite and grains 0.5 to 2 mm in size which have beem completely altered. Some of these altered grains have a roughly rectangular cross section and a few of the smaller ones are included in larger microcline crystals. They have been completely replaced by sericite possibly associated with other clay minerals and are stained by extremely small crystals or particles of dark red to reddish-brown iron oxide probably mainly hematite but possibly also including some goethite. In some of these altered crystals small aggregates of a very fine-grained iron oxide are concentrated along parallel planes which were either cleavage planes or twinning planes and there are also other relict textures in the fine-grained sericite/clay which suggest the former presence of cleavage and/or twinning. These altered crystals were almost certainly feldspar and may have included some plagioclase. Many are in sharp contact with unaltered microcline and clearly they have been more susceptible to alteration to sericite and clay than the microcline which also suggests the possibility of plagioclase but in a few places small veinlets of similar sericitic material are present in microcline.

The biotite flakes in this rock have been partly altered and slightly expanded probably due to the formation of some clay mineral and they are also stained by very fine-grained iron oxide which is concentrated along some cleavage planes and grain boundaries.

Accessory minerals in this rock include a few crystals of opaque iron-titanium oxide or iron oxide and a few of zircon.

Conclusion:

Granitic gneiss in which some feldspar, probably plagioclase, has been preferentially replaced by sericite and possibly other clay minerals stained by extremely fine-grained iron oxide, some of which is concentrated along former cleavage and/or twinning planes.

Sample: P317/76; TS36299   - 6737 RS 165 AMDEL REPORT MP304/77.

Location:

MGD 151, 10.3 m.

Hand Specimen:

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

Thin Section:

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

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

Quartz and feldspar or altered feldspar crystals commonly 1.5 - 3.0 mm. in size are intergrown with smooth to slightly curved grain boundaries giving a texture typical of that of metamorphic rocks. Biotite and altered biotite occur as elongate aggregates mainly along grain boundaries and these aggregates are sub-parallel to the foliation, although the constituent flakes vary in orientation. Some of the quartz also occurs as elongate aggregates parallel to the foliation and many of the feldspar crystals are also slightly elongated in this direction. The section includes portion of a large porphyroblast of microcline 12.0 mm. in size and this contains a few inclusions of quartz and a few very small inclusions of sericitized plagioclase, mainly near the boundary. The large porphyroblast is cut by numerous small ?tension joints which are almost at right angles to the direction of foliation and these contain traces of sericite or clay. There are a few small zircon grains occurring mainly in aggregates of biotite but one small crystal was found included in altered feldspar.

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

Conclusion:

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

Sample P318/76; TS36300 *6737 AS 166 AMDEL REPORT MP304/77.*

Location:

MGD 151 at 14.1 m.

Hand Specimen:

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

Thin Section:

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

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

Conclusion:

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

Sample P319/76; TS36301   6737 RS 167   AMDEL REPORT MP 304/77.

Location:

MGD 151 at 24.3 m.

Hand Specimen:

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

Thin Section:

This is similar to specimen 318/76 in texture and grain size and in the occurrence of quartz and sericitized plagioclase but it differs from P318/76 in that much of the microcline has also been extensively altered and has been replace by clay minerals, sericite and locally by some moderately fine grained quartz.. Biotite has been completely replaced by white mica stained by iron oxide. Some quartz grains are surrounded by irregular fringes of secondary overgrowth quartz which has penetrated the surrounding, altered feldspar.

Conclusion:

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

Sample P320/76; TS36302 6737 RS 168 AMDEL REPORT MP304/77.

Location:

MGD 151 at 38.2 m.

Hand Specimen:

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

Thin Section:

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

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

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

Conclusion:

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

Sample P321/76; TS36303   6737 RS 169   AMDEL REPORT MP 304/77.

Location:

MGD 151 at 45.4 m.

Hand Specimen:

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

Thin Section:

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

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

Conclusion:

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

Sample P311/76; TS36293 & TS36482   6737 AS 159   AMDEL REPORT MP 304/77.

Location:

MGD 151 at 94.28 to 94.44 m.

Hand Specimen:

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

Thin Section:

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

Some of the larger clasts are of moderately fine grained quartz-feldspar-biotite gneiss containing 2-3% iron oxide. Most of the feldspar in this gneiss has been replaced by sericitic material or clay and in general appearance this rock is very similar to the altered feldspathic gneiss of sample P312/76. Some of these clasts are angular but the largest clast (6 cm. long) appears rounded or corroded. The outer bleached or altered zone in this large clast contains little or no sericite and its place has been taken by patches of turbid, possibly secondary microcline with a common grain size of 0.2 to 0.6 mm. and this is now intergrown with some quartz and aggregates of stained and altered biotite. Some of the microcline contains scattered crystals and aggregates of fine grained iron oxide, probably magnetite or martite. There are also a few small aggregates of fine grained, recrystallized leucoxene.

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

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

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

Conclusion:

This breccia is composed predominantly of clasts of sericitized quartz-feldspar-biotite gneiss and of metasomatic rock now containing abundant turbid microcline and an anomalous amount of iron oxide. It is possible that the metasomatic, microcline-rich rock represents altered portions of the gneiss as an altered and bleached border zone of one large clast shows a similar composition. The matrix is predominantly brown-stained, altered biotite and/or chlorite. There is no absolutely conclusive evidence from which to determine the origin of this breccia but there is certainly some evidence of tectonic fracturing.

Sample P312/76; TS36294 6737 RS 160 AMDEL REPORT MP304/77.

Location:

MGD 151 at 94.73 m. Mount Gee East Prospect.

Hand Specimen:

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

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

Thin Section:

A visual estimate of the constituents is as follows:

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

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

Sample: 6737 RS 1145 (JFD 21/80); TSC30344 AMDEL REPORT GS1460/81

Location:

Drillhole MGD151 at 99.38-99.48 m

Hand Specimen:

A breccia containing clasts of pale grey quartz, some of quartz-feldspar rock and some of granitic gneiss very similar to sample 6737 RS 1144. There are also a few patches of moderately coarse-grained biotite which may be deformed biotite schist. The matrix is pale orange clay-like material stained by iron oxide.

Thin Section:

In the area sectioned there are numerous angular clasts varying greatly in size from 0.5 mm to over 15 mm and they include coarse-grained quartz, potash feldspar, extensively sericitized gneissic rock, now mainly quartz, sericite and iron oxide, and some deformed, coarse-grained biotite schist. There is portion of one large clast composed mainly of quartz, mica (biotite and muscovite), calcite and minor potash feldspar. There is one area of granitic gneiss in which some grains (plagioclase?) have been replaced by sericite.

The matrix is mainly extremely fine-grained muscovite or sericite with very small grains, aggregates and streaks of iron oxide and a few scattered, generally deformed flakes of muscovite and biotite, possibly derived from clasts of schist. The sericite is lightly stained by iron oxide and may include other clay minerals but determination of its exact mineral composition would require X-ray diffraction. There are a few small patches of calcite in the matrix.

Conclusion:

Breccia containing clasts of altered or partly sericitized granitic gneiss (similar to 6737 RS 1144), some coarse-grained quartz, quartz-feldspar rock and biotite schist. The matrix is mainly sericite or very fine-grained muscovite possibly associated with other clay minerals and it is lightly stained by iron oxide. There are a few small patches of calcite in the matrix. No evidence was found to suggest a chloritic matrix.

Sample: 6737 RS 1146 (JFD 22/80); TSC30345 ANDEL REPORT GS 1460/81.

Location:

Drillhole MGD151 at 139.00-139.19 m

Hand Specimen:

Some zones in the rock contain medium-grained quartz, a little pink feldspar and moderately abundant dark reddish grains similar to the sericitized and stained feldspar found in the previous few samples. These zones have a granoblastic texture and are almost certainly metamorphic rock. In this length of drill core there are also small intersecting veins and irregular areas 2 to 3 cm in size which contain relatively high concentrations of pale pink feldspar found by staining with cobaltinitrite to be potash feldspar In places, these zones of pale pink feldspar appear to have encroached on the granoblastic metamorphic rock containing dark reddish grains.

Thin Section:

The finer-grained zones in the rock contain over 40% of grains which have been replaced by sericite stained by very fine-grained iron oxide and they show relict textures inherited from cleavage and/or twinning. These are very similar to the sericitized grains in sample 6737 RS 1144 and may have been predominantly plagioclase but there are also a few corroded remnants of microcline in some of the areas of sericite indicating that it has also replaced some of the potash feldspar. These sericitized grains are intergrown with quartz and a little altered mica and this area of rock has a granoblastic texture with possibly a very weak foliation due to orientation of mica flakes. There is a trace of zircon. This metamorphic rock has a common grain size of 1 to 2 mm.

The sericitized metamorphic rock has been locally fractured and sheared or crushed and the fractured zone is now cut by veins and patches of quartz which, in places, has crystallized across the earlier rock and now contains clouds of tiny iron oxide and possibly other inclusions.

In some zones the rock is now composed predominantly or almost entirely of large microcline crystals 3 to 6 mm in size which are intergrown with very irregular grain boundaries and in places there is a little quartz in interstices. Many of these large microcline crystals contain small patches and inclusions of fine-grained muscovite which does not appear to be related to present cleavage planes, twinning planes or fractures although there are areas where this muscovite is concentrated along thin, parallel lines or planes. Some of these parallel planes of fine-grained muscovite continue without interruption across boundaries between two and sometimes three microcline crystals which suggests that this coarse-grained microcline crystallized across a pre-existing rock, remnants of which are represented by these lines and small patches of fine-grained muscovite.

The rock has been fractured after crystallization of this coarse-grained microcline and some slightly deformed microcline crystals are now cut by small veins of quartz. There is also an interstitial area of calcite which locally has invaded microcline and this calcite contains lines and aggregates of fine-grained iron oxide.

Conclusion:

The less-altered zones are sericitized granitic gneiss probably similar to sample 6737 RS 1144 and this is interrupted by zones and vein-like patches in which the rock has been replaced by masses of relatively coarse-grained, turbid microcline. The rock has been fractured after crystallization of this coarse-grained microcline which, in places, is now veined by quartz and also contains some secondary calcite.

Sample: P322/76; TS36304 6737 RS 170 AMDEL REPORT MP304/77.

Location:

MGD 151 at 150.2 m.

Hand Specimen:

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

Thin Section:

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

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

Conclusion:

The sample contains breccia in contact with underlying quartz-feldspar-biotite gneiss and in a zone adjacent to the contact the gneiss contains an anomalous amount of monazite. Material in the breccia shows evidence of tectonic stress but no recognizable evidence to suggest a sedimentary origin.

Sample: P323/76; TS36305   6737RS/71   AMDEL REPORT MP 304/77

Location:

MGD 151 at 151.1 m.

Hand Specimen:

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

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

Thin Section:

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

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

Conclusion:

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

Sample: 6737 RS 1147 (JFD 23/80); TSC30346   AMDEL REPORT GS 1460/81

Location:

Drillhole MGD151 at 154.00-154.16 m

Hand Specimen:

A medium-grained rock containing abundant salmon-pink feldspar intergrown with quartz and relatively minor dark mica. There are a few corroded, leached zones or voids up to 2 cm long in which there are projecting crystals of quartz, pink feldspar and specular hematite. In parts of the rock there is a suggestion of a very weak foliation due to the presence of some sub-parallel, elongate aggregates of quartz and feldspar but this is not strongly developed.

Thin Section:

The rock contains over 70% of turbid, pink-stained microcline, lesser quartz and traces of opaque iron oxide, zircon and rutile probably representing recrystallized leucoxene.

The microcline is of variable grain size up to 6 mm and the crystals are intergrown with very irregular boundaries. It shows patchy turbidity and staining and the general impression is that it has crystallized across an earlier rock. Some of the microcline contains a few small inclusions of zircon and at least one of these appears to have been fractured, the portions displaced and these fragments included in the coarse-grained, turbid microcline. A little opaque iron oxide is also included in some microcline.

Quartz tends to occur as subparallel, elongate aggregates and some of this has clearly crystallized after the microcline. Both microcline and quartz have been subsequently deformed and the quartz now shows extensive strain with some small areas where it has been granulated to a finer grain size. Microclir also shows evidence of strain and there are subparallel zones of finer-grained microcline which has probably recrystallized under the conditions of tectonic stress. Where iron oxide is now closely associated with, or included in quartz it has recrystallized to aggregates of specular hematite and there are groups of zircon crystals associated with some of this hematite. There may also be a trace of monazite but confirmation of this is beyond the scope of the present investigation. In a few places, some specular hematite crystals have been replaced by quartz and only the outline of the former crystals has been preserved. Some of the quartz contains a few small inclusions of microcline and in some places where it is in contact with microcline there are small overgrowths of clear microcline which have tended to develop crystal boundaries now surrounded by the quartz.

A careful search of the coarse-grained microcline showing patchy staining did not reveal any definite relict textures but in some of the larger crystals there are a few small areas of clear microcline with different optical orientation and in one there are two rhomb-shaped "voids" 0.5 and 0.6 mm in size which have been filled by quartz. One small inclusion of apatite was found and, as noted above, there are a few groups of zircon grains included in the microcline.

Conclusion:

Feldspathic gneiss which has almost certainly been metasomatically altered and both microcline and quartz are probably secondary. Textures suggest that the quartz crystallized after the microcline and both have been at least slightly deformed.

Sample: 6737 RS 1148 (JFD 24/80); TSC30347 AMDEL REPORT GS 1460/81

Location:

Drillhole MGD151 at 166.82-166.97 m. Reported to be ?chloritized clasts from chloritic breccia for complete description of alteration.

Hand Specimen:

A medium-grained to moderately coarse-grained rock with a mottled appearance containing quartz, pink and white ?feldspar and also many small dark green chloritic patches.

Staining with cobaltinitrite shows up to 20% potash feldspar.

Thin Section:

The area sectioned now contains at least 50% of quartz, lesser fine-grained muscovite or sericite and chlorite and relatively minor (less than 15%) potash feldspar but there are some other areas in the rock which contain slightly more potash feldspar. There are traces of opaque oxide and zircon.

Textures suggest that this rock has been subjected to extensive metasomatic alteration and quartz has been the last mineral to be introduced, migrate and/or recrystallized and clearly it has invaded and partly replaced portions of the other minerals. It now forms aggregates 2 to 10 mm in size and some large strained and partly recrystallized grains. Patches of secondary or migratory quartz contain inclusions of fine-grained muscovite, patches of chlorite and small corroded remnants of microcline and there are areas where quartz has clearly invaded and partly replaced aggregates of microcline and also of chlorite.

In areas not replaced by quartz, there are a few remnants of moderately coarse-grained, turbid microcline intergrown with former crystals which have been replaced by varying proportions of sericite or fine-grained muscovite and chlorite. Similar chlorite and fine-grained muscovite have also invaded some of the microcline grains and it is not certain whether the grains which have been completely replaced by fine-grained muscovite and chlorite were plagioclase or other areas of potash feldspar. There were at least a few sub-rectangular crystals up to 4 mm long which have been replaced by chlorite and lesser sericite and in these there is a little very fine-grained iron oxide probably hematite, some of which outlines former cleavage planes in the earlier, coarse-grained feldspar.

The turbid potash feldspar was almost certainly of metasomatic origin and some of it contains groups of small iron oxide crystals mainly concentrated along one thin band and there are also a few small inclusions of zircon and one larger (0.5 mm) inclusion of apatite. This apatite crystal has an outer zone with a concentration of tiny voids and/or other inclusions.

Conclusion:

This rock has had very complex history of metasomatic alteration. It contains turbid microcline which almost certainly replaced portions of an earlier rock and may have been intergrown with plagioclase and/or other silicate. At some stage in the history of the rock feldspar and possibly also a little mica was extensively replaced by fine-grained chlorite associated with fine-grained muscovite and sericite. These were then invaded and partly replaced by migratory or secondary quartz.

Sample: 6737 RS 1149 (JFD 25/80); TSC30376 AMDEL REPORT GS 1460/81.

Location:
Drillhole MCD151 at 212.34-212.47 m

Hand Specimen:
The sample contains bands or layers 1 to 2 cm thick of brownish-red, fine-grained hematitic siltstone alternating with bands or layers of coarser-grained hematitic breccia in which there are fragments and aggregates of specular hematite and also moderately abundant quartz. In one area some hematitic breccia is cut off sharply by a band of fine-grained hematitic siltstone.

Staining with cobaltinitrite does not show any potash feldspar.

Thin Section:
The zones of coarser-grained breccia contain crystals and angular fragments of specular hematite varying in size from 0.05 mm to 1.5 mm long, some grains or fragments composed of very fine-grained sericite and some fragments of coarse-grained quartz. In at least one band there are fragments composed of fine-grained clay. There are also a few small fragments of monazite and one larger monazite chip 0.8 mm long, and a few flakes and small aggregates of muscovite which could have been in some altered ?feldspar. There is one large fragment of coarse-grained quartz containing a local concentration of specular hematite and a trace of carbonate. In one band of breccia there is an elongate zone 5 to 6 mm long containing contorted and altered mica now predominantly sericite or secondary muscovite stained by iron oxide and with thin lines of iron oxide along possible former cleavage planes but the material has been so extensively altered and deformed that its origin is uncertain. It contains a trace of rutile.

In general, the texture in the coarse-grained breccia bands appears chaotic with no regular or recognizable pattern. In one of the bands the matrix is predominantly sericite and clay more or less heavily stained by very fine-grained red to reddish-brown iron oxide but in another band or zone, there is an abundance of secondary quartz which has replaced much of the matrix and now contains clouds of impurities mainly sericite, clay and very fine-grained iron oxide. Some of this quartz has formed as optically continuous overgrowths of clastic quartz grains and fragments and the outline of the former clastic grain or fragment is generally defined by a film or concentration of very fine-grained iron oxide. Fragments of specular hematite, fragments of monazite, a few flakes of muscovite and patches of sericite are all included in a mass of intergrown secondary quartz crystals which have invaded and partly replaced some zones or bands in the hematitic breccia.

The finer-grained siltstone layers have also been extensively replaced by a mass of intergrown quartz crystals. They contain small fragments of hematite and a few angular chips of monazite, many of them less than 0.05 mm in size and relict textures suggest that there were also a few angular fragments of quartz varying in size from less than 0.05 mm to 0.2 mm. There are small patches or remnants of clay and sericite but it is not possible to determine whether these were clastic grains or portion of the earlier matrix. Most of the patches of sericite and clay are stained by very fine-grained reddish-brown iron oxide and this is also present in the secondary quartz which has replaced much of this siltstone. In the finer-grained siltstone bands there are a few larger clasts averaging about 0.5 mm in size but varying up to 1.5 mm and these include coarse-grained quartz, specular hematite, fragments composed of sericite and one or two composed of fine-grained chlorite. There are also a few former ?crystals with sub-rectangular shape which have been replaced by secondary quartz.

In general, there is no definite pattern in the siltstone layers but there is one band in which there could be graded bedding as there is a zone 4 to 5 mm thick containing moderately large clasts of quartz and specular hematite up to 1 mm long grading into the finer-grained siltstone without any apparent sharp division or break and the finer-grained siltstone contains a few of the larger fragments. In the coarser-grained zone in this layer, some of the elongate fragments of specular hematite and also a few of elongate fragments of quartz and monazite show a preferred orientation parallel to the banding in the rock. The coarser-grained zone has now been extensively replaced by secondary quartz but the outline of many fragments is well preserved by iron oxide staining and the specular hematite fragments remain unaltered. Relict textures defined by the iron oxide staining show that some of the grains were probably rounded or had rounded corners indicating abrasion and the manner in which these grains are packed suggests that they were transported and deposited in fluid but there is no means of determining whether this was in a large body of water or in voids and fractures in a breccia. Unfortunately, much of the original texture has been at least partly obliterated by silicification.

Conclusion:

Layers of hematitic breccia alternate with layers of hematitic siltstone and both of these contain fragments of hematite, quartz, grains composed of sericite, clay and minor chlorite, traces of muscovite and a few angular fragments of monazite. There is some evidence to suggest that there may have been an early matrix composed predominantly of sericite stained by extremely fine-grained iron oxide but throughout most of the area examined the matrix and also some of the grains and clasts have been replaced by secondary quartz. Relict textures show that some grains were partly rounded by abrasion and almost certainly the material in the finer-grained layers was transported and deposited by fluid. There is, however, no way of determining whether this was in a large body of water or in fractures or voids in a breccia.

Sample: 6737 RS 1150 (JFD 26/80); TSC30375 AMDEL REPORT GS 1460/81.

Location:

Drillhole MGD151 at 253.88-254.00 m

Hand Specimen:

A moderately coarse-grained rock containing patches of brown biotite intergrown with patches and blebs of white quartz. There is a weak foliation which has probably been modified by crystallization of the quartz. Description and identification of the quartz blebs was requested with emphasis on the possibilit that the quartz may have replaced sillimanite.

Staining of the sample with cobaltinitrite shows a few moderately large patches of potash feldspar between some of the quartz blebs and most of these zones of potash feldspar contain oriented inclusions of mica.

Thin Section:

All of the mica schist has been altered to some degree but the evidence in least altered zones suggests that it is a medium-grained schist containing pale brown biotite, fine-grained quartz (grain size 0.1 to 0.3 mm) and some feldspar but in many zones the ?feldspar and/or other silicate has been replaced by sericite which also occurs as thin films along all grain boundaries. There are zones in the rock which contain moderately coarse-grained to finer-grained microcline and there are at least a few large areas or crystals of optically continyous microcline up to 5 mm in size which contain numerous inclusions of bleached biotite and quartz but it is possible that these are relatively large porphyroblasts of microcline. There has been some deformation of the rock after crystallization of this microcline and some of it has been subsequently replaced by sericite. Many of the microcline crystals now have thin veins of sericite particularly in zones where the crystals have been deformed. This biotite schist contains a few small crystals of zircon which tend to occur in groups and some are included in biotite, some in microcline.

There is one area in the rock where mica, probably mainly bleached biotite but possibly including some muscovite, shows radiating and flamboyant textures but no remnants of sillimanite were found in these zones and therefore it cannot be seriously suggested that this mica replaced sillimanite.

The rock has been invaded by quartz which now forms numerous interconnected veins and blebs generally 2 to 4 mm thick but coalescing in places to form patches of quartz 5 mm x 10 mm. Where this is in contact with the schist it has clearly penetrated the earlier rock engulfing small remnants of this schist which are now represented by inclusions of biotite and sericite and a few of biotite and microcline. Calcite is associated with this quartz in places and in one zone there are some crystals of potash feldspar grading to a vein of microcline which cuts the schist. There is also a vein of calcite cutting both coarse-grained quartz and biotite schist.

Some of the quartz contains lines and planes of minute voids, a few of which can be seen to have barely visible fluid inclusions and there are also the few mineral inclusions noted above. A careful search did not show any remnants or relict textures to suggest the former presence of sillimanite in the zones now composed of quartz or in any other areas of the rock but in one area there are a few very small fibrous inclusions of rutile in the quartz.

Conclusion:

Deformed and partly altered biotite schist has been invaded and extensively replaced by blebs and patches of quartz. There are also patches of microcline but the relationship of the microcline to the schist is not absolutely clear. No evidence could be found to suggest the former presence of sillimanite and almost certainly the quartz blebs are not pseudomorphs after sillimanite.

Sample P313/76; TS36295 6737RS 161 AMDEL REPORT MP304/77

Location:

MGD 151 at 256.3 m.

Hand Specimen:

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

Thin Section:

A visual estimate of the constituents is as follows:

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

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

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

Conclusion:

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

Sample: 6737 RS 1151 (JFD 27/80) AMDEL REPORT GS 1460/81.

Location:

Drillhole MGD151 at 261.08 m

This was submitted as a possible ?tremolite vein from schistose basement and identification of the vein mineral by X-ray diffraction was requested

X-ray Diffraction:

This gave the following results:

Laumontite	Dominant
Calcite	Accessory
Montmorillonite	Accessory

Conclusion:

The vein is predominantly laumontite.

Sample: P314/76; TS36296 6737 RS 162 AMDEL REPORT MP 304/77.

Location:

MGD 151 at 266.5 m.

Hand Specimen:

A massive, dull yellowish-green to olive-green rock composed largely of moderately coarse grained biotite. Through this mass of biotite there are patches of very pale-green, translucent and "waxy" clay 3.0 to 8.0 mm. in size. There is no evidence of a foliation in the hand specimen.

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

Thin Section:

A visual estimate of the constituents is as follows:

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

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

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

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

Conclusion:

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

Sample P324/76; TS36306 6737 RS 172 AMDEL REPORT MP 304/77.

Location:

MGD 151 at 289.9 m.

Hand Specimen:

A pale pink to pale brown, fine grained rock with numerous altered patches now composed of pink-stained clay. This clay swells on contact with water.

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

X-ray diffraction:

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

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

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

Thin Section:

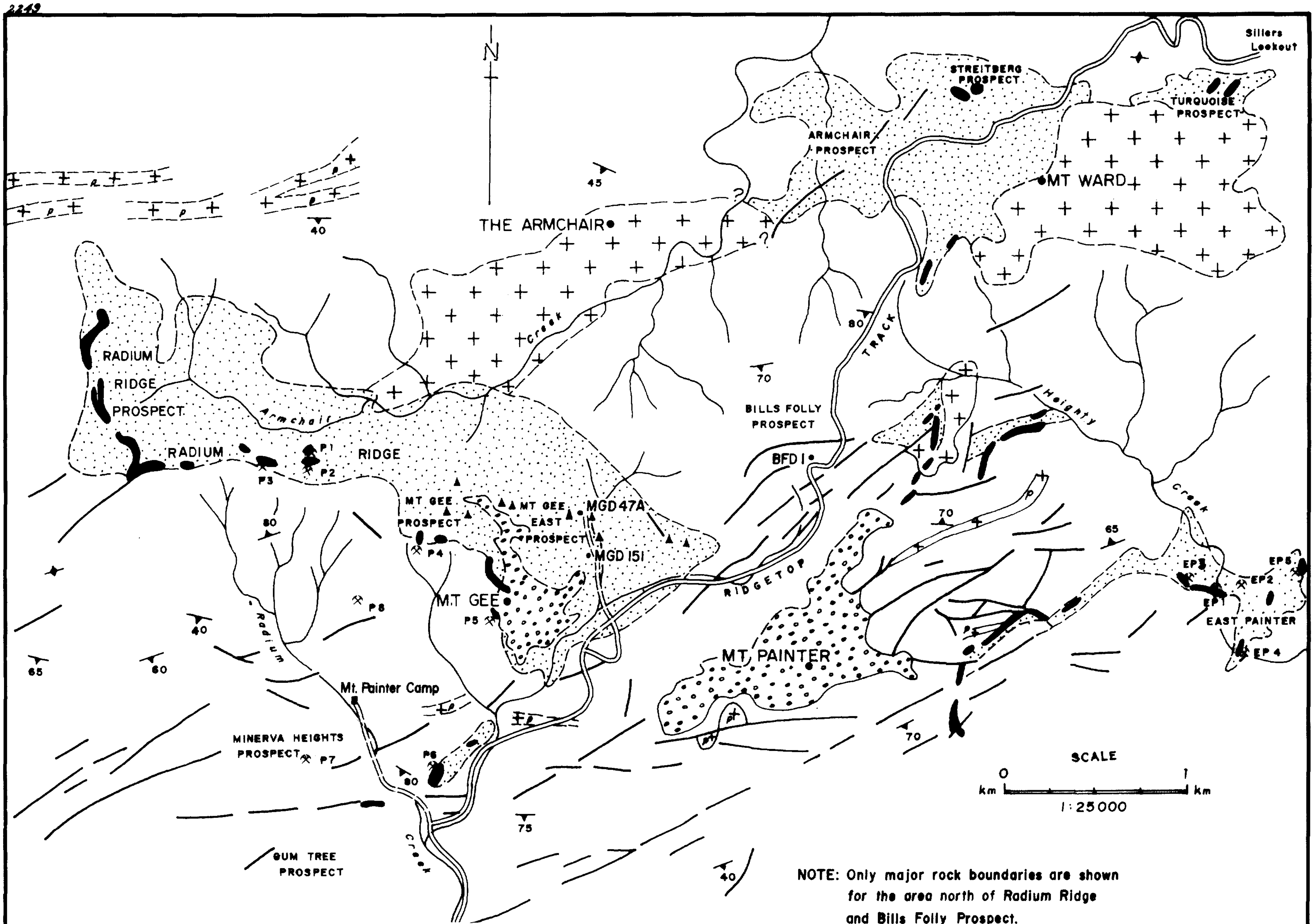
In addition to the minerals identified by X-ray diffraction the thin section shows a trace of microcline.

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

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

Conclusion:

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



NOTE: Only major rock boundaries are shown for the area north of Radium Ridge and Bills Folly Prospect.

LEGEND

PALAEOZOIC or YOUNGER

MOUNT GEE UNIT (formerly Mount Gee Beds):
layered quartz – hematite;
hematitic breccia

MASSIVE GRANITIC BRECCIA (formerly Radium Ridge Beds):
breccias of predominantly local clasts
? Sturtian ? Tillite

ORDOVICIAN

"YOUNGER GRANITE SUITE":
undifferentiated microcline - quartz granitoid
pegmatite

MIDDLE PROTEROZOIC

BASEMENT:
undifferentiated granite of the "OLDER GRANITE SUITE" and metasediments of the RADIUM CREEK METAMORPHICS.

Faults and Fault Breccia

Diamond Drillholes
- BFD 1
- MGD 47A
- MGD 151

Uranium Workings: Painter — P
East Painter — EP

Geological Boundary: Observed
Approximate or Inferred

Gneissosity / Schistosity — 70

FIG. 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

MOUNT PAINTER AREA
DIAMOND DRILLING PROGRAMME 1976
GENERALISED LOCAL GEOLOGY AND DRILL HOLE LOCATIONS

COMPILED J.F.D.
DRAWN E.C.
DATE 8/12/80
CHECKED
CDO DATE
SCALE 1:25,000
PLAN NUMBER 80-859