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Samples: RB83101, RB83102, RB83107A,B,E,F, RB83105, RB83103, RB83114, TL8347, TL8349.

Summary

1) Andesite porphyry: RB83101, RB83102.

These are strongly porphyritic rocks of similar andesitic composition and are probably subvolcanic intusive rocks. Plagioclase forms euhedral phenocrysts crowded in a fine grained plagioclase groundmass (mineralized with biotite). Hornblende phenocrysts also occur and these are almost completely altered to biotite (same biotite as the groundmass),chlorite and actinolite. They are similar in texture and composition to samples 8302-313,367,370 previously submitted.

2) Andesitic pyroclastics: RB83103, RB83105.

RB83103 is a volcanic breccia consisting of andesite and plagioclase fragments in a fine grained plagioclase matrix. Moderate to intense biotite and epidote mineralization has occured in the matrix and minor alteration has occured in the fragments.

RB83105 is a laminated tuff consisting of very fine plagioclase and quartz fragments in an extremely fine grained plagioclase matrix. Biotite mineralization has occured throughout the matrix but is concentrated somewhat in some bands. Epidote mineralization occurs in some bands and this gives some bands their dark colour. Light layers tend to be free of fragments.

3) Rhyolite: TL8347, TL8349.

These are crumbly,vuggy,white volcanic rocks consisting mainly of quartz and K-spar with lesser plagioclase.

(continued)

Summary (cont.)

Quartz occurs in a system of vuggy veins surrounding fragments of the rhyolite in sample TL8347. There is a flow texture to the K-spar grains in this sample. In sample Tl8349 the quartz occurs in spherulitic patches,vein-like patches and in vugs. The K-spar forms feathery grains forming a spherultic aggregate around the quartz or around the plagioclase.

These rocks are either (a) viscous rhyolitic volcanic rocks which have collapsed into themselves during cooling with subsequent formation of quartz (and K-spar in TL8349) or (b) rocks which have been brecciated and completely altered by silica and K-spar.

In view of the contact relationships described below,the latter hypothesis may be preferable. The original rock could be the "rhyodacite".

There is a montmorillonite-like clay in sample TL8347 but this is probably late forming associated with limonite.

4) Rhyolitic volcanic breccia: RB83114 (RB83107A, RB83107B, RB83107F)

RB83114 consists of andesite,plagioclase and some quartzitic fragments in a very fine grained matrix consisting mainly of K-spar and FE-Ti oxides. Biotite is lacking in this sample. Some of the fragments are highly altered to epidote and chlorite. Fine epidote is disseminated in the groundmass and is concentrated in bands (due to slightly different fragment and matrix composition? - compare sample RB83103)

RB83107A,B and F are contacts with cherty looking material (see below). The rocks are volcanic breccias with fragments of andesite, plagioclase and some quartz set in a fine grained matrix consisting mainly of K-spar mixed with very fine biotite. Epidote and chlorite mineralization is minor,as is Fe-Ti oxide. Apart from the alteration, these rocks are similar to RB83114.

5) Banded dacite-rhyodacite: RB83107E and RB83107A-A.

RB83107E is a fine to medium grained grey and white banded rock; the grey material is quartz and the white material is plagioclase. There are plagioclase phenocrysts in some bands. Contacts between some bands are fairly sharp in some cases. K-spar forms very fine grains mixed with sericite and occurs between the quartz and plagioclase at the interface between the bands. The K-spar is secondary or at least very late forming.

RB83107A-A is a similar rock but contains much more K-spar which occurs in a closely spaced network of veinlets and patches. Patches of biotite and epidote occur within the plagioclase. Quartz does not occur in the section,apart from traces in veinlets.

(continued)

Summary (continued)

6) Cherty-looking rhyolite contacts.

Betweeen the banded dacite-rhyodacite and the rhyolitic volcanic breccia there is a very fine grained cherty-looking band which consists almost entirely of extremely fine grained K-spar. Fine quartz,biotite and Fe-Ti oxides occur in small veinlets and patches.

Contacts on both sides of this band are sharp,although slightly sinuous. Against the rhyodacite there has been offsets due to fracturing. This is definately not a chilled margin of the banded rhyodacite against the volcanic breccia.The edge of the breccia against the "chert" is slightly finer grained and this may represent chilling against the cherty looking material. This zone is less than 2mm wide. If this does represent chilling,then the breccia is later than the cherty material. Field evidence may indicate otherwise.

I think that the cherty looking material is a very fine grained layer (tuff?) of the banded rhyodacite. Staining of slabs and the offcuts indicate that K-spar mineralisation is intense near the contact. In sample RB83107E there is little K-spar and it occurs at the interfaces of the bands. In sample RB83107A-A the K-spar occurs in a network of patches and veinlets. This sample is against the contact. Intense feldspathisation has affected the cherty-looking layer. There are vague patches in the cherty material which remind me of fragments in the tuffs and breccias.

This intense feldspathisation suggsests that much,if not all, of the K-spar in the rhyolitic volcanic breccias (RB83114) and in the rhyolites (TL8347,TL8349) is secondary in origin. These samples do not contain biotite which is widespread throughout all the other rocks and which could have formed by K (and Fe) metasomatism.

A. L. Littlejohn, M.Sc.

RB83102 Andesite porphyry

This is a medium to fine grained porphyritic rock dominated by plagioclase phenocrysts in a fine grained plagioclase rich matrix. Fine biotite occurs throughout the matrix amd in the phenocrysts. Rounded to irregularly shaped amygdales 1 to 3mm in size occur within the groundmass. These are filled mainly with an intergrowth of quartz,biotite and epidote;some contain minor chlorite and prehnite occurs in a few. Composition is:

plagioolase phenocrysts	40%	
"hornblende" phenocrysts	6	- 90% altered (biotite,chlorite,
amygdales	8	actinolite)
plagioclase groundmass	28	
biotite	12	
Fe-Ti oxide	2	
chlorite	2	
opaque	1	
apatite	1	
epidote	minor	
sphene	minor	

Plagioclase phenocrysts are subhedral to euhedral and vary in size from 0.5 to 2.5mm,averaging about 1.5mm. They are dusty with fine hematite and small diffuse patches of biotite occur in all of them. In some there are small patches of chlorite and a few grains of epidote.

Hornblende phenocrysts are subidiomorphic and range in size from 0.4 to 1.5mm,averaging about 0.8mm. Most have been entirely replaced by a mass of fine biotite with thin acicular grains of actinolite within the biotite. Fine quartz is sometimes intergrown with the biotite. Chlorite is also present in some;small hornblendes? are entirely replaced by chlorite in a few cases.

Amygdales are filled mainly with an intergrowth of quartz and epidote or with quartz and biotite. The quartz forms rounded to elongated grains up to 0.2mm in size and occurs at the edges. Epidote forms rounded grains about 0.1mm in size towards the core. In a few places the epidote is dominant and forms prismatic grains up to 0.8mm in size. The biotite forms a spherulitic mass of grains about 0.1mm in size. It is the same biotite which occurs within the groundmass. Where chlorite is present it occurs with the epidote. Prehnite forms stellate clusters of ragged,bladed grains about 0.1mm in size which occur in rounded patches within the biotite.

Plagioclase in the groundmass froms shapeless to lath-like interlocking grains about 0.05mm in size. Extremely fine grained biotite is disseminated throughout the groundmass. Small diffuse patches are present in places and these are sometimes full of cubic opaque grains (sulphide or oxide?) 0.02 to 0.08mm in size. Small rounded patches of chlorite also occur within the groundmass.

(continued)

RB83102 (cont.)

Extremely fine grained Fe-Ti oxide is also disseminated throughout the groundmass. The grains sometimes coalesce to form subcubic patches about 0.2mm in size. In places this material has formed dark sphene grains with subidiomorphic outline. Well formed sphene grains about 0.05mm in size are scattered about the groundmass and sometimes occur within the altered hornblendes.

Apatite forms subidiomorphic grains up to 0.3mm in size which occur scattered about the groundmass.

RB83103 Laminated andesite tuff

This is a very fine grained volcaniclastic rock with well developed dark and light layers 0.2 to 2.0mm thick. Composition is:

plagioclase fragments	22%
quartz fragments	12
plagioclase	33
biotite	22
epidote	8
opaque	3
chlorite	trace

Quartz fragments are rounded to subangular and vary in size from 0.005 to 0.05mm. Plagioclase fragments are angular to lath-like or ovoid and vary in size from 0.005 to 0.2mm. Occasional fragments are about 0.5mm in size. The larger plagioclase fragments are concentrated in some layers. Quartz fragments are evenly distributed. The lighter coloured layers are relatively free of plagioclase fragments.

The groundmass consists of a mass of rounded plagioclase grains intimately intergrown with biotite. Grain size is less than 0.005mm. The darker layers contain more biotite. Rounded patches up to 0.2mm in size consist of slightly coarser biotite without plagioclase. Biotite also occurs in small ragged patches within the plagioclase fragments.

Epidote forms extremely fine grains which occur in very thin layers (veins?) along the biotite-plagioclase layers. In these it is associated with opaque grains. Most of the opaques (mainly Fe-oxide from the hand specimen) form cubic to rounded grains 0.005 to 0.1mm in size which are disseminated evenly throughout the rock. Most of the epidote occurs as fine rounded to subprismatic grains less than 0.05mm in size which replace parts of the plagioclase fragments. Some of the fragments are completely replaced. There is also a vein-like patch of epidote about 1.0mm thick which cuts across the layering.

Chlorite forms ragged patches less than 0.2mm in size which occur within the matrix. It rarely replaces plagioclase and quartz fragments.

RB83105 Andesite breccia

This is a fine grained volcaniclastic rock which is quite crowded with small fragments of plagioclase and andesite in a very fine grained plagioclase-biotite matrix. Late epidote mineralization occurs in patches. Composition is:

andesite fragments	16%
plagioclase fragments	20
plagioclase	20
biotite	27
epidote	10
opaque	4
quartz	2
chlorite	trace

Andesite fragments are subrounded and vay in size from 0.5 to 2.5mm; most are less than 1.5mm. They consist of a mass of subrounded interlocking grains about 0.05mm in size. A few also contain fine laths of plagioclase.

Plagioclase fragments are lath-like,often ovoid,and range in size from 0.05 to 0.3mm,averaging about 0.1mm. Quartz fragments are rounded and less than 0.1mm in size.

The groundmass consists of an extremley fine grained intergrowth of plagioclase and biotite with grain size less than 0.005mm. Biotite distribution is patchy. Ragged,diffuse patches of biotite occur within the andesite and plagioclase fragments.

Opaques (appear to be mainly Fe-oxide) are rounded and vary in size from 0.03 to 0.3mm,averaging about 0.05mm. They are disseminated throughout the groundmass of the rock and also occur in some fragments. It is often associated with epidote in patches where the grains size tends to be larger.

The epidote mainly occurs in irregularly shaped patches up to 10mm in size. In the core the epidote forms a mass of rounded to prismatic grains about 0.1mm in size. It is sometimes intergrown with quartz and chlorite. Ragged opaque grains occur in places. Small patches of epidote also occur in the andesite and plagioclase fragments. Around the core of the epidote patches the epidote becomes much finer grained and is intimately intergrown with the groundmass of the rock. The margins of the patches are rather indistinct. In one patch there is a core of a large,partly replaced,plagioclase grain. Some epidote occurs in veinlets less than 0.2mm thick where it is intergrown with biotite and quartz. Opaques also occur in these veinlets. There is a very thin veinlet containing only quartz.

RB83101 Andesite porphyry

This is a fine to medium grained porphyritic rock dominated by plagioclase phenocrysts in a fine grained plagioclase-rich matrix. Extremely fine grained biotite is disseminated throughput the groundmass and has largely replaced hornblende phenocrysts. Sulphides (mainly pyrite,judging from hand specimen) are scattered through the groundmass and within the altered hornblende. Minerals are:

plagioclase phenocrysts	46%	
hornblende phenocrysts	8	- altered to biotite
plagioclase groundmass	24	
biotite groundmass	15	
Fe-Ti oxide	3	
sulphide	2	- mainly pyrite
apatite	1	
quartz	1	
chlorite	minor	
epidote	minor	

Plagioclase phenocrysts are euhedral and range in size from 1.0 to 3.0mm,averaging about 2.5mm. They are slightly zoned. The hornblende phenocrysts are idiomorphic and range in size from 0.5 to 3.0mm,averaging about 1.0mm. Many have been completely altered to a mass of very fine grained dark olive-green biotite,similar to that in the groundmass. Some are unaltered. A few aggregates of plagioclase or hornblende phenocrysts occur.

The groundmass consists of an intergrowth of feathery plagioclase laths and shapeless plagioclase grains about 0.1mm in size. Rounded grains of Fe-Ti oxide about 0.03mm in size are disseminated in the groundmass. Extremely fine grained olive-green biotite is also disseminated throughout the groundmass and may be concentrated in small diffuse patches. Small patches also occur within the plagioclase phenocrysts.

Sulphides form rounded to subcubic grains 0.1 to 0.6mm in size which occur within the groundmass or intergrown with the altered hornblende. Where this occurs the hornblende has sometimes been altered,in patches, to chlorite and epidote. Quartz is sometimes present with these and also forms in thin discontinuous veinlets less than 0.2mm in width within the groundmass. Small patches of quartz occur adjacent to the plagioclase phenocrysts. Some of the sulphides have a thin discontinuous rim of Fe-Ti oxide,particularly where associated with the hornblende. Epidote also forms prismatic grains up to 0.3mm in size which occur in patches within the plagioclase phenocrysts.

Apatite forms rounded to subidiomorphic grains 0.2 to 0.6mm in size which are scattered about the groundmass.

RB83107A Rhyolite breccia - rhyolite contact

This sample consists of rhyolitic volcanic breccia in contact with cherty looking,very fine grained rhyolite. The rhyolite forms a band 1 to 3cm thick within the breccia. Quartz veinlets occur in the breccia and the rhyolite. The matrix of the breccia and the rhyolite are similar except that the breccia contains disseminated biotite. The matrix of the breccia in contact with the rhyolite at one side of the band is slighltly finer grained and conld have been chilled. I think that the rhyolite is a thin flow (tuff??) from the same magma that produced the breccia. The breccia was erupted on top of this after solidification and a thin chilled zone developed in the breccia right at the contact. The contact is fairly sharp. The rhyolite was probably erupted along with rhyodacite simialr to sample RB83107E.

The rhyolite consists of a mass of interlocking K-spar grains about 0.005mm in size. Extremely fine grained Fe-Ti oxides are disseminated throughout. Thin quartz veins less than 0.05mm thick cut the rhyolite. Some of these also contain Fe-Ti oxides.

The breccia oonsists of:

plagioclase fragments	18%
andesite fragments	25
dacite fragments	4
quartzite fragments	minor
quartz fragments	trace
K-spar	33
biotite	15
Fe-Ti oxide	2
opaque (mainly pyrite and pyrrhotite)	2
quartz (in veinlets)	1
epidote	minor
chlorite	trace

Plagioclase fragments are ovoid to subhedral and vary in size from 0.1 to 1.5mm; most are less than 0.8mm. They are dusty with fine hematite and some are weakly sericitic. Diffuse patches of biotite occur in all of them and some of the small ones are completely replaced by biotite. Andesite fragments are ovoid or rounded and vary in size from 0.5 to 2.5mm. Most consist of an aggregate of shapeless interlocking plagioclase grains 0.03 to 0.1mm in size. Each fragment tends to be equigranular. A few consist of fine feathery plagioclase laths up to 0.1mm in size. The dacites are similar to the coarser andesites except that they contain a fairly high proportion of quartz intergrown with the plagioclase. A few rounded quartzite fragments consisting of shapeless interlocking quartz grains about 0.05mm in size. Size of the fragments is about 0.4mm. Scattered subangular quartz grains about 0.2mm in size occur.

(continued)

RB83107A (continued)

The groundmass consists of a mass of fine K-spar grains about 0.005mm in size which are intergrown with extremely fine grained biotite. The biotite tends to be concentrated in indistinct patches. Extremely fine grained Fe-Ti oxides are disseminated throughout the matrix and sometimes occurs in angular patches up to 0.2mm in size where it is intergrown with epidote. Epidote also occurs with the Fe-Ti oxide in patches in the andesites. Ragged patches of chlorite less than 0.2mm in size are scattered in the matrix.

Opaque grains (pyrrhotite and pyrite) are subcubic to rounded and vary in size from 0.1 to 0.5mm. They occur in clusters of a few grains within the matrix.

Quartz forms in veinlets 0.05 to 0.2mm in width which cut the matrix and the fragments. Fine Fe-Ti oxide mixed with epidote occurs in some of them.

RB83107A-A Rhyodacite - rhyolite contact

This sample consists of rhyodacite (feldspathised dacite?) in contact with a cherty looking,very fine grained rhyolite. The rhyolite forms a band 1 to 3cm thick. Quartz veinlets with biotite occur in the rhyolite;patches of biotite and epidote occur in the rhyodacite. The contact is sharp,although sinuous in places and has been offset by fractures in places. Within the rhyodacite the K-spar forms a mass of extremely fine grains similar to those in the rhyolite. These occur in a very closely spaced network of veinlets and patches which are replacing the plagioclase. The rhyodacite is banded but the bands have been somewhat obscured by later alteration. I think that the rhyolite is a fine grained (tuffaceous?) band or layer associated with the rhyodacite. Both have been intensely altered by K-spar.

The rhyolite consists almost entirely of a mass of fine rounded K-spar grains with grain size less than 0.005mm. Extremely fine grains of Fe-Ti oxides are disseminated throughout. In places these occur in thin discontinuous veinlets. There is a veinlet along the contact. Biotite occurs in veinlets up to 0.2mm thick. Some of these also contain fine quartz.

The rhyodacite consists of:

plagioclase phenocrysts	6%
plagioclase	40
K-spar	33
biotite	12
epidote	7
Fe-Ti oxide	1
chlorite	1
opaque	minor
sericite	minor

Quartz occurs elswhere in the rock.

Plagioclase phenocrysts form squat subidiomorphic grains 0.3 to 1.0mm in size which occur in indistinct bands within a finer grained plagioclase groundmass. The plagioclase in the groundmass forms subrounded to shapeless interlocking grains 0.05 to 0.2mm in size. There are diffuse bands in which the grain size in more or less equigranular. In some bands the grains are subhedral. Very fine grained sericite is disseminated betweeen the plagioclase grains throughout the rock.

Biotite forms fine flakes less than 0.01mm in size which occur in irregularly shaped,indistinct patches less than 0.5mm in size occuring throughout the rock. There are also concentrations of biotite in partly interconnected patches up to 2mm in size which replace the plagioclase. In some of these the biotite is intergrown with fine epidote and Fe-Ti oxides. Some patches consist almost entirely of epidote forming rounded to subprismatic grains 0.05 to 0.2mm in size. Ragged shapeless opaque grains about 0.1mm in size are intergrown with the epidote.

Chlorite forms ragged patches of very fine grains less than 0.2mm in size which occur within the plagioclase of the groundmass.

(continued)

RB83107A-A (continued)

The K-spar forms extremely fine grains less than 0.005mm in size which occur in a closely spaced network of veinlets and patches within the plagioclase. Staining of slabs indicate that remnant plagioclase occurs in patches. This K-spar appears similar to that in the rhyolite.

RB8307B Rhyolite breccia

This is a fine grained volcaniclastic rock consisting of plagioclase and andesite fragments of variable size up to 3mm set in a very fine grained K-spar matrix mixed with fine biotite. Composition is:

plagioclase fragments	30%	
andesite fragments	18	
quartzite fragments	2	
K-spar	29	
biotite	18	
opaque	3	- mainly pyrite
Fe-Ti oxide	1	
epidote	1	
chlorite	minor	

Plagioclase fragments vary in shape from squat,subidiomorphic laths to rounded or ovoid grains;size varies from 0.2 to 2.5mm. The andesite fragments are up to 3.0mm in size and are generally ovoid in shape. A variety of types are present. The commonest,and usually smaller, consist of a mass of fine feathery laths less than 0.1mm in size. Larger fragments consist of shapeless interlocking grains about 0.1mm in size. A few fragments consist of subhedral laths about 0.1mm in size which are intergrown with shapeless grains of plagioclase with minor quartz. Both the shapeless aggregates and feathery laths contain plagioclase phenocrysts up to 0.4mm in size. A few of the plagioclase grains contain thin inclusions of apatite.

The matrix consists of extremely fine rounded grains of K-spar less than 0.002mm in size. It is intergrown with fine biotite of about the same size. Distribution of the biotite is patchy. Biotite also occurs in all the fragments and some have been completely replaced by biotite. The quartz-bearing andesites are particularly susceptible to biotite alteration. Extremely fine grained Fe-Ti oxide is disseminated throughout the groundmass and also in all the fragments. It is sometimes concentrated in the fragments where it may be intergrown with very fine grained epidote. Epidote also occurs in small patches within the plagioclase fragments.

Opaque grains (mainly pyrite judging from the hand specimen) are cubic and up to 0.4mm in size. They may contain inolusions of the matrix. There are a few vein-like patches of pyrite. Some of the grains are partly altered to goethite. They usually occur within the matrix but some are partly within the fragments. In places there is a thin partial rim of chlorite around the pyrite. Small ragged patches occasionally occur in the matrix.

RB8307E (? Flow)banded dacite (rhyodacite?)

This is a fine grained volcanic rock,white in colour with rather indistinct bands from 2 to 20mm thick of greyish material. The white bands are dominantly plagioclase; the grey bands are dominantly quartz and mixtures occur in some bands. Sericitic K-spar occurs between the quartz and plagioclase in some of the thinner bands. Composition is:

plagioclase	50%
plagioclase phenocrysts	6
quartz	35
K-spar	6
sericite	3
rutile	minor
opaque (hematite)	minor
apatite	trace
zircon	trace

Plagioclase phenocrysts are subhedral and range in size from 0.3mm to 1.5mm,averaging about 0.8mm. They sometimes occur in clusters. They occur mostly in the quartz-free bands.

Plagioclase forms subrounded to lath-like grains 0.04 to 0.1mm in size. Quartz forms subrounded to shapeless grains 0.05 to 0.2mm in size. The quartz and plagioclase are intimately intergrown where they occur together. Grains in individual bands tend to be the same size and the coarser grains occur in the thicker bands.

K-spar froms extremely fine grains which occur in intergranular patches between the quartz and plagioclase. It is usually sericitic. Fine sericite is disseminated between the quartz and plagioclase grains throughout. It sometimes forms clusters of flakes up to 0.1mm in size.

Rutile forms acicular to prismatic grains less than 0.05mm in size which occur in clusters within the plagioclase grains. It is sometimes associated with ragged,rounded opaque grains (hematite?) which also occur in clusters within and between plagioclase and quartz grains. In some clusters the two minerals are intimately intergrown and form a Fe-Ti oxide.

A few zircon grains are scattered between the quartz and plagioclase. These are rounded and about 0.05mm in size. Acicular apatite grains about 0.05mm in length occur within the plagioclase.

RB83307F Rhyolite breccia - rhyolite contact

This sample consists of rhyolitic volcanic breccia in contact with a small piece of extremely fine grained rhyolite (chert in your notes). Biotite mineralization,associated with thin quartz veins affects both the breccia and the rhyolite,but in different styles. There is no chilling effect observable in the breccia in this sample (compare RB83307A). In the breccia the biotite is disseminated within the fine grained feldspathic groundmass. The rhyolite itself is similar to the groundmass of the breccia without the biotite. Veinlets of biotite, associated with quartz and Fe-Ti oxide and traces of pyrite cut the rhyolite. Similar veinlets occur in the breccia as well. Near the contact there is also minor disseminated biotite in the rhyolite.

The rhyolite consists almost entirely of a mass of very fine grained K-spar grains less than 0.005mm in size. In places there are vague outlines of lath-like grains about the same size. Quartz and biotite occur in discontinuous veinlets less than 0.05mm thick. Quartz veinlets are slighlty thicker. There is a dark veinlets about 0.2mm thick which is parallel to the contact and lies 1 - 2mm from it. This consists of extremely fine grained Fe-Ti oxide mixed with fine biotite. Contacts are not sharp and the K-spar has coarsened slighlty on either side of the vein. Biotite is disseminated in the rhyolite between this vein and the breccia. The contact is marked by an increase in biotite where fragments are not present in the breccia. The contact itself is somewhat sinuous. A plagioclase fragment penetrates part way into the rhyolite.

The breccia consists of:

plagioclase fragments	35%
andesite fragments	15
quartzite fragments	5
quartz fragments	minor
K-spar	26
biotite	16
opaque	2
Fe-Ti oxide	1
chlorite	minor
epidote	minor
quartz (in veins)	minor

Plagioclase fragments are ovoid or squat subidiomrphic in shape and range in size from 0.2 to 2.0mm. They are dusty with fine hematite. Small diffuse patches and strigers of biotite occur within them and some of the smaller ones have been almost completely replaced by biotite. A few have patches of K-spar alteration. Andesite fragments are rounded and vary in size from 0.5 to 2.0mm. Most consist of a mass of fine feathery plagioclase laths up to 0.1mm in size,often with parallel orientation. Some contain phenocrysts of plagioclase. There are a few which consist of subrounded interlockibg plagioclase grains baout 0.1mm in size. Quartzite fragments are rounded to angular and vary in size from 0.2 to 0.6mm. They consist of shapeless interlocking quartz grains 0.01 to 0.05mm in size. One quartzite fragment about 1.5mm in size has been partly replaced by biotite,occuring between the quartz grains. A few rounded quartz fragments up to 0.2mm in size occur.

(continued)

RB83407F (continued)

The groundmass of the breccia consists of a mass of rounded K-spar grains about 0.005mm in size. It is mixed with similarly sized biotite grains. The biotite is often concentrated in small indistinct patches. Extremely fine grained Fe-Ti oxides are disseminated throughout the groundmass and also occur in some fragments. Ragged patches up to 0.3mm in size consist of a mass of fine chlorite grains. A few of these also occur in the fragments. Traces of epidote,forming rounded grains less than 0.1mm in size are scattered about the groundmass.

Opaque grains (mainly pyrite) are subcubic and up to 0.4mm in size. They occur within the matrix. Many have been partly altered to goethite.

Quartz occurs in thin veinlets up to 0.2mm wide which cut the matrix and the fragments.

RB83114 (? Flow) banded rhyolitic breccia

Note. This sample is from a 5m wide zone of intense shearing. It was submitted with the idea of checking whether or not the material is a mylonite. L.R.B.

This is a volcaniclastic rock consisting of an extremely fine grained K-spar rich matrix crowded with angular to rounded fragments of andesite and plagioclase with some quartz. Epidote alteration has affected many of the fragments. It is a greenish colour and different shades of green are evident in bands 2 to 20mm thick in the hand specimen. Composition is:

andesite fragments	40%
plagioclase fragments	15
altered fragments	8
quartz fragments	2
quartzite fragments	minor
K-spar	20
Fe-Ti oxide	10
epidote	4
opaque	1
sphene	trace
calcite	trace

Andesite fragments are rounded to subangualr and are very variable in size,ranging from 0.3mm to 6.0mm,averaging about 1.5mm. A variety of textural types are present. The commonest,forming most of the finer fragments,consists of a mass of fine feathery laths about 0.1mm in size. Very fine grained fragments consist of a mass of interlocking shapeless plagioclase grains less than 0.05mm in size. Some of these contain fine laths of plagioclase,and there appears to be a gradation between these two types. Many fragments consist of a mass of shapeless interlocking plagioclase grains about 0.1mm in size. Some of the fragments (of all types) are porphyritic,but most of these have been completely altered. Many of the andesite and some of the larger plagioclase fragments are completely altered to epidote and chlorite. The epidote forms prismatic grains up to 0.2mm in size. Chlorite occurs between the epidote grains. Some contain quartz intergrown with the epidote. A few fragments are completely altered to chlorite. Single grains or small clusters are common in most of the larger fragments.

Plagioclase fragments are ovoid in shape and generally less than 1.0mm in size;many are less than 0.1mm. Quartz fragments are rounded or angular and vary in size from 0.05 to 0.5;most of the larger ones are angular. There are also a few rounded quartzite fragments consisting of shapeless interlocking quartz grains about 0.1mm in size.

The matrix consists of extremely fine grained K-spar less than 0.005mm in size which is mixed with Fe-Ti oxide of about the same size. Epidote grainsabout 0.01mm in size are mixed with patches of the Fe-Ti oxide and a few subidiomorphic sphene grains about 0.1mm in size are scattered through the rock. Traces of very fine calcite occur mixed with the Fe-Ti oxide around some of the fragments. The Fe-Ti oxide is also weakly disseminated within the fragments. Opaque grains (probably Fe-oxide) are cubic and up to 0.05mm in size. They are scattered within the matrix.

TL8347 Rhyolite

This is a massive,vuggy,white volcanic rock consisting mainly of K-spar and quartz with lesser amounts of plagioclase. The vugs are lined with subidiomorphic quartz grains and are associated with a network of veins and patches which is full of angular to subrounded fragments of the rhyolite 0.5 to 5.0mm in size. This occurs in a zone about 5cm wide which appears to be a breccia zone. It may have formed by autobrecciation during consolidation of the viscous rhyolite lava. Composition is:

K-spar	50%	
quartz	40	
plagioclase	5	
sericite	1	(includes some muscovite)
opaque	2	(hematite and limonite)
Fe-Ti oxide	1	
clay	1	(montmorillonite??)

The less quartzitic parts of the rock consists of a mass of fine feathery K-spar grains 0.01 to 0.05mm in size which are intergrown with more shapeless grains of K-spar and some plagioclase. Quartz forms shapeless grains less than 0.1mm insize which occur in small aggregates and thin vein-like patches. The K-spar and the quartz'veins' have a flow texture. PLagioclase forms subidiomorphic laths 0.2 to 1.5mm in size scattered within the finer grained K-spar and quartz.

Extremely fine grained sericite is disseminated throughout the rock, including the plagioclase grains. Fine grained Fe-Ti oxide grains about 0.01mm in size are also disseminated throughout the rock. In places the sericite coarsens to muscovite flakes which may be up to 0.5mm in size. Possibly these are altered plagioclase? Hematite forms ragged rounded grains about 0.1mm in size which occur in small clusters scattered about the rock. Patches and stringers of limonite occur around these.

Within the breccia zone the quartz forms interlocking subrounded grains o.02 to 0.1mm in size. More idiomorphic grains line the vugs. Fine sericite is disseminated between the quartz grains. In places there are small patches of a brownish clay (montmorillonite?) which is intergrown with the quartz. Spherulitic patches up to 0.3mm in size occur within the rhyolite. The rhyolite fragments are highly hematiised within the quartzitic breccia zone and limonite staining is quite intense.

TL8349 Rhyolite

This is a massive,vuggy white coloured volcanic rock consisting almost entirely of quartz,K-spar and plagioclase. Spherulitc structures of quartz and K-spar,along with vein -like patches of quartz,occur within a fine grained intergrowth of plagioclase and K-spar. Vugs are lined with quartz crystals. Plagioclase phenocrysts occur within the fine grained material. I don't think that this rock has been altered and brecciated; the fabric is a result of cooling of a highly viscous rhyolitic lava (analogous to ropey lava of Hawaii). Composition is:

quartz	35%
K-spar	50
plagioclase	15
sericite	minor
Fe-Ti oxide	minor

Quartz forms subrounded to shapeless interlocking grains 0.05 to 0.2mm in size which occur in spherulitic aggregates 0.2 to 3.0mm in size. Larger grains,sometimes idiomorphic,occur in larger vuggy patches. Quartz also occurs in a network of vein-like patches.

The quartz aggregates are surrounded by spherulitic splays of thin feathery K-spar grains up to 1.0mm in length. Some of these splays have a core consisting of a euhedral plagioclase grain. Plagioclase laths 0.3 to 0.8mm in size occur elswhere also. Smaller spherulitic patches of K-spar occur by themselves within a fine grained mixture of shapeless K-spar and plagioclase with grains size less than 0.1mm. Distribution of plagioclase is patchy within the K-spar. In places there are thin lath-like grains of K-spar which have a flow texture around the quartz and K-spar spherules.

Extremely fine grained acicular grains of Ti-oxide? are crowded within the quartz grains. Rounded grains of Fe-Ti oxide are disseminated throughout the rock. These are less than 0.03mm in size.

Sericite forms flakes less than 0.01mm in size which are disseminated throughout the rock and sometimes form aggregates at the cores of the quartz spherules.