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Samples: Five samples labelled 2, 2c, 3, 3b, and 4

The samples are grouped as follows:

## 1. Tuffaceous rocks

composition from andesite to dacite, with a variety of fragments of andesite and dacite as well as fragments of plagioclase and quartz phenocrysts

#2 : fine grained tuff, variable texture, fragments of andesite, porphyritic andesite, and of quartz and plagioclase grains in a groundmass dominated by plagioclase, possibly with quartz, and lesser sericite, biotite, and Ti-oxide. The presence of andesite fragments and of biotite and Ti-oxide in the groundmass suggests that this rock is more mafic than the other tuffaceous rocks, and it is given the name andesite. Probably it is intermediate between andesite and dacite.

#3 : fine dacite tuff, scattered fragments of quartz and plagioclase grains in groundmass dominated by plagioclase and sericite. The rock contains moderately abundant pores.

#3b: coarse dacitic tuff, abundant fragments of various types of dacite and of plagioclase phenocrysts, minor fragments of quartz and muscovite phenocrysts in a groundmass dominated by plagioclase and sericite, with patches of very fine grained opaque.

## 2. Hypabyssal intrusive rocks

composition dacitic, porphyritic with plagioclase, hornblende, and minor biotite phenocrysts in a groundmass of plagioclase, quartz, (chlorite), and moderately abundant opaque, apatite and Ti-oxide; moderately to strongly altered, especially phenocrysts

#2c : hypabyssal dacite porphyry, plagioclase phenocrysts altered to sericite-epidote?; hornblende phenocrysts altered to actinolite-epidote-chlorite-(calcite) in various assemblages. Secondary patches of coarse grained quartz-calcite with actinolite needles in calcite and a few patches of chlorite.

#4 : hypabyssal dacite porphyry, groundmass finer than for #2c; plagioclase phenocrysts altered to kaolinite-sericite+limonite; hornblende phenocrysts altered to calcite-sericite-quartz

*John Payne*  
John Payne,  
October 1981

Sample #2      Altered Andesite Tuff

The rock is a variable fine grained tuff, probably of andesitic composition, which has been somewhat altered with addition of sericite and pyrite. The rock contains several fragments up to 2 mm across. Some fragments are difficult to distinguish from groundmass; variations in composition in patches from 1 to 3 mm exist which may be original fragments or just variations in groundmass composition in an inhomogeneous rock.

definite fragments	
quartz grains	4- 5%
plagioclase grains	2- 3
epidote-rich patches	1- 2
lathy andesite	3- 5
porphyritic andesite	1- 2
groundmass	
plagioclase-quartz	45-50
sericite	15-20
biotite	7-10
Ti-oxide rich patches	5- 7
pyrite	1- 2

Quartz forms subangular grains from 0.15 to 0.5 mm in size. These probably represent fragments of original phenocrysts in dacite.

Plagioclase forms grains from 0.3 to 0.5 mm in size; some are partly altered to fine grained epidote. These are original plagioclase phenocrysts in andesite or dacite.

Epidote-rich patches consist mainly of epidote and opaque, possibly with Ti-oxide. Grains average 0.3-0.5 mm in size. Epidote commonly forms prismatic grains up to 0.2 mm long in a very fine grained groundmass of epidote and opaque. Some of these may represent altered mafic phenocrysts, or possibly even plagioclase phenocrysts.

Rock fragments include two types of andesite. They form fragments up to 2 mm across. The first type consists of plagioclase laths averaging 0.1-0.2 mm in grain size in a very fine grained groundmass of plagioclase and epidote. The second contains a few plagioclase phenocrysts up to 0.7 mm long in a very fine grained groundmass dominated by plagioclase laths averaging 0.1 mm long. The latter are in subparallel orientation suggesting that the fragment is part of an andesite flow.

The groundmass has a variable composition, with irregular patches containing more or less sericite, biotite, and Ti-oxide. Much of the groundmass consists of extremely fine grained (0.01 mm) plagioclase possibly with quartz. Sericite occurs in the groundmass as scattered grains and patches up to a few mm across which are mainly sericite. Possibly sericite is an alteration of the plagioclase-rich groundmass. A few patches appear to be composed mainly of extremely fine grained quartz, and may represent cherty sediments, possibly of exhalite origin. Biotite occurs as extremely fine grained patches, possibly of secondary origin; patches are up to 0.2 mm across and grade gradually to rapidly into the plagioclase-rich groundmass. Some patches contain abundant Ti-oxide; these average 0.1-0.15 mm in size, and grade into the plagioclase-rich groundmass.

Pyrite forms scattered anhedral grains averaging 0.1-0.3 mm in size, with a few up to 1 mm across.

One fragment 0.3 mm across consists of a very fine grained aggregate of muscovite.

Sample #2c Hypabyssal Dacite Porphyry

The sample contains plagioclase and lesser hornblende and minor biotite phenocrysts in a groundmass dominated by plagioclase with lesser quartz, chlorite, opaque, and epidote. Scattered coarse grained patches consist of quartz-calcite-(actinolite-chlorite). The yellow stain on the cffcut block is due to sericite alteration of plagioclase phenocrysts and groundmass; no K-feldspar was identified in the rock.

phenocrysts	
plagioclase	35-40%
hornblende	8-10
biotite	½- 1
groundmass	
plagioclase	35-40
quartz	5- 7
chlorite	3- 5
epidote	½- 1
opaque	2- 3 (moderately abundant magnetite)
apatite	minor
patches	
quartz	2- 3
calcite	1- 1½
actinolite	0.3
chlorite	minor

Plagioclase forms subhedral prismatic phenocrysts averaging 0.5-1.5 mm in size, with a few over 2 mm long. Grains are slightly overgrown by irregular patches of plagioclase in the groundmass, giving the phenocrysts ragged outlines. Alteration is to extremely fine grained sericite and epidote? (very high relief dusty inclusions).

Hornblende forms subhedral to euhedral grains averaging 0.5-1.5 mm in size. They are variably altered. Some altered grains consists mainly of actinolite with minor epidote patches. Others appear to be replaced further along the borders of grains to very fine grained chlorite, and a few grains consist mainly of chlorite with minor actinolite and minor to moderately abundant epidote. Calcite occurs in a few altered grains.

Biotite forms a few phenocrysts from 0.5 to 1 mm in size. They are completely altered to pseudomorphic chlorite with minor patches of epidote and Ti-oxide.

The groundmass is dominated by plagioclase, which forms an aggregate of anhedral to prismatic grains averaging 0.05-0.2 mm in length. They are slightly to moderately altered to dusty sericite and epidote. Quartz forms scattered interstitial grains averaging 0.03-0.05 mm in size. Chlorite forms patches averaging 0.05-0.3 mm in size. Pleochroism of chlorite is from pale to light-medium green. Epidote forms irregular grains and clusters of grains averaging 0.05-0.15 mm in size; clusters commonly are associated with opaque grains and clusters. Opaque forms equant grains averaging 0.03-0.05 mm in size, with a few up to 0.3 mm in size. The latter occur in clusters with epidote and minor apatite. Apatite forms grains from 0.05-0.15 mm in size, with a few elongate grains up to 0.4 mm long.

Alteration patches up to 3 mm across consist of aggregates of coarse to medium grained quartz and calcite, with abundant acicular to elongate prismatic actinolite grains in calcite, and scattered patches of chlorite. Actinolite grains average 0.3-0.5 mm in length, with a few up to 1 mm long. Chlorite occurs in a very fine grained aggregate.

Sample #3

## Fine Dacite Tuff

The rock contains scattered fragments of quartz and plagioclase crystals, probably original phenocrysts, in an extremely fine grained groundmass dominated by plagioclase and sericite, with minor opaque (hematite?) and Ti-oxide. The rock contains moderately abundant pores up to 1 mm in size, averaging 0.1-0.2 mm.

## fragments

quartz	1%
plagioclase	0.5-1
groundmass	
plagioclase	65-70
sericite	20-25
hematite	2- 3
Ti-oxide	1- 2
pores	5- 7
epidote	one grain (origin uncertain)

Quartz forms subangular to angular fragments averaging 0.05-0.3 mm in size, with a few up to 0.7 mm across. These are of single grains or locally of quartz aggregates of a few grains.

Plagioclase forms grains from 0.2-0.6 mm in size with subhedral outlines, probably representing original plagioclase phenocrysts. They are mainly unaltered to very slightly altered to dusty sericite? and opaque.

The groundmass consists mainly of extremely fine grained (0.01-0.02 mm) plagioclase in equant aggregates, with local patches up to 0.03 mm in grain size. Intergrown relatively uniformly with plagioclase is very fine grained sericite flakes. Locally sericite occurs in sericite-rich patches up to 0.5 mm in size. A few muscovite flakes up to 0.15 mm long are present. Sericite shows no preferred orientation.

Hematite? forms disseminated grains and clusters of grains averaging 0.03-0.05 mm in grain size, and also forms dusty grains scattered through the groundmass.

Ti-oxide forms patches averaging 0.05-0.1 mm in size, composed of very fine grained aggregates.

Epidote forms one subrounded grain 0.1 mm across; it may be a fragment or may be of secondary origin.

The rock contains moderately abundant pores averaging 0.05-0.3 mm in size, with a few over 1 mm across. Borders generally are irregular, but a few have subhedral to euhedral outlines, suggesting that the pores once held a mineral which has since been completely removed. Probably most pores represent original cavities in the rock.

The rock is cut by a few limonite veinlets with alteration halos in which limonite is intergrown with sericite of the groundmass. These probably are of weathering origin.

Sample #3b

## Coarse Dacitic Tuff

The sample contains fragments of several types of dacitic rocks, and fragments of plagioclase and of quartz grains in an extremely fine grained groundmass of plagioclase and sericite with patches of opaque.

## fragments

## dacite

Type A 15-20%

Type B 7-10

Type C 1- 2

Type D  $\frac{1}{2}$ - 1

plagioclase 7-10

quartz  $\frac{1}{2}$ - 1

muscovite minor

## groundmass

plagioclase 30-35

sericite 25-30

opaque 2- 3

Type A dacite forms fragments up to several mm across. It is a porphyritic dacite with 10-25% phenocrysts of plagioclase up to 1 mm in size in a very fine grained groundmass of plagioclase and sericite.

Type B dacite is a fine grained rock composed of equant grains of plagioclase and quartz averaging 0.05-0.2 mm in size, with abundant opaque grains up to 0.5 mm in size and Ti-oxide grains up to 0.15 mm across. Some fragments appear to have the texture of a vein, with more abundant quartz and opaque relative to plagioclase and sericite.

Type C dacite is an extremely fine grained rock with abundant epidote alteration. Some fragments contain scattered plagioclase laths up to 0.3 mm in size.

Type D dacite is a very fine to extremely fine grained rock composed of cherty quartz or quartz-plagioclase.

Some fragments are difficult to classify. As well, some fragments appear to have a very similar texture to the groundmass, with borders of fragments outlined by slightly different contents of sericite (generally higher along the contacts).

Plagioclase forms scattered to locally abundant crystal fragments from 0.3 to 1 mm in size. These are slightly altered to extremely fine grained sericite.

Quartz forms angular grains averaging 0.2-0.5 mm in size, with a few up to 1 mm across.

Muscovite forms a few grains and clusters of grains from 0.3-0.6 mm in size.

The groundmass consists of extremely fine grained plagioclase with variable amounts of extremely fine to very fine grained sericite and patches of opaque. Sericite locally is very abundant, and the texture suggests that some of these patches may be sericite-rich fragments, possibly pumice in origin. However, these appear to grade into normal groundmass. Opaque forms clusers up to 1 mm in size of clusters of equant grains averaging 0.03-0.05 mm in size. These are partly intergrown with groundmass plagioclase and sericite.

Sample #4 Hypabyssal Dacite Porphyry (Plagioclase, Hornblende),  
strongly altered phenocrysts

The rock contains plagioclase and hornblende phenocrysts in a groundmass dominated by plagioclase and lesser quartz, with moderately abundant apatite and opaque as accessory minerals. Plagioclase is altered to kaolinite-sericite-limonite. Hornblende is altered to a variety of combinations of sericite-calcite-quartz.

phenocrysts	
plagioclase	35-40%
hornblende	10-12
biotite	minor
groundmass	
plagioclase	35-40
quartz	8-10
opaque	2- 2½
Ti-oxide	1- 1½
apatite	1- 1½

Plagioclase forms euhedral prismatic grains from 0.5 to 1.2 mm in size. These are in random orientation throughout the rock. They are completely altered to very fine grained to extremely fine grained aggregates of kaolinite-sericite with or without limonite as very fine grained patches. Most grains contain more kaolinite than sericite, but a few contain more abundant sericite.

Hornblende forms euhedral prismatic phenocrysts up to 1.2 mm in size. They are also randomly distributed through the rock. Alteration shows a variety of assemblages and textures. Some grains are altered to patches of very fine grained sericite in the cores, with thin rims composed of fine to very fine grained quartz and lesser interstitial sericite. It is difficult to determine if the quartz is part of the original grain or is a reaction with the groundmass during alteration. Other grains contain cores of fine to medium grained calcite with patches of sericite and rims of quartz. Some do not have the quartz rim, and others do not have the zone of sericite. A few are replaced entirely by fine to medium grained aggregates of calcite. Associated with hornblende are abundant grains of apatite and opaque, either along hornblende grain borders or in inclusions.

Biotite forms a few ragged phenocrysts up to 0.5 mm in size. These are replaced by irregular aggregates of muscovite.

In the groundmass, plagioclase occurs as irregular aggregates of grains averaging 0.03-0.05 mm in size. They are slightly altered to very fine grained sericite. This probably is what causes the yellow stain in the offcut block, rather than K-feldspar; however, it is possible that the groundmass contains extremely fine grained K-feldspar. Dusty opaque masks the texture of altered plagioclase.

Quartz forms equant anhedral grains averaging 0.03-0.05 mm in size intergrown with plagioclase.

Opaque forms grains averaging 0.05-0.1 mm in size, and locally forms clusters of grains up to 0.5 mm across. Apatite commonly is associated with opaque as subhedral grains averaging 0.05-0.1 mm in size. A few apatite grains are up to 0.4 mm long. Ti-oxide forms scattered grains averaging 0.05-0.2 mm in size, commonly associated with irregular opaque grains and patches.

Rocks for thin section - Bran Group

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- 2 ΔC - from station c composition presumably andesite, intrusive texture.
- 3 - rhyolite
- 3b - rhyolite breccia / tuff
- 4 - possible andesite, fairly coarse intrusive looking, unusual texture
- 2 - fine grained andesite - volcanic

11b

11c