

JJ-6 (main rock)      Altered Porphyritic Quartz Diorite-Diorite  
(Unit 3A)

The rock is very similar in texture to sample JJ-12, but generally is finer grained and less intensely altered. Phenocrysts include plagioclase, biotite, and hornblende, with a few quartz grains which may be phenocrysts. These are set in a groundmass dominated by anhedral plagioclase. Pyrite is moderately abundant; it is altered to hematite in textures similar to those in JJ-12.

phenocrysts	
plagioclase	15-20%
biotite	2- 3
hornblende	2- 3
quartz	minor
groundmass	
plagioclase	
quartz	3- 5
pyrite	1½-2
hematite	2- 3
apatite	½- 1
Ti-oxide	0.3-0.5

Plagioclase forms subhedral prismatic phenocrysts averaging 0.7-1.5 mm in size. They are variably altered, from moderate to complete, to aggregates of sericite and patches of calcite. A few completely altered grains have fine grained sericite aggregates as in JJ-12. Hematite is not abundant except locally, and some sericite aggregates are stained yellow by limonite.

Mafic phenocrysts are completely altered, and can be distinguished only on crystal outlines and a few pseudomorphic textures in biotite. Biotite forms books up to 1.5 mm in size; some are equant and others are thin. It is altered in two manners: a) to pseudomorphic muscovite with very abundant hematite and lesser Ti-oxide, and b) to irregular patches of calcite, with abundant hematite especially along grain borders, and locally sericite patches. Some hematite contains corroded cores of pyrite, with very abundant tiny pyrite spots surrounded by secondary hematite. Hornblende has subhedral to anhedral outlines, with prismatic cross-sections and elongate prisms being distinctive. Alteration is to irregular patches of calcite with abundant hematite especially along grain borders. Phenocrysts without distinctive outlines could be either biotite or hornblende.

Quartz forms a few grains and patches of grains averaging 0.3-0.5 mm in size.

The groundmass is dominated by anhedral intergrowths of fine grained plagioclase averaging 0.05-0.15 mm in size. Plagioclase is moderately altered to very fine grained sericite. Quartz forms scattered grains and patches of grains averaging 0.05-0.1 mm in size. Pyrite forms grains up to 0.5 mm in size; they are slightly to strongly altered to hematite along tightly spaced fractures. Hematite also forms irregular patches of extremely fine grained aggregates. Apatite forms subhedral prismatic grains up to 0.5 mm in size. Locally it occurs in very fine grained clusters associated with elongated hornblende phenocrysts; these apatite grains are subhedral to euhedral, averaging 0.05-0.1 mm in size. Ti-oxide forms scattered grains averaging 0.05-0.1 mm in size, with a few up to 0.3 mm.

JJ-6 (dike) Porphyritic Dacite

The rock contains plagioclase and biotite phenocrysts in a very fine grained groundmass dominated by plagioclase with lesser sericite and hematite.

phenocrysts	
plagioclase	17-20%
biotite	8-10
groundmass	
plagioclase	45-50
sericite	12-15
hematite	7- 8
Ti-oxide	0.3

Plagioclase forms subhedral to euhedral prismatic phenocrysts averaging 0.2-0.7 mm in length, with a few up to 1.5 mm long. They are moderately to very strongly altered to very fine grained aggregates of sericite.

Biotite forms books from 0.2-1 mm in length. They are completely altered to pseudomorphs of muscovite with scattered irregular patches of Ti-oxide and hematite.

The groundmass is dominated by very fine grained, anhedral plagioclase averaging 0.03-0.07 mm in grain size, with a few prismatic grains up to 0.15 mm long. Sericite forms disseminated flakes and patches of flakes averaging 0.05 mm in length; it may be an alteration product of plagioclase, and possibly of other groundmass minerals.

Hematite forms extremely fine grained, very irregular patches intergrown with the groundmass plagioclase and sericite; patches average 0.1-0.3 mm in size.

Ti-oxide forms scattered equant grains averaging 0.02-0.05 mm in size.

The rock contains altered plagioclase phenocrysts, quartz phenocrysts, and altered biotite phenocrysts in a groundmass dominated by fine to medium grained plagioclase. A few patches of very fine grained groundmass are present.

## phenocrysts

plagioclase	20-25%	(completely altered to sericite-hematite)
quartz	5- 7	
biotite	5- 7	(completely altered to muscovite-pyrite- (calcite))
groundmass		
plagioclase	50-55	
quartz	3- 4	
calcite	$\frac{1}{2}$ - 1	
apatite	$\frac{1}{2}$ - 1	
pyrite	$\frac{1}{2}$ - 1	
Ti-oxide	0.3	
very fine grained rock	2- 3	

Plagioclase forms euhedral phenocrysts from 1 to 2.5 mm in size, with a few up to 4 mm across. They are completely altered to fine grained radiating aggregates of sericite flakes mixed with scattered to moderately abundant irregular patches of hematite. The only suggestion that these are original plagioclase grains is their shape, and comparison with fresh rocks in nearby outcrops which contain feldspar phenocrysts up to 8 mm in size.

Quartz forms subhedral to subrounded phenocrysts up to 1.2 mm in size, and a few clusters of irregular phenocrysts which may have originally been parts of one larger phenocrysts which subsequently was broken, with groundmass material crystallized in narrow fractures.

Biotite forms phenocrysts up to 1.5 mm in size. These contain moderately abundant inclusions of euhedral apatite averaging 0.05 mm in size. Biotite is completely altered to muscovite with irregular patches up to 1 mm in size of pyrite and locally abundant calcite in medium grained patches. Pyrite is strongly altered to hematite in an unusual texture, with very abundant cores of pyrite averaging 0.02-0.03 mm in size surrounded by hematite.

The groundmass is dominated by anhedral, irregular plagioclase grains averaging 0.3-0.5 mm in size. These are slightly to moderately altered to fine to very fine grained sericite flakes. Quartz forms scattered grains averaging 0.1-0.2 mm in size. Very fine grained patches consist mainly of these minerals in anhedral aggregates averaging 0.02-0.03 mm in grain size.

Calcite forms irregular patches up to 0.5 mm in size, commonly associated with biotite phenocrysts.

Apatite forms anhedral to subhedral grains from 0.1-0.15 mm in size as well as the grains included in biotite.

Pyrite forms grains ranging up to 0.5 mm in size. Alteration is very variable, from almost complete to minor, with hematite being the alteration product.

Ti-oxide forms scattered grains and clusters of grains averaging 0.05-0.1 mm in size.

The rock contains plagioclase and sparse quartz phenocrysts in a very fine grained groundmass dominated by plagioclase. Alteration of phenocrysts of plagioclase and groundmass is to irregular patches of one or more of sericite, calcite, and hematite.

phenocrysts	
plagioclase	17-20%
quartz	two grains
groundmass	
plagioclase	55-60
quartz	2- 3
calcite	7-10
sericite	2- 3
hematite	2- 3
pyrite	1½-2
Ti-oxide	½- 1
apatite	1- 1½
zircon	one grain
chalcopyrite	one grain

Plagioclase forms subhedral to anhedral phenocrysts averaging 0.5-1 mm in size, with irregular prismatic habit. They are altered variably to patches of calcite and sericite, with alteration ranging from slight to complete. Some irregular patches of calcite and sericite with or without hematite may represent completely altered plagioclase phenocrysts, or may represent altered mafic phenocrysts; no distinctive texture is present to indicate the parent.

Quartz forms sparse subrounded to rounded grains from 0.3-0.7 mm in size, and a few finer grains about 0.1-0.15 mm in size.

The groundmass is dominated by very fine grained (0.02-0.05 mm) plagioclase, with scattered quartz grains. Calcite forms irregular patches of very fine to medium grained aggregates, in part associated with hematite and/or sericite. A few patches of sericite-hematite occur with textures similar to altered plagioclase phenocrysts in JJ-12. Pyrite forms scattered grains and clusters of grains averaging 0.1-0.3 mm in size, with a few up to 1.5 mm across. Most are partly altered to hematite as in JJ-12. Some elongate pyrite patches up to 0.3 mm long are present. Ti-oxide forms patches up to 0.3 mm in size of very fine grained aggregates of grains averaging 0.02-0.05 mm in size. Apatite forms a few subhedral grains averaging 0.15-0.2 mm in size, and subhedral to euhedral prismatic grains from 0.05-0.1 mm in length. A few ragged grains from 0.05-0.15 mm across are present as well. Zircon forms one subhedral stubby prismatic grain 0.07 mm long. Chalcopyrite forms one irregular grain 0.1 mm long.

JJ-30      Porphyritic Diorite (Plagioclase, Hornblende Phenocrysts)  
\*Pyrrhotite

The rock contains phenocrysts of plagioclase and lesser hornblende in a groundmass dominated by plagioclase and K-feldspar. Pyrrhotite is moderately abundant as disseminated patches. Alteration minerals include calcite, actinolite, sericite, and tourmaline.

phenocrysts	
plagioclase	30-35%
hornblende	7- 8
biotite	minor
groundmass	
plagioclase	25-30
K-feldspar	15-20
quartz	2- 3
pyrrhotite	3- 4
Ti-oxide	1½-2
apatite	0.5
tourmaline	½-.1
zircon	trace
sericite	2- 3
chlorite	minor

Plagioclase forms subhedral to euhedral phenocrysts up to a few mm across. Most are equant in shape and show concentric oscillatory zones. Composition is probably andesine. Plagioclase is irregularly altered to patches of epidote up to 1 mm in size; epidote forms about 3-5% of the rock.

Hornblende forms phenocrysts averaging 0.3-0.5 mm in size, with a few prismatic grains from 1 to 1.5 mm in length. It is strongly altered to secondary patches of actinolite with or without calcite; in places calcite is the dominant alteration mineral. Some irregular patches of calcite may be replacements of mafic phenocrysts.

Biotite forms a few phenocrysts up to 1 mm in size. They are completely altered to pale green chlorite plus abundant Ti-oxide and hematite.

The groundmass contains equant grains of plagioclase averaging 0.03-0.05 mm in size with interstitial K-feldspar of similar size. Quartz forms scattered grains averaging 0.03 mm across. Sericite and chlorite form extremely fine grains, in part as an alteration of plagioclase. Locally graphic intergrowths of K-feldspar and quartz are present in grains up to 0.15 mm across.

Pyrrhotite forms irregular patches averaging 0.05-0.2 mm in size. Some are partly altered to secondary pyrite and other Fe-minerals in a typical alteration of pyrrhotite.

Ti-oxide forms patches averaging 0.2-0.3 mm in size composed of extremely to very fine grains.

Apatite forms a few euhedral prismatic grains up to 0.7 mm long and moderately abundant smaller grains averaging 0.1 mm in size.

Tourmaline occurs in one patch 1.5 mm long of grains averaging 0.2-0.3 mm long. Pleochroism is intense from light brown to very dark bluish green.

Zircon forms one grain 0.05 mm long.

JJ-31 Plagioclasite Dike (Well Banded) (Unit 3B)

The rock consists of bands a few mm thick defined by trains of patches of pyrite and Ti-oxide, and possibly by kaolinite-sericite concentrations. The rock tends to break readily into plates parallel to this banding. The rock contains scattered plagioclase phenocrysts (completely altered) in a groundmass of strongly interlocking fine to medium grained plagioclase.

phenocrysts	
plagioclase	2- 2½
groundmass	
plagioclase	80-85
kaolinite	7-10
sericite	2- 3
Ti-oxide	2- 2½
pyrite	0.3

Plagioclase phenocrysts are subhedral prismatic grains averaging 0.7-1 mm in length. They are completely altered to a dense mass of extremely fine grained sericite.

The groundmass is dominated by very irregular interlocking plagioclase grains averaging 0.3-0.7 mm in size. These are slightly altered to extremely fine grained sericite. The texture is unusual, and suggests very rapid cooling as would be expected in a narrow dike.

Kaolinite forms extremely fine grained patches interstitial to and intergrown with plagioclase. Patches generally are less than 0.15 mm in size, and have very irregular outlines against plagioclase. A few patches are up to 1.5 mm across.

Sericite forms irregular flakes scattered through the rock, and commonly associated with borders of plagioclase grains and with kaolinite patches. Flakes average 0.03 mm in size.

Ti-oxide forms irregular patches up to 0.5 mm in size of extremely fine grained, non-reflective grains. Some are associated with pyrite grains from 0.05-0.2 mm in size. Pyrite is moderately to strongly altered to hematite along grain borders. Ti-oxide and hematite patches are oriented in planar zones between plagioclase-rich plates; this texture is more obvious in hand sample than in thin section.

The rock contains plagioclase and sparse quartz phenocrysts in a fine grained groundmass dominated by plagioclase or quartz. Alteration is very strong, with plagioclase phenocrysts completely replaced by kaolinite and minor hematite, and with abundant calcite in the groundmass.

phenocrysts	
plagioclase	15-20%
quartz	one
mafic	one
groundmass	
plagioclase-quartz	50-55
calcite	12-15
Ti-oxide	1½-2
hematite	4- 5
pyrite	1½-2
zircon	one grain
vein	
calcite	3- 5

Plagioclase forms subhedral to euhedral prismatic phenocrysts from 0.5 to a few mm long. They are completely replaced by extremely fine grained aggregates of equant kaolinite flakes and minor dusty to irregular fine grained hematite patches.

Quartz forms one subrounded phenocryst 1.5 mm across.

One mafic? phenocryst 0.6 mm long is present. It may have been a biotite book, which now consists of a very fine grained aggregate of calcite with irregular patches and lenses of hematite.

The groundmass is dominated by fine grained irregular equant grains of plagioclase or quartz. The mineral probably is plagioclase, but its properties are not definitive, and quartz is a possibility. The grains show no twinning, and have a very slight dusty overprint of extremely fine grained sericite.

Calcite forms irregular equant patches averaging 0.02-0.05 mm in size, grading into lenses and veinlets up to 1 mm long. It is more abundant near the major calcite vein than further away.

Ti-oxide forms scattered grains from 0.02-0.05 mm in size, and patches of grains up to 1 mm across.

Hematite forms a dusty to irregular patchy alteration throughout the rock. Locally patches up to 0.7 mm long are present.

Pyrite forms scattered grains and clusters of grains averaging 0.05-0.15 mm in size, with a few up to 0.5 mm across. In the more strongly weathered part of the sample, pyrite is moderately to strongly altered to hematite. Elsewhere pyrite is relatively fresh.

Zircon forms one subhedral prismatic grain 0.1 mm long.

The rock is cut by a medium to coarse grained calcite vein, whose crystals show twinning suggestive of mild deformation.