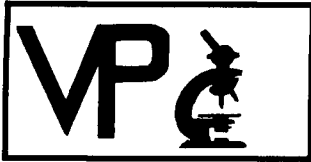


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Samples: 43334 - 43340

Summary:

Samples 43334, 43337, 43338, 43339 and 43340 are of porphyritic, hypabyssal, plagioclase-rich rocks, herein designated hypabyssal diorite to granodiorite. Sample 43339 is strongly brecciated and altered.

Sample 43335 is of an altered gabbro, which was partly replaced by epidote-pyrite-(chalcopyrite) skarn.

Sample 43336 is a skarn dominated by pyrite-actinolite.

Sample 43334 is a hypabyssal porphyritic quartz diorite containing strongly zoned plagioclase phenocrysts and less hornblende phenocrysts in a groundmass dominated by plagioclase and quartz, with less biotite and magnetite, and minor epidote. Early veins of quartz-gypsum-pyrite-epidote-chlorite have halos of sericite/K-feldspar. Later veins are of quartz-gypsum with minor pyrite and chalcopyrite.

Sample 43335 is a medium to coarse grained gabbro which was altered and replaced strongly, probably in a skarn environment. It contains three main zones.

- 1) dominated by actinolite with less epidote and ilmenite/Ti-oxide.
- 2) dominated by plagioclase.
- 3) dominated by epidote and actinolite, with less pyrite, and minor chalcopyrite-(bornite).

Gypsum forms irregular replacement patches and veinlets. The epidote-rich replacement patch and gypsum veinlets are cut by a late breccia zone in which the rock was granulated strongly.

Sample 43336 is a medium to coarse grained, patchy skarn dominated by pyrite and actinolite, with less apatite, magnetite, epidote, and ankerite. Magnetite is earlier than pyrite and chalcopyrite, and actinolite and apatite are earlier than epidote.

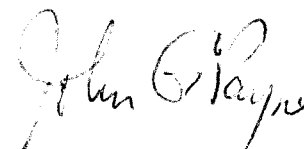
(continued)

Sample 43337 is a **hypabyssal quartz diorite** containing a few phenocrysts of plagioclase and abundant finer plagioclase grains in a sparse groundmass dominated by quartz and biotite/chlorite, with minor epidote, ankerite, apatite, and sphene/Ti-oxide/ilmenite. Veinlets are of a few types, dominated by one or more of chlorite/serpentine, quartz, and epidote.

Sample 43338 is a **hypabyssal pyritic quartz diorite** dominated by fine grained plagioclase with much less biotite and interstitial quartz. Pyrite forms ragged, disseminated grains and skeletal clusters. The hand sample contains a parallel set of fractures; these were not obvious in the thin section.

Sample 43339 is a brecciated and altered **hypabyssal diorite(?)** containing ragged relic plagioclase phenocrysts in an extremely fine grained plagioclase altered strongly to sericite and ankerite. Pyrite and tourmaline are disseminated replacement minerals. The rock was brecciated coarsely, with the matrix being dominated by quartz, with veinlets of ankerite and minor pyrite.

Sample 43340 is a **porphyritic hypabyssal granodiorite** containing phenocrysts of plagioclase in a finer grained groundmass dominated by plagioclase and K-feldspar with minor biotite, ankerite, quartz, and pyrite.


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Sample 43334**Hypabyssal Porphyritic Quartz Diorite; Early Veins of Quartz-Pyrite-Gypsum-Chlorite-Epidote, and Later Vein of Quartz-Gypsum-(Pyrite-Chalcopyrite)**

The rock contains strongly zoned plagioclase phenocrysts and less hornblende phenocrysts in a groundmass dominated by plagioclase and quartz, with less biotite and magnetite, and minor epidote. Early veins of quartz-gypsum-pyrite-epidote-chlorite have halos of sericite/K-feldspar. Later veins are of quartz-gypsum with minor pyrite and chalcopyrite.

phenocrysts	
plagioclase	35-40%
hornblende	4- 5
quartz	minor
groundmass	
plagioclase (coarser)	3- 4
quartz (coarser)	1- 2
plagioclase/quartz (finer)	30-35
biotite	2- 3
magnetite	1- 2
pyrite	1
chlorite	0.3
epidote	0.3
chalcopyrite	minor
apatite	trace
veins	
quartz-pyrite-epidote-chlorite-gypsum(?)	3- 4
quartz-gypsum-(pyrite-chalcopyrite)	7- 8

Plagioclase forms subhedral, equant to prismatic phenocrysts averaging 0.3-0.7 mm in size. Zonation is strong from more-calcic cores (andesine) to more-sodic rims (oligoclase/andesine). Alteration is slight to locally moderate to patches of sericite and lesser ones of epidote, and is concentrated in calcic cores.

Hornblende forms subhedral to anhedral prismatic phenocrysts up to 1.7 mm long. Some grains are altered to pale to medium green, pseudomorphic actinolite, which in places is replaced by extremely fine grained aggregates of chlorite, quartz, and Ti-oxide. Other grains are altered completely to aggregates of chlorite and less epidote, quartz, and Ti-oxide.

Quartz forms a few irregular phenocrysts up to 1 mm in size.

Interstitial to plagioclase phenocrysts are minor anhedral plagioclase and quartz grains averaging 0.07-0.2 mm in size. These are intergrown with interstitial patches of intimate intergrowths of plagioclase and quartz averaging 0.015-0.025 mm in grain size.

Biotite forms ragged, equant flakes averaging 0.2-0.3 mm in size, with a few up to 1.2 mm long. Alteration generally is complete to pseudomorphic chlorite and minor Ti-oxide. A few elongate biotite flakes up to 1.2 mm long are replaced by patches of epidote and less chlorite.

Magnetite forms equant grains averaging 0.05-0.15 mm in size, with a few up to 0.3 mm across. A few are altered slightly to moderately to patches of hematite. A few are replaced partly by pyrite and less chalcopyrite.

Pyrite forms anhedral grains averaging 0.05-0.15 mm in size. Some contain minor to abundant blebby inclusions of chalcopyrite and/or pyrrhotite averaging 0.01-0.02 mm in size.

(continued)

Chlorite forms a few irregular interstitial patches up to 0.3 mm in size.

Epidote forms anhedral patches averaging 0.1-0.2 mm in size.

Apatite forms a grain 0.2 mm long associated with the hornblende phenocryst.

A set of subparallel, early veinlets averaging 0.1-0.3 mm wide are dominated by very fine grained quartz and gypsum, with less pyrite, epidote, and chlorite, and minor chalcopyrite. Gypsum commonly is concentrated in cores of veins, and was removed partly from the section during weathering and/or sample preparation. Veinlets are rimmed by halos up to 2 mm wide in which plagioclase and chlorite are altered to sericite and probably K-feldspar, which give these parts of the stained offcut block a light yellow color. These are offset by the main vein.

The main late vein up to 2 mm wide is dominated by patches of anhedral, slightly interlocking quartz grains averaging 0.2-0.5 mm in grain size, and others of anhedral gypsum aggregates ranging from patches of 0.01-0.02 mm grain size up to others of 0.05-0.1 mm in grain size. Pyrite forms a few anhedral, equant grains up to 0.3 mm across and moderately abundant anhedral grains averaging 0.01-0.03 mm in size, mainly in the gypsum-rich part of the vein. Chalcopyrite forms scattered anhedral grains averaging 0.03-0.5 mm in size in the quartz-rich part of the vein. Molybdenite forms a cluster of ragged flakes averaging 0.01-0.03 mm in length associated with quartz-gypsum. Epidote forms a few anhedral grains up to 0.1 mm in size.

Wispy gypsum veinlets average 0.01-0.02 mm in width; some are associated with the other veins, and some are late.

**Sample 43335 Gabbro/Skarn(?): Actinolite-Epidote-Plagioclase-
Ilmenite-Pyrite-Gypsum; Gypsum Veinlets; Late Breccia Beam**

The sample is a medium to coarse grained gabbro which was altered and replaced strongly, probably in a skarn environment. It contains three main zones. The first (at one end of the section) is dominated by actinolite with less epidote and ilmenite/Ti-oxide. The second (in the center) is dominated by plagioclase. The third (at the other end) is dominated by epidote and actinolite, with less pyrite, and minor chalcopyrite-(bornite). The medium to coarse texture and the presence of abundant ilmenite suggests that the original rock was a gabbro. Gypsum forms irregular replacement patches and veinlets. The epidote-rich replacement patch and gypsum veinlets are cut by a late breccia zone in which the rock was granulated strongly.

actinolite	35-40%	ankerite	1%
epidote	30-35	chlorite	0.5
plagioclase	17-20	gypsum	0.2
pyrite	3- 4	chalcopyrite	0.1
ilmenite/Ti-oxide	2- 3	bornite	trace
veinlets, replacement patches			
gypsum	1		
breccia zone	1- 2		

Actinolite forms ragged prismatic grains averaging 0.3-1 mm in size, with a few up to 2.5 mm long. Pleochroism is from pale to light green. Some grains are replaced partly by irregular patches of epidote in the epidote-rich replacement zone.

Epidote forms patches up to 1.5 mm in size with a variety of replacement textures. Grain size ranges from extremely fine to fine.

Plagioclase forms grains up to 2.5 mm in size. Alteration in the plagioclase-rich zone is moderate to sericite and less epidote. Elsewhere, irregular patches of extremely fine to fine grained epidote probably represent completely altered plagioclase.

Ilmenite forms irregular patches with subrounded borders averaging 0.2-0.5 mm in size. Alteration is variable. At one end of the section, grains are relatively fresh, with minor to moderately abundant plates of Ti-oxide along a few crystallographic directions. With increasing alteration, Ti-oxide ribs are preserved, and ilmenite is replaced by cryptocrystalline silicates. Ilmenite patches may be loci for pyrite replacement in the epidote-pyrite replacement zone.

Pyrite is concentrated at one end of the section, where it forms anhedral grains averaging 0.1-0.5 mm in size. In some patches, pyrite grains are skeletal and intergrown intimately with epidote. Elsewhere it forms discontinuous, wispy veinlets averaging 0.02-0.03 mm wide. A few grains contain blebby inclusions of chalcopyrite or pyrrhotite averaging 0.01-0.02 mm in size; a few chalcopyrite inclusions are from 0.05-0.1 mm long.

Ankerite forms anhedral grains averaging 0.2-0.4 mm in size.

Gypsum forms patches of very fine grains interstitial to epidote.

Chlorite forms a few interstitial patches up to 0.2 mm in size and wispy veinlets up to 0.02 mm wide.

Chalcopyrite forms irregular patches averaging 0.03-0.15 mm in size. Bornite occurs with chalcopyrite as grains averaging 0.02-0.03 mm in size.

Gypsum forms replacement patches and veinlets of grains averaging 0.05-0.1 mm in size. One replacement patch up to 1.5 mm across contains grains up to 0.5 mm in size.

At one end of the sample is an irregular breccia zone up to 0.4 mm wide in which the rock was granulated strongly. This zone cuts the gypsum veinlets.

Sample 43336**Pyrite-Actinolite-Magnetite-Apatite-Epidote-Ankerite
Skarn**

The rock is a medium to coarse grained, patchy skarn dominated by pyrite and actinolite, with less apatite, magnetite, epidote, and ankerite. Magnetite is earlier than pyrite and chalcopyrite, and actinolite and apatite are earlier than epidote.

pyrite	30-35%
actinolite	25-30
magnetite	10-12
apatite	10-12
epidote	8-10
ankerite	5- 7
chalcopyrite	0.1
sphene	*
pyrrhotite	*

Actinolite forms anhedral, commonly ragged, prismatic grains averaging 0.5-1.5 mm in size, with a few up to 3.5 mm long. Color in thin section is pale green. In some patches, actinolite grains appear to be granulated slightly, and in others they appear to be replaced by epidote.

Magnetite forms anhedral grains up to a few mm across. It is strongly granulated, and fragments are enclosed in a matrix of pyrite and less chalcopyrite, and locally of calcite. Locally, magnetite grains are altered in small patches along their margins to hematite.

Pyrite forms patches up to a few mm across. Pyrite/magnetite textures range from pure pyrite grains through pyrite grains with moderately abundant inclusions of magnetite, to magnetite grains with fractures filled by pyrite. Some pyrite grains are intergrown intimately with silicates and some contain moderately abundant inclusions of silicates.

Apatite forms patches up to 2 mm across of aggregates of anhedral to prismatic grains averaging 0.05-0.15 mm in size. Interstitial to apatite in some patches is minor to moderately abundant ankerite, and in a few other patches is minor epidote.

Ankerite forms interstitial grains averaging 0.5-1 mm in size intergrown with actinolite. It forms skeletal grains up to 2 mm across interstitial to and in fractures in sulfide patches and in apatite aggregates.

Epidote forms patches up to a few mm across of anhedral grains averaging 0.05-0.15 mm in size. Commonly it is intergrown with, and may be a replacement of actinolite. In a few patches it is intergrown intimately with apatite. Epidote forms a few discontinuous veinlets up to 0.05 mm wide.

Chalcopyrite forms interstitial patches up to 0.2 mm in size, in part alone and in part associated with pyrite in fractures in magnetite. A few irregular inclusions up to 0.06 mm in size occur in large pyrite grains.

Sphene forms anhedral grains averaging 0.1 mm in size.

Pyrrhotite forms blebby to cusped inclusions averaging 0.01-0.02 mm in size in pyrite.

Sample 43337**Hypabyssal Quartz Diorite; Veins of
Chlorite-Epidote-Ankerite-(Sphene); Quartz**

A few phenocrysts of plagioclase and abundant finer plagioclase grains are set in a sparse groundmass dominated by quartz, and biotite/chlorite, with minor epidote, ankerite, apatite, and sphene/Ti-oxide/ilmenite. Veinlets are of a few types, dominated by one or more of chlorite/serpentine, quartz, and epidote.

plagioclase	82-85%	veins, veinlets	
quartz	7- 8	1) chlorite	1- 2%
biotite/chlorite	4- 5	epidote	1
ankerite	1	ankerite	0.5
epidote	1	sphene	0.2
apatite	0.5	Ti-oxide	minor
sphene	0.3	2) quartz	0.3
Ti-oxide/ilmenite	0.3	epidote	0.1
zircon	*	opaque (pyrite?)	minor

Plagioclase forms a few subhedral, stubby prismatic phenocrysts averaging 1-1.5 mm in size. Alteration is strong to patches of epidote and flakes of sericite. Plagioclase also forms anhedral to subhedral, stubby prismatic to slightly interlocking grains averaging 0.3-0.6 mm in length. Alteration is slight to moderate to disseminated sericite and patches of calcite and of epidote. Plagioclase contains abundant dusty inclusions, giving it a pale brown color in plane light.

Quartz forms anhedral grains averaging 0.1-0.4 mm in size, interstitial to plagioclase.

Biotite forms flakes averaging 0.5-0.8 mm long. Alteration is complete to pseudomorphic chlorite with minor patches of Ti-oxide along cleavage, and minor patches of ankerite and/or epidote disseminated in chlorite.

Ankerite forms interstitial patches up to 1.2 mm in size, generally of single grains or fine grained aggregates.

Sphene forms anhedral to euhedral grains averaging 0.05-0.2 mm in size. Ti-oxide forms clusters of anhedral grains averaging 0.03-0.05 mm in size. Many patches have ragged cores of ilmenite up to 0.05 mm in size.

Apatite forms patches up to 1 mm in size of aggregates of anhedral to subhedral prismatic grains averaging 0.05-0.1 mm in size.

Zircon forms a few subhedral, stubby prismatic grains averaging 0.05-0.07 mm long.

A lensy vein up to 0.7 mm wide is dominated by very fine to fine grained intergrown with patches of subhedral to anhedral epidote, lesser anhedral ankerite, and minor very fine to extremely fine grained sphene and Ti-oxide. Two veinlets up to 0.2 mm wide are of very fine grained chlorite; these are preserved poorly in the section.

A vein up to 0.3 mm wide is dominated by quartz with minor epidote; associated with the vein is a patch of anhedral opaque (pyrite?) grains averaging 0.1-0.4 mm in size.

A few veinlets up to 0.1 mm wide are of one or more of ankerite, chlorite, and epidote.

Sample 43338**Hypabyssal Pyritic Quartz Diorite**

The rock is dominated by fine grained plagioclase with much less biotite and interstitial quartz. Pyrite forms ragged, disseminated grains and skeletal clusters. The hand sample contains a parallel set of fractures; these were not obvious in the thin section.

phenocrysts	
plagioclase	3- 4%
groundmass	
plagioclase	82-85
biotite	4- 5
quartz	3- 4
pyrite	3- 4
apatite	0.3
epidote	0.2
pyrrhotite	trace
Ti-oxide/sphene	trace
zircon	*
veinlets	
calcite	trace

Plagioclase forms a few subhedral to anhedral phenocrysts averaging ranging from 0.5-1.4 mm in size. These are surrounded by anhedral plagioclase grains averaging 0.1-0.5 mm in size. Alteration generally is slight to disseminated flakes of sericite. Less common alteration minerals include patches of calcite and of epidote averaging 0.03-0.07 mm in size.

Biotite forms disseminated, stubby to locally slender flakes averaging 0.1-0.5 mm in size, and one patch 1.5 mm across of a few grains. Alteration is complete, generally to pseudomorphic chlorite with minor to abundant patches of epidote, and less commonly and in smaller flakes to pseudomorphic muscovite. In both alteration types, irregular patches of calcite are common. A few grains are replaced completely by patches of calcite and epidote.

Quartz forms anhedral, interstitial grains and clusters of grains averaging 0.05-0.08 mm in grain size.

Apatite forms a few unusual, subhedral prismatic grains up to 1 mm in length. Some grains appear to be aggregates of grains averaging 0.03-0.05 mm in size in subparallel orientation. Other grains are replaced slightly by very irregular to skeletal patches of calcite.

Epidote forms a few replacement patches up to 0.4 mm in size.

Pyrite forms skeletal clusters up to 1 mm across of very irregular grains averaging 0.05-0.15 mm in size, intergrown with and interstitial to silicates. A few grains are up to 0.5 mm across. Several pyrite grains contain one to a few blebby inclusions of pyrrhotite averaging 0.01-0.02 mm in size.

Ti-oxide forms disseminated grains averaging 0.02-0.05 mm in size. Some are associated with similar grains of sphene.

Zircon forms subhedral, prismatic grains averaging 0.03-0.05 mm long.

Calcite forms a few discontinuous veinlets up to 0.05 mm wide.

Sample 43339**Brecciated and Altered Hypabyssal Diorite(?);
Matrix of Quartz; Veinlets of Ankerite-(Pyrite)**

Ragged relic plagioclase phenocrysts are set in an extremely fine grained plagioclase altered strongly to sericite and ankerite. Pyrite and tourmaline are disseminated replacement minerals. The rock was brecciated coarsely, with the matrix being dominated by quartz, with veinlets of ankerite and minor pyrite.

phenocrysts			
plagioclase	8-10%		
hornblende	minor		
groundmass			
plagioclase	30-35	chlorite	1%
sericite	25-30	Ti-oxide	0.5
ankerite	10-12	chalcopyrite	trace
pyrite	2- 3	tetrahedrite	*
tourmaline	1	magnetite	*
matrix		pyrrhotite	*
quartz	10-12		
ankerite	2- 3		
pyrite	1- 2		
sericite	0.3		

Plagioclase forms anhedral, ragged phenocrysts averaging 0.5-1.5 mm in size. Alteration is moderate to strong to sericite.

Hornblende(?) forms a subhedral phenocryst 0.6 mm long; it is altered completely to ankerite and sericite.

The groundmass is dominated by plagioclase, which is altered strongly to extremely fine grained sericite with ragged patches of extremely fine grained ankerite. Ti-oxide forms disseminated grains averaging 0.005-0.01 mm in size and is concentrated locally in ragged patches up to 0.2 mm in size of similar grains.

Pyrite forms disseminated subrounded to irregular grains and clusters of grains averaging 0.05-0.2 mm in size, with a few up to 0.7 mm across. A small percentage of these contain one or several blebby inclusions of pyrrhotite averaging 0.007-0.015 mm in size. A moderate percentage contain abundant tiny inclusions of silicates.

Tourmaline forms disseminated prismatic grains and clusters, in part radiating, of a few grains averaging 0.1-0.2 mm in length. A few dense patches consist of unoriented, stubby prismatic grains averaging 0.03-0.07 mm in length. Most single tourmaline grains and those in radiating clusters and dense patches are colorless; in most subradiating clusters tourmaline grains are pleochroic from pale to medium green.

Chlorite forms a few irregular replacement(?) patches up to 2 mm in size, which contain minor disseminated Ti-oxide.

Chalcopyrite forms an anhedral patch 0.2 mm across. Tetrahedrite occurs on the borders of this patch as several anhedral grains averaging 0.01-0.03 mm in size.

Magnetite forms a few ragged relic grains averaging 0.05-0.08 mm in size.

Quartz occurs mainly in irregular replacement patches with diffuse borders against the host rock. Grain size averages 0.03-0.1 mm, and varies moderately between patches. In a few patches, grains are strongly interlocking and average 0.01-0.015 mm in size. Sericite forms extremely fine grained seams and patches. Ankerite is most common in irregular veins averaging 0.2-0.4 mm wide; locally these veins contain pyrite grains up to 0.5 mm long.

Sample 43340**Porphyritic Hypabyssal Granodiorite;
Ankerite Veinlets**

Phenocrysts of plagioclase are set in a finer grained groundmass dominated by plagioclase and K-feldspar with minor biotite, ankerite, quartz, and pyrite.

phenocrysts	
plagioclase	40-45%
groundmass	
plagioclase	25-30
K-feldspar	15-17
ankerite	3- 4
biotite	3- 4
quartz	2- 3
pyrite	1- 2
pyrrhotite	*
veinlets	
ankerite	minor

Plagioclase forms subhedral, prismatic phenocrysts averaging 0.3-0.8 mm in size, with a few up to 1.7 mm long. Alteration is moderate to disseminated and patchy sericite and ragged patches of ankerite.

Interstitial to coarser grained plagioclase are extremely fine grained intergrowths of plagioclase and K-feldspar and ragged patches of ankerite. Plagioclase is altered slightly to sericite.

Biotite forms ragged flakes averaging 0.15-0.5 mm in size, with a few up to 1.8 mm long. Alteration is complete to carbonate (ankerite and or calcite) with minor to moderately abundant chlorite or muscovite and minor Ti-oxide. Most large grains are replaced by single grains or a few grains of calcite whose texture reflects some of that of the original biotite grains.

Quartz forms interstitial grains averaging 0.05-0.2 mm in size, and locally up to 0.7 mm long. A few interstitial patches up to 0.2 mm in size are of extremely fine grained, slightly interlocking aggregates of quartz.

Pyrite forms anhedral grains averaging 0.05-0.2 mm in size. It is concentrated moderately in patches surrounding coarser biotite grains. A few pyrite grains contain one or two blebby inclusions of pyrrhotite averaging 0.01 mm in size.

Veinlets averaging 0.05-0.07 mm in width are dominated by ankerite grains averaging 0.03-0.07 mm in size.