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Samples: RSH-ROD-1, RSH-ROD-2

Summary:

The rocks are from an intermediate to felsic volcanic environment, in which the magma shows strong fractionation between phenocrysts and groundmass. Phenocrysts are of plagioclase, hornblende, and K-feldspar, with minor ones of sphene and apatite. The groundmass is dominated by K-feldspar. Moderate alteration and replacement has produced patches dominated by one or more of quartz, pyrrhotite, pyrite, calcite/ankerite, tremolite, and chlorite.

RSH-ROD-1 latite lapilli tuff: many different types of fragments from 2-15 mm in size: latite, andesite, diorite, and a variety of alteration types, phenocrysts of K-feldspar and minor apatite and sphene (plagioclase phenocrysts in some fragments)

RSH-ROD-2 porphyritic alkali latite, with phenocrysts of plagioclase, hornblende, K-feldspar, and minor apatite in a groundmass dominated by K-feldspar with minor plagioclase and quartz; patches of pyrrhotite (altered to hematite) and of pyrite; veinlets of calcite-quartz.


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The rock contains fragments averaging 2-15 mm in size of a wide variety of andesites and latites, as well as patches of secondary replacement in a sparse to moderately abundant K-feldspar-rich groundmass as in RSH-ROD-2. The abundance of different fragment types could not be estimated accurately. Because of the inhomogeneous composition of the rock, this is not as significant as the fact that they are present.

phenocrysts	
K-feldspar	2- 3%
apatite	0.5
sphene	0.3
fragments	60-65
replacement patches	15-17
groundmass	
K-feldspar	15-17
plagioclase	1- 2
quartz-opaque	1- 2
chlorite	0.5
sphene	0.2
carbonate	0.3
Ti-oxide	0.1

K-feldspar forms a few elongate prismatic phenocrysts up to 3.5 mm in length. Apatite is concentrated locally as subhedral prismatic grains up to 0.6 mm in length. Sphene forms a few subhedral grains from 0.3-0.9 mm in size; some contain tiny ilmenite inclusions, in part concentrated near borders of grains.

Several fragments up to 5 mm across contains K-feldspar phenocrysts up to 3 mm long and minor altered hornblende phenocrysts up to 1.2 mm long in a groundmass dominated by subparallel, lathy plagioclase grains averaging 0.1 mm in length, with lesser interstitial, finer grained plagioclase and irregular replacement patches of calcite/ankerite. Hornblende is altered to chlorite-calcite-(opaque). Some of the carbonate patches in the groundmass probably are secondary after original hornblende. Apatite forms several subhedral phenocrysts up to 0.5 mm in size. Sphene forms a few anhedral, disseminated grains up to 0.2 mm in size.

One fragment 1.8 mm across consists of anhedral K-feldspar grains averaging 0.2-0.8 mm in size surrounded by very fine grained, interlocking aggregates of K-feldspar, which may have formed by granulation and partial recrystallization of the coarser grains.

One fragment up to 2 mm across of fine grained diorite(?) is dominated by anhedral to subhedral plagioclase grains averaging 0.2-0.5 mm in size, with interstitial patches of calcite, and replacement patches up to 1.5 mm in size of very fine grained, strongly interlocking opaque and quartz. It contains a few ragged patches up to 0.5 mm across of ilmenite surrounded by abundant extremely fine grained Ti-oxide.

One fragment 2 mm across contains abundant subhedral plagioclase grains from 0.1-0.4 mm in size and minor sphene grains up to 0.1 mm in size in an extremely fine grained groundmass of plagioclase moderately replaced by calcite.

One fragment a few mm across is dominated by medium grained, anhedral plagioclase grains with much less extremely fine to very fine grained groundmass of plagioclase-(quartz). It contains abundant irregular to skeletal interstitial patches of calcite up to 1.7 mm in size, and moderately abundant interstitial patches of chlorite and of sphene-ilmenite averaging 0.1-0.2 mm in size, with a few patches up to 0.6 mm long. Ilmenite forms abundant tiny cores surrounded by sphene.

One patch 2 mm across is dominated by interlocking, very fine grained quartz, K-feldspar, and opaque, with lesser actinolite, chlorite, apatite, and sphene. It probably is of replacement origin.

A few patches up to 4 mm across consist of aggregates of strongly interlocking, very fine to fine grained chlorite, calcite, and opaque, with lesser interstitial quartz. These may be secondary after mafic aggregates or may represent replacement patches in the groundmass.

One patch 3.5 mm across is dominated by anhedral, very fine to fine grained calcite with abundant ragged, unoriented, elongate prismatic grains of tremolite averaging 0.2-0.3 mm in length, and minor interstitial quartz.

One fragment 3 mm long consists of subradiating aggregates of prismatic tremolite grains averaging 0.05-0.1 mm in length, with a few up to 0.3 mm long. Extremely fine grained feldspar forms minor to locally moderately abundant interstitial patches. One fragment 1.4 mm long consists of an aggregate of anhedral apatite grains averaging 0.03-0.05 mm in size, with lesser interstitial calcite and fluorite(?).

The groundmass is dominated by anhedral, strongly interlocking, feathery K-feldspar grains averaging 0.01-0.3 mm in size, with minor to locally moderately abundant plagioclase of similar or slightly coarser grain size. Ankerite forms very irregular replacement patches up to 5 mm in size of skeletal grains up to 3 mm in size.

Quartz and opaque form replacement patches up to 1 mm in size in the groundmass; these consist of grains averaging 0.05-0.15 mm in size.

Apatite forms disseminated, subhedral grains averaging 0.1-0.15 mm in size.

Sphene forms disseminated subhedral to locally euhedral grains up to 0.4 mm in size, and one elongate grain 0.9 mm long.

Sulfides are dominated by pyrrhotite (3-4%) with minor intergrown patches of chalcopyrite averaging 0.03-0.05 mm in size. Pyrite forms minor subhedral grains from 0.1-0.25 mm in size. Some pyrite grains contain abundant tiny silicate inclusions.

The rock is cut by a few late, discontinuous veinlets up to 0.2 mm wide of carbonate. Associated with a narrow one of these is a cluster of euhedral pyrite grains averaging 0.03-0.07 mm in size.

The rock contains phenocrysts of plagioclase, hornblende, and K-feldspar in an extremely fine grained groundmass dominated by K-feldspar with minor patches rich in quartz-(pyrrhotite). The contrast of phenocryst and groundmass composition indicates strong fractionation in the magma. Braided veinlets are of calcite-quartz.

phenocrysts	
plagioclase	17-20%
hornblende	10-12
K-feldspar	4- 5
apatite	0.3
groundmass	
K-feldspar	50-55
plagioclase	5- 7
quartz	2- 3
tremolite-chlorite-calcite patches	2- 3
pyrrhotite	0.7
pyrite	0.5
apatite	0.5
chalcopyrite	trace
veinlets	
calcite-quartz	1

Plagioclase forms euhedral to subhedral phenocrysts averaging 0.2-1 mm in size, with a few up to 2.5 mm across. Alteration is slight to dusty to extremely fine grained sericite, and locally to patches of chlorite or calcite. A few contain irregular replacement(?) patches of K-feldspar. Phenocrysts grade downwards in size to disseminated anhedral grains in the groundmass averaging 0.05-0.1 mm in size.

Hornblende forms euhedral to subhedral, prismatic phenocrysts averaging 0.7-2 mm in size. Alteration is in part to pseudomorphic tremolite/actinolite, and more commonly to aggregates of chlorite, calcite, and quartz in varying proportions, with minor Ti-oxide and locally abundant epidote. In many strongly altered grains, original hornblende textures are vaguely to moderately preserved. In a few altered grains dominated by quartz, original textures, except for crystal outlines are destroyed.

K-feldspar forms euhedral, commonly prismatic phenocrysts averaging 0.5-1.5 mm long. They contain moderately abundant dusty opaque inclusions, which along with the absence of sericite alteration, distinguishes them from plagioclase. Some K-feldspar phenocrysts contain irregular inclusions of plagioclase, whose textures suggest that these phenocrysts were in part at least formed by replacement of plagioclase. Elsewhere, plagioclase and K-feldspar phenocrysts are adjacent along sharp contacts, indicating that both minerals were formed as primary phenocrysts.

Apatite forms a few euhedral to subhedral, prismatic phenocryst up to 0.4 mm in length.

The groundmass is dominated by an interlocking aggregate of K-feldspar grains averaging 0.01-0.03 mm in size.

Quartz is concentrated in a few equant to irregular patches up to 1 mm in size as anhedral grains averaging 0.05-0.1 mm in size. A few large patches contain abundant irregular pyrrhotite grains from 0.05-0.2 mm in size.

Bordering some hornblende phenocrysts and in disseminated patches in the groundmass are distinct to ragged patches averaging 0.2-0.7 mm in size of very fine grained tremolite-chlorite-calcite.

Pyrite forms anhedral to subhedral, equant grains and clusters averaging 0.05-0.15 mm in size, with a few up to 0.8 mm across.

Pyrrhotite forms anhedral grains averaging 0.1-0.5 mm in size. Many are altered secondary marcasite/pyrite, which in turn is altered strongly to opaque hematite and reddish-orange brown hematite/limonite.

Chalcopyrite is concentrated in a few patches as anhedral grains averaging 0.01-0.02 mm in size disseminated in the groundmass.

Apatite forms disseminated anhedral to euhedral, equant to prismatic grains averaging 0.03-0.1 mm in size. These grade upwards to coarser grains described above.

Braided veinlets up to 0.2 mm wide consist of very fine to fine grained calcite and quartz.