

SAMPLE NUMBER: MAC 33 622279 250.0 m

SUMMARY: This rock is a monomict basaltic lava breccia derived from a poorly augite-phyric basalt, with distinctive large reacted and rounded plagioclase xenocrysts.

HAND SPECIMEN:

This is a dark grey-green and strongly altered apparently polymict basaltic to andesitic lava breccia with fragments to at least several cm long

THIN SECTION DESCRIPTION:

This sample is a basaltic lava breccia, and despite the appearance in hand specimen strongly suggesting a polymict origin, thin section examination shows that it is a monomict lava breccia. The apparent variation in hand specimen of the lava fragments is attributable to variable styles and intensities of alteration. The rock was an augite-phyric basalt with occasional altered olivine phenocrysts and very distinctive and unusual strongly resorbed plagioclase phenocrysts. The augite phenocrysts make up about 2 modal% of the rock and are mainly small (<0.5mm long), although occasional larger euhedral crystals to 2mm long are present. Augite phenocrysts are mainly fresh stubby prisms, often in clots of three or four crystals, although some clots composed of more than twenty crystals are also present. Former olivine phenocrysts are mainly smaller than 1 mm long and are not very common; they are replaced by polycrystalline quartz and minor chlorite. There are quite a few rather large (to 3mm long) strongly rounded and reacted (resorbed) former plagioclase phenocrysts (albitized) in this lava breccia that are obviously out of equilibrium in this magma. They occur within fragments, not between fragments, and are clearly xenocrystal, probably derived from pre-existing dacitic magmas that used the same plumbing as this basaltic magma. The groundmass of the lava fragments varies slightly in texture from devitrified to spherulitic glass with tiny albite microlites and more granular augite crystals, to slightly more slowly-cooled basalt in which the devitrified glass is far more strongly charged with oriented and stouter plagioclase microlites.

The fragments in this sample have very diffuse and reacted margins against the inter-fragment matrix. The latter varies significantly in texture from rather coarse-grained polygonal quartz - prehnite-hematite intergrowths in most recrystallized areas, to more typical still relatively coarse-grained quartzo-feldspathic intergrowths with abundant interstitial and patchy chlorite.

This sample may have been the quenched and autobrecciated (hydrofractured) upper part of a basaltic lava flow that has suffered moderate hydrothermal alteration (mainly silica-alteration).

SAMPLE NUMBER: MAC 33 622280 320.8m.

SUMMARY: This rock is a rather well-preserved plagioclase+ augite-phyric dacitic lava with rare resorbed quartz and hornblende phenocrysts, and a low-grade regional burial metamorphic assemblage.

HAND SPECIMEN:

This is a pale grey, massive, plagioclase-phyric dacitic lava with diffuse patchy silica alteration of the groundmass, and calcite-quartz veinlets.

THIN SECTION DESCRIPTION:

The protolith of this sample was probably very close mineralogically and texturally to sample 622286, being a sparsely plagioclase-phyric almost trachytic-textured lava with occasional augite microphenocrysts. However, the presence of a few distinct reacted and resorbed quartz phenocrysts or xenocrysts is one difference from 622286. Plagioclase phenocrysts make up about 1-2 modal% of this sample, and are small tabular to blocky albitized prisms, and augite phenocrysts are much less common fresh small (<0.3mm long) equigranular prisms. Two small resorbed phenocrysts of pleochroic hornblende are present, with ultra fine-grained reaction rims.

The groundmass of this sample was vitrophyric, composed of abundant tiny albite microlites and far less abundant tiny granular augite crystals set in devitrified glass. The latter has recrystallized to a very fine-grained rather murky quartzofeldspathic material containing tiny fluffy leucoxene grains. Occasional small vesicles and tension gashes are filled by coarse-grained polycrystalline quartz and some fibrous epidote and pale green chlorite.

This is a well-preserved plagioclase+augite-phyric dacitic lava with a low-grade burial metamorphic mineral assemblage (albite-chlorite-silica-epidote-leucoxene).

SAMPLE NUMBER: MAC 33 622281

340.4 m

SUMMARY: This rock is a former sparsely plagioclase-phyric dacitic to rhyolitic lava breccia or hyaloclastite in which the brecciated texture has been enhanced by strong hydrothermal silica alteration.

HAND SPECIMEN:

This is a strongly hydrothermally altered felsic lava breccia with dark clasts of plagioclase-phyric lava in a silica-altered matrix. Some clasts are several cm across.

THIN SECTION DESCRIPTION:

This sample is a former dacitic to rhyolitic lava breccia or hyaloclastite that has suffered strong 'false brecciation' and hydrothermal alteration. Fragments are widely dispersed, angular, and consist of a few modal% of small albitized plagioclase phenocrysts (<1 mm across) and a single obvious quartz phenocryst, in a vitrophyric groundmass charged with tiny albite microlites set in devitrified glass. Epidote fans and granules are common in many plagioclase phenocrysts. The latter has recrystallized to an exceptionally fine-grained, low-birefringent silica-chlorite-leucoxene material with occasional spots of secondary quartz and patches of epidote.

The matrix in which the lava fragments are immersed consists of relatively coarse-grained polycrystalline silica containing subordinate anhedral albite grains and pale green chlorite. Less abundant phases in the silica-rich matrix are crystalline epidote in the most coarse-grained areas and segregations, sometimes intergrown with not uncommon red hematite.

The angular sharply-bounded fragments in this sample (though not all) suggest that this was a hyaloclastitic lava breccia. Subsequent quite strong hydrothermal alteration has enhanced the brecciation, leading to silica flooding and further disaggregation of the lava breccia.

SAMPLE NUMBER: MAC 33 622282

362.8m

SUMMARY: This rock is an augite+sparingly olivine-phyric basaltic lava with a prehnite-pumpellyite grade regional metamorphic overprint.

HAND SPECIMEN:

This is a very sparsely vesicular, finely augite-phyric basaltic lava.

THIN SECTION DESCRIPTION:

This sample is a texturally very well-preserved augite+sparingly olivine-phyric basaltic lava. About 5-8 modal% of the sample is made up of small prismatic euhedra of perfectly fresh augite phenocrysts and microphenocrysts. Many of these show significant compositional zoning, and multi-crystal clots of smaller, more anhedral or subhedral crystals are common. Small (<0.5mm long) euhedral former olivine phenocrysts make up <<<1 modal% of the rock, and are totally replaced by polycrystalline silica. There are no plagioclase phenocrysts or microphenocrysts in this sample.

The groundmass of this rock contains a few vesicles filled by polycrystalline quartz, hematite and epidote, and a few discontinuous, en echelon streaks of strained polycrystalline calcite. The groundmass consists of abundant tiny acicular to microlitic albitized plagioclase laths and less abundant small granular equidimensional augite all set in devitrified glass. The latter has recrystallized to anhedral quartz patches with subordinate chlorite and tiny fluffy leucoxene spots.

This is an augite-phyric basaltic lava typical of the Hellyer basalt, with a low-grade regional burial metamorphic overprint.

SAMPLE NUMBER: MAC 33 622283

427.3m

SUMMARY: This rock is a plagioclase-phyric acid andesite lava with an unusual formerly vitrophyric groundmass texture.

HAND SPECIMEN:

This is a massive slightly plagioclase-phyric basaltic to andesitic lava with occasional epidote segregations.

THIN SECTION DESCRIPTION:

This sample is a massive moderately plagioclase-phyric andesitic lava with about 8-10 modal% of albitized plagioclase phenocrysts that are mainly discrete tabular prisms less than 1 mm long, occasionally containing granular epidote inclusions and patchy hematite dust. There are no clear former mafic phenocrysts.

The groundmass texture of this sample is most unusual, with blebby areas to about 2mm across with trachytic textures that look almost like lapilli. These blebs often have cores of polycrystalline secondary quartz. Interstitial areas between the rounded blebs make up from about 5 to 15 modal% of the rock, and are much darker coloured, being composed of an exceptionally fine-grained messy epidote-rich aggregate with minor chlorite, that overprints the original texture. Perfectly rounded vesicles are present throughout the rock, making up a few modal% of the sample, and being filled by radiating secondary quartz. Several quartz-epidote veinlets cut the sample, and carry a small amount of rather yellow Fe-rich sphalerite

This rock is probably a vitrophyric-textured lava of acid andesite composition, judging by the abundance of epidote and the hand specimen appearance. .

SAMPLE NUMBER: MAC 33 622284

438.2m

SUMMARY: This rock is formerly glassy acid andesite to dacite lava breccia that has suffered hydrothermal alteration that produced false brecciation accompanied by silica-chlorite alteration.

HAND SPECIMEN:

This is an almost black autobrecciated or false brecciated felsic lava breccia with common small plagioclase phenocrysts.

THIN SECTION DESCRIPTION:

This sample is a very complex lava breccia that has suffered strong silica alteration and accompanying 'false' brecciation. The rock was probably initially a lava breccia, with jigsaw fit fragments of moderately plagioclase-phyric acid andesite lava. Some of these have well-preserved perlitic cracks preserved, attesting to the originally glassy nature of this lava breccia. In most of the fragments, plagioclase phenocrysts and microphenocrysts make up about 3-5 modal% of the rock and are small (< 1 mm) tabular albitized crystals with variably intense very fine-grained messy epidote overprinting. The groundmass of the best-preserved fragments is a mosaic-textured very fine-grained quartzo-feldspathic intergrowth with tiny albite microlites throughout. A few fragments are strongly chlorite-altered, although these are usually smaller than the well-preserved fragments. The inter-fragment areas are coarser-grained and cleaner quartz-dominated intergrowths, and fragments no longer show any evidence of jigsaw fit, and have been thoroughly disaggregated.

This sample was probably a polymict, glassy, plagioclase-phyric acid andesite to dacite lava breccia. Initial chlorite-silica hydrothermal alteration of fragment margins and inter-fragmental areas was followed by silica flooding and further disaggregation of the original breccia texture.

SAMPLE NUMBER: MAC 33 622285

468.2 m

SUMMARY: This rock is a hydrothermally-altered sparsely plagioclase-phyric dacitic hyaloclastite in which the brecciation has been enhanced by the passage of, and alteration by the hydrothermal fluids, that produced silicification of matrix areas.

HAND SPECIMEN:

This is a hydrothermally altered (partially silicified) dacitic to andesitic lava breccia or hyaloclastite with pinkish ultra-fine-grained silica in more intensely altered areas between darker green lava fragments that are up to several mm long.

THIN SECTION DESCRIPTION:

This sample is, in many respects, very similar to the altered hyaloclastite 622289. It consists of darker coloured fragments from 1cm to <1mm of perlitically-cracked, formerly glassy lavas containing around 1-2 modal% of small, tabular albitized plagioclase phenocrysts to about 0.3mm long. The once-glassy groundmass of these fragments has devitrified and recrystallized to either a murky strongly chlorite-altered material containing tiny albite microlites, or else to a clearer fine-grained quartzo-feldspathic aggregates with limited sericite-calcite overprint. In the chloritized areas, the perlitic cracks are picked out by trails of quartz.

The formerly glassy lava fragments are immersed in a pervasive 'matrix' of rather cleaner, sugary quartzo-feldspathic material that contains occasional quartz-chlorite spots, and common larger areas of calcite overprinting. In much of this section, the matrix is volumetrically far more abundant than the fragments. This sample was initially a hyaloclastite or subaqueous chill breccia in which the brecciation has been enhanced during hydrothermal alteration.

SAMPLE NUMBER: MAC 33 622286

495.3m

SUMMARY: This rock is a trachytic-textured dacitic lava with a low-grade burial metamorphic overprint.

HAND SPECIMEN:

This is a grey to pinkish grey altered felsic to intermediate near aphyric lava with a few small calcite veinlets.

THIN SECTION DESCRIPTION:

This sample is a sparsely plagioclase-phyric trachytic-textured dacitic to acid andesite lava. Small tabular prismatic phenocrysts of albitized plagioclase to about 1 mm maximum length make up around 1-2 modal% of the rock, and contain abundant chlorite inclusions. Some are overprinted by dusty prehnite and intergrown calcite. There were apparently no mafic silicate phenocrysts in this sample, but small FeTi oxide microphenocrysts are scattered through the rock and are altered to an intergrowth of chlorite, magnetite and sphene.

The groundmass of this sample is a fine-grained aggregate composed of small oriented albite laths set in volumetrically subordinate devitrified glass that has recrystallized to a quartz-feldspathic intergrowth. This produces a rather swirling pilotaxitic or trachytic texture, interrupted by segregations of anhedral secondary quartz that occasionally coalesce to form veinlets of polycrystalline quartz. Small blebs and patches of chlorite are not uncommon through the groundmass, but the sample shows no sign of significant chlorite (hydrothermal) alteration. A few calcite veinlets cut the sample and one thicker vein (7mm wide) consists of intergrown calcite and quartz, with at least one crystal of barite growing in the vein.

This is a low-grade burial metamorphosed, sparsely plagioclase-phyric dacitic lava.

SAMPLE NUMBER: MAC 33 622287

503.2m

SUMMARY: This rock is a formerly glassy, very well-preserved plagioclase-phyric dacitic lava with a low-grade regional burial metamorphic alteration assemblage.

HAND SPECIMEN:

This is a dark red plagioclase-phyric massive felsic lava.

THIN SECTION DESCRIPTION:

This sample is a plagioclase-phyric texturally rather distinctive dacitic to rhyolitic lava. It consists of around 5-8 modal% of albitized plagioclase phenocrysts set in a formerly glassy groundmass. The plagioclase phenocrysts are mainly less than 1 mm long, and usually occur in multi-crystal clots up to a few mm across. There is no convincing evidence for the original presence of any mafic phenocrysts in this lava.

The groundmass of this rock was originally glassy to spherulitic, and is composed of a very clean quartzo-feldspathic intergrowth dominated by tiny microlites of albite that merge at their margins into the anhedral quartzo-feldspathic intergrowth that makes up most of the groundmass. Throughout the groundmass there are abundant small to several mm-sized angular fracture fillings and irregular patches of secondary quartz and unusually crystalline sericite (muscovite?) and sphene. The latter is perfectly euhedral and up to almost 1 mm long crystals in places.

This is a very well-preserved formerly glassy dacitic lava.

SAMPLE NUMBER: MAC 33 622288

524.0m

SUMMARY: This rock is a perlitically-cracked, formerly glassy, sparsely plagioclase-phyric dacitic lava.

HAND SPECIMEN:

This is a dark green sparsely plagioclase-phyric dacitic lava with quite clearly visible perlitic cracking.

THIN SECTION DESCRIPTION:

This sample is a well-preserved dacitic lava with about 3-5 modal% of albitized plagioclase phenocrysts in a perlitically-cracked groundmass. The plagioclase phenocrysts are up to several mm long, and occur as subhedral to euhedral, prismatic to blocky crystals, often aggregated in clots of three or four crystals. They are generally slightly sericite altered. Small euhedral to subhedral former augite phenocrysts, mainly less than 0.4mm long, are not uncommon, although most occur interstitially in clots of plagioclase phenocrysts. They are invariably altered to green chlorite. The same applies to small FeTi oxide phenocrysts that are altered to messy leucoxene.

The groundmass of this sample was undoubtedly originally glassy, and preserves abundant areas of strong perlitic cracking, in which the cracks are defined by fine-grained chloritic aggregates separating domains of fine-grained quartzo-feldspathic material after original glass. Tiny albite microlites are scattered in the quartzo-feldspathic material after glass. Other components in the altered glass are quite common fine-grained flaky chlorite and very fine-grained fluffy leucoxene granules. The distribution of groundmass chlorite is rather patchy, and in some parts of the thin section it is quite intensely developed. Narrow quartz- and quartz-calcite veinlets are not uncommon, and the latter define faults along which the quartz veins have been offset by up to a cm. Small trails and aggregates of an unidentified opaque phase (probably pyrite) are present throughout the groundmass, although they are modally insignificant.

This is a well-preserved formerly glassy dacitic lava.

SAMPLE NUMBER: MAC 33 622289

625.5m

SUMMARY: This rock is a hyaloclastite or hydrofractured dacitic lava breccia derived from a plagioclase-phyric dacitic lava.

HAND SPECIMEN:

This is a plagioclase-phyric mid-grey weakly autobrecciated dacitic lava with fragments up to 2cm across, but mostly much smaller.

THIN SECTION DESCRIPTION:

This sample in thin section was clearly a glassy dacitic lava that suffered limited hydrofracturing during eruption and cooling. Cores of fragments show well-preserved perlitic cracks, and in these best preserved areas, the rock can be seen to be composed of around 5 modal% of albitized plagioclase phenocrysts that commonly contain abundant inclusions of granular yellow epidote and minor chlorite. No convincing former mafic silicate phenocrysts are present, and occasional small FeTi oxide phenocrysts are altered to leucoxene. The groundmass of these fragments was glassy, and has perlitic cracks preserved by narrow lines of chlorite; the glass has recrystallized to a fairly fine-grained murky quartzo-feldspathic intergrowth. Other less well-preserved fragments show no perlitic cracks and a heavy overprinting by very fine-grained, messy epidote.

The 'matrix' areas between fragments are clearer or 'cleaner' than the fragments themselves, probably due to some degree of silicification of the former granulated glass that probably existed along the fragment boundaries and in the cracks produced between fragments during hyaloclastitic brecciation. The texture of the matrix areas is little different from that of the fragments, except that the secondary sugary quartz grains are slightly coarser-grained. No jig-saw fit fragments are obvious, so the sample protolith was probably brecciated during eruption to the extent that fragments were disaggregated. The low-grade burial metamorphic assemblage is prehnite-pumpellyite facies.

SAMPLE NUMBER: 622276 MAC-33, 676m

SUMMARY:

This is a weakly hyaloclastic silicic andesitic lava in which the original brecciation has been enhanced by later low-grade hydrothermal alteration.

HAND SPECIMEN:

This is a dark grey plagioclase-phyric dacitic lava that shows a feint hyaloclastitic or pseudo-brecciated texture.

THIN SECTION:

This is a plagioclase-phyric formerly glassy lava with abundant well-preserved areas of perlitic cracking separated by domains in which the original perlitic texture has been disrupted due to more intense alteration related to fluid focussing.

The rock consists of around 3-5 modal% of fairly small, mainly euhedral albitized plagioclase phenocrysts (<1mm long) that sometimes occur in clots of two or three crystals. Many have distinctive rows of chloritized melt inclusions, and small fans of prehnite are not uncommon replacing parts of plagioclase phenocrysts and small areas of groundmass. There are no former mafic phenocrysts in this sample, and the not uncommon small phenocrysts of FeTi oxide are totally replaced by messy leucoxenitic intergrowths.

The groundmass of this sample was undoubtedly entirely glassy, as perlitic cracks are well preserved and picked out by very fine-grained chlorite. The abundance of chlorite decreases sharply into inter-fragment domains, that are dominated by very fine-grained silica and sericite. This has produced a texture in both hand specimen and thin section in which it is very difficult to decide whether the rock was originally composed of angular glassy lava fragments (a hyaloclastite) or whether the texture is a false brecciation due to hydrothermal alteration. The alteration is fairly low-grade, and dominated by silica. A few small veinlets of calcite transect the slide, and a number of small trails of very fine-grained euhedral magnetite or pyrite are also present.

I think that this rock was probably from the upper portion of a cooling unit, and that it cracked and shattered, without being too disaggregated, during eruption in water. The cracks focussed later hydrothermal alteration, which enhanced the original vague brecciated texture (hyaloclastitic?) to produce what is best classified as a false brecciated texture.

The abundance of chlorite in this sample is certainly more than I would expect to see in a 'normal' Que-Hellyer dacite, and suggests that this rock is more probably a silicic andesite.

SAMPLE NUMBER: MAC 33 622290

733.6m

SUMMARY: This rock is a plagioclase+sparsely augite-phyric dacitic lava with a low-grade (chlorite-sericite-albite-silica) burial metamorphic assemblage.

HAND SPECIMEN:

This is a mid- to dark green, sparsely plagioclase-phyric andesitic lava with abundant small chlorite spots and at the edge of the thin section chip, a darker green lithic fragment (or possibly contact with an adjacent flow).

THIN SECTION DESCRIPTION:

This sample is a plagioclase +sparse augite-phyric andesitic to dacitic lava with around 10-12 modal% of plagioclase phenocrysts and probably less than one modal% of altered augite phenocrysts. The plagioclase phenocrysts vary from blocky to tabular prisms that often occur in clots of three or four crystals, reaching a few mm in size. They are usually fairly strongly overprinted by sericite. Former augite phenocrysts are mainly smaller than 0.5mm long, with distinctive stubby prismatic euhedral shapes, and all are pseudomorphed by green chlorite. Former FeTi oxide phenocrysts are altered to leucxenitic aggregates. A number of lithic fragments are present in the section. The largest is more than 1cm across and is composed of a quenched intergrowth of long, bladed albitized plagioclase and chloritized augite crystals. Two others are composed of small euhedral plagioclase and chloritized augite crystals and appear to be small, cognate microgabbroic clots, probably ripped from the walls of the conduit during passage of this lava to the surface.

The groundmass of this sample was probably mainly glassy, with a common indistinct patches in which tiny plagioclase microlites had nucleated. The glass has devitrified to a very fine-grained quartzo-feldspathic intergrowth that is quite heavily laced by a mesh of sericite, and also contains common small clots of chlorite and leucxenitized opaques. Some meandering stylolitic pressure solution boundaries transect the rock, and are defined by concentrations of altered insoluble oxides.

This is a low-grade burial metamorphosed dacitic lava, probably transitional to an acid andesite.