

SAMPLE NUMBER: 622351 MAC 30

57.8m

SUMMARY: This is a quite strongly altered augite-phyric basaltic breccia derived from a quench-fragmented flowtop. Alteration is variable, with a localized epidosite alteration and a more pervasive silica (\pm chlorite) alteration.

HAND SPECIMEN:

This is a dark porphyritic basaltic breccia with variably altered fragments to at least 6-8 cm across. A zone of lighter coloured intense epidote-dominated alteration is present at one end of the block, and has minor fuchsite I think.

THIN SECTION:

This sample in thin section contains essentially two petrographic domains, reflecting different styles of alteration. It is likely that this was a monomict basaltic lava breccia, with fragments derived quench fragmentation from the same eruptive unit. The basalt was strongly augite-phyric, with less abundant phenocrysts of plagioclase and olivine, set in a variably glassy to vitrophyric groundmass. Augite phenocrysts are mainly still fresh, make up about 10 modal% of the sample, and are frequently fractured euhedra to about 1.5-2mm long that show strong compositional zoning. They are occasionally altered to pale green chlorite. Former olivine phenocrysts make up less than 1 modal% of the rock and are totally altered to intergrowths of chlorite and polygonal quartz. Former plagioclase phenocrysts are albitized, and many are riddled with very fine-grained, almost isotropic epidote aggregates. In that part of the rock that is strongly epidote-altered, former plagioclase phenocrysts are obliterated.

The groundmass of various fragments shows a significant textural variation, due initially to slightly varying crystallization rates (from quenching producing crystal-free glass, to crystallite-charged glass further in from fragment margins), and enhanced by variable response to alteration. The glassy fragments (most of the dark areas of the section) have groundmass glass devitrified and crystallized to form fine-grained blebby quartz set in darker messy chlorite-quartz-Fe(Ti?) oxide intergrowths. Patches of coarser-grained chlorite are common, often with globular quartz rimming their margins. Occasional inter-fragment patches of chalcedonic quartz also occur, possibly with minor prehnite and fibrous sericite. In the lighter-coloured areas of the section, alteration is of a different style. Quite coarse-grained patches of monomineralic epidote, or epidote plus quartz

(epidosite) are dominant, and replace large areas of this section, leaving core and spots of less altered fragments little different from the darker areas of this thin section. Strangely, it appears that the silica-dominated alteration post-dated the epidosite alteration, as the former invades the latter in places along the contact.

This sample is a basaltic breccia, probably derived from the quench fragmentation of the upper part of a submarine flow. It has suffered localized epidosite alteration, overprinted in part by recrystallization of unepidotized formerly glassy groundmass to silica-dominated assemblages.

126.8m

SAMPLE NUMBER: 622352

SUMMARY: This is a plagioclase+hornblende-phyric andesitic dyke rock, very atypical of the Hellyer lava sequence.

HAND SPECIMEN:

This is an unusual rather coarse-grained brown feldspar-phyric andesite (?) quite unlike most rocks I've looked at from the Hellyer Volcanics.

THIN SECTION:

This is an unusual and interesting rock. It is clearly a shallow intrusive andesite, and former phenocryst phases were dominantly plagioclase and probably hornblende, present in about subequal proportion and making up about 5-8 modal% of the rock. Former plagioclase phenocrysts are up to about 3mm long and vary from elongate but stout prisms to rather rounded equidimensional crystals. All have been albitized, and an unusual feature is that the outer rims of the plagioclase crystals are quite pinkish, probably reflecting Fe-tainted albite (submicroscopic hematite) rather than pink K feldspar, although without microprobe analysis it is difficult to prove this supposition. Former hornblende phenocrysts are entirely replaced by epidote and occasional quartz, and exhibit characteristic elongate hexagonal prismatic sections on crystals up to 3mm long.

The groundmass of this sample is little altered, and clearly holocrystalline, and consists of a relatively coarse-grained intergrowth of albitized feldspar, quartz and minor chlorite-altered mafic blades, probably once hornblende. Feldspar in the groundmass is subhedral, growing into anhedral quartz. Tiny altered FeTi oxides, and occasional larger FeTi oxide microphenocrysts are present, mainly replaced by leucogenetic material. Patches of secondary quartz, yellow epidote, and pale green chlorite are typically developed throughout the groundmass, and veinlets of secondary quartz are common.

This feldspar+plagioclase-phyric andesitic dyke is an unusual lithology in the Hellyer sequence. It appears to intrude Hellyer basalts, and thus must be very late in the magmatic sequence in the Mount Read Volcanics. The nearest analogues are probably the plagioclase+hornblende -phyric andesites that intrude the top section of the Central Volcanic Complex at Crown Hill etc. This should be analyzed.

274.5 m

SAMPLE NUMBER: 622353

SUMMARY: This is a texturally well-preserved, strongly augite-phyric basaltic lava, typical of the Hellyer basalt.

HAND SPECIMEN:

This is a strongly augite-phyric fairly well-preserved basaltic lava with occasional clots and tension gashes filled by quartz and chlorite.

THIN SECTION:

This is a texturally well-preserved basaltic lava dominated by abundant (approx. 12-15 modal%) of euhedral, clear fresh augite phenocrysts, most less than 1mm across. The augite phenocrysts commonly occur in multi-crystal clots, and some small cognate nodules (to almost 1cm across) composed of aggregates of augite phenocrysts are present, with devitrified glass between the cumulate crystals. Albitized plagioclase phenocrysts, mainly much less than 1mm long, make up about 0.5-1% of the rock, and often contain inclusions of dirty brown to isotropic fine-grained epidote, and or minor sericite streaking.

The groundmass of this rock was vitrophyric, but dominated by bladed microlites of augite and more acicular plagioclase crystallites, with tiny altered FeTi oxide grains. The limited volume of interstitial glass has altered to very fine-grained quartz-chlorite intergrowths. Occasional clots of secondary quartz in the groundmass are intergrown with pale prehnite, and sometimes deeper yellow epidote. Clots of chlorite are also common, and some veinlets of quartz-epidote contain a fine-grained clear mineral with a cleavage, and higher relief than quartz, that is probably albite. Patches of chalcedonic silica are also not uncommon.

This is a typical Hellyer basalt (is such a thing exists).

342.5m

SAMPLE NUMBER: 622354 MAC 30

SUMMARY: This is a well-preserved augite-phyric vesicular basaltic lava, typical also of the Hellyer basalts.

HAND SPECIMEN:

This is a slightly vesicular augite-phyric basaltic lava with quartz and epidote filling vesicles.

THIN SECTION:

This sample is a texturally well-preserved augite-phyric basaltic lava with notably less abundant phenocrysts (~ 5 modal%) than in the previous sample, although like 353, it also carries subordinate small albitized plagioclase phenocrysts. Augite phenocrysts are mainly less than 1mm long, fresh, with slight compositional zoning; they typically occur in multi-crystal clots. In a few areas, they are replaced by brownish-green pumpellyite and minor chlorite. Plagioclase phenocrysts are spotted by fine-grained isotropic epidote and minor sericite. Vesicles are filled by chalcedonic quartz, patchy prehnite and more granular and crystalline epidote, and deeper green-brown pumpellyite is intergrown with chlorite in several vesicles.

The groundmass of this basalt was a fairly fine-grained vitrophyric-textured intergrowth of randomly orientated acicular plagioclase microlites intergrown with very small chlorite-altered augite blades and subordinate altered FeTi oxide granules. The mesostasis glass is devitrified, but volumetrically much less abundant than the microlites in the groundmass.

This is another typical Hellyer basalt, although the vesicularity, and especially the significantly lower modal abundance of augite phenocrysts indicates that it is unlikely to come from the same flow unit as 353.

355 = 395.9m
356 = 453.8m

SAMPLE NUMBER: 662355 and 662356

SUMMARY: These are identical olivine+augite+ plagioclase - phyric vesicular basaltic lavas formed by mixing of primitive and more evolved Hellyer basalts.

HAND SPECIMEN:

These are vesicular basaltic lavas with black chlorite-filled vesicles and less abundant quartz-filled vesicles.

THIN SECTION:

These samples are remarkably similar in thin section, and must surely come from the same eruptive unit. They were more primitive than the basalts described above, as both contain common former olivine phenocrysts in addition to augite phenocrysts and albitized plagioclase microphenocrysts. The former olivine phenocrysts are mainly euhedral prisms less than about 1mm long, and make up around 3 modal% of the rock. They are replaced by a very fine-grained intergrowth of secondary quartz and minor chlorite and hematite flakes. Augite phenocrysts are also mainly less than 1mm long, and show unusual rounding in many crystals and crystal aggregates, suggesting strong reaction with the transporting magma. Plagioclase phenocrysts are albitized and strongly altered, so that it is often difficult to discern the crystal margins; many appear to be rounded and resorbed.

Vesicles in sample 355 are up to 1cm across, and make up at least 30 modal% of the rock, whereas they are somewhat smaller and less abundant in 356. Most are circular with cores of radial grown pale green chlorite, rimmed by blebby quartz. In a few of the larger vesicles, the cores are composed of intergrown rosettes of epidote and pumpellyite in a fabulous colour range that Maggie Tabberer would just adore. Minor calcite alteration overprints the more typical quartz-albite-epidote- prehnite-pumpellyite-chlorite alteration.

The groundmass of both samples were texturally identical to that in the previous sample 354, although in places it approaches a quench texture, with sheaves of tiny augite blades and plagioclase microlites in devitrified glass.

The presence in both samples of quite abundant euhedral olivine phenocrysts, and rather rounded and resorbed plagioclase and augite phenocrysts, indicates that they formed from a mixed magma, produced from thorough mixing of a primitive olivine-bearing basalt and a more evolved basaltic lava that was probably petrographically close to 354. Such mixing typically occurs when a new batch of hot primitive magma drives into the magma chamber in which an earlier magma batch is cooling and fractionating through to augite and plagioclase saturation. In most respects, these are typical Hellyer basalts.

504.2m

SAMPLE NUMBER: 622357

SUMMARY: This is a sparsely vesicular, sparsely augite-phyric probably fairly evolved Hellyer basaltic lava.

HAND SPECIMEN:

This is an almost aphyric fine-grained basaltic lava with common calcite-filled fractures.

THIN SECTION:

In thin section, this sample is seen to be a sparsely augite-phyric basaltic lava, composed of around 1-3 modal% of small augite phenocrysts, most of which occur as small clots of four or five fresh euhedral crystals. Rather flattened or stretched vesicles, filled by pale green chlorite make up about 1-3 modal% of the rock.

The groundmass of this sample was probably vitrophyric, dominated by rather long acicular plagioclase microlites in glass that has devitrified to very fine-grained quartz-chlorite intergrowths. Bladed crystals of groundmass augite are subordinate to the plagioclase microlites, but mainly highly fractured or replaced by chlorite. A few veinlets of epidote and quartz transect the section, and are overprinted by calcite in places. Coarser-grained foliated calcite occurs in a few larger tension gashes and fractures.

This is a rather evolved Hellyer basalt compared to most of the preceding samples, judging by the relative sparsity of mafic phenocrysts. However, it is not an uncommon lithology in the Hellyer basalts.

551.1 m

SAMPLE NUMBER: 662358

SUMMARY: This is a primitive olivine+augite-phyric basaltic lava typical of the more mafic Hellyer basalts.

HAND SPECIMEN:

This is a strongly vesicular and strongly augite-phyric basaltic lava with quartz- and chlorite-filled vesicles.

THIN SECTION:

This is a quite primitive olivine+augite-phyric basaltic lava. The former olivine phenocrysts make up about 5-8 modal% of this rock and are altered to very fine-grained silica with minor chlorite and hematite, identical to the olivine alteration observed in samples 355 and 356. They also contain small chromite euhedra. Unlike those samples, however, the augite phenocrysts in this sample are abundant, large (to 2mm long) and euhedral, with complex compositional zoning. They often occur intergrown with olivine phenocrysts. Albitized plagioclase microphenocrysts are much less abundant than the mafic phenocrysts. A few small clinopyroxenite cognate nodules are present, with interstitial devitrified glass.

Vesicles in this sample make up about 7-10 modal% of the rock and are mainly less than 2mm across. They are filled by pale green chlorite, with quartz along the margins. Less abundant vesicles contain intergrown prehnite and quartz with hematite flakes and occasionally also epidote needles and prisms. Calcite overprints many vesicle assemblages.

The groundmass of this basalt was vitrophyric, with abundant plagioclase microlites (albitized) showing weak preferred (flow) orientation, and less obvious, possibly altered tiny augite blades in devitrified glassy mesostasis speckled with tiny altered FeTi oxide granules.

This is a quite primitive Hellyer basaltic lava, clearly derived from a different, much less evolved flow unit than sample 357.

601.5m

SAMPLE NUMBER: 662359 MAC 30

SUMMARY: This is a rather altered plagioclase+augite-phyric intrusive andesite, unlike andesitic dyke 662352 in that it lacks the hornblende phenocrysts notable in 352.

HAND SPECIMEN:

This is a rather altered but homogeneous dark grey aphyric basaltic lava(?) with calcite veinlets.

THIN SECTION:

Thin section shows that this is likely to be an intrusive rock. It is a finely porphyritic evolved basalt or andesite composition dominated by strongly altered plagioclase phenocrysts (~ 5 modal%) and less abundant phenocrysts of a chloritized mafic phase (2-3 modal%); former FeTi oxide phenocrysts are also not uncommon, unlike the lavas in this sequence. Former plagioclase phenocrysts are mainly less than 1mm long and are albitized, and strongly sericitized, so that few fresh albitic areas remain. The former mafic phenocrysts are replaced by green chlorite; most are less than 1mm long, and they are mainly prismatic with shapes suggestive of augite precursors. I can't convince myself that any of the chloritic pseudomorphs were originally hornblende (and thus be similar to 352). FeTi oxide phenocrysts are altered to leucoxene.

The groundmass of this rock was holocrystalline, and dominated by a ragged intergrowth of albitized plagioclase with interstitial quartz, chlorite and tiny altered FeTi oxide granules. Alteration assemblages include patches of intergrown quartz and chlorite, sericite and quartz, and calcite, the latter clearly overprinting earlier alteration. A few veinlets of epidote cut the sample, but epidote is notably less abundant in this rock than the basalts described above, implying less Ca availability, and thus a more andesitic composition for this rock.

This is an andesitic dyke rock notably more evolved (as indicated by the relative paucity of mafics compared to the above basalts). It appears to be petrographically different from the andesitic dyke rock 662352, as indicated by the lack of phenocrystal hornblende in this sample.

660.2m

SAMPLE NUMBER: 662360

SUMMARY: This is a sparsely plagioclase+augite-phyric evolved basaltic rock with a texture suggestive of crystallization in either a shallow dyke, or the central portion of a thick flow.

HAND SPECIMEN:

This is a homogeneous dark fine-grained, possibly aphyric basaltic lava.

THIN SECTION:

This is an evolved basaltic rock, with a texture that I would judge (after much soul searching and reading your notes) to be very shallow intrusive. It is sparsely plagioclase + augite-phyric with about 2-3 modal% of each phase. Plagioclase phenocrysts are albitized and largely sericite-altered, but also contain areas of dark, very fine-grained epidote alteration. Augite phenocrysts are rarely larger than 1mm long, and are fractured and largely replaced by almost isotropic chlorite and fine-grained calcite, although fresh cores are not uncommon.

The groundmass of this sample is quite altered, but clearer patches indicate that it was close to holocrystalline, with intergrown weakly flow-aligned plagioclase laths with interstitial and subordinate chloritized augite and leucoxene-altered FeTi oxide granules. Formerly glassy mesostasis is difficult to recognize with certainty. Abundant segregations of secondary quartz are present throughout the groundmass. Calcite veinlets, and some calcite-hematite veinlets cut the sample.

This is an evolved basalt. Without your notes suggesting that it is probably intrusive, I would have argued that it came from the internal part of a thick flow. It is not nearly as clearly intrusive as 352 and 359.

683.6 m

SAMPLE NUMBER: 662361

SUMMARY: This rock is very close to 662360 and is a sparsely plagioclase+augite-phyric evolved basalt either from the interior of thick flow, or from a dyke or shallow intrusive body.

HAND SPECIMEN:

This is a vesicular sparsely porphyritic basaltic lava.

THIN SECTION:

In most respects this sample is petrographically very similar to the previous sample, except that it is more vesicular and more altered. Altered plagioclase and augite phenocrysts were present in subequal abundances (<3-5 modal%). Plagioclase phenocrysts are sericitized to a large degree. Unlike in 360, in which augite phenocrysts were partially preserved, the augite phenocrysts in this rock are totally altered to calcite, pale green chlorite and a messy brown material (oxychlorite?). Vesicles are mainly filled by calcite

The groundmass of this rock is petrographically very similar to that of the previous rock in that it apparently approached a holocrystalline texture dominated by intergrown plagioclase laths with interstitial bladed augite (chloritized) and quite common altered FeTi oxides and disseminated fine-grained hematite. Calcite is the main veinlet mineral, but is not abundant.

This rock is an evolved basalt, and like 360, it is either from the central portion of a thick flow, or from a shallow intrusive body.

781.4m

SAMPLE NUMBER: 662362

SUMMARY: This is a notably strongly-altered (calcite-sericite) formerly olivine+augite+plagioclase-phyric basaltic lava.

HAND SPECIMEN:

This is a fairly strongly altered, weakly vesicular and aphyric basaltic lava or dyke.

THIN SECTION:

This sample is considerably more altered than all the samples described above, and the alteration is typical of localized hydrothermal alteration rather than pervasive regional alteration. The sample is in fact, not aphyric, but rather strongly porphyritic. However, strong alteration makes it difficult to determine the original abundances and identity of many of the phenocrysts. Clearly, many were plagioclase, which has been albitized and then strongly sericitized. These are mainly less than 1.5mm long. The former mafic phenocrysts are so strongly altered, and even partly deformed, that it is difficult to determine with certainty their original identity. However, relic shapes and experience suggest that most were probably augite; they range up to at least 3mm long, and are now replaced by fine-grained calcite. A few phenocrysts replaced by very fine-grained quartz, and containing small red chromite inclusions, were almost certainly olivine.

There is no hope of telling from the groundmass texture whether this sample was intrusive or a lava, although a few places better preserved have textures very close to the previous two samples (with their inherent ambiguities). Abundant fine-grained calcite and sericite pervades the groundmass, in which blebs of secondary quartz are the only other notable feature. A few veinlets of fine-grained yellowish epidote are present.

This was an olivine+augite+plagioclase-phyric basaltic lava (?) with a far stronger alteration signature (calcite-sericite) than any of the foregoing samples.