THIN SECTIO Observer: Thin section Thin section	N LABE on thick on sum	EL ID: mess: mary:	<b>390C-U1557B</b> PDK, EC standard aphyric basalt	-65X-1-W 15/1	17-TSB-TS7	Thi Pie Uni	n section no.: 7 ace no.: it/subunit: 1
		Plane-po	larized: 6263	3401	Cross	s-polarized: 6	2633381
65X-1,15/17				15578 (7)	65X-1.15/17		1557B (7)
Igneous Pe	etrolo	ду					
Lithology:		. aj	phyric basalt		Rock texture:		holocrystalline
Style of empla	cement	: bre	eccia		Groundmass grain	n size (avg.):	cryptocrystalline
Major ground	mass tex	<b>cture:</b> int	ersertal		Minor groundmas	ss Texture:	intergranular
Sample domai	in name	(if>1) 1			Domain relative a	bundance (%)	100
Groundmass	Original (%)				Comment		
Olivine	10	preser	nce of olivine inferration	ed from alteration s to the larger pheno	tyle of groundmass, i.e. sm cryst. Abundance estimate	nall equant 'patche ed on the basis of t	s' that have a similar style of hese patches.
Plagioclase	15	elongate,	acicular to tabular	crystals, unaltered.	Some skeletal, exhibiting uggesting rapid crystallizat	"box" texture with tion	acicular extensions on corners,
Clinopyroxene	50	exhibits textures,	plumose quench te but these may be a	extures in between a fine grained interg	plagioclase microlites. Una growth between cpx and a over estimated.	altered. Modal abu nother mineral, so	ndance based on the plumose the modal abundance may be
Fe-Ti oxide	5		occurs as tir	ny equant crystals in	n clusters around the edge	s of cpx plumose q	uench crystals.
Mesostasis	20	Groundma microlite	ass / mesostasis coi s. In patches, the g	nsists predominantl roundmass is coarse	ly of cpx plumose quench e grained enough that cpx with one another.	textures in betwee and plag exhibit s	n acicular to tabular plagioclase ubophitic textural relationship
Vesicle	Original (%)	Size Mode (mm)	Shape	Comments			
Vesicle	0.05		round	round vesicles, <19	% of the mode, observed,	100% filled by zeol	ites and/or smectite.
Alteration							
Domain number 1 (if>1)	Domain na	me Basalt b	background alteration	Domain comment	Pervasive speckled orange b breccia)	ackground altered (in	core of large basalt clast from

Alteration mineral Fe oxyhydroxide Mineral abundance (%)

5

Replacing/filling 2

olivine

Replacing/filling 3

plagioclase

Replacing/filling 4

vesicles

Replacing/filling 1

groundmass

Domain number if>1)	nain 1ber 1 Domain name Basalt background alteration 1)					Domain comment	Pervasive speckled orange background altered (in core of large basalt clast from breccia)			
Alter	ation mi	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4	
	aponite	2		1	grou	ndmass	vesicles			
Alteratio Domain	n					Domain	Ponyaciya spacklad oranga	background altered (in core	of large bacalt clast from	
Alteratio Domain number (if>1)	n 1	Domain n	ame	Basalt background a	Iteration	Domain comment	Pervasive speckled orange breccia)	background altered (in core	of large basalt clast from	
Alteratio Domain number (if>1)	n 1 ation mi	Domain n neral	ame Mine	Basalt background a	Iteration <b>Replaci</b> r	Domain comment	Pervasive speckled orange breccia) <b>Replacing/filling 2</b>	background altered (in core <b>Replacing/filling 3</b>	of large basalt clast from Replacing/filling 4	

THIN SECTION LABEL ID: Observer:	<b>390C-U1557B-66X-2-W 5/7-TSE</b> PDK, EC	3-TS8	Thin section no.: Piece no.:	8
Thin section thickness:	standard		Unit/subunit:	1
Thin section summary:	Breccia consisting of altered glas (domain 2) clasts in a microspar detailed description in the extrus of the various clasts observed.	ss (domain 1) and altered (recrystallized) carbonate ive-hypabyssal tab for eac	cryptocrystalline b sediment (domair ch domain is an ar	vasalt າ 3). The nalgamation
Plane-p	olarized: 62633321	Cross-polarized	d: 62633361	



# **Igneous Petrology**

Lithology:	0
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Style of emplacement: breccia

Major groundmass texture: glass

Sample domain name (if>1) 3

Rock texture:	hypohyaline
Groundmass grain size (avg.):	glass
Minor groundmass Texture:	
Domain relative abundance (%)	45

Glass	Glass present (%)	Glass replace d (%)	Glass original (%)	Glass comment
Glass	0	100	100	Unusual concentric replacement texture, golden yellow brown outer layers with a carbonate interior and spherulitic structures.

Lithology:	Rock texture:	holocrystalline
Style of emplacement:	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture: dendritic or skeletal	Minor groundmass Texture:	
Sample domain name (if>1)	Domain relative abundance (%)	25

Igneous Petrology	
Lithology:	Rock texture:
Style of emplacement: dike	Groundmass grain size (avg.):
Major groundmass texture:	Minor groundmass Texture:
Sample domain name (if>1)	Domain relative abundance (%) 30

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Alteration	1										
Domain number (if>1)	1	Domain	name	Altered glass clasts		Domain comment	Large glass clast with conce	Large glass clast with concentric zonation of alteration mineral			
Alterat	tion mi	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
са	rbonate	5		25	glass		veins				
lteratior Domain number (if>1)	ר 1	Domain	name	Altered glass clasts		Domain comment	Large glass clast with conce	entric zonation of alteration	minerals		
Alterat	tion mi	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
clay	/ minera	als		50	q	lass					
number (if>1)	a <b>ain</b> ber 1 <b>Domain name</b> Altered glass clasts )		Ntered glass clasts		Domain comment	Large glass clast with conco	entric zonation of alteration	minerals			
Altore			1								
Feox	tion mi	neral xide	Mine	eral abundance (%) 5	<b>Replacir</b> g	n <b>g/filling 1</b> Ilass	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
Iteration	tion mil yhydro: ] ]	neral xide Domain I	Mine	Altered glass clasts	<b>Replaci</b>	ng/filling 1 lass Domain comment	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
Iteration	tion mil yhydro: 1 1 tion mil	Domain n	Mine	Altered glass clasts	Replacir g Replacir	Domain comment	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
Alteration Jomain number (if>1) Altera	tion min yhydro: 1 1 tion min zeolite	neral xide Domain I	Mine name Mine	Altered glass clasts 20	Replacir g Replacir g	Domain comment	Replacing/filling 2 Large glass clast with conce Replacing/filling 2	Replacing/filling 3	Replacing/filling 4 minerals Replacing/filling 4		
Alteration Fe ox Iteration Domain number (if>1) Alteration 2 2 2 2 2 2 2 2 2 2 2 2 2	tion mil yhydro: 1 1 tion mil zeolite	neral Domain n neral Domain n	Mine name Mine	Altered glass clasts 20 Altered basalt clasts	Replacir 9 Replacir 9	Domain comment lass Domain comment Domain comment	Replacing/filling 2         Large glass clast with concorned         Replacing/filling 2         Deep orange-brown altered	Replacing/filling 3 entric zonation of alteration of alter	Replacing/filling 4         minerals         Replacing/filling 4         sts		
Iteration Domain number (if>1) Alteration Domain number (if>1) Alteration	tion min yhydro: 1 1 tion min zeolite 1 2 tion min	neral	Mine name Mine name Mine	Altered glass clasts 20 Altered basalt clasts 20 Altered basalt clasts	Replacir g Replacir g Replacir	Domain comment lass Domain comment lass Domain comment	Replacing/filling 2         Large glass clast with concernation         Replacing/filling 2         Deep orange-brown altered         Replacing/filling 2	Replacing/filling 3 entric zonation of alteration of alter	Replacing/filling 4         minerals         Replacing/filling 4         sts         Replacing/filling 4		
Alteration Domain number (if>1) Alteration Domain number (if>1) Alteration	tion min yhydro: 1 1 tion min zeolite 2 1 2 tion min y minera	neral Domain n neral Domain n neral	Mine	Altered glass clasts and abundance (%) 20 Altered basalt clasts aral abundance (%) 50	Replacir 9 Replacir 9 Replacir 9 Replacir	Domain comment lass Domain comment lass Domain comment ag/filling 1 ndmass	Replacing/filling 2         Large glass clast with concernant of the second se	Replacing/filling 3 entric zonation of alteration of alter	Replacing/filling 4         minerals         Replacing/filling 4         sts         Replacing/filling 4		
Alteration Domain number (if>1) Alteration Domain number (if>1) Alteration Clay Literation Domain	tion min yhydro: 1 1 tion min zeolite	neral Domain n neral Domain n neral	Mine name Mine Name	Altered glass clasts eral abundance (%) 5 Altered glass clasts eral abundance (%) 20 Altered basalt clasts eral abundance (%) 50	Replacir g Replacir g Replacir g grou	Domain comment Ilass Domain comment Ilass Domain comment Ilass	Replacing/filling 2         Large glass clast with concernation         Replacing/filling 2         Deep orange-brown altere         Replacing/filling 2	Replacing/filling 3 entric zonation of alteration of alter	Replacing/filling 4 minerals Replacing/filling 4 sts Replacing/filling 4		
Alteration Fe ox: Iteration Domain number (if>1) Alteration Domain number (if>1) Alteration Clay Iteration Domain number (if>1)	tion mil yhydro: 1 1 tion mil zeolite 2 tion mil y minera	neral Domain I neral	Mine Mine Mine Mine Mine Mine	Altered basalt clasts aral abundance (%) 5 Altered glass clasts aral abundance (%) 20 Altered basalt clasts aral abundance (%) 50 Altered basalt clasts	Replacir g Replacir g Replacir g rou	Domain comment dass Domain comment dass Domain comment ndmass	Replacing/filling 2         Large glass clast with concord         Replacing/filling 2         Deep orange-brown altered         Replacing/filling 2         Deep orange-brown altered         Deep orange-brown altered	Replacing/filling 3 entric zonation of alteration of alter	Replacing/filling 4         minerals         Replacing/filling 4         sts         Replacing/filling 4         sts		
Alteration Pomain number (If>1) Alteration Domain number (If>1) Alteration Clay Literation Clay Literation Domain number (If>1) Alteration Alteration	tion min yhydro: 1 1 tion min zeolite 2 tion min r 2 2	neral Domain n neral Domain n neral Domain n neral Domain n neral	Mine Mine Mine Mine Mine Mine Mine	abundance (%)         5         Altered glass clasts         and abundance (%)         20         Altered basalt clasts         and abundance (%)         50         Altered basalt clasts         Altered basalt clasts         and abundance (%)         50         and abundance (%)         50         and abundance (%)         and abundance (%)         and abundance (%)	Replacir g Replacir g Replacir grou	Domain comment dass Domain comment dass Domain comment dass Domain comment	Replacing/filling 2         Large glass clast with concernation         Replacing/filling 2         Deep orange-brown alterer         Replacing/filling 2         Deep orange-brown alterer         Replacing/filling 2         Replacing/filling 2	Replacing/filling 3 entric zonation of alteration of alter	Replacing/filling 4     minerals     Replacing/filling 4     sts     Replacing/filling 4     sts     Replacing/filling 4		

Alteration										
Domain number (if>1) 3	Domain na	ame Sediment n	natrix		Domain comment	Carbonate sediment + glas	s rich igneous fragment	S		
Alteration min	eral	Mineral abundan	ice (%)	Replacir	ıg/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
carbonate		100		grour	ndmass					
	otrolo	av								
Lithology:		0				Rock texture:		hypohyaline		
Style of empla	cement	: brecc	ia		Groundmass gra	in size (avg.):	glass			
Major groundı	mass tex	<b>xture:</b> glass				Minor groundma	ass Texture:			
Sample domai	in name	( <b>if&gt;1)</b> 3				Domain relative	abundance (%)	45		
ilass	Glass preser (%)	Glass replace d (%)	Glass original (%)	Glass	comment					
Slass	0	100	100	Unus with a	ual concent a carbonate	ric replacement text interior and spheru	ture, golden yellc litic structures.	ow brown outer layers		
Major groundi Sample domai	mass tex	kture: dendi e (if>1)	ritic or ske	eletal		Minor groundma Domain relative	ass Texture: abundance (%)	25		
gneous Pe Litholoav:	etrolo	gy				Rock texture:				
Style of empla	cement	: dike				Groundmass grain size (avg.):				
Major ground	mass tex	xture:				Minor groundma	ass Texture:			
Sample domai	in name	e (if>1)				Domain relative	abundance (%)	30		
Alteration										
Domain number 1 (if>1)	Domain na	ame Altered glas	ss clasts		Domain comment	Large glass clast with conc	entric zonation of altera	tion minerals		
Alteration min	eral	Mineral abundan	ice (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
carbonate		25		g	lass	veins				
Alteration										
Domain number 1 (if>1)	Domain na	ame Altered glas	ss clasts		Domain comment	Large glass clast with conc	entric zonation of altera	tion minerals		
Alteration min	eral	Mineral abundan	ice (%)	Replacir	ıg/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		

clay minerals

glass

Alteratior	ı											
Domain number (if>1)	1	Domain r	ame	Altered gla	ss clasts		Domain comment	Large glass clast with conc	entric zonation of alteration r	ninerals		
Altera	tion mi	neral	Min	eral abundar	ice (%)	Replaci	ng/filling 1	Replacing/filling 2	Replacing/filling 3	blacing/filling 3 Replacing/filling 4		
Fe oxyhydroxide 5			g	lass								
Iteratior	า											
Domain number if>1)	1	Domain r	ame	Altered gla	ss clasts		Domain comment	Large glass clast with conc	entric zonation of alteration r	ninerals		
Altera	tion mi	neral	Min	eral abundar	ice (%)	Replacii	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
	zeolite			20		g	lass					
teratior Domain Jumber If>1)	2	Domain r	ame	Altered bas	alt clasts		Domain comment	Deep orange-brown altere	d cryptocrystalline basalt clas	ts		
Altera	tion mi	neral	Min	eral abundar	ice (%)	Replaci	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
clay	miner	als		50		grou	ndmass					
0omain Jumber f>1)	2	Domain r	ame	Altered bas	alt clasts		Domain comment	Deep orange-brown altere	d cryptocrystalline basalt clas	its		
Altera	tion mi	neral	Min	eral abundar	ice (%)	Replaciı	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
Fe ox	yhydro	xide		50		grou	ndmass					
Iteratior	١											
Domain number if>1)	3	Domain r	ame	Sediment n	natrix		Domain comment	Carbonate sediment + gla:	ss rich igneous fragments			
Altera	tion mi	neral	Min	eral abundar	ice (%)	Replaci	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4		
са	rbonat	e		100		grou	ndmass					
jneou	s P	etrolo	ogy	,								
.itholog	y:			0				Rock texture:	hyj	oohyaline		
Style of o	empl	acemen	t:	brecc	ia			Groundmass gra	l <b>in size (avg.):</b> gla	SS		
Major gr	ounc	lmass te	extur	e: glass				Minor groundm	ass Texture:			
Sample	doma	ain nam	e (if>	<b>▶1)</b> 3				Domain relative	<b>abundance (%)</b> 45			
lass		Glass prese (%)	nt	Glass replace d (%)	Glass original (%)	Glass	comment					
ilass 0 100 100 Unusual concer with a carbonat						Unus with	ual concen a carbonate	tric replacement tex e interior and spheru	ture, golden yellow k litic structures.	prown outer layers		

Igneou	s Po	etrolo	ogy						
Lithology	y:						Rock texture:	ŀ	olocrystalline
Style of e	empla	acemen	t:				Groundmass gra	i <b>n size (avg.):</b> c	ryptocrystalline
Major gro	ound	mass te	xtur	e: dendritic or	skeletal		Minor groundma	ass Texture:	
Sample o	loma	in name	e (if>	1)			Domain relative	abundance (%) 2	5
Igneou	s Po	etrolo	ogy						
Lithology	y:						Rock texture:		
Style of e	empla	cemen	t:	dike		Groundmass gra	in size (avg.):		
Major gro	ound	mass te	xtur	e:			Minor groundma	ass Texture:	
Sample o	loma	in nam	e (if>	1)			Domain relative	abundance (%) 3	0
Alteration									
Domain number (if>1)	1	Domain n	ame	Altered glass clasts		Domain comment	Large glass clast with conc	entric zonation of alteratic	n minerals
Alterat	ion mir	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4
car	bonate	2		25	g	lass	veins		
Alteration	1	Domain n	ame	Altered glass clasts		Domain comment	Large glass clast with conc	entric zonation of alteratic	n minerals
Alterat	ion mir	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4
clay	minera	ls		50	g	lass			
Alteration	Domain number (if>1)     Domain name     Altered glass clasts     Domain comment     Large glass clast with concentric zonation of alteration minerals								
Alterat	ion mir	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4
Fe oxy	hydrox	ide		5	g	lass			
Alteration									
Domain number (if>1)	1	Domain n	ame	Altered glass clasts		Domain comment	Large glass clast with conc	entric zonation of alteratic	n minerals
Alterat	ion mir	neral	Mine	eral abundance (%)	Replacir	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4
Z	eolite			20	g	lass			

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Alteration									
Domain number (if>1)	2	Domain n	ame	Altered basalt clasts		Domain comment	Deep orange-brown altere	d cryptocrystalline basalt clas	sts
Alterat	ion mir	neral	Mine	eral abundance (%)	Replaci	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4
clay minerals 50		grou	ndmass						
Alteration         Domain number (if>1)       2       Domain name       Altered basalt clasts       Domain comment       Deep orange-brown altered cryptocrystalline basalt clasts									
Alteration mineral         Mineral abundance (%)         Replacing/filling 1         Replacing/filling 2         Replacing/filling 3         Replacing/filling		Replacing/filling 4							
Fe oxyhydroxide			50	groundmass					
Domain number (If>1)     3     Domain name     Sediment matrix     Domain comment									
Alterat	ion mir	neral	Mine	eral abundance (%)	Replaci	ng/filling 1	Replacing/filling 2	Replacing/filling 3	Replacing/filling 4
carbonate 100		100	grou	ndmass					

	300-111557D-2P-1-W 38/40-T	SB-TS67	Thin section no :
Observer:	PDK FC	30-1307	Piece no ·
Thin section thickness:	standard		Init/subunit: 1b
Thin section summary:	standard Aphyric basalt: This is an aph (fewer than ~ 10 or 12 crystal: microphenocrysts are 100% a oxyhydroxides) +/- calcite. Th green clay? The same clay m consists of acicular skeletal pl similar to the plagioclase micr grain sizes. In between the pla- clinopyroxene (inferred). It is p Groundmass olivine is replace oxyhydroxide that has replace masses of opaque minerals fi round vesicles. In some areas presumably flow alignment, br appears to show several mutu pale brown saponite (radial/fe colours); bright green clay (low order); and bright yellow to or usually associated with red-br Saponite, red Fe oxyhydroxid throughout the section. Fe oxy mesostasis and olivine. Sapon patches in the groundmass. ( a halo around the edge of mu composition gradient e.g. acro altered to produce the other). combinations across the slide There is reasonable evidence Conversely saponite is rarely suggesting it may be an early oxyhydroxide although it ofter carbonate formation?).	yric basalt with very sparse m s in the TS) and plagioclase ( ltered to dark orange brown b e plagioclase microphenocrys agioclase crystals that appea ophenocryst, although it's diff agioclase crystals is plumose bad by the same dark reddish b ed by the same dark reddish b ed the olivine microphenocryst il interstitial areas. The rock is the plagioclase crystals show ut it is not consistent througho ally overprinting alteration mi athery to crystocrystalline; <1 w relief, <1st order purple int. ange clay (very similar optical own Fe oxyhydroxides (likely e mixture (incl. iddingsite after /hydroxides are most common hite and calcite fill vesicles an Green and yellow-orange clay ch of the section and rarely co pass a small area (the impressi The remaining minerals all co thought the order of formation of Fe oxyhydroxides overgrop present when the other altera phase. Carbonate typically on fills vesicles alone without ot	Jnit/subunit: 1b icrophenocrysts of olivine   crystal), The olivine y iddingsite (smectite + Fe t is altered ~80% to a pale icles. The groundmass r to be replaced in a manner cult to assess at these fine quench growth of relatively unaltered. rown smectite + Fe s. Small equant to elongate sparsely vesicular with small v preferred orientations, ut the slide. This section nerals; crystalline carbonate; st o. red/purple interference colours, mostly low 1st properties to green clay) a spectrum of compositions). olivine) and calcite are seen n replacing groundmass d occur as small scattered s are predominantly seen as o-exist except as a on overall being that one is -exist in various n is rarely simply apparent. wing all the other phases. tion mineral are abundant vergrows all phases but Fe her minerals (two phases of
Plane	-polarized: 63075731	Cross-polarized	63075711
			675
Janoous Potrology			
	an humin hanalt	De dir textures	h e le envete ll'er -
			noiocrystaillne
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline

Sample	domain	name	(if>1)	1
p			(	

390-U1557D-2R-1-W 38/40-TSB-TS67 Page 1 of 0

Major groundmass texture: dendritic or skeletal

9

Minor groundmass Texture:

Domain relative abundance (%) 100

THIN SECTION LABEL ID:	390-U1557D-2R-1-W 97/99-0-TSB-TS106	Thin section no.:
Observer:	PDK	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1b
Thin section summary:	Breccia: This is an example of the finer grained point consists of angular to subangular clasts of cryptic pelagic sediment. The breccia is matrix supported recrystallization of the micritic limestone (original precipitation of the micritic limestone (original precipitation) anhedral zeolite outlines the palagonite clasts adjusted as that have been disrupted (by the calcite veripelagic sediment. The palagonite is typical pale years of plagioclase crystals and shows patch within the yellow palagonite. Most of the basalt class alteration of groundmass and pervasive replaced several of these clasts. Opaque blebs, likely Mn/F are common in the fine grained pelagic sediment. A sediment appears to be a concentration of fine grained pelagic sediment.	brition of the breccia in U1557D. Here, ocrystalline basalt and palagonite in and there is evidence for belagic sediment) to a microspar. An acent to sparry calcite and cements ning?) and incorporated into the ellow. One clast has atypically large by alteration to brown ?saponite clays asts show intense deep brown ent of plagioclase by low birefringence le fills or groundmass replacement in e oxides and disaggregated forams diffuse dark pinkish red band in the ained amorphous Fe oxides, possibly xyhydroxide alteration of the basalts).
Plane-polarized: 63232371 Cross-polarized: 63232351		



Igneous Petrology
Lithelemu Dedictosture.
Lithology: Rock lexture:
Style of emplacement: breccia Groundmass grain size (avg.):
Major groundmass texture: Minor groundmass Texture:
Sample domain name (if>1)   Domain relative abundance (%)   100

THIN SECTION LABEL ID: Observer:	<b>390-U1557D-2R-2-W 34/36-TSB-TS68</b> PDK, EC	Thin section no.: Piece no.:		
Thin section thickness:	standard	Unit/subunit: 1b		
Thin section summary:	Aphyric basalt: This is an aphyric basalt The groundmass consists of acicular ne appear to be replaced by clay minerals grain sizes. In between the plagioclase of olivine and/or clinopyroxene, now tota is brown to orangish brown in color, ind Groundmass olivine is replaced by the Fe oxyhydroxide that has replaced the (+ plagioclase) form the centers of the r outer ring of a different mineral / different (pseudomorphs), which would be consis- by the microphenocrysts present in the The rock is sparsely vesicular with sma pale brown clay overgrown by a clear m int. colours) and are otherwise unfilled. this thin section, which subophitically er 100% replaced by fibrous or radiating, p this may also be what is replacing plagi	t (or possibly plagioclase olivine microphyric). eedles to skeletal crystals of plagioclase that (?), although it's difficult to assess at these fine crystals is plumose quench and skeletal growth ally replaced by smectite + Fe oxyhydroxides. It icating complete alteration throughout. same dark reddish brown iddingsite/smectite + olivine microphenocrysts. In some areas, olivine adiating quench growth, with a lighter brown nt style of alteration This could be cpx stent with the crystallization sequence suggested rock, i.e. olivine or plagioclase first, with cpx last. Il round vesicles. Most of these have a thin rim of nineral possibly silica, chalcedony (<1st o. white There is also a large cpx xenocryst (unaltered) in ncloses plagioclase laths that are substantially to pale brown clays, possibly an illite(suggesting oclase in the groundmass).		
Plane-polarized: 63075751 Cross-polarized: 63075771				
R R R R R R R R R R R R R R R R R R R				

Igneous Petrology			
Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	
Sample domain name (if>1)	1	Domain relative abundance (%)	100

THIN SECTION LABEL ID:	390-U1557D-3R-2-W 54/57-T	SB-TS69 Thi	in section no.:	
Observer:	PDK, EC	Pie	ce no.:	
Thin section thickness:	standard	Un	it/subunit: 1b	
Thin section summary: Aphyric basalt: This is an aphyric basalt and the thin section was taken to capture a alteration halo from grey-brown background alteration to more intense orange altera in the halo. Olivine microphenocrysts are 100% altered to iddingsite. The groundma consists of acicular needles to skeletal crystals of plagioclase in a sea of plumose quench growth of olivine and clinopyroxene. Groundmass alteration is somewhat pa everywhere but varies in overall intesity across the slide with the more altered areas defining the orange halo across one side of the slide (also extending along a halo). I the less altered portion of the slide, the plagioclase appears to relatively unaltered, although it's difficult to assess at these fine grain sizes. The olivine skeletal growth is between plagioclase crystals is now totally replaced by smectite + Fe oxyhydroxides such that it is now dark orangish brown color, The cpx plumose quench growth is pa brown and appears to be relatively unaltered. Tiny equant opaque minerals line the boundaries between different dendritic masses. The rock is sparsely vesicular with s round vesicles. Throughout the slide these are mostly filled by pale brown saponite carbonate, the latter commonly overgrowing a saponite rim. The front of the alteration halo (and its extension along the vein) is marked by abundant bright yellow clay (low order int. colours) replacing groundmass and rimming or filling vesicles. Yellow clay are overgrown by saponite or carbonate. In the most altered part of the rock the feldspars are replaced by clay (and in one place by calcite). Within the halo groundr is intensely red-brown coloured although still patchy as outside the halo. This patchi may follow variation in the proportions of original groundmass phases; olivine is replaced by the dark reddish brown smectite + Fe oxyhydroxides and the plumose c appears to been replaceed by a lighter brown mineral that is birefringent (pseudomorphed cpx exhibits a sweeping extinction - this co				
Plane-p	olarized: 63076481	Cross-polarized: 6	63076501	
Igneous Petrology				
Lithology:		ROCK texture:	holocrystalline	
Style of emplacement:	preccia	Groundmass grain size (avg.):	cryptocrystalline	
Major groundmass texture: c	lendritic or skeletal	Minor groundmass Texture:		
Sample domain name (if>1) 1		Domain relative abundance (%)	100	

THIN SECTION LABEL ID:	390-U1557D-3R-3-W 65/67-0-TSB-TS107	Thin section no.:
Observer:	PDK	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grained p it consists of angular to subangular clasts of cryp cement that ranges from sparry calcite to 'dirty' m typically occurs as anhedral / cryptocrystalline ma palagonite clasts. It tends to cement the finest gra- intergrown within the micritic / microspar material sparry calcite, which fills the centers of veins. Cla- silt (or even clay). No evidence for pelagic sedim- shows typical pale yellow colours and relatively h green) at the edges of clasts, typically transitionir centre. Some clasts have abundant quench sphe brownish ?saponite clays (<1st order red int. cols mostly cryptocrystalline and intensely altered to c clays. Plagioclase appears 100% replaced by low and/or zeolites. Olivine is 100% altered to iddings blends into the altered groundmass. Vesicles are	ortion of the breccia in U1557D. Here, tocrystalline basalt and palagonite in a hicrospar + a zeolite. The zeolite asses that lines the edges of basalt and ained igneous detritus. It also occurs s. The rock as a whole is cemented by ist range in size from up to 2 cm to fine ent was identified. The palagonite igh interference colours (<2nd order ng to les crystalline material in the rules and these are typically altered to s., radial fibrous structure). Basalt clasts deep red-brown Fe oxyhydroxide + v birefrigence minerals likely clays site +/- minor clays/carbonate and mostly filled by radiating zeolites.
Plane-r	olarized: 63232301 Cross	-nolarized: 63232411





Igneous Petrology	
Lithology:	Rock texture:
Style of emplacement: breccia	Groundmass grain size (avg.):
Major groundmass texture:	Minor groundmass Texture:
Sample domain name (if>1) 1	Domain relative abundance (%) 100

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THIN SECTION LABEL ID:	390-U1557D-3R-3-W 108/110-0-TSB-TS108	Thin section no.:	
Thin section thickness:	standard	Linit/subunit: 1c	
Thin section summary:	Breccia: This is an example of the finer grained point consists of angular to subangular clasts of cryptocement that ranges from sparry calcite to 'dirty' mice typically occurs as anhedral / cryptocrystalline massigneous detritus. It also occurs lining the edges of the tends to form short, stubby blades that terminate a sparry calcite and the zeolite are typically separate calcite. The rock as a whole is cemented by sparry veins. Clast range in size from up to 2 cm to fine si pelagic sediment was identified. Palagonite after glaminated botryoidal nucleation texture. There are rich material on the outmost edges of the clasts an alteration or later addition?). Basalt clasts are highly stubby groundmass crystals are 100% replaced by by low birefrigence clays or zeolite +/- carbonate. The a very dark, almost opaque, dull brown, markedly olivine (more saponite alteration?). There is some by bright yellow to orange clay (+ Fe oxyhydroxide).	rtion of the breccia in U1557D. Here, crystalline basalt and palagonite in a rospar + a zeolite. The zeolite ses that cement the finest grained basalt and palagonite clasts, where it gainst sparry calcite cement. The d by a narrow band of microspar calcite, which fills the centers of It (or even clay). No evidence for lass shows typical yellow colour and thin rims of brown Fe oxyhydroxide d along cracks (first phase of y altered; olivine phenocrysts and red-brown iddingsite and plagioclase The groundmass mesostasis is altered y less red than psueomorphs after patchy replacement of groundmass ).	
Plane-polarized: 63232431 Cross-polarized: 63232451			
	5570		

igneous renology	Igneous	Petrology
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Lithology:

Style of emplacement: breccia

Major groundmass texture:

Sample domain name (if>1) 1

Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

THIN SECTION LABEL ID:	390-U1557D-3R-3-W 128/130-TSB-TS70	Thin section no.:	
Observer:	PDK, EC	Piece no.:	
Thin section thickness:	standard	Unit/subunit:	1c
Thin section summary:	Highly plagioclase olivine clinopyroxene phyric basalt: The olivine-clinopyroxene phyric basalt. The plagioclase phere equant to tabular. They exhibit the typical polysynthetic to almost ubiquitously sieve textured. Smaller tabular phenot they are also less altered. They are also highly altered; a hampered by the thin section quality (it appears that either plagioclase or whatever occupied the centers of some cr some places, calcite is observed replacing the plagioclase be zeolites. Olivines are replaced by dark brown iddingsi of carbonate, throughout. Cr spinel inclusions were obse Clinopyroxene occurs in subophitic relationships with pla unaltered. The groundmass consists of small acicular to by plumose textured quench growth. Mineralogy of the gr determine at these cryptocrystalline grain sizes, but it is a olivine. Groundmass is substantially altered to red-brown clays giving a muddy overall appearance. Red colours ar of individual plumes likely picking out olivine-rich areas. If minerals line the boundaries between adjacent plumes or sparsely vesicular. Vesicles are partially lined by brown to xyhydroxides) and either unfilled or filled by calcite. The around several (carbonate filled) vesicles which appear to phenocrysts in a well defined radius area around the ves alteration of quench groundmass (to dusty clays + Fe oxy circular patch of this same material may cut a similar zon central vesicle. In some larger voids this is overgrown and then carbonate. Throughout the section there are irrer groundmass replaced by calcite, some with a botryoidal plining the edges. A brown to very pale green cryptocrysta across the slide, commonly in the core of altered plagioclas biefing preferential ground thin in many places, or both. In the pale brown clay described as saponite in other section.	is is a highly plagio iocrysts range from vinning. Larger crys ocrysts don't show t ssessing the alterat at there are holes in ystals has been plue e; in other places, if ie, typically with sm rved in one olivine p gioclase and it is la tabular plagioclase roundmass is difficu- assumed to be a mi Fe oxyhydroxides e strongest towards Relatively abundant f quench growth. The orange smectite ( re are thick dark cir o result from a lack icles combined with /hydroxides as else e without intersection ys cross the section veins, replacing gro by brown Fe oxyh egular patches of th yellow-orange smect to f extremely fine g other respects this ns.	bolase- subhedral stals are his feature; tion style is o the cked out). In t appears to all domains ohenocryst. rgely surrounded ult to x of cpx and and dusty s the middle opaque he rock is +/- Fe rcular rims of o enhanced ewhere). A ng the h. Similar oudmass ydroxides he ctite partially occurs low grain size or resembles



Cross-polarized: 63076281



Lithology:	highly plagioclase-olivine phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	
Sample domain name (if>1	) 1	Domain relative abundance (%)	100

F		
THIN SECTION LABEL ID: Observer:	<b>390-U1557D-4R-1-W 28/30-TSB-TS72</b> PDK, EC	Thin section no.: Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	phyric basalt: This is a microcrystalline aphyric basalt. The overall alteration is very imilar to TS71 and consists of both light brown saponite and yellow-orange smectite + e oxyhydroxides replacement distributed across the slide without any clear spatial attern or restriction to either. The groundmass consists of plagioclase and cpx in ubophitic textural relationships and at least 75% of the groundmass is occupied by nese microcrystalline textures. The plagioclase is slightly altered to clay minerals(?) but ne cpx appears to be relatively unaltered. Groundmass olivines are equant and uhedral, now 100% replaced by light brown saponite . The remaining groundmass is ryptocrystalline mesostasis that appears to be quite heavily altered to a dusty/slightly paque mixture of reddish brown Fe oxyhydroxides and clays throughout. Discrete atches are replaced by light brown saponite and/or golden brown smectite + Fe wyhydroxide. Equant to acicular opaque minerals are restricted to occurrence in the litered mesostasis. Round vesicles are typically concentrically filled with slightly darker rown saponite lining the edges and a lighter paler yellow brown clay (with lower nterference colours) overgrowing towards the center. The outer rim is variably bright ellow-orange (i.e. one section of the vesicle rim is a deep orange colour but this doesn't rrap around the full circumference) but the pale yellow clay in the center is almost never ffected implying it grew later. Equally some vesicles do not follow this pattern and are 00% filled by pale brown saponite while others are entirely filled by bright yellow- orange smectite + Fe oxyhydroxides. In rare examples there may be a thin lining of pale preen clay as the first layer at the rim. One vesicle has a small patch of carbonate but therwise carbonate is rare in the sample.	
Plane-p	polarized: 63076321 C	ross-polarized: 63076301
	32	5570

Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	microcrystalline
Major groundmass texture:	subophitic	Minor groundmass Texture:	intersertal
Sample domain name (if>1)	) 1	Domain relative abundance (%)	100

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THIN SECTION LABEL ID:	390-U1557D-4R-1-W 124/127-TSB-TS71	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Sparsely olivine phyric basalt: This is a microc Alteration to light brown saponite clay predomi alteration. The olivine phenocrysts are so heav difficult to distinguish them from the altered gro replacement is by light brown saponite only (so colours, <2nd o. blue, possibly suggest a talc of alteration olivines are replaced either by bright (commonly gradational with coexisting saponit iddingsite, carbonate and saponite +/- ?talc. Th one example saponite veins appear to cross-c The groundmass consists of plagioclase and of at least 75% of the groundmass is occupied by remaining groundmass is cryptocrystalline mean reddish brown Fe oxyhydroxides and dusty bro Round vesicles are filled by pale brown sapon Fe-oxyhydroxide (or in one example, opaque F minerals form small patches replacing groundr out of originally round vesicles. The distinction commonly gradational and typically occurs late that one forms as a secondary alteration produ There is no obvious spatial pattern to the occur clays and their appearance defines a macrosc	rystalline sparsely olivine phyric basalt. nates with patches of more oxidative <i>i</i> lly (and complexly) altered that it is bundmass in some places. In some areas ometimes with quite high intereference component). In areas of more oxidative yellow-orange clay + Fe-oxyhydroxides e) or by a chaotic mixture of brown ne order of events is unclear although is ut the iddingsite + carbonate replacement px in subophitic textural relationships and v these microcrystalline textures. The sostasis and is quite heavily altered to own. slightly opaque clay throughout. ite to dark golden yellow smectite / clay + Fe oxyhydroxides). Similar mixtures of mass, some of these appearing to grow between saponite and yellow clay is erally across a vesicle or patch, implying uct of the other rather than overgrowing it. rrence or lack of these golden yellow opic orange mottling to the rock.
Plane-p	polarized: 63076321 Cro	oss-polarized: 63076301
		5570





Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	microcrystalline
Major groundmass texture:	subophitic	Minor groundmass Texture:	intersertal
Sample domain name (if>1)	) 1	Domain relative abundance (%)	100

THIN SECTION LABEL ID:	390-U1557D-5R-1-W 28/32-TSB-TS73	Thin section no.:	
Observer:	PDK, EC	Piece no.:	
Thin section thickness:	standard	Unit/subunit: 1c	
Thin section summary:	Moderately plagioclase-olivine-clinopyroxene phyric basa section consists of two domains. One is the chilled margin The other is a small fragment of the breccia matrix in whit description: This is a moderately plagioclase-olivine-clino plagioclase phenocrysts are subhedral tabular and are all pseudomorphically altered to carbonate. Identification of the complicated by the quality of this particular thin section. To occur in glomerocrystic clusters with euhedral equant oliv mixture of iddingsite and carbonate. The high degree of a cryptocrystalline matrix make identification of the olivines they merge with that alteration, but the presence of the ca alteration is distinct from the rest of the groundmass. Clin relationship with plagioclase in two of the glomerocrystic colors for the cpx are too high, indicating that the thin sec portion of the clast, now totally altered to palagonite, start growth, and spherulites in this rock are small (<0.1 mm); i coalesced spherulites over a very short distance (<2 mm) there into variolitic and plumose quench growth. Irregular oxyhydroxides in both basalt and sediment mark interface sparsely vesicular, with round vesicles now concentrically either partly unfilled or, in some cases, filled by opaque ? completely altered to yellow palagonite with a beautiful co texture around the clast margins and vesicles (indicating sites for alteration). This shows higher birefringence (<2n in examples seen from Hole U1556B (typically <1st o. yel even allowing for the slightly thick cut section, potentially in alteration mineralogy. Breccia matrix description: The b on two sides in this thin section. At one end, the cement i of inclusions) and there are small (0.1 to 0.6 mm) fragmen cryptocrystalline basalts. Clast sizes range from >3 mm to set in a 'dirty' micrite to microsparry calcite. Locally the m inclusion-free sparry calcite.	It with breccia matrix: This the of a plagioclase phyric basis ich the clast occurs. Basalt pyroxene phyric basalt. The most completely the alteration in all areas is he plagioclase phenocrysts ine and are 100% altered to literation of the difficult in places, because arbonate in the olivine opyroxene occurs in suboph clusters; note, the interference tion is too thick. The glassy s with the zone of spherulite the zone transitions to and quickly transitions from growth of opaque between the two. The rock is borcentric laminar/spherulitic these formed the nucleation d order green int. colours) th low and/or poorly crystalline/ suggesting a slight difference obasalt clast has cement / mat s sparry calcite (relatively fre nts of palagonite and er end, the matrix is more e clasts, but also to < 0.01 mm and the clasts a icrite has recrystallized to an	in alt. a itic is an ) ∋ rix e are

Plane-polarized: 63079581



Cross-polarized: 63079621



Lithology:	moderately plagioclase phyric basalt	Rock texture:	
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	glass
Sample domain name (if>1)	) 1	Domain relative abundance (%)	80

THIN SECTION LABEL ID:	390-U1557D-5R-3-W 109/111-TSB-TS74	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Sparsely plagioclase-olivine phyric basalt with bre of two domains. One is a cryptocrystalline basalt the breccia matrix in which the clast occurs. Ident complicated by the quality of the thin section. Bas plagioclase-olivine phyric basalt. The plagioclase highly altered to carbonate and brownish clay. Th glomerocrystic clusters with euhedral equant olivi iddingstie +/- calcite except far from the sediment 100% light brown saponite is seen. The groundm plagioclase crystals embedded in plumose quence plagioclase has been altered in a style similar to the plumes' of ferromagnesian minerals (either olivin suggesting that they are highly altered. Along the alteration halo in the basalt defined by abundant the interference colours) filling/rimming vesicles and some vesicles this is overgrown by thin layers of colourless low birefringence ?zeolite (or chalcedor sparsely in the rest of the section but are less brigs in the halo. The rock is sparsely vesicular, with ro are filled mainly by carbonate adjacent to the hald (often overgrowing rims of red-brown Fe-oxyhydr in a single vesicle, carbonate overgrows saponite one vug where all three phases occur). The groun replacement by carbonate, generally in distinct sec concentrations of vesicles. Around the carbonate altered to greyish brown, slightly dusty/opaque or appears to overgrow the surrounding red-altered not uncomplicatedly apparent. Breccia matrix des fragment of breccia cement / matrix on one side of cement/matrix are dominated by palagonite, which moderate interference colours to palagonite in TS spherulites, one is pale brown and has plagioclass dark red and presumably olivine. Clast sizes rang are set in a carbonate cement that is predominant low relief and very low birefringence zeolite. This have a radiating growth habit (similar to zeolite ce confirmed as phillipsite by XRD). Looking at the b sector zoned. Likely the zeolite phillipsite (known forms complexly sector zoned crystals). Zeolite a and sand size fraction of igneous detritus. Essent are higher,	eccia matrix: This thin section consists clast. The other is a small fragment of ification of the alteration in all areas is salt description: This is a sparsely phenocrysts are subhedral tabular and e plagioclase phenocrysts occur in ne, which is now 100% altered to basalt contact where replacement by ass consists of acicular skeletal th growth. It looks like the groundmass that of the phenocrysts. Most of the e or cpx) are orange brown in color, sediment-basalt interface there is an bright yellow clay (1st order patchily replacing groundmass. In brownish ?saponite and finally by on?) Yellowish brown clays occur ghtly coloured and less abundant than ound vesicles, which (outside the halo) o and mainly by pale brown saponite oxide) further away; where both occur (which itself overgrows yellow clays in ndmass has also undergone patchy emi-connected patches often around patch the groundmass is mostly yptocrystalline clays (?saponite) which groundmass, though relative order is of the thin section. The clasts in the h is concentrically zoned (with similar 573) and contains two types of e microlites at their core; the other is ge from 10 mm to < 0.01 mm. Clasts thy sparry carbonate and rimmed by crystallizes as elongate blades that ements in Hole 1556B which were olades end-on, they look like they are to be associated with palagonite and lso cements the very fine grained silt ially, where the silt and clay fractions where, you get sparry calcite.

Plane-polarized: 63079541



Cross-polarized: 63079561



Igneous Petrology			
Lithology:	sparsely plagioclase-olivine phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	
Sample domain name (if>1)	1	Domain relative abundance (%)	80

THIN SECTION LABEL ID:	390-U1557D-5R-4-W 109/112-TSB-TS75	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Moderately plagioclase-olivine-clinopyroxene p section consists of two domains. One is a mode phyric clast. The other is a small fragment of th occurs. Identification of the alteration in all area section and section is cut slightly thin. Basalt de plagioclase-olivine-clinopyroxene phyric basalt. subhedral tabular and highly altered to a pale b occur in glomerocrystic clusters with euhedral ca abundant; it occurs in some glomerocrystic clus plagioclase, but not all. The glomerocrysts are a There is one large anhedral cpx macrocryst that of elongate skeletal plagioclase crystals embed presumably dominated by cpx. In more coarsel subophitic relationships with plagioclase. Opaq mesostasis areas between the cpx 'plumes'. Th vesicles 100% filled, variously, by carbonate, zr matrix-basalt contact there is an alteration hald olivine is altered to dark brown iddingsite + cart groundmass mesostasis is altered a greyish ree hydroxides and clays and the intensity of the co contact. Vesicles are mostly rimmed by brown f (v. low birefringence; some radiating some mor Plagioclase is ubiquitously altered to very pale cryptocrystalline and polished thin and so appe occurs in the groundmass and in the vesicles a The green clay is overgrown by successive layor pale brown ?saponite in vesicles. Adjacent vesi of green (secondary alteration of green clay or Beyond the alteration halo, pale brown and gre though slightly greener than typically seen in pr pseudomorphing olivine (iddingsite is rare) and carbonate also occur as vesicle fill and vesicles occur immediately adjacent to one another. Pla halo but to a lesser extent. The mesostasis is g oxyhydroxide, judging from the alteration colour clast has a fragment of breccia cement / matrix clasts in the cement/matrix are dominated by an plus a clast of 'dirty' micrite in which angular clas palagonite are 'floating'. The micrite is partially places to sparry calcite. No fossils or burrows w may be some preferred alignment of some elor structure on deposition (maybe?). The micrite is	hyric basalt with breccia matrix: This thin erately plagioclase-olivine-clinopyroxene e breccia matrix in which the clast s is complicated by the quality of the thin escription: This is a moderately The plagioclase phenocrysts are rown clay. The plagioclase phenocrysts equant olivine, which is now 100% altered lote. The clinopyroxene is not very sters in subophitic relationship with more commonly plagioclase + olivine. t is unaltered. The groundmass consists ded in plumose quench growth, which is y crystalline areas the cpx is observed in ue minerals are concentrated in the re rock is sparsely vesicular, with round eolite and clays. Paralelling the about 10mm wide. Within this halo, bonate + clays in a chaotic mixture. The d-brown by alteration to Fe oxy- olour increases approaching the basalt Fe oxyhydroxides and filled by zeolites e equantly crystalline) or carbonate filled green or brown clay +/- calcite, typically aring almost isotropic. Bright green clay long the boundary of the alteration halo. ers of dark brown Fe oxyhydroxide and cles are filled by yellow clays with a hint compositional gradient in a single halo?). en clay (likely a variety of saponite evious samples) predominates, filling many vesicles. Zeolite and with completely different filling can gioclase is altered similarly to within the rey brown with much less Fe . Breccia matrix description: The basalt on one side of the thin section. The ngular cryptocrystalline basalt fragments, ists of predominantly basaltic glass / recrystallized to microspar and in some vere observed in the micrite, but there gate clasts, suggesting a sedimentary s being disaggregated and/or
Plane-p	olarized: 63079521 Cros	ss-polarized: 63079501





Igneous Petrology			
Lithology:	moderately plagioclase-olivine phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	
Sample domain name (if>1)	1	Domain relative abundance (%)	80

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THIN SECTION LABEL ID:	390-U1557D-5R-4-W 128/130-TSB-TS76	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Standard Unit/Subunit: 1C Breccia: This is an example of the finer grained portion of the breccia in U1557D. H it consists of angular to subangular clasts of cryptocrystalline basalt and palagonite cement that ranges from sparry calcite to 'dirty' microspar + a zeolite. The zeolite typically lines the edges of basaltic clasts at the interface with the sparry calcite. It a occurs intergrown within the micritic / microspar materials Clast range in size from to 2 cm to fine silt (or even clay). No evidence for pelagic sediment was identified. The palagonite has yellow colour and concentric laminar texture in vein bounded domai similar to previous examples seen. The cores of some of the palagonite domains at formed of light brown saponite and large patches of dark brown to opaque Fe oxyhydroxides grow irregularly across the palagonite. The basalt clasts show typica replacement of groundmass olivine by red-brown iddingsite and alteration of mesos to a dull brown mixture of Fe oxyhydroxides and clays. Thin plagioclase lathes are generally altered to zeolite which has no been the case in previous examples and r relate to the abundance of glass and zeolite in the matrix. Vesicles are rimmed by saponite and either zeolite filled or unfilled, except one example intersected by a th carbonate vein which is carbonate filled. Small irregular patches of clay replace the groundmass (or may in some cases be filling small irregular voids) and show a compositional spectrum between pale brown saponite, bright yellow ?smectite clay brown Fe oxyhydroxide - smectite mixtures.	
Plane-p	olarized: 63079461	Cross-polarized: 63079481
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igneous		iogy -

Lithology:

Style of emplacement:

..breccia

breccia

Major groundmass texture:

Sample domain name (if>1) 1

Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

THIN SECTION LABEL ID: Observer:	<b>390-U1557D-6R-1-W 34/36-TSB-TS77</b> PDK, EC	Thin section no.: Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer graine to the sample 5R-4 128/130 Here, it consists of cryptocrystalline basalt and palagonite in a cer 'dirty' microspar + a zeolite. The zeolite typical interface with the sparry calcite. It also occurs materials Clast range in size from up to 2 cm t pelagic sediment was identified. Palagonite is zoned with low 1st order interference colours ( change in mineralogy/composition from rim to cryptocrystalline with plumous groundmass ter altered to intense red Fe oxyhydroxides + sme completely altered to pseudomorphic carbona making the latter blend into the groundmass. S rimmed by yellowish brown smectite clays and clay or else unfilled.	d portion of the breccia in U1557D, similar of angular to subangular clasts of ment that ranges from sparry calcite to ly lines the edges of basaltic clasts at the intergrown within the micritic / microspar o fine silt (or even clay). No evidence for typical yellow colour and concentrically (possibly cut slightly thin) and no obvious core. Largest basalt clast is xture still discernible but pervasively ectite. Plagioclase phenocrysts almost te and olivine to iddingsite + carbonate, Small vesicles quite abundant, mostly d filled by dusty brown cryptocrystalline
Plane-p	olarized: 63079441 Cro	oss-polarized: 63079421





# **Igneous Petrology**

Lithology:

..breccia

breccia

Style of emplacement:

Major groundmass texture:

Sample domain name (if>1) 1

**Rock texture:** Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100 Γ

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THIN SECTION LABEL ID:	390-U1557D-6R-3-W 106/110-TSB-TS78	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grained port to samples 5R-4 128/130, and 6R-1 34/36. This thir (up to 2.5 cm) subangular clasts of cryptocrystalline (they are orange brown in hand sample), presumab breccia. The area in between the larger clasts is cer microspar that is filled by mm- to sub-mm-size partic clasts are dominated by angular palagonite fragmer recognizable, clasts of cryptocrystalline basalt. Zeol clasts and are intergrown with the micrite / microspa igneous detritus. The zeolite abundance is highest i sand-size igneous detritus. No evidence for pelagic of the largest basalt clast is characterised by abund opaque F oxyhydroxides overgrowing the groundma anything or growing along any particular features. T halos recorded during vein logging. The basalt itself groundmass replaced by a dense mixture of Fe oxy remnant of any original igneous texture except for o These, and larger plagioclase phenocrysts are 1009 inclusions of brownish clay and Fe oxyhydroxide. O to iddingsite enclosing small domains of carbonate a groundmass if it were not for these. Vesicles are pre- lining of yellow brown ?smectite and a few carbonate	tion of the breccia in U1557D, similar a section contains numerous large basalt that have been highly altered ly, prior to incorporation in the mented by sparry calcite and a 'dirty' cles of igneous origin. The smaller hts but also some small, but still ites encircle many of the basaltic ar in some of the areas with high n the areas with the highest silt and sediment was identified. The margin ant irregular blebs of very dark - ass, not obviously pseudomorphing hese define the "fuzzy/dendritic" is almost completely altered with hydroxides and clays with little riented needles of plagioclase. & altered to carbonate with livine phenocrysts are 100% altered and would be indistinguishable from edominantly unfilled excpet for a thin te-filled vugs.
Plane-p	olarized: 63086381 Cross-po	blarized: 63086361





Lithology:	breccia	Rock texture:
Style of emplacement:	breccia	Groundmass grain size (avg.):
Major groundmass texture	:	Minor groundmass Texture:
Sample domain name (if>1	) 1	Domain relative abundance (%) 100

THIN SECTION LABEL ID:	390-U1557D-6R-4-W 101/103	-TSB-TS79 Th	in section no.:
Observer:	PDK, EC	Pie	ece no.:
Thin section thickness:	standard	Ur	iit/subunit: 1c
Thin section summary:	Standard Unit/subunit: 1c Highly plagioclase-olivine-clinopyroxene phyric basalt: This is a highly plagioclase- olivine-clinopyroxene phyric basalt. The plagioclase phenocrysts range from subhedral equant to tabular. They exhibit the typical polysynthetic twinning. Larger crystals are typically sieve textured and overgrown on their rims by a later generation of plagioclase. Even some of the smaller tabular crystals, often intergrown with cpx, appear to show sieve textures (I don't think it is alteration, but some of it could be partial replacement by clay or zeolites; slide quality makes it hard to say for sure). The plagioclase appears to be largely unaltered though rare grains show incipient patchy replacement by carbonate Olivines are replaced by red brown iddingsite + / - carbonate throughout. Two large equant Cr spinel crystals were observed adjacent to a pseudomorphed olivine phenocryst. Clinopyroxene occurs in subophitic relationships with plagioclase and is unaltered. Glomerocrystic clusters are common, both plag + cpx and plag + olivine. The groundmass exhibits an intersertal texture consisting of small tabular plagioclase in subophitic relationship with groundmass cpx, plus brown cryptocrystalline mesostasis in between. The groundmass cpx and plag are largely unaltered although fine grained plagioclase is in some examples partially replaced by carbonate as with the phenocrysts. Groundmass olivine is 100% altered, mostly to iddingsite and but possible to pale green brown ?saponite in patches (though these are difficult to distinguish unambigously from groundmass replacement). Mesostais areas are variably altered in a similar manner, mostly to brownish Fe oxyhydroxides but also in places to pale greenish brown saponite and patches of carbonate. Golden yellow clay also replaces groundmass in a narrow band which appears to be a front to a halo which just cuts the top left corner of the slide. Small opaque minerals occur in the interstitial areas between plag + cpx subophitic clusters. The rock is sparsely		
Plane	-polarized: 63086401	Cross-polarized:	63086421
			15570 (79)
Igneous Petrology			
Lithology:	highly plagioclase-olivine-augite phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline

Major groundmass texture: intersertal

Sample domain name (if>1) 1

Minor groundmass Texture:subophiticDomain relative abundance (%)100

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THIN SECTION LABEL ID:	390-U1557D-6R-6-W 1/3-TSB-TS80	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grained to samples 5R-4 128/130, and 6R-1 34/36. Here clasts of cryptocrystalline basalt and palagonite calcite to 'dirty' microspar + a zeolite. The zeolit clasts at the interface with the sparry calcite. It a / microspar materials. The zeolite abundance is and sand-size igneous detritus. No evidence for alteration of the basalt clasts is typical of similar to red-brown Fe oxyhydroxides and clays with r possibly to carbonate) and plumose groundmas phenocrysts are altered to iddingsite + subordin background. Plagioclase is 100% altered to carf abundant filling/lining vesicles and replacing sm voids otherwise predominantly filled by very low with previous observations of phillipsite (radiatir crystalline possible another zeolite species. Slig alteration of mesostasis mainly to dull brown du (phenocrysts and in groundmass) altered to dee seen in several samples and likely defines the b orange halos described macroscopically. Glass yellow palagonite with concentric laminae, mod slight darker brown cores.	portion of the breccia in U1557D, similar e, it consists of angular to subangular in a cement that ranges from sparry e typically lines the edges of basaltic also occurs intergrown within the micritic highest in the areas with the highest silt r pelagic sediment was identified. The r samples: groundmass is highly altered elicts of acicular plagioclase (altered, ss texture identifiable. Olivine hate carbonate and blend in the altered bonate. Bright yellow clay is relatively hall patches of groundmass. Vesicles and birefringence zeolite mostly consistent ng bladed habit), but a few more coarsely ghtly coarser grained basalt clast shows isty looking clays with only olivine ep red-brown - this type of alteration prownish oxidative alteration distinct from is altered in a typical manner to bright erate 1st order interference colours and
Plane-p	olarized: 63079381 Cros	ss-polarized: 63079401
Cr.	-	



# **Igneous Petrology**

Lithology:	breccia
Style of emplacement:	breccia
Major groundmass texture	:

Sample domain name (if>1) 1



Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

THIN SECTION LABEL II	D: 390-U1557D-7R-2-W 85/87-TSB-TS81	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thicknes	ss: standard	Unit/subunit: 1c
Thin section summar	'y: Breccia: This is an example of the finer grate to samples 5R-4 128/130, and 6R-1 34/36 looks almost cream coloured). This thin see subangular clasts of cryptocrystalline base orange brown in hand sample), likely at lead breccia. The area in between the larger clas microspar that is filled by mm- to sub-mm- clasts are dominated by angular palagonite recognizable, clasts of cryptocrystalline base clasts and are intergrown with the micrite / igneous detritus. There are whole patchess zeolites and in some areas it appears that cemented 'clasts'. The zeolite abundance is sand-size igneous detritus. No evidence for altered in a typical manner to bright yellow interference colours (<2nd order blue thou cores. The alteration of the basalts is in me halos at pillow margins with fine-grained pl Fe oxyhydroxides. At the edges of the indi Vesicles show unusual filling appearing to dark greenish clay forming discrete patche appearing slightly altered to brown along if another phase of ?celadonitic alteration th order in this section.	ained portion of the breccia in U1557D, similar b. Section is cut slight thick (e.g. carbonate ection contains numerous large (up to 2.5 cm) alt that have been highly altered (they are ast partially, prior to incorporation in the asts is cemented by sparry calcite and a 'dirty' size particles of igneous origin. The smaller e fragments but also some small, but still asalt. Zeolites encircle many of the basaltic / microspar in some of the areas with high s of detritus that are cemented by just the the calcite veining is fracturing the zeolite- is highest in the areas with the highest silt and or pelagic sediment was identified. Glass is / palagonite with concentric laminae, moderate igh section cut thick) and slight darker brown ost ways typical of intense orange alteration dumose groundmass extensively replaced by ividual plumes the groundmass is a very dark. consist of granular particles of brown and es within the vesicle and the greenish clay ts edges. The presence of this mineral implies rough there is no clear evidence of relative
Plar	ne-polarized: 63086441	Cross-polarized: 63086461





Igneous Petrology				
Lithology:	breccia	Rock texture:		
Style of emplacement:	breccia	Groundmass grain size (avg.):		
Major groundmass texture:		Minor groundmass Texture:		
Sample domain name (if>1)	1	Domain relative abundance (%)	100	

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THIN SECTION LABEL ID:	390-U1557D-7R-3-W 52/56-T	<b>SB-TS82</b> Th	in section no.:	
Observer:	PDK, EC	Pie	ece no.:	
Thin section thickness:	standard	Un	it/subunit: 1c	
Thin section summary:	<ul> <li>standard Unit/subunit: 1c</li> <li>Highly plagioclase-olivine phyrice basalt with breccia matrix: This thin section consists of two domains. One is the chilled margin of a highly plagioclase-olivine phyric basalt. The other is a small fragment of the breccia matrix in which the clast occurs. Basalt description: This is a highly plagioclase-olivine phyric basalt. The plagioclase phenocrysts are subhedral tabular and highly altered to calcite. Some of them may have exhibited sieve textures but it's hard to say with certainty, because the high degree of calcite replacement could be filling the sieve holes or creating new ones. The plagioclase phenocrysts occur in glomerocrystic clusters with euhedral equant olivine, which is now 100% altered to a mixture of iddingsite +/- calcite +/- ?colite (very low birefrigence mineral integrown with iddingsite). The glassy portion of the clast, now totally altered to palagonite, starts with the zone of spherulite growth, and spherulites in this rock are small (&lt;0.1 mm); the zone transitions to coalesced spherulites over a very short distance (&lt;2 mm) and quickly transitions from there into variolitic and plumose quench growth. The spherulites growth nucleated on plagioclase microlites. In the crypstocrystalline interior, olivine quench growth dominates. The altered groundmass is somewhat mottled between more and less intense red-brown colours, likely reflecting variations in the nucleation of quench minerals and/or differential nucleation of alteration on heterogeneities such as phenocrysts. The rock is sparsely vesicular, with round vesicles which typically have a thin rim of light brown clas thas cement / matrix on one side adjacent to the glassy margin of the basalt clast. The glassy margin has been fractured on one side. The palagonite is edged by bladed growth of calcite and/or zeolites, oriented perpendicular to the clast edge. The breccia amatrix is a mix of igneous detritus (0.1 to 0.6 mm) fragments of palagonite and cryptocrystalline basalt floating in</li></ul>			
Plane	-polarized: 63086501	Cross-polarized:	63086481	
Igneous Petrology				
Lithology:	highly plagioclase-olivine phyric basalt	Rock texture:		
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline	
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	glass	
Sample domain name (if>1)	1	Domain relative abundance (%)	90	

THIN SECTION LABEL ID:	390-U1557D-8R-3-W 39/41-TSB-TS83	Thin section no.:	1
Observer:	PDK, EC	Piece no.:	
Thin section thickness:	standard	Unit/subunit:	1c
Thin section summary:	Moderately plagioclase-olivine phyric basalt: This is a n phyric basalt. The alteration is typical of the hybrid brow and yellow-brown smectite + Fe oxyhydroxide phases u The plagioclase phenocrysts range from euhedral (near exhibit the typical polysynthetic twinning. Larger crystal show complex zoning indicating multiple periods of grow tabular crystals, often intergrown with cpx, appear to sh is alteration, but some of it could be partial replacement makes it hard to say for sure). Olivines are replaced by calcite throughout and are notable dark brown (cf. red-thave remnants of (or incipient alteration to) saponite ald spinel crystals were observed adjacent to an olivine phy Groundmass texture is predominantly intersertal. Elong framework with cpx forming relatively coarse-grained pl Where grain sizes are large enough, the relationship be subophitic. Small opaque minerals, mostly equant in sh between plag + cpx clusters. Groundmass olivine is 100 that shown by the phenocryst phases. Mesostasis area with most of the alteration in discrete patches, variably calcite, light brown saponite and/or some mix of Fe oxy represent filling of irregular porespace. The rock is spar by pale brown saponite, with some partially lined by gol overgrown by a dark reddish brown Fe-oxyhydroxide +/ the saponite and yellow clays is hard to determine; the outermost in vesicles but the two minerals do not form s could form from oxidative alteration of saponite as sapo overgrow yellow clays.	noderately plagioclas <i>in</i> alteration with bot ibiquitous throughou iy) equant to tabular s are typically sieve wth. Even some of th ow sieve textures (I t by clay or zeolites; iddingsite / Fe oxyhy prown) in this sample ong veins. Two large anocryst (pseudomo ate plagioclase laths umose structures in atween cpx and plag ape, occur in the intr 0% altered in a style s are in many places altered to golden yel hydroxides. Some of sely vesicular. Vesic den yellow/brown cla - smectite. The relat yellow clays are usu simple concentric lay onite or, equally, sap	se-olivine h saponite t the section. They textured and te smaller don't think it slide quality vdroxides + Some may equant Cr rph). form the between. becomes erstitial areas similar to s quite fresh low clay, f these likely cles are filled ay and some ive order of ally vers. Yellow onite could
Plane-p	olarized: 63086521 Cross-polari	zed: 63086541	





Igneous Petrology			
Lithology:	moderately plagioclase phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	intersertal	Minor groundmass Texture:	
Sample domain name (if>1)	1	Domain relative abundance (%)	100

THIN SECTION LABEL ID:	390-U1557D-8R-3-W 103/106-TSB-TS84	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Sparsely plagioclase-olivine phyric basalt: This thin see One is the chilled margin of a sparsely plagioclase-oliv small fragment of the breccia matrix in which the clast a sparsely plagioclase-olivine phyric basalt. Alteration assessing some aspects of the primary igneous feature overprint. The plagioclase phenocrysts appear to be m tabular to subequant, but they are highly to completely They occur both in glomerocrystic clusters and as indiv olivine, which is now 100% altered to a mixture of iddin glomerocrystic clusters, but in general the plag and olin glassy portion of the clast, now totally altered to palago spherulite growth, and spherulites in this rock are smal to coalesced spherulites over a very short distance (<2 there into variolitic and plumose quench growth. The s plagioclase microlites. In the crypstocrystalline interior, dominates, now replaced 100% by iddingsite. Groundn acicular to elongate skeletal microlites; they are highly minerals. Small equant euhedral olivine crystals also o are 100% altered in a manner similar to that shown by opaque minerals line the edges of the plumose quench The rock is moderately vesicular, with vesicles that are show a distinctive and unusual fill sequence. They are mineral with low interference colors (<1st order white; o second concentric lining of pale brown clay minerals w almost appearing isotropic. The same mineral also nea much of the replacement of plagioclase phenocrysts (a TS75) and commonly has a slight vermicular habit - un with very low birefrigence or a zeolite or some mixture a 'dirty' looking fill of granular dark brown and black ma are unfilled (or this part of the filling was lost in thin sec vesicles are lined by bright orange-brown clay which fr appears likely to derive from staining/mixing of the brow oxyhydroxides. Breccia matrix description: The basalt side adjacent to the glassy margin of the basalt clast. T growth of zeolites, oriented perpendicular to the clast e of igneous detritus (0.1 to 0.6 mm) fragments of palago 'floating' in a mi	ction consists of two domains. ine phyric basalt. The other is a occurs. Basalt description: This is of this clast is very high, so as is compromised by this later ostly anhedral to subhedral altered to a pale brown ?clay. ridual crystals. Euhedral equant gsite +/- calcite, also occurs in rine form separate Clusters. The onite, starts with the zone of I (<0.1 mm); the zone transitions mm) and quickly transitions from oherulites start out dominated by spherulitic growth nucleated on olivine quench growth nass plagioclase occurs as to completed altered to clay ccur in the groundmass and they the phenocrysts. Tiny equant growth and in mesostasis areas, unusually irregular in outline and concentrically lined by a coloress quartz/chalcedony?) with a ith extremely low birefringence, arly isotropic is responsible for llso observed previously e.g. clear what this is, could be a clay thereof. Some vesicles then have iterial (amorphous clays?); others ction preparation). Less commonly om it's appearance and habit wn isotropic clay with Fe clast has cement / matrix on one The palagonite is edged by bladed adge. The breccia matrix is a mix onite and cryptocrystalline basalt spar and sparry calcite.

Plane-polarized: 63086581



# Cross-polarized: 63086561



# Igneous PetrologyLithology:sparsely plagioclase-olivine phyric<br/>basaltRock texture:Style of emplacement:brecciaGroundmass grain size (avg.):cryptocrystallineMajor groundmass texture:dendritic or skeletalMinor groundmass Texture:glassSample domain name (if>1)1Domain relative abundance (%)90

THIN SECTION LABEL ID:	390-U1557D-8R-5-W 94/97-TSB-TS85	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Aphyric basalt: This is an aphyric or very sparsely olivir phenocryst identified in the thin section). The overall alt with disseminated brown iddingsite/Fe oxyhydroxides, j bright yellow clays mainly replacing groundmass and o euhedral and it is 100% altered to clays ranging in colo pale brown saponite with dark brown to opaque Fe oxy yellower clays (like mixed with Fe oxyhydroxides) typic: compositional/colour gradient across a single grain. Gr similar manner. Groundmass plagioclase is elongate an extensions on the ends of the elongate crystals; it is lar textures involving cpx are unusual because they range quench in an apparently random fashion; this suggests enough to form the subophitic plag-cpx relationship and plumose quench growth. Opaque minerals occupy the clinopyroxenes. The mesostasis is partially altered in p color (Fe oxyhydroxides) with some dusty opacity, like! There is also replacement of small patches of groundm across the sample without any clear spatial pattern. Re saponite is rarely seen. The rock is sparsely vesicular. ranging from pale brown saponite to golden yellow/orar oxyhydroxide) often co-existing across a single vesicle. consistent sense of concentric layering to these minera cross-fibrous carbonate vein, lined by opaque amorpho the sample.	he phyric basalt (one olivine teration is very similar to TS83 pale yellow-brown saponite and livine. The olivine is equant and r from golden yellow/brown to hydroxides. Saponite and ally co-exist as a pundmass olivine is altered in a nd skeletal, with horned gely unaltered. The groundmass from subophitic to plumose two stages of coolingone slow d a faster cooling that led to the mesostasis areas in between atches to a dark reddish brown y imparted by clay minerals. lass by golden yellow/brown clay, placement of the groundmass by The vesicles are filled by clays nge (likely smecite + some Fe . As in other samples there is no ils where they co-exist. A thin pus ?clay/Fe oxyhydroxides cuts
Plane-r	polarized: 63086601 Cross-polar	ized: 63086621

#### Plane-polarized: 63086601





#### **Igneous Petrology** . aphyric basalt Lithology: **Rock texture:** holocrystalline Style of emplacement: breccia Groundmass grain size (avg.): cryptocrystalline Minor groundmass Texture: Major groundmass texture: dendritic or skeletal subophitic 100 Sample domain name (if>1) 1 Domain relative abundance (%)

THIN SECTION LABEL ID:	390-U1557D-9R-1-W 42/43-TSB-TS86	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Aphyric basalt: This is an aphyric (or sparsely of predominantly by pale greenish brown saponite, phases, and a well developed green halo front of microphenocrysts appear to have been equant a either by pale gresnish brown saponite (radial fe dark reddish brown iddingsite, or both. Where ic clear evidence of order though some relationshi iddingsite. The groundmass consists of acicular with clinopyroxene in an incipient subophitic tex fully exhibit the texture. Instead, they form a coa plagioclase appears to be partially replaced by p the clay is replacing the mesostasis that occupie crystals). The cpx appears to be unaltered. Sma shape, occur in the interstitial areas. The rock is by brown saponite, some of which shows a radia vesicle walls. Crossing the middle of the section (fibrous or cryptocrysatlline, low interference col also replaces small patches of groundmass and unambiguously overgrown by radial saponite in olivine where saponite appears to overgrow the iddingsite/Fe oxyhysdroxides. The narrow band to be a halo front but there is no obvious different the front (i.e. inside or outside of the halo itself).	livine microphyric) basalt. Alteration is , with minor Fe oxyhydroxide bearing crosses the section. Olivine and euhedral. They are 100% replaced bathery habit, <1st o. red int. colours) or Idingsite and saponite coexist there is no ps suggest saponite radially overgrew skeletal plagioclase crystals intergrown ture, but the cpx crystals are too small to arse-grained plumose texture. The bale brown saponite (or it may be that es the centers of the skeletal plagioclase all opaque minerals, mostly equant in a moderately vesicular. Vesicles are filled al growth habit growing inward from the is a front of abundant green clay ours). This mainly occurs in vesicles but partially replaces olivine in places. It is at least one vesicle. There is also an green clay and itself be overgrown by in which the green clay occurs appears nce in the mineralogy to either side of
Plane-	oolarized: 63134001 Cros	s-polarized: 63133981
		Management of the local division of the loca
-0	2	





Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	intergranular	Minor groundmass Texture:	
Sample domain name (if>1)	) 1	Domain relative abundance (%)	100

		4 TOD TO07	<b>T</b> I. '
THIN SECTION LABEL ID:	390-U1557D-10R-1-W 122/124	4-1SB-1S8/	Thin section no.:
Ubserver:	PDK, EC		Piece no.:
Thin section thickness:	standard	the finer areined perties of	Unit/subunit: 1C
	an interval of dark green overa the most notable thing about th intervals despite the major diffe contains numerous large (up to have been highly altered (they incorporation in the breccia. Th calcite and a 'dirty' microspar ti origin. The smaller clasts are of small, but still recognizable, cla the basaltic clasts and are inte with high igneous detritus. The the zeolites and in some areas cemented 'clasts'. The zeolite a sand-size igneous detritus. It a the sparry calcite. Compared th appears to be more zeolite rich logging. No evidence for pelag green in hand specimen appear hand specimen); it is pale yello concentric laminae and first or apparent from previous examp pale greenish brown ?saponite example is cemented in the ce opaque phase. In another ther and a less coloured isotropic m could be fluid inclusions or som mineral. The basalt clasts are to the intense orange-red to re Most are too fine grained to de alteration (e.g. Fe oxyhydroxid a clay) are superimposed on o	Il alteration characterised h is section is how similar it prence in macroscopic app of 1 cm) subangular clasts of are orange brown in hand he area in between the larg hat is filled by mm- to sub- lominated by angular palag asts of cryptocrystalline bas rgrown with the micrite / m re are whole patches of de it appears that the calcite abundance is highest in the ppears that zeolite formation he brown glass breccias the h, as was suspected from it is sediment was identified. Ars similar to previous exam w, possibly slightly more in der interference colours. The les is that some of the larg build by Fe-oxid e are unusual vermiform in hineral which is abundantly he very fine grained and wo highly altered and distinctly d-brown colours typical of termine minerals but the in es) and some kind of green he another.	by dark green glass. Perhaps is to ones from orange-altered earance. The thin section of cryptocrystalline basalt that sample), presumably, prior to per clasts is cemented by sparry mm-size particles of igneous gonite fragments but also some salt. Zeolites encircle many of icrospar in some of the areas etritus that are cemented by just veining is fracturing the zeolite- e areas with the highest silt and on precedes crystallization of e cement in this green breccia is appearance during core The palagonite, although nples (which are dark brown in ntensely coloured, with ne only major difference er glass clasts have a core of erulites/radial fans and in one le rich (speckled bright in RFL) tergrowths of the brown clay included by fine blebs which eakly coloured amorphous v brown in colour in comparison other highly altered clasts. npression is that red-brown in alteration mineral (most likely
Plane-p	olarized: 63134021	Cross-polarize	ed: 63134041
Igneous Petrology			
Lithology: .	. breccia	Rock texture:	
Style of emplacement: b	preccia	Groundmass grain size (avg	J.):
Major groundmass texture:		Minor groundmass Texture	:
Sample domain name (if>1) 1		Domain relative abundance	e <b>(%)</b> 100

THIN SECTION LABEL ID:	390-U1557D-10R-2-W 82/84-TSB-TS88	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Sparsely plagioclase phyric basalt: This is a micro basalt. The overall alteration comprises abundant almost opaque replacement of the groundmass in combination of saponite/clay and Fe oxyhydroxid crystals occurring in glomerocrystic clusters. The brown clay. In one place, a glomerocrystic cluster based on the crystal shapes, these may have orige relationships with cpx; at least 75% of the ground microcrystalline textures. The plagioclase is slight cpx appears to be relatively unaltered. Groundman now 100% replaced by Fe oxyhydroxides + clay. cryptocrystalline mesostasis that appears to be q dark brown (likely Fe oxyhydroxides and clays) w brown saponite, or carbonate. Golden yellow clay patches of replacement for groundmass and parti- spatial control (e.g. a halo). They often appear to product of, saponite. A thin vein of this golden yel section. Equant to acicular opaque minerals are r mesostasis. The rock is moderately vesicular, wit by pale brown saponite clay or, less commonly, n filled with carbonate. Some vesicles have multiple layer, followed by Fe oxyhydroxides and then fille	borystalline sparsely plagioclase phyric t saponite replacement and very dark nesostasis, possibly resulting from a es. The plagioclase occurs as anhedral plagioclase is partially altered to pale r is replaced 100% by clay + calcite; ginally been olivine, but it's hard to tell. e crystals in subophitic textural mass is occupied by these tly altered to clay minerals(?) but the ass olivines are equant and euhedral, The remaining groundmass is uite heavily altered mostly to a very ith smaller patches replaced by pale vs also occur throughout the sample as ially rimming vesicles, without any clear be associated with, or any alteration llow brown clay also crosscuts the thin estricted to occurrence in the altered h round vesicles typically thickly lined hearly opaque Fe oxyhydroxides, and e linings, with clay forming the outer ed with carbonate.
Plane-r	olarized: 63134061 Cross	-polarized: 63134081

#### Plane-polarized: 63134061





Lithology:	sparsely plagioclase phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	microcrystalline
Major groundmass texture:	subophitic	Minor groundmass Texture:	intergranular
Sample domain name (if>1	) 1	Domain relative abundance (%)	100

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THIN SECTION LABEL ID:	390-U1557D-10R-3-W 22/24-TSB-TS89	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grainer thin section contains numerous large (up to 1 of basalt that have been highly altered (they are presumably, prior to incorporation in the brecc is cemented by sparry calcite and a 'dirty' micr particles of igneous origin. The smaller clasts a fragments but also some small, but still recogn Zeolites encircle many of the basaltic clasts ar microspar in some of the areas with high igned detritus that are cemented by just the zeolites calcite veining is fracturing the zeolite-cemente veins. The zeolite abundance is highest in the igneous detritus. It appears that zeolite formatic calcite. No evidence for pelagic sediment was highly plagioclase phyric. Plagioclase has bee is replaced by iddingsite. The groundmass is h similar to some other examples of "hybrid" alter alteration colours (likely from Fe oxyhydroxide yellow clay is moderately abundant replacing g latter mostly filled by carbnate. This clast has a amounts of partially interconnected vuggy pore by bright orange-red Fe oxyhydroxides.	d portion of the breccia in U1557D. The cm) subangular clasts of cryptocrystalline orange brown in hand sample), ia. The area in between the larger clasts ospar that is filled by mm- to sub-mm-size are dominated by angular palagonite nizable, clasts of cryptocrystalline basalt. do are intergrown with the micrite / bus detritus. There are whole patches of and in some areas it appears that the ed 'clasts'. and /or filling the middles of areas with the highest silt and sand-size ion precedes crystallization of the sparry identified. The largest basalt clast is n pervasively altered to carbonate. Olivine nighly altered to a dark brown colour eration with overprinting orange + green s and green/ish clays respectively). Bright groundmass and rimming vesicles, the an unusual morphology with large espace which is filled by matrix and lined
Plane-p	olarized: 63134121 Cro	oss-polarized: 63134101



# Igneous Petrology

Lithology:	breccia
Style of emplacement:	breccia
Major groundmass texture:	

Sample domain name (if>1) 1

Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

THIN SECTION LABEL ID:	390-U1557D-10R-3-W 13 <sup>,</sup>	I/134-TSB-TS90	Thin section no.:	
Observer:	PDK, EC		Piece no.:	
Thin section thickness:	standard		Unit/subunit:	1c
Thin section summary:	Cryptocrystalline basalt clast with breccla matrix. This thin section consists of two domains. One is a cryptocrystalline basalt clast that occupies ~ 25% of the thin section. The basalt is completely altered, with ferromagnesian minerals (olivine and cpx) completely replaced by dark orange brown Fe oxyhydroxides + clay. In a few patches the groundmass is instead replaced by light brown ?saponite or yellow-orange smectite + Fe oxyhydroxides. These patches appear at their edges to be overgrown by the darker red-brown groundmass (e.g. botryoidal laminae appear cut off by overgrowing red-brown Fe oxyhydroxides in one patch) but it is hard to be certain. Groundmass plagioclase microlites are acicular and completely replaced. The rock is moderately vesicular, with vesicles either unfilled or filled by zeolites, carbonate or amorphous/cryptocrystalline clay. A carbonate vein cuts the section and is associated with blebs of opaque Fe oxyhydroxides replacing groundmass. Similar disseminated growths of opaques occur throughout the section. The other domain in this thin section is a fragment of the breccia matrix in which the clast occurs. The breccia matrix is a mix of igneous detritus (0.1 to 0.6 mm), including fragments of palagonite and cryptocrystalline basalt 'floating' in a mix of cements that include zeolite, microspar and sparry calcite. There are several examples in this thin section that suggest some of the zeolite-cemented detritus may			
Plane-p	olarized: 63134141	Cross-po	olarized: 63134161	_

Igneous Petrology		
Lithology:	breccia	Rock texture:
Style of emplacement:	breccia	Groundmass grain size (avg.):
Major groundmass texture	:	Minor groundmass Texture:
Sample domain name (if>1	1) 1	Domain relative abundance (%) 100

Observer: PE Thin section thickness: sta Thin section summary: Cr 22 ab mi	PDK, EC tandard Cryptocrystalline basalt clast with breccia matrix: This thin 2/24. It consists of two domains. One is a cryptocrystallin bout one-third of the thin section. The basalt is completel ninerals (olivine and cpx) completely replaced by deep re-	Piece no.: Unit/subunit: section is similar to basalt clast that ly altered, with ferro	1c o 10R-3 occupies
Thin section thickness: sta Thin section summary: Cr 22 ab mi	tandard Cryptocrystalline basalt clast with breccia matrix: This thin 2/24. It consists of two domains. One is a cryptocrystallin bout one-third of the thin section. The basalt is completel ninerals (olivine and cpx) completely replaced by deep re-	Unit/subunit: section is similar to basalt clast that ly altered, with ferro	1c o 10R-3 occupies
Thin section summary: Cr 22 ab mi cla	Cryptocrystalline basalt clast with breccia matrix: This thin 2/24. It consists of two domains. One is a cryptocrystallin bout one-third of the thin section. The basalt is completed ninerals (olivine and cpx) completely replaced by deep re-	n section is similar to the basalt clast that of ly altered, with ferro	o 10R-3 occupies
ca cry mi lini an un An bro srr is of cry sp thi its	lay. There are two olivine phenocrysts (now 100% altered alcite). Associated with the two olivine pseudomorphs is a rystal of Cr spinel that is dark reddish brown in color. Gro nicrolites are acicular skeletal and completely altered. The <i>i</i> th vesicles filled by a pale brown saponite/smectite whice ning the vesicles. Equant olivine microphenocrysts are er nd very dark brown/opaque Fe oxyhydroxides with a sma nclear if either saponite or iddingsite/Fe oxyhydroxide is of nother small clast of basalt is highly plagioclase phyric al rown (hybrid alteration - Fe oxyhyroxide + a green clay?) mectite filling vesicles and replacing groundmass. The ot is a fragment of the breccia matrix in which the clast occur f igneous detritus (0.1 to 0.6 mm), including fragments of ryptocrystalline basalt 'floating' in a mix of cements that ir parry calcite (which retains a 2mm void in one area). The nis thin section that suggest some of the zeolite-cementer self, being outlined by rims of microsparry calcite and/or l parry calcite.	d-brown Fe oxyhyd d to Fe oxyhydroxid a large (0.3 mm) ed bundmass plagiocla e rock is moderatel ch exhibits a radiatii ntirely replaced by i all proportion of sap overgrowing the oth nd shows very dark and abundant brig ther domain in this f palagonite and nclude zeolite, micr ere are several exan d detritus may be a being crosscut by v	Inagnesian Iroxides + Jes and Juant Ise y vesicular, ng habit iddingsite ponite. It is her. c grey Jht yellow thin section trix is a mix rospar and mples in a 'clast' veins of
Plane-polarized: 63134201 Cross-polarized: 63134181			



Lithology:	breccia	Rock texture:
Style of emplacement:	breccia	Groundmass grain size (avg.):
Major groundmass textures		Minor groundmass Texture:
Sample domain name (if>1	) 1	Domain relative abundance (%) 100

THIN SECTION LABEL ID	: 390-U1557D-11R-1-W 91/93-1	T <b>SB-TS92</b> Th	nin section no.:	
Observer:	PDK, EC	Pi	ece no.:	
Thin section thickness	: standard	Ur	nit/subunit: 1c	
Thin section summary	Sparsely plagioclase phyric basalt: This is a sparsely plagioclase phyric basalt. The overall alteration style is a typical hybrid with pervasive saponite and more oxic alteration co-existing across the slide. The plagioclase occurs as large anhedral isolated crystals that exhibit sieve textures and contain melt inclusions; zoning is limited to very thin rims around the crystals. Collectively, this suggests the crystals are xenocrysts or at least macrocrysts rather than phenocrysts. Aside from the sieve textures, the plagioclase is largely unaltered. The groundmass consists of elongate plagioclase crystals in incipient subophitic textural relationships with cpx, but the cpx is too fine grained and the texture is executed as more like plumose quench for the cpx. Olivine is either limited to dendritic crystal growth in the groundmass or its alteration is just so extensive and similar to that of the groundmass mesostasis that it's difficult to distinguish the two. The groundmass is variably altered by reddish brown to grey Fe oxyhydroxides + dusty clays. The intensity of alteration increases towards the bottom edge of the slide and is paralleled by an increase in the abundant of bright yellow clays. These occur throughout the sample, replacing patches of groundmass, in some cases with botryoidal habit, and rimming/filling vesicles. Saponite, possibly mixed with a higher birefrigence phase in places (talc?) occurs across the slide, mostly as rims on vesicles but also replacing small patches of groundmass are restricted to occurrence in the mesostasis. The rock is moderately vesicular, with round vesicles filled by clay in various shades of brown. There is a banding in the alteration from brown to darker reddish brown, and this variation seems to be reflected in the vesicle fillings, which in some areas are a strong golden yellow brown and in others a pale brown			
Plane-polarized: 63134241 Cross-polarized: 63134221				
igneous Petrology				
Lithology:	sparsely plagioclase phyric basalt	Rock texture:	holocrystalline	
Style of emplacement:	breccia	Groundmass grain size (avg.):	microcrystalline	

Major groundmass texture: subophitic Sample domain name (if>1) 1

Minor groundmass Texture: Domain relative abundance (%) 100

intergranular

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THIN SECTION LABEL ID:	390-U1557D-11R-2-W 81/87-TS	<b>B-TS93</b> Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Fault gouge: This thin section was made from a rubble clast from a bin of clasts adjacent to the fault in Section 11R-2. In consists of clasts (up to 1.5 cm) of cryptocrystalline basalt (now highly altered to Fe oxyhdroxides, clays and calcite) along with smaller clasts of palagonite and zeolite-cemented silty particles, orange-brown in color and probably of igneous origin. The clasts are embedded in a sediment / cement of micritic to microspar calcite. There are veins and a very fine network of thin recrystallized (?) zones that parallel the long axis of some particles, creating what appears to be a preferred orientation. The basalt clasts are highly altered with groundmass replaced by dark brown Fe oxyhydroxides and clays. In the largest clast, plagioclase phenocrysts are 100% altered to carbonate, highly included by brownish clays, while in another, smaller clast they are replaced by zeolite. Olivine phenocrysts are pseudomorphed by iddingsite and carbonate + dark nearly opaque Fe oxyhydroxides. In the larger clast a spectrum of clay compositions from pale brown saponite to bright yellow smectite (likely including some Fe oxyhydroxide) are seen replacing groundmass and filling vesicles.	
Plane-polarized: 63134301 Cross-polarized: 63134321		
12 Contest		

Lithology:

. . breccia

Style of emplacement: breccia

Major groundmass texture:

Sample domain name (if>1) 1

Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

THIN SECTION LABEL ID:	390-U1557D-11R-2-W 116/118-TSB-TS94	4 Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Plagioclase-olivine phyric basalt with bread domains. One consists of several cryptoch occupy about 1/3 of the thin section and th clasts occur. The basalts are completely al phenocrysts are 100% altered to iddinsgite phenocrysts are generally completely pseu cryptocrystalline groundmass is completely oxyhydroxides + clay and has become alm with vesicles either unfilled, filled by zeolite domain in this thin section is a fragment of This breccia matrix is much more lithic rich observed. Effectively, it is a calcite-cement rich microsparite. The sand and silt-size cli- basalt, palagonite, and fragments of zeolite to reddish brown silt and clay size particles between this and the matrix of breccias hig zeolite fringes around the mafic clasts.	cia matrix: This thin section consists of two ystalline basalt and palagonite clasts that he other is the breccia matrix in which the ltered. Equant and euhedral olivine and carbonate. Tabular plagioclase udomorphed by carbonate. The y replaced by dark orange brown Fe host opaque. The rock is moderately vesicular, es or, in some cases, carbonate. The other the breccia matrix in which the clast occurs. In and carbonate cement poor than previously ted, poorly sorted, lithic sandstone or a lithic- asts in the matrix include cryptocrystalline e-cemented sedimentsplus a lot of dark grey is too small to identify. A big difference gher up in the hole is the absence of the
Plane-polarized: 63134281 Cross-polarized: 63134261		





Igneous Petrology			
Lithology:	sparsely plagioclase-olivine phyric basalt	Rock texture:	
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:	
Sample domain name (if>1)	1	Domain relative abundance (%)	100

THIN SECTION LABEL ID:	390-U1557D-12R-3-W 61/63-TSB-TS95	Thin section no.:	
Observer:	PDK, EC	Piece no.:	
Thin section thickness:	standard	Unit/subunit:	1c
Thin section summary:	Plagioclase olivine phyric basalt: This is a sparsely plag plagioclase phenocrysts range from subhedral tabular to They exhibit the typical polysynthetic twinning and com- clusters. Most appear to exhibit sieve textures, although the 'holes' are produced by alteration or the alteration is existing sieve textures, as these tend to be filled by a pa- mineral appears to have a slight micaceous parting in s birefringence, commonly appearing isotropic. Overall it saponite in optical properties. Olivines phenocrysts are broad zonation (halo?) in olivine alteration across the sa section, olivine is replaced by pale brown to yellow brow section the halo olivine is replaced by iddinsgite + calcit the section). There is a oxidative overprint which affects spatial distribution to that of iddingsite, occuring mainly is seen as irregular diffuse yellow to brown staining whi saponite and does not appear to follow the microstructu be an oxidative overprint. The groundmass texture is pr to acicular to skeletal plagioclase laths form the framew structures in between. Alteration of the groundmass pla small grain size and quality of the thin section but it app altered. Groundmass cpx also appears to be partially al orange-brown color that is atypical of fresh cpx plumose minerals, mostly equant in shape, occupy the interstitial Groundmass olivine is 100% altered in a style similar to phases. Mesostasis areas are also an dark grey with a suggesting that they are similarly altered, possibly by bo The rock is sparsely vesicular and the vesicle fills follow the fill mineralogy, with rims that are pale yellow brown by a darker brown clay, then a colorless layer that has v (zeolite?) and lastly an opaque slight dusty lining inside oxyhydroxides). The centres of the vesicles are typically groundmass are filled in a similar manner. At the botton commonly entirely fills vesicles without obvious zonation still seen) but with the same irregular reddening describ	ioclase-olivine phyric o more equant and a monly occur in glome it is isn't entirely cle taking advantage of ale brown clay miner ome examples and is doesn't conform to ty equant and euhedra ample. At the bottom vn saponite (); at the e (+/- saponite in the the saponite and ha at the bottom of the ch cuts across doma re of the clays. This edominantly interser ork with cpx forming g is hard to assess, ears to be moderate tered, as much of it le quench crystals. Of areas between cpx that shown by the p distinct orange brow oth clays and Fe oxy v a similar zonation a s exhibit a concentric or very pale green cl very low interference that (possibly Fe v unfilled. Irregular pan of the section sapo n (though concentric ed above.	c basalt. The inhedral. erocrystic ear whether f the pre- al. This s very low /pical l. There is a of the top of the emiddle of as a different section. This ins of appears to tal. Elongate plumose given the ly to highly has an paque plumes. henocryst n color hydroxides. is olivine c zoning in lay, followed colors atches in the nite more zonation is



Cross-polarized: 63148801



lase-olivine phyric Rock texture:	holocrystalline
Groundmass grain size (a	vg.): cryptocrystalline
Minor groundmass Textu	re: dendritic or skeletal
Domain relative abundan	<b>ce (%)</b> 100
	lase-olivine phyric Groundmass grain size (a Minor groundmass Textu Domain relative abundan

THIN SECTION LABEL ID:	390-U1557D-12R-6-W 50/53-TSB-TS96	Thin section no .:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grained portion an interval where macroscopic core description reports deformation. In this thin section, the breccia matrix con submm-sized clasts of igneous detritus cemented pred largest clasts (up to ~ 2 cm) are all angular to subangu basalt. They range from aphyric to sparsely plagioclase clasts include both angular palagonite fragments and s of cryptocrystalline basalt, along with a high proportion creates the 'dirty' microspar cement. There are strong t section that reflect the deformation. Some areas appear up in the hole, where the igneous clasts are cemented microspar. In other areas, the zeolites appear to have the sparry calcite appears as rounded clasts in a sea of 'din areas appear to consist almost entirely of silt or clay-siz carbonate cement. In some areas there appears to be elongate clasts parallel to the orientation of thin veins a more coarsely crystalline matrix has been comminuted Basalt clasts are highly altered with groundmass altere oxyhydroxides + clays or to darker brown colour. Reast colour are not obviously clear. Most primary minerals re possibly zeolites. Glass is all 100% altered to yellow to growth laminae. Some of this appears to be undergoing	of the breccia in U1557D from the breccia has undergone sists of densely packed mm- to ominantly by carbonate. The ar fragments of cryptocrystalline e-olivine phyric. The smaller mall, but still recognizable, clasts of silt to clay-size material that extural variations across the thin r similar to breccias view higher by sparry calcite, zeolites and/or been largely removed and the ty' micrite / microspar. Some ze material with little to no a preferential alignment of ind broader areas where the to the fine silt-clay size material. d either to deep red-brown Fe ons for the contrast in altered eplaced by carbonate, clays or brown palagonite with concentric g incipient disaggregation.
Plane-p	olarized: 63148841 Cross-polar	ized: 63148861



# Igneous Petrology

Lithology:	
Style of emplacement:	breccia
Major groundmass texture:	
Sample domain name (if>1)	1

Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

THIN SECTION LABEL ID: Observer:	<b>390-U1557D-12R-7-W 70/72-TSB-TS97</b> PDK, EC	Thin section no.: Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grain 'matrix' in between larger clasts). The thin so of cryptocrystalline basalt (up to ~1 cm) that angular palagonite fragments. The area in b sparry calcite and a 'dirty' microspar + zeolit particles of igneous origin. The smaller class fragments but also some small, but still reco Zeolites provide the cement for large areas appearing more like veins that crosscut thes than in samples higher up in the hole, formin coarse bladed crystals. The basalt clasts are without much reddening (abundant clays?) of groundmass and filling of vesicles by bright by dark red-brown iddingsite. Plagioclase are birefringence mineral, possibly a zeolite. Ve carbonate or by concentric layers of yellow a	ned portion of the breccia in U1557D (i.e. the ection contains numerous subangular clasts have been highly altered and abundant etween the larger clasts is cemented by es that is filled by mm- to sub-mm-size s are dominated by angular palagonite gnizable, clasts of cryptocrystalline basalt. that are detritus rich, with the sparry calcite e patches. The zeolite is much finer grained og small indistinct masses rather than e almost all altered to a very dark brown One clast shows replacement of yellow clay. Olivine is pervasively replaced opears to be replaced by a very low sicles are mostly filled by zeolites +/- and brown clays + Fe oxyhydroxides.
Plane-p	oolarized: 63148901 (	Cross-polarized: 63148881





Igneous	Petrolo	ogy
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Lithology:

Style of emplacement: breccia

Major groundmass texture:

Sample domain name (if>1) 1

Rock texture: Groundmass grain size (avg.): Minor groundmass Texture: Domain relative abundance (%) 100

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THIN SECTION LABEL ID:	390-U1557D-13R-1-W 97/99-	TSB-TS98 Thi	n section no.:
Observer:	PDK, EC	Pie	ce no.:
Thin section thickness:	standard	Uni	it/subunit: 1c
Thin section summary:	Aphyric basalt with breccia ma a small fragment of breccia att The breccia is dominated by a clasts of cryptocrystalline basa clasts are cemented by a mix phillipsite. The largest basalt of to sparry calcite. The phillipsite areas where the igneous detrii grained crystals with bladed a sparry calcite has a 'space-filli disrupting the textures. The pa and zonation with higher interf more crystalline structure?). It centre of clasts.	atrix: This thin section contains a tached. This description pertains ingular clasts of palagonite, alon alt. Clasts range in size from a fe of sparry calcite, 'dirty' (i.e. inclu clast (described separately) is ou e is commonly intergrown with th tus is more fine grained. It also on ind twinned habit where in proxin ng' look about it, i.e. it doesn't se alagonite is very pale green and terence colours (<1st order white appears to be altering to clays in	n aphyric basalt clast with a to the breccia material. g with more subangular we mm to silt size. The sion-filled) microspar, and itlined by a layer of bladed he 'dirty' microspar in boccurs as more coarse- nity to palagonite. The even to be a vein that is shows radial laminations a) in the centre (slightly n some patches at the
Plane	-polarized: 63148921	Cross-polarized: 6	3148941
13R-1 97/99	1 5570 (98) 1		15570 (98) 1
Igneous Petrology			
Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	intergranular	Minor groundmass Texture:	dendritic or skeletal
Sample domain name (if>1)	1	Domain relative abundance (%)	80
Igneous Petrology			
Lithology:		Rock texture:	
Style of emplacement:		Groundmass grain size (avg.):	
Major groundmass texture:		Minor groundmass Texture:	
Sample domain name (if>1)	2	Domain relative abundance (%)	20
<b>. .</b>			
Igneous Petrology			
Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	intergranular	Minor groundmass Texture:	dendritic or skeletal
Sample domain name (if>1)	1	Domain relative abundance (%)	80

Igneous Petrology	
Lithology:	Rock texture:
Style of emplacement:	Groundmass grain size (avg.):
Major groundmass texture:	Minor groundmass Texture:
Sample domain name (if>1) 2	Domain relative abundance (%) 20

	200 114557D 42D 2 W 24/26	TED TEON	hin contian no l	
THIN SECTION LABEL ID:	390-01557D-13R-2-W 34/36	-198-1988		
This section thickness	PDR, EC	F	lece no	
Observer:         PICK, EC         Piece no.:           Thin section thickness:         standard         Unit/subunit:         1c           Thin section summary:         Aphyric basalt with breccia matrix: This is an aphyric basalt contains a single, anhedral, highly resorbed plagioclase xenocryst. Aside from being highly resorbed, the plagioclase appears to be only slightly altered. There is also one olivine phenocryst, 100% altered iddingsite/Fe-oxyhydroxides and brown saponite. The groundmass texture is predominantly intersertal. Acicular skeletal plagioclase laths form the framework with cpx forming plumose structures in between. The rock exhibits patchy alteration and in areas of lower alteration both the plagioclase and the cpx appear to be relatively unaltered. Elsewhere, both groundmass cpx and plagicclase appear to be relatively unaltered. The plagioclase is replaced by a clay mineral (?) and much of the groundmass cpx has an orange-brown color that is atypical of fresh cpx plumose guench crystals, suggesting replacement by smectite. Groundmass olivine is replaced by iddingsite / Fe oxyhydroxide replacement. The alteration highlights the skeletal cryst morphologies. Opaque minerals, mostly equant in shape, occupy the interstitial areas between cpx plumes. The basalt has a 'vein' of carbonate material that intrudes it that links to the breccia matrix, indicating that the two are linked. The vein' consists of a mi of clay, sparry calcite and zeolites. The spasely vesicular. Vesicles fills define a halo around the top edge of the clast and along a vein extending into the clast. Within the halo vesicles are filled by bright green clay (radial to microcrystalline, low '1st order int. cols.) which is patchily oxidised to yellow-brown colours and overgrown by red-brown saponite and darker slight opaque clays which may be saponite or another clay mineral clay sy pred-brown oxyhydroxi				
Plane	-polarized: 63148981	Cross-polarized:	63148961	
Igneous Petrology				
Lithology:	. aphyric basalt	Rock texture:	holocrystalline	
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline	
Major groundmass texture:	intergranular	Minor groundmass Texture:	dendritic or skeletal	
Sample domain name (if>1)	1	Domain relative abundance (%	<b>6)</b> 80	
Igneous Petroloav				
Lithology:		Rock texture:		
Style of emplacement:				
		Groundmass grain size (avg.):		

Sample domain name (if>1) 2

Domain relative abundance (%) 20

Igneous Petrology			
Lithology:	. aphyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	cryptocrystalline
Major groundmass texture:	intergranular	Minor groundmass Texture:	dendritic or skeletal
Sample domain name (if>1	) 1	Domain relative abundance (%)	80
Igneous Petrology			
Igneous Petrology Lithology:		Rock texture:	
Igneous Petrology Lithology: Style of emplacement:		Rock texture: Groundmass grain size (avg.):	
Igneous Petrology Lithology: Style of emplacement: Major groundmass texture:		Rock texture: Groundmass grain size (avg.): Minor groundmass Texture:	

THIN SECTION LABEL ID:	390-U1557D-13R-3-W 7/9-TSB-TS100	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Plagioclase olivine phyric basalt: This is a min phyric basalt. The plagioclase occurs as annu- glomerocrystic clusters, but also as isolated of appear to exhibit sieve textures, although it is the crystals are due to the sieve texture or a fi- partially altered to pale brown clay. Olivine ph- replaced by iddingsite and carbonate. The gr crystals in subophitic textural relationships wi occupied by these microcrystalline textures. minerals(?) but the cpx appears to be relative small and difficult to distinguished from alterer Fe oxyhydroxides and smectite. The cryptocr heavily altered, mostly to a very dark brown r with smaller patches replaced by saponite wh orange brown, likely reflecting variable stainin moderately vesicular, with round vesicles typ which shows a variable oxidative overprinted oxyhydroxides cutting across the crystalline r colours from pale brown to orange-brown. In blebs of earlier Fe oxyhydroxides and in othe generation of saponite with concentric laters A few vesicles are lined by brown saponite and	crocrystalline sparsely plagioclase-olivine edral crystals occurring commonly in crystals. The plagioclase phenocrysts difficult to determine whether the 'holes' in function of alteration, because they are nenocrysts are euhedral equant and 100% oundmass consists of elongate plagioclase th cpx; at least 90% of the groundmass is The plagioclase is slightly altered to clay ely unaltered. Groundmass olivines are d mesostasis. They appear to be altered to ystalline mesostasis appears to be quite nineral (likely Fe oxyhydroxides and clays) nich ranges in colour from pale brown to ng by Fe oxyhydroxides. The rock is ically filled by radially fibrous saponite seen as irregular staining by Fe nicrotexture and results in a range of places the saponite overgrowns earlier rs there appear to be more than one of slight different colour and birefringence. nd filled by carbonate.
Plane-p	polarized: 63149001 C	ross-polarized: 63149021
		and the second sec





Lithology:	sparsely plagioclase-olivine phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	microcrystalline
Major groundmass texture:	subophitic	Minor groundmass Texture:	intergranular
Sample domain name (if>1	) 1	Domain relative abundance (%)	100

THIN SECTION LABEL ID:	390-U1557D-13R-4-W 28/30-TSB-TS101	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grained p'matrix' in between larger clasts). The thin section cryptocrystalline basalt (~1 cm) and one subang The remainder of the thin section consists of a h that is of the mm- to sub-mm size range in a cent smaller clasts are a roughly even mix of angular cryptocrystalline basalt clasts. Carbonate is muct thin section. It occurs as sparry calcite in a few p that are parallel to one another, but the thick spate absent. Palagonite is yellow to brownish-yellow a gapear to postdate the alteration of the glass since the state of the	portion of the breccia in U1557D (i.e. the in contains one subangular clast of jular clast of palagonite of a similar size. high concentration of igneous detritus nent that is predominantly zeolite. The palagonite fragments and h more limited in its occurrence in this batches and forms thin ribbon-like veins arry calcite veins and sealing cement are and shows concentric laminae around carbonate veins cut the clasts and hee they crosscut the growth laminae.

#### Plane-polarized: 63149061







Igneous Petrology			
	Rock texture:		
breccia	Groundmass grain size (avg.):		
	Minor groundmass Texture:		
1	Domain relative abundance (%)	100	
	breccia 1	Nock texture:brecciaGroundmass grain size (avg.):Minor groundmass Texture:1Domain relative abundance (%)	

THIN SECTION LABEL ID: Observer:	<b>390-U1557D-14R-2-W 26/29-TSB-TS102</b> PDK, EC	Thin section no.: Piece no.:	
Thin section thickness:	standard	Unit/subunit:	1c
Thin section summary:	Breccia: This is an example of the finer grained portion of 'matrix' in between larger clasts). The clasts are all less the the thin section consists of a high concentration of igneous sub-mm size range. The clasts are a roughly even mix of and cryptocrystalline basalts. Modal abundance of cemer The cement is a mix of sparry calcite, zeolites and some is roughly that order of abundance. There are palagonites we margins that I hadn't really noticed before. Do these represent and of provide the source of silica for the phillipsite replacement of olivine and ?plagioclase by pale yellowish that this has not been overprinted within the breccia - or p within the breccia). Pervasive replacement of plagioclase occurrence in most of the clasts might suggest it represented to provide the clasts might suggest it represented to provide the clasts might suggest it represented to plagioclase occurrence in most of the clasts might suggest it represented to provide the clasts might suggest it represented to provide the clasts might suggest it represented to plagioclase occurrence in most of the clasts might suggest it represented to plagioclase occurrence in the plagioclase occurrence in most of the clasts might suggest it represented to plagioclase occurrence in most of the clasts might suggest it represented to plagioclase occurrence in the plagioclase occurence in the plagiocl	the breccia in U15 ian 1 cm in size and is detritus that is of angular palagonite it overall appears to nclusion-riddled mi <i>i</i> th 'spongy' texture esent the breakdow ? Basalt clasts sho brown saponite (in bossibly it could hav is unusual in the ho the in situ alteration	57D (i.e. the d most of the mm- to fragments b be low. icrospar, in es on their on of the w abundant teresting /e occurred ole and its

#### Plane-polarized: 63149081



Cross-polarized: 63149101



Igneous Petrology				
Lithology:	Rock texture:			
Style of emplacement: breccia	Groundmass grain size (avg.):			
Major groundmass texture:	Minor groundmass Texture:			
Sample domain name (if>1) 1	Domain relative abundance (%) 100			

THIN SECTION LABEL ID: Observer: Thin section thickness: Thin section summary:	<b>390-U1557D-14R-3-W 85/87-</b> PDK, EC standard Sparsely olivine phyric basalt: phenocrysts are 100% altered oxyhydroxides) and pale brow and they appear to have beer iddingsite / clays. Some are a reddish brown Cr spinel crysta plagioclase crystals that appe although it's difficult to assess crystals is plumose quench gr orange-brown, suggesting tha replaced by the same dark rep	TSB-TS103 Th Pi Ur This is sparsely olivine phyric b to dark orange brown iddingsit of saponite. They are typically en partially resorbed (or skeletal) ssociated with very large (up to als. The groundmass consists of ar to be partially replaced by a p to at these fine grain sizes. In bet owth of clinopyroxene (inferred) to ti is partially altered. Groundm ddish brown smectite + Fe oxyh	in section no.: ece no.: hit/subunit: 1c basalt. The olivine e (smectite + Fe quant to elongate in shape before being replaced by ~ 0.15 mm), equant, dark f acicular skeletal bale brown clay mineral, ween the plagioclase b. It is pale brown to slightly ass olivine is skeletal and ydroxide that has replaced	
	the olivine phenocrysts. Smal The rock is sparsely vesicular majority are completely or par structure. Some of these show layers of slightly different textor crystalline carbonate or by ze oxyhydroxides. These two ves saponite overgrows a brown F overgrow a thin rim of saponit > zeolite/carbonate. The rock	l equant masses of opaque min with small round vesicles with tially filled by pale brown sapon v evidence for two generations of ure. Slightly less commonly, ves olite, in some cases overgrowin sicle fills are very rarely seen to to e oxyhydroxide rim and in anot e; the sequence is therefore Fe is crosscut by anastomosing sp	erals fill interstitial areas. /ariable fillings. The ite with radial fibrous of saponite with concentric icles are filled by g a thin rim red-brown Fe gether but in one example her zeolite appears to oxyhydroxides > saponite arry calcite veins.	
Plane	-polarized: 63149141	Cross-polarized:	63149121	
Plane-polarized: 63149141 Cross-polarized: 63149121				
lithology:	sparsely olivine phyric basalt	Rock texture	holocrystalline	
Style of emplacement	breccia	Groundmass grain size (avg.).	cryptocrystalling	
Major groundmass texture:	dendritic or skeletal	Minor groundmass Texture:		

Sample domain name (if>1) 1

Domain relative abundance (%) 100

THIN SECTION LABEL ID: Observer:	<b>390-U1557D-14R-4-W 110/112-TSB-TS104</b> PDK, EC	Thin section no.: Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Breccia: This is an example of the finer grained portic 'matrix' in between larger clasts). The clasts are all le the thin section consists of a high concentration of ig sub-mm size range. The clasts are a roughly even m and cryptocrystalline basalts. The middle/core of the their mineralogy; while some are the same pale yello rims, some have developed into multiple spherical ac are filled by crystalline carbonate. Modal abundance low. The cement is dominated by zeolites followed by microspar; sparry calcite is the least abundant. The p examples of its bladed habit in this thin section. There with a 'spongy texture either appearing to disaggrega with patchy replacement by zeolites.	on of the breccia in U1557D (i.e. the ss than 1 cm in size and most of neous detritus that is of the mm- to ix of angular palagonite fragments palagonite clasts are variable in w, laminated palagonite as the ccumulations of ?clays while others of cement overall appears to be r 'dirty' (inclusion-riddled) hillipsite shows some nice e are also examples of palagonite te into the fine grained matrix or

#### Plane-polarized: 63149161



Cross-polarized: 63149181



Igneous Petrology				
Lithology:	Rock texture:			
Style of emplacement: breccia	Groundmass grain size (avg.):			
Major groundmass texture:	Minor groundmass Texture:			
Sample domain name (if>1) 1	Domain relative abundance (%) 100			

THIN SECTION LABEL ID:	390-U1557D-14R-6-W 2/4-TSB-TS105	Thin section no.:
Observer:	PDK, EC	Piece no.:
Thin section thickness:	standard	Unit/subunit: 1c
Thin section summary:	Highly plagioclase-olivine-clinopyroxene basalt: This clinopyroxene phyric clast. The plagioclase phenocry subhedral elongate crystals that are moderately to hig Larger, and less common, macrocrysts are more equ partially resorbed cores with rim overgrowth that show phenocrysts occur in glomerocrystic clusters with euh 100% altered to variable combinations of iddinsgite + carbonate - as well as clinopyroxene, which is typical and plagioclase exhibit a subophitic textural relations larger olivines contains equant inclusions of dark redis incipient subophitic, consisting of elongate skeletal altered (?) with small cpx crystals partially enclosing t largely unaltered. Groundmass olivines are small equat to a dark reddish brown Fe oxyhydroxide + clay mine concentrated in the mesostasis. The rock is moderate 100% filled. Vesicle are predominantly fillined by pale are filled by carbonate. Partially rims of bright yellow-oxyhydroxide are common and are mostly concentrate the left hand edge of the section. Yellow-orange clays thin concentric layer of Fe oxyhydroxide rich material Carbonate overgrows the yellow clays but rarely co-e some cases adjacent vesicles show similar yellow clays aponite or carbonate (replacement of saponite by carbonate are prediment of saponite by carbonate are placement of groundmass by saponite, carbonate are placement of groundmass by saponite, carbonate are placement of groundmass by saponite, carbonate and placement of groun	is a highly plagioclase-olivine- sts occur predominantly as ghly altered to pale brown saponite ant and typically have older, vs subtle zoning. The plagioclase ledral equant olivine - which is now pale yellowish brown saponite +/- ly unaltered. The clinopyroxene hip in the glomerocrsts. Some brown Cr spinel. The groundmass plagioclase crystals, partially he plag. The cpx appears to be ant crystals that are 100% altered rals. Opaque minerals are ely vesicular, with round vesicles yellow-brown saponite and some orange to brown smectite/Fe ed in a halo extending ~5mm from s are commonly overgrows by a and then by pale brown saponite. xists with saponite in vesicles. In by linings but are filled entirely by urbonate?). There is also patchy and golden brown clay.

#### Plane-polarized: 63149221





Lithology:	highly plagioclase-olivine-augite phyric basalt	Rock texture:	holocrystalline
Style of emplacement:	breccia	Groundmass grain size (avg.):	microcrystalline
Major groundmass texture:	subophitic	Minor groundmass Texture:	intersertal
Sample domain name (if>1)	1	Domain relative abundance (%)	100