Appendix 1, Table 1. Bulk-rock compositions of YTT pumice and post-YTT lava dome samples used in this study

	YTT pumice[a]						**Lava dome end-members**[b]				**Extended suite of lava dome compositional range**[b]								
Sample:	T-57A1	T-12A1	T-13A4	T-22A1	T-20A1	T-5B3	TT-7	SF-1	SF-3	TT-2	TT-3	TT-1	TT-4	TT-9	TT-6	TT-5	TT-11	TT-8	TT-10
SiO_2	69.49	71.79	73.93	74.81	75.81	76.67	69.52	70.66	75.23	75.76	69.57	70.55	71.59	72.05	72.45	72.57	72.73	72.55	74.72
TiO_2	0.54	0.27	0.25	0.13	0.13	0.06	0.4	0.29	0.14	0.12	0.3	0.32	0.31	0.29	0.22	0.22	0.25	0.26	0.17
Al_2O_3	15.04	15.88	13.6	14.08	13.24	13.27	15.32	15.65	13.53	13.11	15.11	15.34	14.78	14.68	14.85	14.84	14.52	14.49	13.66
Fe_2O_3	3.79	2.77	2.53	1.68	1.75	1.21	3.58	2.52	1.53	1.4	2.83	2.84	2.95	2.61	2.16	2.19	2.18	2.48	1.81
MnO	0.08	0.08	0.07	0.06	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
MgO	0.94	0.48	0.53	0.3	0.27	0.18	1.01	0.66	0.24	0.18	0.67	0.69	0.68	0.63	0.44	0.42	0.58	0.57	0.3
CaO	3.23	2.07	2.25	1.32	1.15	0.67	3.21	2.43	1.33	1.14	2.63	2.87	2.64	2.49	1.83	2.02	2.24	2.28	1.56
Na_2O	3.21	2.79	2.94	2.91	2.74	2.93	3.45	3.57	3.08	3.4	5.04	3.51	3.4	3.35	3.32	3.41	3.19	3.32	3.17
K_2O	3.64	3.84	3.83	4.7	4.82	4.91	3.33	4.08	4.84	4.81	3.7	3.71	3.55	3.77	4.6	4.25	4.17	3.9	4.51
P_2O_5	0.04	0.03	0.06	0.01	0.01	0.02	0.11	0.06	0.01	0.01	0.08	0.09	0.04	0.06	0.05	0.01	0.07	0.07	0.03
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
AN	36.7	29.9	30.2	20.8	19.6	11.4	34.2	27.9	20.0	16.3	15.2	31.5	30.9	29.7	23.7	25.6	28.4	27.9	21.9
Q	27.6	34.9	35.9	36.0	38.0	38.7	28.0	28.2	35.5	34.9	20.5	28.8	31.4	32.0	31.0	31.5	32.7	32.7	35.3
or	21.5	22.7	22.6	27.8	28.5	29.0	19.6	24.1	28.6	28.4	21.8	21.9	20.9	22.2	27.1	25.1	24.6	23.0	26.6
ab	27.2	23.6	24.9	24.6	23.2	24.8	29.1	30.2	26.0	28.7	42.6	29.7	28.7	28.3	28.1	28.8	26.9	28.0	26.8
an	15.8	10.1	10.8	6.5	5.6	3.2	15.2	11.6	6.5	5.6	7.7	13.6	12.8	11.9	8.7	9.9	10.7	10.8	7.5
C	0.0	3.4	0.7	1.8	1.5	2.0	0.5	1.1	0.8	0.3	0.0	0.5	0.6	0.7	1.2	1.0	0.8	0.8	0.8
hy	4.7	3.2	3.1	2.0	2.1	1.5	3.8	1.6	0.6	0.5	0.3	2.0	2.2	1.6	1.1	1.0	1.5	1.4	0.8
mt	1.8	1.3	1.2	0.8	0.8	0.6	2.8	2.3	0.0	0.0	2.6	2.7	2.6	2.6	1.5	1.6	1.3	2.3	0.7
il	1.0	0.5	0.5	0.3	0.3	0.1	0.8	0.6	0.2	0.2	0.6	0.6	0.6	0.6	0.4	0.4	0.5	0.5	0.3
ap	0.1	0.1	0.1	0.0	0.0	0.1	0.3	0.1	0.0	0.0	0.2	0.2	0.1	0.1	0.1	0.0	0.2	0.2	0.1

Notes: YTT sample names are subsequently shortened (e.g., T-57A1 = T-57). No bulk-rock chemical analysis exists for samples T-5C, T-5D, and SF-3-13. Pumice T-5C is banded and contains coarse-grained type ‘A’ (like T-57A1 to T-20A1) YTT magma mingled or juxtaposed with fine-grained dacitic magma. Pumice T-5D is banded and contains fine-grained type ‘B’ (like T-5B3) YTT magma mingled with the same dacitic magma.

[a] Chesner (1998).

[b] This study.

Appendix 1, Table 2.
Samples and materials studied

	Sample	Thin sections	Thick serial sections	Quartz CL-imaged
YTT				
Compositional range				
	T-5B	1	2	80
	T-5C	1	3	18
	T-5D	1	3	5
	T-20	3	6	68
	T-22	1	1	24
	T-13	3	9	34
	T-12	3	6	23
	T-57	3	7	42
Total		*16*	*37*	*294*
Post-YTT lava domes				
Compositional end-members				
	TT-2	1	3	122
	SF-3	1	3	55
	SF-3-13	1	1	31
	SF-1	1	3	42
	TT-7	1	3	52
Extended suite of compositional range				
	TT-1	1	4	39
	TT-3	1	3	26
	TT-4	1	1	29
	TT-5	1	1	33
	TT-6	1	4	31
	TT-8	1	3	31
	TT-9	1	3	23
	TT-10	1	4	51
	TT-11	1	2	28
Total		*14*	*38*	*593*
Total YTT & domes	*22*	*30*	*75*	*887*

Appendix 1, Table 3. Relative crystallographic orientation measurements of grouped quartz units using EBSD

		Angle measurements (deg.)				
	Unit pair	*c*-axes [0001]	*a*-axes $[10\bar{1}0]$	$\{10\bar{1}1\}$	$\{10\bar{1}\bar{1}\}$ or $\{01\bar{1}1\}$	Orientation
EBSD results						
YTT						
T-20 (2.9)	U1,U2	85	4, 71, 79	10,38, 39	11, 41, 40	Verespatak twin
	U1-U3	85	4, 71, 79	10,38, 39	11, 41, 40	Verespatak twin
	U2-U3	0	0, 0, 0			Parallel
T-20 (4.1)	U1-U2	0	0, 0, 0			Parallel
	U2-U3	75		9, 1, 3	21, 22, 40	Esterel twin[a]
	U3-U4	12	7, 13, 13			Parallel[a]
	U4-U5	46-49		13, 22, 27	36, 44, 63	[c]
	U3-U5	56				See U7-U5 [c]
	U5-U6	63				Sardinian? [c]
	U2-U6	44				Cornish twin? [c]
	U6-U7	49				[c]
	U7-U8	43				Cornish twin? [c]
	U2-U5	75		8, 9, 9	14, 28, 40	Esterel twin[a]
	U5-U9	38				[c]
	U7-U5	64				Sardinian twin? [c]
	U6-U4	36				[c]
	U6-U8	6	3, 7, 9			Parallel [a]
	U3-U6	42				[c]
	U3-U7	10	7, 10, 10			Parallel[a]
	U2-U7	76		2, 4, 10	20, 24, 38	Esterel twin[a]
	U3-U9	77		26, 28, 29	25, 43, 43	See U4-U9
	U4-U9	66	24, 48, 65	17, 18, 26	24, 43, 54	Sardinian twin? [c]
	U9-C9	88	15, 78, 73	11, 31, 38	24, 28, 29	[b]
	U9-U10	45	20, 25, 46	19, 20, 20	38, 50, 50	Cornish twin? [c]
	U10-U11	10	8, 11, 10			Parallel [a]
	U11-U12	41	20, 21, 41	25, 28, 40	27, 30, 48	Cornish twin? [c]
	U12-C10/11	80	34, 43, 80			[b]
	U10-C10/11	47	23, 28, 47			[b]
	U11-C10/11	39	15, 25, 39			[b]
	U10-C9	84	34, 60, 83	19, 23, 24	16, 30, 35	[b]
	U9-U12	15				
	U9-U11	54	31, 54, 22			[b]
	U2-U9	81				?
	U4-U10	70				?
	U4-C9	77		11, 11, 12	10, 28, 38	Esterel twin[a]

Table 3 continued.

T-13 (H6)	U1-U2	66		4, 6, 6	25, 28. 43	MCT-1 [c]
	U1-U3	76		0, 1, 10	20, 20, 39	Esterel twin[a]
	U2-U3	75		5, 5, 6	24, 28, 44	Esterel twin[a]
T-13(n16)	U1-U2	74		9, 2, 1	21, 21, 39	Esterel twin[a]
T-13 (F6)	U1-U2	36	17, 18, 37	23, 26, 37	25, 27, 37	[c]
T-13 (a16)	U1-U2	3	1	2, 1, 2	1, 2, 2	Parallel
T-13 (B11)	U1-2-3-4-6-7-8	0, o. cont.	0, 0, 0			Parallel
	U1-U5	87	0, 78, 79	18,43, 43	18, 44, 44	Verespatak twin
T-12 (C10)	U1-2-3-4-5	0, o. cont.	0, 0, 0			Parallel
T-12 (E11)	U1-U2	3	0, 1, 2			Parallel[a]
Lava domes						
SF-3 (3.1)	U1-U2	71		6, 5, 5	28, 32, 34	Esterel twin
	U2-U3	o. cont.				Parallel
	U3-U4	75		4, 13, 8	25, 25, 28	Esterel twin
	U1-U4	67		12, 10, 10	28, 39, 42	MCT-1 [c]
SF-3 (3.10)	U1-2-3-5	o. cont.				Parallel
	U3-U4	4	4, 4, 3	3, 3, 1	3, 1, 3	Parallel
	U7-U3	2	3, 4, 3			Parallel
	U4-U6	o. cont.				Parallel
	U4-U7	5	5, 6, 7	6, 6, 2	4, 5, 7	Parallel
	U6-U7	5	5, 6, 7	6, 6, 2	4, 5, 7	Parallel
	U5-U6	4	4, 4, 3	3, 3, 1	3, 1, 3	Parallel
SF-3 (3.12)	U1-U2	o. cont.				Parallel
	U1-U3	o. cont.				Parallel
	U1-U4	45	23, 25, 49	34, 37, 49	33, 39, 49	Cornish twin? [c]
SF-3 (2.19)	U1-U2	74		5, 6, 7	28, 31, 34	Esterel twin
	U1-U3	5	2, 3, 6			Parallel
	U2-U3	71		3, 8, 7	30, 34, 36	Esterel twin
	U2-U4	o. cont.				Parallel
TT-2 (4.7)	U1-U2	89	9, 70, 80	9, 49, 44	11, 41, 44	Verespatak twin

Table 3 continued.

TT-2 (4.7m)	U1-U2	4	1, 4, 4			Parallel
TT-2 (4.7t)	U1-U2	57	14, 39, 54	14, 17, 22	32, 42, 43	Belowda twin? [c]
	U2-U3	43	19,23,42	29, 33, 42	27, 34, 43	Cornish twin? [c]
	U2-U4	76		5, 4, 11	28, 29, 31	Esterel twin
	U3-U4	33	15,19,34	22, 23, 42	24, 26, 34	MCT-2 [c]
	U1-U3	38				
	U1-U4	45				CTL-1 [c]
TT-2 (4.17)	U1-U2	86	31, 49, 85	13, 13, 23	17,21,29	offset Verespatak
TT-2 (4.18)	U1-U2	55	22, 30, 54	8, 11, 21	41, 49, 51	Belowda twin?[c]

Notes: Values represent measurements obtained through EBSD analysis; U1, U2,… = unit 1, unit 2,…
[a]Interpreted as initial relation prior to crystal rupture.
[b]High uncertainty due to crystal rupture.
[c]Symmetry indicated by pole figures; angles possibly produced by multi-component twinning or combined twin laws described in Table 4 of Appendix[1] and by Drugman (1927) and Watanabe (1974).

Appendix 1, Table 4. Quartz twin laws and possible symmetries considered in this study

Twin law[a]	Other names	Twin type	Twin axis	Rotation	Twin plane	*c*-axes	Additional distinguishing criteria[b]	Frequency[a]
Dauphiné	electrical twinning	penetration	[0001]	180°		**0°**	Irregular intergrowths of like-handedness; *c*-axis [0001] poles overlap; *a*-axes poles overlap; $\{10\bar{1}0\}$ poles overlap; $\{10\bar{1}1\}$ poles of twin 1 rotated 180° (or 60°) about $\{10\bar{1}1\}$ poles of twin 2.	Common
Brazil[f]	optical twinning	penetration	[0001]		refl. $\{11\bar{2}0\}$	**0°**	Geometric or lamellar intergrowths of unlike-handedness; same pole figures as Dauphiné twins; optically detectable.	Common
Japan (α)	Verespatak (β)	contact	⊥ to $(11\bar{2}2)$	180°	$(11\bar{2}2)$	**84°33'**	One $\{10\bar{1}0\}$ pole overlaps, and one $\{11\bar{2}2\}$ pole overlaps.	Second most common contact
Esterel (β)	Reichenstein-Grieserntal (α)	contact	⊥ to $(10\bar{1}1)$	180°	$(10\bar{1}1)$	**76°26'**	One $\{10\bar{1}1\}$ pole overlaps, the other two nearly overlap (4–10° apart); $\{10\bar{1}\bar{1}\}$ or $\{01\bar{1}1\}$ poles are all between 20 and 40° apart; see Zhao et al. (2013).	Most common contact
Sardinian (β)	Sella's (α)	contact	⊥ to $(10\bar{1}2)$	86°4'	$(10\bar{1}2)$	**64°50'**	See Zhao et al. (2013)	Very rare
Belowda (β)	$(30\bar{3}2)$	contact	⊥ to $(30\bar{3}2)$		$(30\bar{3}2)$	**55°24'**		Rare
Breithaupt (β,α)	Zwickau	contact	⊥ to $(11\bar{2}1)$		$(11\bar{2}1)$	**48°54'**	See Zhao et al. (2013)	Very rare
Cornish (β)	$(20\bar{2}1)$	contact	⊥ to $(20\bar{2}1)$		$(20\bar{2}1)$	**42°58'**	See Zhao et al. (2013)	Rare
Zinnwald (α)		contact		0°	$(10\bar{1}0)_1 \parallel (10\bar{1}1)_2$	**38°13'**		Rare
W. Coates (β)	$(21\bar{3}1)$	contact	⊥ to $(21\bar{3}1)$		$(21\bar{3}1)$	**33°8'**		Very rare
Possible *c*-axis coordinations of combined twin laws (CTLs) and multi-component twins (MCTs) of the same law								
MCT-1 (ABC)[c]	A-B	Esterel						
	B-C	Esterel						
	A-C	outer crystals				**~67° (or 113°)**		
CTL-1 (ABC)[d]	A-B	Esterel						
	B-C	Belowda						
	A-C	outer crystals				**48°10'**		
CTL-2 (ABC)[d]	A-B	Esterel						
	B-C	Sardinian						
	A-C	outer crystals				**38°44'**		
MCT-2 (ABC)[d]	A-B	Esterel						
	B-C	link				**27°8'**		
	A-C	Esterel						
MCT-3 (ABCD)[e]	Theory	Repeated Japan				**~84°, 60°, 51°, 33°, 9°**		

[a]Twin law theory is compiled from Drugman (1927), Kozu (1952), Frondel (1962), and Grimmer (2006). A complete list of twin laws, including subtypes and rare theoretical and reported laws not listed here, are found in Drugman (1927) and Frondel (1962). Parenthetical β and α denote the polymorph for which the twin law name was given, although nearly all contact twin laws are analagous between β- and α-quartz polymorphs due to their independence of the *c*/*a* axial ratio according to Grimmer (2006). Dauphiné and Brazil intergrowths only form in α-quartz structure (Frondel 1962).

[b]Beane and Wiebe (2012); Zhao et al. (2013).

[c]This study. A, B, C, or D represent twin individuals for [c-e].

[d]Reported by Drugman (1927). Referred to as "triplets" or "repeated twinning".

[e]Watanabe (1974). Referred to as "triplets and quadruplets" or "multi-component twinning".

[f]The Combined Law (Dauphiné-Brazil) is described by Frondel (1945, 1962).