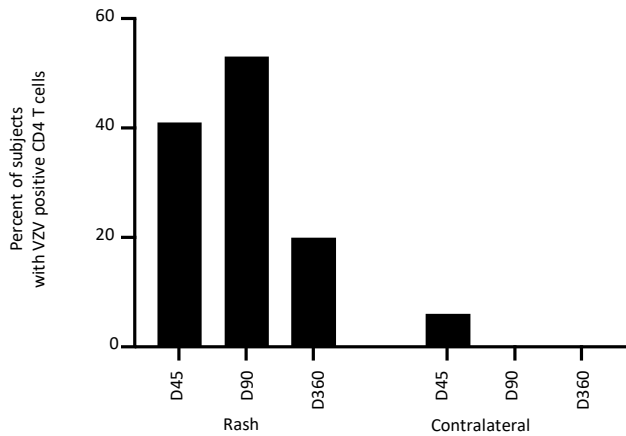
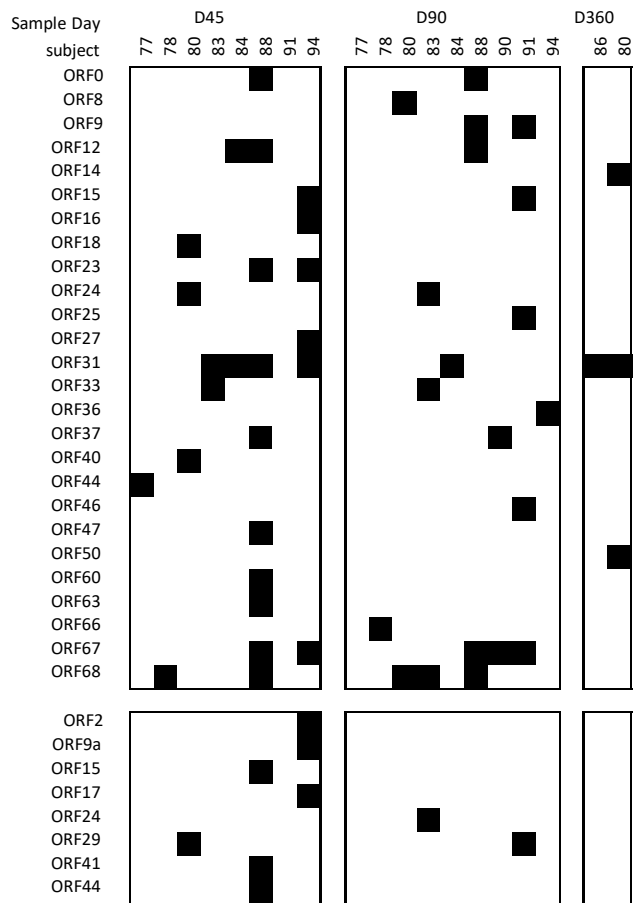


Supplementary Fig. 1, Laing et al.

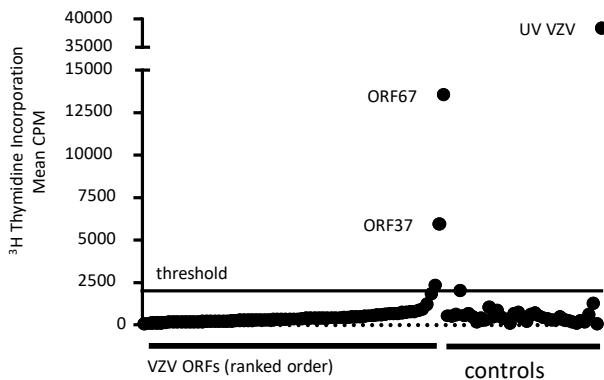
A



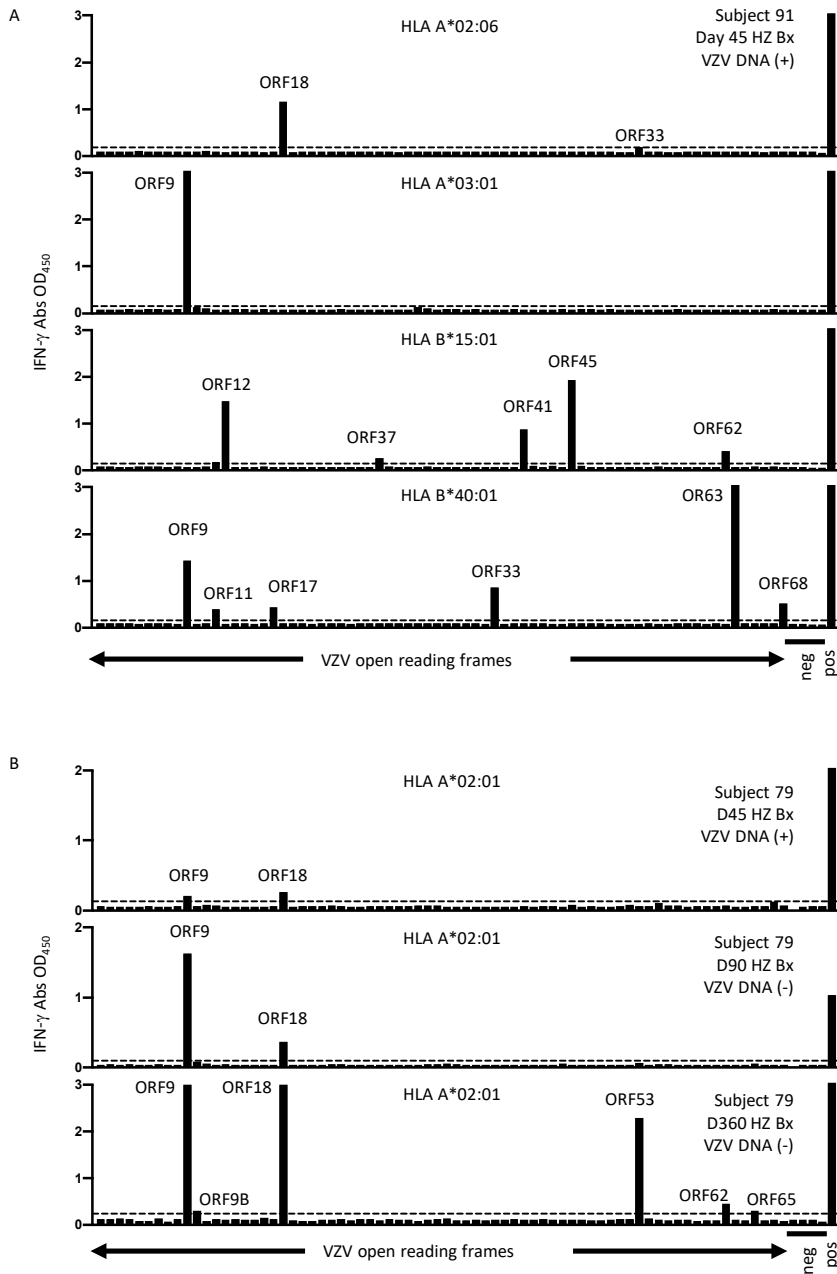
C



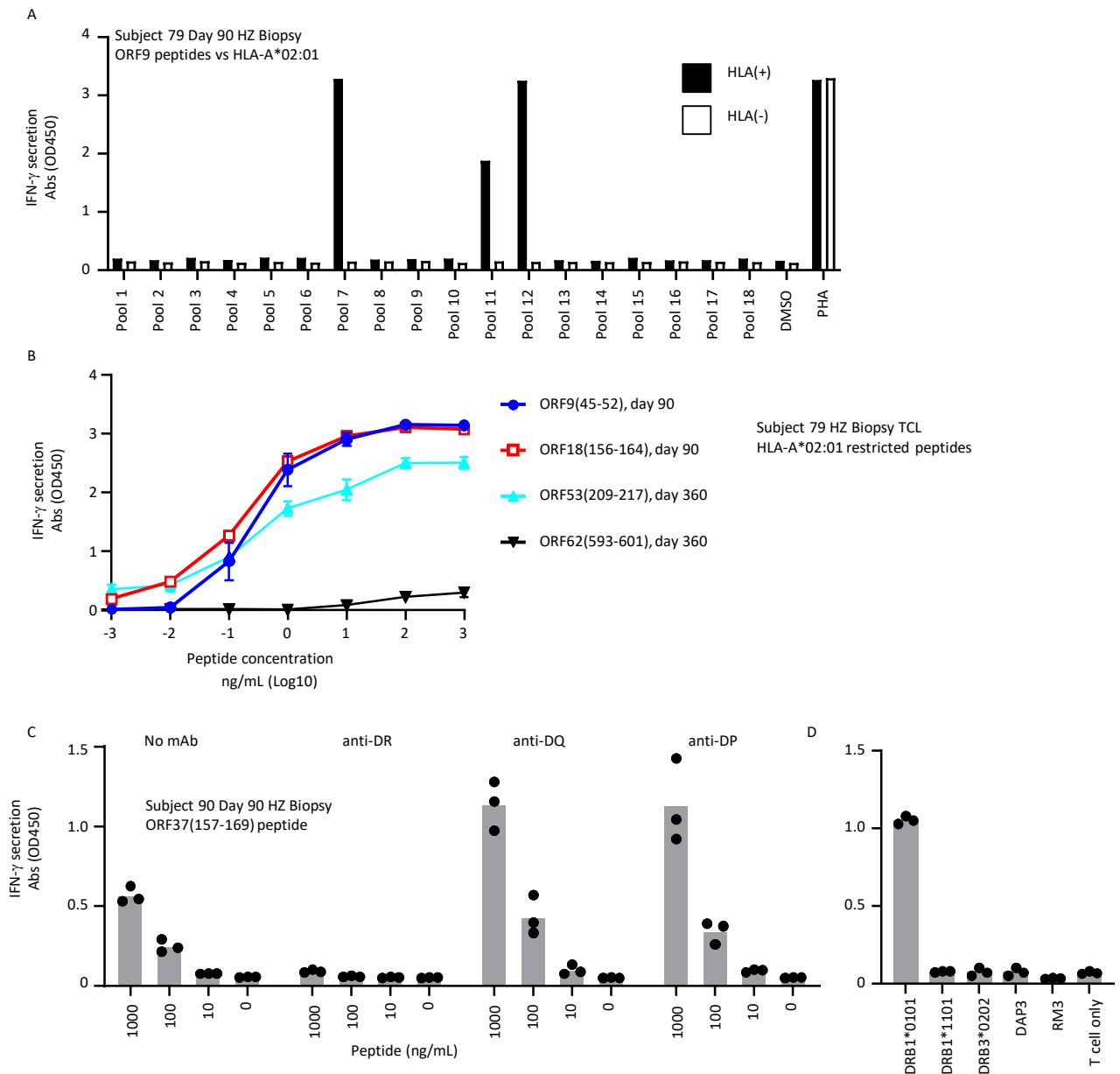
B



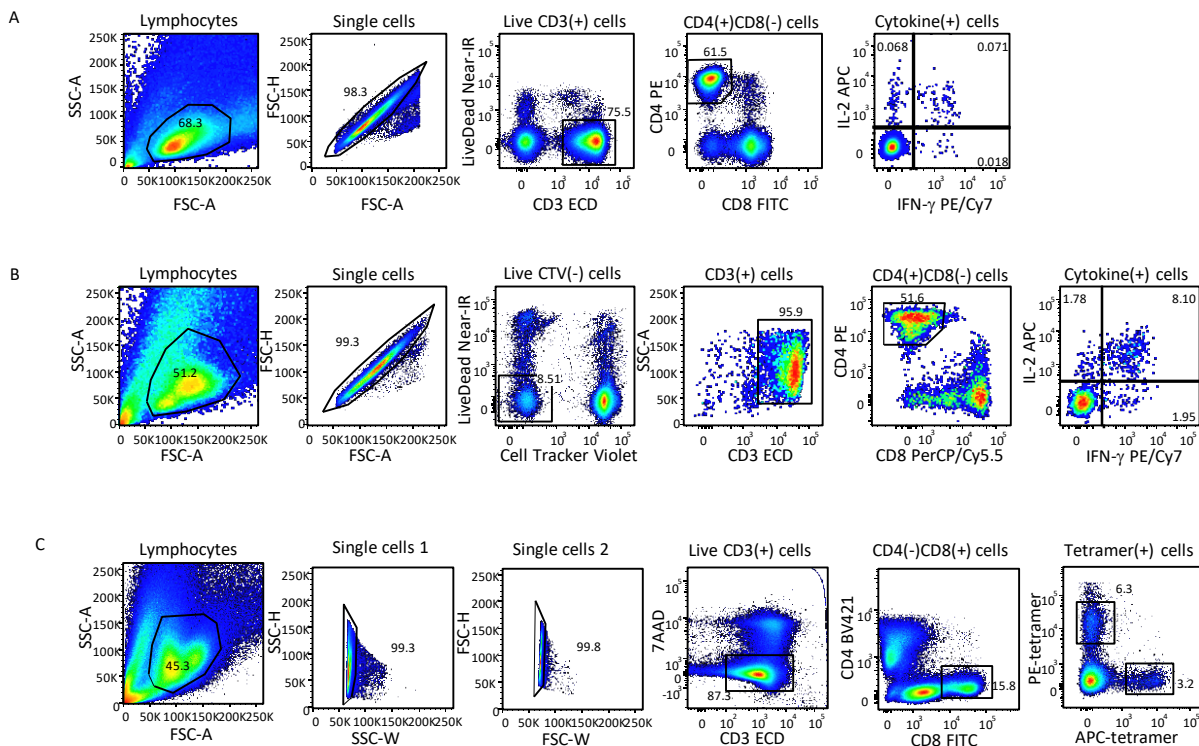
Supplementary Fig. 1 A. Expanded T cell lines from rash and unaffected contralateral skin were scored positive if net CD4 T cell responses to VZV detected by ICS for IFN- γ and/or IL-2 exceeded 3% of all CD4 T cells. Bar graphs show the percent of subjects with positive response on an indicated day (day 45 and day 90 n=17; day 360, n=10). B. Representative screen for T cell proliferative responses to all VZV proteins using ^3H -thymidine incorporation. A cell line-specific threshold for positivity was determined using outlier analyses based on the median + (3.2 x MAD) responses of a series of negative controls as detailed in Methods. C. Heatmap showing positive CD4 T cell responses (black squares) to VZV ORFs for T cell lines from the HZ skin sites (HZ-TCL) or contralateral skin sites (CON-TCL) at the day 45, 90, and 360 time-points. Only ORFs that gave at least one positive response are shown. ICS, intracellular cytokine staining; ORF, open reading frame; D45, day 45; D90, day 90; D360, day 360; CPM, counts per minute; VZV, varicella zoster virus; UV VZV, UV-inactivated VZV. Source data are provided as a Source Data file.



Supplementary Fig. 2. Representative genome-wide screens for CD8 T cell responses to each VZV protein using Cos-7-derived artificial antigen presenting cells (aAPC) co-transfected separately with each subject-specific class I HLA and a single VZV ORF and tested in duplicate with biopsy-derived bulk T cells. Negative controls include Cos-7 transfected with empty vector, the indicated HLA cDNA alone, or no transfection. Positive control is unmanipulated Cos-7 with PHA included in assay wells. CD8 T cell activation was detected by IFN- γ ELISA. Bars represent mean of duplicates. Responses were considered positive if they were at least 2X the negative control containing no transfected VZV ORF and had an OD₄₅₀ reading at least 0.15 (horizontal line). **A**. Polyclonal T cells expanded from biopsy 45 days after rash onset from subject 91 show broadly HLA class I-restricted recognition of VZV ORFs. Reactive VZV ORFs are labeled. **B**. HLA-A*02:01 restricted CD8 T cell responses over one year measured in biopsies from subject 79. ORF, open reading frame; D45, day 45; D90, day 90; D360, day 360; HZ Bx, herpes zoster rash site skin biopsy; Abs OD₄₅₀, absorbance optical density at 450 nanometers; VZV, varicella zoster virus; neg, negative control; pos, positive control. Source data are provided as a Source Data file.



Supplementary Fig. 4: Full-length ORFs that gave positive CD8 or CD4 T cell responses were decoded using peptide pools followed by single peptides. A. The representative example shows VZV ORF9 responses in subject 79 using aAPC expressing (black bars) or lacking (white bars) HLA-A*02:01 to present peptides to skin-derived T cell lines. T cell activation was detected by IFN- γ ELISA. Bars represent mean of duplicate wells. B. Representative dose-response data from subject 79 for four HLA-A*02:01 restricted epitopes using bulk HZ-site expanded T cells. Data represent mean and SD of triplicate wells. C. Example of HLA restriction locus identification for CD4 T cell epitopes using anti-HLA blocking antibodies during T cell assay exposure to the indicated antigenic peptide. B-LCL were used as APC. Assay readout was IFN- γ ELISA. Bars represent mean of triplicate wells. Anti-HLA-DR antibodies are clearly inhibitory for T cell activation by peptide ORF37(157-169) in day 90 HZ biopsy-derived cultures from subject 90. D. Example of HLA allele determination for the using the same cell line/peptide combination described in C. APC express the indicated HLA class II gene or are negative control parental cell lines lacking HLA (DAP.3 and RM3), or T cells alone. Data represent net IFN- γ responses to peptide after subtraction of data from wells exposed to DMSO. Bars show mean of triplicate wells. ORF, open reading frame; VZV, varicella zoster virus; UV VZV, UV-inactivated VZV; Abs OD₄₅₀, absorbance optical density at 450 nanometers; B-LCL, B-lymphoblastoid cell line; HZ, herpes zoster rash site skin. Source data are provided as a Source Data file.



Supplementary Fig 5: Gating strategies for flow cytometric analyses for: A) ex vivo abundance of cytokine (IFN- γ and/or IL-2) positive CD4 T cells in PBMC exposed to VZV or control antigens. Example shows subject 80, day 45 PBMC. B) VZV-specific CD4 T cells in skin biopsy-derived T cell lines when CTV-stained PBMC are used as antigen-presenting cells. Example shows subject 94, day 90 rash site T cell line. C) sorting tetramer-specific CD8 T cells from skin biopsy-derived T cell lines. Example shows subject 79, day 360 rash site T cell line.

Supplementary Table 1. Demographic and serologic characteristics and summary of HZ (shingles, zoster) for study subjects.

Subject	Sex	Herpesvirus serostatus				Zoster episode				HLA-A, -B	
		VZV	HSV-1	HSV-2	CMV	Rash onset to screen, day	Antiviral therapy	Corticosteroid therapy	Dermatome ¹	A	B
77	Male	pos	neg	neg	neg	33	yes	No	L1-L2 (L)	*24:02 *32:01	*07:02 *40:01
78	Female	pos	neg	neg	pos	37	yes	no	T7-T8 (R)	*32:01 *33:03	*15:01 *51:01
79	Female	pos	pos	neg	neg	28	yes	no	T6-T7 (R)	*02:01 *32:01	*15:01
80	Female	pos	pos	neg	neg	31	yes	no	C5-C6 (L)	*03:01	*07:02 *51:01
81	Male	pos	pos	neg	neg	35	yes	no	T4 (R)	*01:01 *02:01	*08:01 *27:05
82	Female	pos	neg	neg	pos	21	yes	no	T6-T7 (L)	*02:01 *29:02	*44:03 *51:01
83	Male	pos	pos	neg	pos	23	yes	no	T8-T9 (R)	*01:01 *30:01	*07:02 *13:02
84	Male	pos	pos	neg	pos	32	yes	no	T7-T8 (R)	*24:02 *33:03	*35:01 *44:03
85	Female	pos	pos	neg	neg	29	yes	no	T4 (R)	*01:01 *26:01	*08:01 *14:01
86	Male	pos	pos	neg	pos	38	yes	no	T6-T7-T8 (L)	*11:01 *30:02	*15:01 *18:01
87	Male	pos	pos	neg	neg	32	yes	no	C7-C8 (L)	*02:01	*44:02
88	Male	pos	neg	neg	neg	30	no	no	T8 (R)	*25:01 *30:01	*13:02 *18:01
89	Male	pos	pos	pos	pos	22	yes	no	T6 (R)	ND	ND
90	Female	pos	neg	neg	neg	31	yes	systemic	T5-T6 (R)	*03:01 *24:02	*35:01 *51:07
91	Male	pos	pos	neg	pos	26	yes	no	T1-T2 (R)	*02:06 *03:01	*15:01 *40:01
92	Male	pos	atypical	neg	pos	31	yes	topical	C2 (L)	*02:01 *02:02	*45:01 *53:01
93	Female	pos	pos	neg	pos	38	yes	no	C8 (R)	*24:02 *29:02	*41:02 *44:03
94	Female	pos	pos	neg	pos	33	yes	systemic	T2 (R)	*02:07 *11:02	*40:01 *46:01

¹ L, T, and C refer to lumbar, thoracic, and cervical dermatomes, respectively. L and R refer to left and right.

Supplementary Table 2. Summary of immune responses in study subjects

Subject	HZ VZV DNA ¹ (copies/swab)				CON VZV DNA ² (copies/swab)				Blood ex vivo ICS ³ (% of CD4 T cells)			HZ skin T cell line ICS (% of CD4)			CON skin T cell line ICS (% of CD4)			Number of VZV proteins recognized by CD4 T cells from HZ-TCL ⁴			Number of VZV proteins recognized by CD4 T cells from CON-TCL			Number of VZV proteins recognized by CD8 T cells from HZ-TCL			Number of VZV proteins recognized by CD8 T cells from CON-TCL				
	D30	D45	D90	D360	D30	D45	D90	D360	D45	D90	D360	D45	D90	D360	D45	D90	D360	D45	D90	D360	D45	D90	D360	D45	D90	D360	D45	D90	D360	D45	D90
77	4500	0	0	dec ⁵	ns ⁶	0	0	dec	0.05	0.05	dec	3.35	3.62	dec	0.06	0.06	dec	0	0	dec	1	0	dec	5	3	dec	0	0	dec		
78	0	0	0	0	ns	0	0	257	0.07	0.04	0.06	25.7	14.9	0.09	2.7	0	0	1	1	nd ⁷	0	0	nd	1	1	0	0	0	0		
79	11250	1953.5	0	0	ns	0	0	0	0.07	0.04	0.06	0.11	0	0.26	0	0	0	nd	nd	nd	nd	nd	nd	2	2	6	1	1	1		
80	0	0	0	0	ns	0	0	0	0.13	0.13	0.03	0.36	26.1	13.8	0.2	0.14	0	3	2	3	1	0	0	4	4	0	0	0	0		
81	1850	0	0	0	ns	0	0	0	0.06	0.02	0.02	0.09	0.63	0.11	0	0	0	nd	nd	nd	nd	nd	nd	0	0	0	1	1	0		
82	900	389.5	0	dec	ns	0	0	dec	0.14	0.13	dec	0.08	0	dec	0.93	1.54	dec	nd	nd	dec	nd	nd	dec	1	1	dec	1	1	dec		
83	24000	0	0	0	ns	0	0	0	0.20	0.18	0.03	21.5	5.9	0	0	0	0	2	3	nd	0	1	nd	8	1	2	1	2	0		
84	198.5	360	0	dec	ns	0	0	dec	0.29	0.05	dec	7.02	7.33	dec	0.05	0.37	dec	2	1	dec	0	0	dec	4	2	dec	1	2	dec		
85	859.5	22573.5	3745	0	ns	0	0	0	0.07	0.02	0.02	1.2	0.09	0	0	0	0	nd	nd	nd	nd	nd	nd	2	1	1	3	0	0		
86	5490	1934	0	0	ns	0	0	0	0.07	0.02	0.04	0.73	0.09	4.05	1.38	0	0	nd	nd	nd	nd	nd	nd	4	1	0	0	0	1		
87	1650000	84547	181.5	dec	ns	0	0	dec	0.22	0.04	dec	0	0	dec	0.12	0	dec	nd	nd	dec	nd	nd	dec	4	2	dec	0	1	dec		
88	0	0	0	dec	ns	0	0	dec	0.17	0.08	dec	43.4	50.9	dec	4.29	0	dec	10	5	dec	3	0	dec	4	0	dec	0	0	dec		
89	7000	dec	dec	dec	ns	dec	dec	dec	0.19	0.12	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec	dec		
90	33645.5	151.5	0	0	ns	0	0	0	0.16	0.06	0.08	0.47	22.2	0	0	2.89	0	nd	0	nd	nd	2	nd	4	2	0	1	1	0		
91	157700	1931.5	0	0	ns	0	0	0	0.45	0.15	0.12	6.11	28.7	0	0	0.32	0	0	1	nd	0	6	nd	13	0	1	0	3	0		
92	0	0	0	dec	ns	0	0	dec	0.03	0.15	dec	0	0.01	dec	0.01	0	dec	nd	nd	dec	nd	nd	dec	0	0	dec	0	0	dec		
93	1176	0	0	0	ns	0	0	0	0.40	0.09	0.12	1.09	2.57	0.25	0.02	0	0.24	nd	nd	nd	nd	nd	nd	2	3	1	0	1	0		
94	0	0	0	0	ns	0	0	0	0.26	0.30	0.14	73.1	9.54	0	0	0	0	6	1	nd	3	0	nd	4	2	3	1	0	0		

¹ HZ VZV DNA, copies of VZV DNA determined by PCR from healed site of herpes zoster eruption

² CON VZV DNA, copies of VZV DNA determined by PCR from contralateral, uninvolved skin

³ ICS values represent net % of cytokine positive CD4 T cells in whole VZV antigen-exposed samples after subtraction of mock-exposed sample values

⁴ TCL, T cell line

⁵ dec, no sample due to subject declining biopsy

⁶ ns, no swab acquired. A VZV swab sample was not collected from contralateral skin at day 30.

⁷ nd, not determined due to lack of adequate sample

Supplementary Table 3. Absorbance OD450 values for anti-VZV gP IgG from ELISA

Specimen		Serum dilution					
Subject	Day	20	80	320	1280	5120	20480
77	45	4.68	4.05	4.01	2.43	1.01	0.34
	60	5.94	4.33	3.43	1.69	0.67	0.22
	90	4.48	4.00	2.89	1.39	0.52	0.16
78	45	5.94	5.63	3.84	2.11	0.81	0.25
	60	5.34	4.14	3.31	1.51	0.53	0.18
	90	3.66	3.90	3.18	1.66	0.66	0.22
	360	3.50	3.67	2.55	1.14	0.41	0.15
79	45	3.60	3.60	2.25	1.09	0.47	0.18
	60	3.62	3.57	2.25	0.91	0.34	0.12
	90	3.61	3.56	2.05	0.83	0.31	0.11
	360	3.62	2.80	1.39	0.49	0.18	0.10
80	45	3.53	3.94	3.38	1.95	0.85	0.40
	60	3.60	3.96	3.07	1.58	0.67	0.26
	90	4.90	4.44	3.25	1.51	0.61	0.27
	360	4.27	3.27	1.89	0.75	0.29	0.15
	500	3.95	3.05	1.72	0.68	0.24	0.11
81	45	4.66	5.93	3.70	1.94	0.78	0.27
	60	4.90	5.93	3.60	1.93	0.76	0.26
	90	5.04	5.93	3.42	1.88	0.84	0.28
	360	5.94	3.98	2.54	1.11	0.37	0.13
82	45	4.11	4.25	4.46	3.22	1.52	0.55
	60	5.92	5.94	5.92	2.32	0.88	0.30
	90	5.92	4.46	3.37	1.76	0.67	0.25
83	45	5.92	5.94	3.83	2.55	0.95	0.34
	60	4.38	5.94	3.83	2.07	0.81	0.26
	90	5.92	5.94	3.62	1.74	0.74	0.26
	360	5.92	4.46	2.83	1.27	0.46	0.17
84	45	5.92	5.94	2.73	1.04	0.37	0.15
	90	5.31	3.93	2.24	0.92	0.31	0.11
85	45	5.94	5.93	3.61	1.74	0.69	0.24
	60	4.98	3.95	2.92	1.34	0.49	0.19
	90	4.04	3.42	2.14	0.95	0.35	0.13
	360	3.68	2.45	1.38	0.64	0.18	0.09
86	45	4.38	4.28	4.11	3.10	1.57	0.57
	60	5.94	5.93	5.96	3.06	1.64	0.51
	90	5.94	4.40	5.96	2.95	1.45	0.80
	360	4.58	4.38	3.78	1.87	0.78	0.23
87	45	5.92	5.94	5.92	3.02	1.45	0.50
	60	4.20	4.74	5.92	2.40	1.06	0.38
	90	3.80	4.28	3.64	1.91	0.70	0.24
88	45	4.06	3.79	2.32	0.90	0.31	0.12
	60	3.81	3.67	2.29	0.87	0.30	0.13
	90	4.30	3.77	2.18	0.78	0.27	0.11
89	45	4.47	5.94	3.89	1.72	0.71	0.28
	60	3.97	4.70	3.02	1.40	0.49	0.17
	90	4.44	3.90	2.75	1.11	0.39	0.14
90	45	3.84	3.95	4.16	3.10	1.52	0.66
	60	3.85	3.75	3.87	2.89	1.38	0.47
	90	3.90	3.74	3.75	2.72	1.26	0.44
	360	4.01	3.77	3.22	1.72	0.65	0.23
91	45	3.72	3.85	4.01	3.14	1.48	0.50
	60	3.97	3.86	3.91	2.33	0.85	0.28
	90	3.77	3.77	3.33	1.64	0.54	0.18
	360	3.83	2.89	1.47	0.54	0.19	0.08
92	45	3.78	3.38	1.95	0.81	0.32	0.13
	60	3.97	3.14	1.69	0.73	0.27	0.13
	90	3.64	3.14	1.73	0.68	0.28	0.14
93	45	3.99	4.04	3.78	3.08	1.69	0.75
	60	3.81	3.67	3.74	2.58	1.24	0.46
	90	3.91	3.93	3.65	2.37	0.96	0.37
	360	3.64	3.48	2.45	1.02	0.33	0.08
94	45	4.49	3.19	1.47	0.55	0.22	0.13
	60	3.97	2.94	1.30	0.49	0.22	0.12
	90	3.85	2.31	0.94	0.34	0.15	0.10
	360	3.60	1.88	0.69	0.24	0.12	0.09

Supplementary Table 4. Immunohistochemistry staining of skin biopsies.

Metric	Subject	D45_CON	D45_HZ	D90_CON	D90_HZ	D360_CON	D360_HZ
A. Number of T cells per mm ²	83	28.93	9.4	67.21	83.26		
	77	8.15	292.27	37.85	17.89		
	87	71.25	322.33	49.71	100.89		
	78	64.72	214	146.24	123.24	99.96	112.28
	91	185.3	308.08	109	116.7	85.8	70.2
	84	39.84	147.12	57.58	109.76		
	90	101.43	220.68	112.66	331.22	158.48	80.02
B. Number of CD4 T cells per mm ²	83	10.27	4.39	36.64	50.47		
	77		121.06	28.33	10		
	87	46.18	141.88	37.8	98.82		
	78	173.4	84.89	59.7	25.3	21.28	35.3
	91	125.37	181.58	64.18	125.36	7.14	43.06
	84	20.33	124.85	17.8	80.35		
	90	45.2	81.62	56.93	276.45	25.47	21.5
C. Number of CD8 T cells per mm ²	83	11.32	4.55	14.46	55.22		
	77		39.2	11.66	7.01		
	87	9.98	88.8	13.36	16.26		
	78	76.73	70.28	42.95	34.71	21.28	21.35
	91	36.64	113.91	41.55	36.56	7.14	7.7
	84	6.43	45.67	5.3	17.63		
	90	18.68	86.01	19.08	161.22	25.47	16.14
D. Percent of CD69+ T cells	83			100	90.5		
	77			94.1	84.7		
	87	82.3	94.1	91.3	100		
	78		93.9	77.1	62	86.1	87.5
	91	100	86.1	100	88.2	76.1	
	84	91.6	71.5	82.3	85.9		
	90	89.6	82.5	100	100	100	80.5
E. Percent of CD103+ T cells	83	11.8	9.1	31.7	9.8		
	77		15	18.5	27		
	87	38.9	23.8	4.4	13.55		
	78	13.3	24.7	11		7	12.2
	91	23.5	33.4	12.4	26	18.7	
	84	12.6	30	6.2	12.1		
	90	13.5	31.7	21.4	15.4	15.8	13.2
F. Percent of TIA-1+ T cells	83	21.1	38.8	26.8	16.4		
	77	55	37.9	16.9	33.3		
	87	9.9	74.3	7.1	28.6		
	78	17.3	31.4	17.4	43.1	23.5	28
	91	13.1	34.4	25.9	13.5	40	16.7
	84	14.8	79	8.3	27.8		
	90	14.4	42.4	10.8	61	9.6	19.6
G. Percent of FOXP3+ T cells	83	8.9	0.8	2.2	5.3		
	77		2.7	7.6	4.5		
	87	0.2	1.7	4.7	19		
	78	0	2.7	4.1	9.8	7.2	5.2
	91		10.4	5.7	14.1	0	6.1
	84	17	4.8	8.5	7.6		
	90	3.6	4	9.9	8.1	8.2	4.6

D45, day45; D90, day 90; D360, day 360; HZ, herpes zoster rash skin site; CON, contralateral skin site

Supplementary Table 6: Productive reads and clonotype diversity for CDR3 sequences calculated using VDJTools CalcDiversityStats function

Specimen type*	Day	Productive TRB reads	Number of unique clonotypes (diversity)
HZ Biopsy	45	56188	14022
HZ Biopsy	90	29070	9684
HZ Biopsy	360	13092	4920
Con Biopsy	45	7318	2891
Con Biopsy	90	11256	4040
Con Biopsy	360	21964	6580
PBMC	45	309879	197002
PBMC	90	264437	184989
PBMC	360	329770	226618

* HZ, herpes zoster rash site; Con, contralateral skin site

Supplementary Table 7. TR8 CDR3 sequences of VZV epitope-specific CD8 T cells.

ORF	Epitope	cdr3nt	cdr3aa	v	d	j	In column names: FREQ = frequency among all TRB sequences, CON = contralateral, D = day.											
							Rank	FREQ_RASH	D45_SKIN	FREQ_CON	D45_SKIN	FREQ_PBMIC	D45	FREQ_RASH	D90_SKIN	FREQ_CON	D90_SKIN	FREQ_PBMIC
ORF9	SLGVIYTVG	TGTGCCAGCAGTAATAATACAGGGGACTATGGCTACACCTT	CASSKYTGVDGYTF	TRBV6-5	TRBD1-1	TRBJ2-1	1	6.52E-02	4.65E-03	3.02E-03	5.83E-02	7.20E-03	1.53E-03	2.50E-02	1.37E-03	1.73E-03		
ORF9	SLGVIYTVG	TGTGCCAGCAGTAAATAATACAGGGGACTATGGCTACACCTT	CASSKINTAAPQETQYF	TRBV12	TRBD1-1	TRBJ2-5	2	1.06E-02	4.10E-04	2.13E-04	1.04E-02	5.33E-04	6.43E-05	3.28E-03	2.28E-04	7.28E-05		
ORF9	SLGVIYTVG	TGTGCCAGCAGCCCGCTGGGGAGCCGCAAGAACCCAGTACTT	CASRPALGANHYQTF	TRBV6-5	TRBD1-1	TRBJ2-1	3	3.84E-03	1.37E-04	3.39E-04	4.27E-03	3.55E-04	1.17E-04	1.22E-03	9.11E-05	2.49E-04		
ORF9	SLGVIYTVG	TGTGCCAGCAGCCGAGTGGGGAGCTGGAAGTGGCTACTT	CASSPTPLNGYTF	TRBV7-8	TRBD1-2	TRBJ2-2	4	3.93E-03	0.00E+00	1.39E-03	4.32E-03	4.44E-04	1.13E-03	4.44E-04	1.37E-04	5.15E-05		
ORF9	SLGVIYTVG	TGTGCCAGCAGCCTTTAGGAGCCATGAACACTGAAGCTTCTT	CASSPLPQNTTEAFF	TRBV7-2	TRBD1-1	TRBJ2-1	5	3.36E-03	0.00E+00	1.74E-04	3.34E-03	3.55E-04	4.92E-05	1.30E-03	2.75E-04			
ORF9	SLGVIYTVG	TGTGCCAGCAGCTGGGGAAAACAGGGAGCTACCCCTCCACTT	CASSLGGQSDPLHF	TRBV7-6	TRBD1-1	TRBJ2-6	6	2.74E-03	1.37E-04	3.87E-05	2.30E-03	0.00E+00	2.27E-05	9.93E-04	0.00E+00			
ORF9	SLGVIYTVG	TGTGCCCATAGTGAAGCAGGGGAGTACGGAGTAGTGACACAGATCCGATTTTT	CAISEPAPLAGVSDTQYF	TRBV10-3	TRBD1-2	TRBJ2-3	7	9.61E-04	2.73E-04	4.20E-05	5.75E-04	8.88E-05	1.51E-05	4.55E-05	1.52E-05			
ORF9	SLGVIYTVG	TGTGCCCATAGTGAAGCAGGGGAGTACGGAGTAGTGACACAGATCCGATTTTT	CAISEPAPLAGVSDTQYF	TRBV10-3	TRBD1	TRBJ2-5	8	4.45E-04	2.73E-04	4.20E-05	5.16E-04	8.88E-05	1.89E-05	2.29E-04	4.55E-05			
ORF9	SLGVIYTVG	TGTGCCAGCAGCTCCCGGAGCCAGGACACAGCAGTACTT	CASSRVVGDGHEQYF	TRBV7-6	TRBD1-1	TRBJ2-7	9	2.31E-04	0.00E+00	5.42E-04	5.85E-04	0.00E+00	4.73E-04	1.53E-04	0.00E+00			
ORF9	SLGVIYTVG	TGTGCCAGCAGCTTTGCAAGGGGACTGGCTACACCTT	CASSLFRDQYF	TRBV7-9	TRBD1-1	TRBJ2-2	10	2.14E-04	1.37E-04	2.29E-04	6.19E-04	8.88E-05	2.76E-04	2.29E-04	4.55E-05			
ORF9	SLGVIYTVG	TGTGCCAGCAGCAGTAACTGAGGGGAGTACGACATCGCATTTTTGG	CASSJADGSRVAFWF	TRBV11-3	TRBD1-1	TRBJ2-3	11	1.74E-04	2.73E-04	0.00E+00	3.78E-04	1.87E-03	0.00E+00	1.83E-03	1.41E-03			
ORF9	SLGVIYTVG	TGTGCCAGCAGCTCCCGGAGCCGAGTACGACTACTT	CASSPTGATSEYQF	TRBV7-9	TRBD1-2	TRBJ2-2	12	1.42E-04	0.00E+00	3.44E-05	0.00E+00	0.00E+00	3.44E-05	0.00E+00	4.98E-03			
ORF9	SLGVIYTVG	TGTGCCAGCAGCCAGCCCTCAGGAGAGAACCCAGTACTT	CASRHPLEGTQYF	TRBV28-1	TRBD1-1	TRBJ2-5	13	1.25E-04	0.00E+00	9.68E-06	1.38E-04	0.00E+00	1.13E-05	0.00E+00	0.00E+00			
ORF9	SLGVIYTVG	TGTGCCAGCAGCCCGGAGCTAAATTCACCCCTCACTT	CASSPANNPLHF	TRBV6-5	TRBD1-1	TRBJ2-6	14	1.07E-04	0.00E+00	1.41E-02	1.03E-04	1.78E-04	8.17E-03	1.53E-04	4.55E-05			
ORF9	SLGVIYTVG	TGTGCCAGCTCACTCAGGGAGCTGGAAACCAATATTTTT	CASSPTGSSNTYF	TRBV18-1	TRBD1-1	TRBJ2-1	15	1.07E-04	6.83E-04	1.61E-05	1.38E-04	1.24E-03	1.51E-05	3.06E-04	1.00E-03			
ORF9	SLGVIYTVG	TGTGCCAGCAGTAAAGTGGAGCTGTGGTACACCTT	CASVESYGYTF	TRBV6-1	TRBD1-1	TRBJ2-2	16	8.90E-05	0.00E+00	1.45E-03	6.88E-05	8.88E-05	5.84E-04	0.00E+00	1.06E-03			
ORF9	SLGVIYTVG	TGTGCCAGCAGTAACTGACACAGATACGAGTATTT	CASSYHSDTQYF	TRBV6-5	TRBD1	TRBJ2-3	17	7.12E-05	4.10E-04	0.00E+00	1.72E-04	5.33E-04	7.56E-06	3.06E-04	6.06E-06			
ORF9	SLGVIYTVG	TGTGCCAGCAGCTAGCTAGTGGTATTGATGAAGCTTCTT	CASSLRVSEAFF	TRBV11-2	TRBD1-1	TRBJ2-1	18	1.78E-05	4.10E-04	1.16E-04	3.44E-05	2.67E-04	9.83E-03	1.82E-04	8.19E-05			
ORF9	SLGVIYTVG	TGTGCCAGCAGCCAGCCAGGGTGGTGGTACCGCAGCATTTT	CASRDPLSQDQYF	TRBV6	TRBD1-1	TRBJ2-1	19	1.78E-05	0.00E+00	4.20E-05	0.00E+00	0.00E+00	7.56E-06	0.00E+00	2.12E-05			
ORF9	SLGVIYTVG	TGTGCCAGCAGCCAGGGGAGCCGAGTACGACTACTT	CASRAGTGEAFF	TRBV27-1	TRBD1-1	TRBJ2-1	20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			
ORF9	SLGVIYTVG	TGTGCCAGCAGCCAGGGGAGCCGAGTACGACTACTT	CASSRQDRENEQYF	TRBV5-1	TRBD1-1	TRBJ2-1	21	0.00E+00	0.00E+00	6.45E-06	3.44E-06	0.00E+00	3.78E-06	0.00E+00	3.03E-06			
ORF9	SLGVIYTVG	TGTGCCAGCAGCCGTGGTGGAGGATGAAGCTTCTT	CASSRGEYEAFF	TRBV11-3	TRBD1-1	TRBJ2-1	22	0.00E+00	0.00E+00	1.94E-05	0.00E+00	0.00E+00	1.89E-05	0.00E+00	1.52E-05			
ORF9	SLGVIYTVG	TGTGCCAGCAGCTGACTGCTGGGTTGTCAGGGGCGGTTTTATGGCTACACCTT	CATSARNGTGGGPGYTF	TRBV24-1	TRBD1-1	TRBJ2-2	23	0.00E+00	0.00E+00	3.87E-05	0.00E+00	0.00E+00	1.89E-05	0.00E+00	4.55E-05			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTGCGAGACGTGGACCCCTATGGCTACACCTT	CASSFTVDVPGYTF	TRBV7-8	TRBD1-1	TRBJ2-1	1	8.46E-02	0.00E+00	4.71E-04	5.58E-02	8.88E-05	2.31E-04	1.13E-02	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGCCAGGGGAGCCGAGTATGGCTACACCTT	CATSTRATVYGYTF	TRBV15-1	TRBD1-1	TRBJ2-2	2	6.40E-02	2.26E-03	1.78E-03	5.51E-02	6.22E-04	1.35E-03	6.11E-03	1.21E-03			
ORF18	ILIEGIFVS	TGTGCCAGCAGTGAAGCCAGGGCCCAAGCCATGGCTACACCTT	CASSEAOPIHGYTF	TRBV6-1	TRBD1-1	TRBJ2-2	3	1.05E-02	0.00E+00	1.45E-04	6.23E-03	0.00E+00	6.81E-05	7.64E-04	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCCTCAGGGGCTTGAACACTGAAGCTTCTT	CASSPOGALNTFAFF	TRBV14-1	TRBD1-1	TRBJ2-1	4	4.66E-03	0.00E+00	3.23E-05	4.09E-03	0.00E+00	1.89E-05	9.17E-04	2.12E-05			
ORF18	ILIEGIFVS	TGTGCCAGCTGCTCAAGGGGGTACGGGGTGGGGGAGCGTGTTTTT	CASSPQGGSSRGLLEFF	TRBV11-2	TRBD1-2	TRBJ2-2	5	2.90E-03	0.00E+00	2.90E-05	2.27E-03	0.00E+00	1.51E-03	1.07E-03	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCAGCAGGGGCTGGGGAGGGGGGCTGTTTTT	CASSYTGALGTLEFF	TRBV13-1	TRBD1-1	TRBJ2-2	6	2.83E-03	4.10E-04	1.74E-04	2.17E-03	1.24E-03	1.10E-04	5.46E-04	1.67E-04			
ORF18	ILIEGIFVS	TGTGCCAGCAGTACTTCTCAAGAGCTGAGCAGTCTT	CASSYFTRTEQYF	TRBV6-6	TRBD1	TRBJ2-1	7	2.67E-03	0.00E+00	3.23E-05	1.82E-03	0.00E+00	2.27E-05	8.40E-04	2.43E-05			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGGGGCTGGGATGGCCACTGAAGCTTCTT	CASSOGGAMATEAFF	TRBV14-1	TRBD1	TRBJ2-1	8	2.62E-03	0.00E+00	0.00E+00	1.79E-03	0.00E+00	3.78E-06	0.00E+00	0.00E+00			
ORF18	ILIEGIFVS	TGCAGTCTAGGGAGCCAGGGGACTGAAGCTTCTT	CASRDGTEAFF	TRBV20	TRBD1-1	TRBJ2-1	9	1.42E-03	6.45E-06	4.47E-04	0.00E+00	0.00E+00	0.00E+00	3.02E-04	3.03E-06			
ORF18	ILIEGIFVS	TGTGCCAGTAAAGGAGTCAATGAAGCTTCTT	CASISGYNQYF	TRBV2-1	TRBD1	TRBJ2-1	10	9.61E-04	0.00E+00	5.81E-05	9.63E-04	8.88E-05	2.65E-05	3.29E-04	1.37E-04			
ORF18	ILIEGIFVS	TGTGCCAGTAAAGTCACTAGGGTCTCAATGAAGCAGTCTT	CASSMSTGSYNEQYF	TRBV19-1	TRBD1-1	TRBJ2-1	11	7.12E-04	0.00E+00	4.84E-04	1.03E-03	8.88E-05	3.03E-04	1.37E-04	3.43E-04			
ORF18	ILIEGIFVS	TGTGCCAGCTCAGGGGCTGGGCTGATGGCTACACCTT	CASSQSGAPVGYTF	TRBV19-1	TRBD1-1	TRBJ2-2	12	6.23E-04	0.00E+00	5.29E-04	5.50E-04	8.88E-05	2.80E-04	3.06E-04	9.11E-05			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGGGGCTTACGAGCAGTACTT	CASKRGSQYF	TRBV28-1	TRBD1-1	TRBJ2-1	13	5.87E-04	1.37E-04	4.20E-04	6.88E-04	8.88E-05	4.58E-04	1.53E-04	4.55E-05			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGGGGAGCCGAGTACGACTACTT	CASSPQDRENEQYF	TRBV6-1	TRBD1-1	TRBJ2-1	14	5.87E-04	0.00E+00	3.44E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTGGTGGTGGAGCTGATATTCACCCCTCACTT	CASSLWRSSYNSPLHF	TRBV6-5	TRBD1-1	TRBJ2-6	15	5.52E-04	1.37E-04	9.68E-05	8.94E-04	8.88E-05	1.02E-04	5.35E-04	3.64E-04			
ORF18	ILIEGIFVS	TGTGCCAGCAGTGAAGGGGAGCCGAGGGGGGAGCGTGTTTTT	CASSPQGGSSRGLLEFF	TRBV11-2	TRBD1-2	TRBJ2-2	16	5.52E-04	0.00E+00	6.45E-06	3.10E-04	0.00E+00	3.78E-06	1.00E+00	9.10E-06			
ORF18	ILIEGIFVS	TGTGCCAGCAGTAAAGGGGCTGGGAGGAGTACGAGTATTTG	CASSDRGLWEIGERISL	TRBV10-1	TRBD1-2	TRBJ2-3	17	3.56E-04	0.00E+00	3.23E-06	3.06E-04	0.00E+00	3.78E-06	7.64E-05	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTTCCAGGGGAGCCGAGTACGACTACTT	CASSLRGSEYQYF	TRBV7-8	TRBD1-2	TRBJ2-7	18	3.38E-04	2.73E-04	9.65E-03	2.78E-04	1.78E-04	8.91E-03	2.92E-04	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGTGTCCCAAGGGGAGCCGAGTAAACCAATATTTTT	CASVPRGQVPEYLF	TRBV5-1	TRBD1-1	TRBJ2-3	19	3.38E-04	0.00E+00	2.58E-04	5.16E-04	8.88E-05	1.13E-04	3.06E-04	4.55E-05			
ORF18	ILIEGIFVS	TGTGCCAGTAAAGTCACTAGGGTCTCAATGAAGCAGTCTT	CASSMSTGSYNEQYF	TRBV19-1	TRBD1-2	TRBJ2-2	20	3.38E-04	0.00E+00	1.23E-04	3.78E-04	1.78E-04	1.13E-04	3.06E-04	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTCGAGACAGGGGCTGATGGCTACACCTT	CASSSTGSEYQYF	TRBV9-1	TRBD1-1	TRBJ2-2	21	1.96E-04	2.60E-03	6.45E-06	6.54E-04	2.75E-03	7.56E-06	1.15E-03	7.28E-04			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGGGGAGCCGAGTACGACTACTT	CASSRHWGGYQETQYF	TRBV7-8	TRBD1-1	TRBJ2-5	22	1.78E-04	1.39E-04	9.68E-06	2.75E-04	0.00E+00	3.78E-06	0.00E+00	3.03E-06			
ORF18	ILIEGIFVS	TGTGCCAGCAGTACTGCTGCTTCACTGAGCAGTACTT	CASDLVITVPTSTYS	TRBV6-4	TRBD1-2	TRBJ2-2	23	1.42E-04	4.10E-04	1.74E-04	1.78E-04	1.42E-04	3.19E-04	1.13E-04	1.67E-04			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCCTGACTTCTCAAGCAGTACTT	CASSPTSEYQYF	TRBV9-1	TRBD1	TRBJ2-2	24	1.25E-04	1.37E-04	1.87E-03	3.44E-05	0.00E+00	1.84E-03	1.53E-04	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGTAAAGGGGAGCCGAGGGGGGAGCGTGTTTTT	CASSEVSTRRYTF	TRBV6-1	TRBD1-1	TRBJ2-2	25	1.25E-04	3.10E-03	3.44E-05	0.00E+00	0.00E+00	1.84E-03	4.55E-05	2.54E-03			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGCTCAAGCAGGGGAGCCGAGTACTT	CASSQTSRDEQYF	TRBV4-1	TRBD1-2	TRBJ2-2	26	1.07E-04	0.00E+00	1.97E-04	6.88E-05	0.00E+00	1.29E-04	7.64E-05	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTTCCAGGGGAGCCGAGTAAACCAATATTTTT	CASSALPAGTNEKLF	TRBV7-6	TRBD1-1	TRBJ2-4	27	1.07E-04	0.00E+00	2.28E-03	1.03E-04	8.88E-05	1.41E-03	0.00E+00	1.64E-04			
ORF18	ILIEGIFVS	TGTGCCAGTAAAGTCTAGGGGAGCCGAGTAAACCAATATTTTT	CASSPTSGGNQPHF	TRBV19-1	TRBD1-1	TRBJ2-5	28	1.07E-04	0.00E+00	1.00E-04	1.03E-04	8.88E-05	1.51E-05	7.64E-05	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGTAAAGTCTAGGGGAGCCGAGTACTT	CASSMGTQYF	TRBV19-1	TRBD1-2	TRBJ2-5	29	8.90E-05	0.00E+00	3.23E-06	6.88E-05	8.88E-05	3.78E-06	0.00E+00	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGGGGAGCCGAGTACGACTACTT	CASSPQDRENEQYF	TRBV6-1	TRBD1-1	TRBJ2-3	30	7.12E-05	0.00E+00	1.72E-04	0.00E+00	0.00E+00	3.03E-05	0.00E+00	6.06E-05			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTTCCAGGGGAGCCGAGTACGACTACTT	CASSRQDRENEQYF	TRBV6-5	TRBD1-2	TRBJ2-2	31	7.12E-05	0.00E+00	3.23E-05	6.88E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTTCCAGGGGAGCCGAGTAAACCAATATTTTT	CATSVPSSYNEQYF	TRBV6-2	TRBD1-1	TRBJ2-1	32	7.12E-05	0.00E+00	1.29E-05	0.00E+00	0.00E+00	1.51E-05	0.00E+00	2.12E-05			
ORF18	ILIEGIFVS	TGCAGTGGAAATCAGGCTTACGAGCAGTACTT	CASANTGSEYQYF	TRBV20	TRBD1-1	TRBJ2-3	33	5.34E-05	0.00E+00	6.55E-04	2.06E-04	8.88E-05	7.07E-04	7.64E-05	1.82E-04			
ORF18	ILIEGIFVS	TGTGCCAGCAGTCCAGTCTTACGGGGGCTCAATGAAGCAGTCTT	CASSPFPAGYNEQYF	TRBV4-1	TRBD1-2	TRBJ2-4	34	5.34E-05	0.00E+00	3.07E-04	1.38E-04	0.00E+00	2.19E-04	0.00E+00	9.11E-05			
ORF18	ILIEGIFVS	TGTGCCAGCAGCCAGGGGAGCCGAGGAGCGGAGCTGTTTTT	CASSQETGGIGLEFF	TRBV4-2	TRBD1-1	TRBJ2-2	35	5.34E-05	0.00E+00	1.68E-04	3.44E-05	0.00E+00	1.93E-04	1.53E-04	0.00E+00			
ORF18	ILIEGIFVS	TGTGCCAGCAGCTACCCAGGAGAAAACCTGTTTTT	CASSHPDKLFF	TRBV12-3/1	TRBD1-1	TRBJ2-4	36	5.34E-05	0.00E+00	4.84E-05	1.38E-04</							