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Avian influenza A virus adaptation to the equine host and identification of host-specific markers

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Summary. – Avian influenza A viruses (IAVs) are able to overcome the interspecies barrier and adapt to the new non-avian host. The process of adaptation requires the adaptive changes of IAV genome resulting in amino acid substitutions. The aim of this work was the description of amino acid substitutions in avian influenza A viruses (IAVs) occurring during their adaptation to equine host. Today, viruses of the equine influenza H3N8 subtype, first isolated in 1963, represent a single genetic lineage of IAV causing a respiratory disease in horses. We compared the amino acid sequences of the conserved proteins PB2, PB1, PA, NP, M1, M2, NS1 and NEP of equine influenza H3N8 subtype IAV with sequences of avian viruses, both available in the NCBI's Influenza Virus Resource Database. The amino acid substitutions persisting in equine IAV isolates and occurring in avian IAV at <5% frequency were included into the list of equine host-specific markers. We documented amino acid substitutions in the examined IAV proteins of equine IAV isolates in the period 1963–2013 and observed their quasi-linear accumulation. The substitution rate for the virus ribonucleoprotein (RNP) complex (PB2, PB1, PA, and NP) was calculated as $R = 0.69 \times 10^{-3}$ per position per year. For other examined proteins (M1, M2, NS1, and NEP), calculated R-values ranged from 0.48×10^{-3} to 1.30×10^{-3} per position per year. We identified 127 equine host markers distributed among all internal virus proteins, 38 of which were present already in 1963 and other 89 accumulated during the period since 1963 until 2013. Ten equine host marker positions overlap with known human marker positions (Miotto *et al.*, 2010) and five of them are occupied with identical amino acids in IAV of both hosts.

Keywords: equine influenza virus; equine H3N8 virus lineage; adaptation to host; amino acid substitution; host-specific marker

Introduction

Waterfowl is considered to be a reservoir of influenza A viruses (IAVs), which are potentially able to replicate and spread to new hosts after overcoming the interspecies barrier (Webster *et al.*, 1992). The best-described examples are the influenza pandemic that spread in humans in the 20th century, the repeated transmissions of highly pathogenic avian H5N1 viruses (Subbarao and Shaw, 2000), and the recently described H7N9 influenza zoonotic infections of humans (Gao *et al.*, 2013). As these zoonotic IAV infections are considered to be a major epidemic threat for humans, the study of the evolutionary process of IAVs and their adaptation to new mammalian hosts is of high importance. Relevant data on amino acid changes accumulated in viral proteins during the adaptation of avian IAVs to humans were collected using a large number of IAV nucleotide genome sequences and amino acid sequences of the corresponding IAV proteins. The analysis of IAV human host markers is of great interest because disclosing the possible adaptation changes occurring over time can help to defend humans against zoonoses with pandemic potential. Sixty-eight human host markers in the PB2, PB1, PA, NP, M1, M2, NS1, NS2 (NEP) proteins were described by Miotto (Miotto *et al.*,

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Abbreviations: IAV(s) = influenza A virus(es); RNP = ribonucleoprotein

2010). These markers distinguish human IAV strains from those circulating among birds.

IAVs cause respiratory diseases also in horses. The first equine isolate of IAV was obtained in 1956 in Czechoslovakia and was characterized as an H7N7 subtype (A/eq/Prague/56) (Sovinova *et al.*, 1958). Equine H7N7 represented a distinct line, which disappeared after the year 1977, when the last equine H7N7 virus was isolated. During the outbreak of respiratory disease of horses in Florida in 1963, IAV of the H3N8 subtype (A/equine/Miami/1/1963[H3N8]) was isolated for the first time (Waddell *et al.*, 1963). Since the late 1970s until present, the H3N8 subtype has been the dominant equine IAV and persisted in horses until now (Yoon *et al.*, 2014).

Aquatic birds are considered to be a reservoir not only of human, but also of equine IAV. During bird-to-horse IAV transmission, and subsequent adaptation to equine host, viruses undergo changes in the genome and consequently in the encoded proteins, resulting in the ability to replicate and spread in equine hosts.

Utilizing the NCBI's Influenza Virus Resource database, we analysed IAVs of the H3N8 subtype isolated from equine hosts from the period 1963 up to the present, in order to describe the natural course of avian-to-equine IAV adaptation. We determined conserved equine IAV marker amino acids, which were characterized with respect to the time of their appearance, uniqueness for equine host, incidence in individual proteins, the type of amino acid substitution and the possible influence on the function of a particular protein. A comparison of equine host markers with those described in human IAV was also performed.

Materials and Methods

Equine IAV H3N8 viruses. Amino acid sequences of the conserved proteins (i.e., PB2, PB1, PA, NP, M1, M2, NS1, and NEP) of all equine influenza A H3N8 isolates (between 1963, when the first isolate was obtained, and 2013) found in the NCBI's Influenza Virus Resource database (Bao *et al.*, 2008) were utilized to perform the alignments.

Alignment of influenza A H3N8 equine lineage proteins. Accession numbers and alignments of aa sequences of analysed proteins of virus isolates with identified equine host markers are given in Supplementary Tables.

The amino acid sequences of a working set of each protein of interest were sorted by the year of isolation. Then, sequence alignment of the individual proteins was executed online at http://www.ncbi.nlm.nih.gov/genomes/FLU/FLU.html.

Substitution rate determination. For each protein, a plot was constructed that showed the accumulation of substitutions in the lineages of individual proteins from 1963 to 2013. The alignment plots were assessed. Outliers, evidently not belonging to the lineage (e.g., the particular sequence was too distant from the H3N8 lineage), were removed. To calculate the intrinsic amino acid substitution rate of influenza A H3N8 equine lineage, a number of substitutions accumulated in a recent (A/equine/Xuzhou/01/2013(H3N8)) in relation to an early A/equine/Miami/1/1963(H3N8)) member of the lineage were counted. This approach was employed due to a quasi-linearity of substitutions that accumulated over time. The substitution rate, i.e., the number of amino acid substitutions per position per year was determined using the formula $R = S/(L \times Y)$, where S is the number of substitutions between two aligned sequences, L is the length of the protein (number of amino acids), and Y is time between isolations of the two aligned sequences, measured in years.

For the purpose of calculation of the number of substitutions in NS1 protein, a deleted part of C-terminal amino acids of NS1 protein was taken as a single substitution.

Equine markers identification. To delineate amino acid positions characterizing equine lineages in each internal protein, we compared the sequences of equine lineages with sequences from all avian hosts isolated until 2013, found in the database. This limitation was chosen to reduce the number of isolates, as no more than 10,000 sequences are allowed as input to the Analyze Sequence Variation (SNP) tool at http://www.fludb.org. First, we delineated the accumulation of amino acid substitutions in all internal proteins studied from equine isolates during the period 1963–2013. The year of appearance of any amino acid change that persisted at a given position was determined.

For each amino acid position, the consensus amino acid of the influenza A H3N8 equine lineage together with accumulated substitutions and their frequencies among avian isolates were determined. This data was obtained from the NIAID IRD (Squires *et al.*, 2012) at http://www.fludb.org. Within the influenza A H3N8 equine lineage we have been looking for amino acid sequence positions occupied with residues considerably distinct from those prevailing in avian isolates that fulfilled the following criteria. We identified amino acid positions that were conserved throughout the whole monitored time-span (1963–2013) and, at the same time, amino acids at these positions differed from those in the avian "consensus" sequence. Several of these amino acid substitutions are fully conserved in equine IAVs, i.e., they have no (or only a few) alternatives since 1963, and they occur among avian sequences at <5% frequency. These we refer to as "early" equine-specific markers. Moreover, we identified additional long-lasting conserved substitutions that emerged in years after 1963 and occurred among the avian sequences at <5% frequency, which we refer to as "recent" equine-specific markers.

Results

The sequences of over 100 equine IAVs isolated since 1963 are available in the NCBI's Influenza Virus Resource database. All sequences in the database of equine H3N8 isolated between 1963 and 2013 belonged to the genotype

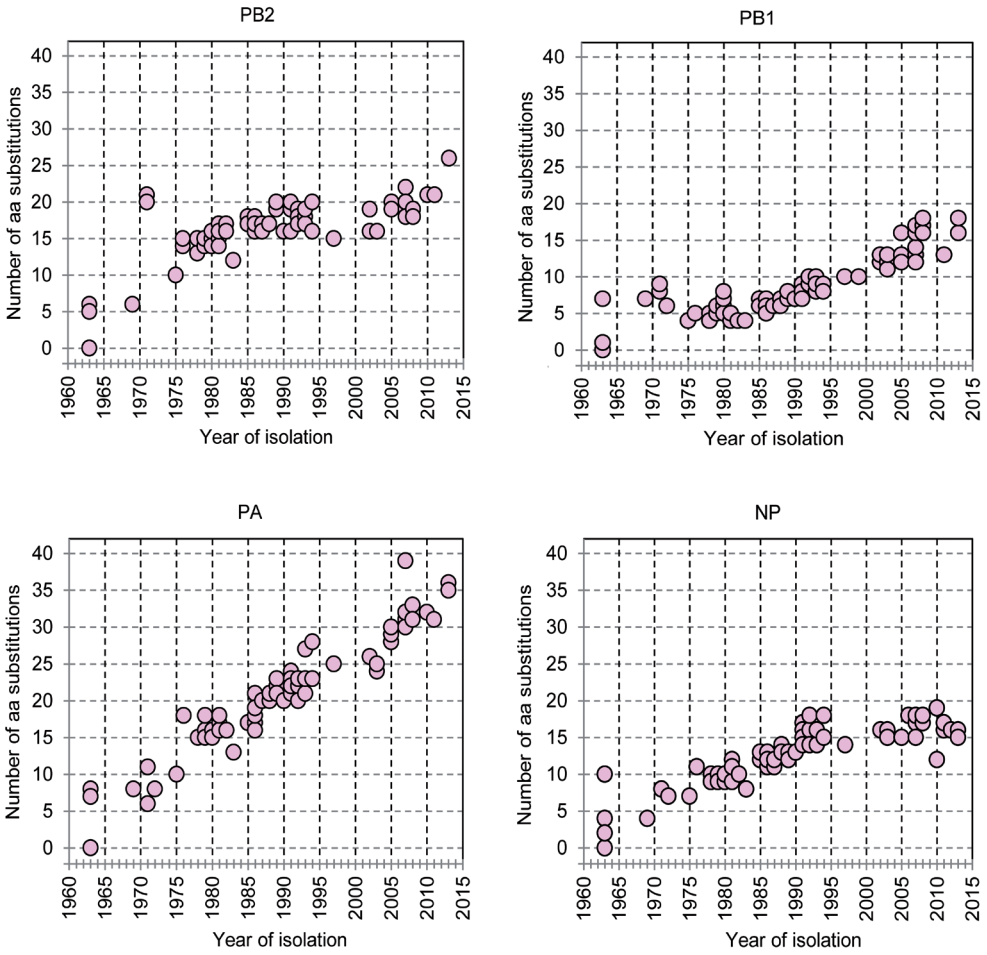

Fig. 1

Accumulation of amino acid substitutions in proteins of the RNP complex of the influenza A H3N8 equine lineage
Each point represents a particular sequence; some sequences are condensed to a single point due to identical coordinates. The number of amino acid substitutions in each isolate was counted with reference to the A/equine/Miami/1/1963 (H3N8) isolate.

comprising individual lineages of virus RNA segments (C/seg1, I/seg2, G/seg3, 3F/seg4, C/seg5, 8B/seg6, E/seg7, 1D/seg8) (Lu *et al.* 2007). Therefore, here we have used the term influenza A H3N8 equine lineage for sequences of this genotype.

Accumulation of substitutions in conserved proteins of the influenza a H3N8 equine lineage

We analysed amino acid sequences of conserved IAV proteins, i.e., proteins of the polymerase complex: PB2, PB1, PA, and NP; proteins encoded by segment 7 (M1 and M2); as well as by segment 8 (NS1, NEP) of H3N8 equine isolates available in the NCBI's Influenza Virus Resource database (Bao *et al.*, 2008). The amino acid sequences of particular proteins were sorted by the year of isolation. Their alignments showed gradual accumulation of substitutions in proteins over a period of 50 years. Throughout the monitored time-span (1963–2013), the principal influenza A H3N8 equine lineage underwent mutations at several sequence locations, which subsequently became fixed. The plots in Fig. 1 and Fig. 2 demonstrate the number of substitutions within each isolate in comparison with an early virus isolate, A/equine/Miami/1/1963 (H3N8).

The number of substitutions occurring between the first sequenced isolate, A/equine/Miami/1/1963 (H3N8), and the latest isolate A/equine/Xuzhou/01/2013 (H3N8) was determined to calculate the amino acid substitution rate, i.e., the number of substitutions per position per year, for each protein. Among proteins in the polymerase complex, the highest substitution rate was found for PA ($R = 0.98 \times 10^{-3}$ amino acid substitutions per position per year), while the lowest rate was found in the PB1 protein with an amino acid substitution rate $R = 0.47 \times 10^{-3}$ (Table 1). Substitu-

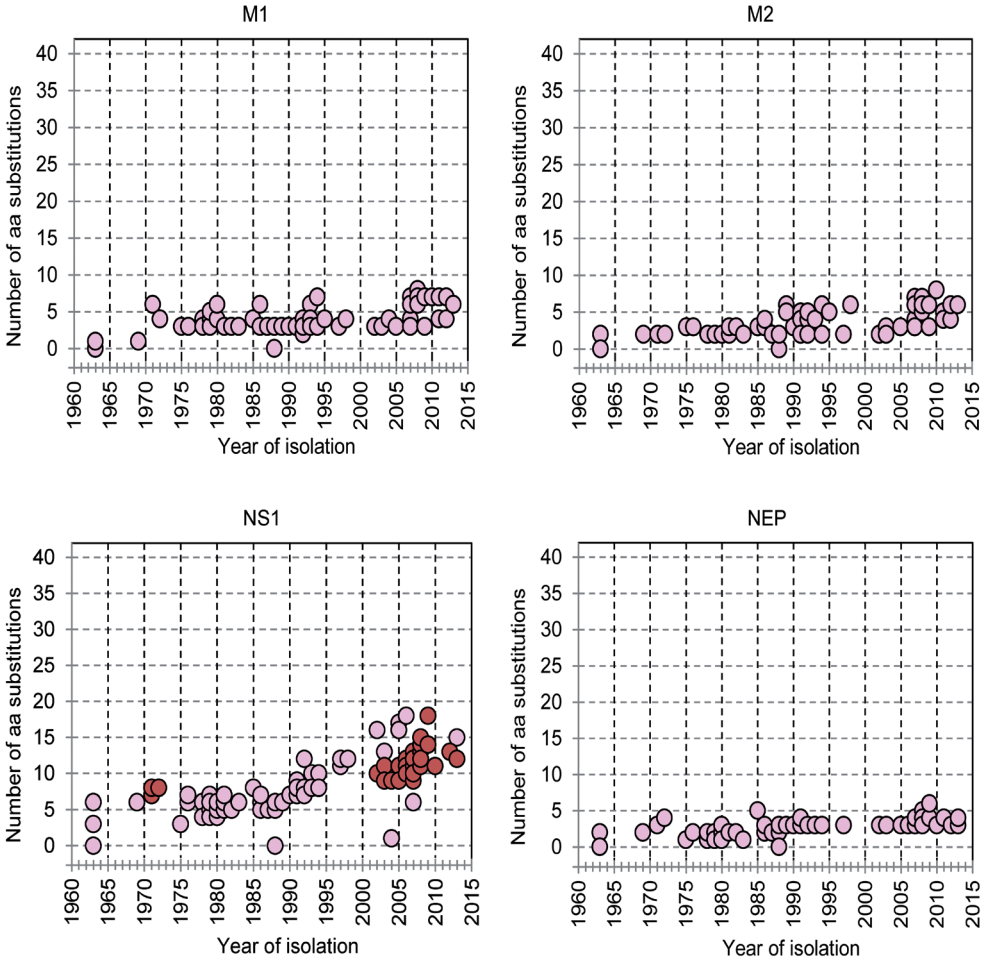

Fig. 2

Accumulation of amino acid substitutions in the M1, M2, NS1, and NEP proteins of the influenza a H3N8 equine lineage
Each point represents a particular sequence; some sequences are condensed to a single point due to identical coordinates. The number of amino acid substitutions in each isolate was counted with reference to the A/equine/Miami/1/1963 (H3N8) isolate. Dark-coloured circles (in NS1) stand for sequences in which C-terminal deletions were counted as a single substitution.

tion rates of NP (0.64×10^{-3}) and PB2 (0.69×10^{-3}) and the substitution rate for the entire polymerase complex (PB1, PB2, PA, and NP), $R = 0.69 \times 10^{-3}$ per position per year, were calculated. The following substitution rates were calculated for proteins encoded by segments 7 and 8: $R = 0.48 \times 10^{-3}$ for M1, $R = 1.24 \times 10^{-3}$ for M2, $R = 1.30 \times 10^{-3}$ for NS1, and $R = 0.66 \times 10^{-3}$ for NEP (Table 1). However, the linearity of amino acid substitution accumulation in proteins coded by segments 7 and 8 was not as apparent as it was in proteins of the RNP complex (compare Fig. 1 and Fig. 2).

Equine host markers

The amino acid sequences of PB2, PB1, PA, NP, M1, M2, NS1, and NEP of influenza a H3N8 equine lineage were aligned with influenza a sequences isolated from avian hosts, which have been deposited in the NIAID Influenza Research database (IRD) at http://www.fludb.org (Squires *et al.*, 2012). Protein sequence variance analysis provided the "consensus" sequences of IAVs (all subtypes) isolated from avian hosts and a survey of alternative amino acids occurring at individual positions.

Amino acids defined as equine markers, which distinguish equine viruses from avian strains, are summarized in Table 2, 3, and 4. The frequency of an equine-specific amino acid at a given position among avian IAVs (<5%) reflects the equine host marker potency: the lower is the occurrence of an equine-specific amino acid among avian sequences, the higher is its marker potency. In proteins PB2, PB1, PA, NP, NS1, and NEP, we found both early and recent equine-

Table 1. Amino acid substitutions accumulated in proteins of the influenza A H3N8 equine lineage (period 1963–2013)

	Protein							
	PB2	**PB1**	**PA**	**NP**	**M1**	**M2**	**NS1**	**NEP**
L	759	757	716	498	252	97	230[a]	121
S	26	16	36	16	6	6	15[b]	4
S/Y	0.52	0.32	0.70	0.32	0.12	0.12	0.70	0.08
R	$\mathbf{0.69 \times 10^{-3}}$	$\mathbf{0.42 \times 10^{-3}}$	$\mathbf{0.98 \times 10^{-3}}$	$\mathbf{0.64 \times 10^{-3}}$	$\mathbf{0.48 \times 10^{-3}}$	$\mathbf{1.24 \times 10^{-3}}$	$\mathbf{1.30 \times 10^{-3}}$	$\mathbf{0.66 \times 10^{-3}}$

L = length of the protein (number of amino acids); S = number of substitutions between 2 aligned sequences, the early isolate A/equine/Miami/1/1963 (H3N8) and the late isolate A/equine/Xuzhou/01/2013 (H3N8); Y = time between the isolations of the 2 aligned sequences (50 years); R = substitution rate, i.e., the number of amino acid substitutions per position per year, calculated using the formula shown in the Methods section; [a]Full length of NS1 (without deletions in the C-terminus); [b]C-terminal deletions occurring in some isolates were counted up as a single substitution.

Table 2. Equine-specific markers identified in the equine influenza H3N8 virus proteins PB2 and PB1

	Equine-specific markers in PB2			Avian
Pos.	**Marker (%)[a]**	**Year of isolation**	**Marker potency**	**Consensus**
Early equine markers				
530	**I** *(100)*	1963	**0.0005**	T
559	**I** *(89)* **F** *(55)*	1963-2013 1989-1994	0.0307 0.0001	T
586	**R** *(100)*	1963	0.0113	K
701	**N** *(100)*	1963	**0.0009**	D
Recent equine markers				
12	**L** *(100)*	2002	**0.0080**	S
105	**A** *(72)*	2007	0.0334	T
109	**I** *(98)*	1975	0.0463	V
147	**V** *(100)*	1976	0.0285	I
251	**K** *(72)*	2007	0.0150	R
299	**K** *(99)*	1975	0.0191	R
344	**M** *(98)*	1985	0.0173	V
511	**I** *(100)*	1985	0.0496	V
575	**I** *(99)*	1976	**0.0070**	M
588	**T** *(99)*	1975	0.0282	A
613	**A** *(100)*	1975	0.0109	V
715	**K** *(100)*	1975	**0.0005**	N
717	**T** *(60)*	1971	0.0213	A
	N = 98			N = 9580 (2011)

[a]Per cent of occurence of a marker amino acid in a group of equine isolates since indicated year up to 2013 or as indicated. Marker potency is printed in bold if an equine marker amino acid occurs among avian influenza sequences at less than 1% frequency. Consensus sequence of avian IAV refers to the most frequent amino acid at a given position. N designates the number of analysed sequences, and (yyyy) means that all utilized avian strains were isolated until the indicated year.

	Equine-specific markers in PB1			Avian
Pos.	**Marker (%)[a]**	**Year of isolation**	**Marker potency**	**Consensus**
Early equine markers				
157	**S** (*100*)	1963	**0.0020**	A
214	**R** (*97*)	1963	0.0355	K
261	**R** (*100*)	1963	**0.0000**	S
383	**D** (*100*)	1963	0.0216	E
429	**R** (*100*)	1963	**0.0062**	K
642	**S** *(98)*	1963	0.0355	N
Recent equine markers				
61	**I** (*100*)	1975	**0.0006**	T
114	**I** (*100*)	1997	0.0133	V
119	**M** (76)	2007	**0.0036**	V
164	**M** (*100*)	1975	**0.0025**	I
198	**R** (*100*)	1988	**0.0048**	K
221	**T** (*100*)	1997	**0.0004**	A
317	**I** (*100*)	1997	0.0254	M
329	**R** (*76*)	2007	**0.0000**	Q
377	**E** (76)	2007	**0.0017**	D
397	**V** (*100*)	1986	**0.0022**	I
457	**G** (71)	2007-2008	**0.0023**	E
587	**T** (*100*)	1975	**0.0070**	A
618	**D** (*76*)	2007	0.0102	E
621	**K** (81) **R** (*46*)	1975-2013 2005-2013	0.0152 0.0214	Q
738	**D** (*100*)	1997	**0.0017**	E
	N = 102			N = 9609 (2011)

specific markers. In contrast, no early markers were identified in the M1 and M2 protein sequences.

We did not include into the list of equine markers (Table 2, 3, and 4) those substitutions, which occurred during the monitored time-span, and reverted to the avian consensus sequence, nor substitutions that occurred after the year 2008, the stability of which is hard to predict.

The number of marker positions per unit length of the protein, i.e. the density of equine marker positions for individual proteins was determined as follows: NS1 (7.4%), NP (5.0%), PA (4.8%), NEP (4.1%), M2 (4.1%) PB1 (2.7%), PB2 (2.2%), M1 (1.6%).

Comparison of the influenza A H3N8 equine lineage to avian influenza sequences revealed 127 equine-specific

Table 3. Equine-specific markers identified in the equine influenza H3N8 virus proteins PA and NP

Equine-specific markers in PA				Avian
Pos.	**Marker (%)[a]**	**Year of isolation**	**Marker potency**	**Consensus**
Early equine markers				
61	**V** *(98)*	1963	0.0342	I
63	**I** *(99)*	1963	0.0338	V
99	**R** *(95)*	1963	0.0104	G
217	**H** *(100)* **Y** *(100)*	1963-1972 1975-2013	**0.0000** **0.0000**	Q
270	**I** *(82)* **M** *(100)* **IM** *(100)*	1963-1994 1997-2013 1963-2013	**0.0007** **0.0003** **0.0010**	L
272	**G** *(100)*	1963	0.0164	D
336	**Q** *(100)*	1963	**0.0002**	L
689	**S** *(100)*	1963	**0.0010**	A
Recent equine markers				
55	**N** *(100)*	1975	0.0116	D
57	**L** *(100)*	1972	**0.0003**	R
62	**V** *(100)*	1997	0.0282	I
64	**D** *(75)*	2007	**0.0012**	E
86	**I** *(75)*	2007	0.0112	M
100	**A** *(96)*	1975	0.0187	V
114	**K** *(78)*	2008	**0.0035**	E
118	**V** *(99)*	1975	0.0229	I
158	**R** *(60)*	2007	0.0147	K
213	**K** *(97)*	2002	0.0128	R
216	**N** *(99)*	1976	0.0206	D
231	**V** *(100)*	1987	**0.0005**	A
237	**K** *(75)*	2007	0.0206	E
244	**S** *(100)*	1975	**0.0002**	G
261	**S** *(100)*	1975	**0.0013**	L
277	**H** *(99)*	1976	**0.0006**	S
343	**E** *(97)*	1997	**0.0002**	A
345	**I** *(97)*	1997	**0.0053**	L
353	**R** *(94)*	2002	0.0175	K
400	**T** *(99)*	1975	**0.0092**	PSQ
437	**Y** *(100)*	1975	0.0180	H
450	**I** *(97)*	1994	**0.0054**	V
476	**T** *(75)*	2007	**0.0008**	A
479	**E** *(100)*	1985	**0.0022**	D
532	**F** *(98)*	1987	**0.0000**	L
683	**I** *(100)*	1975	0.0123	L
	N = 100			N = 9580 (2011)

Equine-specific markers in NP				Avian
Pos.	**Marker (%)[a]**	**Year of isolation**	**Marker potency**	**Consensus**
Early equine markers				
41	**V** *(100)*	1963	0.0250	I
117	**M** *(99)*	1963	**0.0003**	R
146	**T** *(100)*	1963	**0.0062**	A
245	**G** *(98)*	1963	**0.0021**	S
305	**K** *(100)*	1963	**0.0065**	R
345	**N** *(100)*	1963	**0.0003**	S
351	**K** *(100)*	1963	0.0451	R
359	**A** *(83)* **T**[b] *(54)* **AT** *(100)*	1963-2013 2002-2012 1963-2013	**0.0049** **0.0001** **0.0050**	S
374	**I** *(99)*	1963	0.0216	M
453	**S** *(97)*	1963	**0.0041**	P
496	**F** *(99)*	1963	0.0146	Y
Recent equine markers				
16	**D** *(98)*	1988	**0.0005**	G
50	**N** *(98)*	1976	0.0192	S
100	**K** *(98)*	1985	**0.0030**	R
111	**H** *(99)* **Q** *(100)*	1976-2012 2013-2013	**0.0018** **0.0000**	Y
136	**I** *(67)*	2007	**0.0010**	L
257	**T** *(67)*	2007	**0.0081**	I
286	**T** *(98)*	1988	**0.0001**	A
293	**K** *(100)*	1975	0.0113	R
312	**I** *(100)*	1975	**0.0032**	V
319	**K** *(100)*	1975	**0.0038**	N
344	**L** *(100)*	1985	0.0103	S
384	**K** *(95)*	1997	0.0181	R
397	**S** *(97)*	1975	0.0262	N
498	**S** *(99)*	1975	0.0157	N
	N = 110			N = 9580 (2011)

[a]Per cent of occurence of a marker amino acid in a group of equine isolates since indicated year up to 2013 or as indicated. [b]Amino acid T (NP protein) has co-circulated with a since 2002. Marker potency is printed in bold if an equine marker amino acid occurs among avian influenza sequences at less than 1% frequency. Consensus sequence of avian IAV refers to the most frequent amino acid at a given position. N designates the number of analysed sequences, and (yyyy) means that all utilized avian strains were isolated until the indicated year.

marker amino acids in the analysed proteins. Of these, 38 early markers persisted since 1963 and additional 89 recent markers continued to emerge after 1963. Among all markers, 69 are of high potency (21 early and 48 recent), having <1% occurrence among avian influenza amino acid sequences (Table 2, 3, and 4).

Relationship of equine and human host markers

We compared equine host marker positions described above with those located at 'characteristic sites' identified in human influenza viruses by other authors (Finkelstein *et al.*, 2007; Miotto *et al.*, 2010) (Table 5). While Miotto found 68 human characteristic sites in PB2, PB1, PA, NP, M1, M2,

Table 4. Equine-specific markers identified in the equine influenza H3N8 virus proteins M1, M2, NS1, and NEP

Pos.	Equine-specific markers in M1			Avian Consensus
	Marker (%)[a]	Year of isolation	Marker potency	
Recent equine markers				
80	**I** *(79)*	2007	**0.0015**	V
85	**S** *(99)*	1975	**0.0027**	N
95	**K** *(79)*	2007	0.0243	R
	K *(86)*	1976-2013	**0.0000**	
208	**R** *(99)*	2003-2013	**0.0003**	Q
	KR (99)	1976-2013	**0.0003**	
	No. = 146			N = 9938 (2010)

Pos.	Equine-specific markers in M2			Avian Consensus
	Marker (%)[a]	Year of isolation	Marker potency	
Recent equine markers				
48	**S** *(72)*	2007	**0.0017**	F
50	**F** *(99)*	1975	**0.0057**	C
85	**S** *(78)*	2007	**0.0000**	D
89	**S** *(76)*	2007	0.0217	G
	N = 144			N = 9571 (2010)

Pos.	Equine-specific markers in NS1			Avian Consensus
	Marker (%)[a]	Year of isolation	Marker potency	
Early equine markers				
96	**D** *(96)*	1963	**0.0007**	E
139	**E** *(99)*	1963	**0.0044**	D
156	**V** *(98)*	1963	**0.0032**	I
	H *(90)*	1963-2013	**0.0006**	
207	**Y** *(29)*	2006-2007	**0.0000**	N
	HY *(96)*	1963-2013	**0.0006**	
209	**N** *(98)*	1963	0.0326	D
213	**S** *(96)*	1963	0.0345	P
214	**F** *(100)*	1963	**0.0090**	L
Recent equine markers				
45	**R** *(70)*	2008-2009	**0.0005**	G
48	**I** *(87)*	2007	**0.0068**	S
59	**H** *(88)*	1997	0.0217	R
67	**Q** *(97)*	1981	**0.0087**	R
71	**K** *(90)*	1997	0.0116	E
84	**I** *(84)*	2006	0.0120	V
86	**T** *(88)*	1997	0.0470	A
186	**K** *(98)*	1975	**0.0059**	E
194	**I** *(82)*	1990	0.0150	V
216	**S** *(88)*	1997	0.0123	P
	N = 169			N = 9621 (2009)

Pos.	Equine-specific markers in NEP			Avian Consensus
	Marker (%)[a]	Year of isolation	Marker potency	
Early equine markers				
35	**L** *(100)*	1963	0.0160	F
63	**E** *(99)*	1963	0.0102	G
Recent equine markers				
33	**I** *(95)*	1976	**0.0071**	T
34	**R** *(96)*	1988	0.0283	Q
89	**N** *(99)*	1975	**0.0083**	I
	N = 130			N = 9010 (2009)

[a]Per cent of occurence of a marker amino acid in a group of equine isolates since indicated year up to 2013 or as indicated. Marker potency is printed in bold if an equine marker amino acid occurs among avian influenza sequences at less than 1% frequency. Consensus sequence of avian IAV refers to the most frequent amino acid at a given position. N designates the number of analysed sequences, and (yyyy) means that all utilized avian strains were isolated until the indicated year.

NS1, and NEP, only 10 equine-specific marker positions (out of total 127) are identical with them in both hosts. However, of these 10 positions, five are occupied by identical amino acids in human and equine IAVs, namely PA-55, PA-100, NP-16, NP-136, and NP-305 (Table 6). In spite of this, great majority of equine marker amino acids described here are located at positions differing from those found by Miotto *et al.* (2010) for human influenza viruses.

Table 5. Number of marker positions of equine and human influenza viruses

Protein	Number of equine markers		Number of human markers[a]
	Early, already since 1963	All, fixed until 2013	
PB2	4	17	17
PB1	6	21	1
PA	8	34	17
NP	11	25	12
M1	0	4	3
M2	0	4	9
NS1	7	17	6
NEP	2	5	3
All	**38**	**127**	**68**

[a]Human markers refer to sites characteristic of human-to-human transmission, as reported by Miotto *et al.* (2010).

Table 6. Marker positions common for equine and human viruses

Protein/ position	Equine marker	[a]Human marker	Prevailing amino acid in avian host
PB2/588	T(1975)	I	A
PA/55[d]	N(1975)	N	D
PA/57	L(1972)[b]	Q	R
PA/100[d]	A(1975)	A	V
PA/400	T(1975)[b]	L	PSQ
NP/16[d]	D(1988)[b]	D	G
NP/100	K(1985)[b]	VI	R
NP/136[d]	IM[c]	MI	L
NP/305[d]	K(1963)[b]	K	R
NS1/84	I(2006)	TA	VS

[a]Sites characteristic of human-to-human transmission, as reported by Miotto *et al.* (2010). [b] Amino acids occurring in the avian IAV sequences at a <1% frequency, i.e., markers of high potency. [c]Amino acid M at position NP/136 occurrs in the avian IAV sequences at a 8.4% frequency. [d]Marker position where the same amino acid both in human and equine virus strains are present.

Discussion

Aquatic birds are considered to be a reservoir of IAVs, which can overcome interspecies barriers under suitable conditions and infect mammals, including humans. Interspecies transmission of avian viruses requires adaptation changes in the genome, characteristic for a particular new host, to enable optimal replication. The accumulation of adaptive changes in the genome of IAV establishes a new virus lineage associated with the new host. Currently, the best studied human influenza virus lineages are the H1N1 (1918), H2N2 (1957), H3N2 (1968), and H1N1 (2009) subtypes. Less studied are the non-avian IAV lineages of other animal hosts.

During the last 50 years, the sequences of over 100 equine IAV isolates have been determined and are available in public databases. In this study, we analysed sequences of the influenza a H3N8 equine lineage, the only equine lineage currently in circulation. We focused on the conserved proteins, i.e. proteins of the RNA polymerase complex (PB2, PB1, PA, and NP), as well as the M1, M2, NS1, and NEP proteins. The aim was to describe the evolutionary dynamics of these proteins and to identify equine host markers, i.e. their positions and the amino acids characteristic for the equine host, absent or occurring very rarely (<5%) among avian influenza sequences. Such "persistent host markers" were described for avian-to-human IAV adaptation (Finkelstein *et al.*, 2007; Miotto *et al.*, 2010).

Our analysis showed that some of equine host markers were already present in 1963, when influenza A H3N8 virus was isolated from horses for the first time. IAV of subtype H7N7 circulated in horses before 1963 and was first isolated in 1956. This lineage was of a different genotype and was competitively eliminated in 1970's by the onset of the H3N8 lineage (Murcia *et al.* 2011). The presence of several equine host markers in equine H3N8 viruses identified in isolates from 1963 indicates that equine IAVs branched off earlier.

According to our findings, the substitution rate R for all proteins of the polymerase complex (PB2, PB1, PA, and NP) of equine influenza virus equals 0.69×10^{-3} substitutions per year per amino acid position. Our observations did not show any reassortment event in the equine H3N8 lineage, as continuity of accumulation of amino acid substitutions was not interrupted since 1963 in any of examined internal genes. We showed that the accumulation of amino acid substitutions over time was linear, as was also shown for the human H1N1 lineage (Carter and Sanford, 2012). Comparison of markers defined here for equine H3N8 isolates with those of human H(1, 2, 3)N(1, 2) isolates showed that the equine and human lineages are evolutionarily distinct. In the equine H3N8 lineage, similar to human viruses, short-lived side branches were present for a certain period of time and then disappeared, and only one main lineage continues. Our results based on the sequence alignment show that differences between human and equine lineages have continued to grow over time. Accumulation of new equine markers has taken place mainly at positions where human markers are not present, namely at 117 positions out of a total of 127 positions.

Some amino acid substitutions described here as equine host markers can have an impact on the RNA-polymerase activity of the virus, progressively reducing its restrictions in the new host.

In the H3N8 equine lineage, we found a few amino acid substitutions occurring in the region of the **PB1-PA** interface. An amino acid substitution in PB1 (T61I) emerged in the Influenza A H3N8 equine lineage in 1975. This position is part of the region involved in the PB1 interaction with the PA-linker (aa 196–257) (Pflug *et al.*, 2014). In particular, at PA position 217, histidine was present already in 1963 but was substituted with tyrosine (H217Y) in 1975, and both amino acids have remained exclusively characteristic of equine viruses to date. Position 217 is localized inside a cluster of equine-specific markers (213, 216, 217, 231, 237, and 244) in the nuclear localisation signal 2 region of PA (aa 186–247) (Nieto *et al.*, 1994; Hu and Liu, 2015).

The E627K substitution in the **PB2** protein is a well-known adaptive change of IAV in mammalian hosts. Ninety-seven per cent of avian isolates have a glutamic acid (E) residue at this position. This substitution overcomes mammalian antiviral RIG-I impairment of vRNPs (Weber *et al.*, 2015). Surprisingly, all equine isolates also exclusively show an E (identically with avian IAVs) at this position. In contrast to avian IAVs, equine isolates possess an additional substitution – D701N. This mutation plays an important role in viral adaptation to the nuclear import machinery

and enhances the nuclear import of newly synthesized PB2 (Gabriel *et al.*, 2008). The N701 equine marker in PB2 was present already in 1963. Residue N701 is involved in binding mouse host protein importin α5 (Naffakh *et al.*, 2008) and was also described in human H5 and H7 isolates (Gabriel and Fodor, 2014). However, it was not found in any human H1N1 or H3N2 lineages. Other equine-characteristic substitutions N715K and A717T had occurred already in 1975 and 1971, respectively, and these positions, similar to position 701, are localized in the binding region for the host protein importin alpha 5 (Naffakh *et al.*, 2008). The equine-characteristic amino acids at positions 701 and 715 mentioned above are present only in <0.1% of avian isolates; therefore, we consider them to be of high importance for IAV replication in equine host. PB2 protein plays also an important role in recognizing host mRNA caps, essential during IAV replication. Changes in the cap-binding domain of PB2 can influence host specificity. In equine IAV isolates, we found a V344M substitution, localized in the cap-binding domain of PB2 (residues 318–483) described by Guilligay *et al.* (2008) and by Pflug *et al.* (2014).

The region restricted by amino acid positions 107–134, the putative active endonuclease site of **PA** (Yuan *et al.* 2009), has involved equine host markers K114 and V118, which have been present in equine isolates since 2008 and 1975, respectively.

The **NP** N319K substitution described here as an equine host marker was shown to be associated with enhanced binding of the NP protein to importin alpha 1 in mammalian cells (Gabriel *et al.*, 2008). We identified an early equine marker V41 on NP. This position was described in the context of enhanced H7N9 IAV replication at lower temperature as potentially contributing to viral transmissibility (Zhu *et al.*, 2015).

NP of IAV plays a crucial role in the resistance to interferon-inducible Mx protein, an antiviral host factor. Similar to human MxA, equine Mx1 is phylogenetically distant from the avian Mx protein (Haller *et al.*, 2015). Therefore, equine IAVs are also under constant evolutionary pressure by Mx1 restriction. Amino acid substitutions in NP associated with MxA resistance among human IAVs can be only partially found in the equine NP. The human MxA-resistance NP amino acid cluster is thought to be determined mainly by V/I100, P283, and Y313 with additional amino acids associated with MxA resistance: N52, D53, H289, Y/V313, K305, M316, K350, K351, I353, K357 (Mänz *et al.*, 2013; Riegger *et al.* 2015; Götz *et al.*, 2016). Importantly, it is believed that MxA-resistance amino acid substitutions must be accompanied by compensatory stabilizing mutations to maintain viral fitness. Such compensatory mutations were determined to occur at amino acids D16, C385, and Y101 (Götz *et al.*, 2016).

We found only three equine-specific amino acids at positions associated with MxA resistance matching the equine NP sequence: K305, K351, and I353. We identified two of them (K305 and K351) as early equine-adaptation markers. The third substitution, V353I, occurs at >5% frequency among avian isolates, therefore, we did not include it into the list of equine-specific substitutions. The R100K substitution is a recent marker that may also play a role in overcoming Mx1 restriction in further virus-adaptation processes. Moreover, we identified a recent equine-adaptation marker (G16D substitution), which is still the only documented compensatory stabilizing substitution that does not abrogate Mx1 resistance acquired by substitutions mentioned above (Götz *et al.*, 2016). It is possible that some early equine markers on NP could represent further stabilizing mutations, like G16D, contributing to viral fitness. There is also an indication that the Mx1 polymorphism may be associated with equine resistance to IAVs (Manuja *et al.*, 2014).

Until the 1970's, influenza M proteins were not involved in the adaptation process to a new equine host, in contrast to other virus proteins. All equine host markers in the **M1 and M2** proteins that can influence the functional properties of M1/M2 were introduced in the 1970s or later, which means that in these proteins are present only recent markers. The first adaptation changes in the M1 protein within the influenza a equine H3N8 lineage occurred in 1975 (N85S) and 1976 (Q208K). Recent equine markers identified in the M1 protein (80I, 85S, and 95K) are localized in the amino acid region 76–115, which is essential for NEP binding (Shimizu *et al.*, 2011). In the M2 protein the substitutions C50F and G89S may influence phosphorylation (Holsinger *et al.*, 1995; Schnell *et al.*, 2008), but do not influence M2 ion channel activity. Therefore, changes at these positions are probably not essential for avian IAV adaptation to equine host.

The **NS1** protein is composed of two main parts – the effector domain and the RNA-binding domain. These domains comprise numerous sites mediating the various activities of the NS1 protein (Marc, 2014). The equine marker positions in NS1 are almost all localized outside of the known active sites. The only exception is the substitution E96D, which is positioned in the α4 helix of the effector domain, the binding site for phosphatidylinositol 3-kinase. Amino acid E96 is highly conserved in birds, bats, and human isolates, but the equine H3N8 lineage possesses aspartic acid (D) in this position, which was already present in 1963 isolates. Another amino acid substitution (E186K occurring in 1975) is localized in NS1 contact area with a cellular 30-kDa subunit of cleavage and polyadenylation specificity factor CPSF30 (Das *et al.*, 2008). Both equine markers in NS1 – 96D and 186K – are of high potency. The mutation G45R in NS1 was described to induce increased virulence and an earlier robust pro-inflammatory response in mice (Kaewborisuth *et al.*, 2017). The same mutation appeared as a high-potency marker in equine strains in 2008–2009.

Shortened form of NS1 protein, due to the deletion of eleven amino acids at C-terminus, appeared in 2002 in the

majority of equine lineage isolates. Such shortened form of this protein occurs in avian isolates permanently with a 10% frequency.

In **NEP,** the equine marker I89N (emerged in 1975) forms part of the interaction site with M1 and functions in the nuclear export of progeny vRNPs (Shimizu *et al.*, 2011). The nuclear export signals, NES1 and NES2, in NEP are recognized by chromosome region maintenance protein 1, which mediates export of the viral RNP complex out of the nucleus. The T33I, Q34R, and F35L substitutions, determined as equine-adaptation changes, reside inside NES2 (31-IITQFESLKI-40) and can affect the export of RNP proteins and, consequently, the budding of progeny virions (Li *et al.*, 2015).

Conclusion

In conclusion, we identified 127 equine host markers that distinguish present-day equine H3N8 viruses from avian IAVs. Thirty-eight of them were already present in 1963 and another 89 accumulated during the period of 1963–2013. Among all 127 equine markers, 69 (21 early and 48 recent) are of high-potency, i.e., the particular amino acid at the given position occurs among avian strains at <1% frequency, or they do not occur at all.

We identified 10 overlapping human and equine marker positions in proteins PB2, PA, NP, and NS1, 5 of which represent identical amino acid residues in corresponding positions. This indicates that some common (mammalian?) features arose during the process of adaptation of avian IAV to human or equine host. However, as follows from the comparative analysis of human and equine markers, the great majority of them localize to distinct positions, in a strictly host-specific manner. Such a divergence of markers indicates the breadth of the evolutionary diversity of equine and human IAVs.

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Supplementary information is available in the online version of the paper and in the EXCELL format from corresponding author.

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Supplementary information

Avian influenza A virus adaptation to the equine host and identification of host-specific markers

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Supplementary Tables. Acc. Nos. alignments of aa sequences of analysed proteins of virus isolates with identified equine host markers (these supplementary tables are also available in Excell format from the corresponding author F. Kostolanský, E-mail: virufkos@savba.sk)

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

| | | |


100
G K W T T N T E T G A P Q L N P I D G P L P E D N E P S G Y A Q T D C V L E A M A F L E E S H P G I F E N S C L E
I
T8
L2
L12S1
53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109
G K W T T N T E I G A P Q L N P I D G P L P E D N E P S G Y A Q T D C V L E A M A F L E E S H P G I F E N S C L E

T M E V V Q Q T R V D K L T Q G R Q T Y D W T L N R N Q P A A T A L A N T I E V F R S N G L T A N E S G R L I D F
110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166
T M E V V Q Q T R V D K L T Q G R Q T Y D W T L N R N Q P A A T A L A N T I E V F R S N D L T S N E S G R L M D F


100 94 100
L K D V M E S M D K E E M E I T T H F Q R K R R V R D N M T K K M V T Q R T I G K K K Q R L N K R S Y L I R A L T
R R T
I2 V1 P1 D1 K1 I6 K2 I3 K44 R1 L1 M1 K3 R1 G1 T34
0 0 0 2 1 0 1 0 1 0 0 1 6 0 0 0 0 0 0 0 2 0 0 0 0 0 0 0 3 0 0 44 0 0 0 0 0 0 0 0 1 0 0 1 0 1 0 4 1 1 0 0 0 0 35 0 0
167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223
L K D V M E S M N K E E M E I T T H F Q R K R R V R D N M T K R M V T Q R T I G K K K Q R L N R K S Y L I R A L T

																																					100																			
L	N	T	M	T	K	D	A	E	R	G	K	L	K	R	R	A	I	A	T	P	G	M	Q	I	R	G	F	V	Y	F	V	E	T	L	A	R	S	I	C	E	K	L	E	Q	S	G	L	P	V	G	G	N	E	K	K	A
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0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280
L	N	T	M	T	K	D	A	E	R	G	K	L	K	R	R	A	I	A	T	P	G	M	Q	**I**	R	G	F	V	Y	F	V	E	T	L	A	R	**R**	I	C	E	K	L	E	Q	S	G	L	P	V	G	G	N	E	K	K	A
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100
76
K L A N V V R K M M T N S Q D T E L S F T I T G D N T K W N E N Q N P R M F L A M I T Y I T R N Q P E W F R N V L
I
R
T2 I3 X1 I37 S4 R13 K2 I1
0 0 0 0 0 0 0 0 0 2 0 0 0 0 0 0 0 3 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 37 0 0 0 0 0 0 0 0 0 0 4 13 0 2 0 0 0 0 1 0
281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337
K L A N V V R K M M T N S Q D T E L S F T I T G D N T K W N E N Q N P R M F L A M I T Y I T R N Q P E W F R N V L


76
100
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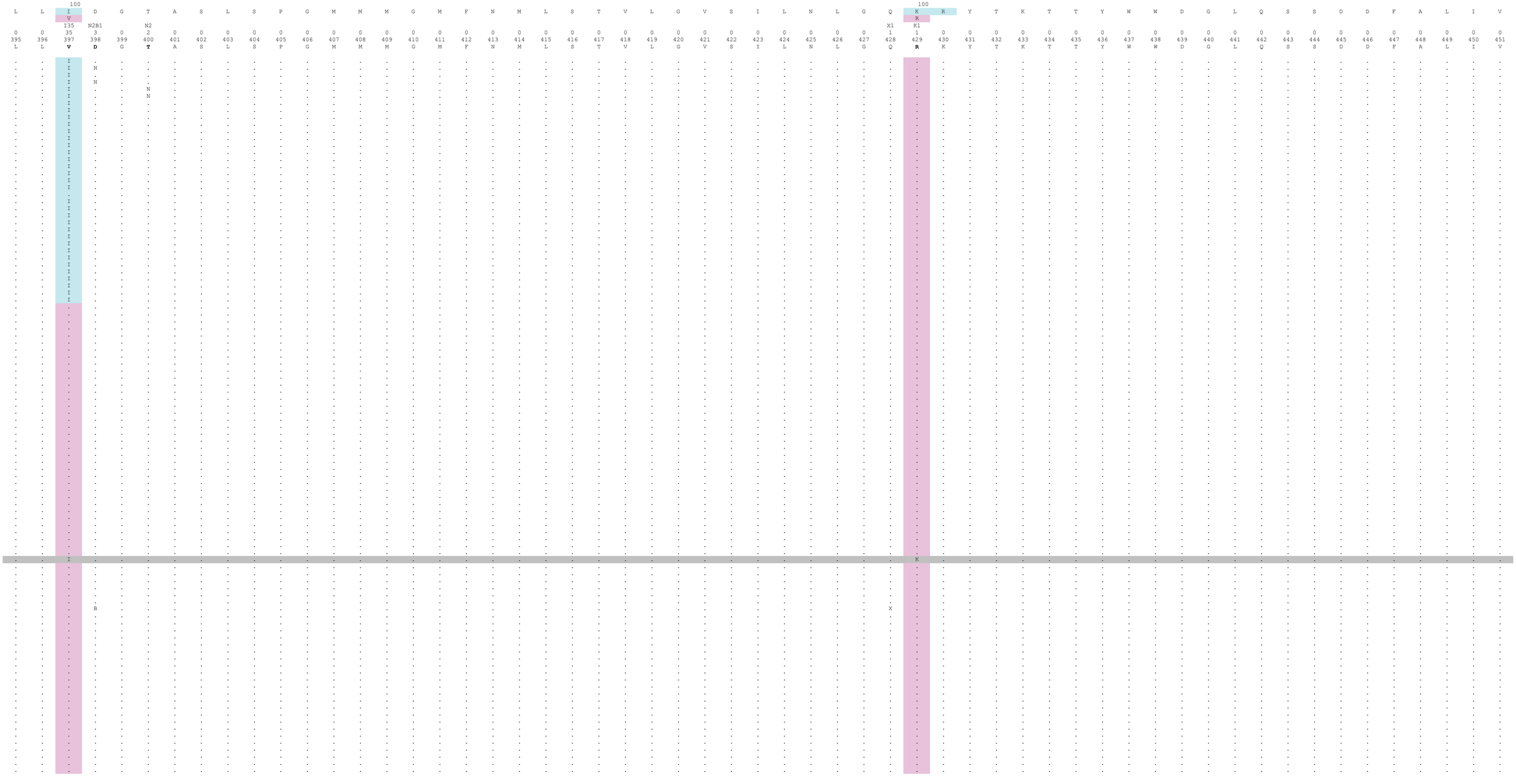
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N A P N H E G I Q A G V D R F Y R T C K L V G I N M S K K K S Y I N R T G T F E F T S F F Y R Y G F V A N F S M E
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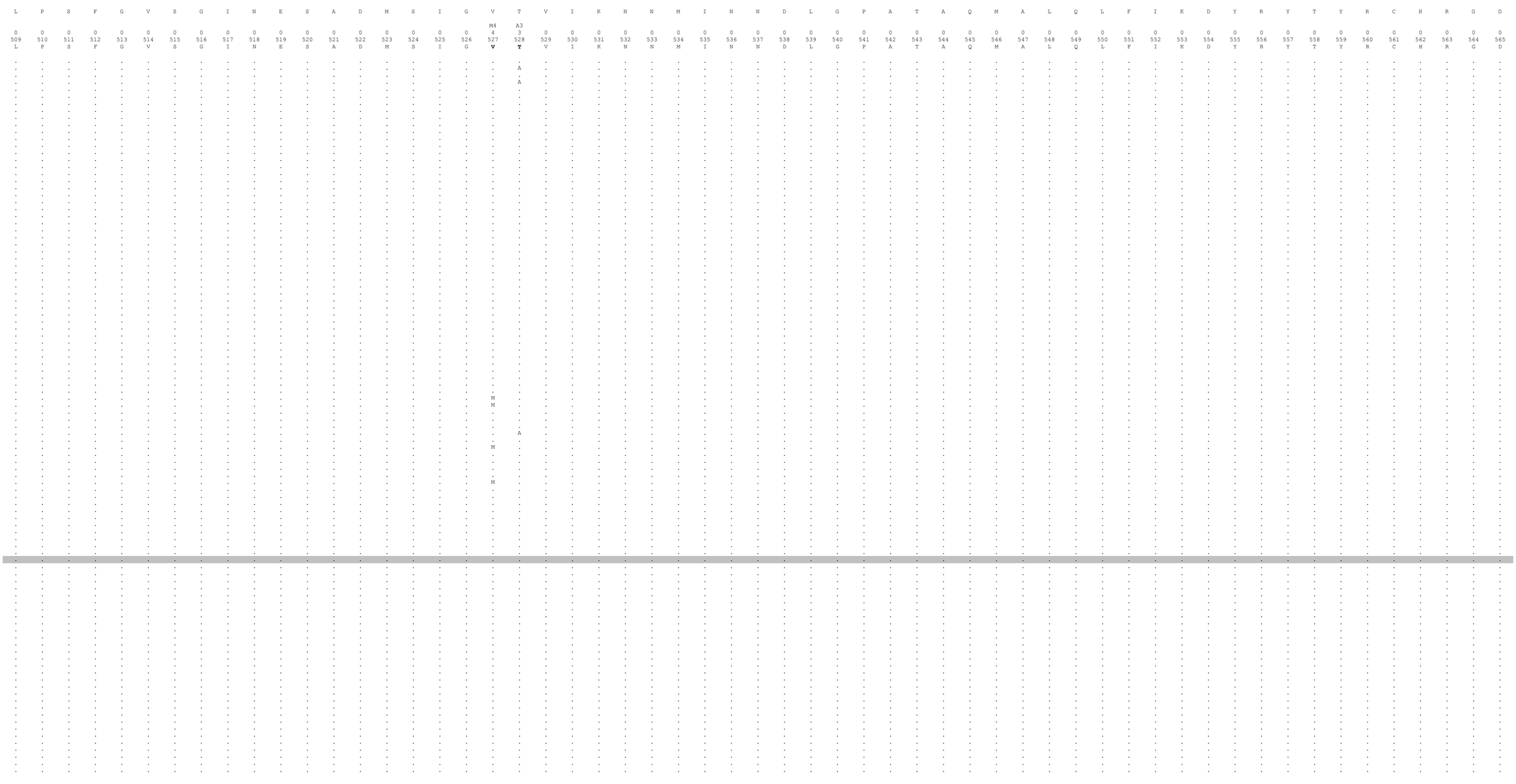
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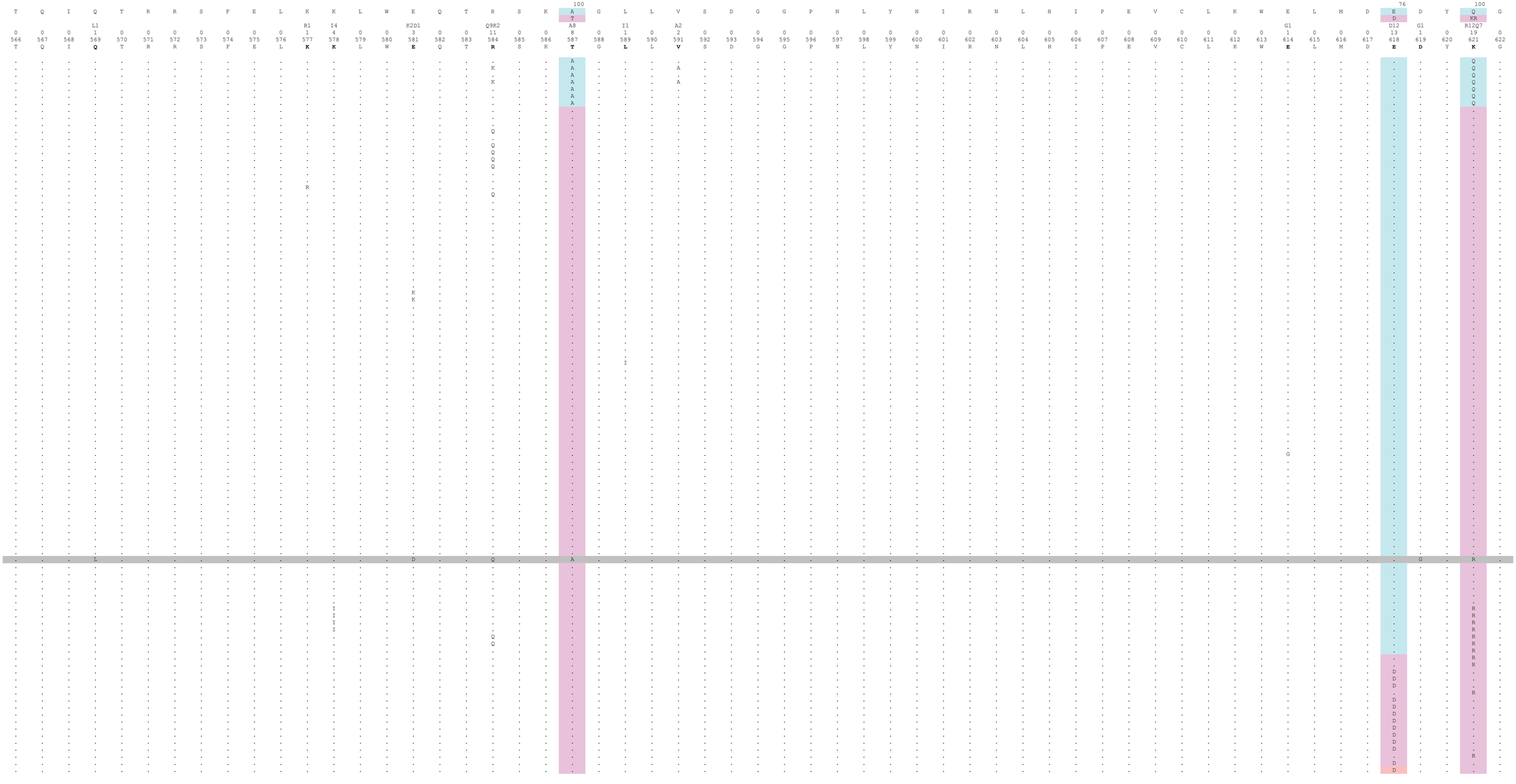
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100 76 100

98
R L C N P L N P F V S H K E I E S V N N A V V M P A H G P A K S M E Y D A V A T T H S W I P K R N R S I L N T S Q
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623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679
R L C N P L N P F V S H K E I E S V N S A V V M P A H G P A K S M E Y D A V A T T H S W I P K R N R S I L N T S Q


R G I L E D E Q M Y Q K C C N L F E K F F P S S S Y R R P V G I S S M V E A M V S R A R I D A R I D F E S G R I K
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	D																			
	D42			T3S1											G1K1	F3				
0	42	0	0	4	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0
737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757
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Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine PB1 H3N8				Permanent aa change				Avian_PB1 all subtypes				
Pos	Consensus	No of	Alternatives	From	To	Year of substitution	Marker	Pos	Consensus	Score	Alignment Details	#
1	M	0						1	M	0	M=9597	9597
2	D	0						2	D	2	A=2,D=9586,E=4,G=4,S=1,V=1	9598
3	V	0						3	V	2	A=2,C=1,I=8,L=1,F=1,V=9585	9598
4	N	0						4	N	3	N=9582,D=1,Del=5,H=2,I=5,K=2,F=1,S=1,T=2,Y=1	9602
5	P	0						5	P	2	R=1,Del=5,Q=2,L=2,F=1,P=9594,S=1	9606
6	T	0						6	T	3	A=9,D=3,Del=5,I=1,P=1,S=1,T=9587	9607
7	L	0						7	L	2	Del=6,E=1,L=9593,F=7,S=1	9608
8	L	0						8	L	3	Del=6,I=7,L=9585,F=7,P=1,T=1,V=1	9608
9	F	0						9	F	1	L=1,F=9604,S=2,Y=1	9608
10	L	0						10	L	1	Del=2,L=9601,F=1,P=1,S=2,V=1	9608
11	K	0						11	K	3	R=13,N=2,Del=1,E=8,K=9584	9608
12	V	0						12	V	13	D=1,Del=1,E=2,G=1,I=96,L=3,M=28,S=2,V=9473,Xaa=1	9608
13	**P**	**1**	Q1					13	P	0	H=1,P=9607	9608
14	A	0						14	A	67	A=7948,G=1,S=1,T=4,V=1654	9608
15	Q	0						15	Q	1	A=1,R=1,Q=9603,H=2,P=1	9608
16	N	0						16	N	3	N=9580,D=4,S=24	9608
17	A	0						17	A	1	A=9603,G=3,V=2	9608
18	I	0						18	I	1	I=9597,L=1,V=10	9608
19	S	0						19	S	1	N=1,D=1,C=1,G=1,S=9604	9608
20	T	0						20	T	11	A=7,I=123,P=1,S=2,T=9475	9608
21	T	0						21	T	0	P=2,T=9606	9608
22	F	0						22	F	0	I=1,F=9606,Xaa=1	9608
23	P	0						23	P	0	P=9607,T=1	9608
24	Y	0						24	Y	0	S=1,Y=9607	9608
25	T	0						25	T	0	A=1,R=1,I=1,T=9605	9608
26	G	0						26	G	0	E=1,G=9607	9608
27	D	0						27	D	2	A=3,N=8,D=9592,E=3,G=2	9608
28	P	0						28	P	0	A=1,K=2,P=9605	9608
29	P	0						29	P	0	P=9607,S=1	9608
30	Y	0						30	Y	1	H=6,F=1,S=2,Y=9599	9608
31	S	0						31	S	0	N=2,C=1,S=9605	9608
32	H	0						32	H	0	R=1,H=9607	9608
33	G	0						33	G	0	G=9608	9608
34	T	0						34	T	0	A=1,E=1,P=1,T=9605	9608
35	**G**	**1**	E1					35	G	0	G=9608	9608
36	T	0						36	T	0	A=1,P=1,T=9606	9608
37	G	0						37	G	0	G=9608	9608
38	Y	0						38	Y	2	C=3,H=9,Y=9595,V=1	9608
39	T	0						39	T	1	A=10,I=1,P=1,T=9596	9608
40	M	0						40	M	4	I=25,L=7,M=9575,T=1,Xaa=1	9609
41	D	0						41	D	0	D=9607,E=2	9609
42	T	0						42	T	0	A=1,P=1,T=9607	9609
43	V	0						43	V	1	A=2,I=3,F=1,V=9603	9609
44	N	0						44	N	5	N=9567,D=2,I=2,S=21,T=17	9609
45	R	0						45	R	0	R=9607,G=1,I=1	9609
46	T	0						46	T	0	A=1,T=9608	9609
47	H	0						47	H	0	R=1,H=9607,L=1	9609
48	Q	0						48	Q	13	N=2,Q=9449,H=2,L=1,K=154,P=1	9609
49	Y	0						49	Y	0	C=3,Y=9606	9609
50	S	0						50	S	1	A=3,P=1,S=9605	9609
51	E	0						51	E	1	N=1,D=1,E=9601,G=3,K=2,Xaa=1	9609
52	K	0						52	K	18	R=166,N=32,Q=4,E=10,K=9391,M=6	9609
53	G	0						53	G	0	G=9609	9609
54	K	0						54	K	45	R=701,N=8,Q=1,E=65,I=1,K=8832,V=1	9609
55	W	0						55	W	0	R=2,Del=1,W=9606	9609
56	T	0						56	T	13	A=141,I=8,K=2,M=1,S=2,T=9455	9609
57	T	0						57	T	16	A=13,Q=2,I=26,K=122,M=20,T=9426	9609
58	N	0						58	N	1	N=9598,H=2,S=8,Xaa=1	9609
59	T	0						59	T	81	A=2,I=2,L=1,M=1,P=11,S=2271,T=7321	9609
60	E	0						60	E	2	D=4,E=9596,G=2,K=2,V=5	9609
61	**I**	**8**	T8	T	I	1975	0,0006	61	T	1	A=1,I=6,S=1,T=9601	9609
62	G	0						62	G	17	R=38,N=6,D=1,E=36,G=9416,K=110,Y=2	9609
63	A	0						63	A	0	A=9607,S=1,V=1	9609
64	**P**	**2**	L2					64	P	10	A=9,R=1,H=3,L=73,P=9506,S=15,T=2	9609
65	Q	0						65	Q	1	Q=9602,H=1,L=1,P=5	9609
66	L	0						66	L	1	L=9605,F=1,V=3	9609
67	N	0						67	N	1	N=9603,D=1,H=1,S=4	9609
68	P	0						68	P	0	Q=1,P=9608	9609
69	I	0						69	I	3	I=9577,T=1,V=30,Xaa=1	9609
70	D	0						70	D	1	N=3,D=9602,E=1,G=2,Xaa=1	9609
71	G	0						71	G	0	G=9608,Xaa=1	9609
72	P	0						72	P	0	L=1,P=9607,Xaa=1	9609
73	L	0						73	L	1	Q=1,I=3,L=9603,V=1,Xaa=1	9609
74	P	0						74	P	1	P=9599,S=9,Xaa=1	9609
75	E	0						75	E	22	D=198,E=9339,G=15,L=1,K=13,V=42,Xaa=1	9609
76	D	0						76	D	17	N=188,D=9391,E=5,G=22,S=1,Y=1,Xaa=1	9609
77	N	0						77	N	4	N=9571,D=17,H=18,I=1,T=1,Xaa=1	9609
78	E	0						78	E	8	D=82,Q=1,E=9522,G=2,K=1,Xaa=1	9609
79	P	0						79	P	0	P=9608,Xaa=1	9609
80	S	0						80	S	5	R=2,N=26,C=5,I=3,S=9561,T=11,Xaa=1	9609
81	G	0						81	G	0	R=1,G=9607,Xaa=1	9609
82	Y	0						82	Y	0	S=2,Y=9606,Xaa=1	9609
83	A	0						83	A	2	A=9591,G=2,S=13,T=1,V=1,Xaa=1	9609
84	Q	0						84	Q	1	R=2,Q=9605,H=1,Xaa=1	9609
85	T	0						85	T	1	A=4,M=2,T=9602,Xaa=1	9609
86	D	0						86	D	3	D=9584,E=23,G=1,Xaa=1	9609
87	C	0						87	C	0	C=9608,Xaa=1	9609
88	V	0						88	V	0	V=9608,Xaa=1	9609
89	L	0						89	L	1	I=6,L=9602,Xaa=1	9609
90	E	0						90	E	0	E=9607,K=1,Xaa=1	9609
91	A	0						91	A	1	A=9601,D=1,S=1,V=5,Xaa=1	9609
92	M	0						92	M	1	I=1,L=2,M=9603,V=2,Xaa=1	9609
93	A	0						93	A	0	A=9606,D=1,S=1,Xaa=1	9609
94	**F**	**13**	L12S1					94	F	8	C=3,L=33,F=9535,S=14,Y=21,Xaa=3	9609
95	L	0						95	L	1	L=9605,M=1,Xaa=3	9609
96	E	0						96	E	2	D=13,E=9589,G=4,Xaa=3	9609
97	E	0						97	E	12	A=3,R=1,N=18,D=12,E=9493,G=9,K=65,V=4,Xaa=4	9609
98	S	0						98	S	1	A=2,C=1,S=9601,T=2,Xaa=3	9609
99	H	0						99	H	1	N=1,Q=1,H=9603,Xaa=4	9609
100	P	0						100	P	2	P=9594,S=12,Xaa=3	9609
101	G	0						101	G	1	R=4,E=1,G=9601,Xaa=3	9609
102	I	0						102	I	6	I=9552,L=49,F=1,V=4,Xaa=3	9609
103	F	0						103	F	1	C=1,L=1,F=9599,Y=5,Xaa=3	9609
104	E	0						104	E	12	A=1,D=14,E=9469,G=119,K=1,V=1,Xaa=4	9609
105	N	0						105	N	10	R=2,N=9513,D=6,H=28,K=1,S=23,T=32,Xaa=4	9609
106	S	0						106	S	1	L=1,S=9604,Xaa=4	9609
107	C	0						107	C	1	R=1,C=9603,G=1,Xaa=4	9609
108	L	0						108	L	7	R=2,I=54,L=9540,F=5,P=1,V=3,Xaa=4	9609
109	E	0						109	E	1	A=1,D=1,E=9602,G=1,Xaa=4	9609
110	T	0						110	T	3	A=18,M=6,P=1,T=9580,Xaa=4	9609
111	**M**	**1**	V1					111	M	11	I=125,M=9475,T=1,V=4,Xaa=4	9609
112	E	0						112	E	1	E=9604,K=1,Xaa=4	9609
113	V	0						113	V	78	A=13,I=1939,M=2,F=16,T=9,V=7625,Xaa=5	9609
114	**V**	**35**	I33	V	I	1997	0,0133	114	V	12	A=6,I=128,L=4,F=1,V=9467,Xaa=3	9609
115	Q	0						115	Q	1	Q=9604,H=1,K=1,Xaa=3	9609
116	Q	0						116	Q	1	R=1,Q=9605,Xaa=3	9609

117	T	0							117	T	2 A=11,K=1,T=9594,Xaa=3	9609
118	**R**	**1**	K1						118	R	1 R=9604,K=2,Xaa=3	9609
119	**V**	**13**	M13	V	M		2007	0,0036	119	V	6 E=1,I=6,L=10,M=35,V=9554,Xaa=3	9609
120	D	0							120	D	1 D=9602,E=2,G=1,T=1,Xaa=3	9609
121	K	0							121	K	2 R=12,N=2,Q=1,K=9591,Xaa=3	9609
122	L	0							122	L	1 L=9600,M=6,Xaa=3	9609
123	T	0							123	T	1 A=8,T=9598,Xaa=3	9609
124	Q	0							124	Q	1 R=5,Q=9601,Xaa=3	9609
125	G	0							125	G	1 G=9604,S=2,Xaa=3	9609
126	R	0							126	R	1 R=9604,C=1,H=1,Xaa=3	9609
127	Q	0							127	Q	1 R=2,Q=9604,Xaa=3	9609
128	T	0							128	T	1 I=1,T=9605,Xaa=3	9609
129	Y	0							129	Y	2 F=8,Y=9596,Xaa=5	9609
130	D	0							130	D	1 A=1,D=9602,G=1,Xaa=5	9609
131	W	0							131	W	1 R=1,W=9603,Xaa=5	9609
132	T	0							132	T	1 A=3,I=1,T=9600,Xaa=5	9609
133	L	0							133	L	2 I=4,L=9593,M=3,S=2,V=2,Xaa=5	9609
134	N	0							134	N	3 N=9581,D=17,I=2,K=2,S=1,Xaa=6	9609
135	R	0							135	R	2 R=9596,E=1,K=5,S=1,Xaa=6	9609
136	N	0							136	N	1 N=9601,S=2,Xaa=6	9609
137	Q	0							137	Q	1 R=1,Q=9600,Xaa=8	9609
138	P	0							138	P	1 A=1,R=1,L=1,P=9598,T=1,Xaa=7	9609
139	A	0							139	A	1 A=9598,G=2,P=2,Xaa=7	9609
140	A	0							140	A	1 A=9598,S=3,T=1,Xaa=7	9609
141	T	0							141	T	1 A=2,S=1,T=9598,Xaa=8	9609
142	A	0							142	A	1 A=9600,D=1,V=1,Xaa=7	9609
143	L	0							143	L	1 L=9601,F=1,Xaa=7	9609
144	A	0							144	A	2 A=9591,T=9,V=2,Xaa=7	9609
145	N	0							145	N	2 N=9592,D=5,S=5,Xaa=7	9609
146	T	0							146	T	2 A=3,I=1,P=1,S=1,T=9595,Xaa=8	9609
147	I	0							147	I	2 I=9597,M=2,T=1,V=1,Xaa=8	9609
148	E	0							148	E	2 D=1,Q=1,E=9595,G=3,K=1,Xaa=8	9609
149	**V**	**1**	I1						149	V	57 I=1235,T=3,V=8363,Xaa=8	9609
150	F	0							150	F	2 L=3,F=9596,S=1,Y=1,Xaa=8	9609
151	R	0							151	R	7 R=9540,G=1,K=58,M=1,Xaa=9	9609
152	S	0							152	S	17 A=15,L=166,M=1,P=1,S=9401,T=17,Xaa=8	9609
153	N	0							153	N	1 N=9599,D=1,S=1,Xaa=8	9609
154	**D**	**34**	G34	D	G		2002	0,0156	154	G	27 N=7,D=150,C=5,G=9271,S=168,Xaa=8	9609
155	L	0							155	L	3 I=9,L=9580,M=11,P=1,Xaa=8	9609
156	T	0							156	T	20 A=117,I=17,K=24,M=32,S=3,T=9398,V=10,Xaa=8	9609
157	**S**	**1**	A1			Early marker - 1963		0,0020	157	A	22 A=9354,N=13,D=2,I=17,S=19,T=176,V=20,Xaa=8	9609
158	**N**	**2**	S2						158	N	19 N=9343,S=258,Xaa=8	9609
159	**E**	**1**	D1						159	E	9 D=56,E=9518,G=19,K=4,V=3,Xaa=9	9609
160	S	0							160	S	1 K=1,S=9599,T=1,Xaa=8	9609
161	G	0							161	G	1 G=9601,Xaa=8	9609
162	R	0							162	R	2 R=9596,P=1,S=2,T=2,Xaa=8	9609
163	L	0							163	L	1 L=9599,M=2,Xaa=8	9609
164	**M**	**8**	I8	I	M		1975	0,0025	164	I	6 I=9556,L=3,M=24,V=18,Xaa=8	9609
165	D	0							165	D	2 A=1,N=2,D=9596,E=1,Y=1,Xaa=8	9609
166	F	0							166	F	4 I=1,L=16,F=9578,S=4,Y=1,Xaa=9	9609
167	L	0							167	L	1 L=9599,V=2,Xaa=8	9609
168	K	0							168	K	3 R=24,K=9577,Xaa=8	9609
169	D	0							169	D	2 R=1,N=2,D=9596,E=1,G=1,Xaa=8	9609
170	**V**	**2**	I2						170	V	2 A=2,G=1,I=4,M=1,V=9593,Xaa=8	9609
171	**M**	**1**	V1						171	M	29 A=2,Del=1,I=115,L=15,M=9268,T=41,V=159,Xaa=8	9609
172	E	0							172	E	32 N=1,D=318,Del=1,Q=1,E=9182,G=68,K=28,V=2,Xaa=8	9609
173	**S**	**1**	P1						173	S	1 Del=1,L=1,S=9600,Xaa=7	9609
174	M	0							174	M	10 Del=1,I=36,L=2,M=9517,T=9,V=37,Xaa=7	9609
175	**N**	**1**	D1						175	D	33 N=484,D=9086,E=10,G=20,Y=1,Xaa=8	9609
176	K	0							176	K	8 R=50,N=7,Q=4,E=4,K=9536,Xaa=8	9609
177	E	0							177	E	21 A=2,R=1,N=10,D=62,Q=1,E=9387,G=82,K=57,Xaa=7	9609
178	**E**	**1**	K1						178	E	22 A=3,D=10,E=9339,G=147,K=102,V=1,Xaa=7	9609
179	**M**	**6**	I6						179	M	39 I=314,L=25,K=1,M=9058,T=5,V=199,Xaa=7	9609
180	E	0							180	E	6 D=11,E=9555,G=31,K=4,V=1,Xaa=7	9609
181	I	0							181	I	6 I=9555,L=1,M=4,T=1,V=40,Xaa=8	9609
182	T	0							182	T	24 A=3,R=1,I=330,T=9258,V=10,Xaa=7	9609
183	T	0							183	T	4 A=21,I=3,M=2,T=9576,Xaa=7	9609
184	H	0							184	H	2 R=1,Q=4,H=9595,P=1,Y=1,Xaa=7	9609
185	F	0							185	F	1 L=1,F=9601,Xaa=7	9609
186	Q	0							186	Q	3 Q=9581,H=20,P=1,Xaa=7	9609
187	**R**	**2**	K2						187	R	1 R=9597,K=4,Xaa=8	9609
188	K	0							188	K	2 R=3,N=1,K=9596,M=1,Xaa=8	9609
189	R	0							189	R	3 R=9587,G=1,I=1,K=11,S=1,Xaa=8	9609
190	R	0							190	R	2 R=9595,I=1,K=5,Xaa=8	9609
191	V	0							191	V	15 I=166,L=4,M=11,V=9420,Xaa=8	9609
192	R	0							192	R	2 R=9593,G=1,K=5,Xaa=10	9609
193	D	0							193	D	2 A=1,D=9590,E=2,G=3,H=2,Y=1,Xaa=10	9609
194	N	0							194	N	5 N=9567,S=28,T=2,Y=2,Xaa=10	9609
195	**M**	**3**	I3						195	M	9 I=48,L=2,M=9526,T=7,V=16,Xaa=10	9609
196	T	0							196	T	2 A=1,I=1,P=2,S=4,T=9591,Xaa=10	9609
197	K	0							197	K	8 R=67,N=2,Q=2,I=1,K=9524,T=1,Xaa=12	9609
198	**R**	**44**	K44	K	R		1988	0,0048	198	K	6 R=46,N=1,Q=1,E=1,K=9549,Xaa=11	9609
199	M	0							199	M	2 I=1,L=4,M=9589,V=4,Xaa=11	9609
200	V	0							200	V	32 A=3,I=509,F=2,T=1,V=9083,Xaa=11	9609
201	T	0							201	T	2 A=3,R=1,I=1,P=2,S=1,T=9590,Xaa=11	9609
202	Q	0							202	Q	2 R=5,Q=9590,H=1,P=1,Xaa=12	9609
203	R	0							203	R	3 R=9588,G=3,K=4,S=2,Xaa=12	9609
204	T	0							204	T	3 A=2,I=8,K=1,P=3,S=2,T=9581,Xaa=12	9609
205	I	0							205	I	8 R=1,I=9527,L=10,M=6,V=53,Xaa=12	9609
206	G	0							206	G	2 A=1,R=2,E=1,G=9592,V=1,Xaa=12	9609
207	**K**	**1**	R1						207	K	6 R=39,N=1,E=1,K=9555,T=1,Xaa=12	9609
208	K	0							208	K	3 R=9,E=4,K=9584,Xaa=12	9609
209	K	0							209	K	7 R=53,N=4,E=3,I=1,K=9536,Xaa=12	9609
210	Q	1	L1						210	Q	4 Q=9577,H=12,L=4,K=4,Xaa=12	9609
211	R	0							211	R	27 A=3,R=9270,E=3,G=93,K=224,M=4,Xaa=12	9609
212	**L**	**1**	M1						212	L	6 I=14,L=9555,M=14,V=14,Xaa=12	9609
213	N	0							213	N	29 A=2,N=9277,D=12,G=2,H=3,I=36,K=41,S=153,T=68,Y=3,Xaa=12	9609
214	**R**	**4**	K4	R	K		2013	0,0355	214	K	26 R=341,N=19,Q=4,I=1,K=9231,Xaa=13	9609
215	**K**	**1**	R1				1963	0,2144	215	R	77 R=7529,Q=1,E=1,G=4,K=2060,Xaa=14	9609
216	**S**	**1**	G1						216	S	35 A=1,R=2,N=228,C=3,E=1,G=206,I=8,S=9147,T=1,Xaa=12	9609
217	Y	0							217	Y	2 C=3,H=4,L=1,Y=9589,Xaa=12	9609
218	L	0							218	L	3 I=8,L=9586,M=1,F=1,V=1,Xaa=12	9609
219	I	0							219	I	3 G=1,I=9581,M=1,T=4,V=9,Xaa=13	9609
220	R	0							220	R	2 R=9595,K=2,Xaa=12	9609
221	**A**	**35**	T35	A	T		1997	0,0004	221	A	3 A=9589,G=2,S=2,T=4,V=1,Xaa=11	9609
222	L	0							222	L	3 L=9588,M=8,S=1,V=1,Xaa=11	9609
223	T	0							223	T	4 A=31,T=9567,Xaa=11	9609
224	L	0							224	L	1 L=9598,Xaa=11	9609
225	N	0							225	N	1 N=9597,S=1,Xaa=11	9609
226	T	0							226	T	2 A=1,K=1,P=1,T=9595,Xaa=11	9609
227	M	0							227	M	2 I=1,K=1,M=9595,T=1,Xaa=11	9609
228	T	0							228	T	2 A=4,I=1,S=1,T=9592,Xaa=11	9609
229	K	0							229	K	2 R=1,E=1,K=9596,Xaa=11	9609
230	D	0							230	D	2 N=5,D=9592,G=1,Xaa=11	9609
231	A	0							231	A	1 A=9598,Xaa=11	9609
232	E	0							232	E	2 Q=1,E=9594,K=2,Xaa=12	9609
233	R	0							233	R	2 R=9595,G=2,T=1,Xaa=11	9609
234	G	0							234	G	2 R=1,G=9594,S=2,Xaa=12	9609
235	K	0							235	K	2 N=1,E=1,K=9595,Xaa=12	9609
236	L	0							236	L	2 R=1,L=9593,F=1,S=2,Xaa=12	9609
237	K	0							237	K	9 R=80,N=1,E=3,G=1,K=9510,M=2,Xaa=12	9609
238	R	0							238	R	2 R=9591,K=6,Xaa=12	9609
239	R	0							239	R	1 R=9597,Xaa=12	9609
240	A	1	X1						240	A	2 A=9595,Del=1,E=1,T=1,Xaa=11	9609
241	I	0							241	I	2 Del=1,I=9592,F=1,V=3,Xaa=12	9609

242	A	0						242	A	1	A=9597,Del=1,Xaa=11		9609
243	T	0						243	T	2	A=1,Del=1,T=9594,Xaa=13		9609
244	P	0						244	P	2	P=9595,S=1,Xaa=13		9609
245	G	0						245	G	2	G=9594,P=1,Xaa=14		9609
246	M	0						246	M	4	R=1,I=19,M=9574,V=1,Xaa=14		9609
247	Q	0						247	Q	2	R=1,Q=9593,T=1,Xaa=14		9609
248	**I**	**1**	V1					248	I	3	N=1,I=9585,L=1,F=2,T=6,Xaa=14		9609
249	R	0						249	R	3	R=9586,K=3,T=1,Xaa=19		9609
250	G	0						250	G	2	G=9595,Xaa=14		9609
251	F	0						251	F	2	I=1,F=9589,S=3,Xaa=16		9609
252	V	0						252	V	2	A=1,I=2,V=9592,Xaa=14		9609
253	Y	0						253	Y	10	C=1,H=70,F=16,Y=9507,Xaa=15		9609
254	F	0						254	F	4	L=2,F=9579,S=4,V=9,Xaa=15		9609
255	V	0						255	V	3	A=1,I=7,V=9586,Xaa=15		9609
256	E	0						256	E	2	Q=1,E=9592,G=1,Xaa=15		9609
257	T	0						257	T	23	A=263,I=13,M=6,S=4,T=9308,Xaa=15		9609
258	L	0						258	L	2	I=1,L=9590,M=3,Xaa=15		9609
259	A	0						259	A	2	A=9591,P=1,T=1,V=1,Xaa=15		9609
260	R	0						260	R	4	R=9574,G=2,K=17,W=1,Xaa=15		9609
261	**R**	**1**	S1		Early marker - 1963		0,0000	261	S	20	A=13,N=29,C=91,G=31,S=9404,T=25,Xaa=16		9609
262	I	0						262	I	2	I=9588,M=1,T=1,V=3,Xaa=16		9609
263	C	0						263	C	2	C=9593,Xaa=16		9609
264	E	0						264	E	4	D=18,E=9574,Xaa=17		9609
265	K	0						265	K	2	R=2,K=9590,Xaa=17		9609
266	L	0						266	L	2	I=1,L=9590,V=1,Xaa=17		9609
267	E	0						267	E	2	D=1,Q=1,E=9588,G=2,Xaa=17		9609
268	Q	0						268	Q	2	R=1,Q=9590,P=1,Xaa=17		9609
269	S	0						269	S	3	A=4,F=2,S=9584,T=1,Xaa=18		9609
270	G	0						270	G	2	E=1,G=9590,Xaa=18		9609
271	L	0						271	L	2	L=9588,F=2,Xaa=19		9609
272	P	0						272	P	2	H=1,P=9589,Xaa=19		9609
273	V	0						273	V	4	G=1,I=10,F=1,V=9578,Xaa=19		9609
274	G	0						274	G	2	R=1,G=9589,Xaa=19		9609
275	G	0						275	G	2	R=1,G=9589,Xaa=19		9609
276	N	0						276	N	2	N=9588,K=1,M=1,Xaa=19		9609
277	E	0						277	E	2	D=1,E=9588,K=1,Xaa=19		9609
278	K	0						278	K	2	R=1,K=9589,Xaa=19		9609
279	K	0						279	K	3	N=2,K=9586,M=1,Xaa=20		9609
280	A	0						280	A	2	A=9587,G=3,Xaa=19		9609
281	K	0						281	K	2	N=1,K=9588,Xaa=20		9609
282	L	0						282	L	2	L=9588,Xaa=21		9609
283	A	0						283	A	3	A=9584,G=4,S=1,Xaa=20		9609
284	N	0						284	N	2	N=9587,S=1,Xaa=21		9609
285	V	0						285	V	100	Del=3943,V=5645,Xaa=21		9609
286	V	0						286	V	5	A=18,G=1,I=4,V=9564,Xaa=22		9609
287	R	0						287	R	3	R=9583,I=1,K=3,Xaa=22		9609
288	K	0						288	K	2	K=9587,Xaa=22		9609
289	M	0						289	M	2	M=9587,Xaa=22		9609
290	**M**	**2**	T2					290	M	3	I=1,M=9585,Xaa=23		9609
291	T	0						291	T	4	A=9,I=3,T=9573,V=1,Xaa=23		9609
292	N	0						292	N	6	A=1,N=9550,D=10,K=1,S=25,Xaa=22		9609
293	S	0						293	S	3	A=1,L=1,P=1,S=9584,Xaa=22		9609
294	Q	0						294	Q	8	R=22,Q=9532,H=19,L=6,K=8,Xaa=22		9609
295	D	0						295	D	3	D=9584,E=2,Y=1,V=1,Xaa=21		9609
296	T	0						296	T	4	A=5,N=1,I=8,S=2,T=9572,Xaa=21		9609
297	E	0						297	E	3	D=4,Q=1,E=9583,Xaa=21		9609
298	**L**	**3**	I3					298	L	17	I=141,L=9416,F=5,P=1,V=25,Xaa=21		9609
299	S	0						299	S	3	S=9585,T=1,Xaa=23		9609
300	F	0						300	F	2	L=1,F=9587,Xaa=21		9609
301	T	0						301	T	3	A=1,S=1,T=9586,Xaa=21		9609
302	I	1	X1					302	I	7	I=9537,T=2,V=48,Xaa=22		9609
303	T	0						303	T	3	I=2,T=9585,Xaa=22		9609
304	G	0						304	G	2	G=9587,Xaa=22		9609
305	D	0						305	D	3	D=9585,G=1,K=1,Xaa=22		9609
306	N	0						306	N	3	N=9583,H=1,K=2,S=1,Xaa=22		9609
307	T	0						307	T	2	A=1,T=9586,Xaa=22		9609
308	K	0						308	K	3	K=9585,T=1,Xaa=23		9609
309	W	0						309	W	3	R=2,W=9583,Xaa=24		9609
310	N	0						310	N	3	N=9585,Xaa=24		9609
311	E	0						311	E	3	D=1,E=9584,Xaa=24		9609
312	N	0						312	N	3	N=9583,Xaa=26		9609
313	Q	0						313	Q	3	Q=9581,H=1,P=1,Xaa=26		9609
314	N	0						314	N	13	N=9461,K=1,S=122,Xaa=25		9609
315	P	0						315	P	3	P=9583,S=1,Xaa=25		9609
316	R	0						316	R	3	R=9579,K=3,W=1,Xaa=26		9609
317	**M**	**37**	I37	M	I	1997	0,0254	317	M	47	A=1,R=1,I=244,M=8919,T=34,V=384,Xaa=26		9609
318	F	0						318	F	3	F=9583,Xaa=26		9609
319	L	0						319	L	5	L=9563,M=20,Xaa=26		9609
320	A	0						320	A	22	A=9304,S=4,T=272,V=2,Xaa=27		9609
321	M	0						321	M	4	R=1,I=4,M=9576,Xaa=28		9609
322	I	0						322	I	6	I=9549,M=4,T=1,V=28,Xaa=27		9609
323	T	0						323	T	4	A=1,I=2,M=8,T=9571,Xaa=27		9609
324	Y	0						324	Y	4	F=11,Y=9571,Xaa=27		9609
325	I	0						325	I	4	I=9572,M=7,T=2,Xaa=28		9609
326	T	0						326	T	3	T=9580,Xaa=29		9609
327	R	0						327	R	9	R=9508,K=71,W=1,Xaa=29		9609
328	**N**	**4**	S4					328	N	19	N=9410,D=7,G=1,H=10,K=64,S=77,T=9,Y=2,Xaa=29		9609
329	**Q**	**13**	R13	Q	R	2007	0,0000	329	Q	101	Del=3943,Q=5635,K=1,Xaa=30		9609
330	P	0						330	P	3	H=1,P=9578,Xaa=30		9609
331	**E**	**2**	K2					331	E	22	A=1,R=1,N=1,D=34,Q=1,E=9371,G=76,K=89,V=4,Xaa=31		9609
332	W	0						332	W	3	W=9577,Xaa=32		9609
333	F	0						333	F	4	L=9,F=9568,Xaa=32		9609
334	R	0						334	R	3	R=9577,K=1,Xaa=31		9609
335	N	0						335	N	4	N=9573,D=3,T=1,Xaa=32		9609
336	**V**	**1**	I1					336	V	13	A=40,I=61,V=9476,Xaa=32		9609
337	L	0						337	L	4	L=9573,M=2,S=1,Xaa=33		9609
338	S	1	X1					338	S	7	R=1,N=5,C=25,I=3,S=9542,T=2,Xaa=31		9609
339	**I**	**1**	M1					339	I	11	I=9500,M=16,T=1,V=61,Xaa=31		9609
340	A	0						340	A	3	A=9578,Xaa=31		9609
341	**P**	**1**	T1					341	P	3	P=9576,S=1,Xaa=32		9609
342	I	0						342	I	5	I=9558,L=4,V=14,Xaa=33		9609
343	M	0						343	M	4	I=3,M=9575,Xaa=31		9609
344	F	0						344	F	3	F=9578,S=1,Xaa=30		9609
345	S	0						345	S	3	A=1,S=9578,Xaa=30		9609
346	N	0						346	N	3	N=9577,D=1,K=1,Xaa=30		9609
347	K	0						347	K	3	K=9579,Xaa=30		9609
348	M	0						348	M	6	I=3,L=5,K=3,M=9558,V=9,Xaa=31		9609
349	A	0						349	A	4	A=9571,Del=1,G=3,T=3,V=2,Xaa=29		9609
350	R	0						350	R	6	R=9550,Del=1,I=3,K=26,Xaa=29		9609
351	L	0						351	L	4	Del=1,I=4,L=9575,Xaa=29		9609
352	G	0						352	G	3	R=1,Del=1,G=9577,Xaa=30		9609
353	K	0						353	K	28	R=379,N=1,E=2,K=9196,Xaa=31		9609
354	G	0						354	G	3	R=1,G=9579,Xaa=29		9609
355	Y	0						355	Y	3	S=1,Y=9579,Xaa=29		9609
356	M	0						356	M	3	M=9579,T=1,Xaa=29		9609
357	F	0						357	F	4	I=1,L=4,F=9575,Xaa=29		9609
358	E	0						358	E	5	A=1,D=1,Q=1,E=9566,G=2,K=4,Y=1,V=4,Xaa=29		9609
359	S	0						359	S	3	N=1,G=1,S=9578,Xaa=29		9609
360	K	0						360	K	10	R=58,N=10,E=1,K=9511,Xaa=29		9609
361	**S**	**1**	R1					361	S	16	R=14,N=33,G=28,I=59,S=9444,V=1,Xaa=30		9609
362	M	0						362	M	4	I=1,L=6,M=9573,Xaa=29		9609
363	**K**	**1**	R1					363	K	13	R=120,K=9458,M=1,Xaa=30		9609
364	L	0						364	L	7	H=1,I=33,L=9539,F=2,P=1,V=2,Xaa=31		9609
365	R	0						365	R	4	R=9572,G=3,L=1,Xaa=33		9609
366	**T**	**4**	A4					366	T	6	A=26,I=1,P=1,T=9548,Xaa=33		9609
367	Q	0						367	Q	4	Q=9574,H=1,L=1,Xaa=33		9609
368	I	0						368	I	28	I=9206,L=1,M=13,T=1,V=355,Xaa=33		9609
369	P	0						369	P	11	Q=10,L=1,P=9499,S=65,T=1,Xaa=33		9609
370	A	0						370	A	5	A=9559,K=1,S=2,T=12,V=2,Xaa=33		9609
371	**E**	**4**	G3V1					371	E	4	D=4,E=9570,K=1,Xaa=34		9609
372	M	0						372	M	15	R=2,I=57,L=16,K=1,M=9458,T=16,V=26,Xaa=33		9609
373	L	0						373	L	8	I=40,L=9534,F=1,P=1,Xaa=33		9609
374	A	0						374	A	18	A=9428,E=52,S=47,T=41,V=7,Xaa=34		9609
375	S	0					0,3476	375	N	123	N=5843,D=128,Del=1,G=10,H=5,K=3,S=3340,T=244,Xaa=35		9609
376	I	0						376	I	7	Del=1,I=9539,M=1,F=2,V=32,Xaa=34		9609
377	**D**	**13**	E13	D	E	2007	0,0017	377	D	8	A=1,N=20,D=9534,Del=1,E=16,G=2,T=1,Xaa=34		9609
378	L	0						378	L	5	Del=2,L=9560,M=4,F=6,P=2,Xaa=35		9609
379	K	0						379	K	8	R=35,N=3,Del=1,Q=4,I=1,K=9528,T=1,Xaa=36		9609
380	Y	0						380	Y	101	Del=3944,Y=5630,Xaa=35		9609
381	F	0						381	F	4	Del=1,F=9572,S=1,Xaa=35		9609
382	N	0						382	N	4	N=9568,H=1,L=1,T=1,Y=2,Xaa=36		9609
383	**D**	**1**	E1		Ea… …963		0,0216	383	E	35	R=1,N=2,D=208,E=9147,G=5,K=202,V=7,Xaa=37		9609

vmuc:
Not a marker
(>0.05)

vmuc:
Not a marker
(>0.05)

384	**S**	**1**	P1						384	S	75	A=16,Q=6,I=37,L=1062,P=135,S=8267,T=47,Y=1,V=1,Xaa=37	9609
385	T	0							385	T	102	R=1,**Del=3943**,F=1,P=6,S=1,T=5620,Xaa=37	9609
386	**K**	**1**	R1			1963	0,1420		386	R	148	**R=4260**,N=1,**Del=3943**,Q=1,G=2,**K=1364**,T=1,Xaa=37	9609
387	K	0							387	K	37	R=85,N=8,Q=113,E=223,K=9140,M=2,T=1,Xaa=37	9609
388	K	0							388	K	5	R=10,K=9560,T=1,Xaa=38	9609
389	I	0							389	I	5	I=9562,M=1,T=1,V=8,Xaa=37	9609
390	**E**	**2**	K2						390	E	16	D=2,Q=1,E=9448,G=4,I=10,L=1,K=23,M=80,V=2,Xaa=38	9609
391	**K**	**11**	R11						391	K	22	R=201,N=25,E=2,K=9341,T=2,Xaa=38	9609
392	I	0							392	I	12	I=9482,L=12,M=4,T=3,V=69,Xaa=39	9609
393	R	0							393	R	5	R=9563,I=1,K=5,Xaa=40	9609
394	P	0							394	P	6	A=2,R=1,H=2,L=1,P=9554,S=6,T=3,Xaa=40	9609
395	L	0							395	L	12	I=89,L=9475,F=2,V=1,Xaa=42	9609
396	L	0							396	L	5	I=5,L=9562,Xaa=42	9609
397	**V**	**35**	I35	I	V	1986	0,0022		397	I	29	R=2,N=5,I=9281,L=134,M=77,T=47,V=21,Xaa=42	9609
398	**D**	**3**	N2B1						398	D	39	A=1,N=28,D=8996,E=535,G=4,Y=4,Xaa=41	9609
399	G	0							399	G	10	D=8,G=9507,P=1,S=51,Xaa=42	9609
400	**T**	**2**	N2						400	T	11	A=79,K=1,P=1,T=9487,Xaa=41	9609
401	A	0							401	A	6	A=9553,P=1,S=1,T=1,V=13,Xaa=40	9609
402	S	0							402	S	7	A=26,P=1,S=9541,Xaa=41	9609
403	L	0							403	L	4	L=9568,Xaa=41	9609
404	S	0							404	S	5	R=1,N=1,Del=1,S=9562,T=2,Xaa=42	9609
405	P	0							405	P	4	Del=1,L=1,P=9566,Xaa=41	9609
406	G	0							406	G	4	Del=1,G=9566,V=1,Xaa=41	9609
407	M	0							407	M	5	R=1,Del=1,L=1,M=9562,T=1,V=2,Xaa=41	9609
408	M	0							408	M	5	R=1,I=3,L=2,M=9561,Xaa=42	9609
409	M	0							409	M	5	R=1,I=1,L=1,M=9562,T=2,Xaa=42	9609
410	G	0							410	G	4	G=9566,V=1,Xaa=42	9609
411	M	0							411	M	4	I=1,M=9564,T=2,Xaa=42	9609
412	F	0							412	F	4	I=1,L=1,F=9565,Xaa=42	9609
413	N	0							413	N	5	N=9559,D=2,H=1,S=2,T=3,Xaa=42	9609
414	M	0							414	M	5	I=1,L=1,M=9564,T=1,V=1,Xaa=41	9609
415	L	0							415	L	4	L=9568,F=1,Xaa=40	9609
416	S	0							416	S	4	R=1,S=9568,Xaa=40	9609
417	T	0							417	T	4	S=1,T=9568,Xaa=40	9609
418	V	0							418	V	4	I=2,Y=1,V=9567,Xaa=39	9609
419	L	0							419	L	4	C=1,L=9566,F=1,V=1,Xaa=40	9609
420	G	0							420	G	4	G=9569,Xaa=40	9609
421	V	0							421	V	4	I=2,V=9567,Xaa=40	9609
422	S	0							422	S	11	A=42,Q=1,L=2,F=1,P=1,S=9503,T=19,Xaa=40	9609
423	I	0							423	I	14	I=9440,L=1,T=1,V=127,Xaa=40	9609
424	L	0							424	L	4	L=9567,P=1,V=1,Xaa=40	9609
425	N	0							425	N	4	N=9565,I=1,K=1,S=2,Xaa=40	9609
426	L	0							426	L	5	I=12,L=9557,Xaa=40	9609
427	G	0							427	G	4	A=1,G=9567,W=1,Xaa=40	9609
428	Q	1	X1						428	Q	5	R=1,Q=9564,E=1,H=1,L=1,K=1,Xaa=40	9609
429	**R**	**1**	K1		Early marker - 1963		0,0062		429	K	10	R=60,N=3,Q=6,K=9502,Xaa=38	9609
430	K	0				1963	0,1114		430	R	56	R=8488,E=8,G=3,K=1070,S=1,T=1,Xaa=38	9609
431	Y	0							431	Y	7	C=3,H=26,S=1,Y=9543,Xaa=36	9609
432	T	0							432	T	5	A=1,N=1,I=4,P=1,S=2,T=9564,Xaa=36	9609
433	K	0							433	K	13	R=92,Q=14,E=1,K=9466,Xaa=36	9609
434	T	0							434	T	4	A=1,N=3,K=1,T=9568,Xaa=36	9609
435	T	0							435	T	8	A=5,I=28,M=3,P=1,S=5,T=9530,Xaa=37	9609
436	Y	0							436	Y	5	C=1,H=2,F=8,Y=9563,Xaa=35	9609
437	W	0							437	W	4	L=2,W=9572,Xaa=35	9609
438	W	0							438	W	4	R=3,G=1,W=9570,Xaa=35	9609
439	D	0							439	D	4	D=9574,E=2,Xaa=33	9609
440	G	0							440	G	3	E=1,G=9575,Xaa=33	9609
441	L	0							441	L	3	L=9578,Xaa=31	9609
442	Q	0							442	Q	4	R=1,Q=9573,L=1,P=2,Xaa=32	9609
443	S	0							443	S	3	P=1,S=9576,Xaa=32	9609
444	S	0							444	S	3	F=1,S=9575,Xaa=33	9609
445	D	0							445	D	4	N=2,D=9573,E=1,G=2,Xaa=31	9609
446	D	0							446	D	4	N=3,D=9575,Xaa=31	9609
447	F	0							447	F	3	L=1,F=9578,Xaa=30	9609
448	A	0							448	A	4	A=9570,G=1,T=6,V=2,Xaa=30	9609
449	L	0							449	L	4	I=1,L=9576,F=1,P=1,Xaa=30	9609
450	I	0							450	I	3	I=9577,M=2,V=1,Xaa=29	9609
451	V	0							451	V	13	G=1,I=14,L=74,M=12,V=9479,Xaa=29	9609
452	N	0							452	N	3	N=9577,D=1,Y=2,Xaa=29	9609
453	A	0							453	A	3	A=9579,E=1,Xaa=29	9609
454	**P**	**1**	S1						454	P	12	Q=20,L=34,P=9489,S=25,T=2,Xaa=39	9609
455	N	0							455	N	17	N=9428,D=60,G=1,S=81,T=1,Xaa=38	9609
456	**H**	**1**	Y1						456	H	16	R=11,N=9,Q=6,H=9440,L=1,P=1,Y=103,Xaa=38	9609
457	**E**	**12**	G12	E	G	2007-2008	0,0023		457	E	9	A=1,D=17,E=9527,G=22,K=4,Xaa=38	9609
458	G	0							458	G	5	E=9,G=9558,S=1,V=4,Xaa=37	9609
459	I	0							459	I	6	I=9549,M=1,V=23,Xaa=36	9609
460	Q	0							460	Q	5	R=3,Q=9567,E=1,K=2,P=2,Xaa=34	9609
461	A	0							461	A	3	A=9586,P=2,S=1,Xaa=20	9609
462	G	0							462	G	3	R=4,E=1,G=9585,Xaa=19	9609
463	**V**	**1**	I1						463	V	6	A=2,G=1,I=36,M=1,V=9550,Xaa=19	9609
464	D	0							464	D	10	A=1,N=81,D=9506,E=1,S=1,Xaa=19	9609
465	**R**	**2**	K2						465	R	4	R=9568,K=21,W=1,Xaa=19	9609
466	F	0							466	F	2	F=9590,S=1,Xaa=18	9609
467	Y	0							467	Y	2	F=1,Y=9590,Xaa=18	9609
468	R	0							468	R	3	R=9585,G=1,K=4,M=1,Xaa=18	9609
469	**T**	**2**	I2						469	T	4	A=7,I=9,S=2,T=9573,Xaa=18	9609
470	C	0							470	C	3	D=1,C=9587,G=1,S=1,W=2,Xaa=17	9609
471	K	0							471	K	2	E=1,K=9591,Xaa=17	9609
472	L	0							472	L	2	L=9589,M=2,V=1,Xaa=17	9609
473	V	0							473	V	7	A=3,I=34,L=8,V=9546,Xaa=18	9609
474	G	0							474	G	2	G=9592,Xaa=17	9609
475	I	0							475	I	2	I=9589,T=1,V=2,Xaa=17	9609
476	N	0							476	N	2	N=9588,D=1,I=2,Y=2,Xaa=16	9609
477	M	0							477	M	3	L=1,M=9587,T=2,V=3,Xaa=16	9609
478	S	0							478	S	3	R=1,N=6,S=9583,T=3,Xaa=16	9609
479	K	0							479	K	2	Q=2,E=1,K=9590,Xaa=16	9609
480	K	0							480	K	4	R=21,K=9572,Xaa=16	9609
481	K	0							481	K	2	N=1,E=1,K=9590,T=1,Xaa=16	9609
482	S	0							482	S	2	F=1,S=9591,Y=1,Xaa=16	9609
483	Y	0							483	Y	2	N=1,C=1,S=1,Y=9590,Xaa=16	9609
484	I	0							484	I	3	I=9580,L=3,M=8,V=1,Xaa=17	9609
485	N	0							485	N	2	N=9592,D=1,Xaa=16	9609
486	**R**	**1**	K1						486	R	8	R=9524,Q=1,G=1,L=1,K=64,P=1,Xaa=17	9609
487	T	0							487	T	2	A=2,R=1,P=1,T=9589,Xaa=16	9609
488	G	0							488	G	2	G=9593,Xaa=16	9609
489	T	0							489	T	2	T=9593,Xaa=16	9609
490	F	0							490	F	3	C=5,L=1,F=9586,Xaa=17	9609
491	E	0							491	E	2	D=1,E=9592,Xaa=16	9609
492	F	0							492	F	3	C=2,L=4,F=9584,S=3,Xaa=16	9609
493	T	0							493	T	2	T=9593,Xaa=16	9609
494	S	0							494	S	2	S=9592,T=1,Xaa=16	9609
495	F	0							495	F	2	L=1,F=9591,S=1,Xaa=16	9609
496	F	0							496	F	2	L=2,F=9590,Y=1,Xaa=16	9609
497	Y	0							497	Y	3	N=1,C=3,H=1,F=2,S=1,Y=9585,Xaa=16	9609
498	R	0							498	R	2	R=9588,C=2,H=2,P=1,Xaa=16	9609
499	Y	0							499	Y	3	N=1,H=4,F=1,Y=9586,Xaa=17	9609
500	G	0							500	G	2	G=9593,Xaa=16	9609
501	F	0							501	F	2	F=9593,Xaa=16	9609
502	V	0							502	V	3	I=6,V=9587,Xaa=16	9609
503	A	0							503	A	3	A=9582,P=2,S=9,Xaa=16	9609
504	N	0							504	N	2	N=9590,H=1,P=1,S=1,Xaa=16	9609
505	F	0							505	F	2	L=3,F=9589,S=1,Xaa=16	9609
506	S	0							506	S	2	S=9592,T=1,Xaa=16	9609
507	M	0							507	M	2	I=2,M=9590,T=1,Xaa=16	9609
508	E	0							508	E	2	D=2,E=9590,K=1,Xaa=16	9609
509	L	0							509	L	2	L=9592,F=1,Xaa=16	9609
510	P	0							510	P	2	A=1,P=9592,Xaa=16	9609
511	S	0							511	S	2	N=2,S=9591,Xaa=16	9609
512	F	0							512	F	3	L=9,F=9581,S=1,Y=2,Xaa=16	9609
513	G	0							513	G	2	Del=1,G=9593,Xaa=15	9609
514	V	0							514	V	2	A=1,Del=1,G=1,V=9592,Xaa=14	9609
515	S	0							515	S	8	A=26,Del=1,P=34,S=9533,Y=1,Xaa=14	9609
516	G	0							516	G	2	R=2,Del=1,G=9593,Xaa=13	9609
517	I	0							517	I	16	N=1,I=9407,T=15,V=173,Xaa=13	9609
518	N	0							518	N	1	N=9597,Y=1,Xaa=11	9609
519	E	0							519	E	2	D=1,E=9596,G=1,Xaa=11	9609
520	S	0							520	S	2	A=1,S=9595,T=1,Xaa=12	9609
521	A	0							521	A	2	A=9595,S=2,T=1,Xaa=11	9609
522	D	0							522	D	1	D=9598,Xaa=11	9609
523	M	0							523	M	3	I=13,L=2,M=9581,T=2,Xaa=11	9609
524	S	0							524	S	2	N=1,G=6,I=1,S=9589,Xaa=12	9609
525	I	0							525	I	6	I=9549,M=7,T=3,V=39,Xaa=11	9609
526	G	0							526	G	1	G=9598,Xaa=11	9609
527	**V**	**4**	M4						527	V	18	A=9,I=192,L=8,S=1,V=9388,Xaa=11	9609
528	**T**	**3**	A3						528	T	4	A=23,I=1,P=1,S=1,T=9572,Xaa=11	9609
529	V	0							529	V	3	I=2,L=3,M=5,V=9588,Xaa=11	9609
530	I	0							530	I	2	I=9592,L=1,M=1,V=4,Xaa=11	9609
531	K	0							531	K	5	R=33,E=1,K=9565,Xaa=10	9609
532	N	0							532	N	2	N=9595,D=1,S=2,T=2,Xaa=9	9609

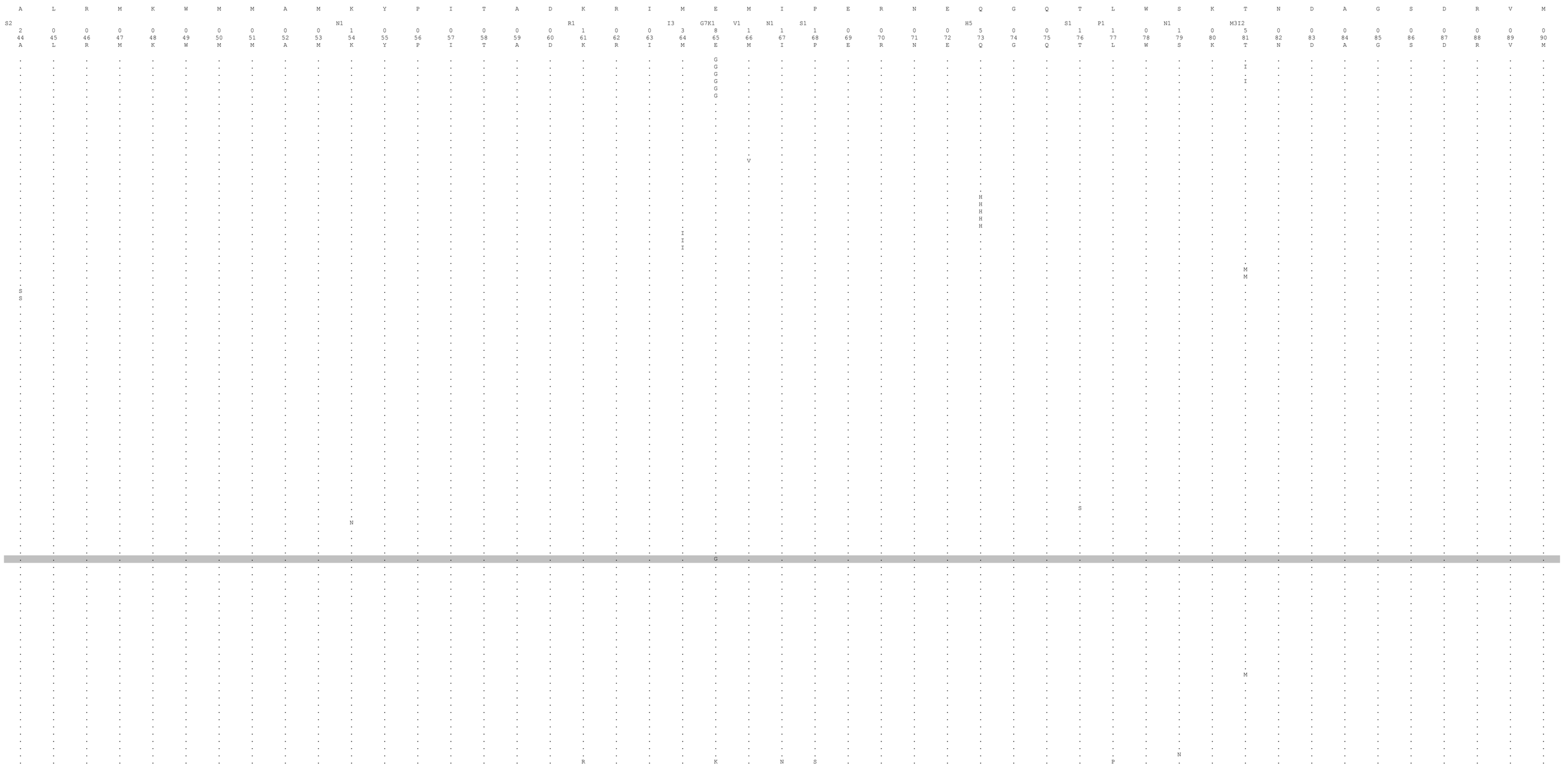
vmuc:
Not a marker
(>0.05)

533	N	0							533	N	2	N=9589,H=1,S=10,Xaa=9			9609
534	M	0							534	M	1	M=9599,V=1,Xaa=9			9609
535	I	0							535	I	5	I=9567,M=2,T=1,V=30,Xaa=9			9609
536	N	0							536	N	2	N=9594,D=3,H=1,K=1,T=1,Xaa=9			9609
537	N	0							537	N	2	N=9589,D=2,F=1,S=8,Xaa=9			9609
538	D	0							538	D	2	A=3,N=2,D=9592,E=1,G=2,Xaa=9			9609
539	L	0							539	L	1	H=1,L=9599,Xaa=9			9609
540	G	0							540	G	1	R=1,G=9599,Xaa=9			9609
541	P	0							541	P	1	P=9598,T=1,Xaa=10			9609
542	A	0							542	A	2	A=9595,S=2,T=2,Xaa=10			9609
543	T	0							543	T	1	A=1,T=9598,Xaa=10			9609
544	A	0							544	A	1	A=9597,G=1,S=1,Xaa=10			9609
545	Q	0							545	Q	1	Q=9598,H=1,Xaa=10			9609
546	M	0							546	M	1	M=9599,Xaa=10			9609
547	A	0							547	A	1	A=9597,G=1,T=1,Xaa=10			9609
548	L	0							548	L	1	I=1,L=9598,Xaa=10			9609
549	Q	0							549	Q	2	R=1,Q=9592,H=4,P=2,Xaa=10			9609
550	L	0							550	L	2	I=5,L=9590,M=3,P=1,Xaa=10			9609
551	F	0							551	F	1	F=9599,Xaa=10			9609
552	I	0							552	I	3	I=9581,S=1,T=2,V=15,Xaa=10			9609
553	K	0							553	K	2	R=6,Q=1,G=1,K=9591,Xaa=10			9609
554	D	0							554	D	1	D=9599,Xaa=10			9609
555	Y	0							555	Y	3	N=1,C=1,F=16,Y=9581,Xaa=10			9609
556	R	0							556	R	1	R=9597,Q=1,G=1,Xaa=10			9609
557	Y	0							557	Y	1	Y=9599,Xaa=10			9609
558	T	0							558	T	1	P=2,T=9597,Xaa=10			9609
559	Y	0							559	Y	1	F=1,Y=9597,Xaa=11			9609
560	R	0							560	R	2	R=9596,G=1,L=1,Xaa=11			9609
561	C	0							561	C	2	R=1,C=9594,G=2,W=1,Xaa=11			9609
562	H	0							562	H	2	H=9595,F=1,Y=2,Xaa=11			9609
563	R	0							563	R	2	R=9592,G=2,K=4,Xaa=11			9609
564	G	0							564	G	2	R=1,E=1,G=9589,S=7,Xaa=11			9609
565	D	0							565	D	2	N=6,D=9590,G=2,Xaa=11			9609
566	T	0							566	T	11	A=25,N=1,K=6,M=49,S=15,T=9503,Xaa=10			9609
567	Q	0							567	Q	9	R=5,N=1,Q=9525,H=52,I=1,K=14,P=1,Xaa=10			9609
568	I	0							568	I	4	I=9580,L=4,T=6,V=9,Xaa=10			9609
569	**Q**	**1**	L1						569	Q	3	R=2,Q=9584,H=4,L=3,K=2,P=4,Xaa=10			9609
570	T	0							570	T	1	A=2,T=9597,Xaa=10			9609
571	R	0							571	R	5	R=9557,G=4,K=38,Xaa=10			9609
572	R	0							572	R	1	R=9597,K=2,Xaa=10			9609
573	S	0							573	S	17	A=213,S=9384,T=2,Xaa=10			9609
574	F	0							574	F	2	L=2,F=9595,S=1,V=1,Xaa=10			9609
575	E	0							575	E	1	E=9598,K=1,Xaa=10			9609
576	L	0							576	L	10	I=67,L=9502,M=30,Xaa=10			9609
577	**K**	**1**	R1						577	K	15	R=148,N=7,E=10,K=9430,T=4,Xaa=10			9609
578	**K**	**4**	I4						578	K	12	R=102,N=1,E=5,G=3,K=9483,S=5,Xaa=10			9609
579	L	0							579	L	3	I=2,L=9584,M=13,Xaa=10			9609
580	W	0							580	W	1	G=1,W=9598,Xaa=10			9609
581	**E**	**3**	K2D1						581	E	11	D=80,E=9496,G=11,K=13,Xaa=9			9609
582	Q	0							582	Q	3	R=1,Q=9584,H=6,K=8,P=1,Xaa=9			9609
583	T	0							583	T	9	A=4,I=7,P=1,S=78,T=9510,Xaa=9			9609
584	**R**	**11**	Q9K2						584	R	27	R=9214,N=1,C=3,Q=17,H=360,L=5,Xaa=9			9609
585	S	0							585	S	2	P=2,S=9597,T=1,Xaa=9			9609
586	K	0							586	K	10	R=104,Q=1,K=9493,M=1,T=1,Xaa=9			9609
587	**T**	**8**	A8	A	T		1975	0,0070	587	A	11	A=9500,P=3,S=13,T=67,V=17,Xaa=9			9609
588	G	0							588	G	2	R=2,E=1,G=9597,Xaa=9			9609
589	**L**	**1**	I1						589	L	1	L=9599,P=1,Xaa=9			9609
590	L	0							590	L	1	L=9599,M=1,Xaa=9			9609
591	**V**	**2**	A2						591	V	13	G=1,I=157,V=9442,Xaa=9			9609
592	S	0							592	S	15	A=176,P=2,S=9421,Xaa=10			9609
593	D	0							593	D	100	N=2,D=5650,Del=3943,G=1,Y=3,Xaa=10			9609
594	G	0							594	G	1	G=9600,Xaa=9			9609
595	G	0							595	G	2	R=3,G=9596,Xaa=10			9609
596	P	0							596	P	2	L=1,P=9591,S=6,T=1,Xaa=10			9609
597	N	0							597	N	2	N=9596,D=1,I=1,K=1,Xaa=10			9609
598	L	0							598	L	3	I=1,L=9584,P=11,S=2,Xaa=11			9609
599	Y	0							599	Y	2	H=1,F=3,Y=9595,Xaa=10			9609
600	N	0							600	N	2	N=9591,D=2,H=3,I=1,S=2,Xaa=10			9609
601	I	0							601	I	3	I=9584,L=2,T=2,V=11,Xaa=10			9609
602	R	0							602	R	1	R=9599,W=1,Xaa=9			9609
603	N	0							603	N	1	N=9600,Xaa=9			9609
604	L	0							604	L	3	I=1,L=9588,F=10,P=1,Xaa=9			9609
605	H	0							605	H	2	N=1,D=1,H=9596,P=2,Xaa=9			9609
606	I	0							606	I	4	I=9577,L=8,V=15,Xaa=9			9609
607	P	0							607	P	2	Q=4,L=1,P=9590,S=4,T=1,Xaa=9			9609
608	E	0							608	E	2	R=1,E=9594,K=4,Y=2,Xaa=8			9609
609	V	0							609	V	6	A=41,I=8,S=3,V=9549,Xaa=8			9609
610	C	0							610	C	5	R=1,C=9567,G=30,F=1,Y=2,Xaa=8			9609
611	L	0							611	L	2	L=9590,M=4,S=5,V=1,Xaa=9			9609
612	K	0							612	K	1	N=3,K=9598,Xaa=8			9609
613	W	0							613	W	1	R=1,W=9598,Xaa=10			9609
614	**E**	**1**	G1						614	E	6	A=1,D=18,E=9558,G=18,K=4,V=1,Xaa=9			9609
615	L	0							615	L	2	Q=1,I=3,L=9595,P=1,S=1,Xaa=8			9609
616	M	0							616	M	2	M=9597,T=1,V=3,Xaa=8			9609
617	D	0							617	D	1	D=9600,G=1,Xaa=8			9609
618	**E**	**13**	D11	E	D		2007	0,0102	618	E	21	R=2,N=1,D=98,E=9377,G=41,K=39,V=44,Xaa=7			9609
619	**D**	**1**	G1						619	D	17	N=25,D=9414,E=149,G=12,H=1,Y=1,Xaa=7			9609
620	Y	0							620	Y	1	Y=9603,Xaa=6			9609
621	**K**	**19**	R12Q7	Q	K	K1975; 2005R; 2007RK		0,0152	621	Q	27	R=206,Q=9251,K=146,Xaa=6			9609
622	G	0							622	G	3	A=1,R=3,D=1,E=2,G=9585,S=11,Xaa=6			9609
623	R	0							623	R	1	R=9601,K=2,Xaa=6			9609
624	L	0							624	L	2	I=7,L=9593,M=1,V=2,Xaa=6			9609
625	C	0							625	C	1	C=9601,S=2,Xaa=6			9609
626	N	0							626	N	2	N=9595,H=6,S=3,Xaa=5			9609
627	P	0							627	P	2	L=1,P=9594,S=6,T=3,Xaa=5			9609
628	L	0							628	L	23	N=2,Q=25,I=1,L=9290,M=283,P=2,S=1,Xaa=5			9609
629	N	0							629	N	1	N=9603,S=1,Xaa=5			9609
630	P	0							630	P	1	P=9603,T=1,Xaa=5			9609
631	F	0							631	F	1	L=1,F=9603,Xaa=5			9609
632	**V**	**1**	I1						632	V	4	A=9,I=19,V=9576,Xaa=5			9609
633	S	0							633	S	18	N=91,C=4,G=6,S=9405,T=98,Xaa=5			9609
634	H	0							634	H	2	N=1,Q=4,H=9594,L=1,P=3,Y=1,Xaa=5			9609
635	K	0							635	K	10	R=107,N=2,E=2,K=9491,T=1,Xaa=6			9609
636	E	0							636	E	2	Q=1,E=9589,G=13,K=1,Xaa=5			9609
637	I	0							637	I	109	A=2,Del=3943,I=5534,L=15,M=8,F=3,V=99,Xaa=5			9609
638	**E**	**1**	D1						638	E	18	N=1,D=240,E=9358,K=6,Xaa=4			9609
639	S	0							639	S	1	A=7,S=9598,Xaa=4			9609
640	**V**	**1**	M1						640	V	8	A=9,I=32,L=16,M=9,T=1,V=9538,Xaa=4			9609
641	N	0							641	N	1	A=2,N=9601,D=1,H=1,S=2,T=1,Xaa=1			9609
642	**S**	**3**	N3			Early marker - 1963		0,0355	642	N	23	N=9262,H=1,I=1,S=341,T=1,Y=2,Xaa=1			9609
643	A	0							643	A	2	A=9595,D=1,T=10,V=2,Xaa=1			9609
644	**V**	**4**	I4						644	V	27	A=4,E=1,I=364,M=30,T=1,V=9208,Xaa=1			9609
645	V	0							645	V	3	A=3,I=9,M=13,T=1,V=9581,Xaa=2			9609
646	M	0							646	M	4	R=1,I=8,L=12,M=9573,T=5,V=9,Xaa=1			9609
647	**P**	**1**	S1						647	P	3	Q=3,L=2,P=9589,S=10,T=4,Xaa=1			9609
648	A	0							648	A	7	A=9534,S=57,T=9,V=8,Xaa=1			9609
649	H	0							649	H	0	Q=2,H=9606,Xaa=1			9609
650	G	0							650	G	0	G=9608,Xaa=1			9609
651	P	0							651	P	0	L=1,P=9607,Xaa=1			9609
652	A	0							652	A	5	A=9563,P=1,S=27,T=11,V=6,Xaa=1			9609
653	K	0							653	K	3	R=18,N=1,K=9587,M=1,Xaa=2			9609
654	**S**	**2**	N2						654	S	24	A=65,N=165,C=1,G=30,I=4,S=9328,T=15,Xaa=1			9609
655	M	0							655	M	13	I=100,L=4,M=9462,T=11,V=31,Xaa=1			9609
656	E	0							656	E	0	D=1,E=9606,K=1,Xaa=1			9609
657	Y	0							657	Y	0	F=2,Y=9606,Xaa=1			9609
658	D	0							658	D	1	D=9604,E=3,Xaa=2			9609
659	A	0							659	A	1	A=9603,D=1,G=1,T=1,V=1,Xaa=2			9609
660	V	0							660	V	3	A=3,I=24,F=3,V=9578,Xaa=1			9609
661	A	0							661	A	2	A=9597,G=1,T=9,V=1,Xaa=1			9609
662	T	0							662	T	1	N=2,S=2,T=9604,Xaa=1			9609
663	T	0							663	T	0	S=1,T=9607,Xaa=1			9609
664	H	0							664	H	0	Q=1,H=9606,L=1,Xaa=1			9609
665	S	0							665	S	1	F=1,P=2,S=9605,Xaa=1			9609
666	W	0							666	W	0	G=1,W=9607,Xaa=1			9609
667	**I**	**2**	V2						667	I	35	A=10,I=9135,L=23,F=1,S=1,T=123,V=314,Xaa=2			9609
668	**P**	**1**	S1						668	P	1	L=1,P=9598,S=9,Xaa=1			9609
669	K	0							669	K	0	K=9608,Xaa=1			9609
670	R	0							670	R	1	R=9603,G=3,K=1,Xaa=2			9609
671	N	0							671	N	0	N=9608,Xaa=1			9609
672	R	0							672	R	0	R=9608,Xaa=1			9609
673	S	0							673	S	0	F=1,S=9607,Xaa=1			9609
674	I	0							674	I	2	I=9594,V=14			9608
675	L	0							675	L	1	H=1,I=3,L=9603,Xaa=1			9608
676	N	0							676	N	0	N=9605,K=1,T=1,Y=1			9608
677	T	0							677	T	0	A=1,S=1,T=9606			9608
678	S	0							678	S	3	R=1,N=12,C=5,G=4,I=1,S=9585			9608
679	Q	0							679	Q	1	Q=9602,H=4,K=1,S=1			9608
680	R	0							680	R	2	R=9591,K=17			9608
681	G	0							681	G	0	G=9608			9608

682	**I**	**1**	V1					682	I	5	I=9552,T=4,V=52		9608
683	L	0						683	L	2	E=1,I=13,L=9593,Xaa=1		9608
684	E	0						684	E	1	A=1,E=9604,K=2,V=1		9608
685	D	0						685	D	1	N=1,D=9602,E=1,G=1,Y=2,Xaa=1		9608
686	E	0						686	E	1	A=1,D=2,E=9604,Xaa=1		9608
687	Q	0						687	Q	5	R=19,Q=9567,H=7,L=3,K=12		9608
688	M	0						688	M	2	I=4,L=1,M=9596,V=7		9608
689	Y	0						689	Y	0	D=1,C=1,H=1,Y=9605		9608
690	Q	0						690	Q	3	R=9,Q=9583,H=2,K=14		9608
691	K	0						691	K	4	R=32,N=2,E=2,K=9569,Xaa=3		9608
692	C	0						692	C	0	C=9608		9608
693	C	0						693	C	0	C=9605,Y=3		9608
694	N	0						694	N	50	N=8673,D=2,H=1,I=7,S=877,T=47,Y=1		9608
695	L	0						695	L	2	Q=1,H=1,I=11,L=9594,V=1		9608
696	F	0						696	F	1	I=1,L=2,F=9604,S=1		9608
697	**E**	**1**	G1					697	E	1	E=9603,G=1,V=1,Xaa=3		9608
698	K	0						698	K	2	R=4,N=2,E=3,K=9595,T=4		9608
699	F	0						699	F	0	L=1,F=9606,Y=1		9608
700	F	0						700	F	0	L=1,F=9606,S=1		9608
701	P	0						701	P	0	P=9608		9608
702	**S**	**2**	G2					702	S	0	R=1,S=9607		9608
703	S	0						703	S	1	C=2,G=4,S=9602		9608
704	S	0						704	S	0	L=1,P=1,S=9605,T=1		9608
705	Y	0						705	Y	0	C=1,Y=9607		9608
706	R	0						706	R	1	R=9600,G=1,K=7		9608
707	R	0						707	R	0	R=9606,G=1,K=1		9608
708	P	0						708	P	0	P=9608		9608
709	V	0						709	V	3	I=32,V=9576		9608
710	G	0						710	G	0	R=1,G=9607		9608
711	I	0						711	I	1	I=9604,L=1,V=3		9608
712	S	0						712	S	0	C=1,S=9605,Y=2		9608
713	S	0						713	S	1	R=1,I=2,S=9600,T=5		9608
714	M	0						714	M	1	R=1,I=1,K=1,M=9604,V=1		9608
715	V	0						715	V	10	A=6,G=32,L=1,M=60,V=9509		9608
716	E	0						716	E	1	D=5,Q=1,E=9600,G=2		9608
717	A	0						717	A	2	A=9588,S=20		9608
718	**M**	**1**	V1					718	M	0	I=2,M=9606		9608
719	**V**	**1**	M1					719	V	15	A=5,I=45,L=5,M=120,V=9433		9608
720	S	0						720	S	2	F=12,S=9594,Y=1,Xaa=1		9608
721	R	0						721	R	1	R=9604,K=2,S=1,T=1		9608
722	A	0						722	A	1	A=9597,G=8,S=1,T=1,V=1		9608
723	R	0						723	R	2	R=9595,Q=10,G=1,P=1,Xaa=1		9608
724	I	0						724	I	0	I=9604,T=2,Xaa=1		9607
725	D	0						725	D	0	N=1,D=9604,Y=2		9607
726	A	0						726	A	1	A=9600,P=1,S=4,T=1,V=1		9607
727	R	0						727	R	0	R=9606,P=1		9607
728	I	0						728	I	8	I=9531,L=2,T=38,V=36		9607
729	D	0						729	D	1	N=1,D=9601,E=2,G=1,V=2		9607
730	F	0						730	F	2	L=3,F=9595,S=7,V=2		9607
731	E	0						731	E	1	D=4,Q=1,E=9598,G=1,H=1,K=2		9607
732	S	0						732	S	1	A=5,P=1,S=9600,T=1		9607
733	G	0						733	G	1	R=4,E=6,G=9597		9607
734	R	0						734	R	1	R=9597,Q=3,K=5,T=1,W=1		9607
735	I	0						735	I	5	I=9565,M=7,T=6,V=29		9607
736	K	0						736	K	8	R=42,N=12,Del=1,Q=1,E=12,K=9536,M=1,T=1,Xaa=1		9607
737	K	0						737	K	6	R=47,N=3,Q=5,E=4,L=1,K=9545,T=2		9607
738	**E**	**42**	D42	E	D	1997	0,0017	738	E	6	A=3,D=16,Q=8,E=9552,G=21,I=1,K=5,V=1		9607
739	E	0						739	E	8	D=39,E=9533,G=7,K=26,S=1,V=1		9607
740	F	0						740	F	3	C=2,L=13,F=9579,S=1,Y=11,V=1		9607
741	**A**	**4**	T3S1					741	A	15	A=9435,N=2,G=2,S=33,T=123,V=12		9607
742	E	0						742	E	2	D=1,E=9593,K=12,Xaa=1		9607
743	I	0						743	I	1	I=9596,M=1,T=3,V=6,Xaa=1		9607
744	M	0						744	M	32	A=4,I=141,L=142,K=1,M=9221,T=69,V=28,Xaa=1		9607
745	K	0						745	K	10	R=43,Q=1,E=56,G=1,K=9501,M=1,T=3,Xaa=1		9607
746	I	0						746	I	11	I=9465,F=1,T=140,V=1		9607
747	C	0						747	C	0	R=2,C=9604,S=1		9607
748	S	0						748	S	6	A=1,C=9,F=20,P=2,S=9555,T=4,Y=15,V=1		9607
749	T	0						749	T	2	A=2,I=1,P=3,S=4,T=9596,Xaa=1		9607
750	I	0						750	I	1	I=9602,L=1,M=1,T=2,Xaa=1		9607
751	E	0						751	E	2	A=1,E=9594,G=3,K=9		9607
752	**E**	**2**	G1K1					752	E	5	A=3,D=12,E=9565,G=13,K=13,V=1		9607
753	**L**	**3**	F3					753	L	6	H=4,I=14,L=9552,F=21,P=4,V=12		9607
754	R	0						754	R	10	R=9505,Q=1,E=2,G=65,K=34		9607
755	R	0						755	R	1	R=9600,Q=4,P=3		9607
756	Q	0						756	Q	32	R=48,Q=9159,E=1,H=29,L=3,K=2,P=361,S=2,Xaa=1		9606
757	K	0						757	K	28	R=148,N=79,Q=27,E=6,G=49,I=2,K=9282,M=1,S=1,T=8		9603
								758	Q	83	R=20,N=1,Q=489,K=45,S=2,W=12,Y=1		570

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

| | | |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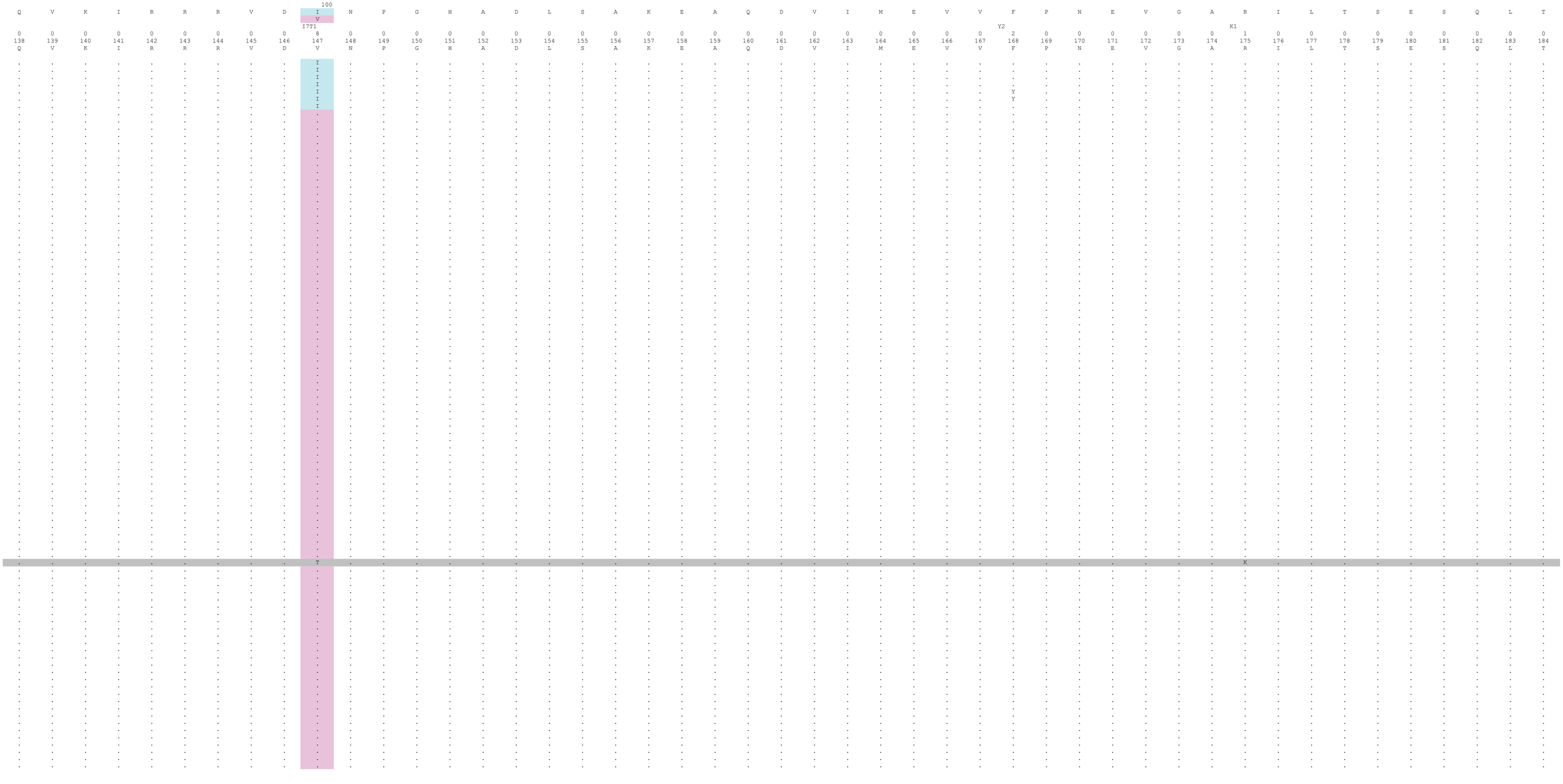
S2 N1 R1 I3 G7K1 V1 N1 S1 H5 S1 P1 N1 M3I2
2 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 0 0 3 8 1 1 1 0 0 0 5 1 0 0 5 0 0 0 0 0 0 0 0 0
44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
A L R M K W M M A M K Y P I T A D K R I M E M I P E R N E Q G Q T L W S K T N D A G S D R V M
G
G I
G I
G
G
G
V
H
H
H
H
I
I
I
M
M
S
S
N
G
R K N S P
M
N


72 98
V S P L A V T W W N R N G P T T S T V H Y P K V Y K T Y F E K V E R L K H G T F G P V H F R N
A I
A13 A2 V9 R1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 13 2 0 0 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137
V S P L A V T W W N R N G P T T S T I H Y P K V Y K T Y F E K V E R L K H G T F G P V H F R N


100
I
V
I7T1
Y2
K1
Q V K I R R R V D I N P G H A D L S A K E A Q D V I M E V V F P N E V G A R I L T S E S Q L T
0 0 0 0 0 0 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184
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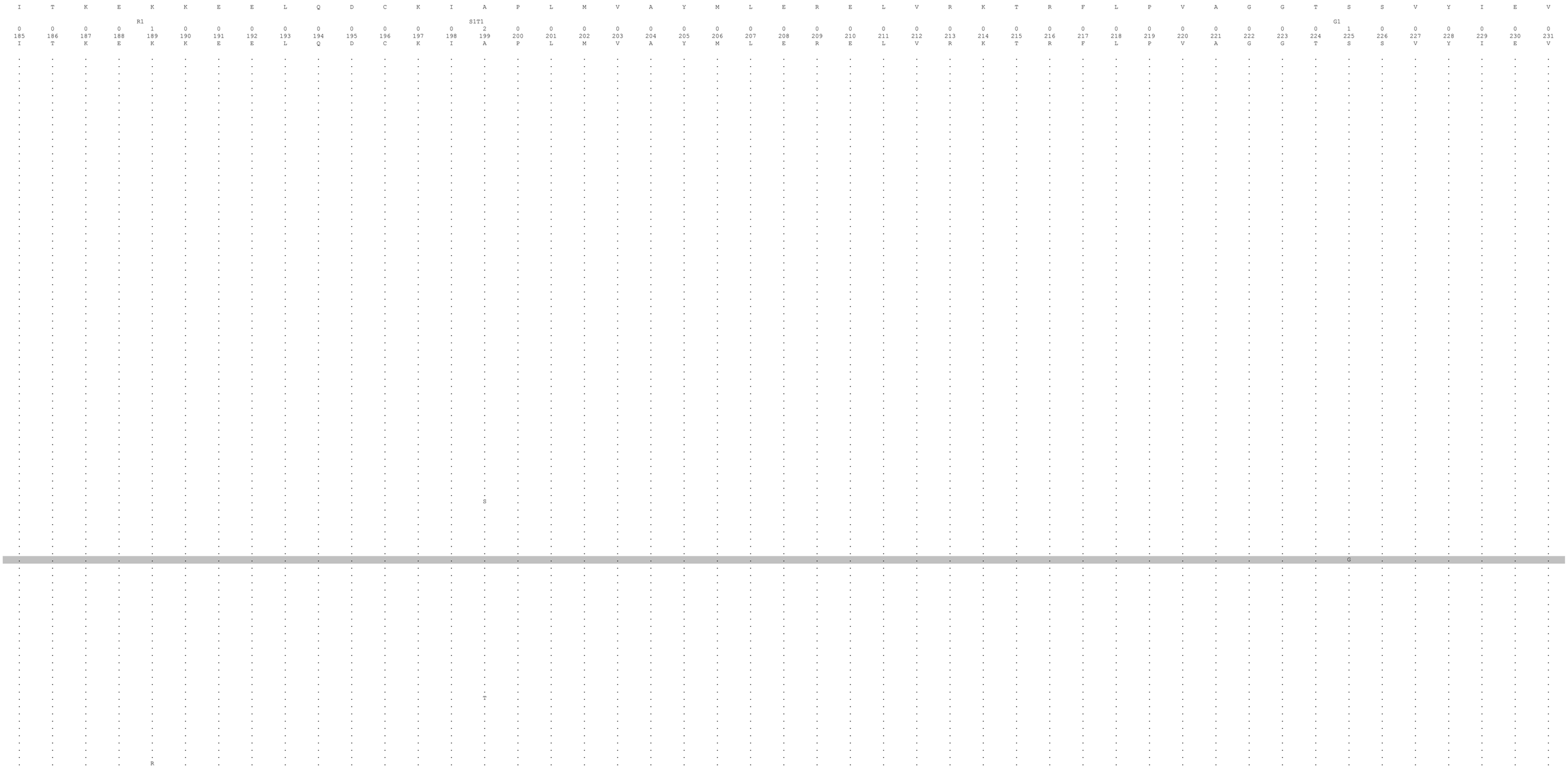
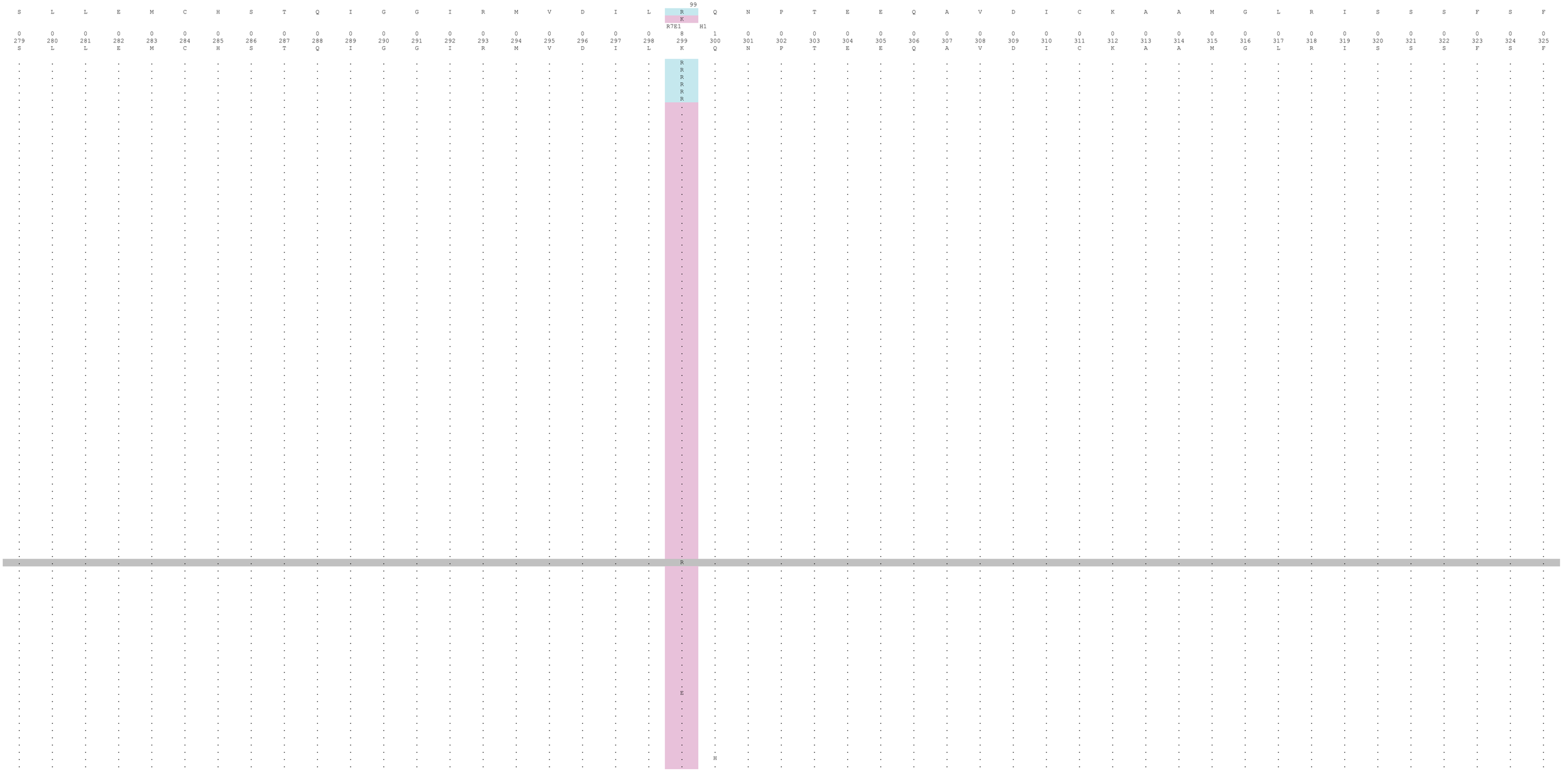
T
K


I T K E K K E E L Q D C K I A P L M V A Y M L E R E L V R K T R F L P V A G G T S S V Y I E V
R1
S1T1
G1
0 0 0 0 1 0 0 0 0 0 0 0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0
185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231
I T K E K K E E L Q D C K I A P L M V A Y M L E R E L V R K T R F L P V A G G T S S V Y I E V
S
T
R

72
L H L T Q G T C W E Q M Y T P G G E V R N D D V D Q S L I I A A R N I V R R A T V S A D P L A
K
K2 K14 V8 K2 A1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 14 0 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0 2 0 0 1 0 0 0 0 0 0 0
232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278
L H L T Q G T C W E Q M Y T P G G E V R N D D I D Q S L I I A A R N I V R R A T V S A D P L A


S L L E M C H S T Q I G G I R M V D I L R K 99
R7E1 H1
Q N P T E E Q A V D I C K A A M G L R I S S S F S F
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0 280 L
0 281 L
0 282 E
0 283 M
0 284 C
0 285 H
0 286 S
0 287 T
0 288 Q
0 289 I
0 290 G
0 291 G
0 292 I
0 293 R
0 294 M
0 295 V
0 296 D
0 297 I
0 298 L
8 299 K
1 300 Q
0 301 N
0 302 P
0 303 T
0 304 E
0 305 E
0 306 Q
0 307 A
0 308 V
0 309 D
0 310 I
0 311 C
0 312 K
0 313 A
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0 320 S
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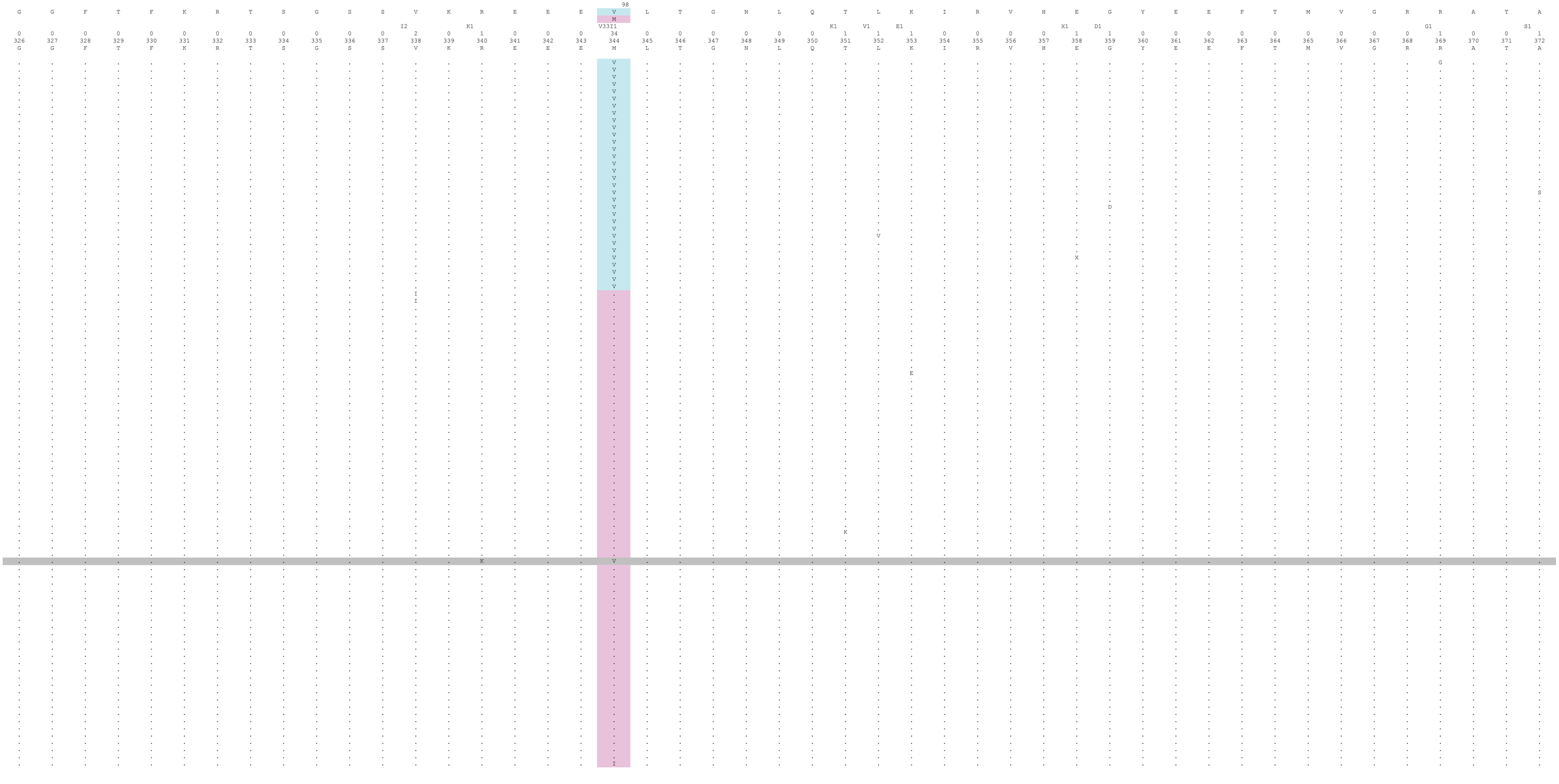
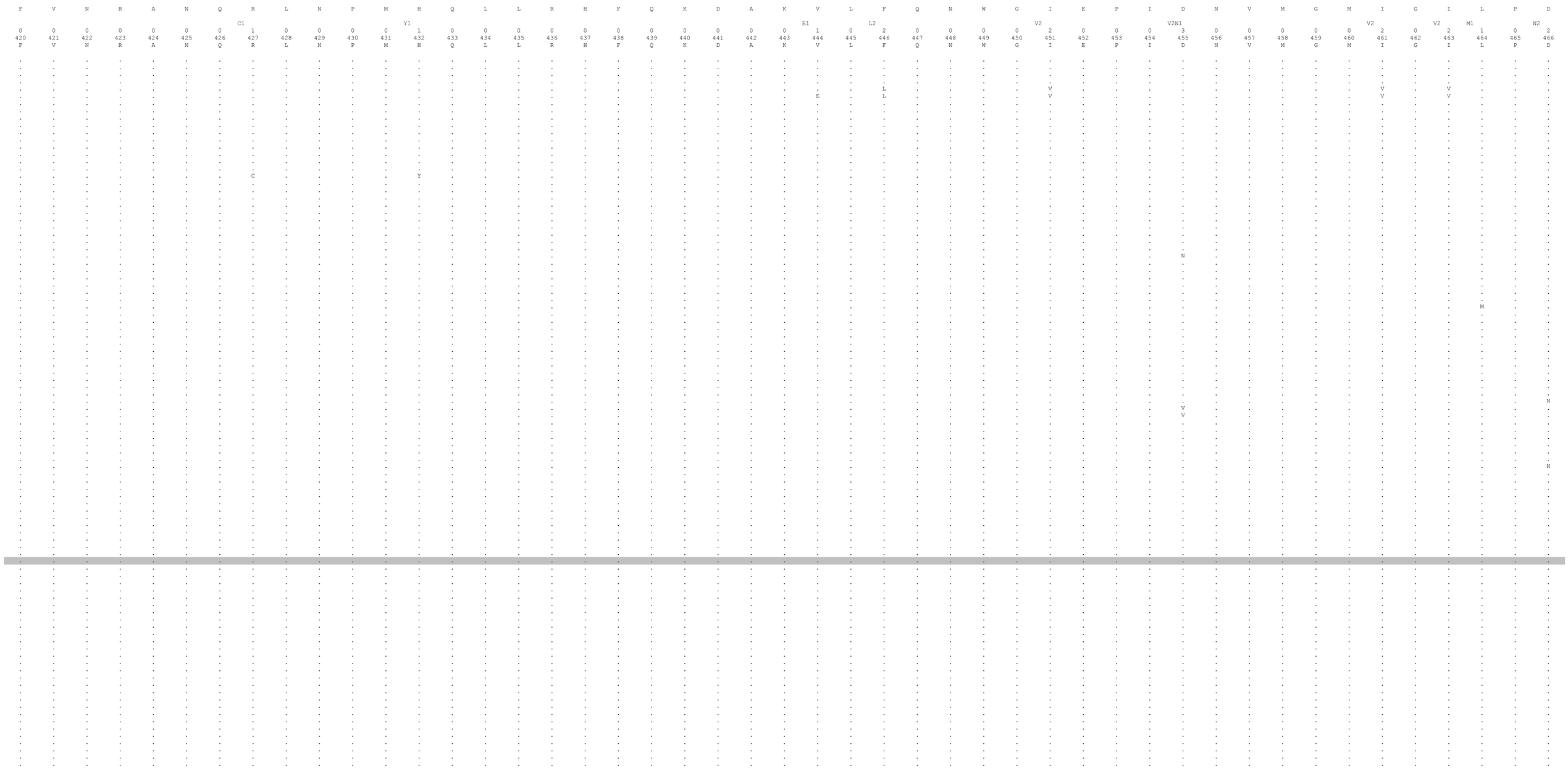
0 323 F
0 324 S
0 325 F




I L R K A T R R L I Q L I V S G R D E Q S I A E A I I V A M V F S Q E D C M I K A V R G D L N
T14E4V3 I1N1P1 K2 K4S3G1 F2S1 I4 V10 N2 I1 V8 A1 Q1
0 0 0 0 21 3 2 8 0 3 0 0 0 4 0 0 0 0 0 0 0 0 0 0 0 0 0 10 0 0 0 0 0 0 0 0 0 0 0 2 0 1 8 0 0 1 1 0 0 0 0
373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419
I L R K A T R R L I Q L I V S G R D E Q S I A E A I I V A M V F S Q E D C M I K A V R G D L N


F V N R A N Q R L N P M H Q L L R H F Q K D A K V L F Q N W G I E P I D N V M G M I G I L P D
C1 Y1 E1 L2 V2 V2N1 V2 V2 M1 N2
0 0 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 0 0 1 0 2 0 0 0 0 0 3 0 0 0 0 0 0 2 2 1 0 2
420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466
F V N R A N Q R L N P M H Q L L R H F Q K D A K V L F Q N W G I E P I D N V M G M I G I L P D
C Y E L L V V N V V M M
V V N
N
M
N
N


100
M T P S T E M S L R G I R V S K M G V D E Y S S T E R V V V S I D R F L R V R D Q R G N V L L
I
L1 I1 I2 Q1 H1 M2 C1S1 K2 H2 V31
1 0 0 0 0 0 0 0 0 0 0 1 0 2 0 1 0 0 0 0 0 1 0 0 0 0 0 0 2 0 0 0 0 0 2 0 2 0 0 0 2 0 0 0 31 0 0
467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513
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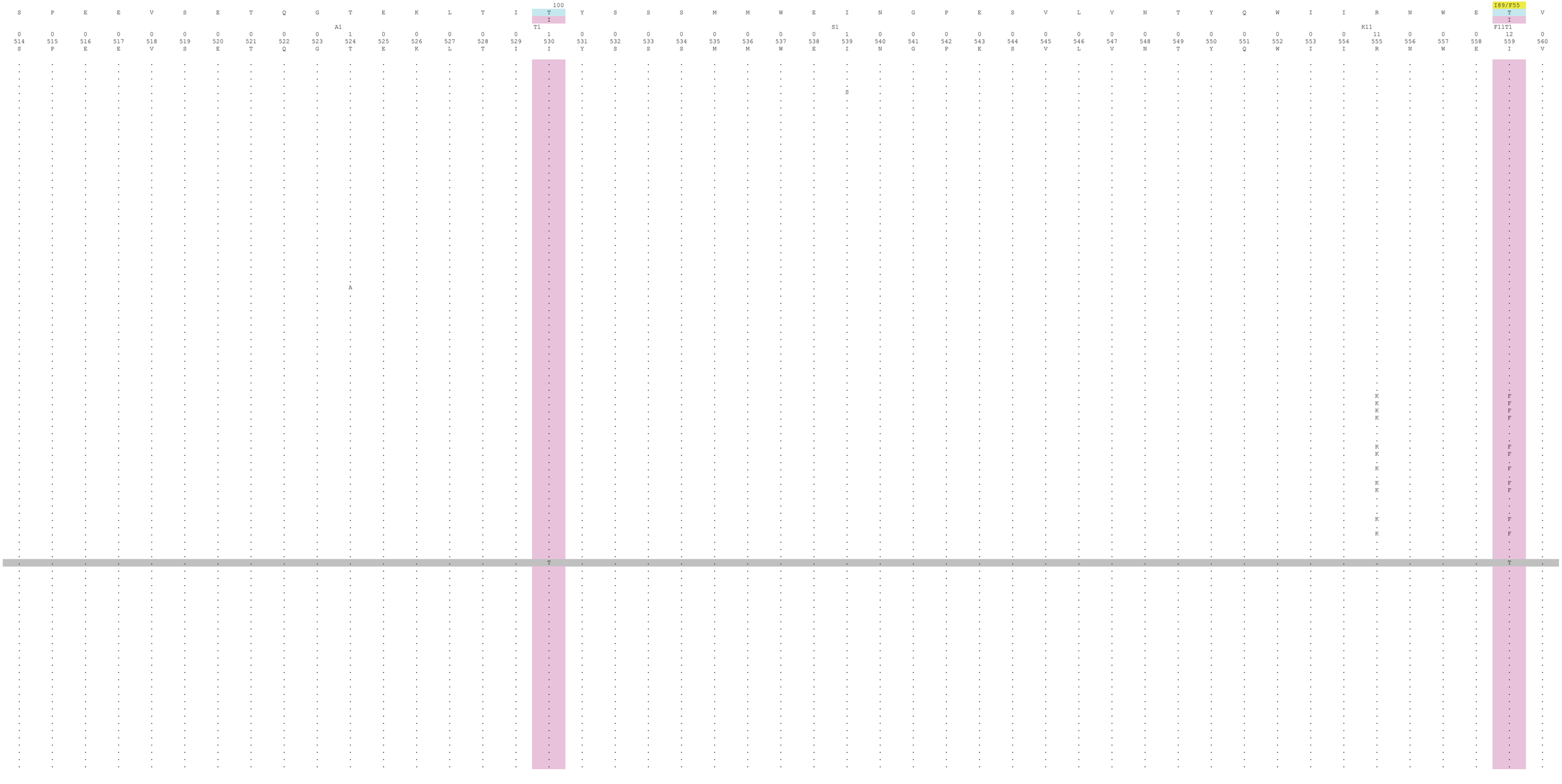
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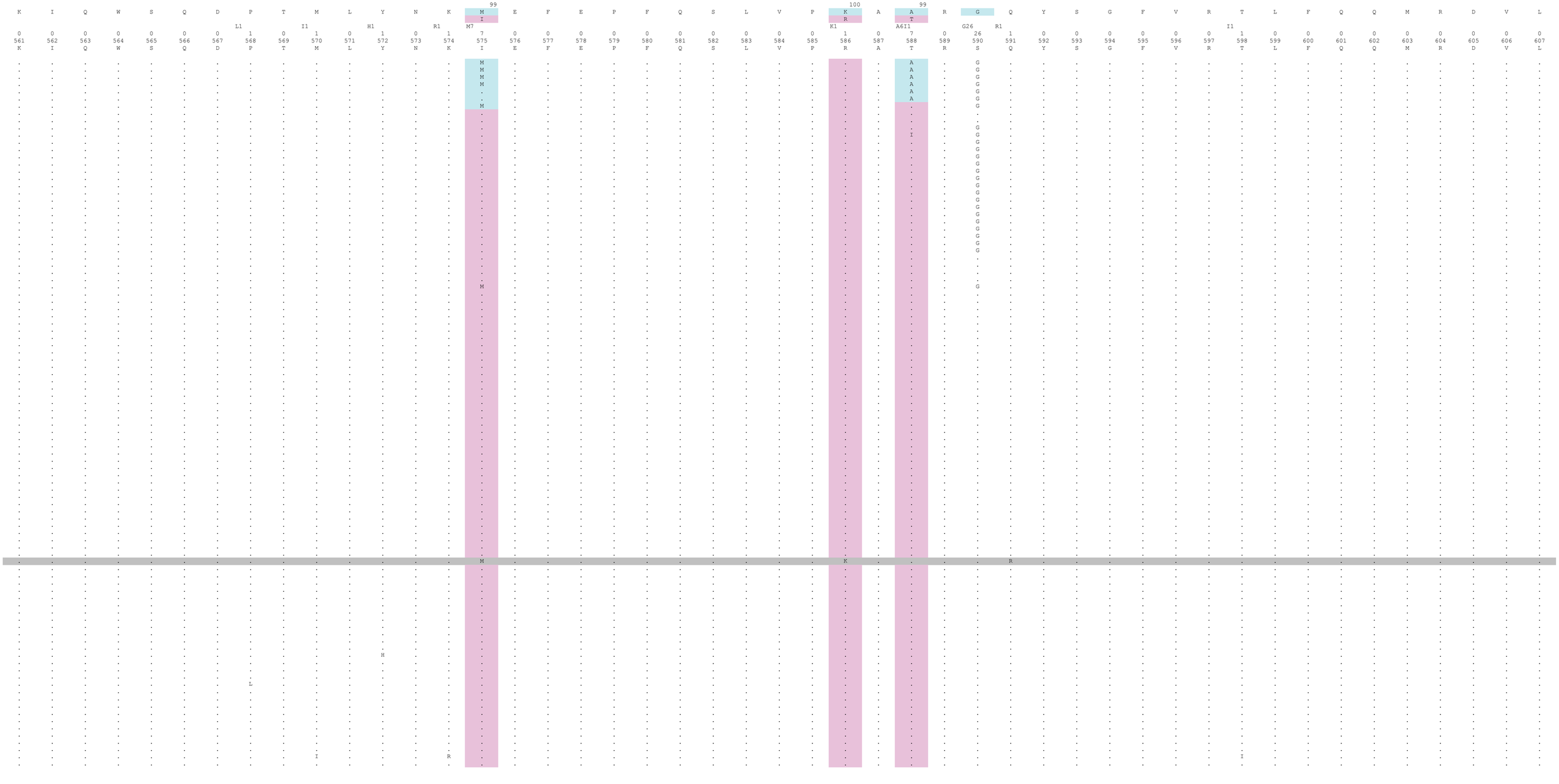
T
I
A1
T1
S1
K11
I89/F55
T
I
F11T1


K I Q W S Q D P T M L Y N K M I E F E P F Q S L V P K R A A T R G Q Y S G F V R T L F Q Q M R D V L
99
100
99
L1 I1 H1 R1 M7 K1 A6I1 G26 R1 I1
0 0 0 0 0 0 0 1 0 1 0 1 0 1 0 7 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 7 0 26 1 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0
561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607
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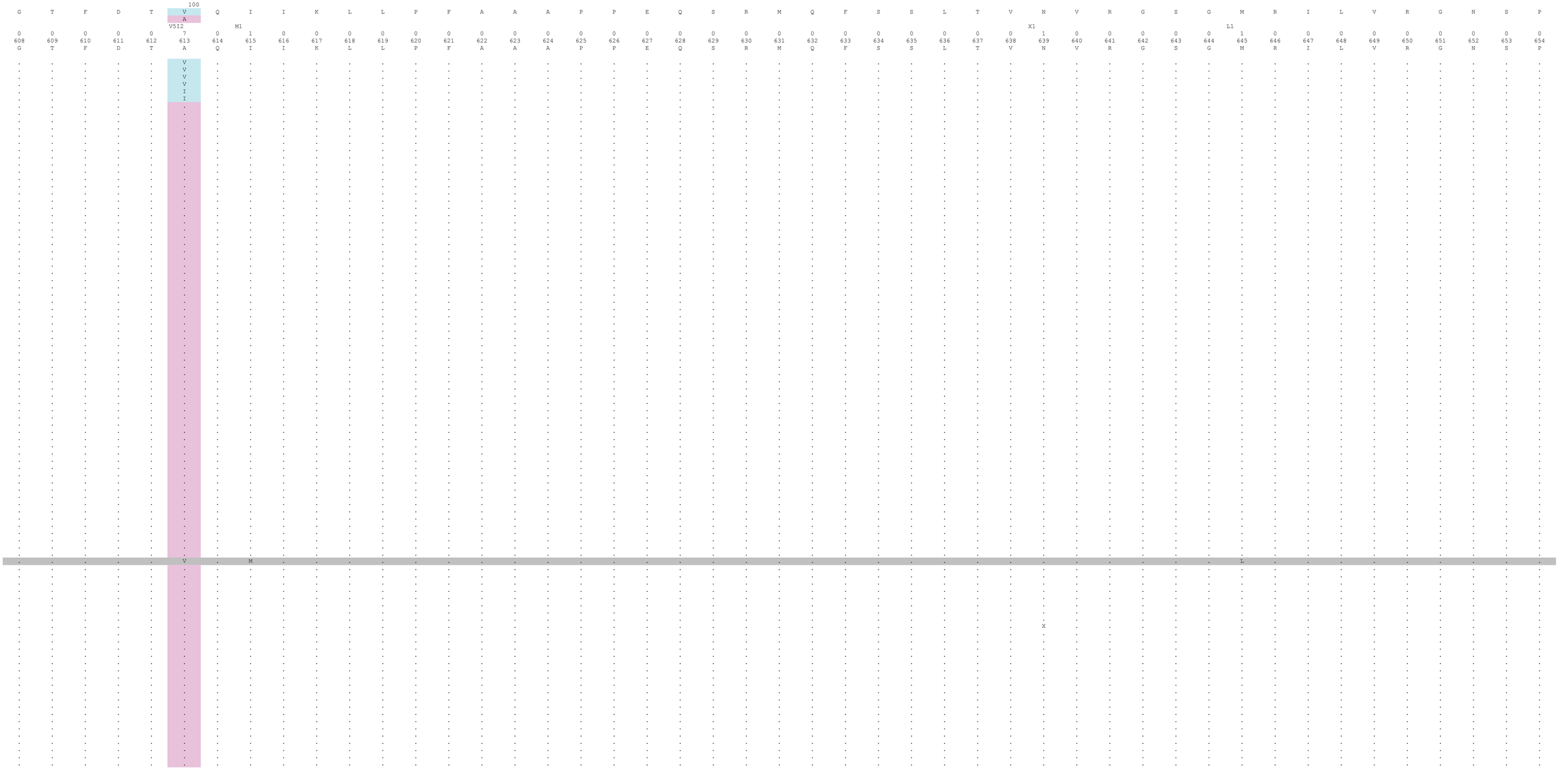
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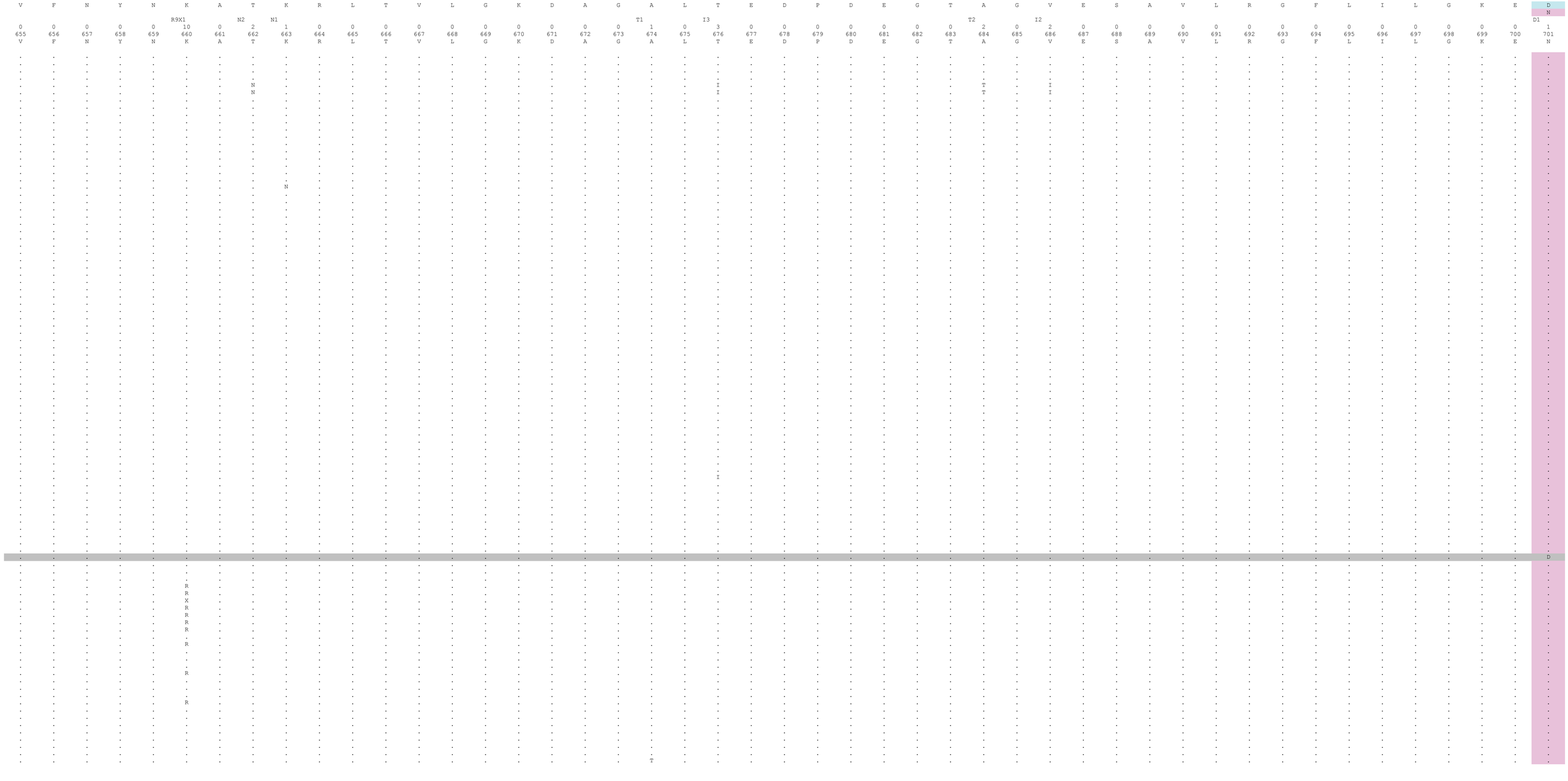
V5I2
M1
X1
L1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D
N
R9X1
N2
N1
T1
I3
T2
I2
D1
V F N Y N K A T K R L T V L G K D A G A L T E D P D E G T A G V E S A V L R G F L I L G K E
0 0 0 0 0 10 0 2 1 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1
655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701
V F N Y N K A T K R L T V L G K D A G A L T E D P D E G T A G V E S A V L R G F L I L G K E N
N
I
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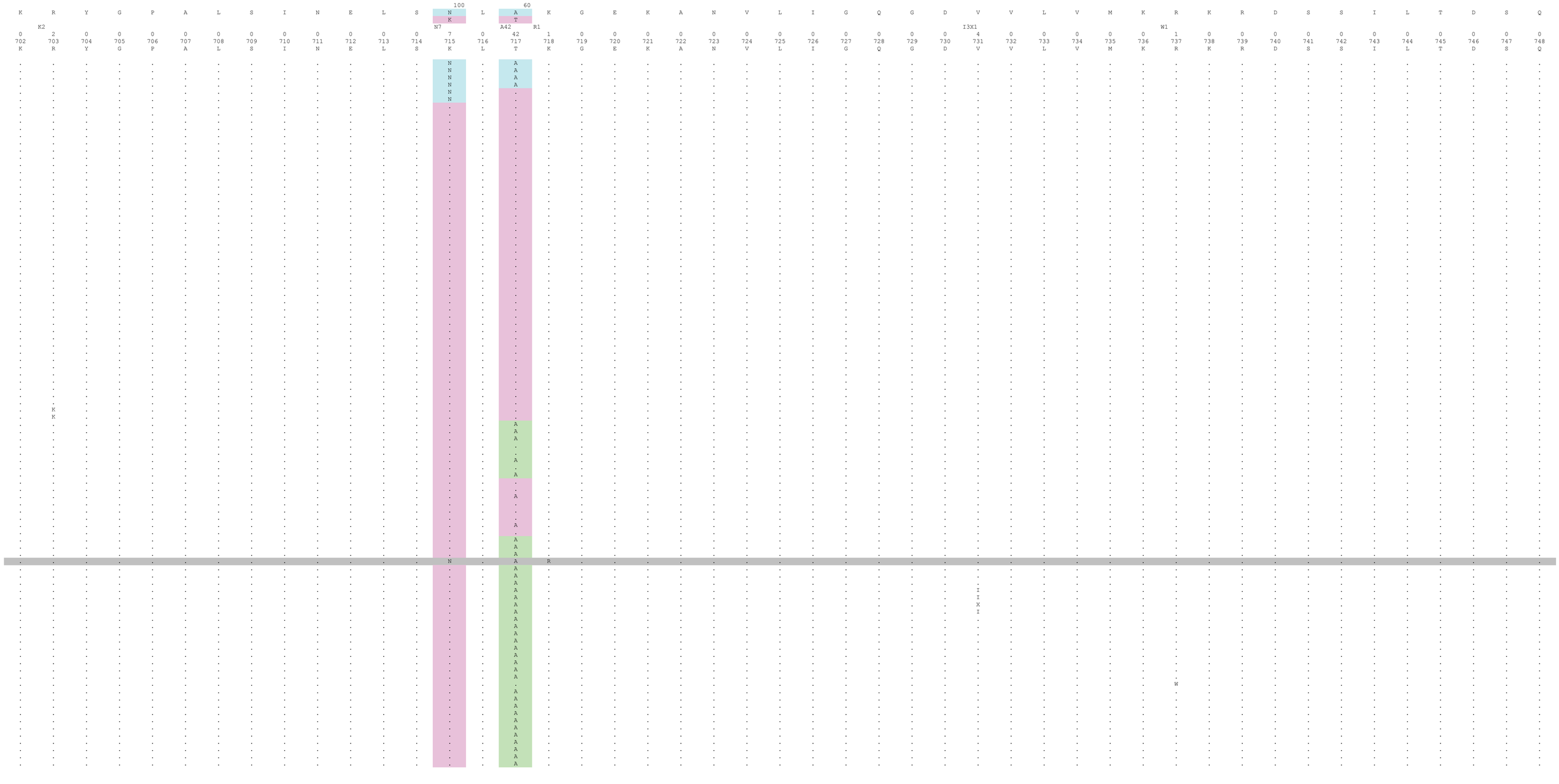
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K2
N7
A42
R1
I3X1
W1

T	A	T	K	R	I	R	M	A	I	N	
		S1								S2	
0	0	1	0	0	0	0	0	0	0	2	97
749	750	751	752	753	754	755	756	757	758	759	760
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749	750	751	752	753	754	755	756	757	758	759	-
T	A	T	K	R	I	R	M	A	I	N	-
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0	0	1	0	0	0	0	0	0	0	2	-
749	750	751	752	753	754	755	756	757	758	759	-
T	A	T	K	R	I	R	M	A	I	N	-
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Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine PB2 H3N8				Permanent aa change				Avian_PB2 all subtypes				
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	0						1	M	0	Del=1,M=9579	9580
2	E	0						2	E	13	N=23,D=113,Del=1,E=9436,G=5,K=2	9580
3	R	0						3	R	2	R=9567,Del=1,G=2,I=1,K=5,S=4	9580
4	I	0						4	I	2	N=2,D=2,I=9563,L=1,K=1,M=2,T=2,V=6,Xaa=1	9580
5	K	2	I2					5	K	3	R=15,N=1,Q=1,E=5,K=9558	9580
6	E	0						6	E	3	A=1,D=6,Q=1,E=9554,G=12,K=4,V=1,Xaa=1	9580
7	L	0						7	L	0	I=1,L=9577,F=2	9580
8	R	2	K2					8	R	2	R=9561,I=3,K=15,S=1	9580
9	D	0						9	D	13	N=75,D=9437,C=1,E=57,G=5,Y=5	9580
10	L	0						10	L	1	I=3,L=9574,M=1,S=1,V=1	9580
11	M	0						11	M	1	R=1,I=2,L=2,M=9574,V=1	9580
12	S	31	L31	S	L	2002	0,0080	12	S	9	A=2,L=77,P=1,S=9489,T=10,W=1	9580
13	Q	0						13	Q	3	R=8,Q=9552,H=6,L=5,K=9	9580
14	S	0						14	S	2	A=1,F=7,P=7,S=9564,T=1	9580
15	R	0						15	R	1	R=9569,C=7,G=2,H=2	9580
16	T	1	I1					16	T	1	A=2,I=2,T=9576	9580
17	R	0						17	R	3	R=9555,C=4,H=17,S=4	9580
18	E	0						18	E	2	E=9560,G=20	9580
19	I	0						19	I	1	I=9569,M=1,T=1,V=9	9580
20	L	0						20	L	0	L=9580	9580
21	T	0						21	T	3	A=12,I=6,K=1,M=1,P=1,T=9559	9580
22	K	0						22	K	19	R=247,N=3,Q=9,K=9320,Xaa=1	9580
23	T	0						23	T	0	N=1,I=1,S=1,T=9577	9580
24	T	0						24	T	1	A=1,N=2,P=2,S=4,T=9571	9580
25	V	0						25	V	0	A=1,G=1,V=9578	9580
26	D	0						26	D	0	A=1,D=9577,G=2	9580
27	H	0						27	H	0	N=1,H=9579	9580
28	M	0						28	M	2	I=9,M=9561,T=5,V=5	9580
29	A	2	T2					29	A	2	A=9567,P=3,S=3,T=4,V=3	9580
30	I	0						30	I	5	I=9536,L=10,M=3,V=31	9580
31	I	1	X1					31	I	1	G=1,I=9574,L=3,F=1,V=1	9580
32	K	0						32	K	1	R=7,Q=1,E=2,K=9569,Xaa=1	9580
33	K	0						33	K	1	R=8,G=1,K=9571	9580
34	Y	0						34	Y	1	C=3,H=1,F=2,S=5,Y=9569	9580
35	T	0						35	T	1	P=3,S=1,T=9576	9580
36	S	0						36	S	1	P=1,S=9574,T=5	9580
37	G	0						37	G	0	E=1,G=9579	9580
38	R	0						38	R	1	R=9575,G=1,I=1,K=1,S=1,T=1	9580
39	Q	0						39	Q	1	R=1,Q=9575,E=1,L=1,K=1,Xaa=1	9580
40	E	0						40	E	0	E=9579,G=1	9580
41	K	0						41	K	1	R=4,N=2,K=9573,T=1	9580
42	N	0						42	N	0	N=9579,S=1	9580
43	P	0						43	P	0	L=1,P=9578,S=1	9580
44	A	2	S2					44	A	103	A=4968,Del=4580,S=29,T=3	9580
45	L	0						45	L	100	Del=4580,L=5000	9580
46	R	0						46	R	0	R=9577,I=1,K=1,S=1	9580
47	M	0						47	M	1	N=1,I=1,M=9573,V=5	9580
48	K	0						48	K	1	R=8,E=1,K=9571	9580
49	W	0						49	W	0	W=9580	9580
50	M	0						50	M	5	R=1,Del=1,I=37,M=9533,T=3,V=5	9580
51	M	0						51	M	0	L=1,M=9578,V=1	9580
52	A	0						52	A	0	A=9578,S=1,T=1	9580
53	M	0						53	M	1	I=2,M=9573,T=2,V=2,Xaa=1	9580
54	K	1	N1					54	K	3	R=32,I=1,K=9547	9580
55	Y	0						55	Y	2	H=15,F=2,Y=9563	9580
56	P	0						56	P	1	Del=1,Q=1,P=9570,S=8	9580
57	I	0						57	I	2	Del=1,I=9565,M=5,F=1,T=2,V=6	9580
58	T	0						58	T	3	A=22,I=1,M=1,P=2,S=1,T=9552,Xaa=1	9580
59	A	0						59	A	0	A=9579,Del=1	9580
60	D	0						60	D	7	A=1,N=25,D=9518,E=14,G=21	9580
61	K	1	R1					61	K	6	R=60,N=1,D=1,I=1,K=9516,M=1	9580
62	R	0						62	R	13	R=9429,Q=1,G=68,I=1,K=81	9580
63	I	0						63	I	5	I=9525,L=1,M=1,T=4,V=49	9580
64	M	3	I3					64	M	59	I=1023,L=13,M=8450,T=61,V=33	9580
65	E	8	G7K1	G	E	1975	0,0031	65	E	24	N=3,D=290,E=9250,G=30,K=5,T=1,V=1	9580
66	M	1	V1					66	M	16	A=5,I=29,L=5,M=9402,T=16,V=122,Xaa=1	9580
67	I	1	N1					67	I	13	I=9422,L=1,M=3,T=1,V=153	9580
68	P	1	S1					68	P	0	P=9580	9580
69	E	0						69	E	1	A=3,D=2,E=9572,G=1,K=2	9580
70	R	0						70	R	2	R=9558,G=1,K=21	9580
71	N	0						71	N	0	N=9577,I=2,K=1	9580
72	E	0						72	E	1	D=1,E=9576,V=2,Xaa=1	9580
73	Q	5	H5					73	Q	4	R=11,Q=9546,E=1,H=12,K=10	9580
74	G	0						74	G	2	D=1,C=1,E=5,G=9568,S=5	9580
75	Q	0						75	Q	0	Q=9579,H=1	9580
76	T	1	S1					76	T	22	A=40,I=124,K=54,M=21,S=5,T=9335,V=1	9580
77	L	1	P1					77	L	0	L=9579,F=1	9580
78	W	0						78	W	0	W=9580	9580
79	S	1	N1					79	S	8	R=2,N=15,G=7,I=6,S=9503,T=47	9580
80	K	0						80	K	18	R=247,N=2,Q=2,I=1,K=9327,M=1	9580
81	T	5	M3I2					81	T	12	A=61,I=46,L=1,K=3,M=7,S=6,T=9456	9580
82	N	0						82	N	16	R=1,N=9395,H=8,K=15,S=138,T=23	9580
83	D	0						83	D	1	D=9576,Del=1,V=2,Xaa=1	9580
84	A	0						84	A	0	A=9578,V=1,Xaa=1	9580
85	G	0						85	G	0	G=9579,Xaa=1	9580
86	S	0						86	S	1	L=1,P=1,S=9576,T=1,Xaa=1	9580
87	D	0						87	D	6	N=35,D=9529,E=4,G=10,I=1,Xaa=1	9580
88	R	0						88	R	2	R=9566,G=3,K=10,Xaa=1	9580
89	V	0						89	V	7	E=2,I=10,L=26,M=24,V=9517,Xaa=1	9580
90	M	0						90	M	11	I=98,L=1,K=1,M=9460,T=3,V=15,Xaa=2	9580
91	V	0						91	V	1	A=1,I=2,L=1,V=9575,Xaa=1	9580
92	S	0						92	S	0	A=1,P=1,S=9577,Xaa=1	9580
93	P	0						93	P	5	L=5,P=9532,S=27,T=14,Xaa=2	9580
94	L	0						94	L	1	R=1,L=9574,M=1,P=1,Xaa=3	9580
95	A	0						95	A	2	A=9568,T=7,V=1,Xaa=4	9580
96	V	0						96	V	3	A=1,I=19,V=9556,Xaa=4	9580
97	T	0						97	T	1	A=2,I=1,T=9573,Xaa=4	9580
98	W	0						98	W	1	W=9576,Xaa=4	9580
99	W	0						99	W	1	R=3,W=9573,Xaa=4	9580
100	N	0						100	N	1	N=9573,D=1,I=2,Xaa=4	9580
101	R	0						101	R	1	R=9572,K=4,Xaa=4	9580
102	N	0						102	N	9	N=9492,D=1,K=16,S=65,T=2,Xaa=4	9580
103	G	0						103	G	1	A=1,G=9575,Xaa=4	9580
104	P	0						104	P	2	Q=4,L=4,P=9564,S=2,T=1,Xaa=5	9580
105	T	13	A13	T	A	2007	0,0334	105	T	31	A=320,R=1,I=40,K=13,M=15,P=6,S=2,T=9172,V=5,Xaa=6	9580
106	T	2	A2					106	T	25	A=291,N=16,I=2,K=4,S=24,T=9238,Xaa=5	9580
107	S	0						107	S	22	R=2,N=211,D=19,G=29,I=2,S=9310,T=2,Xaa=5	9580
108	T	0						108	T	28	A=431,I=1,T=9135,V=8,Xaa=5	9580
109	I	9	V9	V	I	1975	0,0463	109	V	31	A=12,G=2,I=444,L=3,F=10,V=9102,Xaa=7	9580
110	H	0						110	H	2	R=1,N=1,Q=1,H=9566,Y=4,Xaa=7	9580
111	Y	0						111	Y	1	C=1,H=2,F=1,Y=9569,Xaa=7	9580
112	P	0						112	P	4	Q=1,L=2,P=9550,S=17,T=3,Xaa=7	9580
113	K	0						113	K	8	R=12,N=1,Q=49,E=1,L=2,K=9507,T=1,Xaa=7	9580
114	V	0						114	V	9	I=101,V=9472,Xaa=7	9580
115	Y	0						115	Y	1	N=1,H=1,F=1,S=1,Y=9569,Xaa=7	9580
116	K	0						116	K	13	R=143,N=1,Q=1,E=2,K=9425,T=1,Xaa=7	9580
117	T	0						117	T	12	A=38,N=16,I=3,P=30,S=19,T=9467,Xaa=7	9580
118	Y	0						118	Y	1	C=2,H=1,F=1,Y=9569,Xaa=7	9580
119	F	0						119	F	1	F=9573,Xaa=7	9580
120	E	0						120	E	6	D=44,E=9519,G=8,K=2,Xaa=7	9580
121	K	0						121	K	3	R=15,K=9558,Xaa=7	9580
122	V	0						122	V	15	A=39,G=1,I=70,M=31,F=3,V=9429,Xaa=7	9580
123	E	0						123	E	22	A=11,D=72,Q=3,E=9340,G=66,K=70,V=12,Xaa=6	9580
124	R	0						124	R	1	R=9574,Xaa=6	9580
125	L	0						125	L	1	L=9572,F=1,S=1,Xaa=6	9580
126	K	0						126	K	6	R=54,N=3,Q=1,K=9516,Xaa=6	9580
127	H	1	R1					127	H	31	R=32,N=322,Q=9,H=9166,L=1,Y=44,Xaa=6	9580
128	G	0						128	G	1	G=9575,Xaa=5	9580
129	T	0						129	T	16	A=54,N=29,I=66,S=7,T=9412,V=7,Xaa=5	9580
130	F	0						130	F	1	L=1,F=9573,S=1,Xaa=5	9580
131	G	0						131	G	1	D=1,G=9574,Xaa=5	9580
132	P	0						132	P	1	H=2,P=9573,Xaa=5	9580
133	V	0						133	V	6	A=2,I=50,L=1,V=9520,Xaa=7	9580
134	H	0						134	H	4	R=10,H=9549,Y=16,Xaa=5	9580
135	F	0						135	F	2	F=9565,Y=10,Xaa=5	9580
136	R	0						136	R	2	R=9564,Q=9,G=1,K=1,Xaa=5	9580
137	N	0						137	N	5	N=9528,D=2,S=42,T=2,Xaa=6	9580
138	Q	0						138	Q	1	R=1,Q=9571,E=2,Xaa=6	9580

vmuc:
backward
substitution

139	V	0						139	V	12	I=143,L=1,V=9430,Xaa=6		9580
140	K	0						140	K	1	K=9574,Xaa=6		9580
141	I	0						141	I	2	I=9564,K=1,T=6,V=2,Xaa=7		9580
142	R	0						142	R	2	R=9568,H=1,K=4,Xaa=7		9580
143	R	0						143	R	1	R=9571,G=1,K=1,Xaa=7		9580
144	R	0						144	R	3	R=9554,Q=1,K=18,Xaa=7		9580
145	V	0						145	V	2	A=4,G=1,I=3,V=9565,Xaa=7		9580
146	D	0						146	D	2	A=1,N=4,D=9567,G=1,Xaa=7		9580
147	V	8	I7T1	I	V	1976	0,0285	147	I	70	I=8341,L=1,M=61,T=897,V=273,Xaa=7		9580
148	N	0						148	N	2	N=9565,S=6,T=2,Xaa=7		9580
149	P	0						149	P	1	P=9569,S=1,T=3,Xaa=7		9580
150	G	0						150	G	2	A=2,D=1,G=9567,S=1,V=1,Xaa=8		9580
151	H	0						151	H	2	N=8,Q=1,H=9562,P=1,Xaa=8		9580
152	A	0						152	A	12	A=9456,E=3,S=70,T=24,V=19,Xaa=8		9580
153	D	0						153	D	3	A=2,N=11,D=9556,G=2,Y=1,Xaa=8		9580
154	L	0						154	L	2	H=1,L=9566,F=4,P=1,Xaa=8		9580
155	S	0						155	S	14	N=124,G=14,I=6,S=9426,T=1,Xaa=9		9580
156	A	0						156	A	10	A=9486,D=5,E=7,G=1,I=1,P=1,S=21,T=27,V=22,Xaa=9		9580
157	K	0						157	K	4	R=18,Q=5,E=2,K=9546,Xaa=9		9580
158	E	0						158	E	3	A=1,D=4,Q=1,E=9557,G=2,K=5,Xaa=10		9580
159	A	0						159	A	2	A=9568,P=1,T=2,Xaa=9		9580
160	Q	0						160	Q	2	Q=9565,L=1,K=4,P=1,Xaa=9		9580
161	D	0						161	D	2	N=3,D=9563,E=3,Y=1,Xaa=10		9580
162	V	0						162	V	3	G=1,I=12,L=3,V=9555,Xaa=9		9580
163	I	0						163	I	2	I=9567,L=1,V=3,Xaa=9		9580
164	M	0						164	M	2	I=3,L=1,M=9565,V=2,Xaa=9		9580
165	E	0						165	E	1	A=1,E=9569,V=1,Xaa=9		9580
166	V	0						166	V	5	A=2,G=1,I=33,V=9535,Xaa=9		9580
167	V	0						167	V	2	A=1,I=8,V=9562,Xaa=9		9580
168	F	2	Y2					168	F	4	L=1,F=9542,S=4,Y=24,Xaa=9		9580
169	P	0						169	P	2	R=1,Q=1,P=9567,S=2,Xaa=9		9580
170	N	0						170	N	2	N=9562,D=3,S=1,T=1,Xaa=13		9580
171	E	0						171	E	2	A=1,E=9565,G=1,Xaa=13		9580
172	V	0						172	V	4	A=1,I=3,L=1,M=12,V=9550,Xaa=13		9580
173	G	0						173	G	2	A=1,R=5,G=9560,Xaa=14		9580
174	A	0						174	A	2	A=9560,P=1,S=4,T=1,Xaa=14		9580
175	R	1	K1					175	R	16	R=9382,G=4,I=2,K=177,S=1,Xaa=14		9580
176	I	0						176	I	8	I=9510,M=15,T=16,V=24,Xaa=15		9580
177	L	0						177	L	5	I=29,L=9536,P=2,Xaa=13		9580
178	T	0						178	T	5	A=17,I=3,M=3,P=2,S=4,T=9538,Xaa=13		9580
179	S	0						179	S	3	A=5,L=5,S=9557,Xaa=13		9580
180	E	0						180	E	3	D=4,E=9558,G=5,K=1,Xaa=12		9580
181	S	0						181	S	3	A=4,L=1,P=3,S=9558,T=2,Xaa=12		9580
182	Q	0						182	Q	2	R=1,Q=9565,P=2,Xaa=12		9580
183	L	0						183	L	4	R=1,L=9541,M=26,Xaa=12		9580
184	T	0						184	T	25	A=231,I=7,K=20,M=30,S=8,T=9272,Xaa=12		9580
185	I	0						185	I	10	I=9483,L=3,M=5,T=11,V=65,Xaa=13		9580
186	T	0						186	T	3	A=2,I=4,K=1,M=3,P=2,T=9555,Xaa=13		9580
187	K	0						187	K	24	R=233,N=9,Q=3,I=1,K=9281,T=40,Xaa=13		9580
188	E	0						188	E	6	D=7,E=9526,G=16,K=15,V=1,Xaa=15		9580
189	K	1	R1					189	K	2	R=2,K=9565,Xaa=13		9580
190	K	0						190	K	11	R=104,N=3,G=1,K=9459,Xaa=13		9580
191	E	0						191	E	14	R=1,D=21,Q=1,E=9434,G=9,K=99,T=1,V=2,Xaa=12		9580
192	E	0						192	E	3	A=2,D=7,E=9553,G=4,K=2,Xaa=12		9580
193	L	0						193	L	3	I=2,L=9559,M=2,F=5,Xaa=12		9580
194	Q	0						194	Q	15	R=14,Q=9428,H=56,L=1,K=66,Xaa=15		9580
195	D	0						195	D	40	N=389,D=9032,E=67,G=59,H=4,I=1,S=1,Y=15,Xaa=12		9580
196	C	0						196	C	2	R=1,C=9564,G=1,F=1,W=1,Xaa=12		9580
197	K	0						197	K	18	R=115,N=62,D=1,Q=2,E=2,K=9376,M=4,S=2,T=4,Xaa=12		9580
198	I	0						198	I	3	I=9556,V=10,Xaa=14		9580
199	A	2	S1T1					199	A	10	A=9482,D=4,S=26,T=52,V=2,Xaa=14		9580
200	P	0						200	P	2	H=1,L=3,P=9560,S=1,T=1,Xaa=14		9580
201	L	0						201	L	2	L=9564,M=2,Xaa=14		9580
202	M	0						202	M	4	R=2,I=21,L=1,M=9541,V=1,Xaa=14		9580
203	V	0						203	V	12	A=2,E=1,G=1,I=6,L=21,M=79,V=9455,Xaa=15		9580
204	A	0						204	A	2	A=9565,T=1,Xaa=14		9580
205	Y	0						205	Y	2	C=1,H=4,Y=9561,Xaa=14		9580
206	M	0						206	M	3	R=1,I=7,K=1,M=9556,V=1,Xaa=14		9580
207	L	0						207	L	2	L=9561,F=1,W=1,Xaa=17		9580
208	E	0						208	E	2	D=1,Q=1,E=9561,K=1,Xaa=16		9580
209	R	0						209	R	2	R=9561,K=2,S=1,Xaa=16		9580
210	E	0						210	E	2	D=2,E=9560,G=1,K=1,Xaa=16		9580
211	L	0						211	L	2	L=9561,P=1,V=1,Xaa=17		9580
212	V	0						212	V	4	A=2,I=15,L=1,V=9545,Xaa=17		9580
213	R	0						213	R	2	R=9561,H=1,Xaa=18		9580
214	K	0						214	K	5	R=20,N=3,Q=1,E=1,K=9536,T=2,Xaa=17		9580
215	T	0						215	T	4	A=4,I=2,K=2,M=9,P=1,T=9545,Xaa=17		9580
216	R	0						216	R	3	R=9555,K=4,S=2,Xaa=19		9580
217	F	0						217	F	2	F=9561,S=1,Xaa=18		9580
218	L	0						218	L	2	L=9562,Xaa=18		9580
219	P	0						219	P	2	A=1,P=9561,Xaa=18		9580
220	V	0						220	V	4	Del=1,I=12,L=3,K=1,V=9546,Xaa=17		9580
221	A	0						221	A	18	A=9385,Del=1,S=92,T=63,V=17,Xaa=22		9580
222	G	0						222	G	3	R=6,Del=1,G=9553,Xaa=20		9580
223	G	0						223	G	3	A=2,Del=1,G=9557,Xaa=20		9580
224	T	0						224	T	3	A=5,Del=1,I=2,T=9551,Xaa=21		9580
225	S	1	G1					225	S	6	N=4,G=26,S=9528,Xaa=22		9580
226	S	0						226	S	3	R=2,G=1,S=9554,Xaa=23		9580
227	V	0						227	V	7	A=8,I=26,M=5,V=9518,Xaa=23		9580
228	Y	0						228	Y	3	C=2,H=2,F=1,Y=9552,Xaa=23		9580
229	I	0						229	I	8	I=9492,M=1,V=64,Xaa=23		9580
230	E	0						230	E	3	E=9556,Xaa=24		9580
231	V	0						231	V	11	A=3,E=2,I=72,M=8,V=9471,Xaa=24		9580
232	L	0						232	L	3	L=9556,Xaa=24		9580
233	H	0						233	H	3	Q=2,H=9552,L=2,Xaa=24		9580
234	L	0						234	L	3	L=9549,M=1,F=3,S=1,W=1,Xaa=25		9580
235	T	0						235	T	3	A=3,S=1,T=9552,Xaa=24		9580
236	Q	0						236	Q	3	Q=9553,H=2,S=1,Xaa=24		9580
237	G	0						237	G	3	R=3,G=9553,Xaa=24		9580
238	T	0						238	T	5	A=9,D=1,I=8,P=2,T=9537,Xaa=23		9580
239	C	0						239	C	3	A=2,C=9550,S=4,Xaa=24		9580
240	W	0						240	W	3	R=3,G=2,L=1,W=9552,Xaa=22		9580
241	E	0						241	E	3	D=1,E=9555,K=1,V=1,Xaa=22		9580
242	Q	0						242	Q	3	R=2,Q=9553,H=3,Xaa=22		9580
243	M	0						243	M	8	I=2,L=31,K=6,M=9511,F=1,S=4,T=1,V=2,Xaa=22		9580
244	Y	0						244	Y	3	C=1,G=1,S=1,Y=9555,Xaa=22		9580
245	T	0						245	T	4	N=11,P=5,S=1,T=9541,Xaa=22		9580
246	P	0						246	P	3	Q=1,P=9553,T=3,Xaa=23		9580
247	G	0						247	G	3	R=3,Del=1,G=9550,S=3,Xaa=23		9580
248	G	0						248	G	4	R=1,Del=1,E=6,G=9548,Xaa=24		9580
249	E	2	K2					249	E	21	R=1,N=5,D=21,Del=1,E=9351,G=110,K=69,Xaa=22		9580
250	V	0						250	V	3	A=1,Del=1,L=1,M=1,V=9554,Xaa=22		9580
251	R	14	K14	R	K	2007	0,0150	251	R	16	R=9398,G=6,I=9,K=144,Xaa=23		9580
252	N	0						252	N	3	N=9553,H=1,S=2,Y=1,Xaa=23		9580
253	D	0						253	D	3	N=4,D=9551,G=2,Xaa=23		9580
254	D	0						254	D	4	N=1,D=9546,E=7,Y=1,V=1,Xaa=24		9580
255	I	8	V8	V	I	1976	0,0827	255	V	47	A=5,D=1,G=1,I=792,L=15,M=1,F=4,T=1,V=8737,Xaa=23		9580
256	D	0						256	D	3	N=1,D=9554,E=1,G=1,Xaa=23		9580
257	Q	0						257	Q	5	R=2,Q=9540,H=10,K=5,Xaa=23		9580
258	S	0						258	S	3	S=9554,T=2,Xaa=24		9580
259	L	0						259	L	3	I=1,L=9554,V=1,Xaa=24		9580
260	I	0						260	I	9	I=9491,T=2,V=63,Xaa=24		9580
261	I	0						261	I	7	I=9513,T=29,V=15,Xaa=23		9580
262	A	0						262	A	3	A=9555,P=1,V=1,Xaa=23		9580
263	A	0						263	A	4	A=9545,D=1,S=9,T=1,Xaa=24		9580
264	R	0						264	R	3	R=9555,K=1,S=1,Xaa=23		9580
265	N	0						265	N	8	N=9504,H=2,K=1,S=47,T=2,Xaa=24		9580
266	I	0						266	I	5	I=9535,L=2,V=19,Xaa=24		9580
267	V	0						267	V	3	I=3,L=1,V=9552,Xaa=24		9580
268	R	2	K2					268	R	3	R=9551,G=2,K=2,Xaa=25		9580
269	R	0						269	R	3	R=9553,K=2,Xaa=25		9580
270	A	0						270	A	4	A=9544,S=10,Xaa=26		9580
271	T	1	A1					271	T	17	A=31,I=91,M=29,S=1,T=9401,V=2,Xaa=25		9580
272	V	0						272	V	4	E=1,G=1,I=10,V=9543,Xaa=25		9580
273	S	0						273	S	3	A=2,S=9552,Xaa=26		9580
274	A	0						274	A	5	A=9533,S=2,T=18,Xaa=27		9580
275	D	0						275	D	3	A=1,D=9549,E=1,G=1,Xaa=26		9580
276	P	0						276	P	3	P=9554,Xaa=26		9580
277	L	0						277	L	4	Q=1,I=1,L=9548,M=1,S=1,W=1,Xaa=27		9580
278	A	0						278	A	14	A=9450,Q=2,E=3,G=1,L=44,P=2,S=4,T=10,V=37,Xaa=27		9580
279	S	0						279	S	4	A=2,L=3,F=2,P=1,S=9545,Xaa=27		9580
280	L	0						280	L	3	L=9551,P=1,Xaa=28		9580
281	L	0						281	L	5	I=1,L=9540,M=1,S=5,W=3,V=3,Xaa=27		9580
282	E	0						282	E	5	D=9,Q=8,E=9534,G=1,K=1,Xaa=27		9580
283	M	0						283	M	3	I=2,M=9550,T=3,Xaa=25		9580
284	C	0						284	C	3	C=9553,G=1,Xaa=26		9580
285	H	0						285	H	7	N=12,Q=3,H=9519,P=1,Y=19,Xaa=26		9580
286	S	0						286	S	5	N=2,G=16,S=9536,Xaa=26		9580
287	T	0						287	T	3	A=1,Q=1,T=9552,Xaa=26		9580
288	Q	0						288	Q	17	R=98,Q=9402,E=1,L=33,K=19,Xaa=27		9580

vmuc:
Not a marker (>0.05)

289	I	0						289	I	4	Del=1,I=9544,M=1,V=8,Xaa=26		9580
290	G	0						290	G	4	A=4,Del=2,G=9544,S=4,Xaa=26		9580
291	G	0						291	G	4	R=1,Del=2,E=3,G=9547,Xaa=27		9580
292	I	0						292	I	74	A=14,N=1,Del=2,G=1,I=8392,L=3,K=1,M=210,T=204,V=722,Xaa=30		9580
293	R	0						293	R	17	R=9397,Del=2,Q=3,E=1,G=22,K=114,M=4,S=4,W=4,Xaa=29		9580
294	M	0						294	M	3	Del=1,K=1,M=9548,T=1,V=1,Xaa=28		9580
295	V	0						295	V	28	A=29,I=308,M=12,T=1,V=9201,Xaa=29		9580
296	D	0						296	D	5	A=1,N=4,D=9540,E=4,G=2,Xaa=28		9580
297	I	0						297	I	8	R=1,I=9496,L=2,T=2,V=52,Xaa=27		9580
298	L	0						298	L	5	I=5,L=9535,F=9,Xaa=31		9580
299	K	8	R7E1	R	K	1975	0,0191	299	R	19	R=9348,Q=4,L=4,K=183,M=7,T=4,Xaa=30		9580
300	Q	1	H1					300	Q	6	R=3,Q=9521,H=28,K=1,Xaa=27		9580
301	N	0						301	N	4	N=9546,H=1,I=2,S=3,Y=1,Xaa=27		9580
302	P	0						302	P	4	L=1,P=9539,S=12,T=1,Xaa=27		9580
303	T	0						303	T	7	A=1,N=1,H=1,I=14,M=1,P=2,S=16,T=9516,Xaa=28		9580
304	E	0						304	E	3	E=9551,K=1,V=1,Xaa=27		9580
305	E	0						305	E	3	E=9551,K=2,Xaa=27		9580
306	Q	0						306	Q	3	R=2,Q=9550,P=1,Xaa=27		9580
307	A	0						307	A	3	A=9553,Xaa=27		9580
308	V	0						308	V	4	E=1,G=1,I=4,M=1,V=9546,Xaa=27		9580
309	D	0						309	D	20	A=1,N=73,D=9361,E=67,G=49,Y=2,Xaa=27		9580
310	I	0						310	I	3	I=9549,M=3,F=1,Xaa=27		9580
311	C	0						311	C	3	C=9553,F=1,Xaa=26		9580
312	K	0						312	K	8	R=62,K=9491,M=1,Xaa=26		9580
313	A	0						313	A	3	A=9549,G=1,S=1,T=1,V=2,Xaa=26		9580
314	A	0						314	A	4	A=9539,S=14,Xaa=27		9580
315	M	0						315	M	24	I=114,L=151,M=9284,V=5,Xaa=26		9580
316	G	0						316	G	3	G=9553,V=1,Xaa=26		9580
317	L	0						317	L	11	Q=2,I=8,L=9461,M=80,F=2,P=2,Xaa=25		9580
318	R	0						318	R	14	R=9412,G=1,K=137,M=2,S=1,Xaa=27		9580
319	I	0						319	I	4	I=9541,T=2,V=12,Xaa=25		9580
320	S	0						320	S	4	R=3,N=6,F=2,S=9543,T=1,Xaa=25		9580
321	S	0						321	S	3	L=2,P=2,S=9551,Xaa=25		9580
322	S	0						322	S	3	F=2,S=9551,T=1,Xaa=26		9580
323	F	0						323	F	3	F=9554,Xaa=26		9580
324	S	0						324	S	4	N=1,Q=1,G=2,S=9548,T=2,Xaa=26		9580
325	F	0						325	F	4	I=1,L=5,F=9547,Y=1,Xaa=26		9580
326	G	0						326	G	3	R=1,C=1,G=9552,Xaa=26		9580
327	G	0						327	G	6	R=4,N=3,E=4,G=9524,S=19,Xaa=26		9580
328	F	0						328	F	3	L=3,F=9550,Y=2,Xaa=25		9580
329	T	0						329	T	5	A=4,N=12,I=5,P=1,T=9533,Xaa=25		9580
330	F	0						330	F	3	L=4,F=9549,S=1,Xaa=26		9580
331	K	0						331	K	4	R=1,Q=1,E=1,K=9545,M=7,Xaa=25		9580
332	R	0						332	R	6	R=9522,Q=1,G=2,I=2,K=28,Xaa=25		9580
333	T	0						333	T	3	A=1,T=9553,Xaa=26		9580
334	S	0						334	S	11	R=11,N=12,G=2,K=57,S=9472,Xaa=26		9580
335	G	0						335	G	3	G=9554,Xaa=26		9580
336	S	0						336	S	8	A=2,H=1,L=7,F=15,P=1,S=9504,T=23,V=1,Xaa=26		9580
337	S	0						337	S	3	A=1,F=1,S=9551,Y=1,Xaa=26		9580
338	V	2	I2					338	V	59	A=71,N=2,D=3,I=840,L=3,F=22,T=45,V=8568,Xaa=26		9580
339	K	0						339	K	59	A=5,R=46,N=14,Q=8,E=2,G=89,K=8637,M=20,T=731,V=2,Xaa=26		9580
340	R	1	K1					340	R	94	R=6651,E=2,G=8,I=1,K=2877,S=15,Xaa=26		9580
341	E	0						341	E	7	D=7,Q=1,E=9512,G=19,K=15,Xaa=26		9580
342	E	0						342	E	7	D=26,E=9520,G=4,K=3,V=2,Xaa=25		9580
343	E	0						343	E	6	R=3,D=16,Del=1,E=9528,G=7,V=1,Xaa=24		9580
344	M	34	V33I1	V	M	1985	0,0173	344	V	18	A=1,Del=1,E=2,I=3,L=17,M=166,V=9365,Xaa=25		9580
345	L	0						345	L	3	Del=1,I=1,L=9549,F=3,Xaa=26		9580
346	T	0						346	T	3	Del=1,P=1,T=9553,Xaa=25		9580
347	G	0						347	G	3	R=1,Del=1,G=9554,Xaa=24		9580
348	N	0						348	N	3	N=9549,Q=1,H=1,S=4,Xaa=25		9580
349	L	0						349	L	3	A=1,L=9551,P=4,Xaa=24		9580
350	Q	0						350	Q	3	Q=9554,H=2,L=1,Xaa=23		9580
351	T	1	K1					351	T	6	A=29,R=1,K=1,T=9526,Xaa=23		9580
352	L	1	V1					352	L	3	L=9552,M=1,F=3,S=1,Xaa=23		9580
353	K	1	E1					353	K	14	R=144,N=1,E=3,K=9409,Xaa=23		9580
354	I	0						354	I	20	I=9357,L=50,K=1,M=61,V=88,Xaa=23		9580
355	R	0						355	R	30	R=9225,Q=12,G=17,I=68,L=1,K=209,M=23,T=2,Xaa=23		9580
356	V	0						356	V	23	A=3,I=199,L=8,M=52,V=9294,Xaa=24		9580
357	H	0						357	H	16	N=10,D=8,Q=12,H=9403,P=1,Y=123,Xaa=23		9580
358	E	1	X1					358	E	15	A=42,D=4,Q=4,E=9442,G=3,I=2,K=9,M=26,V=25,Xaa=23		9580
359	G	1	D1					359	G	3	E=1,G=9555,Xaa=24		9580
360	Y	0						360	Y	6	C=9,H=18,F=2,S=1,Y=9528,Xaa=22		9580
361	E	0						361	E	2	E=9559,Xaa=21		9580
362	E	0						362	E	3	Q=1,E=9557,G=1,Xaa=21		9580
363	F	0						363	F	4	L=20,F=9539,Xaa=21		9580
364	T	0						364	T	3	A=2,I=3,P=1,T=9554,Xaa=20		9580
365	M	0						365	M	11	I=79,L=11,M=9461,T=1,V=8,Xaa=20		9580
366	V	0						366	V	5	A=1,G=1,I=26,F=1,V=9530,Xaa=21		9580
367	G	0						367	G	2	G=9560,W=1,Xaa=19		9580
368	R	0						368	R	49	R=8778,Q=639,G=2,L=1,K=139,P=1,Xaa=20		9580
369	R	1	G1					369	R	15	R=9422,G=6,K=107,M=4,S=20,T=1,W=2,Xaa=18		9580
370	A	0						370	A	2	A=9559,G=1,P=1,S=1,Xaa=18		9580
371	T	0						371	T	2	A=1,T=9561,Xaa=18		9580
372	A	1	S1					372	A	2	A=9561,T=1,Xaa=18		9580
373	I	0						373	I	3	I=9552,L=9,Xaa=19		9580
374	L	0						374	L	12	I=57,L=9461,M=20,F=15,V=8,Xaa=19		9580
375	R	0						375	R	3	R=9551,E=1,G=1,K=4,M=3,W=1,Xaa=19		9580
376	K	0						376	K	3	R=2,E=1,K=9558,Xaa=19		9580
377	A	21	T14E4V3					377	A	6	A=9527,E=1,G=1,S=32,Xaa=19		9580
378	T	3	I1N1P1					378	T	3	A=1,I=2,P=2,S=1,T=9555,Xaa=19		9580
379	R	2	K2					379	R	15	R=9402,K=154,M=4,Xaa=20		9580
380	R	8	K4S3G1					380	R	4	R=9541,G=1,K=17,T=1,Xaa=20		9580
381	L	0						381	L	9	L=9482,M=78,Xaa=20		9580
382	I	3	F2S1					382	I	17	I=9358,T=1,V=201,Xaa=20		9580
383	Q	0						383	Q	3	R=1,Q=9553,H=3,K=1,P=1,Xaa=21		9580
384	L	0						384	L	3	I=1,L=9553,M=3,Xaa=23		9580
385	I	0						385	I	4	I=9548,L=3,M=1,F=1,V=6,Xaa=21		9580
386	V	4	I4					386	V	4	A=5,G=1,I=6,L=1,V=9545,Xaa=22		9580
387	S	0						387	S	7	N=2,C=6,G=31,S=9516,T=1,Xaa=24		9580
388	G	0						388	G	3	G=9556,Xaa=24		9580
389	R	0						389	R	29	R=9147,G=7,K=401,S=2,Xaa=23		9580
390	D	0						390	D	38	A=1,N=616,D=8933,E=4,G=2,H=1,I=1,Xaa=22		9580
391	E	0						391	E	7	D=19,Q=10,E=9522,G=5,K=1,V=1,Xaa=22		9580
392	Q	0						392	Q	3	Q=9552,E=2,H=4,Xaa=22		9580
393	S	0						393	S	3	A=8,L=1,S=9549,Xaa=22		9580
394	I	0						394	I	11	I=9464,L=2,T=14,V=79,Xaa=21		9580
395	A	0						395	A	11	A=9468,D=1,F=1,P=6,S=19,T=63,V=1,Xaa=21		9580
396	E	0						396	E	3	D=1,E=9553,G=4,K=1,Xaa=21		9580
397	A	0						397	A	8	A=9505,R=1,G=1,S=1,T=6,V=44,Xaa=22		9580
398	I	10	V10					398	I	14	I=9445,L=10,M=22,T=47,V=35,Xaa=21		9580
399	I	0						399	I	3	I=9554,M=1,T=2,V=1,Xaa=22		9580
400	V	0						400	V	5	A=19,I=6,V=9533,Xaa=22		9580
401	A	0						401	A	3	A=9551,G=1,P=1,S=2,T=2,Xaa=23		9580
402	M	0						402	M	4	I=5,L=4,M=9547,V=1,Xaa=23		9580
403	V	0						403	V	3	A=1,I=3,L=1,V=9552,Xaa=23		9580
404	F	0						404	F	5	L=19,F=9536,S=1,Xaa=24		9580
405	S	0						405	S	4	P=8,S=9543,T=5,Xaa=24		9580
406	Q	0						406	Q	3	Q=9553,L=1,P=1,Xaa=25		9580
407	E	0						407	E	3	D=2,E=9551,G=2,Xaa=25		9580
408	D	2	N2					408	D	9	N=5,D=9485,E=65,Xaa=25		9580
409	C	0						409	C	8	R=31,C=9503,G=1,S=14,Y=5,Xaa=26		9580
410	M	1	I1					410	M	4	I=1,L=2,M=9542,T=1,V=9,Xaa=25		9580
411	I	8	V8					411	I	15	I=9409,L=2,M=26,T=1,V=117,Xaa=25		9580
412	K	0						412	K	7	R=40,K=9511,T=3,Xaa=26		9580
413	A	0						413	A	6	A=9525,S=28,T=1,Xaa=26		9580
414	V	1	A1					414	V	4	A=2,G=1,I=6,L=1,V=9544,Xaa=26		9580
415	R	1	Q1					415	R	3	R=9553,Xaa=27		9580
416	G	0						416	G	4	D=3,G=9542,S=8,Xaa=27		9580
417	D	0						417	D	3	D=9553,Xaa=27		9580
418	L	0						418	L	3	L=9552,S=1,Xaa=27		9580
419	N	0						419	N	4	N=9548,E=1,I=2,S=1,T=1,Xaa=27		9580
420	F	0						420	F	4	L=1,F=9546,S=1,Y=1,V=3,Xaa=28		9580
421	V	0						421	V	6	A=1,I=23,L=2,F=1,V=9526,Xaa=27		9580
422	N	0						422	N	3	N=9548,D=2,I=2,Xaa=28		9580
423	R	0						423	R	3	R=9551,K=1,S=1,Xaa=27		9580
424	A	0						424	A	3	A=9553,S=1,Xaa=26		9580
425	N	0						425	N	3	N=9550,H=1,I=1,K=1,T=1,Xaa=26		9580
426	Q	0						426	Q	4	Q=9548,H=2,K=3,P=1,Xaa=26		9580
427	R	1	C1					427	R	4	R=9548,I=2,L=2,K=2,Xaa=26		9580
428	L	0						428	L	3	I=1,L=9551,F=1,S=1,Xaa=26		9580
429	N	0						429	N	3	N=9551,F=1,S=1,Xaa=27		9580
430	P	0						430	P	11	P=9453,T=100,Xaa=27		9580
431	M	0						431	M	3	L=1,M=9552,Xaa=27		9580
432	H	1	Y1					432	H	5	R=1,H=9539,P=2,Y=11,Xaa=27		9580
433	Q	0						433	Q	3	Q=9551,H=2,Xaa=27		9580
434	L	0						434	L	4	L=9543,F=7,P=2,Xaa=28		9580
435	L	0						435	L	3	Q=1,L=9549,M=2,V=1,Xaa=27		9580
436	R	0						436	R	4	R=9547,K=4,S=1,Xaa=28		9580
437	H	0						437	H	3	N=1,H=9549,L=1,Y=1,Xaa=28		9580
438	F	0						438	F	3	C=1,L=2,F=9548,S=1,Xaa=28		9580

439	Q	0						439	Q	4	R=1,Q=9543,H=4,P=2,Xaa=30		9580
440	K	0						440	K	8	R=56,K=9496,Xaa=28		9580
441	D	0						441	D	12	A=1,N=52,D=9468,E=8,G=14,H=3,I=1,M=1,S=1,T=1,Xaa=29		9580
442	A	0						442	A	4	A=9540,Q=1,S=9,T=1,V=1,Xaa=28		9580
443	K	0						443	K	5	R=14,N=1,Q=3,E=3,K=9531,Xaa=28		9580
444	V	1	E1					444	V	12	A=2,R=1,E=2,I=54,L=7,M=16,T=4,V=9466,Xaa=28		9580
445	L	0						445	L	3	L=9553,P=1,Xaa=26		9580
446	F	2	L2					446	F	3	L=3,F=9549,S=2,Xaa=26		9580
447	Q	0						447	Q	8	Q=9504,H=44,L=2,K=3,Xaa=27		9580
448	N	0						448	N	19	N=9371,D=12,E=1,H=8,K=12,S=137,T=10,Y=1,Xaa=28		9580
449	W	0						449	W	3	G=1,L=1,W=9551,Xaa=27		9580
450	G	0						450	G	3	E=1,G=9552,Xaa=27		9580
451	I	2	V2					451	I	72	N=3,I=8306,L=16,M=2,T=429,V=798,Xaa=26		9580
452	E	0						452	E	3	E=9552,G=2,K=1,Xaa=25		9580
453	P	0						453	P	50	A=45,R=1,Q=10,H=70,I=1,L=27,P=8925,S=348,T=125,Y=3,Xaa=25		9580
454	I	0						454	I	4	I=9544,L=1,M=1,F=1,S=1,T=3,V=4,Xaa=25		9580
455	D	3	V2N1					455	D	4	N=1,D=9544,E=9,G=1,Xaa=25		9580
456	N	0						456	N	25	N=9283,D=135,H=20,I=1,K=2,S=109,Y=5,Xaa=25		9580
457	V	0						457	V	8	A=1,I=47,M=2,V=9505,Xaa=25		9580
458	M	0						458	M	3	M=9556,Xaa=24		9580
459	G	0						459	G	3	R=1,G=9555,Xaa=24		9580
460	M	0						460	M	3	I=4,L=1,M=9552,Xaa=23		9580
461	I	2	V2					461	I	22	A=3,I=9288,L=3,M=1,T=2,V=258,Xaa=25		9580
462	G	0						462	G	3	R=4,G=9553,Xaa=23		9580
463	I	2	V2					463	I	15	I=9417,L=21,M=28,T=1,V=90,Xaa=23		9580
464	L	1	M1					464	L	5	L=9538,M=16,F=1,S=2,Xaa=23		9580
465	P	0						465	P	8	A=2,H=9,P=9500,S=45,T=1,Xaa=23		9580
466	D	2	N2					466	D	4	A=1,N=5,D=9546,E=1,G=4,Xaa=23		9580
467	M	1	L1					467	M	7	I=5,L=40,M=9513,V=1,Xaa=21		9580
468	T	0						468	T	5	A=21,I=3,P=1,T=9533,Xaa=22		9580
469	P	0						469	P	3	R=2,L=1,P=9556,Xaa=21		9580
470	S	0						470	S	15	R=2,N=154,C=3,I=2,S=9397,T=1,Xaa=21		9580
471	T	0						471	T	25	A=206,N=19,I=51,M=2,P=3,S=1,T=9277,Xaa=21		9580
472	E	0						472	E	13	R=1,D=97,Q=1,E=9440,G=11,K=3,V=5,Xaa=22		9580
473	M	0						473	M	64	R=1,Q=2,E=4,G=1,I=152,L=209,K=8,M=8710,T=136,V=334,Xaa=23		9580
474	S	0						474	S	3	H=1,P=1,S=9556,T=1,Xaa=21		9580
475	L	0						475	L	7	L=9512,M=45,S=1,W=1,Xaa=21		9580
476	R	0						476	R	4	A=1,R=9548,K=6,S=3,Xaa=22		9580
477	G	0						477	G	5	R=30,G=9527,Xaa=23		9580
478	V	1	I1				0,4115	478	I	103	A=1,I=5582,L=4,M=30,V=3942,Xaa=21		9580
479	R	0						479	R	3	R=9555,I=2,K=2,T=2,Xaa=19		9580
480	V	2	I2					480	V	17	A=6,E=1,I=184,V=9371,Xaa=18		9580
481	S	0						481	S	2	C=2,S=9560,Xaa=18		9580
482	K	1	Q1					482	K	7	R=41,N=3,I=1,K=9516,T=1,Xaa=18		9580
483	M	0						483	M	16	R=1,I=11,M=9409,P=6,T=35,V=102,Xaa=16		9580
484	G	0						484	G	2	G=9565,Xaa=15		9580
485	V	0						485	V	3	E=1,G=1,I=8,L=4,V=9551,Xaa=15		9580
486	D	0						486	D	2	D=9563,L=1,Xaa=16		9580
487	E	0						487	E	3	A=1,E=9550,G=13,Xaa=16		9580
488	Y	1	H1					488	Y	2	H=2,Y=9561,Xaa=17		9580
489	S	0						489	S	6	A=9,F=2,P=16,S=9532,T=2,Y=3,Xaa=16		9580
490	S	0						490	S	9	R=6,N=68,G=4,S=9485,T=2,Xaa=15		9580
491	T	0						491	T	10	A=67,I=11,P=6,T=9481,Xaa=15		9580
492	E	0						492	E	2	D=1,Q=2,E=9561,G=1,Xaa=15		9580
493	R	0						493	R	5	R=9528,K=37,Xaa=15		9580
494	V	0						494	V	13	A=6,I=127,V=9431,Xaa=16		9580
495	V	2	M2					495	V	30	A=123,G=1,I=153,L=3,M=8,T=53,V=9223,Xaa=16		9580
496	V	0						496	V	3	A=3,E=1,L=5,F=1,V=9555,Xaa=15		9580
497	S	0						497	S	17	R=6,N=192,G=1,S=9365,T=2,Xaa=14		9580
498	I	0						498	I	3	N=1,I=9557,M=1,S=1,V=6,Xaa=14		9580
499	D	0						499	D	2	A=2,N=2,D=9562,Xaa=14		9580
500	R	0						500	R	3	R=9555,C=1,Q=3,H=5,P=1,S=1,Xaa=14		9580
501	F	2	C1S1					501	F	2	L=1,F=9564,S=1,Xaa=14		9580
502	L	0						502	L	2	L=9561,M=1,F=2,S=1,Xaa=15		9580
503	R	2	K2					503	R	3	R=9553,K=11,W=1,Xaa=15		9580
504	V	0						504	V	2	A=1,I=4,V=9560,Xaa=15		9580
505	R	0						505	R	5	R=9538,Q=5,G=1,H=5,K=14,W=2,Xaa=15		9580
506	D	0						506	D	2	N=1,D=9562,E=1,Xaa=16		9580
507	Q	2	H2					507	Q	5	R=1,Q=9535,H=22,L=4,K=1,P=1,Xaa=16		9580
508	R	0						508	R	51	R=8803,Q=594,G=2,H=1,L=51,K=55,M=51,P=2,W=3,Xaa=18		9580
509	G	0						509	G	3	R=5,E=2,G=9557,Xaa=16		9580
510	N	0						510	N	5	N=9530,D=28,S=2,Y=4,Xaa=16		9580
511	I	31	V31	V	I		1982 0,0496	511	V	30	I=475,L=1,M=3,V=9089,Xaa=12		9580
512	L	0						512	L	2	I=1,L=9567,F=1,Xaa=11		9580
513	L	0						513	L	2	I=1,L=9563,F=4,V=1,Xaa=11		9580
514	S	0						514	S	2	F=1,P=1,S=9564,T=3,Xaa=11		9580
515	P	0						515	P	2	H=1,K=1,P=9567,T=1,Xaa=10		9580
516	E	0						516	E	1	Q=1,E=9569,Xaa=10		9580
517	E	0						517	E	2	D=1,Q=1,E=9562,G=2,K=2,Xaa=12		9580
518	V	0						518	V	2	I=5,V=9564,Xaa=11		9580
519	S	0						519	S	2	R=1,N=1,C=1,S=9563,T=1,Xaa=13		9580
520	E	0						520	E	2	D=4,E=9562,G=1,K=1,Xaa=12		9580
521	T	0						521	T	9	A=51,N=16,K=7,S=1,T=9492,Xaa=13		9580
522	Q	0						522	Q	5	R=2,Q=9539,E=1,H=8,L=18,Xaa=12		9580
523	G	0						523	G	2	R=1,E=2,G=9565,Xaa=12		9580
524	T	1	A1					524	T	24	A=30,I=152,L=1,K=1,M=78,S=1,T=9304,V=1,Xaa=12		9580
525	E	0						525	E	2	A=1,D=1,E=9565,Xaa=13		9580
526	K	0						526	K	9	R=75,N=5,K=9485,T=4,Xaa=11		9580
527	L	0						527	L	3	L=9552,M=17,V=1,Xaa=10		9580
528	T	0						528	T	2	A=8,I=1,P=1,T=9560,Xaa=10		9580
529	I	0						529	I	2	I=9563,M=1,V=6,Xaa=10		9580
530	I	1	T1			Early marker - 1963	0,0005	530	T	2	A=2,I=5,T=9563,Xaa=10		9580
531	Y	0						531	Y	1	Y=9570,Xaa=10		9580
532	S	0						532	S	3	A=3,L=6,P=3,S=9556,T=1,Xaa=11		9580
533	S	0						533	S	1	L=1,S=9568,Xaa=11		9580
534	S	0						534	S	13	A=1,L=1,F=5,P=133,S=9427,T=2,Xaa=11		9580
535	M	0						535	M	4	L=27,K=1,M=9539,V=1,Xaa=12		9580
536	M	0						536	M	2	R=3,I=2,M=9561,V=1,Xaa=13		9580
537	W	0						537	W	2	R=1,G=1,W=9565,Xaa=13		9580
538	E	0						538	E	2	E=9566,G=1,Xaa=13		9580
539	I	1	S1					539	I	6	I=9529,L=5,M=4,T=7,V=22,Xaa=13		9580
540	N	0						540	N	3	N=9559,S=6,T=1,Y=1,Xaa=13		9580
541	G	0						541	G	2	R=1,G=9564,V=1,Xaa=14		9580
542	P	0						542	P	5	R=1,H=1,L=1,P=9533,S=30,Xaa=14		9580
543	E	0						543	E	9	D=87,E=9477,K=2,Xaa=14		9580
544	S	0						544	S	2	L=1,P=1,S=9565,Xaa=13		9580
545	V	0						545	V	4	I=18,L=1,M=6,V=9542,Xaa=13		9580
546	L	0						546	L	3	I=10,L=9556,P=1,Xaa=13		9580
547	V	0						547	V	15	I=184,V=9383,Xaa=13		9580
548	N	0						548	N	2	N=9566,Y=1,Xaa=13		9580
549	T	0						549	T	2	A=3,P=2,T=9562,Xaa=13		9580
550	Y	0						550	Y	2	F=5,Y=9562,Xaa=13		9580
551	Q	0						551	Q	2	R=3,Q=9563,P=1,Xaa=13		9580
552	W	0						552	W	1	W=9567,Xaa=13		9580
553	I	0						553	I	11	N=1,I=9444,V=122,Xaa=13		9580
554	I	0						554	I	3	I=9556,M=1,S=3,T=2,V=4,Xaa=14		9580
555	R	11	K11					555	R	11	R=9448,I=1,K=118,Xaa=13		9580
556	N	0						556	N	10	N=9479,D=3,H=7,I=3,K=5,S=70,T=2,Xaa=11		9580
557	W	0						557	W	2	G=2,W=9566,Xaa=12		9580
558	E	0						558	E	1	E=9569,Xaa=11		9580
559	I	12	F11T1			Early marker - 1963; 1985	0,0307	559	T	71	A=328,N=162,I=294,M=27,F=1,P=4,S=94,T=8603,V=56,Xaa=11		9580
560	V	0						560	V	13	A=2,I=110,L=16,M=6,T=1,V=9433,Xaa=12		9580
561	K	0						561	K	1	K=9567,Xaa=13		9580
562	I	0						562	I	3	I=9552,T=2,V=12,Xaa=14		9580
563	Q	0						563	Q	3	R=5,Q=9555,H=1,L=2,K=1,Xaa=16		9580
564	W	0						564	W	2	C=1,G=1,W=9562,Xaa=16		9580
565	S	0						565	S	2	L=3,S=9561,Xaa=16		9580
566	Q	0						566	Q	5	R=1,Q=9541,H=16,K=5,P=1,Xaa=16		9580
567	D	0						567	D	12	A=1,N=21,D=9465,E=65,G=7,Y=1,V=4,Xaa=16		9580
568	P	1	L1					568	P	2	A=1,Del=1,P=9564,Xaa=14		9580
569	T	0						569	T	5	A=9,N=1,Del=1,I=1,M=2,P=1,S=7,T=9541,Xaa=17		9580
570	M	1	I1					570	M	33	R=1,Del=1,I=450,L=1,K=3,M=9085,T=3,V=20,Xaa=16		9580
571	L	0						571	L	2	Del=1,I=1,L=9562,P=1,S=1,Xaa=14		9580
572	Y	1	H1					572	Y	2	C=2,H=1,Y=9561,Xaa=16		9580
573	N	0						573	N	2	A=1,N=9561,K=2,Xaa=16		9580
574	K	1	R1					574	K	6	R=44,K=9519,Xaa=17		9580
575	I	7	M7	M	I		1976 0,0070	575	M	23	R=1,I=91,L=67,M=9329,T=13,V=63,Xaa=16		9580
576	E	0						576	E	2	E=9561,K=2,Xaa=17		9580
577	F	0						577	F	2	L=5,F=9559,Xaa=16		9580
578	E	0						578	E	3	A=1,D=4,E=9555,G=2,K=1,S=1,Xaa=16		9580
579	P	0						579	P	4	A=1,P=9547,S=15,Xaa=17		9580
580	F	0						580	F	2	L=3,F=9560,S=2,Xaa=15		9580
581	Q	0						581	Q	2	R=1,Q=9563,Xaa=16		9580
582	S	0						582	S	3	A=2,F=1,P=2,S=9558,Y=2,Xaa=15		9580
583	L	0						583	L	6	L=9518,M=43,F=1,P=1,S=1,Xaa=16		9580
584	V	0						584	V	14	A=1,I=160,F=1,V=9402,Xaa=16		9580
585	P	0						585	P	3	L=1,P=9558,S=5,Xaa=16		9580
586	R	1	K1			Early marker - 1963	0,0113	586	K	11	R=108,N=1,K=9453,Xaa=18		9580
587	A	0						587	A	2	A=9561,P=1,T=2,Xaa=16		9580
588	T	7	A6I1	A	T		1975 0,0282	588	A	34	A=9136,G=1,I=44,P=1,S=6,T=270,V=104,Xaa=18		9580

vmuc:
Not a marker (>0.05)

589	R	0						589	R	3	R=9558,K=5,Xaa=17	9580
590	S	26	G26	G	S	1985	0,0992	590	G	54	A=2,R=1,N=8,C=40,G=8560,S=950,Xaa=19	9580
591	Q	1	R1					591	Q	13	R=18,Q=9459,H=27,L=45,K=11,P=3,Xaa=17	9580
592	Y	0						592	Y	2	D=1,Y=9561,Xaa=18	9580
593	S	0						593	S	2	N=1,S=9562,Xaa=17	9580
594	G	0						594	G	2	G=9563,Xaa=17	9580
595	F	0						595	F	2	L=1,F=9562,Xaa=17	9580
596	V	0						596	V	3	A=1,I=7,V=9556,Xaa=16	9580
597	R	0						597	R	2	R=9562,G=1,K=1,Xaa=16	9580
598	T	1	I1					598	T	21	A=39,I=3,M=22,T=9328,V=171,Xaa=17	9580
599	L	0						599	L	2	L=9563,Xaa=17	9580
600	F	0						600	F	3	L=1,F=9559,S=3,Y=2,Xaa=15	9580
601	Q	0						601	Q	2	Q=9565,H=1,P=1,Xaa=13	9580
602	Q	0						602	Q	1	Q=9567,Xaa=13	9580
603	M	0						603	M	2	I=1,M=9561,T=1,V=4,Xaa=13	9580
604	R	0						604	R	2	R=9567,S=1,Xaa=12	9580
605	D	0						605	D	1	D=9567,Xaa=13	9580
606	V	0						606	V	7	I=67,V=9501,Xaa=12	9580
607	L	0						607	L	6	R=1,I=25,L=9524,M=5,F=4,W=2,V=7,Xaa=12	9580
608	G	0						608	G	1	G=9568,Xaa=12	9580
609	T	0						609	T	2	K=1,T=9567,Xaa=12	9580
610	F	0						610	F	3	L=8,F=9559,S=1,Xaa=12	9580
611	D	0						611	D	10	A=1,N=15,D=9484,E=63,G=5,Y=1,Xaa=11	9580
612	T	0						612	T	3	A=3,N=3,I=6,F=2,S=3,T=9553,Xaa=10	9580
613	A	7	V5I2	V	A	1975	0,0109	613	V	16	A=104,I=72,V=9394,Xaa=10	9580
614	Q	0						614	Q	1	Q=9568,H=1,P=1,Xaa=10	9580
615	I	1	M1					615	I	7	I=9507,L=2,M=4,T=3,V=54,Xaa=10	9580
616	I	0						616	I	4	I=9547,M=7,T=3,V=13,Xaa=10	9580
617	K	0						617	K	1	R=2,K=9568,Xaa=10	9580
618	L	0						618	L	4	R=1,Del=1,L=9546,M=22,Xaa=10	9580
619	L	0						619	L	2	I=5,L=9564,V=1,Xaa=10	9580
620	P	0						620	P	1	P=9569,T=1,Xaa=10	9580
621	F	0						621	F	2	C=1,L=2,F=9566,V=1,Xaa=10	9580
622	A	0						622	A	3	A=9554,S=2,T=14,Xaa=10	9580
623	A	0						623	A	4	A=9541,D=1,S=27,T=1,Xaa=10	9580
624	A	0						624	A	2	A=9562,D=1,S=6,T=1,Xaa=10	9580
625	P	0						625	P	1	P=9569,Xaa=11	9580
626	P	0						626	P	1	P=9568,S=1,Xaa=11	9580
627	E	0						627	E	29	A=1,E=9174,G=3,K=315,V=75,Xaa=12	9580
628	Q	0						628	Q	3	R=2,Q=9553,H=6,L=3,K=2,P=4,Xaa=10	9580
629	S	0						629	S	5	R=2,N=35,G=2,S=9531,T=1,Xaa=9	9580
630	R	0						630	R	6	R=9521,K=50,Xaa=9	9580
631	M	0						631	M	2	I=2,L=6,K=1,M=9562,Xaa=9	9580
632	Q	0						632	Q	2	R=3,Q=9567,H=1,Xaa=9	9580
633	F	0						633	F	1	L=1,F=9569,Y=2,Xaa=8	9580
634	S	0						634	S	4	F=15,P=1,S=9550,T=2,Y=2,Xaa=10	9580
635	S	0						635	S	1	F=2,P=2,S=9569,Xaa=7	9580
636	L	0						636	L	2	I=1,L=9567,M=6,F=1,Xaa=5	9580
637	T	0						637	T	3	A=3,N=2,I=10,S=2,T=9558,V=1,Xaa=4	9580
638	V	0						638	V	1	G=1,I=4,L=1,V=9570,Xaa=4	9580
639	N	1	X1					639	N	5	N=9537,I=2,K=1,S=28,T=8,Xaa=4	9580
640	V	0						640	V	3	A=1,I=24,L=2,V=9549,Xaa=4	9580
641	R	0						641	R	2	R=9564,G=8,K=4,Xaa=4	9580
642	G	0						642	G	1	A=1,G=9575,Xaa=4	9580
643	S	0						643	S	7	A=1,L=2,S=9509,T=64,Xaa=4	9580
644	G	0						644	G	1	R=2,E=1,G=9573,Xaa=4	9580
645	M	1	L1					645	M	3	I=1,L=19,M=9554,V=3,Xaa=3	9580
646	R	0						646	R	1	R=9573,K=4,Xaa=3	9580
647	I	0						647	I	6	I=9524,L=4,M=7,T=1,V=41,Xaa=3	9580
648	L	0						648	L	19	A=1,I=12,L=9353,M=7,F=7,P=27,V=170,Xaa=3	9580
649	V	0						649	V	38	I=669,L=4,M=4,V=8899,Xaa=4	9580
650	R	0						650	R	1	R=9574,K=1,S=1,Xaa=4	9580
651	G	0						651	G	1	A=1,R=1,C=2,G=9573,Xaa=3	9580
652	N	0						652	N	3	N=9558,H=4,S=15,Xaa=3	9580
653	S	0						653	S	1	C=1,F=3,S=9574,Xaa=2	9580
654	P	0						654	P	2	H=1,P=9564,S=13,Xaa=2	9580
655	V	0						655	V	10	A=83,G=3,I=1,L=16,M=2,V=9473,Xaa=2	9580
656	F	0						656	F	1	F=9576,S=2,Xaa=2	9580
657	N	0						657	N	3	N=9561,D=1,I=1,K=4,M=1,S=6,T=2,Y=2,Xaa=2	9580
658	Y	0						658	Y	4	D=1,C=3,H=17,F=7,Y=9550,Xaa=2	9580
659	N	0						659	N	6	N=9521,D=1,H=3,I=1,M=1,S=50,T=1,Xaa=2	9580
660	K	10	R9X1					660	K	12	R=143,N=1,Q=1,K=9431,M=1,Xaa=3	9580
661	A	0						661	A	22	A=9314,E=1,G=8,S=42,T=171,V=42,Xaa=2	9580
662	T	2	N2					662	T	8	A=3,N=5,G=31,I=10,S=19,T=9510,Xaa=2	9580
663	K	1	N1					663	K	6	R=37,N=5,Q=10,E=2,G=1,K=9523,Xaa=2	9580
664	R	0						664	R	1	R=9575,Del=1,K=1,T=1,W=1,Xaa=1	9580
665	L	0						665	L	1	D=2,I=7,L=9569,F=1,V=1	9580
666	T	0						666	T	9	A=48,I=34,M=1,S=1,T=9493,V=3	9580
667	V	0						667	V	25	A=2,R=1,I=390,V=9187	9580
668	L	0						668	L	2	I=9,L=9567,F=3,Xaa=1	9580
669	G	0						669	G	0	R=1,E=1,G=9577,Xaa=1	9580
670	K	0						670	K	1	R=3,K=9574,T=2,Xaa=1	9580
671	D	0						671	D	2	N=13,D=9562,E=2,G=2,Xaa=1	9580
672	A	0						672	A	1	A=9576,C=1,T=2,Xaa=1	9580
673	G	0						673	G	1	R=2,G=9574,S=3,Xaa=1	9580
674	A	1	T1					674	A	22	A=9330,E=22,G=5,P=1,S=123,T=81,V=15,Xaa=3	9580
675	L	0						675	L	0	L=9577,K=1,M=2	9580
676	T	3	I3			1971		676	T	65	A=357,R=7,N=19,E=2,I=248,K=6,M=201,S=19,T=8678,V=43	9580
677	E	0						677	E	15	D=38,E=9416,G=102,K=23,Xaa=1	9580
678	D	0						678	D	3	N=8,D=9552,G=14,Y=3,V=2,Xaa=1	9580
679	P	0						679	P	5	R=1,Q=14,L=14,P=9538,S=11,T=2	9580
680	D	0						680	D	19	N=73,D=9365,E=113,G=22,Y=3,V=3,Xaa=1	9580
681	E	0						681	E	2	D=10,E=9564,G=5,K=1	9580
682	G	0						682	G	2	A=1,R=1,D=2,C=1,G=9565,S=10	9580
683	T	0						683	T	19	A=131,R=1,I=27,K=20,M=5,S=24,T=9370,V=2	9580
684	A	2	T2			1971		684	A	15	A=9413,D=2,E=2,G=7,S=13,T=128,V=14,Xaa=1	9580
685	G	0						685	G	0	R=2,G=9578	9580
686	V	2	I2			1971		686	V	5	G=1,I=48,L=1,M=1,V=9529	9580
687	E	0						687	E	0	D=1,E=9579	9580
688	S	0						688	S	5	A=1,F=46,S=9529,Xaa=4	9580
689	A	0						689	A	0	A=9577,G=1,P=2	9580
690	V	0						690	V	0	D=1,I=2,V=9577	9580
691	L	0						691	L	0	L=9578,F=1,W=1	9580
692	R	0						692	R	1	R=9576,G=2,K=2	9580
693	G	0						693	G	0	G=9580	9580
694	F	0						694	F	0	L=3,F=9577	9580
695	L	0						695	L	0	I=1,L=9579	9580
696	I	0						696	I	2	I=9565,T=1,V=14	9580
697	L	0						697	L	1	I=3,L=9575,P=2	9580
698	G	0						698	G	2	A=1,G=9566,S=13	9580
699	K	0						699	K	6	R=39,N=12,Q=5,K=9523,M=1	9580
700	E	0						700	E	2	D=1,E=9561,G=17,V=1	9580
701	N	1	D1		Early marker - 1963		0,0009	701	D	2	N=9,D=9564,E=6,V=1	9580
702	K	0						702	K	14	R=159,N=9,Q=3,G=1,I=1,K=9405,T=2	9580
703	R	2	K2					703	R	1	R=9573,G=3,K=4	9580
704	Y	0						704	Y	4	C=1,H=2,F=32,Y=9545	9580
705	G	0						705	G	1	R=1,Del=2,G=9576,S=1	9580
706	P	0						706	P	1	Del=1,P=9576,S=3	9580
707	A	0						707	A	4	A=9540,P=2,S=36,T=2	9580
708	L	0						708	L	1	L=9567,F=13	9580
709	S	0						709	S	1	R=1,N=2,G=2,I=1,S=9571,T=2,Xaa=1	9580
710	I	0						710	I	1	I=9573,T=3,V=4	9580
711	N	0						711	N	13	N=9427,D=38,K=2,S=112,T=1	9580
712	E	0						712	E	0	E=9578,G=1,Xaa=1	9580
713	L	0						713	L	1	R=1,Del=1,I=1,L=9570,M=7	9580
714	S	0						714	S	12	N=3,G=128,I=1,S=9439,T=9	9580
715	K	7	N7	N	K	1975	0,0005	715	N	12	N=9444,D=2,H=2,I=1,K=5,S=120,T=5,Y=1	9580
716	L	0						716	L	2	H=1,I=6,L=9565,F=7,P=1	9580
717	T	42	A42	A	T	1971	0,0213	717	A	19	A=9334,S=5,T=204,V=36,Xaa=1	9580
718	K	1	R1					718	K	5	R=56,E=1,K=9523	9580
719	G	0						719	G	0	R=2,G=9578	9580
720	E	0						720	E	0	D=1,E=9577,G=2	9580
721	K	0						721	K	2	R=6,N=3,E=2,K=9564,M=4,Xaa=1	9580
722	A	0						722	A	3	A=9560,N=1,G=4,S=3,T=5,V=7	9580
723	N	0						723	N	1	N=9576,D=2,I=1,K=1	9580
724	V	0						724	V	0	A=1,G=1,I=1,V=9577	9580
725	L	0						725	L	1	Del=1,I=1,L=9573,K=3,M=1,P=1	9580
726	I	0						726	I	2	Del=1,I=9561,M=1,T=4,V=13	9580
727	G	0						727	G	2	R=18,Del=1,G=9559,M=2	9580
728	Q	0						728	Q	0	Q=9579,P=1	9580
729	G	0						729	G	0	R=1,G=9579	9580
730	D	0						730	D	0	N=1,D=9577,E=1,G=1	9580
731	V	4	I3X1					731	V	12	A=3,I=117,L=2,M=11,T=2,V=9444,Xaa=1	9580
732	V	0						732	V	0	M=1,V=9579	9580
733	L	0						733	L	0	L=9579,W=1	9580
734	V	0						734	V	2	A=8,I=6,V=9566	9580
735	M	0						735	M	0	I=1,K=1,M=9578	9580
736	K	0						736	K	1	R=2,N=2,E=1,K=9575	9580
737	R	1	W1					737	R	1	R=9576,P=4	9580
738	K	0						738	K	0	R=1,N=1,K=9578	9580

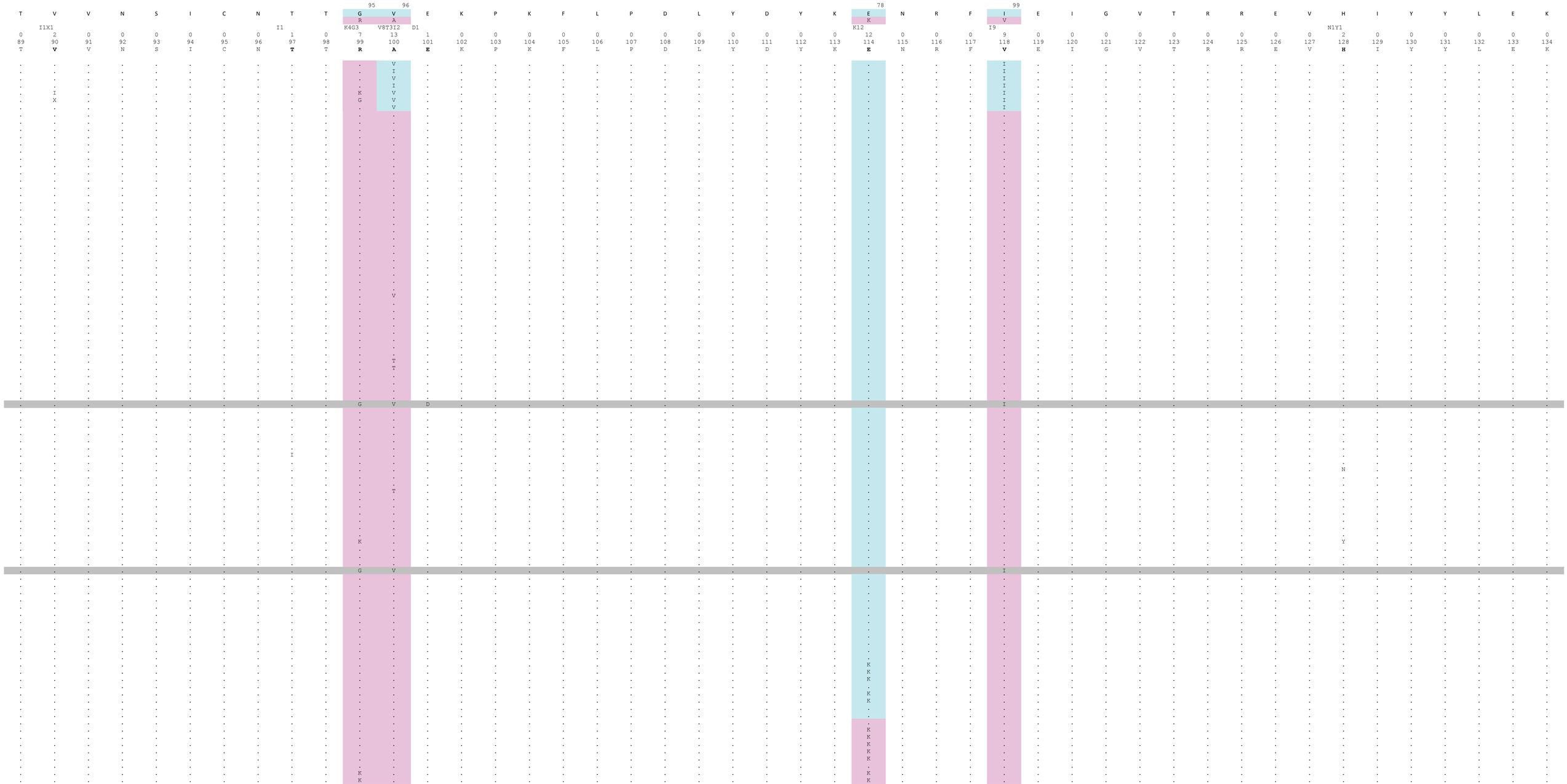
vmuc:
Not a marker
(>0.05)

739	R	0		739	R	1 R=9576,P=4	9580
740	D	0		740	D	2 N=18,D=9559,E=1,G=1,Xaa=1	9580
741	S	0		741	S	3 A=2,F=21,S=9556,Xaa=1	9580
742	S	0		742	S	0 G=1,S=9577,T=2	9580
743	I	0		743	I	1 I=9568,L=12	9580
744	L	0		744	L	0 L=9579,F=1	9580
745	T	0		745	T	1 I=9,P=1,T=9570	9580
746	D	0		746	D	0 D=9580	9580
747	S	0		747	S	1 R=1,N=1,C=1,G=1,I=1,S=9575	9580
748	Q	0		748	Q	1 R=1,Q=9576,H=1,L=1,P=1	9580
749	T	0		749	T	0 P=1,T=9579	9580
750	A	0		750	A	0 A=9577,G=1,P=2	9580
751	T	1	S1	751	T	0 N=1,P=2,T=9577	9580
752	K	0		752	K	1 R=3,Q=1,I=1,K=9574,T=1	9580
753	R	0		753	R	1 R=9573,N=1,K=5,S=1	9580
754	I	0		754	I	2 H=1,I=9561,L=3,F=3,T=2,V=10	9580
755	R	0		755	R	1 R=9571,Q=3,G=2,P=2,W=2	9580
756	M	0		756	M	5 R=4,D=1,I=4,L=7,M=9537,S=1,T=6,V=20	9580
757	A	0		757	A	2 A=9561,D=2,G=1,P=3,S=1,V=12	9580
758	I	0		758	I	5 N=2,I=9528,M=1,F=2,T=44,V=2,Xaa=1	9580
759	N	2	S2	759	N	9 N=9495,D=1,H=1,I=18,K=11,F=1,S=2,T=2,Y=48,V=1	9580

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

| | | |


E V C F M Y S D F H F I D N E R L G E S I V I V E D S G D P N A L L K H R F E I I E G R D R T M I A W
100 100 98 100 99 75 75
D8 R6 S1 G1 I2M1X1 V33 V3 D15 F1 X1 A2 I15
0 43 E
0 44 V
0 45 C
0 46 F
0 47 M
0 48 Y
0 49 S
0 50 D
0 51 F
0 52 H
0 53 F
0 54 I
8 55 N
0 56 E
6 57 L
1 58 G
1 59 E
0 60 S
4 61 V
33 62 I
3 63 I
15 64 E
1 65 S
0 66 G
0 67 D
0 68 P
0 69 N
0 70 A
1 71 L
0 72 L
0 73 K
0 74 H
0 75 R
0 76 F
0 77 E
0 78 I
0 79 I
0 80 E
0 81 G
0 82 R
0 83 D
0 84 R
2 85 T
15 86 M
0 87 A
0 88 W


95 96
78
99
I1X1
I1
K4G3
V8T3I2
D1
K12
I9
N1Y1

60
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R
G2
R13G2
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 15 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180
A N K I K S E K T H I H I F S F T G E E M A T K A D Y T L D E E S R A R I K T R L F T I R Q
G
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G


97
99 H100Y100
E M A S R G L W D S F R Q S E R G E E T I E E R F E I T G T M R R L A D Q S L P P N F S S L
K N HY
V2 M1 K3 K1 K1 K4 A1M1 K31 D10 H7Q2 F1
0 0 2 1 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 0 4 0 2 0 0 31 0 0 10 9 0 0 0 0 0 0 0 0 1
181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226
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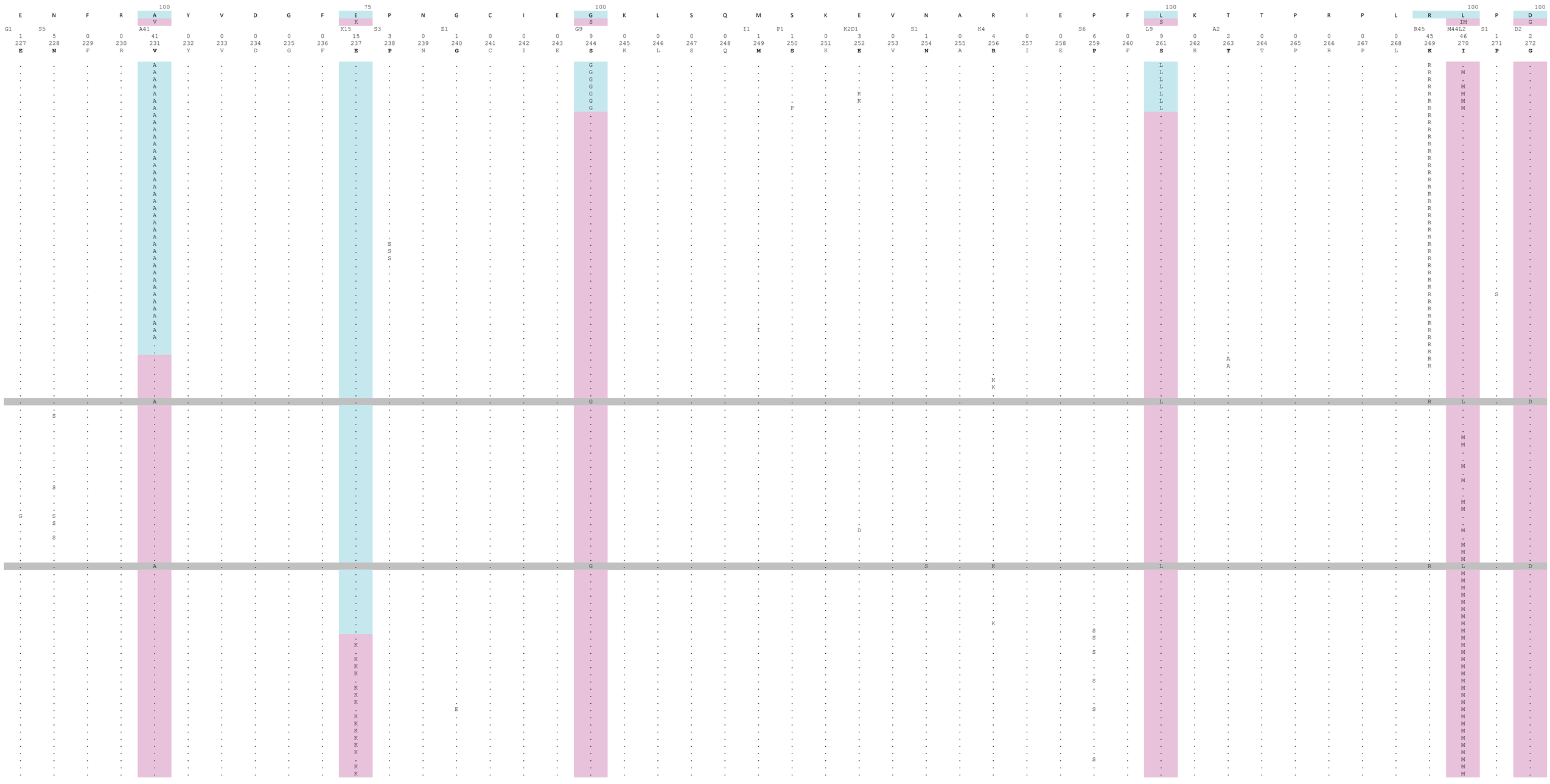
100
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100
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G1 S5 A41 K15 S3 E1 G9 I1 P1 K2D1 S1 K4 S6 L9 A2 R45 M44L2 S1 D2
227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272
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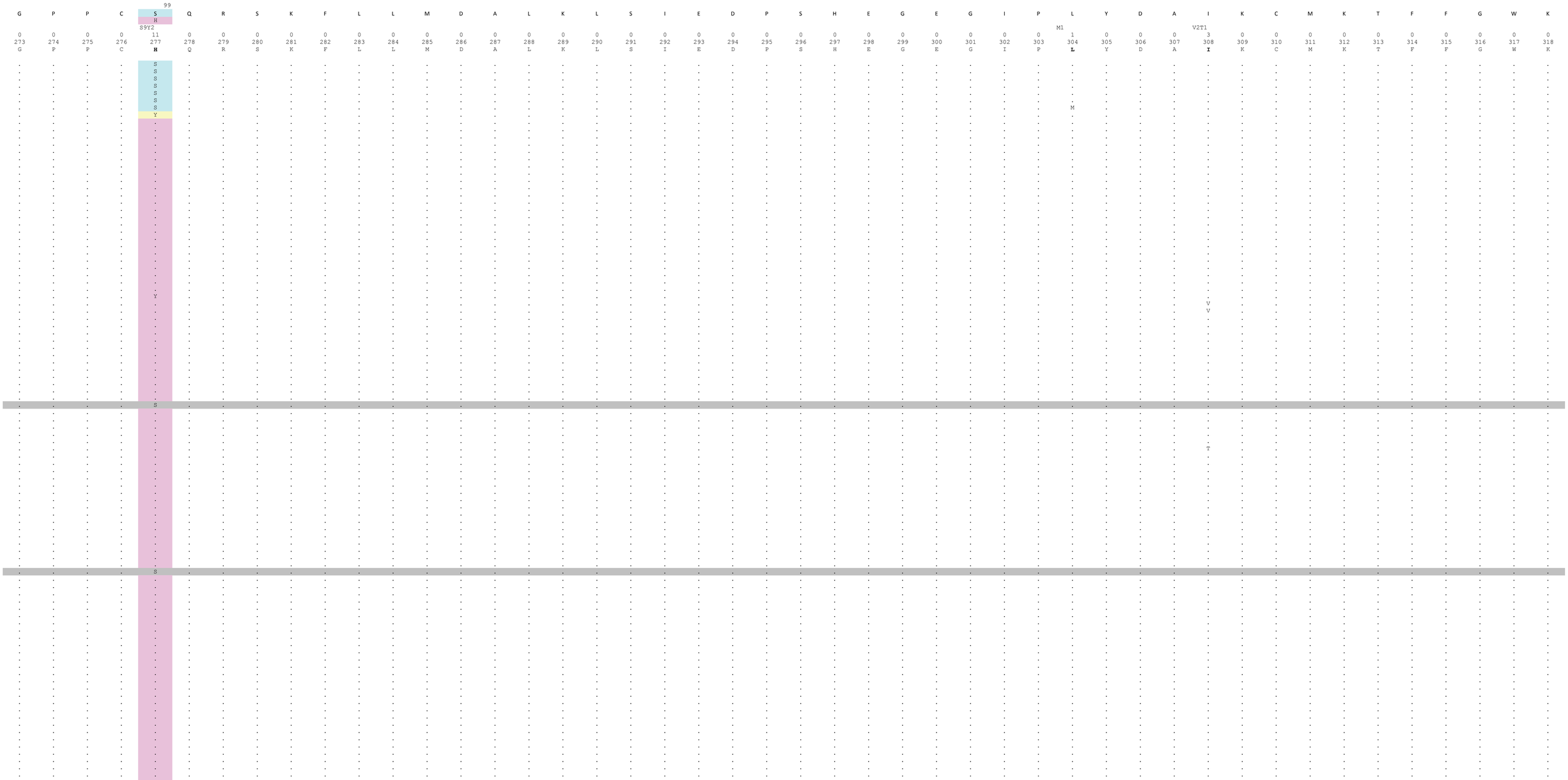
99
S9Y2
M1
V2T1


E P N I V K P H E K G I N P N Y L L A W K Q V L A E L Q D I E N E E K I P K T K N M K K T S
319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364
E P S I V K P H E K G I N P N Y L Q A W K Q V L A E L Q D L E N E E K T P K T K N M K K T S


99
Q L K W A L G E N M A P E K V D F E D C K D V S D L K Q Y D S D E P E PSQ R S L A S W I Q S E
T
G1 D1 E1 V2 N29G1 N1 K5 A5P5 I1 V1 N7
0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 2 30 0 0 0 0 0 1 0 0 0 0 5 10 0 0 1 0 0 0 1 0 7 0
365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410
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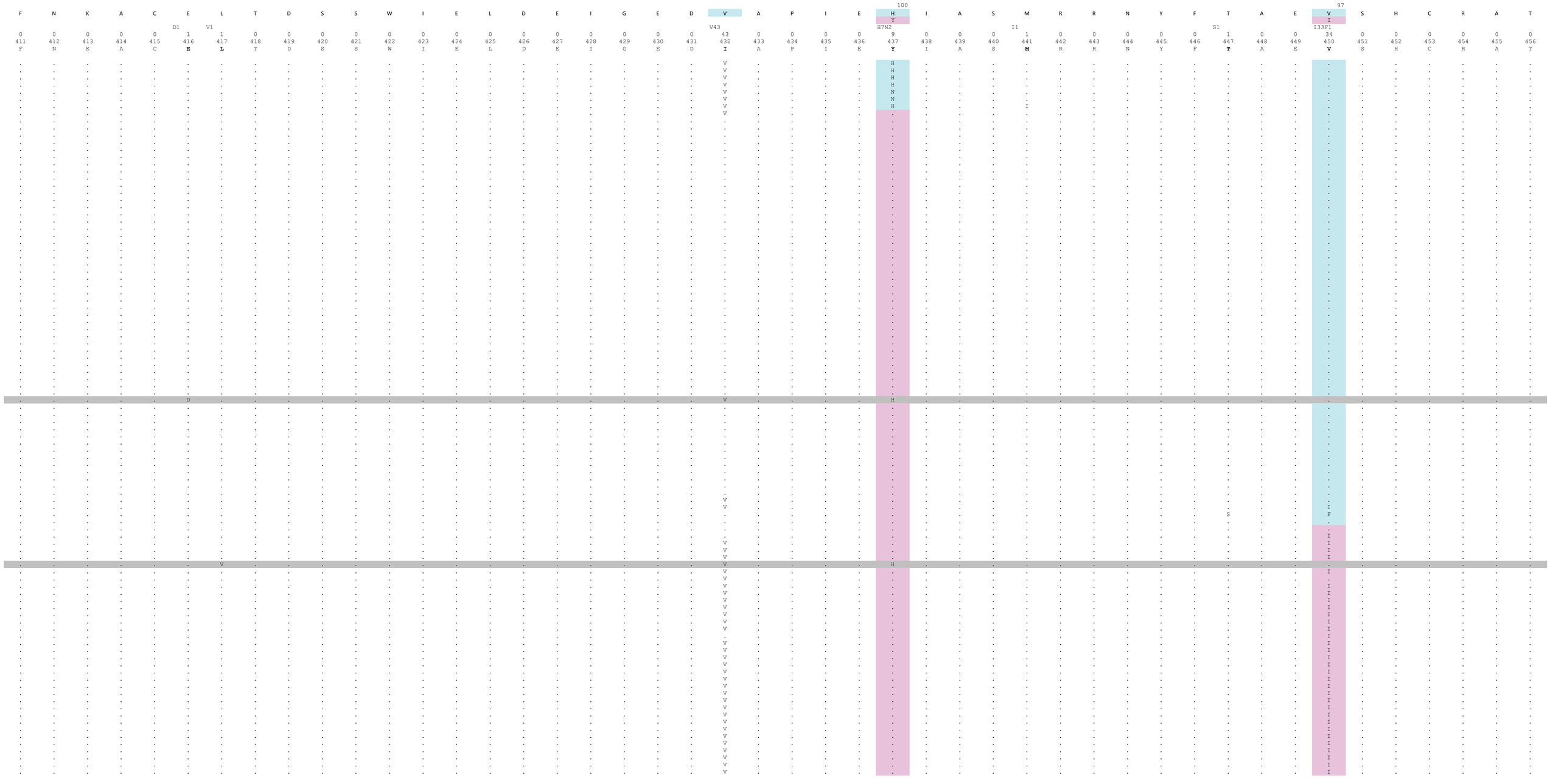
D1
V1
V43
H7N2
I1
S1
I33F1
100
97


E Y I M K G V Y I N T A L L N A S C A A M D D F Q L I P M I S K C R T K E G R R K T N L Y G
75
100
A
T
D
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V12
T15
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Y3L1
0 0 0 0 0 0 0 0 12 0 0 0 0 0 0 0 0 0 0 15 0 0 35 4 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502
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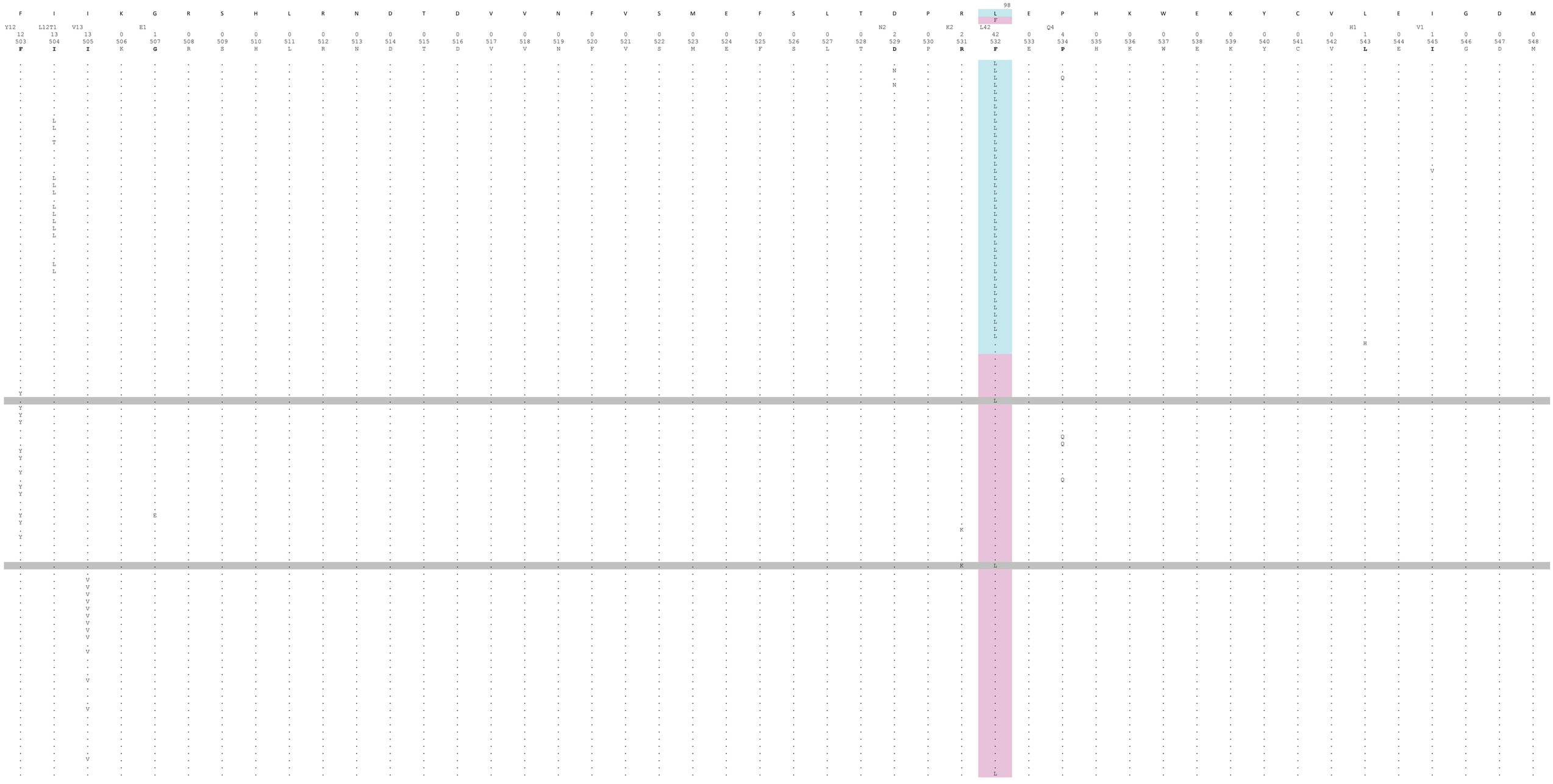
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Y12 L12T1 V13 E1 N2 K2 L42 Q4 H1 V1
12 13 13 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 2 42 0 4 0 0 0 0 0 0 0 0 1 0 1 0 0 0
503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548
F I I K G R S H L R N D T D V V N F V S M E F S L T D P R L E P H K W E K Y C V L E I G D M
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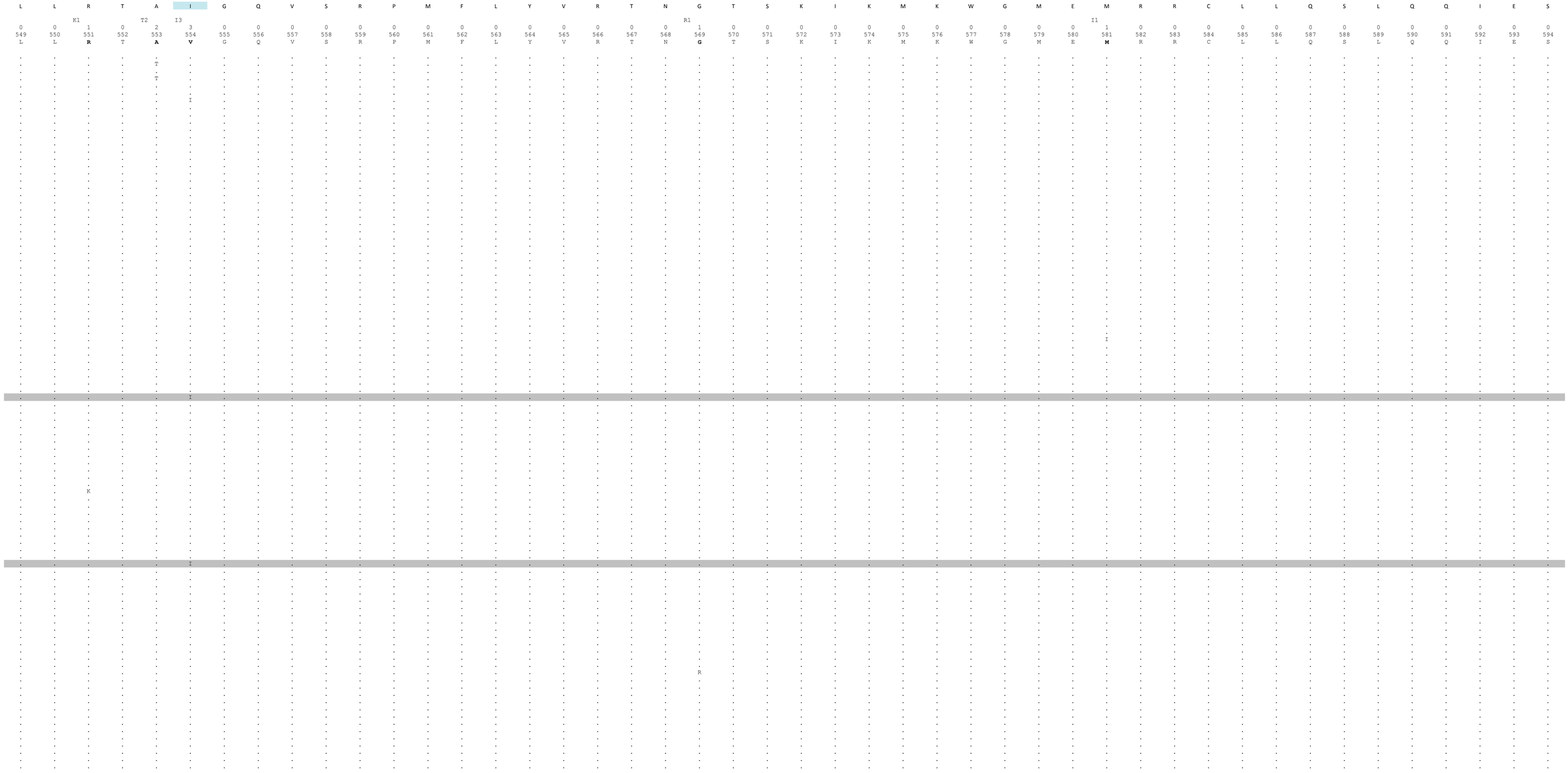
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K1 T2 I3 R1 I1
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L L R T A V G Q V S R P M F L Y V R T N G T S K I K M K W G M E M R R C L L Q S L Q Q I E S
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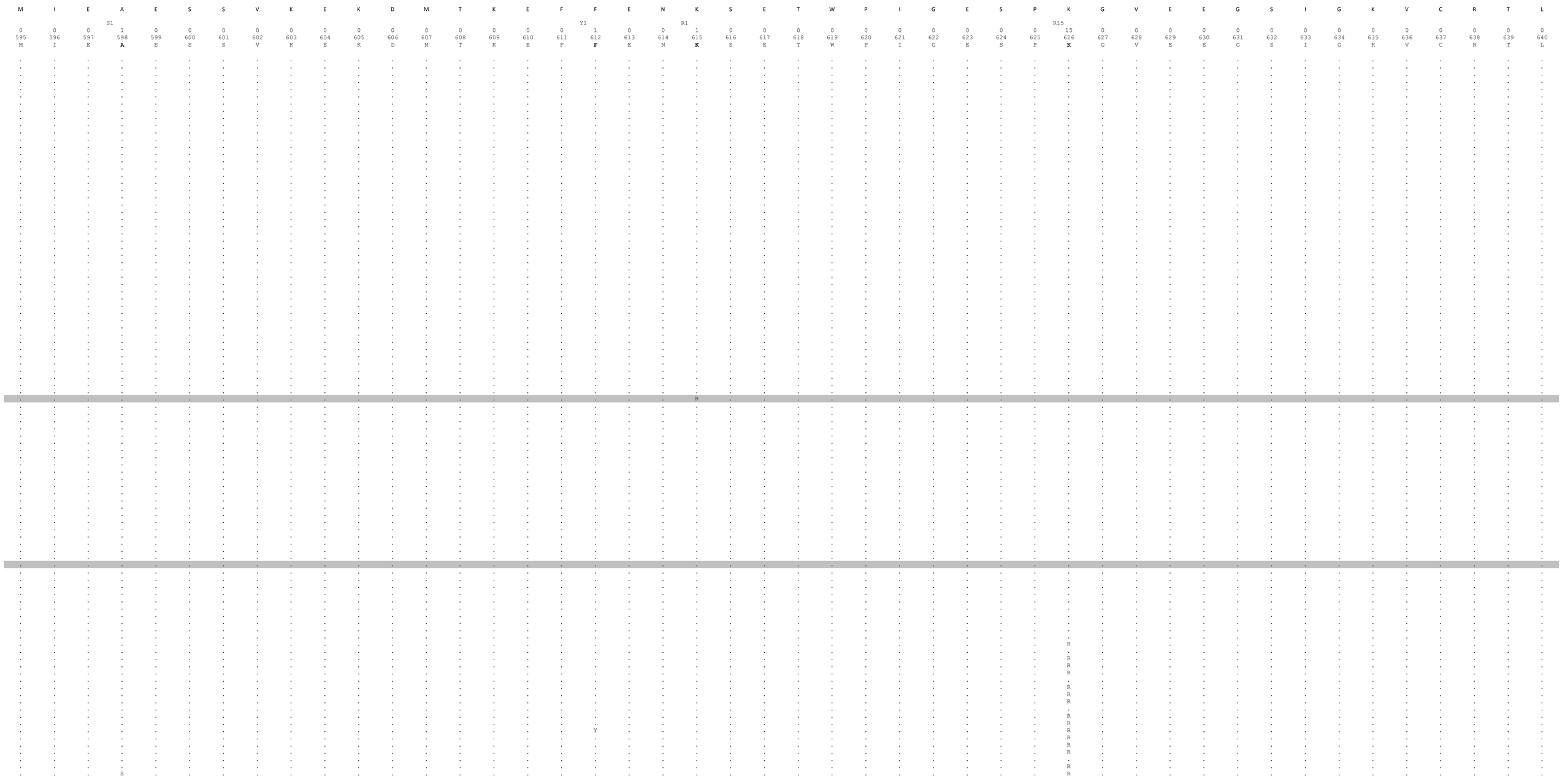
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S1
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M I E A E S S V K E K D M T K E F F E N K S E T W P I G E S P K G V E E G S I G K V C R T L
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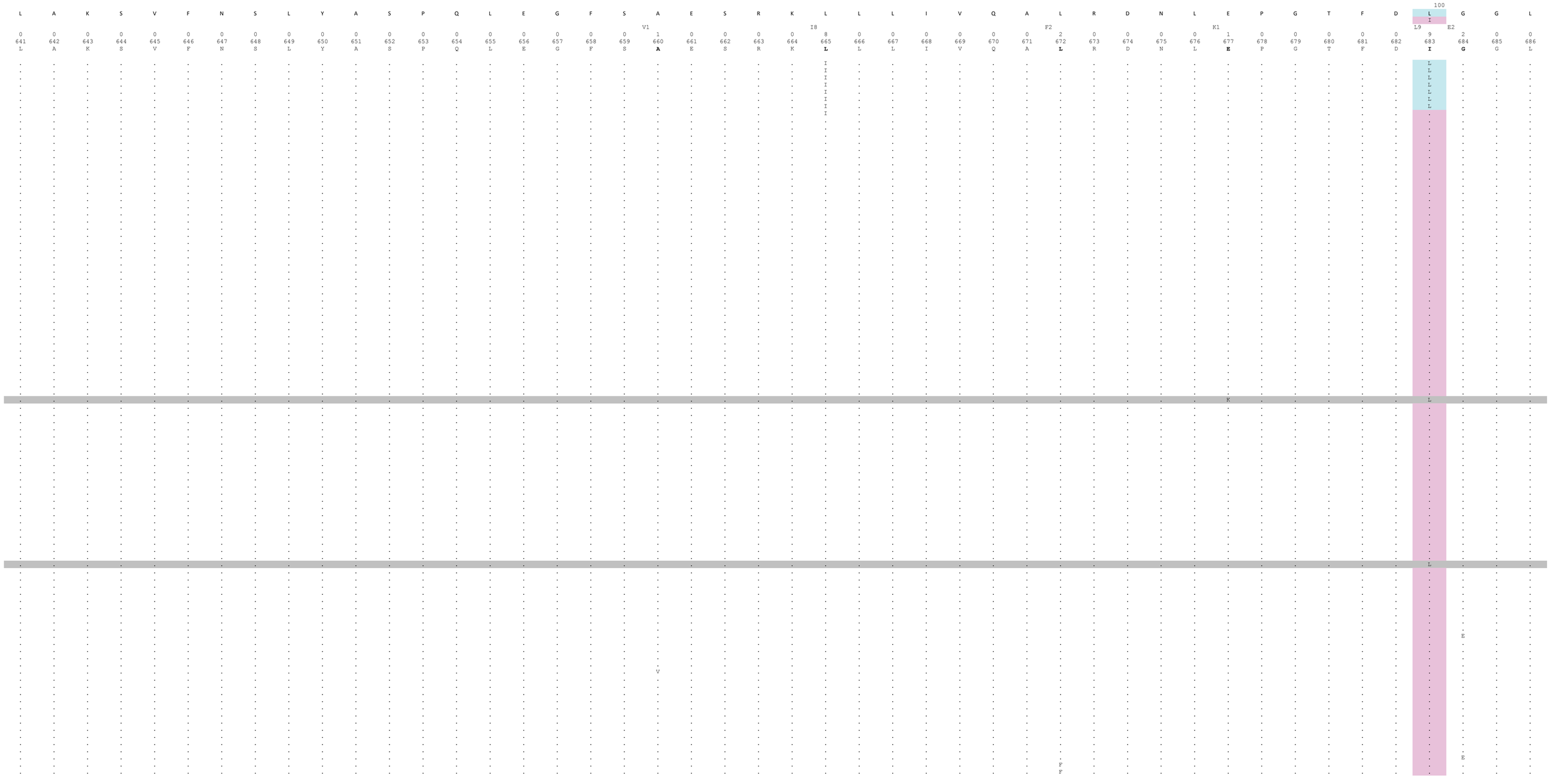
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		100																											
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		S																											
		A2							S1											V1				V1	I1K1				R2
0	0	2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	2	0	0	0	2
687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716
Y	E	**S**	I	E	E	C	L	I	**N**	D	P	W	V	L	L	N	A	S	W	**F**	N	S	F	**L**	**T**	H	A	L	**K**
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Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine PA H3N8				Permanent aa change				Avian_PA all subtypes			
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	0						1	M	0	M=9726	9726
2	E	0						2	E	4	A=1,Q=1,E=9708,G=22,K=3,V=4	9739
3	**D**	2	N1G1					3	D	14	A=1,R=2,N=121,D=9582,E=25,G=5,H=1,Y=2	9739
4	F	0						4	F	2	L=18,F=9720,V=1	9739
5	V	0						5	V	5	A=10,D=1,G=1,L=13,M=14,V=9700	9739
6	R	0						6	R	0	A=1,R=9738	9739
7	Q	0						7	Q	2	A=1,R=3,Q=9728,H=1,K=2,P=2,S=1,T=1	9739
8	C	0						8	C	3	C=9717,G=1,S=10,W=2,Y=9	9739
9	F	0						9	F	1	L=3,F=9733,Y=1,V=1,Xaa=1	9739
10	**N**	1	Y1					10	N	4	N=9701,D=2,H=1,I=2,S=32,T=1	9739
11	P	0						11	P	1	L=1,P=9735,S=3	9739
12	M	0						12	M	2	I=14,M=9723,V=2	9739
13	**I**	2	M1V1					13	I	15	R=1,I=9565,M=1,T=80,V=90,Xaa=2	9739
14	V	0						14	V	7	A=44,I=27,F=1,V=9666,Xaa=1	9739
15	**E**	1	V1					15	E	2	Q=1,E=9717,G=20,K=1	9739
16	L	0						16	L	0	H=1,L=9737,Xaa=1	9739
17	A	0						17	A	1	A=9728,G=1,S=5,T=3,V=1,Xaa=1	9739
18	**E**	2	G1K1					18	E	2	D=3,E=9726,G=8,K=2	9739
19	K	0						19	K	6	R=40,N=13,E=2,K=9683,S=1	9739
20	**A**	3	T3					20	A	12	A=9597,E=2,S=3,T=134,V=3	9739
21	M	0						21	M	1	I=3,M=9733,T=1,V=2	9739
22	**K**	1	R1					22	K	4	R=36,I=1,K=9702	9739
23	E	0						23	E	0	E=9736,G=2,V=1	9739
24	Y	0						24	Y	4	D=2,H=34,Y=9702,Xaa=1	9739
25	G	0						25	G	0	G=9738,W=1	9739
26	E	0						26	E	1	D=1,Q=1,E=9733,G=3,K=1	9739
27	**D**	1	N1					27	D	26	A=8,N=286,D=9389,E=4,G=3,K=1,S=24,T=8,Y=10,V=6	9739
28	P	0						28	P	3	Q=1,H=1,L=10,P=9712,S=11,T=4	9739
29	K	0						29	K	6	R=44,N=1,Q=1,E=6,G=1,I=1,K=9684,F=1	9739
30	I	0						30	I	13	A=1,I=9600,L=34,F=1,T=24,Y=1,V=78	9739
31	E	0						31	E	1	D=1,E=9731,G=3,K=4	9739
32	**T**	1	M1					32	T	5	A=5,N=14,I=3,K=1,M=11,S=5,T=9700	9739
33	N	0						33	N	1	N=9734,D=1,K=2,S=1,T=1	9739
34	K	0						34	K	0	R=1,K=9737,T=1	9739
35	F	0						35	F	3	L=28,F=9709,P=1,S=1	9739
36	A	0						36	A	5	A=9697,S=9,T=28,V=4,Xaa=1	9739
37	A	0						37	A	9	A=9635,S=103,T=1	9739
38	I	0						38	I	4	I=9696,L=1,M=4,T=1,V=37	9739
39	C	0						39	C	0	R=1,C=9736,S=1,Y=1	9739
40	T	0						40	T	2	A=7,I=8,T=9724	9739
41	H	0						41	H	0	R=1,Q=1,H=9737	9739
42	L	0						42	L	2	I=2,L=9723,M=10,F=2,S=2	9739
43	E	0						43	E	1	D=2,Q=8,E=9728,G=1	9739
44	V	0						44	V	11	A=9,G=1,I=120,F=1,V=9607,Xaa=1	9739
45	C	0						45	C	0	C=9737,S=1,W=1	9739
46	F	0						46	F	0	L=1,F=9738	9739
47	M	0						47	M	0	M=9739	9739
48	Y	0						48	Y	0	F=1,Y=9738	9739
49	S	0						49	S	1	A=3,L=4,S=9730,T=2	9739
50	D	0						50	D	0	D=9738,H=1	9739
51	F	0						51	F	2	L=14,F=9724,Xaa=1	9739
52	H	0						52	H	0	H=9738,L=1	9739
53	F	0						53	F	0	L=2,F=9736,S=1	9739
54	I	0						54	I	2	I=9718,L=1,M=3,T=2,V=15	9739
55	**N**	8	D8	D	N		1975 0,0116	55	D	9	N=113,D=9626	9739
56	E	0						56	E	2	D=8,E=9722,G=3,V=6	9739
57	**L**	6	R6	R	L		1972 0,0003	57	R	14	R=9570,Q=148,G=1,L=3,K=5,W=12	9739
58	**G**	1	S1					58	G	46	N=14,D=5,E=5,G=8860,S=855	9739
59	**E**	1	G1					59	E	11	A=2,N=5,D=34,E=9635,G=14,K=47,V=1,Xaa=1	9739
60	S	0						60	S	2	A=1,L=1,P=9,S=9727,Xaa=1	9739
61	**V**	4	I2M1X1			Early marker - 1963	0,0342	61	I	53	R=1,I=8978,L=10,K=14,M=96,T=304,W=1,V=333,Xaa=2	9739
62	**I**	33	V33	I	V		1997 0,0282	62	I	20	I=9449,L=3,M=2,T=9,V=275,Xaa=1	9739
63	**I**	3	V3			Early marker - 1963	0,0338	63	V	33	A=56,I=329,L=27,M=45,V=9281,Xaa=1	9739
64	**E**	15	D15	E	D		2007 0,0012	64	E	2	A=4,D=12,Q=1,E=9721,G=1	9739
65	**S**	1	F1					65	S	16	A=14,L=5,F=72,P=37,S=9575,T=13,Y=7,V=14,Xaa=2	9739
66	G	0						66	G	14	R=2,N=1,D=27,C=1,Del=1,E=9,G=9584,S=111,V=1,Xaa=2	9739
67	D	0						67	D	2	A=4,N=10,D=9722,G=1,Xaa=2	9739
68	P	0						68	P	7	Q=21,H=1,L=15,P=9679,S=20,T=1,Xaa=2	9739
69	N	0						69	N	1	N=9730,H=4,S=2,T=1,Y=1,Xaa=1	9739
70	A	0						70	A	18	A=9503,M=1,S=3,T=27,V=204,Xaa=1	9739
71	L	1	X1					71	L	2	I=1,L=9722,F=1,P=13,Xaa=2	9739
72	L	0						72	L	1	L=9735,M=2,V=1,Xaa=1	9739
73	K	0						73	K	3	R=11,Del=1,Q=1,E=1,I=2,K=9719,T=3,Xaa=1	9739
74	H	0						74	H	0	H=9738,Xaa=1	9739
75	R	0						75	R	0	R=9737,Q=1,Xaa=1	9739
76	F	0						76	F	0	C=1,L=1,F=9736,Xaa=1	9739
77	E	0						77	E	1	D=3,E=9733,G=2,Xaa=1	9739
78	I	0						78	I	3	I=9706,L=30,T=1,V=1,Xaa=1	9739
79	I	0						79	I	2	I=9719,L=2,M=5,F=1,V=11,Xaa=1	9739
80	E	0						80	E	0	E=9738,Xaa=1	9739
81	G	0						81	G	0	R=2,G=9736,Xaa=1	9739
82	R	0						82	R	1	R=9735,I=1,K=2,Xaa=1	9739
83	D	0						83	D	1	N=3,D=9730,E=1,G=4,Xaa=1	9739
84	R	0						84	R	0	R=9737,Xaa=2	9739
85	**T**	2	A2					85	T	20	A=118,N=75,I=26,M=1,P=6,S=3,T=9509,Xaa=1	9739
86	**M**	15	I15	M	I		2007 0,0112	86	M	21	I=109,L=68,K=2,M=9499,S=1,T=1,V=58,Xaa=1	9739
87	A	0						87	A	1	A=9732,D=1,G=1,V=4,Xaa=1	9739
88	W	0						88	W	1	R=3,C=1,W=9735	9739
89	T	0						89	T	1	A=7,S=1,T=9730,Xaa=1	9739
90	**V**	2	I1X1					90	V	9	A=31,G=4,I=16,L=5,M=30,V=9653	9739
91	V	0						91	V	5	G=1,I=41,L=1,M=4,V=9692	9739
92	N	0						92	N	1	N=9734,S=2,Y=2,Xaa=1	9739
93	S	0						93	S	1	R=1,C=1,G=1,I=3,S=9731,T=2	9739
94	I	0						94	I	7	I=9671,L=16,M=1,V=50,Xaa=1	9739
95	C	0						95	C	3	C=9709,F=1,S=27,Y=2	9739
96	N	0						96	N	9	R=5,N=9644,H=5,K=59,P=1,S=24,T=1	9739
97	**T**	1	I1					97	T	5	A=9,N=4,I=16,S=11,T=9699	9739
98	T	0						98	T	4	A=34,I=1,M=1,P=1,T=9702	9739
99	**R**	7	K4G3			Early marker - 1963	**0,0104**	99	G	14	R=101,E=55,G=9575,K=2,V=6	9739
100	**A**	13	V8T3I2	V	A		1975 0,0187	100	V	24	A=182,D=2,I=129,F=1,T=3,V=9422	9739
101	**E**	1	D1					101	E	82	A=1,N=26,D=1675,E=7875,G=137,K=20,Y=2,V=3	9739
102	K	0						102	K	0	R=1,K=9737,Xaa=1	9739
103	P	0						103	P	1	L=1,P=9735,S=3	9739
104	K	0						104	K	13	R=144,N=9,E=1,I=1,K=9578,T=6	9739
105	F	0						105	F	15	C=1,L=51,F=9578,S=32,Y=76,Xaa=1	9739
106	L	0						106	L	1	H=1,I=8,L=9729,V=1	9739
107	P	0						107	P	0	P=9738,S=1	9739
108	D	0						108	D	1	N=3,D=9734,E=1,G=1	9739
109	L	0						109	L	1	L=9735,M=1,S=1,W=1,V=1	9739
110	Y	0						110	Y	0	F=2,Y=9737	9739
111	D	0						111	D	1	D=9735,E=1,H=2,Xaa=1	9739
112	Y	0						112	Y	0	C=1,Y=9738	9739
113	K	0						113	K	2	R=18,N=1,K=9719,T=1	9739
114	**E**	12	K12	E	K		2008 0,0035	114	E	4	E=9696,G=9,K=34	9739
115	N	0						115	N	22	N=9507,D=74,G=14,H=3,K=60,S=63,T=8,Y=9,Xaa=1	9739
116	R	0						116	R	1	R=9729,Q=7,H=1,W=2	9739
117	F	0						117	F	0	F=9739	9739
118	**V**	9	I9	I	V		1975 0,0229	118	I	29	I=9369,L=101,M=2,S=1,T=43,V=223	9739
119	E	0						119	E	0	D=1,E=9738	9739
120	I	0						120	I	6	I=9674,M=1,V=64	9739
121	G	0						121	G	0	R=2,G=9737	9739
122	V	0						122	V	1	I=8,L=2,V=9728,Xaa=1	9739
123	T	0						123	T	0	A=1,T=9737,Xaa=1	9739
124	R	0						124	R	0	R=9737,K=1,Xaa=1	9739
125	R	0						125	R	0	R=9736,K=2,Xaa=1	9739
126	E	0						126	E	2	D=3,E=9722,G=13,Xaa=1	9739
127	V	0						127	V	8	A=9,C=1,I=85,V=9644	9739
128	**H**	2	N1Y1					128	H	2	R=4,N=5,Q=2,H=9720,P=4,Y=4	9739
129	I	0						129	I	57	A=2,I=8737,L=13,M=72,T=831,V=83,Xaa=1	9739
130	Y	0						130	Y	0	Y=9739	9739
131	Y	0						131	Y	0	C=1,Y=9738	9739
132	L	0						132	L	1	Q=1,I=2,L=9730,M=5,S=1	9739
133	E	0						133	E	2	D=10,E=9726,G=2,K=1	9739
134	K	0						134	K	0	K=9738,Xaa=1	9739
135	A	0						135	A	4	A=9706,D=1,S=25,T=6,Xaa=1	9739
136	N	0						136	N	7	N=9658,D=1,H=1,K=1,P=2,S=74,T=1,Xaa=1	9739
137	K	0						137	K	1	R=3,Q=1,K=9734,Xaa=1	9739
138	I	0						138	I	2	I=9720,M=6,T=1,V=9,Xaa=3	9739

139	K	0							139	K	1	R=2,N=2,K=9734,Xaa=1	9739
140	S	0							140	S	11	A=23,L=2,F=4,P=1,S=9618,T=90,Xaa=1	9739
141	E	0							141	E	4	D=18,E=9701,G=9,K=10,Xaa=1	9739
142	K	0							142	K	20	R=168,N=54,D=4,Q=6,E=6,K=9494,M=4,T=1,Xaa=2	9739
143	T	0							143	T	1	A=3,M=1,P=1,T=9733,Xaa=1	9739
144	H	0							144	H	1	R=2,N=1,Q=2,H=9732,L=1,Xaa=1	9739
145	I	0							145	I	1	I=9734,F=1,V=3,Xaa=1	9739
146	H	0							146	H	0	H=9737,P=1,Xaa=1	9739
147	I	0							147	I	1	I=9730,M=2,F=1,V=3,Xaa=3	9739
148	F	0							148	F	1	L=2,F=9733,Y=2,Xaa=2	9739
149	S	0							149	S	1	P=4,S=9733,Xaa=2	9739
150	F	0							150	F	1	L=2,F=9733,S=1,Y=1,Xaa=2	9739
151	T	0							151	T	12	A=9,N=70,I=39,S=3,T=9615,Xaa=3	9739
152	G	0							152	G	0	E=1,G=9736,Xaa=2	9739
153	E	0							153	E	1	A=1,Del=1,E=9729,G=2,K=5,Xaa=1	9739
154	E	0							154	E	1	D=2,Del=1,E=9731,K=4,Xaa=1	9739
155	M	0							155	M	2	Del=1,I=2,L=4,M=9727,T=1,V=1,Xaa=3	9739
156	**A**	2	G2						156	A	4	A=9698,Del=1,T=6,V=33,Xaa=1	9739
157	T	0							157	T	8	A=27,N=1,I=1,S=49,T=9659,Xaa=2	9739
158	**K**	15	R13G2	K	R		2007	0,0147	158	K	15	R=143,N=1,Q=20,E=2,G=5,K=9563,M=1,T=1,Xaa=3	9739
159	A	0							159	A	7	A=9676,C=1,E=19,S=24,T=14,V=3,Xaa=2	9739
160	D	0							160	D	10	N=34,D=9639,E=58,G=5,K=1,Xaa=2	9739
161	Y	0							161	Y	4	N=2,C=1,H=25,T=1,Y=9707,Xaa=3	9739
162	T	0							162	T	5	A=4,N=2,I=30,S=3,T=9697,Xaa=3	9739
163	L	0							163	L	3	A=1,I=16,L=9717,F=1,P=1,Xaa=3	9739
164	D	0							164	D	1	N=1,D=9730,G=2,H=1,S=1,V=1,Xaa=3	9739
165	E	0							165	E	3	A=1,D=16,E=9716,G=1,S=1,Xaa=4	9739
166	E	0							166	E	1	E=9731,K=5,Xaa=3	9739
167	S	0							167	S	1	N=1,I=1,S=9734,Xaa=3	9739
168	R	0							168	R	1	R=9735,K=1,Xaa=3	9739
169	A	0							169	A	1	A=9731,G=1,P=4,Xaa=3	9739
170	R	0							170	R	1	R=9733,G=3,Xaa=3	9739
171	I	0							171	I	5	I=9698,L=1,K=1,M=1,F=2,T=2,V=31,Xaa=3	9739
172	K	0							172	K	1	N=3,K=9733,Xaa=3	9739
173	T	0							173	T	1	A=2,S=4,T=9730,Xaa=3	9739
174	R	0							174	R	1	R=9731,G=2,K=2,T=1,Xaa=3	9739
175	L	0							175	L	1	R=1,Q=1,L=9730,M=3,P=1,Xaa=3	9739
176	F	0							176	F	3	C=1,L=1,F=9708,S=1,Y=25,Xaa=3	9739
177	T	0							177	T	1	A=2,N=2,P=2,T=9730,Xaa=3	9739
178	I	0							178	I	2	I=9722,K=1,T=2,V=11,Xaa=3	9739
179	R	0							179	R	1	R=9731,S=5,Xaa=3	9739
180	Q	0							180	Q	2	R=1,Q=9727,E=1,H=4,K=1,P=2,Xaa=3	9739
181	E	0							181	E	2	D=15,E=9719,K=2,Xaa=3	9739
182	M	0							182	M	7	I=1,L=68,K=1,M=9665,V=1,Xaa=3	9739
183	**A**	2	V2						183	A	2	A=9727,D=1,G=1,P=1,S=2,T=3,V=1,Xaa=3	9739
184	**S**	1	M1						184	S	16	R=2,N=90,G=34,I=35,S=9566,T=9,Xaa=3	9739
185	**R**	3	K3						185	R	4	R=9699,G=2,K=31,M=1,S=1,Xaa=5	9739
186	G	0							186	G	8	D=1,G=9649,S=85,Xaa=4	9739
187	L	0							187	L	6	I=54,L=9673,M=8,F=1,Xaa=3	9739
188	W	0							188	W	0	W=9736,Xaa=3	9739
189	D	0							189	D	2	N=1,D=9720,E=8,G=5,V=1,Xaa=4	9739
190	S	0							190	S	7	F=2,P=65,S=9667,T=1,Y=1,Xaa=3	9739
191	F	0							191	F	1	L=1,F=9735,Xaa=3	9739
192	R	0							192	R	3	R=9714,C=14,H=3,L=3,P=1,S=1,Xaa=3	9739
193	Q	0							193	Q	2	R=2,Q=9726,H=1,L=4,K=3,Xaa=3	9739
194	S	0							194	S	1	A=1,F=2,S=9732,Y=1,Xaa=3	9739
195	E	0							195	E	1	R=1,Q=1,E=9734,Xaa=3	9739
196	R	0							196	R	2	R=9727,G=1,I=2,K=3,S=3,Xaa=3	9739
197	G	0							197	G	2	D=6,C=1,G=9727,S=2,Xaa=3	9739
198	E	0							198	E	1	Q=1,E=9735,Xaa=3	9739
199	E	0							199	E	15	A=1,D=172,E=9545,G=11,K=7,Xaa=3	9739
200	T	0							200	T	1	A=1,D=1,I=2,T=9732,Xaa=3	9739
201	I	0							201	I	20	N=2,I=9486,L=2,M=6,S=2,T=19,V=217,Xaa=5	9739
202	E	0							202	E	1	Q=2,E=9734,Xaa=3	9739
203	E	0							203	E	1	E=9735,G=1,Xaa=3	9739
204	**R**	1	K1						204	R	43	R=8897,G=4,K=831,S=2,Xaa=5	9739
205	F	0							205	F	1	L=2,F=9734,Xaa=3	9739
206	**E**	1	K1						206	E	5	A=1,D=23,E=9698,G=6,K=8,Xaa=3	9739
207	I	0							207	I	3	I=9716,L=15,V=5,Xaa=3	9739
208	**T**	4	K4						208	T	22	A=153,R=3,N=8,I=5,K=85,P=1,S=5,T=9476,Xaa=3	9739
209	G	0							209	G	3	R=5,N=1,D=7,E=2,G=9719,T=1,Xaa=4	9739
210	**T**	2	A1M1						210	T	7	A=53,N=4,Q=1,I=2,S=2,T=9673,Xaa=4	9739
211	M	0							211	M	8	I=56,L=9,M=9657,T=1,V=12,Xaa=4	9739
212	R	0							212	R	5	R=9695,C=11,H=23,L=5,P=1,Xaa=4	9739
213	**R**	31	K31	R	K		2002	0,0128	213	R	12	R=9597,G=1,I=1,K=125,M=7,S=4,Xaa=4	9739
214	L	0							214	L	3	I=17,L=9710,F=5,P=1,S=1,Xaa=5	9739
215	A	0							215	A	1	A=9729,S=1,T=3,V=1,Xaa=5	9739
216	**N**	10	D10	D	N		1976	0,0206	216	D	22	A=1,N=201,D=9464,E=55,G=8,S=3,Y=2,Xaa=5	9739
217	**Y**	9	H7Q2	H	Y	Early marker - 1963: H 1975 H->Y		H=0.0000 Y=0.0000	217	Q	1	R=2,Q=9730,K=1,P=1,Xaa=5	9739
218	S	0							218	S	1	R=1,G=1,I=2,S=9729,Xaa=6	9739
219	L	0							219	L	2	G=1,I=10,L=9720,F=1,P=1,Xaa=6	9739
220	P	0							220	P	1	P=9728,S=2,T=1,Xaa=8	9739
221	P	0							221	P	3	R=2,Q=2,L=5,P=9712,S=7,T=2,Xaa=9	9739
222	N	0							222	N	4	N=9702,D=2,H=2,K=2,S=20,T=2,Y=1,Xaa=8	9739
223	F	0							223	F	2	L=1,F=9725,S=2,Y=2,V=1,Xaa=8	9739
224	S	0							224	S	5	P=12,S=9689,T=29,Xaa=9	9739
225	S	0							225	S	5	R=1,N=15,C=13,G=3,S=9699,Xaa=8	9739
226	**L**	1	F1						226	L	18	R=1,Q=1,I=11,L=9500,F=217,P=1,Xaa=8	9739
227	**E**	1	G1						227	E	6	D=8,E=9687,G=17,K=18,Xaa=9	9739
228	**N**	5	S5						228	N	4	N=9703,D=10,H=3,K=7,S=4,T=3,Xaa=9	9739
229	F	0							229	F	2	I=1,L=6,F=9722,Xaa=10	9739
230	R	0							230	R	2	R=9720,G=1,I=1,K=7,Xaa=10	9739
231	**V**	41	A41	A	V		1987	0,0005	231	A	8	A=9662,G=1,I=1,S=1,T=59,V=5,Xaa=10	9739
232	Y	0							232	Y	1	N=1,C=1,Y=9728,Xaa=9	9739
233	V	0							233	V	1	V=9729,Xaa=10	9739
234	D	0							234	D	1	N=1,D=9727,E=1,Xaa=10	9739
235	G	0							235	G	2	R=4,G=9724,Xaa=11	9739
236	F	0							236	F	2	C=1,F=9725,S=1,Y=1,Xaa=11	9739
237	**E**	15	K15	E	K		2007	0,0206	237	E	19	Q=2,E=9502,G=12,K=201,V=9,Xaa=13	9739
238	**P**	3	S3						238	P	2	L=3,P=9722,S=1,T=1,Xaa=12	9739
239	N	0							239	N	3	N=9715,D=1,K=2,S=2,T=2,Y=5,Xaa=12	9739
240	**G**	1	E1						240	G	2	G=9721,S=6,Xaa=12	9739
241	C	0							241	C	14	R=2,C=9579,F=11,S=18,W=1,Y=115,Xaa=13	9739
242	I	0							242	I	2	I=9722,L=3,F=1,Xaa=13	9739
243	E	0							243	E	2	D=2,E=9722,G=1,K=1,Xaa=13	9739
244	**S**	9	G9	G	S		1975	0,0002	244	G	2	G=9723,S=2,V=1,Xaa=13	9739
245	K	0							245	K	3	R=7,N=1,Q=2,K=9715,Xaa=14	9739
246	L	0							246	L	2	L=9724,P=1,Xaa=14	9739
247	S	0							247	S	5	A=18,L=1,F=3,P=2,S=9697,Y=1,Xaa=17	9739
248	Q	0							248	Q	2	Q=9719,H=1,L=1,K=1,P=2,Xaa=15	9739
249	**M**	1	I1						249	M	2	I=1,M=9721,W=1,V=1,Xaa=15	9739
250	**S**	1	P1						250	S	6	L=2,F=1,P=36,S=9684,T=1,Xaa=15	9739
251	K	0							251	K	5	R=22,N=1,Q=1,E=1,K=9697,M=1,Xaa=16	9739
252	**E**	3	K2D1						252	E	16	A=11,N=34,D=12,E=9572,G=17,K=77,Xaa=16	9739
253	V	0							253	V	3	A=2,E=1,I=2,L=3,M=1,Y=1,V=9713,Xaa=16	9739
254	**N**	1	S1						254	N	15	A=1,N=9576,D=1,C=3,I=1,K=6,M=1,S=60,T=75,Xaa=15	9739
255	A	0							255	A	2	A=9721,G=1,T=2,Xaa=15	9739
256	**R**	4	K4						256	R	10	R=9641,Q=9,G=4,I=3,K=63,T=2,W=1,Xaa=16	9739
257	I	0							257	I	4	N=1,I=9701,V=22,Xaa=15	9739
258	E	0							258	E	4	D=18,E=9702,K=2,V=2,Xaa=15	9739
259	**P**	6	S6						259	P	12	A=1,Q=86,L=1,P=9611,S=20,T=5,Xaa=15	9739
260	F	0							260	F	2	C=1,F=9721,S=1,V=1,Xaa=15	9739
261	**S**	9	L9	L	S		1975	0,0013	261	L	41	Q=58,I=1,L=9148,M=443,F=14,S=13,T=7,W=1,V=38,Xaa=16	9739
262	K	0							262	K	29	R=409,N=10,E=5,K=9299,T=1,Xaa=15	9739
263	**T**	2	A2						263	T	20	A=131,R=4,N=6,E=7,I=4,K=41,M=1,S=7,T=9523,Xaa=15	9739
264	T	0							264	T	2	G=1,K=1,T=9721,Xaa=16	9739
265	P	0							265	P	3	L=1,P=9717,S=4,T=1,Xaa=16	9739
266	R	0							266	R	9	R=9654,C=16,Q=9,H=32,L=2,P=2,S=6,Xaa=18	9739
267	P	0							267	P	13	C=1,H=21,L=9,P=9609,S=77,T=4,Xaa=18	9739
268	L	0							268	L	6	I=13,L=9685,F=17,P=2,V=2,Xaa=20	9739
269	**K**	45	R45	R	K		1988	0,2832	269	R	91	R=6935,E=2,G=3,I=14,K=2758,P=1,T=1,Xaa=25	9739
270	**I**	46	M44L2	IM	M	Early marker - 1963: IM 1975 M		I=0.0007 M=0.0003	270	L	4	Del=1,I=7,L=9703,M=3,F=3,T=1,Xaa=21	9739
271	**P**	1	S1						271	P	4	R=1,L=1,F=1,P=9706,S=8,T=1,Xaa=21	9739
272	**G**	2	D2			Early marker - 1963		0,0164	272	D	111	A=2,N=268,D=7190,C=3,E=2041,G=160,K=15,F=1,S=25,Y=1,V=11,Xaa=22	9739
273	G	0							273	G	3	E=1,G=9715,F=1,W=1,Xaa=21	9739
274	P	0							274	P	11	A=8,R=2,H=7,L=44,P=9629,S=25,T=1,Xaa=23	9739
275	P	0							275	P	28	H=1,L=352,P=9333,S=29,Y=1,Xaa=23	9739
276	C	0							276	C	3	C=9715,Q=1,Xaa=23	9739
277	**H**	11	S9Y2	S	H		1976	0,0006	277	S	21	A=16,C=5,H=6,L=1,K=1,F=120,P=13,S=9514,T=8,Y=29,Xaa=26	9739
278	Q	0							278	Q	3	Q=9712,H=1,L=1,K=1,Xaa=24	9739
279	R	0							279	R	3	R=9708,Q=3,G=1,H=1,K=1,P=1,Xaa=24	9739
280	S	0							280	S	3	A=1,G=1,F=1,S=9711,W=1,Xaa=24	9739
281	K	0							281	K	3	G=1,K=9714,Xaa=24	9739
282	F	0							282	F	3	I=1,L=1,F=9712,S=1,Xaa=24	9739
283	L	0							283	L	3	L=9711,M=2,F=1,W=1,Xaa=24	9739
284	L	0							284	L	5	R=1,L=9698,M=14,F=1,P=1,Xaa=24	9739
285	M	0							285	M	4	I=3,L=1,K=1,M=9706,T=3,V=1,Xaa=24	9739
286	D	0							286	D	3	N=1,D=9713,K=1,Xaa=24	9739

vmuc:
Not a marker
(>0.05)

287	A	0						287	A	13	A=9586,N=1,G=3,S=124,T=1,V=1,Xaa=23	9739	
288	L	0						288	L	3	L=9711,M=2,P=1,V=1,Xaa=24	9739	
289	K	0						289	K	3	R=1,Q=1,K=9713,Xaa=24	9739	
290	L	0						290	L	3	I=1,L=9714,Xaa=24	9739	
291	S	0						291	S	4	N=11,G=3,I=2,S=9699,Xaa=24	9739	
292	I	0						292	I	6	R=1,Del=1,I=9686,L=1,K=1,M=1,V=22,Xaa=26	9739	
293	E	0						293	E	3	D=1,Del=1,E=9709,G=1,K=1,Xaa=26	9739	
294	D	0						294	D	8	A=1,N=44,D=9658,E=7,P=1,S=1,V=1,Xaa=26	9739	
295	P	0						295	P	4	Q=2,E=1,L=5,P=9707,Xaa=24	9739	
296	S	0						296	S	14	R=6,N=36,G=82,I=1,K=1,S=9586,V=1,Xaa=26	9739	
297	H	0						297	H	3	H=9709,Y=6,Xaa=24	9739	
298	E	0						298	E	5	D=16,E=9691,G=1,K=6,T=1,Xaa=24	9739	
299	G	0						299	G	3	R=1,Del=1,G=9713,S=1,Xaa=23	9739	
300	E	0						300	E	3	R=1,Del=1,E=9710,G=1,K=3,Xaa=23	9739	
301	G	0						301	G	3	C=1,Del=1,G=9716,Xaa=21	9739	
302	I	0						302	I	4	Del=1,I=9705,L=1,V=11,Xaa=21	9739	
303	P	0						303	P	2	P=9718,Xaa=21	9739	
304	**L**	1	M1					304	L	4	I=11,L=9701,M=6,Xaa=21	9739	
305	Y	0						305	Y	9	C=22,H=33,F=5,Y=9656,Xaa=23	9739	
306	D	0						306	D	3	N=1,D=9716,E=1,Xaa=21	9739	
307	A	0						307	A	6	A=9674,S=43,Xaa=22	9739	
308	**I**	3	V2T1					308	I	11	A=1,I=9630,L=2,F=7,S=2,T=8,V=67,Xaa=22	9739	
309	K	0						309	K	6	R=23,N=7,Q=2,K=9684,T=1,Xaa=22	9739	
310	C	0						310	C	2	C=9717,Y=1,Xaa=21	9739	
311	M	0						311	M	8	I=24,L=27,M=9665,T=1,V=1,Xaa=21	9739	
312	K	0						312	K	7	R=16,N=28,K=9672,M=2,Xaa=21	9739	
313	T	0						313	T	3	I=1,M=1,S=1,T=9715,Xaa=21	9739	
314	F	0						314	F	3	F=9715,S=3,Xaa=21	9739	
315	F	0						315	F	5	L=13,F=9692,S=1,W=1,Y=12,Xaa=20	9739	
316	G	0						316	G	3	E=1,G=9715,S=3,Xaa=20	9739	
317	W	0						317	W	3	R=3,C=1,G=1,W=9714,Xaa=20	9739	
318	K	0						318	K	6	R=38,E=2,K=9679,T=1,Xaa=19	9739	
319	E	0						319	E	10	D=66,E=9639,G=5,K=7,V=1,Xaa=21	9739	
320	P	0						320	P	2	A=1,L=1,P=9717,S=1,Xaa=19	9739	
321	**S**	25	N25					321	N	42	A=1,N=9223,D=5,H=4,I=63,K=203,S=119,T=57,Y=45,Xaa=19	9739	
322	**I**	2	V2					322	I	15	I=9554,L=1,M=1,F=1,V=162,Xaa=20	9739	
323	**V**	1	I1					323	V	106	A=65,E=2,I=3545,L=34,T=9,V=6064,Xaa=20	9739	
324	K	0						324	K	2	K=9718,T=1,Xaa=20	9739	
325	P	0						325	P	12	Q=13,L=5,P=9620,S=71,T=9,Xaa=21	9739	
326	H	0						326	H	3	R=1,Q=1,H=9713,L=1,T=1,Xaa=22	9739	
327	**E**	3	K3					327	E	21	A=1,R=2,D=18,E=9502,G=94,K=88,V=11,Xaa=23	9739	
328	K	0						328	K	14	R=137,N=4,E=7,I=1,K=9568,Xaa=22	9739	
329	G	0						329	G	3	A=1,D=1,G=9713,S=1,Xaa=23	9739	
330	**I**	1	V1					330	I	7	I=9676,L=2,M=1,T=3,V=34,Xaa=23	9739	
331	N	0						331	N	3	N=9709,I=1,S=1,T=4,Xaa=24	9739	
332	**P**	1	S1					332	P	15	H=4,L=10,P=9567,S=124,T=11,Xaa=23	9739	
333	N	0						333	N	3	N=9710,I=6,Xaa=23	9739	
334	Y	0						334	Y	3	C=5,Y=9711,Xaa=23	9739	
335	L	0						335	L	4	I=9,L=9699,F=5,P=1,V=1,Xaa=24	9739	
336	**Q**	2	L2			Early marker - 1963	0,0002	336	L	7	R=3,Q=2,L=9670,M=37,F=2,P=1,Xaa=24	9739	
337	**A**	34	T34	A	T	2002	0,0681	337	A	42	A=9021,D=1,E=2,G=1,K=1,P=1,S=1,T=663,V=24,Xaa=24	9739	
338	W	0						338	W	3	R=4,G=1,W=9710,Xaa=24	9739	
339	K	0						339	K	8	R=43,N=6,E=2,K=9663,T=1,Xaa=24	9739	
340	Q	0						340	Q	3	Q=9710,E=1,H=1,P=2,Xaa=25	9739	
341	V	0						341	V	7	A=2,G=1,I=7,L=25,K=1,M=2,T=4,V=9673,Xaa=24	9739	
342	L	0						342	L	25	Q=4,I=2,L=9371,M=338,Xaa=24	9739	
343	**A**	31	E31	A	E	1997	0,0002	343	A	23	A=9475,D=1,E=2,P=1,S=44,T=142,V=49,Xaa=25	9739	
344	E	0						344	E	4	D=3,Q=1,E=9706,G=1,K=2,T=1,Y=1,Xaa=24	9739	
345	**L**	31	I31	L	I	1997	0,0053	345	L	8	Q=1,I=52,L=9656,F=5,Xaa=25	9739	
346	Q	0						346	Q	9	R=1,N=5,Q=9655,H=46,L=2,K=5,P=1,Xaa=24	9739	
347	D	0						347	D	4	A=1,N=7,D=9702,E=1,G=1,Y=2,Xaa=25	9739	
348	**L**	9	I9				0,2105	348	I	84	N=1,I=7593,L=2050,M=10,F=21,T=6,V=32,Xaa=26	9739	
349	E	0						349	E	7	D=15,Del=1,Q=1,E=9675,G=20,K=3,V=1,Xaa=23	9739	
350	**N**	2						350	N	39	A=1,N=9185,D=12,Del=1,H=36,I=3,K=1,P=2,S=406,T=68,Xaa=24	9739	
351	E	0						351	E	21	D=199,Del=1,E=9483,G=25,K=6,V=2,Xaa=23	9739	
352	**E**	2	A1K1					352	E	14	A=1,D=95,E=9590,G=17,K=11,Y=1,Xaa=24	9739	
353	**K**	29	R29	K	R	2002	0,0175	353	K	18	R=170,N=11,Q=1,E=13,I=2,K=9517,T=1,Xaa=24	9739	
354	**T**	38	I36D2	I	I	1976T,1980-1982T,1985-2005T,2011	0,0133	354	I	25	A=11,N=2,I=9450,L=17,M=5,F=4,P=1,S=2,T=130,V=94,Xaa=23	9739	
355	P	0						355	P	7	R=1,Q=5,L=11,P=9679,S=18,T=2,Xaa=23	9739	
356	**K**	1	R1					356	K	10	R=73,N=6,I=1,K=9634,Xaa=25	9739	
357	T	0						357	T	9	A=10,I=21,K=9,M=3,T=9659,V=14,Xaa=23	9739	
358	K	0						358	K	3	R=8,K=9708,Xaa=23	9739	
359	N	0						359	N	6	?=2,N=9690,D=4,I=1,K=11,S=5,T=3,Xaa=23	9739	
360	**M**	1	I1					360	M	12	I=9,L=95,M=9607,V=4,Xaa=24	9739	
361	K	0						361	K	16	R=167,N=3,E=1,K=9541,T=1,Xaa=26	9739	
362	**K**	1	R1					362	K	6	R=26,N=2,K=9686,T=1,Xaa=24	9739	
363	T	0						363	T	3	A=1,P=1,S=4,T=9710,Xaa=23	9739	
364	**S**	1	I1					364	S	12	A=1,N=13,G=72,I=18,S=9612,Xaa=23	9739	
365	Q	0						365	Q	25	R=2,Q=9377,H=320,L=1,P=15,Xaa=24	9739	
366	L	0						366	L	3	L=9713,F=3,S=1,Xaa=22	9739	
367	K	0						367	K	33	R=438,Q=2,K=9238,M=39,Xaa=22	9739	
368	W	0						368	W	3	R=2,W=9716,Xaa=21	9739	
369	A	0						369	A	12	A=9602,P=1,S=3,T=110,V=2,Xaa=21	9739	
370	L	0						370	L	3	I=1,L=9716,V=1,Xaa=21	9739	
371	**G**	1	G1					371	G	2	G=9718,Xaa=21	9739	
372	E	0						372	E	4	D=7,E=9706,G=2,K=1,Xaa=23	9739	
373	N	0						373	N	4	N=9704,D=2,K=2,S=10,Xaa=21	9739	
374	M	0						374	M	11	R=2,I=34,L=3,M=9634,T=4,V=41,Xaa=21	9739	
375	A	0						375	A	2	A=9716,E=1,Xaa=22	9739	
376	P	0						376	P	3	R=1,P=9715,S=1,Xaa=22	9739	
377	E	0						377	E	3	Q=1,E=9713,K=3,Xaa=22	9739	
378	K	0						378	K	3	R=8,K=9710,Xaa=21	9739	
379	V	0						379	V	17	A=2,I=51,L=33,M=82,V=9551,Xaa=20	9739	
380	D	0						380	D	5	A=1,N=3,D=9699,E=6,G=8,Y=2,Xaa=20	9739	
381	F	0						381	F	2	L=2,F=9717,Xaa=20	9739	
382	**E**	1	D1					382	E	43	A=2,D=787,E=8926,G=2,V=1,Xaa=21	9739	
383	**D**	1	E1					383	D	5	N=7,D=9696,E=9,G=4,V=3,Xaa=20	9739	
384	C	0						384	C	3	C=9716,S=1,Y=2,Xaa=20	9739	
385	K	0						385	K	8	R=44,N=2,Q=6,E=1,I=1,K=9664,Xaa=21	9739	
386	D	0						386	D	9	N=44,D=9654,E=10,G=10,Y=1,Xaa=20	9739	
387	**I**	2	V2				0,1496	387	V	66	A=2,D=1,I=1457,L=3,M=2,F=14,V=8239,Xaa=21	9739	
388	**S**	30	N29G1					388	S	119	R=385,N=219,D=33,C=4,G=2077,I=13,S=6985,Xaa=23	9739	
389	D	0						389	D	3	D=9715,E=1,G=1,Y=1,Xaa=21	9739	
390	L	0						390	L	3	I=2,L=9714,V=2,Xaa=21	9739	
391	K	0						391	K	106	R=4272,N=1,Q=3,G=1,I=2,K=5399,M=11,S=2,T=23,Xaa=25	9739	
392	Q	0						392	Q	2	Q=9716,H=1,Xaa=22	9739	
393	Y	0						393	Y	2	Y=9716,Xaa=23	9739	
394	**D**	1	N1					394	D	32	A=1,N=266,D=9342,Q=8,E=27,G=33,H=31,Y=1,V=7,Xaa=23	9739	
395	S	0						395	S	7	N=29,C=1,G=9,S=9676,T=1,Xaa=23	9739	
396	D	0						396	D	24	A=1,N=123,D=9472,C=1,E=37,G=52,H=5,S=9,Y=7,V=9,Xaa=23	9739	
397	E	0						397	E	4	D=1,E=9702,G=6,K=7,Xaa=23	9739	
398	P	0						398	P	3	Q=1,P=9714,S=1,Xaa=23	9739	
399	**E**	5	K5					399	E	24	R=1,N=2,D=36,Q=2,E=9452,G=38,K=183,V=1,Xaa=24	9739	
400	**T**	10	A5P5	P	T	1975	0,0092	400	PSQ	192	A=83,R=4,Q=2007,H=175,I=6,L=76,K=75,M=8,F=21,P=4185,S=2973,T=90,Y=11,Xaa=25	9739	
401	R	0						401	R	15	R=9550,N=1,G=2,I=1,K=159,S=3,Xaa=23	9739	
402	S	0						402	S	3	A=6,S=9709,T=2,Xaa=22	9739	
403	**L**	1	I1					403	L	7	I=36,L=9668,F=1,P=10,S=1,V=1,Xaa=22	9739	
404	A	0						404	A	44	A=8992,E=1,G=1,P=4,S=669,T=41,V=8,Xaa=23	9739	
405	S	0						405	S	22	A=52,N=7,C=137,G=7,I=9,S=9489,T=16,Xaa=22	9739	
406	W	0						406	W	3	R=2,G=1,W=9714,Xaa=22	9739	
407	**I**	1	V1					407	I	24	A=3,I=9417,T=24,V=273,Xaa=22	9739	
408	Q	0						408	Q	2	Q=9716,P=1,Xaa=22	9739	
409	**S**	7	N7					409	S	43	R=2,N=723,G=16,K=1,S=8974,Xaa=23	9739	
410	E	0						410	E	3	E=9714,G=1,V=2,Xaa=22	9739	
411	F	0						411	F	3	F=9716,Y=3,Xaa=20	9739	
412	N	0						412	N	2	N=9719,Xaa=20	9739	
413	K	0						413	K	3	R=8,K=9710,Xaa=21	9739	
414	A	0						414	A	3	A=9715,G=1,T=2,Xaa=21	9739	
415	C	0						415	C	2	C=9717,W=1,Xaa=21	9739	
416	**E**	1	D1					416	E	3	D=1,E=9716,K=1,Xaa=21	9739	
417	**L**	1	V1					417	L	3	I=1,L=9715,V=2,Xaa=21	9739	
418	T	0						418	T	3	A=6,T=9712,Xaa=21	9739	
419	D	0						419	D	12	N=39,D=9614,E=17,G=47,Y=1,Xaa=21	9739	
420	S	0						420	S	3	A=1,P=1,S=9714,T=2,Xaa=21	9739	
421	S	0						421	S	9	N=12,G=15,I=34,S=9655,T=1,Xaa=22	9739	
422	W	0						422	W	2	W=9717,Xaa=22	9739	
423	I	0						423	I	29	A=1,I=9378,L=21,M=187,T=4,V=126,Xaa=22	9739	
424	E	0						424	E	4	D=9,E=9707,V=1,Xaa=22	9739	
425	L	0						425	L	5	L=9693,M=1,F=23,Xaa=22	9739	
426	D	0						426	D	3	D=9707,E=10,Xaa=22	9739	
427	E	0						427	E	3	D=1,E=9714,G=2,Xaa=22	9739	
428	I	0						428	I	4	I=9706,L=6,M=2,V=2,Xaa=23	9739	
429	G	0						429	G	3	R=3,E=1,G=9713,Xaa=22	9739	
430	E	0						430	E	11	A=8,D=37,E=9638,G=8,K=1,V=24,Xaa=23	9739	
431	D	0						431	D	4	N=12,D=9704,H=1,Xaa=22	9739	
432	**I**	43	V43	V	V	1976-1994I	0,1288	432	V	60	A=3,I=1254,L=17,F=1,V=8443,Xaa=21	9739	
433	A	0						433	A	2	A=9717,S=1,Xaa=21	9739	
434	P	0						434	P	3	Q=1,P=9716,S=1,Xaa=21	9739	
435	I	0						435	I	3	N=1,I=9713,L=1,V=3,Xaa=21	9739	

vmuc:
Not a marker
(>0.05)

vmuc:
Not a marker
(>0.05)

vmuc:
Not a marker, not
conserved to presence

vmuc:
Not a marker
(>0.05)

vmuc:
Not a marker
Not conserved to
presence

436	E	0						436	E	3	D=1,E=9715,Xaa=23	9739
437	**Y**	9	H7N2	H	Y	1975	0,0180	437	H	16	N=1,Q=6,H=9544,Y=165,Xaa=23	9739
438	I	0						438	I	7	I=9666,M=2,S=2,V=45,Xaa=24	9739
439	A	0						439	A	3	A=9714,F=1,V=1,Xaa=23	9739
440	S	0						440	S	3	N=1,G=4,S=9710,T=1,Xaa=23	9739
441	**M**	1	I1					441	M	11	R=2,I=11,L=2,K=22,M=9632,T=30,V=16,Xaa=24	9739
442	R	0						442	R	3	R=9708,K=7,Xaa=24	9739
443	R	0						443	R	3	R=9714,K=1,M=1,Xaa=23	9739
444	N	0						444	N	7	N=9673,D=16,H=1,K=2,S=20,T=4,Xaa=23	9739
445	Y	0						445	Y	4	C=1,H=3,F=7,Y=9705,Xaa=23	9739
446	F	0						446	F	3	K=1,F=9715,Xaa=23	9739
447	**T**	1	S1					447	T	4	A=6,I=1,P=1,S=3,T=9704,Xaa=24	9739
448	A	0						448	A	9	A=9652,E=30,S=5,T=28,V=1,Xaa=23	9739
449	E	0						449	E	3	A=1,E=9712,G=2,Xaa=24	9739
450	**V**	34	I33F1	V	I	1994	0,0054	450	V	8	A=7,I=53,S=1,V=9654,Xaa=24	9739
451	S	0						451	S	5	A=11,F=6,P=1,S=9695,T=2,Y=1,Xaa=23	9739
452	H	0						452	H	6	R=16,N=1,Q=8,H=9686,K=2,Y=5,Xaa=21	9739
453	C	0						453	C	3	C=9712,F=1,S=4,Y=1,Xaa=21	9739
454	R	0						454	R	3	R=9712,G=1,K=1,M=1,T=3,Xaa=21	9739
455	A	0						455	A	4	A=9707,G=4,S=2,V=6,Xaa=20	9739
456	T	0						456	T	2	S=3,T=9717,Xaa=19	9739
457	E	0						457	E	2	E=9719,G=1,Xaa=19	9739
458	Y	0						458	Y	2	H=1,Y=9719,Xaa=19	9739
459	I	0						459	I	12	I=9615,L=11,M=80,T=3,V=11,Xaa=19	9739
460	M	0						460	M	6	I=22,L=2,M=9688,T=1,V=7,Xaa=19	9739
461	K	0						461	K	3	R=6,N=2,K=9712,M=1,Xaa=18	9739
462	G	0						462	G	2	G=9721,Xaa=18	9739
463	V	0						463	V	3	I=11,V=9711,Xaa=17	9739
464	Y	0						464	Y	5	D=1,H=24,F=1,Y=9696,Xaa=17	9739
465	**I**	12	V12					465	I	20	A=2,I=9516,L=2,M=80,T=51,V=71,Xaa=17	9739
466	N	0						466	N	4	N=9706,H=1,I=1,K=2,S=10,T=2,Xaa=17	9739
467	T	0						467	T	2	Q=1,I=1,S=1,T=9718,Y=1,Xaa=17	9739
468	A	0						468	A	3	A=9716,D=1,P=1,S=2,T=1,V=1,Xaa=17	9739
469	L	0						469	L	5	I=1,L=9696,M=25,F=1,Xaa=16	9739
470	L	0						470	L	2	C=1,E=1,I=1,L=9719,Y=1,Xaa=16	9739
471	N	0						471	N	3	N=9717,I=1,K=1,S=2,T=2,Xaa=16	9739
472	A	0						472	A	8	A=9650,S=71,T=1,V=1,Xaa=16	9739
473	S	0						473	S	2	A=1,F=2,S=9718,T=1,Y=1,Xaa=16	9739
474	C	0						474	C	2	C=9719,G=1,S=4,Xaa=15	9739
475	A	0						475	A	4	A=9708,Q=1,P=1,T=10,V=4,Xaa=15	9739
476	**A**	15	T15	A	T	2007	0,0008	476	A	5	A=9694,G=1,P=1,S=13,T=8,V=7,Xaa=15	9739
477	M	0						477	M	2	I=2,L=2,K=1,M=9718,Xaa=16	9739
478	D	0						478	D	6	N=7,D=9681,E=35,Xaa=16	9739
479	**E**	35	D35	D	E	1985	0,0022	479	D	6	N=14,D=9685,E=21,G=2,Y=1,Xaa=16	9739
480	**F**	4	Y3L1					480	F	4	L=2,F=9700,S=2,Y=19,Xaa=16	9739
481	Q	0						481	Q	2	Q=9718,H=1,L=1,K=1,P=2,Xaa=16	9739
482	L	0						482	L	3	L=9714,M=6,P=1,V=2,Xaa=16	9739
483	I	0						483	I	3	I=9717,M=1,T=1,V=4,Xaa=16	9739
484	P	0						484	P	2	A=1,Q=2,P=9718,S=1,T=1,Xaa=16	9739
485	M	0						485	M	4	I=14,K=3,M=9706,Xaa=16	9739
486	I	0						486	I	4	I=9701,L=10,M=10,V=2,Xaa=16	9739
487	S	0						487	S	3	N=13,S=9713,T=1,Xaa=12	9739
488	K	0						488	K	3	R=4,Q=2,E=5,K=9717,Xaa=11	9739
489	C	0						489	C	5	C=9686,Del=1,S=40,Xaa=12	9739
490	R	0						490	R	3	R=9719,G=1,I=3,L=1,K=3,T=1,Xaa=11	9739
491	T	0						491	T	4	N=6,I=9,L=1,P=2,S=8,T=9702,Xaa=11	9739
492	K	0						492	K	27	R=410,Q=2,I=3,K=9313,Xaa=11	9739
493	E	0						493	E	2	D=2,E=9722,G=1,K=3,Xaa=11	9739
494	G	0						494	G	1	E=1,G=9727,Xaa=11	9739
495	R	0						495	R	3	R=9712,Q=4,G=3,I=2,K=3,S=1,W=2,Xaa=12	9739
496	R	0						496	R	2	R=9724,Q=2,K=1,T=1,Xaa=11	9739
497	K	0						497	K	8	R=65,E=12,K=9651,Xaa=11	9739
498	T	0						498	T	3	A=12,I=3,K=1,S=1,T=9711,Xaa=11	9739
499	N	0						499	N	2	N=9718,K=1,S=9,Xaa=11	9739
500	L	0						500	L	1	L=9727,P=1,Xaa=11	9739
501	Y	0						501	Y	2	N=1,F=2,S=1,Y=9724,Xaa=11	9739
502	G	0						502	G	1	G=9728,Xaa=11	9739
503	**F**	12	Y12					503	F	2	L=2,F=9726,Xaa=11	9739
504	**I**	13	L12T1					504	I	8	I=9663,L=14,M=5,F=3,V=43,Xaa=11	9739
505	**I**	13	V13					505	I	17	I=9504,M=2,T=3,V=219,Xaa=11	9739
506	K	0						506	K	1	R=1,K=9727,Xaa=11	9739
507	**G**	1	E1					507	G	1	R=1,G=9727,Xaa=11	9739
508	R	0						508	R	3	R=9710,G=2,K=14,S=1,Xaa=12	9739
509	S	0						509	S	1	A=1,S=9727,Xaa=11	9739
510	H	0						510	H	1	R=1,H=9727,Xaa=11	9739
511	L	0						511	L	2	L=9726,W=1,V=1,Xaa=11	9739
512	R	0						512	R	2	R=9726,G=1,M=1,Xaa=11	9739
513	N	0						513	N	2	N=9721,D=2,K=1,S=3,Y=1,Xaa=11	9739
514	D	0						514	D	2	N=5,D=9722,E=1,Xaa=11	9739
515	T	0						515	T	2	I=3,S=2,T=9723,Xaa=11	9739
516	D	0						516	D	2	N=2,D=9725,Y=1,Xaa=11	9739
517	V	0						517	V	2	I=1,L=2,M=1,S=1,V=9723,Xaa=11	9739
518	V	0						518	V	3	A=9,I=1,L=2,V=9716,Xaa=11	9739
519	N	0						519	N	2	N=9722,D=1,S=2,T=3,Xaa=11	9739
520	F	0						520	F	6	I=1,L=2,F=9685,Y=40,Xaa=11	9739
521	V	0						521	V	10	I=3,L=82,M=10,V=9633,Xaa=11	9739
522	S	0						522	S	2	R=2,N=1,S=9725,Xaa=11	9739
523	M	0						523	M	1	L=1,M=9727,Xaa=11	9739
524	E	0						524	E	2	D=1,E=9725,G=1,V=1,Xaa=11	9739
525	F	0						525	F	1	F=9728,Xaa=11	9739
526	S	0						526	S	1	P=1,S=9728,Xaa=10	9739
527	L	0						527	L	2	I=1,L=9721,F=6,Xaa=11	9739
528	T	0						528	T	2	I=6,P=1,S=2,T=9720,Xaa=10	9739
529	**D**	2	N2					529	D	2	N=8,D=9720,E=1,Xaa=10	9739
530	P	0						530	P	1	L=1,P=9728,Xaa=10	9739
531	**R**	2	K2					531	R	9	R=9650,G=18,I=1,K=51,M=11,Xaa=8	9739
532	**F**	42	L42	L	F	1987	0,0000	532	L	4	I=19,L=9706,M=5,V=1,Xaa=8	9739
533	E	0						533	E	2	D=6,E=9724,K=1,Xaa=8	9739
534	**P**	4	Q4					534	P	11	Q=4,L=78,P=9618,S=30,T=1,Xaa=8	9739
535	H	0						535	H	9	R=2,N=5,Q=6,H=9642,P=3,Y=73,Xaa=8	9739
536	K	0						536	K	2	R=2,N=1,E=1,K=9727,Xaa=8	9739
537	W	0						537	W	1	M=1,W=9729,Xaa=9	9739
538	E	0						538	E	4	D=3,E=9705,G=12,K=1,V=10,Xaa=8	9739
539	K	0						539	K	12	R=139,E=1,K=9591,Xaa=8	9739
540	Y	0						540	Y	3	H=3,F=12,Y=9716,Xaa=8	9739
541	C	0						541	C	2	C=9724,S=6,Y=1,Xaa=8	9739
542	V	0						542	V	5	A=1,I=44,V=9686,Xaa=8	9739
543	**L**	1	H1					543	L	10	I=85,L=9634,F=1,P=9,S=2,Xaa=8	9739
544	E	0						544	E	5	R=28,D=3,Q=2,E=9692,G=1,K=5,Xaa=8	9739
545	**I**	1	V1					545	I	60	I=8363,M=1,T=1,V=1367,Xaa=7	9739
546	G	0						546	G	1	R=1,G=9731,Xaa=7	9739
547	D	0						547	D	8	N=19,D=9654,E=59,Xaa=7	9739
548	M	0						548	M	4	I=29,M=9699,V=4,Xaa=7	9739
549	L	0						549	L	8	I=52,L=9664,F=8,V=8,Xaa=7	9739
550	L	0						550	L	5	I=35,L=9693,M=2,P=1,Xaa=8	9739
551	**R**	1	K1					551	R	3	R=9708,K=22,S=1,W=1,Xaa=7	9739
552	T	0						552	T	8	A=81,N=2,G=1,T=9648,Xaa=7	9739
553	**A**	2	T2					553	A	10	A=9624,E=1,P=2,S=106,T=1,Xaa=5	9739
554	**V**	3	I3				0,0994	554	I	49	I=8748,L=7,M=11,V=968,Xaa=5	9739
555	G	0						555	G	2	D=1,C=2,Del=1,G=9720,S=10,Xaa=5	9739
556	Q	0						556	Q	5	R=5,N=4,Q=9697,H=20,L=4,K=1,P=4,Xaa=4	9739
557	V	0						557	V	5	A=4,I=23,M=15,V=9693,Xaa=4	9739
558	S	0						558	S	5	A=17,L=18,P=1,S=9695,T=4,Xaa=4	9739
559	R	0						559	R	1	R=9728,G=1,K=6,Xaa=4	9739
560	P	0						560	P	6	A=16,H=2,L=1,P=9687,S=19,T=9,Xaa=5	9739
561	M	0						561	M	11	I=52,L=55,M=9619,T=1,V=7,Xaa=5	9739
562	F	0						562	F	2	F=9721,S=1,Y=13,Xaa=4	9739
563	L	0						563	L	1	L=9735,Xaa=4	9739
564	Y	0						564	Y	1	C=1,F=2,Y=9733,Xaa=3	9739
565	V	0						565	V	30	A=3,I=441,L=1,M=21,V=9270,Xaa=3	9739
566	R	0						566	R	1	R=9731,G=1,K=2,T=1,Xaa=4	9739
567	T	0						567	T	1	A=2,I=1,T=9735,Xaa=1	9739
568	N	0						568	N	1	N=9734,I=2,K=2,Xaa=1	9739
569	**G**	1	R1					569	G	0	E=1,G=9737,Xaa=1	9739
570	T	0						570	T	2	A=3,I=14,T=9721,Xaa=1	9739
571	S	0						571	S	1	P=2,S=9735,Xaa=2	9739
572	K	0						572	K	1	Q=4,K=9734,Xaa=1	9739
573	I	0						573	I	3	I=9714,T=8,V=16,Xaa=1	9739
574	K	0						574	K	1	R=1,Q=1,K=9735,Xaa=2	9739
575	M	0						575	M	1	I=1,L=3,M=9732,T=1,Xaa=2	9739
576	K	0						576	K	0	N=1,Del=1,K=9736,Xaa=1	9739
577	W	0						577	W	1	C=1,Del=1,G=1,W=9735,Xaa=1	9739
578	G	0						578	G	1	D=1,G=9729,S=8,Xaa=1	9739
579	M	0						579	M	2	I=12,L=1,M=9722,T=1,Xaa=3	9739
580	E	0						580	E	1	R=1,D=1,E=9734,G=2,Xaa=1	9739
581	**M**	1	I1					581	M	2	I=13,L=1,M=9721,T=3,Xaa=1	9739
582	R	0						582	R	0	R=9736,K=1,T=1,Xaa=1	9739
583	R	0						583	R	1	R=9730,Q=1,G=2,H=4,P=1,Xaa=1	9739
584	C	0						584	C	0	C=9736,G=1,S=1,Xaa=1	9739
585	L	0						585	L	1	L=9731,F=2,P=5,Xaa=1	9739

vmuc:
Not a marker
(>0.05)

586	L	0						586	L	2	L=9725,F=10,P=1,Xaa=3		9739
587	Q	0						587	Q	0	Q=9736,H=1,P=1,Xaa=1		9739
588	S	0						588	S	1	A=1,F=1,P=3,S=9732,Xaa=2		9739
589	L	0						589	L	1	I=1,L=9731,F=4,P=1,Xaa=2		9739
590	Q	0						590	Q	91	R=1,Del=3097,Q=6638,H=1,P=1,Xaa=1		9739
591	Q	0						591	Q	0	Q=9736,P=2,Xaa=1		9739
592	I	0						592	I	3	I=9715,M=2,V=21,Xaa=1		9739
593	E	0						593	E	0	E=9737,G=1,Xaa=1		9739
594	S	0						594	S	3	R=2,N=10,G=5,S=9719,T=1,Xaa=2		9739
595	M	0						595	M	6	I=48,L=7,M=9678,T=2,V=2,Xaa=2		9739
596	I	0						596	I	5	Del=1,I=9691,T=1,V=45,Xaa=1		9739
597	E	0						597	E	1	D=2,Del=2,E=9732,G=1,K=1,Xaa=1		9739
598	**A**	1	S1					598	A	2	A=9727,S=2,T=7,V=1,Xaa=2		9739
599	E	0						599	E	2	D=2,Q=2,E=9728,G=3,K=2,V=1,Xaa=1		9739
600	S	0						600	S	1	F=5,P=2,S=9730,Xaa=2		9739
601	S	0						601	S	0	F=2,S=9736,Xaa=1		9739
602	V	0						602	V	14	A=4,I=166,F=1,T=2,V=9565,Xaa=1		9739
603	K	0						603	K	9	R=102,Q=1,E=1,K=9632,T=2,Xaa=1		9739
604	E	0						604	E	0	E=9737,G=1,Xaa=1		9739
605	K	0						605	K	1	R=9,Q=1,K=9728,Xaa=1		9739
606	D	0						606	D	1	N=2,D=9734,E=1,G=1,Xaa=1		9739
607	M	0						607	M	13	I=5,L=133,M=9579,V=21,Xaa=1		9739
608	T	0						608	T	0	S=2,T=9736,Xaa=1		9739
609	K	0						609	K	19	R=285,K=9453,Xaa=1		9739
610	E	0						610	E	7	A=2,D=62,E=9666,G=5,K=2,Xaa=2		9739
611	F	0						611	F	1	L=4,F=9732,S=1,V=1,Xaa=1		9739
612	**F**	1	Y1					612	F	0	F=9737,S=1,Xaa=1		9739
613	E	0						613	E	5	D=2,E=9696,G=7,L=6,K=5,V=21,Xaa=2		9739
614	N	0						614	N	30	A=4,N=9345,D=55,K=1,S=84,T=246,Xaa=4		9739
615	**K**	1	R1					615	K	13	R=168,N=2,K=9568,Xaa=1		9739
616	S	0						616	S	4	A=6,L=10,P=5,S=9702,T=15,Xaa=1		9739
617	E	0						617	E	2	A=1,Q=1,E=9720,G=4,K=3,V=2,Xaa=8		9739
618	T	0						618	T	35	A=62,R=3,I=1,K=265,M=129,S=2,T=9275,V=1,Xaa=1		9739
619	W	0						619	W	1	R=3,C=1,W=9734,Xaa=1		9739
620	P	0						620	P	2	P=9721,S=2,T=14,Xaa=2		9739
621	I	0						621	I	10	I=9621,M=1,T=2,V=114,Xaa=1		9739
622	G	0						622	G	0	A=1,G=9737,Xaa=1		9739
623	E	0						623	E	1	D=2,E=9730,G=6,Xaa=1		9739
624	S	0						624	S	0	S=9738,Xaa=1		9739
625	P	0						625	P	0	P=9736,S=1,Xaa=2		9739
626	**K**	15	R15					626	K	76	R=1928,N=8,Q=12,E=4,G=9,I=3,K=7772,T=2,Xaa=1		9739
627	G	0						627	G	3	R=14,E=5,G=9713,K=5,Xaa=2		9739
628	V	0						628	V	7	Del=1,G=2,I=31,L=17,M=15,T=1,W=1,V=9670,Xaa=1		9739
629	E	0						629	E	1	A=1,R=1,E=9733,G=3,Xaa=1		9739
630	E	0						630	E	11	A=1,D=80,E=9625,G=8,K=7,V=17,Xaa=1		9739
631	G	0						631	G	24	R=2,N=1,C=2,G=9368,S=361,V=3,Xaa=2		9739
632	S	0						632	S	2	A=1,F=4,P=7,S=9726,Xaa=1		9739
633	I	0						633	I	2	I=9723,L=2,S=1,V=12,Xaa=1		9739
634	G	0						634	G	0	R=1,E=1,G=9736,Xaa=1		9739
635	K	0						635	K	0	K=9738,Xaa=1		9739
636	V	0						636	V	3	A=1,G=2,I=3,L=20,V=9712,Xaa=1		9739
637	C	0						637	C	1	C=9735,G=2,Y=1,Xaa=1		9739
638	R	0						638	R	0	R=9736,K=2,Xaa=1		9739
639	T	0						639	T	3	A=30,T=9708,Xaa=1		9739
640	L	0						640	L	1	L=9734,M=3,F=1,W=1		9739
641	L	0						641	L	0	I=1,L=9736,M=2		9739
642	A	0						642	A	1	A=9728,G=1,S=7,T=3		9739
643	K	0						643	K	2	R=21,K=9718		9739
644	S	0						644	S	0	F=1,P=1,S=9737		9739
645	V	0						645	V	1	A=3,I=1,L=7,V=9728		9739
646	F	0						646	F	1	L=2,F=9735,S=2		9739
647	N	0						647	N	1	N=9732,D=2,S=2,T=3		9739
648	S	0						648	S	7	A=1,R=1,N=48,C=8,G=7,S=9674		9739
649	L	0						649	L	6	I=59,L=9676,M=3,S=1		9739
650	Y	0						650	Y	1	H=1,F=4,Y=9734		9739
651	A	0						651	A	4	A=9697,S=39,T=3		9739
652	S	0						652	S	0	F=1,S=9738		9739
653	P	0						653	P	30	A=21,P=9261,S=452,T=5		9739
654	Q	0						654	Q	0	Q=9739		9739
655	L	0						655	L	1	I=2,L=9733,F=4		9739
656	E	0						656	E	0	E=9738,Xaa=1		9739
657	G	0						657	G	0	G=9739		9739
658	F	0						658	F	0	L=1,F=9737,Xaa=1		9739
659	S	0						659	S	0	Q=1,L=1,P=1,S=9736		9739
660	**A**	1	V1					660	A	1	A=9730,G=1,L=1,P=1,S=6		9739
661	E	0						661	E	0	Del=1,E=9738		9739
662	S	0						662	S	2	A=15,L=2,S=9722		9739
663	R	0						663	R	0	R=9737,Q=1,K=1		9739
664	K	0						664	K	3	R=28,E=1,K=9709,Xaa=1		9739
665	**L**	8	I8	I	L		1976	665	L	9	I=19,L=9638,M=77,F=5	0,0020	9739
666	L	0						666	L	1	I=2,L=9729,F=7,T=1		9739
667	L	0						667	L	1	L=9734,F=3,S=1,Xaa=1		9739
668	I	0						668	I	2	I=9721,L=1,V=17		9739
669	V	0						669	V	42	A=696,I=11,S=1,T=33,V=8998		9739
670	Q	0						670	Q	0	R=1,Q=9737,H=1		9739
671	A	0						671	A	0	A=9739		9739
672	**L**	2						672	L	93	Del=3097,I=3,L=6616,F=21,V=1,Xaa=1		9739
673	R	0						673	R	4	R=9704,G=9,K=17,M=9		9739
674	D	0						674	D	1	A=1,D=9735,G=3		9739
675	N	0						675	N	13	N=9600,D=1,G=1,H=7,K=25,S=94,T=2,Y=8,Xaa=1		9739
676	L	0						676	L	0	L=9738,P=1		9739
677	**E**	1	K1					677	E	1	A=1,D=4,E=9729,G=4,K=1		9739
678	P	0						678	P	0	P=9738,S=1		9739
679	G	0						679	G	0	R=1,G=9737,W=1		9739
680	T	0						680	T	1	A=1,S=4,T=9733,Xaa=1		9739
681	F	0						681	F	0	L=1,F=9738		9739
682	D	0						682	D	3	N=24,D=9712,G=1,H=1,Y=1		9739
683	**I**	9	L9	L	I		1975	683	L	10	I=120,L=9615,F=4	0,0123	9739
684	**G**	2	E2					684	G	18	A=6,R=14,E=210,G=9507,W=2		9739
685	G	0						685	G	0	G=9739		9739
686	L	0						686	L	1	Q=1,L=9730,V=8		9739
687	Y	0						687	Y	0	H=1,Y=9738		9739
688	E	0						688	E	9	D=8,E=9645,G=82,K=2,V=2		9739
689	**S**	2	A2	Early marker - 1963			0,0010	689	A	1	A=9728,P=1,S=10		9739
690	I	0						690	I	4	I=9704,M=2,T=4,V=29		9739
691	E	0						691	E	0	E=9738,G=1		9739
692	E	0						692	E	1	E=9735,G=3,K=1		9739
693	C	0						693	C	1	R=1,C=9735,G=2,Y=1		9739
694	L	0						694	L	1	L=9728,M=5,P=1,V=5		9739
695	I	0						695	I	3	I=9716,L=1,T=1,V=21		9739
696	**N**	1	S1					696	N	2	N=9718,K=1,S=19,Xaa=1		9739
697	D	0						697	D	3	N=21,D=9714,E=1,G=1,Xaa=2		9739
698	P	0						698	P	1	L=1,P=9735,S=3		9739
699	W	0						699	W	0	R=1,L=1,W=9736,Xaa=1		9739
700	V	0						700	V	1	A=2,G=2,I=1,L=1,V=9733		9739
701	L	0						701	L	0	C=1,L=9737,F=1		9739
702	L	0						702	L	1	I=2,L=9735,P=1,V=1		9739
703	N	0						703	N	1	N=9732,D=1,I=1,K=1,S=4		9739
704	A	0						704	A	0	A=9738,V=1		9739
705	S	0						705	S	1	F=3,P=3,S=9729,Y=4		9739
706	W	0						706	W	1	C=1,G=3,L=1,W=9731,Xaa=3		9739
707	**F**	1	V1					707	F	4	L=30,F=9705,S=3,V=1		9739
708	N	0						708	N	0	N=9736,I=1,S=1,Xaa=1		9739
709	S	0						709	S	1	F=5,P=1,S=9733		9739
710	F	0						710	F	1	L=4,F=9733,S=2		9739
711	**L**	1	V1					711	L	3	Q=1,I=6,L=9714,F=17,P=1		9739
712	**T**	2	I1K1					712	T	60	A=764,R=1,I=234,K=3,M=20,P=4,T=8705,V=6,Xaa=2		9739
713	H	0						713	H	1	R=2,N=1,Q=1,H=9734,Y=1		9739
714	A	0						714	A	4	A=9699,S=1,T=1,V=38		9739
715	L	0						715	L	1	R=2,E=1,G=1,L=9734,V=1		9739
716	**K**	2	R2					716	K	66	R=887,N=25,Q=39,E=205,G=6,I=1,K=8571,T=1,Xaa=2		9737

vmuc:
backward
substitution

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

| | | |

						98																																								
C	T	E	L	K	L	S	D	Y	E	G	R	L	I	Q	N	S	I	T	I	E	R	M	V	L	S	A	F	D	E	R	R	N	K	Y	L	E	E	H	P	S	A	G	K	D	P	K
						N																																								
						S6G1							T1							G1																										
0	0	0	0	0	0	7	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
C	T	E	L	K	L	**N**	D	H	E	G	R	L	**I**	Q	N	S	I	T	I	**E**	R	M	V	L	S	A	F	D	E	R	R	N	K	Y	L	E	E	H	P	S	A	G	K	D	P	K

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98 96 99 67
K T G G P I Y R R R D G K W M R E L I L Y D K E E I R R I W R Q A N N G E D A T A G L T H L M
K H M I
K2 R23 I8V2 Y11Q3 I1R1 V3 R1 I21L2
0 0 0 0 0 0 0 0 2 23 0 0 0 0 10 0 0 0 0 0 14 0 0 0 0 0 2 0 3 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 23 0
91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137
K T G G P I Y R R K D G K W M R E L I L H D K E E I M R I W R Q A N N G E D A T A G L T H M M

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K	G	V	G	T	M	V	M	E	L	I	R	M	I	K	R	G	I	N	D	R	N	F	W	R	G	E	N	G	R	R	T	R	I	A	Y	E	R	M	C	N	I	L	K	G	K
					I3	I10					Q1						V3													K5								K1								
0	0	0	0	0	3	10	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0	0	0
184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229
K	G	V	G	T	**M**	**V**	M	E	L	I	**R**	M	I	K	R	G	**I**	N	D	R	N	F	W	R	G	E	N	G	R	**R**	T	R	I	A	Y	E	**R**	M	C	N	I	L	K	G	K
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230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275
F	Q	T	A	A	Q	R	A	M	M	D	Q	V	R	E	G	R	N	P	G	N	A	E	I	E	D	L	I	F	L	A	R	S	A	L	I	L	R	G	S	V	A	H	K	S	C
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L P A C V Y G L A V A S G Y D F E R E G Y S L V G I D P F R L L Q N S Q V F S L I R P N E N
T K K I K
T1 A49 T1 H1 R9 I1 V6T1 R1 V7 L1 N9
0 0 0 0 0 0 0 0 1 0 49 1 0 1 0 0 0 9 0 0 0 0 0 1 0 7 0 0 0 1 0 0 0 0 0 0 7 1 0 0 0 0 0 9 0 0
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321
L P A C V Y G L A V T S G Y D F E K E G Y S L V G I D P F K L L Q N S Q I F S L I R P K E N

100 100 100 100
P A H K S Q L V W M A C H S A A F E D L R V S S F I R G T R V V P R G Q L S T R G V Q I A S
L N K AT
M2 K1 S30 S1 R1 V9 R2K1 T19S1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 1 0 30 1 0 0 0 0 0 1 1 9 0 0 0 3 0 20 0 0 0 0 0 0 0 0
322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367
P A H K S Q L V W M A C H S A A F E D L R V L N F I R G T K V I P R G Q L A T R G V Q I A S

99 95 97
N E N M E T M D S S T L E L R S R Y W A I R T R S G G N T N Q Q R A S A G Q I S V Q P T F S
I K S
M2 C2N2 V1 K44 K1 N12 K1 K3
0 0 0 0 0 0 2 0 1 4 0 1 0 0 0 0 44 0 0 0 0 0 0 1 0 0 0 0 0 12 1 0 3 0 0 0 0 0 0 0 0 0 0 0 0 0
368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413
N E N M E T I D S S T L E L R S R Y W A I R T R S G G N T S Q Q R A S A G Q I S V Q P T F S

																																							97						
V	Q	R	N	L	P	F	E	R	A	T	I	M	A	A	F	T	G	N	T	E	G	R	T	S	D	M	R	T	E	I	I	R	M	M	E	N	A	R	P	E	D	V	S	F	Q
																																				S			S						
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Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine NP H3N8				Permanent aa change				Avian_NP all subtypes				
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	0						1	M	0	M=9239	9239
2	A	0						2	A	0	A=9236,T=1,V=2	9239
3	S	0						3	S	12	A=5,L=90,F=11,P=7,S=9119,T=5,Y=2	9239
4	Q	0						4	Q	1	R=2,Q=9232,E=1,H=2,P=2	9239
5	G	0						5	G	1	A=1,G=9232,S=6	9239
6	T	0						6	T	0	A=3,T=9236	9239
7	K	0						7	K	0	K=9239	9239
8	R	0						8	R	0	R=9239	9239
9	S	0						9	S	4	G=1,F=2,P=26,S=9202,T=8	9239
10	Y	0						10	Y	11	H=132,L=1,Y=9106	9239
11	E	0						11	E	0	D=1,E=9237,G=1	9239
12	Q	0						12	Q	2	Q=9222,H=1,L=1,K=13,M=1,Xaa=1	9239
13	M	0						13	M	0	M=9239	9239
14	E	0						14	E	0	D=3,E=9236	9239
15	T	0						15	T	2	A=1,N=1,I=11,P=1,T=9225	9239
16	**D**	49	G49	G	D	1988	0,0005	16	G	32	N=1,D=5,C=1,Del=110,G=8802,S=320	9239
17	G	0						17	G	0	D=1,G=9238	9239
18	E	0						18	E	3	D=17,E=9218,G=2,K=1,V=1	9239
19	R	0						19	R	0	R=9236,N=1,H=2	9239
20	Q	0						20	Q	2	Q=9227,H=1,P=10,Xaa=1	9239
21	N	0						21	N	5	N=9191,D=30,K=5,S=13	9239
22	A	0						22	A	7	A=9181,P=1,S=27,T=18,V=11,Xaa=1	9239
23	T	0						23	T	9	N=51,I=1,P=2,S=35,T=9150	9239
24	E	0						24	E	1	D=4,E=9234,V=1	9239
25	I	0						25	I	1	I=9233,S=1,T=1,V=4	9239
26	R	0						26	R	0	R=9239	9239
27	A	0						27	A	4	A=9204,S=17,T=17,Xaa=1	9239
28	S	0						28	S	0	S=9238,T=1	9239
29	V	0						29	V	1	A=1,G=3,I=5,V=9230	9239
30	G	0						30	G	0	R=2,E=1,G=9236	9239
31	R	0						31	R	3	R=9209,G=5,K=25	9239
32	M	0						32	M	0	M=9239	9239
33	V	0						33	V	28	A=2,I=442,V=8795	9239
34	G	0						34	G	64	A=1,R=1,N=60,D=4,C=1,G=7911,S=1258,V=3	9239
35	G	0						35	G	1	A=3,R=4,G=9232	9239
36	I	0						36	I	2	N=1,I=9222,L=1,F=2,T=1,V=11,Xaa=1	9239
37	G	0						37	G	0	R=2,G=9236,Xaa=1	9239
38	R	0						38	R	8	R=9147,K=91,Xaa=1	9239
39	F	0						39	F	1	L=2,F=9235,Y=1,Xaa=1	9239
40	Y	0						40	Y	0	Y=9238,Xaa=1	9239
41	**V**	1	I1			Early marker - 1963	0,0250	41	I	18	A=3,I=8998,M=1,T=5,V=231,Xaa=1	9239
42	Q	0						42	Q	0	R=2,Q=9236,Xaa=1	9239
43	M	0						43	M	2	I=6,M=9221,T=6,V=5,Xaa=1	9239
44	C	0						44	C	0	C=9236,G=1,S=1,Xaa=1	9239
45	T	0						45	T	0	T=9238,Xaa=1	9239
46	E	0						46	E	1	D=1,E=9235,K=1,V=1,Xaa=1	9239
47	L	0						47	L	4	H=1,I=19,L=9205,F=13,Xaa=1	9239
48	K	0						48	K	4	R=24,N=3,Q=2,G=1,I=1,K=9207,Xaa=1	9239
49	L	0						49	L	2	I=6,L=9226,F=5,P=1,Xaa=1	9239
50	**N**	7	S6G1	S	N	1976	0,0192	50	S	22	N=177,D=16,G=56,I=1,S=8983,T=5,Xaa=1	9239
51	D	0						51	D	8	N=18,D=9161,E=58,Y=1,Xaa=1	9239
52	H	0					0,0652	52	Y	62	N=217,C=4,Q=122,H=602,F=1,S=1,Y=8291,Xaa=1	9239
53	E	0						53	E	1	D=5,Q=1,E=9231,Xaa=2	9239
54	G	0						54	G	2	C=8,G=9224,S=5,W=1,Xaa=1	9239
55	R	0						55	R	1	R=9231,G=1,M=6,Xaa=1	9239
56	L	0						56	L	1	L=9230,M=1,V=7,Xaa=1	9239
57	**I**	1	T1					57	I	12	I=9109,L=46,T=1,Y=1,V=81,Xaa=1	9239
58	Q	0						58	Q	0	Q=9237,H=1,Xaa=1	9239
59	N	0						59	N	0	N=9236,K=1,T=1,Xaa=1	9239
60	S	0						60	S	0	G=1,S=9236,T=1,Xaa=1	9239
61	I	0						61	I	9	R=1,I=9142,L=4,M=79,V=11,Xaa=2	9239
62	T	0						62	T	1	A=1,P=2,T=9235,Xaa=1	9239
63	I	0						63	I	9	I=9156,L=23,M=14,T=1,V=44,Xaa=1	9239
64	**E**	1	G1					64	E	0	E=9237,K=1,Xaa=1	9239
65	R	0						65	R	1	R=9231,K=6,S=1,Xaa=1	9239
66	M	0						66	M	1	I=2,M=9235,V=1,Xaa=1	9239
67	V	0						67	V	9	A=8,I=55,L=26,V=9148,Xaa=2	9239
68	L	0						68	L	0	L=9236,F=2,Xaa=1	9239
69	S	0						69	S	0	F=1,S=9236,Xaa=2	9239
70	A	0						70	A	1	A=9231,S=7,Xaa=1	9239
71	F	0						71	F	0	F=9237,S=1,Xaa=1	9239
72	D	0						72	D	0	D=9236,E=1,G=1,Xaa=1	9239
73	E	0						73	E	0	D=1,E=9236,G=1,Xaa=1	9239
74	R	0						74	R	0	R=9236,G=1,K=1,Xaa=1	9239
75	R	0						75	R	0	R=9238,Xaa=1	9239
76	N	0						76	N	0	N=9238,Xaa=1	9239
77	K	0						77	K	78	R=2073,N=1,Q=2,I=1,K=7161,Xaa=1	9239
78	Y	0						78	Y	0	Y=9238,Xaa=1	9239
79	L	0						79	L	0	L=9236,M=1,P=1,Xaa=1	9239
80	E	0						80	E	0	D=1,E=9237,Xaa=1	9239
81	E	0						81	E	2	D=11,E=9221,G=5,K=1,Xaa=1	9239
82	H	0						82	H	7	R=1,N=65,H=9168,P=1,S=1,Y=2,Xaa=1	9239
83	P	0						83	P	0	L=1,P=9237,Xaa=1	9239
84	S	0						84	S	13	R=7,N=97,H=1,I=1,S=9104,T=28,Xaa=1	9239
85	A	0						85	A	11	A=9127,D=1,S=13,T=81,V=15,Xaa=2	9239
86	G	0						86	G	2	R=7,G=9223,K=8,Xaa=1	9239
87	K	0						87	K	9	R=104,K=9134,Xaa=1	9239
88	D	0						88	D	0	N=1,D=9236,G=1,Xaa=1	9239
89	P	0						89	P	1	H=6,P=9232,Xaa=1	9239
90	K	0						90	K	2	R=15,N=1,K=9221,T=1,Xaa=1	9239
91	K	0						91	K	0	N=1,K=9237,Xaa=1	9239
92	T	0						92	T	0	T=9238,Xaa=1	9239
93	G	0						93	G	0	G=9237,V=1,Xaa=1	9239
94	G	0						94	G	0	G=9238,Xaa=1	9239
95	P	0						95	P	1	P=9230,S=8,Xaa=1	9239
96	I	0						96	I	5	I=9194,L=4,M=1,F=1,T=4,V=34,Xaa=1	9239
97	Y	0						97	Y	0	H=1,S=1,Y=9236,Xaa=1	9239
98	R	0						98	R	20	R=8952,G=1,K=285,Xaa=1	9239
99	**R**	2	K2					99	R	1	R=9233,K=4,M=1,Xaa=1	9239
100	**K**	23	R23	R	K	1985	0,0030	100	R	6	R=9182,I=6,K=28,V=22,Xaa=1	9239
101	D	0						101	D	17	A=1,N=11,D=9018,E=208,Xaa=1	9239
102	G	0						102	G	1	A=3,R=3,G=9230,V=2,Xaa=1	9239
103	K	0						103	K	5	R=49,N=2,E=1,K=9186,Xaa=1	9239
104	W	0						104	W	1	L=5,W=9233,Xaa=1	9239
105	**M**	10	I8V2					105	M	124	A=17,Q=6,I=330,L=12,K=4,M=5528,T=70,V=3269,Xaa=3	9239
106	R	0						106	R	1	R=9234,K=4,Xaa=1	9239
107	E	0						107	E	1	A=1,E=9233,G=4,Xaa=1	9239
108	L	0						108	L	1	I=1,L=9233,M=4,Xaa=1	9239
109	I	0						109	I	23	I=8962,L=1,M=3,S=3,T=97,V=172,Xaa=1	9239
110	L	0						110	L	0	I=2,L=9236,Xaa=1	9239
111	**H**	14	Y11Q3	Y	H Q	1976	H:0.0018 Q:0.0000	111	Y	9	N=1,C=12,H=17,F=50,Y=9158,Xaa=1	9239
112	D	0						112	D	4	N=16,D=9208,E=10,G=2,H=1,Y=1,Xaa=1	9239
113	K	0						113	K	0	Q=1,K=9237,Xaa=1	9239
114	E	0						114	E	10	A=1,D=116,E=9120,G=1,Xaa=1	9239
115	E	0						115	E	0	E=9236,G=1,K=1,Xaa=1	9239
116	I	0						116	I	7	I=9172,L=44,T=1,V=21,Xaa=1	9239
117	**M**	2	I1R1			Early marker - 1963	0,0003	117	R	3	R=9218,G=1,K=14,M=3,S=1,T=1,Xaa=1	9239
118	R	0						118	R	2	R=9224,K=14,Xaa=1	9239
119	**I**	3	V3					119	I	12	N=32,D=1,I=9117,L=8,M=3,T=2,V=75,Xaa=1	9239
120	W	0						120	W	0	W=9237,Xaa=2	9239
121	R	0						121	R	3	R=9219,C=2,G=1,H=13,P=1,S=2,Xaa=1	9239
122	**Q**	1	R1					122	Q	2	R=7,Q=9228,L=2,P=1,Xaa=1	9239
123	A	0						123	A	1	A=9235,R=1,S=1,V=1,Xaa=1	9239
124	N	0						124	N	2	N=9221,D=1,H=13,S=2,T=1,Xaa=1	9239
125	N	0						125	N	4	N=9208,D=1,H=1,S=26,T=1,Y=1,Xaa=1	9239
126	G	0						126	G	1	R=1,E=2,G=9234,V=1,Xaa=1	9239
127	E	0						127	E	15	N=1,D=191,E=9042,G=3,K=1,Xaa=1	9239
128	D	0						128	D	5	N=8,D=9193,E=33,G=3,Y=1,Xaa=1	9239
129	A	0						129	A	9	A=9140,D=1,G=2,S=87,T=7,V=1,Xaa=1	9239
130	T	0						130	T	17	A=15,N=64,I=1,L=1,P=107,S=1,T=9049,Xaa=1	9239
131	A	0						131	A	1	A=9229,L=1,P=2,S=1,T=5,V=1	9239
132	G	0						132	G	1	G=9235,S=4	9239
133	L	0						133	L	6	I=59,L=9180	9239
134	T	0						134	T	1	I=1,S=8,T=9229,Xaa=1	9239
135	H	0						135	H	0	H=9238,Xaa=1	9239
136	**M**	23	I22L1	M	I	2007	M:0.0840 I:0.0100	136	L	50	I=92,L=8366,K=1,M=776,V=4	9239

vmuc:
Not a marker
(>0.05)

137	M	0					137	M	0	R=1,M=9238			9239
138	I	0					138	I	1	I=9233,L=1,V=5			9239
139	W	0					139	W	0	W=9238,Xaa=1			9239
140	H	0					140	H	0	R=1,H=9238			9239
141	S	0					141	S	0	F=1,S=9236,T=1,Xaa=1			9239
142	N	0					142	N	0	A=1,N=9237,S=1			9239
143	L	0					143	L	2	I=1,L=9227,M=4,V=7			9239
144	N	0					144	N	1	N=9234,D=1,H=2,K=1,Y=1			9239
145	D	0					145	D	1	N=1,D=9235,E=1,G=2			9239
146	**T**	1	A1			Early marker - 1963	0,0062	146	A	9	A=9148,S=30,T=57,V=4		9239
147	T	0						147	T	0	A=1,I=2,T=9236			9239
148	Y	0						148	Y	0	S=1,Y=9238			9239
149	Q	0						149	Q	1	Q=9233,H=5,Xaa=1			9239
150	R	0						150	R	0	R=9237,S=1,T=1			9239
151	T	0						151	T	0	P=1,T=9237,Xaa=1			9239
152	R	0						152	R	0	R=9236,G=3			9239
153	A	0						153	A	0	A=9237,G=1,P=1			9239
154	L	0						154	L	1	H=2,I=2,L=9233,F=1,V=1			9239
155	V	0						155	V	0	A=1,I=1,V=9237			9239
156	R	0						156	R	0	R=9239			9239
157	**T**	34	A34					157	T	15	A=16,P=1,S=173,T=9049			9239
158	G	0						158	G	0	G=9238,Xaa=1			9239
159	M	0						159	M	0	L=1,M=9237,V=1			9239
160	D	0						160	D	0	D=9237,G=2			9239
161	P	0						161	P	0	A=1,P=9237,T=1			9239
162	R	0						162	R	1	R=9233,I=1,K=2,M=1,T=1,Xaa=1			9239
163	M	0						163	M	1	M=9231,T=6,Xaa=2			9239
164	C	0						164	C	1	R=1,C=9235,G=1,Xaa=2			9239
165	S	0						165	S	1	C=1,F=1,P=1,S=9234,Xaa=2			9239
166	L	0						166	L	1	I=1,L=9235,M=1,Xaa=2			9239
167	**M**	1	T1					167	M	1	K=1,M=9234,T=1,Xaa=3			9239
168	Q	0						168	Q	1	Q=9233,H=1,L=1,K=1,P=1,Xaa=2			9239
169	G	0						169	G	1	A=1,R=1,G=9235,Xaa=2			9239
170	S	0						170	S	0	P=1,S=9236,Xaa=2			9239
171	T	0						171	T	1	A=1,N=1,S=1,T=9234,Xaa=2			9239
172	L	0						172	L	1	I=1,L=9232,F=2,P=2,Xaa=2			9239
173	P	0						173	P	0	P=9236,Xaa=3			9239
174	R	0						174	R	1	R=9234,K=1,T=1,Xaa=3			9239
175	R	0						175	R	0	R=9236,K=1,Xaa=2			9239
176	S	0						176	S	1	P=1,S=9235,Xaa=3			9239
177	G	0						177	G	0	R=1,G=9236,Xaa=2			9239
178	A	0						178	A	1	A=9233,D=1,F=1,S=1,V=1,Xaa=2			9239
179	A	0						179	A	0	A=9237,Xaa=2			9239
180	G	0						180	G	1	R=1,G=9235,V=1,Xaa=2			9239
181	A	0						181	A	1	A=9231,S=5,Xaa=3			9239
182	**A**	1	S1					182	A	2	A=9224,G=1,S=8,T=3,Xaa=3			9239
183	**V**	2	I2					183	V	21	A=1,I=218,L=1,M=42,V=8974,Xaa=3			9239
184	K	0						184	K	1	R=1,K=9234,Xaa=4			9239
185	G	0						185	G	1	G=9235,V=1,Xaa=3			9239
186	V	0						186	V	24	I=361,V=8875,Xaa=3			9239
187	G	0						187	G	1	R=3,G=9233,Xaa=3			9239
188	T	0						188	T	1	A=1,Q=1,P=1,T=9233,Xaa=3			9239
189	**M**	3	I3					189	M	7	I=58,L=3,M=9172,V=3,Xaa=3			9239
190	**V**	10	I10					190	V	8	A=68,G=2,I=5,T=2,V=9159,Xaa=3			9239
191	M	0						191	M	1	L=5,M=9229,V=2,Xaa=3			9239
192	E	0						192	E	1	E=9235,Xaa=4			9239
193	L	0						193	L	2	I=14,L=9220,M=1,V=1,Xaa=3			9239
194	I	0						194	I	20	N=1,I=8975,F=1,T=7,V=252,Xaa=3			9239
195	**R**	1	Q1					195	R	1	R=9235,Q=1,Xaa=3			9239
196	M	0						196	M	1	I=1,M=9233,T=2,Xaa=3			9239
197	I	0						197	I	6	I=9178,T=3,V=55,Xaa=3			9239
198	K	0						198	K	3	R=12,N=2,K=9219,S=1,T=2,Xaa=3			9239
199	R	0						199	R	1	R=9233,Q=2,G=1,Xaa=3			9239
200	G	0						200	G	1	R=3,E=1,G=9232,Xaa=3			9239
201	**I**	3	V3					201	I	26	A=1,N=1,I=8856,M=1,T=4,V=373,Xaa=3			9239
202	N	0						202	N	1	N=9231,D=1,H=1,S=2,T=1,Xaa=3			9239
203	D	0						203	D	1	A=1,N=2,D=9232,I=1,Xaa=3			9239
204	R	0						204	R	1	R=9231,Q=1,P=3,W=1,Xaa=3			9239
205	N	0						205	N	1	N=9234,K=1,S=1,Xaa=3			9239
206	F	0						206	F	1	F=9233,Xaa=6			9239
207	W	0						207	W	1	W=9234,Xaa=5			9239
208	R	0						208	R	1	R=9233,G=1,Xaa=5			9239
209	G	0						209	G	1	G=9234,Xaa=5			9239
210	E	0						210	E	13	D=157,E=9075,G=1,P=1,Xaa=5			9239
211	N	0						211	N	4	N=9208,D=2,S=14,T=10,Xaa=5			9239
212	G	0						212	G	1	E=2,G=9232,Xaa=5			9239
213	R	0						213	R	1	R=9233,P=1,Xaa=5			9239
214	**R**	5	K5					214	R	8	R=9148,L=1,K=85,Xaa=5			9239
215	T	0						215	T	2	A=4,N=1,P=2,T=9227,Xaa=5			9239
216	R	0						216	R	3	R=9214,G=1,K=16,M=2,W=1,Xaa=5			9239
217	I	0						217	I	27	A=2,N=3,I=8909,L=1,M=5,F=1,T=222,V=91,Xaa=5			9239
218	A	0						218	A	1	A=9230,G=1,P=1,T=2,Xaa=5			9239
219	Y	0						219	Y	1	C=1,Y=9233,Xaa=5			9239
220	E	0						220	E	2	D=8,E=9224,K=1,Xaa=6			9239
221	**R**	1	K1					221	R	1	R=9233,G=1,Xaa=5			9239
222	M	0						222	M	1	I=2,M=9232,Xaa=5			9239
223	C	0						223	C	1	C=9232,S=1,Y=1,Xaa=5			9239
224	N	0						224	N	1	N=9232,K=1,T=1,Xaa=5			9239
225	I	0						225	I	1	I=9229,V=5,Xaa=5			9239
226	L	0						226	L	1	L=9233,P=1,Xaa=5			9239
227	K	0						227	K	1	K=9234,Xaa=5			9239
228	G	0						228	G	1	R=2,G=9232,Xaa=5			9239
229	K	0						229	K	1	K=9232,T=1,Xaa=6			9239
230	F	0						230	F	3	I=2,L=14,F=9216,S=2,Xaa=5			9239
231	Q	0						231	Q	1	R=2,Q=9229,P=3,Xaa=5			9239
232	T	0						232	T	3	A=2,I=12,T=9219,Xaa=6			9239
233	A	0						233	A	1	A=9234,Xaa=5			9239
234	A	0						234	A	5	A=9195,I=1,S=31,T=3,V=4,Xaa=5			9239
235	Q	0						235	Q	1	Q=9234,Xaa=5			9239
236	R	0						236	R	3	R=9212,G=1,K=21,Xaa=5			9239
237	A	0						237	A	4	A=9208,G=15,S=1,T=7,V=3,Xaa=5			9239
238	M	0						238	M	1	I=3,L=1,M=9229,T=1,Xaa=5			9239
239	M	0						239	M	13	R=1,G=1,I=2,M=9083,T=4,V=142,Xaa=6			9239
240	D	0						240	D	1	A=1,N=1,D=9231,I=1,Xaa=5			9239
241	Q	0						241	Q	1	Q=9232,H=1,K=1,Xaa=5			9239
242	V	0						242	V	1	A=4,I=1,V=9229,Xaa=5			9239
243	R	0						243	R	1	R=9231,Q=2,K=1,Xaa=5			9239
244	E	0						244	E	1	E=9233,K=1,Xaa=5			9239
245	**G**	3	S3			Early marker - 1963	0,0021	245	S	3	N=1,G=19,S=9214,Xaa=5			9239
246	R	0						246	R	2	R=9227,G=1,K=4,T=1,Xaa=6			9239
247	N	0						247	N	9	N=9149,D=1,G=1,H=1,S=79,T=3,Xaa=5			9239
248	P	0						248	P	1	P=9233,T=1,Xaa=5			9239
249	G	0						249	G	1	R=2,E=2,G=9229,V=1,Xaa=5			9239
250	N	0						250	N	1	N=9233,S=1,Xaa=5			9239
251	A	0						251	A	3	A=9208,V=26,Xaa=5			9239
252	E	0						252	E	1	E=9234,Xaa=5			9239
253	I	0						253	I	5	I=9194,M=2,T=4,V=34,Xaa=5			9239
254	E	0						254	E	1	E=9233,G=1,Xaa=5			9239
255	D	0						255	D	1	N=1,D=9229,E=1,G=2,H=1,Xaa=5			9239
256	L	0						256	L	1	I=2,L=9229,F=1,V=2,Xaa=5			9239
257	**I**	17	T16S1	I	T	2007	0,0081	257	I	9	A=1,I=9151,L=3,S=1,T=75,V=3,Xaa=5			9239
258	F	0						258	F	1	F=9233,V=1,Xaa=5			9239
259	L	0						259	L	2	R=2,Q=1,I=2,L=9224,P=1,S=4,Xaa=5			9239
260	**A**	4	T4					260	A	2	A=9226,T=7,Xaa=6			9239
261	R	0						261	R	1	R=9234,Xaa=5			9239
262	S	0						262	S	1	C=1,S=9232,Xaa=6			9239
263	A	0						263	A	1	A=9232,P=1,Xaa=6			9239
264	L	0						264	L	1	I=1,L=9231,P=2,Xaa=5			9239
265	**I**	1	V1					265	I	3	I=9216,L=1,V=15,Xaa=7			9239
266	L	0						266	L	2	Q=1,L=9227,M=1,P=2,V=2,Xaa=6			9239
267	R	0						267	R	1	R=9232,K=1,Xaa=6			9239
268	G	0						268	G	1	R=2,E=2,G=9229,Xaa=6			9239
269	S	0						269	S	10	A=98,P=2,S=9131,T=2,Xaa=6			9239
270	V	0						270	V	11	A=2,I=78,L=2,M=21,V=9130,Xaa=6			9239
271	A	0						271	A	1	A=9229,G=1,P=2,S=1,Xaa=6			9239
272	H	0						272	H	1	H=9232,L=1,Xaa=6			9239
273	K	0						273	K	1	K=9233,Xaa=6			9239
274	S	0						274	S	1	S=9233,Xaa=6			9239
275	C	0						275	C	2	C=9225,S=5,W=1,Y=1,Xaa=7			9239
276	L	0						276	L	2	L=9226,M=4,P=1,W=1,Xaa=7			9239
277	P	0						277	P	2	A=1,H=2,P=9228,S=1,Xaa=7			9239
278	A	0						278	A	2	A=9226,D=1,S=2,T=2,V=1,Xaa=7			9239
279	C	0						279	C	1	R=1,C=9228,G=2,Xaa=8			9239
280	V	0						280	V	5	A=3,G=1,I=31,M=5,V=9191,Xaa=8			9239
281	Y	0						281	Y	2	N=1,H=1,F=1,S=1,Y=9227,Xaa=8			9239
282	G	0						282	G	1	A=1,R=3,G=9228,Xaa=7			9239
283	L	0						283	L	3	I=15,L=9213,P=4,Xaa=7			9239
284	**A**	1	T1					284	A	2	A=9226,T=4,V=2,Xaa=7			9239
285	V	0						285	V	2	A=1,I=6,L=1,V=9224,Xaa=7			9239

286	**T**	49	A49	A	T		1988	0,0001	286	A	6	A=9181,L=2,P=3,S=1,T=1,V=44,Xaa=7	9239
287	**S**	1	T1						287	S	11	N=16,G=96,I=1,S=9118,T=1,Xaa=7	9239
288	G	0							288	G	1	A=2,R=1,G=9230,Xaa=6	9239
289	**Y**	1	H1						289	Y	6	H=38,F=11,Y=9184,Xaa=6	9239
290	D	0							290	D	10	A=1,N=67,D=9142,E=14,G=1,H=1,S=3,V=1,Xaa=8	9239
291	F	0							291	F	1	L=3,F=9230,Xaa=6	9239
292	E	0							292	E	4	Q=3,E=9210,G=15,K=1,V=3,Xaa=7	9239
293	**K**	9	R9	R	K		1975	0,0113	293	R	10	R=9124,G=2,I=3,K=104,Xaa=6	9239
294	E	0							294	E	2	A=2,D=3,E=9225,G=1,K=2,Xaa=6	9239
295	G	0							295	G	1	R=4,G=9229,Xaa=6	9239
296	Y	0							296	Y	4	H=26,S=1,Y=9207,Xaa=5	9239
297	S	0							297	S	1	L=1,P=1,S=9232,Xaa=5	9239
298	L	0							298	L	1	L=9231,P=1,S=1,V=1,Xaa=5	9239
299	**V**	1	I1						299	V	1	I=2,V=9232,Xaa=5	9239
300	G	0							300	G	1	R=1,G=9233,Xaa=5	9239
301	**I**	7	V6T1						301	I	15	R=6,N=1,I=9079,L=18,K=1,M=12,F=4,V=113,Xaa=5	9239
302	D	0							302	D	2	A=2,N=1,D=9223,E=2,G=3,Xaa=8	9239
303	P	0							303	P	2	L=1,P=9226,S=7,Xaa=5	9239
304	F	0							304	F	2	L=1,F=9227,S=3,Y=3,Xaa=5	9239
305	**K**	1	R1			Early marker - 1963		0,0065	305	R	8	R=9165,H=7,K=60,S=2,Xaa=5	9239
306	L	0							306	L	2	L=9226,M=5,P=1,V=2,Xaa=5	9239
307	L	0							307	L	1	L=9233,F=1,Xaa=5	9239
308	Q	0							308	Q	4	Q=9207,K=27,Xaa=5	9239
309	N	0							309	N	2	A=1,N=9224,D=1,K=4,S=2,T=2,Xaa=5	9239
310	S	0							310	S	4	N=1,G=2,S=9205,T=23,V=3,Xaa=5	9239
311	Q	0							311	Q	1	R=1,Q=9233,Xaa=5	9239
312	**I**	7	V7	V	I		1975	0,0032	312	V	4	A=1,I=30,V=9203,Xaa=5	9239
313	**F**	1	L1						313	F	9	I=8,L=53,F=9151,S=14,Y=2,V=6,Xaa=5	9239
314	S	0							314	S	1	C=2,S=9232,Xaa=5	9239
315	L	0							315	L	4	I=31,L=9202,P=1,Xaa=5	9239
316	I	0							316	I	5	I=9194,L=1,M=7,T=1,V=31,Xaa=5	9239
317	R	0							317	R	1	R=9231,S=3,Xaa=5	9239
318	P	0							318	P	18	Q=1,L=4,K=1,P=9017,S=207,T=4,Xaa=5	9239
319	**K**	9	N9	N	K		1975	0,0038	319	N	6	N=9182,D=1,I=1,K=35,S=12,T=3,Xaa=5	9239
320	E	0							320	E	1	D=1,E=9231,G=1,K=1,Xaa=5	9239
321	N	0							321	N	3	N=9212,I=1,K=4,S=15,T=1,Y=1,Xaa=5	9239
322	P	0							322	P	3	A=2,Q=1,P=9211,S=19,T=1,Xaa=5	9239
323	A	0							323	A	8	A=9163,P=1,S=33,T=11,V=25,Xaa=6	9239
324	H	0							324	H	1	Q=1,H=9232,Xaa=6	9239
325	K	0							325	K	1	R=1,Q=1,K=9231,Xaa=6	9239
326	S	0							326	S	2	G=9,I=1,S=9224,Xaa=5	9239
327	Q	0							327	Q	1	R=1,Q=9232,P=1,Xaa=5	9239
328	L	0							328	L	1	L=9230,M=1,F=2,V=1,Xaa=5	9239
329	V	0							329	V	11	A=1,E=1,I=110,M=2,V=9120,Xaa=5	9239
330	W	0							330	W	1	G=1,W=9233,Xaa=5	9239
331	M	0							331	M	5	I=21,L=7,M=9200,T=1,V=5,Xaa=5	9239
332	A	0							332	A	1	A=9232,T=2,Xaa=5	9239
333	C	0							333	C	1	C=9233,S=1,Xaa=5	9239
334	H	0							334	H	1	R=1,N=2,H=9229,P=1,Y=1,Xaa=5	9239
335	S	0							335	S	3	A=6,F=2,P=2,S=9220,T=1,Xaa=8	9239
336	A	0							336	A	2	A=9224,P=2,S=3,T=3,V=2,Xaa=5	9239
337	A	0							337	A	2	A=9226,S=1,T=3,V=5,Xaa=4	9239
338	F	0							338	F	1	F=9231,S=1,Y=2,Xaa=5	9239
339	E	0							339	E	1	E=9234,Xaa=5	9239
340	D	0							340	D	1	N=2,D=9231,G=1,H=1,Y=1,Xaa=3	9239
341	**L**	2	M2						341	L	1	L=9230,M=6,Xaa=3	9239
342	**R**	1	K1						342	R	1	R=9232,G=2,K=1,S=1,Xaa=3	9239
343	V	0							343	V	3	A=1,I=15,L=1,M=6,V=9212,Xaa=4	9239
344	**L**	30	S30	S	L		1985	0,0103	344	S	9	A=1,L=95,F=1,S=9136,T=3,Xaa=3	9239
345	**N**	1	S1			Early marker - 1963		0,0003	345	S	2	N=3,G=8,S=9224,T=1,Xaa=3	9239
346	F	0							346	F	2	L=13,F=9221,Xaa=5	9239
347	I	0							347	I	3	I=9214,L=2,V=20,Xaa=3	9239
348	R	0							348	R	1	R=9233,G=1,K=2,Xaa=3	9239
349	G	0							349	G	1	R=1,G=9235,Xaa=3	9239
350	T	0							350	T	37	A=492,I=23,K=30,M=2,P=1,S=7,T=8681,Xaa=3	9239
351	**K**	1	R1			Early marker - 1963		0,0451	351	R	27	R=8816,G=1,I=2,K=417,Xaa=3	9239
352	**V**	1							352	V	27	A=7,I=93,L=39,M=175,V=8921,Xaa=4	9239
353	**I**	9	V9	V	I		1975	0,0641	353	V	51	A=52,I=592,L=124,F=6,S=1,V=8461,Xaa=3	9239
354	P	0							354	P	1	P=9235,S=1,Xaa=3	9239
355	R	0							355	R	0	R=9236,Xaa=3	9239
356	G	0							356	G	1	R=3,E=1,G=9232,Xaa=3	9239
357	**Q**	3	R2K1						357	Q	6	R=4,Q=9178,K=53,T=1,Xaa=3	9239
358	L	0							358	L	2	Q=1,L=9223,M=10,T=1,Y=1,Xaa=3	9239
359	**A**	20	T19S1	A	AT	Early marker - 1963 AT from 2002		A:0.0049 T:0.0001	359	S	6	A=45,C=1,P=1,S=9186,T=1,Y=1,V=1,Xaa=3	9239
360	T	0							360	T	1	A=1,P=2,T=9232,Xaa=4	9239
361	R	0							361	R	1	R=9232,G=1,I=1,K=2,Xaa=3	9239
362	G	0							362	G	1	R=2,G=9234,Xaa=3	9239
363	V	0							363	V	14	A=5,I=165,L=1,F=2,V=9064,Xaa=2	9239
364	Q	0							364	Q	1	Q=9233,E=1,L=2,K=1,Xaa=2	9239
365	I	0							365	I	14	N=1,I=9057,M=1,T=1,V=177,Xaa=2	9239
366	A	0							366	A	1	A=9232,S=6,Xaa=1	9239
367	S	0							367	S	1	L=1,F=1,P=1,S=9234,W=1,Xaa=1	9239
368	N	0							368	N	3	N=9210,K=3,F=1,S=24,Xaa=1	9239
369	E	0							369	E	1	E=9235,G=1,K=2,Xaa=1	9239
370	N	0							370	N	3	N=9212,H=2,S=24,Xaa=1	9239
371	M	0							371	M	40	A=1,I=91,L=5,M=8720,T=140,V=281,Xaa=1	9239
372	E	0							372	E	20	D=277,Del=1,E=8957,G=4	9239
373	T	0							373	T	74	A=1444,Del=1,I=44,L=3,M=29,P=3,S=11,T=7691,V=13	9239
374	**I**	2	M2			Early marker - 1963		0,0216	374	M	18	Del=1,I=200,L=3,M=9009,V=26	9239
375	D	0							375	D	24	N=80,D=8985,Del=1,Q=1,E=99,G=23,S=42,V=7,Xaa=1	9239
376	**S**	1							376	S	1	A=2,Del=1,H=1,F=1,S=9233,Y=1	9239
377	**S**	4	C2N2						377	S	67	R=4,N=1485,D=1,C=1,Del=1,G=4,H=1,I=3,M=1,P=1,S=7725,T=12	9239
378	T	0							378	T	1	A=1,Del=1,P=2,S=1,T=9234	9239
379	**L**	1	V1						379	L	1	Del=1,I=1,L=9235,P=1,Xaa=1	9239
380	E	0							380	E	1	D=1,Del=1,E=9235,G=1,K=1	9239
381	L	0							381	L	1	Del=1,L=9232,M=5,P=1	9239
382	R	0							382	R	1	R=9232,Del=1,G=1,L=1,K=4	9239
383	S	0							383	S	1	N=1,G=1,I=1,S=9235,Xaa=1	9239
384	**R**	44	K44	R	K		1997	0,0181	384	R	14	R=9065,Q=4,I=1,K=167,Xaa=2	9239
385	Y	0							385	Y	1	H=4,F=1,Y=9232,Xaa=2	9239
386	W	0							386	W	1	R=1,C=1,G=1,W=9235,Xaa=1	9239
387	A	0							387	A	0	A=9237,S=1,V=1	9239
388	I	0							388	I	0	I=9238,K=1	9239
389	R	0							389	R	6	R=9173,K=65,W=1	9239
390	T	0							390	T	1	A=1,N=1,I=1,M=1,P=3,S=1,T=9231	9239
391	**R**	1	K1						391	R	3	R=9212,Q=1,G=1,I=2,K=22,P=1	9239
392	S	0							392	S	0	R=1,G=1,S=9237	9239
393	G	0							393	G	0	G=9238,Xaa=1	9239
394	G	0							394	G	0	R=1,G=9237,K=1	9239
395	N	0							395	N	10	N=9142,D=3,Del=1,H=1,K=1,S=16,T=75	9239
396	T	0							396	T	6	A=10,N=40,Del=1,P=1,S=1,T=9186	9239
397	**S**	12	N12	N	S		1975	0,0262	397	N	19	N=8988,D=1,Del=1,H=1,I=3,K=1,S=242,T=1,Xaa=1	9239
398	**Q**	1	K1						398	Q	5	R=9,N=1,Q=9193,H=25,L=1,K=8,Xaa=2	9239
399	Q	0							399	Q	8	R=1,N=10,Q=9161,H=67	9239
400	**R**	3	K3						400	R	17	R=9019,I=1,K=216,S=1,W=1,Xaa=1	9239
401	A	0							401	A	2	A=9221,E=1,G=3,S=6,T=5,V=3	9239
402	S	0							402	S	3	A=1,F=6,P=1,S=9220,T=2,Y=3,Xaa=6	9239
403	A	0							403	A	0	A=9236,T=3	9239
404	G	0							404	G	0	G=9239	9239
405	Q	0							405	Q	0	Q=9238,H=1	9239
406	I	0							406	I	14	I=9059,L=1,T=3,V=176	9239
407	S	0							407	S	0	R=1,S=9237,Xaa=1	9239
408	V	0							408	V	30	I=482,L=2,T=1,V=8753,Xaa=1	9239
409	Q	0							409	Q	0	Q=9238,Xaa=1	9239
410	P	0							410	P	0	R=1,P=9237,Xaa=1	9239
411	T	0							411	T	2	A=8,P=1,S=2,T=9227,Xaa=1	9239
412	F	0							412	F	0	L=1,F=9237,Xaa=1	9239
413	S	0							413	S	0	P=1,S=9236,T=1,Xaa=1	9239
414	V	0							414	V	2	I=13,V=9225,Xaa=1	9239
415	Q	0							415	Q	1	Q=9233,H=5,Xaa=1	9239
416	R	0							416	R	1	R=9234,G=1,Xaa=4	9239
417	N	0							417	N	22	N=8937,D=8,G=1,K=1,S=284,T=7,Xaa=1	9239
418	L	0							418	L	1	I=2,L=9232,F=2,P=1,Xaa=2	9239
419	P	0							419	P	0	P=9237,S=1,Xaa=1	9239
420	F	0							420	F	1	L=2,F=9235,S=1,Xaa=1	9239
421	E	0							421	E	1	D=1,E=9235,K=1,Xaa=2	9239
422	R	0							422	R	1	R=9232,G=2,K=4,Xaa=1	9239
423	A	0							423	A	11	A=9127,S=63,T=35,V=13,Xaa=1	9239
424	T	0							424	T	2	A=4,I=2,S=1,T=9228,Xaa=4	9239
425	I	0							425	I	8	I=9151,M=2,V=85,Xaa=1	9239
426	**M**	1	I1						426	M	1	I=2,L=3,K=1,M=9231,T=1,Xaa=1	9239
427	A	0							427	A	1	A=9235,S=1,T=1,V=1,Xaa=1	9239
428	A	0							428	A	2	A=9221,S=9,T=3,V=5,Xaa=1	9239
429	F	0							429	F	1	L=5,F=9232,Y=1,Xaa=1	9239
430	**T**	1	A1						430	T	24	A=115,N=4,I=5,K=115,S=32,T=8966,V=1,Xaa=1	9239
431	G	0							431	G	0	G=9237,V=1,Xaa=1	9239
432	N	0							432	N	6	N=9178,D=3,H=2,S=48,T=7,Xaa=1	9239

vmuc:
Not a marker
(>0.05)

433	T	0							433	T	31	A=186,N=112,I=11,M=5,P=30,S=23,T=8871,Xaa=1	9239
434	E	0							434	E	1	D=6,E=9232,Xaa=1	9239
435	**G**	2	R2						435	G	1	A=1,C=1,G=9234,S=2,Xaa=1	9239
436	R	0							436	R	0	R=9237,D=1,Xaa=1	9239
437	**T**	2	A2						437	T	2	A=1,I=13,F=1,T=9223,Xaa=1	9239
438	S	0							438	S	1	R=1,F=5,S=9229,T=1,Y=1,Xaa=2	9239
439	D	0							439	D	1	D=9235,E=1,H=1,Xaa=2	9239
440	M	0							440	M	1	E=1,L=6,M=9230,V=1,Xaa=1	9239
441	R	0							441	R	1	R=9234,G=2,K=1,T=1,Xaa=1	9239
442	**T**	3	M3						442	T	5	A=9,E=1,S=30,T=9198,Xaa=1	9239
443	E	0							443	E	1	E=9235,G=1,I=1,V=1,Xaa=1	9239
444	I	0							444	I	5	I=9189,F=1,T=3,V=45,Xaa=1	9239
445	I	0							445	I	1	I=9230,V=8,Xaa=1	9239
446	R	0							446	R	28	R=8811,G=3,I=1,K=419,M=2,S=1,Xaa=2	9239
447	M	0							447	M	7	I=9,L=5,M=9179,T=41,V=4,Xaa=1	9239
448	M	0							448	M	1	R=1,I=1,L=1,M=9235,Xaa=1	9239
449	**E**	1	G1						449	E	0	D=1,E=9238	9239
450	**N**	20	S20	N	S		2007	0,3932	450	N	101	R=1,N=5571,D=3,G=13,H=1,I=14,K=1,S=3633,T=2	9239
451	A	0							451	A	8	A=9164,C=1,S=40,T=22,V=12	9239
452	**K**	53	R53	R	K		1990	0,0824	452	R	42	R=8468,Q=3,G=4,K=761,S=2,T=1	9239
453	**S**	4	P4			Early marker - 1963		0,0041	453	P	7	A=4,Q=1,L=6,P=9179,S=38,T=9,Xaa=2	9239
454	**E**	1	G1						454	E	8	D=81,E=9150,G=7,K=1	9239
455	D	0							455	D	3	N=7,D=9215,E=15,G=1,V=1	9239
456	**V**	1	A1						456	V	9	A=3,L=57,M=26,V=9153	9239
457	S	0							457	S	0	F=1,S=9238	9239
458	F	0							458	F	0	F=9236,S=2,Xaa=1	9239
459	Q	0							459	Q	2	R=3,Q=9226,H=8,K=1,Xaa=1	9239
460	G	0							460	G	1	R=5,E=1,G=9233	9239
461	R	0							461	R	0	R=9237,P=1,W=1	9239
462	G	0							462	G	0	A=1,G=9238	9239
463	V	0							463	V	0	A=3,V=9236	9239
464	F	0							464	F	0	R=1,F=9237,S=1	9239
465	E	0							465	E	1	A=1,E=9235,G=2,K=1	9239
466	**L**	1	F1						466	L	5	I=27,L=9191,F=20,V=1	9239
467	S	0							467	S	1	A=2,P=1,S=9231,T=3,W=1,Y=1	9239
468	D	0							468	D	1	A=1,N=1,D=9234,E=2	9239
469	E	0							469	E	1	D=2,E=9234,K=1,S=1,Xaa=1	9239
470	K	0							470	K	1	R=2,N=1,E=1,K=9233,T=2	9239
471	A	0							471	A	0	A=9237,R=1,I=1	9239
472	T	0							472	T	4	A=33,R=1,K=1,M=1,S=1,T=9202	9239
473	N	0							473	N	4	N=9202,H=2,K=1,S=33,T=1	9239
474	P	0							474	P	1	P=9229,S=9,T=1	9239
475	I	0							475	I	2	I=9223,T=2,V=14	9239
476	V	0							476	V	1	A=3,L=1,V=9235	9239
477	P	0							477	P	0	P=9239	9239
478	S	0							478	S	2	F=9,P=3,S=9227	9239
479	**F**	1	L1						479	F	2	L=14,F=9224,V=1	9239
480	D	0							480	D	3	N=10,D=9214,E=14,G=1	9239
481	M	0							481	M	6	H=1,I=15,L=3,K=2,M=9182,T=1,V=35	9239
482	**S**	5	N4G1						482	S	71	N=1713,D=1,C=1,Del=2,E=1,G=2,I=1,S=7511,T=7	9239
483	N	0							483	N	27	N=8829,D=4,K=404,S=1,Y=1	9239
484	E	0							484	E	3	D=27,E=9209,G=2,V=1	9239
485	G	0							485	G	1	R=4,E=1,G=9233,S=1	9239
486	S	0							486	S	1	I=1,F=1,P=1,S=9232,T=2,Y=1,Xaa=1	9239
487	Y	0							487	Y	0	N=1,H=2,Y=9236	9239
488	**F**	1	Y1						488	F	1	F=9232,S=7	9239
489	**F**	1	Y1						489	F	1	L=1,F=9234,S=4	9239
490	G	0							490	G	0	E=2,G=9236,V=1	9239
491	D	0							491	D	1	A=3,N=2,D=9230,E=3,G=1	9239
492	N	0							492	N	5	N=9203,D=4,H=7,I=2,K=3,S=16,T=3,Y=1	9239
493	**A**	1	T1						493	A	0	A=9239	9239
494	E	0							494	E	4	D=21,E=9201,G=2,K=14,Xaa=1	9239
495	E	0							495	E	3	D=20,E=9213,G=1,K=5	9239
496	**F**	2	Y2			Early marker - 1963		0,0146	496	Y	12	H=1,I=3,F=135,S=1,Y=9098	9238
497	D	0							497	D	17	A=1,N=1,D=9026,E=202,G=2,H=1,T=2,Y=3	9238
498	**S**	8	N8	N	S		1975	0,0157	498	N	14	N=9073,D=1,H=5,I=5,K=5,S=145,Y=1,Xaa=3	9238

vmuc:
Not a marker
(>0.05)

vmuc:
Not a marker
(>0.05)

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

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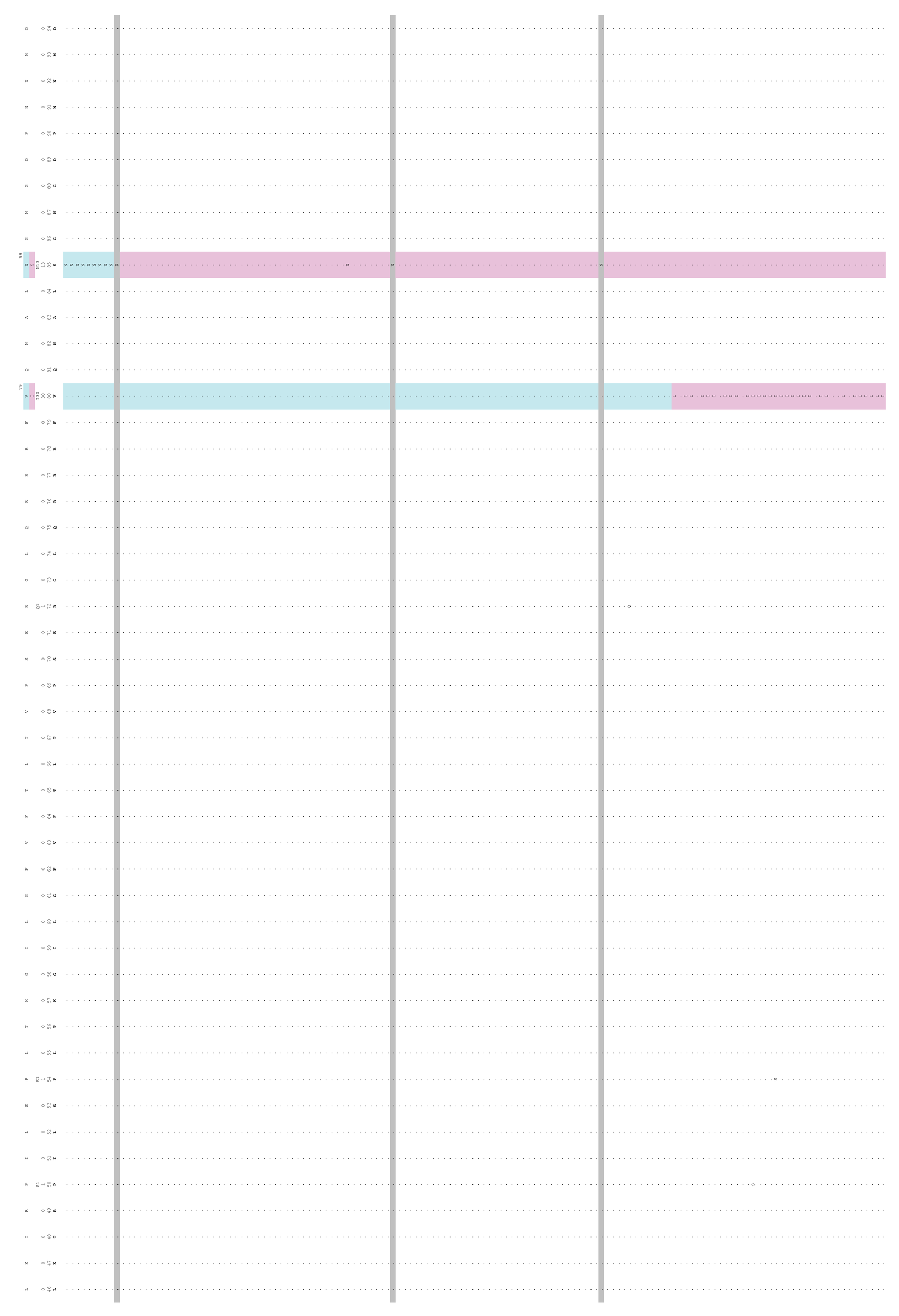

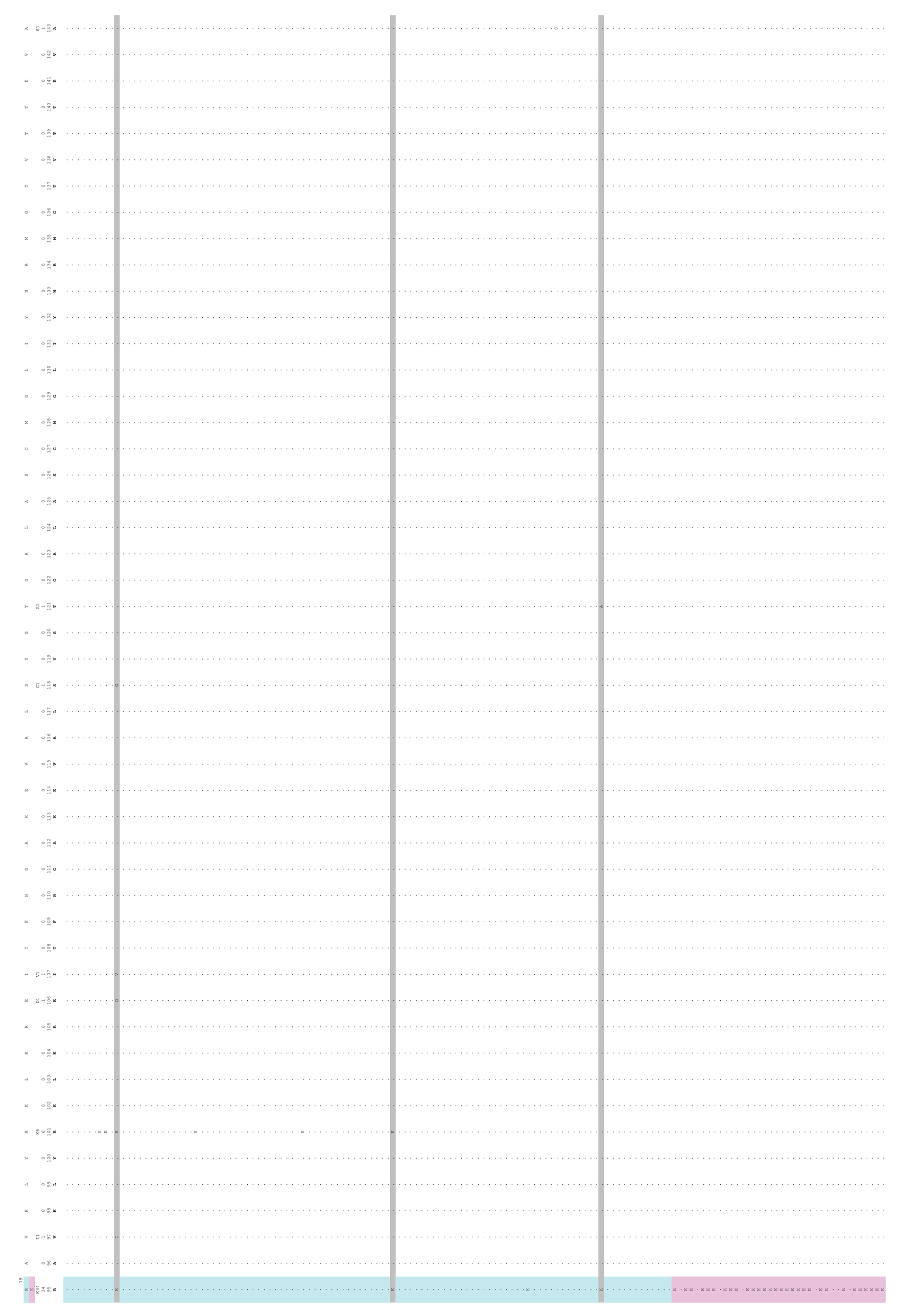

F	G	L	V	C	A	T	C	E	Q	I	A	D	S	Q	H	R	S	H	R	Q	M	V	T	T	T	N	P	L	I	R	H	E	N	R	M	V	L	A	S	T	T	A	K	A	M	E	Q	M
										X1						T1	A1	Y3			I1	A1	I1	I5													I1	V1						T5X1				V2X2
0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	3	0	0	1	1	1	5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	6	0	0	0	4
144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192
F	**G**	**L**	**V**	**C**	**A**	**T**	**C**	**E**	**Q**	**I**	**A**	**D**	**S**	**Q**	**H**	**R**	**S**	**H**	**R**	**Q**	**M**	**V**	**T**	**T**	**T**	**N**	**P**	**L**	**I**	**R**	**H**	**E**	**N**	**R**	**M**	**V**	**L**	**A**	**S**	**T**	**T**	**A**	**K**	**A**	**M**	**E**	**Q**	**M**

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99
A G S S E Q A A E A M E V A S Q A R Q M V Q A M R T I G T H P S S S A G L K D D L L E N L Q A Y Q
KR
N1 N1 I4 N1 Q14,R18 I1 V1 N3 N1 T2 R1 N7 N1 V2D1 V1
0 0 0 1 0 0 0 0 1 0 0 0 4 0 1 32 0 0 0 0 0 0 0 0 0 1 1 0 0 3 0 1 0 0 2 1 0 0 7 1 0 0 3 0 0 0 1 0 0
193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241
A G S S E Q A A E A M E V A S K A R Q M V Q A M R T I G T H P S S S A G L K D D L L E N L Q A Y Q

K	R	M	G	V	Q	M	Q	R	F	K
242	243	244	245	246	247	248	249	250	251	252
0	0	0	0	0	0	L5 5	R1 1	0	0	0
K	**R**	**M**	**G**	**V**	**Q**	**M**	**Q**	**R**	**F**	**K**

Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine M1 H3N8				Permanent aa change				Avian_M1 all subtypes			
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	0						1	M	0	M=9864,S=1	9865
2	S	0						2	S	1	R=2,N=1,D=1,Del=1,E=2,I=2,S=9928,T=1	9938
3	L	0						3	L	3	C=1,H=1,I=1,L=9912,F=15,P=3,Xaa=5	9938
4	L	0						4	L	1	R=1,L=9931,F=1,P=1,S=3,Xaa=1	9938
5	T	0						5	T	3	I=6,P=19,S=2,T=9908,Y=2,Xaa=1	9938
6	E	0						6	E	2	R=11,D=1,E=9921,G=3,K=2	9938
7	V	0						7	V	1	I=3,L=1,V=9934	9938
8	E	0						8	E	2	A=14,E=9919,G=3,K=1,F=1	9938
9	T	0						9	T	1	A=1,K=2,T=9934,V=1	9938
10	Y	0						10	Y	1	L=1,F=2,S=3,Y=9932	9938
11	V	0						11	V	1	A=1,G=1,I=1,S=1,V=9934	9938
12	L	0						12	L	2	L=9926,F=8,P=2,V=1,Xaa=1	9938
13	S	0						13	S	1	A=1,F=3,P=2,S=9931,Xaa=1	9938
14	**I**	3	V3					14	I	6	I=9880,L=1,F=1,T=17,V=39	9938
15	**V**	41	I37L3M1	V	I	2007	0,3305	15	V	93	I=3285,L=2,F=1,T=11,V=6638,Xaa=1	9938
16	P	0						16	P	2	R=4,L=2,P=9922,S=10	9938
17	**S**	1	A1					17	S	1	A=1,P=1,S=9934,T=2	9938
18	G	0						18	G	1	A=1,R=2,C=2,G=9932,S=1	9938
19	P	0						19	P	0	H=1,L=2,P=9935	9938
20	L	0						20	L	1	H=2,I=3,L=9927,F=2,P=4	9938
21	K	0						21	K	1	A=1,R=1,Q=2,K=9934	9938
22	A	0						22	A	1	A=9930,D=1,S=4,T=2,V=1	9938
23	E	0						23	E	1	R=1,D=2,Q=4,E=9930,K=1	9938
24	I	0						24	I	0	I=9936,T=1,V=1	9938
25	A	0						25	A	0	A=9938	9938
26	**Q**	1	R1					26	Q	2	R=4,Q=9926,G=1,H=2,L=5	9938
27	R	0						27	R	62	R=8448,G=1,K=1485,S=1,T=2,Xaa=1	9938
28	L	0						28	L	3	H=3,I=18,L=9913,F=2,P=2	9938
29	E	0						29	E	0	E=9937,G=1	9938
30	**D**	6	N6					30	D	2	N=5,D=9923,E=2,G=2,S=4,Y=2	9938
31	V	0						31	V	1	C=1,I=7,M=1,F=1,V=9927,Xaa=1	9938
32	F	0						32	F	1	A=1,L=4,F=9932,S=1	9938
33	A	0						33	A	4	A=9896,S=35,V=6,Xaa=1	9938
34	G	0						34	G	0	R=1,G=9937	9938
35	**K**	2	N1R1					35	K	1	R=10,N=1,E=1,K=9926	9938
36	N	0						36	N	3	N=9910,D=4,K=3,S=16,T=5	9938
37	**T**	2	A2					37	T	17	A=125,I=8,P=3,S=65,T=9732,V=5	9938
38	D	0						38	D	1	A=1,N=2,D=9933,E=1,H=1	9938
39	L	0						39	L	1	I=1,L=9931,F=5,P=1	9938
40	E	0						40	E	2	D=10,Q=1,E=9921,G=6	9938
41	A	0						41	A	6	A=9877,G=3,S=1,V=56,Xaa=1	9938
42	L	0						42	L	2	I=14,L=9918,F=3,P=1,T=1,Xaa=1	9938
43	M	0						43	M	1	Q=1,M=9934,T=3	9938
44	E	0						44	E	1	D=2,E=9934,G=2	9938
45	W	0						45	W	1	R=3,C=1,G=1,W=9933	9938
46	L	0						46	L	17	Q=1,I=243,L=9692,T=1,Xaa=1	9938
47	K	0						47	K	1	R=3,E=1,K=9933,M=1	9938
48	T	0						48	T	1	A=3,P=5,T=9930	9938
49	R	0						49	R	0	R=9936,G=2	9938
50	**P**	1	S1					50	P	0	A=1,L=1,P=9936	9938
51	I	0						51	I	1	N=1,I=9931,K=4,M=1,T=1	9938
52	L	0						52	L	1	R=3,Q=1,L=9932,M=1,P=1	9938
53	S	0						53	S	1	A=1,Q=1,P=1,S=9934,T=1	9938
54	**P**	1	S1					54	P	7	H=2,L=3,P=9858,S=74,Xaa=1	9938
55	L	0						55	L	1	L=9932,P=4,Xaa=2	9938
56	T	0						56	T	2	I=7,S=7,T=9923,Xaa=1	9938
57	K	0						57	K	1	R=5,N=2,I=1,K=9930	9938
58	G	0						58	G	0	E=2,G=9936	9938
59	I	0						59	I	47	I=9077,M=765,T=1,V=94,Xaa=1	9938
60	L	0						60	L	0	L=9936,S=1,W=1	9938
61	G	0						61	G	0	R=2,E=1,G=9935	9938
62	F	0						62	F	2	L=18,F=9918,V=2	9938
63	V	0						63	V	3	E=1,I=30,V=9907	9938
64	F	0						64	F	1	I=1,L=1,F=9934,Y=2	9938
65	T	0						65	T	0	T=9938	9938
66	L	0						66	L	0	L=9938	9938
67	T	0						67	T	0	A=1,S=1,T=9936	9938
68	V	0						68	V	0	G=1,M=1,V=9936	9938
69	P	0						69	P	1	A=1,H=1,L=3,P=9927,S=1,T=5	9938
70	S	0						70	S	2	N=24,S=9914	9938
71	E	0						71	E	1	Q=1,E=9934,G=3	9938
72	**R**	1	Q1					72	R	2	R=9924,Q=13,P=1	9938
73	G	0						73	G	0	R=2,G=9936	9938
74	L	0						74	L	1	R=2,Q=1,L=9932,M=1,P=1,V=1	9938
75	Q	0						75	Q	0	Q=9938	9938
76	R	0						76	R	1	R=9931,C=2,G=1,S=4	9938
77	R	0						77	R	2	R=9923,I=4,K=8,T=1,Xaa=2	9938
78	R	0						78	R	1	R=9932,Q=3,G=1,H=1,L=1	9938
79	F	0						79	F	0	L=1,F=9937	9938
80	**V**	30	I30	V	I	2007	0,0015	80	V	2	I=15,V=9923	9938
81	Q	0						81	Q	0	Q=9936,H=1,L=1	9938
82	N	0						82	N	4	N=9903,D=1,H=3,I=1,K=2,S=19,T=8,Y=1	9938
83	A	0						83	A	2	A=9921,P=3,S=13,V=1	9938
84	L	0						84	L	0	H=1,L=9936,S=1	9938
85	**S**	13	N13	N	S	1975	0,0027	85	N	5	N=9889,D=15,S=27,T=7	9938
86	G	0						86	G	1	E=1,G=9933,V=4	9938
87	N	0						87	N	1	N=9931,H=2,K=1,S=4	9938
88	G	0						88	G	0	A=1,E=2,G=9935	9938
89	D	0						89	D	1	A=1,N=1,D=9933,H=2,L=1	9938
90	P	0						90	P	1	A=5,P=9929,S=3,T=1	9938
91	N	0						91	N	11	N=9821,D=1,H=3,I=2,S=92,T=15,Y=4	9938
92	N	0						92	N	2	N=9927,D=3,H=1,I=1,K=1,T=2,Y=2,Xaa=1	9938
93	M	0						93	M	2	I=17,M=9920,Xaa=1	9938
94	D	0						94	D	5	A=26,N=4,D=9894,E=1,G=10,H=2,Xaa=1	9938
95	**R**	34	K34	R	K	2007	0,0243	95	R	17	R=9691,G=3,I=1,K=241,T=1,Xaa=1	9938
96	A	0						96	A	0	A=9937,T=1	9938
97	**V**	1	I1					97	V	1	A=1,I=12,V=9925	9938
98	K	0						98	K	2	R=5,N=6,Q=1,E=2,K=9921,M=1,T=1,Xaa=1	9938
99	L	0						99	L	1	I=3,L=9931,M=4	9938
100	Y	0						100	Y	0	C=1,F=2,Y=9935	9938
101	**R**	6	K6					101	R	85	R=7223,G=1,K=2713,T=1	9938
102	K	0						102	K	0	E=1,K=9937	9938
103	L	0						103	L	2	I=2,L=9922,M=12,V=2	9938
104	K	0						104	K	1	R=2,Q=1,E=1,I=1,K=9933	9938
105	R	0						105	R	0	R=9937,S=1	9938
106	**E**	1	D1					106	E	0	E=9936,G=1,Xaa=1	9938
107	**I**	1	V1					107	I	47	I=8997,M=921,T=1,V=18,Xaa=1	9938
108	T	0						108	T	1	H=1,I=2,P=4,T=9931	9938
109	F	0						109	F	2	L=3,F=9920,Y=14,V=1	9938
110	H	0						110	H	2	N=3,Q=1,H=9919,P=1,Y=14	9938
111	G	0						111	G	3	R=23,E=6,G=9907,V=2	9938
112	A	0						112	A	3	A=9908,D=1,G=3,K=1,S=22,T=2,V=1	9938
113	K	0						113	K	2	R=13,N=2,I=1,K=9922	9938
114	E	0						114	E	1	D=6,E=9929,G=3	9938
115	V	0						115	V	4	A=1,E=1,G=2,I=22,L=3,M=6,F=1,V=9902	9938
116	A	0						116	A	14	A=9745,G=1,M=1,P=3,S=186,T=1,Xaa=1	9938
117	L	0						117	L	5	H=2,I=24,L=9892,F=9,P=3,V=6,Xaa=2	9938
118	**S**	1	G1					118	S	8	R=3,N=1,G=89,I=1,M=1,S=9841,Xaa=2	9938
119	Y	0						119	Y	0	C=2,F=1,Y=9935	9938
120	S	0						120	S	1	P=4,S=9929,T=5	9938
121	**T**	1	A1					121	T	15	A=214,P=3,T=9721	9938
122	G	0						122	G	0	G=9938	9938
123	A	0						123	A	1	A=9932,S=6	9938
124	L	0						124	L	0	R=1,L=9937	9938
125	A	0						125	A	5	A=9888,P=1,S=2,T=46,V=1	9938
126	S	0						126	S	3	G=34,S=9903,T=1	9938
127	C	0						127	C	0	C=9937,W=1	9938
128	M	0						128	M	1	R=1,I=1,L=4,M=9931,Xaa=1	9938
129	G	0						129	G	0	C=1,G=9936,S=1	9938
130	L	0						130	L	1	I=5,L=9930,P=1,V=2	9938
131	I	0						131	I	2	I=9923,L=13,T=1,V=1	9938
132	Y	0						132	Y	0	Y=9938	9938
133	N	0						133	N	2	N=9926,D=2,H=2,S=5,T=2,Xaa=1	9938
134	R	0						134	R	4	R=9901,K=36,Xaa=1	9938
135	M	0						135	M	0	R=1,M=9937	9938
136	G	0						136	G	0	G=9937,M=1	9938
137	T	0						137	T	8	A=65,D=24,P=1,S=1,T=9847	9938
138	V	0						138	V	3	A=2,I=2,L=1,M=21,V=9912	9938

vmuc:
Not a marker
(>0.05)

139	T	0						0.0000	139	T	11	A=46,N=73,I=1,P=5,S=1,T=9812	9938
140	T	0						0.0000	140	T	19	A=272,S=9,T=9657	9938
141	E	0						0.0000	141	E	0	E=9935,G=2,Xaa=1	9938
142	V	0						0.0000	142	V	41	A=40,G=441,S=146,V=9309,Xaa=2	9938
143	**A**	1	S1					0.0000	143	A	1	A=9934,T=2,V=1,Xaa=1	9938
144	F	0						0.0000	144	F	49	L=1054,F=8883,Xaa=1	9938
145	G	0						0.0000	145	G	0	D=1,G=9936,Xaa=1	9938
146	L	0						0.0000	146	L	0	L=9937,Xaa=1	9938
147	V	0						0.0000	147	V	2	A=1,I=2,L=8,M=2,V=9924,Xaa=1	9938
148	C	0						0.0000	148	C	0	C=9937,Xaa=1	9938
149	A	0						0.0000	149	A	1	A=9933,S=2,T=1,V=1,Xaa=1	9938
150	T	0						0.0000	150	T	2	A=2,I=8,M=2,S=1,T=9924,Xaa=1	9938
151	C	0						0.0000	151	C	0	C=9935,S=1,Xaa=2	9938
152	E	0						0.0000	152	E	0	E=9936,G=1,Xaa=1	9938
153	Q	0						0.0000	153	Q	1	R=1,Q=9933,H=2,P=1,Xaa=1	9938
154	I	1	X1					0.0000	154	I	0	N=1,I=9935,T=1,Xaa=1	9938
155	A	0						0.0000	155	A	1	A=9933,G=1,S=1,V=2,Xaa=1	9938
156	D	0						0.0000	156	D	1	N=1,D=9931,E=4,H=1,Xaa=1	9938
157	S	0						0.0000	157	S	31	A=547,G=2,L=1,S=9386,T=1,Xaa=1	9938
158	Q	0						0.0000	158	Q	23	R=1,Q=9581,H=354,Xaa=2	9938
159	H	0						0.0000	159	H	0	Q=1,H=9936,Xaa=1	9938
160	**R**	1	T1					0.0000	160	R	1	R=9934,Q=2,K=1,Xaa=1	9938
161	**S**	1	A1					0.0000	161	S	4	A=31,F=2,P=3,S=9901,Xaa=1	9938
162	**H**	3	Y3					0.0000	162	H	1	Q=5,H=9932,Xaa=1	9938
163	R	0						0.0000	163	R	1	R=9929,G=8,Xaa=1	9938
164	Q	0						0.0000	164	Q	1	R=1,Del=1,Q=9930,L=3,K=2,Xaa=1	9938
165	**M**	1	I1					0.0000	165	M	2	I=8,L=2,M=9926,V=1,Xaa=1	9938
166	**V**	1	A1					0.0000	166	V	88	A=2590,I=37,M=8,T=10,V=7292,Xaa=1	9938
167	**T**	1	I1					0.0000	167	T	32	A=493,N=5,I=12,S=8,T=9417,V=1,Xaa=2	9938
168	**T**	5	I5					0.0000	168	T	65	A=18,I=1568,K=1,P=1,T=8349,Xaa=1	9938
169	T	0						0.0000	169	T	2	N=1,I=13,S=2,T=9921,Xaa=1	9938
170	N	0						0.0000	170	N	1	N=9929,D=1,S=5,T=2,Xaa=1	9938
171	P	0						0.0000	171	P	0	P=9936,T=1,Xaa=1	9938
172	L	0						0.0000	172	L	1	I=2,L=9932,M=3,Xaa=1	9938
173	I	0						0.0000	173	I	1	I=9934,T=1,V=2,Xaa=1	9938
174	R	0						0.0000	174	R	5	R=9888,G=1,K=47,S=1,Xaa=1	9938
175	H	0						0.0000	175	H	0	R=1,H=9936,Xaa=1	9938
176	E	0						0.0000	176	E	0	D=1,E=9935,G=1,Xaa=1	9938
177	N	0						0.0000	177	N	1	N=9929,D=2,K=1,S=4,T=1,Xaa=1	9938
178	R	0						0.0000	178	R	0	R=9936,K=1,Xaa=1	9938
179	M	0						0.0000	179	M	0	I=1,M=9935,V=1,Xaa=1	9938
180	V	0						0.0000	180	V	0	G=1,V=9936,Xaa=1	9938
181	**L**	1	I1					0.0000	181	L	6	I=20,L=9886,M=26,P=1,W=1,V=3,Xaa=1	9938
182	**A**	1	V1					0.0000	182	A	1	A=9933,T=4,Xaa=1	9938
183	S	0						0.0000	183	S	1	C=1,G=1,I=1,S=9934,Xaa=1	9938
184	T	0						0.0000	184	T	1	A=1,H=1,I=4,P=2,T=9929,Xaa=1	9938
185	T	0						0.0000	185	T	1	A=1,P=2,T=9934,Xaa=1	9938
186	A	0						0.0000	186	A	1	A=9932,G=1,P=2,T=1,V=1,Xaa=1	9938
187	K	0						0.0000	187	K	1	R=4,K=9933,Xaa=1	9938
188	**A**	6	T5X1					0.0000	188	A	0	A=9937,Xaa=1	9938
189	M	0						0.0000	189	M	1	I=1,M=9933,V=3,Xaa=1	9938
190	E	0						0.0000	190	E	0	E=9936,G=1,Xaa=1	9938
191	Q	0						0.0000	191	Q	2	R=3,Q=9923,H=4,L=2,K=1,Xaa=5	9938
192	**M**	4	V2X2					0.0000	192	M	21	I=45,M=9641,V=250,Xaa=2	9938
193	A	0						0.0000	193	A	1	A=9933,D=1,E=1,P=1,V=1,Xaa=1	9938
194	G	0						0.0000	194	G	0	D=1,G=9936,Xaa=1	9938
195	S	0						0.0000	195	S	2	A=10,L=1,P=1,S=9920,T=4,W=1,Xaa=1	9938
196	**S**	1	N1					0.0000	196	S	2	N=18,I=2,K=1,S=9916,Xaa=1	9938
197	E	0						0.0000	197	E	1	D=1,Q=2,E=9932,G=1,K=1,Xaa=1	9938
198	Q	0						0.0000	198	Q	2	R=2,Q=9919,H=15,P=1,Xaa=1	9938
199	A	0						0.0000	199	A	0	A=9936,Xaa=2	9938
200	A	0						0.0000	200	A	5	A=9890,E=1,M=13,P=1,S=12,T=3,V=17,Xaa=1	9938
201	**E**	1	N1					0.0000	201	E	2	D=6,E=9925,K=6,Xaa=1	9938
202	A	0						0.0000	202	A	1	A=9931,R=3,P=1,T=1,V=1,Xaa=1	9938
203	M	0						0.0000	203	M	2	I=8,M=9924,V=5,Xaa=1	9938
204	E	0						0.0000	204	E	3	D=22,E=9913,K=2,Xaa=1	9938
205	**V**	4	I4					0.0000	205	V	29	A=6,I=452,T=7,V=9471,Xaa=2	9938
206	A	0						0.0000	206	A	1	A=9932,G=1,P=1,V=3,Xaa=1	9938
207	**S**	1	N1					0.0000	207	S	77	N=1698,C=7,G=127,I=1,K=1,S=8102,T=1,Xaa=1	9938
208	**K**	32	Q14,R18	Q	K KR	1976 2003		0.0000 0.0003	208	Q	1	R=3,Q=9931,H=1,P=1,S=1,Xaa=1	9938
209	A	0						0.0000	209	A	6	A=9875,R=1,G=2,T=60	9938
210	R	0						0.0000	210	R	1	R=9931,K=7	9938
211	Q	0						0.0000	211	Q	4	R=3,Q=9903,E=1,H=19,L=1,K=10,Xaa=1	9938
212	M	0						0.0000	212	M	0	I=2,M=9935,V=1	9938
213	V	0						0.0000	213	V	1	A=1,E=2,G=5,I=2,V=9928	9938
214	Q	0						0.0000	214	Q	4	R=2,Q=9893,H=42,Xaa=1	9938
215	A	0						0.0000	215	A	1	A=9933,S=1,T=4	9938
216	M	0						0.0000	216	M	0	M=9937,V=1	9938
217	R	0						0.0000	217	R	0	R=9936,I=1,K=1	9938
218	**T**	1	I1					0.0000	218	T	20	A=289,N=1,I=1,P=1,S=4,T=9642	9938
219	**I**	1	V1					0.0000	219	I	25	I=9540,M=2,T=1,V=395	9938
220	G	0						0.0000	220	G	0	R=1,G=9936,V=1	9938
221	T	0						0.0000	221	T	0	T=9938	9938
222	**H**	3	N3					0.0000	222	H	26	R=4,N=17,Q=373,H=9540,L=2,S=1,Xaa=1	9938
223	P	0						0.0000	223	P	2	H=22,P=9916	9938
224	**S**	1	N1					0.0000	224	S	70	R=6,N=1806,G=2,K=3,S=8118,T=1,Y=1,Xaa=1	9938
225	S	0						0.0000	225	S	25	C=2,I=1,F=1,S=9529,T=405	9938
226	S	0						0.0000	226	S	1	R=5,I=1,S=9931,T=1	9938
227	**A**	2	T2					0.0000	227	A	27	A=9495,D=1,Q=1,P=1,S=2,T=437,V=1	9938
228	**G**	1	R1					0.0000	228	G	2	R=15,D=1,G=9919,I=1,S=2	9938
229	L	0						0.0000	229	L	2	Q=1,L=9923,M=8,V=2,Xaa=4	9938
230	K	0						0.0000	230	K	68	R=1811,K=8127	9938
231	**D**	7	N7	N(D)	D	1971		0.0028	231	D	6	N=28,D=9877,E=31,H=1,V=1	9938
232	**D**	1	N1					0.0000	232	D	67	N=1742,D=8196	9938
233	L	0						0.0000	233	L	1	I=1,L=9933,F=3,V=1	9938
234	L	0						0.0000	234	L	44	I=901,L=9037	9938
235	**E**	3	V2D1					0.0000	235	E	3	D=7,E=9911,G=12,K=8	9938
236	N	0						0.0000	236	N	2	N=9924,D=1,H=1,I=1,K=4,S=1,T=5,Y=1	9938
237	L	0						0.0000	237	L	1	L=9933,S=2,W=2,V=1	9938
238	Q	0						0.0000	238	Q	0	Q=9936,L=1,Xaa=1	9938
239	**A**	1	V1					0.0000	239	A	4	A=9905,G=4,P=1,T=24,V=4	9938
240	Y	0						0.0000	240	Y	2	H=2,F=11,Y=9925	9938
241	Q	0						0.0000	241	Q	1	Q=9930,H=5,P=1,Xaa=2	9938
242	K	0						0.0000	242	K	7	R=13,N=45,K=9869,S=1,T=10	9938
243	R	0						0.0000	243	R	0	R=9935,P=2,W=1	9938
244	M	0						0.0000	244	M	1	R=1,L=1,K=2,M=9934	9938
245	G	0						0.0000	245	G	0	E=1,G=9937	9938
246	V	0						0.0000	246	V	12	A=1,G=6,L=124,M=16,V=9791	9938
247	Q	0						0.0000	247	Q	0	Q=9937,H=1	9938
248	**M**	5	L5					0.0000	248	M	29	I=53,L=362,M=9510,V=12,Xaa=1	9938
249	**Q**	1	R1					0.0000	249	Q	4	R=5,Q=9904,H=28,L=1	9938
250	R	0						0.0000	250	R	0	R=9938	9938
251	F	0						0.0000	251	F	3	L=25,F=9913	9938
252	K	0						0.0000	252	K	2	R=13,Q=1,E=2,L=1,K=9920,M=1	9938

vmuc:
backward
substitution

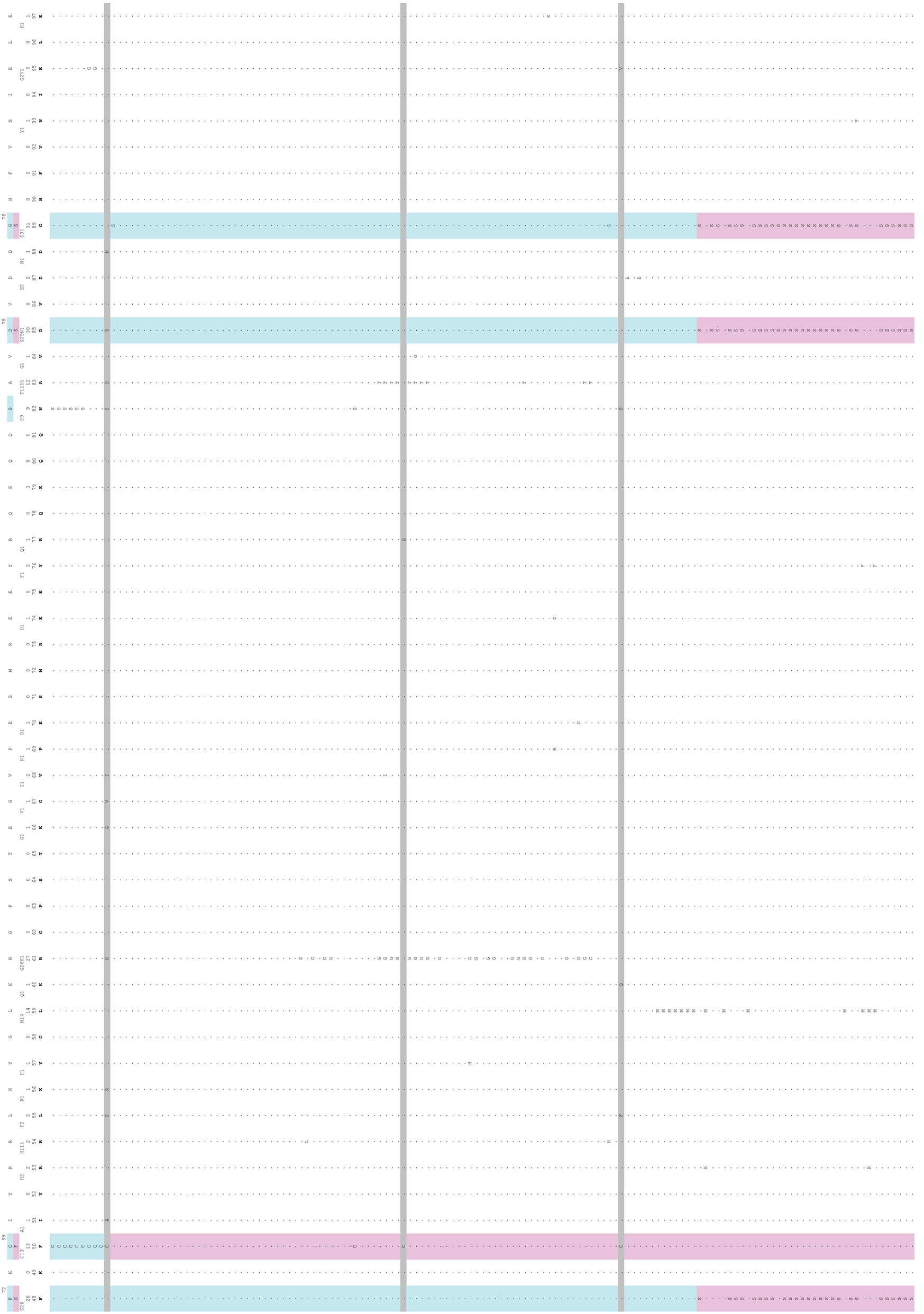
vmuc:
Not a marker
(>0.05)

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

Legend:

1. Outlier strains which obviously do not fit into the H3N8 equine lineage are shaded grey and are not included on plots.
2. Both early and recent marker positions are colored magenta (Row 5).
3. The virus strains utilized for amino acid substitution rate calculation of influenza A H3N8 equine lineage, A/equine/Miami/1/1963(H3N8) and A/equine/Xuzhou/01/2013(H3N8), are highlighted in magenta.

| | | |



Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine M2 H3N8				Permanent aa change				Avian_M2 all subtypes				
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	0						1	M	0	M=9555	9555
2	S	0						2	S	0	I=1,S=9569,T=1	9571
3	L	0						3	L	2	C=1,H=1,L=9552,F=12,P=1,V=1,Xaa=3	9571
4	L	0						4	L	1	R=1,L=9566,P=1,S=2,Xaa=1	9571
5	T	0						5	T	2	N=1,P=7,S=2,T=9559,Y=2	9571
6	E	0						6	E	1	Del=1,E=9567,G=2,K=1	9571
7	V	0						7	V	1	Del=1,I=3,L=1,V=9566	9571
8	E	0						8	E	3	A=19,Del=1,E=9547,G=3,K=1	9571
9	T	0						9	T	1	A=1,R=1,Del=1,P=1,T=9567	9571
10	P	1	S1					10	P	53	Del=38,H=319,L=477,P=8737,S=1	9572
11	T	1	I1					11	T	38	Del=38,I=587,S=11,T=8935,Xaa=1	9572
12	R	1	K1					12	R	20	R=9314,Del=38,K=217,P=1,T=1,Xaa=1	9572
13	N	1	S1					13	N	54	A=2,N=8770,D=8,Del=37,H=6,I=1,K=136,S=526,T=85,Xaa=1	9572
14	G	4	E4					14	G	68	A=6,R=1,D=1,Del=37,E=1536,G=7989,V=2	9572
15	W	0						15	W	0	R=2,G=1,W=9569	9572
16	E	0						16	E	25	D=8,E=9206,G=337,K=1,V=20	9572
17	C	1	Y1					17	C	4	R=1,C=9532,G=1,F=1,Y=36,Xaa=1	9572
18	K	6	N5R1					18	K	117	R=3732,N=333,I=1,K=5496,S=9,Xaa=1	9572
19	C	0						19	C	5	C=9523,F=1,Y=47,Xaa=1	9572
20	S	3	N2D1					20	S	23	R=17,N=224,C=1,G=3,I=27,K=17,S=9282,Xaa=1	9572
21	G	68	D20V1					21	D	18	D=9330,G=231,V=11	9572
22	S	0						22	S	4	L=36,S=9536	9572
23	S	0						23	S	6	N=50,C=2,G=8,S=9510,Xaa=1	9571
24	D	0						24	D	5	N=47,D=9516,E=8	9571
25	P	1	L1					25	P	4	H=2,L=10,P=9536,S=12,T=9,Xaa=2	9571
26	L	0						26	L	22	R=1,I=278,L=9270,F=20,V=2	9571
27	V	1	I1					27	V	51	A=82,E=1,G=6,I=773,L=4,M=4,F=3,T=10,V=8686,Xaa=2	9571
28	I	2	A2					28	I	94	A=16,D=9,I=7378,L=34,M=1,F=181,S=3,T=17,Y=2,V=1930	9571
29	A	1	I1					29	A	11	A=9464,D=1,G=1,S=16,T=48,V=41	9571
30	A	0						30	A	3	A=9548,E=1,S=8,T=12,Xaa=2	9571
31	S	0						31	S	37	R=2,N=646,D=2,G=5,I=1,K=1,S=8913,Xaa=1	9571
32	I	0						32	I	20	I=9283,F=4,T=6,V=277,Xaa=1	9571
33	I	6	V5T1					33	I	5	I=9518,L=4,T=1,V=47,Xaa=1	9571
34	G	0						34	G	0	G=9571	9571
35	I	0						35	I	5	I=9523,M=1,S=6,T=1,V=38,Xaa=2	9571
36	L	0						36	L	1	L=9566,M=1,W=1,V=3	9571
37	H	0						37	H	0	D=1,Q=1,H=9568,P=1	9571
38	L	0						38	L	2	L=9555,K=1,F=15	9571
39	I	0						39	I	9	R=1,I=9488,K=2,M=11,T=28,V=41	9571
40	L	0						40	L	1	L=9564,M=2,F=3,S=1,W=1	9571
41	W	0						41	W	1	R=1,C=2,G=1,L=1,W=9566	9571
42	I	0						42	I	5	I=9526,M=9,S=1,T=24,V=10,Xaa=1	9571
43	L	1	F1					43	L	16	A=1,I=15,L=9381,F=164,P=1,S=3,T=6	9571
44	D	0						44	D	4	N=35,D=9531,E=1,Y=3,V=1	9571
45	R	0						45	R	3	R=9541,C=3,H=25,L=1,S=1	9571
46	L	0						46	L	2	I=8,L=9558,F=4,P=1	9571
47	F	1	S1					47	F	3	L=32,F=9538,Y=1	9571
48	F	26	S26	F	S	2007	0,0017	48	F	3	L=8,F=9545,S=16,Y=1,V=1	9571
49	K	0						49	K	1	R=4,Q=2,K=9565	9571
50	F	13	C13	C	F	1975	0,0057	50	C	19	R=1,C=9343,F=55,S=1,W=3,Y=168	9571
51	I	1	A1					51	I	17	A=1,I=9348,L=4,T=11,V=207	9571
52	Y	0						52	Y	14	N=1,C=86,H=52,F=10,S=4,Y=9418	9571
53	R	2	H2					53	R	1	R=9563,C=6,G=1,L=1	9571
54	R	2	H1L1					54	R	5	R=9531,C=17,H=13,I=1,L=3,S=5,Xaa=1	9571
55	L	2	F2					55	L	66	I=116,L=8186,F=1265,Xaa=4	9571
56	K	1	R1					56	K	7	R=72,E=5,I=1,K=9493	9571
57	Y	1	H1					57	Y	3	N=1,C=2,H=20,Y=9547,Xaa=1	9571
58	G	0						58	G	15	A=6,R=4,D=32,E=100,G=9416,S=7,V=6	9571
59	L	14	M14					59	L	1	L=9566,F=2,P=2,V=1	9571
60	K	1	Q1					60	K	2	R=3,Q=11,E=1,K=9556	9571
61	R	27	G26K1					61	R	29	R=9214,N=1,E=1,G=116,I=18,K=187,S=34	9571
62	G	0						62	G	2	R=7,E=1,G=9559,S=2,W=1,V=1	9571
63	P	0						63	P	1	L=1,P=9567,S=1,T=1,Xaa=1	9571
64	S	0						64	S	25	A=286,F=32,P=4,S=9234,T=5,Y=10	9571
65	T	0						65	T	9	A=10,R=7,K=28,M=33,S=1,T=9491,V=1	9571
66	E	1	G1					66	E	37	A=486,E=9003,G=24,K=32,T=24,V=1,Xaa=1	9571
67	G	1	V1					67	G	1	R=8,G=9563	9571
68	V	2	I1					68	V	20	A=22,I=65,L=28,M=99,T=2,V=9355	9571
69	P	1	R1					69	P	1	L=4,P=9567	9571
70	E	1	D1					70	E	16	R=1,D=1,Q=1,E=9374,G=3,K=182,T=8,V=1	9571
71	S	0						71	S	1	A=1,C=1,F=3,S=9564,Y=2	9571
72	M	0						72	M	0	I=2,M=9568,T=1	9571
73	R	0						73	R	1	R=9561,K=6,M=2,T=2	9571
74	E	1	D1					74	E	2	A=6,D=3,E=9555,G=2,K=4,Xaa=1	9571
75	E	0						75	E	2	D=2,Q=1,E=9559,G=2,K=7	9571
76	Y	2	F1					76	Y	1	N=1,C=2,F=3,S=1,Y=9564	9571
77	R	1	Q1					77	R	11	R=9433,Q=132,L=1,P=2,W=3	9571
78	Q	0						78	Q	4	R=1,Q=9537,E=2,H=23,L=4,K=1,F=1,P=2	9571
79	E	0						79	E	3	E=9544,K=26,S=1	9571
80	Q	0						80	Q	7	R=22,Q=9503,H=1,L=2,K=42,P=1	9571
81	Q	0						81	Q	3	R=10,Q=9545,H=8,L=4,K=2,P=1,Xaa=1	9571
82	N	9	S9	S	N	1971	0,1218	82	S	56	N=1166,D=5,G=12,I=1,K=1,S=8381,T=4,Xaa=1	9571
83	A	12	T11D1					83	A	4	A=9536,G=1,T=29,V=5	9571
84	V	1	G1					84	V	4	A=9,G=14,L=1,M=4,W=1,V=9542	9571
85	D	30	S29N1	D	S	2007	0,0000	85	D	6	N=18,D=9515,E=2,G=36	9571
86	V	0						86	V	2	A=5,I=5,F=2,S=1,V=9558	9571
87	D	2	E2					87	D	2	N=2,D=9558,E=4,H=1,T=2,Y=2,V=1,Xaa=1	9571
88	D	1	N1					88	D	26	A=6,R=1,N=196,D=9261,E=4,G=53,H=6,I=1,M=1,T=1,Y=15,V=25,Xa	9571
89	G	31	S31	G	S	2007	0,0217	89	G	23	R=1,D=28,C=18,G=9288,S=208,V=26,Xaa=2	9571
90	H	0						90	H	2	R=3,N=1,Q=7,H=9555,P=3,T=1,Y=1	9571
91	F	0						91	F	2	A=1,L=14,F=9556	9571
92	V	0						92	V	6	A=60,C=5,L=1,F=1,V=9504	9571
93	N	1	Y1					93	N	6	N=9519,D=35,H=8,S=6,Y=3	9571
94	I	0						94	I	3	R=2,G=1,I=9549,L=1,K=1,M=4,T=3,V=10	9571
95	E	3	G2V1					95	E	8	A=5,D=1,Q=11,E=9498,G=5,K=21,S=1,V=26,Xaa=3	9571
96	L	0						96	L	6	Q=1,L=9515,K=3,M=32,F=2,P=17,Xaa=1	9571
97	E	1	K1					97	E	17	R=1,D=6,E=9358,G=38,K=167,V=1	9571

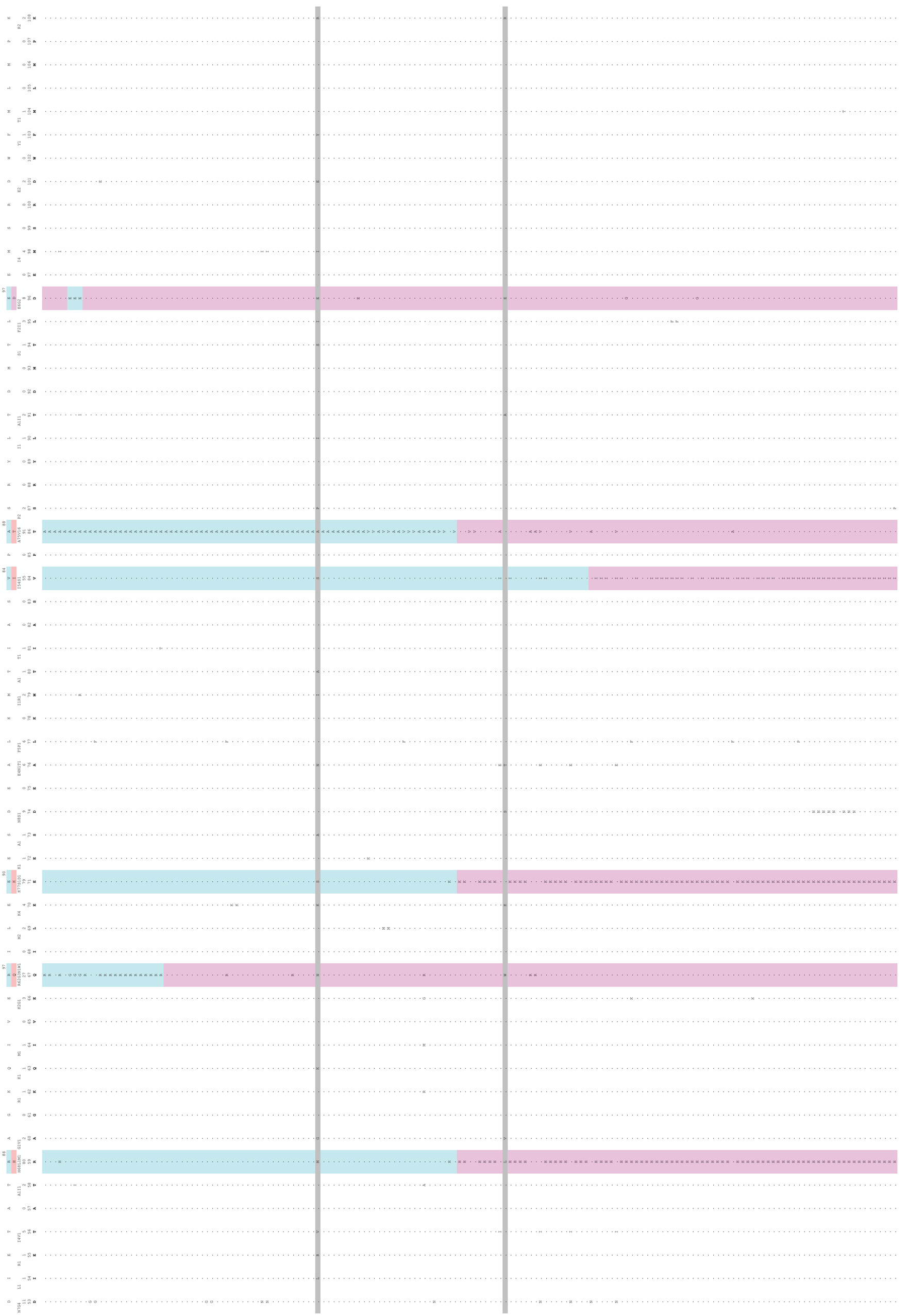
vmuc:
not a marker

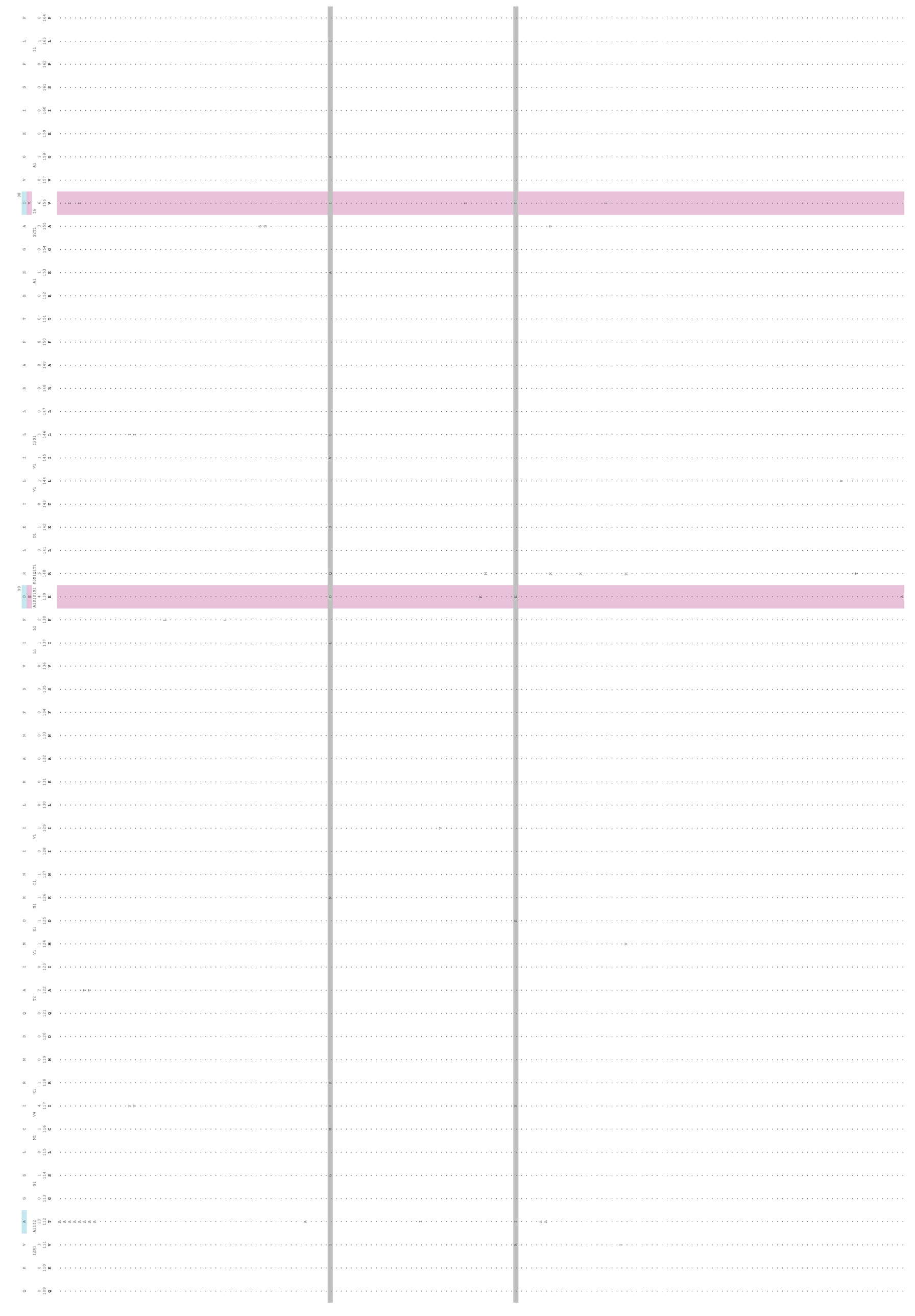
Percent of occurence of equine charactreistic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

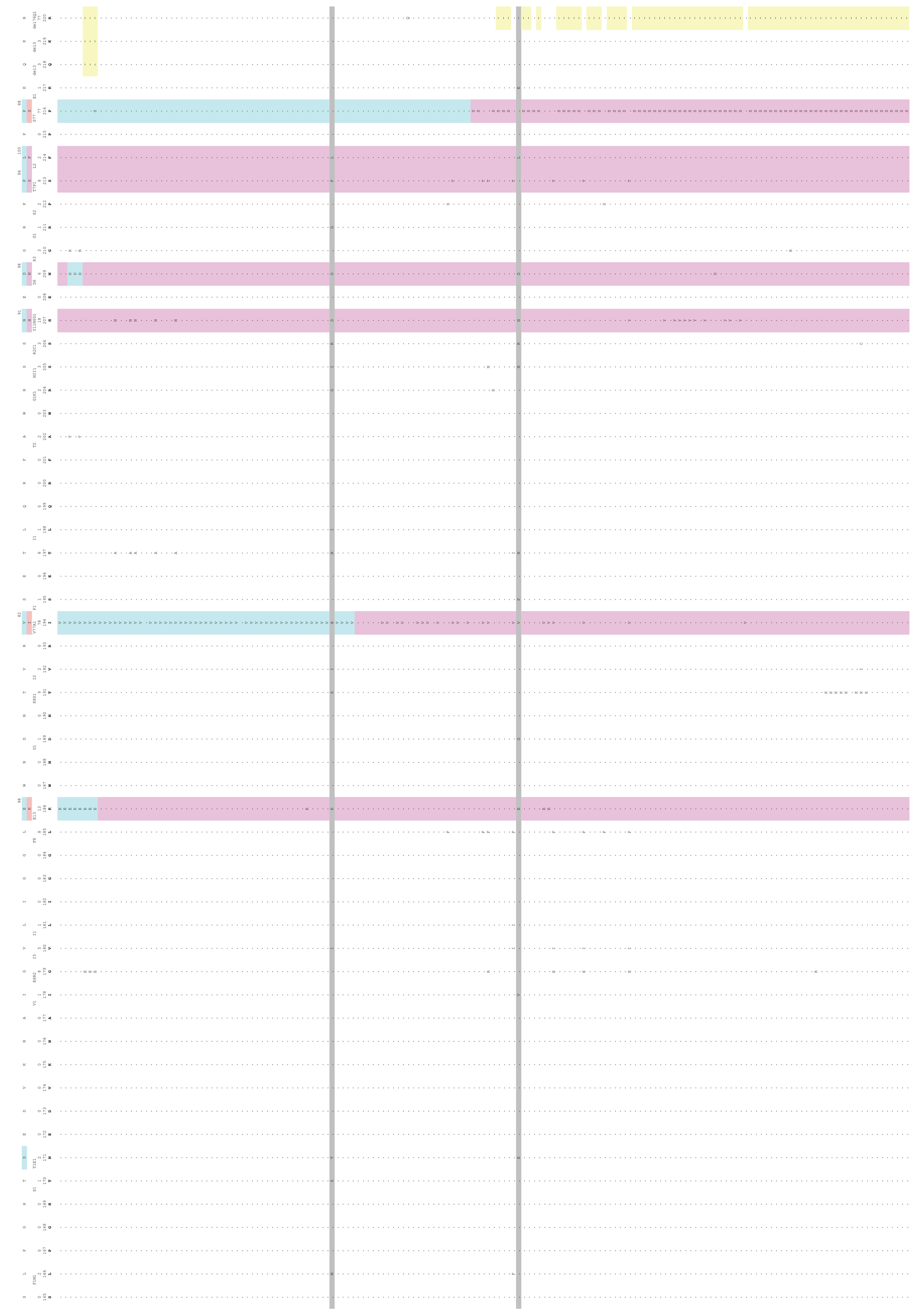
Legend:

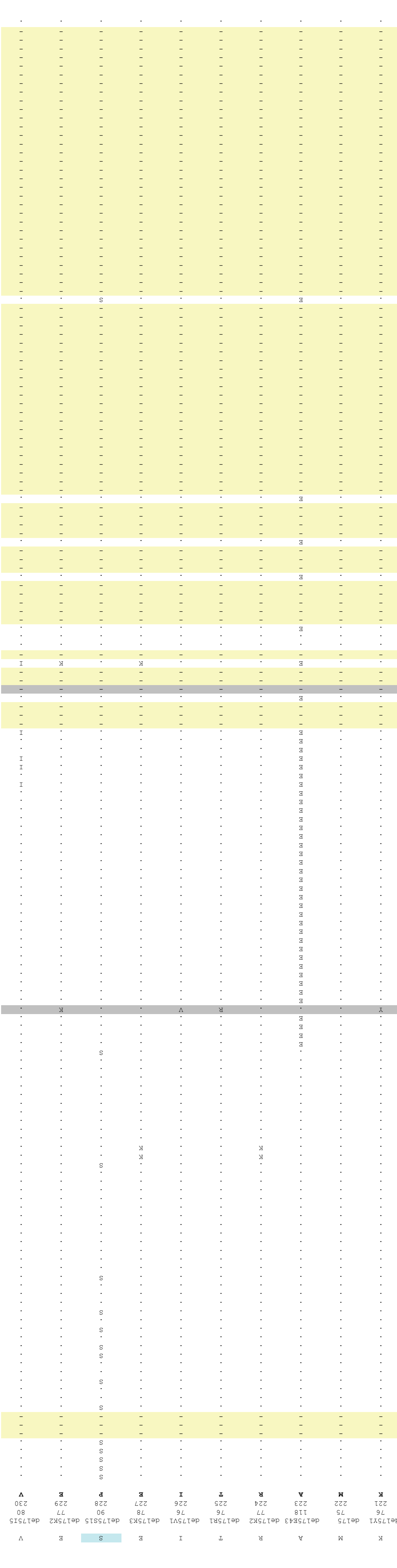
1. Outlier strains which obviously do not fit into the H3N8 equine lineage are shaded grey and are not included on plots.
2. Both early and recent marker positions are colored magenta (Row 5).
3. The virus strains utilized for amino acid substitution rate calculation of influenza A H3N8 equine lineage, A/equine/Miami/1/1963(H3N8) and A/equine/Xuzhou/01/2013(H3N8), are highlighted in magenta.

| | | |








K M A R T I E S E E V
del75V1 del175 del175E43 del175K2 del175R1 del175V1 del175K3 del175S15 del175K2 del175I5
76 75 118 77 76 76 78 90 77 80
221 222 223 224 225 226 227 228 229 230
K M A R T I E S E V

Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine NS1 H3N8				Permanent aa change				Avian_NS1 all subtypes				
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	0						1	M	0	M=9620,Xaa=1	9621
2	D	0						2	D	5	N=27,D=9577,E=6,G=8,K=1,Y=1,Xaa=1	9621
3	S	5	P3F2					3	S	13	G=1,L=3,F=18,P=127,S=9468,T=3,Y=1	9621
4	N	0						4	N	3	N=9600,D=1,H=2,I=5,K=4,S=6,T=3	9621
5	T	1						5	T	1	A=1,H=1,P=2,S=1,T=9616	9621
6	V	1						6	V	93	A=10,R=2,C=1,G=3,I=2240,L=2,M=105,P=1,T=41,V=7216	9621
7	S	1						7	S	91	A=4,L=131,F=1,P=1,S=7144,T=2339,V=1	9621
8	S	0						8	S	1	D=2,G=3,K=1,S=9614,T=1	9621
9	F	0						9	F	1	L=4,F=9614,Y=3	9621
10	Q	0						10	Q	1	Q=9614,H=2,L=2,K=2,S=1	9621
11	V	0						11	V	1	A=2,G=1,I=1,L=2,T=2,V=9612,Xaa=1	9621
12	D	0						12	D	1	D=9613,E=4,G=1,H=1,S=1,Xaa=1	9621
13	C	0						13	C	1	R=1,C=9612,G=1,H=1,S=5,Xaa=1	9621
14	F	1						14	F	81	F=7275,S=1,Y=2343,Xaa=2	9621
15	L	0						15	L	3	I=21,L=9594,F=5,Xaa=1	9621
16	W	0						16	W	1	L=4,W=9616,Xaa=1	9621
17	H	1						17	H	3	R=1,N=7,Q=9,H=9594,Y=9,Xaa=1	9621
18	V	2						18	V	82	A=1,I=2397,L=4,M=4,T=1,V=7213,Xaa=1	9621
19	R	0						19	R	0	R=9619,C=1,G=1	9621
20	K	0						20	K	4	R=24,N=5,E=5,I=1,K=9584,F=1,T=1	9621
21	R	1						21	R	84	R=7269,Q=21,H=1,I=13,L=2316,P=1	9621
22	F	1						22	F	89	I=97,L=2347,F=7169,P=1,S=1,V=6	9621
23	A	1						23	A	82	A=7280,N=2,G=2,S=2324,V=13	9621
24	D	2						24	D	81	A=1,D=7291,E=2,I=1,K=3,M=2320,T=1,V=2	9621
25	Q	2						25	Q	85	R=2353,N=25,D=1,Q=7228,H=1,L=1,K=9,P=1,S=1,W=1	9621
26	E	2						26	E	90	N=1,D=2383,E=7141,G=50,K=45,Xaa=1	9621
27	L	1						27	L	93	R=27,Q=3,I=8,L=6733,M=2841,F=1,P=2,S=1,T=2,V=3	9621
28	G	3						28	G	81	N=1,C=2331,G=7278,S=9,V=2	9621
29	D	0						29	D	0	D=9621	9621
30	A	0						30	A	1	A=9615,T=2,V=4	9621
31	P	0						31	P	0	P=9620,T=1	9621
32	F	0						32	F	1	L=2,F=9615,S=3,V=1	9621
33	L	1						33	L	84	R=1,N=13,D=2312,H=7,I=5,L=7276,M=1,F=1,P=4,S=1	9621
34	D	0						34	D	1	D=9617,V=4	9621
35	R	0						35	R	0	R=9618,M=2,P=1	9621
36	L	0						36	L	6	R=2,I=52,L=9563,F=3,P=1	9621
37	R	0						37	R	1	R=9612,C=3,K=4,S=2	9621
38	R	0						38	R	0	A=1,R=9618,G=1,K=1	9621
39	D	0						39	D	0	D=9620,H=1	9621
40	Q	0						40	Q	5	R=17,Q=9578,H=6,L=1,K=19	9621
41	K	0						41	K	11	R=137,K=9484	9621
42	S	1						42	S	80	A=2327,C=1,P=3,S=7290	9621
43	L	0						43	L	1	I=4,L=9615,P=2	9621
44	R	84	K43E1					44	R	86	R=7004,G=11,I=2,K=2602,M=1,T=1	9621
45	G	9	R9	G	R	2008-9	0,0005	45	G	1	R=5,G=9616	9621
46	R	0						46	R	0	R=9619,K=2	9621
47	G	4						47	G	34	A=1,C=25,G=9062,S=533	9621
48	S	47	I44N2G1	S	I	2007	0,0068	48	S	68	R=4,N=1433,C=2,G=3,H=1,I=65,S=8113	9621
49	T	1						49	T	1	A=3,D=1,T=9617	9621
50	L	0						50	L	1	I=11,L=9609,P=1	9621
51	G	3						51	G	2	D=2,E=3,G=9601,S=15	9621
52	L	2						52	L	13	Q=1,I=68,L=9477,M=73,F=1,V=1	9621
53	D	11						53	D	12	N=95,D=9491,E=15,G=16,H=1,S=1,Y=2	9621
54	I	1						54	I	83	I=7284,L=2299,M=3,P=27,T=4,V=4	9621
55	E	1						55	E	102	A=1,R=2921,N=1,D=15,Q=10,E=6557,G=38,K=75,S=2,Xaa=1	9621
56	T	5						56	T	97	A=177,R=5,N=1,I=24,K=5,M=15,P=3,T=7102,V=2289	9621
57	A	0						57	A	2	A=9599,S=20,T=2	9621
58	T	2						58	T	2	A=6,N=1,I=6,K=1,S=1,T=9606	9621
59	R	70	H68L1M1	R	H	1997	0,0217	59	R	135	R=6541,C=424,G=1,H=209,I=52,L=35,M=2243,S=35,T=28,Y=51,V=2	9621
60	A	2						60	A	109	A=6469,D=16,E=2928,G=13,I=3,K=5,M=9,S=57,T=49,V=72	9621
61	G	0						61	G	0	R=1,E=1,G=9619	9621
62	K	1						62	K	10	R=120,N=1,Q=1,K=9498,T=1	9621
63	Q	1						63	Q	143	R=170,N=2,Q=6247,E=1,H=610,I=9,L=305,K=2275,W=2	9621
64	I	1						64	I	26	I=9308,L=89,M=32,T=11,V=181	9621
65	V	0						65	V	19	A=3,G=2,I=181,L=9,M=37,F=1,V=9388	9621
66	E	3						66	E	7	A=1,N=1,D=4,Q=1,E=9559,G=23,K=32	9621
67	Q	27	R62G3N1W1	R	Q	1980	0,0087	67	R	106	R=7126,N=34,D=2157,Q=84,E=122,G=14,K=30,M=14,P=3,S=2,W=33,Y=	9621
68	I	0						68	I	5	A=1,I=9570,L=2,T=10,V=37,Xaa=1	9621
69	L	2						69	L	5	R=1,Q=17,I=6,L=9574,M=22,Xaa=1	9621
70	E	4						70	E	98	R=4,N=1,D=122,Q=3,E=6915,G=45,K=2528,V=3	9621
71	E	69	K67S1D1	E	K	1997	0,0116	71	E	123	A=3,R=84,N=138,D=40,Q=4,E=6836,G=211,I=2,K=112,S=2188,T=1,V=2	9621
72	E	1						72	E	3	D=1,E=9596,G=4,K=20	9621
73	S	1						73	S	91	A=4,N=23,K=1,M=12,F=4,P=80,S=7228,T=2262,Y=7	9621
74	D	7						74	D	18	N=150,D=9414,E=24,G=12,S=19,Y=1,V=1	9621
75	E	0						75	E	32	D=42,E=9161,G=28,K=381,W=3,V=5,Xaa=1	9621
76	A	6						76	A	101	A=7101,N=2263,D=4,E=61,H=6,I=47,K=1,P=1,S=25,T=111,V=1	9621
77	L	6						77	L	12	Del=2,G=1,I=12,L=9489,F=113,P=4	9621
78	K	0						78	K	20	R=233,N=2,Del=5,Q=8,E=10,K=9360,T=3	9621
79	M	2						79	M	90	R=1,N=2,Del=2,I=2361,L=1,K=4,M=7156,T=60,V=33,Xaa=1	9621
80	T	1						80	T	146	A=2365,N=97,D=1,Del=1333,G=3,I=9,L=1,S=57,T=5755	9621
81	I	1						81	I	76	Del=1332,I=8046,M=3,T=16,V=224	9621
82	A	0						82	A	68	A=8181,D=3,Del=1332,P=6,T=44,V=55	9621
83	S	0						83	S	60	Del=1332,P=14,S=8274,Y=1	9621
84	V	45	I44S1	V	I	2006	0,0120	84	V	162	A=25,R=2,N=66,C=2,Del=1332,G=10,I=115,L=23,M=63,S=2220,T=69,V=	9621
85	P	0						85	P	12	R=1,Q=4,H=14,L=21,F=1,P=9500,S=54,T=26	9621
86	T	91	A75V16	A	T	1997	0,0470	86	A	61	A=8729,N=4,D=41,G=9,I=4,F=2,S=217,T=452,V=161,Xaa=2	9621
87	S	1						87	S	99	A=35,Q=2,H=14,L=27,F=1,P=3042,S=6488,T=12	9621
88	R	0						88	R	8	R=9545,C=22,Q=7,H=41,L=2,S=3,Xaa=1	9621
89	Y	0						89	Y	1	H=3,S=1,Y=9617	9621
90	L	1						90	L	95	R=2,Q=8,I=2364,L=7093,M=56,F=1,P=1,V=96	9621
91	T	2						91	T	17	A=51,N=2,C=1,I=22,M=4,P=3,S=102,T=9436	9621
92	D	0						92	D	8	N=1,D=9541,E=67,G=10,K=1,V=1	9621
93	M	0						93	M	0	I=2,M=9618,T=1	9621
94	T	1						94	T	84	A=2,N=43,G=1,S=2324,T=7251	9621
95	L	3						95	L	98	A=1,R=1,I=2348,L=7064,M=40,F=7,P=141,T=4,V=15	9621
96	D	8	E6G2			Early marker - 1963	0,0007	96	E	2	D=7,E=9607,G=1,K=5,S=1	9621
97	E	0						97	E	1	D=2,E=9614,K=4,S=1	9621
98	M	4						98	M	81	I=2310,L=2,K=1,M=7301,T=1,V=6	9621
99	S	0						99	S	2	A=1,N=6,C=1,G=1,P=1,S=9605,T=6	9621
100	R	0						100	R	7	R=9551,G=4,I=1,K=64,M=1	9621
101	D	2						101	D	90	N=20,D=6990,E=2560,G=49,K=2	9621
102	W	0						102	W	1	C=3,G=1,L=1,W=9616	9621
103	F	1						103	F	116	C=1,H=4,I=2,L=673,F=6603,S=17,Y=2320,V=1	9621
104	M	1						104	M	2	I=6,L=10,M=9602,T=2,Xaa=1	9621
105	L	0						105	L	2	I=8,L=9608,F=3,P=1,Xaa=1	9621
106	M	0						106	M	39	R=3,I=683,M=8925,T=8,V=2	9621
107	P	0						107	P	1	H=2,L=1,P=9617,S=1	9621
108	K	2						108	K	81	R=2344,Q=2,G=1,K=7271,M=1,Xaa=2	9621
109	Q	0						109	Q	3	R=4,Q=9601,E=1,H=7,L=3,K=2,W=3	9621
110	K	0						110	K	2	R=11,N=1,Q=1,E=3,K=9604,T=1	9621
111	V	3						111	V	105	A=10,R=1,G=1,I=2031,L=13,M=263,F=137,T=4,V=7160,Xaa=1	9621
112	T	13	A11I2	A	T	1975	0,3437	112	A	103	A=6201,E=4,I=57,K=2,S=10,T=3307,V=39,Xaa=1	9621
113	G	0						113	G	3	R=5,D=6,C=3,E=1,G=9598,S=6,Xaa=2	9621
114	S	1						114	S	109	A=1,N=1,G=2209,F=1,P=578,S=6828,T=3	9621
115	L	0						115	L	1	I=2,L=9615,F=4	9621

vmuc:
not a marker
(>0.05)

116	C	1						116	C	101	R=66,C=7153,G=1,I=99,L=6,M=2211,F=6,S=47,W=2,Y=16,V=14	9621
117	I	4						117	I	82	A=1,Del=1,I=7250,M=2,F=2,T=4,V=2361	9621
118	R	1						118	R	98	R=5589,Del=1,K=4030,Xaa=1	9621
119	M	0						119	M	9	Del=3,I=23,L=47,M=9536,T=1,V=11	9621
120	D	0						120	D	1	D=9617,Del=3,V=1	9621
121	Q	0						121	Q	3	R=2,N=1,Del=4,Q=9594,H=17,K=2,P=1	9621
122	A	2						122	A	3	A=9600,Del=4,E=1,S=13,T=3	9621
123	I	0						123	I	28	Del=4,I=9244,M=26,T=293,V=54	9621
124	M	1						124	M	38	A=15,R=2,Del=4,I=119,L=46,M=9127,S=1,T=13,V=294	9621
125	D	1						125	D	22	N=221,D=9343,Del=4,E=26,G=26,V=1	9621
126	K	1						126	K	4	R=16,N=12,Del=4,Q=1,E=2,K=9586	9621
127	N	1						127	N	176	A=12,R=2261,N=5336,D=90,Del=4,E=66,I=48,K=124,M=1,P=4,S=18,T=1	9621
128	I	0						128	I	8	Del=4,I=9537,L=3,T=1,V=76	9621
129	I	1						129	I	101	R=1,Del=4,I=7255,L=24,K=32,M=167,S=3,T=2046,V=88,Xaa=1	9621
130	L	0						130	L	1	Del=4,I=2,L=9612,F=2,P=1	9621
131	K	0						131	K	2	R=9,N=1,Del=4,E=1,K=9606	9621
132	A	0						132	A	1	A=9614,Del=4,G=2,Xaa=1	9621
133	N	0						133	N	1	N=9612,D=1,Del=4,K=1,S=1,T=1,Xaa=1	9621
134	F	0						134	F	2	Del=4,L=11,F=9605,V=1	9621
135	S	0						135	S	3	R=2,N=12,C=1,Del=4,G=2,S=9597,T=2,Xaa=1	9621
136	V	0						136	V	11	A=13,Del=4,I=80,L=7,M=7,V=9509,Xaa=1	9621
137	I	1						137	I	110	A=34,N=4,Del=4,G=1,I=6932,L=2314,M=43,F=10,S=6,T=182,V=90,Xaa=	9621
138	F	2						138	F	31	C=7,Del=4,L=27,F=9178,S=34,Y=371	9621
139	E	4	A1D1K1N1			Early marker - 1963	0,0044	139	D	72	N=1277,D=8158,Del=4,E=42,G=138,S=1,Xaa=1	9621
140	R	5						140	R	81	R=7273,Del=3,Q=2339,H=1,K=3,P=1,W=1	9621
141	L	0						141	L	12	Del=3,I=5,L=9481,M=130,F=1,S=1	9621
142	E	1						142	E	11	D=99,Del=3,E=9504,G=8,K=7	9621
143	T	0						143	T	47	A=625,N=124,Del=3,I=6,S=11,T=8852	9621
144	L	1						144	L	0	Del=3,L=9618	9621
145	I	1						145	I	89	Del=3,I=6897,M=3,T=27,V=2690,Xaa=1	9621
146	L	3						146	L	81	C=1,Del=3,L=7292,M=1,F=1,P=1,S=2320,Xaa=2	9621
147	L	0						147	L	3	Del=3,H=1,I=19,L=9595,V=3	9621
148	R	0						148	R	1	R=9613,Del=3,G=2,K=3	9621
149	A	0						149	A	1	A=9614,D=1,Del=3,P=1,T=1,Xaa=1	9621
150	F	0						150	F	1	Del=3,L=7,F=9611	9621
151	T	0						151	T	1	Del=3,S=8,T=9610	9621
152	E	0						152	E	100	R=4,N=94,D=2538,Del=3,E=6897,G=16,K=22,S=47	9621
153	E	1						153	E	96	N=26,D=2373,Del=3,E=7063,G=125,H=1,K=8,S=20,Y=1,Xaa=1	9621
154	G	0						154	G	5	R=4,N=1,D=11,Del=3,E=4,G=9580,S=18	9621
155	A	3						155	A	15	A=9458,D=1,Del=3,E=3,G=1,S=30,T=82,V=42,Xaa=1	9621
156	V	6	I6			Early marker - 1963	0,0032	156	I	4	Del=3,I=9583,M=1,F=1,S=1,T=1,V=31	9621
157	V	0						157	V	5	A=10,Del=3,I=31,V=9577	9621
158	G	1						158	G	80	A=2328,Del=3,G=7290	9621
159	E	0						159	E	1	Del=3,E=9611,G=1,K=2,V=4	9621
160	I	0						160	I	1	Del=3,I=9611,V=7	9621
161	S	0						161	S	13	Del=3,L=5,F=2,P=1,S=9469,T=5,Y=136	9621
162	P	0						162	P	8	Q=76,L=2,P=9538,S=4,T=1	9621
163	L	1						163	L	90	I=2232,L=7257,M=5,F=94,S=3,V=30	9621
164	P	0						164	P	8	A=1,H=15,L=13,P=9552,S=26,T=3,W=2,Y=8	9620
165	S	0						165	S	12	F=30,P=1,S=9488,T=2,Y=99	9620
166	L	2						166	L	102	R=2,I=24,L=6980,M=2295,F=312,P=2,T=1,V=3,Xaa=1	9620
167	P	0						167	P	3	A=1,G=2,L=4,P=9599,S=14	9620
168	G	0						168	G	1	E=4,G=9614	9618
169	H	0						169	H	2	R=2,H=9605,L=2,P=1,S=1,Y=7	9618
170	T	1						170	T	87	A=4,N=49,I=17,F=1,S=2328,T=7219	9618
171	N	2	T1E1				0,0624	171	D	173	=1,A=99,R=6,N=600,D=5686,E=113,G=862,K=6,S=78,T=2146,Y=19,V=2	9618
172	E	0						172	E	13	Q=1,E=9455,G=1,K=161	9618
173	D	0						173	D	1	N=2,D=9614,E=1,G=1	9618
174	V	0						174	V	1	I=2,L=1,F=1,V=9614	9618
175	K	0						175	K	3	R=1,N=1,Q=20,E=2,K=9594	9618
176	N	0						176	N	10	N=9520,D=50,G=1,H=3,I=25,K=1,M=1,S=15,T=2	9618
177	A	0						177	A	1	A=9611,C=1,G=1,S=3,T=2	9618
178	I	1						178	I	5	N=2,I=9573,L=1,M=3,F=1,W=1,V=37	9618
179	G	8						179	G	7	R=5,D=11,E=55,G=9545,P=1,S=1	9618
180	V	5						180	V	89	A=23,D=6,G=3,I=2637,M=1,S=1,T=7,V=6940	9618
181	L	1						181	L	1	R=1,I=2,L=9610,F=3,P=1,S=1	9618
182	I	0						182	I	3	I=9589,L=2,M=1,S=1,T=9,V=16	9618
183	G	0						183	G	4	R=21,D=6,G=9586,K=1,S=3,Xaa=1	9618
184	G	0						184	G	2	R=2,D=1,E=8,G=9606,S=1	9618
185	L	8						185	L	40	L=8872,F=744,P=1,T=1	9618
186	K	13	E13	E	K	1975	0,0059	186	E	6	D=1,E=9557,G=2,K=57,V=1	9618
187	W	0						187	W	0	R=1,C=1,W=9615,Xaa=1	9618
188	N	0						188	N	2	R=1,N=9604,K=1,S=12	9618
189	D	1						189	D	8	N=34,D=9536,E=1,G=42,Y=5	9618
190	N	0						190	N	96	N=5983,D=1,Del=3633,Y=1	9618
191	T	7						191	T	99	A=4,Del=3633,P=1,S=26,T=5954	9618
192	V	1						192	V	99	Del=3633,I=40,V=5945	9618
193	R	0						193	R	100	R=5939,N=3628,Q=47,H=1,Y=3	9618
194	I	78	V77A1	V	I	1990-2005	0,0150	194	V	147	A=31,G=12,I=144,L=5,K=1,F=1,P=4,S=2279,T=1343,V=5798	9618
195	S	1						195	S	133	I=2299,L=2,F=1,P=1,S=5977,T=5,V=1331,Xaa=2	9618
196	E	0						196	E	105	R=3516,D=1,Q=118,E=5974,K=7,P=1,Xaa=1	9618
197	T	8						197	T	179	A=2429,N=485,D=3,I=435,K=1,S=4,T=5091,V=1170	9618
198	L	1						198	L	134	I=347,L=5629,F=2,S=3282,T=348,V=8,Xaa=2	9618
199	Q	0						199	Q	97	Q=5984,E=3623,G=2,H=1,K=8	9618
200	R	0						200	R	146	A=103,R=5974,N=2358,D=1,E=1,I=161,K=9,S=10,T=1001	9618
201	F	0						201	F	115	I=3248,L=384,F=5978,Y=6,V=2	9618
202	A	2						202	A	103	A=5901,R=1,D=2,Q=3630,H=2,I=1,P=1,S=8,T=72	9618
203	W	0						203	W	97	R=3629,K=7,S=1,W=5977,Xaa=1	9615
204	R	2						204	R	111	R=5893,C=1,Del=2,G=43,L=4,K=44,F=3527,Y=99,V=2	9615
205	S	3						205	S	144	A=3512,R=8,N=294,C=1,G=275,I=41,K=4,F=1,S=5353,T=108,V=14,Xaa=	9615
206	S	2						206	S	152	R=63,N=30,C=613,E=1,G=24,H=1,I=201,L=1,F=2,S=5020,W=3629,V=29,	9615
207	H	18	Y11N6D1			Early marker - 1963 Y(2006-2007)	H=0.0006 Y=0.0000	207	N	169	R=1109,N=5049,D=849,E=3,G=2586,H=6,K=9,S=3,W=1	9615
208	E	0						208	E	162	A=4,N=14,E=5975,G=92,I=813,L=3,K=6,S=1231,T=2,V=1474,Xaa=1	9615
209	N	6	D6			Early marker - 1963	0,0326	209	D	174	=1,R=2214,N=313,D=5557,C=52,G=126,H=26,I=137,L=1,S=1156,T=1,V=	9615
210	G	3						210	G	113	R=26,N=229,D=3387,E=2,G=5956,H=4,W=8,Y=3	9615
211	R	1						211	R	108	R=5807,Del=3632,G=176	9615
212	P	2						212	P	116	A=1,Del=3632,H=2,L=293,P=5659,S=26,T=2	9615
213	S	8	T7P1			Early marker - 1963	0,0345	213	P	125	Del=3632,L=108,K=1,P=5521,S=332,T=21	9615
214	F	2	L2			Early marker - 1963	0,0090	214	L	104	R=1,Del=3632,H=6,I=1,L=5887,F=87,P=1	9615
215	P	0						215	P	129	Del=3632,L=51,P=5343,S=584,T=2,Y=3	9615
216	P	67	S67	P	S	1997-2005	0,0123	216	P	112	A=21,E=3603,K=29,P=5813,S=118,T=30,V=1	9615
217	K	1						217	K	155	R=5,N=2397,D=1377,E=39,G=97,K=5598,S=54,T=14,V=31,Xaa=3	9615
218	Q	3	-3	Q	del			218	Q	0	Q=8694,S=1,Xaa=1	8696
219	K	3	-3	K	del			219	K	21	A=1,N=97,E=138,K=8460	8696
220	R	67	-66Q1	R	del	2002-2007		220	R	22	R=8437,C=57,Q=107,L=2,P=4,W=56	8663
221	K	67	-66Y1	K	del	2002-2007		221	K	98	R=5,N=5,D=1,C=33,Q=1,E=57,H=45,K=6269,F=3,T=3,Y=2211	8633
222	M	66	-66	M	del	2002-2007		222	M	16	L=125,M=8460,V=48	8633
223	A	109		A	E	1988		223	A	22	A=8338,E=293,L=1,S=1	8633
				E	del	2001-2007						
224	R	68		R	del	2002-2007		224	R	19	R=8421,E=1,G=178,I=3,L=1,K=26,W=3	8633
225	T	67		T	del	2002-2007		225	T	89	A=33,R=2223,E=4,G=15,K=2,P=1,S=2,T=6299	8579
226	I	67		I	del	2002-2007		226	I	96	A=59,I=6255,S=1,T=94,V=2170	8579
227	E	69		E	del	2002-2007		227	E	23	R=1,E=8314,G=164,K=100	8579
228	P	81	S15del166	S	P	1976	0,0231	228	S	16	Q=1,P=198,S=8379,T=1	8579
				P	del	2002						
229	E	68		E	del	2002-2007		229	E	32	A=1,E=8042,K=487	8530
230	V	71		V	del	2002-2007		230	V	20	A=1,I=256,F=6,V=8267	8530

vmuc:
not a marker
(>0.05)

Percent of occurence of equine charactreristic amino acid(s) at a given position in a group of equine virus isolates (in the column colored in magenta) since indicated year up to 2013 or during years of isolation.

| | | |


99
D S L G E A V M R M G D L H S L Q S R N G K W R E Q L S Q K F E E I R W L I E E V R H R L K
E
S1T1 I3 Y1 N2 A1K1 T1 K2D1 K2E1 G1 L2R1 V3L1 A1D1 C1 N1 I1 R1T1
0 0 0 0 0 2 0 0 0 3 0 0 0 0 1 0 0 2 0 0 2 1 0 0 3 3 0 1 3 0 0 0 0 4 0 0 0 0 2 0 1 0 1 1 0 2
43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88
D S L G E A V M R M G D L H S L Q S R N E K W R E Q L S Q K F E E I R W L I E E V R H R L K

| | | |

Legend:
1. **Alternatives**: aa different from consensus , e.g., Q1 means that Q occurred in one isolate
2. **Score**: Data taken from the Database describing measure of variability.
3. **Alignment Details**: number of occurrences of various amino acids.
4. High-potency and Low-potency **markers** are colored green and yellow, respectively.

Equine PB1 H3N8				Permanent aa change				Avian_PB1 all subtypes				
Pos	Consensus	No of Diffs	Alternatives	From	To	Year of substitution	Marker potency	Pos	Consensus	Score	Alignment Details	# Sequences
1	M	1	del1					1	M	0	M=9002,Xaa=1	9003
2	D	0						2	D	5	N=24,D=8965,E=6,G=8,K=1,Y=2,Xaa=1	9007
3	S	5	P3F2					3	S	13	G=1,L=3,F=16,Pro=123,S=8860,T=3,Y=1	9007
4	N	0						4	N	3	N=8985,D=1,H=2,I=5,K=4,F=1,S=6,T=3	9007
5	T	0						5	T	0	H=1,Pro=1,S=1,T=9004	9007
6	V	1	T1					6	V	93	A=8,R=2,Cys=1,G=3,I=2087,L=2,M=106,T=38,V=6760	9007
7	S	1	T1					7	S	91	A=4,L=127,F=1,Pro=1,S=6689,T=2184,V=1	9007
8	S	0						8	S	1	D=2,G=3,K=1,S=8999,T=2	9007
9	F	0						9	F	1	Del=1,L=4,F=8999,Y=3	9007
10	Q	0						10	Q	1	Del=4,Q=8997,H=2,L=2,K=1,S=1	9007
11	D	0						11	D	8	A=4,N=4,D=8929,Del=1,G=70	9008
12	I	0						12	I	3	I=8988,M=4,F=1,T=13,V=2	9008
13	L	0						13	L	5	L=8957,M=46,V=5	9008
14	M	2	K1Q1					14	M	163	A=13,R=14,Q=2073,E=91,G=1,I=77,L=21,K=91,M=5541,T=272,V=81	9008
15	R	0						15	R	0	R=9005,G=1,K=2	9008
16	M	0						16	M	1	I=2,M=9004,S=1,V=1	9008
17	S	0						17	S	0	S=9008	9008
18	K	0						18	K	2	R=7,N=3,K=8997,T=1	9008
19	M	0						19	M	5	N=1,I=4,L=25,M=8963,V=15	9008
20	Q	0						20	Q	19	A=1,R=246,Q=8758,E=1,H=1,Pro=1	9008
21	L	0						21	L	1	I=1,L=9000,M=2,S=2,W=3	9008
22	G	5	K2R2E1					22	G	138	A=1137,R=49,E=2345,G=5459,K=2,T=11,V=5	9008
23	S	0						23	S	14	A=3,F=11,Pro=28,S=8873,T=6,Y=86,V=1	9008
24	S	0						24	S	2	H=1,L=14,F=1,Pro=1,S=8991	9008
25	S	1	L1					25	S	4	L=23,Pro=10,S=8975	9008
26	E	4	G3V1					26	E	97	A=24,E=6639,G=190,K=1,M=4,V=2149,Xaa=1	9008
27	D	0						27	D	9	N=8,D=8912,G=87,V=1	9008
28	L	0						28	L	1	L=9002,S=2,W=4	9008
29	N	0						29	N	12	N=8871,D=2,K=1,S=131,T=1,Y=1,Xaa=1	9008
30	G	0						30	G	0	G=9007,V=1	9008
31	M	0						31	M	5	I=36,K=1,M=8961,V=10	9008
32	I	1	V1					32	I	4	I=8967,M=1,T=1,V=39	9008
33	I	17	T17	T	I	1976	0,0071	33	T	6	I=64,T=8944	9008
34	R	48	Q48	Q	R	1988	0,0283	34	Q	19	R=255,Q=8747,H=2,L=3,Pro=1	9008
35	L	2	F2			Early marker - 1963	0,0160	35	F	12	L=144,F=8860,S=3,V=1	9008
36	E	0						36	E	32	D=5,Q=1,E=8600,G=249,K=152,Xaa=1	9008
37	S	1	R1					37	S	83	A=11,R=2159,Cys=8,G=1,H=4,F=3,S=6820,T=2	9008
38	L	0						38	L	0	L=9008	9008
39	K	0						39	K	18	R=229,E=2,I=1,K=8775,Xaa=1	9008
40	L	2	I2					40	L	94	R=1,I=2632,L=6311,K=1,M=2,F=34,T=18,V=9	9008
41	Y	0						41	Y	0	L=1,F=1,Y=9005,Xaa=1	9008
42	R	0						42	R	3	R=8985,I=3,K=20	9008
43	D	0						43	D	3	=1,A=1,N=14,D=8984,E=2,G=3,V=3	9008
44	S	0						44	S	23	A=1,L=179,M=1,S=8726,T=101	9008
45	L	0						45	L	2	I=3,L=8994,F=11	9008
46	G	0						46	G	1	E=5,G=9003	9008
47	E	0						47	E	6	A=2,R=4,D=5,Del=2,E=8953,G=5,K=37	9008
48	A	2	S1T1					48	A	108	A=6453,R=1,N=1,D=7,E=1,I=5,K=3,F=2,Pro=5,S=2182,T=285,V=59	9008
49	V	0						49	V	62	A=502,I=31,L=353,M=29,S=9,T=2,V=8081,Xaa=1	9008
50	M	0						50	M	10	R=1,I=33,M=8902,V=72	9008
51	R	0						51	R	0	R=9006,W=1,Xaa=1	9008
52	M	3	I3					52	M	45	I=276,L=54,M=8415,T=17,V=244,Xaa=2	9008
53	G	0						53	G	2	R=19,G=8989	9008
54	D	0						54	D	1	N=1,D=8998,E=6,G=2,V=1	9008
55	L	0						55	L	58	I=6,L=7787,F=1212,Pro=1,Y=2	9008
56	H	0						56	H	11	Q=1,H=8881,L=4,Y=122	9008
57	S	1	Y1					57	S	17	A=1,Q=4,H=1,L=31,F=99,Pro=2,S=8838,T=6,Y=26	9008
58	L	0						58	L	14	I=3,L=8845,F=157,Pro=1,S=1,V=1	9008
59	Q	0						59	Q	2	R=6,Q=8997,Pro=4,Xaa=1	9008
60	S	2	N2					60	S	132	A=3,R=11,N=1444,D=2,G=3,H=1,I=1109,S=6231,T=198,V=5,Xaa=1	9008
61	R	0						61	R	8	R=8918,K=90	9008
62	N	0						62	N	9	N=8910,K=1,T=97	9008
63	E	2	A1K1			Early marker - 1963	0,0102	63	G	100	A=2170,R=30,E=92,G=6623,K=50,S=1,W=23,V=19	9008
64	K	1	T1					64	K	97	A=34,R=14,N=73,D=10,Q=7,E=10,I=9,K=6724,S=22,T=2104,Xaa=1	9008
65	W	0						65	W	0	Cys=3,W=9005	9008
66	R	0						66	R	0	R=9007,K=1	9008
67	E	3	K2D1					67	E	39	R=23,N=16,D=496,Q=1,E=8440,G=14,K=15,Y=3	9008
68	Q	3	K2E1					68	Q	83	R=5,Q=6824,E=2151,G=16,H=1,L=1,K=10	9008
69	L	0						69	L	0	L=9006,M=1,V=1	9008
70	S	1	G1					70	S	29	R=1,N=1,D=1,G=440,S=8563,Xaa=1	9007
71	Q	3	L2R1					71	Q	8	R=24,Q=8937,H=42,L=3,K=1	9007
72	K	0						72	K	2	R=8,N=5,Q=1,K=8993	9007
73	F	0						73	F	0	L=1,F=9005,S=1	9007
74	E	0						74	E	2	D=7,E=8989,G=10,V=1	9007
75	E	0						75	E	0	E=9004,K=3	9007
76	I	4	V3L1					76	I	8	I=8938,L=4,K=1,M=41,T=2,V=21	9007
77	R	0						77	R	21	R=8712,K=294,T=1	9007
78	W	0						78	W	1	G=2,L=3,W=9002	9007
79	L	0						79	L	5	L=8956,M=48,S=1,V=2	9007
80	I	0						80	I	4	I=8967,M=1,V=39	9007
81	E	2	A1D1					81	E	87	A=2163,D=4,E=6768,G=66,S=3,T=2,V=1	9007
82	E	0						82	E	2	A=1,D=2,E=8993,G=10,K=1	9007
83	V	1	C1					83	V	111	A=2,R=2,Cys=2168,I=371,L=7,M=71,F=1,T=3,V=6382	9007
84	R	0						84	R	0	R=9006,Q=1	9007
85	H	1	N1					85	H	95	A=7,R=27,N=2127,D=2,Q=10,H=6723,L=18,S=69,T=3,Y=21	9007
86	R	1	I1					86	R	96	R=6671,G=2,I=2136,K=157,M=7,S=1,T=3,V=30	9007
87	L	0						87	L	1	L=9003,F=1,W=3	9007
88	K	2	R1T1					88	K	98	A=36,R=173,N=13,Q=1,I=6,K=6659,M=3,S=1,T=2115	9007
89	N	11	I9K1A1	I	N	1975	0,0083	89	I	149	A=16,R=37,N=75,Q=14,I=5715,L=1,K=2115,M=15,F=17,S=22,T=123	9007
90	T	0						90	T	1	A=4,I=2,Pro=2,S=2,T=8997	9007
91	E	1	D1					91	E	1	D=1,Q=2,E=8999,G=5	9007
92	N	3	S3					92	N	9	N=8915,D=5,K=1,S=85,T=1	9007
93	S	0						93	S	2	R=3,G=15,S=8989	9007
94	F	0						94	F	4	L=1,F=8973,S=1,Y=32	9007
95	E	0						95	E	1	D=4,Q=3,E=8997,G=2,K=1	9007
96	Q	0						96	Q	1	R=3,Q=9001,H=3	9007
97	I	0						97	I	0	N=2,I=9004,T=1	9007
98	T	0						98	T	0	R=1,Pro=2,T=9004	9007
99	F	0						99	F	1	L=4,F=9003	9007
100	M	1	L1					100	M	88	I=45,L=2202,K=1,M=6733,T=1,V=24,Xaa=1	9007
101	Q	1	R1					101	Q	2	R=2,Q=8996,L=4,Pro=5	9007
102	A	0						102	A	1	A=9001,S=1,T=5	9007
103	L	0						103	L	0	G=1,L=9005,K=1	9007
104	Q	0						104	Q	2	Q=8992,H=10,K=4,Pro=1	9007
105	L	0						105	L	2	I=13,L=8993,V=1	9007
106	L	0						106	L	1	L=9001,F=1,Pro=1,W=1,Y=1,V=1,Xaa=1	9007
107	L	0						107	L	1	Q=1,L=9003,F=1,Pro=2	9007
108	E	0						108	E	1	D=1,Q=1,E=9000,G=5	9007
109	V	0						109	V	2	A=5,E=2,G=2,I=2,K=1,M=2,V=8993	9007
110	E	0						110	E	1	D=1,E=9000,G=4,K=2	9007
111	Q	1	S1					111	Q	86	R=1,N=59,Q=6823,G=4,H=1,L=5,K=3,Pro=3,S=2107,Xaa=1	9007
112	E	0						112	E	2	N=1,D=12,E=8993,G=1	9007
113	I	0						113	I	7	I=8934,M=72,Xaa=1	9007
114	R	0						114	R	2	R=8992,E=1,G=1,K=7,S=2,T=1,W=1,Xaa=2	9007
115	T	0						115	T	41	A=700,N=1,D=2,L=4,Pro=2,S=1,T=8297	9007
116	F	0						116	F	1	N=1,I=1,L=2,F=8999,S=2,Y=1,V=1	9007
117	S	0						117	S	1	A=1,S=9003,T=3	9007
118	F	0						118	F	1	L=4,F=8998,Y=2,V=3	9007
119	Q	0						119	Q	2	R=3,Q=8995,H=4,L=1,Pro=1,S=2,Xaa=1	9007
120	L	0						120	L	2	R=2,H=2,I=1,L=8990,F=7,Pro=1,S=1,Xaa=3	9007
121	I	0						121	I	1	I=8998,L=2,M=2,F=2,S=1,T=1,Y=1	9007