Compilation of tRNA sequences and sequences of tRNA genes

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INTRODUCTION

This compilation contains 413 tRNA sequences and 665 sequences of tRNA genes so far published covering the literature to the end of 1986. An overview about published sequences is given in Table 1. The numbering system derived from yeast $tRNA^{Phe}$ as adopted in the Cold Spring Harbour Symposium on tRNA in 1979, is used (Fig. 1, ref. 1). Secondary structure of tRNAs are indicated by region-specific underlining of the sequences. In the case of most mitochondrial tRNAs the alignment according to the accepted numbering system (Fig. 1) is not possible and an arbitrary alignment was adopted. For the nomenclature of modified nucleosides see Table 2, and reference 2. A list of distribution of modified nucleosides over the species has been included into the compilation (Table 3).

The title of each sequence contains a one letter code for the particular amino acid depicting the specificity of tRNA, a three digit number, the anticodon sequence in unmodified form and name of the organism from which the tRNA originates. The numbers for tRNAs are used on such a way, that each biological species has the same number regardless the amino acid the tRNA is coding for. In the case of tRNA genes the nucleotides preceding nucleotide residue 1 and the nucleotide following residue 76 as well as the intervening sequences have been excluded from the compilation. Some $tRNAs^{His}$ and $tRNA^{His}$ genes possess a nucleoside in position zero. The CCA sequence is included into the gene sequence only if it is coded for in the gene. The occurrence of intervening se-

quences after a particular nucleotide is indicated by an asterik and defined in the footnote.
As compared with the last compilations (ref. 3) there are deviations in the numbering.

Sequences of tRNA-precursors and tRNA-mutants are included into compilation only when there are no mature and wild type tRNA-sequences, respectively, available. This cases are indicated in the footnote. The sequences originating from transformed, or differentiated cells of a same species are considered as a separate entry only in the case of nucleoside replacement (different genes).

Footnotes are numbered according to the coordinates of the corresponding nucleoside and are indicated on the sequence by asteriks. The references and footnotes are listed on the end of the particular compilation under corresponding sequence number. The references are restricted to one citation unless additional specific sequence information was obtained in a later work.

The compilation is deposited in Nucleotide Sequence Data Library at the European Molecular Biology Laboratory, Heidelberg.

1. Transfer-RNA: Structure, Properties and Recognition. P.R. Schimmel, D. Söll, J.N. Abelson, Eds., 1979, Cold Spring Harbour Laboratory, N.Y., pp. 518-519

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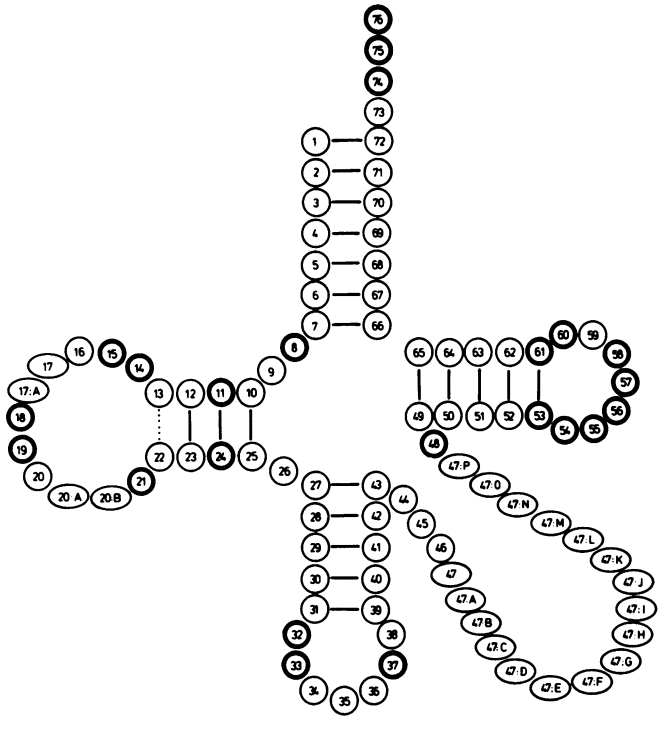

Figure 1: Numbering of nucleotides in tRNAs. Circles represent nucleotides which are always present; among these, the thick-edged circles denote invariant or semiinvariant nucleotides. Ovals represent nucleotides which are not present in each sequence: these are the nucleotides before the two constant GMP residues (18,19) in the D loop, the nucleotides after these GMP residues, and the nucleotides in the variable loop which may be up to 17 nucleotides.
A nucleotide to be added at a given site is indicated by the number of the preceding nucleotide followed by a colon and a capital letter in alphabetical order. Thus, e.g. 20:A and 20:B mean the first and the second nucleotide after position 20. The absence of a nucleotide is indicated by the absence of a number, e.g. if no residue is found in position 17, the sequence then reads C16-C18. The numbering for the D loop, when one, two or three nucleotides are present each between 15 and 18 or between 19 and 21, is then 16 and 16, 17 and 16, 17, 17:A or 20 and 20, 20:A, 20:B respectively. When the variable loop is five-membered, the numbering is 44, 45, 46, 47, 48. 47 is eliminated when the variable loop if four-membered. For large variable loops, capital letters are added onto 47, e.g. for thirteen nucleotides 44, 45, 46, 47, 47:A, 47:B, 48:C, 47:D, 47:E, 47:F, 47:G, 47:H, 47:I.

Table 1. tRNAs and tRNA genes included in the compilation

Name (synonym)	numberrange	tRNA (2)	tDNA (2)
name (1)			
virus	000-099		
Avian Onco-Virus	010	M	
Chicken ASV/AMV/RSV	012	W	
Mouse M-Mulv.	013	P,P	
Phage T4	020..021	R,Q,G,I,I,L,P,S,T	R,Q,G,I,L,P,S,T
Phage T5	040..041	N,D,Q,H,L,P	D,Q,K,X,P,S,S,V
archaebacteria	100-199		
Halobacterium cut.	110..112	A,R,N,Q,G,H,X,S,T,V,V,V	A,C
Halobacterium hal.	112		A
Halobacterium med.	115		W
Halobacterium vol.	120..124	A,A,A,R,R,R,N,D,C,Q,E,E, G,G,G,G,H,I,I,L,L,L,L,L, K,K,M,X,F,P,P,P,S,S,S,T, T,W,Y,V,V	C,W
Halococcus morrhuae	130	X	
Methanobac.formi.	135		A
Methanobac.therm.	140	N,G	
Methanococ.vani.	145..146		A,R,N,D,Q,E,H,I,L,K,F,P,T,T,Y,V
Sulfolobus acido.	150	X	
Sulfolobus solfa.	160		L,S
Thermoplasma acido.	180	M,X	
eubacteria	200-299		
Mycoplasma capric.	200..201	F	W,W
Mycoplasma mycoid.	203..204	G,X	A,R,R,D,I,M,X,F,P,S
Spiroplasma melif.	206		A,R,D,C,I,M,X,F,P,S
Streptomyces gris.	215	X	
Staphylococ.epid.	220..221	G,G	
Mycobac. smeg.	227	X	
Bacillus stearo.	230	L,F,Y,V	
Bacillus subtilis	235..238	A,R,G,K,K,M,X,F,P, T,Y,Y,V	A,A,A,A,R,N,N,D,C,Q,E,G,G,H,H,I,I,I,L, L,L,L,K,M,M,X,F,F,P,S,S,S,T,T,T,Y,V,W
Thermus thermophi.	240..241	I,X,X	
E. coli	250..253	A,A,A,R,R,R,R,N,D,C,Q, Q,E,E,E,G,G,G,H,I,I,I,I, L,L,L,K,M,X,X,F,S,S,S, S,S,T,W,Y,Y,V,V,V	A,R,R,R,D,Q,Q,E,G,G,H,I, L,L,L,K,M,X,F,P,P,S,S,T,T,T,T,Y,V,W
Salmonella typhi.	255..257	G,H,L,P,P,P	R,H,L,P
Pseudomonas aer.	260		T
Campylobac.jejuni	270		A,I
Caulobacter cres.	272		A,I

Rhodospiril.rub.	280	L,F	
Agmenellum quad.	285	F	
Anacystis nidulans	290..291	L,L,X	A,I
Chloroplasts	300-399		
Chlamydomonas reinh.	300		A,I
Chlorella elipsoidea	305		I
Euglena gracilis	307..309	F	A,A,R,N,C,Q,E,G,G,H,I,L,L,L,M,M,F,S,T,W,Y,V
Scenedesmus obliq.	310	M,X,Y	
Marchantia polym.	312		G,X,S
Hordeum vulgare	313..314		G,G,M,X,S,T,V
Triticum aestivum (wheat)	315..316		R,D,C,G,G,M,X,T,Y
Sorghum bicolor	318		L
Zea mays	320..321	I	A,R,N,E,H,I,L,L,M,F,S,S,T,V,V
Brassica oleracea	325		L
Glycine max (soy bean)	327..329	L,L,L	
Nicotiana tabacum	335..337		A,R,R,N,D,C,Q,E,G,G,H,I,I,I,L,L,L,K,M,X,F,P, S,S,S,T,T,W,Y,V,V
Nicotiana debneyi	340		H
Pelargonium zonale	345		R
Phaseolus vulgaris (bean)	350..352	L,L,L,X,F,W	
Pisum sativum (pea)	355..356		R,R,N,D,E,H,L,S,Y,V
Sinapis alba (mustard)	360		V
Spinacia oleracea (spinach)	365..366	I,I,L,M,X,F,P,T,W,V	R,D,C,E,H,I,M,S,S,T,T,Y,Y,V
Spirodelia oligorh.	370..371		R,R,N
Vicia faba	375..376		E,L,L,F,T,Y
mitochondria	400-499		
single cell organisms and fungi	400-410 and 411-429		
Paramecium prim.	405		Y
Paramecium tetra.	406		W,Y
Tetrahymena pyrif.	407	F,Y	H,F,W
Aspergillus nidul.	410..411		A,R,N,D,C,C,Q,E,G,G,H,I,L,L,K,M,M,X,F,P,S,S,T,W,Y,V
Neurospora crassa	412	A,X,T,W,Y,V	A,R,C
Podospora anserina	414		D,S,W,V
Saccharomyces cer. (yeast)	417..419	R,R,G,I,L,L,K,M,M,F,P,P,P,T, S,S,S,W,Y	A,R,R,N,D,C,Q,E,G,H,K,M F,P,S,S,T,T,Y,Y,V,V
Schizosaccha. pom.	421		G,H,L
Torulopsis glab.	425		A,R,N,D,C,Q,E,G,H,I,L,K,M,X,F,P,S,S,T,T,W,Y,V
Yeast	428	H,X	L,X,W
plants	430-459		
Lupinus luteus (lupine)	436		G,X
Oenothera sp.	440		X
Phaseolus vulg. (bean)	445		M,X,F,W,Y
Triticum aestiv. (wheat)	452		X
Zea mays	456		D,H,M,X

animals 460-499			
Aedes albopictus (mosquito)	460	R,D,Q,E,G,I,K,M,S,V	A,R,N,E,G,L,F,S,V
Drosophila melanogaster	465		D,C,L,K,W,Y
Drosophila yakuba	468..469		A,R,N,D,C,Q,E,G,H,I,L,L,K,X,F,P,S,S,T,W,Y,V
Xenopus laevis	474.475		A,R,N,D,C,Q,G,H,I,L,L,K,M,F,F,P,S,S,T,W,Y,V
Hamster	475	R,D,K,S	
Rat	477..479	R,D,D,L,L,K,F,W, V,V	A,R,N,N,N,D,D,C,C,Q,Q,E,G,H,I,L,L, K,K,X,X,F,P,P,S,S,S,T,T,W,W,Y,V
Mouse	480..482		A,R,N,D,C,Q,E,G,H,I,L,L,K,M,F,P,S,S,T,W,Y,V
Bovine	483..484	R,E,G,I,L,L,K,M,T,V,S, S,W	A,R,N,D,C,Q,E,G,H,I,L,L,K,M,F,P,S,S,T,W,Y,V
Chimpanzee	485		H,L,S
Gibbon	487		H,L,S
Gorilla	489		H,L,S
Human	493..494	S	A,R,N,D,C,Q,E,G,H,I,L,L,K,M,F,P,S,S,T,W,Y,V
Orang Utan	496		H,L,S
eukaryotes	500-999		
Euglena gracilis	510	D,F	
Tetrahymena therm.	530..533	Q,Q,Q,X	Q
Scenedesmus obliq.	540	X,F,Y	
Dictyostelium dis.	555..556		E,W,V,V
Neurospora crassa	560	X,F	L,F
Podospora anserina	565..566		S,S
Saccharomyces cer. (yeast)	570..572	G,H,H,I,L,L,K,M,X,S,W	A,R,R,R,D,Q,E,G,G,H,L,K,K,M,X,X,S,Y,V
Schizosaccha.pom.	575..577	E,F,Y,	R,R,D,E,H,K,X,X,F,S,S,S
Torulopsis utilis	580	A,I,L,X,P,Y,V	
Yeast	590..592	A,R,R,R,N,D,C,E,K,F,S,S, T,T,Y,V,V,V	I,F,S,S,S,W
Hordeum vulgare (barley)	620	F	
Triticum aestivum (wheat)	625..626	R,G,M,X,F,W,Y,Y	
Brassica harpus	630	F	
Glycine max (soy bean)	635..636		D,M,M
Lupinus luteus (lupine)	640	G,M,X,F,Y	
Phaseolus vulg. (bean)	645..646	X	P,P
Pisum sativum (pea)	650	F	
Nicotiana rust.	655..656	Y,Y	Y
Petunia	660		N
Caenorhabdi eleg.	700	L	D,L,K,P
Asterina amur.	750	X	
Bombyx mori	770..771	A,A,G,G,F,F	A,E,G,K
Drosophila melano.	780..783	E,H,K,K,X,F,Y,V,V,V,V	A,R,R,N,D,E,E,E,G,H,I,L, L,K,K,X,X,F,P,P,T,V,V,V
Euphausia sperba (krill)	790	X	
Xenopus laevis	830..831	D,X,F	L,X,X,F,Y
Salmon	850	X	
Chicken	850	W	K,S

Mouse	950..952	R,R,I,K,M,X,F,F,F,S,V	D,E,G,H,L,K,X,P
Rat	955..957	N,N,D,D,Q,E,L,L,K,K,K,S, S,S,V,V	D,D,E,E,E,G,G,L,L,L,K,P,P
Rabbit	965..967	D,K,K,K,M,X,F,V	
Bovine	970..972	R,R,R,N,D,Q,L,F,F,S,S,T,W,Y	
Calf	974	F	
Cow	975..976	L,L	
Sheep	980	H,X	
Human	995..996	N,G,G,H,L,M,X,F,S,V	N,N,Q,E,G,G,L,K,M,X,Y,Y,V,V

(1) abbreviations of names used in the compilation
(2) specifity of the tRNA is defined by amino acid one-letter-code

Table 2. ABBREVIATIONS FOR MODIFIED NUCLEOSIDES

A1	M1A	1-METHYLADENOSINE
A2	M2A	2-METHYLADENOSINE
A3	M1AM	2'-O-METHYL-1-METHYLADENOSINE
A4	I6A	N6-ISOPENTENYLADENOSINE
A5	MS2I6A	2-METHYLTHIO-N6-ISOPENTENYLADENOSINE
A6	M6A	N6-METHYLADENOSINE
A7	T6A	N-((9-BETA-D-RIBOFURANOSYLPURINE-6-YL)CARBAMOYL)-THREONINE
A8	MT6A	N-((9-BETA-D-RIBOFURANOSYLPURINE-6-YL)N-METHYL-CARBAMOYL)-THREONINE
A9	MS2T6A	N-((9-BETA-D-RIBOFURANOSYL-2-METHYLTHIOPURINE-2-YL)CARBAMOYL)-THREONINE
C2	S2C	2-THIOCYTIDINE
C3	CM	2'-O-METHYLCYTIDINE
C4	AC4C	N4-ACETYLCYTIDINE
C5	M5C	5-METHYLCYTIDINE
C6	M3C	3-METHYLCYTIDINE
D	D	DIHYDROURIDINE
F	F	PSEUDOURIDINE
F1	M1F	1-METHYLPSEUDOURIDINE
F3	FM	2'-O-METHYLPSEUDOURIDINE
G1	M1G	1-METHYLGUANOSINE
G2	M2G	N2-METHYLGUANOSINE
G3	GM	2'-O-METHYLGUANOSINE
G4	M22G	N2,N2-DIMETHYLGUANOSINE
G7	M7G	7-METHYLGUANOSINE
G5	M22GM	N2,N2,3'-TRIMETHYLGUANOSINE
I	I	INOSINE
I1	M1I	1-METHYLINOSINE
Q	Q	QUEUOSINE
Q1	MAN_Q	BETA,D-MANNOSYLQUEUOSINE
Q2	GAL_Q	BETA,D-GALACTOSYLQUEUOSINE
T1	T	5-METHYLURIDINE
T2	S2T	5-METHYL-2-THIOURIDINE
T3	TM	2'-O-METHYL-5-METHYLURIDINE
U1	MAM5U	5-METHYLAMINOMETHYLURIDINE
U2	S2U	2-THIOURIDINE
U3	UM	2'-O-METHYLURIDINE
U4	S4U	4-THIOURIDINE
U6	CM5U	5-CARBAMOYLMETHYLURIDINE
U7	MCM5U	5-METHOXYCARBONYLMETHYLURIDINE
U8	MAM5S2U	5-METHYLAMINOMETHYL-2-THIOURIDINE
U9	MCM5S2U	5-METHOXYCARBONYLMETHYL-2-THIOURIDINE
V1	O5U	URIDINE-5-OXYACETIC ACID
V2	MO5U	5-METHOXYURIDINE
V3	MV	URIDINE-5-OXOACETIC ACID METHYL ESTER
V4	CMNM5U	5-CARBOXYMETHYLAMINOMETHYLURIDINE
V5	CMNM5S2U	5-CARBOXYMETHYLAMINOMETHYL-2-THIOURIDINE
V6	CHM5U	5-(CARBOXYHYDROXYMETHYL)URIDINE
X	X	3-(3-AMINO-3-CARBOXYPROPYL)URIDINE, (ACP3)U
Y1	YW	WYBUTOSINE
Y2	O2YW	WYBUTOXOSINE

Table 3. OCCURRANCE OF MODIFIED NUCLEOSIDES IN tRNAs

tRNAs are defined by their amino acid specificity and species number

THE NUMBERS IN PARENTESIS INDICATE THE AMOUNT OF MODIFIED NUCLEOSIDES IN PARTICULAR tRNA

M1A (184):A580,A770,A771,R460,R474,R475,R477,R590,R591,R592,R625,R950,R951, R970,R971,R972,N590,N955,N956,N970,N995,D460,D475,D477,D478,D965, D970,C590,Q460,Q530,Q531,Q532,Q955,Q970,E460,E483,G460,G483,G625, G640,G770,G771,G995,G996,H780,H980,I240,I570,I580,I950,L230,L477, L478,L479,L483,L484,L571,L580,L955,L956,L970,L975,L976,L995,K475, K477,K483(2),K570,K590,K780,K781,K950,K955,K956,K957,K965,K966, K967,M010,M460,M570,M625,M640,M950,M965,M995,X150,X180,X215,X230, X240,X241,X530,X540,X560,X570,X580,X625,X640,X645,X750,X780,X790, X830,X850,X950,X955,X980,X995,F477,F510,F540,F560,F590,F620,F625, F630,F640,F650,F770,F771,F780,F830(2),F950(2),F951(2),F952 (2),F965(2),F970(2),F971(2),F974(2),F995(2),P013,P014, P570,P571,P580,S950,S955,S956,S957,S970,S971,S995,T483,T590,T591, T970,W010,W477,W483,W570,W625,W870,W970,Y230,Y235,Y236,Y540,Y575, Y580,Y590,Y625,Y626,Y640,Y655,Y656,Y780,Y970,V460,V483,V477,V478, V580,V590,V591,V592,V780,V781,V782,V950,V955,V956,V965,V995

M2A (13):R250,R251,R625,D250,Q020,Q250,Q251,E250,E251,E252,H250,H255,M310

I6A (17):C590,G417,S570,S590,S591,S950,S955,S957,S970,S971,S995,Y235,Y310, Y417,Y575,Y580,Y590

MS2I6A (22):C250,L020,L230,L250,F230,F235,F250,F280,F285,F350,F365,F477,S020, S250,S254,W250,W477,W483,Y230,Y236,Y250,Y251

M6A (7):A235,G203,L040,M235,X445,V235(2),V252

T6A (96):R252,R253,R418,R591,R592,R971,R972,N110,N120,N140,N250,N590,N955, N956,N970,N995,D460,Q530,Q531,E460,I120,I121,I240,I250,I251,I252, I320,I365,I366,I417,I460,I483,I570,I580,I950,K120,K121,K250,K417, K475,K477,K460,K570,K590,K780,K781,K955,K956,K965,K966,M010,M120, M180,M250,M417,M418,M460,M570,M950,M965,M995,X181,X530,X540,X560, X570,X580,X625,X640,X645,X750,X780,X790,X830,X850,X950,X955,X980, X995,S120,S251,S460,S475,S483,S484,S493,T110,T120,T121,T235,T412, T483,T590,T591,T970,V460

MT6A (5):M625,M640,S956,T250,T365

MS2T6A (3):K236,K957,K967

S2C (4):R250,R252,R253,S251

CM (128):A110,A120,A121,A122,R110,R120,R121,R122,R625,R950,R951,R970,N110, N120,N140,D120,D970,C120,Q110,Q120,Q531,Q955,Q970,E120,E121,E780, G110,G120,G121,G122,G123,G140,G570,G625,G640,G995,H110,H120,I120, I121,L120,L121,L122,L123,L124,L230,L327,L350,L580(2),K120(2), K121(2),M010,M120(2),M180(2),M625,M640,M950,M965,M995,X110, X120,X130,X150(2),X180(2),X181(2),X240,X241,X250,X251,X290, F120,F510(2),F540(2),F560,F575,F590,F620,F625,F630,F640,F650, F770,F771,F780,F830,F950,F951,F965,F970,F971,F974,F995,P120,P121, P122,P256,P570,P571,P580,S020,S110,S120,S121,S122,S254,S460,S970, T110,T120,T121,W010(2),W120(3),W250,W350,W445,W570(2),W625 (2),W870(2),W970(2),Y120(2),V111,V112,V120,V121,V780,V950, V955,V965

AC4C (23):Q120,E120,L570,L571,L580,L700,L955,L956,L970,L975,L976,L995,K121, M250,P120,S110,S121,S570,S590,S591,S955,S956,S957

M5C (172):A110,A120(2),A121(2),A122(2),A412,A770,A771,R110,R120,R121, R122,R590,R625,R950,R951,R972,N110,N120(2),N590,D590,D830(3), D955(3),D956(3),D965(2),D970,C120,C590,Q530,Q531,Q532,Q955 (2),Q970,E120,E121,E483,E575,E590,E955(2),G110(2),G120,G121, G122,G123,G570,G625(4),G640(4),G770(4),G771(2),G995(2), G996(4),H570,H571,H780(2),H980(2),H995(2),I120(2),I121, I570,I580,I950,L120,L121,L122(2),L124,L477,L478,L479,L483,L570 (2),L571,L580,L955,L956,L970,L975,L976,L995,K120,K121,K590,K781, K950,K955,K956,K957(2),K965,K966,K967(2),M010(2),M120,M570, K950,K955,K956,K957(2),K965,K966,K967(2),X580(2),X625(2),

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                X640,X645,X750,X780,X830,X850,X950,X955,X980,X995,F120,F540(  2),
                F560(  2),F575,F590(  2),F770,F771,F830,F950,F951,F952,F965,F970,
                F971,F974,F995,P013(  2),P014(  2),P120(  2),P121,P122(  2),P580
                (  2),S110,S120(  2),S121,S122,S484,S570,S590,S591,S955,S956,S957,
                T110(  2),T120,T121(  2),T590,T591,T970(  2),W120,Y120,Y412,Y575,
                Y580,Y590,Y970,V111,V112,V120,V121,V580,V590,V591,V592,V780,V950
                (  3),V955(  3),V956(  3),V965(  3),V995(  2)
M3C       (   9):R971,R972,S955(  2),S956(  2),S957(  2),T483,T590,T591,T970
D         ( 299):A235,A250(  2),A251,A252,A412(  2),A580(  4),A590(  3),A770,A771,
                R020,R235,R250(  2),R251(  2),R252,R417(  2),R418(  2),R590(  3),
                R591(  2),R592(  2),R625(  2),R950(  3),R951(  3),R970(  3),R971
                (  3),R972(  3),N250(  2),N590(  5),N955(  3),N956(  3),N970(  3),
                N995(  3),D250(  3),D510(  2),D590(  2),D830,D955,D956,D965,D970,
                C250(  2),C590(  3),Q020(  3),Q250,Q251,Q530(  2),Q531(  3),Q532
                (  2),Q955(  3),Q970(  3),E575,E590,E780(  2),E955(  2),G020,G220,
                G221,G235,G250,G251(  3),G255,G417(  2),G570(  2),G625,G640,G770,
                G771(  2),G995,G996,H250(  3),H255(  3),H428(  2),H570(  3),H571
                (  3),H780(  3),H980(  3),H995(  3),I020(  2),I240,I250(  3),I251
                (  2),I252(  2),I320,I365,I366(  2),I417(  3),I570(  5),I580(  5),
                I950(  5),L020(  3),L040(  2),L230,L250(  2),L251(  3),L252(  3),
                L255(  3),L280(  2),L290(  2),L291(  2),L327,L328,L329,L350,L351,
                L352,L365,L412(  2),L413(  2),L417(  2),L477,L478,L479,L483,L484,
                L570(  2),L571(  4),L580(  2),L700,L955,L956,L970,L975,L976(  2),
                L995,K235(  2),K236(  2),K250(  3),K417(  2),K570(  2),K590(  4),
                K780(  3),K781(  3),K950(  2),K955(  3),K956(  3),K957(  3),K965
                (  3),K966(  3),K967(  3),M010(  2),M235(  2),M250(  4),M310(  2),
                M365(  2),M417(  3),M418(  3),M445(  3),M570(  2),M625(  3),M640
                (  3),M950(  3),M965(  3),M995(  3),X203(  2),X215,X230,X235,X240,
                X241,X250,X251,X290,X310(  2),X355,X365,X412(  2),X428(  2),X445
                (  2),X530,X540(  2),X560,X570(  2),X580(  2),X625,X640,X645,X750,
                X780,X830,X850,X950,X955,X980,X995,F200,F230,F235(  2),F250(  2),
                F280(  2),F285(  2),F307(  2),F350(  2),F365,F407,F417(  2),F445
                (  2),F510(  2),F540,F560(  3),F575(  2),F590(  2),F620(  3),F625
                (  3),F630(  3),F640(  3),F650(  3),F770(  3),F771(  3),F780(  3),
                F830(  3),F950(  2),F951(  2),F952(  2),F965(  3),F970(  3),F971
                (  3),F974(  3),F995(  3),P013(  2),P014(  2),P020,P040,P235,P255,
                P256,P257,P365,P417,P570(  2),P571(  2),P580(  3),S020(  2),S250,
                S251,S252,S253(  2),S254(  2),S417(  2),S418(  2),S419(  2),S570
                (  3),S590(  3),S591(  3),S955(  3),S956(  3),S957(  3),S970,T020
                (  2),T235(  2),T250(  3),T365(  2),T412,T417(  2),T590(  4),T591
                (  4),T970(  3),W010,W250(  3),W365,W412,W417(  2),W445,W570(  3),
                W625(  4),W870,W970(  3),Y310,Y407(  2),Y412,Y417(  2),Y445(  2),
                Y540(  2),Y575(  4),Y580(  6),Y590(  6),Y625(  2),Y626(  2),Y640
                (  2),Y655(  2),Y656(  2),Y780(  3),Y970(  3),V235(  2),V250(  4),
                V251(  4),V252,V365,V412,V580(  3),V590(  4),V591(  2),V592(  4),
                V780,V781(  2),V782(  2),V950(  4),V955(  4),V956(  4),V965(  4),
                V995(  4)
F         ( 392):A110,A120,A121,A122,A235,A250(  2),A251,A252,A412,A580(  3),A590
                (  2),A770(  3),A771(  2),R020(  2),R110(  2),R120,R121(  2),R122,
                R235,R250,R251,R252,R253(  2),R417(  3),R418(  3),R460(  3),R474,
                R475(  2),R477(  2),R590(  3),R591(  3),R592(  3),R625,R950(  5),
                R951(  4),R970(  3),R971(  4),R972(  5),N040(  2),N110,N120,N140
                (  2),N250(  2),N590(  2),N955(  3),N956(  3),N970(  3),N995(  3),
                D040(  2),D120(  2),D250(  2),D460(  4),D475,D477,D478,D510(  3),
                D590(  3),D830(  2),D955(  2),D956(  2),D965(  2),D970(  2),C120,
                C250(  3),C590(  3),Q020(  2),Q040(  2),Q110(  3),Q120(  3),Q250
                (  3),Q251(  2),Q460,Q530(  3),Q531(  3),Q532(  3),Q955(  4),Q970
                (  5),E120(  2),E121(  2),E250(  2),E251(  2),E252(  2),E460(  3),
                E483(  3),E575,E590(  3),E780(  2),E955(  3),G020(  2),G110(  2),
                G120,G121(  2),G122(  2),G123,G140(  2),G203,G235,G250,G251,G252,
                G255,G417(  2),G460(  2),G483,G570(  4),G625(  2),G640(  2),G770,
                G771(  3),G995(  2),G996,H040(  2),H110(  2),H120(  3),H250(  3),
                H255( . 3),H428(  4),H570(  4),H571(  3),H780(  3),H980(  3),H995
                (  3),I020,I120(  2),I121,I240,I250(  2),I251(  2),I252(  2),I320,
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                I365,I366( 3),I417( 2),I460( 4),I483,I570,I580( 2),I950( 3),
                L020( 2),L040( 2),L120( 2),L121,L122,L123( 2),L124,L230( 2),
                L250( 3),L251( 3),L252( 2),L255( 3),L280( 2),L290( 2),L291
                ( 3),L327( 2),L328( 3),L329,L350,L351( 3),L352,L365,L412,L413
                ( 2),L417( 3),L477,L478,L479,L483( 2),L484( 3),L570( 3),L571
                ( 4),L580( 2),L955( 5),L956( 5),L970( 5),L975( 5),L976( 2),
                L995( 5),K120,K121( 3),K235( 2),K236( 2),K250( 2),K417( 3),
                K475,K477,K460( 3),K483,K570( 3),K590( 5),K780( 3),K781( 4),
                K950( 3),K955( 3),K956( 3),K957( 3),K965( 3),K966( 3),K967
                ( 3),M010( 4),M120( 4),M180( 2),M235,M250( 2),M310( 4),M365
                ( 5),M417( 2),M418( 2),M445( 3),M460( 4),M483,M570( 4),M625
                ( 4),M640( 4),M950( 4),M965( 4),M995( 4),X110( 2),X120( 2),
                X130,X180( 3),X181( 2),X203,X215,X230,X235,X240,X241,X250,X251,
                X290,X310( 3),X355,X365,X428( 2),X445( 3),X530( 3),X540( 2),
                X625( 2),X640( 2),X645,X750,X790,F120( 2),F200( 2),F230( 2),
                F235( 2),F250( 3),F280( 2),F285( 2),F307( 2),F350( 2),F365,
                F407,F417( 3),F445( 2),F477,F510( 5),F540( 4),F560( 3),F575
                ( 4),F590( 2),F620( 3),F625( 3),F630( 3),F640( 3),F650( 3),
                F770( 4),F771( 4),F780( 4),F830( 4),F950( 4),F951( 4),F952
                ( 4),F965( 4),F970( 4),F971( 4),F974( 4),F995( 4),P013( 4),
                P014( 5),P020( 2),P040,P120( 3),P121( 2),P122( 2),P235( 2),
                P255,P256( 2),P257( 2),P365( 5),P417( 2),P570( 4),P571( 4),
                P580( 4),S020,S110( 2),S120,S121( 3),S122,S250,S251,S252( 2),
                S253( 2),S254,S417( 3),S418( 4),S419( 3),S460( 2),S570( 2),
                S590( 3),S591( 3),S950,S955( 2),S956( 4),S957( 2),S970,S971,
                S995,T020( 2),T110( 2),T120,T121( 2),T235( 2),T250,T365,T412
                ( 2),T417( 4),T483,T590( 2),T591( 2),T970,W010( 3),W120,W250,
                W350( 3),W365( 3),W412,W417( 3),W445( 2),W570( 6),W625( 3),
                W870( 3),W970( 3),Y120( 2),Y230( 2),Y235( 2),Y236( 2),Y250
                ( 2),Y251( 2),Y310( 3),Y407( 4),Y412( 2),Y417( 2),Y445( 2),
                Y540( 3),Y575( 3),Y580( 4),Y590( 3),Y625( 3),Y626( 3),Y640
                ( 3),Y655( 3),Y656( 3),Y780( 3),Y970( 2),V110( 2),V111( 2),
                V112( 2),V120( 2),V121( 2),V235( 2),V250,V251,V252,V365,V412,
                V460( 6),V483,V477,V478,V580( 4),V590( 4),V591( 5),V592( 3),
                V780( 3),V781( 3),V782( 4),V950( 3),V955( 3),V956( 3),V965
                ( 3),V995( 3)
M1F      (  52):A110,A120,A121,A122,R110,R120,R121,R122,N110,N120,D120,C120,E120,
                E121,G110,G120,G121,G122,G123,G460,H110,I120,I121,L120,L121,L122,
                L123,L124,K120,K121,M120,X110,X120,X130,F120,P120,P121,P122,S110,
                S120,S121,S122,T110,T120,T121,W120,Y120,V110,V111,V112,V120,V121
FM       (  10):G995,L970,L975,S955,S957,W010,W625,W870,W970,Y970
M1G      ( 140):A580,A590,R110,R120,R121,R122,R235,R590,R591,R592,R625,R950( 2),
                R951( 2),R970( 2),R971,R972,N955,N956,N970,N995,D590,D830,C120,
                Q110,Q120,Q532,Q955,Q970,E121,E575,E955,G570,G625,G640,G770,G771,
                H110,H120,H428,H570,H571,H780,H980,I460,I483,I570,L120,L121,L122,
                L123,L124,L291,L329,L352,L365,L413,L417,L477,L478,L479,L483,L484,
                L570,L571,L580,L970,L975,L976,L995,K460,M625,M640,X412,X428,X530,
                X540,X560,X570,X580,X625,X640,X645,X750,X780,X790,X830,X850,X950,
                X955,X980,X995,F120,F200,F417,F540,F770,F771,F780,F952,P013( 2),
                P014( 2),P020,P040,P120,P121,P122,P235,P255,P256,P257,P417,P570
                ( 2),P571,P580( 2),S110,S418,S419,T417,T970,W010( 2),W120,W570,
                W625( 2),W870( 2),W970( 2),Y120,Y540,Y575,Y580,Y625,Y626,Y640,
                Y655,Y656,Y780,Y970,V111,V580,V590,V780
M2G      ( 150):A122,A770,A771,R122,R590,R591,R592,R625,R950,R951,R970,R971,N590,
                N955,N956,N970,N995,D830,D970,Q530,Q531,Q532,E483,G110,G120,G121,
                G122,G123,G483,G995,G996,H980,I570,I580,I950,L123,L477,L478,L479,
                L483,L484( 2),L570,L571,L580,L955( 2),L956( 2),L970,L975,L976
                ( 2),L995( 2),K475( 2),K477( 2),K483,K570( 2),K590,K780,K781,
                K950,K955( 2),K956( 2),K957( 2),K965,K966,K967,M010,M570,M625,
                M640,M950( 2),M965( 2),M995( 2),X130,X150,X180,X540( 2),X570,
                X580,X625( 2),X640,X645( 2),X750,X780( 2),X790( 2),X830( 2),
                X850,X950( 2),X955( 2),X980( 2),X995( 2),F407,F510,F540,F560,
                F590,F620,F625,F630,F640,F650,F770,F771,F780,F830,F950,F951,F952,
                F965,F970,F971,F974,F995,P013,P014,P417,S418,S419,S970,T417,T590,
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                T591,T970,W010,W365,W483,W570,W625,W870,W970(  2),Y407,Y417,Y445,
                Y580,Y590,Y625,Y626,Y640,Y656,Y780,Y970(  2),V460,V483,V477,V478,
                V591(  2),V592,V950,V955,V956,V965,V995
GM       ( 114):A770,A771,R020,R625,R970,D510,D970,Q250,Q251,Q955,Q970,G020,G255,
                H570,H571,I020,I240,I252,I320,I365,I366,L020,L040,L250,L251,L252,
                L255,L327,L328,L329,L350,L351,L352,L365,L570,L571,L580,M250,M310,
                M365,M445,X150,X240,X241,X310,X355,X365,X445,X530,X645,F230,F235,
                F285,F307,F350,F365,F445,F510,F540,F560,F575,F590,F620,F625,F630,
                F640,F650,F770,F771,F780,F830,F950,F951,F965,F970,F971,F974,F995,
                P365,S020,S250,S252,S253,S254,S570,S590,S591,S955,S956,T365,W010,
                W350,W365,W445,W570,W625,W870,W970,Y230,Y250,Y251,Y310,Y445,Y540,
                Y580,Y590,Y625,Y626,Y640,Y655,Y656,V110,V365,V956
M22G     ( 129):A110,A120,A580,A590,A770,A771,R110,R120,R121,R590,R591,R592,R625,
                R950,R951,N590,N955,N956,N970,N995,D120,Q110,Q120,E120,E121,G417,
                H110,H120,I120,I121,I320,I365,I366,I580,I950,L120,L121,L122,L124,
                L417,L570,L571,L580,L955,L956,L970,L975,L976,L995,K120,K121,K570,
                K590,M010,M180,M570,M625,M640,M950,M965,M995,X181,X310,X560,X570,
                X580,X640,X850,F407,F417,F510,F540,F560,F590,F620,F625,F630,F640,
                F650,F770,F771,F780,F830,F950,F951,F952,F965,F970,F971,F974,F995,
                P120,P121,P122,S110,S120,S121,S122,S570,S590,S591,S955,S956,S957,
                T110,T120,T121,T590,T591,T970,W010,W120,W445,W625,W870,W970,Y407,
                Y412,Y540,Y580,Y590,Y625,Y626,Y640,Y655,Y656,Y780,Y970(  2),V592
M7G      ( 163):A235,A250,A251,A252,A770,A771,R235,R250,R251,R972,N040,N250,N955,
                N956,N970,N995,D250,D970,C590,G251,H250,H255,I020,I240,I250,I251,
                I252,I320,I365,I950,L329,L352,L365,K235,K236,K250,K570,K590,K780,
                K781,K950,K955,K956,K957,K965,K966,K967,M010,M235,M250,M310,M365,
                M570,M625,M640,M950,M965,M995,X230,X240,X241,X251,X290,X310,X355,
                X365,X445,X530,X540,X560,X570,X580,X625,X640,X645,X750,X780,X790,
                X830,X850,X950,X955,X980,X995,F200,F230,F235,F250,F280,F285,F307,
                F350,F365,F445,F510,F540,F560,F575,F590,F620,F625,F630,F640,F650,
                F770,F771,F780,F830,F950,F951,F952,F965,F970,F971,F974,F995,P013,
                P014,P020,P040,P235,P255,P256,P257,P365,P570,P571,P580,T020,T235,
                T250,T365,W010,W250,W350,W445,W570,W870,W970,Y540,Y575,Y625,Y626,
                Y640,Y655,Y656,Y780,Y970,V235(  2),V250,V251,V252,V365,V590,V591,
                V780,V781,V782,V950,V955,V956,V965,V995
I        (  31):A580,A590,A770,A771,R235,R250,R251,R590,R625,R950,R951,I570,I580,
                I950,L700,L970,L975,P013,S590,S591,S955,S957,T590,T591,T970,V580,
                V590,V780,V950,V955,V965
M1I      (  44):A110,A120,A121,A580,A590,A770,A771,R110,R120,R121,R122,N140,D120,
                C120,E121,G110,G120,G121,G122,G140,I120,L120,L121,L122,K120,K121,
                X110,X120,X130,X150,F120,P122,S110,S121,S122,T110,T120,T121,W120,
                Y120,V110,V111,V112,V121
Q        (  17):N250,N955,N970,N995,D250,D477,H250,H255,H980,Y230,Y235,Y236,Y250,
                Y251,Y407,Y625,Y780
MAN_Q    (   4):D830,D956,D965,D970
GAL_Q    (   1):Y970
T        ( 236):A235,A250(  2),A251,A252,A412,A580,A590,R020,R235,R250,R251,R252,
                R253,R417,R418,R590,R591,R592,R625,R970,R971,R972,N040,N250,N590,
                D040,D250,D510,D590,D830,D955,D956,D965,D970,C250,C590,Q020,Q040,
                Q250,Q251,E250,E251,E252,E575,E590,E780,G020,G235,G250,G251,G252,
                G255,G417,G570,G770,G771,G995,G996,H040,H250,H255,H428,H570,H571,
                I020,I250,I251,I252,I320,I365,I366,I417,I570,I580,I950,L020,L040,
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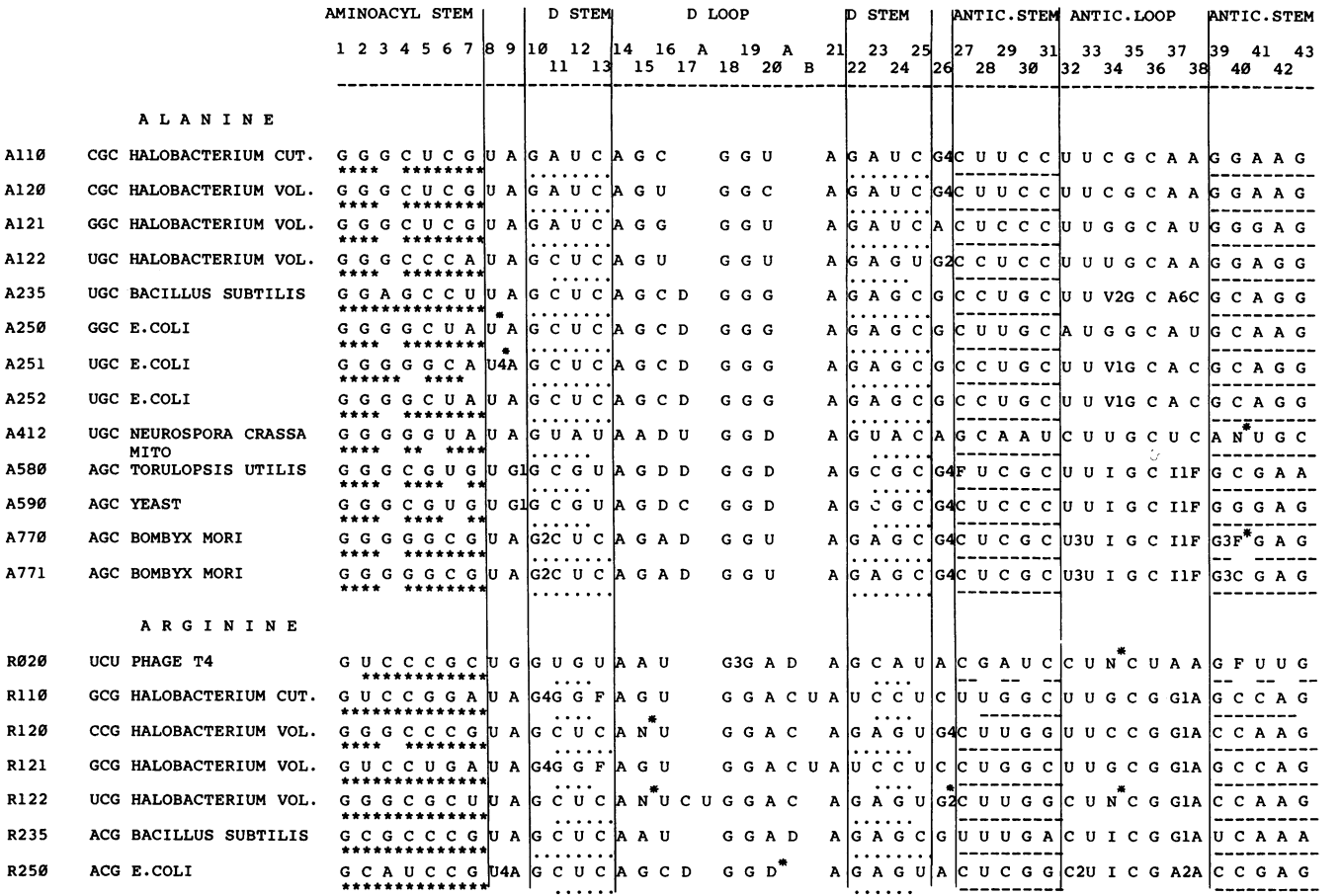
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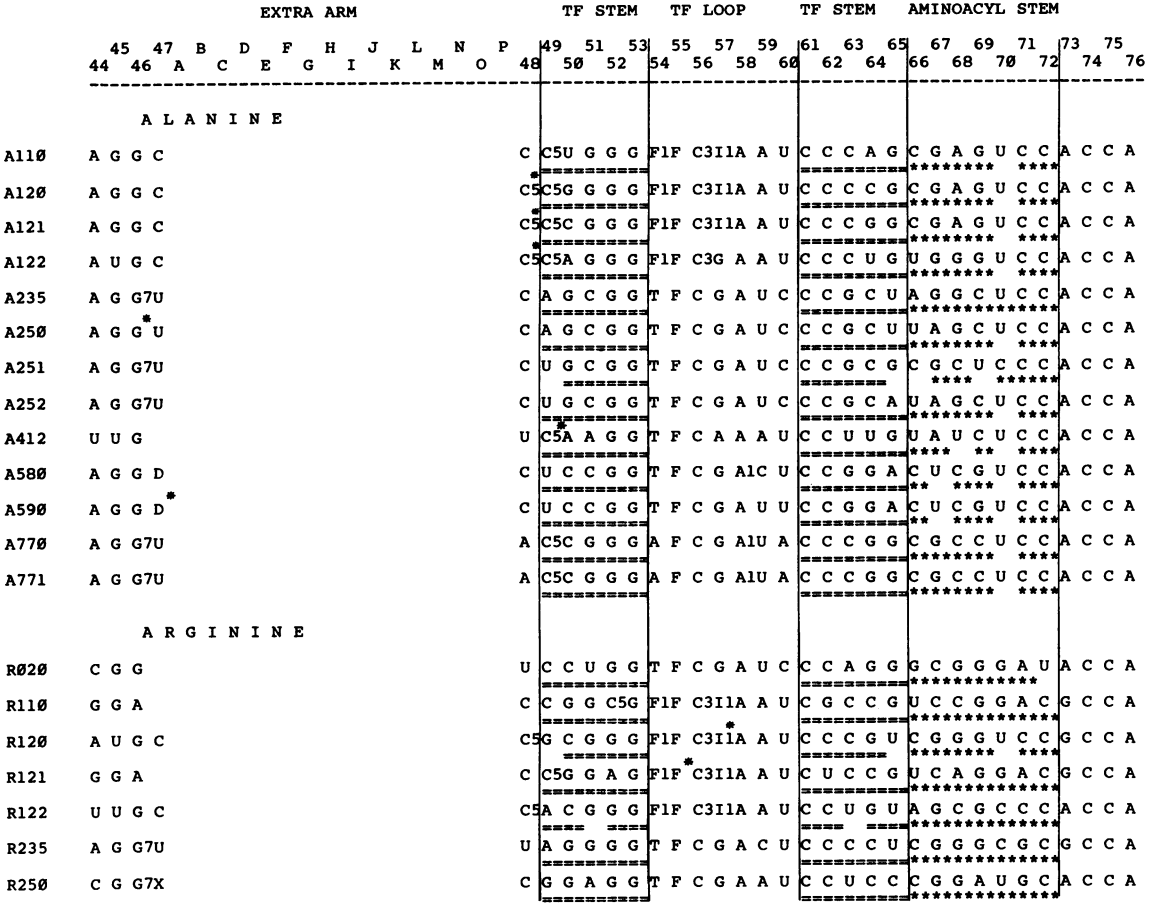
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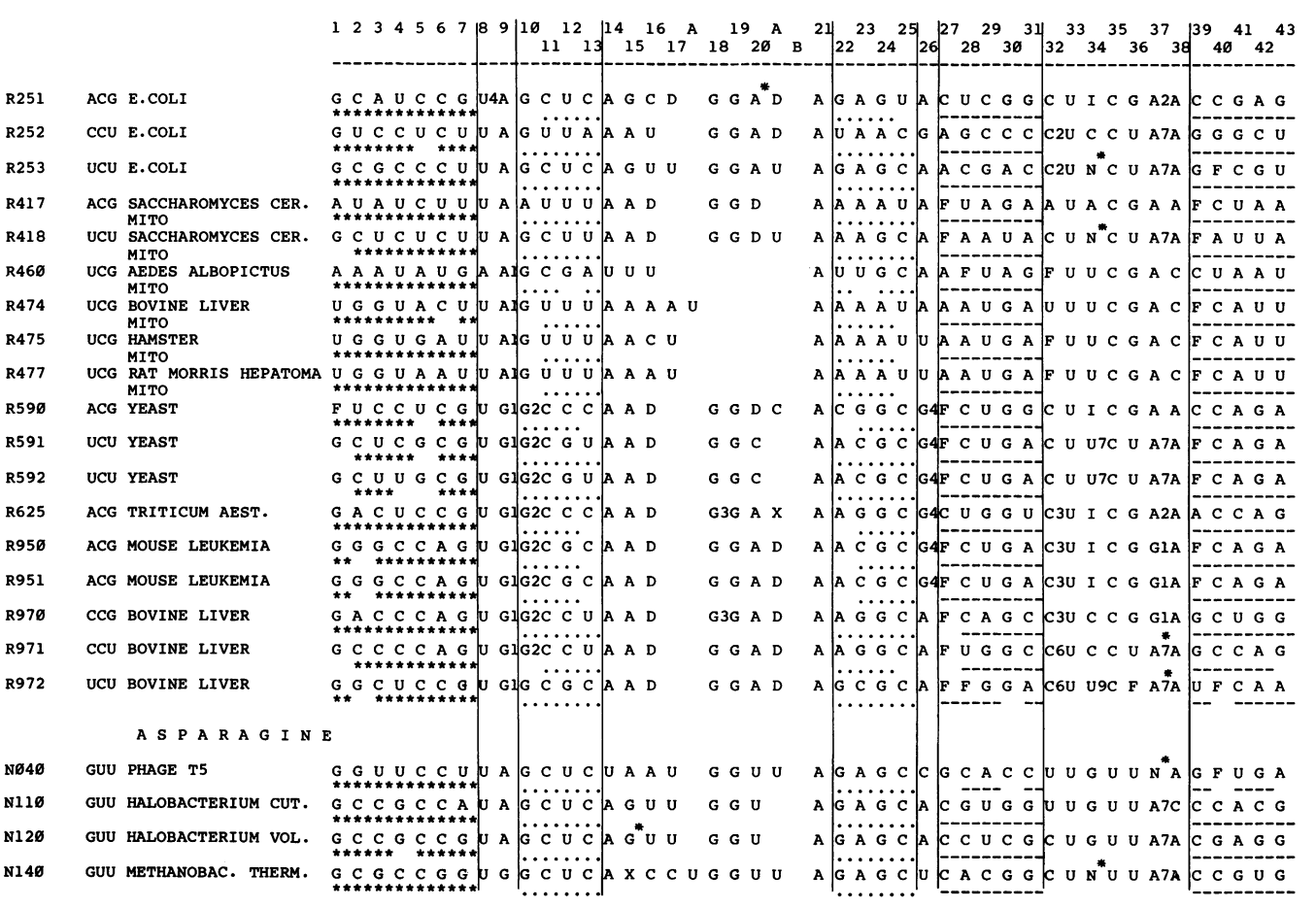
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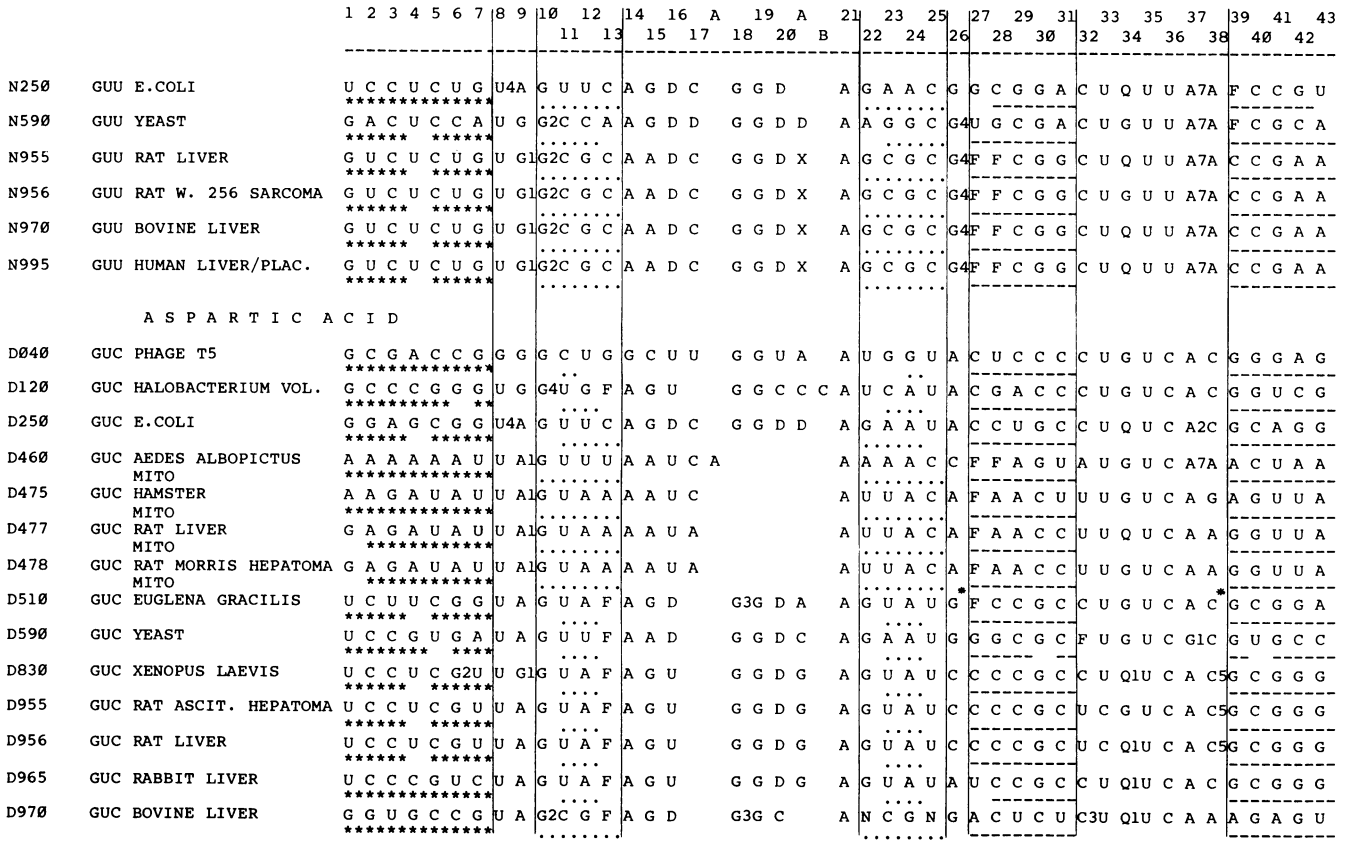
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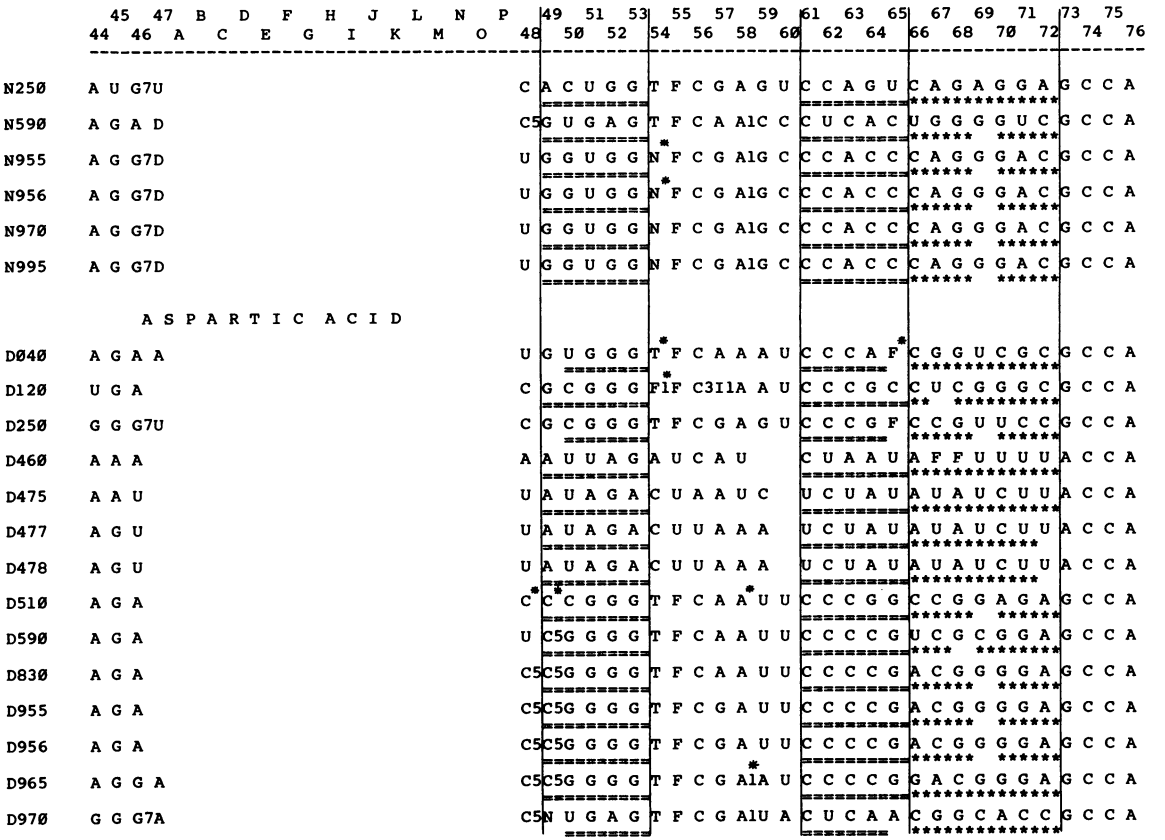
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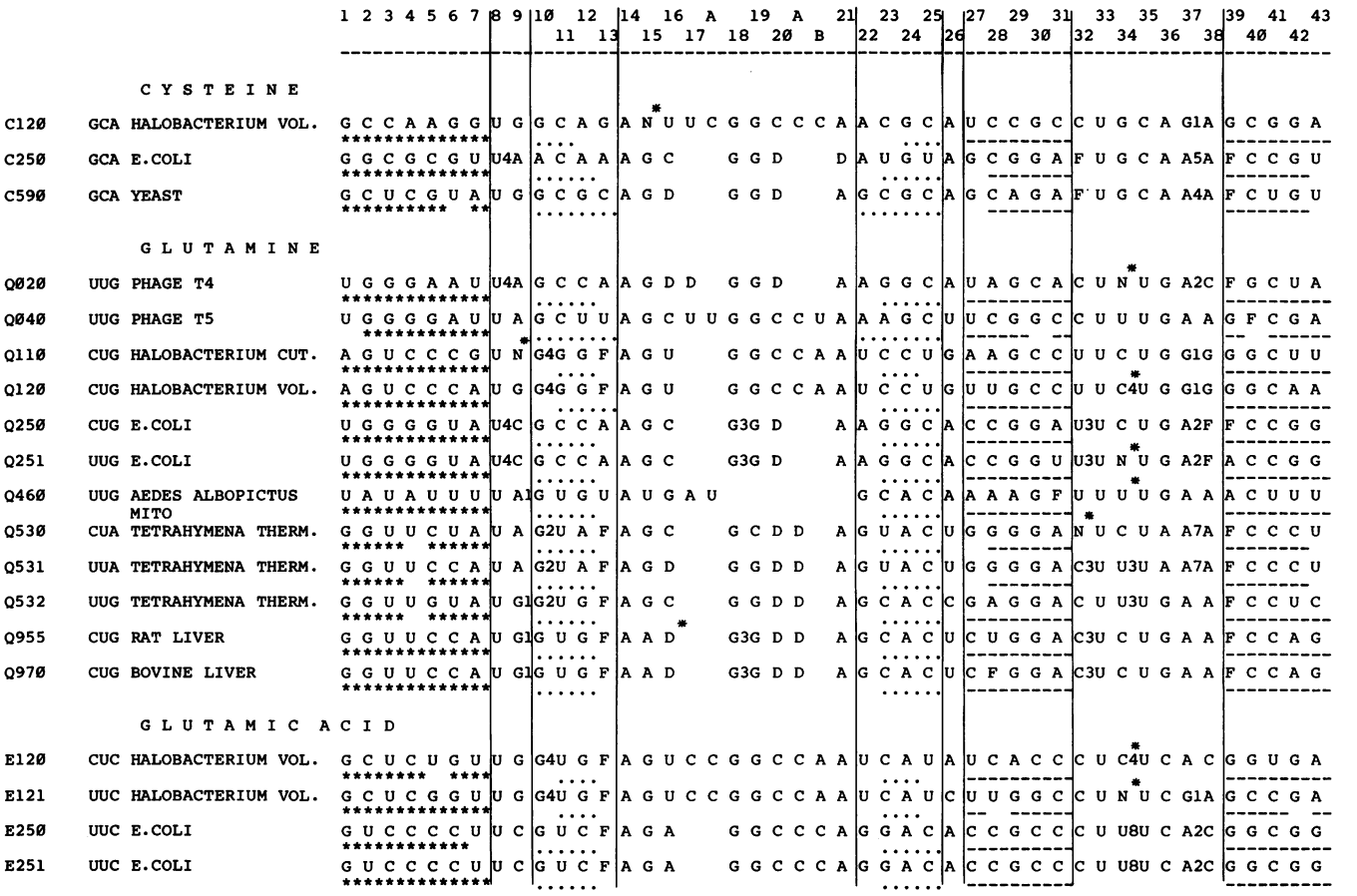
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GLUTAMIC ACID
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E250 UUC E.COLI G U C C C C C U U C G U C F A G A G G C C C A G G A C A C C G C C C U U8U C A2C G G C G G
E251 UUC E.COLI G U C C C C C U U C G U C F A G A G G C C C A G G A C A C C G C C C U U8U C A2C G G C G G

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G L U T A M I N E
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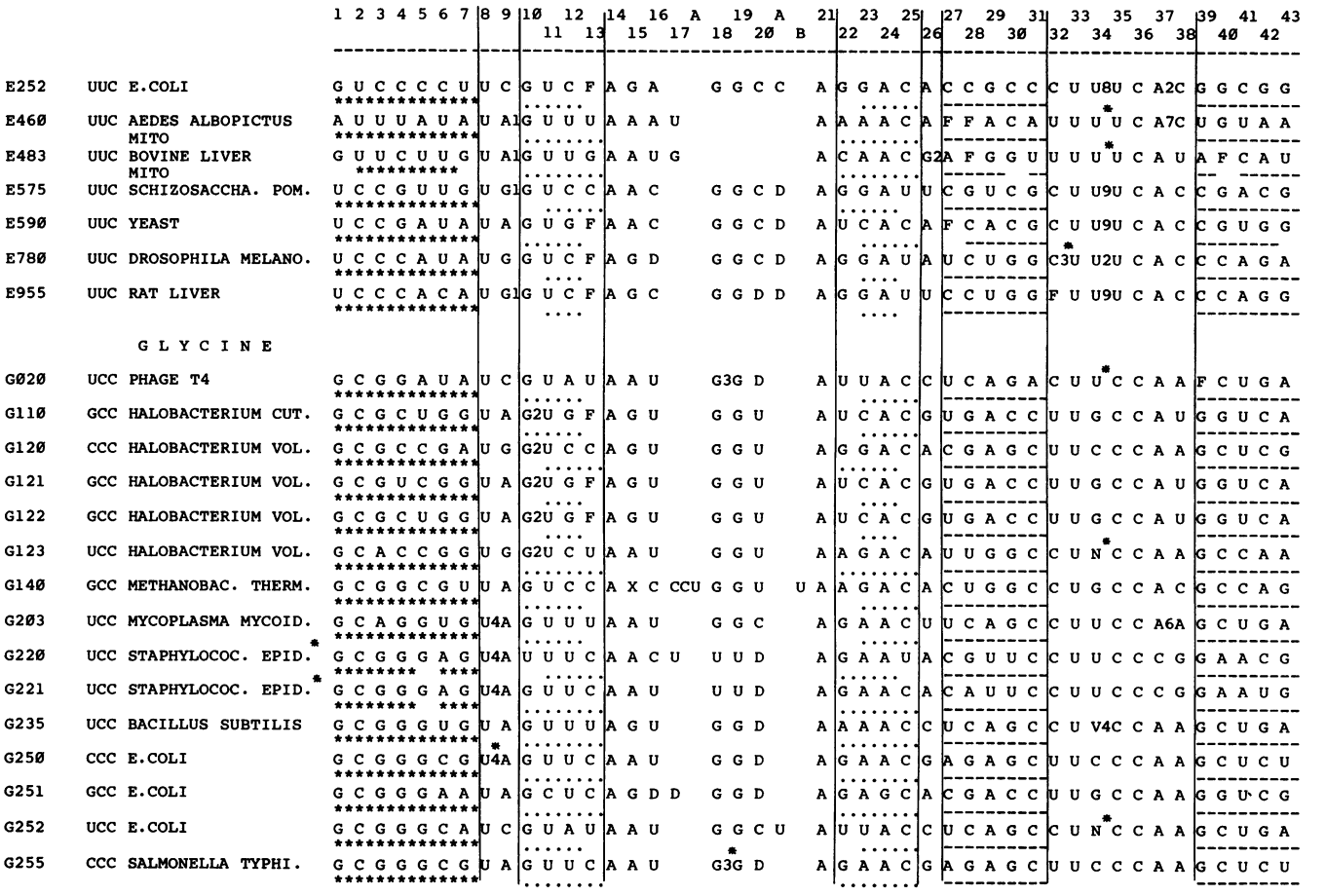
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G L Y C I N E
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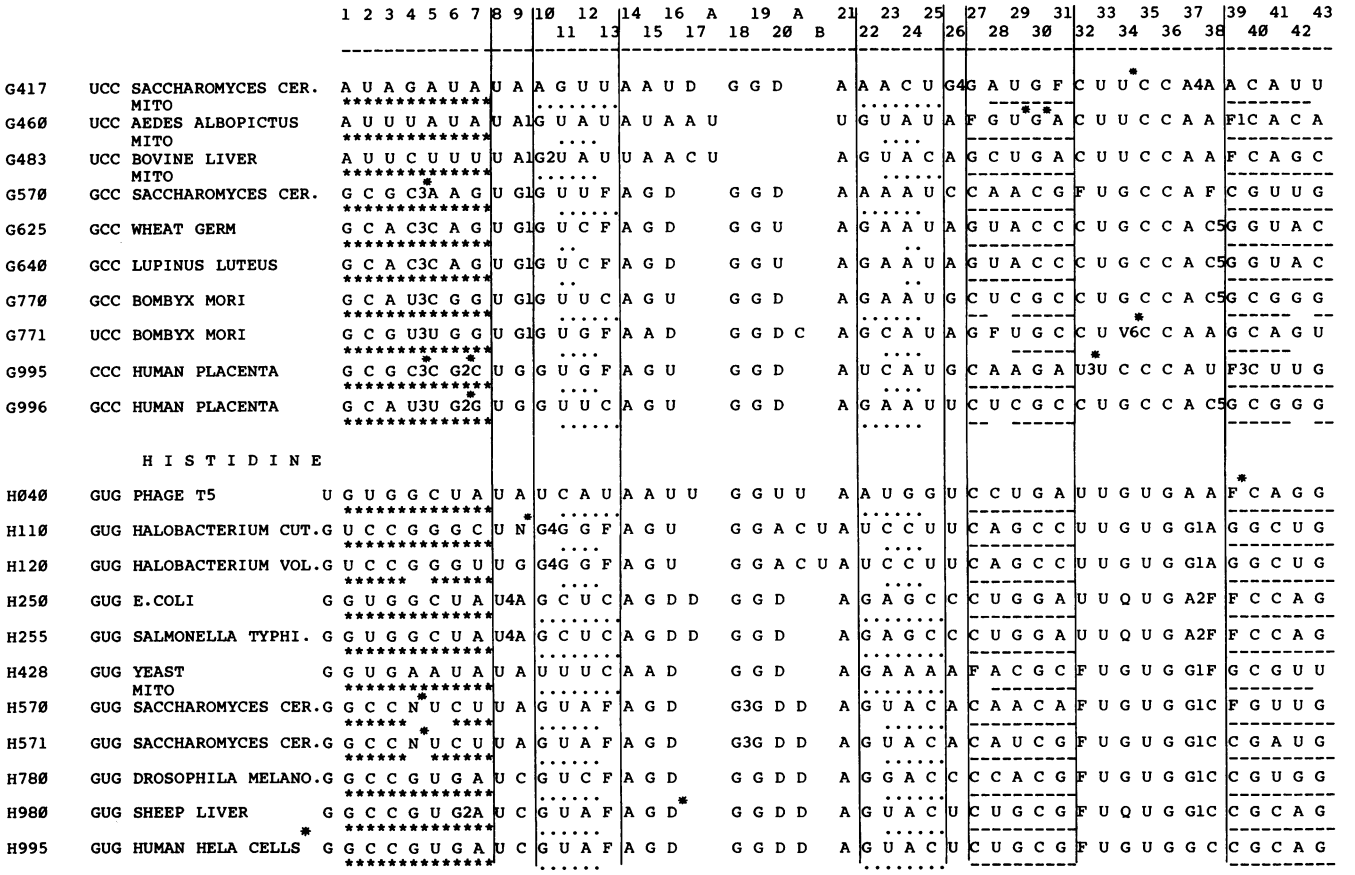
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G625 GCC WHEAT GERM
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HISTIDINE
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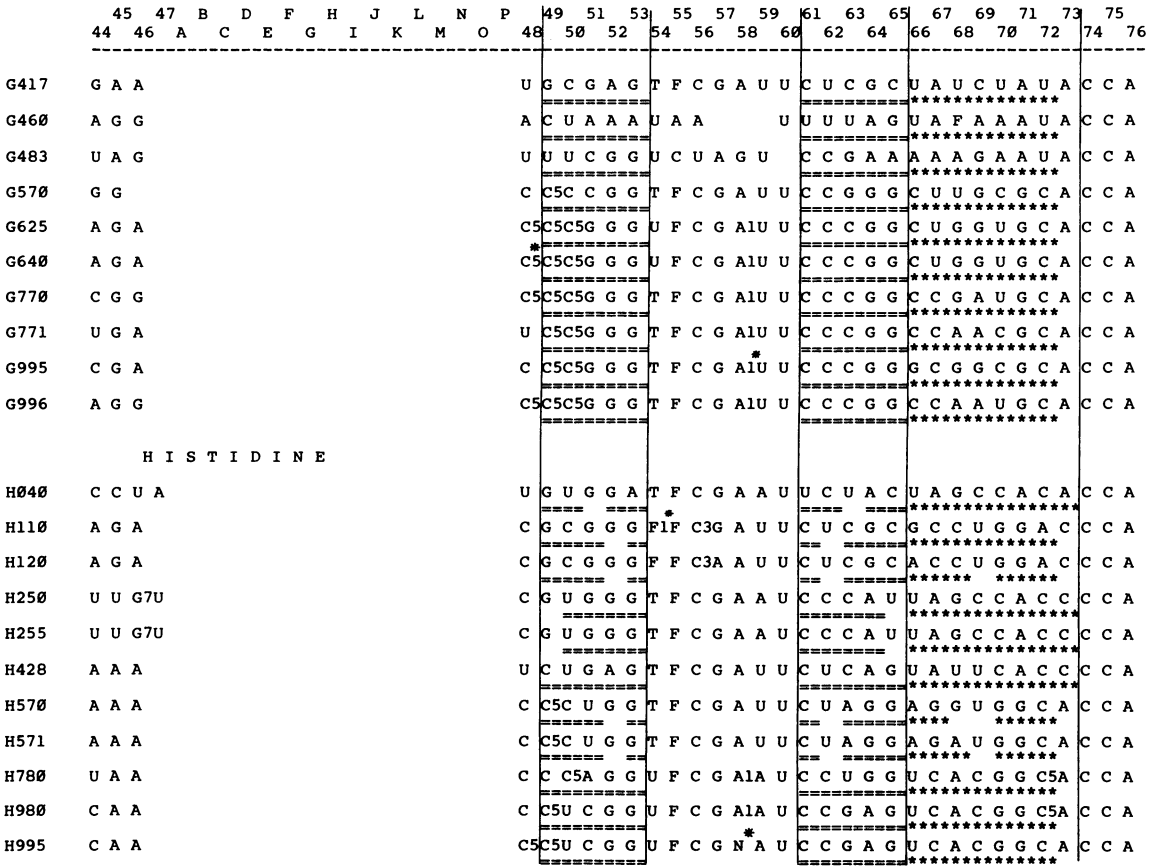
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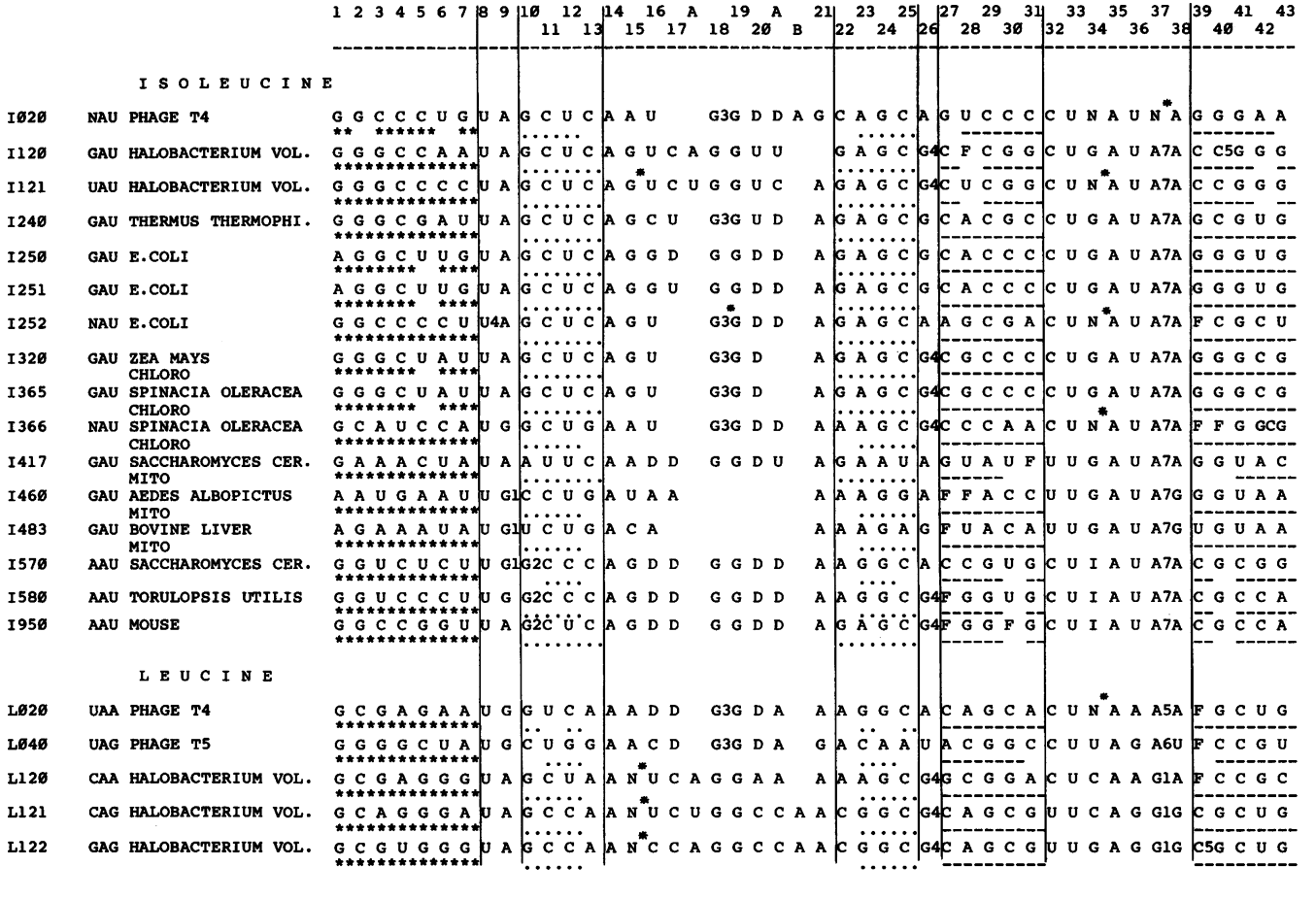
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I250 GAU E.COLI
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I365 GAU SPINACIA OLERACEA CHLORO
I366 NAU SPINACIA OLERACEA CHLORO
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I460 GAU AEDES ALBOPICTUS MITO
I483 GAU BOVINE LIVER MITO
I570 AAU SACCHAROMYCES CER.
I580 AAU TORULOPSIS UTILIS
I950 AAU MOUSE
LEUCINE
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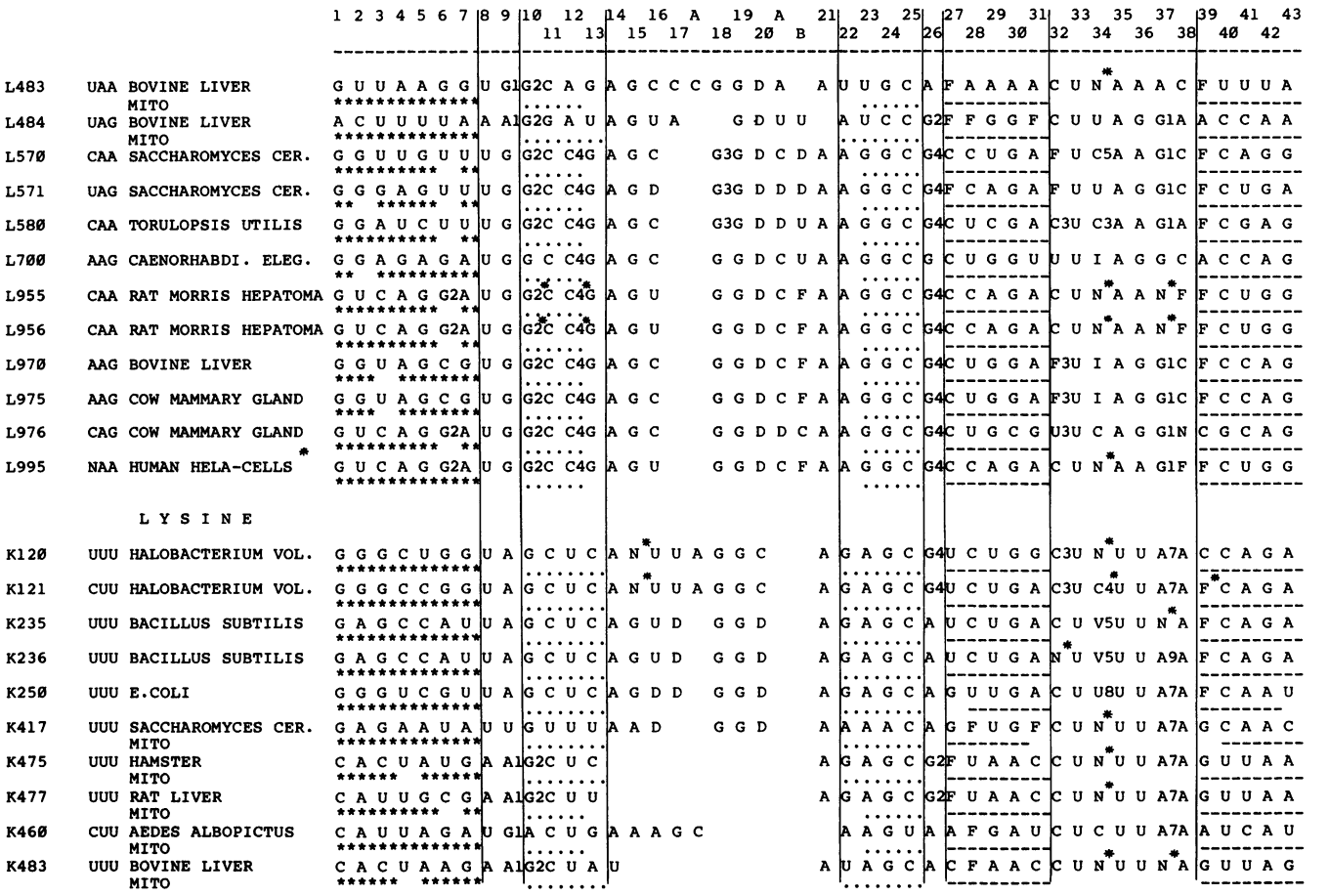
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LYSINE
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K250 UUU E.COLI
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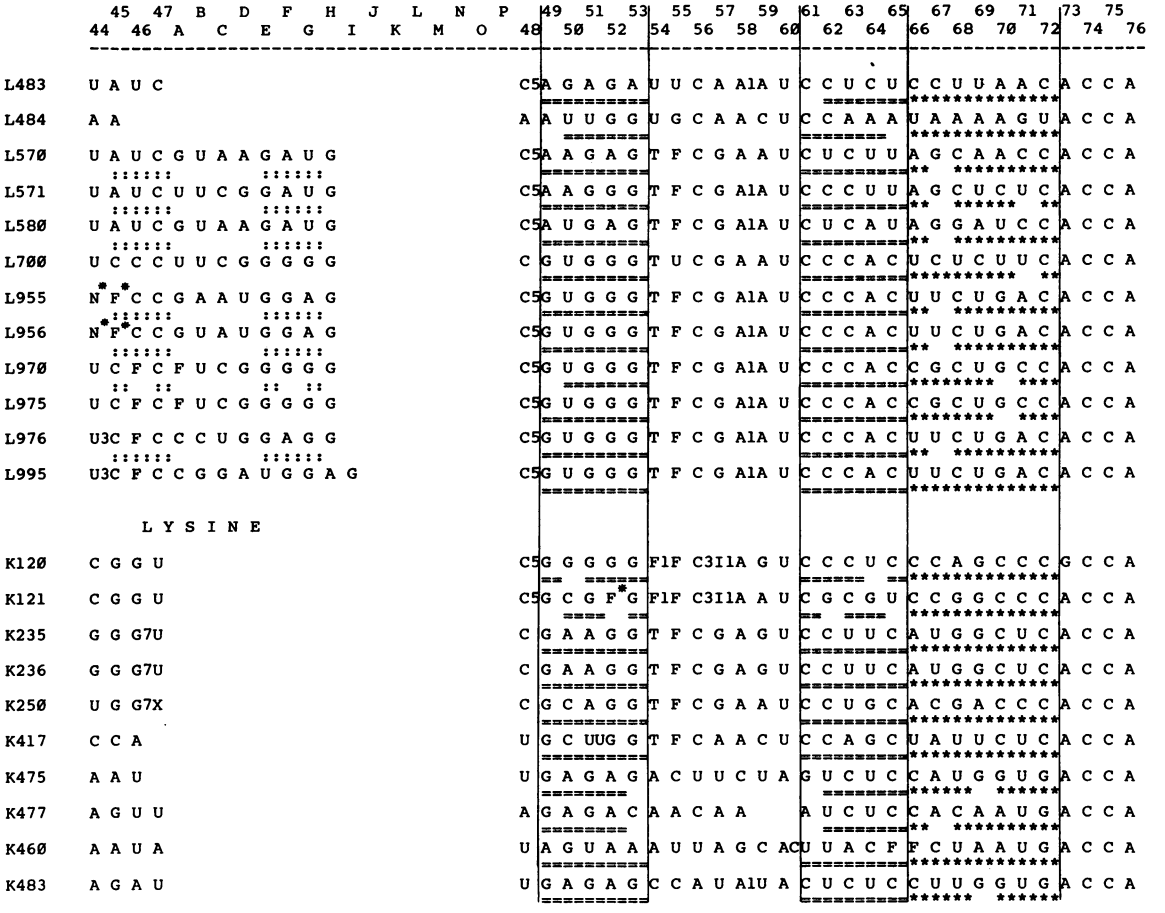

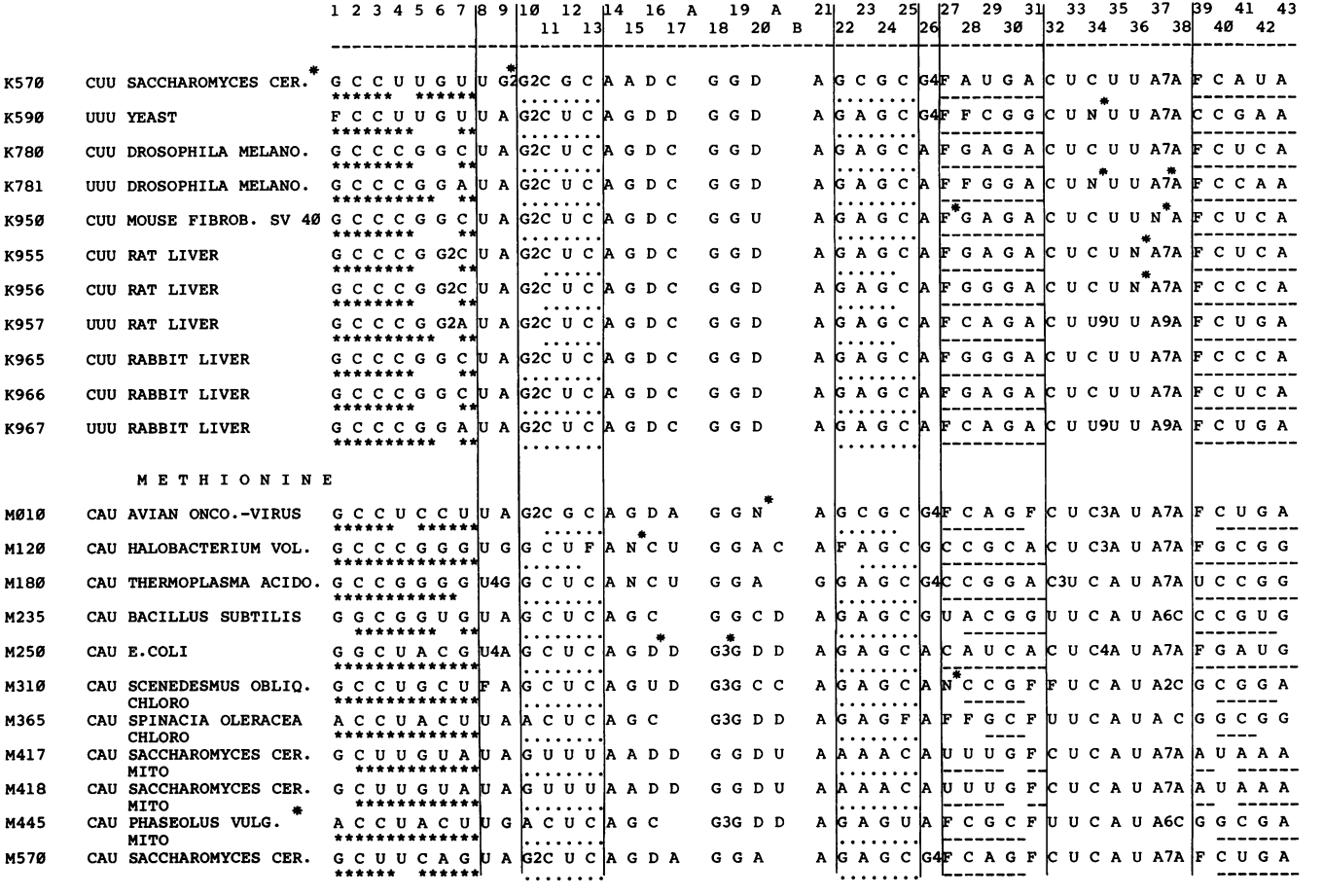
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K590 UUU YEAST
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K781 UUU DROSOPHILA MELANO.
K950 CUU MOUSE FIBROB. SV 40
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METHIONINE
M010 CAU AVIAN ONCO.-VIRUS
M120 CAU HALOBACTERIUM VOL.
M180 CAU THERMOPLASMA ACIDO.
M235 CAU BACILLUS SUBTILIS
M250 CAU E.COLI
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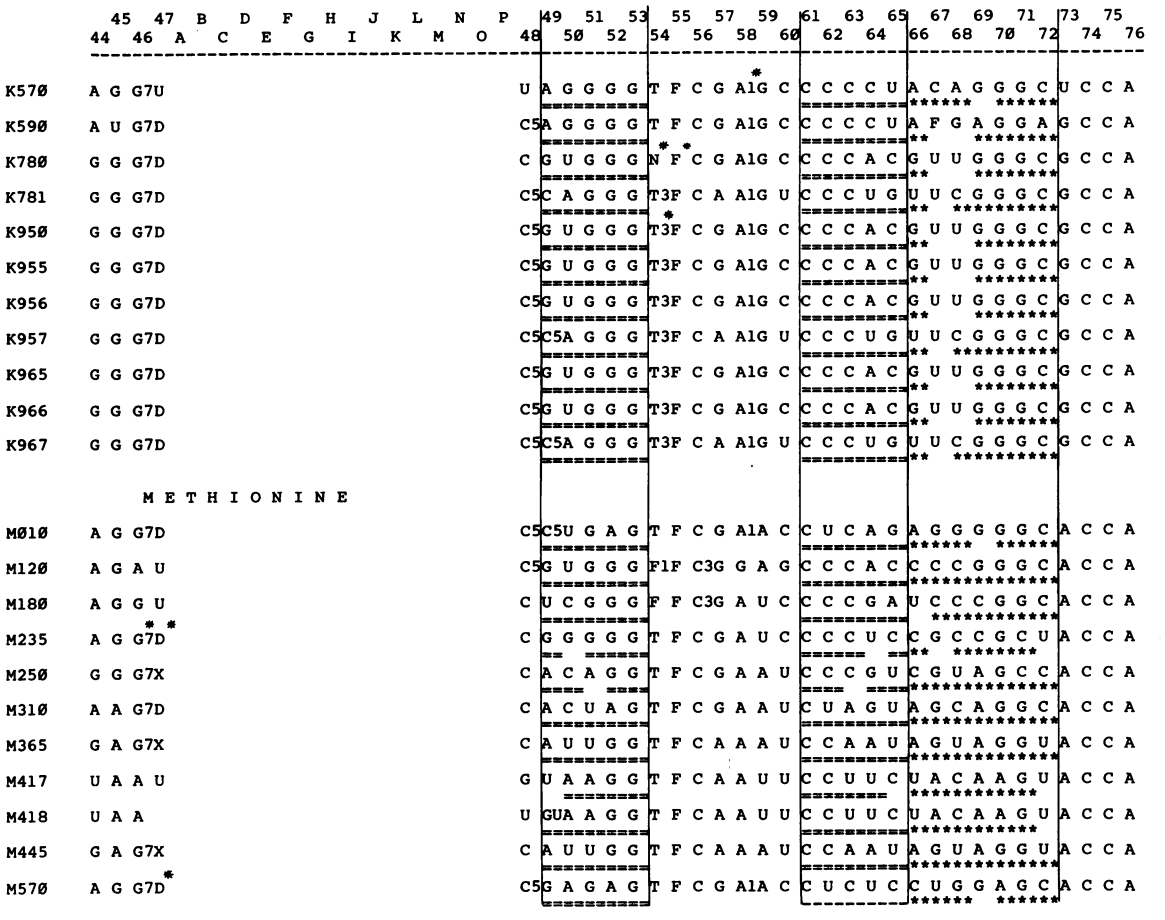
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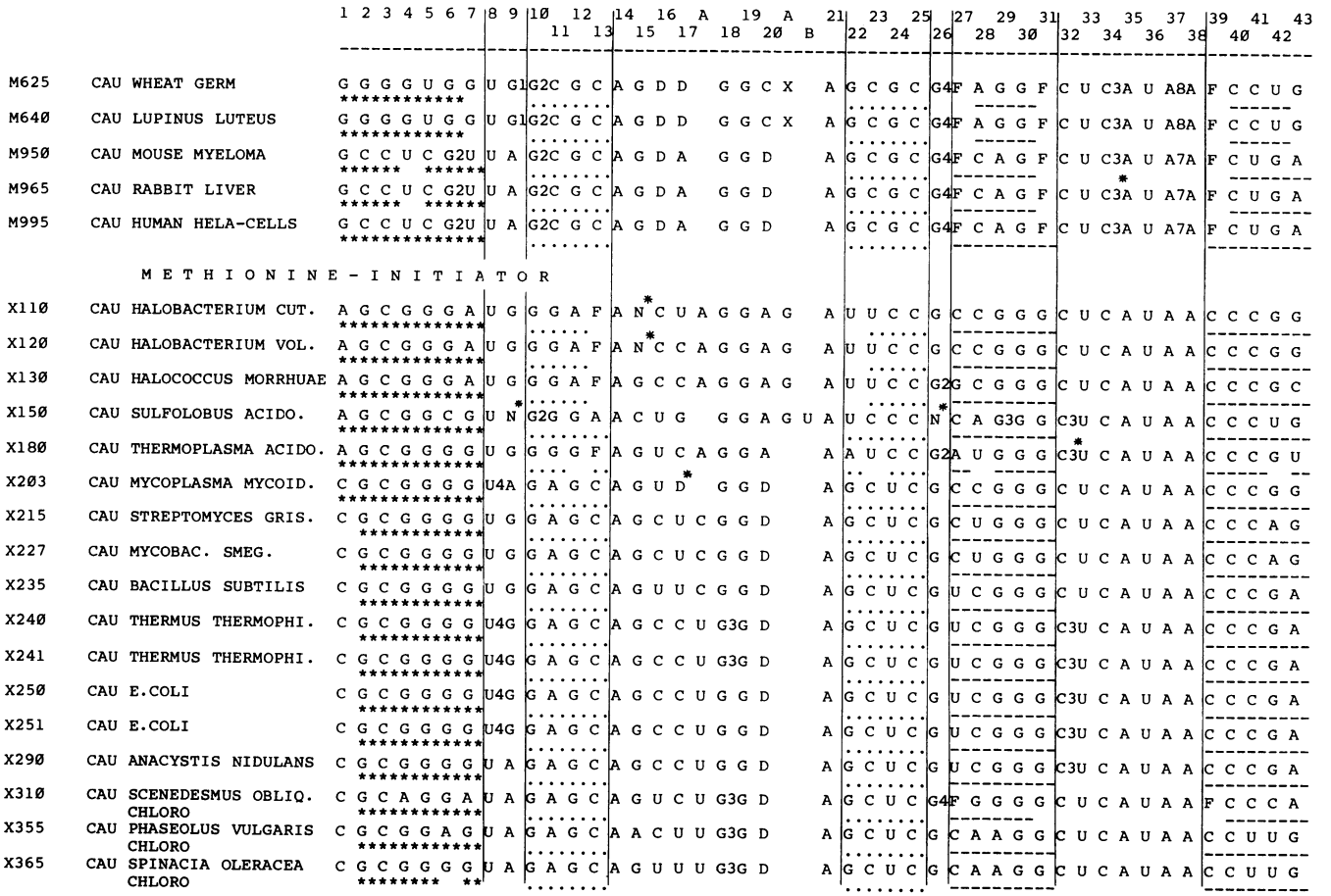
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METHIONINE-INITIATOR
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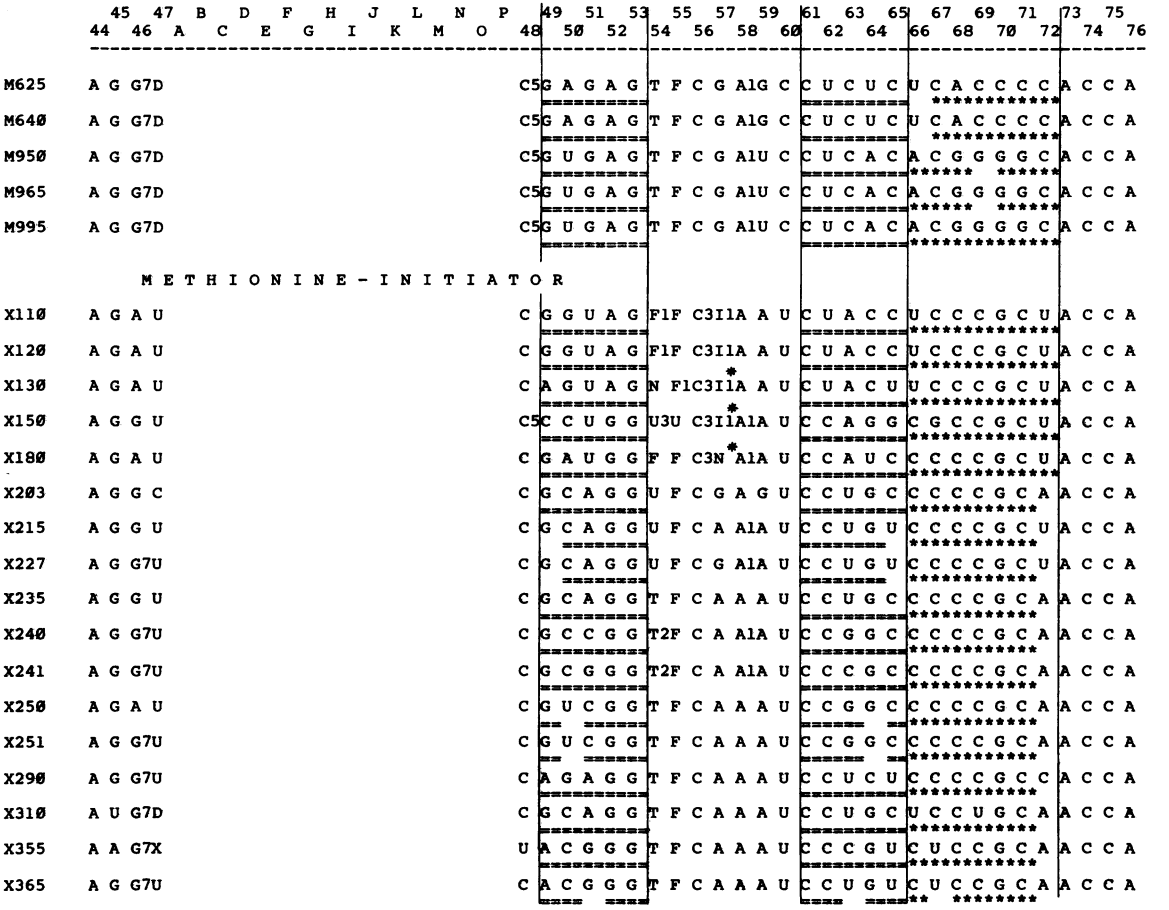
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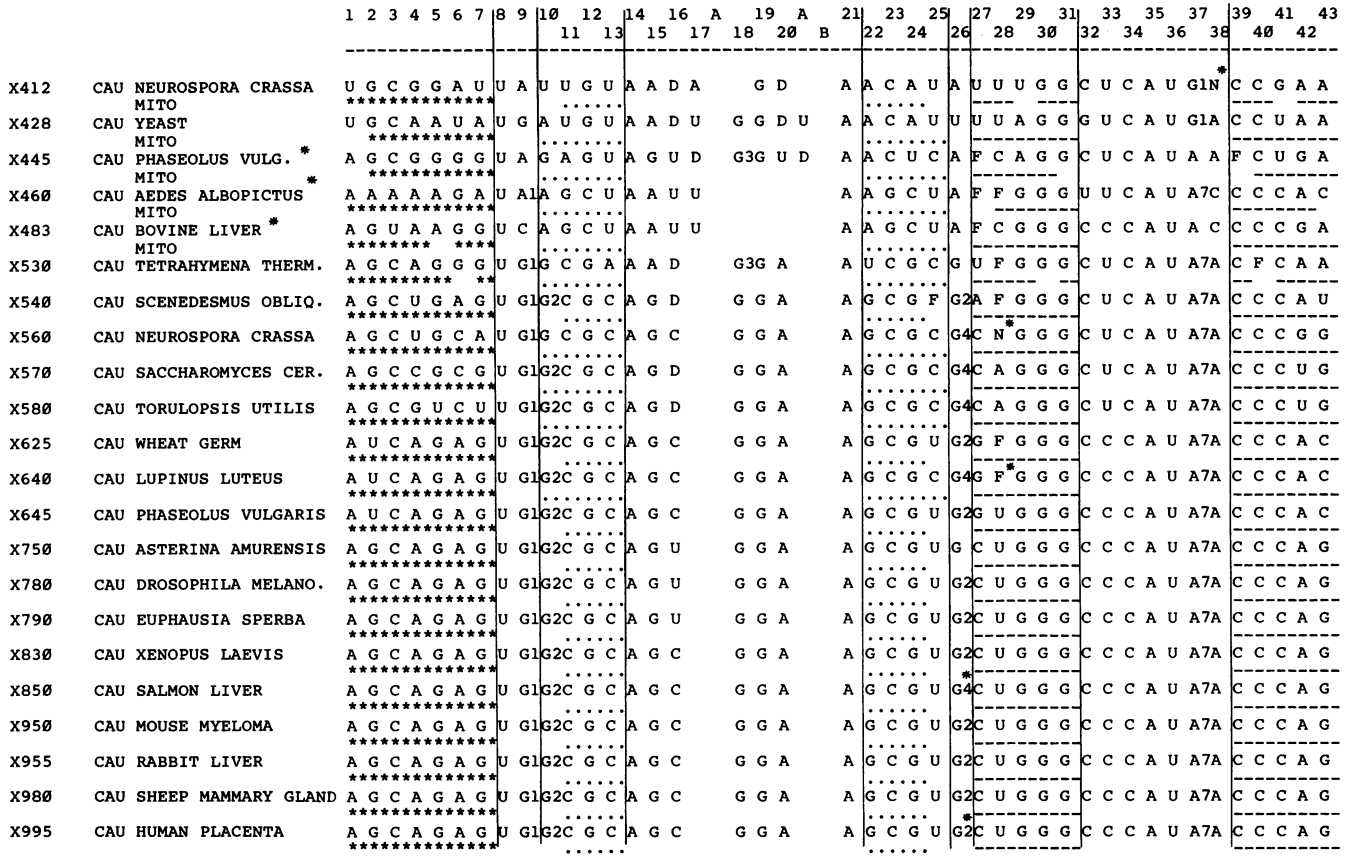
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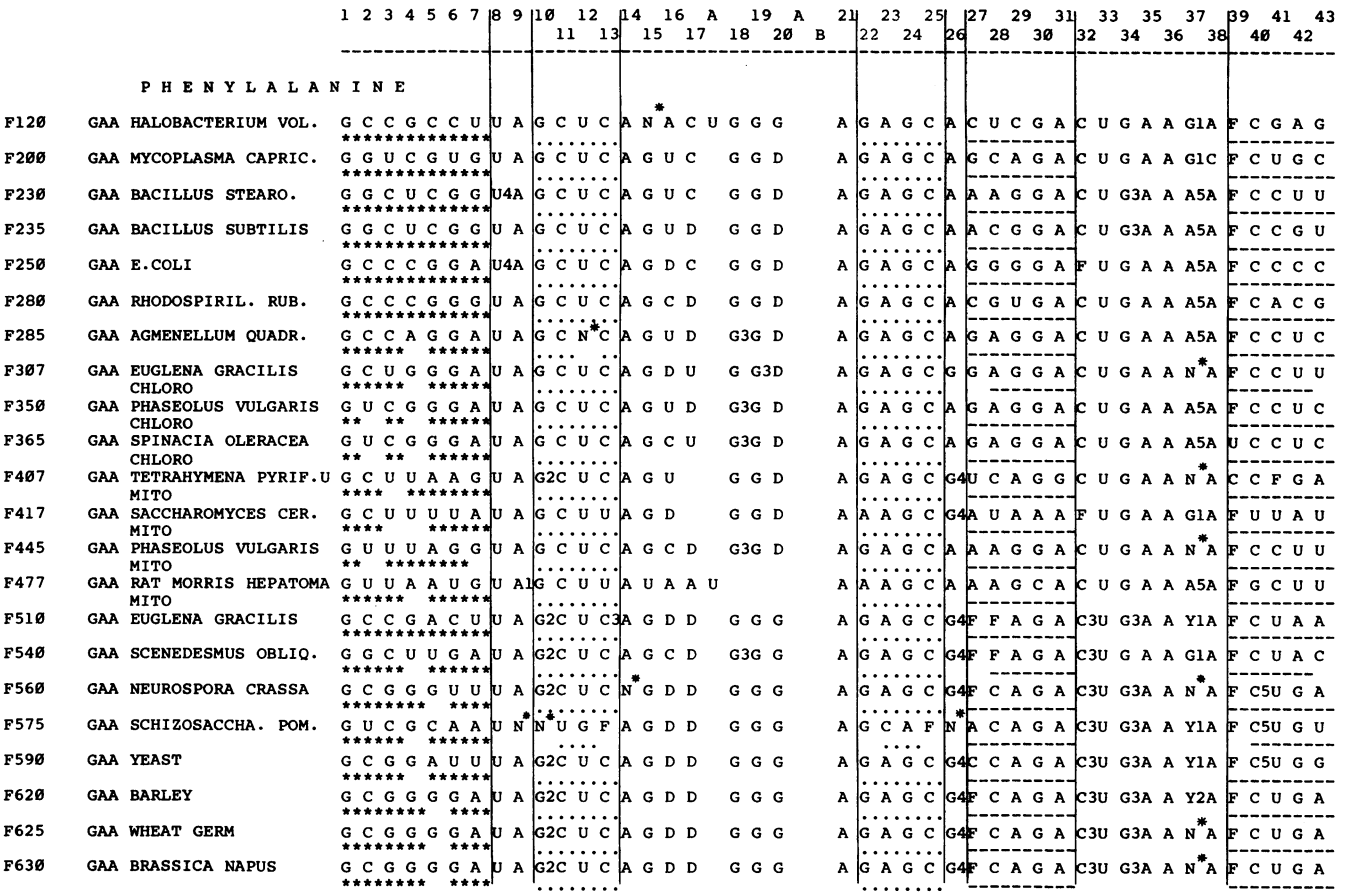
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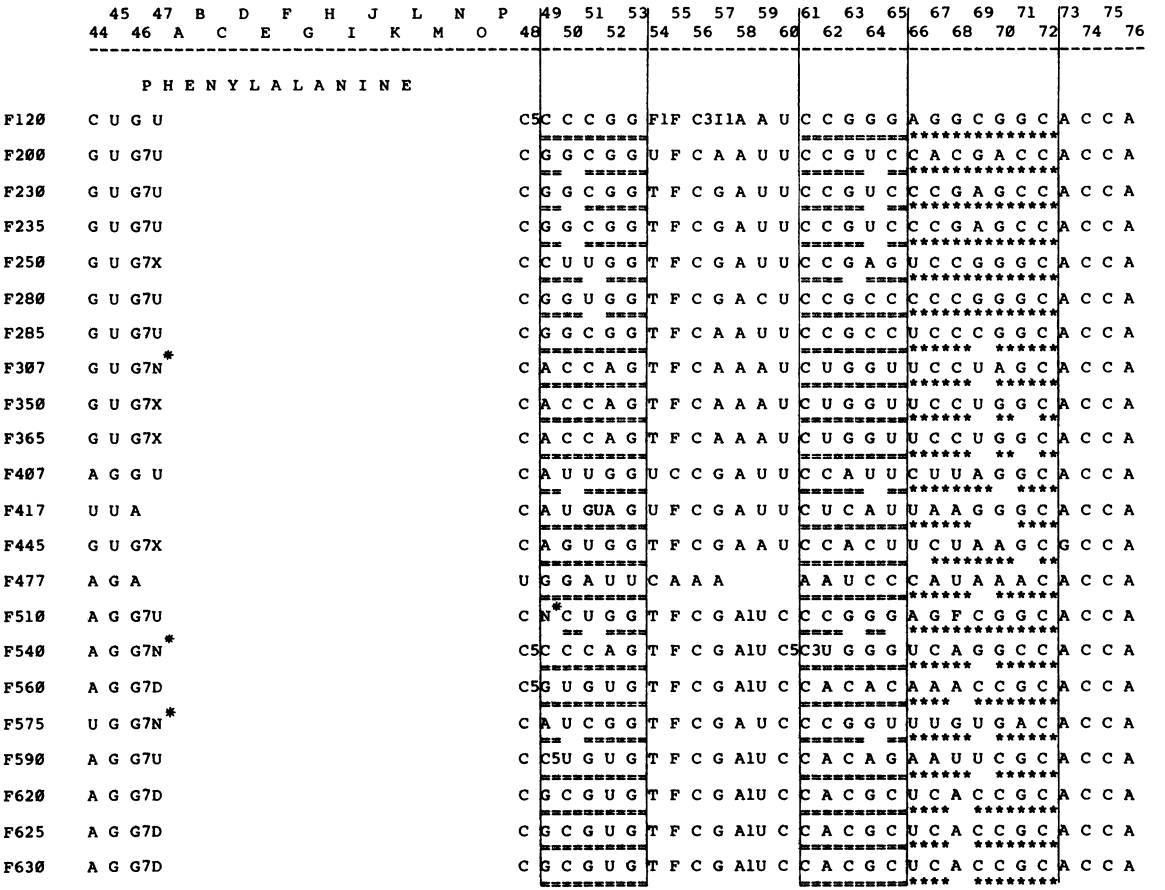
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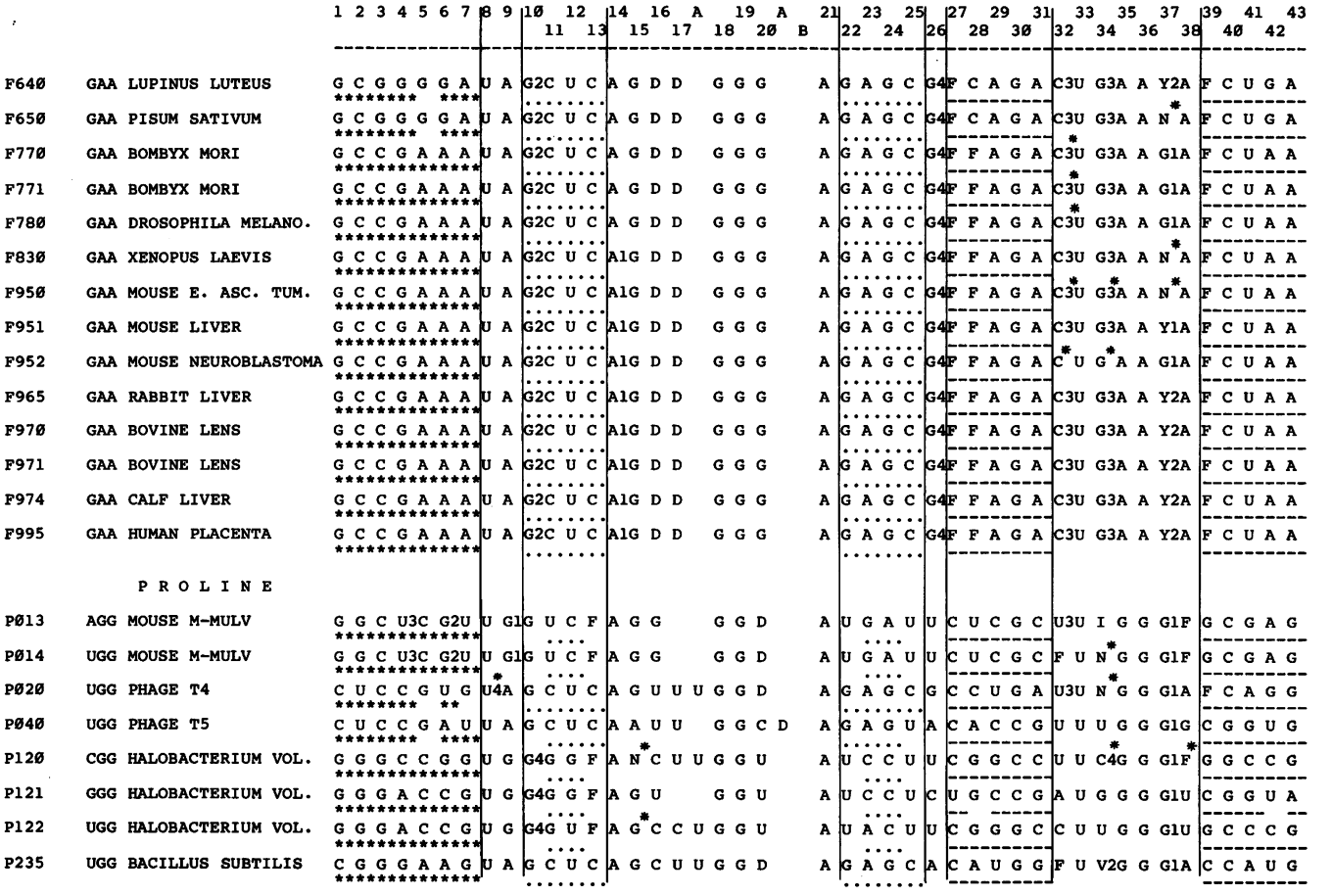
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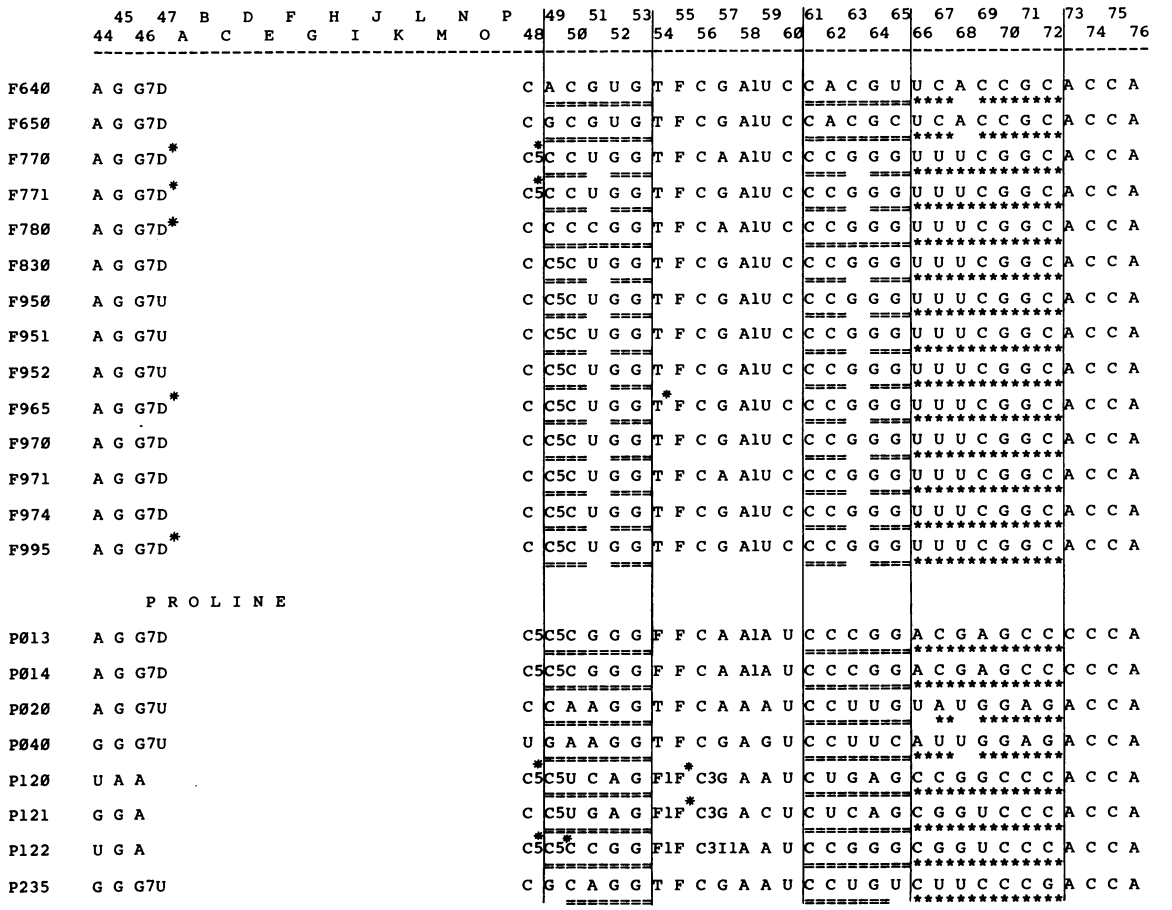
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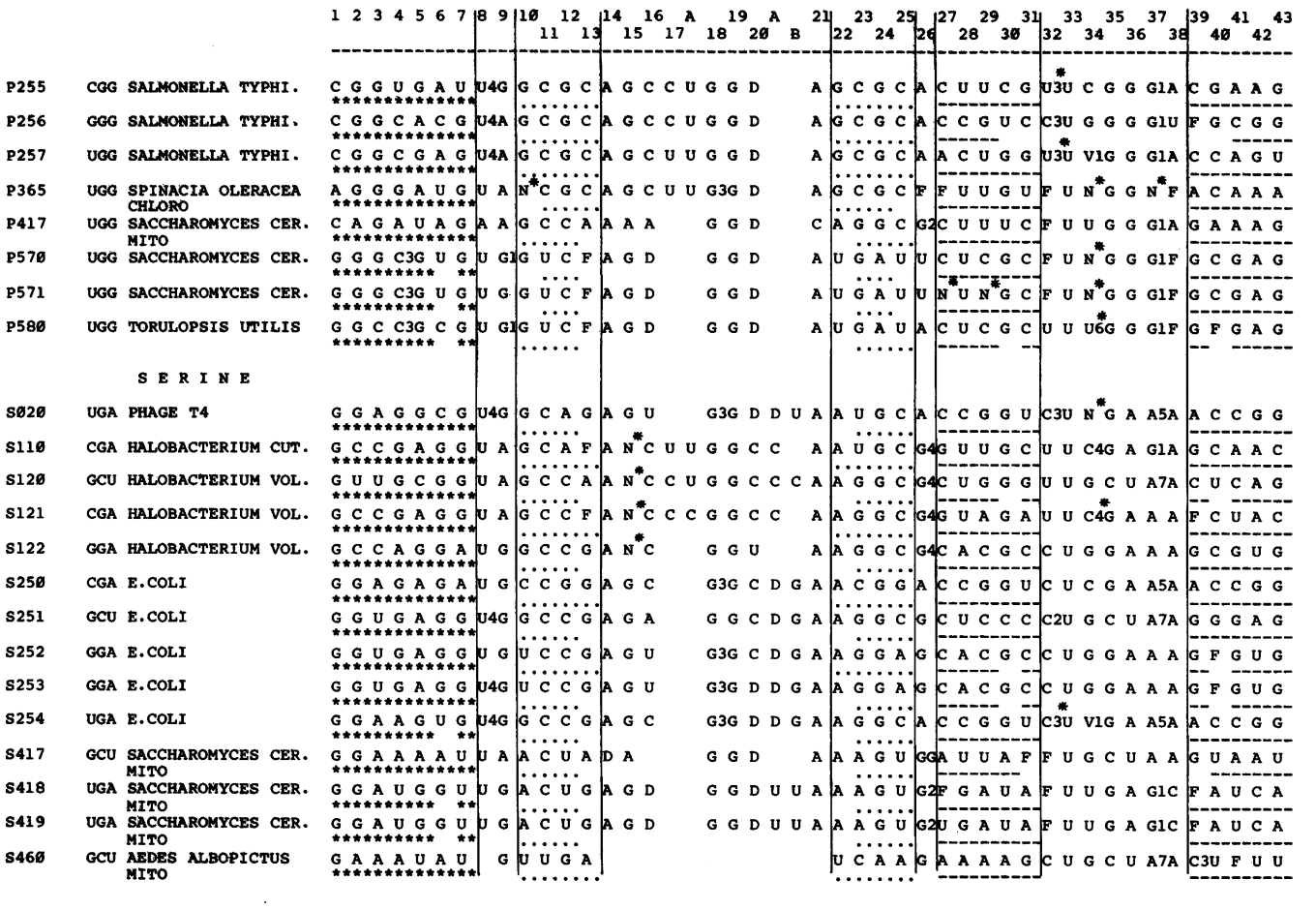
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SERINE
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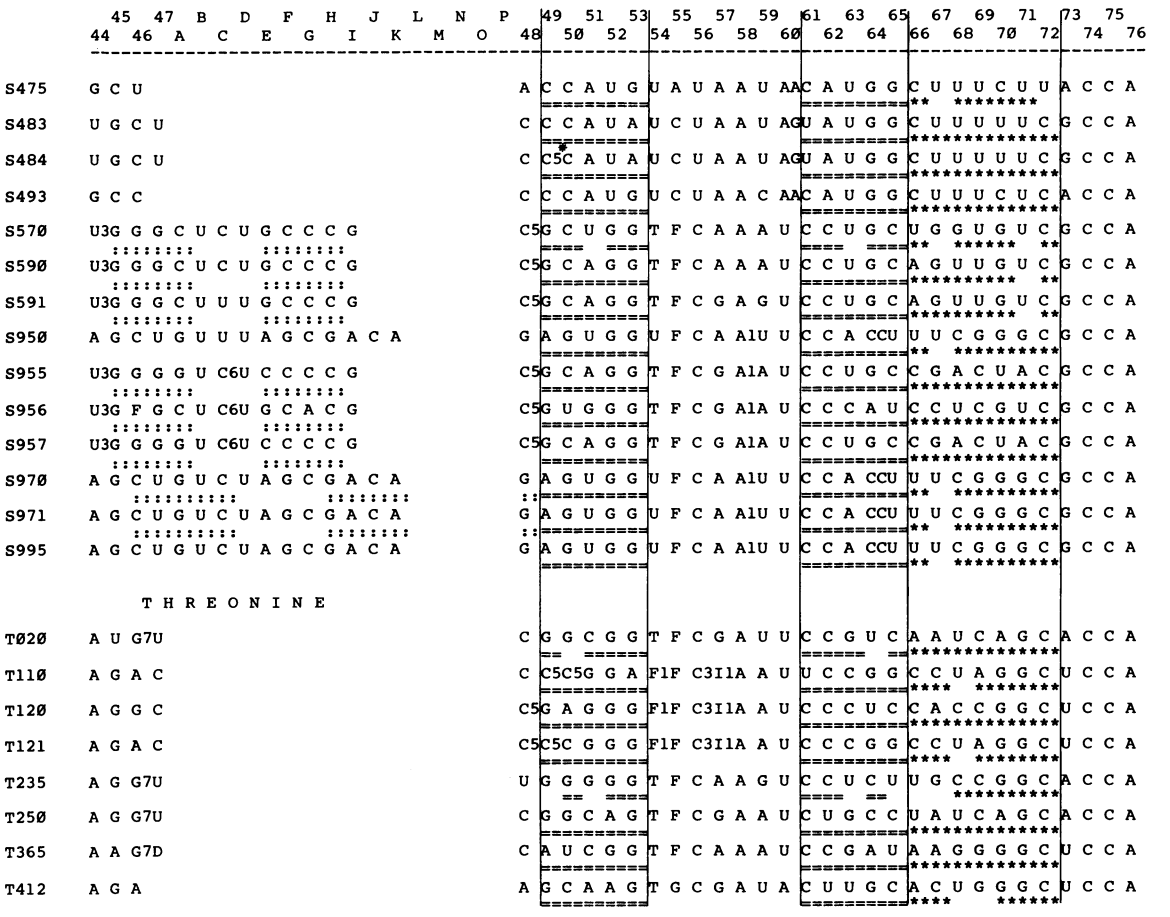
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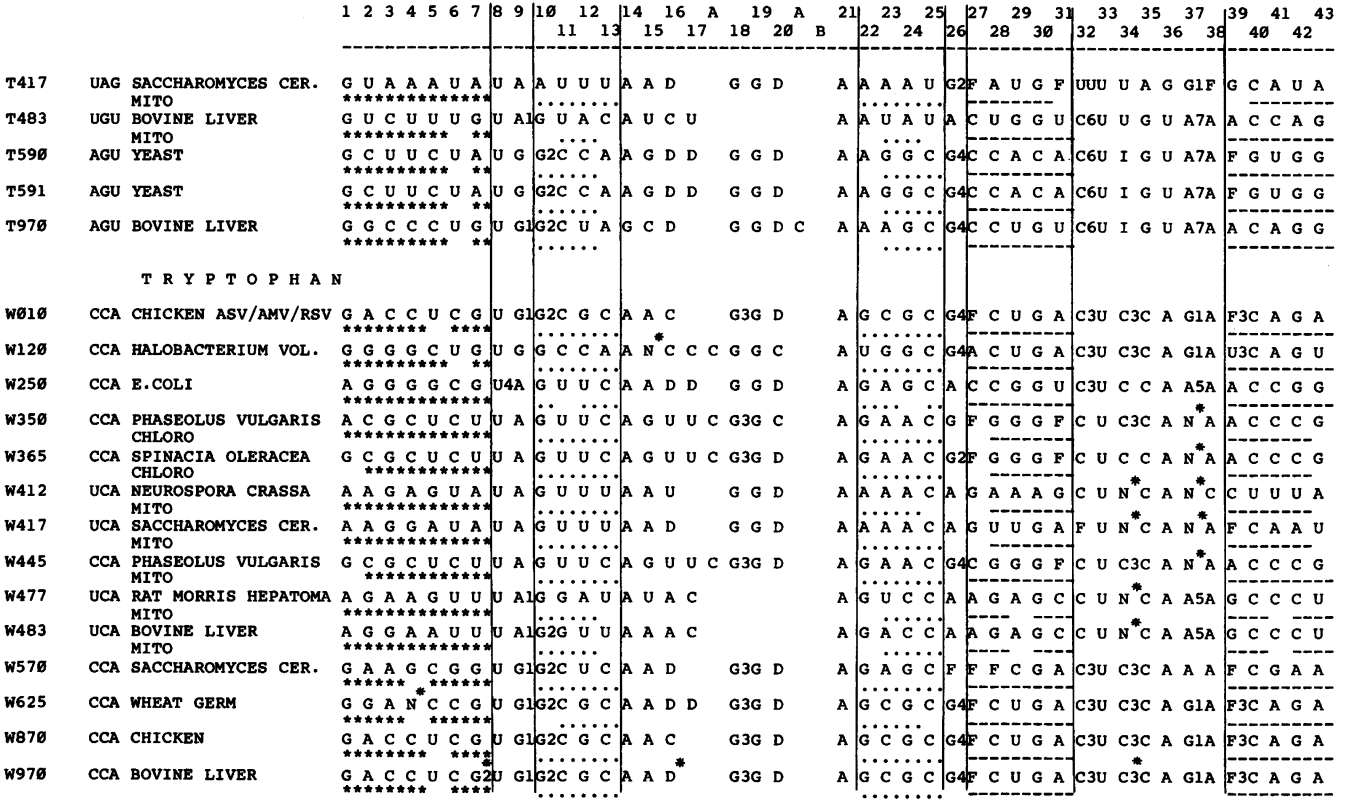
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T591 AGU YEAST
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TRYPTOPHAN
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W120 CCA HALOBACTERIUM VOL.
W250 CCA E.COLI
W350 CCA PHASEOLUS VULGARIS CHLORO
W365 CCA SPINACIA OLERACEA CHLORO
W412 UCA NEUROSPORA CRASSA MITO
W417 UCA SACCHAROMYCES CER. MITO
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W477 UCA RAT MORRIS HEPATOMA MITO
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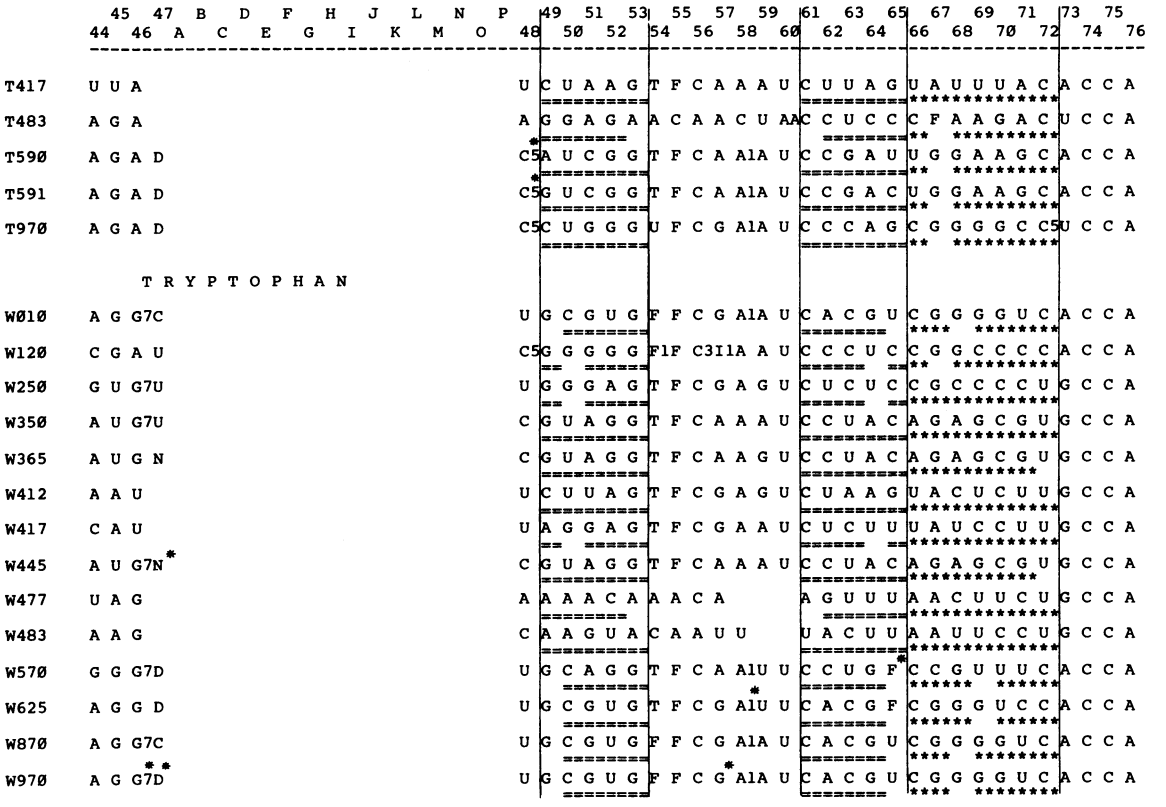
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TRYPTOPHAN
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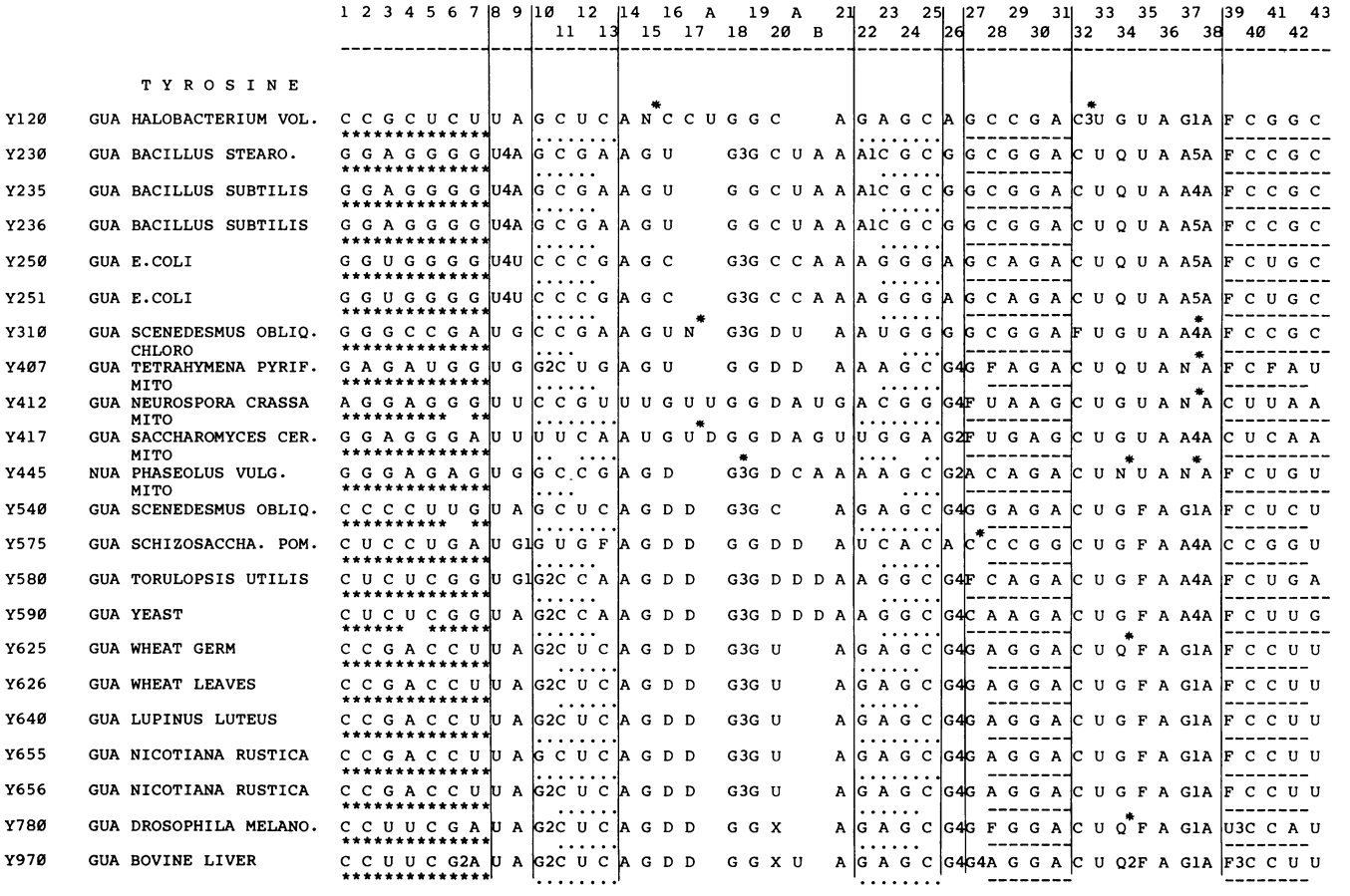
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Y235 GUA BACILLUS SUBTILIS
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Y251 GUA E.COLI
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Y407 GUA TETRAHYMENA PYRIF. MITO
Y412 GUA NEUROSPORA CRASSA MITO
Y417 GUA SACCHAROMYCES CER. MITO
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Y575 GUA SCHIZOSACCHA. POM.
Y580 GUA TORULOPSIS UTILIS
Y590 GUA YEAST
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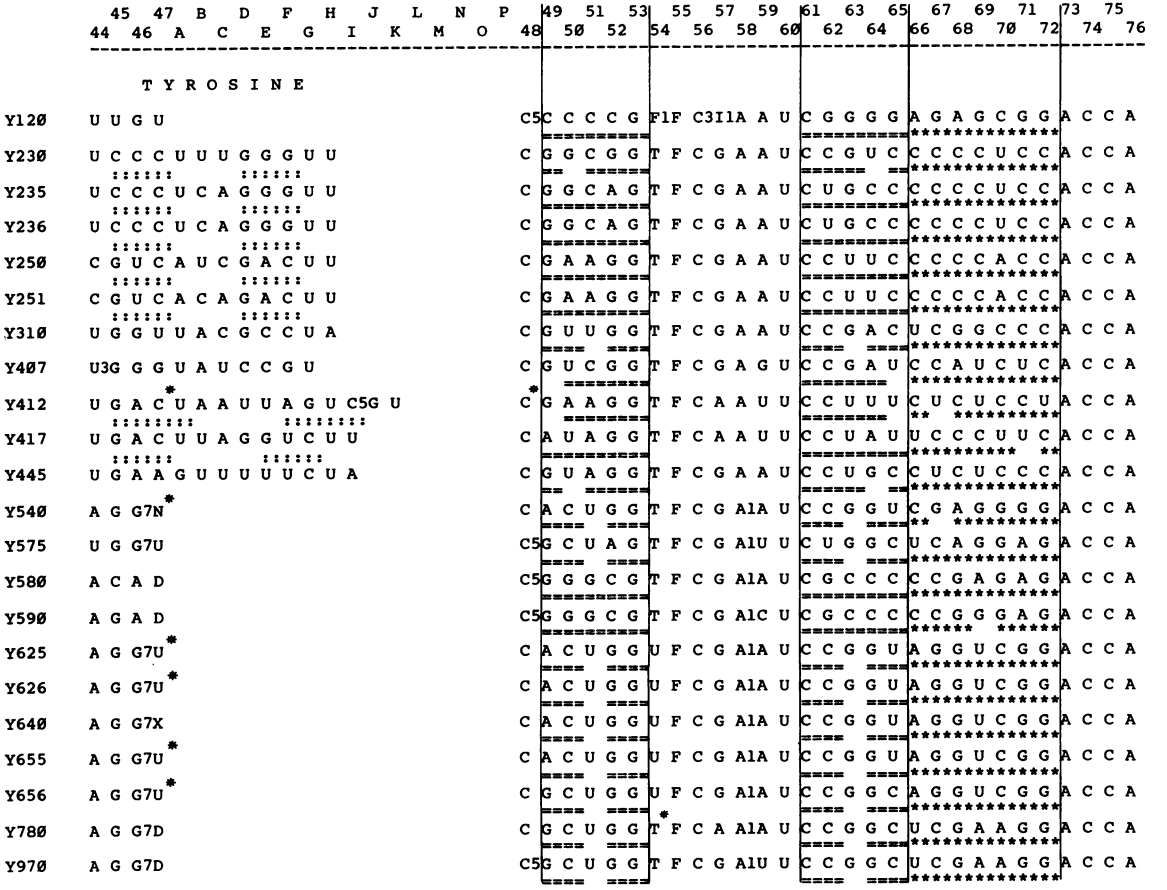
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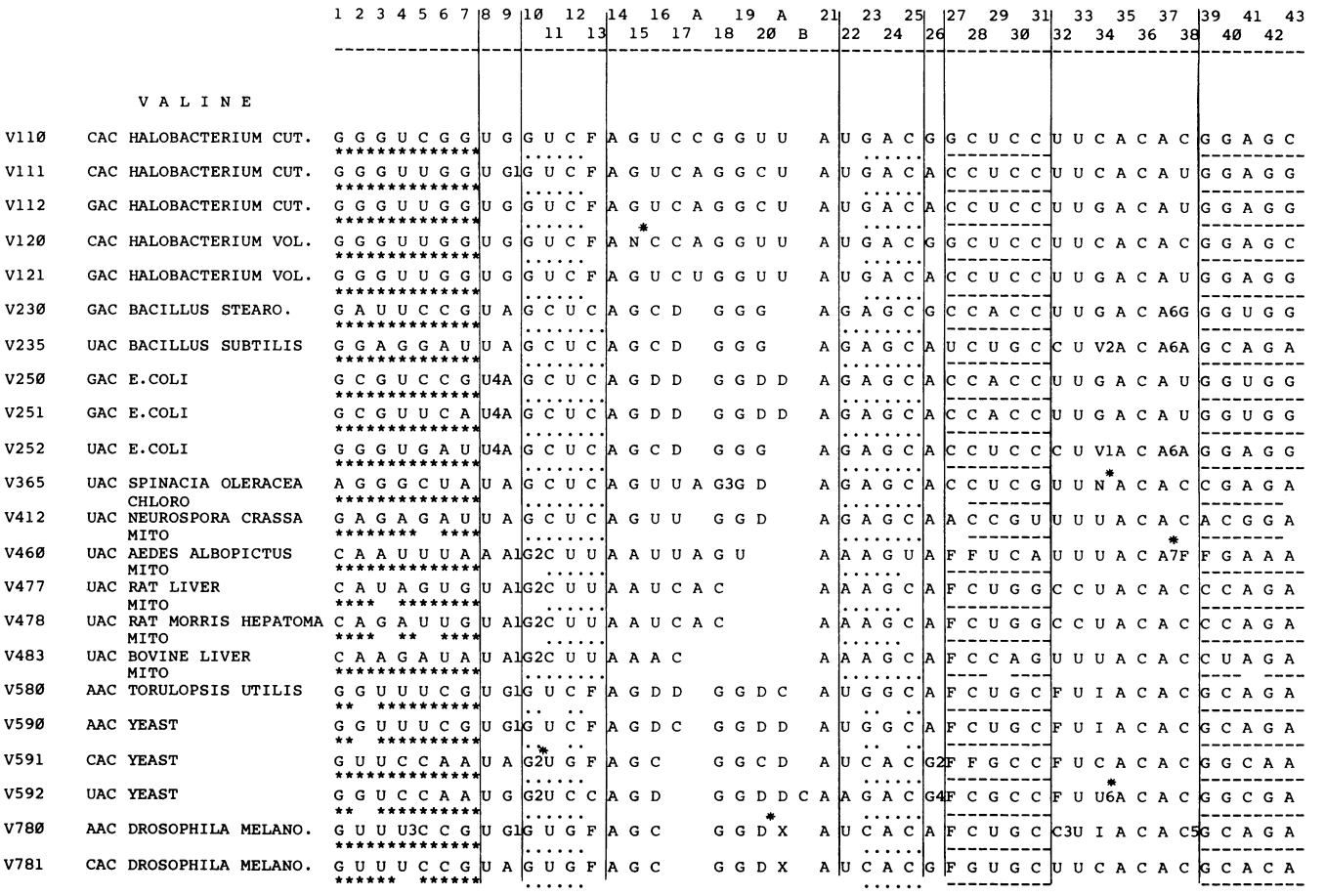
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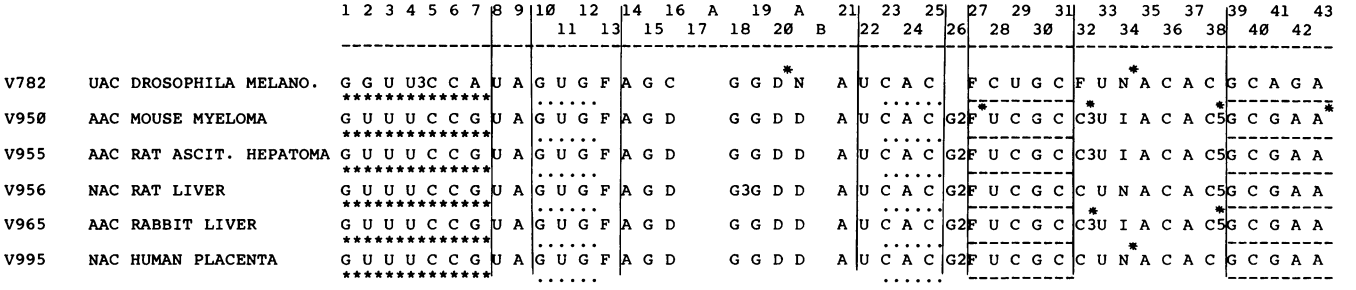
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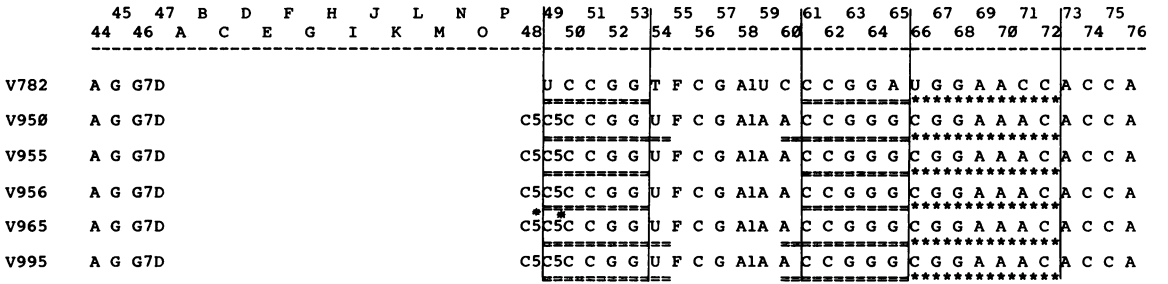
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R972/54 PARTIALLY F
N040/37 N IS A DERIVATIVE OF A
N120/15 PARTIALLY MODIFIED
N120/48 PARTIALLY C
N140/34 N IS A MODIFIED G
N955/54 N IS AN UNKNOWN MODIFIED NUCLEOTIDE
N956/54 N IS AN UNKNOWN MODIFIED NUCLEOTIDE
D040/54 PARTIALLY U
D040/65 PARTIALLY MODIFIED
D120/54 PARTIALLY F
D510/26 PROBABLY MODIFIED
D510/38 PROBABLY MODIFIED
D510/48 PROBABLY MODIFIED
D510/49 PROBABLY MODIFIED
D510/58 PROBABLY MODIFIED
D965/58 PARTIALLY A
C120/15 N IS A MODIFIED G
Q020/34 N IS A MODIFIED U
Q040/54 PARTIALLY U
Q110/9 N IS A MODIFIED NUCLEOTIDE
Q120/34 PARTIALLY A MODIFIED C
Q251/34 N IS PROBABLY U2
Q460/34 PROBABLY MODIFIED
Q530/32 N IS PROBABLY A DERIVATIVE OF C
Q955/16 PARTIALLY U
Q955/50 PARTIALLY C
E120/34 PARTIALLY C
E120/54 PARTIALLY F
E121/34 N IS A MODIFIED U
E121/49 PARTIALLY C
E460/34 PROBABLY MODIFIED
E483/34 PROBABLY MODIFIED
E780/32 PARTIALLY C
E780/49 C IS C5 IN POS. 49 AND/OR 50
G020/34 PROBABLY MODIFIED
G123/34 N IS A UNIDENTIFIED MODIFIED U
G220/0 PROBABLY NOT ACTIVE IN PROTEIN SYNTHESIS
G221/0 PROBABLY NOT ACTIVE IN PROTEIN SYNTHESIS
G250/8 PROBABLY MODIFIED
G252/34 N IS A MODIFIED U
G255/18 PARTIALLY G
G417/34 PARTIALLY MODIFIED, PROBABLY TO V4
G460/29 PARTIALLY MODIFIED
G460/30 PARTIALLY MODIFIED
G570/4 TENTATIVELY IDENTIFIED
G640/48 PARTIALLY MODIFIED
G771/34 T.KONDO ET AL. (1983) NUCL. ACIDS SYMP. SER. 1
G995/4 PARTIALLY C
G995/6 PARTIALLY G
G995/32 PARTIALLY U
G995/58 PARTIALLY A
G996/6 PARTIALLY G
H040/39 PARTIALLY U
H110/9 N IS A MODIFIED NUCLEOTIDE
H110/54 PARTIALLY F
H570/4 N IS A MODIFIED A
H571/4 N IS A MODIFIED A
H980/16 PARTIALLY U
H995/0 5'TERMINAL NUCLEOTIDE IS A METHYLATED G
H995/58 N IS PROBABLY A1
I020/37 N IS A MODIFIED A
I121/15 PARTIALLY MODIFIED
I121/34 N IS A MODIFIED U
I240/54 PARTIALLY T
I252/18 PARTIALLY G
I252/34 N IS A MODIFIED NUCLEOTIDE
I365/46 PARTIALLY G
I366/34 N IS PROBABLY A MODIFIED C
L020/34 N IS A MODIFIED U
L120/15 N IS A MODIFIED G
L121/15 N IS A MODIFIED G
L121/57 PARTIALLY A

L122/15 N IS A MODIFIED G
L123/15 N IS A MODIFIED G
L124/15 N IS A MODIFIED G
L124/34 N IS PROBABLY V2
L230/8 PROBABLY U4
L250/34 N IS A MODIFIED A
L251/37 N IS A MODIFIED G
L252/37 N IS A MODIFIED G
L255/37 N IS A DERIVATIVE OF G
L280/37 N IS A MODIFIED A
L290/37 N IS A MODIFIED A
L327/37 N IS A MODIFIED A
L328/37 N IS A MODIFIED A
L350/37 N IS A4 OR A5
L351/34 N IS A MODIFIED U
L351/37 N IS A4 OR ZEATIN
L412/34 N IS A MODIFIED U
L417/34 N IS A MODIFIED U
L483/34 N IS A MODIFIED U
L955/10 PARTIALLY G
L955/12 PARTIALLY C
L955/34 N IS A MODIFIED C
L955/37 N IS A MODIFIED G
L955/44 N IS A MODIFIED U
L955/45 PARTIALLY U
L956/10 PARTIALLY G
L956/12 PARTIALLY C
L956/34 N IS A MODIFIED C
L956/37 N IS A MODIFIED G
L956/44 N IS A MODIFIED U
L956/45 PARTIALLY U
L995/0 PRECURSOR
L995/34 N IS A MODIFIED NUCLEOTIDE
K120/15 N IS A MODIFIED G
K120/34 N IS A MODIFIED U
K121/15 N IS A MODIFIED G
K121/34 PARTIALLY C
K121/39 PARTIALLY U
K121/52 PARTIALLY U
K235/37 N IS A7 OR A9
K236/32 N IS A MODIFIED C
K417/34 N IS A MODIFIED U
K475/34 N IS A DERIVATIVE OF U
K477/34 N IS A DERIVATIVE OF U
K483/34 N IS A MODIFIED U
K483/37 N IS A MODIFIED A
K570/0 HAPLOID
K570/9 PARTIALLY G
K570/58 PARTIALLY A
K590/34 N IS A DERIVATIVE OF U9
K780/54 N IS PROBABLY T3
K780/55 PARTIALLY U

K781/34 N IS PROBABLY U9
K781/37 PARTIALLY MODIFIED
K950/27 PARTIALLY U
K950/37 N IS PROBABLY A PRECURSOR OF A7
K950/54 PARTIALLY U,T1,F
K955/36 N IS PROBABLY A MODIFIED U
K956/36 N IS PROBABLY A MODIFIED U
M010/20 N IS PROBABLY A MODIFIED U
M120/15 N IS A MODIFIED G
M235/46 PARTIALLY G
M235/47 PARTIALLY U
M250/16 PARTIALLY U
M250/18 PARTIALLY G
M310/27 N IS PROBABLY U
M445/0 ELONGATION- AND INITIATION-tRNA MAY ORIGINATE
M570/47 PARTIALLY U
M965/34 PARTIALLY MODIFIED
X110/15 N IS A MODIFIED G
X120/15 N IS A MODIFIED G
X130/57 Z.YAMAIZUMI ET AL. (1982) NUCL. ACIDS SYMP. SE
X150/9 N IS A MODIFIED NUCLEOTIDE
X150/26 N IS PROBABLY G5
X150/57 Z.YAMAIZUMI ET AL. (1982) NUCL. ACIDS SYMP. SE
X180/32 PARTIALLY C
X180/57 N IS PROBABLY I
X203/17 PARTIALLY U
X412/38 N IS PROBABLY F
X428/72 PARTIALLY U
X445/0 ELONGATION- AND INITIATION-tRNA MAY ORIGINATE
X460/0 ELONGATION- AND INITIATION-tRNA MAY ORIGINATE
X483/0 ELONGATION- AND INITIATION-tRNA MAY ORIGINATE
X540/64 N IS PROBABLY G3
X560/28 N IS A MODIFIED PYRIMIDINE
X560/47 PARTIALLY U
X560/64 N IS A MODIFIED G
X570/64 N IS A MODIFIED A
X570/65 N IS A MODIFIED G
X580/64 N IS A DERIVATIVE OF G
X625/64 N IS A MODIFIED G
X640/28 PARTIALLY U
X640/49 N IS A MODIFIED C
X830/48 R.A.KOSKI ET AL. ONLY FIND C
X850/26 PARTIALLY G2
X995/26 PARTIALLY DEFICIENT
F120/15 N IS A MODIFIED G
F285/12 N IS A MODIFIED U
F307/37 N IS PROBABLY A5
F307/47 N IS PROBABLY A DERIVATIVE OF X
F407/37 N IS A MODIFIED A
F445/37 N IS A4 OR A5
F510/49 N IS A MODIFIED C
F540/47 N IS A MODIFIED NUCLEOTIDE

F560/14 N IS A MODIFIED A
F560/37 N IS A DERIVATIVE OF Y
F575/9 N IS A MODIFIED G
F575/10 N IS PROBABLY G2
F575/26 N IS PROBABLY G2
F575/47 N IS PROBABLY A MODIFIED U
F625/37 N IS PROBABLY Y2
F630/37 N IS Y1 OR Y2
F650/37 N IS PROBABLY Y2
F770/32 PARTIALLY C
F770/47 PARTIALLY U
F770/48 MODIFICATION EITHER IN POSITION 48 OR 49
F771/32 PARTIALLY C
F771/47 PARTIALLY U
F771/48 MODIFICATION EITHER IN POSITION 48 OR 49
F780/32 PARTIALLY C
F780/47 PARTIALLY U
F830/37 N IS PROBABLY Y2
F950/32 PARTIALLY C
F950/34 PARTIALLY G
F950/37 N IS A UNDERMODIFIED WYBUTOSINE
F952/32 PARTIALLY C
F952/34 PARTIALLY G
F965/47 PARTIALLY U
F965/54 PARTIALLY U
F995/47 PARTIALLY MODIFIED
P014/34 N IS A MODIFIED U
P020/8 PARTIALLY U
P020/34 N IS A MODIFIED U
P120/15 N IS A MODIFIED G
P120/34 PARTIALLY C
P120/38 PARTIALLY U
P120/48 PARTIALLY C
P120/55 PARTIALLY U
P121/55 PARTIALLY U
P122/15 PARTIALLY MODIFIED
P122/48 PARTIALLY C
P122/49 PARTIALLY C
P255/32 PARTIALLY U
P257/32 PARTIALLY U
P257/65 PARTIALLY U
P365/10 N IS PROBABLY A MODIFIED G
P365/34 N IS A MODIFIED U
P365/37 N IS A MODIFIED A
P570/34 N IS PROBABLY A MODIFIED U
P571/27 N IS C OR C5
P571/29 N IS C OR C5
P571/34 N IS A MODIFIED U
P571/48 N IS C OR C5
P571/49 N IS C OR C5
P580/34 K.OGAWA, T.KONDO, M.KAWAKAMI, S.TAKEMURA (1983)
NUCL. ACIDS SYMP. SER. 12, 131-132

S020/34 N IS A MODIFIED U
S110/15 N IS A MODIFIED G
S120/15 N IS A MODIFIED G
S121/15 N IS A MODIFIED G
S121/34 PARTIALLY C
S122/15 N IS A MODIFIED G
S254/32 Y.YAMADA, H.ISHIKURA (1975) BIOCHIM. BIOPHYS.
S484/49 PARTIALLY MODIFIED
S570/32 N IS PROBABLY O6
S570/34 N IS A MODIFIED U
S950/34 N IS PROBABLY A MODIFIED U
S970/0 CAN BE PHOSPHORYLATED TO PHOSPHOSERYL-TRNA; UG
S971/0 CAN BE PHOSPHORYLATED TO PHOSPHOSERYL-TRNA; UG
S995/34 N IS PROBABLY A MODIFIED U
T020/34 N IS A MODIFIED U
T020/37 N IS A MODIFIED A
T120/15 N IS A MODIFIED G
T121/15 PARTIALLY MODIFIED
T235/20 PARTIALLY U
T590/48 PARTIALLY C
T591/48 PARTIALLY C
W120/15 N IS A MODIFIED G
W350/37 N IS A4 OR A5
W365/37 N IS A4 OR A5
W412/34 N IS A MODIFIED U
W412/37 N IS A MODIFIED A
W417/34 N IS A MODIFIED U
W417/37 N IS A4 OR A5
W445/37 N IS A4 OR A5
W445/47 N IS A MODIFIED NUCLEOTIDE
W477/34 N IS A MODIFIED U
W483/34 N IS A MODIFIED U
W570/65 PARTIALLY U
W625/4 N IS A MODIFIED U
W625/58 PARTIALLY A
W970/7 PARTIALLY G
W970/16 PARTIALLY C
W970/34 PARTIALLY C
W970/46 PARTIALLY G
W970/47 PARTIALLY C
W970/57 PARTIALLY A
Y120/15 N IS A MODIFIED G
Y120/32 PARTIALLY C
Y310/17 N IS A MODIFIED U
Y310/37 PARTIALLY A5
Y407/37 N IS A MODIFIED A
Y412/37 N IS PROBABLY A4
Y412/47 PROBABLY MODIFIED
Y412/48 PROBABLY MODIFIED
Y417/17 A PARTIALLY U
Y445/18 PARTIALLY MODIFIED
Y445/34 N IS A MODIFIED NUCLEOTIDE

Y445/37 N IS A4 OR A5
Y540/47 N IS A MODIFIED NUCLEOTIDE
Y575/27 PARTIALLY F
Y625/34 PARTIALLY G
Y625/47 PROBABLY X
Y626/47 PROBABLY X
Y655/47 PROBABLY X
Y656/47 PROBABLY X
Y780/34 PARTIALLY MODIFIED
Y780/54 PARTIALLY MODIFIED
V120/15 N IS A MODIFIED G
V121/55 PARTIALLY U
V365/34 N IS A MODIFIED U
V460/37 PARTIALLY A
V591/10 PARTIALLY G
V592/34 N.YAMAMOTO ET AL. (1985) J. BIOCHEM. 97, 361-364
V780/20 PARTIALLY MODIFIED
V780/49 PROBABLY C5
V782/28A N IS A MODIFIED U
V782/26 PARTIALLY MODIFIED
V782/34 N IS A MODIFIED U
V782/48 PARTIALLY MODIFIED
V950/27 PARTIALLY C
V950/32 PARTIALLY C
V950/38 PARTIALLY C
V950/43 PARTIALLY G
V965/32 PARTIALLY C
V965/38 PARTIALLY C
V965/48 PARTIALLY C
V965/49 PARTIALLY C
V995/34 N IS I OR C

A110 X.-R.GU, K.NICOGHOSIAN, R.J.CEDERGREN, J.T.-F.WONG (1983) NUCL. ACIDS RES. 11, 5433-5442

A120 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

A121 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

A122 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

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A250 B.H.MIMS, N.E.PRATHER, E.J.MURGOLA (1985) J. BACT. 162, 837-839

A251 R.J.WILLIAMS, W.NAGEL, B.ROE, B.DUDOCK (1974) BIOCHEM. BIOPHYS. RES. COMM. 60, 1215-1221

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A412 J.E.HECKMAN ET AL. (1980) PROC. NATL. ACAD. SCI. USA 77, 3159-3163

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A590 J.R.PENSWICK, R.MARTIN, G.DIRHEIMER (1975) FEBS LETTERS 50, 28-31

A770 K.U.SPRAGUE, O.HAGENBUCHLE, M.C.ZUNIGA (1977) CELL 11, 561-570

A771 K.U.SPRAGUE, O.HAGENBUCHLE, M.C.ZUNIGA (1977) CELL 11, 561-570

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R110 K.NICOGHOSIAN, X.-R.GU, R.CEDERGREN (1985) FEBS LETTERS 193, 255-260

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R121 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

R122 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

R235 H.ISHIKURA, K.MURAO, Y.YAMADA, EMBO-FEBS MEETING, STRASBOURG, JULY 1980

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R251 K.CHAKRABURTTY (1980) NUCL.ACIDS RES. 8, 4459-4472

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R253 W.FISCHER, S.KIESEWETTER, M.SPRINZL (1986) PERSONAL COMMUNICATION

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R474 B.A.ROE, J.F.H.WONG, E.Y.CHEN, P.A.ARMSTRONG (1981) PROC. THIRD CLEVELAND SYMP. A.G.WALTON (ED.) ELSEVIER AMSTERDAM

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R590 J.WEISSENBACH, R.MARTIN, G.DIRHEIMER (1975) EUR. J. BIOCHEM. 56, 527-532

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N590 G.KEITH, G.PIXA (1984) BIOCHIMIE 66, 639-643

N955 E.Y.CHEN, B.A.ROE (1978) BIOCHEM. BIOPHYS. RES. COMM. 82, 235-246;

N956 B.A.ROE ET AL. (1979) NUCL. ACIDS RES. 6, 673-688

N970 E.Y.CHEN, B.A.ROE (1980) BIOCHIM. BIOPHYS. ACTA 610, 272-284

N995 E.Y.CHEN, B.A.ROE (1980) BIOCHIM. BIOPHYS. ACTA 610, 272-284

D040 M.G.SHLYAPNIKOV, V.N.KSENZENKO, V.M.KRYUKOV, A.A.BAYEV (1986) EUR. J. BIOCHEM. 156, 285-289

D120 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

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D477 K.RANDERATH, H.P.AGRAWAL, E.RANDERATH (1983) REC. RES. CAN. RES. 84, 103-120

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D830 E.HAUMONT, K.NICOGHOSIAN, H.GROSJEAN, R.J.CEDERGREN (1984) BIOCHIMIE 66, 579-582

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D956 Y.KUCHINO ET AL. (1981) J. BIOL. CHEM. 256, 9059-9062

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Q040 M.G.SHLIAPNIKOV ET AL. (1984) BIOCHIM. BIOPHYS. ACTA 782, 313-319

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Q120 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471

Q250 M.YANIV, W.R.FOLK (1975) J. BIOL. CHEM. 250, 3243-3253

Q251 M.YANIV, W.R.FOLK (1975) J. BIOL. CHEM. 250, 3243-3253

Q460 D.T.DUBIN, C.-C.HSUCHEN (1984) PERSONAL COMMUNICATION

Q530 N.HANYU, Y.KUCHINO, S.NISHIMURA, H.BEIER (1986)

EMBO J. 5, 1307-1311
Q531 N.HANYU, Y.KUCHINO, S.NISHIMURA, H.BEIER (1986)
EMBO J. 5, 1307-1311
Q532 N.HANYU, Y.KUCHINO, S.NISHIMURA, H.BEIER (1986)
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Q955 J.A.YANG ET AL. (1983) NUCL. ACIDS RES. 11, 1991-1996
Q970 G.KEITH (1984) NUCL. ACIDS RES. 12, 2543-2547
E120 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471
E121 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471
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E252 K.WATANABE, K.-I.MIURA (1985)
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E460 D.T.DUBIN, C.-C.HSUCHEN, L.E.TILLOTSON (1986)
CURR. GEN. 10, 701-707
E483 B.A.ROE, J.F.H.WONG, E.Y.CHEN (1982) PERSONAL COMMUNICATION
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E780 M.ALTWEGG, E.KUBLI (1980) NUCL. ACIDS RES. 8, 215-223
E955 J.C.CHAN ET AL. (1982) NUCL. ACIDS RES. 10, 3755-3758
G020 S.STAHL, G.V.PADDOCK, J.ABELSON (1974) NUCL. ACIDS RES. 1, 1287-1304
G110 K.NICOGHOSIAN, X.-R.GU, R.CEDERGREN (1985)
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G120 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471
G121 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471
G122 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471
G123 R.GUPTA (1984) J. BIOL. CHEM. 259, 9461-9471
G140 X.-R.GU, K.NICOGHOSIAN, R.J.CEDERGREN (1984)
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G203 M.W.KILPATRICK, R.T.WALKER (1980) NUCL. ACIDS RES. 8, 2783-2786
G220 R.J.ROBERTS (1974) J. BIOL. CHEM. 249, 4787-4796
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G252 J.W.ROBERTS, J.CARBON (1975) J. BIOL. CHEM. 250, 5530-5541
G255 C.W.HILL ET AL. (1973) J. BIOL. CHEM. 248, 4252-4262
G417 A.-P.SIBLER, G.DIRHEIMER, R.P.MARTIN (1986)
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G460 D.T.DUBIN, C.-C.HSUCHEN, L.E.TILLOTSON (1986)
CURR. GEN. 10, 701-707
G483 B.A.ROE, J.F.H.WONG, E.Y.CHEN, P.A.ARMSTRONG (1981)
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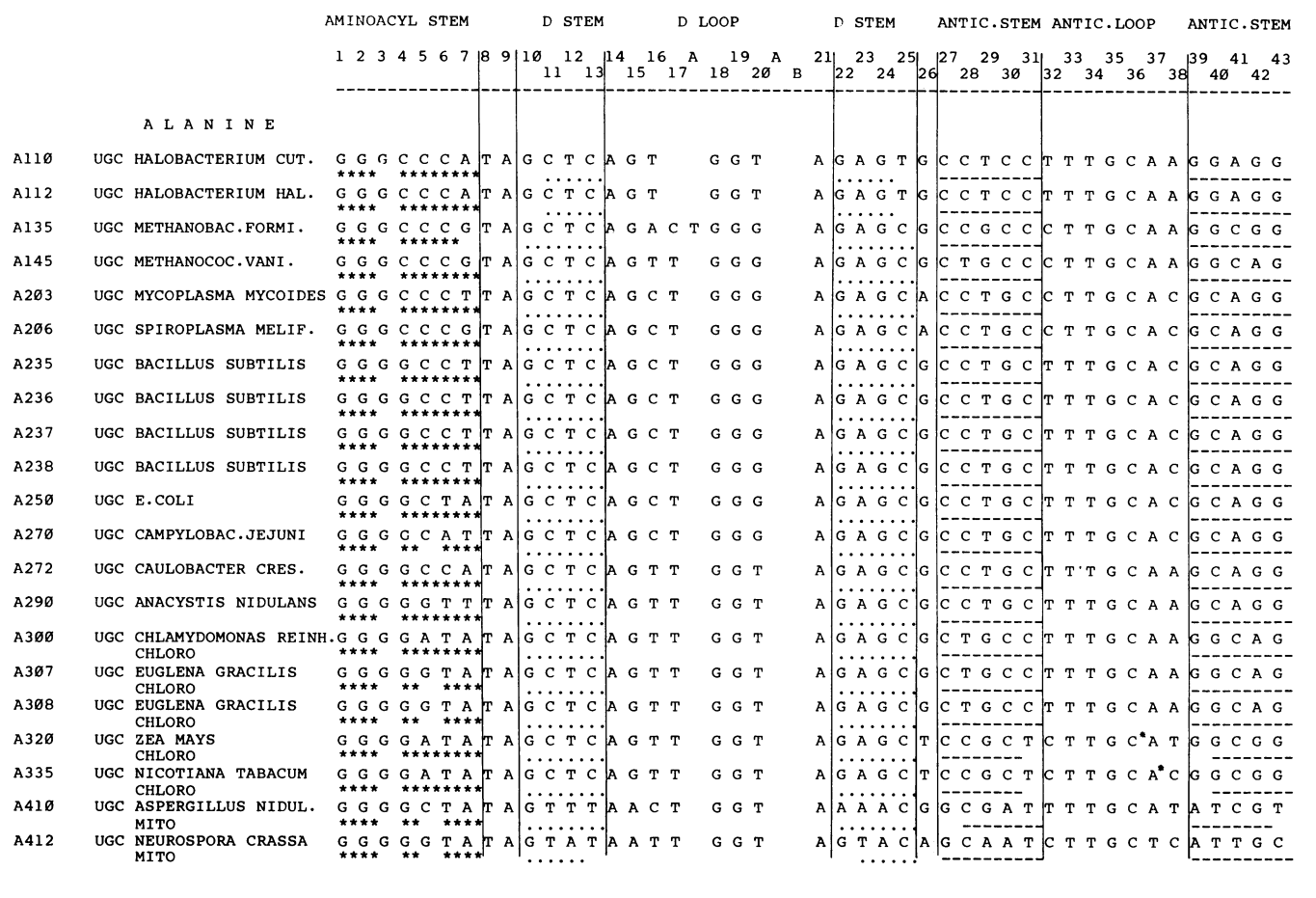
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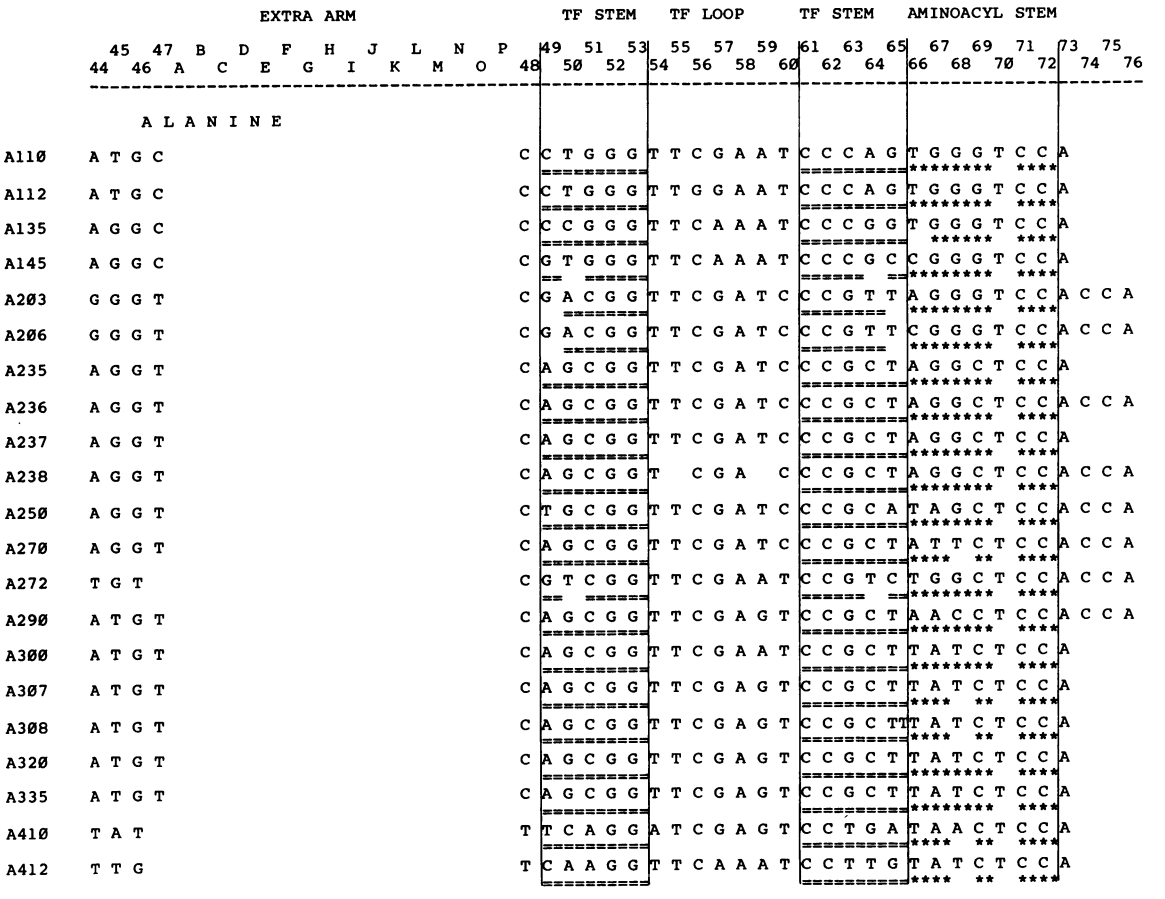
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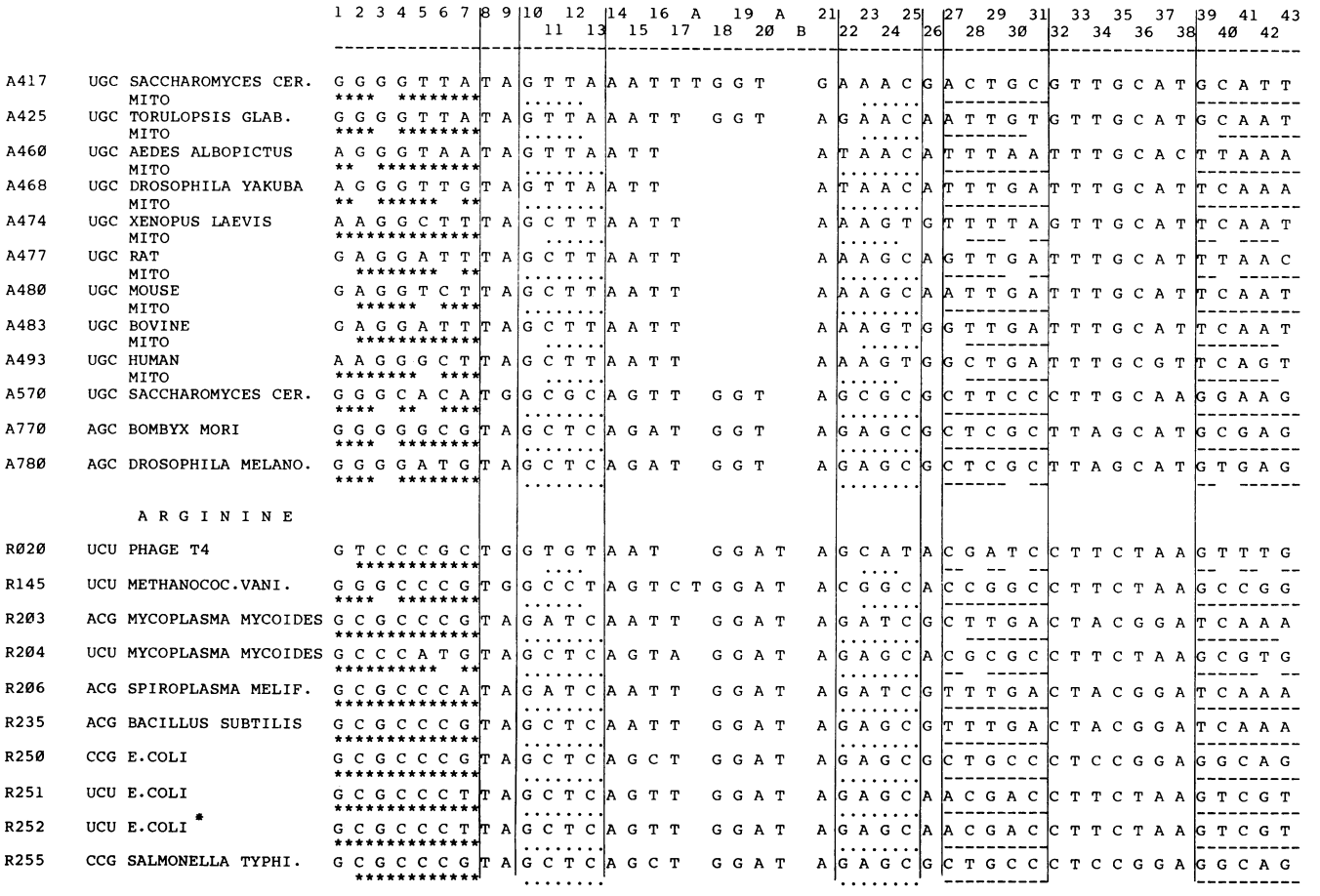
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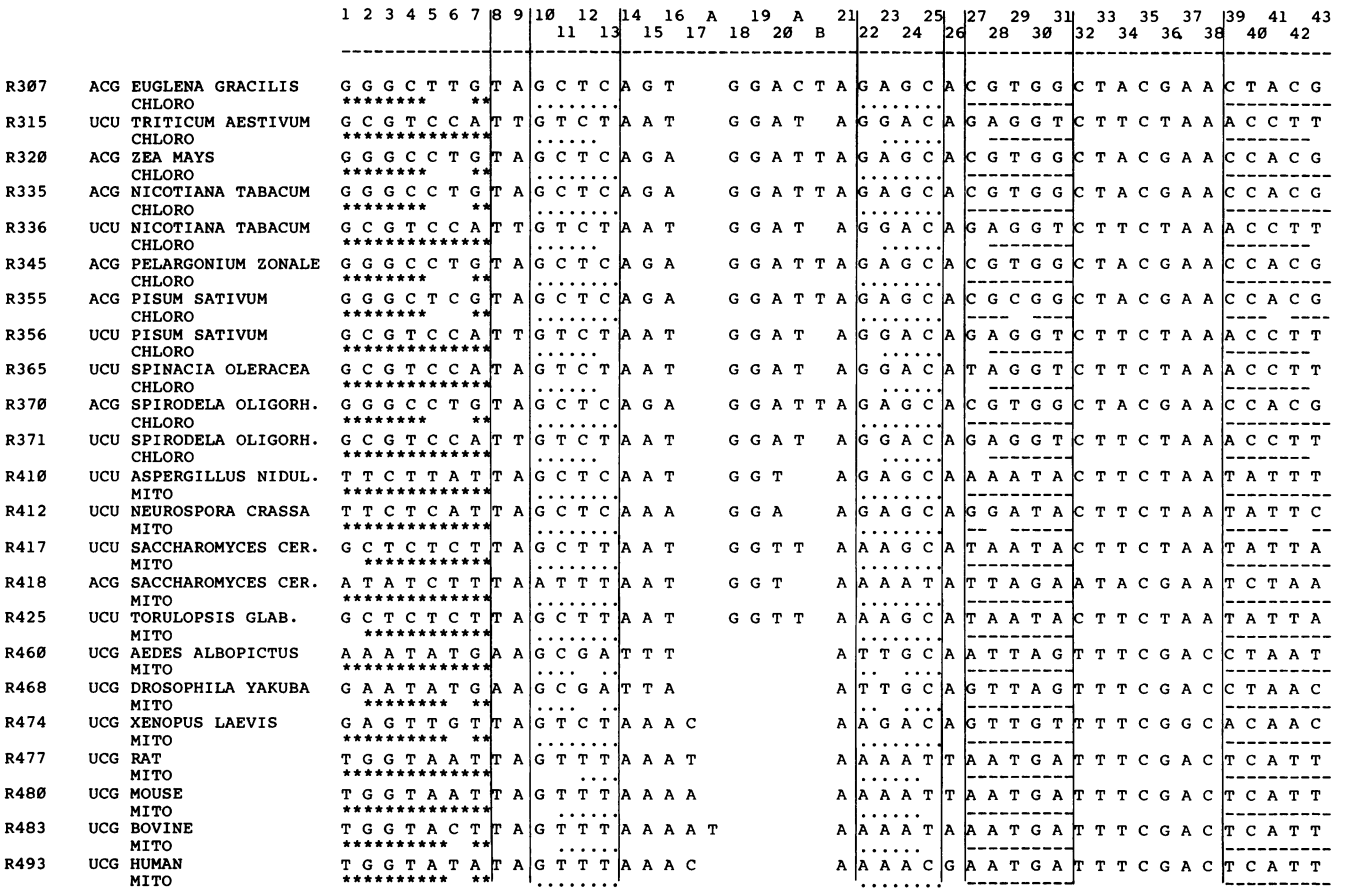
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CHLORO
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CHLORO
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CHLORO
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CHLORO
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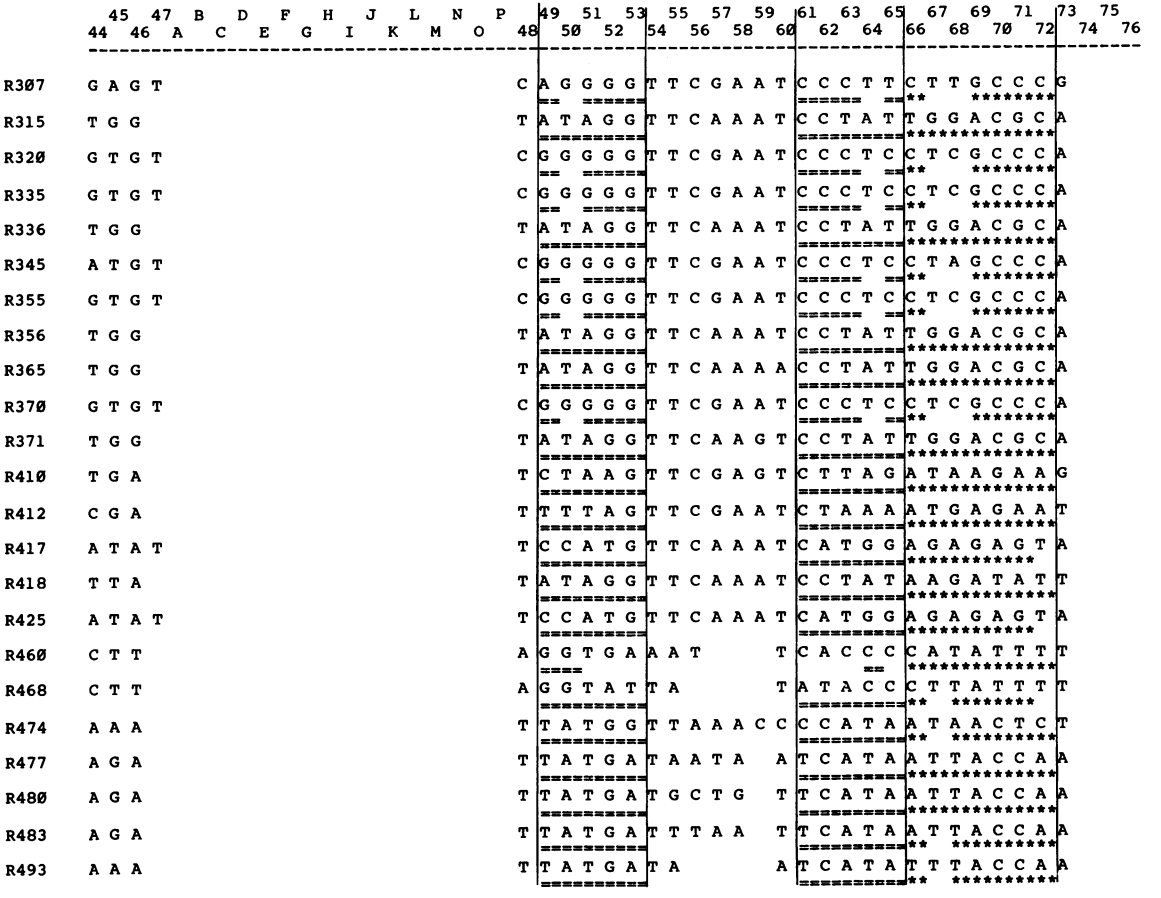
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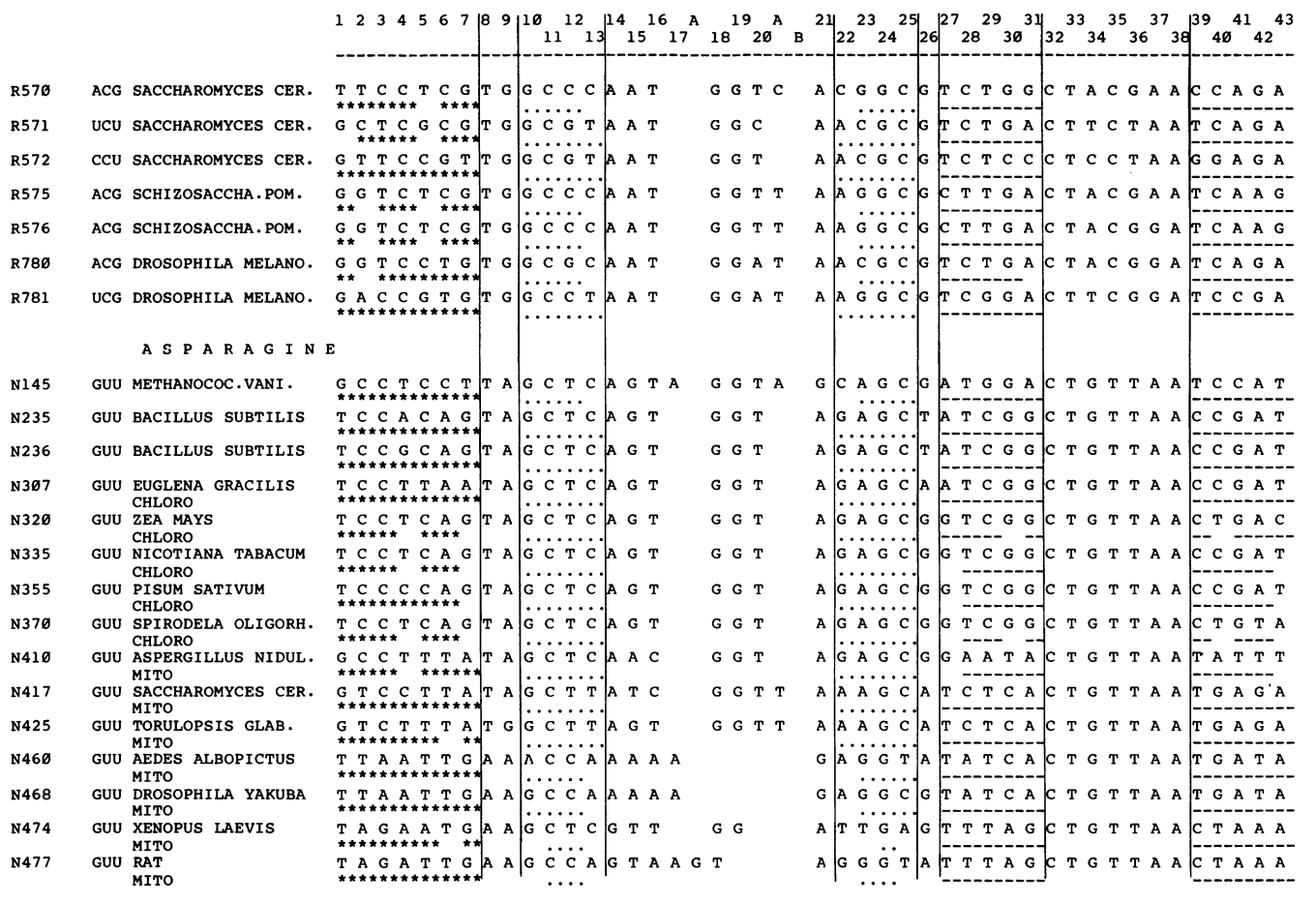
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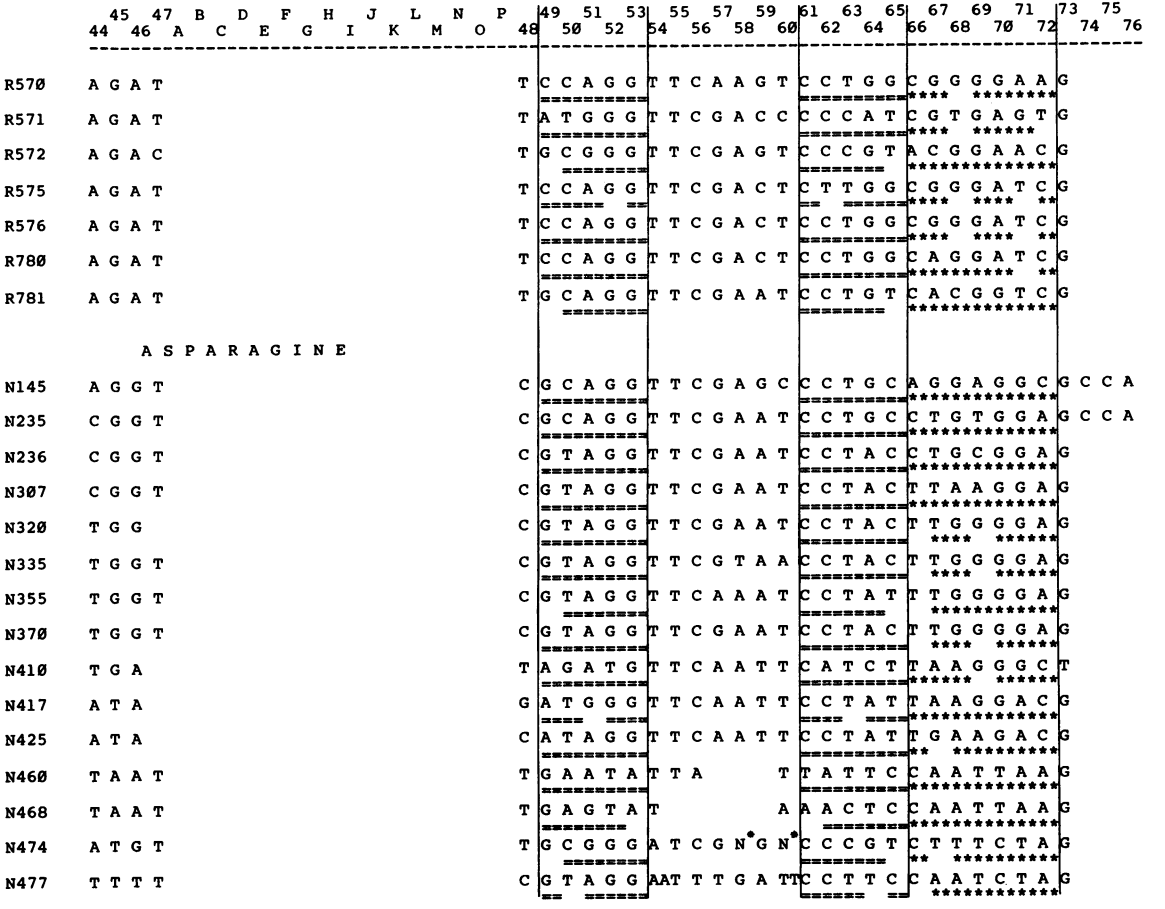
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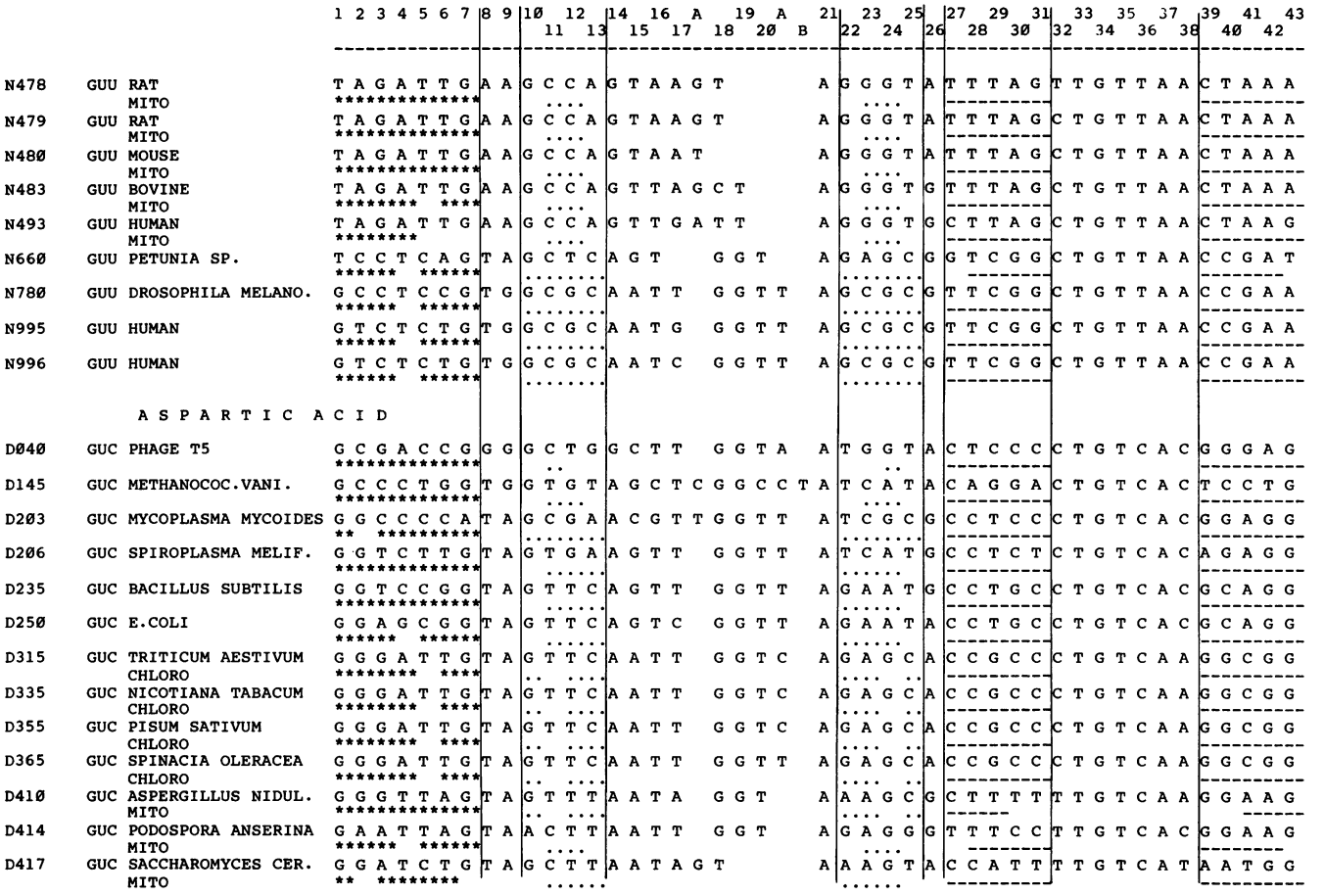
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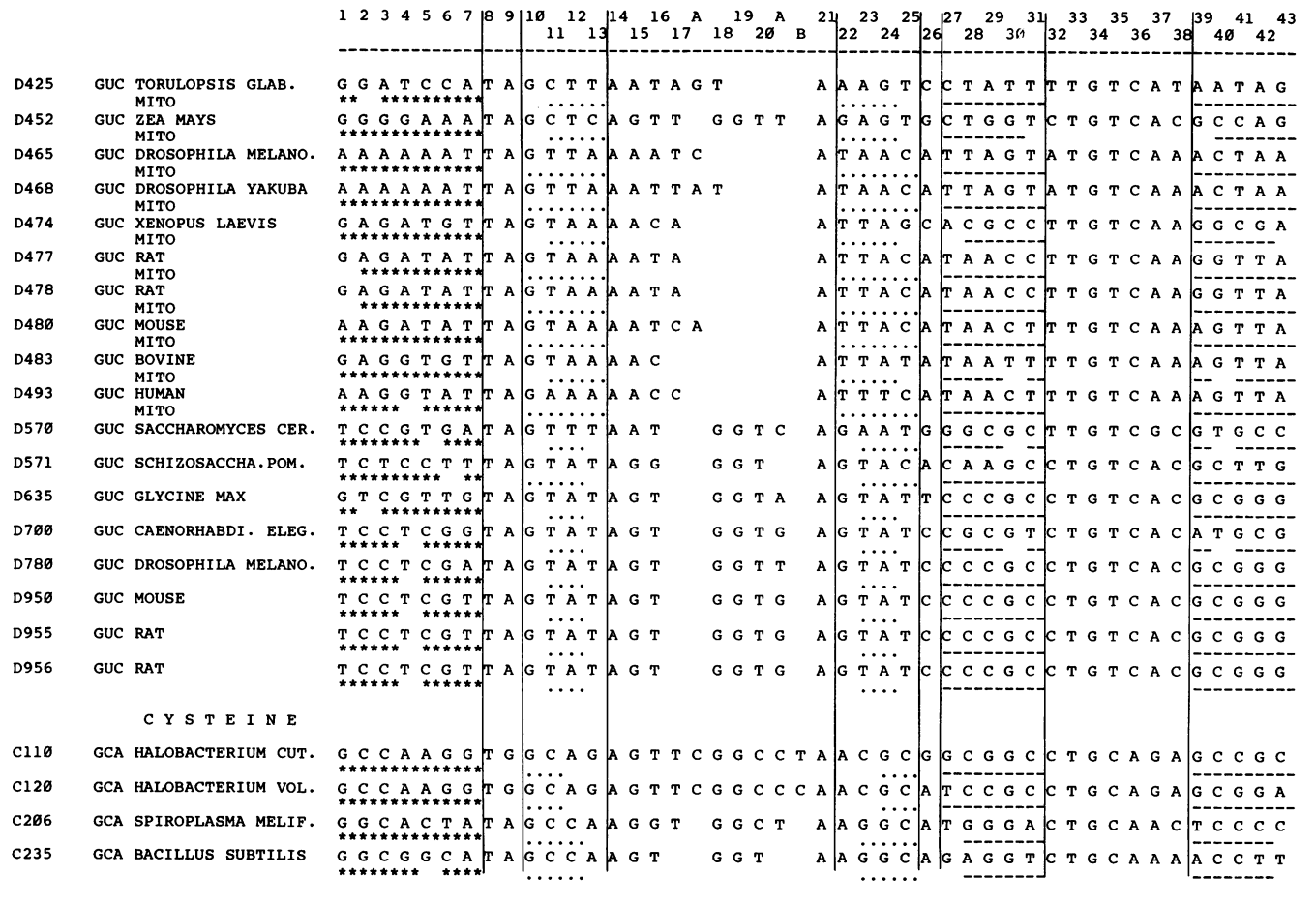
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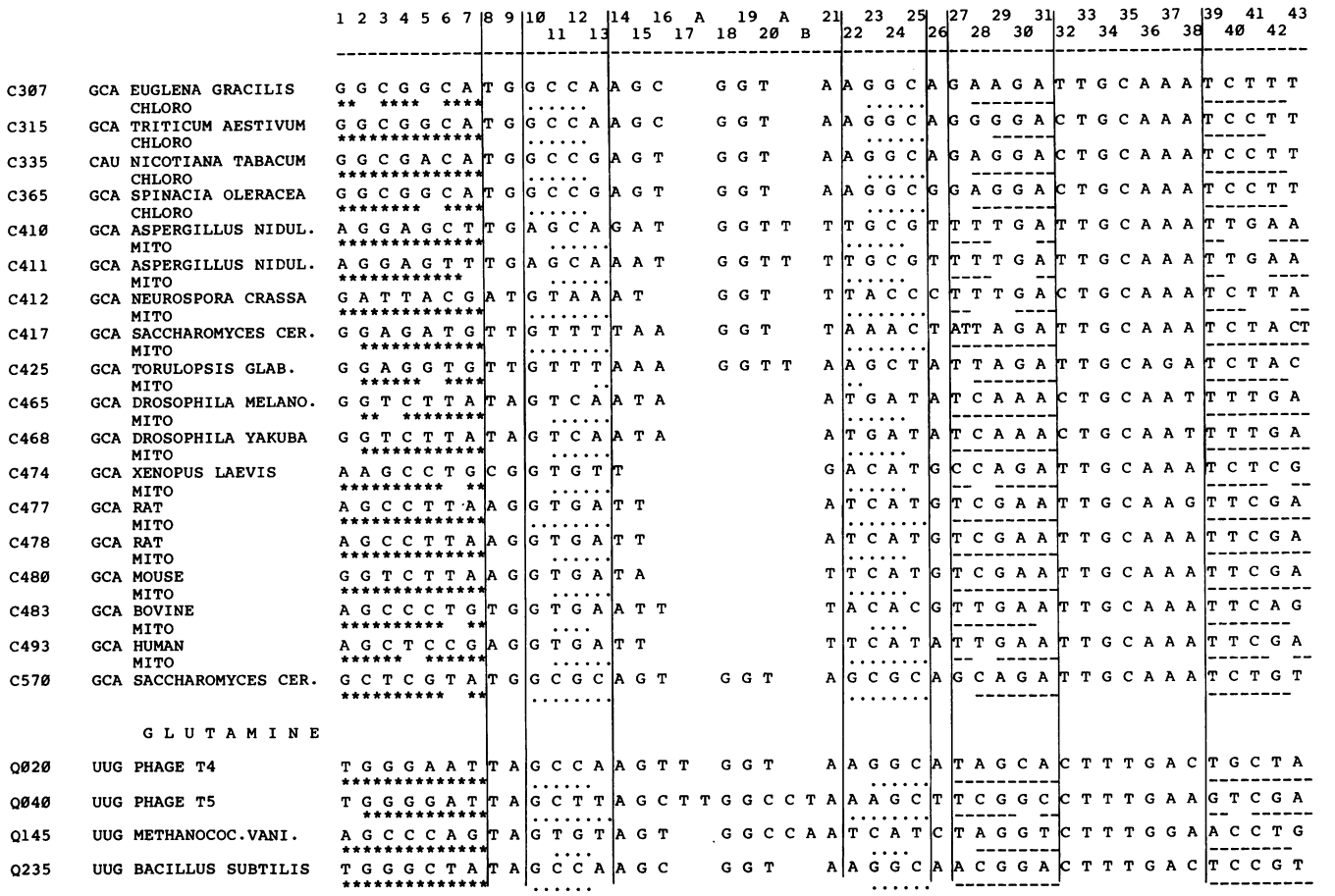
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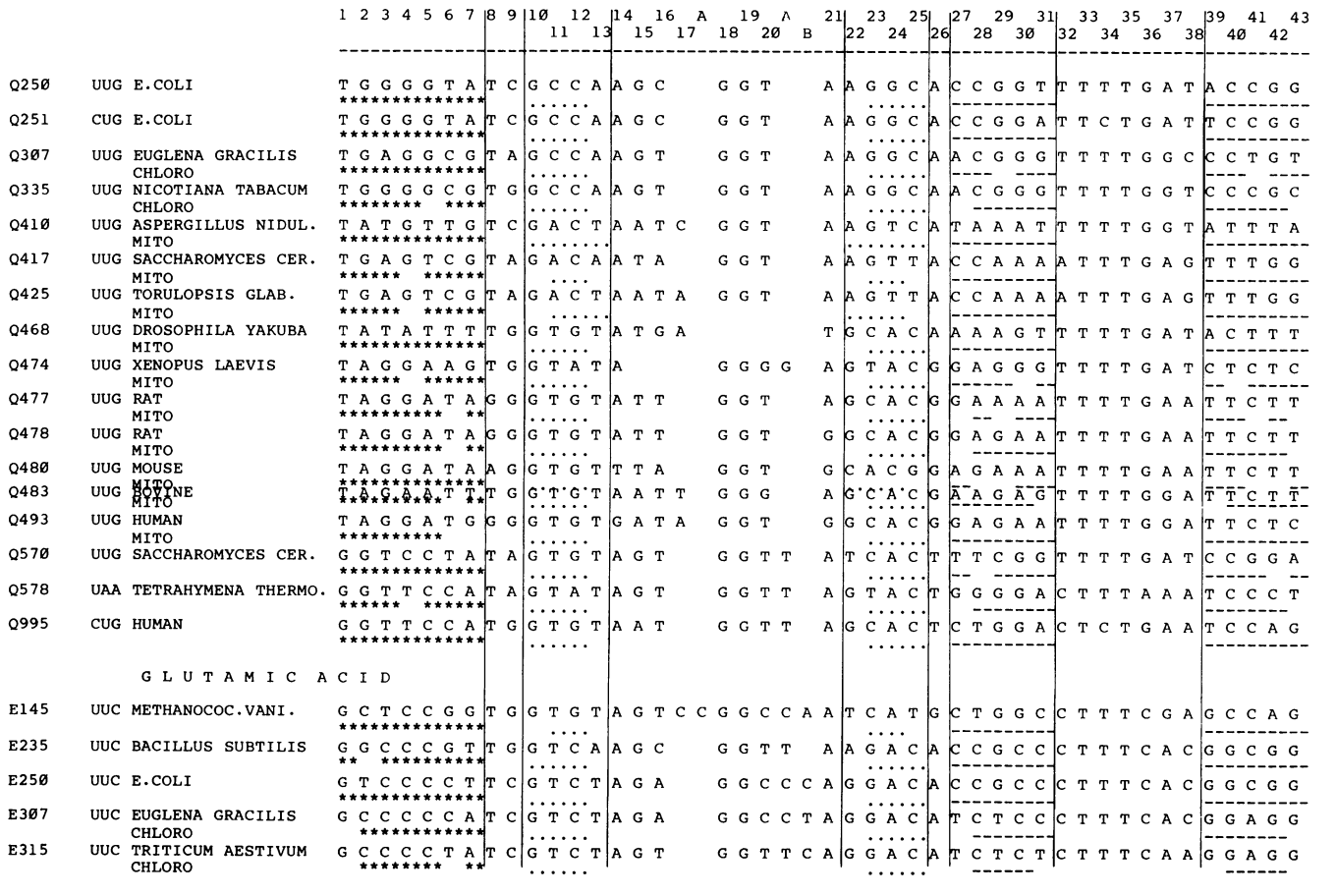
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E307 UUC EUGLENA GRACILIS CHLORO G C C C C C A T C G T C T A G A G G C C C T A G G A C A T C T C C C T T T C A C G G A G G
E315 UUC TRITICUM AESTIVUM CHLORO G C C C C T A T C G T C T A G T G G T T C A G G A C A T C T C T C T T T C A A G G A G G

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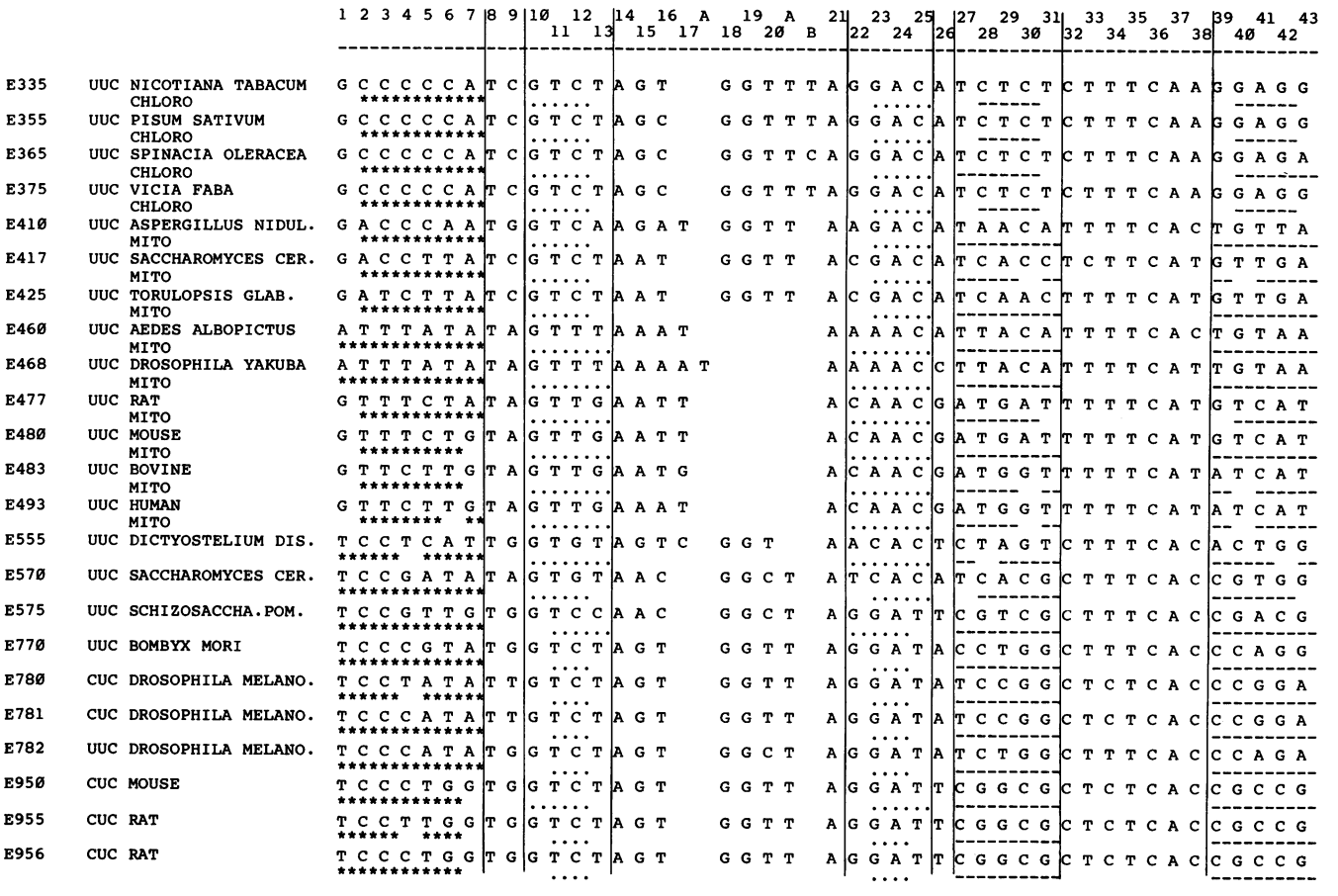
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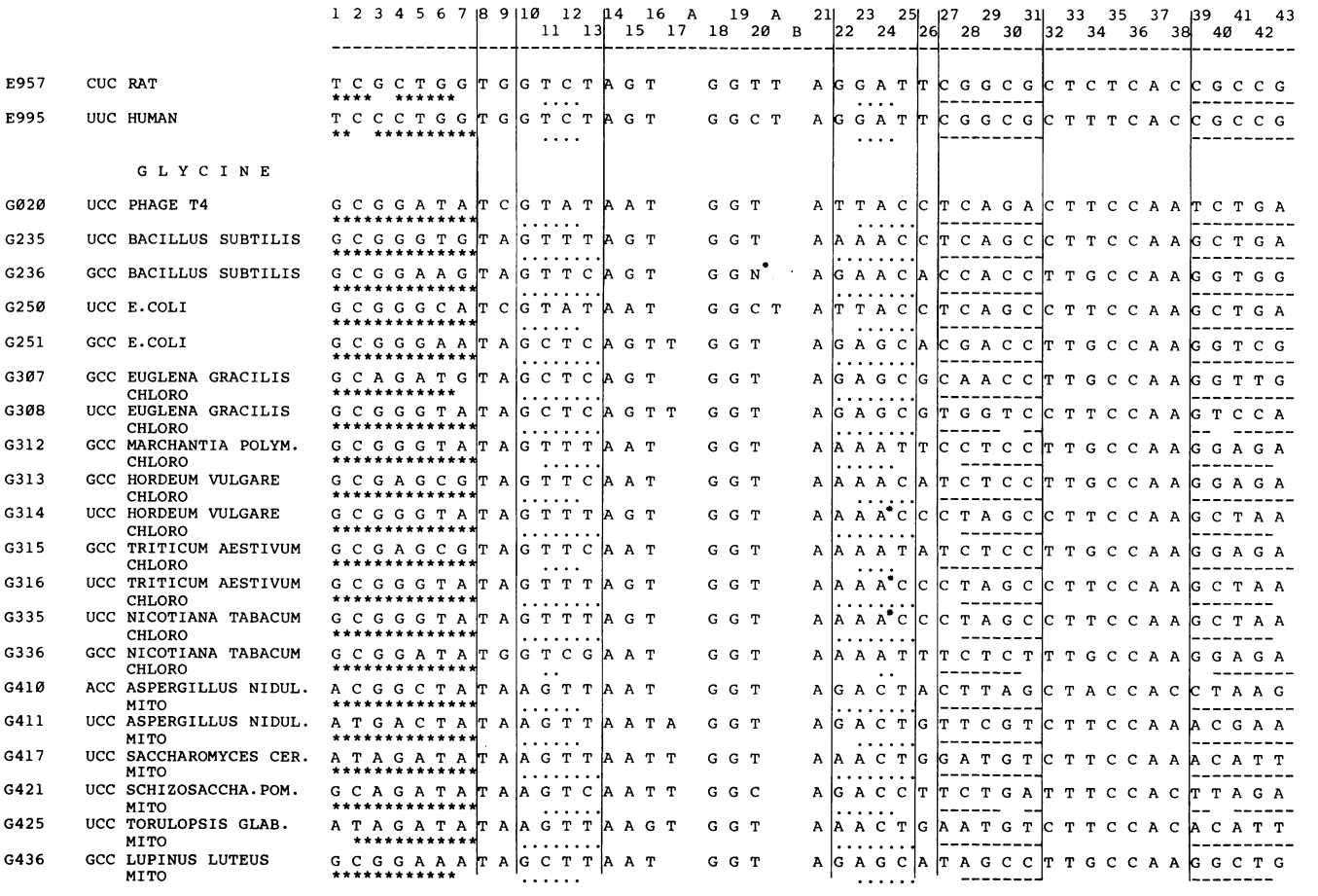
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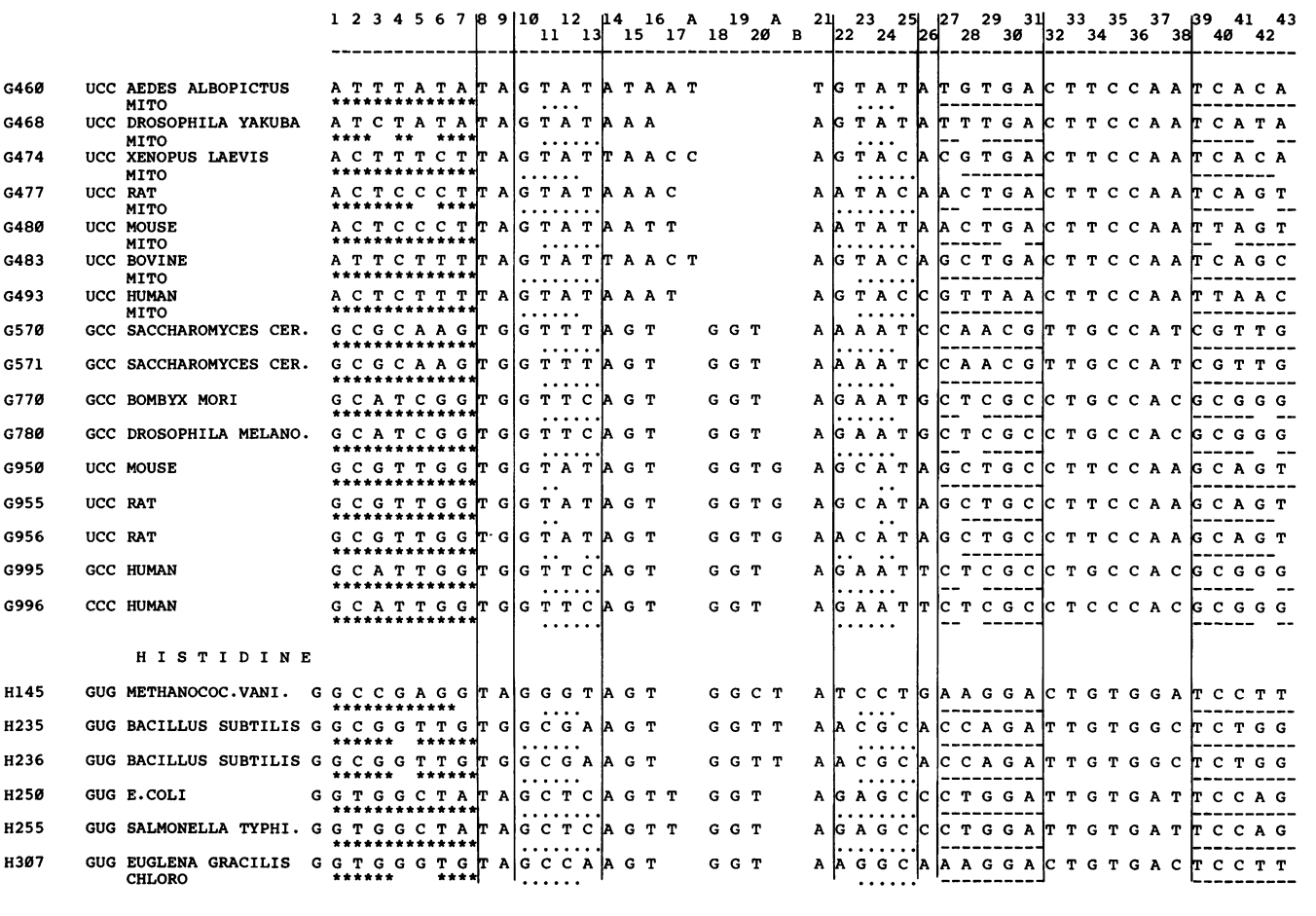
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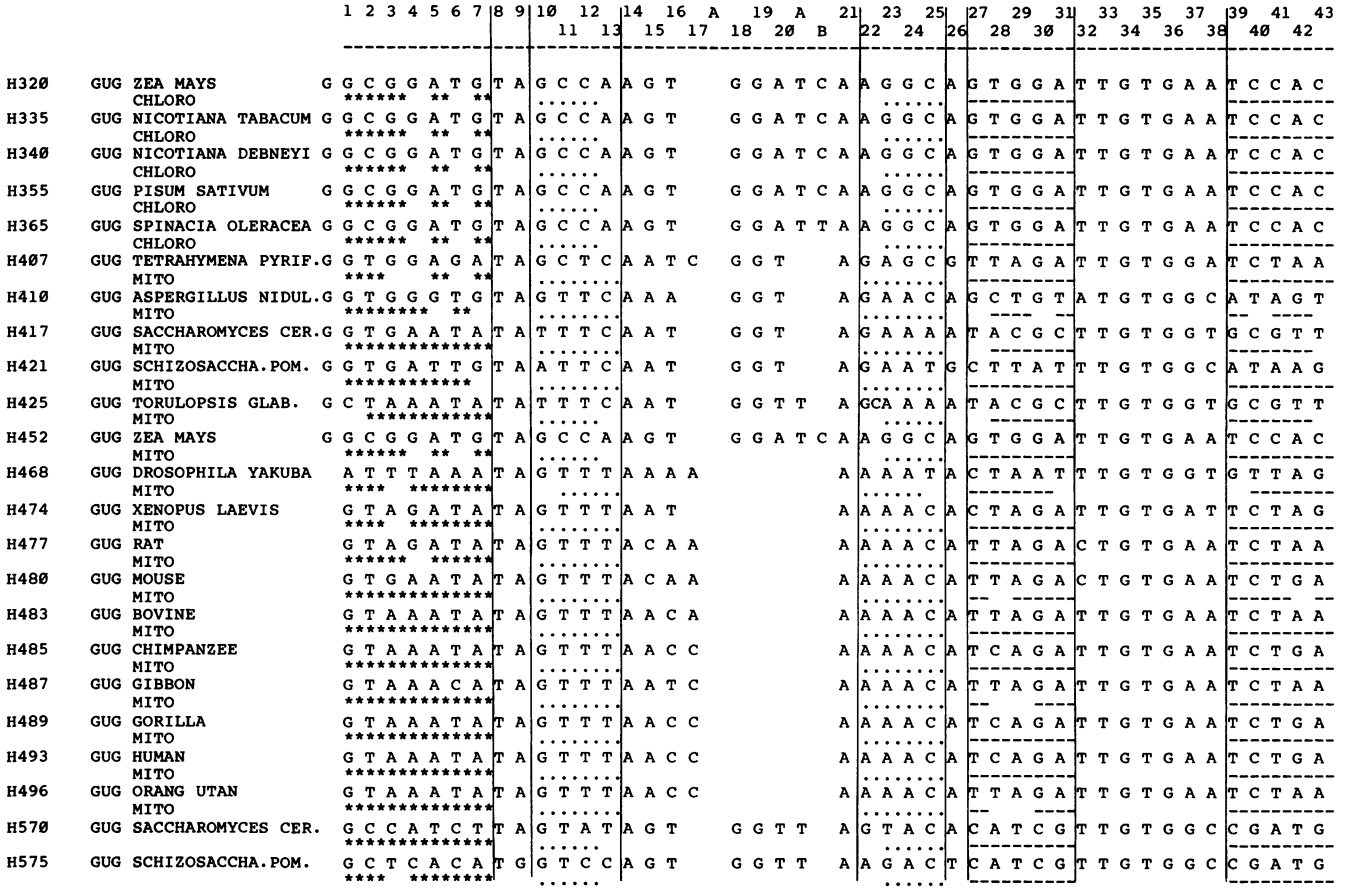
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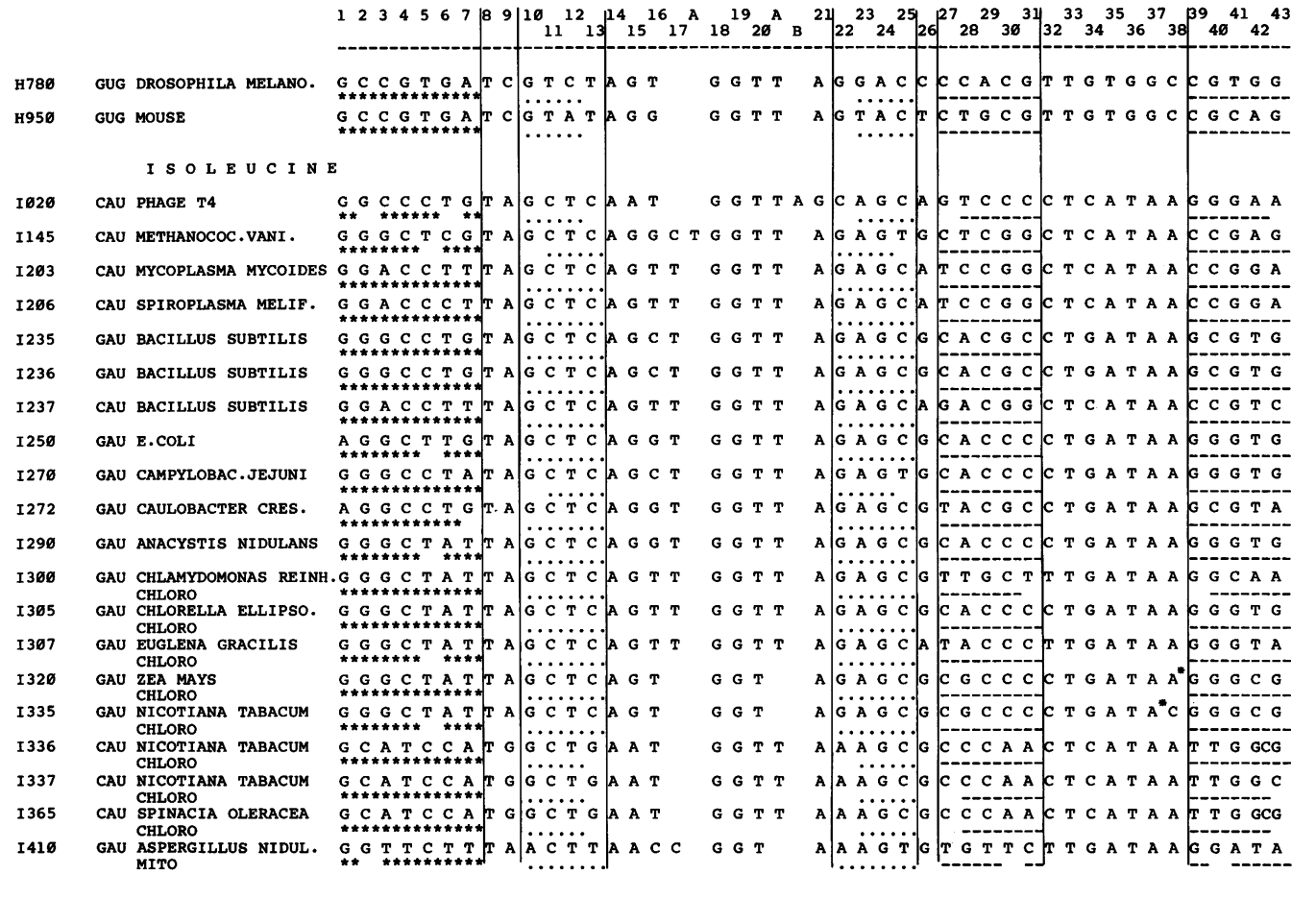
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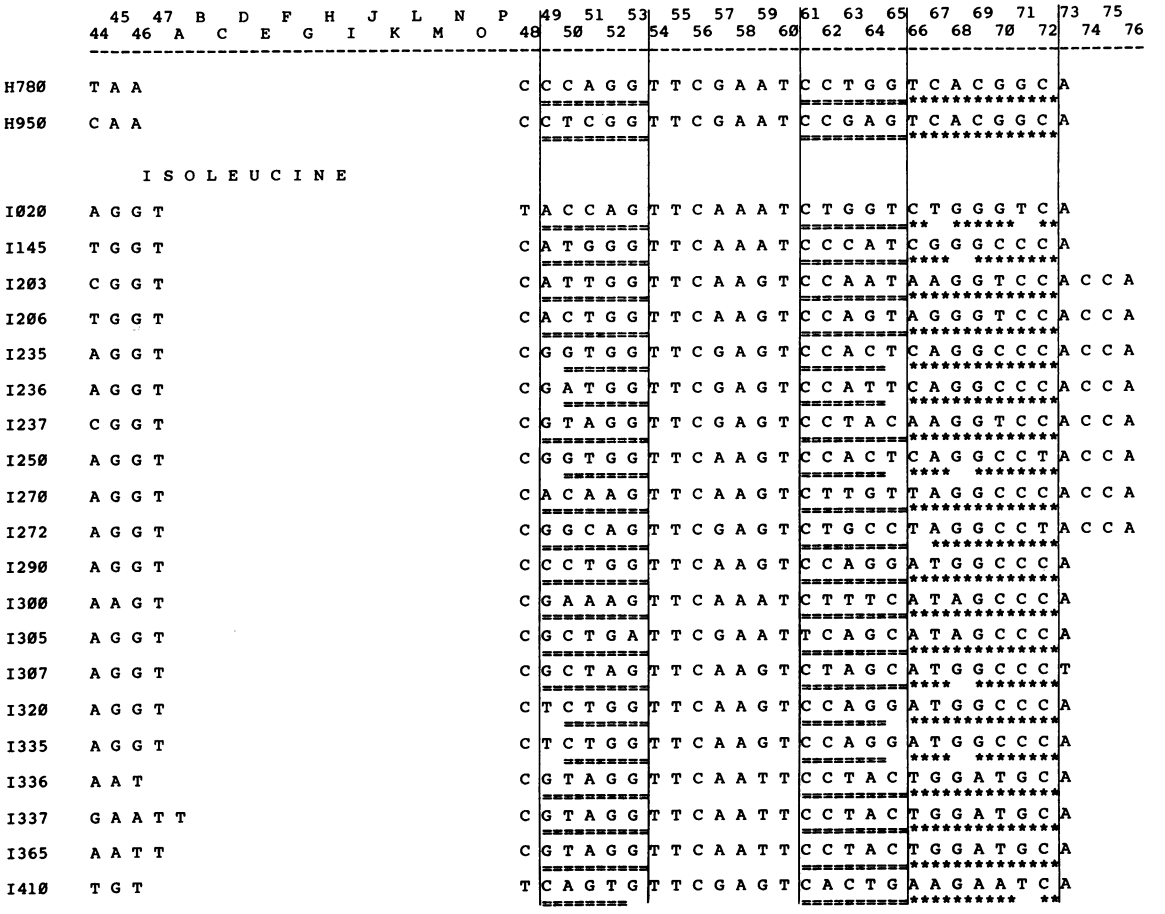
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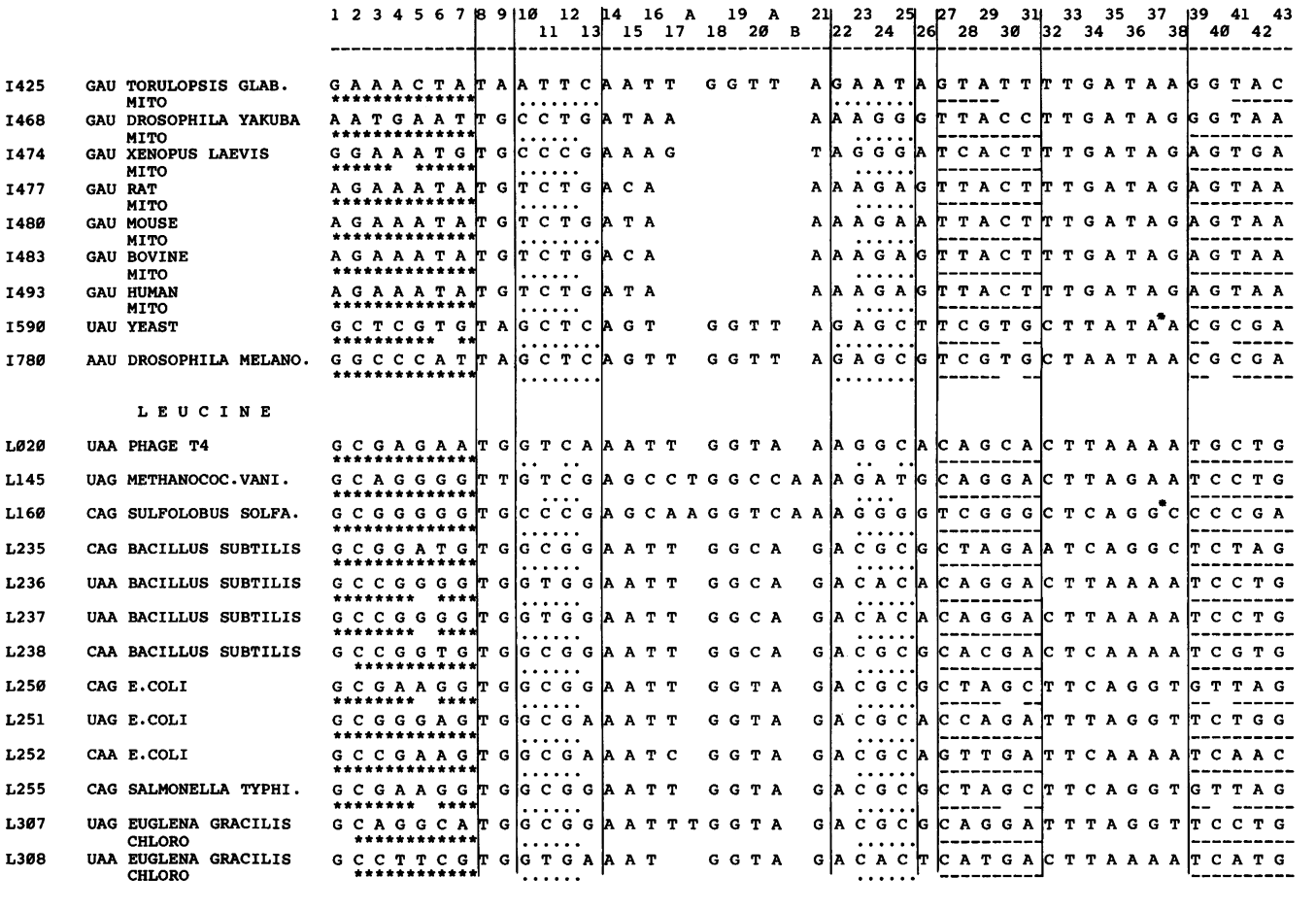
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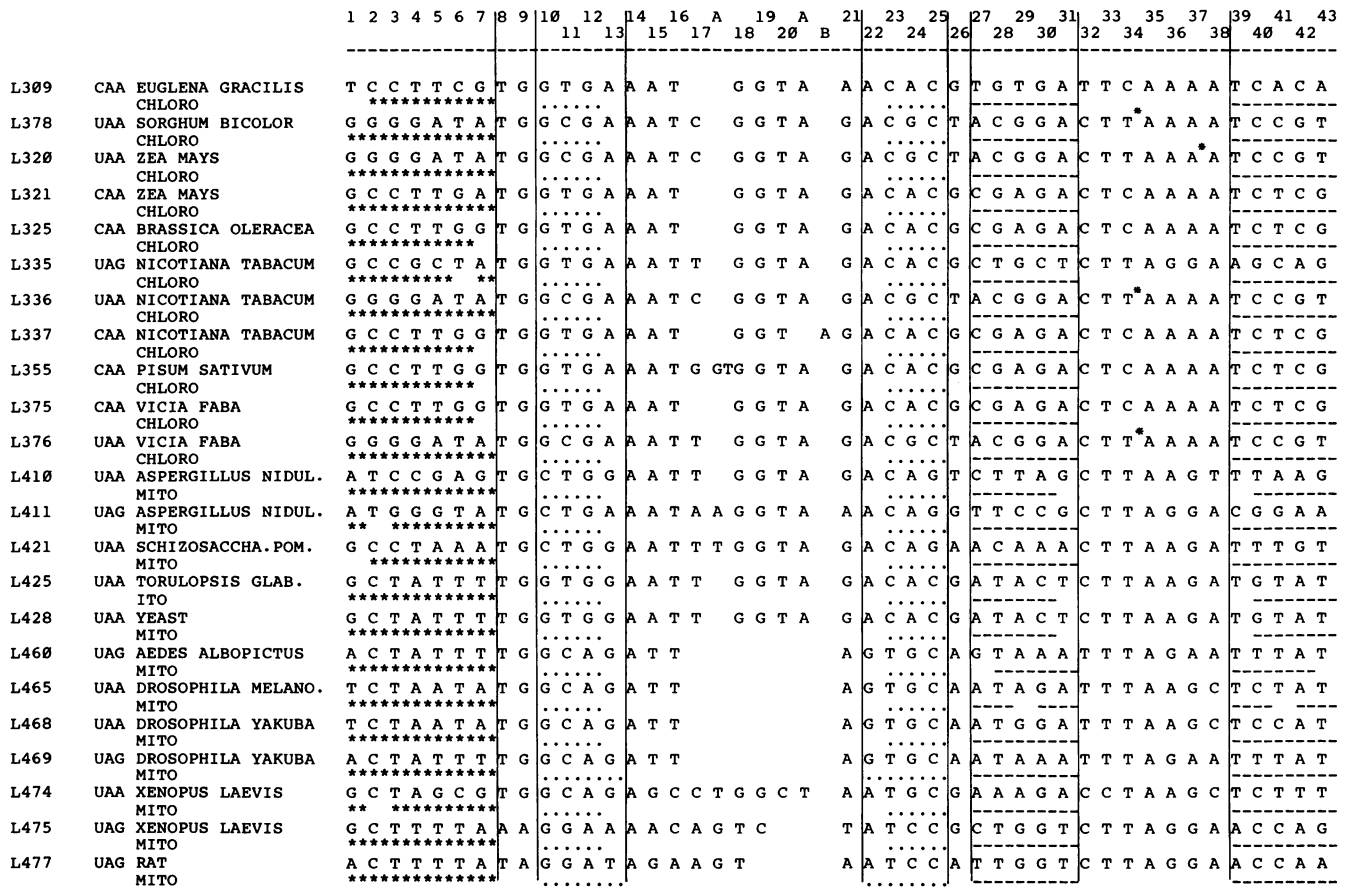
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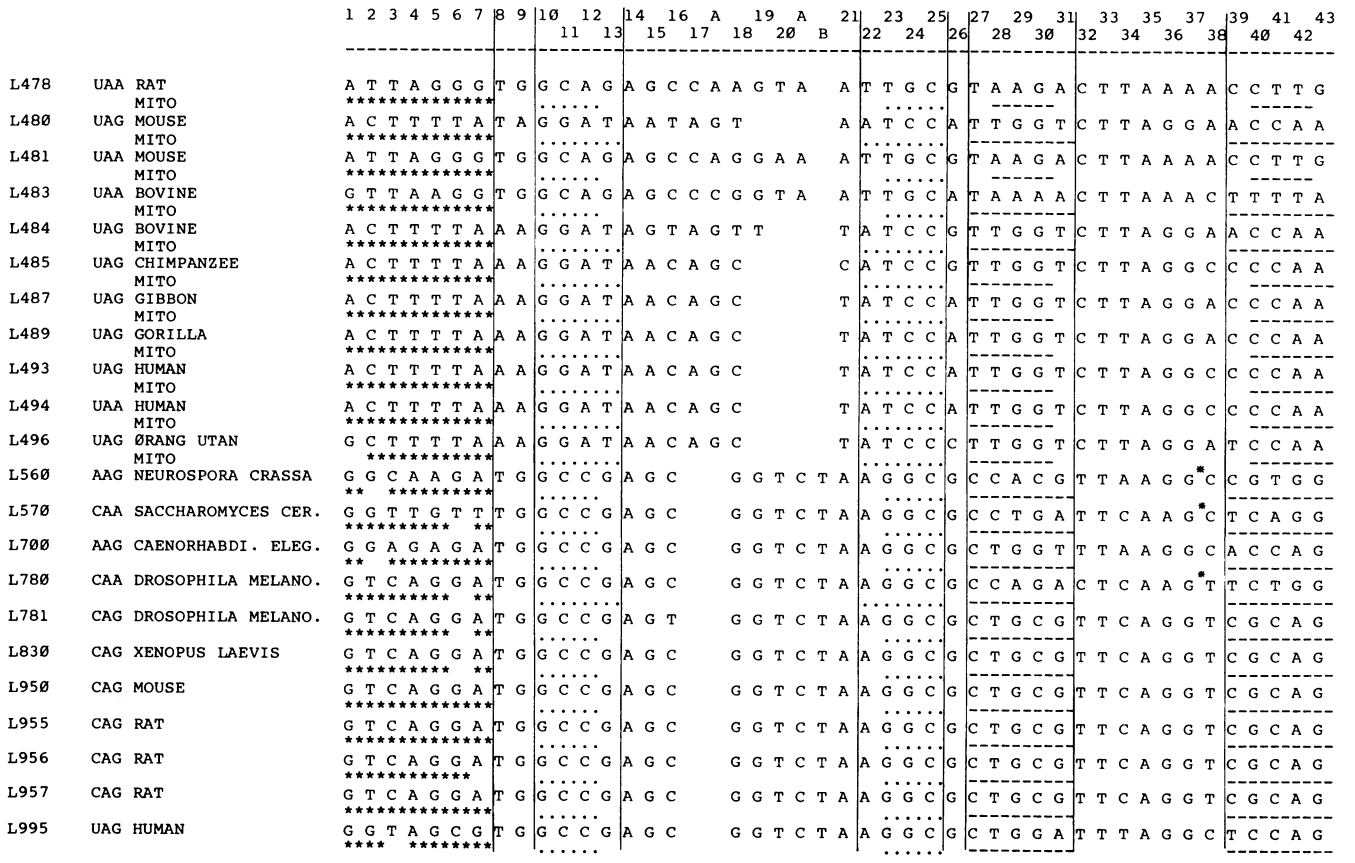
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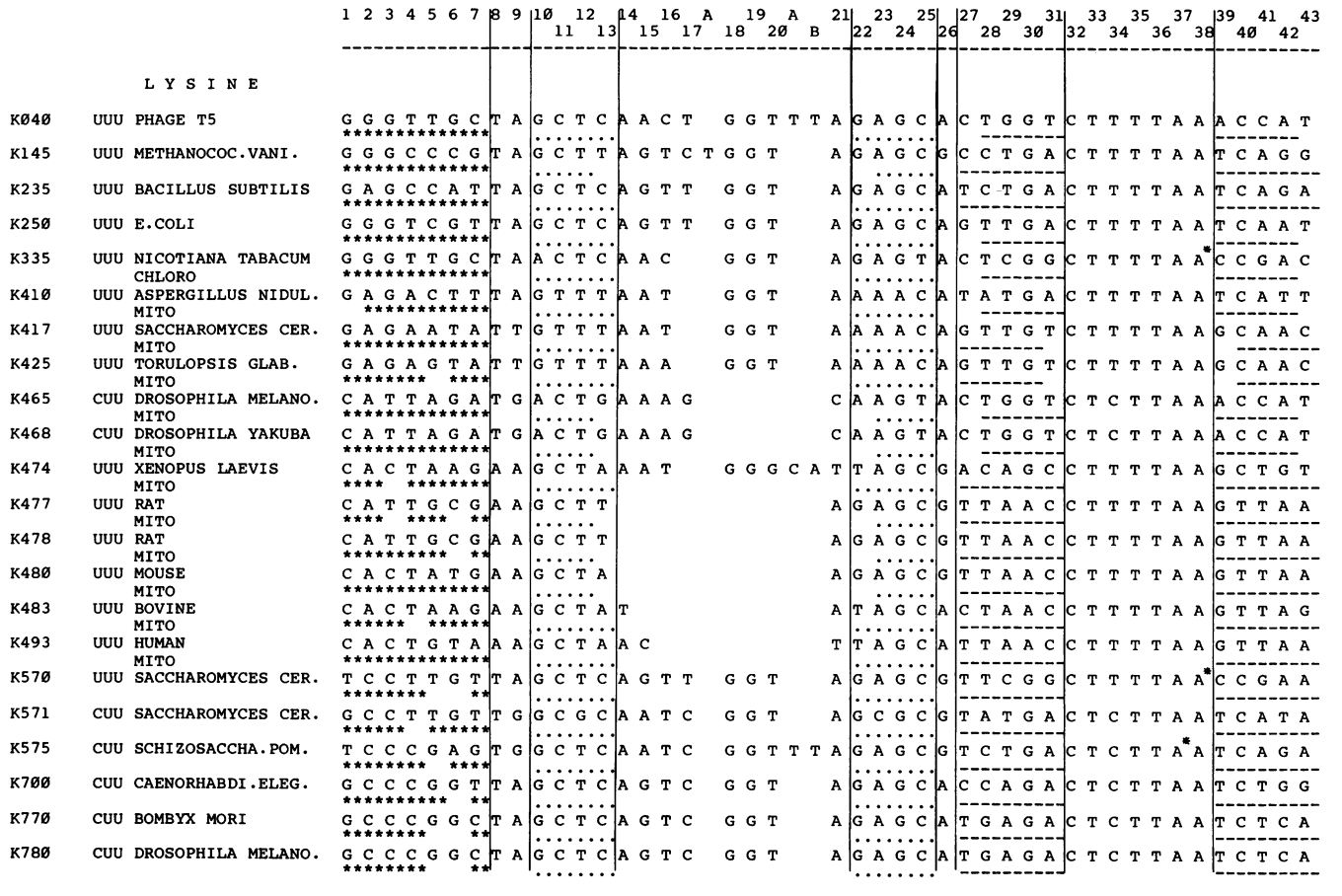
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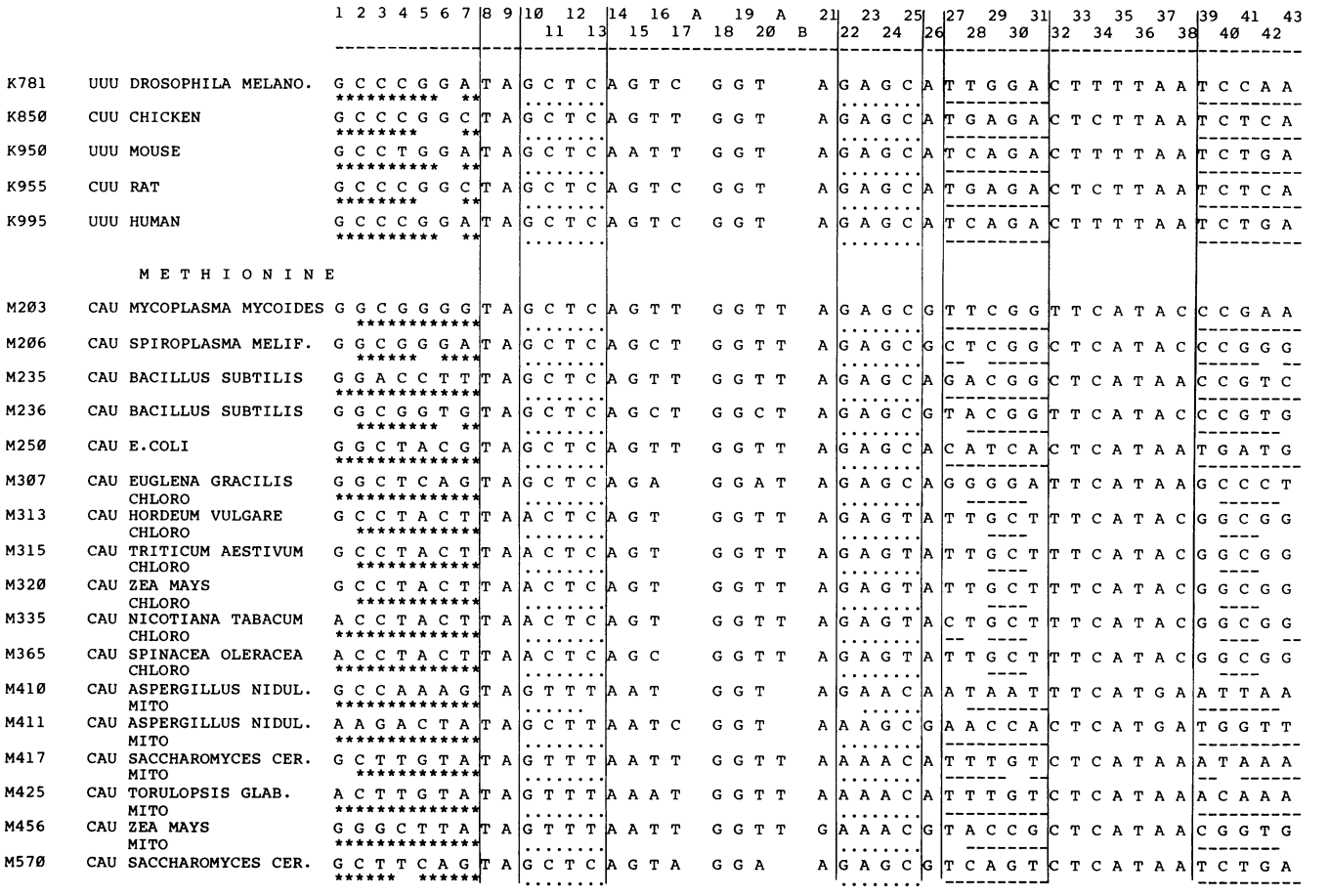
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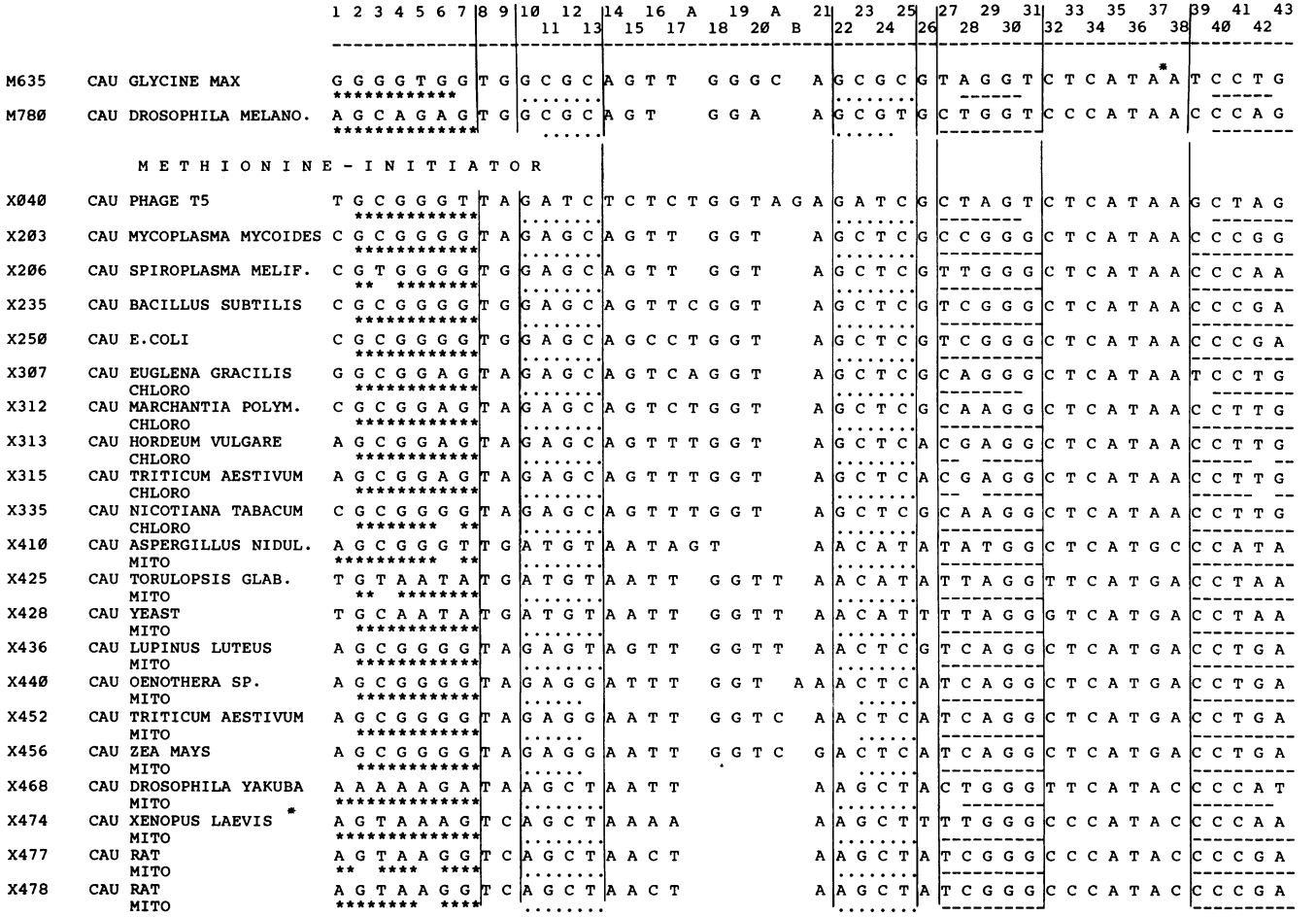
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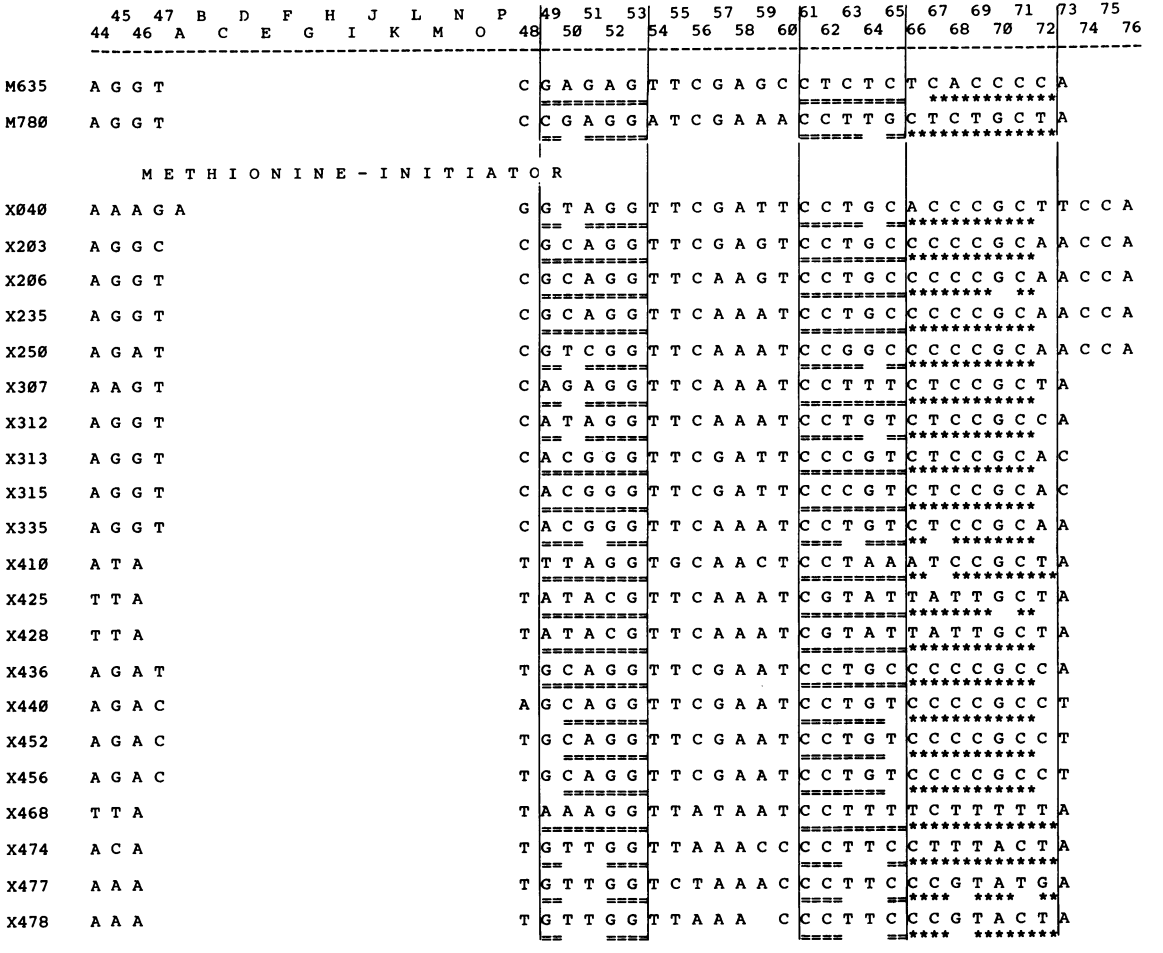
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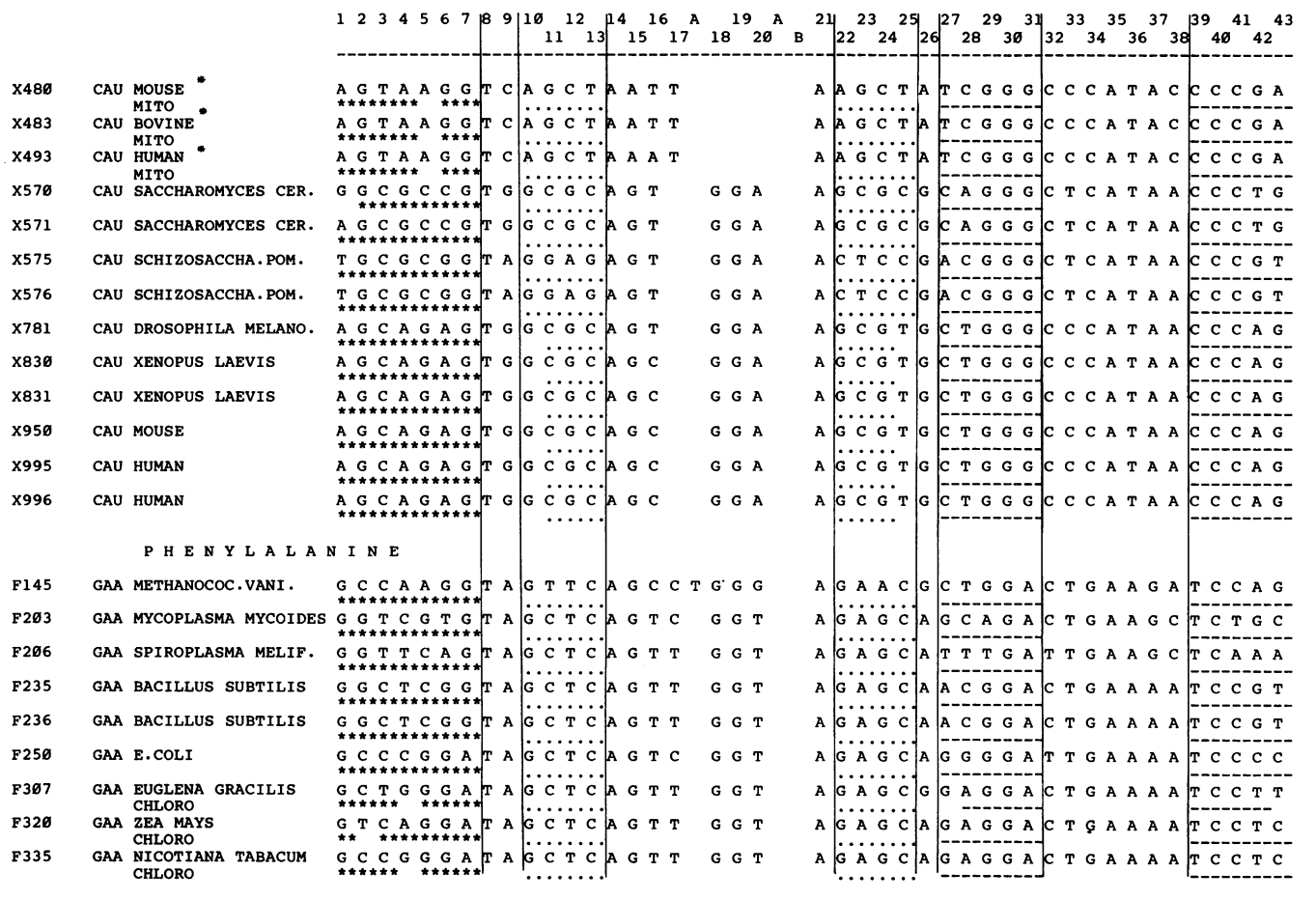
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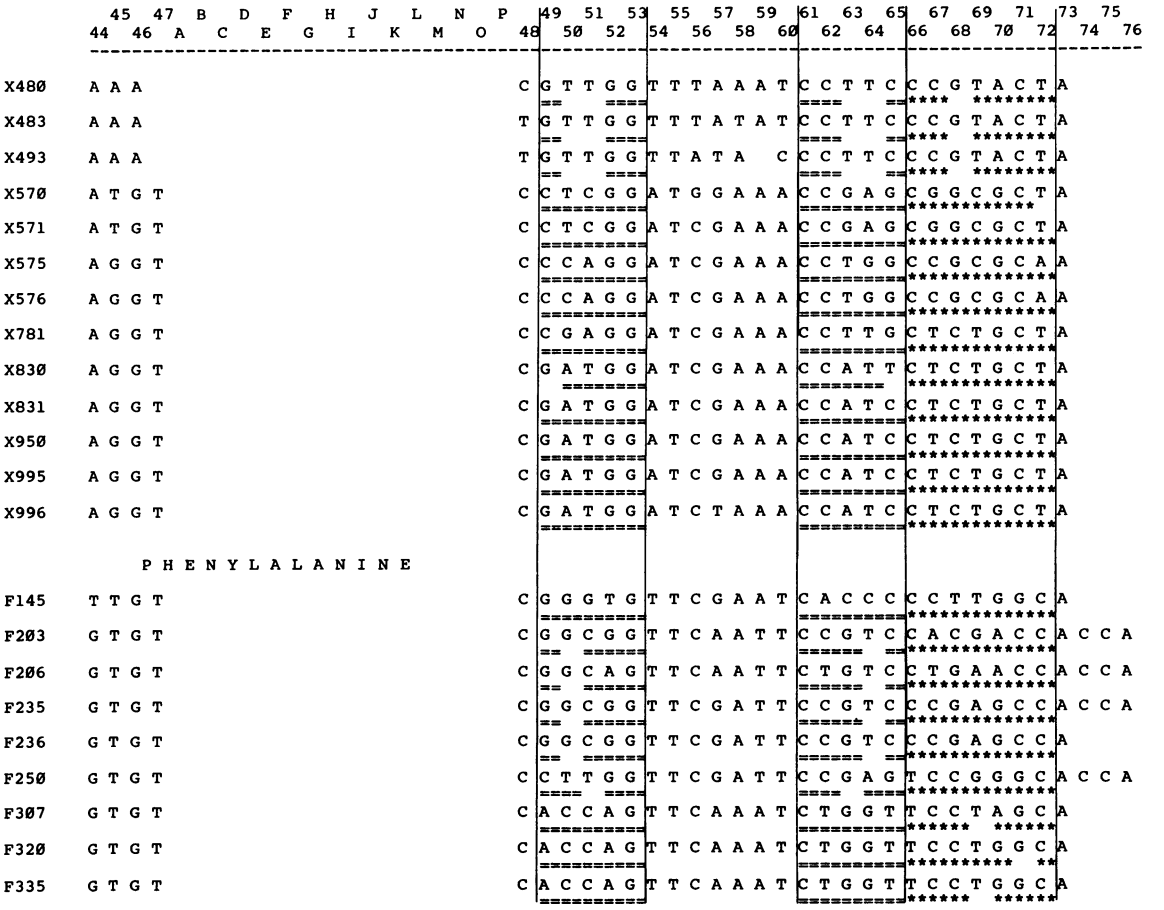
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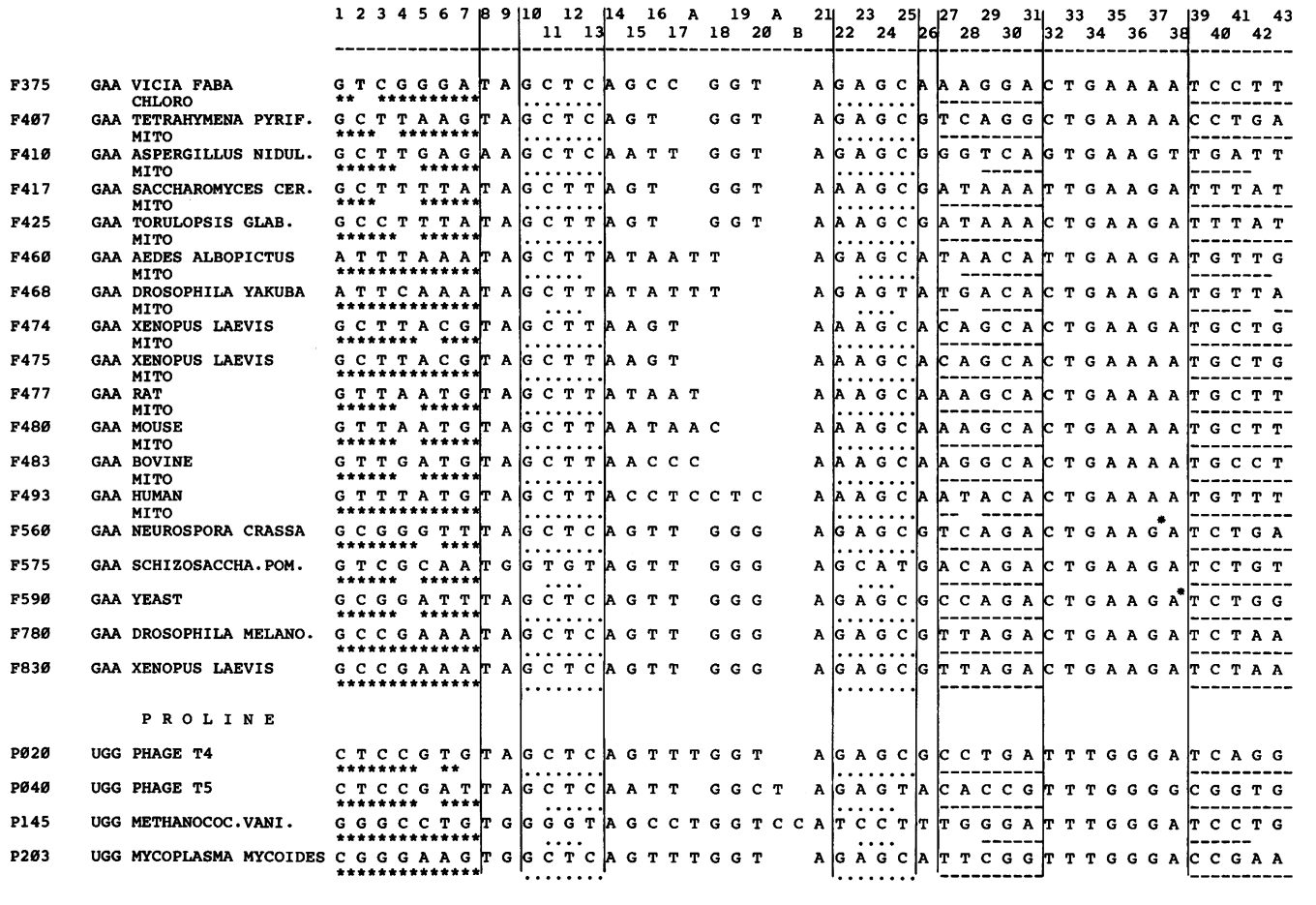
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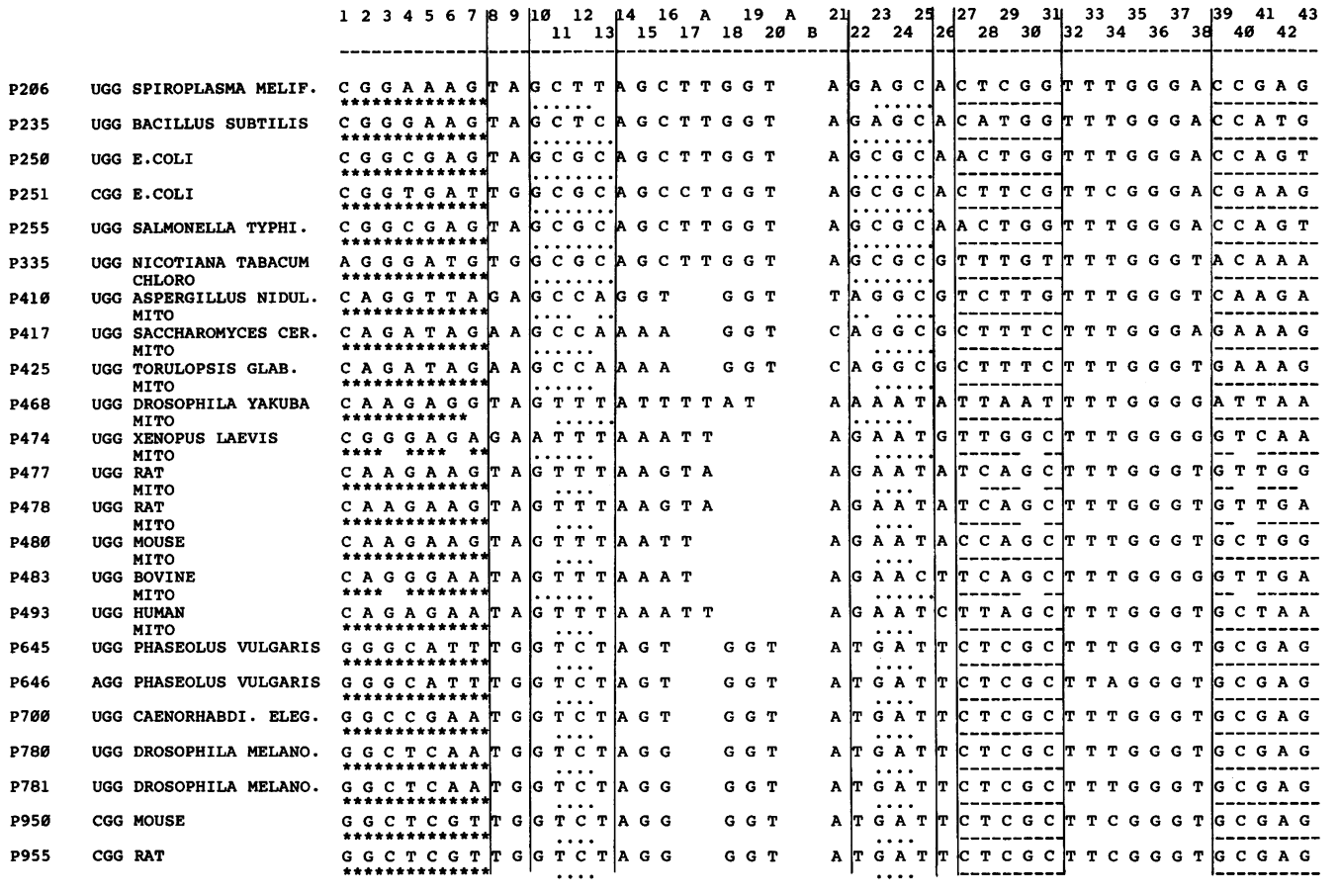
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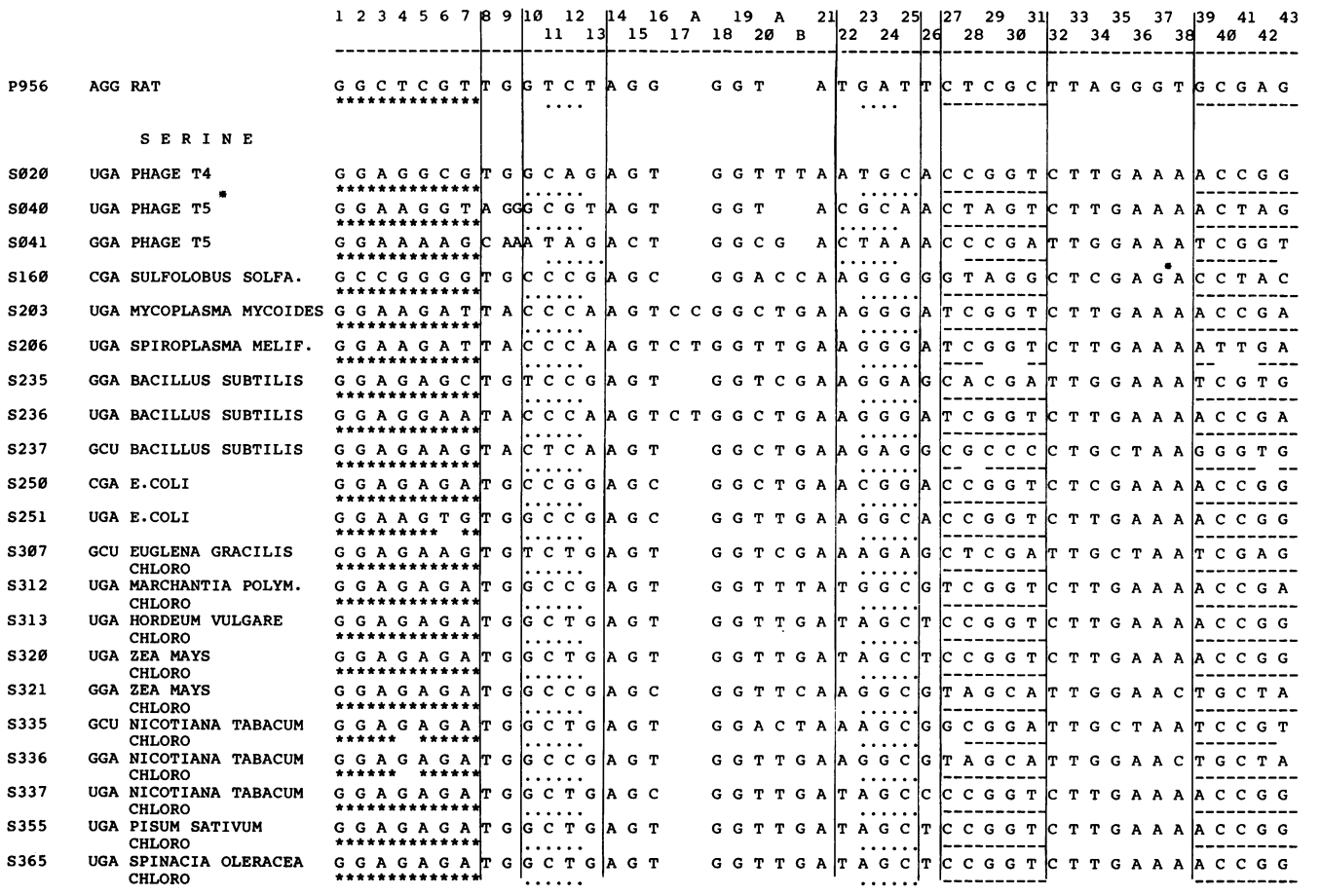
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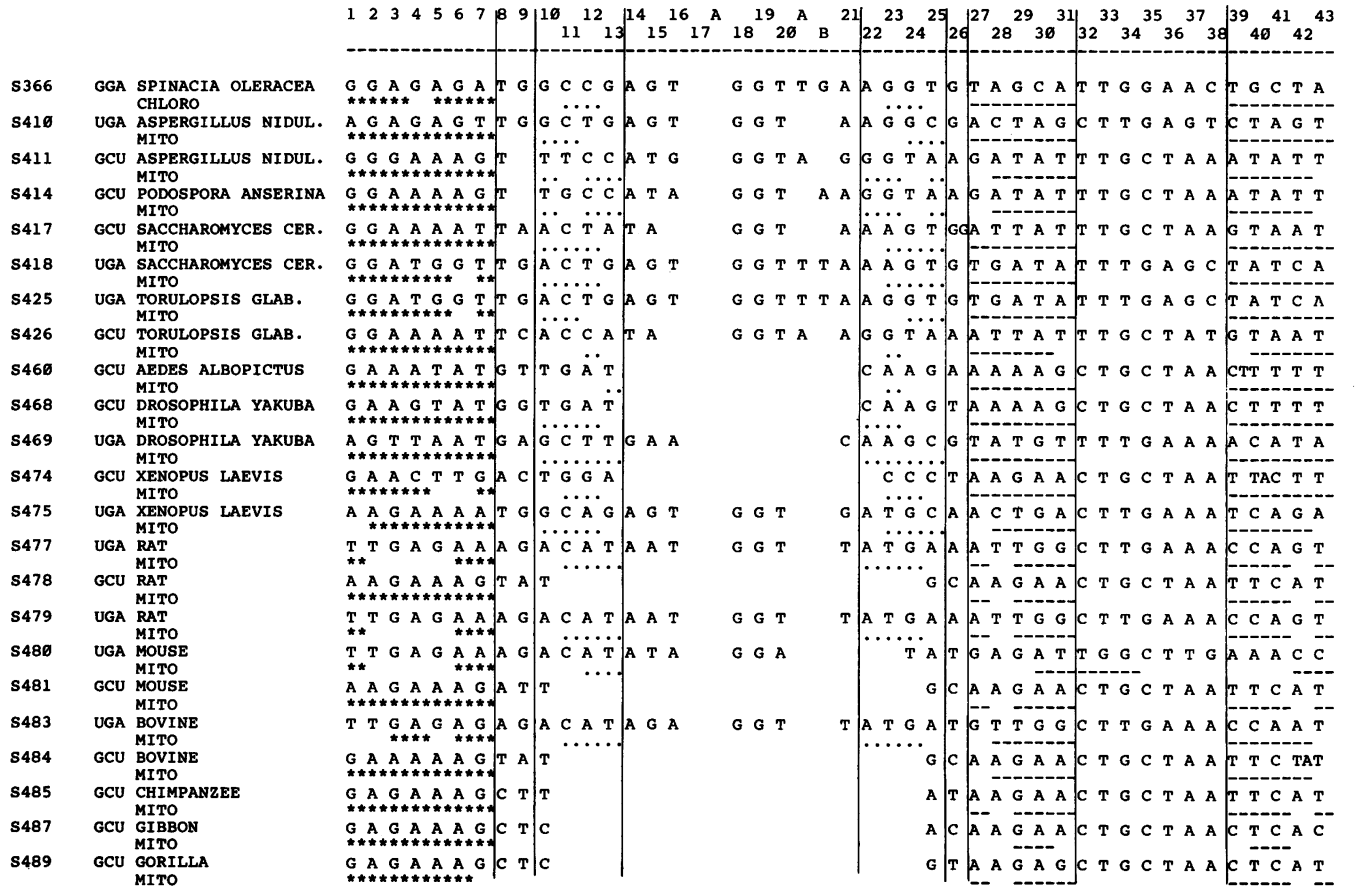
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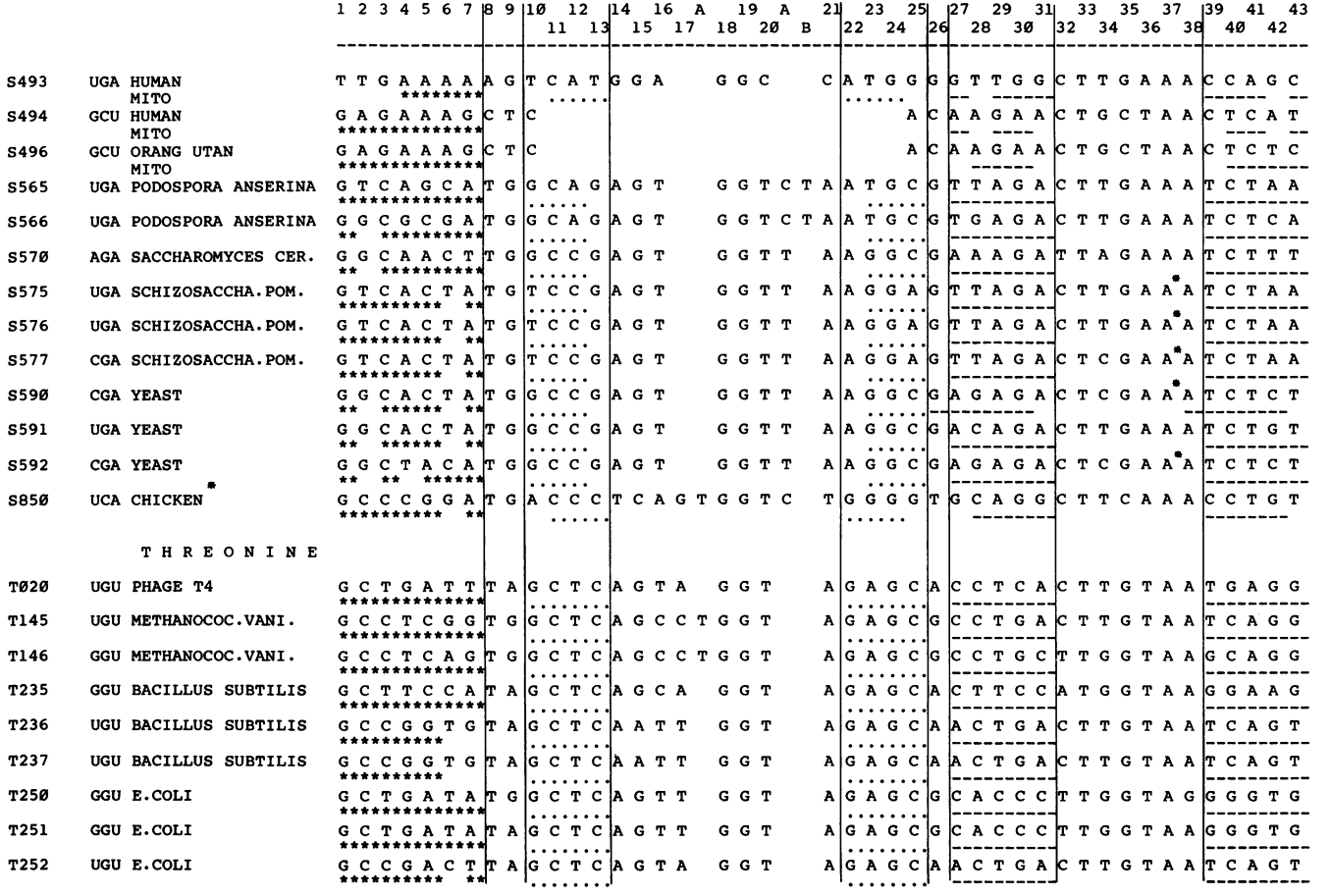
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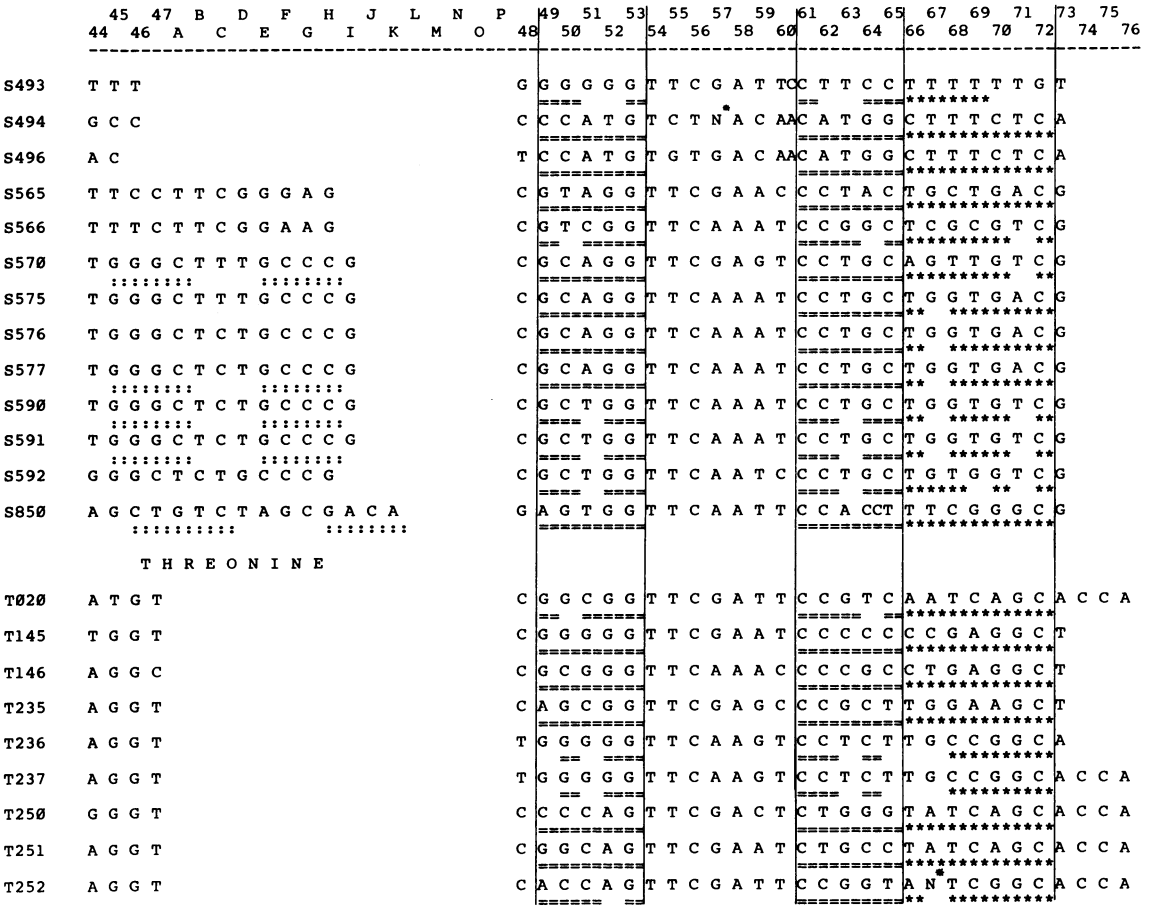
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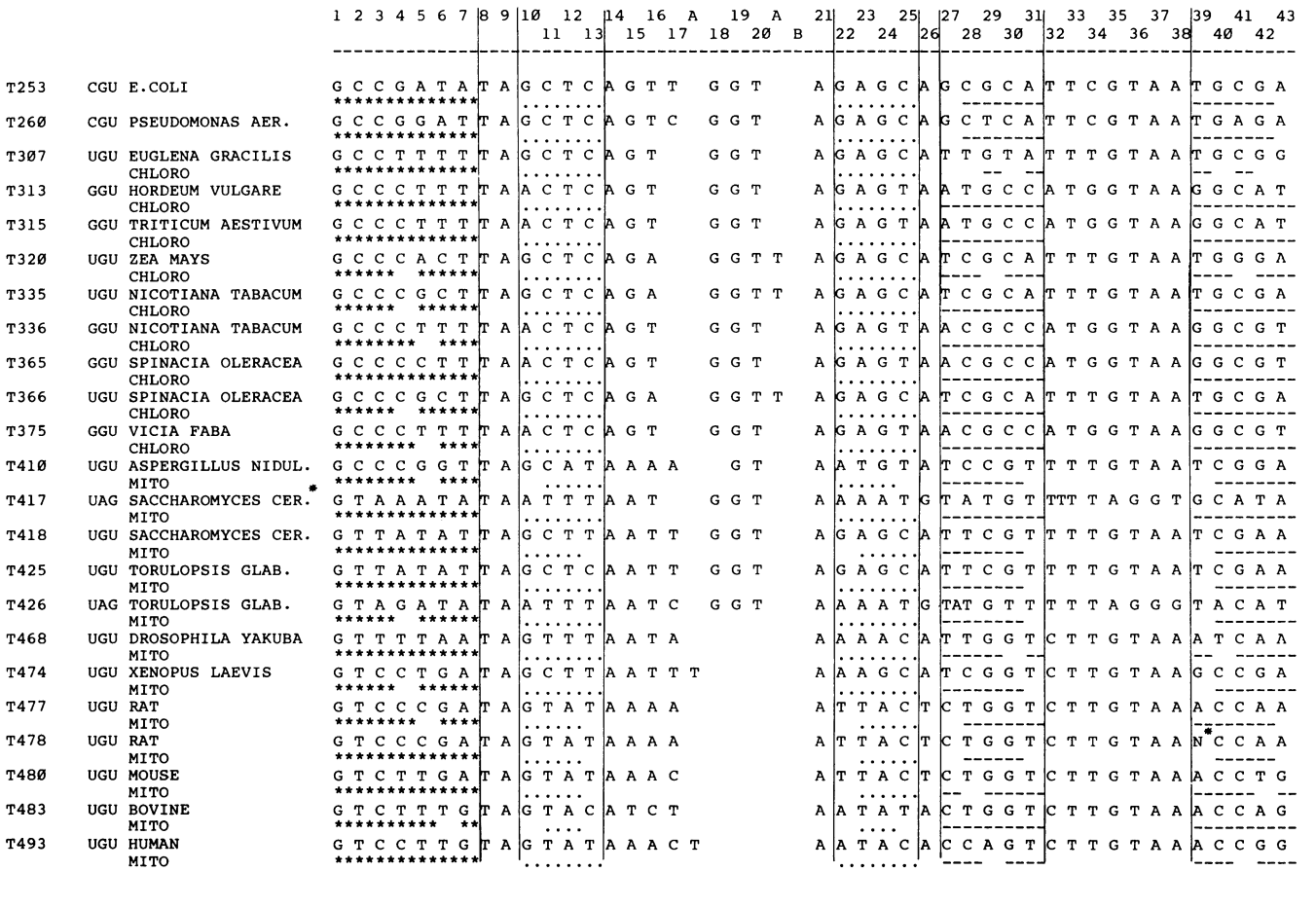
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T375 GGU VICIA FABA CHLORO
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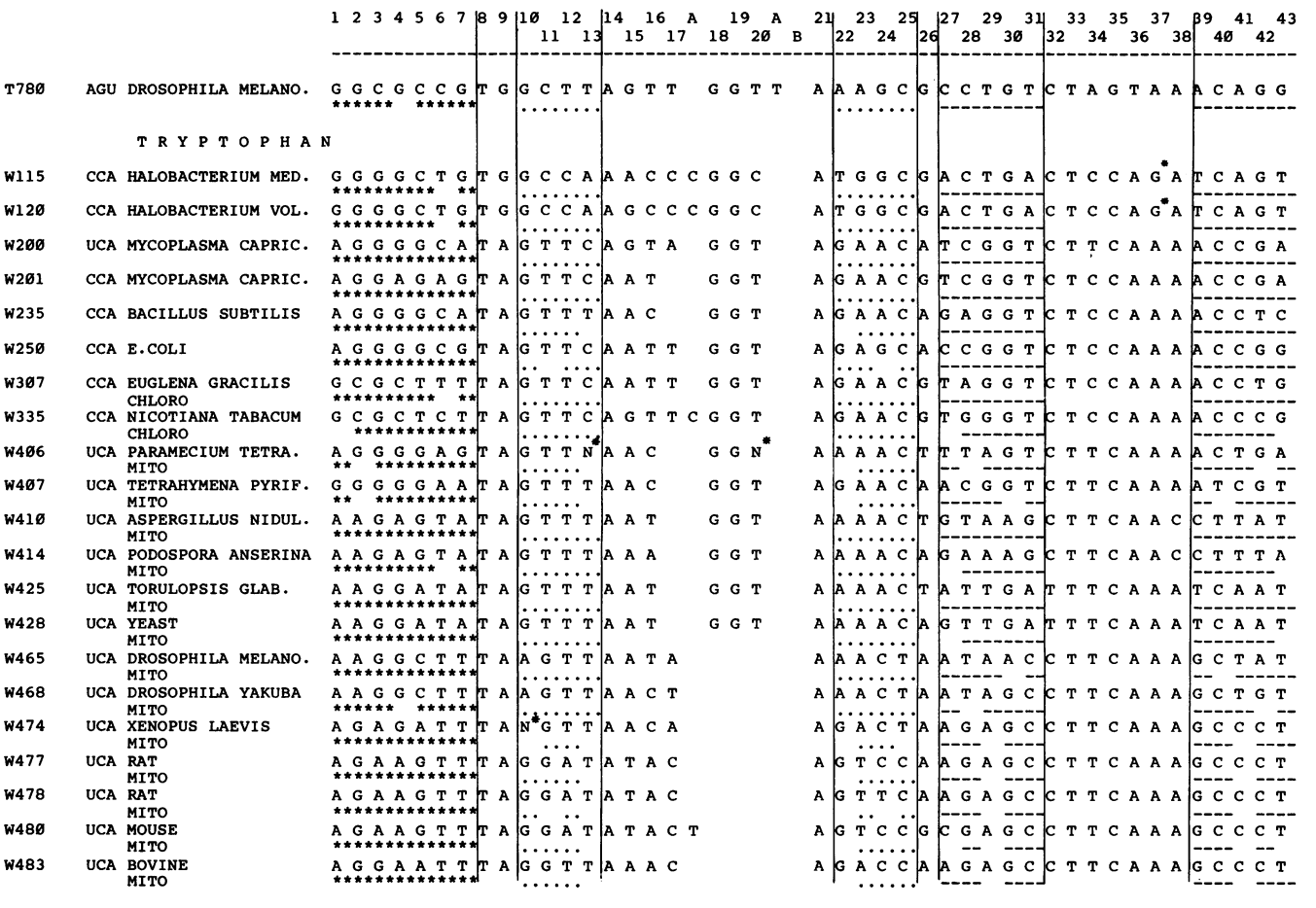
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CHLORO
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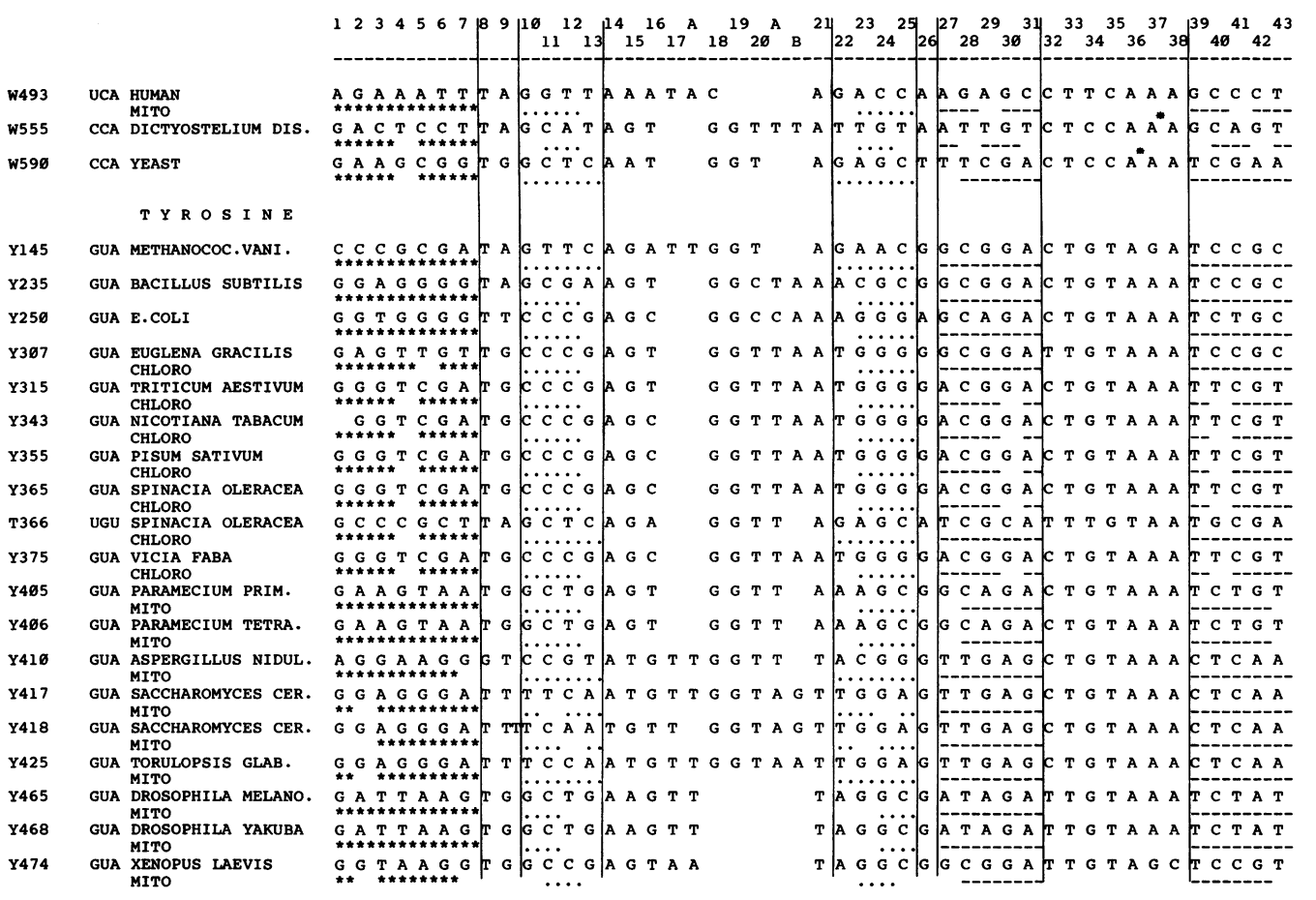
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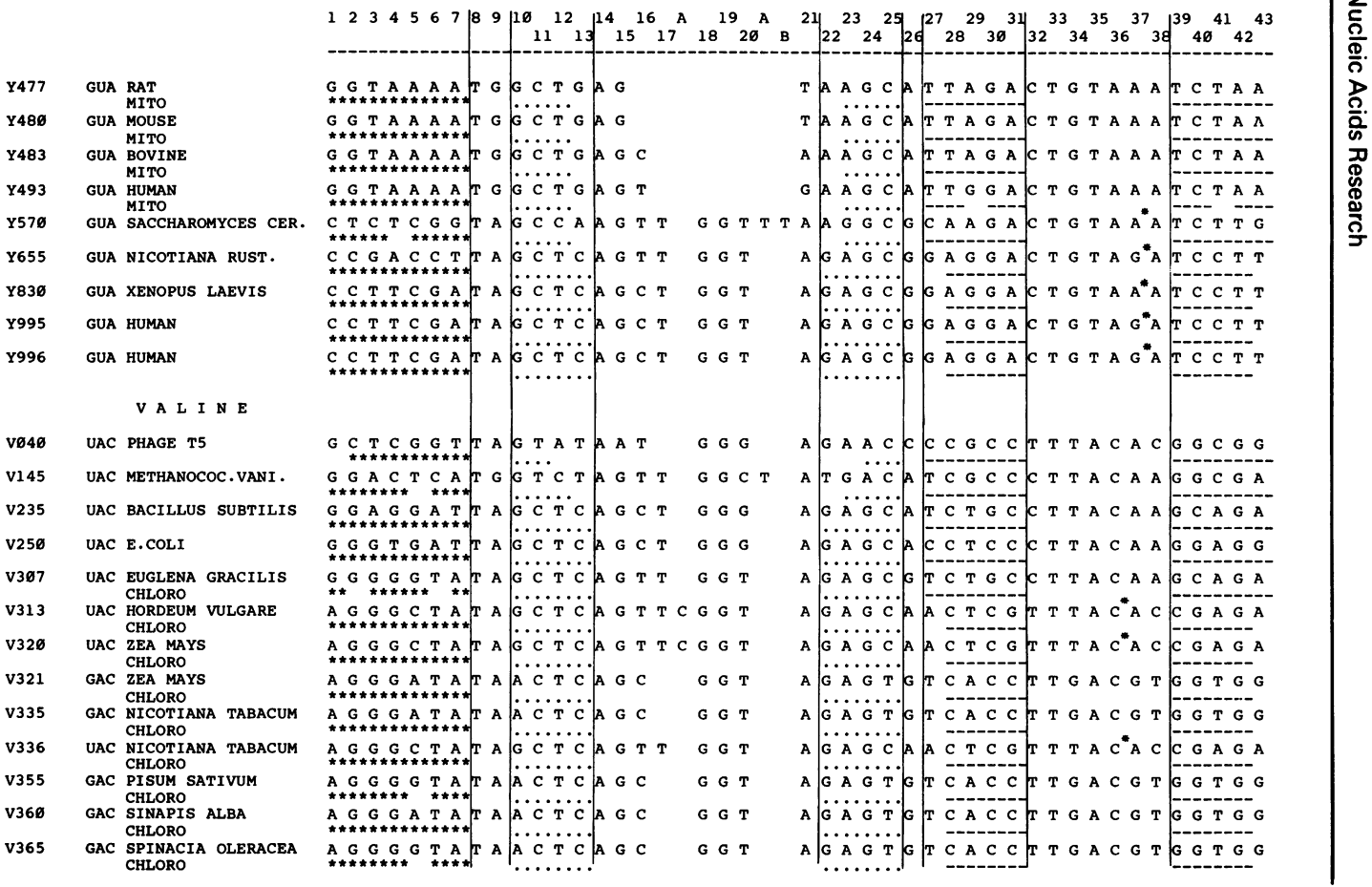
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CHLORO
V336 UAC NICOTIANA TABACUM A G G G C T A T A G C T C A G T T G G T A G A G C A A C T C G T T T A C A C C G A G A
CHLORO
V355 GAC PISUM SATIVUM A G G G G T A T A A C T C A G C G G T A G A G T G T C A C C T T G A C G T G G T G G
CHLORO
V360 GAC SINAPIA ALBA A G G G A T A T A A C T C A G C G G T A G A G T G T C A C C T T G A C G T G G T G G
CHLORO
V365 GAC SPINACIA OLERACEA A G G G G T A T A A C T C A G C G G T A G A G T G T C A C C T T G A C G T G G T G G
CHLORO

45 47 B D F H J L N P
44 46 A C E G I K M O
48 49 51 53 55 57 59 61 63 65 67 69 71 73 75
50 52 54 56 58 60 62 64 66 68 70 72 74 76
VALINE
Y477 A G A C A G G G G T G A G C C C C T T T T A C C A
Y480 A C A C A G A G G T T T A A A T C C T C T T T T A C C A
Y483 A G A T A G A G G T T T G A C T C C T C T T T T A C C A
Y493 A G A C A G G G G T T A G G C C T C T T T T A C C A
Y570 A G A T C G G C G T T C G A C T C G C C C C C G G G A G A
Y655 A G G T C A C T G G T T C G A A T C C G G T A G G T C G G A
Y830 A G G T C G C T G G T T C G A T T C C G G C T C G A A G G A
Y995 A G G T C G C T G G T T C A A T T C C G G C T C G A A G G A
Y996 A G G T C G C T G G T T C G A T T C C G G C T C G A A G G A
V040 T T G T G A T A G T T C G A T T C T A T C A C C G A G T A C C A
V145 G G G T C G C C G G T T C G A A T C C G G C T G G G T C C A
V235 G G G T C G G C G G T T C G A G C C C G T C A T C C T C C A C C A
V250 G G G T C G G C G G T T C G A T C C C G T C A T C A C C C A C C A
V307 A T G T C A G C G G T T C G A A T C C G T T T G C C C T C A
V313 A G G T C T A C G G T T C G A G T C C G T A T A G C C C T A
V320 A G G T C T A C G G T T C G A A T C C G T A T A G C C C T A
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V360 A A G T C A T C A G T T C G A G C C T G A T T A T C C C T A
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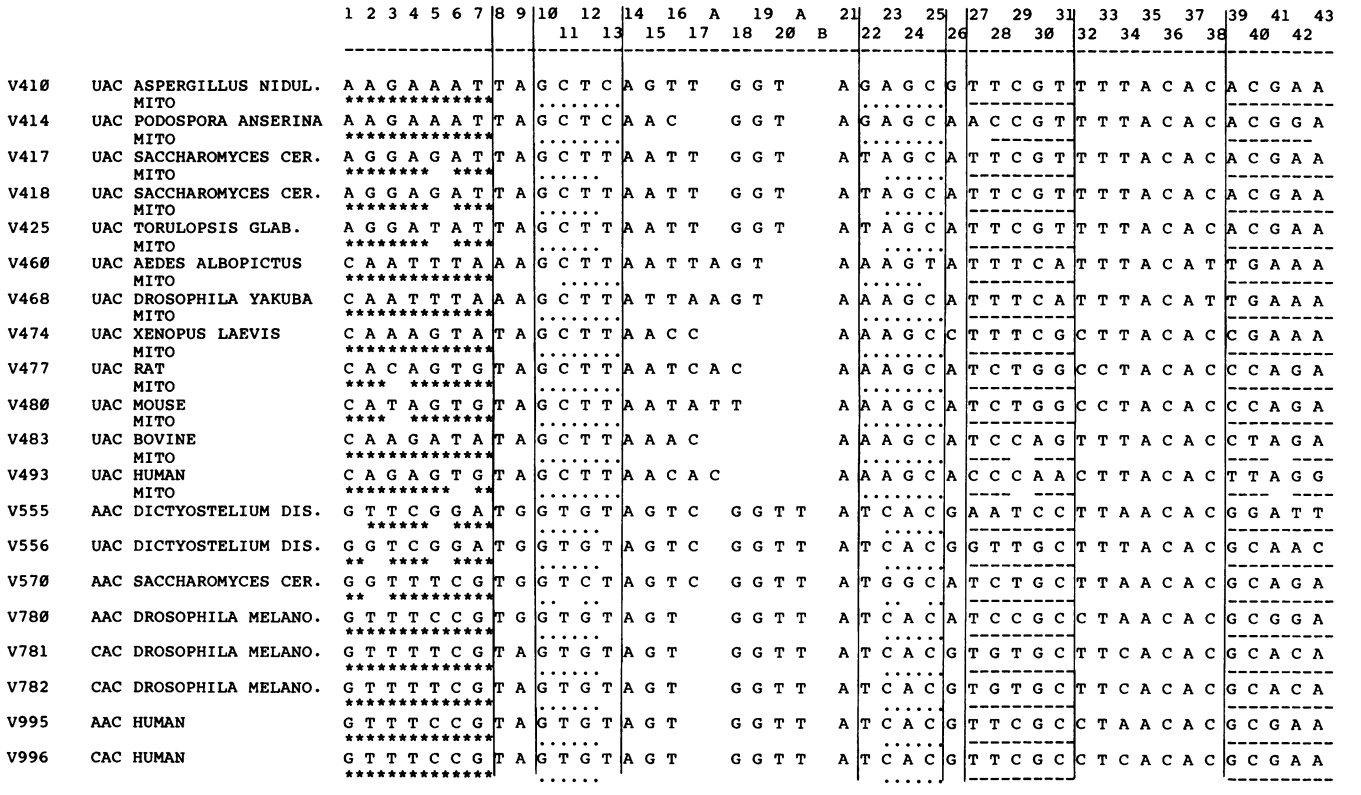
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 A 18 19 20 A B 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43
V410 UAC ASPERGILLUS NIDUL. A A G A A A T T A G C T C A G T T G G T A G A G C G T T C G T T T T A C A C A C G A A
MITO
V414 UAC PODOSPORA ANSERINA A A G A A A T T A G C T C A A C G G T A G A G C A A C C G T T T T A C A C A C G G A
MITO
V417 UAC SACCHAROMYCES CER. A G G A G A T T A G C T T A A T T G G T A T A G C A T T C G T T T T A C A C A C G A A
MITO
V418 UAC SACCHAROMYCES CER. A G G A G A T T A G C T T A A T T G G T A T A G C A T T C G T T T T A C A C A C G A A
MITO
V425 UAC TORULOPSIS GLAB. A G G A T A T T A G C T T A A T T G G T A T A G C A T T C G T T T T A C A C A C G A A
MITO
V460 UAC AEDES ALBOPICTUS C A A T T T A A A G C T T A A T T A G T A A A G T A T T T C A T T T A C A T T G A A A A
MITO
V468 UAC DROSOPHILA YAKUBA C A A T T T A A A G C T T A T T A A G T A A A G C A T T T C A T T T A C A T T G A A A A
MITO
V474 UAC XENOPUS LAEVIS C A A A G T A T A G C T T A A C C A A A G C C T T T C G C T T T A C A C C G A A A A
MITO
V477 UAC RAT C A C A G T G T A G C T T A A T C A C A A A G C A T C T G G C C T A C A C C C A G A A
MITO
V480 UAC MOUSE C A T A G T G T A G C T T A A T A T T A A A G C A T C T G G C C T A C A C C C A G A A
MITO
V483 UAC BOVINE C A A G A T A T A G C T T A A A C A A A G C A T C C A G T T T A C A C C T A G A A
MITO
V493 UAC HUMAN C A G A G T G T A G C T T A A C A C A A A G C A C C C A A C T T A C A C C T T A G G
MITO
V555 AAC DICTYOSTELIUM DIS. G T T C G G A T G G T G T A G T C G G G T T A T C A C G A A T C C T T A A A C A C G G A T T
V556 UAC DICTYOSTELIUM DIS. G G T C G G A T G G T G T A G T C G G G T T A T C A C G G T T G C T T T A C A C G C A A C
V570 AAC SACCHAROMYCES CER. G G T T T C G T G G T C T A G T C G G G T T A T G G C A T C T G C T T A A C A C G C A G A
V780 AAC DROSOPHILA MELANO. G T T T C C G T G G T G T A G T G G G T T A T C A C A T C C G C C T A A C A C G C G G A
V781 CAC DROSOPHILA MELANO. G T T T T C G T A G T G T A G T G G G T T A T C A C G T G T G C T T C A C A C G C A C A
V782 CAC DROSOPHILA MELANO. G T T T T C G T A G T G T A G T G G G T T A T C A C G T G T G C T T C A C A C G C A C A
V995 AAC HUMAN G T T T C C G T A G T G T A G T G G G T T A T C A C G T T C G C C T A A C A C G C G A A
V996 CAC HUMAN G T T T C C G T A G T G T A G T G G G T T A T C A C G T T C G C C T C A C A C G C G A A

F O O T N O T E S

A320/36 AFTER RESIDUE 36,37 OR 38 INTERVENING SEQUENCE OF 806 BP
A335/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 710 BP
R252/0 COMPARE: M.J.FOURNIER, H.OZEKI (1985) MICROBIOL REV. 49, 379-397
N474/58 N IS EITHER G OR A
N474/60 N IS EITHER A OR G
D478/59 N IS EITHER A OR T
D478/60 N IS PROBABLY C
C365/62 N IS EITHER C OR T
G236/20 N IS EITHER A OR T
G314/24 AFTER RESIDUE 24 INTERVENING SEQUENCE OF 677 BP
G316/24 AFTER RESIDUE 24 INTERVENING SEQUENCE OF 676 BP
G335/24 AFTER RESIDUE 24 INTERVENING SEQUENCE OF 691 BP
I320/38 AFTER RESIDUE 38 INTERVENING SEQUENCE OF 949 BP
I335/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 707 BP
I590/37 AFTRE RESIDUE 37 INTERVENING SEQUENCE OF 60 BP
L160/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 15 BP
L318/34 AFTER RESIDUE 34 INTERVENING SEQUENCE OF 450 BP
L320/37 AFTER RESIDUE 34 INTERVENING SEQUENCE OF 458 BP
L336/34 AFTER RESIDUE 34 INTERVENING SEQUENCE OF 503 BP
L376/34 AFTER RESIDUE 34 INTERVENING SEQUENCE OF 451 BP
L560/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 27 BP
L570/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 32 OR 33 BP
L780/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 38 (LEU A) OR 45 (LEU B) BP
K335/38 AFTER RESIDUE 38 INTERVENING SEQUENCE OF 2526 BP
K570/38 AFTER RESIDUE 38 INTERVENING SEQUENCE OF 23 BP
K575/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 8 BP
M635/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 11 BP

X474/0 ELONGATOR AND INITIATOR TRNA MAY ORIGINATE FROM IDENTICAL GENE
X480/0 ELONGATOR AND INITIATOR TRNA MAY ORIGINATE FROM IDENTICAL GENE
X483/0 ELONGATOR AND INITIATOR TRNA MAY ORIGINATE FROM IDENTICAL GENE
X493/0 ELONGATOR AND INITIATOR TRNA MAY ORIGINATE FROM IDENTICAL GENE
F560/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 16 BP
F590/38 AFTER RESIDUE 38 INTERVENING SEQUENCE OF 18 OR 19 BP
S040/0 IN KRYUKOV ET AL. ALIGNMENT DEVIATING
S160/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 25 BP
S236/46 E.F.WAWROUSEK ET AL. FIND FOUR G
S494/57 N IS EITHER A OR G
S575/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 15 BP
S576/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 15 BP
S577/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 16 BP
S590/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 19 BP
S592/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 19 BP
S850/0 UGA SUPPRESSOR TRNA
T252/67 N IS EITHER G OR C
T417/0 A LEUCINE TRNA ENCODES FOR THREONINE
T478/39 N IS EITHER G OR A
T478/59 N IS PROBABLY C
W115/37 AFTER RESIDUE 37 OR 38 INTERVENING SEQUENCE OF 103 BP
W120/37 AFTER RESIDUE 37 OR 38 INTERVENING SEQUENCE OF 105 BP
W406/13 N IS EITHER T OR C
W406/20 N IS EITHER T OR A
W474/10 N IS EITHER G OR T
W555/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 13 BP
W590/36 AFTER RESIDUE 36,37 INTERVENING SEQUENCE OF 34 BP
Y570/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 14 BP
Y655/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 13 BP
Y830/37 AFTER RESIDUE 37 INTERVENING SEQUENCE OF 13 BP
Y995/37 AFTER RESIDUE 37 OR 38 INTERVENING SEQUENCE OF 21 BP
Y996/37 AFTER RESIDUE 37 OR 38 INTERVENING SEQUENCE OF 21 BP
V313/36 AFTER RESIDUE 36,37 OR 38 INTERVENING SEQUENCE OF 597 BP
V320/36 AFTER RESIDUE 36, 37 OR 38 INTERVENING SEQUENCE OF 603 BP
V336/36 AFTER RESIDUE 36 OR 37 INTERVENING SEQUENCE OF 571 BP

A110 I.HUI, P.P.DENNIS (1985) J. BIOL. CHEM. 260, 899-906

A112 A.S.MANKIN, V.K.KAGRAMANOVA (1986) MOL. GEN. GENET. 202, 152-161

A135 K.LECHNER, G.WICH, A.BOECK (1985) SYSTEM. APPL. MICROBIOL. 6, 157-163

A145 M.JARSCH, A.BOECK (1983) NUCL. ACIDS RES. 11, 7537-7544

A203 T.SAMUELSSON, P.ELIAS, F.LUSTIG, Y.S:GUINDY (1985) BIOCHEM. J. 232, 223-228

A206 M.J.ROGERS, A.A.STEINMETZ, R.T.WALKER (1986) NUCL. ACIDS RES. 14, 3145

A235 E.F.WAWROUSEK, N.NARASIMHAN, J.N.HANSEN (1984) J. BIOL. CHEM 259, 3694-3702

A236 K.LOUGHNEY, E.LUND, J.E.DAHLBERG (1982) NUCL. ACIDS RES. 10, 1607-1624
E.F.WAWROUSEK, J.N.HANSEN (1983) J. BIOL. CHEM. 258, 291-298

A237 C.J.GREEN, G.C.STEWART, M.A.HOLLIS, B.S.VOLD, K.F.BOTT (1985) GENE 37,261-266

A238 N.OGASAWARA, S.MORIYA, H.YOSHIKAWA (1983) NUCL. ACIDS RES. 11, 6301-6318

A250 R.A.YOUNG, R.MACKLIS, J.A.STEITZ (1979) J. BIOL. CHEM. 254, 3264-3271

A270 A.RASHTCHIAN, M.SCHAFFER (1986) NUCL. ACIDS RES. 14, 5560-5560

A272 J.FEINGOLD, V.BELLOFATTO, L.SHAPIRO, K.AMEMIYA (1985) J. BACT. 163, 155-166

A290 S.E.WILLIAMSON, W.F.DOOLITTLE (1983) NUCL. ACIDS RES. 11, 225-235
N.TOMIOKA, M.SUGIURA (1984) MOL. GEN. GENET. 193, 427-430

A300 M.SCHNEIDER, J.D.ROCHAIX (1986) PLANT MOL. BIOL. 6, 265-270

A307 L.GRAF, H.KOESSEL, E.STUTZ (1980) NATURE 286, 908-910;
R.B.HALLICK ET AL. (1984) PLANT. MOL. BIOL. 3, 169-175

A308 M.R.EL-GEWELY, R.B.HELLING, J.G.TH.DIBBITS (1984) MOL. GEN. GENET. 194, 432-443

A320 W.KOCH, K.EDWARDS, H.KOESSEL (1981) CELL 25, 203-213

A335 M.SUGIURA, K.SHINOZAKI, M.OHME IN:NATO ASI SER; SER. A 83 (1985) (MOL. FORM FUNCT. PLANT GENOME) 325-334

A410 H.G.KOECHEL, C.M. LAZARUS, N.BASAK, H.KUENTZEL (1981) CELL 23, 625-633

A412 M.R.GREEN, M.F.GRIMM, R.R.GOEWERT, R.A.COLLINS (1981) J. BIOL. CHEM. 256, 2027-2034

A417 S.G.BONITZ, A.TZAGOLOFF (1980) J. BIOL. CHEM. 255, 9075-9081

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A460 D.T.DUBIN, C-C.HSUCHEN, L.E.TILLOTSON (1986) CURR. GEN. 10, 701-707

A468 D.O.CLARY, D.R.WOLSTENHOLME (1985) J. MOL. EVOL. 22,252-271

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R.GROSSKOPF, H.FELDMANN (1981) CURR. GEN. 4, 191-196
G.PEPE ET AL. (1983) BIOCHEM. INT. 6, 553-563
M.TAIRA ET AL. (1983) NUCL. ACIDS RES. 2, 1635-1643

A480 M.J.BIBB, R.A.VAN ETTEN, C.T.WRIGHT, M.W.WALBERG, D.A.CLAYTON (1981) CELL 26, 167-180

A483 S.ANDERSON ET AL. (1982) J.MOL.BIOL. 156, 683-717

A493 S.ANDERSON ET AL. (1981) NATURE 290, 457-465

A570 H.J.DRABKIN, U.L.RAJBHANDARY (1985) J. BIOL. CHEM. 260, 5596-5602

A770 O.HAGENBUECHLE, D.LARSON, G.I.HALL, K.U.SPRAGUE (1979) CELL 18, 1217-1229
R.L.GARBER, L.P.GAGE (1979) CELL 18, 817-828
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A780 R.DELOTTO, P.SCHEIL (1984) J. MOL. BIOL. 179, 587-605

R020 J.BROIDA, J.ABELSON (1985) J. MOL. BIOL. 185,545-563

R145 G.WICH, L.SIBOLD, A.BOECK (1986) SYSTEM. APPL. MICROBIOL. 7, 18-25

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R255 L.BOSSI (1983) MOL. GEN. GENET. 192, 163-170

R307 R.B.HALLICK ET AL. (1984) PLANT. MOL. BIOL. 3, 169-175

R315 C.J.HOWE (1985) CURR. GEN. 10, 139-145

R320 D.DORMANN-PRZYBYL, G.STRITTMATTER, H.KOESSEL (1986) PLANT MOL. BIOL. 7, 419-431

R335 A.KATO, F.TAKAIWA, K.SHINOZAKI, M.SUGIURA (1985) CURR. GEN. 9,405-409

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R355 D.R.SHAPIRO, K.K.TEWARI (1986) PLANT MOL. BIOL. 6, 1-12

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RES. 10, 4783-4794
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I236 C.J.GREEN, G.C.STEWART, M.A.HOLLIS, B.S.VOLD, K.F.BOTT (1985) GENE 37,261-266
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I300 M.SCHNEIDER, J.D.ROCHAIX (1986) PLANT MOL. BIOL. 6, 265-270
I305 T.YAMADA, M.SHIMAJI (1986) NUCL. ACIDS RES. 14, 3827-3839
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I335 M.SUGIURA, K.SHINOZAKI, M.OHME IN:NATO ASI SER; SER. A 83 (1985) (MOL. FORM FUNCT. PLANT GENOME) 325-334
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I480 M.J.BIBB, R.A.VAN ETTEN, C.T.WRIGHT, M.W.WALBERG, D.A.CLAYTON (1981) CELL 26, 167-180
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L309 A.MONFORT, B.RUTTI E.STUTZ (1986) NUCL. ACIDS RES. 14, 3971-3971
L318 D.P.MA, J.DOEBLEY (1986) GENE 43, 169-174
L320 A.STEINMETZ, E.J.GUBBINS, L.BOGORAD (1982) NUCL. ACIDS RES. 10, 3027-3037
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L336 K.YAMADA, K.SHINOZAKI, M.SUGIURA (1986) PLANT MOL. BIOL. 6, 193-199
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L478 G.SACCONE ET AL. (1981) NUCL. ACIDS RES. 9, 4139-4148
L480 M.J.BIBB, R.A.VAN ETTEN, C.T.WRIGHT, M.W.WALBERG, D.A.CLAYTON (1981) CELL 26, 167-180
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L830 G.GALLI, H.HOFSTETTER, M.L.BIRNSTIEL (1981) NATURE 294, 626-631
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K850 S.WITTIG, B.WITTIG (1982) NATURE 297, 31-38
K950 J.H.HAN, J.D.HARDING (1983) NUCL. ACIDS RES. 11, 2053-2064
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M203 T.SAMUELSSON, P.ELIAS, F.LUSTIG, Y.S.GUINDY (1985) BIOCHEM. J. 232, 223-228
M206 M.J.ROGERS, A.A.STEINMETZ, R.T.WALKER (1986) NUCL. ACIDS RES. 14, 3145
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M236 C.J.GREEN, G.C.STEWART, M.A.HOLLIS, B.S.VOLD, K.F.BOTT (1985) GENE 37,261-266
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M313 G.ZURAWSKI, M.T.CLEGG (1984) NUCL. ACIDS RES. 12, 2549-2559
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M411 H.G.KOECHEL, C.M.LAZARUS, N.BASAK, H.KUENTZEL (1981) CELL 23, 625-633
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X206 M.J.ROGERS, A.A.STEINMETZ, R.T.WALKER (1986) NUCL. ACIDS RES. 14, 3145-3145
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X250 S.ISHII ET AL. (1984) NUCL. ACIDS RES. 12, 3333-3342
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X312 K.UMESONO, H.INOKUCHI, K.OHYAMA, H.OZEKI (1984) NUCL. ACIDS RES. 12, 9551-9565
X313 R.P.OLIVER, C.POULSEN (1984) CARLSBERG RES. COMMUN. 49, 647-673
X315 F.QUIGLEY, J.H.WEIL (1985) CURR. GEN. 9, 495-503
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X440 M.GOTTSCHALK, A.BRENNICKE (1985) CURR. GEN. 9,165-168
X452 M.W.GRAY, D.F.SPENCER (1983) FEBS LETTERS 161, 323-327
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X571 A.M.CIGAN, T.F.DONAHUE (1986) GENE 41, 343-348
X575 H.AMSTUTZ, P.MUNZ, W.D.HEYER, U.LEUPOLD, J.KOHLI (1985) CELL 40, 879-886
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F206 M.J.ROGERS, A.A.STEINMETZ, R.T.WALKER (1986) NUCL. ACIDS RES. 14, 3145-3145
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F407 Y.SUYAMA (1985) NUCL. ACIDS RES. 13,3273-3284
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