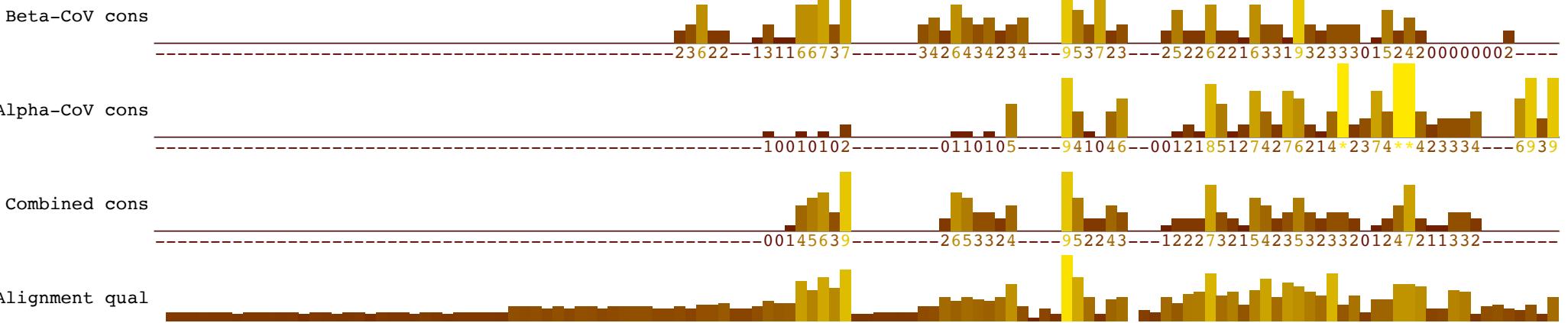
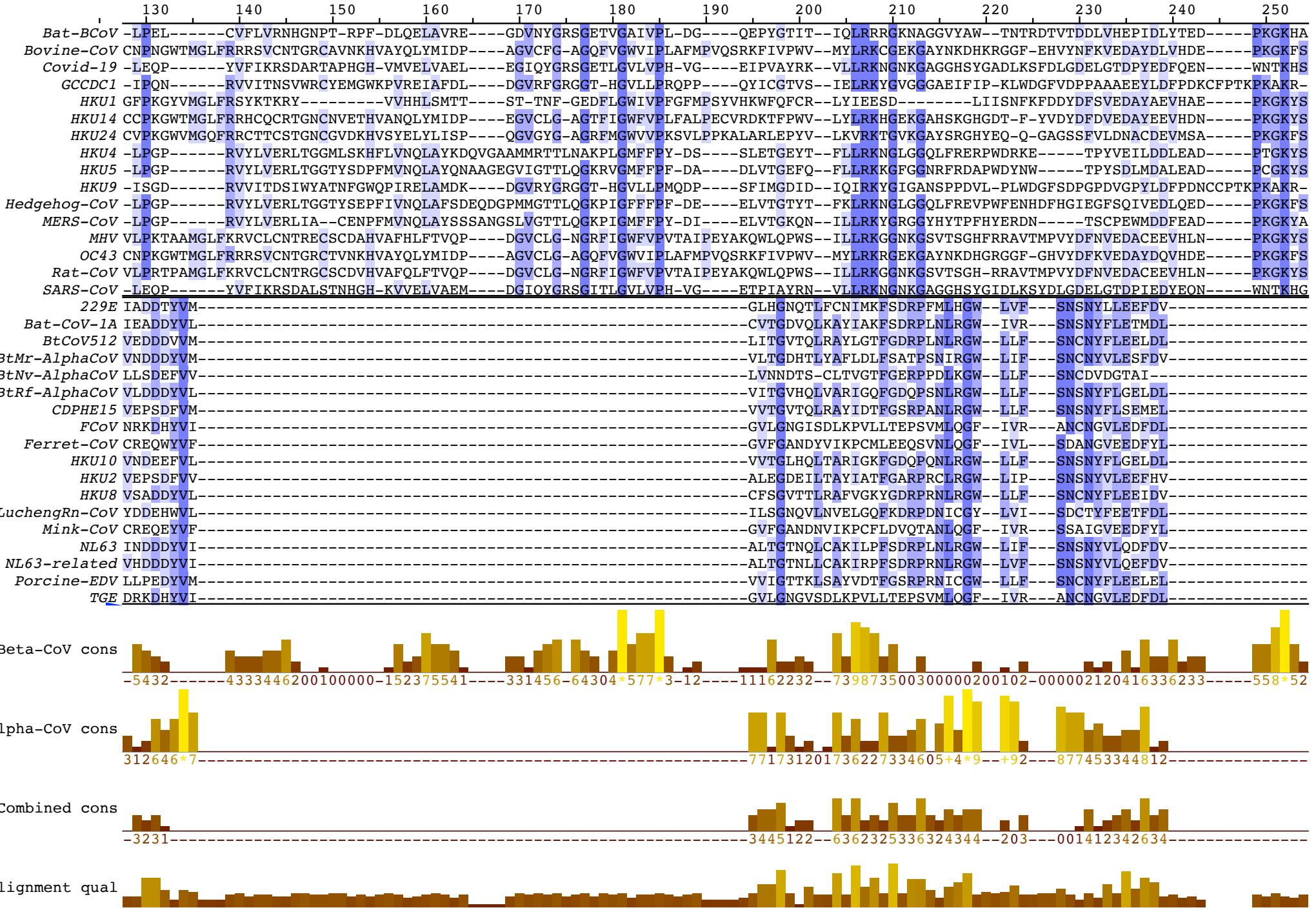
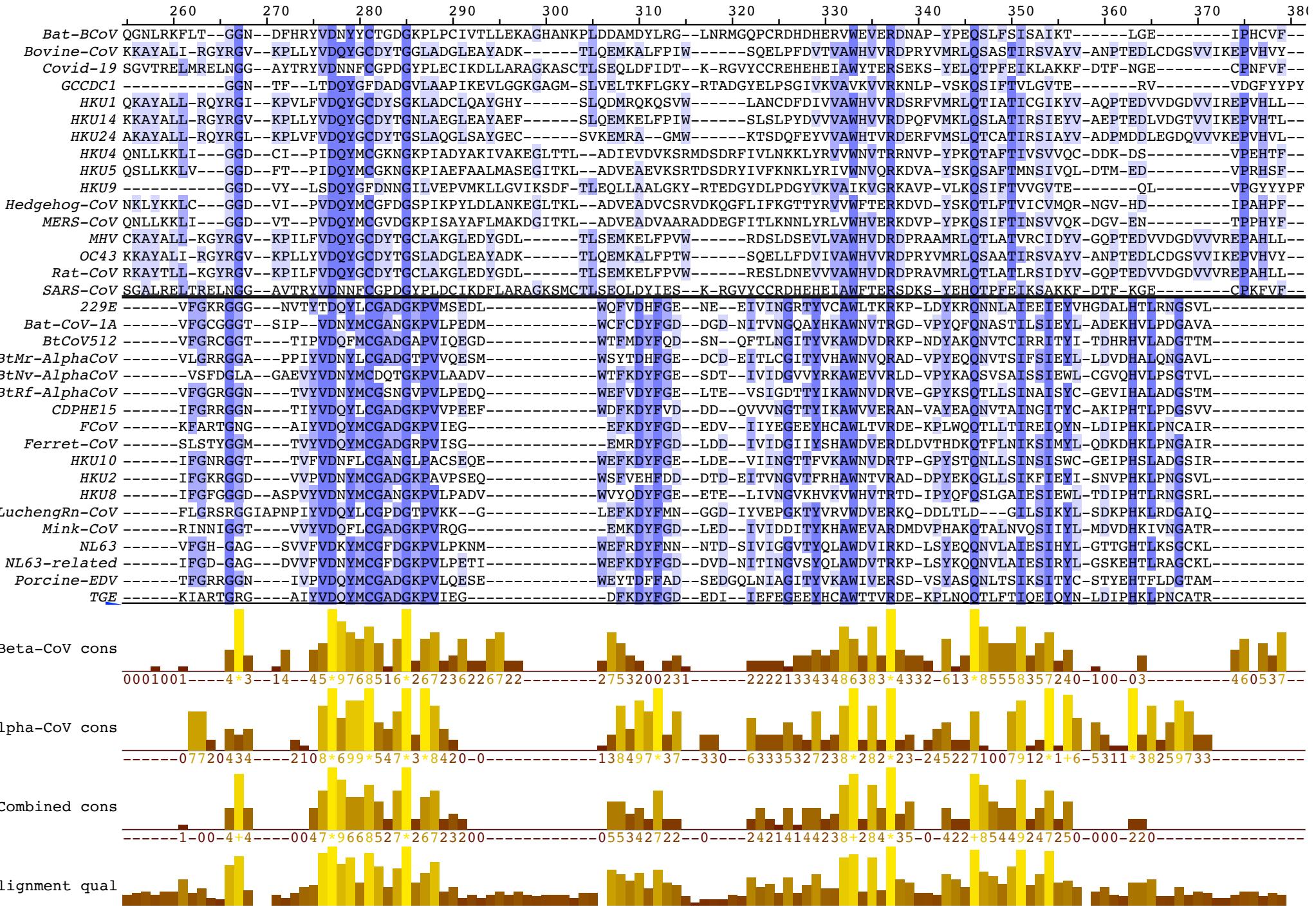


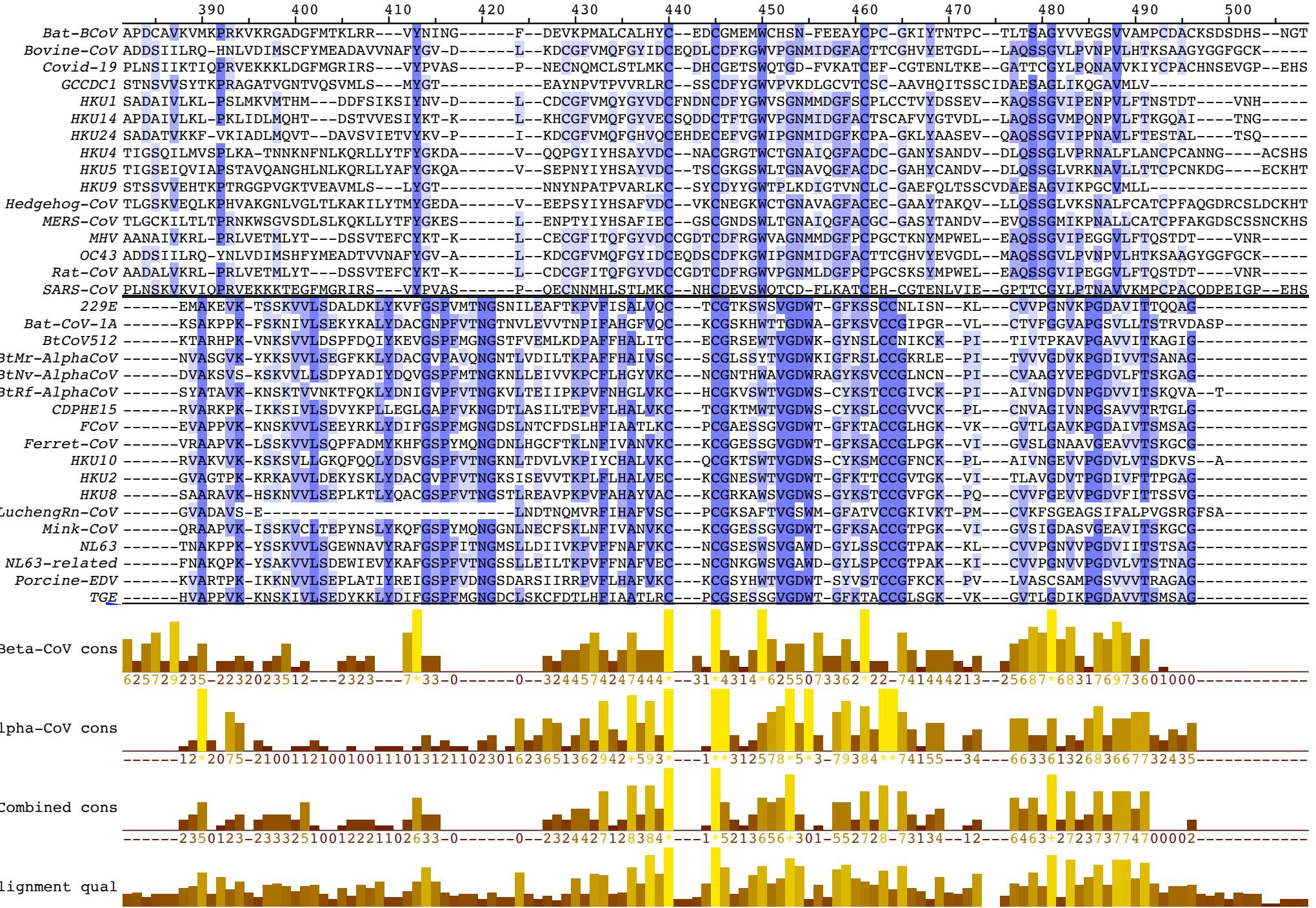
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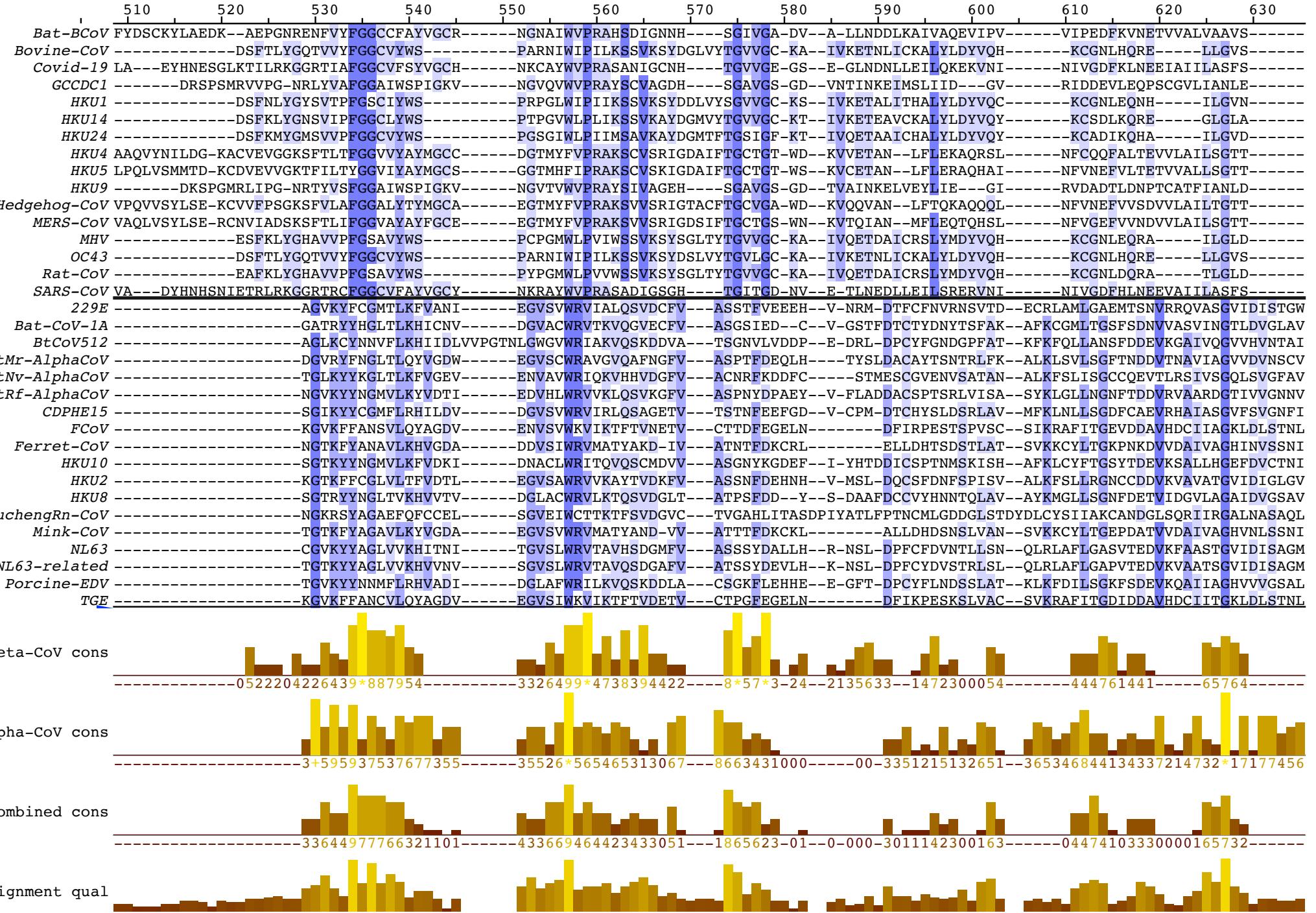


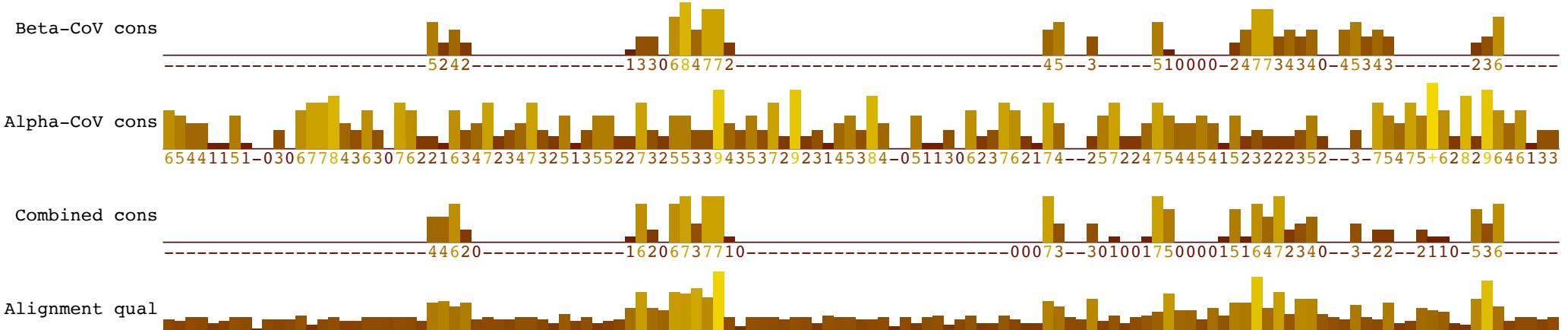
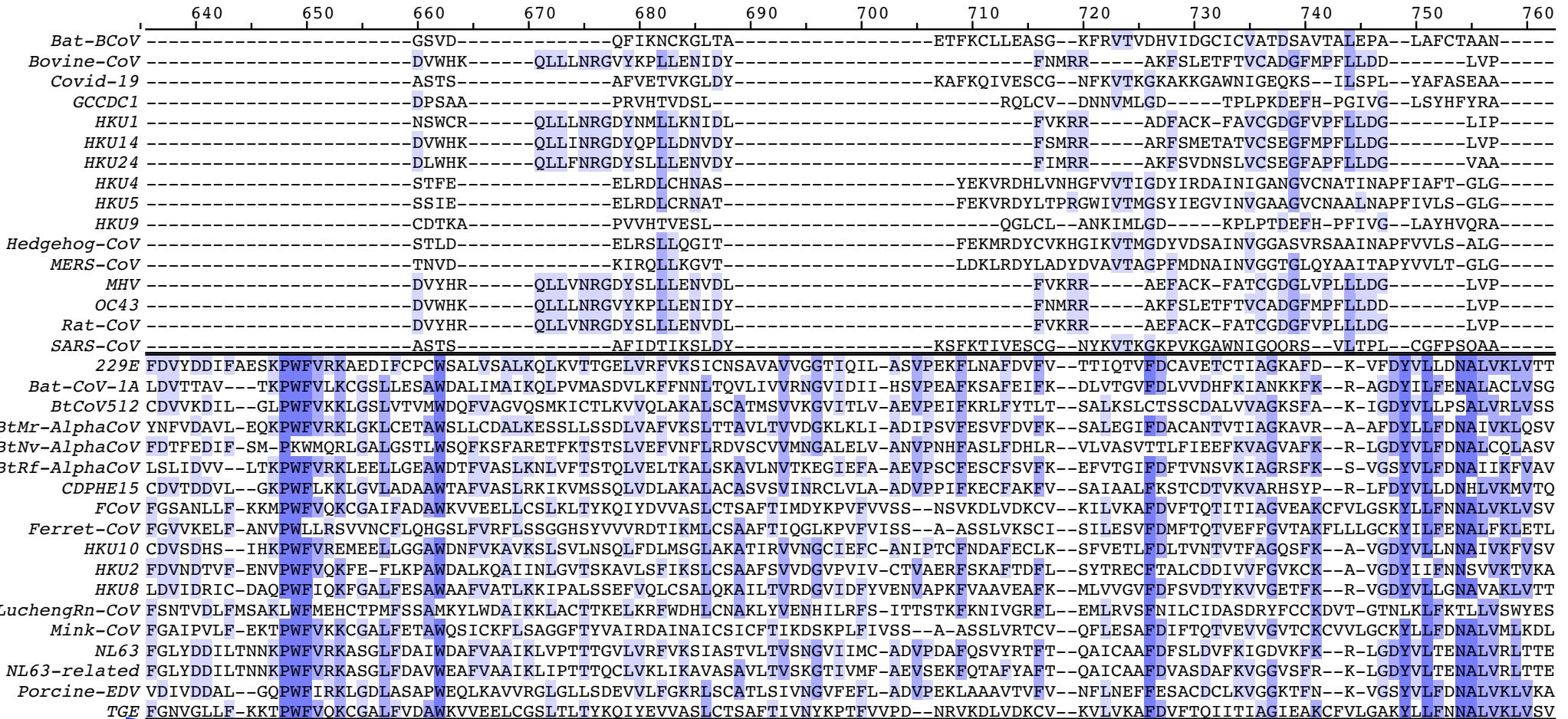






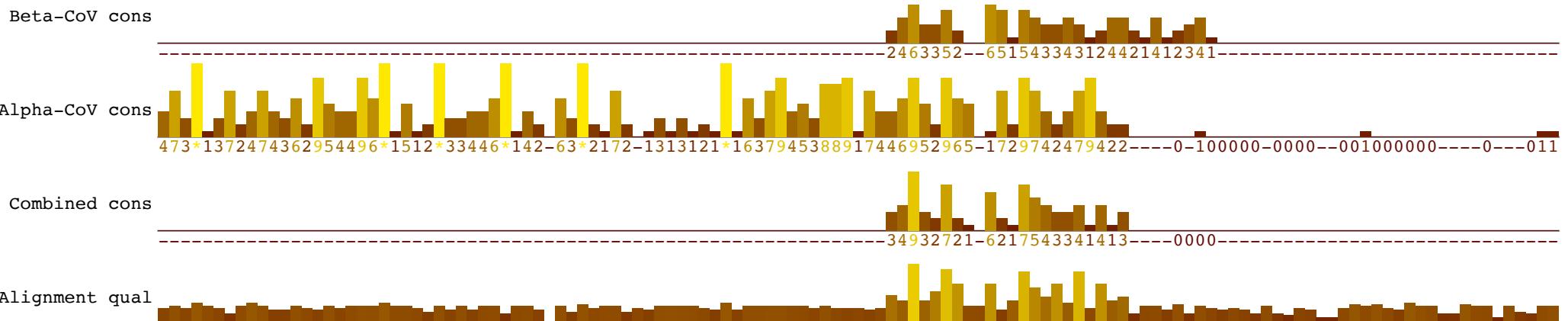


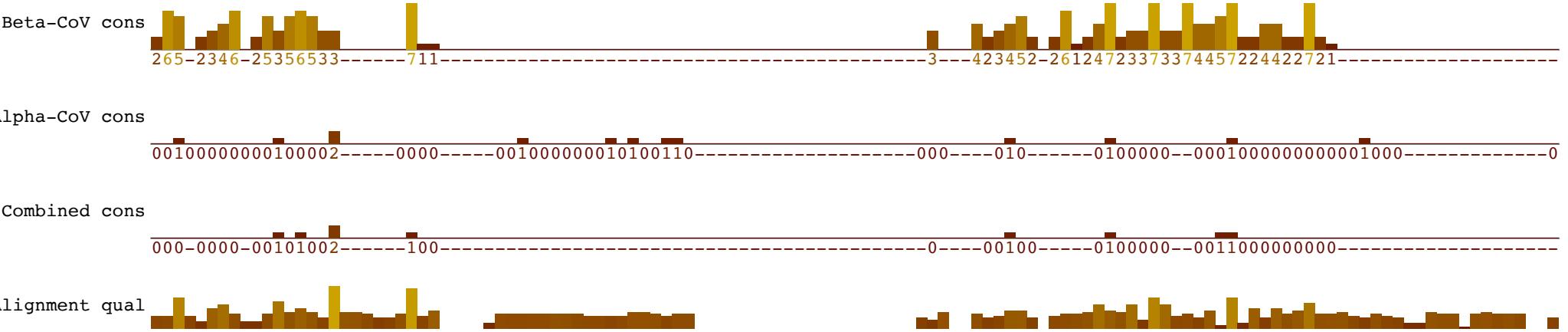
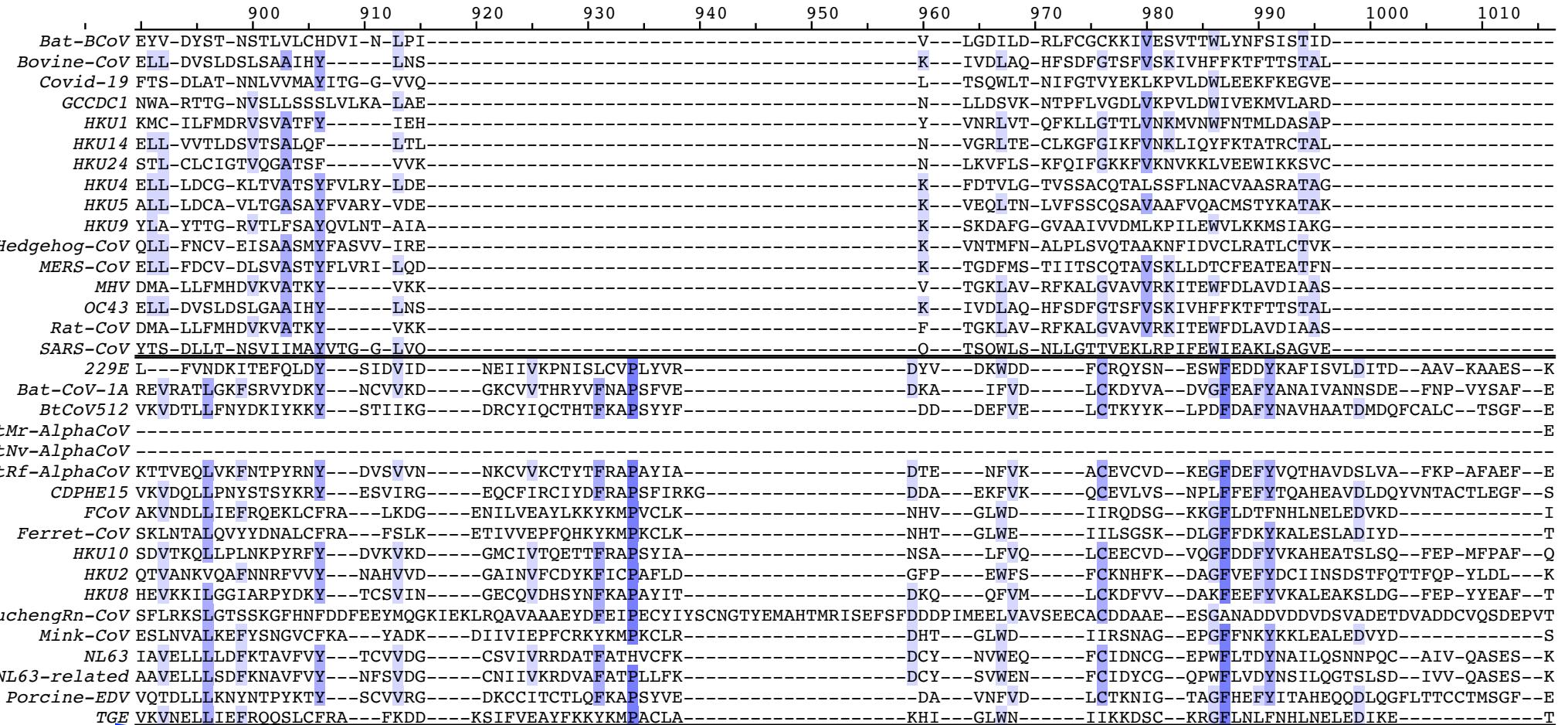


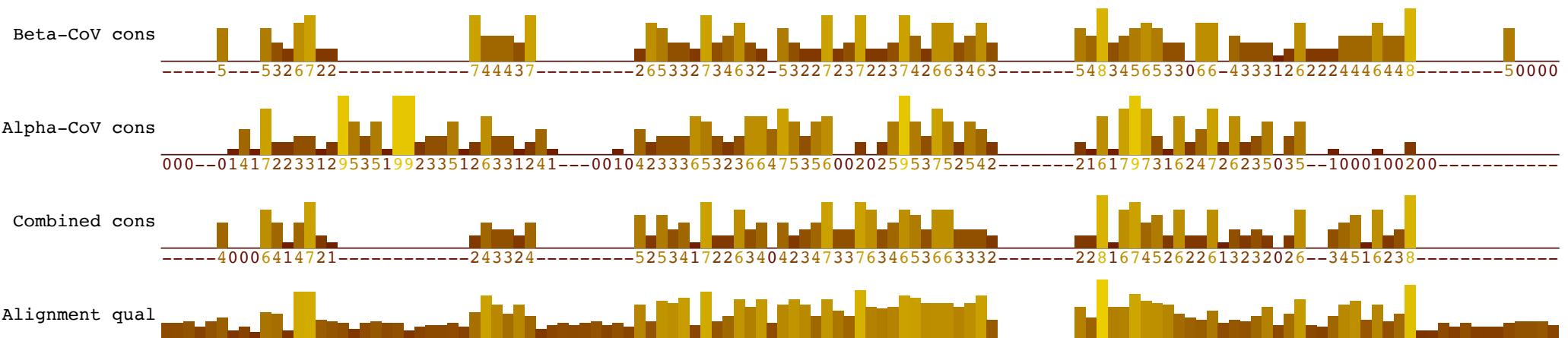
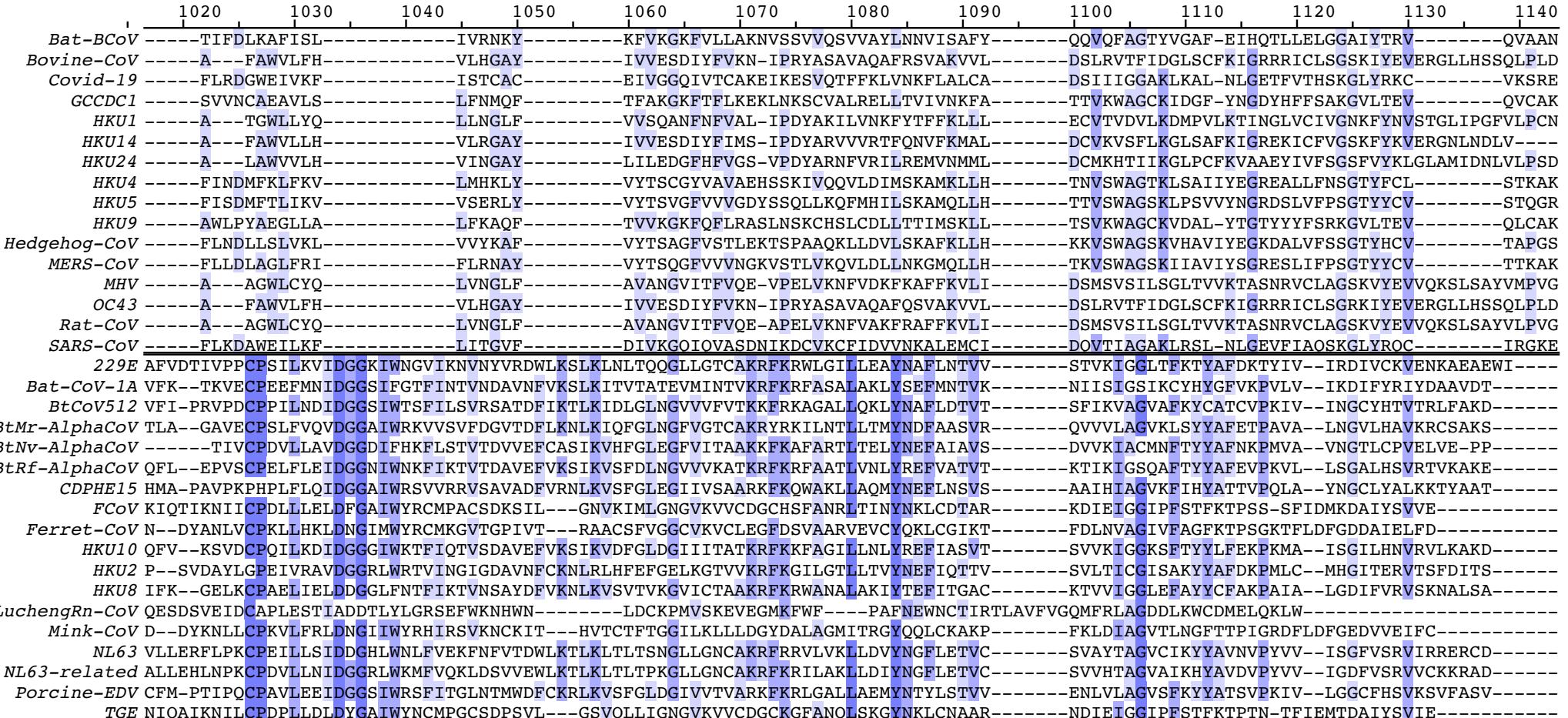


Bat-BCoV 770 - 880
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 Covid-19
 GCCDC1
 HKU1
 HKU14
 HKU24
 HKU4
 HKU5
 HKU9
 Hedgehog-CoV
 MERS-CoV
 MHV
 OC43
 Rat-CoV
 SARS-CoV
 229E
 Bat-CoV-1A
 BtCoV512
 BtMr-AlphaCoV
 BtNv-AlphaCoV
 BtRf-AlphaCoV
 CDPHE15
 FCoV
 Ferret-CoV
 HKU10
 HKU2
 HKU8
 LuchengRn-CoV
 Mink-CoV
 NL63
 NL63-related
 Porcine-EDV
 TGE

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 RAYYLAV--SGQAFCDYADKICHAVVSKSK--
 RVVRSIFSRTLETAQNSVRVLQKAATILDGISQYSLRL--I--DAMM
 CWYGVLTAKSFGAFKELLQSEEVRLSHFCANI--RRC--L--DRAL
 RSYYLIQ--SGIFFTSLMSQFSQEVSMDCL--
 RTYYLVK--SGQAFCDMLCEFGQEVADLSK--
 RAYYINCCLSAPGLPESLCKLGIEVGWSWCQ--
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 ESFKVAATPWKLCSSLRETLDHYADSITYRVFPYDIPC--D--VTDYT
 CWYGALASRTFEAFRDFVRTEERFAQFFGKV--CAP--I--NGCV
 ESFKKIAAVPFKVGSSFLKTWEYLSDCIVYRVLPLYELE--D--VSDFV
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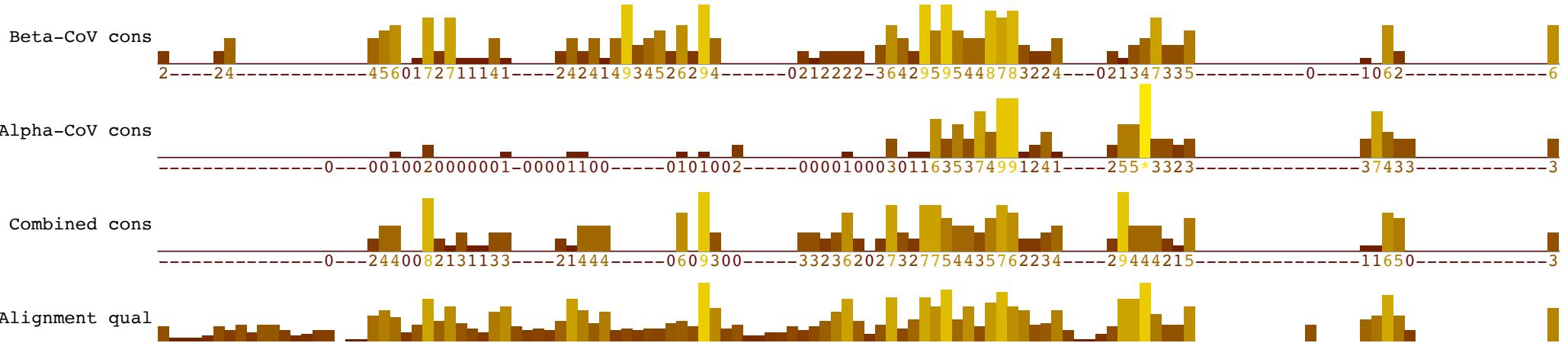


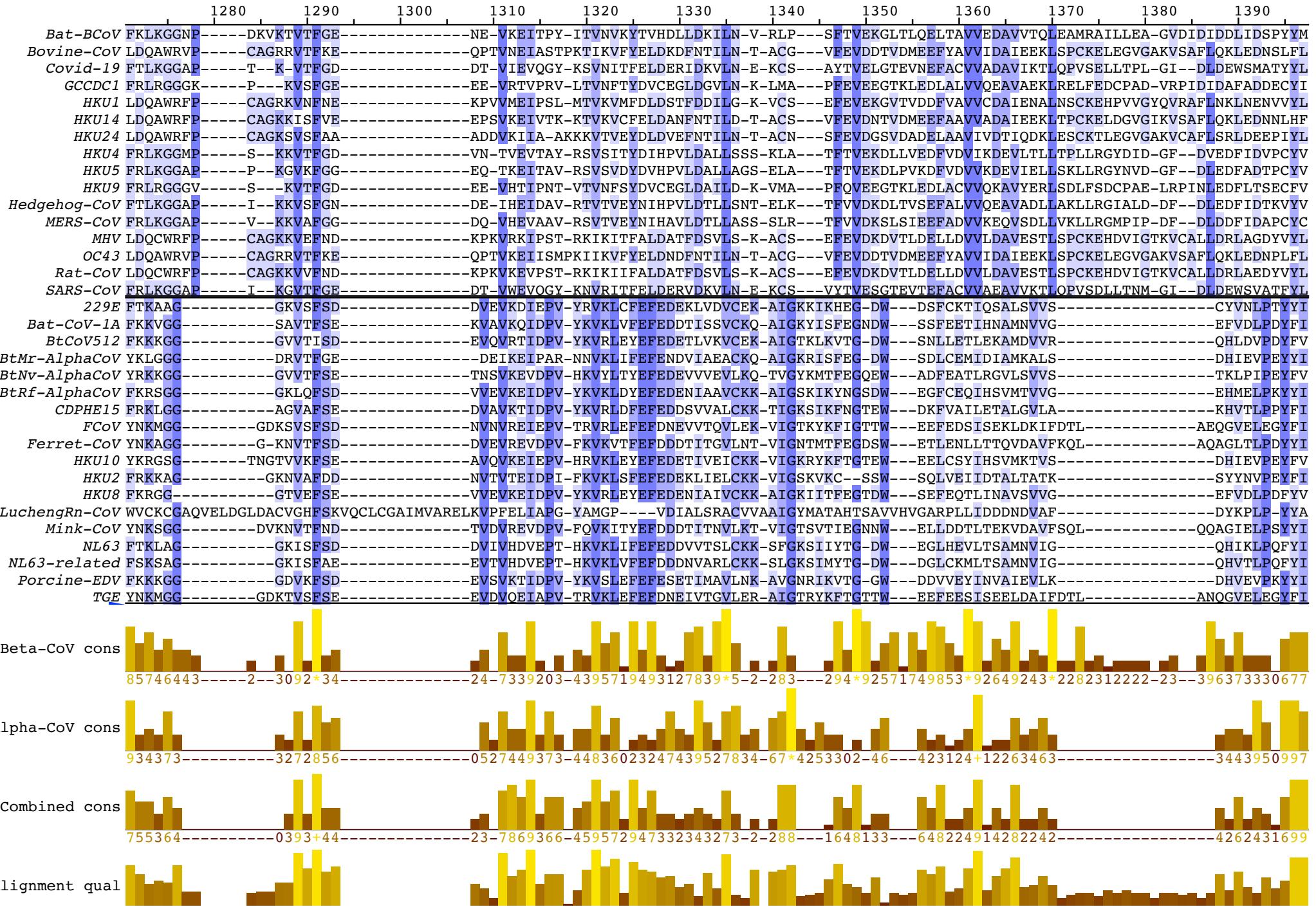


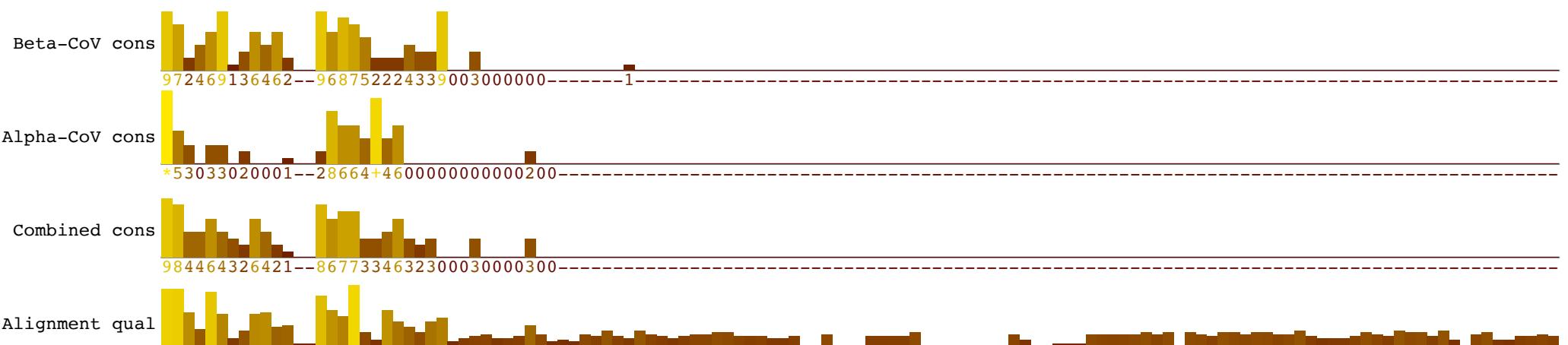
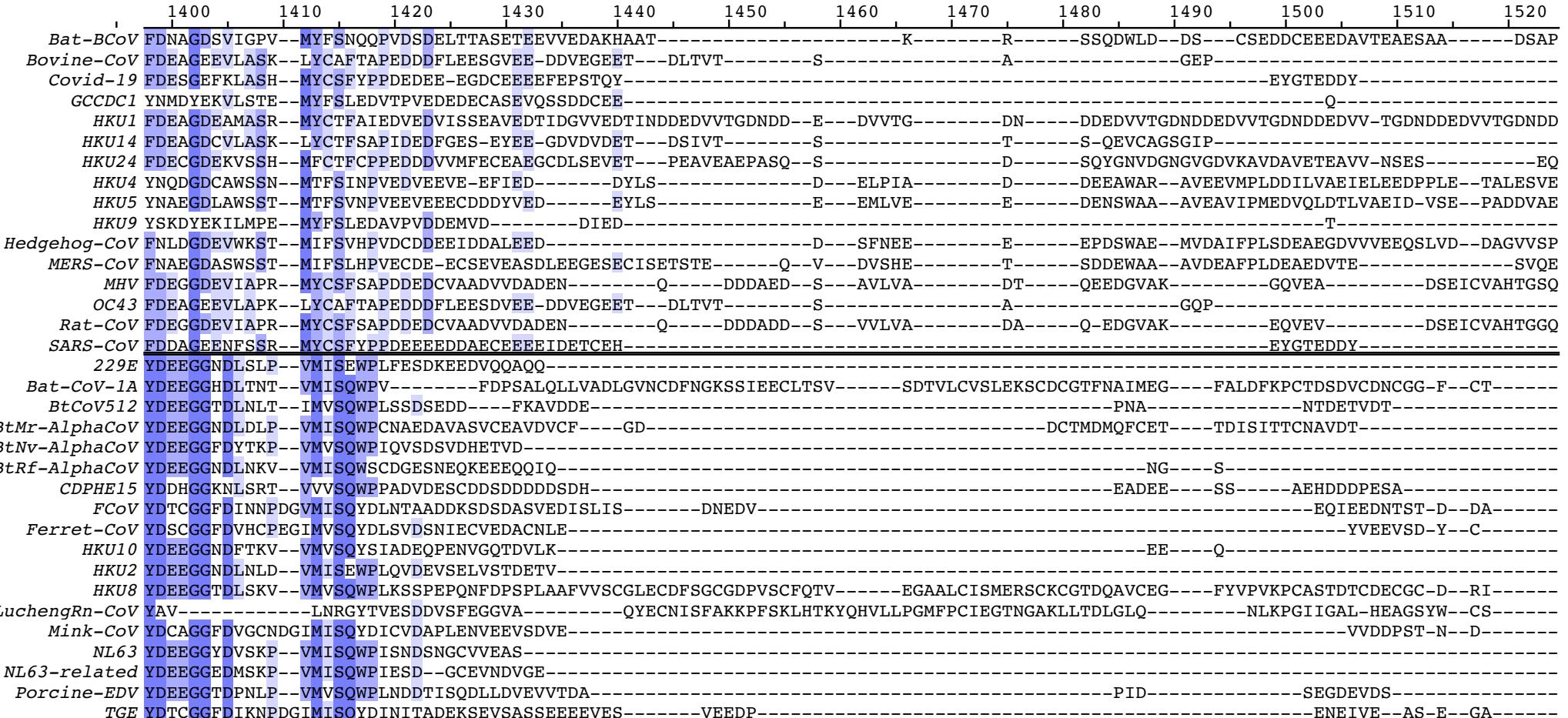


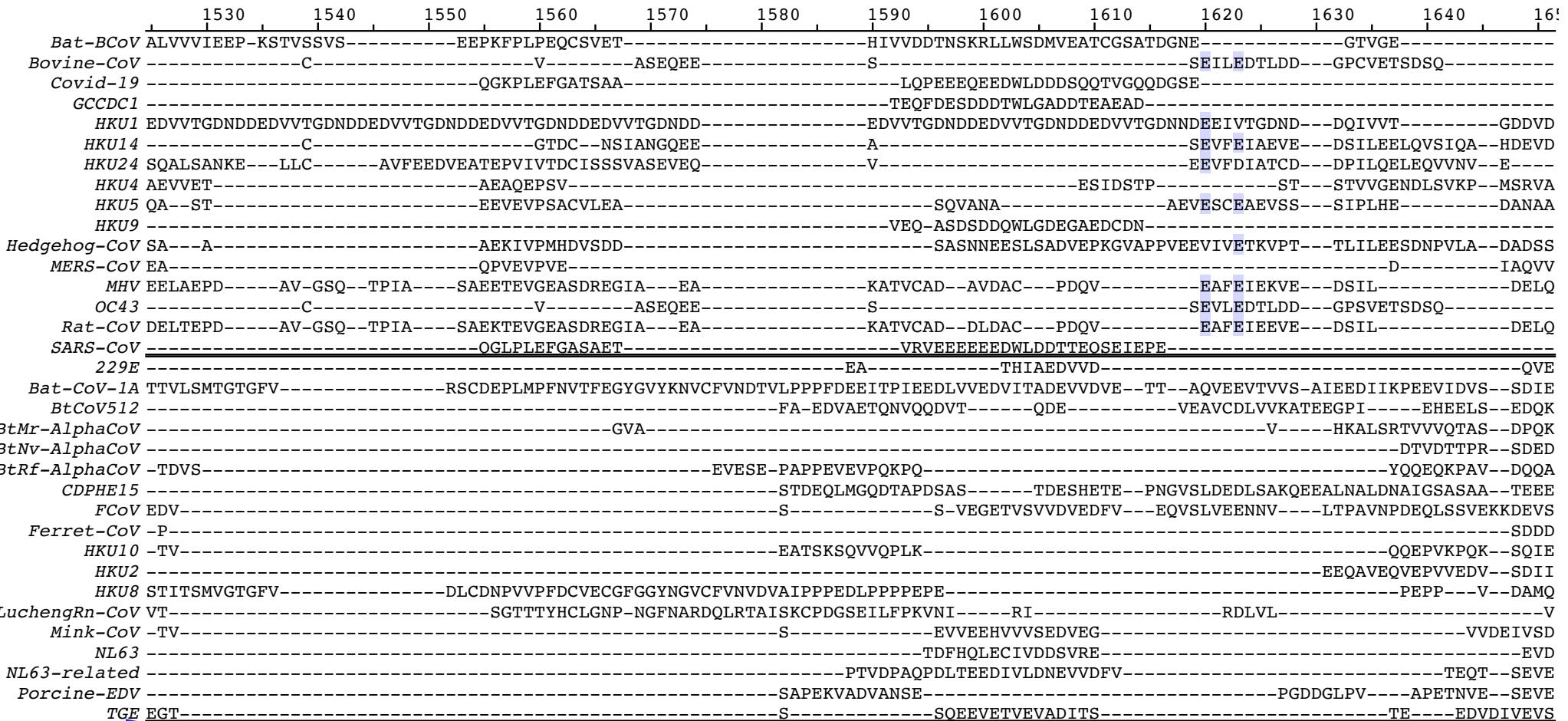
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<i>Bat-BCoV</i>	S---IQDLVLPSTVSK---KELTFVDGHAI DT---ELTSEEVTLEGIV EQLDTDTN KIAGDSIKGDLTVNNCVFVRFGDG---NL-SPATTD	C---QATKG---V
<i>Bovine-CoV</i>	V---YDLTMPSQVQK-AKQKPIYLKGSGSDF---SLADSVVVTTSLTPC---GYSEPPK-VADKICIVDNVYMAKAG---DKYYPV VVD	GHVG---L
<i>Covid-19</i>	E---TGLLM-PLKAP---KEIIFLEGETLPT---EVLTTEEVV LKTGDLQPLQOPTSEAPEALVGT P CINGLM LLEIKDT---EKYCALAPN	MVTNN---T
<i>GCCDC1</i>	T---LGAMLTPRQR---MEVEVLDGKYDAP---VAITVPELEELNGTLEEVFG---FDDLT LVRGS LVALASKVFVRTDDG---LLFRYVKSG	G---V-FLK---A
<i>HKU1</i>	A---QE---QQIYFFEGVAESV---IVEDDVIENVKSSLSSY---EYCQPPK-SVEKICII DNM YM GKG C---DKFFPIVMN	D---KNIC---L
<i>HKU14</i>	R---RDILVVPSVTQRAKNQQPVYLTGNACPV---NVDDD VVVEV TNPV TSC---GYQKPPQ-KCDKICIVDNVYMAKCG---EKFFPV VVN	E---DYIG---L
<i>HKU24</i>	M---IQ---SELLAHGDVIPV---TLESEVVEVV KQPLKPL---GYRKPPM-KAARLCVVDNL YMAQNG---DCLYPVIFD	G---ORIG---L
<i>HKU4</i>	TLQGQMLVLPGDYNK---KTLGILD PVPNA D T D V N A N S T V V D V V H G Q L E ---PTNEHGP SMIVGN YV L V S D K L F V R T E D E ---EFYPLCTN	G---KVVST---L
<i>HKU5</i>	SLQDQFDL V I P G D L S K ---KQIGI LEPTPN S T T V D K K I N T N V V E V V V G Q L E ---PTKEHSPELVVGDYVIISNK I F V R S V E D S E T V F Y P L C T D	G---KIVPT---L
<i>HKU9</i>	R---LGLLLTPKQ QK---MEVEVLDGDFDAP---VTLTDLE ECTGV LEEVFG---ASDV KLVKG TL VSL ASK L F V R T E D G ---FLYRYVKSG	G---V-LGK---A
<i>Hedgehog-CoV</i>	V V G A H L E A T I P G E V V K ---KQLSM I T A T N Y S T T V D V R P K T R N V E L V Y G Q L E ---TTNMHS PD V V V G D Y V I V S D K V F V R S E E D G R L A F Y P M C T N	G---KAVPC---M
<i>MERS-CoV</i>	SVQQDLDVILPGEFSK---KQLGLLQPTD N S T T V S V T V S S N M V E T V V G Q L E ---QTNMHS PD V I V G D Y V I I S E K L F V R S K E E D G F A F Y P A C T N	G---HAVPT---L
<i>MHV</i>	C---SE---ATC---LVGEIEPA---VFEDDV V DV KAPL TYQ---GCCKPPT-SFEKICIVDKLYMAKCG---DQFYPV VVD	N---DTVG---V
<i>OC43</i>	V---YDLTMPSQVQK-AKQKPIYLKGSGSDF---SLADSVVVTTSLTPC---GYSEPPK-VAAKICIVDNVYMAKAG---DKYYPV VVD	DHVG---L
<i>Rat-CoV</i>	C---SE---ATC---LVGESEPA---VFEDDV V DV KAPL TYQ---GCCKPPT-SFEKICIVDKLYMAKCG---DQFYPV VVD	N---DTVG---V
<i>SARS-CoV</i>	O---LOLLM-PLKAP---KEVTFLEGDSHDT---VLTSEEV L K N G E L E A L E T P V D S F T N G A I V G T P V C V N G L M L L E I K D K ---EOYCALSPG	L---LATNN---V
	229E---ELFPHNDR I---KSFS T F E S A Y M P I A D P T H F D I E ---EVELLDA---EFV EP G C G G I L A V I D E H V F Y K K D G ---VYYPSNGT	NILPV---A
<i>Bat-CoV-1A</i>	FNVAVEAGL---NTVKTFSGGENP I-TFSRVEVA---SVELEHA---EYV K P E A N G H V S V I N G H T F Y T C G D ---Y Y Y P C D Q N	NCFSQ---C
<i>BtCoV512</i>	LQIPTEDGV---ADFNTFHCVFPV-NPTRIETD---SLEEEV---DFV EP G V D G K L V I L D D Y S F Y S D G T ---N Y Y P S D G K	G V V A S ---C
<i>BtMr-AlphaCoV</i>	LDVPCCEGA---AEFN V F E G V H L L -KPTA VELA---SDMELLET---D Y V EP C A G G V L R I C D D Y A W Y M D G D ---R F Y P Y G D N	G V I P L ---C
<i>BtNv-AlphaCoV</i>	SDVSKEALV---TDFMVFKSPDTHV-KPIRIETE---SCELHEV---DFV T P R D G G V V K I I D G Y A F Y E S N G ---N Y Y P S S V D	G V K N V ---T
<i>BtRf-AlphaCoV</i>	LNLSVQDV V---V E F N V F D G A T V E V -TPK R V E K E ---EVS LEEV---E F I P P V S N G S I A V V D G Y S F Y S C G D ---L Y Y P S N E N	AVVPL---C
<i>CDPHE15</i>	VGLQTEEGV---DGFYAFDH C Q L P V -T P R L L Q V E ---D V N L E E A ---D F K P P V G G G C V A V I N G Y S F Y V E G D ---S Y Y P T D C S	A I H S L ---R
<i>FCoV</i>	Y---GEALSF K T A S V P V T N S G I I T T D D W -S D P I L L E P A ---D Y V EP K D N G D V I V I A G Y T F Y K D E D ---D H F Y P Y G S G	M V V Q K ---M
<i>Ferret-CoV</i>	D---EPVRCFTGATV P V N V S D F E D D V R -G D V V -L E E C ---E Y Q P P R D E G I V V N L G G Y T F Y T T D N ---E K F Y P F G D C	K V V P K ---L
<i>HKU10</i>	CTIAAEDIL---VEMTVFDSF E I P I -QPSRVEVQ---Q V E F E E A ---E F V Q P Q A G G V L A V V N K H V F Y N K G D ---Y Y Y P A N E T	H A V P V ---C
<i>HKU2</i>	LGK P I L D G L ---S R C N V F A R G S N A V -V V D S V D H E ---L L D L E E C ---D F V EP A S H G V L V V S D D Y G F Y S C E T ---G I Y P Y A S D	G---K V L P L ---R
<i>HKU8</i>	FNR P T E A G A ---V D A L V F E G G D I E T -V C S R V Q F D ---T V A L E P V ---Q E V P V P S D G Y V A V V D G Y T F F T D G T ---H Y F P T G L S	R C Y T T ---C
<i>LuchengRn-CoV</i>	-----ETKSQ Y L W Y K L A V ---A A E P D K V E R G N E G S Y S G N G M D Y N T V F R V A L R K L K L S N A K A C	
<i>Mink-CoV</i>	G---GKTRCFSGASIPV S V E K I V E D D V W -S T T I -L E E T ---E Y Q P P K N G G V V V V I D G Y T F Y T C N H ---E Q F Y P F G D S	K V V Q K ---L
<i>NL63</i>	MTFPCVSCV---T FF Y E F L D T C F G V S K P N A I D V E ---H L E L K E T ---V F V EP K D G G Q F F V S G D Y L W Y V V D D ---I Y Y P A S C N	G V L P V ---A
<i>NL63-related</i>	VPVPCDSRI---T S F H E F V D A V Y K V G K P T T I D V E ---H L E L K E T ---S F V EP K E G G Q F V V S D D Y F W Y I M D D ---I C Y P A S E D	G V L P V ---A
<i>Porcine-EDV</i>	FQIPVQAGI---EKF KVFLNCVHPV-VPRVIETS---F V E L E E T ---T F K P P A L N G G I A I V D G F A F Y D G T ---L Y Y P T D G N	S V P I ---C
<i>TGE</i>	O---GKALSFRDADPV V D N G T I S T A D W -S E P I L L E P A ---E Y V K P K N N G V I V I A G Y T F Y K D E D ---E H F Y P Y G F G	K I V O R ---M









Beta-CoV cons



Alpha-CoV cons

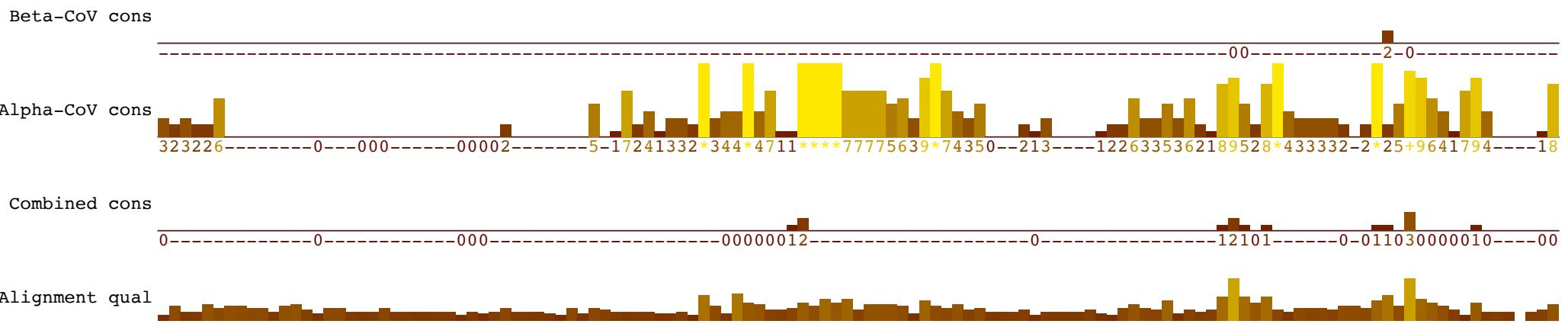
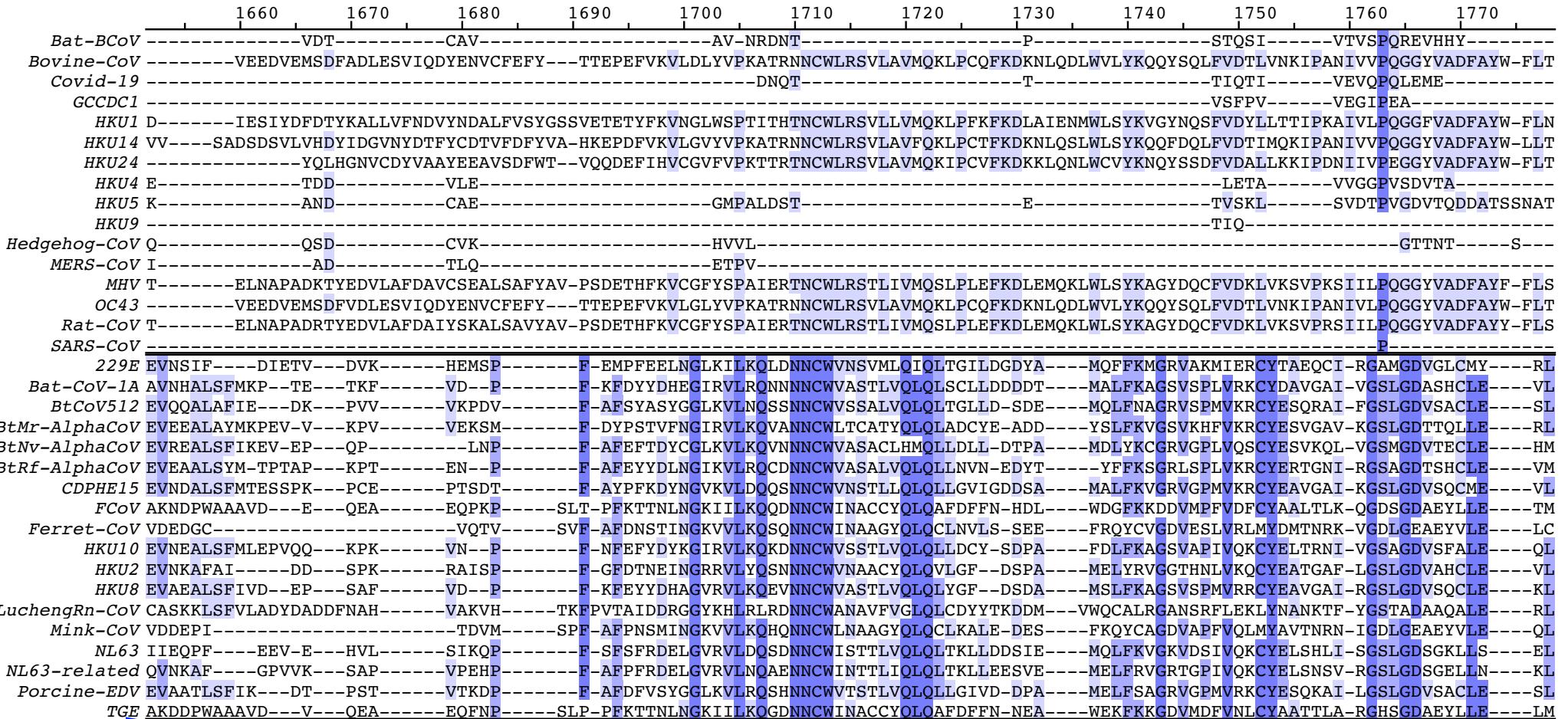


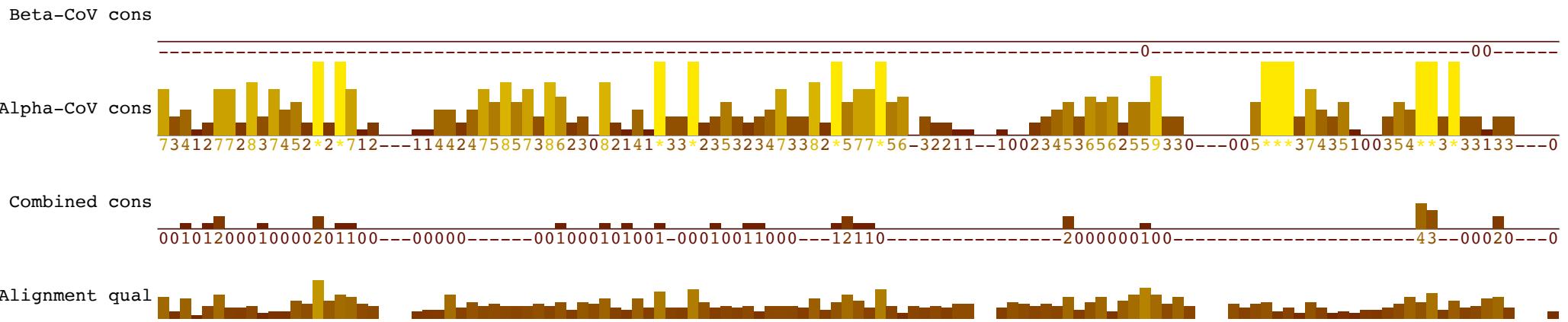
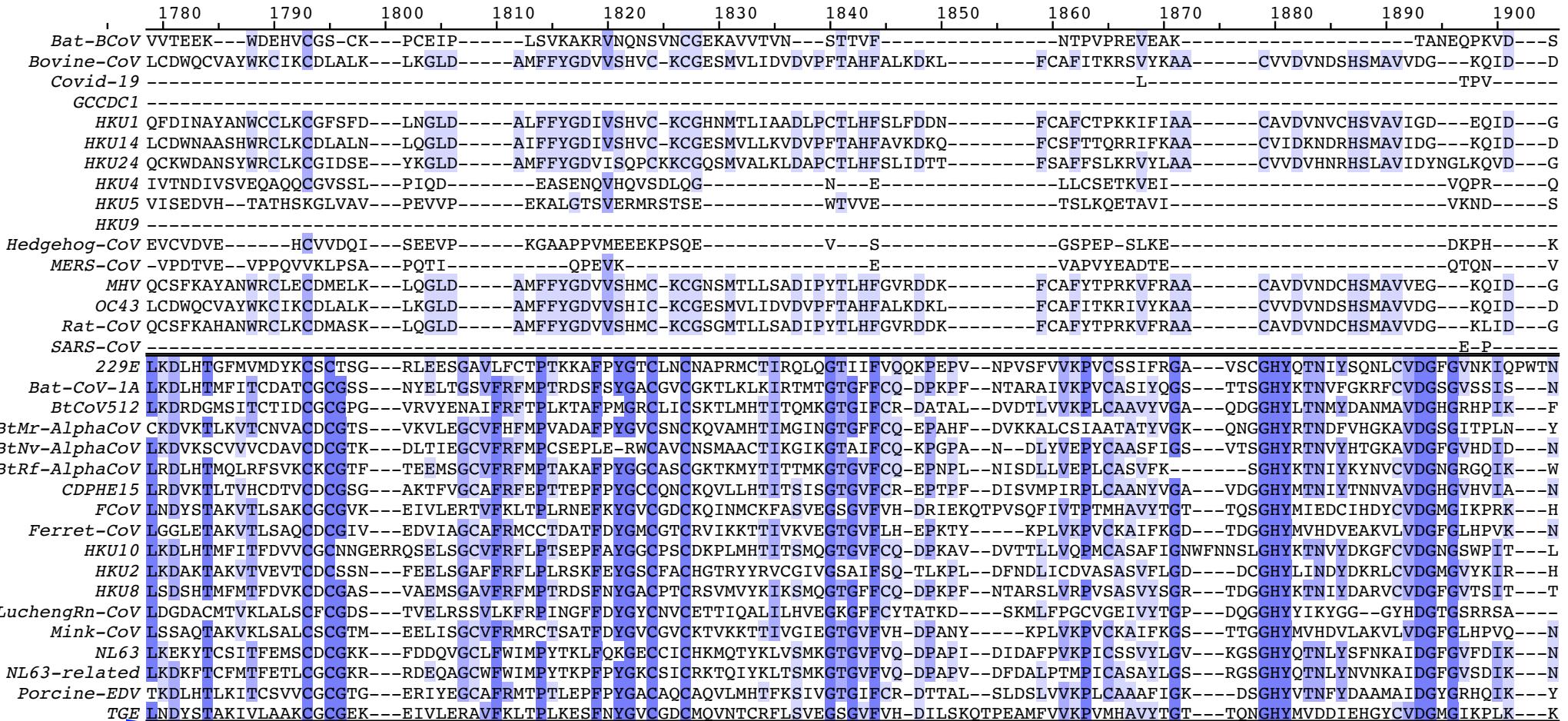
Combined cons

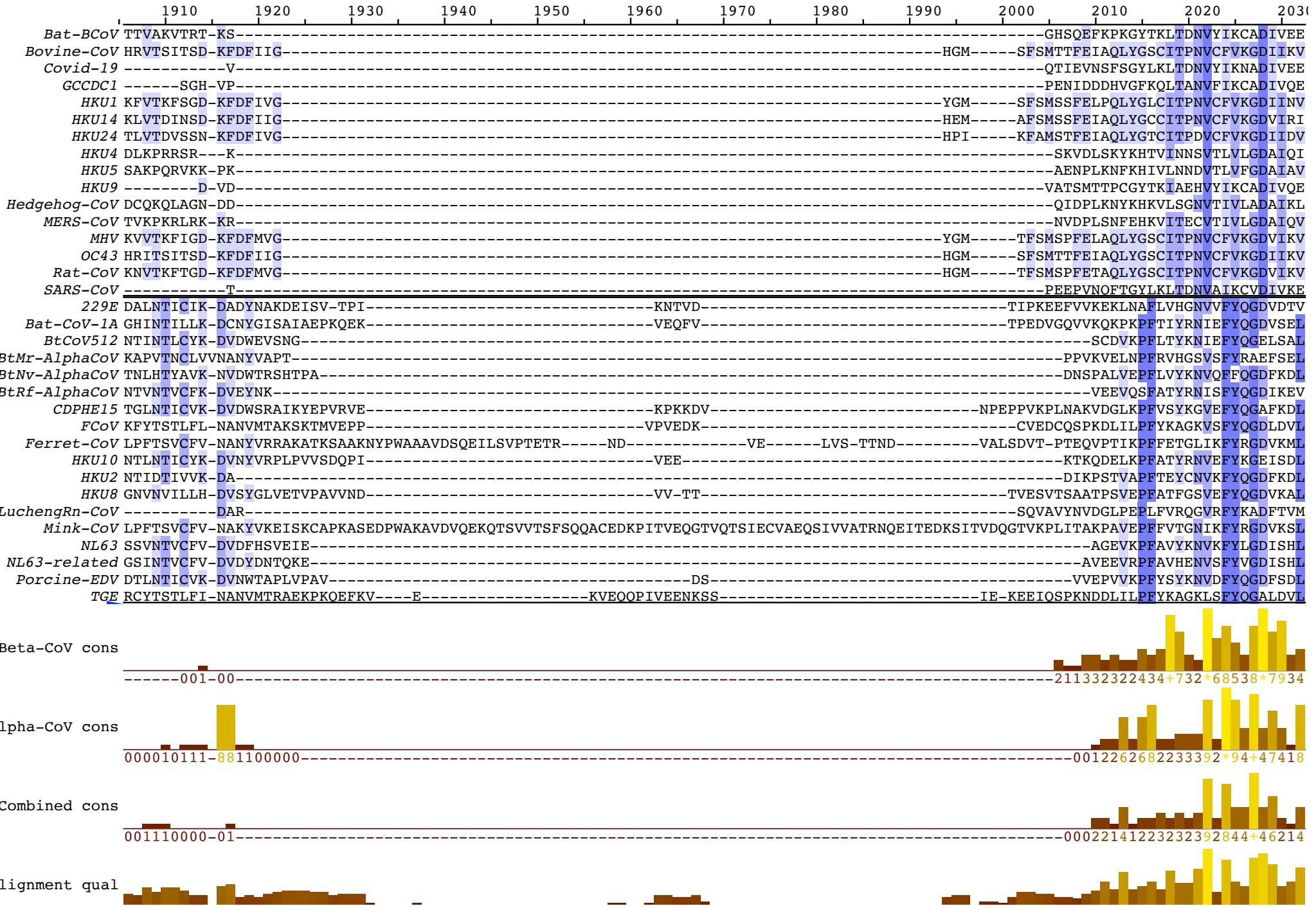


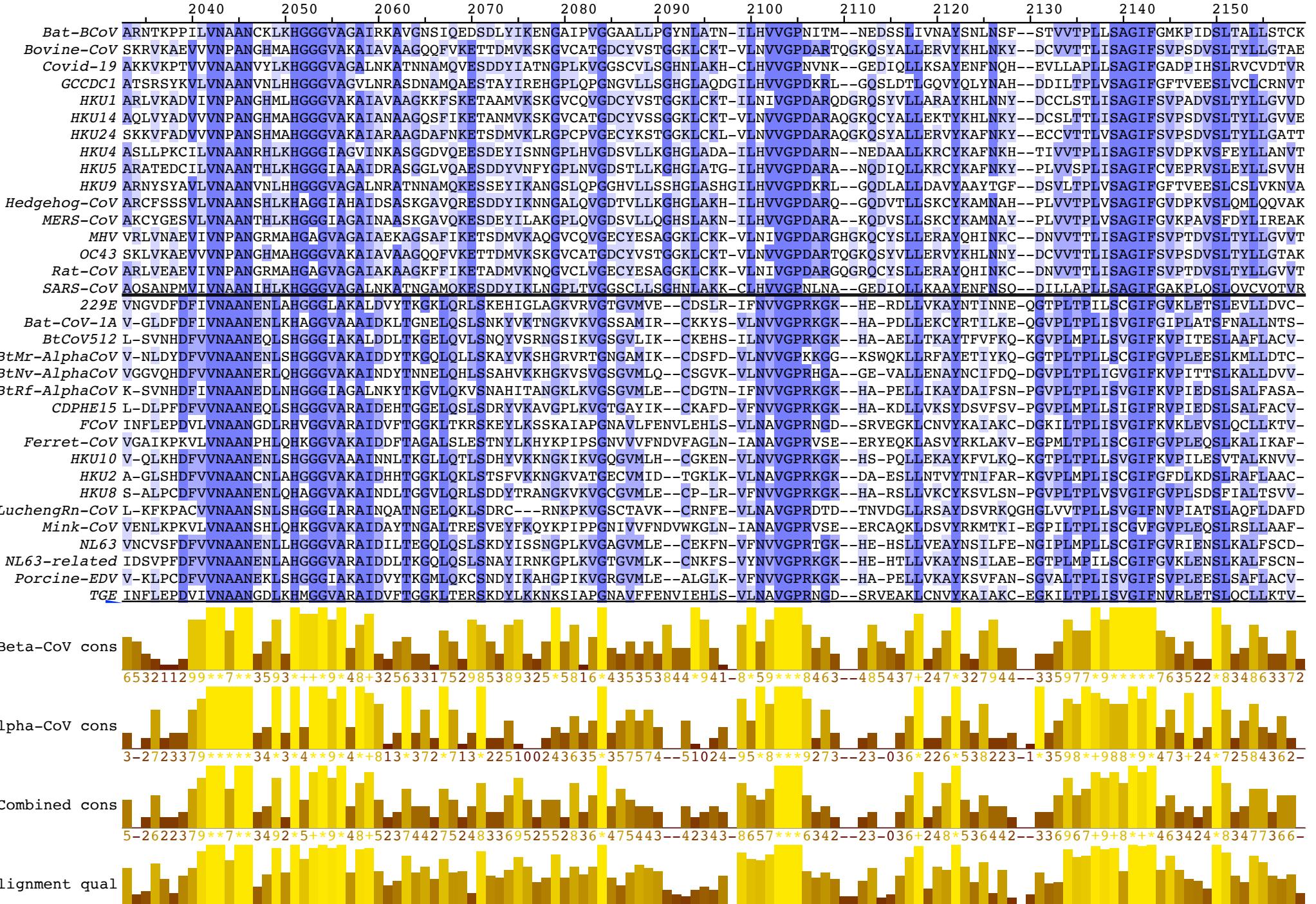
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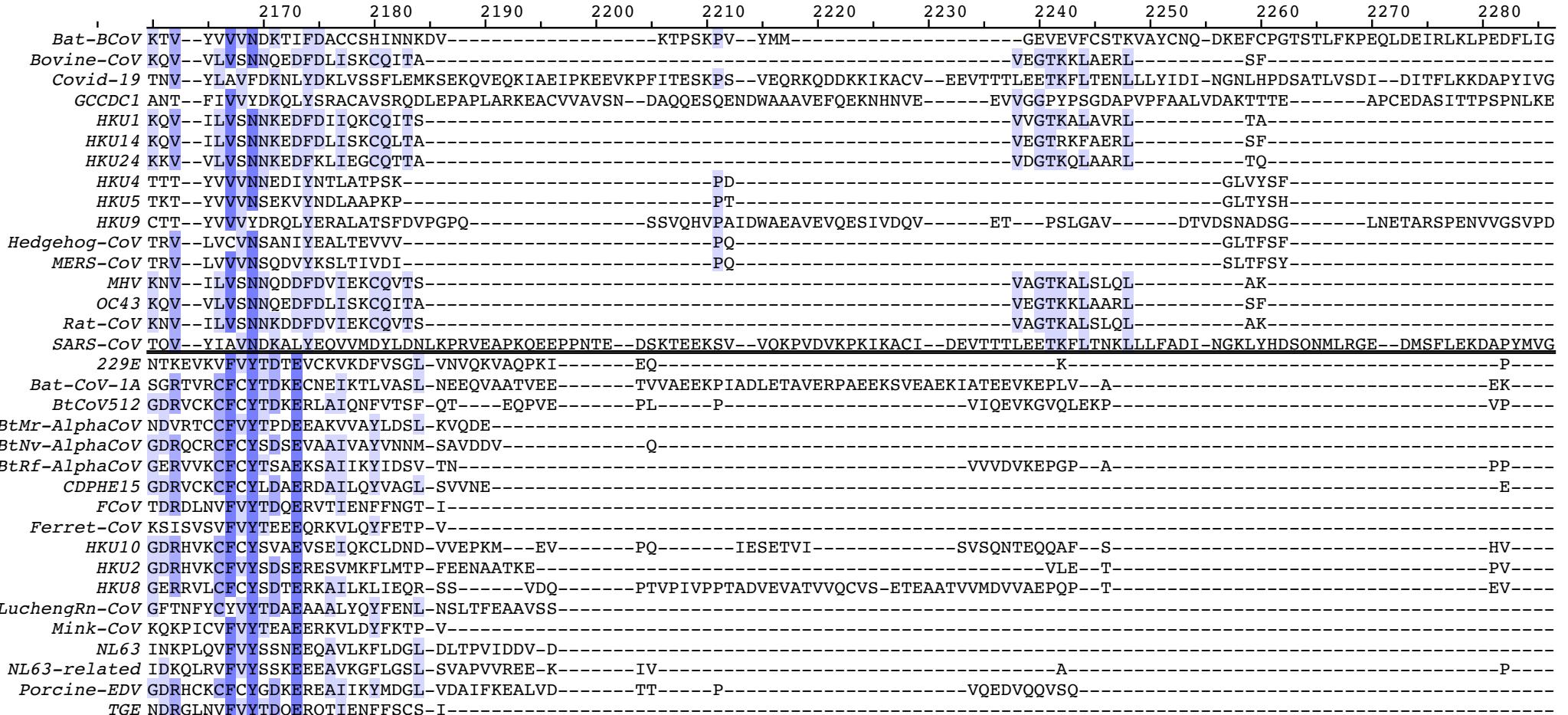


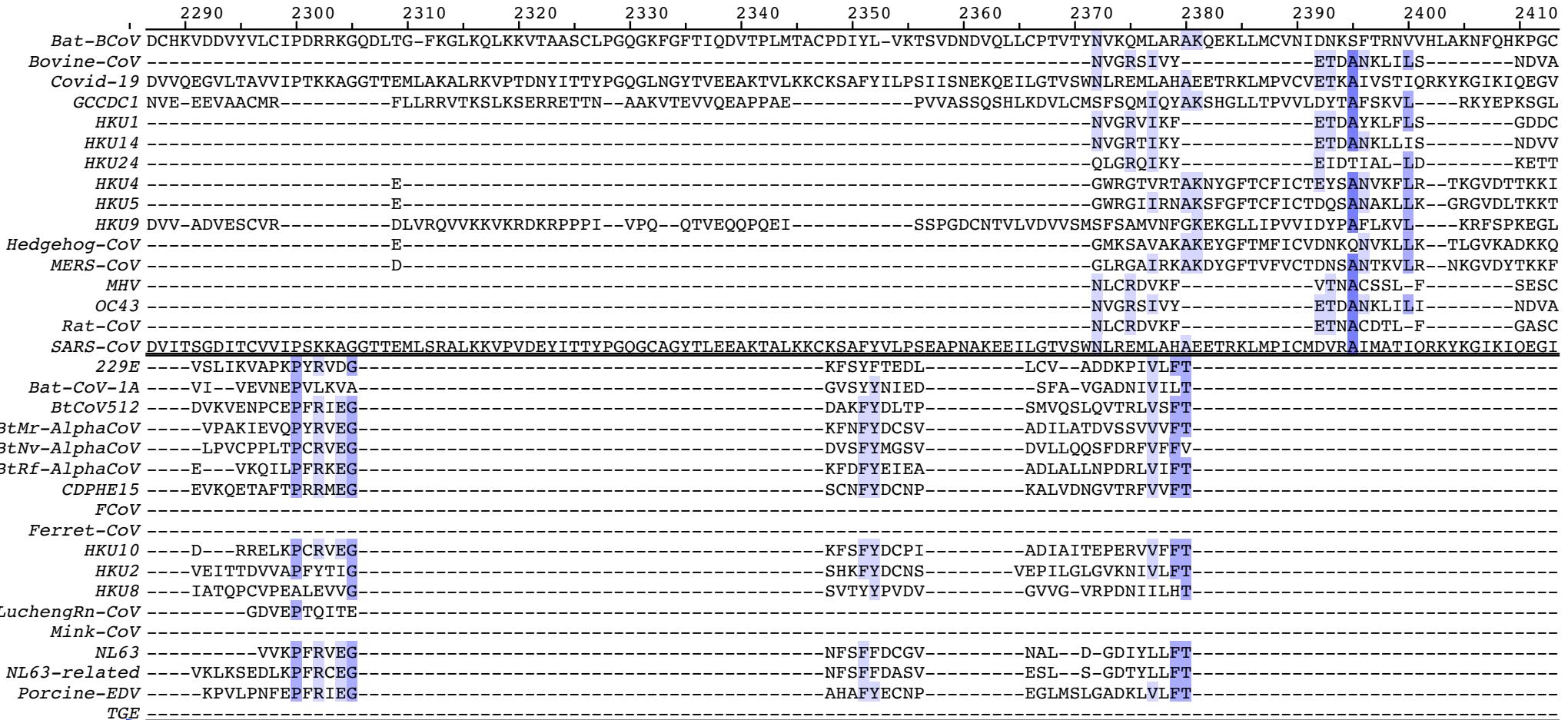


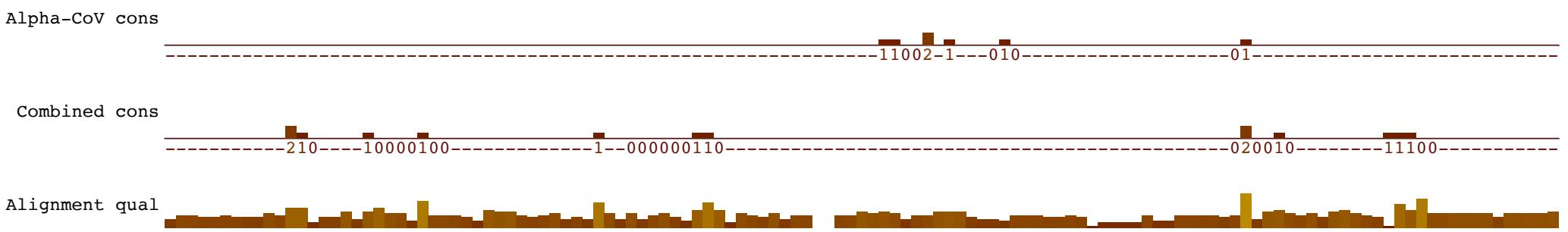
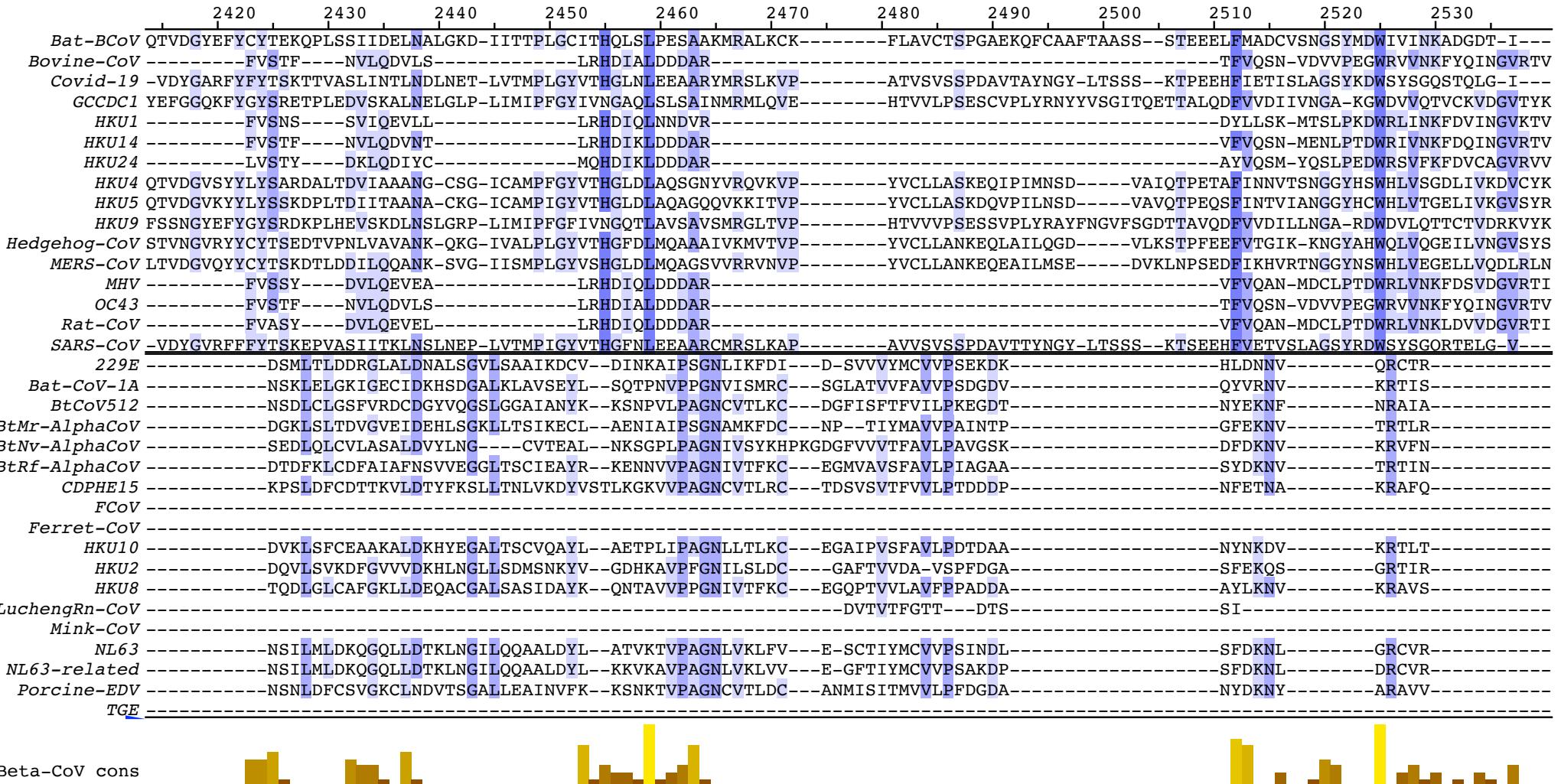


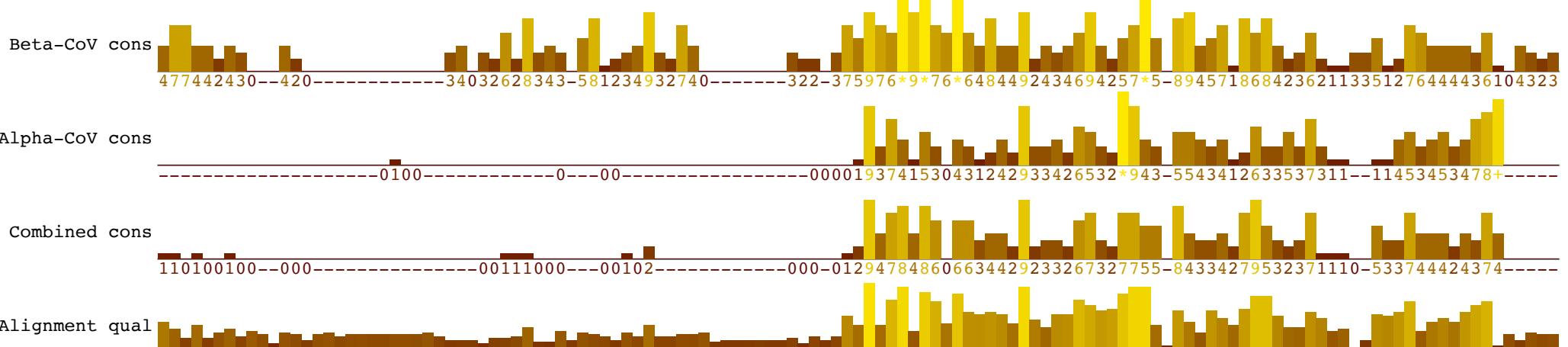
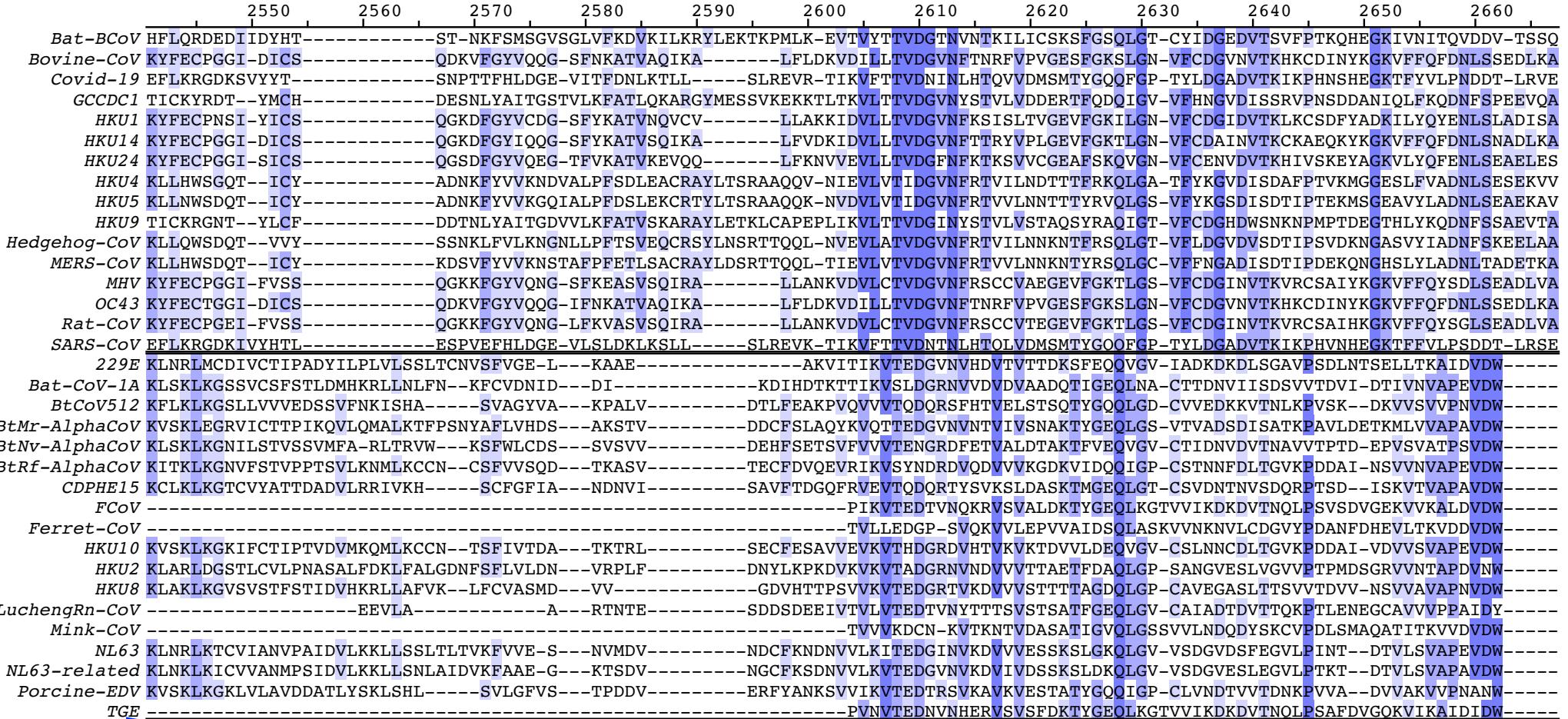


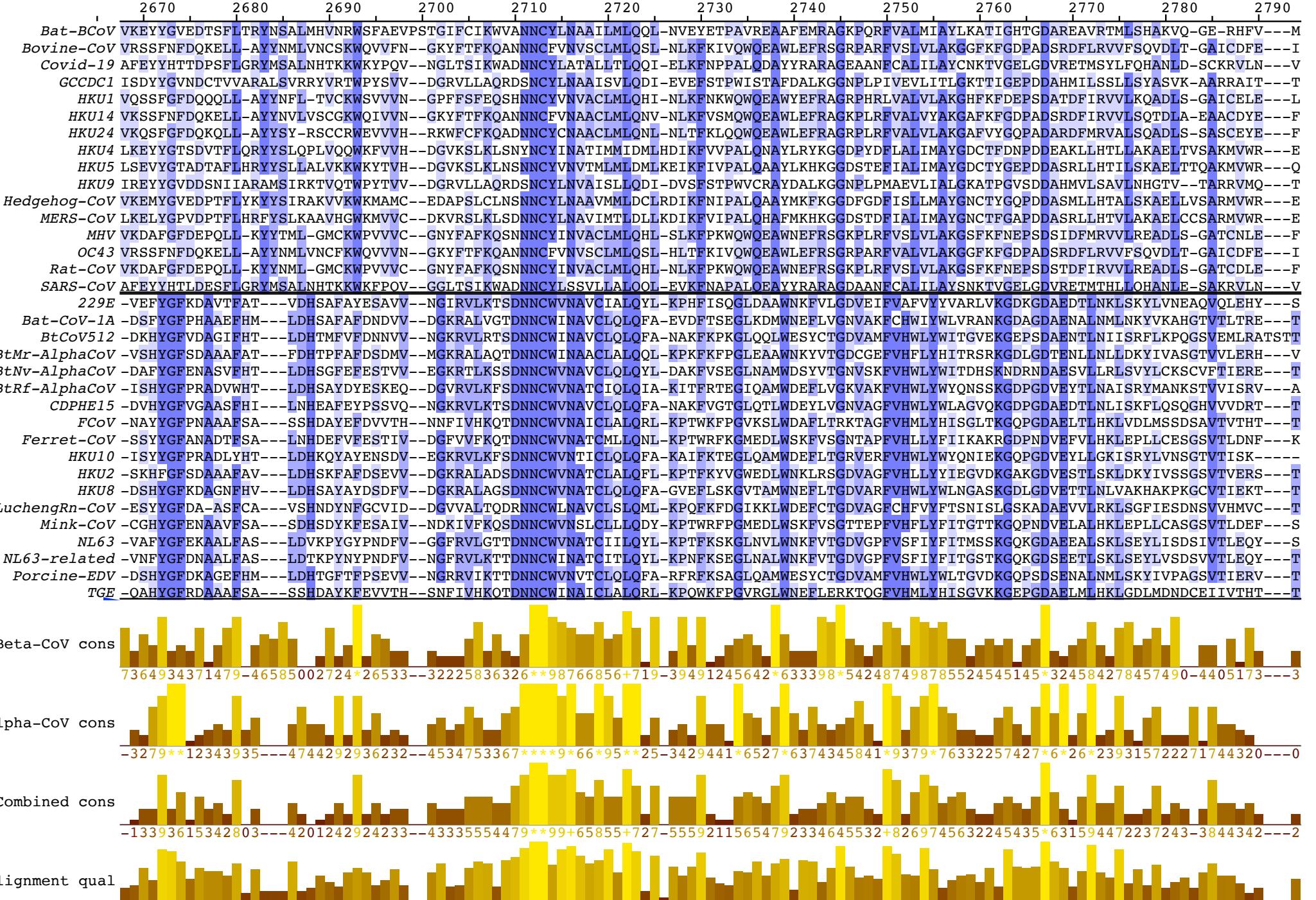


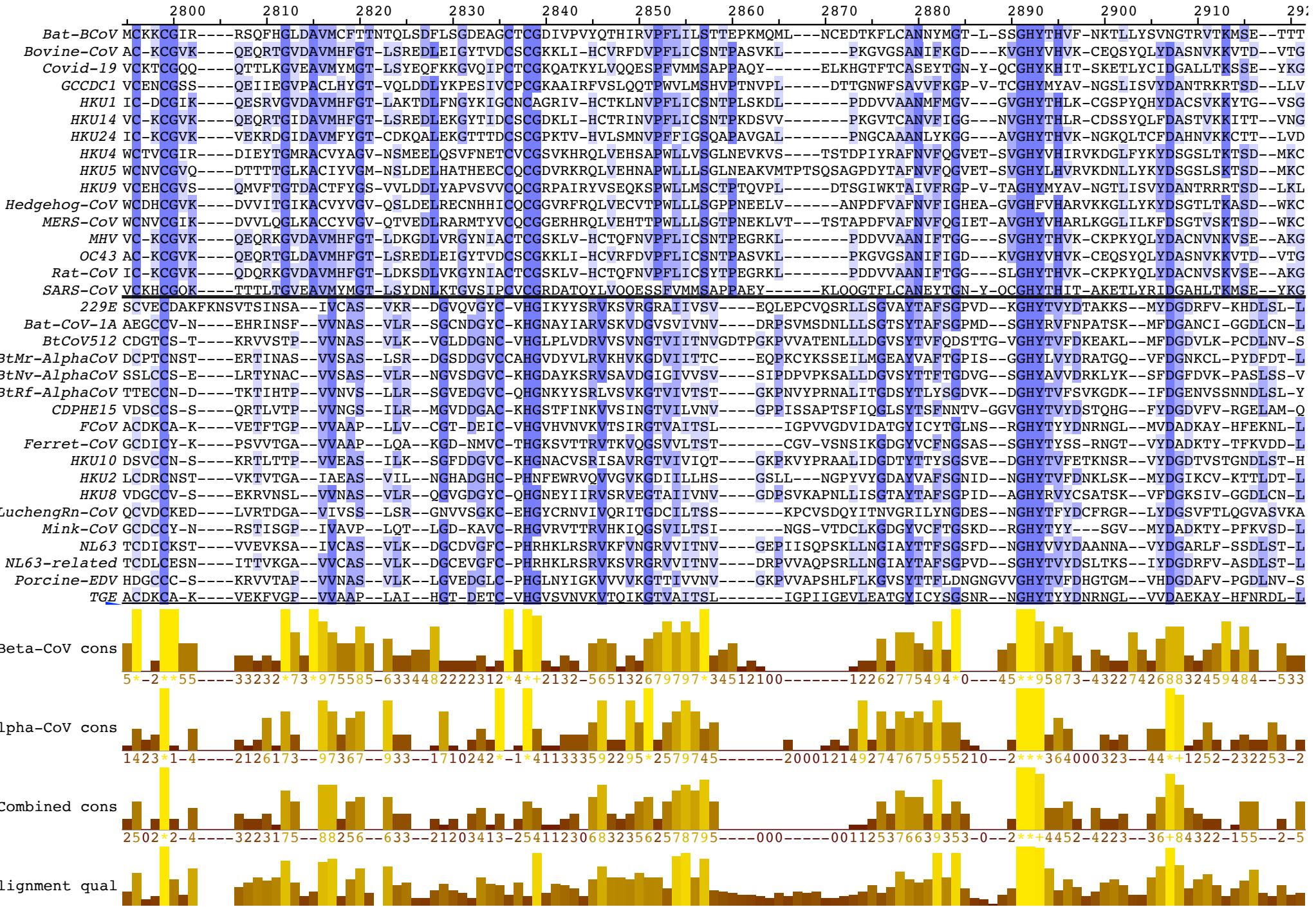


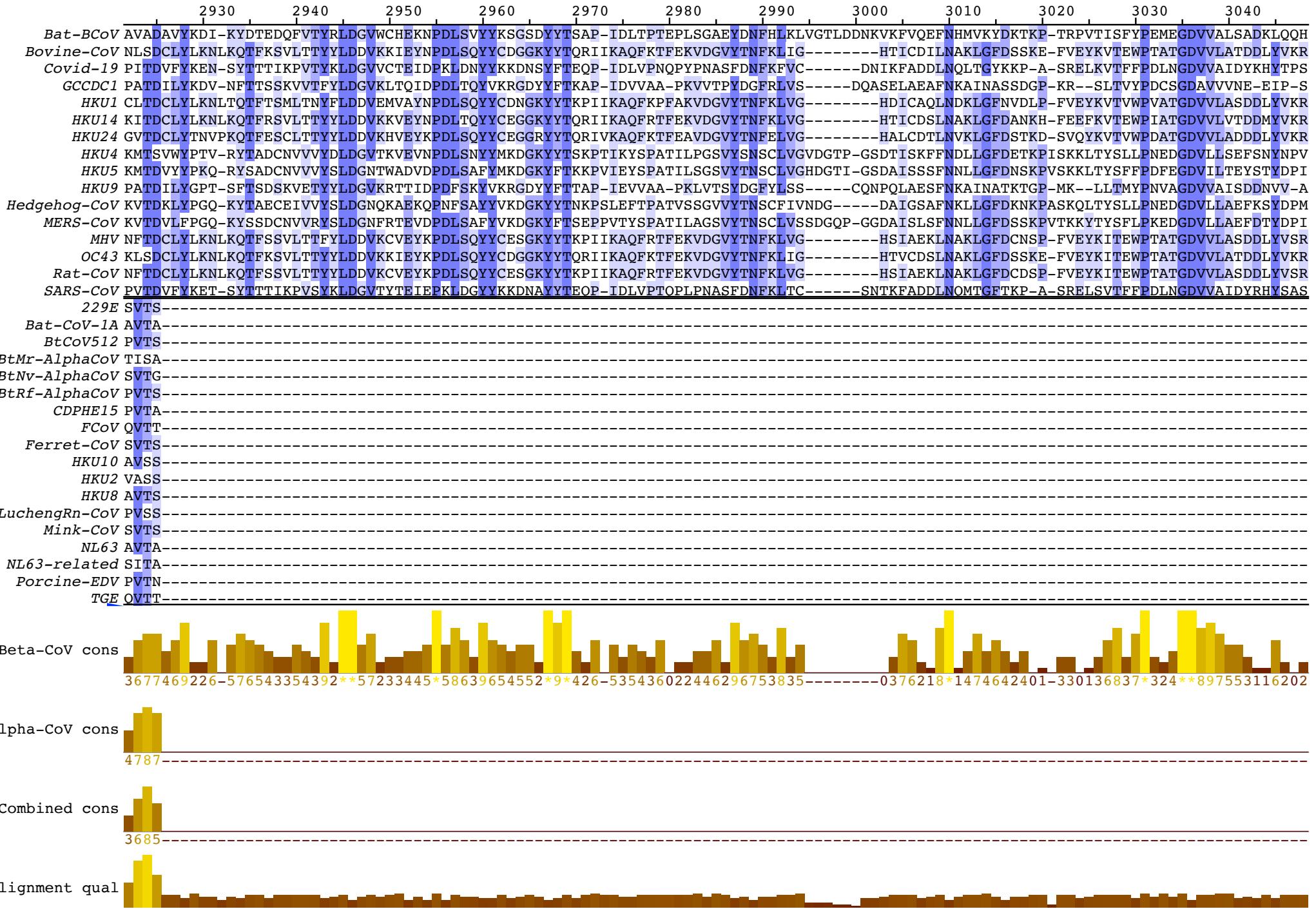


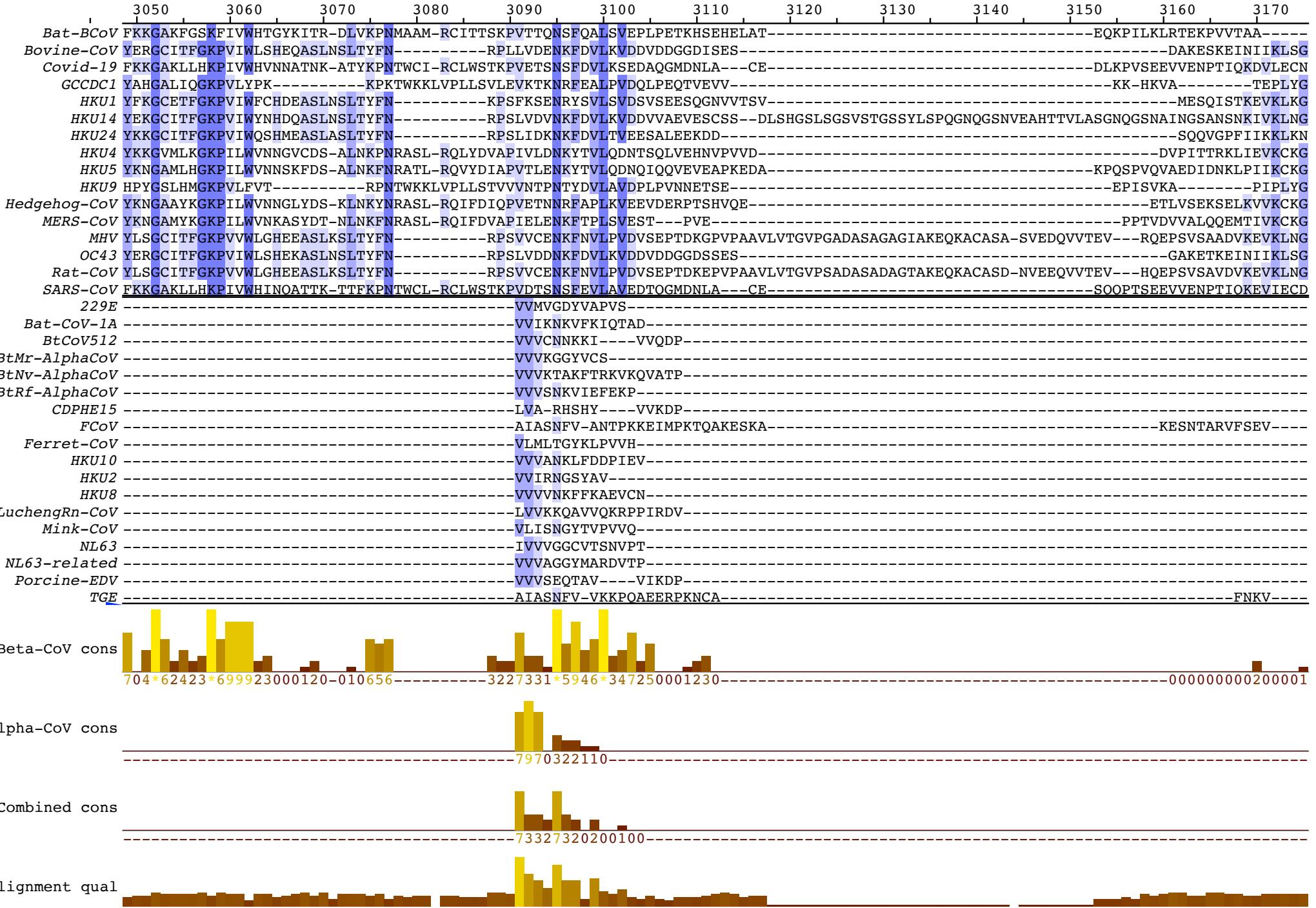


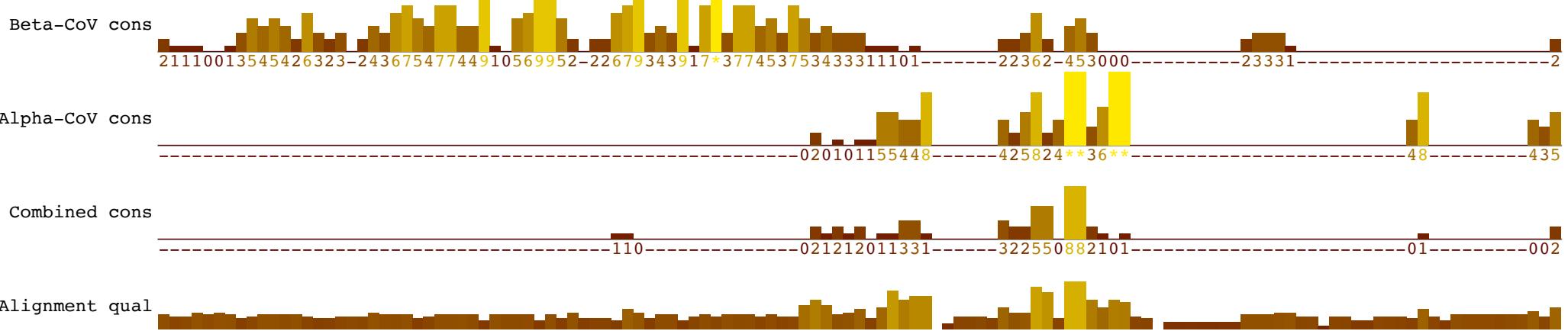
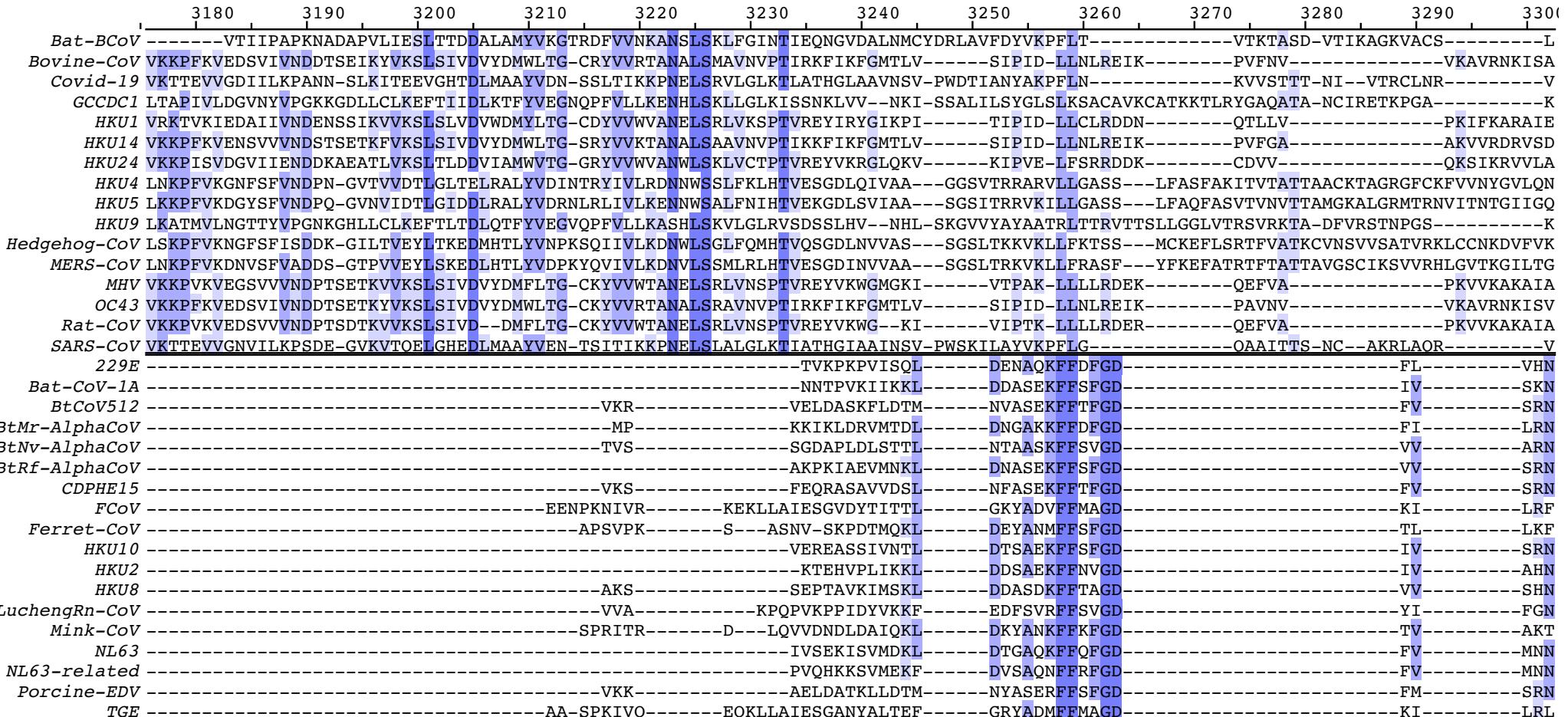


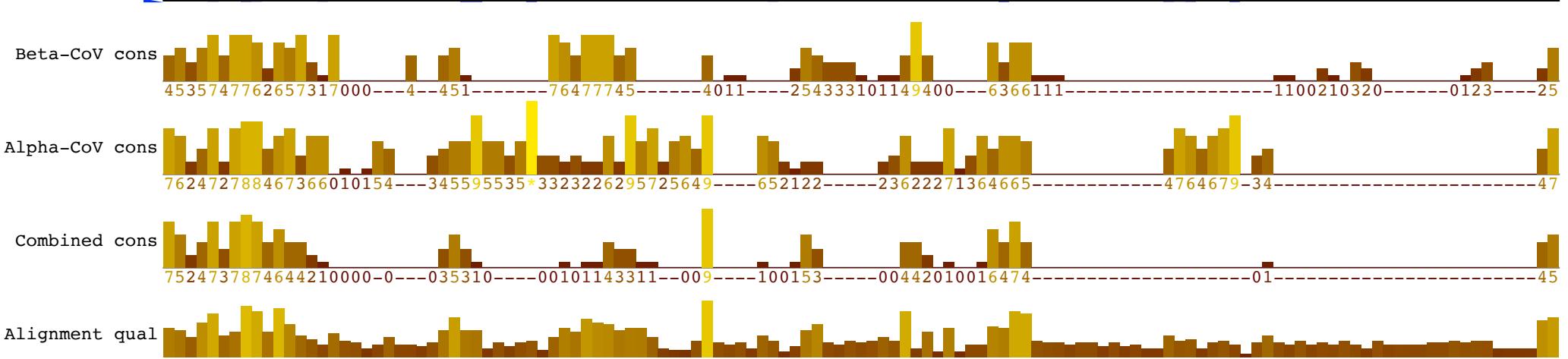
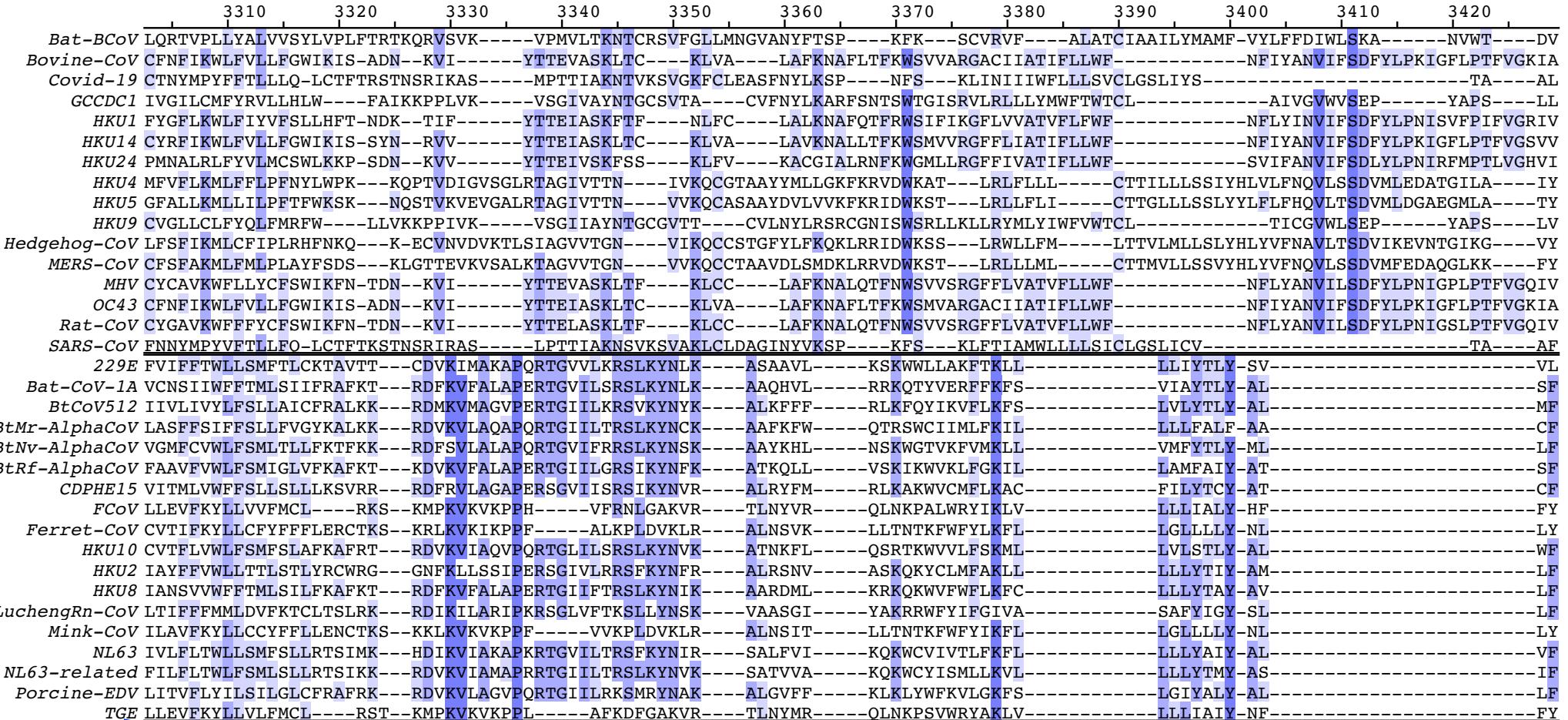


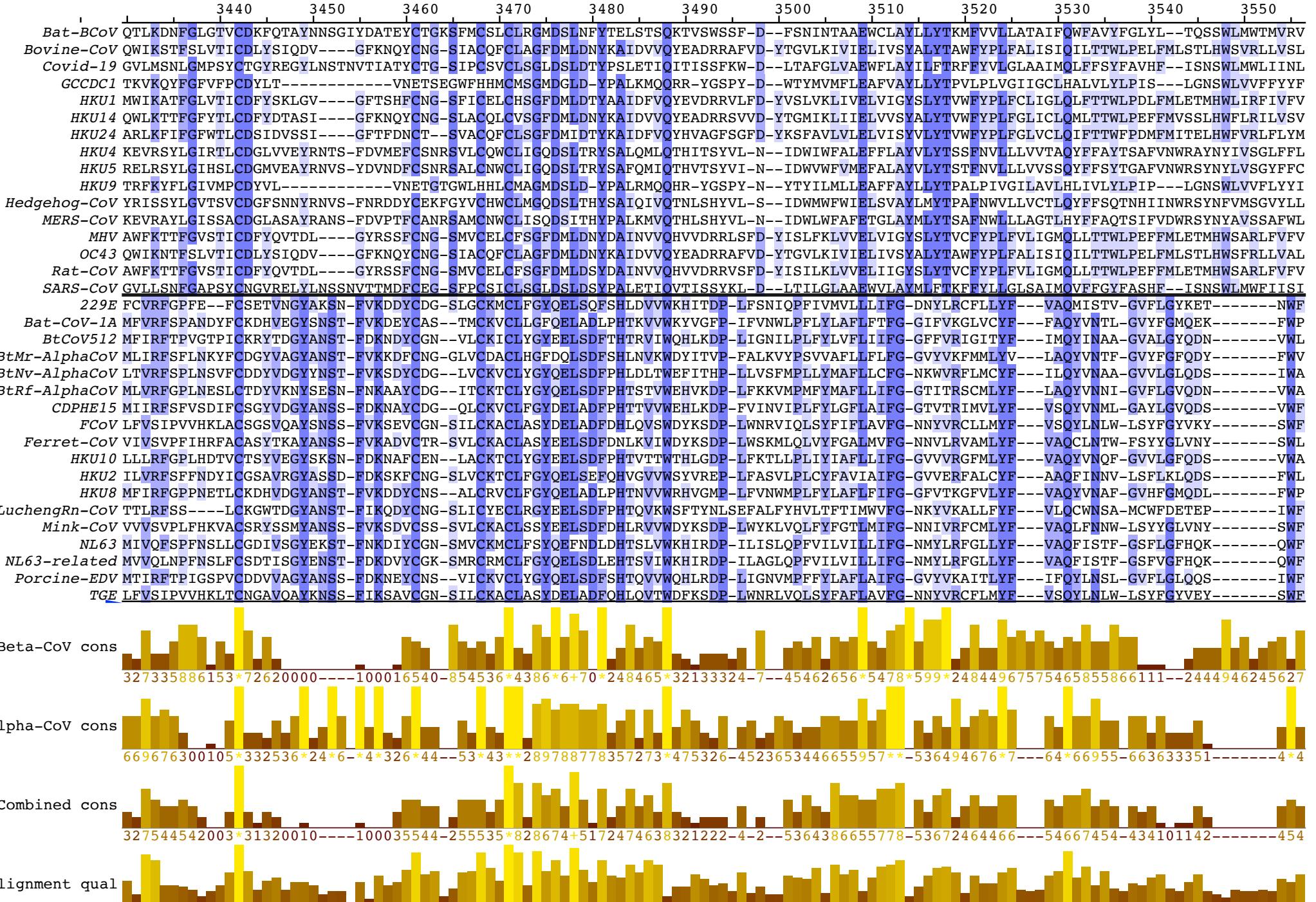


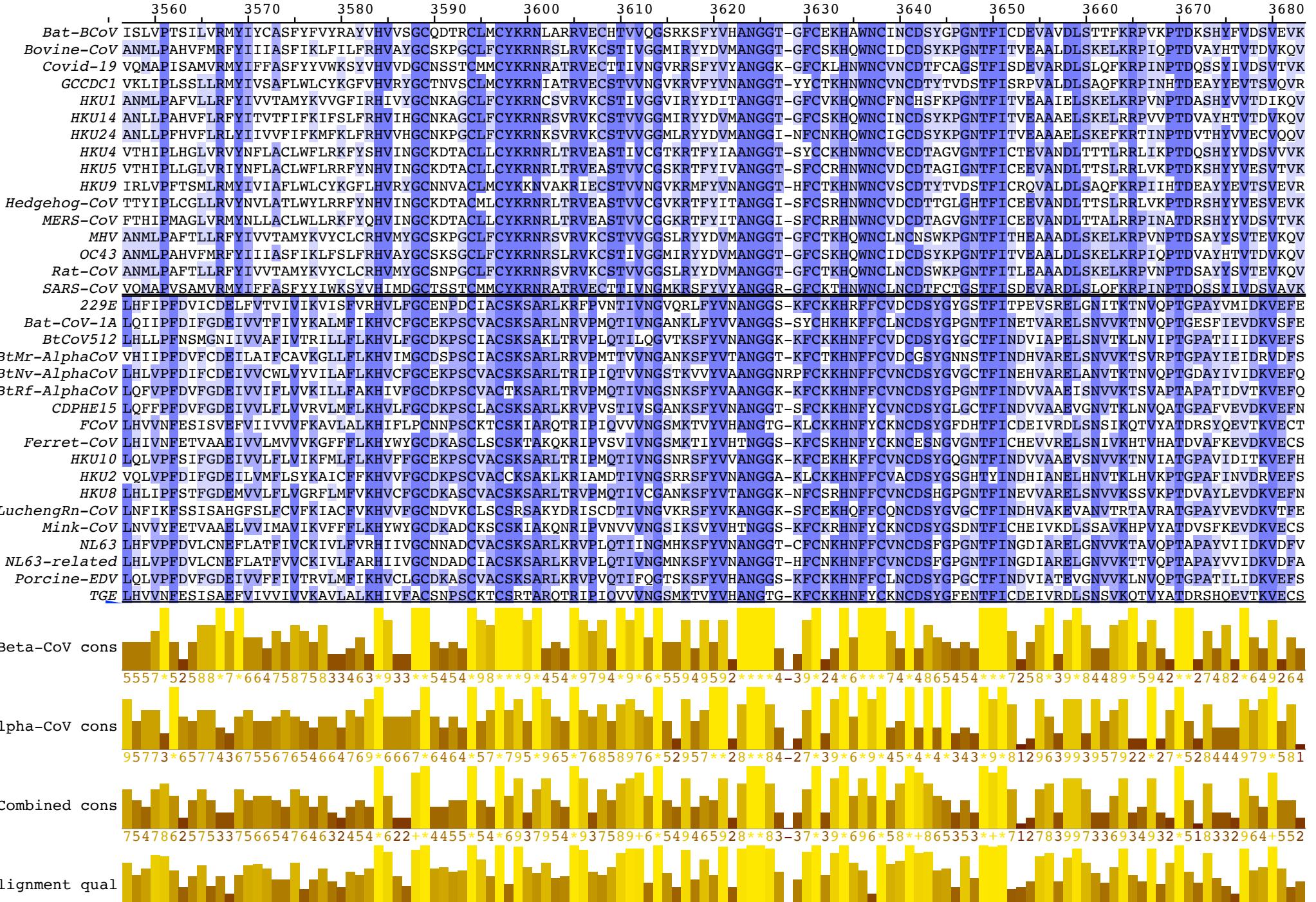


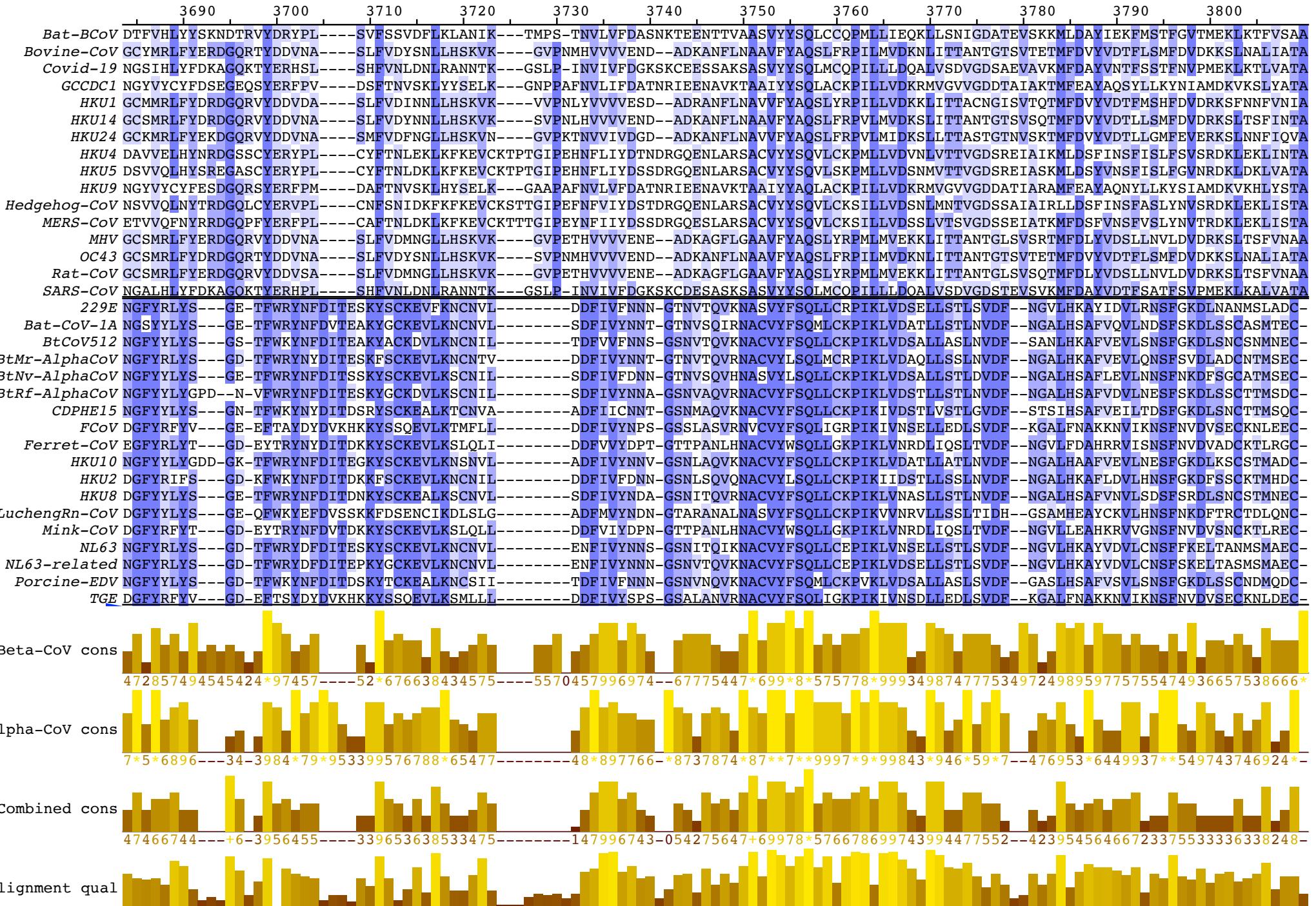


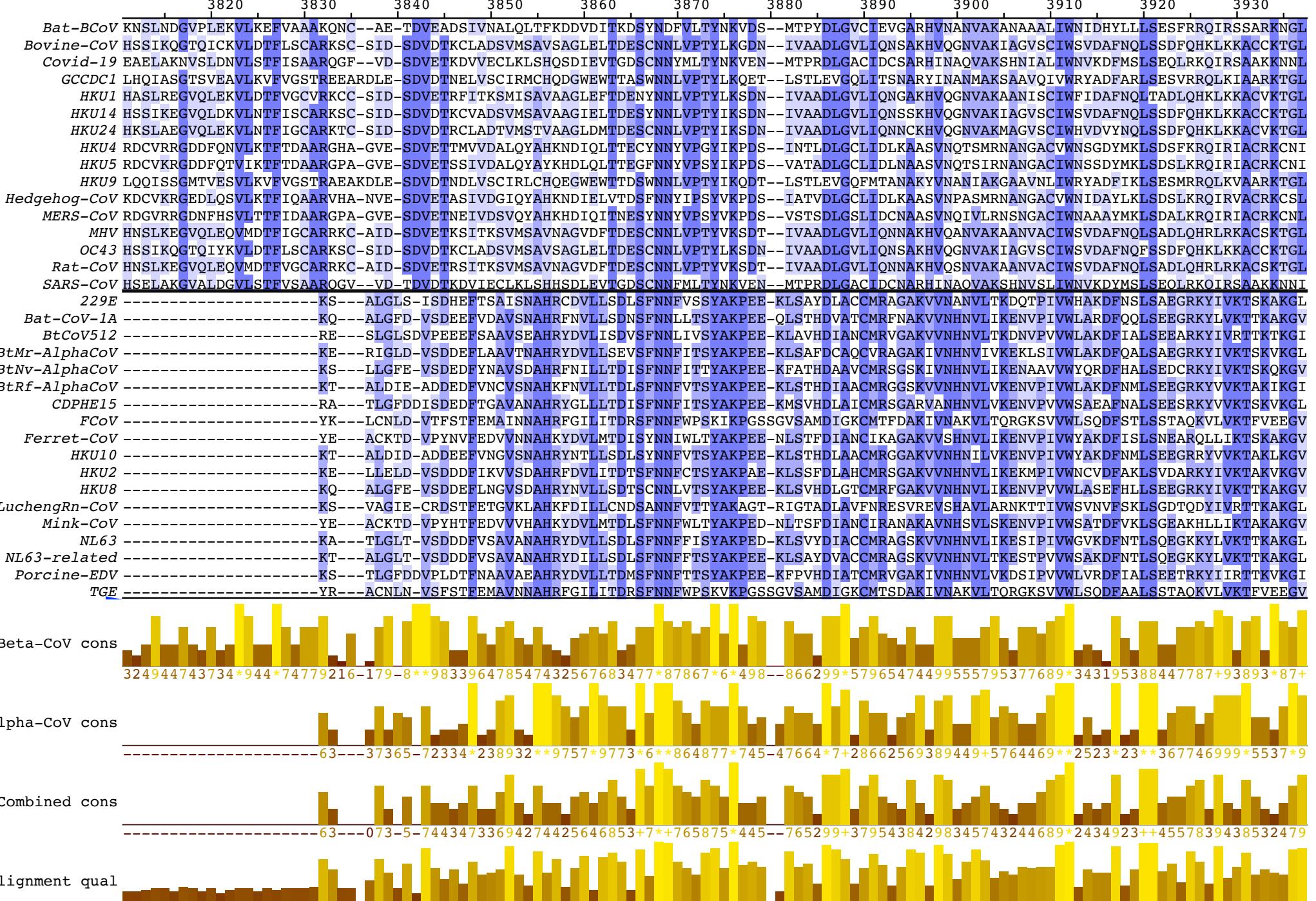


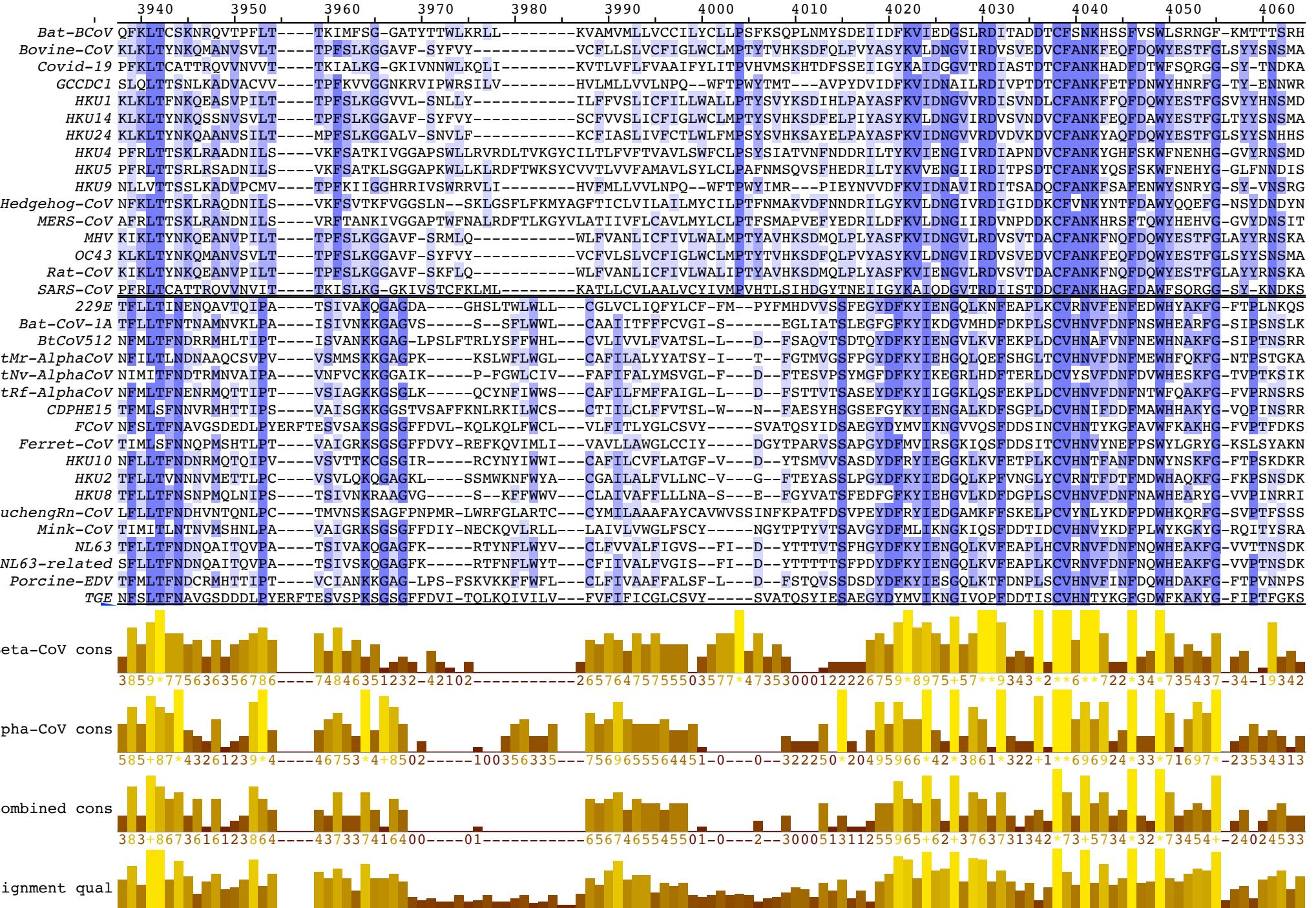


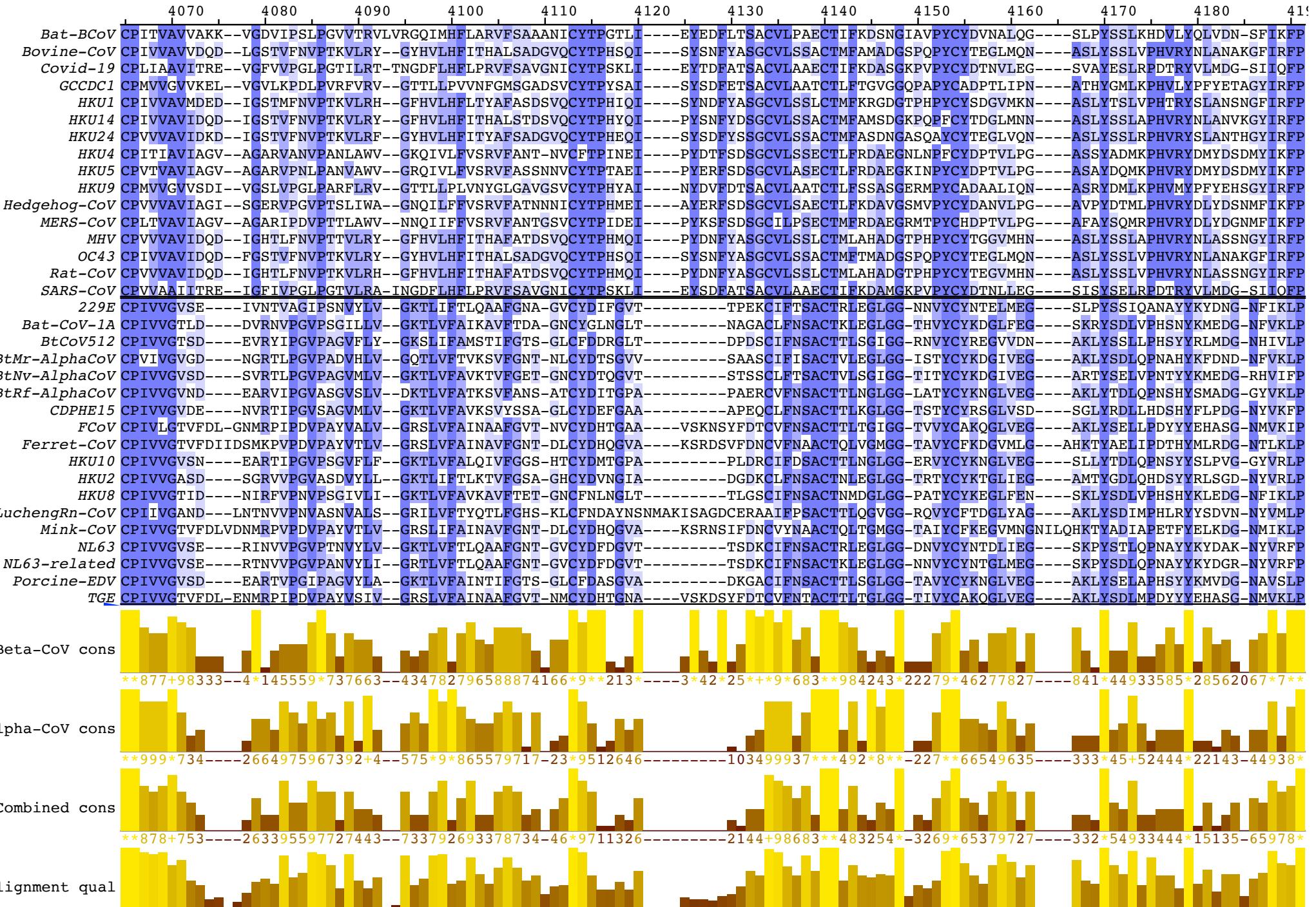


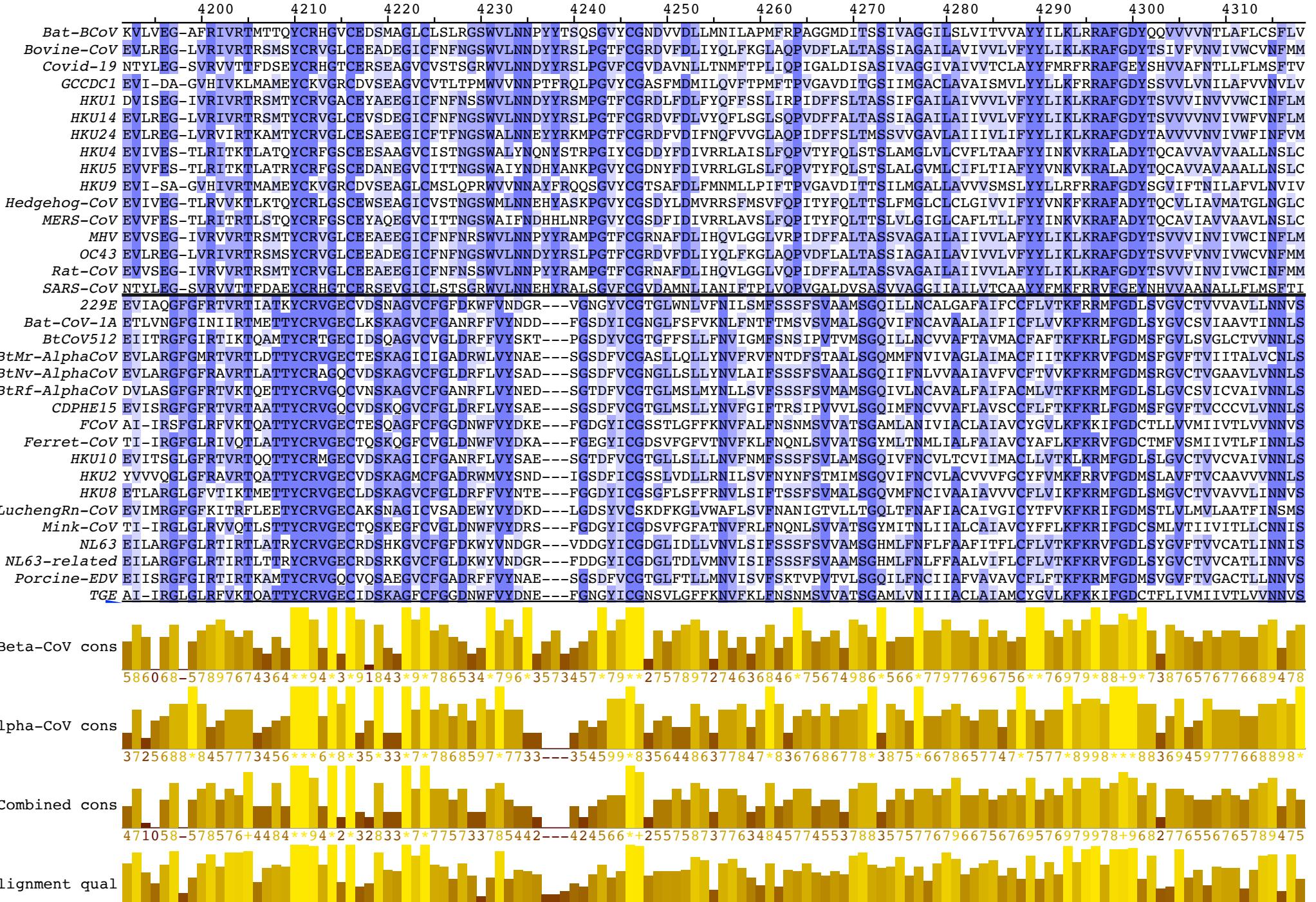


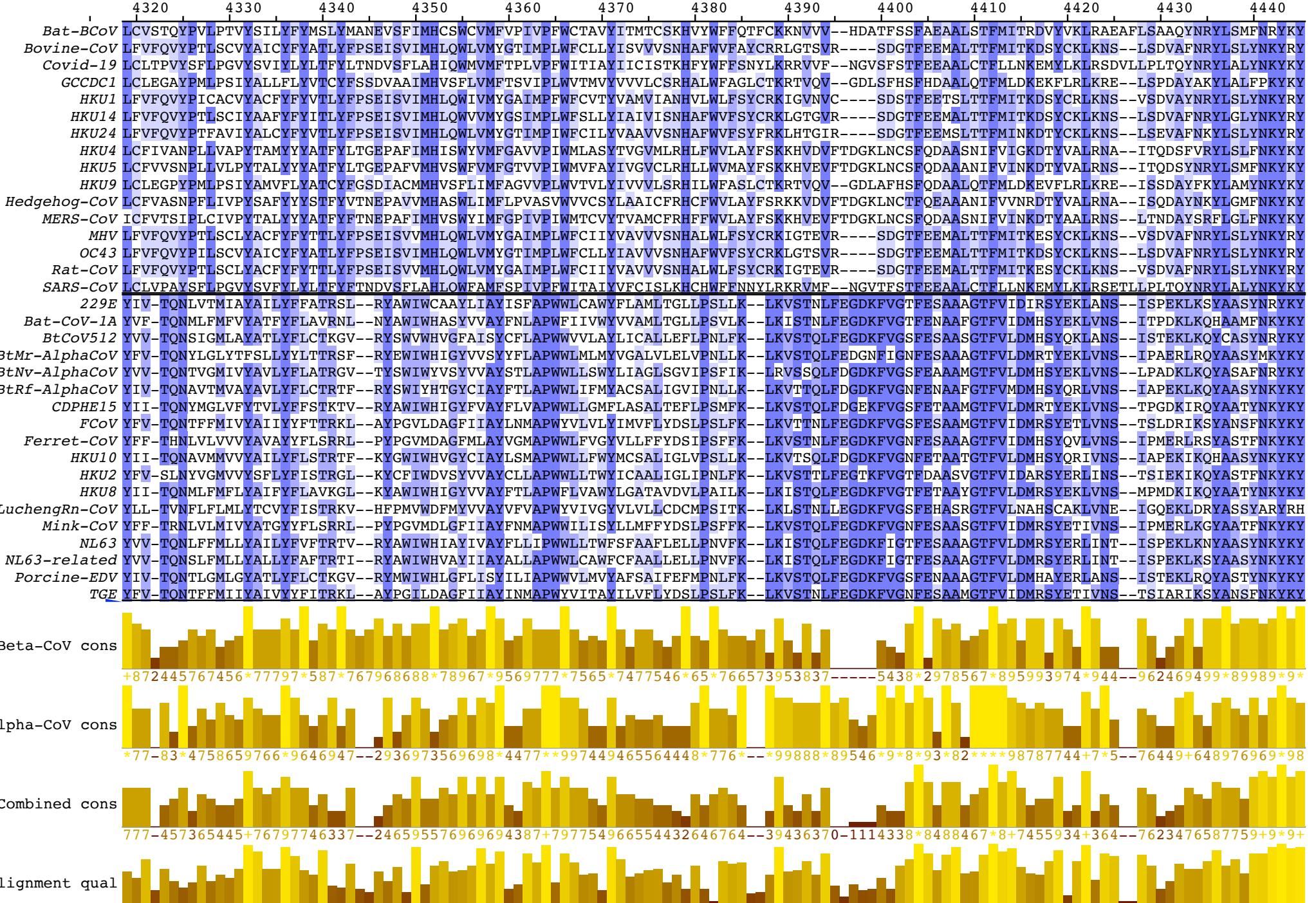


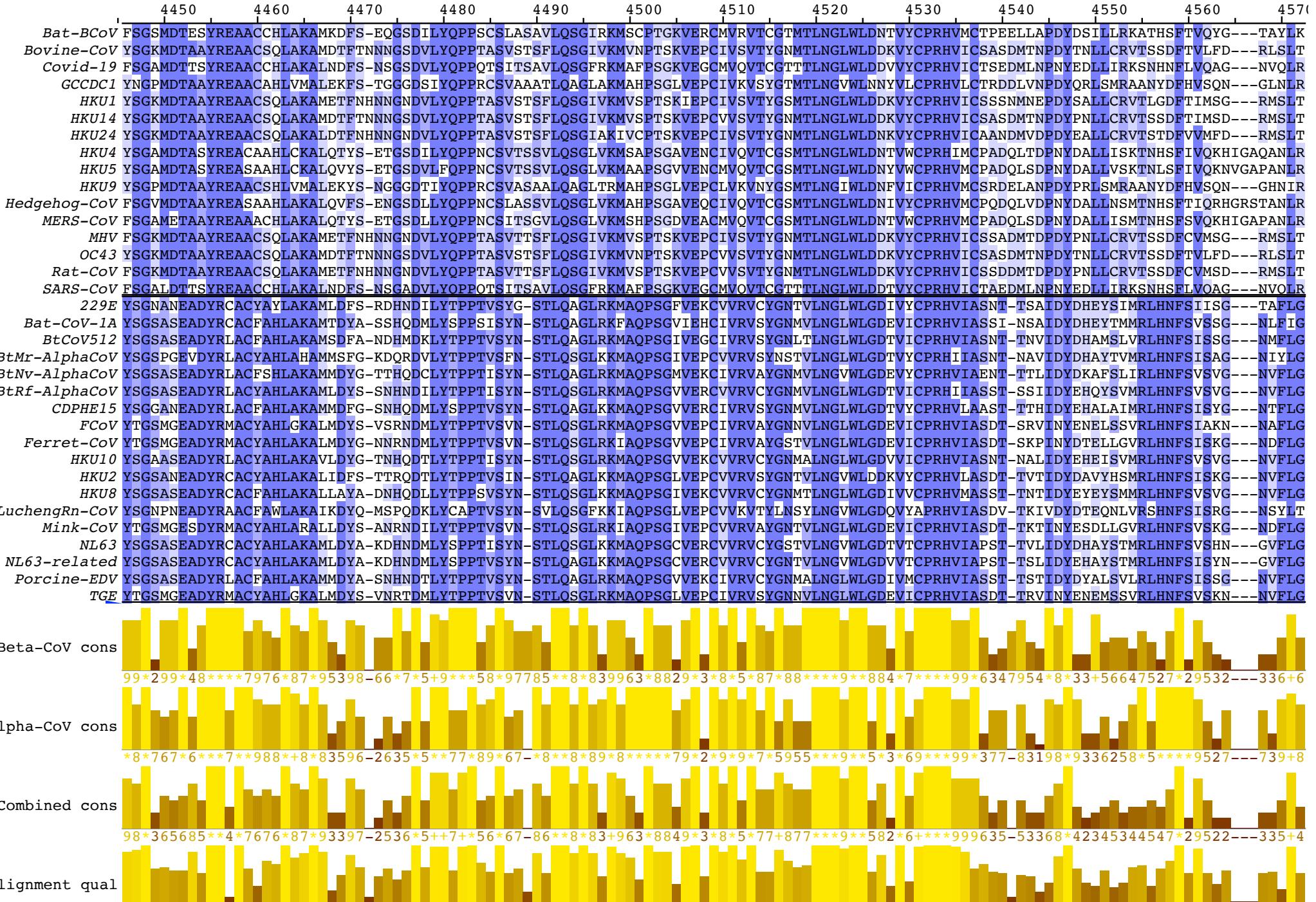


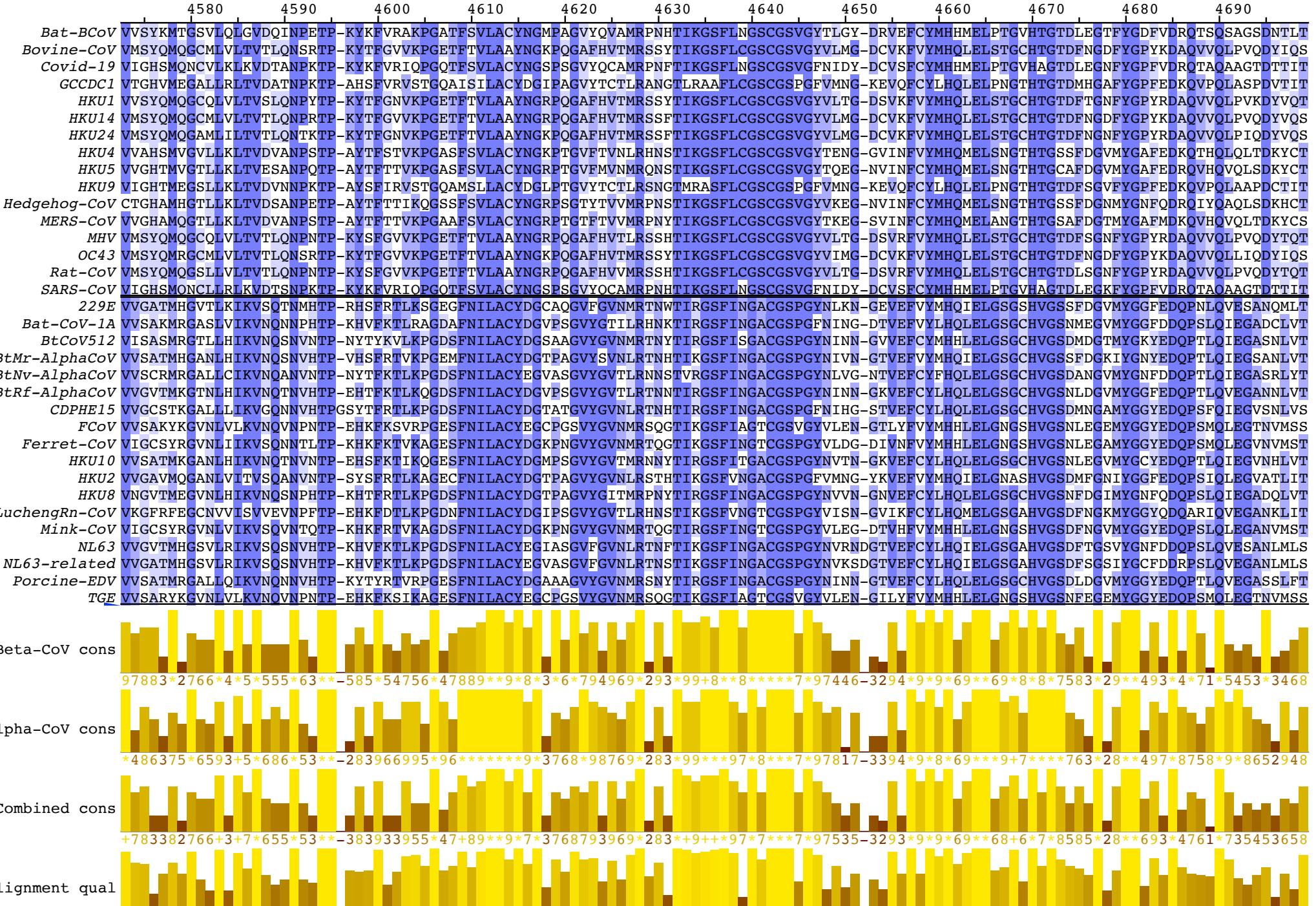


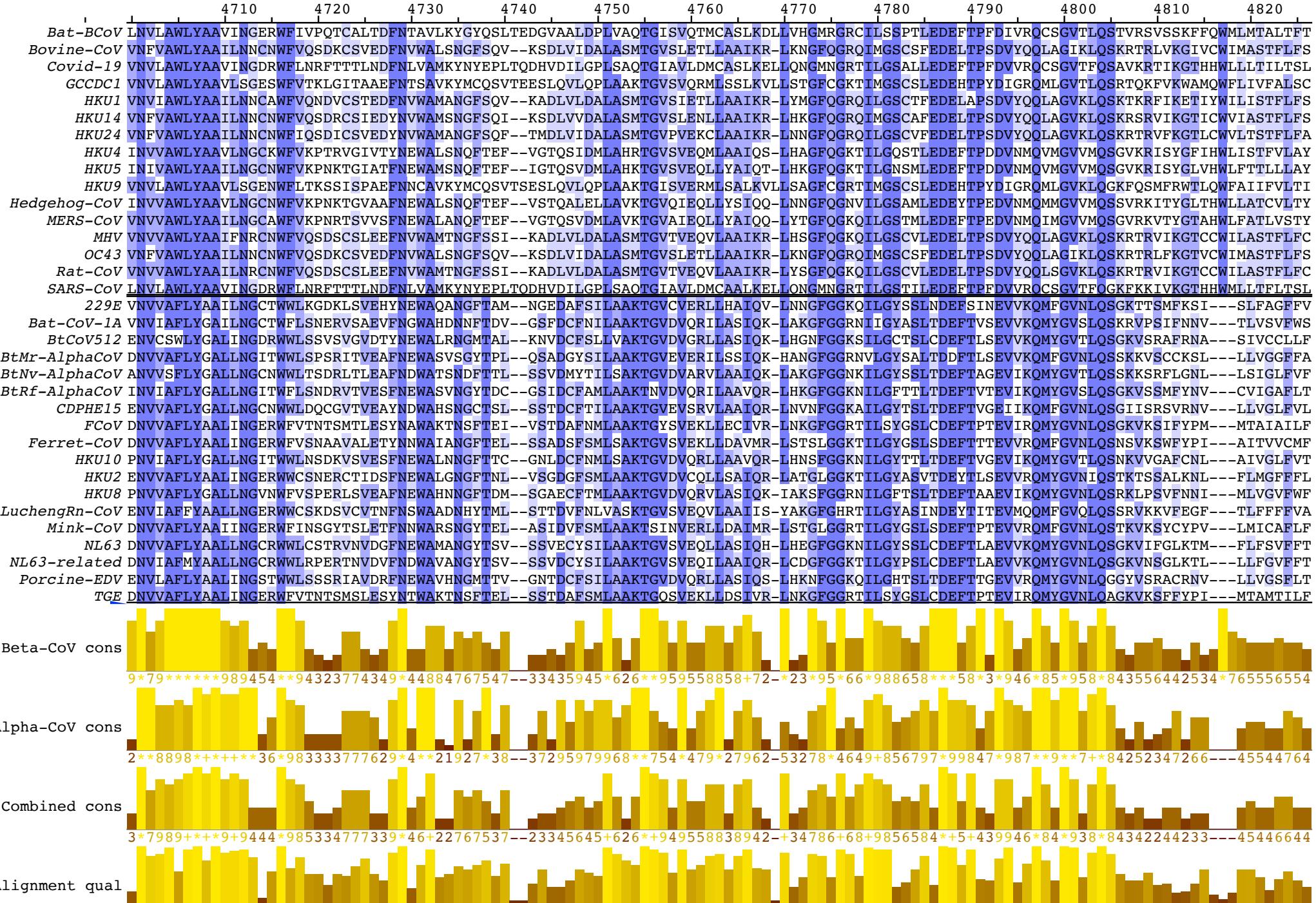




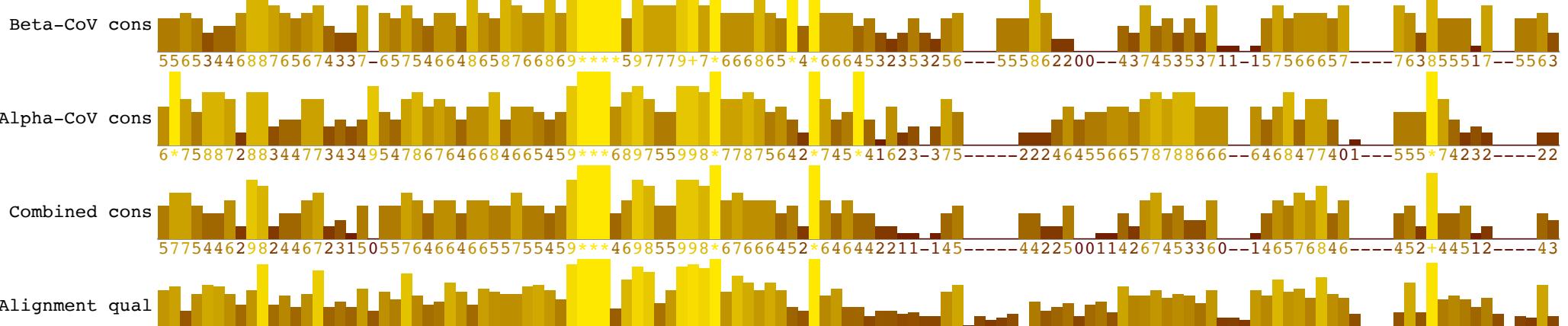


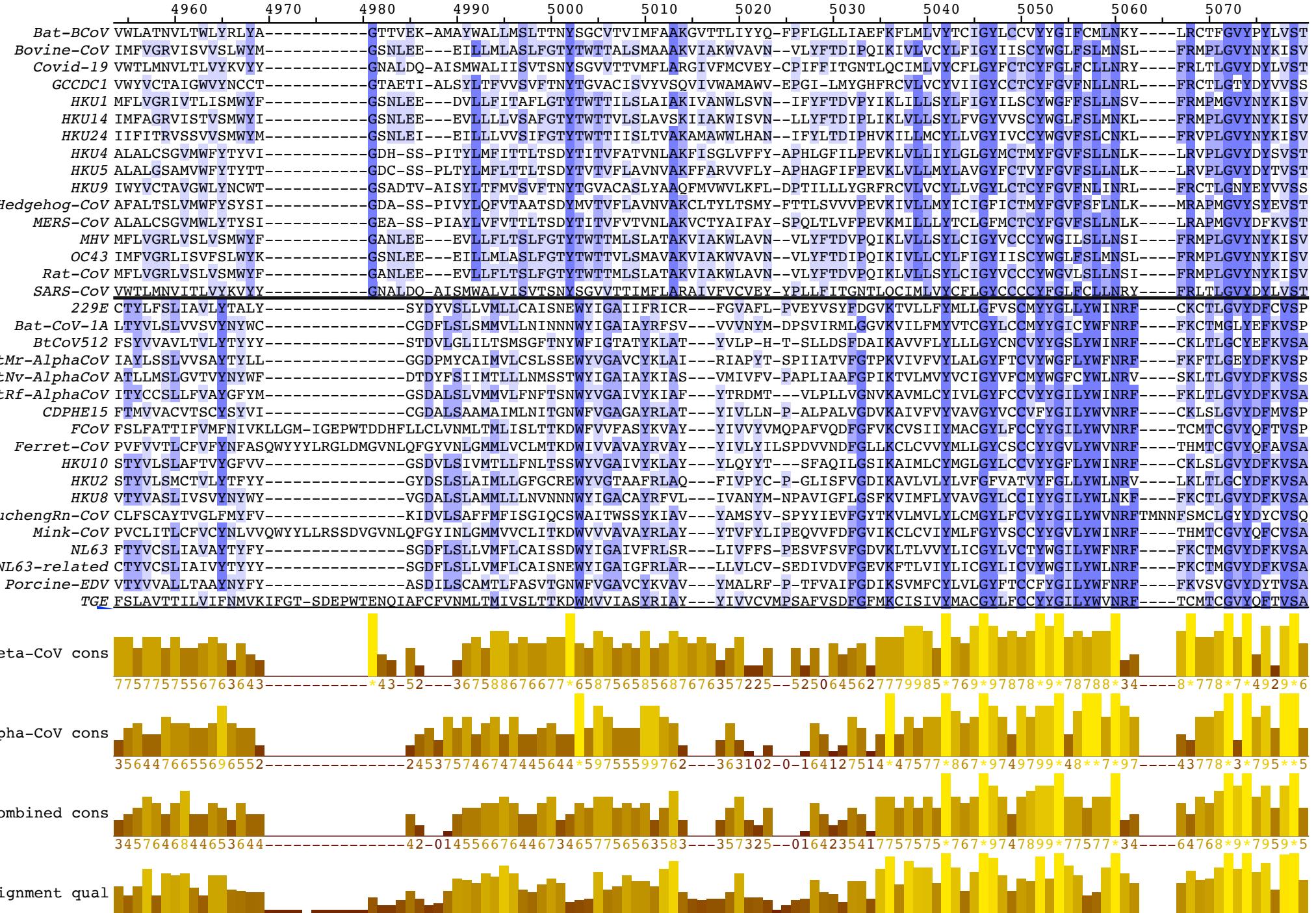


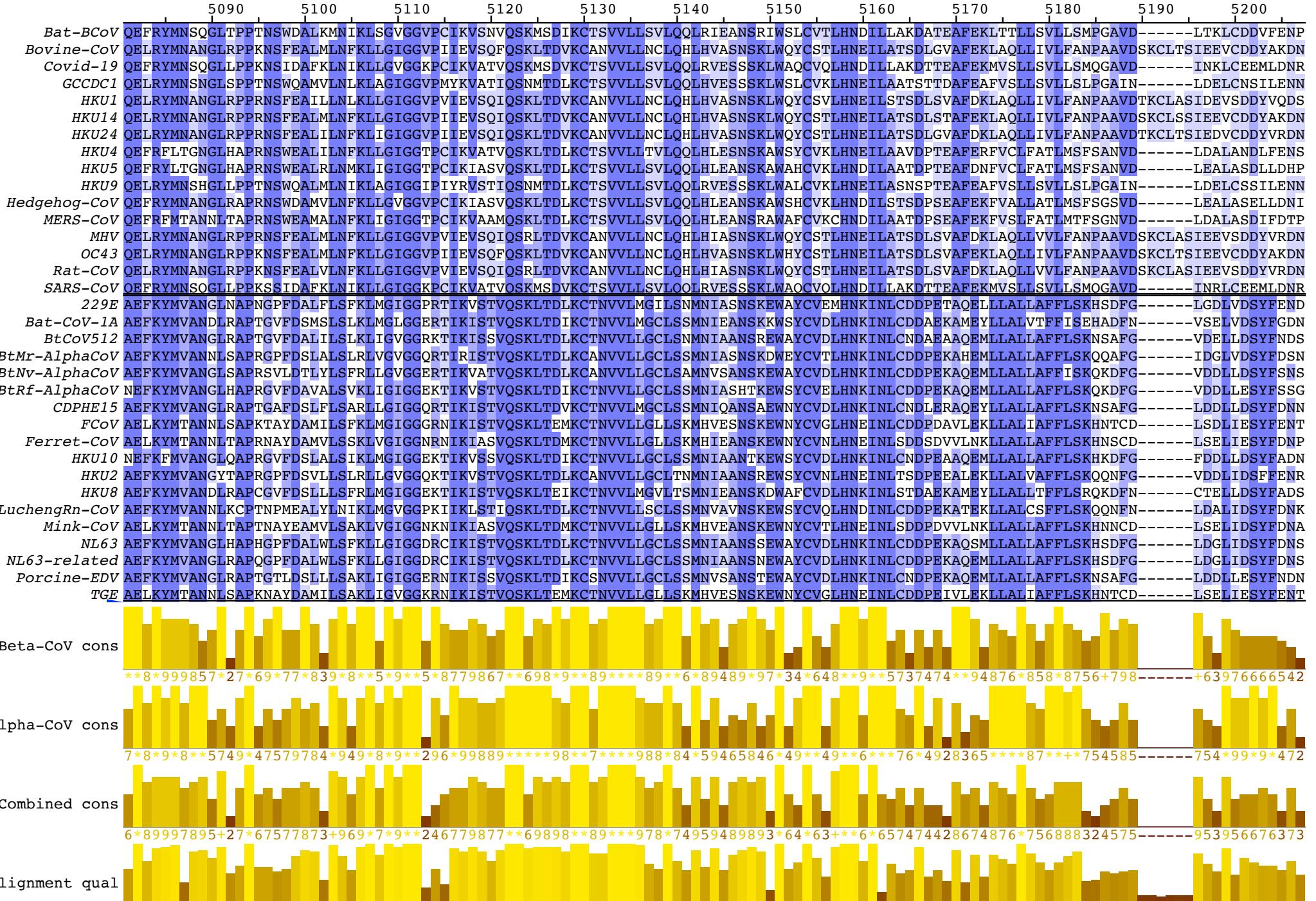


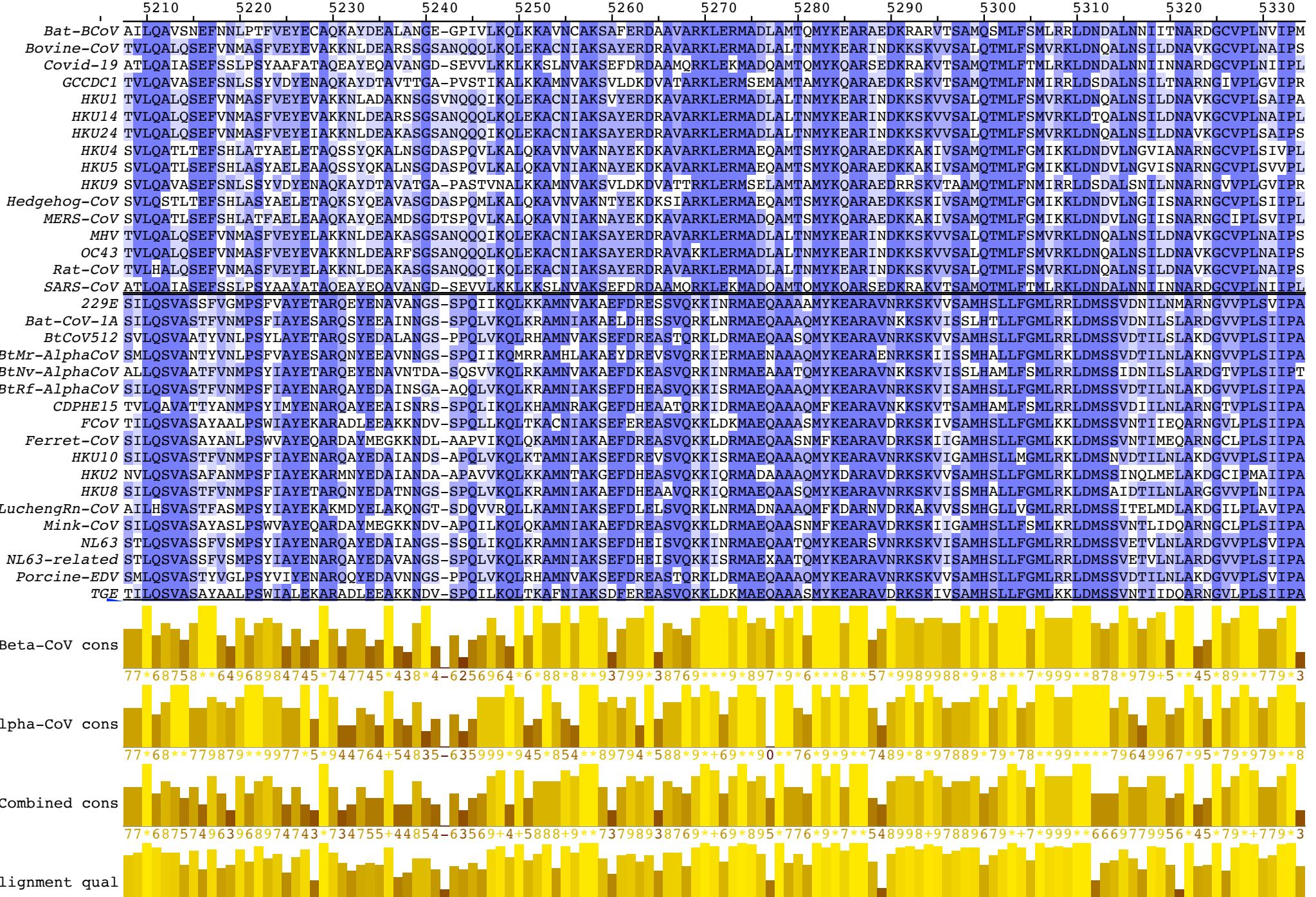


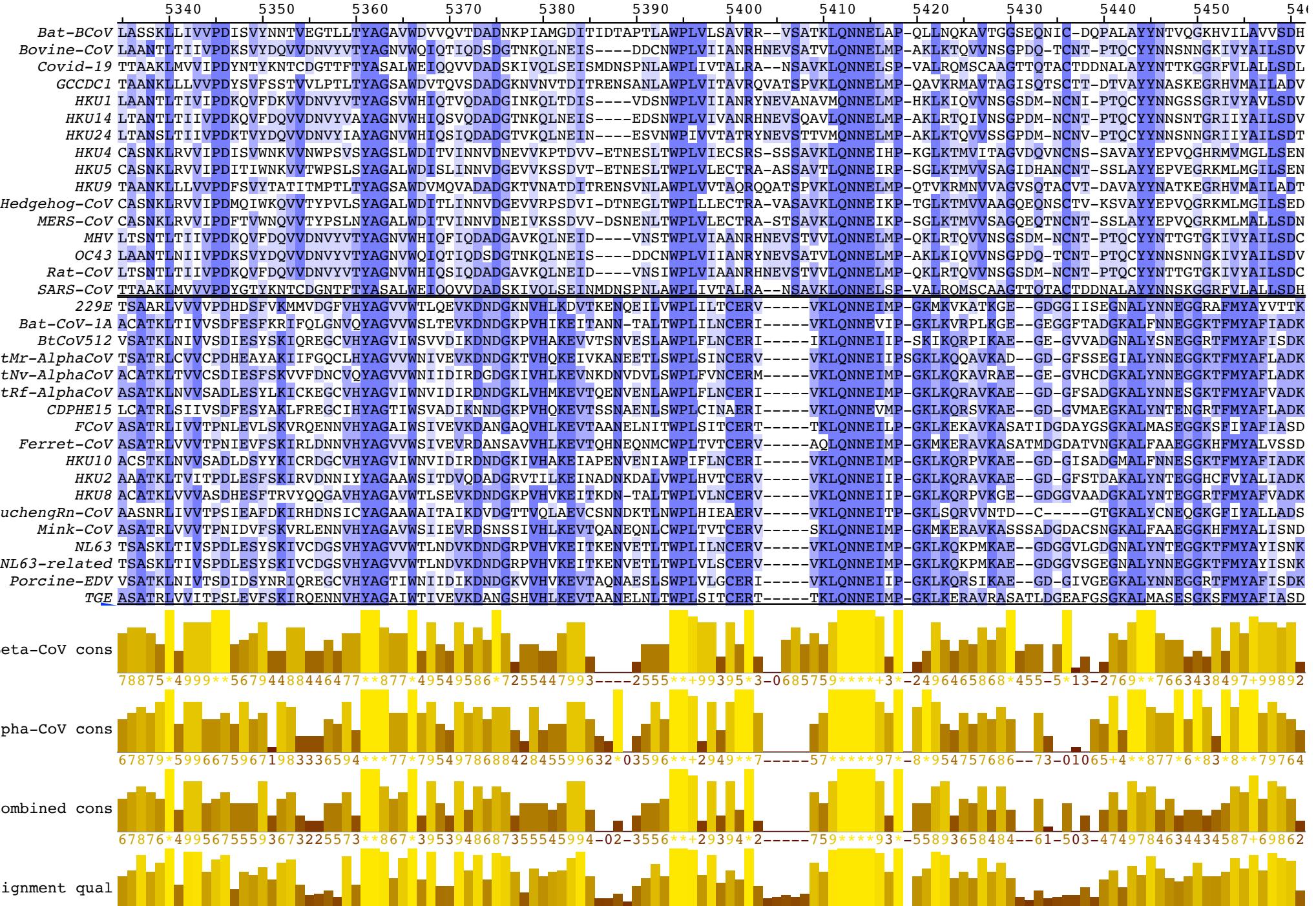
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Bovine-CoV CIIITAFVKWTMFMYVTTNM-LSITFCALCVISLAMLLVVKHKHLYLTMYIIPVLFITLYNNYLVVKQTFRGYV---YAWLSYYVPS-VEYTYTDEVIYGMLLLIGMVF---VTLRSINHD--LFSF
Covid-19 LVLVQSTQWSLFFFYENAFLPFAMGIAMSAFAMMFVKHKHAAFLCLFLPLSLATVAYFMNVMPASWVMRIM-T-WLDMVDT--SLSGFKLKDCVMY-ASAVVLLIL---MTARTVYDD--GARR
GCCDC1 LTLLHLSQWTVLGALPLQLLPLLGFISCCVGFAMFIKHKHTFLTVYLLPVVMVAAYYNFQYQPEGIQGYLL-YVYNYVNPGRFD-MGFDLTTML---VISGITT---LSVRIAKSD--TYSR
HKU1 CIISAFVKWTIFMYINTHM-IGVTLCLCVSFMMMLLVKHKHFYLTMYIIPVLFITLYNNYLVVKEGFRGFT---YVWLSSYFVPA-VNFTTYEVFYGCILCVFAIF---ITMHSINHD--IFSL
HKU14 CIITAFVKWTMFMYVTTHM-LSVTVLALCCSFTMLLVKHKHFYLTMYIIPVLLTLYNNYLVVKHSFRGYV---YAWLSSHFMPS-VDYTYTDEVIYSIVLLFGMIF---ITMRSINHD--VFSV
HKU24 CILSAFKWKTMFMYVTLNV-LSVTIGTLCVACAMLFIKHKHFYLTMFILPVFLTLYNTLVVYKQSFRGYA---YAWLSYYVPS-VDYTYTDEVIYGCCAVLFMIF---TTMRSINHD--LFSI
HKU4 VSVMLQTKFTMWTFYTFETIPTQMTPLLLGFMACVMFTVKHKHTFMSLFLPVALCLTYANIVYEPQTLISSTLIAVANWLPTTSV-YMRTTHFDGLY-ISLSFVLAI---IVRRRLYRPS--MSNL
HKU5 VATLQLTKFTIWNYLFEVPIPLQLTPLVLCVMACVMLTVKHKHTFLTLFLPTAICLTYANIVYEPQTPVSSALIAVANWLNPASV-YMRTTHTDLGVY-LSLCFALAV---VVRRRLYRPN--ASNL
HKU9 LLLLQLAQWTFVGALPFTLLLPLIGFVAVCVGFVSLLIKHKHTYLTLYVLLPVAMTAYNFQYTPEGVQGYLL-SLYNYVNPGRIDVIGTDLTML---IISVACTL---LSVRMVRTD--AYSR
Hedgehog-CoV VVILQLTKFTIWNFLFNVIPQLTPIMFVLAALAMLCVKHKHAAFLTTFLPGALCLTYANLVYEPNTPVSSFLIMCVNWLPDGT-YMRTTHMDLGVY-VSLCLALLV---VVRRRLYKPS--VTNC
MERS-CoV VIIQATKFTLWNYLFETIPTQFLPFLFVMAFVMLLVKHKHTFLTLFLPVAICLTYANIVYEPPTPISSALIAVANWLAPTA-YMRTTHTDIGVY-ISMSLVLVI---VVKRLYNPS--LSNF
MHV SIIISAFVKWTMFMYVTTHM-LGVTLCALCFVSFAMLIKHKHFYLTMYIMPVLFITLYNNYLVVKQSFRGLA---YAWLSSHFMPS-VDYTYTDEVLGVVLLVAMVF---VTLRSINHD--VFSI
OC43 CIITAFVKWTMFMYVTTNM-FSITFCALCVISLAMLLVKHKHFYLTMYIPTVLFITLYNNYLVVKHTFRGYV---YAWLSYYVPS-VEYTYTDEVIYGMLLLVGMVF---VTLRSINHD--LFSF
Rat-CoV SIIIAAFVKWTMFMYVTTHM-LGVTLCALCFVSFAMLIKHKHFYLTMYIMPVLFITLYNNYLVVKQSFRGLA---YAWLSSHFMPS-VDYTYTDEVLGVVLLIAMVF---VTLRSINHD--VFSI
SARS-CoV LILVOSTOWSLFFFVYENAFPLFTLGIMAIAACAMLLVKHKHFCLFLPLSLATVAYFMNVMPASWVMRIM-T-WLEIADT--SLSGYRLKDCVMY-ASAVVLLIL---MTARTVYDD--AARR
229E MFWAELFVYTTTIWNVPGFLTPFMILLVALSCLTFVVKHKVLFQVFLPLPSITVAIAIQNCAWDYHITK-VLA---EKFDYNVSVMQMDIQGFVN--IFICLFLVALL--HTWRFAKER--CTHW
Bat-CoV-1A MFLSELLYYTSSYWIKPDLITAVFVLLFGIAVMLTLTICKHKVLFYTFLIPSVVISACYNLAWDLYIRE-LLA---KYFDYHMSIFSMDIQGCFN--IVACILVNAI--HTWRFVKTG--TATR
BtCoV512 LFLSEMLNHSKLFWINPGYIPTVFLAIIVASSALMMLVKHKHFQYIPLPSLCIVSGYNIFKDYHFYT-YML---EEFDYKVPFGGFNVTVGVLN--ISLCCFVM--GLHTFRFLQTPN--KI
BtMr-AlphaCoV MFWGEFLMYSSVMVHPAVVTPILLCLGLVSLMLSGLIKHKMMFLQTFPLPSIVVIAANNNFWDYFVTQ-LLV--QYFDYTAFLSLSLDIQCQGLN--IAMCLFVML--HTYRFVSTGN--NA
BtNv-AlphaCoV MFWSEFLSYSAFWINANVLTPIFLCLCGFSVVLTVGLKHKHFYTFLIPTVVLLAAINSWDFYLRA-LLS--STVGYHTSLMSFDLQGVLN--IAICAFVSGL--HLYRFSPNVG--SC
BtRf-AlphaCoV MFWSELLHYTAFFWISPGFIFTMFFMLMVSFFMCALKHKIMFLYTFLIPAVIVTSCNFAWDWFYITS-VLA---TTFDYHVSLLSLDIQCQVIN--VSACVFVTL--HTFRCCKSSVNYSSV
CDPHE15 LFWSELVITYPFFWVSPAYITPLFLIVSGVSILCMSLLKKHTLFLQMFIPAVIAVSAYNLADEIR-WMA---TKLDYHASILSFNIQCQIFN--IMVCCVVVCL--HAYRCVTRSS--SV
FCoV AFWLEEFFMYTPFTWINPTFVSVVLAITLVSLLVAGIKHKMFLFMSFVMPSPVILATAHNVVWDMTYYESLOV---LIVENVNTTFPLPVDMQGVML--ALFCVVVVFVI--CTIRFFTCKO--SW
Ferret-CoV AFWTEFFFLYTPFSWFGPASIGCLLLMTVVVSALLTIFVKHKMLYFMSFLLPSVILMTVSNLVWDSLYIAAVQA---KLVEVNMSLIAVDMQSVL--MVLCLLVAIV--HCYRFCTQRQ--SI
HKU10 MFWSELLQYTAFFWVSPGFPTVFFALLVSVILMCFLKHKVLFLYTFLIPSVIIMASYNFMWDWSVAA-ELA---RIFDYHVSIVSFDIQCQGLN--VAVCLFVTLL--HTMRRFFKTNT--SI
HKU2 LFWSEFFMYSTILWINPGLITTFLGLFVMLSMLASCIKHKMFLQFLPLPSIIIAACYNFAWDMEVTR-MLA---TQFDYHVSFLNMDIQCQGAIN--IIVCFIGISL--HTYRFFLDTQ--LRSY
HKU8 MFISEMLYYTSSYWIKPDLITPIFIILFAIAVFLTAFKHKVLFYTFLIPVPGIVITATSNLAWDCYVRD-LLA---KYLDYHMSIFNMDIQCQGVFN--IAACFMVNAL--HTWRYMRSG--YTTR
LuchengRn-CoV LFWTQFLMYTSVSIQWEVIIISVLVGLTCASAIIIVFIKHKMVFLYGYVVATLVVFSNFLWDYVVS-A-IM---EHASFMSAYFSFDVQSVFN--IFMLSFVLLI--HLARFYCSGGAL-IT
Mink-CoV AFWSEFFFLYTPFTWFSPTMISCILFVTVVISAIFTTFVHKMLYCSSFLLPSIILMTCSNLVWDYFYFEAVQA---KLVEINLSLSIDMQSVL--IILCVLIACV--HCYRFVTQKQ--SI
NL63 MFWAELFIYTNTIWINPVLTPIFCLLLFLSVLTMFLKHKFLFLQFLLPTVIATALYNCVLDYYIVK-FLA---DHFNYYNSVSLQMDVQGLVN--VLVCLFVVFL--HTWRFSKER--FTHW
NL63-related MFWAELFIYTNTIWINVNVLPVFCILLFLSVLTMILLKHKFLFLQFLLPTVIATALYNCWAQDYYMAR-FLA---DHFDYNVSVLQMDIQCQGLN--VLVCLLVAFL--HTWRFAKER--FTHW
Porcine-EDV FFWSELVSYTKFFWVNPNGVTPMFACLSLSSLMLFTKHKTFLFQVFLIPALIVTSCINLAFDVEVYN-YLA---EHFDYHVSLMGFNAQGLVN--IFVCFVVTILHGTYTWRFNTPA--SS
TGE AFWLEEFFMYTPFTWINPTFVSVVLAITLVSLLVAGIKHKMFLFMSFVLPSPVILVTAHNLFWDFSYYESLOS---IVENTNTMFLPVDMQGVML--TVFCFIVFVT--YSVRFRTCKO--SW

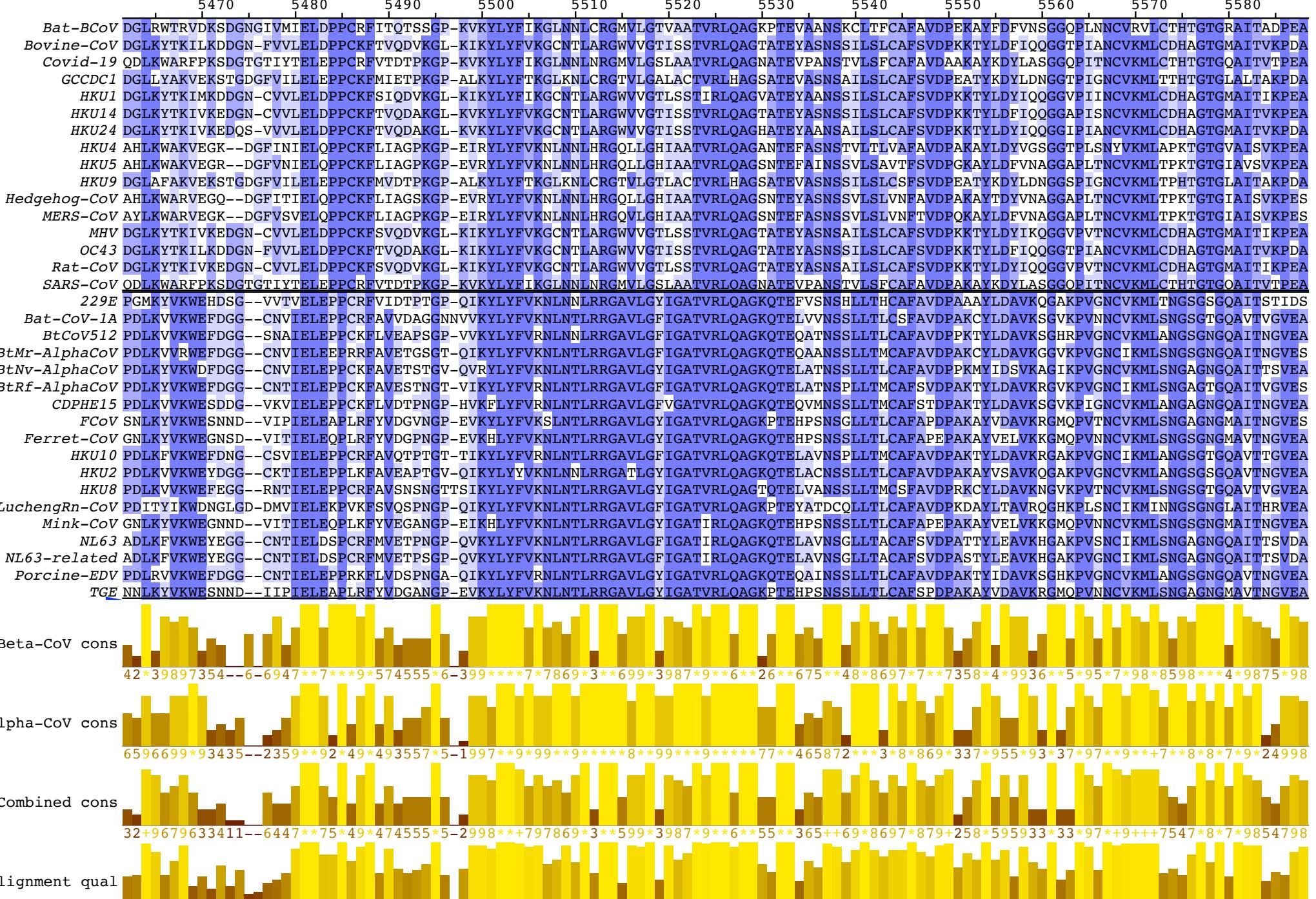


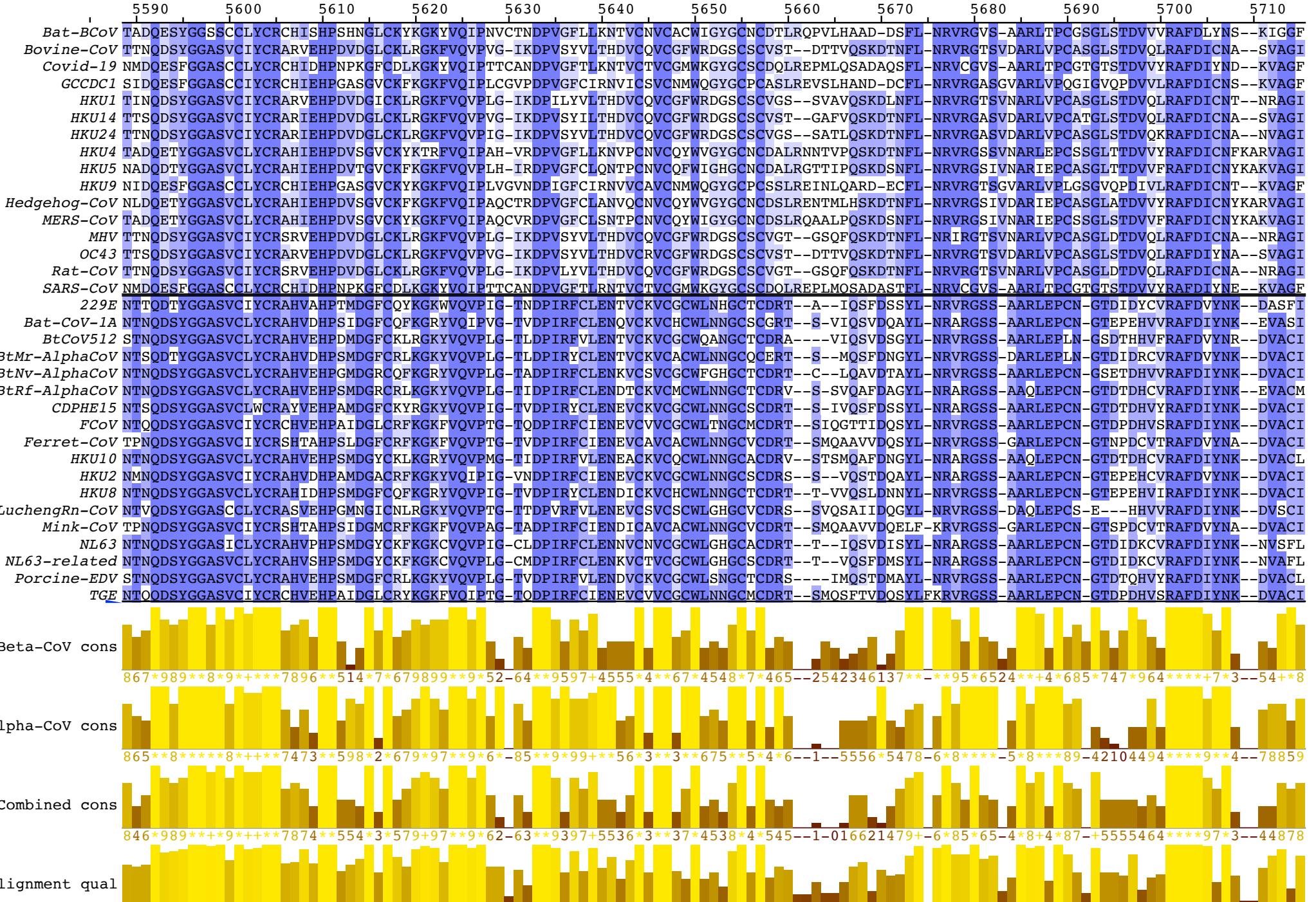


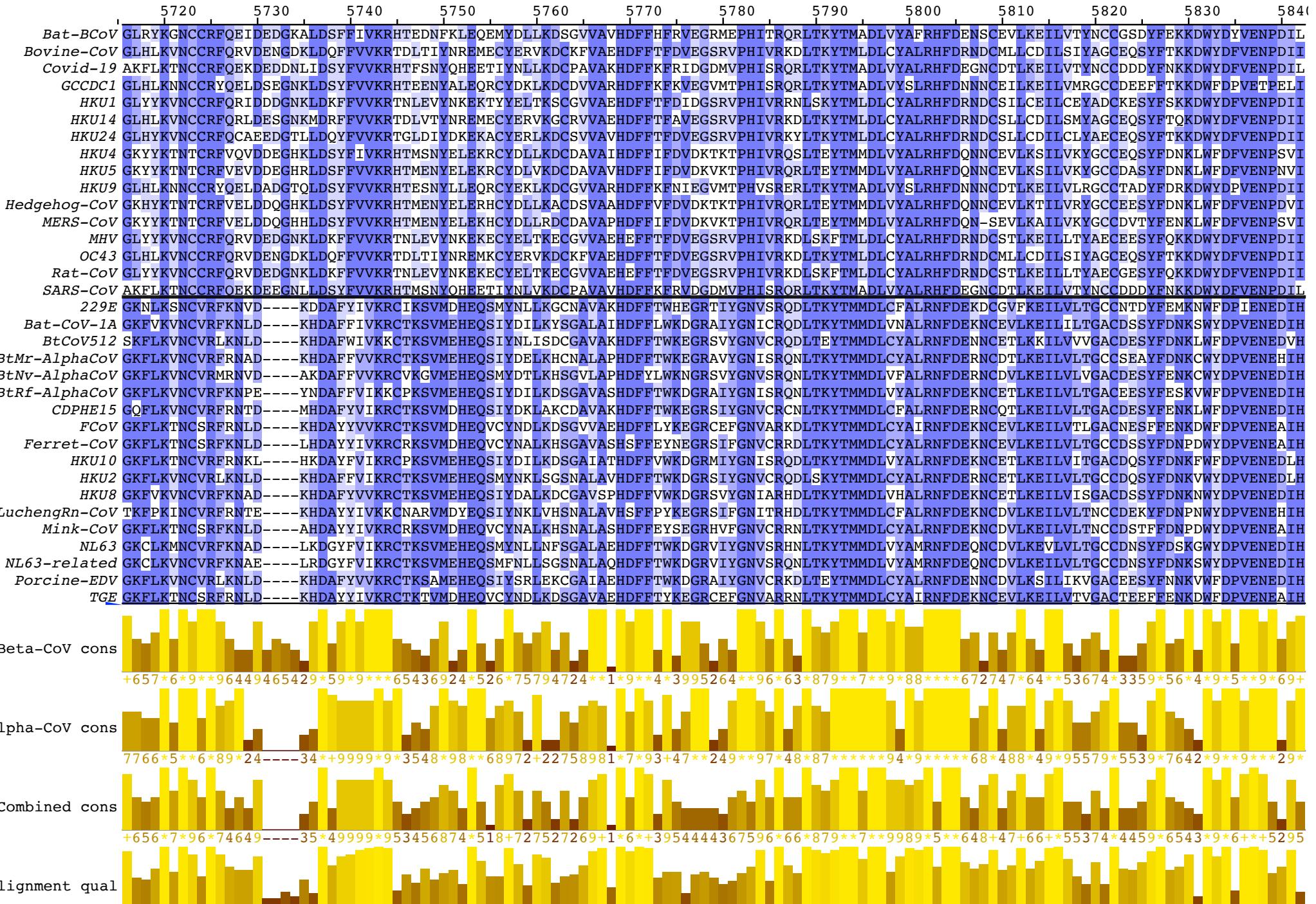


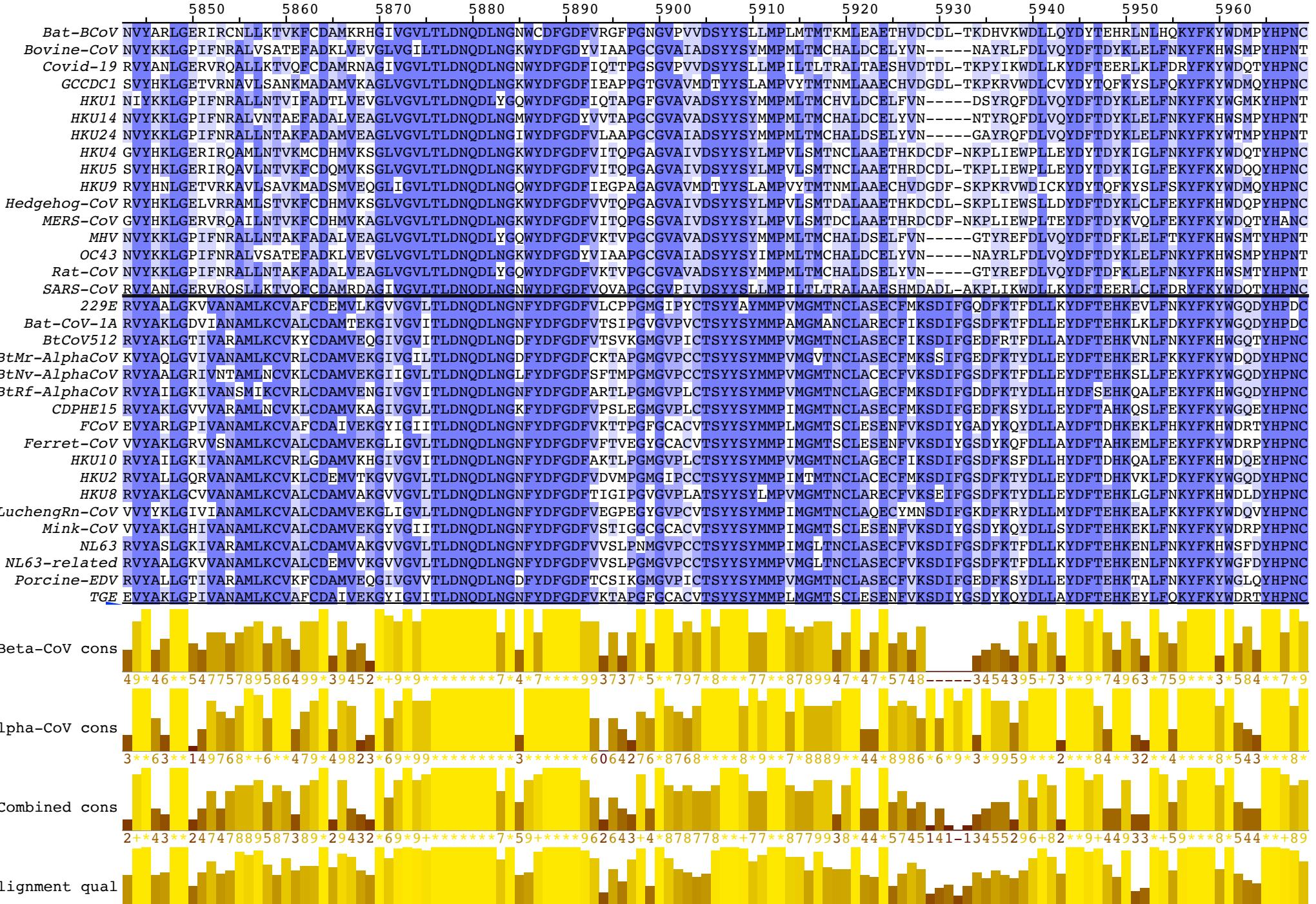


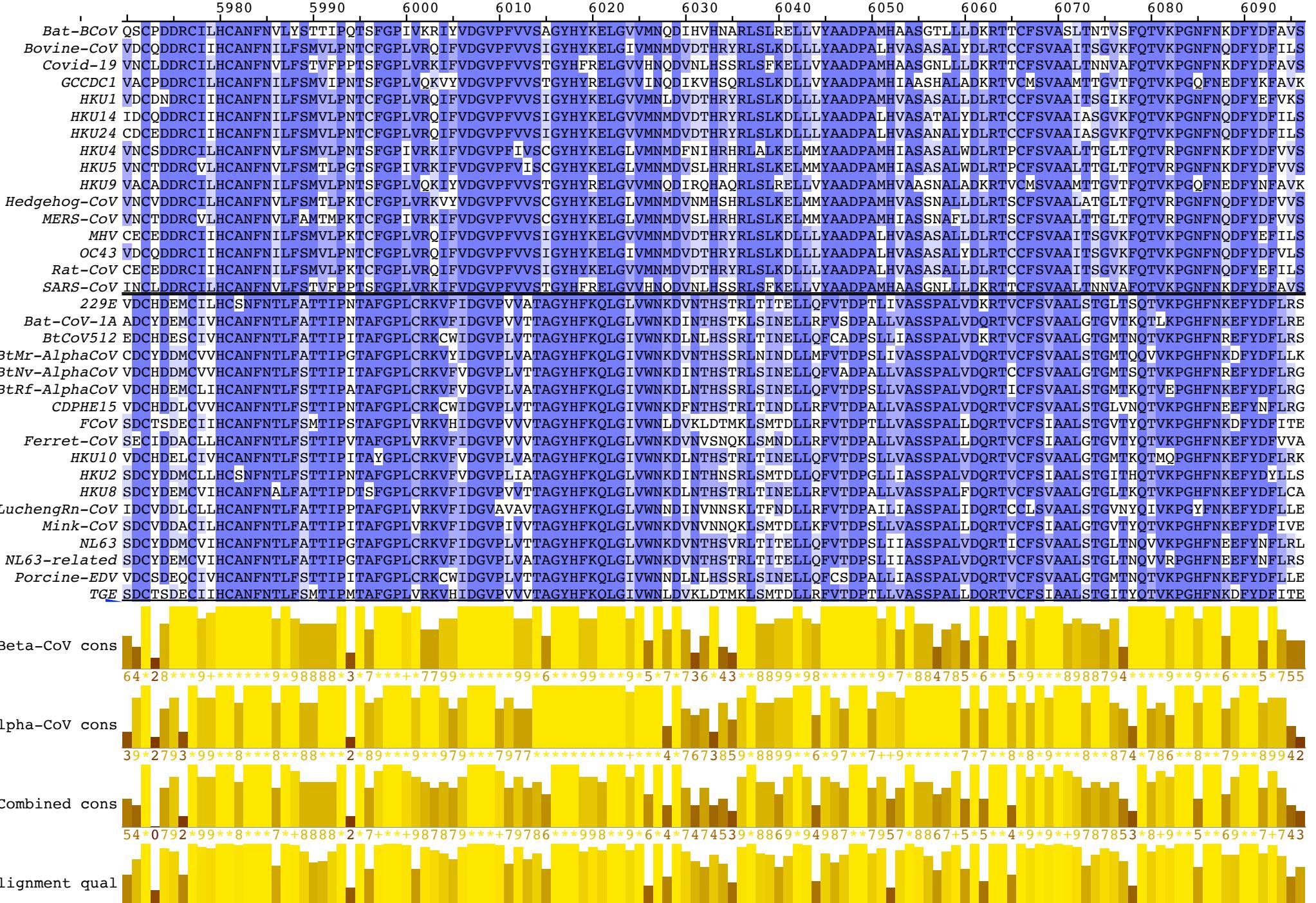


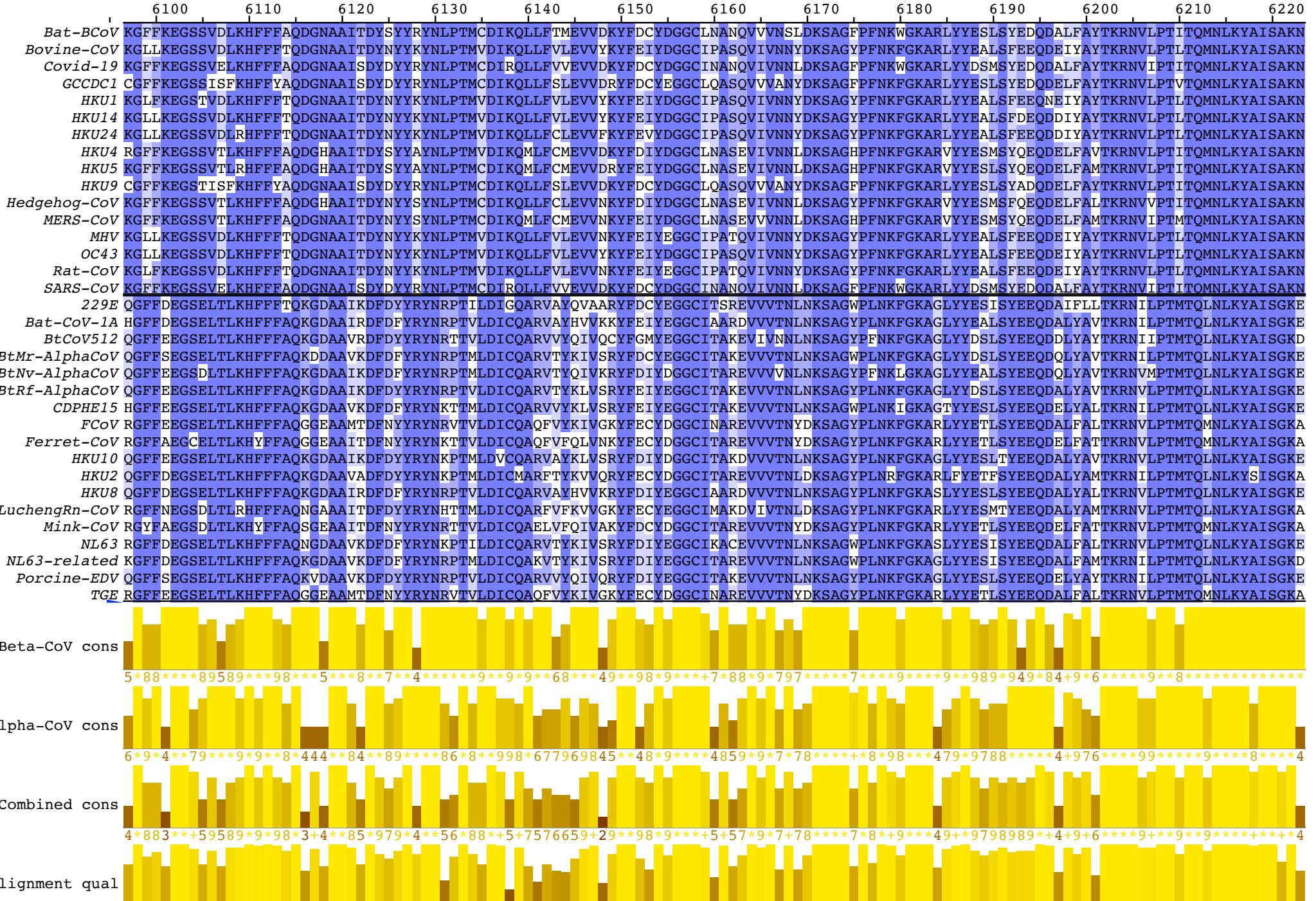


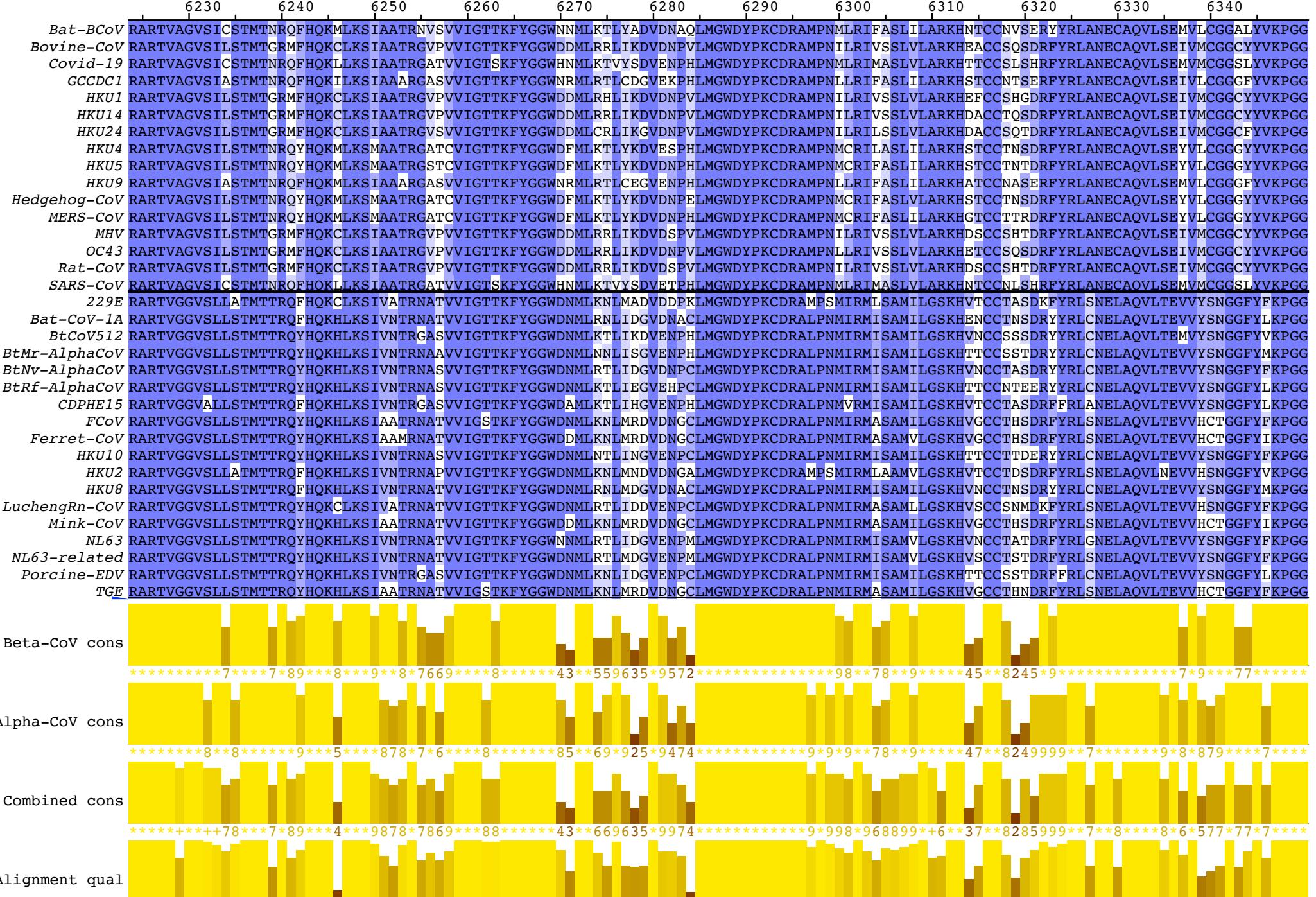


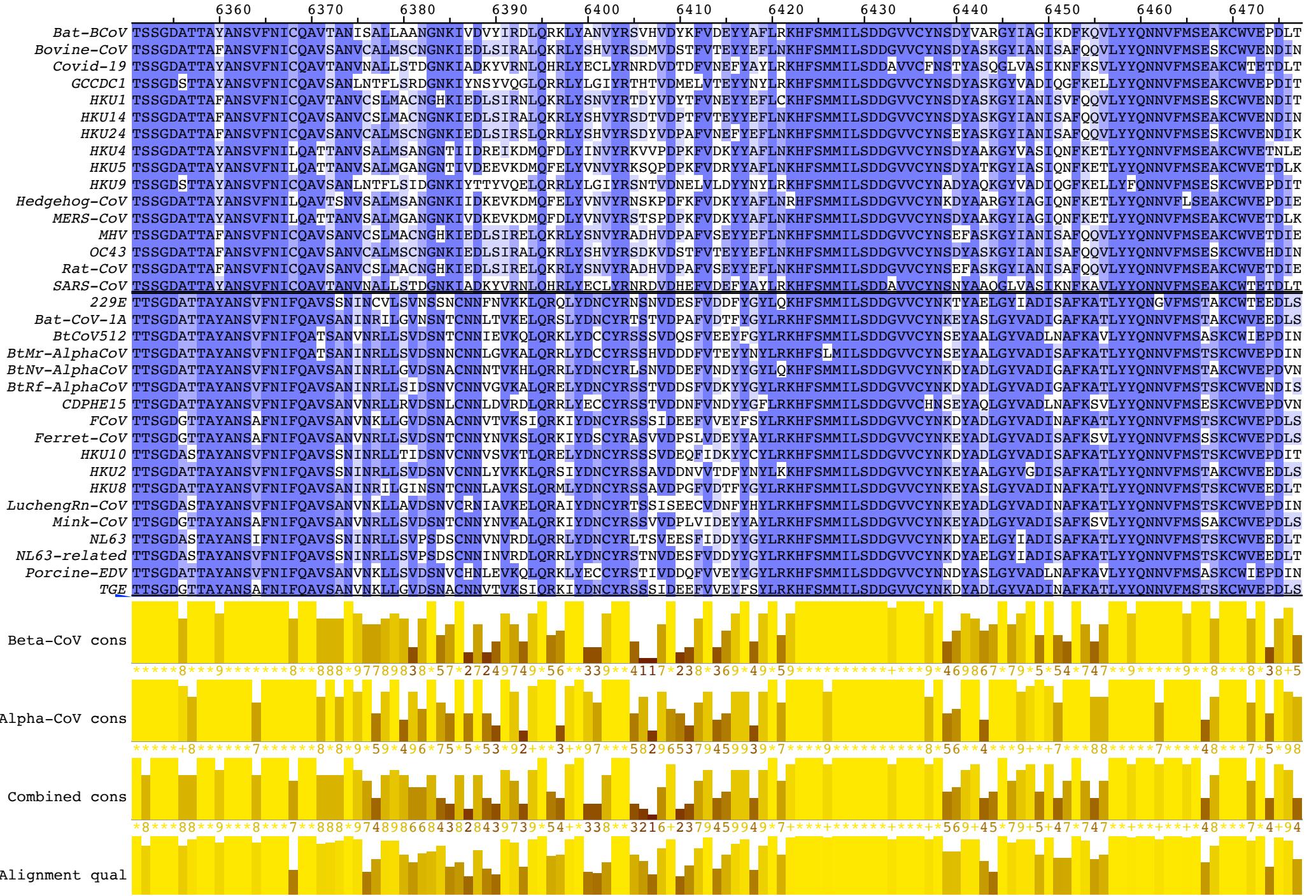


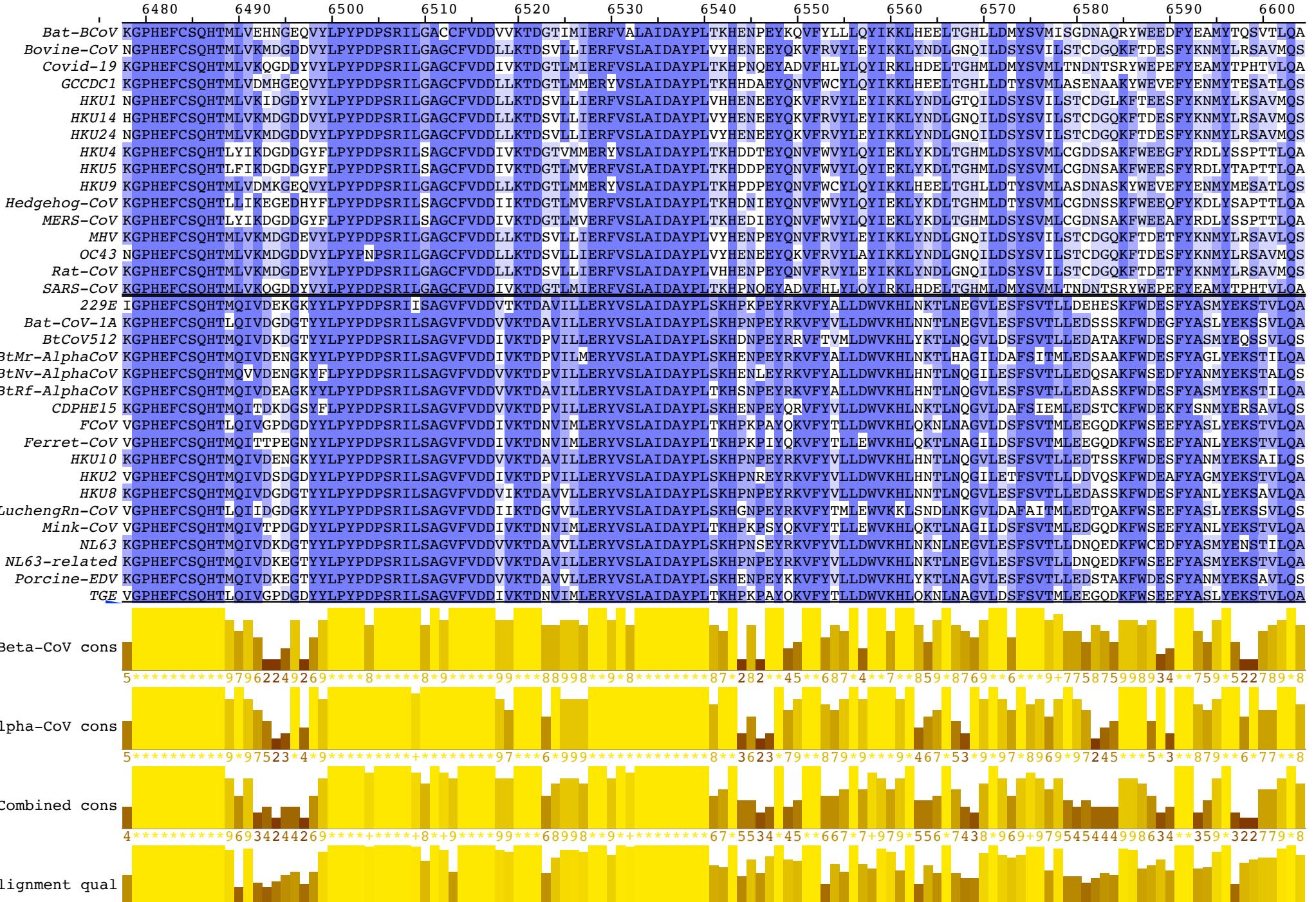


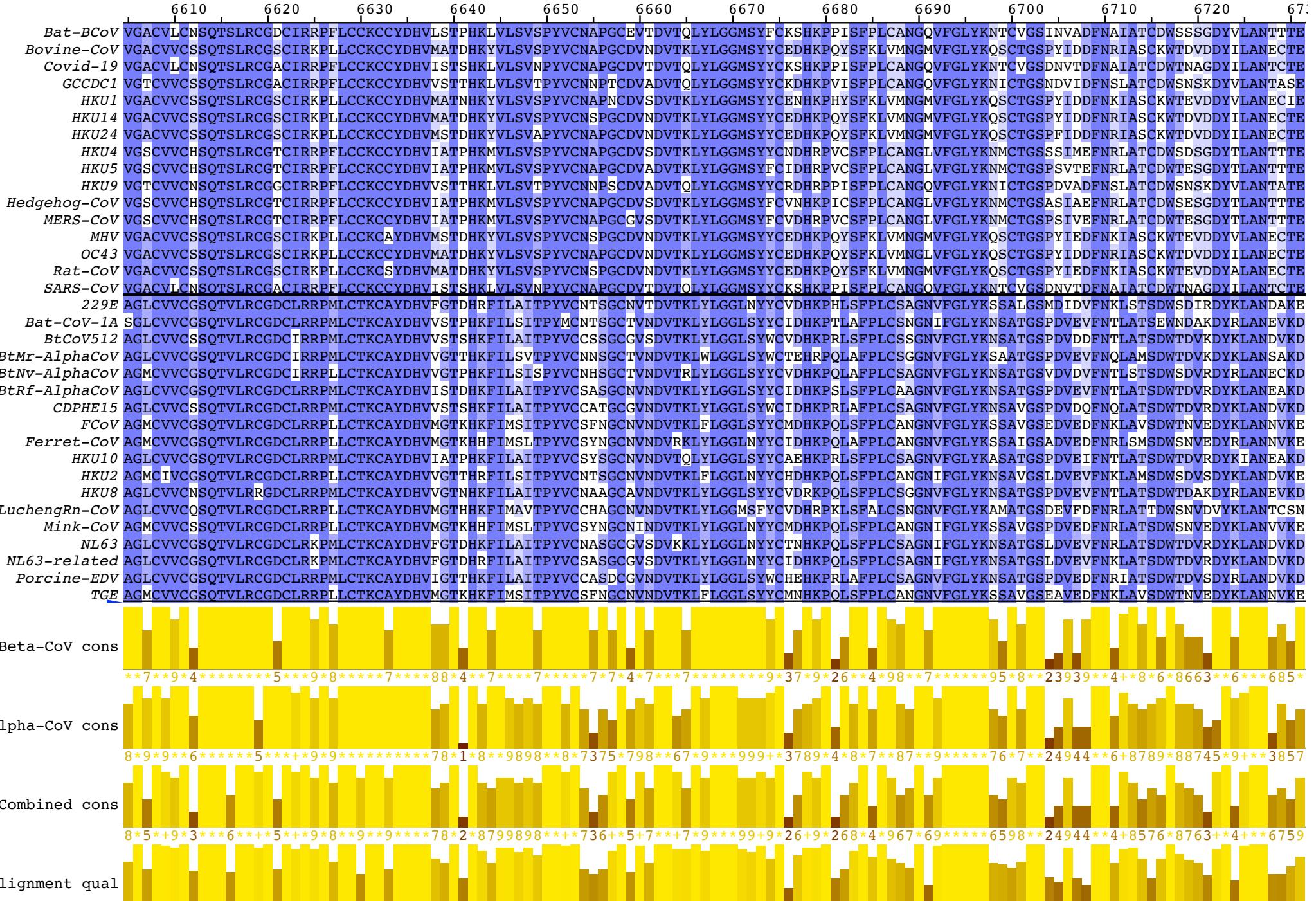


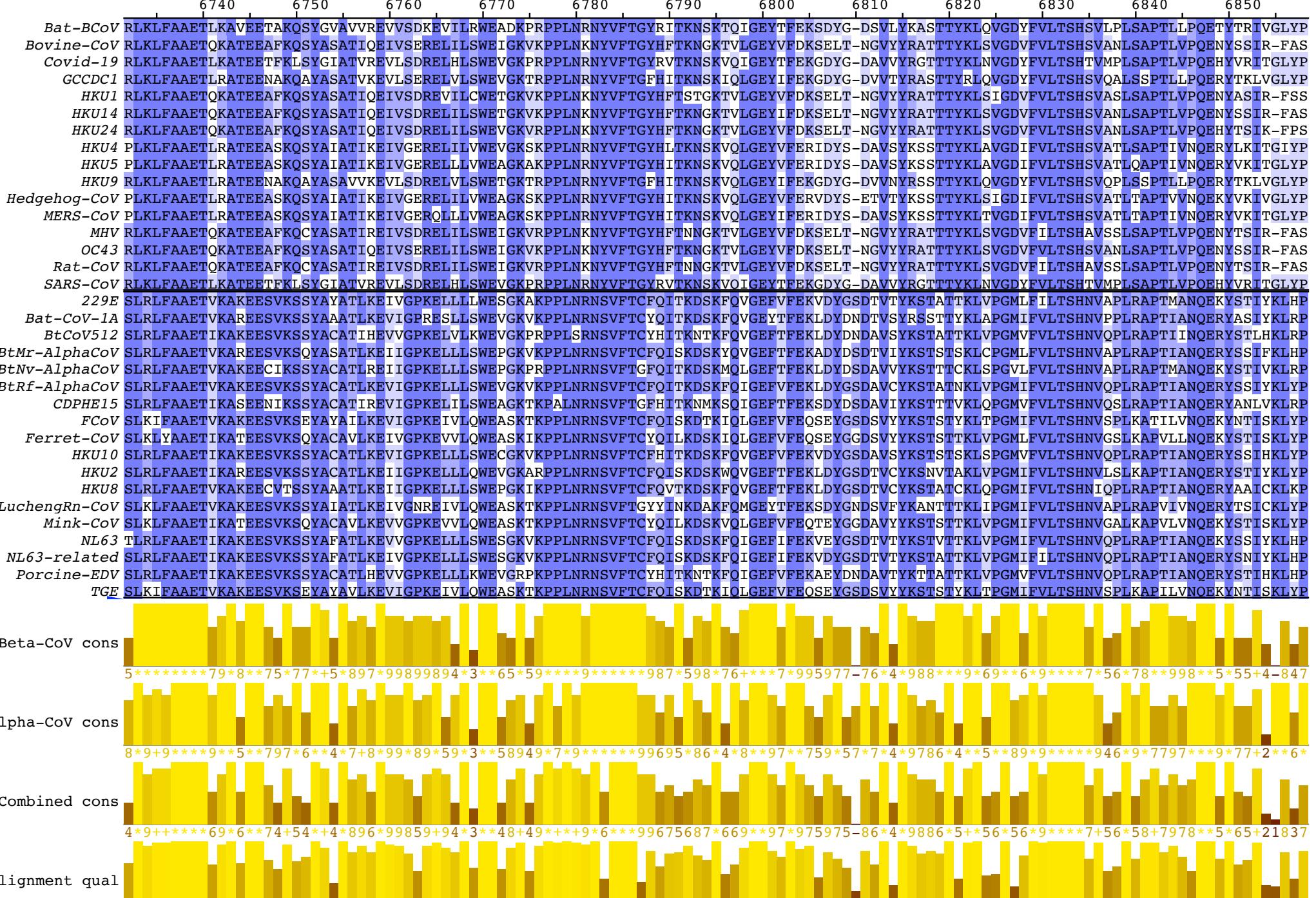


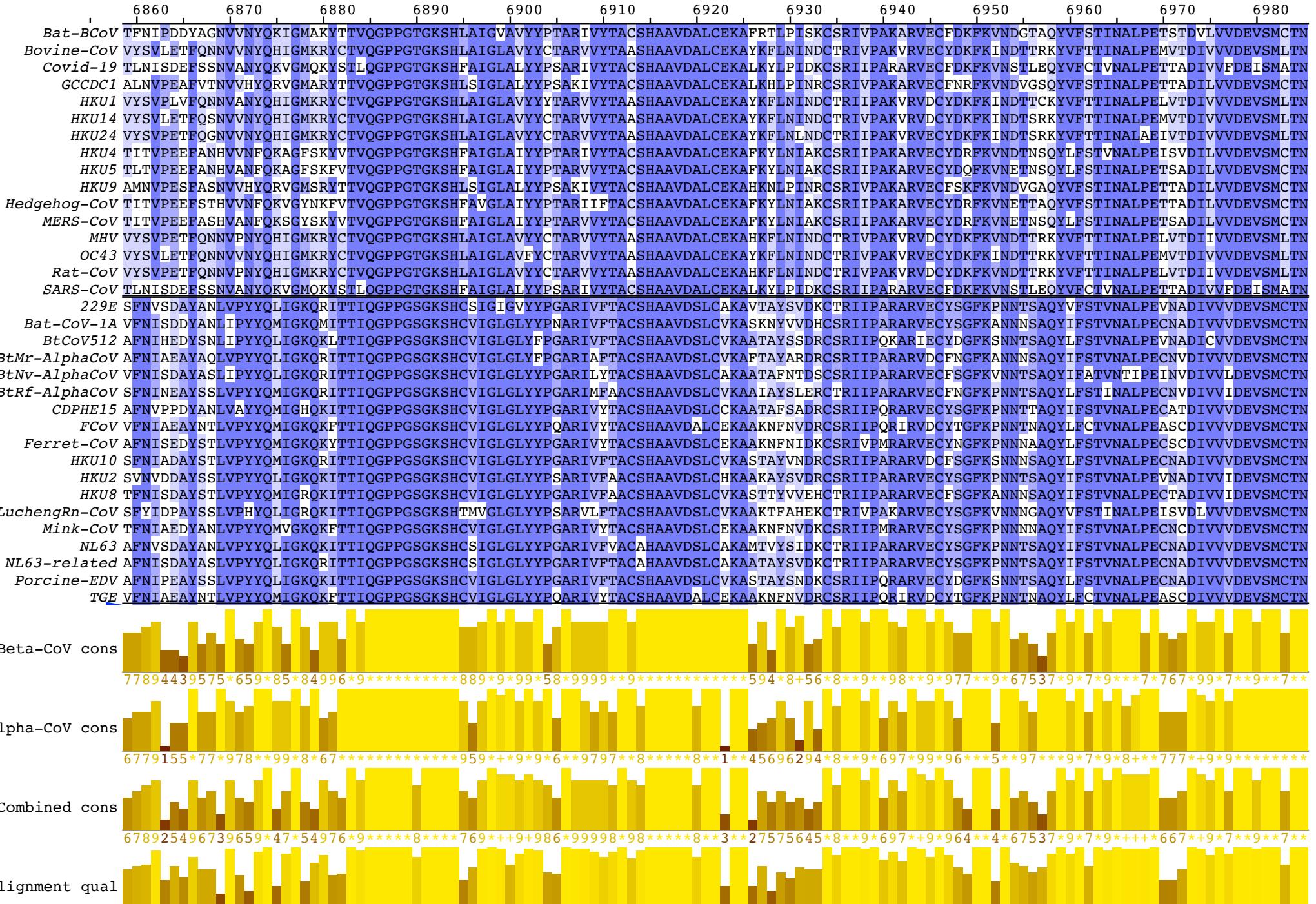


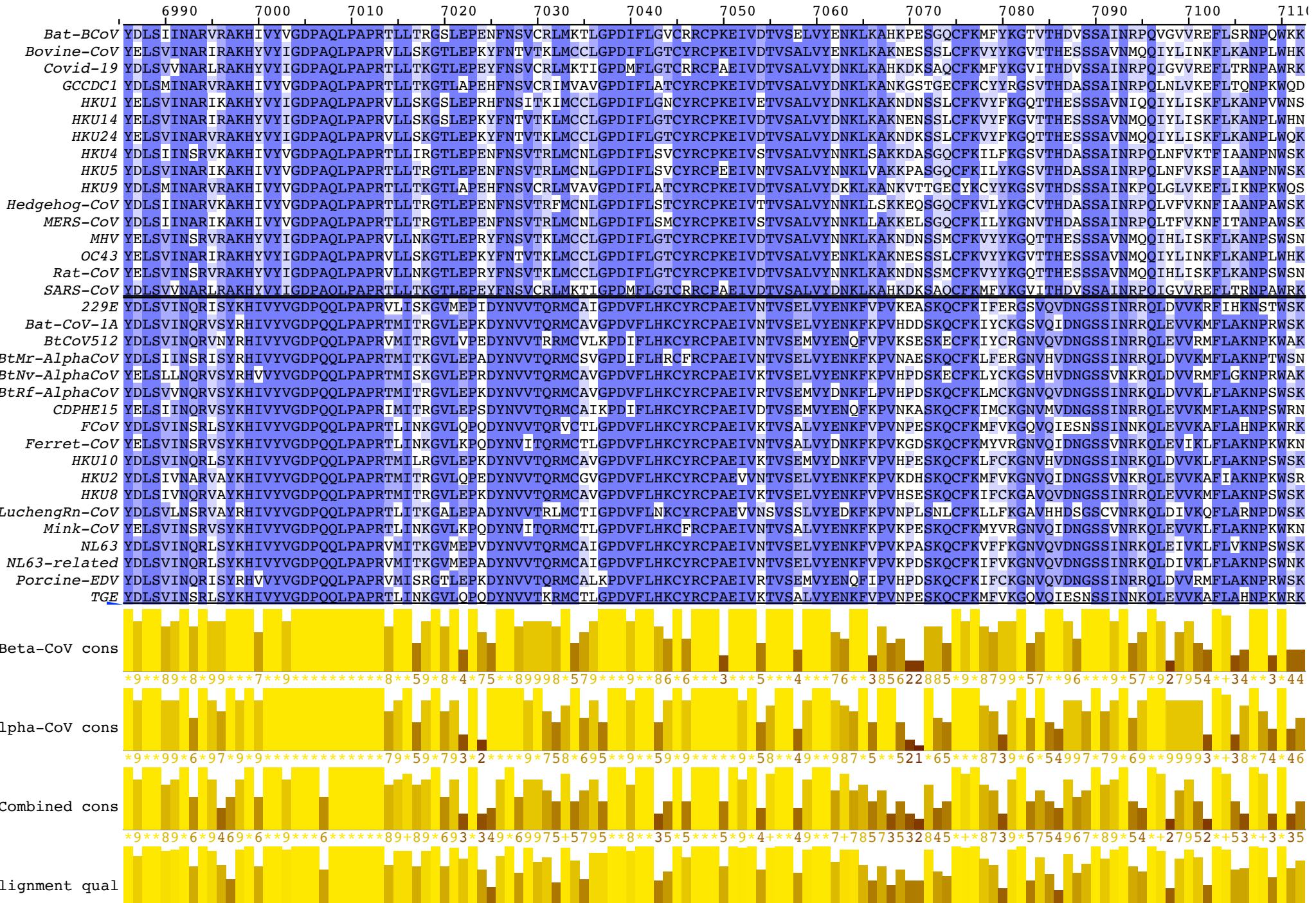


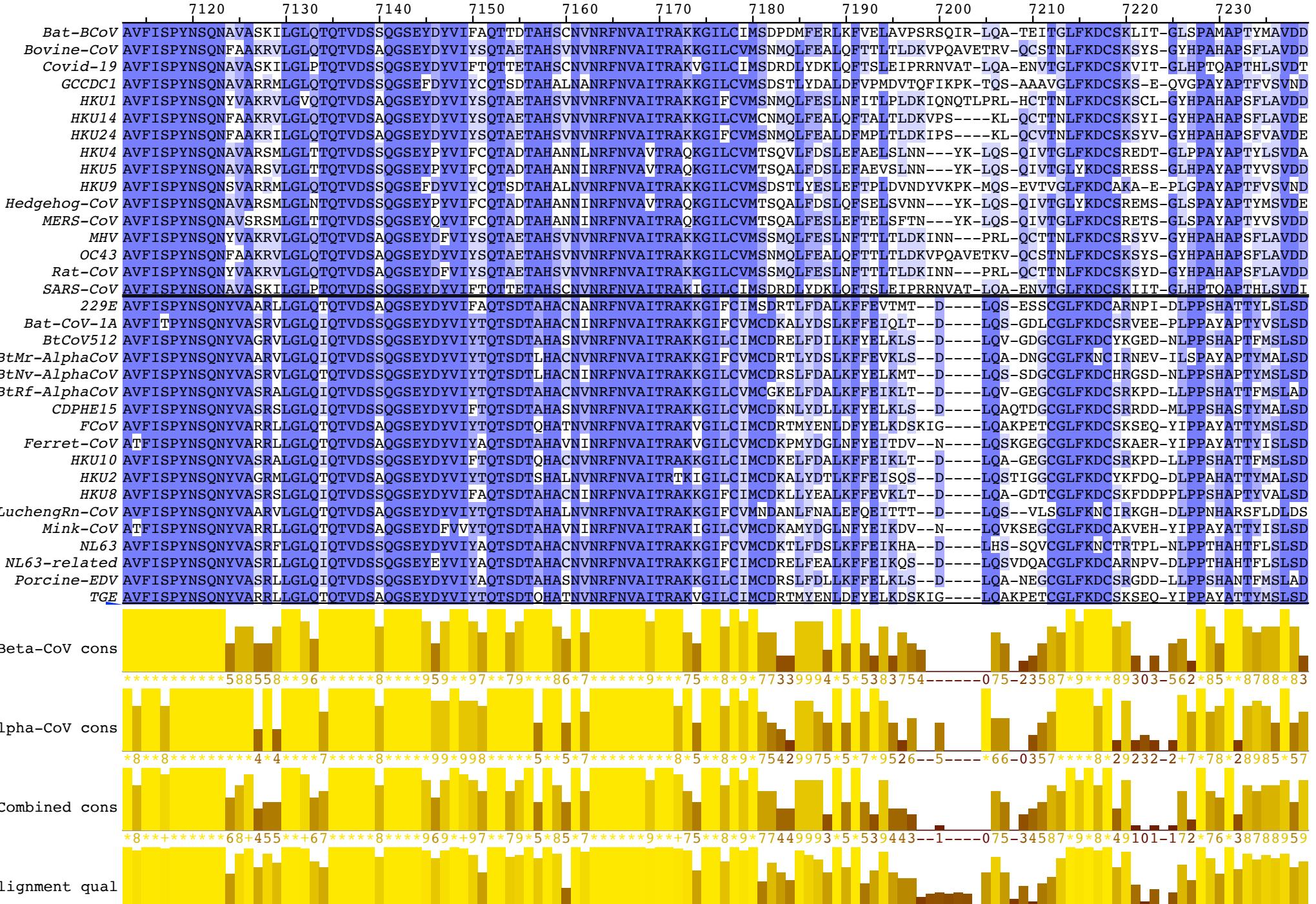


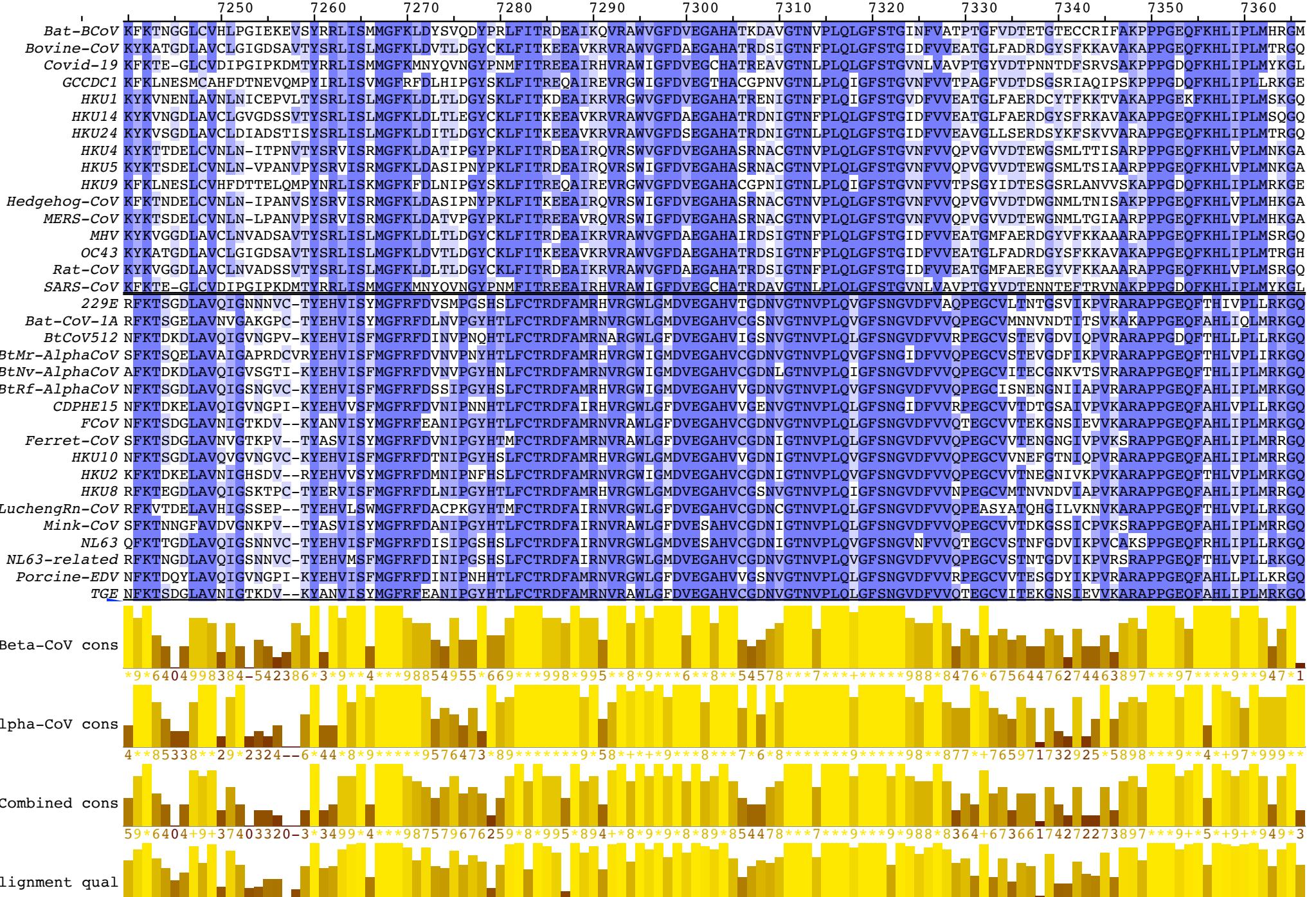


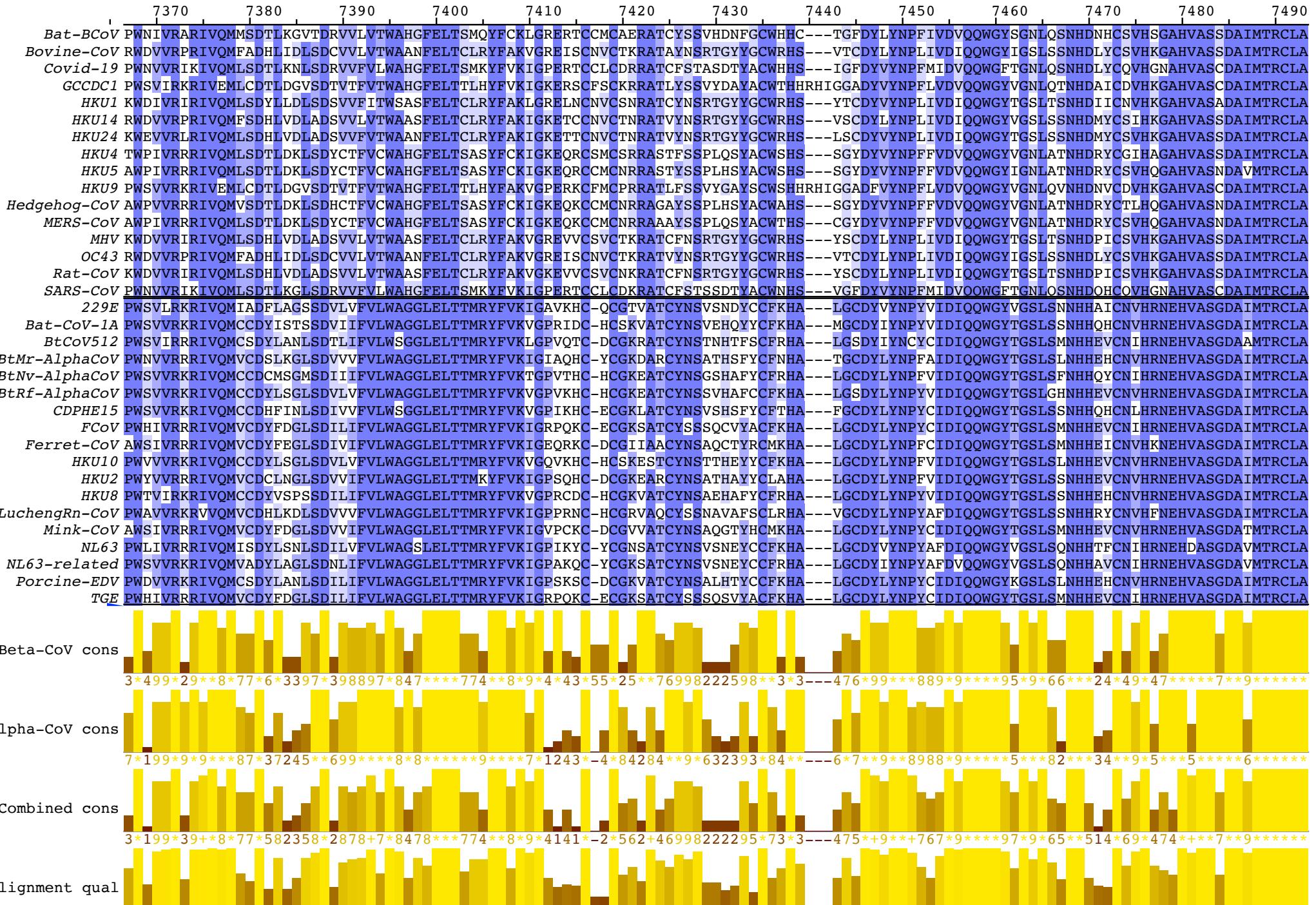


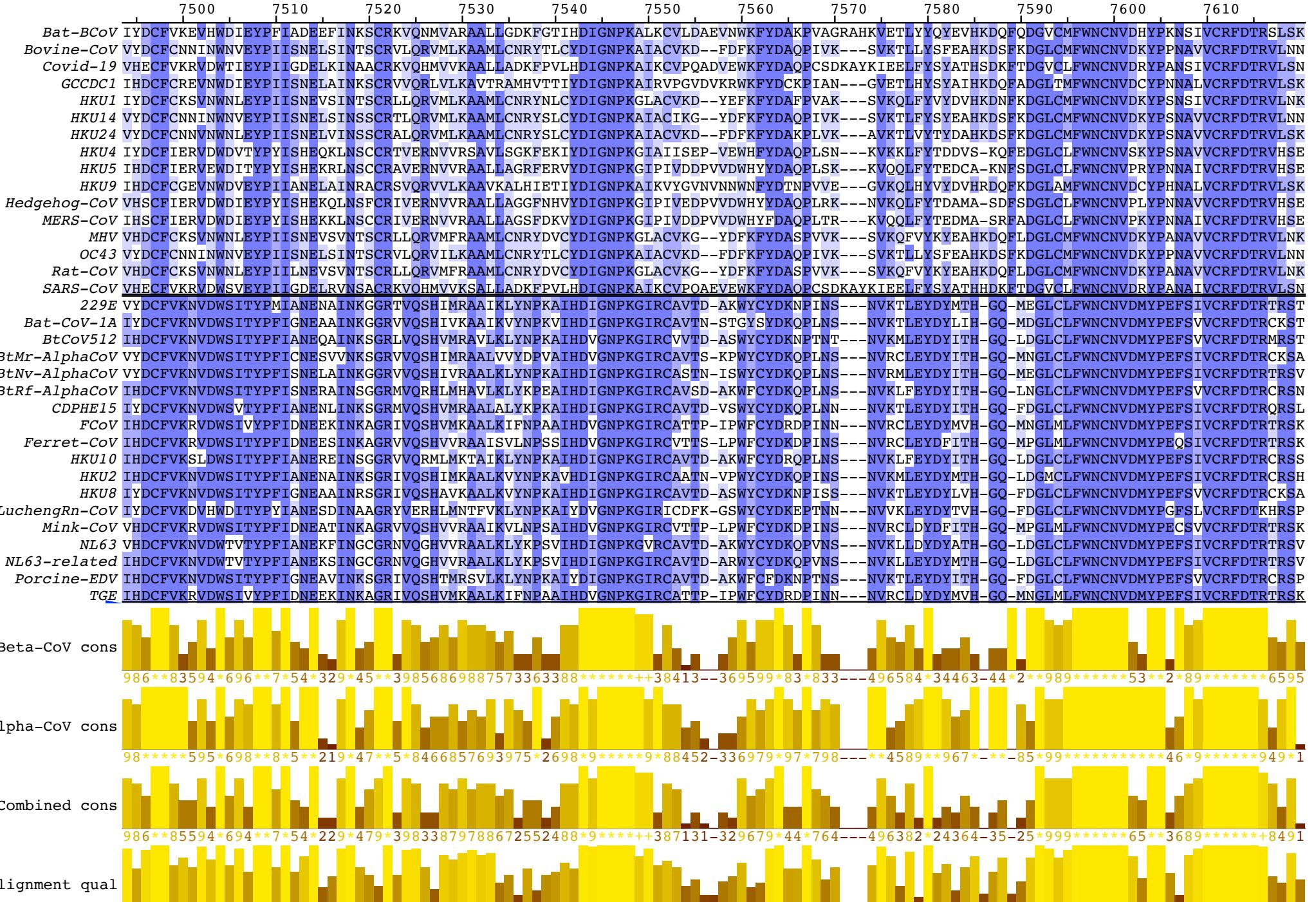


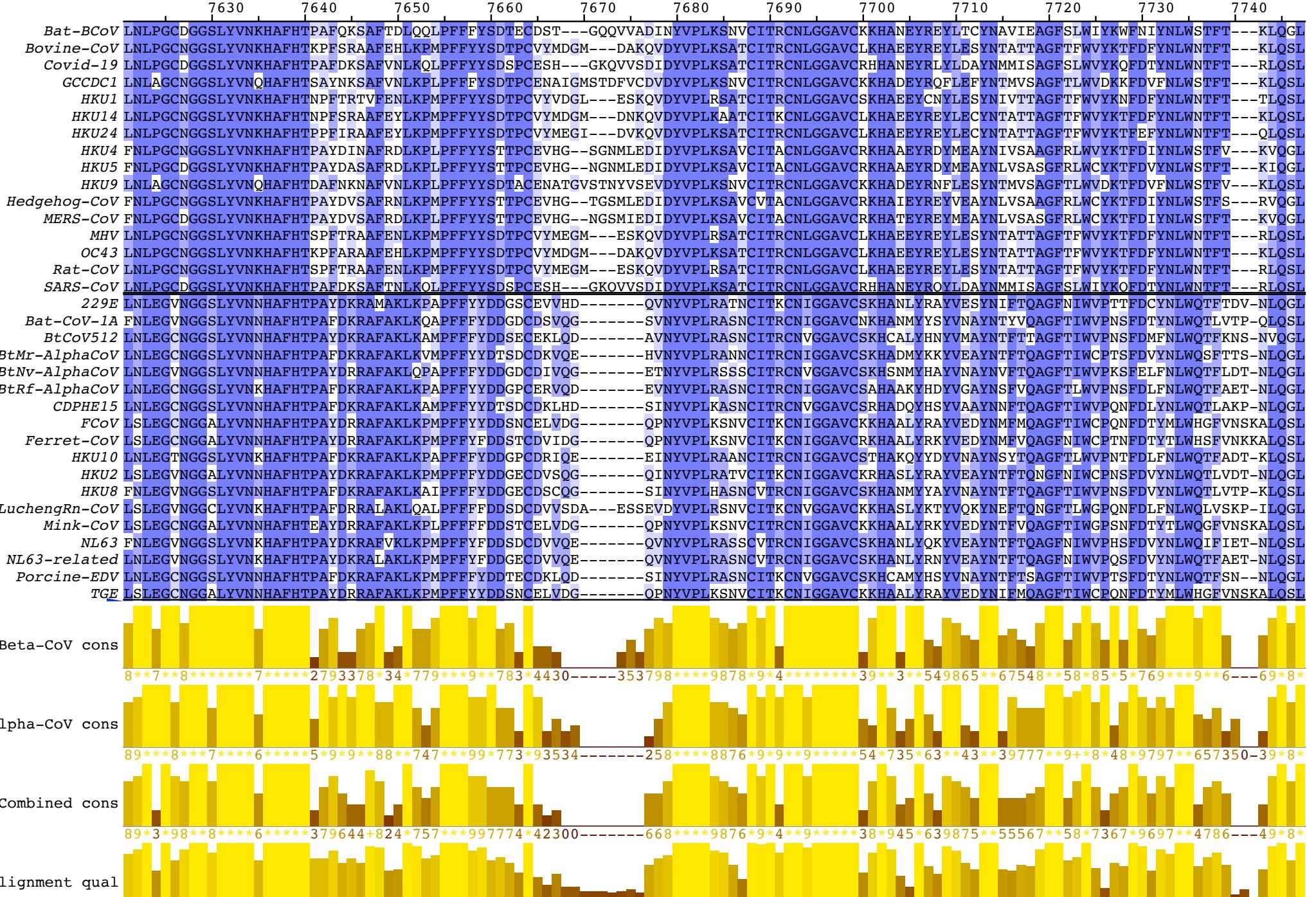


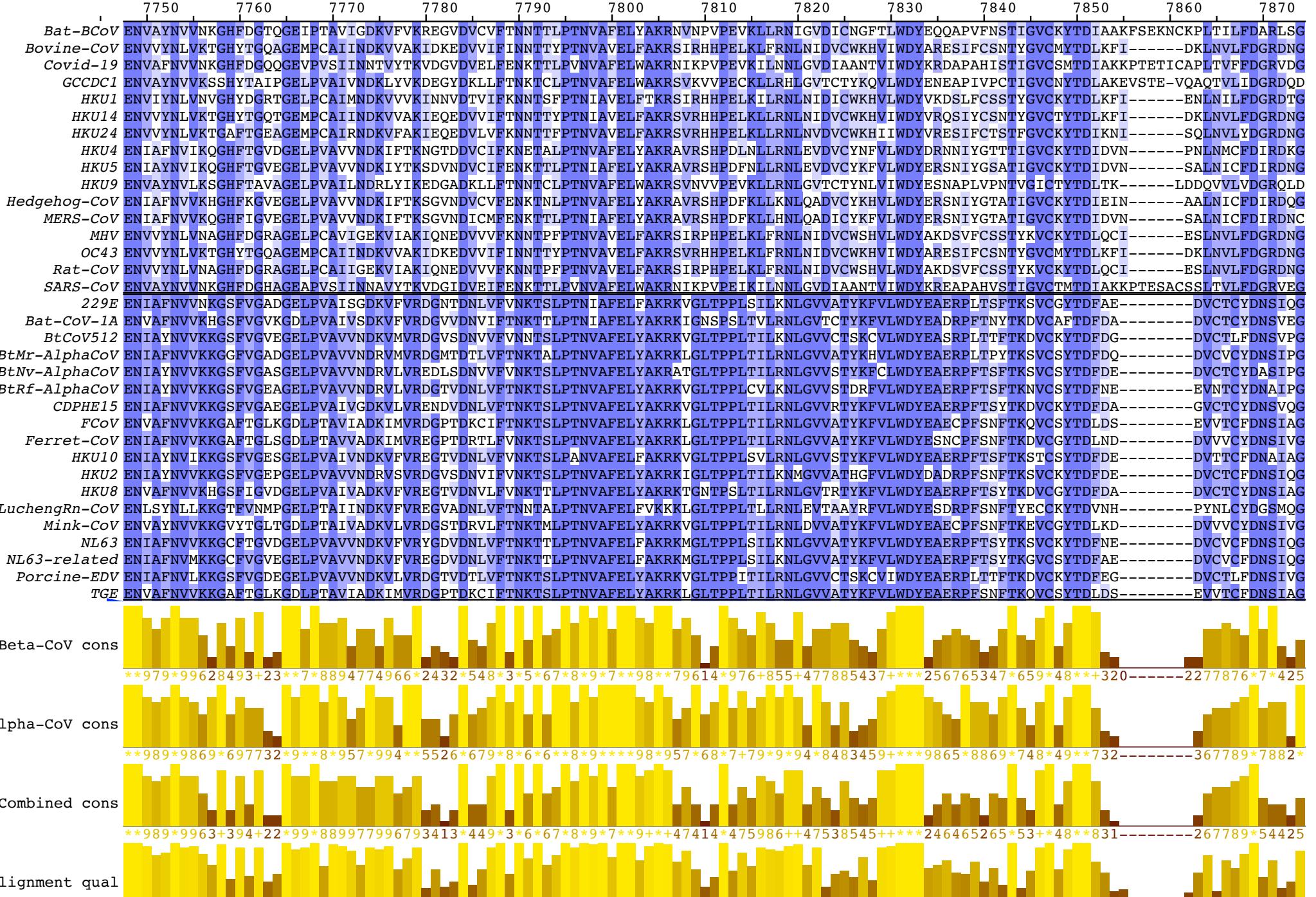


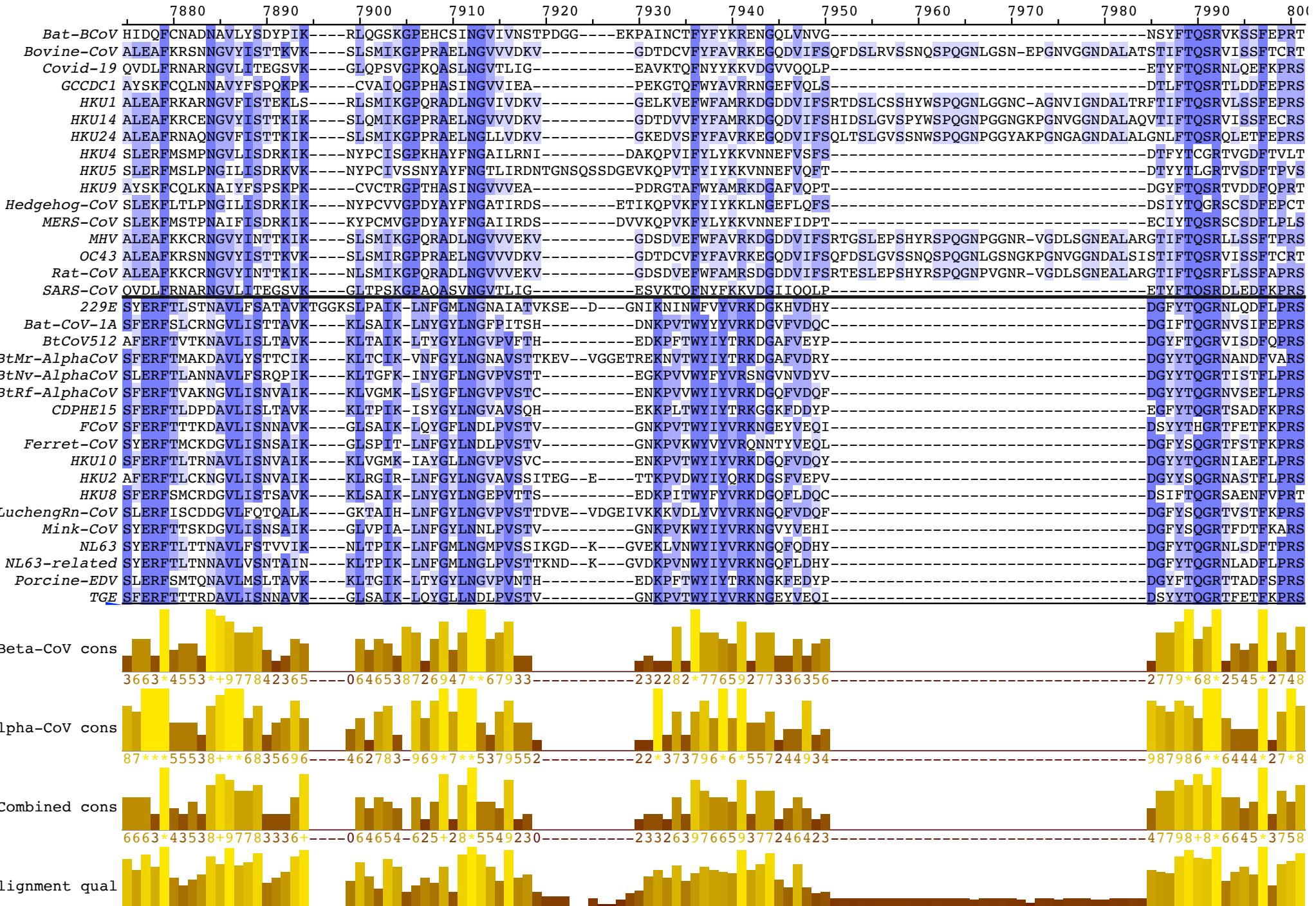


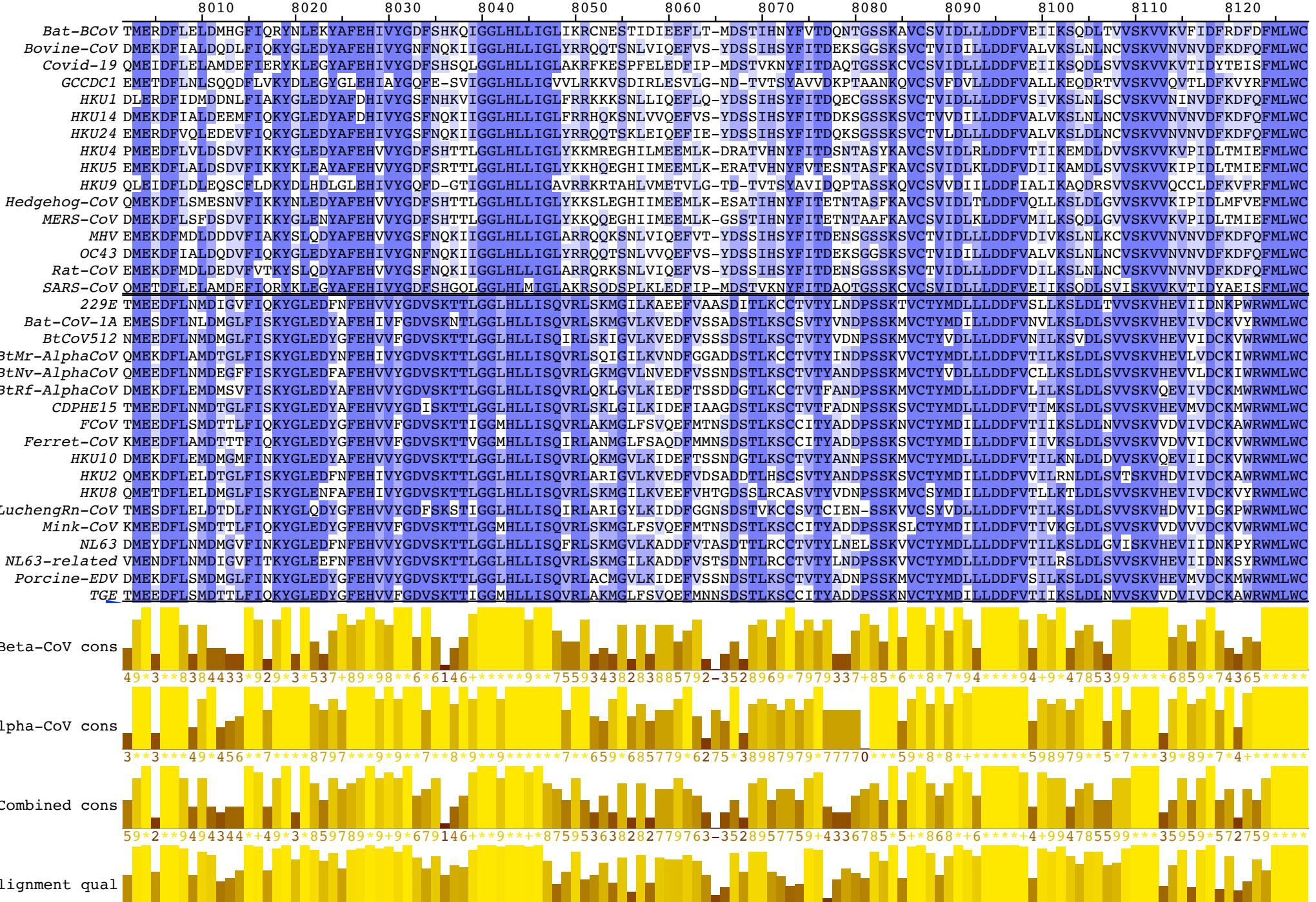


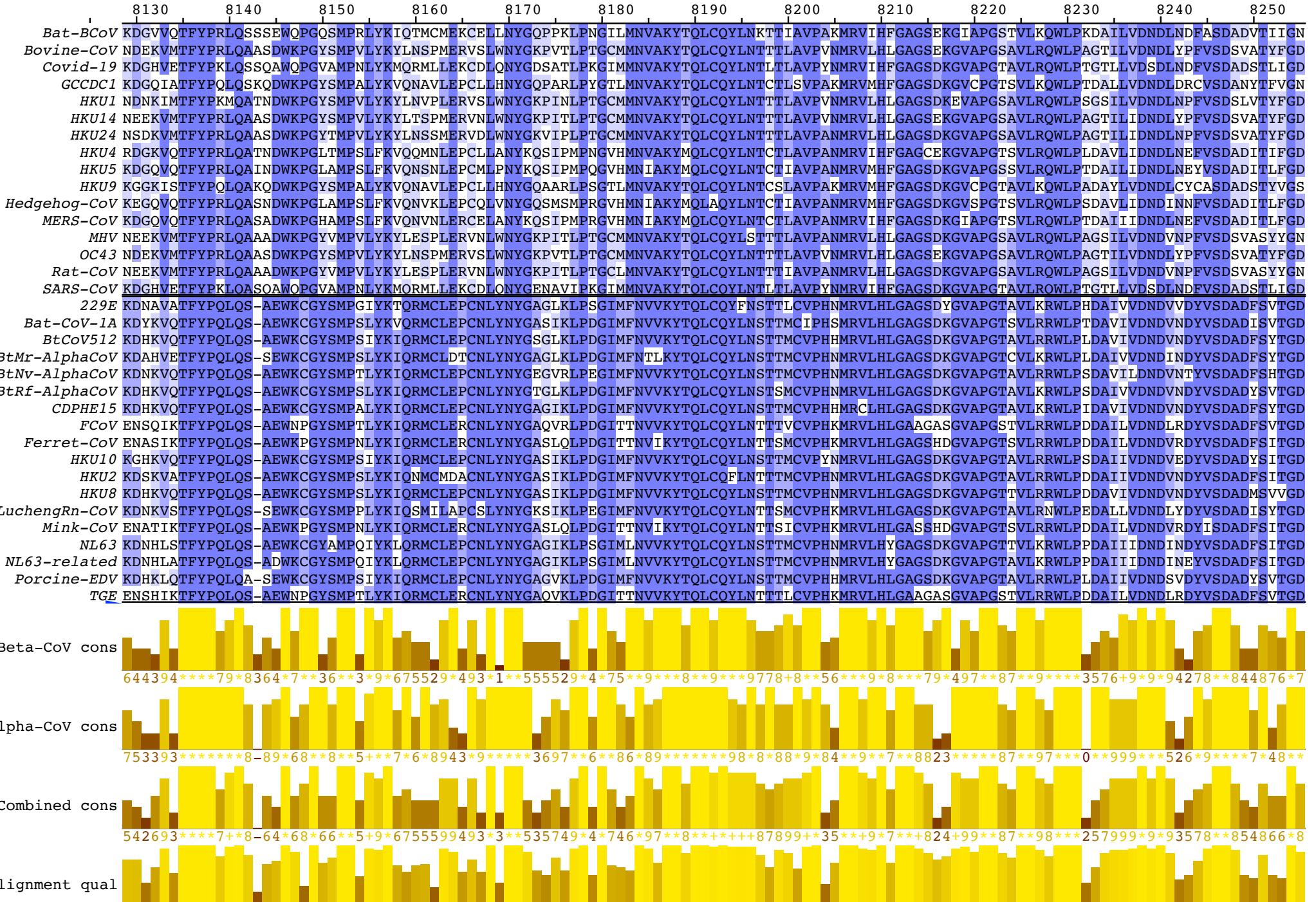


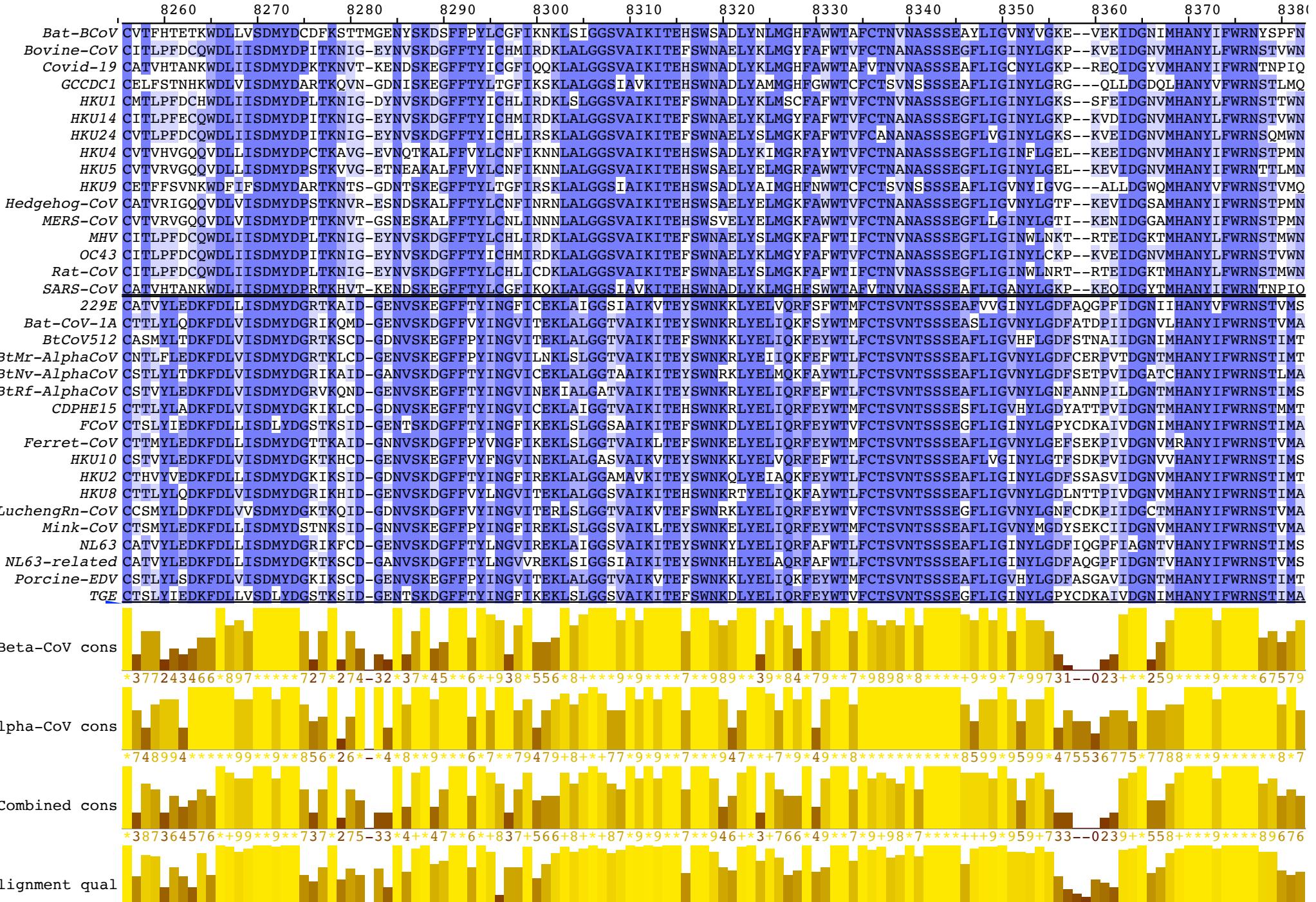


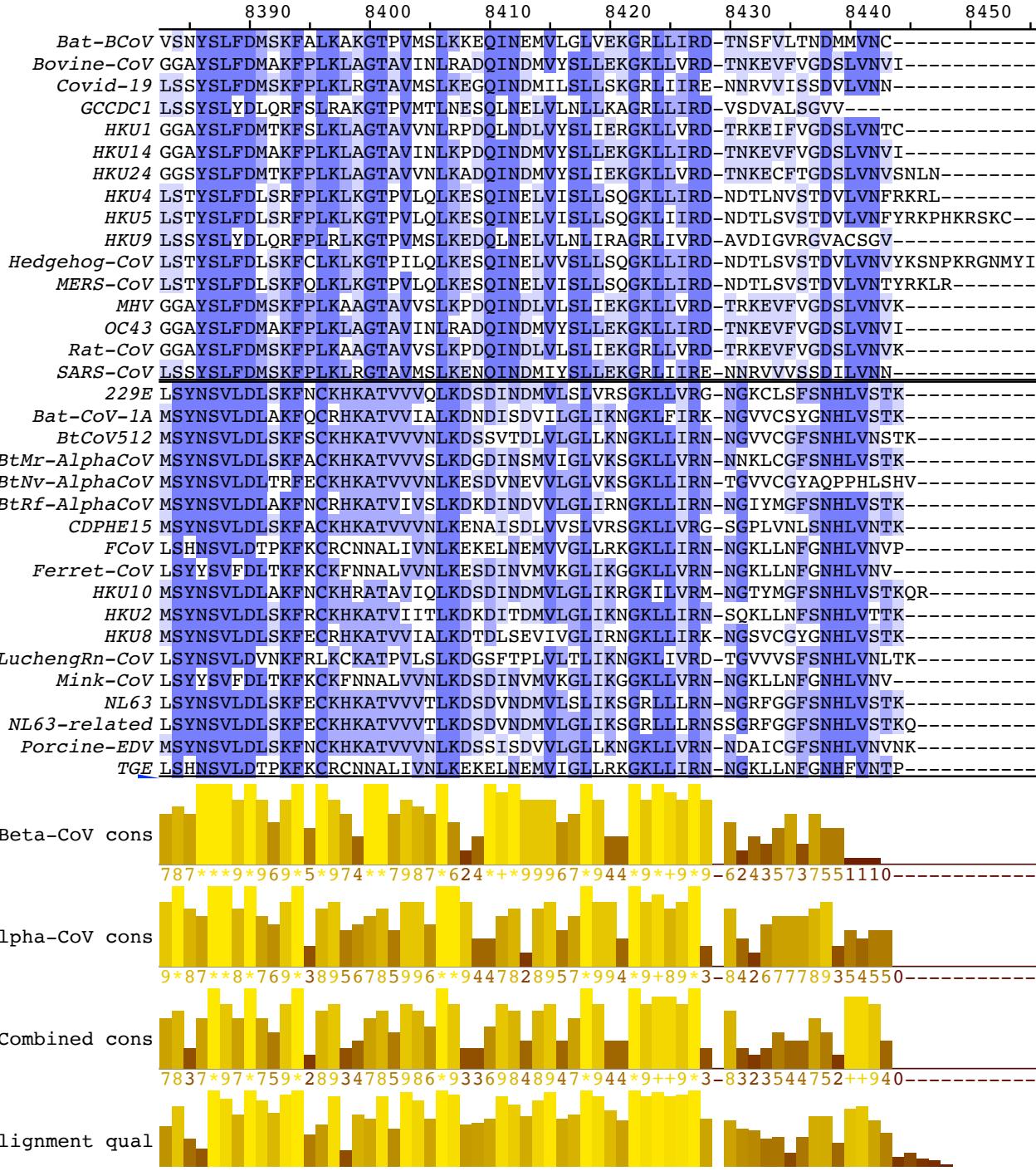












Spike (S) Protein

10 20 30 40 50 60 70 80

SARS-CoV-2 1 --MEFVLFLLLPLV-S-----SOC-----VN-L-----TT--RTOLP---PAY---TNSFRTRVVYPPDKVFRSSVLHSTQDL
 SARS-CoV 1 --MEIFLFLFTLT-S-----GSD-----LD-R-----CTTFDDVVA---PNYTOHTSMSRGVYPPDEIFRSRDTLYTLTQDL
 HKU1 1 --MILLIILSILP-TLAVIGDFNCTNPA- IN-----D-LNTTVTPRISEYVVDVSYGLCTYVILDRVVLNTLTLTFLGY
 OC43 1 --MFLLILSILP-AFAVIGDLKCTSDN- IN-----D-KDTGPPISTDVTDVTNGLCTYVILDRVVLNTLTLTFLNG
 MERS-CoV 1 MHSHVELLMFLTPTESVYDVGPDSVKSAC- IEVDI-----QQTFFDKTW---PRP-IDVSKAD-III-PQGRYTSNITITYOGL
 229E 1 -----
 NL63 1 --MKLFLLILVVLPLASCLFF--TCNSANALSMQLQGVPDNSSSTIVGLLPTTHWFC-ANQSTSYSANSGFP- IDVGNHRSAPALHTGY

90 100 110 120 130 140 150 160 170

SARS-CoV-2 55 FLPLFFPSVNT--WHFHAIHVGSGNGTKR---FDNP-VLP-NDGVYFAST---E-----KSNINIWGWFDT
 SARS-CoV 59 FLPLFYSVNT--GFHTIN-----HT----FGNF-VIPFKDGJYFAAT----E-----KSNVWRGVWFGST
 HKU1 67 FPKGSANFRDL--SLKGTYLSTL-WLWQKFPLSDFNFSRVRK-N-----TKLYVNTKL-----YSEFTIVIIGSV
 OC43 68 YPTSTCSTYRNM---ALKGVSLLSR-LWKPFPPLDFEINGIFAKVN- N-----TKVIKDRVM-----YSEPAITIGST
 MERS-CoV 75 F-PYQGDHGDMYVYSAAGHATGTTPOKLFLVANVYSDQ-VKQFANGFVVRIG--A-----AANSTGTVIIISPSTSATIRKIYPAFMGSS
 229E 1 -----MFVLLVA
 NL63 82 YDAN---QYYIYTNEIGLNASVTLKI--CKFSRNTTFDLSNASSSPDCIVNLLTPEQLGAPLGITISGETVRLHLYNVTRTYPVPA

180 190 200 210 220 230 240 250 260

SARS-CoV-2 110 LDKSTQ-----SLLI-----VNN-----A-----TNVVIKVE-----
 SARS-CoV 107 MMNKSQ-----SVII-----INN-----S-----TNVVIACN-----
 HKU1 130 FINNSY-----TIVV-----QPH-----NGVLEITACO-----
 OC43 131 FVNTSY-----SVV-----OPRTINS-TODGDNKLQGGLEVSVC-----
 MERS-CoV 153 VGNFSDGKMGRRFNHTLV-LPD-----G-----CGTLLRAF-----
 229E 8 Y-----A-----LLHIAGCQTTNG-----INTSHSVLNGCVGHSENPAVEESGGYIIPNSFSFNWWFLNTFNSVVDGV
 NL63 166 YKLTKL-SVKCYFNYSCFESVSVNATVTVNVTHTNG-----RVNVNTYVEDDCNGYTDNIFSFVQDGRIPNGPFNNWWFLNTGNTLVGV

270 280 290 300 310 320 330 340 350

SARS-CoV-2 133 FQFNDPFLGVYVHHNN-----KSWMESEFRVYSSANNCTFEVSPQPFMLMDLEGKQGNFKNLNREFV
 SARS-CoV 130 FECDNPPFAVSKPKPMET-----QHTHMIDFNAFNCFTFEISADFSLVSEKSGNFKHLREFV
 HKU1 153 YTMCXEYHPTICKS-KGSSRNESWHFDKESEPLC-----LFKNKFTYNS-T-----DWL-----YFH
 OC43 166 YNPFQFQTCIICHPNLHGRKELWHDGTGVSC-----LTKRNKFTEDVN-A-----DYL-----YFH
 MERS-CoV 184 YCILEPRTSRGHNCPAGNSYTFATYHTPATDSCDGHYNNRNRNASLNSFKKEYFLNKRNCFTMYTNTITEDEILEWFGTQTAQG-V
 229E 71 VRSFQPLLLNCLWSVSGSQTTEFYVFN-----GTGRG-ACK-G-FYS-----NASSDVFIRYNNIFEE-----NLR-RGTIL
 NL63 249 SRLYQPLRLCLWPVPLGKSLXSTCFVFN-----ATGSDVNCN-G-YQH-----NSVSDVMRYNLSANSNL-D-----NLK-SGVIV

360 370 380 390 400 410 420 430 440

SARS-CoV-2 194 KNIDGKYKILSKHPTPLNVLRDLPGFSALEPLVDPFICINIRTFOT-----LLALHRSYL-----T
 SARS-CoV 187 FANKGFLVVKGYQPIDVVRDLPSGFTNLKIPFLPLGJNINTRFA-----ILTAFS-----
 HKU1 202 PYQERGFTYAYWADS-----GMG-TTFPLSFLYLTLLSHYVV-----LPLTCN-----
 OC43 216 YTQECGFTYAYFTDT-----GTV-CKTFNLYVNLMSKSHYVV-----MPLTCN-----
 MERS-CoV 264 HLFLSSRYVWDLYGGN-----MFOFATPLPVYDITKHYSI-----IPHSIR-----S
 229E 134 EKTYSGAVFVCTNNTLVLSG-----DAHIPSCTVLGNFXYCFVNNTIGNETTSASFVGPALPKTVREFVISRTGHFYINGYRYS
 NL63 317 EKTQYDVLPCNSNSSGV-----DTTIPFCGPSSQPYCFCININSTINTHVSTEVGILPPTREIVVARTQGFYINGKFYD

450 460 470 480 490 500 510 520 530

SARS-CoV-2 251 PGDSS---SGWTAGAAAYVGYIOPRTFLLKYNENGTITDAVDCAKDPLSETKCTLKSFTVEKGIYOTSNSNFRVQOTESIVRFPNITNL
 SARS-CoV 240 --PAQO---DIWGTSQVYKGYQPIDVVRDLPSGFTNLKIPFLPLGJNINTRFA-----ILTAFS-----
 HKU1 258 --AIS---SNTNTLQWVTPLSKQRQYLLDFTDNRVYIPTAVNDCSNSSSFTSEI0CKTCKLSPNTVYDLSGFTKVFTAVHVRIPNLD
 OC43 258 --S-----KLTLEWVTPTSQSRQYLLNQDFGIL11NNAVDCSNSMSEIMEKCTKQGIAAPPTEGVVYDFTVQIADYVYRKPKNLPN
 MERS-CoV 303 IQSDR---KAW-----AAFYVVKLPTLFLDFTSDVYDFTVQIADYVYRKPKNLPN-----
 229E 211 LGDVEAVFVNFTVNAA-TIVCTVLAASYADWVNSQTAALANIYCN-SVINRLRCQDLSFDPDGFYTSFPIQVPELPMISVSLPV-----
 NL63 394 LGFIEAVFVNFTVNTATSDFTWTFVATFVDTWVNVSATNQNLQYD-SPEFEKLQCHLQGQD-FISANFLDDNNVLPETTVVALPI---

540 550 560 570 580 590 600 610 620

SARS-CoV-2 336 CPFGEVFNATRFAVYVANNRKRISNCVADYSVLYNSASFSTFKCYGVSPSTKLNDLCTKNTVYADS-----VIRGDEVRIQAPIGQTKIADYNYK
 SARS-CoV 323 CPFGEVFNATKPFPSVYAWERKKRISNCVADYSVLYNSTFSTFKCYGVSPATKLNDLCTKNSVYADS-----FVVKGDDVROIAQPOTGVIADYNYK
 HKU1 327 CD1DKWLNLFNVPSPLNWERKIFLNSCNFLNLSLTLRBDTDSFNSNDEFSKYLIGCSKFSKLSVLDKAIFPNSRSRSLDOLGSSGFLQSSNPK
 OC43 335 CNIANLNDKSVPSPLNWERKTFNSCNFNMSSMSFQIADSFTCNNDIAAKYLGCFSSITDIDKFAIPNGRKVDTDLQNLGNYLQOSFWYR
 MERS-CoV 383 DDFSPILLSG-TPFQVNFNFKLVRPTCNYNTITLSSFLVNTDTSQISPAIASNCYSSLILYD-SYPLSMSKSDLSVSSAIPQSFNPK
 229E 295 Y-----LHKBHTFV-----LHVFKFEE-QRGPKGCYNCRPSV-----ITLANNE-----ITKGPLCVDTSVQTFQVDN
 NL63 479 Y-----Y-QHTDID-----FTAT-----ASFPGSCYVCKPHQVN-----ISLNG-----NTSVCVCRTSFHSIRYI

630 640 650 660 670 680 690 700 710

SARS-CoV-2 425 LPDDETGVIAWNNSNLDLSKVGNN-----YNYLVLRLFRKS-----NPKPERDISTEYQA-GSTPQNGV-----B-GFN
 SARS-CoV 412 LPDDETMGCVQWLNWTRNIDATSTGN-----YNYKYYRLRHG-----KRPKPERDISNVPFSP-DGKPCPT-----P-ALN
 HKU1 416 IDPTTSSCQLYSLPAINTINNYNPSNWNRIKGFNNF-----NLSHSHVSYVRCFSVUNNTFCPKAPSKFAS-SCKSHKPPSAS
 OC43 424 IDTTATSQOLYLNPAANVSVSPWNTRKPFIEDVSFKPFRPAGVLTNHDVYVQAHCFKAPNFCPCKLNGSCVSGPCKNGN1GT
 MERS-CoV 471 QFSNPNPCLLILATPVPHNLTITKTP-----LTKYNSVNCR-----LSDRDTFVQLVNUAN--QYSPCVSI-----V-PST
 229E 353 Y-----KLRARNSAINTNG-NC-----PFSFGKVNNE-FVKGSCVFSL-----KDPPIGG
 NL63 530 Y-----RVKSGSPGDSSWVHILYKSG-TC-----PFSFSKLNNE-QKFKTICFST-----VEVPGS

720 730 740 750 760 770 780 790 800

SARS-CoV-2 488 Y-----YF-----JLQSYGFQPT-----NGVQYQPY-----RVVVLSP-----
 SARS-CoV 474 C-----YW-----HLNDYGFYTT-----TIGVQYQPY-----RVVVLSP-----
 HKU1 495 CPIGTYNRSCESTVLLDHTDWCRCSCPFDITAYDPRSCSKQSKLSVVGHECAHGCKVDEEKGDFVLDLGSYVNSCLCSCTDAPLFWGSDTVC
 OC43 513 CPAGTNLYLTC-----NLCTPDITFDTGTYCQKPTSKLVGIGEHCGLSVAKSVDYCCG-----NSCTCPRQAFGLWPSADSC
 MERS-CoV 534 V-----WEDGDYRKRQL-----SELEGQGVWLA-----SGSTVAMT-----EQLOMGP
 229E 394 CAM-----BIMANLNVNWK-----SHNIGSLVSYWSDGDOI
 NL63 577 ENF-----PLEATWHYTS-----YTIIVGALYVWSEGNNSI

810 820 830 840 850 860 870 880

SARS-CoV-2 516 ELL-----HAPATVCGP-----KSTNLVKNKCVUNFNFGNLTGCVLTSNEKKFL-PFOQGRDIA-DTT-ADVRDPQTLIE
 SARS-CoV 502 ELL-----NAPATVCGP-----KLS-TDLKQCNVFNPNGLTICGVLTPSFSKRFQ-PFOQGRDVS-DFT-DSVRDPKTSEI
 HKU1 548 SNNCRNIFNSFLINLNGNSCTCNS-DLQPNPTEVTFDVCVCDNDLQYDITGOGIYKEFVSAYVNNYWSNQNLLYDSN-GNII-GKDFDVTNKT
 OC43 584 QGDKCNIFANFILHWDVNSLGCST-----DLQKANTDILIIQVLCVNDNDLQYDILGILQGIVFPEVATYNNYWSNQNLLYDSN-GNII-GKDFDVTNKT
 MERS-CoV 572 GITVQYGTDTNSVCPKLFENDTAKIASOLGNCWVYSLYGVSGRGRVQFQNCATAVGV-RQORFVYDAY-ONLVGYYSD--DGNY
 229E 424 TGV-----PKPV-----EGVSSFMVNTLNUKTCYNNIYDVSQGVGVIYRISNDTFLNG---ITYTSSTGML-EGFKVVTNGT
 NL63 607 TGV-----PKPV-----SGIREFSNLVNLNUKTCYNNIYDVSQGVGVIYRISNDTFLNG---ITVNSGML-LGFKNVSTGN

900 910 920 930 940 950 960 970

SARS-CoV-2 585 LDITPCSGFGVSVITPTGNTNSNOVAVYQDQVNCTEVPAVHADQLT-----PTWRVYSTGSNVQFOTRAGLICIAEHVN--NSYEDQIPIGAC
 SARS-CoV 571 LDISPCAFGGVSVITPTGNTNSASSEVYQDQVNCTEVPAVHADQLT-----AISNNNTIAIPTNTSISIYDQVNCTEVPAVHADQLT-----TSEYDQIPIGAC
 HKU1 669 YNIFPCYAGRVAFAH--QNASSLALLYRNRLCKSYVLLNN-----LTTQ-----PFDSYLGCVFNADNLTDYVSVCALRMSS
 OC43 669 FMRCSYCSGRVVAFAH--ANSEFALLFRNVCXVYFVNLSLTDQF-----NFSYDYLGCVFNADNLTDYVSVCALRMSS
 MERS-CoV 715 YKLRCRASCPVSPVSYV1D-----KETKTHATLFGSVCHEIHSNTSQSRSTSLRMLKRDSTYQGZPLQTPVCCVGLN-LFVEDCQLPLQ
 229E 490 YSITCPNPQDQLVYVYQ-----AVGAMLENFTSYGFSVNVNEMP-----KFTYASN-----GTYNCTD-----AVLTYSSFC
 NL63 673 FITVTCNPQDQVAVYQ-----SIIGAMTAVNESTRYQGLNQLLQ-----NPFYVSN-----GCGNNTT-----AVMVTNSNFG

980 990 1000 1010 1020 1030 1040 1050 1060

SARS-CoV-2 670 IEGAQYQT-NSPRRAWSAQ-SI-----I-AYTMSLAEGNSV-----AISNNNSIAIPTNTSISIYDQVNCTEVPAVHADQLT-----PTWRVYSTGSNVQFOTRAGLICIAEHVN--NSYEDQIPIGAC
 SARS-CoV 656 ICASTHTV-S-L-----LTSQSK-SI-----I-AYTMSLGAID-----AISNNNTIAIPTNTSISIYDQVNCTEVPAVHADQLT-----AISNNNTIAIPTNTSISIYDQVNCTEVPAVHADQLT-----
 HKU1 743 FCDVNDPNSSSSSRRRKRSLISASYRFTVFPFVNFVNF-----VNDNSIESVCGLVEIYIPTNTSISIYDQVNCTEVPAVHADQLT-----
 OC43 746 YEVDFR-----NRRSRAITGTYRFTNPFVPTVNS-VNDSLPVEGGLYIEQIPTNTSISIYDQVNCTEVPAVHADQLT-----
 MERS-CoV 735 LCALDPTSTLTLTRPSVSPVGE-MRLASI-AFNHPQV-DOL-----NNSYFLKSLIPNTSISIYDQVNCTEVPAVHADQLT-----
 229E 553 VCAADCIIA-----VQPRNVSYD-----SV-SAIVTANLSIISNNTISIYDQVNCTEVPAVHADQLT-----
 NL63 736 ICADGSLIP-----VPRPNNSDN-----GI-SAIITANLSIISNNTISIYDQVNCTEVPAVHADQLT-----
 1070 1080 1090 1100 1110 1120 1130 1140 1150

SARS-CoV-2 751 NLLQYGSFCQTLNRLATGIAVEADQNTQEFAVQKQIYKTPPIKDFG-----G-F-NFSQILP-DP-----SKPSKRSFIEDLLFNPKVTLA
 SARS-CoV 733 NLLQYGSFCQTLNRLATGIAVEADQNTQEFAVQKQIYKTPPIKDFG-----G-F-NFSQILP-DP-----LKPXTKRSFIEDLLFNPKVTLA
 HKU1 831 DLSLEYQGFCDFNINSLIDEVGNDLTTDOLVHALTMOQVTLSSNLTNLLHFDVNINQFSKLSVGLCPHGS-BSSRFSFEDDLFNPKV
 OC43 829 SOLVEYGSFCDFNINAIATEVNEVDNLTTDOLVQANSLMNGVNTLSTKLQDFVNLNFNDIINFSPVQLGCLGSECSKASSRAIDEDLFDKVKLS
 MERS-CoV 819 QLRLYQGFCFSKINQALHGANLQDSDVNRVNLQFASVKSQKSSQASVQ-----GDFPLTLL-----VSISTGSRSARSAIDEDLFDKVK
 229E 619 ELKQYQTSACKTEDALRNLSAMLESADVSEMLTDFDQSNLFLTAKLQ-----GQYDLSVSPVSLPSRSGSRVAGRSAIDEDILFSKLV
 NL63 802 ELKQYQTSACKTEDALRNLSAMLESADVSEMLTDFDQSNLFLTAKLQ-----GQYDLSVSPVSLPSRSGSRVAGRSAIDEDILFSKLV
 1160 1170 1180 1190 1200 1210 1220 1230 1240

SARS-CoV-2 830 DAGFIK-OYQGDEL-----GDDAIRDLCIAQKFNGLTVPPLTDEMDIAQYI-SALLAGIT-----GTFWFGAGAALQIPEFQAMAYFNGVTONY
 SARS-CoV 812 DAGMFK-OYQGDEL-----GDDAIRDLCIAQKFNGLTVPPLTDEMDIAQYI-SALLAGIT-----GTFWFGAGAALQIPEFQAMAYFNGVTONY
 HKU1 919 DVGFEV-----AYNNCT-----GGSEIRDLLCV-----FSGNIGKVLPLPSESQIYSGCTT-----PQDFSYLGCVFNADNLTDYVSVCALRMSS
 OC43 918 DVGFEV-----AYNNCT-----GGAEIRDLCV-----SYKQGKVLPLPLLSENIQSGCTT-----AIGFPPYLNQVYRINGLGVTMDV
 MERS-CoV 902 DGDYQG-MQDCHQMQPSASDILCAQYAVGKVLPMFVNDMEAATYNTLSSLGISQAVGWTAGLSSFMSYKHSFYSKIEISFKTFLV
 229E 702 GLGTDADYKXKCTT-----KGLSLIADIAQACYQYNGIMVLP-----GQYDQVNLQFASVADERMANYGTSISLGGIGALGLT-----
 NL63 885 GLGTDVVDYKXKCTT-----KGLSLIADIAQACYQYNGIMVLP-----GQYDQVNLQFASVADERMANYGTSISLGGIGALGLT-----
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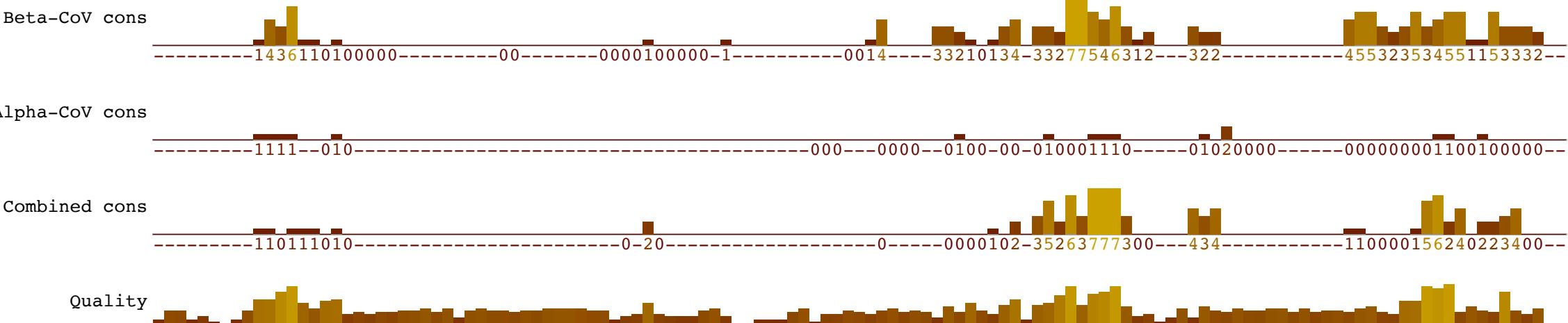
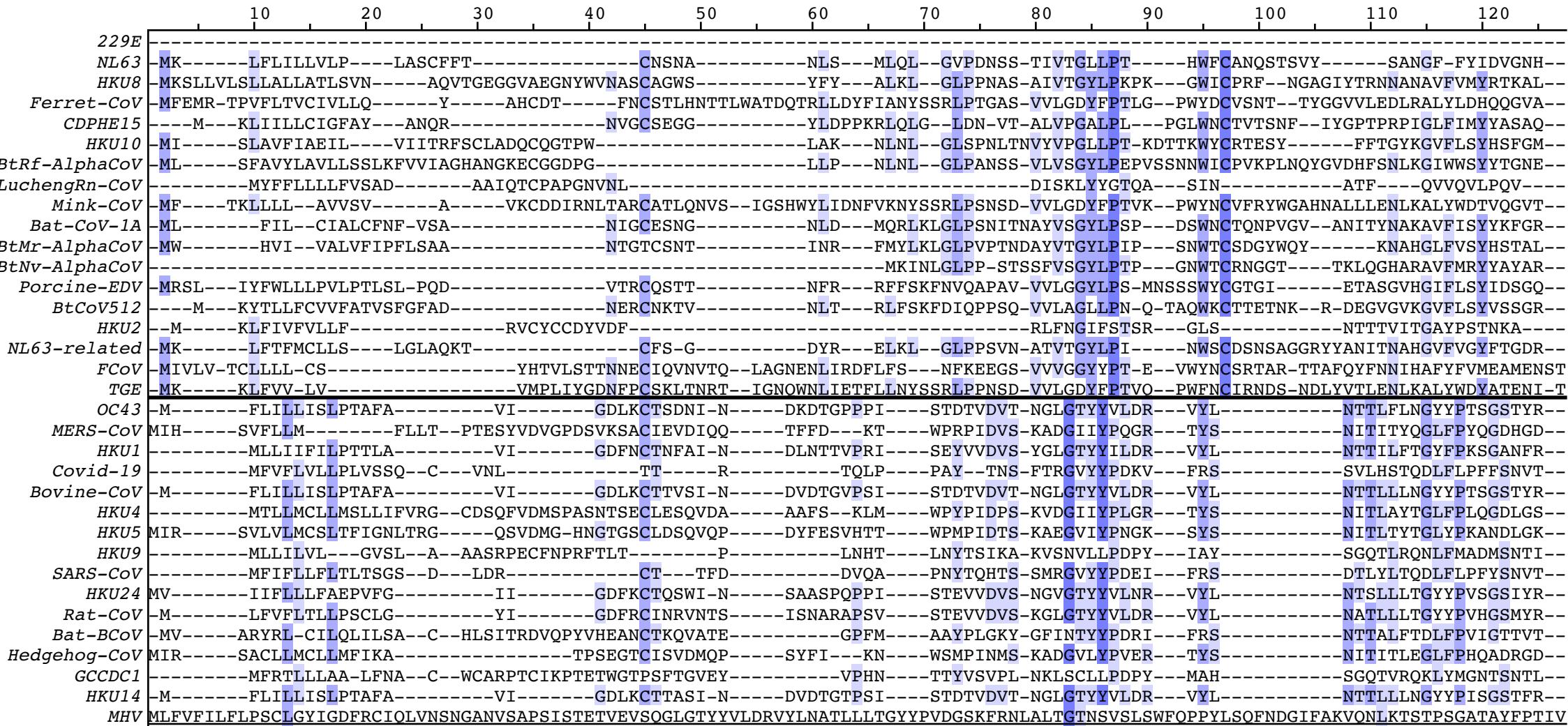
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 SARS-CoV 898 LYENQKQIYDLSLSTTA-----SALIGCQDQVNLQFASVADERMANYGTSISLGGIGALGLT-----
 HKU1 1001 LNKKQNLIAATFANLNSQNSQFASVADERMANYGTSISLGGIGALGLT-----
 OC43 1000 LNSQNLIAATFANLNSQNSQFASVADERMANYGTSISLGGIGALGLT-----
 MERS-CoV 990 LSENOQKLIQANFNLQGAMTQFTTT-----EFOVQDQVANNAQNSQNLKASELSNFTGSAIISGIDQYIQLVQBLQD
 229E 785 LSENOQKLIQANFNLQGAMTQFTTT-----EFOVQDQVANNAQNSQNLKASELSNFTGSAIISGIDQYIQLVQBLQD
 NL63 968 LSENOQKLIQANFNLQGAMTQFTTT-----EFOVQDQVANNAQNSQNLKASELSNFTGSAIISGIDQYIQLVQBLQD
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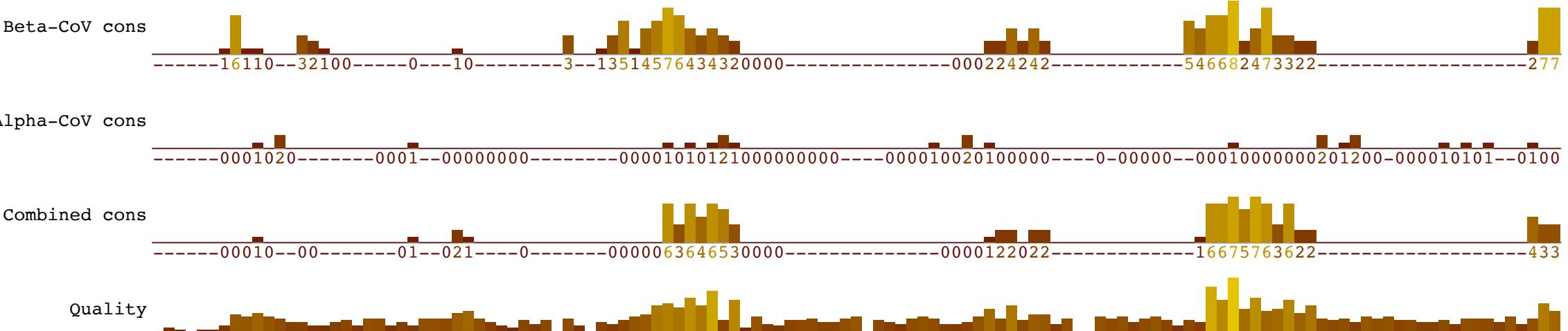
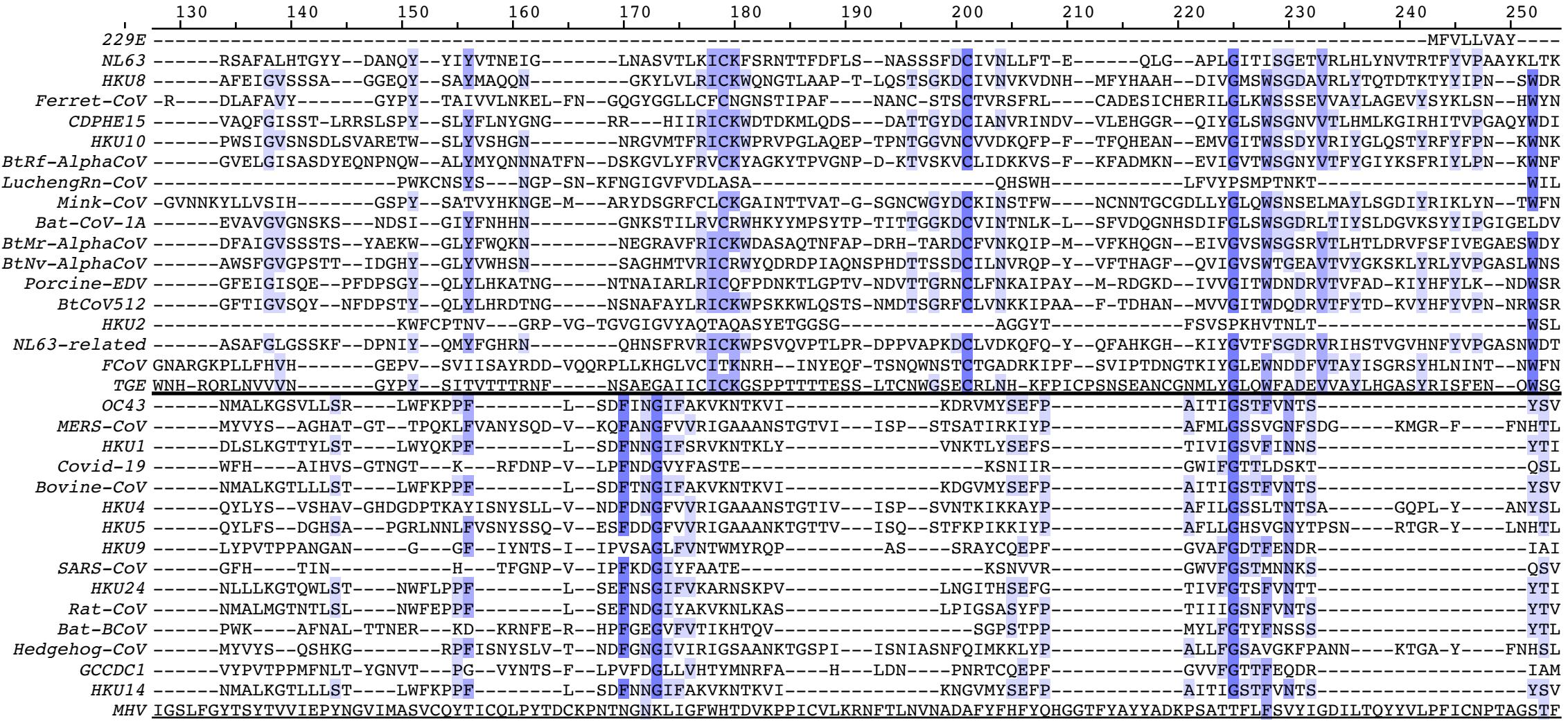
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 SARS-CoV 973 VOIDRLITGRLQSLQYIYQOLIIRABIRASANLAIATMSECVLSGSKRUVFDCGKGYELMSPQFQAPCIVVFLRIVYEAQEKNTTAP
 HKU1 1075 VOIDRLITGRLTALNAYNSQQLSDLSVLFKQGALAMVECNVCKSVP-----NFTKAPLV-----LNBHWFVKEKLSDEESELHSHWFK
 OC43 1075 AQIDRLITGRLTALNAYNSQQLSDLSVLFKQGALAMVECNVCKSVP-----NFTKAPLV-----LNBHWFVKEKLSDEESELHSHWFK
 MERS-CoV 1065 AQIDRLITGRLTALNAYNSQQLSDLSVLFKQGALAMVECNVCKSVP-----NFTKAPLV-----LNBHWFVKEKLSDEESELHSHWFK
 229E 874 QOVDRLITGRLAALNVPWHT-----LTKYEVTRASRQLAQ-----EYIPTNTVMMSTCA-----NYTKAPYVM-----LNTS1NLPDFLKEQD
 NL63 1057 QOVDRLITGRLAALNVPWHT-----LTKYEVTRASRQLAQ-----EYIPTNTVMMSTCA-----NYTKAPYVM-----LNTS1NLPDFLKEQD
 1430 1440 1450 1460 1470 1480 1490 1500 1510

SARS-CoV-2 1080 AICHGK-A-----HFPREGVFSN-----GTHWVFTORNYE-----QIYTNTDFTVSGNCNDVIGIVVNNTYDPLQ-----PELDSEKELDQYFK
 SARS-CoV 1062 AICHGK-A-----HFPREGVFSN-----GTFWFTORNFPSQIYQIYTNTDFTVSGNCNDVIGIVVNNTYDPLQ-----PELDSEKELDQYFK
 HKU1 1165 GLCISGDV-----GIAPKOGYIYK-----NOHNMFTGSSYYREPI-----LSDKVNFMNTCSN-----NFTKAPLV-----LNBHWFVKEKLSDEESELHSHWFK
 OC43 1164 GLCISGDR-----GIAPKOGYIYK-----NOHNMFTGSSYYREPI-----LSDKVNFMNTCSN-----NFTKAPLV-----LNBHWFVKEKLSDEESELHSHWFK
 MERS-CoV 1154 GLCDAANPCTNQIAPIVNGYI-----IYKNTNNTIVDEWY-----TGSYQYI-----EPTI-----LSDKVNFMNTCSN-----NFTKAPLV-----
 229E 963 GLCVCVGIN-----GYVLRQPNLALY-----KEGNYRIRIYNSRIMF-----PRPI-----TQI-----LSDKVNFMNTCSN-----NFTKAPLV-----
 NL63 1146 GICVQDGY-----GYVLRQPNLALY-----KEGNYRIRIYNSRIMF-----PRPI-----TQI-----LSDKVNFMNTCSN-----NFTKAPLV-----
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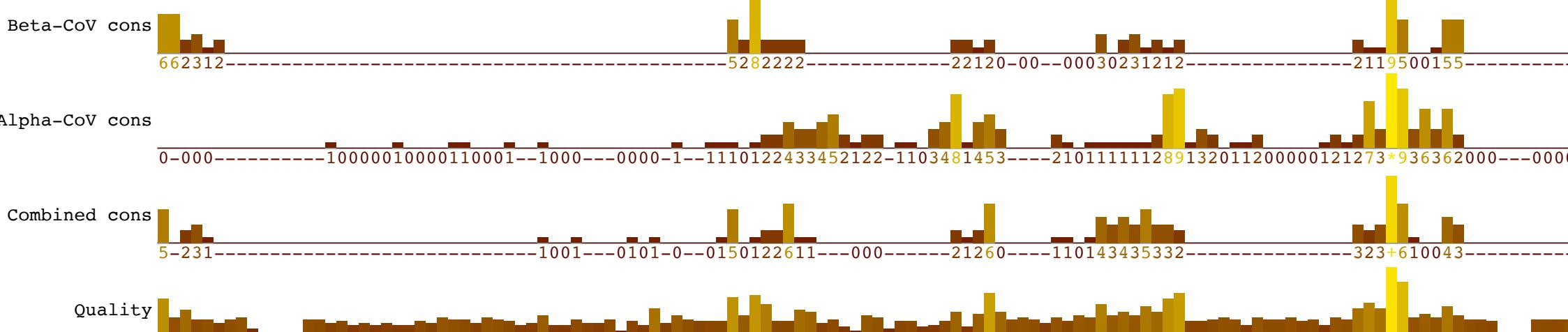
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 HKU1 1245 QFS-ATPMLNTLHTMIAF-----L-----YEMNLIQESISLNSLNQYI-----LSDKVNFMNTCSN-----NFTKAPLV-----
 OC43 1244 QFS-ATPMLNTLHTMIAF-----L-----YEMNLIQESISLNSLNQYI-----LSDKVNFMNTCSN-----NFTKAPLV-----
 MERS-CoV 1154 GLCDAANPCTNQIAPIVNGYI-----IYKNTNNTIVDEWY-----TGSYQYI-----EPTI-----LSDKVNFMNTCSN-----NFTKAPLV-----
 229E 1045 LPNNTYVTPD-----VVEQYQNIQIYLNLTSEISTLENKSAELNVTYDQQLTIDN-----LSDKVNFMNTCSN-----NFTKAPLV-----
 NL63 1228 LPKVKVNP-----DITPFLNLYI-----LNSLSELKQLEASLTFQTTV-----LSDKVNFMNTCSN-----NFTKAPLV-----
 1610 1620 1630 1640 1650

SARS-CoV-2 1232 IMLCQMSCSCL-----KGCCS-GSCCKF-----DEDDSEPVVLGKVLHYT
 SARS-CoV 1214 ILLCMCSMSCL-----KGACGSCGKCF-----DEDDSEPVVLGKVLHYT
 HKU1 1319 FFICCTCGCSAC-----FS-----KCHNCND-----VGGHDFVIK-TSHDD-----
 OC43 1316 GLCIAQD-----GIAPKOGYIYK-----NOHNMFTGSSYYREPI-----LSDKVNFMNTCSN-----NFTKAPLV-----
 MERS-CoV 1315 FFLCICCTGCTNC-----MGLKLVNCRCDR-----EYEDLEPHVKVH-----
 229E 1172 LLCCGTSGCCGFFCSPASSIYKCC-----STKLQFVYDVEKIHQ-----
 NL63 1315 VFCFLSFGCCGNCNLCTSSMRCGCD-----GKSTLQFVYDVEKIHQ-----



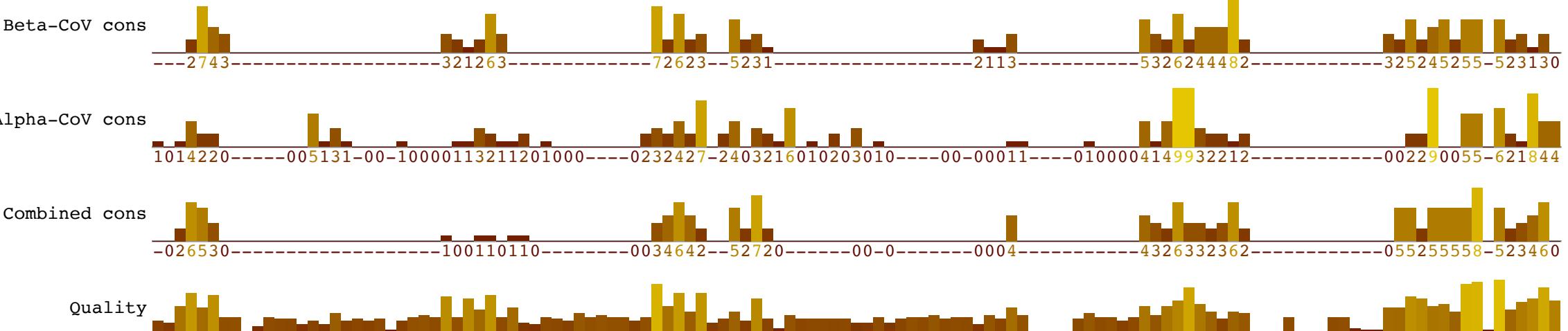


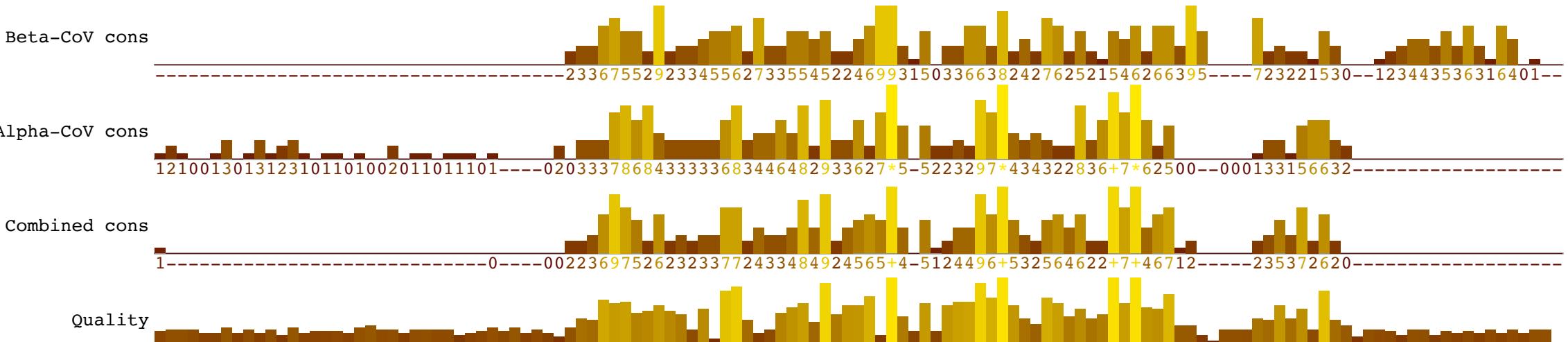
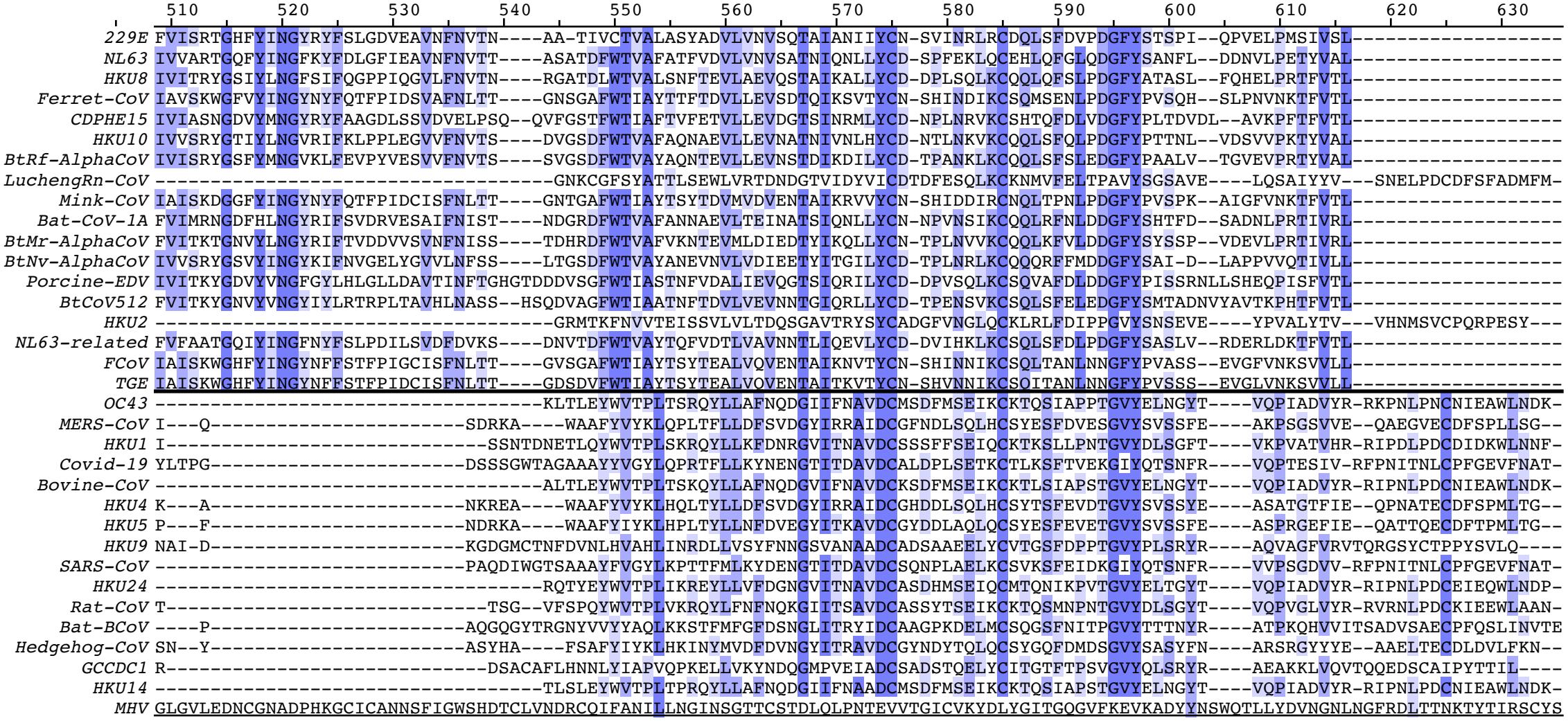
260 270 280 290 300 310 320 330 340 350 360 370 380
 229E -A--LLHI--AGCQT-TNGTN-T--SHSVCNGCVGHSENVF-AVESGGYIPS---NFSNNWFLLTNTSSVVDGVVRSFQPLLNCLWSVSGSQF--TTGF
 NL63 L-SVK-----CYFNYSCVFSSVNVATVT--VNVTT-HNGRV-V--NYTVCDDCNGYTDNIF-SVQQDGRIPN----GFPNNWFLLTNGSTLVDCVSRLYQPLRLTCLWPVPGLKS--STGF
 HKU8 V-SIR-----CPDKFSCSSQIVTKAIT--VNVTTFANGTI-D--KYAICDNCNGYPAHIF-PVSEGGLIPA---DFNFSNWFLLTNSSTIVDGRIVSEQPVLLMCLWAVPGLMS--TNSF
Ferret-CoV NVTIKTQTN-----ANQIYWWFNPVRDLSYYVNWKTV--DSTI-VVSNCT--SDCSGYAANIF-AVETGGFIPS---SFSFNNWFVLTNSSTIVSGKFVSSQPLLVNCNLPVPSFGD--ETSI
CDPHE15 I-RFS-----CGHKDSCGHQVVYSTNVFNLNG--FI-T-NYQLPDSGEFSNDLF-TVGDDGSIPP---SFGFNNWFVLSNSSSISGTVVSNQPLRLTCLWPPIPSTG--ALAT
 HKU10 V-NVN-----CAHKSSCQVYPVKDSVT--WVVNTTADGRV-K--DYTICGSCNGFPQHVF-PVSPGGLIIPP---DFSFDGWYVLTNSSTMVQGKFAVASQPLKLLCLWPVPALDS--SASV
BtRf-AlphaCoV V-AVK-----CLVKETCAFFAAHKMVT--LNITTNGQGLI-K--NYSVCKDCNGFPQHVF-PVLDGGKIPG---DFSFDNWFLLTNSSTIVNGKIVDIQPLKLLCLWPVPALVA--NDNK
LuchengRn-CoV SWADTH-----T-----SFEHGSVISYVQICKYPSNVVTI--TNNGCHTNMAG-PGATTCDVILSS-----PLECVLNRTY
Mink-CoV NATISNTFA---SNGTTSNSWWFNPVYNLTYYRVNKT--DNTV-VVQNCT--NNCADYVNNIF-STESGGIIP-----GFSFNNWFVLTNDSTITDGRFLTRQPLLNCLWPVPSFSE--TSQN
Bat-CoV-1A V-SFR-----CVYKETCAHQVITKPIT--AIVNTTADGLI-S--GYSVCCDDGFPKYVF-AVTEGGEVPP---NFRLDNWFYLTNSSTPISGMFTSVQPFNLSCVWTVPVLTN--NSLP
BtMr-AlphaCoV A-TLR-----CANGYACAHQVYVNPVTT--VIVTTVAAG-I-Q--KYTLCDNCTGFPQHVF-ATMENGEIPP---SFNFANWFYLTNSSSPVSSRVVGLQPLLLTCLWPPIPALLG--TATD
BtNv-AlphaCoV V-AFT-----CSKDDSCGHQIITKPIT--VNATTDDKGVI-T--SYTVCDCRDGFPHHV-AVQEGGKIPG---SFDFTNWFYLTNTSSPFDGRFVFSNQPLQIQLWPIPALTS--TTGI
Porcine-EDV V-ATR-----CYNRRSCAMQYVYTPTYYMLNVTSAGEDGI-Y--YEPCATCTGYAANVF-ATDSNCHIPE---GFSFNNWFLLSNDSTLLHGKVVSNQPLLVNCLLAIPKIYG--LGQF
BtCoV512 V-VSW-----CSAADSCAMQYINSTIYYNLNVTPGPGBI-T--YSVCTKHCTGLADNVF-STDQGHHIPP---IFPYNNWFLLNTSTLVQGVTRVQFLVNCVALPKLQG--LTTF
 HKU2 WVHRP-----WGA-NANVTVRLCRWQKFSF-----NETAHFQOPAG-P-----SS-----AFCCLVNGSF
NL63-related V-AIA-----CDNPTSCYHSVVTQLAT--VRVQTDKGLI-S--SFEPCQNCCEGFAENVF-AVEASGKIP-----DFSFNNWFLLTNSSSVVDGKVRSLQPLKVLCLRAPSLLS--TKEV
FCoV NVTLLYSRSSTAT--WEYSAAYAYQGSNFTYYKLNNT--NGLK-TYELCEDYEHCTGYATNVF-APTSGGYIPD---GFSFNNWFLLTNSSTFVSGRFVTNQPLINCLWPVPSFGV--AAQE
 TGE TVTFGDMRATTLEVAGTLVLDLWWFNPVYDVSYYRVNNK--NGTT-VVSNCT--DOCASYVANVF-TTOPGGFIPS---DFSFNNWFLLTNSTLVSGKLVTKOPLLVNCCLWPVPSFEE--AAST
 OC43 VVQPERTIN-----ST-----QD-----GDNKLQGLLEV-SVCQYNMCEYPQT-----ICHPN-LG-NHRKELWHDGT-----VVSCLYKRNF
MERS-CoV VLLPDG-C-----GTLLRAFYCI-----LEPRSG-----NHCPAGNSYTSFATYHTPATDCSDGNYNRNASLNSFKEYFN-----LRNCTFMYTY
 HKU1 VVQPHN-----GVLEI-TACQYTMCEYPHT-----ICKSK--GSSRNESWHFDKS-----EPLCLFKKNF
Covid-19 LIVNNA-----TNVVIKV-CEFQFCNDPF---LGV-----YYHKNNKS--WMESEFRVYSS-----ANNCTFEYVS
Bovine-CoV VVQPHTTI-----LGNKLQGFLEI-SVCQYTMCEYPNT-----ICNPN-LG-NQRVELWHDGT-----VVSCLYKRNF
 HKU4 TIIPDG-C-----GTVLHAFYCI-----LKPRTV-----NRCPSTGTGVSYFIYETVHNDQCS-TINRNAALSFKSFFD-----LVNCTFFNSW
 HKU5 VILPDG-C-----GTILHAFYCV-----LHPRTQ-----QNCAGETNFKSLSLWDTPASDCVSGSYNQEATLGAFKVYFD-----LINCTFRYNY
 HKU9 LIMAPDNL-----GSW---SA-----VAPRNQNTNIYLLVCSNATLCINPG---FNR-----WGPAGSF-----APDALVDH-----SNSCF--VN
SARS-CoV IIINNS-----TNVVIRA-CNFELCDNPF---FAV-----SKPMGT-----QTHTMIFDN-----AFNCTFEYIS
 HKU24 VIEPSTQI-----VNGKLIGTLSA-SVCQYTMCEYPNT-----ACNPV-LG-NGRPSLWHASIG-----IVPCLYQRNF
Rat-CoV VLEPYN-----GIIMA-SICQYТИCQLPHT-----YCKPN-TGGNTLIGFWHTDLR-----SPVCILTRNF
Bat-BCoV AISLDG-----LYRRIEV-CNFQVCQNPV---MYY-----AKVSNPAQGNPLIYSQRAYTD-----YNSCVS-QTS
Hedgehog-CoV VILPEK-C-----GTVITALYCV-----LEPKND-----TNCTGSSGYVSYLFENFSCDATT--DGNLKNSLQWFN-----IKDCLFEKNY
 GCCDC1 VIIAPGEF-----GMW---GQ-----VNRPNNTFVHVVACSNATICAYPM---FNR-----WGPAGSIH-----AENSFVEH-----NSSCF--LN
 HKU14 VVQPHTTI-----SDKVLLGLEI-SVCQYTMCEYPHT-----ICHPN-LG-NKRIELWHDFTD-----VVSCLYKRNF
 MHV APRYWVTPLVKROYLFNFNOKGVITSAVDCASSYTSEIKKTOSMLPSTGVYELSGYTVOPGVVYRRVANLPACNIEEWLTARSPVSPLNWERKTFOCNFNLSSLLRYVOAESLFCNNIDASKVY

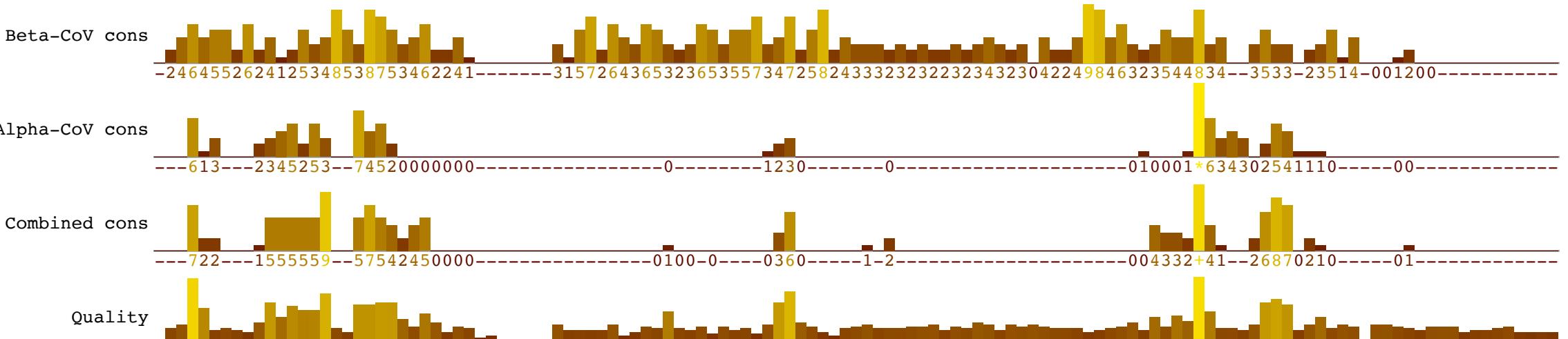
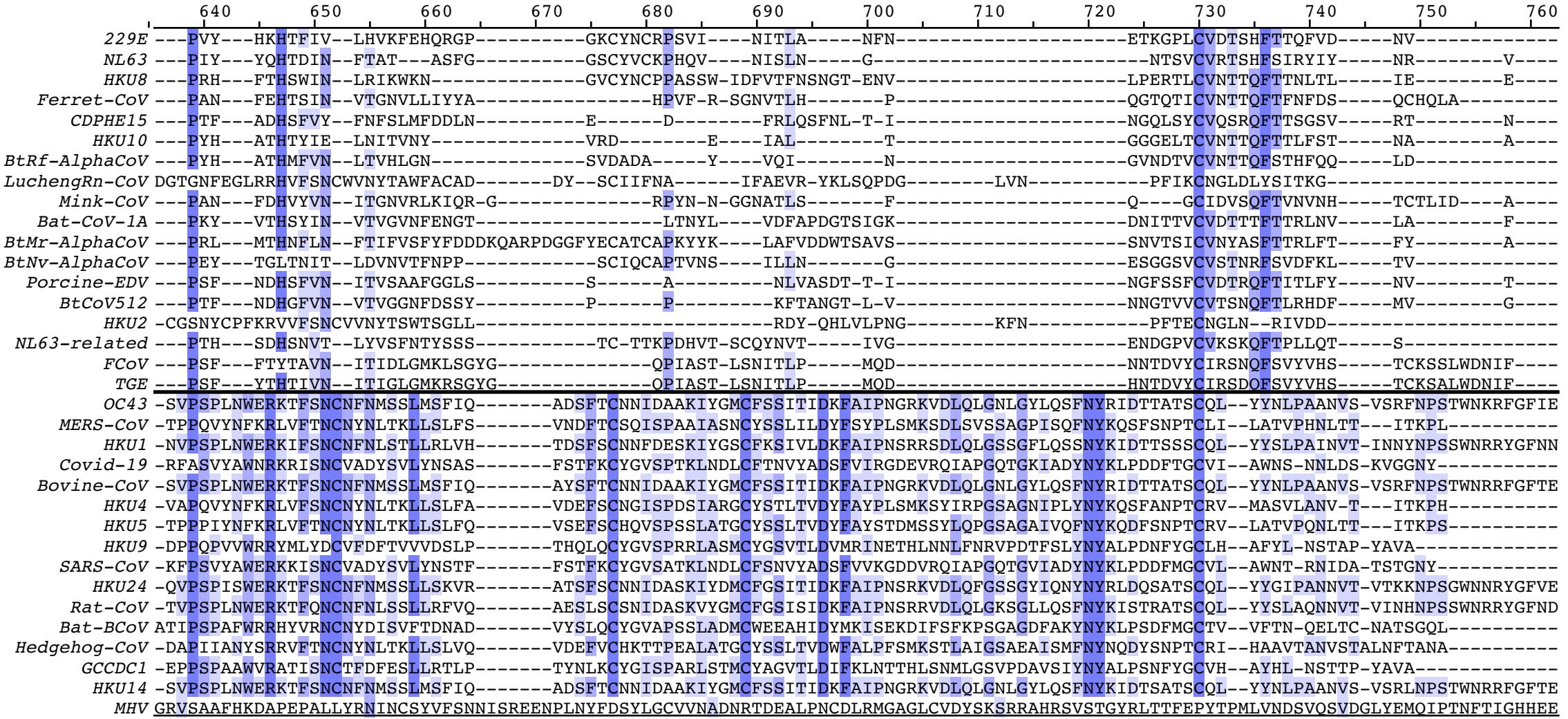


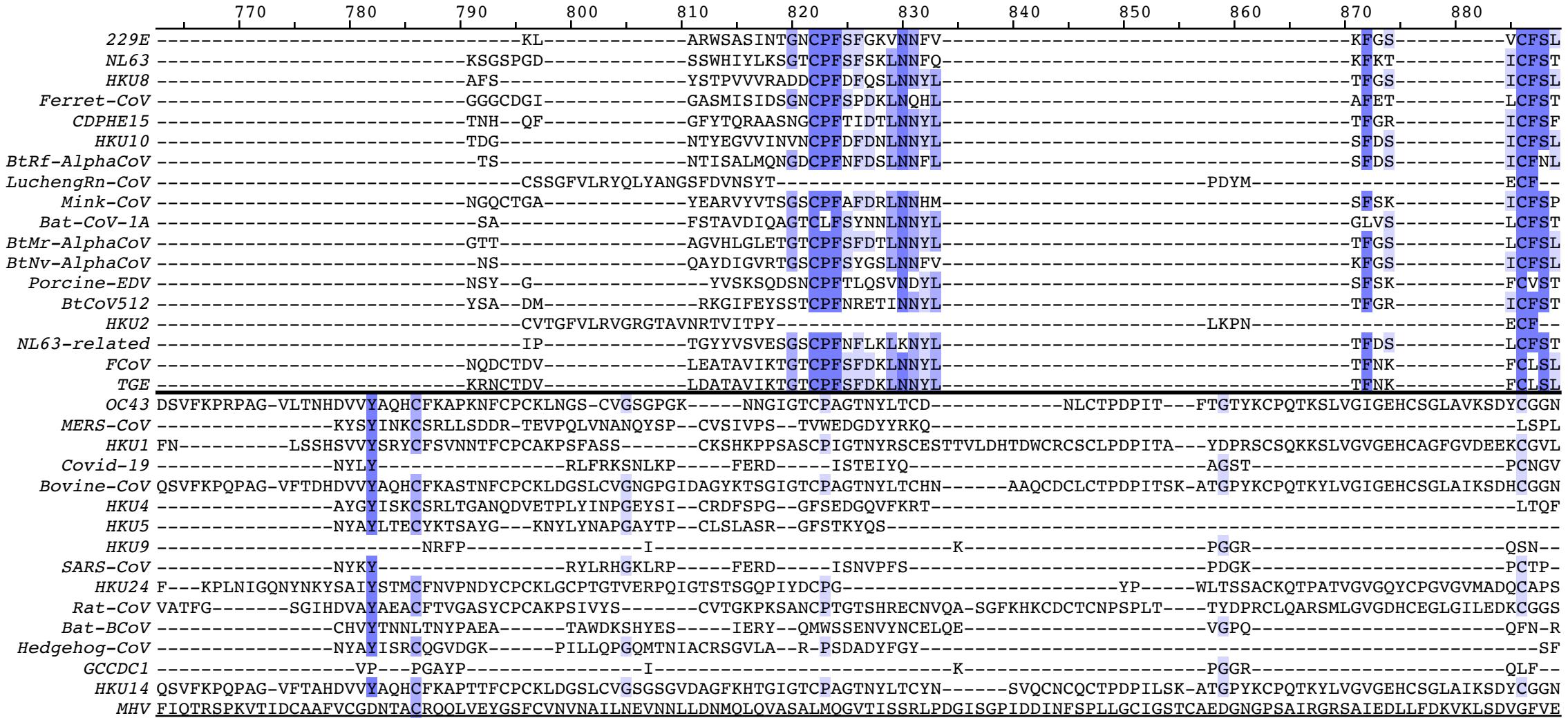
390 400 410 420 430 440 450 460 470 480 490 500

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HKU8 VYFNGTA--PNKQCNGYATD-SAF-EALRFSLNFTDERVFA-GSGSVL-LVSLQYKFSCTNNSE--AVIDSGIP--FGNVVEPFYCFVSING--TSIFVGML-PAVLRE
Ferret-CoV INFDTV-P---SQCNGA-TV-NGSFDVVRFLNFTANVASSSGTSFLALNTGGVVLYLSCFNETKTTNLYMSEGALP--FGTHEGALCYVSYNE--TSFKYIGVLPSSVKE
CDPHE15 IYFNGT--NGAQCNMF-DS-NAPFDAIRFLNGLSG--HNFVSGFVLHAANGATLGFSCTNSTDA--PY-LRQIP--FGIGDTPYYCYLNVT--D--IN--STMSFGAL-PLNLRE
HKU10 VYFNLSR--SSAQCNMG-TE-NGLADALRFSMNFSRNG-FS-GAHLSTL-KG-AIDYVFRCNTNTN--VTSFYSIP--FGYIKTVYRCFVSYNS--T--NG--TVSEFGVLPPLVKE
BtRf-AlphaCoV IYFNITG--ANCNGFKDE-NAYADVLRFSLNFTNSQFN-GIHSVTV-NVVGDLKFSCSNTSTY--AESDEVLP--FGPLSSVYYCFVNKG--G--ND--TFSRFGVIL-PPVVKE
LuchengRn-CoV --SQQ-----Y-----AGVSYI-TWYNDHI--IA-----SI-----QGEVFTFDIG--EVLQW--SNFSACCGT
Mink-CoV FCFNTEDF--AQCNMGY-RL-NSTADVIRFLNLFNTHETVAASGTTFFELNTTGGVVLHISCVNQSRTE-AVTSEGFLP--FGYHENSLYCYVSYNE--TLQKFLGVL-PPSVKE
Bat-CoV-1A VYFNMSM--NENVTCGYSNFDVGVDAMRFSLNFTDQII--RKGVISV-FTSTNVNFSCTNNSVL--DG--DAVIP--FGDVAQTHYCFIKYFT--N--ITSGESVSQFVGIL-PPQVKE
BtMr-AlphaCoV ITFDRNG--TSDVRCNGFASNE--TADAMRFSLNFTDAVFA-KEGVITL-KTLSNTFKFSCSNSSTY--QA--PYVIP--FGHIDQPYYCFTFYI--N--ETAGTTTSFVGML-PPVVRE
BtNv-AlphaCoV IYFNSSRFTDPHQRCNGYNEV-GGLADHRLRAINVTDRGAF--QLGVISL-LAVHNAYNFSCSNISNF--VDATTIGVP--FGKTYQPYYCFCVTEGY--N--ISA--NRTFVGVM-PSDVRE
Porcine-EDV FSFNHTMD--GVCNGA-AV-DRAPEALRFNINDTSVI--LAEGSIVLHTALGTNLFSVCSNSSDP--HLAIFAIP--LGATEVPYYCFLKVDT--Y--NS--TVYKFLAVL-PPTVRE
BtCoV512 LSFDSPLN-VPGFSCNGA-NG-SSSAEAFRFNVNDTKLF--VGAGAVTLNTVDGVNVSVICSNNAQ--PTRSN--NLQEDLPYYCFTNTSS--G--TN--HTVKFLSVF-PPIIRE
HKU2--PSSQ-----HK-----GYMFGV-TWYNDFV--RI-----IF-----PPTVFELOLD--G-LQWEYVQFTGPVNA
NL63-related ISLSGVN--AD-KCNGH-SI-NETAGALRFNLFNFTSNPINALASKIFI-SSSGNVTIFCSNSSDP--GSSADAFIA--MGSTSAAVYCFANSTF--G--NV--TSLDFIGVL-PVTVRE
FCoV FCFEGAQF--SQCNGV-SL-NNTVDVIRFLNFTADQSGMGTAVFSLNTTGGVILEISCYSDTVSESSSYSGEIP--FGITDGPRYCYVLYNG--TALKYLGTL-PPSVKE
TGE FCFEGAGF--DOCNGA-VL-NNTVDVIRFLNFTTNVOSGKGATVFSLNTTGGVTLIEISCYT--VSDSSFFSYSGEIP--FGVTDGPRYCYVHYNG--TALKYLGTL-PPSVKE
OC43 -TYDVNA-----DYLYFHFYQ--EGGTFYA--YFTD-----TGVV-----TKFLFNVYLG--MALSHYYVM-PLTCNS
MERS-CoV --NITE----D-----EILEWF--GITQT--AQGVHL--FSSRYVDL--YGGN--MFQFATLPVY--DTIKYYSIIPHSIRS
HKU1 -TYNVST-----DWLYFHFYQ--ERGTFYA--YAD-----SGMP--TTFLFLSYLG--TLLSHYYVL-PLTCNA
Covid-19 QPFLMDL--EGKQGNF--KNLREFVFKN--IDGYFKI--YSKHT--PINL-VRDLPQGFS--LEPLVLDLPIG--INITRFQTL-LALHRS
Bovine-CoV -TYDVNA-----DYLYFHFYQ--EGGTFYA--YFTD-----TGVV-----TKFLFNVYLG--TVLSHYYVM-PLTCNS
HKU4 --DITA----D-----ETKEWF--GITQD--TQGVHL--YSSRKGD--YGGN--MFRFATLPVY--EGIKYYTVI-PRSR
HKU5 --TITE----D-----ENAEEWF--GITQD--TQGVHL--YSSRKENV--FRNN--MFHFATLPVY--QKILYYTVI-PRSR
HKU9 NTFSVNIS--T-----SRISLASF--KDGDLI--YHSGWL--PTSNFEHGFSRGSH--MTYFMSPVG--GNLPRAQOFF-QSIVRS
SARS-CoV DAFSLDV--SEKSGNF--KHLREFVFKN--KDGFLYV--YKGYQ--PIDV-VRDLPSPGFNT--LKPIFKLPLG--INITNFRAI-LTAFS
HKU24 -TYNVA-----DNIYFHFYQ--DGGTFYA--YVG-----KSPI--TTLLFQVYLG--TVVTHYYVL-PLVCNA
Rat-CoV -TFNVNA-----EWLYFHFYQ--QGGTFYA--YAD-----VSSA--TTFLFSSYIG--AVLTQYFVL-PYMCNP
Bat-BCoV QSFNTSQ--GDKNGAFSK--DTITTYVFKY--QNGIFSV--FHGFH--NGTD--HVPI--PKPAFEFPLD--IPITHIFIIP-PTVEE
Hedgehog-CoV --NVTD----D-----EREERWF--GIIQD--QQGVHL--YTSRKN-G--YSNN--MFLFATLPIY--DQILYYTVM-PRSI
GCCDC1 DTFEIPMG--T-----SRVNLAFR--QDGNL--YHTAWL--PTENYTL--SGDYP--LRYARSGVG--SNLPFAQFF-QSVARA
HKU14 -TYDVNA-----DFLYFHFYQ--EGGTFYA--YFTD-----TGTV-----TKFLFNVYLG--TVLSHYYVM-PLTCDS
MHV GRCFGSISVDKFAVPRSROVDLOLGNNSGFLOTANYKIDTAATSCOLHYTLPKNNVTINNNPSSWNRRYGFNDAGVFGKNOHDVVYAOQCFTVRSSYCPAOPDIVSPCTTOTKPKSAFVNVDHCE









Beta-CoV cons



Alpha-CoV cons



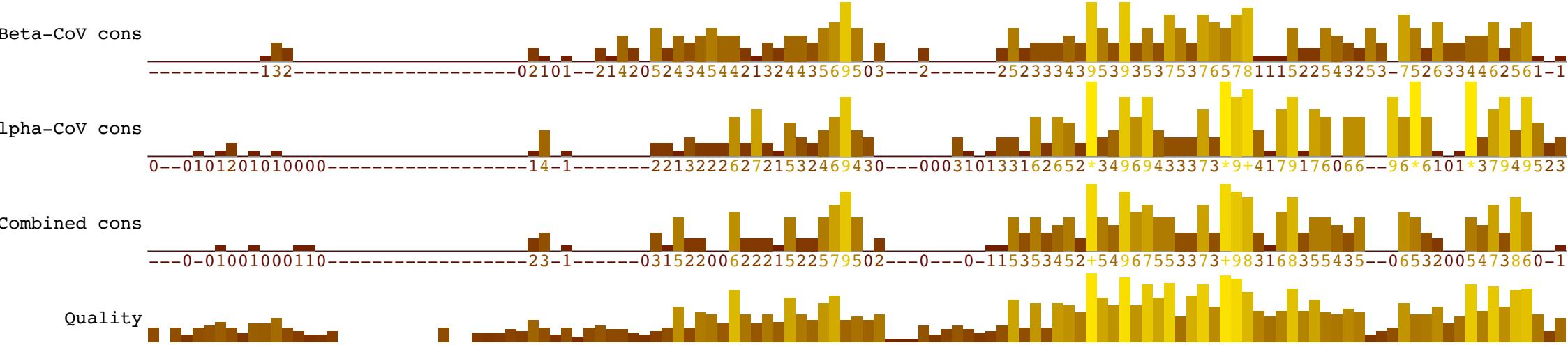
Combined cons



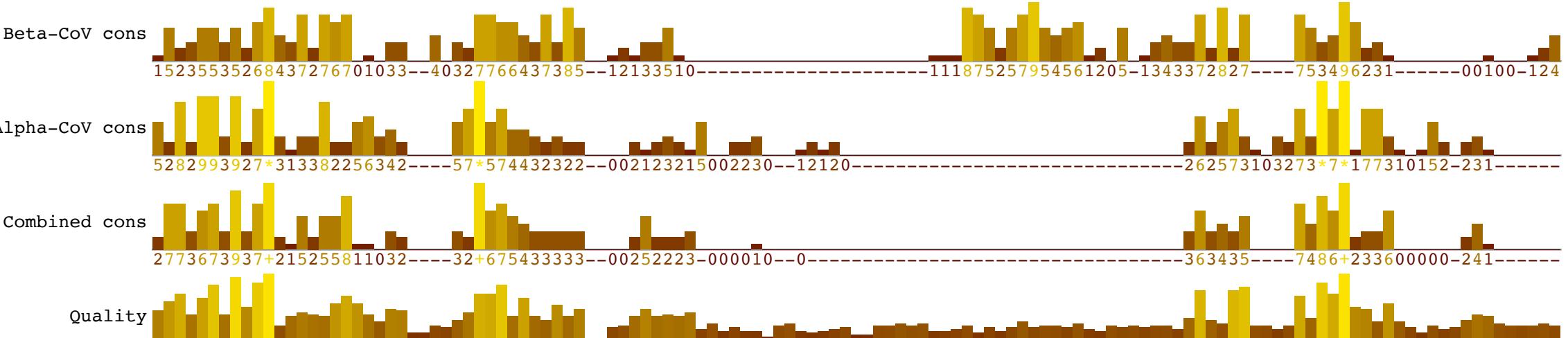
Quality



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 NL63 V-EVPGSCNFPLEATW-----HY-T-----SYTIVGALYVTWSEGSNTGVPY---PVSGIREFSNLVLNNCTKYNIYDVGTGIIRSSNQSLAGG--ITYVSNSGNLLGFKNV
 HKU8 NGTIKGCTLGIYKRA-----SS-Q-----YIPIWNVWVAYTSGDNILGVRE---PNVGVRDQSVVHQNVCTSNTIFCHSGRGIIRPANISYIAG--VYYTAASQOLLGFKNV
Ferret-CoV L-PTGSDCAFSLTVQN-----RYFT-----RVFAHLFVTYKYGLDHLGQVOT---PDVGVKDLSVVYQNVCTEYNNIYGHAGVGIIRSTNQTLLGG--LYYTSLSGDLLGFKNV
CDPHE15 G-ESGAGCGVDMVYES-----QYNM-----FKVTTIFVSYSEGDIAGMPK---PSEGIRDVSKIHLDCVCSTYSIYGHGTGDIIRLTNDTLLGG--LYYTS...
HKU10 K-PIAGGCTMRLVKQI-----LV-S-----YFDIGVLYVSYTPGSKITGVLQ---PTGGVYDPSIVHMGVCTDYYVYGLTGRGVISVSNTTYIAG--LYYTS...
BtRf-AlphaCoV Q-PVGSSCTISIMKNW-----MG-F-----KAPWKSVYVTFKRGNRITGVKN---ASTGIFDPSVMQLNECTDYTIYGVSGRGIIRKANSSYISG--LYYTS...
LuchengRn-CoV -----GYFALY-----NGYVIYN--AKFVSKGLTVCVVQ-----PVEPELDVCKSYTIDGVTFOQILRNTTHQIDSFHNILYY--GDMVSYV-R
Mink-CoV V-PLGDDCRLDLTVQT-----RYFT-----GVFAHVYVSYKFGLDIVGLPR---ADAGLKDLISVLHLNVCTEYNVYGFAGTCGIIRETNQTVMGG--LYYTS...
Bat-CoV-1A K-PNGGCMMSSVVAR-----YFGE-----FQKGVLYVSVFTKGDNVLGVPNNIPTIGVSDMSDVKLNVCTTFIYGHTRGIIINKSNTTFVSG--LFYTS...
BtMr-AlphaCoV V-ANGGCTMNIVTQG-----PYGL-----PHTIAVLYVSYTEGDNNIIGVPLSNIPPLGVSDMSQVYLDTCTTYTIYGMTGRGVITRSNNNTFITG--LYYTS...
BtNv-AlphaCoV V-DNGGCPMPINAIN-----YIKI-----EYPIGVLYVTHSPGEAITGVPKGFIKRLGFLDASILHLNVCTEYNNIYGVGKGIIINKANSTLHTG--IVYTD...
Porcine-EDV S-LLAGACTIDLFGYP-----AFGS-----GVKL-TSLYFQFTKGELITGTPK---PLEGITDVSFMTLDVCTKYTIYGFKEGIITLTNSSLAG--VYYTS...
BtCov512 S-PADGACELKYYVWN-----TIGA-----VSHLAGTLYVQHTKGDIITGTPK---PLOGLNDISELHLDTCCTTYTIYGF...
HKU2 -----GWSWND-YQDSIYDWI--ADFVSTGAFVCEKN-----PDAPRTGVCITYTIEKVTFOQVLYESENFTFAQYYNVLF--GSOLKYV-R
NL63-related K-QLPGGCCSMLIKRSN-----VN-Y-----NSDIGVIYVSHSPGNNILGPQ---ASTGVKDL...
FCoV S-PVGANCKFDVAART-----RTNE-----QVVRSLYVVIYEEGDNIVGVPS---DNSGLHDLSVLHLD...
TGE S-PVGANCKFDVAART-----RTNE-----QVVRSLYVVIYEEGDNIVGVPS---DNSGVHDL...
OC43 -----SCTCRPQ-----AFLGWSADS-CLQGDCKNIFANFILHDVNSGLTCSTD--L--QKANTDIILGVCVNYDLYGILGQGIFVEVNATYYNS...
MERS-CoV ---EGGGWLVASG-----S-----TVA-----MTEQLQMGFGITVQYGTDTNSVCPKL---EFAND-TKIASQLGN...
HKU1 ---D-GSYNVSCLCSTD-----AFLGWSYDT-CVSNNRCNIFSNFILNGINS...
Covid-19 ---EGFNCFPLQSYG-----F-----QPTNGVYQP-YRVV...
Bovine-CoV -----PCTCQPQ-----AFLGWSVDS-CLQGDCKNIFANFILHDVNSGLTCSTD--L--QKSNTDIILGVCVNYDLYG...
HKU4 ---EGGGGLLIGVG-----T-----RVP-----MTDNLQMSFIISVQYGTGTD...
HKU5 ---HSDGELETTG-----Y-----IYP-----VTGNLQMAFIISVQYGTDTNSVCPM...
HKU9 -----SAFIDTV-----I-----NAAHY-SPFSYVYGLAVITLKPAAGSKLVCP-V--AN-----DTVVITDRCVQY...
SARS-CoV ---PALNCYWPLNDY...
HKU24 ---MPGNSILTCSCSNTQYSAGNSQ...
Rat-CoV ---N-----ICNCSAD-----AFVGWAKDS-CLSNDRC...
Bat-BCoV ---MPRNCYVRSNN...
Hedgehog-CoV ---QGRNYYLGRK-----S-----YKPKT-DEGDVQM...
GCCDC1 -----NSFV...
HKU14 -----PCTCQPQ-----AFLGWSVDS-CLQGDCKNIFANL...
MHV AYNNCTGGOEVRD...
 229E K-DIPGGCAMPIMANL-----VN-H-----KSHNIGSLYVWSDGDVITGVPK---PVEGVSSFMNVTLNKCTKYNIYDVSGVGVRISNDTFLNG--ITYTSTS...
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 HKU8 NGTIKGCTLGIYKRA-----SS-Q-----YIPIWNVWVAYTSGDNILGVRE---PNVGVRDQS...
Ferret-CoV L-PTGSDCAFSLTVQN-----RYFT-----RVFAHLFVTYKYGLDH...
CDPHE15 G-ESGAGCGVDMVYES-----QYNM-----FKVTTIFVSYSEGDIAGMPK---PSEGIRDVSKIHL...
HKU10 K-PIAGGCTMRLVKQI-----LV-S-----YFDIGVLYVSYTPGS...
BtRf-AlphaCoV Q-PVGSSCTISIMKNW-----MG-F-----KAPWKS...
LuchengRn-CoV -----GYFALY-----NGYVIYN--AKFVSK...
Mink-CoV V-PLGDDCRLDLTVQT-----RYFT-----GVFAHVYVSYKFGL...
Bat-CoV-1A K-PNGGCMMSSVVAR-----YFGE-----FQKGVLYVSVFTKGD...
BtMr-AlphaCoV V-ANGGCTMNIVTQG-----PYGL-----PHTIAVLYVSYTEGD...
BtNv-AlphaCoV V-DNGGCPMPINAIN-----YIKI-----EYPIGVLYVTHSPGEA...
Porcine-EDV S-LLAGACTIDLFGYP-----AFGS-----GVKL-TSLYFQFTKGELITGTPK---PLEGITDVSFMTLDVCTK...
BtCov512 S-PADGACELKYYVWN-----TIGA-----VSHLAGTLYVQHTKGDIITGTPK---PLOGLNDISELHLDTC...
HKU2 -----GWSWND-YQDSIYDWI--ADFVSTGAFVCEKN-----PDAPRTGVCITYTIEKVTFOQVLYESENFTFAQYYNVLF--GSOLKYV-R
NL63-related K-QLPGGCCSMLIKRSN-----VN-Y-----NSDIGVIYVSHSPGN...
FCoV S-PVGANCKFDVAART-----RTNE-----QVVRSLYVVIYEEGDNIVGVPS---DNSGLHDLSVLHLD...
TGE S-PVGANCKFDVAART-----RTNE-----QVVRSLYVVIYEEGDNIVGVPS---DNSGVHDL...
OC43 -----SCTCRPQ-----AFLGWSADS-CLQGDCKNIFANFILHDVNSGLTCSTD--L--QKANTDIILGVCVNYDLYGILGQGIFVEVNATYYNS...
MERS-CoV ---EGGGWLVASG-----S-----TVA-----MTEQLQMGFGITVQYGTDTNSVCPKL---EFAND-TKIASQLGN...
HKU1 ---D-GSYNVSCLCSTD-----AFLGWSYDT-CVSNNRCNIFSNFILNGINS...
Covid-19 ---EGFNCFPLQSYG-----F-----QPTNGVYQP-YRVV...
Bovine-CoV -----PCTCQPQ-----AFLGWSVDS-CLQGDCKNIFANFILHDVNSGLTCSTD--L--QKSNTDIILGVCVNYDLYG...
HKU4 ---EGGGGLLIGVG-----T-----RVP-----MTDNLQMSFIISVQYGTGTD...
HKU5 ---HSDGELETTG-----Y-----IYP-----VTGNLQMAFIISVQYGTDTNSVCPM...
HKU9 -----SAFIDTV-----I-----NAAHY-SPFSYVYGLAVITLKPAAGSKLVCP-V--AN-----DTVVITDRCVQY...
SARS-CoV ---PALNCYWPLNDY...
HKU24 ---MPGNSILTCSCSNTQYSAGNSQ...
Rat-CoV ---N-----ICNCSAD-----AFVGWAKDS-CLSNDRC...
Bat-BCoV ---MPRNCYVRSNN...
Hedgehog-CoV ---QGRNYYLGRK-----S-----YKPKT-DEGDVQM...
GCCDC1 -----NSFV...
HKU14 -----PCTCQPQ-----AFLGWSVDS-CLQGDCKNIFANL...
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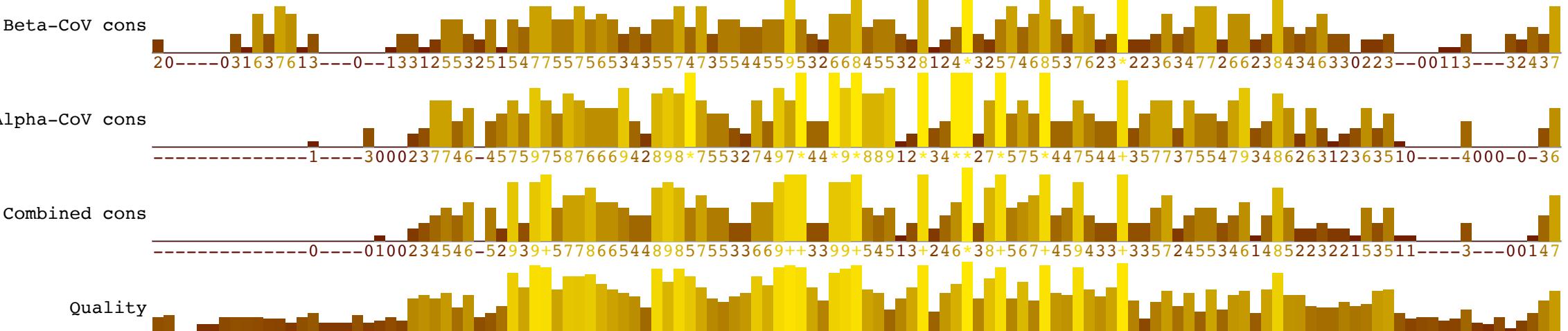


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 NL63 STGNIFIVTPCNQPDQVAVYQQS--IIGAMTAVNESR--YGLQNLQLPNFFYYV--SNGGN--NCTTAVMTYSSNFGICADGSLIPVR-PRN--
 HKU8 TTGEVFSVTPCNPSSQAVVVKDR--LVGVMSSTSTVS--IPFNNNTIPTPSFYH--SNATS--SCDDPSVYSSIGICDDGGITFVN-STR--
Ferret-CoV TTGEVYSIVPCQLSAQAAVINGK--IVGAUTSVQSPI--LDLPHHVTPQFYHHSIYNYSATPTSYRTNNGFDKYL--VNCTPIITYNSNMGVCENGALVFIN-ITQ--
CDPHE15 TTGEIYSVTPCSLTQQVAVVSD--IVGVVSSSANVDQFSFTYTTVTEQFYMM--TDGNS--SCSEPVLTYSLLGVCKDGAIRLQ-PRE--
HKU10 TTGVLYAVEPCDTSSQAVVGDA--IIGAMTSSANVT--FGVNTTVLPSPFYH--TNFGF--GCQTPVLEYGSMGLCADGSVVDVT-LRQ--
BtRf-AlphaCoV TTGEVFSVTPCQLTMQAAVNDD--IVGVVSSNTSG--INFTHITTKTFFYH--TNVQQ--NCSEPVLTYANIGVCSDGSITEVT-VRK--
LuchengRn-CoV IRGVVYAVESCRNFYYS-VFKTL--SAIGLYLSGATCD--STDVTTFMT--KA--RA--TTFVDSSLGCFIDVSV-TDGNYTDCLNPI---GNGFCVDVNVTGQPVVG--
Mink-CoV TTGTVYSITPCELSAQAVIDGS--IVGAITSVNSEL--LGLKNHIVTPYFYYSVYNYTADNN--SRSMQKYD--VNCTPVISYSNMGVCANGALVFIN-VTH--
Bat-CoV-1A TTGEIFSISPCQLTTQVAAVSDK--IVGVAATKEVT--LPFDTHVSLGSFYHYKNSNAE--LCKNPSLMYGGLGVCEDGRILVNIS-RSE--
BtMr-AlphaCoV TTGVVNVYVPCQLSSQAVASIDA--IVGMASSTPNVS--IDFNVTVVADNFYYL--SNSAQ--PCDQPVLYAGIGICSDGSITNST-ARR--
BtNv-AlphaCoV TTGDIYSVIPCQTSMOYAVIADN--IVGVISADTATG--ITFNHTIATPMFYYS--TNTDR--NCTEPVLTYATMGICADGAIGYVQ-PRV--
Porcine-EDV TSGAVYSVTPCSFSEQAAYVNDD--IVGVISSLSNST--FNNTRELPGFFYH--SNDGS--NCTEPVLVYSSNIGVCKSGSIGYVP-SQY--
BtCoV512 TTGQIYSVTPCQLVQQAFVEDR--IVGVISSANNTG--FFNSTRTFPGFYH--SNDTT--NCTSPRLVYSSNIGVCTSAGIQLLS-PKA--
HKU2 ILGKVYEVAPCFEASYDVLFRSS--SSFGLLYRSFDCN--QLRISASRF--AE--RLLPSHNGTATALGCLFNATYAPNDTMVNCTNPL---GDGFCADLL--SNVVVRR--
NL63-related TDSTVYTVPACATATQLAQVKQK--VLGAITAVKNDS--FGFNSTLTLPLFYH--SNGKV--NCTEPILVYSSIGICPDGTMIQIK-PVE--
FCoV SDGVIYSVTPCDVSAQAVIDGA--IVGAMTSINSEL--LGLTHWTTTPNFFYYSIYNTSERTR--GTAIDSND--VDCEPVITYSNIGVCKNGALVFIN-VTH--
TGE SDGVIYSVTPCDVSAQAVIDGT--IVGAITSINSEL--LGLTHWTTTPNFFYYSIYNTNDRTR--GTAIDSND--VDCEPVITYSNIGVCKNGAFVFIN-VTH--
OC43 ITNRTFMIRSCYSGRVSAAFHAN--SSEPALLFRNIKCN--YVFNNSLT--RQLQPINYFDSYLGCVVNAYNSTAISVQTCDLTV---GSGYCVDYS---KNRRSRGAIT
MERS-CoV DDGNYYCLRACSVVPVSVIYDKE--TKTHATLFGSVACE--HISSTMSQYSRSTRSMLK--RRDSTYGPLQTPGVCLGLVNSS-LFVEDCKLPL--GQLCALPDTPSTL-TPRSVRSP
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Covid-19 QTLEILDITPCSFGGVSVITPGNTNSQAVLYQDVNCT--EVPAIHADQLPTWRVYSTG---SNVFQTRAGCLIGAEH-V-NNSYECDIPI--GAGICASYQTQTNSPRRAR-SVA
Bovine-CoV LTNRTFMIRSCYSGRVSAAFHAN--SSEPALLFRNIKCN--YVFNNTLS--RQLQPINYFDSYLGCVVNADNSTSSVQTCDLTV--GSGYCVDYS---TKRRSRRSIT
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SARS-CoV KTSEILDISPCAFCGGVSVITPGTNASSEVAVLYQDVNCT--DVSTAIAHADQLTPAWRIYSTG--NNVFQTOAGCLIGAEH-V-DTSYECDIPI--GAGICASYHTVSL--LRSTS
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Rat-CoV VTNKTYLLRSCYSGRVSAAYHSD--APEPALLYRNLKCD--YVFNNNIS--REETPLNYFDNYLGCVNADNSTEHVDACDLRM--GSGLCVNYS---TAHRARRSVS
Bat-BCoV YNNTIYGILPCAQAQVSIVTAGSNHD--NVAVVYNGLCN--AFQSKMQG-VDNTEWSVYTNF--SSPIDTPVGCLTGAIQAO-ENSTEQFAL--GLDSCVNYTADTRL-RT-AR-AAD
Hedgehog-CoV KNGTYYCMAPCVSVPVSVIYDKS--SDVHATLYSSVECN--HIKSVATVFSRQTESKLR--S-SDNGLLQTAVGCVIGFRNTS-DTVEDCTLPL--GQLCAKPPSFSSR-STN---VN
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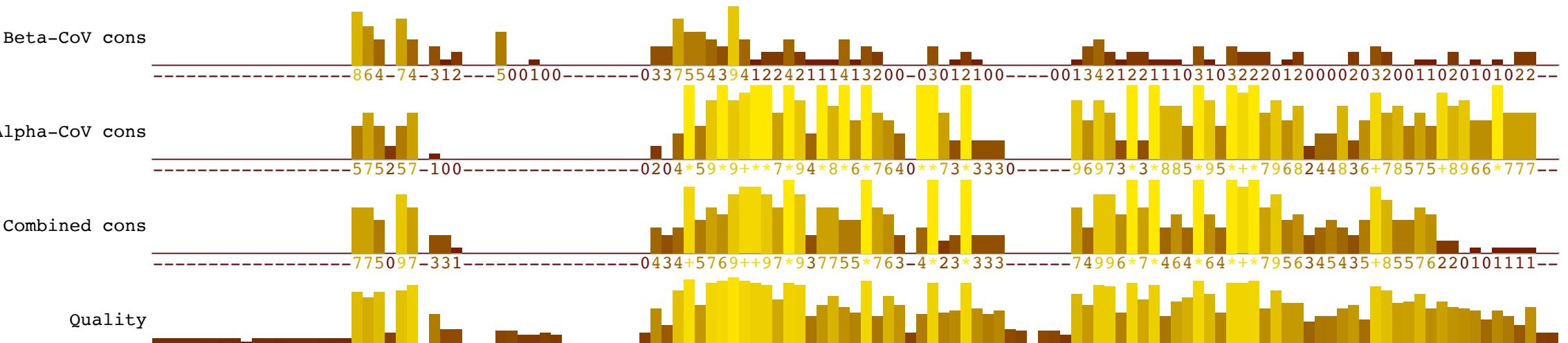


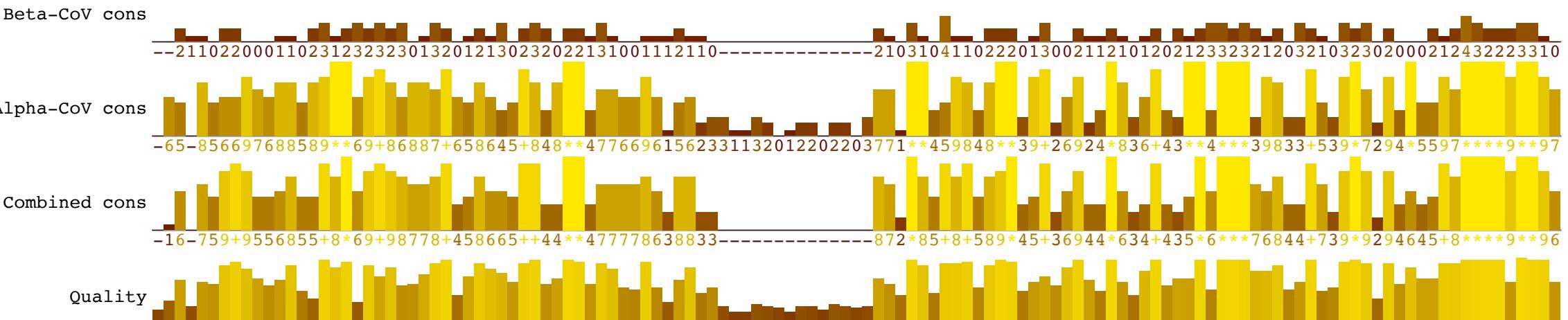
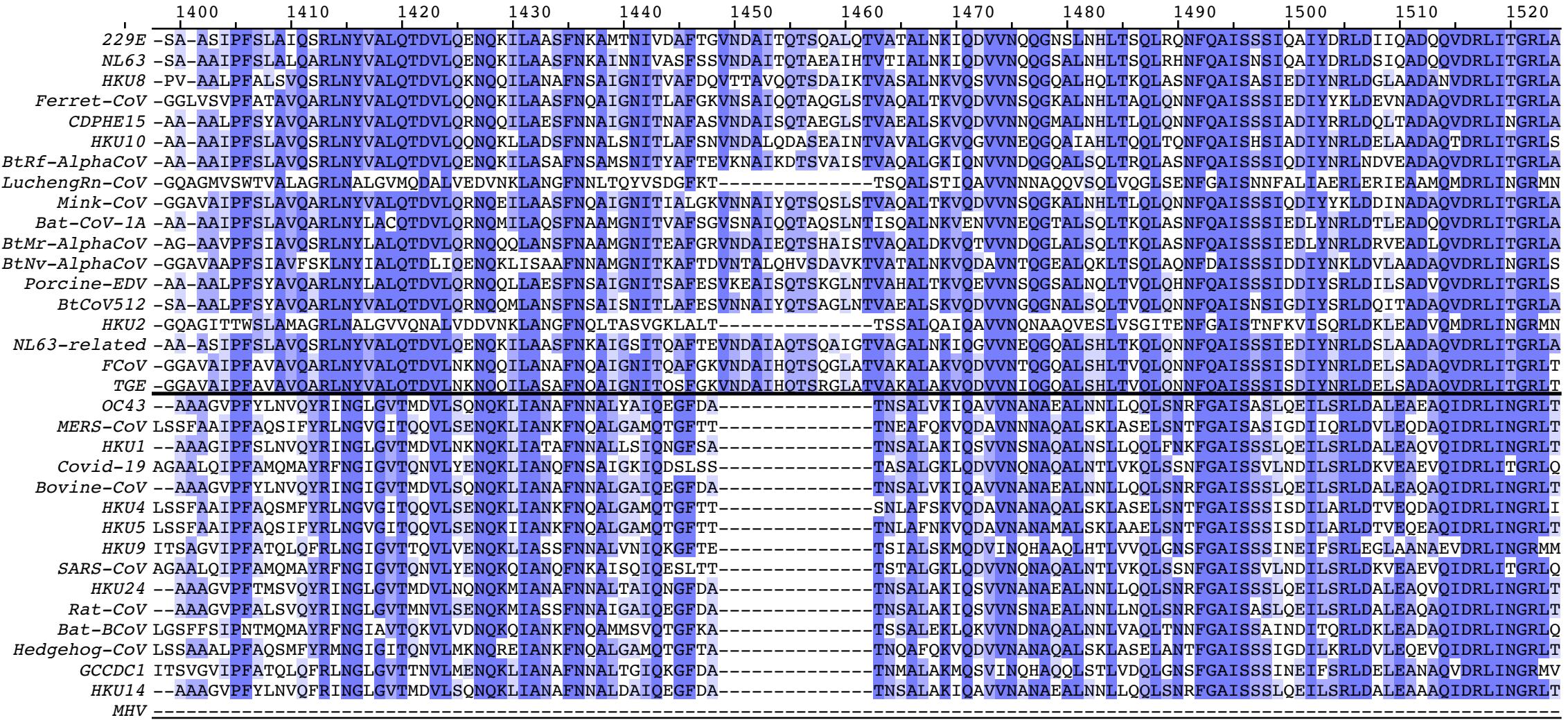
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 NL63 -----S-SDNGISAIIT-ANLSIPSNWTSVQVEYLQITSTPIVVDCATYVCNGNPRCKNLLKQYTSACKTIEDALRNSAHLETNDVSSMLTFDSNAFLSAN---VTSF-G-DY
 HKU8 -----V-RGEPDPAISM-GNISVPSNFTVSQIYQVEYLQMSIRPVSIDCAMYVCNGNPHCTRLLQOYISACRTIEEALQLSARLESFEVNSMLTVSETALDLVN---ISTF-GGDY
Ferret-CoV -----S-EN-PVQPIST-GNVTIPSNFTISVQVEYLQMSSEAVSIDCAQYVCNGNPRCNRLLAQYISACHAIEQALITSTRLEALESMISISDNALALAT---VETFNSSDY
CDPHE15 -----D-TTQ-PTPIVS-GVVISIATNFTLSVVTEYIQLANTPISVDCAMYVCNGNPRCNMLLAQYSSACQTIEALQLSAKLESIEVTNMLTVSEDNLQIAN---ISTFNGGY
 HKU10 -----Y-QPAPVSPPIAT-TNISIPLNFTISIQTTEYIQMYSQSVSVDSCMYVCNGNVRCLRLLTQYATACRNIESALQLSARLESLEVSSVSVSENALKLAN---ITHF-D-SY
BtRf-AlphaCoV -----T-EPEPVAPIIT-GNLSIPSNWTSVQVEYLQMYNKPVSVDCQTYVCNGNPRCLKLLTQYATACRTIEEALQLSARLESVEVANMAVSDEAVQLAN---VSYF-D-TY
LuchengRn-CoV -----IFIQTH-DDTYARPILTAQQIELPIDHYVSVKEQFIQTSTPKFDVDCERYICDVSSDCRELLVKYGGYCSKILADIKSSSIQLDYQILGLYKTLAVDFKV---PDI---DFGDF
Mink-CoV -----T-NG-DVQPIST-GNVTIPSNFTISVQMEYVQVSTELVSIDCARYVCNGNARCGRLLSQYVSACQTIEQALAMGSRLESMELESMSISENALKLAS---VEEFNSSAM
Bat-CoV-1A -----D-T-FVPSAVIS-GNITIPANFSFVVPQPEYIQIMTKPVSVDCSVYVCNGNPRCLQLLTQYASVCRTEEPQLQNLARLEALELTSMIIIVQDKTLKLGV---ASNFN-DTF
BtMr-AlphaCoV -----A-AADPVPVIS-GNISVPTNFTFSVQVEYIQMLKPVTVDCSVYVCNGNPRCLQLLAQYASACRTIEQALQLSARLESVEVNSMISISQEALALGV---IDNFK-HDF
BtNv-AlphaCoV -----V-STTPATPITT-GNLTIPVNFTVSQIAEYVQVSLRAVVDCATYVCNGNVRCLQLLRQYVTACTSVENALALNARLESQEVAADMALAVDYAAVRSSELN-TPQFE-NGF
Porcine-EDV -----G-QVK-IAPVTI-GNISIPTNFSMSIRTEYIQLYNTPVSVDCATYVCNGNSRCKQLLTQYTAACKTIESALQLSARLESVEVNSMLTISEEEALQLAT---ISSFNGDGY
BtCov512 -----A-QPO-VQPMFO-GNISIPTNFTMSVRTEYIQLFNKPVSVDCAMYVCNGNDRCKQLLSQYTSACKNIESALQLSARLESMEVNSMLTVSDEALKLAT---ISOFPGGY
 HKU2 -----MTFEKH-DDTYVAPVTNERFTELPLDHLQLVLTQFQLOTTMPKFISCTEYICDVSKACKNLLFRYGGFCQKIEADIRGAGVLLSDVSGLYSTIAAKTSS---ITP---TTDRF
NL63-related -----T-TPQVVAPIVT-ANISIPLNFTTSVQVEYLQLSSRPVSVDCATYVCNGNPRCLTLLTQYSSACKTAAEALQLTARLEASEVNSMIKSLPTAIDNANKLGVSTYQ-G-GF
FCoV -----S-DG-DVQPIST-GNVTIPTNFTISVQVEYMQVYTPVSIDCARYVCNGNPRCNKLLTQYVSACQTIEQALAMGARLENMEVDSMLFVSENALKLAS---VEAFNSTEN
 TGE -----S-DG-DVQPIST-GNVTIPTNFTISVQVEYIQVYTPVSIDCARYVCNGNPRCNKLLTQYVSACOTIEQALAMGARLENMEVDSMLFVSENALKLAS---VEAFNSSET
 OC43 TG---YRFTNFEPPFTVNSVNDSEPVGGLYEIQIPSEFTIGNMVEFIQTSSPKVTIDCAAFVCGDYAACSQLVEYGSFCNDINAILTEVNELLDTTQLQVANSLMNGVTLSTKLKGVNFNVDDI
MERS-CoV GE--MRLASIAFNHP---I-QVDQLNSSYFKLISIPTNFSFGVTQYEIQTTIQLKVTVDCKQYVCNGFKCEQLLREYGQFCSKINQALHGANLRQDDSVRNLFAVKSSQSS---PIIPG---FGGDF
 HKU1 AS---YRFVTPEPNVSFVNDSIESVGGLYEIKIPTNFTIVGQEEFIQTNSPKVTIDCSLFVCSNYAACHDLLSEYGTFCNDINSILDEVNGLLDTTQLHVADTLMQGVTLSSNLNTLHFVDVNI
Covid-19 SQ---SIIAYTMS---LGAENSVAYSNNIAIPTNFTISVTEILPVSMTKTSVDCTMYICGDSTECNSNLLQYGSFCQTLNRALTGIAVEQDKNTQEVAQVKQIYKTP---PIK---DFGGF
Bovine-CoV TG---YRFTNFEPPFTVNSVNDSEPVGGLYEIQIPSEFTIGNMEEFIQTSSPKVTIDCSAFVCGDYAACSQLVEYGSFCNDINAILTEVNELLDTTQLQVANSLMNGVTLSTKLKGVNFNVDDI
 HKU4 SQ--FQLAVLNFTSP---I-VVTPINSSGFTAAIPTNFSFSVTQYEIETSIQKVTVDCKQYVCNGFTRCEKLLVEYGQFCSKINQALHGANLRQDESVYSLYSNIKTSTQ---TLEYG---LNGDF
 HKU5 DV--FQIATLNFNTSP---L-TLAPINSTGFVVAVPNTFTFGVQEFIEETTIQKITVDCCKQYVCNGFKCEDLLKEYGQFCSKINQALHGANLRQDESIANLFSSIKTQNTQ---PLQAG---LNGDF
 HKU9 R---LQLVNYDPL---YDNSTATPMTPVYWKVPTNFTLSATEEYIQTAPKITIDCARYLCGDSRCLNVLLHYGTCFCNDINKALSRVSTILDSALLSLVKELSI-NTRDEVTTFS---FDGDF
SARS-CoV QK---SIVAYTMS---LGADSSIAYSNNIAIPTNFSISITTEVMPVSMAKTSVDCNMYICGDSTECANLLQYGSFCQTLNRALSGIAAEQDRNTREVFAQVKQOMYKTP---TLK---YFGGF
 HKU24 TG---YRFTNFEPPFTVNLDSVESVGGLYEIQIPTEFTIGNLEEFVQTTSPKVTIDCAAFVCGDYAACREQLVEYGSFCNDINTILNEVNSMIDTSQYQLASTLMNGVTLSSRLKGIFNQDDI
Rat-CoV TG---YKLTTFEPPFTVSIVNDSVESVGGLYEMQIPTNFTIASQQEFIQTRSPKVTIDCAAFVCGDYTVCRQQLVDYGSFCNDINAILGEVNNLIDTMQLQVASALIQGVTLNSRLADGISQIDD
Bat-BCoV RALTFNYMYFAQELP---SQSEQSVAFDNSTLQIPIINFTEIGIEYETIPVTPMPKVTVDCAQYVCGDNSECRTLLVQYGTFCETINDALRGVALQQDVNQKDFVSSVRRLAKVSSPMNLG---NLNGF
Hedgehog-CoV NT--FALVHMLFQNP---L-KVSVLNSTEFQVSIPQNFSFGITEEFIETSIQKVTVDCKQYVCNGFERCEQLLVQYQGQFCSKINQALHGVNLRQDDATKSLFEDIKVQPSV--PLMTS---LTGDF
 GCCDC1 L----LSLVVYDPT---D-AGLKVLTPVYWVSIPTNFTLAATTEYIQTAPKVNVDCKVYLCGDSERCIDVLSQYGAFCEDVNKALADVSAIIDSSMVTMSELTA-GVMWSETPQA---NVGSY
 HKU14 TG---YRFTNFEPPFTVNAVNDSLQPVGGLYEIQIPSEFTIGNMEEFIQTSPKVTIDCAAFVCGDYAACSQLVEYGSFCNDINAILTEVNELLDTTQLQVANSLMNGVTLSTKLKGVNFNVDDI
 MHV **GYFVODDGWEWKTGSSYYYYPEPITDKNSVIMSSCAVNYTAKAPEVFLNTSIPNPPDFKEELDKWFKNOTSIAPDLSLDFEKLNVTLLDTYEMNRIODAIKKLNESYINLKEVGTYEMYVKWPWYVWL**



1280 1290 1300 1310 1320 1330 1340 1350 1360 1370 1380 1390
 229E NLSSVI-PSL--PRSGSR--VAGRSAIEDILFSKLVTSGLGTVDADYKKCTKGLS--IADLACAQYYNGIMVLPGVADAERMAMYTGSLIGGIALGGLT--
 NL63 NLSSVL-PQR--NIRSSR--IAGRSALEDDLFKVVTSGLGTVDYKSCTKGLS--IADLACAQYYNGIMVLPGVADAERMAMYTGSLIGGMLGGLT--
 HKU8 NLTALL-PQG--G--GKRSVIEDILFDKVVTSGLGTVDDEDYKRCTNGIG--IADVPCAQYYNGIMVLPGVDEEKMSIYTASLLGGMTMGGFT--
Ferret-CoV LDPVYNDQHNTIGGIYMDGLKDLL-PRR--SCANKH--GTCRSVIEELLFNKVVTSGLGTVDDEDYKRCTNGLD--IADLVCAQYYNGIMVLPGVNVADKMAMYTASLAGGITLGALG--
CDPHE15 NFTNLM-GTT--YSTKSVVEDILFDKVVTSGLGTVDADYKACNSNGLS--IADLVCAQYYQGVMVLPGVDAAKLHMYASALMGGMALGGVT--
HKU10 NLSVLL-PKS--D--G-KSVVEDILFDKVVTSGLGTVDQDYKNCVGKLGVAQDIADVGAQYYNGIMVLPGVNEAKMGLYTASLTGAMVMGGFT--
BtRf-AlphaCoV NVSVLL-PRG--Q--SRGSVIEDLLFNKVITSGLGTVDDEDYKACTGD-GFGAALADLFCAQYYNGIMVLPGVDETKGMLYTASLTGAMVMGGFT--
LuchengRn-CoV NFSMYM--SE--ANGRSFIEDLLFDKIVTTGPGFYQ-DYDCKM--NLQDLTCKQYYNGIMVIPVMDTLITFWSSAVAGSMTAGLFG--
Mink-CoV LNPIYNESGNTIGGIYLDGLKDIL-PRK--NKH--GSSRSTIEDLLFNKVVTTGLGTVDDEDYKRCTKGSD--IADLACAQYYNGIMVLPGVANDGKMSMYTASLSSGIGALG--
Bat-CoV-1A DLTAL-PRQ--HQRSAIEDLLFSKIVTSGLGTVDDDYKECAAKM--ANTIAEAGCVQYYNGIMVLPGVDPSSLQYTAALTGAMVLGGVT--
BtMr-AlphaCoV NLTNVL-PAS--VGAKSAVEDLLFDKVVTSGLGTVDADYKECASRT--ANTVAEVGCVQYYNGIMVLPGVDSQSLAQYSAAALTGAMVFGGV--
BtNv-AlphaCoV NISAVL-PAG--EGKGSFIEDLLFDKVITNGLGTVDADYKRCIEEK--GAIADVVCROYYKGISVLPALTDPMGGLYSASLMGALTLGAFG--
Porcine-EDV NFTNVL-GASVYDPASGRV--VQKRSVIEDLLFNKVVTNGLGTVDDEDYKRCNSNGLS--VADLVCAQYYSGVMVLPGVDAEKLHMYASLIGGMALGGIT--
BtCov512 NFTNIL-PAN--PGARSVIEDILFDKVVTSGLGTVDDEDYKRCNSNGLS--IADLACAQHYNGIMVLPGVADWEKVHMYASLVEGGMTLGGIT--
HKU2 NVSQFFLPKV--QSNER--FESRSVIEDLLFSKIETTGPFGFYG-DYYNCKKN--AIQDLTCAQYHNGILVIPPVMDAETLGMYGGIAAASLTGIFG--
NL63-related NLTSVV-PQT--PASTSG--SFRGSFIEDLLFNKVITSGLGTVDADYKECTKGLS--IADLACAQYYNGIMVLPGVVAEKMAMYTASLTGAMVMGGLS--
FCoV LDPIYKEW-PSIGGSWLGLKDIL-PSH--NSK--RKYGSIAEDLLFDKVVTSGLGTVDDEDYKRCTGGYD--IADLVCAQYYNGIMVLPGVANADKMTMYTASLAGGITLGALG--
TGE LDPIYKEW-PNIGGSWLEGKYIL-PSH--NSK--RKYRSAIEDLLFDKVVTSGLGTVDDEDYKRCTGGYD--IADLVCAOYYNGIMVLPGVANADKMTMYTASLAGGITLGALG--
OC43 NFSPVLI-GCL--GSEC SK--ASSRSAIEDLLFDKVVKLSDVGFVE-AYNNCTGG--AEIRDLCVQS YKGIKVLPPLSENQISGYT LAATSASLFPPT--
MERS-CoV NLT-LL-EPV--SISTGS--RSARSAIEDLLFDKVTIADPGYMO-GYDDCMQQ-G-PASARDLICAQYVAGYKVLPPMDVNMEAAYTSSLLGSIAGVGWTAG--
HKU1 NFKSLV-GCL--GPHCGS--SSRSFFEDLLFDKVVKLSDVGFVE-AYNNCTGG--SEIRDLLCVQSFNGIKVLPPLSENQISGYTTAATVAAMFPWS--
Covid-19 NFSQIL-PDP--S--K--PSKRSFIEDLLFNKVTLADAGFIK-QYGDCLGD--IAARDLICAQKFNGLTVPPLLTDEMIAQYT SALLAGTITSGWTFG--
Bovine-CoV NFSPVLI-GCL--GSDCNK--VSSRSAIEDLLFSKVVKLSDVGFVE-AYNNCTGG--AEIRDLCVQS YNGIKVLPPLSENQISGYT LAATSASLFPWS--
HKU4 NLT-LL-QVP--QIGGSS--SSYRSAIEDLLFDKVTIADPGYMO-GYDDCMKQ-G-POSARDLICAQYVSGYKVLPPLYDPNMEAAYTSSLLGSIAGAGWTAG--
HKU5 NLT-ML-QIP--QVTTGE--RKYRSTIEDLLFNKVTIADPGYMO-GYDEC CMQO-G-POSARDLICAQYVAGYKVLPPLYDPYMEAAYTSSLLGSIAGASWTAG--
HKU9 NFTGLM-GCL--GPNCGA--TTYRSAFS DLLYDKV RITDPGFMQ-SYOKCIDSQW-GGSIRDL LCTOTYNGIAVLPIVSPAMQALYTSLLVGAVASSGYTFG--
SARS-CoV NFSQIL-PDP--L--K--PTKRSFIEDLLFNKVTLADAGFMK-QYGECLGD--INARDLICAQKFNGLTVPPLLTDDMIAAYTAALVSGTATAGWTFG--
HKU24 NFSSVM-GCV--GSNCI--SHRSAIEDILFNKVVKLSDVGFV--AYNNCTQG--SEIRDLCVQS FNGIKVLPPLVLESQMSGYATGVGLSMLFPFS--
Rat-CoV NFSPILL-GCL--GSYCSE--GTMAVQGRSAIEDVLFDKVVKLSDVGFV--AYNNCTGG--QEVRDLLCVQSFNGIKVLPPLVLESQISGYTAGATASAMFPWS--
Bat-BCoV NFSSIL-NQE--AINGNN--FQARSAIEDLFFDKIETADVGFKQ-KYDECTGG--SVVKDLGCAQSFNGLMVLPPQMTDAHVAAYTTSAA--
Hedgehog-CoV NLS-LF-EAP--NIGSGN--NNYRSALEDDLFKVTLSDPGYMK-GYDEC MKK-G-PPSARDLICAQYVSGYKVLPPLYDANMEAMYTASLTGSIAGSFWTGG--
GCCDC1 NFGSLM-GCL--GSNCQE--KQYRSAIS DLLY NKVKVADPGFMG-AYQKCIDEQW-GGSVRD LICTQTFNGISVLPIVSPGMQALYTSLLVGAVASSGYTFG--
HKU14 NFSPVLI-GCL--GSDCNK--ASSRSAIEDLLFDKVKLADVGFV--AYNNCTGG--AEIRDLCVQS YNGIKVLPPLSENQISGYT LAATSASLFPPT--
MHV LIGLAGVAVCVLLFFICCCTGCGCCFKCGNCCDEYGGHODSIVIHNISSED--





1530 1540 1550 1560 1570 1580 1590 1600 1610 1620 1630 1640 165

229E ALNVFVSHTLTKYTEVRASROLAQQKVNECVKSQSQRGYFCGN-GTHIFSLVNAAPEGLVFLHTVLLPTQYKDVEAWSGLCV--DGINGYVLRQPNLALYKEG-----NYYRITSRIMFEPRIP

NL63 ALNAFVSQVLNKYTEVRGSRRLAQQKINECVKSQSQRGYFCGN-GTHIFSLVNAAPEGLVFLHTVLLPTQYKDVEAWSGLCV--DGIGYGVLRQPNLVLYSDN-----GVFRVTSRVMFQPRLP

HKU8 ALNAFVTQTLTKYTEVRASRLLAQEKINECVKSQSTRYGFCGN-GTHLFSIPNAAPEGIMLFHTVLVPTEYVSVTAWSGYCH--NG-VGYAVKDVGNQLFQFN-----NTFYITPRNMYPQPRTP

Ferret-CoV SLNAFVTQTLTNQAQIRASRQLSKEKINECVRSSRFGFCGN-GTHLFSLANAAPRGVMLFHTVLLPTSYKTVTAWSGVCAISNNKTMGFIVKDVDSTLTFKNH-----DDKFYLTPRTMYEPRVA

CDPHE15 ALNAFVSQTLTKYQSVQASRSLAKQKINECVLSQSPPRYGFCDGGGRHVTQAAPOQILFLHTVLRPTGSVNVTAAAGICV--DGA-GYALNQPGLVLIYQD-----GTYLITPRVMFEPQRP

HKU10 ALNAFVTQTLTKYTEVRASRQLAQEKINECVKSQSRYGFCGN-GTHLFSIVNNAPNGLMFHTVLVPTVYVTVSAWAGVCF--NNRA-YILRDVESVLF-NN-----NGYYVTNRKMYEPRVP

BtRf-AlphaCoV ALNAFVTQTLTKYTEVRASRQLAQEKINECVKSQSRYGFCGN-GTHLFSISNAAPQGIIFFHTVLLPTEYQTVTAWSGVCV--NNHYGLVLRNVDALYKRN-----DSYFITSRDMYEPRVP

LuchengRn-CoV ILQNFTVNTYKLKISELKSOQALAQSLINECVYAQSSRNGFCGD-GLHLFSLMQRAPDGIMFFHYTLKPNNTIIVETTPGLCLSND---VCIAPKDGFLFVRLSTA-----RDTDWHFTTRNRSPEPI

Mink-CoV ALNAFVTQTLTRQAEVRASRQLAKQKVNECVRSQSSRFGFCGN-GTHLFSLANAAPNGMVFHTVLVPTAYQTVTAWSGICASDGDRFTGLIVKDVDSTLFRNY-----NNSFYLTPTRTMYQPRIA

Bat-CoV-1A ALNAFVTQQLRYSEVRASRQLAQEKINECVKSQSRYGFCGN-GTHVFSVANAAPDGIMFLHANLVPТАFIEVSAGAGVC--DGR-ALVLRGRDEVLFQKP-----DTDQYLITPRLLFEPV

BtMr-AlphaCoV ALNAFVAQQLTKYTDVRASRQLAQDKINECVKSQSFRYGFCGN-GTHVFSVVNAAPDGMMFFHSVLLPTAYMEVAAFSGLCV--EGN-GYVLRDTGNVLFER-----NGQYLITARKMFEPV

BtNv-AlphaCoV ALSTFVSAQLVKYSEVKASRNLLAMQKVNECVKSQSRLGFCGN-GTHLFSMVTGAPDGLMFLHTVLLPTEYKEVAAWAGLCV--GGK-AFVLRDVQLLLFIR-----IIQYLVTSRNMYQPRVP

Porcine-EDV ALNAFVAQTLTKYTEVQASRKLAQQKVNECVKSQSQRGYFCGGDGEHIFSLVQAAPQGLLFLHTVLVPGDFVNVLIAAGLCV--NGETIALTREPGLVLFTHE-LQTYTATEYFVSSRRMFEPRKP

BtCov512 ALNAFVAQSLTKYAEVQASRTLAKQKVNECVKSQSPPRYGFCDGEGEHIFSLTQAAPOGLMFLHTVLVPGNFINVATVGLCV--DETIAMTLRQSGFVLFVQN-----GNYLVSPRKMFEPRRP

HKU2 VLQLFVTNTYKLKIAELRNTHRYVQSLINECVYAQSLRNGFCQ-GLHVLSLMQAPSGIMFFHYSLIPNNNTIVKTTPLCESDELGSKCIVAKDGLVLS--A-----NLSYWQWSPRNLKYKPENL

NL63-related ALNSFVTQTLTRQTVRASRELAMQKINECVKSQSDRYGFCGN-GTHLFSIANAAPEGLLFLHTVLVPPDDVTVTAWSGICF--GGDKGFIILRDFQTLIKYD-----NKYKVTSRKMFQPRNA

FCoV ALNAFVSQTLTRQAEVRASRQLAKDKVNECVRSQSRQYGFCGN-GTHLFSLANAAPNGMIFFHTVLLPTAYETVTAWSGICASDGDRFTGLVVKDVDQLTLFRNL-----DDKFYLTPRTMYQPRVA

TGE ALNAFVSOTLTRQAEVRASROLAKDKVNECVRSOSORFGFCGN-GTHLFSLANAAPNGMIFFHTVLLPTAYETVTAWSGICASDGDRFTGLVVKDVDVOLTLFRNL-----DDKFYLTPRTMYQPRVA

OC43 ALNAYVSQQLSDSTLVKFSAAQAMEKVNECVKSQSRRINFCCN-GNHIIISLVQNAPYGLYFIHFVSYVPTKVTARVSPGLCIA----DRGIAPKSGYFVN-----NTWMYTGSYYYYPEPI

MERS-CoV TLNAFVAQQLVRSESAALSAQLAKDKVNECVKAQSKRSGFCQ-GTHIVSFVVNAPNGLYFMHGYYPSNHIEVVSAYGLCDAAN-PTNCIAPVNGYFIKTNNTR-----IVDEWSYTGSSFYAPEPI

HKU1 ALNAYVSQQLSDISLVKFGAALAMEKVNECVKSQSRRINFCCN-GNHILSLVQNAPYGLLFMHFSYKPISFKTVLVSPGLCISG-----DVGIAPKQGYFIKHN-----DHWMFTGSSYYYYPEPI

Covid-19 SIQTYVTQQLIRAAEIRASANLAATKMSECVLGQSKRVDGCK-GYHLMSPQASPHGVVFLHTVYVPAQEKNFTTAPAIICHG-----KAHPREGVVFVSN-----THWFVTOQRNFYEPQII

Bovine-CoV ALNAYVSQQLSDSTLVKFSAAQAMEKVNECVKSQSRRINFCCN-GNHIIISLVQNAPYGLYFIHFVSYVPTKVTAKVSPGLCIA----DRGIAPKSGYFVN-----NTWMFTGSGYYYYPEPI

HKU4 SLNAFVSQQLVRSETAARSAQLASDKVNECVKSQSRRNGFCGS-GTHIVSFVVNAPNGFYFHGVYVPTNTVNTAAYGLCN----PPLCIAPIDGYF1TNQTTT-----SVDTEWYTGSFYKPEPI

HKU5 SLNAFVAQQLVRTEAAARSAQLAQDKVNECVKSQSRRNGFCGT-GTHIVSFAINAPNGLYFFHGVYQPTSHVNATAAYGLCNEN-PQKCIAPIDGYFVNLQTTSTVADSDQOWYYTGSSFFHPEPI

HKU9 VLNTYVTQLLIQASEAKAONALAAQKISECVKAQSLRNDFCGN-GTHVLSIPQOLAPNGVLFIHAYPTPEYAFVQTSAGLCHNG-----TGYAPRQGMFVLPNNT-----NMWHFTTMQFYNPVNI

SARS-CoV SLQTYVTQQLIRAAEIRASANLAATKMSECVLGQSKRVDGCK-GYHLMSPQAAAPHGVVFLHTVYVPSQERNFTTAPAIICHG-----KAYFPREGVVFVNG-----TSWFITQRNFFSPQII

HKU24 ALNAYVSQQLSDITLVKFSASQAIKEVNECVKSQSRTNFCCN-GNHILSLVQNAPYGLYFIHFVSYQPTKTTAYVSPGLCLAG-----DVGVAPKSGYF1KVN-----DKWMFTGSGAYYHPEPI

Rat-CoV ALNAYVSKHLSDMTLIKVSAQAIKEVNECVKSQSRRINFCCN-GNHILSLVQNAPYGLYFIHFVSYVPTSTTVNVSPGLCISG-----DRGLAPKAGYFVQDH-----GEWKFTGSYYYYPEI

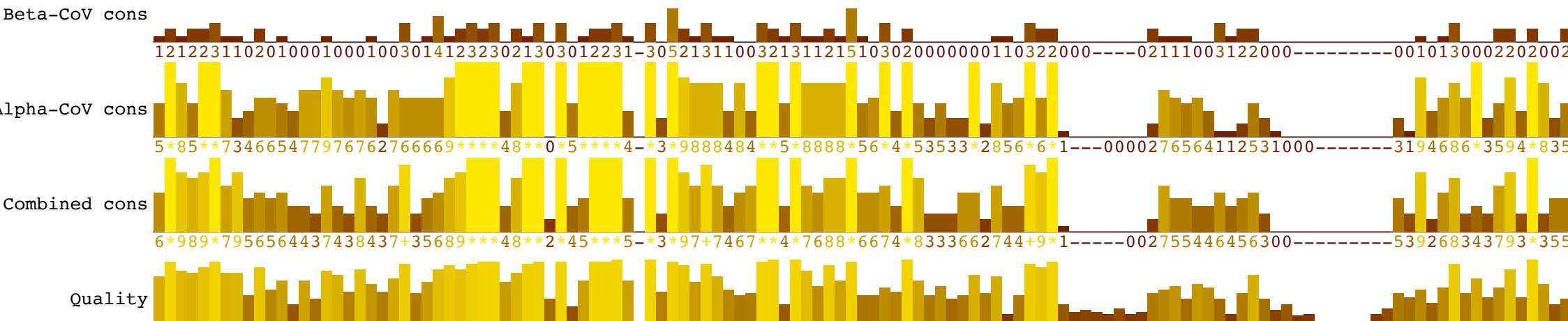
Bat-BCoV VLQFTVTQQLIRASEIRASAKLAAQKMSECVQGQSQRLDFCGR-GMHLMSFPQAAPYGMVFLHVLYKPTDYINVTTVPAICSN-----VAYFPVDPGVFVYYN-----NSLMFTKRNYFEPEII

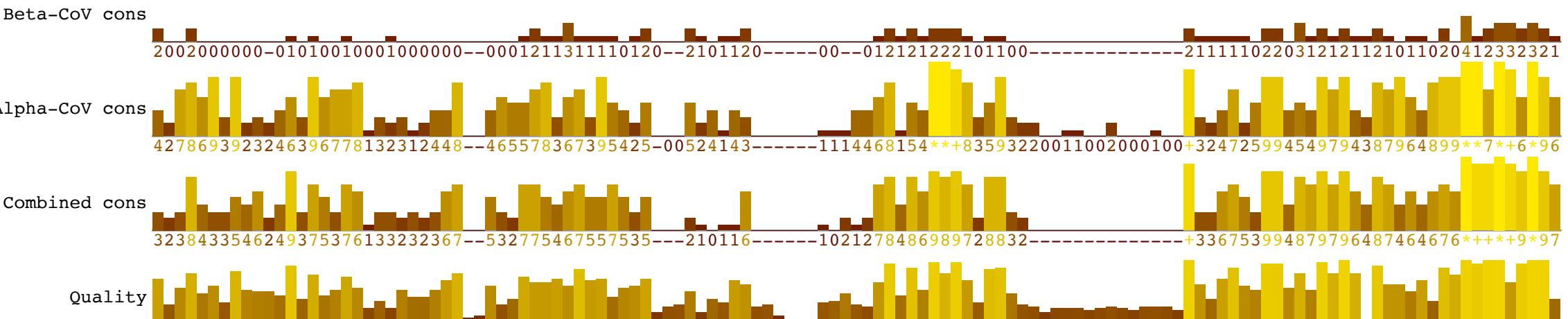
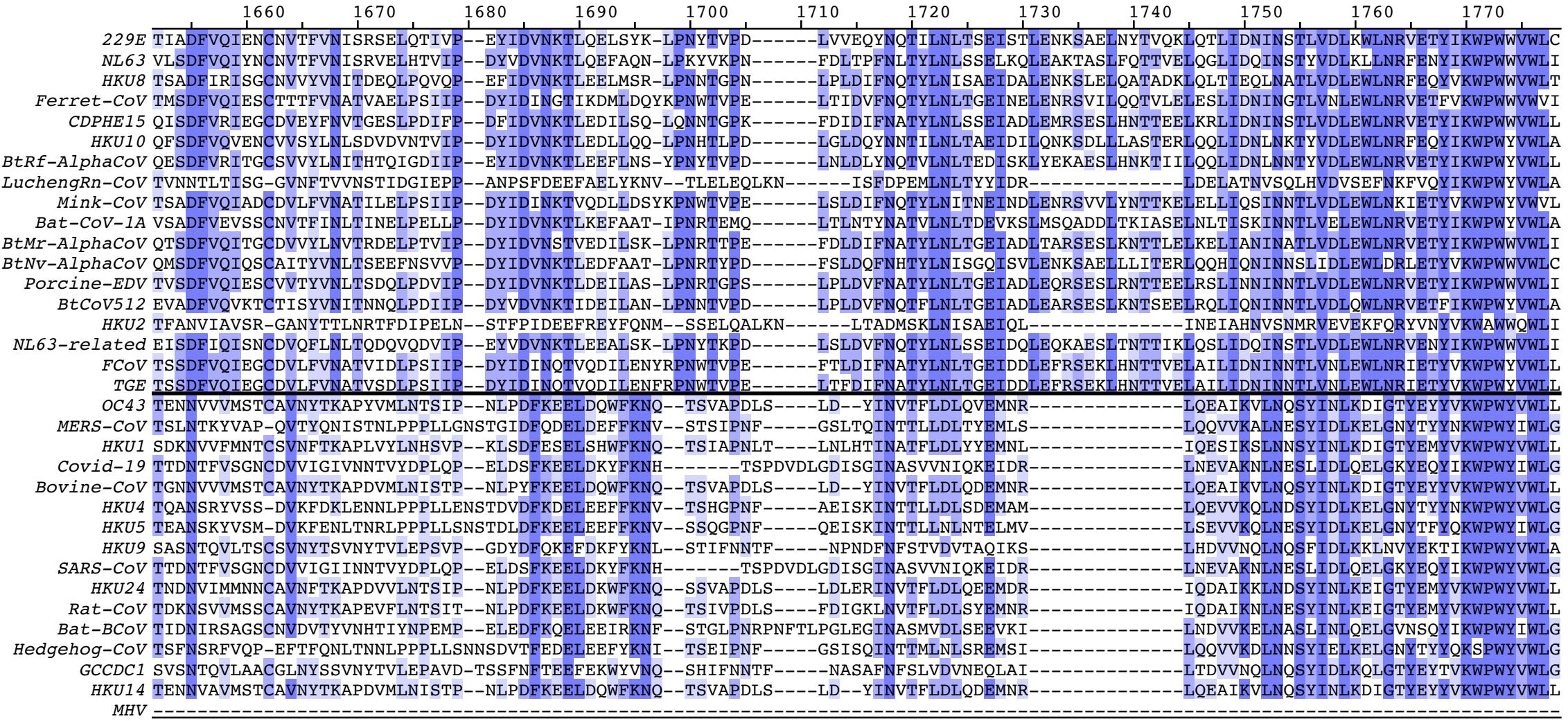
Hedgehog-CoV SLNAFVSQQLVRSEAAARSSQLAKEKINECVKAQSTRSGFCQ-GTHIVSFVINAPNGFYIHGVYHPQDYVNQTAAYGLCDSS--SSKCIAAKNGYFVKNDSD-----SDSWSYTGSSFYQPEPI

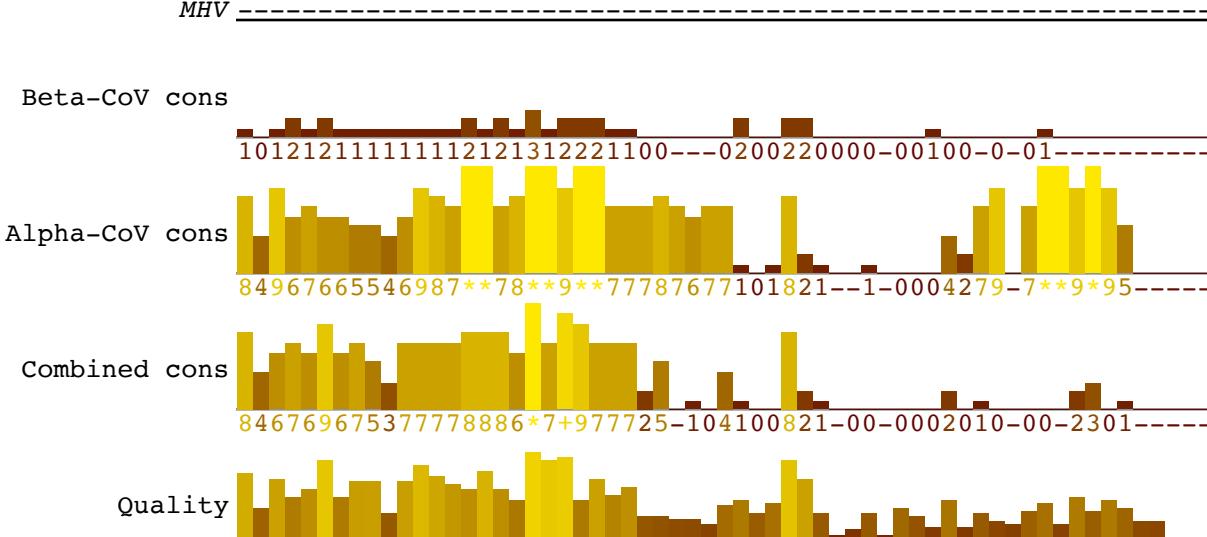
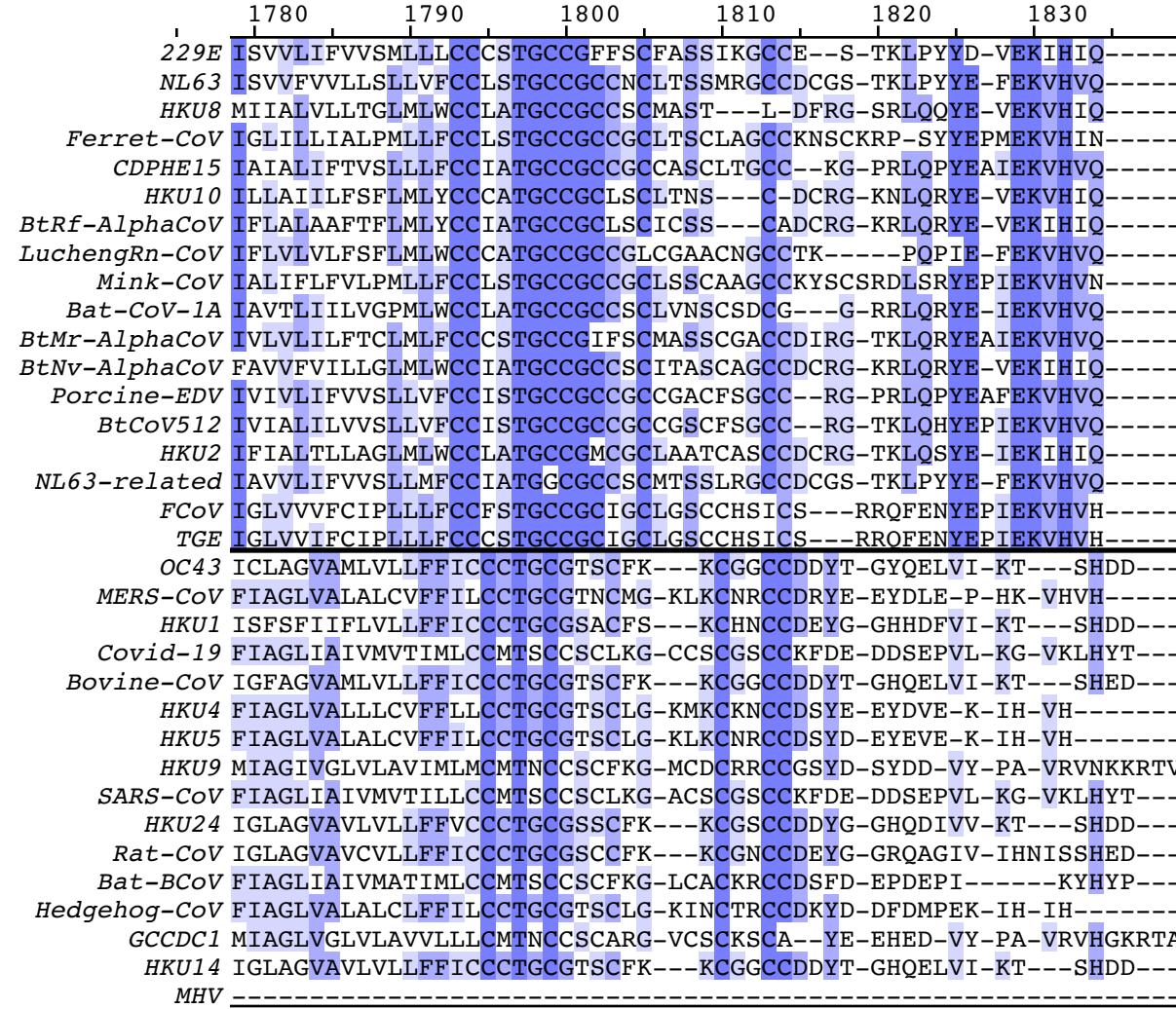
GCCDC1 VLNTYVTQLLIRASEVKAQALASQKISECVKAQSQRNDFCCN-GTHVLSIPQMAPNGVLFHYSYQPTAYNLVRTAAGLCFND-----TGYAPLGGFLVLPNNT-----DRWLFTKMSFYDPVNI

HKU14 ALNAYVSQQLSDSTLVKFSAAQAMEKVNECVKSQSRRINFCCN-GNHIIISLVQNAPYGLYFIHFVSYVPTKVTAKVSPGLCIA----DRGIAPKSGYFVN-----NTWMFTGSGYYYYPEPI

MHV -----



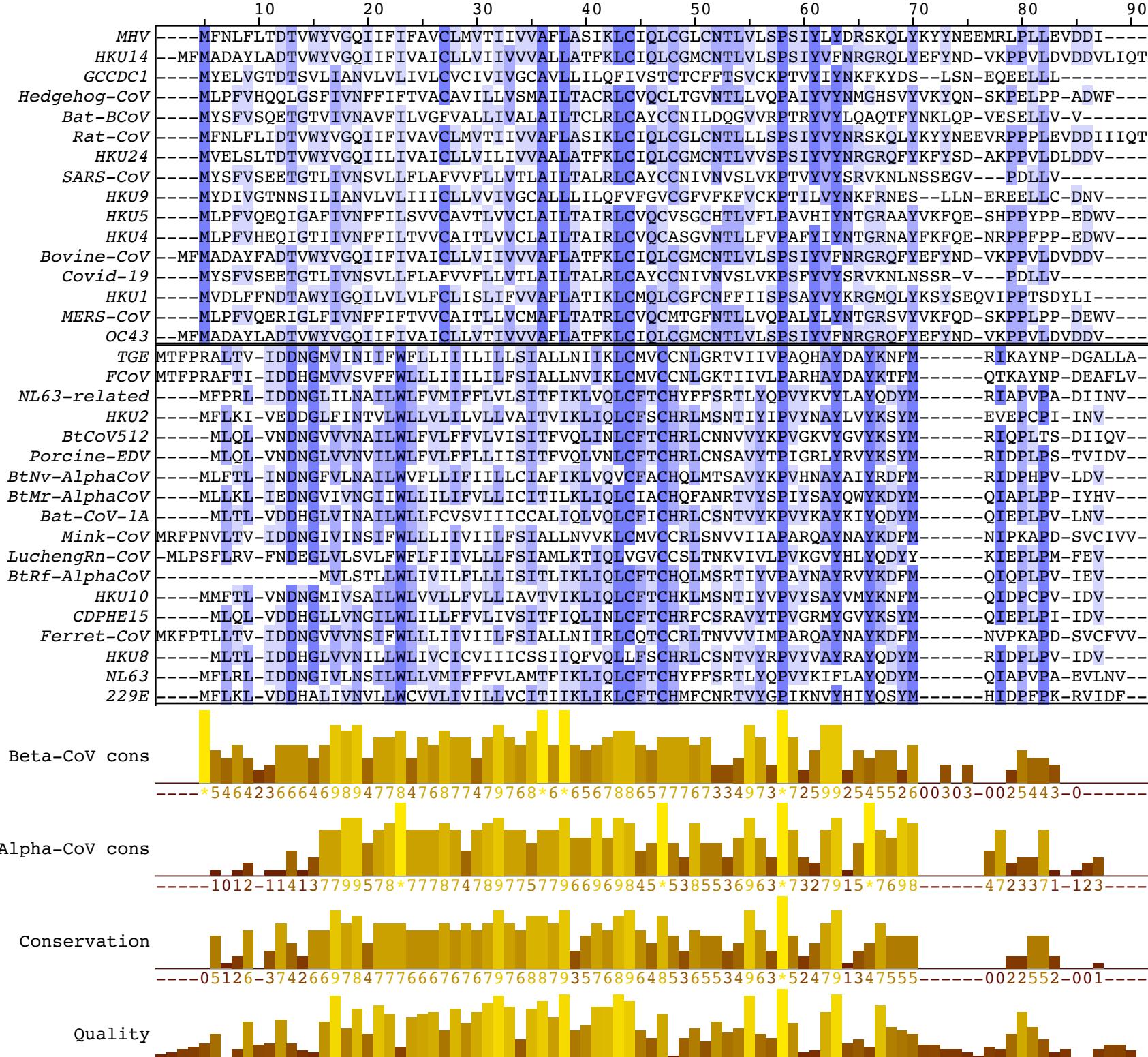




Envelope (E) protein

10 20 30 40 50 60 70 80

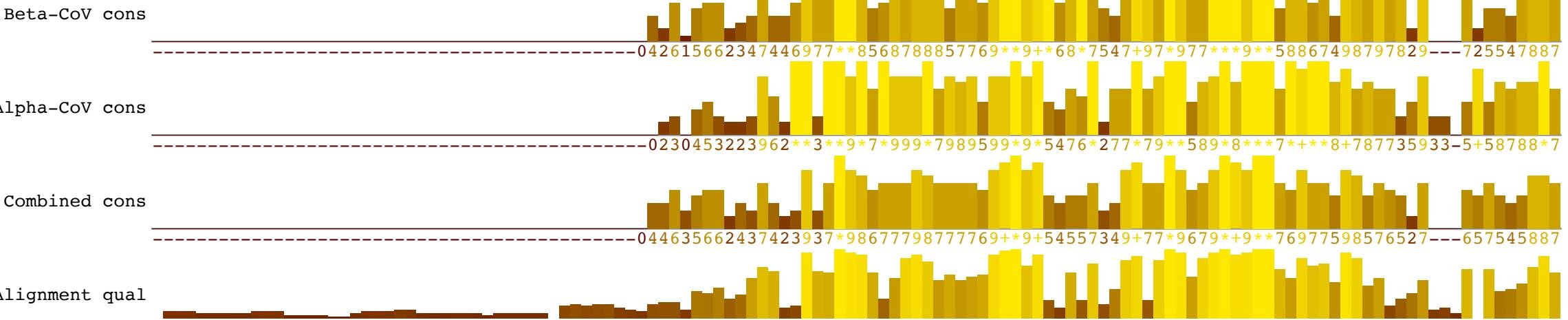
SARS-CoV-2	1 --MYSFVSEETGTLIVNSVLLFLAFVVFLLVTLAILTALRLCAYCCNIVNVSLVKPSFYVYYSRVKNLNSS--R-VPD----LLV-
SARS-CoV	1 --MYSFVSEETGTLIVNSVLLFLAFVVFLLVTLAILTALRLCAYCCNIVNVSLVKPTVYVYYSRVKNLNSS--EGVPD----LLV-
HKU1	1 --MVDLFFNDTAWYIGQILVLVLFLCLISLIFVVAFLATIKLCMQLCGFCNFFIISPSAYVYKRGMQLYKSYSSEQVIPPSTDYLI-
OC43	1 MFMADAYLADTVWYVGQIIIFIVAIICLLVTIVVVVAFLATFKLCIQLCGMCNTLVLSPSIYVFNRGRQFYEFYNDVKP-PVLDVDDV
MERS-CoV	1 --MLPFVQERIGLFIVNFFIFTVVCAITLLVCMAFLTATRLCVQCMTGFNTLLVQPALYLYNTGRSVYVKFQDSKPPLPPDEWV-
229E	1 --MFLKLV-DDHALIVNVLLWCVVLIVILLVCITIIIKLIKLCFTCHMFCNRTVYGPIKNVYHI----YQSYM HIDPFP-KRVIDF
NL63	1 --MFLRLI-DDNGIVLNSILWLLVMIFFFVLAMTFIKLIQLCFTCHYFFSRTLQYPVYKIFLA---YQDYMQIA PVP-AEV LNV



Membrane (M) Protein

	10	20	30	40	50	60	70	80	90	
<i>SARS-CoV-2</i>	1	-----MADSNGTITVEELKKLLEQWNLVIGFLFLTWICLLQFAYANRNRLFYI	I	KLIFLWLLWPVTLACFVLAAV	--YRINWITGGIAIAM					
<i>SARS-CoV</i>	1	-----MADNGTITVEELKQLLEQWNLVIGFLFLAWIMLLQFAYSNRNRLFYI	I	KLVFLWLLWPVTLACFVLAAV	--YRINWVTGGIAIAM					
<i>HKU1</i>	1	---MNKSFLPQFTSDQAVTFLKEWNFSLGVILLFITIIILQFGYTSRSRMFVYLIKMI	I	LWLMWPLTITLTIFNCF	--YALNNNAFLAFSIVF					
<i>OC43</i>	1	MSSKTPAPVYIWTADEAIKFLKEWNFSLGIIILLFITIIILQFGYTSRSRMFVYVIKMI	I	LWLMWPLTIILTIFNCV	--YALNNVYLGLSIVF					
<i>MERS-CoV</i>	1	-----MSNMTQLTEAQIIIAIKDWNFIAWSLIFLLLITIVLQYGPSRSMTVYVF	KMFVWLWLPSSMALSIFSAV	--YPIDLASQIISGIV						
<i>229E</i>	1	-----MSND-NCTGDIVTHLKNWNFGWNVILTI	FIVILQFGHYKYSRLFYGLKMLVWLWLPVLALSIFDTWANWDSNWAFVAFSFLM							
<i>NL63</i>	1	-----MSNSSVPLLEVYVHLRNWNFSWNL	ILTFLIVVLQYGHYKYSRLLYGLKMSVLWCLWPLVLALSIFDCFVNFDWVFFGFSILM							
	100	110	120	130	140	150	160	170	180	
<i>SARS-CoV-2</i>	85	ACLVGLMWLSYFIASFRLFARTRS	MWSFN	PETNILLNVPLHGTILTRP	PLESELVIGAVILRGHLRIAGHHLGRC	-DIKDLPKEITVATSR				
<i>SARS-CoV</i>	84	ACIVGLMWLSYFVASFRLFARTRS	MWSFN	PETNILLNVPLRG	TIVTRP	LMESELVIGAVIIRGHLRMAGHSLGRC	-DIKDLPKEITVATSR			
<i>HKU1</i>	86	TIISIVIWI	LYFVN	SIRLFIRTGS	WWSFNPETNNL	MCIDMKGKMFVRPVIEDYHTL	TATVIRGHL	YIQGVKLGTGYTLS	SDLPVYVTVAKVQ	
<i>OC43</i>	90	TIVAIIMWIVYFVN	SIRLFIRTGS	FWSFNPETNNL	MCIDMKGTMV	YRPIIEDYHTL	TVTII	IRGHL	YIQGIKLGTGYS	SLADLPAYMTVAKV
<i>MERS-CoV</i>	84	AAVSAMMWISYFVQ	SIRLFMRTGS	WWSFNPETNC	LLNVPGGGTTVVRPLVED	STSVTAVVTNGH	LKMAGMHFGAC	-DYDRLPNEV	TVAKPN	
<i>229E</i>	84	AVSTLVMWV	MYFANSFRL	FRRARTFWA	NPEVNAITVTTVL	GQTYQPIQQAPT	GITV	LLSGVLYVDGH	RLASGVQVHNLPEY	MVTAVPS
<i>NL63</i>	85	SIITLCLWV	MYFVN	SFRLWR	RVKTFWA	FPN	PETNAIISLQVYGH	NYLPVMAAPTGV	TLLSGVLLVDGH	KIATRVQVGQLPKYVIVATPS
	190	200	210	220	230					
<i>SARS-CoV-2</i>	175	TLSYYKLG	-ASQRVAGD	SGFAA	YSRYRIGNYKLNTDH	SSSSDNIALLVQ	--			
<i>SARS-CoV</i>	174	TLSYYKLG	-ASQRVGTD	SGFAA	YNRYRIGNYKLNTDH	AGSNDNIALLVQ	--			
<i>HKU1</i>	177	VLCTYKRA	-FLDKLDV	NSGF	AVFVKSKVGN	YRLPSS-KPSGMDT	ALLRA	--		
<i>OC43</i>	181	HLCTYKRG	-FLDRISDT	SGF	AVVVKSKVGN	YRLPSTQKGSGMDT	ALLRNNI			
<i>MERS-CoV</i>	174	VLIALKMV	-KRQSYGT	NSGVAIYHRY	KAGNYRSPPITA	--DIEL	ALLRA	--		
<i>229E</i>	175	TTI	YSRVGR	SVNSQN	STGWVFYVRV	KHGDFSAVSSPM	SNMTENER	LLHFF		
<i>NL63</i>	176	TTIVCDR	VGR	SVNETSQTG	WAFYVRA	KHGDFSGV	ASQEGVL	SEREK	LLHLI	

	10	20	30	40	50	60	70	80	90	100	110	120	
<i>MHV</i>				-M-S-T-T-Q-A-P-E-P-V-Y-Q-W-T-A-D-E-A-V-Q-F-L-K-E-W-N-F-S-L-G-I-I-L-L-F-I-T-T-I-L-Q-F-G-Y-T-S-R-S-M-F-I-Y-V-V-K-M-I-I-L-W-L-M-W-P-L-T-I-V-L-C-I-F-N-C-V-Y-A-L--								NNVYLGFSI	
<i>HKU14</i>				-M-S-S-T-T-P-A-P-V-Y-I-W-T-A-D-E-A-I-K-F-L-K-E-W-N-F-S-L-G-I-I-L-L-F-I-T-T-I-L-Q-F-G-Y-T-S-R-S-M-F-V-Y-V-I-K-M-I-I-L-W-L-M-W-P-L-T-I-I-L-T-I-F-N-C-V-Y-A-L--								NNVYLGFSI	
<i>GCCDC1</i>				-M-S-G-G-N-G-T-I-P-R-S-E-V-M-A-A-L-R-D-W-N-F-A-I-S-V-V-L-L-F-I-T-A-L-L-Q-W-G-Y-P-T-R-C-K-P-L-W-V-I-K-M-C-I-L-W-L-L-W-P-V-S-I-A-A-V-F-A-A-L-Y-P-I--								NDVAFGFAI	
<i>Hedgehog-CoV</i>				-M-S-N-D-T-L-S-Q-E-E-V-I-A-V-I-K-D-W-N-F-A-W-S-I-V-F-L-I-I-T-A-V-L-Q-Y-G-Y-P-S-R-S-M-T-A-Y-V-V-K-M-F-L-W-L-L-W-P-C-S-I-A-L-A-V-F-S-A-V-Y-P-I--								NLVSQIISG	
<i>Bat-BCoV</i>				-M-S-G-D-S-N-N-T-I-T-Q-E-E-L-F-K-V-V-K-E-W-N-F-A-L-G-I-M-L-F-I-F-I-T-L-L-Q-Y-A-Y-A-T-R-S-L-G-L-Y-I-L-K-L-V-L-W-L-M-W-P-L-T-F-A-C-F-V-L-A-A-I-Y-H-V--								NNVFMGFAI	
<i>Rat-CoV</i>				-M-S-S-T-T-S-A-P-Q-T-V-Y-Q-W-T-A-D-V-A-V-R-F-L-K-E-W-N-F-L-L-G-I-I-L-L-F-I-T-T-I-I-L-Q-F-G-Y-T-S-R-S-M-F-I-Y-V-V-K-M-I-I-L-W-L-M-W-P-L-T-I-V-L-C-I-F-N-C-V-Y-A-L--								NNVYLGFSI	
<i>HKU24</i>				-M-S-G-Q-A-T-T-P-E-P-I-Y-S-W-T-A-D-E-A-I-R-F-L-K-E-W-N-F-S-L-G-I-I-L-L-V-I-T-T-I-I-L-Q-F-G-Y-T-S-R-S-M-F-V-Y-V-I-K-M-I-I-L-W-L-M-W-P-L-T-I-I-L-V-I-F-N-C-V-Y-A-L--								NNVYLGFSI	
<i>SARS-CoV</i>				-M-A-D-N-G-T-I-T-V-E-E-L-K-Q-L-L-E-Q-W-N-L-V-I-G-F-L-F-L-A-W-I-M-L-L-Q-F-A-Y-S-N-R-N-F-L-Y-I-I-K-L-V-L-F-W-L-L-W-P-V-T-L-A-C-F-V-L-A-A-V-Y-R-I--								NWVTGGIAI	
<i>HKU9</i>				-M-S-N-N-C-T-N-T-V-P-R-P-E-V-I-A-A-L-K-D-W-N-F-A-V-S-V-I-L-L-F-I-T-V-L-L-Q-W-G-Y-P-S-R-C-K-P-I-W-V-I-K-M-F-L-I-L-W-L-L-W-P-L-S-I-A-A-V-F-A-A-I-H-P-I--								NSVAFGFAI	
<i>HKU5</i>				-M-A-S-S-N-V-T-L-S-N-D-E-V-L-R-L-V-K-D-W-N-F-T-W-S-V-V-F-L-L-I-T-I-V-L-Q-Y-G-Y-P-S-R-S-M-F-V-Y-V-I-K-M-F-V-L-W-L-W-P-A-S-M-A-L-S-I-F-C-A-V-Y-P-I--								DLASQIISG	
<i>HKU4</i>				-M-S-S-N-G-S-L-T-K-D-E-V-V-N-I-I-K-D-W-N-F-S-W-S-I-I-F-L-L-I-T-I-V-L-Q-Y-G-Y-P-S-R-S-M-M-V-Y-V-K-M-F-I-L-W-L-L-W-P-A-S-M-A-L-S-I-F-S-A-I-Y-P-I--								SLSSQIISG	
<i>Bovine-CoV</i>				-M-S-S-V-T-T-P-A-P-V-Y-T-W-T-A-D-E-A-I-K-F-L-K-E-W-N-F-S-L-G-I-I-L-L-F-I-T-V-I-L-Q-F-G-Y-T-S-R-S-M-F-V-Y-V-I-K-M-V-I-L-W-L-M-W-P-L-T-I-I-L-T-I-F-N-C-V-Y-A-L--								NNVYLGFSI	
<i>Covid-19</i>				-M-A-D-S-N-G-T-I-T-V-E-E-L-K-K-L-L-E-Q-W-N-L-V-I-G-F-L-F-L-T-W-I-C-L-L-Q-F-A-Y-A-N-R-N-F-L-Y-I-I-K-L-I-F-L-W-L-L-W-P-V-T-L-A-C-F-V-L-A-A-V-Y-R-I--								NWITGGIAI	
<i>HKU1</i>				-M-M-N-K-S-F-L-P-Q-F-T-S-Q-A-V-T-F-L-K-E-W-N-F-S-L-G-V-I-L-L-F-I-T-T-I-I-L-Q-F-G-Y-T-S-R-S-M-F-V-Y-L-I-K-M-I-I-L-W-L-M-W-P-L-T-I-T-L-T-I-F-N-C-F-Y-A-L--								NNAFLAFSI	
<i>MERS-CoV</i>				-M-S-N-M-T-Q-L-T-E-A-Q-I-I-A-I-K-D-W-N-F-A-W-S-L-I-F-L-L-I-T-I-V-L-Q-Y-G-Y-P-S-R-S-M-T-V-Y-V-F-K-M-F-V-L-W-L-L-W-P-S-S-M-A-L-S-I-F-S-A-V-Y-P-I--								DLASQIISG	
<i>OC43</i>				-M-S-S-K-T-T-P-A-P-V-Y-I-W-T-A-D-E-A-I-K-F-L-K-E-W-N-F-S-L-G-I-I-L-L-F-I-T-T-I-I-L-Q-F-G-Y-T-S-R-S-M-F-V-Y-V-I-K-M-I-I-L-W-L-M-W-P-L-T-I-I-L-T-I-F-N-C-V-Y-A-L--								NNVYLGFSI	
<i>TGE</i>	-M-K-I-L-L-I-L-A-C-V-I-	-A-C-A-C-G-E-R-Y-C-A-M-K-S-D-T-D-L-S-C-R-N-S-T-A-S-D-C-E-S-C-F-N-G-G-D-L-I-W-H-L-A-N-W-N-F-S-W-S-I-I-L-I-V-F-I-T-V-L-Q-Y-G-R-P-Q-F-S-W-F-V-Y-G-I-K-M-L-I-M-W-L-L-W-P-V-L-A-L-T-I-F-N-A-Y-Q-V-S-R-Y-V-M-F-G-F-S-I											
<i>FCoV</i>	-F-K-Y-I-L-L-I-L-A-C-I-I-	-A-C-V-Y-G-E-R-Y-C-A-M-Q-D-S-G-L-Q-C-I-N-G-T-N-S-R-C-Q-T-C-F-E-R-G-D-L-I-W-H-L-A-N-W-N-F-T-W-S-V-V-F-L-L-I-T-I-V-L-Q-Y-G-Y-P-S-R-S-M-F-V-Y-V-I-K-M-F-V-L-W-L-W-P-A-S-M-L-S-I-F-D-C-W-A-N-F-G-K-D-D-W-V-F-F-A-F-S-L											
<i>NL63-related</i>				-M-S-T-T-M-S-N-E-S-I-P-L-T-E-V-Y-E-H-L-R-N-W-N-F-S-W-S-V-I-L-I-V-F-I-T-V-L-Q-Y-G-R-P-Q-F-S-W-L-V-Y-G-I-K-M-L-I-M-W-L-L-W-P-V-M-L-A-L-S-I-F-D-C-W-A-N-F-G-K-D-D-W-V-F-F-A-F-S-L									
<i>HKU2</i>				-M-S-S-N-S-T-E-S-V-P-V-T-E-V-L-E-H-L-R-N-W-N-F-S-W-S-N-I-I-L-T-V-F-I-A-V-L-Q-Y-G-N-M-K-Y-S-F-F-L-Y-G-V-K-M-L-I-M-W-L-L-W-P-L-V-L-A-L-S-I-F-N-A-Y-A-D-F-G-V-N-N-W-W-F-F-S-F-S-I									
<i>BtCoV512</i>				-M-S-S-N-Q-S-V-P-V-E-E-V-I-K-H-L-R-N-W-N-F-S-W-S-N-I-I-L-T-I-L-L-V-L-L-Q-Y-G-H-Y-K-Y-S-R-V-L-Y-G-L-K-M-A-I-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-A-W-S-F-N-V-N-N-W-V-F-F-A-F-S-I									
<i>Porcine-EDV</i>				-M-S-N-G-S-I-P-V-D-E-V-I-E-H-L-R-N-W-N-F-T-W-N-I-I-L-T-I-L-L-V-L-L-Q-Y-G-H-Y-K-Y-S-V-F-L-Y-G-V-K-M-A-I-L-W-L-L-W-P-L-V-L-A-L-S-I-F-L-D-A-W-S-F-Q-V-N-N-W-V-F-F-A-F-S-I									
<i>BtNv-AlphaCoV</i>				-M-S-S-S-N-Q-T-I-P-V-T-E-V-V-E-H-L-R-N-W-N-F-A-W-N-V-I-L-T-V-L-L-V-L-L-Q-Y-G-N-F-K-Y-S-K-V-L-Y-G-L-K-M-I-V-L-W-V-L-W-P-T-V-L-A-L-S-I-F-N-A-W-A-E-F-N-V-N-N-W-V-M-F-S-F-S-I									
<i>BtMr-AlphaCoV</i>				-M-S-D-N-S-T-V-P-V-A-D-V-I-E-H-L-R-N-W-S-F-A-W-N-I-L-L-T-L-L-I-A-L-L-Q-Y-G-N-F-K-Y-S-K-L-L-Y-G-L-K-M-A-L-W-L-L-W-P-C-V-I-A-L-S-I-T-N-A-W-A-D-F-N-V-N-N-W-A-Y-F-G-I-S-I									
<i>Bat-CoV-1A</i>	-M-I-N-F-I-V-L-C-C-A-F-I-G-V-I--Y-A-D-N-G-D-	-N-T-T-A-V-T-P-T-L-P-P-Q-Q-I-P-L-K-E-V-M-E-H-L-R-N-W-N-F-S-W-N-I-V-L-T-V-F-L-I-V-M-Q-Y-G-H-F-K-Y-S-T-I-L-Y-G-L-K-M-L-I-V-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-A-W-S-T-F-G-Q-K-W-V-M-F-A-F-S-I											
<i>Mink-CoV</i>	-M-E-V-L-L-V-A-A-T-A-V-L-S-V-I-P-T-S-H-A-T-N-L-Y-C-L-M-N-T-T-S-V-A-N-N-T-C-Q-N-T-N-G-I-C-D-T-C-I-N-E-G-N-L-I-W-H-L-M-N-W-N-F-S-W-S-V-L-L-I-L-F-I-T-I-L-Q-Y-G-R-P-Q-V-S-W-F-I-Y-G-I-K-M-L-I-M-W-L-L-W-P-L-V-L-A-L-T-I-F-N-A-Y-E-T-S-Y-V-M-F-G-F-S-V												
<i>BtRf-AlphaCoV</i>				-M-S-N-N-S-T-V-P-V-E-V-V-E-H-L-R-N-W-N-F-S-W-N-V-V-L-T-V-F-L-L-V-L-L-Q-Y-G-Q-Y-K-Y-S-K-L-L-Y-G-L-K-M-L-I-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-S-W-A-S-F-G-V-N-N-W-V-F-F-A-F-S-I									
<i>HKU10</i>				-M-S-N-G-D-N-S-T-I-P-T-D-V-V-I-Q-H-L-R-N-W-N-F-S-W-N-V-I-L-T-I-F-L-V-L-L-Q-Y-G-H-Y-K-Y-S-A-V-A-L-Y-I-L-K-M-T-I-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-S-W-S-S-F-G-N-N-W-T-M-F-A-F-S-I									
<i>CDPHE15</i>				-M-A-N-G-S-V-S-E-E-I-I-H-H-L-R-N-W-N-F-G-W-N-I-I-L-T-I-F-I-V-V-L-Q-Y-G-Q-Y-K-Y-S-A-F-L-Y-G-L-K-M-L-V-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-A-Y-A-S-F-N-V-N-N-W-V-F-F-A-F-S-I									
<i>Ferret-CoV</i>	-M-I-E-I-V-L-L-V-C-S-A-I-A-A-M-V-P-T-T-A-A-S-G-N-R-Y-C-L-V-N-N-T-E-G-A-T-Q-N-C-S-	-I-N-D-C-I-D-E-G-S-L-I-W-H-L-M-N-W-S-F-S-W-S-V-V-L-I-V-F-I-A-I-L-Q-Y-G-R-P-Q-F-S-W-F-M-Y-G-V-K-M-L-I-M-W-L-L-W-P-L-V-L-A-L-T-I-F-N-A-Y-E-A-F-K-S-S-R-Y-V-M-F-G-F-S-V											
<i>LuchengRn-CoV</i>				-M-V-L-F-C-E-F-N-T-S-S-A-D-G-C-S-A-C-V-A-Q-G-C-T-G-A-G-V-T-S-A-I-T-W-H-L-L-N-W-N-F-S-W-S-V-I-L-T-V-F-V-S-V-L-Q-Y-G-N-L-K-Y-S-M-I-L-Y-I-L-K-M-I-I-M-W-L-L-W-P-I-V-I-A-L-T-I-F-D-A-I-E-T-F-K-Q-E-R-Y-V-M-F-G-F-S-I									
<i>HKU8</i>	-M-I-F-L-I-L-L-G-I-I-C-A-C-S-A-N-G-D-	-N-T-T-A-P-P-T-V-P-Q-S-I-P-V-E-Q-V-V-E-H-L-R-N-W-N-F-S-W-N-V-I-L-T-V-F-L-I-V-L-Q-Y-G-N-F-K-Y-S-K-L-L-Y-G-L-K-M-V-I-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-A-W-S-F-G-V-N-W-T-F-F-A-F-S-I											
<i>NL63</i>				-M-S-N-S-V-P-L-L-E-V-Y-V-H-L-R-N-W-N-F-S-W-N-L-I-L-T-L-F-I-V-V-L-Q-Y-G-H-Y-K-Y-S-R-L-L-Y-G-L-K-M-S-V-L-W-C-I-L-W-P-L-V-L-A-L-S-I-F-D-C-F-V-N-F-N-V-D-W-V-F-F-G-F-S-I									
<i>229E</i>				-M-S-N-D-N-C-T-G-D-I-V-T-H-L-K-N-W-N-F-G-W-N-V-I-L-T-I-F-I-V-I-L-Q-F-G-H-Y-K-Y-S-R-L-F-Y-G-L-K-M-L-V-L-W-L-L-W-P-L-V-L-A-L-S-I-F-D-T-W-A-N-W-D-S-N-W-A-F-V-A-F-S-F-I									



130 140 150 160 170 180 190 200 210 220 230 240 250

MHV VFTIVSIVIWMYFVNSIRLFIRTGSWSFNPETNNLMCIDMKGTVVYRPIIEDYHTLTATIIRGHLYMQGVKLGTSLSLDPAYVTVAKS~~H~~LCTYKR-AFLDKVDGVSGFAVYVSKVGNYRLPS

HKU14 VFTIVAIIMWIVYFVNSIRLFIRTGSWSFNPETNNLMCIDMKGRMYVRPIIEDYHTLTVTIIRGHLYIQGIKLGTGYSLSDLPAYVTVAKVTHLC~~T~~TYKR-GFLDRIGDTSGFAVYVSKVGNYRLPS

GCCDC1 TFACISSIMWL~~S~~YFISSFRLLCRTGPWSMPETNMLLN~~V~~PLIGRTVTRPILADSPAVQFLILRGDLRFEGFNLGQC-RPGEMPDTVTVAKAASLHWYKK-ALTRAIGKESAIIVYIKYKVG~~N~~HRVQ~~N~~

Hedgehog-CoV LLA~~A~~SVFMWLGYFLQSFR~~R~~RTGSWSFNPETNCLLN~~V~~PIGGTTVVRPLVEDSTS~~V~~TAVTNGYLKMAGMHFGQC-DYSRLPTEITVAKPNVLIA~~L~~KM-VKRQDYGVNSGV~~A~~IYHRYKAGNYRRPP

Bat-BCoV TFAIIVGCMWLGYWIASIRLF~~R~~RTGSWSFNPETNRLNVAIRGTMYTRPLQEDAVIVATVARGVAVFAGHKLGRA-DLES~~L~~PNEITVATSRTL~~S~~YFKM-SRKVNIGVGSGVAT~~L~~RYKVG~~N~~HRVPN

Rat-CoV VFTIVSIVMWIMYFVNSIRLFIRTGSWSFNPETNNLMCIDVKGTVVYRPIIEDYHTLTATNVRGHLYMQGVKLGTSLSLDPAYVTVAKVSHLC~~T~~TYKR-AFLDKVDGVSGFAVYVSKVGNYRLPS

HKU24 VFAIVSIIMWIVYFVNSIRLFIRTGSWSFNPETNNLMCIDMKGRMFVRPIIEDYHTLTVTIIRGHLYIQGIKLGTGYTLSDLPAYVTVAKVTHIC~~T~~TYKR-AFLDKIGDISGFAVYVSKVGNYRLPS

SARS-CoV AMACIVGLMW~~S~~YFVASFR~~L~~FARTRSMSFNPETNILLN~~V~~PLRG~~T~~IVTRPLMESELVIGAVIIRGHLRMAGHSLGRC-DIKDLPKEITVATSRTL~~S~~YYKL-GASQRVGTDSGFAAYNRYRIGNYKLNT

HKU9 AFACISGIMWL~~S~~YFISSFRLLCRTGSAWSMPETDMLINIP~~L~~LGRTVTRPIISDSPAVQFLIRGELRFDGFTL~~G~~RC-DPGDMPDIVTIARPNA~~L~~HWYKR-ALTRNMYTRSA~~I~~LYIKYKVG~~N~~HRVQ~~N~~

HKU5 ILAATSCAMWISYFVQSIRLFMRTGSWSFNPESNC~~L~~N~~V~~PIGGTTVVRPLVEDSTS~~V~~TAVT~~D~~G~~Y~~LKMAGMHFGAC-DFQRLPSEVTVAKP~~N~~V~~L~~IA~~L~~KM-IKRQAYGTNSGV~~A~~IYHRYKAGNYRRPP

HKU4 ILAAICAVMW~~L~~AYFVQSIRLFMRTGSWSFNPESNC~~L~~N~~V~~PIGGTTVVRPLVEDSTS~~V~~TAVVNDG~~H~~LKMAGMHFGRC-DYDRLPMEITVAKPSV~~L~~IA~~L~~KM-VKRQSYGTNSGV~~A~~IYHRYKAGNYRRPT

Bovine-CoV VFTIVAIIMWIVYFVNSIRLFIRTGSWSFNPETNNLMCIDMKGRMYVRPIIEDYHTLTVTIIRGHLYMQGIKLGTGYSLSDLPAYVTVAKVSHLLTYKR-GFLDKIGDTSGFAVYVSKVGNYRLPS

Covid-19 AMACLVGLMW~~S~~YFIASFR~~L~~FARTRSMSFNPETNILLN~~V~~PLHG~~T~~ILTRPLLESELVIGAVILRGHLRIAGHHL~~G~~RC-DIKDLPKEITVATSRTL~~S~~YYKL-GASQRVAGDSGFAAYSRYRIGNYKLNT

HKU1 VFTIISIVIWI~~L~~YFVNSIRLFIRTGSWSFNPETNNLMCIDMKGKMFVRPVIEDYHTLTATVIRGHLYIQG~~V~~KLG~~T~~GYTLSDLPVYVTVAKVQVL~~C~~TYKR-AFLDKLDVNSGFAVFKSKVGNYRLPS

MERS-CoV IVAAVSAMMWISYFVQSIRLFMRTGSWSFNPETNCLLN~~V~~PF~~G~~TTVVRPLVEDSTS~~V~~TAVTNGHLKMAGMHFGAC-DYDRLPNEVTVAKP~~N~~V~~L~~IA~~L~~KM-VKRQSYGTNSGV~~A~~IYHRYKAGNYRSP~~P~~

OC43 VFTIVAIIMWIVYFVNSIRLFIRTGSWSFNPETNNLMCIDMKGTMYVRPIIEDYHTLTVTIIRGHLYIQGIKLGTGYSLADLPAYMTVAKVTHLC~~T~~TYKR-GFLDRISDTSGFAVYVSKVGNYRLPS

TGE AGAIVTFVLUWIMYFVRSIQLYRRTKSWSFNPETKAILCVSALGRSYVLPLEGVPTGVTL~~T~~LLSGNLYAE~~G~~FKIAGGMNIDNL~~P~~KYVMVALPSRTIVYTLVGK~~K~~LKASSATGW~~A~~YYVSKKAGDYSTE~~A~~

FCoV AGAVVTFALWMMYFVRSVQLYRRTKSWSFNPETNA~~I~~LCVNALGRSYVLP~~L~~D~~G~~PTGVTL~~T~~LLSGNLYAE~~G~~FKMAGGLTIE~~H~~LPKYVM~~I~~ATPSRTIVYTLVGKQLKATTATGW~~A~~YYVSKKAGDYSTE~~A~~

NL63-related LMTIITLCLWIMYFVNSFKLYRRVKT~~W~~AFNPETNA~~I~~ISLQVYGHNYQPVMTAPTGVTL~~T~~LLSGV~~L~~IEGHKVAIRVQVQLPKY~~L~~IVATPRTT~~I~~YDRVGRSVNESSQTGWAFYVRSKHGDFSGIA

HKU2 LMLVITLVLWLMY~~I~~INSFKLYRRRTFWAFNPETDA~~I~~AVISVFGRSY~~S~~IPMPV~~V~~APT~~G~~ITLT~~I~~LSG~~T~~LF~~D~~GIRIATGVQPA~~H~~L~~P~~Q~~V~~TVAKPG~~T~~IIYTRAGRSLNASTNTGWAFYVRSKHG~~D~~Y~~S~~ALS

BtCoV512 LMACVTA~~V~~LWIMYFVNSIRLWRRTHSWWSYN~~P~~ETDS~~I~~LSV~~S~~VLGRVCL~~I~~LG~~A~~PTGV~~T~~LLNG~~T~~LLVE~~G~~YQVATGVQVNNL~~P~~GYVTVA~~K~~ASTT~~I~~YQRVGRSMN~~A~~STGWAFFVSK~~K~~HGDY~~Y~~AAA

Porcine-EDV LMACITLMLWIMYFVNSIRLWRRTHSWWSFNPETDALLTT~~S~~VMGRQVC~~I~~PVLG~~A~~PTGV~~T~~LLSG~~T~~LLVE~~G~~YKVATGVQVSQLPNFVTVA~~K~~ATT~~T~~IVYGRVGRSVNASSGTGWAFYVRSKHG~~D~~Y~~S~~AVS

BtNv-AlphaCoV IMACVTFVLUWIMYFVNSFKLYRRQT~~W~~AFNPETDA~~I~~ITLNVFGRTVA~~I~~PV~~I~~ATPT~~G~~ITLT~~V~~LN~~G~~Q~~L~~VE~~G~~YKVANGQVQ~~G~~QLPSY~~V~~TVAKP~~S~~TT~~I~~YQRVSRS~~I~~NR~~S~~NTGWAFFVRSKNGDF~~S~~ALA

BtMr-AlphaCoV FMLVVT~~L~~VLWIMYFVNSFR~~L~~YRR~~R~~TRSF~~W~~AFNPETDS~~I~~IVFSVY~~G~~TT~~S~~Y~~I~~PVIQAPQ~~G~~IT~~T~~VL~~S~~GT~~L~~LDG~~K~~IVATGV~~R~~IEALP~~Q~~Y~~V~~TVAKATT~~T~~IVFHRVGKAVNERTQ~~G~~WLFFVRS~~G~~Y~~D~~Y~~A~~HS

Bat-CoV-1A VMACT~~T~~VLWLMY~~F~~INSFR~~L~~YRR~~T~~Q~~S~~FWAFNPETDA~~I~~ITISVFG~~K~~TA~~V~~IPV~~L~~VP~~T~~GI~~T~~TV~~V~~LS~~G~~KL~~L~~VE~~G~~YQV~~A~~NG~~I~~T~~V~~GV~~Q~~LP~~E~~F~~V~~TV~~A~~K~~A~~T~~T~~TT~~I~~YR~~R~~AGR~~S~~LN~~A~~K~~T~~Q~~T~~GWAFYVRA~~K~~NGDY~~S~~AIM

Mink-CoV AGSVLT~~F~~VLUW~~M~~YFVRSIQLWRR~~T~~RT~~W~~SFNPETNA~~I~~LC~~L~~NAV~~C~~NR~~F~~VL~~P~~LN~~G~~APT~~G~~IT~~T~~LLSG~~N~~LYAE~~G~~FKVGS~~G~~V~~N~~EN~~L~~PKY~~I~~MV~~A~~TP~~G~~NT~~I~~IVYHQV~~G~~KS~~L~~KASSATGW~~S~~YYVRA~~K~~AGDYSTE~~A~~

BtRf-AlphaCoV LMSCITLVLWIMYFVNSFR~~L~~YRR~~R~~QT~~W~~AFNPETDA~~I~~ITLSVFG~~R~~Q~~V~~S~~I~~PT~~I~~V~~V~~PT~~G~~IT~~T~~VL~~S~~GT~~L~~LLVE~~G~~IKVATGV~~V~~Q~~S~~QL~~P~~TY~~L~~TVAKP~~F~~TT~~I~~YQRAGR~~S~~V~~N~~ARS~~N~~TGWAFFVRSKNGDY~~S~~AVS

HKU10 LMACITLVLWIMYFVNSFR~~L~~YRR~~R~~TF~~W~~AFNPETDA~~I~~ITLSVFG~~R~~Q~~V~~S~~I~~PA~~L~~V~~A~~PT~~G~~IT~~T~~VL~~S~~GT~~L~~LLVE~~G~~IKVATGV~~V~~Q~~N~~QL~~P~~TY~~I~~TVAKP~~F~~TT~~I~~YQRAGR~~S~~LN~~T~~RS~~N~~TGWAFFVRSKNGDY~~S~~AVT

CDPHE15 LMACV~~G~~T~~V~~LW~~M~~YFVNSIRLWRR~~T~~KS~~W~~AW~~S~~PETDT~~I~~LAT~~T~~VL~~G~~RT~~V~~Y~~L~~PL~~P~~A~~A~~PT~~G~~VT~~T~~LLNG~~T~~LLVE~~G~~FKVAV~~G~~V~~T~~VEL~~P~~DY~~V~~V~~V~~AKP~~H~~TT~~I~~YQRVGR~~S~~V~~N~~RS~~N~~TGWS~~F~~Y~~V~~K~~A~~Y~~G~~DY~~A~~TT~~G~~

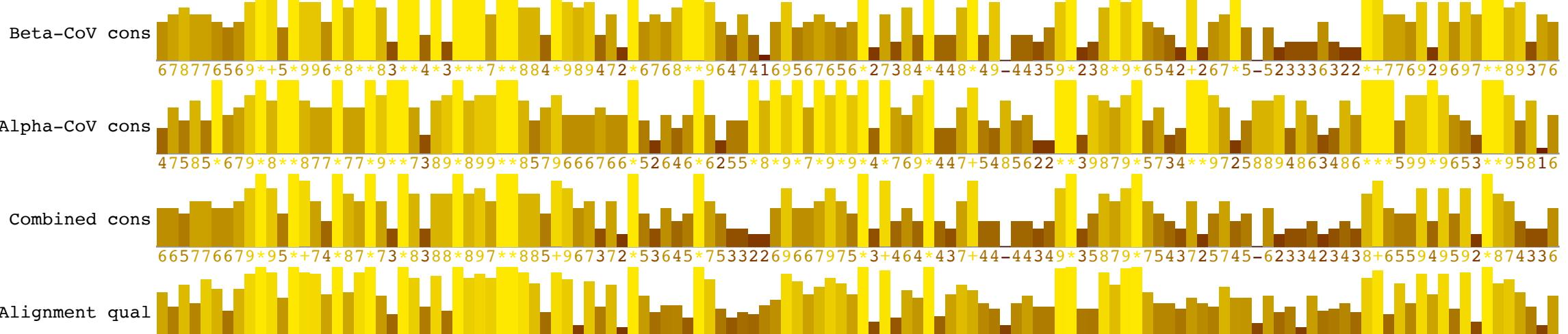
Ferret-CoV SGAMV~~T~~VL~~M~~WIMYF~~A~~RSIQLWRR~~T~~RT~~W~~SFNPETNA~~I~~LC~~L~~SSVG~~K~~RF~~V~~PL~~S~~GA~~P~~PT~~G~~VT~~T~~LLSG~~N~~LYAE~~G~~FKVGS~~G~~V~~N~~DN~~L~~PKY~~I~~MV~~A~~TP~~G~~NT~~I~~IVYHQV~~G~~KS~~L~~KASSATGW~~S~~YYVRA~~K~~AGDYSTE~~A~~

LuchengRn-CoV ALGVV~~T~~TL~~L~~WIMYFVNSFR~~L~~YRR~~R~~TC~~Q~~FWAFNPETDA~~I~~ITLSVFG~~K~~IV~~A~~IPV~~M~~PT~~P~~GI~~T~~LT~~I~~LS~~G~~KL~~L~~VE~~G~~YQV~~A~~NG~~I~~T~~V~~GV~~Q~~LP~~E~~F~~V~~TV~~A~~K~~A~~T~~T~~TT~~I~~YR~~R~~AGR~~S~~LN~~A~~K~~T~~Q~~T~~GWAFYVRA~~K~~NGDY~~S~~AIM

HKU8 VMACT~~T~~MLWIMYFVNSFR~~L~~YRR~~R~~RC~~Q~~FWAFNPETDA~~I~~ITLSVFG~~K~~IV~~A~~IPV~~M~~PT~~P~~GI~~T~~LT~~I~~LS~~G~~KL~~L~~VE~~G~~YQV~~A~~NG~~I~~T~~V~~GV~~Q~~LP~~E~~F~~V~~TV~~A~~K~~A~~T~~T~~TT~~I~~YR~~R~~GR~~S~~LN~~A~~AS~~Q~~TGWAFYVRA~~K~~NGDY~~S~~AVS

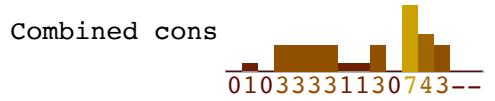
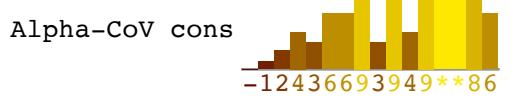
NL63 LMSIITLCLWIMYFVNSFR~~L~~W~~R~~RV~~K~~TF~~W~~AFNPETNA~~I~~ISLQVYGHNY~~Y~~LP~~V~~MA~~A~~PT~~G~~VT~~T~~LLSG~~V~~LL~~D~~G~~H~~K~~I~~AT~~R~~V~~Q~~G~~Q~~LP~~K~~Y~~V~~V~~I~~AT~~P~~ST~~T~~IVCDRVGR~~S~~V~~N~~ET~~S~~Q~~T~~GWAFYVRA~~K~~HGDF~~S~~GV~~A~~

229E LMAVST~~L~~VM~~V~~W~~M~~YF~~A~~NSFR~~L~~FR~~R~~ART~~W~~FW~~A~~W~~N~~PE~~V~~NA~~I~~TV~~T~~TV~~L~~G~~O~~TY~~Y~~OP~~I~~OO~~A~~PT~~G~~IT~~T~~VL~~S~~GT~~L~~LY~~D~~G~~H~~R~~L~~AS~~G~~VO~~H~~N~~L~~PE~~Y~~MT~~V~~AV~~P~~ST~~T~~IIY~~S~~RV~~G~~RS~~V~~NS~~O~~NTG~~W~~V~~F~~Y~~V~~RV~~V~~K~~H~~G~~D~~SA~~V~~



260 270

<i>MHV</i>	NK-PSGADTALLRT--
<i>HKU14</i>	TQKGTGMDTALLRNNI
<i>GCCDC1</i>	AREDGDTIAM-FIA--
<i>Hedgehog-CoV</i>	VVVDEEL-AL-LRA--
<i>Bat-BCoV</i>	ARASEDQEDLLVVS--
<i>Rat-CoV</i>	NK-PSGADTALLRI--
<i>HKU24</i>	SQKGNGMDTALLRNNV
<i>SARS-CoV</i>	DHAGSNDNIALLVQ--
<i>HKU9</i>	TTEDGDRLAM-FVA--
<i>HKU5</i>	IIQDQEL-AL-LRA--
<i>HKU4</i>	IIQDEEL-AL-LRA--
<i>Bovine-CoV</i>	TQKGSGLDTALLRNNI
<i>Covid-19</i>	DHSSSSDNIALLVQ--
<i>HKU1</i>	SK-PSGMDTALLRA--
<i>MERS-CoV</i>	ITADIEL-AL-LRA--
<i>OC43</i>	<u>TOKGSGMDTALLRNNI</u>
<i>TGE</i>	-RTDNLSEQEKLHLHV
<i>FCoV</i>	-RTDNLSEHEKLHLHV
<i>NL63-related</i>	SQENVLSEREKLLHLV
<i>HKU2</i>	NSSDNLTENDRLLHLV
<i>BtCoV512</i>	NPTEVVTDSEKILHLV
<i>Porcine-EDV</i>	NPSAVLTDSEKVHLV
<i>BtNv-AlphaCoV</i>	TDNETMTERERLLLHLV
<i>BtMr-AlphaCoV</i>	TGTGQMTESEKLLHIA
<i>Bat-CoV-1A</i>	TMADSFSENERLLLHLV
<i>Mink-CoV</i>	-RNDNLSEHEKLHLHV
<i>BtRf-AlphaCoV</i>	SHSDSMTEDERVHLHV
<i>HKU10</i>	SSADSLTEDEKLLHLV
<i>CDPHE15</i>	HSNDKVPDSEVVLLHLV
<i>Ferret-CoV</i>	-RHDLNLEHEKLHLHV
<i>LuchengRn-CoV</i>	-SGGSLSDQEQLLHLV
<i>HKU8</i>	NPSDSYTDTDRLLLHLV
<i>NL63</i>	SQEGVL SEREKLLHLI
<i>229E</i>	<u>SPMSNM TENERLLLHF</u>



Nucleocapsid (N) protein

10 20 30 40 50 60 70 80 90

SARS-CoV-2 1 MSD-NGPQ-NQ-----RNAPRITFGGPDSTGSNQNGERSGARSK-----QRRPQGLPNNTA**SWFTALTQHGK**-EDLKFPRGQGV
SARS-CoV 1 MSD-NGPQSNQ-----RSAPRITFGGPTDSTDNNQNQNGGRNGARPK-----QRRPQGLPNNTA**SWFTALTQHGK**-EELRFPRGQGV
HKU1 1 MSYTPGHYAGSRSSSGNRSGILKKTSWADQSERNYQTF---NRGRKTQPKFTVST--QPOQGNTIPHYSWFSGITQFQKGRDFKFSDGQGV
OC43 1 **MSFTPQKQSSSRASSGNRSGNG**-ILKWADQSDQFRNVQ---TRGRRAQPKQTATSQOPSGGNVPYYSWFSGITQFQKGKEFEFVEGQGV
MERS-CoV 1 -----MASP-----AAPRAVSFADNNNDITNTN-----LSRGRGR-----NPKPRAAPNNTVSWYTGLTQHGK-VPLTFPPGQGV
229E 1 -----MATVKWADASEPQ-----RGRQ-----GRIPYSLYSPLLVDS-EQPWKVIPRNLV
NL63 1 -----MASVNWADDRAA-----RK-----KFPPPSFYMPPLLVSSEDKAPYRVIPRNLV

100 110 120 130 140 150 160 170 180

SARS-CoV-2 73 PINTNSSPDDQI**G**YRRATRR-IRGGD**G**KMKDLSPRWFYLLGTGP**E**AGLPYGANKD**G**IIVVATEGALNTPKD**H**IGTRNPANNAIAVLQLP
SARS-CoV 74 PINTNSGPDDQI**G**YRRATRR-VRGGDG**G**KMKELSPRWFYLLGTGP**E**ASLPYGANKEGIVVVATEGALNTPKD**H**IGTRNPNNNAATVQLLP
HKU1 86 PIAFGVPPSEAKGYWYRH**R**HSRRSF**K**TAD**Q**QQ**K**OLL**P**RWFYLLGTGP**E**ANASYGESLEG**V**FVANHQADTSTPSDVSSRDPTTQEAIPTRF**P**
OC43 87 PIAPGVPA**T**EAKGYWYRH**R**NSRF**K**TAD**Q**NQR**Q**LL**P**RWFYLLGTGP**E**AKD**Q**Y**G**TID**D**G**V**W**A**SNQ**Q**AD**V**NT**P**AD**I**VD**R**DP**S**DEAIPTRF**P**
MERS-CoV 64 ELNANSTPAQNAGYWR**R**QDR**K**-INT**G**NG-**I**K**Q**LAPRWY**F**YY**T**TGTGP**E**AA**L**PFRAV**K**D**G**IV**V**V**H**EDGAT**D**APS-TF**G**TRNPNN**D**SAIV**T**QFA
229E 45 PVNKKD-KNKLIGYWNV**Q**KR--FRTRKG**K**RVD**L**SP**K**LHFYLLGTGP**H**KDAFK**R**ERVE**G**V**V**V**A**VG**A**KT**E**PT-GY**G**V**R**R**K**N**S**EP**E**IP**H**-F-
NL63 43 PI**G**KGN-K**D**E**Q**I**G**Y**W**N**V**Q**E**R-WRM**R**R**C**QR**V**D**I**PP**K**V**H**Y**F**Y**Y**LLGTGP**H**K**D**L**K**F**R**Q**R****S**D**G**V**V**W**V**A**K**E**G**A**K**T**V**N**T**-SL**G**N**R**K**R**N**Q**K**P**LE**P****K**-F-

190 200 210 220 230 240 250 260 270

SARS-CoV-2 163 QGTTLPKG**F**YAE**G**SRGG**S**QASS**R**SS--RSRNSSRN**N**STPGSSRG-TSPARMA-----GNGGDAALALLLDRLNQLES**K**-MSG**K**G--Q-Q
SARS-CoV 164 QGTTLPKG**F**YAE**G**SRGG**S**QASS**R**SS--RSRGNSRN**N**STPGSSRG-NSPARMA-----SGGETALALLLDRLNQLES**K**-VSG**K**G--Q-Q
HKU1 177 PGT**I**LP**Q**Y**Y**VEG**S**GR**S**ASN-SRP-----GSRSQS**R**GPNNR**S**LS**R**S**N**FR**R**HS-----DSIV**K**P**D**MADE**I**ANL-VLA**K**LG**K**D-S
OC43 178 PGT**V**LP**Q**Y**Y**IE**G**SG**R**SAP**N**-SRS-----TSRT**S**RASSAG**S**RS**R**AN**S**GN**R**TP-----TSG**V**TP**D**MAD**Q**I**A**SL-VLA**K**LG**K**D-A
MERS-CoV 152 PGT**K**LP**K**N**F**H**I**E**G**GG**N**S**Q**SS**R**ASS--LSRNSSR**S**SS**S**Q**G**SR**S**G-NSTRGTS--PGPS**G**IGAV**G**DD**L**Y**L**LD**L**LN**R**Q**A**LF-ES**G**K**V**--K-Q
229E 130 -NQ**K**LP**N**G**V**T**V**A**E**EP**D**SR-----APS**R**S**Q**SR**S**Q**R**SR**V**ES**K**QS-RNPSSDRNH**N**SQ**D**IM**K**A**V**A**A**ALK**S**LG**F**D**K**P**Q**E**K**D**K**SA**K**T**G**TP**K**P
NL63 128 -SIAL**P**PELS**V**VE**F**ED**R**SN**N**NS**R**ASS**R**S**S**TR**N**NS**R**DS**R**ST**S**R**Q**-QSRT**R**SD**S**N**Q**SS**D**L**V**A**V**TL**K**N**L**GF**D**N**Q**SK**S**PS**S**SS--GT**S**TP

280 290 300 310 320 330 340 350 360

SARS-CoV-2 241 Q**O**Q**G**OT-V**T**K-----KSAA-----EASK**K**P**Q**K**R**T**A**T**K**A--Y**N**V**T**Q**A**F**G**R**R**PE**Q**T**Q**GN**F**G**D**Q**E**LI**I**Q**G**T**D**Y**K**W**P**Q**I**A**Q**F**A**P**S**A**S**
SARS-CoV 242 Q**O**Q**G**OT-V**T**K-----KSAA-----EASK**K**P**Q**K**R**T**A**T**K**Q--Y**N**V**T**Q**A**F**G**R**R**PE**Q**T**Q**GN**F**G**D**Q**D**LI**I**Q**G**T**D**Y**K**W**P**Q**I**A**Q**F**A**P**S**A**S**
HKU1 248 -K**P**Q**Q**-V**T**K-----Q**N**AK**E**IR**H**K**I**L**T**K**P**Q**K**R**T**P**N**KH--CNV**Q**Q**C**FG**K**R**G**PS**Q**--NFG**N**AE**M**KL**G**T**D**P**Q**F**P**I**L**A**E**L**A**P**T****P****G**
OC43 249 T**K**P**Q**Q-V**T**K-----HT**A**KE**V**R**Q**K**I**L**N**K**P**Q**K**R**T**P**N**K**Q**--CTV**Q**Q**C**FG**K**R**G**PN**Q**--NFG**G**GE**M**KL**G**T**D**P**Q**F**P**I**L**A**E**L**A**P**T****A**
MERS-CoV 233 S**Q**P**K**V-I**T**K-----K**D**AA-----AA**K**N**K**M**R**H**K**R**T****S**T**K**S--F**N**M**V**Q**A**F**G**L**R****G**P**G**D**L**Q**G**N**F**G**D**I**Q**LN**K**L**G**T**D**P**R**W**P**Q**I**A**E**L**A**P**T****A**
229E 214 SRN**O**SP**A**SSQ**S**AA**K**I**L**AR**S**Q**S**SET**K**EQ**Q**HE**M**Q**K**P**R**W**K**R**Q**P**N**D**V**T**S**N**V**T**Q**C**F**G**P**R**L**D**H**--NFG**S**AG**V**V**A**NC**V**K**A**G**Y**P**Q**F**A**E**L**V**P****S****T****A**
NL63 214 K**K**PN**K**P**L**-----SQ**P**R**A**D**K**P**SQL**KK**P**R**W**K**V**P**T****R**E--ENV**I**Q**C**FG**P**R**D****F**N**H**--NM**G**D**S**DL**V**Q**N**CV**D**AK**G**F**P**Q**L**A**E**L**I**P**N**Q**A**

370 380 390 400 410 420 430 440 450

SARS-CoV-2 314 F**F**G**M**S**R**I**G**M**E**V**T**P-----SGT**W**L**T**Y**T**G**A**I**K**L**D**D**K**D**P**N**F**K**D**Q**V**I**I**L**N**K**H**I**D**AY**K**T**F**P**P**T**E**P**K**D**KK**K**K****A**D--ET**Q**AL**P**Q**R**Q-----
SARS-CoV 315 F**F**G**M**S**R**I**G**M**E**V**T**P-----SGT**W**L**T**Y**H**G**A**I**K**L**D**D**K**D**P**Q**F**K**D**N**V**I*I***L**N**K**H**I**D**AY**K**T**F**P**P**T**E**P**K**D**KK**K**K**T**D--EA**Q**PL**P**Q**R**Q-----
HKU1 321 FFFF**G**SK**L**DL**V**K**R**D---SEAD**S**P**V**K**D**V**F**E**L**HY**S**GS**I**R**F**D**S**T**L**P**F**E**T****I**M**V****L**E**E**N**L**N**A**Y**V**N**S**Q-----NTD**S**DSL**S**K**P**Q**R**K**G**V**K**
OC43 323 FFFF**G**SR**L**E**L**A**K**V**Q**N**L**S**G**N**P**D**E**P**Q**K**D**V**Y**E**L**R**Y**N**G**A**I**R**F**D**S**T**L**S**G**F**E**T**I**M**V****L**N**E**N**L**N**A**Y**Q**Q**D**G-----MMN**M**S**P**K**P**Q**R**Q**R**G**H**K
MERS-CoV 306 FM**G**MS**Q**F**K**L**T****H**Q**N**---NDD**H**GN**P**V**Y**F**L**R**Y**S**G**A**I**K**L**D**P**K**N**P**N**Y**N**K**W**L**E**Q**N**I**D**AY**K**T**F**P**K**E**K**K**Q**K**A**P**K**E**E**STD**Q**M**S****E**P**P****K**E**Q**R**V****G**
229E 302 M**L**F**D**SH**I**V**S**K**E**G-----NTV**V**L**T**F**T**TR**V**T**V**K**D**H**H**LG**K**F**L**E---LNA**F**T**R**E**M**QQ**Q**P**L**N**P**-----SA**L**E**F**N-----
NL63 287 L**F**F**D**SE**V**S**T**D**E**V**G**-----DN**V**Q**I**T**Y**K**M**L**V**A**K**D**N**K**N**L**P****K**I**E**Q---IS**A**F**T**K**P**S**S**I**K**E**M**Q**S**Q-----SSH**V**A-----

460 470 480 490 500

SARS-CoV-2 387 -----KK**Q**QT-----VT**L**PA**A**D**D**FS**K**Q**L**Q**Q**S**M**S**S**A**D****S**T**Q**A-----
SARS-CoV 388 -----KK**Q**P**T**-----VT**L**PA**A**D**M**DD**F**SR**Q**L**Q**N**S**MSG**A**S**A**D**S**T**Q**A-----
HKU1 400 L**P**E**Q**F**D**SL**N**LS**A**---GT**Q**H**I**S**N**D**F**T**P**E**D**HS**L**LA**T**LL**D**P**V**E**D**S**V**A-----
OC43 402 G**Q**G**E**D**N**I**S**V**A**V**P**K**S**R**V**Q**Q**N**K**S**R**E**L**T**A**E**D**I**S**LL**K**K**M**D**E**P**T**E**D**T**S****E**I
MERS-CoV 392 I**T**Q**R**T**R**TR**P**S-----V**Q**P**G**P**M**I**D**V**N**T-----
229E 363 -----P---S**Q**T**S**P-----AT**V**E**P**V**R**D**E**V**S**I**E**T**D**I**I**D**E**V**N**-----
NL63 348 -----NT**V**LN**A**S**I**-----P**E**S**K**P**L**ADD**S**A**I**I**E**I**V**N**E**V**L**H-----

10 20 30 40 50 60 70 80 90 100 110 120

MHV MSFVPGQENAGGRSSSVN RAGNGILKTTW-----ADQT-----ERGPNNQNRGR-RNQPKQTATT-QPNNSGVVPHYSWFSGITQFQKGKEFQFAEGQGVPIAPGVATEAKGYWYRHNR
HKU14 MSFTPQKQP-SSRASSGNRAGNGILK---W-----ADQS-----EQSRNIQTRGR-RAQPKQTQVTSQQPTGGNVVPPYSWFSGITQFQKGKEFEAEGQGVPIAPGVATEAKGYWYRHRSRR
GCCDC1 MSGR-----NT-PKGRQ-----TP-KVSFKQESDSDSE-ADRHTTRNGARPKT--NNGP-ATIKPEK-----PRAAPMQNVSWFAPLVQTGK-SDLKFAHGEQGPVQGDGTYQHGYWLRTQ-R
Hedgehog-CoV MAT-----PQ-----QPRAVTF-----ADNN-----GNQQN-----GNN-RGRPRQPK-----PRPAPNVSWSWYTGITQHGK-QPLAFPAQGVPLNANSTPKQNAGYWRROD-R
Bat-BCoV MAA-----E-----GQ-RVTFLTQGSQNQNN-----NNQEN-----QDGR-GARPKTRK-----PRPAPQNNVSWFTPLTQHGK-QALTFNPQGVPLNANDDPSRIGYWRRI-R
Rat-CoV MSFVPGQENAGSRSSSGNRAGNGILKTTW-----ADQT-----ERGQNNQNRGR-RNQPKQTATT-QPNTGSVVPHYSWFSGITQFQKGKEFQFAGQQGVPIANGIPSSQEKGWYRHNR
HKU24 MSHTPGKAG-S-RSSSGNR-NGGILK---W-----ADQT-----EP-NNVNSRGR-RAQPKQTANT-QASGGNVVPPYSWFSGITQFQKGQEFQFEGQGVPLTNGVPPSEEKGWYRHNR
SARS-CoV MSDN-----GPQSNQRS-----AP-RITF-GGPTDST-----DNNQN-----GGRN-GARPQKR-----PQGLPNNTASWFTALTQHGK-EELRFPRQGVPIINTNSGPDDQIGYRRAT-R
HKU9 MSGR-----NRSRSQTP-----SP-KVTFKQESDGSDSEERRNGNRNGARPKN-----NNSR-GSAPKPEK-----PKAAPPQNVSWFAPLVQTGK-AELRFPRGEQGPVQGDSTYEHGYWLRTQ-R
HKU5 MAT-----PA-----PPRAVVF-----ADNN-----ETPTN-----SQR-SGR-PRTK-----PRPAPNTTVSWFTGLTQHGK-QPLAFPPQGVPLNANSTPAQNAGYWRROD-R
HKU4 MAT-----PA-----APRTISF-----ADNN-----DNQPN-----QQO-RGRGRNP-----PRPAPNNTVSWYTGLTQHGK-NPLAFPPQGVPLNANSTTAQNAGYWRROD-R
Bovine-CoV MSFTPQKQS-SSRASSGNRSGNGILK---W-----ADQS-----DQSRNVQTRGR-RAQPKQTATSQQPSGGNVVPPYSWFSGITQFQKGKEFEAEGQGVPIAPGVATEAKGYWYRHNR
Covid-19 MSDN-----GPQ-NQRN-----AP-RITF-GGPTDST-----GSNQN-----GERS-GARSKQRR-----PQGLPNNTASWFTALTQHGK-EDLKFPQGVPIINTNSPDDQIGYRRAT-R
HKU1 MSYTPGHYA-GSRSSSGNR-SGILKKT SW-----ADQS-----ERNYQTFNRGR-KTOPKFTVSTQ-----PQGNTIPHYSWFSGITQFQKGRDFKFSDQGVPIAFGVPPSEAKGYWYRHRSRR
MERS-CoV MAS-----PA-----APRAVSF-----ADNN-----DITNT-----NLS-RGRGRNP-----PRAAPNNTVSWYTGLTQHGK-VPLTFFQGVPLNANSTPAQNAGYWRROD-R
OC43 MSFTPQKOS-SSRASSGNRSGNGILK---W-----ADQS-----DOFRNVOTRGR-RAOPKOTATSOOPSGGNVVPYYSWFSGITOFQKGKEFEFVEGOGVPIAPGVATEAKGYWYRHNR
TGE MAN-----QGQRVSW-----GDES-----T-K-----TRGRSNSRGRKN-----NNIPLSFFNPITLQQGSKFWNLCPDFVPKGIGN-RDQQIGYWNRQ-T
FCoV MAT-----QGQRVN -----GDEP-----S-K-----RRGRSNSRGRKN-----NDIPLSFYNPITLEQGSKFWNLCPDLVPKGIGN-KDQQIGYWNRQ-I
NL63-related -----MATVN -----AD-----D-KRGK-----R-----KYPPPSFYLPPLVVKSDQPYKVI PRNLVPKGKGN-KDQQIGYWNVQ-R
HKU2 -----MATVN -----GDAV-----EQAE-----SRG-----R-----KRIPLSLFAPLRVTDGKNFNWNVMPRNGVPTGRGN-PDQQIGYWEQK
BtCoV512 -----MASVKF-----QP-----RGR-----SK-----GRVPLSLFAPLRVTDEKPLYKVLPPNAVPQGMGG-KDQQIGYWEQ-Q
Porcine-EDV -----MASVSF-----QD-----RGR-----KRVPLSLYAPLRVTNDKPLSKVLANNAVPTNKGN-KDQQIGYWNNEQ-I
BtNv-AlphaCoV MSS-----SKGNVGF-----DN-----A-ARGR-----S-----GRVPFSFYMPVINNSSQPFYKVMQNAVPKGQGN-KDQQIGYWNNEQ-V
BtMr-AlphaCoV -----MSSVKF-----EA-----SGR-----T-----GRTPLSFFAPLTVSSDKFVNVLPKNAVPTGKGN-AKQQVGYWNNEQ-P
Bat-CoV-1A -----MASVQF-----EDT-----N-SRGR-----S-----GRIPLSYYAPLRVADDKFLKSMPGNGVPKGGMG-KAEQIGYWT EQR
Mink-CoV MAG-----NGNRVN -----GDEP-----SPSQ-----NRGRSRSRSRKN-----ENIPLSFFNPITHGNKKFWNVAPKDLVPKGKGN-RDQQVGYWNRQ-E
LuchengRn-CoV -----MSSNVSW-----ADQV-----ETVN-----RRQRSRSRGRSO-----NRTNASNPLSWFTSIIDESNGFISLMPHSGVPTGMGT-AAQQCGYWYRAP-T
BtRf-AlphaCoV -----MASVSF-----QE-----E-KRGR-----S-----GKVPLSYYNPIVSGDKFWKVMPPNAVPKGKGN-KDQQIGYWNNEQ-P
HKU10 MAS-----GGNNVSF-----AN-----K-PRGR-----S-----GKVPLSYYSPVMIDGDQFWKVMPTNAVPTGMGD-KNQQIGYWNNEQ-P
CDPHE15 -----MASVKF-----AK-----NNR-----R-----GRMEYSYFAPLIINSDQPIWKVLPPNAVPVGKGG-KDEQIGYWNNEQ-P
Ferret-CoV MAG-----NGQRVN -----GDEP-----VPSQ-----KRGRSRSRSRRN-----ADIPLSYFNPITHEGKKSFWTVAPKDFVPIKGKGN-KDQQVGYWNRQ-Q
HKU8 -----MASVSF-----SD-----E-PRGR-----S-----GRVPLSLFAPLRTTDGSLFFRAMPQNGVPKGFGN-KDQQVGYWNNEQ-V
NL63 -----MASVNW-----AD-----D-RAAR-----K-----KFPPPSFYMPLLVSSDKAPYRVI PRNLVPIGKGN-KDEQIGYWNVQ-E
229E -----MATVKW-----ADAS-----E-P-QRGR-----O-----GRIPYSLYSPLLVDSEQ-PWKVIPRNLLVPVNKKD-KNKLIGYWNVOK--

