





December 2019

November 2020

May 2021

- **Three independent emergences of N501Y lineages (alpha, beta, gamma).**

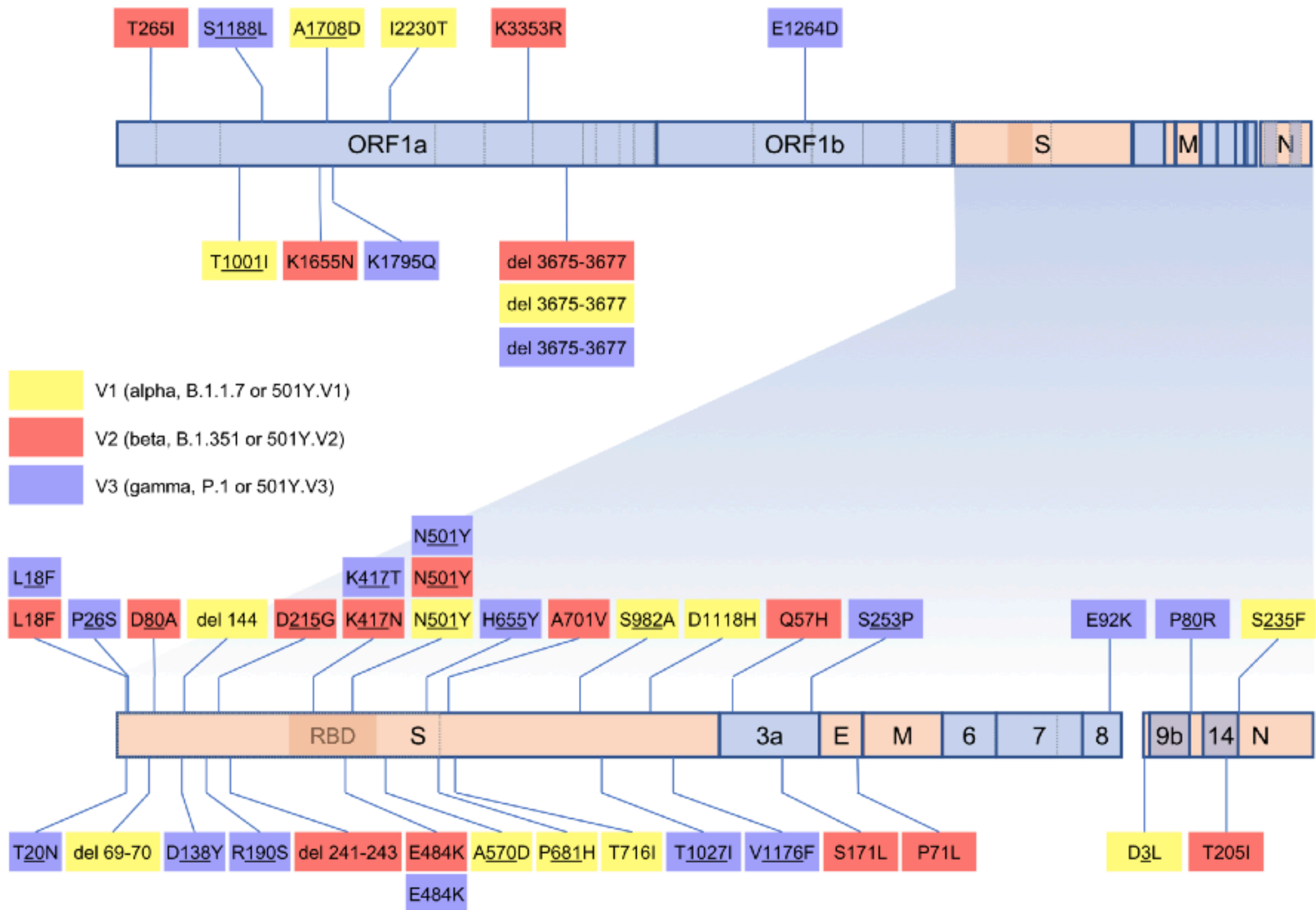
- Striking patterns of shared changes.

- Set out to perform detailed analyses of >2M GISAID sequences to identify where and how convergent evolution may be operating.



Martinez, 2021, Cell 184, 5189–5200 The emerging evolution of the SARS-CoV-2 N501Y lineage





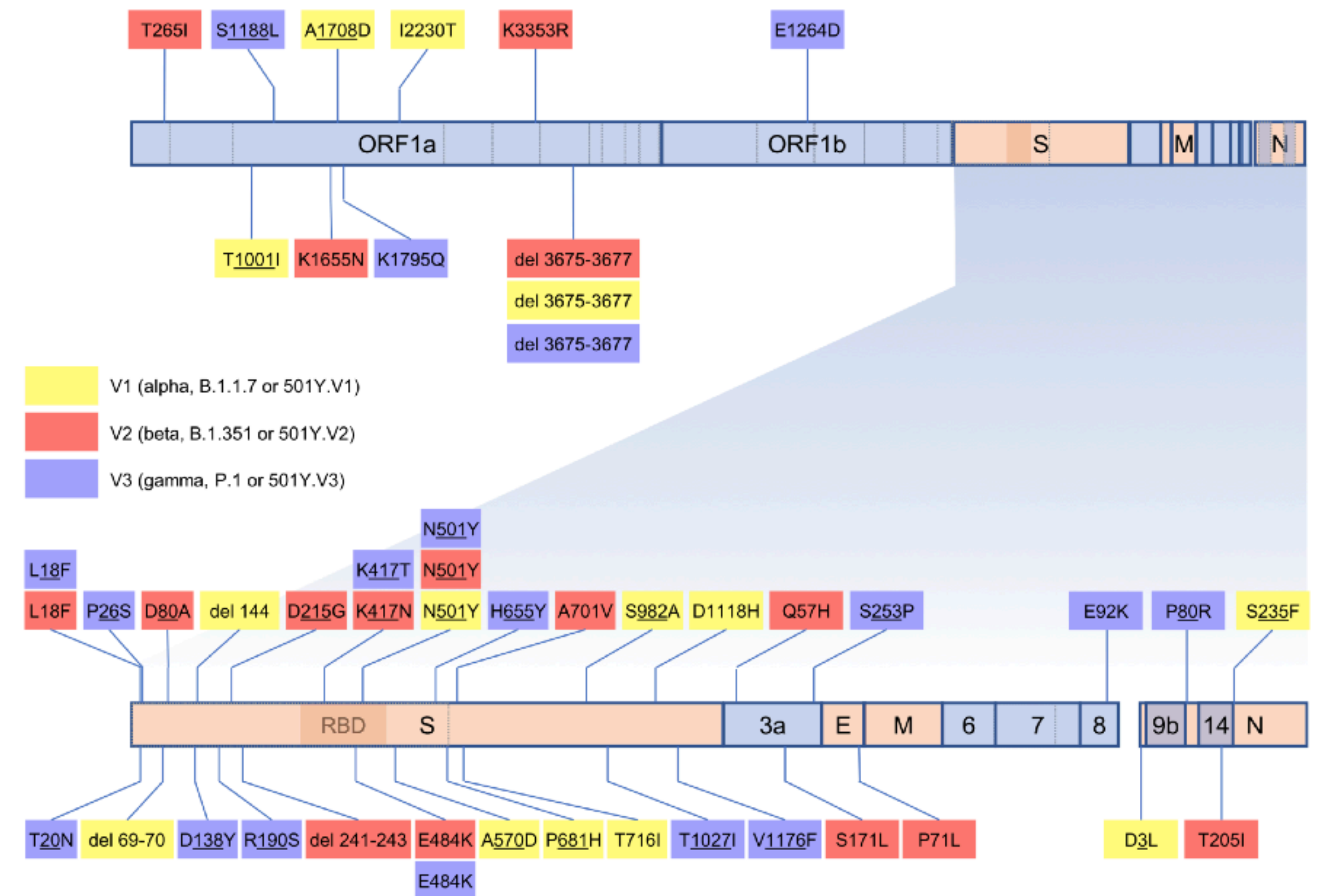
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Selective shift,  
501Y VOC

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Selective shift,  
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Sampled  
genomes  
encoding E or K  
at a protein site



Pre-November 2020:  
The evolutionary signal in the codon encoding this protein  
site fails to trigger a positive selection signal