

The Lineages of Dissimilatory Phosphate Oxidation Genes Indicate an Ancient, Vertically Transferred Metabolism

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Abstract

- Dissimilatory Phosphate Oxidation (DPO) is an energy metabolism in which phosphate is used as an electron donor.
- DPO attributed to the *ptxDE-ptdCFGHI* gene cluster
- Only two species of DPO organisms are known.

The prevalence and evolution of DPO is unclear.

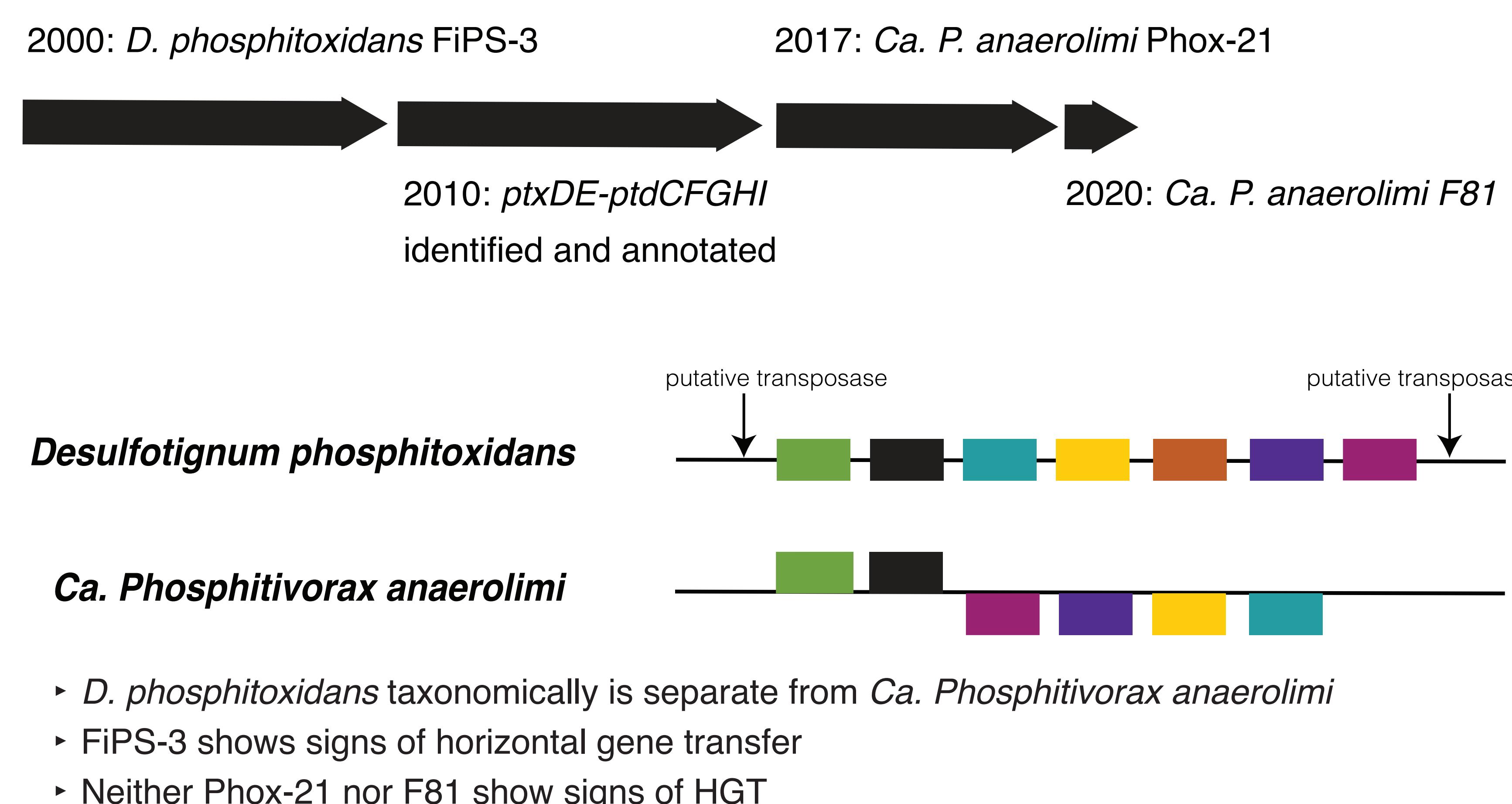
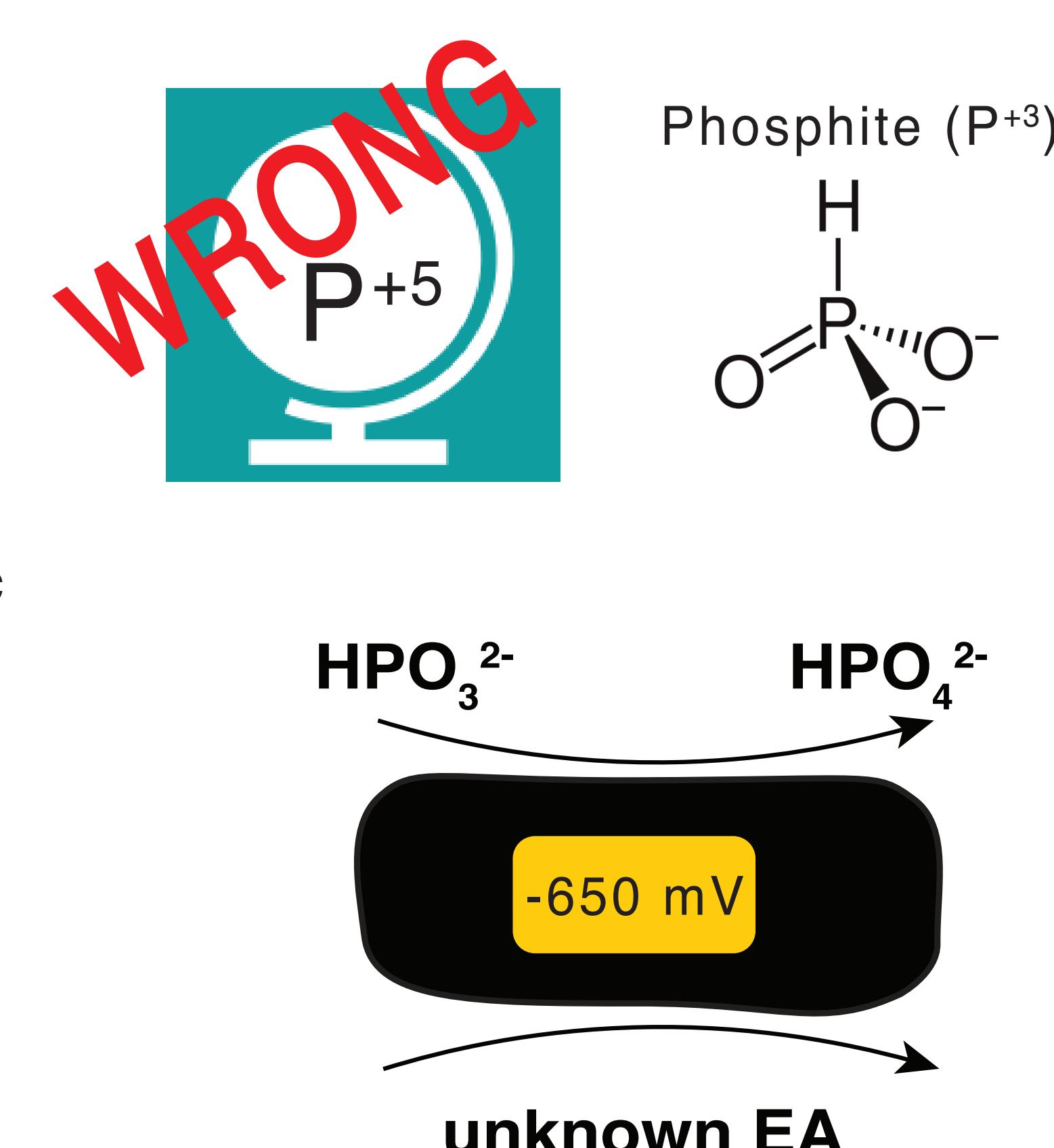
METHODS:

- We used the *ptxD*, *ptdC*, and *ptdF* genes to probe metagenomic databases for the *ptx-ptd* cluster
- We compared the phylogenetic relationships of genes to determine the evolution of DPO metabolism

RESULTS:

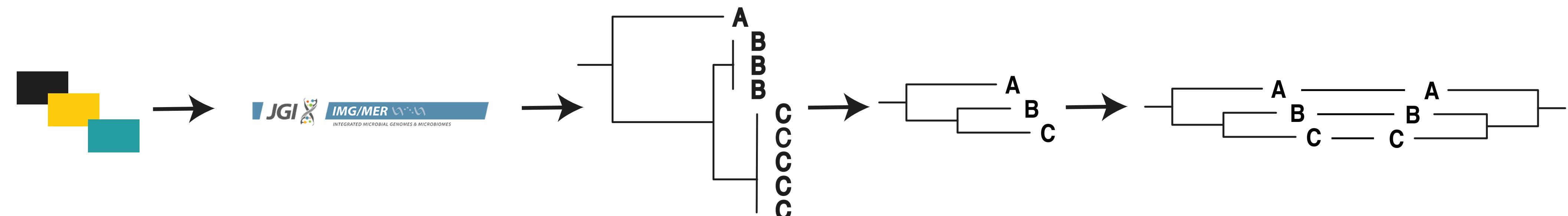
- DPO host organisms are prevalent and taxonomically diverse
- The DPO gene cluster is prevalent, diverse, and vertically transferred

Background

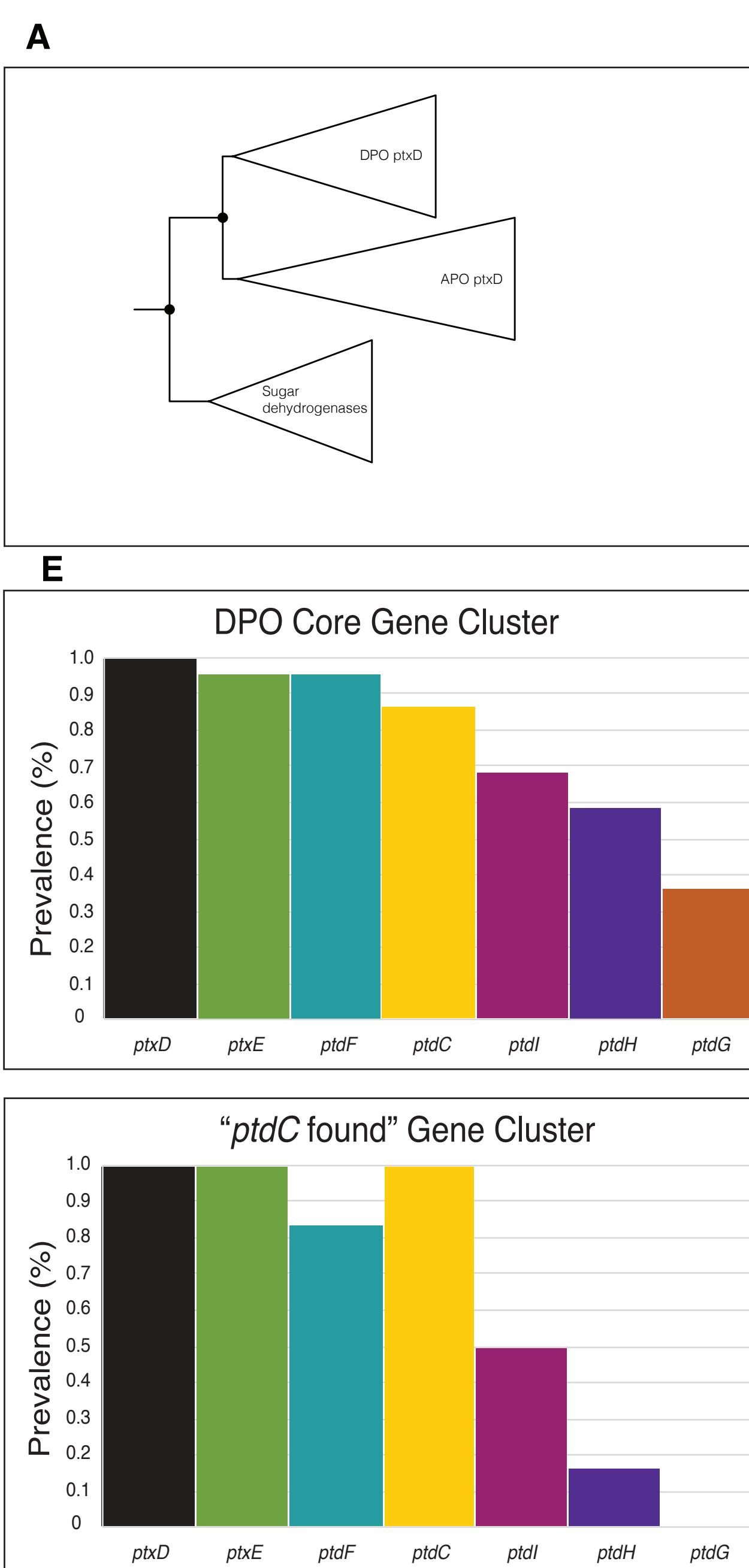


Methods

- Probe the JGI for *ptxD*, *ptdC*, and *ptdF*
- Generate phylogenetic tree with hits
- DerePLICATE the tree, deleting identical genes and truncated genes
- Generate a tanglegram to align genes from the same contig



Results



Phylogenetic tree of JGI hits from *ptxD* probe featuring (A) a reduced phylogeny, (B) a phylogenetic tree of binned organisms from binned metagenomes and JGI hits, (C) presence and absence matrix of the *ptxDE-ptdCFGHI* gene cluster, (D) a logarithmic description of scaffold size, and (E) two bar graphs displaying the prevalence of genes in the known DPO cluster and in the hypothetical Gene Cluster obtained by probing for the *ptdC*.

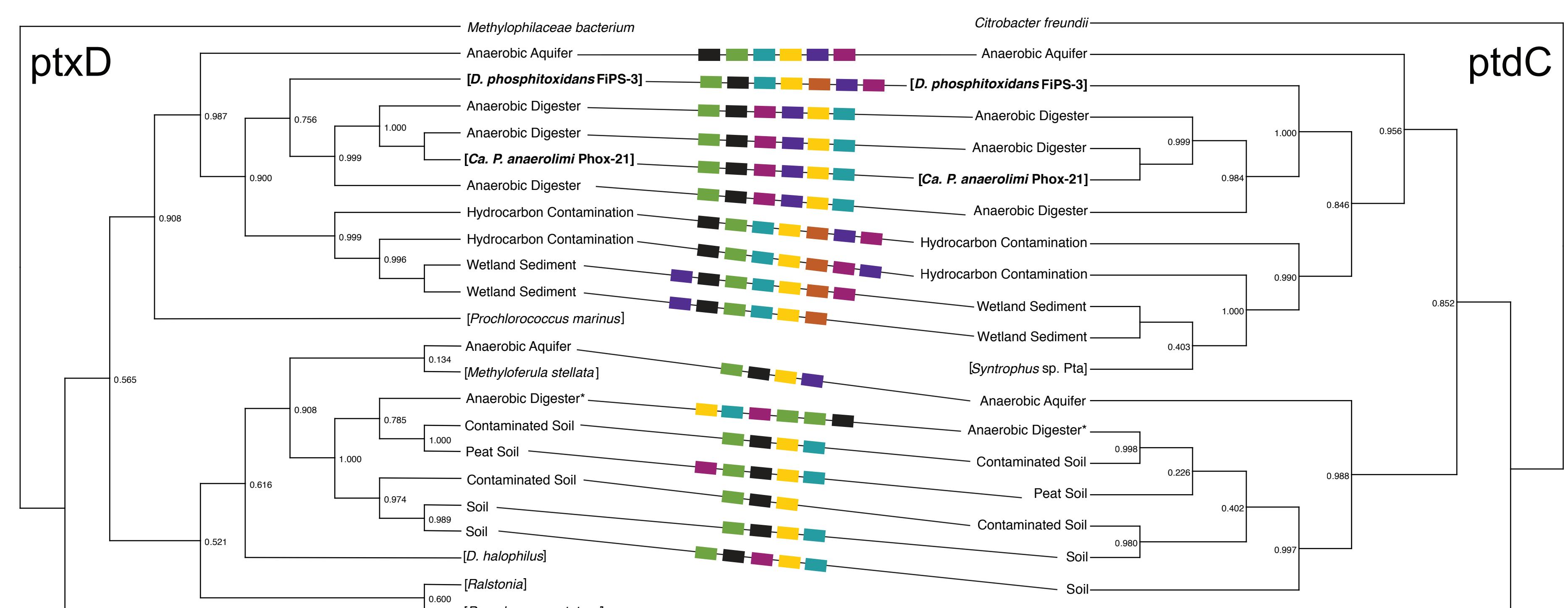
Conclusions

- (1) Ptx-ptd phylogenetic relationships show vertical evolution
- (2) Diversity from *ptxD* search is increased by the *ptdC* search
- (3) Synteny and gene inclusion analyses show diversity in the gene cluster construct
- (4) Phylogenetic diversity of metabolism and congruence with phylogeny implies ancient metabolism with gene loss

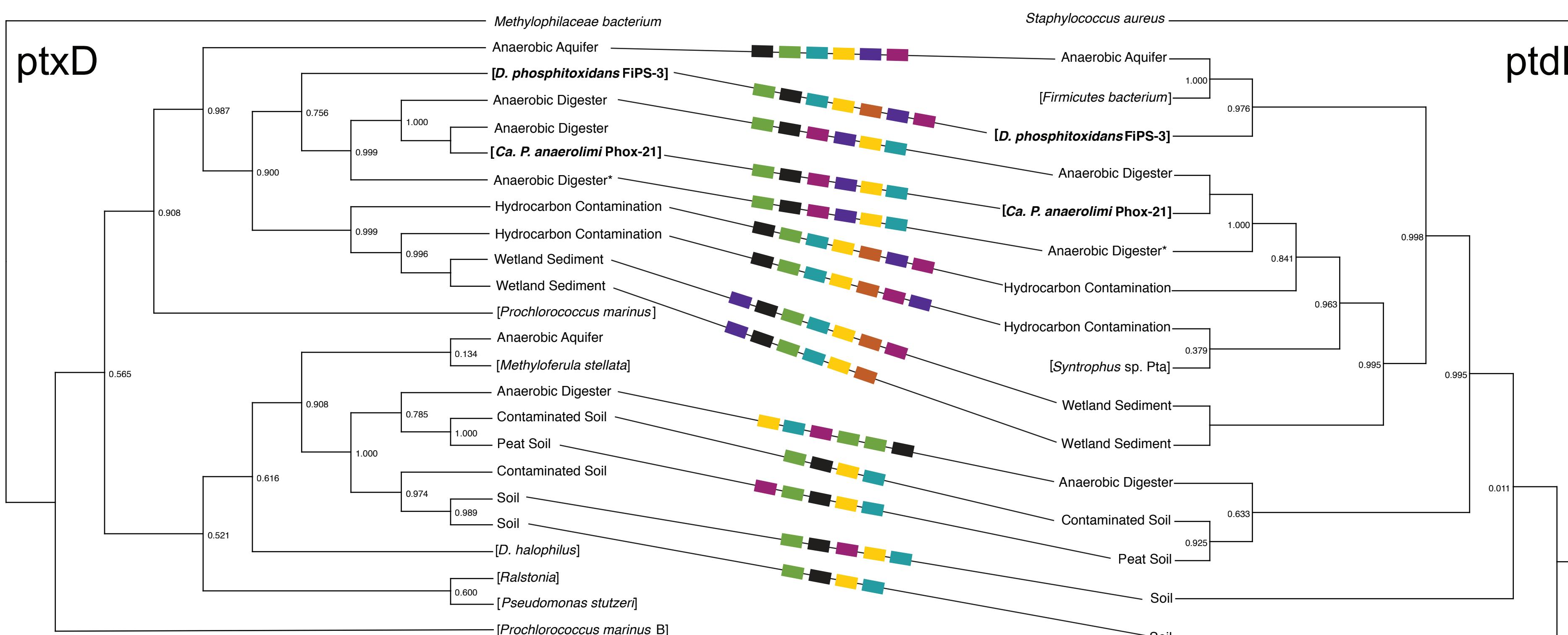
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(F) Comparative phylogeny of the *ptxD* and *ptdC* demonstrating co-evolution.



(G) Comparative phylogeny of *ptxD* and *ptdF* demonstrating co-evolution.



Future Work

- We are testing a community identified through the *ptdC* probe from an anaerobic digester* for DPO
- We plan to examine synteny to find a core gene set outside of the *ptx-ptd* gene cluster

References:

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