

Adaptive strategies of sediment microbiomes towards long-term anthropogenic metal pollution: An integrative molecular approach

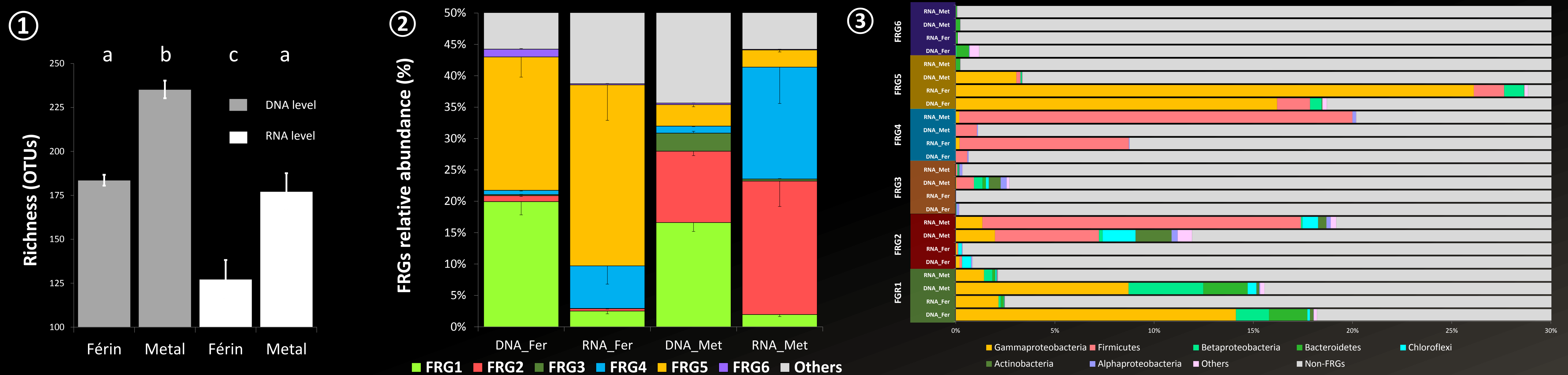
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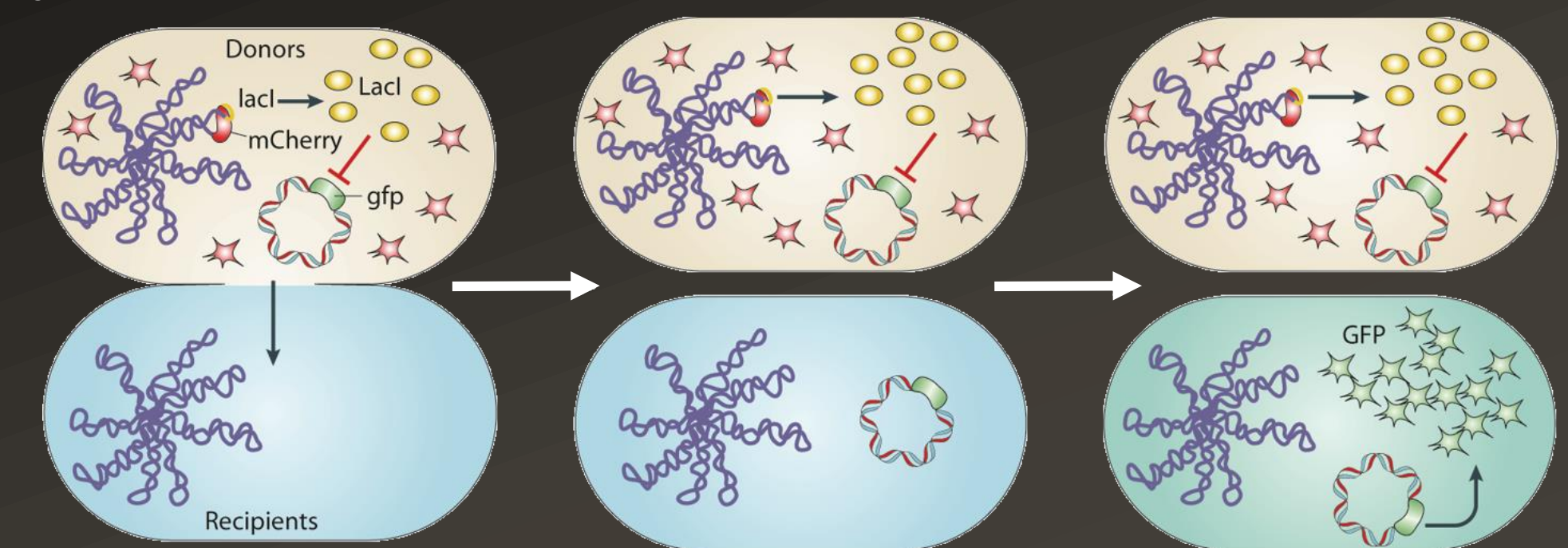
Metal contamination poses serious **biotoxicity and bioaccumulation** issues, affecting both abiotic factors and biological activity in ecosystem trophic levels, especially **sediments**. The MetalEurop foundry released metals directly into the French river “la Deûle” during a century, contaminating sediments increasing metal concentrations up to 30-fold compared to upstream unpolluted areas (Férin, Sensée canal).

By complementing DNA and RNA 16S rRNA sequencing, we decipher the adaptive tolerance range of the communities with the ecological concept of Functional Response Groups (FRGs) assorting OTUs by their metal effect ②③. 16S profiles revealed clear indication that metal selected for mechanisms such as microbial facilitation via “public-good” providing bacteria, Horizontal Gene Transfer (HGT), and community coalescence, overall resulting in an unexpected higher microbial richness at the metal polluted site ①.

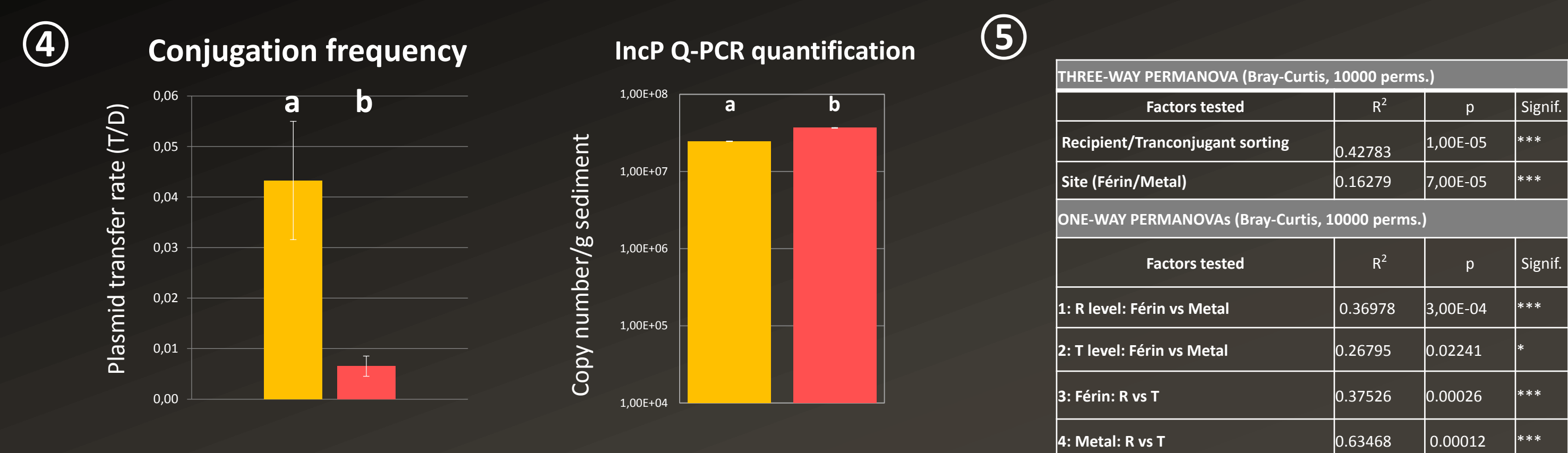


Functional Response Groups via nbGLM and Euclidian clustering for heatmaping

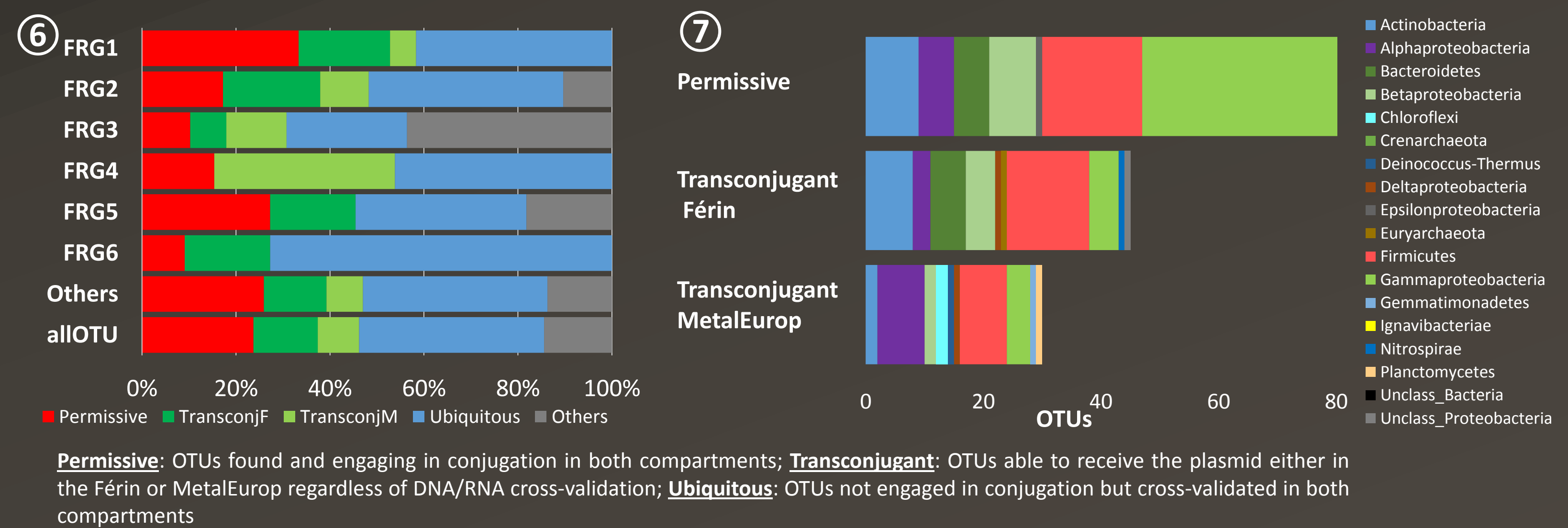
The impact of in situ long-term metal contamination on a broad-host-range plasmid permissiveness was assessed. The **taxonomic permissive profiles of river sediment microbiomes** were obtained from two stations and compared to measure their response to anthropogenic metal exposure. Filter mating assays were assessed using a *incP*-plasmid ④. The recipient and transconjugant communities 16SrRNA profiles were obtained ⑤⑥⑦⑧.



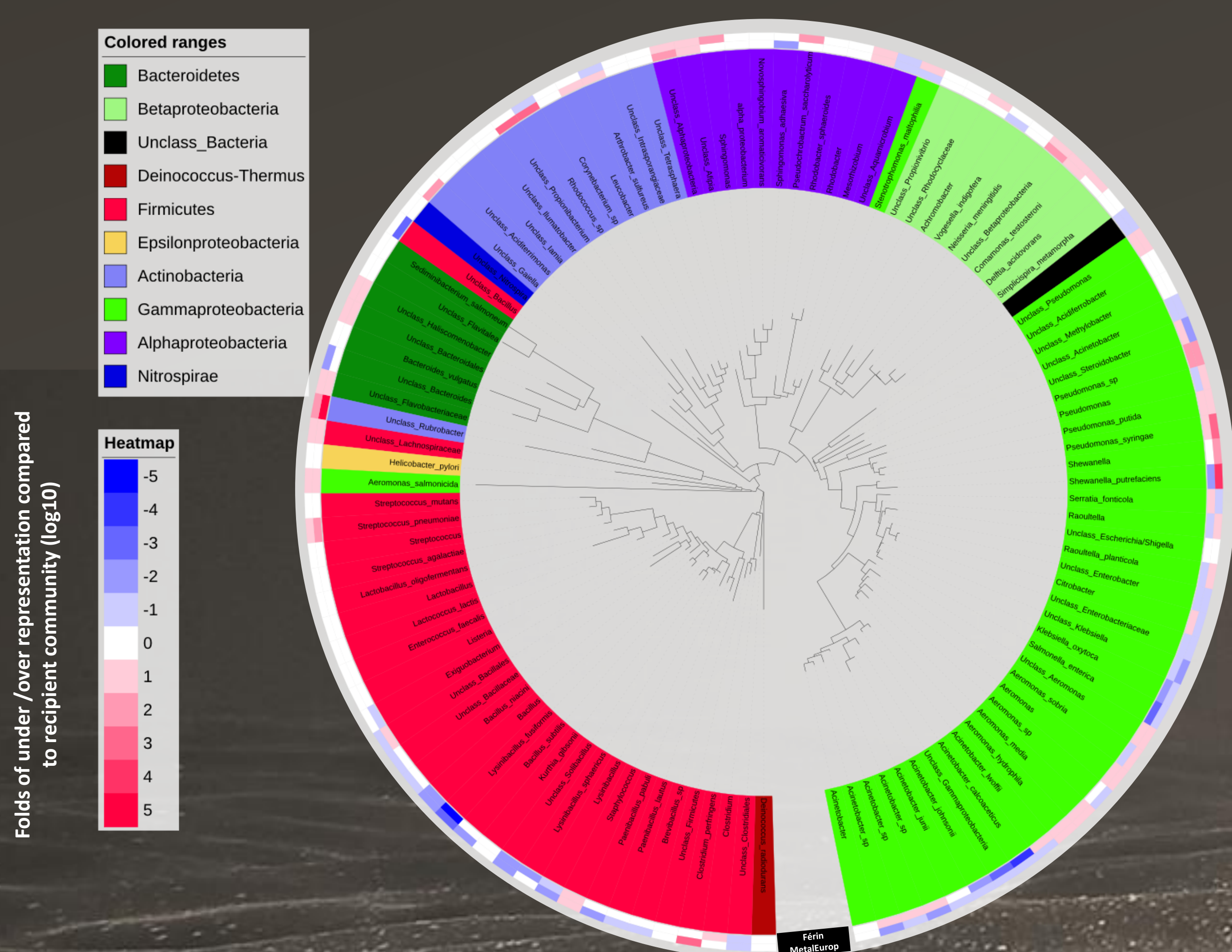
Sørensen et al. 2005



PERMANOVA comparison of the 16SrRNA profiles of the total recipient communities and transconjugant part of these communities



8 Phylogenetic tree assorting transconjugant OTUs and their representation compared to the recipient community (outer-circle Heatmap)



- MetalEurop community displays a higher OTUs richness
- MetalEurop sediment community is less permissive to a new *incP* plasmid
- The transconjugant part of the community from Férin is closer to the Férin total community in comparison with the transconjugant and total part of MetalEurop community → A smaller part of the MetalEurop community gets the plasmid but *IncP* plasmids are already significantly enriched at the polluted site
- The plasmid permissiveness profile depends on the Functional Response Group
- The transconjugant profiles are diverse
- Impact of metals on permissiveness depends on the strain
- Sediments are hotspots for HGT where conjugative plasmid can be exchanged between coalescent microbial communities and this dynamics is changed with metals. For instance, *Clostridium perfringens* belongs to FRG4 and increases its permissiveness in MetalEurop

Reference- Sørensen, S.J., Bailey, M., Hansen, L.H., Kroer, N., Wuertz, S., Sørensen, S.J., et al. (2005) Studying plasmid horizontal transfer in situ: a critical review. *Nat. Rev. Microbiol.* 3: 700–710.

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