Sediment microbial ecology and methane (CH_4) dynamics during resuspension events in a hypersaline coastal lagoon

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Introduction

- Wetlands produce up to **33% of global CH_4.**[1]
- **Hypersaline** wetlands make up large areas of global coastline, and are poorly understood.
- **The Coorong Lagoon** is an **internationally important wetland**, at the estuary of the Murray-Darling Basin, in South Australia.[2,3,4]
- **Reverse estuary**, with **salinity** often reaching **3-4x marine levels** in the South Lagoon, forming sediment **depositional zones (DZs).**
- **Previously, 4-7 fold increases** in surface water [CH_4] detected during sediment resuspension.
- We hypothesise
  1. In **DZ sediments, methanogenic communities and metabolisms are more abundant/active.**
  2. **Resuspension in DZs can bypass oxic methanotrophy, increasing surface water [CH_4].**

Methods

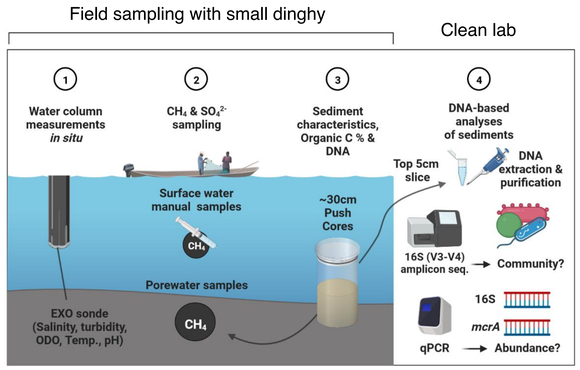
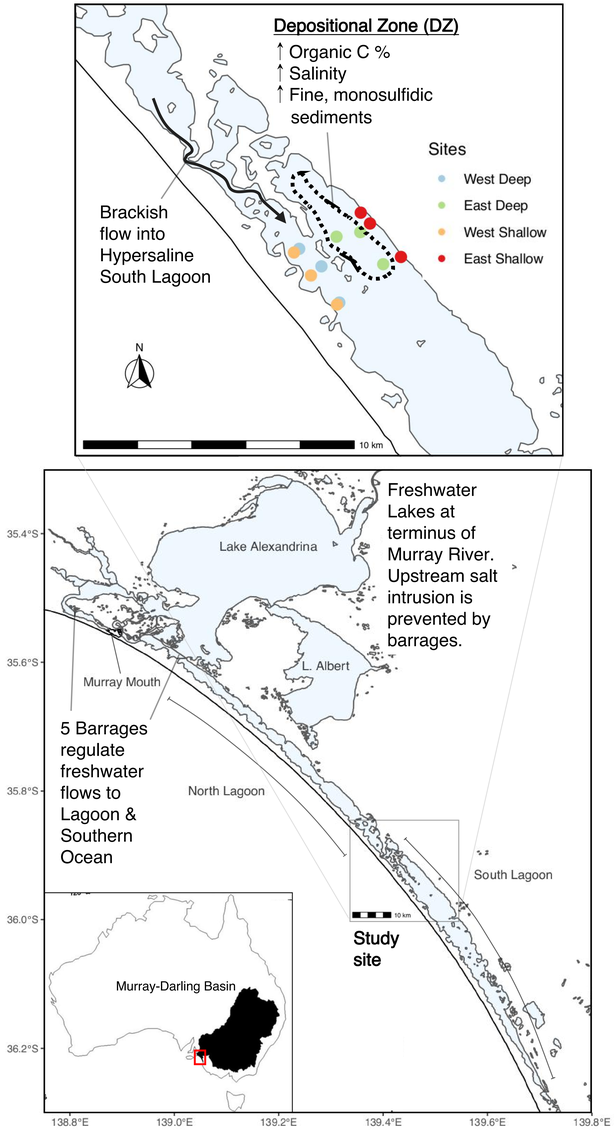


Figure 1. Simplified conceptual model of field sampling campaign & methods. 16S gene: total prokaryotes, *mcrA* gene: total methanogens.

Figure 2. Map of study site (The Coorong: South Lagoon).



Results

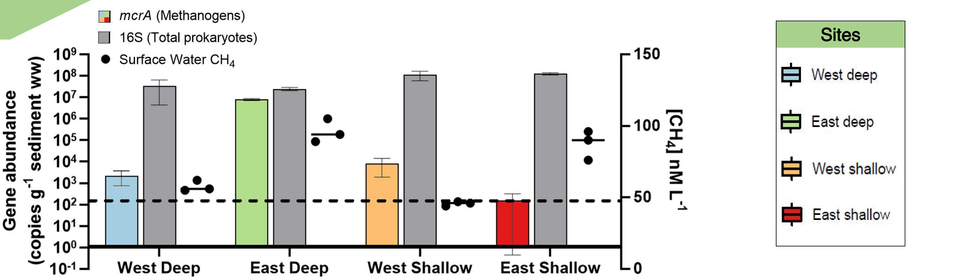


Figure 3. Genetic quantification & surface water [CH_4]. Dotted horizontal line represents the assay limit of quantification for the *mcrA* gene.

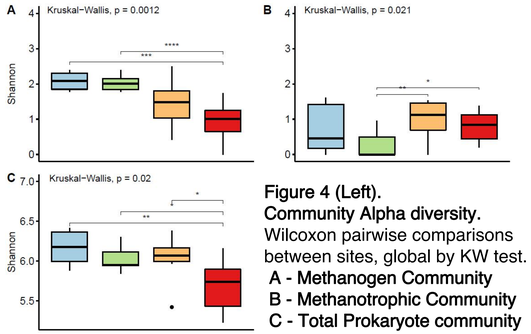


Figure 4 (Left). Community Alpha diversity. Wilcoxon pairwise comparisons between sites, global by KW test.
A - Methanogen Community
B - Methanotrophic Community
C - Total Prokaryote community

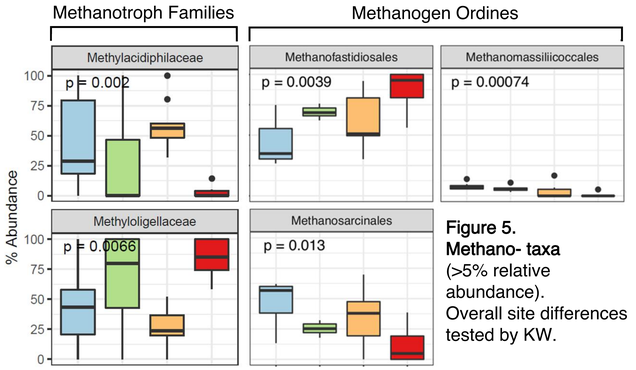


Figure 5. Methano- taxa (>5% relative abundance). Overall site differences tested by KW.

Conclusions

- **↑ Methanogen DNA in DZ sediment, ↑ [CH_4] in nearby surface waters (Figure 3).**
- **Dominance of** Order **Methanofastidiosales (fmr. Class WSA2) in** DZ **(Figure 5)** – suggests importance of **obligate H_2-dependent reduction of methylated thiols.**[5]
- Methanotroph communities simplified in DZ **(Figures 4, 5) – CH_4 may bypass methanotrophy as a result of sediment resuspension.**
- Therefore, **DZs may be a significant source of atmospheric greenhouse gas.**

In future, CH_4 fluxes and seasonal var. must be captured. This will help quantify hypersaline coastal lagoons as potential sources of atmospheric CH_4 & improve global models and budgets.

References
[1] R B Jackson *et al* 2020 *Environ. Res. Lett.* **15** 0710002, [2] L Mosley *et al* 2017 Dept. of Env, Water and Nat. Res. (DEWNR).
[3] Coorong Lower Lakes and Murray Mouth – A Decade of Connection and Healing (YouTube)
[4] Can microbes help restore the Coorong? (YouTube) [5] M Nobu *et al 2016 ISME J* **10**, 2478–2487

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