The Response of Anaerobic Prokaryotic Communities in Severn Estuary Sediments to Environmental Change

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Background to Benthic SRB and Methanogens

• Both are groups of prokaryotes that respire anaerobically.

• Sulphate-reducing bacteria (SRB) are members of the *Proteobacteria* that use SO$_4^{2-}$ as a terminal e$^-\,$ acceptor and produce H$_2$S (Nealson, 1997)

• Methanogens are *Archaea* that produce CH$_4$ as a respiration product.

• Both use organic compounds or H$_2$ as e$^-\,$ donors and organic compounds as C sources - acetate.

• Usually occur in specific biogeochemical depth zones in the sediment due to competition for substrate.

Modified from Canfield and Thamdrup (2009).
Background to the Severn Estuary

• Located between South Wales and Gloucestershire/Somerset.

• Very tidally dynamic - has the 3rd highest tidal range in the world - >12m (Uncles, 2010).

• Strong currents result in well mixed water column with respect to temperature and salinity however [SPM] is stratified - lutoclines.

• Very unstable sediment regime, seafloor often scoured clean and fine sediment is concentrated in sink areas - Bridgewater Bay, Newport Deep.

• Fluid mud “slugs” in deep water (Kirby, 2010).
Current Knowledge - Severn Microbiology

• Very little known about the Severn’s endobenthic microbiology.

• Epibenthic and planktonic microbes almost nonexistent - currents and SPM.

• Wellsbury *et al.* (1996) - Anaerobes play major role in C mineralization and occur in specific depth zones - disturbed by tidal/current regime.

• Webster *et al.* (2010) - Anaerobic processes detected within *in situ* cores but not in lab slurries, suggested that groups of uncultured bacteria are responsible for C and S cycling in Severn sediments.
Current Knowledge - Severn Environment

• Plenty of work - though much debated.
• No consensus on sediment source or import/export regime.
• No research into role of groundwater input (Slomp and Van Cappellen, 2004).
• Sedimentation pattern changes rapidly - currents and tides.
• Effects of barrage strongly debated - eutrophication and anoxia vs clear-water and increased biodiversity.

Modified from Kirby, 2010
Aims of this Study

• Survey the extent of prokaryotic processes in the Estuary - Where are they?

• Characterise the diversity of prokaryotes as an indicator of biogeochemical potential - Who are they and what are they doing?

• Determine prokaryotic biomass and activity - How many are there and how much work are they doing?

• Determine the response of the organisms to changing environmental parameters in the lab - Will they like global warming/the barrage?
Methodology

• Collect sediment cores from intertidal and subtidal sediments - “Guiding Light”.

• Determine biodiversity and biomass using oligonucleotide analyses (16s rRNA, \textit{dsrAB} etc.) such as FISH, CARD-FISH and Q-PCR.

• Determine microbial activity based on substrate and waste product fluxes - radiotracer measurements.

• Subject a representative sample to differing environmental conditions: temperature, current speeds, increases/decreases in substrates and other compounds and then measure any changes that occur to determine the effects of future environmental change.
Summary

• Severn microbes - very little known.

• Severn sediments/hydrology - very little agreed upon.

• Aims - Who’s there? Where are they? What are they doing? How busy are they? How’s the future looking for them? Will Newport turn into a fetid swamp?
References


Thank you for listening...

... are there any questions?