

Benthic pH and oxygen dynamics – A seasonal and spatial study

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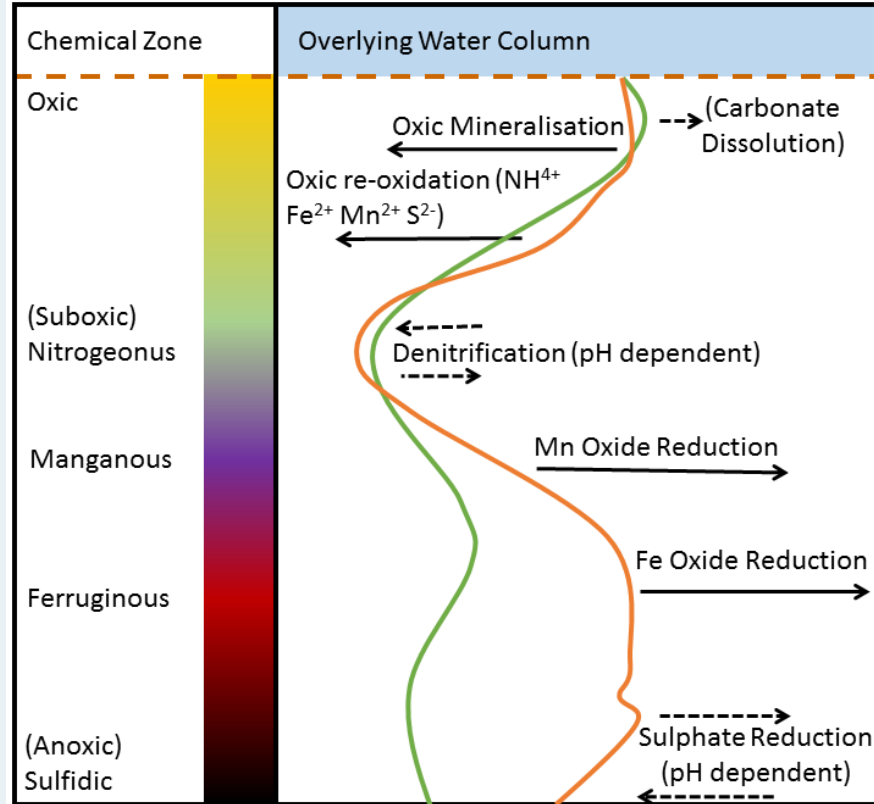
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Why is there so much pH variability in sediments?

(Def: *pH* is a numeric scale used to specify the acidity or basicity of an aqueous solution. It is the negative of the logarithm to base 10 of the activity of the hydrogen ion and frequently plotted on a scale of 0-14, with 7 being neutral)



Lots of processes driving pH
~ free proton concentrations
up or down

Oxygen penetration profiles
are very important

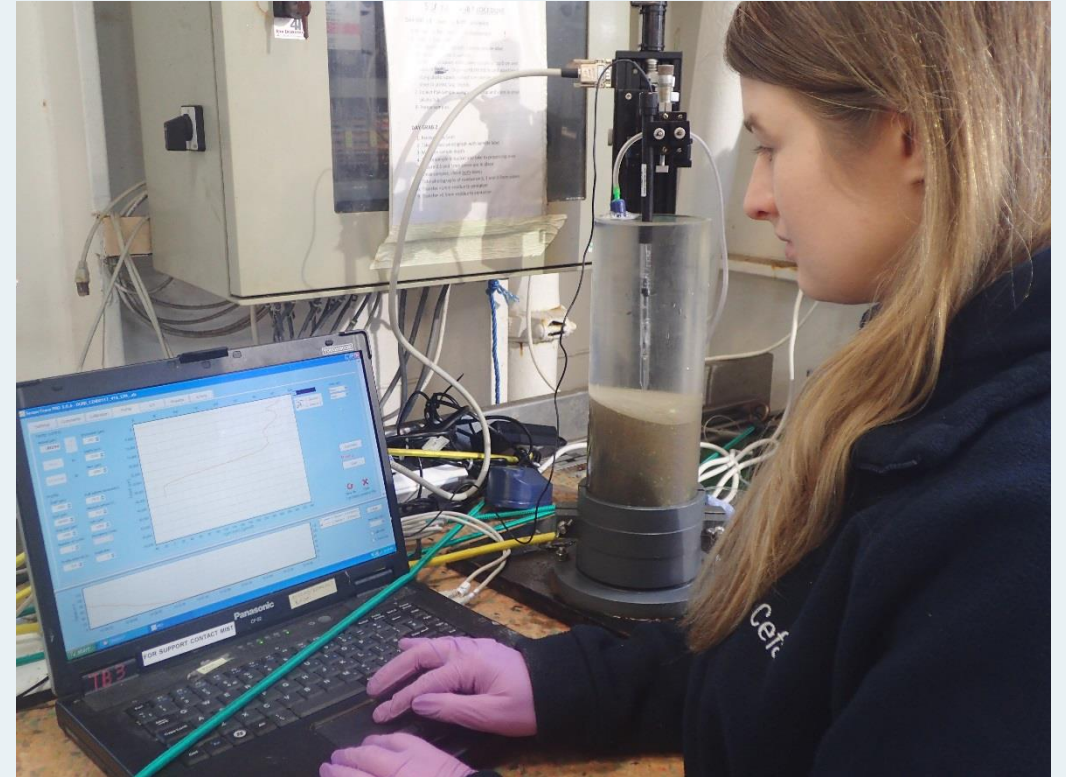
Exemplar pH profiles used in this diagram
recorded in 2011 in the central North Sea
(muddy sand, ca. 50 m depth)
Chemical zones within the sediment
are described using Canfield (2009)

pH and oxygen profiling method

- pH and oxygen glass microelectrodes (Unisense, Aarhus, Denmark)
- Insertion using micro-profiler into fresh sediment cores (NIOZ corer) immediately after recovery on board ship

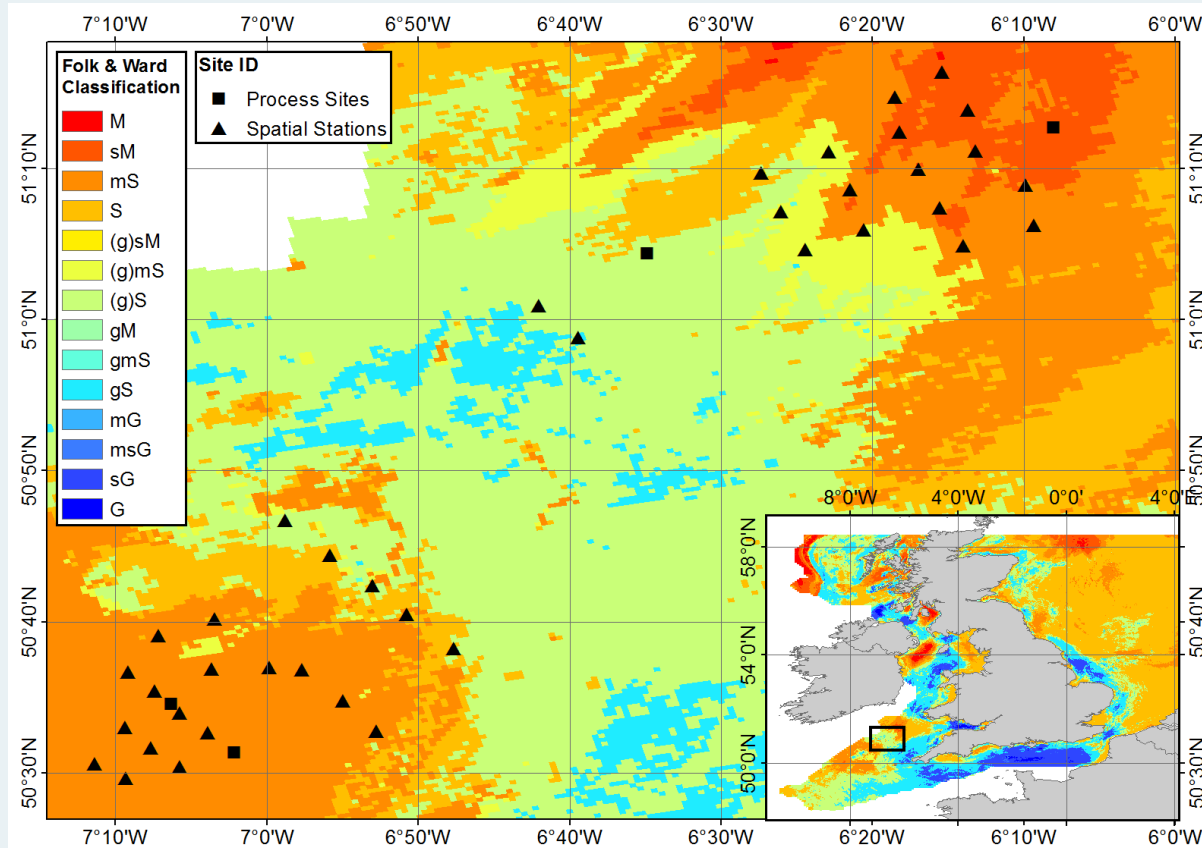
for methods and more details of the Celtic Sea pH work see:

Silburn et al., Biogeochemistry (2017). doi:10.1007/s10533-017-0323-z and for oxygen: *Hicks et al., Biogeochemistry (2017)*



Where: Study site Celtic Sea

– spatial distribution of sample sites and background sediment composition



For details of the site characteristics see Thompson et al., Biogeochemistry special issue, 2017 (submitted)

We also have more pH profiles from regions in the **North Sea** recorded during earlier work.

Predicted surficial sediment Folk and Ward textural classifications based on surface sediment maps, with Process Sites and Spatial Stations indicated. Insert NW Atlantic Shelf around the UK

Observational results 1:

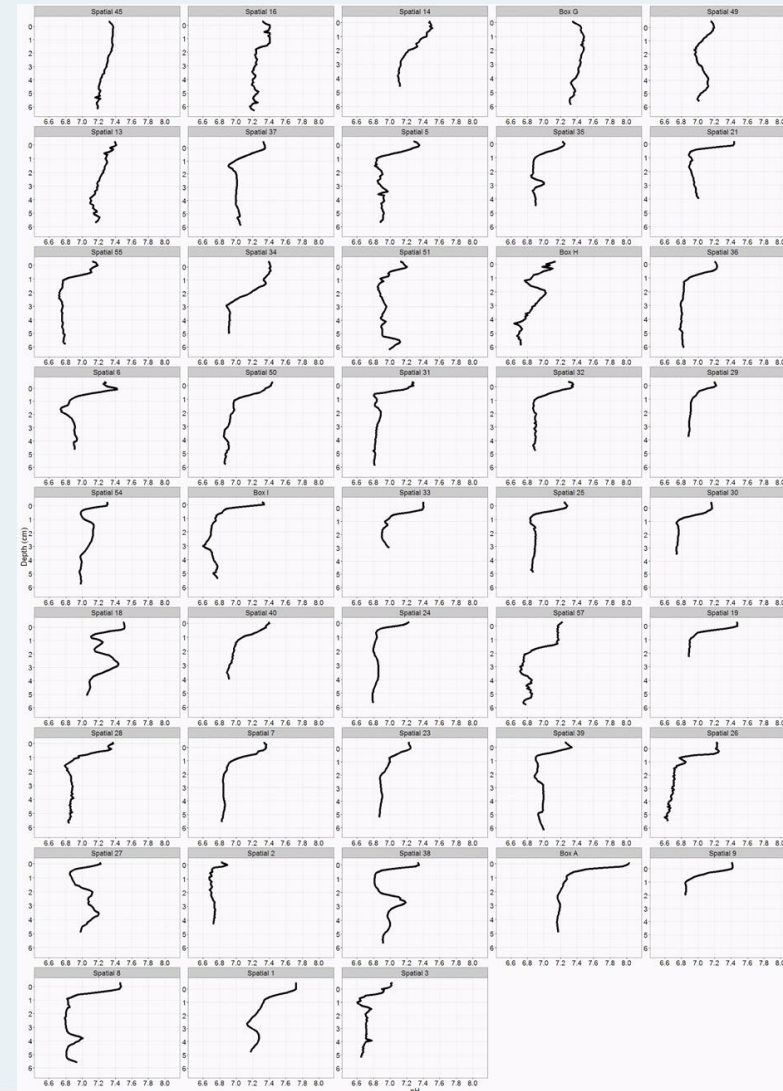
Comprehensive set of pH profiles showing variability with location and sediment composition

Porewater pH profiles of Celtic Sea Spatial Survey (including main process sites)

Profile depth in cm (water column above core to max. 6 cm sediment depth)

sorted by % fines: top left least fines (sand) to bottom right most fines (mud)

pH scale 6.6 to 8.00



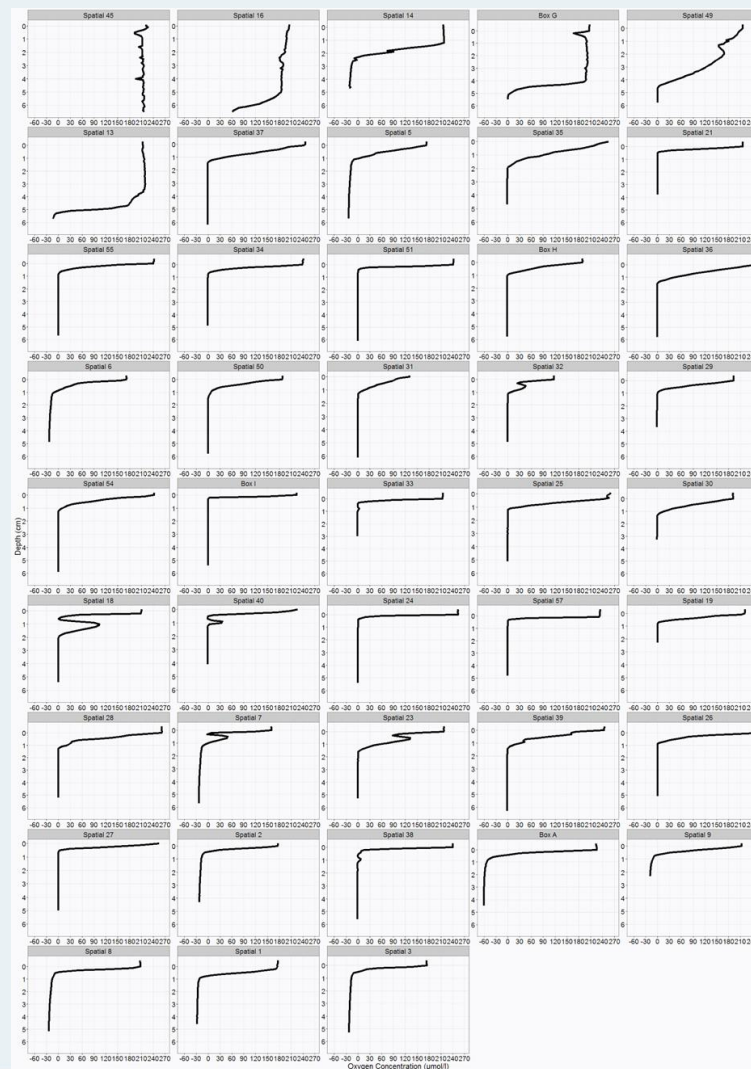
Observational results 2: Oxygen variability with location and sediment composition

Porewater oxygen profiles of
Celtic Sea Spatial Survey
(including main process sites)

*Profile depth in cm
(water column above core
to max. 6 cm sediment depth)*

*sorted by % fines: top left least fines
(sand) to bottom right most fines (mud)*

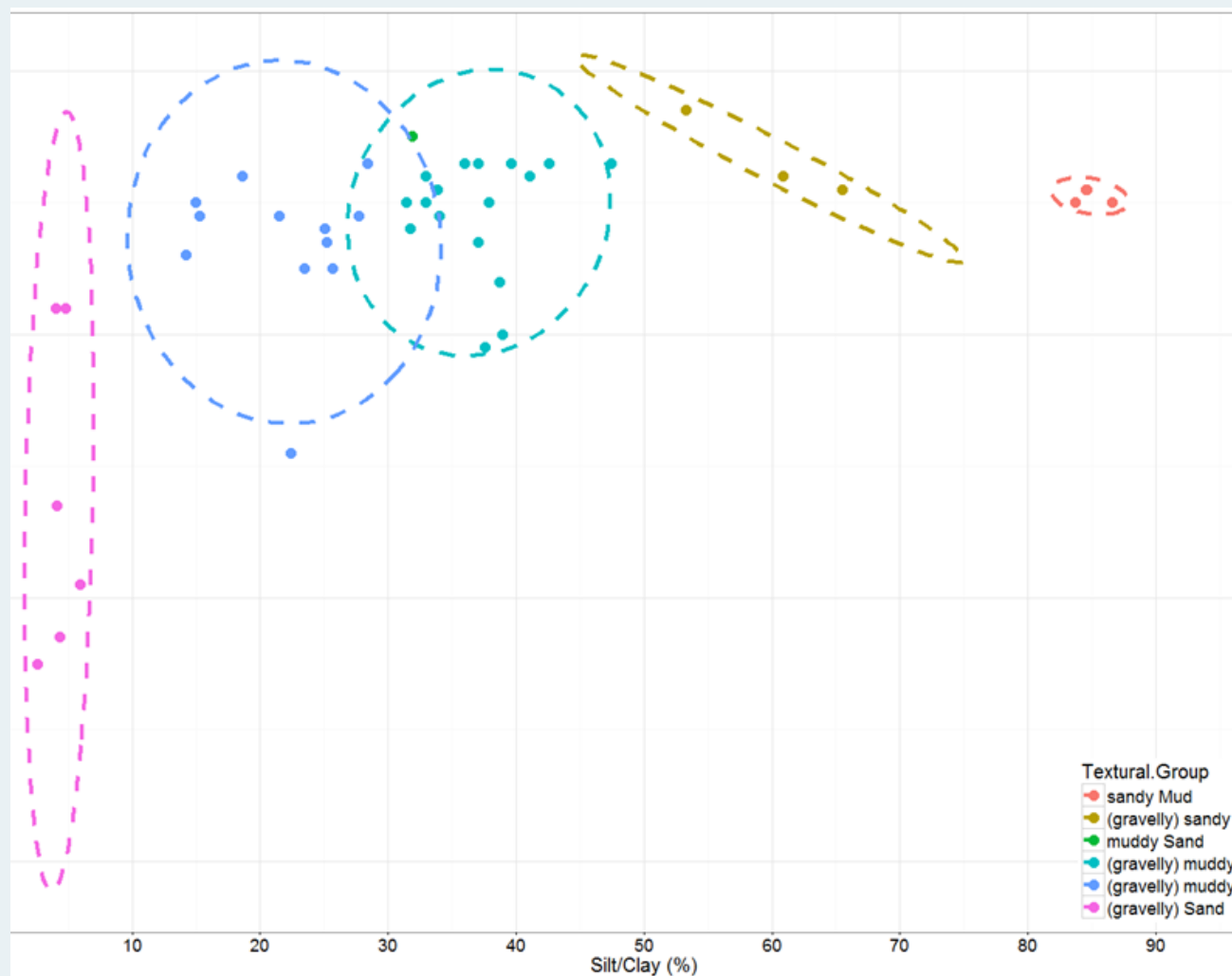
Oxygen in micromole, low (-60 left) to high (+270 right)



Does the lowest observed pH value (minima) correlate with the sediment composition?

pH Sub-surface minima depth Vs percentage Silt/Clay,

Clustered and coloured by Sediment Textural Group.



Key findings

Key findings

Sediment porewater pH is extremely spatially and temporally heterogeneous, but always much lower than any observed water column pH values.

This is true even considering the low pH values recorded in the watercolumn just above the seabed/water interface (which in turn are much lower than the generally recorded and/or assumed pelagic values midwater or at the surface).

Physical sediment characteristics (such as Folk class) and co-observed chemical parameters (such as carbon content and oxygen penetration depth) correlate with some profiles features but can not explain all observed variability.

Biological activity (macro- and meiofaunal bioturbation and microbial activity) will account for another proportion of the remaining variability.

Episodic and sporadic events (tides, storms, trawls) will also influence pH profiles (short, medium and long term).



Acknowledgements & Contact details

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