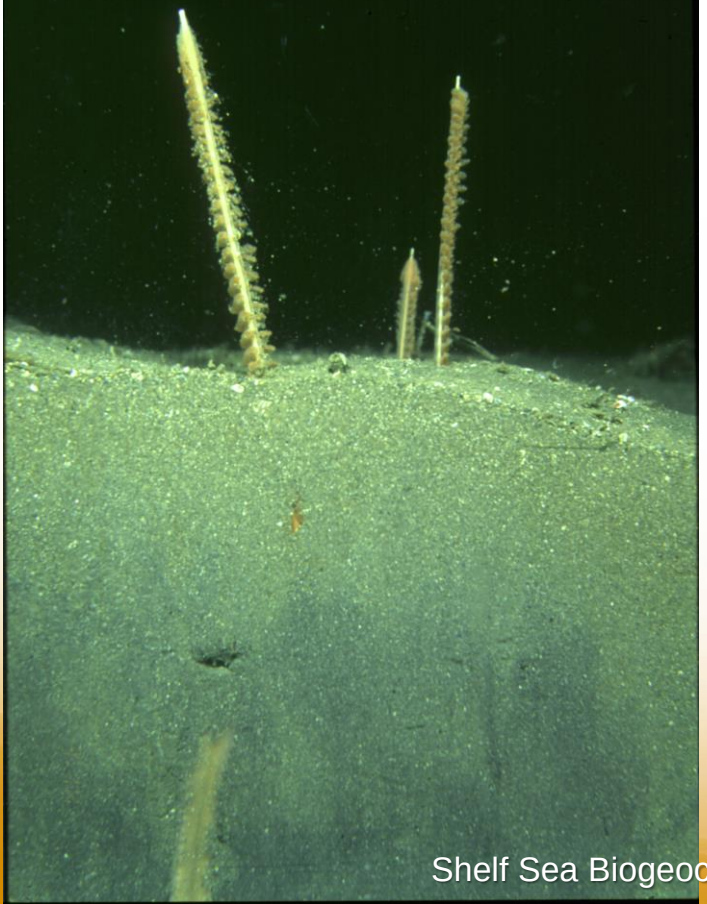
Biogeochemistry, macronutrient and carbon cycling in the benthic layer (BMCC)



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Spatio-temporal patterns of fresh organic matter remineralization, benthic bacterial biomass and bacterial respiration

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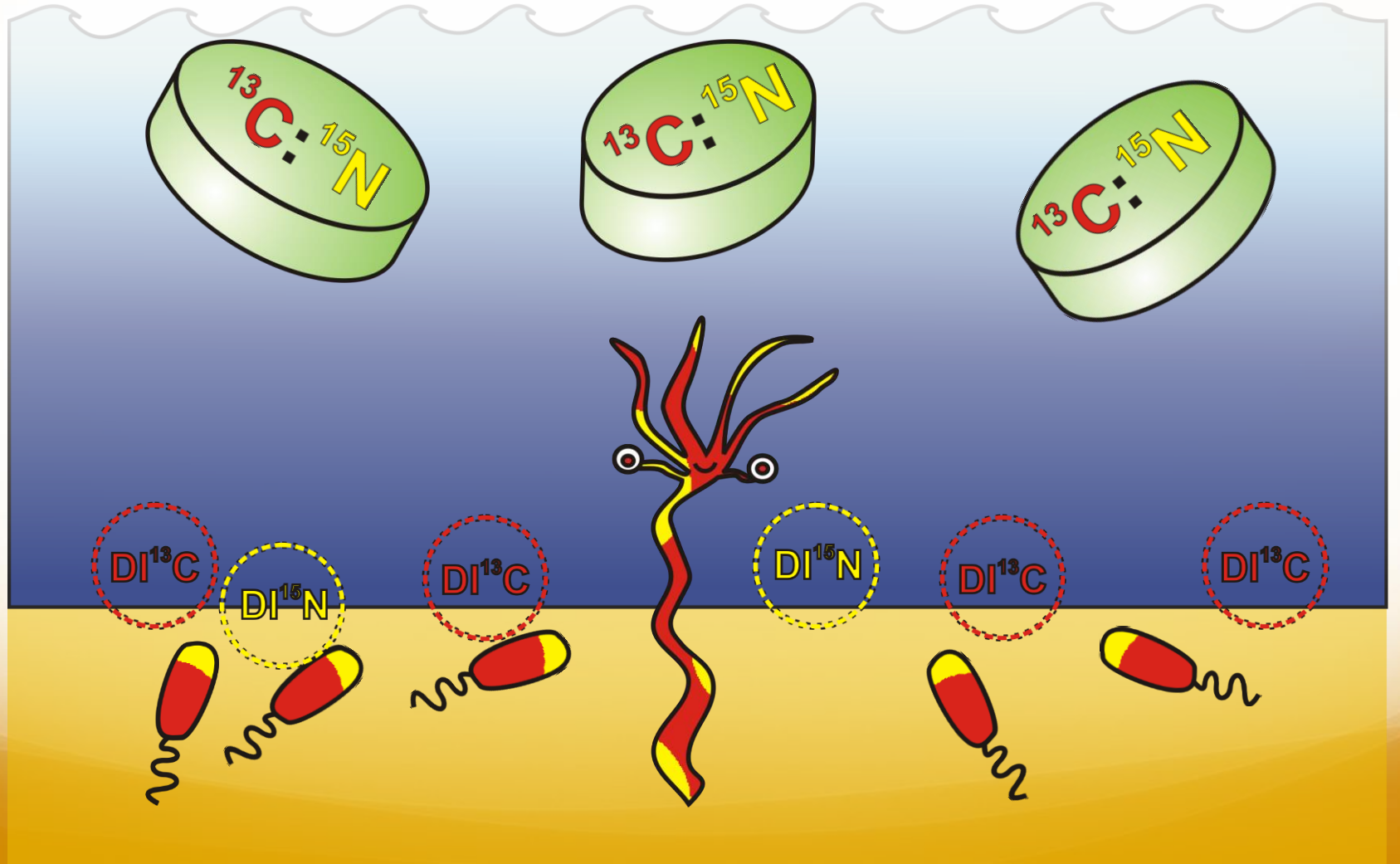
Dan Mayor, Karen Tait, Barry Thornton

Shelf Sea Biogeochemistry final science meeting, 5th–6th June 2017, University of Winchester

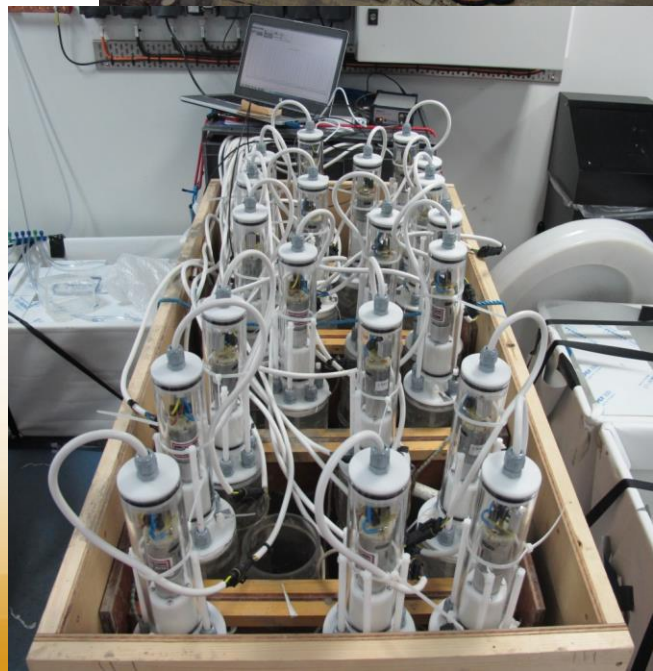
Benthic pelagic coupling across the Celtic Sea

Aim: “quantitatively describe the rates and stoichiometry of organic matter remineralization at the seafloor, the organisms responsible and how these change in space and time”


^{13}C:^{15}N
^{13}C:^{15}N
^{13}C:^{15}N
DI^{13}C
DI^{15}N
DI^{13}C
DI^{15}N
DI^{13}C
DI^{13}C

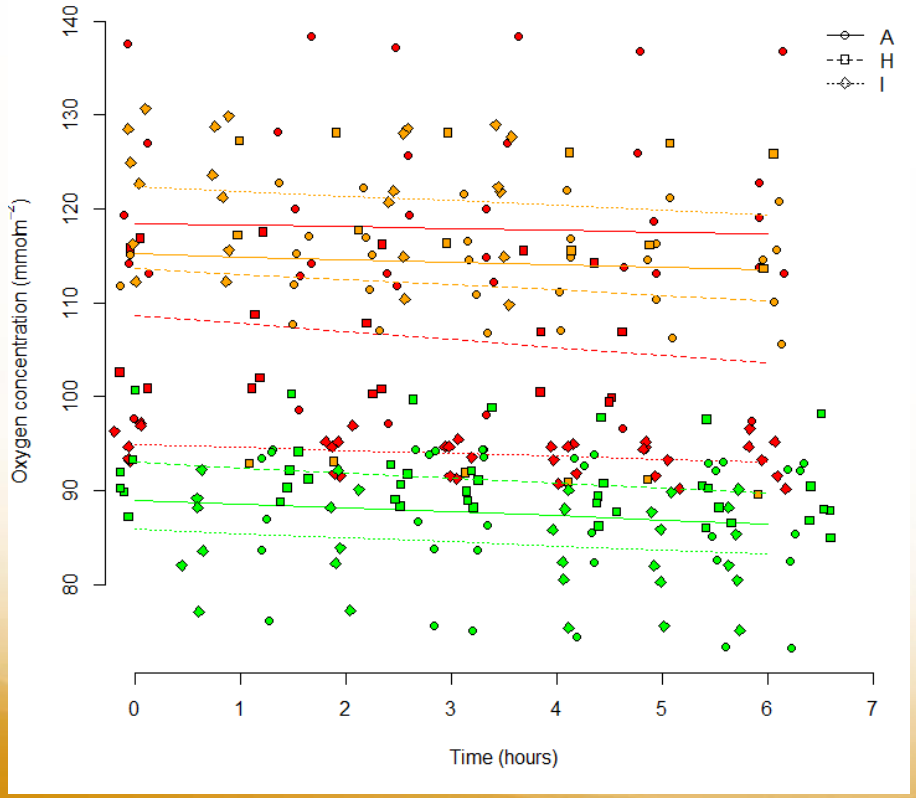
Methods

- Sub-core from NIOZ box core at each site
- Add ^{13}C + ^{15}N labelled diatoms (17 mmol C m^{-2})
- Incubate for 24 hrs in controlled temperature room in dark
- Cores continuously stirred
- O_2 monitored every hour via optode
- T0, T18, T24 – O_2, nutrients, DI^{13}C, DI^{15}N
- Sediments sliced and sampled for macrofauna and molecular + phospholipid fatty acid analyses



Oxygen Fluxes

DY021
DY030
DY034



No effect of diatom addition ($p > 0.1$)

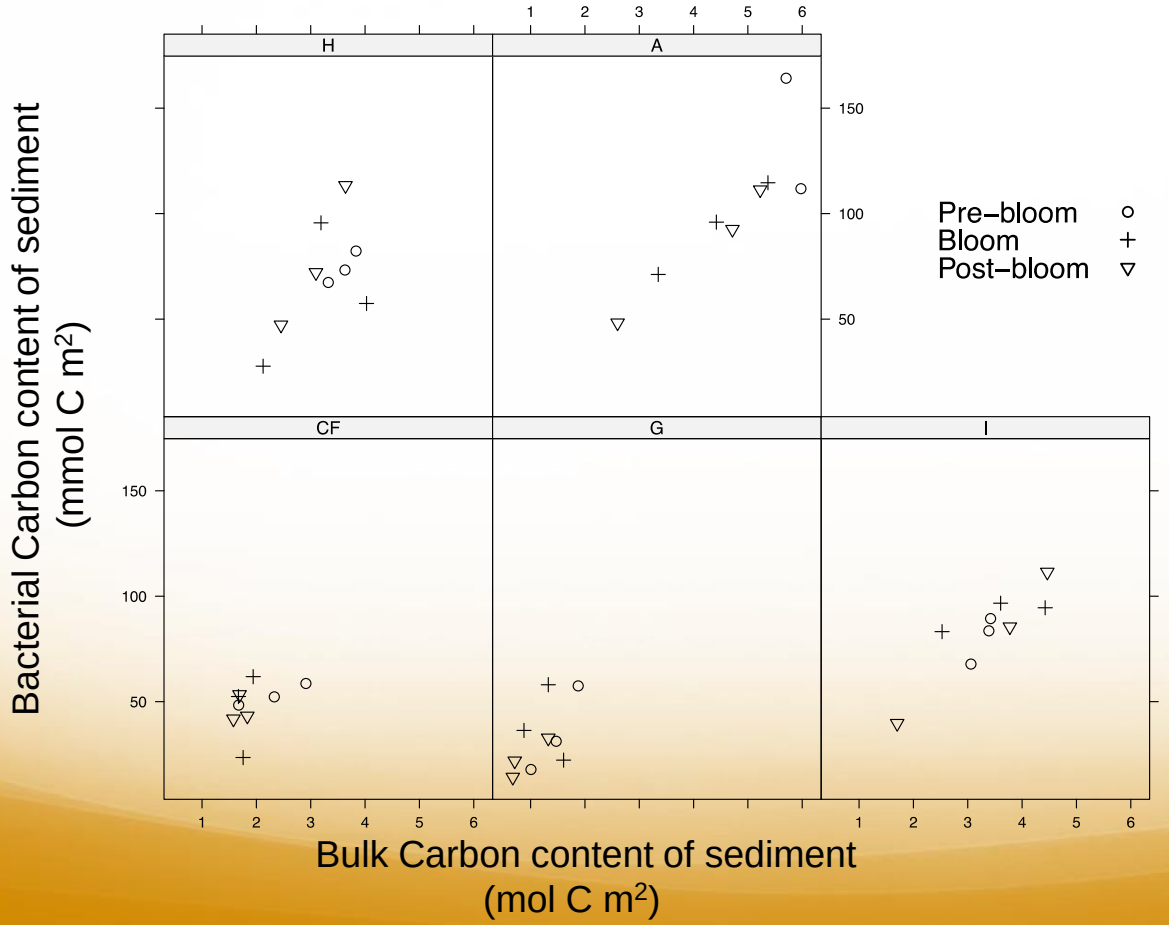
- so the experiment does not affect the natural functioning of the system

Benthic community oxygen consumption rate varies in space and time

(time x site x cruise interaction, $p = 0.004$)

Rates ~ 1 - 14 mmol m^2 d^{-1}

Bacterial Biomass & Bulk Carbon



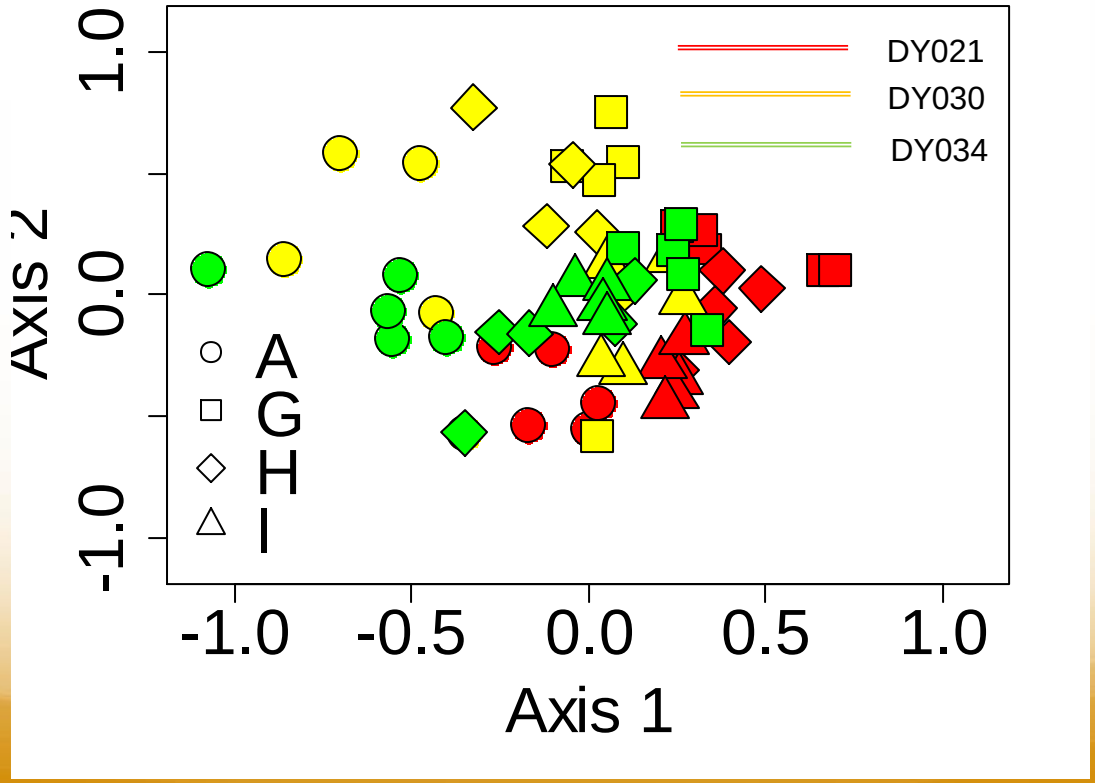
Bacterial biomass ranged between ~50-100 mmol C m^{-2}

Strongly correlated with sediment carbon content (unsuprisingly)

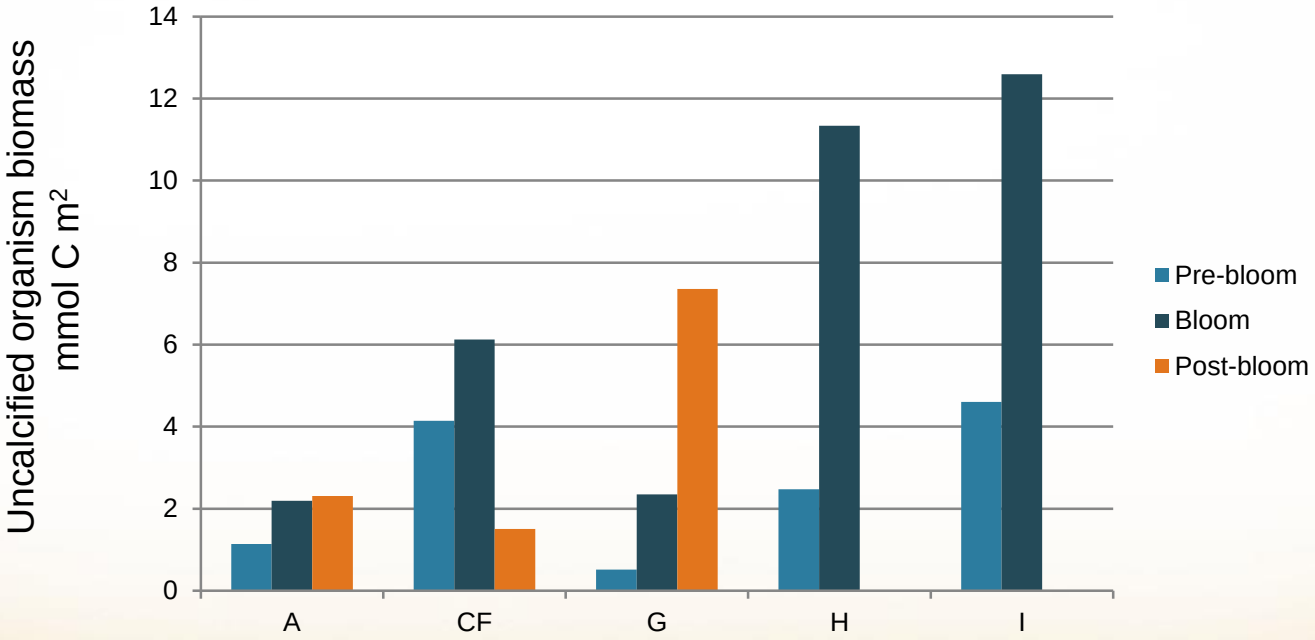
Microbial community structure

Phylum-level microbial community structure varies in space and time

(site x cruise interaction, $p < 0.001$)



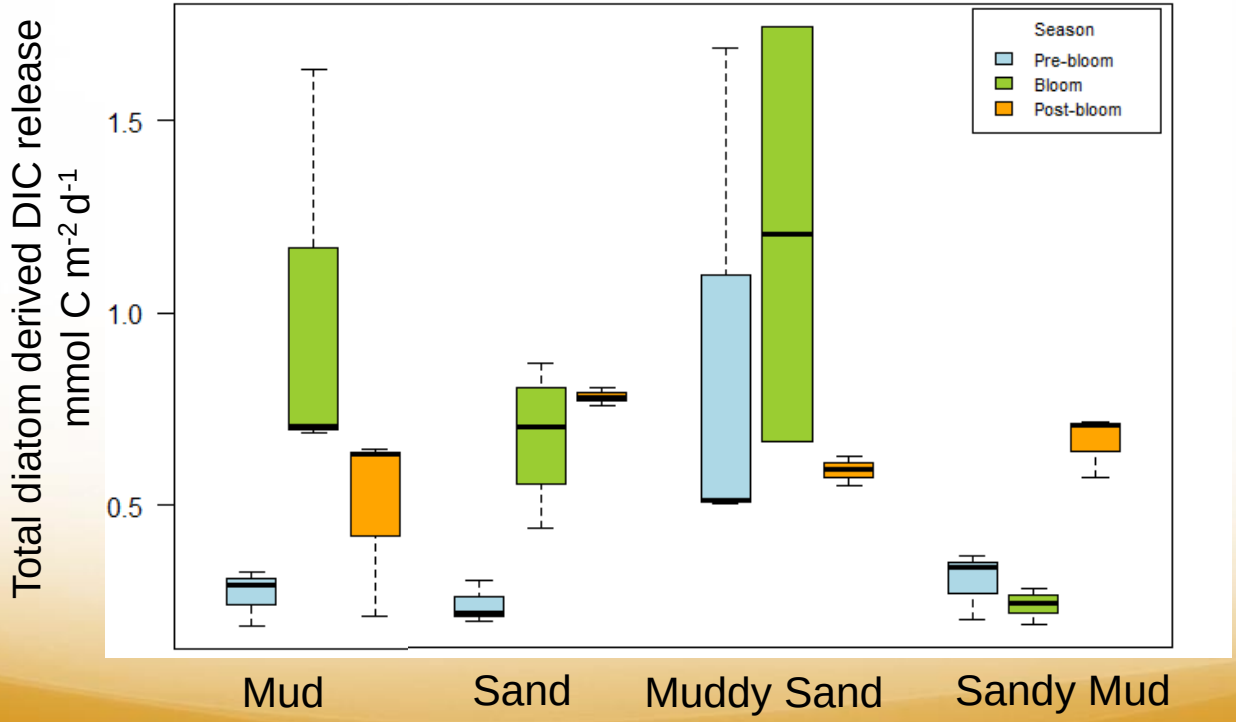
Faunal biomass



Faunal biomass ranged between ~1-10 mmol C m^{-2}
(an order of magnitude lower than bacteria)

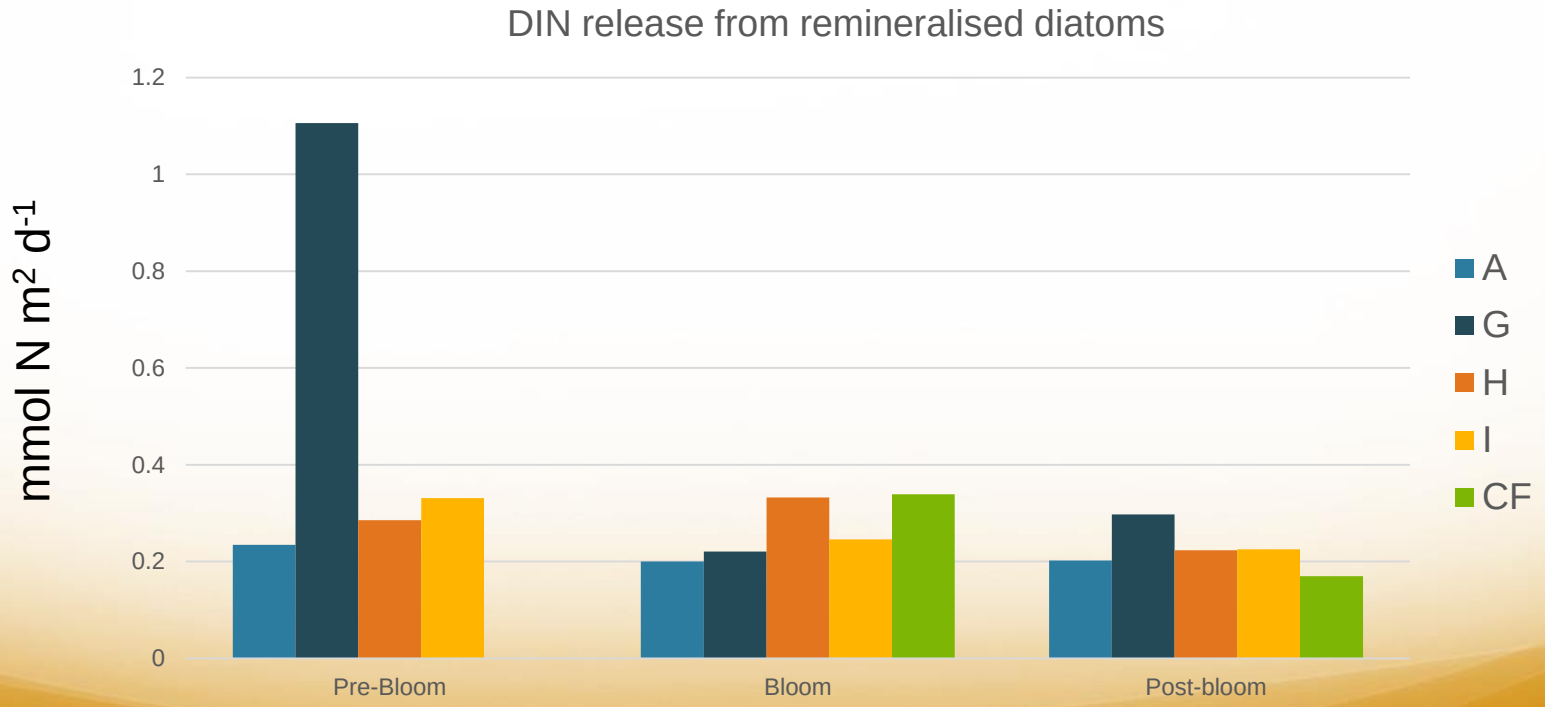
Stable Isotope labelled DIC flux

Remineralisation of added diatom carbon varies in space and time
(site x cruise interaction, $p < 0.001$)



Stable Isotope labelled DIN flux

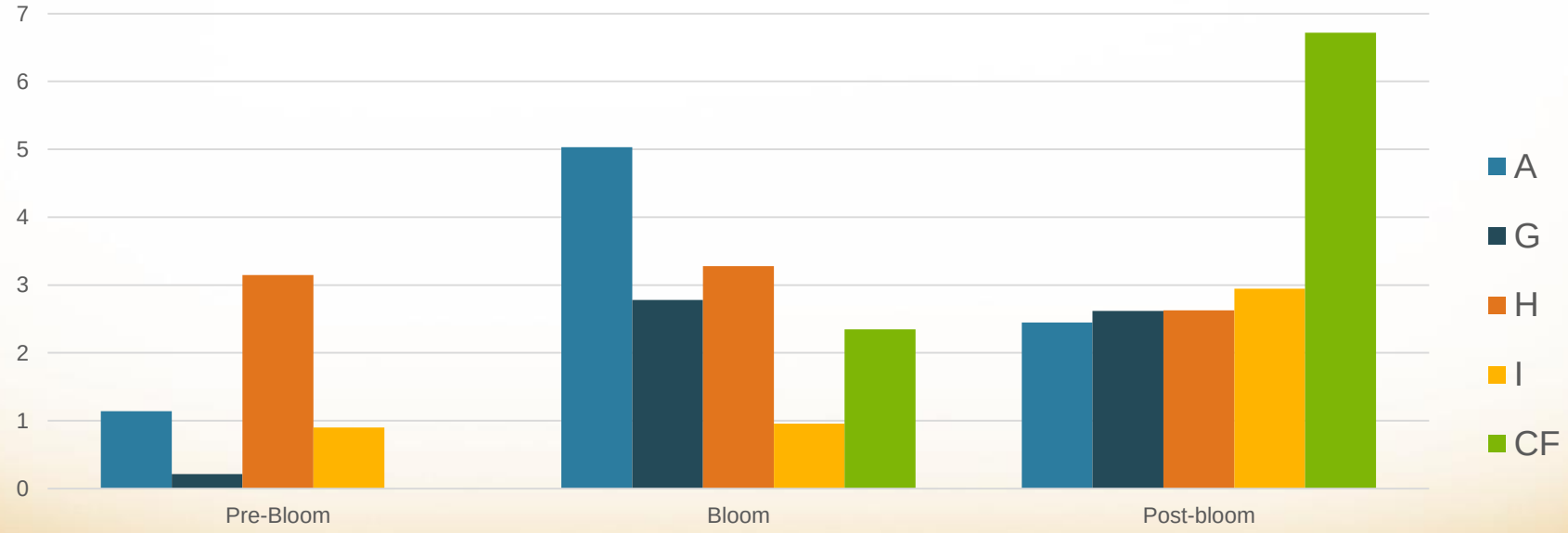
Remineralisation of added diatom nitrogen varies in space and time
(site x cruise interaction, $p < 0.001$)



Stoichiometry of remineralization

CN of remineralisation products varies in space and time

(site x cruise interaction, $p < 0.001$)



Variable, but always low (< Redfield)!

Summary

Bacteria clearly dominate benthic biomass at all stations

Interactive effects are common – community composition and biogeochemical functioning of the seafloor both vary in space and time

Benthos can rapidly process the addition of labile carbon, regardless of space/time

Remineralization stoichiometry is always low (CN <7 by atoms) – suggests community is:

- non-N limited (possible C limitation?)
- a strong source of DIN to the overlying water column