Impacts of ocean acidification on key benthic ecosystems, communities, habitats, species and life cycles

Aim 2

Quantify the impacts of ocean acidification on microbial communities and elemental cycling in coastal ecosystems

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Aim 2 - Quantify the impacts of ocean acidification on microbial communities and elemental cycling in coastal ecosystems

Task 2.1 Determine the impact of acidification on the distribution and fluxes of nutrients in sediment (Henrik Stahl, SAMS)

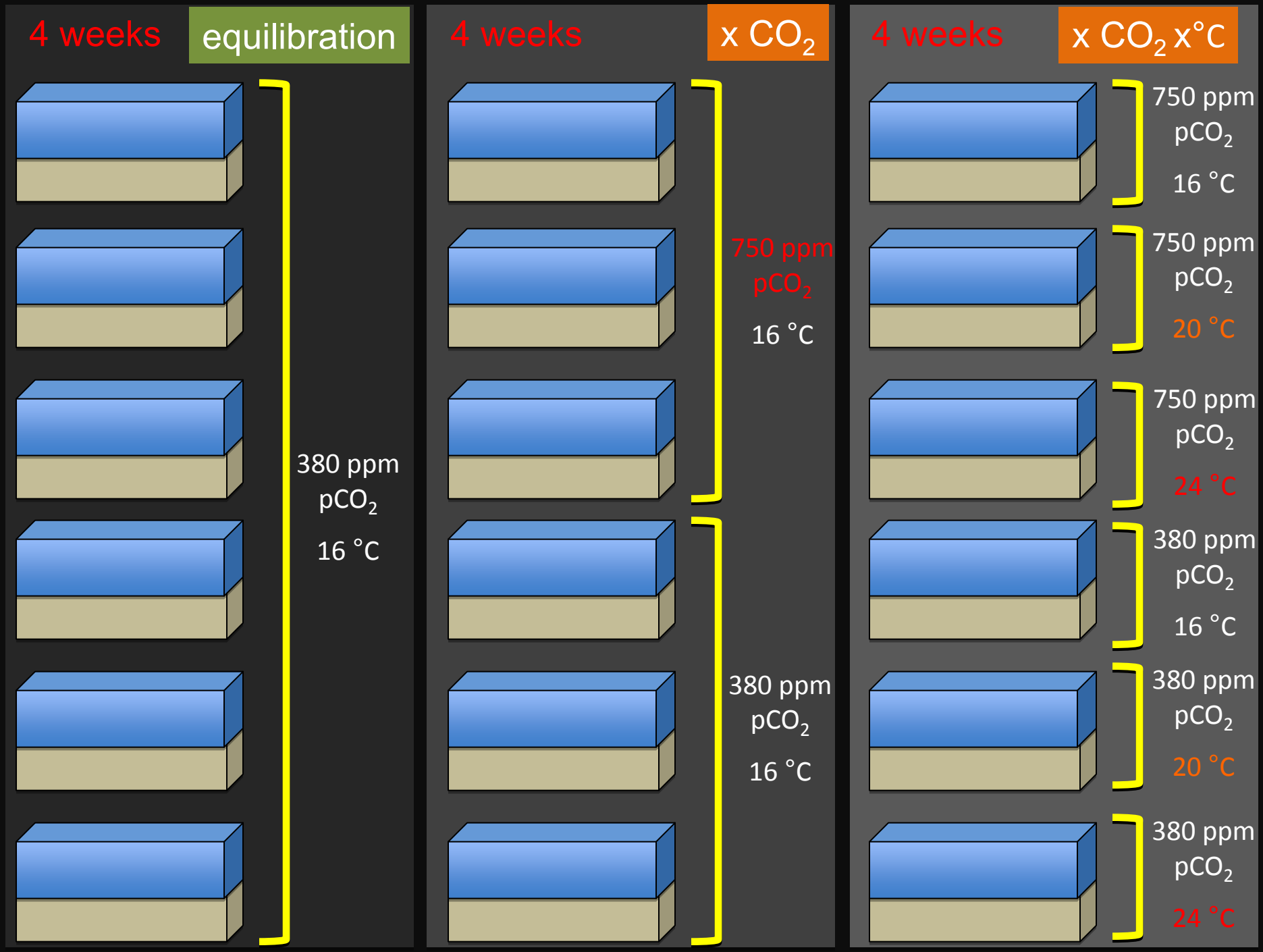
Task 2.2 Quantify the response of sediment microbial communities and N-cycling functional guilds to high CO_2 (Mark Osborn, Hull)

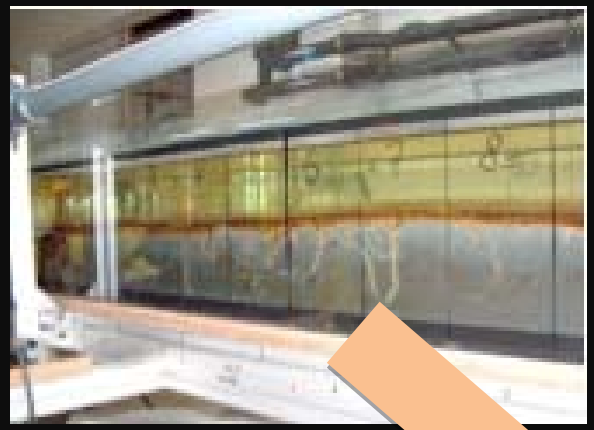
Task 2.3 Model the impact of ocean acidification on sediment nutrient cycling and shelf productivity (Jerry Blackford, PML)

Task 2.4 Quantify the impact of ocean acidification on biofilms from rocky habitats (Karen Tait, PML)

Experimental Systems:

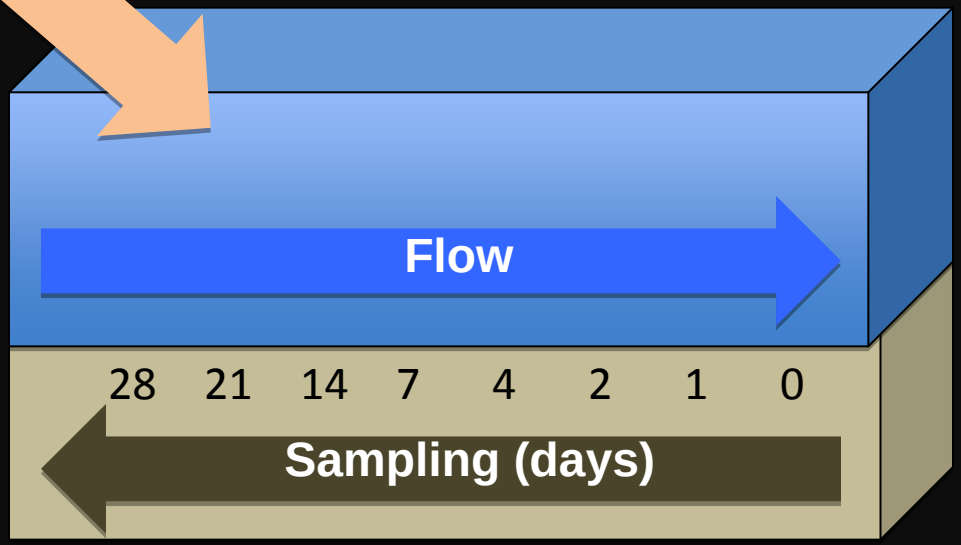
- Flume and percolation experiments (Henrik Stahl, SAMS)
- Settlement panels (Tom Vance, PML)


4 weeks
equilibration
380 ppm
pCO2
16 °C
4 weeks
x CO2
750 ppm
pCO2
16 °C
380 ppm
pCO2
16 °C
4 weeks
x CO2 x°C
750 ppm
pCO2
16 °C
750 ppm
pCO2
20 °C
750 ppm
pCO2
24 °C
380 ppm
pCO2
16 °C
380 ppm
pCO2
20 °C
380 ppm
pCO2
24 °C



Nutrient fluxes
(incl. NO_2^- NO_3^-, NH_3/NH_4^+, DON)
Sediment O_2, CO_2, pH, redox, alkalinity
Rates of nitrification, DN, anammox

silicate sands
cohesive muds
carbonate
sands
maerl



Biofilm structure (LTSEM)
Microphytobenthos activity
(PAM fluorescence)

Microbial analysis (DNA/RNA):
rRNA gene fingerprinting/sequencing
N-cycling gene abundance/diversity

Task 2.1 *Determine the impact of acidification on the distribution and fluxes of nutrients in sediment*

H_0 Elevated CO_2x temperature will have no significant impact on key sedimentary biogeochemical processes

Determine impact of elevated CO_2 x temperature on:

- sediment geochemistry
  (eg. redox, chemical distributions, alkalinity generation)
- nutrient cycling processes
  (nitrification, denitrification, anammox)

Analysis across spatial (μm to cm) and time (sec to days)

Impact on bioturbation (dialysis tubing model)

Complementary percolating core systems

Task 2.2 Quantify the response of sediment microbial communities and N-cycling functional guilds to high CO_2

H_0 Elevated CO_2 x temperature will have no significant impact on the structure, diversity and functioning of sediment microbial communities

Determine impact of elevated CO_2 x temperature on:

- bacterial/archaeal community structure and taxon diversity (T-RFLP and pyrosequencing of 16S rRNA genes)
- N-cycling gene abundance (Q-PCR) and diversity (nitrification, denitrification, anammox)
- MPB structure and activity

Analysis with depth (redox gradients) and time (days)

Multivariate comparison of microbial and geochemical datasets

Task 2.3 Model the impact of ocean acidification on sediment nutrient cycling and shelf productivity

H_0 Elevated CO_2x temperature will have no significant impact on the mediation of ecosystem function by sediment processes

Predict impact of elevated CO_2 x temperature on:

benthic-mediated UK shelf processes
(improved models for embedding in ERSEM-GOTM)

Formulate conceptual model to address OA impacts on interactions between microbial communities and geochemical cycling

Quantify process responses w.r.t. single and multiple driver scenarios (CO_2 × temperature treatments)

Task 2.4 Quantify the impact of ocean acidification on biofilms from rocky habitats

H_0 Elevated CO_2x temperature will have no significant impact on the diversity and functioning of microbial biofilms

Predict impact of elevated CO_2 x temperature on:

- structure and diversity of rocky habitat microbial biofilms
  (DGGE and sequencing analyses)
- MPB responses
  (eg. biomass, chlorophyll, primary productivity)

Biofilm microstructure

Utilising novel microbial settlement panels

OA impacts investigated over time (up to 12 weeks)