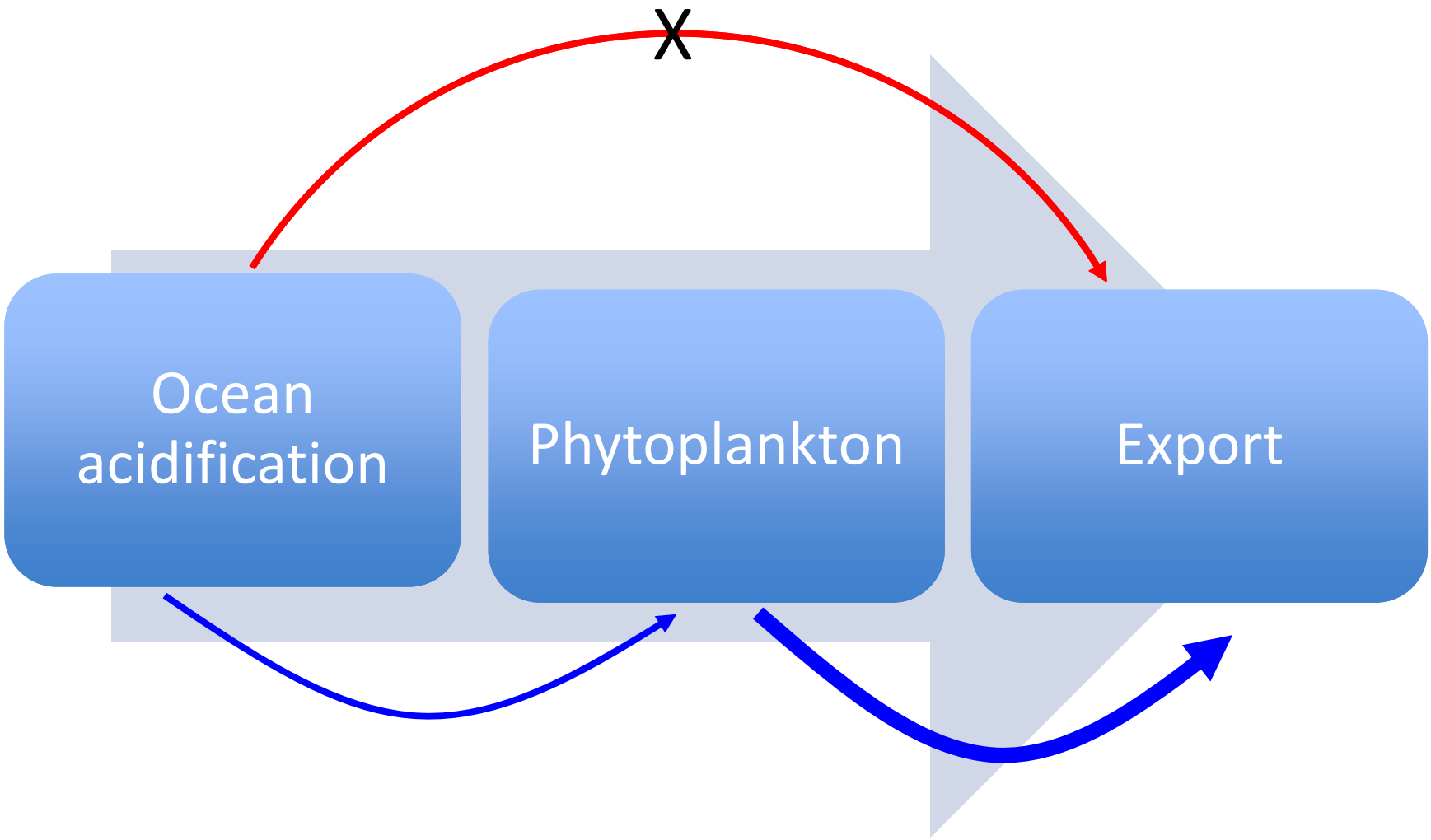
Ocean Acidification Impacts on Particle Sinking and Ballast

Helen Smith

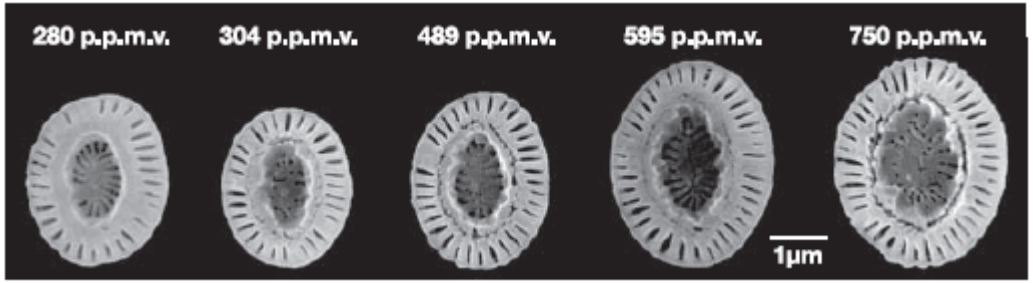
National Oceanography Centre
Southampton

Supervisors: Dr. Alex Poulton, Dr. Richard Sanders, Prof. Richard Lampitt

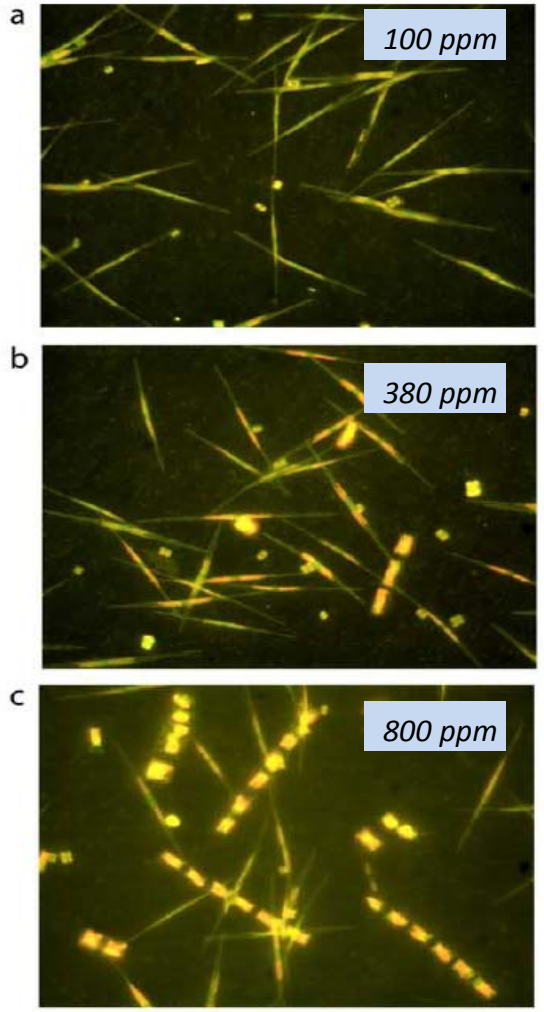

X
Ocean acidification
Phytoplankton
Export

- Particle sinking rates determined by size, shape & density
  - Surface community provides basis for particles

- Ballast = excess density (Klass & Archer, 2002)
  - Availability of $CaCO_3$ & BSi
  - Focus on coccolithophores and diatoms

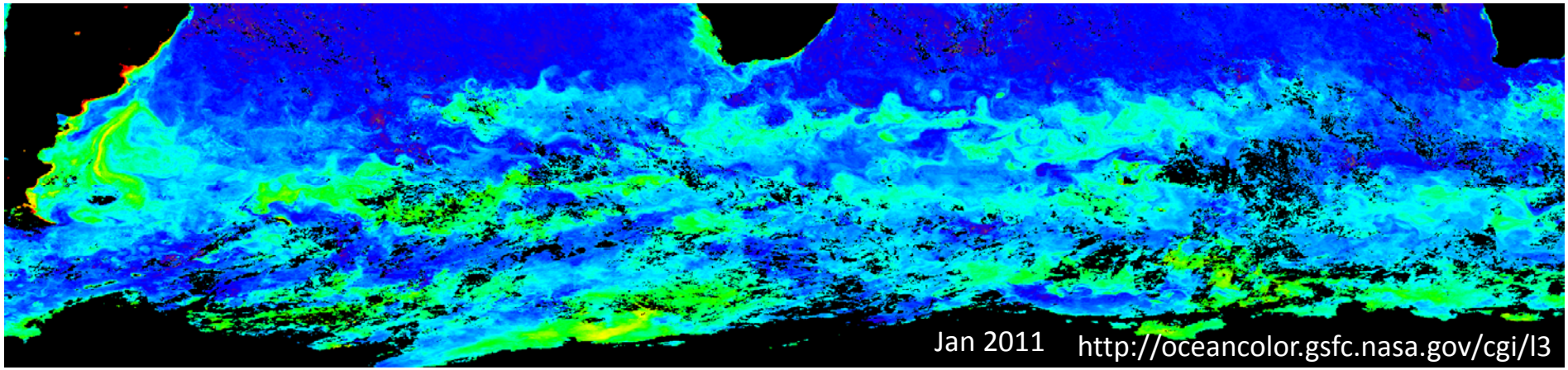


Iglesias-Rodriguez et al. (2008)



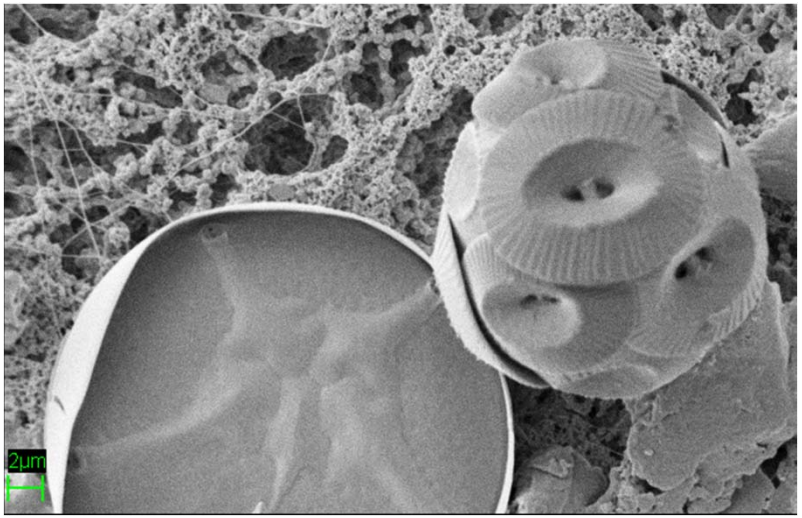
Tortell *et al.*, 2008

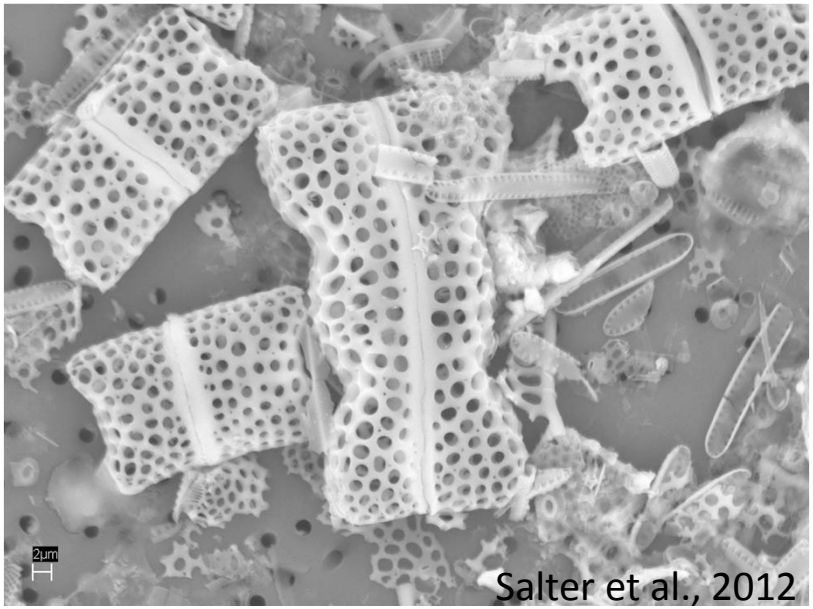
- Polar Oceans vulnerable to OA
- Lack trans-ocean studies into phytoplankton distribution, dominant functional group and export
- Great Calcite Belt – 40-60^{o}S
  - Compare export within and outside feature



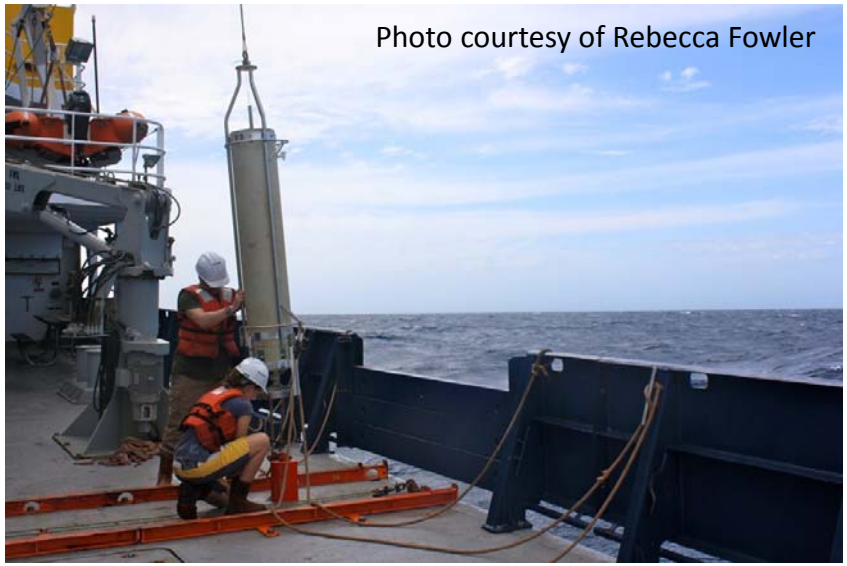
Marine snow

- Aggregates/pellets > 0.5 mm diameter
- Main contributor to biological carbon pump
- Selective export observed
  - N. Atlantic = *C. pelagicus* *(J. Hurst, MSc 2011)*
  - Crozet, Southern Ocean = *Eucampia antarctica* (Salter et al., 2012)
- What is the spatial variation?

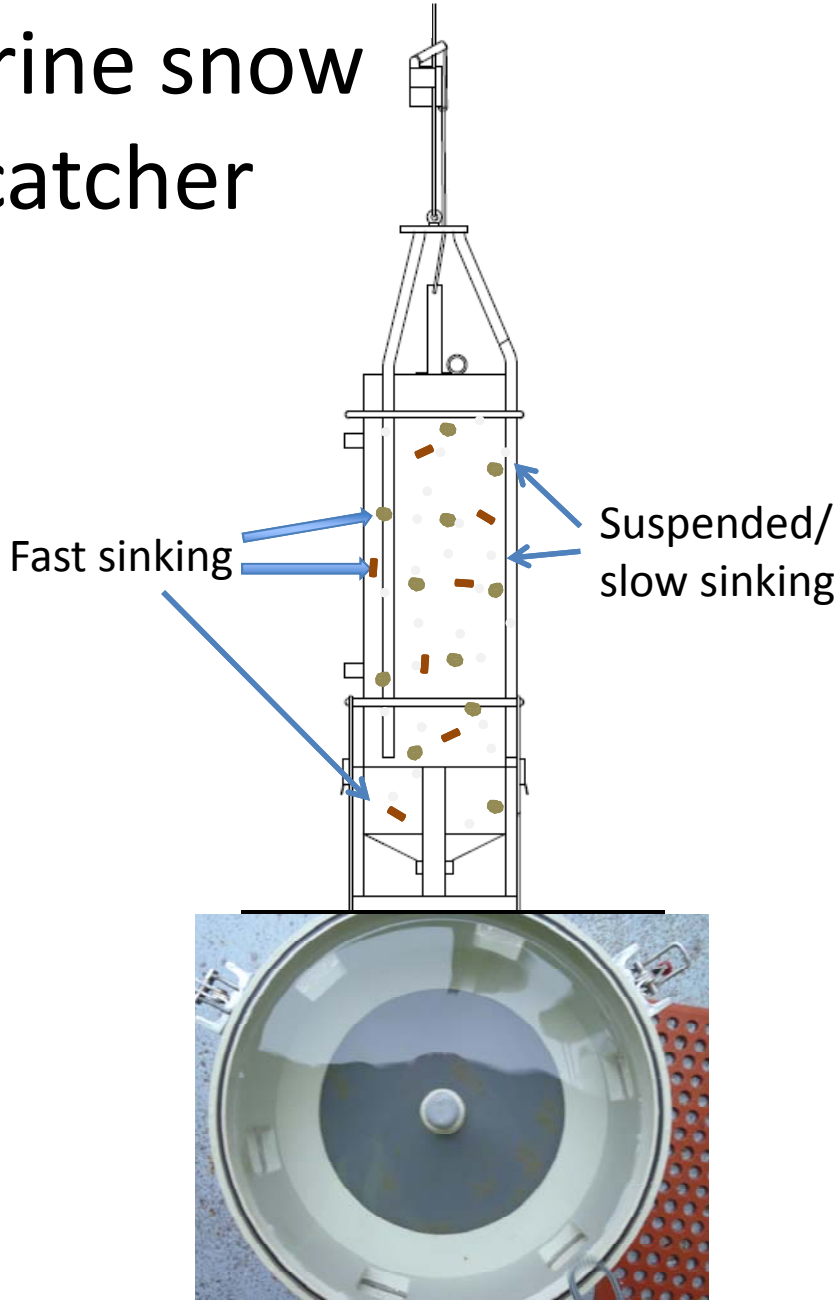




Salter et al., 2012



Marine snow catcher

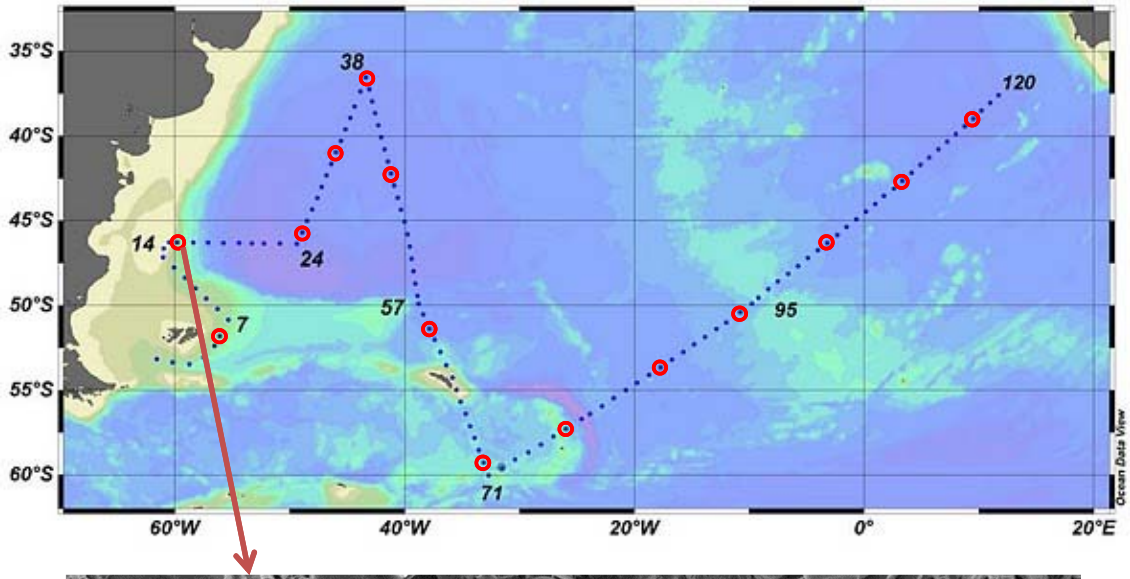


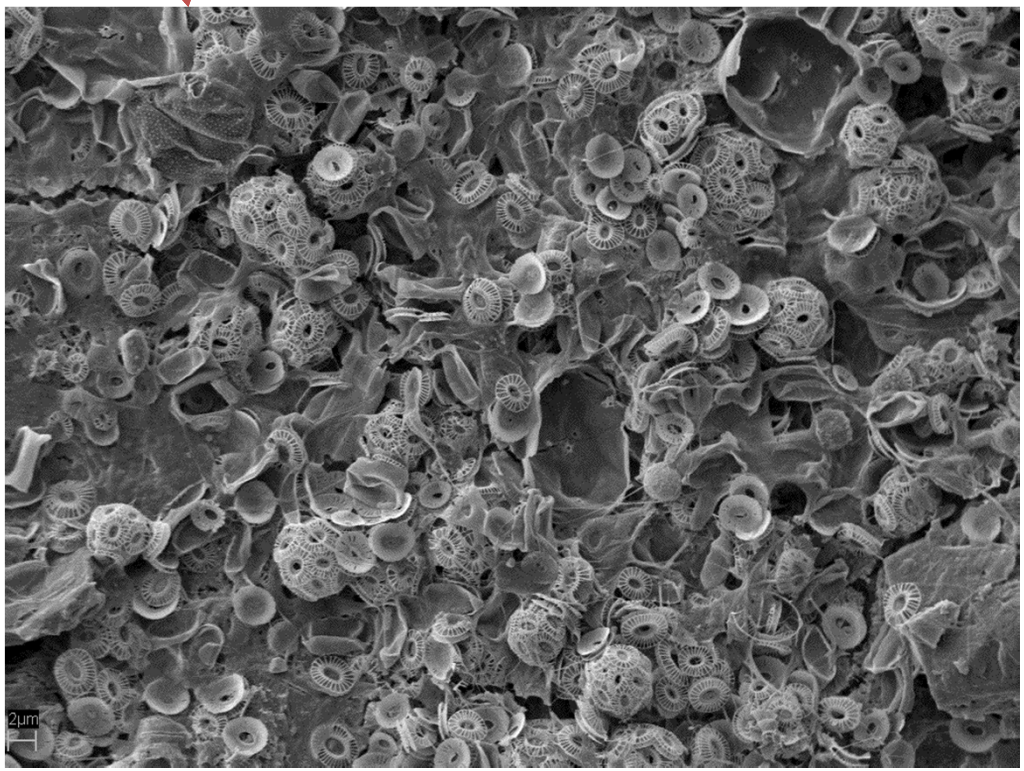
PI - Barney Balch

MV1101

Jan - Feb 2011

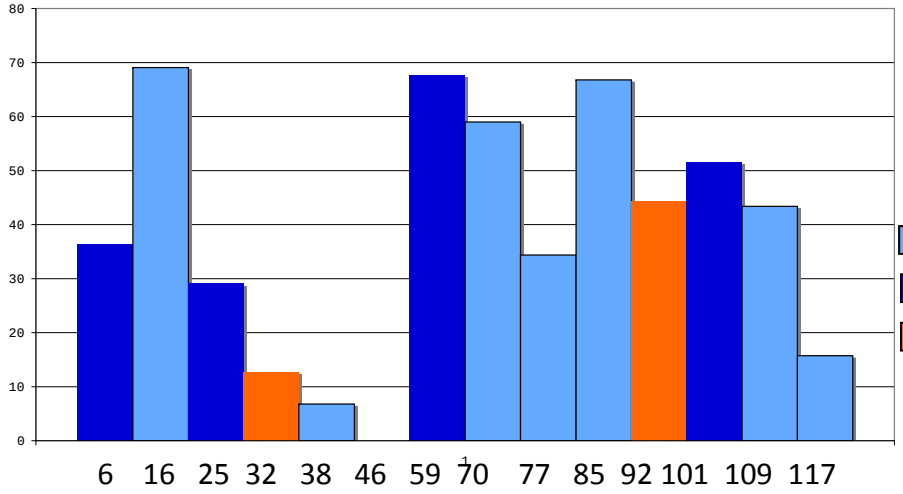
NE/F015054/1



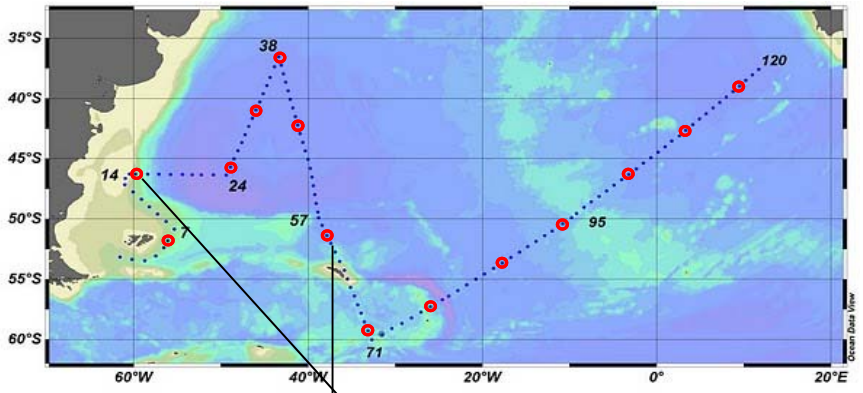


E. huxleyi type B/C bloom on the Patagonian shelf
+ *Fragilariopsis* ssp

Bray Curtis similarity
between surface and export community



Diatom
Coccolithophore
Mixed

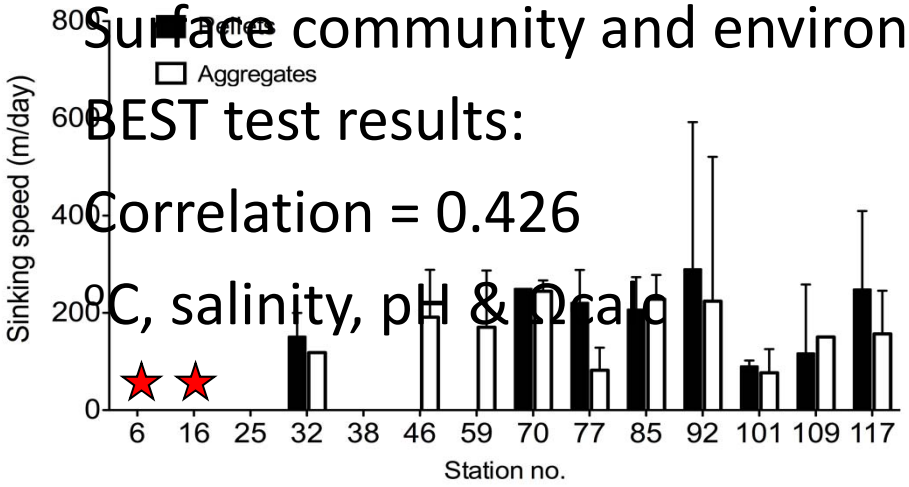


Surface community and environment

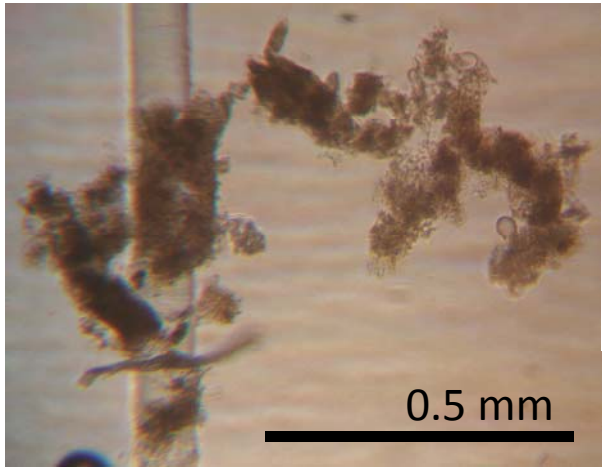
BEST test results:

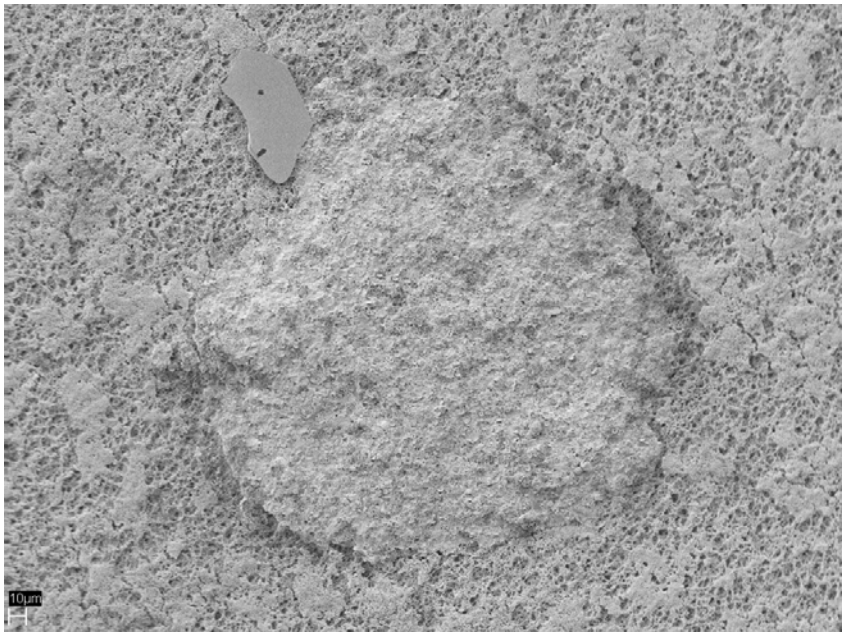
Correlation = 0.426

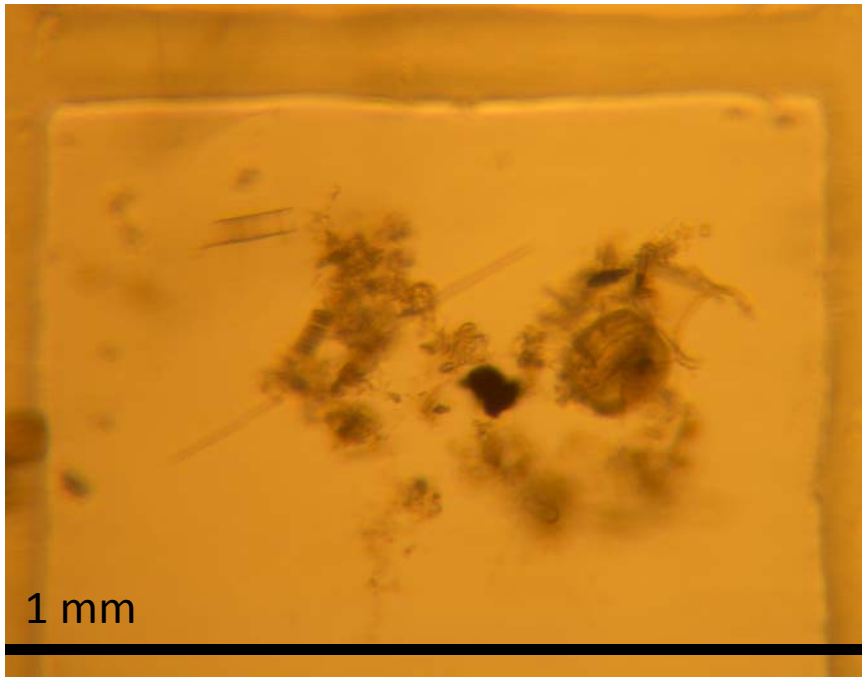
T, salinity, pH & Ωcalc

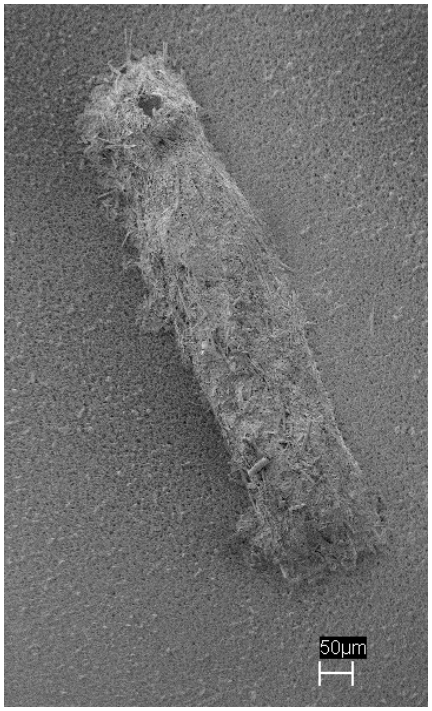


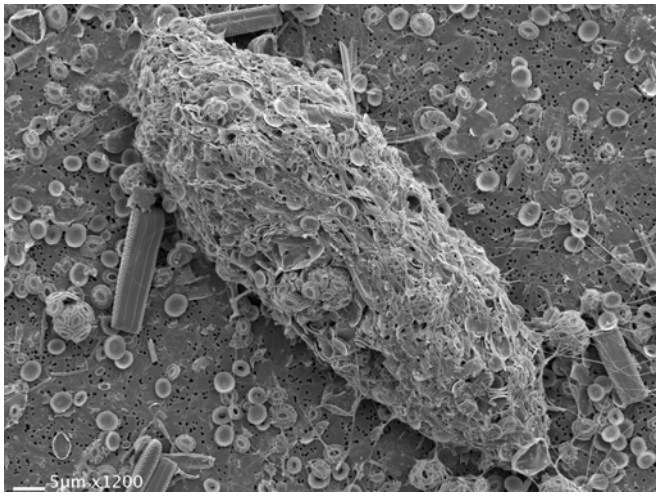
★ Aggregates present but too delicate to re-sink











Poulton (2008) *E. huxleyi bloom, Patagonian Shelf*

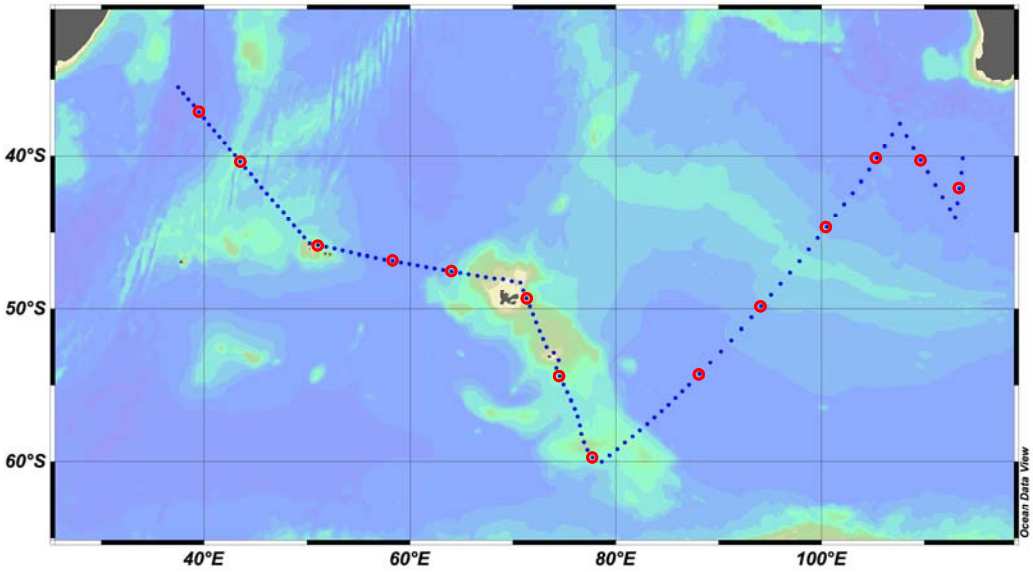
PI - Barney Balch

RR1202

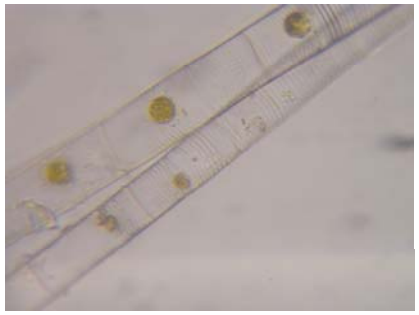
Feb - Mar 2012

OA added value grant

UK Ocean Acidification Research Programme



- Highly diatomaceous aggregates in places
  - *Dactyliosolen* and *Rhizosolenia* ssp chains



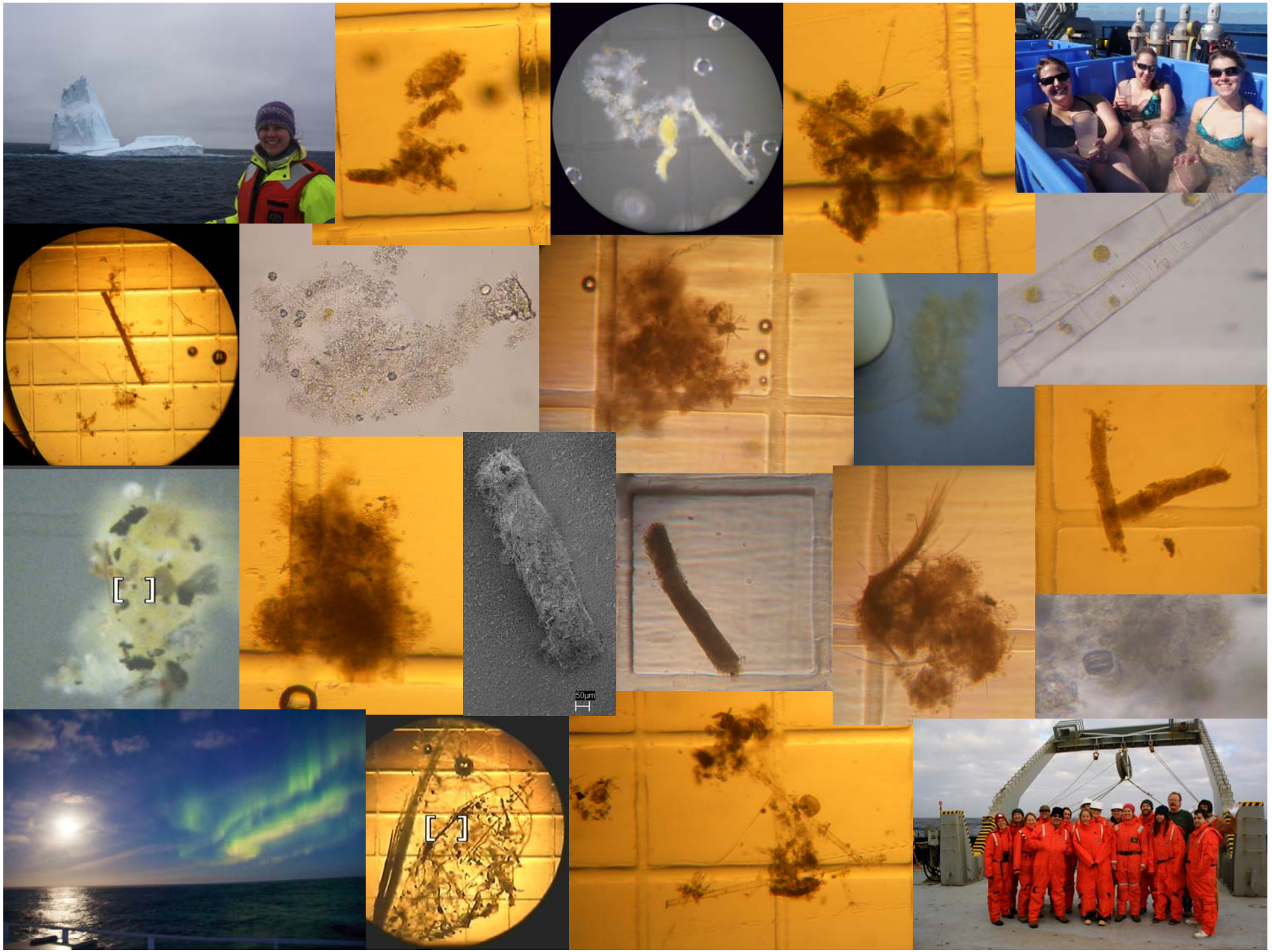
- More extreme sinking rates

- CO_2 and Fe addition
  - Longer incubations >120 hours

JR271

UK Ocean Acidification Research Programme

- 2010 cruise found pellets - diatom content (J. Riley)
- Deploy MSC alongside thorium casts and SAPs
- ~ 14 stations
- 2x deployment per station where possible
  - Increase spatial or temporal resolution



SEM images from MV1101 carboy experiments
Sinking speed vs co32- saturation state