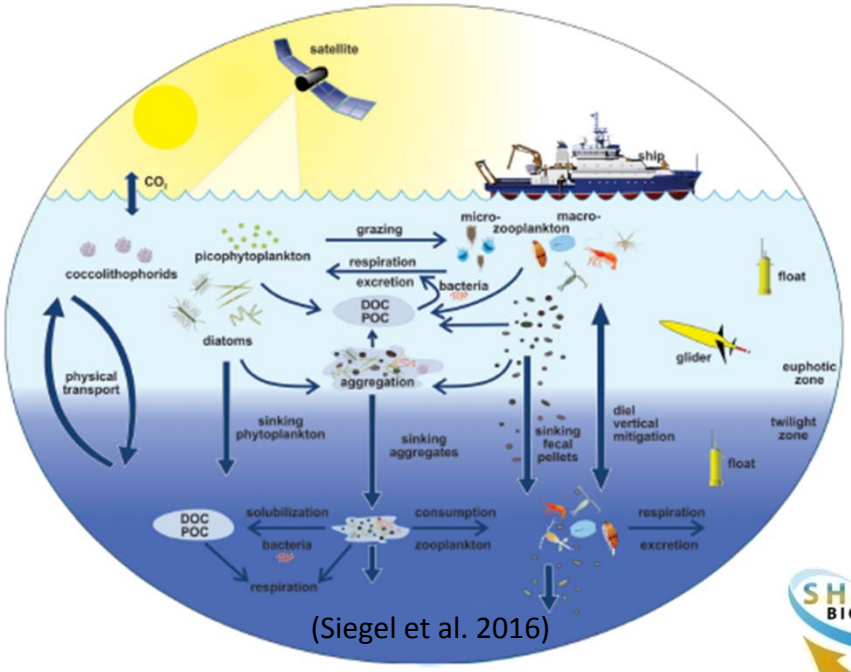
# Dynamics of Transparent Exopolymer Particles (TEP) and their contribution to carbon export

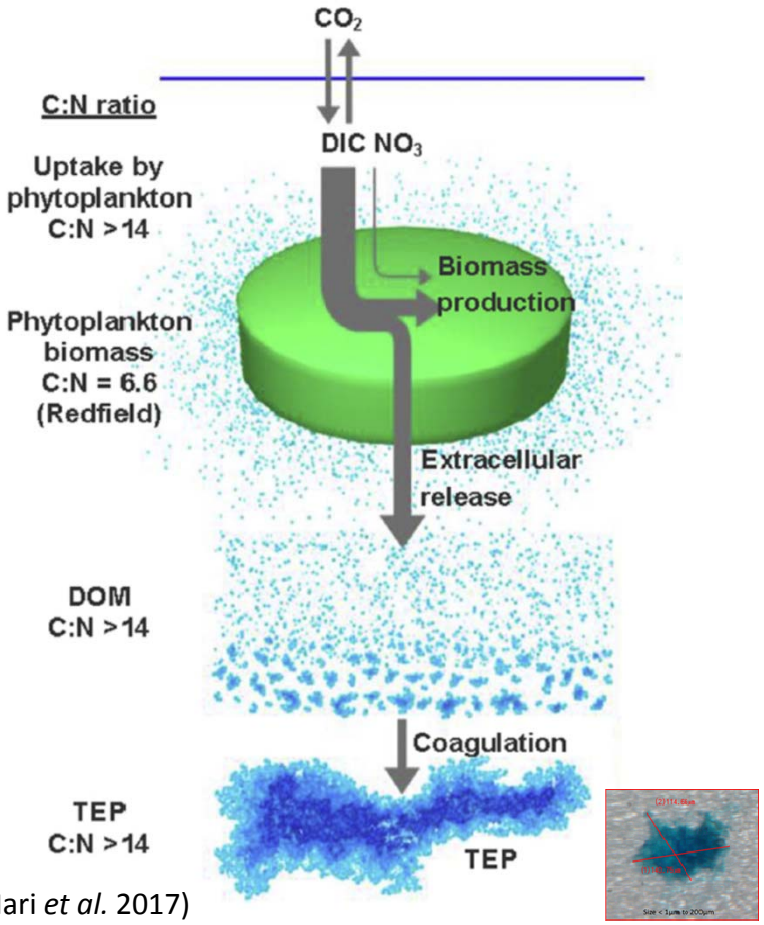
**Gianfranco Anastasi** (UEA/Cefas), Martin Johnson (UEA/Cefas), Gill Malin (UEA), Dorothee Bakker (UEA), Naomi Greenwood (Cefas) and Luca Polimene (PML)




(Siegel et al. 2016)

SSB meeting Winchester 5-6 June 2017

# What is TEP and Why do we study it?




(Mari *et al.* 2017)

TEP is a transparent gel particle formed from extracellular polymeric substances (EPS) exuded by microorganisms

(Alldredge *et al.* 1993)

High content in C and poor in N

(Mari *et al.,* 2001)

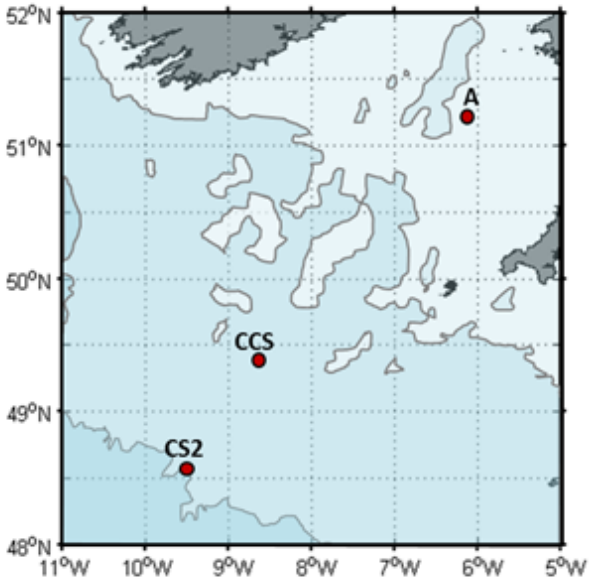
High capability to aggregate solid particles

(Engel and Passow 2001)

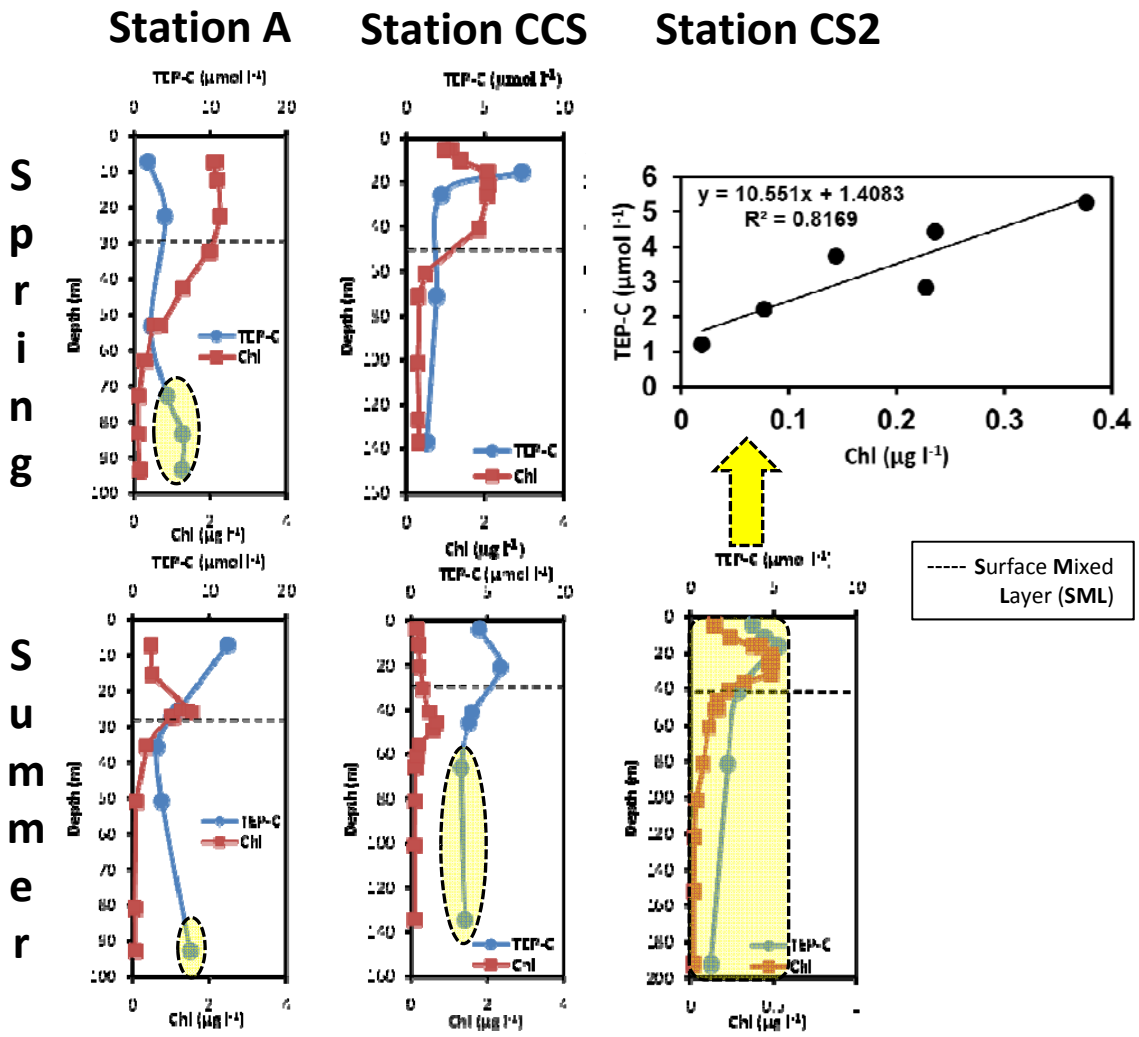
TEP may increase the flux of carbon from the atmosphere to the seafloor at a higher atmospheric concentration of $CO_2$

(Arrigo 2007)

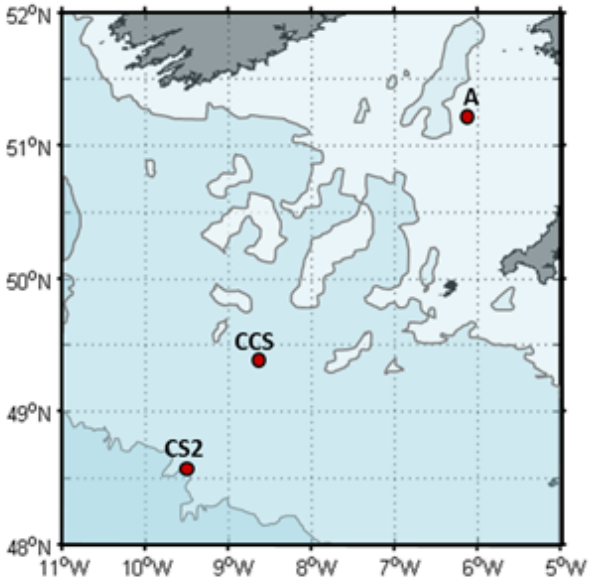
# TEP in the Celtic Sea



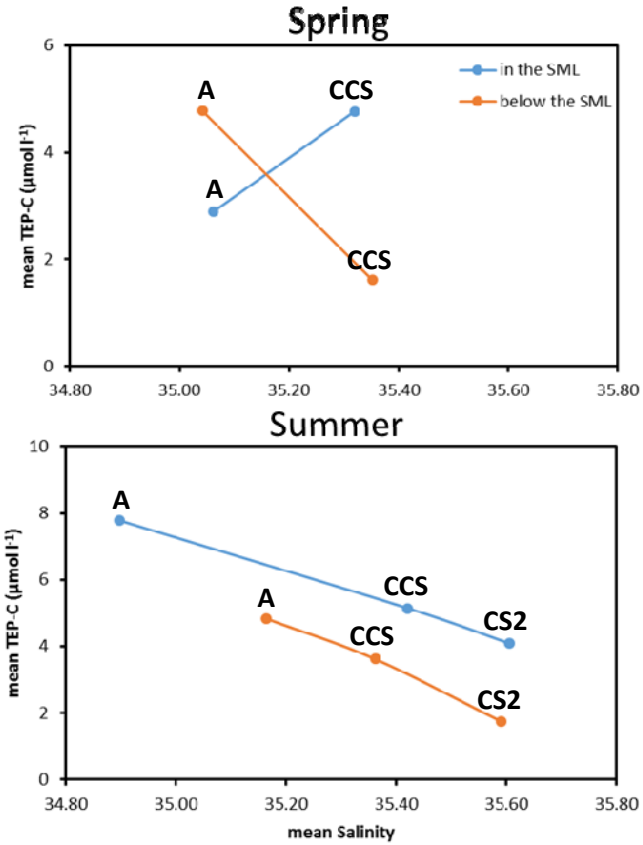

- ✓ Lower concentrations of TEP and Chl in the Celtic Sea respect to that of the North Sea
- ✓ St. A benthic influence
- ✓ St. CCS accumulation of TEP
- ✓ St. CS2 strong relationship between TEP and Chl



# TEP along a transect from coast to open ocean

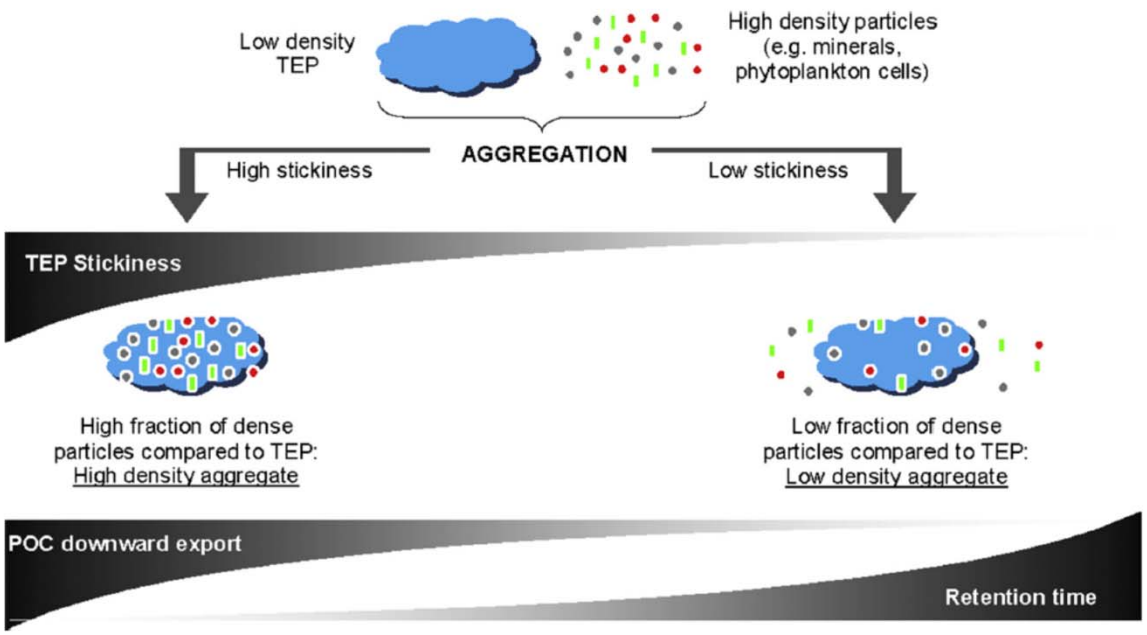



✓ Decreasing concentrations of TEP from coast to open ocean



# TEP aggregates : formation and sinking

## Conceptual diagram




(Mari *et al.* 2017)

## Method

**Calculated parameters :**

- ✓ TEP aggregate composition
- ✓ TEP aggregate density [1] and sinking velocity (Stokes' Law)
- ✓ TEP and POC fluxes

**Assumptions:**

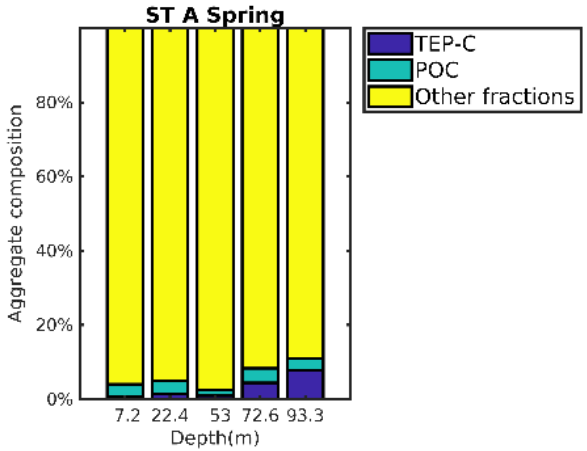
- ✓ Aggregates are spherical and consist of TEP, POC and Other fractions
- ✓ ~ 50% of TEP-C is retained on GF/F filters used for POC analysis [2]
- ✓ Densities: TEP 700-840 kg/m$^3$ [3], POC [4] and Other fractions 2100-2600 kg/m$^3$ [5]
- ✓ Aggregate porosity 0-0.99 and radius 0.1-5 µm

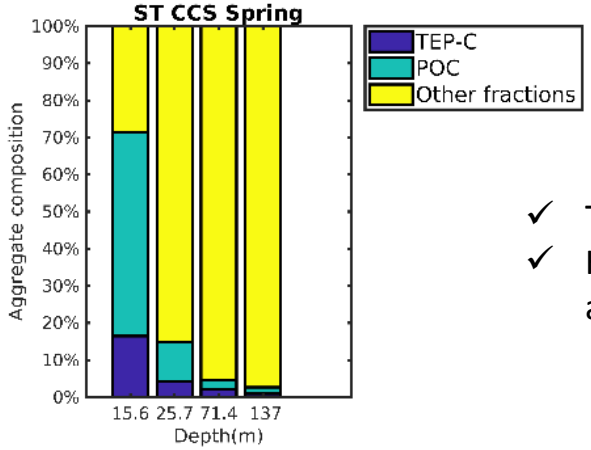
**Limitations :**

- ✓ Range of values equally spaced, each value has the same weight
- ✓ Fluxes heavily influenced by aggregate size

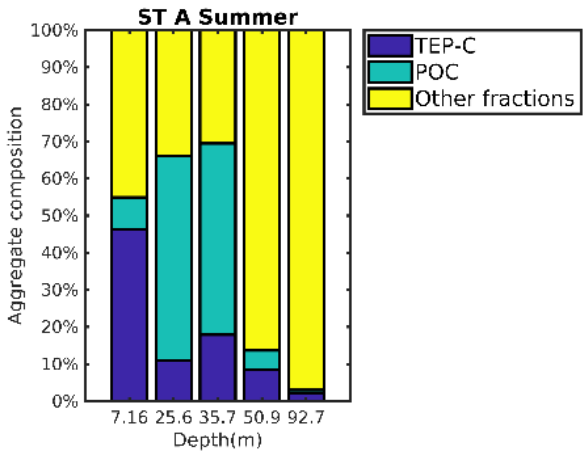

[1] Mari *et al.* 2017 [2] Passow and Alldredge 1995
[3] Azetsu-Scott and Passow 2004 [4] Van Ierland and Peperzak 1984
[5] Chen *et al.* 2011

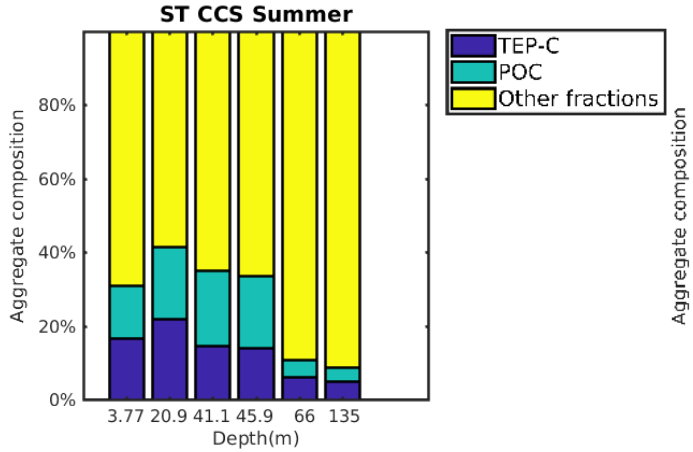
# TEP in aggregates

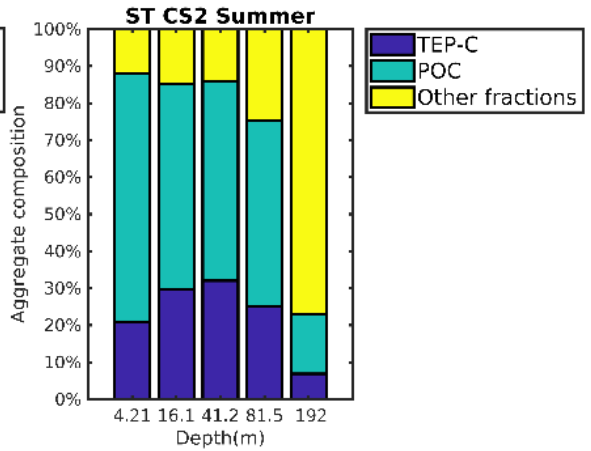


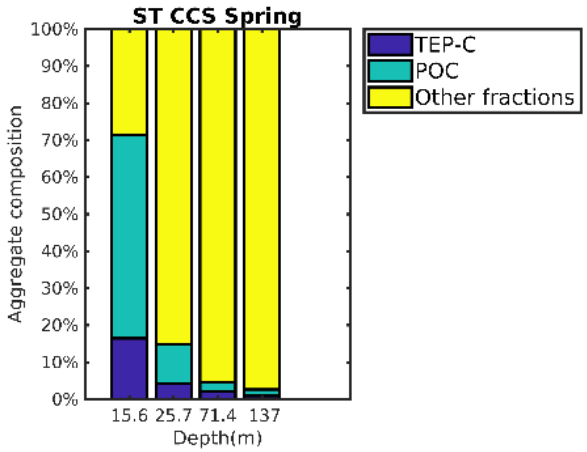

- ✓ TEP density 700-840 kg/m$^3$
- ✓ High % of TEP can make the aggregate lighter

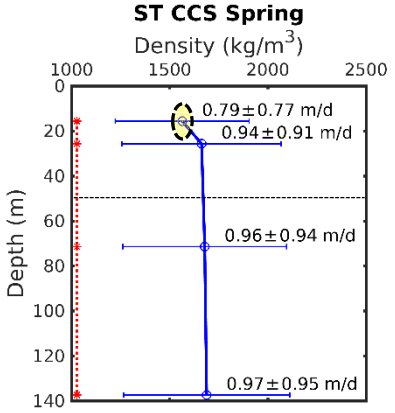


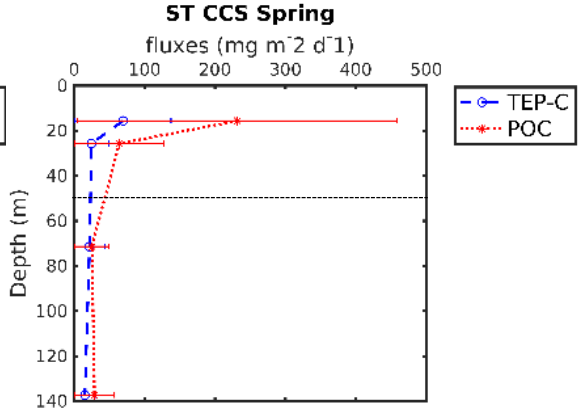



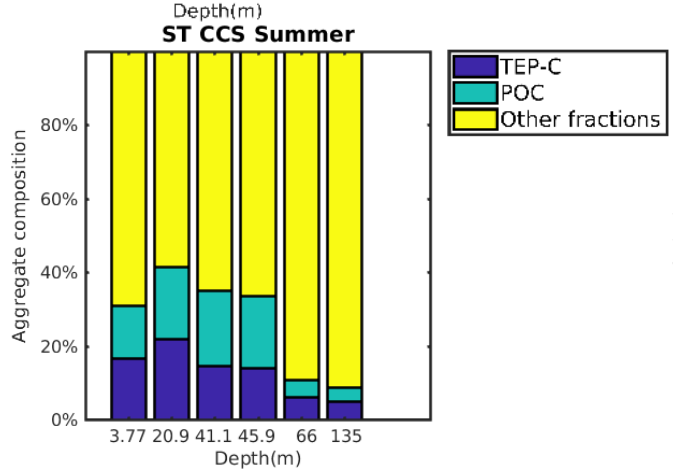



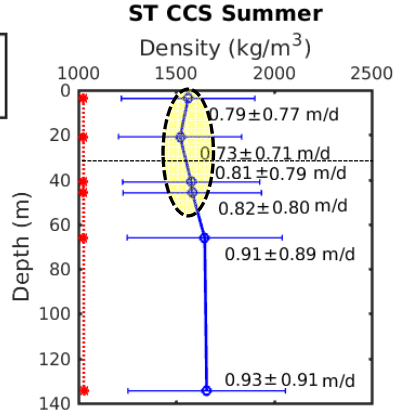
# Example of TEP in aggregates: CandyFloss (Station CCS)

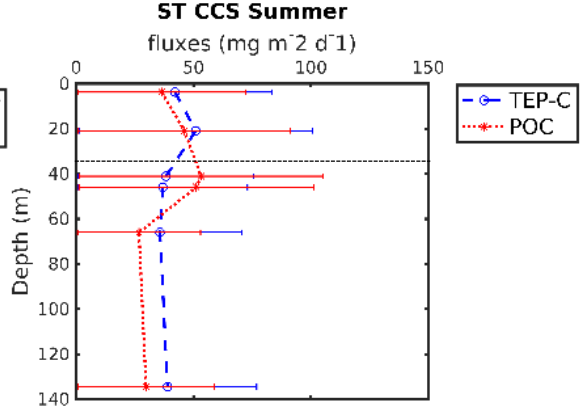


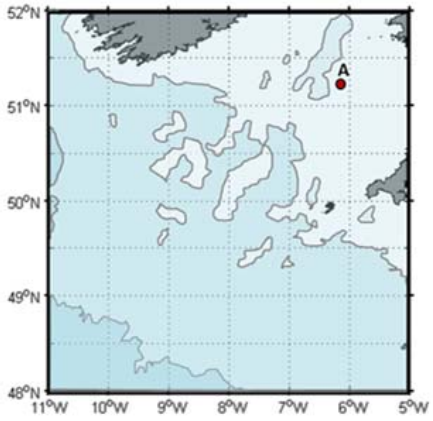



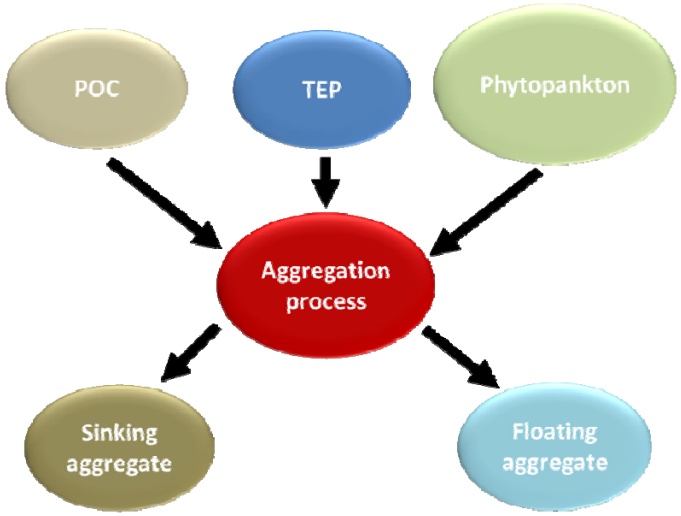



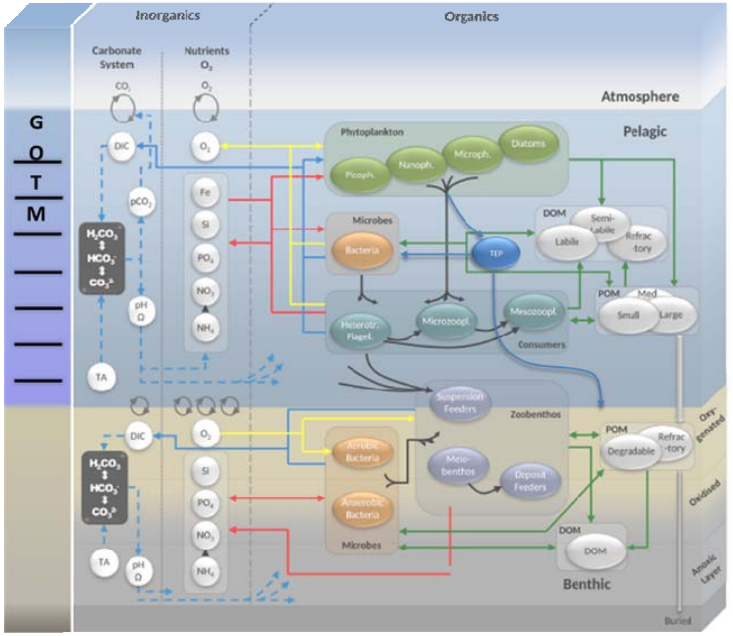



# TEP in aggregates: Modeling TEP aggregates in the shelf sea

Ongoing work: use TEP aggregate density and TEP stickiness to predict the fate of TEP in shelf sea



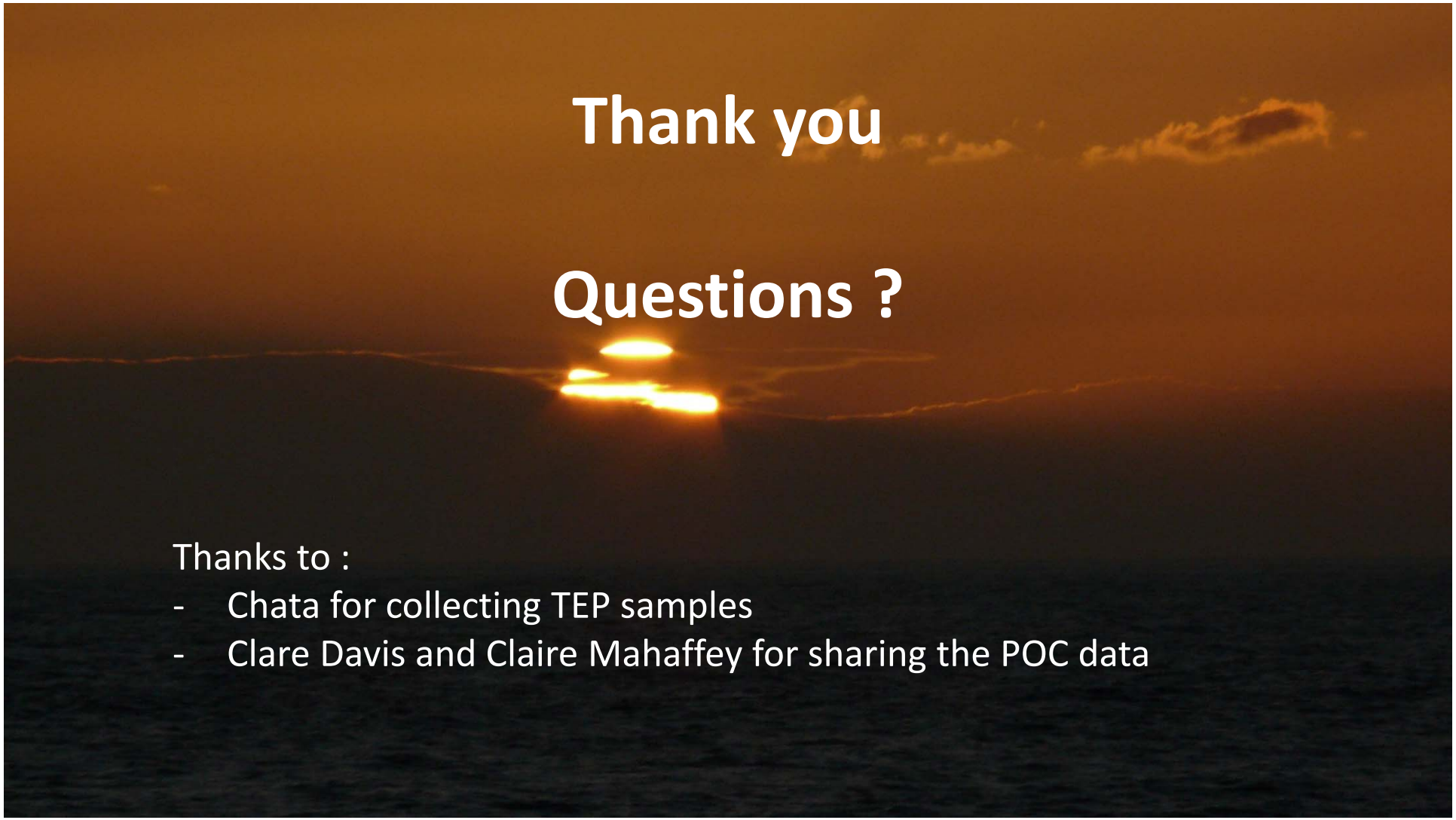



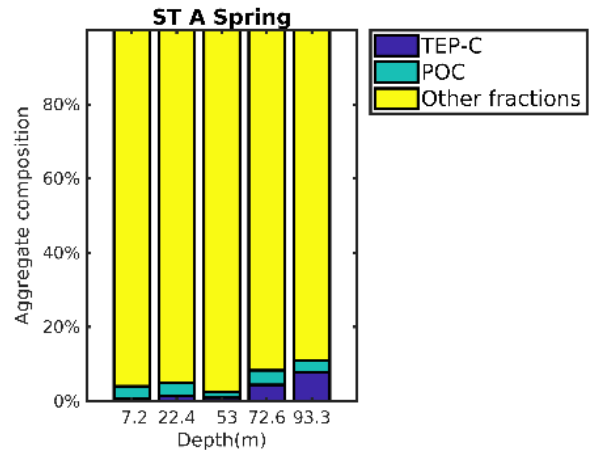

New formulation in European Regional Seas Ecosystem Model (Butenschön *et al.* 2016) describing TEP dynamicis

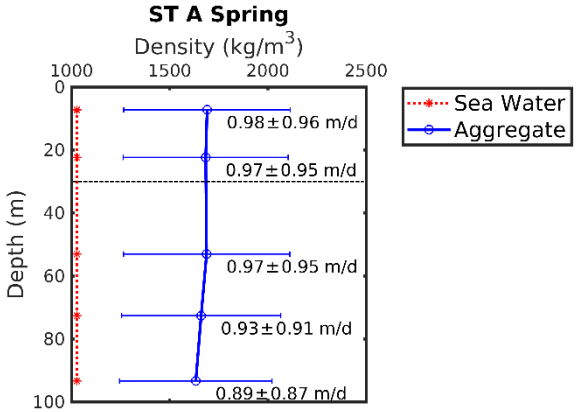
# Conclusions on TEP in the Celtic Sea

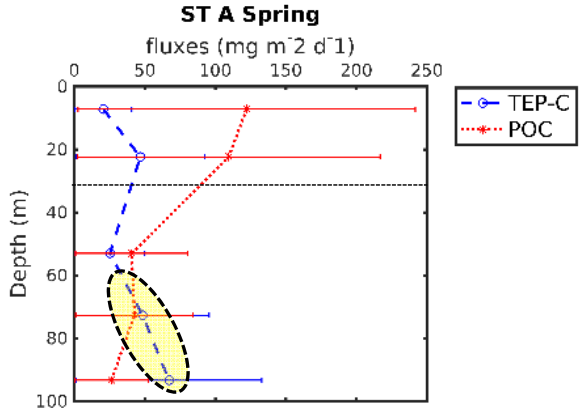
- ✓ The vertical distribution of TEP in the Celtic Sea is site specific:
  - Station A potential benthic interaction by the resuspension of old TEP
  - Station CCS export of TEP from the SML and accumulation of TEP below the SML from spring to summer
  - Station CS2 strong relationship between TEP and Chl a
- ✓ TEP concentration decrease from coast to shelf edge
- ✓ TEP acting as a glue lead to the formation of particles heavy enough to sink
- ✓ High concentration of TEP can make the aggregate lighter and reduce its sinking velocity
- ✓ **TEP production may increase/decrease the vertical flux of POC (and TEP)**

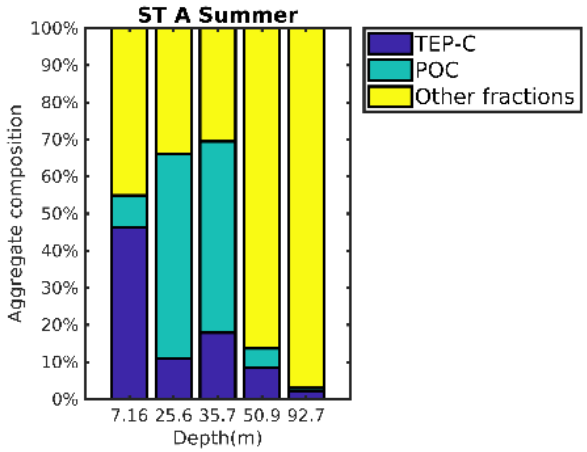

Thank you
Questions ?
Thanks to :
- Chata for collecting TEP samples
- Clare Davis and Claire Mahaffey for sharing the POC data

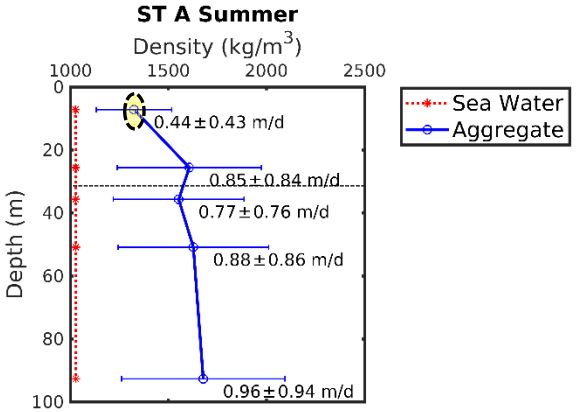
# TEP in aggregates: Celtic Deep (Station A)

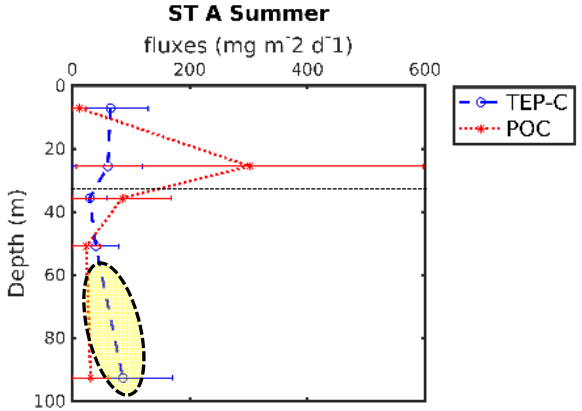


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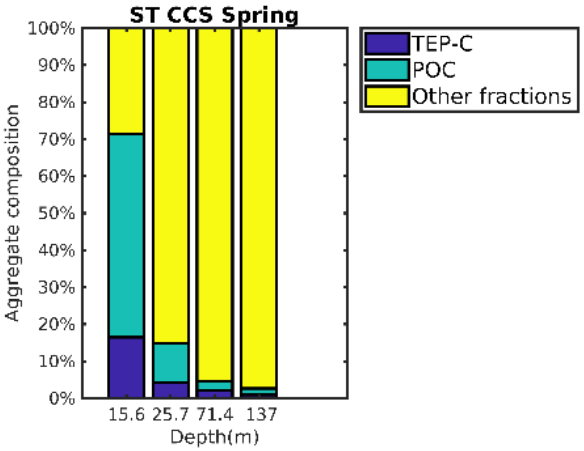


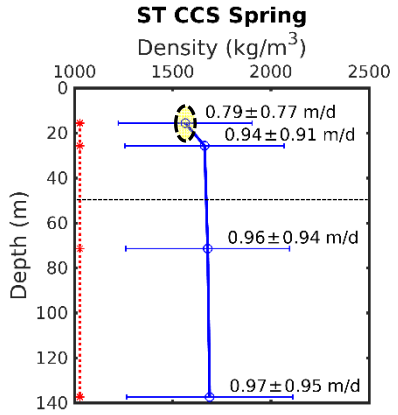


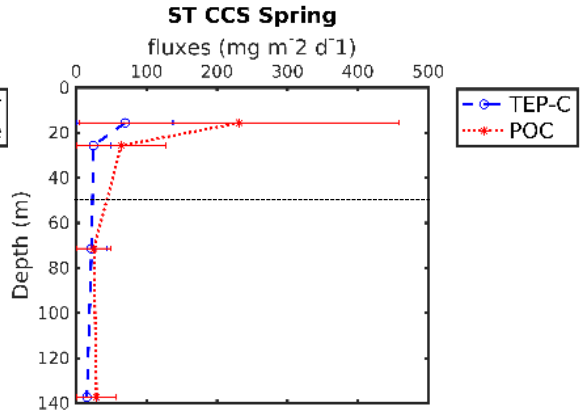


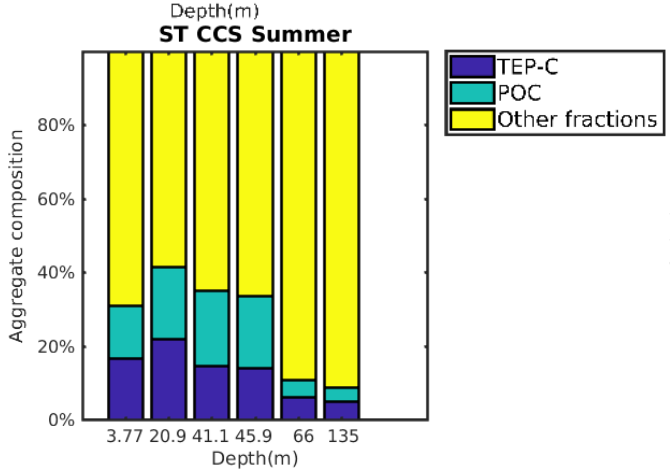


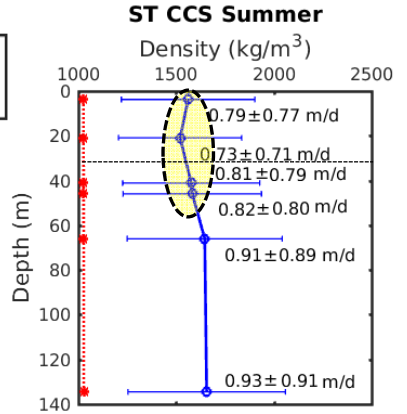


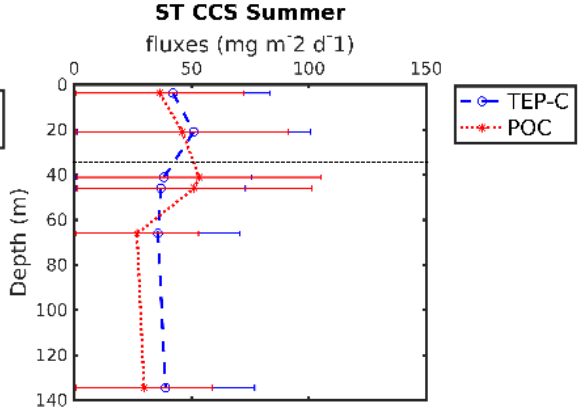

# TEP in aggregates: Shelf Edge (Station CS2)