

SURFACE-ACTIVE PARTICLES IN A PHYTOPLANKTON BLOOM

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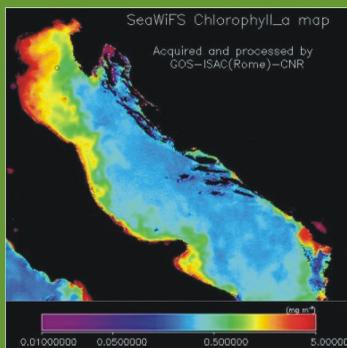
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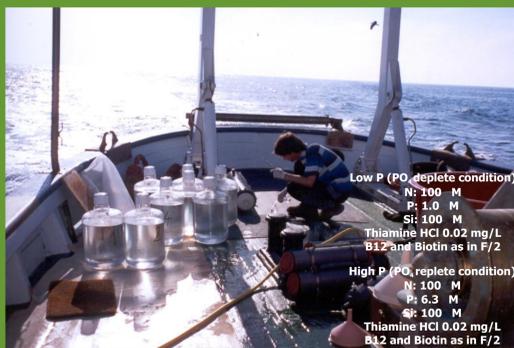
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Mesocosm experiment "Rovinj 2003"



Chlorophyll a values from the satellite images at the time of seawater collection.



Onboard enrichment of collected seawater after partitioning into 8 bottles.



View on simplistic construction and positioning of mesocosm experiment.



The bloom experiment on day 11 (May 17th).

PARAMETER	UNITS
Chlorophyll a	μg/L
Primary production rate	μg C/(Lb)
Nutrients	μmol/L
PO ₄	
Total P	
NO ₃	
NO ₂	
NH ₄	
Si	
Microphytoplankton	N/L
Pico and nanoplankton	N/L
Bacteria	
Cyanobacteria	
Aut. nanoflagellate	
Aut. phaeoflagellate	
Het. nanoflagellate	
Het. phaeoflagellate	
Bacterial production	
Bacterial enzymatic activity	μg C/(Lb)
Phosphatase	nmol/(Lb)
Protease	
Lipase	
glucuronidase	
CFC-stained bacteria	N/L (%)
Viable bacteria (CFU)	
Microparticles	Nx10 ⁷ /L
Surface-active	
Gel	mg/L
DOC	μmol/L
DOC	μmol/L
TPN	μmol/L
TEP	N/L
YEP	μg/L
Naturalium red particles	
CSP	N/L
CSP, DYP & BDP	N/L
Bacterial community	N/L
Fatty acids	
Oxygen	% Sat.

Measured parameters

The Adriatic Sea is mainly phosphorus (P) limited, and this was the basis of the design of mesocosm bloom experiment Rovinj 2003 to follow the dynamics of particle formation. We used a low (1 μM) and a high (6.3 μM) P addition, to attempt to achieve two different levels of biomass accumulation. At the same time, this was the unique opportunity to evaluate relation and relevance of presently available measurement techniques for monitoring marine particles. A more specific goal was to contrast particle formation in low P and high P nutrient enrichments using the advantages offered by electrochemical approach.

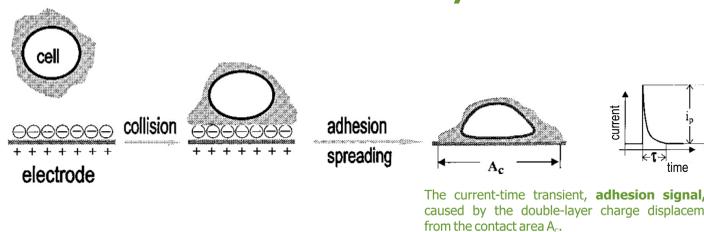
Present state of knowledge of abiotic particles produced during phytoplankton bloom experiments as well as in the upper ocean is mostly based on information gathered by staining techniques. The most frequently followed microparticle class are transparent exopolymeric particles stainable by alcian blue (TEP). TEPs are described as gel particles in the size range from 3-5 μm to 100 μm. Particles retained on filters are stained with alcian blue (cationic dye that stains anionic polysaccharides) at pH 2.5. Such procedure may produce structural artifacts including aggregation and rearrangements.

Electrochemical technique - chronoamperometry at mercury electrode

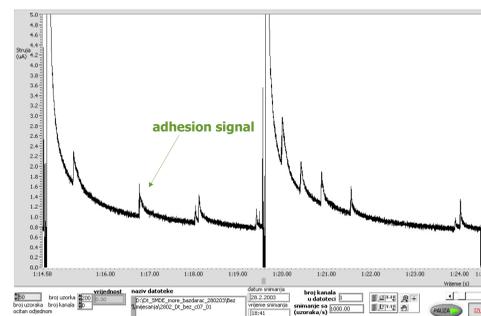
In order to gain information on native structure of particles it is essential to develop methods and techniques with potential to analyze particles in their natural aquatic environment without separation (filtration, centrifugation) and to avoid drying process.

Electrochemical technique we developed fulfills this requirement. Cell adhesion to mercury electrode demonstrates the general significance of adhesion phenomena in single particle-electrode interaction.

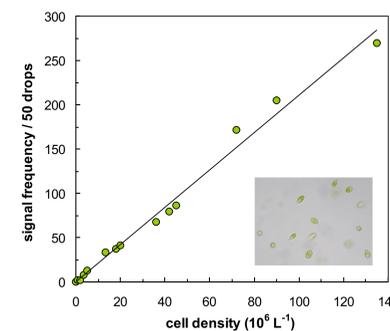
Cell adhesion to mercury electrode



The current-time transient, adhesion signal, is caused by the double-layer charge displacement from the contact area A_c .



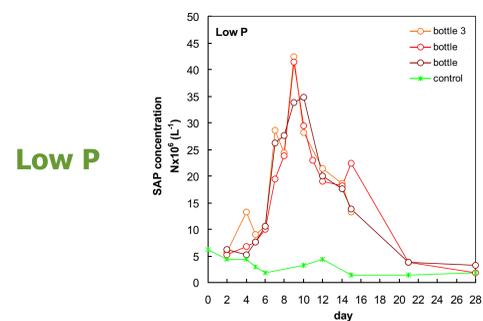
Adhesion signals of *Dunaliella tertiolecta* cells superimposed on chronoamperometric curve of oxygen reduction. The current-time curves are recorded with time resolution of 1 ms using DAQ card and the application developed in LabView 6.1 software, National Instruments system.



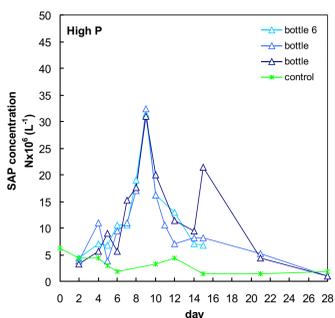
Dunaliella tertiolecta cells (6-9 μm) as a model monodispersed system for the calibration of electrochemical response in natural aquatic samples.

Results

surface-active particles



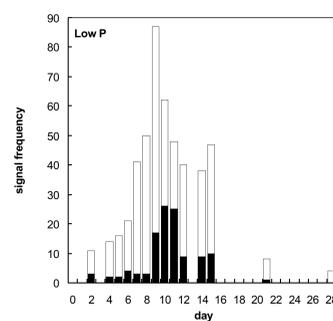
Low P



High P

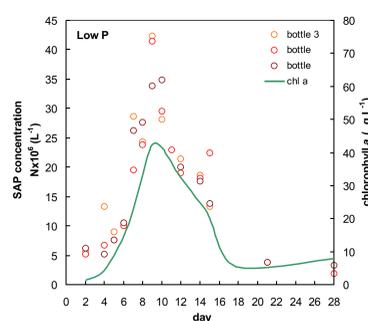
Surface-active particle (SAP) concentration in the course of bloom experiment in bottles with low P and high P and the control bottle.

signal size and frequency

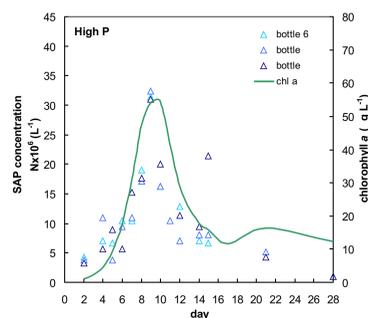


Contribution of two categories of signal amplitudes (<1μA, □) and (>1μA, ■) to the total number of signals during the bloom experiment recorded in bottle 4 (Low P) and bottle 7 (High P). Signal of 1μA corresponds to particle of 10 μm in diameter.

SAP vs. Chl a



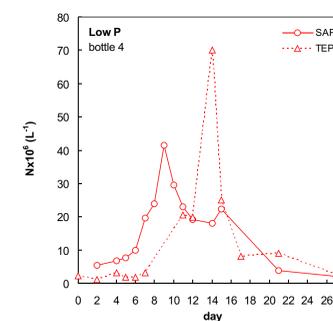
Low P



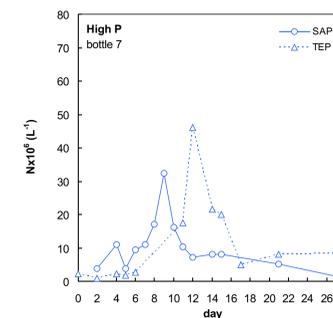
High P

Data points of SAP concentration compared to *Chlorophyll a* curve during the bloom experiment for two P regimes. *Chlorophyll a* line was generated using mean values of 3 replicates.

SAP vs. TEP



Low P bottle 4



High P bottle 7

Variation of SAP and TEP concentration in the course of the bloom experiment for bottles 4 (Low P) and 7 (High P).