Characterization of surface active substances in the natural sea surface microlayers of the coastal Middle Adriatic stations

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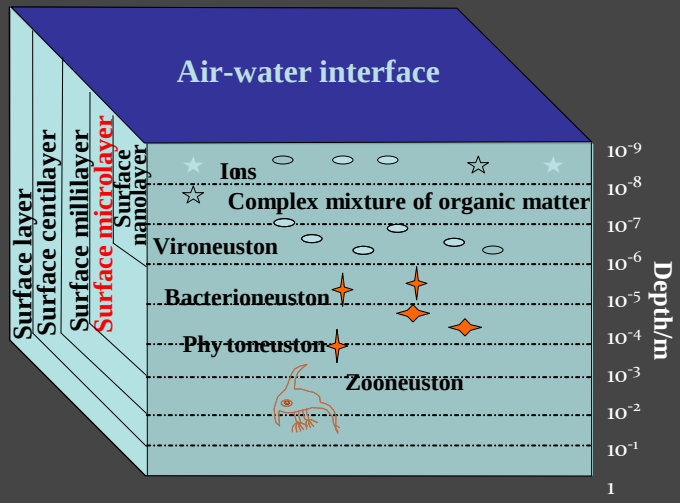
Sea surface microlayer (SSM)

- **the uppermost 30–300 μm layer of the sea surface**
- **enrichment of organic matter, trace metals and organisms**



surface active substances (SAS) → sea surface film

Trace metals in the sea surface microlayer

- complexing with particulate organic matter and surface active organic material

The SSM concept:

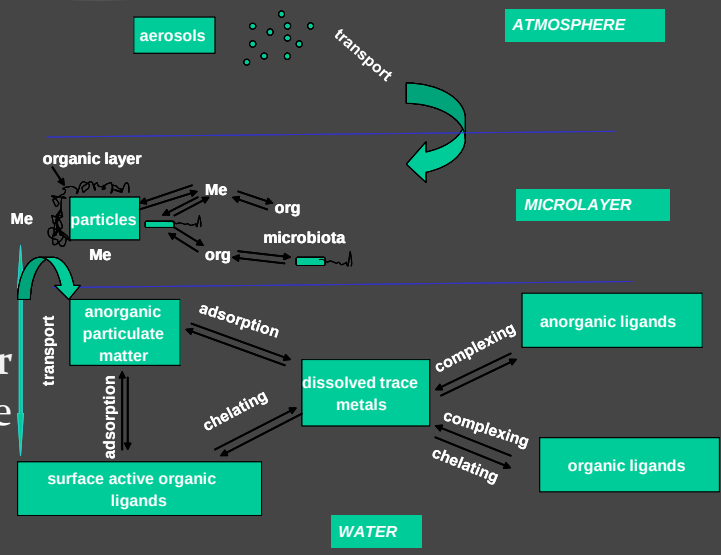
→ gelatinous organic matrix formed by a complex structure :

- polysaccharides
- polypeptides
- humic-type material
- lipids

Sea surface microlayer (SSM)

- **a key role in the global biogeochemical cycling**

- **investigations of the SSM are crucial for better understanding the** fluxes and the processes that control these fluxes **across the natural air-sea boundary**



The scope:

To give contribution for better understanding the fundamental questions regarding organic films at the sea surface:

- chemical composition
- rheological characteristics
- morphology
- build-up mechanisms

Methodological approach

Electrochemical methods

- quantitative and qualitative determination of SAS in the SSM

Monolayer technique

Surface pressure- area (π-A) isotherms

- physical states of different microlayers
- structural parameters (molecular weight, miscibility, elasticity)

Brewster angle microscopy (BAM)

- characterization and optical visualization of microlayers
- characterization of morphology and dynamical processes at the interface giving information on second order phase transitions, aggregation mechanisms at the interface and structural changes

Direct determination of SAS in original SSM and ULW samples

Seasonal variability of SAS concentrations in the SSM and ULW samples and enrichment factor (EF), Rogoznica Lake.

Sample	Date sampled	SAS γ (T-X-100, eq.) / mgdm^{-3}		EF
		SSM	ULW	
R1	05.03.2001	0,70	0,11	6,5
R2	21.05.2001	1,60	0,06	26,7
R3	05.09.2001	0,88	0,07	3,1
R4	16.10.2001	0,71	0,19	3,7
R5	20.02.2002	0,60	0,17	3,5
R6	21.05.2002	3,80	0,22	17,3
R7	24.06.2002	0,32	0,30	1,1
R8	28.01.2003	0,29	0,08	3,6
R9	14.04.2003	0,48	0,08	6,0
R10	26.08.2003	1,40	0,11	12,7
R11	03.10.2003	1,30	0,27	4,8
R12	28.08.2005	1,40	0,18	7,78
R13	14.05.2007	0,82	0,10	8,2

SAS concentration in the SSM : 0,29 - 3,80 mgdm^{-3} (eq. T-X-100)

EF: 1,1 - 26,7

WARM PERIOD:
conc. SAS > 0,70 mgdm^{-3}

COLD PERIOD:
conc. SAS< 0,70 mgdm^{-3}

Investigations at the air-water interphase

Rogoznica lake

SSM samples	A_0/cm^2	π_{MAX}/mNm^{-1}	C_S^{-1}/mNm^{-1}	C_S/mmN^{-1}	Physical states and phase transitions
R1 (05.03.2001)	119	10,2	12,949	0,077	LE
R2 (21.05.2001)	121	24,8	16,311	0,061	LE
R3 (05.09.2001)	120	12,5	14,084	0,071	LE
R4 (16.10.2001)	91	12,4	14,285	0,070	LE
R5 (20.02.2002)	121	5,2	6,002	0,167	G
R6 (21.05.2002)	114	39,8	32,232	0,031	LE
R7 (24.06.2002)	122	6,3	5,894	0,170	G
R8 (28.02.2003)	72	2,7	3,356	0,298	G
R9 (14.04.2003)	70	2,6	5,845	0,171	G
R10 (26.08.2003)	100	23,7	20,002	0,050	LE
R11 (03.10.2003)	96	18,3	18,868	0,053	G→LE
R12 (28.08.2005)	121	20,1	19,231	0,052	LE
R13 (14.05.2007)	121	36,8	30,620	0,033	LE

Gaseous state

Liquid-expanded state

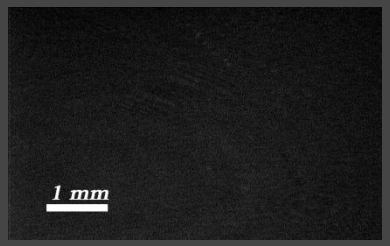
SSM samples - colder season

SSM samples - warmer season

Investigations at the air-water interphase - BAM

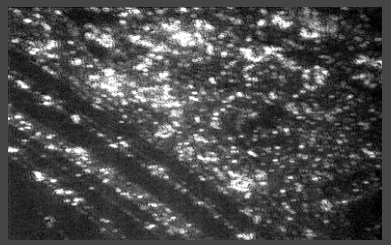
BAM technique – static conditions

formation and organization of the sea surface microlayer at the air-seawater interface during 24h

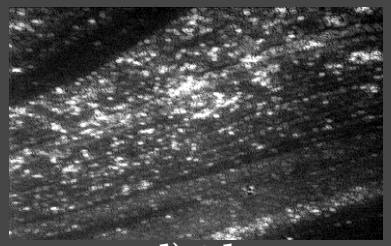


a) 0 h

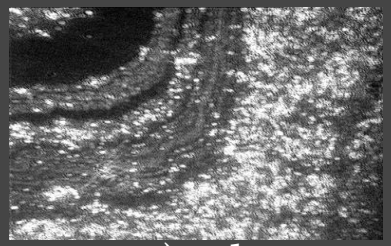
b) 2 h



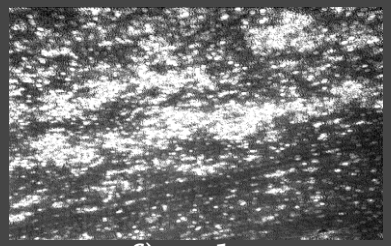
c) 5 h



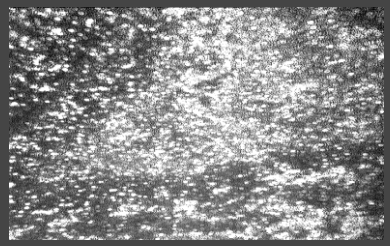
d) 8 h



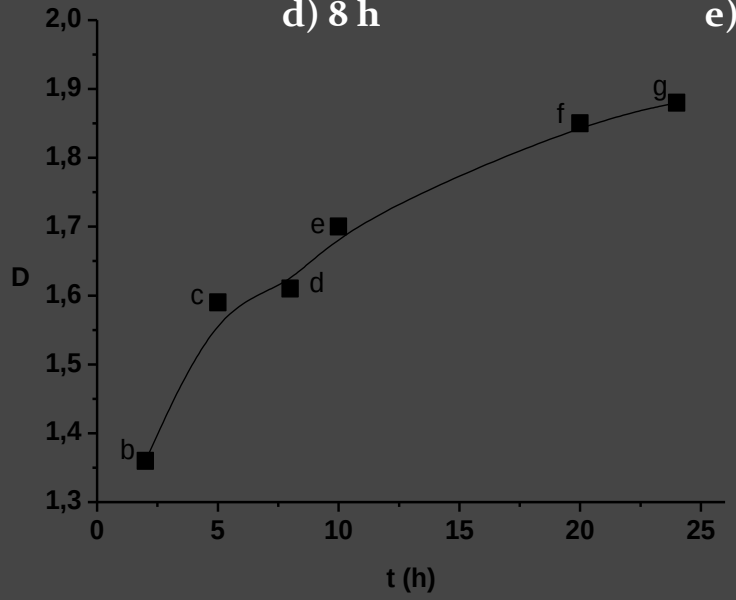
e) 10 h



f) 20 h



g) 24 h



Fractal analysis

Surface structure – fractal properties

D ≤1,6 **Diffusion limited aggregation**

D >1,6 **Adsorption limited aggregation**

Collaboration with Dr. D. Risović, IRB, Croatia

Research plan

DISTRIBUTION OF ORGANIC AND INORGANIC MATTER

MIDDLE ADRIATIC STATIONS

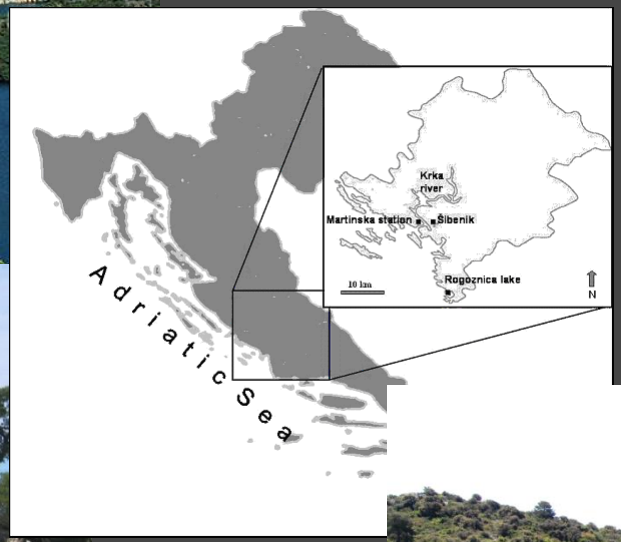
AEROSOL

SEA SURFACE MICROLAYER

WATER BULK

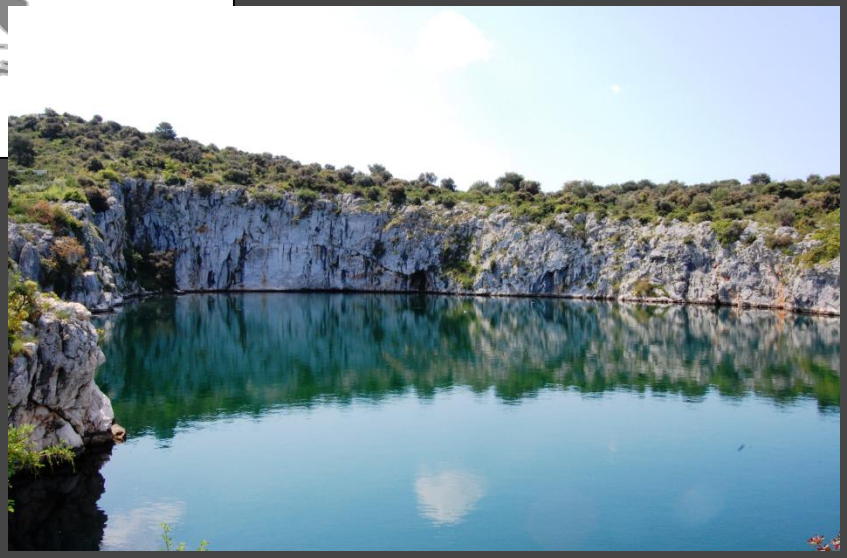
SAMPLING PLACES

Middle Adriatic stations



Martinska station

Rogoznica lake



THANK YOU FOR YOUR ATTENTION !