MONITORING OF REACTIVE MICROPARTICLES DISTRIBUTION IN THE NORTHERN ADRIATIC SEA

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Abstract
The purpose of this study is monitoring of reactive microparticles in seawater and design of an early warning system for critical evolution in particle aggregation. Dropping mercury electrode was used as the adhesion sensor for the monitoring of microparticles distribution in the seawater samples from the Northern Adriatic Sea. The technique we used was chronoamperometry of oxygen reduction at the potential of maximal attraction. *Dunaliella tertiolecta* cells were used as model particles.

Keywords: Adriatic Sea, electrochemistry, monitoring, particle aggregation

Introduction

A major characteristic of a seawater sample containing colloidal particles is its intrinsic instability due to continuing aggregation processes and microbial activity. Sampling and sample processing should be shortened as much as possible (1). The electrochemical particle analysis, being direct, rapid and simple, meets these requirements and also offers the possibility of single particle analysis (2,3). Electrochemical adhesion sensor enables direct and simple recording of attachment signals (millisecond duration) of reactive particles in seawater samples over a time interval. A simple biological standard (a cell suspension) can be used for calibration (4).

Material and methods

The electrochemical technique is based on the chronoamperometric measurement of single events and attachment and spreading of surface-active particles at the dropping mercury electrode/seawater interface. This is a modification of a widely used polarographic technique for measurements of surface-active organic matter in aquatic environment.

Laboratory culture of the marine nanoflagellate *Dunaliella tertiolecta* Butcher was used as a source of model particles. *Dunaliella tertiolecta* cells (6-10 μm) do not possess a cell wall, only a flexible outer membrane, and because of that behave as fluid particles.

Results and discussion

Adhesion of reactive organic microparticles at the electrode result in attachment signals of millisecond duration. Characteristic electrical signals appearing as sharp spikes on current-time curves are the result of random attachment of surface-active particles. The attachment signals appear at irregular intervals and with different amplitudes. The amplitudes of attachment signals reflect particle size, while the average signal frequency is directly proportional to the particle concentration in a sample. To interpret the recorded I-t curves in terms of particle abundance in the sample we conducted the series of calibrating experiments using suspensions of *Dunaliella tertiolecta* cells in seawater under identical experimental conditions. The plots of frequency of attachment signals as function of cell density are used as calibration curve. The calibration curves are used to determine the abundance of surface-active particles ($\geq$ 1 μm).

Monitoring of reactive particle abundance in Northern Adriatic was undertaken after the dramatic event of massive macroaggregation in summer 1997 (5). Figure 1a presents the depth distribution of microparticles at an off-shore station in Northern Adriatic in July 1997 and in the same period 1998 (6). The range of particle abundance in 1997 is an order of magnitude higher than in the same period during summer 1998 (figure 1b).

Maximum microparticle concentration in seawater before the phenomenon reached $5x10^7$/l which can be taken as a critical treshold for the onset of the macroscopic phase formation (3).

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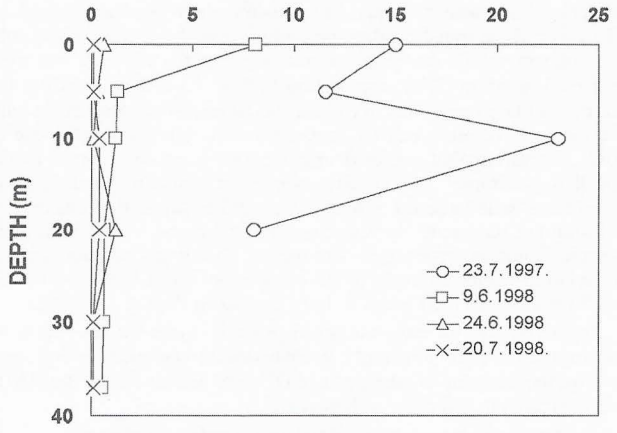

Figure 1a. Depth distribution of microparticle concentration (N) in seawater samples from a Northern Adriatic station (SJ 107; 45°02.8' N, 13°19.0' E) (5).

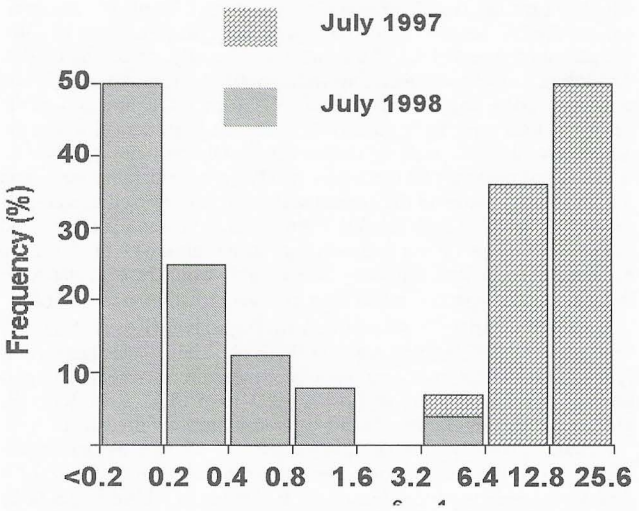

Figure 1b. Comparision of frequency distributions of organic microparticle concentrations in Northern Adriatic in summers of 1997 and 1998. The seawater samples were taken at standard depths at six equidistant stations along the transect Rovinj (Istrian coast) - the Po delta (5).