Benthic Chamber Chemistry*

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Chemie der Benthalkammer

Zusammenfassung. Zur Beurteilung des Umsatzes von Substanzen und Spurenmetallen im Meer ist es von Bedeutung, die Freisetzung von Verunreinigungen und natürlichen Bestandteilen aus den Sedimenten in das Bodenwasser zu messen. Die Technik der Benthalkammer wird zusammenfassend dargestellt und die analytischen Methoden erwähnt, die zur Aufklärung der chemischen Reaktionen im Bodenwasser und der oberen Sedimentschicht benutzt werden. An zwei Beispielen wird die Wirkung von Benthalorganismen auf die Geschwindigkeit der Freisetzung gezeigt.

Summary. The release of pollutants and natural constituents from the sediments to the bottom water is an important flux measurement which is required in order to establish the turnover of substances and trace metals in the marine environment. The article summarizes the benthic chamber technique and the analytical methods used to establish the chemical reactions that occur in the bottom water and the top layer of the sediments. Two results illustrate the effect of benthic organisms on the release rates.

Introduction

Sediments are built up of material carried to the sea by runoff from land. In addition a vast amount of organic matter is produced by photosynthesis. Much of this material reaches the seabed as fecal particles when passing through the food chain. Bioproduction also results in the formation of hard parts in the form of biogenic silica and calcium carbonate which are mixed with the river-borne clay particles. Coastal sediments are often heavily polluted, and it is a wish in vain that the pollutants are fixed in the sediments once they have reached the seabed.

The Benthic Chamber

The fallout in seawater can be measured with sediment traps such as the one that has recently been made at Institut der Meereskunde an der Universität Kiel. The reactivity of the seabed is studied by benthic chambers. The study of coastal sediments can be made by simple plastic chambers placed on the sea bottom by SCUBA divers (see Fig. 1). These divers also sample the bottom water enclosed above the sediment. They can also inject radioactive elements and substances in order to study their reactivity. Since it can be shown that the benthic infauna promotes the efflux of many constituents of the sediments, the oxygen concentration in the chamber is important. If it is allowed to drop towards anoxic conditions due to oxygen consumption by the enclosed organic matter the organisms will suffocate and their activity will cease. This asphyxiation technique has been treated by Rutgers van der Loeff et al. [1]. In order to keep the oxygen concentration at the ambient level it can be supplied by diffusion through thin plastic tubing (see Fig. 1). The carbon dioxide produced can be neutralized by adding sodium hydroxide; thus keeping a constant pH in the chamber. Slow stirring prevents the built-up of concentration gradients in the enclosed water.

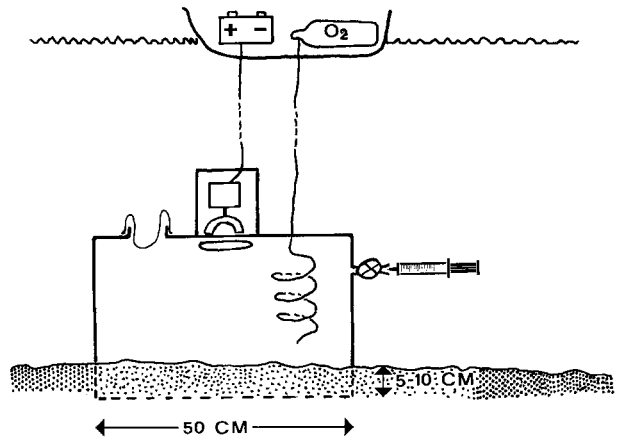

Fig. 1. Benthic chamber with stirrer, oxygen supply, sample withdrawal syringe and sample volume compensator (plastic bag)

Analytical Techniques

The success of the studies with benthic chambers depends on the availability of diving chemists and a marine zoologist who can identify the various benthic organisms. But to a large extent studies are dependent on the range and quality of the analytical techniques available. The interpretation of the different determinations can only be made with good knowledge of marine sediment chemistry. The following constituents were determined:

* This article is dedicated to Professor Wilhelm Fresenius, who for decades has skillfully promoted the science of analytical chemistry, on the occasion of his 70th birthday

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