A PROTOTYPE BENTHIC CHAMBER FOR THE DETERMINATION OF NUTRIENT FLUXES AT THE WATER - SEDIMENT INTERFACE

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Abstract

The quantification of nutrient fluxes between sediment and water is important for the designing of proper environmental management plans in any coastal marine zone where anthropogenic activities play a significant role. This work presents a prototype benthic chamber which allows the study and calculation of benthic fluxes based on laboratory simulations.

Keywords : Coastal Management, Sediments, Sampling Methods.

Nutrient elements' speciation in the water - sediment interface is a difficult achieved task, due to space and time fluctuations continuously present in an open system such as a coastal area. The water currents and the sea waves continuously affect the surface sediment, the particulate matter and the water masses. The *in situ* benthic chamber techniques initially employed to study these phenomena [1-2], present an inherent difficulty in handling the overall experiment, in addition to a series of disadvantages deriving from the lack of a regulatory system for oxygen supply, and thus the redox conditions, in the chamber.

In order to overcome these disadvantages, we introduced a prototype portable benthic chamber, capable of sampling surface sediment along with its overlying water column, which can be transported undisturbed from the study area to the laboratory where simulation experiments are carried out. The benthic chamber (Fig. 1) is made of a stainless steel ring with properly attached "knives" embedded in a lidded Plexiglas cylinder (typical dimensions: 120 cm long, 40 cm diameter) with sprung Plexiglas plates covering the top and the bottom of it. The chamber, placed by scuba divers into the seabed can capture sufficient sample quantities (30 to 50 cm) of sediment along with its overlying sea water column.

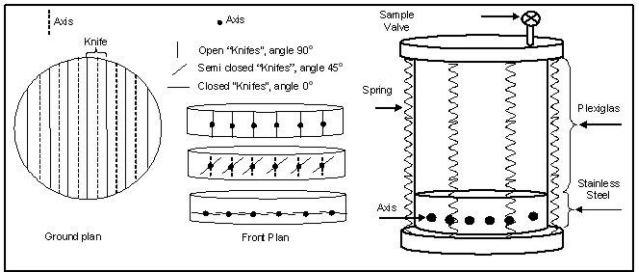

Fig. 1. The benthic chamber.

The watertight chamber is specifically connected with an electronic system using an oxygen meter an electronic valve, a Teflon oxygen supply tubing and a Teflon coated magnetic stirring, in order to retain the oxygen concentration at any set value from 0.0 mg/l to 20.0 mg/l (Fig 2A). The chamber is also equipped with a second electronic system using a cooling/thermal spiral, a digital thermometer and a circulator capable of retaining the water temperature constant at any set value (Fig. 2B).

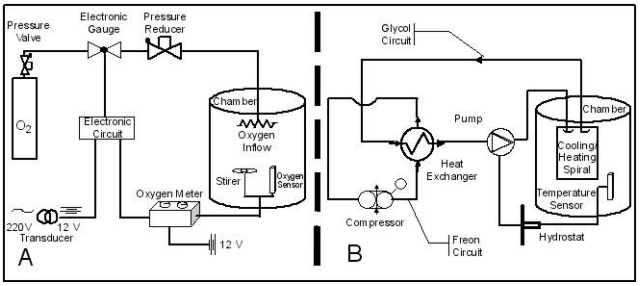

Fig. 2. Electronic control of dissolved oxygen (A) and temperature (B).

This benthic chamber allows the full and fine control of the dissolved oxygen concentration - and thus of the redox potential - as well as the water temperature, while sub samples of both water and sediment can be easily obtained and analysed for a series of chemical substances. The simulation technique employing the chamber is capable of investigating most of the coastal water sediment interfaces.

Concerning the determination and the distribution of nutrient fluxes, a series of experiments took place near fish farm installations and coastal lagoon areas. The calculated fluxes (μM/d) inside the benthic chambers can be used as first approximations of the actual natural conditions. The results showed that even minor changes in the redox conditions at a relatively narrow zone near the water-sediment interface have significant impacts on the concentrations of dissolved nitrogen, phosphorus and silicate compounds [3]. The use of this type of benthic chamber, in combination with in situ studies, can achieve a realistic assessment of the consequences of marine pollution in coastal embayments and improve the design of environmental management plans.

References

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