Relationships between Oxygen and Alkalinity Benthic Fluxes at Cadiz Bay (S.W. Spain)

J.-M. FORJA and A. GOMEZ-PARRA

Instituto de Ciencias Marinas de Andalucia (C.S.I.C.), 11510 Puerto Real, Cadiz (Spain)

Nutrients benthic regeneration through biogenic decomposition of organic matter in coastal ecosystem is mainly produced by aerobic oxidation and sulphate-reduction pathways (Jorgensen, 1982; Crill and Martens, 1987). The relative contribution of both processes is very variable, depending on many environmental factors, and can be assessed determining the fluxes across the sediment-water interface of both oxygen and alkalinity. This has been frequently realized by means of the chemical concentration profiles in pore water (eg, Aller and Yingst, 1980; Jorgensen and Sorensen, 1985; Crill and Martens, 1987). In this paper, the stoichiometric values of oxygen and carbonate alkalinity "in situ" fluxes are measured in order to evaluate the participation of the two main alternative mechanisms for nutrient regeneration in coastal sediments. The study are carried out over a year period in a site located in the bay of Cadiz.

EXPERIMENTAL

The Bay of Cadiz is a productive shallow coastal ecosystem, receiving a large input of organic matter. The bay has a mixed bathymetry and it is subject to a semidiurnal tidal regime with about 2,70 m average amplitude. These facts generate a complex hydrodynamic and sedimentary behaviour. Sampling station is located in a argillaceous subtidal area (8 m in depth) and it is affected by a moderate flood current system. Its botton contains a large assemblage of infaunal benthos, mostly pollychaeta.

Matter fluxes across the sediment-water interface were determined by means of benthic stirred opaque chambers. They were made of plexiglass and semiellipsoid revolution shape of circular section. These chambers cover 0.385 m^2 of bottom and contain between 65 and 90 L. Chamber incubation of botton lasted 3-5 h. A previously calibrated YSI 5739 polarographic sensor was used for measuring oxygen concentration every 5 min. Alkalinity was determined by Gran titration method in samples withdrawn from the chambers each 15-20 min. Complementary pore water chemical profiles were obtained from 40 mm i.d. cores by centrifugation at 24,000 g.

RESULTS

In relation to the temporal evolution of the oxygen benthic demand and carbonate alkalinity flux (fig. 1a), two facts can be noted: i) both oxygen and alkalinity fluxes show a clear seasonal trend;

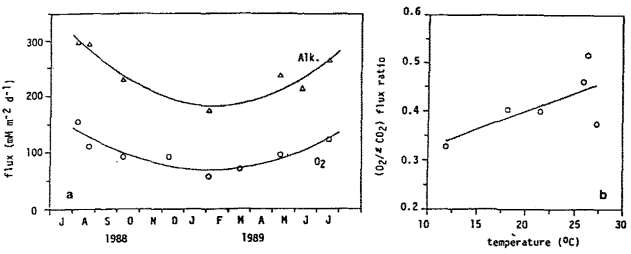

Figure 1

ii) measured fluxes are high, specially in summer. Their values are generally greather than those obtained in other zones at a similar latitude.

Fluxes of ΣCO_2 are always greather than oxygen fluxes. According to Redfield's ratios and assuming that organic matter decomposition would occur exclusively via aerobic pathway, the $O_2/\Sigma CO_2$ fluxes ratio would have a value of 1.3. Values obtained for this ratio in Cadiz bay are always smaller than 0.5. This denotes the importance of anaerobic degradation processes. On the other hand, an increase of ($O_2/\Sigma CO_2$) fluxes ratio with temperature has been found (fig. 1b). This suggests that the aerobic pathways contribution in degradation processes is greater in summer, in spite of the oxygen concentration in the water column being apprecibly lesser than in winter. Two explanation can be suggested: i) benthic macrofauna density is greather in summer (about 250 specimens m^{-2}), and also their activity. In this way, Revsbech *et al.* (1983) have reported the existence of oxic microenvironment at depths below the oxic layer, due to the macrofaunal irrigation in the sediments; ii) The increase of the temperature in summer, acelerating the benthic metabolism, is specially important in the sediment surface. In this layer the aerobic degradative processes take place; therefore these can be enhanced.

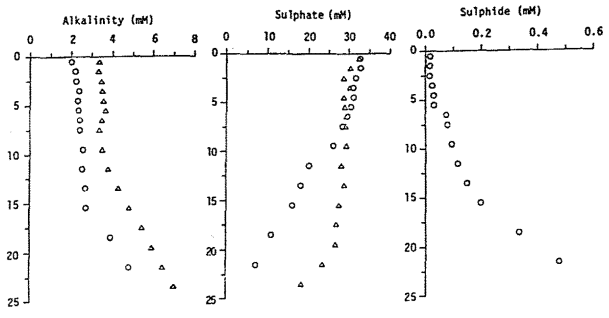

Figure 2

In fig. 2, pore water profiles of carbonate alkalinity, sulphate and sulphide are showed for winter (○) and summer (●). Low gradient concentration upper 10 cm of sediment can be observed. Similar variations are encountered by other authors (Goldhaber et al., 1977) and they are related with the influence of benthic macrofauna irrigation. For this reason, diffusive fluxes calculated by means of vertical profiles in interstitial water are very low in relation to "in situ" fluxes.

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