PRELIMINARY STUDY ON OXYGEN AND REDOX PROFILES IN SEDIMENTS FROM THE LAGOON OF VENICE (ITALY)

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The concentration of dissolved oxygen is a sensitive indicator of diagenetic redox reactions occurring in the marine sediments. Microbial oxidation of organic matter in the sediment utilizes dissolved O_2 from interstitial water as the preferential electron acceptor. It can further proceed through a variety of alternate acceptors (as NO_3-, Mn^{4+}, Fe^{3+}, SO_4^{2-}) until methanogenesis occurs (BERNER, 1980), and this sequence is marked by progressively decreasing redox potential (E_h). Oxygen also can be consumed by the oxidation of sulfide phases present in the sediments. Oxygen dissolved in the overlying water column can diffuse across the sediment-water interface to support this "sediment oxygen demand". When the consumption of O_2 in the sediment is large and its supply from the overlying water is limited, reduced conditions progressively extend toward the sediment-water interface, and hypoxia or anoxia in the overlying water column may even result. Redox potential profiles in surface sediment cores can be considered as an index of the imbalance between oxygen supply and its demand in the sediments (ZOBELL, 1946; CALLAME, 1968) but, due to chemical and thermodynamical limitations, E_h readings by Pt electrodes often do not provide meaningful information on specific redox equilibria. The interpretation of observed trends of E_h readings therefore requires the knowledge of the actual concentration of the chemical species involved. The present study was performed to investigate dissolved oxygen profiles in the near-bottom water and near-interface sediments of the Venice Lagoon, in order to evaluate the pattern of oxygen uptake in the sediments. A comparison was also made between measurements of dissolved oxygen and redox potential profiles, to investigate the relationship between the oxygen uptake and redox conditions in the sediment. Two sub-tidal areas of the Venice Lagoon, which had been previously characterized with respect to hydrodynamics, sediment characteristics and contaminant distribution, were chosen for the study. Sites were selected to be representative of the different sediment conditions. Four sites were in an eutrophied area near the Giudecca Isle, close to the City of Venice. The other 4 sites were in the Cona Marsh, the estuarine area of the Dese River, one of the main tributaries of the basin. The mean depth of the water column is about 0.5 m at all sites. Samples for dissolved oxygen measurement consisted of 7 cm diameter and 20 cm long undisturbed sediment cores, taken with overlying water. Dissolved oxygen was measured with a Clark-style microelectrode with guard cathode (Diamond General Development Corp.) (REVSBECH, 1989), mounted in a micromanipulator capable of vertical adjustement in mm, positioned about 1 cm above the sediment and gradually lowered in 0.5 mm increments. Redox potential profiles were measured in 4 cm-diameter cores at depths corresponding to 2, 5, 10, 20 and 40 cm from the core top, using combined Pt electrodes with a Ag|AgCl reference half-cell (201/L-SM-PT, CLR Milano, Italy) and following a previously tested methodology (ARGESE *et al.*, 1992). The Venice Lagoon represents an ecosystem in which coupling between the sediments and water column may be especially strong because of the organic-rich nature of the sediments and the shallow water column (mean depth of 0.5 m). One feature commonly observed in the oxygen microelectrode profiles is the production of dissolved oxygen by microalgae at the sediment-water interface (Fig.1, profile 1). Cores incubated in the dark overnight show the disappearance of this feature (Fig. 1, profile 2). Dissolved oxygen penetrates to less than 2.5 mm depth at all sites. Redox values at a depth of about 15-20 cm are similar (≈-180 mV) in all the investigated cores, which is a general feature in the sediment of the Venice Lagoon (ARGESE *et al.*, 1992; ZONTA *et al.*, 1994). The gradient between E_h values observed at 2 cm and at 20 cm may be taken as a measure of the extent of reduction of the upper sediment column, with large gradients indicating less reduction in the surface sediments. Oxygen penetration (Fig. 2) is correlated with the redox gradient, with the more reducing sediments of Cona having relatively shallow oxygen penetration depths. The Cona samples appear to have a different trend from those at Giudecca, in part due to differences in grain size and in the type and amount of organic matter for the sediment of the two areas. The data suggest that sediment oxygen demand is greater at Cona than at Giudecca and further studies to determine oxygen fluxes on incubated cores are planned.

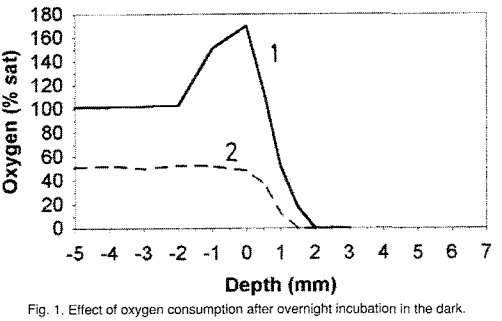

Fig. 1. Effect of oxygen consumption after overnight incubation in the dark.

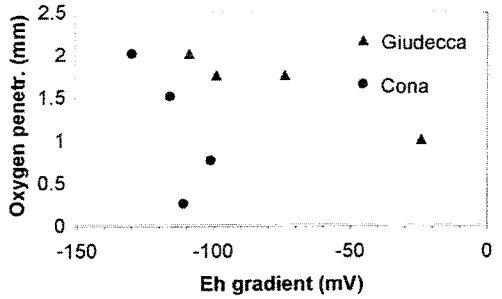

Fig. 2. Plot of the gradient between Eh values at 2 and 20 cm vs. the oxygen

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