BENTHIC RECYCLING OF PHOSPHORUS IN THE COASTAL WATERS OF ALEXANDRIA

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Since the cessation of the Nile flood by the erection of Aswan High Dam completed in 1965, the discharge of nutrients through the Nile to the S.E. Mediterranean has drastically declined. Landbased sources including agricultural runoff from coastal lagoons, industrial and sewage discharges substituted, with a lower magnitude, the Nile water discharge. However, the productivity of the coastal waters are still dramatically affected. Most of the recent studies (DOWIDAR and ABDEL-MOATI, 1990), indicated that phosphorus is the key limiting nutrient regulating such productivity.

Being an important component of the biogeochemical cycles and flow of energy, benthic communities become progressively an important partner in marine ecosystems. Examining the functional aspects of such communities is an attempt to understand their active role in marine environment, especially the regeneration of nutrients. The purpose of the present study was to quantify the nutrient regeneration role of benthos using *in situ* measurements of net sediment/water flux of phosphorus.

Three locations were selected in the coastal waters of Alexandria during the period July - December 1992 (depth range 5-7 m), for measuring sediment/water nutrient flux. Quantitative samples were taken to characterize the communities while sediment samples were analyzed for grain size and organic matter. Station A was characterized by coarse sand and amphipods dominating the biotic community (organic matter 1.5%). A sandy silt bottom characterized station B (organic matter 4.5%) dominated by polychaetes and bivalves. Station C was on a sandy silt base (organic matter 4.1%) dominated by hatchet foot pelecypods.

Net exchanges of dissolved substances across the sediment/water interface was determined by entrapping a known water volume exposed to a known sediment area in a bottom chamber and monitoring phosphorus concentrations over time. Three opaque PVC pipe cut chambers 120 cm long x 30 cm diameter having a bottom area : volume ratio of 90 cm^2 l^{-1}, were carefully placed in each location by SCUBA divers. Simultaneously, dark bottles filled with bottom waters were incubated beside the chambers for correction of oxygen and nutrient changes caused by plankton inside the chambers.

The mean oxygen uptake by sediments and associated benthos was 45.6, 38.9 and 40.1 mg m^{-2} h^{-1} for different locations. The range for the *in situ* inorganic phosphorus flux in the three stations was -0.63 to 47.98 (av. 16.4 ± 8.5), -2.44 to 36.3 (av. 8.1 ± 6.3) and -10.7 to 18.4 (av. 5.3 ± 4) µM m^{-2} h^{-1} at the sampling sites, respectively, with an overall mean of 10.3 ± 4.8 µM m^{-2} h^{-1}. Replicate variations between chambers at the same site did not exceed 10%. Phosphorus release at all stations showed a highly significant correlation with temperature and oxygen uptake giving rise to the regression equations: P flux = -10.4 + 1.66 T ($r = 0.89$, $p < 0.01$) and P flux = -6.23 + 0.03 O_2 uptake ($r = 0.69$, $p < 0.05$). The slope and intercept for station A were significantly greater ($p < 0.05$) than B and C, while the intercepts but not the slopes of B and C were significantly different ($p < 0.05$). The overall correlation between released phosphorus and that present in the overlying water was positive ($r = 0.73$) in the whole area indicating that sediments are not buffering phosphorus concentrations in water. Organic matter content of sediments showed an association with increased phosphorus fluxes. The relationship between phosphorus release at the three localities with numerical abundance appeared to be stronger than with biomass.

The mean O:P ratio (atoms) for the three studied locations was 192 ± 86, 385 ± 190 and 421 ± 292, respectively. This ratio generally increased with decreasing temperature showing a significant ($p < 0.05$) O:P ratio on temperature.

Due to the intermittent appearance of anoxic conditions in some areas off Alexandria coast, specially during summer time, a long term measurement (96 hr) at station B during July showed an initial increase in phosphorus concentration after which it tended to level off as the concentration gradient between interstitial and overlying waters decreased. When DO become near depletion (0.8 ml l^{-1}), phosphorus release rate increased gradually towards the end of the experiment reaching 108 µM m^{-2} h^{-1}. The sudden increase resulted as response to anoxia indicating nutrient desorption to the overlying water.

Compared to previous estimates in area B performed using lab experiments (DOWIDAR *et al.*, 1990), the present phosphorus fluxes were nearly 10 times higher than previous records. Consequently, it seems likely that the contribution of benthic fluxes during maximum regeneration can supply a substantial amount of phosphorus requirements of phytoplankton. Further evidences of benthic releases indicating a phytoplankton bloom are needed.

Although discrepancies regarding considerations of bottom currents and sediment resuspension leading to underestimates of actual fluxes, results must be regarded as a preliminary attempt to assess the relative importance of benthic regeneration in the area.

REFERENCES

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