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Oxygen depletion in a semi-enclosed area of Aegean Sea (East Mediterranean)

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In this work, we analyze hypoxia and anoxia in a shallow semi-enclosed area of Mediterranean Sea, Elefsis Bay, using historical data on physico-chemical characteristics from 1987 to 2010 and sediment records covering most of the Holocene.
Elefsis Bay is a semi-enclosed basin of Aegean Sea (East Mediterranean Sea) where the anoxic near-bottom layer is an intermittent feature that is developed every year during the warm period (May – late October). The development of a strong temperature-driven pycnocline results in the isolation of the deeper part of the water column, leading to insufficient oxygen supply from either atmospheric or photosynthetic sources, while oxidation of the organic matter results in hypoxic and anoxic conditions for five months annually. This situation retains nutrients and organic matter within the basin and leads to high nutrient accumulation. The Elefsis ecosystem seems to be very complicated, variable and "fragile", due to its morphology (enclosed), bathymetry (shallow, 33m maximum depth) and intense anthropogenic activity (domestic, industrial and naval pollution).
During the warm/stratified period, the ammonium concentrations increase significantly with depth against nitrite and nitrate but in parallel with silicate and phosphate suggesting the occurrence of organic matter remineralisation processes.
The chemical characteristics of the anoxic layer indicate that denitrification occurs, even though this has not been confirmed by direct measurements of denitrification in the water column or measurements of sulfide concentrations, so the evidence for denitrification is indirect. However, denitrification could be the controlling factor of the DIN:P values in the near-bottom waters of Elefsis Bay.
Historical data for the last 30 years showed that after 2000 till today, relatively low phosphate concentrations were observed in the hypoxic and anoxic waters of Elefsis Bay, whereas, the ratio DIN:P increased significantly after 2000, indicating phosphorus limitation for phytoplankton growth, which indicates a change of the ecosystem after 2000, that possibly reflects the decrease of the pollution in the bay mainly due to the operation of the Sewage Treatment Plant in Psitallia in the end of 1994.
Sediment records covering most of the Holocene gave evidence that the area was affected by hypoxia and/or anoxia in the past. The occurrence of hypoxia in Elefsis Bay on "geological" timescale seems to be related to climate fluctuations. Warmer periods contributed to stratification of the water column and to relative higher productivity. These factors were the primary forcing for hypoxia in the Elefsis Bay. Further analysis will provide more information and will give more specific answers to the three basic questions: where, when and why was the study area hypoxic or anoxic in the past.
Additionally, the analysis of our data showed a variation in the intense of the hypoxia/anoxia developed in the bay, which could be related to local climate variability and will be further examined.