Temporal and Spatial Variations in Concentrations of Sediment Nutrients and Carbon in the Keta Lagoon, Ghana

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Abstract

Sediment characteristics and dating show that the Keta Lagoon about 976 ^{14}C year BP (calibrated age AD 1333-1399) changed from accumulating dark, fine-grained sediments with a high content of remains of wood and plant debris and no molluscs (1.2% C, 0.7% N and 0.18‰ P) to accumulating lighter, coarse sediments with many mollusc (2% C, 0.8% N and 0.2‰ P) indicating a shift from anaerobic to aerobic conditions in the accumulated sediments. Near fully marine conditions and temperatures similar to present day temperatures are indicated by $\delta^{13}C$ and $\delta^{18}O$ values, respectively, obtained from shell material in the transition layer. The average sedimentation rate in the period ~1365 - 1902 was 0.2 mm/year. Since 1902, the sedimentation rate has gone up from 0.2 to 1.3 mm/year. A comparison of maps from 1975 and satellite images from 1999, showing a smaller present area of the lagoon, suggests that the sedimentation rate is high at the NE fringe of the lagoon. Due to a long flushing time (no flushing in the dry season), the present nutrient contents of the sandy surface sediments (0-0.08% N and 0.04-0.36‰ P) are relatively high when compared to other shallow estuaries with higher terrestrial supply of nutrients. Low nutrient contents in the inlet from the open sea indicate that nutrients in the lagoon are of local origin. The content of carbon and phosphorus in the surface sediment depends on resuspension potential and is high in the deepest parts of the study area. Very high values are, however, found close to Keta, apparently from sources associated with farming activities. The spatial distribution of nitrogen appears to be more random.

Introduction

Coastal lagoons are environments suitable for human activities such as habitation, tourism, fishing, aquaculture and transportation (Isla, 1995). A detailed knowledge of these coastal features, therefore, becomes crucial because changes could impact greatly on many people. Numerous studies have been carried out in order to assess the effects of nutrient input to oceans and estuaries (Christiansen *et al.*, 1997; Emeis *et al.*, 2000). These studies have shown that anthropogenic influence in the form of high population densities, industrial activity and use of fertilizers may disturb the natural balance of nutrient fluxes.

Few studies, however, have been carried out in shallow tropical lagoons characterized by weak hydrodynamics and low but regular wind stress (Arfi *et al.*, 1993; Andrews *et al.*, 1998). Tropical lagoons may behave differently from lagoons in high and mid latitudes. From time to time, some of the tropical lagoons become hypersaline with a higher salinity in the lagoon than the coastal water (Isla, 1995). Once a lagoon is hypersaline it is under the influence of an inverse estuarine circulation. This process may cause inflow of water at the surface and outflow of the denser saline water near