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ORIGINAL ARTICLE

Distribution of total carbohydrates in surface sediments of the Egyptian Mediterranean coast, in relation to some inorganic factors

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Abstract The interrelation between calcium, magnesium, carbonate, fluoride and total carbohydrates (THCO) distribution was investigated for surface sediments collected from three sectors (A–C) along the Egyptian Mediterranean coast during the summer of 2008. The recent ultrasound-acetic acid technique was used for the simultaneous extraction and hydrolysis of total carbohydrates. Based on the average values, the sandy sediments of sector (C) exhibited the highest THCO levels (163.78 ± 53.28 μg/g). In contrast, the silty sand sediments of sector (A) had the lowest average THCO level (8.56 ± 2.60 μg/g). Linear regression model with one predictor showed that there are significant correlations between total carbohydrates, carbonate and fluoride suggesting the common origin of these components. Neither calcium nor magnesium has correlation with THCO. This study revealed that carbonate is the dominant factor affecting the distribution of carbohydrates in the sediments. The spatial distribution of THCO was not affected by the potential sources of runoff, but varied according to the sediments mineralogy.

1. Introduction

In the biosphere, carbohydrates are the major organic compounds produced photosynthetically by autotrophic organisms. They have a substantial amount of the dissolved and particulate organic carbon in water and sediments of marine environments (Khodse et al., 2008). Because carbohydrates are ubiquitous and abundant, they play an important role in biogeochemical cycles occurring in the marine water column and sediment–water interface. Thus, they may account for 10–85% of the dissolved organic carbon in seawater (Pakulski and Benner, 1994) and in sediments' pore waters (Arnosti and Holmer, 1999; Burdige et al., 2000). Also, about 3–16%, 2–13,

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3–20% of the particulate organic carbon are found in the suspended (D'souza and Bhosle, 2001) and sedimenting particles (D'souza et al., 2003; Panagiotopoulos and Sempéré, 2005) and in marine sediments (Burdige et al., 2000; Jensen et al., 2005), respectively. Moreover, carbohydrates serve as an important energy source for heterotrophic organisms (Decho, 1990) and are a potential precursor of refractory organic matter in sedimentary rocks (Sinninghe Damsté et al., 1998). In the marine system, total carbohydrates are present in monosaccharide, disaccharide, and polysaccharide forms (Borch and Kirchman, 1997; Skoog and Benner, 1997; Bhosle et al., 1998). Throughout the world, carbohydrates have received broad attention and are extensively studied by many investigators (Mecozzi et al., 2000; Unger et al., 2005; Wang et al., 2006; Khodse et al., 2007, 2008). A number of these studies focused on the relationship between carbohydrates and organic carbon. Moreover, the distribution of carbohydrates in relation to mineralogic and granulometric composition of surface sediments was taken into consideration (Hazdija et al., 1985). However, to our best knowledge, there is little information available about the distribution of total carbohydrates in sediments in relation to some inorganic factors. Therefore, it is essential to gain insights on this topic.

Several studies have been focused on the presence of organic and inorganic contaminants in the Mediterranean coast of Egypt. However, only rare studies focused on the distribution of total carbohydrates in relation to different inorganic factors along the Egyptian Mediterranean coast. Therefore, this study was under taken to investigate the distribution of total carbohydrates and some inorganic components (calcium, magnesium, carbonate and fluoride) in the surface sediments of the Egyptian Mediterranean Sea coast. The correlations between total carbohydrates and major inorganic factors of sediments were investigated.

2. Sediment quality of the studied area

The Egyptian Mediterranean Sea coast's sediments differ in their mineral composition (Fig. 1). Among them are off the Nile Delta, off Alexandria and the western sectors. Off the Nile Delta sector, the mud and sands of the inner and middle shelf contain very little biogenic carbonate. The mud and mud–sand mixture from the outer shelf is moderately calcareous, and the sands and some of the sand–mud mixture from the lower terraces are highly calcareous. However, the sediments of the western part of the Nile Shelf are mainly aragonite and calcite carbonate (Summerhayes et al., 1978). The mud fraction of the eastern part of the Nile Shelf deposits is dominantly terrigenous, composed of (1) detrital sands which are primarily quartz admixed with pyroxenes, amphiboles, epidote, garnet, zircon, tourmaline, rutile and apatite (Stanley et al., 1979); (2) detrital mud which is composed of 15% kaolinite, 8% illite, 72% montmorillonite and 5% chlorite (El-Sammak, 1987). El-Wakeel and El-Sayed (1978) stated that biogenic clastics are the major

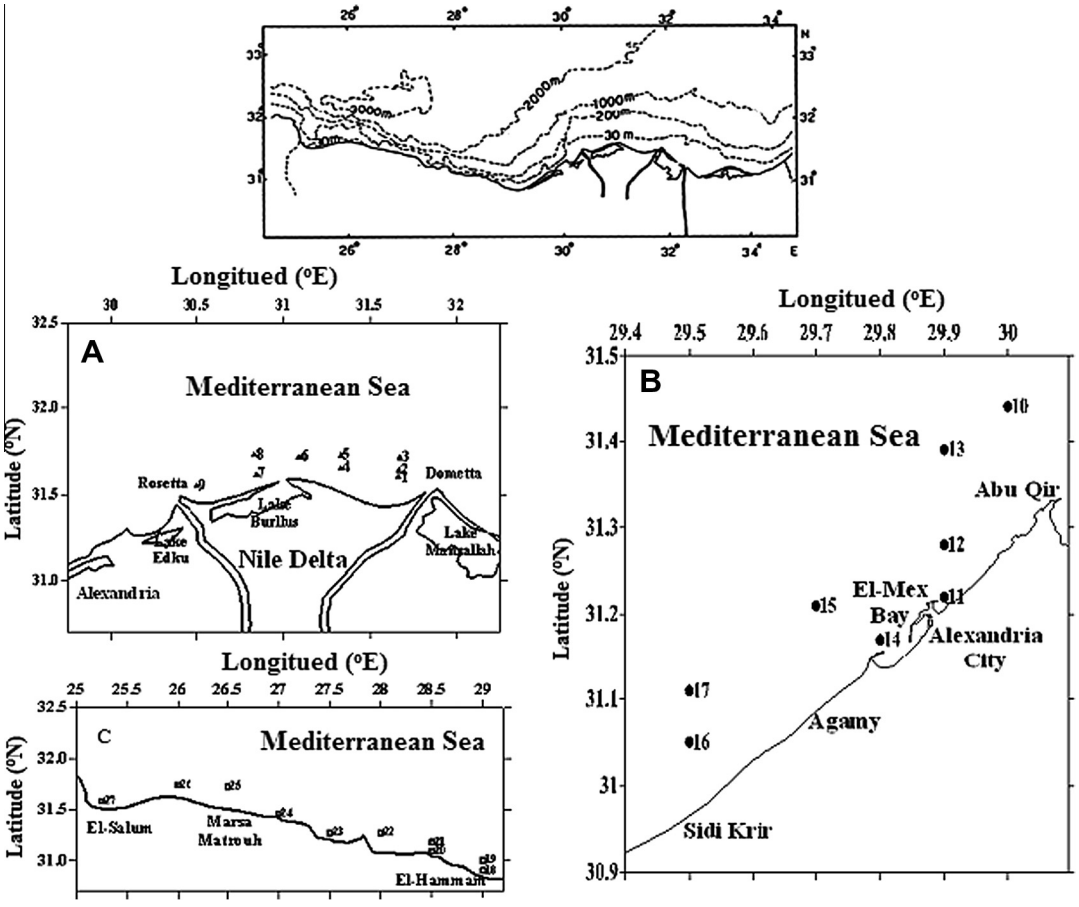

Figure 1 Sampling locations of marine sediments along the Mediterranean coast of Egypt.