BENTHIC FLUX OF SILICATE IN THE COASTAL AREA OF THE MIDDLE AND SOUTHERN ADRIATIC SEA

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Abstract

The benthic flux of silicate was determined during the period June 1997-October 2000 at 8 stations in the coastal area of the Eastern Adriatic Sea. Temporal distribution of fluxes showed enhanced fluxes during the warm period of the year. During this time significant correlation of Si-fluxes with PO4-fluxes and the bottom layer Si concentrations were found. An estimation of silicate contribution to the coastal zone by benthic flux (BF-Si) versus riverine Si input (R-Si) showed a ratio of BF-Si : R-Si of 3.8 : 1 in the warm period and 1.1: 1 in the cold period of year.

Keywords: Adriatic Sea, Benthic-Pelagic coupling, Geochemical cycles

Introduction

Dissolved silicate is an essential nutrient for diatom and radiolarian skeleton development. After the life cycle of this species, biogenic silica (opal) dissolves to a great degree in the water column (1) while the remainder reaches the sediment and continues to dissolve at the sediment/water interface and in the sediment (2). Besides dissolution of biogenic silica, another important process in seawater silica enrichment can be river inflow, especially in estuarine regions and nearshore waters (3).

Material and Methods

Sediment sampling was performed by a gravity corer (plastic tube, i.d. = 6.5 cm, l = 100 cm) in triplicate at 8 stations (depth between 38 and 82 m) in the coastal area of the eastern Adriatic Sea during 1997 – 2000 period. The sediment samples were incubated onboard the R.V. *Bios* for 9 – 12 h at bottom temperature after exchange of the sediment overlying seawater with collected bottom water. The benthic flux of silicate has been calculated on the basis of concentration changes in the overlying water during the incubation and the surface area of the sediment samples. Silicate concentrations were determined by a standard photometric method using an AutoAnalyzer II (4).

Results and Discussion

Analysis of established silicate flux values during 1997 –2000 in the coastal waters of Croatia (from Dubrovnik to Zadar) showed different situations in the warm (WPY: May to October) and cold period of year (CPY: November to April). The flux (mmol m^{-2} day^{-1}) in the WPY was in the range between 0.78 – 2.67, and 0.16 to 1.87 in the CPY. The difference in Si-flux behaviour in the cold and warm period of the year is probably related to different hydrodynamic conditions throughout the year in the studied area. In addition, the increased bottom layer temperature in the WPY (up to 7.3 °C) may enhance Si-flux during this period by increasing the Si-sediment diffusion coefficient as well as the solution rate constant of opal (2). In comparison with other coastal areas (5), the flux in the eastern Adriatic sector is lower.

Correlation analysis between benthic Si-flux and N-, P-fluxes as well as between benthic Si-flux and Si bottom water layer concentrations showed significant correlation only in the WPY for the Si – PO4 flux pair ($r = 0.620$, $p < 0.05$, $n = 12$), and the Si concentration-Si flux concentration ($r = 0.646$, $p < 0.01$, $n = 18$). The possible relation between Si-PO4 fluxes has already be stated by Redfield et al. (6), while flux-bottom concentrations relations hips have been found by Henriksen et al. (7) for nitrate.

As the coastal waters of the eastern Adriatic receive freshwater from four main rivers (Neretva, Cetina, Jadro and Krka, Fig. 1), an estimation of silica enrichment of the water column by rivers versus benthic silicate flux has been made.

The coastal area of the eastern Middle Adriatic region was estimated to be 1.941 x 10^9 m^2. Using average Si-fluxes for this area, a benthic flux contribution of 5.45 x 10^8 mole Si (WPY) and 3.27 x 10^8 mole Si in the CPY was estimated. Based on hydrological data for average monthly River flow (Fig. 1) and corresponding Si concentrations in 1998, the calculated average riverine Si-input was 1.45 x 10^8 mole in the WPY and 3.09 x 10^8 mole Si in the CPY. This indicates that benthic Si-flux contribution in the coastal area of middle and southern Adriatic is especially important in the WPY, while in the cold period riverine inputs and flux contributions are of the same order of importance.

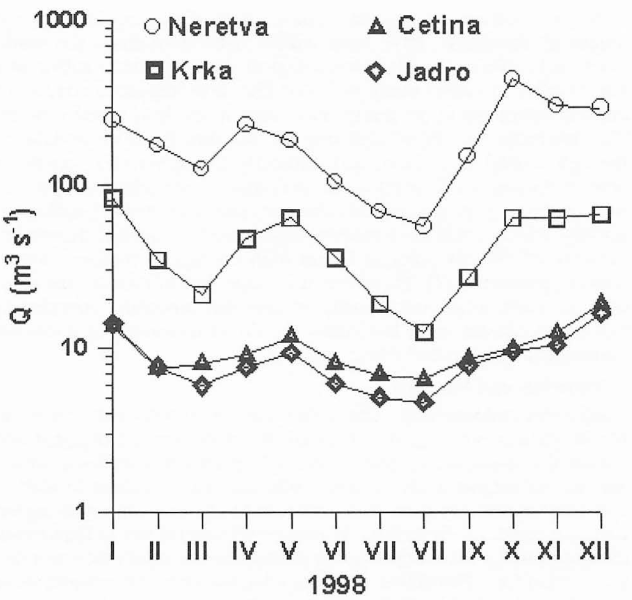

Figure 1. Average monthly flow of the main rivers on the eastern Adriatic coast.

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