ORGANIC CARBON BALANCE ON A NORTH-SOUTH TRANSECT ACROSS THE EASTERN ALBORAN SEA

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Abstract

Our study provides the first estimates of particulate organic carbon export in the Alboran Sea. A vertical organic carbon balance has been estimated using satellite-derived primary production, organic carbon fluxes down the water column, and mean accumulation rates in bottom sediments. Results suggest that less than 1% of the carbon fixed during photosynthesis in surface waters is vertically transferred and finally buried in deep sediments. A large portion is supplied by lateral advection and by shelf-derived benthic nepheloid supply.

Keywords: sediment traps, organic carbon, Alboran Sea

To know the transport of particulate organic carbon (POC) in the oceans is crucial for the understanding of the global carbon cycle and its response to climate change. Only a small fraction of the organic carbon produced in the euphotic zone sinks out, reaches the deep-sea floor and is buried forming the sedimentary record.

We have attempted to constrain the production, transfer and burial of POC in the Eastern Alboran Sea. Particle flux data were obtained from three mooring arrays deployed during one year, from June 1997 to May 1998, following a north to south transect along 1°30' W in the Eastern Alboran Sea [1]. Each mooring line was equipped with three sediment traps at 500-700 m depth, 1000-1200 m depth, and 30 m above the sea floor. The study was part of the European MTPII-MATER multidisciplinary project.

By combining measurements of primary production data from [2], algorithm-generated POC fluxes with an adapted version of Martin's et al. (1987) equation, POC fluxes measured at three sediment trap-depths [1], and mean accumulation rates measured from sediment cores [3], balances of carbon are presented in Figure 1.

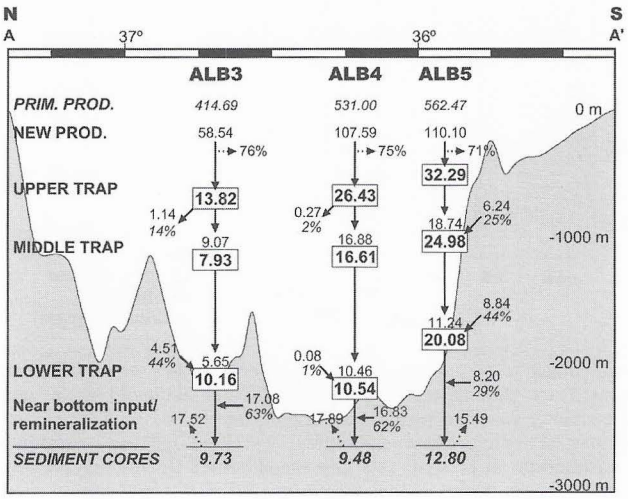

Fig. 1. Organic carbon flux balance across the Eastern Alboran Sea following a North-South transect along 1º30' W. Bold data within rectangles represent measured organic carbon fluxes by the sediment traps; data among arrows represent inferred lateral organic carbon fluxes. All POC fluxes are in mg $m^{-2}d^{-1}$.

Data reveal that a 14-21% of the primary production in surface waters is exported through the euphotic zone. There is, however, a northwards decrease of export fluxes that likely reflects the advection to the east and to the south of phytoplankton-rich water by the Atlantic jet, as depicted by SeaWiFS images [1]. Vertical POC fluxes down the water column are largest in the southern site. Lateral POC fluxes are also higher, where inputs represent 25% and 44% of the total POC flux at middle and lower depths, respectively. In the northern site ALB3 a loss that accounts for 14% of the POC is observed between upper and middle depths, and lateral input reappears between the middle and lower traps with an input of 44% of the organic carbon. A strong input of POC is supposed to occur below 30 meters above bottom at the three stations to account for the difference between what is accumulated [3] plus remineralized [4] and what is collected at the lower bottom trap. This accounts for up to 63% of total POC reaching the sea floor. The three sediment cores below the moorings have similar organic carbon accumulation rate, a situation that has been attributed to the spatial homogenisation capacity of near bottom transport [3].

Computation of the total export ratio, which is the proportion of primary production exported from the surface layer and buried in the sediments after arriving at the sea floor either vertically or advectively, yields the following values of 2.35% (ALB3), 1.79% (ALB4) and 2.28% (ALB5). However, the primary export ratio, which is the proportion of primary production arriving at the sea floor vertically, is only 0.48%, 0.68% and 0.89% for ALB3, ALB4 and ALB5, respectively. Therefore, only 0.5-0.9% of the carbon fixed during photosynthesis in surface waters of the Eastern Alboran Sea is vertically transferred and buried into the deep sediments to form the sedimentary record. A larger carbon portion is supplied by lateral advection at intermediate depths and by benthic nepheloid layers, probably derived from the continental margin, which in consequence would constitute a significant source of organic carbon to the deep Eastern Alboran Sea.

References

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