CARBON AND ^{210}PO IN THE SURFACE MICROLAYER AND ITS ROLE IN NEAR SURFACE PARTICLE FLUXES IN THE NW MEDITERRANEAN COASTAL ZONE.

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Abstract

Carbon and ^{210}Po were measured in the surface microlayer and subsurface waters concomitantly with shallow sediment trap deployments for assessing the potential enrichment of these elements in the surface microlayer and sedimenting particles. . Higher concentrations of both elements were found in the surface microlayer. The enrichment on organic carbon and ^{210}Po observed in surface waters compared to subsurface waters was not directly manifested in the vertical C or ^{210}Po flux but rather reflected in the relative composition of the settling particles.

Keywords: surface microlayer, particle flux, carbon, polonium-210

Introduction

The sea surface microlayer (SML, i.e. top few hundred microns) is a matrix of organic and inorganic particles, detritus and micro-life. This organically-rich surface film is formed from biogenic materials produced by plankton in the water column that collect at the sea surface. The abundance of organic matter provides a substrate for the growth of larger organisms (neuston). Most studies suggest that the SML represents a highly productive, metabolically active interface and a vital biological habitat. Therefore, within the EU-sponsored AIRWIN project, carbon and ^{210}Po were measured in the SML, subsurface waters (SSW) and settling particles below the SML in order to assess the potential impact of the microlayer on the enrichment of these elements in settling particles.

Material and Methods

Vertical particulate flux was measured using a newly designed upper water, sediment trap mooring. Small cylindrical sediment traps were deployed at 0.4, 2.4, 4.4, 6.4, 8.4 and 10.4 m in a water column of 26 m depth about 1/2 miles off Banyuls (42°29.21 N, 3°08.52 E; France). Four identical particle interceptor traps constructed from transparent acryl each with a H/W ratio of 6.25 and a collection area of 0.004 m^2, were attached on a cross at the upper three depths. Traps could pivot around the fixation axis and thus remained vertical during the sampling period. A similar system with only two traps was used at the lower three depths The mooring was surface tethered and attached to a buoy 25 m distant that was fixed to a bottom weight. The traps were deployed 4 times for periods ranging from 48 - 127 hours in May-July 2002 (31 May to 3 June, 3 to 5 June, 25 to 29 June and 29 June to 4 July) and were recovered by hand from small boats. Because of the short deployment period no chemical preservatives were used.

During the deployment periods, SML samples were collected from the upper 40-50 micrometers using the glass plate method (1) with a sampler fabricated in the laboratory. One liter of seawater was collected for measuring ^{210}Po and 500 ml for total and organic carbon. ^{210}Po was also analyzed in subsurface water collected ~0.5 m below the surface. CTD-Rosette profiles were taken during the deployment period to assess environmental changes and measure carbon content in the water column.

Carbon was measured by high temperature combustion using a Vario-El CHN microanalyzer (2). Samples for polonium were spiked following pretreatment with ^{209}Po and the polonium isotopes analyzed following standard procedures (3).

Results and Discussion

Carbon content was found to be consistently higher in the SML than in the SSW. The organic C concentration was variable depending on wind conditions, with values in the range of 156 to 338 mg l^{-1} in the SML and 131-213 mg l^{-1} in the SSW and, with a SML enrichment factor (EF) of 1.2 to 1.6. The C/N ratio was also higher in the SML suggesting that there was some degradation of the accumulated organic material in the surface microlayer.

Total ^{210}Po concentrations in the SSW were very uniform, in the range of 1.62 to 1.92 mBq l^{-1}, with only 1 to 3 % of the activity in the particulate fraction. The ^{210}Po concentrations in the SML were higher, 4.66 to 6.29 mBq l^{-1}, with 2-6 % of the activity in particles. The SML enrichment factor for ^{210}Po ranged from 2.4 to 3.3. The SML data reported falls well within the range of previously published data (1.41 to 8.33 mBq l^{-1}, 4).

Carbon fluxes were the lowest during period 1 and increased progressively with depth, from 20 mg POC m^{-2} d^{-1} in the upper 2 m to 50-55 mg POC m^{-2} d^{-1} at 8-10 m. In contrast, during the second period they were the highest, reaching 120 to 130 mg POC m^{-2} d^{-1} in the upper 6 m and decreasing at greater depth. During periods 3 and 4 which occurred 20 days later, POC fluxes were intermediate and there was a trend to return to the conditions observed in period 1. The rapid change in flux observed on June 3rd was associated with changes in wind direction and consequent coastal input of particles.

^{210}Po fluxes globally showed the same pattern as POC fluxes during the 4 periods, with lowest values noted during the first sampling period - in the range of 172 to 332 mBq m^{-2} d^{-1} - and the highest during the second period - 662 to1156 mBq m^{-2} d^{-1} -. The measured fluxes are similar to those reported for other coastal Mediterranean waters (5). Interestingly, the ^{210}Po/ POC ratio was always higher in particles sedimenting very near the surface (upper 2 m) and lowest in particles settling at 4-6 m depth. This could also be a reflection of the relative lower fluxes of ^{210}Po observed at 4 m compared to corresponding fluxes just above that depth.

The enrichment of organic carbon and ^{210}Po observed in surface waters compared to subsurface waters was not directly mirrored in the vertical C or ^{210}Po flux but rather in the relative composition of the settling particles. Further analysis of the organic composition of the settling material should confirm the SML fingerprint on these particles.

References

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