DOC EXPORT BELOW THE MIXED LAYER IN THE SOUTHERN ADRIATIC SEA

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Abstract

DOC data collected in the Southern Adriatic Sea in three different seasons showed that the physical processes (thermocline, water masses circulation, deep water formation) strongly affected DOC distribution. In the surface layer (0-200 m) a clear seasonality was observed and it was mainly due to the occurrence of the thermocline. When the thermocline breaks the DOC accumulated in summer is transported below the mixed layer, from these data we can roughly estimate that the C export through this process is comparable to the export of POC.

Keywords: Carbon, Adriatic Sea, Deep Sea Processes, Organic Matter

Dissolved organic carbon (DOC) represents the largest, the most complex and the less understood reservoir of organic carbon on the Earth. The difficulty to describe and quantify marine DOC dynamics and cycles is due to the very scarce information on its numerous sources and sinks and to its variable and unknown composition. Although the bulk of DOC represents a continuum of biological lability, three fractions have been defined in the Ocean [1]: (1) a labile fraction, with a turnover time of minutes to days; (2) a semi-labile fraction, with turnover time of months to years; and (3) a refractory fraction, with a turn over time of centuries to millennia. DOC concentrations in oceanic waters are mainly the result of biological activity, whereas its distribution is driven by water mass circulation [2], such as has been previously reported for the Mediterranean Sea [3, 4, 5]. DOC data were collected in 9 stations, along the whole water column, in fall (November 2006), winter (February 2007) and spring (April 2007) (Fig.1), in the framework of the Italian Project "VECTOR" in the southern Adriatic Sea, an important site of deep water formation for the whole Eastern Mediterranean Sea. Main goals of this work were: (i) to evaluate the seasonal variability of DOC; (ii) to assess the processes mainly driving DOC distribution; (v) to estimate the role of DOM in carbon export at depth.

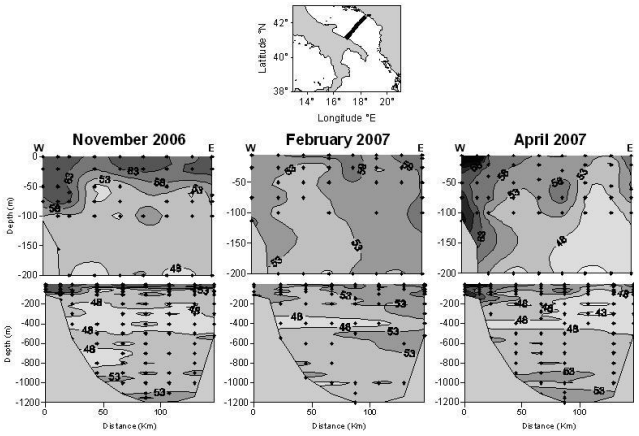

Fig. 1. DOC (mM) distribution along a section in the Southern Adriatic Sea (see the inset map), in three different periods.

In general DOC showed highly variable values (50-80 uM**)** in the surface layer (0-100 m), a decreasing until values of 42-48 uM at 300-500 m and concentrations ranging from 50 to 60 uM in the deep waters. In all the stations, the highest DOC values (> 63 uM) were observed in the mixed layer (< 50 m) after the summer, when the water column was well stratified (November 2006). In contrast, in winter, when the water column was mixed, almost homogeneous values were found until 200 m depth, without accumulation in the surface layer. These data suggest that the physical processes (thermocline, water masses circulation, deep water formation) strongly affected DOC distribution. In the surface layer (0-200 m) a clear seasonality was observed and it was mainly due to the occurrence of the thermocline. When the thermocline breaks the DOC accumulated in summer is transported below the mixed layer, from these data we can roughly estimate that the C export through this process is comparable to the export of POC. Considering the intermediate waters, in all the periods, DOC showed a minimum (42-48 uM) in the core of the Levantine intermediate water (LIW), recognizable by its salinity maximum (>38.77) and its oxygen minimum (<210 uM). In contrast, the deep waters were characterized by an increase in DOC (>53 uM). This increase was attributed to the occurrence of young waters, recently ventilated (DO>228 uM). This water may be advected from the northern Adriatic sea or it may be formed by deep convection in the central part of the section. Assuming that the concentration of the refractory fraction of DOC in the Mediterranean Sea is 40 uM (like in the Ocean), in the LIW the semi-labile DOC should account for only the 5% to 17%. In contrast, in the young deep water, the high DOC concentration suggests the occurrence of a semi-labile fraction of DOC higher than 10 mM, this is transported at depth during deep water formation and it is not yet consumed. These data indicate that the deep waters should contain an high percentage of semi-labile DOC (20-33%). This could represent a very important source of energy for deep sea ecosystem.

References

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