DISSOLVED ORGANIC CARBON IN THE IONIAN SEA AS FUNCTION OF WATER MASS CIRCULATION

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Abstract

Dissolved Organic Carbon (DOC) in the Ionian Sea was investigated during two surveys carried out in January 1999 and April 2002. The highest values (50-89 μM) were found in the upper layers (0-100 m). In the intermediate layer DOC concentration was of 40-58 μM in 1999 and 48-58 μM in 2002; the lowest values were found in the LIW during the first survey. In the deep layer the DOC ranged from 46 to 57 μM in 1999 and 2002, respectively. In 2002 the Adriatic Sea regains the main role as principal source of deep waters for the Eastern Mediterranean.

Keywords: DOC, water masses, Ionian Sea.

In the early 1990s, the hydrological characteristics of intermediate and deep waters of the Eastern Mediterranean (EM) were affected by substantial changes as a consequence of the major climatic event named Eastern Mediterranean Transient (EMT) [1]. This important event also influenced the biogeochemistry of the water column [2]. The Ionian sea is an area where the thermohaline circulation has an effect on the whole EM [1].

Figure 1 shows the study area and DOC vertical profiles in two stations (A01 and G99) investigated both in 1999 and 2002. DOC in the surface waters (0-100 m) ranged from 50 to 89 μM in all the stations, without any connection with the time of survey. On the contrary, different DOC values were observed in the intermediate and deep waters in the two periods. In winter 1999, the Levantine Intermediate Water (LIW) exhibited very low DOC values (40-42 μM), because of the reduction of this water mass that was prevalently constrained to re-circulate in the Levantine basin; in the meanwhile, the new Cretan Intermediate Water (CIW) occupied the intermediate layer mostly in the eastern portion of the Ionian sea exhibiting larger DOC values (54-62 μM). In 1999, the LIW was particularly old indicating that a large part of DOC was probably already mineralised, therefore the remaining part should be mainly constituted by the "refractory" fraction [3]. In contrast, the CIW in the first survey exhibited DOC values relatively high because of its young age, being very close to the source. The deep layer in the 1999 was occupied by both the new Cretan Deep Water (CDW) and the Eastern Mediterranean Deep Water (EMDW) of Adriatic origin. The latter was elevated at shallower depth, because of the intrusion in the bottom layer of the much more dense CDW. Therefore, the DOC exhibited values ranging from 43 to 47 μM in the CDW and 44-48 μM in the EMDW.

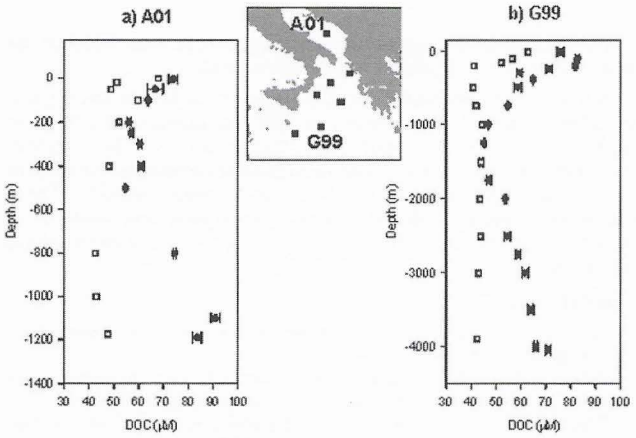

Fig. 1. Comparison between DOC vertical profiles in 1999 (γ) and 2002 (•) in the stations: A01, located in the Southern Adriatic Sea and G99, located in the Central Ionian, as shown in the inserted map.

A rather different situation was observed during the second survey carried out, in the same area of the Ionian sea, in spring 2002. The LIW circulates more abundant from east to west, as it was the case before the EMT; and the Adriatic Deep Water (ADW) returned to be the main source of deep waters for the whole EM. Therefore, DOC in the LIW has shown concentrations (48-59 μM) much higher than those observed in 1999, whilst the CIW exhibited values (mean value 58 μM) similar to those found in the 1999, although its contribution was restricted to a smaller area. Concerning the deep waters, the ADW at its source region (station A1 located in the southern part of the Adriatic sea at the interior of the gyre) exhibited DOC concentrations of 74 μM. Then, during its route towards the south into the Ionian, it mixes with the surrounding "older" EMDW to give a "new" product, with DOC values ranging from 57 to 75 μM, which are, however, higher than those observed in 1999. In the station A1 (Fig. 1a), the DOC concentration is higher (≈ 74 μM) in 600-1000 m depth range; it may be attributed to the deep convective movements of surface waters in the interior of the southern cyclonic gyre; whilst DOC values of 80-90 μM were observed in the bottom layer below 1000 m, presumably because of the arrival of much more dense waters formed in the northern shelf region. In the station G99 (Fig. 1b), the increase of DOC to values >50 μM in the layer below 2000 m, may be connected to the arrival of "new" EMDW; therefore, the moderate increase of DOC may be the result of a mixing between the recent ventilated ADW, rich of DOC, and the resident EMDW.

In conclusion, the DOC behaviour in the water column, monitored in different periods, confirms the strict correlation occurring between DOC and physical characteristics of the different water masses.

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