THE EVOLUTION OF THE INTERMEDIATE WATER MASSES OF THE EASTERN MEDITERRANEAN

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Abstract

Hydrographic observations in 1999 and 2001 are used to highlight the evolution in the intermediate water masses. During the current stage of the Eastern Mediterranean Transient the Aegean is an active source of a warm and highly saline intermediate water mass. The distributions of the tracer CFC-12 show that the Cretan Intermediate Water (CIW) is strongly ventilated and is now spreading along the main pathways of Levantine Intermediate Water towards the Strait of Sicily.

Keywords: Intermediate waters, ventilation, tracer

Introduction

The Eastern Mediterranean Transient (EMT) is a major disturbance of the thermohaline circulation of the Eastern Mediterranean. It started in the early 1990s, when the Aegean took over the leading role in deep water production from the Adriatic. One of the most prominent features during the early stages of the EMT had been the massive ventilation of the deep water masses. This could be seen very clearly in the strongly increased concentrations of the tracer CFC-12. As a side effect of the massive outflow of dense water from the Aegean ‚old' Eastern Mediterranean Deep Water (EMDW) was pushed upward and diluted the Levantine Intermediate Water (LIW) layer, causing salinities to decrease. The evolution of the intermediate waters is of great interest because the salt they are transporting is an important prerequisite to achieve high densities during convection. The initial decrease of salinity in the LIW had been linked to the lack of convective activity in the Adriatic during the 1990s and it had been postulated that the resumed salt advection into the Adriatic by the Cretan Intermediate Water (CIW) would help the Adriatic to regain its leading role in deep water production [1, 2].

Materials and Methods

The data presented in this study have been obtained during two cruises of RV *METEOR* in April/May 1999 and October/ November 2001 in the Eastern Mediterranean. The data comprise hydrographic profiles, nutrient and oxygen profiles, as well as profiles of transient tracers (CFCs, helium isotopes, and tritium). Atmospheric concentrations of CFCs display a time-dependant behaviour. CFCs are introduced into the ocean by air/sea gas exchange and carry the time-varying signal into the ocean. They are therefore excellent tools to identify ventilation and spreading pathways of water masses.

Results and Discussion

Figure 1 shows the change in concentration of CFC-12 between 1999 and 2001 along an east/west transect in the Eastern Mediterranean. The evolution of CFC-12 between 1999 and 2001 shows only moderate increases in the deep water (H>1500m). One area of increase is observed close to the Italian continental break and the other is seen in the Levantine Basin, where spreading of the dense water from the Aegean is still continuing. Whereas a very strong signal of ventilation is observed in 200-400 m depth range. This signal is persistent from the eastern Straits of the Cretan Arc toward the Strait of Sicily but is absent in the Levantine Basin. A closer examination of the T/S properties shows that the CFC-12 increase is associated with the Cretan Intermediate Water. CIW is warmer and saltier than LIW and therefore is found on top of the LIW in the water column. In the salinity profiles CIW and LIW overlap into large subsurface salinity maximum, but the CFC-12 distributions clearly mark CIW as the more ventilated water mass and allow the separation of the two intermediate water masses. In 1999 CIW had not been found in the Cretan Passage, but was exchanged through Antikythera Strait into the Ionian and advected into the Adriatic. The salt advected into the Adriatic by the CIW and previously the LIW is a prerequisite for deep convection in the southern Adriatic. The 2001 observations indicate that CIW is now following one of the main spreading pathways of LIW, flowing westward towards the Strait of Sicily and is thus included into the exchange of water masses between the Eastern and Western Mediterranean. In the Levantine Basin the CFC-12 differences between 1999 and 2001 indicate decreasing concentrations. This results from the absence of CIW and from the still ongoing upward movement of ‚old' EMDW into the LIW horizon.

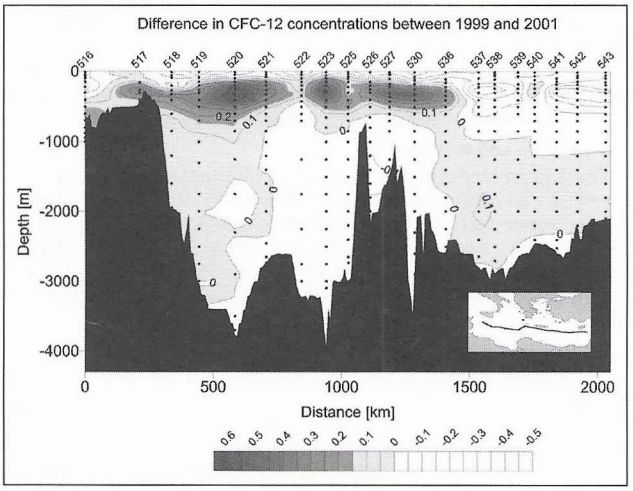

Fig. 1. Difference in CFC-12 concentrations [pmol/kg] between 2001 and 1999 along a section between Sicily and Cyprus. Positive values correspond to an increase in CFC-12 from 1999 to 2001, negative values denote a decrease.

References

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