DENSE WATER FORMATION AND CIRCULATION IN THE SOUTHERN ADRIATIC SEA DURING WINTER 1996

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Abstract

The South Adriatic has been indicated by many authors as a possible site of dense water formation. Experimental evidence of an open-ocean deep convection event has been documented by Ovchinnikov *et al.* (1). New evidence for such a process was observed during winter 1996. A very deep mixed water column and a baroclinic cyclonic circulation provided the necessary preconditioning. A strong northerly wind episode contributed to the cooling of surface high density waters ($\gamma_\theta \cong 29.15$ kg/m^3) upwelled from the deep layer, while a deepening of the oxygen rich water column from 300 down to 600 m was observed at a horizontal scale of a few tens of nautical miles after 8 days.

Key-words: Deep Waters, Hydrology, Open Sea, Water Convection, Adriatic Sea

Introduction

The Adriatic Sea is the primary source of the deep water mass for the entire Eastern Mediterranean (2). Even though results from a recent hydrographic survey show that the influx of Aegean water has replaced 20% of Eastern Mediterranean Deep Waters (3), the Adriatic Deep Water (ADW) still exits through the Otranto Strait and spreads into the deep layer of the Ionian interior (4). The role of the Southern Adriatic as a possible site of deep water formation has been pointed out by many authors, although experimental evidence for open-ocean deep convection events is poorly documented in historical data. Ovchinnikov *et al.* (1), from a few coarse spatially distributed hydrological data collected during mid-February and early April 1977 found only the initial and concluding stages of convection. Later on, during the March 1982 expedition, the energetic mixing and sinking phase of dense water formation after favourable weather conditions was documented.

The aim of the present work is to describe and discuss recent evidence of deep water formation in the Southern Adriatic observed during winter 1996. Cooling of saline surface water caused by a strong wind together with an intensification of cyclonic movement provided suitable conditions for deep water formation.

Plan of Measurements

During the winter 1996 cruise, carried out in the framework of the PRISMA (Programma di Ricerca e Sperimentazione del Mare Adriatico) collaborative Italian research program, the Southern Adriatic Sea was visited from 17 to 28 February. The hydrological station network (Fig. 1) was designed with the aim of investigating the transport of major water masses crossing the transects in Pelagosa sill (about 200 m depth) and Otranto Strait (about 800 m depth). The large topographic depression inside this region, down to about 1200 m depth, was investigated as well. Synoptic shipboard measurements included CTD casts, using a Seabird SBE 911 plus equipped with oxygen sensor, in combination with a Rosette water sampler to collect samples for salinity calibration and oxygen determinations following the Winkler method. The CTD data were checked and calibrated according to the standard procedures, and subsequently averaged over 1 dbar pressure intervals.

Results and Discussion

Objective analyses of temperature and salinity at surface (Fig. 2a and b) show that relatively cold (θ<13.4°C), high salinity (S>38.60) waters were found in the middle of Southern Adriatic basin. This area was occupied by a large multi-lobe cyclonic gyre marked at the surface by the 29.15 kg/m^3 isopycnal (not shown). Some elongations toward the north shelf break area and close to the eastern coast are indicative of isolated patches where vertical mixing events may occur at horizontal space scales of a few tens of nautical miles. The presence of a strong thermohaline frontal zone separates the light coastal water, which flows southward along the western Italian coastline, from the open-seawater limiting the area of vertical

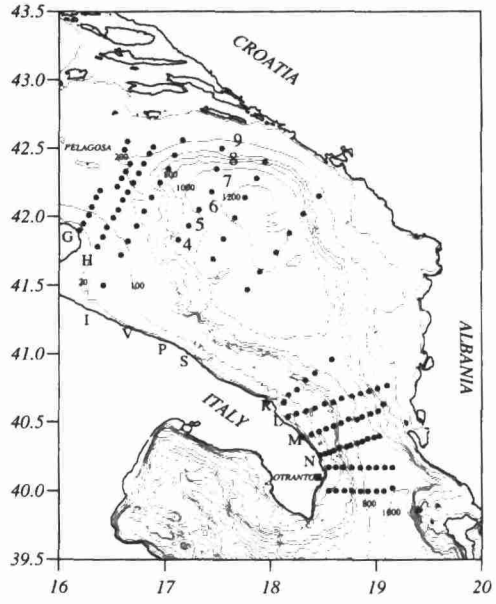

Figure 1- Location of hydrological stations (dots) superimposed on batymetry (depth in meters). The letters along the Italian coast denote the transverse sections. The numbers of stations mentioned in the text are indicated.

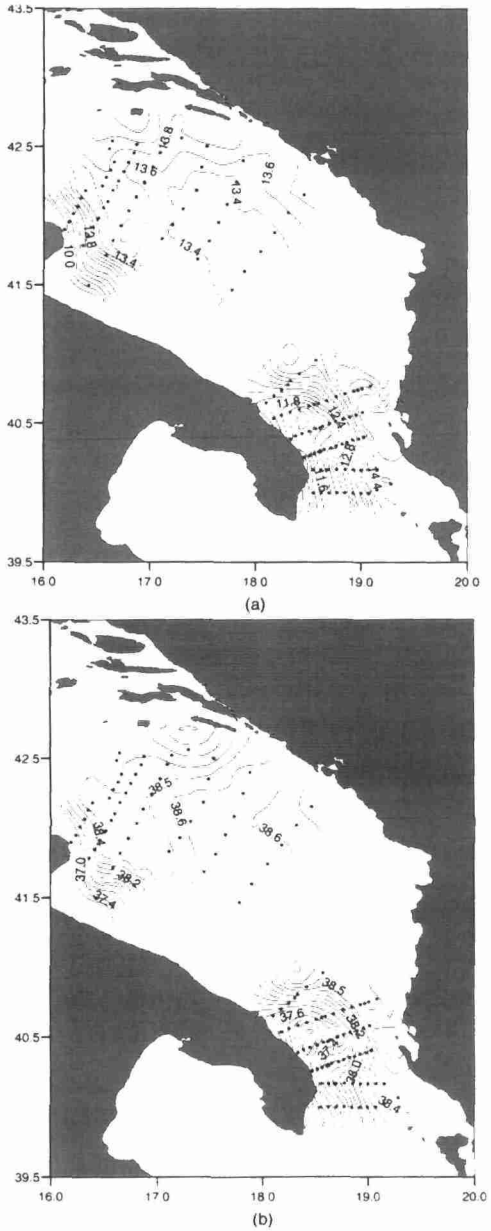

Figure 2 - Objective analysis of temperature(a) and salinity(b) at surface. The positions of stations used in the map are indicated by dots.