HYDROLOGY AND ASSOCIATED SPM DISTRIBUTION OVER THE NORTHERN MARGIN OF THE ISLAND OF CRETE

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Abstract

The circulation over the continental margin of Crete in 1994-1995 was dictated by a mesoscale eddy dipole system, inducing a shoreward flow at the study area. Light transmission was correlated to SPM concentrations ranging between 1.5 mg/l and 0.2 mg/l. The highest SPM concentrations were found close to the sea-bed over the shelf-break and upper slope (mostly terrigenous), and in the upper water column offshore (mostly biogenic). The offshore SPM distribution is governed by the general circulation pattern. The bottom nepheloid layer (BNL) over the shelf-brake and upper-slope region may be attributed to seismicity, bottom currents, internal waves and trawling.

Key-words: particulates, Cretan Sea, Coastal Processes, Continental Margin

Introduction

The present investigation was performed within the framework of the CINCS (Pelagic-benthic Coupling IN the oligotrophic Cretan Sea) experiment, aiming to study the coupling of biogeochemical fluxes over the southern margin of the Cretan Sea, the largest and deepest (2500 m deep) basin of the Aegean Sea (Fig.1). The Cretan Sea exchanges water with the N. Aegean Sea through various passages of the Cyclades Plateau, and with the eastern Mediterranean Sea through the Cretan straits. In particular, the area under investigation extends from the narrow continental shelf of Crete through the steep (3°-4°) continental slope to the deeper than 1700 m basin.

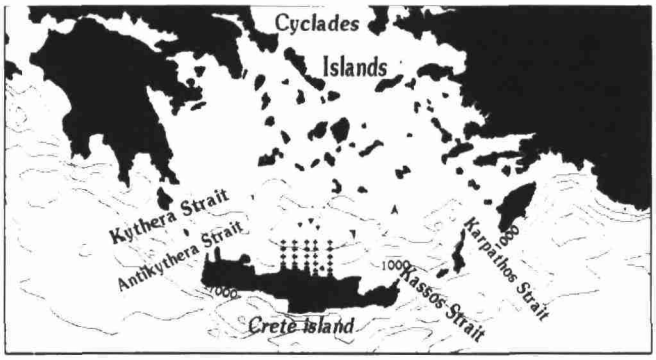

Figure 1. The geographical ambience and bathymetry (isobath every 1000 m) of the Cretan Sea. The dominant mesoscale circulation is shown, as well as the CINCS station network.

The major hydrodynamic features of the Cretan Sea have been described in the past by various investigators (1, 2, 3). A more recent picture has emerged through the POEM (4) and PELAGOS (5) programs; an interesting feature since 1992 is the presence of a semi-permanent mesoscale eddy dipole consisting of an anticyclone in the western Cretan Sea, and a cyclone in the eastern part.

CTD casts accompanied by nephelometric measurements have been widely used for the study of suspended particulate matter (SPM) in Mediterranean continental margins (off the mouth of major rivers): the Gulf of Lions (6), the R. Ebro (Spain) continental shelf (7) and the Thermaikos Gulf (NW Aegean Sea) (8, 9).

Data collection and methodology

A hydrographic network of 35 stations was laid over the Cretan slope, extending from the inner shelf to the deep basin (Fig. 1). The stations were distributed on a square grid of five meridional sections (code-named A-D from south to north) and seven zonal sections (code-named 1-7 from west to east). CTD and light transmission measurements (with a 10-cm path transmissometer) were used to provide "snapshots" of the distribution of the various water masses and the associated SPM on a seasonal basis (5/1994, 11/1994, 2/1995, 5/1995 and 9/1995). For the measurement of SPM, water samples (4 to 8 liters) were collected using Niskin bottles from depths where low light transmission was observed. The samples were immediately filtered through pre-weighted Nuclepore membrane filters filters (47mm diameter, 0.4mm pore size). Samples from selected depths were used to relate the observed (%) light transmission with SPM in mg l^{-1}; the correlation was fairly good ($0.77<R<0.98$) during the various sampling periods.

Water masses and circulation

The various water masses identifiable in figure 2 are present in the Cretan Sea throughout the CINCS experiment. The surface water (SW), with characteristics determined mainly by air-sea interactions, is generally distinguished by its high salinity and temperature. Often, and depending on the degree of suface mixing, low salinity water of North Atlantic origin, the Modified Atlantic Water (MAW) is traceable as a very thin subsurface layer, from 15 to 50 dbar. A salinity maximum below 50 dbar denotes a layer of the locally formed Cretan Intermediate Water (CIW), similar in characteristics with the Levantine Intermediate Water (LIW) but still warmer and slightly saltier. In the deeper layers, the so-called Transition Mediterranean Water (TMW) can be identified by the low salinity (S~38.9 psu) of its core, the latter lying between 300-400 dbar. The deep and bottom layers are occupied by the very dense Cretan Deep Water (CDW).

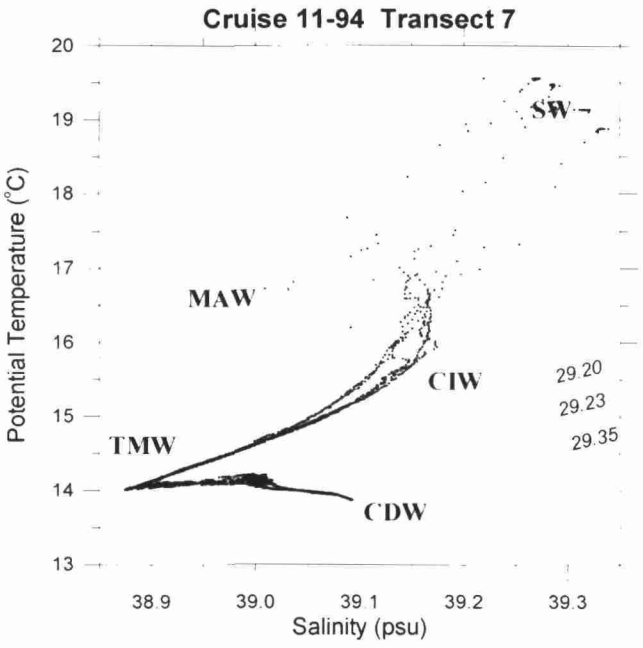

Figure 2. θ/S diagram from all the stations of the deepest zonal transect during the CINCS-II cruise, identifying the various water masses present.

As mentioned above, the PELAGOS project has revealed the dominance of a mesoscale eddy dipole over the central Cretan Sea throughout 1994-1995. The dipole consisted of a cyclone over the eastern-central Cretan Sea and an anticyclone over the western-central part. As the CINCS observations certified (Fig. 3), these eddies induced a southward flow at the northern boundary of the sampling area towards Crete. The local signature of the eddy dipole is identifiable through the upward slope of the isopycnals towards the east. Throughout most of the sampling period, the CINCS region remained between the southern extensions of the two eddies, thus the northern boundary experienced only southward flow. However, during winter 1995, the cyclone shrunk in size and increased in intensity, moving the local signature of its centre by about 20 km to the west. Then, the southward flow became stronger, and a northwest flow is observed exiting the CINCS sampling area at its northeastern corner.