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Advection of resuspended material along the slope of the Thermaikos Margin

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Hydrodynamical and sedimentological characteristics of the Thermaikos margin and of the Sporades basin have been described by BALOPOULOS et al. (1987) and LYKOUSIS et al. (1981). More recently, an extensive coverage of this area by hydrological and nephelometric casts provided an improved picture of the general circulation and of the distribution of the suspended matter (CHRONIS et al., 1987).
The geostrophic flow calculated at the eastern limit of the Sporades basin indicates an anti-cyclonic flow above the no-motion depth and a cyclonic flow in the deep water (fig.1). This circulation is in agreement with the isopycnal and isothermal structures in the Sporades basin. The depth of reference has been determined using the inverse method based on the conservation of the fluxes (VERONIS, 1987).
The dynamical method cannot be applied to the shallow water of the shelf. However, the nepheloid structures illustrate the combined effect of these two circulations on the transport of suspended matter in the transitional area of the continental slope. An axial section across the shallow basin (fig.2) shows a detached shelf-BNL extending above the slope at depth of the shelf break and an INL between 400 and 500 meters (fig. 3 a). From the transect along slope (fig. 2), this INL is interpreted as a consequence of the erosion of the slope (fig. 3 b), as confirmed by the high turbidity spot between the two canyons. The absence of intensive BNL in the canyons indicates that erosion and subsequent advective transport compete with the predominant down-canyon transfer from the shelf observed on other continental margins (MONACO et al., 1987). The horizontal processes are therefore believed to play a major role in the distribution of suspended matter on the Thermaikos margin and in the Sporades basin.

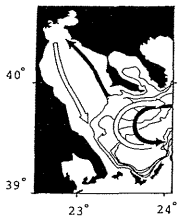

Figure 1 . Schematic flow pattern as deduced from the survey (spring, no significant wind conditions) :
The white arrows represent the surface water flow on the shelf and geostrophic flow above the depth of no motion (ca. 400 m) in the Sporades basin. The black arrows represent the bottom water flow on the shelf and geostrophic flow below the depth of no motion in the Sporades basin.

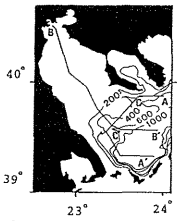

Figure 2 . Bathymetry and sections across the Thermaikos shelf and the Sporades basin :
(A-A'): along margin section
(B-B'): longitudinal section
(C) and (C'): canyons

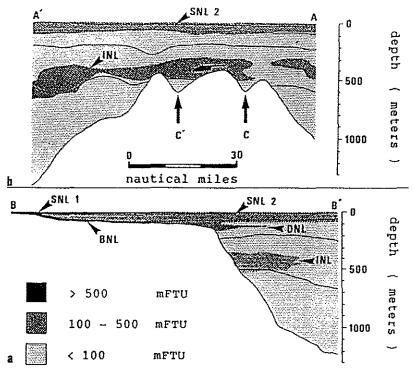

Figure 3. Turbidity and density structures. (a): cross-section of the Thermaikos shelf and the Sporades basin. (b): section along the margin. Turbidity is expressed as FTU (Formazine Turbidity Unit).
The vertical distribution of suspended matter follows the isopycnals surfaces and is subdivided roughly in four nepheloid layers :
- The Surface Nepheloid Layer has a predominant terrigeneous origin near-shore (SNL 1) and is more biogenic off-shore (SNL 2).
- The Detached Nepheloid Layer (DNL) at shelf-break depth originates mainly from the Bottom Nepheloid Layer (BNL) observed on the shelf.
- By contrast, the Intermediate Nepheloid Layer (INL) at depth between 400-500 m is attributed to resuspension processes and transport by the general circulation along the slope as suggested by an absence of a BNL in the canyons C and C'.

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Hydrological conditions and material transfer mechanisms in the Northwestern Aegean Sea (Thermaikos Plateau and Sporadhes Basin) : research activity within the framework of the EURECOMARGE Project

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INTRODUCTION

The northwestern Aegean region of the Eastern Mediterranean Sea invites the attention of marine scientists because alterations are occurring in its waters, as a consequence of urban waste disposal and industrial effluent inputs. Of particular scientific interest are the alterations occurring in the marine environment from the outflows of large river systems (Axios River, Loudhias River, Aliakmon River, Pinios River), which discharge along the northern and western coastlines. The rivers supply large quantities of freshwater (total annual discharge of some 10.2×10^6 m^3 of water) and associated fine-grained terrigeneous material (of the order of $3-4 \times 10^6$ tonnes/year), influencing greatly the ecosystem and in particular the hydrodynamical and sedimentological conditions in the area (Balopoulos et al., 1987; Chronis et al., 1987; Chronis et al., 1988).

In the framework of the EURECOMARGE Project, the northwestern Aegean Sea (Thermaikos Plateau and Sporadhes Basin) was surveyed by the R/V AEGAIO during the ECOAEGAIO-I-87 Cruise (1-6 June 1987).

METHODS

Hydrographic casts were made at 85 stations using a Neel Brown CTD profiler, coupled with a transmissometer (for the measurement of the concentration of the suspended material, expressed in units of turbidity Formazine FTU). In addition, two current meter moorings, consisting of three self-recording current meters (Aanderaa RCM5) each, were maintained on the shelf break (water depth 200-210m), during the same time period, to study near-surface, mid-depth and near-bed currents.

RESULTS

Surface waters were generally characterized by higher temperatures and lower salinities, than the underlying waters. This lowered the water density of the upper layers and resulted in strong stratification. In Thermaikos Gulf surface temperatures and salinities ranged between 19.0-20.0 °C and 36.0-37.7‰, respectively. The thermocline and halocline extended down to around 30m. Below this depth temperature decreased gradually with increasing depth and salinity increased only slightly. In Sporadhes Basin surface temperatures and salinities varied between 17.0-19.0 °C and 36.0-38.5‰, respectively. Here, the stratification extended down to a depth of around 50m, below which was present an almost homogeneous water mass of low temperature 12.5-13.5 °C and hihg salinity 38.7-38.8‰.

To the north, surface waters of low salinity (34.0-36.5‰), high temperature (20.0-21.0 °C) and high turbidity (1400-2000 mFTU), related to the discharges of the Rivers Axios and Aliakmon, were flowing towards the Aegean Sea along the western coastline (Fig. 1). The outflow from the Pinios River was present as a tongue of surface water of low salinity (35.8-37.0‰) and high turbidity (1400-2400 mFTU), extending towards the northeast. Further south (Station 1) water flow was towards the southwest at speeds of less than 13 cm/s (Table 1) Relatively data records collected in the west (Stations A and B) were all unimodally distributed, showing high concentrations northwards.

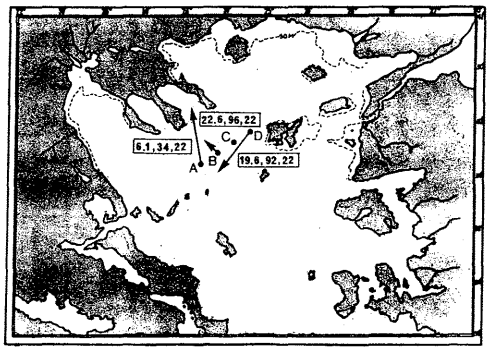

Fig. 1. Summary of near-surface residuals in North Aegean Sea. [Arrows indicate direction. Lengths are proportional to the magnitude of the vector means. Each set of the three values represent: residual flow in cm/s; the steadiness factor "B", as a percentage (Balopoulos et al., 1986b); and, the length of the record in days (in that order)].

In the west (Station A), residual currents (Table 1) exhibited quite important speeds (22.6 cm/s at the near-surface layers, 13.8 cm/s at mid-depth and 11.2 in the near-bed layer). Here, residual flow was, in all cases, northwards (e.g., see Fig. 1). At the adjacent Station B, the residual current was in the same direction but much lower in magnitude (6.11 cm/s at the near surface layers, 3.8 cm/s at mid-depth and 1.8 cm/s in the near-bed layer). In the east (Stations C and D), the magnitude of the residual current, in the near-bed layer, was around 8.5 cm/s. The residual flow was towards the southwest at Station C and towards the northwest at Station D. At the latter station the residual flow at the near-surface and mid-depth layers was towards the southwest at around 19.6 cm/s and 7.1 cm/s, respectively.

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