THE TELECOMMUNICATION BETWEEN THE AEGEAN AND THE ADRIATIC SEAS THROUGH THE INTERMEDIATE WATERS INFLUENCES THE DEEP CONVEYOR BELT OF THE EASTERN MEDITERRANEAN (1986-1999).

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Abstract

This work summarizes the variability of the intermediate water characteristics in the eastern Ionian during the period 1986-98, giving evidence to the indirect role that the Aegean plays in modifying the deep thermohaline cell of the eastern Mediterranean.

Keywords: intermediate waters, variability, eastern Mediterranean

The Levantine Intermediate Water (LIW), the most important Mediterranean high saline water mass, is the major constituent of the intermediate waters (200-600m) throughout the Basin. The main route of LIW is westward direct to Sicily Straits, but peeling-off branches appear as LIW is veered around the circulation features. A branch of LIW in the eastern Ionian is directed towards the Adriatic following the Greek coastline. The percentage content in LIW is highest near the coast. Within the period 1986-98, the Aegean contribution to the intermediate layers presented considerable variability (1).

The Adriatic Deep Water (ADW) is considered the source-water of the EMDW since the beginning of the last century (2). The high saline intermediate water participates in the open-ocean formation processes, occurring in the Adriatic southern pit. Salinity is the crucial factor for the density increase (3, 4). The temporal evolution of the Adriatic is attributed at a large extent to changes in the Ionian (5). Favorable winter weather conditions are the major forcing mechanism necessary for the convection. Moreover, the contribution of the North Adriatic Deep Water (NAdDW) is another key factor in determining the final product of the formation processes in the Adriatic (6).

Since 1987, the eastern Mediterranean undergoes abrupt hydrological changes due to the shift of the deep-water formation site from the Adriatic to the Aegean, namely the Eastern Mediterranean Transient (EMT) (7, 8, 9, 10, 11) .The filling of the deep and bottom layers with new denser waters of Aegean origin caused uplifting of the older EMDW and the overlaying transitional waters between the LIW and EMDW by several hundred meters. The above modification of the deep thermohaline cell has been accompanied by changes in the open conveyor belt of the Basin that comprises the intermediate waters. Significant changes in the upper thermocline circulation altered the water mass pathways. The latter along with the evolution of the Aegean to an effective source of a new type of intermediate water, the so called Cretan Intermediate Water (CIW) (11), has considerably influenced the respective layers in the Ionian. Therefore, within the LIW horizons have undergone first dilution of the waters about 30% by the uplifted less saline old mid-depth waters (12) and at a later stage replacement of LIW by the new warmer, more saline CIW (10).

The analysis of the data from "POEM", "MATER" and "NATO-RR97-Ionian" programs shows that in the period 1986-1991 the intermediate waters in the northeastern Ionian present a decreasing trend in temperature ($\Delta\theta$~0.35° C) and salinity (ΔS~ 0.05 psu), which implies an increase in density (σ_θ~0.04 kg/m^3). Thus, the Adriatic is supplied progressively with less salt, but with denser waters before and during the early stages of the EMT. During the winter 1987 strong deep-water formation was reported under very cold and dry meteorological conditions. Moreover, during the coldest winter 1991-1992, the deep density in the Adriatic reached for the last time the value of 29.3 kg/m^3. This coincides with the highest density (σ_θ=29.14 kg/m^3) of the intermediate water observed in the preconditioning period, fall 1991 in the northeastern Ionian and in winter 1991-92 in the Otranto. Until 1995, "low" salinity (S~38.74 psu) was the characteristic of the inflowing "diluted" intermediate waters and lack of deep ventilation and production of dense waters was noted (7). In January 1995, the ADW appeared in the Ionian above the Deep and Bottom Waters of Aegean origin at 1000-1500m depth (1). In 1997-99, the intermediate waters reaching the Adriatic were strongly influenced by the new CIW (S>38.90 psu) providing more salt than before the EMT period. However, their temperature increased ($\Delta\theta$ ~0.46°C) and density fluctuated (σ_θ~ 29.12-29.14 kg/m3). Even though, no deep convection (~400m) in the Adriatic was reported in 1997 and 1998, due to insufficient surface cooling and buoyancy loss (6). The ADW in late fall 1998 had not still enough density to sink to the Ionian bottom, but circulated at depths of ~1000m with salinity higher than that of 1995 by ΔS ~0.06 psu. In 1999 the ventilation in the southern Adriatic went deeper (700m), but the density of the product was insufficient to replace the bottom dense Adriatic water.

Therefore, the above confirms an Aegean remote effect on the Adriatic open-ocean deep-water formation process through the affected intermediate water and thus its indirect role in modifying the deep thermohaline cell of the eastern Mediterranean, apart from the direct influence through the formation of the densest Cretan Deep Water, after 1987.

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