ASSESMENT OF POST-TRANSIENT CHANGES IN LEVANTINE BASIN DEEP WATERS

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Abstract

Large deep water (DW) renewal in the Levantine Basin (LB) by dense water from the Cretan Basin started at about 1989 after massive advection of salty Levantine Surface Water in the Aegean Sea. An apogee of the DW outflow to the LB was observed in 1993 after the abnormally cold winters of 1992-1993. A relatively salty and warm water propagated above the sea bottom from the Cretan Passage with a rate of about 280 km/year. The DW renewal was first recorded near the south eastern continental slope of the LB in 1996. During 2001, the LB DW was quite homogeneous east of 25E. According to observations during 2008, a new DW mass spreads eastwards in the LB. This new water, originating from the Adriatic Sea, has higher potential density than the Cretan origin DW and the pre 1989 Adriatic DW.

Keywords: Deep Waters, Levantine Basin

A comprehensive analysis of Levantine Basin deep water evolution during the Eastern Mediterranean Transient (EMT) [1] brought a vivid picture of Cretan dense water cascading through the Cretan Arc straits and spreading in the Eastern Mediterranean intermediate and particularly bottom layers. Advection of abnormally saline Levantine Surface Water in the Aegean Sea during 1989-1990 [2] followed by extremely cold winters 1992-1993 [3] forced the formation of deep water with potential (relative 2000 db) density anomaly (σ_2) of about 37.83 kg/m^3 [1]. The excess over the pre EMT bottom water density was just 0.03 kg/m^3. However it was enough to generate a wide spreading of newly formed water. In 1995, three years after the apogee of dense water outflow from the Cretan Basin, the Levantine Deep Water below 2000 m had a stable inversion layer both in salinity and potential temperature. According to a long term series of Israeli observations on station h5 located near the continental slope of the south-eastern Mediterranean shelf (33.0°N, 34.5°E) the first evidence of such inversion was found in 1996. A coarse estimation of propagation rate of dense water from Cretan Passage to the south-eastern continental slope was about 280 km per year. Before the EMT influence, the h5 station's water at depth of 1400 m had salinity 38.68±0.02 with a negative vertical gradient of about 0.005 per 100 meters. Potential temperature was 13.37±0.02°C with a decrease rate of 0.015°C per 100 meters. During the period 1996 – 2002, salinity and potential temperature increased monotonically reaching 38.77, 13.59°C and changing the vertical gradients signs.

Relatively regular observations in the framework of Israel's national project "Haifa Section" from 2002 to 2009 show fluctuations in salinity and potential temperature with ranges of 0.02 and 0.02°C respectively. Observations from R/V "Meteor" during 2001 [1] revealed quite homogeneous water for regions east of 25°E and deeper than 2000 m (38.82±0.02, 13.71±0.02°C). However on the most western stations an intrusion of new water was already observed. This water was slightly less saline (38.78) and colder (13.56°C) than the water which originated from Cretan Basin. In the field of potential density relative to 2000 db it is possible to see that the new deep water is denser by about 0.005 kg/m^3 than the relict water from the previous EMT renewal.

Further eastward propagation of the new water, which Roether et al. [1] defined as having Adriatic origin, was observed in summer 2008 during the R/V Shikmona cruise carried out in the framework of EU funded project SESAME (http://www.sesame-ip.eu). The western boundary of the Cretan origin water was shifted to about 27.5°E (Fig). The boundary is clearly observed in the salinity field (Fig) as well as in fields of potential temperature and dissolved oxygen. The Cretan origin deep water were disconnected from their origin in the Aegean Sea and became, due to mixing, less salty and colder (38.79, 13.63°C) than they were during 2001. The Adriatic origin water did not change its parameters compared to observation from 2001. Apparently this water mass had a permanent feeding from the Otranto strait. Differences in potential density between the Adriatic and Cretan water masses remained the same as in 2001 (about 0.005 kg/m^3). The eastward propagation rate of Adriatic origin water was seven times slower than the propagation of the Cretan origin water. This seems to be connected to the smaller difference in potential density.

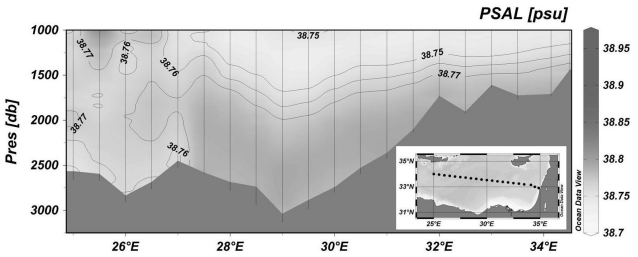

Fig. 1. Vertical distribution salinity in deep layers of the Levantine Basin. R/V Shikmona, summer 2008, SESAME project cruise.

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