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Carbonate system parameters and anthropogenic CO_2 in the North Aegean Sea in October 2013

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Abstract

Data of A_T (total alkalinity) and C_T (total inorganic carbon) collected during October 2013, on a N-S transect crossing the North of Lemnos basin allowed to identify the peculiarities of the CO_2 system in the North Aegean Sea and estimate the anthropogenic CO_2 (C_{ANT}) concentrations.

Extremely high concentrations of A_T and C_T were recorded in the upper layer of the North Aegean reflecting the high loads of A_T and C_T by the brackish BSW (Black Sea Water) outflowing through the Dardanelles strait and by the local rivers runoff. Both A_T and C_T exhibit strong negative linear correlation with salinity in the upper layer (0-20m). Investigation of the A_T-S relationship along with the salinity adjustment of A_T revealed excess alkalinity throughout the water column in relation to surface waters implying the possible occurrence of non-carbonate alkalinity inputs and of other processes taking place probably over the extended shelves that contribute to the alkalinity surplus.

The intermediate layer occupied by the Modified Levantine Intermediate Water (MLIW) mass exhibits the lowest C_T and A_T concentrations, while rather elevated A_T and C_T concentrations characterize the North Aegean Deep Water (NAgDW) mass filling the deep layer of the North of Lemnos basin linked to previous dense water formation episodes.

High anthropogenic CO_2 content was detected at intermediate and deep layers of the North Aegean reflecting the effective transportation of the absorbed atmospheric CO_2 at the surface to the deeper waters via the dense water formation episodes. The MLIW layer is more affected by the penetration of C_{ANT} than the NAgDW that fills the deep part of the basin. The observed variability of C_{ANT} distribution reflects the influence of the intensity of dense water formation events, of the different θ/S properties of the newly formed dense waters as well as of the diverse submarine pathways followed by the cascading dense waters. The invasion of C_{ANT} has lead to more acidic conditions and to lower saturation degree of calcium carbonate in relation to the preindustrial era. The findings of this study provide baseline information about the carbonate system properties of the North Aegean and highlight its active role in sequestering and storing anthropogenic CO_2.

Keywords: carbonate system; anthropogenic CO_2; acidification; North Aegean Sea; Mediterranean Sea