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Biogenic sedimentation in the North Aegean Sea and climatic implications

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Background-Objectives

Coccolithophore assemblages that are recorded in marine sediments generally comprise a successful palaeontological tool for the reconstruction of the paleoclimatic and paleoceanographic conditions in the geological past (e.g., Triantaphyllou et al., 2009; Gogou et al., 2016), as they represent reliable indicators of environmental conditions (e.g., Baumann et al., 2000). However, little is known about the transformation of living coccolithophore communities into coccolith assemblages within the underlying sediments.

In the oligotrophic waters of the Eastern Mediterranean Sea, the high seasonality of the oceanographic parameters affects the coccolithophore abundance and productivity (e.g., Dimiza et al., 2015). The North Aegean Sea (NE Mediterranean) displays less oligotrophic characteristics during the highest productivity spring period (Ignatiades et al., 2002). In the North Aegean Sea, surface Black Sea water outflows from the Dardanelles and meets the salty Levantine waters coming from the southern part of The Aegean. Due to the hydrographic regime, North Aegean supported a deep-water formation, under the influence of anomalously cold winters, known as the Eastern Mediterranean transient (EMT), which has been proven to ventilate the water column of the basin from the surface down to 650 m (Velaoras et al., 2017).

The present study uses new data from the North Aegean sampling site M2, provided by sediment trap time series (Skampa et al., 2019), surface sediments combined with plankton samples (Dimiza et al., 2015) and a sediment core record (Gogou et al., 2016), in order to make a synthesis of the coccolithophores' regime in the photic zone and assess their contribution to the sinking matter towards the seafloor, their preservation as surface sediment particles and, finally, their impact to the sedimentary record (Skampa et al., 2019). The understanding of the modifications between the plankton vs. the exported assemblages and the sediment taphocoenoses can further establish coccolithophores as valuable proxies for the investigation of water column response to paleoceanographic changes (e.g., dense water formation events) in the North Aegean and analogous oceanic sites of deep water formation.

Methods

Quantitative coccolithophore analyses were performed on plankton samples datasets from the Athos basin in the North Aegean Sea (Athos basin-M2 site), which have been collected during January and May 2011 (Dimiza et al., 2015). In addition, the sinking particulate matter derived from a sediment trap deployed at 500 m depth in the Athos basin (M2 site) was examined in order to estimate export fluxes for the time interval January- December 2011 (Triantaphyllou et al., 2014) and October 2014-November 2015 (Skampa et al., 2019). Coccolithophore analyses of surface and core sediments from a 48-cm long multicore (M2), retrieved in 2011 from the same site in the North Aegean Sea (Athos basin, water depth 1018 m), have been conducted in a decadal to multi-decadal high resolution record (Gogou et al., 2016).

Results and Discussion

Emiliania huxleyi was the dominant species in all sampling types, occurring in high relative abundances in the current plankton (~90%) and sediment trap samples (~70%), especially during the low-temperature, high precipitation and max Chl-a winter-spring period. *Emiliania huxleyi* prevailed in the plankton samples with the subordinate presence of Syracosphaeraceae. The species *Florisphaera profunda* was not included in the upper water column plankton assemblage, most probably due to sampling depth limitations, but was present in the sediment traps and surface sediments, presuming to flourish in nutrient-enriched layers below the sampled 100 m water column depth. Plankton samples revealed a well-developed upper euphotic zone community but several fragile *Syracosphaeraceae* and holococcolithophore species were not present in the sinking assemblage or on the seafloor; apparently, currents and circulation patterns of the North Aegean have an impact on the distribution of coccolithophore assemblages and convert them while sinking from the euphotic zone to the seafloor. However, the main features of the living assemblages were generally preserved (Skampa et al., 2019).

Sediment trap calcareous nannoplankton multiannual mean fluxes documented similar values to the accumulation rates recorded in the surface sediment (Skampa et al., 2019). Apart from the loss of the more fragile holococcolithophore species and the delicate *Algirosphaera robusta*, the main features of the living assemblages were generally preserved on the seafloor, pointing out calcareous nannoplanktons' importance as reliable proxy for paleoenvironmental reconstructions.

The coccolithophore assemblage of the past 500 years revealed a periodic occurrence of "*E. huxleyi* dominance" intervals (~60%), indicating strong water column convection EMT-like events, which have been described in the recent fossil

record (last 500 years; Gogou et al., 2016; Incarbona et al., 2016), coupled with positive shifts of the North Atlantic Oscillation (NOA) and volcanic activity within the Dalton solar minimum (Skampa et al., 2019). In contrast, the analogous occurrence of "*F. profunda* dominance" intervals may be linked to increased sea surface temperatures, and stratified conditions in the water column potentially associated with Black Sea Water intrusions (Skampa et al., 2019).

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