EXPORT PRODUCTION AND SEASONALITY OF COCCOLITHOPHORES AND DIATOMS IN THE PELAGIC IONIAN SEA

Elisa Malinverno [1]*, Paola Maffioli [1], Cesare Corselli [1] and Gert J. De Lange [2]
[1] Dept of Geological Sciences and Geotechnologies - Milano-Bicocca University - elisa.malinverno@unimib.it
[2] Geochemistry & Chemical Oceanography - Geosciences, University of Utrecht. The Netherlands

Abstract
In this work we present the results from a time series of sediment trap moorings located at 500 m in the pelagic Ionian Sea, focusing in particular on the biogenic calcareous and siliceous component. We quantify the fluxes of coccolithophores and diatoms, identifying a seasonal succession in the assemblage composition, as related to the environmental conditions.
Keywords: Coccolithophores, Diatoms, Particle Flux, Ionian Sea, Eastern Mediterranean

Introduction
The understanding of present-day biogenic fluxes is of key importance in providing information on how the ecological signal is transferred from the surface waters to the sediment archives, in order to interpret paleofluxes. In the oligotrophic eastern Mediterranean, coccolithophores are known to play a major role as primary producers, while diatoms are subordinate, also due to the significant silica-undersaturation of the basin. Therefore, while there are some previous data on the present-day fluxes of coccolithophores at several locations in the basin [1, 2, 3], there are only a few data on diatom fluxes [4,5] and no detailed information on their specific assemblage composition in the sinking fluxes. We investigated the fluxes of coccolithophores and diatoms along three yearly intervals of a 7-year-long sediment trap deployment above Urania basin (35°13'N, 21°30'E) in the Ionian Sea, aiming at assessing the seasonality and interannual variability of the sinking biogenic fluxes.

Methodology
Sediment traps are PPS5/2, with 1 m^2 aperture and 24 collection vials. Each mooring was deployed for approximately one year, resulting in a sample resolution of 10 to 15 days. Coccolithophores and diatoms were analyzed on sub-samples (1/800-1/8000 and 1/40 respectively) processed following standard methods [6,7 respectively] and expressed as number per square meter per day.

Results and Discussion
Preservation of both coccolithophores (coccoliths and coccospheres) and diatoms was very good at all samples. The presence of delicate species (holococcolithophores,
Discosphaera tubifera among coccolithophores and weakly silicified taxa among diatoms) indicates that no dissolution occurred during either sedimentation through the water column, or sample storage and processing. Overall, the assemblages recovered at our sediment-trap site are typical of subtropical areas of the world's oceans. In fact coccolithophore species are those typically found in assemblages from subtropical and temperate settings, dominated by the cosmopolitan *Emiliania huxleyi*. Diatoms are ~70% tropical-subtropical species, with a minor contribution from subtropical-temperate and temperate taxa and a very slight contribution from cold-water species. During the first year of observation (1999-2000), the total flux of coccolithophores and diatoms was maximum in late summer-fall, along with the total particle flux, decreased during the whole winter period and increased again in late spring. The combined fluxes of coccolithophores and diatoms allowed to identify three main periods within the annual cycle, characterized by different assemblage composition: a) late summer-fall period, characterized by highest coccolithophore species diversity, consisting of both surface oligotrophic and deep-dwelling taxa and warm water diatom taxa dominated by *Nitzschia interruptestriata* and *Thalassionema bacillare*; b) late fall-winter period, characterized by lower coccolithophore diversity, dominated by the cosmopolitan *E. huxleyi* and the deep-dwelling *Florisphaera profunda* and by the increase of cooler-water diatom taxa; c) spring period, characterized by highest relative abundance of *E. huxleyi* and decrease of *F. profunda* within coccolithophores and by an increase in abundance of major and minor diatom taxa. A similar seasonal pattern was identified in coccolithophore assemblage composition in the following years, although the pattern of total particle and coccolithophore flux was different. In fact maxima occurred either in late spring to summer (2000-2001) or in early spring to late spring (2005-2006). Nonetheless, the main changes in the relative abundance of the different coccolithophore species occurred in the same intervals. Diatom assemblages in these series are still under study. Overall, the variations identified in the coccolithophore and diatom fluxes in the investigated three-year time series testify the seasonal changes in surface water conditions, including the sea surface temperature cycle and the presence of stratification in the upper layers. The seasonal cycle of water column mixing and stratification results in fact in the development of a different production depth within the water column, with the increase of surface oligotrophic species from summer to fall, the prolonged persistence of a deep chlorophyll maximum from summer to late winter and a clear dominance of the most abundant r-selected species during periods of more extended water column mixing.

References
1 - Ziveri P., Rutten A., De Lange G., Thomson J. and Corselli C., 2000. Present-day coccolith fluxes recorded in central eastern Mediterranean sediment traps and surface sediments. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 158: 175-195.
2 - Triantaphyllou M.V., Ziveri P. and Tselepides A., 2004. Coccolithophore export production and response to seasonal surface water variability in the oligotrophic Cretan Sea (NE Mediterranean). *Micropaleontology*, 50 (suppl. 1): 127-144.
3 - Malinverno E., Triantaphyllou M.V., Stavrakakis S., Ziveri P. and Lykousis V., 2009. Seasonal and spatial variability of coccolithophore export production at the south-western margin of Crete (eastern Mediterranean). *Marine Micropaleontology*, 71: 131-147.
4 - De Lazzari, A., Boldrin, A., Rabitti, S., Turchetto, M.M., 1999. Variability and downward fluxes of particulate matter in the Otranto Strait area. *Journal of Marine Systems*, 20: 399-413
5 - Boldrin, A., Miserocchi, S., Rabitti, S., Turchetto, M.M., Balboni, V., Socal, G., 2002. Particulate matter in the southern Adriatic and Ionian Sea: characterisation and downward fluxes. *Journal of Marine Systems*, 33-34: (389-410).
6 - Bairbakhish, A.N., Bollman, J., Sprengel, C., Thierstein, H.R., 1999. Disintegration of aggregates and coccospheres in sediment trap samples. *Marine Micropaleontology*, 37 (2): 219-223.
7 - Simonsen, R., 1974. The diatom plankton of the Indian Ocean Expedition of R/V "Meteor" 1964 - 1965. *Reihe, D. "Meteor" Forscg. Ergebnisse*, 19: 1-107.