BIOMARKERS AS TRACERS OF ORGANIC CARBON FLUXES IN THE SW BLACK SEA: A 1-YR SEDIMENT TRAP EXPERIMENT (SESAME PROJECT)

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Abstract

Source-specific lipid biomarkers have been investigated in settling particles recovered from a 1-year sediment trap experiment in the SW Black Sea in 2007-2008. Biomarker amounts and fluxes unravel major marine organic carbon sources. Their temporal patterns mainly reflect primary production variability both quantitative and qualitative (phytoplankton species succession). Comparisons with bulk parameters allow characterising the settling material and assessing the main processes controlling carbon export.

Keywords: Time Series, Particle Flux, Carbon, Black Sea

Gaining insights on carbon cycling and on carbon export is one of the tasks of the European project SESAME. To this purpose, three mooring lines were deployed for 1 year in the Western and Eastern Mediterranean and in the Black sea, each equipped with two sediment traps set at mid- and deep waters. Besides bulk parameters (mass flux, organic carbon, carbonates, opal) we have conducted a study on molecular lipid biomarkers in settling particles aimed at assessing the sources of the organic carbon and at providing clues on major processes that control carbon export/cycling. Here we present data from the Black Sea deployment (43°01N-29°28E, 2000m water depth) spanning the period from October 07 to December 08, with a 15-days resolution. The investigated source-specific biomarkers are *n*-alkanes, highly branched isoprenoids (HBI), sterols, alkenones and diols. They have been analysed by gas chromatography and gas chromatography-mass spectrometry following published procedures [1].

Long chain *n*-alkanes tracing terrestrial sources generally show medium-range concentrations typifying a system that does not receive major terrestrial inputs. Nevertheless, their temporal variations reveal an elevated contribution of terrestrial organic carbon in April-May 08, a period of enhanced discharges of the Danube River. Yet, marine organic sources, deriving from primary production, are predominant in the study area. Specific sterols (brassicasterol, 24-methylene-cholesterol) and HBI trace diatom inputs and show extremely high concentrations and fluxes, typical of highly productive marine settings. Diatoms appear to be major sources of the exported organic carbon in late fall 08, where HBI suggest the presence of *Rhizosolenia* diatoms. Secondary maxima are observed in late spring 08, and fall 08 (Figure 1).

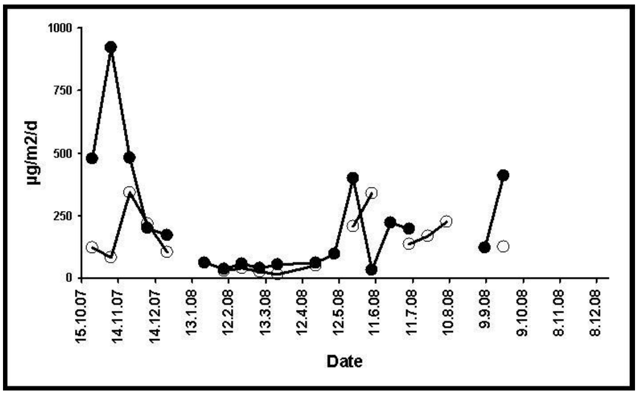

Fig. 1. Fluxes of brassicasterol and 24-methylene-cholesterol tracing diatom inputs in settling particles in mid-waters (full circles) and deep waters (open circles)

The concentrations and fluxes of diatom-biomarkers clearly depict the temporal patterns of downward organic carbon fluxes, suggesting that diatom production exert a main control on carbon export. Besides, diatom biomarkers also portray the temporal variability of opal fluxes. Very high amounts and fluxes of alkenones are observed, consistent with the important coccolithophorid production (mainly *Emiliania huxleyi)* in the Black Sea. The temporal patterns delineate a major coccolithophorid bloom in spring 08 that contributes to the organic carbon fluxes and clearly controls the carbonate flux variability. In addition, dinosterol and diols trace inputs from dinoflagellates and nannoplankton species that show important temporal variation. Biomarkers derived mainly from zooplankton (e.g. cholesterol) show elevated concentrations and fluxes in time intervals characterised by very abundant phytoplakton-biomarkers. Thus, the downward transfer of marine organic carbon appears to be linked to significant zooplankton grazing. Comparisons between the mid-depth and deep traps show that the transfer is rapid and that carbon recycling is not very important, leading to enhanced carbon sequestration in this marine site. Overall, the biomarker data-set sheds light on the origin of organic carbon in settling particles in the SW Black Sea and enables determining its major marine sources linked to the primary production. Biomarker temporal variability allows explaining the patterns of the export organic carbon (but also carbonate and opal) and assessing primary controls on downward fluxes.

References

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