Workshop IODP-Italia "Lo stato delle proposte di perforazione nell'area mediterranea"
Scientific Drilling in the Mediterranean Sea
Roma, 15-16 gennaio 2018

Abstract

I giovani ricercatori italiani nell'ambito dei programmi internazionali di perforazione scientifica

Titolo dell'abstract

The coccolithophores and their role in deciphering the sapropel S1: are sapropel a Gaia hypothesis expression?

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Argomento della ricerca nella perforazione scientifica

Study of the Coccolithophores (CLT) dynamics and their biogeochemical role in the most recent Mediterranean Sapropel deposition, (S1, 9.5-6.5 ky). The Ionian Sea is a crucial site to explore with the Joides Resolution to disentangle the sapropel mystery, and its (paleo) climatic meaning.

Abstract

A high-resolution abundance and biometrical CLT study was performed in core M25/4-12 (Ionian Sea) containing the sapropel S1. By comparison of $\delta^{18}O$ and the CLT relative abundances, the main climatic events characterizing this period have been recognized, such the Last Glacial Maximum (LGM), the Younger Dryas and the Max Monsoon.

Calcareous nannofossils are abundant throughout the studied and the assemblage consists of 20 species of CLT and 1 of dinoflagellate. The most abundant species are *Emiliania huxleyi* (*Emiliania huxleyi* light calcified as EHLC and *Emiliania huxleyi* moderately calcified as EHMC, *sensu* Crudeli *et al*., 2004) followed by *Florisphaera profunda, Rhabdosphaera spp (Rhabdosphaera claviger* and *Rhadosphaera stylifer*), *Syracosphaera spp, Helicosphaera carteri*, *Syracosphaera sp.1* and reworked species; the rare species are *Umbilicosphaera spp, Scapholithus fossils, Coccolithus pelagicus, Umbellosphaera spp, Discosphaera tubifera*; the remaining species are extremely rare.

An interesting shift in the dominance between EHMC and EHLC has been recorded, at the LGM while at the end of S1 a switch toward moderately calcified forms occurs. These two shifts correspond to precession maximum and minimum, respectively. Therefore, these shifts appear to be useful to approximate the LGM and the end of S1, and therefore to evidence the real extent of S1 even without geochemical analyses, when its sedimentological expression has been deleted after oxidation.

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Furthermore in the S1 sediment a typical Deep Chlorophyll Maximum CLT assemblage (*F. profunda* increase) was recognized, indicative of a stratified water column, probably caused by enhanced river fresh water input, also witnessed by the increase in sedimentation rate and by the Ba/Al increase (paleoproductivity proxy).

The biometrical analyses conducted on EHLC suggest a positive correlation between the Central Aperture Length (CAL) and the temperature inferred from the $\delta^{18}O$ value.

Finally, some clues can be depicted after the study of the CLT assemblage. In fact an important feature reported in literature is the correlation existing among the five younger sapropel (S1-S5) deposition and the increase in atmospheric CO_2 content (Negri *et al*., 2012). The authors hypothesized a local response of the systems to carbon removal from the oceanic water masses during the interglacial periods (CO_2 uptake in ocean increases during glacial periods).
According to the literature, the CLT account for the 10% of phytoplankton biomass and the shift observed in the assemblage characterizing S1 indicate that across this event 90 % of the assemblage consisted of *E. huxleyi*. Mesocosm study demonstrated that this specie is furthermore able to secrete Trasparent Exopolymers Particles (TEP), and as all the forms characterized by a calcareous test they promote the so-called Ballast effect. We suggest that enhanced TEP production increasing the aggregation of organic carbon, the protection offered by $CaCO_3$ platelets to avoid the organic matter degradation and the ballast function for the organic matter sinking were crucial for the S1 formation and for the decrease of the atmospheric CO_2 level at the end of S1 deposition, because model study suggest that 33% increase in organic matter was sufficient to draw down the CO_2 in the seawater by approximately 60 ppm. CLT possibly played a key role in this process and in agreement with the Gaia hypothesis (Lovelock 1979), when the atmospheric CO_2 level increases, the biotic component of the ecosystem attenuates the effects sequestering organic carbon (Sapropel) in the sediment whose fate otherwise was to re-enter in the global carbon cycle.

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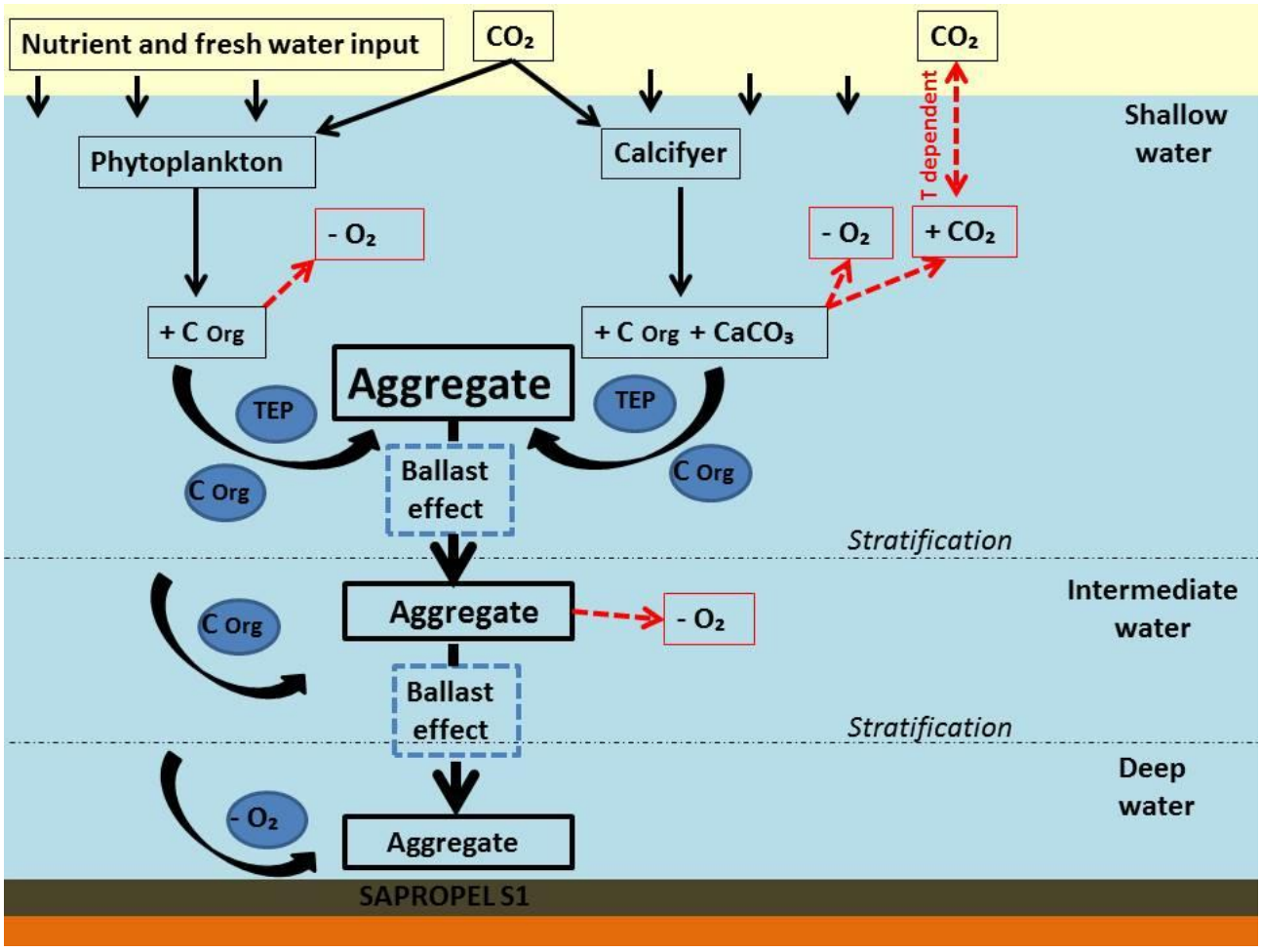

Fig. Schematic illustration of the CLT role in the S1 formation

References

-Crudeli, D., Young, J.R., Erba, E., De Lange, G.J., Henriksen, K., Kinkel, H., Slomp, C.P., Ziveri, P., 2004. Abnormal carbonate diagenesis in Holocene late Pleistocene sapropel-associated sediments from the Eastern Mediterranean: evidence from Emiliania huxleyi coccolith morphology. Marine Micropaleontology 52, 217–240

-Lovelock JE (1979) Gaia. A new look at life on earth. Oxford University Press, Oxford McIntyre A, Ruddiman WF, Jantzen R (1972) Southward penetration of the North Atlantic Polar Front: faunal and floral evidence of large-scale surface water mass movements over the last 225,000 years. Deep-Sea Res 19: 61–77

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- A. Negri, F. Colleoni, S. Masina, 2012. Mediterranean sapropels: a mere geological problem or a research for study of a changing planet?. Alpine and Mediterranean Quaternary, 25 (2), 2012, 81-89