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Biogeosciences Discussions

Interactive comment on "Productivity patterns and N-fixation associated with Pliocene-Holocene sapropels: paleoceanographic and paleoecological significance" *by* D. Gallego-Torres et al.

R. Capozzi (Referee)

rossella.capozzi@unibo.it

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Productivity patterns and N-fixation associated with Pliocene-Holocene sapropels: paleoceanographic and paleoecological significance

D. Gallego-Torres, F. Mart'Äśnez-Ruiz, P. A. Meyers, A. Paytan, F. J. Jimenez-Espejo, and M. Ortega-Huertas

The paper submitted is one more dealing with the geochemistry proxies used for under-

standing the peculiar characteristics of sapropel deposition. A first general comment concerns the selection of the sapropel layers analyzed. There is an attempt to correlate the uppermost horizons of the late Pleistocene, even though the succession is not the same, or complete, in each site and this can determine some difficulties in interpretation. Some analysed horizons (e.g. S3) are in fact only described in the discussion without showing data in the figures. As to concerns the older layers, they are quite scattered through space and time without providing a clear reason for this choice: what is the aim to compare so different layers? Would it be the purpose to shed light on their similarities anyhow you select them? All along the paper the stratigraphic attribution of the sapropel-bearing leyers is not correct. In summary the correct attribution is: i-cycle 2 is Holocene, i-cycles from 8 to 20 belong to Late Pleistocene, from 152 to 182 belong to Early Pleistocene and from 272 to284 belong to Middle Pliocene. All the figures cannot be easily read because of symbols and font size are too small. Figure 6 is not quoted in the text. About the main topics of the paper I think that: It essentially aimed to confirm the high productivity driving to sapropel deposition. The causes of periods of high productivity have been indicated to be the same discussed in the last twenty years, even though different condition have been summarized in the abstract as following:"The evolution of sapropel deposition over the past 3 My is characterized by increased productivity together with enhanced preservation of organic matter during the late Pliocene, peaks in primary and export production and sedimentation rates during the middle Pleistocene, and a relatively weak increase in productivity during formation of the Holocene sapropel accompanied by high sedimentation rates". I would like to understand if the terms export production and productivity have been used as synonymous and what can be the boundary conditions within the basin that can alternatively lead to enhanced preservation but low sedimentation rate, higher productivity or lower productivity, even if both occurring in periods of increasing sedimentation rate, which is often used as "deus ex machina" (see http://en.wikipedia.org/wiki/Deus_ex_machina) to explain differences. Then, it would be useful to know the function used to calculate MARs and (maybe) Pexp. Above all, I didn't find in the paper any hypothesis about

sources of sediment that, for the same location within the basin, could supply variable amount of sediment alaways during wet periods. The only mentioned source is the Nile river, but the data reported in Tab. 1 show a systematic increase of sedimentation rate during the Late Quaternary also in the Ionian basin and in the Mediterranean Ridge. The only exception is for the Eratosthenes Seamount, where a loss of organic carbon rich fine-grained sediment, due to winnowing, cannot be excluded. In this case, as a consequence, the succession is not complete, and the calculated MARs are affected by an indefinite error, because of the mass accumulation rate is a function of OC content and of sedimentation rate. About the other main topic of the paper, that is N-fixation, the proposed interpretation is not free of contradiction. The reported evidence are: 1) "The “d15N vs. d13C plot systematically shows a marine algae composition for non-sapropel samples and a typical marine cyanobacteria composition for sapropel samples” But this latter occurs along with a postulated higher supply of terrigenous OC (see the shift in d13C). Then I would like to understand the true relationship between d15N and d13C when there are uncertainties on the origin of the OC.

2) "the _15N vs. _13C graphs suggest that the sapropels are dominated by marine organic matter TOC/TN value of the exported organic matter is higher than the typical algal signal, partly due to selective remineralization of N and Nrich molecules below the euphotic zone and/or at the sediment surface." Once again, does it depend on faster recycling of nitrogen or on possible other sources of OC?

3) "The increase in TOC/TN can also partly be caused by denitrification under a suboxic environment" My question is: what is the isotopic signal that denitrification can impart? Probably the same of N-fixation. Then the attribution of the signal to N-fixing cyanobacteria can be ruled out.

Finally, I would like to know your opinion about the finding in sapropel-bearing horizons of isorenieratene, known as a distinctive biomarkers produced by green sulfur bacteria, and interpreted as a signal of anoxia extended into the photic zone. How can this latter condition agree with the postulated occurrence of N-fixation? Other comments and

suggestions are reported in the text and in the figures.

Rossella Capozzi

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/7/C2009/2010/bgd-7-C2009-2010-supplement.pdf

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