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Interactive comment on "Composition and sources of sedimentary organic matter in the deep Eastern Mediterranean Sea" *by* R. Pedrosa-Pàmies et al.

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We would like to deeply thank Dr. Tesi for the time and effort provided to review our manuscript and for his constructive comments that greatly helped us improve its quality. We have addressed his suggestions for corrections/modifications in the revised version of the manuscript, in which certain parts (Materials and methods, results, discussion, and Figures 6 and 8) have been re-worked accordingly. Please follow our detailed responses to Dr. Tesi's comments below.

Major points

- Overall I found the text too wordy. The paper would gain fluency by making paragraphs

shorter. Make sure that only the important information is conveyed and try to avoid redundant parts. Furthermore, sentences are a way too long, keep sentences to the point. To give you an example, among several, the potential contribution by IN has been presented at least three times in the discussion. While I agree on the presence of IN (likely ammonia within the mineral clay sheets), this repetition is clearly redundant and doesn't help the reader.

Response: Following the Reviewer's suggestion the revised text has been extensively re-worked making the paragraphs shorter, restructuring the text and deleting the redundant sentences. In order to avoid any repetitions, the discussion on the potential contribution by IN has been focused just in the section 5.2.1 of the revised manuscript.

- Presentation and discussion of the data is fragmented in some sections, especially where the parallel construction is missing. For example, figure 8b has nothing to do with figure 8a. Rather move it to fig 4. Also, as part of the parallel construction, the authors should show both CPIs, not only the n-alkanols.

Response: The figures have been revised accordingly in order to avoid the fragmentation of the sections. Figure TN vs OC has been moved to figure 6 along with the TN/OC ratios vs ïĄď13C. In addition, according to the Reviewer's suggestion the spatial distribution of CPINA has been added in the revised Figure 8.

- Another major issue I see here is the unit used for the PCA. Specifically I'm referring to the mass-normalized biomarker data. By doing so, it's not a huge surprise so observed covariance between terrestrial and marine biomarkers. I question whether this is really informative, because essentially they all mirror changes in OC content that, as the authors suggest, is driven by the surface area (grain size) of the mineral matrix. Have the authors considered presenting both sediment and OC normalized PCA results?

Response: The PCA was performed on standardized variables and with mas-normalized biomarker data. We have specified this in the text to be clear. In order to show the robustness of the methodology applied we have performed the PCA with-

out mass-normalizated biomarkers data (see figure 1 attached). If we compare the PCA with the mass-normalized biomarker data to the PCA without mass-normalizated biomarker data we can see that in both cases the same three main principal components are identified, accounting for 64.3% and 67.8, respectively. In addition, the factor scores on each PC display the same significant variability amongst the studied stations. Also, the spatial variability of biomarkers concentrations normalized to OC content follows, with minor discrepancies, the trends observed for concentrations expressed per gram of sediment (ng g-1). Therefore, we consider that the use of mass-normalized units of the biomarkers presented in the manuscript is appropriate and robust.

Additional points:

- I might have missed it but I do not see anywhere whether or not the TN/OC refers to the molar ratio. Make sure that the ratio is reported with the stoichiometry notation, as the Redfield ratio. If the ratio is indeed molar, make it explicit in the text. If not, tables, text and figures must be modified accordingly.

Response: The TN/OC ratios reported in this study are indeed in stoichiometry notation, as the Redfield ratio. We have put explicit in the text in order to avoid confusions.

- Page 9944, line 1. Please list all the solvents used to elute F1, F2, and F3 fractions as well as how the silica gel column was packed (e.g. if deactivated, pre-packed, etc). Explain how the quantification was performed and how the extraction efficiency was assessed. Finally, how was the UMC quantified? (not in the method)

Response: Following the suggestion of Reviewers #2, #3 and #4, all relevant analytical information regarding the determination of lipid biomarkers have been added accordingly in the materials and methods section 3.2.4 (Lipid biomarkers analysis and definitions of molecular indices) of the revised manuscript.

- Page 9954, line 15 and page 9962, line 23. For the direct comparison with organic material supplied by dense water cascading events from the Adriatic margin, I recom-

mend Tesi et al., 2008 DSR and Turchetto et al., 2007 MARGEO. You would quickly realize that Ionian sediments are more depleted than the material supplied by the Adriatic. This could suggest that either the Adriatic sediments do not make it to the Ionian sector or there are further changes/dilution occurring during transport.

Response: We would like to thank the Reviewer for this comment. The studies by Tesi et al., 2008 and Turcheto et al., 2007 have been carefully consulted and we have improved sections 5.1 and 5.2.2 of the revised manuscript. We now better describe the sediment transport and deposition processes in relation to the organic material supplied by dense water cascading events from the Adriatic margin to the Ionian Sea. An important point that has been considered is that during energetic dense-water cascading events, lateral flux prevails over the vertical flux in the southern Adriatic Sea. In this circumstance, the lignin content doubles and OC content drops, suggesting increased contribution of soil-derived OC during dense water cascading events. Moreover, during such events there is a relatively elevated retention time of sediments on the inner shelf of the southern Adriatic Sea, allowing for significant microbial degradation and/or marine dilution of the terrestrial material that reaches the outer-shelf and shelf-break before arriving to the Ionian Sea (Otto and Simpson, 2006; Tesi et al., 2008).

- As far as the average composition of the African dust concerns, there is a great paper by Eglinton et al in G3, 2002. “Composition, age, and provenance of organic matter in NW African dust over the Atlantic Ocean”. Re-elaborate the discussion to include these results in the discussion.

Response: The Eglinton et al. (2002) study has been carefully consulted during the preparation of the revised manuscript. An important point of this study is the description of OM in Saharan dust, which consists mainly of minute charcoal-like fragments of burnt vegetation, leaf wax-derived lipids absorbed on clays, and cuticular fragments, pollen grains, and fungal spores. Therefore depositions rich in Saharan dust particles contain carbon in amounts that might easily reach 1% dry weight. This carbon pool, originated during vegetation fires and accumulated/stored in soils, is likely not

to be very labile. We have included all this information in the revised version of the manuscript.

- What's the relationship between UCM and CPIs? Shouldn't they trace similar sources (petrogenic/oil sources). Please elaborate this in the text.

Response: As stated in page 9944, lines 4-9 of the BGD paper "the Carbon Preference Indices of long chain n-alkanes (CPINA) and n-alkanols (CPIN-OH) have been used as indicators of terrestrial OM degradation with CPI values in fresh leaves being typically >4, although the occurrence of petroleum hydrocarbons bias (lower) CPINA values with increasing petroleum contribution, since petroleum products present CPINA values $\sim$1". This petroleum bias is associated with the presence of non-degraded (fresh) fossil inputs that could potentially influence only the values of CPINA, since petroleum hydrocarbons (and UCM) are eluted in fraction F1 (aliphatic hydrocarbons) while n-alkanols in fraction F3 (alcohols/sterols). Aliphatic compounds of crude oil and petroleum products released in aquatic environments are subjected to degradation, with a prominent initial microbial preference for straight chain compounds (Wang et al., 1999). This leads to the gradual removal of major compounds that can be resolved by gas chromatography and the subsequent appearance of a UCM, consisting of branched alicyclic hydrocarbons, that is used as an indicator of the contribution from degraded petroleum products (i.e. chronic oil pollution; stated in section 3.2.4). Moreover, as stated in page 9956 - lines 16-17, of the BGD paper, the patterns of long-chain n-alkanes and n-alkanols with elevated CPINA and CPIN-OH values, respectively, indicate the presence of allochthonous natural (terrigenous) inputs from epicuticular higher plant waxes in the study area. Thus, although a prominent signal related to chronic oil pollution (degraded petroleum products) is abundant in the study area (presence of UCM), we assume no important bias associated with the presence of non-degraded (fresh) fossil inputs, and both CPIs trace natural (biogenic) terrestrial inputs. In the opposite case, we would expect significantly lower CPINA values, since n-alkane compounds of petroleum products present CPINA values $\sim$1. The corresponding text has

been re-worked during the preparation of the revised manuscript in order to include the above information and be clearer to the reader that the petroleum hydrocarbons bias on CPINA values is related to non-degraded (fresh) petroleum inputs.

-Page 9957, line 26 "inorganic IN", please correct. -Page 9935, line 18 "approach is hired", please modify.

Response: Corrected according to the Reviewer's suggestion. The sentence 'approach is hired' has been changed by 'approach is carried out'.

Interactive comment on Biogeosciences Discuss., 12, 9935, 2015.

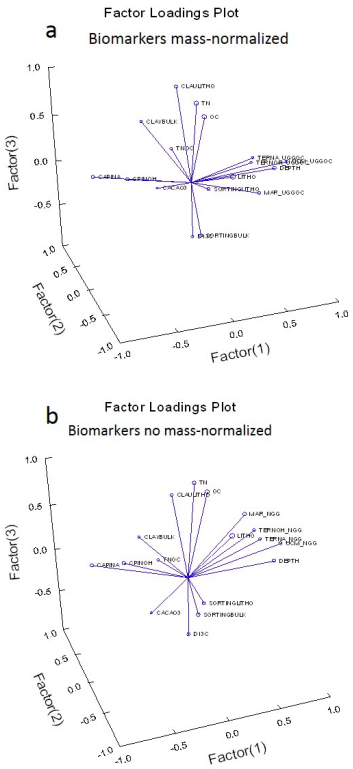
a
Factor Loadings Plot
Biomarkers mass-normalized
Factor(3)
Factor(2)
Factor(1)
b
Factor Loadings Plot
Biomarkers no mass-normalized
Factor(3)
Factor(2)
Factor(1)

Fig. 1.