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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 the Referee for the time and effort provided to review our manuscript and for his/her constructive comments that greatly helped us improve its quality during the revision process. We have addressed the Reviewer's suggestions for corrections/modifications in the revised version of the manuscript, in which certain parts have been re-worked accordingly (Materials and Methods, Results and Discussion sections, Table 2). Please follow our detailed responses to Reviewer's #3 comments below.

General

-At several places in the manuscript (e.g., line 7, p 9956), the authors tell us that the OM in the studied sediments is a mix of terrigenous and marine material ... “thus indicating that the composition of the OM: can be explained as a mixture of terrigenous (low TN/OC and d13C) and marine (high TN/OC and d 13C) derived materials.” It would be very useful to be given some sense of the relative proportions of terrigenous vs marine OM. On p 9940 we see what the primary production rates are, and that 0.3% o this is exported below 2000 m. Most of the terrigenous input comes from Aeolian transport, mainly of Sahara dust, that riverine inputs to these locations is low, the sedimentation rate is given. The discussion then goes on to talks about marine biogenic CaCO3 vs dust/terrigenous clays. But what is missing is some feeling of the relative amounts that each contributes to the overall sediment OM content.

Response: An overall positive relationship for molar TN/OC ratios and d13C values (r=0.53, p<0.05, excluding station Red3) becomes apparent (Fig. 6), thus indicating that the composition of the OM in the studied sediment samples can be explained as a mixture of terrigenous (low TN/OC and d13C) and marine (high TN/OC and ïĄď13C) derived materials. Stations can be grouped by the predominance of either terrestrial or marine OM, according to d13C and TN/OC values. Following the suggestion of the reviewer we have estimated the relative proportions of marine and terrestrial OC using a simple binary mixing model and assuming a marine d13C value of -20.4‰ and a terrestrial d13C value of -27.0‰ (Tesi et al., 2007): marine OC = (d13C+27.0)/(-20.4+ 27.0) terrestrial OC = 1- marine OC

Values obtained are presented in the revised version of the manuscript (see Table 2). This mixing model evidences a mixed contribution of autochthonous and allochthonous sources for the sedimentary OM. In general sediments from the west (Ionian Sea) are characterized by higher contributions of terrigenous OM relative to the other areas in the east (W Cretan Straits, Cretan Sea and NW Levantine Sea) (Figs. 3d-e). The considerable spread of the samples in the plot TN/OC vs ïĄď 13C (Fig. 6b) suggest that some additional local factors probably exerted important influences on these bulk

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tracers of sedimentary OM. Therefore, we can use the simple two-end-member mixing model (between terrestrial and marine OC) to describe the relative contribution of marine and terrestrial sources of OC, taking into consideration however the probable limitations associated to the effect of degradation processes (discussed in the text) on OM preservation. The above information have been added accordingly in the revised version of the manuscript (Results but also Discussion sections, Table 2). We would like to thank the Reviewer for this comment.

Specific comments:

- p 9938 line 16 - “complex topography with tenths of depressions” probably should be “complex topography with ten’s of depressions”. . .

Response: Corrected according to the Reviewer’s suggestion.

- p 9941 line 23 – “freeze-dried and grounded sediments” probably should be “freezedried and ground sediments”. . .

Response: Corrected according to the Reviewer’s suggestion.

- p 9943 line 24 – how was the UCM measured? Response factors same as for the alkanes? How was the UCM integrated? This is important since the UCM seems to be about 10x more concentrated than the long-chain alkanes (extrapolated from Fig. 4).

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.

- p 9944 line 16 – Usually concentrations of alkanols are higher than alkanes, but here the reverse is the case. Presumably some of this reflects the presence of petroleum alkanes as indicated by the UCM. Since _TerNA and _TerN-OH are used as composite concentrations of the terrestrial lipids, were the long-chain even-carbon numbered alkanes used in _TerNA corrected somehow for the contributions of the petroleum HC,

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as would be estimated by the abundances of even-carbon numbered alkanes?

Response: Indeed, in the present study the reported concentrations of TerNA are higher than the concentrations of TerN-OH. 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 is abundant in the study area (presence of UCM), we assume there is no important bias on n-alkanes concentrations (and subsequently TerNA compounds) associated with the presence of non-degraded (fresh) fossil inputs. In the opposite case, we would expect significantly lower CPINA values, since n-alkane compounds of petroleum products present CPINA values $\sim$1. We believe that lower abundances of TerN-OH compared to TerNA can be related to the fact that the overall sedimentation rate in the deep areas of the open EMS is very low (i.e. 2-5 cm kyr-1), and thus to the long residence time of the lipid compounds in the sediment, resulting in the enhanced degradation of -OH relatively to . The latest are more resistant to degradation than their alcohol counterparts. This aspect is further considered in the revised version of the manuscript, in which the relative text on the use of the abundance ratio of to -OH that is hired in the BGD paper as a proxy of the proportion of labile vs. refractory terrestrial components has been reworked accordingly.

- p 9945 line 15 – here mass-normalized concentrations are used for PCA; elsewhere OC-normalized and "not normalized to OC" (e.g., p. 9952 line 24) are used. This is confusing!

Response: and -OH (p 9952 line 22 and p9959 line 11 of BGD paper, respectively) and (p9952 line 24 and p9959 line 22 of BGD paper) values have not been normalized to OC contents because in this section the correlation of these variables to OC is investigated. If the values are normalized to OC contents, the subsequent correlation to OC has no statistical meaning.

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- p 9951 line25 – “PCA results mirror the composition of surface sediments”... Isn’t this statement a given (obvious) since the PCA is based on the composition of the sediments?

Response: The Reviewer is correct. We have deleted the sentence due to the “PCA results mirror the composition of surface sediments” is obvious.

- p 9953 line 22 – is the statement “This strongly suggests that the Sahara desert is the main source of lithogenics to the deep EMS” not a bit contradictory to the sentence on the next page (p 9954 line 9)”The high lithogenic contents found in most Ionian Sea stations points to fluvial inputs reaching this area from in the Adriatic Sea”? Perhaps this is a geographic distinction between regions, but it is unclear.

Response: Corrected according to the Reviewer’s suggestion. The Sahara desert is the main source of lithogenics to the deep EMS, while the influence of terrigenous riverine/estuarine inputs in deep-sea surface sediments of the EMS is limited and localized. However, there are geographic distinctions between regions in the EMS, and for example in the north Ionian Sea, the relatively high lithogenic contents found points to fluvial inputs reaching the area from the Adriatic This paragraph has been modified to clarify its contents.

- p 9957 line 4 – the Rampen et al reference does not seem to be the correct one for diols and keto-ols. Do you mean Rampen et al. (2012) Long chain 1,13- and 1,15-diols as a potential proxy for palaeotemperature reconstruction. Geochim. Cosmochim. Acta 84, 204–216, or one of the Rampen papers cited therein?

Response: The Reviewers is absolutely correct. This was a mistaken Mendeley import. The reference has been of course updated in the revised MS. We would like to thank the Reviewer for this comment.

- p 9957 line 18 – PCA “provides”...; line 26 – should “inorganic IN” just be inorganic N”?

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Response: Corrected according to the Reviewer's suggestion.

- p 9958 line 24 – is 19% correct- it looks more like 0.19% in the figure.

Response: Corrected according the Reviewer's observation. The %TN vs. %OC values in surface sediments of the study area showed a strong linear correlation ($r=0.87$, $p<0.01$, Fig. 6a) with a regression equation as follows: %TN=0.089(%OC)+0.019. The x-intercepts of this regression is on the N axis but close to zero, suggesting that although most of N measured is predominantly organic in origin, there is a constant fraction (0.019%) of IN (presumably as NH4+ adsorbed on clays, mixed with the organic material. Considering that the %TN averages 0.06% then the 0.019% of the regression represents around 30% of inorganic N.

- P 9961line 9 – the Wakeham et al. reference does not provide information about grain size, but rather particle density.

Response: The Reviewer is correct. We have replaced the reference of Wakeham et al., 2009 with the references of Bergamaschi et al., 1997. Bergasmachi et al., (1997) investigate the effect of grain size distribution and sediment surface area on organic matter content and composition in Peru Margin sediments.

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