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Biogeosciences Discussions
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Interactive comment on "Transport of branched tetraether lipids from the Tagus River basin to the coastal ocean of the Portuguese margin: consequences for the interpretation of the MBT'/CBT paleothermometer" *by* C. Zell et al.

C. Zell et al.

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We would like to thank both anonymous referees for their constructive comments, which certainly help to make the revised manuscript more comprehensible. Below we are responding in detail to each comment of reviewer #2.

General comments: Referee #2: The study presented by Zell and co-authors is an attempt at understanding how a proxy signal (here, the MBT'/CBT proxy and related indices) that is assumed to derive from river drainage area soils is transported to marine

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sedimentary archives, where these proxies are usually employed for the reconstruction of paleoenvironmental conditions. This is an important aspect in proxy development and understanding. The underlying assumption is that the terrigenous material transported by a river is representative of its entire drainage area. This assumption, however, is rarely tested and discussed. However, careful consideration of sedimentation processes suggest strongly that it is highly unlikely that a river transports one single "average signal". This should be considered in any study attempting a source-to-sink approach. The major concern I have with the present study is with the comparability of soil samples and river SPM, marine SPM and marine sediments. The soil sampling was not described to have followed a special sampling strategy designed to ascertain that soils samples are accurate representatives of the soils of the Tagus drainage area. Instead, the sampling sites seem to have been chosen rather arbitrarily (or at least the reasoning for the site selection is not given). In spite of this, the soils are compared directly with SPM samples and rather far-reaching inferences are made based on this comparison. Moreover, since the river is regulated by dams it would make sense to compare SPM with only those soils that are collected near the sampling site for SPM (near the river mouth) and upstream only until the nearest dam. Processes of soil and river bank erosion would be worth considering when discussing how a soil signal is transferred to the ocean. Given that knowledge on these processes is rather complicated to obtain and likely not available for the Tagus system, I suggest reducing the detail with which the soil samples are discussed. Instead, the soil information should be treated as just an indication of a how a potential source signal could be like, and the emphasis should be placed on the comparison of the SPM and marine sediment data. Overall, I think the manuscript should be acceptable after moderate revisions. Reply: We thank reviewer #2 for the constructive comments. In the revised version, we will provide more detailed information on the soil sampling and we will clarify the discussion comparing the river SPM with soil data collected near the river SPM sampling site. We acknowledge that there are some caveats in this exercise, also concerning the potential influence of the dams. This will be emphasized in the revised version. However,

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we do not agree with the reviewer for the point that we should reduce the detail with the discussion of soil samples with other data. In our opinion, it is an important step to discuss the potential delivery of soil-derived brGDGTs to the river, even though some processes like riverbank erosion are not documented in the Tagus basin.

Specific comments: Referee #2: Page 3735, line 4: Typo in the name “Bendle”; Reply: We will modify this.

Referee #2: line 7: drier (not dryer); Reply: We will modify this.

Referee #2: Study area: It should be noted somewhere here that the Tagus river is regulated by dams; this is important information for interpretation of the data; Reply: We will add this info in the text.

Referee #2: line 23: insert semicolon or full stop after “wet seasons”; Reply: We will modify this.

Referee #2: line 25: Change to “The Tagus River has one of the largest European estuaries.”; Reply: We will modify this.

Referee #2: line 27: 2 km in width? Reply: We will clarify this.

Referee #2: Page 3736, line 6: Typo in “shelf break”; Reply: We will change this.

Referee #2: paragraph starting line 7: I would like to see another map showing details of the shelf, i.e., locations of the depositional systems described here, isobaths, current directions, and the larger area (e.g., location of the Lisbon canyon); Reply: The current map of the marine sampling sites does already show the isobaths and the Lisbon canyon. We will mark the mud belt and the current directions in the revised map.

Referee #2: line 9: I am confused by the statement that an estuarine river should have a delta front– please explain Reply: We agree that this is not right, since the Tagus system does not have a delta front. We will modify this sentence.

Referee #2: Section 3.1, Sample collection: Please give details about the soil and

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SPM sampling. For soils: Which horizons were sampled? Which were the criteria for sampling site selection? Do the samples accurately represent the soil types present in the catchment? What are the distances to the nearest river or stream? For riverbank samples: Which horizons were sampled? Sampling depth? How does the sampled depth correspond with the entire height of the river bank (i.e., potentially eroded material)? Reply: Top soils (upper 10 cm) were sampled from upstream to downstream of the Tagus River with the intension to cover the whole altitudinal gradient of the catchment area. The soil sampling sites are in general within a few hundred meters from the river. The upper 10 cm layer of the riverbank sediments or surface sediments along the river were collected as river bank sediments. We did not asses the soil types, since the brGDGT distribution on the entire Iberian Peninsula is not related to the specific soil type (see Menges et al., 2014). We will add this information in the revised text.

Referee #2: For SPM: Which water depth was sampled at the river mouth? In the table, 0 m is given as the sampling depth: How do the authors make sure that this sample is representative of the SPM discharge of the river? Please refer to publications like Aufdenkampe et al., 2007 in OG, and Spencer et al., 2012 in GCA, where sampling of SPM is described and reasoned in detail. Reply: Since Tagus River water is constantly well mixed, we assume that this type of sample is sufficiently accurate for our purposes. It can be seen that there is very little change between the DC and MBT' in river water SPM over the whole year and also marine SPM samples in different water depth and sediment close to the river show a very similar signal. Therefore we can assume that the brGDGTs in the surface water of the Tagus River are representative of the entire water depth of the river.

Referee #2: For marine SPM: Was salinity measured as well? This would be an important parameter to discuss water stratification and related sedimentation processes as well as flocculation in the "marginal filter". Reply: In general, salinity was lower and variable on the shelf than at offshore sites, which indicate the influence of the Tagus River outflow. We will mention this info and the related sedimentation processes in the

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revised version.

Referee #2: Line 18 and following: please provide more detail regarding the pH measurement of the soils: How was the soil volume determined? For the mixture with distilled water, did you use 1v of soil and 3.5 v of water, or vice versa? Reply: 1 g of dried soil and 3.5 g of water were used for the pH measurement, so this will be corrected to (w:w) in the revised version.

Referee #2: Page 3738: Paragraph starting line 21: It would be useful to give at least a brief summary of the BD method Reply: A small summary of the BD method will be given in the revised version.

Referee #2: line 25: activated at what temperature and for how long? Reply: 2 hours at 150°C. This info will be added in the revised version.

Referee #2: Page 3741: Line 10: Typo in “compounds” (plural s). Reply: We will change this.

Referee #2: Page 3742: Line 14: normalized to OC (not “on OC”); Reply: We will change this.

Referee #2: line 18: insert comma after BIT and MBT’; Reply: We will change this.

Referee #2: Page 3744: Line 6: typo in “close (or closest?) to the estuary”; Reply: We will change this.

Referee #2: section 5.1 (this page and following): What is the contribution of river phytoplankton? It cannot be assumed that the entire SPM is soil-derived, even though the d13C values are very similar. The authors need to at least discuss the other potential source for river SPM. The soils and river bank d13C values should be averaged and compared with an average SPM d13C value (which seems to be more depleted than soils, another indication of a contribution from phytoplankton). Reply: We will discuss the potential contribution of phytoplankton in the river in the revised version.

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Referee #2: Page 3746: Line 10: I disagree that a temperature range of 10-17C is not substantial! Reply: We agree. This sentence will be reformulated.

Referee #2: Line 22: “soils are notoriously heterogeneous” – this is why it is necessary to characterize the general soil distribution in the water shed before sampling in order to make sure that the soil samples are representative of the soils of the drainage area! Reply: We agree that soil sampling could have been done in much more detail. However, it should be noted that the brGDGT distribution on the entire Iberian Peninsula is not related to the specific soil type (see Menges et al., 2014).

Referee #2: Page 3747: Discussion in section 5.2: The entire discussion is based on the assumption that the soil samples are representative of the eroded material, which is not proven and also debatable, as indicated in the previous section. Therefore, the inferences are rather speculative, which should be acknowledged. For the calculation of weighted mean MBT’ and DC ratios, can you give uncertainties? This would help evaluating the data. Reply: We do think that the brGDGT distribution of the soil samples collected along the Tagus River should give an information on the brGDGTs transported to the river. We agree that our sample set might not be a perfect representation of the whole eroded material, however it is impossible for such a study to analyse so many soil samples that they are really representative of the whole watershed. We will acknowledge this point in the revised text.

Referee #2: Page 3754: Line 12: “since the majority of brGDGTs in SPM from the Tagus River” (not just “in the Tagus River”, as this was not measured!) Reply: We will modify this sentence.

Referee #2: Page 3755: Line 16: “soil brGDGTs in dry environments”(plural s); Reply: We will modify this sentence.

Referee #2: line 26: “as close to the river mouth as possible” Reply: We will modify this sentence.

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Figures: Referee #2: Figure 2: This map is of rather poor quality. It should be larger and it would be worthwhile to show altitude just in contour lines and add a color code for soil type. Reply: We do not agree with the reviewer for this point. We think that this map contain the information needed to follow the story of this manuscript. However, we will enlarge the map considering the complexity of the map. Since we are not concerned about the soil type which was studied in more detail by Menges et al. (2014), we do not feel that it is necessary to indicate the soil type in the map.

Referee #2: Moreover, please show the location of the dams. Reply: The location of the dams will be indicated in the revised map.

Referee #2: Figure 5 B and C and 6: Can you add error bars to allow for evaluation of the significance of the variations? Reply: Due to the low GDGT concentration in SPM samples, we could not replicate the analysis. Therefore we cannot provide error bars for each sample.

Referee #2: Figure 8 and 9 A, C, E: It does not make much sense to generate contour plots with so few data points. It would be preferable to present charts with color coded dots (like in 9B, D, and F). Reply: We have tried both types of plots for A,C,E, but we do think that the trends can be seen much better in the contour plots than in the dot plot, because in the dot plots the dots overlap especially closer to the river mouth, where the tested water depth were close to each other.

Interactive comment on Biogeosciences Discuss., 11, 3731, 2014.