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Interactive comment on "Lack of ^{13}C-label incorporation suggests low turnover rates of thaumarchaeal intact polar tetraether lipids in sediments from the Iceland Shelf" *by* S. K. Lengger et al.

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Dear Dr. Takano,

Thank you for the thorough reading of our manuscript and the constructive comments. We are replying to them below.

Replies to general comments:

[1] We agree that other sedimentary archaea are likely present. However, in this

work, we focused only on the Thaumarchaeota by using turnover estimations of crenarchaeol. This biomarker lipid has presently only been detected in (enrichment) cultures of Thaumarchaeota and no other archaea and is thus considered to be specific for this phylum. This will be more emphasized in the revised manuscript. We have some objections to the suggested title change since the discussion revolves mostly around crenarchaeol, and diether lipids were not analyzed at all, thereby potentially excluding a part of the archaeal community. We thus think that changing the title to "archaeal" might be too general.

[2] The referee is requesting to insert a discussion on the limitations of our experiments as well as on the choice of incubation time. Indeed, previous studies have used labeling times to up to >400 days (Takano et al. 2010, Lin et al. 2012) but this inevitably results in spreading of the label over the whole sedimentary food web as e.g. discussed by Radajewski et al. (2003) for stable isotope probing of nucleic acids. This is why this study and nearly all other incubation studies up to now (e.g. Boschker et al. 1998, Guilini et al. 2010, cf. Middelburg 2013 and references cited therein), including those for sediments (e.g. Middelburg et al. 2000, Moodley et al. 2002), use only a short time interval (mostly just a few days) to avoid this label scrambling. Indeed, our results show that the uptake in bacteria is occurring within a few days suggesting that, if active, microbes rapidly take up label. We will mention the reasoning for our choice in the revised manuscript. About the limitations of laboratory experiments, we would like to point out that we changed conditions to a minor extent only, as we incubated whole cores directly after recovery from the sea floor under similar light and temperature conditions. Only pressure was really affected. However, also in response to reviewer 2, we will clarify these limitations a bit more.

[3] We will now mention this 'blooming' event observed by Takano et al. (2010) in the introduction. However, we did not observe similar responses based on our results.

Other comments and replies to them:

P12809, L19, L27: Need to check the typo, Thaumarchaeote should be Thaumarchaeota

We will change “a Thaumarchaeote” to “Thaumarchaeota”

P12810, L2: There is no reference list for Ouverney et al. (2000). Is that Ouverney and Fuhrman (2000)? The author’s confirmation is needed.

Indeed. We apologize and will correct this mistake.

P12811, L4-8: This is somewhat misleading introduction. Please note that Takano et al. (2010) observed 13C-incorporation processes in benthic archaeal biphytanyl chains up to -9.3‰ (vs. PDB) during 9 days in-situ incubation experiment (also, same timing for blooming of benthic Thaumarchaeota), while biphytanyl chains were then rebounded to -22.0 ‰ (vs. PDB) after 405 days. Please see the Figure 3 and Supplementary Table 2 in the reference, and reorganize the context.

We will mention this blooming event and will also point out to the reader the -9.3‰ value, that was observed in one of the biphytanes on day 9 as reported in the supplementary section to the article by Takano et al. (2010). However, we will also have to point out that this is only one datapoint, and all other biphytane analyses show no incorporation. Furthermore, the data are not discussed at any point by Takano et al. (2010) so we are not sure how we should interpret this single data point.

P12814, L13: Could you provide the name of 16 amino acids or state the serial number?

We will provide this.

P12814, L25: 13DIC should be 13C-DIC.

This will be changed and checked throughout the manuscript.

P12817, L17: I could not find out Schouten et al. (2007) in the reference list. The author’s confirmation is needed.

We will add this reference to the reference list.

P12823, L19-P12824, L9: With respect to in-situ 13C-culture experiment for tracing sedimentary archaeal GDGTs, Nomaki et al. also reported significant 13C-incorporation (+213.8‰ in caldarchaeol and +61.4‰ in crenarchaeol in 9 days, relatives to initial in-situ incubation status of 0 day) by using 13C-labeled Chlorella sp., as organic 13C-substrate to investigate the in-situ benthic response by a sinking primary production. Please see, Nomaki et al., (2011) Marine Ecol Prog Ser, 431, 11-24, and also slightly re-organize the discussion into those lines on page 12823.

We apologize for not citing this study. We will now incorporate this in the discussion. However, as these results are not showing incorporation into the biphytanyl chains, which is what we are discussing on p 12823, we would like to propose to incorporate them on p 12826/12827, where we also discuss the results of Takano et al. (2010).

P12826, L26-P12827, L4: The author needs to modify this misleading discussion, likewise line 4-8 on page 12811. Please note that they reported the biphytanyl chains were slightly 13C-labelled up to -9.3 ‰ (vs. PDB) during 9 days in-situ incubation. Additionally, the author also needs to consider the consequence of 13C-incorporation to archaeal GDGTs reported by Nomaki et al., MEPS (2011).

This labeling is reported in the supplementary information and not discussed in the article by Takano et al. As stated above, it is a single measurement and one point in time, and none of the other biphytanes show significant incorporation. We have included Nomaki et al. in the introduction, however, as previously stated, they do not report label incorporation into the biphytanes, which is why these results are not discussed extensively here.

P12834, L9-11: Please check the latest reference information or note the DOI.

This will be updated.

P12844, Fig. 6, (a) Station 1: The data plot at the depth of 0-1 cm by using bicarbonate

is missing. Presumably, this section is most active sediment-water interface. If the author can reflect on this, please update on it.

Unfortunately, this datapoint is missing. However, we would expect the most active area to be around the oxygen penetration depth which is at depths 1-2 cm. We will discuss this in the revised manuscript.

References used in this reply:

Boschker, H. T. S., Nold, S. C., Wellsbury, P., Bos, D., de Graaf, W. Pel, R., Parkes, R. J. and Cappenberg, T. E.: Direct linking of microbial populations to specific biogeochemical processes by 13C-labelling of biomarkers, Nature, 392, 801-805, 1998.

Guilini, K., Van Oevelen, D., Soetaert, K., Middelburg, J. J., and Vanreusel, A.: Nutritional importance of benthic bacteria for deep-sea nematodes from the Arctic ice margin: results of an isotope tracer experiment, Limnol. Oceanogr., 55, 1977–1989, 2010.

Lin, Y. S., Lipp, J. S., Elvert, M., Holler, T., and Hinrichs, K.-U.: Assessing production of the ubiquitous archaeal diglycosyl tetraether lipids in marine subsurface sediment using intramolecular stable isotope probing, Environ. Microbiol., 15, 1634–1646, 2013.

Middelburg, J. J.: Stable isotopes dissect food webs from top to the bottom, Biogeosciences Discuss., 10, 14923-14952, doi:10.5194/bgd-10-14923-2013, 2013.

Middelburg, J. J., Barranguet, C., Boschker, H. T. S., Herman, P. M. J., Moens, T., and Heip, C. H. R.: The fate of intertidal microphytobenthos carbon: An in situ C-13-labeling study, Limnol. Oceanogr., 45, 1224–1234, 2000.

Moodley, L., Middelburg, J. J., Boschker, H. T. S., Duineveld, G. C. A., Pel, R., Herman, P. M. J., Heip, C. H. R.: Bacteria and Foraminifera: key players in a short-term deep-sea benthic response to phytodetritus, Mar. Ecol. Prog. Ser., 236, 23-29, 2002.

Radajewski, S., McDonald, I. R., Murrell, J. C.: Stable-isotope probing of nucleic acids:

a window to the function of uncultured microorganisms. Curr. Opin. Biotechnol., 14, 296-302, 2003.

Takano, Y., Chikaraishi, Y., Ogawa, N. O., Nomaki, H., Morono, Y., Inagaki, F., Kitazato, H., Hinrichs, K.-U., and Ohkouchi, N.: Sedimentary membrane lipids recycled by deep-sea benthic archaea, Nat. Geosci., 3, 858–861, 2010.

Interactive comment on Biogeosciences Discuss., 10, 12807, 2013.