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Interactive comment on "Distribution of PAHs and the PAH-degrading bacteria in the deep-sea sediments of the high-latitude Arctic Ocean" *by* C. Dong et al.

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We appreciate your constructive suggestions. Your comments and questions were responded as follows.

R.: The authors should highlight the importance of the degradation of PAHs in situ at low temperatures and high pressures. From the physical point of view PAHs degradation is more difficult under these environmental conditions.

It is not understandable why the authors have included in the experimental design, bacterial growth at 15 and 25C. There are many previous works that has study the PAHs degradation at high temperatures.

A.: We agree with your suggestion that deep sea environmental conditions like low temperature and high pressure should be taken into consideration to understand the role of PAH-degradation in the sediments. Another group of our lab starts to mimic the deep sea conditions now and has confirmed PAH degradation under high pressure though the bacteria were initially isolated under normal atmospheric pressure (unpublished). We also start to enrich PAH-degrading bacteria in situ in deep sea water columns at approximately 3000m depth in both Indian Ocean and South China Sea, but enrichments are ongoing without initial results.

As to the low temperature, we have carefully considered about its effect. Initially, PAH-degrading communities were enriched under 4oC, and then were shifted to 15oC to speed up the growth of psychrotolerant PAH-degrading bacteria. Finally, they were incubated under 25oC to observe the effect of temperature increase on community structure. Generally, psychrotolerant bacteria grow better with temperature increase, and have optimal growth temperature approximate 15oC. Hence, we think that enrichments of psychrotolerant PAH-degrading bacteria can happen under both 4oC and 15oC.

R.: There are very interesting data as diversity index (Shannon index) which have been barely discussed.

A.: Thank you for your suggestion. We discussed further at the end of the third paragraph of "Discussion" section as follows.

"The alpha and beta diversity indexes (Fig. S2) both confirmed that significant differences exist among these consortia enriched under different temperatures, and indicated that temperature substantially influenced the bacterial community structure. This could be explained by the enhancement of high temperature on PAHs bioavailability and the metabolism activity of bacteria".

R.: The current manuscript includes deep sediment samples (4000-2500 m) from approximately 250-400 atmospheres of pressure. However, it has not mentioned the

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effect of the high pressure changes that samples are submitted.

A.: As mentioned above, we believe that the PAHs degraders could conduct PAH degradation under high pressures of in situ water depth. Next, we will compare the efficiency of different strains of the same species which are originally isolated from surface water (or coastal areas) and deep sea, respectively, in PAHs degradation under high pressures.

R.: It is not explained in the discussion why the The top-down concept is not well used. This concept is used to refer the depredation control of the processes.

A.: Thank you for your question. The similar question was also raised by the referee Dr. Andrew Steen. We agree that "top-down" is an ecological term referring to predator or prey/nutrient control over populations. Here, we use it (page 13988, line 6) to explain the PAHs sources in deep-sea sediment.

According to previous reports, the main sources of PAHs are long-range atmospheric transport and abiogenic production in some special deep-sea environments, such as hydrothermal vent. So, we modified the sentence (page 13988, lines 5-8) as "Long-range atmospheric transport and abiogenic production in deep-sea hydrothermal vent are all believed to contribute to the accumulation of PAHs (Friedman, C. L. et al., 2012; Proskurowski, G., et al. 2008; Simoneit, B. R. T., et al. 2004; Konn, C., et al. 2009)." in the revised manuscript.

Correspondingly, the origin and distribution of PAHs in the Arctic deep sea sediments was discussed in the second paragraph of the "Discussion" section.

R.: 2.8. Bacteria isolation, identification and phylogenetic analyses. Why 35 cycles for the PCR? The authors should test if that number is too low or too high to avoid amplification of not desirable DNA.

A.: Thirty-five cycles were only performed in the Rep-PCR. We agree that the cycles are more than normal PCR. However, according to our experiences, genome finger-

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printing is not easy to be obtained by amplifying under 30 cycles or less. We usually perform 35 cycles in the Rep-PCR analysis.

R.: 3.3 PAH degradation of PAH enrichment consortia. The first paragraph of this section should be in material and methods.

A.: we agree and delete the first sentence of this paragraph in the revised manuscript. Thanks.

R.: 3.4 community structures of the consortia enriched with PAHs. I think there is a mistake in the figures.

A.: Sorry, we cannot find the mistake in Fig.3b-3d. Would you please specify it?

Interactive comment on Biogeosciences Discuss., 11, 13985, 2014.