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Biogeosciences Discussions

Interactive comment on "Food quality determines sediment community responses to marine vs. terrigenous organic matter in a submarine canyon" *by* W. R. Hunter et al.

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General comments:

The paper by Hunter and co-authors addresses the utilization of marine and terrigenous organic matter by seabed communities from a submarine canyon. In view of the important role generally attributed to submarine canyons in the transfer of organic matter across the continental margins, a study addressing the fate of organic matter in the canyon environment is certainly relevant to BG.

That submarine canyons accumulate and transfer organic matter of different origin and nutritional quality is not a new idea, nor that different groups within the sediment community may utilize different organic matter components. However, in the context of submarine canyons, this study is the first to assess the partitioning of different qualities of organic matter between different groups of organisms by means of in-situ experiments with labelled organic matter.

The paper convincingly demonstrates the preference of metazoan macrofauna and bacteria in submarine canyon sediments for N-rich marine organic matter, relative to N-poor terrigenous organic matter. From the perspective of the consumption of organic matter, this result corroborates the commonly observed successive relative enrichment in canyon sediments of the more refractory organic components (e.g. Epping et al., 2000, Prog. Oceanogr. 52, 399–431; García et al., 2010, Deep-Sea Res. I 57, 1012–1026; Pascual et al., 2011, Mar. Chem. 126, 1–12).

The in-situ incubation of sediments and application of labelled organic matter, subsequent biological and biogeochemical analysis, and statistical analysis of the results, represent state of the art scientific methodology and are described in meticulous detail, warranting traceability of the results. The motivation given under 4.1 for not quantifying the feeding responses of metazoan meiofauna and foraminifera – both representing important components of deep-sea communities – sounds less convincing, however. Uncertainty about the quantity of labelled C and N incorporated by these groups, and in dissolved inorganic carbon, makes inferences about macrofauna-bacteria interactions appear less conclusive.

For what concerns the choice of the experimental sites in the eastern and western canyon branch, this seems not primarily based on existing knowledge about differing sedimentary regimes at these sites, since very little has been published yet about this area. Differences in sedimentary regime at the experimental sites apparently were inferred later on the basis of interpretation of the experimental results.

Extensive referencing to published literature shows that the authors are familiar with related studies on deep-sea trophic interactions. References to studies on submarine canyons are more general, and not specifically addressing the processes that are likely occurring in the Whittard Canyon. The authors should be aware that sediment transport in submarine canyons is not only about episodic events, but that tidal forcing often ensures continuous sediment resuspension and transport, at least in the upper reaches of canyons. See for example Shepard, 1979, SEPM Spec. Pub. 27, 85-94; Petruncio et al., 1998, J. Phys. Oceanogr. 28, 1873-1903; De Stigter et al., 2007, Mar. Geol. 246, 144–164. Surprisingly for a study addressing submarine canyon processes, no mention is made of sedimentary characteristics that might be indicative of sediment gravity transport. A proper description of the sediment substrate is in fact completely missing. What does the sediment at the study sites look like, what is it composed of, is it fine or coarse grained, are there indications of episodic sediment flows, are there indications for extensive burrowing? Here a reference to Duros et al., 2011, Deep-Sea Res. I 58, 128–146, might be appropriate. The study on sediment geochemistry by Otto and Balzer, 1998, Prog. Oceanogr. 42, 127 – 144 may also be relevant to consult.

The title of the paper suggests a broader scope study, where among a number of factors, food quality was found to be the principle factor determining community response. In fact, only food quality was considered. Not investigated, but probably relevant in terms of community response, are the different physical processes associated with the delivery of marine or terrigenous organic matter. Whereas marine organic matter will mostly arrive in relatively concentrated form via vertical settling and redistribution by tidal currents, terrigenous organic matter will typically be supplied in diluted form along with reworked sediments by episodic sediment gravity flows. Not only will the sediment community have a lower energy yield from the diluted organic material, but it may also suffer from the effects of erosion and mass deposition associated with gravity flows. In short, the title without “food quality determines” might be more accurately representing the content of the paper.

Overall, the paper is well organised and clearly phrased. The abstract gives a good summary of the content of the paper. It might be useful sometimes to explicitly mention

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that difference or lack of difference between stations, sediment levels, treatments, etc., is judged in terms of statistical significance. Otherwise it is strange to read for example at the start of 3.1 that "No differences were observed in sediment POC content or C:N ratios, between stations. Sedimentary TN content was greater at ...station...". Mathematical equations, symbols, abbreviations, and units appear generally correct. Tables and figures are also sufficiently clear. For the complete data, the reader is referred to Appendix A and B.

Specific comments:

The effect of macrofauna feeding on bacterial biomass is not entirely convincing. Indeed Fig. 10 shows a crude negative correlation of bacterial biomass with biomass specific macrofauna uptake of C and N. Looking more closely, however, it appears that bacterial biomass in the eastern canyon site decreases anyway after a 3-days incubation period, whether macrofauna uptake of C and N is very low (3 incubations) or high (1 incubation). This makes the reader wonder whether bacterial biomass might have decreased as the result of some other factor that was not investigated in the experiment.

The reference in the introduction to climate change leading to increased incidence of dense shelf water cascading seems inappropriate in the context of the Whittard Canyon, since cascading is unlikely to be important if existing at all in this area. On the other hand, in an area where storm depressions are a common feature, climate change might well lead to increased frequency of storm-induced sediment gravity flows.

Technical corrections:

In 2.3, POM inputs in the bathyal and abyssal NE Atlantic should be given in mgC m-2 yr-1 instead of gC m-2 yr-1.

In Fig. 7 it might be good to mention that the horizontal dashed lines at 4.06 and 22.80 represent C:N ratios of, respectively, the diatoms and wheat phytodetritus.

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