

# ***Interactive comment on “Organic carbon rich sediments: benthic foraminifera as bio-indicators of depositional environments” by Elena Lo Giudice Cappelli et al.***

**Anonymous Referee #3**

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This study attempts to reveal benthic foraminiferal responses to organic carbon in fjords system. Previous studies have revealed that benthic foraminifera are useful proxies for various environmental factors, such as oxygen content and food supply in many field. Each voe may have each sediment system because their bottom topography, surrounding environment, and river and current systems are different. These differences control the distributions of grain size, organic carbon, and benthic foraminifera. However, detailed environmental factors of each voe are not described in the manuscript. The authors discuss the “unrestricted” or “restricted” geomorphology, but figure 1 is quite small and detailed characteristics of each voe and sampling points are missing. There is no information about spatial distribution of grain size within each voe in Figure

3, so it is difficult to evaluate the distribution. Figures of spatial distributions of grain size, organic carbon, and benthic foraminiferal assemblage can assist in understanding the data interpretation. Grain size is another important parameter controlling benthic foraminiferal distribution in marine environments. However, the authors omit the grain size data from discussion of benthic foraminifera vs. environmental parameters for the reason that grain size distributions don't show obvious trend. Complex factors affect the benthic foraminiferal distributions in shallow marine environments, so I strongly recommend that the authors perform statistical analysis concerning the relationship between benthic foraminifera and environmental parameters (not only carbon but also grain size, water depth, BWS, and DO...).

Introduction Pg 2 Line 24-28: The authors mention the TROX model of Jorissen et al. (1995). This model is mainly applied to the deep sea setting because of its relatively stable environment. As mentioned above, shallow marine environment is affected by various environmental factors, so it is difficult to apply the simple relationship.

Pg 3 Line 7 (also for pg 8 Line 31, title of section 4.3, and pg 13 Line 4): The authors use the term "biogeography", but I think this study is not biogeographical study. "distribution" is more adequate than "biogeography".

Materials and methods Pg 3 Line 17: As mentioned above, the detailed descriptions of each vce should be included in the main body of manuscript.

Pg 3 Line 21-25: This part is methodology of foraminiferal analysis. I recommend to move this part to section 2.6.

Pg 3 Line 22-23: Why do you consider that the method of Schönfeld et al. (2012) may lead to underrepresentation of living foraminifera and the method is problematic? The authors explain that the reason for analyzing total (live + dead) assemblage is underrepresentation of living foraminifera in this part. However, the authors mention that the reason is "to provide a tool for the interpretation of fossil foraminiferal assemblages and their relationship with changes in OM and OC content in sediments over time" in page

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5, line 23-24.

BGD

Pg 3 Line 26-27: The authors don't mention BWT. Please describe also about BWT (Fig. 2a).

Pg 4 Line 14: I think the detailed methodology of LOI analysis should be included in the main body of manuscript.

Pg 6 Line 3: "Fig. 4" should be "Fig. 5".

Results Pg 6 Line 26-27: TC data are not shown.

Pg 7 Line 5: The authors argue that high OC and low IC at the head of the voes, but I can't find this trend in figure 4a. Please also see comment below (comment to Pg 9 Line 2-6).

Pg 7 Line 7, 8: The authors use "Quinqueloculina seminulum" in supplementary table.

Pg 8 Line 3-4: Please add relative abundance after Cibicides spp. and E. scaber.

Discussion Pg 9 Line 2-6: The authors argue that a seaward gradient is evident, but I don't agree this argument. First of all, the authors analyze only two stations in Olina Firth and Aith Voe, and three stations in Busta Voe. So, you can't discuss the gradient in these voes. In addition, it seems that samples from Vaila Sound are not collected along the environmental gradient (Fig. 1). Moreover, it seems that there is no obvious seaward gradient in Clift Sound and Sand Sound.

Pg 9 Line 18-22: The authors argue that the high TC content at MD 15-05 is the effect of oil spill. If so, benthic foraminifera may change in response to the effect. Lei et al. (2015\_Marine Pollution Bulletin) suggest that E. scaber is indicator of oils. Your foraminiferal data don't show the effect of oil or high TC.

References: Some articles are overlooked in references. Soil Survey of Scotland, 1981 Alve, 1994 Alve, 1995 Alve and Nagy, 1986 Qvale et al., 1984

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Figure 1: Please add space between “Sand” and “Sound”. As mentioned above, figure 1 is quite small and detailed characteristics of each voe and sampling points are missing.

Figure 2: Please add legends for each profile (i.e. please add “station number”).

Figure 3: Please add legends for each plot (i.e. please add “station number”). It is difficult to identify the relationship between data and sampling point. I think figure 3b is not needed because the data are not discussed enough in the manuscript.

Figure 4: Distance of OCterr of Aith Voe (left one) don't match with OC and LOM. Third plot from the right (Clift Sound) is missing in figure of OCterr.

Figure 5: What are “Head” and “mouth” in the figure of Ammonia? Do you mean horizontal axis of MDS is gradient from head to mouth? Fig. 5-9 is Cibicidoides, but the authors use Cibicides in the text. The authors mention that “we grouped under the name *E. excavatum* both forma *selseyense* and forma *clavata*...”, but “*selseyensis*” is used in figure 5-7. There is no indication of legend unit. Please add the unit (%?). There are no indication about four circled groups, so please add the name of each group near the dashed circles. It would be better to move SEM figures close to each MDS plot.

Supplementary Material: I can't find supplementary figures, so I can't evaluate supplementary figure 1 and 2. The authors use “Fig. 1a” in supplementary material, but figure 1 is single figure. The authors describe “the island of Vaila” and “the isle of Linga”, but I can't identify the islands because there are no indication of these islands in figure 1.

Supplementary Table 1: The authors use Cibicidoides, but “Cibicides” is used in the text. Oolina mellow should be Oolina melo. Trochamina sp. should be Trochammina sp.. There are blanks only in the column of Reophax fusiformis. There is “0.0” in the gray cell of Reophax fusiformis. Please add picked number of specimens in table 1.

Best regards,

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