

## ***Interactive comment on “Historical record of the effects of anthropogenic pollution on benthic foraminifera over the last 110 years in Gamak Bay, South Korea” by Da Un Jeong et al.***

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Received and published: 4 December 2017

1. The age model is very important in this manuscript. The data of Pb-210 acquired from core samples should be evaluated carefully, because of sediment mixing or erosion. Authors were observed carefully to the cross section of core sediment (sediment structure, grain size composition variation of sediment). Sediments composed of homogeneous fine-grained mud facies with 30.02–33.25% silt and 66.10–68.84% clay accumulated in three cores. We could not find a distinct sedimentary structure. Excess  $^{210}\text{Pb}$ , however, did not decline exponentially downward in the cores, and the highest  $^{210}\text{Pb}$  values of cores 10863 and 11285 were found at depths of 3 cm and 7 cm,

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respectively. This abnormality beneath the surface sediment has also been found in other coastal environments (e.g., Ruiz-Fernández et al. 2003; Lubis 2006), probably due to sediment reworking such as waves, current, or bioturbation on the top layer. From the excess  $^{210}\text{Pb}$  activity profile shown in Table 4, we used the Constant Rate of Supply (CRS) model (Appleby and Oldfield, 1992) for calculating the sediment age and accumulation rates, assuming a constant rate of supply of excess  $^{210}\text{Pb}$  per unit time. Yes, of course, I know about the relationship between accumulation rates of geochemical elements and benthic foraminiferal number (BFAR) (Tsujiimoto et al., 2008). It may be also useful tool to know about them. . 2. Tsujiimoto et al. (2008) reported that the steep trend in both the C/S and C/N after the 1990's in Osaka Bay may be due not to the environmental change but instead due to the progress of sulfate reduction by bacteria at a very early stage of diagenesis (Sampei et al., 1997). In our data, the steep variation appeared at TOC of 21 cm (1978 yr) in core 10863 (Figure 2-J). I think that it is too young to occur diagenesis. 3. I know well about *A. beccarii* that is known as the pollution tolerant species. The genus, *Ammonia* is usually described as being tolerant of all kinds of stress conditions, including organic and heavy metal pollution (Armynot du Châtelet, et al., 2004; Ferraro et al., 2006; Frontalini and Coccioni, 2008). Yasuhara et al. (2012) reported that the tolerant genus *Ammonia* increases and the sensitive genus *Elphidium* decrease with increasing eutrophication and resulting hypoxia/anoxia at various locations, including Osaka Bay (Tsujiimoto et al., 2006, 2008), Gulf of Mexico (Sen Gupta et al., 1996; Sen Gupta and Platon 2006; Rabalais et al., 2007), Chesapeake Bay (Karlsen et al., 2000), San Francisco Bay (McGann 2008), Long Island Sound (Thomass et al., 2000), and the Bay of Biscay (Irabien et al., 2008). In this study, abundance frequency of *A. beccarii* and *E. subarcticum* was varied remarkably (Figure 3-III-D, I). *A. beccarii* decreased and *E. subarcticum* increased with increasing eutrophication and hypoxia in assemblages of the northwestern area. Especially, variation of foraminiferal assemblage from Es through Ab-Es-Th to Es distributed between 1988 and 2014 indicates from worsening through recovering to worsening again in benthic ecology and the sedimentary environment. *A. beccarii* may be rapidly

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decreased with rapid deterioration of habitat environment, although *A. beccarii* is a pollution tolerant species. *E. subarcticum*, however, was correlated distinctly with variation of benthic ecology and the sedimentary environment. Therefore, the authors focused on the *E. subarcticum*. 4. I tried to compare to benthic foraminiferal assemblage in equal time zone, and understand the difference of habitat conditions. 5. Inflow into northwestern area of freshwater through very small stream little affected to the salinity environment, because of extremely small quantity. If brackish area was distributed extensively, mussel farm could not developed. 6. Yes, geochemical data do not show the improvement in the benthic environment after dredging. It may be caused by thick polluted sediment body ("pollution storage"). 7. The main factor of pollution in this study is organic materials formed by mussel farm. The TOC is representative geochemical element to organic material. Therefore, the authors focused on the TOC content. 8. I don't think so. Figure 9 suggest that Figure 6 was caused by sea water movement. 9. Thank you for your kindness. I will revise.

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Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-383>, 2017.