

Interactive comment on “The ^{226}Ra -Ba relationship in the North Atlantic during GEOTRACES-GA01” by Emilie Le Roy et al.

Anonymous Referee #2

Received and published: 30 November 2017

General This manuscript brings new data concerning the distribution ^{226}Ra activity and dissolved Ba in the North and Sub-Arctic Atlantic and the Labrador Sea. Authors compare the distributions of Ra and Ba with those of silicic acid, salinity and temperature. Using an OMP approach they estimate the relative importance of conservative mixing in setting the distributions of Ra and Ba. These appear highly correlated (despite differences in source terms) indicating water mass mixing as well as similar biogeochemical processes controlling their distribution. The potential of Ba as the stable analogue of ^{226}Ra (as was noted as early as the 1950's and subsequently during the GEOSECS era) is underlined by the authors, opening a perspective of utilizing the $^{226}\text{Ra}/\text{Ba}$ ratio for water mass dating. In general the paper is well organized and reads rather easily. Overall authors give interesting insights on the different possible controls

[Printer-friendly version](#)

[Discussion paper](#)



on ^{226}Ra , Ba by source functions, internal biogeochemical processing and water mass mixing in this less studied northern Atlantic domain.

Specific comments P1 Lines 29-30: what about impact of radio-decay ?

P3 Line 5: explain parallel carriers

The description of the water masses and circulation as shown in Figure 1 could be more accurate: P 6, Line 24: from Fig. 1 it appears that stations 1 to 26 cover the section between the Iberian Peninsula and the Rockall Through, and not till Reykjanes Ridge as indicated in the text P 6, Lines 27-28: From Figure 1 splitting of the NAC occurs west of the Mid Atlantic ridge, not at the MAR as indicated in text. P6, Lines 30-31: the southern branch of the NAC appears to flow into the Iberian abyssal plain, rather than into the West European basin.

P9, Lines 17-18: positive intercept on Ba axis is explained as either resulting from larger river input relative to ^{226}Ra and larger ^{226}Ra input relative to Ba at the sediment interface; it is not clear how the latter situation may lead to a positive intercept on the Ba axis.

P9: Lines 20-21: slope of regression curves ^{226}Ra -Ba. Alert the reader that units in Fig 5 are not the same as those for the global ocean Ra/Ba ratio. P9 Line 25: change sentence "... small fractionation between Ra and Ba during these processes" to "indicates the fractionation between Ra and Ba during these processes is small".

P10 Lines 5 to 15: Some words of explanation are needed when discussing varying Ra to Si ratios between the major basins. A look at the Sarmiento et al. Nature paper of 2007 could be helpful.

P10 Line23: "These waters then sink and circulate northward into the Atlantic Ocean" specify that these 'waters' are mainly AAIW and also to some extend SAMW.

P10, Line 25 (Fig. 6) and onwards: What explains this abrupt decrease of ^{226}Ra between Eq. and 11°N ? What is the rationale to consider these meridional profiles

as a continuum, or to what extent is this reconstructed meridional section of 226Ra and the other variables depending on the basin they originate from (i.e. west or east Atlantic Basin)? This needs to be clarified. Line 32: clarify the meaning of 'coincide'; you mean geographical coincidence or compositional similarity?

P10 Lines 34-35: sentence unclear. 226Ra activities are high when waters reach 40°N. So they are high compared to the western part of the GA01 section (not the eastern part) ..

P11 Line 13: presence of the MW at about 41% - 66%; % of what ? Specify.

P12 Lines 25- 35: What may cause the absence of a positive anomaly for Si, while the anomaly is strong for Ra ? Is it because the region is dominated rather by coccolithophorids (compared to the western part of the section, where the diatoms dominate), and so sediments may be relatively poor in Si ? Comment please.

P14: title of section 4.3.2 lacks a verb ?

P14 Line14: Acantharians are invoked to explain lower Ra/Ba ratios. Is there any direct evidence during the GEOVIDE cruise for the presence of these organisms ?

P14-15: Differentiation of west and east regarding dominance of diatoms (west) vs coccolithophorids (east) as such is not sufficient to explain the 226Ra distribution. Is it known that these two phytoplankton groups accumulate Ra and Ba in a different way? Please comment further.

P16 Line28: ... "which is within the range of fluxes" .. in fact the calculated flux is clearly larger than the reported fluxes in the literature, so stating that the statement is not appropriate.

P17 lines 15 – 20: It is not because Ra and Ba contents in particles are much lower than the contents in solution, that particle dissolution should be considered as minor. This depends on turn- over rate of particulate vs dissolved phase.

[Printer-friendly version](#)[Discussion paper](#)

P17 Lines 31-32: Potential for $^{226}\text{Ra}/\text{Ba}$ ratio to be used as a clock for THC. From the data here in the North Atlantic there is but poor evidence that with time ^{226}Ra activity relative to Ba is decreasing. Also globally the Ra/Ba ratio appears to stick closely to the 2.2 value. Can you comment on what the effective perspective is for the use of this ratio as a chronometer ? Is it a question of insufficient precision on the present day data ? If so what needs to be done ? A few lines discussing the status of this issue would be welcome.

P18 Line 1-2: The absence of Ba enrichment in deep waters in the western part of the section, while Ra is enriched) is not really discussed. What could be the possible mechanisms?

Figures and tables: Legends should detail all acronyms (water masses) shown or listed.

Table S2: It would be useful to indicate the CTD number of the casts. Why not add also the $\text{Si}(\text{OH})_4$ profiles ? Giving depth values with a decimal seems not realistic given natural variabilities due to waves, swells .. Why are activity and concentration data not expressed per unit weight (Kg) rather than per unit volume, as is standard practice? Also for Ba, the indicated 1.5% precision implies the numbers should be rounded to the first decimal. Some numbers may be suspicious: examples are station 21: $^{226}\text{Ra} = 24.87$ at 4176m; temperature at 794m; station 32: ^{226}Ra at 794m; please check. Station 60: Why is the depth range not continuous ? Are the data from two different CTD casts ? This is what Sal and Temp suggest. Please clarify.

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-478>, 2017.

Printer-friendly version

Discussion paper

