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Interactive comment on "The export flux of particulate organic carbon derived from ^{210}Po / ^{210}Pb disequilibria along the North Atlantic GEOTRACES GA01 (GEOVIDE) transect" *by* Yi Tang et al.

Anonymous Referee #1

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This manuscript presents data on the natural radionuclides 210Po and 210Pb along the GEOTRACES GA01 transect in the Atlantic Ocean. The data are used to estimate the sinking flux of particulate organic carbon (POC) along the transect and are compared with estimates of this parameter derived from disequilibrium between 234Th and 238U. Strong points include the consideration of at least vertical advective influences on the Po deficits, placing the sampling in the temporal context of primary production and comparison with 234Th-derived POC fluxes.

Specific comments: Methods 2.2 Radionuclide sampling. . . (lines 108-119): Were the

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samples precipitated at sea?

2.4 Quantification of vertical advection (lines 172-201): This section should be clarified by pointing out that depth z in the layer for A1Po (0-z) refers to the different depths to which the 210Po was integrated for application of eqn 1 (i.e. the MLD, Z1%, PPZ and ThEq), as defined in the preceding section (2.3).

Results General comment- It would be very useful to present and plot the 210Po and 210Pb profile data.

3.5 POC/210Po ratios in particles (lines 281-292); Values of POC/210Po in the large size fraction were not always "higher" than those in the small size fraction. Many were comparable and a few were lower. (Fig. 4a).

Discussion 4.1 Physical Advection effects… (lines 317=322): It is certainly the case that horizontal physical transport is neglected in most 210Po studies because of lack of spatial resolution, but this is likely not justified- even in the "open ocean". Many of the stations sampled could be called "open ocean". Where exactly are advective effects negligible for Po?

4.3 POC flux calculated from 210Po flux (lines 392-420): The authors use the total particulate POC/210Po ratio to calculate the POC flux from the 210Po flux, and as noted, this is equivalent to the POC/Po in the small size fraction. They justify this by arguing that the flux is dominated by the small size fraction. However, I recommend also using the POC/210Po on the large size fraction. Lemaitre et al. (2018) calculate POC fluxes from 234Th deficits using both size fractions, and it would be interesting to compare the Po-derived POC fluxes from both size fractions with the comparable Th-derived POC fluxes (section 4.5). The POC/Po (or POC/Th) ratio that truly applies is that on sinking particles, and that was not determined in either the present study or that of Lemaitre et al. (2018).

4.5.1 210Po flux vs. 234Th flux (lines 473-483): Comparing these fluxes in relation to

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the stage of bloom at different stations is extremely interesting and bears on the use of these two radionuclides as POC flux proxies. Given the large difference in half-lives, one might expect the 210Po deficit resulting from a bloom to persist longer than that of 234Th. If the eastern section was sampled weeks to months after the bloom (Fig. 7), I would expect Po deficits and fluxes to be higher (proportionately) than those of 234Th. More comparable fluxes (i.e. both high) would be expected at stations sampled right after the bloom (i.e. the western section). Fig. 9 shows the latter pattern for the western section stations, but it shows much higher 234Th fluxes sampled in the eastern section stations. This is counterintuitive if the bloom happened weeks to months before. What conclusions can be drawn from this? Does it reflect advective effects on profiles of the two radionuclides? But if so, why do the effects seem higher for 243Th?

4.5.3 210Po-derived POC flux vs 234Th-derived POC flux (lines 494-513): The authors have estimated the effects of vertical advection on the Po deficits (and Po-derived POC fluxes). Are these advective effects comparable for 234Th fluxes? One could argue that they would be lower, and, it might be preferable to compare the NSS Po-derived POC fluxes with the SS Th-derived POC fluxes. This seems to improve some of the station comparisons in Fig. 10, but not all. In the end, the difference is attributed to the discrepancy between the Po and Th flux estimates (as shown in Fig. 9), but that discrepancy remains unexplained in my mind (see comment above).

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