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Interactive comment on "Seasonal distributions and fluxes of ^{210}Pb and ^{210}Po in the Northern South China Sea" *by* C.-L. Wei et al.

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Review of Wei et al.

The paper by Wei et al. reports on seasonal distributions and fluxes of Pb-210 and Pb-210 in the Northern South China Sea. One of its major goals is to resolve the discrepancy between vertical distributions of Pb-210 and Po-210 between different studies, and between radionuclide fluxes calculated from water column distributions and those measured by sediment traps. I would like to discuss some methodological aspects, as well as the assessment of the study's major goal.

Methods: The methods used in the sediment trap exposures of 15 days, mentioned on p. 11548, needs to be elaborated more in the methods section (e.g., addition of

poisons, sampling details, etc). Furthermore, it should be mentioned that any apparent "dissolution" of radionuclides into the water during exposure and incubation in the traps cups had (apparently) not been directly assessed.

Residence time discussion (page 11549-11550): residence times of Pb-210 would be expected to be a function of depth in semi-enclosed basins, e.g., as had been shown for the Gulf of Mexico (Baskaran, M., and Santschi, P.H. 2002. Particulate and dissolved 210Pb activities in the shelf and slope regions of the Gulf of Mexico waters. Continent. Shelf Res., 22, 1493-1510.), e.g., about 3 years for 1000m, and 6 years for 2000m (and by inference, 11 years for 3500m). These previously determined values for the Gulf of Mexico would compare favorably to the 12-17 years that the authors obtained for the SCS region at 3500m.

Discrepancy of calculated vs. measured Po-210 fluxes. There exists an apparent disagreement between Po fluxes determined in sediment traps and those calculated from inventories of 210Po and 210Pb, with trap fluxes amounting to only about 10% of calculated Po-210 fluxes, and about 50% of calculated Pb-210 fluxes. However, this apparent disagreement between Po fluxes determined in sediment traps and those calculated from inventories of 210Po and 210Pb has yet another explanation that might be more likely: The most likely source of bias is that particulate radionuclides are regenerated into solution ("dissolved") during the 15 days exposure, and the number of months those particles are sitting in the sediment trap cups. Unfortunately, most aquatic scientists are unaware of this potential artifact.

The authors might want to consider mentioning here that there actually exist a small number of studies that previously have pointed out the great need to include the fraction of selected radionuclides (and metal ions) that is "dissolved" during sediment trap exposure. Without such corrections, measured radionuclide fluxes can be in great error. For example, 50% of Po-210 (but $\sim$0% of Pb-210 and Be-7) was released into the overlying solution during 2-3 week sediment trap exposure (50 and 130m depth) in a Swiss lake, as documented by Schuler et al. (1991). While this was carried out in a

lake, I suspect that the effect would be similar or worse in the ocean. This suspicion is based on the documented release of Th-234 (considered a “particle-reactive” isotope) into the overlying water during short-term (1 day) sediment trap exposures (at 65-140 m depth), as documented by Hung et al. (2010) and Xu et al. (2011). This documented loss of Th-234 (∼75%) and organic carbon (∼50%) necessitated major corrections of measured fluxes. While these large losses were documented in the upper 150 m of the water column, 210Po losses could occur also below that depth, like in this ms at 700-3500 m depth. At the very least, this potential loss term needs to be discussed and assessed. Po-210 loss during collection and processing is at least as plausible as a sporadic washout by calcareous ballasts that the authors proposed, which, for some unknown reason, would greatly fractionate between Po-210 and Pb-210. .

Relevant references pointing out the need of correcting natural radionuclide fluxes for dissolution in sediment traps:

Polonium:

Schuler, Ch., Wieland, E., Santschi, P.H., Sturm, M., Lück, A., Farrenkothen, K., Bollhalder, S., Beer, J., Bonani, G., Hofmann, H.J., Suter, M., and Wölfli, W. 1991. A multi-tracer study of radionuclides in Lake Zurich, Switzerland 1. Comparison of atmospheric and sedimentary fluxes of 7Be, 10Be, 210Pb, 210Po and 137Cs, J. Geophys. Res., 96 (C9),17051-17065. Loss of 210Po, but not of 210Pb and 7Be, is documented on page 17061.

Thorium:

Hung, C.-C., Xu, C., Santschi, P.H., Zhang, S., Schwehr, K.A., Quigg, Guo, L., Gong, G.-C., A., Pinckney, J., Long, R., and Wei, C.-L. 2010. Comparative evaluation of sediment-trap and 234Th-derived POC fluxes from the upper oligotrophic waters of the Gulf of Mexico and the subtropical northwestern Pacific Ocean. Mar. Chem, 121, 132–144.

Xu, C., Santschi, P. H., Hung, C.-C., Zhang, S. , Schwehr, K,A., Roberts, K.A., Guo, L.D., Gong, G.-C., Quigg, A., Long, R., Pinckney, J., Duan, S.W., Amon, R., Wei, C.-L. 2011. Controls of Th-234 removal from the oligotrophic ocean by polyuronic acids and modification by microbial activity. Marine Chemistry, 123, 111–126.

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