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Interactive comment on "Effects of ^{238} variability and physical transport on water column ^{234}Th downward fluxes in the coastal upwelling system off Peru" *by* Ruifang Xie et al.

Anonymous Referee #2

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Major comments This study evaluated the impact from the non-linearity of U-S relationship, temporal variability of 234Th and 3-D physical transport of 234Th on the estimation of downward 234Th flux. I initially read the manuscript with interest but realized finally that I need to give it up. This is an important but difficult topic that has been ignored in various 234Th studies, while the superficial description and discussion on the data by the authors keep the manuscript from further acceptance. The non-linearity between 238U and salinity is interesting and I totally agree that will induce an over- or under-estimation on the final 234Th flux. I feel very nerves that the authors attributed such non-linearity to the flooding and landslides without any obvious evidences shown in the manuscript. Meanwhile, if it was true that high uranium was transported from

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the coastal waters, then how was that for 234Th? I guess the 234Th activity could be low in the same water, and including the low 234Th water also elevated the 234Th flux calculation. The authors further examine the physical transport of 234Th, but again the in-depth discussion will be required. Quite a few descriptions and explanations should be listed here: The methods on the upwelling rate estimation using wind stress and its uncertainty, the diffusivity using in situ microstructure measurements and the detail calculation for horizontal advection (the equation 3 showed in the manuscript is way too simple for this paper). I strongly recommend the authors to add these parts in the methods and discussion during the revision, and most importantly, the evaluation of the uncertainty and error should be carefully done. For example, the authors calculated the upwelling rate was on the order of 10-6 to 10-7 m s-1, those values actually were quite low compared to other upwelling sites. In the last part of the discussion, the authors used a whole paragraph for the 234Th residence time. I did not find any wordings on the detailed calculation method for those residence time. I guess they are estimated using an 1-D steady state model, but given that the physical transport was important for some stations as the authors had pointed out, 3-D estimation for the 234Th residence time will also be needed. The 234Th and 238U data obtained in the region could be very interesting, the detailed description of their profiles should be more interesting. I think the authors should expand their methods part, and separate the result and discussion. In addition, I found some sentences in the conclusion should also move to the discussion. I also have quite a few detailed comments listed below. Minor comments: The title: Effects of 238U variability and physical transport..... It gave me an impression that the author is evaluating the 238U transport which is actually 234Th. Page 3, Line 41, Add “in the upper ocean” after “export fluxes” Page 3, Line 47, Bhat et al., 1968 is not a appropriate reference, add some Santschi paper, and show the Kd values here. Page 3, Line 50-51, 234Th flux can be obtained even if you do not integrate with depth. Page 5, Methods part, Add the methods for the upwelling rate estimation, diffusivity calculation and current from ADCP. Page 6, Line 118-120, Did you just assume that 234Th had been in equilibrium with 238U or you

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would acidify those sample and let them stay for a year until the equilibrium would be reached. Please make that clearer. Page 6, Line 125, 1 dpm or 10 dpm? Page 6, Line 125, what was the volume of your sample? 4L or 2L. Page 8, Line 171-172, Show the detailed calculation methods here or in the supplements. I guess here involved the simplification and manipulation of your data. Page 9, Line 180-181, I have concerned on the ADCP-data which are snapshots data during the cruise, while 234Th is a chemical tracer with a time integrated information included. How do you match the different time scale between the two parameters? Page 10, Line 208, Separation between results and discussion could be better. Page 11, Line 221-231, The detailed description of 234Th and 238U activities, ranges, averages, and their relationship with Chl a and oxygen will be appreciated. Page 13, Line 265-267, How about 234Th? Page 13, Line 268-273, This is too superficial? Do you have any optics data here? Page 14, Line 290-295, Show the equation for NSS calculation. I think in the supplement you will also need to explain how you do the error propagation. Page 14, Line 303, How reliable is your upwelling rate? I do not believe those numbers. Show the methods and put more discussion here. Page 15, Line 318, How much is “trivial”? less than 10Page 15, Line 325, How do you calculate the 234Th gradient? Page 16-17, Line 353-355, The time scale for the methods is very different. Page 17, Line 370, How do you do the calculation? 1D steady state? Or 3D steady State? Page 19, Line 411-414, not related, or move to discussion part. Page 19, Line 417-420, Move to discussion part? The references: all numbers of molecular weight for the isotopes should be in the upper case. There are quite a few errors on the references, please do the careful check. Figures: I think adding some figures here will be much helpful. Please add a transect distribution for 238U and 234Th to show the coast to offshore difference. And also add some profiles of the vertical diffusivity should be better. Figure 1: It is better to put the current field here in the map, or show it in a separate figure? Figure 2: Show the MLD and bottom depths here Figure 4, Can you show the profiles of 234Th for stations 458 and 508, although the surface sample was missing.

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