Biogeosciences Discuss., 6, C4184–C4188, 2010
www.biogeosciences-discuss.net/6/C4184/2010/


Biogeosciences Discussions



# *Interactive comment on* "Dissolution of atmospheric cobalt and zinc in seawater" *by* C.-E. Thuróczy et al.

**M. Saito (Referee)**

msaito@whoi.edu

Received and published: 27 January 2010

Review of Thuroczy, Boye, and Losno. Dissolution of atmospheric cobalt and zinc in seawater BG 2010

General Comments: This manuscript present valuable dissolution data for cobalt and zinc from natural dust (Cape Verde) and finer anthropogenic coal dust into seawater using a novel flow through reactor and low level cobalt and zinc voltammetry techniques. The data look quite robust, and as the authors note this is some of the first data of its kind. I would argue with the conclusions that their estimates suggest that the contribution of Co and Zn from dust is negligible. I think it is small, but not negligible as I describe below. Moreover, they do not make similar estimates for contributions from anthropogenic sources in more heavily polluted regions, saying data is unavailable. I



Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

think this is not necessarily true, and some simple estimates would be invaluable in knowing the relative import of their work here. In general the manuscript could use some minor improvements in writing. I recommend accepting after suitable revisions.

Specific Comments: The authors make the interpretation that Co and Zn contributions are negligible, adding 0.5 and 25pM respectively to a 50m mixed layer depth in a strong natural dust event. Yet both cobalt and zinc can be drawn down to very low picomoles/L values in surface waters, particularly in the remote regions of the Pacific (e.g. below 10pM for Co below 50pM for Zn is typical). Comparison of their estimates of dust flux with the Atlantic seawater concentration data is obviously a comparison with a region that receives far more aeolian deposition and hence might already be inclusive of the dust dissolution effects. Moreover, phytoplankton drawdown and subsequent remineralization processes of nutrients at these very low values can likely occur more quickly than homogenization of water masses (and conservative tracers) within the mixed layer, creating observed nutrient-like depletion in 10's of meters. Hence short-term input to the upper 10 or 20m could begin to contribute 25% of existing Co inventory, and perhaps more than 100% of Zn inventory. This may not be enough to create broad surface maxima for Co (as for Al or Pb), but it is likely is a significant contributor to the upper water column inventory.

I think the result that coal materials produce 5-fold more dissolved cobalt than loess is important. In regions that are heavily impacted by coal combustion, could this be a major cobalt source? North America and Asian continents are both major coal combustion sources. Some estimates similar estimates to those presented for loess in Table 5 should be made and included. Given the projected large increases in coal combustion in this century, this is actually potentially quite an important calculation even if a rough estimate. What would this mean for the relative abundances of cobalt and zinc in anthropogenically influenced areas? The potential ecological effects on phytoplankton composition of changing the Co:Zn ratio are also quite important as well, as the authors note. It seems that Zn dissolution is not higher in coal dust, but coal dust be-



BGD

6, C4184–C4188, 2010



gins with 7 fold more Zn, so by quantity of Zn (as opposed to percentage dissolution) anthropogenic sources could be important as well.

Comments on other reviews: Reviewer #1's concerns about contamination are overstated. Cobalt is not highly contamination prone, and cobalt analytical work typically suffers instead from reagent blank contamination, which the authors have constrained. The seawater background level of 49pM is reasonable, suggesting no contamination. The zinc seawater background level of 0.8nM is also reasonable for Southern Ocean waters (KEOPS). Zn contamination, which is extremely easy to do, would be obvious since it typically results in nanomolar concentrations. If anything, these experiments are remarkably clean given the complex manipulations involved and difficultly of working with Zn. Reviewer #1's concern about seawater collection are also overstated: seawater collection was done under trace metal clean conditions, the material was filtered, and the cobalt and zinc background of that water was carefully measured. The Reviewer #1's comments about organic complexes and microbes are important and valuable. However, given this is the first paper on the subject of Co and Zn dissolution, I think it is asking too much to expect additional experimentation regarding complexation and microbial processes. I think discussion of the potential complexation effects should be added (e.g. could there have been natural ligands that promoted some of the dissolution observed here etc.). Reviewer #2's comments about sources of dust are interesting, but again since this is the first focused study on Co and Zn solubility in seawater I do not think the publication of this data should be prevented because they did not also conduct prewetted experiments. More information about the coal dust source would be useful.

Technical comments: Dissolution %'s should be written into the abstract (Table 3 and 5) Cobalt and zinc are sometimes capitalized in the middle of sentences, change to lowercase.

10884: Line11 delete "in" change to "than natural particles"



BGD

6, C4184–C4188, 2010

10884: Line 16 add “a”, “oceans are a major source”

10884: Cobalt is better classified as a hybrid-type profile combining nutrient like and scavenged-like vertical structure, see Noble et al. 2008.

10885: Change activations to activity

10885: Change carboxylic to carbonic

10885: Change Doesn’t to does not

10886: dint?

10886: is there any filtration of the material coming out of the reactor?

10886: Does the first time point contain the very first sample out of the reactor, e.g. any chance for a large spike that is missed by this design?

10890: line 7 “Sensible” replace with significant or clear

10890: line 14: awkward sentence, rewrite

10890: line 25: replace anymore with thereafter

10891: line 5:10 times

10891: line 10 give Fig #.

10891: line 19: zinc

10892: line 20, figure 3 is a cobalt figure, correct fig #, also 10893, line 2.

10892: line 25: complexation processes: discuss in more detail in the paper.

10893 line 16 input

10893 line 20-23: where is the % given? Not in table 2,3? Table 3 caption is unclear. This calculation should be done for coal dust as well.



BGD

6, C4184–C4188, 2010



10893 line 28: From what I have seen in cobalt profiles from around the world, I would argue they are small but likely significant sources.

10894 line 10 change to “provided”

10895 line 10: where no extrapolation

10895 line 11: awkward sentence. Replace with something like: Characterization of Co and Zn dissolution from natural and anthropogenic particles into seawater has not been previously reported to our knowledge.

10895 line 15 awkward: quickly but less. Change to “released Zn quickly, but the quantity was less than. . .”

---

Interactive comment on Biogeosciences Discuss., 6, 10883, 2009.