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Climate of the Past Discussions

Interactive comment on "Trace metal evidence for a poorly ventilated glacial Southern Ocean" *by* M. Wagner and I. L. Hendy

Anonymous Referee #2

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General comments:

This paper sets out to answer the question of whether the Southern Ocean was less well ventilated in the glacial relative to the Holocene by using redox-sensitive trace metal concentrations extracted from two sediment cores. They use contrasting core sites, one south of the Southern ACC front, and one on the northern edge of the APFZ. They acknowledge that each trace metal has ambiguities associated with proxy reconstruction of bottom water oxygen concentration, but by using four trace metals with different deposition and diagenetic controls they try to overcome this.

The question the authors set out to answer is an important paleoceanographic question, however based on their trace metal results I see very little evidence to unambiguously support changes in the bottom water oxygen concentration due to ventilation,

rather than simply changes in the organic carbon flux to the sediment. If the authors were to re-interpret their results, with a simpler conclusion, I see no reason why this study should not be published in CP.

Specific comments:

Section 4.1

1. There are no references to figures in the text.

2. It would be useful to see the U data discussed for comparison with the other trace metals.

Section 4.2

1. RC13-254 interpretation – According to the author's definition in the introduction, elevated Ag and Cd concentrations throughout MIS 2 and 3 indicate high organic C deposition, and in conjunction with elevated Re concentrations this can be interpreted as a sub-oxic sediment boundary close to the sediment-water interface. The only portion of the record where Re is significantly elevated and where Ag and Cd are less so is at $\sim$ 20ka. Can the authors offer literature evidence for why they would expect a linear response between these proxies, and therefore justify their interpretation in terms of bottom water ventilation rather than productivity?

2. TNO57-134p interpretation – Again, with already high Cd concentrations at the beginning of the record, I don't see why the Re peak must be interpreted in terms of bottom water oxygen as opposed to high organic carbon flux? It would be helpful if the axis were split so that the full peaks for these trace metals could be seen.

3. At the end of the section the authors make a statement about spatial heterogeneity in the Southern Ocean. It would be helpful if they discussed the relative magnitude of trace metal concentrations between the two cores, and what this may mean for organic carbon flux across the Antarctic Zone during the glacial. Do their findings agree with other productivity records from this region?

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4. Additionally there is no mention of the fact that the highest organic carbon concentrations were recorded in the core top samples for each core and do not correspond to elevated Ag, Cd or Re, only Mo concentrations. What does this mean for the remainder of the organic carbon records and how this should relate to the trace metal records?

Section 4.3

1. In producing the cross plot (Fig. 5) the authors have included the left hand side of the Re peak, yet in section 4.1 they discussed how oxidative burn-down is likely to have caused this peak. Without the left hand side of the peak, there would not be a positive correlation, therefore this figure is misleading to the reader, and they have over interpreted the relationship.

2. The last part of the section implies that the differences between the two cores are down to bottom water oxygen concentration rather than organic carbon flux. Since the evidence points more towards differences in organic carbon flux, the discussion on watermass restructuring seems like an over-stretch of the data.

Technical corrections:

1. How did the authors ensure good separation of Mo and Cd during column chemistry and analysis? Which resolution mode did they use on the Element? How did they monitor oxide production?

2. It would be helpful if the core locations used for 14C comparison are also on the map.

Interactive comment on Clim. Past Discuss., 11, 637, 2015.