

# ***Interactive comment on “Using $^{226}\text{Ra}$ and $^{228}\text{Ra}$ isotopes to distinguish water mass distribution in the Canadian Arctic Archipelago” by Chantal Mears et al.***

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Mears and colleagues present an extensive dataset from the Arctic, spanning the Canada Basin to Baffin Bay via the Canadian Arctic Archipelago, with the aim of characterizing water mass end-members, evolution of properties and transport. The study employs a range of parameters, including DIC, Ba, oxygen and Ra isotopes to probe the influence of freshwater and shelf interaction, detecting westward flow along the northern flank of Lancaster Sound.

Overall, the context and aims are well established. The introduction provides necessary background to the regional oceanography and methodological approaches. Meth-

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ods are appropriate, adequately detailed and the results clearly support the conclusions drawn and are well situated within the existing literature. I agree with the comments already provided by reviewers Rutgers van der Loeff and Böttcher, including that the manuscript represents an addition worthy of publication in Biogeosciences after minor revisions. My additional comments are that the presentation of some results could be improved to make the interpretations more immediately visible from the figures (specified below), and that providing some additional quantitative details in the implications section could enhance the impact of this manuscript.

Line 101: The final sentence of this paragraph is not needed, and references to what will be discussed or unravelled later in the manuscript should be minimized where possible.

Line 373: Not substantially lower, unless you define the depths – Fig 11c indicates higher 228/226Ra ratios at 100m and 400m, with lower ratios only present at 0, 200 and 700m.

Line 380: the opposing gradients, do you mean the different strength of the gradient?  
Line 374 says “the same pattern”

Line 467: clarify the impact of longer circulation history (it could be interpreted as 228Ra decay, or accumulation of 228Ra from shelf inputs)

Line 296: Mention of CB4 could be integrated more clearly into this paragraph explicitly linking it to the southern flank of LS. Further, what level of confidence do you have in where the inflow turns back around or ceases to influence water properties? The westward flow is not shown reaching CAA6 in Fig 14, but the north/south gradient persists between CAA6 and CAA7 in Figs 12c and 13c - if there is uncertainty in how far this water reaches you could include a dashed arrow?

Line 525: “rerouted” rather than rerouting

Line 531: This section feels a bit unsupported; some quantification effort would deliver

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meaningful context for using these findings as a tool to probe impacts or vulnerability to climate change, and increase the impact of the manuscript. Some suggestions: based on  $^{228}\text{Ra}$  decay, what is the minimum time scale of the eastward transport of water between CAA1 and CAA6? This must make some assumptions (e.g. no additional inputs) but would provide a minimum time scale; is it rapid or slow? What are the temperature differences between east and westward flowing waters? Where will increased heat be delivered – pumped into LS or out into Baffin Bay? Does any historical data support a strengthening or weakening of this u-turn route and what does/would that mean for transport of heat (or nutrients, or any other parameter).

Fig 2: If full CTD cast data is available, it would be preferable to show this rather than only the points for which DIC/Ra/Ba samples were collected, in order to situate samples relative to pycnoclines, thermal minima, etc.

Fig 4: Pink/red colours are difficult or impossible to distinguish for a few of the points. Stick to a different palette for clarity?

Fig 6 legend: Should this read Grey circles? If there are diamonds, they're not visible. Repeat here what the division is between "surface" and "deep" waters.

Fig 8: refer to section of text where the east/west boundary is stated (can it be shown on a map as well?)

Fig 9: Same comment regarding colour bar as Fig 4. Could the CB4 sample be designated with a different symbol so that it can be picked out easily on c and d?

Fig 11 & 12: Colour bar for  $^{228}/^{226}\text{Ra}$  should also go from blue (low) to red (high) - otherwise the rationale for the inversion must be presented.

Fig 12: This figure panel needs overlap with the black/grey/white symbols of 12a and 12b, it's currently not possible to see where each group was collected from on the map. Also there's plenty of space on the map, please label 312 and 314 as readers may not remember all the station designations.

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Fig 13: Include legend on the figure showing what red symbols denote.

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