

Review Report of Janecke et al. (egusphere-2026-5095)

Summary

This study explores the temporal change in freshwater input to the Arctic Ocean by measuring the U isotope composition of a large set of newly sampled seawater. The authors observed that $\delta^{234}\text{U}$ values are lower than those from 20 years ago and discussed the cause of these changes.

Comments

General Comments

1. The authors had to perform several corrections on $\delta^{234}\text{U}_{\text{sec}}$ values because their assumption that HU-1 is at secular equilibrium is no longer valid based on the current precision of U isotope analyses. It is clear that the $\delta^{234}\text{U}_{\text{sec}}$ value of HU-1 is $\sim -1.2\text{‰}$ when normalizing its $^{234}\text{U}/^{238}\text{U}$ ratio to the $^{234}\text{U}/^{238}\text{U}$ ratio at secular equilibrium. I recommend the authors use the more widely used approach to report their $^{234}\text{U}/^{238}\text{U}$ data (see Anderson et al., 2007; Kipp et al., 2022) to avoid such confusion and ensure a direct comparison with literature data. It would be ideal to bracket samples with the CRM-112a standard. If a secondary standard was used for bracketing (HU-1 in this case), the authors can calculate all $\delta^{234}\text{U}_{\text{sec}}$ and $\delta^{238}\text{U}$ relative to HU-1 and then apply the offset between HU-1 and widely used notations in the community to the measured data ($\delta^{238}\text{U}_{\text{CRM-112a}} = \sim -0.5\text{‰}$, $\delta^{234}\text{U}_{\text{sec}} = \sim -1.2\text{‰}$). These two values of HU-1 can use the directly measured values (HU-1 bracketing with CRM-112a) during the session if the authors have enough replicates, or the values averaged from previous studies (assuming HU-1 is homogeneous; see Li and Tissot, 2023 for compilation) if HU-1 was only measured against CRM-112 a few times. I think the authors most likely managed to get the right values at the end by performing these more complicated corrections in the paper, but this section needs to be rephrased and use the more common approach to correct and report U isotope data.

2. The U isotope compositions of the global seawater used for comparison here are salinity-normalized values, as trends have been observed between $\delta^{238}\text{U}/\delta^{234}\text{U}_{\text{sec}}$ and $[\text{U}]/\text{salinity}$ ratios (Kipp et al., 2022). Considering the Arctic Ocean is strongly stratified and can have a salinity gradient, it could be helpful to test whether some trends observed in the data originate from the salinity difference.

3. It is not very clear whether the authors would like to explain the observed U isotope composition trend in Arctic seawater as the result of enhanced vertical mixing or ice melting. The authors prefer enhanced vertical mixing first (Line 269), but the statement of enhanced vertical mixing is not very robust based on the temporal comparison of Makarov Basin. If the endmembers ($[\text{U}]$ and isotopic composition) do not change, the $\delta^{234}\text{U}_{\text{sec}}$ and salinity should fall on the same mixing lines, and the decrease in $\delta^{234}\text{U}_{\text{sec}}$ is accompanied by an increase in salinity. However, the $\delta^{234}\text{U}_{\text{sec}}$ and salinity of the new analysis are both lower than the analysis in 2001, which does not support the enhanced vertical mixing, so the authors seem to tend to discuss the role of freshwater input from Line 292. It will be helpful to quantitatively evaluate whether there are any changes in the flux, U concentration, and $\delta^{234}\text{U}_{\text{sec}}$ of the freshwater inputs to understand the difference between the two sets of data, disentangle the two hypotheses, and test whether the required freshwater inputs are plausible in the Arctic Ocean. Moreover, it will be risky to make statements about the freshwater inputs to the Arctic Ocean based on several samples, since they can be influenced by local processes due to sampling bias.

The major contribution of this study is significantly expanding the U isotope dataset of Arctic seawater. Provided these comments are addressed, the paper could be an interesting topic to Ocean Science.

The specific line-by-line comments are listed below.

Line 52: In Eq. (1), there is no delta notation in isotope ratios (the right-hand side of the equation). For $\delta^{234}\text{U}$, most papers report it relative to secular equilibrium rather than the standard composition.

Line 70: Tissot and Dauphas (2015) is a classical paper for the paleoredox application of U isotopes, but it will be better to cite a bit more references that build the foundation of this application here (e.g., Stirling et al., 2007; Weyer et al., 2008; Romaniello et al., 2013; Andersen et al., 2014).

Line 72: Same for the Eq. (2), there is no delta notation in isotope ratios.

Line 350: There are two approaches to spike the seawater samples properly: (i) assume samples have the same U concentration as the global seawater; (ii) spike the sample with a known amount of ^{233}U - ^{236}U spike during the concentration determination. It is important to spike the sample before U purification to account for the fractionation during separation.

Fig. 1: Please add latitude, longitude, and scale bar on the map.

Fig. 2: I recommend the authors to color code the symbols. In panel b, the symbols of St. 16, 20, and 28 look the same and different from panel a (at least for the reviewer version).

References:

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- Kipp, M. A., Li, H., Ellwood, M. J., John, S. G., Middag, R., Adkins, J. F., & Tissot, F. L. (2022). ^{238}U , ^{235}U and ^{234}U in seawater and deep-sea corals: A high-precision reappraisal. *Geochimica et Cosmochimica Acta*, 336, 231-248.
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- Romaniello, S. J., Herrmann, A. D., & Anbar, A. D. (2013). Uranium concentrations and $^{238}\text{U}/^{235}\text{U}$ isotope ratios in modern carbonates from the Bahamas: Assessing a novel paleoredox proxy. *Chemical Geology*, 362, 305-316.
- Stirling, C. H., Andersen, M. B., Potter, E. K., & Halliday, A. N. (2007). Low-temperature isotopic fractionation of uranium. *Earth and Planetary Science Letters*, 264(1-2), 208-225.
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