Reply CC1: 'Comment on gchron-2023-7', Elisabeth Michel, 23 Jun 2023

All reviewer text is in red. Author replies in black.

The authors present new ^{14}C reservoir ages for surface and deep waters of the North Atlantic and Nordic seas : Labrador sea, Baffin Bay and Iceland Sea, from shell museum collections. The shells have been collected from 1865 to 1931. They present a nice review of existing reservoir ages.

First, they compare the results from shells that were preserved in ethanol in museum collections and those who were dry samples. They found that the mean dry samples ^{14}C reservoir age is much higher than the mean of ethanol preserved samples and argue that the dry samples might be dead since a long time when they were collected.

The authors propose regional ^{14}C reservoir ages within 7 different geographic zones, considering both their new results and 14C reservoir ages from the Marine Reservoir Age Database (Reimer and Reimer 2001) considering only samples preserved in ethanol.

For the relevance of the results, the authors also consider the results of deposit feeders compared to suspension feeder.

For the interpretation of the regional ^{14}C reservoir age they consider the depth of collection of the different samples and shortly discuss the impact of ocean circulation and sea ice.

This paper is mainly a data paper, the discussion of the result is rather short and do not discuss in depth the different factors that could impact their regional ^{14}C reservoir age.

This is partly true, but with little available data, one can also argue against going into too much depth with the discussion of different influences. We believe that we have covered the main influences on the regional reservoir ages in broad terms in the discussion, but indeed there are several other factors that could be added and combined in our investigation. The limitation here becomes the number of data points available to investigate the combination of different factors. One could investigate e.g. the influence of mollusc feeding habit per region, but in most cases the number of samples is too low to infer any significant relationships. We have therefore included the full dataset in the supplementary information, where we provide more details than are included in the discussion. This allows individual users or detailed follow-up studies to use the complete available data to provide regional reservoir age estimates.

Following are some detailed comments and also some ideas for a more complete discussion concerning the regional results.

Considering dry samples, I wonder if there is any evidence on the shell, muscle marks or the like, to tell whether the specimen was collected alive or could have been dead for a long time.

As you suggested, it is possible to look for such evidence on dry samples, but in this study, we unfortunately did not investigate this. Another reviewer also suggested that we tone down our recommendation of simply excluding the dry samples. Based on both of your comments, we will suggest that "wet" samples are preferred where possible, but "dry" samples can be included if carefully examined for signs that would indicate if they were recently alive. We will include this in the revised manuscript and include some references.

For the deposit and suspension feeders, the authors should compare the results zone by zone as they indicated that the ΔR was very different from one zone to another. They could also check the dispersion for species for which the feeding habit is unknown. It would be better to discuss first the aspect linked to the mollusk : dry and ethanol preserved samples, feeding habitat and after all the physical parameters: sea ice, depth and circulation.

This is a great suggestion, but unfortunately there is not enough available data to investigate this in detail. There are approximately 4 times more suspension feeders as deposit feeders in the dataset (Figure 5), and per zone the differences between the groups are not significant. Zones 3 and 4 have the highest ΔR values, but there is no clear difference between the different feeding habits. In Zone 4 (Nares Strait), the values for the few deposit feeders fall right in the middle of those of suspension feeders, while in NW Baffin (Zone 3), the deposit feeders represent both the highest and the lowest ΔR values. The species with unknown feeding preferences are unfortunately represented in even lower numbers.

One question that is not addressed, do the author have an idea of the mean lifetime of the different mollusk?

This was indeed not included, thanks for pointing this out. The lifespan of mollusks is extremely variable between different species and individual specimens and can range from years to decades, to even centuries. To avoid this issue, we made sure to always sample material from the outermost part of the shell, i.e., the carbonate of youngest age. This was stated in the methods section, but we will expand this a bit to include more explanation and a reference.

It seems that the authors choose to include only ^{14}C ΔR measured on molluks. I wonder why they do not compare their results with 14C measurements made directly on DIC of sea water in the early fifties like for example Fonselius and Östlund, 1959 Tellus.

The aim of this study and the dataset is to improve calibrations of radiocarbon datings on marine sediment cores for use in paleoceanography. This is why we restrict ourselves to mollusks since marine carbonate fossils are the main source for radiocarbon dates in these sequences. We hope that our dataset and analyses can be of use by oceanographers as well, but we believe this is outside the focus of our study.

What is the most impressive is the dispersion of the ^{14}ΔR data within some of the geographic zones. The authors discuss the impact of sea-ice checking if a relationship exist between the annual average sea ice concentration of a sample location and its ^{14}C reservoir age (fig. 4). The regressions and their statistics for the different geographic zones are necessary if the authors want to demonstrate that the regional relationships are significant. Furthermore during formation of sea ice the carbon sink in the ocean might be effective thus the impact of non-perennial sea-ice is not obvious.

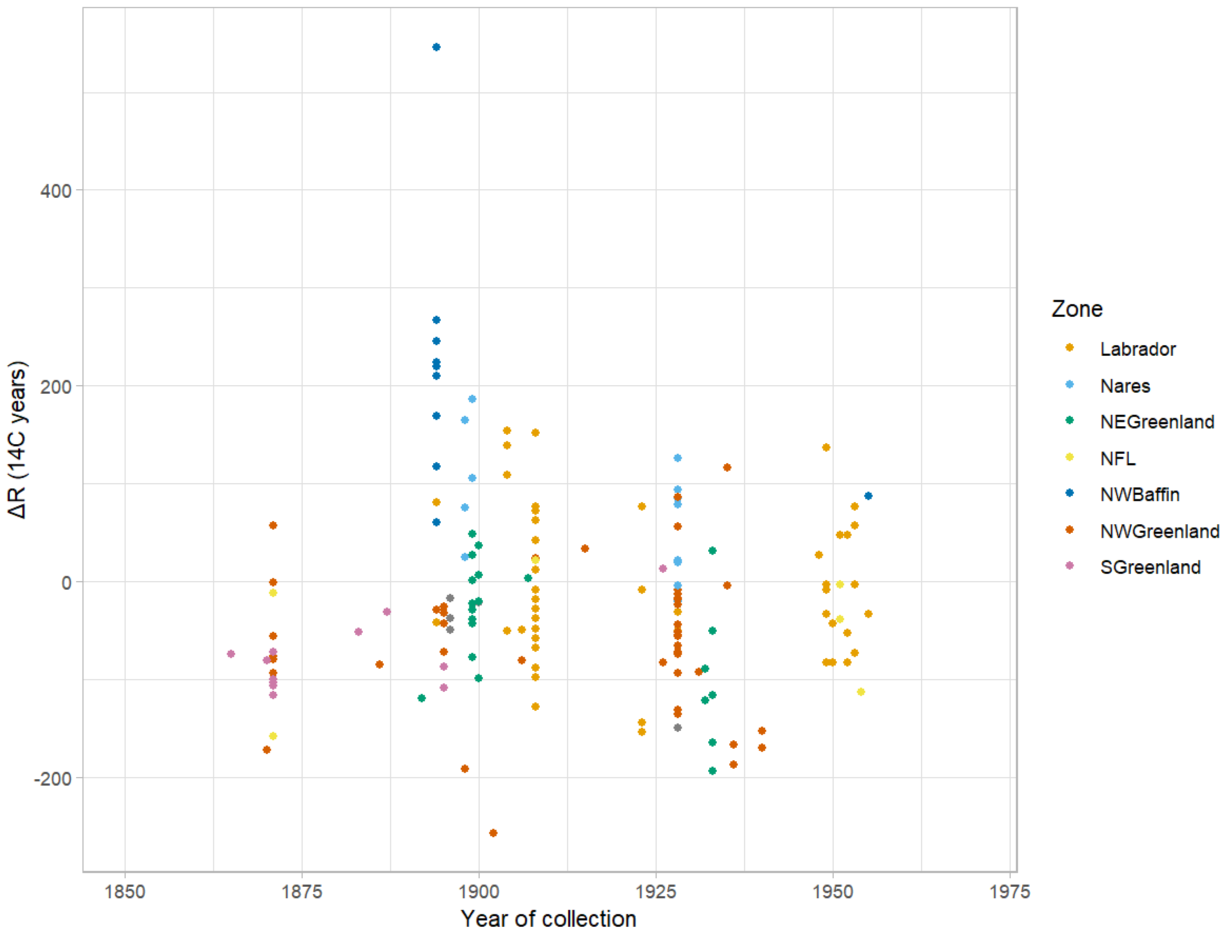
Thank you for this suggestion, which also came up in two other reviews. We have done some significance tests and found that only for Zone 2 we have a significant positive correlation between sea ice and ΔR. For the other regions, the correlations are either too weak, or there are too few datapoints for detecting a significant trend. Zone 2 not only has a large latitudinal range, but it also includes the most samples of any of the zones. We will add this information about significance of the trends to the text.

The authors argue that Heaton et al., 2020, explain that the Marine20 does not apply to the polar regions because of sea ice. Heaton et al, 2020 is as much about ocean circulation as it is about sea ice.

Heaton 2020 specifically discuss the influence of sea ice on the reservoir age but they indeed also mention ocean circulation. We will add this to our introduction.

The role of Ocean Circulation could be considered considering fluxes along the different straits. Furthermore the influence of Atlantic and Artic water masses might changes with time, for example linked to North Atlantic Oscillation. Thus a time evolution of ^{14}C ΔR within the geographical zones could be also discussed and might explain partly the large dispersion of the results?

This is true, but again we are limited by the availability of data. To study proper time series, we would need temporally spaced ΔR values which ideally would come from single specimens, or the same species from similar localities, including water depth. Right now, when the data is plotted by calendar year (see figure below), it is highly regionally clustered around certain years in which the major expeditions took place. Although certain regions were visited during different years, the samples are then not from the same locations, or of the same species.



ΔR could be also influence by continental waters with old ^{14}C DIC coming from under the ice like in the Ross Sea (Mikucki et al., 2009). This point is not discussed.

This is a good point and indeed it is something we have not mentioned. In the introduction we do list continental runoff as a possible influence, but not specifically the input of under-ice pre-age waters. We will include this in the discussion of the spatial variability of the ΔR values. Based on our data however, we don't have the suitable samples to investigate this process.

Figures: even if the projections does not make it easy and they will not be regularly spaced, it would be nice to have some latitudinal and longitudinal tics on the borders of figures 1, 2 and suppl. Fig.1.

We left those out to avoid cluttering the main figures even more, but we see your point. We will add a lat-lon grid to the map of Supplementary Figure 1 which shows the positions of all different samples.