

## ***Interactive comment on “Surface and subsurface Labrador Shelf water mass conditions during the last 6,000 years” by Annalena A. Lochte et al.***

### **Anonymous Referee #2**

Received and published: 22 October 2019

This manuscript uses a multi-proxy approach to reconstruction surface water (alkenone biomarkers) and bottom water (Mg/Ca and stable isotopes) temperatures for the last 6,000 years on the Labrador Shelf and additionally an assessment of the potential role of the Labrador Current (LC) on Labrador Sea convection (LSW formation). Based on these reconstructions, the authors delineate 3 phases of oceanographic conditions in the region. A cold LC phase from 6.2 – 5.6 ka BP, followed by warmer conditions until 2.1 ka BP, which they attribute to the Holocene Thermal Maximum in the region. A water column temperature inversion persisted from 2.1 ka to present, wherein the increasing influence of the warm retroflected West Greenland Current (WGC) and Irminger current (IC) drove warmer bottom water temperature and cooler SSTs and enhanced sea-ice cover were attributed to reduced freshwater supply from a diminished LC. A

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shift to a more positive NAO conditions is posited as a cause for these conditions. Mechanisms linking the LC and LSW formation are explored well.

The role of the LC in LSW formation cannot be unequivocally assessed by the data here (nor do the authors maintain that they can), but the manuscript presents a dataset of high quality that focusses particularly on the role of the LC in deep water formation during the mid- to late Holocene, which has received little focus (largely due to a lack of suitable records). Furthermore, the resolution of the marine record allows for sub decadal reconstructions are often lacking in somewhat deeper sedimentary environments. The proxy methods are clearly written and openly discussed: efforts have been made to identify merits/pitfalls of the chosen calibrations and areas of uncertainty (e.g. UK'37 vs UK37 and %C37:4, sections 3.3.2 and 5.1). I would suggest the following minor revisions/additional information before publication:

Sections 3.1 and 3.2 Material and AMS radiocarbon dating. The number of radiocarbon dates is sufficient for the core and an appropriate reservoir correction is used. If the core is, as stated, homogenous then linear interpolation between ages should be sufficient as a more complex age modelling software, e.g. Bacon (Blaauw and Christensen, 2011) would yield a similar age/depth relationship. In this respect, it would be beneficial to add evidence for this homogeneity, such as linescan images, CT scans, grain size etc as support for this, maybe as an item in the supplementary information. If this information has already been published elsewhere it should be referenced.

Section 3.4 Mg/Ca measurements I would include a short explanation as to why (aside from abundance downcore), *N. labradorica* was chosen for Mg/Ca measurements. E.g. as it is an infaunal species the bottom water carbonate ion concentration has a limited influence and it has, in the Arctic, been deemed a suitable carrier of Mg/Ca in shelf regions (Barrientos et al., 2018). Did the authors consider using the BWT calibration based on the aforementioned paper? As far as I understand it produces estimates in keeping with Skirbekk et al (2016) but extends the temperature range at the cold end of the temperature range? It may not be applicable according to modern BWT (Figures

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1 and 2) It would be beneficial to add the depths/intervals at which this 35% of samples may be less accurate (>4 degrees C).

4.1 Chronology State the time interval the core covers (including the +/- for topmost and lowermost age constraints)

Discussion section 5.1 It could be stated again here when discussing BWT that the temperature inversion occurs at the interval in which Mg/Ca estimates are less accurate and should thus be treated with caution (> 4 degrees C).

p 9 line 1: Is Disko Bugt technically Baffin Bay?

p. 9 line 10: Fig. ref should be 6e,f and g?

p9: line 22: in the Moros et al (2016) paper is this not clearer in the dinocyst species (*I. minutum* %) rather than diatom species at this time?

P. 12 line 28: 'pachyderma'

P. 12 line 29: Figure 6h?

P12 line 31: is this reference to cooling BWTs in the latter part of this interval?

P12 line 31-32: If the previous sentence is referring to cooling BWT temperatures this reference is to subsurface warming? It does not read to clearly and is also mentioned directly in the next paragraph.

P13 line 7: define DWBC as this is the first time it has been mentioned

P13 line 30-31: are there any reconstructions of LSW formation that could be shown on e.g. figure 6?

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