***Responses to reviewers' interactive comments on* "Carbon sources in the Beaufort Sea revealed by molecular lipid biomarkers and compound specific isotope analysis" *by* I. Tolosa et al.**

We appreciated the constructive comments of the referee #3 to our manuscript, which resulted in significant improvements. Below are given, the changes made in response to each reviewer's comments and questions.

Anonymous Referee #3

1) The title should be edited to reflect the focus upon sedimentary OM, rather than just carbon.

We have now modified the title to better reflect the focus on suspended particles and surface sediments: "*Carbon sources in suspended particles and surface sediments from the Beaufort Sea revealed by molecular lipid biomarkers and compound specific isotope analysis*".

2) **Abstract - the abstract could be improved by adding a couple of sentences at the end highlighting what the authors believe to be the most important advance made by this study. I recommend paraphrasing the final paragraph of the discussion. pg 13952**.

According to this suggestion, we have included at the end of the abstract the following sentence:

"These estimates are low compared to other studies conducted 5-20 years earlier and they are likely due to the increase in primary production during the last decade mainly because of the increase in the number of ice-free days and to the strength and persistence of winds favouring upwelling"

3) **The opening two sentences of the intro should be revised for clarity. Right now it reads as if thawing permafrost ice is exposing aquatic environments to sunlight.**

We have modified the concerned phrasings and rephrased the requested paragraph within the text:

"*The Arctic Ocean is known to be very sensitive to climate change. Some consequences of global warning on the Arctic environment are reduction of the ice cover and thawing of the carbon-rich permafrost. This leads to an increase of the surface exposed to solar radiation and of the input of carbon into the Ocean, both favourable to phytoplankton growth*

4) Pg 13927: POC should be defined. 13928: 80's should be 1980's. The abbreviation for Sedimentary organic matter can be introduced here.

We have defined the requested POC acronym and changed the "sedimentary organic matter" for "surface sediments" to avoid misleading with the terms. Also in the Abstract, we removed the term "sedimentary" since we specify that we analyzed suspended particulate organic matter (SPM) and surface sediments.

5) **13937 and throughout: the reporting of depths starting at the deeper depth (e.g. 640-70 m) seems odd. Reorder unless this is recommended for sediment studies. Also, the use of a dash to indicate "to" (i.e. 640-70 m instead of 640 to 70 m) is confusing sometimes in a paper with lots of negative numbers (i.e. the d13C data). Swap the dashes for "to" throughout.**

It seems that the reviewer misunderstood our reporting sample codes for SPM in waters, which is defined in Table 2 ("640–70m" actually must be read as "station 640

at 70 m depth"). For instance, the first number in the code 640-70, refers to the location (640) whereas the second number after the dash indicates the water depth sampled (70m). According to this misunderstanding, we have now added a sentence at the beginning of the results section clarifying the code nomenclature:
"For clarification, the first number in the codes, e.g. 640-70, refers to the station (640) whereas the second number after the dash indicates the water depth sampled (70m)".

We have also carefully revised the text adding "station" before the code number of the location and removing "m" throughout the codes inserted within the text. We hope that now the codes are clear

6) 13938: Much of these paragraphs constitutes discussion and should be moved. Para beginning line 5, the text referencing Belt et al is discussion, not results. Line 17 to 19 is discussion. Para beginning line 20 includes another reference to Belt et al that strays into discussion.

We have moved the concerned sentences to the appropriate discussion sections.

7) 13940, line 23: the d13C values reported for C3 plants (-20 to -32) are bracketed by those for phytoplankton (-25 to -42), yet the text indicates phytoplankton values are depleted compared to C3 values. Check the values in the text or rephrase. Also, most of the time the authors report d13C values as smaller number to bigger number (e.g. -25 to -42), yet report -32 to -20 here. Reverse these values for consistency.

We have rephrased the sentence and reversed the values of C3 plants to be consistent throughout the text (we always report values from smaller to bigger number, meaning from enriched to depleted 13C values).

8) First line 13942: spelling - Artic = Arctic. Line 12: Franklin bay = Bay. Check throughout.

These changes have been done.

9) 13943, line 2: what is North Water?

The North Water is one of the largest polynyas (a significant portion of navigable open water) in the Artic, located in the northernmost of the Baffin Bay. To clarify the geographical location, we have added:
"*Coccolith production appears to be nearly absent in the North Water polynya of the Baffin Bay*"

10)Throughout where water masses are referred to capitalise - i.e. Pacific Water.

These changes have been done

11) 13948, line 9: the correlation indicates not only a common source, but common transport, deposition and degradation pathways.

We agree with the reviewer and we have added these statements in the manuscript.

12) Summary and conc: Finishing on point about sitosterol seems odd. This is quite a reductionist point compared to the statements preceding it in the summ/conc and also in the last paragraph of the discussion. If the point about sitosterol needs to be highlighted here, do so first, then summarize what the study says about SOM sources in the Beaufort Sea.

According to the reviewer' s suggestions, we have modified the summary and conclusions as:

"*The measurement of lipid biomarkers and their compound specific isotope analysis allowed us to characterize the spatial variation of OM over the Mackenzie*

shelf and the slope to better constrain the sources of terrestrial and marine organic matter. Our data highlight that fresh and labile organic matter from diatom blooms sinks to the bottom of the continental shelf and slope whereas terrestrial material is likely transported to the slope by advective processes. Although sitosterol is generally considered to be of terrestrial origin, the carbon isotope ratios we obtained for his compound at site 390 indicated a high autochthonous production. Since $\delta^{13}C$ values obtained for marine phytoplanktonic biomarkers synthesized at this high latitude area with relatively high concentrations of CO_2 might be similarly depleted as the $\delta^{13}C$ values of C_3 terrestrial biomarkers, it is problematic to discern the sources of sitosterol in the marine SPM by using their $\delta^{13}C$.
Although, the Mackenzie River is the primary source of C_3 terrigenous debris and fossil material to the Mackenzie Shelf sediments, refractory algal-derived material was the major lipidic component in the nearshore sediments. However, their relative contributions decreased with water column depth, which lead to an increase in the contributions of fossil and C_3 plant-derived material.
Our evaluations on the terrigenous POC fraction preserved in the sediments of the Beaufort Sea compared to studies prior to the recent decline in Artic summertime ice indicates a decrease during the last decade implying a recent shift between authocthonous and allochtonous sources input over the sediments. Interestingly, these results are supported by the enhancenment of the primary production in the Artic Ocean in the recent years. Our data provides an important baseline for future studies."

13) Table 1: change - "suspended particulate matter" to "suspended particulate matter (SPM)" as SPM is used in the table and not defined. TOC(mg g-1) requires a space between TOC and the unit. TOC also needs to be defined in the table header or written out in full in the table. SEDIMENTS should not be capitalised: Sediments.
Table 2: format so units are under each analyte. Capitalise Depth. What is T and what are the units? Add (SPM) to the title as above.

The required changes have been done.

14) Table 3: the depths look odd in this format (deepest to shallowest), change to shallowest to deepest in all tables. The units for measurements are provided in the table header and in the table - they should just appear in one of these. If in the table, then the should be in parentheses. Define UCM and CPI in the table header or as postscripts.
These same comments apply to many of the other tables, check them all for consistency.
Table 5, 6 and others: Edit to match Table 7 header. "Concentrations of ANALYTE (ng l-1) in suspended particulate material (SPM). Percentage XXX given in brackets. Table 13: The significant figures seem to precise. Just use 2. i.e. 31, 20, 47 etc.

As we clarified previously, the reviewer misunderstood our reporting sample codes for SPM in waters, which is defined in Table 2. For instance, the first number in the code 640-70, refers to the location (640) whereas the second number after the dash indicates the water depth sampled (70m). The abbreviations have already been defined previously in the text and they are acronyms commonly used in our field. They have not been defined in the table header to be more concise. Other requested changes have been done.

15) Fig 1: SPM does not need defining in the title as it is not used in the figure.
Fig 3, 4, 6, 9: y units need to read ng l-1 not ng/l. d13C (per mille) should read d13C (‰) as in the text. Define SPM and FA.

These changes have been done

16) Fig 5, 7, 8, 10, 11, 12: Some of the depths are as deeper - shallower (e.g. 130-3 m), some shallower deeper (e.g. 135-145 m). All should be the same. Suggest shallower to deeper.

As we clarified previously, the reviewer misunderstood our reporting sample codes for SPM in waters, which is defined in Table 2

17) All the acronyms need to be defined in the figures as well, allowing them to be understandable in isolation (e.g. TOC, SPM, PUFA, LCMUOH).

Similar to the Tables, the acronyms that have already been defined previously in the text and which are acronyms commonly used in our field have not been defined in the figures legend to be more concise

18) Fig 7: what is IP25? X units do not need the 2 decimal places. Edited depths format on y axis.

The definition of IP25 has been added and the requested changes have been done.

19) Fig 10, 11, 12: all have units on top x axis in ng/ugC when it should be ng ugC-1 etc. Units should also be in parentheses.

The required changes have been done.