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Interactive comment on "Quantification of calcium carbonate (ikaite) in first- and multi-year sea ice" *by* Heather Kyle et al.

Anonymous Referee #1

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General comments

Heather Kyle et al. quantified ikaite in sea ice by new method. However, this method contains the possibility to do over estimation the ikaite within sea ice because in fact, sea ice contains the many particles (e.g. CaCO3 contained dust, sediment, phyto-plankton etc). Also, difference of ikaite amount between methods changed dramatically for each type of sea ice. Therefore, we cannot quantify the accurate amount of ikaite in sea ice by using new method, and this method cannot apply for various types of sea ice in the polar oceans. In addition, the explanation of TA:DIC ratio in melted ice water was not clear although it is important part in this paper to indicate precipitation of ikaite within sea ice.

Specific comments

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line 20: High presser within sea ice?

line 41: Only Arctic?

lines 45-46: Why DIC etc decrease when dense brine sink?

line 45, TA is not concentration.

line 66: Suddenly you used pCO2, but before you used CO2 concentration (line 46). What differences between them?

line 81: All particles could trapped in filter, not only ikaite but also CaCO3 contained particles (dust, sediments, algae etc). Therefore, I strongly disagree about this method to quantify the ikaite. If you will quantify PIC (particulate inorganic carbon), I agree.

lines 95-96: You should indicate the chemical properties of artificial seawater used at SERF. The amount of ikaite was clearly high as compared to other natural ice. The DIC:TA of ice depend on the seawater properties. Therefore, also please indicate TA and DIC values. In addition, there was no comparison between image method and filtered method (Only used image method). Therefore, this data does not need in this paper.

line 105: You kept samples in freezer. Therefore, we cannot believe that it is real ikaite amount. As you mentioned in discussion (lines 307-309, 376-377), ikaite precipitates at short time scale.

lines 106-107: What kind of gas tight bags? If CO2 coming from outside, ikaite amount would be changed as you mentioned. Therefore, you have to indicate results of gas tight test.

line 138-139: why did you take water sample before filtered? If this water contains ikaite crystals, results will be changed.

line 140: how to do filtration? If filter was vacuumed, DIC will change, and it is not recommended (Miller et al., 2015).

line 170: how statistically agree between each method? You can make 1:1 relationship figures (e.g. image vs filtered) to help leader.

lines 207-208: Under-ice water DIC and TA is need to think what happened in sea ice during sea ice formation.

lines 223-232: I can not understand this comparison. Did you compare the same piece (section) of sea ice sample? You checked for one section by image then filtered same water for filtered method? OR Different piece for each method?

line 223-232: Did you calculate standard error for same samples? Or many ice sections for each method although you indicated section size for image analysis from line 256?

lines 233-246: Again how about the possibility of CaCO3 contained particles?

lines 320-327: When you will make figure about TA vs DIC, can you see the CaCO3 formation from seawater's DIC and TA? Based on this figure, you can also calculate the ikaite amount within sea ice.

line 320-327: You measured TA and DIC for melted-ice water without containing ikaite crystals (Line 138-140."As soon as melting was complete, four 12 ml Exetainers (Labco Limited, High Wycombe, UK) were filled with meltwater for DIC and total alkalinity (TA) analysis"). If so, TA:DIC should low because ikaite precipitation removed TA than DIC from melted water (if ikaite crystals remained, TA remained in crystals, meaning that water TA was low). If you measured TA and DIC after all ikaite was dissolved, I understand that TA: DIC increased with respect to before (e.g. seawater values) when ikaite is precipitated.

line 334-347: TA:DIC ratio changed by many processes (e.g. ikaite, biology, gas exchange). Therefore, drawing DIC vs TA provides detailed discussion.

Figures 2-10: Black line at the outside of figure do not need.

Figures 3-5, Error bar is similar length for each method. But you mentioned that stan-

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dard error for image method was higher than that for filtered method.

Figure 4: Does this difference indicate PIC?

Figure 8: Why sea ice temperature changed dramatically?

Figures 6-9: why no points for TA:DIC profile? And no error bar?

Figure 10d. why only one method? If only one method, we do not need this figure and not important for this method paper.

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