We are thankful to anonymous referee #2 for constructive scientific, language and typographic comments.

Reply to referee #2 comments:

How does the electron beam affect the surface over the time of the experiment? This issue is alluded to in the first paragraph of section 3 (p 3 lines 20-24). The claim is that the electron beam may heat the sample a degree or two. Is this the only effect of the electron beam? Could the temperature gradient be larger for samples at colder temperatures than that at which they observed the ice surface melting? Does the temperature gradient increase over the observation time?

There is a cumulative effect of the electron beam with the energy of 20 keV and of the ions produced inside the ESEM chamber due to the interaction of electrons with a gas. The largest number of ions is generated at the distance of 1 mm from the detection electrode, where the intensity of the field is ≤ 200 V. For that reason, there is only mild effect of the ions on the ice surface, and the heating and disruption of the ice surface by the ions is almost negligible in our ESEM. The applied ESEM contrasts to a microscope with ion beam, where ions are focused to one place and their energy during the collision with the sample surface is generally more than 1 kV.

As the bottom of the ice is cooled by Peltier cooler and the surface is heated by the electron beam, temperature gradient is expected to slightly rise in time. There are two antagonistic effects when considering the dependence of the temperature gradient on temperature. The thermal conductivity of ice is inversely proportional to temperature (Rabin, 2000); therefore, the temperature gradient should be smaller at the lower temperature. On the other hand, water vapour with the temperature around 0 °C is blown to the microscope chamber near the sample surface. This could increase the temperature gradient at lower temperatures. Therefore, it is difficult to predict the overall dependence of the temperature gradient on temperature under given experimental conditions. Except for the observation of the ice melting temperature, we do not have any mean to estimate the sample temperature. However, the sample is relatively stable in time during the experiments if evaporation and condensation are avoided.

Heating of the sample by electron beam, the temperature gradients, and the surface disruption are substantially lower in our non-commercial microscope in comparison with common commercial ESEMs. In our microscope, electron flux is four times lower compared to the ones used in common ESEMs, and the radiation damage is decreased because of high scan rate. One of the fundamental differences between ESEM and SEM is that the electron beam is scattered by the gas in the chamber before it collides with the sample.

Why is the residual NaCl in Figure S3 not composed of cubic crystals?

We suppose that the macroscopic arrangement of the lyophile is a result of evaporation process which did not allow enough time for formation of large NaCl crystals. Also the presence of residual water can contribute to the final appearance of the lyophile.

Technical Corrections

p 1 line 25: “The present microscopic observation: : :” Replace A with The.

p 2 lines 19-21: This sentence is awkward for a couple reasons. Something like, “The fragile structure plus extremely high salinity make FFs the likely cause of chemical reactions and source for SSA.” may express the authors’ point better.

p 4 line 31: Adding the phrase, “These values were calculated from the applied equations: : :” would clarify this section.

p 4 lines 34-35: I don't know what the Journal's editorial standards are regarding mathematical formulas, but I would suggest times symbols, _, instead of asterisks in the equations.
p 5 line 33: Add a dash to "freeze-concentrated solution"
p 6 line 1: Add the at the end of the line: ": : :compared to water at the same temp"
p 8 line 5: Replace "placed" with "located."

p 8 line 19: Should read "enhanced bromide liberation" (missing the d on enhanced)

Thanks to the Referee 2 for corrections – they were all incorporated.

p 9 lines 10-15: The purpose of this paragraph is unclear. Is it to show why SSA is important? It doesn't seem to add anything to the manuscript.

The purpose of this paragraph is to address the chemical potential of sea salt produced via the sublimation process. This paragraph was modified and now moved to section 4.1.

p 13 lin 35: Figure 1 is very hard to see. Can it be improved at all?

We increased the contrast of this picture.

The caption for Figure S3 is missing the length of the scale bar.

The missing length of the scale bar was added.

References:

Rabin, Y.: The effect of temperature-dependent thermal conductivity in heat transfer simulations of frozen biomaterials, Cryo-Letters, 21, 163-170, 2000.