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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaporating brine from frost flowers with electron microscopy, and implications for atmospheric chemistry and sea-salt aerosol formation" *by* Xin Yang et al.

Anonymous Referee #2

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In this work, recent advances in higher-pressure electron microscopy were utilized to observe artificial frost flowers made from aqueous NaCl solutions over a range of temperatures under conditions in which water is evaporating. For the first time the morphology of these surfaces have been observed with micron-scale resolution. This addresses an important and open question about the morphologies of reactive environmental ice surfaces. The images presented in the figures and supplemental videos are detailed, clear, and illuminating. The authors convincingly argue that they are observing brine covering ice at warmer temperatures, and sodium chloride crystals forming on brine covering ice at colder temperatures. They speculate as to some reasonable possible implications for atmospheric chemistry and sea salt aerosol formation. One of the

main conclusions of this work is that frost flowers are robust and sticky and thus won't fall apart to form micrometer-sized particles that could contribute to sea-salt aerosols. This contradicts previous assumptions made about frost flowers, but is corroborated by another recent study. I have two specific questions, followed by a number of technical corrections.

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?

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

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, $\times$, 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)

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.

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

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

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