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The Cryosphere Discussions
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Interactive comment on "The Morphology of Ice and Liquid Brine in the Environmental SEM: A Study of the Freezing Methods" *by* L'ubica Vetráková et al.

Anonymous Referee #2

Received and published: 23 April 2019

This work describes the distribution of brine at the surface of frozen samples. It very convincingly presents experimental evidence from state-of-the-art SEM data for a distribution of the brine at two specific locations: grain boundaries and puddles. The impact of concentration and of freezing method are systematically discussed.

I support publication of the manuscript after a minor revision. The manuscript has a detailed, sound and easy to follow discussion and all conclusions are well supported by data. It is well written. The topic is of very high relevance and this work adds significantly to an ongoing discussion.

Main points 1. I'm a little confused about the detector sensitivity and variation in acqui-

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sition settings. It peaks for the authors that they mention this point so explicitly. I agree with them, that this -while being nasty- does not impact their conclusions. Looking at Figure 3, this might imply that the samples with a high singal intensity, might even have a higer surface coverage of brine, because weaker spots from smaller puddles might be overseen. I might supect that sample g and f show the same fine structure as i their dark areas – but I would not think that this adds significantly to the brine covered area. However, in line 319 to 323 it is not clear to me how the “normlaised brine surface coverage” is defined and why this is free from this artefact. I would suggest to move the discussion from the experimental section here, use Figure 3 more explicitly to discuss the potential impact on your conclusions, and maybe even include estimates of this systematic error in the uncertainties mentioned in lines 315-320. 2. I suggest to add concentration and temperature information of the samples during measurement and ice production to the phase diagram (Figure 1). Throughout the text, I would encourage to be more precise in using the words brine volume, concentration, and salt amount. I’m not so convinced that you can discuss brine volume, as you are not sensitive to the thickness. Your observable is "only" the amount of salt, is it not? Would you expect the shock frozen samples (in N2) to crystalize once temperatures drop below the eutectic and could you comment on the question whether or not the salt deposits would liquify again upon warming to the temperature of investigation taken that this process might be slow. 3. Protecting the sample with a condensed ice layer is a excellent idea. However, could you give more details how you ensured that you “revealed the original surface” for the measurements and not removed too much ice (including some layers of the original surface). (lines 138)

Minor points

lines 12: I’m not a native speaker: What means “threading”? I find the first sentence of the abstract a slightly to abrupt and suggest to start more general.

lines 34: reword: ice and snow are also part of the environment.

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Lines 41: Add reference to Grannas 2007 and/or Bartels-Rausch 2014

Lines 43: Rather “into the ice lattice at high concentration”. Domine’s work clearly shows that ice can hold impurities as solid solution and for some species at sufficient high concentration to impact partitioning to the atmosphere.

Lines 87: I found the discussion in this paragraph too detailed and slightly off topic and suggest to remove it. This paper does not add to the question of interior vs. surface distribution of impurities. It is only sensitive to the surface of the samples.

Lines 168: Is it correct that you never observed a supercooled solution? The brine always started crystalizing at the eutectic temperature? That would be an interesting observation.

Lines 171: What is an BSE detector?

Figure 2: Could you give an estimate on the smallest features that you would detect with the specific detector settings? (lines 213: no brine puddles larger than . . .. Were detected. . .).

In figure 4 the surface coverage seems to increase continioiusly, while T shows steps between -24 to -18°C. Could you comment on this?

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