

Response to Dr. Bartles-Rausch

We would like to thank Dr. Bartles-Rausch for his interest in our manuscript and for his comments. We have addressed his comments/questions below in the order in which they were raised. All page numbers and line numbers are in reference to those in the revised version of the manuscript, except where indicated otherwise. For clarity, the text of the Dr. Bartles-Rausch comments is in **black**, while the authors' responses are in blue.

I read your manuscript with great interest and wish the best for publication in ACP. In particular, I like the increased complexity of your experiments compared to other laboratory studies and the comparison to field data.

Would you mind elaborating in more detail where you think the chemistry is occurring in your samples: the liquid fraction or the ice with its disordered interface? You clearly state that the temperature of the sample was above the eutectic of NaCl, so we can expect the presence of liquid in your system.

Based on the temperature of the experiments, and the ionic strength of the water samples used to make the ice coating, we believe the reactions occur primarily in a liquid brine on the surface of the ice layer and have clarified on lines 158-163, as well as line 2323 of the revised manuscript. This is consistent with Cho et al. (2001) and Oldridge and Abbatt (2011).

By the way, what would be the volume of liquid compared to that of ice?

Our experimental sample was 80.0 mL of an Instant Ocean solution that was made to be approximately 0.56 M with respect to NaCl (the most abundant ions in the salt). Based on simple freezing point depression thermodynamics for a 0.56M NaCl solution and an ice $T = -15^{\circ}\text{C}$, we calculate a liquid fraction of 0.124.

Then, later in the discussion the focus is placed on the disordered interface as host of the reactions - as far as I understand the manuscript. I assume you refer to the disordered interface of ice. Could you specify the role of the liquid fraction and of the ice as host for the chemistry? I think at the end this is a semantic issue, as your data are very nicely compared to studies with liquid samples (L. Artiglia, J. Edebeli, F. Orlando, S. Chen, M.-T. Lee, P. Corral Arroyo, A. Gilgen, T. Bartles-Rausch, A. Kleibert, M. Vazdar, M. A. Carignano, J. S. Francisco, P. B. Shepson, I. Gladich and M. Ammann, Nat Comms, 2017, 8, 700.) and to those with frozen samples with a considerable liquid fraction (N. W. Oldridge and J. P. D. Abbatt, J. Phys. Chem. A, 2011, 115, 2590–2598.) Indeed, Oldridge proposed that the reaction occurs in the liquid fraction of their samples.

For our analysis, we assumed that all of the chemistry occurred in the brine, as indicated on lines 158-163 and 232 of the revised manuscript.