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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Accelerated dissolution of iron oxides in ice" *by* D. Jeong et al.

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We would like to thank Anonymous Referee #1 for the careful consideration of our manuscript, and welcome the opportunity to respond to the comments and integrate the suggestions into the revised manuscript.

Comment 1) The authors should discuss if the reciprocal ice-enhanced dissolution dependence with freezing temperature is simply due to "ice concentration effects" or if the rate of freezing could have affected their observations.

Response) The following sentences were added to discuss this point.

(p. 20120) "Overall, lowering freezing temperature influences the dissolution of iron oxides in ice in a complex way. It may enhance the freeze concentration effect by

reducing the liquid content in the grain boundaries whereas it may cause an opposite effect by retarding the migration of the solutes during the freezing process. Judging from the result of Figure 5, the latter effect seems to prevail."

Comment 2) In several statements and figure captions the use of "FA/HA" or "[fulvic/humic]" should be corrected to "FA and HA" or "[fulvic acid] or [humic acid]" (e.g., p. 20113 l. 14, Table 1, Fig 1.).

Response) We have made corrections as suggested.

Comment 3) To avoid conflicts with the many typos related to negative Celsius temperatures in the text, all temperatures need to be reported in Kelvin.

Response) It is true that temperature in Kelvin is more preferable in terms of avoiding the typos. However, we prefer to retain the Celsius notation because it shows the freezing conditions more explicitly.

Comment 4) Although the work is excellent because two different analytical methods were used to quantify dissolved iron (p. 20117 l. 16), instead of indicating "little difference" the instrumental/method error (as a percentage difference) between AAS and UV-visible measurement should be indicated.

Response) The following sentence was revised for clarification.

(p. 20117) "To assure the results of the colorimetric analysis, some samples were also analyzed by atomic absorption spectroscopy (AAS, SpectrAA-800) and the determined concentration of the total dissolved iron was within 5% difference from that obtained by the above colorimetric analysis."

Comment 5) Similarly, (p. 20118 l. 6-4) instead of "the iron dissolution rates were much slower" quantitative information is needed.

Response) The sentence was modified as follows.

(p. 20118) "At similar conditions (i.e., type and concentration of iron oxide and organic acid, pH, and reaction time), the iron dissolution rates in ice were much slower than the previously reported rate of photoreductive dissolution in ice (by 7-8 times) but the trend remained the same (Kim et al., 2010)."

Comment 6) Indicate the % yield after "15 μM of total dissolved iron" (p. 20118 l. 11).

Response) The % yield was added.

(p. 20118) "However, the aqueous samples with DFOB produced around 15 μM (about 6% of the initial iron oxide) of total dissolved iron from both goethite and maghemite, which reflects the strong iron binding character of DFOB in the aqueous phase (Borer et al., 2009)."

Comment 7) Why did hematite (with the smallest surface area) show negligible iron dissolution? Elaborate (p. 20119 l. 2-3).

Response) To address this point, the following part was rewritten. (p. 20119) "Hematite with the lowest surface area (8 m2 g-1) exhibited the lowest rate of iron dissolution. Table 2 summarizes the initial iron dissolution rates which were obtained using various iron oxides and organic complexing ligands. For the dissolution rates in the absence of organic ligands, the values normalized by the surface area are also compared (numbers in the parentheses). It is noted that the surface area-normalized dissolution rates much less vary among the different iron oxides than the apparent dissolution rates do: the apparent dissolution rate of goethite and hematite in ice is 187 vs 3.9 while its surface area-normalized counterpart is 5.3 vs 2.4. Therefore, the key parameter that determines the dissolution rate of iron oxides in ice should be the surface area, not the crystallinity."

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 20113, 2012.