**Atmospheric
Chemistry
and Physics
Discussions**

Interactive comment on "Iron dissolution kinetics of mineral dust at low pH during simulated atmospheric processing" *by* Z. Shi et al.

Anonymous Referee #2

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General comments

Numerical predictions of iron dissolution are highly uncertain. The authors presented a laboratory study of iron dissolution kinetics of mineral dust, focusing on dust/liquid ratio and pH. The results from the dissolution kinetics studies are needed to improve the predictive capability for the iron solubility. The work conducted in this paper may contribute to understand the processes that dissolve iron in the aerosols. The paper is well written, but it is unclear how the results presented in this study are associated with those presented in previous studies. If the authors provide more discussions, this paper could be improved.

Specific comments

1 Introduction

p. 26610, l.16: It might be appropriate to cite Journet et al. (2008) between the sentences, although it is noted in p.26617. It might be also noted that recent modeling study has shown the sensitivities of Fe depositions to the dust Fe mineralogy (Ito and Feng, 2010), although it is cited in l. 17. These studies may support the necessity of the kinetically-controlled dissolution rate of Fe in dust.

p. 26611: The pH-dependence of iron dissolution rate has been shown in previous studies. Although the references are listed in p.26625, it would be helpful for the reader if you summarize how earlier studies related the variables to iron dissolution rate in introduction. This may help to explain how the data obtained in this study are useful for the modeling studies.

p. 26611, l.11: Please define a dust/liquid ratio.

2 Materials and methodology p. 26613, l.18: Please explain why there was no dissolution data of Tibesti at pH 3.

p. 26613, l.21: Please explain why there was no dissolution data at various dust/liquid ratios over 24 hours.

3 Results and discussion

Fig.7: How did you estimate the total Fe concentrations for various dust/solution ratios?

p. 26624, l.1: Fe dissolution calculated from rate constants used in Meskhidze et al. depends on pH, so the figure should be separated into two (i.e., pH 1 and pH 2). Please show all variables (i.e., K, T, a(H+), f(△G), and W) in the calculation of the Fe dissolution using rate constants in Meskhidze et al., which may correspond to some portions of the slow Fe pool. Presumably, you used the rate constant for the first 0-0.8% of the total Fe in the dust, but it should depend on the total amount of the Fe dissolved. The modeling studies also assume an extractable Fe pool, which may correspond to FeA. What if the three-stage kinetic process is considered for specification of the dissolution constant

(Meskhidze et al., 2005), using FeA as the initial condition for the soluble iron fraction? Also, what if the dissolution rate of illite is used for the dissolution (Ito and Feng, 2010), using FeA as the initial condition for the soluble iron fraction?

p. 26624, l.10: If you mean the effect of the solution saturation state on dissolution rates (p. 26621), the model uses a function of Gibbs free energy change of a particular mineral dissolution reaction. However, it is unlikely to reach true thermodynamic equilibrium in the atmosphere, as you mentioned in p. 26611. Could you specify which effect was not considered in the model?

p. 26624, l.13: Is this true in ambient atmospheric conditions? Is k independent of temperature, type of acids, and so on?

Technical corrections

Correct 300 g/L to 1000 mg/L.

p. 26609, l.3: Boyd and Ellwood, 2010.

p. 26614, l.11: at room temperature "(298 K)".

p. 26615, l.7: Add "Lazaro et al., 2008" to the references.

p. 26616, l.11 - p. 26617, l.14: Most of these may be moved to Appendix.

p. 26618, l.2: Show the unit for rate constant.

p. 26619, l.26: The "equilibrium" Fe concentration may need to be rephrased, because the result for the Beijing dust does not represent the thermodynamic "equilibrium" condition.

p. 26622, l.2: the fact "that".

Fig.4: What is the red circle?

Fig.6: Show the unit for rate constant.

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Interactive comment on Atmos. Chem. Phys. Discuss., 10, 26607, 2010.