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

General comments:

Mineral iron dissolution rates at low pH (=1-3) were measured in this study for two desert dust samples, using established analytical methods and procedures. The dissolution kinetics is strongly dependent on pH (as observed in previous studies), and is best described by the combination of three rate coefficients (e.g., 25, 0.5, 0.0062 $h^{-1}$ at pH=1) for three Fe phases (representing about 0.5-2%, 1-3% and 15-40% of the total Fe in dust samples), respectively. This is a new result for desert dust iron dissolution kinetics, and is important for modeling soluble aerosol iron and its deposition fluxes to the surface ocean. The paper is interesting, well written, and appropriate for publication in ACP.

Specific comments and technique corrections:

(1) Page 26609, lines 25-28. "or measured in fine marine aerosols ..." seems to be irrelevant to the acidity of aqueous solution coating dust particles. These aerosol and cloud observations do not establish the acidity of dust particles.

(2) Page 26610, line 10. "Measures et al, 2010" is missing from the reference.

(3) Page 26610, line 19. Is the iron dissolution kinetics "zero-order" or "first-order"?

(4) Page 26612, line 11. Do you mean "Table 1"?

(5) Page 26620, lines 21-23. It is not clear what it is meant by "is much faster" and by "much larger reactive surface area". Fig. 3 shows that a smaller iron dissolution rate coefficient is obtained at a higher load of dust suspension in the solution. At a dust loading of 1000 mg/L, Fe(III) concentrations resulting from dissolution of FeT (total reducible Fe) are below the equilibrium solubility of ferrihydrite and nanogoethite and near the equilibrium solubility of hematite shown in Fig. 7. Combine results shown in Fig. 3 and Fig. 7, could you conclude that the smaller rate coefficient at higher dust loading is caused by Fe(III) concentration exceeding the solubility of hematite (or the largest crystals of hematite suspended in the solution)? Alternatively, the results shown in Fig. 3 are indicating slower detachment of Fe(III) from the mineral surface when Fe(III) concentration is high in the aqueous phase?

(6) Page 26623, line 7. Perhaps the "slow" iron pool represents crystalline Fe oxides and a fraction of Fe-containing clay minerals? Lafon et al. (2004) suggest

that iron contained in clay minerals is not ″free″. However, previous measurements show clay minerals also dissolve at low pH but at much slower rates, < 1 x $10^{-12}$ mol $m^{-2}$ $s^{-1}$, than hematite and goethite (Ganor et al., 1995; Köhler et al., 2003; Amram and Ganor, 2005).

Amram, K., Ganor, J.: The combined effect of pH and temperature on smectite dissolution rate under acidic conditions, Geochim Cosmochim. Acta, 69, 2535-2546, 2005.

Ganor, J., Mogollon, J.L., Lasaga, A.C.: The effect of pH on kaolinite dissolution rates and on activation energy, Geochim. Cosmochim. Acta, 59, 1037-1052, 1995.

Köhler, S.J., Dufaud, F., Oelkers, E.H.: An experimental study of illite dissolution kinetics as a function of pH from 1.4 to 12.4 and temperature from 5 to 50°C, Geochim. Cosmochim. Acta, 67, 3583-3594, 2003.

Lafon, S., Rajot, J.L., Alfaro, S.C., Gaudichet, A.: Quantification of iron oxides in desert aerosol, Atmos. Environ., 38, 1211-1218, 2004.