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Atmospheric
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Discussions

Interactive comment on “The rate of water vapor evaporation from ice substrates in the presence of HCl and HBr: Implications for the lifetime of atmospheric ice particles” *by* C. Delval et al.

C. Delval et al.

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Answer to Referee Comment by J. P. Devlin in regards to "The rate of water vapor evaporation from ice substrates in the presence of HCl and HBr: Implications for the lifetime of atmospheric ice particles" by C. Delval et al.

The referee certainly has a point in commenting on Figures 9 to 11 from a quantitative point of view. It is true that the labelling of the two FTIR transmission spectra put together into one drawing for the sake of comparison is incomplete and therefore misleading as both scales are dissimilar. We will therefore refer one spectrum to the left, the other to the right hand ordinate in order to remove all ambiguities in Figures 9 to 11.

Specifically, the amplitude of the "pure ice" spectrum in Figure 9 has to be multiplied by a factor of three such that the peak at 3250 cm-1 has an optical density of 1.05. Using column 9 of Table 1 (sorry for the typo: OD of 1.08 corresponds to a thickness of 1.0 mm-and not 1nm!) we infer a total ice thickness of 1 mm. The amplitude of the HCl hydrate FTIR spectrum in Figure 9 has to be divided by a factor of two such that at the moment of recording the amplitude of the (split) peak at average 3250 cm-1 (median of 3264 and 3244 cm-1) would read an OD of 0.05 indicating a thickness of about 50 nm if the absorption cross section of the unperturbed ice spectrum were to be applied.

Once the addition of HCl by backfilling was terminated, stirred flow conditions were established by opening the leak valve such that ice, but no HCl evaporated as observed by MS. The FTIR hydrate spectrum displayed in Figure 9 was recorded just after having passed the third fringe displayed in Figure 3, that is to say approximately at 120 s after the start of the clock (opening of the leak valve). Point C of the HeNe interferogram indicates a total remaining ice thickness of 125 nm so that we may say that the hydrate spectrum of Figure 9 has been recorded at a total ice thickness of less than 125 nm. We think that the quantitative aspect of the FTIR absorption spectrum is consistent with the HeNe interferogram within a factor of two. We do not claim to have measured the differential IR absorption cross section of the HCl hydrate which most probably is sigificantly different from that of pure ice given in Table 1. The assumption of equal values for both cross sections is certainly erroneous.

In numerous reference experiments we have convinced ourselves that the stainless steel walls of the cryostat do not function as a significant source of HCl at the operating pressures of less than 10-7 Torr as very few molecules desorb from the walls. The proposal made by the referee to study hydrate formation at 150 to 160K is not realistic at this time as it would necessitate dosing of HCl at partial pressures of less than 10-8 Torr which is below our present detection limit of the residual gas MS. Figure 2 displays the HCl partial pressure during dosing of less than 10-7 Torr (lower curve) lthat is within our present capabilities. However, we doubt that we can go more than an order of magnitude lower than that.

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We are certainly striving to get the message of our work across to the reader, namely that -based on a multidiagnostic approach- small degrees of contamination of ice by certain atmospheric gases may have a significant effect on the kinetics of condensation and evaporation. We will take all possible measures and precautions that the reader will not miss this point.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 2179, 2003.

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