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Uptake of hypobromous acid (HOBr) by aqueous sulfuric acid solutions: low-temperature solubility and reaction

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Abstract. Hypobromous acid (HOBr) is a key species linking inorganic bromine to the chlorine and odd hydrogen chemical families. We have measured the solubility of HOBr in 45-70wt% sulfuric acid solutions representative of upper tropospheric and lower stratospheric aerosol composition. Over the temperature range 201-252 K, HOBr is quite soluble in sulfuric acid, with an effective Henry's law coefficient, $H^*=10^4$-10^7 mol $L^{-1}atm^{-1}$. H^* is inversely dependent on temperature, with ΔH=-45.0±5.4 kJ mol^{-1} and ΔS=-101±24 J $mol^{-1}K^{-1}$ for 55-70wt% H_2SO_4 solutions. Our study includes temperatures which overlap both previous measurements of HOBr solubility. For uptake into 55-70wt% H_2SO_4, the solubility is described by log H^*=(2349±280)/T-(5.27±1.24). At temperatures colder than ~213K, the solubility of HOBr in 45wt% H_2SO_4 is at least a factor of five larger than in 70wt% H_2SO_4, with log H^*=(3665±270)/T-(10.63±1.23). The solubility of HOBr is comparable to that of HBr, indicating that upper tropospheric and lower stratospheric aerosols should contain equilibrium concentrations of HOBr which equal or exceed those of HBr. Upon uptake of HOBr into aqueous sulfuric acid in the presence of other brominated gases, particularly for 70wt% H_2SO_4 solution, our measurements demonstrate chemical reaction of HOBr followed by evolution of gaseous products including Br_2O and Br_2.

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