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Exposure of NAT crystals to HCl: a spectroscopic study

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As is well known, nitric acid hydrates, and in particular the trihydrate (NAT), are among the main components of polar stratospheric clouds (PSC). The systems formed by hydrogen halides on NAT crystals have been studied from different points of view. We present here a systematic spectroscopic investigation of the effects of exposure of NAT to hydrogen chloride, with the final aim of achieving a better understanding of the physical properties of these ternary systems. The technique used in this study is reflection-absorption infrared spectroscopy. NAT crystals were prepared by freezing of water and nitric acid vapours in the appropriate ratio at 87K, followed by annealing at 175K, and further cooling to the starting temperatures for the process of addition of HCl. These were chosen as 87, 120, 140, 155 and 165 K. The corresponding NAT spectra were then recorded for use as reference. Next HCl was introduced in the sample compartment at a background pressure of either 10^{-4} or 5x10^{-4} mbar, and spectra were recorded at different time steps, until no further changes were observed. Subtraction of the reference NAT spectra allows the study of the exposure effects.

We have found very different behaviour depending on the temperature. For the lower HCl pressure, small changes were observed for temperatures below 150K, but significant alterations are produced at the two highest temperatures recorded, being much faster for the 165K study. In the higher HCl pressure investigation, important spectral changes are found even at the lowest temperature in specific spectral regions. On the other hand, spectral modifications are comparatively much smaller for the 165K.

We will discuss in the meeting these effects and propose some mechanisms to explain them.