SUBLIMATION RATE OF VOLATILES IN PURE AND MIXED ICES.

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Volatile molecules are found in ices on Solar System bodies. For example, H_2O, NH_3, CO_2, or CH_4 have been detected and quantified in the Cabeus crater on the moon by LCROSS [1]. Some super-volatiles have even been detected, despite lukewarm surface temperatures at which they should not be in the condensed phase if they were pure. Current surface models that employ sublimation rate inputs to predict ice composition do not account for the existence of entrapment mechanisms by the more abundant water molecules [2]. Moreover, most sublimation rates applied to surfaces at cryogenic temperatures encountered in the Solar System are extrapolations based on vapor pressure measurements performed at higher temperatures.

Here we present measurements of the H_2O and CO_2 sublimation rates at cryogenic temperatures for pure ices and preliminary results for CO_2 mixed with H_2O. These measurements have been obtained by depositing ice films onto a gold coated electrode of a quartz crystal microbalance cooled at low temperature (T~10K) under ultra high vacuum. The ice is further warmed up and the rate at which molecules sublimate is measured by the microbalance for various temperatures (see Figure 1). A mass spectrometer is employed in the case of mixtures to decompose the microbalance ice loss rates into species specific components.

Small temperature shifts due to phase changes are observed for pure ice sublimation (e.g. for amorphous vs crystalline H_2O ice), which emphasizes the impact of the ice structure onto its thermodynamical parameters. In the case of volatiles mixed with H_2O ice, a fraction of the volatiles stays trapped at high temperature until the H_2O matrix desorbs. Preliminary results on entrapment parameterization as a function of the mixing ratio is presented. Such parameterization could be included in models to contribute to a better ice composition prediction as a function of surface temperature.

References:

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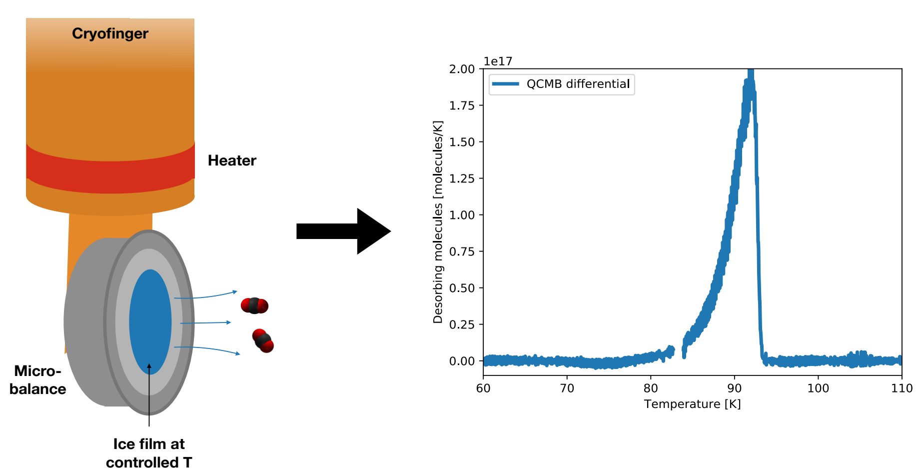

Figure 1: (left) Cartoon of the experimental setup with a desorbing ice film on a microbalance attached to a cryocooler. (right) Pure CO_2 ice sublimation rate as a function of temperature.