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Evolution of ice/dust mixtures upon sublimation of ice, implications for comets and larger icy objects

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1. Introduction

The surfaces of many objects in the Solar System comprise substantial quantities of water ice either in pure form or mixed with minerals and/or organic molecules. Sublimation is a process responsible for shaping and changing the reflectance properties of these objects. This peculiar process is not known enough and requires experimental studies.

2. Methods

We present laboratory data on the evolution of the structure and the visible and near-infrared spectral reflectance of icy surfaces made of mixtures of water ice and non-volatile components (complex organic matter and silicates), as they undergo sublimation of the water ice under low temperature and pressure conditions [1,2]. We prepared icy surfaces which are potential analogues of ices found on comets, icy satellites or trans-neptunian objects (TNOs). The experiments were carried out in the SCITEAS simulation setup built as part of the Laboratory for Outflow Studies of Sublimating Materials (LOSSy) at the University of Bern [3].

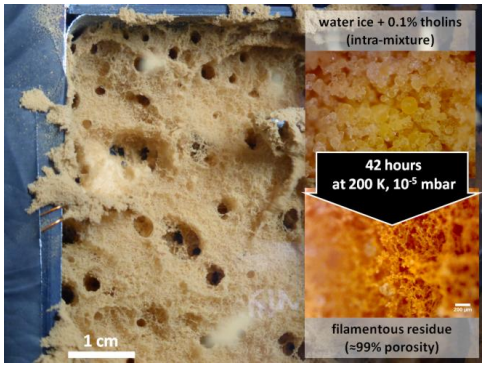

Figure 1: Formation of a dry foam-like porous organic matrix after sublimation of the water ice [1].

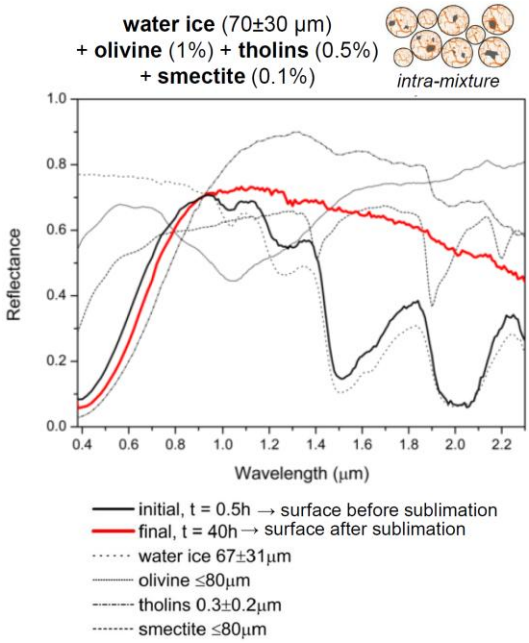

Figure 2: Reflectance spectra of a sample surface before and after sublimation [2].

3. Results

As the water ice sublimated, we observed *in situ* the formation of a sublimation lag deposit, or sublimation mantle, made of the non-volatiles at the top of the samples (Figure 1). The texture (porosity, internal cohesiveness etc.), the activity (outbursts and ejection of mantle fragments) and the spectro-photometric properties (Figure 2) of this mantle are found to differ strongly depending on the chemical nature of the non-volatiles, the size of their particles, the way they are mixed with the volatile component and the dust/ice mass ratio. The results also indicate

how the band depths of the sub-surface water ice evolve during the build-up of the sublimation mantle.

These data provide useful references for interpreting remote-sensing observations of Rosetta [4], Dawn [5], and also New Horizons.

References

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