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Reflectance of low-albedo dusts and water ice mixtures. Application to the surface of comet 67P.

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1. Introduction

Even though it is admitted that cometary nuclei are ice-rich in bulk, comets present extremely low albedo at their surface. The case of the comet 67P is not different; its water content at the surface has been estimated to be lower than 10 wt% from its reflectance spectrum [1].

Back in 2015, we measured the bidirectional visible reflectance of intimate mixtures of grained water ice and referenced lunar regolith simulant JSC1-AF [2]. We observed that it is possible to mix up to 75 wt% of ice within the dust without increasing its reflectance notably, therefore making this ice hardly detectable for visible imagers.

Here, we present the reflectance of these samples extended to the near-IR (up to 2.4 µm). We have also used a powder darker than JSC1-AF, as well as tried other association modes between dust and water ice, such as frost deposition. We propose a way to distinguish between frost and intimate mixing only from the reflectance spectra, without the need of reflectance models.

2. Samples

On the one side, we have repeated the intimate mixtures with JSC1-AF and water ice, whose preparation is fully detailed in [2]. We have prepared the same kind of mixtures with a darker basalt, described in [3].

On the other side, we have condensed frost onto the dark basalt. To do so, we have designed and built a sample holder that allows to cold trap atmospheric water on the powder. We have measured three different thicknesses of frost layers, which we estimate to be from the micrometres to hundreds of micrometres thick.

The reflectance measurements have been acquired with the Simulation Chamber for Imaging the Temporal Evolution of Analogue Samples (SCITEAS), at the Laboratory for Outflow Studies of Sublimating icy materials (LOSSy) [4].

We have performed spectral analysis by computing the depth of the water bands and the visible and near-infrared spectral slopes.

3. Results

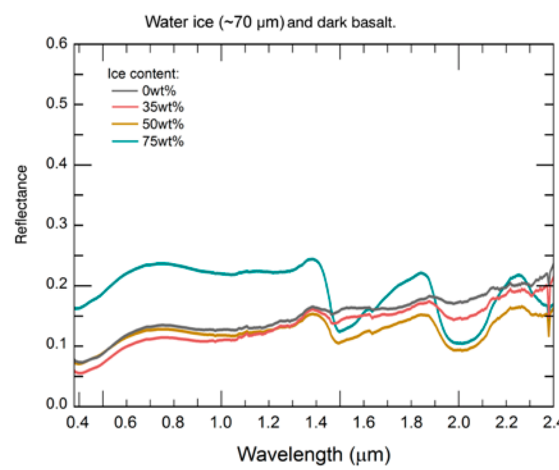

Figure 1 Reflectance spectra of various intimate mixtures of water ice and dark basalt.

Figure 1 shows the reflectance of intimate mixtures of water ice and dark basalt. As observed in [2], the reflectance in the visible range of the reflectance spectrum only rises when water ice is present in more than a 50 wt%.

Figure 2 shows the effect of frost deposition on the reflectance of dark basalt. The different curves represent the estimated thickness of the frost layers on top of the powders.

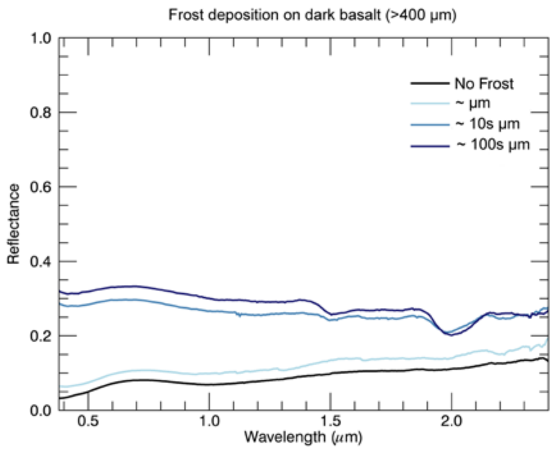

Figure 2 Various layers of water frost on a sample of dark basalt with grains bigger than 400 μm

4. Discussion

Looking at Figures 1 and 2, we understand the different effect that water has on reflectance depending on if it is present as frost or intimately mixed. Nevertheless, when we look at a cometary surface, it is not straightforward to distinguish frost from intimate mixtures.

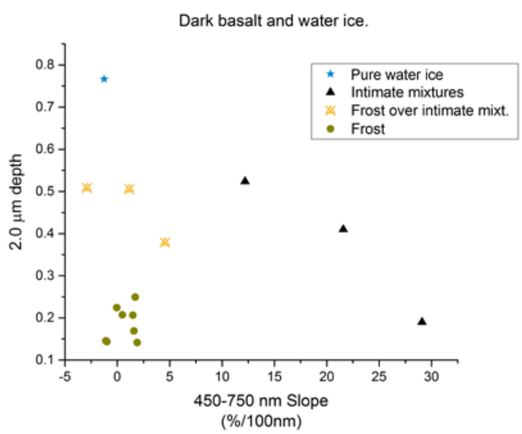

Figure 3 Comparison of the depth of the H_2O band at 2.0 μm with the VIS spectral slope for various association modes

Figure 3 shows how the comparison of spectral parameters can help to discern different association modes between soil and water ice.

In this conference, we present the application of these methods to the surface of comet 67 P.

Acknowledgements

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