Quantification of organic content and coating on laboratory generated dust particles and their effect on ice nucleation processes

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The ice nucleation efficiencies of various dust, mineral, and soot particles as a function of mineral composition, ambient temperature, freezing mode, and organic and sulfuric acid coating were investigated within the first part of the Fifth International Ice Nucleation Workshop (FIN-1) at the Aerosol Interaction and Dynamics in the Atmosphere (AIDA) chamber at the Karlsruhe Institute of Technology in November 2014.

A high-resolution time-of-flight aerosol mass spectrometer (AMS) was used to quantify non-refractory components of particles with a vacuum aerodynamic diameter of up to 3 microns using a high-pressure aerodynamic lens. Measurements revealed that laboratory generated dust and mineral particles already contain an atmospherically relevant fraction of organic matter. For particles in the ~1 micron size range, the mass of this inherent organic fraction can correspond to that of several monolayers of organic molecules generated by ozonolysis of α-pinene. High-resolution analysis of organic mass spectra indicates differences in the composition of the inherent organic content and the organic coating added (Figure 1). Furthermore, changes in single particle morphology were observed with the onset of coating.

We will present quantitative data of the inherent organic fraction for the different dust, mineral, and soot particles. We will discuss the importance of organic content and the effect of the additional organic coating as well as sulfuric acid coating for ice nucleation at various temperatures and freezing modes and its implications for the real atmosphere.

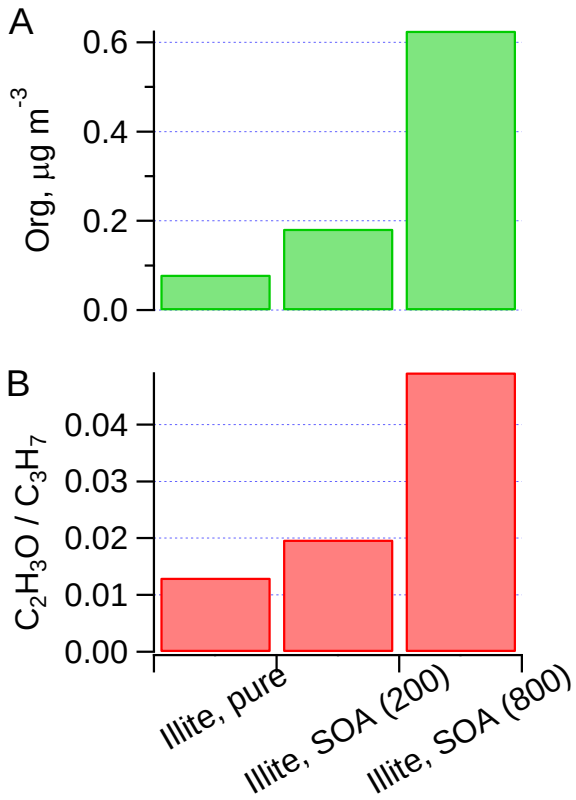

Figure 1. Organic mass measured with the AMS for pure Illite, Illite with secondary organic aerosol (SOA) from 200 ppt, and 800 ppt of α-pinene, respectively (A). With the addition of SOA, the ratio of the two ions at mass-to-charge ratio 43 changes; mass fragment C_2H_3O increases relative to C_3H_7 (B).