

The evolution of α -pinene SOA at low temperatures: What is the influence of warm and cold conditions during SOA formation on its chemical composition?

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The formation of secondary organic aerosol (SOA) from the oxidation of biogenic precursors, α -pinene in particular, has been studied extensively in smog chambers. Recently many organic species in α -pinene SOA have been identified, and can be grouped into semi-volatile/low-volatility monomers and extremely low volatility dimers (Zhang et al, 2015). Zhang *et al* (2015) also found distinct differences of the chemical composition of SOA in response to varying temperature (T) and relative humidity (RH) conditions, but only explored the T range of 285 K-298 K. T and RH conditions representative of the upper troposphere where SOA can be transported to or formed in-situ are rarely simulated in chamber studies, despite their potential importance for the chemical composition and phase state of SOA and thus their cloud formation potential (Zhang et al, 2015, Virtanen et al, 2010).

In order to investigate α -pinene SOA evolution at low T, we conducted 2 chamber experiments at 223 K and high RH (~ 95%) for the comparison of the chemical composition at molecular level. And we deployed the recently developed Filter Inlet for Gases and AEROSols (FIGAERO) coupled with a high-resolution time-of-flight chemical ionization mass spectrometer (HR-ToF-CIMS) for the measurement of both gases and particles (Lopez-Hilfiker et al, 2014). For the first chamber experiment, SOA was produced directly in the cold and humid AIDA simulation chamber (84.5 m³); for the second chamber experiment, SOA was first produced in the smaller NAUA chamber (3.7 m³) at room temperature (296 K) and then transferred to the cold and humid AIDA chamber.

We analysed thermograms resulting from the thermal desorption of SOA particles deposited on the Teflon filter in FIGAERO for specific ions. Maximum desorption temperatures (T_{max}) of single mode thermograms are correlated with a compound's enthalpy of sublimation; multi-mode thermograms indicate contributions from isomers having different vapor pressures or decomposition of larger molecules (Lopez-Hilfiker et al, 2015).

The experimental data exhibit differences in T_{max} of pinic acid and norpinic acid for the two experimental conditions (Fig. 1). A higher T_{max} was observed for compounds when SOA was produced in cold AIDA compared to SOA formed at 296 K and then transferred to cold AIDA. Multi-mode desorption profiles for pinic acid and norpinic acid, potentially resulting from high molecular weight organics and/or oligomers (i.e., multi-

phase accretion reaction products) were also observed when SOA was produced directly in cold AIDA, while only single mode desorption profiles were observed when SOA was generated at 296 K.

The results provide insights into the influence of changing T and RH conditions on the chemical composition and morphological properties of SOA during its evolution in the atmosphere.

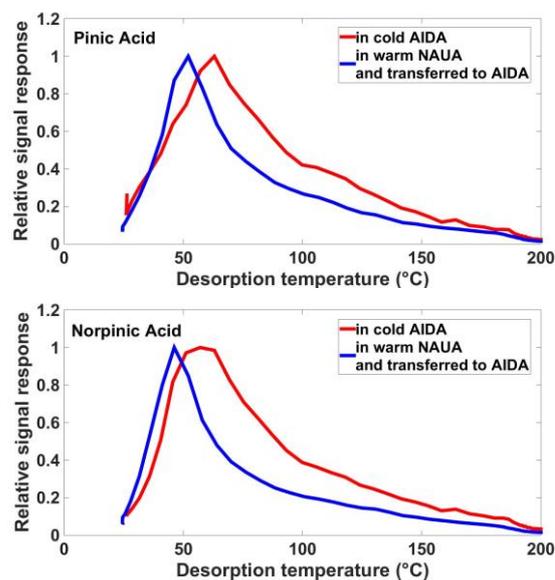


Figure 1. FIGAERO thermograms for pinic acid and norpinic acid produced directly in cold AIDA at 223 K with 95% RH (red) or formed in NAUA at 296 K and transferred to cold AIDA at 223 K with 95% RH (blue).

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