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Clearing up the Haze

Researchers develop a strategy for studying organic atmospheric aerosols

Sometimes a blue haze lingers over forests. This „blue-haze phenomenon“ is caused by natural organic aerosols. These airborne particles absorb, reflect, and scatter incoming solar radiation, thus causing the bluish shimmer that can be seen over forests on sunny days. They also play a role in the formation of the droplets in clouds. German researchers have now developed an analytical approach for the detailed study of these aerosols.

Thus far, little is known about the way in which atmospheric organic aerosols are formed. A key role is clearly played by the reaction of terpenes with tropospheric ozone. Terpenes are widespread plant products and are components of many etherial oils and spices that give every forest its smell.

Wolfgang Schrader’s research team has developed and optimized analytical methods for studying the reaction – as reproduced in the lab – of pinene, the terpene most commonly emitted from plants, with ozone. Many different products are formed in this reaction, most of which could not be completely characterized before. Schrader and his co-workers first separated the components of the mixture by liquid chromatography. In this process the different compounds travel through a separating agent in a column at different rates. A mass spectrometer awaits them at the end of the column, allowing the exact masses of the products to be specifically determined, and their chemical composition to be precisely calculated. In order to obtain further clues about the structures of the compounds, a portion of the liquid was diverted and examined in parallel by nuclear magnetic resonance spectroscopy (NMR). This method is based on the fact that the spins of hydrogen atom nuclei align themselves in a magnetic field, and can be made to „flip“ by electromagnetic radiation. Neighboring hydrogen atoms within a molecule have a strong influence on each other in this process. These neighborhood relationships can be seen in the NMR spectrum, so conclusions can be drawn about the structure of the compound.

„Surprisingly, we found far more complex products than was previously supposed,“ relates Schrader. The reaction scheme for the ozonolysis of pinene was filled out more completely on the basis of the new findings. „For the first time, we have tools that can give us insights into a problem as complex as the atmospheric reactions of terpenes.“