# Chemical composition of the 300°C refractory fraction of the atmospheric aerosol at the Central European station Melpitz, Germany

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The volatilization of the atmospheric aerosol leaves so-called refractory particle cores containing material that is non-volatile at the given temperature. In the fine particle mode (particle diameter < 1 µm), this refractory material can be mainly associated with soot particles and low-volatile organics, and occasionally to a smaller fraction with sea salt and mineral dust. The carbonaceous materials have in common that they are responsible for effects as different as atmospheric light absorption (black carbon, BC), and adverse effects upon human health (toxic compounds attached to diesel soot). In consequence, there is a significant interest to describe the carbonaceous particle mass fraction in functional detail, and characterize the existing methodologies for their continuous monitoring in the atmosphere.

This work analyses the refractory atmospheric aerosol fraction at the regional Central European research site Melpitz (Germany). The experimental methods combine a mobility particle size spectrometer (3-800 nm) in conjunction with a thermodenuder working at 300°C (residence time of 0.8 – 1 s), a multi-angle absorption photometer (MAAP), and an aerosol mass spectrometer (AMS) during two intensive field campaigns (May-June 2008 and February-March 2009). As a first result, we detected refractory volume fractions of 11±3 % (2008) and 17±8 % (2009) in the atmospheric aerosol. In both periods, BC was in close linear correlation with the refractory fraction, but was not sufficient to quantitatively explain the refractory particle mass concentration.

Based on the assumption that BC is not altered by the heating process, the refractory particle mass fraction was explained by black carbon and a refractory organic aerosol (ROA) contribution estimated as a fraction of the Low-Volatility Oxygenated Organic Aerosol (LV-OOA); the latter was identified from AMS data by factor analysis. Although carbonaceous compounds dominated the refractory particle mass fraction for most of the observation time, a cross-sensitivity of partially volatile marine aerosol particles could be seen in Atlantic air masses during February-March 2009. These particles were originally in the super-µm range, but moved into the submicrometer range after volatilization. In summary, after correction from the supermicrometer artifact for each period, our results confirm that the volatilization of the atmospheric aerosol in a thermodenuder at 300°C leaves not only major fractions of black carbon (47% and 59% of the estimated refractory mass for the 2008 and 2009 campaigns, respectively), Figure 1, but also of organic compounds (53% and 41% of the estimated refractory mass for the 2008 and 2009 campaigns respectively).

The present work shows that organics were more volatile in summer than in winter, which emphasizes the influence of different organic sources as well as differences in the organic aerosol behavior in the atmosphere (e.g. secondary organic aerosol formation and/or aging processes). Different sources of uncertainty and factors influencing the present estimation will be presented. Furthermore, recommendations are proposed for future long-term observations using a thermodenuder.

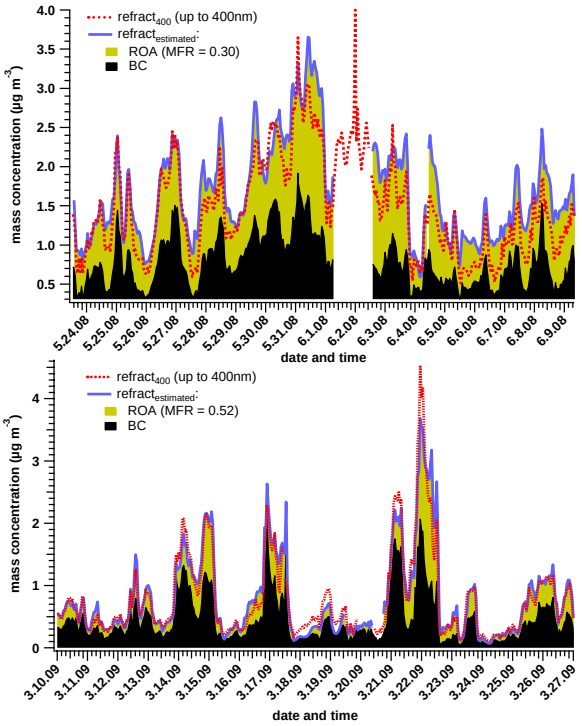


Figure 1: Time series of the measured (red line) and estimated (blue line) refractory mass concentration for late spring 2008 (top) and early spring 2009 (bottom). Contributions of BC and Refractory organic aerosol (ROA) are also included.

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