

Volatility of Materials Internally Mixed with Black Carbon from Biomass Burning

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Biomass burning (BB) is a huge source for black carbon (BC) containing aerosols to the troposphere. Both BC's absorption of light, and its lifetime in the atmosphere are affected by the amount of other materials internally mixed with it. These "coatings" can be formed of materials that condense onto the BC aerosol as the particles age in the atmosphere, or they can also occur at the time of emission. For BB, the properties of BC coatings (amount, composition) can potentially indicate differences in fuel types and/or burn conditions; e.g. burns producing more brown carbon have previously been associated with organic compounds with very low volatility (Saleh et al., 2014). Additionally, as pollution is transported from BB sources, it is diluted, leading to changes in gas/aerosol phase partitioning of intermediate volatility compounds. It is not yet known whether the volatility of the materials internally mixed with BC is the same as the volatility of the bulk aerosols. Measurements with a single particle soot photometer (SP2) during FireLab at the U.S. Department of Agriculture (USDA) Fire Sciences Lab in Missoula, MT provide a large data set of BC-specific information for a variety of fuels common to North American wildfires. Here, we examine the mixing state of BC aerosols for different fuel types in controlled laboratory burns. We also study the evolution of the internal mixing state and size distribution of the aerosols in chamber experiments simulating dilution of initially highly concentrated smoke plumes (See Fig. 1). To assess the changing composition of internally mixed materials on BC, as dilution and repartitioning occur, I investigate whether the volatility of the materials internally mixed with the BC does indeed differ from bulk aerosol, and to what extent the SP2 can constrain these effects.

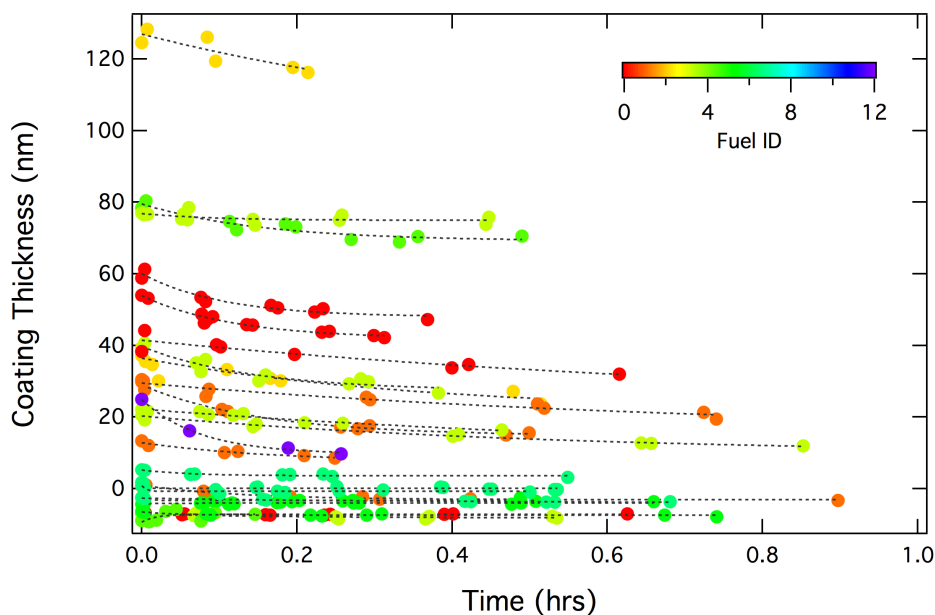


Figure 1. Evaporation of coatings on BC (4-6 fg cores) measured by the NOAA single-particle soot photometer during measurements of smoke inside a barrel from stack burns during Firelab. Smoke is initially drawn into the barrel near the beginning of the burn, and after the barrel is filled, it is closed off from the fire and continually diluted with filtered air. SP2 sampling occurs over typically 15 minutes during the dilution period. Initial coating thickness demonstrates large variability, and coatings evaporate faster at the beginning of the dilution.