2.089 Formation and chemical processing of spherical organic aerosol particles, or “tar balls,” from biomass burning in the northwestern US.

Presenting Author:
KOUJI ADACHI, Meteorological Research Institute, Japan, adachik@mri-jma.go.jp

Co-Authors:
Arthur Sedlacek, Brookhaven National Laboratory, USA
Lawrence Kleinman, Brookhaven National Laboratory, USA
Timothy Onasch, Aerodyne Research Inc., USA
Stephen Springston, Brookhaven National Laboratory, USA
Peter Buseck, Arizona State University, USA

Abstract:

Biomass burning is a major source of atmospheric aerosol particles and gases and has important implications on regional and global climate. Smoke from wild fires contain extremely high concentrations of aerosol particles and the particle chemistry, viscosity, and volatility rapidly change within the few hours following their emission. Understanding these rapid processing is critical to accurately evaluating the influences of aerosol particles from biomass burning on the climate.
We measured aerosol particles, collected during the 2013 Biomass Burning Observation Project (BBOP) using an aircraft, from forest wild fires in North America [1-2]. Here we focus on individual particle properties using a transmission electron microscope (TEM) in samples with ages ranging < 1 hour to several hours from emission.
Most aerosol particles consist of organic matter with inorganic inclusions such as potassium salts and ns-soot. When fresh (<1 hour aging), these particles are characterized by low viscosity and spread over the substrate. Upon aging, they increased their viscosity on the substrate and became spherical particles called tar balls (TBs). We estimated the TB mass fractions in the smoke using a TEM and a single particle soot photometer (SP2) and showed that the TBs have weak light absorbance, with refractive index m=1.56-0.02i. We also measured volume changes upon heating and found TBs display low volatility upon heating. The chemical compositions of individual TBs, measured using an energy dispersive X-ray spectrometer (EDS) with a TEM, showed that TBs include nitrogen and potassium within the carbonaceous body. These findings will improve the evaluations of their inventory and climate influences.
1: Adachi, K., Sedlacek, A.J., Kleinman, L., Chand, D., Hubbe, J.M., Buseck, P.R. Aerosol Sci. Technol., 52, 46-56, 2018.
2: Sedlacek, A.J., Buseck, P.R., Adachi, K., Onasch, T.B., Springston, S.R., Kleinman, L., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-41, 2018.