Photochemical and biological lability of soot black carbon in soils from Phoenix, AZ

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Soot BC is the product of incomplete combustion of biomass and fossil fuels. Soot BC is traditionally thought to be chemically non-reactive because it is highly aromatic and has a low O:C ratio; however, the inherent imbalance between sources and sinks in the global black carbon budget suggests soot BC in soils may be considerably more reactive than previously considered. Soil is a potential storage reservoir for soot BC especially in urban regions with significant fossil fuel combustion. Phoenix, AZ is a rapidly urbanizing arid region with relatively low bulk soil organic carbon content; soot BC is a significant fraction of the soil organic matter and may play a major role in soil biogeochemical cycling in this region (Hamilton and Hartnett, 2013). Soot BC:OC ratios in soils from the CAP-LTER Survey 200 are as high as 30% which is among the highest reported in any soils.

We investigated both photo-chemical oxidation and microbial degradation of soil soot BC. Soot BC was readily photo-oxidized by UV light in the laboratory; we observed a loss of ~19% of the soil soot BC over ~24h. This corresponds to a solar-equivalent degradation rate of 0.55 ± 0.1 g soot BC/kg soil/y. In mesocosm biodegradation experiments CO_2 production by soil microbes increased by 64 to 100% over controls, even when soot BC was the only carbon source present. Both photo-oxidatin and biodegradation not only reduce the amount of soot BC present in soils but also alter the chemical composition of soot BC as determined by Fourier-Transform Infra-Red (FTIR) spectroscopy and 2D fluorescence analysis. Taken together, these results strongly imply that soot BC plays an active role in the soil biogeochemical cycling of this urban desert ecosystem.

[1] Hamilton & Hartnett (2013) *Org. Geochem.* **59**, 87-94.