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The formation of light absorbing insoluble organic compounds from the reaction of biomass burning precursors and Fe(III)

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Dust particles and volatile organic compounds from fuel or biomass burning are two major components that affect air quality in urban polluted areas. We characterized the products from the reaction of soluble Fe(III), a reactive transition metal originating from dust particles dissolution processes, with phenolic compounds , namely, guaiacol, syringol, catechol, o- and p- cresol that are known products of incomplete fuel and biomass combustion but also from other natural sources such as humic compounds degradation.

We found that under acidic conditions comparable to those expected on a dust particle surface, phenolic compounds readily react with dissolved Fe(III), leading to the formation of insoluble polymeric compounds. We characterized the insoluble products by x-ray photoelectron microscopy, UV-Vis spectroscopy, mass spectrometry, elemental analysis and thermo-gravimetric analysis. We found that the major chromophores formed are oligomers (from dimers to pentamers) of the reaction precursors that efficiently absorb light between 300nm and 500nm. High variability of the mass absorption coefficient of the reaction products was observed with catechol and guaiacol showing high absorption at the 300-500nm range that is comparable to that of brown carbon (BrC) from biomass burning studies.

The studied reaction is a potential source for the *in-situ* production of secondary BrC material under dark conditions. Our results suggest a reaction path for the formation of bio-available iron in coastal polluted areas where dust particles mix with biomass burning pollution plumes. Such mixing can occur, for instance in the coast of West Africa or North Africa during dust and biomass burning seasons