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# CHEMICAL CHARACTERIZATION OF WILDFIRE AEROSOL EMISSIONS AND PRODUCTS OF ATMOSPHERIC AGING BY ULTRAHIGH RESOLUTION MASS SPECTROMETRY

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Particulate matter (PM) is widely recognized as a threat to public health and a key driving force of climate change. The chemical composition significantly influences the properties of the particles, especially their interactions with solar radiation and their role in inducing adverse health effects. Atmospheric aging modifies aerosol composition, forming new compounds and increasing complexity. Despite progress, both primary and processed aerosols remain poorly characterized, contributing to uncertainties in climate models and a limited understanding of their effects on humans. The frequency and intensity of wildfires have risen in recent decades, a trend expected to persist with global warming. This study investigates aerosol emissions from wildfire and peat-burning scenarios using real-world samples and laboratory-simulated conditions. [1-7] Peatlands, which store one-third of terrestrial organic carbon, were a particular focus. [3,4]
High-resolution mass spectrometry methods combined with soft ionization techniques were applied for a systematic study of combustion-derived PM covering emissions [1,3,4], atmospheric transformation [5,7] and ambient air [2,6]. Fourier-transform ion cyclotron resonance mass spectrometry systems of magnetic field strengths from 7 to 21 T as well as Orbitrap systems were utilized to examine the complex PM chemistry, together with the development of sample preparation protocols and an improved understanding of the ionization characteristics for PM analysis.
Peat-burning emissions revealed an exceptionally complex molecular composition, with an average of more than 30,000 assigned compounds, including oxygen-, nitrogen-, sulfur-, and phosphorus-containing species. High levels of nitrogen-containing compounds (up to six nitrogen atoms) and characteristic biomass-burning markers, such as levoglucosan and terpenoids, were identified. Regional vegetation influenced the chemical profiles of peat-burning aerosols, yet over 10,000 common CHO and CHNO compounds were consistent across samples, forming a foundational set of peat-derived organic carbon. Notably, sulfur-rich compounds originating from Sphagnum moss-derived peat highlight peat combustion as a significant source of organic sulfur to the atmosphere. These findings underscore the need to consider Arctic and boreal peat smoldering as significant contributors to atmospheric sulfur cycling. [3,4]

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[6] Schneider, E., et al. ACS Earth Space Chem. 2022, 6 (4), 1095–1107.
[7] Czech, H., et al. Environ. Sci.: Atmos. 2024, 4, 718–731.

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