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Genetic-altering Compounds Found in Forest Fire Smoke

Researchers use EMSL mass spectrometer to advance frontiers of particle science

Smoke from burning ponderosa pines contains previously undetected alkaloids, according to a just-published study by scientists working at the Department of Energy's EMSL. The alkaloids are potent mutagens that can affect human health and ecosystems in areas near or downwind of the fires. Researchers have long suspected the presence of alkaloids in smoke particles produced in forest fires, but no direct measurements had been made.

With the help of the Forest Service Fire Sciences Laboratory, a team from Pacific Northwest National Laboratory and EMSL sampled the smoke from smoldering fires of ponderosa pine and underbrush. Then, they devised a method that provides highly detailed information about the smoke's composition. This method included using EMSL's LTQ-Orbitrap™ high-resolution mass spectrometer to characterize the smoke. Compared to other studies, the team found that 70% of the molecules detected in the smoke had not been previously reported. More than 30% of newly detected species were alkaloids.

Scientific impact: This and earlier studies by the team will aid in understanding the possible effects of smoke particles emitted during forest fires on the environment and human health. The results suggest that smoke might carry biologically useful nitrogen in the form of alkaloids. In addition, alkaloids may present a considerable source of basic compounds in smoke particles, which can impact cloud formation processes important to agriculture and water supplies. This is part of EMSL's characterization of materials at unprecedented resolution.

Societal impact: Every year, ponderosa wildfires occur along the nation's West Coast. While some fires are accidental, others are prescribed land management events. The researchers found that smoldering fires such as those in controlled burns produce more alkaloids than blazing fires. Because some plant alkaloids might be harmful, the result could affect planned fires upwind of human populations.

For more information, contact EMSL Communications Manager Mary Ann Showalter (509-371-6017).

References: Smith JS, A Laskin, and J Laskin. 2009. "Molecular Characterization of Biomass Burning Aerosols Using High Resolution Mass Spectrometry." *Analytical Chemistry* 81:1512-1521. doi: 10.1021/ac8020664

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Previously undetected compounds were detected in smoke from a smoldering fire with a new method devised at EMSL.