Utilizing Ultrahigh Resolution Mass Spectrometry to Elucidate the Composition of Dissolved Organic Matter in Fire-Affected Headwaters

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Abstract: Since 1970, the fire-season length in the western U.S. has increased from 166 to 222 days, and Colorado has been experiencing this surge in wildfire activity firsthand. The Cameron Peak Fire of 2020 was Colorado's largest wildfire in recorded history, burning over 200,000 acres of forest land in Northern Colorado over the course of four months. This fire was located in the headwaters of multiple rivers, such as the Cache la Poudre River, which supply water to nearly half a million Front Range municipal, industrial, and agricultural users. The combustion and heating of wildfires can alter the organic content of soils and vegetation which is exported out of these burned watersheds as dissolved organic matter (DOM). Determining the chemical composition of this fire-affected DOM is imperative; for example, chlorination of some DOM compounds can potentially produce toxic disinfection byproducts during water treatment. Thus, the objective of this study is to employ ultrahigh resolution mass spectrometry to elucidate the composition of DOM in five headwater catchments affected by the Cameron Peak Fire. Throughout the first year following the fire, water samples were collected by the U.S Forest Service from streams in burned and unburned CLP sub-catchments during baseflow conditions, spring snowmelt, and monsoonal summer storm events. The DOM content was analyzed with ultrahigh resolution mass spectrometry: a powerful analytical technique that can accurately identify the composition of thousands of DOM molecules in a single sample. The results of this study will advance the evaluation of fire-affected DOM composition which may inform prudent water-treatment approaches following severe wildfires.