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Isotopic Evidence for Multiple Mercury Sources in a Fire-impacted Mining District

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In 2022, the Moose Fire burned 574 km^2 in the Salmon-Challis National Forest, Idaho. The fire perimeter included the Leesburg mining district, with extensive placer tailings from that were generated from 1866 to 1945. Presumed mercury sources included regional deposition of gaseous elemental mercury, local deposition from recovered gold/mercury amalgams, redistribution of mercury volatilized during the fire, and geologic sources. We used a paired watershed approach to investigate whether fire exacerbated the remobilization of mercury from placer tailings. Stream chemistry confirmed that greater concentrations of mercury were in burned watersheds relative to unburned watersheds, with greater concentrations of mercury in streams from burned and mined watersheds. Soils collected from burned plots had low mercury concentrations due to volatilization during the fire. Soil plots in wetland and upland soils in the Leesburg mining district had elevated mercury concentrations relative to other soil plots in the study area. Mercury concentrations in water and soil associated with an unburned, unmined control watershed adjacent to the Leesburg mining district were greater than expected, suggesting that local mercury deposition extended beyond the mined watersheds. Atmospheric mercury deposition originating from multiple sources can be challenging to constrain. We used mercury isotope compositions of soils to determine if different atmospheric sources could be distinguished. The mercury isotopic composition of soil samples collected from the study area reflected two primary end-members: 1) Negative values for mass dependent and mass independent mercury associated with regional mercury deposition and 2) positive values of mass independent mercury associated with soils collected from the Leesburg mining district. Soils from the control watershed had a range of mercury compositions interpreted to reflect mixing between these sources. These data demonstrate the presence of a large pool of soil mercury associated with historical mining activities that will complicate ongoing stream restoration and mining remediation efforts.