

PFAS source identification, fate, and transport in semi-arid soils, New Mexico, USA.

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Per and polyfluoroalkyl substances have been detected in soil and groundwater on and near an Air Force facility in the state of New Mexico in the southwestern United States. Multiple potential source areas have been identified within the facility, including current and former fire training areas (FTAs), treated wastewater effluent lagoons, and areas irrigated with treated wastewater effluent. While the source areas and most likely inputs are relatively straightforward to define (i.e. Aqueous Film Forming Foam (AFFF) usage at FTAs), linking these source areas to the presence of PFAS in groundwater provides a significant challenge given our limited understanding of abiotic (i.e. soil sorption) and biological (i.e. precursor transformation, degradation) factors controlling PFAS fate and transport. Furthermore, only limited information is available for PFAS transport through a thick (>100m) vadose under the semi-arid conditions found at this site. To better understand the factors controlling PFAS fate and transport under these conditions, 19 groundwater samples and 7 soil cores were obtained from the site, including areas both with and without known or suspected inputs of PFAS. Soil and groundwater samples were analyzed for PFAS, total oxidizable precursors (TOP), a wide range of physical and chemical parameters, and microbial community structure. Distinct PFAS compositions were observed between the FTAs and the wastewater lagoons. Predictive modelling using a combination of targeted PFAS and TOP data enabled tentative identification of potential AFFF source formulations used at the FTAs and indicated the application of different formulations over time. Microbial community analysis indicated that the relative abundance of Nitrospirota and Chloroflexi was elevated in samples with higher total PFAS concentrations; Nitrospirota have been linked to the biotransformation of perfluorosulfonamides and Chloroflexi have been linked to the transformation of halogenated compounds. Further work will assist in refining the modelling approach used for source identification and better link biological activity to PFAS and precursor biotransformation.