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Unusually High $\Delta^{12}CH_2D_2$ Signature in Sewer Manholes on University of Maryland, College Park Campus, Possibly Due to Steam Contamination.

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Methane is an extremely potent greenhouse gas, with a global warming potential substantially higher than carbon dioxide. Sewer systems generate methane via microbial methanogenesis and can also accumulate methane from leaking adjacent natural gas pipes. If methane accumulates to high levels it can present an explosion hazard. We conducted frequent surveys throughout the summer of 2023, measuring methane and ethane concentrations along various sewer manholes across the University of Maryland, College Park campus. We additionally collected a subset of samples for $\Delta^{12}CH_2D_2$ and $\Delta^{13}CH_3D$ monthly/biweekly from the summer of 2023 to spring of 2024. Two manholes sampled in July 2023 produced methane with unusually high $\Delta^{12}CH_2D_2$ signatures, which do not represent mixing of any known natural gas or microbial sources. Noticeable quantities of steam vent from these manholes, suggesting that the signature is from methane produced within the campus steam system, or as a result of chemistry associated with the release of this steam into the sewer system. The samples yield strongly positive $\Delta^{12}CH_2D_2$, which we interpret as an indication that the signature represents residual methane after oxidation reaction(s). Subsequent sampling reveals that the $\Delta^{12}CH_2D_2$ signature varies temporally, which may represent a change in the steam chemistry or generation process at the steam plant. We hypothesize that the methane originates via thermal decomposition of steam additives during steam production, which is generated via different pathways depending on demand. Current work focuses on identifying the production and oxidation pathways for steam associated with methane and includes plans for direct sampling of steam from the steam plant and possible hydrothermal experiments.