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CHARACTERIZING THE VOLATILOME OF LAND-DISPOSED SEWAGE SLUDGE UNDER SEASONAL TEMPERATURE REGIMES

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ABSTRACT

About eight million dry tons of sewage sludge waste is generated in the US annually, with more than half of that now land-disposed on agricultural and forested lands. Though containing essential plant nutrients, sludge also harbors complex mixtures of volatile organic compounds (VOCs) that result in toxic emissions therefrom. While ecotoxic impacts to sludged ecosystems are a primary concern, the stifling emissions are most obvious to and disconcerting for the public, which has led to increasing concerns for the safety of this practice. The large-scale disposal of sludge in the temperate rainforests of the Puget Sound Watershed has resulted in acute toxicity to macrobiota, and despite escalating concerns for detrimental impacts, little is known about the total VOC inventories, or "volatilomes," of these complex wastes. To address this knowledge gap, we characterized VOC emissions from forest-disposed sewage sludge over a range of seasonal temperature regimes. We also incubated sludge samples at the more extreme 100 °C to assess the "complete volatilome." After 1-hr incubations in gastight vials, VOCs accumulated in the headspace were sampled with a gastight syringe and analyzed with gas chromatography-mass spectrometry to generate distinct chemical fingerprints of sludge sample volatilomes over the range of temperatures. Total integrated chromatographic peak areas increased with temperature, indicating increased VOC production. Sludge volatilomes were dominated by a multitude of aliphatics and aromatics, with comparatively lesser emissions of alcohols, esters, aldehydes, terpenes, and nitrogen-, sulfur-, and halogen-containing compounds.