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Methane Emissions from Landfill: Isotopic Evidence for Low Percentage of Oxidation from Gas Wells, Active and Closed Cells

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Large landfill sites remain a significant source of methane emissions in developed and developing countries, with a global estimated flux of 29 Tg / yr in the EDGAR 2008 database. This is significantly lower than 20 years ago due to the introduction of gas extraction systems, but active cells still emit significant amounts of methane before the gas is ready for extraction. Historically the methane was either passively oxidized through topsoil layers or flared. Oxidation is still the primary method of methane removal in many countries, and covered, remediated cells across the world continue to emit small quantities of methane.

The isotopic signatures of methane from landfill gas wells, and that emitted from active and closed cells have been characterized for more than 20 UK landfills since 2011, with more recent work in Kuwait and Hong Kong. Since 2013 the emission plumes have been identified by a mobile measurement system (Zazzeri et al., 2015). Emissions in all 3 countries have a characteristic δ^{13}C signature of -58 $\pm$ 3 ‰ dominated by emissions from the active cells, despite the hot, dry conditions of Kuwait and the hot, humid conditions of Hong Kong. Gas well samples define a similar range. Surface emissions from closed cells and closed landfills are mostly in the range -56 to -52 ‰These are much more depleted values than those observed in the 1990s (up to -35 ‰) when soil oxidation was the dominant mechanism of methane removal.

Calculations using isotopic signatures of the amount of methane oxidised in these closed areas before emission to atmosphere range from 5 to 15%, but average less than 10%, and are too small to calculate from the high-emitting active cells. Compared to other major methane sources, landfills have the most consistent isotopic signature globally, and are distinct from the more ^{13}C-enriched natural gas, combustion and biomass burning sources.

Zazzeri, G. et al. (2015) Plume mapping and isotopic characterization of anthropogenic methane sources, Atmospheric Environment, 110, 151-162, doi.org/10.1016/j.atmosenv.2015.03.029.