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Abiotic methyl bromide formation from vegetation at ambient temperatures

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Methyl bromide is the most abundant brominated organic compound in the atmosphere with a tropospheric mixing ratio of 8 pptv and a lifetime of around 0.7 years. On a per-atom basis bromine is 50-60 times more effective than chlorine in depleting ozone (Butler, 2000). Although, methyl bromide is known to have several natural and anthropogenic sources, many uncertainties remain in the strength and the underlying mechanisms of its sources and sinks.

A possible new methyl bromide source from vegetation is shown via the same abiotic process described by Hamilton et al. (2003). In this process, methyl chloride was released from pectin and chloride ion present in senescent or dead plant material over a wide temperature range (30-350 ºC).

Ash (*Fraxinus excelsior*), saltwort (*Batis maritima*), tomato reference material (NIST-1573a), hay powder reference material (IAEA V-10) and bromine enriched pectin were incubated overnight in the temperature range of 25˚C to 50˚C at 5˚C incremental steps and analyzed for methyl bromide formation using GC-MS. Methyl bromide emissions show an exponential increase with increasing temperature. A dramatic increase in emission rates (by a factor of up to 42) was observed when the temperature was increased from 25 to 50˚C. Thus emissions were observed to approximately double with every 5ºC rise in temperature. Bromine was found to be more efficiently methylated than chloride in the plant samples.

The potential environmental implications of this process are discussed. It is suggested that abiotic methyl bromide emissions will vary regionally tremendously as a result of large differences in the geographical distribution of bromide concentrations in terrestrial plants. Furthermore, the process is considered of high importance as global warming scenarios predict increasing temperatures which will thus increase methyl halide emissions from plant matter and debris.

References:

Butler, J. H. (2000). "Better budgets for methyl halides?" Nature 403(6767): 260-261.

Hamilton, J. T. G., W. C. McRoberts, et al. (2003). "Chloride methylation by plant pectin: An efficient environmentally significant process." Science 301(5630): 206-209.