

Formation of secondary organic aerosol tracers from the photooxidation of isoprene-derived alkene diols under low-NO_x conditions

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Isoprene, a five-carbon diene, is a major contributor to nonmethane hydrocarbon emissions in the atmosphere, where it is rapidly oxidised by the hydroxyl (OH) radical. Photooxidation of isoprene leads to volatile gas-phase products but also to secondary organic aerosol (SOA) products such as the 2-methyltetrols (2-MTs), 2-methylglyceric acid (2-MG) and C₅-alkene triols.^[1-3] These SOA tracers are known to be second-generation oxidation products but their formation mechanism is not fully understood.^[4,5] In the present study, we have evaluated whether isomeric C₅-alkene diols can serve as precursors for these SOA tracers at low-NO_x, considering that they are formed from isoprene under these conditions.^[6,7] The atmospheric relevance of the C₅-alkene diols has been shown from ambient denuder samples.^[7]

The C₅-alkene diols were synthesised following published procedures.^[6] Isoprene and the C₅-alkene diols were oxidised by OH generated through the photolysis of hydrogen peroxide in a 19 m³ Teflon reaction chamber in the absence of NO_x (thus at background NO_x levels). SOA products were collected on Teflon filters and measured using gas chromatography/mass spectrometry (GC/MS) with prior trimethylsilylation. Figure 1 shows GC/MS data for SOA from isoprene (A) and the isomeric C₅-alkene diols (B-D). It can be seen that 2-MG is not only formed from isoprene but also from the C₅-alkene diols. As expected, C₅-alkene diols serve as precursors for the 2-MTs, 2-methylthreitol (2-MTh) and 2-methylerythritol (2-MEr). However, it appears unlikely that they function as precursors for the C₅-alkene triols (1, 2 and 3).

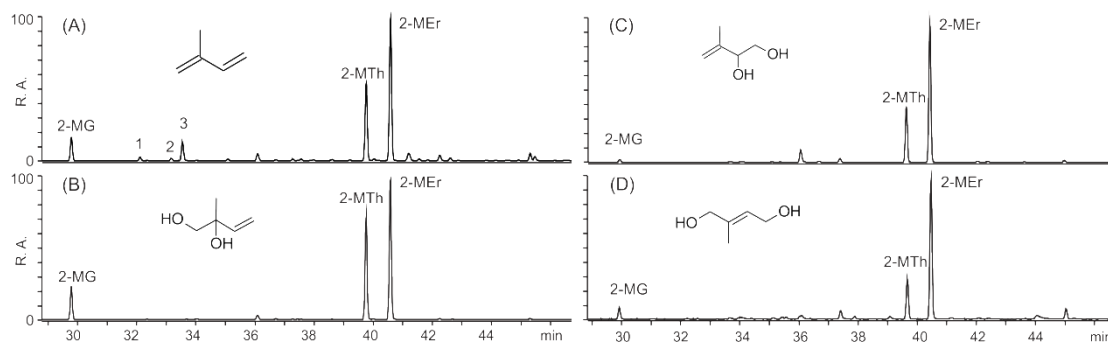


Figure 1. GC/MS extracted ion chromatograms (m/z 219 + 231) obtained for SOA from the photooxidation of (A) isoprene, (B) 1,2-dihydroxy-2-methyl-2-butene, (C) 1,2-dihydroxy-3-methyl-3-butene, and (D) 1,4-dihydroxy-2-methyl-2-butene (*cis* + *trans*). Abbreviation: R.A., relative abundance.

In conclusion, our results indicate that photooxidation of the C₅-alkene diols is a possible pathway that leads to the formation of 2-methylglyceric acid under low-NO_x conditions and rule out their involvement in the formation of the C₅-alkene triols.

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