Geophysical Research Abstracts, Vol. 8, 04346, 2006
SRef-ID: 1607-7962/gra/EGU06-A-04346

Chemical composition analysis of secondary aerosol produced from the atmospheric oxidation of some biogenic compounds by SFE-GC-MS

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Atmospheric aerosols are known to affect climate by scattering and absorbing solar radiation and altering clouds properties. They can also alter visibility and population health. Amongst the atmospheric particulate burden, secondary organic aerosols (SOA) may play a significant role.

Because these phenomena are linked to the SOA chemical composition, it is necessary to characterize it as well as its formation and evolution mechanism. However, such a characterization is a real analytical challenge because of the complexity of SOA whose components show a wide range of functionality, solubility and polarity and may be present at trace levels. An on-line supercritical fluid extraction – gas chromatography – mass spectrometry (SFE/GC/MS) technique (coupled to a BSTFA derivatization technique) was developed to overcome these difficulties. This method avoids tedious and time-consuming manual sample pre-treatment and therefore reduces sources of errors by contamination and analytes loss. It thus enhances significantly the sensitivity and minimizes the analysis time. Moreover, the sample derivatization carried out in-situ within the extraction cell, allows a specific detection of functionalized compounds which are supposed to be detected in SOA. This work presents the development of this time-saving, highly sensitive and pre-treatment-free technique and its application to the analysis of SOA formed from the ozonolysis of a biogenic hydrocarbon: sabinene. Ozonolysis of sabinene were performed in a 6 m^3 Teflon simulation chamber. The aerosols, collected on glass fiber filters, were extracted by supercritical CO_2, in situ derivatised (in the extraction cell) by a trimethylsililation agent, BSTFA

and analysed by GC/MS. More than thirty products could be measured and nine were identified and quantified, among them: sabinaketone, sabinic acid and other multi-functional compounds including dicarboxylic acid, aldehydes and alcohols. Reaction formation pathways are assumed for each identified product.