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Recent Advances in Mass Spectrometry Techniques

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Emission of carbon from ecosystems in the form of volatile organic compounds (VOC) represents a minor component flux in the global carbon cycle that has a large impact on ground-level ozone, particle and aerosol formation and thus on air chemistry and quality. Moreover, combustion of solid and liquid fuels is the largest source of potentially toxic VOC, which can strongly affect health and the physical and chemical properties of the atmosphere. Among combustion processes, biomass burning is one of the largest at global scale. We used a Proton Transfer Reaction "Time-of-Flight" Mass Spectrometer (PTR-TOF-MS), which couples high sensitivity with higher mass resolution, both in combination with the eddy covariance method to measure by-directional fluxes of VOC in a poplar-based short rotation coppice (SRC) plantation, and for real-time detection of a multiple VOC emitted by burned hay and straw in a barn located near our measuring station. Whereas abundant fluxes of isoprene, methanol and, to a lesser extent, fluxes of other oxygenated VOC such as formaldehyde, isoprene oxidation products (methyl vinyl ketone and methacrolein), methyl ethyl ketone, acetaldehyde, acetone and acetic acid, were exchanged between the poplar plantation and the atmosphere, we detected 132 different organic ions directly attributable to VOC emitted from the fire. Methanol, acetaldehyde, acetone, methyl vinyl ether (MVE), acetic acid and glycolaldehyde dominated the VOC mixture composition. The time-course of the 25 most abundant VOC, representing ~ 85% of the whole mixture of VOC, was associated with that of carbon monoxide (CO), carbon dioxide (CO_2) and methane (CH_4) emissions. The strong linear relationship between the concentrations of pyrogenic VOC and of a reference species (i.e. CO) allowed us to compile a list of emission ratios (ERs) and emission factors (EFs), but values of ER (and EF) were over estimated due to the limited mixing of the gases under the stable (non-turbulent) nocturnal conditions. In addition to the 25 most abundant VOCs, chemical formula and concentrations of the residual, less abundant VOCs in the emitted mixture were also estimated by PTR-TOF-MS. Furthermore, a time-resolved evolution of the complex combustion process was described on the basis of the diverse types of pyrogenic VOCs recorded.

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Determination of rare earth elements and Nobel metals in rock samples by inductively coupled plasma mass-spectrometry

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Inductively coupled plasma mass spectrometry (ICP-MS) is the most widely used technique for determination of rare earth elements (REEs) and Nobel metals (NMs) in different types of rock samples. The rock sample digestion stage should provide the completeness of the analyte transfer from a solid sample to liquid phase and, if possible, the minimization of the matrix elements concentration in the final solution. The concentration of elements in the solution to be analyzed after digestion of rock samples is reduced by one to two orders of magnitude. Besides, the spectral and non-spectral interferences caused by high concentrations of matrix elements reduce the sensitivity of mass spectrometric determination. Therefore, the preconcentration stage is usually needed. Different methods of rock sample digestion for final analysis by ICP-MS technique were investigated. To avoid problems with the introduction in ICP (the variation of plasma temperature, contamination of the sample introduction system and clogging of the cones) of high total dissolved solid concentrated solutions after fusion and compensate the loss of sensitivity preconcentration using Pol-DETATA (diethyltriaminetetraacetate), hyper-cross linked polystyrene and Strata X-AW (with ethylenediamine groups) sorbents were tested. Flow-injection mode was used for organic and high acidity eluates introduction to ICP-MS.

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