Influences of thermal degradation on lipid composition of crop plant biomass

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Lipids are main components of fresh crop plant biomass. Only low amounts of those lipids are able to be incorporated and stabilized in soils due to e.g. the removal of biomass upon harvest or immediate remineralization. Incorporation pathways of lipids from plant biomass towards soil organic matter have been intensively studied throughout the past decades. However, it still remains unknown how the lipid composition of plant biomass is modified by thermal degradation, e.g. during burning. Within this study, we will show the effect of thermal degradation of maize and rye straw at several temperatures based on the lipid composition.

Maize and rye-straw were degraded thermally at temperatures of 300°C, 400°C and 500°C. Free lipids were extracted using ASE and thereafter separated into five fractions (aliphatic and aromatic hydrocarbins, low polar components including alcohols and ketones, acids and a high molecular weight and high polarity fraction) via a sequential chromatographic clean-up using SPE and MPLC. Deuterated standards were added to the lipid fractions. Identifications and qautification were performed using a GC-MS after optional derivatisation.

The thermal degradation even at low temperatures (300-400°C) resulted in a reduction of the amounts of most lipid components, while the proportions of aromatic hydrocarbons were observed to increase. This was related to the incomplete combustion of the plant biomass forming new components at low temperatures. Especially at a temperature of 400°C large amounts of 3-6-ring PAHs including their alkylated counterparts were formed. At higher temperatures (500°C) more effective combustion resulted in lower concentrations of detectable aromatic hydrocarbons.

In contrast to predictable PAH formation, surprising results were obtained for the behaviour of carboxylic acid fractions. Similar to the other straight-chain lipids, the amounts of carboxylic acids decreased significantly with increasing temperature. But in contrast to other lipids like alkanes and alcohols, selected acids were still observable at 500°C. At 300°C preferentially straight-chain, branched, and unsaturated short-chain acids became relatively diminished in comparison to long-chain homologues. Conversially, higher relative proportions of short-chain acids were obtained upon combustion at 500°C. We postulate that these short-chain acids may have been extracted from organic components like black carbon, newly synthezised during the degradation process, which is subject of ongoing studies.

Constraining magmatic differentiation at Teide/Pico Viejo and associated rift zones, Tenerife, Canary Islands

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To unravel magma chamber processes and eruption triggers at the central volcanic complex Pico Teide/Pico Viejo (TPV) and its adjacent rift zones on Tenerife, we investigated 52 samples for their Sr isotope composition in feldspar phenocrysts. Processes such as magma mixing and contamination can be masked in whole-rock analyses, which merely represent the integrated average of all component parts involved (crystals, liquid, xenoliths). As feldspar crystals record prolonged crystallisation histories, we employ a micro-analytical approach to resolve magmatic processes. LA-MC-ICPMS represents the best means to a) yield a stratigraphy of Sr isotope ratios over core-to-rim profiles of single phenocrysts, i. e. a 'timeline' of the magma's isotopic evolution and b) to carry out a large number of analyses in a relatively short time.

$^{87}Sr/^{86}Sr$ has been analysed in plagioclase phenocrysts of the most recent eruptive products on Tenerife that built the TPV-complex and effused from the rift zones to the NW and NE over the last 35,000 yrs [1]. No correlation between $^{87}Sr/^{86}Sr$ and An content has been detected in feldspars of these deposits, in concordance with the results from other localities such as Merapi or Krakatau [2; 3].

Crystal populations are found to be very heterogenous amongst the sample suite and also within single samples [cf. 4], The latter may range from no significant variation in $^{87}Sr/^{86}Sr$ and An in some crystals to significant rises and subsequent falls of $^{87}Sr/^{86}Sr$ independent of associated An variations in others.

A wide array of processes including FC, AFC and magma mixing is suggested to influence the evolution of TPV and rift zone lavas, demonstrating a complex interplay of differentiation processes within the TPV plumbing system.

References

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