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## VOC analysis in soils – Extending SPME to SPME-trap and SPME-trap with enrichment.

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The ability of an agricultural soil to function and sustainably provide an increasing food supply for a rapidly increasing global population has become of vital worldwide importance. Traditionally, soil health has been determined on a physico-chemical basis with biological characteristics often being ignored. Although several biological methods have been proposed, to date, none of these methods adequately indicate soil health. One method proposed to correct these circumstances is profiling or fingerprinting the volatile organic compounds (VOCs) from soil. VOCs in soils originate from a large variety of biological sources; microbial, fungal, animal- and plant-derived. These volatiles are vital to plant/fungi-microbe and animal/human-microbe interactions and therefore offer a potential reactive, functional diagnostic tool to determine soil health by investigating the intra and interspecies interactions.

The standard methodology for VOC profiling has been solid phase microextraction (SPME). This automated VOC extraction method allows the monitoring of the community structure, physiological state, and activity of any microbial community in a soil without the need of manual extraction or cultivation procedures. Other common techniques that could be used to monitor the VOC fingerprints from soils include high capacity sorptive extraction (HCSE) or thermal desorption using sorbent-packed tubes for passive, in-situ sampling of soil gas.

Combining each of these techniques with an innovative cryogen-free focussing and pre-concentration trap has two main advantages:

- All extraction techniques can run on a single platform without the need to change the hardware.
- Single (SPME-trap) and multiple extractions (SPME-trap with enrichment) can be carried out automatically on a single sample to increase the analytical sensitivity, thus achieving a comprehensive VOC profile.

In this microcosm study, soils were treated in three different ways and their VOC profiles investigated. A 'good' soil comprised of brown earth and compost, a 'medium' soil of unaltered

brown earth and a 'bad' soil of brown earth held under eutrophic anaerobic conditions. 2 g of each soil was analysed with SPME-trap, SPME-trap with enrichment, HCSE and sorbent tubes. Both a targeted (phenol, p-cresol, isophorone, indole and trans- $\beta$ -ionone) and untargeted approach indicates that there are significant differences between the different soil types. By increasing the sensitivity of the untargeted approach with SPME-trap enrichment, this study was able to extend the number of VOCs identified, allowing a much more comprehensive VOC profile and possibility to determine the actual functions of specific VOC produced by the soil microbial community.