

# Review: Microbial Volatile Organic Compounds (mVOCs) emissions by soil

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# REVIEW: MICROBIAL VOLATILE ORGANIC COMPOUNDS (MVOCs) EMISSIONS BY SOIL

Letizia Abis<sup>1,2</sup>, Raluca Ciuraru<sup>2</sup>, Florence Lafouge<sup>2</sup>, Benjamin Loubet<sup>2</sup>, Maron P.A.<sup>3</sup>, Sophie Sadet-Bourgeteau<sup>3</sup>

<sup>1</sup> INRA, UMR ECOSYS, Sorbonne University UPMC /F-78850 Thieveral Grignon, France, letizia.abis@grignon.inra.fr

<sup>2</sup> INRA, UMR ECOSYS, AgroParisTech Environm & Grandes Cultures, F-78850 Thiverval Grignon, France

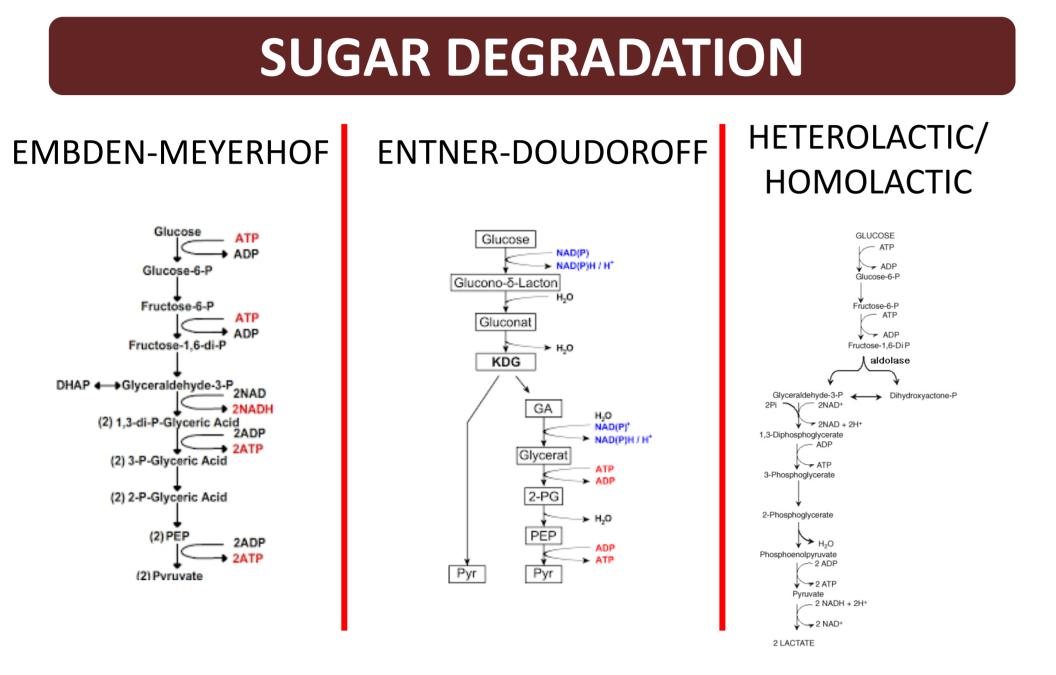
<sup>3</sup>INRA, UMR AgroEcologie, AgroSup Dijon, BP 87999, 21079 Dijon cedex, France

### **ABSTRACT**

Volatile Organic Compounds (VOCs) have a central role in the chemistry and composition of the troposphere. VOCs are precursors of atmospheric aerosols (PM 2.5) and tropospheric ozone (O<sub>3</sub>). Biogenic VOCs (bVOCs) are estimated to contribute up to 90% of the total VOCs emissions globally. One of the sources of bVOC is soil microorganisms, especially through sugar degradation but also through secondary metabolism processes. Microbial VOCs production in soils depends also on: nutrients, physiological state of the microorganisms, pH, temperature and oxygen availability.

The aim of this poster shows an overview of the existing knowledge on VOC emissions by microorganisms in soil, the reasons why VOCs are emitted and which are the metabolic pathway involved. A focus on the most used techniques to detect VOCs in soils is given and in particular advantages of PTR-MS technique are shown.

# METABOLIC PATHWAY FOR THE VOCs PRODUCTION



# PYRUVATE, GLYCERALDEHYDE-3-PHOSPHATE, LACTATE, ACETATE

PRECURSORS OF THE VOCS **FORMATION** 

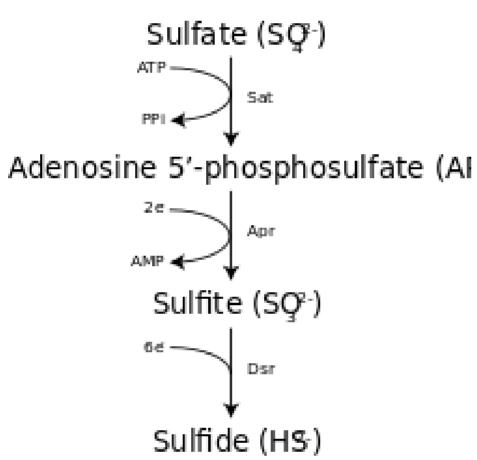
**SECONDARY METABOLITES:** play a central role in interorganismic interactions. Innumerous cases volatile and non-volatile metabolites secondary been defense and communication implicated in organisms.

### FATTY ACID DEGRADATION CoA + ATP -AMP1 PP1 < Saturated Saturated acyl-CoA 2-Enoyl-CoA Acyl-CoA R.CH=CHCO-S-CoA R.CH2CH2CO-S-CoA acylcarnitine Saturated acyl-3-Hydroxyacyl-CoA R.C-OH.HCH2CO-S-CoA R.C=0,CH2CO-S-CoA R.CO-S-CoA

## SULPHUR REDUCTION

Acetyl-CoA

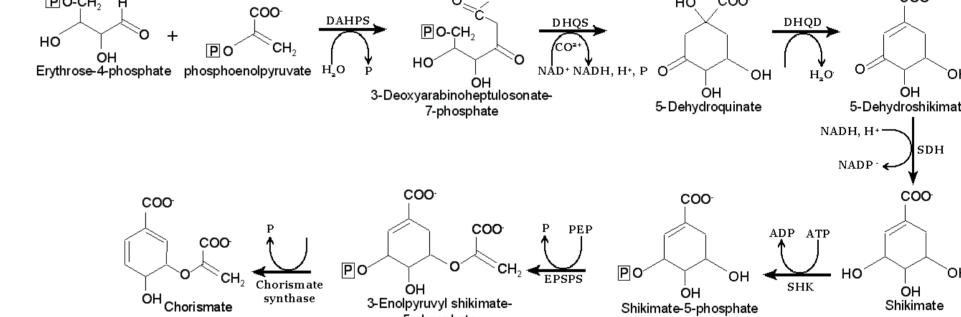
CH3CO-S-CoA



**MOST IMPORTANT VOLATILE SULPHUR COMPOUNDS** 

- H<sub>2</sub>S,
- methanethiol,
- dimethyl sulphide (DMS),
- dimethyl disulphide (DMDS)

dimethyl trisulphide (DMTS)



AMINOACID BIOSYNTHESIS

SHIKIMATE PATHWAY

**ALCOHOLIC FERMENTATION** 

2 ADP

2 NAD+

Glucose

CH<sub>3</sub>

2 Ethanol

2 ATP

2 NADH

CH<sub>3</sub>

CH<sub>3</sub>

2 Acetylaldehyde

2 CO<sub>2</sub>

2 Pyruvate

2-PHENYLETHANOL: ONE OF THE MOST WIDESPREAD **VOLATILE AROMATIC COMPOUNDS (synthetized by phenolopyruvate)** 

# WHAT CAN AFFECT MICROBIAL VOCs PRODUCTION

Microbial VOCs production in soils is strongly depending on:

1. NUTRIENTS 2. OXYGEN AVAILABILITY

they also depend on

**SOIL MOISTURE SOIL TEXTURE MICROBIAL ACTIVITY** pН

**TEMPERATURE** 

3. PHYSIOLOGICAL STATE OF THE MICROORGANISMS

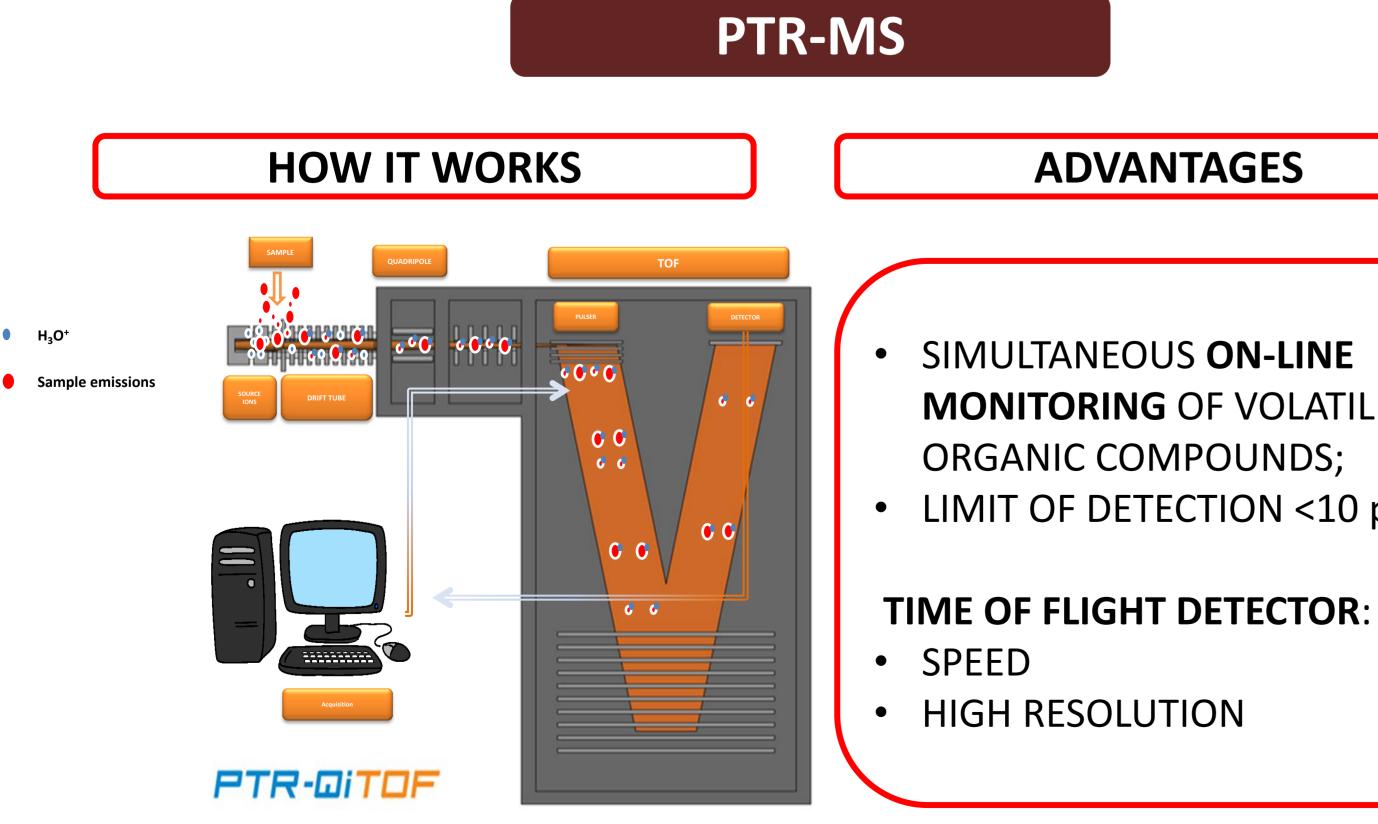
MOST INFLUENT PARAMETER

O<sub>2</sub> HIGHLY EFFECTIVE RESPIRATION

MICRO- AEROBIC OR ANAEROBIC CONDITION:

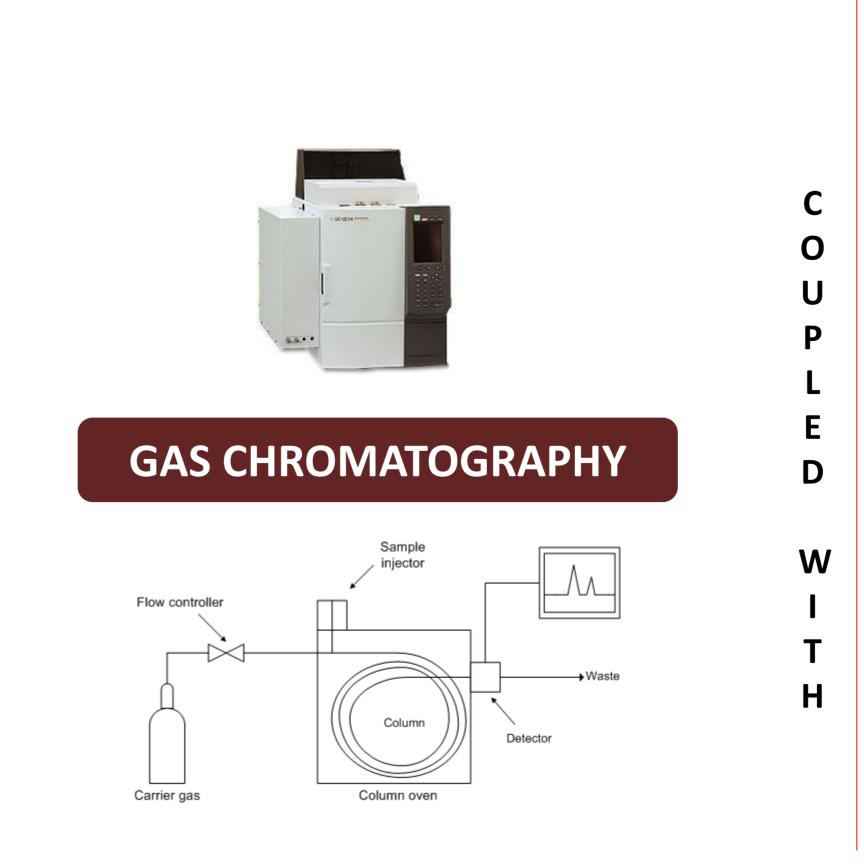
- C-org ARE THE END PRODUCT OF **HETERO** AND HOMOFERMENTATIVE PROCESS;
- DIVERSITY AND AMOUNT OF VOCS EMITTED **INCREASE**

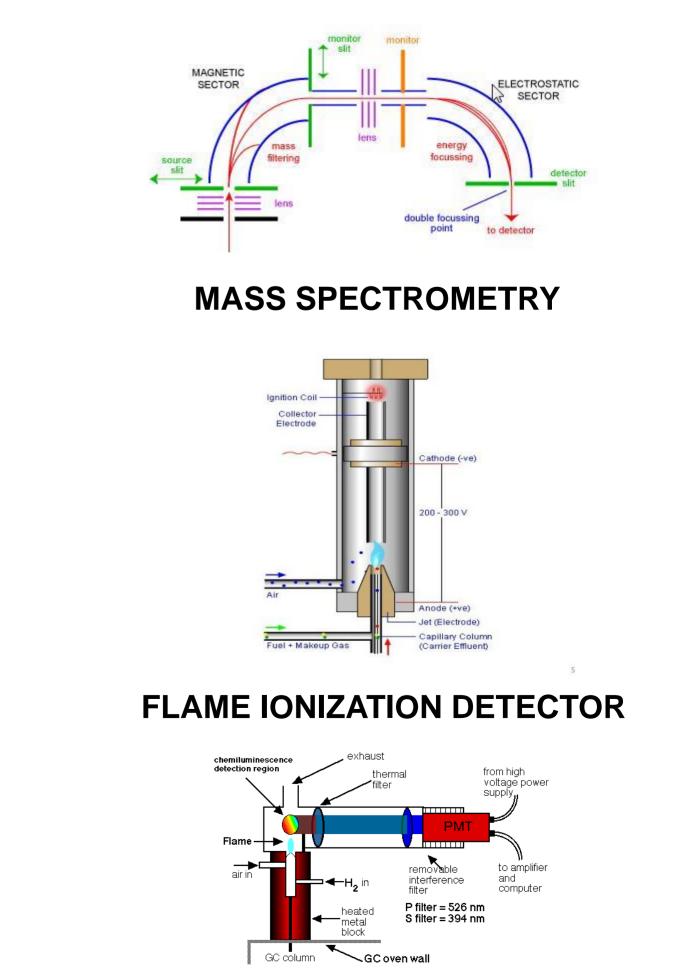
# **VOCs DETECTION TECHNIQUES**



## **ADVANTAGES**

- SIMULTANEOUS **ON-LINE MONITORING** OF VOLATILE ORGANIC COMPOUNDS;
- LIMIT OF DETECTION <10 pptv
- HIGH RESOLUTION





FLAME PHOTOMETRIC DETECTOR

THESE TECHNIQUES NEED A METHOD FOR THE VOCs EXTRACTION FROM SAMPLES (e.g. SOLID PHASE MICRO-EXTRACTION (SPME)