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# Input of organic pollutants to soil by compost and digestate application and their origin

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Schmid, P.<sup>4</sup>, Berger, U.<sup>5</sup>, Stahel, A.W.<sup>7</sup>, Stadelmann, F.X.<sup>ex2</sup>, and Tarradellas, J.<sup>ex8</sup>**


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## Overview

- What are organic pollutants?
- Inputs of organic pollutants to Swiss agricultural soils
- Trial of source apportionment
  - Profile of 16 PAHs
  - Characteristic ratios
- Take home message




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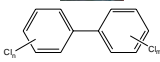
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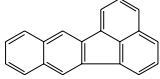
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## Organic pollutants.....

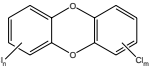
1969  organochlorine pesticides e.g. DDT



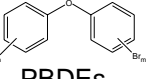
PCBs



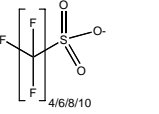
PAHs



PCDDs



PBDEs




PFASs

**main source: anthroposphere**


**effects: toxic, carcinogenic, endocrine disruptors...**

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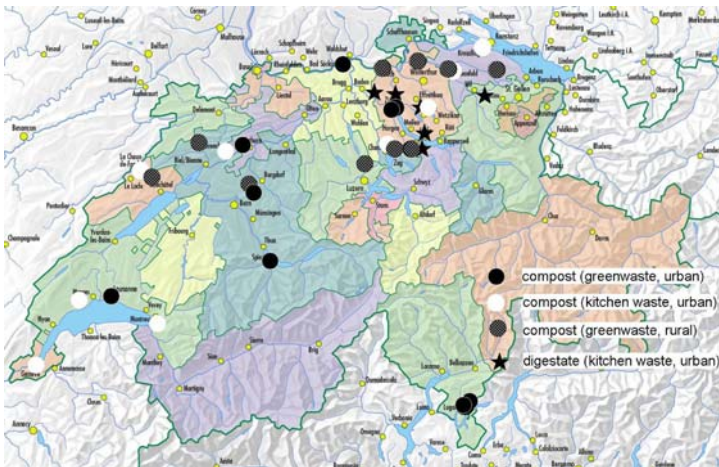


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## Sampling sites



80 samples were taken from 39 sites

- compost (greenwaste, urban)
- compost (kitchen waste, urban)
- compost (greenwaste, rural)
- ★ digestate (kitchen waste, urban)

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## Sampling and sample preparation



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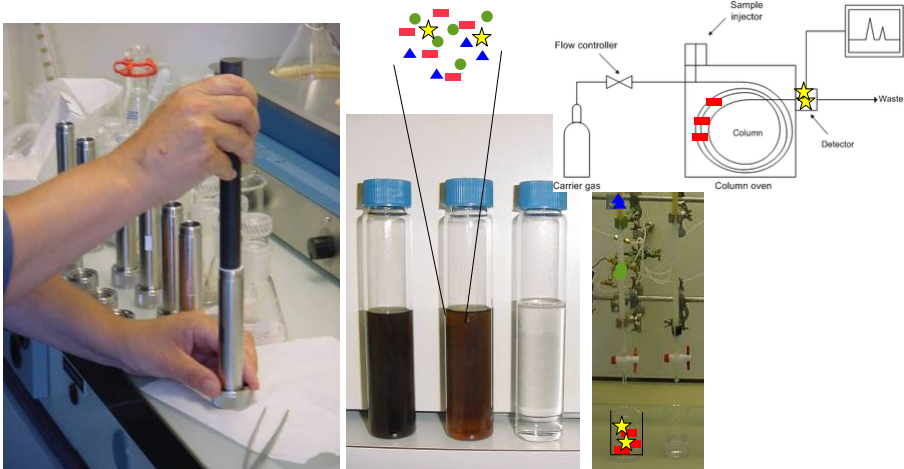
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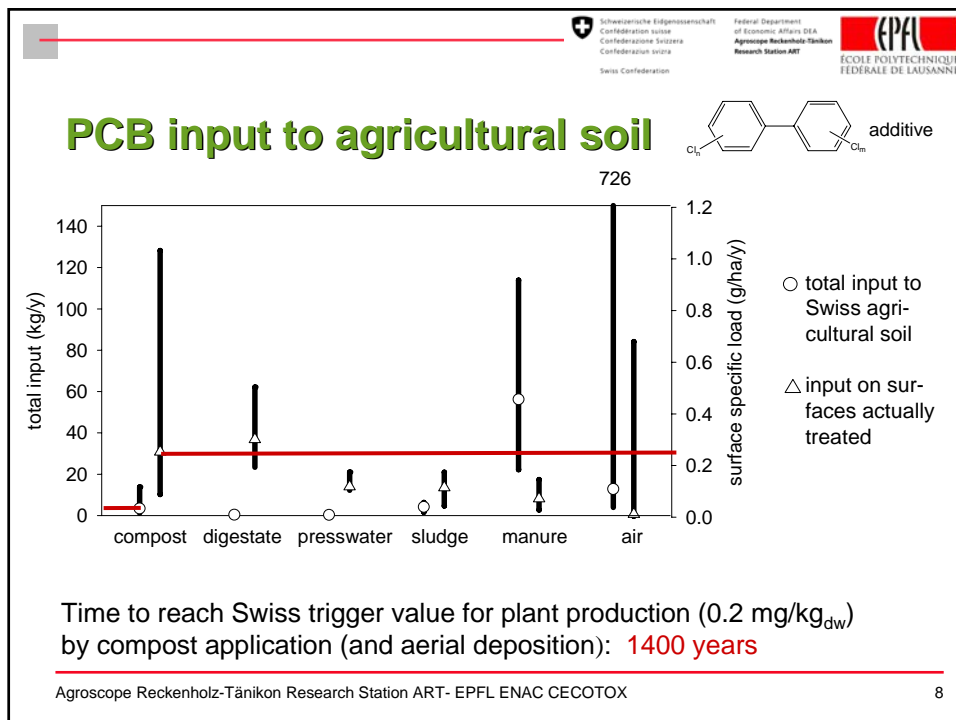
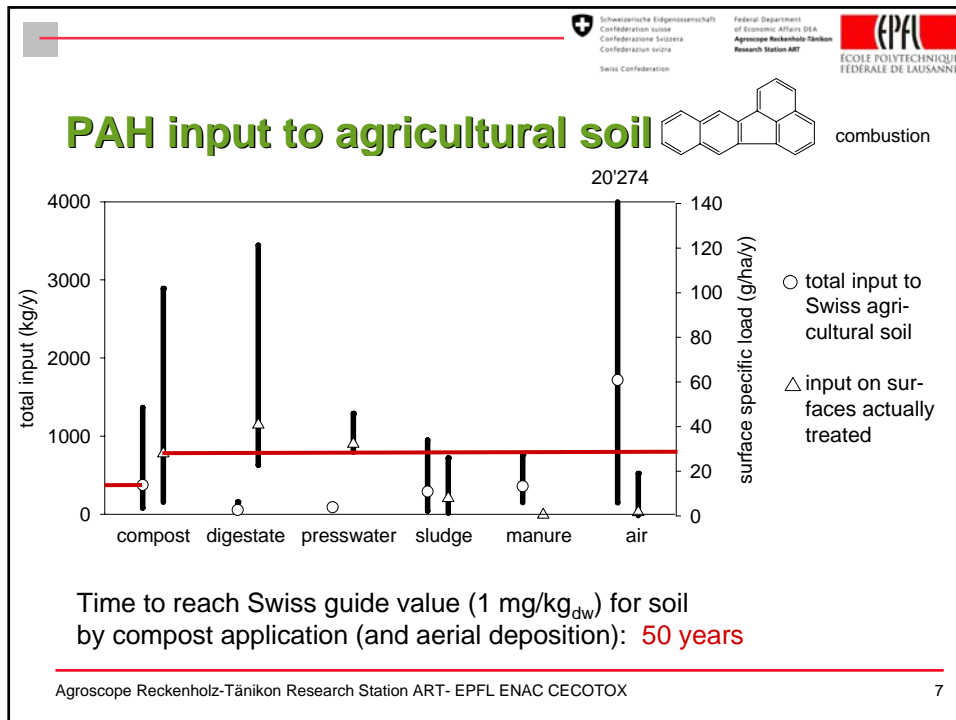
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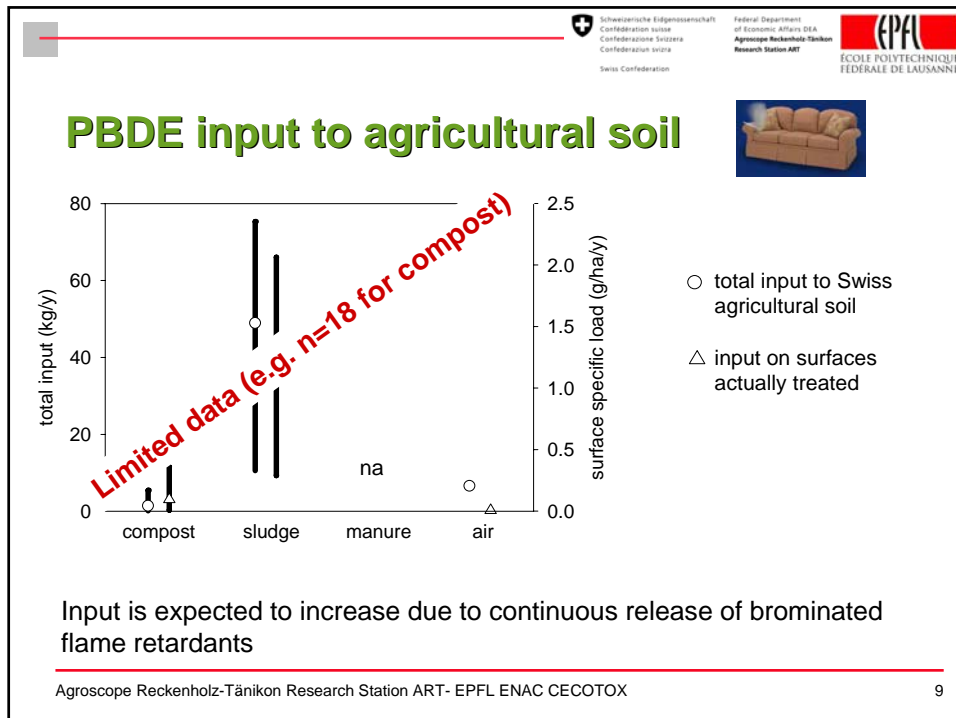
## Extraction, clean-up and detection



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- Take home message inputs of organic pollutants to Swiss agricultural soil**
- PAH concentrations in compost and digestate can be high and time to reach the Swiss guide value for soil is short
    - Reduction measures needed
  - PCB input to Swiss agricultural soil is low
    - very limited risk
  - PBDE input to Swiss agricultural soil seemed to be limited
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## Where do the PAHs in compost come from?


### An attempt of source apportionment

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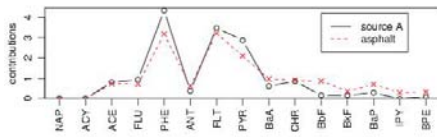
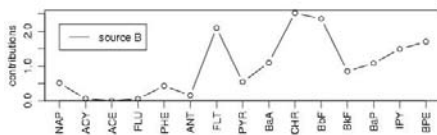
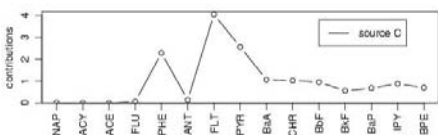
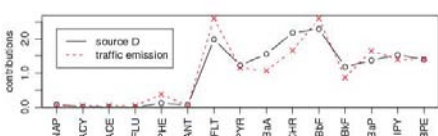
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## Taking the profile into account







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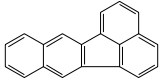


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## Characteristic Ratio and Marker Concept

- Petrogenic/Pyrogenic
  - ANT/(ANT&PHE)
  - BaA/(BaA&CHR)
  - FLT/(FLT&PYR)
  - IPY/(IPY&BPE)
  - ComPAH/(Σ16PAH)
  - (MPHE&ANT)/PHE
  - (MFLT&PYR)/PYR
  - 1,7-/ (2,7-&2,6-)DmpPHE
  
- Liquid fossil fuel and  
grass/wood/coal combustion
  - FLT/(FLT&PYR)
  - IPY/(IPY&BPE)
  - RET/(RET&CHR)
  - 1,7-/ (2,7-&2,6-)DmpPHE

- Traffic/non-traffic
  - BaP/BPE
  - 1,7-/ (2,7-&2,6-)DmpPHE
  
- Diagenic/pyrogenic
  - PER/Σ16PAH
  
- Marker
  - COR: vehicle exhaust
  - CPHE: pyrogenic marker
  - CPYR: wood or traffic marker




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## Evolution of ratios from emission to compost

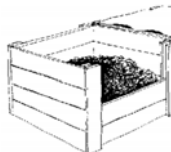
**Emissions**



**Input  
material**

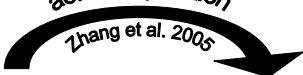


**Compost**



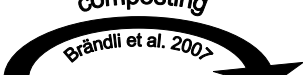
aerial deposition

Zhang et al. 2005




composting

Brändli et al. 2007

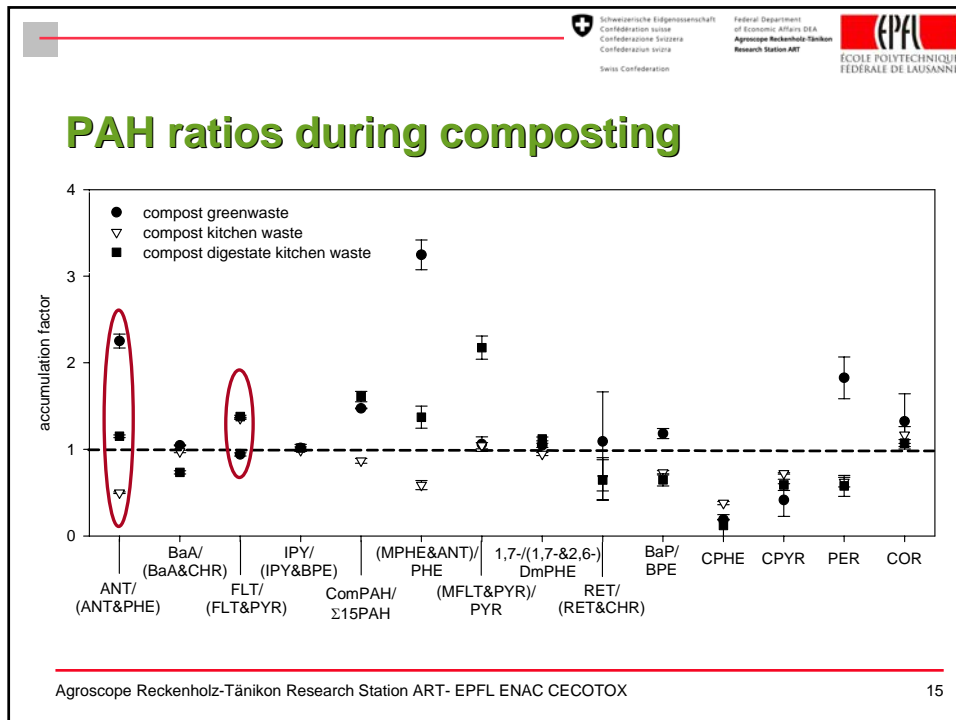


direct application



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**Petrogenic/Pyrogenic**


	sources	env.frac	composting
ANT/(ANT&PHE)			x
BaA/(BaA&CHR)			
FLT/(FLT&PYR)			√
IPY/(IPY&BPE)			
ComPAH/(Σ16PAH)			
(MPHE&ANT)/PHE			
(MFLT&PYR)/PYR			
1,7-/(2,7-&2,6-)DmPHE			

~ limited    √ suitable    x unsuitable    na: not available (yet)

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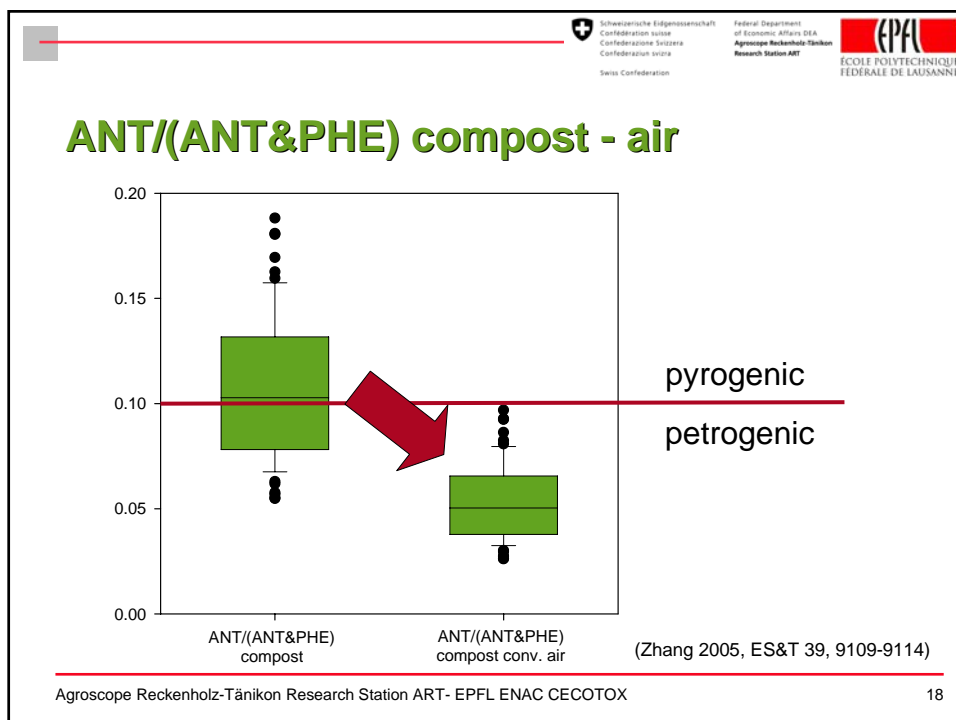
## Petrogenic/Pyrogenic

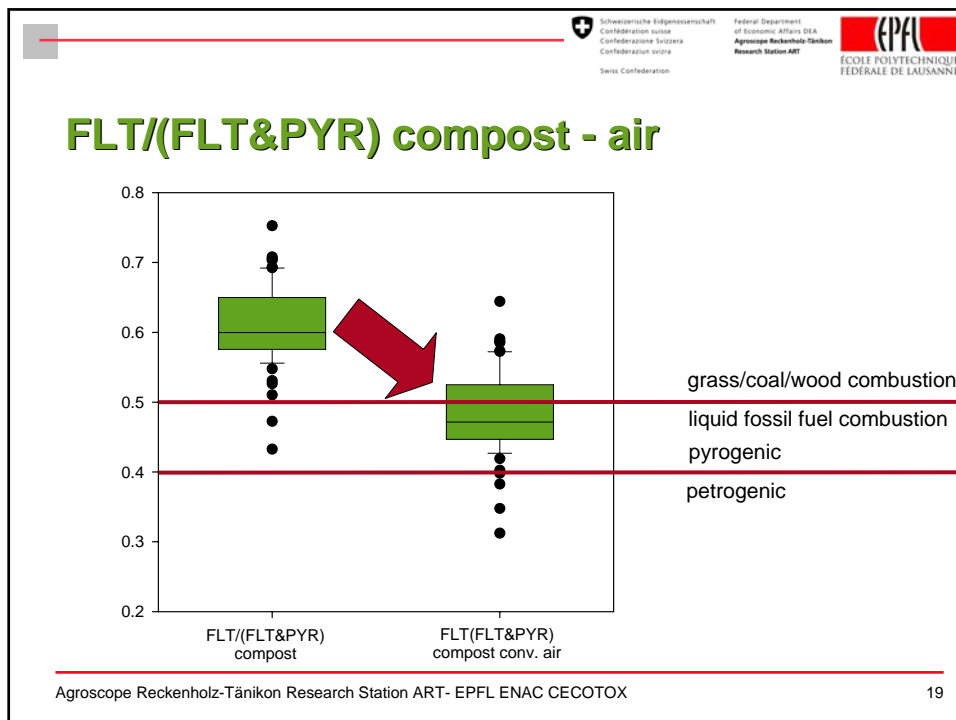
	sources	env.frac	composting
ANT/(ANT&PHE)			x
BaA/(BaA&CHR)			√
FLT/(FLT&PYR)			√
IPY/(IPY&BPE)			√
ComPAH/(Σ16PAH)			x
(MPHE&ANT)/PHE			x
(MFLT&PYR)/PYR			~
1,7-/(2,7-&2,6-)DmPHE			√

~ limited
√ suitable
x unsuitable
na: not available (yet)

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**Petrogenic/Pyrogenic**


	sources	env.frac	composting
ANT/(ANT&PHE)		x	x
BaA/(BaA&CHR)			√
FLT/(FLT&PYR)		√	√
IPY/(IPY&BPE)			√
ComPAH/(Σ16PAH)			x
(MPHE&ANT)/PHE			x
(MFLT&PYR)/PYR			~
1,7-/(2,7-&2,6-)DmPHE			√

~ limited    √ suitable    x unsuitable    na: not available (yet)

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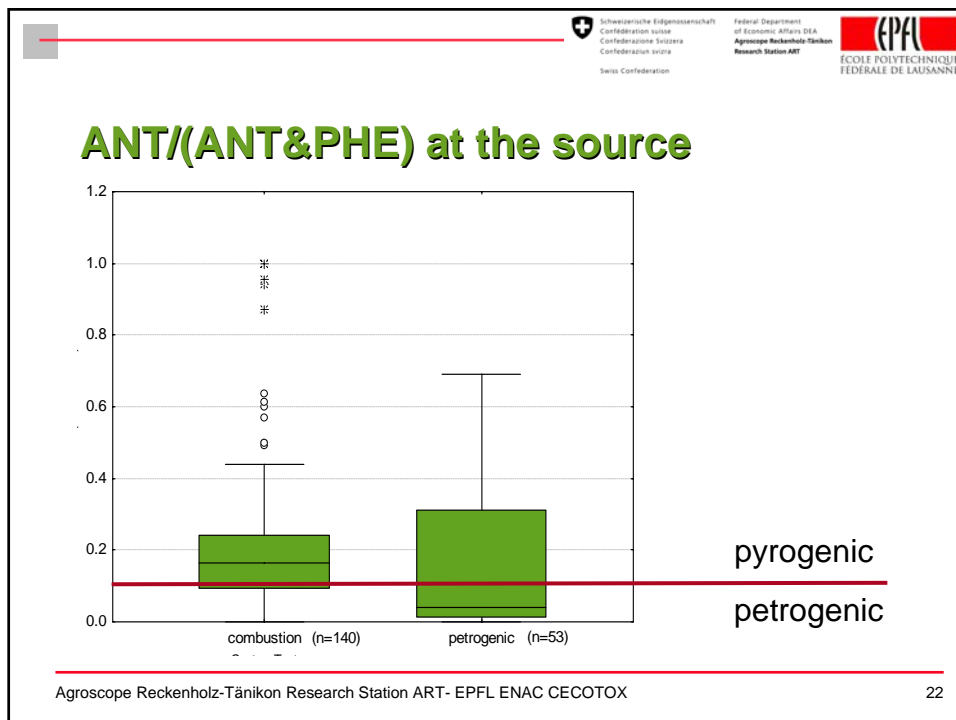
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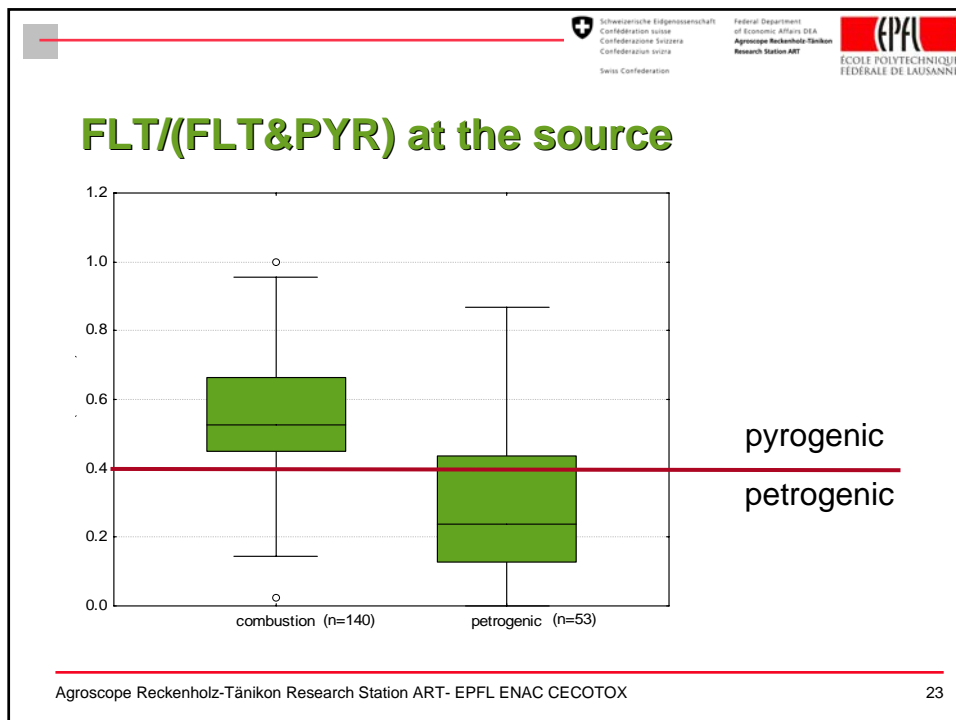
## Petrogenic/Pyrogenic

	sources	env.frac	composting
<b>ANT/(ANT&amp;PHE)</b>		<b>x</b>	<b>x</b>
<b>BaA/(BaA&amp;CHR)</b>		√	√
<b>FLT/(FLT&amp;PYR)</b>		√	√
<b>IPY/(IPY&amp;BPE)</b>		~	√
<b>ComPAH/(Σ16PAH)</b>		na	<b>x</b>
<b>(MPHE&amp;ANT)/PHE</b>		na	<b>x</b>
<b>(MFLT&amp;PYR)/PYR</b>		na	~
<b>1,7-/(2,7-&amp;2,6-)DmPHE</b>		na	√

~ limited
√ suitable
x unsuitable
na: not available (yet)

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**Petrogenic/Pyrogenic**

	sources	env.frac	composting
ANT/(ANT&PHE)	~	x	x
BaA/(BaA&CHR)		√	√
FLT/(FLT&PYR)	√	√	√
IPY/(IPY&BPE)		~	√
ComPAH/(Σ16PAH)		na	x
(MPHE&ANT)/PHE		na	x
(MFLT&PYR)/PYR		na	~
1,7-(2,7-&2,6-)DmPHE		na	√

~ limited      √ suitable      x unsuitable      na: not available (yet)

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### Petrogenic/Pyrogenic

	sources	env.frac	composting
ANT/(ANT&PHE)	~	<b>x</b>	<b>x</b>
BaA/(BaA&CHR)	~	√	√
FLT/(FLT&PYR)	√	√	√
IPY/(IPY&BPE)	~	~	√
ComPAH/(Σ16PAH)	~	na	<b>x</b>
(MPHE&ANT)/PHE	na	na	<b>x</b>
(MFLT&PYR)/PYR	na	na	~
1,7-/(2,7-&2,6-)DmPHE	na	na	√


~ limited      √ suitable      **x** unsuitable      na: not available (yet)

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### Petrogenic/Pyrogenic origin in compost and soil?

	sources	env.frac	composting	source app. (org./conv.)
ANT/(ANT&PHE)	~	<b>x</b>	<b>x</b>	
BaA/(BaA&CHR)	~	√	√	pyr/pyr
FLT/(FLT&PYR)	√	√	√	pyr/pyr
IPY/(IPY&BPE)	~	~	√	pyr/pyr
ComPAH/(Σ16PAH)	~	na	<b>x</b>	
(MPHE&ANT)/PHE	na	na	<b>x</b>	
(MFLT&PYR)/PYR	na	na	~	
1,7-/(2,7-&2,6-)DmPHE	na	na	√	pet/-

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### Liquid fossil fuel (1) and grass/wood/coal (2) combustion origin of PAH in compost and soil

	sources	env.frac	composting	source app. (org./conv.)
FLT/(FLT&PYR)	√	√	√	2/1
IPY/(IPY&BPE)	wood-liquid √ coal-liquid x	~	√	1/2
RET/(RET&CHR)	na	na	x	
1,7-/(2,7-&2,6-) DmPHE	na	na	√	pet/-

~ limited      √ suitable      x unsuitable      na: not available (yet)

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### Conclusion PAH ratios and molecular markers

- Characteristic ratio and marker concept is ambiguous even at emission
- PAH in Swiss soil and compost originated predominately from pyrogenic sources
- The farther from the source, the more difficult source apportionment in recipient matrices
- Also comparing compost profiles of the 16 PAHs with 600 literature profiles source apportionment was not possible

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**And many others!**

**Questions are very welcome**

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