Characterization of hot spots for natural chloroform formation: Relevance for groundwater quality

Ole Stig Jacobsen
Christian Albers
Troels Laier
### Chloroform sources

- **Natural**
  - Marine
  - Terrestrial
  - Geological
  - Estuarian
- **Anthropogenic**
  - Industrial use
  - Water works
  - Paper production

### Forest Research Sites
Concentration of chloroform in the soil

- Methods

Soil air concentration in ppt vol at 50 cm depth

Viborg Plantation / spruce / pine / beech / pasture
Productions measurements in the laboratory www.geus.dk

Chloroform net-production www.geus.dk

<table>
<thead>
<tr>
<th></th>
<th>Spruce</th>
<th>Beech</th>
<th>Pasture</th>
</tr>
</thead>
<tbody>
<tr>
<td>µg CHCl₃ m⁻² d⁻¹</td>
<td>245</td>
<td>156</td>
<td>63</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>11</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Total chlorine in Topsoil

<table>
<thead>
<tr>
<th></th>
<th>mg Cl / kg soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce</td>
<td>66.1797</td>
</tr>
<tr>
<td>Beech</td>
<td>66.1799</td>
</tr>
<tr>
<td>Grassland</td>
<td>66.1795</td>
</tr>
</tbody>
</table>

TOCl

inorganic Cl

www.geus.dk

Concentration of chloroform in the topsoil

- Hotspot results

Huge spatial variation:

70 m transect of soil air at 40 cm depth

Distance (m)

CHCl₃-conc. (ppbv)

www.geus.dk
Variability in soil air chloroform

Concentration of chloroform in the soil

www.geus.dk

More than 10 parameters like general microbial activity, pH, thickness of organic layer, SOM quality, chloride content, organic chlorine etc. did not explain variation

No visual difference in the field:

Chloroform Hot Spot
Chloroform Low Spot
Subsurface fate of chloroform in the soil

Seasonal variation and leaching

Sampling in Groundwater wells
• Production of Chloroform takes place in most soils
• Production is highest in coniferous forests and hotspots contribute significantly
• Chloroform is soluble in water and stays as long as the groundwater is oxic
• Chloroform is found in water of high age (>40 år)
• We can differentiate between natural and industrial Chloroform (isotopes)