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Effects of early diagenesis on the isotopic signature of wood (δ13C and δ15N): incubation in aquatic microcosm

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Introduction

1. Observations: Fungi as main decomposers?

Morphologies of the wood pieces before (t0) and after degradation (t1 to t6).

- A (DW) and B (RW) correspond to wood before (t0) and after 6 weeks (t6).
- a) brown-rotted areas = soft or black rot fungi
- b) brown fungi feeding on water and growing in the growth-rings
- c) rotten particles of wood (bottle and spongy traits)
- d) material which aspect = white-rot fungi
- e) color uniformisation = white-rot fungi

Distilled Water (DW) River Water (RW)

<table>
<thead>
<tr>
<th>Visual ASPECTS</th>
<th>Distilled Water (DW)</th>
<th>River Water (RW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dark color</td>
<td>Color uniformisation</td>
<td></td>
</tr>
<tr>
<td>Growth-rings brownish</td>
<td>Mottled &amp; Spongy traits</td>
<td></td>
</tr>
</tbody>
</table>

2. Microflora in powder

Functional diversity of the bacterial communities using Method BiologECO (Garland & Mills 1991)

- Similar community structure, but twice higher activity in DW than in RW

3. Degradation state

Mass loss of wood pieces vs time

- Leaching of table constituents (monosaccharides, amino acids...)
- Biotic degradation by (micro-)organisms like fungi

Bacteria are NOT the main decomposers Fungi are the main decomposers

4. Effects on the isotopic signature of wood pieces and powders

Carbon and Nitrogen

- Pieces: Low variability in δ13C and δ15N
- Loss of 13C-depleted compounds (cf. flotting particles; tannins, lignin, other non-polar compounds; Melillo et al., 1989)
- Powders: complex dynamic
- Key role of respiration leading to δ13C-enrichment

Distilled Water (DW) VS River Water (RW)

- Pieces of wood or powders
- T° = 22 °C - pH neutral
- Permanent Oxygenation (aerobic)
- Darkness (avoid photo-organisms development)
- 73 weeks (wood photo-organisms development)

Initial Variability (%)

<table>
<thead>
<tr>
<th>Elements</th>
<th>Average</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon</td>
<td>47.5</td>
<td>0.9</td>
<td>46.7, 48.3</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>9.0</td>
<td>0.2</td>
<td>8.0, 10.1</td>
</tr>
</tbody>
</table>

Average bacterial activity (AWCD*)

- Similar between pieces and powders
- Nitrogen gain in pieces in RW > δ15N-enrichment

Nitrogen loss in pieces in DW > δ15N-depletion

AWCD: (Average Well Colour Development) index showing the development of microorganisms on different tested substrates. It corresponds to the bacterial activity and diversity in the study environment (Zak et al., 1994; Zhao et al., 2013).

Conclusions

- δ13C values of organic matter has lower variability than δ15N values, which confirms its interest as a source and environment indicator
- Without invalidating the use of δ15N as a paleoenvironmental marker, this study shows that early diagenesis leads to the integration of isotopic compositions from multiple environmental origins that should be addressed when interpreting δ15N in soils and sediments

Acknowledgments

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