The mesolithic site Ullafelsen in the Fotsch Valley (Tyrol, Austria) – a biomarker perspective

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M Lerch, M Bliedtner, C Geitner, D Schäfer, JN Haas, S Szidat, R Zech, B Glaser
& Michael Zech

Heisenberg-Professorship for Physical Geography with focus on paleoenvironmental research

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TU Dresden
With the finding of „Ötzi“ in 1991, high mountain (geo-)archaeology received high attention.

Our motivation/aim:

to contribute to a better understanding of human-climate-environment interaction
1860 m asl, subalpine zone, mean annual precipitation of about 1500 mm

- rock hummock, gneiss, moraine cover
- grasses, herbs, dwarf-shrubs, *Pinus cembra*
- 25 m² excavation, 7931 artefacts, 14 fire places
- wood
- water
- stone tools
- hunting area
- cf. Kaseralmschrofen

- 1860 m asl, subalpine zone, mean annual precipitation of about 1500 mm
- rock hummock, gneiss, moraine cover
- grasses, herbs, dwarf-shrubs, *Pinus cembra*
- 25 m² excavation, 7931 artefacts, 14 fire places
- 20 AMS $^{14}$C-data (9.6-11.2 cal ka BP)
<table>
<thead>
<tr>
<th>Layer</th>
<th>pH ((\text{CaCl}_2))</th>
<th>C%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A_h</strong></td>
<td>3.7</td>
<td>16.4</td>
</tr>
<tr>
<td><strong>LL</strong></td>
<td>3.7</td>
<td>1.8</td>
</tr>
<tr>
<td><strong>B_{h}/fA_h</strong></td>
<td>4.1</td>
<td>10.7</td>
</tr>
</tbody>
</table>

One of the open questions: B_{h}-horizon due to podzolization or buried former topsoil \(fA_h\)?

Thin section analyses / \(^{13}\text{C}-\text{NMR} etc. provided no clear answer, hitherto.

LL: contains 62% of the artefacts → living floor
What are alkane biomarkers and why do we interrogate them?

alkanes are hydrocarbons and important constituents of **leaf waxes**

**Working hypothesis:**
Horizon contains alkanes → former topsoil $fA_h$; if it doesn’t contain alkanes → $B_h$ podzol horizon
What are alkane biomarkers and why do we interrogate them?

Alkanes are hydrocarbons and important constituents of leaf waxes.

Moreover:

\[ \frac{C_{31}}{C_{27}} \]

\( \rightarrow \) proxy for vegetation changes

Chemotaxonomy based on number of C-atoms (Lit):
- \( C_{27} \) & \( C_{29} \): trees
- \( C_{31} \) & \( C_{33} \): grasses and herbs
Result I: Chemotaxonomic differentiation of dominant vegetation

**Chemotaxonomic differentiation of dominant vegetation**

**Soil**
- Alkanes serve as plant-derived biomarkers
- \( \frac{C_{31}}{C_{27}} \) → proxy for vegetation changes

**Subalpine zone**
- Alpin grassland

**Chemotaxonomy based on number of C-atoms (Lit):**
- \( C_{27} \) & \( C_{29} \): trees
- \( C_{31} \) & \( C_{33} \): grasses and herbs
Result IIa: $B_h/fA_h$-horizon contains no alkanes $\rightarrow$ no $fA_h$!

Result IIb: Alkane $^{14}C$ dating from LL yielded 5 to 8 cal ka BP vs. 10 to 11 cal ka BP for charcoal! ;-)
Result III: Clear indication of vegetation change in alpine peats

→ 2 m and 9 cal ka BP environmental and climate archive
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