Supported lead in Pb-210 chronology
Daniela Pittauerová; Bernd Hettwig; Helmut W. Fischer

Institute of Environmental Physics, University of Bremen, Bremen, GERMANY
pittauerova@iup.physik.uni-bremen.de

Introduction
How does a possible supported 210Pb underestimation affect the 210Pb chronology?

The total signal of 210Pb in recent sediment profile consists of:
- supported 210Pb, which is present due to autigenic material of the sediment and
- unsupported (excess) 210Pb, which originates from the atmospheric deposition.


210Pb is usually assumed to be in radioactive equilibrium with its parent nuclide 226Ra (half-life 1600 yr).

210Pb analytical options using gamma spectroscopy:
- direct estimation using the 226Ra gamma line at 186.2 keV (interference with the 137Cs 185.7 keV gamma line and higher detection limits)
- using 226Ra daughter products (risk of 210Pb underestimation due to lack of radioactive equilibrium caused by Rn loss from the sample)

Two model sediment activity profiles

1) A simple profile

INPUTS:
Depth 30 cm
Slices 1 cm
Sedimentation rate 0.25 cm/yr
Initial total 210Pb activity 100 (rel.)
Supported 210Pb const., 25% of initial total 210Pb
Its underestimation 12%

2) A scattered (more realistic) profile

INPUTS:
The same as 1)
A scatter added (using normally distributed random number generator) to 210Pb and 210Pb sodom.
Error bars added.

Constant initial concentration (CIC) model:
(Robbins, 1978)
210Pb profiles were fitted by a simple 2 parameter exponential function using least square algorithm. Based on resulting parameters, sedimentation rates were calculated.

Constant rate of supply (CRS) model:
(Appleby and Oldfield, 1978)
For comparison, 210Pb profiles were used for calculation of ages according to CRS chronology model.

Comparison of chronologies derived by the CIC and CRS models

A simple profile
A scattered profile

Conclusions and outlook

Sedimentation rates (cm/yr) derived by the CIC model:

<table>
<thead>
<tr>
<th>Simple profile</th>
<th>Correct supported lead</th>
<th>Underestimated supported lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scattered profile</td>
<td>0.250</td>
<td>0.284 ± 0.004</td>
</tr>
<tr>
<td>Scattered profile</td>
<td>0.247 ± 0.024</td>
<td>0.280 ± 0.026</td>
</tr>
</tbody>
</table>

- Systematic underestimation of 210Pb by 12% leads to overestimation of sedimentation rates by over 13%. That results in underestimation of ages in 210Pb derived chronologies.
- On a realistic dataset (with scatter caused by counting statistics and other natural causes) the 210Pb overestimation can remain unobserved, and could also be attributed to not reaching the “dancing horizon”.
- The described effect will be strongest in environments with higher proportion of 210Pb.
- A method for testing and correcting possible underestimation of 210Pb in sediment profiles measured by gamma-spectroscopy is currently being developed.

References