Aerosol and Rainfall Sampling and Analysis for GEOTRACES

Bill Landing
Department of Oceanography
Florida State University
Tallahassee, FL 32306-4320
850-644-6037
wlanding@fsu.edu

GEOTRACES Mediterranean Planning Workshop
Oct. 4-6 2010  Nice
There is wide acceptance that aerosol Fe input strongly affects primary productivity.

Recent evidence (Paytan et al., 2009) indicates that toxicity of soluble aerosol copper can influence phytoplankton community structure.

Atmospheric nitrate deposition affects $\delta^{15}$N of nitrate in surface waters, confounding nitrogen fixation estimates.

Aerosol and rainfall sampling for trace elements and nutrients should therefore be part of GEOTRACES and SOLAS cruises.

The US equipment for collecting multiple types of aerosol samples, along with filtered and unfiltered rainfall, is available for GEOTRACES and SOLAS cruises.
GEOTRACES Hi-Vol Aerosol Samplers: Tisch-5170VBL (equipped with brushless motors) on RSMAS roof in September 2008 for 1\textsuperscript{st} GEOTRACES Aerosol intercalibration experiment.

Shipboard deployment would be on 03 or 04 decks (as high as possible. Sampling (ON/OFF) is controlled by wind speed and sector.
1\textsuperscript{st} and 2\textsuperscript{nd} Aerosol samplers use 20cm x 25cm filters: Whatman-41 (pre-cleaned) for inorganic TEIs and quartz microfiber (pre-baked) for N isotopes and organics.

Flow rates are 1.2 m\textsuperscript{3}/minute; 24-hour integrated sampling; >1,700 m\textsuperscript{3} of filtered air.

Filters can be subsampled for many groups and TEIs; Remaining filter will be archived (frozen).
3rd Aerosol sampler accepts a “Sierra-style” slotted impactor for size-fractionation studies (needed for modeling dry deposition and studies of particle chemistry as a function of particle size). >7.2, >3.0, >1.5, >0.95, >0.49, and <0.49 μm particle cut-offs. Filters can be subsampled; archived.
Modified sampler head to collect 12 replicate 47mm filters.
Event-based rainfall sampling with modified N-CON rain samplers. Lid design and movement minimizes splash into the bucket.

Pre-cleaned HD polyethylene funnels (attached to 500-1000mL receiving bottles) are inserted into the buckets.

25 cm funnel diameter (490cm²); 1 cm rain yields 490 mL.
Digestion methods comparison

• Heating
  – Microwave
  – Oven
  – Hotplate

• Acid mixtures
  – HNO₃
  – H₂O₂
  – HF (some with H₃BO₃)
Filter blanks and detection limits

Sample blanks and detection limits are similar for all filter types, indicating that cutting and handling during subsampling can be performed without contaminating filters.

<table>
<thead>
<tr>
<th></th>
<th>Strips</th>
<th>Disks</th>
<th>Impactor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28 strips per 8&quot; x 10&quot; sheet</td>
<td>13 discrete disks</td>
<td>9 slotted impactor strips per stage, 5 stages per frame</td>
</tr>
<tr>
<td></td>
<td>Average ng/cm²</td>
<td>StDev ng/cm²</td>
<td>Average ng/cm²</td>
</tr>
<tr>
<td>Al</td>
<td>21.1</td>
<td>9.1</td>
<td>27.4</td>
</tr>
<tr>
<td>Fe</td>
<td>4.22</td>
<td>0.53</td>
<td>1.58</td>
</tr>
<tr>
<td>Mn</td>
<td>0.052</td>
<td>0.006</td>
<td>0.019</td>
</tr>
<tr>
<td>V</td>
<td>0.015</td>
<td>0.002</td>
<td>0.005</td>
</tr>
<tr>
<td>Zn</td>
<td>1.21</td>
<td>0.55</td>
<td>1.64</td>
</tr>
</tbody>
</table>
Total Fe (W41; n=5)
Total Fe (Impactor; n=3)
Soluble Fe (W41; n=4)
W41 Digests summary

• But within individual labs, similar imprecision

  – Al  2% to 21%  <1% to 22%
  – Fe  6% to 17%  <1% to 19%
  – V   4% to 10%  <1% to 13%
  – Cd  Worst (73%)  3% to 51%
  – Co  Best  <1% to 28%
  – Ni  6% to 25%  <1% to 52%
  – Zn  ~30%  <1% to 32%
  
  Between labs  Within a lab
Results, to date

• Different digest methods = similar efficiencies
  *HF is essential for some elements*

• Imprecision *within* lab group similar to imprecision observed *between* lab groups (W41)
  *Wait to draw conclusions until more labs report*

• Some variability within soluble fraction results
  *Differences in extraction methods:
  Bulk equilibration vs. Flow-through extraction*
Acknowledgements

• Mike Trapp
• Joe Prospero
• Participating lab groups
• NSF
• Brian Kilgore
• Vincent Salters/NHMFL

• **Opportunities to participate!**
  
  Contact Bill Landing:
  [wlanding@fsu.edu](mailto:wlanding@fsu.edu)