

MEASURING AND MODELLING THE DYNAMIC RESPONSE  
OF REMOTE MOUNTAIN LAKE ECOSYSTEMS TO  
ENVIRONMENTAL CHANGE

A programme of **MO**untain **LA**ke **R**esearch

**MOLAR**

**PROTOCOL FOR SAMPLING FOR  
SPHEROIDAL CARBONACEOUS PARTICLE  
ANALYSIS**

**Neil Rose**

University College London

# The NEW Molar Protocol for Sampling for Spheroidal Carbonaceous Particle Analysis

All SCP samples should be sent to:

Neil Rose,  
Environmental Change Research Centre,  
University College London,  
26 Bedford Way, London WC1H 0AP, U.K.

e-mail: [nrose@geog.ucl.ac.uk](mailto:nrose@geog.ucl.ac.uk)  
Tel: +44 0171 387 7050 (ext. 5543)  
Fax: +44 0171 380 7565

## 1. Sediment cores

0.1 - 0.2 g of dried sediment should be sent from every level of the extruded sediment core. Samples should be sent in individual plastic bags, clearly labelled with site name and sediment depth. It is important that there is a good sediment water interface and that the cores are extruded following the coring protocol.

Cores will be analysed from:

WP2- Jorisee, Gossenkollersee, Redo, Øvre Neådalsvatn & Lochnagar  
WP3- Jezero Ledvich, Saanjarvi & Hagelsee

The following samples will be analysed for **SCP FROM WP2 SITES ONLY**:

## 2. Sediment traps

SCP will be analysed from the sediment trap samples from all WP2 sites. Traps should be deployed at approximately 1-2 m above the sediment/water interface and additionally about 2 m below the water surface. At Starolesnienske Pleso - only a single trap will be developed as the lake is only 4 m deep.

0.1 - 0.2 g of dried sediment is required (if possible) and all samples should be clearly labelled with site name, 'deep' or 'shallow' trap, and the period of deployment (e.g. 3rd Sept 1996 - 4th October 1996). **IT IS ALSO IMPORTANT TO KNOW THE TOTAL DRY WEIGHT OF SEDIMENT COLLECTED IN THE SEDIMENT TRAP OVER THE SAMPLING INTERVAL.**

Sediment traps need to be emptied annually for SCP. However, if the traps are being emptied more frequently for other areas of MOLAR then send sub-samples of these.

## 3. Snow

SCP are to be analysed from snow pack samples taken towards the end of the winter. The full snow profile should be taken in order to gain an SCP inventory for the winter period. Sampling should follow the snow pack protocol. The snow should be melted and then filtered through a Whatman GF/C filter. Fold the filter in half once, so that any filtered particles are enclosed and store each filter paper flat in an individual plastic bag. Clearly label each plastic bag with site name, date, 'Snow'. The bags should then be sent to Neil Rose at ECRC.

It is also important to include the following information with the samples. Date and location of sampling and the volume of snow melted and filtered for SCP.

## 4. Bulk Deposition

This is the most important parameter to be measured. Although frequent sampling to determine episodicity of deposition is of great interest, the most important measurement is the **TOTAL ANNUAL SCP DEPOSITION PER UNIT AREA** for the site. This can be calculated by adding up the more frequent depositions over a year or from an annual collector.

Please make sure that at least 500ml and preferably >1000ml is filtered for SCP. If there appears to be insufficient sample to filter for SCP then leave the collectors for two weeks or one month rather than a weekly sample. **THIS IS ESPECIALLY IMPORTANT FOR THE CLEANER SITES.**

A note should be made of the total wet deposition before removing the sample and then the walls of the collector should be washed with deionised water to remove any particulate matter sticking to the walls.

If a bulk deposition sampler is used for SCP **ONLY** then the whole sample should be filtered through a Whatman GF/C filter, if more analyses are to be done then a **KNOWN FRACTION** of the deposition should be filtered through a Whatman GF/C filter. As much sample as possible should be filtered for SCP. Filters should be folded once to include any particles and stored flat in an individual, labelled (site name, 'Bulk deposition', dates) plastic bag. These should be sent to Neil Rose. If the bulk deposition collector contains snow or ice, again, a known fraction should be sub-sampled for SCP, and melted before filtration.

**WITH EACH SAMPLE IT IS ESSENTIAL TO KNOW:**

- **THE SAMPLING INTERVAL DATES**
- **THE TOTAL AMOUNT OF WET DEPOSITION THAT HAS FALLEN OVER THE SAMPLING PERIOD**
- **THE FRACTION OF THE TOTAL THAT HAS BEEN FILTERED FOR SCP.**

**IF SAMPLES ARE STORED PRIOR TO FILTRATION, REMEMBER IT IS IMPORTANT TO HOMOGENISE THE SAMPLE BEFORE SUB-SAMPLING FOR SCP. FAILURE TO DO THIS WILL RESULT IN SCP SETTLING & INACCURATE RESULTS.**

## 5. Lake water

At least twice through the year (e.g. end of summer, end of winter is a minimum), **AT LEAST 20 LITRES** of lake water should be filtered through a Whatman GF/C filter. If necessary, more than 1 filter can be used to filter the required sample volume but please try to keep filter numbers to a minimum. Each sample bag should be labelled with site name, 'lake water', and the volume filtered.

As with the sediment trap work, **IT IS ESSENTIAL THAT THE TOTAL AMOUNT OF SUSPENDED MATTER IS ALSO KNOWN**. Therefore, please preweigh the filters prior to sampling. After filtering, dry and weigh the filter again so that the total amount of suspended matter can be calculated.

**AGAIN AT THE CLEANER SITES 20 LITRES MUST BE CONSIDERED A MINIMUM**. In addition to this sampling it is hoped to obtain the filters resulting from the large volume filtration work of the Barcelona group.

## **6. Soil core**

Soil coring is being done for the radionuclide work of Peter Appleby. This protocol is presented elsewhere. Soil cores are to be extruded in 1cm intervals down to 10cm and then at 2cm intervals below this. Please send a small sub-sample (0.2g dry weight) from each level of one core to Neil Rose for SCP analysis.

## **7. Streams**

It is important to get an estimate of SCP input and output via streams. Therefore as often as you can through the year please:

- filter at least 20 litres (more if possible) from each discrete inflow stream and the outflow.
- measure the volume of water flow in each stream.

An estimate of flow is important for many aspects of MOLAR. It maybe that a permanent flow gauge is established at the outflow. For inflows, dilution gauging may be the best approach. In addition, please record when the streams start and stop flowing, if applicable. Filters should be treated as above.

## **8. Littoral sediments**

If possible (and if your lake contains areas of shallow sediments) please send a sediment core from this area for SCP analysis. The core should be treated in exactly the same way as in (1) above.

## **9. Catchment and lake information**

The following information is required for the SCP model. Many of these may require estimates. Some may not be possible. Please send what you can. A complete list of all required measurements will be circulated to Site Operators.

- Lake area
- Area of lake surface overlying deep water accumulating sediments
- Area of littoral (the rest!)
- Fraction of littoral containing sediment material
  
- Lake volume
- Water residence time
  
- Catchment area

- % of catchment covered by bare rock
- Fraction of bare rock that runs off directly into lake only over rock i.e. no soil or vegetation between deposition point and lake edge
- % of catchment covered by soil and vegetation
  
- Radius of sediment traps
- Area of bulk deposition collector
  
- Accumulation rate of soil in catchment ? - **may not be possible**
- Rate of soil erosion ? - **may not be possible**
- Length of eroding shoreline ? - **may not be possible**
  
- Estimate of annual volume of water input by discrete streams - **from 7 above**
- Estimate of annual volume of outflow - **from 7 above**
  
- Length of deployment of deep water sediment trap (approx. annual) - **from 2 above**
- Total dry mass of sediment collected by deep water sediment trap - **from 2 above**
  
- Length of deployment of surface water sediment trap (approx. annual) - **from 2 above**
- Total dry mass of sediment collected by surface water sediment trap - **from 2 above**
  
- Mass of suspended solids per unit volume of lake water - **from 5 above**

## 10. Analytical Methods

For sediment and soil material the technique described in Rose (1994) will be used for SCP analysis. This involves the sequential removal of unwanted sediment fractions by chemical attack. HF, HNO<sub>3</sub> and HCl are used to remove silicates (biogenic and mineral), organic material and carbonates respectively. A known fraction of the resulting suspension is evaporated onto a cover-slip and counted under a microscope at x400 magnification.

All other samples (snow, bulk deposition, lake water) should be sent as GF/C filters. These readily dissolve in HF although a white BF<sub>3</sub> precipitate can sometimes form. This is dissolved using HCl leaving a suspension of particulates. Because of this precipitate formation, small GF/C filters should be used wherever possible and especially for the smaller sample volumes (e.g. bulk deposition). Filter number should also be kept to a minimum.

### References

Rose, N.L. (1994) A note on further refinements to a procedure for the extraction of carbonaceous fly-ash particles from sediments. J. Paleolim. 11: 201-204.

PLEASE REMEMBER THE FOLLOWING.....

- CLEARLY LABEL THE SAMPLES
  
- SUPPLY ALL THE REQUESTED INFORMATION FOR EVERY SAMPLE (e.g. volumes, dates etc) WHEN IT IS SENT
  
- INFORM Neil Rose IF ANY SAMPLES OR DATA ARE MISSING OR UNOBTAINABLE