

Processing Mineral Soil Samples

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Summary

This report describes the methods presently being used by the Alberta Biodiversity Monitoring Institute (ABMI) to process mineral soil samples. Mineral soil samples are collected from terrestrial sites and sent to an accredited laboratory for analysis of organic carbon and pH.

Sample Transfer from Field Crews to Temporary Storage

- Cloth soil bags containing composite mineral soil cores are placed inside a cooler and shipped via courier to the ABMI Processing Center at Royal Alberta Museum (see Terrestrial Field Protocols). The cooler prevents water loss, damage, and sample over-heating.
- All samples in the cooler are electronically recorded on a shipping manifest. A copy of the manifest is placed on a USB in a Ziploc and taped to the inside of the cooler lid.
- Samples are logged in when they arrive at the storage facility. Each shipment is assigned a lot number, and the samples are tracked by that number.
- A detailed description of the data log is provided in Appendix 1.
- The data log includes information about the date the lot arrived, the location where the samples are stored, the ABMI sites where the samples were collected, the number of mineral soil samples in the lot, and a detailed listing about each sample.
- The lab coordinator ensures that all mineral soil bags from each ABMI site are present in the storage facility and recorded in the log book.
- Mineral soil samples are removed from the cooler and placed in a moisture free environment for drying.
- If mineral soil samples are moved to a different location for temporary storage, the new location and the date of movement are recorded in the log book.

Mineral Soil Analyses

Mineral soil samples must be analyzed within 28 days of being collected.

Moving Samples to the Analyzing Laboratory

- To facilitate transport of the mineral soil samples, the ABMI lab coordinator places the samples in a shipping box lined with plastic.
- The box is transported via courier, or delivered by the lab coordinator if the distance is short, to a qualified soil laboratory.
- To be classified as a qualified soil laboratory, the lab must be accredited by and be in good standing with the Canadian Association for Laboratory Accreditation (CALA) or the Standards Council of Canada.
- Mineral soil samples are logged out of the storage location and into the analyzing laboratory. The laboratory coordinator records the new location and the date of transfer in the log book.
- Receiving personnel at the analyzing lab ensure that all mineral soil samples from each ABMI site have been received.

Analysis of the Mineral Soil Samples

- Mineral soil samples are analyzed for organic carbon and pH.

Organic Carbon

- Sample analysis follows Exova; Nelson and Sommers 1996; ISO 17025:
 - A sub-sample is obtained from each soil sample collected.
 - Catalytic tube combustion is used to separate elemental gases in adsorption columns.
 - A thermal conductivity detector is used to measure total carbon.
 - The soil is ignited at 500°C for 2 hours to burn off organic carbon, and then inorganic carbon is measured.
 - Organic carbon is calculated as: $C_{org} = C_{total} - C_{inorganic}$

pH

- Sample analysis follows Exova; McKeague 1978; ISO 17025:
 - A sub-sample is obtained from each soil sample collected
 - Soil pH is measured using 1:2, Soil: water Potentiometric Method.
 - The sample is dried and ground to pass a 2 mm sieve, then mixed with water in a 1:2 ratio and swirled for 30 ± 1 minutes creating a solution.
 - An electrode is placed in the soil solution and an electrical potential difference will develop.
 - The magnitude of the difference is proportional to the $[H^+]$ and therefore can be used to calculate pH.
 - A pH meter consisting of indicator and reference electrodes is calibrated in a buffer solution of pH 4.0, then adjusted to read 4.0, rinsed with distilled water and repeated at pH 7 and 10.
 - The pH of the soil solution is read against the pH meter.

Quality Control During Analyses***Organic Carbon***

- Farm soil standards and method blanks are analyzed at the same time as each ABMI soil sample group. The values obtained from the standards must be within $\pm 10\%$ of prepared values. If the values are not within $\pm 10\%$ of prepared values, the instruments are re-calibrated and the samples re-analyzed.
- Additional standards are analyzed for quality control (F. Maglalang, pers. comm. December 3, 2007). Duplicates are analyzed with every batch and every 10 samples within a batch. Duplicate results must be within 1 percent (absolute weight) or 20 percent (relative weight).

pH

- Farm soil standards and method blanks are analyzed along with the batch. Duplicate results must be within 0.3 pH units absolute for pH. The high and low limits must be within the control limits as set on the control chart.
- Additional standards are analyzed for quality control (F. Maglalang, pers. comm. December 3, 2007). Duplicates are analyzed with every batch and every 10 samples within a batch.

Data Management

- Results of the analyses are recorded by the soil lab on in-house data sheets, and entered into an electronic spread-sheet (see Appendix 2 for a copy of the spreadsheet format).
- The electronic spread-sheet is emailed to staff at the ABMI Processing Center, and a paper copy is mailed.
- Processing Center staff check the spread-sheet to ensure all the required information has been collected. Verified data is then sent to the Information Center.
- Processing Center staff send an email to the soil lab indicating the information from all samples has been received and is in good order. The soil lab then forwards the soil samples to the University of Alberta.
- In the log book, Processing Center staff record that mineral soil information has been obtained and the mineral soil samples have been shipped to M. Derek MacKenzie-Assistant Professor. University of Alberta - Renewable Resources. University of Alberta, 334 Earth Sciences, Edmonton, AB T6G 2E3

Literature

- Exova. (Unpublished). Measuring pH and Electrical Conductivity Soil. Edmonton, Alberta: Exova. Standard Operating Procedure.
- Exova. (Unpublished). Measuring Carbon and Nitrogen in Soils by Elementar Combustion. Fort St. John, British Columbia: Exova. Standard Operating Procedure.
- McKeague, J.A., ed. 1978. Manual on Soil Sampling and Methods of Analysis. 2nd ed.
- Nelson, D.W., and L.E. Sommers. 1996. Total Organic Carbon, Organic Carbon and Organic Matter. In: Sparks, D. editor. Methods of Soil Analysis Part 3 – Chemical Methods. SSSA Book Series 5. Madison (WI): Soil Science Society of America. Chapter 34.

Appendix 1. Data Log for ABMI Mineral Soil Samples

ID	RAM Project	Year	RAM Lot	Sample Type	Type Count	Site #	Site Quadrant	Collector	Collection Date	Arrival Date	Processing Location	Processing Deadline	Out Lab Date

Appendix 2. Data Sheets for Soil Analysis

Analytical Report Mineral Soil Analyzing Laboratory													
Company/Lot Information							Sample Information				Analyte		
Company	Project ID	Project Location	Lot ID	Date Received	Date Reported	Report Number	Sample Reference #	Sample Date	Sample Label Description	Matrix	Total Carbon (% Dry Weight)	Carbon Detection Limit	pH (1:2 Soil:Water) (pH units)