Soil processing from field soils (Quick reference in Appendix A)

**Data sheets are available in the Sample Data Sheets Excel file.

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Introduction

Soils fresh from the field must be processed quickly after collection. In order to ensure the validity of later analyses soils must be subsampled and dried by the type of analysis. Drying temperature is important as temperatures over 50°C can volatilize organic compounds and cause a loss of carbon and other nutrients (Boone et al. 1999).

Step 1:
Fresh (field condition) soil sieving

Introduction

Mineral soil is comprised of sand, silt, and clay particles that all measure less than 2 mm in diameter. To ensure that you are analyzing only mineral soil, field collected soils are sieved. Sieving also helps homogenize the soil by breaking up aggregates that can store soil organic matter.

Limitations

Soils that are predominantly clay or aggregated should be sieved through a 4 mm sieve and then air dried before further processing. Extremely wet or waterlogged soils are best dried prior to sieving. Soils can be air dried or oven dried at 50°C.

Equipment Needed

2 mm (No. 10) stainless steel sieve and bottom
Wire brush
Paper towels
Weighed Ziploc bags
Forceps
Balance

Procedure

1. Clean the sieve before starting with the wire brush on both sides of the mesh. Wipe any dust or dirt out of the sieve using a dry paper towel.
2. Pour soil into the sieve and gently shake the soil through the mesh.
3. Ensure that all of the soil has gone through the mesh by gently running your hand over the mesh surface and ensuring all aggregates are broken up.
4. After sieving the entire sample, pick out large roots. If you are subsampling for Elemental Analysis take a 5 g subsample and follow the root picking procedure outlined in Step 2 Section C.
5. Pour the sieved soil into a weighed Ziploc bag and record the weight.

Relevant equations and calculations

Bag weight should be subtracted from the total weight of the sample for soil and coarse fraction weights.

References

Boone, R.D., Grigall, D.F., Sollins, P., Ahrens, R.J., and Armstrong, D.E. (1999). Sampling, Preparation, Archiving, and Quality Control. Standard Soil Methods for Long-Term Ecological Research. Pp. 3-28. Oxford University Press.

Brady, N.C. and Weil, R.R. (2008). *The Nature and Properties of Soils*. Pp. 19-21. Pearson Prentice Hall.

Step 2:
Subsample for analyses

a) Gravimetric Water Content

Introduction

The availability of water is critical to primary production and the activity of soil microorganisms. To understand how soil water content affects these organisms and the availability of soil resources (e.g. nutrient availability), gravimetric water content is typically determined anytime other soil properties are measured. For more detailed discussion and alternate methods of determination see Robertson et al. (1999) or Dane and Topp (2002).

Equipment needed

Soil tins
Spoon or spatula
Kimwipes and isopropyl alcohol to clean spoon between samples
Desiccator and fresh desiccant
Coarse balance (0.01 g)
105°C oven

Procedure

1. Record soil tin weight. Mark bottom of tin with ID # or record existing tin #. Do not use Sharpie; engrave tins using a pen or pencil with ID number.
2. Place 20-30 g of sieved (<2 mm) soil into tin and weigh, this is your ***wet*** or ***pre-oven wt***. Record.
3. Place soil tins in 105°C oven for 24 to 48hr.
4. After at least 24hrs, place tins in desiccator to let cool for 15 minutes, then weigh your ***dry*** or ***post oven wt***. Do not remove all the samples from the desiccator at once to weigh and do not leave desiccator door open, samples will absorb moisture from the atmosphere and will gain wt; weigh in batches of 10 tins.
    a. Make sure the Drierite in desiccator is fresh (should be blue if fresh, purple if spent).

Relevant equations and calculations
Calculate the fraction of soil moisture (remember to subtract the tin weight from the wet and dry weights):

Soil Gravimetric Water Content (GWC) (i.e. based on mass) =

$$\frac{\text{wet soil (g) - dry soil (g)}}{\textbf{dry} \text{ soil (g)}}$$

Soil Moisture = (i.e. used for soil nutrient concentration calculations) =

$$\frac{\text{wet soil (g) - dry soil (g)}}{\textbf{wet} \text{ soil (g)}}$$

References
Robertson, G. P., Coleman, D. C., Bledsoe, C. S., & Sollins, P. (1999). *Standard soil methods for long-term ecological research*. Pg. 55-73. Oxford University Press.

Dane, J. H., Topp, C., Campbell, G. S., Horton, R., Jury, W. A., Nielsen, D. R., ... & Topp, G. C. (2002). Pg. 417-546. Part 4-Physical methods. *Methods of Soil Analysis*.

b) Archive sample

Introduction
Analyses that are not time or moisture sensitive can be carried out on air-dried soils. A subsample of soil is air-dried and stored to ensure that there is sample for any future work that may be carried out.

Equipment needed
Sieved soil sample
Envelopes, scintillation vials, etc.
Scoop or spatula
KimWipes and isopropyl alcohol
Sharpie
Clear lab bench or other space to dry samples

Procedure
1. Mix the sample well to ensure even distribution of particles.
2. Using a clean scoop or spatula put ~25 g of soil into a labeled envelope or other storage container.
3. Set the envelope upright in a box or out on the lab bench to dry for a minimum of 2-3 days.
4. Clean the scoop or spatula with a KimWipe and isopropyl alcohol.
5. Repeat with all samples.
6. Once dry the samples can be stored in a box or other container until needed.

c) Sample for Elemental Analysis (for C and N determination)

Introduction

Samples run on the EA must be dried prior to being analyzed. This is to ensure the carbon and nitrogen determined is from the soil not the soil water. Samples are dried at 55°C for 24-48 hours and kept in a dessicator to keep moisture at a minimum. This temperature is enough to rid the soils of the majority of the moisture present but not high enough to volatilize any carbon so the total carbon pool is accounted for.

Equipment Needed

Sieved soil sample
Envelopes, scintillation vials, etc.
Scoop or spatula
KimWipes and isopropyl alcohol
Sharpie
Oven set at 55°C
Forceps
2 mm reference
White pan

Procedure

1. Mix the sample well to ensure even distribution of particles.
2. Using a clean scoop or spatula weigh ~5 g of soil into a weigh boat or tin.
3. Pour the sample into the white pan and spread the sample around the base.
4. With forceps, pick out all roots longer than 2 mm that are light colored leaving darker pieces of decayed or decaying organic matter in the sample.
5. Continually mix the sample to ensure all roots have been picked from the entire sample.
6. Once finished transfer the sample to a tin being sure to get as much of the sample from the white pan.
7. Place the sample in an oven set to 55°C for 24-48 hours.
8. Remove the sample and store in a dessicator until rolled into tin boats*.
9. Clean the scoop or spatula with a KimWipe and isopropyl alcohol.
10. Repeat with all samples.

*see protocol for weighing tin boats for analyzing samples on the EA

References
LTER handbook pp. 13

d) Fresh soil

Some soil will need to be used immediately for analyses such as microbial assays, enzyme work, and pH. For this the remaining soil should be kept at 4°C until used. After all time and moisture sensitive work has been completed remaining sample

can then be air-dried and archived if needed. When all of the subsamples have been taken reseal the collection bag with as little air as possible and refrigerate.

Appendix A: