

Sep 22, 2025

🌐 Mineral Associated Organic Matter (MAOM) and Particulate Organic Matter (POM) Size Fractionation Protocol

DOI

dx.doi.org/10.17504/protocols.io.bp2l6z8o1gqe/v1

Thomas Muratore¹, Grady Welsh¹

¹Dartmouth College

Tumber-Dávila Lab

Tech. support email: grady.welsh@dartmouth.edu



Thomas Muratore

Dartmouth College

Create & collaborate more with a free account

Edit and publish protocols, collaborate in communities, share insights through comments, and track progress with run records.

Create free account

OPEN  ACCESS



DOI: <https://dx.doi.org/10.17504/protocols.io.bp2l6z8o1gqe/v1>

Protocol Citation: Thomas Muratore, Grady Welsh 2025. Mineral Associated Organic Matter (MAOM) and Particulate Organic Matter (POM) Size Fractionation Protocol. **protocols.io** <https://dx.doi.org/10.17504/protocols.io.bp2l6z8o1gqe/v1>

License: This is an open access protocol distributed under the terms of the **Creative Commons Attribution License**, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited

Protocol status: Working

We use this protocol and it's working

Created: September 10, 2025

Last Modified: September 22, 2025

Protocol Integer ID: 226924

Keywords: mineral associated organic matter, particulate organic matter, maom fraction, pom fractionation procedure, chemical fractionation step, interests in the maom fraction, organic matter, size fractionation protocol purpose, associated organic matter, soil, based fractionation approach, fractionation approach, size into sand, mineral, mineral surface, microbial residue, different fraction, particle size, particulate, maom, maom form, fraction, soil carbon dynamic, sand, persistent sides of soil, organic compound, complementary aspects of soil carbon dynamic, sodium hexametaphosphate, microaggregate, term carbon reservoirs on earth

Abstract

Purpose: The aim of this protocol is to fractionate soils based on particle size to recover mineral-associated organic matter (MAOM) and particulate organic matter (POM) fractions. In the MAOM/POM fractionation procedure, soils are dispersed in sodium hexametaphosphate (HMP) to disrupt microaggregates, and subsequently separated by size into sand (> 53 μm) and silt + clay (<53 μm) fractions. This is a simple size-based fractionation approach to isolate particulate organic matter (POM) and mineral-associated organic matter (MAOM) fractions, recommended in a comprehensive methods review by Poeplau et al. (2018) and adapted from Sanderman et al. (2013). Depending on your interests in the MAOM fraction, an additional density or chemical fractionation step may be paired with this approach to further isolate putatively stable pools of SOM (see Poeplau et al., 2018 and data on corresponding turnover times associated with different fractions).

Studying these fractions is particularly exciting because they represent two contrasting but complementary aspects of soil carbon dynamics. POM, consisting of plant and microbial residues, is a highly active pool that turns over rapidly and provides a direct window into how fresh carbon inputs are cycled through the soil. By contrast, MAOM forms when organic compounds bind tightly to mineral surfaces, creating one of the most stable long-term carbon reservoirs on Earth. Together, they capture both the dynamic and the persistent sides of soil organic matter: the short-term energy fueling microbial processes and the long-term storage that underpins soil's role in climate regulation.

Guidelines

Procedure

1. Soil Preparation

1. Air-dry soils completely before beginning the fractionation procedure.
2. Weigh **5.00 g** of air-dry soil into a 50 mL conical tube. **Record exact mass.**

2. Dispersal

3. Prepare 0.5% HMP solution: dissolve 5 g sodium hexametaphosphate in 1 L DI water.
4. Add **15 mL** of 0.5% HMP solution (1:3 ratio of soil:solution) to each tube containing 5 g of soil.
5. Cap tubes and place on shaker table. Shake **vigorously for 18-24 h** to fully disperse microaggregates.

3. Sieving and Rinsing

6. After shaking, position a clean **53 µm sieve** over a clean collection basin (plastic weigh boat).
7. Prewet the sieve with some 0.5% HMP.
8. Pour a small portion of the soil slurry onto the clean sieve at a time.
9. Rinse soil through sieve using **200 mL of HMP solution** (measure carefully with graduated cylinder). 200 mL must pass through the sieve.
 - Pour/rinse solution evenly over the soil on the sieve, avoiding direct pressure with your hands.
 - Swirl or gently tap the sieve frame to encourage fine particles to pass through.
 - Take your time.

10. Once collection basin is clear, you know you have collected majority of the POM. Take your time. This is a long process.

5. Collecting the MAOM Fraction (<53 µm)

13. Periodically, collect the MAOM slurry that passed through the sieve in the weigh boat to avoid over filling the weigh boat.
14. Pour the MAOM slurry from the collection basin into **4 × 50 mL conical tubes** (fill to just below the 50 mL mark).

- If more volume remains, use additional conical tubes if necessary (try to keep to 4 tubes per sample to simplify centrifugation).

4. Collecting the POM Fraction (On Sieve)

9. Using the DI squirt bottle, rinse POM (on top of the sieve) toward one edge of the sieve and collect it into a **pre-weighed aluminum tin**.

10. Record the tin weight with its label before adding POM.

11. Place POM tins into a drying oven set to **60 °C for ≥24 h**.

12. After drying, reweigh the tin + POM to calculate dry POM mass.

6. Centrifugation of MAOM conical tubes

16. **Balance the tubes** carefully: use DI water to bring all tubes to the same weight (within 1 g of each other).

17. Load tubes into the centrifuge(s). Always ensure each rotor is fully balanced before starting.

18. Centrifuge at **10,000 RPM for ~10 min**.

- If pellets are too compact and hard to resuspend, try slightly lowering the RPM in future runs.

19. Carefully decant the supernatant into a waste container, leaving a small layer of water above the pellet to prevent loss.

7. Pellet Recovery and Drying

20. Resuspend each pellet in a small amount (5 mL) of DI water by gently swirling or pipetting.

21. Transfer the slurry into a **pre-weighed smooth aluminum tin** (avoid tins with wrinkles where MAOM could get trapped).

22. Record tin weight with label before adding MAOM.

23. Place tins into oven set to **105 °C** and dry 24 hrs.

24. After drying, weigh tins again to determine MAOM dry mass.

Notes and Tips

• **Tube Management:** Keep track of which tubes belong to which sample (label each tube with sample ID + tube number).

- **Water Use:** Be conservative with DI water use, especially during sieving.
- **Balancing Tubes:** Poorly balanced tubes may damage centrifuge — check carefully before spinning.
- **Pellet Care:** Decant supernatant slowly to avoid losing MAOM pellet.
- **Data Sheet:** Use a standardized spreadsheet to track:
 - o Tube weights (before/after filling)
 - o Oven times and temperatures
 - o Final dry weights of POM and MAOM fractions
 - o Centrifuge RPM and time settings

Materials

- 0.5% Sodium hexametaphosphate (HMP) solution (5 g HMP / 1 L DI water)
- 53 μm sieve (4-inch diameter)
- Balance (calibrated, 0.01 g precision)
- 50 mL conical tubes for pre-weighting samples in and shaking samples in HMP.
- 4 \times 50 mL conical tubes (fill to just below the 50 mL mark) (noted in procedure for MAOM collection)
- Shaker table
- Squirt bottle with DI water
- 200 mL graduated cylinder (for measuring HMP rinse volume) or some other method.
- Plastic weigh boats (v shaped or hexagonal for easy pouring)
- Pre-weighed smooth aluminum tins (labeled for each sample; avoid tins with wrinkles where MAOM could get trapped)
- Smooth aluminum drying tins (4-inch diameter)
- Centrifuge with rotor compatible with 50 mL tubes (can spin ≥ 8 tubes simultaneously)
- Drying ovens (**60 °C for POM, 105 °C for MAOM**). **You must dry MAOM fraction in aluminum tin but can dry POM in a plastic tin.**
- Clean collection basin (e.g., plastic weigh boat)
- Small volume pipettes or means to resuspend pellets (for ~5 mL DI water additions)

Troubleshooting

Safety warnings

- **Balancing Tubes:** Poorly balanced tubes may damage centrifuge — check carefully before spinning.
- **Water Use:** Be conservative with DI water use, especially during sieving.
- **Pellet Care:** Decant supernatant slowly to avoid losing MAOM pellet.

Before start

Air-dry soils completely before beginning the fractionation procedure.



Soil Preparation

1 Air-dry soils completely before beginning the fractionation procedure.

2

Note

Weigh 5.00 g of all samples before doing fractionations. Confirm all samples are accounted for.

Weigh **5.00 g** of air-dry soil into a 50 mL conical tube. **Record exact mass.**

Dispersal

3

Note

Soils that have more clay may require more HMP. Instead of 0.5% try up to 5% HMP. We can confirm how well the HMP is dispersing soil by looking at the first few POM fractions and visually confirming soils have been separated using a stereo microscope.

We will be using a lot of HMP and will likely be returning to this step many times throughout the processes.

Prepare 0.5% HMP solution (W/v): dissolve 5 g sodium hexametaphosphate in 1 L DI water.

4

Note

Only do this step for the number of samples you are prepared to do the next day for fractionation. To start, 1-2 samples is probably good but as you get better you can increase this to 4 or more depending on how efficient you have gotten at the fractionation.

Add **15 mL** of 0.5% HMP solution (1:3 ratio of soil:solution) to each tube containing 5 g of soil.

5 Cap tubes and place on shaker table horizontally. Shake **vigorously for 18-24 h** to fully disperse microaggregates.

Sieving and Rinsing



- 6 After shaking, position a clean **53 μm sieve** over a clean collection basin (plastic v-shaped weigh boat).
- 7 Prewet the sieve with some 0.5% HMP.
- 8 Pour a small portion of the soil slurry onto the clean sieve at a time.

Note

If you add too much soil slurry at once you will clog the sieve and it will take longer and be more difficult.

- 9 Rinse soil through sieve using **200 mL of HMP solution** into the weigh boat (measure carefully with graduated cylinder and add to squirt bottle). 200 mL must pass through the sieve.
 - 9.1 Pour/rinse solution evenly over the soil on the sieve, avoiding direct pressure with your hands.
 - 9.2 Swirl or gently tap the sieve frame to encourage fine particles to pass through.
 - 9.3 Take your time.

Collecting the MAOM Fraction (<53 μm)

- 10 Periodically, collect the MAOM slurry that passed through the sieve to avoid over filling the weigh boat.
- 11 Pour the MAOM slurry from the collection basin into **4 \times 50 mL conical tubes** (fill to just below the 50 mL mark).
 - 11.1 If more volume remains, use additional conical tubes if necessary (try to keep to 4 tubes per sample to simplify centrifugation).

Completing MAOM Fraction



- 12 Once collection basin is clear (no longer cloudy with clay particles, you know you have collected majority of the MAOM. Take your time. This is a long process.

Collecting the POM Fraction (On Sieve)

- 13 **Record the tin weight with its label before adding POM.**
- 14 Using the DI squirt bottle, rinse POM fraction (on top of the sieve) toward one edge of the sieve and collect it into a **pre-weighed aluminum tin**.
- 15 Place POM tins into a drying oven set to **60 °C** for ≥ 24 h.
- 16 After drying, reweigh the tin + POM to calculate dry POM mass.

Centrifugation of MAOM conical tubes

- 17 **Balance the tubes** carefully: use DI water to bring all tubes to the same weight (within 1 g of each other).
- 18 Load tubes into the centrifuge(s). Always ensure each rotor is fully balanced before starting.

19

Note

It is unlikely that the centrifuge that we have in the lab will spin up to 10k RPM. Instead just spin at "Full" speed.

Centrifuge at **10,000 RPM for ~10 min**.

- 19.1 If pellets are too compact and hard to resuspend, try slightly lowering the RPM in future runs.
- 20 Carefully decant the supernatant into a waste container, leaving a small layer of water above the pellet to prevent loss.



Pellet Recovery and Drying

- 21 Resuspend each pellet in a small amount (5 mL) of DI water by gently swirling or pipetting.
- 22 Transfer the slurry into a **pre-weighed and pre-labeled** smooth aluminum tin (avoid tins with wrinkles where MAOM could get trapped).
- 23 **Record** tin weight with label before adding MAOM.
- 24 Place tins into oven set to **105 °C** and dry 48 hrs.
- 25 After drying, weigh tins again to determine MAOM dry mass.

Protocol references

Poeplau et al. (2018); Sanderman et al. (2013).