South Florida / Caribbean Network

National Park Service
Inventory & Monitoring Division

Standard Operating Procedure SET06

Measuring Accretion with a Feldspar Marker Horizon—Version 1.00

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Summary

The following standard operating procedure (SOP) outlines the process of establishing a marker horizon made from white feldspar mineral and measuring the sediment accreted on top of the feldspar layer using a cored plug method. The following procedures for feldspar marker horizon installation and sampling—part of the South Florida / Caribbean Network mangrove surface elevation table (SET) monitoring—are adapted from procedures from the United States Geological Survey (USGS) Patuxent Wildlife Research Center website (see "Establishing Marker Horizons" in Cahoon and Lynch 2003, available at: http://www.pwrc.usgs.gov/set/installation/markers.html) and the Louisiana Department of Natural Resources (DNR) coastal restoration protocol (Folse and West 2004), and from the Southeast Coast Network SOP *Measuring Accretion with a Feldspar Marker Horizon* (Asper and Curtis 2012).

Revision Log

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #

Overview

Soil surface change measured by the rod surface elevation table (RSET) is influenced by both surface and subsurface processes occurring in the soil profile, whereas depth to the feldspar marker horizon measures only surface accretion (Cahoon et al. 1996, Figure 1). When these two techniques are used in conjunction, they can provide information on below-ground processes that influence elevation change (Cahoon et al. 1995).

Accretion will be measured by the establishment of three 0.5 × 0.3 meter (m) accretion plots systematically placed around a platform. Accretion plots are to be established on the same day that the initial RSET readings are recorded. This gives the best known baseline for both the accretion and RSET data sets to be interpreted when analysis occurs. The marker horizon is white feldspar mineral that is evenly sprinkled on the surface of the wetland within the accretion plot, upon which sediments naturally settle and accrete. Depth to the feldspar marker horizon is then measured at the three replicate plots each time the SET is sampled by the coring plug method.

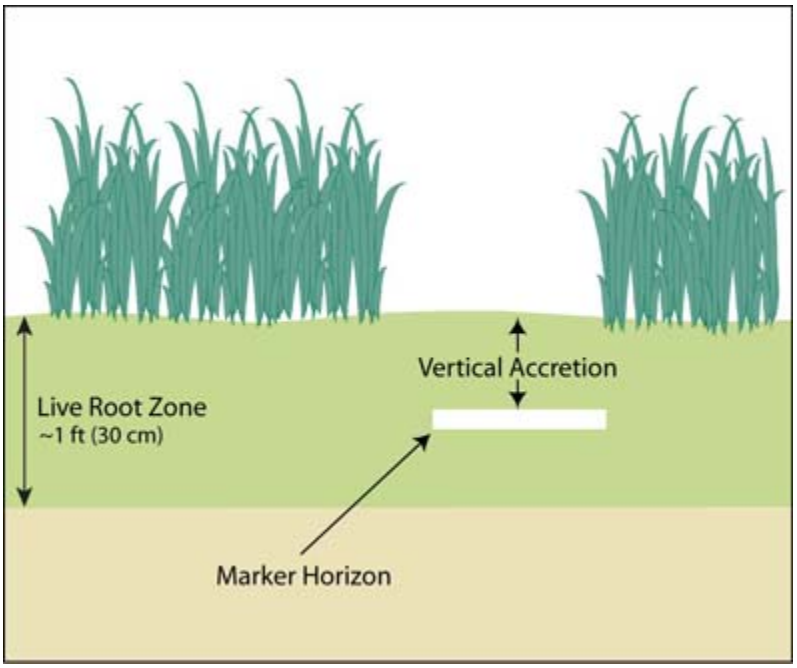

Figure 1. A model depicting the accretion measurement gained from using a marker horizon (from USGS Patuxent website—Cahoon and Lynch 2003).

Procedures

The following procedures for feldspar marker horizon installation and sampling are adapted from the Louisiana DNR Coastal Resource Division protocol (Folse and West 2004).

Accretion Plot Establishment

Numerous materials could be used as a marker horizon; however, we have settled on using feldspar mineral which is commonly used in the ceramic industry. Feldspars, as a group, are naturally occurring crystalline rocks that are typically ground to a very fine size and added to clay and glazes. We use a specific variety called G200 or Minspar 200 $(Na,K,Ca)AlSi_3O_8$ from the Feldspar Corporation (Figure 2).The feldspar is made from a naturally occurring innocuous mineral that has no adverse ecological effects (see Material Safety Data Sheets from The Quartz Corporation). Feldspar is a brilliant white material that forms a cohesive layer once it gets wet and is easily distinguishable from the surrounding sediment. Feldspar typically comes in 50-pound (lb) bags, each of which is equivalent to about six feldspar plots (50 × 30 centimeters [cm]).

Figure 2. Feldspar bags used to make a marker horizon.

Three accretion plots will be established along the boardwalk for each SET benchmark in a manner that ensures the plots can be easily sampled from the boardwalk at a later date. The plots are placed using professional judgment and, when possible, will be placed parallel to the platform (long dimension parallel to boards) and outside the RSET sampling area (Figure 3).

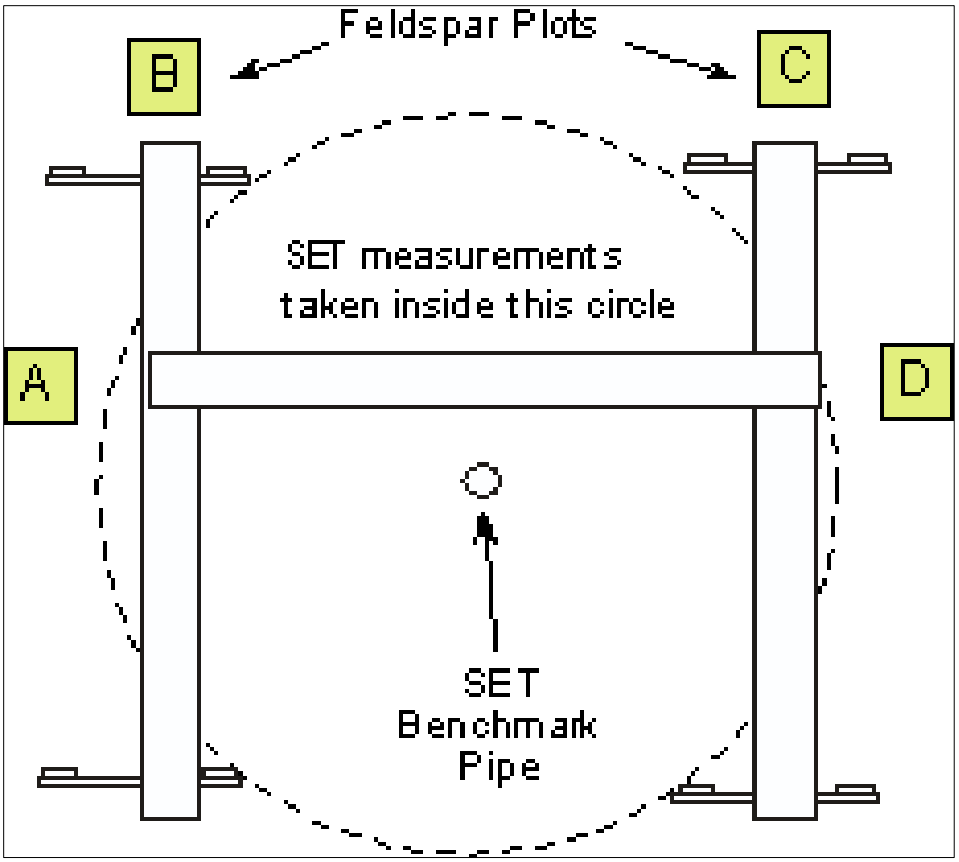

Figure 3. Example location of accretion plots.

Materials

- Feldspar—white feldspar mineral, Minspar 200 or equivalent (Minimum 5.5 cups or 5 millimeter thickness per plot; 6 plots per 50-lb bag).
- Two 0.5″ PVC pipes, 2′ long per plot
- Plastic measuring cup
- NIOSH/OSHA-approved respirator
- Gloves
- Eye protection
- Watering can or one-gallon pesticide sprayer
- Trashcan (> 0.5 × 0.3 m, bottom cut out if necessary)
- Meter stick
- Digital camera
- GPS

Instructions **NOTE**: All plot establishment procedures must be performed from the boardwalk.

When applying the feldspar, appropriate respirator, gloves, and eye protection are required since the material is a fine powder and can be easily inhaled.

1. Complete the top section of the site establishment form (Appendix A).
2. Mark the accretion plots using no less than two pieces of PVC.
    a. Place the PVC pipes at the middle of the short side (30 cm) of the rectangular plot and just outside the plot.
    b. The PVC poles should be pushed into the soil surface until resistance is met or 1.5 feet of PVC is above the surface.
3. In the "Notes" section of the site establishment form (Appendix A), record the water level with respect to soil surface within the accretion plot area.
    a. If no water is present, write "dry."
    b. If water is present, measure the water depth using the meter stick and record it on the site establishment form.
4. Using the measuring cup, evenly sprinkle the feldspar on the soil surface within the accretion plot (mark plot out on surface if needed), making sure not to leave any on the vegetation. Vegetation can be gently shaken to knock any feldspar from the plant to the soil surface or the sprayer/watering can may be used to rinse the vegetation. Each plot is evenly coated until a minimum thickness of 5 millimeters is achieved or approximately 5.5 cups of feldspar is used.
    a. If the soil is dry on the day of the plot establishment, the feldspar needs to be compacted with water after it is applied. Carefully spray water through a watering can or gallon pesticide sprayer to moisten the feldspar and consolidate the material. Make sure no feldspar voids are created on the soil surface. If voids are created, reapply feldspar and water.
    b. If the soil surface is flooded on the day of the plot establishment, the trashcan needs to be used as a barrier to allow the feldspar to settle to the soil surface without drifting out of the boundary of the plot. Place the trashcan on the soil until it slightly penetrates the surface so there is no space between the soil and trashcan. Sprinkle feldspar onto the water surface inside the trashcan. Wait 15 minutes or longer for all the feldspar to settle since the feldspar has a tendency to float when it is applied. Remove the barrier when all the feldspar has settled.

5. Repeat steps 1–4 for the remaining two accretion plots.

6. Using a digital camera, take pictures of each accretion plot and the entire site to show the establishment and orientation of the three plots. Take one picture directly above each accretion plot with the PVC pipes in place and another picture of the entire site.

7. Draw a sketch of the RSET benchmark site with accretion plots and platform placement on the site establishment form. Take a compass bearing from the SET benchmark to the middle of each accretion plot (Appendix A).

Sampling of Feldspar Marker Horizon

Sampling should be conducted every time SET benchmark measurements are collected. Feldspar is easily distinguishable from the surrounding soil due to its white color. Knowing the date of establishment and the date of sampling, a rate of accretion/erosion can be determined for the site by measuring the amount of sediment above the feldspar layer. This process begins by taking a core sediment sample out of the feldspar plot. During data collection, careful notes should be recorded in regard to the condition of the sample, number of cores pulled before measurements can be taken, and any other problems or concerns that may arise.

The plot is considered sampled when either three measurements can be collected from a core sample, or when three core attempts are made but no feldspar is collected. If three attempts are made with no feldspar visible, note this on the datasheet and attempt sampling the same plot one additional time on the next visit. If again no feldspar is recovered, then this plot should be abandoned. Typically, once recovery has become problematic (making two to three core attempts to recover feldspar) a new accretion plot should be established. It takes about six months for the feldspar marker material to become covered with a soil layer, and the plot is ready for coring after one year. SET sampling at six-month intervals allows the staggered establishment of new feldspar plots as old plots are abandoned; this way there is a continuous accretion metric to be measured.

REMEMBER: All data collection is done from the boardwalk. No walking on the soil surface is permitted.

Feldspar Coring Equipment List

- Coring tube (prepared 150 cc syringe with plunger)
- Filet knife
- Calipers (mm), stainless steel
- Data sheet
- Field notebook
- Pencils
- Camera
- Extra PVC pipe

Feldspar Data Collection Procedures

1. Carefully brush aside any fresh vegetative deposits (loose, green leaves and sticks) that lie within the feldspar plot.

2. Randomly select a spot within the plot, avoiding any roots or pneumatophores.

3. Place the coring tube into the selected position and push it straight down into the soil.

    a. We use a plastic 150 cc (4-cm diameter) syringe, which has had the end cut off and sharpened. This allows one to place the plunger in the tube after the tube has been pushed into the soil. The plunger creates a very strong suction, allowing the removal of a core sample even under water.

    b. Use the knife to cut a clean edge through the top layer of leaf litter if there is any resistance that is causing compaction.

4. Be sure to push the tube down far enough to ensure that the sample core goes beyond the feldspar layer.

5. Put the plunger top back onto the tube or use your hand to cover the end to create suction. Twisting the tube, slowly pull the sample core straight up.

6. Release the sample core by pushing from the bottom of the sample (the deepest soil layer) with the plunger, until the entire core is out of the tube in one piece. By pushing the core out from the bottom of the tube you minimize the compaction that can occur. Place the core on the board or on clipboard. Skip to step 9 if a core was successfully obtained.

7. When there is excessive material deposited on the site or there are numerous pneumatophores, the core tube does not work well and we revert to cutting a core, or plug. Cut a small, four-sided plug (about 3 × 3 cm, looks like an inverted pyramid) from within the marker horizon plot using a long, sharp fillet knife.

8. Pry the plug out of the ground from one of the sides. The plug will be about 3 × 3 × 6 centimeters in size. You need to make sure the core is deep enough to include the marker horizon. The maximum depth is determined by the length of your knife blade.

9. With the knife, cut the core in half lengthwise, so that you now have two equal pieces of soil core. Cut from the bottom of the core to the top to help minimize core compaction. Measurements will be taken from the “inside” of the core.

10. With the caliper, measure from the TOP of the feldspar layer to the top of the soil surface (measurement in mm). Take care to not manually compact the soil sample while handling. Record the reading on a data sheet (Figures 4 and 5).

11. With the caliper, now measure from the BOTTOM of the feldspar layer to the top of the soil surface (measurement in mm) at the same place as in step 10 (Figure 4). Record the reading on a data sheet.

12. Repeat steps 10 and 11 two more times, at different locations on the core. Each sample core will have a total of three measurement pairs.

13. Review the data and make sure you have recorded six measurements (three paired) from the soil core sample—three top-to-top and three bottom-to-top measurements.

14. Carefully put the core halves back together and place the core into the hole, with the same orientation as it had originally. Do not push it down excessively to avoid compaction.

15. Repeat steps 1–14 for the two additional feldspar plots associated with each SET device.

Each site has three SET benchmarks, and each benchmark has three feldspar plots. Each plot yields one soil core sample that has six measurements (three measurement pairs—top-to-top and bottom-to-top). By the end of the sampling event, nine soil cores will have been collected (3 plots × 3 benchmarks) and measured from the site. With each core yielding six measurements, a total of 54 readings are obtained for the entire SET site.

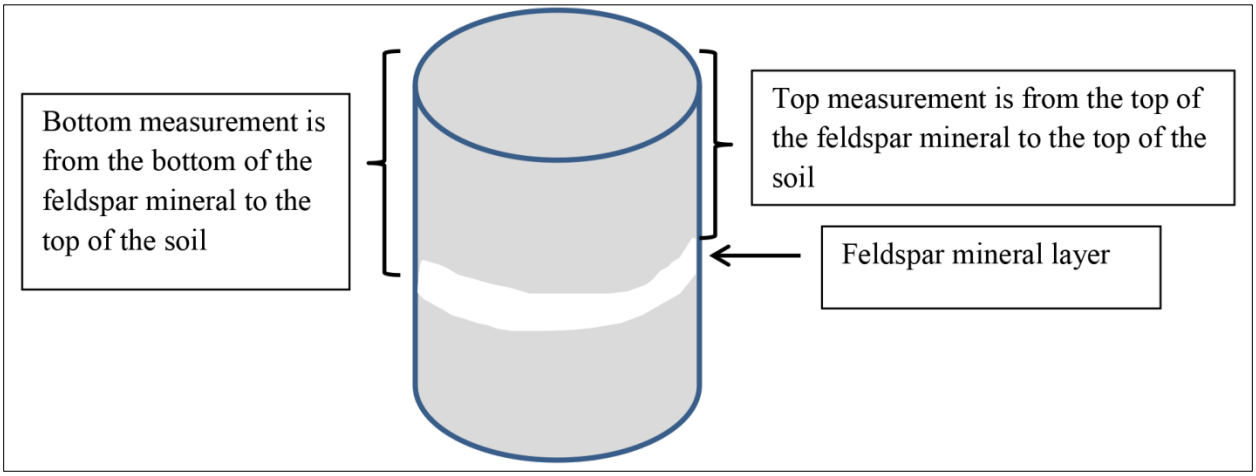

Figure 4. Soil core taken from an accretion plot with the feldspar mineral (white) as a layer in the core. The top accretion measurement is from the top of the feldspar to the top of the soil core. The bottom accretion measurement is from the bottom of the feldspar to the top of the soil core. In practice the core would have been split in half before measurements were taken.

Figure 5. Example showing measurement of the accretion layer above a feldspar layer.

Literature Cited

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Callaway, J. C., D. R. Cahoon, and J. C. Lynch. 2014. The surface elevation table-marker horizon method for measuring wetland accretion and elevation dynamics. Pages 901–917 *in* Methods in biogeochemistry of wetlands. Soil Science Society of America.

Folse, T. M., and J. L. West. 2004. A standard operating procedures manual for the Louisiana Department of Natural Resource's Coastal Restoration Division: Methods for data collection, quality assurance / quality control, storage, and products. Louisiana Department of Natural Resources, Baton Rouge, Louisiana.

Appendix A—Field Forms

Site Establishment Form

RSET ID:_____ **Feature Name**: _____

Establishment Date:_____ **Established by**:_____

Field Personnel / Organization:_____

Sketch of Site (include measurements and dimensions)

Notes_____

Figure A-1. Site establishment form.

Accretion Measurement Field Form

BISC 1: Feldspar Core Readings Established on 2/11/2011										
Samples Collected by:										
Recorded by:										
Date:										
Seagrass present: Yes No							**Site:** Wet Dry			
Circle: Cut Plug Syringe Core Measurements are in mm										
	Plot	**TOP Readings**			**BOTTOM Readings**			**No. of Attempts**	**Core Quality**	**Comments**
		1	**2**	**3**	**1**	**2**	**3**			
1	**1a**									
2	**1b**									
3	**1c**									
4	**2d**									
5	**2e**									
6	**2f**									
7	**3g**									
8	**3h**									
9	**3i**									
			In case new feldspar plots need to be added list them below							
Each row is a single core with three measurement with paired (top & bottom) readings.										
Core Quality Codes: (P) poor, (O) ok, (G) good, (E) excellent, (NR) no recovery Excellent - Bright Feldspar -thick layer Good - Feldspar clearly evident - layer moderately thick Ok - Feldspar - present - layer very thin Poor - Feldspar - present but hard to see, spot distribution										
Comments:										

Figure A-2. Accretion measurement field form.