Drive rod surface coring using the LRC MUCK or MOCK corer

The purpose of surface coring is to collect the uppermost 1-2m of sediment (i.e., the most recently deposited sediments), frequently including the sediment-water interface. This sediment may be preserved intact in the core liner, or may be extruded vertically and subsampled in the field to preserve stratigraphy and water content. For a discussion of coring and extrusion techniques, see Glew et al 2001 and references therein.

The LRC MUCK (Multi-Use Coring Kit) is used with 2.75” (70 mm) O.D. (outer diameter) polycarbonate core tubing, and consists of a piston, cable, and head that can be converted from drive rod piston corer to trigger or messenger gravity corer (without a piston). This discussion will cover only drive rod coring, because where possible (i.e., in water depths less than ~30m) this technique is recommended over gravity coring, which can cause differential thinning of sedimentary layers (Glew et al 2001). In drive rod mode the MUCK head’s only purposes are to (1) couple the drive rods to the polycarbonate tube, and (2) prevent the piston from coming out the top of the polycarbonate tube. As it turns out, these two purposes can be accomplished with more basic equipment (i.e., adhesive tape and an endcap), so all one actually needs to collect a surface core is:

- Polycarbonate (or other) tubing
- Piston that fits snugly inside this tubing (a tennis ball works for the above polycarb!)
- Piston cable for total water+sediment depth; we use 1/16” plastic-coated cable
- Slip-on endcaps for O.D. of tubing
- Drive rods for total water+sediment depth
- Climbing figure 8 belay device and carabiner (see Fig. 1 at end)
- Floral foam or Zorbitrol to fix watery sediment surface (unless extruding)
- Electrical tape and duct tape
- Vise grips
- Adjustable crescent wrench
- Cable cutters
- Tubing cutter
- Towels

This lower-tech version of the MUCK has come to be known as the “MOCK” corer. This procedure will focus on use of the MOCK, since nearly all the steps are the same as for the MUCK.

Procedure

- Measure water depth from your datum (e.g., ice surface or deck of boat)
- If you wish to capture the sediment-water interface, you should start coring 20-40 cm above the interface. Determine your preferred distance and subtract it from the water depth to datum. This length is your depth to drive.
- Thread the piston cable through the hole in the piston (or through a hole all the way through the tennis ball) and tie in a knot large enough not to slip through. Take up the
slack on the piston cable and tape this knot to the shaft of the piston using electrical
tape, so that it can’t get in the way of the piston sealing against the tubing wall.
• Draw a line all the way along two opposite sides of the polycarbonate tube and add
arrowheads pointing “up” (to one end of the tube).
• With the piston relatively loose, insert the piston into the top (“up” end) of the tube and
push the piston, conical end downward, down to the far (bottom) end of the
polycarbonate tube using a drive rod. Pull the piston out the end by grabbing the flat
sides of the point with vise grips.
• Using the crescent wrench, tighten the two nuts near the center of the piston shaft to
squeeze the piston gaskets and increase their diameter. Test for proper tightness by
sliding the piston back into the tube. When tight you should be able to see a black ring
all the way around the tube where the piston contacts the tube, and the piston should be
difficult to move by hand. (The piston may need to be wet in order to see the black lines
most clearly.)
• When tight, place the piston in the tube so that only the conical portion sticks out.
• Lay a drive rod, male end toward the bottom of the polycarbonate tube, next to the
polycarbonate tube so that the two overlap by about 0.5 m at the top of the polycarb
tube.
• Tape the rod to the tube securely but not too tightly (too tight and it can deform the tube
and keep the piston from traveling smoothly inside it) in several places, using electrical
or duct tape.
• Measure the distance from the bottom of the polycarb to the top of the drive rod. This is
the length of your corer.
• Subtract the corer length from the depth to drive. This is the length of drive rods you
need.

Example:
Water depth to datum: 8.25 m
Start above sediment by 30 cm
Depth to drive = 7.95 m (8.25-0.30)
Corer length: 1.90 m
Total drive rod length needed = 6.05 (7.95-1.90)

And so if using 2m long drive rods you would mark 5 cm up from the bottom of the 4th rod.
When that point reaches your datum, you set the piston and begin the drive. Keep your drive
rods in a predetermined order so that you know you have put on the correct number of rods
for your mark to be at the right depth. (It also helps to count the rods out loud as you put each
one on and again, counting down, as you take them off.)

You should also make a mark higher on the rod to indicate where you will stop driving: to
calculate this, simply subtract the length of the piston from the length of the polycarbonate
tube.

Example:
Tube length 1.0 m
Piston length 0.20 m  
Length of drive 0.80 m

And you would make a second mark 85 cm up the 4th rod, i.e., 80 cm above your first mark. When this second mark reaches your datum, the tube is full of mud (and water) and you stop pushing.

- Stand up the tube with its attached drive rod. You will need to fill the tube with water so that when you lower the tube into the water, the water pressure outside the tube does not push the piston up. (In Livingstone-type piston coring this role is filled by the square rod.) Using a bucket, dip water from the lake and pour it into the top of the tube until the tube is full. (A short [40 cm] scrap piece of polycarb, with an endcap taped on one end, makes a nice bucket especially when you are working through a relatively small hole in the ice in winter coring.)
- Cut a slit in an endcap from the center of the flat side of the cap to one edge and down the wall. Place this endcap on the top end of the polycarb: the slit is for the cable to exit through. Tape this endcap on. It does not need to seal – just to stay on the end of the tubing so that the piston can’t come out the top of the tube.
- Place an eye bolt or other anchoring hardware about 25 cm away from your coring hole (hole in boat deck or ice; in winter a rock climbing ice screw makes a very good anchor) and clip the carabiner through it. The carabiner should also be clipped through the smaller of the two holes in the figure 8 belay device (see Fig. 1).
- You are almost ready to core. Carefully move the corer near your coring hole (remember that the water can force the piston out the bottom; keep a little tension on the cable to prevent this from happening).
- Grasping the cable (taut) against the drive rod, begin to lower the corer into the water. Once the water level in the tube is the same as outside the tube, you can release active tension on the cable, but keep the cable the same length as the rods, i.e., lower them together. Add drive rods until your first mark is at the datum.
- Set the piston: one or more people hold the corer (rods) at the correct level and one person takes the cable, unclips the figure 8 from the carabiner, and puts a doubled section of cable through the hole of the larger loop and around the outside of the smaller loop. Clip the smaller loop back into the carabiner. When the two portions of the doubled cable are parallel with each other the cable will slide, and when they are non-parallel and there is tension on both ends the cable does not slide (See Fig. 1). Take any slack out of the piston cable by pulling the doubled cable parallel (be careful not to raise the corer) and then let go of the part of the cable that leads to the corer and pull on the end away from the corer. Now the piston is fixed in space (i.e., can’t move any farther down) and you are ready to drive.
- One person keeps tension on the piston cable and two or three push down on the drive rods. The push should begin with a firm jerk (to overcome the initial friction of the piston) and continue smoothly until the second mark reaches the datum. In soft and watery upper sediments this is usually a pretty easy drive, unless the lake has dried out in the recent past or had a slump of coarse material across your coring site.
- Take the cable off the figure 8 and grasp it along with the drive rods again. Do not allow the cable (and piston) to slide down as you bring up the corer.
- Pull up the corer, pausing to take off drive rods as needed.
- When you reach the rod that is taped to the tube, one person gets ready a bottom endcap (white if using white (bottom) and blue (top) coded caps, otherwise red). Bring the corer up out of the water smoothly and the person with the cap places the cap on the bottom of the tube (using a slight twisting motion helps). Dry the tube and tape the cap on securely with electrical tape before proceeding with the disassembly of the corer. (If you plan to extrude the core in the field, a second piston should be inserted into the bottom of the core, rather than a cap.) Be as gentle and smooth as possible bringing the corer up, as the soft and watery sediments can be relatively unconsolidated and jostling can cause the sediment to drop out the bottom of the tube.
- Remove drive rod from tube by cutting tape. Wash any mud off the male end of the rod.
- Using a tubing cutter, cut around the tube at the level of the lower metal plate of the piston (just above the conical part), using the piston to keep the tube from collapsing (See Fig. 2). Remove the scrap piece of polycarbonate, with the piston in it.
- If there is water above the sediment surface, it can be fixed, with varying degrees of success and geochemical disturbance, with floral foam or with Zorbitrol (sodium acrylate), which gelatinizes the water and preserves the sediment-water interface nicely (Tomkins et al., 2008), so that the core can be laid down rather than transported vertically. Although the uppermost sediments are >95% water, even cores that are laid horizontal and carried in a vehicle can make it back to the lab surprisingly undisturbed, as long as you fix the surface carefully. If you need a very precise surface, water content, etc., we recommend extruding and sectioning the core in the field (and taking a companion core to return to the lab so that the in-situ lithology and stratigraphy can be investigated) or using a freeze corer.
- Recent sediments, especially from deep, eutrophic, and/or anoxic lakes, can have large quantities of gas (CH$_4$, H$_2$S) dissolved in them. When brought to surface pressure and temperature, these gases expand and can push the endcaps off. Degas the core by drilling small holes in the endcaps and if necessary in a straight line along the length of the core. (Only on one line so that when the cores are run for gamma density, all the holes can easily be positioned out of the gamma ray beam.) The escape of gas and sediment can disturb the stratigraphy a bit, but it is preferable to the loss of bulk core material out the top and bottom of the tube. Again, field extrusion and freeze coring are means of avoiding gas issues.

References


1. Figure 8 belay device and carabiner (clipped to ice screw) used to fix piston cable. In this position the cable will not slide as long as there is tension applied (gloved hands pulling cable toward left of photo).

2. Tubing cutter used at bottom of piston to cleanly and squarely cut polycarbonate core liner tube. This is a Reed brand cutter with capacity to cut a tube up to 4” in diameter.