

Taking the Ice Core into the Classroom

Procedures, Safety, and Core Information

EriC Kelsey and Erik Froburg

Items You Need to Bring

TESSE cooler with ice core and silver bubble insulation
12 lbs dry ice for 24 hours (8 lbs for each additional day)
4 eutectics (large blue ice packs)
bottle of methanol
small box of Kimwipes
Denali firn core cuttings (optional)
box of plastic gloves
pair of thin gloves
pair of thick gloves
battery
snow shovel (if snow is on the ground at destination)

- Much of this equipment will be in the warm room of the freezer in a cardboard box.
- If you'll have the core out for more than 2 days, you'll need to bring an extra cooler for the additional dry ice. Only ~25 lbs can fit in the core cooler.
- Be sure to lay a few layers of the silver bubble insulation on top of everything in the cooler; it should already be in the cooler.

Procedure

You will need to see Erik Froburg or EriC Kelsey to access the freezer.

Days ahead of time:

- To ensure you can get enough dry ice, you must call the chemistry stock room (143 Parsons, 2-4474) and request dry ice. They place weekly orders on Mondays and receive it on Tuesday. Be sure to call no later than early Monday (best to do it the week before) to ensure they will have your dry ice for the next seven days (Tuesday-Monday). You will need the Leitzel Center encumbrance number to purchase the dry ice (E9URE79).
- Once you have the dry ice at the freezer, place the eutectics in the dry ice to freeze them.

Departure day or day before:

-Remove the plastic core containers and fill dry ice under both layers of foam. Place the plastic containers with the core back in the cooler and snap shut the lid on the core container. On top of the foam and core container place the eutectics, bottle of methanol, and bag of Denali firn core cuttings, and then the layers of insulation. Snap the cooler shut and you're ready to roll.

Show time:

- I prefer to show them the firn core cuttings first and the ice core second. This gives me time to prep the ice core while they're looking at the firn core.
- Be sure to wear your thin gloves with plastic gloves when handling the firn and ice core.
- Place a couple pieces of the firn core in a glass beaker and allow the students to examine them and pass it around. Instruct the students to only touch the glass beaker, and NOT

the firn core because it is about as cold as the dry ice and can cause instant frostbite. The firn core can be out for about 5 minutes without melt. Place them back in the bag before showing the core, and place the bag in between the bubble insulation during the viewing of the ice core.

- Before showing the core, moisten a few Kimwipes with methanol and wipe the surface of the ice core to remove any frost. Repeat until the core is crystal clear. Keep the methanol cold so that you do not cause any melting of the core when applying it. Do not apply methanol directly to the core because it melts ice at sub-freezing temperatures.
- Plug in the battery and take a look at the core from different angles to find the best angle to see the layers. They are subtle, and generally looking perpendicular to the axis of the core gives the best view. You may need to rotate the core a little to find the best view.

During down time or overnight:

- If the outside temperature is $< 60^{\circ}\text{F}$, keep the cooler cold by placing it outside. Never place the cooler in the sun. In the winter, burying the cooler in snow is the best way to insulate.

Safety

- Tape a sign on the freezer door stating the presence of dry ice, your name, and phone number.
- The ice core lab is a great opportunity to give a lesson on safety and preventing contamination.
- Dry ice is frozen carbon dioxide. Its freezing temperature is $-109^{\circ}\text{F}/-78^{\circ}\text{C}$.
- Be sure to instruct the students on how to properly handle dry ice; it can cause instant frostbite if it directly touches your skin.
- Do not place any dry ice on top of the top layer of foam; there's no need to tempt the students!
- Always wear gloves when handling anything in the cooler: core, firn, eutectics, etc.
- Always wear plastic gloves when touching any of the ice to prevent contamination.

About the Ice Core and Firn Core

The ice core was extracted from the Newall Glacier in Antarctica in 1988-1989 by a team of researchers including some from UNH. The core was analyzed for ions and particles at UNH. The team drilled 175 m deep, and this section of core is from a depth of 126 m. We estimate the age of our section of ice to be 5000 years old. The core is 22 cm long and 5 inches in diameter. I have counted 11 annual layers of ice, where the clear layers are summer layers and the slightly opaque layers are winter layers. This translates to an average of 2 cm/yr of water equivalent. Using a standard 10:1 ratio of snow to water equivalent, this means 20 cm (8 inches) of snow fell on average each year. The present day accumulation rate is likely to be approximately the same. This location of Antarctica is therefore very dry and considered a desert.

The Denali firn core was taken from 9700 ft in elevation in Denali National Park, Alaska in May 2008 by a team including Eric Kelsey and Cameron Wake from UNH. The cuttings came from a depth of 15 m, well above the transition to solid ice (usually around 100 m). This snow fell in 2005. "Firn" simply means snow that survives year after year and doesn't melt during the summer. As you can see, the snow turns granular as it becomes buried deeper and deeper. The firn core was drilled as part of a reconnaissance mission to find a suitable location to drill a surface-to-bedrock ice core in Denali National Park, which we hope to drill in 2010.