NGEE Permafrost Core Jamboree: February 24-28, 2014

Cathy Wilson, Heather Throckmorton, Alexander Kholodov, Yuxin Wu, Craig Ulrich, Tim Kneafsey, Catherine McKnight, Shan Dou
Goal: characterize and initialize multi-scale model domains (ground truth geophysics and calibrate CT scan density)

47 cores; 36 for model properties (Others for metagenomics and incubations)
Yellow are “priority” cores for processing Feb 2014
Pink is (future) proposed (priority) additions
Yellow are “priority” cores for processing Feb 2014
Pink is (future) proposed (priority) additions
Yellow are “priority” cores for processing
Pink is (future) proposed (priority) additions

Young (< 50 ybp)
Ancient (2000-5500 ybp)

DTLB-2
Slice/sample breakdown by analysis type:

1A. (while processing) Thermal conductivity (Frozen): 2” probe = 5cm probe
1B. LANL: Bulk Density -> Thermal conductivity thawed (5cm minimum); C/N (50g); moisture (50g)
1C. Carbon and Nitrogen
7cm minimum slice; Sample label: PP and CN

2. LANL: Water isotopes (20mL water)
10-20g ice wedge or ~50g mineral soil- (aim for 2cm), WI

3. LBL: Texture (5g);
aqueous geochemistry (100g)
Minimum = 150g (aim for 5cm), TA

4. LBL: a) Permeability (3” slice = 8cm slice);
b) water retention curve (3cm slice)
Minimum 11cm slice if combined (aim for 15cm), PWR

5. LANL: Nitrate concentration/N-isotopes; water isotopes
Minimum 10-20mL mL (or gram) of ice = 3-5cm slice, N
**Sampling flow-chart**

**At LBL (step 1)** (while processing)
- Horizon delineation (Measure/photograph cores/notes composition).
- Double check sampling protocols/CT scans with horizon compositions, to see if changes need to be made to sampling protocol before slicing.
- Pre-label bags.
- Color test (1 per distinct horizon).

**AT LBL (while processing):**
5-7cm slice for frozen thermal conductivity.
Note exact length of slice (for bulk density and ice content)
Weigh and note sample frozen (for bulk density and ice content)

**Package for ship to LANL**

1. **LANL:** Dry Thermal conductivity
Dry – measure dry weight (Bulk density / ice content)
Grind (dry sample): C/N; 14C; etc.

2. **LANL ~2cm slice for water isotopes**

3. **LBL:** (post-processing)
Texture; aqueous geochemistry (100g)

4. **LBL:** (post-processing)
Permeability; water retention

**4.** **LBL:** IF NOT ENOUGH SAMPLE PER HORIZON FOR GEOCHEMISTRY
Subsample this piece for texture (~5g dry)

**IF NOT ENOUGH SAMPLE FOR GEOCHEMISTRY**
Package subsample for LBL Texture

**2.** **LANL:** Nitrate
NGEE Arctic “permafrost core jamboree” team

Left to Right: Catherine McKnight (LBNL), Heather Throckmorton (LANL), Alex Kholodov (UAF), Craig Ulrich (LBNL), Cathy Wilson (LANL) and Yuxin Wu (LBNL). Photo credit Roy Kaltschmidt (LBNL).
Collection of permafrost cores (Barrow)

Left to Right: Garrett Altmann (LANL), Andy Chamberlain (UAF), Joel Rowland (LANL) and Alexander Kholodov (UAF). Photo credit Cathy Wilson (LANL).
CT scanning

Tim Kneafsey (LBNL) working on NGEE Arctic cores with the CT scanner (Left). CT images from a permafrost core that is ca. one meter in length (Right). Photo credit Roy Kaltschmidt (LBNL).
Core processing

Cathy Wilson (LANL) annotating the CT scan image and labeling sample bags. CT images were annotated with sample analysis information and sample depth intervals in preparation for sub-sampling with the chop saw in the cold lab. Photo credit Roy Kaltschmidt (LBNL).
Core processing

NGEE Arctic researchers working on cores inside the cold lab. Right to left: Craig Ulrich (LBL), Alex Kholodov (UAF), Heather Throckmorton (LANL). Photo credit Roy Kaltschmidt (LBNL).
Core slice sample

Sectioned NGEE Arctic core sample from the center of a transitional polygon showing a brown mineral silty sand appearance with porous cryostructure and an ice inclusion. Photo credit Roy Kaltschmidt (LBNL).
Files: Scanned notes from processing

Scanned notebook with all notes (core descriptions and subsampling info)

Annotated CT scans with sampling info
Location: Richmond Field station
2/25/2014
Initials: AK, CU, CW, HT, KM

Alex describing core:
BD-003
Top of core 16mm from top of liner.
Evidence of sublimation on core; cracks have lost ice. Organic soil is OK. Mainly mineral soil.

0–2 cm: vegetation layer
2–11 cm: dark brown peat, plant macro-fossils or roots about 1 mm in diameter.
Cryogenic structure: organic matrix with spot of ice at 4.5 cm and horizontally oriented. 5 mm thick and 1 cm long. Slightly deformed layers in peat.
Color: 5 ytr 2.5/2.
11.5 cm: boundary between organic and mineral layer.
11.5 cm mineral soil, grey, 10yr 4/2.
18 cm: silt? Vertically oriented plant macrofossils or roots.
18 cm: inclusion of fine material; maybe clay horizontally oriented (3 mm thick).
Cryogenic structure: micro-lenticular, with inclined ice layers.
21–212 cm: some mineral soils with porous ice content (not visible). Crack at 21 cm.
21–24 cm: silt and the same mineral layer as above. Porous ice with small lens of peat at 21 cm horizontally oriented and 3 mm thick. Subtle micro-layering in soil.
24–32 cm: same mineral soil, porous ice at 24–29 cm. Inclined ice layer ~45 degrees, about 1 mm thick (ice is sublimated). At 30 cm evidence of ferruginization along possible macro plant fossil.
32–41 cm: same mineral layer. 5 mm piece of rock at depth of 34.5. Inclined sublimated ice layer.

BD-001
Alex describing core
Top of the core 8 mm below top of liner.
0–3 cm: vegetation/moss
Lenticular, Ice layer thickness 1–2 mm.
7–21.5 cm: mineral soil. Gray silt (?). Plant microfossils. Roots and grass.
Micro-lenticular. Ice layer thickness ~1 mm.
21.5–48 cm: porous ice (cryo structure).
Vertical cracks with sublimated (?) ice < 1 mm thick.
40–57 cm (same mineral soil). Reticular. Subvertical ice veins with a thickness < 2 mm. Horizontal ice veins 1–3 mm thick.
Distance between horizontal veins in upper part of horizon about 1 cm. Lower part
BD-002
Alex describing core
Top of the core 9 mm below top of liner.
0–5 cm: vegetation/moss
Lenticular. Ice layer thickness 1–2 mm.
7–21.5 cm: mineral soil. Gray silt (?). Plant microfossils. Roots and grass.
Micro-lenticular. Ice layer thickness ~1 mm.
21.5–48 cm: porous ice (cryo structure).
Vertical cracks with sublimated (?) ice < 1 mm thick.
40–57 cm (same mineral soil). Reticular. Subvertical ice veins with a thickness < 2 mm. Horizontal ice veins 1–3 mm thick.
Distance between horizontal veins in upper part of horizon about 1 cm. Lower part

BD-004
Alex describing core
Top of the core 9 mm below top of liner.
0–5 cm: vegetation/moss
Lenticular. Ice layer thickness 1–2 mm.
7–21.5 cm: mineral soil. Gray silt (?). Plant microfossils. Roots and grass.
Micro-lenticular. Ice layer thickness ~1 mm.
21.5–48 cm: porous ice (cryo structure).
Vertical cracks with sublimated (?) ice < 1 mm thick.
40–57 cm (same mineral soil). Reticular. Subvertical ice veins with a thickness < 2 mm. Horizontal ice veins 1–3 mm thick.
Distance between horizontal veins in upper part of horizon about 1 cm. Lower part

Files: post-processing

Document with transcribed soil descriptions for all cores (example page above)

Spreadsheet with subsampling info (core ID, depth info, weight, sample type)
# Thermal conductivity results

<table>
<thead>
<tr>
<th>Core ID</th>
<th>Depth interval, cm</th>
<th>ThC1</th>
<th>ThC2</th>
<th>ThC3</th>
<th>ThC average, W/(m*K)</th>
<th>Std. Deviation</th>
<th>Std. Error</th>
<th>Soil description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BD03</td>
<td>15-21</td>
<td>1.80</td>
<td>1.74</td>
<td>1.87</td>
<td>1.80</td>
<td>0.07</td>
<td>0.04</td>
<td>Mineral soil with microlenticular cryostructure</td>
</tr>
<tr>
<td>BD01</td>
<td>7-14</td>
<td>2.50</td>
<td>2.56</td>
<td>2.53</td>
<td>2.53</td>
<td>0.04</td>
<td>0.03</td>
<td>Mineral soil with microlenticular cryostructure</td>
</tr>
<tr>
<td></td>
<td>21-28</td>
<td>2.34</td>
<td>2.26</td>
<td>2.16</td>
<td>2.25</td>
<td>0.09</td>
<td>0.05</td>
<td>Mineral soil with porous ice</td>
</tr>
<tr>
<td></td>
<td>77-83</td>
<td>2.09</td>
<td>2.22</td>
<td>2.38</td>
<td>2.23</td>
<td>0.14</td>
<td>0.08</td>
<td>Organic rich mineral soil with microlenticular cryostructure</td>
</tr>
<tr>
<td>BD02</td>
<td>8-15</td>
<td>2.72</td>
<td>2.64</td>
<td>2.47</td>
<td>2.61</td>
<td>0.13</td>
<td>0.08</td>
<td>Organic rich mineral soil with porous ice</td>
</tr>
<tr>
<td></td>
<td>32-40</td>
<td>1.56</td>
<td>1.60</td>
<td>1.58</td>
<td>1.58</td>
<td>0.03</td>
<td>0.02</td>
<td>Peat with matrix cryostructure</td>
</tr>
<tr>
<td>BD04</td>
<td>8-16</td>
<td>0.16</td>
<td>0.17</td>
<td>0.17</td>
<td>0.17</td>
<td>0.00</td>
<td>0.00</td>
<td>Fibrous with matrix and porphirous cryostructure</td>
</tr>
<tr>
<td></td>
<td>27-35</td>
<td>1.36</td>
<td>1.44</td>
<td>1.52</td>
<td>1.44</td>
<td>0.08</td>
<td>0.05</td>
<td>Organic rich mineral soil with braided cryostructure</td>
</tr>
<tr>
<td>BD05</td>
<td>7-15</td>
<td>1.95</td>
<td>1.93</td>
<td>1.71</td>
<td>1.86</td>
<td>0.13</td>
<td>0.08</td>
<td>Mineral soil with lenticular cryostructure</td>
</tr>
<tr>
<td></td>
<td>21-29</td>
<td>0.89</td>
<td>0.94</td>
<td>0.91</td>
<td>0.91</td>
<td>0.02</td>
<td>0.01</td>
<td>Organic rich mineral soil with porous ice</td>
</tr>
<tr>
<td></td>
<td>39-46</td>
<td>1.51</td>
<td>1.62</td>
<td>1.70</td>
<td>1.61</td>
<td>0.10</td>
<td>0.06</td>
<td>Mineral soil with layered cryostructure</td>
</tr>
</tbody>
</table>