Cold Soils

Phillip Owens and USC Cold Soils Task Group
Cold Soils Task Group

- Meeting in Fairbanks Alaska – November, 2012
- Jon Hempel and Erika Micheli – Co-Chairs of IUSS USC Working Group
- Sergey Goryachkin – Task Group Chair
- Chen-Lu Ping, Cezary Kabala, Megan Balks, Charles Tanocai, Mark Clark, Dave Swanson, Dmitry Konyushkov,, Jim Bockheim, Phillip Owens, Anna Rannveig, Arwyn Jones and Laura Bowling
Differences in Taxonomic Systems for Cold Soils

- WRB Cryosols Mineral soil - Permafrost 100 cm
- Russian System Cryozems - Mineral soils Permafrost 100 cm
- Soil Taxonomy Gelisol - Mineral and Organic Permafrost 100-200 cm
- Canadian System Cryosols - Mineral and Organic Permafrost 100-200 cm

**Different definitions generate different maps**
- Cyosols - WRB

- Cryozems – Russian Taxonomy

- Gelisols - Soil Taxonomy
Different Global Maps

Canadian Soil Classification System

US Soil Taxonomy Classification System

Russian Soil Classification System

WRB Correlation / Classification System
Goals of the Task Group

The expectations of this workshop, as defined by the group at the beginning of the meeting, were as follows:

1. Define cold soils
2. Outline central Great Soil Groups
3. a) Define properties and ecosystem function of cold soils distinct from other soils
   b) Define diagnostic criteria for cold soils
4. Identify all available data for calculation of data-driven group centroids
5. Describe one unified method for characterizing the morphology of cold soils
6. Capture Arctic, Antarctic, alpine and boreal differences in the USC
7. Address unique situations: depth of permafrost in shallow soils and “ultracontinental” climates
8. Define meaning of pedon
Define Cold Soils

- The definition of cold soils will be used to define the limits of the responsibilities of this working group.
- The current working definition of cold soils includes those soils with:
  1) permafrost in the top 100 cm;
  2) permafrost at some depth and the presence of gelic materials within the control section;
  3) presence of active cryoturbation2 in the control section; or
  4) gelic temperature regime (MAST < 0 °C at 50 cm).
Control section

• This includes two distinct classes according to Soil Taxonomy: i) permafrost in top 200 cm and gelic materials, which would be a gelisol and ii) permafrost deeper than 200 cm and presence of gelic materials in the control section, which is not a gelisol, but can be considered a permafrost-affected soil.

• In Soil Taxonomy cannot have gelic material in permafrost free regions because it is defined in terms of the active layer.

• There was by no means consensus on this final definition and some strong opinions were voiced against it.
Discussion

- The definition originally proposed by SG included two categories, the permafrost soils or Xisols (avoid bias to any one classification system) and permafrost-affected soils.

Xisols:
- permafrost in the top 100 cm; or
- permafrost in the top 200 cm and gelic materials.

Permafrost-affected soils:
- permafrost deeper than 200 cm and presence of gelic materials in the control section;
- presence of active cryoturbation in the control section
- gelic temperature regime (MAST < 0C at 50 cm)

There was a great deal of discussion and counter-proposals for a simpler and broader definition.
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Key Principles

• Climate should not be in great groups, it should come in at a lower level than great groups.

• HistiX should use about the same number of great groups as what are in Histels

• Need some description of OM in Turbims: Foli, Histi, Molli. Umbri

• About the same groups will be in ortiX (central concept is ordinary, but in Gelisols there is nothing ordinary). Group agreed to replace with HapliX.

• For other orders (when permafrost > 200 cm and cryoturbation or just cryoturbation) we propose the following great groups: Turbortents, Turbaquolls and Turbnatrale

• LithiX will be a complicated situation. We should use the same criteria as the lithic sub-group -> lithic contact within 25 cm, rock temperature below 0 °C. SG is fine with this, but feels there are contradictions with the definition of control section, so need to clarify the language in Chapter 1.
Define properties and ecosystem function of cold soils and diagnostic criteria for cold soils

1. Depth of the active layer/depth to permafrost
2. Form of permafrost: dry versus ice cemented or rock
3. Extent of cryoturbation (as percentage within the control section (active layer or 200 cm, whichever is shallower))
4. Ice percentage
5. Pattern ground form and size (vertical/horizontal to define the pedon)
6. EC
7. Anion/cation
8. Weathering stage
9. Salt stages
10. Crystratigraphy or cryogenic structure (ice lens, wedge, ground ice)
We need Data!
Describe one unified method for characterizing the morphology of cold soils

• Charles Tarnocai and CL Ping will collaborate to merge their written descriptions on methodology for describing the morphology of cold soils.

• Megan will send everyone a link to the location on the ANTPAS website for sampling and classifying Antarctic soils including: description method, weathering stages and salt stages.
Address unique situations

• Permafrost can be defined in underlying rock when there is a shallow lithic layer.
• Ultracontinental climates are not captured well with cold soils but warm summers. Some suggested using Subgelic, pergelic, gelic, hypergelic to describe regions of extreme variations. This requires additional review. Soil Temp and Moisture task group will research this.