What Lies Beneath the Soils of the Northern Circumpolar Region?

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Soil, the skin of the earth
Soils at the interface between Atmosphere, Hydrosphere, Lithosphere and Biosphere

**Soil** defined as the top layer of the earth’s crust situated between the bedrock and the surface.

(source: L.P. Wilding & H. Lin, 2006)
Understanding the soils of the Northern Regions

What is soil? Where does soil come from? What is special about soil in the northern latitudes? How do our activities affect soil? What are the links between soil and climate change?

The first ever SOIL ATLAS OF THE NORTHERN CIRCUMPOLAR REGION uses striking maps, informative texts, and stimulating photographs to answer and explain these and other questions.

Leading soil scientists from Europe, Russia, Canada, Greenland and the United States of America have collaborated under the auspices of the International Polar Year 2007-2008 to produce this unique document. Using state-of-the-art computer mapping techniques, the SOIL ATLAS OF THE NORTHERN CIRCUMPOLAR REGION shows the changing nature of soil in northern territories.

The SOIL ATLAS OF THE NORTHERN CIRCUMPOLAR REGION explains the origin and role of soil, describes the different soil types that can be found in this environment and their impact in global issues. It also discusses the possible impacts of climate change on soil and the relationship between soil and global climate.

The SOIL ATLAS OF THE NORTHERN CIRCUMPOLAR REGION assumes that soil is more than just a material left over from an earlier geological period. Rather, it presents an interpretation of an often neglected natural resource that surrounds and affects us all.

The SOIL ATLAS OF THE NORTHERN CIRCUMPOLAR REGION is an essential reference to a non-renewable resource that is fundamental for life on this planet.
A common understanding of the distribution and properties of the soils around the North Pole requires the adoption of common standards and classification systems.
The Atlas

A3 book of 144 pages (Portrait)

Opens to A2 spreads (Landscape)
Explain cold soils in a clear manner

Key facts about soil

- A typical sample of soil comprises 45% minerals, 25% water, 25% air and 5% organic matter. In northern regions, the water will occur as ice.
- Permanent or perennially frozen soil contains about 50% of the carbon stored in the soil.
- Natural permafrost is found in topsoils.
- In some regions, permafrost can be found well below the surface.
- Soil redox potential and can affect plant growth.

What is pH?

When soil scientists describe soil they often refer to it as being acid or alkaline or having a certain pH value.

The pH index is a number used to express the concentration of hydrogen ions in a solution. While the scale is from 0 to 14, soils typically fall between pH3 to pH11, with a neutral soil having a pH of 7. Alkaline soils will range from pH8 to pH11 (strongly alkaline) while acid soils will range from pH6 to pH2 (strongly acid).

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<th>Acidity</th>
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- e.g. Podzols
- Humid regions, Arid regions
- Range for most mineral soils
- Saline soils
An Atlas Needs Maps!

- Nearly 200 A4 pages of text
- Heart of the atlas based on digital soil datasets:
  - Northern and Mid-Latitude Soil Database (Cryosol WG)
  - Soil Geographical Database of Eurasia (ESBN/JRC)
  - Digital Soil Map of the World (FAO)
  - Northern Circumpolar Soil Carbon Database 2007 (Tarnocai)
- Dominant Soil Type assigned to each polygon.
- Novel conversion of soil nomenclature to international classification/correlation scheme (WRB 2006)
Cryosols

Soil of cold regions with permafrost within a depth of 1m from the surface, or within 2m if accompanied by features of cryoturbation in the upper part of the soil (from the Greek kreas, meaning cold or ice).

Cryosols develop in cold regions where permanently frozen subsoil (permafrost) is found. In this type of soil, water occurs primarily in the form of ice and cryogenic processes such as freeze-thawing cycles, cryoturbation (warping), frost heave, cryogenic sorting, cracking and ice segregation are the dominant soil forming processes that result in distorted horizons and patterned ground. They correlate with Gelsols (Soil Taxonomy), Cryosols (Canada) and Cryozems (Russia) – see page 43 for a fuller discussion in this matter.

Left: A degraded pinga in the tundra of Greenland. As the core melts, the pinga collapses and the soil covering the ice slides down forming a characteristic ring or crater-like structure (SRC). Below: This profile from Kussa shows a permafrost table at 70 cm depth as represented by the cavity caused by melting of the ice due to the excavation of the soil pit. The profile is cryoturbated and the grey colours indicate waterlogging. A 15 cm organic layer occurs on the top. Right: The map shows the location of areas where Cryosols are the dominant soil type (covering around 20% of the region shown on the map).
Global Change

Circum-Arctic snapshot of mean annual ground temperature (MAGT) in permafrost during the International Polar Year (2007-2009; from Romanovsky et al. 2010).

Source: http://www.arctic.noaa.gov/reportcard/permafrost.html
Northern soils in a global context
A new digital soil map of the world
Soils as a cross-cutting theme between food security, climate change, desertification and biodiversity.
Northern soil in a local context

The process of soil formation plays a huge role in all landscapes and major soil types can vary significantly in composition. Soil formation is influenced by a variety of factors, such as climate, vegetation, and topography. In the example shown, the process of soil formation is illustrated in a local context, where the development of soil is shown to be influenced by the local climate and vegetation. The diagram also shows the impact of human activity on soil formation, such as deforestation and land use changes.

The European Union supports research and development in the field of soil science to promote sustainable land use and agricultural practices. This includes the study of soil composition, soilforming processes, and the impact of climate change on soil formation. The European Commission provides funding for research projects that aim to improve our understanding of soil formation and to develop strategies for sustainable land use.

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The way forward!
Thank you for your attention.

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