# PERMAFROST

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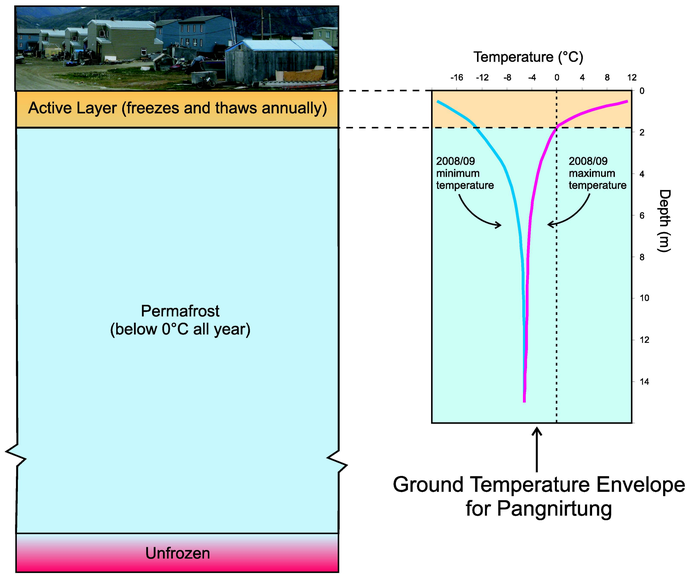
## What is Permafrost?

Permafrost depends on ground temperature and is defined as soil or rock that remains below 0ºC all year. For permafrost to form, the ground must cool enough in winter so that it does not completely thaw in summer, leaving a frozen layer that lasts all year.

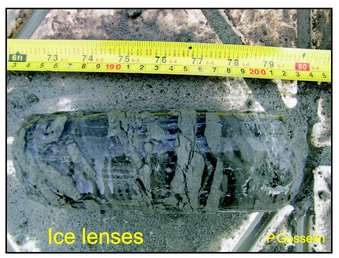
Above the permafrost, near the ground surface, there is a layer that freezes and thaws each year called the active layer.



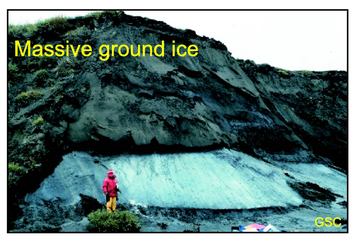

## Ground Ice

In permafrost, almost all the water is frozen. This ground ice occurs in the form of pore ice, ice lenses, or massive ice.

Ice contributes to the strength of the ground. If it thaws, it can cause landslides or weakening and settlement of the soil, especially in areas where there is excess ground ice.









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References:

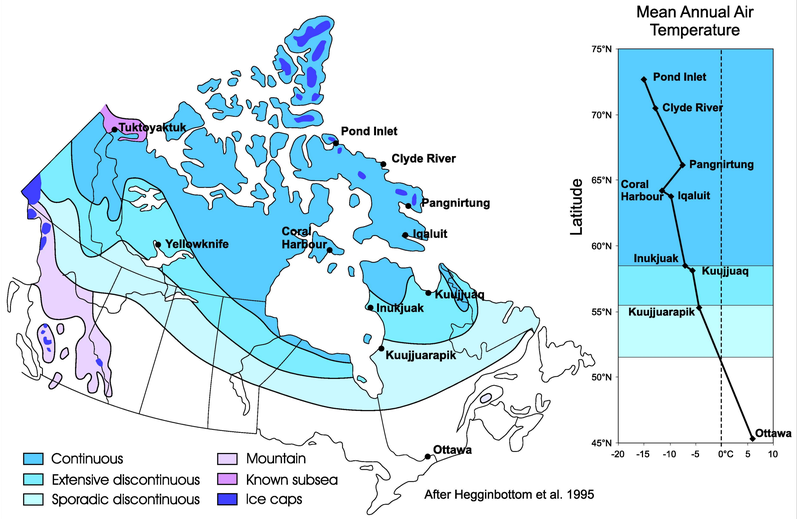
French, H.M. 1996. The Periglacial Environment. 2nd Edition, Addison Wesley Longman Ltd, Essex, England, 341p.

Hegginbottom, J.A., Dubeuil, M.A., and Harker, P.T. 1995. Canada, Permafrost. National Atlas of Canada, 5th Edition, National Atlas Information Service, Natural Resources Canada, MCR 4177.

Some of the text is extracted from http://gsc.nrcan.gc.ca/permafrost/index_e.php


Canada

## Permafrost and Climate



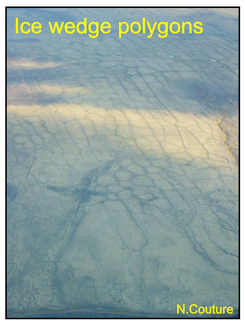

After Hegginbottom et al. 1995

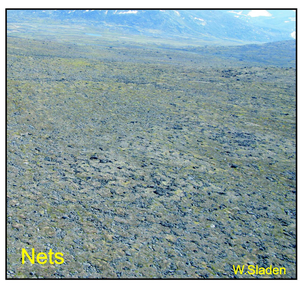
Climate is the main factor determining the existence of permafrost. However, latitude, water bodies, mountains, and local climate also influence where you find permafrost and how thick it is. The permafrost region, which underlies 50% of Canada, is divided into zones of continuous and discontinuous permafrost. Continuous permafrost means that permafrost occurs everywhere except beneath large bodies of water. In discontinuous permafrost, areas of frozen ground are separated by areas of unfrozen ground. In the far North, permafrost can be more than 500m thick.

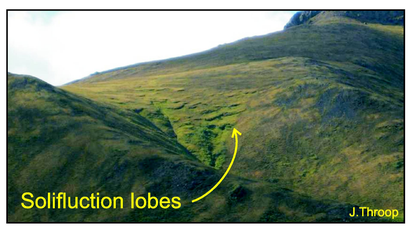
The graph (above, on the right) shows how mean annual air temperature (MAAT) decreases as latitude increases. Mean annual ground temperatures are usually warmer than MAATs because of surface environment effects. For continuous permafrost to form, typically MAATs of -6 to -8ºC or colder are required (French, 1996).

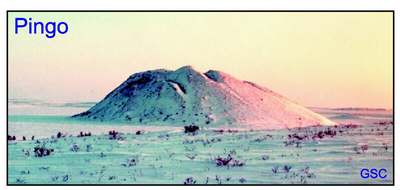
## Permafrost Features

Because of the unique nature of freezing and thawing soils, solifluction, patterned ground and frost mounds are often seen in permafrost terrain. Solifluction refers to the lobes that can form at the base of slopes. It is caused by shallow downslope movement, usually no deeper than the active layer. Patterned ground includes sorted circles, nets, hummocks, and ice wedge polygons. It is caused by frost heave and thermal contraction of the ground. Frost mounds such as pingos, palsas and frost blisters are formed by the accumulation of ice.



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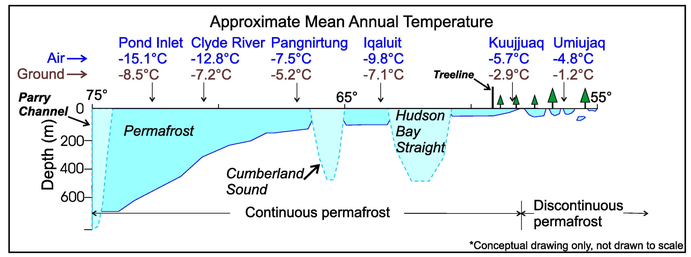
## Vertical Distribution and Thickness

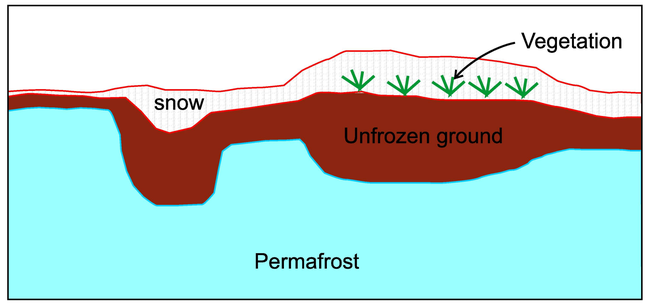



Typically in Canada, the extent and thickness of permafrost increases as latitude increases. This figure illustrates how mean annual air and ground temperatures and permafrost thickness can vary with latitude in the eastern Arctic.

## Permafrost and Local Climate

The temperature at the ground surface influences the temperature, thickness and geographic distribution of permafrost. The ground surface temperature depends on local climatic conditions and such things as vegetation, snow cover, lakes, rivers, and soil properties.

For example, snow insulates the ground causing warmer ground conditions in the winter, whereas thin or no snow cover leads to colder ground conditions. The type of vegetation and the characteristics of the ground surface will affect where snow accumulates.



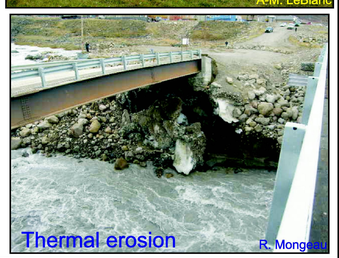

## Impacts of Thawing Permafrost

Permafrost affects how people live in the North; construction of roads, buildings and bridges, and delivery of community services such as water and sewage must be modified to account for frozen ground.

Natural or human changes to the environment can cause warming or thawing of permafrost. Depending on soil conditions, thawing of ice-rich permafrost can result in subsidence and settlement of the ground. This can lead to foundation issues and landslides.




Increasing thaw





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