What is permafrost?

Permafrost is soil that is permanently frozen that occurs primarily in polar and alpine environments. Soils are considered to be continuously frozen if the mean soil temperature remains at or below 0 °C, the freezing point of water, for two or more consecutive years. Permafrost has its greatest extent in areas where it has existed for thousands of years or longer. Permafrost generally occurs terrestrially, but also exists in the seabed in polar regions. Permafrost affects approximately 25% of the earths land area mostly in the arctic and sub-arctic. Permafrost covers approximately 80% of Alaska, 50% of Canada, and 60% of Russia. (2018 pollard).

Permafrost is classified in to three groups: continuous, discontinuous, and sporadic. Continuous permafrost covers 90% or more of a specific landscape with mean annual soil temperatures around -8 °C. Discontinuous permafrost occupies 50-90% of landscapes in permafrost areas with mean soil temperatures around -5 °C. Sporadic permafrost covers less than 50% of these environments, and the annual soil temperatures near 0 °C. Stable mean annually temperature is important to permafrost, as low heat flux is important for maintaining permafrost. Soil moisture, air temperature, snow cover, aspect, and elevation also influence the local heat fluxes.

Permafrost depth ranges from more than 1000m to only a few meters at its southern limits. The deepest know permafrost occurs in Siberia and is around 1400m thick. The maximum depth of permafrost is limited by heat in the earth’s mantle. During summer, as temperatures rise above 0C the top layer of permafrost seasonally thaws. This layer is known as the active layer. The active layer depth ranges from a few decimeters in the far north to several meters in the discontinuous permafrost zone. The active layer buffers permafrost from warm summer temperatures. The conditions at the surface of the soil determine the influence the of air temperature on frozen soils. These conditions include slope, aspect, soil moisture, and snow cover. Warmer summer temperatures are increasing the active layer depth and increasing destabilization of near surface permafrost. `

Permafrost landscapes also include ground ice which refers to all types of ice in freezing and frozen ground. There are many types of ground ice ranging from massive ice deposits to small ice crystals in soil called pore ice. Ground ice can be ice that has formed in the soil or ice that has become covered as soil is deposited. Ice wedges are one type of ground ice that occur as moisture seeps into cracks in permafrost. These wedges grow as the ice freezes and thaws allowing more water in. These wedges reach 10m in depth and range from 2-3m wide. Networks of ice wedge features come together in distinctive polygonal patterns called ice wedge polygons that range in size from 8 to 18 m across. Ice wedges, along with other ground ice features, are prone to completely melt as temperatures warm. This leaves distinctive depressions in landscapes a process is called thermokarst.